

## TECHNICAL GUIDANCE ON DESIGNING UNPROTECTED STEEL STRUCTURE OF MAXIMUM HEIGHT 11 METER OR 3 STORIES OR LESS

### Scope:

The scope of this technical guidance note is applicable to unprotected noncombustible type buildings which are constructed and occupied post 11 February 2021 and is limited to 3 stories with maximum height 11m.

### Design steps:

#### Step 1

According to BNBC 2020 Table 3.2.4; unprotected non-combustible construction is accepted for moderate hazard industries i.e., for garment manufacturing units (G occupancy). The factory can design and build unprotected non-combustible buildings (prefab steel building). However, there are some certain guidelines to design and construct such types of buildings explained in the following steps.

২৬৭৬ বাংলাদেশ গেজেট, অতিরিক্ত, ফেব্রুয়ারি ১১, ২০২১

**Table 3.2.4: Permitted Types of Construction and Fire Zones for Various Occupancy Groups**

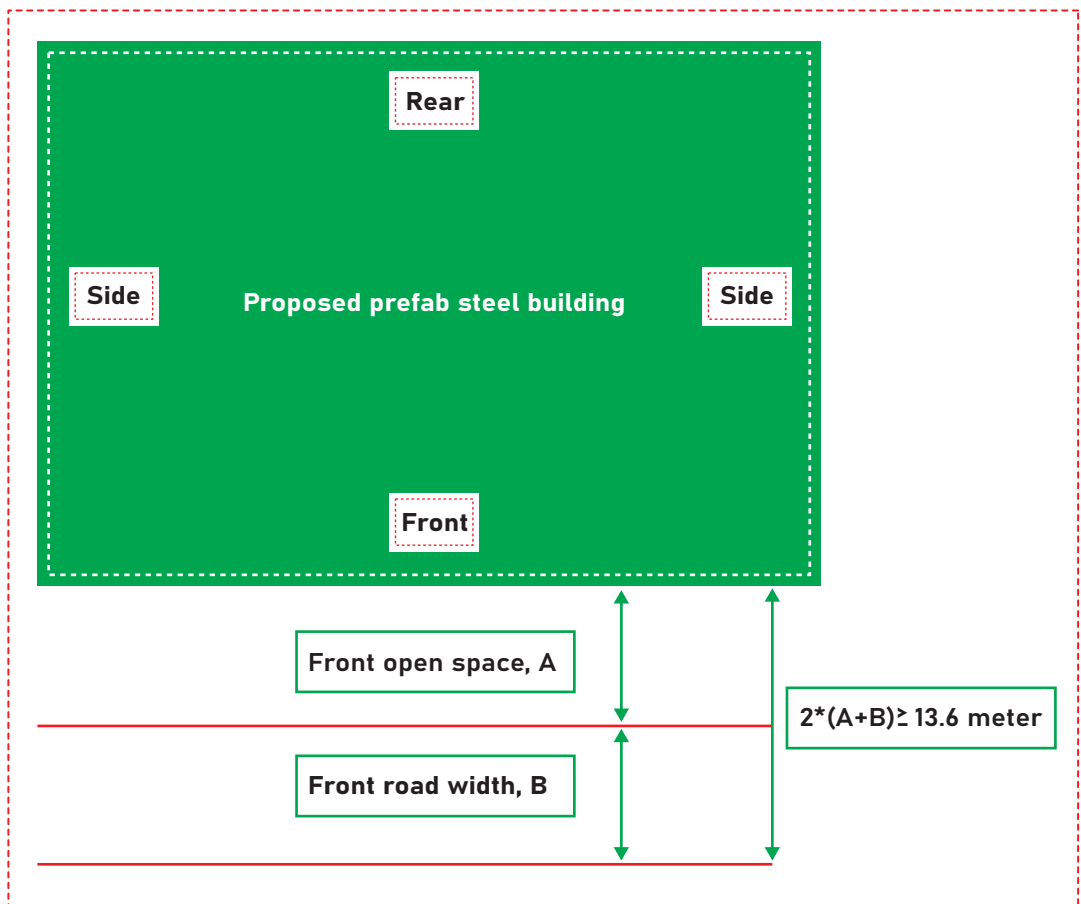
Occupancy	Permitted Types of Construction	Fire Zones
A B C D E1 F1, F2 I K1, K2, M2	Group I and Group II*	1
E2, E3, F3, K3, M1 G H	Group I or Group II*	2
J	Group I	3

