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INDIA'S
No. 1
STRUCTURAL STEEL TUBE COMPANY



THE GAME CHANGER
IN CONSTRUCTION IS HERE

*India's No. 1 by Market Share



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APPLICATION OF APOLLO COLUMN

COMPANY OVERVIEW

APL Apollo Tubes Limited is the largest producer of Electric Resistance Welded (ERW) steel pipes and tubes in India with an annual capacity of more than 3.6 million tons. It caters extensively to the domestic region and exports to over 30 countries globally. The company's vast distribution network is spread across India, with warehouses and branch offices in various cities.

At APL Apollo, we believe in bringing change to meet the needs of an ever evolving economy by infusing superior cutting-edge technology and innovative solutions. Founded in 1986 in Delhi, it has catapulted to newer heights in the last three decades with newer products, improved quality, increased productivity and by bench marking its entire product line to international standards. This has helped it to gain mind space of a large number of customers, thereby redefining the market space for steel pipes.

The organisation believes in measuring its success and pushing its limits through regular review and by generating feedback. Add to this, its customer-centric approach and best practices from across the globe enables the organisation to upscale its core business with creativity and purpose.

The Company's products are certified by reputed international agencies like SGS (France), CE (Europe), UL (USA) and many more. It has received the Recognised Export House status and is also ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 certified. Our all products are BIS - marked.

CONTENT

BIG SHIFT IN PRE-ENGINEERED BUILDING

USE OF HOLLOW STEEL SECTIONS (HSS)

Around the world, there is a shift toward high-performance materials in structural engineering. In the steel construction sector, this has been more evident with built-up sections, but hollow sections are now in the process of raising the strength levels of their products. The use of HSS has the potential to reduce material costs and project cost.

The popularity of HSS in construction has increased dramatically over the years as engineers have become aware of the advantages of steel tubes. The incorporation of HSS connections in the AISC standard have simplified connection design and contributed to the rise in use of hollow structural steel. HSS are very efficient sections and their major benefits are inherent in their shape and engineering properties. The closed shape and relatively large moment of inertia about the weak axis make them highly resistant against the torsional effects. Architects & Engineers can take advantage of the modern and aesthetically pleasing appearance of exposed HSS structures.



Why HSS in PEB?

PEB has seen tremendous growth in the last decade over the conventional steel building. Currently PEB manufacturers are using built-up sections manufactured by welded plates .

Constraints of PEB



Higher Steel Consumption



High Project Costs



Long Project Duration



Higher Wastage

Can we make PEB better?

Advantages of using HSS in PEB



Lower Steel Consumption



Low Project Costs



Lower Project Duration



Minimal Wastage

Comparison of structural properties between HSS and Built-Up Section

	I Shape	C Shape	L Shape	T Shape	HSS
Axial - Axial Strength	Good	Moderate	Moderate	Moderate	Good
Flexure X-X - Bending capacity of steel in X-X direction	Poor	Poor	Moderate	Poor	Good
Flexure Y-Y - Bending capacity of steel in Y-Y direction	Good	Moderate	Poor	Moderate	Good
Buckling - Bending due to stress	Poor	Poor	Poor	Poor	Moderate
Torsion - Twisting of steel	Poor	Poor	Poor	Poor	Good
Shear - shearing steel into short lengths to a high heat	Good	Moderate	Moderate	Moderate	Good
Example(s)	Steel Girders/Floor Beams/Columns	Joints in roof framing system	Truss bracing members	Truss chord members	Columns











THE GAME CHANGER IN CONSTRUCTION

Introducing Apollo Column

Apollo Column is a range of hollow structural sections that gives a futuristic edge to construct structures of any design & elevation. It offers India's largest range of hollow structural sections ranging from 12x12 mm to 300x300 mm in size. Apollo Columns are suitable building material for infrastructure, commercial as well as residential projects.

Apollo Column is the irreplaceable member of structural buildings due to its high load bearing capacity & strength-to-weight ratio. It offers higher radii of gyration about both axes providing superior compression performance and significant weight savings.

Advantages

- | | |
|--|--|
|  <p>Flexibility in design
Gives the engineer & architects enough flexibility to create unique structures</p> |  <p>Environmental friendly
Conventional construction methodology causes severe pollution</p> |
|  <p>Uniform strength
No weaker axis due to uniform distribution of material around its axis</p> |  <p>Less consumption of steel
Use of HSS sections reduces the weight of steel structure</p> |
|  <p>Aesthetically pleasing
Smooth profile of Apollo Columns enhances the aesthetic appeal of the structures.</p> |  <p>Lower project cost
Low erection & Low transportation cost saves overall project cost</p> |
|  <p>Easy to paint
Apollo Columns are easily painted due to uniform & smooth shape</p> |  <p>Easy to install
Use of conventional bolting system makes the installation easier</p> |
|  <p>Higher torsional strength
Apollo Columns delivers exceptional torsional resistance. 200 times greater torsion than open sections</p> |  <p>Ease of fabrication
Ease of welding, punching, bending & drilling makes Apollo Column a perfect choice</p> |
|  <p>Less wastage of material
Apollo Column provides cut to length sizes from 4 to 12 mm to avoid wastage</p> |  <p>High strength-to-weight ratio
High Strength to weight ratio results savings in steel consumption</p> |

APOLLO COLUMN

10 - 20% CHEAPER THAN CONVENTIONAL PEB

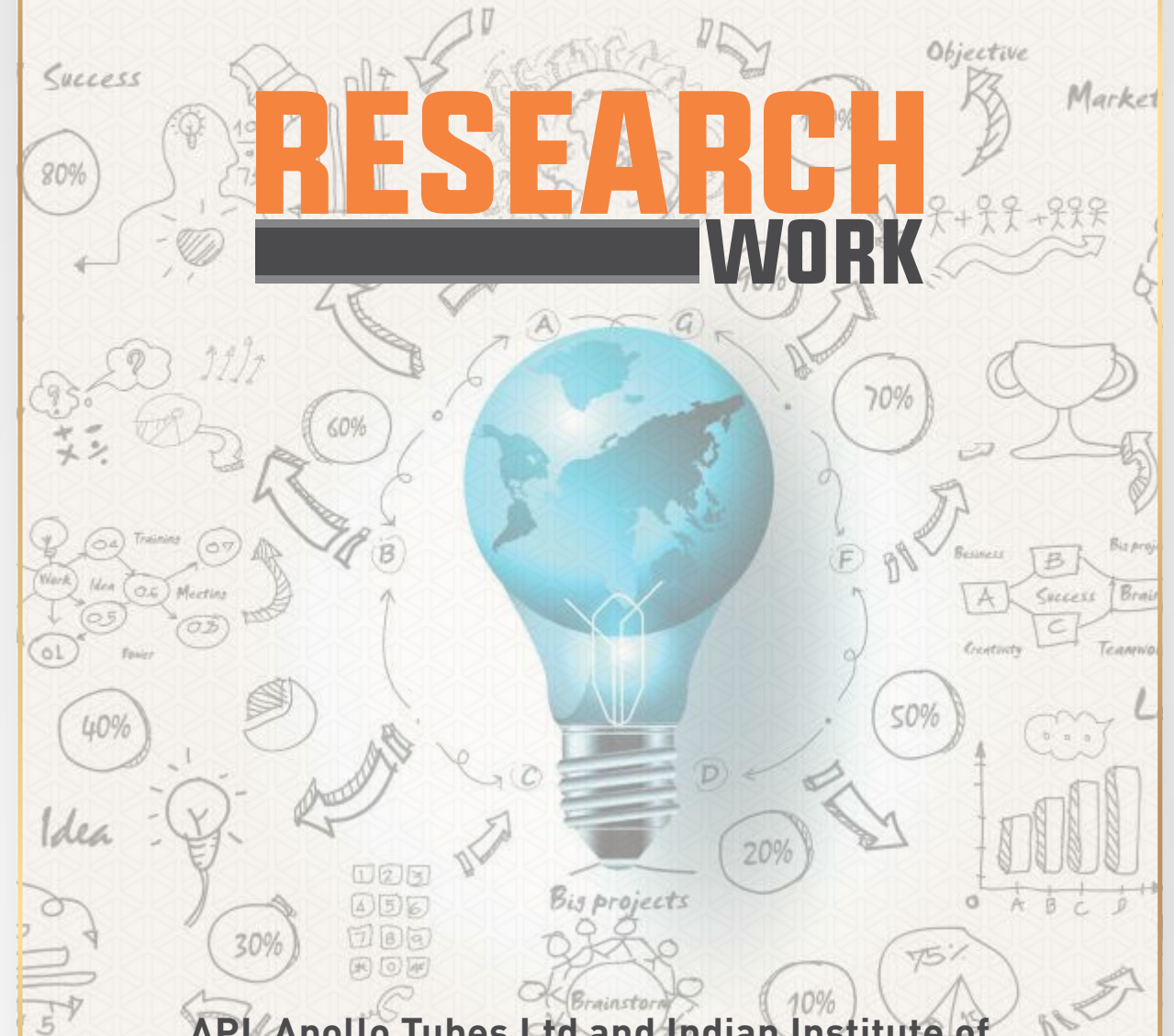
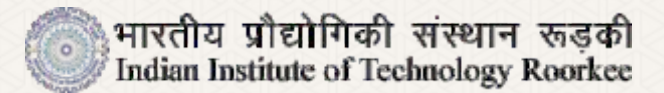
HSS structures reduce overall project cost

The unit material cost of HSS is higher than that of open built-up sections, but that's not the whole story. The additional strength of steel tube permits an optimum design. Use of HSS sections against Built-up sections significantly reduces weight. Reducing the weight also saves in transportation and erection cost. In those applications where paint is required, the fact that hollow sections have 30-40% less surface area than equivalent built-up sections can result in using less material and reducing application time, both of which reduce costs. Furthermore, the smooth corners in HSS structures reduce susceptibility to corrosion which lessens the life cycle cost.

Research work with IIT Roorkee

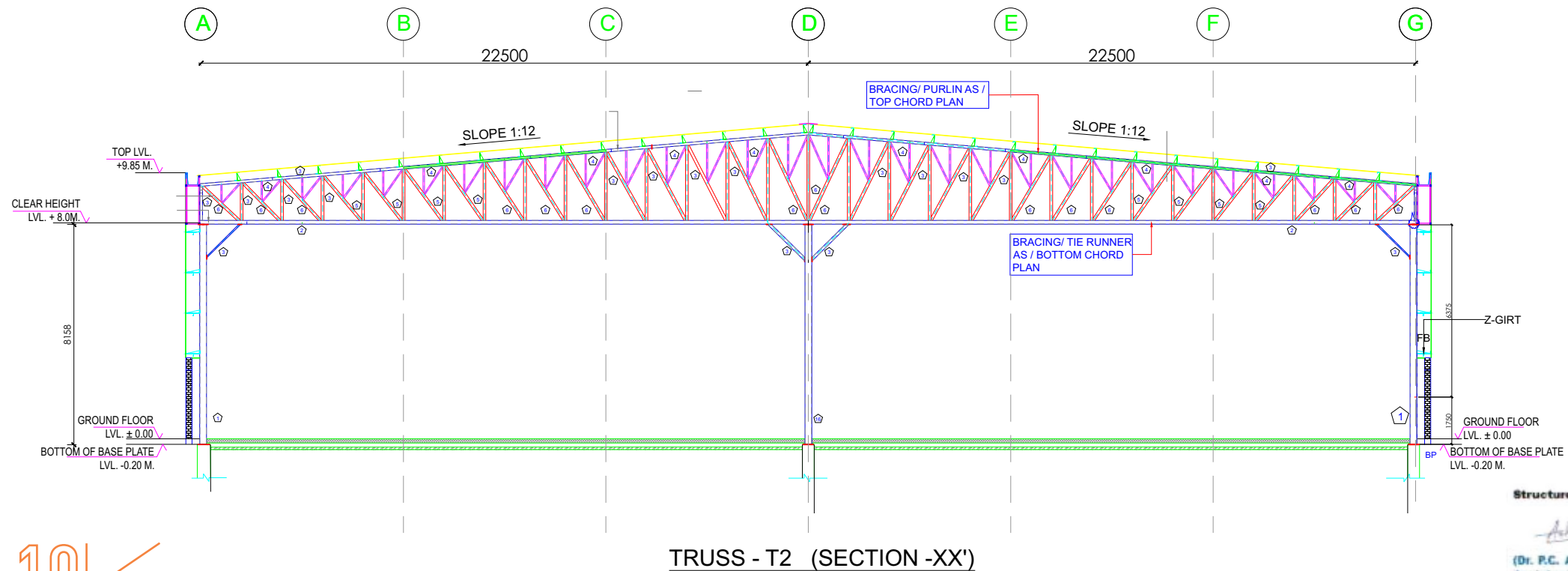
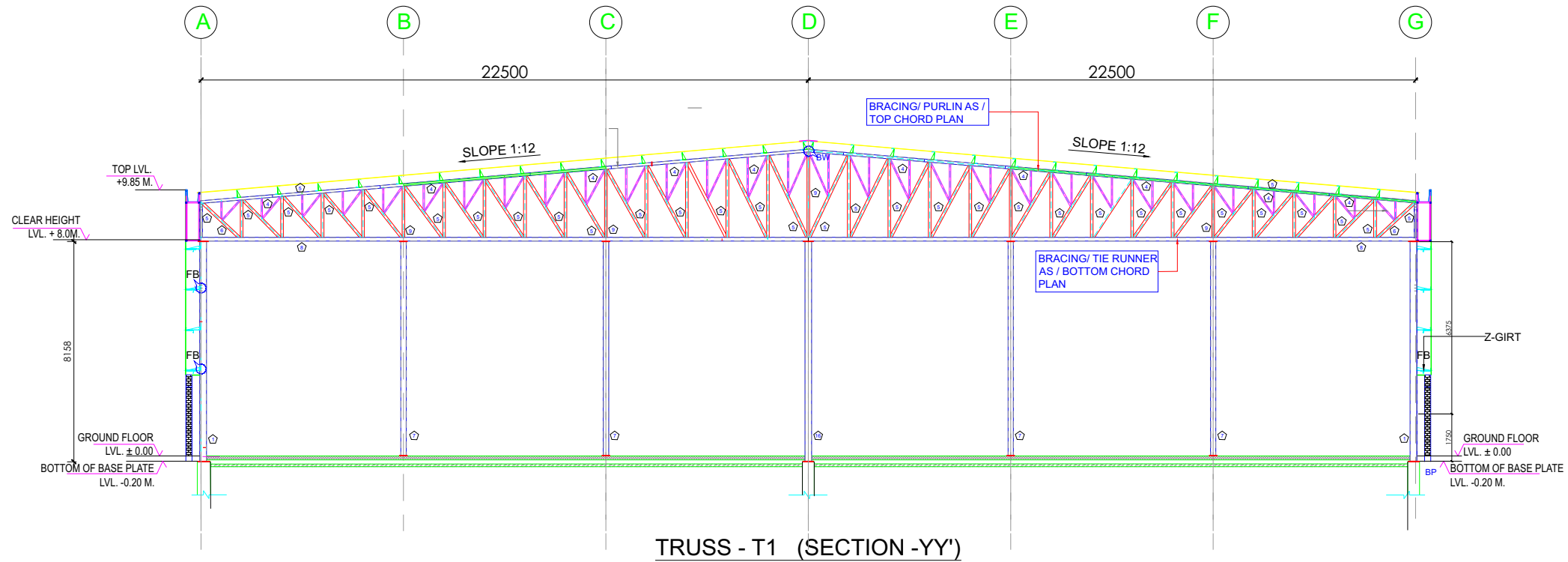
To understand & advocate the benefits of Hollow Steel sections in steel structures, APL Apollo has done extensive research work with Indian Institute of Technology, Roorkee. The research work comprises of the case studies intended to compare the tonnage and indicative costing of HSS & Built-up Sections Steel Structures for Industrial Shed, Warehouse Shed and Commercial Multi-Storey Building. Our extensive research shows that use of HSS sections in structural buildings reduces the consumption of steel by 15-25% and ultimately reduces the project cost.

APL Apollo is doing a live project to build an Industrial shed using Apollo Column at Dujana Plant to put all the research findings into a real-time activity.



APL Apollo Tubes Ltd and Indian Institute of Technology (IIT), Roorkee have done a research work on steel structures, objective of the project is to provide an economical solution to the construction industry.

