# A PRACTICE GUIDE FOR BUILDING A SUSTAINABLE DUBAI

100

## 101: INTRODUCTION

### 101.01: SUSTAINABLE DEVELOPMENT

On 24 October 2007, His Highness Sheikh Mohammed bin Rashid Al Maktoum, UAE Vice President, Prime Minister and Ruler of Dubai, stated:

***All owners of residential and commercial buildings and properties in the Emirate of Dubai must comply with international recognised environmental-friendly specifications to turn Dubai into a healthy city that meets the demand of best practice and the benchmarks of a pollution-free sustainable development.***

This statement set Dubai on a “greener” and more sustainable development path. Governments around the world are now seeking the best ways through which a low carbon and more sustainable future can be achieved.

Green building is the practice of creating structures, using processes that increase the efficiency of resource use such as energy, water and materials; while reducing impacts of the building on human health and the environment during the building’s lifecycle, through better siting, design, construction, operation, maintenance and decommissioned.

Dubai has taken a bold step forward with the new building regulations which address the Emirates’ most urgent sustainability issues of energy and water demand, carbon emissions and public health. These regulations shall be known and cited as Al Sa’fat - Dubai Green Building System in the Emirate of Dubai.

Al Sa’fat is a system for evaluating green buildings in the Emirate of Dubai, which aims to:

- Increase the vitality and improve the quality of the internal environment in Dubai buildings
- Increase energy efficiency, achieve higher standards and improve operating efficiency
- Enhance the efficiency of infrastructure to meet future development needs
- Support the Dubai Strategic Plan for creating a more sustainable urban environment

The regulations are divided into 3 Sa’fat categories - Silver Sa’fa, Golden Sa’fa and Platinum Sa’fa. These regulations are additional to the Dubai Municipality Regulations, specially The Administrative Resolution No. 125 of the year 2001 - Approving Building Regulations and Specifications and its modifications.

## 101.02: OVERVIEW OF PRACTICE GUIDE

This document is a practice guide that provides guidance on each regulations that has been promulgated. Within this document, Al Sa'fat - Dubai Green Building System in the Emirate of Dubai is also referred to as "the regulations".

This practice guide has seven sections.

The first section of this guide is 'Administration' and it provides details on the Al Sa'fat - Dubai Green Building System and its link to sustainability and overall Dubai's Strategic Vision. The Administration section also includes all procedural requirements of Al Sa'fat such as building typologies, applicability details, enforcement and legislation details, water and energy compliance methods, implementation system and guidelines to use the practice guide.

The second section of this guide contain 'Definitions' used in the practice guide. Sections three to seven contain detailed guidance for each regulation. These include requirements for each regulations, their Sa'fa levels and provides understanding on the significance of the regulation, implementation requirements and documentation that needs to be provided for compliance. Practice guide is not intended to provide detailed design information or reference standards or to be a substitute for the experience and expertise of the building designers and contractors.

Practice guide contains the following sections:

1. Section One (100): Administration
2. Section Two (200): Definitions
3. Section Three (300): Ecology & Planning
4. Section Four (400): Building Vitality
5. Section Five (500): Energy Efficiency
6. Section Six (600): Resource Effectiveness - Water
7. Section Seven (700) : Resource Effectiveness - Materials & Waste

## 101.03: LINK TO SUSTAINABILITY

Sustainability is a complex concept which has rapidly developed in the past few years. Founded in the Brundtland Report 'Our Common Future' the concept of Sustainable Development addresses the environmental and social issues in the contest of economic growth. In the context of the built environment and climate change, sustainability has become the benchmark terminology for the response required from human influenced activities. Dubai examined the traditional definition of Sustainable Development as defined by the Brundtland Commission in 1987, which states that:

*"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own need"*

Dubai also reviewed the common principles of sustainability, often referred as the 'Triple Bottom Line'. This concept is a way of going beyond just the economic aspects of any product, project or programme. It includes three aspects: Social, Environment and Economic and is often viewed as interlocking circles as depicted in fig. 101.03(1).

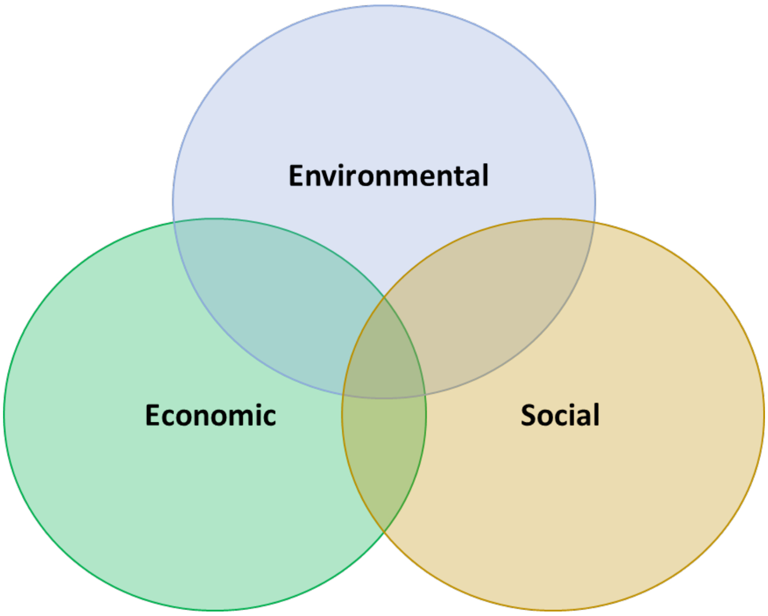


Fig 101.03(1): Three Pillars of Sustainability

It was the intent of Dubai that in developing the 'Al Sa'fat - Dubai Green Building System' that they were lined to the higher principles of Sustainability. With Al Sa'fat, Dubai wishes to balance the opportunities and challenges of each aspect in the 'triple bottom line' ensuring a positive outcome for all. Al Sa'fat aims to deliver a built environment that delivers environmental improvement and a better quality of life for the people and visitors of Dubai and in support for future economic growth.

The goal is to apply sustainable principles to the tasks of building design, construction, operation, maintenance, change of use and deconstruction in Dubai.

**Environmental**

Buildings has many impacts on the environment. From materials that is manufactured, to the multiple facets of construction, to the long term operation and maintenance period and to the final disassembly and disposition of components, a building have an impact on the environment.

To achieve a more sustainable built environment, Dubai has identified the following important consideration regarding these new regulations:

- Reduce Energy, Water and Carbon Emissions – The primary focus for Al Sa'fat is to address issues related to energy and water demand, increase energy security, reduce infrastructure costs and mitigate carbon emissions.
- Responsiveness to Dubai Climate – This single factor is a significant issue for building construction in areas such as building's core and shell, its mechanical components, air conditioning and materials used. As an example, sustainable buildings in Dubai aims to reduce the heat impact with Heat Island strategies, light colours and hear rejection approaches.
- Pollution reduction or elimination - A building and activities related to the building should attempt to minimise or eliminate pollution and seek to protect the environment within the building site and around it. As an example, light pollution and even condensate drainage should be controlled.
- Minimising and conserving resources – Natural resources create the basic needs for life and form the basis for all man-made materials. Minimising and effectively using these resources form the principle of good stewardship in sustainability. Thus, sustainable buildings in Dubai encourage to recycle materials, use green products and reduce demolition and construction waste, among others.

### Economic

In a lifespan of a building, many economic impacts are associated with the construction and operation of the building.

An evaluation of costs and benefits is necessary to examine the efficiency for the life cycle of building's development. The ability to quantify cost helps to maximise the benefits in developing sustainable cities. These impacts are not related to buildings but also to the site and surrounding environment. Economic impacts occur not only during the construction but also before and after construction. Each building has the potential to have an impact on its neighbours, local community as well as the Emirate of Dubai. To achieve sustainability, the following measures have been identified to assess the economic impact of buildings.

- Efficiency - Identified as the optimum use or productivity of any mechanical, structural or building component and when no further improvements can be made. Efficiency seeks to maximise the value of materials or systems. As an example, this can lead to more efficient elevator, better control systems and the water efficient fixtures for buildings in Dubai.
- Cost of benefit throughout the building life cycle - This includes costs and benefits during the phases of design, construction, operation and maintenance of the building. Efficient techniques or maintaining mechanical systems or ensuring that commissioning is accomplished can have a positive economic impact.
- Balancing performance - This economic principle applies to balancing performance with the most cost-effective response based on the conditions prevailing in Dubai. Use of specific energy performance for glazing, prevention of cooling from air loss and condensate recovery are various methods for balancing performance in the building.

### Social

Buildings are built for people. Healthy well-being and livability in buildings are important aspects to be addressed in a sustainable strategy to strive towards the goal of ensuring a positive quality of life for present and future generations. Furthermore, buildings impact social fabric of any city. While the structure may vary in complexity and use, the goal of each building is to provide a positive human interaction within that building. Each user must accomplish their goals in using the building and the user's health, safety and welfare during that period must be ensured. To achieve sustainability, Dubai has identified the following aspects as important social considerations.

- Protect health - Sustainable buildings in Dubai aims to protect the health and well-being of buildings occupants. This level of sustainability is achieved through the implementation of low VOC paints and coatings, ensuring adequate ventilation and restricting the use of asbestos containing materials.
- Ensure comfort and livability – A positive quality of life in and around the building is important for sustainability. Buildings must be livable and promote comfortable surroundings with both active and passive systems. Thus, in Dubai, this aspect of sustainability includes measures such as lighting and thermal controls, views from the building and good acoustical control.
- Heritage and Community - The social aspect includes sensitivity to Dubai specific culture and heritage. It also ensures that building is accessible to everyone in the community. For buildings in Dubai, this include ensuring enabled access for People of Determination and incorporation of indigenous plants that are less water consuming. The social aspect also includes encouraging responsible use of resources by the community and instilling conservation ideals.

### Sustainability Aspects are Interrelated

As shown in fig. 101.03(2), all aspects of sustainability are interrelated. The interdependence of these principles reflects the interdependence of the building, the systems within the building and the site on which the building is located. Each of the regulations impacts all three areas of the triple bottom line, a well as all the various aspects described above.

Impacts occur during every phase of a building life cycle from site development to deconstruction. This practice guide identifies impacts as they related to sustainability (within the "significance" section of each regulation) and therefore recognises the cross-correlation of these principles and aspects. Sustainability is the pathway on which the regulations are built and they seek continuous improvement in building development for its entire life cycle.

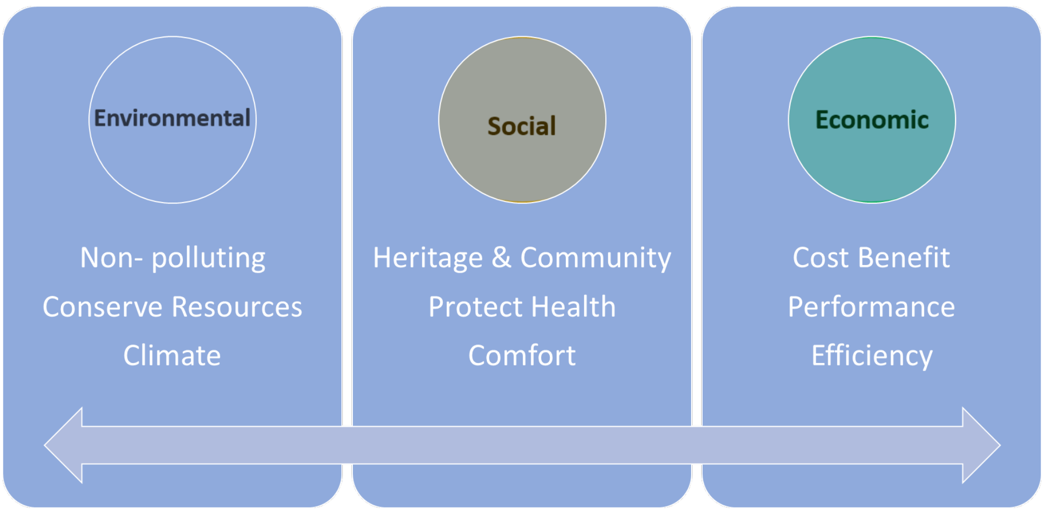


Fig 101.03(2): Interrelated Sustainability Aspects

## 101.04: LINK TO STRATEGIC VISION

Al Sa'fat - Dubai Green Building System form part of a wider initiative from His Highness Sheikh Mohammed bin Rashid Al Maktoum, UAE Vice President, Prime Minister and Ruler of Dubai, steering Dubai's development towards a more sustainable growth trajectory. Al Sa'fat should be understood within the context of Dubai's Strategic Plan 2021, as well as other initiatives on building performance standards within the UAE.

Key areas where Al Sa'fat contributes to the vision of Dubai are:

**Leadership**

Dubai's objective is to become the leading city in sustainability. Leadership in building performance aims to increase Dubai's long-term sustainability goals. Al Sa'fat regulations demonstrate global leadership by creating a forward looking and comprehensive green building evaluation system for all buildings in Dubai. It provides with a global best practice while reflecting on the uniqueness of Dubai.

**Competitiveness**

Al Sa'fat regulations enhances Dubai's competitiveness in the following areas:

- Branding, which allows benchmarking against international standards.
- Efficiency, which ensures peak and the base loads of energy can be reduced. It promotes recovery and reuse of water. It ensures there is reduction in waste. Efficiency will also optimise for a better use of land and capital.
- Resilience, which can help anticipate and mitigate likely climate change impacts on Dubai and Dubai's dependence on imported energy and resources.

**Livability**

Improved outdoor and indoor environments will promote good quality of life for visitors and residents, and therefore to a high level of livability. The quality of the urban environment is a key factor in making this achievable.

## 101.05: General Provisions

**Competent Authority**

Dubai Municipality is the competent authority for legislating and implementing Al Sa'fat - Dubai Green Building System. Dubai Municipality may choose to devolve this power to any other organisation in Dubai including Free Zone regulators and other third parties.

**Revocation of Existing Legislation**

These regulations are additional to the Dubai Municipality Regulations, specially The Administrative Resolution No. 125 of the year 2001 Approving Building Regulations and Specifications and its modifications. Any article or regulation in the following Administrative Resolutions and Circulars that conflicts with these regulations are hereby revoked:

a. The Administrative Resolution No. 66 of the year 2003 Approving Regulations on the Technical Specifications for Thermal Insulation Systems and Rationalise the consumption of energy of air conditioned buildings in the Emirate of Dubai.

b. Circular No. 161 of the year 2008 issued on Implementing Green Building Regulations in the Emirate of Dubai
c. Circular No. 171 and circular No 174 of the year 2009 issued on Implementing Building Green Roofs and facades
d. The Administrative Resolution No. 30 of the year 2007 issued on Promulgating the Implementing Regulations of the Local Order No 11 of the year 2003 On Public Health and Safety in the Emirate of Dubai.

**Temporary Buildings**

These regulations do not apply to temporary buildings which will be removed within two years of construction.

**Exemptions: Special Projects and Special Applications**

Large scale projects or projects of a specialised nature, wherein some regulations of Al Sa'fat - Dubai Green Building System cannot be easily applied, are considered as special projects. These special projects are exempted from these regulations. Examples of such projects are: extremely high buildings, large shopping malls, hospitals and laboratories. In order to preserve the character of these buildings, it may not be possible to meet some of the requirements of the regulations. For such projects, it will be possible to apply to Dubai Municipality for dispensation from specific requirements of these regulations, if it can be demonstrated that compliance to those requirements cannot be achieved. Dubai Municipality reserves the right to request any other reasonable measures to be taken in pursuit of the goals of the regulations.

**Exemptions: Heritage Buildings**

Heritage Buildings, as identified by Dubai Municipality, having difficulty in complying with some of the requirements of the Al Sa'fat - Dubai Green Building System are exempted from those regulations in order to preserve the character of these buildings. For such projects, it will be possible to apply to Dubai Municipality for dispensation from specific requirements of these regulations, if it can be demonstrated that compliance to those requirements cannot be achieved. Dubai Municipality reserves the right to request any other reasonable measures to be taken in pursuit of the goals of the regulations.

**Additions, Extensions, or Refurbishment Details**

a. Relative to Al Sa'fat applicability stated further in section 101.07, new additions, extensions or refurbishments, which require a building permit, must meet the requirements of the regulations.
b. Existing portions of the building, which are not part of the new work, will not be required to be upgraded to meet the regulations. Existing parts of a building will require upgrading, if after the addition, extension or refurbishment, the existing building performs in a less energy efficient manner than previously, because of the addition or extension. Any upgrading required must bring the building back to at least its minimum level of previous energy performance before the addition or extension.

### Effective Dates

These Regulations will be issued by an Administrative Resolution which will determine the effective date for implementation.

### Referenced Codes and Standards

The codes and standards referenced in these regulations shall be considered part of the requirements of these regulations to the prescribed extent of each such reference.

### Alternative Materials, Designs and Methods of Construction and Innovation Equipment

The provisions of these regulations actively encourage innovation and are not intended to prevent the use of any suitable alternate material, appliance, installation, device, arrangement, design, or method of construction that is not specifically prescribed by the regulations. However, approval of the alternatives will be required from Competent Department.

## 101.06: Building Typologies

Al Sa'fat - Dubai Green Building System applies to the following building typologies:

a. **Villa**: There are two types of villas.
   1. Investment villas
   2. Private villa

b. **Residential/Commercial Building**: This building typology includes (Table 101.06(1)):

**Table 101.06 (1): Type of Residential and Commercial Buildings**

| Building Typologies | |
|---|---|
| **Residential** | **Commercial** |
| Apartments | Hotels, Motels and Furnished Apartments |
| | Laboratories |
| Labour Accommodation | Offices |
| | Resorts |
| Mass Housing | Restaurants / Food Outlets |

c. **Public Building**: This building typology includes (Table 101.06(2)):

**Table 101.06 (2): Type of Public Buildings**

| Building Typologies | |
|---|---|
| **Public Buildings** | |
| Banks | Post Offices |
| Cinema / Theatres | Retail Outlets |
| Educational Facilities | Shopping Malls |
| Government Buildings | Masjid and Worship Houses |
| Health Care Facilities | Exhibitions and Festival Centres |
| Historical / Heritage Buildings | Gymnasium and Sports Complexes |
| Museums | Sports and Entertainment Complexes |
| Petrol Stations | |

Dubai Municipality has the right to apply special standards for Historical buildings and Heritage buildings (if required).

**Industrial Building:** This building typology includes (Table 101.06(3)):

**Table 101.06 (3): Type of Industrial Buildings**

| Building Typologies | | |
|---|---|---|
| **Industrial** | | |
| Factories | Warehouses | Workshops |

## 101.07: APPLICABILITY

a. The regulations apply to:
   1. All new buildings.
   2. Additions, extensions and refurbishment of existing buildings which require a building permit from Dubai Municipality.
   3. For existing buildings, for any addition, extension or refurbishment that may result in the building performing less energy efficient manner than previously built building.

b. In Mixed-use buildings - When a building combines more than one use, each portion of the building must comply with the relevant regulations for that particular typology.

c. Refer to Tables 101.07(1) to 101.07(3). The objective is to state the mandatory regulations for that building type, as per required Sa'fa. '✓' in the provided Tables means the particular regulation is applicable for that building type, whereas 'x' in the provided Tables means the particular regulation would be optional for that building type. However, for Golden and Platinum Sa'fa, all mandatory and optional requirements for Silver Sa'fa must be met.

d. Change of use – When there is a change of use for a building (for example, the change in use from a residential villa to a school); these regulations apply for the new use.

## Table 101.07(1): Silver Sa'fa Requirements as per Building Type

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Private Villas | Investment Villas | Apartments | Labour Accommodation | Mass Housing | Hotels, Motels and furnished Apartments | Laboratories | Offices | Resorts | Restaurants / Food Outlets | Factories | Warehouse | Workshops |
| 301.01 | Enabled Access | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 301.02 | Preferred Parking | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 302.01 | Local Species | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 303.01 | Exterior Light Pollution and Controls | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 304.01 | Urban Heat Island Effect | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 304.02 | Heat Rejection Equipment Installation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.04 | Colors on the Outside of Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.05 | Orientation of Glazed Facades | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 304.06 | Hardscape | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 304.07 | Shading of Public Access Areas | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 305.01 | Environmental Impact Assessment | × | × | × | × | × | × | ✓ | × | × | × | ✓ | ✓ | ✓ |
| 401.01 | Minimum Ventilation Requirements for Adequate Indoor Air Quality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.02 | Indoor Air Quality During Construction, Renovation or Decoration | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.03 | Air Inlets and Exhausts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.04 | Isolation of Pollutant Sources | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.05 | Openable Windows | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.06 | Indoor Air Quality Compliance – New Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.07 | Indoor Air Quality Compliance – Existing Buildings | × | × | × | × | × | ✓ | × | × | ✓ | × | × | × | × |
| 401.08 | Sealing Doors and Window Frames | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.09 | Inspection and Cleaning of HVAC Equipment | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.10 | Parking Ventilation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.11 | Environmental Tobacco Smoke | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 402.01 | Thermal Comfort | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.01 | Acoustical Control | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.02 | Silencers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.03 | Expansion Joints and Vibration Prevention | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table 101.07(1): Silver Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Private Villas | Investment Villas | Apartments | Labour Accommodation | Mass Housing | Hotels, Motels and furnished Apartments | Laboratories | Offices | Resorts | Restaurants / Food Outlets | Factories | Warehouse | Workshops |
| 404.01 | Low Emitting Materials: Paints and Coatings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 404.02 | Low Emitting Materials: Adhesives and Sealants | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 404.03 | Carpet Systems | × | × | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 405.01 | Provision of Natural Daylight | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 405.02 | Views | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 406.01 | Legionella Bacteria and Building Water Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 406.02 | Water Quality of Water Features | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.01 | Impact of Construction, Demolition and Operational Activities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.01 | Minimum Building Envelope Performance Requirements | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.02 | Thermal Bridges | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.03 | Air Conditioning Design Parameters | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.04 | Air Loss from Entrances and Exits | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 501.05 | Air Leakage | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 501.06 | Shade Effect Calculations | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.01 | Energy Efficiency – HVAC Equipment and Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.02 | Demand Controlled Ventilation | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.03 | Elevators and Escalators | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.04 | Lighting Power Density - Interior | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.05 | Lighting Power Density - Exterior | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.06 | Lighting Controls | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.07 | Electronic Ballasts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.08 | Control Systems for Heating, Ventilation and Air Conditioning (HVAC) Systems | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.09 | Control Systems for Hotel Rooms | × | × | × | × | × | ✓ | × | × | ✓ | × | × | × | × |

## Table 101.07(1): Silver Sa'fa Requirements as per Building Type

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 502.10 | Exhaust Air Energy Recovery Systems and Condensation of Water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.11 | Pipe and Duct Insulation | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.12 | Thermal Storage for District Cooling | Mandatory only for District Cooling Plants | | | | | | | | | | | | |
| 502.13 | Ductwork Air Leakage | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 502.14 | Maintenance of Mechanical Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.20 | Air Conditioning of Industrial Buildings | × | × | × | × | × | × | × | × | × | × | ✓ | ✓ | ✓ |
| 502.21 | Cooling Water Purification to Enhance Cooling Efficiency | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.01 | Commissioning of Building Services – New Buildings | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 503.02 | Re-Commissioning of Building Services – Existing Buildings | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 503.03 | Electricity Metering | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 503.04 | Air Conditioning - Metering | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 503.05 | Central Control and Monitoring System (CCMS) | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 504.01 | On-Site Renewable Energy – Small to Medium Scale Embedded Generators | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 504.02 | On-Site Renewable Energy– Sustainable Water Heating System | ✓ | ✓ | × | ✓ | × | ✓ | × | × | ✓ | × | × | × | × |
| 601.01 | Water Efficient Fittings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 601.02 | Condensate Drainage | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 601.03 | Condensate Reuse | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 601.04 | Water Efficient Irrigation | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 602.01 | Water Metering | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 603.01 | Wastewater Reuse | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 603.02 | Water Consumption for Heat Rejection Including Cooling Towers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table 101.07(1): Silver Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
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| 701.01 | Thermal and Acoustical Insulation Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.02 | Certified/ Accredited Timber | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 701.03 | Asbestos Containing Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.04 | Lead or Heavy Metals Containing Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.05 | Ozone Depletion Potential (ODP) Material Management | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.06 | Recycled Content | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 701.07 | Regional Materials | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 701.08 | Composite Wood Products | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 702.01 | Construction and Demolition Waste | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 702.02 | Bulk Waste Collection | × | × | ✓ | × | × | × | × | × | × | × | × | × | × |
| 702.03 | Waste Storage | ✓ | ✓ | ✓ | × | × | × | × | × | × | × | × | × | × |
| 702.04 | Waste Collection | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |
| 702.05 | Recyclable Waste Management Facilities | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 301.01 | Enabled Access | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 301.02 | Preferred Parking | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 302.01 | Local Species | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 303.01 | Exterior Light Pollution and Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.01 | Urban Heat Island Effect | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## Table 101.07(1): Silver Sa'fa Requirements as per Building Type

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema / Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical / Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 304.02 | Heat Rejection Equipment Installation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.04 | Colors on the Outside of Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.05 | Orientation of Glazed Facades | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.06 | Hardscape | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 304.07 | Shading of Public Access Areas | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 305.01 | Environmental Impact Assessment | × | × | × | × | ✓ | × | × | ✓ | × | × | × | × | × | × | × |
| 401.01 | Minimum Ventilation Requirements for Adequate Indoor Air Quality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.02 | Indoor Air Quality During Construction, Renovation or Decoration | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.03 | Air Inlets and Exhausts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.04 | Isolation of Pollutant Sources | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.05 | Openable Windows | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.06 | Indoor Air Quality Compliance – New Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.07 | Indoor Air Quality Compliance – Existing Buildings | × | ✓ | ✓ | ✓ | ✓ | × | × | × | × | × | ✓ | ✓ | × | × | × |
| 401.08 | Sealing Doors and Window Frames | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.09 | Inspection and Cleaning of HVAC Equipment | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.10 | Parking Ventilation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 401.11 | Environmental Tobacco Smoke | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 402.01 | Thermal Comfort | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.01 | Acoustical Control | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.02 | Silencers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 403.03 | Expansion Joints and Vibration Prevention | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table 101.07(1): Silver Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 404.01 | Low Emitting Materials: Paints and Coatings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 404.02 | Low Emitting Materials: Adhesives and Sealants | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 404.03 | Carpet Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 405.01 | Provision of Natural Daylight | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 405.02 | Views | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 406.01 | Legionella Bacteria and Building Water Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 406.02 | Water Quality of Water Features | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.01 | Impact of Construction, Demolition and Operational Activities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.01 | Minimum Building Envelope Performance Requirements | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.02 | Thermal Bridges | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.03 | Air Conditioning Design Parameters | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.04 | Air Loss from Entrances and Exits | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.05 | Air Leakage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 501.06 | Shade Effect Calculations | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.01 | Energy Efficiency – HVAC Equipment and Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.02 | Demand Controlled Ventilation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.03 | Elevators and Escalators | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.04 | Lighting Power Density - Interior | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.05 | Lighting Power Density - Exterior | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.06 | Lighting Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.07 | Electronic Ballasts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## Table 101.07(1): Silver Sa'fa Requirements as per Building Type

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 502.08 | Control Systems for Heating, Ventilation and Air Conditioning (HVAC) Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.09 | Control Systems for Hotel Rooms | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 502.10 | Exhaust Air Energy Recovery Systems and Condensation of Water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.11 | Pipe and Duct Insulation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.12 | Thermal Storage for District Cooling | Mandatory only for District Cooling Plants | | | | | | | | | | | | | | |
| 502.13 | Ductwork Air Leakage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.14 | Maintenance of Mechanical Systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.20 | Air Conditioning of Industrial Buildings | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 502.21 | Cooling Water Purification to Enhance Cooling Efficiency | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.01 | Commissioning of Building Services – New Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.02 | Re-Commissioning of Building Services – Existing Buildings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.03 | Electricity Metering | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.04 | Air Conditioning - Metering | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.05 | Central Control and Monitoring System (CCMS) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 504.01 | On-Site Renewable Energy – Small to Medium Scale Embedded Generators | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 504.02 | On-Site Renewable Energy– Sustainable Water Heating System | × | × | ✓ | × | × | × | × | × | × | × | × | ✓ | × | × | × |

**Table 101.07(1): Silver Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 601.01 | Water Efficient Fittings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 601.02 | Condensate Drainage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 601.03 | Condensate Reuse | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 601.04 | Water Efficient Irrigation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 602.01 | Water Metering | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 603.01 | Wastewater Reuse | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 603.02 | Water Consumption for Heat Rejection Including Cooling Towers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.01 | Thermal and Acoustical Insulation Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.02 | Certified/ Accredited Timber | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.03 | Asbestos Containing Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.04 | Lead or Heavy Metals Containing Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.05 | Ozone Depletion Potential (ODP) Material Management | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.06 | Recycled Content | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.07 | Regional Materials | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 701.08 | Composite Wood Products | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 702.01 | Construction and Demolition Waste | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 702.02 | Bulk Waste Collection | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 702.03 | Waste Storage | × | × | × | × | × | × | × | × | × | × | × | × | × | × | × |
| 702.04 | Waste Collection | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 702.05 | Recyclable Waste Management Facilities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

### Table 101.07(2): Golden Sa'fa Requirements as per Building Type

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Private Villas | Investment Villas | Apartments | Labour Accommodation | Mass Housing | Hotels, Motels and furnished Apartments | Laboratories | Offices | Resorts | Restaurants / Food Outlets | Factories | Warehouse | Workshops |
| 301.03 | Charging Equipment of Electrical Vehicles | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 301.04 | Bicycle Storage | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.02 | Ensuring Quality and Safety for Construction Activities | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.03 | Sustainable Concrete | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.15 | Control of Air Flow | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.16 | Control of Chilled Water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.19 | Air Conditioning of Parking Areas | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.22 | Heat Exchangers | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.06 | Cost of the Expected Performance Assessment | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.07 | Performance and Commissioning Reports | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.08 | Sustainable Awareness | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 504.03 | On-Site Renewable Energy– Electrical Power Generation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.01 | Reduction of Energy Demand | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.03 | Efficiency of Building Performance | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table 101.07(2): Golden Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 301.03 | Charging Equipment of Electrical Vehicles | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 301.04 | Bicycle Storage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.02 | Ensuring Quality and Safety for Construction Activities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 407.03 | Sustainable Concrete | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.15 | Control of Air Flow | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.16 | Control of Chilled Water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.19 | Air Conditioning of Parking Areas | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.22 | Heat Exchangers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.06 | Cost of the Expected Performance Assessment | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.07 | Performance and Commissioning Reports | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 503.08 | Sustainable Awareness | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 504.03 | On-Site Renewable Energy– Electrical Power Generation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.01 | Reduction of Energy Demand | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.03 | Efficiency of Building Performance | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table 101.07(3): Platinum Sa'fa Requirements as per Building Type**

| Regulation No. | Regulation Title | Villas | | Residential | | | Commercial | | | | | Industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Private Villas | Investment Villas | Apartments | Labour Accommodation | Mass Housing | Hotels, Motels and furnished Apartments | Laboratories | Offices | Resorts | Restaurants / Food Outlets | Factories | Warehouse | Workshops |
| 304.03 | Green Roof | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.17 | Control of Air Conditioning Zones | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.18 | Cooling of Corridors and Public Areas | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.02 | Smart Building | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

| Regulation No. | Regulation Title | Public Building | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Banks | Cinema/ Theatres | Educational Facilities | Government Facilities | Health Care Facilities | Historical/ Heritage Buildings | Museums | Petrol Stations | Post Offices | Retail Outlets | Shopping Malls | Masjid and Worship Houses | Exhibition and Festival Centers | Gymnasium and Sports Complex | Sports and Entertainment complexes |
| 304.03 | Green Roof | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.17 | Control of Air Conditioning Zones | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 502.18 | Cooling of Corridors and Public Areas | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 505.02 | Smart Building | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## 101.08: USE OF AL SA'FAT REGULATIONS

The following steps explain how to use these regulations:

1. Establish the building type and applicability as described in 101.06 and 101.07.
2. Determine the required Sa'fa as per Table No. 102.05(1) to Table No. 102.05(3), noting that the Regulations listed in Table No. 102.05(1) are considered Silver Sa'fa Requirements and binding.
3. Review the mandatory Regulations for that building type provided in Table No. 101.07(1) to Table No. 101.07(3), as per required Sa'fa.
4. Practice guide provides information on implementation and compliance, as required.
5. Use the approved implementation mechanism from Building Department for the regulation.

# 102: DOCUMENTATION AND CALCULATION

## 102.01: ENERGY COMPLIANCE METHOD

There are two compliance routes for energy performance in these regulations. The standard method is referred to as the Elemental Method; the alternative method is referred to as the Performance Method.

a. Elemental Method: All buildings must comply with each of these regulations.

b. Performance Method: Alternatively, a calculation method may be employed for a building which may not comply with all the elemental requirements of those Regulations listed in Table 102.01 (1).

The Performance Method, using a calculation tool such as dynamic thermal modelling, must compare the annual energy consumption of the proposed building with that of a reference building which meets all the elemental requirements listed in Table 102.01 (1). The reference building must be equal in shape, size and operational patterns to the proposed building. This shall be done as per ASHRAE 90.1 Appendix G, except for the minimum requirements for building envelope, equipment efficiencies and other parameters and conditions that are already set in Al Sa'fat.

Compliance with Al Sa'fat - Dubai Green Building System will be demonstrated, if the annual energy consumption of the proposed building is equal to or lower than the annual energy consumption of the reference building.

**Table 102.01(1): List of Regulations to be complied with for Energy Compliance**

| Al Sa'fat - Dubai Green Building System for Elemental Method of Energy Compliance |
|---|
| 304.05 Orientation of Glazed Facades |
| 501.01 Minimum Envelope Performance Requirements |
| 502.01 Energy Efficiency– HVAC Equipment and Systems |
| 502.04 Lighting Power Density - Interior |

## 102.02: WATER COMPLIANCE METHOD

There are two compliance routes for water performance in these regulations. The standard method is referred to as the Elemental Method; the alternative method is referred to as the Performance Method.

a. Elemental Method: All buildings must comply with each of these regulations.

b. Performance Method: Alternatively, a calculation method may be employed for a building which may not comply with the elemental requirements for water efficient fixtures detailed in *Regulation 601.01*.

The Performance Method, using a calculation tool, must compare the annual water consumption of the proposed building with that of a reference building which meets all the elemental requirements detailed in *Regulation: 601.01*. The reference building must be equal in shape, size and operational patterns to the proposed building.

Compliance with the Al Sa'fat - Dubai Green Building System will be demonstrated if the annual water consumption of the proposed building is equal to or lower than the annual water consumption of reference building.

## 102.03: DRAWINGS, PLANS AND CALCULATION DOCUMENTS

a. Construction documents shall be of sufficient clarity to indicate the location, nature and scope of the proposed green building feature and show that it will conform to the provisions of these regulations and other relevant laws, ordinances, rules and regulations, as determined by the Competent Authority.

b. The legibility and clarity of information is the responsibility of the applicant.

c. Submissions will be made as per the Dubai Municipality approved template, available online in the website of Dubai Municipality's construction permits section.

## 102.04: VERIFICATION OF IMPLEMENTING AL SA'FAT REGULATIONS

a. Evidence of compliance for all applicable Green Building measures shall be provided to the Competent Authority. Specific requirements for information that demonstrates compliance are included within the practice guide.

b. Alternative methods of documentation shall be acceptable (with appropriate discretion) when the Competent Authority finds that the proposed alternate documentation is satisfactory to demonstrate substantial conformance with the intent of the proposed green building measure.

## 102.05: REGULATIONS CATEGORIES

The regulations are divided into 3 Sa'fat categories.

- Silver Sa'fa
- Golden Sa'fa
- Platinum Sa'fa

The requirements stated in each category must be met cumulatively, i.e. targeted Sa'fa requirements and all preceding Sa'fa requirements must be met. The following tables provide the requirements for all the 3 categories.

**Table 102.05(1): Silver Sa'fa Requirements**

| S. No. | Section | Chapter | Regulation No. | Regulation Title |
|---|---|---|---|---|
| 1 | Ecology and Planning (300) | Chapter 1 - 301: Access and Mobility | 301.01 | Enabled Access |
| 2 | | | 301.02 | Preferred Parking** |
| 3 | | Chapter 2 - 302: Ecology and Landscaping | 302.01 | Local Species |
| 4 | | Chapter 3 - 303: Neighbourhood Pollution | 303.01 | Exterior Light Pollution and Controls* |
| 5 | | Chapter 4 - 304: Microclimate and Outdoor Comfort | 304.01 | Urban Heat Island Effect* |
| 6 | | | 304.02 | Heat Rejection Equipment Installation |
| 7 | | | 304.04 | Colours on the Outside of Buildings |
| 8 | | | 304.05 | Orientation of Glazed Facades** |
| 9 | | | 304.06 | Hardscape* |
| 10 | | | 304.07 | Shading of Public Access Areas** |
| 11 | | Chapter 5 - 305: Environmental Impact Assessment | 305.01 | Environmental Impact Assessment |
| 12 | Building Vitality (400) | Chapter 1 - 401: Ventilation and Air Quality | 401.01 | Minimum Ventilation Requirements for Adequate Indoor air quality |
| 13 | | | 401.02 | Indoor Air Quality During Construction, Renovation or Decoration |
| 14 | | | 401.03 | Air Inlets and Exhausts |
| 15 | | | 401.04 | Isolation of Pollutant Sources |
| 16 | | | 401.05 | Openable Windows |
| 17 | | | 401.06 | Indoor Air Quality Compliance - New Buildings |
| 18 | | | 401.07 | Indoor Air Quality Compliance – Existing Buildings |
| 19 | | | 401.08 | Sealing Doors and Window Frames |
| 20 | | | 401.09 | Inspection and Cleaning of HVAC Equipment |
| 21 | | | 401.10 | Parking Ventilation |
| 22 | | | 401.11 | Environmental Tobacco Smoke |
| 23 | | Chapter 2 - 402: Thermal Comfort | 402.01 | Thermal Comfort |
| 24 | | Chapter 4 - 403: Acoustic Comfort | 403.01 | Acoustical Control |
| 25 | | | 403.02 | Silencers |
| 26 | | | 403.03 | Expansion joints and vibration prevention |
| 27 | | Chapter 4 - 404: Hazardous Materials | 404.01 | Low Emitting Materials: Paints and Coatings |
| 28 | | | 404.02 | Low Emitting Materials: Adhesives and Sealants |
| 29 | | | 404.03 | Carpet Systems |
| 30 | | Chapter 5 - 405: Day lighting and Visual Comfort | 405.01 | Provision of Natural Daylight |
| 31 | | | 405.02 | Views |

| S. No. | Section | Chapter | Regulation No. | Regulation Title |
|---|---|---|---|---|
| 32 | Building Vitality (400) | Chapter 6 - 406: Water Quality | 406.01 | Legionella Bacteria and Building Water Systems |
| 33 | | | 406.02 | Water Quality of Water Features |
| 34 | | Chapter 7 - 407: Responsible Construction | 407.01 | Impact of Construction, Demolition and Operational Activities |
| 35 | Energy Efficiency: (500) | Chapter 1 - 501: Conservation and Efficiency: Building Fabric | 501.01 | Minimum Building Envelope Performance Requirements |
| 36 | | | 501.02 | Thermal Bridges |
| 37 | | | 501.03 | Air Conditioning Design Parameters |
| 38 | | | 501.04 | Air Loss from Entrances and Exits** |
| 39 | | | 501.05 | Air Leakage* |
| 40 | | | 501.06 | Shade Effect Calculations** |
| 41 | | Chapter 2 – 502: Conservation and Efficiency: Building Systems | 502.01 | Energy Efficiency - HVAC Equipment and Systems |
| 42 | | | 502.02 | Demand Control Ventilation* |
| 43 | | | 502.03 | Elevators and Escalators |
| 44 | | | 502.04 | Lighting Power Density - Interior |
| 45 | | | 502.05 | Lighting Power Density - Exterior |
| 46 | | | 502.06 | Lighting Controls** |
| 47 | | | 502.07 | Electronic Ballasts |
| 48 | | | 502.08 | Control Systems for Heating, Ventilation and Air Conditioning (HVAC) Systems** |
| 49 | | | 502.09 | Control Systems for Hotel Rooms |
| 50 | | | 502.10 | Exhaust Air Energy Recovery Systems and Condensation of Water |
| 51 | | | 502.11 | Pipe and Duct Insulation* |
| 52 | | | 502.12 | Thermal Storage for District Cooling* |
| 53 | | | 502.13 | Ductwork Air Leakage* |
| 54 | | | 502.14 | Maintenance of Mechanical Systems |
| 55 | | | 502.20 | Air Conditioning of Industrial Buildings |
| 56 | | | 502.21 | Cooling Water Purification to Enhance Cooling Efficiency |
| 57 | | Chapter 3 - 503: Commissioning and Management | 503.01 | Commissioning of Building Services – New Buildings** |
| 58 | | | 503.02 | Re-Commissioning of Building Services – Existing Buildings** |
| 59 | | | 503.03 | Electricity Metering* |
| 60 | | | 503.04 | Air Conditioning - Metering** |
| 61 | | | 503.05 | Central Control and Monitoring System (CCMS)* |
| 62 | | Chapter 4 - 504: On-site Systems: Generation & Renewable Energy | 504.01 | On-Site Renewable Energy – Small to Medium Scale Embedded Generators |
| 63 | | | 504.02 | On-Site Renewable Energy – Sustainable Water Heating System |

| S. No. | Section | Chapter | Regulation No. | Regulation Title |
|---|---|---|---|---|
| 64 | Resource Effectiveness: Water (600) | Chapter 1 - 601: Conservation and Efficiency | 601.01 | Water Efficient Fittings |
| 65 | | | 601.02 | Condensate Drainage* |
| 66 | | | 601.03 | Condensate Reuse* |
| 67 | | | 601.04 | Water Efficient Irrigation* |
| 68 | | Chapter 2 – 602: Commissioning and Management | 602.01 | Water Metering* |
| 69 | | Chapter 3 – 603: On-site Systems: Recovery and Treatment | 603.01 | Wastewater Reuse* |
| 70 | | | 603.02 | Water Consumption for Heat Rejection Including Cooling Towers |
| 71 | Resource Effectiveness: Materials and Waste (700) | Chapter 1 - 701: Materials and Resources | 701.01 | Thermal and Acoustical Insulation Materials |
| 72 | | | 701.02 | Certified / Accredited Timber* |
| 73 | | | 701.03 | Asbestos Containing Materials |
| 74 | | | 701.04 | Lead or Heavy Metals Containing Materials |
| 75 | | | 701.05 | Ozone Depletion Potential (ODP) Material Management |
| 76 | | | 701.06 | Recycled Content* |
| 77 | | | 701.07 | Regional Materials* |
| 78 | | | 701.08 | Composite Wood Products* |
| 79 | | Chapter 2 - 702: Waste Management | 702.01 | Construction and Demolition Waste* |
| 80 | | | 702 .02 | Bulk Waste Collection* |
| 81 | | | 702.03 | Waste Storage |
| 82 | | | 702.04 | Waste Collection* |
| 83 | | | 702.05 | Recyclable Waste Management Facilities** |

(*) Optional requirements for private villas and industrial buildings

(**) Optional requirements for private villas, investment villas and industrial buildings

Note:

In case greywater reuse system is installed inside the building or Treated Sewage Effluent, all requirements of Regulation No. 603.01 are mandatory.

If the green roof provides 30% of the total surface area of the building, it will be exempted from the requirements of Regulation No. 304.01.

**Table 102.05(2): Golden Sa'fa Requirements**

| S. No. | Section | Chapter | Regulation No. | Regulation Title |
|---|---|---|---|---|
| Requirements of Silver Sa'fa | | | | |
| 1 | Ecology and Planning (300) | Chapter 1 - 301: Access and Mobility | 301.03 | Charging equipment for electrical vehicles |
| 2 | | | 301.04 | Bicycle Storage |
| 3 | Building Vitality (400) | Chapter 7 - 407: Responsible Construction | 407.02 | Ensuring Quality and Safety for construction Activities |
| 4 | | | 407.03 | Sustainable Concrete |
| 5 | Energy Efficiency: (500) | Chapter 2 – 502: Conservation and Efficiency: Building Systems | 502.15 | Control of Air Flow |
| 6 | | | 502.16 | Control of Chilled Water |
| 7 | | | 502.19 | Air Conditioning of Parking Areas |
| 8 | | | 502.22 | Heat Exchangers |
| 9 | | Chapter 3 – 503: Commissioning and Management | 503.06 | Cost of the Expected Performance Assessment |
| 10 | | | 503.07 | Performance and Commissioning Reports |
| 11 | | | 503.08 | Sustainable Awareness |
| 12 | | Chapter 4 - 504: On-site Systems: Generation & Renewable Energy | 504.03 | On-Site Renewable Energy – Electrical Power Generation |
| 13 | | Chapter 5 – 505: Energy Demand | 505.01 | Reduction of Energy Demand |
| 14 | | | 505.03 | Efficiency of Building Performance |

**Table 102.05(3): Platinum Sa'fa Requirements**
**Required in addition to Silver and Golden Requirements**

| S. No. | Section | Chapter | Regulation No. | Regulation Title |
|---|---|---|---|---|
| 1 | Ecology and Planning (300) | Chapter 4 - 304: Microclimate and Outdoor Comfort | 304.03 | Green Roofs |
| 2 | Energy Efficiency (500) | Chapter 2 - 502: Conservation and Efficiency: Building Systems | 502.17 | Control of Air Conditioning Zones |
| 3 | | | 502.18 | Cooling of Corridors and Public Areas |
| 4 | | Chapter 5 – 505: Energy Demand | 505.02 | Smart Building |

# 103: PRACTICE GUIDE OVERVIEW

## 103.01: USE OF PRACTICE GUIDE

This guide is intended to provide general information on each regulation in Al Sa'fat - Dubai Green Building System. The guide is intended for professionals associated with building industry such as owners, developers, architects, engineers, general contractors, facility managers, product manufacturers, etc. The guidance identified in this guide is intended to provide an overall understanding of the regulation, its significance, implementation strategies and submittal documents for complying with Al Sa'fat - Dubai Green Building System.

This Practice Guide is not intended to provide detailed information or to be a substitute for the experience and expertise of the building designers and contractors. This guide also does not relieve any professionals from ensuring the requirements of Al Sa'fat regulations are fully complied. Case studies included in this document is for additional guidance only. This guide is organised as follows:

- Section 100: Administration
- Section 200: Definitions
- Section 300: Ecology & Planning
- Section 400: Building Vitality
- Section 500: Energy Efficiency
- Section 600: Resource Effectiveness - Water
- Section 700: Resource Effectiveness - Materials & Waste

Each Regulation is divided into sections as follows.

**Intent**

This section outlines the objective for implementing the regulation.

**Requirements**

This section states the requirements of the regulation that the project needs to comply.

**Applicability**

This section identifies the building types to which the regulation applies.

**Significance**

This section explains the impact of the regulation as it relates to sustainability principles.

### Implementation

This section provides detailed information for project teams on the steps to be taken, to ensure the project is in compliance with the requirements of Al Sa'fat - Dubai Green Building System. Information included in the implementation section varies based on the complexity of individual regulation and includes:

- Further detailing on requirements stated in the regulation
- Information on documents that needs to be referenced
- Examples or illustrative applications for further understanding
- Case study for understanding the approach towards compliance

For most topics there are many other guidance documents from a wide variety of countries around the world. Many of these documents have significant amount of material diagrams, approaches, pictures and details. To aid the project team in achieving compliance, various documents in the regulation are referred in the practice guide.

### Compliance Documentation

This section provides information on submission requirements that the project team need to submit in various stages, to conform compliance with the regulation.

### References and Additional Information

This section lists the references used in the regulation, for further information. It also provides additional information, as applicable, for further reading and understanding.

# DEFINITIONS

200

### Acoustical Control

Controlling noise sources, transmission path and/or receiver in order to reach an acceptable noise environment for a particular space.

### Addition

An extension or increase in floor area or height of a building outside of the existing building envelope (walls and roofs).

### Adhesive

Material used to bond one surface to another by attachment.

### Air Break

A piping arrangement where a drain from an appliance or fixture discharges into an airspace and then into another fixture, receptacle, or interceptor; used to prevent back siphonage or backflow.

### Air Contaminants

Unwanted airborne constituent that may reduce acceptability or adequacy of the air quality.

### Air Leakage

Air that escapes from or to a building through a joint, coupling, junction, or the surfaces which enclose the building. The flow of uncontrolled air within a building through cracks or openings.

### Air Tightness (of a building)

The property of an enclosure or barrier that precludes the passage of air.

### Air Volume

The amount (volume) of air delivered to a space through ventilation (typically specified in l/s or $m^3/m$).

### Air, Ventilation

The share of supply air that is outdoor air, plus any recirculated air that has been filtered or otherwise treated to maintain acceptable indoor air quality.

### Airborne Sound Insulation

Insulation against noise originating in air, such as voices, music, motor traffic and wind.

### Architecture Accent Lighting

Lighting that highlights an area or object of a building to emphasise that area or object.

### Asbestos

A group of impure magnesium silicate minerals which occur in fibrous form. Asbestos has been used in a variety of building construction materials for insulation and as a fire-retardant. However, long term exposure or big amounts of asbestos can have severe health impacts, such as chest and abdominal cancers and lung diseases. Therefore the use of asbestos products has been restricted in many countries.

### ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers.

### Balancing (Air System)

To ensure that correct volumes of air are supplied by adjusting airflow rates through air distribution system devices (such as fans and diffusers) by manually adjusting the position of dampers, splitter vanes, extractors, etc. or by using automatic control devices, such as constant air volume or variable air volume boxes.

### Brightness Contrast Ratio

The ratio of illuminance between the highest and lowest illuminance value in a room.

### Building Commissioning

The process of ensuring that all building systems are designed, installed, tested and operated in conformity with design intent.

### Building Completion Certificate

Certificate issued by Dubai Municipality, upon completion of entire construction work, on inspection and approval.

### Building Envelope

The exterior elements of a building which form a barrier between the internal and exterior spaces. For an air conditioned building, the building envelope is defined as the elements of a building that separate conditioned spaces from the exterior.

### Building Fabric

Refers to the ceiling, walls, windows, floors and doors of a building, which play a major role in the energy efficiency of a structure.

### Building Management System (BMS)

A computer based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment, such as ventilation, lighting, power systems, fire systems and security systems.

### Building Metering

The use of meters in a building to track the use of utilities (such as water and electricity).

### Building Occupants (also Building Users)

Persons using the building. Full-time occupants use the building for at least 8 hours most days. Part-time occupants use the building for less than 8 hours most days. Transient occupants, such as visitors, customers, students, use the building at irregular times.

### Building Operator

The person who has full operational control of the place (the land or building or any part thereof), whether owner or tenant or holder or any other capacity by which he is authorised to occupy the place.

### Building Owner

The person or establishment (government or private) that owns the building and/or the land on which the building works (construction, refurbishing, demolition, or removal of a building) is to be performed or their representative.

### Building Works Permit

Permit issued by authorised department from the Dubai Municipality on specific land as per drawings, specifications and regulations.

### Building services

All necessary services required to operate the building such as plumbing, mechanical, electrical and others.

### Carpet

A fixed floor covering made from thick woven fabric, natural or synthetic material. This excludes rugs and non-permanent woven coverings.

### Carpool Vehicles

Shared vehicle used, especially for commuting to work and often by people who each have a car but travel together to save cost, to reduce driving stress and to promote other socio-environmental benefits. Vehicles must be registered with the Dubai Road and Transport Authority (RTA).

### Central Business District (CBD)

The old area of Dubai as defined on the Land Use and Classification System or any other area classified by Permitting Authorities that has special requirements.

### Central Control and Monitoring System (CCMS)

A computer-based control system that controls and monitors the mechanical and electrical equipment, such as ventilation, lighting, power systems, fire systems and security systems in a building or controlling and monitoring a number of buildings.

### Central Plant

The main equipment within a building or series of buildings, which provides cooling, ventilation, heating, water, and other services to the whole building or buildings.

## Certified Timber

Timber certification is a process that results in a certificate (written statement) attesting to the origin of wood raw material and its status and/or qualifications, often following validation by an independent third party. Certification is intended to allow participants to measure their forest management practices against standards and to demonstrate compliance with those standards. Timber certification generally includes two main components: certification of sustainability of forest management (which occurs in the country of origin) and product certification (which covers the supply chain of domestic and export markets).

## Chlorofluorocarbons (CFCs)

CFCs are odourless, colourless, non-flammable non-toxic chemicals. They vaporise easily at low temperatures making them ideal coolants in refrigerators and air conditioners. CFCs are also used in foam for seat padding and insulation. Until recently, they were used extensively in aerosol spray cans. CFCs cause stratospheric ozone depletion.

## Composite Wood Products

Products such as plywood, panel substrates, door cores, particle board and medium density fibreboard.

## Condensation

The process through which a gas or vapour changes to liquid form, water is produced in this process.

## Construction Activity

Includes all activities that are part of new construction, alteration, repair, maintenance, refurbishing and any other physical changes to a building.

## Construction and Demolition Waste

Waste generated from construction, renovation and demolition or deconstruction of structures. Land clearing debris including soil, vegetation and rocks are typically not considered construction and demolition waste.

## Contractor

Natural or considerable person registered and licenced to practise contracting profession in the Emirate of Dubai.

## Control Systems

Controls that allow users to change/adjust the level of lighting and air conditioning in a space.

## Control Zone (HVAC)

A space or group of spaces with heating or cooling requirements that is sufficiently similar so that desired conditions (e.g. temperature) can be maintained throughout by using a single controller. The zone may be part of a larger space, an individual office or a small dwelling.

## Cooling Coil

A coiled arrangement of tubing or pipe for the transfer of heat between a cold fluid and air.

### Cooling Load

The amount of cooling that a building will require to meet the conditions specified by Dubai Municipality. The cooling load will be determined by the output of the heat load calculation required by Dubai Municipality.

### Cooling Tower

Heat removal devices used to transfer process waste heat to the atmosphere. Cooling towers may either use the evaporation of water or rely solely on air to cool the working fluid. Common applications include removing heat from the water used to cool refrigeration chillers.

### Corrective Maintenance

Maintenance service or procedures intended to fix equipment failure or damage. This service is carried out in response to a fault and not planned in advance.

### Cycles of Concentration

The level of solids in the recirculating cooling tower water in comparison to the level of solids of the original raw make up water. If the circulating water has three times the solids concentration of the make up water, then the cycles of concentration are 3.

### Daylighting

The use of natural light from the sun to provide illumination in interior spaces.

### Demand Controlled Ventilation (DCV)

A ventilation system that provides for the automatic reduction of outdoor air intake below design rates, when the actual occupancy of spaces served by the system is less than design occupancy. Demand is often assessed by using the measure of the amount of carbon dioxide ($CO_2$) in a space to reflect occupancy levels.

### Designated Preferred Parking Spaces

Parking spaces that are closest to the main entrance of a building exclusive of spaces designated for people of determination. Alternatively, these can be parking spaces closest to the pedestrian exit leading from the parking area.

### District Cooling

A district cooling system distributes thermal energy, in the form of chilled water or other media, from a central source to multiple buildings or facilities through a network of underground pipes for use in space and process cooling. The cooling (or heat rejection) is usually provided from a central, dedicated cooling plant, which eliminates the need for separate systems in individual buildings. A district cooling system consists of three primary components: the central plant (which may include the cooling equipment, power generation and thermal storage), the distribution network, and the consumer system (typically comprising of air handling units and chilled water piping in the building).

### Diversity Factor

Relates to the thermal characteristics of the building envelope, temperature swings and occupancy load.

### Drip Water Delivery System (Drip Irrigation)

A high efficiency irrigation method where water is delivered at low pressure through buried pipes and sub-pipes, which in turn distribute water to the soil from a network of perforated tubes or emitters.

### Dual Plumbed

A building or structure with two sets of pipes: one for drinking water and one for recycled or greywater.

### Ductwork

Air-tight devices that carry conditioned air throughout the building. This includes terminal fixtures to distribute air.

### Ductwork Leakage

The outcome of air conditioning ductwork that is leaking and therefore lets air out through cracks and gaps. Ductwork leakage will result in an increase in energy consumption of supply and return air fans.

### Electrical System

Permanently installed wiring, switchgear, distribution boards, transformers, controls and other devices used in distributing electricity into and through a building.

### Electrical Sub-metering

The installation of separate meters to allow the measurement of electricity used in specific areas or individual items of equipment.

### Electronic Ballast

A piece of equipment required to control the starting and operating voltages of fluorescent lights. Electronic lighting ballasts use solid state circuitry and can greatly reduce or eliminate any flicker in the lamps.

### Enabled Access

Project design that incorporates accessibility for the people of determination to and within a building.

### Environmental Tobacco Smoke (ETS) (second hand smoke)

Airborne particles emitted from the burning of cigarettes, pipes, cigars or shishas and from smoker's exhaled air.

### Entrance Lobby

Space immediately between the entrance-door and the interior of a building which acts as a transition area into the building.

### Equivalent

Measure, standard or reference material that has been deemed to be equal or better by Dubai Municipality.

### Exhaust Air

Air removed from a building space and discharged to the outside of the building through a mechanical or natural ventilation system.

### Facilities Operator

Party responsible for the maintenance and operation of a building or facility.

### Fan Systems

A system of fans used to supply or exhaust air from a building space.

### Fenestration

Another term for 'glazed elements'.

### Fresh Air

Outside air supplied to a building space through mechanical or natural ventilation to replace air in the building that has been exhausted.

### Glazed Elements

All areas in the building envelope that let in light, including windows, plastic panels, clerestories, skylights, doors that are more than one half glass and glass block walls.

### Glazing Area

The area of glazed elements in the exterior walls of a building.

### Global Warming Potential (GWP)

Expresses contribution of greenhouse gases released to the atmosphere in the global warming phenomenon.

### Green Roofs

See vegetated roofs.

### Greywater

Untreated household wastewater, which has not come into contact with toilet waste. Greywater includes used water from showers, washbasins, bathtubs, laundry sinks and clothes washers.

### Halons

Substances used in fire suppression systems and fire extinguishers. These substances deplete the stratospheric ozone layer.

### Hardscape

The area of a project site, excluding buildings, made with hard materials, including roads, car parks, patios, courtyards and walkways.

### Hazardous Fumes or Chemicals

Fumes/gases or chemicals that can adversely impact human health when inhaled or when they come into contact with a person's skin; also includes fumes/gases and chemicals that can create a hazardous condition (such as explosive or flammable substances).

### Hazardous Waste

Any waste material that can cause substantial harm to humans, properties or to the environment due to its inherent hazardous characteristics. Hazardous waste takes the form of solid, liquid, sludge, gas or any combination thereof.

### Heat Island Effect (HIE)

Heat Island Effect occurs when warmer temperatures are experienced in urban/developed areas compared to adjacent undeveloped areas due to solar energy retention on constructed surfaces. Some of the surfaces that contribute to the Heat Island Effect are paved streets, sidewalks, parking lots and buildings.

### Heat Load Calculation

The heat load calculations are the process of calculating the total heat generated inside the building by various sources. These calculations must be submitted to Dubai Municipality for approval. These calculations must be submitted to Dubai Municipality for approval. These calculations must be based on the design of the building to be constructed and follow the form and use the parameters required by Dubai Municipality.

### Heat Load Calculation Parameter

The design parameters used in Heat Load calculation according to Dubai Municipality requirements.

### Heating, Ventilation, and Air Conditioning (HVAC) System

The equipment, distribution systems and terminals that provide either individually or collectively, the processes of heating, ventilating, or air conditioning to a building or a portion of a building.

### Heat Rejection Equipment

Equipment, which is used to disperse the heat produced in the air conditioning process. Heat rejection equipment, such as cooling towers, may be located outside of the building envelope; however it may also be a component of the air conditioning equipment, such as with window or split systems.

### Heavy Metals

A metal of relatively high density or of high relative atomic weight. Examples are cadmium, chromium, mercury, arsenic etc.

### Heritage Building

A building having historical architectural elements, situated inside a Dubai historical area. No demolition or variation works shall be carried out on a heritage building except after obtaining approval from the Competent Authority.

### Hybrid Vehicle

A hybrid vehicle is a vehicle using two different forms of power, such as an electric motor and an internal combustion engine, or an electric motor with a battery and fuel cells for energy storage.

### Hydraulic Elevator

An elevator operated by the use of liquid pressure.

### Hydrochlorofluorocarbons (HCFC)

Refrigerants used in building equipment that deplete the stratospheric ozone layer, but to a lesser extent than CFCs.

### Hydrofluorocarbons (HFCs)

Refrigerants that do not deplete the stratospheric ozone layer. However, some HFCs have a high Global Warming Potential.

### Industrial Building

An industrial building is any building directly used in manufacturing, processing, technically productive enterprises or storage. This includes workshops, factories and warehouses.

### Land Clearing Debris

Solid waste generated solely from land-clearing activities, including brush, stumps, soil material and rocks.

### Land Disturbance

Any project that changes the physical conditions of landform, vegetation and hydrology, creates bare soil, or otherwise may cause erosion or sedimentation. The activities include, but are not limited to, clearing of land, removal of vegetation, stripping, grading, excavating, filling and storing of materials.

### Legionella Bacteria

Legionella bacteria are the causative agent of Legionnaires' disease and its lesser form, Pontiac fever. The bacteria grow in water between 20º C and 45º C and can be spread by water droplets.

### Light Fixture

The component of a luminaire that houses the lamp(s), positions the lamp, shields it from view, and distributes the light. The fixture also provides for connection to the power supply, which may require the use of ballast.

### Lighting Power Density (LPD)

The maximum lighting power per unit area.

### Light Reflectance Value (LRV)

A measure of the total quantity of useable and visible light reflected by a surface in all directions on a scale from 0% to 100%. Zero percent is assumed to be an absolute black and 100% represents an assumed perfectly reflectance white. The blackest achievable wall finish has a LRV of approximately 5% and the whitest available finish approximately 85%.

### Light Transmittance

The percentage of incident light that passes through the glazing elements. When this percentage increases, the day light amount into the building will increase.

### Line of Sight

An imaginary line from the eye to a perceived object or view.

### Local Species

Local plants and adapted plants to the local environment.

### Lux

The international system unit of illumination, equal to one lumen/$m^2$.

### Mechanical System

Those systems within a building, which include components of mechanical plant or machinery. These systems include, but are not limited to, the HVAC system of a building.

### Mechanical Ventilation (Active Ventilation)

Ventilation provided by mechanically powered equipment, such as fans.

### Minimum Efficiency Reporting Value (MERV)

Minimum Efficiency Reporting Value (MERV) is an expression of the filtering efficiency of an air filter that has been evaluated using the ASHRAE Standard 52.2 Test Procedure. An air filter's performance is determined by comparing airborne particle counts upstream and downstream of the air filter (or other air cleaning device) under test conditions. A higher MERV rating equates to higher air filtration efficiency.

### Mixed Mode Ventilation

A combination of mechanical and natural ventilation.

### Monitoring Equipment

Equipment used to measure and record status or conditions related to a building or to verify pre-set conditions and provide control or alarm functions if conditions vary.

### Natural Ventilation (Passive Ventilation)

Ventilation provided by thermal, wind or diffusion effects through windows, doors or other openings in the building.

### Negative Pressure

Pressure less than that in adjoining spaces.

### Occupancy Sensor

A device that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

### Occupant Lighting Controls

A means of controlling the level of lighting, which is easily accessible to a building occupant. Includes on/off switches.

### Office

A building in which business, clerical or professional activities are conducted and having an area of 50 m$^2$ at a minimum.

### Opaque

All areas of a building envelope, which do not transmit light. Fenestration and building service openings, such as vents and grilles, are not opaque.

### Open Grid Pavement

Pavement surfaces composed of structural units with void areas that are filled with pervious materials, such as sand or grass turf.

### Outdoor Environment

The environment outside of buildings, not enclosed by walls.

### Ozone Depletion Potential (ODP)

Expresses contribution to the deterioration of the stratospheric ozone layer.

### Parking Area - Enclosed

Area of a building which is used for parking of motor vehicles but is not an open parking area. As it does not meet the criteria for open parking areas and is considered enclosed, mechanical ventilation is required to compensate for the lack of natural ventilation.

### Parking Area - Open

Area of a building which is used for parking of motor vehicles and that requires uniformly distributed openings on two or more sides for natural ventilation on every level of parking. The total area of openings to the atmosphere must be at least 20% of the total perimeter wall areas for each level of parking. Although openings on a third side are not required, openings on opposing sides are preferred for cross ventilation.

### Parking Ventilation

Ventilation, that is required to maintain a satisfactory level of air quality within a vehicle parking facility.

### Perimeter Zone

The interior space adjacent to the perimeter walls of a building.

### Plumbing System

Permanently installed piping, pumps, valves, tanks, taps, controls and other devices used in distributing water into, within and away from a building.

### Positive Pressure

Pressure greater than that in adjoining spaces.

### Potable Water

Water that is suitable for human consumption.

### Pressure Differential

The difference in pressure between two points of a system, or two different spaces of a building.

### Preventative Maintenance

Maintenance service or procedures intended to prevent or reduce equipment failure or damage.

### Primer

Material applied to a surface to improve adhesion of a subsequently applied paint or adhesive.

### Public Building

A building which provides access to the general public. This building typology includes healthcare facilities, educational facilities, governmental buildings, worship houses, petrol stations, shopping malls, retail outlets, post offices, banks, museums, cinema/theatres, and historical/heritage buildings, exhibitions and festival centres, gymnasium and sports complex and sports and entertainment complexes.

### Radiant Heat / Temperature

Thermal radiation is the heat that radiates from a warm object. Radiant heat may be present if there are heat sources in an environment. Examples of radiant heat sources include: the sun, fire, ovens, driers, hot surfaces and machinery, etc.

### Recycling

Processing of used materials into new products in order to prevent the waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution and water pollution by reducing the need for "conventional" waste disposal.

### Reflectivity (Solar Reflectance)

Reflectivity measures how well a material bounces back solar radiation.

### Refrigerants

Working fluids of refrigeration cycles, which absorb heat at low temperatures and reject heat at higher temperatures.

### Refurbish (Retrofit)

The substantial alteration of a building or building services to replace or improve the quality of the building. This may occur when a new tenant occupies the building or part of the building.

### Regional Materials

Materials that were extracted, processed, and/or manufactured within the Gulf Cooperation Council (GCC) area. GCC member countries are: United Arab Emirates, the Kingdom of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, Qatar and Kuwait.

### Regularly Occupied Areas (non-residential buildings)

Those areas within non-residential buildings where building users are sitting or standing, while working inside of a building or use the building space.

### Relative Humidity

Ratio of partial density of water vapour in the air to the saturation density of water vapour at the same temperature and the same total pressure.

### Residential / Commercial Building

This building typology includes: apartments, labour accommodations, student accommodations, offices, hotels, resorts, restaurants/food outlets and laboratories.

### Retail

Business dedicated to the sale of goods or commodities in small quantities directly to consumers.

### Reuse

Any activity that lengthens the life of an item, typically consisting of returning the item to active use in the same or related capacity.

### Safety Factor (Heating/Cooling)

An allowance to cover any heating or cooling load greater than the design conditions.

### Sealants

Material with adhesive properties that is used for the general purpose of filling, sealing or waterproofing gaps or joints between two surfaces.

### Secure Bicycle Racks or Storage Areas

Structures where individual bicycles can be locked and/or stored. Such structures should be inside or shaded if outdoors.

### Service Logbook

A book where all maintenance works for a specific site or piece of equipment is recorded in detail (including dates and specific information regarding what service was performed and who carried out the work).

### Shading Coefficient (SC)

A measure of the amount of heat passing through glazing compared with the heat passing through a single clear glass. It is the ratio of solar heat gain at normal incidence through glazing to that occurring through an approximately 3 mm (1/8 inch) thick clear, double-strength glass.

### Showroom

Any space allocated for conducting a commercial business such as displaying commodities for purpose of wholesale or retail sale, and has a road front façade not less than 9 m wide, and an area of 80 $m^2$ at a minimum.

### Solar Reflectance Index (SRI)

SRI is an index that combines reflectivity and emissivity, measuring a material's ability to reject solar heat. SRI for a standard black (reflectance 0.05 and emittance 0.90) is 0 and a standard white (reflectance 0.80 and emittance 0.90) is 100. Materials with higher SRI absorb less heat and can reduce heat island effect.

### Substrate

The base material to which a process, such as painting, is applied to produce new films or layers of a different material.

### Thermal Bridges

Component or assembly of components, in a building envelope, where the insulation is not continuous and through which heat is transferred at a substantially higher rate than through the surrounding envelope area, such as a metal fastener, concrete beam, slab or column.

### Thermal Comfort

A satisfied condition experienced by building occupants with the thermal environment.

### Thermal Insulation

Materials or the methods and processes used to reduce heat transfer. Heat energy can be transferred by conduction, convection or radiation. The flow of heat can be delayed by addressing one or more of these mechanisms and is dependent on the physical properties of the material employed to do this.

### Thermal Transmittance

Also known as U-value, is the rate of transfer of heat (in watts) through one square metre of a structure divided by the difference in temperature across the structure. It is expressed in $W/m^2K$. Well-insulated parts of a building have low thermal transmittance whereas poorly-insulated parts of a building have high thermal transmittance.

### Total Planted Area

The total external landscaped area of a building plot, including landscaped areas on roofs (vegetated roofs).

### Total Vehicle Parking Capacity

Total number of parking spaces within the site as specified by Dubai Municipality.

### Totalising Meter

Measures the flow and provides a total of the quantity that has passed through the meter. This is indicated in the form of a numeric readout.

### Toxic Waste

Waste containing poisonous substances. These substances may have acute effects (causing death or violent illness) or chronic effects (slowly causing irreparable harm) even in very small or trace amounts.

### Treated Sewage Effluent (TSE)

The product of the process of removing physical, chemical and biological contaminants from wastewater. The process produces treated effluent suitable for reuse or discharge into the environment and solid waste (or sludge).

### U-value

Refer Thermal Transmittance.

### Urea Formaldehyde

Combination of urea and formaldehyde used in some glues. Formaldehyde is a naturally occurring VOC that is an irritant to most people when found in high concentrations and is also carcinogenic. Urea-formaldehyde may emit formaldehyde at room temperature.

### Variable Air Volume System

An air handling system that conditions the air to a constant temperature and varies the outside airflow to ensure thermal comfort.

### Vegetated Roof (Green Roof)

A vegetated roof consists of vegetation and soil or a growing medium, planted over a waterproofing membrane on rooftops. Vegetated roofs may also include additional layers, such as a root barrier and drainage and irrigation systems. The use of vegetated roofs may have different purposes, from energy savings to stormwater management and aesthetic benefits.

## Villa

Private Villa: Separate or semi-detached building with ground entrance and independent parking in addition to independent outdoor spaces.

Investment Villa: A complex of separate, connected or semi-connected private villas in which outdoor spaces and recreational services can be shared, and ownership is not allowed to be split unless there are legal repercussions between them.

## Volatile Organic Compound (VOC)

Organic chemicals that have a high vapour pressure and easily form vapours at normal temperature and pressure. The term is generally applied to organic solvents, certain paint additives, aerosol spray can propellants, fuels (such as gasoline and kerosene), petroleum distillates, dry cleaning products and many other industrial and consumer products ranging from office supplies to building materials.

## Wall Washing Light

Light fixture used for architectural or aesthetic purposes, transmitting variable colour light or flash (with possibility of modifying the speed of movement) and be programmed to operate automatically and can work to direct the light down for long distances and can be used inside or outside the building.

## Warehouse

A place in which goods or merchandise are stored; a storehouse.

## Water Feature

Features within a range of man-made fountains, ponds, cascades, waterfalls and streams, not intended for human contact with the water. Therefore, for these regulations, the definition of water features excludes swimming pools and spas.

# CHAPTER 1 - ACCESS AND MOBILITY



## 301.01 ENABLED ACCESS

Silver Sa'fa

### INTENT

Provide accessibility that increases usability, safety, health and social participation for People of Determination.

### REQUIREMENT

All new buildings, other than villas, must comply with Dubai Municipality Building Regulations, with regards to the People of Determination. They must be enabled for their access, internal movement and ability to engage with the building functions.

### SIGNIFICANCE

As of 2017, about 3,376 people of determination are estimated to live in the Emirate of Dubai. People of determination may have disabilities that restrict mobility and create obstacles to them being able to access buildings.

The importance of this issue has been recognised within UAE. Article 2 of Dubai Local Law No. 2, 2014 requires "*Accessible environment must be provided to ensure that People of Determination enjoy all their rights under legislation in force*".

The ability for all users to enter a building and engage in building functions without obstacles is an integral part of sustainable design that must be applied in Dubai. The provision of enabled access to buildings for people of determination allows them to have easy access to the building's facilities or services, such as in offices, retail, or other purposes. This ensures people of determination enjoy all their rights, integrate them into the society as effective members and fosters a respect for them.

### APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

In order to comply with this regulation, it is recommended that at least one accessible route be provided from the exterior of a building, through the building or facility entrance and within all accessible spaces and elements within the building. A range of measures like ramps, railings, signages, etc. can be used to help accommodate people of determination (fig. 301.01(1) and fig. 301.01(2)).

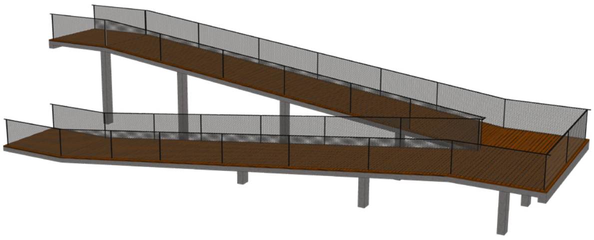


Fig 301.01(1): Ramp (Sample 1)

Fig 301.01(2): Ramp (Sample 2)

The provisions for people of determination must be in compliance with Dubai Universal Design Code.

Building design should comply with UAE Federal Law No. 29, 2006, Article 23 and DM Building Regulations Administrative Resolution No. 125-2001, Article 27 or any updated version of resolution; which details specific requirements for public buildings, commercial buildings and hotels. This regulation requires that the provisions of Article 27 must be applied to all new buildings in Dubai other than villas.

Building design must comply with 'The Building Regulations and Facilities for the Disabled 2010, United Arab Emirates' released by Ministry of Public Works.

## COMPLIANCE DOCUMENTATION

**Table 301.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural drawings indicating locations of parking spaces for people of determination with signage details.<br>2. Architectural drawings indicating provisions provided for enabled access, internal movement and ability to engage with building function, for People of Determination.<br>3. Provide parking calculations for the total number of parking spaces and the number of parking spaces provided for People of Determination. |
| Construction Completion Application | 1. Final approved drawings highlighting the locations of parking spaces for People of Determination with signage details.<br>2.Final approved drawings for all measures required for People of Determination. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Statistics Center (2017). Determined Ones Type of Disability, Gender and Nationality Registered at Ministry of Community Development - Emirates of Dubai (Table 05-09), Dubai.

Government of Dubai (2017). Law No. 2, 2014 - Concerning Protection of the Rights of Persons with Disabilities in the Emirate of Dubai (Article 2), Dubai.

Government of Dubai (2017). Dubai Universal Design Code.

Dubai Municipality (2001). Article 27 of DM Building Regulations Administrative Resolution No. 125-2001.

Ministry of Public Works (2010). The Building Regulations and Facilities for the Disabled, United Arab Emirates.

# CHAPTER 1 - ACCESS AND MOBILITY



## 301.02 PREFERRED PARKING

Silver Sa'fa

### INTENT

Encourage the use of electrical, hybrid and carpooling vehicles, thereby reducing the pollution and traffic volume impacts from automobile use.

### REQUIREMENT

For all new buildings, other than villas, that have more than 20 parking spaces, designated preferred parking must be provided for a combination of hybrid vehicles, electrical vehicles and carpool vehicles. The percentage required for preferred parking spaces shall be calculated based on the total vehicle parking spaces required for the building, as defined in the Dubai Municipality (DM) Building Regulations. The percentages required for preferred parking are as follows:

- 5% for Silver Sa'fa
- 7% for Golden Sa'fa
- 10% for Platinum Sa'fa

The above percentages, does not include the spaces provided for People of Determination.

### SIGNIFICANCE

High numbers of private cars on the road leads to severe traffic management woes. Modern and urban cities like Dubai have a high vehicle density levels. Higher vehicle density levels are one of the major contributor for air pollution levels. Use of conventional fuel vehicles not only affects the greenhouse gas emissions but also pose public health risks.

By encouraging the use of low emission hybrid vehicles and electric vehicles or alternatively opting for carpooling can reduce air pollution levels. Hybrid vehicles with their higher fuel economy along with a reduced consumption of fossil fuel help the environment to preserve its natural wealth.

The environmental benefits of carpooling are significant (fig. 301.02(1)). Carpooling reduces the number of vehicles on the road, reduces the use of fossil fuel, and thereby reduces the air pollution. Carpooling also reduces the size of the parking areas needed to support building occupants.

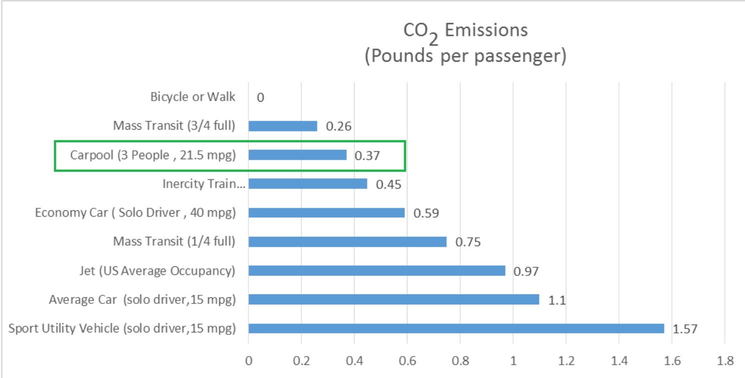



Fig 301.02(1): Reduced $CO_2$ emissions from Carpooling

This regulation promotes the use of low-emitting, fuel efficient vehicles and shared transportation such as carpooling by providing designated preferential parking for these vehicles. An increase in the use of such vehicles will potentially reduce pollution from motor vehicle sources and reduce traffic volumes, congestion and demand for additional roads infrastructure.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The number of parking spaces required for a building is specified by Dubai Municipality Building Regulations, Administrative Resolution No 125-2001, Article 24 and 25. To determine the number of required preferred parking spaces for electrical vehicle, hybrid and carpool vehicle, multiply the total number of parking spaces proposed for the project by required percentage. If the calculated number includes a fraction, it must be rounded up to the next higher whole number.

Preferred parking refers to parking spaces that are closest to main entrance of the project or to internal access points such as stairs or elevators as shown in fig. 301.02(2).

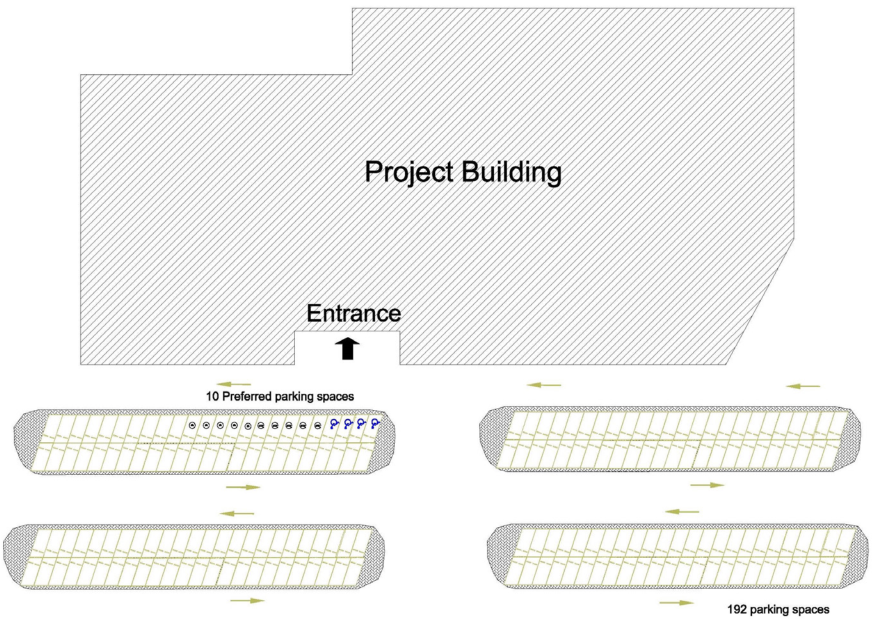



Fig 301.02(2): Location of Preferred Parking

Designated parking spaces for use of electrical, hybrid and carpool vehicles must be clearly identified. Possible means of identifications are provided below in fig. 301.02(3):

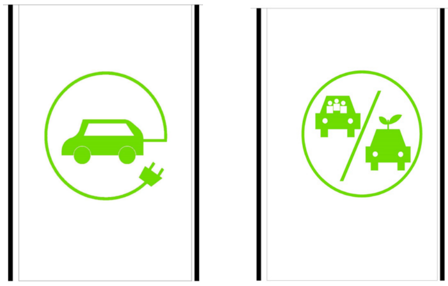


Fig. 301.02(3): Possible Means of Identification

Permanent pavement signage as shown in fig. 301.02(4) is required to clearly identify reserved parking spaces, in addition to signage to enable drivers to locate the preferred parking spaces.

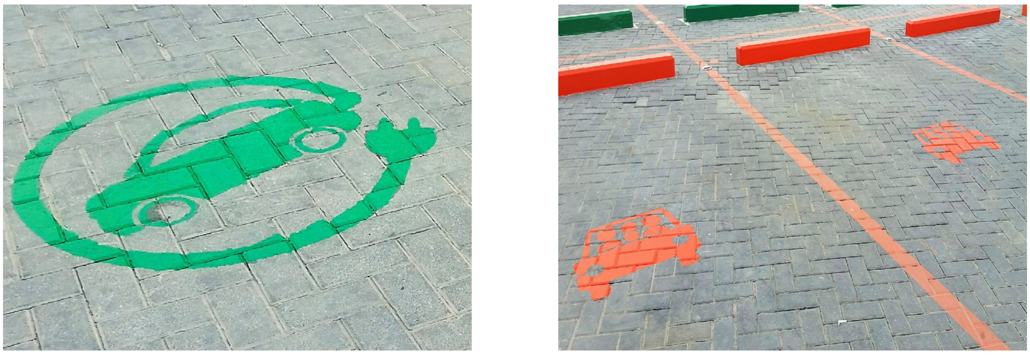


Fig 301.02(4): Signage for Preferred Parking

**Case Study**

A new commercial building in Dubai targeting Silver Sa'fa is designing to provide designated preferred parking spaces for electrical, hybrid and carpool vehicles. As per Dubai Municipality Building Regulations, Administrative Resolution No. 125-001, Articles 24 and 25, the total parking capacity of the project is 420 spaces. 5% of the total parking spaces is 21 spaces, hence 21 parking spaces near the building entrance has been allocated as preferred parking space for electric vehicles, hybrid and carpool vehicles.

## COMPLIANCE DOCUMENTATION

**Table 301.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural drawings indicating locations of preferred parking spaces with signage details.<br>2. Provide parking calculations for the total number of parking spaces and the number of preferred parking spaces. |
| Construction Completion Application | 1. Final approved architectural drawings indicating locations of preferred parking spaces with signage details. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2001). Dubai Municipality Building Regulations, Administrative Resolution No. 125-2001, Articles 24 and 25.

