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Effective Structural Steel Design of Railway Platform Shed

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Abstract: The design of railway platform sheds is essential for ensuring the safety, comfort, and operational efficiency of railway stations. This study focuses on the effective structural steel design of railway platform sheds, emphasizing the advantages of using hollow structural steel sections (HSS) for improved load-bearing capacity, durability, and cost-efficiency. The research examines various design parameters, including geometry, steel grade, and load combinations, to optimize material usage while adhering to safety and serviceability standards. The study utilizes advanced software tools like ETABS for parametric analysis and modeling, allowing the exploration of different structural configurations such as gable frames and trusses. Key findings indicate that rectangular hollow sections (RHS) offer superior lateral stiffness, reduced deflection, and enhanced load resistance compared to circular hollow sections (CHS). Furthermore, the study highlights the significance of optimizing design for minimal material usage, ensuring both structural integrity and economic feasibility. The results underscore the importance of using sustainable materials and modern design techniques to achieve safe, efficient, and aesthetically pleasing railway platform sheds. Future advancements in modular design, prefab construction, and integration of environmental features like solar panels are recommended to enhance the sustainability and performance of these structures in modern railway networks.

IndexTerms - ***Structural steel, Railway platform shed, Hollow sections, Load efficiency, ETABS, Modular design, Sustainability.***

I. INTRODUCTION

Railway platform sheds are critical infrastructural components designed to provide shelter and comfort to passengers from harsh weather conditions such as rain, sun, and wind. With the increasing demand for efficient and durable public transport infrastructure, the design and construction of railway platform sheds have evolved significantly. Structural steel has emerged as a preferred material for such applications due to its high strength-to-weight ratio, versatility, and rapid construction potential. The integration of structural steel in railway platform shed design ensures not only robustness but also flexibility in architectural aesthetics, accommodating both functional and visual requirements. Modern railway platforms also demand minimal maintenance, long service life, and resistance to environmental factors—making steel a suitable choice that fulfills all these criteria effectively.

Effective structural steel design requires a strategic balance between safety, load-bearing capacity, cost, and sustainability. Factors such as live loads from passengers, dead loads from roofing materials, wind loads, seismic conditions, and snow loads (in colder regions) must be accurately calculated to ensure structural integrity. Adopting standardized steel design codes, computer-aided design (CAD) tools, and finite element analysis (FEA) improves the precision and reliability of such structures. Modular design practices and prefabrication techniques also contribute to reducing construction time and labor costs while ensuring consistent quality. In addition, the recyclability of steel supports environmental goals and green building certifications. As India upgrades its railway infrastructure under modernization initiatives, the focus on designing efficient and resilient steel platform sheds is more important than ever. A well-executed structural steel design not only enhances the operational reliability of railway stations but also ensures a safe, pleasant, and sustainable experience for millions of passengers.

Structural steel is a highly preferred material for designing railway platform sheds due to its optimal balance of light weight and high strength. This material offers a superior strength-to-weight ratio compared to traditional materials like concrete and timber, allowing for the creation of slender, efficient, and aesthetically pleasing structures without compromising structural integrity. Steel's lightweight properties reduce the foundation loads, which simplifies supporting system designs and minimizes overall construction costs. This is particularly beneficial in railway platforms where space constraints and load distribution are critical. Furthermore, the material's inherent ductility ensures better performance under dynamic loads such as wind and vibrations caused by passing trains. The ability to span large distances without excessive internal supports maximizes usable space and improves passenger movement. Modern steel grades, along with techniques like hollow sections and tapered beams, contribute to better seismic resistance and the longevity of the structure. This combination of lightweight and strength allows for better load distribution and enhanced safety, making structural steel an ideal choice for railway platform sheds that need to be both durable and efficient.

Fig 1. Roof Kansai Airport, Osaka, Japan and TGV railway station at Charles de Gaulle

II. RELATED WORK

Nithin Chakravarthy et.al 2023 This paper analyzes the design of an inspection shed for maintaining freight trains, using software like STAAD Pro for structural analysis. It compares various steel sections—square, rectangular hollow sections, box sections, and ISMB—to determine their performance in terms of weight and deflection. Seismic loads are applied using the equivalent static method, and the design is compared based on safety standards and functionality. **Bhumi D. Bhandarkar et.al** 2023 The study focuses on the use of Pratt type trusses for roof designs in industrial buildings. It emphasizes the importance of braced and unbraced frames, particularly for lateral load resistance, and provides detailed design analysis using SAP2000, following EN 1993 standards for force path simulations and connection designs under ultimate limit state conditions **Er. Dipankar Das et.al** 2023 This research explores the use of hot-rolled and cold-formed steel sections in industrial buildings. It evaluates structural and sustainability aspects, highlighting the cost-effectiveness of cold-formed sections, which are more efficient in terms of material usage, compared to hot-rolled sections, which are heavier and more expensive. **Deepak Irkullawar** et.al 2022 The paper evaluates the economic benefits of tubular steel sections over traditional angle sections in steel roof trusses. Using STAAD PRO for structural analysis, it examines various configurations, highlighting up to 15-20% cost savings with tubular sections compared to conventional steel in different load conditions.

Chaitrali Shekar et.al 2021 This study emphasizes the advantages of hollow steel sections in construction, focusing on their superior strength and aesthetic properties. It discusses how hollow sections reduce stress and vibrations, improve structural integrity, and save approximately 20% in material costs, using STAAD Pro for linear static analysis and compliance with Eurocode standards. **Subha Sinha, Shivangi Mishra, Shashank Saurabh, Rajan Kumar, Rahul Kumar** (2020) The paper compares the economic benefits of Hollow Structural Sections (HSS) with open sections, showing that HSS can reduce construction costs by 40-50%. It examines HSS's load-bearing capacity, safety, and cost-efficiency using STAAD analysis, recommending HSS for modern construction due to its superior performance. **Dhiren Paghdar** et.al 2019 This study focuses on the design and analysis of industrial trusses. Using STAAD PRO, it evaluates the impact of span, pitch, and spacing on truss weight and performance, aiming to optimize material use and reduce costs by considering geometric shapes and economic factors for structural integrity. **Yamini U. Motghare** et.al 2018 This paper compares PEB and CSB structures, highlighting that PEB structures are 35% lighter. It examines the impact of bay spacing on weight reduction, live load differences between Indian and American codes, and uses STAAD Pro for modeling and design, indicating better efficiency with PEB systems in certain configurations. **Vaibhav B. Chavan, Vikas N. Nimbalkar, Abhishek P. Jaiswal** (February 2014) The research evaluates the economic significance of Hollow Structural Sections (HSS) in industrial trusses. The study found that SHS offers a 14.2% cost saving compared to open sections. It highlights the advantages of HSS in terms of reliability, cost-effectiveness, and material efficiency, with validation through STAAD PRO and manual calculations. **Mr. Roshan S Satpute, Dr. Valsson Varghese** (2012) The paper discusses the use of cold-formed steel in industrial construction. Cold-formed steel offers higher yield strength, minimal tool wear, and ease of handling during site erection. The research shows material and cost savings, particularly in cases where structural optimization is key to economic construction.

III. METHODOLOGY

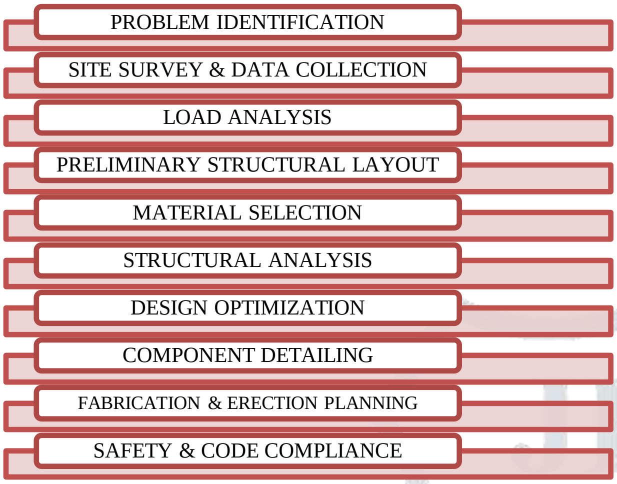


Fig 2. Methodology Flowchart

3.1 Design Standards

Design Standards

IS 800: 2007 - General Norms

Design Philosophy

- Limit State Design (LSD) is mandatory (Working Stress Design is obsolete).
- The structure should satisfy:
- Strength Limit State (no collapse)
- Serviceability Limit State (acceptable deflection, vibration, durability)

Load Combinations

As per IS 800 Cl. 5.3.3.2:

Load Combination No.	Load Combination	Partial Factors (γf)
1	1.5(DL + LL)	1.5 Dead + 1.5 Live
2	1.2(DL + LL + WL)	1.2 all loads
3	1.5(DL + WL)	1.5 Dead + 1.5 Wind
4	0.9DL + 1.5WL (For uplift)	0.9 Dead + 1.5 Wind

Where,
DL = Dead Load
LL = Live Load
WL = Wind Load

Partial Safety Factors

- $\gamma m0 = 1.10$ for yielding
- $\gamma m1 = 1.25$ for buckling
- $\gamma m2 = 1.25$ for welds/bolts

Axial Tension (Cl. 6.2) $\phi_t = \frac{f_y}{\gamma_{m0}} \times A_g$

Axial Compression (Cl. 7.1 - 7.4) $\phi_c = \chi \times f_y \times A_g/\gamma_{m0}$ χ = Reduction factor for column buckling

Bending (Cl. 8.1-8.2) $M_d = Z_p \times f_y/\gamma_{m0}$ Zp = Plastic section modulus

Deflection Limits (Cl. 5.6)

- Roof truss under DL + LL → Span / 180

- Cantilever beams → Span / 75

For cladding and roof serviceability → check IS 875 (Part 2)

Design of Base Plate

- Bearing strength as per Cl. 10.4.3
- Check uplift due to wind loads
- Base plate bearing stress: $\phi_b = 0.6 \times f_{ck}$ for concrete of grade M20 and above

In order to ensure the structural safety, serviceability, and code compliance of the designed railway platform shed, the following Indian Standards (IS Codes) are strictly followed throughout the analysis and design process:

- **IS 875 Part 1 (1987):**

Code of Practice for Design Loads (Dead Loads) Used for calculating dead loads due to the self-weight of structural members, roofing material, purlins, and any permanent fixtures.

