5 INDOOR ENVIRONMENT [IE]

5.1 GENERAL

5.1.1 Scope

1 The Indoor Environment category consists of factors associated with indoor environmental quality such as thermal comfort, air quality, acoustic quality, and light quality..

(a) Impacts: Impacts resulting from ineffective control and design of the indoor environment include:

(i) Climate Change

(ii) Fossil Fuel Depletion

(iii) Air Pollution

(iv) Human Comfort & Health

(b) Mitigate Impact: Factors that could improve indoor environmental quality include:

(i) Monitoring air temperature and quality and adjusting or calibrating as appropriate

(ii) Maximizing the time period that the building can utilize natural ventilation

(iii) Designing an adequate mechanical ventilation system

(iv) Ensuring adequate illuminance levels for visiual performance and comfort

(v) Maximizing the use of natural lighting in interior spaces

(vi) Providing for occupant comfort by minimizing glare

(vii) Maximizing views to the exterior for all occupants

(viii) Controlling the amount of noise produced by or transferred from the building interior and exterior

(ix) Specifying materials with low VOC levels

(x) Controlling indoor pollutants and sources of airborne contamination

(c) The QCS's requirements for Sub-Indoor Environment criteria Includes:

(i) Thermal Comfort

(ii) Natural Ventilation

(iii) Mechanical Ventilation

(iv) Low-Emitting Materials

2 The Public and Government Buildings are to be considered as commercial for the purpose of Indoor Environment calculation as applicable.

5.1.2 Reference

1 The following documents are referred to in this section:

- Global Sustainability Assessment System (GSAS) - v2.1 2013,
- ASHRAE 62.1, ASHRAE 55, ANSI/ASHRAE/ASHE 170. And other related American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards.
- CIBSE GUIDES A & B
- International mechanical Code, IMC 2015
- ISO 17772: Energy performance of buildings — Indoor environmental quality,
- EN 16798: Energy performance of buildings - Ventilation for buildings

5.2 INDOOR ENVIRONMENT [IE.1] THERMAL COMFORT

5.2.1 Scope

1 The Indoor Environment for Thermal Comfort shall be measured for the following categories of the buildings:

Table 1: Building Typology

Commercial
Governmental
Education
Mosques & other religious buildings
Light Industry
Health Centres
Railways Terminals
Sports Facilities

5.2.2 Description

1 The Project shall provide a thermaly comfortable environment to ensure the comfort and health of building occupants.

5.2.3 Measurement Principle

1 The Engineer shall calculate the system capacity and either PMV or ADPI Values for the hottest hour of the year for the worst case for all applicable occupied spaces

2 Sport Facilities.

The Project shall also Calculate the heat loads for all critical seats for the hottest outdoor conditions for scheduled events.

5.2.4 Measurement (Thermal Comfort)

1 The Project shall complete the Thermal Comfort Calculator (Considering GSAS Assessment System or any other recommended system) in order to compute PMV or ADPI values and demonstrate that system Capacity can meet the peak cooling loads for the worst case for all typical occupied spaces.

(a) System Capacity : The capacity of the system should be properly sized to meet the peak cooling loads of critical spaces. All projects will calculate the peak cooling loads for the hottest hour of the year.

(b) PMV values: The project will evaluate all critical spaces and perform thermal comfort assessment for the hottest hour of the year. Calculate PMV values of different positions in critical spaces such as different positions relative to window and diffuser locations and select the worst PMV value for assessment.

(c) ADPI values: The project will evaluate the selected worst case for each typical space and perform thermal comfort assessment for the hottest hour of the year in terms of Air Diffusion Performance Index.

2 The following table outlines the measurement type and typical spaces used in the calculation according to the appropriate typology:

Table 2: measurement type and typical spaces

TYPOLOGY	MEASUREMENT TYPE	TYPICAL SPACES
Commercial	PMV	Office, Reception Areas
Education	ADPI	Classrooms, Offices, Special Functional Spaces.
Mosques	ADPI	Prayer Halls
Light Industry	PMV	Office , Operational Areas
Health Centres	PMV	Typical Occupied Spaces
Sports	PMV or ADPI for the worest case Heat Load	Office spaces (a),Exposed Spectator Seating (b)

5.2.5 Score *

Note: (*) minimum QCS's requirements unless other values specified by the relevant authority

1 The score values for Commercial, Light Industry Typologies

Table 3: Commercial & Light Industry Typologies

PMV	1.5 < PMV ≤ 2.0 Under the system capacity meeting the peak load

2 The score values for Education, Mosques Typologies

Table 4: Education, Mosques Typologies

ADPI	80 ≤ ADPI< 85 Under the system capacity meeting the peak load

3 The score values for Health Centres Typology

Table 5: Health Centers

The Building will Comply with ASHRAE Standards- Design Manual for Hospital and Clinics

4 The score values for Sports Typology

Table 6: Railways Typology

a. for office spaces (a)

PMV	1.5 < PMV ≤ 2.0 Under the system capacity meeting the peak load

b. for Exposed Spectator Seating (b)

ADPI	1.185 < b ≤ 1.600 worest case heat load

5.3 INDOOR ENVIRONMENT [IE.2] NATURAL VENTILATION

5.3.1 Scope

1 The Indoor Environment for Natural Ventilation shall be measured for the following categories of the buildings.

Table 6: Building Typologies

Commercial
Governmental
Education
Mosques & other religious buildings
Light Industry
Health Centres
Rail Buildings
Sports

5.3.2 Description

1 The Project shall encourage effective natural ventilation strategies in conjunction with mechanically ventilated systems.