## 301.03 CHARGING EQUIPMENT FOR ELECTRICAL VEHICLES

Golden Sa'fa

### INTENT

To promote green transportation by providing electric vehicle charging infrastructure.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, where preferred parking spaces were provided according to *Regulation 301.02*, necessary charging equipment for electrical vehicles must be provided for 30% of the total preferred parking spaces.

### SIGNIFICANCE

Electric Vehicles (EV) play a key role in transiting from fossil-fuelled vehicles to a sustainable mode of transportation. Use of electric vehicles would reduce the harmful air pollution from exhaust emissions of fossil fuel driven vehicles.

International Energy Agency forecasts the electric car users to grow from 3 million to 125 million around the world by 2030.

Dubai government has taken several initiatives to encourage use of electrical vehicles in Dubai and this regulation supports the initiative. While preferred parking is provided for electrical vehicles (under *Regulation 301.02*), further this regulation makes sure charging equipment are provided within the preferred parking spaces. An easy access to charging stations (fig. 301.03(1)) and preferred parking spaces would encourage the use of electric vehicles.

The Dubai Supreme Council of Energy (DSCE) has launched a campaign entitled "E-Sayyara," meaning E-Car in Arabic, to increase the number of E-Vehicles driven by the private sector and residents in Dubai. E-Sayyara initiative comes in line with the Dubai Green Mobility Strategy 2030, UAE Vision 2021 and Dubai Plan 2021 which supports the efforts of Dubai Emirate to accelerate the penetration of hybrid and electric vehicles.

Fig 301.03(1): Electric Vehicle Charging Station

Dubai Electricity and Water Authority (DEWA) as part of EV Green Charger Initiative, encourages the use of environmentally friendly electric vehicles in the emirate in order to reduce carbon emissions and support sustainable modes of transport in Dubai. Several charging stations have been installed at government offices, airports, petrol stations, shopping malls, commercial offices, clinics and hospitals, residential complexes and establishments.

## APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07 (2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Design team must provide charging equipment for 30% of the total preferred parking spaces identified in *Regulation 301.02* (which states the number of preferred parking spaces required). Individual electric vehicle parking spaces shall be provided with either a dedicated charging point or a single charging station with multiple vehicles charging options may be provided. To comply with this regulation, it should be ensured that all available electric car parking spaces are able to charge the parked cars, simultaneously.

Provision of charging stations shall accommodate the needs of all type of electrical vehicles. Electrical connectors/plugs/ ports at the charging stations shall comply with all local or international standards.

The following table (Table 301.03 (1)) shows the type of charging stations and approximate time taken for charging.

Table 301.03 (1): Type of Charging Stations

| Charging Station Types | Approximate Charging Time Required |
|---|---|
| Wall Box Charger | 2 to 4 Hours |
| Public Charger | 2 to 4 Hours |
| Fast Charger | 20 to 40 Minutes |

Referred charging time in Table 301.03 (1) is approximate based on the market standard, actual charging time depends on various factors like charging mechanism of the inbuilt battery systems, size of the battery and speed of different charging points.



Fig 301.03(2): Electric Vehicle Charging Station and Signage

Developers and property owners in Dubai must obtain approvals from DEWA, prior to establishing, installing, operating or maintaining an electric vehicle charging station at their premises. Type of charging station required for specific building types must be as defined by DEWA. Typical electric vehicle charging station and signage is shown in fig. 301.03(2) and their location in drawings is shown in fig. 301.03(3).

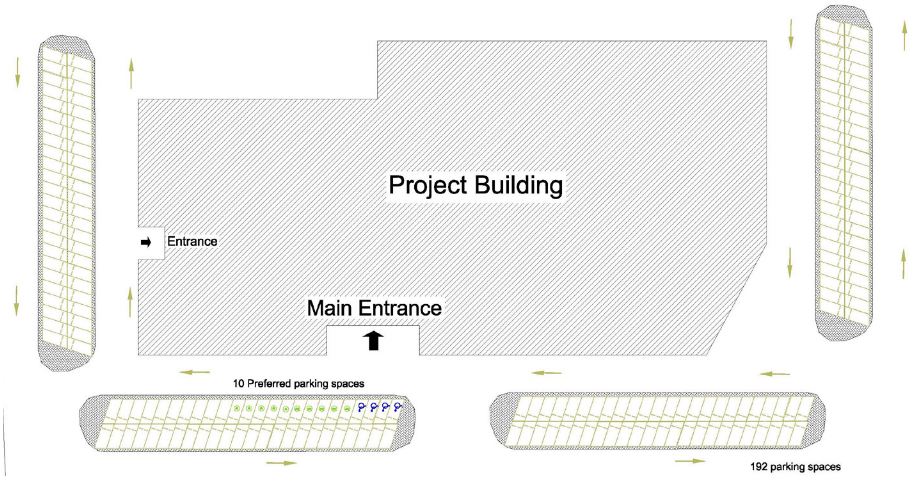



Fig 301.03(3): Location of Preferred Parking for Electrical Vehicles

## COMPLIANCE DOCUMENTATION

**Table 301.03(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural drawings indicating locations for electrical charging points.<br>2. Calculations for the number of electrical charging points provided. |
| Construction Completion Application | 1. Final approved drawings indicating locations for electrical charging points.<br>2. Technical data-sheet indicating specification for the charging points.<br>3. DEWA approval. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2019). Al Sa'fat Regulation No. 301.02: Preferred Parking.

International Energy Agency (n.d.). Global EV Outlook 2018. Retrieved from https://www.iea.org/gevo2018.

DEWA (n.d.). EV Green Charger. Retrieved from https://www.dewa.gov.ae/en/customer/innovation/smart-initiatives/electrical-vehicle-charging-stations.

DEWA (n.d.). EV Green Charger - Frequently Asked Questions. Retrieved from https://www.dewa.gov.ae/en/customer/innovation/smart-initiatives/faq---ev-green-charger.

# CHAPTER 1 - ACCESS AND MOBILITY



## 301.04 BICYCLE STORAGE

Golden Sa'fa

### INTENT

Encourage bicycle use to minimise pollution and greenhouse gas emissions, improve connectivity, promote active lifestyle and associated health benefits.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, other than villas, secured and covered racks or storage areas for bicycles must be provided within the building or within a shaded area located on the ground floor and no more than 30m from a building entrance within the plot limit. Secure racks or storage areas must be provided for a number of bicycles equal to at least 10% of the number of car parking spaces required for the building, as defined in the Dubai Municipality (DM) Building Regulations.

For student accommodation and labour accommodation, secure racks or storage areas must be provided for bicycles, for at least 10% of building occupants, with the same above conditions.

### SIGNIFICANCE

There is an increasing use of bicycles in Dubai for recreation and as a means of transportation to work. The development of new residential areas close to work places in Dubai will allow many employees to consider bicycles as a viable means of transportation. Most new major developments in Dubai are being promoted as pedestrian and bicycle-friendly.

The successful implementation of a strategy to increase the use of bicycles in Dubai, depends partly on adequate infrastructure. Dubai currently has over 250km of dedicated cycling tracks (fig. 301.04(1)) and Roads and Transport Authority (RTA) has plans of constructing more tracks in the coming years, as part of their strategic approach to ease traffic congestion and increase road safety. The provision of bicycle storage at destinations is important in ensuring the success of such a strategy.

Fig 301.04(1): Cycle Track in Dubai

Use of bicycles produces no emissions and does not require use of fossil fuels. Bicycle commuting contributes to relieving traffic congestion and reducing noise pollution. Reduced traffic volumes will in turn result in reduced air pollution, reduced demand for infrastructure for roadways and parking lots. Bicycle usage will also promote active healthy lifestyle amongst the population.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Secure bicycle racks or storage areas must be available for individual bicycles to be locked and stored. Storage should protect bicycles from theft.

Multi-use building: For the purpose of this regulation, each portion of the building which has a different usage shall use the compliance calculation for that usage type.

For residential buildings (depending on building usage), requirements are based on either the number of car parking spaces or the number of occupants. The number of occupants shall be used as a criteria for labour and student accommodation.

The number of building users (or occupants) shall be the number declared in documentation submitted to Dubai Municipality at the permit application stage.

The exact location and design of the racks or storage will be different for each building; however it is important that the bicycles must be secured. Because of the Dubai climate, all bicycle storage areas should be indoors or be shaded. Sample bicycle storage area and drawing are shown in fig. 301.04(2) and fig. 301.04(3), respectively.

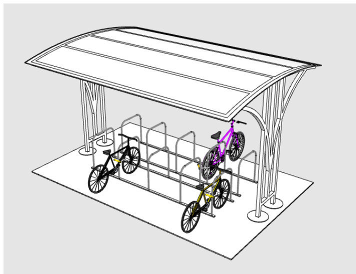


Fig 301.04(2): Sample Bicycle Storage Area

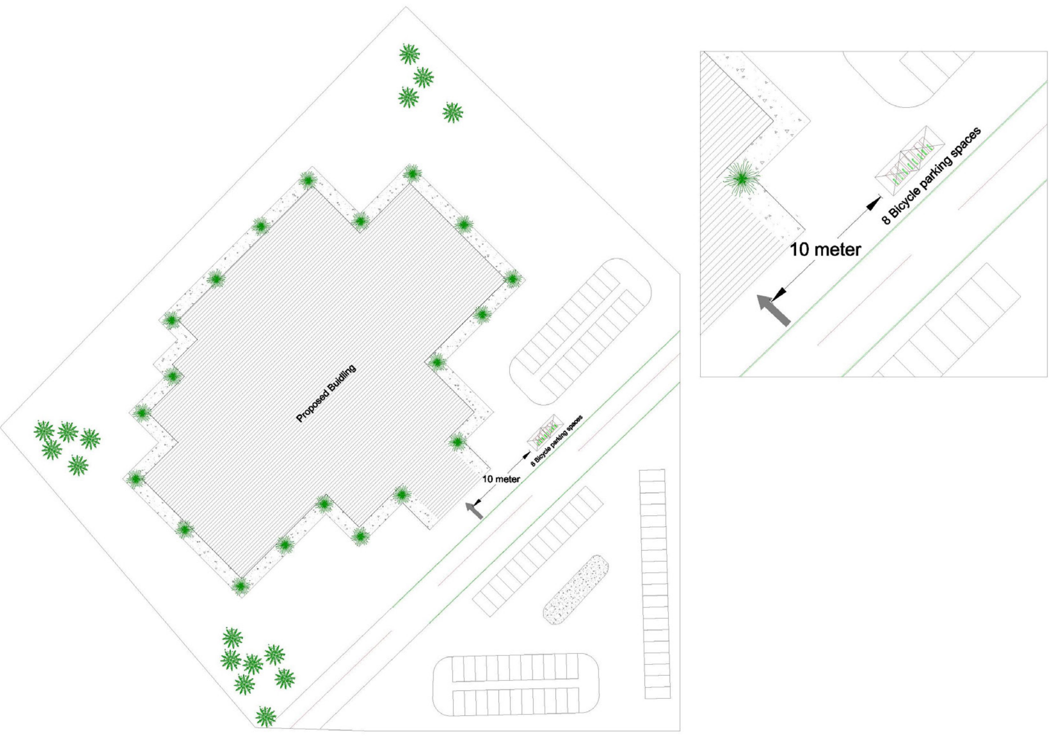



Fig 301.04(3): Sample Drawing - Bicycle Parking Spaces

ECOLOGY AND PLANNING

### Case Study

An office project in Dubai is being designed to provide bicycle storage and shower facilities for the employees. Total number of parking spaces required for the building is 812.

As per the regulation, secured or covered racks requirement is 10% of the total parking spaces. Hence, the project has to provide 81 bicycle storages within 30m from the building entrance to comply with this regulation.

## COMPLIANCE DOCUMENTATION

**Table 301.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Drawings to indicate locations for bicycle parking areas, shading structure provided to the bicycle storage and distance of bicycle storage area from entrance of the building.<br>2. Calculation for number of bicycle parking spaces. |
| Construction Completion Application | 1. Final approved architectural drawings indicating the locations of bicycle parking areas and distance from entrance of the building.<br>2. Final approved drawings to indicate the shading structures provided to the bicycle storage. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Roads and Transport Authority (n.d.). Cycling Track. Retrieved from https://www.rta.ae/wps/portal/rta/ae/home/about-rta/cycling-track.

# CHAPTER 2 - ECOLOGY AND LANDSCAPING

300

## 302.01 LOCAL SPECIES

Silver Sa'fa

### INTENT

To enhance the local biodiversity by encouraging the use of indigenous plants thereby reducing the water usage and achieve cost savings in utility bills.

### REQUIREMENT

For all new buildings, a minimum of 25% of the total planted area within the building plot, including green roofs, must utilise plant and tree species indigenous or adapted to Dubai's climate and region.

In addition to above, for all new villas at least one palm tree must be planted.

### SIGNIFICANCE

Landscaped and vegetated areas provide a good aesthetic viewing and a comfortable outdoor space. Developing and maintaining the landscaped areas may require high water consumption. The water demand depends on the plant species. Turf and several non-native plants consume large volumes of water, while native and adaptive plants require less.

Efficient use of water resources is a key element for sustainable development. Landscape with native and adaptive plants not only reduces the overall irrigation demand, it also helps in integrating the building site with its natural surroundings and enhances the local biodiversity. As native plants are well suited for local site conditions, they require less soil modifications and fertilizer quantities, thereby aids in reducing operating costs. The culture and heritage of Dubai also gets reflected by the use of native plant species.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires that a minimum of 25% of the total planted area of a building plot utilises plant and tree species appropriate for Dubai's climate. The total planted area is defined as the total external landscaped area of a building plot, including landscaped areas on roofs (vegetated roofs). Landscaped areas are those with trees, shrubs, grasses, or planted beds, including xeriscape areas, i.e. landscaping that is designed specifically to minimise water use.

This regulation recognises that, in Dubai, grass (turf) forms a large part of the planted area around the buildings. In order to reduce the amount of irrigation water needed, turf areas should be limited due to its high water requirement. Turf should be used primarily for functional benefits, such as recreational areas. Landscaping design must include plant and tree species appropriate for Dubai's climate and region. These include native (indigenous) plants, desert adapted plants, foreign drought resistant plants and salt tolerant plants suitable for use in Dubai. The use of such species contributes to water savings. Planting trees is encouraged, since the shade from trees helps to lower the air and soil temperatures, which in turn reduces the moisture loss of nearby plants and soil. Table 302.01(1) lists some examples of plants that can be used in water efficient landscaping in Dubai.

**Table 302.01(1): Examples of Water Efficient Plants**

| Scientific Name | English Name | Arabic Name | Growth Form | Indigenous/ Introduced |
|---|---|---|---|---|
| Acacia tortillis | Umbrella thorn | Samr, salam | Tree | Indigenous |
| Aerva javanica | Kapok bush | Alara', twaim, efhe, tirf | Bush | Indigenous |
| Cenchrus ciliarus | Foxtail grass, buffel grass, sand burr | Sabat, khadir, thumum, gharaz, drab, labaytad | Grass | Indigenous |
| Chloris virgata | Featherfinger grass | Khazamzam | Grass | Indigenous |
| Cistanche tubulosa | Desert hyacinth | Thanoon, tartooth, basul, dhamin | Parasitic flower | Indigenous |
| Citrillus colocynthis | Desert squash, bitter gourd | Shary, handhal, murrah, serew, hanzal, suri, hedeg | Ground cover | Indigenous |
| Convulvulus virgatus | Morning glory family | Hub alrisha, adlam | Bush | Indigenous |
| Cymbopogon commutatus | Incense grass | Alklathgar, sakhbar, hamra, idhkhir, khasaab | Grass | Indigenous |
| Euphorbia larica | Euphorbia | Isbaq, ibiq | Bush | Indigenous |
| Leptadenia pyrotechnica | Firemaker / broom bush | Markh, ma'aleet | Bush | Indigenous |
| Nerium oleander | Oleander | Defla, haban | Tree | Indigenous |
| Phoenix dactylifera | Date palm | Nakhl, amm-amm | Palm | Indigenous |
| Prosopis cineraria | Mimosa family | Ghaf, harb,awd, hadheeb, shibhan | Tree | Indigenous |
| Reseda aucheri | Mignonette family | Dhaub-nabmm, zinban | Bush | Indigenous |

| Scientific Name | English Name | Arabic Name | Growth Form | Indigenous/ Introduced |
|---|---|---|---|---|
| Stipagrostis plumosa | Plumose triple awned grass | Nussi, sabat, rahim, bathoot, tubaynee, thighaam, dawit | Grass | Indigenous |
| Sporobolus spicatus | Drop seed grass | Dhafrem, defera, sakham, rashad, halfa barri | Grass | Indigenous |
| Sueda vermiculata | Sea blite | Suweda, meliah, tuwaim, girm, hamd, tahmar | Bush | Indigenous |
| Tamarix nilotica/ arabica | Tamarisk | Tarfa, athl | Tree | Indigenous |
| Zizyphus spina cristi | Christ thorn | Sidr, ber<br>Fruit: Nabaq, dum | Tree | Indigenous |
| Zygophyllum qatarense | Bean caper | Haram, rotreet, balbal, theromet | Bush | Indigenous |

Note:

1. When calculating the area planted with local species, the area of the trunk of local trees planted in a grassed space is to be used in the calculation not the area covered by the tree's branches. This is because the grass under the tree will still need irrigation at a higher volume than local plants would require.
2. *Regulation 601.04* requires that all irrigation be with non-potable water or by drip or sub-surface irrigation systems.

Following are additional recommendations for the management of a water efficient landscape.

**Soil Improvement**

- Routine soil cultivation and adding organic matter (such as compost) improves soil's ability to retain moisture.
- Heavy or compacted soil around trees should be loosened and aerated by manual digging.
- Organic mulches include shredded bark or chips, wood grindings, compost, aged sawdust, or even low-growing ground cover. Organic mulches improve the organic matter content of the soil as they decay. However, this may be undesirable for plants that require excellent drainage and dislike wetter soil conditions. Inorganic mulches, such as gravel or rock, allows water drainage and are frequently used with plants susceptible to crown rot. 5 cm to 10 cm layer of mulch can help to even out temperature extremes and keep soil cooler on hot days. It also prevents soil from crusting, allowing better water penetration. By mulching around trees and planting beds, moisture is retained in the soil and weeds are discouraged.

**Landscape Maintenance**

- Proper maintenance keeps plants healthy and helps conserve water. For example, by weeding regularly, landscape plants do not have to compete with weeds for water.
- Fertility requirements of the plants should be considered. An adequate amount of nutrients is necessary, but over-applying fertilizers may create excessive growth and increase in maintenance requirements. Excessive addition of fertilizers may also leave plants more susceptible to insects and diseases.

### Calculations

Following equation must be used to calculate the overall percent of local species for the project:

$$\text{Percent local species} = \frac{\text{Area planted with local and adaptive plants}}{\text{Total vegetated area}} \times 100\%$$

### Case Study

A residential building is designed with 2,800 m² landscape area on ground and 350 m² area of green roof. To comply with Al Sa'fat, the project should have native plants for at least 25% of total vegetated area i.e. 788 m². Hence local species must be planted for at least 788 m² of the area (Ref Table 302.01 (2)).

**Table 302.01(2): Case Study**

| Description | Area (m²) |
|---|---|
| Total landscape area | 2,800 |
| Total green roof area | 350 |
| Total vegetated area | 3,150 |
| Area with local species | 787.50 |
| % Landscape area with local species | 25% |

## COMPLIANCE DOCUMENTATION

**Table 302.01(3): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dept. of Planning and Development – Trakhees, Government of Dubai (2018). Regulation EN- 9.0 Landscape Regulations: Comprehensive List of Suitable Plants for the UAE. Dubai.

Dubai Desert Conservation Reserve (n.d.). Flora & Fauna. Retrieved from https://www.ddcr.org/florafauna.

Dept. of Urban Planning and Municipalities - Abu Dhabi (2018). Abu Dhabi Public Realm Design Manual: Plant List. Abu Dhabi.

# CHAPTER 3 - NEIGHBOURHOOD POLLUTION



## 303.01 EXTERIOR LIGHT POLLUTION AND CONTROL

Silver Sa'fa

### INTENT

To reduce the light trespass from building sites and to increase night sky access.

### REQUIREMENT

For all new buildings, permanently installed exterior lighting must comply with the following requirements:

1. All exterior light fixtures on the building site, other than architectural accent lighting and Civil Aviation safety lighting, must be shielded, so that the full light emitted by the fixture, either directly or indirectly by reflection or by refraction from any part of the fixture, is projected below the horizontal plane passing through the lowest part of the fixture.
2. Architectural accent lighting must be aimed or shielded to prevent the lighting of the night sky. Wall washing lights must spill no more than 10% of the lighting, past the building façade.
3. Downward directed lighting must be used for lighting of signage.
4. All exterior lighting must be fitted with automatic controls, to ensure that lights do not operate during daylight hours.

### SIGNIFICANCE

Light pollution (also known as photopollution or luminous pollution) is excessive, misdirected or intrusive use of artificial outdoor lighting. Light pollution creates several environmental problems that include disturbance for wildlife species to hunt or forage at night, disorientation for migratory birds during migration and disruption in circadian rhythms and melatonin production in humans. Excessive use of exterior lighting is also a waste of electricity.

While parts of Dubai are known to have a vibrant nightlife, with many iconic buildings illuminated, the use of exterior lighting needs to be controlled to reduce the impact from over lighting. This regulation aids to reduce light pollution and night sky glow and provide several benefits that include people to enjoy the view of night sky.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation should be considered together with *Regulation 502.05* which specifies the maximum lighting power density that can be used for exterior lighting. Exterior lighting should use the lowest possible illumination to provide adequate light for safety and security.

Unless it is required for safety or security, direct lighting must not extend beyond property boundaries. Efficient lighting design can reduce light pollution by reducing the uplight, glare and light trespass. Minimising direct views of lamps avoids glare. Also, efficient use of sensors, timers and appropriate selection of light fittings can effectively optimise light usage, reduce light pollution and also reduce the energy consumption and costs.

In order to comply with this regulation, exterior lighting must be shielded as shown fig. 303.01(1), so that all of the light emitted by the fixture, either directly or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal plane passing through the lowest part of the fixture. The light fitting type should not emit light above the horizontal plane and be shielded to direct all light towards the ground so that the lighting elements are not exposed to normal view or create or constitute a hazard or nuisance to motorists/ pedestrians / neighbouring residents.

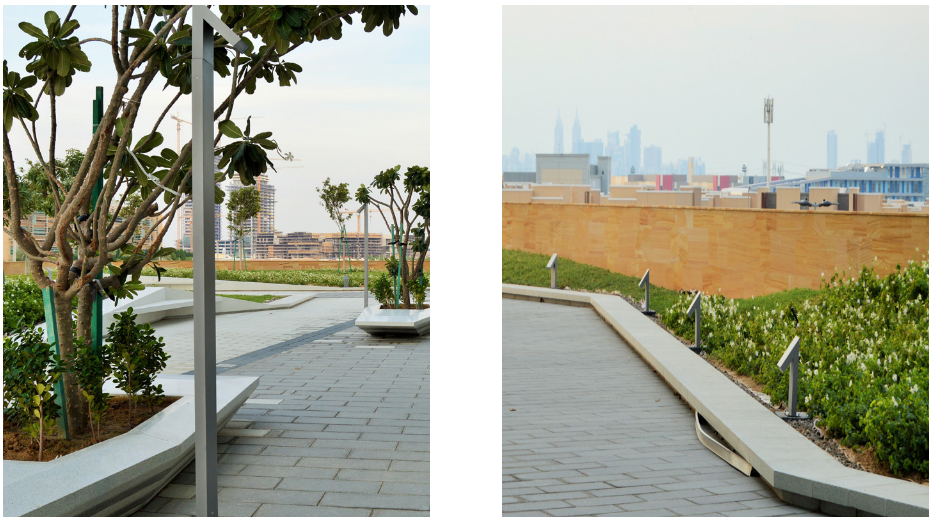


Fig 303.01(1): Full Cut-off Light Fixture

Daylight sensors or timers must be used to ensure that exterior lighting is not operating during daylight hours. Spotlights may only be used for special occasions and only with the permission of Dubai Municipality.

Choose outdoor light fixtures that are full cut-off, meaning there is a solid cap above the light bulb that prevents light from being emitted directly to the sky to minimise light pollution.

The use of motion sensors, timers, photocells or other means of activating lighting when it is needed is encouraged to conserve energy and avoid light pollution.

Install motion sensors on outdoor fixtures so they turn on when needed and turn off after a short time. Make sure to test and adjust the motion detector's sensitivity as needed to prevent the lights from turning on and off unnecessarily.

The maximum lighting power density allowable for outdoor lighting is specified in *Regulation 502.05*.

## COMPLIANCE DOCUMENTATION

Table 303.01(1): Documents Required

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. External lighting layout.<br>2. External light fixtures manufacturer's datasheet, luminaire schedule and photometric report.<br>3. Exterior lighting control system (photocells, timer control) manufacturer's datasheet.<br>4. External lighting fixtures, lighting controls & signage lightings delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, www.ashrae.org.

The Chartered Institution of Building Services Engineers. (2016). CIBSE Standard: LG06/16 Lighting Guide 06: The Exterior Environment - LG6, www.cibse.org.

The Lighting Research Center - Rensselaer Polytechnic Institute, USA. (n.d.). What is light pollution? Retrieved from https://www.lrc.rpi.edu/programs/nlpip/lightinganswers/lightpollution/lightpollution.asp.

# CHAPTER 4 - MICROCLIMATE AND OUTDOOR COMFORT



## 304.01 URBAN HEAT ISLAND EFFECT

Silver Sa'fa

### INTENT

To reduce absolute urban temperature and day time temperature range thereby improve pedestrian and building occupant comfort and reduce cooling demand.

### REQUIREMENT

For all new buildings, all opaque external roofing surfaces must comply with a minimum Solar Reflectance Index (SRI) value according to Table 304.01(1), for a minimum of 75% of the roof area:

**Table 304.01(1): Roof SRI Requirements**

| Type of Roof | Minimum Roof SRI |
|---|---|
| Steep Sloped Roofs (slopes steeper than 1:6) | 29 |
| Flat and Low Sloped Roofs | 78 |

### SIGNIFICANCE

The Urban Heat Island (UHI) effect (fig. 304.01(1)) is the temperature difference between urban and undeveloped areas. The UHI effect occurs due to the amount of high thermal mass materials present in built up areas, such as concrete and tarmac, which are commonly used in the construction of roads, sidewalks, parking lots, buildings and roofs. These materials absorb solar radiation during the day and then re-radiate some of it, leading to temperature differences of up to 3°C between urban and the surrounding undeveloped areas.

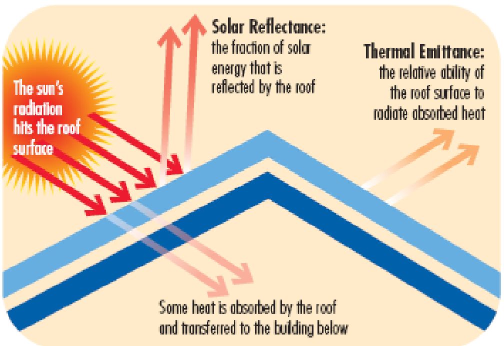


Fig 304.01(1): Urban Heat Island Effect

Solar Reflectance Index (SRI) is a measure of solar reflectance and emissivity of the material. Materials with higher SRI absorb less heat and reduce the UHI effect.

Solar reflectance (or reflectivity) indicates how well a material reflects solar radiation. Surfaces with a low solar reflectance are usually dark in colour and absorb a high fraction of solar radiation. The amount of energy absorption also depends on a material's specific heat capacity – how much heat they can store. The absorbed energy is then re-radiated by the material. Thermal emittance (or emissivity) indicates the ability of a material to radiate heat that it has absorbed. Surfaces with low emissivity cannot effectively radiate energy and therefore heat up.

Designing buildings that use materials with higher SRI values will help to reduce both absolute urban temperatures and reduce the daytime temperature range. This will improve pedestrian and building occupant comfort and is likely to reduce cooling demand within some building typologies. Cool roof products (fig. 304.01(2)) also help to reduce heat gain.

Fig 304.01(2): Example for Cool Roof

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The calculation of the total roof area does not include the area required for heating, ventilation, and air conditioning (HVAC) equipment, renewable energy generating equipment, building maintenance units, walkways for access to plant equipment and storage tanks. Walkways must be provided to allow service access to any equipment located on the roof.

Indicative SRI values for some common roofing materials is given in Table 304.01(2).

**Table 304.01(2): SRI Values for Roofing Materials**

| Roofing Materials | Typical SRI Value |
|---|---|
| Grey EPDM (enthlene propylene diene monomer) | 21 |
| Unpainted Cement Tile | 25 |
| Red Clay Tile | 36 |
| Light Gravel on Built-up Roof | 37 |
| Aluminum | 56 |
| White Ceramic Tile | 90 |
| White Coating | 100 |
| Light Beige Concrete Tile | 76 |
| Light Brown Concrete Tile | 48 |
| Pink and Grey Concrete Tile | 63 |
| Off White Concrete Tile | 92 |

Dark hard surfaces with high heat retention increase the overall temperature of the area and should be avoided where possible. Use of dark materials around buildings lead to increase in temperature at ground level and is discouraged.

All materials used for opaque external roofing surfaces must have a minimum SRI as indicated in the regulation. SRI values should be complied and reported in the DM Building Glazing Schedule Roof Table.

SRI is a measure of the surface's ability to reflect solar heat, as shown by a temperature rise. A standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. Once the maximum temperature rise of a given material has been computed, the SRI can be computed by interpolating between the values for white and black.

SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM C 1549 and Emittance is measured according to ASTM E 408 or ASTM C 1371.

A typical roof layout is shown in fig. 304.01(3).

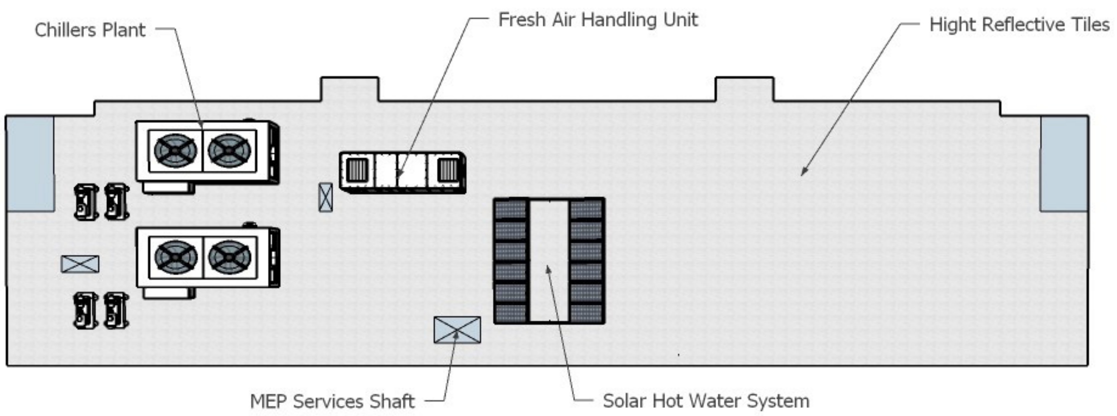



Fig 304.01(3): Sample Roof Layout

Manufacturers and suppliers of proprietary roofing products should be able to provide Material Specification Data Sheets (MSDS) and DCL test certificate confirming the SRI value of the products. Duly filled DM Building Glazing schedule with roof area details must be submitted to demonstrate the compliance.

Note: For Silver Sa'fa, if the green roof provides 30% of the total surface area of the building, it will be exempted from the requirements of *Regulation No. 304.01*.

**Calculation**

The following equation to be used to check compliance for this regulation:

$$\frac{\text{Area of high reflectance roof + Area covered by Solar PV}}{\text{Total effective roof area}} \geq 75\%$$

**Case Study**

A commercial project has a roof area of 11,000 m², of which 2,100 m² is covered by mechanical equipment. The effective roof area of the project is 8,900 m², in which 1,800 m² area is shaded by solar panels. To comply with the regulation, the project is proposing high reflective roof with SRI 83 for an area of 6,000 m². The project team can calculate the compliance using equation provided above.

$$\frac{\text{Area of high reflectance roof } (6{,}000 \text{ m}^2) + \text{Area covered by Solar PV } (1{,}800 \text{ m}^2)}{\text{Total effective roof area } (8{,}900 \text{ m}^2)} = 87\%$$

The total percentage of high reflectance roof is 87%, which is exceeding the required percentage of 75%, thereby the project complies with this regulation.

## COMPLIANCE DOCUMENTATION

**Table 304.01(3): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Provide roof drawings as per the requirements. It must indicate the total roof area, the effective roof area available and areas utilised by services.<br>2. Roof area calculations confirming compliance to the requirements.<br>3. Glazed elements schedule . |
| Construction Completion Application | 1. Provide as-built roof drawings as per the requirements. It must indicate the total roof area, the effective roof area available and areas utilised by services.<br>2. Purchase receipts/delivery notes for the roof material.<br>3. DCL certificate for the SRI value. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

ASTM E1980-11, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces, ASTM International, West Conshohocken, PA, 2001, www.astm.org.

ASTM C1549-16, Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer, ASTM International, West Conshohocken, PA, 2016, www.astm.org.

ASTM E408-13, Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques, ASTM International, West Conshohocken, PA, 2013, www.astm.org.

ASTM C1371-15, Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers, ASTM International, West Conshohocken, PA, 2015, www.astm.org.

# CHAPTER 4 - MICROCLIMATE AND OUTDOOR COMFORT



## 304.02 HEAT REJECTION EQUIPMENT INSTALLATION

Silver Sa'fa

### INTENT

To reduce urban heat island effect contributed by air conditioning system.

### REQUIREMENT

For all new buildings, individual heat rejection equipment having a power rating greater than 4.0 kW and which exhausts externally, must be installed not less than 3m above the ground level of the building.

### SIGNIFICANCE

Intense urbanisation has led more than 50% of world's population to live in cities. Urbanisation alters the local intra-urban climate by reduction in rainfall and increase in night time temperatures. It also influences absorption and reflection of solar radiation, ability to store heat, absorption and emittance of long wave radiation, winds and evapo-transpiration. Human activities such as cooling of buildings, vehicular traffic and industrial production also affect the built environment.

Urban Heat Island (UHI) effect is the temperature difference between urban and undeveloped areas. Research carried out by Liu et al in 2011, have found that for a typical office building cluster, the largest heat island intensity contributed by air conditioning systems can reach 0.7 °C at midday and contribute to a daily average rise of 0.53 °C. Increase in local temperature at street level linearly depends on the sensible heat released through air conditioning equipment.

This regulation proposes to improve the thermal environment by appropriately managing the exhaust heat from heat rejection system. This ensures that street level heat and UHI effect are reduced. The reduction in ambient temperature around the buildings by elevating the heat rejection equipment also increases pedestrian comfort.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation in conjunction with *Regulation 304.01*, aims to reduce both absolute urban temperature and the daytime temperature range. This results in minimisation of urban heat island effect (UHI).

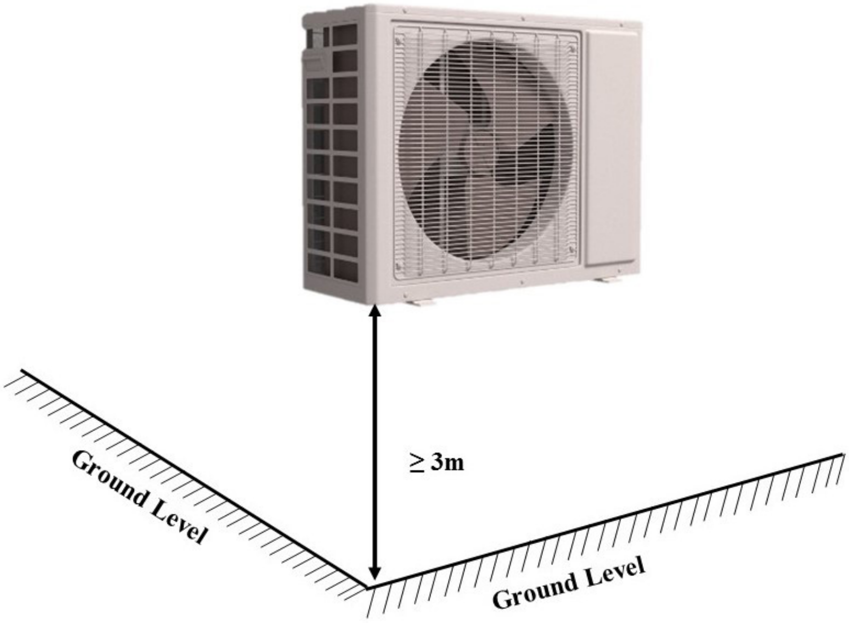



Fig 304.02(1): Installation Height for Heat Rejection Equipment ($P_i \geq 4kW$)

For buildings, heat rejection equipment must not be installed at lower levels, to ensure urban heat island (UHI) does not increase. This requires the unit such as window air conditioner or condenser of split units with an input power rating of 4 kW or greater, be installed at a level more than 3m from ground level as shown in Fig 304.02(1).

The heat rejection equipment mounted on the specified level / roof should allow safe access to condenser fan and fin sides for maintenance. It should also ensure scaffold access if fans are installed on a higher level. Proper installation procedures must be followed to avoid any loss of air circulation or reduced cooling capacity.

## COMPLIANCE DOCUMENTATION

**Table 304.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Plans and sections showing the location & mounting heights for the proposed heat rejection equipment. |
| Construction Completion Application | 1. Final approved plans and sections showing the location & the mounting heights for the proposed heat rejection equipment. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION


Chun-Ming Hsieh., Toshiya Aramaki., Keisuke Hanaki. (2010). Managing heat rejected from air conditioning systems to save energy and improve the microclimates of residential buildings.

Karin Lundgren., Tord Kjellstrom. (2013). Sustainability Challenges from Climate Change and Air Conditioning Use in Urban Areas.

Hsieh, C. M., Aramaki, T., & Hanaki, K. (2007a). The feedback of heat rejection to air conditioning load during the night in subtropical climate. Energy and Buildings, 39, 1175–1182.

Liu, J.; Ma, F.; Li, Y. The effect of anthropogenic heat on local heat island intensity and the performance of air conditioning systems. Adv. Mater. Res. 2011, 250–253, 2975–2978.

## 304.03 GREEN ROOF

Platinum Sa'fa

### INTENT

To minimise impact on microclimate thereby enhancing outdoor thermal comfort and reduce energy consumption with improved roof insulation.

### REQUIREMENT

For Platinum Sa'fa and for all new buildings, the roof of the building should be provided with vegetated roof (green roof) for at least 30% of the total roof area, or for the remaining area after complying the following conditions:

- The services should be grouped and distributed on each surface so that the space is optimised.
- At least 150 m$^2$ of roof area is available on any roof surface.

### SIGNIFICANCE

Green roofs (vegetated roof) provide several benefits at economic, ecological and societal levels. While green roofs reduce urban heat island effect, they also reduce energy consumption through shading, evapotranspiration, insulation and increase in thermal mass.

The reduction in energy bills is the most convincing factor for building owners to install green roofs. Green roofs also provide protection of roof elements, resulting in operational lifetimes that can be twice as conventional roofs.


Fig 304.03(1): Example for Green Roof

Furthermore, green roofs provide significant acoustic insulation through the absorption, reflection and deflection of noise. The substrate of a green roof tends to block noise in the lower frequency range while plants block noise.

Green roofs improve the appearance of the cityscape and encourage biodiversity. Green roof may also serve as outdoor social area (as shown in fig 304.03(1)).

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(3) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Installing a green roof requires special attention during the design, installation and subsequent maintenance phases. Green roof design must consider structural implications, as they are heavier than conventional roofing systems. Waterproof membrane or layers must be installed between the roof and the soil bed of the green roof to prevent surface runoff, or leaks, from damaging the building elements. A tough and impermeable layer is required to prevent the plant roots from damaging the supporting structure.

The project site illustrated below (fig. 304.03(2)) includes roof elements that incorporate green roofs.

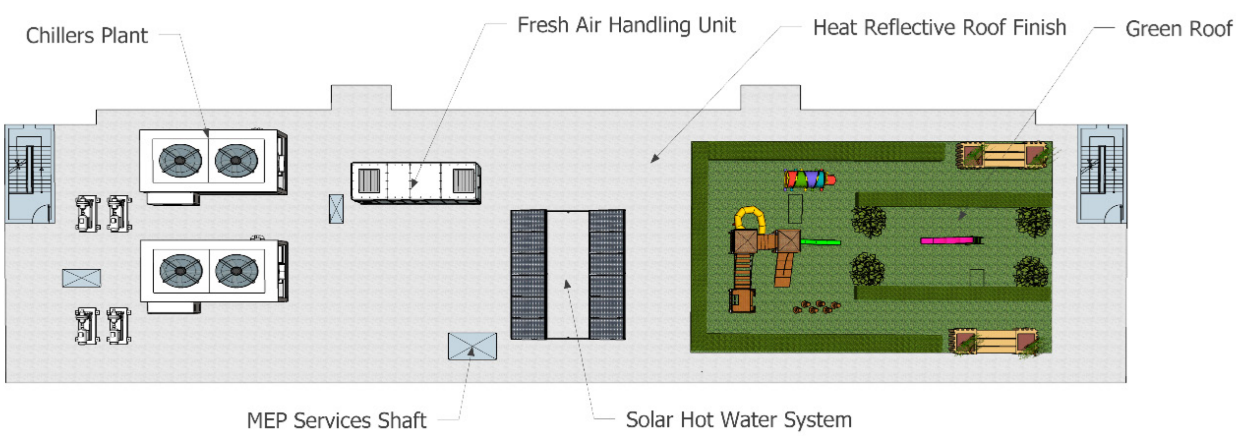



**Fig 304.03(2): Illustration for Green Roof**

Proper maintenance would be required to keep the plants healthy and the structure in good condition.

Water consumption is a significant consideration when using green roofs, especially in Dubai. The use of potable water needs to be kept to a minimum or even eliminated. Properly recycled gray water or water recovered from machinery condensate can be used effectively for green roof irrigation. Irrigation must use drip or sub-surface systems or use of non-potable water. For plant types suitable for Dubai's climate, refer to *Regulation 302.01: Local Species*.

Note: If the green roof provides 30% of the total surface area of the building, it will be exempted from the requirements of *Regulation 304.01*.

### Case Study

A new office building has a roof area of 1,100 m², of which 350 m² is covered by mechanical equipment. The effective roof area is 750 m². Minimum required roof area for Green Roof is 30% of the total roof area i.e. 330 m². Hence green roof should be at least 330 m². Since, the effective roof area exceeds 150 m² and the total calculated vegetated roof area meets 30% of the total roof area (as indicated in Table 304.03 (1)), the project complies with this regulation.

**Table 304.03(1): Case Study for Green Roof**

| Description | Area (m²) |
|---|---|
| Total roof area | 1,100 |
| Mechanical services area | 350 |
| Effective roof area | 750 |
| Vegetated roof area | 330 |
| Percentage of vegetated roof | 30% |

## COMPLIANCE DOCUMENTATION

**Table 304.03(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Roof layout highlighting area of green roof.<br>2. Calculations for green roof area. |
| Construction Completion Application | 1. Final approved roof layout highlighting area of green roof. |
| After Completion | 1. Photographs of green roof. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2019). Al Sa'fat Regulation No. 302.01: Local Species.

Dubai Municipality (2019). Al Sa'fat Regulation No. 304.01: Urban Heat Island Effect.

## 304.04 COLOURS ON THE OUTSIDE OF BUILDINGS

Silver Sa'fa

### INTENT

To reduce the internal temperature of buildings and associated cooling demand and to help reduce the overall Urban Heat Island effect.

### REQUIREMENT

For all new buildings, at least 75% of the area for external walls, must have a minimum Light Reflectance Value (LRV) of 45%.

### SIGNIFICANCE

Passive building design and material choices that avoid absorption of the sun's heat to promote thermal comfort and energy conservation, are traditional methods used by early inhabitants of Dubai, who constructed their homes and buildings from light coloured and white materials.

A large amount of heat can be reflected away from a building through the use of reflective exterior surfaces. The amount of energy absorbed and retained by a building is affected by surface colour. Light colours reflect a greater proportion of the solar energy whilst darker colours retain more solar energy resulting in the heating of the object and the surrounding air.

Light colours on outside of the buildings would encourage and preserve the rich heritage of the traditional building characteristic while at the same time help reduce energy use within the Emirate.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Final surface finishes applied to external walls of buildings must have a minimum Light Reflectance Value (LRV) of 45%. LRV is a measure of the total quantity of useable and visible light reflected by a surface in all directions on a scale from 0% to 100% as shown fig 304.04(1). Absolute black is assumed to be 0% and 100% represents perfectly reflective white. The blackest achievable wall finish has a LRV of approximately 5% and the whitest available finish approximately 85%.

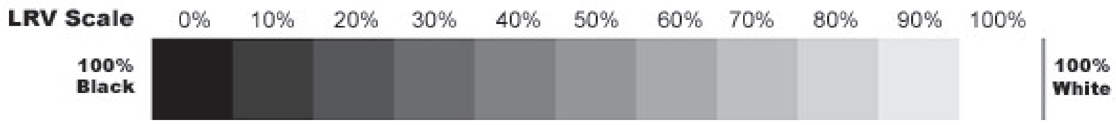



Fig 304.04(1): LRV Scale

The LRV of surface finishing materials are often stated by manufacturers on colour sample sheets or within material specification and data-sheets and in laboratory test results for individual products.

The LRV value is measured when the coating is applied to a test surface. The value does not change when applied to different surfaces.

The intent of this regulation is to use external finishes which reflect more light and heat. Increasing the LRV will increase the solar reflectivity. The LRV compliance should be complied and reported in the DM Building Glazing Schedule Wall table.

Manufacturers of external material/ finishes should specify LRV values on colour sample sheets or within material specification and data-sheets. These should be based on laboratory test results for individual products.

### Case Study

An office building has external wall area of 8,560 m². The project team employs strategies to reduce the urban heat island effect and cooling demand of the building, installing aluminum composite panels with LRV > 45 and painting with high LRV paints. Table 304.04 (1) below lists the qualifying areas.

$$\text{Requirement} = \frac{\text{Area of elevation finished with LRV>45}}{\text{Total external wall area}} \geq 75\%$$

**Table 304.04(1): Sample Qualifying Area**

| Description | Area (m²) |
|---|---|
| Total elevation area | 8,560 |
| Painted wall with LRV 60 | 3,720 |
| Stone cladding with LRV 38 | 1,360 |
| Aluminium cladding with LRV 49 | 2,900 |
| Wooden finish with LRV 28 | 580 |
| Total qualifying area (which have LRV above 45) | 6,620 |
| Total qualifying percentage | 78% |

Since the total qualifying percentage is more than 75%, the project is complying with this regulation.

Note: Area complying with this regulation can be computed in DM's Glazed Elements Schedule sheet.

## COMPLIANCE DOCUMENTATION

**Table 304.04(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Elevation layout with finishing schedule including notes for LRV requirements.<br>2. Calculations to indicate the percentage of external wall comply with the requirements.<br>3. DM BLDG glazed schedule. |
| Construction Completion Application | 1. Final approved elevation layout with finishing schedule.<br>2. Material technical data-sheets and test certificate of finishing material and paints and coatings indicating the LRV value.<br>3. Evidence of purchase order / delivery notes for compliant material. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

British Standards Institution (2010). BS 8493:2008+A1: Light reflectance value (LRV) of a surface.

# CHAPTER 4 - MICROCLIMATE AND OUTDOOR COMFORT



## 304.05 ORIENTATION OF GLAZED FAÇADES

Silver Sa'fa

### INTENT

To reduce heat gain through building facades thereby reducing cooling demand, achieving better energy savings and lowering carbon emissions.

### REQUIREMENT

For all new buildings, other than villas and industrial buildings, one of the following must be achieved for Silver Sa'fa, whereas for Golden and Platinum Sa'fa both the requirements must be achieved:

1. At least 50% of the total glazed surface area of the building, (excluding glazed areas with back insulated panels), must be facing the angle located between the east and the north-west which equals to 135° starting from the east.
2. South and west glazed areas, excluding glazed areas with back-insulated panels, must be treated environmentally.

### SIGNIFICANCE

At near-equatorial latitudes, such as in Dubai, the sun appears at higher polar angles with a more even irradiance of the south, east and west quadrants of the sky than it would be at higher latitudes (as shown in fig. 304.05(1)). The direct solar heat gains (i.e. heat arising from sunlight penetration through glazing) will be significantly lower in buildings where most of the unshaded glazing has a predominantly north orientation.

Direct solar radiation through glazing substantially increases the cooling load of buildings. In densely occupied building types in Dubai such as offices and other commercial buildings, the demand for cooling tends to be high already without solar loads, due to the internal heat gains generated by lighting, equipment and the occupants themselves. Therefore, it is important to minimise any additional solar load to the cooling demand of buildings. The most effective way of reducing solar gains in buildings is by external shading. Another means of reducing solar gains is to restrict the amount of glazing which faces the sun.

Successful implementation of this regulation will help to address energy efficiency right at the front end of the design process. It requires designers to take early consideration of building form, orientation and rationalisation of the use of glass in buildings, which ultimately will help reduce the demand for cooling in buildings. By reducing cooling requirements, energy savings could be achieved.

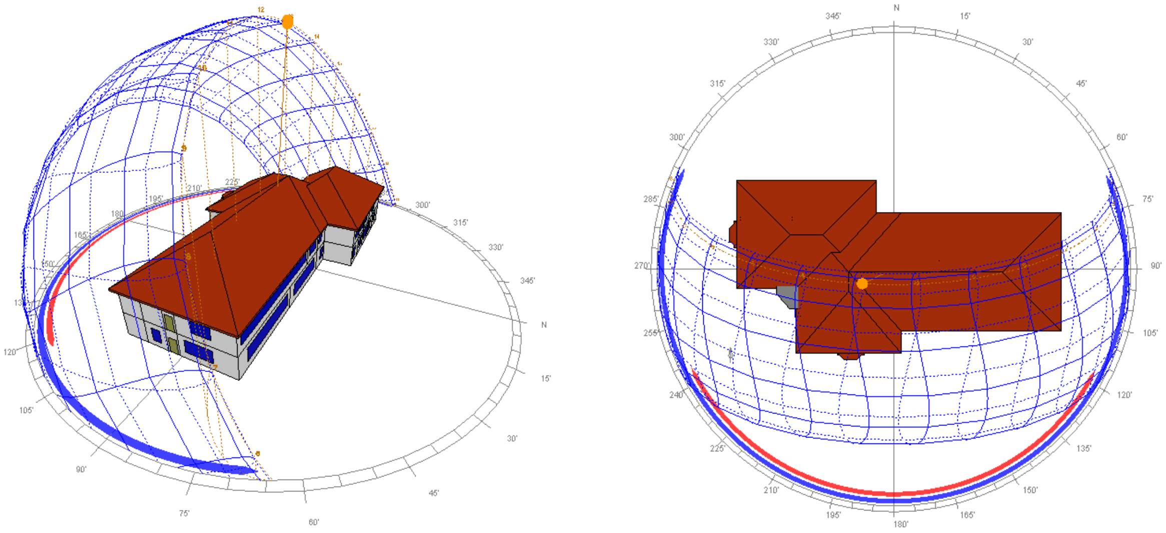


Fig 304.05(1): Annual Sun Path Diagram in Dubai

## APPLICABILITY

This regulation is applicable to all building types except villas and industrial buildings. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

For the orientation option, calculate the total area of glazing on each façade and confirm that the north façade has at least 50% of the total area of glazing. Predominantly, North orientation percentage can be calculated by using Dubai Municipality Glazed Elements - Fenestration Performance Requirements table.

Unprotected glazing in Dubai is not recommended and where practical, it is always preferable to use external shading or reduce the amount of glazing facing the sun.

Low Emissivity glass (or Low-e glass) is another way to improve overall performance of window and reduce the cooling and lighting costs of the building. Low E coatings will minimise the amount of ultraviolet and infrared light that can pass through glass without compromising the amount of visible light that is transmitted. Low-e reduces the amount of solar energy from entering the building.

Tinted glass and internal blinds which are directly exposed to solar radiation absorb large amounts of heat which is then transferred into the building by conduction and convection. This results in additional cooling loads but the greatest negative effect is that it increases the internal surface temperature of the windows. This increases the mean radiant temperature of the room, making occupants feel uncomfortable, even when the air temperature is within comfortable levels. With external shading, direct solar radiation is intercepted before it reaches the glass. Also, external shading will remove the restriction for glazing orientation i.e. glazing can be used in any orientation.

Where external shading can be integrated into the design in the form of balconies, canopies and other façade structures, further design efficiencies can be achieved. Smaller the vertical and horizontal shadow angles, better the shading effect. However, careful design will also have to balance effective shading with other façade design requirements such as the need for views and daylight.

## COMPLIANCE DOCUMENTATION

**Table 304.05(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Elevation layout highlighting vision and spandrel glass, shading elements and details.<br>2. DM BLDG glazed schedule indicating the percentage of the glazed façade area between the east and north west angle.<br>3. Mechanism of environmental treatment of the south and west façade in case of non-compliance with the requirement. |
| Construction Completion Application | 1. Final approved elevation drawing indicating the vision, spandrel glass, shading element and details. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook - Fundamentals: Chapter 15, Fenestration, www.ashrae.org.

Kohler, Christian, Yash Shukla, and Rajan Rawal. "Calculating the Effect of External Shading on the Solar Heat Gain Coefficient of Windows." Building Simulation 2017. San Francisco, CA, 2017. LBNL-2001057.

## 304.06 HARDSCAPE

Silver Sa'fa

### INTENT

To reduce absolute urban temperature thereby reducing the cooling demand and improving the pedestrian comfort.

### REQUIREMENT

For all new buildings, 50% of the hardscape of the development must achieve at least one of the following:

1. Demonstrate a Solar Reflectance Index (SRI) of at least 29.
2. Use an open grid pavement system.
3. Be shaded by vegetation.
4. Be shaded by materials with an SRI equal to or greater than those specified in Table 304.01 (1).

### SIGNIFICANCE

Heat islands are created by dark, non-reflective surfaces used for parking, roads, roofs, walkways and other hardscapes that absorb the sun's warmth and radiate heat. Other contributing factors include vehicle exhaust, air conditioners and street equipment. Buildings and narrow streets may also reduce airflow and exacerbate the effect.

Properties of urban materials, in particular solar reflectance, thermal emissivity and heat capacity, also influence urban heat island development, as they determine how the sun's energy is reflected, emitted, and absorbed. Surfaces with a low solar reflectance are usually dark in colour and absorb a high fraction of incoming solar radiation.

Mitigating heat island effects can have multiple benefits that include improved human health and comfort, reduced energy costs and lower greenhouse gas emissions. Strategies include increasing vegetative cover or creating green-roofs, reducing hardscape and incorporating high-SRI materials for pavements and shaded parking (sample shaded parking is provided in fig. 304.06(1)).

Fig 304.06(1): Example for Shaded Parking

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Solar Reflectance Index (SRI) as defined by ASTM E1980 (Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces), incorporates both reflectivity and emissivity. Standard black (reflectivity 5%, emissivity 90%) has an index of 0, and standard white (reflectivity 80%, emissivity 90%) has an index of 100. Materials with higher SRI absorb less heat and reduce the Urban Heat Island (UHI) effect. Shading of hardscape by permanent structures or plantings will also reduce the UHI effect, however the shading material must have a SRI equal to or greater than those specified in Table 304.01 (1).

This regulation requires the use of materials having an SRI of 29 or higher for at least 50% of the hardscape of any building development, including paving materials and vehicle parking spaces. Hardscape includes parking areas, roadways, paved courtyards and paths. Sample hardscape drawing is illustrated in fig. 304.06(2).

Open grid (porous pavers) pavement systems are defined as pavement that is less than 50% impervious. The system is typically composed of concrete or masonry units where at least 50% of the surface area consists of holes or openings that are filled with sand, gravel, other porous material, or vegetation. The use of an open grid structure reduces the amount of material, which absorbs heat, and so is a suitable means of reducing the UHI effect.

Manufacturers or suppliers of proprietary paving products should be able to provide DCL test report which detail the SRI value of their products. Indicative SRI values for some common paving materials are given in Table 304.06 (1).

**Table 304.06 (1): SRI Values for Common Paving Materials**

| Materials | Typical SRI Value |
|---|---|
| New Asphalt | 0 |
| New Grey Concrete | 35-50 |
| New White Concrete | 80-90 |

Note: To meet above requirements, new material should be used.

The SRI value of 29 has been chosen for this regulation as it allows the use of most types of concrete and concrete pavers but excludes asphalt. Proper periodical cleaning of hardscape surfaces will be needed to maintain good reflectance.

Materials for paving and vehicle parking spaces should be specified with SRI as indicated in the Regulation. Material Specification Data Sheets (MSDS) should detail the SRI value of the products.

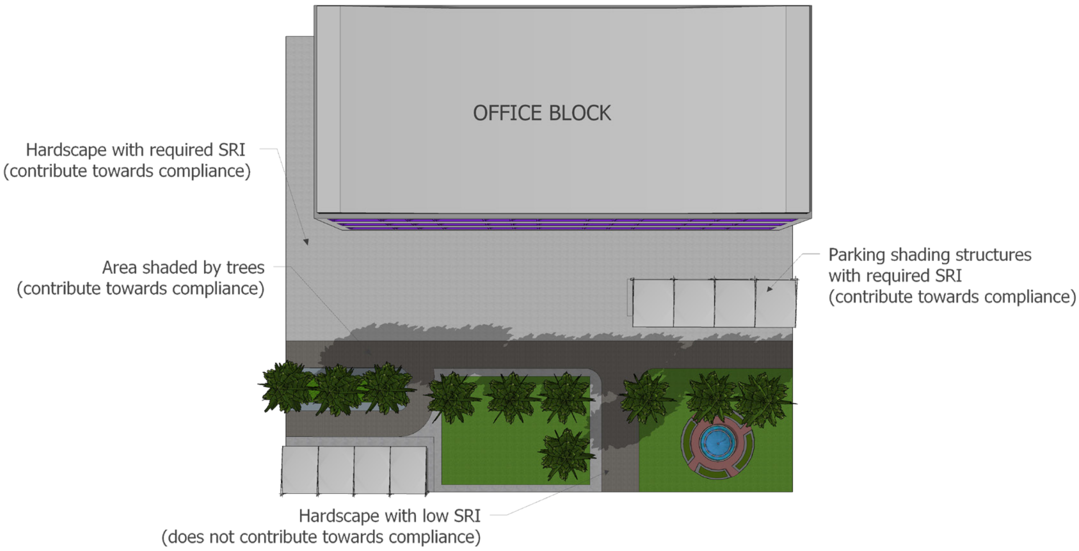



Fig 304.06(2): Sample Drawing

Refer to *Regulation 304.01: Urban Heat Island Effect* in Al Sa'fat Dubai Green Building System: Practice Guide, for information on Solar Reflectance Index (SRI).

Landscaping should utilise species as detailed in *Regulation 302.01: Local Species*.

### Calculation

The following equation to be used to check compliance for this regulation:

$$\frac{\text{Area of high reflectance car parking roof + Area covered by high reflective hardscape material + Area covered by open grid pavement + Area covered by shaded vegetation}}{\text{Total hardscape area}} \geq 50\%$$

Note: Area that contain more than one compliance option, shall be counted only once.

### Case Study

An office building is located on a 3,000 m² site, of which 2,000 m² is occupied by the building footprint. The remaining area is used for parking, driveway and walkways. The project team employs strategies to reduce heat island effect for non-roof surfaces, by planting trees to shade parking and driveway areas and by using light-coloured concrete having a SRI value of 35 for driving aisles and walkways. Areas that contain both light-coloured hardscapes and that are shaded by trees are counted only once.

**Table 304.06 (2): Case Study for Hardscape**

| Description | Area ($m^2$) |
|---|---|
| Total non-roof hardscape area | 1,000 |
| Shaded Area | 300 |
| Areas of hardscape with minimum SRI of 29 | 350 |
| Total area complying with Hardscape requirements | 650 |
| Percentage compliance (minimum 50%) | 65% |

The minimum requirement for complying with this regulation is 50%. As in the above case study (Table 304.06 (2)), percentage compliance is > 50%, the project complies with this regulation.

## COMPLIANCE DOCUMENTATION

**Table 304.06(3): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Site plan(s) showing project boundary, building footprint and hardscape area and SRI values for paving / shading materials.<br>2. Hardscape area calculations. |
| Construction Completion Application | 1. Final approved site plan(s) with elements and measurements, including project boundary, building footprint and hardscape area.<br>2. DCL certificate (SRI Value) of hardscape finishing material.<br>3. Proof of purchase - Purchase receipts/delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2019). Al Sa'fat Regulation No. 302.01: Local Species.

Dubai Municipality (2019). Al Sa'fat Regulation No. 304.01: Urban Heat Island Effect.

# 304.07 SHADING OF PUBLIC ACCESS AREAS

Silver Sa'fa

## INTENT

To improve conditions for pedestrians and reduce short distance vehicle use and urban heat island effect.

## REQUIREMENT

For all new buildings, other than villas, all pedestrian linkages within the plot area must be shaded using materials having a Solar Reflectance Index (SRI) equal to or greater than those specified in Table 304.01 (1).

## SIGNIFICANCE

Dubai's hot and humid climate makes it uncomfortable for pedestrians to walk for any significant distance in the summer months. Therefore, this regulation aims to provide a more comfortable outdoor environment for building users moving from car parking to the building entrances and along adjacent street pavements during the summer months through the provision of shading. The shading will also reduce short distance vehicle use and the Urban Heat Island (UHI) Effect.

Pedestrian-friendly development encourages people to walk more. When people walk more, they are more physically fit and have less health problems. Walking more and driving less also reduces greenhouse gas emissions and results in other environmental benefits.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The main pedestrian routes between parking areas and building entrances should be identified, along with a means of providing shading along the route. The shaded routes (as shown in fig. 304.07(1)) should extend into the parking areas as much as practicable but must, at least, be to the boundary of the parking area. A shaded route is required from a parking building that is located separately from the main building.

Fig 304.07(1): Sample Shaded Walkway

The shaded pedestrian route must lead to and from the building entrance closest to the building.

Wherever there is a pedestrian route on the building plot which runs alongside a public road, that route should be shaded. Shading of the public road is not required by this regulation. Sample layout is shown in fig. 304.07(2).

Following will qualify as meeting the required SRI values:

- Pedestrian area covered by photo-voltaic panels
- Building access from underground parking

Shade structure material on the roof must be selected based on the angle of roof. Refer to *Regulation 304.01: Urban Heat Island Effect* for information on Solar Reflectance Index (SRI).

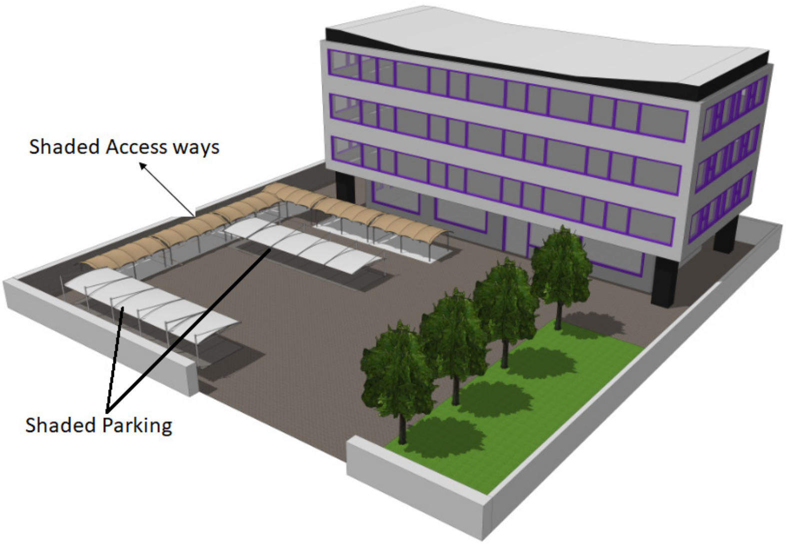



Fig 304.07(2): Sample Layout for Shaded Access

## COMPLIANCE DOCUMENTATION

Table 304.07(1): Documents Required

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Site plan drawings indicating shading details for pedestrian linkage and SRI values for shading materials. |
| Construction Completion Application | 1. Final approved site plan / drawings indicating shading details for pedestrian linkage.<br>2. DCL certificate (SRI Value) for the shading materials. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2019). Al Sa'fat Regulation No. 304.01: Urban Heat Island Effect.

# CHAPTER 5 - ENVIRONMENTAL IMPACT ASSESSMENT



## 305.01 ENVIRONMENTAL IMPACT ASSESSMENT

Silver Sa'fa

### INTENT

To predict and determine significant environmental impacts, to identify and incorporate appropriate abatement and mitigation measures and to identify and incorporate safety and health plans.

### REQUIREMENT

For all new buildings, if any of the following criteria is applicable, then an Environmental Impact Assessment (EIA) and/or a Construction Environmental Management Plan (CEMP) would be required and must be submitted and approved by Environment Department of Dubai Municipality:

1. If the building is intended as industrial building.
2. If the building has the potential to generate hazardous or toxic wastes such as laboratories, waste recycling or waste treatment.

The Dubai Municipality Environment Department's relevant Technical Guidelines for the Environmental Impact Assessment Procedure must be followed.

### SIGNIFICANCE

All new buildings will certainly have an impact on Dubai environment, but level of impact will vary based on size, location and other factors.

Environmental Planning & Studies Section (EPSS) Technical Guideline No. 1 requires that all new industrial facilities must submit an Environmental Impact Assessment (EIA) to obtain environmental clearance approval from municipality. The requirements and procedures for industrial projects are provided in Environmental Compliance Guideline for the Industrial Sector of Dubai.

By requiring all new building to be assessed as to their level of impact to the environment, DM will be able to ensure that projects, which may have a high impact, are identified and mitigation measures are carried out as required. Any project development must be environmentally sustainable and equitably meets the needs of present and future generations.

### APPLICABILITY

This regulation is applicable to industrial buildings and those buildings that has the potential to generate hazardous or toxic waste. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Upon application from the building developer, the Environmental Department of DM, will decide whether EIA or CEMP is required for the new building or whether neither will be required. EIA is required for all industrial buildings and buildings that has the potential to generate hazardous or toxic wastes such as laboratories, waste recycling or waste treatment and located in a environmentally sensitive area.

Implementation of any proposed project, development, activity or industrial establishment and any expansion, which has the potential to cause significant adverse environmental impacts, shall not commence unless an EIA process is undertaken and an "environmental license" or Environmental Clearance (EC) is obtained in advance from the EPSS of DM Environment Department.

Integration of the EIA process early into the project development cycle is a vital aspect of project planning and design. EIA process, which primarily deals with assessing the overall impacts of any proposed project, development or activity, also ensures the inclusion of necessary environmental protection, mitigation and enhancement measures into the project design elements.

CEMP is a site-specific plan developed to ensure that appropriate environmental management practices are followed during the construction phase of a project.

The intent of CEMP is :

- Provide effective, site-specific and implementable procedures and mitigation measures to monitor and control environmental impacts throughout the construction phase of the project.
- Ensure that construction activities do not adversely impact amenity, traffic or the environment in the surrounding area.

The main goals of CEMP are to specify the roles and responsibilities of personnel involved with all aspects of the construction activities; identify potential environmental impacts and the mitigation measures that will be used to address them; establish procedures for audits, monitoring and inspections; and specify training, record-keeping and documentation requirements.

Based on the project type, Environmental Department of DM will decide whether a proponent is required to submit a CEMP.

## COMPLIANCE DOCUMENTATION

**Table 305.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Obtain Dubai Municipality Environmental Department approval. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Environment Department - Dubai Municipality (2018). Technical Guideline No. 1 – Environmental Impact Assessment.

Environment Department - Dubai Municipality (2018). Technical Guideline No. 2 – Environmental Impact Assessment (EIA) Requirements for Development, Infrastructure, and Utility Projects.

# CHAPTER 1 - VENTILATION AND AIR QUALITY

400

## 401.01 MINIMUM VENTILATION REQUIREMENTS FOR ADEQUATE INDOOR AIR QUALITY

Silver Sa'fa

### INTENT

To maintain healthy internal environment for occupants by providing minimum ventilation requirements.

### REQUIREMENT

All new and existing buildings which are air conditioned must be mechanically or mixed mode ventilated and also must comply with the minimum requirements of latest edition of ASHRAE Standards 62.1, 62.2 and 170.

Occupancy density for each space shall be determined based on its activity and shall be in accordance with Dubai Municipality's requirements. If the occupancy density values are not mentioned then, default occupancy density values stated in the latest edition of ASHRAE Standards 62.1, 62.2 and 170 shall be considered.

### SIGNIFICANCE

Indoor Air Quality (IAQ) of a building affects the occupant comfort, well-being and productivity. Providing adequate ventilation in indoor spaces will reduce the contaminant within the building while maintaining comfortable environment for the occupants.

ASHRAE standard requires ventilation systems are designed to provide indoor air quality that will be acceptable to human occupants and is intended to minimise the potential for adverse health effects. It also prevents uptake of contaminants, minimises growth of microorganisms and removal of particulates. Building functionality is one of the factors that determine indoor air quality.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

ASHRAE Standard 62.1 shall be applied to spaces intended for human occupancy within buildings except those within dwelling units in residential occupancies in which occupants are non-transient. ASHRAE 62.2 shall be applied to dwelling units in residential occupancies in which the occupants are non-transient.

ASHRAE Standard 170 shall be applied to healthcare facilities.

Section 6 in ASHRAE 62.1, determines the minimum ventilation rates required for various applications using ventilation rate procedure (VRP). The ventilation rate procedure determines the outdoor rate intake based on space type/application, occupancy level and floor area.

Minimum rates are based on contaminant sources and source strengths that are typical for the listed space types. Occupancy density for each space shall be determined based on its activity and shall be in accordance with Dubai Municipality's requirements. If the occupancy density values are not mentioned then, default occupancy density values stated in the latest edition of ASHRAE Standards 62, shall be considered.

**Calculations**

The outdoor air flow required to be supplied to each zone by supply air distribution shall be no less than the value determined in accordance with the equation:

$$V_{oz} = \frac{(R_p \times P_z + R_a \times A_z)}{E_z}$$

where,

$V_{oz}$ = zone outdoor airflow

$A_z$ = zone floor area: the net occupiable floor area of the ventilation zone ($m^2$)

$P_z$ = zone population: the number of people in the ventilation zone during typical usage

$R_p$ = outdoor airflow rate required per person as determined from Table 6.1 of ASHRAE 62.1

$R_a$ = outdoor airflow rate required per unit area as determined from Table 6.1 of ASHRAE 62.1

$E_z$ = zone air distribution effectiveness as determined from Table 6.2 of ASHRAE 62.1

For dwelling unit in residential occupancies in which the occupants are non-transient shall follow ASHRAE 62.2, Section 4 to determine the ventilation rate in order to meet the regulation.

In addition to all above requirements for the fresh air ventilation, the project should also meet exhaust air ventilation requirements as per ASHRAE 62.1 or ASHRAE 62.2 standards.

For parking ventilation, the project should meet *Regulation 401.10* also in addition to meeting the minimum exhaust ventilation requirement as per this regulation.

## COMPLIANCE DOCUMENTATION

**Table 401.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Provide ventilation rate calculation through heat load analysis report, ventilation design drawing, and DM BLDG AC Unit Schedule. |
| Construction Completion Application | 1. Final approved ventilation layout and schematic including equipment schedule.<br>2. DM BLDG AC unit schedule.<br>2. Technical data sheet for ventilation equipment.<br>3. Delivery notes for the equipment. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE Standard 62.1: Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE Standard 62.2: Ventilation for Acceptable Indoor Air Quality in Low-Rise Residential, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Standard 170: Ventilation of Health Care Facilities, www.ashrae.org.

Chartered Institution of Building Services Engineers (CIBSE). (2015). AM10 Natural Ventilation in Non-Domestic Buildings, www.cibse.org.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.02 INDOOR AIR QUALITY DURING CONSTRUCTION, RENOVATION OR DECORATION

Silver Sa'fa

### INTENT

Reduce indoor air quality problems arising during construction, renovation and decoration works.

### REQUIREMENT

For all the buildings under construction or renovation, building occupants and systems must be protected from airborne contaminants that are generated or spread during construction or renovation works, carried out inside the buildings. These contaminants include toxic substances or substances that are harmful to the human body, such as asbestos, lead, pesticides, heavy metals, mold, dust, fumes, paints, etc.

Unless it is required to provide ventilation during construction, the supply and return heating, ventilation and air conditioning (HVAC) system openings must be closed and protected from contamination. All duct and related air distribution component openings, must be covered with tape, plastic, sheet metal or other suitable methods to prevent dust or debris from collecting in the system.

If the HVAC system is used during construction or renovation, temporary return air filters must be installed with at least a Minimum Efficiency Reporting Value of 8 (MERV 8).

Prior to occupancy, all temporary return air filters must be removed and replaced with permanent filters having at least Minimum Efficiency Reporting Value of 8 (MERV 8).

### SIGNIFICANCE

During construction and renovation works, large quantities of dust and other debris are generated and if ducts and air handlers, fan coil units and vents are not adequately protected, they will get contaminated by dusts and other debris. This can lead to mechanical damage to equipment, reduction in equipment efficiency and increased cost for equipment maintenance. This air contamination will also affect occupant's health.

Implementation of construction indoor air quality management plan will help protecting the building occupant's health. This shall also aid in reducing damage of equipment and cost for their maintenance.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Development of construction indoor air quality management strategies is the first step towards compliance. Project specific requirements and guidelines should be integrated into design specifications.

Prior to commencement of construction works, a detailed indoor air quality (IAQ) management plan incorporating the various indoor air quality implementation strategies associated with the specific project should be developed. This plan shall state compliance with applicable local or international standards.

During construction works, the plan should incorporate, at a minimum the following:

**System Protection**: If permanently installed HVAC systems are used during construction but prior to occupancy, the system shall be equipped with MERV 8 filters as determined in ASHRAE 52.2 (latest version) or equivalent filtration media in the supply air system. Instead of using permanent HVAC systems, temporary systems can be employed to provide comfort requirements to workers.

Protect stored on-site or installed absorptive building materials from weather and moisture; wrap with plastic and seal tight to prevent moisture absorption (fig. 401.02(1)). Absorption of moisture by building material may build up mold in future.

After commissioning and immediately prior to occupancy, MERV 8 filters or equivalent filters shall be installed in the supply air system. Additionally, all other filters that were used during construction shall be replaced with new filters.

All installed HVAC equipment and duct systems including all return and supply air vents and any open ductwork shall be sealed properly to eliminate air borne construction debris or dust from accumulating inside. Same strategies shall be followed for storage of HVAC systems prior to installation.

**Fig 401.02(1): Sample Photo of System Protection**

**Source Control**: Identify potential source of contamination from both outdoors as well as indoors. Exposure to Volatile Organic Compounds (VOCs) from building materials can cause uneasiness and discomfort. Low-toxicity, low-emitting, moisture-resistant materials can be selected wherever possible. Restrict traffic volume and prohibit idling of motor vehicles where emissions could be drawn into the building. Implementation of non-smoking policy is recommended.

**Pathway Interruption**: Identify potential source of pollution causing activities and isolate the work areas from clean or occupied spaces (as shown in fig. 401.02(2)). Ventilation and exhaust systems can be employed to create pressure difference between two spaces and preventing the dirty air entering the clean sections. Doors, windows, stairs and cutouts shall be closed to prevent them acting as conduits for contaminants.

**Scheduling**: Schedule the wet application of materials (including paints, sealers, insulation, adhesives, caulking and cleaners) to take place prior to installing highly absorbent materials (such as ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, etc.).

Fig 401.02(2): Sample Photo of Pathway Interruption

**House Keeping**: Perform thorough cleaning of the site during construction works and prior to occupancy of the building. Suppress and minimise dust with wetting agents or sweeping compounds during housekeeping. Quickly clean up spills and prevent accumulations of water inside the building. Prior to installation, store the building materials in clean and protected way especially those with moisture absorbing properties should be kept dry.

For renovation or decoration projects, develop IAQ impact assessment plan pertaining to all anticipated work activities, associated source contaminants like lead, asbestos, it's generation points and areas affected by the migration of air contaminants. Identify specific control measures required for the project like removal and disposal of the asbestos, carried out as per the guidelines of Dubai Municipality and by approved personnel, isolating areas under renovation from adjacent occupied spaces using impermeable barriers, usage of proper ventilation strategy to prevent migration of air contaminants, identifying logistic plans through unoccupied areas and away from building entrances and occupants. Contractor to ensure adequately trained staffs are employed during the renovation activities to implement the IAQ strategies.

## COMPLIANCE DOCUMENTATION

**Table 401.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Completed construction IAQ planning checklists and evaluations of proposed measures.<br>2. Technical data sheet for temporary and final filter used for MERV requirement.<br>3. Proof of purchase / delivery notes for temporary and final filter. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE standard 55: Thermal Environmental Conditions for Human Occupancy, www.ashrae.org.

Sheet Metal and Air Conditioning National Contractors Association. (2007). (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, ANSI/SMACNA 008–2008, www.smacna.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE standard 55.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size, www.ashrae.org.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.03 AIR INLETS AND EXHAUSTS

Silver Sa'fa

### INTENT

To maintain healthy internal environment for occupants by restricting entry of contaminants from outdoor sources.

### REQUIREMENT

For all new and existing buildings, outdoor air intakes for all ventilation systems, including doors and operable windows, that are part of mixed mode ventilation system, must be located at a suitable distance from potential sources of contamination. This is to reduce the possibility of odor, smoke or other air contaminants entering the ventilation system. This must also be in compliance with Dubai Municipality's requirements or with the latest edition of ASHRAE Standards 62.1 and 62.2.

Exhaust air must be discharged in a way that it does not get drawn back into the building or the building ventilation system. It also must not become a nuisance to the building occupants or occupants for nearby buildings or to pedestrians.

### SIGNIFICANCE

Fresh air intakes into the ventilation systems of buildings, if poorly planned and positioned, may lead to pollutants, odours and excessive heat being introduced into the building causing poor health, discomfort and increasing energy consumption. Exhaust air must be discharged in a manner that avoids it being drawn back into the building system. Exhaust air discharge must not become a nuisance to neighbouring building systems or pedestrians.

In a building, several exhaust vents such as toilet exhausts, kitchen fan exhausts, plumbing vents, cooling tower vents may be present. If separation distances are not maintained between building outdoor air intake opening or operable window or door opening with these types of exhaust vents, exhaust air would re-enter the building ventilation systems and may affect the building occupant's health.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Outdoor air inlets must be located away from potential sources of contamination to reduce the possibility of odours, smoke or other air contaminants entering the ventilation system.

ASHRAE 62.1 / ASHRAE 62.2 specifies the minimum separation distance between outdoor air intakes (including doors and windows that are required as a part of natural ventilation) and building exhaust or any specific potential outdoor contaminant source.

Table 401.03(1) below (from ASHRAE 62.1, Table 5.5.1) specifies the minimum separation distance for various sources of exhaust that needs to be met for compliance with this regulation.

**Table 401.03(1): Minimum Separation Distance for Air Intake**

| Object | Minimum Distance (m) |
|---|---|
| Class 2 air exhaust/relief outlet (Note 1) e.g. pump room, elevator room, electrical room exhaust etc. | 3m |
| Class 3 air exhaust/relief outlet (Note 1) e.g. residential kitchen, commercial kitchen hoods other than grease, toilet exhaust, pantry exhaust etc. | 5m |
| Class 4 air exhaust/relief outlet (Note 2) e.g. hazardous material storage room defined in section 401.04, or any harmful gases etc. | 10m |
| Plumbing vents terminating less than 1 m above the level of the outdoor air intake | 3m |
| Plumbing vents terminating at least 1 m above the level of the outdoor air intake | 1m |
| Vents, chimneys, and flues from combustion appliances and equipment (Note 3) | 5m |
| Garage entry, automobile loading area, or drive-in queue (Note 4) | 5m |
| Truck loading area or dock, bus parking/idling area (Note 4) | 7.5m |
| Driveway, street, or parking place (Note 4) | 1.5m |
| Roof, landscaped grade, or other surface directly below intake (Notes 5) | 0.3m |
| Garbage storage/pick-up area, dumpsters | 5m |
| Cooling tower intake or basin | 5m |
| Cooling tower exhaust | 7.5m |

Note 1: This requirement applies to the distance from the outdoor air intakes for one ventilation system to the exhaust/relief outlets for any other ventilation system.
Note 2: Minimum distance listed does not apply to laboratory fume hood exhaust air outlets. Separation criteria for fume hood exhaust shall be in compliance with ANSI/AIHA Z9.5 Information on separation criteria for industrial environments can be found in the ACGIH Industrial Ventilation Manual and in the ASHRAE Handbook— HVAC Applications.
Note 3: Shorter separation distances shall be permitted when determined in accordance with (a) ANSI Z223.1/NFPA 54 for fuel gas burning appliances and equipment, (b) NFPA 31 for oil burning appliances and equipment, or (c) NFPA 211 for other combustion appliances and equipment.
Note 4: Distance measured to closest place that vehicle exhaust is likely to be located.
Note 5: The minimum separation distance shall not apply where outdoor surfaces below the air intake are sloped more than 45° from horizontal or less than 30mm in width.

Low-rise buildings shall follow section 6.8 of ASHRAE 62.2, which requires a minimum separation distance of 3m is maintained between outdoor air intake and sources of contamination such as stack, vent, exhaust hood or vehicle exhaust.

The above information is currently based on ASHRAE 62.1 & 62.2-2016 version. Latest version of the standard that is in force at the commencement of project design, shall be followed for compliance.

**Example**

The below layout (fig. 401.03(1)) illustrates the separation distance of more than 5m is maintained between fresh air intake louver and general exhaust outlet at the fresh air handling unit.