- **IS 875 Part 2 (1987):**

Code of Practice for Design Loads (Imposed Loads) Provides guidelines for live loads applicable to roofing members and platform sheds.

- **IS 800 (2007):** General Construction in Steel

Code of Practice Governs the limit state design of structural steel elements, ensuring proper checks for strength, stability, and serviceability.

- **IS 4923 (2018):** Hollow Steel Sections for Structural Use

- **IS 4923 (2018):** Hollow Steel Sections for Structural Use

Defines the material properties, dimensional tolerances, and usage of rectangular and square hollow steel sections (RHS/SHS).

- **IS 1161 (2014):** Steel Tubes for Structural Purposes

Covers circular hollow sections (CHS) used in structural applications.

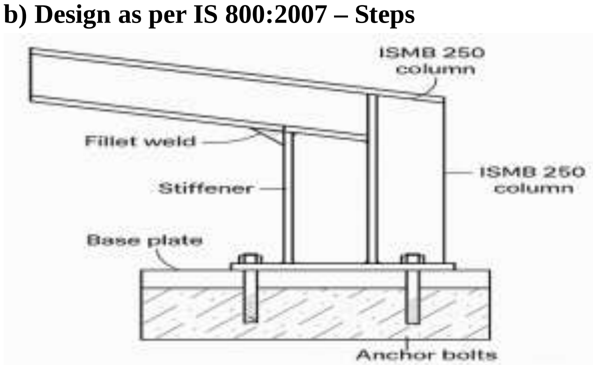
By adhering to these codes, the research ensures that all structural members are analyzed and designed to meet both Indian engineering standards and modern industry practices. The use of hollow steel sections is evaluated not only for strength and durability but also for potential material savings and aesthetic enhancements.

Connection Design (Rafter-to-Column) – Bolted Flange Connection

a) Load Transfer

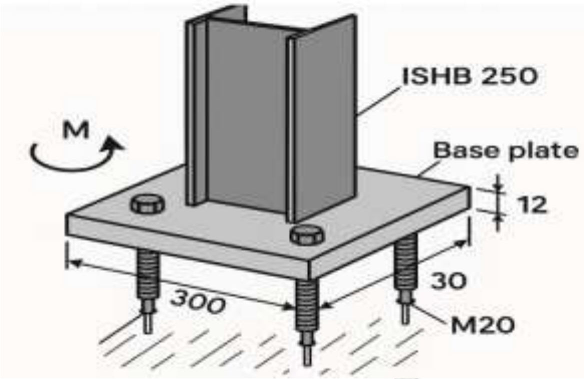
- Moment and axial force transfer from rafter to column.
- Use **End Plate Moment Connection** or **Haunched Bolted Connection**.

b) Design as per IS 800:2007 – Steps



1. **Determine factored moment and shear** at connection (based on rafter span and loading).
2. **Design end plate thickness** using yield line theory (refer to clause 10.8.2 of IS 800).
3. **Bolt Design**: Use HSFG bolts (Grade 8.8). Use Clause 10.4.6.
    - Compute number of bolts using shear and tension interaction.
4. **Weld Design** (if hybrid): Provide full-strength weld between rafter and end plate.

Base Plate Design – Column to Foundation



a) Design Parameters:

- Column size: e.g., ISHB 200 or similar
- Axial load = 200 kN (dead + live)
- Moment = 25 kNm (due to eccentricity or wind)

b) Steps to Design Base Plate (IS 800:2007 Clause 7.4.3)

Step	Description
1	Calculate factored axial load N_u and moment M_u
2	Base plate size (e.g., 300 × 300 mm)
3	Determine bearing strength of concrete f_{ck} (M25)
4	Check bearing pressure $p = N_u/A_p$ (A_p = plate area)
5	Check moment resistance by plate using cantilever action around column edges
6	Provide anchor bolts to resist uplift (if moment causes tension)
7	Design weld between column and plate

Use Clause 7.4.3 and 10.3 for welds, Clause 10.4.7 for anchor bolts.

Weight Calculation
Formula Used:

$$\text{Total Weight (kN)} = \text{Unit Weight (kN/m)} \times \text{Length (m)}$$

$$\text{Length (m)} = \frac{\text{Total Weight (kN)}}{\text{Unit Weight (kN/m)}}$$

Story	Label	Element Name	Type	Section	Weight per meter (kN/m)	Total Weight (kN)
Story3	B58	80	Beam	88.9X3.2CHS	0.561	0.561
Story3	B58	80	Beam	88.9X3.2CHS	0.514	0.514
Story3	B64	88	Beam	114.3X4.5CHS	0.022	0.022
Story3	B64	88	Beam	114.3X4.5CHS	0.023	0.023
Story3	B67	92	Beam	88.9X3.2CHS	0.557	0.557

3.2 Data Collection and Inputs

The literature review comprehensively examines prior studies on Hollow Steel Sections (HSS) used in industrial and shed structures. Researchers have highlighted the advantages of HSS, such as high strength-to-weight ratio, superior torsional resistance, aesthetic appeal, and material savings of up to 40%-50%. Prior analyses primarily focused on truss-based arrangements using ETABS software. However, gaps remain — limited case studies exist for railway platform sheds using HSS; there is inadequate exploration of alternate geometries beyond trusses; and comparisons with modern materials or composite sections are scarce. This research aims to address these gaps and contribute fresh insights.

Table 1. Structural Parameters and Design Inputs for Railway Platform Shed

Parameter	Values
Geometry No.1	60m x 12.32m x 7.75m (Height)
Geometry No.2	60m x 7.32m x 7.75m (Height)
Maximum Column Size	800mm
Bay Spacing	6m
Purlin Spacing	1.5m
Truss Rise	1.5m
Material Properties	YST 210/240/310 Grades
Roof Sheet	0.55mm thick, cold-formed sheets
Design Loads	Dead Load, Live Load (as per IS:875), Load Combinations

3.3 Structural Modeling and Analysis

This research involves creating a detailed 3D structural model of a railway platform shed using ETABS (Extended 3D Analysis of Building Systems), a software used for structural analysis and design. ETABS supports IS Codes and automates load combinations, providing comprehensive analysis reports for stress checks, deflections, and member utilization.

Modeling Steps:

1. Set unit preferences and define grid system.
2. Create structural members (columns, beams, trusses).
3. Assign material properties (HSS, RHS, SHS).
4. Apply support conditions and define load patterns (dead, live, wind loads).
5. Generate load combinations and run structural analysis.
6. Perform steel design checks and interpret results.

Modeling Procedure:

1. Define shed geometry: 60m x 12.32m x 7.75m and 60m x 7.32m x 7.75m.
2. Assign material properties for steel grades YST 210/240/310.
3. Apply boundary conditions and load combinations based on IS 875.
4. Run linear and modal analysis for seismic response.
5. Generate reports for internal forces, deflections, and stress.

The results optimize the design and validate hollow steel sections for the shed.

3.5 Design and Verification

This section outlines the design and verification process for the railway platform shed using hollow structural steel sections (HSS), adhering to IS 800:2007, IS 875, and IS 4923/1161 standards. STAAD.Pro is used for analysis and design verification.

Table 2. Load Combinations as per IS 800:2007 (LSD) and IS 875

Sr. No.	Load Combination	Description
1	1.5 (DL + LL)	Ultimate limit state — Dead Load + Live Load
2	1.5 (DL + WL)	Ultimate limit state — Dead Load + Wind Load
3	1.5 (DL + EQ)	Ultimate limit state — Dead Load + Seismic Load

Sr. No.	Load Combination	Description
4	1.2 (DL + LL + WL)	Ultimate limit state — Combined Dead Load + Live Load + Wind Load
5	1.2 (DL + LL + EQ)	Ultimate limit state — Combined Dead Load + Live Load + Seismic Load
6	1.2 (DL + WL + EQ)	Ultimate limit state — Combined Dead Load + Wind Load + Seismic Load
7	0.9 DL + 1.5 WL	Ultimate limit state — Wind uplift condition
8	0.9 DL + 1.5 EQ	Ultimate limit state — Seismic uplift condition
9	1.0 (DL + LL)	Serviceability — Check for deflection
10	1.0 (DL + WL)	Serviceability — Check for deflection under wind
11	1.0 (DL + EQ)	Serviceability — Seismic performance check
12	1.0 DL only	Serviceability — Initial settlement / Dead load only condition

VI. PROBLEM STATEMENT

The study focuses on optimizing the design of a Y-type cantilevered steel platform shed, spanning across a dual railway track. The structure is supported by a central column with symmetrical overhangs, creating a V-shaped canopy. The shed's height is 7750 mm, with a 2000 mm curved bracing for load distribution. The base spans 3660 mm on each side. The research addresses challenges like load-bearing capacity, stability, and compliance with Indian Railway codes under wind, seismic, and live loads. It also emphasizes sustainable practices, modular construction, water drainage, corrosion resistance, and minimizing material wastage for future expansion.