WAREHOUSE DRAWINGS - VETTED BY IIT ROORKEE



- 1 RHS 250X150X10.0
- 2 SHS 140X140X3.6
- 3 SHS 100X100X2.9
- 4 SHS 30X30X2.6
- 5 SHS 50X50X2.9
- 6 SHS 75X75X2.6
- 7 SHS 200X200X6.0
- 8 SHS 120X120X2.9
- 9 SHS 240X120X6.0
- 10 CHS 88.9X2.6
- 11 CHS 101X2.6
- 12 CHS 76.2X2.6
- 13 CHS 127X2.6
- 14 CHS 139.7X2.9
- 15 CHS 114.3X2.6
- 16 RHS 250X150X5.0

PROJECT :::
WAREHOUSE CASE STUDY

CLIENT :::



GENERAL NOTES :::
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NOTE:
 GRADE OF PLATES - YST 345
 (YIELD STRENGTH F_y - 345 N/MM²)

GRADE OF PIPES - YST210,

THE SHED IS SYMMETRIC ABOUT GRID 'D'

- FB FLANGE BRACING
- BW BUTT WELDING
- CP CONNECTION PLATE
- TP TOP PLATE
- SP SPLICE PLATE
- BP BASE PLATE

RO	22.09.2020	TAPESH	
REV NO.	DATE	DESCRIPTION	ISSUED BY
REVISIONS			

DEALT	==	CHECKED	==
DESIGN	:::	TAPESH	APPROVED
			PRO. ASWHIN

DRAWING TITLE:
TRUSS SECTIONS & DETAILS
 WAREHOUSE

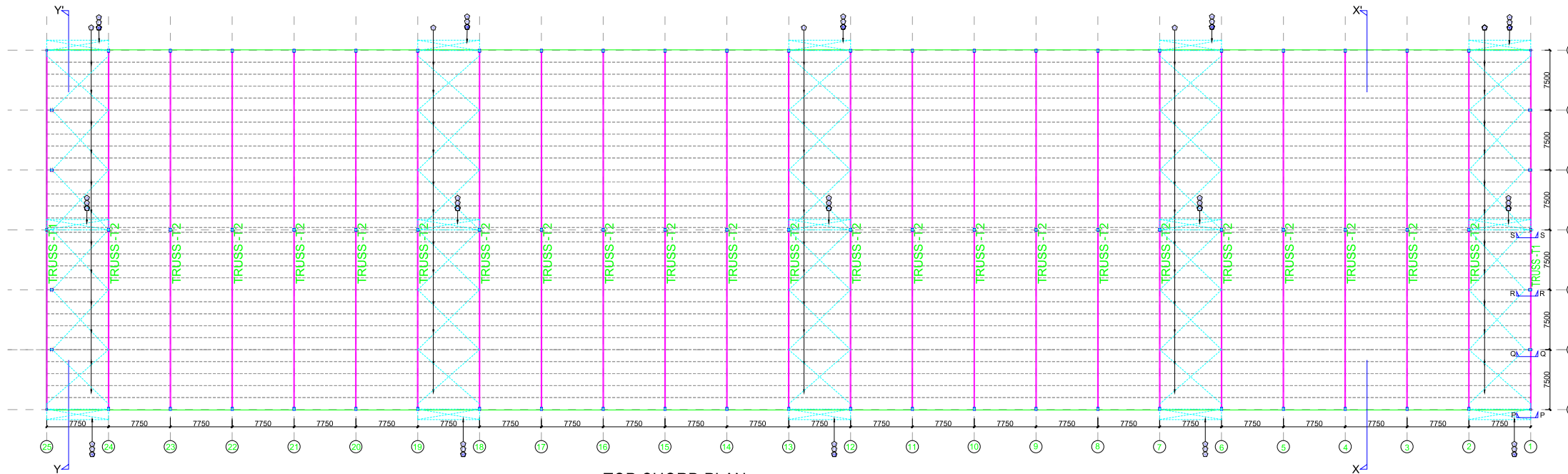
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Corp. Office : B-1, Faridkot, New Road, Faridkot, Punjab (India) - 151001, India. Tel: +91-182 2641 400 | Fax: +91-182 2641 441



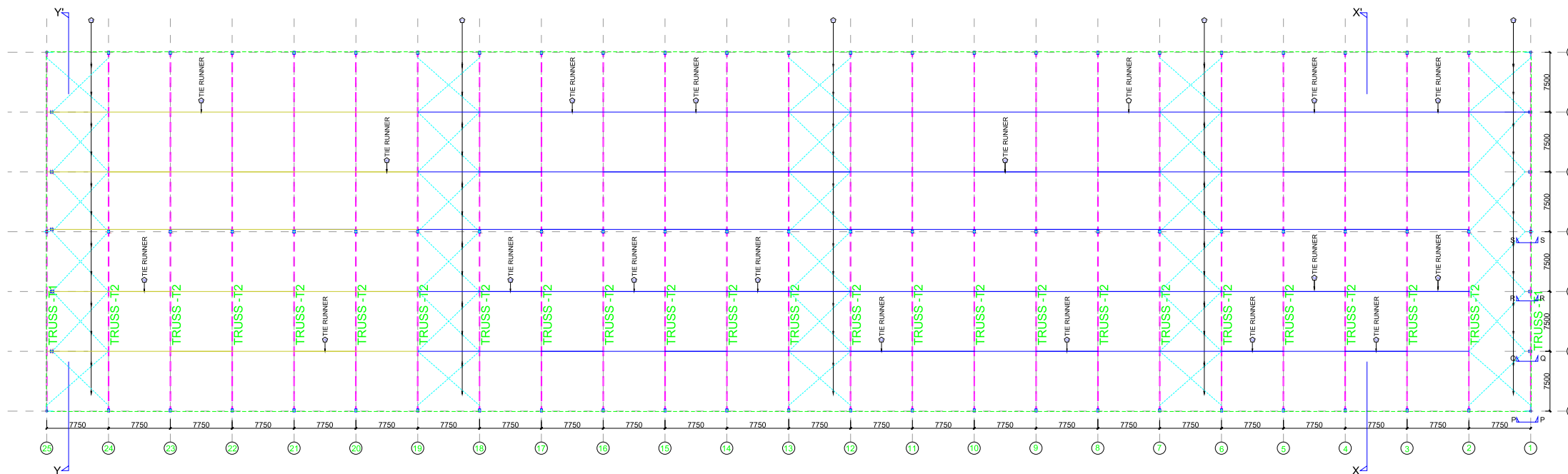
Structure Design Vetted by:

 (Dr. P.C. Ashwin Kumar)
 Assistant Professor
 Dept. of Earthquake
 Engg.
 IIT Roorkee, Roorkee -
 247667

WAREHOUSE DRAWINGS - VETTED BY IIT ROORKEE



TOP CHORD PLAN



BOTTOM CHORD PLAN

PROJECT :::
WAREHOUSE CASE STUDY

CLIENT :::



GENERAL NOTES :::

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S.No	Section Sizes	Quantity	Total Weight	Grade
1	250X150X10.0RH5			YST210
2	140X140X3.65HS			YST210
3	200X200X6.05HS			YST210
4	250X150X5.0RH5			YST210
5	240X120X6.0RH5			YST210
6	100X100X2.95HS			YST210
7	30X30X2.65HS			YST210
8	50X50X2.95HS			YST210
9	75X75X2.65HS			YST210
10	120X120X2.95HS			YST210
11	88.9X2.6CH5			YST210
12	101.6X2.6CH5			YST210
13	76.2X2.6CH5			YST210
14	127X2.6CH5			YST210
15	139.7X2.9CH5			YST210
16	Purlin			
17	Girt			

RO	22.09.2020	TAPESH	
REV NO.	DATE	DESCRIPTION	ISSUED BY

REVISIONS

DEALT	==	CHECKED	:::
DESIGN	:::	TAPESH	APPROVED ::: PRO. ASWHIN

DRAWING TITLE:
TRUSS SECTIONS & DETAILS
WAREHOUSE

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Corp. Office : B-1, Faridkot, New Road, Jalandhar, Distt. Jalandhar - 143001, India | Tel: +91-181-2611400 | Fax: +91-181-2611401

Structure Design Vetted by:

Ashwin Kumar
(Dr. P.C. Ashwin Kumar)
Assistant Professor
Dept. of Earthquake
Engg.
IIT Roorkee, Roorkee -
247667



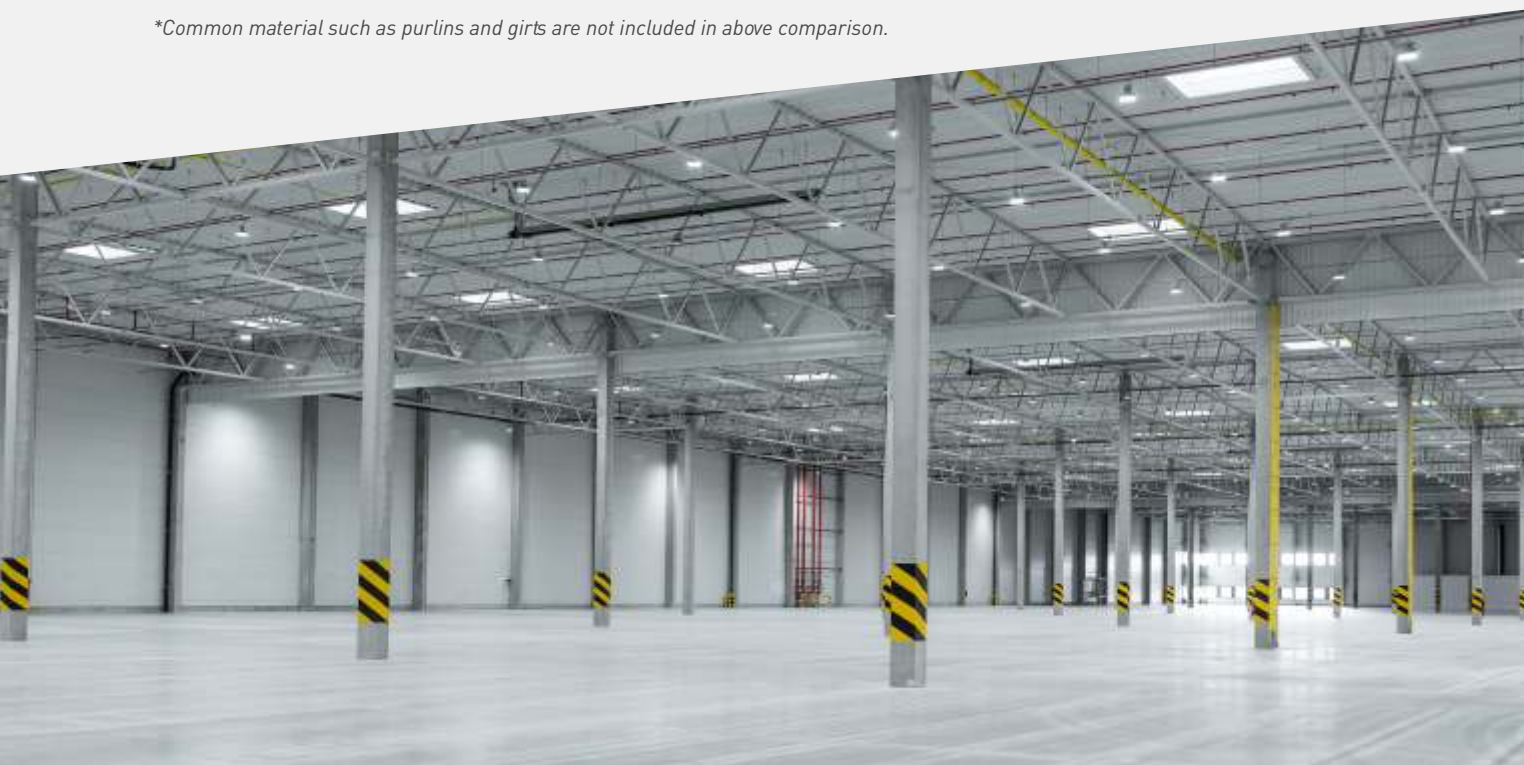
CASE STUDY 1

WAREHOUSE SHED USING APOLLO COLUMN

COST COMPARISON OF WAREHOUSE SHED

Particulars	PEB – Using Built - Up Section	PEB – using Apollo Column
Total Steel consumption (Ton)	161.10	120.50 25% ↓
Raw Material (Rs/kg)	41.50	46.50
Conversion Cost (Rs/kg)	15.00	16.00
Transportation (Rs/kg)	1.00	1.20
Erection (Rs/kg)	5.00	5.00
Total cost (Rs/kg)	62.50	68.70
Project Cost (Rs Cr)*	1.01	0.83 18% ↓

*Common material such as purlins and girts are not included in above comparison.



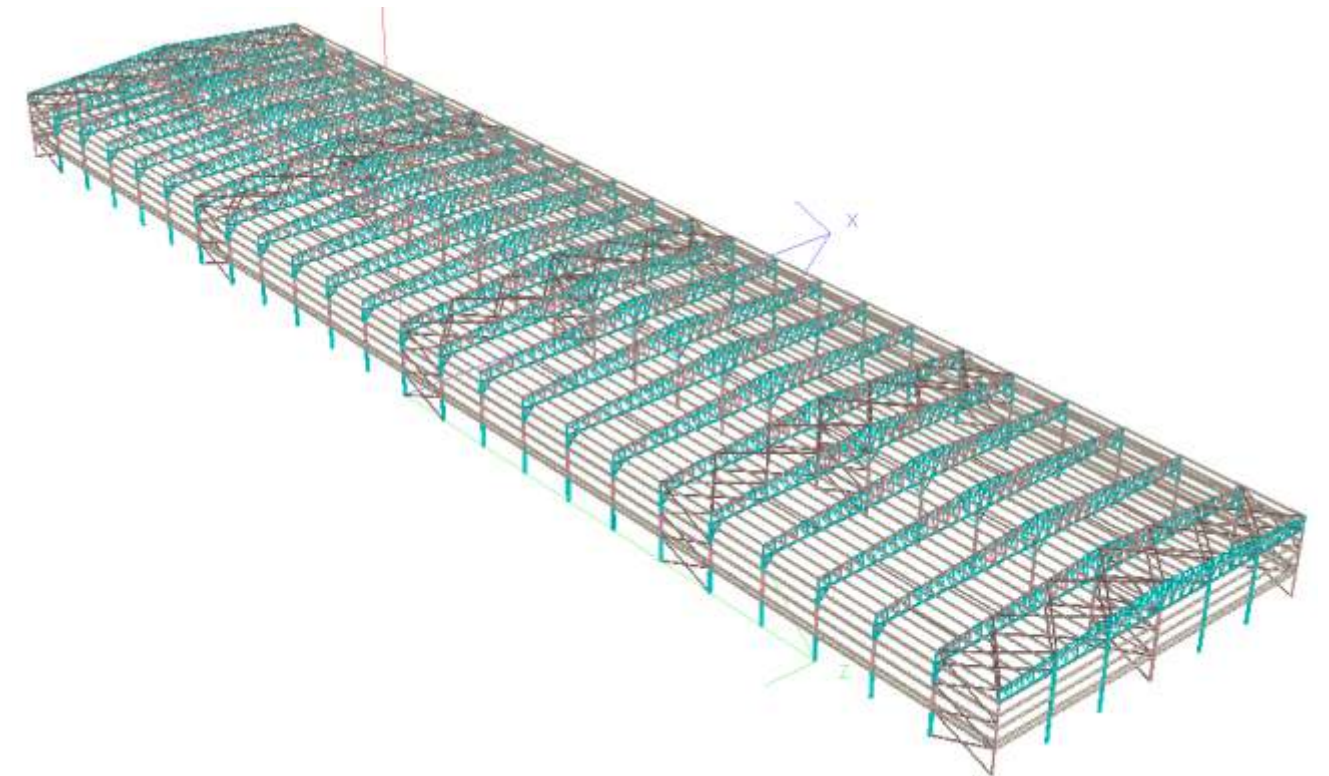
WAREHOUSE SHED

OVERVIEW:

The Warehouse Shed of 9000 sq. m designed having with equal bays and single pitched roof. The structure designed with 2 configurations, one using Built-up I sections and another using Hollow steel section (HSS). The structures are designed for the Dead Load, Live Load, Wind Load & Seismic Load

APPROACH:

The building is designed with the two structural configurations for optimizing the material consumption while meeting structural strength requirements. After preliminary sizing of various structural members, 3-D CAD Model of the structural frame of the building has been generated using STAAD-Pro Connect The permissible values of the load factors and stresses has been considered as per guidelines of Indian Standards.



ISOMETRIC VIEW

MATERIAL

Tubular sections : Conforming to IS:4923 & IS 1161

Built-up sections : Conforming to IS:2062 for HR plates

Roofing Sheet : 0.47 mm thick (TCT) Bare Galvalume Sheet of 550 MPa Grade

Wall Cladding : 0.5 mm thick (TCT) Colour Coated Sheet of 550 MPa Grade

LOAD CALCULATIONS

(i) DEAD LOAD

The dead load on structure includes all the permanent loads attached with structure i.e. self-weight of structure, roofing sheet. Following are the permanent loads which have been considered in design & analysis.

Weight of structure	-	Self weight
Weight of connections	-	15 % of self-weight
Weight of roof sheeting	-	4.5 kg/sqm
Weight of wall cladding	-	4.5 kg/sqm
Load on purlins	-	$(.03+0.045)*1.42 = 0.1065 \text{ kN/m}$
Load on girts	-	$0.045*1.42 = 0.0639 \text{ kN/m}$

(ii) IMPOSED LOADS

Imposed loads as per IS: 875 (Part-2), acting on the structure have been considered

Roof live load	-	0.75 kN/sqm
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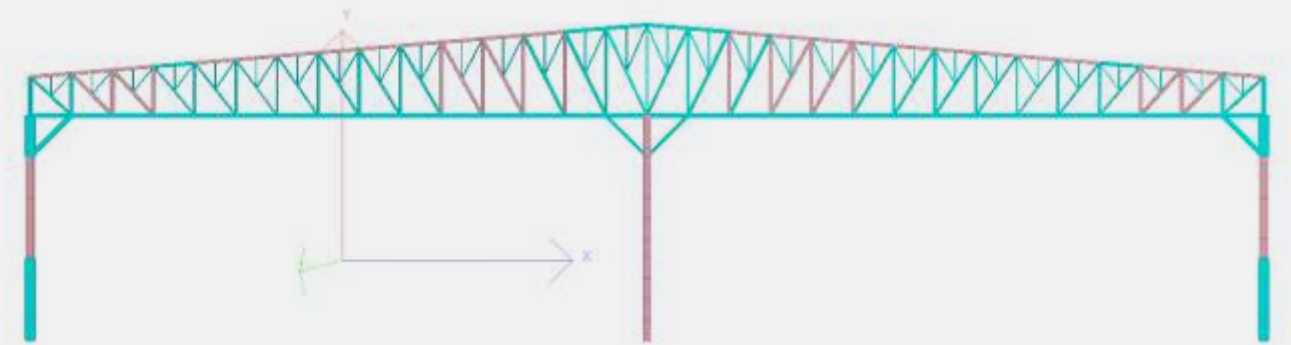
(iii) WIND LOAD

Wind loads has been calculated as per IS:875 part 3-2015.

