

Ingenious blend of concrete, steel and glass for an International Exhibition Centre

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Summary

This paper highlights the innovative blend of different building materials to create a world class Trade Fair centre. India's most modern International Trade Fair centre called HITEX is located at Hyderabad which consists of large column free Exhibition halls, Trade Fair Office building, Entrance plaza, ample car park and a landmark structure. The Exhibition hall has a clear column free space of 48m x 72m with a height of 19.5m at the highest point on the roof. The Exhibition hall is made of Reinforced concrete columns, beams and slab up to roof level. The roof is made up of structural steel with solid machine cut natural stonewall cladding and Heritage finish at sides and front cladded with glass giving it a unique appearance.

Keywords: Profile, Structural floor, Structural steel, concrete, epoxy coating, Curtain glazing, Profiled metal sheet, Glass Wool insulation.

1. Introduction

Hyderabad International Trade Exposition centre called HITEX is located at Hyderabad, the emerging business and technology hub of India. Conceptualized by leading German Architects M/s JV Consult, HITEX caters to all types of exhibitions and is built to international standards. The materials for the exhibition halls and the adjoining buildings in the trade fair complex have been chosen so as to form an innovative blend of varied nature to create unique structures in a pleasant setting.

2. The Site



The site, which is now transformed into one of India's biggest trade fair centres, originally comprised of deep valleys and rock crops. The ground gradient was so high and called for a huge amount of filling to make the level throughout the trade fair even. A natural rivulet runs across the site and the same was allowed to run along its natural course below the exhibition halls by way of providing channelised flow in the form of box culverts. A lake at one end of the site has been maintained in its natural sense and gives a perfect setting for the campus.

Fig 1: The site being cleared for construction

3. The Project



Fig.2: View of the fair ground from entrance

The master plan of HITEX envisages eight indoor Exhibition Halls, an open Exhibition area, a trade fair office building, a conference building, entrance plazas and ample car space spread over nearly 100 acres of land out of which three Halls, trade fair office building, entrance plaza which has a tree shaped appearance, an elephant tusk shaped landmark building and car park have been constructed in the first phase. Each building in the trade fair center has been conceptualized in such a manner as to create the best ambience for any kind of International event.

As a basic concept, the entire trade fair ground is maintained at the same finished level to cater to movement of materials in and out of the Exhibition halls.

4. The Structure – Exhibition Hall



Fig 4: The Exhibition hall



Fig.5: Basement showing service lines

The exhibition hall has a clear column free space of 48m x 72m . The building rests on isolated footings and the superstructure is a reinforced concrete framed structure with a clear height of 10.5m. The floor of the hall is a suspended structural concrete floor to avoid huge filling below creating a basement void incidentally which can be used for taking various service lines, storage and other miscellaneous activities. The structural floor has been designed for a live load of 50 kN/sqm to allow for movement of heavy vehicles inside the hall. The hall is air-cooled and the ducts for the same also made up concrete, forms an integral part of the floor. The requirements for various service lines differ for varied types of exhibitions and in order to cater for the extensive service and utility requirements like electrical, data, communication, water, compressed air, gas etc., flexible tapping points are provided on the floor. Hence it acts as a basement cum service floor. The structural concrete floor has been finished with epoxy coating to render it dust free. The columns that rise up to support the roof are H-shaped in cross section to allow for passage of service lines/pipes. The columns are spaced at 12m centres.



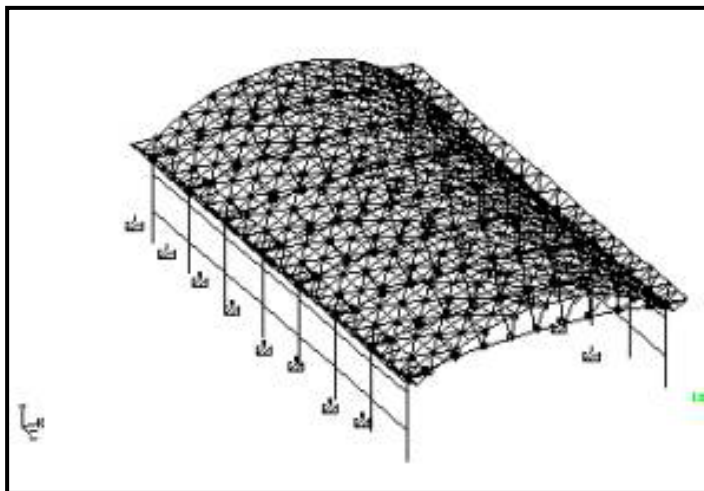
The roof of the Exhibition hall is barrel vault shaped made of structural steel members. The shape of the roof provides a clear height of 20m at the crown and 10.5m at the ends. This was aimed to achieve faster construction and economy due to adoption of uniform sections. The unique design of Octagonal junction boxes at nodes with eight faces has resulted in quicker fabrication and erection. Double skin profiled metal sheets with 50mm glass wool insulation of density 2.4kN/cum covers the impressive steel spatial frame.