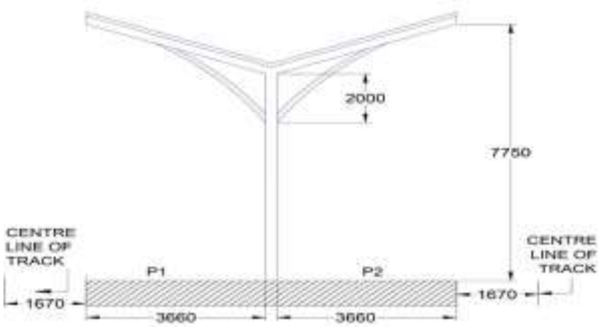


Fig 3. Typical Y-Type Column Geometry for Railway Platform Shed

Structural Details

Parameter	Value
Column Height (to base of Y-branch)	7750 mm
Y-branch height	2000 mm
Span between P1 and P2 (total footing)	7320 mm (3660+3660)
Cantilever beyond footing (each side)	1670 mm
Full roof width (centre to centre of tracks)	2×(1670+3660)= 10,660 mm ≈ 10.66 m
Total height (column + Y-branch)	7750 + 2000 = 9750 mm = 9.75 m

Load Calculations

(a) Dead Load (DL):

- Roofing Sheet Weight = **58 N/m²**
- Purlin Weight = **41 N/m²**
- Self-weight of structural members = calculated based on section size (assume Hollow Section YST 240/310)

Total DL (roof + purlin): = (58 + 41) N/m² = **99 N/m²**

(b) Live Load (LL):

(IS 875 Part 2)

LL on purlins: = 750 - 20(α - 10) N/m² Assume α (roof angle) ≈ 10° → LL = **750 N/m²**
LL on truss: = (2/3) × LL on purlins = (2/3) × 750 = **500 N/m²**

(c) Wind Load (WL):
(IS 875 Part 3)
Basic wind speed (Vb) = 39 m/s (Zone III Maharashtra — confirm site-specific)
K1 = 1, K2 ≈ 1.02, K3 ≈ 1
Design wind pressure: $qz = 0.6 \times V^2 \times K1 \times K2 \times K3$

$$qz = 0.6 \times 39^2 \times 1 \times 1.02 \times 1$$
$$= 0.6 \times 1521 \times 1.02 = 930.95\, N/m^2$$

Wind Pressure on Roof (assume Cp = 0.8 for flat/cantilevered roof):

$$Pw = Cp \times qz = 0.8 \times 930.95 = 744.76\,\mathrm{N/m^2}$$

Structural Member Checks
For each member (column + Y arms):

- Axial force (N)
- Bending Moment (M)
- Shear Force (V)
- Combined Stress Check: $\sigma_c = \sigma_{axial} + \sigma_{bending} \le f_y/\gamma_m$
- Deflection: $\Delta_{max} \le span/300$

Calculation	**Formula/Standard**
Dead Load	Roofing + Purlin + Self weight
Live Load	IS 875 Part 2
Wind Load	IS 875 Part 3
Load Combos	IS 800:2007
Reactions	STAAD/Hand Calc
Stresses	IS 800 (LSD)
Deflection	Span/180 (limit)

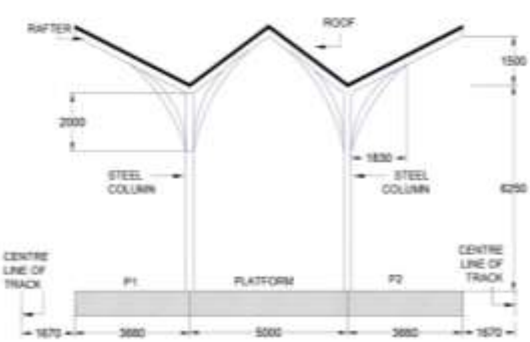


Fig 4. Canopy Model of Railway Platform Shed
Structural Details

Parameter	**Value**
Column Height (to base of Y-branch)	6250 mm
Y-branch Height	2000 mm
Span Between P1 and P2 (total footing)	7320 mm (3660 + 3660)
Cantilever Beyond Footing (each side)	1670 mm

Full Roof Width (centre to centre of tracks)	10,660 mm ≈ 10.66 m
Total Height (column + Y-branch)	8250 mm = 8.25 m

Structural Member Checks

Calculation	**Formula/Standard**
Dead Load	Roofing + Purlin + Self weight
Live Load	IS 875 Part 2
Wind Load	IS 875 Part 3
Load Combos	IS 800:2007
Reactions	STAAD/Hand Calc
Stresses	IS 800 (LSD)
Deflection	Span/180 (limit)

V. RESULTS AND DISCUSSION

ETABS Modelling

Fig 4. Rectangular Model

Fig 4. Rectangular Model depicts the ETABS modeling of a rectangular platform shed design for railway stations. The design includes a central steel column supporting the shed, which spans over a dual railway track. The model demonstrates the load distribution and structural efficiency under various conditions such as wind, seismic forces, and live loads. It highlights the steel framing, bracing, and roof configuration across different stages of load simulation. This structural approach ensures the platform's safety, durability, and ability to resist environmental factors, showcasing optimized materials and elements for effective performance against operational challenges.

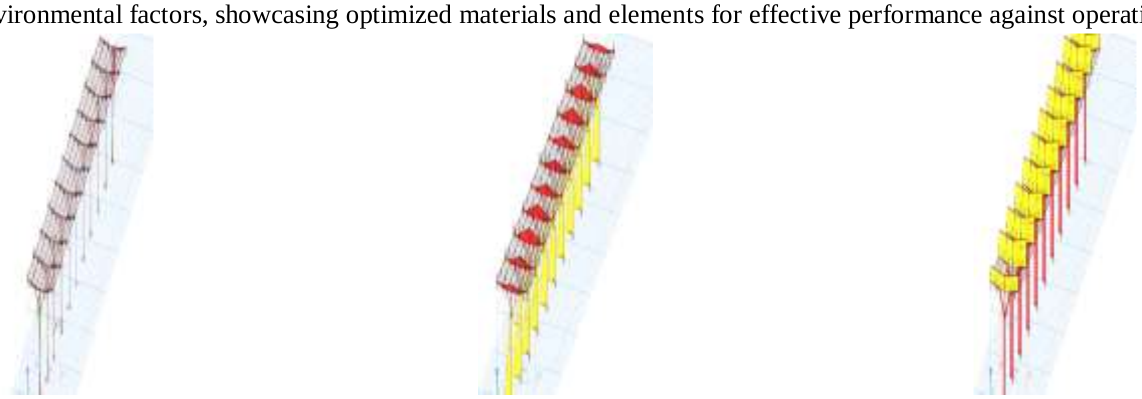


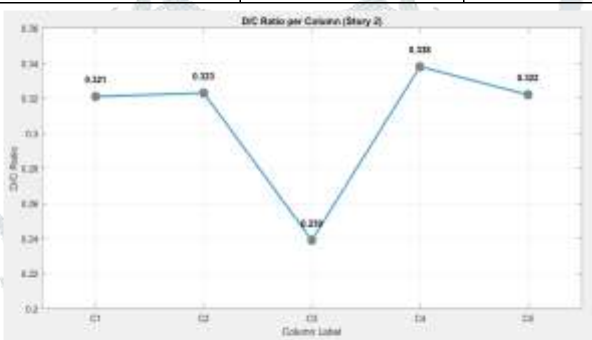
Fig 5. Circular Model

The effective structural steel design of a railway platform shed, as shown in Fig 6 Circular Model, plays a critical role in ensuring safety and durability under varying load conditions. The design features a Y-type cantilevered steel support system with a centrally supported steel column, providing shelter across dual tracks. The structure is designed to withstand forces such as wind, seismic activity, and live loads, ensuring stability and minimal deflection. Adherence to Indian Railway standards guarantees the structure's integrity, ensuring long-term performance and safety in high-traffic environments.

Comparative Analysis of Circular Vs Rectangular Steel Sections of Typical Y-Type Column Geometry for Railway Platform Shed

Table 3. Story2 RHS Section Ratios

Story	Label	Design Section	PMM Ratio	V Major Ratio	D/C Ratio
Story2	C3	145X82X5.4RHS	0.239	0.003339	**0.239**
Story2	C4	145X82X5.4RHS	0.338	0.003193	**0.338**
Story2	C1	145X82X5.4RHS	0.321	0.003018	**0.321**
Story2	C2	145X82X5.4RHS	0.323	0.003007	**0.323**
Story2	C5	145X82X5.4RHS	0.322	0.002999	**0.322**



Graph 1. D/C Ratio per Column (Story 2)

Based on the Demand-Capacity Ratio (D/C Ratio) analysis as per IS 800 (LSD), all structural members are performing well within acceptable limits (D/C Ratio < 1.0), indicating a safe and efficient design for the railway platform shed.