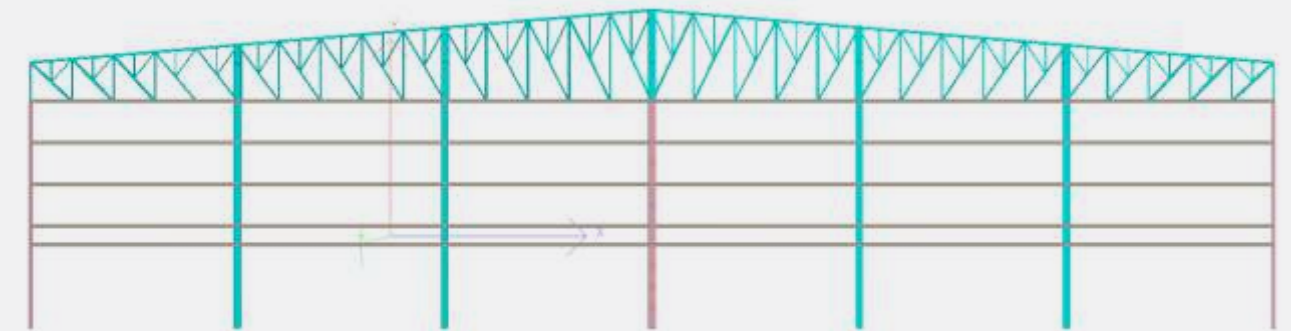
Basic wind speed of	-	47 m/s, (as per NBC 2016)
Terrain category	-	2
Design Life	-	50 years
Percentage openings	-	5 to 20% of wall

(iv) SEISMIC LOAD

In light weight low-rise structures such as the proposed building, seismic loads are inconsequential while wind load affects are pre-dominant, still seismic loads as per IS 1893 have been evaluated by static method and the structure have been checked for adequacy for relevant seismic load combinations.

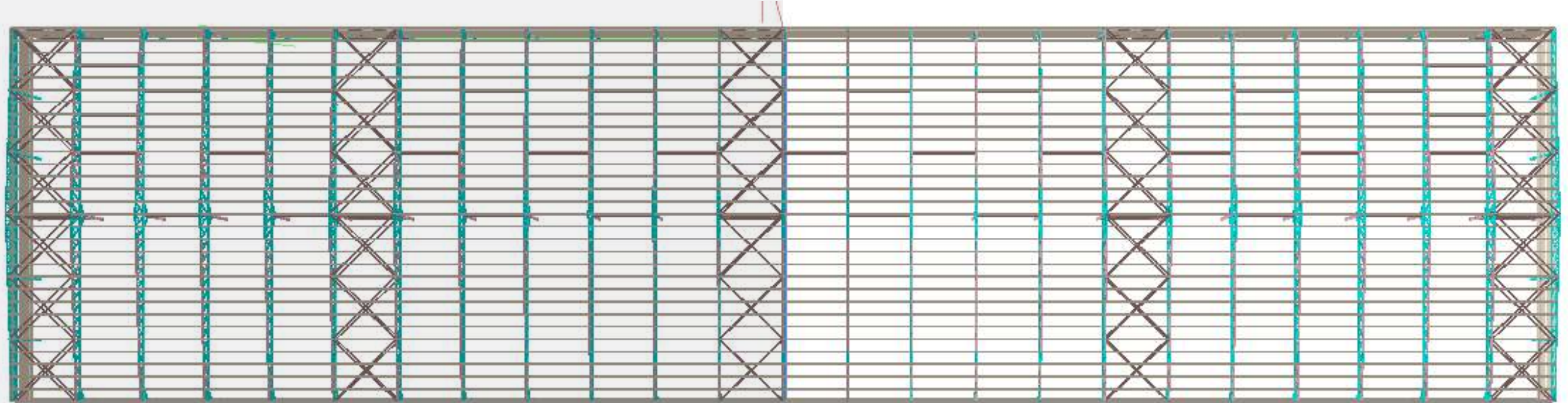


MID FRAME



GABLE END FRAME





PLAN

COMPARISON OF STEEL CONSUMPTION:

Element	Tonnage (MT)	
	Built-up Sections	Apollo Column
HR Plate sections with web stiffeners	122.20	-
Pipe/Tube sections	9.20	95.50
Connection plates and stiffeners	11.30	10.00
Anchor bolts & connection bolts	10.80	12.50
Flange brace angles	7.60	2.50
Total Steel Consumption(MT)	161.10	120.50

RESULT & CONCLUSIONS



25% Less Steel Consumption



18% Saving In Total Project Cost

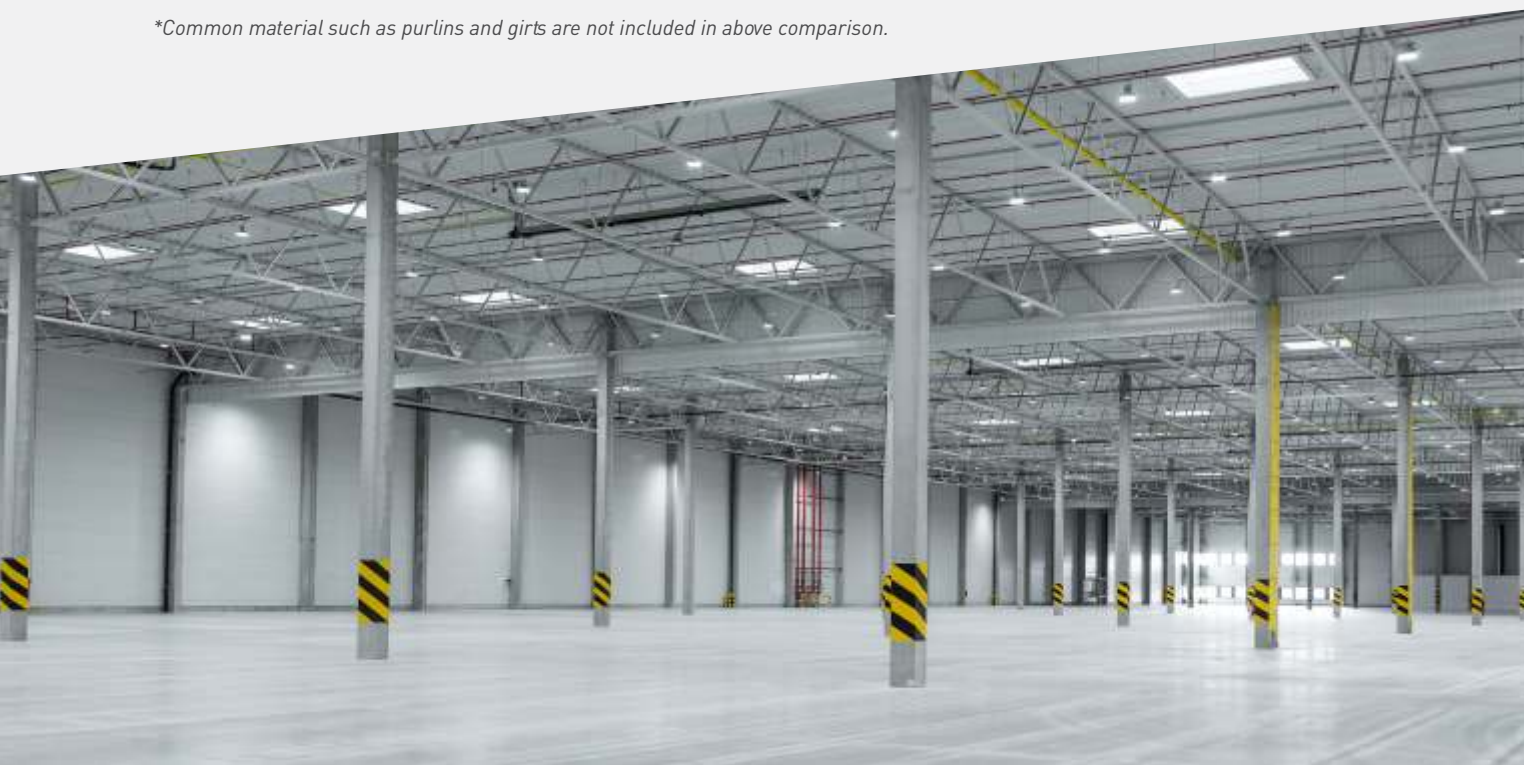
CASE STUDY 2

INDUSTRIAL (COAL STORAGE) SHED USING APOLLO COLUMN

COST COMPARISON OF COAL STORAGE SHED

Particulars	PEB – Using Built - Up Section	PEB – Using Apollo Column
Total Steel consumption (Ton)	2938.0	2290.0 23.0% ↓
Raw Material (Rs/kg)	60.0	65.0
Conversion Cost (Rs/kg)	20.0	15.0
Transportation (Rs/kg)	1.0	2.0
Erection (Rs/kg)	20.0	20.0
Total cost (Rs/kg)	101.0	102.0
Project Cost (Rs Cr)*	29.7	23.4 21.3% ↓

*Common material such as purlins and girts are not included in above comparison.



CASE STUDY

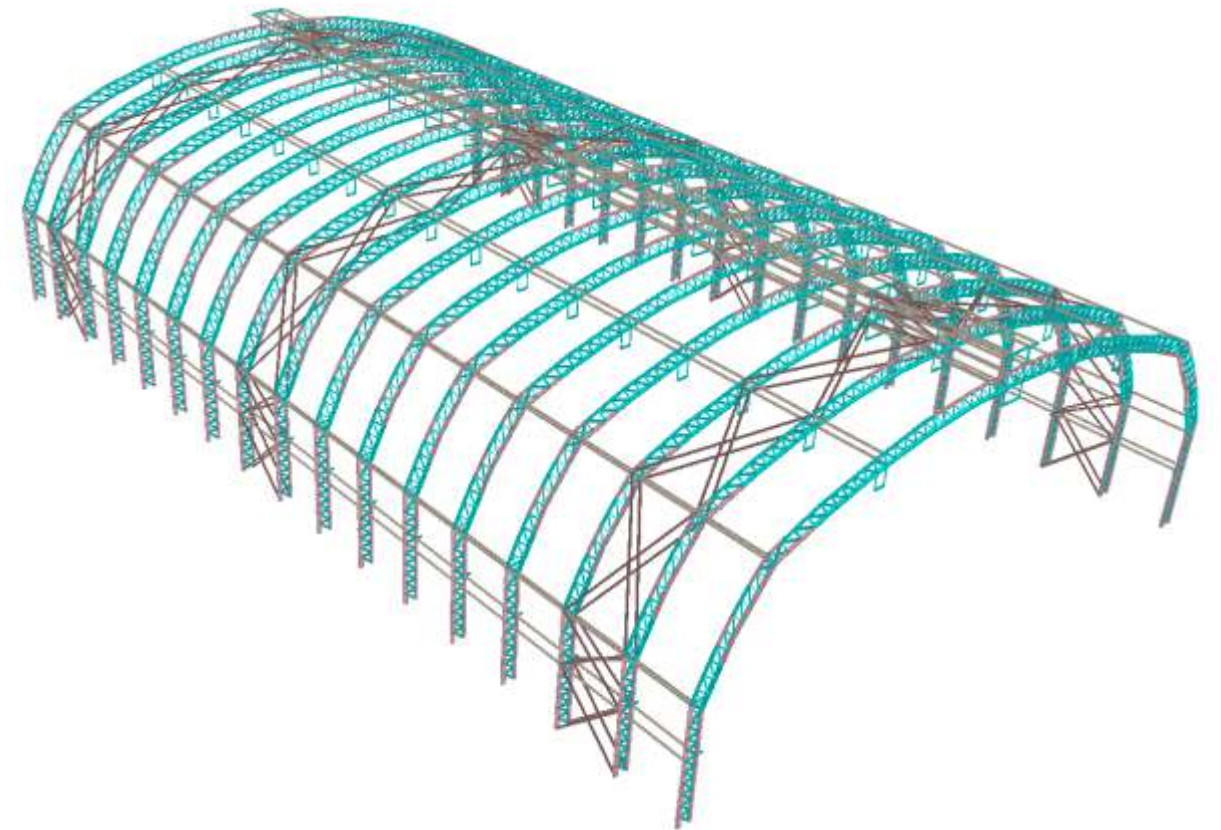
INDUSTRIAL SHED

OVERVIEW:

The Coal storage shed of built-up area 32475 sqm. Clear Span Building with 86.6m clear span, 35m height (ridge location) & 375m length shed designed using IS800, IS 875, IS 1893 using structural steel tubes using STAAD-Pro Connect. The structure designed with two configurations, one using built-up sections and another using hollow section (HSS). The structures are designed for the dead load, live load, wind load and seismic load.

APPROACH:

The building is designed with the two structural configurations for optimizing the material consumption while meeting structural strength requirements. After preliminary sizing of various structural members, 3-D CAD Model of structural frame of building has been generated using Staad-Pro connect the permissible values of the load factors and stresses has been considered as per guidelines of reference standard.



MATERIAL

Tubular sections: Conforming to IS: 4923 & IS 1161

Built-up sections: Conforming to IS: 2062 for HR plates

Roofing Sheet: 0.47 mm thick (TCT) Bare Galvalume Sheet of 550 MPa. Grade

Wall Cladding: 0.5 mm thick (TCT) Colour Coated Sheet of 550 MPa. Grade

LOAD CALCULATIONS

(i) DEAD LOAD

The dead load on structure includes all the permanent loads attached with structure i.e. self-weight of structure, roofing sheet. Following are the permanent loads which have been considered In design & analysis.

Structural load – Self weight of structure

Connections load -15% of weight of structure

Dead weight of roof sheeting – 4.5kg/sqm

Dead weight of wall cladding – 4.5kg/sqm

Load on purlins – $(0.03 + 0.045) \times 1.5 = 0.1125\text{kN/m}$

Load on girts – $0.045 \times 1.5 = 0.0675\text{kN/m}$

(ii) IMPOSED LOADS

Imposed loads as per IS: 875 (Part-2), acting on the structure have been considered Roof live load – 0.75kN/sqm

(iii) WIND LOAD

Wind loads has been calculated as per IS:875 part 3-2015.

Basic wind speed of - 33 m/s, (as per NBC 2016)

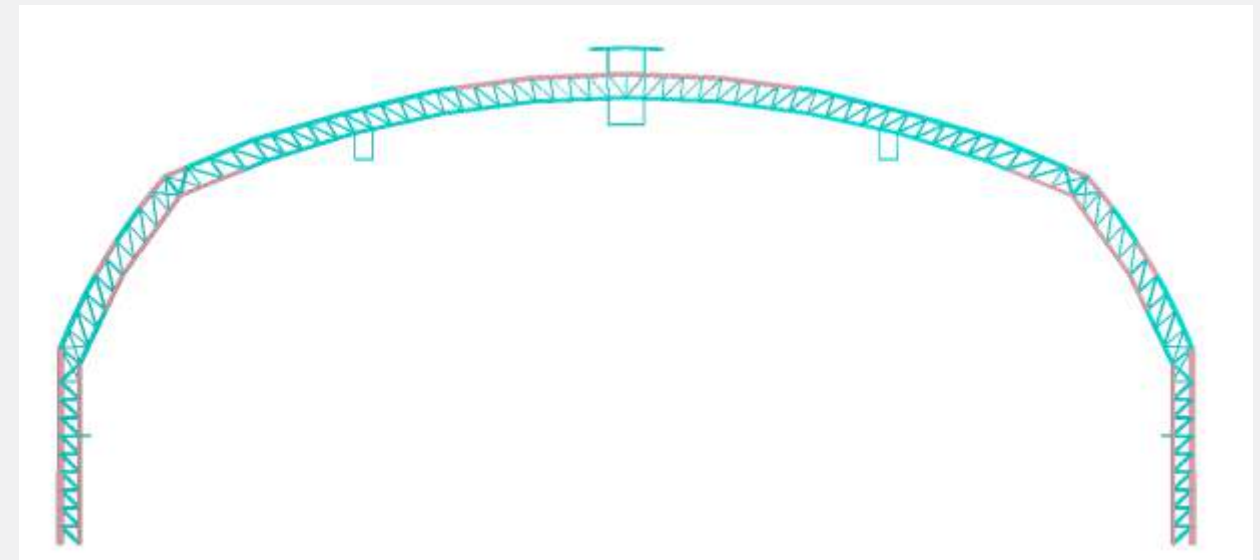
Terrain category - 2

Design Life – 50yrs

Percentage openings – 5-20% opening

(iv) SEISMIC LOAD

In light weight High-rise structures such as the proposed building, seismic loads are Inconsequential as seismic mass is lower than win loads. So in these structure, while wind load affects are pre-dominant still we have considered seismic loads as per IS 1893 (evaluated by static method) and the structure have been checked for adequacy for relevant seismic load combinations.



