DESIGNING FOR FIRE SAFETY


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APAM MIFireE MMIArbs

PAM CPD SEMINAR
The Uniform Building By-Laws

is a

“PRESCRIPTIVE” BUILDING CODE

• Compliance with this code is a requirement by law
• Sets rules and regulations on the application of the code
• Provides pre-determined prescriptions

The prescriptions are absolute:

no smaller than……
no bigger than……
  no shorter than……
  no longer than……
or
no less than and no more than.
The MS 1183:2015

is a

“Descriptive” code of practice

• Provides informative descriptions
• Establishes normative practices
• Describes performance criteria
CONCEPTS OF FIRE SAFETY

1 EVACUATION

2 PASSIVE CONTAINMENT

3 ACTIVE INTERVENTION

4 ACCESS FOR FIRE FIGHTING AND RESCUE
PURPOSE GROUP

130. Fifth Schedule of the principle By-Laws is amended—

(a) by substituting for paragraph (I) the following paragraph:
“1. Small residential

Private dwelling house detached or semidetached or terraced.”;

(b) in paragraph (II)—

(i) by substituting for the words “Hospital, school” the words “Hospitals, schools, colleges, libraries, nursing homes”; and

(ii) by inserting after the word “used” the words “for education or”;

(c) in paragraph (III), by inserting after the words “I and II” the words “, including hotels, hostels, dormitories, apartments, flats, old folks homes and orphanages.”;

(d) in paragraph (V), by substituting for the words “meaning thereby premises not being a shop but “ the words “shopping complexes, food courts, wet and dry markets, premises”; and

(e) in paragraph (VII), by inserting after the words “I to VI” the words “, including convention centres, museums, art galleries, cinemas, theatres, auditoriums, places of worship, transportation passenger terminals”.

I : Small Residential

II : Institutional

III : Other Residential

IV : Office

V : Shop

VI : Factory

VII : Place of Assembly

VIII : Storage and general
# MS 1183:2015: Occupancy characteristics

<table>
<thead>
<tr>
<th></th>
<th>FAMILIAR</th>
<th>UNFAMILIAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AWAKE</strong></td>
<td>Office</td>
<td>Carpark</td>
</tr>
<tr>
<td></td>
<td>Warehouse</td>
<td>Bus station</td>
</tr>
<tr>
<td></td>
<td>School</td>
<td>Hospital</td>
</tr>
<tr>
<td></td>
<td>Cinema</td>
<td>outpatient</td>
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<tr>
<td></td>
<td>Shop</td>
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<tr>
<td></td>
<td>Shopping Complex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Factory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Private house</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Condominium</td>
<td></td>
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<tr>
<td></td>
<td>Hotel</td>
<td></td>
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<tr>
<td></td>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td><strong>ASLEEP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long term</td>
<td></td>
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</tr>
<tr>
<td>Short term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• EVACUATION

• Detection
• Alarm
• Exits
• Travel distance
• Components
• Capacity of exits

Accepted assumption in designing for safe evacuation:

“Only one fire at one location at a time”
NATURE OF FIRE

- Stage 1: Ignition & growth
- Stage 2: Development
- Stage 3: Full fire
- Stage 4: Decay

Temperature / size

- Untenable condition
- Flashover
Available Safe Egress Time (ASET) vs. Time

- Temperature / size axis
- Time axis

- Ignition
- Detection
- Alarm
- Movement
- Total evacuation
- Untenable condition

- Factor of safety: \( RSET < 0.75 \text{ ASET} \)
exit

- Final exit
- ‘Alternative exits’
- Storey exit
- Horizontal exit
- Exit route
Final exit

• **UBBL 133** – interpretations

• Final exit refers to the threshold that separates “still within the building” and “out of the building”. The liability of the design for evacuation from the building ends at this point.
‘Alternative exits’

• **UBBL 166**

• This is the primary concept for safe evacuation. Every floor space shall be provided with at least two exits on the basis that if one exit is inoperable, the other exit can serve the function.

• This ‘designing for redundancy’ principle applies to all aspects of evacuation.
Horizontal exit

• UBBL 171

• Exits that lead to an adjacent (horizontal) separated compartment within the same floor
Storey exit

- **UBBL 167, 174**

- Exits from a floor which is of a different level from the final exit, or, if on the same level, a distance away from the final exit.

- A storey exit is to lead to a final exit.
Exit route

- UBBL 133 – interpretations
- UBBL 169

- the protected passage from a storey exit that leads to the final exit.
- Can include spaces that are designated as areas of refuge anywhere between the storey exit and the final exit
MS 1183:2015
EVACUATION STRATEGIES

TOTAL EVACUATION

• Simultaneous
• Phased

PROGRESSIVE EVACUATION

• Vertical or horizontal
• Zoned
SIMULTANEOUS EVACUATION

Travel distance

Exit route

Final exit

storey exit
SIMULTANEOUS EVACUATION

storey exit

Exit route

Final exit
PHASED EVACUATION

1. Floor on fire
2. Floor above fire
3. Topmost floor
4. Other floors above
5. Other floors

Exit route

Final exit
PROGRESSIVE EVACUATION: VERTICAL and HORIZONTAL

- Storey exit
- Exit route
- Refuge
- Horizontal exit
- Final exit
ZONED EVACUATION

final exit
horizontal exit
horizontal exit
final exit
EVACUATION LIFTS

UBBL 2012
34A
“ Any building shall
  a) be approved with access to enable disabled persons to
get into, out of and within the building…….”
c)…..(to be in)...compliance with Malaysian Standards
  MS 1183 and MS 1184

MS 1184:2014
15.6
“All lifts in new buildings should comply to statutory requirement on
fire requirement for evacuation.”

MS 1183:2015
Annex G
Recommendations for refuges and evacuation lifts
EVACUATION LIFTS

A designated Evacuation Lift ..... 

• Shall be within a Protected Shaft  

• Shall be a component within a protected Exit Route  

• Shall be able to switch to evacuation mode by Authorised Person at the Fire Fighting Access Level  

• Preferably to be a lift in every day use  

• i.e the physical and functional requirements is similar to a BOMBA lift.
Travel distance

- **UBBL 165**

- **7th Schedule**

- **Dead end**
  - initial travel distance before a point where an alternative path becomes available

- **Direct distance**
  - Stipulates that travel distance must be measured along the actual path of travel

- **Open plan**
  - Where an actual path of travel cannot be determined, the direct distance can be measured as a straight line direct to the exit. Permitted travel distance is then reduced to 2/3.
Evacuation: multiple areas

Final exits

To comply with dead end and travel distance

Max distance is 15m within room plus max allowable travel distance From door of room to final exit

UBBL 165 (B) Max 15m if room < 6 pax
| 165. Measurement of travel distance to exits. | (3) In the case of individual rooms which are subject to occupancy of not more than six persons, the travel distance shall be measured from the doors of such rooms:

Provided that the travel distance from any point in the room to the room door does not exceed 15 metres. |
|---|---|
| (3) In any of individual room which is subjected to occupancy of not more than six persons, the travel distance shall be measured from the door of such room:

Provided that the area of the room does not exceed 15 square metres or any other area determined by the Fire Authority. |
| To clarify that this requirement is applicable to each individual room. |
| Measurement based on floor area of a room provides stricter control. |
Evacuation: multiple areas

Final exits

UBBL 165 (B)

Travel distance measured from door if room is less than 15m² and with less than 6 occupants

Evacuation: multiple areas
Evacuation: multiple areas

Horizontal exits

storey exits

Evacuation: multiple areas
Horizontal exits
Horizontal exits
Exit Route components

• Exit door
• Exit discharge
• Protected corridor
• Protected staircase
• Balcony approach
• Single staircase
Exit door, exit discharge

- UBBL 173
- UBBL 186
- UBBL 193
- UBBL 133 - interpretations

- ‘Door’ refers to the physical door installed at an exit, and all its functional components e.g. locksets, latches, hinges and closers
- ‘discharge’ refers to the ‘doorway’ or threshold of an exit
Exit door, exit discharge

- Not all fire rated doors are exit doors
- Not all exit doors need to be fire doors
- Not all doors need to be exit doors
- Not all doors can be exit doors

**To qualify as an Exit Door:**
- Exit doors must always be able to be opened (without undue effort) at all times
- Exit discharge must always allow the passage of people at all times
- ‘Exit’ in this context means storey exit, horizontal exit or final exit
Protected corridor, protected staircase

- UBBL 133-interpretations
- UBBL 157, 189, 190, 191

- While not expressed, it is inferred from the UBBL that all components that form the Exit Route shall be of protected construction.