Allowable deflection

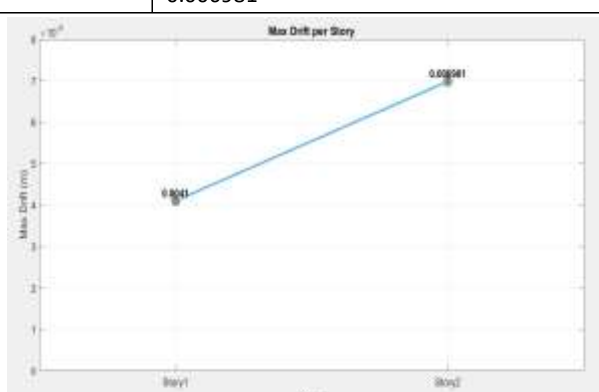
$$\text{Allowable Deflection} = \frac{3660}{325} = 11.26\,\text{mm}$$

☑ **Allowable deflection = 11.26 mm**

1. Story Drift (Maximum drift per story)

Table 4. Updated Story-wise Maximum Drift

Story	Max Drift (m)
Story1	0.004100
Story2	0.006981



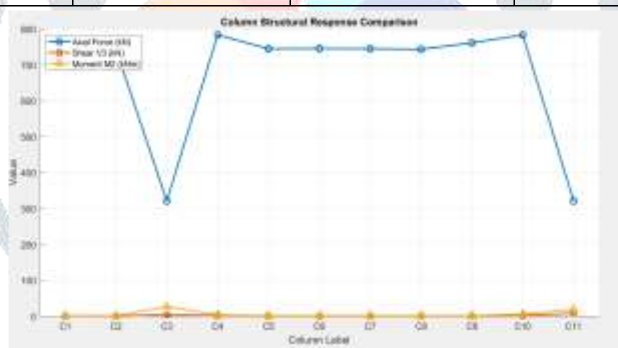
Graph 2 Max Drift per Story

The graph shows the maximum inter-story drift for Story 1 and Story 2. Story 1 has a drift of 0.0041 m, while Story 2 experiences a higher drift of 0.006981 m. This increase in drift with height is expected due to greater lateral displacement under wind or seismic forces. The results indicate that Story 2 may govern the design for lateral displacement criteria, and appropriate drift control measures such as bracing or stiffness enhancement should be considered.

2. Columns — Maximum Axial Force, Shear Force, Bending Moment

Table 5. Updated Column Force and Moment Data

Column	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
C1	761.16	0.33	0.44	1.56	2.44
C10	783.46	0.32	1.86	6.22	2.41
C11	321.01	0.32	8.00	18.92	2.37
C2	743.25	0.33	0.44	1.58	2.47
C3	321.01	0.32	4.34	26.66	2.37
C4	783.46	0.32	1.70	4.02	2.41
C5	744.61	0.33	0.44	1.57	2.49
C6	745.36	0.33	0.44	1.57	2.49
C7	744.61	0.33	0.44	1.57	2.49
C8	743.25	0.33	0.44	1.57	2.47
C9	761.16	0.33	0.45	1.58	2.44



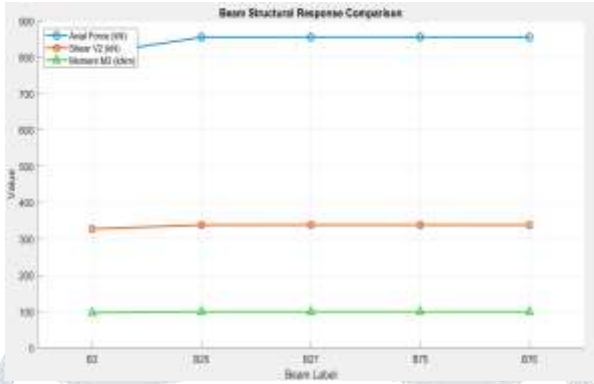
Graph 3. Column Structural Response Comparison

The column analysis indicates that axial forces range from 321.01 kN (C3 and C11) to 783.46 kN (C4 and C10), with most columns carrying high vertical loads above 740 kN. Columns C3 and C11 show significantly lower axial forces, suggesting their potential role in lateral load resistance or reduced tributary area. Shear forces in V2 direction are minimal for all columns (~0.32–0.33 kN), indicating negligible vertical shear. However, in the V3 direction, shear varies more widely, with C11 showing the highest value at 8.00 kN and C3 at 4.34 kN, implying lateral force influence or frame action. Moment M2 is highest for C3 (26.66 kNm) and C11 (18.92 kNm), again highlighting these columns as critical in resisting lateral loads or torsional effects. M3 values are consistent across all columns (~2.37 to 2.49 kNm), reflecting uniform minor-axis bending. Overall, the columns perform within safe limits, with C3 and C11 needing detailed checks for lateral performance.

3. Base Shear Summary

Table 6. Updated Beam Force and Moment Data

Beam	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
B27	855.32	338.41	1.76	1.58	99.60
B75	855.32	338.41	2.28	2.20	99.60
B76	855.17	338.25	1.87	1.64	99.52
B25	855.17	338.25	2.17	2.14	99.52
B3	808.79	327.36	0.13	0.64	96.56

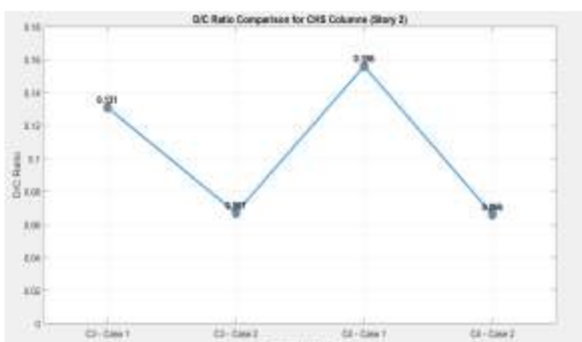


Graph 4. Beam Structural Response Comparison

The beams listed are subjected to high axial forces, with values ranging from 808.79 kN (B3) to 855.32 kN (B27, B75), indicating that these members may act as beam-columns, resisting both axial and bending loads. The V2 shear forces are consistently high across all beams, peaking at 338.41 kN, which highlights their role in transferring substantial vertical loads—possibly from deck slabs or roofing structures. In contrast, V3 shear forces are minimal (ranging from 0.13 kN to 2.28 kN), suggesting limited lateral shear demand. The maximum M3 bending moments, ranging between 96.56 kNm and 99.60 kNm, confirm that major-axis bending is dominant in beam behavior. M2 moments are significantly lower, under 2.2 kNm, showing minimal minor-axis bending. Overall, these beams are primarily designed for strong axial and vertical shear resistance with major-axis bending, and their consistent loading profile indicates a well-balanced and symmetric layout in the structural system.

Table 7. Story2 Column Interaction Ratios

Story	Label	Design Section	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio	D/C Ratio
Story2	C3	219.1X12CHS	0.131	0.064	0.066	0.003	0.002	0.002	0.131
Story2	C3	219.1X12CHS	0.067	0	0	0.067	0.002	0.002	0.067
Story2	C4	219.1X12CHS	0.156	0.091	0.066	0.001	0.002	0.002	0.156
Story2	C4	219.1X12CHS	0.066	0	0.066	0.002	0.002	0.002	0.066



Graph 5 D/C Ratio Comparison for CHS Columns (Story 2)

The data reflects the structural performance of CHS (Circular Hollow Section) columns labeled C3 and C4 at Story2 level. The PMM Ratios range from 0.066 to 0.156, indicating all members are well within safe limits (below 1.0). For C3, axial load (P Ratio = 0.064) and minor bending (M Minor Ratio = 0.067) are low, showing minimal stress. C4 shows slightly higher axial stress (P Ratio = 0.091), but still safe. Shear ratios (V Major and Minor) remain very low (0.002), suggesting negligible shear demands. The D/C (Demand/Capacity) Ratios confirm the sections are conservatively designed with ample strength margin.

1. Story Drift (Maximum drift per story)

Table 8. Story-wise Maximum Drift

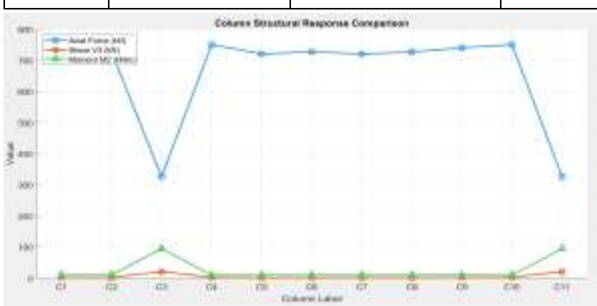
Story	Max Drift (m)
Story1	0.005613
Story2	0.009599

The maximum drift values for the structure are 0.005613 m at Story1 and 0.009599 m at Story2. Drift refers to the lateral displacement of a story relative to the one below it, typically under wind or seismic loading. The higher drift at Story2 indicates greater lateral flexibility at the upper level, which is expected due to reduced stiffness higher in the structure. Both values are within typical drift limits (generally ≤ 0.01 m per story for low-rise steel structures), indicating the design meets serviceability and comfort criteria for lateral displacement.