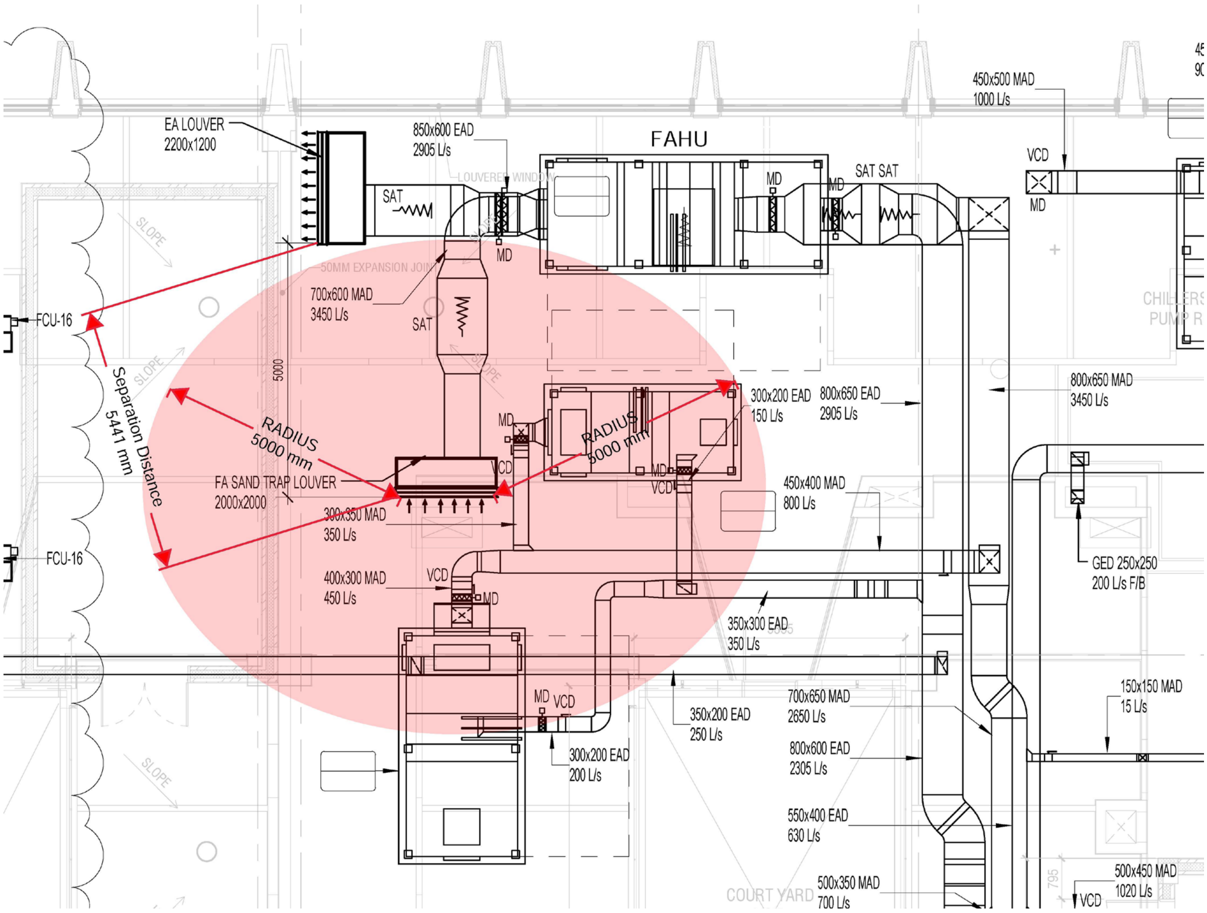



Fig 401.03(1): Roof Layout Showing Separation Distance

## COMPLIANCE DOCUMENTATION

**Table 401.03(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Mechanical drawings, marked-up to clearly show distances between outdoor air intake points including doors & openable windows and exhaust air discharge outlet or other discharge points. |
| Construction Completion Application | 1. Final approved layout, marked-up to clearly show distances between outdoor air intake points including doors & openable windows and exhaust air or other discharge points. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1: Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.2: Ventilation for Acceptable Indoor Air Quality in Low-Rise Residential, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, www.ashrae.org.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.04 ISOLATION OF POLLUTANT SOURCES

Silver Sa'fa

### INTENT

To maintain healthy internal environment for building occupants by isolating hazardous pollutants.

### REQUIREMENT

All new and existing buildings having spaces that has activities producing hazardous fumes or chemicals, must provide dedicated air extraction systems for those spaces. The system must create negative pressure and exhaust the fumes or chemicals to ensure it does not enter adjacent rooms.

Dangerous goods must be stored in accordance with Dubai Municipality's requirements.

### SIGNIFICANCE

Building uses such as cleaning stores, laundry rooms, printing rooms and garbage rooms may produce hazardous fumes or chemicals. If not adequately isolated, these contaminants may enter other occupied areas of the building and in the ventilation system. Prolonged exposure or usage of these hazardous chemicals can have adverse health effects on building occupants. Proper isolation and ventilation of hazardous fumes and chemicals within a building will help to ensure good indoor air quality.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Prior to developing the building design, identify spaces where hazardous gases or chemicals may be handled or used and develop a contaminant control design for those spaces to prevent interior cross-contamination. Hazard study methods can also be used to evaluate design concepts and to validate the HVAC design conforms to applicable safety plans. The nature and quantity of the contaminant, types of operations, and degree of hazard dictate the types of containment and local exhaust devices. Spaces where hazardous gases or chemicals may be present include garages, housekeeping and laundry areas, copying and printing rooms, laboratories, prep rooms, art rooms etc.

Isolation of pollutant sources (fig. 401.04(1)) can be carried out by providing:

- Weather-stripping all doors leading from these spaces into common areas and occupied spaces.
- Self-closing doors, as well as floor to ceiling partitions to create an enclosed space.

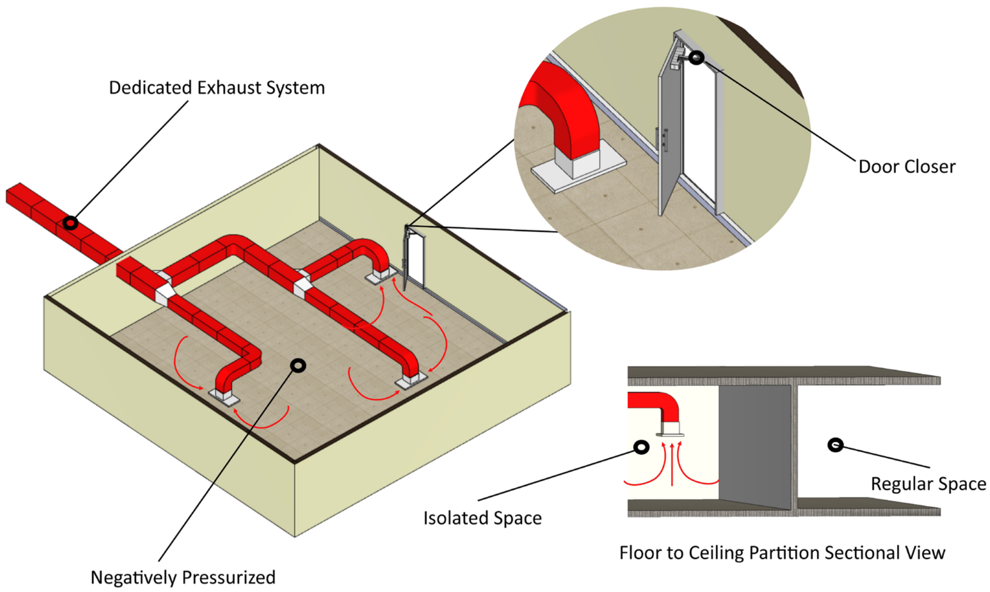



**Fig 401.04(1): Sample Methods for Isolation of Pollutant Sources**

- Direct connection to a dedicated exhaust system that discharges these hazardous fumes or chemicals outside the building (the discharge of waste gases, fumes and dusts shall be in accordance with Dubai Municipality's requirements).
- Separate rooms where chemicals are mixed and disposed. These rooms should also include sinks and /or drains to ensure that chemicals are disposed properly and in compliance with Dubai Municipality's requirements.
- Separation distance between the exhaust outlet of the hazardous pollutant and outdoor air intakes or operable windows and doors must meet the ASHRAE 62.1, Table 5.5.1 and ASHRAE 62.2, section 6.8, minimum requirements in order to avoid re-entry of this hazardous discharge into occupied spaces.
- By creating negative pressure with respect to adjacent spaces.

ASHRAE standard 62.1 provides guidance on Minimum Ventilation rates for different rooms and occupational categories.

The storage of any Hazardous / dangerous material must be carried out in accordance with Dubai Municipality's requirements.

## COMPLIANCE DOCUMENTATION

**Table 401.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Ventilation design drawing for the floor and ventilation schematic for hazardous material storage room. |
| Construction Completion Application | 1. Final approved ventilation design drawing for the floor and ventilation schematic for hazardous material storage room.<br>2. Delivery notes for exhaust fans. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1: Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, www.ashrae.org.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.05 OPENABLE WINDOWS

Silver Sa'fa

### INTENT

To promote natural ventilation and reduce energy consumption during cooler outdoor conditions.

### REQUIREMENT

For all new buildings, openable windows must be provided in accordance with Dubai Municipality Building Regulations unless there is a safety requirement restricting opening of these windows. These windows may be used in special cases like when use of air conditioning or ventilation system is not required or during automatic switch off or during system break-down.

### SIGNIFICANCE

Although the buildings in the Emirate of Dubai are required to have mechanical ventilation and air conditioning, opportunity exists to utilise natural ventilation for some months of the year. By utilising mixed mode ventilation, better indoor air quality and energy savings can also be achieved.

Natural ventilation can be harnessed by the provision of openable windows and doors in buildings. Openable windows provide building occupants to control their indoor environment which enhances their work / living environment. Although this regulation only applies to habitable rooms, openable windows and doors can also be considered for other building spaces.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Implementation of this regulation should be in line with the existing Dubai Municipality (DM) regulation for openable windows.

Building plans must detail the floor area for each habitable room. Habitable rooms are defined as: any room used for sleeping, living or dining purposes, excluding other enclosed places such as closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms and similar spaces.

Window schedule to include the number and size of openable windows and doors. The ratio of openable windows to floor area must be at least 10% and be specified in project documentation.

If a room contains more than one openable window or door, the areas of all the opening parts (doors and windows) may be added to achieve the required proportion of the floor area.

The area of opening is calculated using only those parts of the window or door which actually open. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.

Consideration should also be made to create cross ventilation within or between rooms. Openings on the two sides of each room could provide cross ventilation. For single sided rooms, two openings at different heights (one close to floor and another close to ceiling) could provide vertical air movement.

Windows and doors must also meet the thermal transfer requirements of Dubai Municipality.

The restriction on the opening of windows at higher levels is a safety consideration to remove the risk of objects or children falling from the windows.

**Case study**

Fig. 401.05(1) provides a floor plan of habitable and non-habitable spaces in a general residential unit. Fig. 401.05(2) provides details for window and door. Based on the floor layout and window and door details, Table 401.05 (1) provides a ratio of openable windows to floor area for each habitable space.

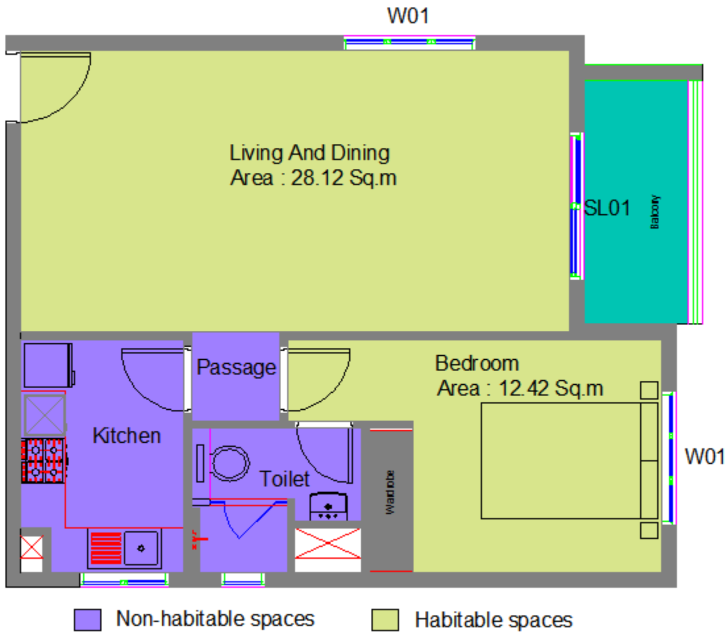



**Fig 401.05(1): Sample Floor Layout**

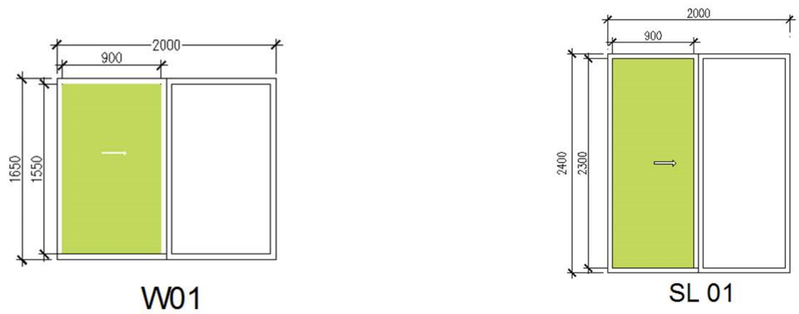



**Fig 401.05(2): Window / Door Schedule**

**Table 401.05(1): Calculation for Openable Area**

| Spaces | Floor Area m² | Required Opening Area (10% of floor area) m² | Window Size | Quantity | Total Openable Area m² | % of Opening Area |
|---|---|---|---|---|---|---|
| Living and Dining | 28.12 | 2.812 | W 01 (2.0 m X 1.65 m) | 1 | 3.47 | 12.33% |
| | | | SL 01 (2.0 m X 2.4 m) | 1 | | |
| Bedroom | 12.42 | 1.242 | W 01 (2.0 m X 1.65 m) | 1 | 1.39 | 11.19% |

## COMPLIANCE DOCUMENTATION

**Table 401.05(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Elevation drawing highlighting the percentage of openable windows. |
| Construction Completion Application | 1. Final approved elevation drawing highlighting the fixed and openable windows. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers, CIBSE. (2005). CIBSE AM10:2005 - Natural Ventilation in Non-Domestic Buildings, www.cibse.org.

BUILDING VITALITY

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.06 INDOOR AIR QUALITY COMPLIANCE – NEW BUILDINGS

Silver Sa'fa

### INTENT

To maintain acceptable indoor air quality (IAQ) levels for occupant well-being.

### REQUIREMENT

For all new buildings, suitable ventilation for the building occupants must be ensured and the air quality must be in accordance with the technical guidelines issued by Dubai Municipality.

The buildings must apply the following procedures:

A. Indoor air quality testing must be carried out prior to occupancy. The maximum limit for the indoor air contaminants stated in Table 401.06 (1), must not be exceeded. Report showing compliance with these requirements, must be submitted to Dubai Municipality.

**Table 401.06(1): Schedule, Duration of Sampling and Maximum Limit for Contaminants**

| Sampling Schedule | Type of Samples | Maximum Acceptable | Sampling Duration |
|---|---|---|---|
| Pre-Occupancy | Formaldehyde | < 0.08 ppm | 8- hour continuous monitoring (8-hour time-weighted average [TWA]) |
| | Total Volatile Organic Compound (TVOC) | < 300 micrograms/m³ | |
| | Suspended Particulates (<10 microns) | < 150 micrograms/m³ | |

B. Air quality testing must be carried out by specialised companies or laboratories.

C. Air quality testing equipment must have initial and periodical calibration certificate. Calibration certification frequency shall either be annually or as per manufacturer specification and shall be from an external calibration facility, accredited by DM. The initial and periodical calibration certificates must be saved in a special register. The calibration certificate would be checked by DM to validate the accuracy of the readings. This also is a requirement for renewing the indoor air quality certificate of the building.

## SIGNIFICANCE

Even with the restrictions on the use of high emitting materials such as volatile organic compounds (VOC) and on the protection of air conditioning equipment during construction, it is still possible the IAQ of the building will not be at the acceptable level. It is important to eliminate various pollutants generated due to construction / renovation activities inside the building. When a healthy indoor air quality is ensured in the building, it will have a positive effect on the comfort, health and productivity of the occupants. Evaluating IAQ levels is imperative to ensure compliance with DM standards, prior to building occupancy.

IAQ test results also guide the project team to identify potential contaminant threat levels, so that corrective actions can be taken to reduce the pollutant levels.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Effective implementation of IAQ plan and strategies would result in compliance of IAQ levels as set forth by this regulation. The schedule, duration of sampling and maximum limit for contaminants as stated in Table 401.06 (1) should be included as part of project specifications. It should also include testing methods / standards, sampling point details and testing agency requirements.

In construction stage, prior to occupancy, testing shall be carried out to demonstrate the indoor pollutant concentration levels do not exceed the values stated in Table 401.06 (1). Report showing compliance with these requirements, must be submitted to DM. Some of the important factors to be considered for IAQ testing:

- To ensure compliance with DM's IAQ standards, performance of each HVAC systems including space temperature, space humidity uniformity, outside air quality, filter installation, drain pan operation and any known contamination sources are verified, prior to IAQ testing.
- IAQ test must be carried out by specialised companies or laboratories.
- An IAQ testing plan specifying the procedures, testing standards, equipment to be used and sampling methods that will be employed, shall be developed.
- IAQ testing shall be carried out following the completion of all interior finishes, not limited to doors, paints, carpet, tiles and furniture, prior to occupancy.
- Perform IAQ testing within the breathing zone between 3 and 6 feet above the finished floor and for a duration of continuous 8 hours.
- Air samples shall be collected during regular operational hours. Ventilation and air conditioning systems should be operating in their normal operating mode for the entire duration of the testing.
- Outdoor samples may also be needed for comparison with indoor samples for some conditions, such as temperature and relative humidity, and some contaminants, such as airborne dust.
- All individual testing equipment and sensors shall have initial and final calibration certificate conforming the compliance levels by DM approved external calibration agency.
- IAQ testing is required to be performed for each parameter for each sampling location, in accordance with the DM requirements.

### Sampling Locations

Recommended number of samples for Residential, Commercial and Industrial buildings are given in Table 401.06 (2), and for Public buildings are given in Table 401.06 (3).

## Table 401.06 (2): Requirement for Number of IAQ Samples

| Category | Sub-category | Building Type | Requirement |
|---|---|---|---|
| Residential | Villas | Investment Villas | 1 in 5 for each typology + 1 per floor |
| | | National Villas | 1 per floor |
| | Apartments | Typical Multi-Family Apartments | 1 in 5 for each typology |
| | | Duplex Flats | 1 in 5 for each typology + 1 per floor |
| | | Pent Houses | 1 in 5 for each typology + 1 for every 500 m² |
| | Labor Accommodation & Mass Housing | | 1 in 5 for each typology + 1 per floor |
| Commercial | Hotels, Motels and Furnished Apartments & Resorts | Villas | 1 in 5 for each typology + 1 per floor |
| | | Studios, One Bedrooms, Two Bedrooms | 1 in 5 for each typology |
| | | Duplex Rooms | 1 in 5 for each typology + 1 per floor |
| | | Pent Houses | 1 in 5 for each typology + 1 for every 500 m² |
| | Laboratories | | 1 for every 500 m² of Office Area + 1 for every 500 m² of Lab Area +1 per floor |
| | Offices | | 1 for every 500 m² of Office Area + 1 per floor |
| | Restaurants / Food Outlets | | 1 for every 500 m² of seating Area+1 per kitchen or for every 1,000 m² +1 per floor |
| Industrial | Factories, Warehouse and Workshop | | 1 for every 500 m² of Office Area + 1 per floor |

## Table 401.06 (3): Requirement for Number of IAQ Samples

| Public Buildings | Requirement |
|---|---|
| Banks / Government Facilities / Post Offices | 1 for every 500 m² of Office Area + 1 per floor |
| Cinema/ Theaters | 1 in 3 for each typology + 1 per floor |
| Educational Facilities | 1 in 3 for each class-room typology + 1 for every 1,000 m² of complex + 1 per floor |
| Health Care Facilities | 1 in 3 for each room typology + 1 for each operation theaters + 1 per floor |
| Historical/ Heritage Buildings /Museums | 1 for every 1,000 m² + 1 per floor |
| Petrol Stations / Retail Outlets | 1 for every 500 m² + 1 per floor |
| Shopping Malls | 1 for every 500 m² of Office Area + 1 for every 1000 m² of public areas + 1 per floor |
| Masjid and Worship Houses | 1 for every 500 m² + 1 per floor |
| Exhibition and Festival Centers | 1 for every 1,000 m² + 1 per floor |
| Gymnasium and Sports Complex | 1 for every 500 m² of Gym + 1 for every 1000 m² of complex + 1 per floor |
| Sports and Entertainment Complexes | 1 for every 1,000 m² + 1 per floor |

If IAQ test report demonstrates that maximum concentrations of contaminants have exceeded, additional flush-out procedures with outside air should be implemented. Test must be conducted again until it can be verified that contaminant levels does not exceed the acceptable range.

## COMPLIANCE DOCUMENTATION

**Table 401.06(4): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Air testing company / laboratory trade license<br>2. Air testing report. Report should include executive summary, test procedures, equipment list, test locations, test dates and result of each test & calibration certificate for testing equipment & calibration validity. |
| After Completion | 1. Air testing company / laboratory trade license<br>2. Air testing report after 6 months of usage. Report should include executive summary, test procedures, equipment list, test locations, test dates and result of each test & calibration certificate for testing equipment & calibration validity. |

## REFERENCES AND ADDITIONAL INFORMATION

Government of Dubai. (2003). Local Order No. 11 (law 53, 54 and 55) and Administrative Resolution (Law 61,62 and 63).

International Organization for Standardization. (2014). ISO 16000-01, Part 1: General aspects of sampling strategy.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.07 INDOOR AIR QUALITY COMPLIANCE – EXISTING BUILDINGS

Silver Sa'fa

### INTENT

To maintain acceptable indoor air quality levels for occupant well-being in existing buildings.

### REQUIREMENT

For all existing hotels, shopping malls, educational facilities, government buildings, healthcare facilities, mosques and worship buildings, theaters, cinemas or any other existing buildings as determined by DM in future, suitable ventilation system must to be provided for the building occupants. The provided system must ensure, the air quality provided is in accordance with the technical guidelines issued by Dubai Municipality.

The buildings must apply the following procedures:

A. Indoor air testing for the contaminants listed in Table 401.07 (1) must be carried out, to ensure the air quality in the building, is suitable for occupancy. The maximum limit for the indoor air contaminants provided in Table 401.07 (1), must not be exceeded.

**Table 401.07 (1): Schedule, Duration of Sampling and Maximum Limit for Contaminants**

| Sampling Schedule | Type of Samples | Maximum Acceptable Limit | Sampling Duration |
|---|---|---|---|
| Testing should be within 5 years of last compliant test | Formaldehyde | < 0.08 ppm | 8-hour continuous monitoring (8-hour time-weighted average [TWA]) |
| | Total Volatile Organic Compound (TVOC) | < 300 micrograms/m3 | |
| | Respirable Dust (<10 μ/m) | < 150 micrograms/m³ | |
| | Ozone | < 0.06 ppm (120 micrograms/m³) | |
| | Carbon Dioxide | < 800 ppm (1440 micrograms/m³) | |
| | Carbon Monoxide | < 9 ppm (10 micrograms/m³) | |
| | Bacteria | < 500 CFU/ m³ (Agar plate) | |
| | Fungi | < 500 CFU/ m³ (Agar plate) | |

B. Air quality testing must be carried out by specialised companies or laboratories.

C. Air quality testing equipment must have initial and periodical calibration certificate. Calibration certification frequency shall either be annual or as per manufacturer specification and shall be from an external calibration facility, accredited by DM. The initial and periodical calibration certificates must be saved in a special register. The calibration certificate would be checked by DM to validate the accuracy of the readings. This also is a requirement for renewing the indoor air quality certificate of the building.

## SIGNIFICANCE

Exposure to air pollutants through inhalation of indoor air could lead to Sick Building Syndrome (SBS). Various indoor air quality factors like volatile organic compounds (VOC) and formaldehyde in chemical contaminant sources, mold and bacteria in biological contaminant sources, asbestos and silicas in particulate contaminant sources and human activities like smoking, body odour, housekeeping activities, inadequate ventilation can cause SBS. It is important to maintain acceptable level of IAQ in the buildings to overcome SBS.

Al Sa'fat *Regulation 401.06* ensures prior to occupancy the indoor air quality levels are within the prescribed limits. However, during building operation various activities by the occupants like introduction of high emitting materials and improper maintenance of ventilation equipment may result in poor air quality. Prolonged exposure of these poor indoor air quality could also lead SBS. This affects the building occupant's health and may cause headache, itchy eyes, throat irritation, fatigue, nausea etc.

Regular testing of indoor air quality (IAQ) levels ensures that buildings provide a healthy environment for its occupants. Testing results also guide the project team to identify potential contaminant threat levels, so that corrective actions can be taken to reduce the pollutant levels. Good indoor air quality has a positive effect on the building occupant's comfort, health and productivity.

## APPLICABILITY

This regulation is applicable to hotels, shopping malls, educational facilities, government buildings, healthcare facilities, mosques and worship buildings, theaters, cinemas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation requires that existing buildings must undertake IAQ testing within 5 years of last compliant test. The minimum IAQ requirements that need to be maintained are presented in Table 401.07 (1).

The schedule, duration of sampling and maximum limit for contaminants as stated in Table 401.07 (1) should be included as part of the project specifications and building operation manual. It should also include testing methods / standards, sampling point details and testing agency requirements.

Some of the important factors to be considered for IAQ testing:

- IAQ test must be carried out by specialised companies or laboratories.
- An IAQ testing plan specifying the procedures, testing standards, equipment to be used and sampling methods that will be employed, shall be developed.
- IAQ testing shall be carried out following the completion of all interior finishes, not limited to doors, paints, carpet, tiles and furniture, prior to occupancy.

- Perform IAQ testing within the breathing zone between 3 and 6 feet above the finished floor and for a duration of continuous 8 hours.
- Air samples shall be collected during regular operational hours. Ventilation and air conditioning systems should be operating in their normal operating mode for the entire duration of the testing.
- Outdoor samples may also be needed for comparison with indoor samples for some conditions, such as temperature and relative humidity, and some contaminants, such as airborne dust.
- All individual testing equipment and sensors shall have initial and final calibration certificate conforming the compliance levels by DM approved external calibration agency.
- IAQ parameter testing is required to be performed for each parameter for each sampling location, in accordance with the DM requirements.

### Sampling Locations

Sampling location for various buildings are stated in Table 401.07 (2) and 401.07 (3).

**Table 401.07(2): Requirement for Number of IAQ Samples**

| Hotels, Motels and Furnished Apartments & Resorts | | | |
|---|---|---|---|
| Villas | Studios, One Bedrooms, Two Bedrooms | Duplex Rooms | Pent Houses |
| 1 in 5 for each typology + 1 per floor | 1 in 5 for each typology | 1 in 5 for each typology + 1 per floor | 1 in 5 for each typology + 1 for every 500 m² |

**Table 401.07(3): Requirement for Number of IAQ Samples**

| Shopping Mall | Educational Facilities | Government Buildings | Health Care Facilities | Mosques and Worship Buildings |
|---|---|---|---|---|
| 1 for every 500 m² of Office Area + 1 for every 1000 m² of public areas + 1 per floor | 1 in 3 for each typology + 1 for every 1,000 m² of complex + 1 per floor | 1 for every 500 m² of Office Area + 1 per floor | 1 in 3 for each room typology + 1 for each operation theaters + 1 per floor | 1 for every 500 m² + 1 per floor |

If IAQ test report demonstrates that maximum concentrations of contaminants have exceeded, additional flush-out procedures with outside air should be implemented. Test must be conducted again until it can be verified that contaminant levels are within the acceptable range.

## COMPLIANCE DOCUMENTATION

**Table 401.07(4): Documents Required**

| Project Stages | Documents Required |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable |
| After Completion | Not applicable |

## REFERENCES AND ADDITIONAL INFORMATION

Government of Dubai. (2003). Local Order No. 11 (law 53, 54 and 55) and Administrative Resolution (Law 61,62 and 63).

International Organization for Standardization. (2014). ISO 16000-01, Part 1: General aspects of sampling strategy.

ASTM International (2018). ASTM D8068 - 18, Standard Practice for Collection of Culturable Airborne Fungi or Bacteria on Agar Plates by Inertial Impaction Systems.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.08 SEALING DOORS AND WINDOWS FRAMES

Silver Sa'fa

### INTENT

Prevent air leakages by proper sealing of doors and windows.

### REQUIREMENT

For all new buildings, doors and window frames on the building exteriors must be sealed from any openings. This must be with a nonflammable materials and with materials that prevent the transmission of air and sound that may occur as a result of difference in pressure across the exterior of the building. Insulation materials selected must be approved by the Dubai Municipality.

### SIGNIFICANCE

Doors and windows are critical components in building envelope. Gaps and leaks in door and window frames due to poor installation or improper design, leads to air leakages. Air leakages results in loss of conditioned air and uncomfortable thermal conditions in buildings. Energy consumption in the building also increases due to leakages. Also proper sealing keeps out contaminants and bacteria from the building.

Leakages can be prevented by proper sealing of door and window frames.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Selection and installation of sealing materials is critical, to ensure proper sealing of door and window frames. Sealing materials must be nonflammable and be approved by Dubai Municipality. Selection of sealing material should be specified in design and installed in construction stage.

Most common types of sealants used for door and window frames are:

- Caulks
- Acrylic Latex
- Butyl Rubber
- Silicone Sealant
- Polyurethanes

Insulation materials must be approved by the Dubai Municipality / Dubai Civil Defense. DCL test certificate for the sealing material complying with this regulation, must be provided. Sealing materials shall be installed as per manufacturer's procedures and guidelines to ensure gaps and leaks are effectively eliminated in door and window frames.

Proper sealing of door and window frames would also assist the building to comply with the air tightness requirements stated in *Regulation 501.05: Air Leakage*.

## COMPLIANCE DOCUMENTATION

**Table 401.08(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Technical data sheet / MSDS of sealing materials.<br>2. Delivery notes for sealing materials. |
| After Completion | NA |

## REFERENCES AND ADDITIONAL INFORMATION

General Headquarters of Civil Defence, Ministry of Interior, UAE. (2018). UAE Fire and Life Safety Code of Practice.

Dubai Municipality. (2018). Al Sa'fat Green Building Regulation 501.05: Air Leakage.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.09 INSPECTION AND CLEANING OF HVAC EQUIPMENT

Silver Sa'fa

### INTENT

To ensure that all HVAC equipment are adequately inspected and cleaned to prevent contamination in indoor spaces.

### REQUIREMENT

For all new and existing buildings, the cleanliness of HVAC equipment and systems must be maintained. All its parts must be inspected and cleaned in accordance with the standard specifications approved by Dubai Municipality and in accordance with the technical guidelines issued by Dubai Municipality. Specialised maintenance companies, approved by Dubai Municipality must carry out this inspection and cleaning. This can also be carried out by the building operator, if sufficient evidence can be provided on their qualification for carrying out these tasks.

### SIGNIFICANCE

Maintaining a clean HVAC system is an important aspect of good indoor air quality (IAQ). This helps to promote comfort, health and productivity of the building occupants.

Ventilation systems draw outside air and also re-circulate the air within the building. The systems including the ductwork are liable to become contaminated with dust and other contaminants. This may be due to filtration equipment not working properly or due to leaks in the system. Presence of high humidity increases the chances of bacterial contamination.

Inspection and remedial measures should be undertaken to ensure that any contamination from construction activity is removed prior to occupancy. During the building operation, suitable quality of indoor air must be maintained, regular inspection followed with cleaning works is a must to ensure contamination is removed.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Building owner is responsible for complying with the requirements of this regulation. Specialised maintenance companies, approved by Dubai Municipality must carry out inspection and cleaning of HVAC systems. This can also be carried out by the building operator, if sufficient evidence can be provided on their qualification for carrying out these tasks.

Inspection shall be carried out to assess the HVAC system's overall condition in terms of its cleanliness and material integrity of various components.

HVAC components that are susceptible to contamination include filters, cooling coils, fan blades and fan housing, heat exchangers, motors, condensate drain pipe and pans, VAV boxes, dampers, grills & diffusers, outside air intakes, ducting system, chilled water pipes etc.

HVAC system must not be operating while inspection and cleaning are being carried out. Controls to the system must be isolated with suitable signage advising that the system is not to be started until the inspection and cleaning works are complete. Inspection and cleaning details must be recorded in the building service logbook provided to the owner by the mechanical, electrical and plumbing (MEP) engineer or installation contractor at the time of building completion. The keeping of a logbook to record both programmed and corrective maintenance is to provide a history of work carried out and to allow the building owner or Dubai Municipality to check that the required level of maintenance is being implemented. It is recommended to carry out the inspection and cleaning of system, as a part of regular building maintenance and the inspection and maintenance schedule should reflect Dubai's specific climatic conditions.

Acceptable methods of inspection and cleaning are outlined in the standards given in the reference section.

Also, this regulation is linked with *Regulation 502.14: Maintenance of Mechanical System* which requires the mechanical systems are installed in a way such that adequate access is available for regular inspection, maintenance and cleaning of the equipment.

## COMPLIANCE DOCUMENTATION

**Table 401.09(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | 1. Maintenance contracts with specialised maintenance companies approved by Dubai Municipality or an evidence that building operators are qualified to carry out inspection and cleaning. |

## REFERENCES AND ADDITIONAL INFORMATION

The National Air Duct Cleaners Association (NADCA). (2013). Standard ACR 2013 – Assessment, Cleaning and Restoration of HVAC Systems.

The National Air Duct Cleaners Association (NADCA). (2017). National Air Duct Cleaners Association Guide Specification Section 230130.51 – HVAC Air Distribution System Cleaning.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. [ASHRAE]. (2018). ANSI/ASHRAE/ACCA Standard 180-2018- Standard Practice for Inspection and Maintenance of Commercial Building HVAC systems.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.10 PARKING VENTILATION

Silver Sa'fa

### INTENT

Maintaining adequate air quality within enclosed car parks to create healthy and safe environment.

### REQUIREMENT

For all buildings having enclosed parking:

A. Mechanical ventilation must be provided, to ensure the Carbon Monoxide (CO) concentration in the enclosed parking area, is maintained below 50 ppm by:

- Providing a minimum of 6 outside air changes per hour, or
- Installing a variable volume ventilation system that is controlled by an input response from a minimum of one CO sensor per 400 m² floor area of parking.

B. Outdoor air must be provided for each parking level.

C. Occupied areas such as offices, shopping centers, hotels, waiting rooms and ticket booths connected to an enclosed parking spaces, must be supplied with conditioned air under positive pressure when compared with adjoining parking area.

D. Ventilation systems must be capable of providing 10 air changes per hour, for smoke clearance purposes in case of a fire incident.

E. CO monitoring equipment must be installed, with a minimum of one CO sensor per 400 m² floor area of parking. Sound alarm should be triggered, when the CO concentration reaches or exceeds 75 ppm, in at least 5% of the monitored locations.

F. Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) is installed, CO concentration must be monitored to allow real-time profiling and management of air quality.

G. CO monitoring equipment must be checked and recalibrated every 6 months or according to manufacturer specification by a specialised calibration company, certified by Dubai Municipality. Test results and calibration certificates must be kept on-site and be readily available for inspection by DM staff.

## SIGNIFICANCE

Buildings with enclosed, basement, or underground parking facilities require suitable ventilation to ensure adequate air quality for the health and safety of people using the parking areas. Open parking facilities may have natural ventilation and may not require additional mechanical ventilation. Enclosed parking facilities require mechanical ventilation to ensure adequate indoor air quality and the safety of users.

Indoor air quality within parking facilities can present several problems, such as high concentrations of carbon monoxide (CO), oxides of nitrogen ($NO_x$), sulphur dioxide ($SO_2$), volatile organic compounds (VOC), particulate lead and particulate matter less than 10 µm (PM10). Exposure to higher concentrations of these chemicals will lead to adverse health effects.

By providing adequate ventilation, the concentration levels of toxic gases are bought within safe limits, ensuring health and safety of parking facility users. Also, by providing adequate ventilation, it helps preventing build-up of gases and particulates in parking areas thereby preventing degradation of coatings and painted surfaces and corrosion of metal parts.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

An open parking area is one which is used for parking of motor vehicles and which requires uniformly distributed openings on two or more sides for natural ventilation on every level of parking. The total area of openings to the atmosphere must be at least 20% of the total perimeter wall areas for each level of parking. Although openings on a third side are not required, openings on opposing sides are preferred for cross ventilation.

An enclosed parking area of a building is one which is used for parking of motor vehicles but is not an open parking area, i.e. it does not meet the criteria for open parking areas. Mechanical ventilation of all enclosed parking areas is required to compensate for the lack of natural ventilation.

Generally, CO emission rates from conventional fuel powered motor vehicles are substantially higher than emission of $NO_x$, $SO_2$ and VOC. Hence, by providing adequate ventilation to dilute carbon monoxide to acceptable levels will also control the other contaminants to safe levels.

Projects with enclosed car parking shall have mechanical ventilation systems to ensure the CO concentration in the enclosed parking area is maintained below 50 ppm, by utilising at least one of the following ventilation systems:

1. **Constant Volume System:** In this system, ventilation fans (as shown in fig. 401.10(1)) are operated at constant speed during the entire occupancy period. It shall be designed to meet the minimum ventilation flow of 6 air changes per hour (ACH).

Fig 401.10(1): Parking Ventilation Fan

2. **On/Off Control System:** In this system, ventilation fans are stopped and started based on the input from CO sensor. Control system is programmed with appropriate set points that ensures that CO concentration in the enclosed parking area is maintained below 50 ppm.
3. **Variable Air Volume (VAV) System:** In this system, ventilation fans speeds vary based on the input from CO sensor. A control system is programmed with appropriate trigger values taking into account response times so that ventilation rates gets adjusted and CO concentration levels is maintained below 50 ppm during the entire occupancy period. Energy is conserved with the use of VAV systems.

For system 2 and 3, the CO monitoring system must be capable of activating both the exhaust fan(s) and the air intake device(s) such as outside air louvers/dampers and make up air units.

All the above ventilation systems shall be capable of providing a ventilation flow of 10 air changes per hour (ACH) for smoke clearance purposes in case of fire incident.

All parking floors shall be provided with outdoor fresh air and the outdoor fresh air intake locations shall be in accordance with *Regulation 401.03: Air Inlets and Exhaust*. Any occupied areas adjacent to the parking must be protected to ensure that the air quality is maintained. This requires that these areas be maintained at a pressure higher than that of the parking areas.

Dubai Municipality may conduct random inspections and monitoring of air quality in parking facilities of buildings.

While installing CO sensors following aspects need to be considered:

A. The CO Monitoring system must be installed in all enclosed parking spaces.

B. The number of CO sensors required are dependent on the size of the car park. Minimum of one CO sensor is required per 400 m² floor area or the radius of coverage needs to be 11.2m per CO sensor (as shown in fig 401.10(2)) of parking and monitoring must take place within the breathing zone.

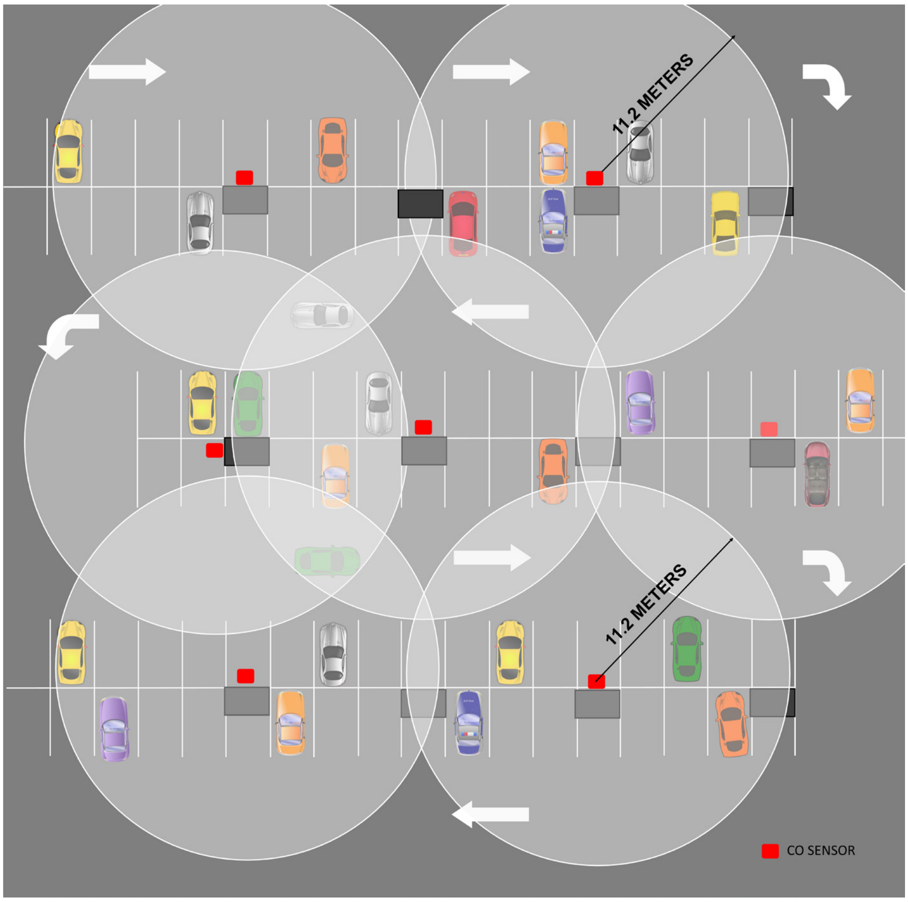



Fig 401.10(2): CO Sensor Location Layout

C. The CO monitoring system must be integrated with audible alarm devices which should be triggered when CO concentration reaches or exceeds 75 ppm in at least 5% of the monitored locations and notify the proper personnel to take corrective actions.

D. Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) is available, all CO sensors need to be integrated with it in order to monitor real time concentration level and management of air quality.

E. CO monitoring equipment required to be checked and re-calibrated every 6 months or according to manufacturer specification by a specialised calibration company, certified by Dubai Municipality. Test results and calibration certificates must be kept on-site and be readily available for inspection by DM staff.

**Case Study**

A 1000 m² (40m x 25m) of enclosed parking with a floor to ceiling height of 5m is being designed for a supermarket. Project team is planning to select dual speed extract fan which shall extract 9,000 l/s at low speed in case of normal operation and 14,000 l/s at high speed in case of fire condition. The makeup fan is also proposed of same capacity. There are louvre openings of size (5m x 5m) on the opposite side of the perimeter walls available for natural ventilation. Let us check whether this design complies with this regulation.

Step 1: Eligibility Check

Perimeter wall area of parking = 2 x ((length x height) + (width x height))

= 2 x ((40m x 5m) + (25m x 5m)) = 650 m²

Total opening area of parking = 2 x (5m x 5m) = 50 m²

Percentage of opening area = 50/650 = 7.6%

The total opening area must be at least 20% of the total perimeter area to identify as a "Open Parking Area". In this case, it is 7.6% hence this regulation is applicable and must be complied.

Step 2: Compliance Check

Air flow (l/s) = (Area (m²) X Height (m) X ACH ) / 3.6 (*3.6 is a conversion factor*)

Air flow = (1,000 X 5 X 6) / 3.6 (*ACH = 6 In normal operation*)

Air flow = 8,333 l/s (*Minimum extract air flow required at low speed in order to achieve 6 ACH*)

Air flow = (1,000 X 5 X 10) / 3.6 (*ACH=10 In fire operation*)

Air flow = 13,888 l/s (*Minimum extract air flow required at high speed in order to achieve 10 ACH*)

The minimum required fan air flow capacity is 8,333 l/s to attain 6ACH and 13,888 l/s for 10ACH. Considering the selected fan capacity is 9,000 l/s at low speed and 14,000 l/s at high speed, the project complies with the regulation.

## COMPLIANCE DOCUMENTATION

**Table 401.10(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Parking ventilation drawing indicating ventilation capacity, the proposed number and location of CO sensors and ventilation fan.<br>2. Parking ventilation calculation indicating that fan is selected to maintain 6 ACH in normal condition and 10 ACH in case of smoke. |
| Construction Completion Application | 1. Final approved parking ventilation drawing indicating ventilation capacity, the proposed number and location of CO sensors and ventilation fans.<br>2. CO sensors data-sheet.<br>3. Delivery notes for CO sensor and parking ventilation fan. |
| After Completion | 1. CO concentration profile.<br>2. CO monitoring equipment calibration certificate (after 6 months of usage). |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1: Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, www.ashrae.org.

# CHAPTER 1 - VENTILATION AND AIR QUALITY



## 401.11 ENVIRONMENTAL TOBACCO SMOKE

Silver Sa'fa

### INTENT

Building a healthy society by prohibiting smoking in Public Areas.

### REQUIREMENT

A. Smoking is strictly prohibited in all public areas in accordance with Local Order No 11 – 2003, including but not limited to shopping centres, hotels, restaurants, government buildings, hospitals, healthcare facilities, commercial buildings, common accommodation, coffee shops and amusement and entertainment or any other places determined by Dubai Municipality, except for places in which smoking is permitted.

B. Places where smoking is permitted are determined in accordance with the conditions listed in the Manual of Regulating Smoking in Public Places issued by Dubai Municipality. It defines the public places where smoking is strictly prohibited and places where smoking is permitted under specific conditions.

C. Designated smoking areas must be at least 7.5m away from the entrances of the building, doors and operable windows and outdoor air intakes of ventilation systems.

D. An annual permit is issued from the competent department of Dubai Municipality for all places where smoking is permitted, upon submission of all required documents and drawings mentioned in the guideline.

### SIGNIFICANCE

Smoking puts non-smokers at risk by exposing them to environmental tobacco smoke (ETS). Passive smoking and prolonged ETS exposure increases the chances of developing lung cancer and other health problems. Prohibiting smoking eliminates the risks associated with ETS. Prohibition of smoking is done through issuance of policies and laws. Implementation of policies that enforce smoke-free public environments is imperative to protect health and well-being of the society.

Recognising this, Dubai Municipality (DM) has established necessary legislation in place for the protection of public health and improving the style of living in the Emirate of Dubai. Parts of this legislation also apply to buildings, which must be considered while designing them. By implementing this regulation, building users will not be exposed to passive tobacco smoke which could negatively impact their health.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07 (1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Annexure of DM Administrative Resolution No 92 – 2009 - "Regulating Smoking in Public Places", titled 'Manual of Regulating Smoking in Public Places', details the restrictions and requirements for smoking in public places.

In accordance with Local Order No. (11) of 2003 - Concerning Public Health and Safety of the Society in the Emirate of Dubai, smoking is strictly prohibited in all public areas including shopping centres, hotels, restaurants, government buildings, hospitals, healthcare facilities, commercial buildings, common accommodation, coffee shops and amusement and entertainment or any other places determined by Dubai Municipality, except for places in which smoking is permitted. Smoking from electric cigarettes is also prohibited in all public areas. Places where smoking is permitted are determined in accordance with the conditions listed in the Manual of Regulating Smoking in Public Places issued by DM. An annual permit is issued from the competent department of Dubai Municipality for all places where smoking is permitted, upon submission of all required documents and drawings mentioned in the guideline.

If permitted, external designated smoking areas shall be identified at least 7.5m away from the entrances of the building, doors and operable windows and outdoor air intakes of ventilation systems. Design drawings shall highlight the requirements detailing the distance to nearest openings and ventilation air intake systems. Additionally, designated smoking areas shall comply with requirements of DM Administrative Resolution No 92, which includes requirements like smoking rooms, self-closing doors etc., and ventilation and negative pressurisation requirements that needs to be followed for the smoking rooms. Design team shall consider the additional ventilation requirements to prevent the leakage between smoking and non-smoking areas by creating negative pressure during closed and open condition. Appropriate signage as shown in fig. 401.11(1) should be in place indicating prohibition of smoking.


Fig 401.11(1): Signage for Smoking Prohibition

For residential buildings and hotel rooms, except public areas where smoking is allowed, all operable windows and doors leading to public areas or outdoor spaces shall be weather sealed properly to prevent leakage of ETS to adjacent rooms.

## COMPLIANCE DOCUMENTATION

**Table 401.11(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural and mechanical drawings for the smoking areas. Drawings should clearly indicate the distance of outside smoking areas from entrances, openable windows and air intakes.<br>2. Approval of the Dubai Municipality - Health and Safety Department. |
| Construction Completion Application | 1. Final approved architectural and mechanical drawings for the smoking areas. Drawings should clearly indicate the distance of outside smoking areas from entrances, openable windows and air intakes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2003). Local Order No. (11) of 2003 - Concerning Public Health and Safety of the Society in the Emirate of Dubai.

Dubai Municipality. (2009). Administrative Resolution No 92 – 2009 - Regulating Smoking in Public Places.

Ministry of Health, United Arab Emirates. (2013). Cabinet Decision No. 24 of 2013 concerning the Implementing Regulation for the Federal Tobacco Control Act No. 15 of 2009.

World Health Organization (2017). WHO report on the global tobacco epidemic: monitoring tobacco use and prevention policies. Geneva.

World Health Organization (2018). WHO global report on trends in prevalence of tobacco smoking 2000 -2025, second Edition, Geneva.

# CHAPTER 2 - THERMAL COMFORT



## 402.01 THERMAL COMFORT

Silver Sa'fa

### INTENT

To maintain comfortable healthy internal environment for occupants.

### REQUIREMENT

For all new and existing buildings, the heating, ventilation and air conditioning (HVAC) system must be capable of providing the following range of conditions for 95% of the year:

**Table 402.01(1): Thermal Comfort Requirements**

| | Lower Limit | Upper Limit |
|---|---|---|
| Dry Bulb Temperature | DB: 22.5 °C | DB: 25.5 °C |
| Relative Humidity | RH: 30% (min) | RH: 60% (max) |

For occupant comfort, normal occupied spaces should have an average air velocity between 0.2 m/s and 0.3 m/s.

### SIGNIFICANCE

"Thermal comfort is that condition of mind which expresses satisfaction with the thermal environment" (ASHRAE Standard 55).

The primary use of air conditioning is to provide a thermally comfortable space for the building occupants. There are six factors affecting thermal comfort in a building. These factors are independent of each other, but together contribute to thermal comfort.

- Ambient temperature (air temperature)
- Radiant temperature (the temperature of the surfaces around us)
- Relative humidity (measurement of the water vapour in an air - water mixture)
- Air motion (the rate at which air moves around and touches skin)
- Metabolic rate (amount of energy expended)
- Clothing insulation (materials used to retain or remove body heat)

Understanding these variables is essential in making informed decisions when planning and designing a building air conditioning system to achieve thermal comfort. Building design should minimise energy consumption for air conditioning while maintaining thermal comfort conditions at an acceptable level for building occupants. While every building occupant may have different levels of thermal comfort, it is important to provide a comfortable environment for the majority of occupants. A better thermal comfort in the building would increase workforce productivity and promote better health for its occupants.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The thermal comfort requirements identified in this regulation are the acceptable comfort range of conditions for most of the occupants in Dubai (shown in fig. 402.01(1)).

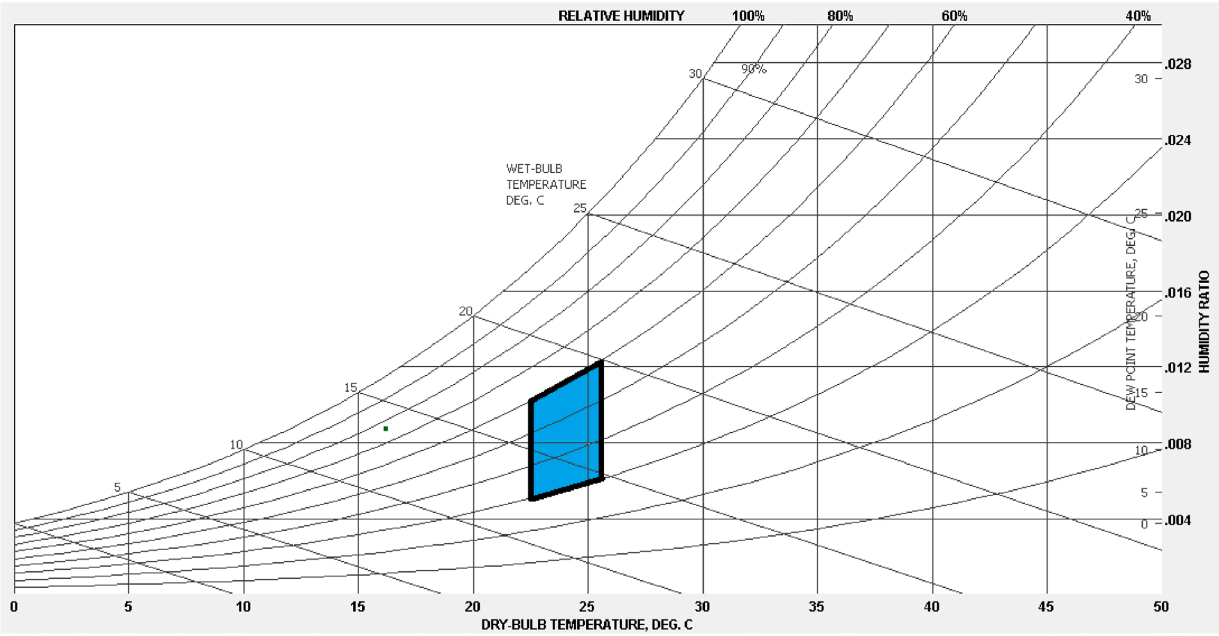



Fig 402.01(1): Thermal Comfort Chart

The air conditioning systems must be designed considering all the factors that impacts the thermal comfort of the occupants such as metabolic rate, clothing, surface temperature, air temperature, humidity and air velocity. It must also maintain the specified comfort ranges at all locations within the occupied space for 95% of the year under varying load conditions (such as partial occupancy and various activity levels). Spaces that may get affected for discomfort, such as areas close to entrances which are prone to drafts or south facing wall that retain heat, should also be considered while designing the air conditioning systems.

In addition to maintaining temperature and humidity, the regulation also specifies the required average air speed in the regularly occupied spaces, which shall be in the range of 0.2 m/s – 0.3 m/s.

Latest edition of ASHRAE Standard 55 shall be used as a general reference for designing the air conditioning systems. The standard specifies the combinations of indoor thermal environmental factors and personal factors that will produce thermal environmental conditions acceptable to most of the occupants within the space. It also provides guidance on the type of air conditioning (active conditioning, passive conditioning or a mix of these two), which can be utilised to achieve these conditions.

## COMPLIANCE DOCUMENTATION

**Table 402.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Heat load analysis report indicating that thermal comfort condition shall be maintained for minimum 95% of the year in all the regularly occupied spaces. |
| Construction Completion Application | 1. Temperature, RH and air speed measurement report in all the regularly occupied spaces. |
| After Completion | 1. Performance and commissioning reports and results. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Standard 55: Thermal Environmental Conditions for Human Occupancy, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, www.ashrae.org.

# CHAPTER 3 - ACOUSTIC COMFORT



## 403.01 ACOUSTICAL CONTROL

Silver Sa'fa

### INTENT

To ensure comfortable acoustic performance through effective acoustic design in the buildings.

### REQUIREMENT

For all new buildings, the acoustic performance relating to internal noise criteria from external noise sources, internal noise criteria from mechanical services noise, internal airborne sound insulation guidance values and internal impact sound pressure levels, must meet the control requirements set out in Table 403.01 (1).

**Table 403.01(1): Acoustical Control Requirements**

| Building Type | Document Reference |
|---|---|
| Villas / Residential* Buildings | Building Regulations Approved Document E (latest version) (UK) |
| Healthcare Facilities | Health Technical Memorandum 08-01 (UK) |
| Educational Facilities** | Building Bulletin 93: Acoustic Design of Schools – A design Guide (UK) |
| Commercial Buildings | Latest BS8233 standard "Sound insulation and noise reduction for buildings – code of practice" (UK) |
| Industrial Buildings | Latest BS8233 standard "Sound insulation and noise reduction for buildings – code of practice" (UK) |
| Public Buildings | Latest BS8233 standard "Sound insulation and noise reduction for buildings – code of practice" (UK) |

* Residential buildings include Villas, Apartments, Labour Accommodations and Student Accommodations.

** Educational Facilities include Nursery Schools, Primary Schools, Secondary Schools, Colleges and Universities.

### SIGNIFICANCE

Noise is an important factor controlling the indoor comfort. Noise affects the comfort, well-being and productivity of building users. High levels of noise can lead to stress, absenteeism, loss of concentration and difficulty in performing cognitive tasks.

This regulation details the acoustical performance required from building elements for specific building types and uses. A good acoustical design helps in controlling the noise from outside the building, noise from plant and services within it and ensures the noise levels in room are moderated.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation adopts British Standard for Acoustic Controls (British Standard BS 8233 - "Sound Insulation and Noise Reduction for Buildings – Code of Practice"). The standard deals with the control of noise from outside the building, noise from plant and services within it and room acoustics and suggests appropriate criteria and limits for different situations. Other codes of practice or standards may be applied upon approval from Dubai Municipality (DM).

Control requirements set out in Table 403.01(1) is further expanded in the following tables (403.01(2-5)). The levels of acoustic performance detailed in the following tables (403.01(2-5)) must be achieved. The complete referenced documents should be consulted when designing the acoustical performance of buildings.

Building should be designed such that ambient internal noise levels from these external sources do not exceed the following criteria mentioned in Table 403.01(2):

**Table 403.01(2): Criteria for Noise Intrusion from External Noise Sources (Maximum)**

| Location | Residential | | Educational | Hospital | | Commercial |
|---|---|---|---|---|---|---|
| | $L_{Aeq}$, 16hr (0700 - 2300) | $L_{Aeq}$, 8hr (2300 to 0700) | $L_{Aeq}$, 1 hr | Day $L_{Aeq}$, 1 hr | Night $L_{Aeq}$, 1 hr | $L_{Aeq}$, 1 hr |
| Habitable Rooms | 35 | 30 | - | - | - | - |
| Non Habitable Rooms | 45 | 40 | - | - | - | - |
| Office (Cellular) | - | - | 40 | 40 | 40 | 35 |
| Office (Open Plan) | - | - | 40 | 40 | 40 | 38 |
| Teaching Room (Standard) | - | - | 35 | 35 | 35 | 30 |
| Meeting Room (Small) | - | - | 40 | 40 | 40 | 40 |
| Meeting Room (Large) | - | - | 35 | 35 | 35 | 35 |
| Board Room | - | - | 30 | 30 | 30 | 35 |
| Hospital Ward (Single bed) | - | - | - | 40 | 35 | - |
| Hospital Ward (Multiple bed) | - | - | - | 45 | 35 | - |
| Operating Theatres | - | - | - | 40 | 40 | - |
| Plant Room | 80 | 75 | 80 | 80 | 80 | 75 |

Notes:

- Night is defined as the hours between 23.00 and 07.00.
- The intrusive noise criteria do not include plant noise from adjacent hospital buildings. This should be considered as mechanical service noise.
- Habitable rooms include: bedrooms, living rooms, dining rooms, hotel guestrooms, student accommodation, nursing accommodation and all rooms intended for residential purposes.
- Non-habitable rooms include: toilets (WC), corridors, kitchen spaces, public and private circulation spaces.

In addition to controlling exterior noise, building should also be designed such that ambient internal noise levels from these mechanical and electrical service sources do not exceed the following criteria mentioned in Table 403.01(3). These requirements are also part of *Regulation 403.02: Silencers*.

**Table 403.01(3): Internal Noise Criteria from Mechanical and Electrical Sources (Maximum)**

| Location | Residential | | Educational | Hospital | | Commercial |
|---|---|---|---|---|---|---|
| | NR $L_{Aeq}$ (0700 - 2300) | NR $L_{Aeq}$ (2300 to 0700) | NR $L_{Aeq}$, 1 hr | Day NR $L_{Aeq}$, 1 hr | Night NR $L_{Aeq}$, 1 hr | NR $L_{Aeq}$, 1 hr |
| Habitable Rooms | 30 | 25 | - | - | - | - |
| Non Habitable Rooms | 40 | 35 | - | - | - | - |
| Office (Cellular) | - | - | 35 | 35 | 35 | 35 |
| Office (Open Plan) | - | - | 35 | 35 | 35 | 38 |
| Teaching Room (Standard) | - | - | 30 | 30 | 30 | 30 |
| Meeting Room (Small) | - | - | 35 | 35 | 35 | 40 |
| Meeting Room (Large) | - | - | 30 | 30 | 30 | 35 |
| Board Room | - | - | 25 | 25 | 25 | 35 |
| Hospital Ward (Single bed) | - | - | - | 35 | 30 | - |
| Hospital Ward (Multiple bed) | - | - | - | 40 | 30 | - |
| Operating Theatres | - | - | - | 35 | 35 | - |
| Plant Room | 75 | 70 | 75 | 75 | 75 | 75 |

Notes:

- The criteria in Table 403.01(3) refer to the total noise from mechanical and electrical services (including rainwater pipes draining under "moderate" rainfall conditions, noise from plant rooms and from plant areas in other parts of the building or site). The noise rating (NR) should take into account, the noise in the octave band range from 63 Hz to 4 kHz.

The building should also be designed such that airborne insulation values of walls and airborne and impact insulation values of floors achieve the following minimum in-situ performance criteria as specified in Table 403.01(4) and Table 403.01(5).

**Table 403.01(4): Internal Airborne Sound Insulation Guidance Values (Minimum)**

| Location | Residential | Educational | Hospital | Commercial |
|---|---|---|---|---|
| | $D_{nTw} + C_{tr}$ | $D_{nTw}$ | $D_{nTw}$ | $D_{nTw}$ |
| Habitable Rooms | 45 | - | - | - |
| Non Habitable Rooms | 45 | 40 | - | - |
| Office (Cellular) | - | 40 | 42 | 40 |
| Office (Open Plan) | - | 40 | 47 | 40 |
| Teaching Room (Standard) | - | 45 | 42 | 45 |
| Meeting Room (Small) | - | 45 | 47 | 45 |
| Meeting Room (Large) | - | 50 | 52 | 50 |
| Board Room | - | 50 | 47 | 50 |
| Hospital Ward (Single bed) | - | - | 47 | - |
| Hospital Ward (Multiple bed) | - | - | 42 | - |
| Operating Theatres | - | - | 47 | - |

Notes:

- The minimum sound insulation requirement depends on the activities in adjacent spaces. The levels specified above must be checked against the relevant documents (ADE, BB93, HTM 08-01 and BS8233)

**Table 403.01(5): Internal Impact Sound Pressure Levels (Maximum)**

| Location | Residential | Educational | Hospital | Commercial |
|---|---|---|---|---|
| | $L'_{nTw}$ | $L'_{nTw}$ | $L'_{nTw}$ | $L'_{nTw}$ |
| Habitable Rooms | 62 | - | - | - |
| Non Habitable Rooms | 62 | - | - | - |
| Office (Cellular) | - | 65 | 65 | 65 |
| Office (Open Plan) | - | 65 | 65 | 65 |
| Teaching Room (Standard) | - | 60 | 65 | 65 |
| Meeting Room (Small) | - | 60 | 65 | 65 |
| Meeting Room (Large) | - | 60 | 65 | 65 |
| Board Room | - | 55 | 65 | 65 |
| Hospital Ward (Single bed) | - | - | 65 | - |
| Hospital Ward (Multiple bed) | - | - | 65 | - |

Notes

- The maximum impact sound pressure level requirement depends on the activities in adjacent spaces. The levels specified above must be checked against the relevant documents listed in Table 403.01(1)

The measurement of noise shall be carried out for at least 5% of the total spaces covering each space type. Where different ventilation strategies are used, measurements should be conducted in rooms utilising each strategy. Measurement positions should include normally occupied positions closest to the most significant noise sources.

Following measurements shall be carried out on-site in order to verify the compliance with the regulation.

**Indoor ambient noise level measurements**

The noise measurement shall be carried out when external noise is representative of conditions during normal working hours and rooms are furnished and unoccupied. The sound level meter shall measure $L_{Aeq}$ equivalent continuous sound level over a period of standard time specified in the table 403.01(2) and 403.01(3).

**Airborne sound insulation**

The airborne sound insulation should be measured in accordance with ISO 16283-1:2014 "Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation". All measurements and calculations should be carried out using one-third octave frequency bands. Performance should be rated in terms of the weighted standardised level difference, in accordance with ISO 717-1:2013.

**Impact sound insulation**

The impact sound insulation should be measured in accordance with ISO 16283-2:2018 "Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 2: Impact sound insulation". All measurements and calculations should be carried out using one-third octave frequency bands. The performance should be rated in terms of the weighted standardised impact sound pressure level in accordance with ISO 717-2:2013.

## COMPLIANCE DOCUMENTATION

**Table 403.01(6): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Noise field test report indicating compliance with the requirements. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

British Standard. (2014). BS 8233:2014 - Guidance on sound insulation and noise reduction for buildings.

Department of Health and Social Care, Government of UK. (2013). Health Technical Memorandum 08-01: Acoustics.

Ministry of Housing, Communities & Local Government, Government of UK. (2015). Building Regulations 2010: Resistance to sound: Approved Document E.

The Department for Education, Government of UK. (2015). BB93: acoustic design of schools - performance standards.

International Organization for Standardization. (2014). ISO 16283-1: Acoustics - Field measurement of sound insulation in buildings and of building elements -- Part 1: Airborne sound insulation.

International Organization for Standardization. (2018). ISO 16283-2: Acoustics - Field measurement of sound insulation in buildings and of building elements -- Part 2: Impact sound insulation.

International Organization for Standardization. (2013). ISO 717-2: Acoustics - Rating of sound insulation in buildings and of building elements -- Part 2: Impact sound insulation.

ASTM International. (2016). ASTM E90-09 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

ASTM International. (2016). ASTM E413-16 - Classification for Rating Sound Insulation.

## 403.02 SILENCERS

Silver Sa'fa

### INTENT

**To improve building acoustic performance by utilising suitable noise reduction strategies in mechanical systems.**

### REQUIREMENT

For all new buildings, the mechanical systems must be designed, equipped and selected with noise control materials, to reduce the transmission of sound and noise through these systems.

Systems include HVAC, air ducts, water pipes and its suspension and installation requirements.

### SIGNIFICANCE

Well-designed buildings tend to incorporate efficient acoustic design. This is required as sound can affect the building occupants, physiologically and psychologically. In mechanical systems, airflow tend to generate turbulence, noise and rumble.

The adverse effect of noise varies between various building typologies. In educational facility, background noises affect student's learning ability, while in a healthcare facility it can affect the patient's healing outcome. Hence, it is important noise control materials are considered to reduce the transmission of sound and noise.

By the control of excessive noise, building's acoustic environment is maintained thereby increasing workplace comfort and productivity.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The objective of this regulation is to design and select noise control materials to reduce the noise generated in the mechanical systems which includes air handling units, ductwork, cooling towers, chillers, piping networks, pumps and ventilation fans.

Sound generation occurs over a wide range of frequencies. Acoustic analysis of transmission of sound and noise considers measurement of sound at varying frequency levels as perceived in a particular environment. Human ear can perceive sounds at frequencies ranging from 20 Hz to 16,000 Hz.

In HVAC systems it is important to identify the path of sound and noise transmissions. Sound / noise created by a source gets transmitted through one or more paths. By evaluating the various sources of noise generation, adequate noise control measures need to be incorporated to reduce unwanted noise.

In order to meet this regulation and background noise levels criteria stated in *Regulation 403.01: Acoustic Control*, the silencers or sound attenuators are required to reduce noise transmitted from source (such as fans, pulley etc.) to receiver.

There are three types of HVAC duct silencers available commercially, which includes dissipative type, fibre-free reactive type and active type. The most common type used is static dissipative type (fig. 403.02(1)) which has sound absorbing material such as fiberglass encased in perforated liners. This static dissipative type silencer is rated in terms of insertion loss and air pressure drop which is critical in designing any ducting system.

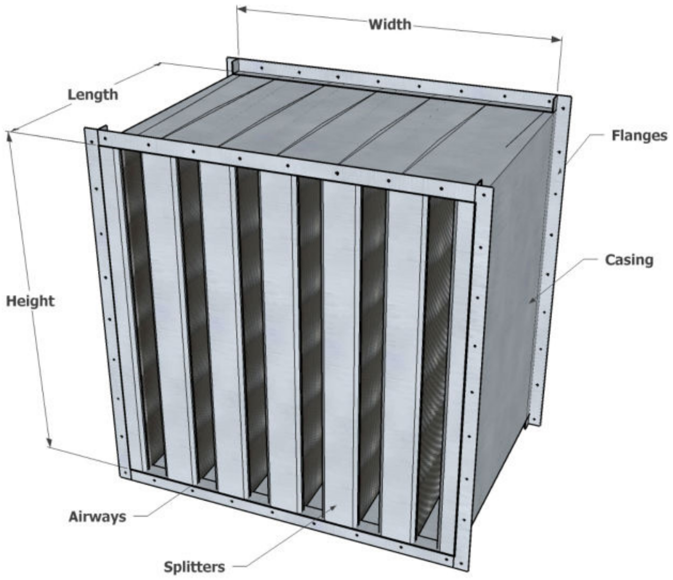



Fig 403.02 (1): Silencer / Sound Attenuator

The location of silencer in any ducting is very important which can affect its effectiveness in reducing noise and the installation of silencer close to bends can cause increases in pressure drop and self-generated noise. The ideal location of silencers is the location where the duct leaves the plant room.

The silencer selected shall be tested according to ASTM standard E477 or ISO standard 7235 which defines its acoustic and aerodynamic performance in terms of dynamic insertion loss, self-generated noise and pressure drop. Some of the other measures to mitigate noise from HVAC systems include addition of sound enclosures around equipment, increasing duct length to attenuate noise and addition of acoustic liner in ductworks.

Water flow noise from chilled water piping networks is also a significant contributor to the background noise level of any living space, hence this regulation intends the designer to consider noise control measures to reduce its transmission. This can be achieved by considering foam rubber wrapping or resilient clamps and hangers to isolate chilled water piping from the building structure. Also, flexible pipe connectors have to be installed to attenuate noise and vibration transmission along the piping from equipment such as pumps.

Additional guidance on acoustic design techniques are provided in ASHRAE Handbook - HVAC Applications, Chapter 48 - Noise and Vibration control and ASHRAE Handbook - Fundamentals, Chapter 8 - Sound and Vibration.

## COMPLIANCE DOCUMENTATION

**Table 403.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Mechanical final approved drawings representing typical floors marked up to clearly indicate noise control features installed. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (1991). DM Local Order No. 61 of 1991 on the Environment Protection Regulations in the Emirate of Dubai, Article (75).

British Standard. (2014). BS 8233:2014 - Guidance on sound insulation and noise reduction for buildings.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, Chapter 48, Noise and Vibration control. www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook— Fundamentals, Chapter 8, Sound and Vibration. www.ashrae.org.

# CHAPTER 3 - ACOUSTIC COMFORT



## 403.03 EXPANSION JOINTS AND VIBRATION PREVENTION

Silver Sa'fa

### INTENT

To ensure the vibration isolation in piping system by utilising vibration control strategies.

### REQUIREMENT

For all new buildings:

1. An automatic air vent shall be installed on each vertical water supply riser, addressed with an isolate valve. A drain valve shall be used at the bottom of the risers.
2. The water network pipes shall be installed with sufficient supports and connectors, to prevent any sound and vibration, while allowing thermal expansion of the pipes through the expansion joints.

### SIGNIFICANCE

Vibrations in the piping systems are induced through the mechanical equipment connected to it. Flow induced vibration is generated by transmission occurring through pipe wall and the water column. Vibration can also be caused by:

- Improper specification or installation of equipment, poor balance, misalignments or operating outside of design conditions.
- Equipment and piping system with inadequate or improper vibration isolation.
- Resonances in equipment, vibration isolation system, building structure, or connected piping system.

Vibrations from the water-flow in pipes can be transmitted from the pipe-runs to the interior building structure. This could turn severe at places where pipes are in direct contact with large building surfaces like walls or slabs. Noise from vibrations may cause severe disturbance to the building occupants.

Prevention of vibrations can help maintaining the acoustic performance in the building, thereby resulting in increased occupant comfort and productivity.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

There are several techniques to isolate or minimise the vibration levels in the piping systems. These include:

**Automatic Air Vent**

In compliance with the regulation requirements, each of the vertical water supply risers shall have an automatic air vent (as shown in fig. 403.03(1)) at high points which shall purge the trapped air out of the pipeline. This would prevent the pipeline from shaking and also avoid loss of carrying capacity, disruption of the flow, reduced pump efficiency, effects on pipe materials and pipeline structure.

The isolation and drain valve shall be located wisely so that these components do not restrict drainage significantly or back-up water behind them in order to drain completely.

Fig 403.03(1): Automatic Air Vent

**Pipe Supports and Hangers**

Resilient pipe hangers and supports (as shown in fig. 403.03(2)) shall be used to prevent vibration and noise transmission from the piping system to the building structure and to provide flexibility in the piping. Rigid mountings around the bend with suitable vibration isolators can be used to minimise pipe vibration.

Fig 403.03(2): Anti-Vibration Pipe Clamp

**Flexible Pipe Connectors / Expansion Joints**

Expansion joints (as shown in fig. 403.03(3)) shall be used in piping, to provide flexibility in the piping network. It also permits the isolators to function properly, protects equipment from strain caused by misalignment and expansion or contraction of piping and attenuates noise and vibration transmission along the piping network.

Fig 403.03(3): Rubber Expansion Joint

The project team may also refer ASHRAE Handbook: Chapter 48 - Sound and Vibration Control, for various methodologies and best practices for piping system vibration control.

## COMPLIANCE DOCUMENTATION

**Table 403.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Plumbing and chilled water final approved drawing indicating the proper air-vent, drain valve, isolation valve, expansion joints and sufficient supports and connectors are installed as per design. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, Chapter 48, Noise and Vibration control. www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook— Fundamentals, Chapter 8, Sound and Vibration. www.ashrae.org.

British Standards. (2017). Guidance on sound insulation and noise reduction for buildings.

Jones, Robert S., Noise & Vibration Control in Buildings, McGraw-Hill, New York, NY 1984.

# CHAPTER 4 - HAZARDOUS MATERIALS



## 404.01 LOW EMITTING MATERIALS: PAINTS AND COATINGS

Silver Sa'fa

### INTENT

To minimise the amount of indoor air contaminants that impacts the health, productivity and wellbeing of occupants and installers.

### REQUIREMENT

For all buildings, including new applications in existing buildings, all paints and coatings used in the building should not exceed the allowed limits for Volatile Organic Compound (VOC) specified by Dubai Municipality. The paints and coatings must be accredited / certified from Dubai Central Laboratory or any other laboratory, approved by Dubai Municipality.

### SIGNIFICANCE

Quality of the indoor environment has a significant influence on the well-being, productivity and quality of life of occupants. Many building products and materials include compounds that have an adverse impact on indoor air quality as well as contributing to outdoor pollution. The most prominent of these compounds are Volatile Organic Compounds (VOC).

Prolonged exposure to high concentrations of some volatile organic compounds has been linked to a wide range of chronic health problems such as asthma, chronic obstructive pulmonary disease and cancer. Short-term exposure to VOCs can also cause acute reactions such as eye, nose, and throat irritation. The harm caused by use of products with high levels of VOC affects the building occupants and those who install or apply these products during construction. Use of low VOC materials will improve the indoor air quality.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

All paints and coatings used in the building must comply with the maximum Volatile Organic Compound (VOC) limits indicated in Dubai Municipality Standard DMS 20-Specification for Paints and Varnishes.

The VOC limits are for paints and coatings as supplied, before addition of water.

Paints and coatings manufacturers should demonstrate compliance by providing material specification data sheets and DCL test certificates that specify the VOC levels of these products. Table 404.01 (1) shows the maximum VOC limit for paints and coatings.

**Table 404.01 (1): Maximum VOC Content Limit Values for Paints and Coatings**

| Product Sub-Category | Type** | VOC (g/l)* |
|---|---|---|
| Interior matt walls and ceilings (Gloss <25 @ 60º) | WB | 30 |
| | SB | 30 |
| Interior glossy walls and ceilings (Gloss >25 @ 60º) | WB | 100 |
| | SB | 100 |
| Exterior walls of mineral substrate | WB | 40 |
| | SB | 430 |
| Interior/Exterior trim and cladding paints for wood and metal | WB | 130 |
| | SB | 300 |
| Interior/Exterior trim varnishes and wood stains, including opaque wood stains | WB | 130 |
| | SB | 400 |
| Interior/Exterior minimal build wood stains | WB | 130 |
| | SB | 700 |
| Primers | WB | 30 |
| | SB | 350 |
| Binding primers | WB | 30 |
| | SB | 750 |
| One-pack performance coatings | WB | 140 |
| | SB | 500 |
| Two-pack reactive performance coatings for specific end use such as floors | WB | 140 |
| | SB | 500 |
| Multi-colored coatings | WB | 100 |
| | SB | 100 |
| Decorative effect coatings | WB | 200 |
| | SB | 200 |

* Ready to use
** WB- Water Based SB-Solvent Based

## COMPLIANCE DOCUMENTATION

**Table 404.01(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. DCL certificate.<br>2. Purchase order/delivery notes as a proof of purchase. |
| After Completion | Not applicable |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2015). Standard DMS 20:2015—Specification for Paints and Varnishes

Dubai Central Laboratory. (2018). Specific Rules for FA Certification of Low Emitting Materials as per Al Sa'fat Dubai Green Building System.

# CHAPTER 4 - HAZARDOUS MATERIALS



## 404.02 LOW EMITTING MATERIALS: ADHESIVES AND SEALANTS

Silver Sa'fa

### INTENT

To minimise the amount of indoor air contaminants from adhesives and sealants that impacts the health, productivity and wellbeing of occupants.

### REQUIREMENT

For all buildings, including new applications in existing buildings, all adhesives, adhesive bonding primers, adhesive primers, sealants and sealant primers used in the building should not exceed the allowed limits for Volatile Organic Compound (VOC) specified by Dubai Municipality. This must be accredited / certified from Dubai Central Laboratory or any other laboratory, approved by Dubai Municipality.

### SIGNIFICANCE

Quality of the indoor environment has a significant influence on the well-being, productivity and quality of life of occupants. Many building products and materials include compounds that have an adverse impact on indoor air quality as well as contributing to outdoor pollution. The most prominent of these compounds are Volatile Organic Compounds (VOC).

Prolonged exposure to high concentrations of some VOCs has been linked to a wide range of chronic health problems such as asthma, chronic obstructive pulmonary disease and cancer. Short-term exposure to VOCs can also cause acute reactions such as eye, nose, and throat irritation. The harm caused by use of products with high levels of VOC affects the building occupants and those who install or apply these products during construction. Use of low VOC containing adhesives and sealants will improve the indoor air quality.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

All adhesives and sealants used in the building must comply with the maximum Volatile Organic Compound (VOC) limits indicated in Dubai Central Laboratory's specific rules for low-emitting materials (as shown in Table 404.02 (1)).

Adhesives and sealants manufacturers should demonstrate compliance by providing material specification data sheets and DCL test certificates that specify the VOC levels of these products.

The VOC limits are for adhesives and sealants, as supplied before addition of water.

**Table 404.02 (1): Maximum VOC Content Limit Values for Adhesives and Sealants**

| Maximum VOC Limits - g/l (less water) | | | |
|---|---|---|---|
| **Architectural Applications** | | **Specialty Applications** | |
| Indoor Carpet Adhesives | 50 | PVC Welding | 510 |
| Carpet Pad Adhesives | 50 | CPVC Welding | 490 |
| Wood Flooring Adhesives | 100 | ABS Welding | 325 |
| Rubber Floor Adhesives | 60 | Plastic Cement Welding | 250 |
| Subfloor Adhesives | 50 | Adhesive Primer for Plastic | 550 |
| Ceramic Tile Adhesives | 65 | Contact Adhesive | 80 |
| VCR & Asphalt Adhesives | 50 | Special Purpose Contact Adhesive | 250 |
| Drywall & Panel Adhesives | 50 | Structural Wood Member Adhesive | 140 |
| Cove Base Adhesives | 50 | Sheet Applied Rubber Lining Operations | 850 |
| Multipurpose Construction Adhesives | 70 | Top & Trim Adhesive | 250 |
| Structural Glazing Adhesives | 100 | | |
| **Substrate Specific Applications** | | **Sealants** | |
| Metal to Metal | 30 | Architectural | 250 |
| Plastic Foams | 50 | Non-Membrane Roof | 300 |
| Porous Materials (except wood) | 50 | Roadway | 250 |
| Wood | 30 | Single-Ply Roof Membrane | 450 |
| Fiberglass | 80 | Other | 420 |
| | | **Sealant Primers** | |
| | | Architectural Non-Porous | 250 |
| | | Architectural Porous | 775 |
| | | Other | 750 |

## COMPLIANCE DOCUMENTATION

**Table 404.02(2): Documents Required**

| Project Stages | Documents Required |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. DCL certificate.<br>2. Purchase order/delivery notes as a proof of purchase. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Central Laboratory. (2018). Specific Rules for FA Certification of Low Emitting Materials as per Al Sa'fat Dubai Green Building System.

# CHAPTER 4 - HAZARDOUS MATERIALS



## 404.03 CARPET SYSTEMS

Silver Sa'fa

### INTENT

To minimise the amount of indoor air contaminants from carpets thereby reducing its impacts on health, productivity and well-being of occupants.

### REQUIREMENT

For all new and existing public and commercial buildings, each new carpet system (carpets or new permanently installed carpet padding) must be certified / accredited from Dubai Central Laboratory or any other laboratory, approved by Dubai Municipality (DM).

Carpets are not allowed to be used in labor accommodation, educational facilities or any other places as determined by DM.

### SIGNIFICANCE

Carpet systems (consisting of the carpet, carpet cushion, and carpet adhesive) have wide range of uses such as cushioning the impact of slips and falls, dampening unwanted noise and for aesthetic appeal. Carpets system also works as a sound barrier between floors by blocking sound transmission to spaces below. Carpet systems can also trap particles like dust, pollen and pet and insect dander and removes them from the breathing zone by reducing their circulation.

Selection of carpet systems is important as they may contain Volatile Organic Compounds (VOC). VOCs have an adverse impact on indoor air quality. New carpet systems (including adhesives used to adhere face fibers to backing materials, carpet cushion and the adhesives used to install carpets), will off-gas VOCs after being installed. This can expose building occupants to contamination and has a significant influence on their well-being, productivity and quality of life.

The use of carpet systems made of low-emitting materials will help to minimise air quality problems in buildings. Healthy building occupants are more productive and will have less illness-related absenteeism.

### APPLICABILITY

This regulation is applicable to all building types except labor accommodation and educational facilities. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation covers carpet systems permanently installed in buildings and does not apply to loose-fitted rugs and mats.

All carpets & carpet cushions installed in the building must be certified /accredited by Dubai Central Laboratory (DCL) or any other laboratory, approved by Dubai Municipality (DM). DCL certificate conforming the VOC limit must be submitted for compliance with this regulation.

All carpet adhesives must meet the requirements stated in *Regulation 404.02 - Low Emitting Materials: Adhesives and Sealants*.

Regular carpet maintenance is also essential to preserve the carpet's initial appearance and for maintaining good indoor air quality.

## COMPLIANCE DOCUMENTATION

**Table 404.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. DCL certificate for VOC.<br>2. Purchase order/delivery notes as a proof of purchase. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Central Laboratory. (2018). Specific Rules for FA Certification of Low Emitting Materials as per Al Sa'fat Dubai Green Building System.

# CHAPTER 5 - DAY LIGHTING AND VISUAL COMFORT



## 405.01 PROVISION OF NATURAL DAYLIGHT

Silver Sa'fa

### INTENT

To promote energy savings and to improve the well-being of building occupants.

### REQUIREMENT

For all new buildings, other than industrial buildings, provision for adequate natural daylight must be made in order to reduce the reliance on electrical lighting and to improve conditions for the building occupants. The provided lighting openings must be in accordance with Dubai Municipality's building regulations and specification.

