**CHAPTER II**

**COOLING AND HEATING LOAD CALCULATION**

This chapter presents the essential data required in establishing the appropriate air conditioning system to be used in the design proper. This includes the building components, material construction, heat load calculation, psychrometric calculation including the psychrometric chart plotting, and piping calculation.

The ground floor of the hospital has less than 70 spaces which primarily consists of work area, storage rooms, operating rooms, examination/ treatment area, emergency room, X-Ray room, OPD clinic medical rooms, administrative office, dark and control rooms, staff dining area, and canteen.

The second floor has also less than 70 spaces which primarily consists of bedwards for patients, isolation rooms, treatment rooms, dirty utility and clean linen, nurse station, conference room, delivery room, labor room, nurseries, breastfeeding room, operating rooms, supply and storage rooms.

The third floor of the hospital has less than 50 spaces which is actually the same rooms for the second room except there is a chapel.

**A. Building Components and Materials Construction**

This section presents the materials used and the composition of the building walls, roofs, doors, glass windows, and partitions.

**1. External Wall**

**Figure \_** Wall Construction

150 mm CHB sand and gravel

25 mm Cement Plaster

25mm Cement Plaster

Inside Air firms

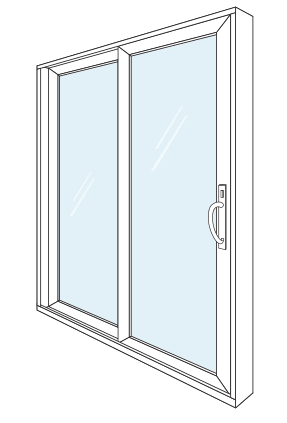
Outside Air Film

|  |  |  |
| --- | --- | --- |
|  | R, m2 ⁰K/Watt | ρS, Kg/m2 |
| outside air film | 0.0440 | --- |
| 25 cement plaster | 0.0347 | 39.95 |
| 150mm CHB sand and gravel | 0.1350 | 147 |
| 25 cement plaster | 0.0347 | 39.95 |
| inside air film | 0.12 | --- |
|  | RT = 1.2695 | ρST = 226 Kg/m2 |
|  | **UW = 2.7144 W/m2K** | **TYPE F** |

**Table 1.0** Properties of each Components of External Wall

This table presents the composition of external wall including the outside and inside surface resistance, 25 mm cement plaster and 150 mm CHB with their corresponding thermal resistivity and surface density. Moreover, the heat transfer coefficient, U, is obtained by getting the inverse of the summation of the resistances of the components. Therefore, use Type F Wall. The height of the wall is 3 meters with permanent light color. Since the total mass per unit area of wall is greater than 226 kg/m2, the type of wall to be used was type F. See Appendix B.

**2. Glass Portion**



**Figure \_** Glass Window

Single Glass, Regular Sheet, Light Venetian Blinds

Number of panels = one to four panels

Area = depends on the architectural plan

Height = 2 m, 0.6 m

Heat Transfer Coefficient use U = 2.8211 W/m2K (fixed)

Heat Transfer Coefficient use U = 2.8722 W/m2K (awning, sliding)

Window Details

|  |  |
| --- | --- |
| **Ground Floor** | |
| **Dimension(m)** | **Description** |
| 2 x 2 | Fixed Window |
| 2 x 2 | Sliding Window |
| 1.2 x 2 | Fixed Window |
| 1.2 x 2 | Awning Window |
| 1.4 x 2 | Sliding Window |
| 0.6 x 0.6 | Awning Window |
| 1.6 x 2 | Fixed Window |
| 2.4 x 2 | Fixed Window |
| 0.9 x 0.6 | Sliding Window |
| 2.44 x 2 | Sliding Window |
| 1.28 x 2 | Sliding Window |
| 1 x 2 | Sliding Window |
| 4.2 x 2 | Sliding Window |
| 1.5 x 2 | Sliding Window |
| 3.35 x 2 | Fixed Window |
| 5.6 x 2 | Fixed Window |
| 1.8 x 2 | Awning Window |
| 2.2 x 2 | Fixed Window |

**Table \_** Ground Floor Window Schedule

This table shows the dimensions of the window included in the ground floor.

|  |  |
| --- | --- |
| **Second Floor** | |
| **Dimension(m)** | **Description** |
| 2.3 x 2 | Sliding Window |
| 2.4 x 2 | Fixed Window |
| 0.6 x 0.6 | Awning Window |
| 1.4 x 2 | Sliding Window |
| 1.4 x 2 | Fixed Window |
| 1.2 x 2 | Fixed Window |
| 2 x 2 | Sliding Window |
| 2.7 x 2 | Sliding Window |
| 1.95 x 2 | Sliding Window |
| 2.1 x 2 | Sliding Window |
| 0.8 x 0.6 | Fixed Window |
| 1.6 x 2 | Fixed Window |

**Table \_** Second Floor Window Schedule

This table shows the dimensions of the window included in the second floor.

|  |  |
| --- | --- |
| **Third Floor** | |
| **Dimension(m)** | **Description** |
| 2.3 | Sliding Window |
| 2.4 | Fixed Window |
| 2.7 | Sliding Window |
| 1.44 | Sliding Window |
| 1.44 | Fixed Window |
| 3.33 | Sliding Window |
| 0.6 x 0.6 | Fixed Window |
| 1.2 x 0.6 | Awning Window |
| 2 | Sliding Window |
| 0.8 | Fixed Window |
| 2.23 | Sliding Window |
| 2.4 | Sliding Window |
| 2.51 | Fixed Window |
| 3.51 | Fixed Window |
| 2.18 | Fixed Window |

This table shows the dimensions of the window included in the third floor.