- Using the same inference, ‘protected’ shall mean ‘enclosed’, ‘separated’ or ‘isolated’ from untenable exposure to Fire or Smoke
Single stair

• **UBBL 194**

• Special provision for the common ‘shop-house’ design

• Usage limited to shop (ground floor only), residential or office.

• Uppermost floor level limited to 12m
UBBL 2012 : amended provision for:


A single staircase may be permitted in the following premises:

(a) any dwellings at a height of 12 metres measured from the fire appliance access level to the highest and lowest floor; and

(a) any shophouses or dwellings not exceeding two (2) storeys or (and) the first storey not exceeding 6 metres from the ground level.
Clause 194 (b) : single staircase for shop house

1) House only on upper floor
2) No more than 2 storeys
3) Height of first floor no more than 6m above ground level

Clause 166 and 167 (not less than two exits) shall apply for other building types
Capacity of exits

- UBBL 7th Schedule
- UBBL 175, 176, 178
- Occupant load
- Exit width
- Application of horizontal exit
Sample calculation

Scenario 1: upper floor assembly area in an institutional building

<table>
<thead>
<tr>
<th>Stair A</th>
<th>Occupancy load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(UBBL 180(b))  = 1.35m²/pax</td>
</tr>
<tr>
<td></td>
<td>1000m² / 1.35m² = 741 persons</td>
</tr>
</tbody>
</table>

Assume lobby C is inaccessible,

Therefore A and B must accommodate total occupancy

741 / 2 stairs = 371 persons per stair

C = horizontal exit, persons per unit = 100

371 pax / 100 = 3.71,

4.0 x 0.55m = 2.20 m min width for lobby C

VII persons per unit for stair = 75

371 / 75 = 4.95, say 5

5 x 0.55m = 2.75m width each stair
Sample calculation

Scenario 2: upper floor assembly area in an institutional building

Assume C inaccessible, either B or D
Must accommodate

519 / 2 exits = 260 persons

\[
B = \text{stair} = 75 \text{ pax per unit} \\
\frac{260}{75} = 3.47 \\
3.0 \times 0.55m = 1.65 + 0.3 = 1.95 \text{ width dth}
\]

\[
D = \text{horizontal exit} = 100 \text{ pax per unit} \\
\frac{260}{100} = 2.6 \\
3.0 \times 0.55m = 1.60 \text{m width}
\]

222 persons

519 persons
Final exit

Exit route

storey exit

250 pax

400 pax

200 pax

300 pax

horizontal exit

200 pax

150 pax

Final exit

250 pax

400 pax

200 pax

Final exit

400 pax
PROGRESSIVE EVACUATION: VERTICAL and HORIZONTAL

200 pax

Exit route

storey exit

REFUGE

200 pax

200 pax

200 pax

200 pax

200 pax

200 pax

1000 pax

Final exit
1000 pax

horizontal exit
UBBL 2012 : 7th Schedule : Maximum Travel Distance

<table>
<thead>
<tr>
<th>Purpose Group</th>
<th>Limit when alternative exits are available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) *Dead-End Limit (metre)</td>
</tr>
<tr>
<td>I. Small Residential</td>
<td>NR</td>
</tr>
<tr>
<td>II. Institutional</td>
<td></td>
</tr>
<tr>
<td>Hospitals, Nursing Homes, etc</td>
<td>9 6</td>
</tr>
<tr>
<td>School</td>
<td>15</td>
</tr>
<tr>
<td>Open Plan</td>
<td>NR</td>
</tr>
<tr>
<td>Flexible Plan</td>
<td>NR</td>
</tr>
<tr>
<td>III. Kediaman lain</td>
<td></td>
</tr>
<tr>
<td>Hotels</td>
<td>10</td>
</tr>
<tr>
<td>Flats</td>
<td>20</td>
</tr>
<tr>
<td>Dormitories</td>
<td>0</td>
</tr>
<tr>
<td>IV. Office</td>
<td>15</td>
</tr>
<tr>
<td>V. Shops</td>
<td>15</td>
</tr>
<tr>
<td>VI. Factory</td>
<td></td>
</tr>
<tr>
<td>General and Special Purpose</td>
<td>15</td>
</tr>
<tr>
<td>High Hazard</td>
<td>0</td>
</tr>
<tr>
<td>Open structures</td>
<td>NR</td>
</tr>
<tr>
<td>VII. Place of Assembly</td>
<td>0</td>
</tr>
<tr>
<td>VIII. Storage and general</td>
<td></td>
</tr>
<tr>
<td>Low and Ordinary hazard</td>
<td>NR</td>
</tr>
<tr>
<td>High Hazard</td>
<td>15</td>
</tr>
<tr>
<td>Parking Garages</td>
<td>15</td>
</tr>
<tr>
<td>Aircraft Hangars (Ground Floor)</td>
<td>15</td>
</tr>
<tr>
<td>Aircraft Hangars (Mezzanine Floor)</td>
<td>15</td>
</tr>
</tbody>
</table>

UBBL 1984 provisions shown in RED
**UBBL 2012:** 7th Schedule: Occupant Load and capacity of exits

<table>
<thead>
<tr>
<th>Purpose Group</th>
<th>Occupant load square metre per</th>
<th><strong>CAPACITY EXITS</strong></th>
<th>No. of persons per unit–Exit Width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Doors outside</td>
<td>Horizontal Exit</td>
</tr>
<tr>
<td>I. Small Residential</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>II. Institutional</td>
<td>2 net 4.5 net</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Class-room Area</td>
<td>3.5 net</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Workshop and Vocational areas</td>
<td></td>
<td>12 gross 24 gross</td>
<td>15</td>
</tr>
<tr>
<td>Day Nurseries with sleeping facilities</td>
<td></td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Hospital</td>
<td>-</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Sleeping Department</td>
<td>20 gross 24 gross</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>In-patient Department</td>
<td></td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>III. Other Residential</td>
<td>100 gross (4)</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Flat</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>General public area in Hotels (Bedroom in hotels at 2 persons per room)</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>IV. Shop</td>
<td>10 gross (4)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>OFFICE</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>SHOP</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Street floor and sale basement</td>
<td>3 gross (4)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Other floors</td>
<td>6 gross (4)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Storage and shipping</td>
<td>10 gross</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>VI. Factory</td>
<td>10 gross</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

UBBL 1984 provisions shown in RED
Horizontal exit
PINTU RINTANGAN API
HENDAKLIAH SENTIASA
DITUTUP.