5.3.3 Measurement Principle

1 The Engineer shall maximize the number of days that the building can utilize natural ventilation, either through user operable windows or through controlled opening

5.3.4 Measurement (Natural Ventilation)

1 All projects using operable windows will complete the Natural Ventilation Calculator to determine the number of months that all typical spaces can utilize natural ventilation by verifying minimum fresh air supply to guarantee indoor air quality as recommended in ASHRAE 62.1-2010. All projects using mechanical ventilation systems will demonstrate thorough calculation and/or simulations the number of months a project can utilize natural ventilation. Exclude all circulation areas from this measurement.

2 The following table outlines the typical spaces used in the calculation according to the appropriate typology:

Table 7: Typical Spaces for Natural Ventilation

Typology	Typical Spaces
Commercial	Office, Reception areas
Education	Classrooms, Libraries
Mosques	Prayer Halls
Light Industry	Office areas
Health Centres	Staff areas, Library/Seminar rooms, Dining rooms

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(a) LIGHT INDUSTRY

(i) Operational Areas associated with the industrial process are not included as part of this criterion.

(b) HEALTH CENTRES

(i) All Projects will undertake a full thermal model analysisto calculate the air flow provided by the natural ventilation to determine if each typical space can gurantee indoor air quality as recommended in ASHRAE 62.1-2010.Circulation areas and Clinical areas can be excluded from this calculation in line with guidance HTM 03-01.

(ii) Typical Spaces to be assessed against the ASHRAE Standards include: Satff areas , Office accommodation, Library /Seminar rooms , Dining rooms .Natural ventilation in accordance to ASHRAE must achieve fresh air rates of 5 l/s/person.

5.3.5 SCORE*

1 The recommended minimum Score for the QCS,s Targeted Typologies :

(*) minimum QCS's requirements unless other values specified by the relevant authority

Table 8: Commercial,Governmental,Sport, Education , Mosques,Light Industry Typologies

Number of Months Natural Ventilation Can be Utilized	0 < months of the year ≤1

Table 9: For Health Centres, Rail Terminals

The Building will Comply with ASHRAE 62.1-2010 Standards- Design Manual for Hospital and Clinics

5.4 INDOOR ENVIRONMENT [IE.3] : MECHANICAL VENTILATION

5.4.1 Scope

1 The Indoor Environment for Mechanical Ventilation shall be measured for the following categories of the buildings

Table 10: Building Typologies

Commercial
Governmental
Education
Mosques
Light Industry
Health Centres
Railways

5.4.2 Description

1 The Project shall provide effective mechanical ventilation to ensure occupant comfort and health.

5.4.3 Measurement Principle

1 The Engineer shall ensure that mechanical ventilation in all primary occupancy areas meets the minimum requirements of ASHRAE 62.1-2010 and the system requirements in ASHRAE 90.1-2010.

5.4.4 Measurement (Mechanical Ventilation)

1 The mechanical system shall meet the minimum requirements of ASHRAE 62.1-2010, ASHRAE 90.1-2007. These requirements include, but are not limited to:

(a) Mechanical equipment must meet minimum Efficiency standards, and be properly verified and labeled.

(b) Mechanical systems must have proper control systems, including the use of zoning, proper dead bands, off-hour controls, and automatic shut-offs.

Note: In the Calculation of the required fresh air supply, both EN-ISO and ASHRAE should be used, and the larger of the two standards should be used in the verification of over ventilation.

2 MEASUREMENT

(a) LIGHT INDUSTRY

(i) Operational Areas associated with the industrial process are not included as part of this criterion.

(b) RAILWAYS

This Criteria applies to both underground or overground stations.

5.4.5 Score (Mechanical Ventilation)*

1 The Recommended minimum Requirements by QCS as shown in (Table 11):

Note: (*) minimum QCS's requirements unless other values specified by the relevant authority

Table 11: Minimum Value

Outdoor Air Volume (X)	≥ 15 % of ASHRAE 62.1-2010 requirement; AND no existence of equipment with efficiency less than specified in ASHRAE 90.1-2010

5.5 INDOOR ENVIRONMENT [IE.4] LOW-EMITTING MATERIALS

5.5.1 Scope

1 The Indoor Environment for Low-Emitting Materials shall be measured for the following categories of the buildings.

Table 12: Building Typologies

Commercial
Governmental
Education
Mosques
Light Industry
Health Centers
Railways
Sports

5.5.2 Description

1 The project shall meet the minimum emissions targets for indoor materials and finishes to ensure the comfort and health of occupants and installers.

5.5.3 Measurement Principle

1 The Engineer shall choose materials and finishes that minimize Volatile Organic Compounds (VOC) emissions.

5.5.4 Measurement (VOC)

1 The Engineer shall complete the Low-Emitting Materials Calculator to evaluate the measured VOC contents of specified indoor materials.

2 The Engineer shall develop a plan to specify materials with low VOC emission rates as found in the Low-Emitting Materials Calculator.

Exclude materials used in spaces that are exposed to the exterior.

3 RAILWAYS: This Criteria applies to both underground and overground stations.

5.5.5 Score (VOC)

1 Recommended minimum Requirements by QCS as shown in (table 6)

Table 13: VOC score value

$VOC_{emi,total}$ (X)	85% < X ≤ 100 %

(*) minimum QCS's requirements unless other values specified by the relevant authority

END OF PART