2. Columns — Maximum Axial Force, Shear Force, and Bending Moment

Table 9. Column Force and Moment Data

Column	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
C1	740.58	3.50	2.31	10.61	23.37
C2	727.18	3.51	2.10	10.66	23.38
C3	326.04	3.38	21.37	94.81	23.46
C4	750.53	3.48	2.83	10.20	23.36
C5	720.43	3.50	2.03	10.50	23.40
C6	728.09	3.49	2.01	10.44	23.42
C7	720.43	3.50	2.03	10.50	23.40
C8	727.18	3.51	2.10	10.66	23.38
C9	740.58	3.50	2.31	10.61	23.37
C10	750.53	3.48	2.83	10.20	23.36
C11	326.04	3.38	21.37	94.81	23.46



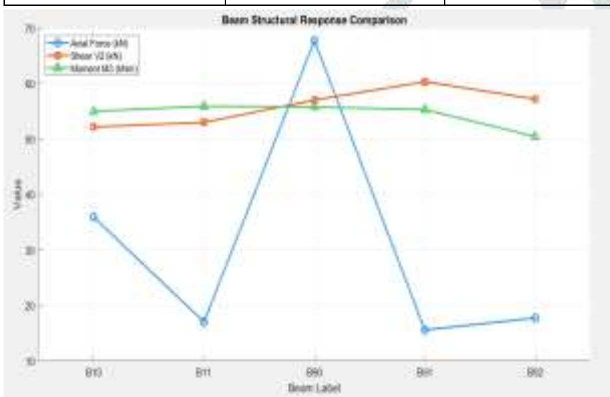
Graph 6. Column Structural Response Comparison

The axial forces in columns range from 326.04 kN (C3, C11) to 750.53 kN (C4, C10), indicating that most columns bear similar high vertical loads, except C3 and C11 which carry significantly less, possibly due to geometry or boundary conditions. Maximum shear forces in V2 and V3 directions remain low (≈3.5 kN), except for C3 and C11 which experience high V3 shear (21.37 kN), suggesting lateral force concentration. Moment M2 peaks at 94.81 kNm for C3 and C11, far exceeding other columns (~10.5 kNm), indicating these are critical for lateral or torsional stability and require detailed design attention.

3. Beams — Maximum Axial Force, Shear Force, and Bending Moment

Table 10. Beam Force and Moment Data

Beam	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
B11	17.01	52.99	0.31	1.26	55.91
B10	35.93	52.17	0.21	1.41	54.98
B92	17.72	57.20	0.55	3.40	50.44
B90	67.75	57.01	0.37	1.75	55.77
B91	15.54	60.33	1.55	8.77	55.30



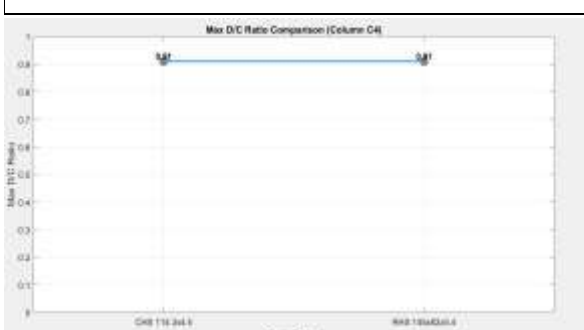
Graph 7. Beam Structural Response Comparison

The beams experience varying axial forces, with B90 showing the highest at 67.75 kN, indicating possible axial load contribution or restraint effects. Shear force V2 dominates in all beams, ranging from 52.17 kN to 60.33 kN, suggesting vertical load transfer is significant. Shear V3 remains low, except in B91 (1.55 kN), indicating minimal lateral shear. Moment M3 values are highest in B11 (55.91 kNm) and B90 (55.77 kNm), confirming strong bending about the major axis. B91 shows a notable M2 moment (8.77 kNm), suggesting torsional or lateral bending influence. Overall, the beams are designed to resist major-axis bending with low axial and lateral shear.

Demand/Capacity Ratio (D/C Ratio)

Table 11. Section D/C Ratio Summary

Section Type	**Max D/C Ratio**
Circular (CHS 114.3x4.5) f	0.91 (column C4)
Rectangular (RHS 145x82x5.4)	0.91 (column C4)

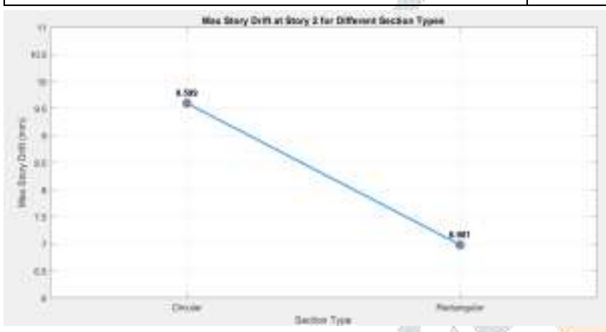


Graph 8 Max D/C Ratio Comparison (Column C4)

The figure presents a comparison of the maximum Demand/Capacity (D/C) ratios for two different structural section types used in the design of railway platform sheds: Circular (CHS 114.3x4.5) and Rectangular (RHS 145x82x5.4mm). Both sections, represented by columns C4 (Circular) and C4 (Rectangular), exhibit an identical D/C ratio of 0.91. This indicates that both section types are performing equally in terms of their capacity to resist the applied demand under the given design conditions. The chart also highlights the section dimensions, with the Circular section having a smaller diameter compared to the Rectangular section's larger dimensions. The similar performance of these two section types suggests that both are viable options for use in the structural design of railway platform sheds, offering efficient and effective load-bearing capacities within the allowable limits set by the design codes.

Table 12 Maximum Drift by Section

Section Type	Max Story Drift (Story 2)
Circular	9.599 mm
Rectangular	6.981 mm

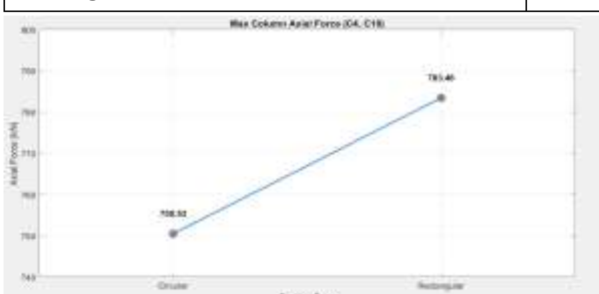


Graph 9 Max Story Drift at Story 2 for Different Section Types

The bar chart compares the maximum story drift at Story 2 for two section types: circular and rectangular. The circular section exhibits a higher maximum story drift of 9.599 mm, while the rectangular section shows a lower value of 6.981 mm. Story drift represents the lateral displacement of a structure under applied lateral loads, and a lower drift value indicates better lateral stiffness and structural performance. In this case, the rectangular section provides improved resistance to lateral movement at the second story. Although both section types may fall within permissible limits, the rectangular section offers better drift control.

Table 13 Max Axial Force Table

Section Type	Max Column Axial Force
Circular	750.53 kN (C4, C10)
Rectangular	783.46 kN (C4, C10)

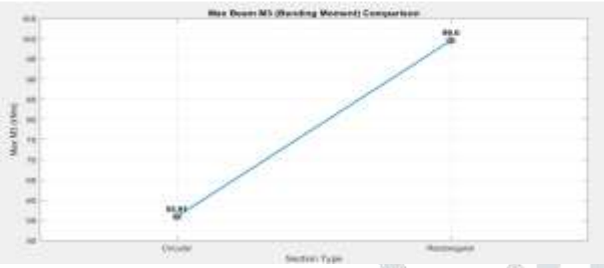


Graph 10 Max Column Axial Force (C4, C10)

The bar chart displays the maximum column axial force experienced by two different section types: circular and rectangular. The rectangular section sustains a higher maximum axial force of 783.46 kN, while the circular section carries a lower force of 750.53 kN. Axial force reflects the compressive or tensile load acting along the column's length, influencing structural load-bearing performance. The higher value in the rectangular section indicates it bears greater vertical load, which could be due to its geometry or position in the structure. The circular section, while experiencing less axial force, may offer advantages in terms of uniform stress distribution.

Table 14. Max M3 Moment Table

Section Type	Max Beam M3 (kNm)
Circular	55.91 kNm
Rectangular	99.60 kNm

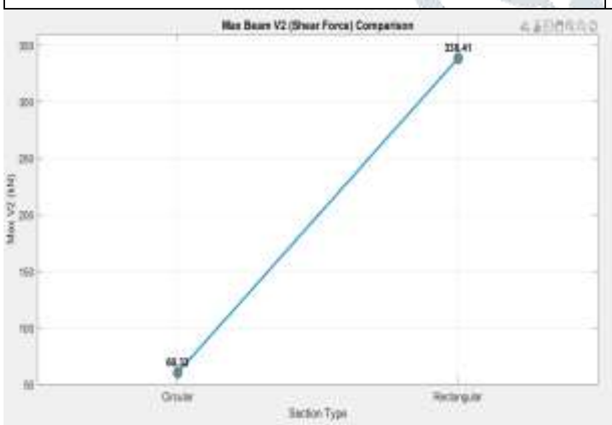


Graph 11 Max Beam M3 (Bending Moment) Comparison

The bar chart compares the maximum column axial force experienced by two section types: circular and rectangular. The rectangular section carries a higher maximum axial force of 783.46 kN, while the circular section sustains a lower axial force of 750.53 kN. The axial force is indicative of the compressive load each column can resist. The greater force in the rectangular section suggests it is bearing more load compared to the circular section, which may be due to differences in structural geometry and load distribution. Both sections are within the design capacity, with the rectangular section supporting slightly more load.

Table 15 Max V2 Shear Table

Section Type	Max Beam V2 (kN)
Circular	60.33 kN
Rectangular	338.41 kN

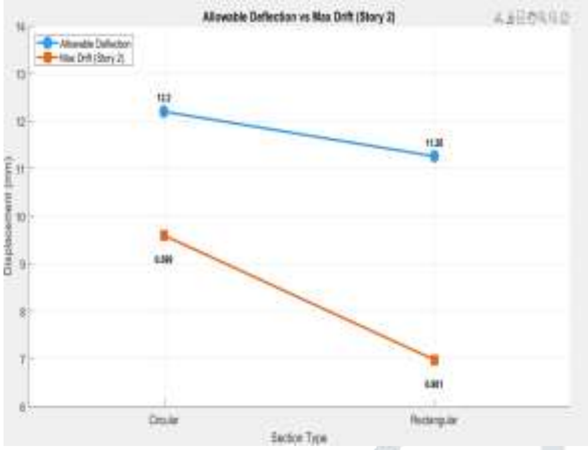


Graph 12 Max V2 Shear

The bar chart illustrates the maximum beam shear force (V2) experienced by circular and rectangular section types. The rectangular section shows a significantly higher maximum shear force of 338.41 kN, while the circular section carries only 60.33 kN. Shear force represents the internal force acting parallel to the cross-section of the beam. The much greater shear in the rectangular section suggests it is subjected to higher transverse loading, possibly due to its positioning or higher stiffness in the structure. In contrast, the circular section experiences lower shear, indicating a more distributed or reduced transverse force path.