Arahan Jabatan Dikta

[Image of a door with a red sign in Indonesian]
Final exit
Compartmentation

• Size limitations of ‘compartments’

• Fire Resistance Ratings of ‘elements of structure’
Compartmentation

- To contain the spread of fire from point of origin
- To limit the potential size of the fire
- To separate areas of different levels of hazard
- To separate areas for safe exit, evacuation or refuge
- To limit threat to the structural integrity of the building
- To allow sufficient time for safe evacuation, active extinguishment of fire and rescue.
compartmentation

Fire Load

• Surface area / volume of combustible content (A)
• Combustion heat per area / volume (B)
• Fire Load = (A) x (B)
EQUAL VOLUME

Temperature / size

Time

'high' Btu

'moderate' Btu

'low' Btu
EQUAL Btu

Temperature / size

Time

'low' volume

'moderate' volume

'high' volume
Limitation of Floor Areas and Volume

Purpose Group classification

Prescription of Fire Resistance Rating
Accepted assumption in designing for **safe evacuation**: “Only one fire at one location at a time”

Primary objective of **compartmentation**: “To contain the one fire within the one location at all times”
Contributing factors to potential fire load:

Contents of the building

- Fittings and furnishings
- Including the building itself
- Furniture and equipment
- Consumables
- Storage items
- Presence of hazardous materials
- Presence (or absence) of human occupants
These factors lead to the designation of purpose groups in the 5th Schedule, UBBL, .......

...and to the prescriptions of UBBL

6th Schedule
8th Schedule
9th Schedule
UBBL 5th Schedule

- UBBL 5th schedule
- UBBL 134
- UBBL 135, 136, 137, 138, 139
- Every building is to have one overall designation

- Individual components of building with different usage from overall must be designed to accommodate the more stringent requirement, and where these requirements ‘spill’ into the other parts of the building, the more stringent requirement applies.

- Only ‘horizontal’ separation is allowed between buildings of different purpose groups
• Dimensions of buildings and compartments

• Single storey buildings: limitations apply only to II and III

• Others: dimensional limitations do not apply to I, IV and VII
other limitations that may affect areas and volumes

- UBBL
- 136, 220: if automatic sprinklers installed, limits can be doubled (x 2)
- 137: floor to floor compartmentation
- 138: floor and wall compartmentation for flats, basement and areas of different usage
- 139: compartmentation of hazardous areas
other limitations that may affect areas and volumes

• 158, 178 to 188: specific coverage for VII – places of assembly

• Travel distances and occupant loads
UBBL 6th Schedule

• UBBL 142, 145  Construction and protection of external walls
UBBL 8th Schedule

• UBBL 204 to 207
• Flame spread over surfaces of walls and ceilings
UBBL 9\textsuperscript{th} Schedule

• Minimum periods of Fire Resistance for Elements of Structure.

• UBBL 213 : every element of structure to have FRP no less than as specified in 9\textsuperscript{th} Schedule
Elements of structure for application of FRP

- Structural frame, beams and columns (excluding roof structures)
- Floor (except the lowest floor)
- Compartment floor
- External wall
- Separating wall (including party wall)
- Compartment wall
- Protected shaft: structure and enclosure
- Load bearing wall
- Gallery
UBBL 2012 : SEPARATING WALL : TERRACE HOUSES

- Constructional function: Party Wall UBBL 86
- Fire safety function: Separating wall to be Compartment Wall UBBL 138(c)
- Check compartment size
- Check Fire Resistance Period of elements of structure

- UBBL 214: External Wall and Separating Wall minimum FRP
### Party walls.

(1) All party walls shall generally be of not less than **200 millimetres** total thickness of solid masonry or in situ concrete which may be made up of two separate skins each of not less than **100 millimetres** thickness if constructed at different times:

Provided that in multi-storeyed flats and terrace houses of reinforced concrete or of protected steel framed construction having floors and roofs constructed to the requirements of these By-laws, the party wall thereof shall not be less than **100 millimetres total thickness**.

(2) Party walls in single storeyed houses may be in load-bearing **100 millimetres solid masonry or in situ concrete** provided the requirements of Part V, VI and VII of these By-laws are complied with.

(3) All party walls shall be carried above the upper surface of the roof to a distance of not less than **230 millimetres** at right angles to such upper surface.

(4) Other non-combustible materials may be used for party walls provided the requirements of Part V, VI and VII of these By-laws are complied with.

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By-law 141: Separating walls has already provided the necessary fire requirements served to prevent the spread of fire from one separate unit of house to another. As such the Fire Authority will only make reference to by-law 141.
COMPARTMENTS, ELEMENTS OF STRUCTURE AND FRP

215(1) : reference to elements of structure, by building, or by compartments

215(2) : reference to height, by building only

137 : floor to floor compartment for buildings > 30m height

138(b) : floor and walls separating flats

138(c) : floor and walls separating purpose group

138(d) : floor separating basements

Service apts

Offices

Shops

Cineplex

Carpark
Basement compartment volume limit 42,000m³

Separation of vertical ‘shaft’

Compartment D

Compartment A

Compartment B

Compartment C
UBBL 6th SCHEDULE

Reference plane

relevant boundary

Reference plane
UBBL 6th SCHEDULE

Reference plane  
notional boundary  
Reference plane  
SEPARATING WALL
Sample calculation

1) Establish Purpose Group

2) Establish height and width of enclosing rectangle

1) Enclosing rectangle on reference plane:
   \(24 \text{m} \times 9 \text{m} = 216 \text{m}^2\)

2) Total unprotected area:
   \((2 \text{m} \times 3 \text{m}) \times 10 = 60 \text{m}^2\)
   \(3 \text{m} \times 9 \text{m} = 27 \text{m}^2\)
   \(\text{total} = 87 \text{m}^2\)

3) Percentage of unprotected area:
   \(\frac{87 \text{m}^2}{216 \text{m}^2} = 40\%\)

4) Minimum distance from reference plane to relevant boundary:
   \(5 \text{m}\)
   (IV – Office)

Office building  Protected staircase
### Sixth Schedule

<table>
<thead>
<tr>
<th>Width of enclosing rectangle in metres</th>
<th>Distance in metres from relevant boundary for unprotected percentage not exceeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>2.0</td>
</tr>
<tr>
<td>12</td>
<td>2.5</td>
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<tr>
<td>15</td>
<td>3.0</td>
</tr>
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<td>18</td>
<td>3.0</td>
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<td>120</td>
<td>5.5</td>
</tr>
<tr>
<td>No limit</td>
<td>5.5</td>
</tr>
</tbody>
</table>
FLAME TRAJECTORY OUTSIDE WALL OPENINGS