### SIGNIFICANCE

Provision of natural light has a profound impact on the well-being of building occupants. It has a positive health impact, increases productivity in workplaces and improves performance of occupants. Natural light also provides occupants with a connection to the outdoor environment. This allows the occupant to adapt to natural changes of daylight levels throughout the day. Providing natural light also reduces energy consumption.

Glazed elements allow natural light into the interior of the building. Large glazed surfaces can cause visual discomfort for building occupants due to excessive brightness, and also consume higher energy. Also highly tinted glazed surfaces reduce the natural light transmitted thereby increasing reliance on electrical lighting. Integrating a well-designed daylight strategy not only reduce the incidence of glare and discomfort but can also reduce the need for electrical lighting. This also contributes in reduction of energy consumption and reduction of carbon emissions.

### APPLICABILITY

This regulation is applicable to all building types except industrial buildings. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The factors affecting the design and control of daylight in buildings include: required internal illumination, size of the windows or glazed elements, properties of the glass, surrounding obstructions, colour of the internal surfaces and sky conditions over the year.

While designing the building, adequate daylight should be provided for all regularly occupied areas. Regularly occupied areas in a building exclude meeting rooms, copy/printing rooms, storage areas, mechanical spaces, restrooms, auditorium, closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms and other intermittently or infrequently occupied spaces or spaces where daylight would interfere with the use of the space.

The Average Daylight Factor (ADF) is the average value of the daylight factor within a room and can be used as an indicator of the overall daylight levels in a room. The ADF within a space is a function of the size of each window, the type of glazing, the amount of sky visible from each window and the overall reflectance of the internal surfaces. Typically, rooms with ADF of 2%, are considered daylit.

ADF is calculated based on the following formula:

$$DF_{avg} = \sum \frac{T \times W \times \theta}{A \times (1 - R^2)} \%$$

Where:

T = Transmission of glazing (0-1), includes corrections for dirt on glass and any blinds/curtains

W = Net glazed area of the window ($m^2$)

$\theta$ = Angle of vertical view from the centre of the window (°)

A = Total area of the room surfaces: wall, floors ceilings and glazing ($m^2$)

R = Average reflectance of surfaces (0-1)

The angle of vertical view from the centre of the window is measured as shown in the Fig 405.01(1). $\theta$ is the angle subtended, in the vertical plane normal to the window, by sky visible from the centre of the window.

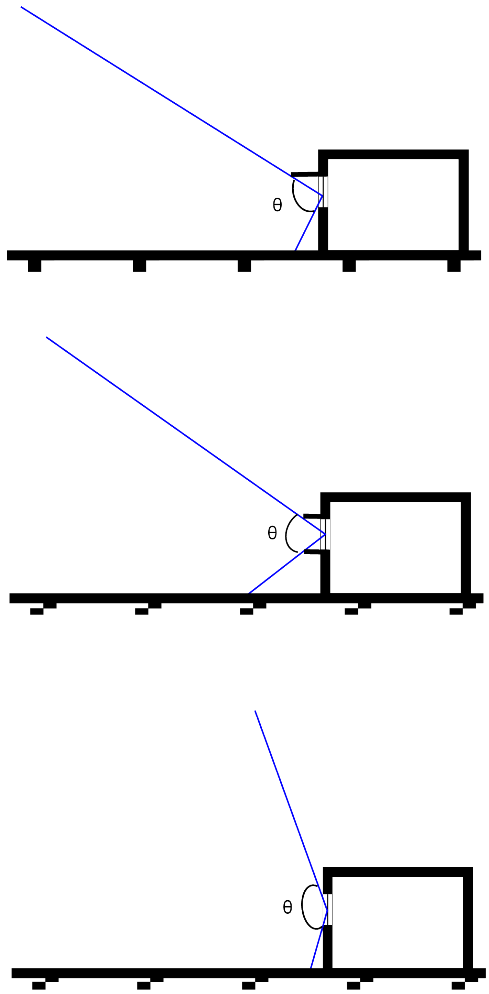



Fig 405.01(1): Measurement for Angle of Vertical View from the Centre of the Window ($\theta$)

This approach can be effectively applied for hand-calculations. However, greater accuracy, design efficiency, speed and flexibility can be achieved through computer modelling.

ADF is a single average value and does not assess whether the daylight is evenly distributed throughout the room. As the distance from the window increases the Daylight Factors decrease. Consequently, the back of deep narrow rooms would be darker than at the perimeter, even if the Average Daylight Factor meets the required level. This can be addressed through the Brightness Contrast or the Uniformity Ratio. Uniformity Ratio ($U_o$) is defined as the ratio of the minimal illuminance over the area weighted average illuminance and is calculated as follows:

$$U_o = \frac{E_{min}}{E_{avg}}$$

where,

$E_{min}$ is the minimal illuminance in an area

$E_{avg}$ is the area weighted average illuminance

In tandem with daylight strategy, glare control strategy should also be considered. This is to ensure the glare levels are minimised. Commonly used glare reduction strategies include exterior shading devices, light shelves, interior blinds and louvres and fritted glazing.

## COMPLIANCE DOCUMENTATION

**Table 405.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural floor plan showing the window location.<br>2. Elevation drawing showing the vision and spandrel glass. |
| Construction Completion Application | 1. Final approved architectural drawing and elevation. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers (CIBSE). (2014). LG10/14 Lighting Guide 10: Daylighting - a Guide for Designers - LG10.

British Standards Institution. (2008). BS 8206-2: Lighting for buildings. Code of practice for daylighting,

Building Research Establishment. (2011). Site layout planning for daylight and sunlight: a guide to good practice (BR 209).

European Standard. (2011). DIN EN 12464-1 Light and lighting - Lighting of work places - Part 1: Indoor work places.

# CHAPTER 5 - DAY LIGHTING AND VISUAL COMFORT



## 405.02 VIEWS

Silver Sa'fa

### INTENT

To improve the well-being of building occupants by connecting the building occupants with the outdoor environment.

### REQUIREMENT

All new commercial, residential and public buildings must provide direct line of sight (views) to the outdoor environment in accordance with Dubai Municipality's building regulation and specification.

### SIGNIFICANCE

Regularly occupied areas of the building ideally should have access to outside views. The use of natural light and the access to outdoor views creates a stimulating environment for building occupants. Views connect the building occupants with the outdoor environment offering them a better visual respite and help them adapt to natural changes of daylight levels throughout the day. Provision of views, increases building occupant's productivity while reducing eyestrain and other health problems.

The provision of views also contribute in reducing energy consumption by reducing the need for electrical lighting due to increased usage of natural light.

### APPLICABILITY

This regulation is applicable to commercial, residential and public building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The factors affecting the design of views in buildings include - heat gain and loss, glare control, visual quality and variations in daylight availability.

For offices, when calculating areas provided for views, the following should be taken into consideration:

- Interior office spaces: The entire area of interior office spaces may be included in the calculation if at least 75% of each area has direct line of sight to perimeter vision glazing.
- Multi-occupant spaces: The calculation shall only include the areas with direct line of sight to perimeter vision glazing.

Regularly occupied areas in a building exclude copy/printing rooms, storage areas, mechanical spaces, restrooms, auditorium and other intermittently or infrequently occupied spaces or spaces where daylight would interfere with the use of the space.

A sample layout for views for an office space is shown in fig. 405.02(1).

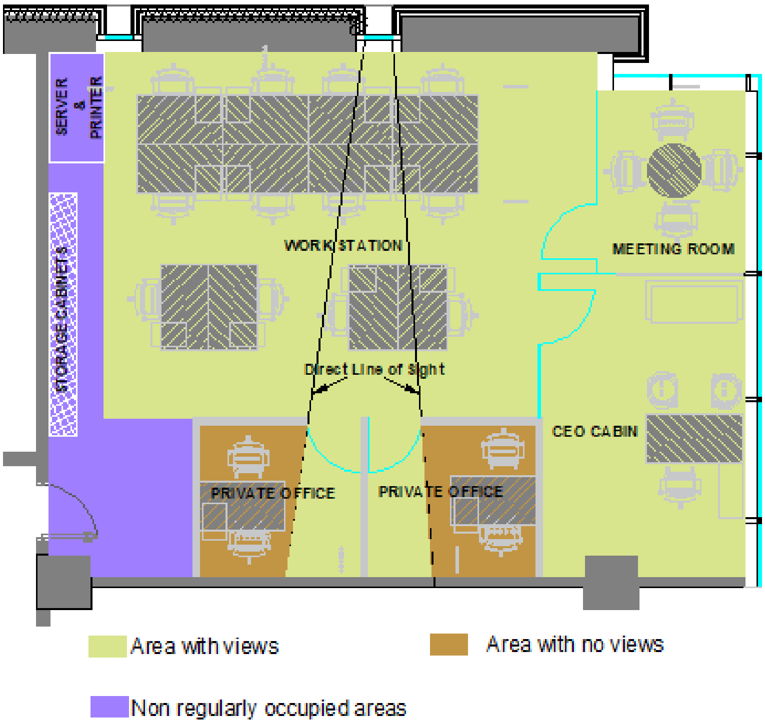



Fig 405.02(1): Sample Layout for Views (Office Space)

For residential buildings, when calculating areas provided for views, 90% line of sight criteria is required for habitable spaces only. Habitable rooms are defined as: Any room used for sleeping, living or dining purposes, excluding other enclosed places such as closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms and similar spaces.

A sample layout for views for a residential unit is shown in fig. 405.02 (2).

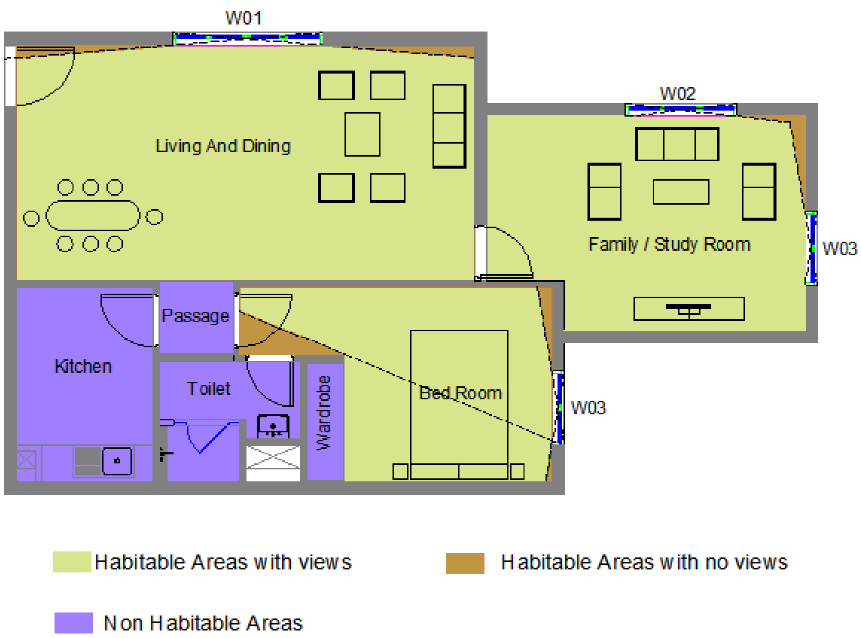



Fig 405.02(2): Sample Layout for Views (Residential Unit)

Views calculations must consider that line of sight can pass through interior glazing, but not through doorways with solid doors. A direct line of sight is required through vision glazing. Line of sight may be drawn through internal glazing. Views that are obstructed from the room due to interior walls, other obstructions (Glazing with frits, fibers, patterns, colors or tints) or views through a roof or high-level window are not considered as “views” for the purpose of calculations for this requirement.

## COMPLIANCE DOCUMENTATION

**Table 405.02(1): Documents Required**

| Project Stages | Documents Required |
|---|---|
| Design Permit Application | 1. Architectural floor plan showing the window location.<br>2. Elevation drawing showing the vision and spandrel glass. |
| Construction Completion Application | 1. Final approved architectural drawings and elevation. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Heschong, Lisa & Aumann, D. & Jenkins, N. & Suries, T. & Therkelsen, R.L.. (2003). Windows and offices: a study of office worker performance and the indoor environment. California Energy Commission. 1-5.

## 406.01 LEGIONELLA BACTERIA AND BUILDING WATER SYSTEMS

Silver Sa'fa

### INTENT

To control and reduce the effects of Legionella Bacteria in the water-based system.

### REQUIREMENT

All new and existing buildings must comply with the technical guidelines issued by Dubai Municipality, which includes:

A. All water systems and networks which create a water spray or aerosol including but not limited to cooling towers, evaporative condensers, hot and cold water systems, showers, evaporative air coolers, spas, fountains, misters, etc., must be periodically maintained, cleaned, disinfected and checked to minimise the risk of legionella bacteria or germs contamination. This must be in accordance with the technical guidelines issued by Dubai Municipality, regarding the control of legionella bacteria in water systems.

B. All water systems equipment and accessories, including but not limited to potable water network, hot and cold water systems, water tanks, pumps, pipes and fittings must be properly maintained, cleaned and disinfected.

C. Sampling and testing must be carried out for the presence of bacteria / germs and legionella bacteria.

D. All equipment and devices used for swimming pools, spa pools, whirlpool baths, hydrotherapy pools and Jacuzzi, must be maintained, cleaned, disinfected and checked, periodically.

Specialised laboratories approved by Dubai Municipality shall carry out the water tests and sampling. All test results must be recorded and kept along with the records for maintenance and remedial works, at site. This would be checked by Dubai Municipality.

### SIGNIFICANCE

Legionnaires' disease is a potentially fatal form of pneumonia which can affect building occupants. It is caused by the bacterium *Legionella pneumophila* and related bacteria. The collective term used to cover the group of diseases caused by legionella bacteria is legionellosis.

Legionella bacteria is found naturally in water sources such as rivers, lakes and reservoirs, usually in low quantities. They may also be found in purpose-built water systems such as cooling towers, evaporative condensers, hot and cold-water systems and spa pools. Legionella bacteria can survive under a wide variety of environmental conditions and are found in water at temperatures between 6°C and 60°C. The legionella growth is most favourable between the temperatures of 20°C and 45°C.

Exposure to legionella bacteria is reduced by incorporating measures that do not allow proliferation of organisms in water systems and by reducing the exposure to water droplets and aerosol.

This regulation focuses on methods to minimise the legionella bacteria contamination in building water systems, specifically in cooling towers. It provides specific environmental and operational guidelines for safe operation of building water systems with the intent of minimising the risk of occurrence of Legionnaires' disease.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The key aspect of this regulation is to ensure that the water systems are kept clean and that a biocidal treatment program is used. The maintenance, monitoring, treatment requirements, water quality guidance, maximum acceptable legionella bacteria count and sampling for the water systems must be followed as stated in the Dubai Municipality Guidelines. This must be carried out by specialised maintenance companies approved by Dubai Municipality.

Projects must develop and implement legionella management plan to control the growth of legionella bacteria within the building water system, during construction and operation phases. Water systems must be analysed for its vulnerability towards bacterial growth which is most significant between 20°C and 45°C. Water systems include all plant/equipment and components associated with that system, e.g. all associated pipe-work, pumps, feed tanks, valves, showers, heat exchangers, quench tanks, chillers etc.

The primary aim of legionella management is:

- To identify and assess risks of legionellosis.
- To avoid the use of systems that give rise to a foreseeable risk of legionellosis or, where this is not reasonably practicable, prepare a written scheme for minimising the risk from exposure.
- Implement and manage the scheme of precautions and keep appropriate records.
- Advise on the management, selection, training and competence of personnel.

Keeping the water systems clean reduces the nutrients available for legionella growth. Regular inspections, cleaning and disinfection by the maintenance staff should be carried out to avoid the build-up of dirt, organic matter or other debris. Mechanical filtration can be used to help reduce this debris. Records for all maintenance works shall be properly maintained.

A complete water treatment programme should be developed, based on the physical and operating parameters for the cooling system and based on the analysis of the make-up water. The components of the water treatment programme should be environmentally acceptable and comply with local discharge requirements. For effective monitoring and control, inhibitors to prevent corrosion, scale formation and fouling should be added on a continuous basis. Biocides can be used to control microbiological activity. Any faults must be corrected and changes be made to prevent a re-occurrence of those faults. If legionella is detected, water systems should be disinfected, cleaned and re-disinfected.

Post-construction, samples from the water systems must be tested for the presence of bacteria / germs and legionella bacteria. Specialised laboratories approved by Dubai Municipality shall carry out the water tests and sampling. Test for aerobic count and legionella shall be done as per DM requirements. All test results must be recorded and kept along with the records for maintenance and remedial works, at site. Testing is not a substitute replacement for sound maintenance practices and water treatment.

## COMPLIANCE DOCUMENTATION

**Table 406.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Semi-yearly water sample analysis test report from DM approved laboratory (bacteria, germs and legionella count).<br>2. Service contract with DM approved maintenance company. |
| After Completion | 1. Water tests and sampling reports. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2010). Guideline for the control of legionella in water systems.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, Chapter 49 - Water Treatment: Deposition, Corrosion and Biological Control. www.ashrae.org.

ASTM International. (2015). ASTM D5952-08: Standard Guide for the Inspection of Water Systems for Legionella and the Investigation of Possible Outbreaks of Legionellosis (Legionnaires' Disease or Pontiac Fever, www.astm.org.

Health and Safety Executive, Government of UK. (2013). Approved Code of Practice and guidance on regulations (L8): Legionnaires' disease – The control of Legionella bacteria in water systems.

British Standards Institution. (2010). BS 8580: Water quality. Risk assessments for Legionella control. Code of practice.

# CHAPTER 6 - WATER QUALITY



## 406.02 WATER QUALITY OF WATER FEATURES

Silver Sa'fa

### INTENT

To control and reduce the effects of legionella bacteria in water features.

### REQUIREMENT

For all new and existing buildings, all water features having a water storage volume of over 1,000 l and which creates a water spray or aerosol, including but not limited to waterfalls, ponds, streams etc., must be maintained, cleaned, disinfected and checked periodically, to minimise the risk of legionella bacteria or germs contamination. It must also not exceed the maximum limits, outlined in the technical guidelines issued by Dubai Municipality.

### SIGNIFICANCE

Water in water features gets contaminated either from surrounding environment or from contact with people or animals. Presence of human or animal waste may lead to detection of fecal coliform in drinking water or swimming pools. Favourable temperature range encourages the growth of legionella bacteria. Occupants exposed to contaminated water may have adverse health problems.

This regulation focuses on methods to minimise the contamination in water features. It provides specific environmental and operational guidelines for minimising the risk of occurrence of Legionnaires' disease.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The key aspect of this regulation is to ensure that water features are kept clean and periodic testing for contaminants is carried out. The maintenance, monitoring, treatment requirements, water quality guidance, maximum acceptable legionella bacteria count and sampling for the water features must be followed as stated in the Dubai Municipality Guidelines. This must be carried out by specialised maintenance companies approved by Dubai Municipality.

A water feature includes all plant/equipment and components associated with that system, e.g. all associated pipe-work, pumps, feed tanks, valves etc.

Keeping the water systems clean reduces the nutrients available for bacterial growth. Regular inspections, cleaning and disinfection by the maintenance staff should be carried out to avoid the build-up of dirt, organic matter or other debris. Mechanical filtration can be used to help reduce this debris. Records for all maintenance works shall be properly maintained.

The amount of organic compounds in water is indirectly measured by measuring the Total Chemical Oxygen Demand (TCOD) and Total Biochemical Oxygen Demand (TBOD). Monitoring the levels of TCOD and TBOD determines the amount of organic pollutants found in surface water. Regular maintenance and testing of water ensure that any contamination does not become a general health hazard.

Samples should be collected from each water system having a water storage capacity more than 1,000 l and which produces spray or aerosol such as spas, fountain, waterfall systems, evaporative water coolers, misters, air washers and humidifiers. Specialised laboratories approved by Dubai Municipality shall carry out water sampling and tests and sampling for all water features. Inspection, cleaning and maintenance regimes must be revised, if any non-compliant test results are obtained. Table 406.02(1) indicates the maximum allowable water quality levels.

All test results must be recorded and kept along with the records for maintenance and remedial works, at site. Testing is not a substitute replacement for sound maintenance practices and water treatment. The requirements stated in *Regulation 406.01: Legionella Bacteria and Building Water Systems* must also be adhered.

**Table 406.02 (1): Maximum Allowable Value for Water Quality**

| Parameter | Units | Maximum Allowable Value |
|---|---|---|
| Legionella Bacteria | cfu/l | 1 |
| Total Bacteria Count (TBC) | cfu/ml | 500 |

## COMPLIANCE DOCUMENTATION

**Table 406.02(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Water sample analysis test report from specialised laboratory mentioning (bacteria, germs and legionella count). |
| After Completion | 1. Water tests and sampling reports. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2010). Guideline for the control of legionella in water systems.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications, Chapter 49 - Water Treatment: Deposition, Corrosion and Biological Control. www.ashrae.org.

ASTM International. (2015). ASTM D5952-08: Standard Guide for the Inspection of Water Systems for Legionella and the Investigation of Possible Outbreaks of Legionellosis (Legionnaires' Disease or Pontiac Fever, www.astm.org.

Health and Safety Executive, Government of UK. (2013). Approved Code of Practice and guidance on regulations (L8): Legionnaires' disease – The control of Legionella bacteria in water systems.

British Standards Institution. (2010). BS 8580: Water quality. Risk assessments for Legionella control. Code of practice.

# CHAPTER 7 - RESPONSIBLE CONSTRUCTION



## 407.01 IMPACT OF CONSTRUCTION, DEMOLITION AND OPERATIONAL ACTIVITIES

Silver Sa'fa

### INTENT

Reduce environmental impacts from construction, demolition and operational activities.

### REQUIREMENT

All new buildings must comply with all related regulations, local orders and their executive orders, technical guidelines and guides applied in the Emirate of Dubai. The following is also required:

1. Neither the construction activity nor the operation of the building may cause land disturbances, surface runoff, soil erosion or sedimentation, on any other property beyond the boundary of the plot.
2. Drainage must avoid pollution of watercourses and groundwater. Discharges made directly to ground, storm or marine waters must comply with Local Order (61) issued in 1991.
3. Dust suppression techniques must ensure that dust generated by construction and demolition activities must meet the requirements of Code of Construction Safety Practice issued by Dubai Municipality.
4. Construction waste materials generated on site must be segregated and stored on site, prior to collection. Segregation must, at a minimum, include labelled storage for inert aggregates, metals, timber, dry recyclables and hazardous material.
5. For the disposal of hazardous waste, permit must be prepared and obtained from Dubai Municipality's Waste Management Department. The hazardous waste must be transported in accordance with the requirements of DM Technical Guidelines and DM Code of Construction Safety Practice.
6. Excluding the usage for drinking, toilet activities and concrete works, potable water cannot be used for construction activities on project site.
7. Construction and demolition noise must be no greater than that detailed in DM Technical Guidelines and DM Code of Construction Safety Practice.
8. Chemicals, fuels, solvents or hazardous wastes must be stored in accordance DM Technical Guidelines and DM Code of Construction Safety Practice.
9. Light pollution from the construction site must be minimised by ensuring that light sources are directed inwards and angled down, so that no light is emitted above the horizontal plane. Lux levels should meet the DM Code of Construction Safety Practice.

## SIGNIFICANCE

Mitigating the impacts of construction on the environment is important for the development of a sustainable city.

Preventing erosion, sedimentation and dust generation during construction activities will result in improved air quality, water quality, water habitat and maintenance of drainage infrastructure. Preventing air and water pollution will reduce environmental damage. Reusing existing building materials, recycling and diversion of waste generated from site will result in reduced construction waste volumes. This also reduces the environmental impacts associated with raw materials extraction, manufacturing and transportation.

This regulation addresses many aspects of the demolition, construction and operation of buildings that must be considered to ensure safe working conditions and to minimise impact on property, people and the environment. Improved control measures aids in better occupational health standards, reduced clean-up cost and to maintain healthier environment.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Reducing the impact of construction activities shall be included in project specifications. Specific considerations should be highlighted for sensitive areas like projects near to water bodies, natural habitats and reserve areas.

Construction activity pollution plan should be developed and implemented for the projects. It can be developed in line with Dubai Municipality Technical Guideline No.1 for undertaking Environmental Impact Assessment (EIA) and Technical Guideline No.2 for Environmental Impact Assessment (EIA) requirements for Development, Infrastructure, and Utility Projects V4.0.

Implementation of construction activities must include measures to:

- Restrict land disturbances, surface runoff, soil erosion or sedimentation, on any other property beyond the boundary of the plot.
- Avoid pollution of watercourses and groundwater through drainage.
- Storage of chemicals, fuels, solvents or hazardous wastes in accordance DM Technical Guidelines and DM Code of Construction Safety Practice.
- Comply with the requirements of Code of Construction Safety Practice issued by Dubai Municipality.

Discharges made directly to ground, storm or marine waters must comply with Local Order (61) issued in 1991.

Best management practices to mitigate the dust pollution must include:

- Soil compaction or stabilisation of all roadways using gravel or crushed concrete waste (fig. 407.01(1)).
- Use of defined, established and restricted roadways.

Fig 407.01(1): Stabilised Site Entrance

Fig 407.01(2): Dust Suppression Methods

- Restriction of vehicle movements to those that are strictly necessary.
- Limiting vehicle/equipment speed on site to no more than 5km/h.
- Sprinkling of water on ground surface for effective dust suppression (fig. 407.01(2)).
- Coordination of earthworks so as to minimise open excavation and work surfaces.
- Cover all stockpiles and rubble so as to minimise wind surface effects.
- Minimisation of height and form of stockpiles.
- Use of wind screens to slow, surface wind movements.
- Cleaning of site surroundings from sands, dust and any other material.

Waste generated during construction or demolition activities should be diverted, recycled, reused or disposed in accordance with DM guidelines by approved waste handlers. For the disposal of hazardous waste, permit must be prepared and obtained from Dubai Municipality's Waste Management Department. The hazardous waste must be transported in accordance with the requirements of DM Technical Guidelines and DM Code of Construction Safety Practice. Additional waste management procedures are detailed in section 702: Waste Management.

Noise pollution or noise nuisance occur during the construction and activities shall not exceed the limit specified in the section 3.11 of DM Code of Construction Safety Practice. In case of noise level exceeding the allowable limits, appropriate personal protective equipment should be provided to the working personnel.

Light pollution from the construction site must be minimised by ensuring that light sources are directed inwards and angled down, so that no light is emitted above the horizontal plane. Lux levels should comply with the values stated in DM Code of Construction Safety Practice.

## COMPLIANCE DOCUMENTATION

**Table 407.01(1): Documents Required**

| Project Stages | Documents Required |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. HSE checklist (Health, Safety and Environment) and noise and lux level log. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2008). Code of Construction Safety Practice.

Environment Department - Dubai Municipality (2018). Technical Guideline No. 1 – Environmental Impact Assessment.

Dubai Municipality. (1991). DM Local Order No. 61 of 1991 on The Environment Protection Regulations in the Emirates of Dubai.

Waste Management Department, Dubai Municipality. (2018). DM Technical Guideline No. (8) Hazardous Waste Disposal.

Waste Management Department, Dubai Municipality. (2015). DM Technical Guideline No. (7) Mandatory Waste segregation.

# CHAPTER 7 - RESPONSIBLE CONSTRUCTION



## 407.02 ENSURING QUALITY AND SAFETY FOR CONSTRUCTION ACTIVITIES

Golden Sa'fa

### INTENT

To ensure the quality and safety of construction activities by engaging qualified and suitably certified primary participants.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, the main consultant and contractor should be certified by approved utilities from Dubai Municipality. To ensure the quality and safety practices of construction activities, they must also be certified for ISO 14004 or OSHA or any equivalent as per the approval of authorised department.

### SIGNIFICANCE

A balance of cost, time and quality define successful completion of a construction project. Importance of level of safety at construction sites and provision of safe and stimulating environment for workers have played an important role in the development of Emirate of Dubai. Construction activities in Dubai have been spearheaded by adoption of best construction practices.

By ensuring a sound general safety and health provisions are implemented in a construction site, a safer job site is created which eliminates any project disruptions, improves staff retention and enhances worker's productivity and competitiveness.

Integrating occupational health and safety management system with robust and reliable environmental management system ensures the project and its stakeholders contribute to the environmental pillar of sustainability. This also enhances the environmental performance, adherence to environmental objectives and fulfillment of compliance obligations.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Dubai Municipality is implementing the highest international standards to provide the highest grades of safety and security as well as public health standards for building a happy and sustainable city.

For compliance with this regulation, the main consultant and contractor must be certified by approved utilities from Dubai Municipality.

Certification schemes which are approved by Dubai Municipality includes:

| | |
|---|---|
| ISO 14004 - Environmental Management Systems | ISO 14004 provides guidance for an organisation on the establishment, implementation, maintenance and improvement of a robust, credible and reliable environmental management system. |
| OSHA (Occupational Safety and Health Administration) | Occupational Safety and Health Administration (OSHA) is created to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. |
| OHSAS 18001: for Health and Safety Managements system | OHSAS 18001 is the internationally recognised management system standard which provides a framework to identify, control and decrease the risks associated with health and safety within the workplace. |
| ISO 45001 - Occupational health and safety | ISO 45001:2018 specifies requirements for an occupational health and safety (OH&S) management system, and gives guidance for its use, to enable organisations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance. |

Apart from the above, Dubai Municipality's Code of Construction Safety Practice must be strictly complied to ensure safety at construction sites.

## COMPLIANCE DOCUMENTATION

**Table 407.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. ISO14004 / OSHA certificate for Consultant. |
| Construction Completion Application | 1. ISO14004 / OSHA certificate for Contractor and Consultant. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

International Organization for Standardization. (2016). Environmental management systems (ISO Standard No. 14004).

British Standards. (2007). Occupational health and safety management systems (BS OHSAS 18001).

International Organization for Standardization. (2018). Occupational health and safety management systems (ISO Standard No. 45001).

Dubai Municipality. Code of Construction Safety Practice.

## 407.03 SUSTAINABLE CONCRETE

Golden Sa'fa

### INTENT

Promote development of low carbon-built environment.

### REQUIREMENT

For Golden and Platinum Sa'fa and all new buildings, concrete mixes shall have an environmental impact less than that specified in Dubai Sustainable Concrete Baseline.

The environmental impact for all mixes used in the project shall be less than the baseline by 7% for Golden Sa'fa and 15% for Platinum Sa'fa.

### SIGNIFICANCE

Concrete is an integral component of the construction industry. Ever-growing demand increases the need to produce more quantities of concrete mixes. Embodied $CO_2$ in cement gets accumulated during extraction of raw materials and processing and during transportation to construction sites. Cement production is one of the leading producers of anthropogenic $CO_2$ in the world. It also has environmental effect on the land degradation and related pollution.

Dubai Municipality has developed Dubai Sustainable Concrete Baseline (DSCB) to reduce the environmental impact of concrete mixtures in the Emirate of Dubai. This is to ensure best practice across the life cycle of concrete in the built environment is provided and to balance the specification of concrete for sustainability while ensuring other performance parameters are optimised.

To reduce the impact of emission associated with concrete, cement portion in concrete mixes is being supplemented with industrial by-products such as Ground Granulated Blast-Furnace Slag (GGBFS), Fly ash or Silica fumes commonly known as supplementary cementitious materials or SCMs. Usage of SCMs helps improve the environmental footprint of concrete and in reduction of greenhouse gas emission.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Dubai Municipality has developed DM Concrete calculator to measure the environmental impact of the use of concrete in construction. The calculator helps in assessing the various concrete mixes against DSCB.

DM – Building Department Circular 225, provides requirements to be used in sustainable concrete sector. Attachment No. 2 of DM Circular 225 provides a baseline mix ratio for different concrete mixes.

Project teams to identify the types of concrete mixes proposed for a project and assess their environmental impact using DM concrete calculator. Project team to compare the environmental impact of proposed concrete mixes against DSCB.

The total Weighted Average Impact (WAI) for all the concrete quantity of proposed mixes used in the project shall be less than that of the corresponding baseline mixes as stated by DM. Smart Concrete calculator developed by Dubai Municipality shall be used for assessing environmental impact and weighted average impact.

$$\sum \text{(WAI of Proposed Mix X Quantity of Mix)} \leq \sum \text{(WAI of Baseline Mix X Quantity of Mix)}$$

Proposed mixes will be compared to the Weighted Average Impact (WAI) of baseline mixes of equivalent. WAI is calculated from the normalised Life Cycle Assessment indicators/ factors of each mix such as Global warming potential (GWP), Acidification potential (AP), Eutrophication potential (EP), Abiotic Depletion Potential Fossil (ADPF), Blue Water Consumption (FW), Reused Water for Washing, Water for Washing.

During construction stage, project team must compile the required datasheet from the concrete manufacturers and re-assess the calculations to confirm the percentage of environmental impacts of concrete are within DM limits.

## COMPLIANCE DOCUMENTATION

**Table 407.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Before Construction Starts (Get approval from Research & Building Systems) | 1. Company license,<br>2. Bill of quantities (showing concrete quantity for each mix grade).<br>3. Proposed concrete mixes used to comply with Dubai sustainable concrete baseline,<br>4. Report generated from DM environmental impact software.<br>5. Project specifications for concrete mixes.<br>6. Concrete trial mix reports (If available). |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (2018). Circular 225 – Regarding the use of environment friendly concrete and mix designs

Dubai Municipality (2018). Circular 225: Attachment No. 2 – Dubai Sustainable Concrete Baseline.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY: BUILDING ENVELOPE



## 501.01 MINIMUM BUILDING ENVELOPE PERFORMANCE REQUIREMENTS

Silver Sa'fa

### INTENT

**Reduce the energy consumption in buildings and also reduce load on air conditioning equipment by improving the performance of building envelope.**

### REQUIREMENT

For all new air conditioned buildings, the average thermal transmittance (also referred as U-value) and shading coefficient (SC) values for the exterior building elements, must not exceed the values indicated in the below tables. The light transmittance values for the glazed elements should be greater than or equal to the values indicated in the below tables.

A. External Walls, Roofs, and Floors:

The average thermal transmittance (U-value) for building elements that include the external walls, roofs, and floors (where one side of the floor is exposed to ambient conditions) must not exceed the following values:

**Table 501.01 (1): Heat Transfer Coefficient for Roof, External Wall and Exposed Floor**

| | For Silver Sa'fa ($W/m^2K$) | For Golden and Platinum Sa'fa ($W/m^2K$) |
|---|---|---|
| Roof | 0.3 | 0.3 |
| External Wall and Exposed Floor | 0.57 | 0.42 |

For the floor area that is in contact with the ground, the insulation should only be applied for 1m, from the perimeter of the building.

Glazed elements having back-insulated panels must be treated as walls and must meet the performance requirement for walls.

B. Glazed Elements – Fenestration:

1. If window to external wall ratio is less than 40%, then the glazing elements must meet the following performance criteria:

**Table 501.01 (2): Glazing Performance Criteria For Window to External Wall Ratio Less Than 40%**

| | For Silver Sa'fa | For Golden and Platinum Sa'fa |
|---|---|---|
| Thermal Transmittance (Summer U-value) in $W/m^2K$ | 2.1 (max) | 1.9 (max) |
| Shading Coefficient (SC) | 0.4 (max) | 0.32 (max) |
| Light Transmittance | 0.25 (min) | 0.25 (min) |

2. If window to external wall ratio is between 40% and 60%, then the glazing elements must meet the following performance criteria:

**Table 501.01 (3): Glazing Performance Criteria**
**For Window to External Wall Ratio Between 40% and 60%**

| | For Silver Sa'fa | For Golden and Platinum Sa'fa |
|---|---|---|
| Thermal Transmittance (Summer U-value) in W/m²K | 1.9 (max) | 1.9 (max) |
| Shading Coefficient (SC) | 0.32 (max) | 0.25 (max) |
| Light Transmittance | 0.1 (min) | 0.1 (min) |

3. If window to external wall ratio is greater than 60%, then the glazing elements must meet the following performance criteria:

**Table 501.01 (4): Glazing Performance Criteria**
**For Window to External Wall Ratio Greater Than 60%**

| | For Silver Sa'fa | For Golden and Platinum Sa'fa |
|---|---|---|
| Thermal Transmittance (Summer U-value) in W/m²K | 1.9 (max) | 1.7 (max) |
| Shading Coefficient (SC) | 0.25 (max) | 0.25 (max) |
| Light Transmittance | 0.1 (min) | 0.1 (min) |

4. For shop-fronts and showrooms, other than those at ground floor level, glazing elements must meet the following performance criteria:

**Table 501.01 (5): Glazing Performance Criteria**
**For Shopfronts and Showrooms, Except Ground Floor**

| | |
|---|---|
| Thermal Transmittance (Summer U-value) in W/m²K | 1.9 (max) |
| Shading Coefficient (SC) | 0.76 (max) |

5. For glazing elements, if the glazing area on the roof is 10% or lower than the total roof area, the following performance criteria must be met:

**Table 501.01 (6): Glazing Performance Criteria**
**For Roof Glazing Area Less Than 10% of Total Roof Area**

| | |
|---|---|
| Thermal Transmittance (Summer U-value) in W/m²K | 1.9 (max) |
| Shading Coefficient (SC) | 0.32 (max) |
| Light Transmittance | 0.4 (min) |

6. For glazing elements, if the glazing area on the roof is greater than 10% than the total roof area, the following performance criteria must be met:

**Table 501.01 (7): Glazing Performance Criteria**
**For Roof Glazing Area Greater Than 10% of Total Roof Area**

| | |
|---|---|
| Thermal Transmittance (Summer U-value) in W/m²K | 1.9 (max) |
| Shading Coefficient (SC) | 0.25 (max) |
| Light Transmittance | 0.3 (min) |

## SIGNIFICANCE

Prevailing climate plays a major role in design and construction of a building and climate must be taken into account when calculating the thermal performance of building envelope, as it determines the cooling load and resultant energy use in a building.

Envelope experiences several loads including structural loads, both static and dynamic, air, heat or thermal, and moisture loads. Design of the envelope is complex in nature as several factors are to be evaluated and balanced to ensure required level of thermal, acoustic and visual comfort together with safety, accessibility and aesthetic excellence. Improper selection of building envelope can lead to inefficient design of HVAC systems, building operation inefficiencies, inadequate condensation resistance at intersections of components and poor occupant comfort.

Considering Dubai's climate, improving the performance of a building's thermal envelope will result in lowered air conditioning requirements, reduced energy use and reduced load on building machinery. This further results in reduced energy costs, lower maintenance costs and better comfort for building occupants.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The implementation strategy for this regulation is to minimise heat gain through the envelope, by enhancing its design and choosing the appropriate building materials.

The building envelope consists of both opaque and transparent parts of the walls and roof which in addition to the floor are connected to the external environment. These may be single or multilayer and represent the partition between the external and internal environment.

Primary heat transfer modes in a building are conduction, convection and radiation (fig. 501.01(1)). The mode of heat transfer can change, as the heat flows through and within the building. Heat radiated by the sun gets absorbed by the building wall. By conduction, this heat gets transferred through the wall, which gets further transferred by convection to the indoor air and by radiation to the indoor surfaces.

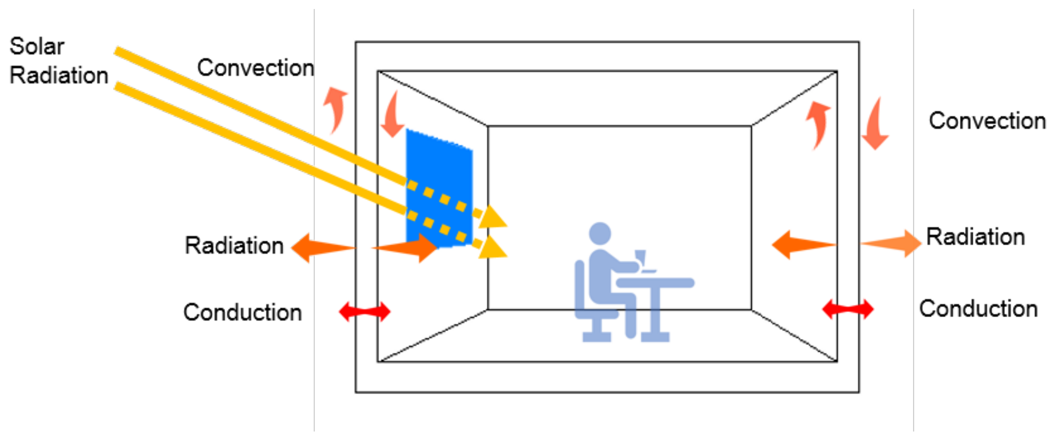



Fig. 501.01(1): Forms of Heat Transfer Through Building Envelope

The materials and layers in the building envelope provide resistance to heat flow and determines the building's thermal performance.

Heat transfer characteristics of building envelope like U-value of walls, roof, floor and glazing, shading coefficient, and solar heat gain coefficient play a major role in a building's thermal performance. Specific requirements for U-values, shading coefficient and minimum light transmittance are detailed in this regulation.

Thermal transmittance is the rate of transfer of heat through matter. U-value is an expression used to represent the thermal transmittance of a material or an assembly (such as wall or roof). U-values are expressed in W/m²K. It is defined as the rate of heat flow in watts (W) through an area of 1 m² for a temperature difference across the structure of 1K. Typically lower U-values represent better insulation.

Fig.501.01(2), illustrates the various construction layers in a building envelope. These layers define the overall thermal resistance of the building.

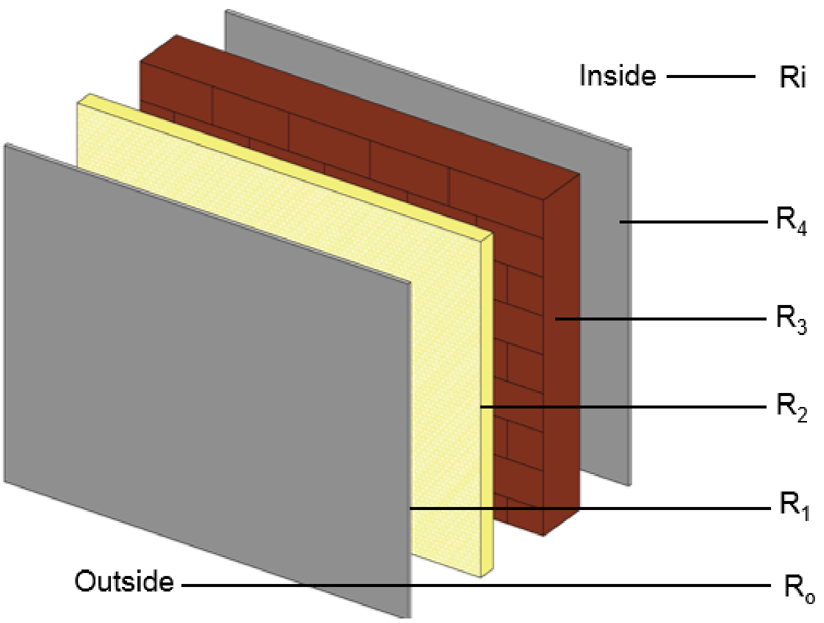



Fig. 501.01(2): Various Construction Layers

U-value of a building element can be calculated using the following equation:

$$U = \frac{1}{R_o + R_1 + R_2 + R_3 + R_4 + R_i}$$

Where,

U is heat transfer coefficient (W/m²k)

R is thermal resistance for different construction layers, (m²K/W)

$R_i$ and $R_o$ are different values for air resistance inside and outside the wall, roof or floor

R-value for each material can be calculated as:

$$R_1 = \frac{d_1}{\lambda_1}$$

Where, R is the thermal resistance ($m^2k/W$), d is the thickness of material (m) and λ is the thermal conductivity (W/m.K) of the material.

The fact that glazing area is an important consideration in a building and larger areas will require better glazing characteristics is recognised by this regulation. This regulation defines glazing area ranges: up to 40% of the façade, between 40% and 60% of the façade and greater than 60%. It also considers glazing area ranges on roof. Glazing performance criteria as indicated and as applicable from Table 501.01 (2) to 501.01 (7) must be considered.

U-values for windows are for the entire window assembly, which includes the frame, glass and any bridging elements. If aluminium window frames are to be used, it would need to incorporate thermal breaks to comply with the required standards.

Transmission of heat in a building also takes place through windows by direct and indirect solar radiation. Ability to control this heat gain through windows could be measured in terms of the shading coefficient and the solar heat gain coefficient.

Shading Coefficient (SC) is the ratio of the amount of heat passing through glazing compared with that through a single clear pane of glass. Shading coefficient is a measure of the heat gain through glass from solar radiation and a lower shading coefficient indicates lower solar gain. SC is expressed as a number between 0 and 1.

Solar heat gain coefficient (SHGC) indicates the percentage of solar radiation (across the entire spectrum) incident upon a glazing assembly (window or skylight) that ends up inside a building as thermal energy (heat). SHGC represents the ability of glazing assembly to resist heat gain from solar radiation. A high value of SHGC means poor resistance for heat gain.

The relationship between shading coefficient (SC) and solar heat gain coefficient (SHGC) can be expressed as:

$$SHGC=SC*0.87$$

Another important factor that must be considered for glazed element is minimum light transmittance value. It is important to achieve a balance between restricting the amount of heat transmitted into the building and achieving a good level of natural light to provide suitable levels of illumination while reducing energy use. By requiring a minimum level of light transmittance to complement the shading coefficient, a balance should be achieved.

Duly filled DM Thermal transmittance calculation sheet (U-value) along with envelope sectional details demonstrating compliance with the regulation, must be submitted to DM. DM Thermal transmittance calculation sheet contains a database of materials and systems and their DCL approved K-value (or R-value), for reference. Project teams can utilise this database for selection of envelope configuration in compliance to the targeted U-value. Materials and systems provided in the database have a unique reference number, which the project teams must input in the DM Thermal transmittance calculation sheet along with thickness, to compute the U-value for the envelope.

As part of procurement of materials during construction stage, thermal and optical specifications of materials should be obtained from manufacturers and suppliers. Based on these specifications, compliance to this regulation should be demonstrated. These specifications also allow for calculation of performance criteria for composite building materials. Project teams can also opt for better thermal performance than those required in this regulation, as it would yield higher energy savings.

## Case Study

2 types of wall configuration (fig. 501.01(3)) were provided to the design team for selection. One was a thermal block with insulation and the other was solid block. Which type should the design team select?

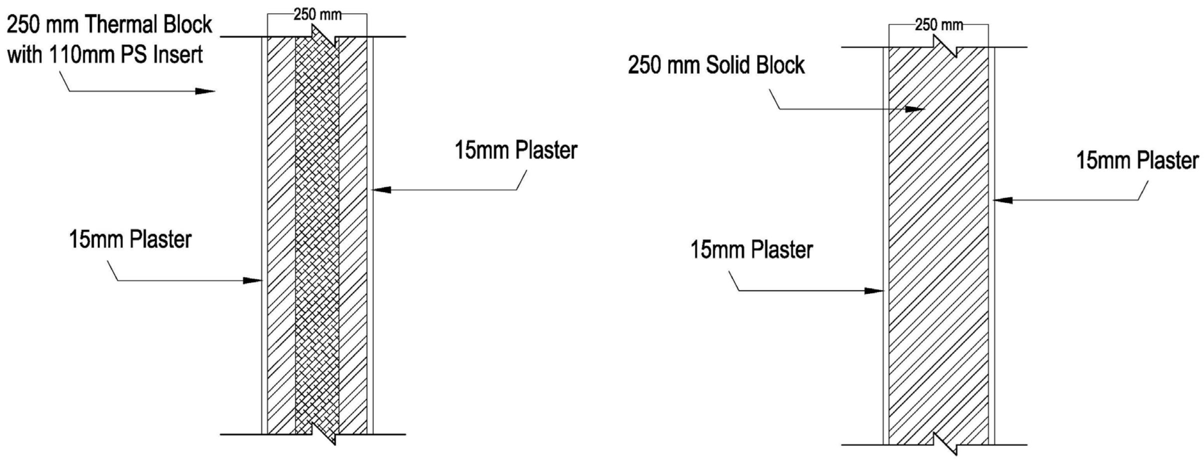



Fig. 501.01(3): Sample Wall Sections with Thermal and Solid Blocks

To determine which wall type to be selected, U-value calculation for each wall type needs to be carried out. Table 501.01(8) and 501.01(9) illustrates the U-value calculation for 2 wall types. It can be observed that U-value for the solid block does not meet minimum DM requirements, whereas the U-value for the thermal block is in conformance to DM requirements.

**Table 501.01 (8): DM U-value Calculator for Thermal Block**

| Layer No. | Thickness mm | External Wall Max.U = 0.57 W/m²K | Density Kg/m³ | Resistance m²K/W | Mass Kg/m² |
|---|---|---|---|---|---|
| 00.000.01 | 0.00 | Inside Surface Film Resistance for Walls | 0 | 0.120 | 0 |
| 00.000.30 | 15.00 | Plaster (Cement / Sand) | 1860 | 0.021 | 279 |
| 04.022.10 | 250.00 | Thermo Block Solid Normal Weight (Sandwich) | 1250 | 3.378 | 3125 |
| 00.000.30 | 15.00 | Plaster (Cement / Sand) | 1860 | 0.021 | 279 |
| 00.000.02 | 0.00 | Outside Surface Film Resistance for Walls | 0 | 0.044 | 0 |
| | 280 mm | Thermal Transmittance U-value: 0.28 W/m²K 0.05 Btu / ºF ft² h | | 3.584 m²K/W | |

**Table 501.01 (9): DM U-value Calculator For Solid Block**

| Layer No. | Thickness mm | External Wall Max.U = 0.57 W/m²K | Density Kg/m³ | Resis-tance m²K/W | Mass Kg/m² |
|---|---|---|---|---|---|
| 00.000.01 | 0.00 | Inside Surface Film Resistance for Walls | 0 | 0.120 | 0 |
| 00.000.30 | 15.00 | Plaster (Cement / Sand) | 1860 | 0.021 | 279 |
| 12.044.09 | 250.00 | Masonry Solid Normal Weight | 2167 | 0.152 | 5417 |
| 00.000.30 | 15.00 | Plaster (Cement / Sand) | 1860 | 0.021 | 279 |
| 00.000.02 | 0.00 | Outside Surface Film Resistance for Walls | 0 | 0.044 | 0 |
| | 280 mm | Thermal Transmittance U-value: 2.79 W/m²K 0.49 Btu / ºF ft² h — Not as/DM Reg. | | 0.358 m²K/W | |

If the project team still would like to use solid block wall type, then additional insulation is required to improve the U-value to meet minimum DM requirements.

## COMPLIANCE DOCUMENTATION

**Table 501.01(10): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. U-value calculation for wall, roof and floor in DM BLDG U-value calculator.<br>2. Glazing U-value, SC & LT in DM BLDG glazed schedule.<br>3. Section details highlighting proposed envelope details for wall, roof, floor and glazing.<br>4. Window to wall area calculation in DM BLDG glazed schedule. |
| Construction Completion Application | 1. DCL approval for insulation material and glazing highlighting U-value, SC & LT.<br>2. Building system approval certificate if applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2003). DM Administrative Resolution No. (66) of 2003 Approving Regulations the Technical Specifications for Thermal Insulation System.

Dubai Municipality. (n.d.) DM BLDG U-Value Calculation Sheet. Available at: https://www.dm.gov.ae/en/pages/default.aspx.

Dubai Municipality. (n.d.) DM BLDG Glazed Schedule Sheet. Available at: https://www.dm.gov.ae/en/pages/default.aspx.

# 501.02 THERMAL BRIDGING

Silver Sa'fa

## INTENT

To reduce energy consumption and maintain adequate thermal comfort for building occupants by eliminating thermal bridges.

## REQUIREMENT

1. For all new air conditioned buildings, thermal bridges must either be eliminated or efficiently insulated to reduce the amount of heat transfer. Thermal bridging may occur at connection points between concrete or steel beams, external walls and columns and around doors and windows.
2. For all villas, thermal bridges can be avoided by increasing the efficiency of building envelope. The average thermal transmittance (U-value) for the building envelope must not exceed 0.40 $W/m^2K$.

## SIGNIFICANCE

The area of a building that has a significantly higher heat transfer than the surrounding materials is called a thermal bridge. These areas may either have a break in insulation or less insulation or penetrated by an element with a higher thermal conductivity. This heat leak will increase the heat flow rates and surface temperatures compared to unbridged structure.

Thermal bridges may increase the risk of condensation on internal surfaces and even cause interstitial condensation within walls and other building elements. Reducing thermal bridging leads to improved performance of building's envelope. This results in reduced energy consumption, lowered air conditioning requirements, less load on air conditioning equipment and better indoor thermal comfort.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Thermal bridging occurs when certain building elements enable the flow of heat from outside to inside of the building. Thermal bridges occur at the junctions between wall and floor, junctions between wall and roof, window and door reveals, holes in building envelope for pipes and cables, and connection points between concrete or steel beams. Thermal bridges may also occur where building elements penetrate through the fabric (around glazing) or where structure penetrates through the envelope (balconies). Poor design or poor workmanship can be responsible for thermal bridges.

Thermal bridges must be eliminated to reduce the amount of heat transfer. Thermal bridges may be avoided with a suitable structural composition and through adequate insulation. The most effective way to minimise the thermal bridges occurring where structural components penetrating the insulation layer is to thermally separate the exterior structure from the interior structure. Thermal insulation reduces the conductive heat flow through the building envelope and reduce the energy consumption associated with cooling.

Design elements of the insulation are critical for its performance. This include its location within walls and roofs, its sequencing with respect to other layers in assembly, its interface with surrounding or penetrating materials and the continuity within and between insulating components. Providing a continuous layer of thermal insulation covering the entire external wall (fig. 501.02(1)) is an efficient way to avoid thermal bridges.

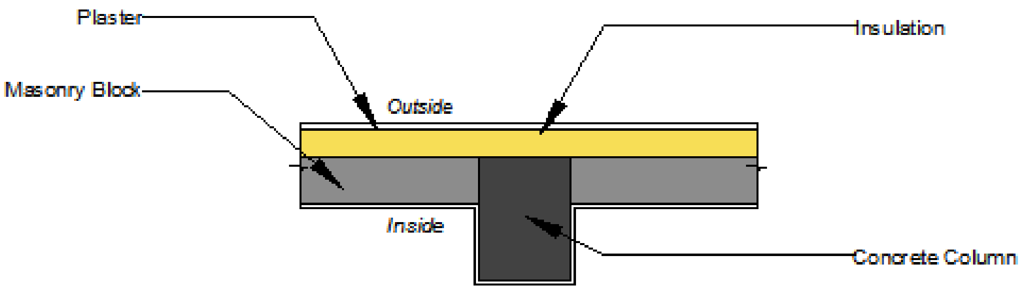



Fig. 501.02(1): Layout of Continuous Insulation

If continuous insulation cannot be provided, then all the areas where thermal bridges occur should be insulated individually (fig. 501.02(2)).

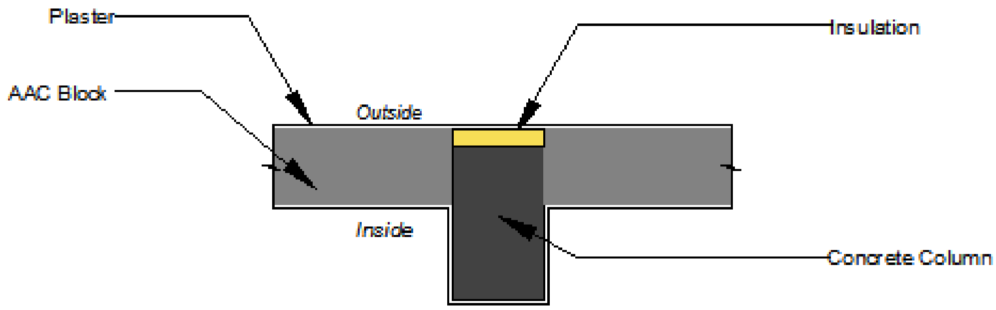



Fig. 501.02(2): Thermal Bridges with Local Thermal Insulation

Care should be taken when providing insulation to avoid thermal bridges. Proper reinforcement (i.e. welded net or wire mesh) should be provided for the external plastering, to avoid any cracks and degradation due to thermal shocks and humidity variations. The building fabric should be constructed such that, there are no readily avoidable thermal bridges in the insulation layers caused by gaps within the various elements at joints between elements and at the edges of elements, e.g. around door and window openings. The building fabric should be constructed to minimise air leakage through the thermal elements.

For villas, thermal bridges can be avoided by increasing the efficiency of building envelope. The average thermal transmittance (U-value) of the wall must not exceed 0.40 W/m²K. Weighted average U-value calculation conforming the average thermal transmittance (U-value) for the building envelope must be submitted. Weighted average U-value allows for trade-off the values between the various wall types. For instance, if the columns and beams are not well insulated, then the remaining portion of the wall must have better U-value to compensate the higher U-value of non-insulated column and beams. Project team can also consider increasing the wall insulation to attain an average wall U-value of 0.4 W/m²K.

Methodology for calculating the average U-value for a sample wall (fig. 501.02(3)) is shown below:

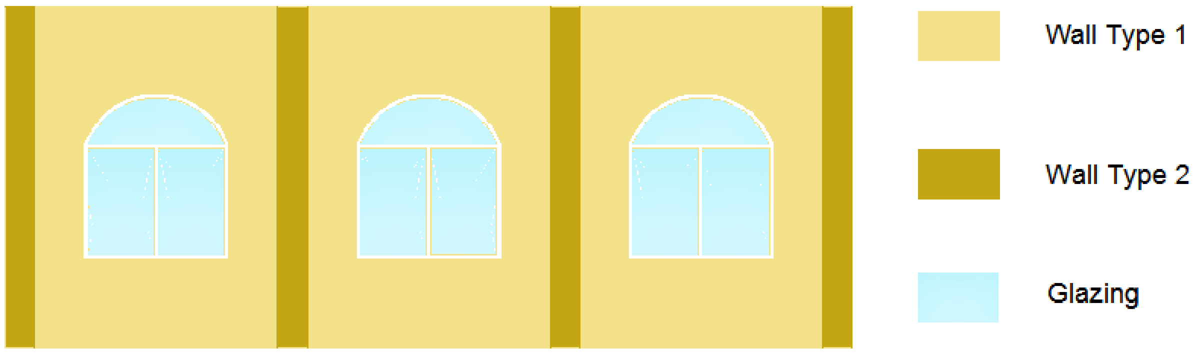



Fig. 501.02(3): Sample Wall Elevation

First, the R-equivalent of each wall type is computed. Based on which the U-value for each wall is calculated, as:

$$U = \frac{1}{R}$$

Then, Weighted Average U-value = $\dfrac{(A_1U_1) + (A_2U_2)}{(A_1+A_2)}$

Where,

R = Thermal Resistance in m²K/W

$A_1$ = External surface area of wall type 1 in m²

$A_2$ = External surface area of wall type 2 in m²

$U_1$ = U-value of wall type 1 in W/m²K

$U_2$ = U-value of wall type 2 in W/m²K

The material layers and thickness considered in the U-value calculator must be consistent with the architectural wall sections. The area of each type of external wall must be calculated and multiplied with those wall section U-value to calculate the heat transmittance of each wall type.

## COMPLIANCE DOCUMENTATION

**Table 501.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural section drawings for all connection points showing the elimination of thermal bridges or continuous insulation for all joints<br>2. Equivalent U-value calculation. |
| Construction Completion Application | 1. Final approved architectural section drawings for all connection points. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2003). Administrative Resolution No. (66) of 2003 Approving Regulations the Technical Specifications for Thermal Insulation System.

The Chartered Institution of Building Services Engineers. (2015). GVA/15 CIBSE Guide A: Environmental Design.

# 501.03 AIR CONDITIONING DESIGN PARAMETERS

Silver Sa'fa

## INTENT

To achieve better thermal comfort and energy efficiency in buildings.

## REQUIREMENT

1. For all new air conditioned buildings, heat load must be calculated in accordance with the following design parameters.
   A. Outdoor Condition of the Building

**Table 501.03 (1): Air conditioning Design Parameters (Outdoor Condition)**

| | |
|---|---|
| Dry Bulb Temperature | 46°C (115° F) |
| Wet Bulb Temperature | 29°C (85° F) |
| Dubai City Location Latitude | (North Latitude) 25° N |
| Extent of Variation in the temperature on the day of design (Outdoor Daily Range) | 13.8°C (25° F) |

   B. Indoor Condition of the Building

**Table 501.03 (2): Air conditioning Design Parameters (Indoor Condition)**

| | |
|---|---|
| Dry Bulb Temperature | 24°C (75° F) |
| Relative Humidity | 50 +/- 5% |

- The heat transfer coefficients used in the calculations for roofs, walls and glazed areas must be the actual design coefficients or as set out in *Regulation 501.01: Minimum Envelope Performance Requirements.*
- When diversity factors to be used in heat load calculations are not known, the coefficients indicated in the latest edition of ASHRAE Fundamentals guide can be used.

   C. The safety factor applied must be no greater than:

**Table 501.03 (3): Air conditioning Design Parameters (Safety Factor)**

| | |
|---|---|
| Sensible Heat | 10% |
| Latent Heat | 5% |

- Heat load calculations must be carried out for each air conditioned space, considering peak load incidence in that space. The calculations must be carried out using software registered with Dubai Municipality.

2. All new air conditioned buildings shall be provided with a fresh air system. The system must ensure that the building is provided with treated fresh air for at least 95% of the year. The design temperatures that needs to be considered, are as follows:
   i. Dry bulb temperature of 34° C (93° F)
   ii. Wet bulb temperature of 32° C (89° F)

## SIGNIFICANCE

Ventilation and air conditioning are vital for the thermal comfort and energy efficiency in a building. The design of the air conditioning and ventilation depends on the cooling (or heating) required. As climatic conditions play a significant role in the design of air conditioning, it is important to consider optimum design parameters while designing.

Heat load calculations must consider the climatic conditions of Dubai and the design parameters stated in this regulation. Applying these design parameter values ensure the building is designed efficiently while reducing energy consumption. It also ensures oversising of equipment is minimised thereby reducing capital expenditure. All this results in enhanced occupant's thermal comfort, while providing greater energy savings and efficient system performance.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The values of the parameters stated in this regulation are consistent with Dubai Municipality Administrative Resolution No. (66) of 2003. Applying these values would ensure that air conditioning equipment is not over-designed or under-designed, while ensuring the goal of thermal comfort and energy conservation is achieved. To maintain the required thermal comfort and to achieve the energy conservation, this regulation specifies the outdoor and indoor design parameters that considers peak climatic condition.

The expected heat load for each building space must be calculated using DM approved software and must be submitted to Dubai Municipality as part of the building permitting process. The results should indicate the input values considered, either as an input report or as a screenshot from the approved software (fig. 501.03(1)). Input values for other parameters like envelope thermal properties, indoor design temperature etc., should also be provided.

The heat load calculations must be computed for all air conditioning spaces in the building at peak load condition. Safety factors stated in this regulation should also be considered in the heat load calculations. If higher safety factors are selected by the project team, this would lead to overdesign and increase in equipment sizing, which should be avoided.

While computing the heat load, if the wall and roof sections are not yet calculated, then maximum thermal properties as stated in *Regulation 501.01: Minimum Envelope Performance Requirements*, may be considered for the heat load calculation.

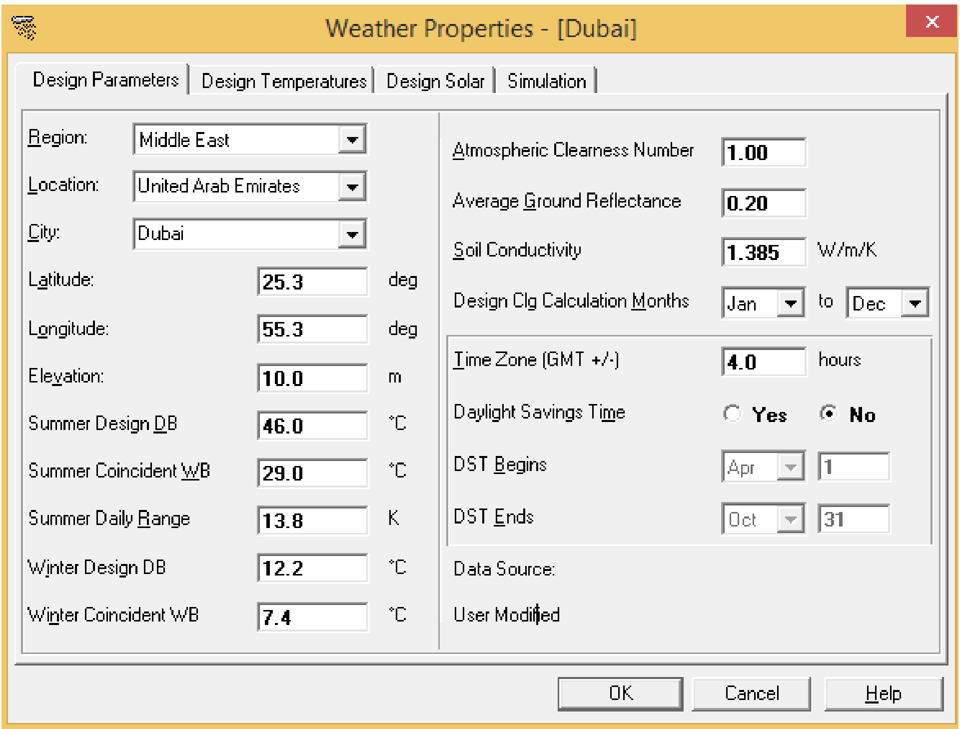


Fig. 501.03(1): Selection of Design Parameters in Heat Load Calculation

Fresh air flow as per *Regulation 401.01* must also be provided. Treated fresh air must be provided for at least 95% of the year. The fresh air handling unit must be designed with dry heat temperature of 34° C and humid heat temperature of 32° C. This ensures equipment oversising is avoided, as extreme hot climatic events are generally for a short duration.

## COMPLIANCE DOCUMENTATION

**Table 501.03(4): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Heat load analysis report indicating input parameters considered related to outdoor condition, indoor condition, diversity factor and safety factor<br>2. DM BLDG AC unit schedule. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2003). DM Administrative Resolution No. (66) of 2003 - Approving Regulations the Technical Specifications for Thermal Insulation System and Control of Energy Consumption for Air-Conditioned Buildings in the Emirate of Dubai.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook — Fundamentals, www.ashrae.org.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY: BUILDING ENVELOPE



## 501.04 AIR LOSS FROM ENTRANCES AND EXITS

Silver Sa'fa

### INTENT

To reduce wastage of energy and to maintain adequate thermal comfort.

### REQUIREMENT

For all new air conditioned buildings other than villas, loss of conditioned air in regularly used air conditioned entrance lobbies, must be mitigated by use of efficient barrier system.

### SIGNIFICANCE

Building entrances in many places like supermarkets, shopping centres, office and residential towers etc. (where the door opening frequency is high) plays a significant role in building's energy consumption. Heat transfer occurs when air enters through the entrances and mixes with conditioned air inside the building. Leakage of conditioned air through entrances adds to the energy wastage, and as a result, this requires additional energy to condition the inside air, thereby increasing the energy consumption.

Having an efficient barrier system at air conditioned building entrances not only reduces the energy losses but also helps maintaining adequate internal thermal comfort for building occupants. It can also act as a barrier for airborne dust, pollution, fumes and bad odours from entering into the building.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Many buildings have an entrance lobby (space immediately between the entrance door and the interior), which acts as a transition area into a building. Heat transfer occurring through the entrances may have a significant impact on energy consumption in a building. This regulation applies to all the buildings that have an entrance lobby and also to the main entrances in showrooms.

Efficient barrier systems should be provided to make sure that the conditioned air is not lost through the lobbies. Conditioned air loss can be minimised with an efficient door design that considers door's function, location and traffic. There are several door design techniques available. The project can incorporate either one or combination of techniques to meet the compliance. Some of them are given below.

1. Revolving doors (fig. 501.04(1)): They efficiently handle bi-directional traffic and reduce energy costs by maintaining an airlock. Also, they improve occupant comfort and offer more usable space at the building entrances compared with similar barrier techniques and are noiseless.

Fig. 501.04(1): Revolving Door

2. Air curtains: An air curtain (fig. 501.04(2)) is a product that creates uniform stream of directed air, across an opening to create an efficient barrier that inhibits transfer of heat and particulate matter from one zone to other. They operate when the door is open. They can be integrated with the existing ventilation system. Air curtains are especially effective in areas where doors are left open for long periods and for entrances which have to be kept open for operational purposes.

Fig. 501.04(2): Air Curtains

3. Double door vestibules: An enclosed double door vestibule (in fig. 501.04(2)) with doors opening into and out of the vestibule with self-closing devices could be another efficient way of controlling air loss from the building entrances. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors don't open at the same time. Interiors and exterior doors in the closed position shall have a minimum distance of not less than 1.2m.

Apart from the above, any other doors with efficient barrier system could be designed which is approved by Dubai Municipality.

While designing the doors, it is important to adhere to Dubai Civil Defence requirements for those doors that are used to exit the building in the event of fire. This regulation does not replace or supersede any fire egress requirements and additional doors that may be required to meet these needs. Additional doors may be required to provide enabled access.

ASHRAE 90.1 (Section 5.4.3.2) provides information on the air leakage rate for entrance doors, which can be used as guidance for door designs.

## COMPLIANCE DOCUMENTATION

**Table 501.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Floor plans highlighting entrances and exists design and details of proposed air barrier systems. |
| Construction Completion Application | 1. Final approved layout highlighting details of proposed air barrier systems. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings.

Air Movement and Control Association International, Inc. (2017). AMCA 222-16: Application Manual for Air Curtains.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY: BUILDING ENVELOPE



## 501.05 AIR LEAKAGE

Silver Sa'fa

### INTENT

To save energy and to provide better thermal comfort for the building occupants by controlling air leakages in building.

### REQUIREMENT

All new air conditioned buildings with a cooling load of 1 MW or greater must be tested to demonstrate that air leakage does not exceed 10 $m^3/hr/m^2$ into or out of the building, at an applied pressure difference of 50 Pa.

Testing must be carried out in accordance with the methodology approved by Dubai Municipality (DM).

For Golden and Platinum Sa'fa, whatever the required cooling load, air leakage test shall be conducted by following the previously specified values.

### SIGNIFICANCE

Air leakage or air infiltration is the unintentional, uncontrolled flow of air into the building. This may happen due to gaps or cracks in the building envelope that are not easily visible. Leaks in building fabric occur for a number of reasons like structural stress, poor workmanship and components and misalignment of designed building elements.

Due to air leakage energy is wasted. Whenever there is infiltration of air, there is corresponding exfiltration elsewhere in the building. While conditioned air is lost on one hand, additional energy is required for cooling the air to compensate lost volume of air. Air leakage also affects the building's performance and occupant comfort.

Controlling air leakage is important to reduce energy bills, reduced condensation, reduce the chance of mold and rot (because moisture is less likely to enter), better performing ventilation system and optimum sizing of cooling equipment.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Air leakages can be in several places of a building. Some of the common air leakage paths are: gaps in and around floors, leaky doors, pathways through floor/ceiling voids and then to the outside, gaps around windows, gaps at the ceiling to wall joint at the eaves, service penetrations through ceilings, vents penetrating the ceiling or floor, bathroom wall vents or extract fans, gaps around bathroom waste pipes, kitchen wall vents or extractor fan, gaps around kitchen waste pipes, gaps around floor to wall joints and gaps in/around electrical fittings.

The use of high quality materials and construction techniques will reduce air leakages. Preventive measures should be taken while construction to avoid air leakages. During construction, care should be taken to make sure there are no gaps in exterior building envelope or between conditioned and unconditioned spaces.

All air barrier components in the building envelope assembly should be clearly identified in construction documents. Design of joints, interconnections and penetrations should be simplified. Construction details should be easy to follow. Where penetration is inevitable, proper sealing should be provided to ensure air leakage is minimised. All external doors and openable windows must be sealed or caulked or gasketed in line with *Regulation 401.08: Sealing of doors and windows*.

Assessment of building envelope air leakage involves establishing a pressure differential across the envelope and measuring the air flow required to achieve that differential. This is normally achieved by utilising variable air flow portable fans which are temporarily installed in doorway or at suitable external opening (as shown in fig. 501.05(1)).

Fig. 501.05(1): Air Leakage Testing

Primary components for a air leakage test are : calibrated variable speed fan, a pressure measurement instrument called a manometer and a mounting system. The variable speed fan should be capable of inducing a range of airflows sufficient to pressurise and depressurise a variety of building sizes. The manometer should simultaneously measure the pressure differential induced across the face of the fan and across the building envelope as a result of fan airflow.

All air conditioning equipment and ventilation units must be switched off and temporarily sealed before test. Doors and windows on the exterior of the air test envelope should be closed and all internal doors must be kept open to allow pressure to equalise fully around the enclosure. Drainage traps in toilets, sinks, showers and wet rooms must be filled with water.

Electrical sockets, downlights, access panels and shower trays should not be sealed during testing. Compartmentalised buildings which are divided into separate units having no internal openings to link them such as residential buildings, may have difficulties to carryout whole building pressurisation tests. In such cases, separate pressurisation tests should be carried out on each self-contained compartment. For high rise building, if it is difficult to achieve equal pressure across the whole building, multiple fans at different points within the building can be used. Lifts or riser shafts could be used by opening of doors at various levels, to ensure equal pressure is achieved in the building. Adequate safety precautions must be followed for carrying out air leakage tests.

It is recommended that site inspections should be carried out at the completion of building envelope and at MEP fit-out stages. Any identified issues and rectification work carried out, should be recorded in the final air tightness test report. For multiple villa complex and apartments with multiple dwelling units, testing a single representative unit at first can help to identify any leakage and highlight areas where additional sealing is likely to be required for other units. Project team can use these test results to improve the construction process so that the remaining units can pass the test.

Guidance on testing are available in ASTM E779-03, CIBSE TM 23 and ATTMA TSL1 & TSL2 standards. Testing must be carried out in accordance with these standards.

## COMPLIANCE DOCUMENTATION

**Table 501.05(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Air leakage test report (must include executive summary, test procedures, equipment list, test locations, test dates and test results & calibration certificate). |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

The Air Tightness and Measuring Association. (2016). Technical Standard L1: Measuring Air Permeability in the Envelopes of Dwellings.

The Chartered Institution of Building Services Engineers. (2000). ATM23: Testing Buildings for Air Leakage.

ASTM International. (2019). ASTM E779-19, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY: BUILDING ENVELOPE



## 501.06 SHADE EFFECT CALCULATIONS

Silver Sa'fa

### INTENT

Use of external shading structures to reduce building heat gain and cooling requirements.

### REQUIREMENT

For all new buildings other than villas, the impact of external shade factors on the building's thermal load must be calculated.

### SIGNIFICANCE

Shading is one of the passive design strategies utilised to make a building energy efficient. Shading devices aid in reducing building heat gain and cooling requirements while improving occupant's visual comfort by controlling glare. Shading devices can also enhance building facades making them aesthetically unique.

Providing shading for external windows is one of the most commonly adopted strategies to reduce solar heat gain inside the building. Other strategies include provision of awnings, roof overhangs, shutters, solar screens etc. Optimisation of equipment selection and reduction in energy consumption can be achieved by including the external shade factors while calculating the heat load for a building. If shading elements are not included for the heat load calculations, the building would be overdesigned and operate inefficiently.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The most effective way to reduce the direct solar heat gain in any building is to intercept it before it reaches to glazing system by the use of external shading elements (fig. 501.06(1)). The addition of an external shading element like an overhang or fin can reduce the amount of solar radiation that reaches a window.

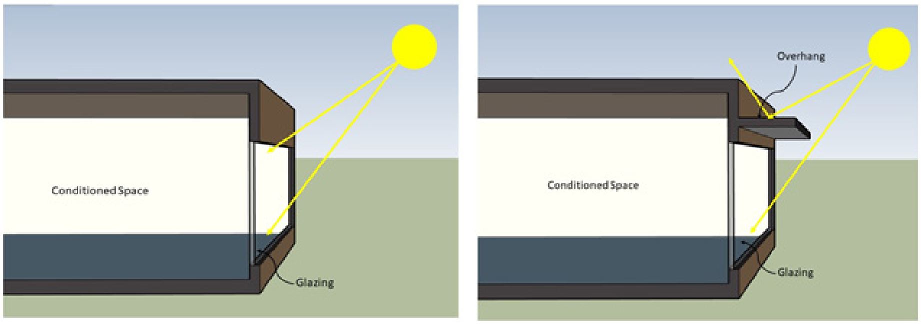



Fig. 501.06(1): Effect of Shading

Hence, this regulation intends the project team to consider all applicable external shading elements such as roof overhangs, architectural projections, balcony, awning and outdoor louvers etc. while calculating the peak thermal load of the building. The properties of the external shading structures should be considered for thermal load calculation.

An overhang is a horizontal projection from a building façade above the window (fig. 501.06(2)). Providing horizontal shade on the south direction of the building is more effective. The input of projection from surface defines the distance between the wall and the outer edge of the overhang measured perpendicular to the building surface. Height above window defines the distance between the top edge of the window aperture and the bottom edge of overhang.

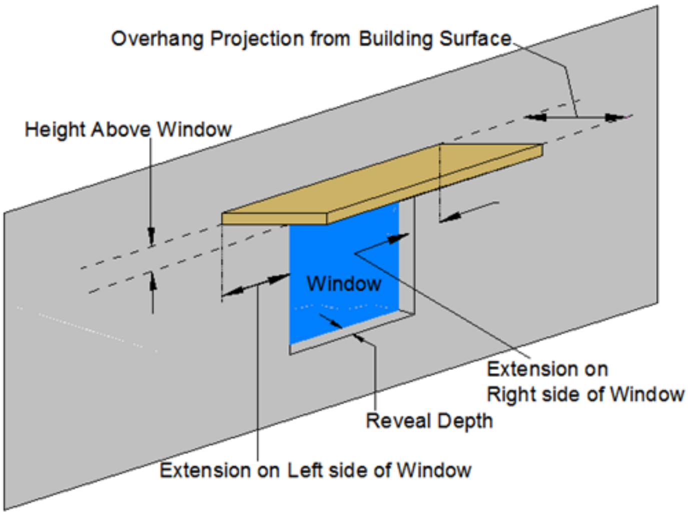



Fig. 501.06(2): Overhang or Horizontal Projection

A fin is a vertical projection from the building surface to the right and/or left of the window (fig. 501.06(3)). The vertical projection for window is more effective on the east and west direction of the building due to the movement of sun.

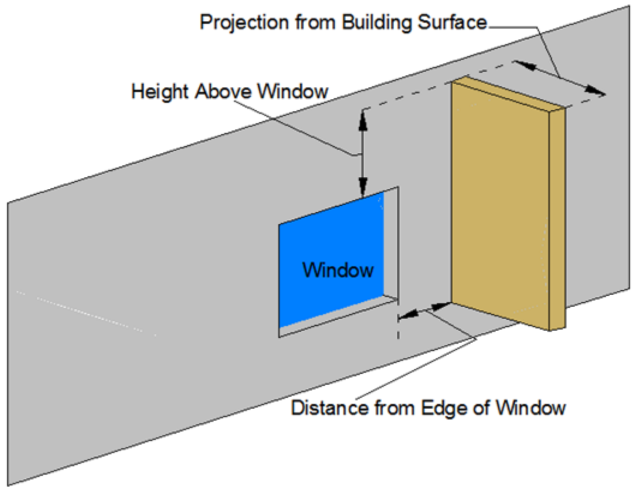



Fig. 501.06(3): Fins or Vertical Projection

The expected heat load for each building must be calculated and the computed results must be submitted to Dubai Municipality as part of the building permitting process. Report should indicate the values of input parameters considered for external shading (fig. 501.06(4)). Shading geometry form is used to define the dimensions of reveal, an overhang or horizontal shade, a right hand fin and a left hand fin or vertical shade, which externally shades the window.

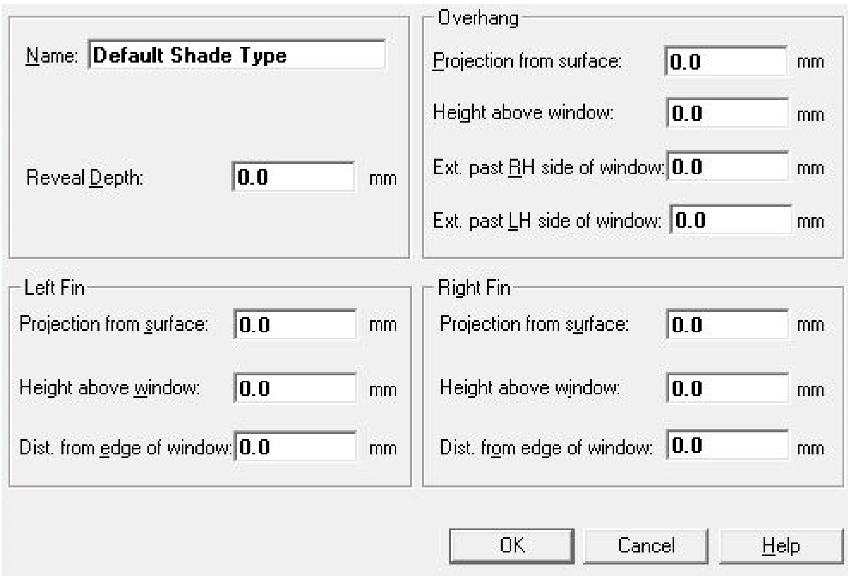



Fig. 501.06(4): Shading Input Section in Heat Load Calculation

## COMPLIANCE DOCUMENTATION

**Table 501.06(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Inclusion of shade into the thermal load calculation. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook— Fundamentals, Chapter 15, Fenestration. www.ashrae.org.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.01 ENERGY EFFICIENCY – HVAC EQUIPMENT AND SYSTEMS

Silver Sa'fa

### INTENT

To improve energy efficiency in buildings and to reduce environmental impacts.

### REQUIREMENT

For all new air conditioned buildings, heating, ventilating and air conditioning equipment and systems must comply with the minimum energy efficiency requirements and test procedures approved by Emirates Authority for Standardization & Metrology (ESMA), as indicated below:

1. Latest edition of UAE.S 5010 -1: Labelling- Energy efficiency label for electrical appliances, Part 1: household air conditioner.

   For Golden Sa'fa: Minimum star rating of 4

   For Platinum Sa'fa: Minimum star rating of 5

2. Latest edition of UAE.S 5010 -5: Labelling – Energy efficiency label for electrical appliances, Part 5: Commercial and central air conditioners:

   - Table-1: Split and packaged unit including cassette type unit
   - Table 4: Multiple split unit.

   For Golden and Platinum Sa'fa: Minimum efficiency shall be at least 10% higher than the efficiencies specified in the tables or the units must be of variable flow type.