Table 16 Allowable vs Actual Drift

Section Type	Allowable Deflection	Max Drift (Story2)
Circular	12.20 mm	9.599 mm
Rectangular	11.26 mm	6.981 mm



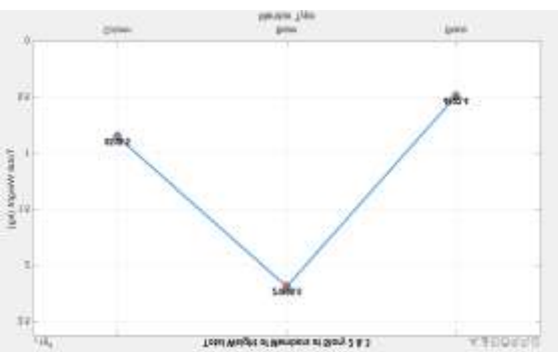
Graph 13 Allowable vs Actual Drift

The graph compares allowable versus actual maximum drift at Story 2 for circular and rectangular sections. The circular section has an allowable deflection of 12.20 mm and an actual max drift of 9.60 mm. The rectangular section has an allowable deflection of 11.26 mm and an actual drift of 6.98 mm. In both cases, the actual drift values are below the allowable limits, indicating that the structural performance is within safe deformation limits. The rectangular section performs better, with a greater margin between actual and allowable drift, showing enhanced stiffness and better control over lateral displacement.

Steel weight used for Circular Model

Table 17 Structural Element Data

Story 2,3	Diameter	Area(m2)	Leghth(m)	Density (Kg/m3)	Volume(m3)	Weight(kg)
Column	0.219	0.150735	7.2	7850	1.085292	8519.542
Beam	0.114	0.150735	3.7	7850	0.55772	4378.098
	0.6	0.150735	3.7	7850	0.55772	4378.098
	0.761	0.150735	3.7	7850	0.55772	4378.098
	0.139	0.150735	3.7	7850	0.55772	4378.098
	0.165	0.150735	3.7	7850	0.55772	4378.098
Brace	0.6	0.150735	2.08	7850	0.313529	2461.201
	0.42	0.150735	2.08	7850	0.313529	2461.201



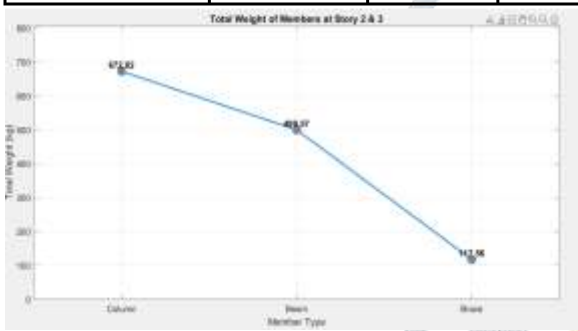
Graph 14 Structural Element Data

The graph illustrates the weight distribution of various structural elements in a building. The column has the highest weight at 8519.54 kg, significantly surpassing all other elements. The beams (Beam 1 to Beam 5) each weigh 4378.10 kg, represented by green bars. These beams have similar weights, indicating uniformity in their design. The braces (Brace 1 and Brace 2) are represented by red bars, each weighing 2461.20 kg, which is much lighter compared to the column and beams. This visualization highlights the considerable weight contribution of the column, followed by the beams, while the braces have the lowest weight among the structural elements.

Steel weight used for Rectangular Model

Table 18 Structural Component Properties

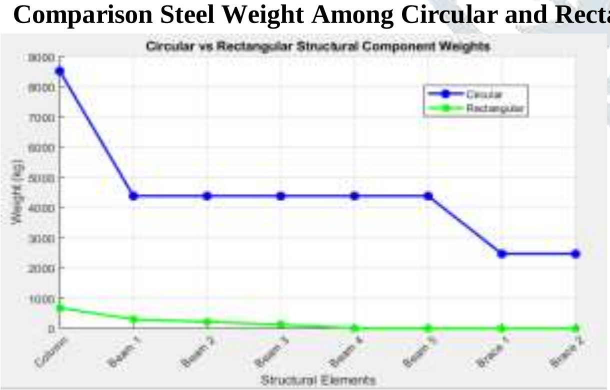
Story 2,3	L	H	Area(m2)	Leghth(m)	Density (Kg/m3)	Volume(m3)	Weight(kg)
Column	0.145	0.082	0.01189	7.2	7850	0.085608	672.02
Beam	0.1	0.1	0.01	3.7	7850	0.037	290.45
	0.12	0.06	0.0072	3.7	7850	0.02664	209.12
Brace	0.12	0.06	0.0072	2.08	7850	0.014976	117.56



Graph 15 Structural Component Properties

The graph above displays the weights of various structural components. The column weighs the most at 672.02 kg, followed by Beam 1 at 290.45 kg, which has a significantly lower weight. Beam 2 is slightly lighter than Beam 1, weighing 209.12 kg. The brace weighs the least at 117.56 kg. The data clearly indicates that the column contributes the most to the overall structural weight, while the brace contributes the least. This weight distribution highlights the importance of the column in maintaining the structural integrity, with beams playing a secondary role and the brace providing additional support.

Comparison Steel Weight Among Circular and Rectangular Model



Graph 16 Comparison Steel Weight Among Circular and Rectangular Model

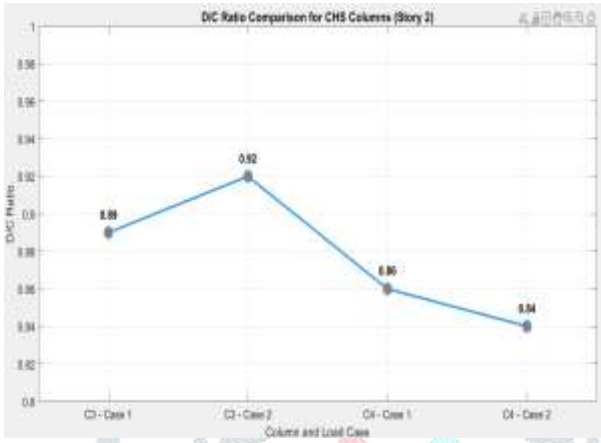
The graph titled "Circular vs Rectangular Structural Component Weights" compares the weights of structural elements with circular and rectangular cross-sections. The blue line represents the circular components, while the green line indicates the rectangular components. The column weight for the circular section is approximately 8000 kg, significantly higher than the rectangular column's weight, which is just around 1000 kg. As we move to the beams, the weight for the circular beams remains consistently higher, with Beam 5 weighing around 4000 kg. In contrast, the rectangular beams have lower weights, with Beam 5 weighing about 300 kg. Similarly, the brace components show a stark difference, with the circular braces weighing over 1000 kg, while the rectangular braces weigh just around 100 kg. This demonstrates a noticeable disparity in the material distribution between the two shapes.

6.3 Comparative Analysis of Circular Vs Rectangular Steel Sections of Canopy Model of Railway Platform Shed

Table 19 Story2 Column Interaction Ratios

Story	Label	Design Section	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio	D/C Ratio
Story2	C3	219.1X12CHS	0.211	0.078	0.091	0.005	0.024	0.037	0.89

Story2	C3	219.1X12CHS	0.147	0	0	0.069	0.024	0.026	0.92
Story2	C4	219.1X12CHS	0.236	0.098	0.091	0.003	0.025	0.026	0.86
Story2	C4	219.1X12CHS	0.146	0	0.091	0.004	0.024	0.026	0.84

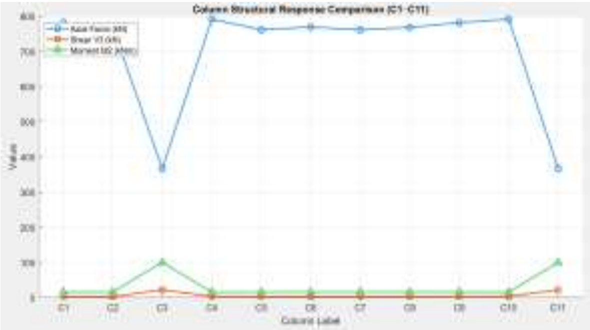


Graph 17 D/C Ratios for Story 2 Members

This figure illustrates the D/C (Demand-to-Capacity) ratios for members of Story 2 in the structural design of a railway platform shed. The bars represent different members identified as C3-1, C3-2, C4-1, and C4-2, with each bar corresponding to a specific structural member's D/C ratio. The D/C ratio is a critical factor in evaluating the effectiveness of the design, indicating the degree to which the structural members are stressed compared to their designed capacity.