Shape of opening

Square

1: 2

1: 3

height

Distance from face of wall
EXTERNAL WALL BARRIERS

UBBL 149

900mm vertical or 750mm horizontal barrier
ATRIUMS

UBBL 2012 clause 137
UBBL 2012 clause 252A
MS 1183:2015 Annex B
COMPARTMENTS, ELEMENTS OF STRUCTURE AND FRP
Atrium Space
<table>
<thead>
<tr>
<th>UBBL 1984</th>
<th>UBBL 2012</th>
<th>To provide stricter requirements in relation to the extent of subdivision of a building as compartment floors.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floor in building exceeding 30 metres in height to be constructed as compartment floor.</strong></td>
<td><strong>Compartmentation by height.</strong></td>
<td></td>
</tr>
<tr>
<td>In any building which exceeds 30 metres in height, any floor which is more than 9 metres above ground floor level which separates one storey from another storey, other than a floor which is either within a maisonette or a mezzanine floor shall be constructed as a compartment floor.</td>
<td>(1) In any building not exceeding 30 metres in height, any floor which is more than 9 metres above ground floor level which separates one storey from another storey, other than a floor which is either within a maisonette or a mezzanine floor shall be constructed as a compartment floor.</td>
<td></td>
</tr>
<tr>
<td><strong>-None-</strong></td>
<td><strong>(2) In any building exceeding 30 metres in height, all floors shall be constructed as compartment floors, other than a compartment which is within a residential maisonette which may comprise two storey levels.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>-None-</strong></td>
<td><strong>(3) An atrium shall comply with the requirements of by-law 252A.</strong></td>
<td></td>
</tr>
</tbody>
</table>

UBBL 1984

UBBL 2012
In any building which exceeds 30 metres in height, any floor which is more than 9 metres above ground floor level which separates one storey from another storey, other than a floor which is either within a maisonette or a mezzanine floor shall be constructed as a compartment floor.
1984 UBBL cl 137

All Buildings above 30m

All floors above 9m to be Compartment Floors

Floors 9m or below need not be compartmented
By inference, buildings below 30m........

........need not have compartmented floors
2012 UBBL

Clause 137 : Compartment Floor

(1) In any building not exceeding 30 metres in height, any floor which is more than 9 metres above ground floor level which separates one storey from another storey, other than a floor which is either within a maisonette or a mezzanine floor shall be constructed as a compartment floor.

(2) In any building exceeding 30 metres in height, all floors shall be constructed as compartment floors, other than a compartment which is within a residential maisonette which may comprise two storey levels.
Any building **NOT** exceeding 30m

All floors above 9m to be Compartment Floors

Floors 9m or below need not be compartmented
2012 UBBL cl 137

Any building exceeding 30m

All floors to be Compartmented

Including floors below 9m
Openings between floors shall be designed as an **ATRIUM**

An atrium shall comply with the requirements of by-law **252A**.
2012 UBBL 252A Atriums in buildings

1. Minimum dimensions: 6m and 95m²
2. Exits separated from atrium
3. 1 hour FRP separation
4. Automatic sprinklers
5. Smoke control/exhaust system
COMPARTMENTS, ELEMENTS OF STRUCTURE AND FRP
Atrium Space  (NFPA 101)

- Minimum dimension of 6m and minimum area of 95m
- Required exits to be separated from atrium volume
- Atrium construction and usage to be of hazard level no higher than ‘ordinary’
- Entire building to have automatic sprinklers
- Designed for smoke exhaust and smoke control
- Atrium volume to be separated from adjacent occupancy, or to be engineered such that the adjacent occupancies are not at risk from a fire originating from the atrium
COMPARTMENTS, ELEMENTS OF STRUCTURE AND FRP

Atrium Space

UBBL 251
Smoke venting for
Safe exit
UBBL 251
Smoke venting for
Safe exit
Compartmentation of large volumes
Compartmentation of large volumes
Protection of penetrations through compartments and elements

**UBBL 141 : Separating walls**

- Diameter of combustible pipe < 25mm
- Diameter of non-combustible pipe < 150mm
- No flue pipes allowed
- Doors to have equal or greater FRP as with the element

**UBBL 148 : Compartment floor and walls**

- Opening for protected shaft
- Ventilation duct with fire damper
- Encased ducts to have FRP no less than half of the element
Protection of penetrations through compartments and elements

UBBL 150: Protected Shafts
- for pipes, ducts, sanitary facilities, staircase, lift

UBBL 156: Ventilating Duct in Protected Shaft
- To have automatic Fire Dampers at ‘appropriate’ intervals
Max 25mm (/
Max 150mm (/)
Required FRP
Half of required FRP
Required FRP
Half of required FRP

Required FRP
Full FRP for structures

Half of required FRP
Active systems for.....

• EVACUATION and FIRST AID
  – Detection and Alarm
  – Communication
  – Smoke control
  – Portable fire extinguishers
Temperature / size

Available Safe Egress Time (ASET)

Factor of safety:

$RSET < 0.75 \text{ ASET}$
Amendment of Tenth Schedule

129. Tenth Schedule of the principal By-Laws is amended—

(a) by substituting for Schedule to the “SCHEDULE OF REQUIREMENTS FOR FIRE DETECTION, FIRE ALARM AND FIRE EXTINGUISHMENT SYSTEMS” the following schedule:

**Tenth Schedule**

**TABLE OF REQUIREMENTS FOR FIRE DETECTION, FIRE ALARM AND FIRE EXTINGUISHMENT SYSTEMS**

(By-law 225 (1), 238)

<table>
<thead>
<tr>
<th>Occupancy Hazard</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Note 2</td>
<td>Note 3</td>
</tr>
<tr>
<td>I. SMALL RESIDENTIAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Private dwelling up to 2 storey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Terrace Type</td>
<td>(See Note 5)</td>
<td>-</td>
</tr>
<tr>
<td>(b) Semi Detached</td>
<td>(See Note 5)</td>
<td>-</td>
</tr>
<tr>
<td>(c) Detached</td>
<td>(See Note 5)</td>
<td>-</td>
</tr>
<tr>
<td>(ii) Private dwelling more than 2 storey</td>
<td>(See Note 5)</td>
<td>(See Note 6)</td>
</tr>
</tbody>
</table>

**NOTE 5:**

Portable fire extinguishers are to be provided for private dwellings.

**NOTE 6:**

Smoke detector of the self contained type is to be provided at the top of the staircase.
## UBBL 2012 amended 10th Schedule

<table>
<thead>
<tr>
<th>Occupancy Hazard</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II. INSTITUTIONAL</strong></td>
<td>Note 2</td>
<td>Note 3</td>
</tr>
<tr>
<td>1. Educational Occupancies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Rooms or halls used for instructional purposes only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Open corridor design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) 2 storeys and below</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(B) 3 to 5 storeys</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(C) 6 storeys and above</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(b) Other designs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Two or more storeys</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(B) Less than 1,000 sq. m per floor</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(C) 1,000 sq. m to 2,000 sq. m per floor</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(D) Exceeding 2,000 sq. m per floor or more than 30 m height</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>(ii) Canteen/kitchen detached</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(iii) Laboratories and Workshops (total floor area per BLOCK)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Low hazard Laboratories and workshops such as physics lab, electronics lab, computer lab and for metal work over 1,000 sq. m in floor area</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(b) High hazard laboratories and workshops such as chemical lab and for wood work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Less than 1,000 sq. m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(B) 1001 to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(C) Exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1 &amp; 3</td>
</tr>
<tr>
<td>(iv) Library (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Less than 500 sq. m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(b) 501 sq. m to 1,000 sq. m</td>
<td>A</td>
<td>- 1</td>
</tr>
<tr>
<td>(c) 1001 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(d) Exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
</tbody>
</table>