COMPARISON OF STEEL CONSUMPTION:

Element	Tonnage (MT)	
	Built-up Sections	Apollo Column
HR Plate sections with web stiffeners	2318.2	-
Pipe/Tube sections	0.0	1916.2
Connection plates and stiffeners	417.3	249.1
Anchor bolts & connection bolts	185.4	124.7
Flange brace angles	17.2	0.0
Total Steel Consumption(MT)	2938	2290

RESULTS & CONCLUSIONS:

- In conventional Steel building, Steel column need to get encased with concrete/Gypsum board to the shed area Dust-free, germs-free, bacteria-free pleasing and aesthetic appearance while in case of Structure tube such encasing is not required, lead to smothering area around column corners i.e. dust, germs & bacteria does not have space to survive around the column as well as in tubular column higher carpet area with reducing finishing work & cost can be achieved easily.
- Wastage of steel in Conventional steel building is approx. 5-6% while in Structural Tube building it is ranging 0.5-1.0 % max zero.
- Structural tubes will be supplied in cut-to-length sizes lead faster fabrication at lower cost while in conventional steel huge fabrication work is required.



23% Less Steel Consumption



21.3% Saving In Total Project Cost

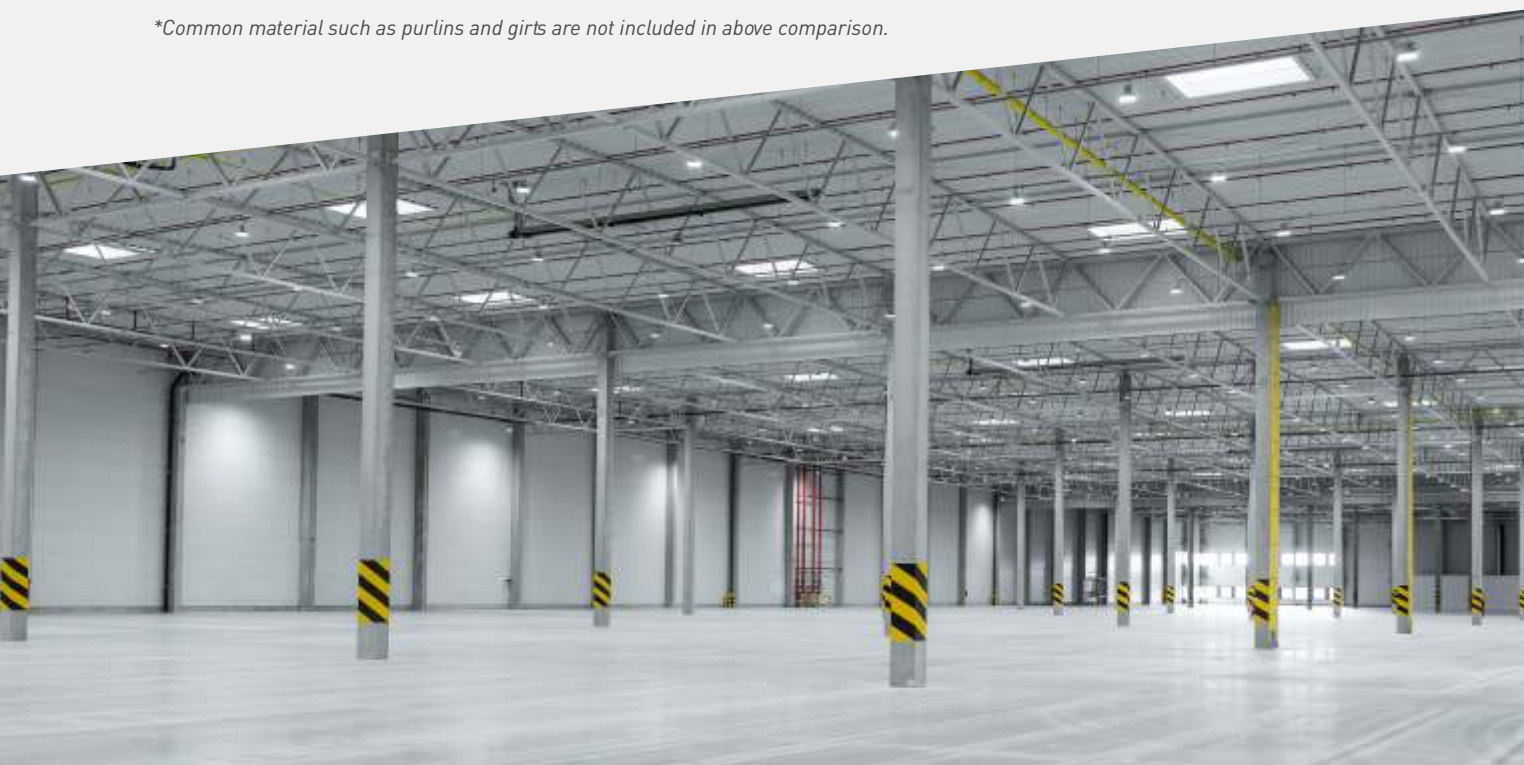
CASE STUDY 3

COMMERCIAL BUILDING USING APOLLO COLUMN (15 STOREY BUILDING)

COST COMPARISON OF COMMERCIAL BUILDING

Particulars	PEB – Using Built - Up Section	PEB – Using Apollo Column
Total Steel consumption (Ton)	1100 MT	800.0 27.0% ↓
Raw Material (Rs/kg)	60.0	65.0
Conversion Cost (Rs/kg)	20.0	15.0
Transportation (Rs/kg)	1.5	2.5
Erection (Rs/kg)	20.0	20.0
Total cost (Rs/kg)	101.5	102.5
Project Cost (Rs Cr)*	11.165	8.20 26.5% ↓

*Common material such as purlins and girts are not included in above comparison.



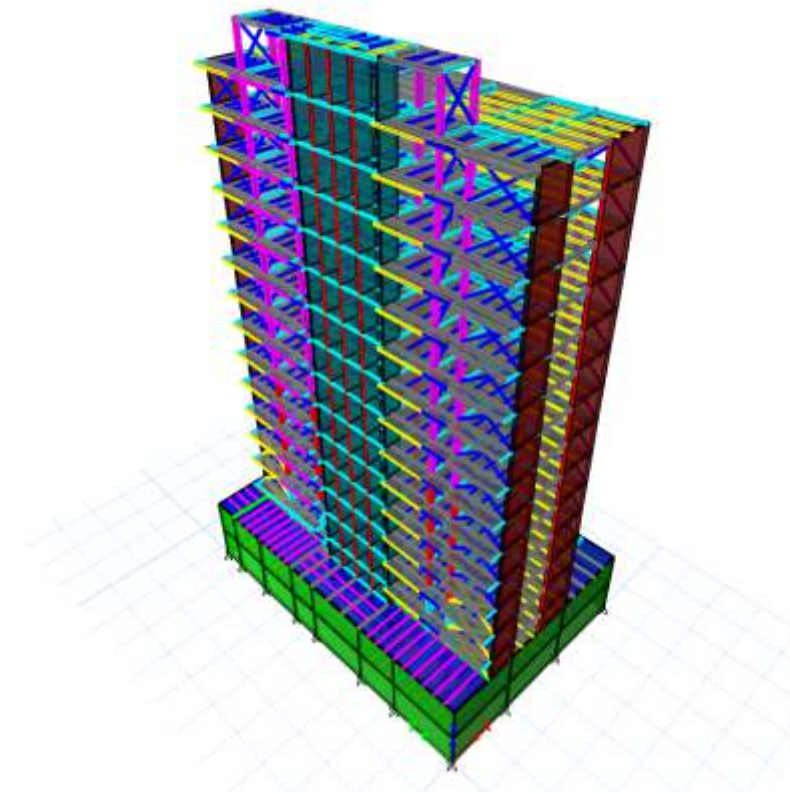
COMMERCIAL BUILDING

OVERVIEW:

The two basement, ground floor+12 floor (15 Floor) Commercial building with built-up area 10684 sqm. Designed using IS800, IS 875, IS 1893 & AISC-360-16. The structure designed with two configurations, one using built-up sections and another using hollow section (HSS). The structures are designed for the dead load, live load, wind load and seismic load. With APL Apollo big sizes section customer will get 2% extra carpet area/seller area because of tubes only. Wastage of steel in pnb steel building is approx. 5-6% while in Structural Tube building it is ranging 0.5-1.0 % max. Structural tubes will be supplied in cut-to-length sizes lead faster fabrication at lower cost while in conventional steel huge fabrication work is required

APPROACH:

The building is designed with the two structural system using Etab software considered. In this building design one structural system is composite design with CFT and second structural system is standard built up section. We have found that composite beam with CFT columns are getting better response in comparison of standard built up sections.



MATERIAL

Tubular sections: Conforming to IS: 4923 & IS 1161

Built-up sections: Conforming to IS: 2062 for HR plates

Deck Sheet: 0.8 mm thick (TCT) Bare Galvalume Sheet of 250 MPa. Grade

LOAD CALCULATIONS

(i) DEAD LOAD

The dead load on structure includes all the permanent loads attached with structure i.e. self-weight of structure, roofing sheet. Following are the permanent loads which have been considered In design & analysis.

- Weight of structure -
- Weight of connections -
- Weight of deck sheeting -
- Weight of ACC wall cladding -

(ii) IMPOSED LOADS

Imposed loads as per IS: 875 (Part-2), acting on the structure have been considered

- Roof live load -

(iii) WIND LOAD

For multi-story buildings as the proposed building, wind loads are inconsequential as seismic mass is higher than win loads. So in these structure, seismic load affects are pre-dominant still we have considered wind load as per IS: 875 part 3-2015 and the structure have been checked for adequacy for relevant wind load combinations.

- Wind loads have been calculated as per IS: 875 part 3-2015.
- Basic wind speed of - 47 m/s, (as per NBC 2016)

(iv) SEISMIC LOAD

For multi-story building seismic loads are critical. Seismic loads as per IS 1893 have been evaluated by dynamic method and the structure have been checked for adequacy for relevant seismic load combinations.

27.0%

COMPARISON OF STEEL CONSUMPTION:

Element	Tonnage (MT)	
	Built-up Sections	Apollo Column
HR Plate sections with web stiffeners	907.5	-
Pipe/Tube sections	-	620
Connection plates and stiffeners	165	160
Anchor bolts & connection bolts	27.5	20
Total Steel Consumption(MT)	1100	800

RESULTS & CONCLUSIONS:

- Building have 2 basements, as need to complete project faster, so basement structure is taken up in steel.
- With APL Apollo big sizes section, customer will get 2% extra carpet area/seller area because of tubes only.
- Building will have deck slab with minimum reinforcement.
- Zero shuttering work for encasing column, as required in built-up sections, lead to same time & cost.
- Wastage of steel in peb steel building is approx. 5-6% while in Structural Tube building it is ranging 0.5-1.0 % max.



27.0% Less Steel Consumption



26.5% Saving In Total Project Cost

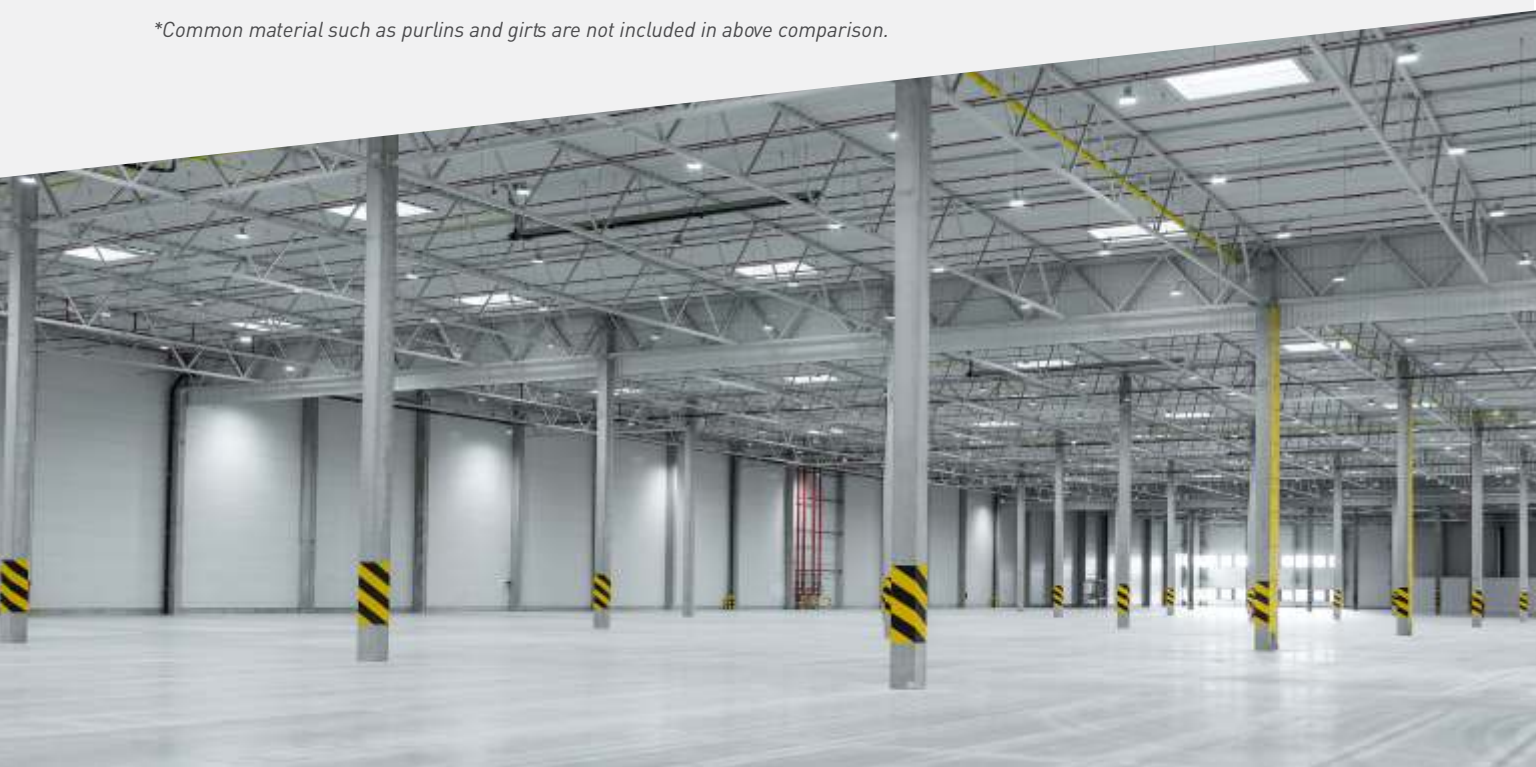
CASE STUDY 4

WAREHOUSE SHED USING APOLLO COLUMN

COST COMPARISON OF WAREHOUSE SHED

Particulars	PEB – Using Built - Up Section	PEB – Using Apollo Column
Total Steel consumption (Ton)	719.4	608.6 15.4% ↓
Raw Material (Rs/kg)	60.0	65
Conversion Cost (Rs/kg)	20.0	15
Transportation (Rs/kg)	1.0	2.0
Erection (Rs/kg)	10.0	10
Total cost (Rs/kg)	91.0	92
Project Cost (Rs Cr)*	6.6	5.6 14.5% ↓

*Common material such as purlins and girts are not included in above comparison.