3. Latest edition of UAE.S 5010 -5: Labelling- Energy efficiency label for electrical appliances, Part 5: Commercial and central air conditioners:

   - Table-2: Water source heat pumps

4. For Chillers – Minimum efficiency requirements and test procedures as listed in Table 502.01 (1):

**Table 502.01 (1): Minimum Efficiency Requirements for Chillers**

| Chillers Equipment Type | Size Category | Minimum Efficiency (T1) | Minimum Efficiency (T3) | Test Procedure |
|---|---|---|---|---|
| Air cooled, with condenser, electrically operated | All capacities | 2.8 COP<br>3.05 IPLV | 1.9 COP | T1-ARI 550/590<br>T3-ISO 5151 |
| Air cooled, without condenser, electrically operated | All capacities | 3.1 COP<br>3.45 IPLV | 2.1 COP | |
| Water cooled, electrically operated, positive displacement (reciprocating) | All capacities | 4.2 COP<br>5.05 IPLV | 2.75 COP | T1-ARI 550/590<br>T3-ISO 5151 |
| Water cooled, electrically operated, positive displacement (rotary screw and scroll) | <150 tons | 4.45 COP | 2.9 COP | T1-ARI 550/590<br>T3-ISO 5151 |
| | >=150 tons and <300 tons | 4.9 COP | 3.2 COP | |
| | >= 300 tons | 5.6 COP | 3.6 COP | |
| Water cooled, electrically operated, centrifugal | <150 tons | 6.0 COP | | T1-ARI 550/590 |
| | >=150 tons and <300 tons | 6.5 COP<br>7.1 IPLV | | |
| | >= 300 tons | 6.5 COP<br>7.68 IPLV | | |
| Air cooled absorption single effect | All capacities | 0.7 COP | | ARI 560 |
| Water cooled absorption single effect | All capacities | 0.7 COP | | |
| Absorption double effect indirect-fired | All capacities | 1.1 COP<br>1.1 IPLV | | |
| Absorption double effect direct-fired | All capacities | 1.2 COP<br>1.2 IPLV | | |

- The chiller equipment requirements apply to all chillers, including where the design leaving fluid temperature is < 4.5° C.

## SIGNIFICANCE

HVAC systems are the main energy consuming sources in a building. Selection of energy efficient system not only reduces energy consumption but also increases overall lifespan of the equipment. Further this leads to operating cost savings, faster payback periods and reduced environmental pollution.

The energy efficiency standardization and labelling (EESL) program encourage the manufacturers to develop new technologies for higher efficiency levels and it continuously raises the efficiency bar of the appliances.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The Energy Efficiency Standardization and Labelling (EESL) program is an energy conservation initiative in the United Arab Emirates. This is implemented and maintained by Emirates Authority for Standardization & Metrology, also known as ESMA.

The program focuses developing and implementing Minimum Energy Performance Standards (MEPS) and Comparative Labelling Scheme on electricity and water consumption for electrical appliances used in the UAE.

This regulation requires the HVAC equipment and systems to comply with the minimum energy efficiency requirements and test procedures as set forth by ESMA as mentioned below.

**Household air conditioners**

Household air conditioning units including non-ducted package units and split-units, must meet at least the minimum energy efficiency requirement (Energy Efficiency Ratio (EER)) as per the latest edition of ESMA UAE.S 5010 - 1: Energy efficiency label for electrical appliances, Part 1: household air conditioner for all buildings. For Golden Sa'fa a minimum 4-star rating and for Platinum Sa'fa a minimum 5-star rating are required.

The star rating is achieved for the air conditioning units based on the performed Energy Efficiency Ratio (EER) at T3 condition.

Energy efficient label is a sticker (as shown in fig 502.01(1)) to be placed on electrical appliances which contain important information about the level of energy consumption of the device.

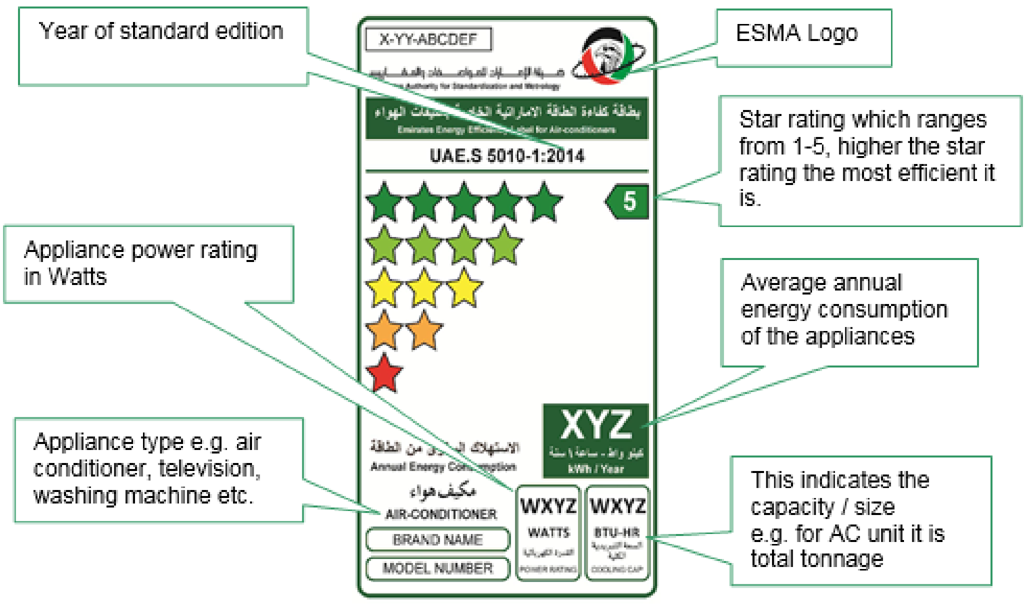



Fig. 502.01(1): The ESMA Energy Efficiency Label

**Commercial and central air conditioners**

Commercial and central air conditioners must meet the minimum energy efficiency requirement (Energy Efficiency Ratio (EER)) as per the latest edition of ESMA UAE.S 5010 - 5: Labelling – Energy efficiency label for electrical appliances, Part 5: Commercial and central air conditioners for all buildings. Golden and Platinum Sa'fa buildings require 10% higher energy efficiency as indicated in Table 502.01 (2).

**Table 502.01 (2): Minimum Energy Star Requirements**

| Equipment Type | Minimum Energy Efficiency (EER) (Btu.h/W) @T3 Condition | For Golden Sa'fa and Platinum Sa'fa |
|---|---|---|
| Split and packaged unit including cassette type unit | As per Table 1 of UAE.S 5010 -5 | 10% higher than the minimum energy efficiency value |
| Multiple split unit | As per Table 4 of UAE.S 5010-5 | 10% higher than the minimum energy efficiency value |

### Water Source Heat Pump

Water source heat pump must meet the minimum energy efficiency requirement (Energy Efficiency Rating (EER)) as per the latest edition of ESMA UAE.S 5010 - 5: Labelling – Energy efficiency label for electrical appliances, Part 5: Commercial and central air conditioners, Table 2 for all buildings.

### Chillers

Chillers must comply with minimum energy efficiency requirements as specified in Table 502.01(1). Appropriate testing procedures must be followed as per chiller types to determine the energy efficiency values on either T1 or T3 temperature conditions.

The T1, T2 and T3 temperature conditions specified in the table 502.01(3) as per AHRI shall be considered for the determination of cooling capacity and energy efficiency.

**Table 502.01 (3): Climatic Conditions (as per AHRI)**

| Equipment Type | T1 (Moderate Climates) | T2 (Cool Climates) | T3 (Hot Climates) |
|---|---|---|---|
| Indoor conditions | 27° C DB, 19° C WB | 21° C DB, 15° C WB | 29° C DB, 19° C WB |
| Outdoor conditions | 35° C DB, 24° C WB | 27° C DB, 19° C WB | 46° C DB, 24° C WB |

As part of design permit application, the project team must provide the complete building equipment details in the AC unit schedule form, including the quantity, equipment type, location, capacity and energy performance (COP/ EER/ Energy Star).

## COMPLIANCE DOCUMENTATION

**Table 502.01(4) - Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. AC equipment manufacturer data highlighting the efficiency (COP/EER/IPLV) and star rating.<br>2. Final approved layout of air conditioning.<br>3. Delivery notes of equipment. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Emirates Authority for Standardization & Metrology. (2016). UAE.S 5010- 1: Labeling - Energy efficiency label for electrical appliances, Part 1: Household Air Conditioners.

Emirates Authority for Standardization & Metrology. (2016). UAE.S 5010- 5: Labeling - Energy efficiency label for electrical appliances, Part 5: Commercial and Central Air Conditioners.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS

500

## 502.02 DEMAND CONTROL VENTILATION

Silver Sa'fa

### INTENT

To promote energy savings in buildings and improve their indoor air quality.

### REQUIREMENT

For all new air conditioned buildings with mechanical ventilation and existing buildings where alteration, changes, modification, expansion or restoration are carried out, Demand Controlled Ventilation (DCV) using Carbon Dioxide ($CO_2$) sensing or by other means to measure occupancy, must be used in spaces larger than 100 m² and having a maximum design occupancy density greater than or equal to 25 people per 100 m². Default occupancy density values from the latest edition of ASHRAE standard 62.1 and 62.2, can be used when the actual occupancy is not known.

$CO_2$ concentration set-point should be kept below 800 ppm.

An alarm must be triggered if $CO_2$ concentration rises above 1,000 ppm. This alarm can either be automatically monitored by a central control system, if available, or give a local audible or visual indication, when activated.

For all new and existing buildings with DCV, the $CO_2$ sensors and systems must be checked and recalibrated as per manufacturer recommendations. Recalibration frequency must not exceed 12 months and must be carried out by specialised companies.

### SIGNIFICANCE

While HVAC systems are designed to cater for maximum occupancy, it is not always possible that maximum occupancy levels are reached. For example, spaces like meeting rooms or lecture halls in educational facilities sometimes may not reach the maximum designed occupancy levels. This may lead to excessive use of HVAC and increased bills. Ventilation could be reduced during the hours of operation when spaces are vacant or at less than the peak occupancy.

Demand control Ventilation (DCV) is an integral part of building's ventilation system. DCV is a real time, occupancy based ventilation approach that can offer significant energy savings particularly where occupancy is intermittent or variable from design conditions. Properly applied DCV allows for maintenance of target per-person ventilation rates at all times. High thermal comfort and satisfactory indoor air quality are some of the other benefits of DCV.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

To comply with this regulation, project teams must incorporate DCV using Carbon Dioxide ($CO_2$) sensing or by other means to measure occupancy in all densely occupied spaces with the following criteria:

- Building space is larger than 100 $m^2$
- Occupant density of that space has more than 25 people / 100 $m^2$

Examples for spaces that are typically considered densely occupied are: conference room, meeting room, lecture hall, ballroom, retail establishment, break room, cafeteria, sport facility, prayer hall, health club etc.

Space carbon dioxide ($CO_2$) sensing is the most common method in demand control ventilation. With $CO_2$ sensor in a DCV system, the ventilation rate differs in line with the number of people in the space. People breathe out $CO_2$, and hence the more people in the space and the sensor increases the ventilation rate.

Design ventilation rates are determined by including both the area and people ventilation rates from ASHRAE Standard 62.1/62.2. Design ventilation rates also consider the peak occupancy rate for that space. Minimum outdoor air rate in accordance with area component of ASHRAE Standard 62.1/62.2, must be supplied for the space.

In a HVAC system, the important elements of a $CO_2$ based DCV system are:

- $CO_2$ sensor – monitors the concentration of $CO_2$
- Ventilation flow logic controller – receives signal from sensor, determines the quantity of outdoor air required and triggers the ventilation system accordingly.
- Conventional ventilation system, usually an air distribution system – incorporates dampers to regulate the amount of outdoor air as per the command received from ventilation flow logic controller.

$CO_2$ sensors should be positioned in the room between 1m and 1.8m above the floor, to most accurately determine the quality of the air breathed by the occupants (breathing zone). Alternatively, the sensor may be installed in the return air duct of the monitored room. $CO_2$ concentration set-point should be kept below 800 ppm. $CO_2$ sensors will determine the occupancy levels in the space and then the sensor further sends signal to the ventilation system through the controller to increase the ventilation from area rate to either full rate or a rate between area rate and full rate. Whenever $CO_2$ levels rises above 1000 ppm, an alarm must be triggered. This alarm can either be automatically monitored by a central control system, if available, or give a local audible or visual indication when activated. The ventilation system should not be shut down when the alarm is activated.

DCV systems using $CO_2$ sensors is most effective if the spaces are served by single zone system (as shown in fig. 502.02(1) and fig. 502.02(2)). If it is served by multiple zone systems, it would require integration with central control and monitoring system (CCMS). This would dynamically check $CO_2$ concentrations based on individual zone airflow rates and design occupancy on a periodic basis.

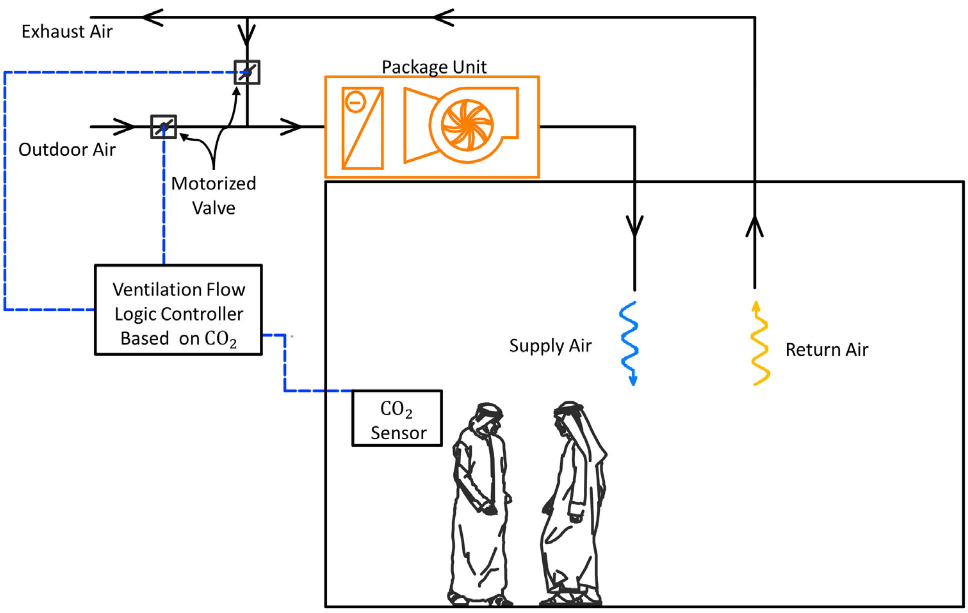



Fig. 502.02(1): Schematic For $CO_2$ based DCV System for Package Unit (Wall Mounted)

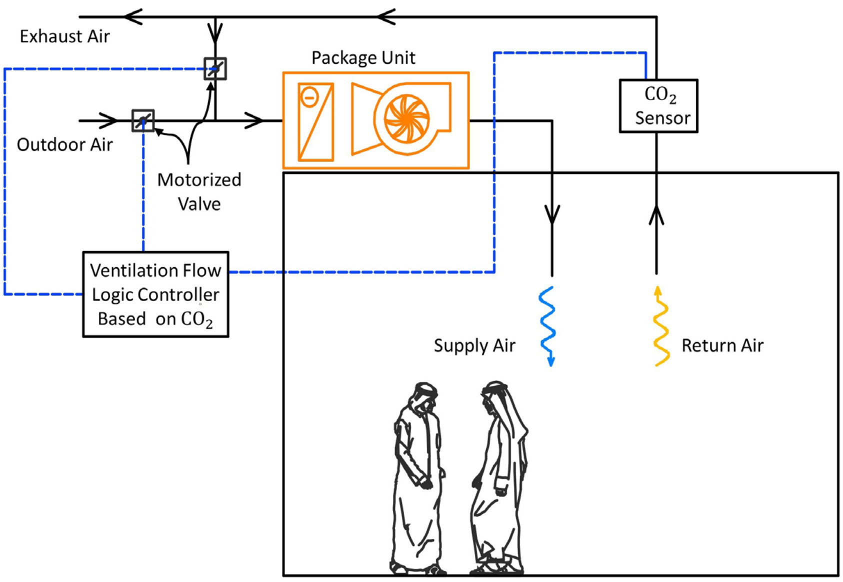



Fig. 502.02(2): Schematic For $CO_2$ based DCV System for Package Unit (Duct Mounted)

$CO_2$ sensors and related systems must be checked and re-calibrated as per manufacturer recommendations. Recalibration frequency must not exceed 12 months and must be carried out by specialised companies.

## COMPLIANCE DOCUMENTATION

**Table 502.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Drawings highlighting rooms that exceeds the criteria of area greater than 100 m² and density greater than or equal to 25 People / 100 m².<br>2. $CO_2$ sensor location layout.<br>3. DM BLDG AC unit schedule. |
| Construction Completion Application | 1. Final approved layout indicating the location of $CO_2$ sensor.<br>2. $CO_2$ sensor manufacturer data-sheet.<br>3. $CO_2$ sensor delivery notes. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1: Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1 User's Manual: Based on Standard 62.1-2016, Ventilation for Acceptable Indoor Air Quality, www.ashrae.org.

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 62.1-2016 for Ventilation for Acceptable Indoor Air Quality.

Stanke, Dennis. (2010). Dynamic Reset for Multiple-Zone Systems. ASHRAE Journal, Vol. 52, No.3.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.03 ELEVATORS AND ESCALATORS

Silver Sa'fa

### INTENT

To promote energy savings in vertical transportation systems with the use of efficient drive technologies and controls.

### REQUIREMENT

1. Escalators:

   For all new buildings, escalators must be fitted with controls to reduce speed or to stop when no traffic is detected. Escalators shall be designed with energy saving features as described below:

   a. Reduced speed control: The escalator shall reduce to a slower speed when no activity has been detected for a maximum period of 3 minutes. Detection shall be by photocell activation, placed at the top and bottom landing areas.

   b. Use on demand: The escalator shall shut down when no activity has been detected for a maximum period of 15 minutes. Use of on-demand escalators must be designed with energy efficient soft start technology. The escalator shall start automatically when required. Detection shall be by photocell activation, placed at the top and bottom landing areas.

3. Elevators (lifts):

   For all new buildings, elevators (lifts) must be provided with controls to reduce the energy demand. The following features must be incorporated in traction drive elevators:

   a. Use of AC Variable-Voltage and Variable-Frequency (VVVF) drives on non-hydraulic elevators.

   b. Energy efficient lighting inside the elevator, including controls to turn lights off when the elevator has been inactive for a maximum period of 5 minutes.

### SIGNIFICANCE

Having an efficient vertical transportation system is an important aspect of building design. Traditional elevators and escalators are generally inefficient and have higher energy consumption levels. Since, elevator and escalator usage represent a significant proportion of a building's electrical load, selecting energy efficient elevators and escalators have a significant impact on total energy consumption.

By incorporating software-based control strategies and usage of energy efficient hardware such as regenerative drives, elevators and escalators can be made energy efficient. Energy efficient elevators also have non-energy benefits like smoother, quieter and faster rides, shorter wait-time and lower service costs.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

An energy efficient practice for escalators is to incorporate speed control systems that reduce speed or stop when no traffic is detected. Use of efficient motor drive control systems like two-speed motor or a variable-voltage variable-frequency (VVVF) converter, not only reduce the speed but also provide improved energy savings. Sensors shall be used to detect the traffic movement in escalators, which relays the information to control systems to reduce the speed.

Escalator speed shall be reduced when no activity has been detected for a maximum period of 3 minutes. During this period, escalator will run on pre-set standby speed and change to full rated speed only when the passenger movement is detected. If no activity is detected for a maximum period of 15 minutes, the escalator shall shut down fully. Escalator shall re-start automatically when sensors detect any activity (fig. 502.03(1)). On-demand system must be designed with soft start technologies that deliver only the required power to meet the current load. Soft starters are also recommended to reduce the sudden impact on the motor while starting and wear and tear of mechanical components associated with it.

Fig. 502.03(1): Sensor Range in an Escalator

Elevators must also be provided with controls that reduce the energy demand. For non-hydraulic elevators, AC Variable-Voltage and Variable-Frequency (VVVF) drives must be used. This eliminates start/stop disturbance, provides smooth acceleration and deceleration, has excellent speed control and reduces noise levels and wear and tear.

Illumination inside elevator can be achieved through energy efficient LED lamps (fig. 502.03(2)). Lighting control strategy shall be employed to switch off lights when the elevator is inactive for a maximum period of 5 minutes.

Fig. 502.03(2): LED Lightings in Elevator

Though this regulation focuses on some of the energy saving technologies, additional energy saving systems can also be considered when designing the vertical transportation systems. Additional strategies that can be considered to reduce energy consumption in elevators include:

- Incorporate destination dispatch systems for elevators wherein passengers are grouped together for the same destination (fig. 502.03(3)). This significantly reduces user wait-time, increases handling capacity, number of stops and decreases the amount of energy wasted.


Fig. 502.03(3): Destination Dispatch System for Elevator

- Incorporate regenerative drive systems. In conventional elevator system, energy generated during the movement is dissipated as heat using heat resistors. Traction energy loss and heat dissipation result in additional energy requirements to cool the mechanical rooms. This makes the entire system non-efficient compared to a regenerative system. Traction lift running in regenerative mode act as power generator based on the lift load while going upward with light load or downward direction with heavy load. Regenerative converters generate and transmit the power to the distribution transformer and supply back to the utility grid. Designers may include the regenerative technologies during elevator design to considerably reduce the energy demand of the vertical transportation.
- Incorporate LED lamps for floor indicators, call buttons and directional arrows. LED lamps provide better energy savings.
- Incorporate more advanced motors like Permanent Magnet Synchronous Motors (PMSM) and Linear Induction Motors (LIM) that require less maintenance than conventional motors. Smart technologies in controllers and sensors like programmable logic controllers (PLC) and microprocessor-based systems can be integrated into the operational side of the vertical transport to minimise waiting time, handling capacity and overall energy consumption.

## COMPLIANCE DOCUMENTATION

**Table 502.03(1) - Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Elevator/Escalator manufacturer technical data-sheet.<br>2. Elevator/Escalator delivery notes. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers. (2015). GVD/15 CIBSE Guide D: Transportation Systems in Buildings.

The Association of German Engineers (VDI). (2013). VDI-Standard: VDI 4707 Part 2 - Lift: Energy efficiency of components.

## 502.04 LIGHTING POWER DENSITY – INTERIOR

Silver Sa'fa

### INTENT

To save energy with the use of energy efficient light fittings for all interior spaces.

### REQUIREMENT

For new buildings, the average Lighting Power Density for the interior connected lighting load must not exceed the values given in Table 502.04 (1).

**Table 502.04(1): Interior Lighting Power Density**

| Building Type | Maximum average (W/m²) across total building area |
|---|---|
| Commercial/Public: Offices, Hotels, Resorts, Restaurants | 10 |
| Educational Facilities | 12 |
| Manufacturing Facilities | 13 |
| Retail Outlets, Shopping Malls, Workshops | 14 |
| Warehouses | 8 |

Lighting Power Density values for the building types not listed in Table 502.04 (1), shall not exceed the values indicated in the latest edition of ASHRAE Standards 90.1 and 90.2 or equivalent as approved by DEWA.

### SIGNIFICANCE

Lighting is an important aspect of building design that enhances the aesthetic appeal and ambience of a living space. It is a vital factor that contributes to the total energy demand in a building. Building's cooling load is also affected by heat generation from interior light fittings. Energy wasted due to excessive lighting design has detrimental effect on the environment and also on energy cost.

By following the maximum average lighting power density values for various building types, electrical energy to provide adequate lighting is restricted, thereby encouraging the use of energy efficient lamps and luminaries resulting in significant energy savings and cooling load reduction.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

As per this regulation, the maximum allowable lighting power density for interior light fittings is restricted. This is to promote variety of efficient light fixtures to be used in various areas.

The counting of the number of interior lighting fixtures and their electricity consumption would give the lighting load in a building. While calculating the lighting load the electrical energy used by the controls and ballasts must also be included. The total energy load is then applied to the gross floor area of the building to give the average lighting power density.

Emergency lighting that is switched off during normal building operation, the lighting that is required by a health or safety regulation and lighting specifically required for specialised equipment or in a medical facility are the exceptions for this regulation.

The maximum lighting power density can be easily achieved by optimising the lux level requirement for each of the spaces based on their activities and by incorporating energy efficient lighting that produces high lumens per watt.

The possible strategies to reduce lighting energy consumption in a building include: minimum possible power density, use of light sources with high luminous efficacy, use of lighting control systems and utilisation of daylight. Also, it is important to remember that the quality of light must be maintained when installed power for lighting is reduced. Selection of lamps has a major impact on the energy usage and hence adequate care must be taken in their selection.

The requirements stated in *Regulation 502.06: Lighting Controls*, must be taken into consideration while designing the interior lightings for the buildings.

### Case Study

Consider an office building having open office, meeting room and manager cabin (fig. 502.04(1)). The lighting plan indicates the number of light fittings for each space and its type. Calculated design LPD values are shown in Table 502.04 (2).

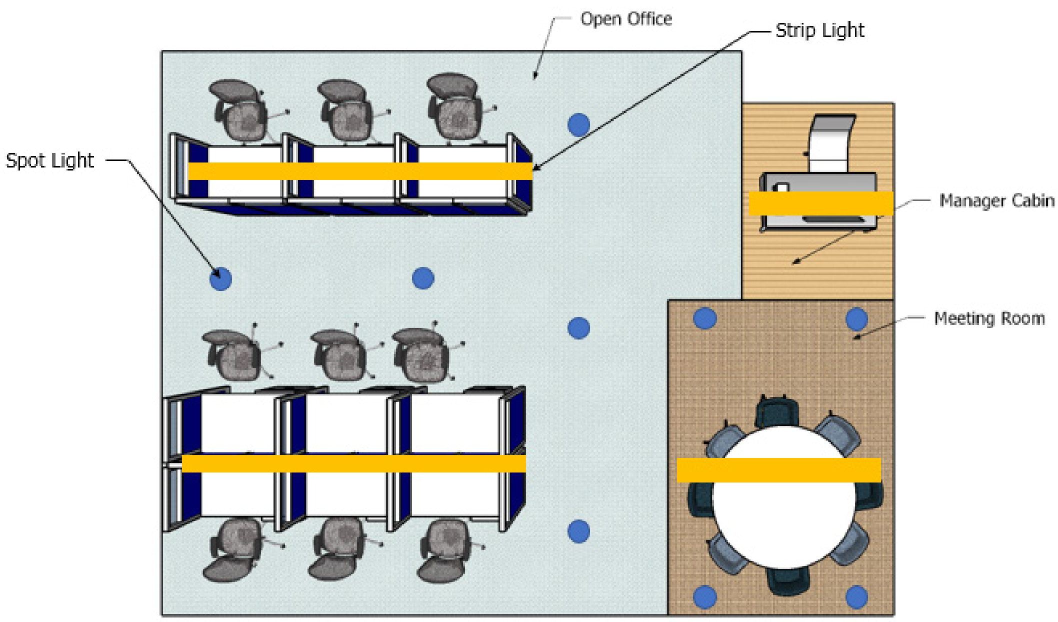



Fig. 502.04(1): Interior Lighting Layout

**Table 502.04(2): Interior Lighting Power Density Calculation**

| Sl. No | Name of the Spaces | Area ($m^2$) | Light Fitting Model | Lighting Fixture (W) | No. of Fixtures | Total Power (W) | | Total LPD ($W/m^2$) |
|---|---|---|---|---|---|---|---|---|
| 1 | Open Office | 60 | Linear Light | 60 | 2 | 120 | 270 | 5.33 |
| | | | Spot Light | 30 | 5 | 150 | | |
| 2 | Manager Cabin | 10 | Linear Light | 40 | 1 | 40 | 40 | |
| 3 | Meeting Room | 20 | Linear Light | 50 | 1 | 50 | 170 | |
| | | | Spot Light | 30 | 4 | 120 | | |
| | Total | 90 | | | | | 480 | |

$$\text{Lighting Power Density} = \frac{\text{Total Wattage of Lighting (W)}}{\text{Total Floor Area } (m^2)}$$

$$\text{Lighting Power Density} = \frac{480}{90}$$

$$= 5.33\ W/m^2$$

The total LPD for this office space is 5.33 $W/m^2$ which is less than the required 10 $W/m^2$ LPD limit as required for Commercial/Public building type. Hence, the proposed lighting design complies with this regulation.

## COMPLIANCE DOCUMENTATION

**Table 502.04(3) - Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Include the lighting power density calculation in the heat load analysis report. |
| Construction Completion Application | 1. Final approved lighting layout indicating locations of the fixtures.<br>2. Lighting fixtures manufacturer technical data-sheet. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings (3 Stories or less, one family and two-family residential buildings), www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2018). ASHRAE standard 90.2: Energy-Efficient Design of Low-Rise Residential Buildings (3 Stories or less, one family and two-family residential buildings), www.ashrae.org

## 502.05 LIGHTING POWER DENSITY – EXTERIOR

Silver Sa'fa

### INTENT

To promote efficient light fittings to optimise exterior lighting energy consumption.

### REQUIREMENT

For all new buildings, the average Lighting Power Density for the exterior connected lighting load for specific building types must not exceed the values given in Table 502.05 (1).

**Table 502.05(1): Building Exterior Lighting Power Density**

| Building Area | Maximum W/m² or linear metre |
|---|---|
| Uncovered parking lots and drives | 1.6 W/m² |
| Walkways less than 3m wide | 3.3 W/linear metre |
| Walkways 3m wide or greater | 2.2 W/m² |
| Outdoor stairways | 10.8 W/m² |
| Main entries | 98 W/linear metre of door width |
| Other doors | 66 W/linear meter of door width |
| Open sales areas (including vehicle sales lots) | 5.4 W/m² |
| Building facades | 2.2 W/m² for each illuminated wall or surface or 16.4 W/linear metre for each illuminated wall or surface length |
| Entrances and gatehouse inspection stations at guarded facilities | 13.5 W/m² |
| Drive-up windows at fast food restaurants | 400 W / drive-through |

Lighting Power Density values for exterior areas for building types not listed in Table 502.05 (1) shall not exceed the values indicated in the latest edition of ASHRAE standard 90.1 or equivalent as approved by DEWA.

If the light power density values for external lighting exceeds the values specified in Table 502.05 (1), the additional lighting load must be powered entirely, through renewable energy sources such as photovoltaic systems or similar.

## SIGNIFICANCE

Excessive exterior lighting is wasteful and wasting energy has huge economic and environmental consequences. As the exterior lighting generally operates on dusk to dawn duration, reducing the electrical load of exterior lighting is very important to reduce energy consumption and carbon emissions.

By following the maximum average lighting power density values for various building types, electrical energy to provide adequate lighting is restricted thereby encouraging the use of energy efficient lamps and luminaries.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

For the exterior lighting, the Lighting Power Density (LPD) limits given in this regulation are the maximum limits. This is to promote variety of efficient light fixtures to be used in various areas.

As part of lighting design, the lighting schedule should include exterior lighting details including wattages and types of lighting fixtures. Project teams in design stage, should maintain consistency in the number of light fittings for each space and the light fixture wattage between the lighting layout and lighting schedule.

By counting the number of exterior lighting fixtures and their designed electricity consumption would give the lighting load. While calculating the lighting load the electrical energy used by the controls and ballasts must also be included. The total energy load is then applied to the gross floor area of the building to give the average lighting power density.

Emergency lighting that is switched off during normal building operation and the lighting that is required by a health or safety regulation are exceptions for this regulation.

The maximum lighting power density can be easily achieved by optimising the lux level requirement for each of the spaces based on their usage and by incorporating energy efficient lighting that produces high lumens per watt. Selection of lamps has a major impact on the energy usage and hence adequate care must be taken in their selection.

If the lighting design is changed during construction, the lighting power density calculation needs to be updated, while ensuring the overall values are still in compliance with this regulation. The changes i.e. wattage and number of light fittings in each space should also be consistent in the updated light power density calculations, light fixture data sheet and in the as-built layout.

If the LPD values for external lighting exceeds the values specified in Table 502.05(1), then the additional lighting load must be powered entirely, through renewable energy sources such as photovoltaic systems or similar. This offers a sustainable alternative to those building owners who wish to have more than the regulated level of outdoor lighting.

The requirement for this regulation should also consider the requirements stated in *Regulation 303.01*. As per *Regulation 303.01*, all exterior lighting must be fitted with automatic controls, to ensure that lights do not operate during daylight hours. This restricts the energy consumption for exterior lighting fixtures, thereby reducing energy requirements.

**Case Study**

An exterior lighting design for a commercial office building with external driveways and walkways (as shown in fig. 502.05(1)) is being proposed by the project team.

The layout also indicates the number of light fittings for each space and lighting legend. 12 nos. of street lights (80 W/Luminaire) are proposed for parking areas and 6 nos. of bollard lights (30 W/ Luminaire) are proposed for walkway areas.

Area details for the project is as follow:

Area for exterior parking = 360 $m^2$

Area for exterior walkaway = 100 $m^2$

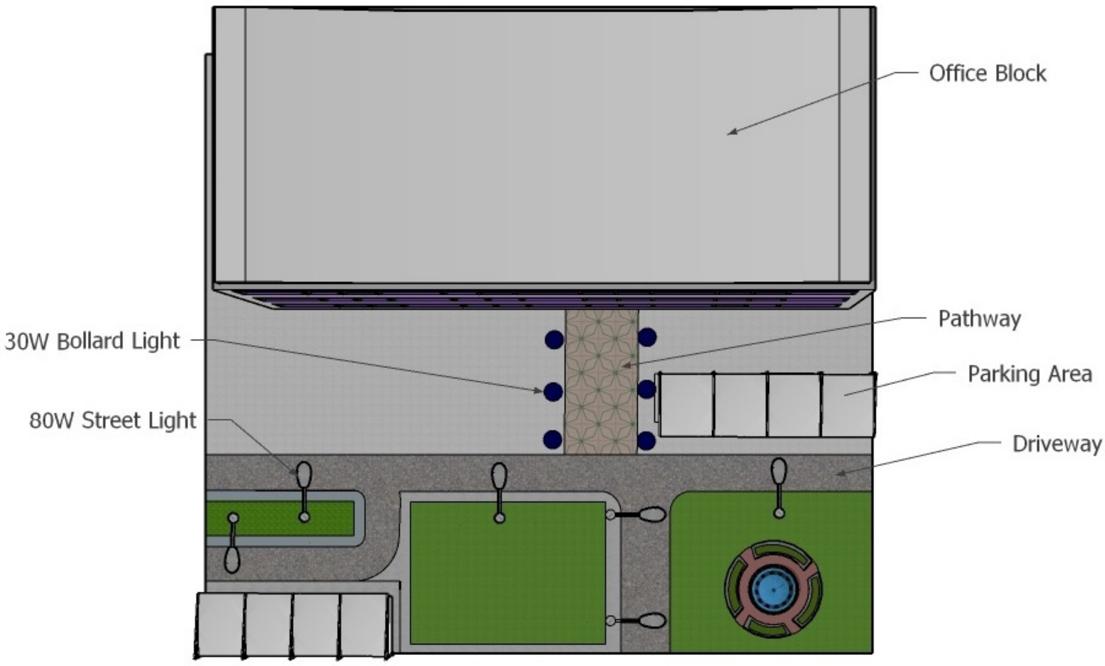



Fig. 502.05(1): Exterior Lighting Layout

Based on this information, design LPD values were calculated and shown in Table 502.05 (2).

The allowable LPD values for Driveways is 1.6 W/$m^2$ and Walkways (3m wide or greater) is 2.2 W/ $m^2$. It can be observed that the exterior LPD values do not exceed the values required under this regulation. Hence, the proposed lighting design complies with this regulation.

**Table 502.05(2): Exterior Lighting Power Density Calculation**

| Space Type | Light Fitting Type | No. of Light Fittings | Lighting Power / Luminare (W) | Total Power (W) | Area ($m^2$) | Total Design LPD (W/ $m^2$) | Allowable LPD (W/ $m^2$) |
|---|---|---|---|---|---|---|---|
| Driveways areas | Street light | 6 | 80 | 480 | 360 | 1.3 | 1.6 |
| Walkways 3m wide or greater | Bollard light | 6 | 30 | 180 | 100 | 1.8 | 2.2 |
| Total | | | | 660 | 460 | | |

In this case study, allowable lighting power for Driveways is 576W and Walkways (3m wide or greater) is 220W.

If the project team propose 150W for street light instead of 80W, then the revised design LPD values are as shown in Table 502.05 (3).

**Table 502.05(3): Exterior Lighting Power Density Calculation**

| Space Type | Light Fitting Type | No. of Light Fittings | Lighting Power / Luminare (W) | Total Power (W) | Area ($m^2$) | Total Design LPD ($W/m^2$) | Allowable LPD ($W/m^2$) |
|---|---|---|---|---|---|---|---|
| Driveways areas | Street light | 6 | 150 | 900 | 360 | 2.5 | 1.6 |
| Walkways 3m wide or greater | Bollard light | 6 | 30 | 180 | 100 | 1.8 | 2.2 |
| Total | | | | 1,080 | 460 | | |

From Table 502.05 (3), it can be observed that the LPD values for Driveways exceeds the requirements. The total lighting power is now 1,080W whereas the allowing lighting power for this project is 796W. The excess lighting power in this case is 284W. Hence, the project team should provide renewable energy for the additional lighting load of 284W, to comply with the regulation.

## COMPLIANCE DOCUMENTATION

**Table 502.05(4): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Final approved lighting layout indicating locations of the fixtures.<br>2. Lighting fixtures manufacturer technical data-sheet. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, www.ashrae.org.

Dubai Municipality. (2018). Al Sa'fat Dubai Green Building System: Regulations 303.01 – Exterior Light Pollution and Control.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.06 LIGHTING CONTROLS

Silver Sa'fa

### INTENT

To save energy by using effective lighting controls.

### REQUIREMENT

For all new buildings other than villas and industrial buildings:

A. Occupant lighting controls must be provided so that it allows the lighting to be switched off when daylight levels are adequate or when spaces are unoccupied. It also allows the occupant to control the lighting levels.

B. Common areas such as corridors and lobbies which are not regularly occupied, the lighting levels should be reduced to a maximum level of 25% of normal condition, when unoccupied.

C. In offices and education facilities, all lighting zones must be fitted with occupant sensor controls capable of switching the electrical lights on and off based on occupancy level. Lighting required for safety purposes is excluded.

D. In offices, if the average design lighting power density value is less than 6 W/m$^2$ of gross floor area (GFA), then the control requirements of Part C of this regulation need not apply.

E. It is recommended (optional) that in offices, the artificial lighting in spaces within 6m in depth from the exterior windows must be fitted with lighting controls. The lighting controls to incorporate photocell sensors capable of adjusting electric lighting levels and shall supplement the natural daylight, when required. The use of both artificial light and daylight must provide an illumination level at the working plane between 400 and 500 lux. When 100% of daylight is available, the lux levels may exceed 500 lux.

### SIGNIFICANCE

The source of lighting in a building is daylight and artificial light. Artificial lighting load is a significant component in total electrical energy consumption. Uncontrolled lighting results in substantial energy waste.

Incorporating effective lighting controls lead to increased occupant comfort, productivity and wellbeing, as each individual or group of occupants can alter the lighting levels to their personal needs and switch off the light when not needed. Switching off light when not needed not only reduces lighting energy consumption, but also results in less heat build-up from lighting system, resulting in lower air conditioning load and higher energy savings.

Considering the high sunlight factor in the Emirate of Dubai, use of daylight contributes significantly in energy conservation.

## APPLICABILITY

This regulation is applicable to all building types except villas and industrial buildings. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

### Occupant Lighting Control

Lighting controls that allow adjustments as per the occupant's needs and preferences should be provided in all spaces. Lighting controls should also turn off the lights when a space is unoccupied.

In cases where automatic lighting controls are not provided, local switches must be installed in easily accessible locations within each working area. Alternatively, they should be installed at boundaries between working areas and general circulation routes that can be manually operated by the occupants. Switches can include dimming devices.

Individual offices are those that have a single working area which would have separate lighting switch for control. In large spaces, such as open plan offices, local switches should be situated nearby to the lighting fixtures for easy access and effective control of light fittings based on user's needs.

Conferences or class rooms and other multi-occupant spaces and those spaces which are normally unoccupied, should have lighting controls that allow the lighting in those areas to be switched off or reduced when unoccupied.

For the effective use of lights and to conserve energy, all the occupants must be educated on the lights and functionality of lighting controls.

### Automatic Lighting Control

For common areas in a building such as corridors and lobbies that are not regularly occupied, the lighting levels should be reduced to a maximum level of 25% of normal condition when unoccupied. This can be achieved either by having 75% of area under a separate lighting circuit, that can be switched off when unoccupied by the use of occupancy sensors or by dimming the lighting levels to 25% for the entire space.

For office spaces, all lighting zones must be fitted with occupant sensor controls capable of switching the electrical lights on and off based on the occupancy. Alternatively, the design must ensure that average design lighting power density value is less than 6 $W/m^2$ of gross floor area.

For educational facilities, all lighting zones must be fitted with occupant sensor control to switch on and off the electrical lights based on occupancy level.

### Perimeter Lighting Control

It is recommended for office buildings that lighting control systems combined with daylight sensors and dimming lights be used in the zones within 6m from exterior windows. Lighting controls should maintain the illumination levels between 400 lux and 500 lux at working plane (WP). Consideration should be given to adjusting the level of dimming of lights, so that those lights closer to the window are dimmed to a greater extent than those further into the building where there is less daylight. The controls are not required where perimeter walls have few or no windows.

For daylit area, one multifunctional sensor can be included which will control the lighting based on both presence detection and ambient light level detection.

Where a daylit space is served by side windows, light fixtures on the perimeter rows within 6m of the window must be separately switched on/off or dimmed. It is recommended to have a separate circuit for each 3m within the 6m band, wherein light fixtures within 3m from window could be switched off, as it would receive the maximum lux level. Light fixtures in the next 3m could be dimmable based on the required or set lux levels. However, this should be evaluated and designed by the project team, based on the size of windows in those spaces. Perimeter walls having no or few windows with inadequate daylight levels need not have separate circuit.

In an office (as shown fig. 502.06(1)) when light fixtures are turned off, the areas near the side window (Zone A) may have a daylighting level of over 400 lux on the working plane (WP), whereas the adjacent space (Zone B) may have less than 400 lux. As the light levels reduce below 400 lux on WP for spaces away from window (Zone B), electrical lighting is switched on / dimmed to meet the required lux level as indicated in fig. 502.06(2). Lighting switches can be controlled manually or automatically. By having individual controls for lighting, effective energy utilisation can be achieved.

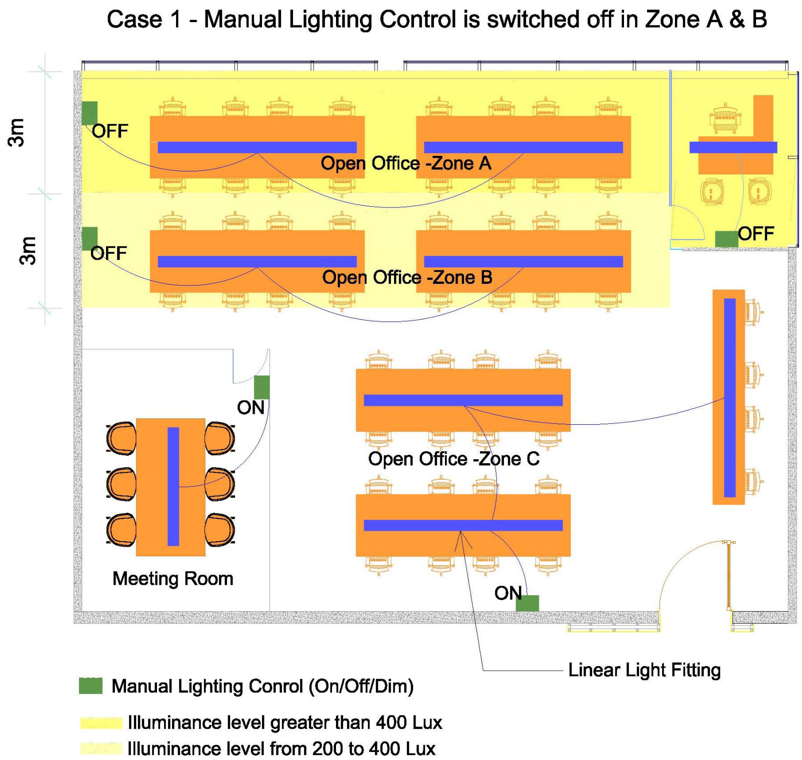



Fig. 502.06.(1): Lux Levels in Zone A and Zone B (Daylighting Only)

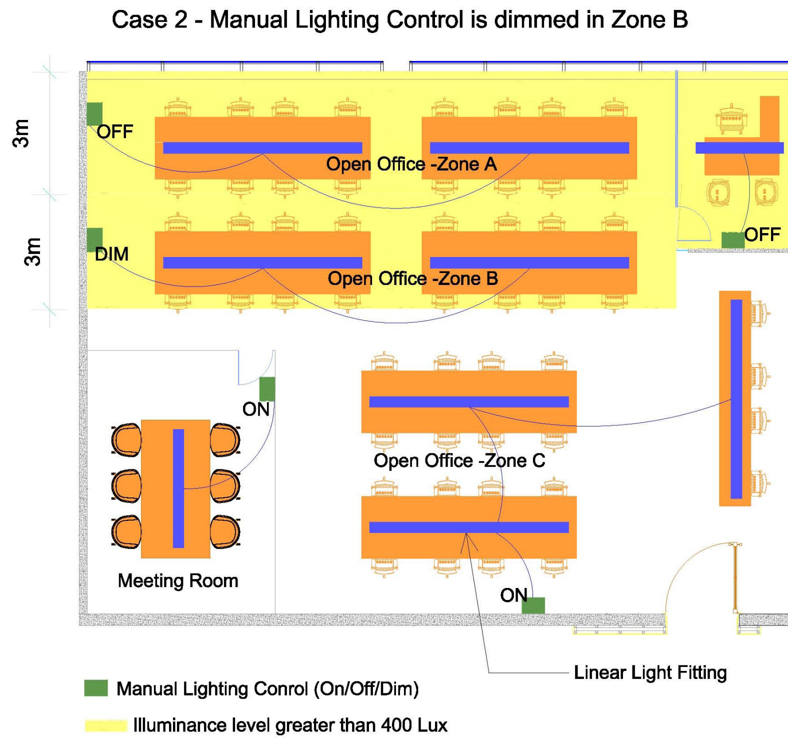



Fig. 502.06.(2): Lux Levels in Zone A and Zone B (Daylighting and Dimming Control)

## COMPLIANCE DOCUMENTATION

**Table 502.06(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Lighting control system layout.<br>2. Lighting control system manufacturer data-sheet.<br>3. Lighting controls delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Ruck, N & Aschehoug, Øyvind & Aydinli, S & Christoffersen, Jens & Edmonds, Ian & Jakobiak, Roman & Kischkoweit-Lopin, M & Klinger, M & Lee, Eleanor & Courret, Gilles & Michel, L & Scartezzini, Jean-Louis & Selkowitz, Stephen. (2000). Daylight in Buildings - A source book on daylighting systems and components. Lawrence Berkeley National Laboratory.

Craig DiLouie. (2005). Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications. Fairmont Press.

Craig DiLouie. (2008). Lighting controls handbook. Fairmont Press.

The Chartered Institution of Building Services Engineers (CIBSE). (2016). LG14 Lighting Guide 14: Control of Electric Lighting.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.07 ELECTRONIC BALLASTS

Silver Sa'fa

### INTENT

To improve the life span of light sources and to increase energy savings.

### REQUIREMENT

For all new buildings, high frequency electronic ballasts must be used with fluorescent lights and metal halide lights, of 150 W and less.

High frequency electronic ballasts must be labelled and must be compliant with international standards as approved by the DEWA and Dubai Municipality.

### SIGNIFICANCE

Ballasts consume a significant portion of power in a lighting system. Improvements in ballasts can reduce the overall energy consumption.

Electronic ballasts are considerably more efficient than magnetic ballasts and produce much less heat. Energy losses from the ballast are reduced as the solid-state circuit contains no copper windings.

The high frequency electronic ballasts eliminate flickering and humming. They provide instant start with higher light output. The lamp is increased due to lower operating current.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires high frequency electronic ballasts to be used with fluorescent lights. Electronic ballast is a device that controls the starting voltage and the operating currents of lighting devices. A typical electronic ballast consists of low-pass filter, rectifier, buffer capacitor and a high frequency (HF) oscillator. In fluorescent lamp, greater efficacy is obtained at high operating frequency. Electronic ballast by working under higher frequency operation increases the efficacy of lamps, thereby enabling the lamp to be operated at a lower input power. Performance characteristics for an electronic ballast considers ballast factor (BF), ballast efficacy factor (BEF) and system efficacy. These characteristics provides information on the various aspect of lamp-ballast system.

To ensure quality of electronic ballasts, project team must ensure electronic ballasts with the following certification are considered:

- UAE.S/IEC 61347-2-8:2012
- American National Standards Institute (ANSI)
- European Electronic Ballast Standard
- Certified Ballast Manufacturers (CBM) standards, or other standard approved by the Dubai Municipality (If CBM standards are used, the certified ballast must meet the electrical requirements as specified by the appropriate section of C82.1 or C82.11 and C78 series)

Normally the certification is printed on the ballasts and this can be used as a proof of compliance. Certification shall be undertaken by an independent testing laboratory approved by DM / DCL. The ballast performance shall be at rated / nominal voltage. Special ballasts are to be used for dimming lights.

## COMPLIANCE DOCUMENTATION

**Table 502.07(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Lighting fixtures manufacturer technical data-sheet including ballast details. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Emirates Authority for Standardization & Metrology. (2012). UAE.S/IEC 61347: Lamp Control Gear – Part 2-8 Particular Requirements for Ballast for Fluorescent Lamps.

American National Standards Institute. (2017). ANSI C82.11: American National Standard for Lamp Ballasts--High-Frequency Fluorescent Lamp Ballasts.

British Standards Institution. (2015). BS EN 61347-1: Lamp controlgear. General and safety requirements.

## 502.08 CONTROL SYSTEMS FOR HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS

Silver Sa'fa

### INTENT

To achieve optimum comfort and energy savings by independently controlling HVAC system in each zone.

### REQUIREMENT

For all new buildings other than villas, HVAC systems shall be equipped with efficient controls to reduce energy consumption. This shall be in accordance with latest edition of ASHRAE standard 90.1 or equivalent.

The following control specification must be included within the HVAC systems:

1. Divide control systems into sub-zones with independent controls for each area of the building zones. Controls for each zone can vary based on the zone's exposure to sun or cooling load levels or by nature of usage.
2. All independent control areas shall be able to:
    - Independently control temperature.
    - Turn off the system when the building or the controlled part of the building is not occupied.
3. Central systems shall operate only when required by zonal control systems.

### SIGNIFICANCE

As HVAC systems consume largest energy in a building, it is important to incorporate efficient controls that can result in significant energy savings. In the absence of suitable controls, air conditioning and ventilation systems tend to be over-designed to compensate for the need to provide controlled environments for large areas with different thermal requirements.

One of the efficient ways to reduce energy consumption in a building is zonal control systems. By adopting zonal control systems, temperatures in each zone can be effectively managed which increases the energy efficiency of HVAC systems. It also helps in eliminating "cold" and "hot" spots thereby improving the overall thermal comfort for building occupants.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation ensures that zones within a building that have different heating or cooling requirements could be controlled specifically to meet those requirements and only be used when required. Efficient controls for HVAC systems shall be in accordance with latest edition of ASHRAE standard 90.1 or equivalent.

The following steps must be followed in order to meet this regulation.

**Zoning of HVAC system**

A “zone” is a physical space within a building that has its independent temperature controller (thermostat) device to control the HVAC system within that zone. The zone should be defined at the building design stage based on expected occupancy patterns and incidence of heat gains and it could be part of a larger space, an individual office or a small dwelling.

For instance, spaces with windows that face south direction should not be zoned with windows facing east direction unless the spaces are sufficiently open to one another such that air may mix well between them to maintain uniform temperature throughout. For example, as shown in fig. 502.08(1), each perimeter zone is controlled by independent air conditioning system. Heat load would also vary in each orientation, based on the level of exposed surface.

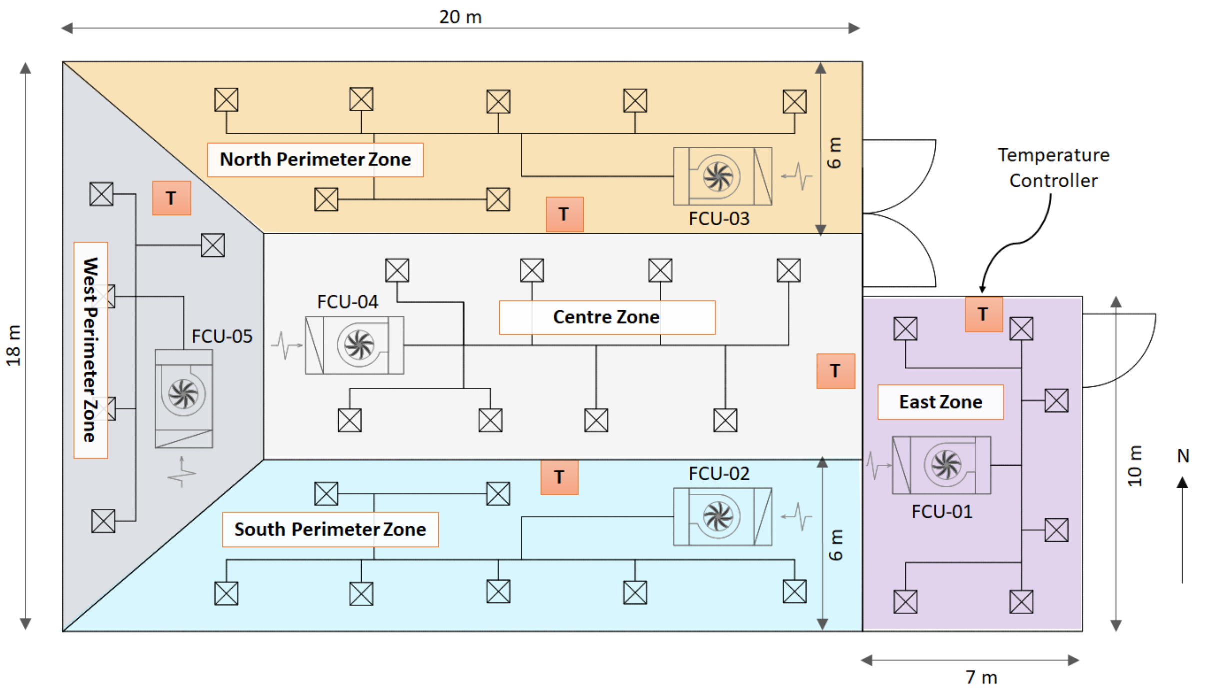



Fig. 502.08(1): Independent Perimeter Zoning for an Office (Sample)

In residential spaces, multiple zones can be considered based on the space type, occupancy pattern or thermal demand. For example, having independent controls for living room and bedroom as shown in fig. 502.08(2) can help in maintaining different temperature for both the areas. This prevents energy loss due to unnecessary cooling when it is not required.


Fig. 502.08(2): Zoning Layout of a Sample Apartment

Similarly, in open office space, multiple zones can be created based on the exposure to sun, space type or thermal demand.

**Controlling the zone**

A zone may have its dedicated HVAC system or centralised HVAC system. Most commonly used zone control device is thermostat. As per this regulation, thermostats need to control the temperature of each zones independently and should have provision to turn-off the system when the zones are not occupied (fig. 502.08(3)).

Where centralised systems are provided, thermostats must indirectly control the operation of central plant through return air temperature sensors, differential pressure sensors etc.


Fig. 502.08(3): Independent Temperature Controller (Thermostat)

**Location of independent temperature controller (thermostat)**

The thermostat must be installed in a place where it is most representative of the occupants' thermal experience. Installing in a place where it may be affected by sun shine, heat from lighting fixtures, direct air flow from diffuser, heat from dimmer switches, near an openable window or close to any other temperature affecting sources must be avoided.

For projects, where central control and monitoring system (CCMS) is applicable as per *Regulation 503.05*, all temperature controllers must be integrated with CCMS. This is to monitor and operate the building HVAC systems more efficiently under varying load condition.

## COMPLIANCE DOCUMENTATION

**Table 502.08(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Mechanical drawing indicating control systems for HVAC and thermostat location. |
| Construction Completion Application | 1. Final approved mechanical drawing indicating control systems for HVAC and thermostat location.<br>2. Thermostat manufacturer data-sheet. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE Handbook — Fundamentals, www.ashrae.org.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, www.ashrae.org.

McDowall, R. (2006). Fundamentals of HVAC Systems (IP): IP Edition Hardbound Book. Elsevier Science.

# 502.09 CONTROL SYSTEMS FOR HOTEL ROOMS

Silver Sa'fa

## INTENT

To achieve energy savings by implementing energy efficient room control strategies.

## REQUIREMENT

For all new hotels, each guest rooms must incorporate control systems that can turn off the lighting, air conditioning and power, when the room is not occupied.

In addition, it is also recommended (optional) that each guest room incorporates control system that can turn off the air conditioning when the balcony door / window is kept open.

## SIGNIFICANCE

When hotel rooms are unoccupied for long periods of time, large amount of energy is wasted in the form of air conditioning and lighting. Control systems like room access cards or occupancy sensors would help turn off the non-essential services during unoccupancy. Use of control systems in hotel guest rooms results in reduction in use of electricity and thus reduce operating costs. Smart control systems can also allow for enhancing guestroom environment to achieve optimum levels of comfort and ease of operation.

## APPLICABILITY

This regulation is applicable to Hotels and Resorts. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Control systems should be provided in the guest rooms that will turn-off the lighting, power and air conditioning when the rooms are unoccupied.

Automatic control can be achieved through networked guest room control systems or standalone guest room management systems. The control systems must be located near the room entrance for easy access to guests on entering the room. Also control systems should have 1-minute delay on deactivation so that guest can exit the room safely. Refrigerator power should remain active at all times and must not be controlled.

It is recommended to have window contact mechanism that ensures the air conditioning is switched off if the window is opened.

Control systems for guest rooms can also be integrated with hotel's central control and monitoring system which would not only provide a centralised control for the hotel operator but also provide holistic approach to optimise energy savings and guestroom comfort.

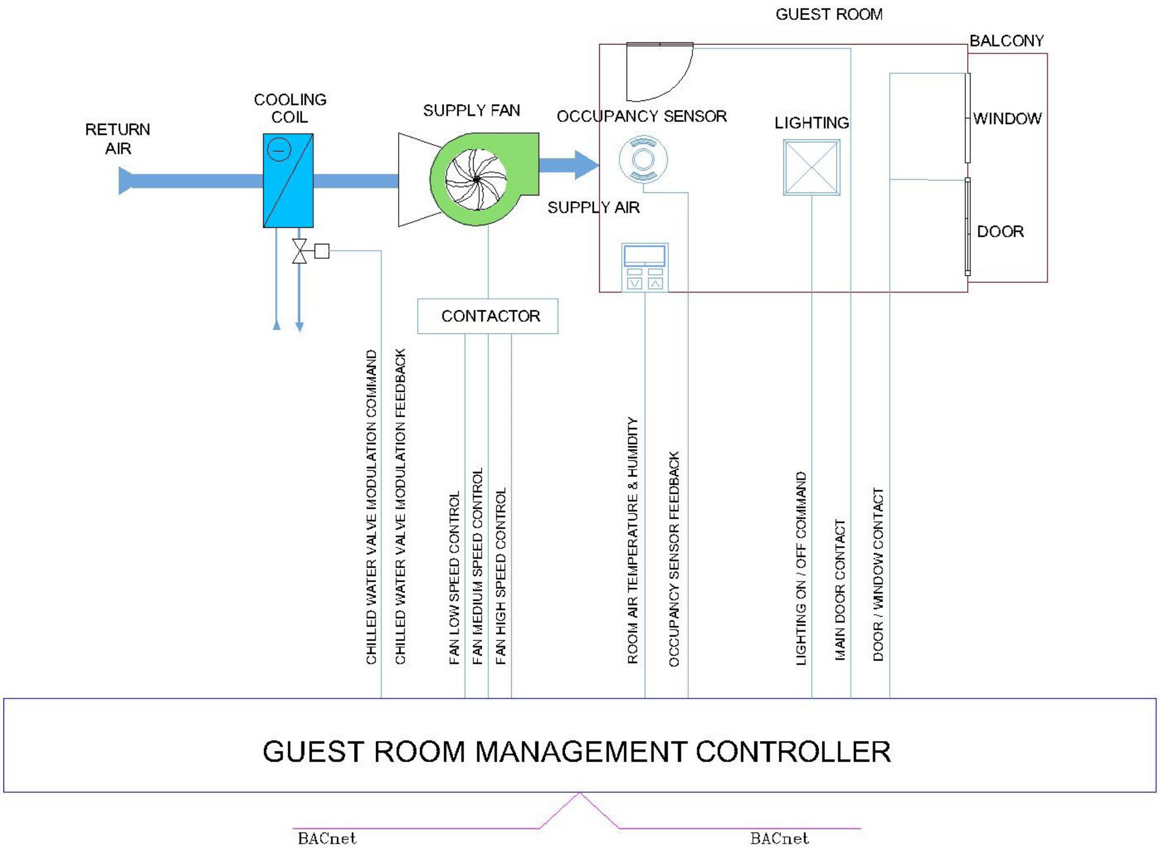



Fig. 502.09(1): Typical Guest Room Management System (GRMS) Control

A typical control system schematic of guest room management system is shown in fig. 502.9(1). It consists of the following components:

- Standalone Thermostat
- Occupancy Sensor
- Window Contact

Standalone Thermostat:

Thermostat allows guest to manually adjust the temperature set-points and air speed of the air conditioning unit. The standalone thermostat also has an integrated temperature sensor, which will compare the room temperature with the desired temperature set-point and modulate the 2-way chilled water valve to maintain the room temperature at the pre-set conditions (e.g. 23 ºC ± 1ºC) while the 3-speed fan will be running at the selected speed.

Occupancy Sensor:

Occupancy sensor will define the occupancy mode for the room. Upon sensing no occupancy, it relays command to the standalone GRMS controller after a predefined time delay. This would in turn shut-off the air conditioning unit and lighting.

Window Contact:

When balcony door or window is opened, this activates the door / window contact which is wired to GRMS controller. After a predefined time delay, the controller would turn off the air conditioning unit.

This regulation only applies to guest rooms; all other areas of the hotel must meet the requirements of *Regulations 502.06: Lighting Controls* and *502.08: Control Systems for HVAC Systems*.

## COMPLIANCE DOCUMENTATION

**Table 502.09(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Control schematic and sequence of operation<br>2. Functional test to verify the controls and sequence of operation. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, Section 6.4.3.3.5 Automatic Control of HVAC in Hotel/Motel Guest Rooms and Section 9.4.1.3: Special Application: Guestrooms.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.10 EXHAUST AIR ENERGY RECOVERY SYSTEMS AND CONDENSATION OF WATER

Silver Sa'fa

### INTENT

To reduce cooling demand by recovering energy from exhaust air and condensate water.

### REQUIREMENT

For Silver Sa'fa and for all new buildings that require treated outdoor air of over 1,000 l/s, energy recovery systems must be provided for at least 50% of the total exhaust air. The energy recovery systems must have at least 70% sensible load recovery efficiency.

For Golden Sa'fa and for all new buildings that require treated outdoor air of over 1,000 l/s, energy recovery systems must be provided for at least 60% of the total exhaust air. The energy recovery systems must have at least 75% sensible load recovery efficiency.

For Platinum Sa'fa and for all new buildings that require treated outdoor air of over 1,000 l/s, energy recovery systems must be provided for at least 70% of the total exhaust air. The energy recovery systems must have at least 80% sensible load recovery efficiency.

For Golden and Platinum Sa'fa and for all new buildings with a cooling load of 1 MW or greater, condensate water must be recollected and used as described in *Regulation 601.03*. The thermal energy from the retrieved condensate water can be restored and can be re-used either in cooling the walking lanes in parking spaces or for public places within plot building limits or for cooling of potable water.

### SIGNIFICANCE

In hot climatic zones, in the HVAC systems, the exhaust air stream would be cooler than the incoming outdoor air stream. Energy recovery is possible by exchanging the energy contained in exhaust air and using it to treat or precondition the incoming outdoor air in buildings.

An energy-recovery system would transfer the cooling energy from the outgoing exhaust air to the incoming fresh air. This decreases the incoming air's temperature, thereby reducing the amount of energy necessary to cool the air to a level required for thermal comfort. Also, by utilising energy recovery systems, size of central cooling plant can be reduced, which further reduces the capital expenditure on HVAC systems.

Also, based on climatic conditions, a good amount of condensate water is generated in HVAC systems. Generally, the condensate water is discarded. By reusing condensate water, a part of energy used could be reduced. It makes the building more energy efficient and helps reducing its carbon footprint.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Energy recovery systems must be provided for all new buildings that require treated outdoor air of over 1,000 l/s.

For Silver B and Silver Sa'fa energy recovery systems must be provided for at least 50% of the total exhaust air and must have at least 70% sensible load recovery efficiency. 70% sensible load recovery effectiveness means that the change in the enthalpy of the outdoor air supply is equal to 70% of the difference between the outdoor air and return air at design conditions.

For Golden Sa'fa energy recovery systems must be provided for at least 60% of the total exhaust air and must have at least 75% sensible load recovery efficiency. For Platinum Sa'fa energy recovery systems must be provided for at least 70% of the total exhaust air and must have at least 80% sensible load recovery efficiency.

The following systems are exempt from complying with this regulation:

a. Laboratory fume hood systems
b. Systems serving spaces that are not cooled
c. Systems exhausting toxic, flammable, paint, or corrosive fumes or dust
d. Commercial kitchen hoods used for collecting and removing grease vapours and smoke

There are several commonly used energy recovery systems available. They include rotary air to air enthalpy wheel or heat recovery wheel, cross plate heat exchanger, heat pipe and run around coil recovery system. Systems can be used separately or combinedly to achieve the required efficiency. Alternative technologies for exhaust energy recovery that comply with this regulation can also be pursued by the project team.

Enthalpy wheels or rotary energy wheels or heat recovery wheels consist of revolving cylinder with an air permeable medium between outside air and exhaust airstreams. As the wheel rotates, energy from the exhaust air is transferred to the incoming air, cooling it up. Effectiveness of the enthalpy wheel defines the performance of energy exchangers. Rotary exchangers have a counter flow configuration and normally use small-diameter flow passages. They are quite compact and can achieve high transfer effectiveness. Typical schematic of an enthalpy wheel is given below in fig.502.10(1).

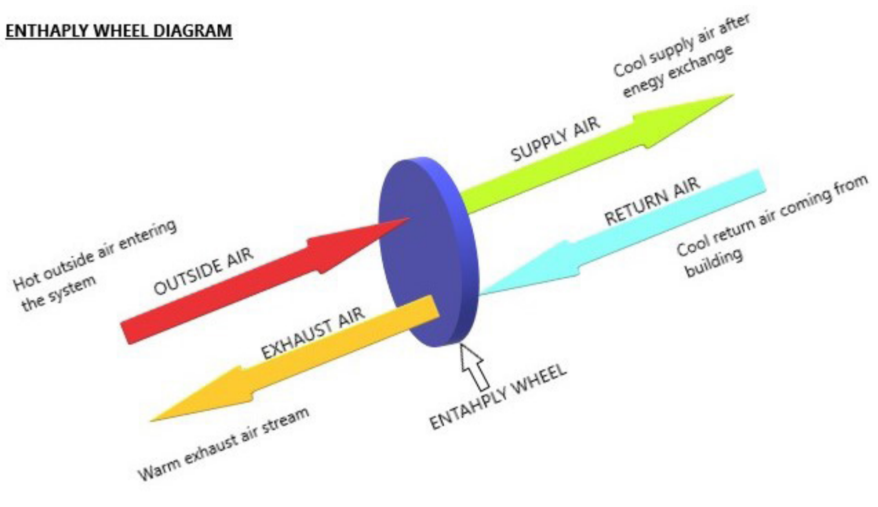



Fig. 502.10(1): Rotary Air to Air Enthalpy Wheel Diagram

ENERGY EFFICIENCY

A run-around coil is a type of energy recovery heat exchanger that is positioned within the supply and exhaust air streams of a building or process. The coils are connected in a closed loop via counter flow piping through which an intermediate heat transfer fluid (typically water or an antifreeze solution) is pumped. Run around coils are used when, complete separation of air paths with no leakages between supply and exhaust air is required to comply with stringent hygienic requirements. These systems are also used when supply and exhaust air systems are separated due to space and technical constraints. This system is commonly used in laboratories and clean rooms where stringent hygienic standards must be maintained.

Heat pipe consists of a sealed pipe or tube made of a material with high thermal conductivity such as copper or aluminium. These tubes are evacuated and backfilled with a working fluid chosen to match the operating temperature of the systems. Using the combination of evaporation and condensation, the phase-changing working fluid transfers the energy between supply and exhaust air streams. The advantage of heat pipe system is that it has no cross contamination and low maintenance / operation cost due to absence of moving mechanical parts.

AHRI standard 1061, ASHRAE 90.1 Section 6.5.6 and ASHRAE 189.1 Section 7.4.3.7- Energy Recovery, provides additional guidance on exhaust energy recovery.

In addition to energy recovery systems, for Golden and Platinum Sa'fa, buildings with a cooling load of 1 MW or greater must collect condensate water and use it as described in *Regulation 601.03*. Project team should calculate the quantity of predicted condensate water production and design the condensate water recovery systems, accordingly.

Project teams need to ensure only minimal energy loss occurs, during storage and transportation of condensate water. Insulation systems can also be used, if required, to prevent energy loss. Thermal energy recovered from condensate water can be re-used either for cooling walking lanes in parking spaces or for cooling public places within plot building limits or for cooling of potable water.

## COMPLIANCE DOCUMENTATION

**Table 502.10(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Energy heat recovery system details.<br>2. Design layout indicating the location of energy recovery unit and capacity.<br>3. Exhaust air flow calculation and percentage of total exhausted air proposed for energy recovery.<br>4. DM BLDG AC unit schedule. |
| Construction Completion Application | 1. Final approved layout indicating the location of energy recovery unit and capacity.<br>2. Energy recovery system manufacturer data-sheet.<br>3. Delivery notes. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2019). Al Sa'fat Dubai Green Building System: Regulation 601.03: Condensate Reuse.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE standard 189.1: Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings.

Air-Conditioning and Refrigeration Institute. (2018). AHRI Standard 1061: Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

## 502.11 PIPE AND DUCT INSULATION

Silver Sa'fa

### INTENT

To minimise energy loss and condensation in the pipe and ducts by using appropriate insulation.

### REQUIREMENT

For all new buildings, all pipes carrying refrigerant, hot water or chilled water and ducts including prefabricated ducts, supplying conditioned air must be insulated, to minimise heat loss and to prevent condensation.

1. Pipes and ducts passing through conditioned spaces must be insulated in accordance with British Standard BS 5422 or other insulation standards as approved by Dubai Municipality.
2. Pipes passing through outside or unconditioned spaces must be insulated with the minimum insulation thickness specified in Table 502.11 (1).

**Table 502.11(1): Minimum Insulation Thickness for Pipes Passing Through Unconditioned Spaces**

| Steel Pipe Nominal Pipe Size (mm) | Temperature of Contents (°C) | | | | | |
|---|---|---|---|---|---|---|
| | 10°C | | 5°C | | 0°C | |
| | Minimum Insulation Thickness (mm) | | | | | |
| | λ = 0.018 W/mK | λ = 0.038 W/mK | λ = 0.018 W/mK | λ = 0.038 W/mK | λ = 0.018 W/mK | λ = 0.038 W/mK |
| 15 | 30 | 45 | 30 | 45 | 30 | 50 |
| 20 | 30 | 45 | 30 | 55 | 30 | 60 |
| 25 | 30 | 55 | 35 | 55 | 40 | 60 |
| 32 | 30 | 55 | 35 | 55 | 40 | 65 |
| 40 | 30 | 55 | 35 | 60 | 40 | 65 |
| 50 | 30 | 60 | 40 | 60 | 45 | 70 |
| 65 | 40 | 60 | 40 | 60 | 45 | 70 |
| 80 | 40 | 60 | 40 | 65 | 45 | 75 |
| 100 | 40 | 70 | 40 | 65 | 45 | 75 |
| 150 | 40 | 75 | 45 | 80 | 50 | 90 |
| 200 | 45 | 75 | 45 | 80 | 55 | 90 |
| 250 | 45 | 75 | 55 | 80 | 55 | 100 |
| 300+ | 70 | 80 | 75 | 100 | 80 | 100 |

λ = thermal conductivity of insulating materials at a mean temperature of 10 °C.

3. Ducts passing through outside or unconditioned spaces must be insulated with the minimum insulation thickness specified in Table 502.11 (2).

**Table 502.11(2): Minimum Insulation Thickness for Ducts Passing Through Unconditioned Spaces**

| Minimum Air Temperature inside Duct (°C) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | | 10 | | 5 | | 0 | |
| Minimum Thickness Of Insulating Material (mm) | | | | | | | |
| λ = 0.018 W/mK | λ = 0.038 W/mK | λ = 0.018 W/mK | λ = 0.038 W/mK | λ = 0.018 W/mK | λ = 0.038 W/mK | λ = 0.018 W/mK | λ = 0.038 W/mK |
| 42 | 61 | 48 | 84 | 57 | 107 | 66 | 127 |

λ = thermal conductivity of insulating materials at a mean temperature of 10 °C.

Insulation materials must meet the requirements of *Regulation 701.01: Thermal and Acoustical Insulation Materials* or BS 5422:2009, whichever is more stringent.

Installation for all insulations must have suitable vapor barrier and protection from Ultra Violet (UV) light.

## SIGNIFICANCE

Considerable lengths of pipework could be noticed in buildings with central chiller and ventilation systems. These pipes include those that carry water from chiller to devices like fan coil units or ducts that carry air cooled at air handling unit. Insulation of these pipes and ducts are very important to save energy from air conditioning systems. If these pipes and ducts are not properly insulated, the temperature of the water or air would increase even before it reaches its destination. To compensate these losses of energy additional cooling energy is utilised. Also, condensation is formed when warm humid air gets in contact with colder object. Further condensation will lead to mold and mildew formation causing severe health issues to building occupants.

Hence, selection and installation of correct insulation material is critical for energy conservation, reduction in heat loss, resistance to moisture absorption, noise attenuation, controlling temperature variation and prevention of condensation. Rusting, resulting from dripping of ducts and pipes can also be reduced by proper insulation.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Thermal conductivity is the main factor for selecting the type of insulation material. Lower the thermal conductivity the better would be the insulation value. Insulation can be designed to achieve a specific resistance value by specifying adequate thickness. Design team shall identify the type of system that require insulation, which is passing through conditioned and unconditioned spaces. Specific requirements related to the insulation shall be included in the technical specifications.

British standard BS 5422 (latest edition): Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C, shall be used for selecting insulation material for pipes and ducts passing through conditioned spaces.

Pipes passing through outside or unconditioned spaces must be insulated with the minimum insulation thickness specified in Table 502.11 (1). Thickness requirement of the pipe insulating material depends on thermal conductivity, thickness of pipe and operating temperature of the fluid passing through the pipes.

Ducts passing through outside or unconditioned spaces must be insulated with the minimum insulation thickness specified in Table 502.11 (2). Thickness requirement of the duct insulating material depends on thermal conductivity and operating temperature of the air passing through the ducts.

All materials used for insulation must be fire retardant and inhibit or resist the spread of fire. In the event of fire, the insulation material must not emit toxic fumes. In addition to this, Insulation materials must meet the requirements of *Regulation 701.01: Thermal and Acoustical Insulation Materials* or BS 5422, whichever is more stringent. BS 5422 standard also covers water vapour permanence, vapour barriers, thickness, temperature limitations and fire-retardant properties. Installation for all insulations must have suitable vapor barrier and protection from UV light.

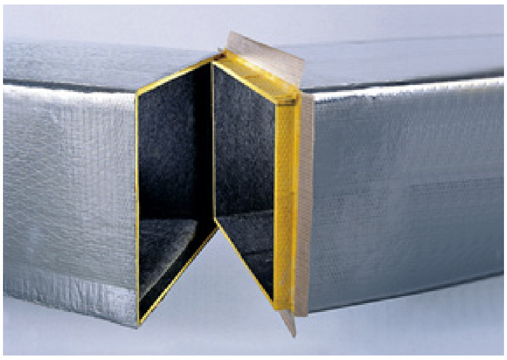
To achieve the required compliance level, various types of insulations can be used. Each type of insulation material has its own insulation level that must be considered as part of selection. The type of insulation will also depend on the temperature of the air / fluid passing through the pipe or duct, pipe diameter and duct size, function of pipe and duct within the system and on thermal conductivity of the insulation material. Commonly used insulation materials include fibre glass, mineral wool, cellulose, polyurethane foam, polystyrene etc (fig. 502.11(1)).


Fig. 502.11(1): Types of Insulation

In construction, contractor should follow manufacturer's instructions for installation of insulation. Improper installation strategies lead to heat / cold loss or gain, condensation, rusting, mold growth etc. Technical datasheet or test certificate confirming the thermal conductivity of the insulation material conforming all the requirements must be included as part of DM submission.

Dubai Central Laboratory standard DM-DCLD-RD-DP21-2185 (IC) states the "Specific Rules for Factory Assessment Certification of Pipe and Duct Insulation" as per Al Sa'fat – Dubai Green Building System. Similarly, "Manual of Green Building Materials, Products & Their Testing Facilities" provides information on testing facilities available for the products and information on DM / DCL approved manufacturers and suppliers. Ducts that are pre-insulated (fig. 502.11(2)) in factories must also meet DM / DCL requirements and the requirements stated in this regulation.

Pre-insulated flexible ducts



Pre-insulated normal ducts

Fig. 502.11(2): Sample Pre-Insulated Ducts

## COMPLIANCE DOCUMENTATION

**Table 502.11(3): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Technical data sheet of pipe and duct insulations confirming the compliance of all the requirements.<br>2. Delivery notes of insulation materials. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

British Standards Institution. (2009). BS 5422: Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.

Dubai Central Laboratory Department. (2019). DM-DCLD-RD-DP21-2185 (IC) details Specific Rules for Factory Assessment Certification of Pipe and Duct Insulation as per Al Sa'fat Dubai Green Building System.

Dubai Central Laboratory Department. (2018). Manual of Green Building Materials, Products & Their Testing Facilities from Dubai Central Laboratory Department, 23/07/2018 Edition (5).

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.12 THERMAL STORAGE FOR DISTRICT COOLING

Silver Sa'fa

### INTENT

**To reduce the chiller plant capacity and size, increase chiller plant efficiency and reduce greenhouse gas emissions by integrating thermal energy storage systems.**

### REQUIREMENT

All new district cooling plants must incorporate a Thermal Energy Storage (TES) facility. TES shall be designed with a capacity of at least 20% of the designed plant capacity.

### SIGNIFICANCE

District cooling systems produce chilled water in centralised energy plant and distribute it through underground pipes to multiple buildings. One of the main aspects of Thermal Energy Storage (TES) is to reduce the peak energy demand and thereby reducing the utility grid stress.

Thermal Energy Storage acts as demand-side energy management by maintaining a balance between energy supply and energy demand. Integrating TES to district cooling systems reduce the capacity of the plant, thereby reducing environmental footprint associated with the central plant system sizing and construction. During the peak demand when the demand for chilled water is higher than the chiller plant capacity, chilled water can be obtained from TES. During night when ambient temperature is lower, cooling energy produced get stored in TES, thereby increasing the chiller plant efficiency.

### APPLICABILITY

This regulation is applicable to all district cooling plants. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires sizing of TES to meet at least 20% of the plant cooling load capacity.

Thermal energy can be stored in various methods. Sensible TES – where the temperature of storage material is increased; Latent TES – where phase transformation occurs to store and discharge energy and; Thermo-chemical energy storage – which uses reversible chemical reactions to store and release energy. Type of technology to be used depends on the project requirements and the condition at which the energy to be delivered to the end user. Fig 502.12(1) details the different TES systems.

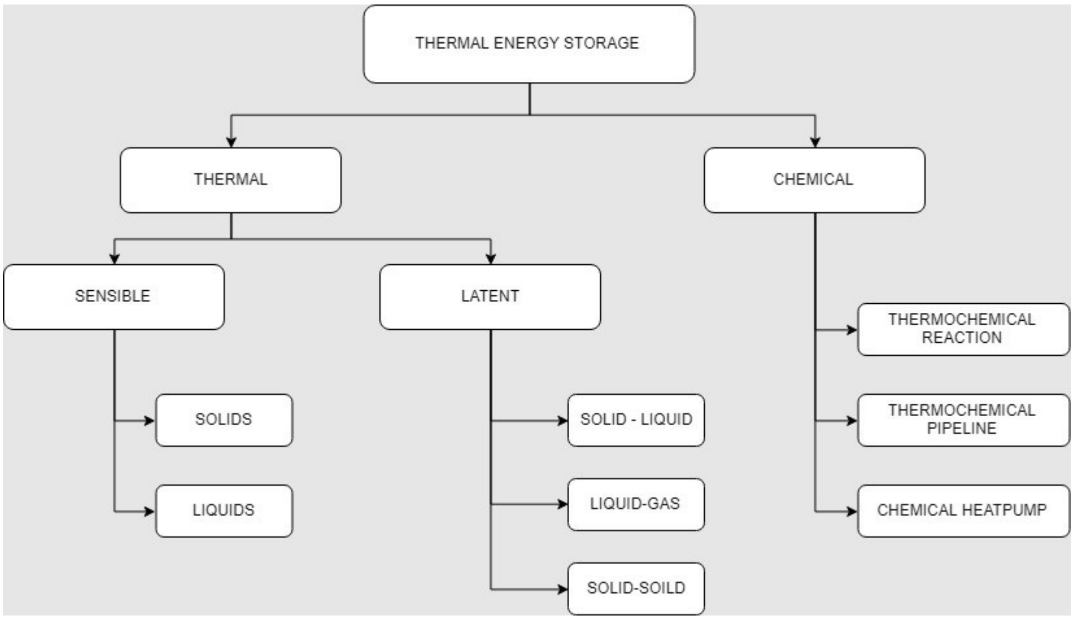



Fig. 502.12(1): Type of Thermal Storage Systems

Thermal energy storage systems are categorised into three groups namely, sensible storage, latent storage and thermo- chemical energy storage.

1. Sensible storage – Sensible storage involves no phase change, where a liquid or solid medium is used to store thermal energy by heating or cooling. Energy is absorbed and released by the storage medium as the operating temperature increases or decreases respectively. Most popular and low-cost storage medium is water, due to its high energy carrying capacity.

2. Latent storage – Latent cold storage involves phase change materials (PCMs) as storage medium. Latent storage can be achieved through solid–solid, solid–liquid, solid–gas and liquid–gas phase changes. Thermal energy is absorbed or released at almost constant temperature with a change in physical state and has the advantages of high-energy storage density. Paraffin compounds, salt hydrate, metallics, eutectic materials are commonly used PCMs.

3. Thermo-chemical energy storage – Chemical thermal storage involves absorption and thermo-chemical reactions. Thermo-chemical materials (TCMs) release or store thermal energy by reversible endothermic / exothermic reactions. TCMs have higher energy densities compared with PCMs and this higher energy density attributes to thermo-chemical TES systems providing more compact energy storage relative to latent and sensible TES.

Design factors such as thermal load profile, type of TES system, selection of storage materials, mode of operations, space availability, capital and operating costs etc., should be considered while designing TES. This ensures TES systems are operated successfully. Thermal energy demand for the building varies daily, weekly, monthly or on seasonal basis. By matching operational pattern of each application, the requirement during peak demand can be effectively met by TES.