A. Hose Reel System  
B. Sprinkler System  
C. Gaseous Extinguishing System  
D. Pressurized Fire Hydrant

1. Manual Electric Fire Alarm  
2. Automatic Fire Detector System  
3. Centralised Monitoring System  
4. Public Address System  
5. Fire Command Center
<table>
<thead>
<tr>
<th>Occupancy Hazard</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v) Vocational School (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Low hazard workshops such as for metal work over 1,000 sq. m in floor area</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(b) High hazard laboratories and workshops such as for wood work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Less than 1,000 sq. m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(B) 1,001 to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(C) Exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1 &amp; 3</td>
</tr>
<tr>
<td>(vi) Multi-purpose hall (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Single storey and less than 2,000 sq. m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(b) 2 storey and above or exceeding 2,000 sq. m</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(vii) Buildings with Central Air-conditioning (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Less than 1,000 sq. m</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(b) 1,001 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(c) Exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>(viii) Educational Institutions in office complexes and shopping complexes</td>
<td>To be considered as part of overall risk in the complex</td>
<td></td>
</tr>
<tr>
<td>2. HOSPITALS AND NURSING HOMES (Total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Clinic-day care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) 1,001 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(b) 1,001 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(c) above 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>(ii) In-patient Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Part of office or shopping complex</td>
<td>To be considered as part of overall risk with special requirements for emergency lighting stretcher lifts.</td>
<td></td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Note 2</td>
<td>Note 3</td>
</tr>
<tr>
<td>(ii) Other Designs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Less than 10 rooms per block</td>
<td>-</td>
<td>(See Note 7)</td>
</tr>
<tr>
<td>(b) 11 rooms to 20 rooms per block</td>
<td>-</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(c) 21 rooms to 50 rooms per block</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(d) 51 rooms and over per block</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(A) 3 storeys and below</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(B) 4 storeys and above or exceeding 18 m height</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>(iii) Hotel above shops or office occupancies</td>
<td>But not less than that required for overall occupancy risk or 1 &amp; 2 above</td>
<td></td>
</tr>
</tbody>
</table>

2. Hostels, Dormitories, Old Folk Homes and Orphanages  

| (i) (a) Single storey | - | - |
| (b) 2 or 3 storeys | A | 1 |
| (c) 4 or 5 storeys | A | 1 (See Note 7) |
| (A) Less than 250 sq. m per floor | A | 1 & 2 |
| (B) More than 250 sq. m per floor | A | 1 & 2 |
| (d) 6 to 10 storeys | A | 1 & 2 |
| (e) 11 storeys and over | A & B | 1, 3, 4 & 5 |
| (ii) Open corridor design, 11 storeys and over and for other designs 6 storeys and over | A & B | 1, 3, 4 & 5 |

NOTE: Hotels at locations that cannot be reached within reasonable time or not accessible to required type and number of fire appliances shall be required to provide higher standard of protection as required by D.G.F.R.

3. Apartments and Flats  

| (i) Apartments/flats 5 storeys and below | (See Note 5) | - |
| (ii) Open corridor design | - | - |
| (a) Apartments/flats 6 storeys to 10 storeys or less than 30 m height | A, (See Note 5) | 1 |

A. Hose Reel System  
B. Sprinkler System  
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<th>Occupancy Hazard</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(b)</em> Apartments exceeding 10 storeys or 30 m</td>
<td>A, (See Note 5)</td>
<td>1</td>
</tr>
<tr>
<td><em>(iii)</em> Internal staircase or core design</td>
<td>A, (See Note 5)</td>
<td>1</td>
</tr>
<tr>
<td><em>(a)</em> 6 storeys to 10 storeys or less than 30 m</td>
<td>A, (See Note 5)</td>
<td>1, 2 &amp; 5</td>
</tr>
<tr>
<td><em>(b)</em> Exceeding 10 storeys or 30 m height</td>
<td>A, (See Note 5)</td>
<td>1, 2 &amp; 5</td>
</tr>
<tr>
<td><em>(iv)</em> Duplex or multi-level units</td>
<td>-</td>
<td>(See Note 6)</td>
</tr>
<tr>
<td><em>(v)</em> Apartments with common central air-conditioning with ducted systems</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td><em>(a)</em> 3 storeys to 5 storeys</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td><em>(b)</em> 6 to 10 storeys (less than 30 m)</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td><em>(c)</em> 11 storeys and over</td>
<td>A &amp; B</td>
<td>1, 3 &amp; 5</td>
</tr>
</tbody>
</table>

### IV. OFFICES (total gross floor area)

1. 4 storeys and less or less than 1,000 sq. m                                  -                    | -                                |
2. 5 storeys and above or exceeding 1,000 sq. m                                A                    | 1                                |
3. Exceeding 18 m but less than 10,000 sq. m                                   A                    | 1 & 2                            |
4. Exceeding 30 m but less than 10,000 sq. m                                   A & B                | 1, 3, 4 & 5                     |

### V. SHOPPING COMPLEXES, SHOPS AND MARKETS

1. *(i)* Floor area not exceeding 250 sq. m, per floor built as separate compartments with building less than 4½ storeys or 18 m height  -                    | -                                |
2. *(ii)* Combination of ground floor shop and/or residential and/or office on upper floors  -                    | -                                |
3. Single storey                                                               -                    | -                                |
   *(i)* Less than 750 sq. m                                                   -                    | -                                |
   *(ii)* 750 to 1000 sq. m                                                   (See Note 8)      | -                                |
   *(iii)* 1,001 to 2000 sq. m                                               A                    | 1 & 2                            |
   *(iv)* More than 2,000 sq. m                                              A & B                | 1 & 3                            |
3. 2 storeys (Total floor area)                                               A & B                | 1 & 3                            |
   *(i)* Less than 750 sq. m                                                   -                    | -                                |

A. Hose Reel System  
B. Sprinkler System  
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D. Pressurized Fire Hydrant

1. Manual Electric Fire Alarm  
2. Automatic Fire Detector System  
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4. Public Address System  
5. Fire Command Center
### Occupancy Hazard

| (ii) 750 to 1,000 sq. m. | (See Note 8) | 2 |
| (iii) 1,001 to 2,000 sq. m. | A | 1 & 2 |
| (iv) More than 2,000 sq. m. | A & B |

<table>
<thead>
<tr>
<th>3 storeys and above (total floor area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Less than 1,000 sq. m.</td>
</tr>
<tr>
<td>(ii) 1,000 – 3,000 sq. m.</td>
</tr>
<tr>
<td>(iii) 3,000 sq. m and over</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hawker Centers, Food Courts, Wet and Dry Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Detached building less than 2,000 sq. m with open structure design and naturally ventilated</td>
</tr>
<tr>
<td>(ii) 2,000 sq. m and over</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combined shop and hotel occupancy and combined office and shop occupancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross area calculated against the highest risk requirement.</td>
</tr>
</tbody>
</table>

### VI. FACTORY

<table>
<thead>
<tr>
<th>1. Single Storeys detached or terrace units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Less than 750 sq. m.</td>
</tr>
<tr>
<td>(ii) 750 to 1,000 sq. m.</td>
</tr>
<tr>
<td>(iii) 1,001 to 2,000 sq. m.</td>
</tr>
<tr>
<td>(iv) More than 2,000 sq. m.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Open Structure Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Steel or metal fabrication works, engineering or metalworks or similar low fire risk establishments</td>
</tr>
<tr>
<td>(ii) Sawmill</td>
</tr>
<tr>
<td>(iii) Steel mills</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Two Storeys detached or terrace units: each floor built as separate compartment single or terrace type construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Each floor area less than 500 sq. m.</td>
</tr>
<tr>
<td>(ii) Each floor area 500 – 1,000 sq. m.</td>
</tr>
<tr>
<td>(iii) Exceeding 1,000 sq. m per floor area</td>
</tr>
</tbody>
</table>

A. Hose Reel System  
B. Sprinkler System  
C. Gaseous Extinguishing System  
D. Pressurized Fire Hydrant

1. Manual Electric Fire Alarm  
2. Automatic Fire Detector System  
3. Centralised Monitoring System  
4. Public Address System  
5. Fire Command Center
### Occupancy Hazard