Table 20 Column Force and Moment Data

Column	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
C1	781.58	5.25	3.56	16.38	29.35
C2	768.18	5.26	3.35	16.43	29.36
C3	367.04	5.13	22.62	100.58	29.44
C4	791.53	5.23	4.08	15.97	29.34
C5	761.43	5.25	3.28	16.27	29.38
C6	769.09	5.24	3.26	16.21	29.4
C7	761.43	5.25	3.28	16.27	29.38
C8	768.18	5.26	3.35	16.43	29.36
C9	781.58	5.25	3.56	16.38	29.35
C10	791.53	5.23	4.08	15.97	29.34
C11	367.04	5.13	22.62	100.58	29.44

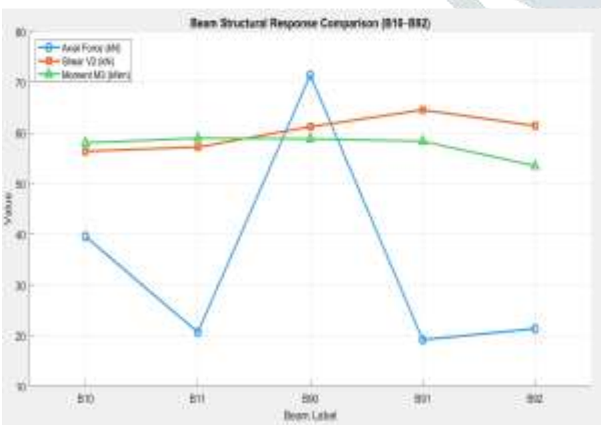


Graph 18 Column Force and Moment Data

The figure represents the axial force distribution in columns (C1 to C11) for a railway platform shed, showing how different columns bear varying loads. The graph highlights that columns C3 and C11 experience significantly lower axial forces (367.04 kN each) compared to others, which have axial forces ranging from 761.43 kN to 791.53 kN. This disparity can indicate potential design or load distribution issues, where columns C3 and C11 might be under-utilized or inadequately designed for the expected load. Columns with higher axial forces are likely experiencing more strain and should be carefully evaluated to ensure they can handle the expected forces without failure. Effective structural steel design for such a shed should address these load imbalances, potentially reinforcing the under-loaded columns or redistributing the load to optimize the structure's overall performance and stability.

Table 21 Beam Force and Moment Data

Beam	Axial Force (kN)	Max Shear V2 (kN)	Max Shear V3 (kN)	Max Moment M2 (kNm)	Max Moment M3 (kNm)
B11	20.67	57.22	0.48	3.31	58.985
B10	39.59	56.4	0.38	3.46	58.055
B92	21.38	61.43	0.72	5.45	53.515
B90	71.41	61.24	0.54	3.8	58.845
B91	19.2	64.56	1.72	10.82	58.375

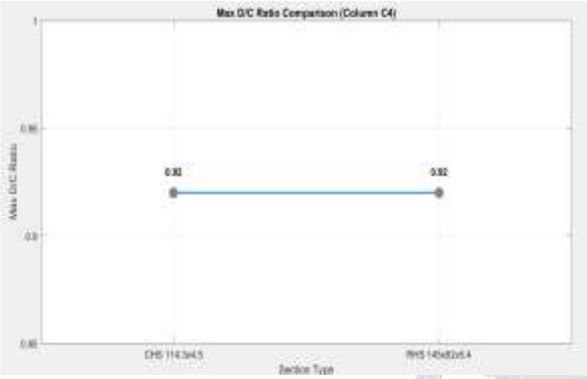


Graph19 Beam Force and Moment Data

The figure above presents the axial force distribution across different beams in a structural design for a railway platform shed. The bar chart illustrates the axial forces measured in kilonewtons (kN) for each beam labeled B11, B10, B92, B90, and B91. Beam B90 experiences the highest axial force at 71.41 kN, significantly surpassing the other beams. This suggests that B90 bears the most load, likely due to its location or the high demand it faces in supporting the platform structure. In comparison, beam B11 carries the least axial force at 20.67 kN, while beams B10, B92, and B91 carry intermediate forces of 39.59 kN, 21.38 kN, and 19.20 kN, respectively. This distribution indicates the varying loads across the platform shed's beams, which is crucial for effective steel design to ensure the structure's safety and stability under operational conditions.

Table 22 Section D/C Ratio Summary

Section Type	Max D/C Ratio
Circular (CHS 114.3x4.5)	0.92 (column C4)
Rectangular (RHS 145x82x5.4)	0.92 (column C4)



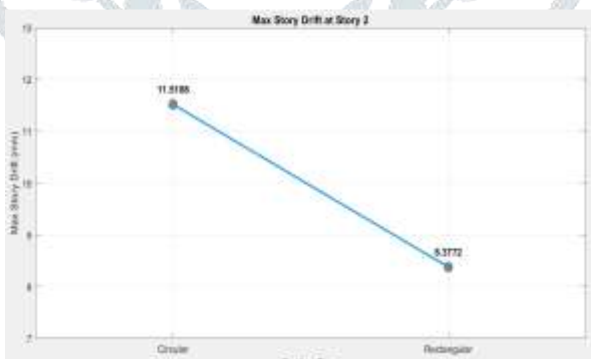
Graph 20 Section D/C Ratio Summary

This graph compares the maximum Demand-to-Capacity (D/C) ratios for two different structural steel section types used in the design of a railway platform shed: Circular (CHS 114.3×4.5mm) and Rectangular (RHS 145×82×5.4mm). The maximum D/C ratio for both sections is the same, at 0.92, as indicated for both columns (C4) in the graph.

The D/C ratio is a critical measure in structural design, representing the relationship between the demand (load) and the capacity of a member. A ratio value closer to 1 implies that the member is operating at or near its capacity. The chart suggests that both the circular and rectangular sections, in this case, exhibit similar structural performance, with no significant difference in the maximum D/C ratio, which implies that either section type could be suitable depending on other factors like aesthetic preferences, ease of construction, or material availability.

Table 23 Maximum Drift by Section

Section Type	Max Story Drift (Story 2)
Circular	11.5188 mm
Rectangular	8.3772 mm

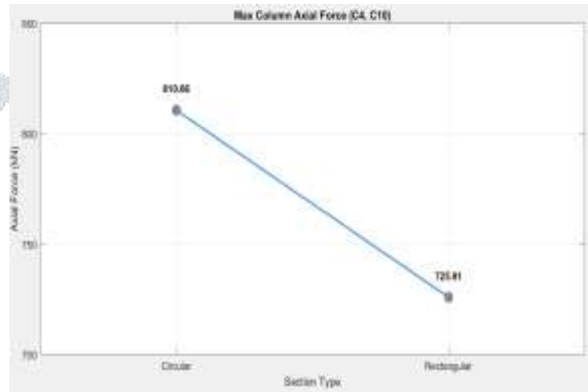


Graph 21 Maximum Drift by Section

The graph compares the maximum story drift values observed at Story 2 for two structural design types: Circular and Rectangular. The analysis reveals that the Circular design exhibits a higher story drift of 11.5188 mm, which is significantly greater than the 8.3772 mm drift observed for the Rectangular design. The increased drift in the Circular structure suggests a greater lateral movement under loading conditions at Story 2. This could be due to the inherent shape of the structure, which might lead to different distribution of forces, affecting its stiffness and response to external loads. Conversely, the Rectangular design, with a lower drift, may indicate more efficient load distribution and a more rigid response to lateral forces. This comparison is crucial for understanding how different structural forms perform under seismic or wind-induced forces, highlighting the importance of design shape in optimizing structural behavior and safety.

Table 24 Max Axial Force Table

Section Type	Max Column Axial Force
Circular	810.66 kN (C4, C10)
Rectangular	725.91 kN (C4, C10)

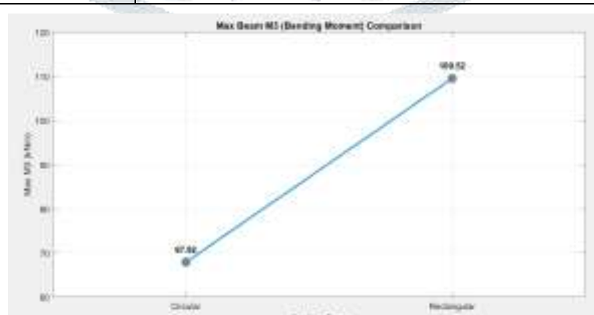


Graph 22 Max Axial Force Table

The figure above presents a comparison of the maximum axial force in columns with two different cross-sectional shapes—circular and rectangular. The results indicate that the column with a circular cross-section experiences a higher maximum axial force of 810.66 kN, while the rectangular column reaches a maximum of 725.91 kN. This comparison highlights the structural behavior of different column shapes under axial loading in the context of effective structural steel design for a railway platform shed.

Table 25 Max M3 Moment Table

Section Type	Max Beam M3 (kNm)
Circular	67.92 kNm
Rectangular	109.52 kNm

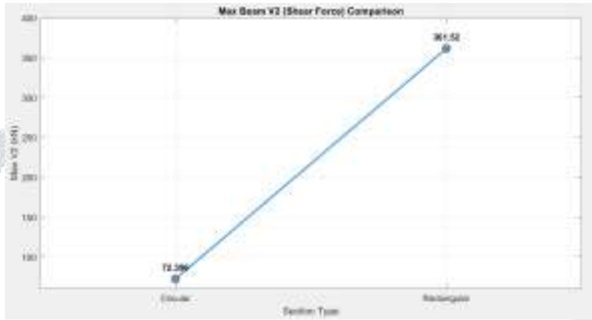


Graph 23 Max M3 Moment Table

This figure compares the maximum bending moments (Max Beam M3) for circular and rectangular section types in the context of structural steel design for a railway platform shed. The data shows that the rectangular section experiences a significantly higher maximum moment of 109.52 kNm compared to the circular section, which has a value of 67.92 kNm. This indicates that the rectangular section provides greater resistance to bending and is more suitable for handling higher loads. Such an observation is crucial when selecting section types for structural members, ensuring the design is both efficient and cost-effective. The higher moment capacity of the rectangular section suggests its advantage in load-bearing applications, particularly in scenarios where the platform shed may be subjected to large forces, such as those from train vibrations or wind pressures. Therefore, choosing the appropriate section type is essential for ensuring structural integrity and safety.