Reference: BNBC 2020 Table 3.2.4



**Step 2:**

To build up to a 3 story prefab steel building up to 11m height (maximum); the surrounding building clearances are a pre-requisite requirement to allow all necessary safety to surrounding buildings against probable fire spreading and possible collapse of this steel building. According to BNBC 2020 Section 1.9.2.4; the maximum permissible height of the building shall be 3 stories or 11m for values of two times the sum of the width of the front road and the front open space not less than 13.6 m.



**Figure 1**

For example, assuming the value of front open space, A is 3m and front road width, B is 4m then  $2(3+4)=14\text{m}$  which is more than 13.6m. So the calculation supports an eligibility of a 3 storied unprotected non-combustible construction up to height 11m.

The guidance for the factory herein is to ensure and check back front open space and front road width to justify the requirement of  $2*(A+B) \geq 13.6\text{m}$ .

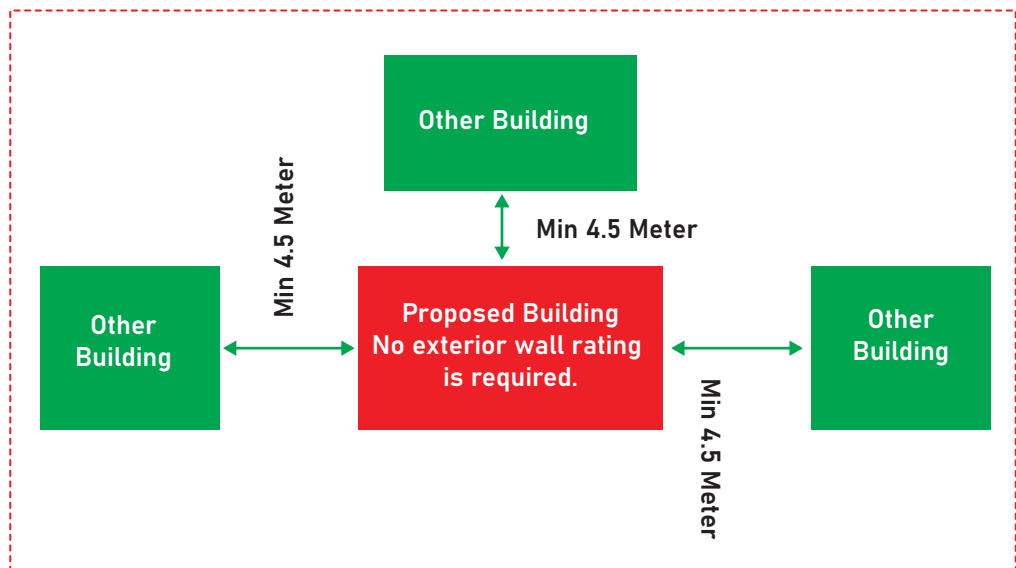
It is also the part of the assessment to verify the rear and side clearances i.e. proximity to surrounding group of occupancies. According to BNBC 2020 Table 3.3.1(a)



**Table 1**

Exterior wall with fire separation distance (Include bearing and non-bearing walls)	Ratings in hours
9 meter or more	0 hours
between 4.5 meter and below 9 meter	0 hours
more than 0.9 meter but less than 4.5 meter	2 hours
less than 0.9 meter	2 hours and openings are not permitted.

From table 1 above, a minimum of 4.5m clearance is required at the rear and 2 sides of the building which will allow no fire resistance rating to its exterior walls. Less than 4.5m clearance would require a minimum 2 hours fire resistance rating. Fire resistance rating of exterior wall is also dependent on BNBC 2020 Table 3.2.2 considering the various occupancy groups.