<table>
<thead>
<tr>
<th>Flattened Factories Block</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(i)</td>
<td>Note 2</td>
</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>Note 3</td>
</tr>
</tbody>
</table>

#### (i) 2 storeys and over

- (a) Less than 500 sq. m per compartment
  - (See Note 8)
  - 1
- (b) 500 - 1,000 sq. m per compartment
  - A
  - 1
- (c) Exceeding 1,000 sq. m per compartment
  - A & B
  - 1, 3, 4 & 5
- (d) Compartment Exceeding 7,000 cu. m
  - -

#### (ii) 3 storeys and over

- A & D
  - 1 & 2

#### (iii) Vehicle Assembly and similar Plants

- (a) Less than 1,000 sq. m
  - -
  - -
- (b) 1,001 to 2,000 sq. m
  - (See Note 8)
  - -
- (c) 2,001 to 5,000 sq. m
  - A & D
  - 1
- (d) Exceeding 5,000 sq. m
  - A & B & D
  - 1, 2, 3 & 5

### Special Hazards

- Factory complexes such as palm oil mill complex, palm oil refinery, sugar mills, paper mills, paint shops, cement works
  - A & D
  - 1
- (i) Buildings with wet processes
  - A
  - 1
- (ii) Building with hazardous processes
  - A, B, C or D
  - 1, 2, 3, 4, 5

### Note:

1. Factories in operation after hours of darkness shall be required to provide emergency light as required by the D.G.F.R.
2. Special risks or hazardous processes or storage shall be required to provide fire protection requirements as required by D.G.F.R.

### VII. Place of Assembly

| Place of assembly below level of exit discharge exceeding 500 sq. m (Total floor area) | A & B | 1 |
| Convention Center, Community Centers, Private Clubs, Exhibition Centers, Museums And Art Galleries (total floor area) | - | - |
| (i) Single storey not exceeding 1,000 sq. m | - | - |

A. Hose Reel System  
B. Sprinkler System  
C. Gaseous Extinguishing System  
D. Pressurized Fire Hydrant

1. Manual Electric Fire Alarm  
2. Automatic Fire Detector System  
3. Centralised Monitoring System  
4. Public Address System  
5. Fire Command Center
<table>
<thead>
<tr>
<th>Occupancy Hazard</th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) Single storey 1,001 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(iii) 2 storey and above or exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>3. Theatres, Cinemas, Concert Halls, Auditoriums (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Single storey or not exceeding 1,000 sq. m</td>
<td>-</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(ii) 2 storeys and above or exceeding 1,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>4. Amusement centers (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Single storey or not exceeding 1,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(ii) 2 storeys and above or exceeding 1,000 sq. m</td>
<td>A &amp; B</td>
<td>1 &amp; 3</td>
</tr>
<tr>
<td>5. Bus terminals, train stations, airports (total floor area)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Single storey or not exceeding 1,000 sq. m</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>(ii) 2 storeys 1,000 sq. m to 2,000 sq. m</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(iii) 3 storeys and above or exceeding 2,000 sq. m</td>
<td>A &amp; B</td>
<td>1, 3, 4 &amp; 5</td>
</tr>
<tr>
<td>6. Place of worship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of assembly used purely for religious purposes</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

A. Hose Reel System  
B. Sprinkler System  
C. Gaseous Extinguishing System  
D. Pressurized Fire Hydrant

<table>
<thead>
<tr>
<th>VIII. STORAGE AND GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Car parks</td>
</tr>
<tr>
<td>(i) Open structure car-parks above ground</td>
</tr>
<tr>
<td>(a) Single storey or less than 750 sq. m</td>
</tr>
<tr>
<td>(b) 2 storeys and above or more than 750 sq. m per floor</td>
</tr>
<tr>
<td>(ii) Underground car parks</td>
</tr>
<tr>
<td>(a) Less than 2000 sq. m (total floor area)</td>
</tr>
<tr>
<td>(b) 2000 sq. m and above at (total floor area)</td>
</tr>
<tr>
<td>(iii) Automated multi level car parks</td>
</tr>
</tbody>
</table>

1. Manual Electric Fire Alarm  
2. Automatic Fire Detector System  
3. Centralised Monitoring System  
4. Public Address System  
5. Fire Command Center
### Occupancy Hazard

<table>
<thead>
<tr>
<th></th>
<th>Extinguishing System</th>
<th>Detection and Fire Alarm Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Note 2</td>
<td>Note 3</td>
</tr>
</tbody>
</table>

#### 2. Warehouse and storage of non-combustible such as clay and bleaching earth

- **(i)** Single storeys and less than 2,000 sq. m
- **(ii)** 2 storeys and above or more than 2,000 sq. m

#### 3. Warehouse and Storage of combustible products

- **(i)** Single storeys (total floor area)
  - **(a)** Open sided exceeding 1,000 sq. m
  - **(b)** Less than 250 sq. m
  - **(c)** 250 – 500 sq. m
  - **(d)** 501 – 1,000 sq. m and less than 7,000 cu. m
  - **(e)** More than 1,000 sq. m or 7,000 cu. m

- **(ii)** Two storeys and over (total floor area)
  - **(a)** Less than 1000 sq. m and less than 7600 cu. m
  - **(b)** Exceeding 1,000 sq. m and over or more than 7,000 cu. m

#### NOTE:

**Open Structure**

1. Total surface area of openings is to be no less than 40% of the total perimeter wall area enclosing the floor or compartment.

2. The opening(s) is too be shaped and located in such a way that total length in plan of the opening(s) is to be no less than 50% of the perimeter of the floor or compartment.

**Open Corridor**

1. Total surface area of openings is to be no less than 25% of the total perimeter wall area enclosing the balcony.

2. The opening(s) is too be shaped and located in such a way that total length in plan of the opening(s) is to be no less than 50% of the perimeter of the balcony.

*Openings* is to be opened to outside, unenclosed space or permitted airwells. Any individual opening having surface area less than 600 mm² or area width of opening is less than 25 mm is not to be regarded as an opening for the purpose.
OPEN STRUCTURES
OPEN CORRIDORS

UBBL 2012 10th Schedule
OPEN STRUCTURE

(1) Total surface area of openings is to be no less than 40% of the total perimeter wall area enclosing the floor or compartment.

(2) The opening is to be shaped and located in such a way that total length in plan of the opening(s) is to be no less than 50% of the perimeter of the floor or compartment.

“Openings” is to be opened to outside, unenclosed space or permitted airwells. Any individual opening having a surface area less than 600mm2 or area width of opening is less than 25mm is not to be regarded as an opening for this purpose.
OPEN STRUCTURES

Example:
Total perimeter length \((25\, \text{m} + 50\, \text{m}) \times 2 = 150\, \text{m}\)

minimum 50% = 75m

Total perimeter wall area \(150\, \text{m} \times 5\, \text{m} = 750\, \text{m}^2\)

minimum 40% = 300m²

Total length of openings \(25\, \text{m} + 50\, \text{m} = 75\, \text{m}\)

Total area of openings \(75\, \text{m} \times 4\, \text{m} = 300\, \text{m}^2\)

Total length of openings \(50\, \text{m} + 50\, \text{m} = 100\, \text{m}\)

Total area of openings \(100\, \text{m} \times 3\, \text{m} = 300\, \text{m}^2\)

Total length of openings \(25\, \text{m} + 50\, \text{m}) \times 2 = 150\, \text{m}\)

Total area of openings \(150\, \text{m} \times 2\, \text{m} = 300\, \text{m}^2\)
OPEN CORRIDOR

(1) Total surface area of opening(s) is to be no less than 25% of the total perimeter wall area enclosing the balcony (corridor).