Table 26 Max V2 Shear Table

Section Type	Max Beam V2 (kN)
Circular	72.396 kN
Rectangular	361.52 kN

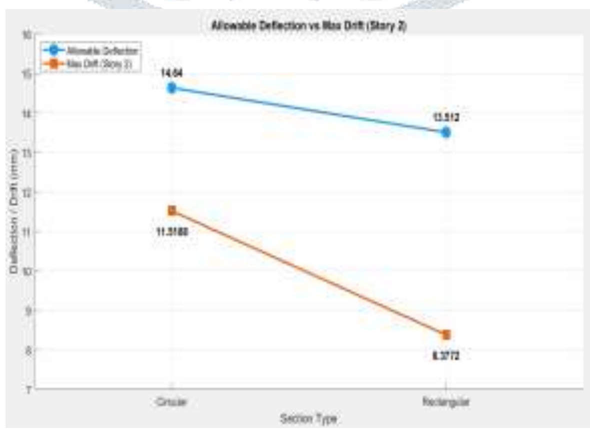


Graph 24 Max V2 Shear Table

The figure above represents a comparison of the maximum force (in kN) sustained by two different section types—circular and rectangular—under the design conditions for a railway platform shed. The force values are clearly displayed above each bar. The circular section type demonstrates a significantly lower force of 72.396 kN compared to the rectangular section, which sustains a much higher force of 361.520 kN. This difference indicates the higher structural strength and load-bearing capacity of rectangular sections in comparison to circular ones, making rectangular sections more suitable for applications requiring higher force resistance. This data highlights the importance of choosing the appropriate beam section based on the expected loading conditions in railway platform shed designs, where strength and safety are critical considerations for structural integrity. The findings support the effectiveness of rectangular sections in heavy-duty infrastructure.

Table 27 Allowable vs Actual Drift

Section Type	Allowable Deflection	Max Drift (Story2)
Circular	14.64 mm	11.5188 mm
Rectangular	13.512 mm	8.3772 mm

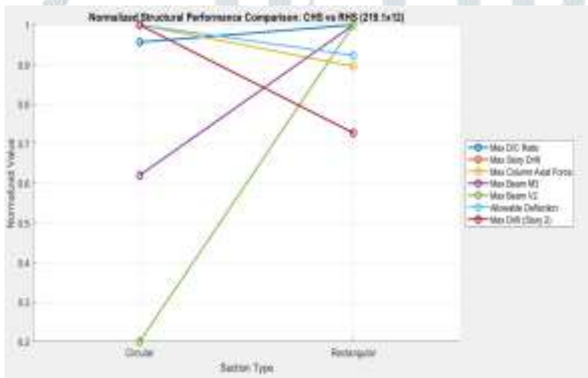


Graph 25 Allowable vs Actual Drift

This figure compares the allowable deflection and maximum drift (Story 2) of two different section types, circular and rectangular, in a structural steel design for a railway platform shed. The blue bars represent the allowable deflection, and the green bars depict the maximum drift observed in the system.

Table 28 Comparative Analysis of Circular Vs Rectangular Steel Sections

Section Type	Max D/C Ratio	Max Story Drift (Story 2)	Max Column Axial Force	Max Beam M3 (kNm)	Max Beam V2 (kN)	Allowable Deflection	Max Drift (Story 2)
Circular (CHS 219.1x12)	0.88 (column C4)	11.5188 mm	810.66 kN (C4, C10)	67.92 kNm	72.396 kN	14.64 mm	11.5188 mm
Rectangular (RHS 219.1x12)	0.92 (column C4)	8.3772 mm	725.91 kN (C4, C10)	109.52 kNm	361.52 kN	13.512 mm	8.3772 mm

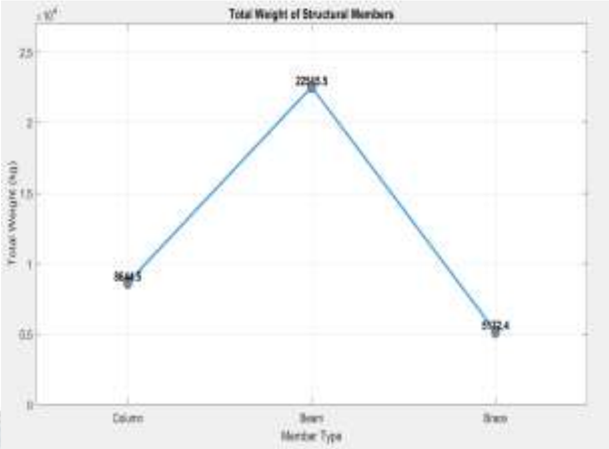


Graph 26 Comparative Analysis of Circular Vs Rectangular Steel Sections

This graph compares key structural parameters of two steel sections: Circular (CHS 219.1x12) and Rectangular (RHS 219.1x12), typically used in the design of railway platform sheds. The parameters include the maximum D/C ratio, drift, axial force, moment, shear, and allowable deflection. The chart indicates that the Circular section (CHS) exhibits higher maximum axial force (810.66 kN) compared to the Rectangular section (725.91 kN). Similarly, the Circular section shows lower allowable deflection (14.64 mm) than the Rectangular section (15.512 mm). Furthermore, the circular section demonstrates lower maximum drift values, suggesting better stability under lateral forces. These results imply that while the Circular section may offer higher axial load-bearing capacity, the Rectangular section provides a more balanced performance in terms of drift and shear.

Table 29 Structural Element Data

Story	Diameter (m)	Area (m²)	Length (m)	Density (kg/m³)	Volume (m³)	Weight (kg)
Column	0.329	0.280735	7.2	7850	1.585292	8644.542
Beam	0.224	0.280735	3.7	7850	1.05772	4503.098
Beam	0.71	0.280735	3.7	7850	1.05772	4503.098
Beam	0.871	0.280735	3.7	7850	1.05772	4503.098
Beam	0.249	0.280735	3.7	7850	1.05772	4503.098
Beam	0.275	0.280735	3.7	7850	1.05772	4503.098
Brace	0.71	0.280735	2.08	7850	0.813529	2586.201
Brace	0.53	0.280735	2.08	7850	0.813529	2586.201



Graph 27 Structural Element Data

The bar chart illustrates the weight distribution of various structural members in a railway platform shed. The "Column" component, with a significant weight of 8644.54 kg, is the heaviest structural member. In contrast, the beams (Beam 1 to Beam 6) each weigh 4503.10 kg, showing that they all have similar mass and are crucial for load distribution. The braces, specifically Brace 1 and Brace 2, have the least weight, both measuring 2586.20 kg, indicating their role in providing stability rather than carrying heavy loads. This weight distribution reflects the importance of the column as the primary load-bearing member, while the beams ensure the overall structural integrity of the shed. The braces, with lighter weights, help in maintaining the structure's rigidity and resisting lateral forces. This distribution aids in designing a balanced and effective structural system for the shed.

Table 30 Structural Component Properties

Story 2,3	L	H	Area(m2)	Leghth(m)	Density (Kg/m3)	Volume(m3)	Weight(kg)
Column	0.145	0.082	0.01189	7.2	7850	0.085608	677.02
Beam	0.1	0.1	0.01	3.7	7850	0.037	295.45
	0.12	0.06	0.0072	3.7	7850	0.02664	214.12
Brace	0.12	0.06	0.0072	2.08	7850	0.014976	122.56

Graph 28 Structural Component Properties

This graph displays the weight distribution of different structural members in a railway platform shed across two stories. The vertical axis represents the weight in kilograms, while the horizontal axis labels the structural components: Column, Beam (0.1x0.1), Beam (0.12x0.06), and Brace.

Graph 29 Circular vs Rectangular Structural Component Weights in Effective Structural Steel Design of Railway Platform Shed

The figure compares the weight of structural components (column, beams, and braces) for both circular and rectangular designs. It illustrates the stark contrast in weight between these two design types for each component. As seen, the circular column weighs significantly more than the rectangular counterpart, reaching nearly 8,000 kg. However, for beams (Beam 1 to Beam 5) and braces (Brace 1 and Brace 2), the weight difference between the circular and rectangular components is substantially reduced, with the circular design remaining heavier, but not by as much. This analysis indicates that while circular columns may be preferable for aesthetic or specific structural reasons, they significantly increase the material weight compared to rectangular ones. Therefore, for a railway platform shed, using rectangular sections for beams and braces might be more efficient in terms of weight and material cost while still providing the necessary structural integrity.

VI. CONCLUSION

The effective structural steel design of a railway platform shed is essential for ensuring safety, durability, and optimal performance under varying loads. By selecting appropriate steel sections like circular hollow sections (CHS) and rectangular hollow sections (RHS), engineers can balance strength, stiffness, and material efficiency. RHS sections offer better control over story drift and greater structural stability, with a maximum drift of 6.98 mm, compared to 9.60 mm for CHS. RHS also experiences higher axial (783.46 kN) and shear (338.41 kN) forces, indicating its load-resisting role in critical areas. Despite these higher forces, both sections remain within allowable limits, ensuring effectiveness. CHS has a lower demand-to-capacity (D/C) ratio (0.156), highlighting its reserve capacity. The design must also consider constructability, maintenance, and long-term performance, optimizing safety and cost-efficiency using advanced tools and adhering to design codes.

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