**Figure 2**



**Step 3:**

According to BNBC 2020 Table 3.3.1(a) accepted requirements for 3 storied building up to height 11 meters (prefab steel building) are listed below:

Elements	BNBC 2020 requirement
Building height	36.08 feet (11 Meter)
Number of stories	3
Roof construction, including beams, trusses and framing including arches, domes, shells, cable supported roofs and roof decks	0 hours
Floor construction including beams	0 hour: however due to mixed occupancy separation issue floor slab rating shall be as per BNBC 2020 Table 3.2.1
Columns, girders, trusses (other than roof trusses) and framing	0 hours
Interior bearing walls and bearing partitions	0 hours

So, no fire resistance rating is required for its structural elements. Along with that below requirement shall be applicable for this type of building according to BNBC 2020 Table 3.3.1 (a)

- a. Access corridor leading to fire exits - 1 hour.
- b. Fire separation wall and party wall - 2 hours.
- c. Shafts (other than exits) and elevator hoist ways - 2 hours.
- d. Fire divisions and fire barrier Walls or partitions or ceiling slab - As per mixed occupancies separation requirement by BNBC 2020 Table 3.2.1.
- e. Enclosure of vertical exits, exit passageways, hoist ways and shafts- 2 hours.



**Step 4:**

Factory needs to check and identify the conditions of mixed occupancies separation which requires both vertical and horizontal separation. In such cases floor to floor separation shall be confirmed between different occupancy types according to BNBC 2020 Table 3.3.1 (a) and BNBC 2020 Table 3.2.1. For example, assuming the occupancy accommodation configuration of this building:

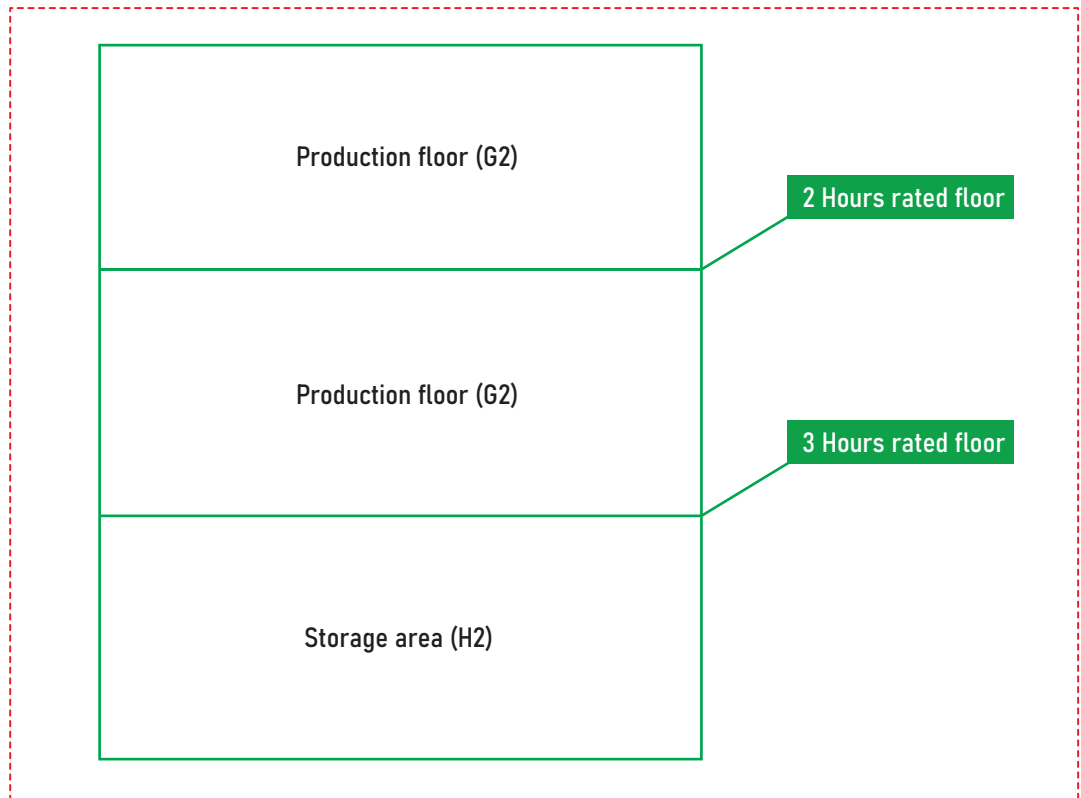


Figure 3

It is important to plan initially the desired type of occupancies for different floors and fire resistance rating of floor slab shall be identified according to BNBC 2020 Table 3.2.1.

**Step 5:**

BNBC 2020 Table 4.1.1 mainly pointed out the fire resistance of structural elements, the minimum thickness and dimensions of structural elements on the basis of construction materials.