(2) The opening(s) is to be shaped and located in such a way that total length in plan of the opening(s) is to be no less than 50% of the perimeter of the floor or compartment.

“Openings” is to be opened to outside, unenclosed space or permitted airwells. Any individual opening having a surface area less than 600mm² or area width of opening is less than 25mm is not to be regarded as an opening for this purpose.
Example (corridor)
Total perimeter length \((24m + 2m) \times 2 = 52m\)
minimum \(50\% = 26m\)

Total perimeter wall area \(52m \times 3m = 156m^2\)
minimum \(25\% = 39m^2\)

Total length of openings \(24m + 2m + 2m = 28m\)
Total area of openings \(28m \times 1.5m = 42m^2\)
## 10th SCHEDULE

### VI. FACTORY

<table>
<thead>
<tr>
<th>1. Single Storeys detached or terrace units</th>
<th>2. Open Structure Design</th>
<th>3. Two Storeys detached or terrace units: each floor built as separate compartment single or terrace type construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Less than 750 sq. m</td>
<td>(i) Steel or metal fabrication works, engineering or metal works or similar low fire risk establishments</td>
<td>(i) Each floor area less than 500 sq. m</td>
</tr>
<tr>
<td>(ii) 750 to 1,000 sq. m</td>
<td>(ii) Sawmill</td>
<td>(ii) Each floor area 500 – 1,000 sq. m</td>
</tr>
<tr>
<td>(iii) 1001 to 2,000 sq. m</td>
<td>(iii) Steel mills</td>
<td>(iii) Exceeding 1,000 sq. m per floor area</td>
</tr>
<tr>
<td>(iv) More than 2,000 sq. m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- [A]: HR
- [B]: Spkr
- [C]: GasEx
- [D]: PrHy

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
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<td></td>
</tr>
</tbody>
</table>
### 10th SCHEDULE

#### VIII. STORAGE AND GENERAL

1. Car parks

   (i) Open structure car-parks above ground
       (a) Single storey or less than 750 sq. m
           -
           -
       (b) 2 storeys and above or more than 750 sq. m per floor
           A
           1

   (ii) Underground car parks
       (a) Less than 2000 sq. m (total floor area)
           A
           1
       (b) 2000 sq. m and above atas (total floor area)
           A & B
           1, 3, 4 & 5
       (iii) Automated multi level car parks
           A & B
           1 & 3
### 10th SCHEDULE

#### II. INSTITUTIONAL

1. Educational Occupancies

   (i) Rooms or halls used for instructional purposes only.

(a) Open corridor design

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) 2 storeys and below</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) 3 to 5 storeys</td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(C) 6 storeys and above</td>
<td>A</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Other designs

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or more storeys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) Less than 1,000 sq. m per floor</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>(C) 1,000 sq. m to 2,000 sq. m per floor</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(D) Exceeding 2,000 sq. m per floor or more than 30 m height</td>
<td>A &amp; B</td>
<td></td>
<td></td>
<td></td>
<td>1, 3, 4 &amp; 5</td>
</tr>
</tbody>
</table>

A : HR
B : Spkr
C : GasEx
D : PrHy

1 : ManAl
2 : AutoD
3 : CMS
4 : PAS
5 : FCC
<table>
<thead>
<tr>
<th>Hotel Details</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Other Designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Open corridor design with open staircase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(a) Less than 10 rooms per block</td>
</tr>
<tr>
<td>(a) 1 to 3 storeys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(See Note 7)</td>
</tr>
<tr>
<td>(A) 50 rooms or less per block</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(b) 11 rooms to 20 rooms per block</td>
</tr>
<tr>
<td>(B) More than 50 rooms per block</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>(See Note 7)</td>
</tr>
<tr>
<td>(b) 4 or 5 storeys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(c) 21 rooms to 50 rooms per block</td>
</tr>
<tr>
<td>(A) 20 rooms or less per block</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>(B) 21 to 50 rooms per block</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>(See Note 7)</td>
</tr>
<tr>
<td>(C) 51 rooms and over per block</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>(d) 51 rooms and over per block</td>
</tr>
<tr>
<td>(c) 6 to 10 storeys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(A) 3 storeys and below</td>
</tr>
<tr>
<td>(A) 50 rooms or less per block</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>(B) 51 rooms and over per block</td>
<td>A &amp; B</td>
<td></td>
<td></td>
<td></td>
<td>(B) 4 storeys and above or exceeding 18 m height</td>
</tr>
<tr>
<td>(d) 11 storeys and over</td>
<td>A &amp; B</td>
<td></td>
<td></td>
<td></td>
<td>A &amp; B</td>
</tr>
</tbody>
</table>

A : HR     1 : ManAl
B : Spkr   2 : AutoD
C : GasEx   3 : CMS
D : PrHy   4 : PAS
5 : FCC
### 3. Apartments and Flats

<table>
<thead>
<tr>
<th>(i) Apartments/flats 5 storeys and below</th>
<th>(See Note 5)</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii) Open corridor design</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(a) Apartments/flats 6 storeys to 10 storeys or less than 30 m height</td>
<td>A, (See Note 5)</td>
<td>1</td>
</tr>
<tr>
<td>(b) Apartments exceeding 10 storeys or 30 m</td>
<td>A, (See Note 5)</td>
<td>1</td>
</tr>
<tr>
<td>(iii) Internal staircase or core design</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(a) 6 storeys to 10 storeys or less than 30 m</td>
<td>A, (See Note 5)</td>
<td>1</td>
</tr>
<tr>
<td>(b) Exceeding 10 storeys or 30 m height</td>
<td>A, (See Note 5)</td>
<td>1, 2 &amp; 5</td>
</tr>
<tr>
<td>(iv) Duplex or multi-level units</td>
<td>-</td>
<td>(See Note 6)</td>
</tr>
<tr>
<td>(v) Apartments with common central air-conditioning with ducted systems</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(a) 3 storeys to 5 storeys</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>(b) 6 to 10 storeys (less than 30 m)</td>
<td>A</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td>(c) 11 storeys and over</td>
<td>A &amp; B</td>
<td>1, 3 &amp; 5</td>
</tr>
</tbody>
</table>
SMOKE CONTROL

UBBL 2012
251
“smoke control systems where specified shall be designed and installed in accordance with MS 1780

MS 1780: 2017
8.5 smoke control of hotel guestroom corridors

8.5.1
“Where internal guestroom corridors are NOT mechanically presurised, such corridors shall be smoke purged or diluted at a rate no less than 10 air change per hour.”