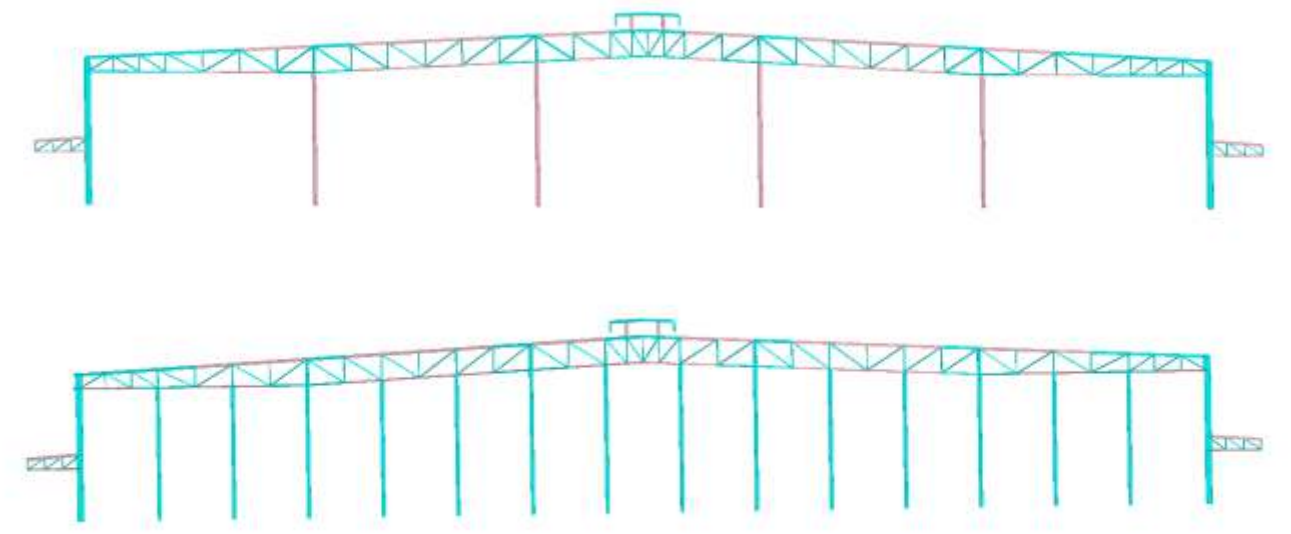
WAREHOUSE SHED

OVERVIEW:

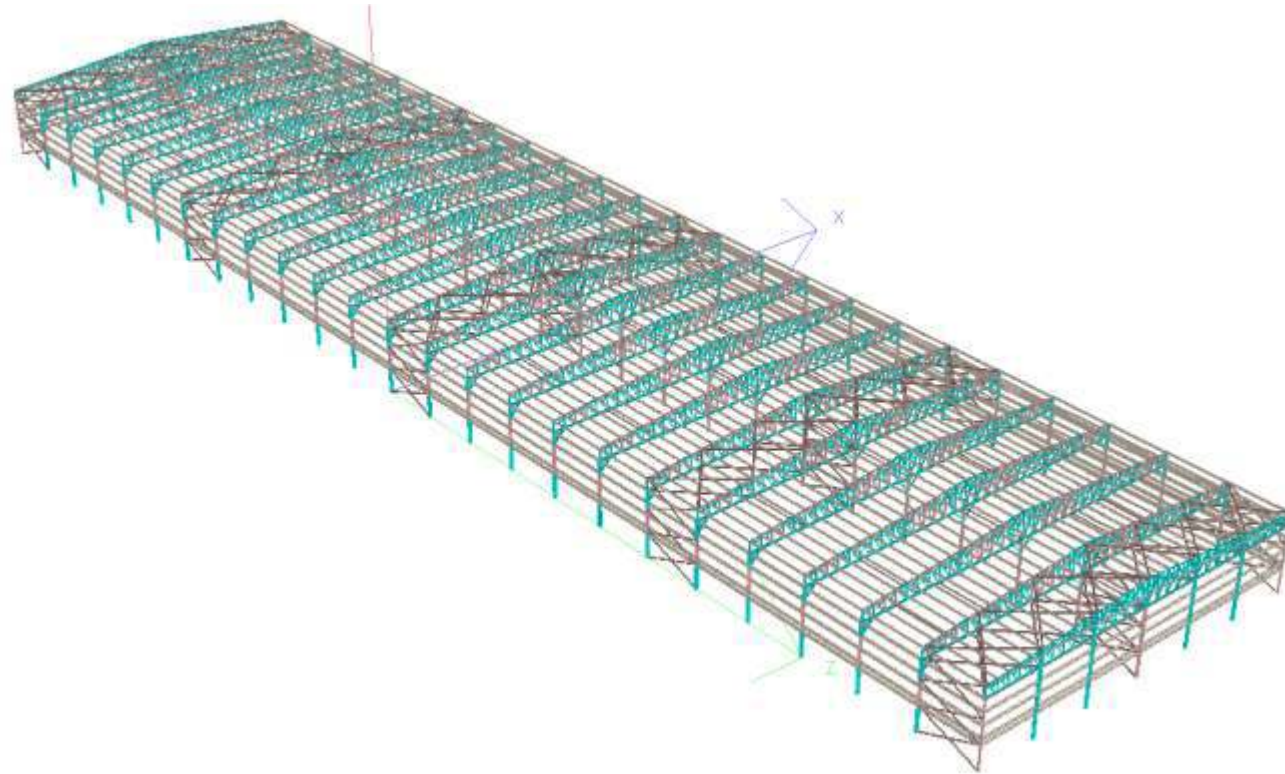
The Warehouse shed of built-up area 30937 sqm. Shed Building have 4.5m wide canopy along length on both sides, Designed using ASIC, MBMA & AISI-96 by staad pro software. The structure designed with two configurations, one using built-up sections and another using hollow section (HSS). The structures are designed for the dead load, live load, wind load and seismic load.

APPROACH:

The building is designed with the two structural configurations for optimizing the material consumption while meeting structural strength requirements. After preliminary sizing of various structural members, 3-D CAD Model of structural frame of building has been generated using staad-pro connect the permissible values of the load factors and stresses has been considered as per guidelines of reference standard.



ISOMETRIC VIEW



MATERIAL

Tubular sections: Conforming to IS: 4923 & IS 1161

Built-up sections: Conforming to IS: 2062 for HR plates

Roofing Sheet: 0.47 mm thick (TCT) Bare Galvalume Sheet of 550 MPa. Grade

Wall Cladding: 0.5 mm thick (TCT) Colour Coated Sheet of 550 MPa. Grade

LOAD CALCULATIONS

(i) DEAD LOAD

The dead load on structure includes all the permanent loads attached with structure i.e. self-weight of structure, roofing sheet. Following are the permanent loads which have been considered In design & analysis.

Structural load – Self weight of structure

Connections load -15% of weight of structure

Dead weight of roof sheeting – 4.5kg/sqm

Dead weight of wall cladding – 4.5kg/sqm

Load on purlins – $(0.03 + 0.045) \times 1.5 = 0.1125\text{kN/m}$

Load on girts – $0.045 \times 1.5 = 0.0675\text{kN/m}$

(ii) IMPOSED LOADS

Imposed loads as per MBMA-2012

Roof live load – 0.57kN/sqm

(iii) WIND LOAD

Wind loads has been calculated as per MBMA-2012

Basic wind speed of - 47 m/s, (as per NBC 2016)

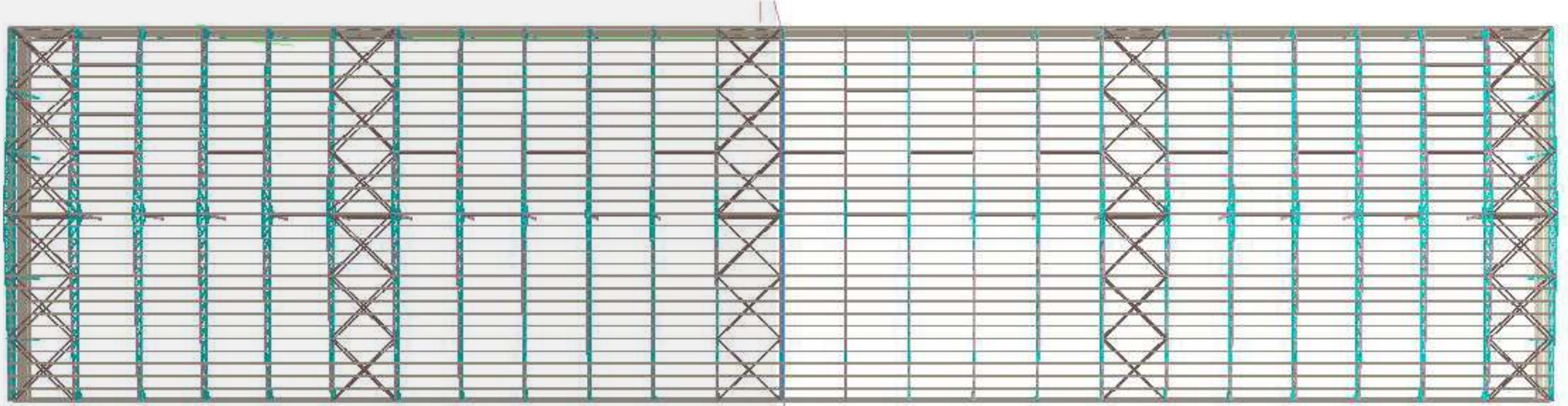
Exposure category – C

Design Life – 50yrs

Enclosure Condition – Enclosed

(iv) SEISMIC LOAD

In light weight low-rise structures such as the proposed building, seismic loads are Inconsequential while wind load affects are pre-dominant, still seismic loads as per IS 1893 have been evaluated by static method and the structure have been checked for adequacy for relevant seismic load combinations.



PLAN

COMPARISON OF STEEL CONSUMPTION:

Element	Tonnage (MT)	
	Built-up Sections	Apollo Column
HR Plate sections with web stiffeners	576	0
Pipe/Tube sections	0	503
Connection plates and stiffeners	76.7	65.4
Anchor bolts & connection bolts	45.5	40.2
Flange brace angles	21.2	0
Total Steel Consumption(MT)	719.4	608.6

RESULT & CONCLUSIONS

- Wastage of steel in peb steel building is approx. 5-6% while in Structural Tube building it is ranging 0.3-0.5 % max.
- Almost Zero waste as Apl Apollo will supply Cut-to-length sizes lead less fabrication time as well as zero wastage
- With APL Apollo DFT sizes, customer will get 5%-10% saving due to customized sizes



15.4% Less Steel Consumption



14.5% Saving In Total Project Cost

APL APOLLO LIVE PROJECT

Dujana Industrial Shed

ABOUT THE PROJECT

Apollo Tricoat Tubes Ltd has an upcoming Greenfield Project at Dujana, UP. The proposed Industrial Structure of 78000 sq. ft. consists of 146 m long shed having 49 m width with clear height of 11 m and 15 MT crane. The shed is constructed using APL Apollo Steel Tube. The structure is well designed for the Dead Load, Live Load, Wind Load, Earthquake Load and Crane Load.

CHALLENGES

The challenge was to reduce the weight and cost of the industrial shed. Our findings in the research work showed a significant reduction in steel consumption in HSS structures as compared to built-up structures. The project aimed at developing an optimised industrial shed with minimum construction time and zero onsite fabrication.

SOLUTION

APL Apollo Steel Tube & Cladding Project Pvt. Ltd. worked together to achieve the results received from the research work & put it all theoretical research work in real time project. The optimised steel structure was designed & constructed using APL Apollo Steel Tube.

RESULT & DISCUSSION



340^{MT} Steel Consumption



25% less steel consumption



15% saving in total project cost




MYTH ABOUT HSS BUILDINGS

Myth
Bolted connections are difficult in HSS structure

1

Fact




Bolted connections are easily implementable in HSS structure as per code compliance. Extended end plate to HSS beam permits the use of conventional bolted connection

2

Myth
High raw material cost increases the project cost

Fact




Use of HSS sections against Built-up sections in steel structures significantly reduces weight which decreases the overall project cost

3

Myth
Unavailability of bigger sizes in the market

Fact




APL Apollo provides tubes of sizes up to 300x300.

4

Myth
HSS structures need site fabrication

Fact




Zero onsite fabrication using automatic welding equipment is possible

5

Myth
HSS structures are architecturally borings

Fact




Ease of fabrication using HSS sections provides flexibility to the architects to shape their structures and express their creativity.

6

Myth
Wastage of material is high

Fact



APL Apollo provides cut to length sizes from 4 to 12 mm to avoid wastage

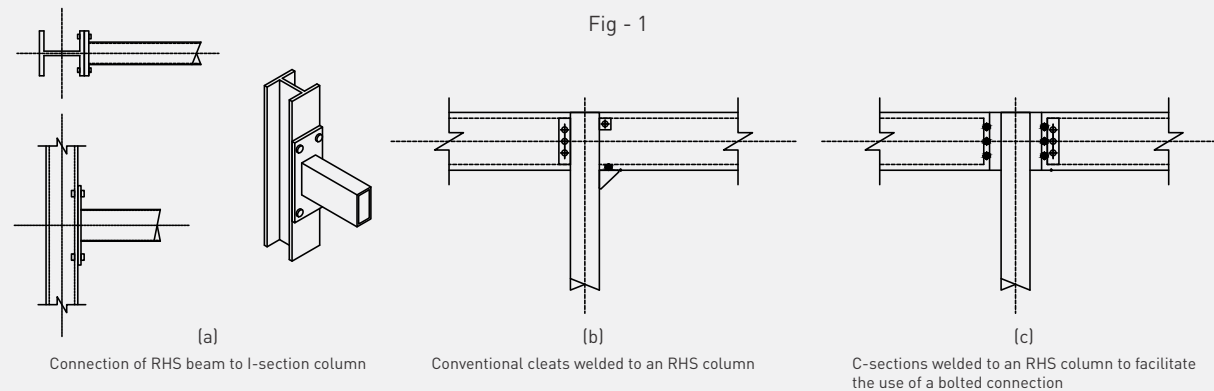
HOW TO MAKE A SUCCESSFUL BUILDING USING HSS?

1. HSS CONNECTIONS

WELDED AND BOLTED CONNECTION

Beams and columns are usually connected on site by bolting. In the case of an RHS beam connection to an I-section column, a welded extended end-plate to the RHS beam permits the use of a conventional bolted connection to the column flange or web (see Figure 1.a). The bolts may be countersunk into the thick end-plate if the connection is important visually.

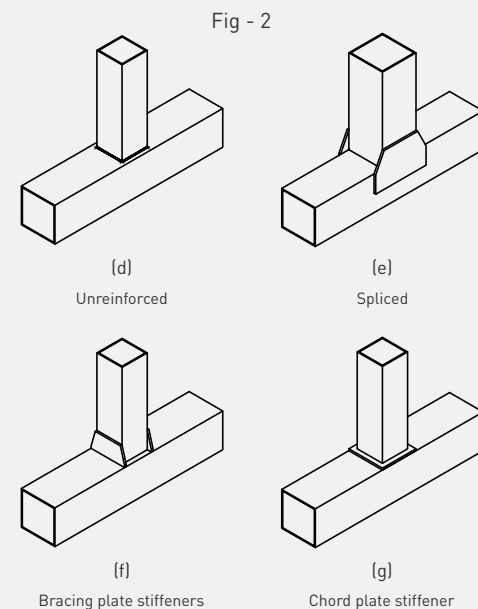
A number of typical simple connections using cleats welded to an RHS column are shown in Figures 1.b to c. Figure 1(b) shows a fin plate welded to the face of the column and the supporting bracket can be detailed to be visually interesting. Figure 1(c) shows the use of channels welded at the tips of their flanges.



VIERENDEEL TRUSSES

are relatively inefficient at resisting high shear forces because of the lack of diagonal bracing and, therefore, it is necessary to use thicker or larger chord members than in triangulated trusses. Ideally, the chord and vertical members should be the same external size. If not, stiffening elements are generally inserted to increase the local bending resistance of the connections. Figure 2 shows various ways in which nominally pinned connections can be strengthened in Vierendeel trusses.

Various ways in which normally pinned connection can be strength Fig - 6 (c)(d)(e)(f)(g)

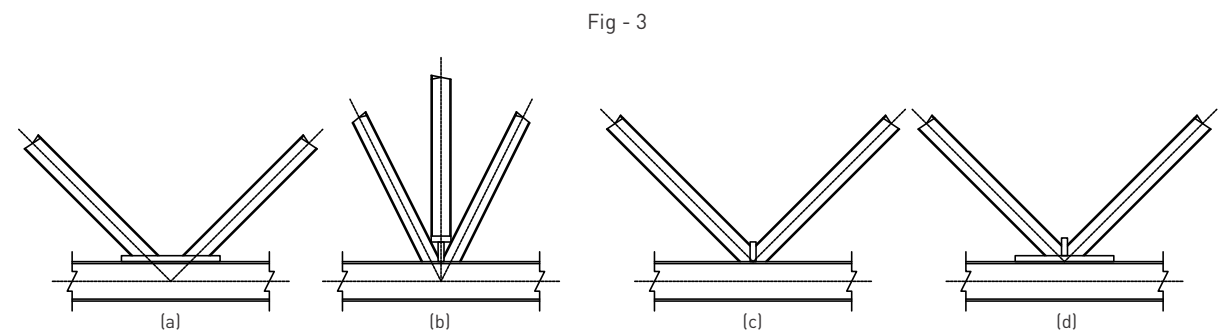


REINFORCEMENT OF CONNECTIONS

For maximum resistance of the members, it is usually more efficient to select larger HSS sections with thin walls. However, when designing the connections, it is more advantageous to use chord members that are thicker and smaller in section (provided that they are not smaller than the bracing members). Therefore, a compromise is necessary for overall design and fabrication efficiency.

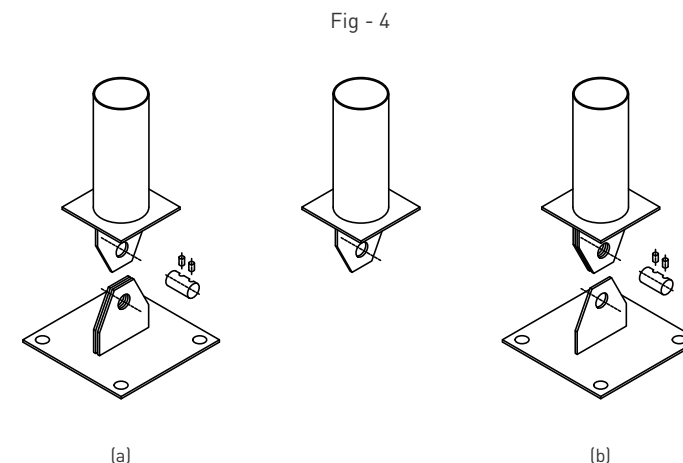
In some cases, connections may have to be strengthened locally to resist the applied forces, if it is not possible to increase the member size or thickness. This can be achieved by welding plates to the chord face (see Figure 3(a)). It should also be noted that overlaps will also increase the connection resistance, especially for RHS members. When a third member is required at the intersection, a 'T' piece can also be used (see Figure 3(b)).

Other non-standard stiffened K connections can be used to increase the load capacity of the connection, as illustrated in Figure 3(c&d).



COLUMN BASES

Bases to HSS columns take two basic forms: pinned and rigid (or moment-resisting). The details employed reflect the transfer of forces and moments. A genuine pinned connection can be achieved by a single pin from a projecting plate, as shown in Figure 4.

