

Date: June 16, 2020

DBR- 03

CASE STUDY: COMMERCIAL BUILDING

DESIGN BASIS REPORT

Structural Consultants:

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1. INTRODUCTION

The proposed **G+4 Commercial Building** consists of 40 m long building having 30 m width with **equal bays and flat roof**.

2. STRUCTURAL SYSTEM

The structure designed with 2 alternative structural configurations:

- a. Built-up I sections
- b. Tubular sections

And the steel tonnage and indicative costing is compared.

The structures are designed for the expected loads, i.e. Dead Load, Live Load, Wind Load and Earthquake Load. Limit State Method of Analysis and Design has been adopted for the design of the building.

3. PERIPHERAL WALLS

All peripheral walls have been conceived in Red Bricks with a density of 19.2 KN/m^3 . Peripheral walls have been considered on external face of the building.

4. MODEL GENERATION

The building is planned with the two structural configuration for optimizing the material consumption while meeting structural strength requirements. After preliminary sizing of various structural members, a 3-D CAD Model of the structural frame of the building has been generated using STAAD-Pro Connect Edition software for carrying out computer analysis for the affects of vertical and lateral loads likely to act on the structure. The permissible values of the load factors and stresses has been considered as per guidelines of Indian Standards. The computer analysis has evaluated individual internal forces, reactions at foundation level and deflection pattern of the entire structure and in the individual members. This data has been used to verify adequacy of the member sizes adopted and further iterations have been carried out as required to rationalize the system and sizes of structural members. The whole structure shall be idealized as a space frame.

5. CONTROL OF DEFLECTION

In order to control deflection of structural elements, the criteria given in IS: 800-2007 LSD has been used for all structural members. Detailed deflection calculations have revealed that the sway/deflections of main structural members are within the required limits.

6. RECOMMENDATIONS FOR MINIMIZING COST

(i) GRID SPACING, MEMBER TYPE AND DIMENSIONS

Grid spacing of 6.5m X 7.5m has been selected with box section columns and flat I section beams based on detailed study of the architectural requirements and time and cost optimization.

(ii) MATERIAL GRADES

For Tubular sections STAAD Model:

Conforming to IS:2062 for rolled steel tube and pipe sections (Fe 355)

For Built-up I sections STAAD Model:

Conforming to IS:2062 for HR plates (Fe 345) and for rolled steel pipe sections (Fe 310)

7. LOADS & LOAD COMBINATIONS

(i) DEAD LOAD

The dead load on structure includes all the permanent loads attached with structure i.e. self-weight of structure, metal deck sheet and solar panels.

Following are the permanent loads which have been considered in design & analysis.

- Self Weight of structural members have been considered on the basis of the following criteria.
- Density of Steel - 78.5 KN/cum
- Weight of connections - 15 % of self-weight
- Steel rolled sections - As per the section tables
- Metal Deck Flooring load - 2.5 KN/sq.m.

T is Time period as per clause 7.6.2 b) of IS:1893

R is Response reduction factor = 4 for Ordinary Moment Resisting Frames

(S_a/g) is average response acceleration coefficient. This is the function of the fundamental time period of vibration of the structure and the type of the founding soil, the value shall be considered for Soil Type III, as per Geotechnical report and 7.6.2 (b) of IS:1893, 2016.

(v) LOAD COMBINATIONS:

D – Dead Load

L - Live Load

W - Wind Load

E - Combined effect of Seismic induced forces

IS-800-2007 – ULS:

Basic Load Combinations

1) $1.5 D + 1.5 L$

2) $1.2 D + 1.2 L + 1.2 W$

3) $0.9 D + 1.5 W$

4) $1.5 D + 1.5 W$

Seismic Load Combinations

5) $1.2 D + 1.2 L + 1.2 E$

6) $0.9 D + 1.5 E$

7) $1.5 D + 1.5 E$

Note:-

1) ULS - Denotes Ultimate Limit State (For Strength Design)

2) Live roof and floor is treated as one class of imposed loads

3) Collateral Load is considered in Dead Load

IS-800-2007 – SLS:

Basic Load Combinations

1) $D + L$

2) $D + 0.8 L + 0.8 W$

3) $D + W$

Seismic Load Combinations

4) $D + 0.8 L + 0.8 E$

5) $D + E$

Note:-

1) SLS - Denotes Serviceability Limit State (For Deflection)

2) Live roof and floor is treated as one class of imposed loads

3) Collateral Load is considered in Dead Load

DESIGN STANDARDS

The important codes which are being followed are.

- a) IS:800 - 2007 , General Construction in Steel, Code of Practice
- b) IS: 875 (Part-I, II), Code of practice for Design loads (other than earthquake)
- c) IS: 875 (Part-III) – 2015, Code of practice for Design Loads (Wind Load)
- d) IS: 1893 part 1-2016 (Criteria for E/Q Resistant Design for Structure)