8.5.3
Natural ventilation is permissible only if induced cross ventilation is available……..”
Protection of stairs and lobbies

UBBL

• 196, 197 - smoke lobbies, protected lobbies
• 198, 199, 200, 201 – ventilation of stairs
• 229 – fire fighting lobbies
Protection of stairs and lobbies

• **Protected Lobby**: protected lobby separated or isolated from fire and smoke infiltration

• **Smoke Lobby**: a protected lobby primarily to isolate staircases from smoke infiltration

• **Ventilated Lobby**: protected/smoke lobby by means of natural ventilation from outside

• **Fire Fighting Access Lobby**: a protected lobby designed for fire fighting access
Protected lobby requirement for building > 18m (By-Law 197)

Building more than 18m above ground level

Protected lobby requirement

External wall

Ventilation opening

No protected lobby required
Omission of protected lobby for pressurised staircase for buildings below 45m

For building above 18m but below 45m: No protected lobby required

Ventilated opening
Above 18m, need PROTECTION
Above 45m, protection by PRESSURISATION

Protected lobby requirement for building > 45m [By-Law 197(2)]
FIRE FIGHTING ACCESS

UBBL clause 140
UBBL clause 197
UBBL clause 197A
UBBL 197B
140 Fire Appliance Access

(1) **Accessway** shall be provided within the site of a building to enable fire appliances to gain access to the building. Access openings shall also be provided along the external walls of buildings fronting the accessway to provide access into the building for fire fighting and rescue operations.

(2) The requirements of accessway shall be as follows:

(a) the accessway shall have a minimum width of 6 metres throughout its entire length and shall be able to accommodate the entry and manoeuvring of fire engine, extended ladders pumping appliances, turntable and hydraulic platforms;

(b) the accessway shall be metalled or paved or laid with strengthened perforated slabs to withstand the loading capacity of stationary 30 tonnes fire appliance;

(c) the accessway shall be positioned so that the nearer edge shall be not less than 2 metres or more than 10 metres from the centre position of the access opening, measured horizontally;

(d) the accessway shall be laid on a level platform or if on an incline, the gradient shall not exceed 1:15. The access road shall be laid on an incline not exceeding a gradient of 1:8.3;

(e) the dead-end accessway and fire engine access road shall not exceed 46 metres in length or if exceeding 46 metres, be provided with turning facilities;

(f) the outer radius for turning of accessway and fire engine access road shall comply with the requirements of the Fire Authority;

(g) the **overhead clearance** of fire engine access road shall be at least 4.5 metres for passage of fire appliances;
197A. Means of access and fire fighting in building over 18.0 metres high.

(1) Buildings in which the topmost floor is more than 18.0 metres above fire appliance access level shall be provided with means of gaining access and fighting fire from within the building consisting of fire fighting access lobbies, fire fighting staircases, fire lifts and dry or wet rising systems.

197B. Fire fighting access lobbies.

Fire fighting access lobbies shall conform to the following requirements:

(a) each lobby shall have a floor area of not less than 6.0 square metres; and

(b) the openable area of windows or area of permanent ventilation shall be not less than 25% of the floor area of the lobby and, if ventilation is by means of openable windows, additional permanent ventilation having a free opening of 464 square centimetres shall be provided except that mechanical pressurisation may be provided as an alternative.
FIRE APPLIANCE ACCESS
2012 UBBL 140

ACCESS WAY
An area for the entry, maneuvering and parking of Fire Appliances during fire fighting and rescue operations

ACCESS ROAD
A road capable of accommodating the passage of Fire Appliances to enter an Access Way

ACCESS OPENINGS
Doorways or openings that allows fast and safe entry of Fire Fighting and Rescue personnel into a building during fire fighting and rescue operations
EXTERNAL ACCESS

Access for emergency and rescue vehicles, equipment and personnel

• Roads
• Pavements
• Parking

Availability of water:

• Hydrants
• Storage tanks
• Lakes, rivers, ponds

And access to fire fighting systems in the premises
AT THE PREMISES

Clarity of:
- Type of building and function
- Configuration of building
- Location of fire control panel
- Location of breaching inlets and pump rooms

Access into the building
- Protected passage
- Protected stairs
- Firemen’s lift
- Fire fighting lobby
Pressurised Hydrant System
Sprinkler System
Dry Riser system
Wet Riser System
External source of water
- Hydrants
- Lakes, Ponds, Pools, rivers
- Fire Tenders

Fire Fighting Appliance on ‘Access Way’

Breaching Inlet
- Sprinklers
- Risers

Internal Systems
- Sprinklers
- Hose reels
- Risers
ACCESS WAY

- Minimum 6m width
- 30 tonnes load
- Gradient <= 1:15
- No overhead obstructions

ACCESS ROAD

- Minimum width 4.5m (suggested)
- Gradient <= 1:8.3
- Minimum overhead clearance 4.5m

ACCESS OPENING

- Located fronting Access Way
- (suggested) width >= required exit width

Required portion of building fronting the Access Way

ACCESS WAY

- Minimum 6m width
- 30 tonnes load
- Gradient <= 1:15
- No overhead obstructions

ACCESS ROAD

- Minimum width 4.5m (suggested)
- Gradient <= 1:8.3
- Minimum overhead clearance 4.5m

Edge of Access Way

- Minimum 2m
- Maximum 10m

Required portion of building fronting the Access Way
Fire Fighting Shaft
Fire Fighting Access Lobbies
Firemen’s Lift
Fire Fighting Staircase
Risers (fire mains)

Maximum 90m
Hydrant to Hydrant

Hydrant

Fire Pumps
Breeching Inlets

Emergency
Power
Generators

Maximum 30m
Hydrant to Breeching Inlet

LALUAN JENTERA BOMBA
KOSONGKAN LALUAN
Evacuation: separation of routes
FIRE FIGHTING SHAFTS : LOCATION

**Direct distance**

**Risers** (UBBL 230, 231)
All parts of floor within 45m from a landing valve

**Fire Fighting Access Lobbies** (UBBL 197A)
Level distance from furthermost point does not exceed 45m

**Route distance**

**Fire Lifts** (UBBL 197A)
Not more than 61m travel distance from furthermost point

**Fire Fighting Shafts** (MS1183 21.2.3)
With Fire Lift, no more than 61m from fire mains outlet measured on route in laying a hose

**AND**

Without Fire Lift, no more than 45m from fire mains outlet measured on route in laying a hose
FIRE FIGHTING SHAFTS: LOCATION check with DIRECT DISTANCE

Risers
All parts of floor within 45m from a landing valve

Fire Fighting Access
Lobbies
Level distance from furthest point does not exceed 45m
FIRE FIGHTING SHAFTS: LOCATION check with ROUTE DISTANCE

START

Is FIRE LIFT within 61m?

NO

Add Fire Fighting Access Lobby

YES

Is FIRE MAINS within 61m?

NO

install FIRE MAINS in secondary protected stair within 45m

YES

FINISH
FIRE APPLIANCE ACCESS: to Breeching Inlets

- Accessway
- Near edge
- Accommodation

Min 6m
- 2m to 10m

Max 30m
- Max 18m
FIRE APPLIANCE ACCESS: to Access Openings

- Min 6m
- 2m to 10m
- Accessway
- Near edge
- Accommodation
- Protected lobby or corridor
- Max 45m
- FFAL
- WR
- BOMBA
- H

Access opening
FIRE APPLIANCE ACCESS to Access Openings without Fire Mains

Min 6m  2m to 10m

Accessway  Near edge

Max 60m
Route distance

Access opening

Max 40m direct distance

BOMBA

Max 30m

H

Near edge

Accommodation

Max 60m
Route distance
Fire appliance access level and Access Way at upper ground level
13,000 m³ (1/6)
8,600 m³ (1/6)
36,000 m³ (1/4)

Access way at upper ground level
Access road / ramp
Access way at appliance access level

Access road / ramp
Access road / ramp

GROUND FLOOR PLAN (36 cp)
Fire Rescue Tender (medium)
Fire Rescue Tender (light)
HAZMAT tender
Turntable ladders
Pump tanker
Hydraulic platforms
THANK YOU

Ar Chong Lee Siong
APAM MIFireE MMIArbs