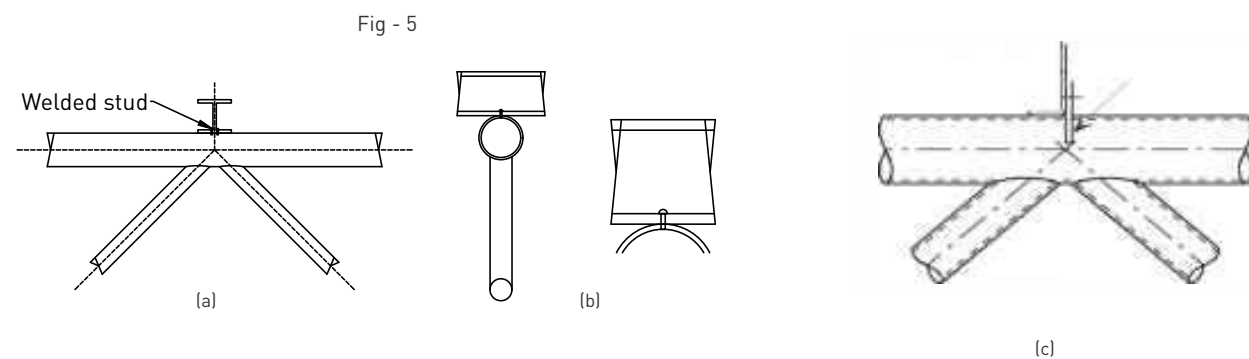


Some examples of HSS connections with pinned ends

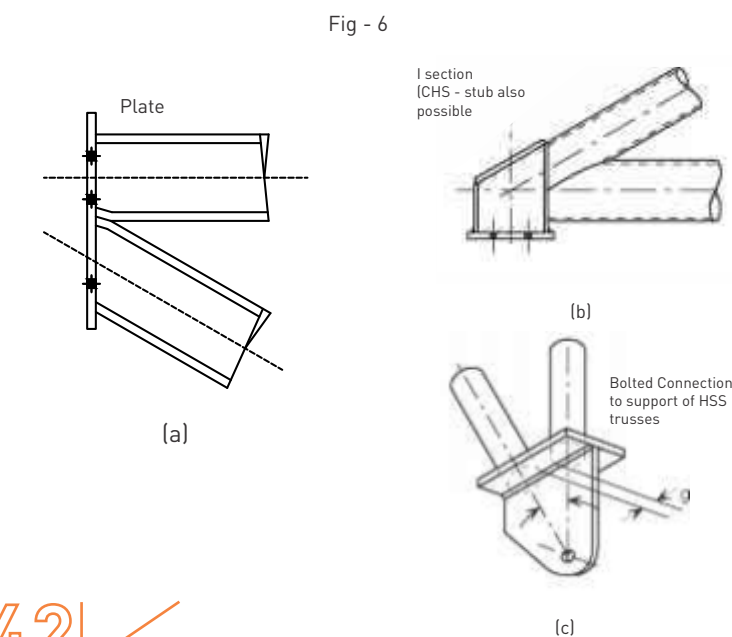
WELDED FINNS

Fins or brackets may be welded to the side of CHS or SHS/RHS sections to provide direct attachment of secondary members such as purlins (see Figure 5). Connections of this type require careful design because of the possible local distortion of the walls of larger hollow sections. Alternatively, welded threaded studs with extended washers may be used to attach the purlins to the section.

The attachment of tension-ties or rod-bracing members requires similar details. High local forces from ties may also be transferred by 'patch-type' connections, which may be profiled around the circular section so that weld forces are transferred smoothly to the walls of the section. Multiple welded fin connections have been used successfully on a number of major projects, such as at the column bases at the Cologne Airport terminal, as shown in Figure 5(d)

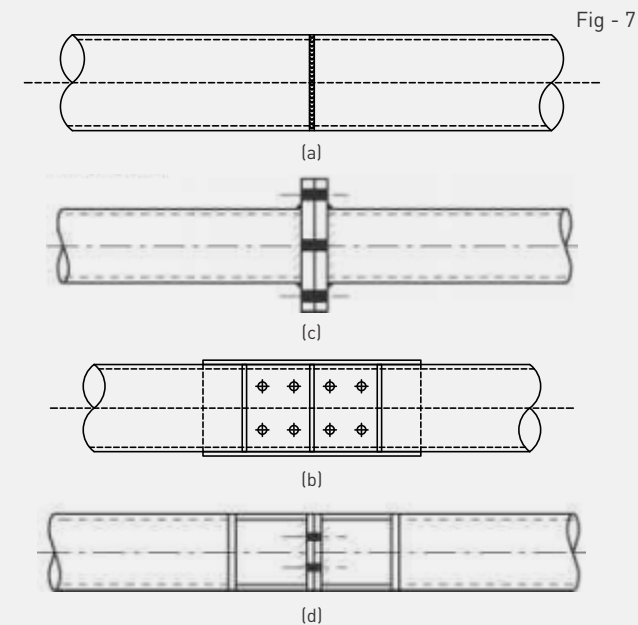


Bolted connections are desirable for site assembly, and large welded sub-assemblies that are prefabricated and bolted together on site at suitable locations. The practical aspects of installation should be considered in the design process. For example, Figure 6 shows



HSS SPLICE CONNECTION

FLANGE PLATES (Figure - 7) are simple to make but are not aesthetically pleasing. They are suitable for compression but are less efficient for tension because of bending in the end plate, requiring thicker plates and more bolts. Fillet welding around the section could cause distortion of thin flange plates.



Moment - resisting connection is achieved by a welded end- plate with four or more bolts. The thickness of the end plate depends on the moment to be transferred

SPLICE CONNECTION WITH PLUG WELDING

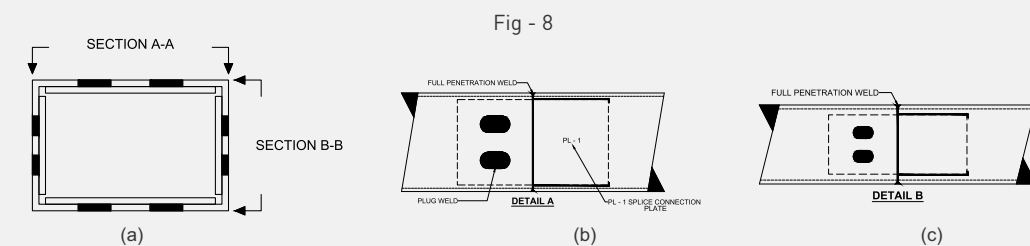


Fig - 9
Interesting details can be created using cast iron or cast steel nodes in a pinned connection

HSS TRUSS

For the connection of HSS trusses to RHS columns, typical bolted details are shown in Figure 10. High shear-forces may require the use of more bolts than shown. The sharing of load between the upper and lower chords in the connection depends on the presence of a vertical bracing member at the end of the truss. In the detail of Figure 11(a), the upper connection will resist all of the applied shear-force. In Figure 10(b), the upper and lower parts of the connections may be assumed to resist equal shear-force.

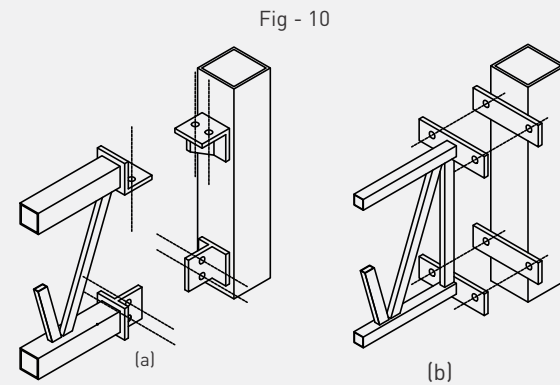
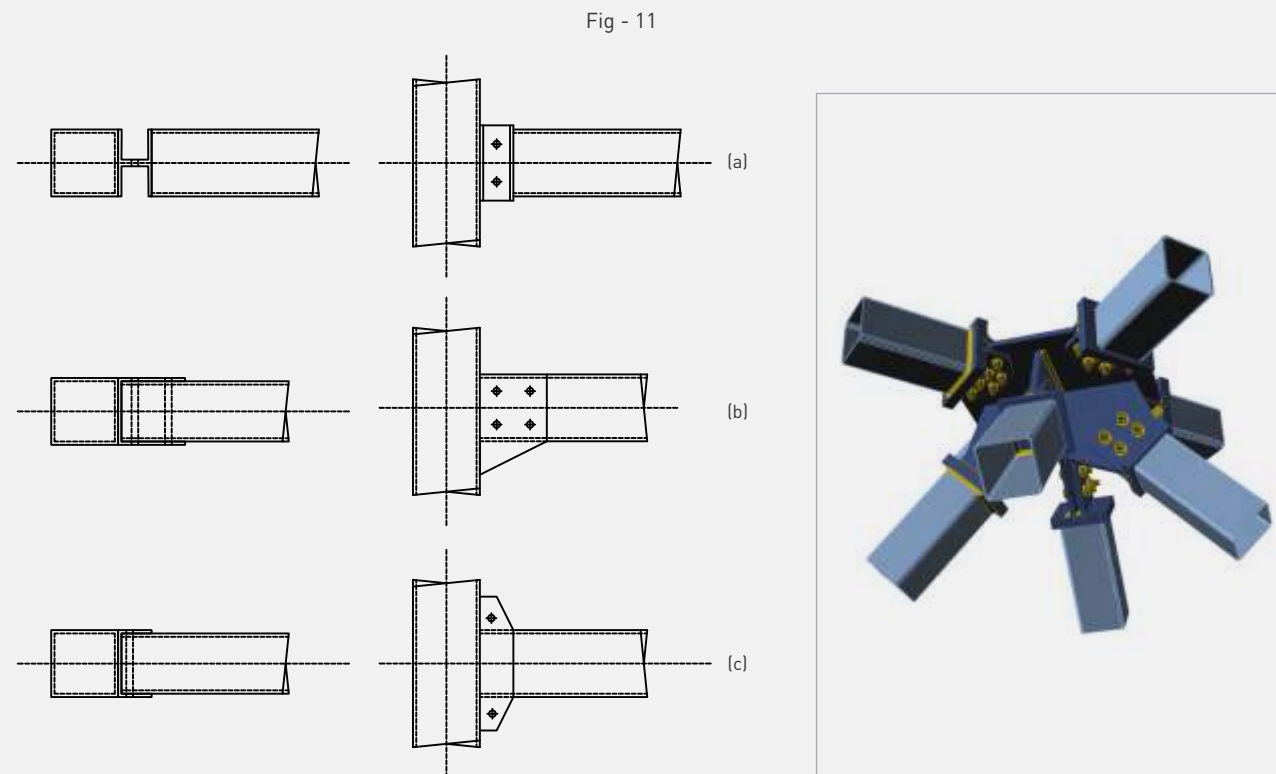


Figure 10(a&b) - Truss to SHS/RHS column connection

HSS BEAM TO AN HSS COLUMN

Figure 11 shows other typical connections of an RHS beam to an RHS column. For lightly loaded connections, the T-section shown in Figure 11(a) may be replaced with a fin plate. Where through bolting is used (as in Figure 11(b) and Figure 11(c)), spacer tubes



Typical connection of an RHS beam to an RHS column a,b&c

2. FACTORY CONTROLLED FABRICATION

Prefabrication is the singled out approach to build steel structures using HSS because it allows the considerable part of the process to happen on the workshop floor where more tools and materials are readily available, thus reducing the costs of transportation and enabling for faster modification & conversion. Fabrication of hollow steel sections carried out in shops is precise and of assured quality.



3. AUTOMATION IN WELDING

With advancement in engineering & technology, automatic weld beam welding lines are available for fabrication of HSS structures. The automated process ensures superior weld quality due to the electronic controller and also the results are much more consistent than in manual welding.

Benefits

- 1) Cost reduction
- 2) Increased productivity
- 3) Consistent accuracy
- 4) Minimum wastage
- 5) Lower labour cost



4. ERECTION USING BOLTING CONNECTION

Erection involves the assembly of HSS components into a desired frame at site. Hollow steel sections are fabricated at the factory to the exact size, transported to site and assembled at site using bolted connections. Bolted connections are easily implementable in HSS structure (Refer: HSS connections). Extended end plate to HSS components permits the use of conventional bolted connections.



SQUARE HOLLOW SECTION



Square Size Range

12mm X 12mm to 500mm X 500mm

Thickness

1mm to 20mm

Upcoming Range

Upto 1000 X 1000mm

Thickness

40mm

SQUARE HOLLOW SECTION (SHS) IS : 4923 : 2017/EN 10219-1 : 2006*/ASTM A-500

Dimension	Weight	Area	Moment of Inertia		Radius of Gyration		Elastic Modulus		Plastic Modulus		Torsional Constants	
			I _{xx} cm ⁴	I _{yy} cm ⁴	R _{xx} cm	R _{yy} cm	Z _{xx} cm ³	Z _{yy} cm ³	S _{xx} cm ³	S _{yy} cm ³	J cm ⁴	C cm ³
12X12X1.6	0.47	0.60	0.10	0.10	0.41	0.41	0.17	0.17	0.22	0.22	0.12	0.18
12X12X2.0	0.55	0.70	0.11	0.11	0.40	0.40	0.19	0.19	0.25	0.25	0.07	0.13
15X15X1.6	0.62	0.79	0.23	0.23	0.54	0.54	0.31	0.31	0.39	0.39	0.32	0.38
15X15X2.0	0.74	0.94	0.25	0.25	0.52	0.52	0.34	0.34	0.44	0.44	0.28	0.35
15X15X2.2	0.79	1.00	0.25	0.25	0.50	0.50	0.34	0.34	0.46	0.46	0.24	0.32
20X20X1.6	0.87	1.11	0.61	0.61	0.74	0.74	0.61	0.61	0.75	0.75	0.95	0.84
20X20X2.0	1.05	1.34	0.69	0.69	0.72	0.72	0.69	0.69	0.88	0.88	1.01	0.90
20X20X2.2	1.13	1.44	0.73	0.73	0.71	0.71	0.73	0.73	0.93	0.93	1.00	0.90
20X20X2.5	1.25	1.59	0.77	0.77	0.70	0.70	0.77	0.77	1.00	1.00	0.95	0.87
25X25X1.6	1.12	1.43	1.28	1.28	0.95	0.95	1.03	1.03	1.24	1.24	2.05	1.46
25X25X2.0	1.37	1.74	1.48	1.48	0.92	0.92	1.19	1.19	1.47	1.47	2.32	1.64
25X25X2.2	1.48	1.88	1.57	1.57	0.91	0.91	1.26	1.26	1.57	1.57	2.40	1.70
25X25X2.5	1.64	2.09	1.69	1.69	0.90	0.90	1.36	1.36	1.71	1.71	2.46	1.75
25X25X2.8	1.79	2.28	1.79	1.79	0.89	0.89	1.44	1.44	1.84	1.84	2.44	1.76
30X30X1.6	1.37	1.75	2.31	2.31	1.15	1.15	1.54	1.54	1.84	1.84	3.73	2.24
30X30X2.0	1.68	2.14	2.72	2.72	1.13	1.13	1.82	1.82	2.21	2.21	4.35	2.59
30X30X2.2	1.82	2.32	2.91	2.91	1.12	1.12	1.94	1.94	2.37	2.37	4.60	2.72
30X30X2.5	2.03	2.59	3.16	3.16	1.10	1.10	2.11	2.11	2.61	2.61	4.89	2.89
30X30X2.8	2.23	2.84	3.37	3.37	1.09	1.09	2.25	2.25	2.83	2.83	5.06	2.99
30X30X3.2	2.49	3.17	3.62	3.62	1.07	1.07	2.42	2.42	3.08	3.08	5.10	3.05
30X30X3.6	2.72	3.47	3.82	3.82	1.05	1.05	2.55	2.55	3.31	3.31	4.92	2.99
30X30X4.0	2.94	3.75	3.97	3.97	1.03	1.03	2.65	2.65	3.50	3.50	4.52	2.84
30X30X4.5	3.19	4.07	4.09	4.09	1.00	1.00	2.73	2.73	3.70	3.70	3.72	2.49
30X30X5.0	3.42	4.36	4.16	4.16	0.98	0.98	2.78	2.78	3.84	3.84	2.69	1.98
30X30X5.4	3.58	4.56	4.17	4.17	0.96	0.96	2.78	2.78	3.93	3.93	1.80	1.49
30X30X6.0	3.79	4.83	4.12	4.12	0.92	0.92	2.75	2.75	4.01	4.01	0.69	0.76
32X32X1.6	1.48	1.88	2.84	2.84	1.23	1.23	1.78	1.78	2.12	2.12	4.59	2.60
32X32X2.0	1.81	2.30	3.36	3.36	1.21	1.21	2.10	2.10	2.54	2.54	5.40	3.02
32X32X2.2	1.96	2.50	3.60	3.60	1.20	1.20	2.25	2.25	2.74	2.74	5.74	3.19
32X32X2.5	2.19	2.79	3.92	3.92	1.19	1.19	2.45	2.45	3.02	3.02	6.15	3.41
32X32X2.8	2.41	3.07	4.21	4.21	1.17	1.17	2.64	2.64	3.28	3.28	6.44	3.56
32X32X3.2	2.68	3.42	4.54	4.54	1.15	1.15	2.84	2.84	3.59	3.59	6.62	3.68
38X38X1.6	1.77	2.26	4.92	4.92	1.48	1.48	2.59	2.59	3.06	3.06	7.93	3.82
38X38X2.0	2.18	2.78	5.88	5.88	1.45	1.45	3.10	3.10	3.70	3.70	9.49	4.51
38X38X2.2	2.38	3.03	6.32	6.32	1.44	1.44	3.33	3.33	4.00	4.00	10.19	4.81
38X38X2.5	2.66	3.39	6.94	6.94	1.43	1.43	3.66	3.66	4.44	4.44	11.11	5.21
38X38X2.8	2.94	3.74	7.51	7.51	1.42	1.42	3.96	3.96	4.84	4.84	11.88	5.55
38X38X3.2	3.29	4.19	8.18	8.18	1.40	1.40	4.31	4.31	5.34	5.34	12.64	5.89
38X38X3.6	3.63	4.62	8.76	8.76	1.38	1.38	4.62	4.62	5.80	5.80	13.07	6.10
40X40X1.6	1.88	2.39	5.79	5.79	1.56	1.56	2.90	2.90	3.41	3.41	9.32	4.28
40X40X2.0	2.31	2.94	6.94	6.94	1.54	1.54	3.47	3.47	4.13	4.13	11.20	5.07
40X40X2.2	2.51	3.20	7.47	7.47	1.53	1.53	3.74	3.74	4.48	4.48	12.05	5.42

Regardless of the above-mentioned sizes, any size up to 1000x1000 and thickness up to 40 mm can be manufactured.