Charging period (when plant is working to produce thermal energy and store a portion of it for future usage) and discharging period (when the stored thermal energy in TES tank is released to meet the cooling demand when the load is higher than the chiller plant capacity or the cooling load is less where the chiller plant could be shutdown), should also be considered while designing TES systems.

Though this regulation sets a limit of 20% of the designed plant capacity with TES, increasing TES capacity can further offset the cooling demand and provide additional cost savings. Typical schematic of TES in a district cooling plant is shown in fig. 502.12(2), 502.12(3), 502.12(4), for charging and discharging process.

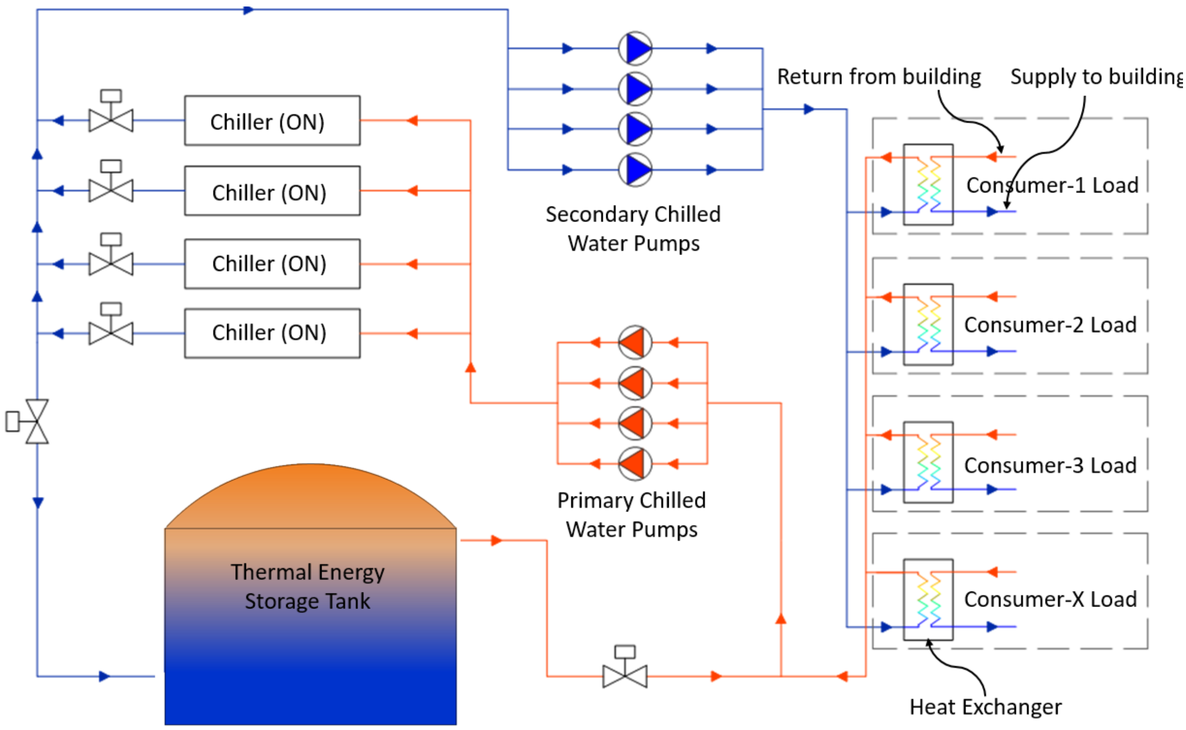



Fig. 502.12(2) Schematic of Thermal Storage System in District Plant (Charging Process with Load)

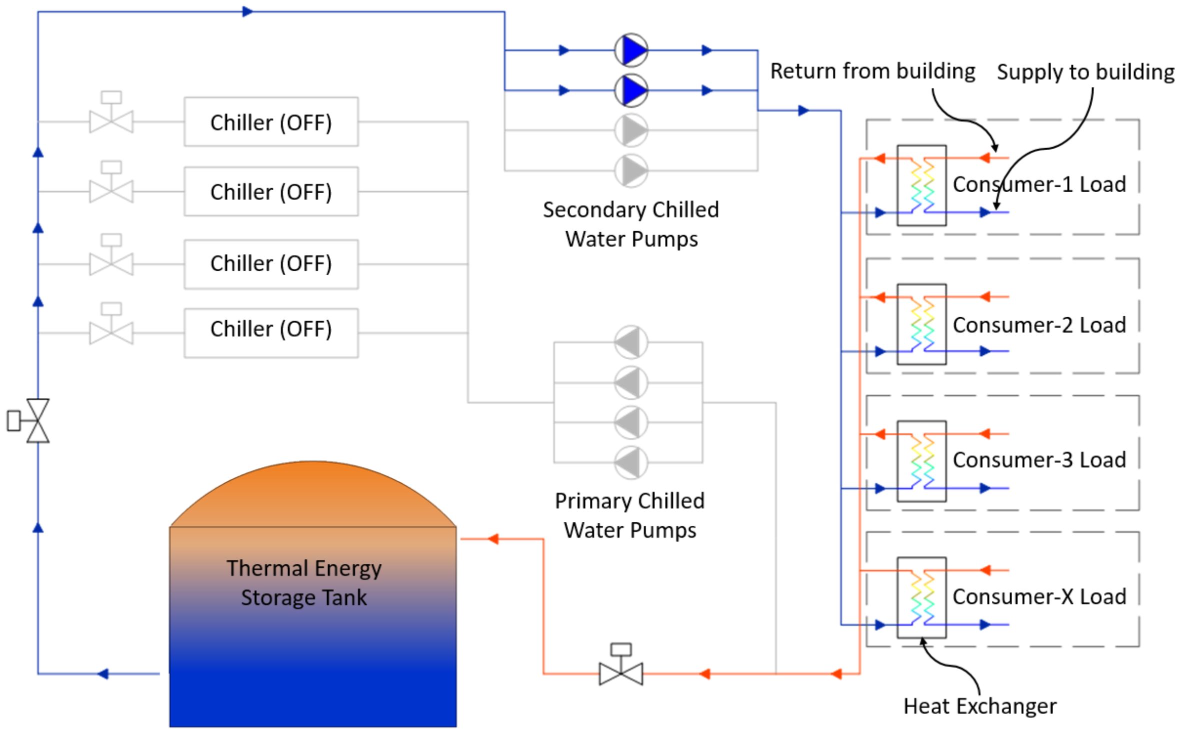



Fig. 502.12(3): Schematic of Thermal Storage System in District Plant (Discharging Process with Low Load)

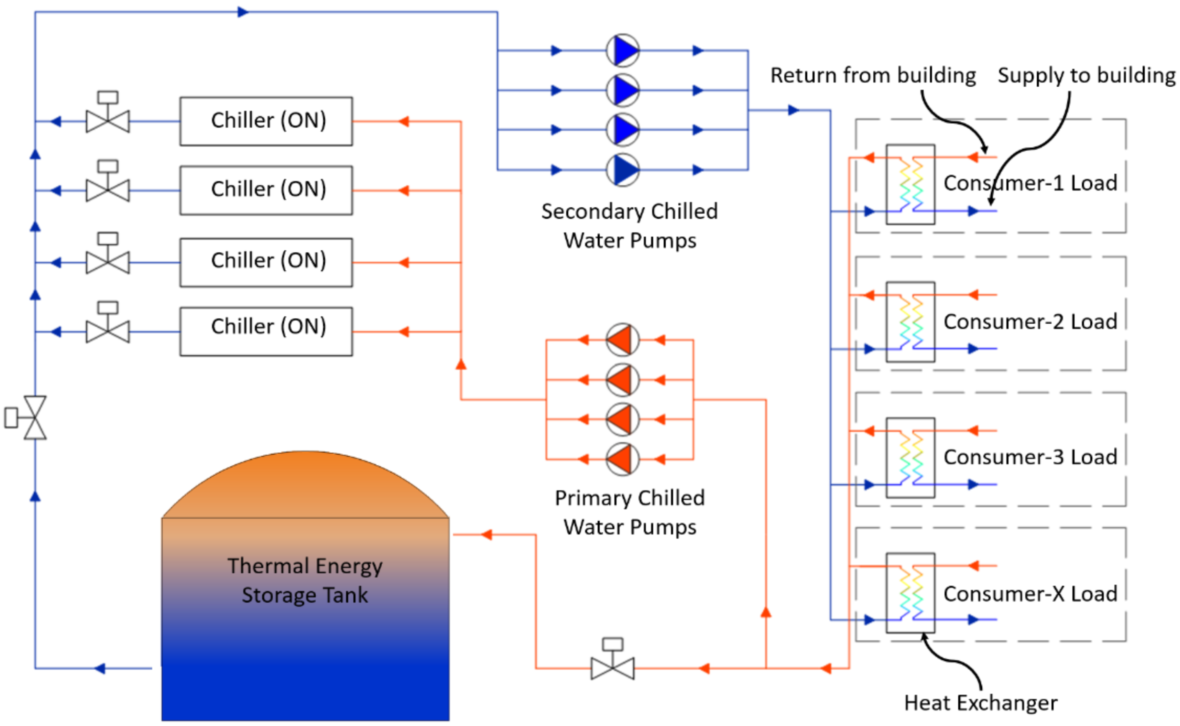



Fig. 502.12(4): Schematic of Thermal Storage System in District Plant
(Discharging Process at High Peak Load)

## COMPLIANCE DOCUMENTATION

**Table 502.12(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Mechanical drawing showing the location and capacity of thermal energy storage tank. |
| Construction Completion Application | 1. Final approved layout showing the location and capacity of thermal energy storage tank.<br>2. Thermal energy storage tank manufacturer data-sheet and delivery note. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

International District Energy Association. (2008). District Cooling Best Practice Guide.

Luisa F. Cabeza. (2015). Advances in Thermal Energy Storage Systems: Methods and Applications. Woodhead Publishing.

ENERGY EFFICIENCY

# 502.13 DUCTWORK AIR LEAKAGE

Silver Sa'fa

## INTENT

Ensuring minimal air leakage resulting in energy savings and improved thermal comfort.

## REQUIREMENT

For all new buildings, air ductwork must be designed, built and installed to ensure air leakage is minimised.

Ductworks attached to an equipment and having an external static pressure of more than 250 Pa and ductworks that are exposed to external ambient conditions or within unconditioned spaces, must be pressure tested prior to occupancy. This must be carried out as per Dubai Municipality's approved methodology and must ensure the compliant amount of air leakage is achieved.

Ductwork leakage testing must be carried out by a company that is specialised in commissioning of buildings and is DM approved.

## SIGNIFICANCE

Leakages in ductworks occur in cracks, joints, connection and at other openings. Air leakages from ducting system can result in inefficient HVAC performance, thermal discomfort for building occupants and increased thermal demand in the building.

A properly sealed and insulated duct system has several advantages such as improved thermal comfort, energy savings and better air quality in the buildings.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation focuses on reduction of air leakages from air conditioning ductworks. It also requires that certain classes of ductwork and associated equipment must be pressure tested to ensure that the maximum allowable amount of air leakage is not exceeded.

Ductworks attached to an equipment and having an external static pressure of more than 250 Pa and ductworks that are exposed to external ambient conditions or within unconditioned spaces must be pressure tested prior to occupancy.

Adequate air tightness for the ducting systems can be ensured by selecting a static pressure construction suitable for the operating condition and by sealing the duct joint and connections properly. Project team must determine the pressure classes required for duct construction and should evaluate the amount of sealing, required to achieve system performance objectives. Installation guidelines, testing standards and requirements for the duct systems, must be included in the technical specification.

Prudent selection and application of sealing methods for joints, seams and connection points to systems by fabricators and installers, should be considered. It should also consider the designated pressure class, pressure mode (positive or negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling, cleanliness of surfaces, product shelf life, curing time, and manufacturer-identified exposure limitations etc.

On completion of installation works, leakage testing for ductworks should be conducted by a DM approved company. Pressure testing must be carried out before the ductwork is insulated unless it is pre-formed ductwork. Methodology stated in SMACNA HVAC Air Duct Leakage Test Manual shall be followed for conducting the air leakage test.

SMACNA HVAC Air Duct Leakage Test Manual, DW/143 - Guide to good practice ductwork leakage testing and DW/144 - Specification for sheet metal ductwork, provides guidance to perform and record testing of air leakage from duct systems.

Test apparatus consists of an airflow measuring device, flow producing unit, pressure indicators and accessories necessary to connect the metering system to the testing duct system. Test apparatus should be accurate within ± 7.5% at the indicated flow rate and test pressure and should have calibration data or a certificate signifying manufacture of the meter in conformance with the ASME Requirements for Fluid Meters. ASME qualified orifice meters do not require calibration.

During testing, ducts should be tested at the specified pressure level, comparing the allowable amount associated with the leakage class and with the leakage in cfm for the section tested. When tests are conducted for different sections within the same system and pressure level, the average leakage rate should not exceed the allowable limit, even if one or more of the sections within the same system exceeds the allowable limits. If pressurisation is not achieved during the testing or leakage rate exceeds maximum allowable limits, visual inspection, smoke bomb test or similar techniques can be used to identify the leak sources.

If significant leaks are not observed, test team shall consider dividing the test segments into much smaller parts or use large test apparatus.

As per SMACNA Test Manual, duct surface leakage factor is identified through the following equation:

$$F = C_L P^N$$

where,

F is a leak rate per unit of duct surface area (typically cfm/100 ft$^2$)
$C_L$ is a leakage class and is a constant
P is static pressure (typically in inches water gauge)
N is an exponent (most typically it is 0.65 but in some cases it can be between 0.5 and 0.9)

Duct leakage results in air infiltration and temperature imbalance. Hence, any observed leak source should be sealed properly after depressurising that zone. Zone should also be re-tested until leakage rate does exceed the acceptable limit. Materials like duct mastic, foil tape or aerosol sealants are commonly used to seal the ducts.

Aerosol sealant system, that uses aerosol mist to seal the leaks from inside the ducts system are recommended for its effectiveness and easiness in sealing the ducts, especially for leakages observed in inaccessible areas.

Test report should include test pressure, leakage class, technical parameters of testing device and all the observation and rectification measures done for the duct segments and systems connection.

## COMPLIANCE DOCUMENTATION

**Table 502.13(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Duct air leakage test report including the summary of corrective actions implemented based on the test findings. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). (2012). HVAC Air Duct Leakage Test Manual.

Building Engineering Services Association. (2016). DSP DW/144 Specification for sheet metal ductwork.

Building Engineering Services Association. (2013). DSP DW/143 Guide to good practice ductwork leakage testing.

## 502.14 MAINTENANCE OF MECHANICAL SYSTEMS

Silver Sa'fa

### INTENT

To practice efficient maintenance of all the building systems to minimise energy usage, reduce operational costs and increase system lifespan.

### REQUIREMENT

For all new and existing air conditioned buildings, all mechanical, electrical and plumbing systems in the buildings must be serviced and maintained regularly.

1. Mechanical systems must be installed in a way such that adequate access is available. This would allow for regular inspection, maintenance and cleaning of the equipment, without the need to remove or dismantle any building components.
2. The building operator must ensure that a proper maintenance manual and schedule is developed for the building. This shall be based on the instructions for preventative maintenance or recommendation from equipment manufacturer or supplier or according to the latest edition of ASHRAE Standard 180 or equivalent as approved by DM.
3. The building operator must either have a service contract with a DM approved maintenance company or provide sufficient evidences that the equipment shall be properly maintained by competent members of their own staff.
4. Service records in the form of a service log book including details of both preventative and corrective maintenance must be kept on-site and be readily available for inspection by DM staff.

### SIGNIFICANCE

Mechanical systems are very critical for a building's operation. It is important that mechanical systems are checked periodically as per operational guidelines. Therefore, easy and adequate access should be provided to them.

Effective operation and maintenance of mechanical systems in buildings can reduce unscheduled shutdowns and repairs, increased equipment life expectancy and maintain overall energy performance.

When the building operator has a service contract with an approved company and maintenance is carried out under the supervision of competent personnel, it ensures proper periodical maintenance is carried out. Properly planned preventive maintenance program can also reduce overtime cost and help to utilise maintenance workers more economically.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Periodical maintenance of mechanical systems is mandatory for trouble free operation of a building. Hence the project team must ensure that adequate clearance space is available around the installed equipment to allow inspection, maintenance and cleaning without removing or dismantling permanent construction elements.

Operational manuals and maintenance requirements of major mechanical equipment should be obtained from the manufacturers and the building operator must ensure that a proper maintenance manual and schedule is developed for the building. This shall be based on the instructions for preventative maintenance or recommendation from equipment manufacturer or supplier or according to the latest edition of American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) standard 180 or equivalent as approved by DM. This Operation and Maintenance (O&M) manual must be maintained on-site by building operator and it should be centrally accessible to entire operation team. This manual shall be updated as necessary.

For specific ventilation system's O&M practices, project team can refer to ASHRAE 62.1, which includes the maintenance frequency and maintenance activity to be followed for ventilation system equipment and associated components.

The building operator must either have a service contract with a specialised maintenance company approved by Dubai Municipality or should hire qualified competent team members with sufficient experience in building operation and maintenance.

Maintenance personnel should ensure the service logbook is readily available for inspection by DM staff. Typically, the logbook should contain details on the dates that maintenance activities occurred and details of work being carried out on that date, along with the signature of the competent professional carrying out that work. Major equipment such as chillers, cooling towers and air handling units may have separate logbooks. Service logbook also should have details of both programmed (preventive) and corrective maintenance along with alterations to building layout and usage.

ANSI/ASHRAE- ACCA-180 standard provides guidance for commercial building HVAC systems ownership and for all methods of delivering inspection and maintenance work. A maintenance programme should be developed and should document the work to be accomplished at scheduled intervals on the equipment. Components of HVAC system that impact the building's performance should be listed. This list shall be used to establish unacceptable system condition indicators, inspection frequencies and maintenance tasks. Maintenance program should also have indicators for thermal comfort, indoor air quality and energy efficiency.

Frequency of inspection and maintenance tasks for inventoried equipment and systems should be established. Inspection should include assessment of systems and/or their components by observation and/or measurement of operating parameters and may include data provided by sensors or a building management system (BMS).

If unacceptable indicators of the condition are found on a system or a component, the maintenance programme should be reviewed to determine if the inspection frequency or the maintenance task frequency should be increased. Further, maintenance task should also be reviewed for improvement opportunities. Degradation of equipment condition or performance that is observed while performing scheduled inspection and maintenance tasks or other occasions shall be documented.

A minimum inspection and maintenance documentation package shall consist of the following items:

1. Listings of HVAC systems and system components with associated performance criteria pertinent to the facility
2. Inspection and maintenance tasks and the method of tracking (automated or manual), and
3. Sufficient record detail and verification (written or electronic) to demonstrate implementation of the maintenance plan.

Additionally, section 5 of ASHRAE 180 further details the required minimum inspection and maintenance tasks for any facility to which this standard applies.

## COMPLIANCE DOCUMENTATION

**Table 502.14(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Maintenance contracts with specialised maintenance companies approved by Dubai Municipality or an evidence that building operators are qualified to carry out the maintenance. |
| After Completion | 1. Maintenance manual and schedule. |

## REFERENCES AND ADDITIONAL INFORMATION

The American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE Standard 62.1-2016 - Ventilation for Acceptable Indoor Air Quality.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2018). ANSI/ASHRAE/ACCA Standard 180 - Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). Fundamental – HVAC Application, Chapter 39 - Operation and Maintenance Management.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2019). ASHRAE Guideline 4 - Preparation of Operating and Maintenance Documentation for Building Systems.

Chartered Institution of Building Services Engineers. (2016). CIBSE TM31 -Building Log book Toolkit.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.15 CONTROL OF AIR FLOW

Golden Sa'fa

### INTENT

To maintain occupant's comfort, health and well-being and to prevent corrosion or mold growth in building fabric.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, the fresh air supply to the building shall be controlled to prevent damage due to moisture. This is to ensure that occupant comfort, safety and health conditions are effectively maintained. This shall be achieved with appropriate and adequate use of temperature, humidity and DDC devices as part of a central building management system.

### SIGNIFICANCE

Humidity control for fresh air supply is an essential element in maintaining a healthy environment for building occupants. Relative Humidity (RH) levels that are too high can contribute to the growth and spread of unhealthy biological pollutants while humidity levels that are too low may contribute to irritation of mucous membranes, dry eyes and sinus discomfort (U.S. EPA, 1997).

RH affects the performance of the buildings causing condensation, mold growth, mildew, staining, slip hazards, damage to equipment and the corrosion and decay of building fabric, as well as poor performance of insulation. RH can also affect the integrity of stored materials and impair the reliability of machinery, resulting in disruption to the manufacturing process.

### APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The key intent of this regulation is to maintain relative humidity in building spaces.

RH in should be maintained between 30% and 60% RH (fig. 502.15(1)) for good occupant comfort, health and wellbeing (Sterling, E.M. & Arundel, A & Sterling, T.D.,1985). This minimises risks to human health by biological contaminants and chemical interaction.

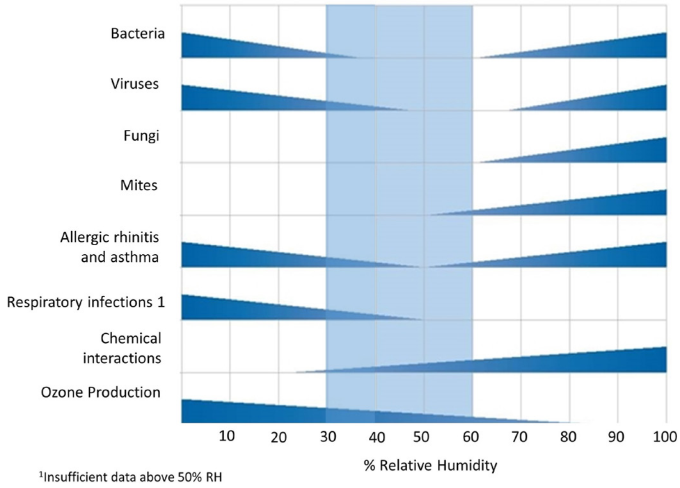



Fig. 502.15(1): Optimum RH Ranges

Following are some of the strategies that can be adopted in order to control relative humidity in supplied fresh air and room spaces.

A. It is important to continuously monitor the ambient air and supplied fresh air temperature and relative humidity, as ambient condition varies substantially. Controlling the supplied fresh air temperature and relative humidity at all varying conditions, ensures space comfort requirements are met. This can be established by providing a temperature and RH sensors connected to a central Building Management System (BMS). The central BMS is responsible to monitor and control temperature and humidity at varying ambient conditions, by appropriately controlling chilled water flow and supply air flow through VFD controls.

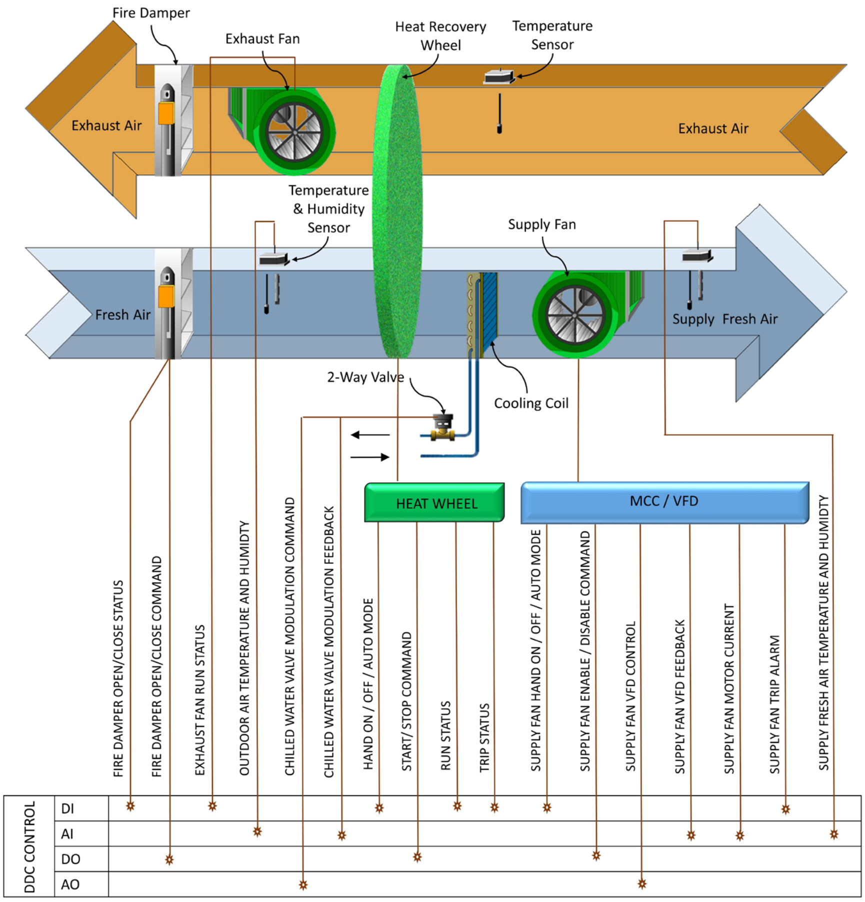



Fig. 502.15(2): Fresh Air Fan BMS Control Schematic

Typical BMS control schematic for controlling relative humidity in the chilled water fresh air handling unit is shown in fig. 502.15(2).

B. During humid condition, when the conditioned space is unoccupied and the cooling system is not operating for longer periods, infiltration may occur which may increase the moisture content in that space. This increase in moisture, may accelerate mold and microbial growth in that space. Hence this regulation requires the cooling system to be operated when the relative humidity exceeds the specified maximum threshold value. This is established by continuous monitoring of space temperature and RH condition through central BMS. The central BMS should be capable to automatically operate the supply air fan (AHU/FCU/VAV) and control chilled water flow, to keep the indoor RH below threshold limit at all periods.

Typical BMS control schematic for controlling relative humidity in the space through chilled water Fan coil unit is shown in fig. 502.15(3).

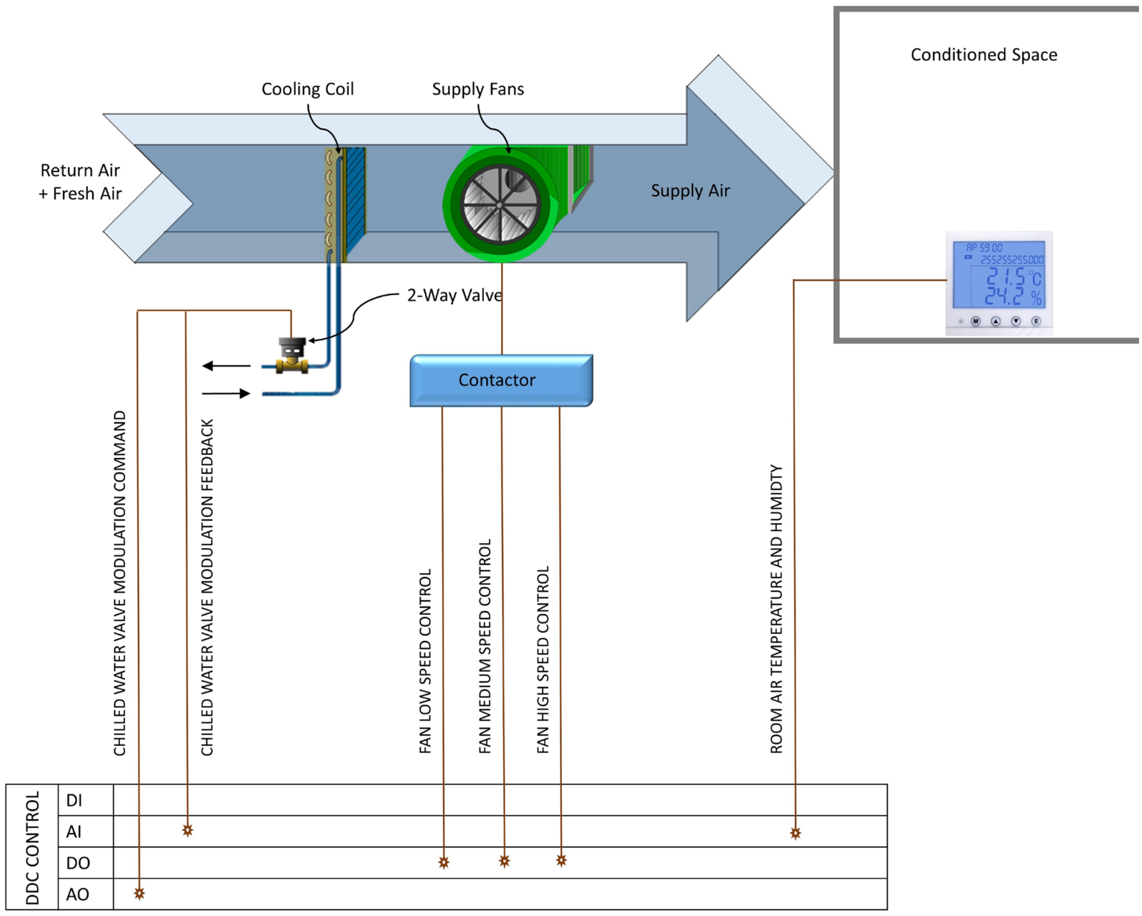



Fig. 502.15(3): Fan Coil Unit BMS Control Schematic

## COMPLIANCE DOCUMENTATION

**Table 502.15(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Detailed drawings showing temperature and humidity sensors on the mechanical drawings. |
| Construction Completion Application | 1. Final approved mechanical drawings showing temperature and humidity sensors/<br>2. CCMS input/ output point summary.<br>3. Temperature & RH sensor / Thermostat manufacturer data-sheet and FAHU technical data sheet.<br>4. Delivery notes for temperature & RH sensor. |
| After Completion | 1. Commissioning results including BMS screen shot to verify the functional performance of FAHU and indoor unit fan in case of high humidity level. |

## REFERENCES AND ADDITIONAL INFORMATION

U.S. Environmental Protection Agency, Indoor Environments Division, Office of Air and Radiation. (1997). An Office Building Occupants Guide to Indoor Air Quality.

Sterling, E.M. & Arundel, A & Sterling, T.D. (1985). Criteria or human exposure to humidity in occupied buildings. ASHRAE Transactions. 91. 611-622.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 62.1: Ventilation for Acceptable Indoor Air Quality.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2018). ASHRAE Position Document on Limiting Indoor Mold and Dampness in Buildings.

ASTM International. (2014). ASTM D7338-14, Standard Guide for Assessment of Fungal Growth in Buildings.

# 502.16 CONTROL OF CHILLED WATER

Golden Sa'fa

## INTENT

To provide optimum thermal comfort and energy efficiency by controlling the chilled water flow in air conditioning units.

## REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, the HVAC equipment and chilled water control shall be equipped with the hydronic balancing valves including pressure independent control valves for optimum energy usage and occupant comfort. The chilled water control shall be achieved with appropriate use of temperature, humidity and pressure monitoring devices as part of a central building management system.

## SIGNIFICANCE

Widely used conventional chilled water control valves are balanced manually at full flow position. It may create unequal distribution of flow if any valve position in the system is changed. This results a change in pressure and causes the system to be unbalanced. This reduces the efficiency and creates discomfort for building occupants.

Automatic balance valves (PIBCV) regulate and maintain a constant flow to the coil even as water pressure in the system varies with the changing load. It delivers better comfort in all condition and allows the system to operate efficiently. Additionally, PIBCV makes installation and commissioning simpler, thereby eliminating the necessity of balancing and rebalancing during commissioning. This saves installation costs for clients.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The key intent of this regulation is to enhance energy efficiency and maintain thermal comfort by utilising pressure independent balancing and control valve (PIBCV), as shown in fig. 502.16(1), in the chilled water network.

The regulation is applicable for the projects which are designed to utilise chilled water system (including chilled water supplied from district cooling plant) for air conditioning and ventilation.

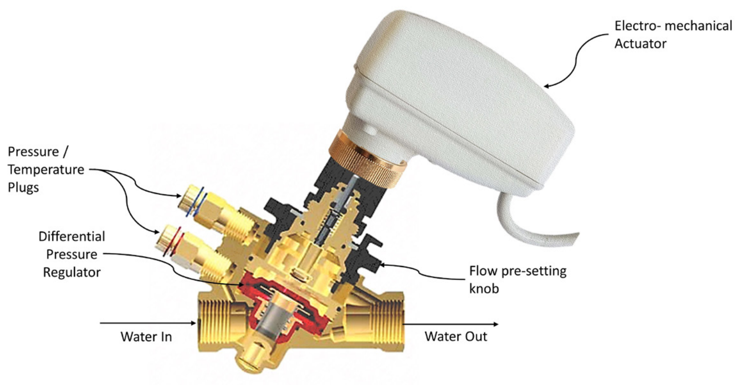



Fig. 502.16(1): PIBCV Valve Details

The PIBCV performs the following functions altogether, which enhances energy efficiency and comfort.

1. Differential Pressure Control

   As the flow rates in the chilled water network fluctuate to match varying load, the available pressure at individual coil varies. To negate these fluctuating pressures, PIBCV maintains a constant pressure drop across its seat, thereby maintaining a constant flow rate in coil.

2. Flow Regulation

   An adjustable opening allows the flow through a PIBCV to the designed flow rate. The opening will be at the outlet of the PIBCV and combined with the function of the pressure-regulating valve, ensures that the design flow rate is maintained irrespective of varying inlet pressures.

3. Comfort Control

   As PIBCV is an integral part of building management system (BMS), it is modulated automatically based on the set-point and readings from room thermostat / return air temperature sensor (as shown in fig. 502.16(2)). This always maintains thermal comfort for building occupants.

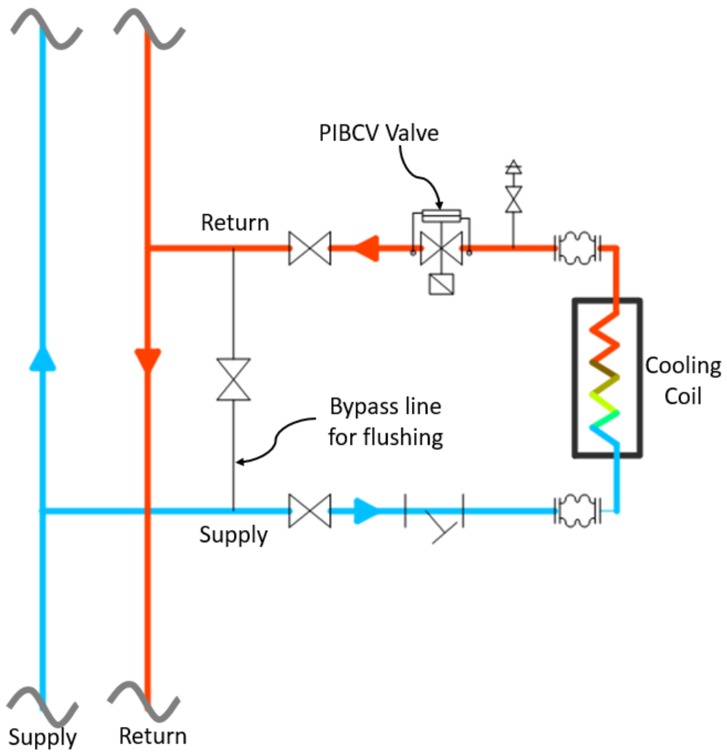



Fig. 502.16(2): PIBCV Valve Connection Details

BSRIA BG 51, provides additional guidance on selection and application of PIBCV, while BSRIA BG 2 and CIBSE CCW Commissioning Code W, provides guidance on commissioning procedures using PIBCVs.

The project team should integrate the temperature, humidity and pressure monitoring devices with central building management system in order to achieve the precise control of chilled water and also the control of air flow.

## COMPLIANCE DOCUMENTATION

**Table 502.16(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Mechanical drawings indicating automatic balance valves, temperature and humidity sensors and pressure monitoring devices. |
| Construction Completion Application | 1.Final approved mechanical drawings indicating automatic balance valves, temperature and humidity sensors and pressure monitoring devices.<br>2. Hydronic balancing and control values technical data-sheet. |
| After Completion | 1. Commissioning results including BMS screen-shot to verify the functional performance of valve. |

## REFERENCES AND ADDITIONAL INFORMATION

The Building Services Research and Information Association. (2014). BG 51: Selection of Control Valves in Variable Flow Systems.

The Building Services Research and Information Association. (2010). BG 2: Commissioning Water Systems.

The Chartered Institution of Building Services Engineers. (2010). CCW Commissioning Code W: Water Distribution Systems.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.17 CONTROL OF AIR CONDITIONING ZONES

Platinum Sa'fa

### INTENT

To achieve optimum thermal comfort and energy savings by controlling air conditioning zones.

### REQUIREMENT

For Platinum Sa'fa and for all new buildings, mechanical ventilation and temperature control system shall be designed such that it allows the occupants to control the air temperature and air speed in each thermal zone. In addition to achieving this requirement, there shall also be control of HVAC system in thermal zones using occupancy sensors that automatically modulate temperature and air flow rate, based on occupancy. The system shall prevent inefficient use of air conditioning system, by use of interlocks in window / door / energy saving input contacts to the control devices. This shall be integrated with central building management system which can generate alarms, in case of deficient use.

### SIGNIFICANCE

Thermal comfort is one of the most fundamental requirements for occupancy. High level of thermal comfort in a building is achieved by proper sub-zoning and controlling each thermal zone independently.

With the use of sensors and automated control system for thermal comfort, the overall energy consumption will also be optimised which is an added advantage for the building owners and operators. Further, the independent controls shall aid in reducing the runtime of HVAC equipment, which will extend the life of the equipment and reduce the maintenance and replacement costs.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(3) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The compliance of *Regulation 502.08: Control systems for HVAC system* forms the basis for implementing this regulation. All thermal control zones must be identified as per *Regulation 502.08* and is based on building space type, occupancy pattern, thermal demand, exposure to sun etc.

In addition to zone control strategies for HVAC system identified in *Regulation 502.08*, following are some of the strategies that must be implemented in order to control each zone and to enhance occupant comfort and energy savings.

**Independent Thermal Controller:** The thermal controller should be installed for each thermal zone with the provision to control both air temperature and air speed independently.

**Occupant Sensor**: HVAC systems for all individual zones must be integrated with occupant sensor that shall be capable of automatically raise the temperature set-points and reduce air speed when no occupant is sensed for a predefined period of time. It shall also detect occupants and automatically modulate the cooling system to maintain zone default set-point temperature as per thermal load.

The automatic control operation of HVAC must be such that it shall not affect the compliance of *Regulation 502.15: Control of airflow*, which requires the space humidity level is maintained below 80% overall, regardless of occupancy of space. The occupant sensor can be integrated with HVAC system through independent controller or via through Central Control Monitoring System (CCMS).

**Window / Door Interlock:** Conditioned spaces that consist of operable window or door openings to the outdoors shall be provided with interlock controls capable of shutting down the air conditioning system when such openings are kept open for certain amount of time e.g.10 min.

The interlocks are not required for doors and windows with automatic closing devices and for those spaces, which are not controlled by independent temperature controller (thermostat).

The window/door contact mounted on the operable window or external door should be integrated with CCMS. Alarm should be generated when operable window or external door is kept open for prolonged period, in order to avoid loss of cooling energy.

A typical control schematic of occupancy sensor / window / door integrated controlled air conditioning zone is shown in fig. 502.17(1).

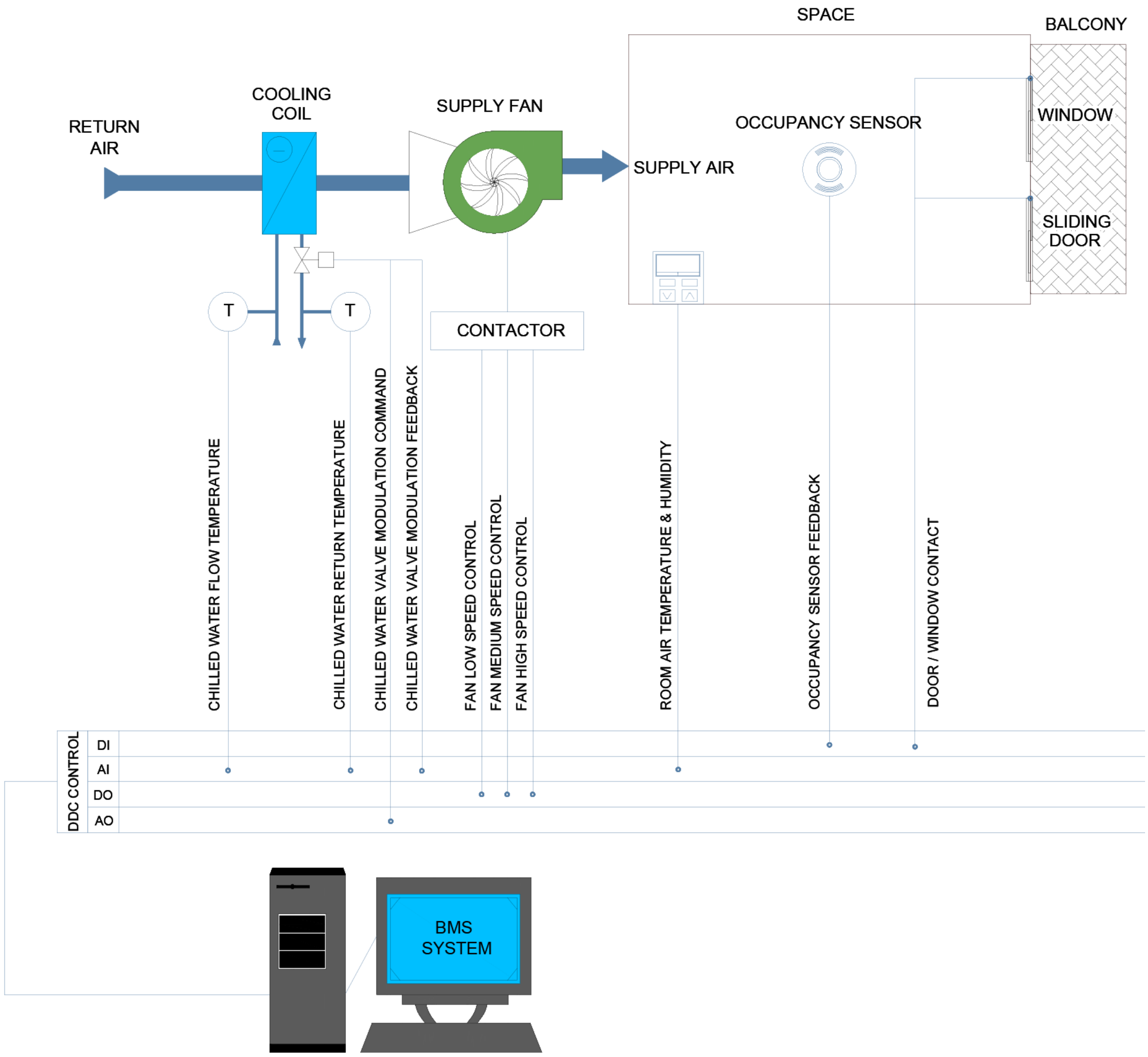



Fig. 502.17(1): Control Schematic of AC Zone

ENERGY EFFICIENCY

### Sequence of Operation

**Occupancy Sensor:** The occupancy sensor will define the occupancy mode of the zone. In case no occupancy is detected for 30 minutes, the sensor will send signal to DDC controller which will automatically increase the temperature set-point thereby modulating the motorised valve to reduce the fan speed. The system will then operate in unoccupied mode. The off-hour controls, setback controls, guest room HVAC set-point controls should be in compliance with Section 6.4.3.3 of ASHRAE 90.1 standard, for default controls during unoccupied mode.

**Door/ Window interlock:** When the door / window which are connected to outdoors are kept open for certain period of time, the DDC controller will send signal for motorised valve to close and fan to turn-off. DDC controller generates an alarm in CCMS, thereby preventing energy wastage.

Note: *The control sequence may vary based on the system selection. The given sequence is not be considered as a standard reference. Section 6.4.3.3 of ASHRAE 90.1 standard, provides additional guidance.*

## COMPLIANCE DOCUMENTATION

**Table 502.17(1) - Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Detailed description and specifications of the proposed control system.<br>2. Mechanical drawing indicating the location of thermostat and occupancy sensor. |
| Construction Completion Application | 1. Final approved mechanical drawing showing the location of thermostat and occupancy sensor.<br>2. Control schematic layout to indicate the integration of door/ window interlock and occupancy sensor with air-conditioning.<br>3. Technical data sheet of thermostat with temperature and velocity control option. |
| After Completion | 1. CCMS input and output point summary report highlighting the digital inputs of door/window interlock with air conditioning system. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, Section 6.4.3: Controls and Diagnostics.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE 62.1-Ventilation for Acceptable Indoor Air Quality.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2017). ASHRAE 189.1- Standard for the Design of High-Performance Green Buildings.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.18 COOLING OF CORRIDORS AND PUBLIC AREAS

Platinum Sa'fa

### INTENT

To utilise renewable energy based systems for cooling open spaces thereby reducing associated carbon emissions.

### REQUIREMENT

For Platinum Sa'fa and for all new buildings other than villas, all open corridors and open public areas shall be cooled by use of renewable energy systems.

### SIGNIFICANCE

During summer months, building occupants and visitors accessing open corridors and public spaces are often exposed to high temperatures, which leads to thermal discomfort. This discomfort if addressed, would encourage people to use outdoor space more often. This would not only be beneficial for human health but also promotes efficient use of outdoor spaces.

Cooling of corridors and outdoor spaces through building systems would increase the energy consumption of the building and thereby increased operating cost. However, cooling of these spaces by using renewable energy systems would help to cut the overall building energy cost, energy demand and reduce carbon emissions.

### APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(3) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires the project team to utilise various innovative cooling strategies to reduce thermal discomfort conditions in open corridors and open public areas. Renewable energy systems should be used for implementing these cooling technologies.

Evaporative cooling (direct / indirect) is a commonly used method to cool open spaces because of its high energy efficiency and it can be powered by an on-site renewable energy system.

In evaporative cooling (direct / indirect) when air blows through wet medium or atomised water, some of the water droplets gets transferred to the air thereby lowering air's dry bulb temperature. The cooling effect depends upon the temperature difference between dry and wet bulb temperatures, the pathway and velocity of the air and the quality and condition of medium.

Direct evaporative cooling (DEC) is the process by which the primary airstream comes in direct contact with the water, either by an extended wetted surface material as shown in fig. 502.18(1) or with a series of spray nozzles. Indirect evaporative cooling (IEC) combines the benefits of evaporative cooling effect for sensible cooling without the addition of moisture into the primary air stream. During this process, a secondary air source is used to remove heat from the primary air using a heat exchanger as shown in fig. 502.18(2). Indirect application has an added benefit of lowering the wet-bulb temperature of primary air.

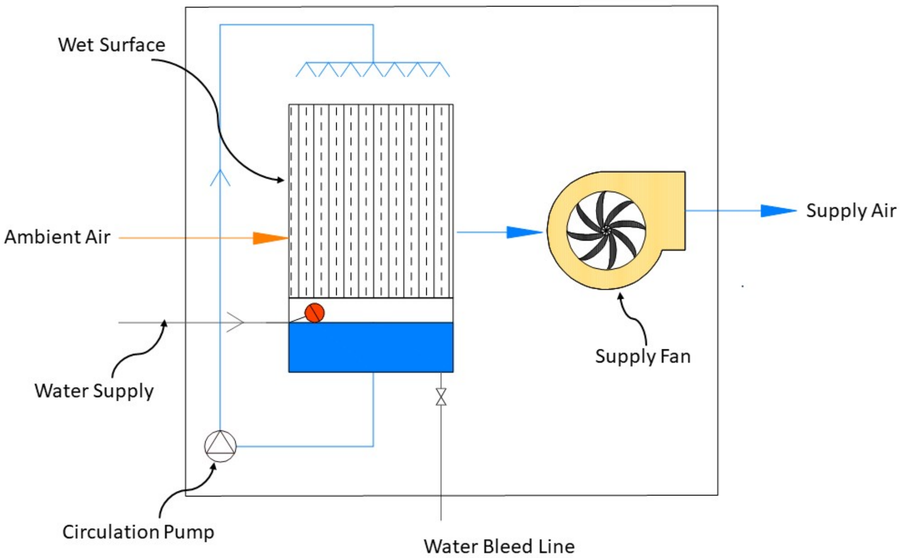



Fig. 502.18(1): Schematic Of Direct Evaporative Cooling

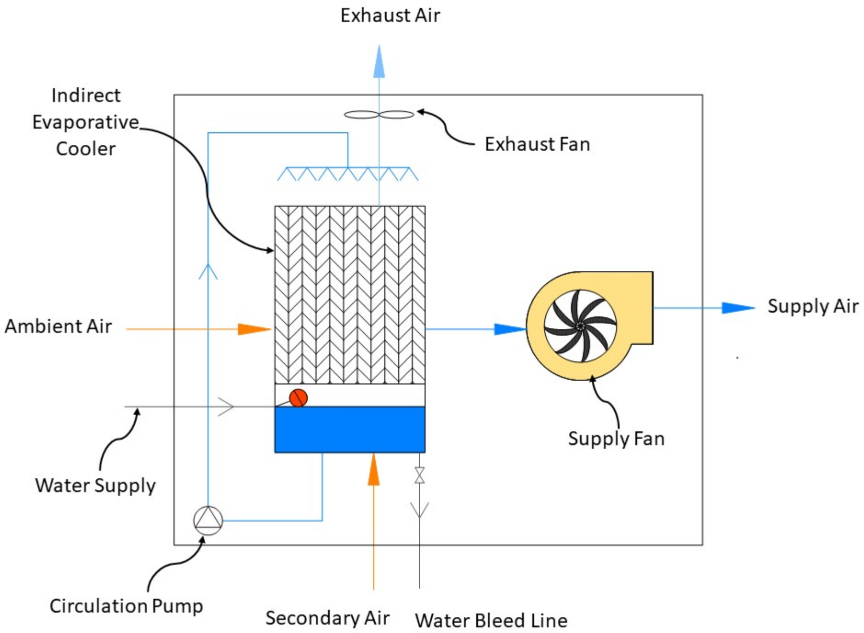



Fig. 502.18(2): Schematic of Indirect Evaporative Cooling

The project team can utilise any of the cooling strategies i.e. either direct evaporative cooling, indirect evaporative cooling or direct-indirect evaporative cooling.

The psychometric process of direct and indirect evaporative cooling is shown in fig. 502.18(3).

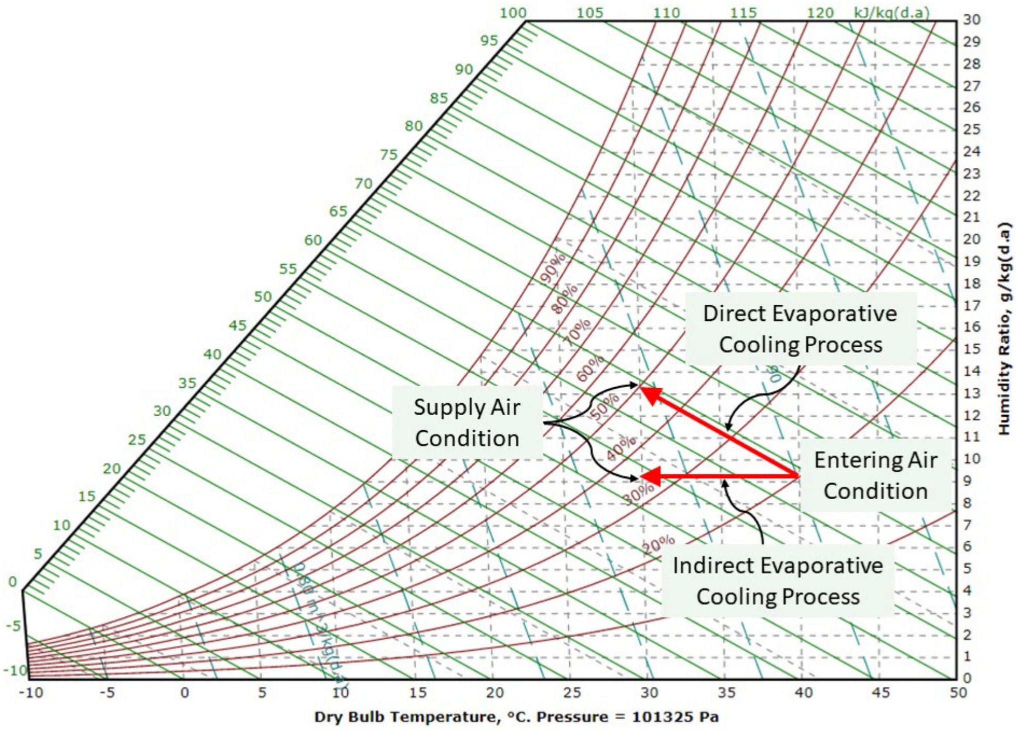



Fig. 502.18(3): Psychometric Process of Direct and Indirect Evaporative Cooling

Direct evaporative cooling effect can also be achieved by atomisation of pure clean fresh water using misting fan that can be installed in the open corridors and open public spaces (fig. 502.18(4)).

Fig. 502.18(4): Mist Fan Installed in Public Space

To ensure that the evaporative water is always safe and clean, treated water must be used and legionella risk assessment must be evaluated as outlined in *Regulation 406.01: Legionella Bacteria and Building Water Systems.*

## COMPLIANCE DOCUMENTATION

**Table 502.18(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Open corridor and open public space mechanical drawing.<br>2. Calculations stating the estimated annual energy consumption for the proposed cooling system.<br>3. Renewable energy system specification, including generation capacity. |
| Construction Completion Application | 1. Final approved open corridor and open public space mechanical drawing.<br>2. Technical data-sheet of the renewable energy system including updated renewable energy simulation report. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications: Chapter 52, Evaporative Cooling.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.19 AIR CONDITIONING OF PARKING AREAS

Golden Sa'fa

### INTENT

To provide thermally comfortable environment to pedestrians and users in parking areas.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, if air conditioning system is installed for cooling of parking area and in case of shortage in condensation water collected for such purpose, an indirect evaporative cooling system must be used, provided that the design comfort temperature is no less than 28 °C.

### SIGNIFICANCE

Due to hot climatic conditions and heat dissipation from vehicles, enclosed parking areas become uncomfortable for users. To avoid this, thermally comfortable walking lanes and spaces in parking areas are required. Normally, for parking spaces it is not necessary to maintain the same temperature as that of a typical air conditioned space and hence these spaces should be maintained at 28°C or more to avoid energy wastage.

In hot and humid climate, large portion of energy is consumed in HVAC system for cooling, filtering and dehumidifying the air. This generates condensate water, which is typically drained off. Re-using condensate water to cool parking areas reduces the ambient temperature and also condensate water is not wasted. Alternative option to cool parking areas and other public areas is to use conventional vapor compression refrigeration-based AC systems or evaporative cooling system. Since conventional systems use more energy, evaporative cooling systems are preferred. Also, indirect evaporative cooling system is environment friendly, as it is a refrigerant-free system. This system also requires less installation costs and maintains good air quality.

### APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Project team can consider utilising condesate water and/or evaporative cooling to cool the walking lanes and other public spaces in the parking areas. When condensate water is not adequate, indirect evaporative cooling system must be utilised in ensuring the comfort temperature is maintained not less than 28 °C.

The indirect evaporative cooling lowers the temperature of primary air via heat exchanger arrangement, in which secondary air stream is cooled by water and which in turn cools the primary air stream. In this process, the cooled air never comes in direct contact with water or environment. Typical indirect evaporative cooling system, delivering cold air to parking areas is shown in fig. 502.19(1).

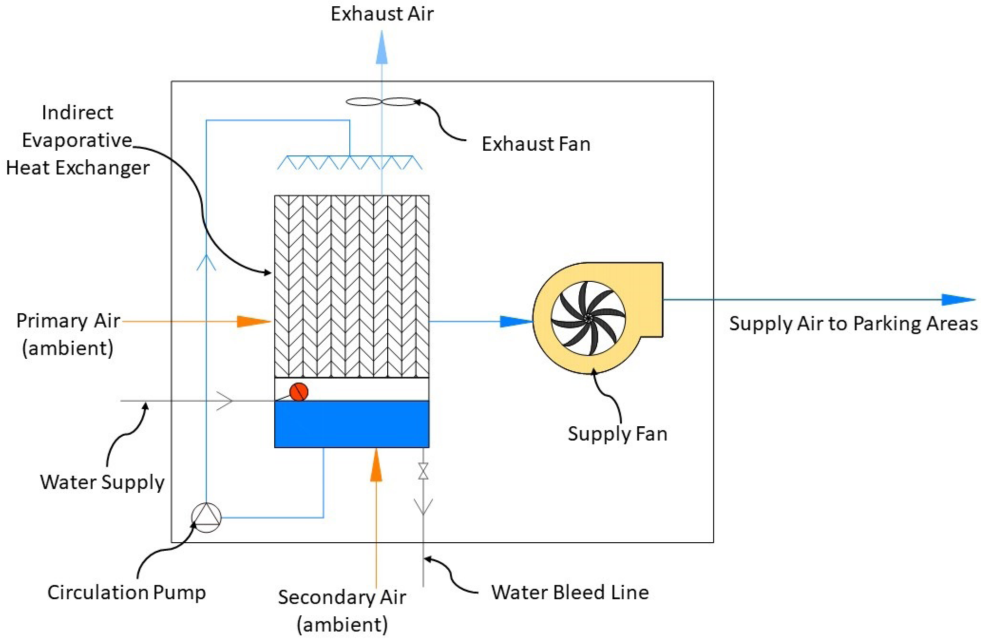



Fig. 502.19(1): Indirect Evaporative Cooling System

The changes in temperature and relative humidity of the air in a typical indirect evaporative cooling system, is shown in fig. 502.19(2).

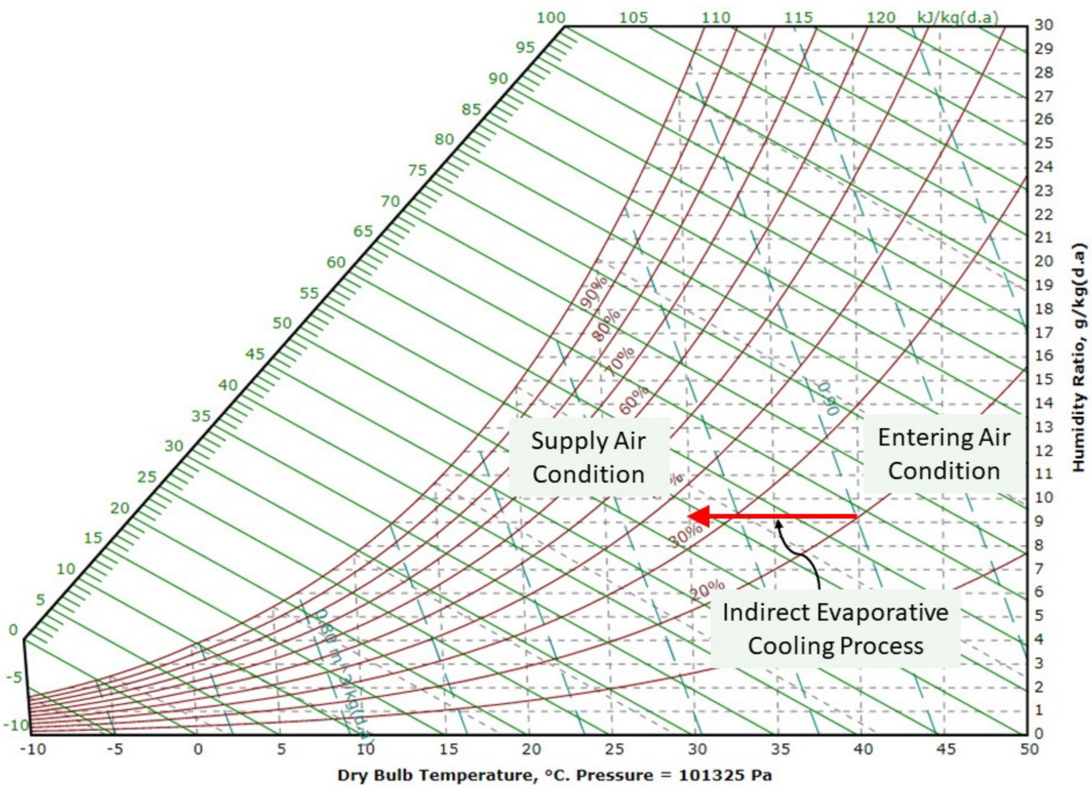



Fig. 502.19(2): Psychrometric Chart showing the Outside Air Condition and Supply Air from Indirect Unit

To ensure that the circulation water is always safe and clean, treated water must be used and legionella risk assessment must be evaluated as outlined in *Regulation 406.01: Legionella Bacteria and Building Water Systems*.

ASHRAE Handbook—HVAC Applications, Chapter 52: Evaporative Cooling, provides additional guidance on evaporative cooling.

## COMPLIANCE DOCUMENTATION

**Table 502.19(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Air-conditioning layout for parking spaces.<br>2. Indirect evaporative cooling system specification.<br>3. Condensate water calculation (if applicable). |
| Construction Completion Application | 1. Final approved layout showing the location of evaporative cooling system and capacity.<br>2. Indirect evaporative cooling system technical data-sheet. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications: Chapter 52, Evaporative Cooling.

Zhiyin Duan, Changhong Zhan, Xingxing Zhang, Mahmud Mustafa, Xudong Zhao, Behrang Alimohammadisagv, Ala Hasan c. (2012). Indirect evaporative cooling past, present and future potentials. Renewable and Sustainable Energy Reviews 16 (2012) 6823–6850.

# CHAPTER 2 - CONSERVATION AND EFFICIENCY: BUILDING SYSTEMS



## 502.20 AIR CONDITIONING OF INDUSTRIAL BUILDINGS

Silver Sa'fa

### INTENT

To enhance energy efficiency in industrial buildings by utilising environment friendly evaporative cooling techniques.

### REQUIREMENT

For all industrial buildings, where air conditioning is required for areas other than areas where special systems are used for manufacturing process, air conditioning shall be achieved by using indirect evaporative cooling system. This system shall be used, provided the design comfort temperature is no less than 28 °C.

### SIGNIFICANCE

Due to high volume and high internal thermal load in industrial buildings, cooling energy requirements are high. More energy is consumed when using conventional vapor compression refrigeration-based AC systems. This necessitates the need of unconventional cooling system that consumes less energy and with less impact on the environment. One of the commercially viable sustainable alternatives to conventional cooling system is evaporation based cooling technique (evaporative cooling system), specifically the indirect type that cools the air without adding moisture into it.

The indirect evaporative cooling system helps to reduce the equipment operating cost by 60% to 75% (ASHRAE Handbook - HVAC Applications; Chapter 52 Evaporative Cooling) as compared with vapor compression refrigeration-based AC systems. It is environment friendly as it is a refrigerant-free system. This system also requires less installation costs and maintains good air quality when compared to conventional AC systems.

### APPLICABILITY

This regulation is applicable to industrial buildings. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Indirect evaporative cooling (IEC) combines the benefits of the evaporative cooling effect for sensible cooling without the addition of moisture into the primary air stream (as detailed in *Regulation 502.18: Cooling of Corridors and Public Areas*). This regulation intends the project team to utilise an indirect evaporative cooling system in industrial building spaces, except for spaces that requires precise thermal control.

A typical packaged indirect evaporative cooling (IEC) system delivering cold air to industrial building consist of a primary (supply fan) and secondary air moving device (exhaust fan), an evaporative heat exchanger, and a water collection and recirculation system that includes a wetting apparatus and pump as shown in fig. 502.20(1).

The indirect evaporative cooling lowers the temperature of primary air via heat exchanger arrangement, in which secondary air stream is cooled by water and which in turn cools the primary air stream. In this process, the cooled air never comes in direct contact with water or environment and humidity ratio of the supply air is maintained constant during process.

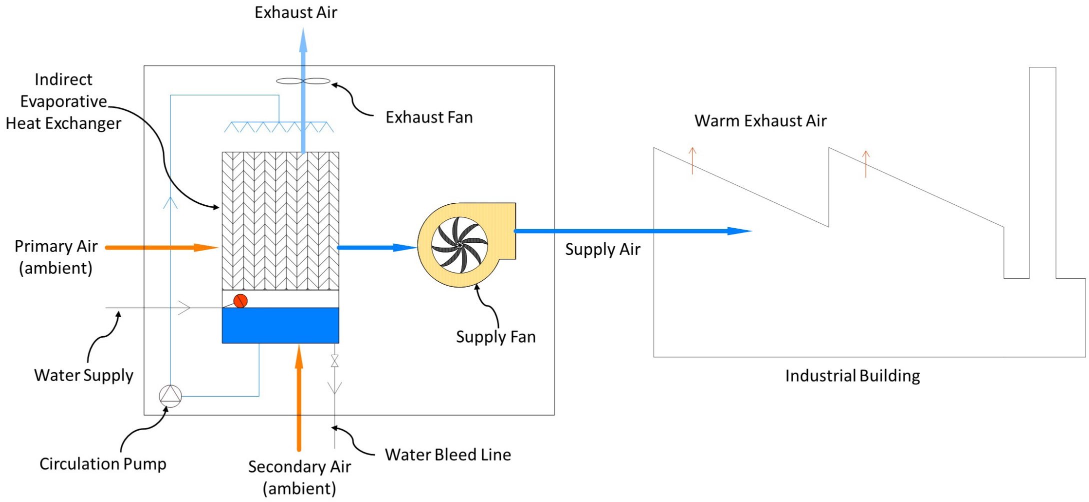



Fig. 502.20(1): Indirect Evaporative Cooling System

The fig. 502.20(2) represents the psychometric process during indirect evaporative cooling where primary air enters at 40 °C DBT and 20% RH and leaves at 30 °C DBT. The humidity ratio is constant over the process as there is no addition of moisture in the primary air stream.

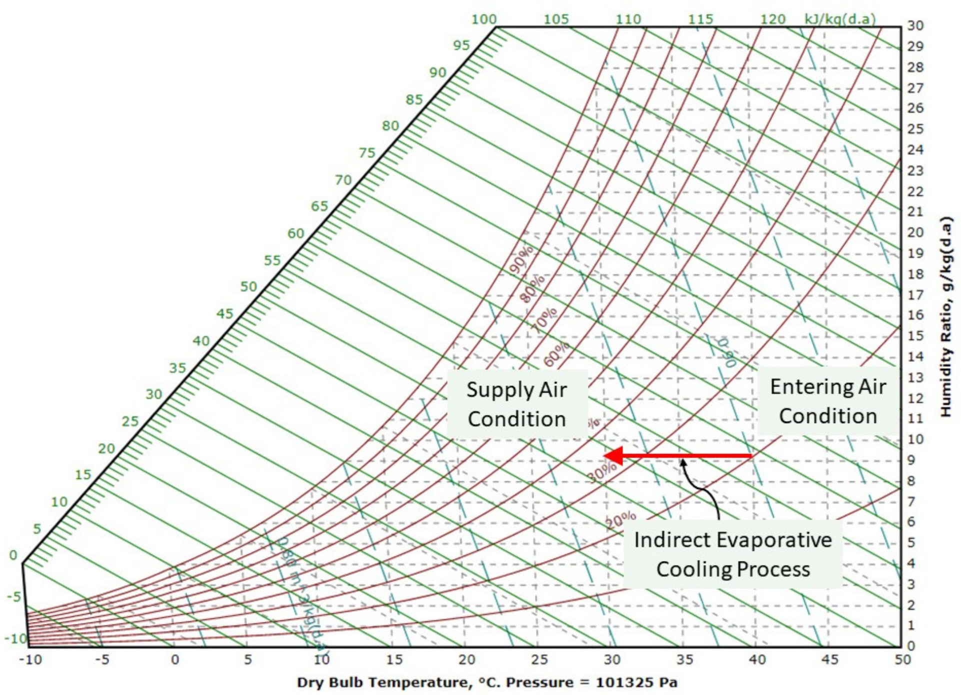



Fig. 502.20(2): Psychrometric Chart Showing The Outside Air Condition and Supply Air From Indirect Unit

Project teams must determine the cooler capacity from standard heat gain calculations (see ASHRAE Handbook - Fundamentals) or by using DM approved computer program and select equipment with appropriate effectiveness, such that comfort temperature of no less than 28 °C is maintained.

To ensure that the circulation water is always safe and clean, treated water must be used and legionella risk assessment must be evaluated as outlined in *Regulation 406.01: Legionella Bacteria and Building Water Systems*.

ASHRAE Handbook—HVAC Applications, Chapter 52: Evaporative Cooling, provides additional guidance on evaporative cooling.

## COMPLIANCE DOCUMENTATION

**Table 502.20(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Air-conditioning layout for the building<br>2. Indirect evaporative cooling system specification. |
| Construction Completion Application | 1. Final approved layout showing the location of evaporative cooling system and capacity.<br>2. Indirect evaporative cooling system manufacturer data sheet. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2015). ASHRAE Handbook—HVAC Applications: Chapter 52, Evaporative Cooling.

Zhiyin Duan, Changhong Zhan, Xingxing Zhang, Mahmud Mustafa, Xudong Zhao, Behrang Alimohammadisagv, Ala Hasan c. (2012). Indirect evaporative cooling past, present and future potentials. Renewable and Sustainable Energy Reviews 16 (2012) 6823–6850.

## 502.21 COOLING WATER PURIFICATION TO ENHANCE COOLING EFFICIENCY

Silver Sa'fa

### INTENT

Purify cooling water to avoid fouling, corrosion and formation of scales in pipelines thereby enhancing efficiency and energy savings.

### REQUIREMENT

For all new buildings other than villas, chilled water system shall include water purification unit to prevent any calcification in the system. This shall also enhance the heat exchanger performance.

### SIGNIFICANCE

The poor water quality in the chilled water network will lead to microbiological fouling, corrosion and scale formation on the internal surface of pipes, cooling coils and valves. This result in wastage of energy, deteriorate system performance and sometimes leads to early replacement of equipment and components.

The cooling water purification is to ensure that chilled water systems (chillers, air handlers, heat exchangers, etc.) maintains its efficiency and achieves or extends its life expectancy.

### APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation aims to control the water quality of cooling water used in closed water system by implementing an appropriate chemical water treatment programme.

A typical chilled water system constitutes a wide range of metallic and non-metallic components. Generally, most of the metallic components are prone to microbially influenced corrosion and pitting corrosion. The non-metallic components such as seals, diaphragms and linings may subject to chemical attack which could cause swelling, softening and cracking etc.

Therefore, it is required to implement a chemical treatment programme for water treatment in a closed water system (i.e. chemical dosing), which is intended for automatic monitoring and controlling of the concentration of chemical dose based on the chilled water quality.

The chemicals used in the system shall have properties of inhibiting corrosion, scale and biofouling. The dosages and target concentrations must be specified and documented by the product supplier.

The common corrosion and scale inhibitors used in closed systems are listed in Table 502.21 (1).

Table 502.21 (1): Common Corrosion and Scale Inhibitors (BS 8552)

| Component | Inhibitor Function |
|---|---|
| Nitrite | Corrosion inhibitor for ferrous material |
| Molybdate | Corrosion inhibitor |
| Azoles | Corrosion inhibitors for copper and copper alloys |
| Phosphate | Corrosion inhibitors for steel |
| Phosphonates | Scale and corrosion inhibitor |
| Silicates | Corrosion inhibitors for steel, copper alloys and aluminum |
| Tannins | Film forming corrosion inhibitor and oxygen scavenger |
| Borate | pH buffer, biocide, corrosion inhibitor |
| Sulfite | Oxygen scavenger |
| Polymers | Scale inhibitor |

The regular monitoring of water samples is essential to evaluate the effectiveness of chemical treatment programme, to ensure that the results are accurate. The monitoring must be carried out using appropriate methodologies and equipment, detailed guidance on sampling and monitoring of water is given in BS 8552.

The sampling point location for different samples are mentioned in Table 502.21 (2).

Table 502.21 (2): Selection Of Sampling Points (BS 8552)

| Type of Sample | Sampling Point | | |
|---|---|---|---|
| | Full bore drain point | Reduced bore drain point | Pressure test point |
| Settled solids | Yes | No | No |
| Suspended solids | Yes | Yes | No |
| “Total” metals | Yes | Yes | No |
| Dissolved solids | Yes | Yes | Yes |
| Microbiology | Yes | Yes | Yes |
| Dissolved oxygen | No | See BS 8552, A.2 | See BS 8552, A.2 |

The chilled water chemical analysis must be conducted at regular frequency as per BS 8552 and reports must be maintained on-site for records and further analysis.

## COMPLIANCE DOCUMENTATION

Table 502.21(3): Documents Required

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Final approved layout of plant room chilled water showing the location of chilled water chemical dosing system.<br>2. Chemical dosing system manufacturer data. |
| After Completion | 1. Chilled water chemical analysis report. |

## REFERENCES AND ADDITIONAL INFORMATION

Brown R (ed.) (2013). BSRIA BG50: Water Treatment for Closed Heating and Cooling Systems.

British Standard. (2012). BS 8552 - Sampling and monitoring of water from building services closed systems. Code of Practice.

## 502.22 HEAT EXCHANGERS

Golden Sa'fa

### INTENT

To optimally design and select heat exchangers for better performance and minimal energy loss.

### REQUIREMENT

For Golden and Platinum Sa'fa and all new buildings other than villas:

1. Heat exchangers shall be designed and certified in accordance with the following:
   - AHRI Liquid to Liquid heat exchanger certification program.
   - The tolerances shall be as per ANSI / AHRI 400.
2. Selection shall consider thermal block load, pressure drop, thermal performance, temperature and provision for future additional loads.

### SIGNIFICANCE

AHRI performance certification programs are well recognised as a performance verifier for heating, air conditioning, and commercial registration equipment. Product connected to a program is tested annually to verify that they conform to specified performance ratings in data sheets. This is useful as the buyers can evaluate and make a fair comparison while selecting heat exchangers. For the project team this reduces time incurred in the heat exchanger selection process and ensures that the optimised equipment is selected.

### APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

The concept of district cooling, which has both economic and environmental benefits has been widely adopted in the region. The district cooling system also offers several benefits such as operating flexibility, saving of space, reduction in maintenance costs, etc.

As indirect cooling systems are common in district cooling and have several benefits over direct cooling systems, it is important to select high-performance heat exchangers.

The most important factors that influence the selection of heat exchangers which the project team must consider are as follows:

1. Building peak cooling load demand considering provision of future load.
2. Inlet and outlet temperatures on the primary and secondary sides.
3. Maximum allowable pressure drop on the primary and secondary sides.
4. Operating pressure on the primary and secondary sides.
5. Flow rate on the primary and secondary sides.

In addition to selection of heat exchanger as per the above requirements, all the heat exchangers selected for the project must be AHRI certified under ANSI/AHRI Standard 400 (IP) program for performance rating of Liquid to Liquid Heat Exchangers to comply with this regulation.

The ANSI/AHRI standard 400 program applicable to the Liquid to Liquid Gasketed Plate-type Heat Exchangers (LLHE) & Liquid to Liquid Brazed & Fusion Bonded Plate-type Heat Exchangers (LLBF).

For detailed program scope and product specific rating tolerances refer the latest edition of product specific operational manual (AHRI LLHE/LLBF OM) listed in reference section.

The AHRI certification is required to ensure a manufacturer's stated performance will be met and operate as designed and also to ensure standard tolerances followed by all manufacturers. As a standard practice by manufacturers, the AHRI certified equipment are delivered with AHRI Mark as shown below in fig. 502.22(1).

AHRI Certified Program specific mark is used to identify the certified performance ratings, in accordance with the rating standard noted on the mark, for an AHRI certified product.


Fig. 502.22(1): Plate Heat Exchanger with AHRI Certified Mark

## COMPLIANCE DOCUMENTATION

**Table 502.22(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Final approved mechanical drawing showing the location of heat exchanger.<br>2. Heat exchanger technical data-sheet.<br>3. AHRI test certificate. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

ANSI/AHRI Standard 400 (IP). (2015). Standard for Performance Rating of Liquid to Liquid Heat Exchangers.

AHRI LLHE OM. (2018). Liquid to liquid heat exchangers certification program (LLHE) operations manual.

AHRI LLBF OM. (2018). Liquid to liquid brazed and fusion bonded plate heat exchangers certification program (LLBF) operations manual.

# CHAPTER 3 - COMMISSIONING AND MANAGEMENT



## 503.01 COMMISSIONING OF BUILDING SERVICES – NEW BUILDINGS

Silver Sa'fa

### INTENT

To ensure the installed building services operate as designed and to be compliant with the local and international standards.

### REQUIREMENT

For all new air conditioned buildings other than villas having a cooling load of 1 MW or greater, commissioning of air distribution systems, water distribution systems, lighting, central control and building management systems, refrigeration systems and boilers must be carried out.

1. Commissioning must be carried out in accordance with the CIBSE Codes listed below or other commissioning standard or code approved by Dubai Municipality (DM).
   - 1.1. 'The Chartered Institution of Building Services Engineers (CIBSE) Commissioning Code, Air Distribution Systems, Code A-2006'
   - 1.2. 'CIBSE Commissioning Code, Water Distribution Systems, Code W-2010'
   - 1.3. 'CIBSE Commissioning Code, Lighting, Code L-2018'
   - 1.4. 'CIBSE Commissioning Code, Automatic Controls, Code C-2001' for central control and Building Management System (BMS)
   - 1.5. 'CIBSE Commissioning Code R: 2002 Refrigeration Systems
   - 1.6. 'CIBSE Commissioning Code B: 2002 Boilers'
2. Commissioning results must be recorded and available for inspection by DM.
3. A system manual, documenting the information required to allow future operations staff to understand and optimally operate the commissioned services, must be developed and provided to the building operator, upon completion of commissioning works.

### SIGNIFICANCE

Commissioning is an important activity for all the buildings. Without proper commissioning, even buildings with high performance design with high energy efficient equipment, system and control, would not provide the expected outcome of energy savings and occupant comfort. When systems fail to function as intended, the comfort of building occupant is affected. Also, this increases the energy consumption of the building and operation and maintenance costs.

A properly commissioned building ensures the performance of the system to be within the acceptable tolerance limits, conforms to design and in line with local and international standards. Any shortfall or the issues found during commissioning can also be rectified prior to building occupancy. This ensures systems in the building provide correct conditions and services to suit the occupants.

The system performance and testing results are well documented during the commissioning process and hence will be helpful for building operational staff.

## APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation states that all the new buildings (other than villas) having a cooling load of 1 MW or greater, must ensure that all building services like air distribution systems, water distribution systems, lighting, central control and building management systems, refrigeration systems and boilers are commissioned in accordance with CIBSE Commissioning Code or any other code or standard approved by Dubai Municipality (DM).

Commissioning process is different from HVAC TAB (Testing, Adjusting and Balancing). TAB is used to achieve proper operation of HVAC systems by performing air and hydronic measurement and adjust it based upon the design flows to achieve optimum performance. Whereas, commissioning is the process of assuring that all systems and components of a buildings are designed, installed, tested, operated and maintained according to the operational requirements of the owner, design and commissioning specifications.

Commissioning process is a quality driven process to achieve, document and evaluate the results of building performance to meet the design intent as well as operational needs. The manufacturing and installation of the systems have complex procedures; hence it is important that proper testing and commissioning is carried out, to ensure correct and optimised operation of systems.

To ensure that the commissioning is carried out in accordance with the code used, the following process must be followed by project teams:

### 1. Commissioning Plan

Commissioning plan should be developed that would outline the scope, the responsibilities, processes and schedules considering the interdependencies of all the building services. The commissioning plan developed shall at least contain the following information:

- General information of the project (project location, size, type of use, timelines, etc.)
- Details of commissioning team for each stage of commissioning (commissioning team member with contact information)
- Systems to be commissioned and scope of work (a detailed scope of work highlighting which systems will be commissioned and what commissioning tasks will be carried out)
- Commissioning schedule (highlighting dates when key commissioning activities need to be completed in line with project construction schedule)
- Roles and responsibility of each commissioning team members
- Documentation requirements associated with commissioning process

### 2. Construction Review

Construction drawings and technical submittal should be reviewed, to ensure that all features and components that are necessary to perform commissioning of the system is considered.

### 3. Pre-Commissioning

Systematically verify and ensure that all the building systems are physically complete, correctly installed and ready for commissioning. Identify any issues that may lead to functional performance problems during commissioning. Project team to follow the pre-commissioning and commissioning procedure in accordance with below CIBSE Commissioning Code or any other code or standard approved by DM.

- CIBSE Commissioning Code A: Air Distribution Systems
- CIBSE Commissioning Code B: Boilers
- CIBSE Commissioning Code C: Automatic Controls
- CIBSE Commissioning Code L: Lighting
- CIBSE Commissioning Code R: Refrigeration
- CIBSE Commissioning Code W: Water Distribution Systems

### 4. Commissioning

Commissioning involves functional testing to document and verify proper operation of equipment and systems in accordance with building specifications, design parameters as outlined in the commissioning plan. The project team can refer detail procedure and checklist pertaining to each element of commissioning from BSRIA guide BG 11 Commissioning Job Book.

It should be ensured that all performance tests required in accordance with the commissioning plan are completed and the required performance outcomes have been met and recorded in the approved checklist. After completion of functional testing, a final commissioning report for all systems, commissioning completion certificates including issue log summary and corrective actions taken, should be prepared and submitted as part of DM submission.

### 5. Operation & Maintenance (O&M) Manual and Building logbook

O&M Manual and Building logbook provides necessary information to building operator / owner, to safely and effectively operate the building and sustain its performance over long term. It should be ensured the same has been completed and reviewed to reflect the accurate details of the system.

## COMPLIANCE DOCUMENTATION

**Table 503.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Final commissioning report for all systems as per required standards including commissioning completion certificates.<br>2. Operation and maintenance manual / systems manual.<br>3. Summary of issue logs and corrective actions taken. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION


The Chartered Institution of Building Services Engineers. (2006). CIBSE Commissioning Code A: Air Distribution Systems.

The Chartered Institution of Building Services Engineers. (2002). CIBSE Commissioning Code B: Boilers.

The Chartered Institution of Building Services Engineers. (2001). CIBSE Commissioning Code C: Automatic Controls.

The Chartered Institution of Building Services Engineers. (2018). CIBSE Commissioning Code L: Lighting.

The Chartered Institution of Building Services Engineers. (2002). CIBSE Commissioning Code R: Refrigeration.

The Chartered Institution of Building Services Engineers. (2010). CIBSE Commissioning Code W: Water Distribution Systems.

The Building Services Research and Information Association. (2010). BG 11: Commissioning Job Book - A framework for managing the commissioning process.

## 503.02 RE-COMMISSIONING OF BUILDING SERVICES – EXISTING BUILDINGS

Silver Sa'fa

### INTENT

To ensure the installed building services continue to operate as designed for optimal performance.