3. **External Roof**

Outside Air Film

13 mm slag or stone

10 mm felt membrane

150 mm concrete

Inside air film

**Figure \_** Roof Construction

|  |  |  |
| --- | --- | --- |
|  | R, m2K/W | ρS, Kg/m2 |
| outside air film | 0.044 | --- |
| 13 mm slag or stone | 0.009 | 881 |
| 10 mm felt membrane | 0.05 | 1121 |
| 150 mm low density conrete | 0.88 | 641 |
| inside air film | 0.12 | --- |
|  | RT = 1.104 m2K/W | ρST = 2643 Kg/m2 |
|  | **UW = 0.9058 W/m2K** | **TYPE 6** roof with suspended ceiling |

**Table \_** Properties of each Components of External Roof

This table presents the composition of roof including the outside and inside surface resistance, 150 mm low-density concrete with 13 mm slag or stone as aggregate and 10 mm felt membrane with their corresponding thermal resistivity and surface density. Moreover, the heat transfer coefficient, U, is obtained by getting the inverse of the summation of the resistances of the components. Therefore, use Type 3 – Roof Terrace System with suspended ceilings.

4. **Partition**

4.1 Internal Wall Partition

Outside Air firms

15 mm cement plaster

150 mm CHB

sand and gravel

Inside Air firms

15 mm cement plaster

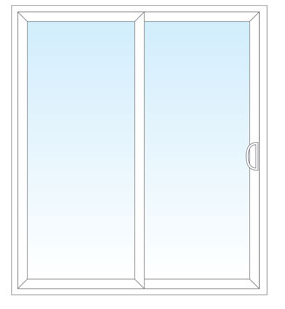
**Figure\_** Internal Wall Construction

|  |  |  |
| --- | --- | --- |
|  | R, m2 ⁰K/Watt | ρS, Kg/m2 |
| inside air film | 0.12 | --- |
| 15 mm cement plaster | 0.0208 | 23.97 |
| 120 mm CHB  sand and gravel | 0.1350 | 117.6 |
| 15 mm cement plaster | 0.0208 | 23.97 |
| inside air film | 0.12 | --- |
|  | RT = 0.3896 m2K/W | ρST = 165.54 Kg/m2 |
|  | **UW = 2.5667 W/m2K** | **TYPE F** |

**Table \_** Properties of each Components of Internal Wall

This table presents the composition of external wall including the outside and inside surface resistance, 15 mm cement plaster and 120 mm CHB with their corresponding thermal resistivity and surface density. Moreover, the heat transfer coefficient, U, is obtained by getting the inverse of the summation of the resistances of the components. The height of the wall is 4 meters with permanent light color. Since the total mass per unit area of wall is 165.54 kg/m2, the type of wall to be used was type F because this value is nearest to 200 kg/m2. See Appendix B.

**4.2 Partition Door**



**Figure \_** Glass Door

|  |  |
| --- | --- |
| **Dimension(m)** | **Description** |
|  | Single Panel Door |
|  | Double Panel Door |
|  | Single Panel Door |
|  | uPVC Panel Door |
|  | Double Panel Door |
|  | Sliding Door |
|  | Single Sliding Door |

**Table \_** Door Details

This table shows the dimensions of the door included in the hospital building. The kinds of the doors used in the hospital are\_

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Description** | **U** |
| D1 | Single glass door | Powder-coated white aluminum frame single swing door with 6mm thick, clear glass | 2.3576 |
| D2 | Single wood door with glass | Single wood door | 1.6493 |
| D4 | Double glass door | Powder-coated white aluminum frame double swing door with 6mm thick, clear glass | 2.3576 |
| D5 | Uneven glass door | Powder-coated white aluminum frame uneven swing door with 6mm thick, clear glass | 2.3576 |
| D6 | Kicking door | Double swing door with laminated surface, glass view panel S.S. push and kick plate | 1.5625 |
| D7 | Comfort Room door | Single single fire rated metal door (1hr fire resistance) | 1.6048 |

**5. Floor**

Outside Air Film

Vinyl tile 30 mm mm30mm

Insulating board

(concrete) 100 mm

50 mm sand blasting

**Figure \_** Floor Construction

|  |  |
| --- | --- |
|  | **R, m2 ⁰K/Watt** |
| outside air film | 0.12 |
| Vinyl tile 30 mm | 0.035 |
| Insulating board concrete 100mm | 0.088 |
| 50 mm Sand blasting | 0.3937 |
|  | RT = 0.0637 |
|  | **UW = 1.570598398 W/m2K** |

**Table \_** Floor Details