SQUARE SIZE RANGE

SQUARE SIZE RANGE

SQUARE SIZE RANGE

SQUARE HOLLOW SECTION (SHS) IS : 4923 : 2017/EN 10219-1 : 2006*/ASTM A-500

Table with 13 columns: Dimension (mm), Weight (kg/m), Area (cm²), Moment of Inertia (Ixx, Iyy in cm⁴), Radius of Gyration (Rxx, Ryy in cm), Elastic Modulus (Zxx, Zyy in cm³), Plastic Modulus (Sxx, Syy in cm³), and Torsional Constants (J, C in cm⁴, cm³).

SQUARE HOLLOW SECTION (SHS) IS : 4923 : 2017/EN 10219-1 : 2006*/ASTM A-500

Table with 13 columns: Dimension (mm), Weight (kg/m), Area (cm²), Moment of Inertia (Ixx, Iyy in cm⁴), Radius of Gyration (Rxx, Ryy in cm), Elastic Modulus (Zxx, Zyy in cm³), Plastic Modulus (Sxx, Syy in cm³), and Torsional Constants (J, C in cm⁴, cm³).

ALLOWABLE STRESS VALUES (IN MPA) AND DIMENSIONAL TOLERANCE IS 4923:2017, TABLE 4, (Clauses 19.2)

Table with 6 columns: S. No., Grade, Tensile Strength (Min), Yield Strength (Min), Elongation (Min), and DIMENSIONAL TOLERANCE (Outside Dimensional, Thickness, Squareness, Corner radius, Weight).

*Galvanised sections can also be manufactured

*Customised sections can also be manufactured.

TENSILE PROPERTIES OF STEEL TUBES FOR STRUCTURAL PURPOSE IS 1161:2014, TABLE 2, (Clauses 3.1 and 11.2)

Table with 5 columns: S. No., Grade, Tensile Strength (Min), Yield Strength (Min), Elongation on Gauge Length (Min).

TENSILE PROPERTIES OF STEEL TUBES SECTIONS IS 4923:2017, TABLE 4, (Clauses 19.2)

Table with 5 columns: S. No., Grade, Tensile Strength (Min), Yield Strength (Min), Elongation (Min).

Regardless of the above-mentioned sizes, any size up to 1000x1000 and thickness up to 40 mm can be manufactured.

Regardless of the above-mentioned sizes, any size up to 1000x1000 and thickness up to 40 mm can be manufactured.

RECTANGULAR HOLLOW SECTION



Rectangular Size Range

26mm X 13mm to 400mm X 200mm

Thickness

1mm to 20mm

Upcoming Range

Upto 1000 X 600mm

Thickness

40mm

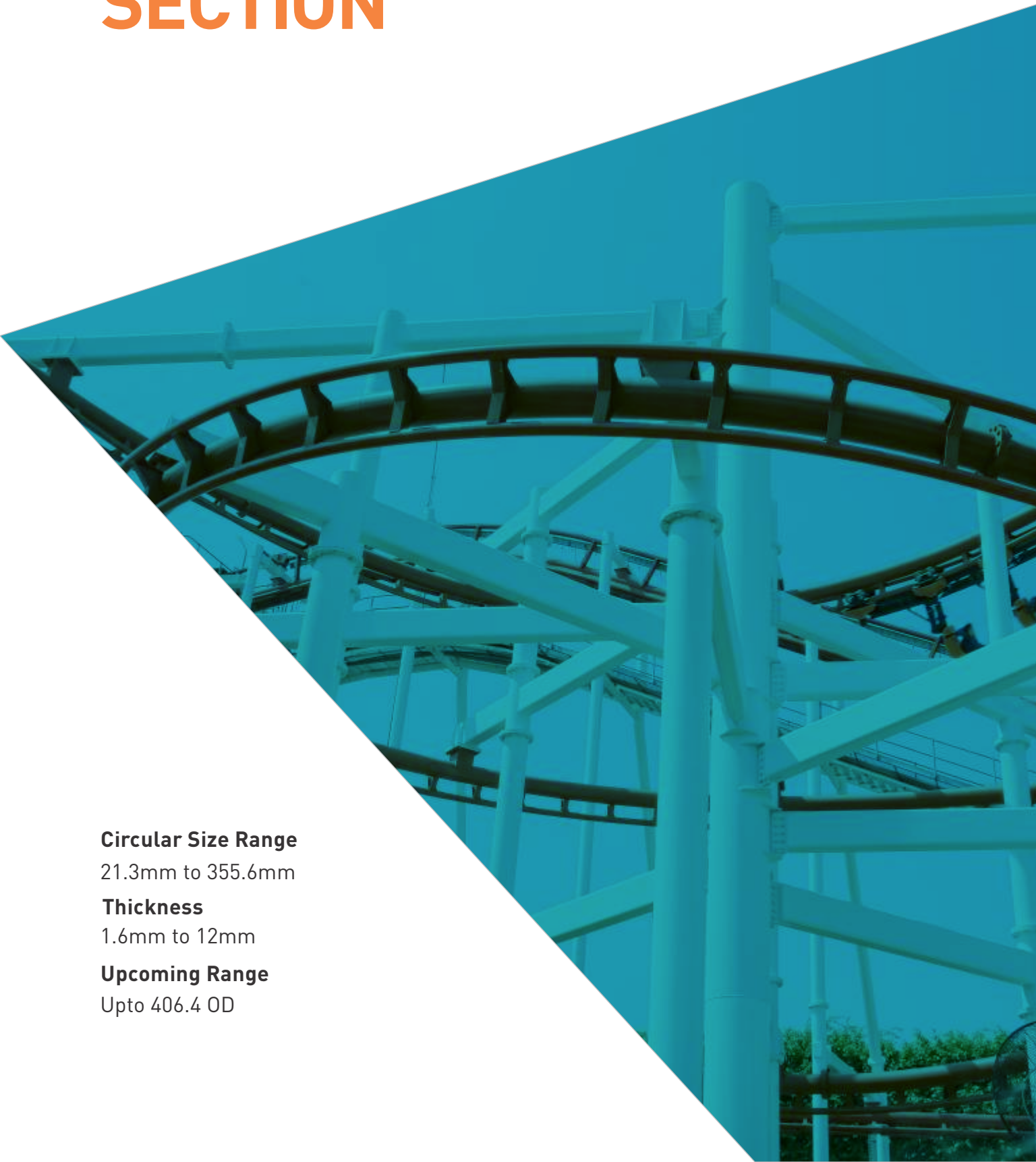
RECTANGULAR HOLLOW SECTION (RHS) IS : 4923 : 2017/EN 10219-1 : 2006*/ASTM A-500

Dimension mm	Weight kg/m	Area cm ²	Moment of Inertia		Radius of Gyration		Elastic Modulus		Plastic Modulus		Torsional Constants	
			I _{xx} cm ⁴	I _{yy} cm ⁴	R _{xx} cm	R _{yy} cm	Z _{xx} cm ³	Z _{yy} cm ³	S _{xx} cm ³	S _{yy} cm ³	J cm ⁴	C cm ³
26 X 13 X 1.6	0.85	1.08	0.83	0.27	0.88	0.50	0.64	0.42	0.84	0.51	0.63	0.66
26 X 13 X 2.0	1.02	1.30	0.94	0.30	0.85	0.48	0.73	0.47	0.98	0.59	0.64	0.67
30 X 20 X 1.6	1.12	1.43	1.66	0.88	1.08	0.78	1.11	0.88	1.39	1.05	1.85	1.38
30 X 20 X 2.0	1.37	1.74	1.94	1.02	1.06	0.77	1.30	1.02	1.65	1.24	2.08	1.55
30 X 20 X 2.2	1.48	1.88	2.05	1.08	1.04	0.76	1.37	1.08	1.76	1.32	2.15	1.60
40 X 10 X 1.6	1.12	1.43	2.25	0.22	1.25	0.39	1.13	0.44	1.57	0.54	0.65	0.76
40 X 10 X 2.0	1.37	1.74	2.60	0.25	1.22	0.38	1.30	0.50	1.85	0.63	0.65	0.78
40 X 20 X 1.6	1.37	1.75	3.43	1.15	1.40	0.81	1.72	1.15	2.18	1.34	2.83	1.92
40 X 20 X 2.0	1.68	2.14	4.05	1.34	1.38	0.79	2.03	1.34	2.61	1.60	3.25	2.19
40 X 20 X 2.2	1.82	2.32	4.32	1.43	1.36	0.79	2.16	1.43	2.81	1.71	3.40	2.29
40 X 20 X 2.5	2.03	2.59	4.69	1.54	1.35	0.77	2.35	1.54	3.09	1.88	3.55	2.40
40 X 25 X 1.6	1.50	1.91	4.02	1.93	1.45	1.01	2.01	1.55	2.49	1.80	4.25	2.51
40 X 25 X 2.0	1.84	2.34	4.77	2.28	1.43	0.99	2.39	1.83	2.99	2.16	4.99	2.91
40 X 25 X 2.2	1.99	2.54	5.11	2.43	1.42	0.98	2.56	1.95	3.23	2.32	5.28	3.07
40 X 25 X 2.5	2.23	2.84	5.57	2.64	1.40	0.96	2.79	2.12	3.56	2.56	5.64	3.27
50 X 25 X 1.6	1.75	2.23	7.02	2.37	1.77	1.03	2.81	1.90	3.53	2.17	5.83	3.21
50 X 25 X 2.0	2.15	2.74	8.38	2.81	1.75	1.01	3.36	2.25	4.26	2.62	6.90	3.76
50 X 25 X 2.2	2.34	2.98	9.01	3.01	1.74	1.01	3.61	2.41	4.61	2.82	7.35	3.99
50 X 25 X 2.5	2.62	3.34	9.89	3.28	1.72	0.99	3.96	2.63	5.11	3.12	7.93	4.29
50 X 30 X 1.6	1.88	2.39	7.96	3.60	1.82	1.23	3.19	2.40	3.91	2.75	8.07	3.96
50 X 30 X 2.0	2.31	2.94	9.54	4.29	1.80	1.21	3.82	2.86	4.74	3.33	9.65	4.67
50 X 30 X 2.2	2.51	3.20	10.27	4.61	1.79	1.20	4.11	3.08	5.14	3.60	10.35	4.99
50 X 30 X 2.5	2.82	3.59	11.30	5.05	1.77	1.19	4.52	3.37	5.70	3.98	11.28	5.40
50 X 30 X 2.8	3.11	3.96	12.24	5.45	1.76	1.17	4.90	3.64	6.23	4.35	12.05	5.75
50 X 30 X 3.2	3.49	4.45	13.38	5.93	1.73	1.15	5.36	3.96	6.89	4.80	12.81	6.11
50 X 30 X 3.6	3.85	4.91	14.38	6.34	1.71	1.14	5.76	4.23	7.50	5.21	13.25	6.33
50 X 30 X 4.0	4.20	5.35	15.25	6.69	1.69	1.12	6.10	4.46	8.05	5.58	13.33	6.42
50 X 30 X 4.5	4.61	5.87	16.16	7.05	1.66	1.10	6.47	4.70	8.67	5.99	12.94	6.35
50 X 30 X 5.0	4.99	6.36	16.87	7.33	1.63	1.07	6.75	4.89	9.20	6.34	12.00	6.06
50 X 30 X 6.0	5.68	7.23	17.77	7.65	1.57	1.03	7.11	5.10	10.04	6.89	8.67	4.86
50 X 30 X 8.0	6.74	8.59	17.66	7.57	1.43	0.94	7.07	5.05	10.83	7.36	1.34	1.45
60 X 40 X 1.6	2.38	3.03	15.22	8.16	2.24	1.64	5.08	4.08	6.12	4.64	17.10	6.63
60 X 40 X 2.0	2.94	3.74	18.41	9.83	2.22	1.62	6.14	4.92	7.47	5.65	20.77	7.96
60 X 40 X 2.2	3.20	4.08	19.92	10.62	2.21	1.61	6.64	5.31	8.12	6.14	22.49	8.56
60 X 40 X 2.5	3.60	4.59	22.07	11.74	2.19	1.60	7.36	5.87	9.06	6.84	24.89	9.41
60 X 40 X 2.8	3.99	5.08	24.10	12.78	2.18	1.59	8.04	6.39	9.95	7.51	27.08	10.17
60 X 40 X 3.2	4.50	5.73	26.61	14.07	2.15	1.57	8.87	7.04	11.09	8.36	29.63	11.05
60 X 40 X 3.6	4.98	6.35	28.90	15.23	2.13	1.55	9.64	7.62	12.16	9.15	31.72	11.79
60 X 40 X 4.0	5.46	6.95	30.99	16.28	2.11	1.53	10.33	8.14	13.16	9.89	33.31	12.36
60 X 40 X 4.5	6.02	7.67	33.31	17.44	2.08	1.51	11.11	8.72	14.32	10.75	34.57	12.85
60 X 40 X 5.0	6.56	8.36	35.33	18.43	2.06	1.48	11.78	9.22	15.38	11.52	34.95	13.08
60 X 40 X 6.0	7.56	9.63	38.50	19.95	2.00	1.44	12.84	9.98	17.20	12.84	33.01	12.74

Regardless of the above-mentioned sizes, any size up to 1000x1000 and thickness up to 40 mm can be manufactured.

RECTANGULAR SIZE RANGE

CIRCULAR HOLLOW SECTION



Circular Size Range

21.3mm to 355.6mm

Thickness

1.6mm to 12mm

Upcoming Range

Upto 406.4 OD

CIRCULAR HOLLOW SECTION IS:1161 : 2014

Outside Diameter	Thickness	Mass	Area of Cross Section	Internal Volume	Moment of Inertia	Elastic Modulus	Plastic Modulus	Radius of Gyration	Square of Radius of Gyration	Torsional Constant
mm	mm	kg/m	cm ²	cm ³ /m	cm ⁴	cm ³	cm ³	cm	cm ²	cm ³
21.3	1.6	0.78	0.99	257	0.48	0.45	0.62	0.70	0.49	0.91
21.3	1.8	0.87	1.10	246	0.53	0.50	0.69	0.69	0.48	0.99
21.3	2.0	0.95	1.21	235	0.57	0.54	0.75	0.69	0.47	1.07
21.3	2.2	1.04	1.32	224	0.61	0.57	0.81	0.68	0.46	1.15
21.3	2.5	1.16	1.48	209	0.66	0.62	0.89	0.67	0.45	1.25
21.3	2.8	1.28	1.63	194	0.71	0.67	0.97	0.66	0.44	1.34
26.4	1.6	0.98	1.25	423	0.96	0.73	0.99	0.88	0.77	1.46
26.4	1.8	1.09	1.39	408	1.06	0.80	1.09	0.87	0.76	1.60
26.4	2.0	1.20	1.53	394	1.15	0.87	1.19	0.87	0.75	1.74
26.4	2.2	1.31	1.67	380	1.23	0.94	1.29	0.86	0.74	1.87
26.4	2.5	1.47	1.88	360	1.35	1.03	1.43	0.85	0.72	2.05
26.4	2.8	1.63	2.08	340	1.47	1.11	1.57	0.84	0.71	2.22
33.7	1.6	1.27	1.61	731	2.08	1.24	1.65	1.14	1.29	2.47
33.7	1.8	1.42	1.80	712	2.30	1.37	1.83	1.13	1.28	2.73
33.7	2.0	1.56	1.99	693	2.51	1.49	2.01	1.12	1.26	2.98
33.7	2.2	1.71	2.18	674	2.71	1.61	2.19	1.12	1.25	3.22
33.7	2.5	1.92	2.45	647	3.00	1.78	2.44	1.11	1.22	3.56
33.7	2.8	2.13	2.72	620	3.27	1.94	2.68	1.10	1.20	3.88
33.7	3.2	2.41	3.07	585	3.60	2.14	2.99	1.08	1.18	4.28
33.7	3.6	2.67	3.40	552	3.91	2.32	3.28	1.07	1.15	4.64
38.1	3.2	2.75	3.51	789	5.39	2.83	3.91	1.24	1.54	5.66
38.1	3.6	3.06	3.90	750	5.87	3.08	4.30	1.23	1.50	6.16
38.1	4.0	3.36	4.29	712	6.31	3.31	4.67	1.21	1.47	6.63
38.1	4.5	3.73	4.75	665	6.82	3.58	5.11	1.20	1.44	7.16
38.1	5.0	4.08	5.20	620	7.28	3.82	5.52	1.18	1.40	7.65
38.1	6.0	4.75	6.05	535	8.07	4.23	6.25	1.15	1.33	8.47
38.1	8.0	5.94	7.56	384	9.17	4.82	7.42	1.10	1.21	9.63
42.4	1.6	1.61	2.05	1207	4.27	2.02	2.66	1.44	2.08	4.03
42.4	1.8	1.80	2.30	1182	4.74	2.24	2.97	1.44	2.06	4.47
42.4	2.0	1.99	2.54	1158	5.19	2.45	3.27	1.43	2.05	4.90
42.4	2.3	2.27	2.90	1122	5.84	2.76	3.70	1.42	2.02	5.51
42.4	2.6	2.55	3.25	1087	6.46	3.05	4.12	1.41	1.99	6.10
42.4	2.9	2.83	3.60	1052	7.06	3.33	4.53	1.40	1.96	6.66
42.4	3.2	3.09	3.94	1018	7.62	3.59	4.93	1.39	1.93	7.19
42.4	3.6	3.45	4.39	973	8.33	3.93	5.44	1.38	1.90	7.86
48.3	1.6	1.84	2.35	1598	6.41	2.65	3.49	1.65	2.73	5.31
48.3	1.8	2.06	2.63	1569	7.12	2.95	3.89	1.65	2.71	5.89
48.3	2.0	2.28	2.91	1541	7.81	3.23	4.29	1.64	2.68	6.47
48.3	2.3	2.61	3.32	1500	8.81	3.65	4.87	1.63	2.65	7.30
48.3	2.6	2.93	3.73	1459	9.78	4.05	5.44	1.62	2.62	8.10
48.3	2.9	3.25	4.14	1419	10.70	4.43	5.99	1.61	2.59	8.86
48.3	3.2	3.56	4.53	1379	11.59	4.80	6.52	1.60	2.56	9.59
48.3	3.6	3.97	5.06	1327	12.71	5.26	7.21	1.59	2.51	10.52
48.3	4.0	4.37	5.57	1276	13.77	5.70	7.87	1.57	2.47	11.40
48.3	4.5	4.86	6.19	1213	15.01	6.21	8.66	1.56	2.42	12.43
48.3	5.0	5.34	6.80	1152	16.15	6.69	9.42	1.54	2.37	13.38
48.3	6.0	6.26	7.97	1035	18.19	7.53	10.81	1.51	2.28	15.07