### REQUIREMENT

For all existing buildings other than villas having a cooling load of 2 MW or greater, recommissioning of ventilation, water systems central plant, lighting and control systems must be carried out, at least once in every 5 years. Where possible, the recommissioning works should be carried out in accordance with the requirements of *Regulation 503.01*. At a minimum, systems that required to be recommissioned should ensure that:

1. The amount of fresh air supplied from each ventilation outlet is within ± 5% of the design volume.
2. The volume of the chilled water supplied to any cooling coil is within ± 5% of the design volume.
3. All mechanical devices, including but not limited to dampers, valves, fans, pumps, motors and actuators, operate freely and as required.
4. Filters and filter housings are sound and secure and that no unfiltered air bypasses the filter assembly.
5. Heat recovery systems are operating as designed.
6. Central plant equipment is tested to ensure that it operates through the full range of its capacity and that all design parameters are achieved.
7. All lighting systems and their controls operate as designed and that required levels of illumination are achieved.
8. Controls are checked and re-calibrated for operation, as designed. And to also ensure that any remote devices respond as required.
9. Pipe and ducts are inspected to ensure there is no air or liquid leakage.

Commissioning results must be recorded and available for inspection by Dubai Municipality.

Where original design requirements are not available, the contractor is to certify that after recommissioning, the installed systems are operating correctly.

## SIGNIFICANCE

The new buildings are expected to perform at the designed levels during occupancy. However, over a period of time, the building systems do not function as they are intended to. Recommissioning is a process that checks the operation and maintenance of buildings to identify ways to improve overall performance and to be in line with the design parameters.

Recommissioning of existing buildings helps to identify and address system inefficiencies, that can cause building owners / tenants to incur high operating and maintenance costs. Recommissioning also helps to enhance building's energy performance and evaluate and improve building occupant's thermal comfort level. Recommissioning helps the building operating staff to have the knowledge and documents needed to service and maintain the building.

## APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation ensures that all buildings with a cooling load of 2 MW or greater continue to operate as designed for its full operating life.

Recommissioning is a systematic process of ensuring the building systems such as HVAC, lighting and control systems that have been already commissioned, continue to operate optimally to meet the current building needs. Recommissioning also identify ways to improve overall building performance.

Prior to commencing recommissioning works, the following information must be gathered, which would form the basis of recommissioning works for the building:

- Commissioning Reports
- O&M Manuals
- Testing, adjusting and balancing (TAB) reports
- As-built drawings
- An equipment list with nameplate information, dates of installation and submittals including pump curves and fan curves
- Current maintenance logs or schedules
- Control system documentation, such as sequences of operation, special control strategies, control diagrams, points list, control programming, etc.

This regulation intends the following process be implemented as a part of recommissioning.

### 1. Re-Commissioning Plan

The recommissioning plan for the existing building must be developed that outlines the current facility requirements, sequence of operation and O&M plan. The systems and parameters that must be verified as part of this regulation, roles and responsibility and documentation requirements associated with the recommissioning process.

### 2. Re-Commissioning Tests

The recommissioning of the systems must be carried out as indicated in the recommissioning plan and should cover at least the systems as stated in the requirement section of this regulation. Tests shall record if the systems are performing as per the requirements stated in this regulation. The recommissioning procedure followed for any system must be in accordance with regulation 503.01 and relevant CIBSE codes.

### 3. Implementation

During implementation, corrective action needs to be taken on all the issues identified during the recommissioning tests and which are not in line with requirements specified in the regulation for all the systems.

The corrective actions must be recorded in the final recommissioning reports or building logbook and shall be available on-site for DM inspection.

The final recommissioning report must include all inspection reports, actual results, corrective action taken, updated sequence of operation and operational schedule if any. The final recommissioning reports must be in line with recommissioning plan and shall be available on-site for DM inspection.

In absence of design data, the competent professional carrying out the recommissioning shall certify that the systems are checked, installed and operating correctly. This will be based on their experience and understanding of the building systems with available information and test results.

## COMPLIANCE DOCUMENTATION

**Table 503.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers. (2006). CIBSE Commissioning Code A: Air Distribution Systems.

The Chartered Institution of Building Services Engineers. (2002). CIBSE Commissioning Code B: Boilers.

The Chartered Institution of Building Services Engineers. (2001). CIBSE Commissioning Code C: Automatic Controls.

The Chartered Institution of Building Services Engineers. (2018). CIBSE Commissioning Code L: Lighting.

The Chartered Institution of Building Services Engineers. (2002). CIBSE Commissioning Code R: Refrigeration.

The Chartered Institution of Building Services Engineers. (2010). CIBSE Commissioning Code W: Water Distribution Systems.

The Building Services Research and Information Association. (2010). BG 11: Commissioning Job Book - A framework for managing the commissioning process.

# 503.03 ELECTRICITY METERING

Silver Sa'fa

## INTENT

To measure and track energy consumption for the building and its major energy consuming systems for effective energy management and cost allocation.

## REQUIREMENT

For all new buildings, meters must be installed to measure and record electricity demand and consumption of the facility as a whole. It must also provide accurate records of consumption and must be complying with DEWA specifications. All meters should be approved by DEWA.

1. For all buildings having a cooling load of at least 1 MW or gross floor area of 5,000 m2 or greater, additional electrical sub-metering (of tariff class accuracy) must be installed to record demand and consumption data for each major energy-consuming system in the building. At a minimum, all major energy consuming systems with a load of 100 kW or greater must be sub-metered.
2. The building operator shall be responsible for recording the details of the energy consumption for the building and for ensuring that major electricity uses are sub-metered. Records must be kept for 5 years.
3. Each individual tenancy in the building must have a sub-meter installed when a building tariff meter is not present. These sub-meters should only be for demand management and electricity cost allocation purposes.
4. Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) is installed, metering must be connected to allow real-time profiling and management of energy consumption.
5. Virtual meters using run-hours are not acceptable as sub-meters.

## SIGNIFICANCE

It is difficult to monitor the energy consumption as a whole, for the buildings with multiple tenants. This data would be vital in determining building's overall energy performance. It will also potentially enable tenants in multi-occupancy buildings to be charged for electricity on the basis of their actual consumption, which will give them an incentive to use electricity more efficiently.

The whole building energy metering allows the owner to analyse and track the energy consumption pattern over the period of time. This monitoring is helpful in identifying areas where improvements are required. It will also assist in planning and implementing energy saving measures.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation ensures metering infrastructure is in place to allow for data to be obtained and monitored.

Metering strategies should be considered at the design stage to ensure that the requirements of this regulation are met. Energy demand load contribution of each of the end uses must be evaluated to determine the metering strategies.

Sub-meters must be used to measure the energy consumed, based on each major energy-consuming system in the building. A reasonable provision of sub-metering is for major energy consuming system with load of 100kW or greater. Some of the major energy consuming systems (fig. 503.03(1)) in the building include elevators, chillers, HVAC equipment e.g. fans and pumps and sub-distribution boards.


Fig. 503.03(1): Sub-metering for Major Energy Consuming Systems

Additionally, all tenants must install sub-meters, if tariff meter is not installed. These meters will only be used for the demand management and the electricity cost allocation.

The sub-meters must meet the DEWA specifications and should be approved by DEWA. Virtual meters that provide the run hours details are not accepted for compliance with this regulation.

The reporting template must clearly mark the meter reference number, location of the meter, end use monitored details and the monthly meter reading. The meter reading must be recorded by the operator in the building logbook or any such records for a minimum 5 years. This recorded data should be available for DM / DEWA or its representative whenever required for inspection.

Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) are installed, metering must be connected to allow real-time profiling and management of energy consumption. Data from DMB / CCMS can generate computerised spreadsheet or trends (fig. 503.03(2)), for further analysis.

Accurate energy consumption data would enable the building owner to observe:

- Trends in energy consumption that reflect season, weekly and other operational parameters
- Comparison of current energy consumption with previous levels to evaluate changes in consumption
- Future energy use patterns if type of activity in the building varies

- Areas of energy wastage
- Benchmarking with similar facilities / typologies
- Develop performance targets for an energy management program

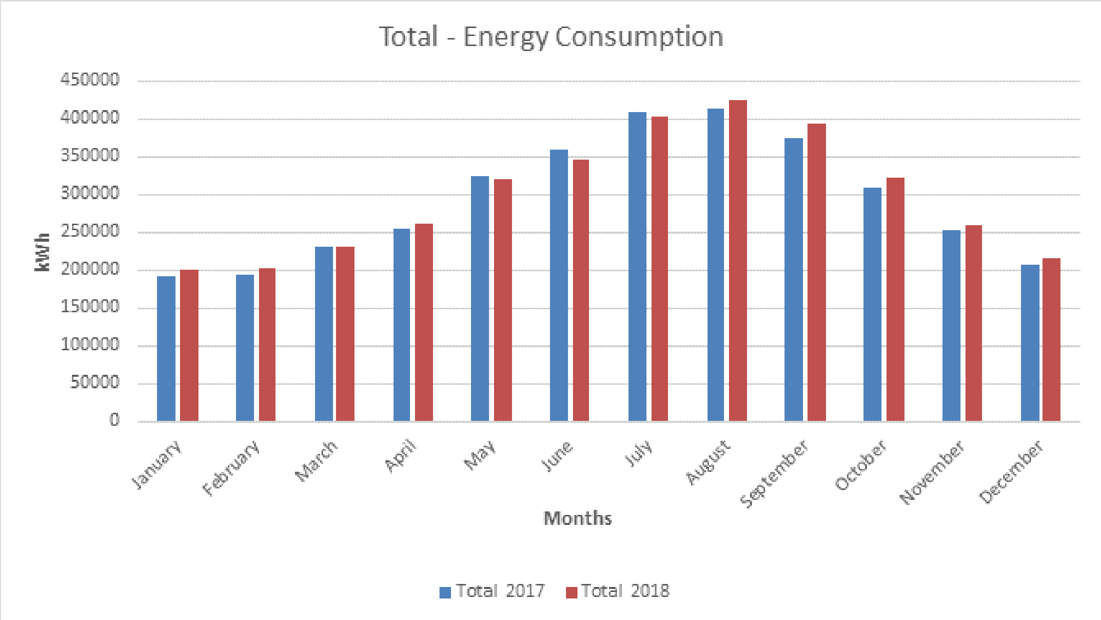



Fig. 503.03(2): Energy Performance Trend and Comparison (Sample)

During construction stage, all relevant proofs for sub-metering like technical data sheets, delivery notes, as-built drawings, metering schedule, schematic diagram of metering and the screen shots or dash boards of the BMS system should be collated for DM submissions.

## COMPLIANCE DOCUMENTATION

**Table 503.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Energy metering schematic.<br>2. Metering manufacturer data-sheet.<br>3. Delivery notes. |
| After Completion | 1. Energy consumption report. |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers. (2006). CIBSE TM22: Energy Assessment and Reporting Methodology.

# CHAPTER 3: COMMISSIONING AND MANAGEMENT



## 503.04 AIR CONDITIONING - METERING

Silver Sa'fa

### INTENT

To individually measure chilled water consumption for demand management and energy savings.

### REQUIREMENT

For all new buildings other than villas, supplied by a central air conditioning source (such as a chiller plant or district cooling) and where cooling energy is delivered individually to several consumers, meters must be installed to measure and record chilled water supply to air conditioning units. It must also provide accurate records of consumption.

A. Energy meters designed to measure the supply of chilled water must be installed for each dwelling unit, office or tenant. The measuring device must measure the water flow and supply and return temperatures to determine the temperature differential for calculating the amount of cooling energy consumed.

B. Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) is installed, metering must be connected to allow real-time profiling and management of energy consumption.

C. Meters used must be specifically designed for the measurement of chilled water and not for hot water.

D. All meters must be capable of remote data access and must have data logging capability.

E. Virtual meters using run-hours are not acceptable as sub-meters.

F. The meter readings and actual consumption details should only be for demand management and cost allocation purposes.

### SIGNIFICANCE

Air conditioning consumes maximum of energy in a building. When cost of electricity is charged to consumers based on floor area, the individual user or tenant do not have any information on the actual usage and will be unable to reduce the consumption. However, if the chilled water that is supplied to tenants is metered individually, the users will have the knowledge on the consumption pattern and will be able to optimise the usage of air conditioning.

This regulation will help the buildings to develop infrastructure, wherein the users will be able to understand actual consumption of chilled water supply. This would provide an incentive for the user to reduce or optimise the usage of air conditioning, thereby reduction in overall usage of electricity and reduced utility bills.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

For the buildings which are in use by multiple tenants and chilled water is supplied from a central chiller plant or a district cooling plant, separate chilled water meter should be provided to each individual user within the building. The meter will be used to measure the actual consumption of chilled water.

Chilled water energy meters are commonly referred as BTU meters. A BTU meter comprises of several components:

- Flow Meter installed in the line
- A temperature transmitter mounted in the supply line to measure the supply temperature
- A temperature transmitter to measure return temperature
- A Flow Computer that will compute the energy flow
- A data logger to log energy consumption data which can be accessed via USB port and/or modem for remote monitoring and recording capability

During design, BTU meter for the measurement of chilled water consumption must be considered for each individual tenant. Chilled water schematic should be developed during design stage to show the regulation compliance along with the meter schedule.

The meters should be specifically designed for measuring the chilled water only not hot water, as there are meters available in the market, which are capable of measuring both. If the building is connected to BMS or Central Control Monitoring System (CCMS) then BTU meters must be connected to it to provide the real time consumption data. Suitable provision should be provided during the design for the BMS / CCMS integration.

Post construction the project team has to provide the approved chilled water schematic showing the BTU meter requirements. The technical data sheet according to the regulation requirement must be submitted along with the delivery notes.

**Example**

The ultrasonic BTU meter can be used for residential and small tenant space where the total chilled water demand is less (fig. 503.04(1)).

Fig. 503.04(1): Ultrasonic BTU Meter

The magnetic type BTU meter can be used for larger establishments where the chilled water demand is higher (fig. 503.04(2)).

Fig. 503.04(2): Magnetic BTU Meter

The BTU meters must be selected as per the approved accuracy level from the local authority / DM or any other internationally recognised standards such as EN Standards, EN 1434.

## COMPLIANCE DOCUMENTATION

**Table 503.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Chilled water schematic layout showing the BTU meters. |
| Construction Completion Application | 1. Final approved chilled water schematic layout showing the BTU meters.<br>2. BTU meter manufacturer data-sheet.<br>3. Delivery notes. |
| After Completion | 1. Energy consumption report. |

## REFERENCES AND ADDITIONAL INFORMATION

British Standards Institution. (2018). BS EN 1434-1: Thermal energy meters. General requirements.

# CHAPTER 3: COMMISSIONING AND MANAGEMENT



## 503.05 CENTRAL CONTROL AND MONITORING SYSTEM (CCMS)

Silver Sa'fa

### INTENT

To fully control the operation of building systems thereby optimising system performance, resulting in energy savings and occupant's comfort.

### REQUIREMENT

For all new buildings having a cooling load of 1 MW or gross floor area of 5,000 $m^2$ or greater, must have a central control and monitoring system capable of ensuring that the building's technical systems operate as designed and as required during all operating conditions. The system shall provide full control and monitoring of system operations, apart from diagnostic reporting.

At a minimum, the system must control the chiller plant, heating, ventilation and air conditioning (HVAC) equipment and record energy and water consumption. It shall also monitor and record the performance of these items.

### SIGNIFICANCE

The central control and monitoring (CCMS) system helps building owners and operators to address a variety of operational goals, such as reducing energy consumption, maintenance and life-cycle costs. This will also in turn ensure occupant comfort through systematic monitoring and intelligent operations.

The CCMS also aids to improve productivity and provide healthy and safe working environment for the occupants through effective control of building HVAC system utilising intelligent controllers which can be programmed to carry out wide range of control function based on received inputs.

The effective real-time monitoring and recording of energy and water consumption helps the building operators / owners / tenants to understand the energy / water usage and identify the benchmark consumption which can be utilised to set targets and make decision regarding operating practices.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation proposes the buildings to have central control and monitoring system (CCMS) that monitor, control and record the functions of building systems.

There are number of similar terms which is used to refer CCMS such as Building Management System (BMS), Building Automation System (BAS), Building Control System (BCS), Building Energy Management System (BEMS) based on its range of monitoring and control technologies.

The CCMS can be used to monitor and control wide range of building services such as HVAC, lightings, power systems, life safety systems, plumbing systems, vertical transportation etc. At a minimum for this regulation compliance, the system must control and monitor HVAC systems (chiller plant, air handling units, fan coil units, chilled water pumps, cooling tower, VAV etc.) for its efficient operation and capability to record and track the real-time energy and water usage of a building as explained below.

**Control of HVAC system**

The automatic control and monitoring of HVAC system helps to maintain a comfortable environment and perform economically under a wide range of operating conditions.

The CCMS shall be capable to automatically calculate the cooling demand from supply/return temperature and flow rate of chilled water to decide the number of chillers, pumps and cooling towers to turn on or off in appropriate sequence to maintain equal running hours.

Similarly, the CCMS shall be integrated with all other HVAC sub-systems such as Air handling units, VAV, FCU, Energy recovery, Ventilation fans etc. The strategy for a complete HVAC system must take into account the interaction between subsystems.

The control of HVAC systems is structured into several logical layers of the traditional HVAC control architecture as shown in fig. 503.05(1).

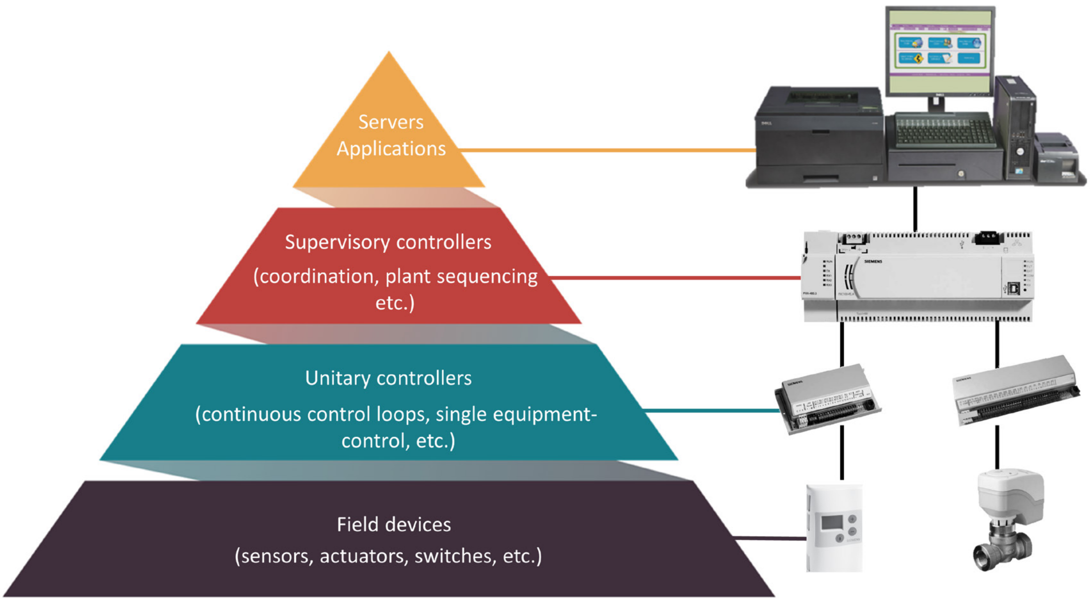



Fig. 503.05(1): Hierarchical Layers of HVAC Control Architecture

For detailed control strategies of each subsystems project team can refer to latest edition of CIBSE Guide H –Building Control System, Chapter 6 Control strategies for buildings.

### Energy and Water Monitoring

The quantity of energy and water meters must be provided in-line with the *Regulation 503.03, 503.04, 602.01* and requires it to be integrated with CCMS for real time tracking and recording.

The energy and water metering is the first step in identifying opportunities to reduce consumption and operating costs. The real time and historical data provided by meters forms the basis for decision making with respect to changes to operation practices, control strategies or capital upgrades.

All the meters installed shall have open communication protocols in order to integrate with CCMS system. The most common protocols include:

- Pulse
- Modbus RS485
- BACNet
- Ethernet
- GSM (i.e. via a telco mobile network)
- Low powered radio mesh

The CCMS is required to be commissioned at the time of the building becoming operational. Consideration must be given to the recommissioning of the system at regular intervals, which should be no longer than three years. The utility consumption data must be exported into a suitable spreadsheet or data file on a monthly basis and be backed up accordingly. The recorded energy and monitoring data shall be utilised to monitor the performance in accordance with *Regulation 503.07: Performance and Commissioning Reports* for Golden and Platinum buildings.

## COMPLIANCE DOCUMENTATION

**Table 503.05(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. CCMS technical specifications.<br>2. Delivery notes for the system. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

The Chartered Institution of Building Services Engineers. (2009). CIBSE Guide H - Building control systems.

## 503.06 COST OF THE EXPECTED PERFORMANCE ASSESSMENT

Golden Sa'fa

### INTENT

To study the cost impacts of additional requirements to meet the Golden and Platinum Sa'fa.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, the consultant must provide a detailed study on the effect of the additional requirements to meet the Sa'fa regulations. The study shall compare the cost of construction and operation of the building for the additional requirements when compared to a building without these additional requirements.

### SIGNIFICANCE

Al Sa'fat green building regulations aim to improve the performance of buildings by increasing efficiency in usage of energy, water and materials and by enhancing the planning, design, construction and operation of buildings. Documenting the performance enhancements including financial component is a critical step in promoting sustainable building practices. This will help to identify and to quantify energy saving opportunities, establish payback periods. Owners can analyse this information and effectively capitalise on the building performance by promoting the "sustainable" credentials of the building.

### APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

For the projects aiming to achieve Golden Sa'fa, the cost of implementing Golden Sa'fa regulations must be included in the assessment report.

Project aiming to achieve Platinum Sa'fa, the cost of implementing Platinum Sa'fa regulations (in addition to Golden Sa'fa requirements) must be included in the assessment report.

Al Sa'fat regulations that require performance enhancement for Golden and Platinum Sa'fa categories, also need to be included in the assessment report.

Project team should calculate the cost incurred for all the additional requirements implemented for Golden Sa'fa and Platinum Sa'fa. This should include the initial cost (capital) and operational cost. For the cost of performance improvement over Silver Sa'fa requirements, project teams should first collect the cost of complying with Silver Sa'fa requirements, from suppliers / vendors. The additional cost to meet Golden / Platinum performance requirements should be then collected and included in the assessment report.

Cost of expected performance includes both energy and non-energy related regulations. Energy savings achieved for the energy related regulations should be quantified in the assessment report. For non-energy related regulations, only installation and operation costs should be included in the report.

Based on the study, a detailed report comparing the cost of construction and operation of the building for implementing the additional requirements with that of a building without these additional requirements must be prepared and submitted.

After construction, the assessment report must be updated with the actual procurement cost.

## COMPLIANCE DOCUMENTATION

**Table 503.06(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Detailed study report indicating the estimated cost addition for Golden and Platinum Sa'fa compared to Silver Sa'fa compliance. |
| Construction Completion Application | 1. Updated detailed study report indicating the cost addition for Golden and Platinum Sa'fa compared to Silver Sa'fa compliance. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

William Manfredonia, CPE, Cost Calculations, Inc. / Joseph P. Majewski, FCPE, P.E., JPM Construction Consultants, Inc. / Joseph J. Perryman, Donnell Consultants, Inc. (2016). Cost Estimating.

# CHAPTER 3 - COMMISSIONING AND MANAGEMENT



## 503.07 PERFORMANCE AND COMMISSIONING REPORTS

Golden Sa'fa

### INTENT

To report actual performance of the building during the operational phase.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, a detailed report on the performance of the building based on the design considerations must be submitted. This should include the actual performance reports for a minimum period of 6 months, of which three months shall be thermal peak months.

### SIGNIFICANCE

The performance measurement of any building during actual operational condition is very important to ascertain successful and efficient operation of all the integrated systems under peak thermal load. It also helps to identify any issues and deficiencies in system where corrective action can be taken during warranty phase. This saves building owner and/or tenants to avoid high operating and maintenance cost, as well as premature replacement cost.

Regular monitoring and recording of operational data, is an effective practice for planning and implementing energy conservation measures. In absence of such data the actual variation is unknown, and no upgrades or improvement can be planned.

### APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

At the initial phases of building operation, the performance of the building systems at or near peak load conditions may not be achievable due to low occupancy levels, weather conditions etc. Hence, this regulation requires performance test to be carried out for all the building systems for a minimum period of 6 months, of which three months shall be thermal peak months.

Contractor and suppliers (as applicable) should be involved in this performance tests and must demonstrate the performance results of their respective systems in compliance with design considerations. Requirements for performance testing must be clearly defined in the contract documents of contractors, as this requires contractor personnel to return to the site after the project is completed and coordinate with building operators, whose role is to facilitate overall process.

For evaluating the performance of building, the following procedures as per ASHRAE can be followed

a. Collect building characteristics
b. Performance observation, measurement, analysis
c. Performance comparison – benchmarking
d. Identify issues needing correction and take corrective action
e. Re-measure performance
f. Compare new to past performance
g. Report results

Building performance measurement plan should be developed that includes the scope, roles and responsibilities of the contractor, building operator, performance monitoring schedule, performance test procedure, performance indicators and baselines and targets. Performance indicators must be identified for all the major system from commissioning test results or technical data sheet.

The performance measurement and analysis must be carried for at least the building systems indicated in Table 503.07 (1). Respective performance indicators must be recorded and compared against the design consideration.

**Table 503.07(1): Performance Indicators For Various Building Systems**

| Building System | Performance Indicator |
|---|---|
| Chiller | COP or kW/ton |
| Chilled water pump | Pump efficiency (μ), Power consumption (kW) |
| Cooling tower | Cooling Tower effectiveness (ϵ), Power consumption (kW) |
| Air handling units / Fan coil units | Supply air quantity (l/s), Space temperature and humidity |
| Fresh air handling units | Fresh air quantity (l/s), Space $CO_2$ level |
| Lighting and Lighting control system | Presence detectors and light sensors control the lighting as intended in design |
| Heat recovery unit | Sensible and latent effectiveness |
| Control system | Sequence of operation |

Additionally, monthly consumption data for the following services should also be recorded: chilled water consumption, energy use intensity, end-use energy consumption cooling, lighting, service water heating, process load etc.), building energy consumption and domestic water consumption.

Occupant survey should also be carried out at least once during performance period. Survey should factor for thermal comfort, acoustics, indoor air quality, lighting levels, building cleanliness and other occupant comfort issues.

Issues identified during the performance measurement periods shall be documented by project operation team and discussed with responsible party for corrective action. Any additional training for building operator to mitigate these issues should also be carried out. Issues under warranty from original construction contract are to be provided to contractor, for resolution.

All the performance indicators for each system must be recorded for every month at least minimum for six months along with list of issues and corrective action taken during this period. The final performance report of these six months must be available on-site for DM inspection.

BSRIA Seasonal Commissioning (BG 44/2013) guideline or ASHRAE Performance Measurement Protocols for Commercial Buildings: Best Practice Guide could be referred for further information.

## COMPLIANCE DOCUMENTATION

**Table 503.07(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | 1. Performance reports for 6 months of operation. |

## REFERENCES AND ADDITIONAL INFORMATION

The Building Services Research and Information Association. (2013). BG 44: Seasonal Commissioning.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2010). Performance Measurement Protocols for Commercial Buildings.

## 503.08 SUSTAINABLE AWARENESS

Golden Sa'fa

### INTENT

To provide awareness to users on sustainability performance of the buildings thereby educating occupants to use resources effectively.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings other than villas, the building operator must develop and provide a clear mechanism for sustainable awareness for the users of the building. This must include information on the consumption of energy and water in the building.

### SIGNIFICANCE

The purpose of implementing green building requirements is to improve the performance of buildings and contribute positively to environment. Performance of sustainable development depends upon participation by occupants and their awareness on building performance. When there is lack awareness, occupants would not know the sustainability features that have been incorporated in the building and knowledge for its optimum use. By creating an awareness medium, building occupants and visitors are educated on the building performance. This ensures the building is not only designed in a sustainable manner but also continues to operate in the same way.

### APPLICABILITY

This regulation is applicable to all building types, except villas. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Project teams must develop and implement a clear mechanism to create sustainability awareness to the users of building. As part of sustainability awareness, various sustainability features of the building could be displayed near the entrance lobby.

The sustainability awareness must include the building's energy and water efficiency measures, indoor environmental quality and how occupant behaviour affects the building performance and information on materials used in building, including environmental and social benefits.

Some of the measures that can be considered are:

- Incorporation of LED monitor (fig. 503.08(1)) at building lobbies that display building data in graphical form i.e. energy consumption, water consumption, renewable energy generation, and other sustainability features.
- Comprehensive signage programs displayed in the common areas that educate the occupants on building's sustainability features. It can also act as interactive learning experience for occupants.
- A manual, guideline or case study detailing the sustainable strategies implemented in the project.


Fig. 503.08(1): Display of Building's Performance

The awareness system may be integrated with building Central Control and Monitoring System (CCMS) to acquire real time energy and water usage data.

The presentation material for the awareness program should be relevant and shall be updated regularly to keep it more interactive. One of the key factors in the implementation of a successful program is to be able to validate successful efforts taken. This can be done by recording data after the awareness program has been initiated and analysing the improvements due to the awareness program. This data can also be compared with previously recorded information and can be shared with building occupants as part of awareness material.

To encourage active participation from building occupants, building owners or operators can also create reward structure for the occupants based on their energy and water savings efforts. Such incentives would allow building occupants to implement more environmentally responsible behaviour.

A sustainability awareness plan detailing the type of mechanism proposed must be submitted for complying the regulation.

## COMPLIANCE DOCUMENTATION

**Table 503.08(1) : Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | 1. Sustainable awareness plan and proof of implementation. |

## REFERENCES AND ADDITIONAL INFORMATION

U.S. Environmental Protection Agency, ENERGY STAR program. (2016). 8 Great Strategies to Engage Tenants on Energy Efficiency.

# 504.01 ON-SITE RENEWABLE ENERGY – SMALL TO MEDIUM SCALE EMBEDDED GENERATORS

Silver Sa'fa

## INTENT

To regulate the design and installation of on-site electricity generators using renewable energy.

## REQUIREMENT

For all new buildings, where a building incorporates on-site generation of electricity from a solar photovoltaic system, it can be a solar grid connected system or a solar off-grid system.

A. The grid connected solar generator shall be connected to Dubai Electricity and Water Authority (DEWA) network, operated and maintained according to DEWA regulations.

B. For off-grid solar system, the backup off-grid load is to be indicated in the Total Connected load (TCL) along with the grid based battery charger load, if applicable.

## SIGNIFICANCE

As the rising cost of energy is an issue in today's world and also energy resources are depleting, the demand of renewable energy such as solar energy continues to rise. As a result, small and medium scale renewable energy systems are becoming more feasible both technically and financially. They also offer many benefits including distribution of energy, energy efficiency and reduced $CO_2$ emissions.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Small-scale and medium scale embedded generators refers to power generation unit, which are located on residential, commercial, schools or small-scale industrial projects.

On-site electricity generators using renewable energy sources are classified based on their connection to other power sources and electrical loads. It is classified as stand-alone systems (off-grid) and grid connected systems.

### Stand-alone electricity generators

Stand-alone electricity generators are designed to feed building electrical loads. They are designed and sized according to building electrical load. Electricity generator may be powered by PV systems (fig. 504.01(1)), or may use wind turbine, or hybrid system.

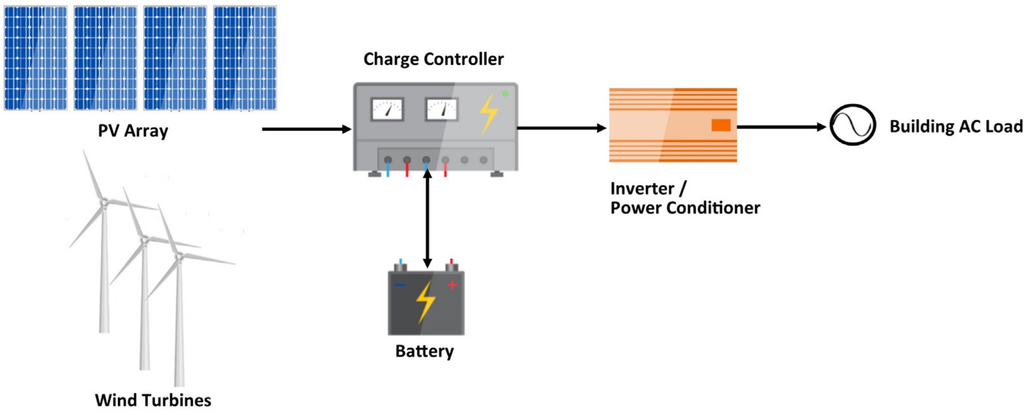



Fig. 504.01(1): Stand-alone PV System

The project team utilising stand-alone type must comply with DEWA guidelines for solar panels and associated equipment.

### Grid Connected electricity generators

Grid connected electricity generators (fig. 504.01(2)), approved by DEWA, are designed to operate in parallel and be interconnected with utility grid network. The power produced on-site, either supplies on-site electrical loads or feeds the utility grid, when generated power is greater than on-site demand. When on-site generated power is less than electrical load demand, particularly at night, the balance power is received from the utility network.

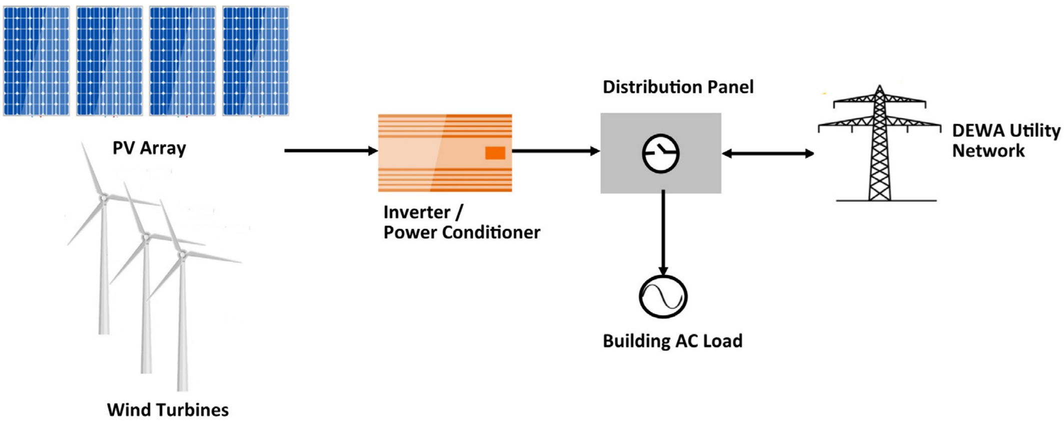



Fig. 504.01(2): Grid-connected PV System

For on-grid systems, the project team should fulfil the technical requirements in accordance with "DEWA standards for Distributed Renewable Resources Generators (DRRG) connected to the distribution network ".

## COMPLIANCE DOCUMENTATION

**Table 504.01(1) - Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Electricity and Water Authority. (2016). Standards for Distributed Renewable Resources Generators Connected to The Distribution Network.

# CHAPTER 4: ONSITE SYSTEMS: GENERATION & RENEWABLE ENERGY



## 504.02 ON-SITE RENEWABLE ENERGY – SUSTAINABLE WATER HEATING SYSTEM

Silver Sa'fa

### INTENT

To reduce the energy consumption for hot water, reduce demand, save energy and costs.

### REQUIREMENT

For all new villas, labor accommodations, hotels, mosques, and educational facilities, sustainable water heaters must be used to provide the total demand of hot water for the building. In case of using solar water heaters specifically, the system must be designed to provide the building with 75% of the total demand on hot water. The tanks and pipes must be insulated.

For Golden and Platinum Sa'fa, this regulation is applied for all types of buildings.

### SIGNIFICANCE

Buildings with higher hot water demands like labor accommodations, hotels, mosques, and educational institutions shall employ the sustainable and efficient heating technologies on-site to reduce the utility cost and promote the alternate / renewable energy usage to reduce the greenhouse gas impacts.

Dubai with favorable weather conditions and yearlong sunshine is beneficial to have solar water heaters. They are economically and environmentally favourable than a conventional electric water heater. Solar water heaters provide a quick payback period coupled with environmental benefits.

### APPLICABILITY

This regulation is applicable to all new villas, labor accommodations, hotels, mosques, and educational facilities. For Golden and Platinum Sa'fa, this regulation is applied for all types of buildings. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

#### Energy Efficient Systems

Design team shall identify new technologies to reduce the water heating power demand compared to conventional electric water systems. 100% hot water demand required for the building shall be supplied with the proposed energy efficient systems. Calculation highlighting the energy demand difference is mandatory for design compliance approval. Designer may choose technologies like air source heat pump or any efficient methods to further reduce the energy impact of hot water systems.

For individual building types, the selection of water heaters system shall be based on building usage type, total hot water demand and area available for the implementation strategy. Individual or centralised systems can be opted, given the proposed system shall be proven energy efficient than the conventional models.

Air source heat pump works by extracting heat from ambient air using a fan to move hot air across the evaporator coil containing refrigerant, which further completes the vapor compression cycle to release the hot thermal energy to the cold water inside the heater system. Dubai's hot ambient temperature condition is perfect for utilising the renewable heat source via a heat pump system to meet the domestic hot water demand. Though the capital cost is higher compared to the electric resistance water heater, better payback period is achieved through reduced annual utility cost. Typical schematic of the air source heat pump is shown in fig. 504.02(1).

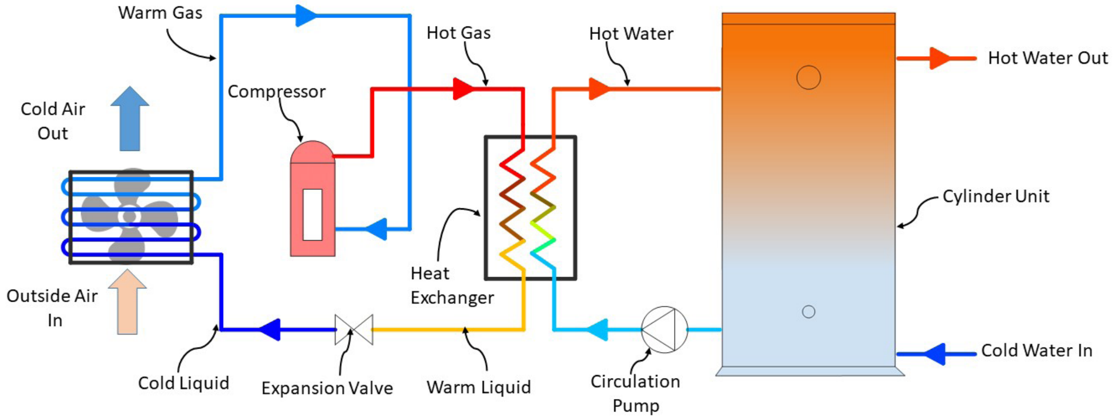



Fig. 504.02(1): Air Source Heat Pump Water Heater

### Solar System

Design team shall identify the solar water heater systems whether suitable for the building application based on usage types. Hot water demand calculation and solar thermal analysis to be performed considering facility load profile and peak demand criteria for conforming the final collector sizing required to meet the hot water demands.

All design factors shall be in accordance with Dubai Municipality Circular (183), 2011, related to use of Solar Water Heating Systems (SWHS) to supply hot water to buildings in the Emirate of Dubai. Design calculation conforming the load requirements and supporting drawings / documents shall be submitted to DM for approval.

Proposed solar hot water system must provide at least 75% of the hot water demand required for the building and remaining 25% shall be supplemented by other sources, commonly, electric water heater. Backup source shall be employed to ensure hot water supply is uninterrupted when solar energy is not sufficient to provide required output. For collection of highest sun radiations throughout the year, Solar collectors must be directed south with an angle approximately equal to the latitude (25°).

Solar hot water system shall be supplied, installed and maintained by DM/DEWA approved companies. Also, it is mandatory for SHW systems to be certified by Dubai Central laboratory. During construction, contractor should propose SHW system conforming the design demand requirements through technical data sheets, drawings and calculations if required.

Solar collector shall be ideally located to improve the efficiency and ensure nothing is obstructing the sun rays from the collector due to installed equipment or roofing systems as part of construction. For buildings where distance between solar tank and consumption point is relatively long, proper thermal insulation to be provided to avoid heat loss.

Due to the arid weather condition in Dubai, dust accumulation is frequent and collector surfaces must be cleaned and maintained regularly for continuous and effective performance.

## COMPLIANCE DOCUMENTATION

**Table 504.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Hot water demand calculation.<br>2. Plumbing layout / solar hot water system or sustainable hot water system layout showing the location of equipment. |
| Construction Completion Application | 1. Final approved layout of hot water system.<br>2. Sustainable hot water system manufacturer data sheet.<br>3. Sustainable hot water system delivery notes.<br>4. DCL certificate for solar hot water system - if used. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2011). DM Circular 183.

# CHAPTER 4: ONSITE SYSTEMS: GENERATION & RENEWABLE ENERGY



## 504.03 ON SITE RENEWABLE ENERGY – ELECTRICAL POWER GENERATION

Golden Sa'fa

### INTENT

To reduce utility energy demand for buildings by harnessing solar energy on site and save energy costs and environment.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, the electrical power shall be generated on-site using solar panels. The power generation shall be 10% of the electrical load of the building (excluding electrical loads for fire extinguishing system, air conditioning units and air conditioning system pumps).

If sufficient space is not available to achieve the above percentages, then the electrical power shall be generated to cover 30% of the lighting load of the common areas, provided that the capacity of the solar panels shall not be less than 20 kWp.

### SIGNIFICANCE

Harnessing solar power is one of the key elements to move towards alternate energy sources. Global trend of utilising renewable energy is increasing and use of the potential energy source for different industrial, residential and commercial is viable with the development of technology. Solar energy is a form of clean energy and also reduces green-house gas emissions.

UAE is located between longitudes 22° and 26.5° North and latitudes 51° and 56.5° East. Plentiful solar radiation and surface temperature available across the region is favorable for the production of the solar energy throughout the year.

To achieve the goal of Dubai vision for a smart and sustainable city, DEWA launched Shams Dubai smart initiative to encourage building owners to install photovoltaic solar panels to generate electricity from solar power. The electricity is used on-site, and surplus energy generated from the site can be fed into DEWA's network and this surplus energy will be credited and used to off-set future consumption of electricity.

Under Dubai Clean Energy Strategy, Dubai aims to produce 75% of its energy requirements from clean sources by 2050. The strategy also aims to make Dubai a global centre of clean energy and green economy.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Designer / architect shall identify open spaces available for the projects to install solar panel to generate power required to meet the compliance. With the technological advancement, various forms of panels are available that can be easily incorporated into different areas of the building structure. Photovoltaic cells and modules can be integrated into building structure in various forms like sun shades, blinds, façade, roof top, car park shade etc.

Though the initiative is to generate the on-site renewable energy, the primary aim of the project team designer must be to design an energy efficient building using technologies to reduce the load demand.

Project team should calculate total building energy load requirement and percentage of energy that can be generated from the on-site solar energy. The power generation from on-site solar energy should be 10% of the electrical load of the building (excluding electrical loads for fire extinguishing system, air conditioning units and air conditioning system pumps). If sufficient space is not available for the solar system to achieve 10% of the electrical load of the building, then 30% of the lighting loads of common areas must be through on-site solar energy. However in this case, the total capacity of the proposed solar panels should not be less than 20 kWp.

Number of photovoltaic panels required to meet the power demand depends on available shade-free area, project orientation etc. Reflectance efficiency and thermodynamic efficiency are the two main factors that influence the efficiency of solar panels. Highly efficient solar panels generate more power and can reduce the total number of panels required.

Design of other major components of the solar PV systems shall be as per the DM or DEWA guidelines. If excess power is produced and surplus is intended to feed into DEWA's network, prior approvals and procedures stipulated by DEWA shall be followed.

During the operational phase of the project, equal importance shall be given to the maintenance of PV systems like other systems. Power loss due to shading, soiling etc are some of the major factors affecting the power generation from PV panels. Scheduled maintenance shall be employed to ensure the PV panels are cleaned and unobstructed for the generation of solar power.

### Case Study

*Scenario 1 (with sufficient roof space)*

Consider a typical G+4 office building with a built-up area of 8,500 $m^2$ and a roof area of 1,800 $m^2$. Roof space consists of MEP equipment like HVAC units, plumbing equipment like tanks, window cleaning systems, open area for tenants etc. The available space on roof to install on-site power generation is 500 $m^2$. Let's find out if this project can comply with Golden Sa'fa requirements.

To start with, electrical loads in the project excluding the load for fire extinguishing system, air conditioning units and air conditioning system pumps are tabulated in Table 504.03 (1).

**Table 504.03(1): Electrical Load**

| Electrical Load | Calculated Load (kW) |
|---|---|
| Lighting | 57.50 |
| Socket Outlets | 92.50 |
| Electrical Water Heaters | 40.00 |
| Home Appliances | 52.50 |
| Lifts, Elevators, Water Pumps, etc. | 68.00 |
| **Total Load** | **310.50** |

For Golden Sa'fa requirements, 10% of the electrical load shall be from on-site solar power.

Based on Table 504.03 (1), for a total electrical load of 310.50 kW, 10% of this load would be 31.05 kW.

For this project, let us consider solar photovoltaic (PV) panels to generate electrical power. To generate 31.05 kW, approximately 320 $m^2$ area would be required. Total available area in the roof is 500 $m^2$ and hence by installing solar panels the requirement of 10% of electrical load is met.

*Scenario 2 (with insufficient roof space)*

Let us consider that the available roof space for solar PV panels is only 280 $m^2$ instead of 500 $m^2$ in the above example (scenario 1). In this case the electrical power generated through solar PV panel would be 28 kW which is less than the required value of 31.05 kW.

In this case, the following approach can be considered.

Common area lighting load = 11.75 kW

For Golden Sa'fa requirements, 30% of the common area lighting load must be met through on-site renewable energy source, which is 3.52 kW. However, the minimum capacity as per the regulation must be 20 kWp. Since the project has 280 $m^2$ of available roof space, by installing solar PV panel for 20 kWp, the project can comply with Golden Sa'fa requirements.

## COMPLIANCE DOCUMENTATION

**Table 504.03(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Electrical load calculation as per the requirements.<br>2. PV system technical specification.<br>3. Design drawing showing the location and capacity of PV system.<br>4. DM BLDG solar power calculator. |
| Construction Completion Application | 1. Final approved design drawing showing the location and capacity of PV system.<br>2. PV system manufacturer data and delivery notes.<br>3. DEWA approval |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

DEWA. (n.d.). Shams Dubai, Information from - https://www.dewa.gov.ae/en/customer/innovation/smart-initiatives/shamsdubai.

DEWA. (n.d.). Shams Dubai, Information from - https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/local-governments-strategies-and-plans/dubai-clean-energy-strategy.

# CHAPTER 5 - ENERGY DEMAND



## 505.01 REDUCTION OF ENERGY DEMAND

Golden Sa'fa

### INTENT

To encourage project team to implement innovative energy reduction strategies.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, innovative ideas and new mechanisms shall be provided that would contribute for at least 5% reduction in energy demand. These ideas or new mechanisms shall not be from the requirements listed in the regulations.

### SIGNIFICANCE

Increased energy consumption has a detrimental effect on natural resources. Countries worldwide are putting their efforts in energy efficiency measures. Prominently, technological development has been on cleaner, more efficient methods of generating electricity. However, the paradigm shift now is on technological advancements to reduce energy demand, itself.

The Dubai Supreme Council of Energy as part of the Dubai Integrated Energy Strategy (DIES) 2030, has developed Demand Side Management (DSM) strategy for the Emirate of Dubai. DSM strategy targets 30% reduction in energy consumption by 2030, putting Dubai at the forefront of global energy efficiency efforts.

Optimising energy demand in buildings not only contributes to this DSM strategy, but also reaps the following benefits:

- Moderates the need for bigger equipment sizing, thereby reducing costs.
- Improves operating efficiencies.
- Reduces carbon emissions and environmental degradation.
- Use of innovative and efficient technologies provides wider visual reach.
- Helps make Dubai one of the most sustainable cities in the world.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation requires project team to utilise innovative ideas and mechanisms that enhances energy efficiency and reduces overall energy demand. These ideas or new mechanisms shall not be from the requirements listed in the regulations.

Project team should explore various new and innovative technologies that not only reduces energy demand, but also can be seamlessly integrated into the project. Some examples for innovative or alternative technologies are given below:

### Climate-Responsive Shading System

By using computer controlled dynamic shading systems, the shading devices are controlled based on the sun direction (fig. 505.01(1)). This not only reduces the building peak heat gain and cooling requirements, but also improves the natural light quality in interior spaces. Shading system integrated with project's BMS can aid in reduction of energy demand.

Fig. 505.01(1): Climate-Responsive Kinetic Facade

### Radiant Cooling System

Radiant cooling systems cool the floor or ceiling of space to remove sensible heat from room and to provide comfortable temperature. Hydronic radiant system is a commonly used system, which utilises water to transport energy and where the temperature of the slab is controlled, to provide superior comfort. As heat transfer capacity of water is 3,400 times more than that for the same volume of air, radiant slabs can transfer energy much more efficiently than a forced-air system. This results in reduction in overall building energy consumption and demand.

### Underfloor air distribution (UFAD) systems

Underfloor air distribution (UFAD) system is an innovative technology that uses underfloor plenum below a raised floor system to supply conditioned air directly into the occupied zone of the building through floor diffusers. Conditioned air can be delivered through supply outlets / diffusers located at floor level or as part of the furniture and partitions. As conditioned air is supplied directly into the occupied spaces, higher supply temperature can be maintained that results in reduced cooling demand and energy consumption. UFAD system benefits from the air flow pattern, wherein air from floor level gets returned through the return grills in ceiling level through natural buoyancy in the heat sources in the occupied space. Combining building's HVAC system with other possible mechanical and electrical services (modular cabling, network cable routing etc.) into one easily accessible service plenum under the raised floor, is also an added advantage for this system.

### Magnetic Refrigeration

Magnetic refrigeration is an innovative and potential low carbon technology. The technology is based on changing magnetic fields that produces a cooling effect. Using this technology refrigerators and air conditioners can significantly reduce the amount of electricity required. Also, as this technology does not need refrigerant, only heating or cooling fluid which could be water-based, this eliminates the possibility of refrigerant leakage and no direct $CO_2$ emissions.

Based on investigation of innovative or new technologies, project teams must demonstrate 5% reduction in energy demand can be achieved through its implementation. Building energy modelling software shall be used to model the building and to evaluate the performance of energy reduction strategies. Guidance on energy modelling requirements is provided in *Regulation 505.03: Efficiency of Building Performance.*

## COMPLIANCE DOCUMENTATION

**Table 505.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Descriptive report of the techniques and measures used to reduce energy demand.<br>2. Energy modeling and simulation report along with input and output summary details. |
| Construction Completion Application | 1. Equipment or materials technical data-sheet for the considered energy conservation measures.<br>2. Delivery notes for the installed systems. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2018). Al Sa'fat Dubai Green Building Systems: Regulations 505.03 – Efficiency of Building Performance.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings, www.ashrae.org.

Yebiyo. M and Maidment, G. (2016). What's so attractive about magnetic refrigeration? CIBSE Journal, Retrieved from www.cibsejournal.com.

# CHAPTER 5 - ENERGY DEMAND



## 505.02 SMART BUILDING

Platinum Sa'fa

### INTENT

To utilise latest intelligent technology in enhancing building performance, without affecting occupant comfort and safety.

### REQUIREMENT

For Platinum Sa'fa and for all new buildings, various building equipment and systems shall be provided with intelligent techniques to control and reduce the energy and water consumption of the building. The intelligent techniques shall also ensure the safety and comfort of the building occupants.

### SIGNIFICANCE

With technology enhancement and upgrades the newly constructed buildings are using latest techniques to reduce the energy and water consumption. Smart building technologies can help in optimising the building performance to a better level. Smart building are the ones which integrate the various components of building operation and use it for better performance, comfort and operation through data monitoring, real time analysis and internet integration.

Dubai being one of the front-runners in adapting the smart city concept, the smart buildings promises to improve efficiency by integrating the systems to reduce operating expenses and increase the safety, productivity and quality of life.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(3) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Buildings using smart technologies should demonstrate that through use of technologies, energy and water consumption is controlled and reduced and provides improved building operation and occupant comfort. Additionally, the smart technologies should be used to create a better and safer building for occupants. Smart building technologies function using computerised and intelligent network of electronic devices, that monitors and controls the mechanical, electrical, lighting and other systems in a building. Building's operation, performance and management can be optimised, by proper integration of smart technologies with building systems.

This regulation requires implementation of various smart building techniques that incorporate the complete integration of following building systems, which dynamically interacts with building occupants and facility operators via smart infrastructure.

- Heating, Ventilation, Air Conditioning (HVAC) systems
- Lighting
- Small power equipment
- Energy and water meters
- Elevators
- Irrigation systems
- Security systems such as access control, surveillance etc.

This regulation requires project teams to explore a variety of innovations from the industry to reduce energy and water consumption. Following are some examples of potential technologies that can be incorporated in smart buildings.

**Intelligent HVAC control**

It functions like the building brain, where all systems and devices under HVAC systems are connected through Internet Protocol (IP) network. Operation of the building is continuously monitored, and informed decision is taken to improve building performance. For instance, if occupancy sensor detects no occupancy in an area, signal can be transmitted to ventilation system to turn off in that area. The system also includes automatic detection of faults in HVAC devices and prompts for maintenance procedures to building facility team. This system can also be user interactive, wherein occupants can interact remotely with the HVAC control system. Interaction could be to remotely control the comfort temperature settings or to view and analyse the consumption patterns.

**Smart Lighting**

The sensors embedded into the building's lights detect building users and allows the users to adjust light levels via a software application. Another possible usage of smart lighting system is to integrate the system with window shade control system. Lighting system would perform an automated comparative analysis on the air conditioning energy use and determine if it is more feasible to shade the windows and turn the lights on.

**Real Time Analysis**

Analytical software can be used to monitor and control energy and water consumption in real time. The real time analysis platform will also interact with building control systems to analyse and predict the consumption and costs of energy and water, as well as the comfort needs of building occupants. The software program includes a server infrastructure to connect smart meters, collect, store and analyse energy and water data, share results of the analysis to the end-users. Results can be shared through a visual representation of the building's energy and water consumption. It can also offer insights in identifying operational abnormalities and in identification of areas with highest consumption. Using previous trends, building operators can predict future patterns and adjust building operations.

**Plug Load Management**

Typical plug load are those that are plugged into a standard wall outlet throughout the buildings. This includes computers, televisions, monitors, refrigerators and similar equipment. This excludes major end uses like heating, ventilation, air conditioning (HVAC), lighting, water heating and so on. By integrating smart technologies, plug load control can avoid wastage of energy. This is determined by analysing the operation of devices connected and switching off the power to that equipment. Smart controls can also be programmed to turn on or off equipment, based on set schedule. Plug load management can be effectively and efficiently controlled either remotely or through smart internet infrastructure.

### Intelligent Elevators

Intelligent technology like smart grouping or destination control allows grouping and assigning passengers in real time based on the selected destination. Smart technologies are also being incorporated in real-time predictive maintenance of elevators. Data from elevators are periodically collected and analysed through a cloud-based analyser algorithm that precisely diagnose the lifetime of components and delivers predictive maintenance messages to the facility team.

### Smart Irrigation Controllers

Automated irrigation infrastructure can be integrated with smart controls that captures real time data on the soil moisture and temperature levels and smartly controls the water pump valves. Control systems also has the ability to analyse in ensuring the uniform water distribution takes place. Integrating the smart control systems through internet infrastructure allows information to be distributed to building operators and to alert maintenance companies if any problems occurs. The data captured also allows the building operators to budget and adjust water sources.

Intelligent techniques identified by the project teams to reduce energy and water consumption of building should be seamlessly integrated into the project. Description of each smart system along with its layout and control schematic must be prepared and submitted for DM approvals.

## COMPLIANCE DOCUMENTATION

**Table 505.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Description about each smart system used to reduce energy and water consumption and improve occupant comfort.<br>2. Provide the layout / control schematic / calculation (as applicable). |
| Construction Completion Application | 1. Final approved layout / control schematic.<br>2. Technical data-sheet for the considered smart systems.<br>3. Delivery notes for the installed smart systems. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

W. Xu et al., "The Design, Implementation, and Deployment of a Smart Lighting System for Smart Buildings," in IEEE Internet of Things Journal, vol. 6, no. 4, pp. 7266-7281, Aug. 2019.

M. Magno, T. Polonelli, L. Benini and E. Popovici, "A Low Cost, Highly Scalable Wireless Sensor Network Solution to Achieve Smart LED Light Control for Green Buildings," in IEEE Sensors Journal, vol. 15, no. 5, pp. 2963-2973, May 2015.

## 505.03 EFFICIENCY OF BUILDING PERFORMANCE

Golden Sa'fa

### INTENT

To achieve high energy savings by improving the performance using advanced energy saving techniques.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, following requirements can be replaced by using techniques that enhances the building performance.

501.01 Minimum Envelope Performance Requirements

501.02 Thermal Bridges

502.04 Lighting Power Density - Interior

502.05 Lighting Power Density - Exterior

502.10 Exhaust Air Energy Recovery Systems and Condensate water

502.16 Control of Chilled Water

502.18 Cooling of Corridors and Public Areas

502.22 Heat Exchangers

503.06 Cost of the Expected Performance Assessment

503.07 Performance and Commissioning Reports

504.03 On-Site Renewable Energy– Electrical Power Generation

505.01 Reduction of Energy Demand

The techniques used should increase the energy savings of the building. The energy savings percentage of the building when compared to a building designed with Silver Sa'fa regulations shall be at least 15% for Golden Sa'fa and 20% for Platinum Sa'fa.

### SIGNIFICANCE

Energy is a vital component and a critical economic issue for buildings. Design and selection of equipment plays an important part in the energy performance of the building. An efficient building design that incorporates optimised building envelope, improved equipment efficiency and controls and smart operational strategies can substantially reduce the energy use of the building. This will reduce the environmental and economic impacts of excessive energy use.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(2) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Energy saving targets should be set early in the design process. This would allow project teams to analyse various energy efficient strategies, integrate these strategies seamlessly with building systems and achieve the targeted energy savings goals.

Some of the strategies that could be considered are:

Enhance the u-values for roof and wall more than those required as per Al Sa'fat regulations. U-values and shading coefficient values for glass facades also can be further enhanced. Building materials and insulation having lower thermal conductivity can also be considered. This ensures building can achieve better energy savings. Smart windows that alter based on solar radiation and daylight levels can be integrated to reduce the energy consumption.

Further reduce the Lighting Power Density (LPD) values for interior and exterior light fixtures than those required for Al Sa'fat regulations. LED light fixtures can be incorporated to reduce the overall LPD values for the building. Incorporating intelligent lighting control systems with sensor and timers in the building design can also maximise the energy savings.

Smart HVAC controls that use sensors integrated with building automation system can optimise the building performance based on occupancy levels or conditions. Integrating the controls with variable speed motors / drives can also further reduce energy consumption in the buildings.

Increasing the usage of renewable energy source to provide energy to the building also helps in reducing the energy consumption. Building integrated renewable technologies can be integrated into the project design. If the proposed design includes excessive on-site renewable energy when compared to Silver Sa'fa requirements, same can be subtracted from the proposed building energy consumption to show additional savings.

The most effective way to optimise the energy efficiency is to use an integrated, whole building approach i.e. energy modelling. It is more flexible and is a tailored way to assess the interactive effects of efficient techniques.

Project team using an energy simulation program must develop model of the building (fig. 505.03 (1)) in compliance with Silver Sa'fa requirements. This model shall serve as the base-case model and shall be used to compare with design features of the building. The reference building must be equal in shape, size and operational patterns to the proposed building.

The identified techniques to increase the building energy performance shall then be incorporated into the reference energy model. The building shape, size, operational patterns weather data and other modelling parameters must be maintained same for both base model and reference building. Both energy models should include all end-use load components like: lighting, cooling, heat rejection pumps, fans, service water heating, and receptacle and process loads. Receptacle and process loads must be modelled identically in both cases. When proposed strategies apply to less than the whole building, only parameters related to the systems should be modified.

$$\text{Performance improvement} = 100 \times \frac{(^{*}\text{Baseline building performance} - \text{Proposed building performance})}{^{*}\text{Baseline building performance}}$$

*Baseline building performance – performance of building designed with Silver Sa'fa regulations

ENERGY EFFICIENCY

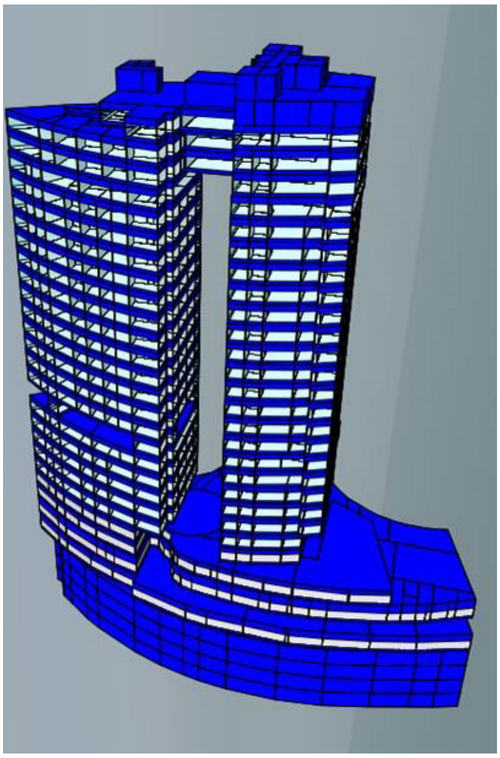


Fig. 505.03.(1): Model Of A Building Developed In Energy Simulation

The energy savings percentage of the building when compared to a building designed with Silver Sa'fa regulations shall be at least 15% for Golden Sa'fa and 20% for Platinum Sa'fa.

ASHRAE 90.1, Appendix G, Performance Rating Method provides additional guidance on energy simulation software requirements and energy modelling procedure.

## COMPLIANCE DOCUMENTATION

**Table 505.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Descriptive report of the energy conservation measures considered to enhance efficiency of building performance.<br>2. Energy modeling and simulation report along with input and output summary details. |
| Construction Completion Application | 1. Equipment or materials technical data-sheet for the considered energy conservation measures.<br>2. Delivery notes for the installed systems. |
| After Completion | 1. Performance and commissioning report. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE standard 90.1, Appendix G, Performance Rating Method.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY



## 601.01 WATER EFFICIENT FITTINGS

Silver Sa'fa

### INTENT

Reducing indoor water consumption using water efficient fittings.

### REQUIREMENT

For all new buildings, following must be used:

A. Water-conserving fixtures meeting the criteria listed in Table 601.01 (1):

**Table 601.01(1): Maximum Flow Rates**

| Fixture Type | Maximum Flow Rate |
|---|---|
| Showerheads | 8 l/min |
| Hand wash basins | 6 l/min |
| Kitchen sinks | 7 l/min |
| Dual Flush Toilets | 6 l Full flush<br>3 l Part flush |
| Urinal | 1l per flush or waterless |

B. Dual Flush toilets.

C. Automatic (proximity detection) / push button faucets in all public facilities.

D. Cisterns serving single or multiple urinals in public, commercial and industrial buildings with manual or automatic flush controls that operate based on usage patterns. Only sanitary flushing is acceptable in the event of building closure or shutdown (including overnight).

Faucets installed for specialised application may be exempt from meeting the flow rates, subject to Dubai Municipality's approval.

### SIGNIFICANCE

The conservation of water is vital in sustaining the needs of future generations. Potable water consumption in buildings if used unrestrictedly would not only deplete the potable water source but also would require significant amount of energy to treat and transport the water. Using larger volumes of water increases the maintenance and life cycle cost of building operations and increases consumer's cost for additional municipal supply and treatment facilities. Conversely, building that uses water efficiently can reduce costs through lower utility charges, less sewerage volume and reduction in energy use. Water efficient fixtures combined with sensible use of water saves water and money.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Use of water efficient fixtures in buildings is an effective way to reduce water consumption. This regulation stipulates fixed flow rates and flush rates for showerheads, faucets, sinks, urinals and toilets. The maximum flow rate defined in Table 601.01 (1), must not be exceeded.

Projects should use the specifications for water fixtures given in this regulation and should not exceed the values under test conditions. As the water pressure in buildings varies, the actual flow rate also varies. Maximum flow rate for the water fixture must be achieved at a water pressure of 300 kPa (3 bar), under factory test conditions. A pressure flow curve for the water fixture should be provided and documented.

Fig. 601.01(1): Water Efficient Fixtures

Some of the water efficient fixtures (fig. 601.01(1)) are discussed below.

**Low flow fixtures**: Low flow plumbing fixtures consume less water than conventional fixtures with the help of aerator nozzles. Aerator nozzles generally introduce air to water that creates an impression of a larger flow of water than what is actually delivered.

**Dual flush toilets**: Dual flush toilets incorporate two different types of levers or buttons, both connected to its own exit valve. While the larger lever or button provides the full volume of water for flushing, the smaller lever or button provides a significantly lower volume of water for flushing. This gives flexibility and choice to building occupants to optimally use the flush system. An indication of the low flush option on a dual flush toilet should be provided.

**Automatic or push-button faucets**: For all public facilities, automatic faucets should be equipped with proximity sensor (active infrared sensor) to detect the hand motion and release the valve for water flow. Alternatively, timer or push-button faucets should be provided that would only dispense water when the button is pressed, for the predefined duration.

**Automatic or timed flush Cisterns**: Automatic or electronic cisterns are provided with Passive Infrared Sensor (PIR) which identifies when the urinal has been used, by detecting the motion which then activates the flush. Automatic cisterns also have an override button for manual flushing.

cisterns serving single or multiple urinals in public, commercial and industrial buildings must be provided with manual or automatic flush controls that operate based on usage patterns. Groups of urinals could be connected to a single overhead cistern, which contains the timing mechanism and the frequency of flushing could be adjusted based on usage pattern.

**Waterless urinals**: Waterless urinals are those, which do not need to be flushed by a cistern. Projects implementing waterless urinals should establish a proper maintenance mechanism.

In an event where the use of low flow water fixtures may create health and safety problems or affect specific processes, DM / DEWA approval would be required to use alternative fixtures.

It is also recommended that apart from providing low flow water fixtures, building occupants may be educated on using water in an efficiently.

## COMPLIANCE DOCUMENTATION

**Table 601.01(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Plumbing fixtures manufacturer data mentioning the flow and flush rate at specified operating pressure.<br>2. Plumbing fixtures delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

European Committee for Standardization. (2008). EN 817: Sanitary tapware - Mechanical mixing valves (PN 10) - General technical specifications.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY



## 601.02 CONDENSATE DRAINAGE

Silver Sa'fa

### INTENT

To utilise efficient condensate discharge system to prevent leaks into the buildings, mold growth and associated health hazards.

### REQUIREMENT

For all buildings including existing buildings, where condensate water is produced by air conditioning equipment, the condensate water must be collected and disposed appropriately. Condensate collection pans and drainage pipes must be installed to provide proper drainage and to prevent any stagnant water. A minimum air break of 25 mm must be provided between the condensate piping and the wastewater pipe. If the condensate water is not reused, it must be discharged into the wastewater system through a properly sized water trap.

### SIGNIFICANCE

Air conditioning systems absorb heat from inside the building and transfer it outside. As the air gets circulated within HVAC systems, due to the temperature difference between the outside air and the cooled air, condensation occurs. In places having high humidity and hot climate, air conditioning equipment produces significant amount of condensate water. Condensate water needs to be removed to prevent damage to equipment and building structure. Stagnant water poses a serious health hazard, as it is a potential place for microbial growth that affects the indoor air quality for building occupants.

Proper collection and disposal of condensate will contribute to the air conditioning system's efficiency and in reducing indoor air quality hazards. As the condensate water has low mineral quality it can be reused for various purposes like irrigation, flushing of toilets, cooling towers, evaporative coolers and many more.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires project team to design condensate drainage system, to ensure condensate from all cooling coils of FAHUs, AHUs, FCUs, CCUs etc., is collected from the drain pan outlet to an appropriate location for disposal in the wastewater system or to a location where it can be stored for reuse.

The following factors shall be considered while designing the condensate drainage system:

Drain pans of air conditioning systems should not allow standing water and must quickly and completely drain off the water, thereby preventing creation of unhealthy pool of contaminants. The size of the drain pan must be such that it spans the entire width of cooling coil and shall be insulated to prevent condensation of moisture on the outside of the unit casing.

It is recommended that drain pans are sloped at least 1/100 to ensure that water drains freely from pan as shown in fig. 601.02(1).

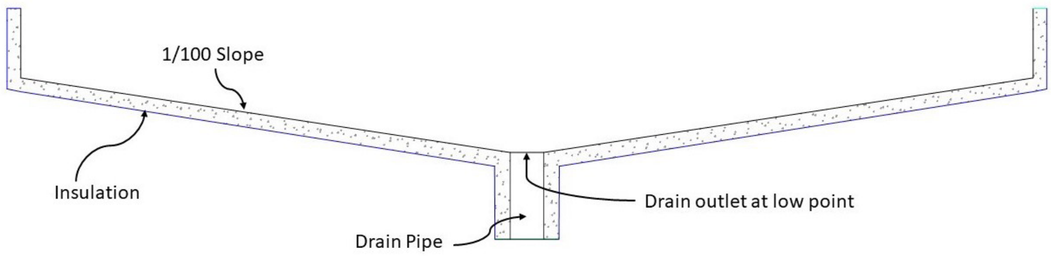



Fig. 601.02(1): Condensate Drain Pan

Condensate drain piping should be insulated and an adequate horizontal slope of not less than 1/100 should be maintained, to ensure free flow of water without any obstruction. A minimum separation distance of 25 mm must be maintained between the condensate piping and the wastewater pipe to avoid any cross contamination.

All condensate drains must have a water trap or other sealing devices to maintain a seal to prevent untreated air from moving in, during operation of air handling devices. It shall allow for complete drainage of the drain pan under all operating conditions, regardless whether the fan is on or off.

The optimum selection of water trap is very important. If trap seal is too shallow, water in it can be sucked or blown dry at each cooling cycle start up and if seal is too deep, it can cause condensate to be held in the pan, which results in clogging. Hence selection of drain seal (fig. 601.02(2)) should consider the minimum height of trap such that it is enough to hold water in order to resist the fan static pressure.

In cases where condensate is discharged into the wastewater system, the water trap helps to prevent foul smell or any contaminated air to enter in either direction, protecting the indoor air quality.

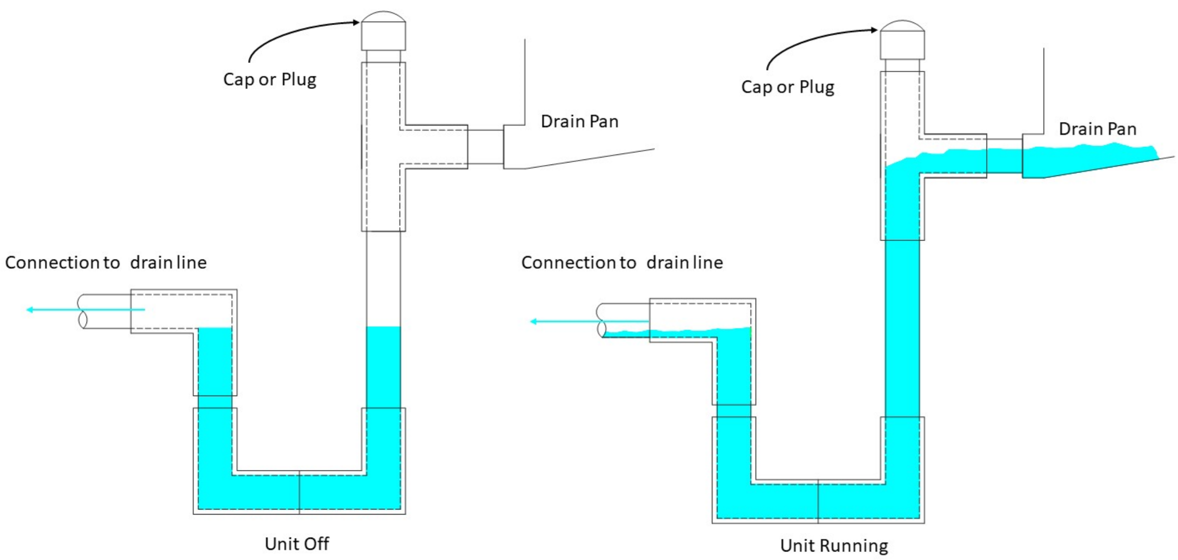



Fig. 601.02(2): Water Trap

Sagging and subsequent stagnation of water may occur in warm conditions if plastic pipes are used for drainage of condensate water. Sagging must be avoided by providing adequate support. Maximum spacing distance between the supports to withstand all anticipated static loads, is based on the piping material and this should be specified in project design. International Mechanical Code provides guidance on the horizontal and vertical spacing that should be considered in project design.

## COMPLIANCE DOCUMENTATION

**Table 601.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Plumbing layout indicating the air gap between condensate piping and wastewater piping and location of the condensate water collecting basin. |
| Construction Completion Application | 1. Final approved plumbing layout indicating the air gap between condensate piping and wastewater piping (if reusing condensate water) and location of the condensate water collecting basin. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

American Society of Heating, Refrigerating and Air-Conditioning Engineers. (2016). ASHRAE Standard 62.1: Ventilation for Acceptable Indoor Air Quality, Section 5.10 Drain Pans.

International Code Council. (2018). International Mechanical Code, Section 305: Piping Support.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY



## 601.03 CONDENSATE REUSE

Silver Sa'fa

### INTENT

To conserve water by promoting recovery and use of air conditioning condensate for non-potable applications.

### REQUIREMENT

For all new buildings with a cooling load not less than 350 kW, condensate water from all air conditioning equipment, air handling units or equipment handling a mixture of return air and outside air, where the outside air is not preconditioned, must be recovered and reused. The condensate water can be reused for irrigation, toilet flushing, or other on-site purposes wherein it will not come into direct contact with the human body. The condensate water can also be reused for heat recovery as per the requirements set in *Regulation 502.10*.

### SIGNIFICANCE

Condensate water is low in mineral content and it can be effectively used in a building for a number of applications. These include irrigating plants, cooling towers, flushing toilets and many more.

On-site reuse of condensate water reduces the building's demand for water. Considering the fact that condensate is of high quality in comparison with treated sewage effluent, condensate water need not be treated before use. Use of condensate water for several applications in a building will lower not just the water demand but also reduce the overall utility bills. Also reuse of condensate water indirectly reduces the load on municipality on supply, treatment and disposal.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

For buildings having cooling loads more than 350 kW, condensate water generated from all the air conditioning equipment like FAHUs, AHUs, FCUs, CCUs etc., should be collected and used for on-site non-potable and non-contact water applications.

While calculating the cooling load of the building, project teams should also calculate the peak condensate generation rate. Based on this, size of the drainpipes, condensate water collection tank and pumps should be designed. The means of collecting and reusing condensate water vary between buildings. Proper planning at the design stage is required for collection, storage and reuse of condensate water.

As the condensate formed from moisture in the air is relatively high quality water with low dissolved mineral content, it is suitable for use in cooling tower, irrigation and toilets or as process water in manufacturing etc.

Condensate water can also be reused for heat recovery as per the requirements set in *Regulation 502.10: Exhaust Air Energy Recovery Systems and Condensation of Water.* Condensate water however should not be used where it will not come in direct contact with the human body.

An example of condensate recovery system configuration is shown in fig. 601.03(1). However, this would vary based on the condensate reuse application in the project.

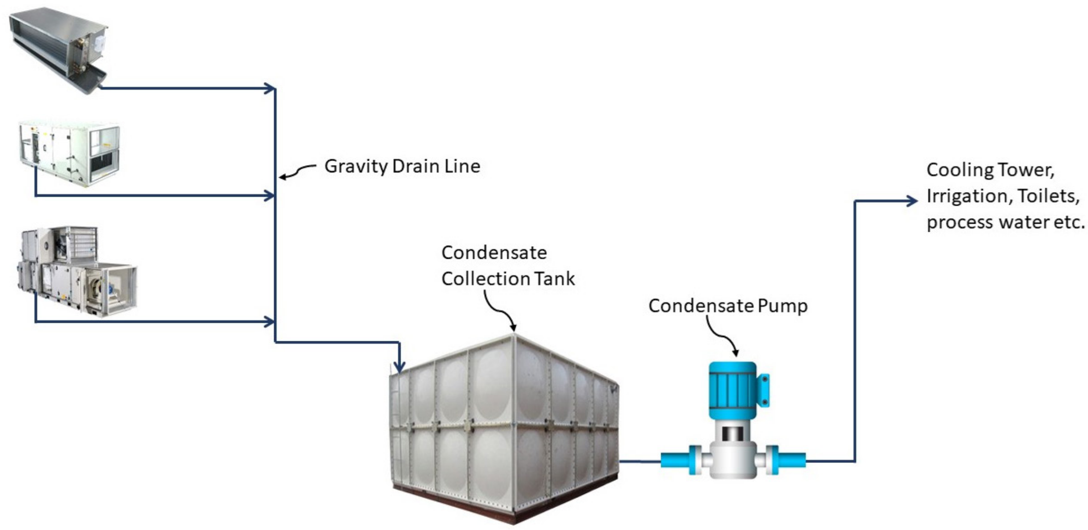



Fig. 601.03(1): Condensate Recovery System Configuration (Sample)

To ensure that the condensate water is safe for the on-site applications, legionella risk assessment must be evaluated as outlined in *Regulation 406.01: Legionella Bacteria and Building Water Systems.*

## COMPLIANCE DOCUMENTATION

**Table 601.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Annual condensate water generation calculation.<br>2. Plumping layout showing the method of reusing condensate water. |
| Construction Completion Application | 1. Final approved plumping layout showing the method of reusing condensate water. |
| After Completion | 1. Calculations of the actual condensate water generated. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2019). Al Sa'fat Green Building Regulations 502.10 – Exhaust Air Energy Recovery Systems and Condensation of Water.

# CHAPTER 1 - CONSERVATION AND EFFICIENCY



## 601.04 WATER EFFICIENT IRRIGATION

Silver Sa'fa

### INTENT

To avoid or reduce the use of potable water for landscape irrigation by either the use of non-potable water or by efficient means of irrigation.

### REQUIREMENT

For all new buildings, 100% water requirement for the total exterior landscaping must be irrigated using non-potable water or by use of drip or subsoil water delivery systems. The landscaping shall also include the area for green roofs.

All irrigation systems must incorporate backflow prevention devices, if at any point they get connected to a potable water supply. The backflow prevention devices must be checked in line with the manufacturer's recommended practice.

### SIGNIFICANCE

Responsible use of water resources is a key element of sustainable development and it is important to address the major water consuming activities. Landscape irrigation practices consume large quantities of potable water in hot climatic zones. Efficient landscape design that incorporates local and adaptive plants and water efficient irrigation systems not only reduce the water usage but also effectively integrates the building with its natural surroundings.

Drip irrigation or subsoil water delivery systems effectively reduce the irrigation water use. Condensate water and treated sewage water or greywater are some of the non-potable water sources that can be used for irrigation.

Significant water savings can be achieved by either using non-potable water or by using efficient means of irrigation. A reduction in the amount of potable water for landscape irrigation will result directly result in cost savings.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

100% of the landscaping area of a building site (including green roofs) should be irrigated using non-potable water or by use of drip or subsoil water delivery systems.

Project teams should use efficient irrigation techniques to reduce the amount of water for irrigation (fig. 601.04(1)). Buried irrigation systems are also very effective in delivering low levels of water to plant roots.

Several irrigation techniques are available that effectively reduce the irrigation water use. Micro-irrigation systems like drip irrigation, soaker hoses and micro sprayers are very efficient in reducing water use and at the same time deliver required amount of water directly at the roots of the plants. Sprinklers can cover large areas for irrigation, however less efficient than drip irrigation.

Fig. 601.04(1): Drip Irrigation System

Alternative forms of irrigations, if used, must not use potable water source. Grey-water or condensate water or Treated Sewage Effluent (TSE) can be considered for irrigation. The use of treated greywater for irrigation is addressed in *Regulation 603.01 Wastewater Reuse*. TSE water for irrigation must be from the sources approved by Dubai Municipality.

To reduce irrigation water demand and consumption, following recommendations for irrigation planning could be considered:

- Planting native and adaptive species would create a self-sustaining landscape, which would require only minimal water, less fertilisers and pesticides.
- Reducing or eliminating turf grass will decrease the irrigation demand. If turf is preferred, use low maintenance and drought tolerant grass.
- Plants can be located and grouped according to their water requirements. This allows for an irrigation schedule to apply the appropriate amount of water to each landscaped area. Trees, shrubs, groundcover, perennials and annuals that naturally grow together and use about the same amount of water should be grouped together.
- Automatic irrigation systems' watering time and schedule should be adjusted throughout the year based on changes in weather or seasons. Routine maintenance of irrigation system should be carried to ensure systems running efficiently.
- A sub-meter may be installed to monitor the water consumption for irrigation application. This would aid in identifying and rectifying any irrigation overuse.
- Night-time irrigation is more efficient, as evaporation is much lower at night.

If irrigation networks get connected to a potable water supply, possibility of any backflow from the irrigated water getting drawn back into the potable water system must be avoided.

Precautions must be taken to ensure prevention of cross-contamination between the irrigation system and the potable water supply. All irrigation systems must incorporate backflow prevention devices (fig. 601.04(2)) that allow water to flow in one direction but never in the opposite direction to prevent the contamination of potable water. The backflow prevention devices must be checked in line with the manufacturer's recommended practice. The devices must be checked to ensure that they operate correctly and do not allow any backflow even when the supply water pressure is reduced.

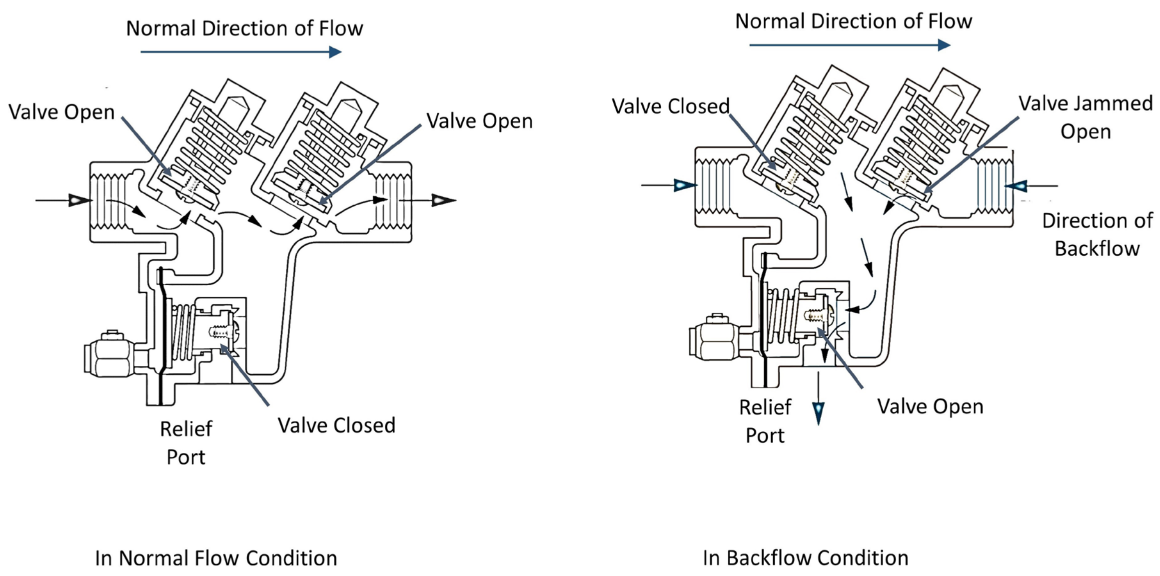



Fig. 601.04(2): Backflow Prevention Devices

## COMPLIANCE DOCUMENTATION

**Table 601.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Irrigation system layout indicating the source of water used in irrigation and the irrigation method. |
| Construction Completion Application | 1. Final approved irrigation layout indicating the source of water used in irrigation and the irrigation method.<br>2. Technical specifications of irrigation system including backflow prevention device.<br>3. Delivery note of the system including backflow prevention device. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

International Organization for Standardization. (2017). IWA 20: Understanding and applying drip irrigation for sustainable agriculture.