If we consider the schematic diagram from step 4 figure 3, 1st floor slab requires 3 hours fire resistance rating. By following the BNBC 2020 Table 4.1.1: the minimum equivalent thickness can be determined. This step would provide guidance to the designer to determine the minimum slab thickness requirement on the basis of categorizing the occupancy type before proceeding to the structural design.

From BNBC 2020 Table 4.1.1; for 3 hours fire resistance rating minimum equivalent thickness of concrete slab will be as below for different concrete aggregate type-



**Table 3**

Concrete aggregate type	Minimum Equivalent Thickness of Concrete Walls, Floors, and Roofs for Fire Resistance Rating of 3 hours
Siliceous	157mm
Carbonate	145mm
Sand-lightweight	117mm
Lightweight	112mm

**Step 6:**

At the Architectural design development stage, the designer shall focus on the number of occupants on each occupied floor; following the occupant load factor from BNBC 2020 Table 4.3.1, egress capacity analysis, location of emergency exit stairs, positioning of aisles and machine layouts, travel distance analysis, required width of egress doors and exit stairs, exit discharge location and the like are to be considered in terms of a fully compliant design.

If the highest occupied floor height is more than 33ft measured from grade where the fire department vehicle can access; the factory needs to fit a standpipe system as the active fire protection measure according to NFPA 14, NFPA 20 and NFPA 22. Automatic fire alarm detection systems shall be installed regardless the building height according to NFPA 72.

The RSC recommends the building owner to arrange for full multi-design/technical discipline coordination by a qualified professional to ensure code compliance and coordination between each technical discipline. Below typical disciplines are listed, to assist the factory to follow a sequential process to incorporate the fire protection and safety related design going forward.

1. Draft architectural & structural plan.
2. Draft building approval plan.
3. Draft machine layout plan.
4. Draft mechanical, electrical & plumbing plan.
5. Draft fire safety plan.
6. Final machine layout plan.
7. Final mechanical, electrical & plumbing plan.
8. Final fire safety plan.
9. Final architectural & structural plan.
10. Final building approval plan preparation & submission



### Design recommendations:

1. BNBC 2020 allows 3 storied un-protected steel structures up to height 11m provided frontage criteria and clearance of other 3 sides are accepted as per BNBC 2020.
2. Proximity (adjacencies) between different groups of occupancies shall be maintained as per the BNBC 2020 Table 3.2.2 and Table 3.3.1 (a).
3. Notwithstanding, fire separation distance as per BNBC 2020 Table 3.2.2 and Table 3.3.1 (a); it is recommended to protect all vertical columns of the building to minimize the risk of property damage including fire rating of exterior wall of the building.
  - a) Un-protected structure is at severe risk to property damage, the implementation of passive fire protection (pfp) would assist to minimize damage to owner's investment.
  - b) If a new building is built adjacent to an un-protected building not maintaining the proximity requirement as per the BNBC 2020: both buildings would require the protection.
4. Floor to floor separation shall be confirmed as per the requirement of mixed occupancies separation from BNBC 2020 Table 3.2.1. Structural design shall be conducted upon the confirmation of floor slab thickness required for mixed occupancy separation.
5. Safe fire protected routes for horizontal and vertical movements of occupants like egress (exit) corridor, shafts and for goods like elevator hoist way, enclosure of vertical exits and exit passageway, mixed occupancy separation is required as per BNBC 2020.
6. Properly designed fire separated means of egress shall be completed based on occupant load in the building as required by BNBC 2020.
7. Standpipe system will be applicable on the basis of building height of the highest occupied floor if more than 33ft measured from grade level where the fire department vehicle can access. Standpipe system design shall conform to NFPA 14, 20 and 22.
8. Automatic fire alarm detection system shall be provided to building based on the occupancy types as per NFPA 72.

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### Limitations

The RSC has prepared this technical guidance note on designing unprotected steel structure of maximum height 11m or 3 stories or less, based on our interpretation of BNBC 2020/ 2006 and current understanding of International best practice. This is a general guide and not to be used and relied upon as 'standard' or 'code'.

It is the sole responsibility of the Factory appointed engineer to carry out design of unprotected steel structure in compliance with National Building Code and International best practice where applicable.