CIRCULAR SIZE RANGE

CIRCULAR HOLLOW SECTION IS:1161 : 2014										
Outside Diameter	Thickness	Mass	Area of Cross Section	Internal Volume	Moment of Inertia	Elastic Modulus	Plastic Modulus	Radius of Gyration	Square of Radius of Gyration	Torsional Constant
mm	mm	kg/m	cm ²	cm ³ /m	cm ⁴	cm ³	cm ³	cm	cm ²	cm ³
168.3	5.0	20.14	25.65	19681	855.85	101.70	133.38	5.78	33.36	203.41
168.3	6.0	24.02	30.59	19187	1008.69	119.87	158.12	5.74	32.97	239.74
168.3	8.0	31.63	40.29	18218	1297.27	154.16	205.74	5.67	32.20	308.32
193.7	2.6	12.26	15.61	27907	712.68	73.59	94.96	6.76	45.66	147.17
193.7	2.9	13.65	17.38	27730	791.21	81.69	105.58	6.75	45.52	163.39
193.7	3.2	15.04	19.15	27553	869.00	89.73	116.14	6.74	45.38	179.45
193.7	3.6	16.88	21.50	27318	971.55	100.31	130.11	6.72	45.19	200.63
193.7	4.0	18.72	23.84	27084	1072.79	110.77	143.97	6.71	45.00	221.54
193.7	4.5	21.00	26.75	26793	1197.52	123.65	161.12	6.69	44.77	247.29
193.7	5.0	23.27	29.64	26504	1320.23	136.32	178.08	6.67	44.54	272.63
193.7	6.0	27.78	35.38	25930	1559.72	161.05	211.46	6.64	44.08	322.09
193.7	8.0	36.64	46.67	24801	2015.54	208.11	276.05	6.57	43.19	416.22
219.7	2.6	13.92	17.73	36136	1044.90	95.12	122.55	7.68	58.92	190.24
219.7	2.9	15.51	19.75	35934	1160.68	105.66	136.31	7.67	58.76	211.32
219.7	3.2	17.09	21.76	35733	1275.49	116.11	150.00	7.66	58.60	232.22
219.7	3.6	19.19	24.44	35466	1427.08	129.91	168.13	7.64	58.39	259.82
219.7	4.0	21.28	27.11	35199	1576.96	143.56	186.13	7.63	58.18	287.11
219.7	5.0	26.48	33.72	34537	1944.29	177.00	230.52	7.59	57.65	353.99
219.7	6.0	31.63	40.28	33882	2301.27	209.49	274.08	7.56	57.13	418.98
219.7	8.0	41.77	53.21	32589	2984.92	271.73	358.71	7.49	56.10	543.45
219.7	10.0	51.72	65.88	31322	3629.46	330.40	440.07	7.42	55.09	660.80
254.0	4.0	24.67	31.42	47529	2455.00	193.31	250.02	8.84	78.15	386.61
254.0	5.0	30.71	39.11	46759	3032.52	238.78	310.05	8.81	77.53	477.56
254.0	6.0	36.70	46.75	45996	3596.01	283.15	369.10	8.77	76.93	566.30
254.0	8.0	48.54	61.83	44488	4681.82	368.65	484.30	8.70	75.73	737.29
254.0	10.0	60.19	76.65	43005	5714.24	449.94	595.69	8.63	74.55	899.88
273.1	5.0	33.06	42.11	54367	3785.05	277.19	359.43	9.48	89.88	554.38
273.1	6.0	39.53	50.35	53543	4492.13	328.97	428.13	9.45	89.22	657.95
273.1	8.0	52.31	66.63	51915	5858.34	429.03	562.39	9.38	87.93	858.05
273.1	10.0	64.90	82.66	50312	7162.25	524.51	692.55	9.31	86.65	1049.03
273.1	12.0	77.28	98.43	48735	8405.78	615.58	818.65	9.24	85.40	1231.17
323.9	5.0	39.33	50.09	77388	6369.42	393.30	508.53	11.28	127.15	786.59
323.9	6.0	47.05	59.92	76405	7572.47	467.58	606.43	11.24	126.37	935.16
323.9	8.0	62.34	79.39	74458	9910.08	611.92	798.51	11.17	124.82	1223.84
323.9	10.0	77.43	98.61	72536	12158.34	750.75	985.67	11.10	123.29	1501.49
323.9	12.0	92.32	117.58	70639	14319.56	884.20	1167.96	11.04	121.78	1768.39
355.6	6.0	51.74	65.90	92725	10070.55	566.40	733.39	12.36	152.82	1132.80
355.6	8.0	68.59	87.36	90579	13201.37	742.48	966.78	12.29	151.11	1484.97
355.6	10.0	85.25	108.57	88457	16223.50	912.46	1194.73	12.22	149.42	1824.92

CIRCULAR HOLLOW SECTION IS:1161 : 2014										
Outside Diameter	Thickness	Mass	Area of Cross Section	Internal Volume	Moment of Inertia	Elastic Modulus	Plastic Modulus	Radius of Gyration	Square of Radius of Gyration	Torsional Constant
mm	mm	kg/m	cm ²	cm ³ /m	cm ⁴	cm ³	cm ³	cm	cm ²	cm ³
355.6	12.0	101.70	129.53	86361	19139.47	1076.46	1417.31	12.16	147.76	2152.92
377.0	6.0	54.91	69.93	104635	12035.01	638.46	825.92	13.12	172.10	1276.92
377.0	8.0	72.81	92.74	102354	15791.85	837.76	1089.46	13.05	170.28	1675.53
377.0	10.0	90.52	115.30	100098	19425.87	1030.55	1347.22	12.98	168.49	2061.10
377.0	12.0	108.04	137.60	97868	22939.76	1216.96	1599.28	12.91	166.71	2433.93
406.4	6.0	59.26	75.47	122170	15128.33	744.50	961.99	14.16	200.45	1489.01
406.4	8.0	78.62	100.13	119704	19873.89	978.05	1269.95	14.09	198.48	1956.09
406.4	10.0	97.78	124.53	117264	24475.81	1204.52	1571.66	14.02	196.54	2409.04
406.4	12.0	116.74	148.69	114849	28937.01	1424.07	1867.19	13.95	194.62	2848.13



OUR PROJECTS

PROJECT - KEMPEGOWDA INTERNATIONAL AIRPORT, BENGALURU
CONTRACTOR - L&T
SUB CONTRACTOR - M/S. YONGNAM ENGINEERING INDIA PVT LTD
CLIENT - GMR/BIAL | **YEAR** - 2019



ABOUT THE PROJECT

Kempegowda International Airport, the third-biggest airport in India, is constructing a garden terminal called T2 to accommodate the increasing passenger traffic. The terminal will feature trees, small gardens and ponds with local species of plants. It is expected to serve approximately 25 million passengers a year. Operated by Bengaluru International Airport Limited (BIAL), it is claimed to be India's first greenfield airport terminal to be built under a public-private partnership. Construction of the terminal began in 2019. With the expected completion of phase one works in March 2021.

CHALLENGE

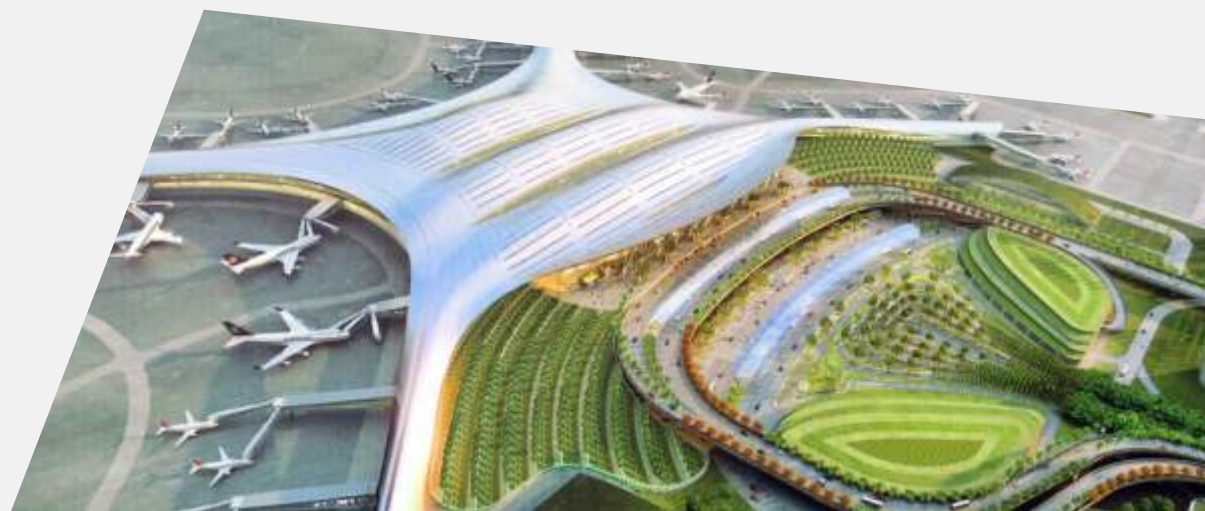
M/S. Yongnam Engineering Sub - Contractor for Bengaluru Airport had a requirement of hollow sections 350 mm x 250 mm X 10 mm from BIAL's preferred make list suppliers for constructing the Terminal building. The preferred make list suppliers were not able to manufacture the required sizes considering they had the capability and capacity constraints. Yongnam Engineering had almost decided to import these sizes from China with a 60 day lead time which would have increased costs.

SOLUTION

The contractor approached APL Apollo Tubes Ltd, for supplying Hollow Sections of size 350 mm x 250 mm x 10 mm. APL APOLLO was able to provide the required sizes and quantity within 7 days of issuing the purchase order.

RESULT AND CONCLUSION

APL Apollo has the technology to service customized Sizes in Minimum Lead Time. This was possible because of DFT (Direct Forming Technology) which is connected only with APL APOLLO in India. This technology helps in giving customized size more exceptional flexibility and minimum lead time.



PROJECT - KARTARPUR CORRIDOR PASSANGER TERMINAL AT DERA BABA NANAK, PUNJAB
CONSULTANT - CREATIVE GROUP
CONTRACTOR - SHAPORJI PALLONJI & CO. PVT. LTD.
YEAR - 2019



ABOUT THE PROJECT

Kartarpur Corridor has been one of our most prestigious projects, as it is a gateway for pilgrims to visit the Gurudwara Kartarpur Sahib in Pakistan. The project was under the limelight of different international and national media houses as this project has been a stepping stone towards improving ties between the two countries.

CHALLENGE

The project was scheduled to be inaugurated as per the defined timeline. But the contractors of the project, were running behind time with their approved vendors for supplying structural pipes & tubes. However, approved vendors were unable to cater to the demand due to shorter lead time.

SOLUTION

Creative Group & Shapoorji Pallonji & Co. Pvt. Ltd. approached APL Apollo Tubes and requested to supply the required structural pipes & tubes in the given time frame. The principals to the project – Land Port Authority of India, a part of Ministry of Home Affairs, were approached by APL Apollo along with Creative Group & Shapoorji Pallonji & Co. to get the approval. The LOI was provided by Shapoorji Pallonji & Co. itself. A presentation was made by APL Apollo to the concerned authorities which highlighted the manufacturing capabilities along with the credentials of the company.

RESULTS AND CONCLUSION

APL Apollo was given a pre-approval on the 24th July 2019 & an LOI on the 26th July 2019 to supply structural pipes. APL Apollo started dispatches from the 27th July 2019 and had supplied approximately 500 Tons out of the total requirement of 615 Tons within 7 days of LOI. With APL Apollo Tube's faster delivery, pan India flexibility on sizes and proximity of plant locations, the company was able to complete the project with great precision.

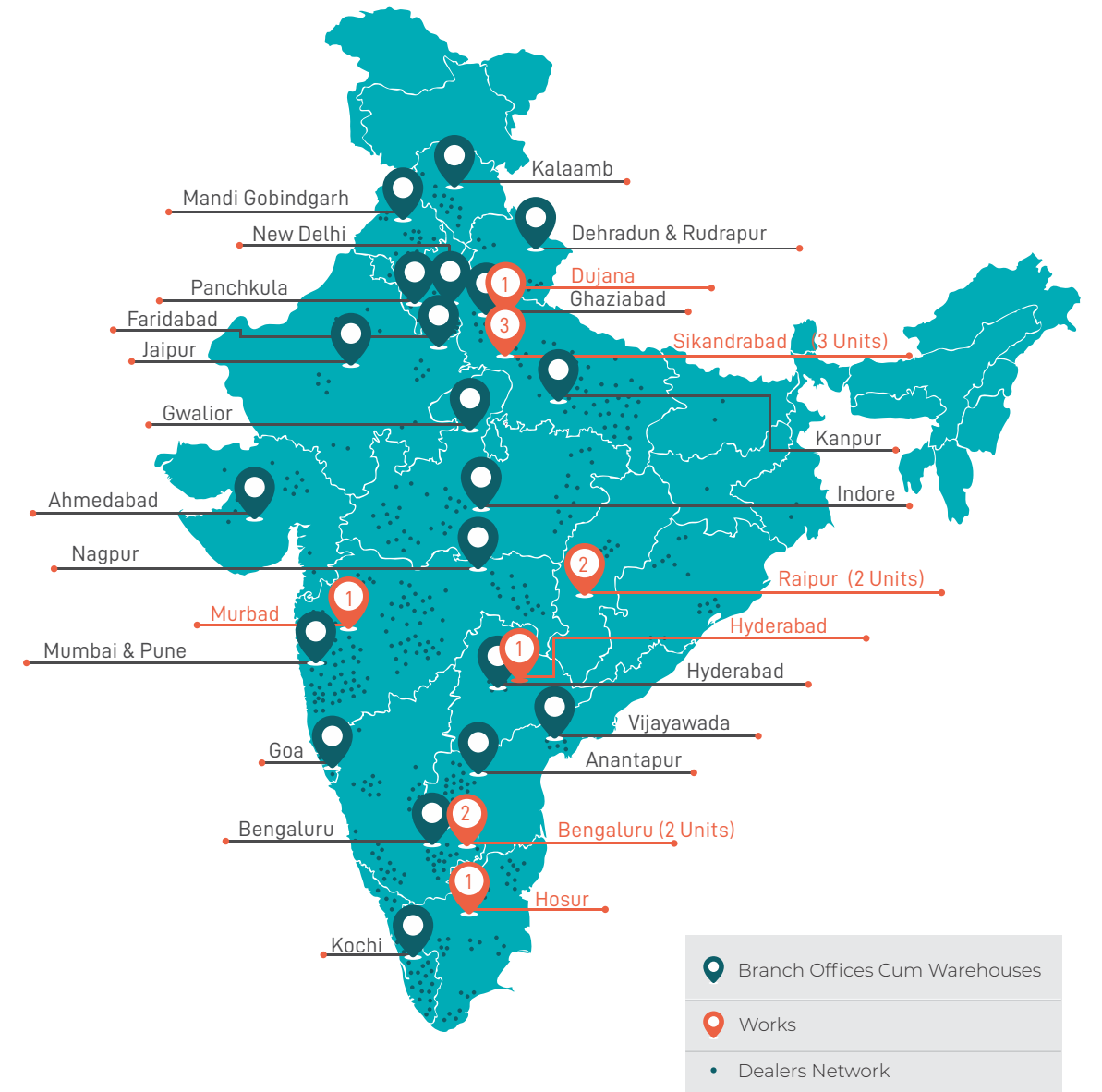




APPLICATIONS OF

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