International Organization for Standardization. (2015). ISO 16075: Guidelines for treated wastewater use for irrigation projects.

# CHAPTER 2 - COMMISSIONING AND WATER MANAGEMENT

600

## 602.01 WATER METERING

Silver Sa'fa

### INTENT

To monitor building water performance and to encourage effective water management practices.

### REQUIREMENT

For all new buildings, meters must be installed to measure and record water demand and consumption of the facility as a whole. It must also provide accurate records of consumption (tariff class meters). All meters should be approved by DEWA and comply with DEWA specifications.

A. For all buildings having a cooling load of at least 1 MW or gross floor area of 5,000 $m^2$ or greater, additional water metering must be installed to record consumption data for major water use of the building and major water uses in and around the building.

B. The building operator shall be responsible for recording water consumption for each individual meter. Records must be kept for 5 years.

C. Each individual tenancy in the building must have a sub-meter installed when a building tariff meter is not present.

D. Where a Building Management System (BMS) or Central Control and Monitoring System (CCMS) is installed, metering must be integrated into the system to allow real time profiling and management of water demand and consumption.

E. Virtual meters using run-hours are not acceptable as sub-meters.

F. The sub-meters should be used for demand management and cost allocation purposes.

### SIGNIFICANCE

Water sub-metering enables building's facility team to identify and monitor different patterns of water use and to implement actions to reduce water use. It also helps to ensure that the water efficient features and techniques are effectively implemented and water savings are achieved.

Individual tenant sub-metering can also encourage behavioural reductions in consumption by increasing consumer knowledge about their water consumption. It will potentially enable tenants in multi-occupancy buildings to be charged for water, based on their actual consumption.

Advanced water metering integrated with Building Management System (BMS) or Central Control and Monitoring System (CCMS) can also enable the building operators to detect water leakage in the supply pipeline, hence prevent water loss, excessive bill and in some cases prevent significant damage and cost of repair resulting from leakage.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Buildings must have a meter to measure and record water consumption of the building as a whole. If there is no separate DEWA tariff meter for each individual tenancy, then a separate meter should be provided to measure the water consumption of the building.

Metering strategies should be considered for all the buildings having a cooling load of at least 1 MW or gross floor area of 5,000 m$^2$ or greater at the design stage. Metering strategies should identify all major water use in and around the building, to ensure requirements of this regulation are met. Major water uses generally include cooling tower make up water, irrigation systems, swimming pools, water features, toilet facilities, kitchen facilities etc. Buildings using non-potable water, such as Treated Sewage Effluent (TSE) or greywater, the consumption of them should also be metered.

All tenants must have sub-meters (fig. 602.01(1)), in case building tariff meter is not installed. These meters will only be used for the demand management and the cost allocation. The sub-meters must meet the DEWA specifications and should be approved by DEWA. Virtual meters using run-hours are not acceptable as sub-meters.

Project teams should also ensure the water sub-meters are suited to the pipe size requirements, to avoid water pressure drop or inaccurate readings.

Fig. 602.01(1): Typical Water Sub-Meter

For projects having Building Management System (BMS) or Central Control and Monitoring System (CCMS), all water sub-meters must be integrated to record both water consumption and demand from each meter, on hourly, daily, monthly and annual basis. BMS or CCMS should also carry out real time profiling and efficiently manage the water demand and consumption. Meter reading records must be kept at least for 5 years and should be available on-site for DM inspection.

In the projects that do not have BMS or CCMS, the building operator must record water consumption on monthly basis from all sub-meters. Annual usage data also should be recorded. The readings shall be recorded in the building logbook. Logbook should maintain the records for at least 5 years and should be available on-site for DM inspection.

## COMPLIANCE DOCUMENTATION

**Table 602.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Final approved plumping layout indicating the water meters.<br>2. Water meter manufacturer data-sheet.<br>3. Delivery notes. |
| After Completion | 1. Water consumption report. |

## REFERENCES AND ADDITIONAL INFORMATION

# CHAPTER 3 - ON-SITE SYSTEMS: RECOVERY & TREATMENT



## 603.01 WASTEWATER REUSE

Silver Sa'fa

### INTENT

To reduce potable water usage by using on-site treated greywater.

### REQUIREMENT

For Golden and Platinum Sa'fa and for all new buildings, the building must be provided with a system for the collection and reuse of greywater (15% for Golden, 30% for Platinum).

For all cases and Sa'fa levels, if a system is installed for the collection and reuse of greywater produced within the building or uses Treated Sewage Effluent (TSE) from an external source, the following must be complied:

A. The building must have dual-plumbing system for the collection and recycled use of drainage water (greywater). Pipes that transport greywater must be colour-coded differently from the pipes that are used for potable (drinking standard) water and must be labelled 'Not Suitable for Drinking.'

B. There must be a minimum air break of 25 mm between any potable water sources and greywater collection systems.

C. Greywater must not be used for purposes wherein it will come into contact with the human body. It must also be treated to the standard set forth by Dubai Municipality.

For all new commercial car washing facilities, at least 50% of the wastewater generated must be recovered and reused.

### SIGNIFICANCE

Population growth and resultant rise in infrastructure development, increases the water demand in cities. This leads to dependence on expanding the water treatment systems and water networks, to cater the increased demand. Utilising water conservation techniques help is successfully reducing the overall demand.

Greywater reuse is one such water conservation technique. Irrigation and flushing toilets do not need high quality water, so treated greywater can be reused for these purposes. Reusing greywater not only reduces the consumption of potable water, it also reduces the volume of water discharged into the sewerage system, thereby conserving water and energy.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation applies to building-specific greywater systems. Greywater must be treated locally before reuse within the building or at the building site. Project team should calculate the expected quantity of greywater generation and design the collection tank and greywater treatment system, accordingly.

For projects targeting Golden and Platinum Sa'fa, greywater treatment system must be provided as per regulation requirements (15% for Golden, 30% for Platinum) and must be reused on-site. The system should treat the greywater to the quality level for its intended end use as per the Local Order No. 61 of 1991 on the Environment Protection Regulations in the Emirate of Dubai.

The piping collection system for greywater can be connected to shower drains, bathtub drains, bathroom wash basin drains and laundry water drains. It must not be connected to toilets, kitchen sinks or dishwashing machines. A collection tank for greywater must be provided in each building and the greywater must be filtered before entering the collection tank.

The following guidelines (for all Sa'fa levels) must be complied for projects using on-site greywater treatment system or using TSE water from external sources:

- Buildings must have dual plumbing system, one for potable water and one for recycled greywater. All distribution pipes for recycled greywater must be differently colour-coded from the distribution pipes of potable water and should be clearly and permanently labelled as "Not Suitable for Drinking".
- There must be a minimum air break of 25 mm between any potable water sources and greywater collection and distribution system, to avoid any contamination to potable water.
- Greywater must not be used for purposes wherein it will come into contact with the human body and must be treated to the standard set forth by Dubai Municipality before reusing.
- Greywater should not be stored longer than 48 hours in order to prevent build-up of contaminants. Hence, the collection tank should be sized accordingly to limit the retention time of greywater to a maximum of 48 hours.
- When unused greywater is drained into sewage system, it is important that it is discharged through a connecting valve with a backflow preventer. Sewage water entering greywater system can be stopped with backflow preventer. Any overflow from the storage tank must be connected with sewage system.

Commercial car washing facilities must recover and reuse a minimum of 50% of their wastewater. Treated recycled water can be used to wash cars. A typical schematic of car wash water reclamation system is shown in fig. 603.01(1), wherein water used for car washing is recovered, treated and reused.

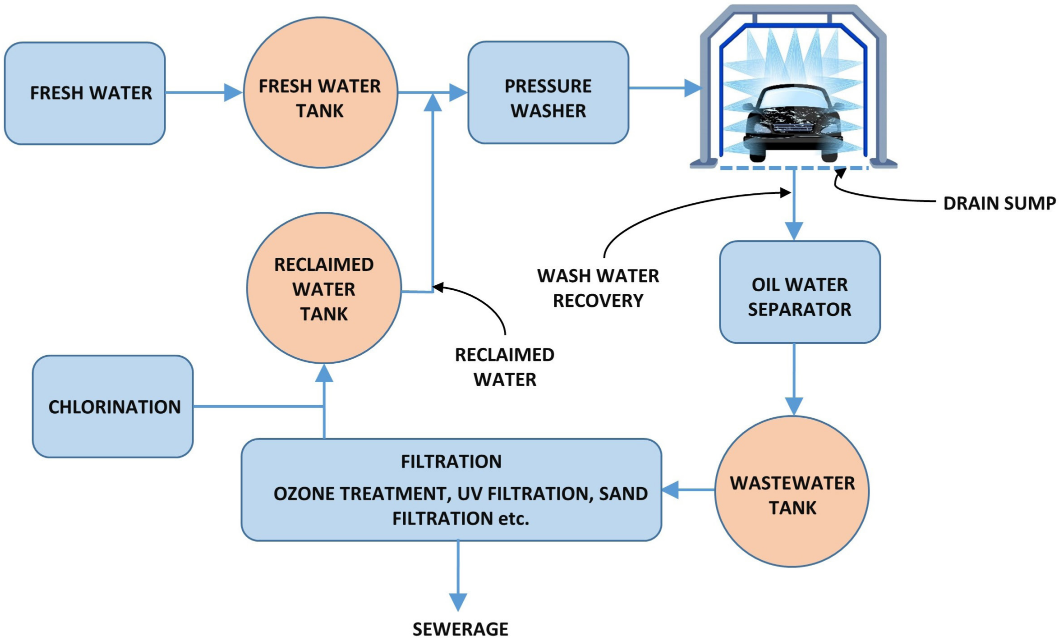



Fig. 603.01(1): Car Wash Water Reclamation System (Sample)

## COMPLIANCE DOCUMENTATION

**Table 603.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Plumbing drawing indicating the dual-plumbing network for collection and reuse of grey water.<br>2. Detailed description of the treated water quality parameters and treatment standards.<br>3. Calculation of expected waste water quantity and capacity of treatment system.<br>4. Design drawing for grey water treatment system. |
| Construction Completion Application | 1. Final approved plumbing drawing confirming dual plumbing with signage details.<br>2. Technical data sheet for the grey water treatment system.<br>3. Final approved design drawing for grey water treatment system. |
| After Completion | 1. Test report for treated water.<br>2. Calculation of the actual treated waste water quantity. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality (1991). DM Local Order No. 61 of 1991 on the Environment Protection Regulations in the Emirate of Dubai, Article (75).

# CHAPTER 3 - ON-SITE SYSTEMS: RECOVERY & TREATMENT



## 603.02 WATER CONSUMPTION FOR HEAT REJECTION INCLUDING COOLING TOWERS

Silver Sa'fa

### INTENT

Reduce potable water usage by utilising the recycled water in heat rejection equipment.

### REQUIREMENT

For all new buildings:

Potable water supplied by Dubai Electricity and Water Authority (DEWA) must not be used for heat rejection purposes.

Where cooling towers are used, Treated Sewage Effluent (TSE), seawater or recycled water must be used to meet the water demand for all heat rejection purposes. Secondary water sources must be approved by Dubai Municipality or DEWA.

A separate totalising meter must be fitted on the water supply line to the individual cooling towers. A daily log of water use must also be kept.

### SIGNIFICANCE

Air conditioning systems play a vital role in providing comfortable conditions for the building occupants. Cooling tower is an important component of water-cooled air conditioning system. Large volume of water gets used in cooling towers, to compensate for the losses from evaporation systems and to flush out the build-up of dissolved minerals. Using potable water for such purposes would not only deplete the fresh water source but also would require significant amount of energy to treat and transport the water.

Alternative options include use of water from Treated Sewage Effluent (TSE), on-site treated greywater or other forms of recycled water. Using alternative methods ensure conservation of water, reduction in costs through lower utility charges, less sewerage volume and reduction in energy use.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Water-cooled systems consist of heat rejection equipment (cooling tower), which uses natural cooling effect from evaporation of water to remove heat from buildings or process. Cooling towers require considerable amount of water, the demand of which depends upon evaporation, bleed-off and losses.

This regulation requires all new buildings to use non-potable water source for all the water-based heat rejection systems used in the project. This non-potable water can be Treated Sewage Effluent (TSE), seawater, on-site recycled water (condensate as per *Regulation 601.03: Condensate Reuse*) or any secondary water source approved by Dubai Municipality or DEWA.

The project team must calculate the cooling tower make-up water requirement, during design by considering all factors (evaporation loss, drift loss and blowdown loss) and determine how this water demand could be met by specified non-potable water sources.

The availability of TSE from the Dubai Municipality or using seawater from the open ocean must be checked with Dubai Municipality, early in design stage. Design for cooling tower that uses seawater requires additional care, as salts in seawater are known to have some operational challenges, including salt deposition, packing blockage, corrosion etc. Hence, proper selection of materials and coatings or considering any treatment to increase the service life and performance of cooling tower is very important.

Make-up water supplied to each cooling tower must be separately metered using totalising meter. A typical schematic diagram of utilising totalising meter in cooling tower water use is shown in fig. 603.02(1). The facility operator should keep a daily log of water consumption and record the same in building logbook. Daily trends can assist in identifying performance evaluation. Meters must be calibrated as per manufacturer's recommended interval.

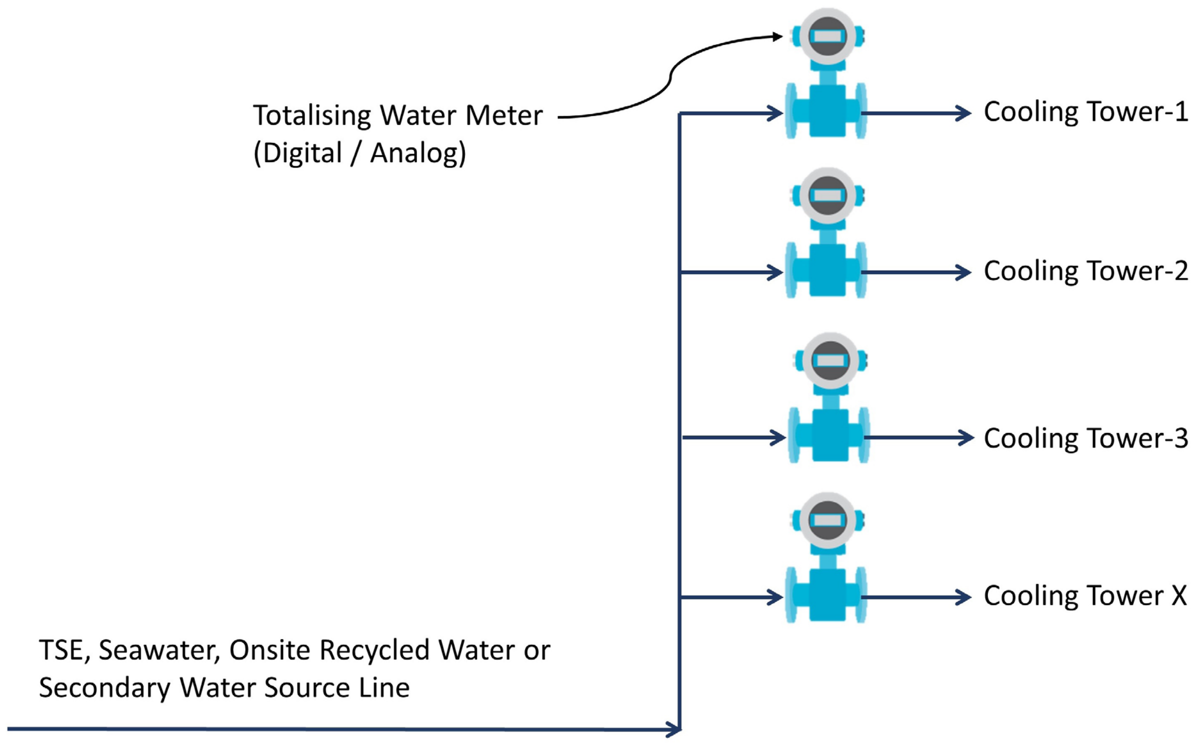



Fig. 603.02(1): Schematic For Totalising Meter In Cooling Tower Wateruse

Cooling tower water must be treated and regularly tested in accordance with *Regulation 406.01, Legionella Bacteria and Building Water Systems, to prevent growth of legionella bacteria.*

Project teams may use suitable water treatment system that treats the water, prior to supplying to the cooling tower. This ensures higher number of cycles of concentration is achieved, minimises blowdown water quantity and reduces make-up water demand.

## COMPLIANCE DOCUMENTATION

**Table 603.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Cooling tower water supply requirement calculation including the loss factor.<br>2. Cooling tower water supply layout showing metering location.<br>3. All the required NOCs if using secondary water sources. |
| Construction Completion Application | 1. Final approved water supply layout showing metering location. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.01 THERMAL AND ACOUSTICAL INSULATION MATERIALS

Silver Sa'fa

### INTENT

To limit toxic contents and thereby provide quality assurance in insulation materials.

### REQUIREMENT

For all new buildings, insulation materials that are installed in the building must:

1. Be manufactured without the use of Chlorofluorocarbons (CFCs).
2. Be non-toxic and does not release toxic fumes during combustion.
3. Have 0.05 ppm or less of added formaldehyde.
4. Have a Threshold Limit Value (TLV) of 0.1 or less of Individual Volatile Organic Compounds.
5. Be fire resistant as per the requirements set forth by Dubai Civil Defence.
6. Thermal insulation materials should be certified by Dubai Central Laboratory.
7. Achieve all the requirements set forth by Dubai Municipality.

All thermal and acoustical insulation must be installed as per the manufacturer's instructions and must be approved by Dubai Municipality.

### SIGNIFICANCE

In hot climates, most of the buildings are fully air conditioned and these buildings need to be adequately insulated to avoid any energy losses. Insulation materials are an integral part of building in not only reducing the energy use by restricting heat transfer within the building but also by contributing to make the building space more comfortable for the occupants.

Thermal insulation is used to reduce heat transfer between objects while acoustical insulation is used to reduce transfer of noise that enters, exits or travels within a room or space. Each type of insulation materials has their own usability, adaptability and performance properties. As large volumes of thermal and acoustical insulation materials are used in the construction of buildings, it is important to minimise their environmental impact. Impacts of insulation materials can be reduced by restricting the use of certain hazardous substances such as formaldehyde binders, CFCs etc., during the manufacturing process.

The Montreal Protocol, to which UAE is a signatory, bans the use of CFCs and restricts the use of Hydrochlorofluorocarbons (HCFCs).

Formaldehyde and Volatile Organic Compounds (VOC) have been identified as a major contributor to poor indoor air quality. Prolonged exposure to these substances may result in chronic health complications such as headache, itchy eyes, throat irritation, fatigue, nausea etc. Also, during installation if poorly installed, possibility of condensation occurs which results in water damage to other building elements.

Hence, it is important that the insulation materials are properly labelled, selected, installed and protected during and after installation. This ensures that the materials perform in an efficient manner, reduces heat and sound transfer and contributes to energy conservation. Restricting the use of hazardous substances also ensures that the impact on environment and human health is minimised.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

All insulation materials (fig. 701.01(1)) used in building should conform to the requirements of this regulation and must be certified by DM/DCL. Also, conformity certificates for the insulation materials should be renewed annually. Materials certified by DCL are available in Dubai Municipality's website/portal.

Acoustic Insulation Slab | Acoustic Foam | Insulation Sheet | Rockwool

Fig 701.01(1): Types Of Insulation (Samples)

Project teams should ensure the insulation materials specified, is manufactured without the use of CFC. There are several substitutes available that are environmental friendly and in compliance with DM requirements.

Combustible insulation materials produce toxic fumes when burned. To regulate the fire toxicity of the insulation materials, Dubai Civil Defence (DCD) has set forth regulations, fire safety standards and test procedure for all applicable insulation materials. Project teams must ensure that insulation materials comply with DCD requirements and is approved by DCD, prior to installation.

Insulation materials must also comply with added formaldehyde and VOC limits set forth in this regulation. Project teams should review the DCL test certificates for the insulation materials, for formaldehyde and VOC levels and ensure compliant materials are used.

To ensure insulation materials are properly installed during construction stage, the following guidelines can be considered by the project teams:

- Exposure to moisture results in degradation of thermal properties of insulation materials. Hence, prior to installation, materials should be stored in dry, covered areas away from any potential source of moisture or dust exposure from general construction activity.

- Wall and roof insulation should have vapour barrier on either side of the insulation, depending on the type of construction. Vapour barriers include polythene sheeting, reflective foil, foil backed plasterboard, water resistant painted surfaces.
- Employee should use necessary respiratory protection masks/ devices to protect from harmful dust, fibres, fumes / gases generated during the installation of insulation materials.
- When cavity walls incorporate insulation, they should be sealed against air leakage.
- Any materials with evidence of mold, mildew or moisture infiltration should be removed and replaced.
- Ensure there is sufficient space for the insulation to retain its normal thickness. In cases where compression cannot be avoided, the final thickness after installation shall be sufficient to provide the required amount of insulation.
- Insulation materials must be kept clear of electrical wiring and fittings. Reflective foil insulation should not be placed on top of ceilings or ceiling joists, nor under floors, as it is electrically conductive. Any such insulation must also be secured with non-conductive staples.
- All fixing fasteners for insulation materials should be rust proof.
- When insulating above ceilings, the insulation weight should not alter the integrity of the ceiling structure.
- Thermal bridging should be avoided, especially with highly conductive metal framing systems.

## COMPLIANCE DOCUMENTATION

**Table 701.01(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Material data-sheets confirming the materials specifications meets requirement.<br>2. DCL certificate for thermal insulation materials.<br>3. Material delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Ministry of Interior, UAE. (2018). UAE Fire and Life Safety Code of Practice.

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.02 CERTIFIED / ACCREDITED TIMBER

Silver Sa'fa

### INTENT

To promote sustainable and environmentally responsible practices.

### REQUIREMENT

For all new buildings, at least 25% by volume of the timber and timber-based products used during construction and permanently installed in the building, must be from a certified / accredited source, approved by Dubai Municipality.

### SIGNIFICANCE

Rapid growth of construction industry has increased the usage of timber and timber products. If sourcing of timber from forests is not managed properly, this can have a detrimental effect on human beings. Negligent practices can lead to deforestation, wildlife habitat loss, soil erosion and water and air pollution. To ensure protection of forest ecosystem certified forest management systems are being adopted worldwide.

Number of internationally recognised schemes has been developed to ensure sourcing of timber is from environmentally responsible and sustainable forest management practices. Environmentally responsible forest management practices include approaches linked to the health and wellbeing of the population near the forest, such as minimising the use of toxic chemicals and water quality considerations. They will also seek to minimise the environmental impact of logging operations including measures to protect local wildlife and biodiversity.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation promotes sustainable and environmentally responsible forest management practices. The requirement is at least 25% by volume of the timber and timber-based products used during construction and permanently installed in the building, must be from a certified / accredited source, approved by Dubai Municipality.

Some of the certification schemes that are approved by DM include the following:

The Forest Stewardship Council (FSC): FSC certification is the most widely recognised timber certification scheme that ensures the products are sourced from a responsibly managed forest.

Programme for Endorsement of Forest Certification (PEFC): PEFC certification ensures that timber and non-timber forest products are produced with respect for the highest ecological, social and ethical standards. It also promotes good practices for the entire forest supply chain.

The Sustainable Forestry Initiative (SFI): The SFI program is a comprehensive system of principles, objectives and performance measures developed by professional foresters, conservationists and scientists, that combines the perpetual growing and harvesting of trees with the long term protection of wildlife, plants, soil and water quality.

The Canadian Standards Association (CSA) Sustainable Forest Management: Forests certified to the CSA Sustainable Forest Management Standard provide independent 3rd party assurance of meeting a strict set of biological, environmental and social criteria.

DCL's Attestation of Conformity Certificate: Manufacturers or suppliers can obtain Attestation of Conformity Certificate for the certified timber products from DCL.

By sourcing timber that is certified through these certification schemes ensures compliance with this regulation.

The percentage of certified timber in the project must include materials permanently installed in the project, including (but not limited to) structural and general dimensional framing, flooring, sub-flooring, wood doors, and finishes. Any timber, which is used during construction, such as boxing and formwork, must also be included even if it does not form part of the completed building.

The project team should identify suppliers of certified timber products that can meet the project's needs early in the project development. The requirements of certified timber products must be part of contract specifications. Certified wood purchased and stored for use in the project construction must be stored in a suitable location that has ambient moisture levels similar to the levels of the final installation.

The percentage of certified timber used in the project could be obtained based on the total volume of timber. Following formula shall be used for the calculation of the percentage of certified timber.

$$\text{Certified Timber Percentage} = \frac{\text{Certified Timber Material by Volume / Weight}}{\text{Total Wood Material by Volume / Weight}} \times 100$$

Project teams should collate supplier invoices for permanently installed timber in the project. For all certified timber used in the project, proof that the timber used is from a sustainable source should be submitted to DM.

**Case Study**

For a residential building, total wood used in the project was 18,965 kg. Table 701.02 (1) lists the various wood materials used / purchased for the project. The certified timber percentage for the project is 29%, thereby complying with this regulation.

Table 701.02(1): Sample Spreadsheet For Certified Timber Calculations

| Description of Material | Manufacturer or Vendor Name | COC /FSC Details | Wood Type | Wood Weight (kg) | Certified Timber Percentage | Certified Timber Weight (kg) |
|---|---|---|---|---|---|---|
| MDF (lobby area) | ******* | COC TT-COC-003xxx | FSC Pure | 10 | 100 | 10 |
| Wooden Doors | ******* | SCS-COC-002xx | FSC MIX (45%) | 7,200 | 45 | 3,240 |
| Cabinets | ******* | SCS-COC-002xx | FSC Pure | 2,160 | 100 | 2,160 |
| Shuttering Material | ******* | - | Non FSC | 2,256 | 0 | - |
| Total Certified Wood (kg) | | | | | | 5,410 |
| Total Wood in the project (kg) | | | | | | 18,965 |
| **Certified Timber Percentage** | | | | | | **29%** |

## COMPLIANCE DOCUMENTATION

**Table 701.02(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. DCL certificate or certificate from certified / accredited source associated with each timber product.<br>2. Purchase order/delivery notes of certified wood products.<br>3. Report from the consultant indicating the total volume of timber used and the precentage of the certified timber used. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Central Laboratory (DCL). (n.d.). Information available at https://www.dm.gov.ae.

The Forest Stewardship Council (FSC). (n.d.). Information available at https://ic.fsc.org/en.

Programme for Endorsement of Forest Certification (PEFC). (n.d.). Information available at https://www.pefc.org.

The Sustainable Forestry Initiative (SFI). (n.d.). Information available at http://www.sfiprogram.org.

The Canadian Standards Association (CSA). (n.d.). Information available at http://www.csasfmforests.ca.

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.03 ASBESTOS CONTAINING MATERIALS

Silver Sa'fa

### INTENT

Restricting the usage of asbestos containing materials in new buildings and protecting occupants from asbestos exposure during maintenance or modification in existing buildings.

### REQUIREMENT

For all new buildings and for the maintenance, addition or alteration of existing buildings, asbestos containing materials must not be used.

### SIGNIFICANCE

Asbestos is a naturally occurring mineral silicate fibre. As the asbestos fibres are strong and resistant to fire and heat, it was commonly used in older buildings, in insulation materials for roofing, textured paints, coating materials, and resilient floor tiles, among other products. Major forms of asbestos used commercially are chrysotile, amosite and crocidolite. Asbestos containing materials (ACM) are mixtures of individual asbestos fibres and binding material.

Asbestos containing material can be crushed easily, which releases asbestos fibre into the air. Improper attempts to disturb or remove these materials can also release asbestos fibres into the air, increasing airborne asbestos levels and exposing building occupants to the inherent risks. Asbestos fibre once enters human body, does not get dissolved due to its composition. Prolonged exposure to asbestos can have severe health impacts, such as chest and abdominal cancers and lung diseases often leading to death.

The use of asbestos products has been restricted or banned in several countries. UAE has also completely banned the import, production and use of Asbestos Boards within the UAE, through Cabinet Resolution No. 39 of 2006.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Materials containing asbestos must not be used in any new buildings or in the maintenance or alteration of existing buildings. DM's guidelines for safety in handling asbestos must be followed to prevent risk of exposure of asbestos and for disposal of asbestos. If the project involves demolition of an existing building or structure, the demolition contractor must be aware of and abide by all local and federal requirements. Prior to any demolition, remodelling or maintenance of existing buildings; the presence or absence of asbestos materials should be determined by a qualified professional. If asbestos is present, removal and/or repair should be done by people trained and qualified in handling asbestos. Appropriate personal protective equipment must be used by all workers engaged in handling, use, transportation, disposal of asbestos fibre or any product containing asbestos.

Project team shall ensure that technical specification must include the requirement for materials to meet this regulation. In construction stage, project team must provide technical datasheet or lab test report confirming that no asbestos containing materials have been used in the project. Typically, asbestos content of suspect materials is determined by analysing samples with polarised light microscopy (PLM). Polarised light is used to observe properties of asbestos fibres to distinguish it from non-asbestos fibres. PLM analysis results provides the percent and type of asbestos in the sample.

## COMPLIANCE DOCUMENTATION

**Table 701.03(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | Not applicable. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Public Health & Safety Department, Dubai Municipality. (2010). Guidelines for Safety in Handling Asbestos.

United Arab Emirates. (2006). Federal Cabinet Resolution No. (39) of 2006 on Banning the Import and Production of Asbestos.

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.04 LEAD OR HEAVY METALS CONTAINING MATERIALS

Silver Sa'fa

### INTENT

Regulating use of heavy metal content in building materials to prevent the health impacts associated with exposure to heavy metals.

### REQUIREMENT

For all new buildings and for the maintenance, addition or alteration of existing buildings, paints or other materials that may contain percentage of lead or other heavy metals that is more than the prescribed limits set by Dubai Municipality, must not be used, unless the metal is encapsulated in systems such as a photovoltaic cell.

All paints and materials containing lead or other heavy metals must be accredited / certified from Dubai Central Laboratory or any source approved by Dubai Municipality.

### SIGNIFICANCE

Lead is a naturally occurring heavy metal found in small amounts in the earth's crust. Lead and lead compounds had been used in a wide variety of building products including paints, ceramics, pipes and plumbing materials, solders, gasoline, batteries and cosmetics.

Lead-based paint is a major source of lead poisoning for children and can also have effect on adults. In children, lead poisoning can cause irreversible brain damage and can severely impair mental and physical development. In adults, it can also have serious impacts, such as poor muscle coordination, nerve damage, reproduction problems and increased blood pressure. Improper attempts to remove lead paint or other products containing lead can also release lead dust, fumes, or chips, thereby exposing occupants to these health risks. Other heavy metals such as cadmium, chromium VI, mercury and arsenic can also cause severe health impacts.

By reducing or eliminating paints or materials that contain lead and other heavy metals, human exposure and associated health impacts from these materials can be prevented.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

In compliance with Dubai Municipality Standard DMS 20-Specification for Paints and Varnishes, the following heavy metals and their compounds must not exceed the required levels in paints or other materials: cadmium, lead, chromium VI, mercury, and arsenic. The maximum limits of these materials that are allowed in any product are stated in Table 701.04 (1).

**Table 701.04(1): Maximum Permissible Limits for Heavy Metals**

| Heavy Metal | Maximum Limits Allowed (mg / kg) |
|---|---|
| Lead | 100 |
| Cadmium | 500 |
| Chromium VI | 500 |
| Mercury | 100 |
| Arsenic | 100 |

Prior to renovating, refurbishing or demolishing an existing building, investigation should be carried out to determine the presence of lead-based paint or other heavy metals. If lead-based paint or other heavy metals are identified, safe work practices must be undertaken to avoid heavy metal exposure to workers, occupants or any other people near the building.

Occupational Safety & Health Administration (OSHA)'s Technical Manual Section V, Chapter 3: Controlling Lead Exposures in the Construction Industry: Engineering and Work Practice Controls details acceptable means of lead-based paint handling and removal through engineering and work practice controls.

Engineering controls, such as ventilation and good work practices are the preferred methods of minimising exposures to airborne lead at the worksite. The engineering control methods that can be used to reduce or eliminate lead exposure are substitution, isolation and ventilation.

Work practice control include: (1) good housekeeping (2) use of appropriate personal hygiene practices (3) periodic inspection and maintenance of process and control equipment (4) use of proper procedures to perform a task (5) provision of supervision to ensure that the proper procedures are followed (6) use of administrative controls.

Administrative control involves scheduling construction activities in ways that minimise employee exposure levels. Alternatively, worker rotation that requires rotating employees into and out of contaminated areas in the course of a shift can be implemented, thereby reducing the full-shift exposure of any given employee. When workers are moved out of the work that involves lead exposure, they should be assigned to a worksite that does not involve lead exposure.

The following general guidelines act as industry best practices and can be followed by contractors for removing lead-based paint:

- Initial assessment should be done to determine the concentration level of lead in existing paint systems. As required by Technical Guideline No.8, prior to disposal of the hazardous lead waste, analysis report from any DM accredited laboratories is required.
- Containment/ventilation systems should be designed and operated so as to create a negative pressure within the structure, which reduces the dispersion of lead into the environment.

- All feasible engineering and work practice controls should be employed to limit the lead exposure levels at or below the permissible exposure limits.
- Contractors should make sure that workers wear respirators designed to avoid inhaling lead.
- Contractors should not allow eating or drinking in the work area. Contractors should cover and seal all cabinets and food contact surfaces.
- Contractors should dispose off clothing worn in the room after working. Workers should not wear work clothing in other areas of the building. Work clothes should be laundered separately to eliminate further contamination.
- Awareness training shall be conducted for workers about dangers of exposure to lead systems and mandatory requirement of standards / methods to be followed to ensure safety and wellness of personal and public health.

## COMPLIANCE DOCUMENTATION

**Table 701.04(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Provide DCL certificate for lead containing materials that were used in the project.<br>2. Delivery notes / purchase orders. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2015). Standard DMS 20:2015—Specification for Paints and Varnishes.

Occupational Safety and Health Administration. (1996). OSHA's Technical Manual Section V, Chapter 3: Controlling Lead Exposures in the Construction Industry: Engineering and Work Practice Controls.

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.05 OZONE DEPLETION POTENTIAL (ODP) MATERIAL MANAGEMENT

Silver Sa'fa

### INTENT

Protection of ozone by restricting ozone depleting refrigerants and substances.

### REQUIREMENT

For all new buildings:

A. Installations of heating, ventilation, and air conditioning (HVAC) and refrigeration equipment must contain refrigerants with zero ozone depletion potential (ODP) or with global warming potential (GWP) less than 100, unless the equipment contains less than 0.23 kg of refrigerant.

B. Fire suppression systems must not contain any ozone depleting substances (Chlorofluorocarbons [CFCs], Hydrochlorofluorocarbons [HCFCs] or Halons).

For existing equipment:

A. CFC and halon-based materials are not to be used for any purposes.

B. From 1 January 2030, HCFC based materials or any other material having any ODP are not to be used for any purposes.

C. The venting or direct discharging of any refrigerants during equipment maintenance is strictly prohibited.

D. Recovery, reclamation, recycling and reuse of refrigerants must be practiced at all times.

### SIGNIFICANCE

Ozone layer in the stratosphere absorbs UV radiation from the sun, thereby preventing it from reaching the planet's surface. UV radiation is linked to several harmful effects, including skin cancers, cataracts and damage to crops and marine life. Reduced ozone levels because of ozone depletion mean less protection from the sun's rays and more exposure to UV radiation at the earth's surface.

Certain compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere. These compounds contribute to ozone depletion and are called ozone depleting substances (ODS). ODS that release chlorine include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), carbon tetrachloride and methyl chloroform. ODS that release bromine include halons and methyl bromide, which are generally used as fire extinguishing agents. Bromine is known to be more potent in destroying stratospheric ozone levels than chlorine. Certain ozone depleting substances also have a significant Global Warming Potential (GWP) which contributes to climate change.

The Montreal Protocol on Substances that Deplete the Ozone Layer is a global agreement, in which UAE is a signatory, to protect the Earth's ozone layer by phasing out the chemicals that deplete it. This phaseout plan includes both the production and consumption of ozone depleting substances. By eliminating or restricting the usage of ODS, global warming impacts are reduced.

## APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

This regulation intents to reduce the use of ozone depleting substances. Project team must select refrigerants with zero ozone depletion potential (ODP) or with global warming potential (GWP) less than 100. ODP is defined as the ratio of the amount of degradation to the ozone layer caused by a particular substance relative to the calculated depletion for the reference gas CFC 11 (ODP=1.0). GWP is the potential for global warming that a substance has relative to 1 unit of carbon dioxide, the primary greenhouse gas. In determining the GWP, the Intergovernmental Panel on Climate Change methodology using a 100-year Integrated Time Horizon should be used. Table 701.05 (1) provides the ODP and GWP values for commonly used Refrigerant. Manufacturer datasheet conforming the refrigerant ODP and GWP values should be submitted as proof of compliance.

Fire suppression systems must not contain any ozone depleting substances and clean agent fire extinguishing systems such as FM-200, Novec 1230, INERGEN or similar systems with no ozone impact should be used to meet the compliance.

**Table 701.05(1): ODP And GWP Values For Commonly Used Refrigerant Gases (100-year Potential)**

| Refrigerant | ODP | GWP | Common Building Applications |
|---|---|---|---|
| Chlorofluorocarbons (CFCs) | | | |
| CFC-11 | 1.0 | 4,680 | Centrifugal chillers |
| CFC-12 | 1.0 | 10,720 | Refrigerators, chillers |
| CFC-114 | 0.94 | 9,800 | Centrifugal chillers |
| CFC-500 | 0.605 | 7,900 | Centrifugal chillers, humidifiers |
| CFC-502 | 0.221 | 4,600 | Low temperature refrigeration |
| Hydrochlorofluorocarbons (HCFCs) | | | |
| HCFC-22 | 0.04 | 1,780 | Air conditioning, chillers |
| HCFC-123 | 0.02 | 76 | CFC-11 replacement |
| Hydrofluorocarbons (HFCs) | | | |
| HFC-23 | ~0 | 12,240 | Ultra low temperature refrigeration |
| HFC-32 | 0 | 675 | Air Conditioning |
| HFC-134a | ~0 | 1,320 | CFC-12 or HCFC-22 replacement |
| HFC-245fa | ~0 | 1,020 | Insulation agent, centrifugal chillers |
| HFC-404A | ~0 | 3,900 | Low-temperature refrigeration |

| | | | |
|---|---|---|---|
| HFC-407C | ~0 | 1,700 | HCFC-22 replacement |
| HFC-410A | ~0 | 1,890 | Air conditioning |
| HFC-507A | ~0 | 3,900 | Low temperature refrigeration |
| Hydrofluoroolefins (HFOs) | | | |
| R-1233zd | 0 | 1 | Air Conditioning |
| R-1234ze | 0 | 7 | Air Conditioning |
| Natural Refrigerants | | | |
| R744 (Carbon dioxide) ($CO_2$) | 0 | 1.0 | |
| R717 (Ammonia) | 0 | 0 | |
| R290 Propane | 0 | 3 | |

For existing buildings, owners and building operators should ensure that CFC and halon-based materials are not to be used for any purposes. All existing equipment or appliances for domestic and commercial refrigeration or air conditioning should always be maintained leak free. Venting of ODS refrigerants during maintenance, servicing, repairing or disposing of air conditioning or refrigeration equipment is prohibited. Sustainable measures like refrigerant gas recycling and reclamation must be employed through a DM approved agency. Recycling old refrigerant requires the refrigerant is processed to reduce contaminants and then reuse the gas in the same system thereby recovering the gas. Reclamation requires reprocessing of used refrigerant to meet the product specifications for newly manufactured refrigerant. Reusing of recycled or reclaimed refrigerants must comply with DM's requirements and standards.

The ODP and GWP values for the various products from the manufacturer should be maintained at site, for any inspection by DM.

## COMPLIANCE DOCUMENTATION

**Table 701.05(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Mechanical drawing indicating the refrigerant used for HVAC. |
| Construction Completion Application | 1. Technical data-sheets of all HVAC refrigerant and all mechanical systems showing the ODP and GWP.<br>2. Technical data-sheets of fire suppression systems. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2001). DM Circular 108: Procedures for controlling the use of ozone depleting material (CFC).

Environment Department, Dubai Municipality. (2018). Technical Guideline No. 2 Environmental Impact Assessment (EIA) Requirements for Development, Infrastructure and Utility Projects.

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.06 RECYCLED CONTENT

Silver Sa'fa

### INTENT

Reducing dependency of virgin material for manufacturing of new products using recycled or recovered materials.

### REQUIREMENT

For all new buildings, of the total materials used in the construction of the building, the following percentage of recycled content must be met:

- 5% for Silver Sa'fa
- 10% for Golden Sa'fa
- 15% for Platinum Sa'fa

### SIGNIFICANCE

The extraction, manufacture, transport, use and disposal of new building materials have environmental effects that includes air and water pollution, natural resources depletion, natural habitat damage and land use impacts. Use of recycled content in construction materials help in reducing the dependency on virgin materials, reduced construction waste that is disposed to landfill, reduced energy and water use, reduced pollution and reduced greenhouse gas emissions.

Manufacturers now employ sustainable production strategies that integrates pre-consumer or post-consumer recycled content to reduce the raw material requirements. This ensures the products containing recycled content reflects the integrity of manufacturer's supply chain and their commitment to environmental stewardship.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Project teams should identify materials with recycled content in the design phase and include it as part of the specifications. During construction, for the identified materials with recycled content, supporting documentation for recycled content should be sourced from suppliers and collated for DM submissions.

Generally, highest contribution of recycling percentage comes from reinforcing steel or aluminium used for façade or finishes. Other materials that can be considered having recycled content, include but not limited to:

- Cement
- Gypsum Board
- Insulation materials
- Blocks
- Metal doors and frames
- Ceramic tiles
- Glass
- Composite wood products
- Pavers
- Structural steel

Only permanently installed materials should be considered for recycle content calculations. Calculation is based on the estimated cost of recycled content of the material against total material cost of the project. Project teams should obtain substantiating documents for the recycled content percentage in the proposed product from manufacturers.

When a component of the material is recycled, the recycled content shall be determined by its contribution to the weight of the product. The fractional value of the weight is then multiplied by the total estimated cost of the material assembly to determine the Recycled Content Value (RCV). The suppliers or manufacturers of these products must provide a declaration as to the recycled content of their products.

Mechanical, electrical and plumbing plant and components should not be included in the recycled material calculation for this regulation.

The calculation of recycled content value (RCV) is as follows:

Recycled Content Value = Percentage of Recycled Content x Material Cost

Total material cost for the project may be determined as either:

- Total actual cost of all materials for use in the project; or
- 45% of the total construction cost of the project.

The following equation shall be used to calculate the overall percent of recycled content for the project:

$$\text{Percent Recycled Content} = \frac{\text{Total RCV} \times 100}{\text{Total Materials Cost}}$$

### Case Study

For a commercial building targeting Golden Sa'fa, total construction cost for the project is AED 41 million. Material cost is computed considering 45% default value i.e. total material cost is 41,000,000 x 0.45 = AED 18,450,000. Table 701.06 (1) lists the materials with recycled content purchased for the project. The percentage of recycled content used for the project is 11%, thereby complying with Golden Sa'fa requirements.

**Table 701.06 (1): Sample Spreadsheet For Recycled Content Calculations**

| Description of Material | Manufacturer or Vendor Name | Material Cost (AED) | Recycled Content (%) | Recycled Content Value (AED) |
|---|---|---|---|---|
| Readymix Concrete | ***** | 3,917,024 | 12.5 | 489,628 |
| AAC Blocks | ***** | 1,378,165 | 5 | 68,908 |
| Aluminium | ***** | 259,259 | 20 | 51,852 |
| Glass | ***** | 1,037,036 | 12 | 124,444 |
| Steel | ***** | 4,896,280 | 27.5 | 1,346,477 |
| Gypsum board | ***** | 77,398 | 15.5 | 11,996 |
| | | | Total Recycled Materials (AED) | 2,093,305 |
| | | | Total Material Cost (AED) | 18,450,000 |
| | | | **Percent Recycled Content** | **11.34%** |

## COMPLIANCE DOCUMENTATION

**Table 701.06(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Manufacturer supporting documents for the recycled content of claimed products.<br>2. Purchase order/delivery notes as a proof of purchase.<br>3. Report from the consultant indicating the percentage of recycled content. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

# CHAPTER 1 - MATERIALS AND RESOURCES



## 701.07 REGIONAL MATERIALS

Silver Sa'fa

### INTENT

Reducing embodied carbon in building materials through regional sourcing.

### REQUIREMENT

For all new buildings, of the total materials used in the construction of the building, the following percentage of materials must be procured regionally:

- 5% for Silver Sa'fa
- 10% for Golden Sa'fa
- 15% for Platinum Sa'fa

### SIGNIFICANCE

Materials and components used within the construction of a building often require significant expenditure of embedded carbon to bring them to the project site in Dubai. If the materials are extracted and manufactured locally, this would reduce the transportation cost and resource expenditure associated with it. Sourcing regionally made materials also helps the local economy, by expanding production and further providing more jobs to the community and region. Localising the supply chain further reduce time required for the delivery of the material, this contributes to the better economic aspects of project procurement costing.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

Building materials and major building elements that are extracted and manufactured within the Gulf Cooperation Council (GCC) countries are considered 'regional materials', in recognition of the economic agreement between the GCC States. To qualify as 'regional materials', these materials must be extracted, processed and manufactured within the GCC countries. Materials which are manufactured regionally but which use imported raw materials do not qualify.

Project teams should identify building materials that can comply with this regulation in the design stage. Materials that can be considered for this regulation include but not limited to:

- Steel
- Cement
- Concrete
- Ceramics
- Block
- Pavers
- Ceramic tiles
- Glass
- Aggregate
- Aluminium

During construction, project teams need to procure complying materials along with supporting documentation conforming the products are extracted, processed and manufactured locally/ regionally. Documentation on the origin and value of regional materials used in the project, must be available for DM inspections and submission. For selection of regional materials conforming to this regulation, the following should be considered:

- Detailed specifications of the finished product, including the identification of each material or component that comprises the finished product, including primary and alternate materials.
- The location where each of the materials or components was extracted or harvested; and confirmation that this is within a GCC member country.
- The manufacturing location, where the finished product is produced,
- The weight of each material used in the manufacture of the finished product.
- The percent (by total weight) that each material is in relation to the total weight of the finished product.

The calculation of the percentage of regional materials must include materials that are permanently installed in the project only. The following materials are not required to be included in the calculation:

- Mechanical plant;
- Electrical installation components;
- Plumbing components;
- Loose furniture and fittings; and
- Specialist equipment and plant.

The following equation shall be used to calculate the overall percent of regional content for the project:

$$\text{Percent Regional Content} = \frac{\text{Total Regional Content Value} \times 100}{\text{Total Materials Cost}}$$

The total value of regional materials is calculated as the estimated total value of building products that are extracted, processed and manufactured in GCC member countries. If regional materials make up only a part of a product, the proportional regional values are to be calculated based on weight as follows:

Regional Content Value = Percentage of Regional Content by weight x Material Cost

total materials cost for the project is determined as either:

- Total cost of all materials for use in the project; or
- 45% of the total construction cost of the project.

## Case Study

For a government building targeting Platinum Sa'fa, the total construction cost for the project is AED 50 million. Total material cost is AED 24,750,000. The project consists of concrete material in which only part of the product complies with regional material requirement. Table 701.07 (1) indicates proportional regional values calculated based on weight for concrete. Table 701.07 (2) lists the regional materials purchased for the project. The Percent Regional Content for the project is 20%, thereby complying with Platinum Sa'fa requirements.

**Table 701.07(1): Proportional Regional Values Calculation for Concrete**

| Material Type | | Material Name | Regional Material | Weight kg/m$^3$ | Regional Material | | % of Total Regional material in (m$^3$) |
|---|---|---|---|---|---|---|---|
| | | | | | Extraction Location | Manufacturing Location | |
| Cementitious Materials | | Portland Cement | Yes | 275 | Oman | Dubai | 14.9% |
| | | GGBS | No | 150 | Japan | Japan | 0.0% |
| | | Micro Silica | No | 0 | China | China | 0.0% |
| Others | Aggregates | 3/4" Cr. Agg | Yes | 300 | RAK | Dubai | 16.3% |
| | | 3/8" Cr. Agg | Yes | 300 | RAK | Dubai | 16.3% |
| | Sand | Dune Sand | Yes | 600 | RAK | Dubai | 32.6% |
| | | 3/16" Cr. Sand | Yes | 50 | Jebel Ali | Dubai | 2.7% |
| | Water | Water | Yes | 159 | Jebel Ali | Dubai | 8.6% |
| | Admixture | PCE | Yes | 0 | KSA | Dubai | 0.0% |
| | | RH-730 | Yes | 7 | KSA | Dubai | 0.4% |
| Total Weight | | | | 1841 | Total Regional Material % | | 91.8% |
| | | | | | | Material Cost (AED) | 3,917,024 |
| | | | | | | **Regional Content Value (AED)** | **3,595,828** |

**Table 701.07(2): Sample Spreadsheet for Regional Content Calculations**

| Description of Material | Manufacturer or Vendor Name | Country of Origin | Material Cost (AED) | Regional Percentage | Regional Content Value (AED) |
|---|---|---|---|---|---|
| Concrete | ********* | UAE | 3,917,024 | 91.8 | 3,595,828 |
| Steel | ********* | OMAN | 466,666 | 100 | 466,666 |
| Pavers | ********* | UAE | 896,750 | 100 | 896,750 |
| | | | | Total Regional Content Value (AED) | 4,959,244 |
| | | | | Total Material Cost (AED) | 24,750,000 |
| | | | | **Percent Regional Content** | **20%** |

## COMPLIANCE DOCUMENTATION

**Table 701.07(3): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Manufacturer supporting documents for the regional content of claimed products.<br>2. Purchase order/delivery notes.<br>3. Report from the consultant indicating the percentage of regional content. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

## 701.08 COMPOSITE WOOD PRODUCTS

Silver Sa'fa

### INTENT

Reduce the use of formaldehyde in building products thereby improving the occupants' comfort, health and well-being.

### REQUIREMENT

For all new buildings, the composite wood products that are used in the interior of the building, the added urea-formaldehyde resins must be within the accepted percentage as prescribed by Dubai Municipality.

### SIGNIFICANCE

Formaldehyde is a naturally occurring volatile organic compound (VOC). Formaldehyde is a colourless, flammable and strong smelling chemical used in construction products such as adhesives and resins. The effects of exposure to high levels of formaldehyde include eye, nose and throat irritation, wheezing and coughing, skin rash or severe allergic reactions. Formaldehyde is also considered to be carcinogenic.

Most significant sources of formaldehyde in a building are composite wood or agrifiber products manufactured using urea formaldehyde resin adhesives. At room temperatures, these products react and may emit gaseous formaldehyde. High levels of VOC affect the building occupants and those who install or apply these products during construction. Reducing the use of formaldehyde in composite wood products used in buildings will improve indoor air quality and will have a positive effect on building occupants' comfort, health and well-being.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

A composite wood product is defined as a product consisting of wood and plant particles or fibres bonded together by a synthetic or resin. Composite wood includes products such as plywood, particle board, composite door cores, oriented strand board (OSB) medium density fibreboard (MDF) etc. Urea-formaldehyde is a combination of urea and formaldehyde present in some types of adhesives, which may emit formaldehyde at room temperature.

This regulation restricts the use of composite wood with urea formaldehyde resin in the building elements. Any composite wood products used in the interior of the building should not contain urea-formaldehyde resins or the added urea-formaldehyde resins must be within the accepted percentage as stipulated by DM.

Formaldehyde content of composite wood should not exceed a maximum level of 0.3 mg/l. DCL certificate conforming the levels of formaldehyde emission must be submitted.

Additionally, as required under *Regulation 401.06*, while carrying out the indoor air quality tests prior to occupancy, the maximum limit of total volatile organic compounds must not be exceeded.

Furniture and equipment are not considered as part of building elements and are therefore exempt from this Regulation. However, the use of any wood products with any added urea-formaldehyde resins should be avoided, whenever possible.

## COMPLIANCE DOCUMENTATION

**Table 701.08(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. DCL certificates for composite wood products.<br>2. Purchase order/delivery notes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Central Laboratory. (2016). Specific Rules for Type 1 Certification of Formaldehyde Content of Composite Wood.

# CHAPTER 2 - WASTE MANAGEMENT



## 702.01 CONSTRUCTION AND DEMOLITION WASTE

Silver Sa'fa

### INTENT

Reduce extraction of raw material by diversion of construction and demolition waste from landfill through Reduce, Reuse and Recycle.

### REQUIREMENT

For all new buildings except buildings in CBD area, at least 50% by volume or weight of waste material generated during the construction and/or demolition of buildings must be diverted from disposal in landfills. Diverted materials must be recycled or reused.

This shall be implemented as follows:

1. Concrete waste must be diverted to Construction Waste Treatment Plant.
2. Other recyclable materials such as woods, plastics and metals can be reused at site.
3. Excavated soil, land-clearing debris and hazardous waste must be diverted to places designated by the concerned departments of Dubai Municipality (these materials are exempt while calculating the percentages for recycling or reuse).

### SIGNIFICANCE

The rapid increase in the construction and development industry has led to increased generation of construction and demolition waste. Also, as the volume of construction waste increases, so does the burden on landfill sites. Additionally, improper management of wastes may further cause soil and water pollution.

To minimise environmental damage and to conserve natural resources, construction and demolition waste must be reduced. Diverting waste from the landfill creates more opportunities to reuse the waste material for similar use or recycle the waste to new products and use of virgin construction materials also will get reduced. Reusing and recycling waste is important for the achievement of higher economic efficiency, as well as for optimum use of resources and land use management efficiency.

### APPLICABILITY

This regulation is applicable to all building types except buildings in CBD areas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

Creating awareness among all stake holders of the project is first step in reducing the construction and demolition waste disposal in landfill. Waste minimisation strategy of '3Rs' - Reduce, Reuse, Recycle is crucial for implementing efficient waste management procedures. Waste reduction during construction and demolition through source reduction is one of the main measures to tackle the growing waste generation from the point where it originates.

Construction waste that is generated during different stages of construction should be reused, salvaged or recycled to reduce the construction landfill waste.

Project teams must divert a minimum of 50% construction and demolition waste, by volume or weight, from the landfill by one, or a combination of the following activities:

- Salvage - Recovery of materials for on-site reuse or donation to a third party.
- Reuse - Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site.
- Source-Separated Recycling - The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.
- Commingled Recycling - The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

Project team at design stage, should develop construction demolition waste management plan detailing the predicted waste stream generation from the project including the specific type of wastes that would be recyclable and non-recyclable. During construction stage, project team should update and implement this plan. Implementation should include responsibilities of project team, appointment of DM approved waste management company, segregation strategy for various waste generated at site and periodic waste collection and transportation to recycling and disposal facilities by waste hauler etc.

At a minimum, waste should be segregated (fig. 702.01(1)) into following categories:

- General waste arising from construction activities not limited to steel, timber, paper, plastic, cardboards, glass, concrete, block, etc.
- Hazardous waste not limited to waste oils, thinner, solvent, medical waste etc.
- Food waste.


Fig 702.01(1): Construction Waste Segregation Area (Sample)

Dubai Municipality Waste Management Department's Technical Guidelines No. 7 details the waste segregation requirements for different types of wastes, while Technical Guideline No. 9 details the classification for recyclable materials.

Excavated soils and land-clearing debris are excluded from the calculations because these products are increasingly being stockpiled for reuse. Hazardous wastes must be disposed of in an appropriate and safe manner as required by DM and must follow Dubai Municipality Waste Management Department's Technical Guidelines No. 8 for Hazardous Waste Disposal.

Project sites having restriction on the space availability for the various waste streams, can consider commingled recycling procedure. Commingled recycling / single stream involves collection of all recyclable wastes in single container and sorting them at the recycling facility where the wastes are sorted, decontaminated, processed, recycled and repurposed. Projects following commingled recycling procedure should ensure through a waste management contract, that clearly stipulates the contractual responsibility of the waste recycler in terms of waste handling, recycling and providing the required recycling documentation in conformance to this regulation.

To meet the requirements of this regulation, records must be kept for all waste generated on-site during construction and demolition. These records must show quantities of waste reused on-site and how much is left at site. The records must indicate whether the material has been sent to landfill, sent for reuse at a different location, or recycled. The destination of any waste material must be recorded together with the quantity.

Records of waste collection should be maintained at the project site. The record should include the details of the quantity of waste, contents and waste reuse/recycling/disposal location. Proof of receipt for waste sent for reuse or recycling, must be obtained from receiving party and the same should be maintained at project site. Records must be kept up to date and must be retained on-site and available for DM inspection.

Waste materials can be recorded, either by weight (kg) or volume ($m^3$). This should be determined very early and must be used consistently for all calculations (i.e. if weight is selected, all materials should be measured in weight. Similarly, if volume is used, all materials should be measured in volume). Based on recorded data, project teams should calculate the percentage of waste, diverted from landfill. If material weights are not readily available, the following conversion table (Table 702.01 (1)) may be used as a general guideline. Project teams may also opt for different density values, if it can be adequately justified.

**Table 702.01(1): Typical Densities of Common Construction Materials**

| Material | Density (kg/$m^3$) |
|---|---|
| Cardboard | 180 |
| Gypsum Wallboard | 900 |
| Mixed Waste | 650 |
| Concrete | 2,500 |
| Steel | 1,800 |
| Wood | 550 |

**Case Study**

For a residential building, contractor is maintaining a log of waste trips (Table 702.01(2)) being done for the project. Based on the recorded data, project team is tracking the waste generated (Table 702.01(3)) in the project to ensure compliance with this regulation.

**Table 702.01(2): Waste Trip Logs**

| Sr. No | Date | Vehicle No. | Qty. | Type of Waste | Transfer Status | Waste Hauler Details | Supporting Document | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 18-Jun-18 | 65394 | 35 | Concrete waste | Treatment plant | SSM | Letter from treatment plant | Sent to treatment plant |
| 2 | 19-Jun-18 | 12424 | 35 | Food waste | Landfill | SSM | Receipt from landfill | Sent to landfill |
| 3 | 20-Jun-18 | 28915 | 35 | General waste | Landfill | SSM | Receipt from landfill | Sent to landfill |
| 4 | 21-Jun-18 | 27083 | 35 | General waste | Landfill | SSM | Receipt from landfill | Sent to landfill |
| 5 | 22-Jun-18 | 73685 | 35 | Concrete waste | Treatment plant | SSM | Letter from treatment plant | Sent to treatment plant |

**Table 702.01(3): Construction Waste Management Tracker**

| | Construction Waste | | | General Construction Waste | | | Wood Waste | | | Metal Waste | | | Paper / Cardboard Waste | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qty (Ton) | Recycle | Disposal | Qty (Ton) | Recycle | Disposal | Qty (Ton) | Recycle | Disposal | Qty (Ton) | Recycle | Disposal | Qty (Ton) | Recycle | Disposal |
| Jan-17 | 29 | 29 | 0 | 29 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Feb-17 | 53 | 53 | 0 | 35 | 0 | 35 | 6 | 6 | 0 | 91 | 91 | 0 | 1 | 1 | 0 |
| Mar-17 | 56 | 56 | 0 | 35 | 0 | 35 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 |
| Apr-17 | 58 | 58 | 0 | 38 | 0 | 38 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-17 | 14 | 14 | 0 | 45 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-17 | 102 | 102 | 0 | 47 | 0 | 47 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-17 | 179 | 179 | 0 | 47 | 0 | 47 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-17 | 206 | 206 | 0 | 29 | 0 | 29 | 5 | 5 | 0 | 83 | 83 | 0 | 0 | 0 | 0 |
| Sep-17 | 199 | 199 | 0 | 32 | 0 | 32 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-17 | 153 | 153 | 0 | 29 | 0 | 29 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 0 |
| Nov-17 | 115 | 115 | 0 | 32 | 0 | 32 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-17 | 113 | 113 | 0 | 35 | 0 | 35 | 17 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jan-18 | 189 | 189 | 0 | 84 | 0 | 84 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Feb-18 | 89 | 89 | 0 | 45 | 0 | 45 | 14 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mar-18 | 189 | 189 | 0 | 60 | 0 | 60 | 13 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Apr-18 | 186 | 186 | 0 | 77 | 0 | 77 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-18 | 187 | 187 | 0 | 29 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2116 | 2116 | 0 | 721.5 | 0 | 721.5 | 100 | 93.34 | 7.02 | 181.2 | 181.2 | 181.2 | 5.26 | 4.02 | 1.24 |

| | |
|---|---|
| Total Construction Waste Generated | 3,125 |
| Total Construction Waste Recycled / Reused | 2,214 |
| Total Construction Waste Landfill / Disposal | 729 |
| **Percentage of Waste Recycled / Reused** | **71%** |

## COMPLIANCE DOCUMENTATION

**Table 702.01(4): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. DM BLDG Al Sa'fat declaration. |
| Construction Completion Application | 1. Records in the form of log must detail size, contents, source and destination of waste.<br>2. Receipt must be provided for waste recycled, reused, or sent outside the construction site. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Waste Management Department, Dubai Municipality. (2015). Technical guidelines No. 2: Waste collection and transport.

Waste Management Department, Dubai Municipality. (2018). Technical guidelines No. 8: Hazardous Waste Disposal.

Waste Management Department, Dubai Municipality. (2018). Technical guidelines No. 9: Recyclable Waste Materials.

## 702.02 BULK WASTE COLLECTION

Silver Sa'fa

### INTENT

To facilitate easy disposal of bulky wastes.

### REQUIREMENT

For all new residential apartment buildings, an area must be provided for residents to place items of bulky waste such as furniture, electrical appliances and sanitary ware. The area provided must cover an area of approximately 10 $m^2$. The area does not need to be designated, solely for the purpose of bulky waste collection (e.g. an area can be set aside in the car park area).

The bulky waste storage area must be reachable and must not restrict access to the building. It must also comply with all fire and safety requirements.

### SIGNIFICANCE

With ever growing population, consumption of resources has increased significantly that leads to generation of more waste. Hence, it is important to take steps that address waste generation and management of waste disposal. Also, by adopting good waste management practices, city's aesthetic appeal is preserved and its waste management infrastructure is effectively managed. It also helps in ensuring hygiene, safety and cleanliness is maintained in developments.

For residential buildings, residents often face issues with bulky items of waste such as furniture, appliances etc. If these wastes are cluttered with regular waste, disposal of these waste creates hindrance to waste disposal operators. It becomes easy to collect and dispose the bulk waste if specific area is provided for them. Hence, provision of waste disposal infrastructure to handle bulk waste ensures that the waste is not dumped anywhere and do no cause inconvenience to other building users.

### APPLICABILITY

This regulation is applicable to residential building types only. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

To ensure bulky waste does not mix with regular waste area, an area must be provided for residents to place such items. This would allow the residents to store bulk waste in those areas prior to collection. The space provided for bulk waste storage does not need to be designated but must cover an area of approximately 10 m². The space allocated for bulky items storage should also consider the intended frequency of collection and should not cause disruption to other users of the building or restrict access to the building.

It must also comply with all fire and safety requirements. The location of bulk waste storage (fig. 702.02(1)) must be accessible to waste haulers for easy handling.

Additionally, to improve resource recovery, it is recommended good waste management practices are established and implemented for the residents. This can include educational signage for residents, on proper disposal means of waste and usage of correct waste storage locations facilities provided in their building.

Dubai Municipality has bulky waste collection services, that must be pre-booked, to collect old furniture, refrigerators, washing machines and other bulky goods from residents.

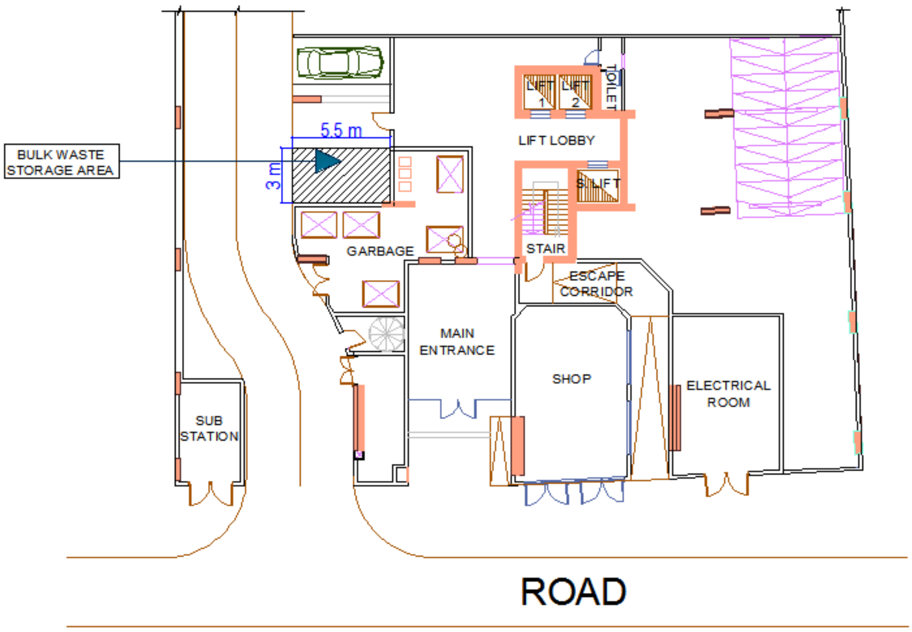



Fig 702.02(1): Location for Bulk Waste Storage Area (Example)

## COMPLIANCE DOCUMENTATION

**Table 702.02(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.Architectural drawings indicating the location of bulk waste storage area and its size. |
| Construction Completion Application | 1. Final approved architectural drawings indicating the location of bulk waste storage area and its size. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

The Department of Environment and Climate Change NSW. (2008). Better Practice Guide for Waste Management in Multi-unit Dwellings.

## 702.03 WASTE STORAGE

Silver Sa'fa

### INTENT

To encourage source separation practices thereby reducing contamination and improve the quality of the recycled product.

### REQUIREMENT

For all new villas and apartments, domestic kitchens must be provided with a minimum 2 storage facilities of 10l waste receptacles. This shall be clearly labeled as 'recyclable' and 'non-recyclable'. The storage facility should be in a proper place within the kitchen.

### SIGNIFICANCE

One of the most important components in developing solid waste management plan for the city, is to have segregation or separation of wastes at source. Source separation has proven effective in increasing recycling rates and in turn waste diversion in a community. Source separation or separating wastes can be done at home, in office, commercial centers, industrial facilities and in public places. By carrying out proper source segregation, it reduces contamination and improves the quality of recycled product. Source segregation also improves the environmental performance and economic efficiencies of waste management options for the city.

In residential units, an impetus can be provided for waste segregation by providing separate collection facilities for recyclable and general wastes. This would increase the recovery and recycling and reduce the disposal to landfill.

### APPLICABILITY

This regulation is applicable to villas and apartments only. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

### IMPLEMENTATION

This regulation requires domestic kitchen to be provided with a minimum of 2 storage facilities (under the kitchen counters, preferably near food preparation areas) of 10l waste receptacles (fig. 702.03(1)). This shall be clearly labeled as 'recyclable' and 'non-recyclable'. Bins should be fitted with lids to avoid odour build up within under-counter cupboard spaces. The storage receptacles should be leak proof and easy to clean.

Fig. 702.03(1): Domestic Waste Bins (Sample)

Dubai Municipality Waste Management Department's Technical Guideline No. 7, already requires establishment of "on-source" separation of wastes as part of Dubai Strategic Integrated Plan for Solid Waste. It also lists the various types of recyclable materials (Table 702.03(1)).

**Table 702.03(1): Types Of Recyclable Materials**

| Materials | Definition |
|---|---|
| Paper | Corrugated paper – cardboard containers, boxes and packaging, including pizza boxes, newspapers, magazines and catalogues, craft paper, office paper, paperboard & mixed paper. |
| Glass | Empty washed glass jars, bottles and containers of clear, green and amber that contained food and drink, caps removed. |
| Metals | All ferrous and nonferrous metals: Steel, aluminium and composite cans and containers, empty aerosol cans, wire, pipes, tubing motors, sheetmetal etc. |
| Plastics | All high-density polyethylene (HDPE) and polyethylene terephthalate (PET) plastic bottles.<br>Excludes vinyl, rigid and foam plastic materials. |

Additionally, *Regulation 702.04: Waste Collection*, requires a separate chute or storage areas to be provided on each floor to place segregated wastes.

## COMPLIANCE DOCUMENTATION

**Table 702.03(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Interior design layout and/or architectural plan indicating the location and size of kitchen waste storage. |
| Construction Completion Application | 1. Final approved interior design layout and/or architectural plan indicating the location and size of kitchen waste storage. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Waste Management Department, Dubai Municipality. (2015). Technical guidelines No. 7: Mandatory Waste Segregation.

## 702.04 WASTE COLLECTION

Silver Sa'fa

### INTENT

To encourage source separation practices thereby reducing contamination and encourage recycling.

### REQUIREMENT

For all new buildings which require chute for general waste as per Dubai Municipality Building Regulations, one of the following must be provided:

1. A second chute must be provided to handle recyclable material and should discharge it into a separate receptacle within the waste management area; or
2. The garbage room on each floor must have a minimum floor area of 2 $m^2$, where recyclable waste can be stored, until collected by the building operator on a daily basis. Waste must be transported in a service lift and must be discharged into a designated receptacle within the waste management area.

All new buildings which does not require chute for general waste, in accordance with Dubai Municipality Building Regulations, the garbage room on each floor must have a minimum floor area of 3 $m^2$, where non-recyclable and recyclable waste can be stored, until collected by the building operator on a daily basis. Waste must be transported in a service lift and must be discharged into a designated receptacle within the waste management area.

### SIGNIFICANCE

Due to population growth and development, the quantities of wastes have increased significantly. Most of the waste ends up in municipal landfills or dumpsites. Building regulations require buildings to have a single or central waste storage areas, which is suitable for handling general wastes only. By encouraging segregation of wastes, recovery or recycling of waste can be carried out that helps in reducing the waste sent to landfill.

The separation of material at the point of collection results in a more homogeneous and higher quality waste materials. Source separated materials which are less contaminated are easier and less costly for recycling facilities to process and recover. Also, source separation significantly improves the environmental performance and economic efficiencies of waste management options.

### APPLICABILITY

This regulation is applicable to all building types. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

The applicability of waste chute for general waste in the project should be first determined through Dubai Municipality Building Regulations by the project team.

If the project requires chute to be provided, the project team should either provide a second chute to handle recyclable waste or provide additional space in the garbage room in each floor to handle recyclable waste.

If second chute is provided, it should handle recyclable wastes only. The chute must discharge the recyclable waste into a separate receptacle within the waste management area. Clear signage must be provided to indicate the corresponding chutes for general waste and recyclable waste.

Alternatively, if second chute cannot be provided, project teams must provide a minimum floor area of 2 $m^2$ in the garbage room in each floor (fig. 702.04(1)), for storing recyclable waste. Clear mechanism should also be proposed to collect the recyclable wastes from the garbage room on a daily basis. Waste should be transported in a service lift and should be discharged into the designated receptacle within the central waste management area.

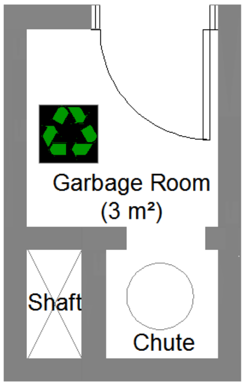



Fig. 702.04(1): Additional space allocation in garbage room

The following should be considered on the location and construction of waste chutes:

- Discharge the solid waste to an appropriate storage container.
- Meet the requirements of DM Administrative Resolution 125-2001 (Building Regulations) Article 51.
- Avoid the likelihood of blockage or leakage.
- Permit easy cleaning and maintenance.
- Avoid the likelihood of foul air or gases accumulating or entering the building.
- Avoid the likelihood of the spread of fire beyond the refuse chute.
- Have openings that allow waste to be safely deposited in the chute.
- Restrict access by children, animals and vermin.

Waste chutes should be also be fitted with side-entry hoppers (fig. 702.04(2)) and should:

- Have a minimum internal diameter of 600 mm.
- Be self-cleaning, vertical and have smooth joints.
- Be vented at the top above the roof line and at the bottom above the container.
- Terminate centrally over a suitable container located in a room complying with *Regulation 702.05: Recyclable Waste Management Facilities*.

Fig. 702.04(2): Waste Chutes with side-entry hoppers

Side-entry hoppers should:

- Have a maximum opening diameter of 250 mm.
- Have self-closing, tight-fitting doors to prevent odours escaping.
- Have an easily cleanable wall surface surrounding the opening for 300 mm (this may be galvanised steel, ceramic tiles or similar material).
- Be located outside any dwelling or enclosed stair access and away from any habitable space or food preparation area.
- Have adequate ventilation, preferably by being in the open air. Where hoppers are inside the buildings, they shall be in separate ventilated compartments.

When a garbage chute is not required in a new building in accordance with DM regulations, project teams must provide a minimum floor area of 3 m$^2$ in the garbage room in each floor (fig. 702.04(3)), for storing recyclable wastes. The room should have storages, where recyclable and general waste can be stored separately, prior to collection.

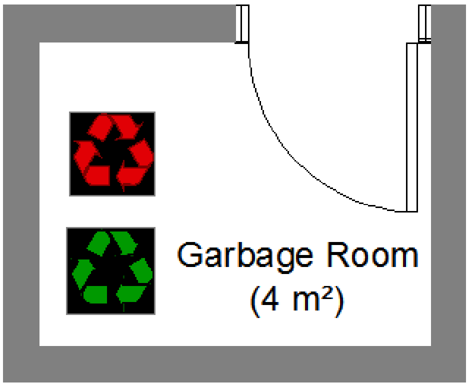



Fig. 702.04(3): Garbage Room Having No Waste Chutes (Example)

## COMPLIANCE DOCUMENTATION

**Table 702.04(1): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1. Architectural drawings indicating the location and area of garbage room for each floor or details of garbage chutes. |
| Construction Completion Application | 1. Final approved architectural drawings indicating the location and area of garbage room for each floor or details of garbage chutes. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2004). Building Code Regulations & Construction Specifications.

Waste Management Department, Dubai Municipality. (2015). Technical guidelines No. 7: Mandatory Waste Segregation.

British Standards Institution. (2005). BS 1703 - Refuse chutes and hoppers. Specification.

# 702.05 RECYCLABLE WASTE MANAGEMENT FACILITIES

Silver Sa'fa

## INTENT

To facilitate the recycling of wastes by providing adequate space for storage and collection of recyclables, thereby minimising the amount of waste hauled and disposed in landfills.

## REQUIREMENT

For all new buildings other than villas, a sorting and storage facility for recyclable materials must be provided.

This facility must be easily accessible and must comply with the requirements for the location, access and specifications of general waste areas set in Dubai Municipality Building Regulations.

The sorting and storage facility may be part of the general waste management facility or a separate facility.

A. Recycled waste facility provided in the general waste collection:

   The size of the room must be increased by 10% but not less than 5 $m^2$, which would allow additional manoeuvrability to sort and store the recyclable waste.

B. Recycled waste facility separated from the general waste collection:

   The recycled waste facility must be sized as a percentage from the total Built Up Area (BUA) of the building, as indicated in Table 702.05 (1).

Where the Total Built Up Area (BUA) of the building falls between the figures outlined in the below table, linear interpolation must be used to determine an appropriate percentage area for the recyclable storage space.

**Table 702.05 (1) – Sizing Requirements**

| Built Up Area (BUA) | Minimum Space for Storage of Recyclables |
|---|---|
| Less than 500 $m^2$ | 7.5 $m^2$ |
| 500 $m^2$ | 1.5% of BUA |
| 1,000 $m^2$ | 0.8% of BUA |
| 5,000 $m^2$ | 0.35% of BUA |
| 10,000 $m^2$ or greater | 0.25% of BUA |

## SIGNIFICANCE

In its goal to provide a sustainable environment to live in, Dubai Municipality has developed a 20-year Dubai Strategic Integrated Plan for Solid Waste. One of the most important requirements of the plan is to have segregation/separation of waste at source.

Wastes generally contain a substantial amount of material which can be reused or recycled. Providing adequate designated space for sorting and storage facility for recyclable wastes in buildings will help reduce the waste directed to landfills and increase the recyclable waste quantity.

## APPLICABILITY

This regulation is applicable to all building types except villas. Refer to Table 101.07(1) in Section One - Administration for detailed applicability levels.

## IMPLEMENTATION

*Regulations 702.03: Waste Storage* and *702.04: Waste Collection*, require facilities in buildings to have provisions for the sorting and collection of recyclable waste. In addition, this regulation requires that a sorting and storage facility for recyclable materials to be provided.

Sorting, storage and collection areas for recyclables must be situated such that it provides safe and easy access for both waste producers (building occupants) and collectors. The design of these areas must minimise the potential for nuisance to building occupants and neighbouring premises.

Sufficient storage space must be provided, for storing at least a week's collection of all non-hazardous recyclable waste.

For projects within a large site, a separate collection area outside of the building footprint and serving more than one building may be utilised, provided convenient access for deposit and collection of recyclables is given.

The requirements of this regulation are in addition to the requirements of Dubai Municipality Building Regulations, Articles 51 and 52 (Garbage/Waste Collection Rooms). However, the recyclable waste management facility may be part of the general waste facility, in which case the room must be increased 10% in size (not less than 5 $m^2$) to allow the processing of the recyclable waste (fig. 702.05(1)).

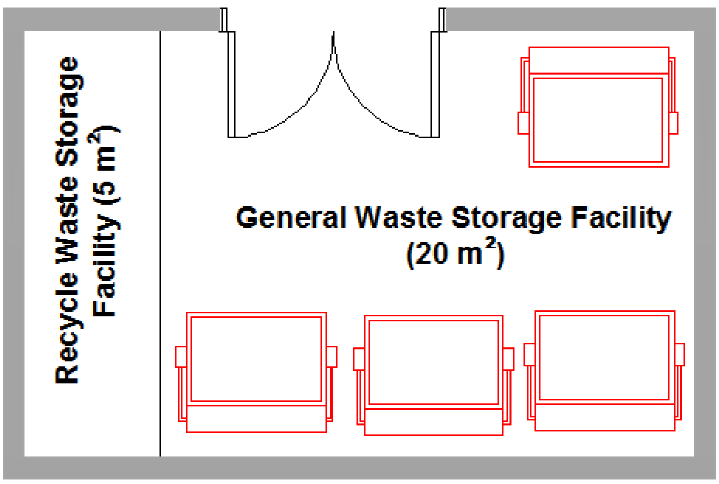



Fig. 702.05(1): Recyclable Waste Management as Part of General Waste Facility (Example)

All waste management facilities must be enclosed to prevent entry of children, animals and vermin. Waste collection contractors shall have adequate access to these facilities for collection of waste. Signages on the use of the waste management system shall also be displayed in the facility.

**Case Study**

A commercial building having a built-up area of 3,000 m², proposes to have a separate recyclable waste facility. To determine the minimum space required for the recyclable facility, project team should use the following formula:

$$\frac{R_n - R_1}{T_n - T_1} = \frac{R_2 - R_1}{T_2 - T_1}$$

Where,
$R_n$ = space required for the recyclable facility for the project
$R_1$ = minimum space required for the recyclable facility for the preceding threshold level from Table 702.05 (1) based on the BUA
$R_2$ = minimum space required for the recyclable facility for the next threshold level from Table 702.05 (1) based on the BUA
$T_n$ = built-up area of the project
$T_1$ = the preceding built-up area threshold level from Table 702.05 (1)
$T_2$ = the next built-up area threshold level from Table 702.05 (1)

For this project having built-up area of 3,000 m² ($T_n$), the values are as follows:
$T_1$ = 1,000 m²
$T_2$ = 5,000 m²
$R_1$ = 8 m² i.e. 0.8% of 1,000 m²
$R_2$ = 17.5 m² i.e. 0.35% of 5,000 m²

$$R_n = \frac{(17.5-8)}{(5000-1000)} \times (3000-1000) + 8$$

$$R_n = 12.75 \text{ m}^2$$

Hence, recyclable facility of minimum 12.75 m² is required to be provided for the project (fig. 702.05(2)).

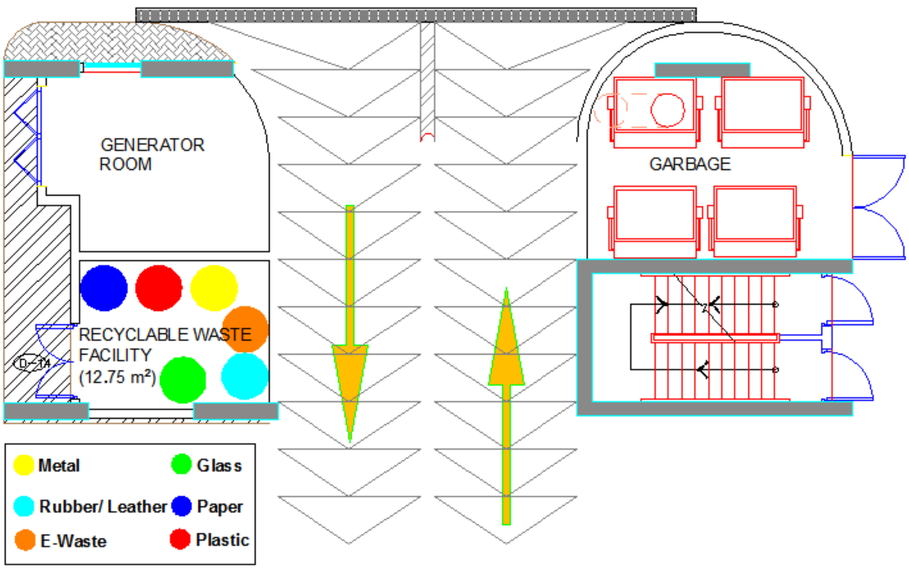



Fig. 702.05(2): Separate Recyclable Waste Facility (Example)

## COMPLIANCE DOCUMENTATION

**Table 702.05(2): Documents Required**

| Project Stages | Submittal Documents |
|---|---|
| Design Permit Application | 1.Architectural drawings indicating the location and area of the recyclable waste management facilities. |
| Construction Completion Application | 1. Final approved architectural drawings indicating the location and area of the recyclable waste management facilities. |
| After Completion | Not applicable. |

## REFERENCES AND ADDITIONAL INFORMATION

Dubai Municipality. (2001). DM Building Regulations – Administrative Resolution 125-2001.

Waste Management Department, Dubai Municipality. (2015). Technical guidelines No. 7: Mandatory Waste Segregation.