Fig.6: Inside view of Hall

A gutter that follows the profile of the roofing runs along the length of the exhibition halls on both sides. A similar roof is provided in the area between the halls for a length of 24m to facilitate loading and unloading of vehicles.

The side walls of the Exhibition hall are clad with natural machine cut limestone and Heritage stone finish. This has been done to blend with the natural settings of the trade fair centre. A considerable area on the front and rear elevations is provided with curtain glazing minimize the usage of artificial lighting in the halls.

4.1 Analysis and Design



Finite Element modeling of the frame of the Exhibition hall with roof was done and analysis carried out with an analysis software . Analysis was carried out for all possible load combinations with Dead loads, Live loads, Wind loads and Temperature loads being the primary load cases. Hanging loads of 1.5 KN was applied on all nodal points. Design of all members was carried out based on the analysis results. All concrete elements were designed as per Limit State method and Steel sections with Working Stress Method.

5. Blending of materials to form a unique exhibition centre

The exhibition hall as a whole manifests itself as a masterpiece of engineering design and construction. This has been achieved by the usage of various materials in proper proportions to make it an engineering marvel. A brief description of the various materials is given below:

5.1 Reinforced concrete

The structural elements of the exhibition halls viz, footings, columns, slab and beams are of reinforced concrete with a characteristic strength of 30 N/sqmm. Blended cement has been added to concrete. High yield strength deformed bars with characteristic strength of 415 N/sqmm was used as Reinforcement steel.

5.2 Structural Steel

The barrel vault shaped roof of the exhibition hall which spans for 48m and length 72m is made of fusion welding quality ST-42W structural steel members. The sections are pre-engineered and prefabricated in a factory. The built-up sections were made of plates varying from 5mm to 12mm thickness. The length of each element of the roof was uniformly maintained at 3m. The entire roof is formed of 3m x 3m grid triangles. The tubular sections used are of ERW Yst240 grade sections. All steel members are painted with two coats of epoxy paint over a coat of red-oxide primer. The roof of the exhibition hall is cladded with 0.5mm total coated thickness high strength profiled sheets with 50mm thick glass wool insulation in between to provide comfortable thermal conditions and energy savings.

5.3 Curtain glazing



The front and rear elevations of the halls are cladded with curtain glazing made of 8mm thick clear reflective tempered glass to minimize the usage of artificial lighting in the halls for exhibitions conducted during the day. The curtain glazing is supported with a framework of structural steel made of sleek tubular sections.

5.4 Sandstone cladding

The front and part of sides of the exhibition centre is covered with a pleasing shade of natural machine cut sandstone. Sandstone being a natural stone, the lots had to be separated to avoid major color variation. Dry fixing of the stones was carried out and the clamps for the same were fixed by drilling holes on to the block work. The size of stones used was 1000mmx500mm and 500mm x 500mm. The 6mm grooves between the sandstone panels were filled with non-staining silicone sealant of black color.

6. Construction

The construction of the exhibition centre was taken up in a galloping phase creating a record. The columns of the exhibition halls were raised from below and roof erection was taken up. The structural floor was completed before the erection of the spatial frame.

Erection of structural steel roof



The structural steel roof was erected in parts of size 6m x 9m on ground and lifted using Tower crane. The entire roof was supported on temporary Heavy duty L&T-Doka staging. Though welding at height was minimized to a great extent, strict quality checks were made to ensure that they meet the design requirements. Erection of steel roof was carried out in panels after which the bottom tie rod of 80mm diameter was placed and welded.

Fig.9: Erection of roof truss in progress

Regular monitoring was done so that the desired profile was achieved. During destaging, deflection checks were carried out very meticulously. Double skin metal profiled sheets with glass wool insulation in between were then fixed to the structural steel members.

7. Techno-Economic indices

The exhibition centre of area 3500 sqm created with a blend of various materials consumed the following quantities:

Table 1 Quantities

Item	Unit	Quantity
Concrete	Cum	2360
Shuttering	Sqm	14205
Reinforcement	MT	385
Structural Steel	MT	225
Curtain Glazing	Sqm	610
Sand Stone Cladding	Sqm	625

The cost per square metre for the hall worked out to US \$ 310 for civil works and to US \$ 430 per square metre including all electro-mechanical and utility services.

8. Conclusion

The entire trade fair complex was completed in a record period of 11 months and inaugurated on January 15th 2003. Figure shows the gathering during the inauguration.



Fig.10: Inauguration