



## SRI SATHYA SAI SANJEEVANI HOSPITAL, BALLABHGARH

a complex heart-shaped structure with unsymmetrical plan

**S**ri Sathya Sai Sanjeevani Hospital is the proposed super-speciality heart centre for children located at Ballabhgarh, Delhi-Mathura Road. The proposed building is G+2 structure with the provision of one future floor. The proposed built-up area is approximately 1,47,300 sq. ft. This multispecialty hospital will offer high quality healthcare services with numerous OTs, ICUs, with modern technology and advancement in heart care.

It is a complex heart shaped building having unsymmetrical plan. The structure is envisaged as a steel-concrete hybrid structure with substructure up to the plinth level in concrete and superstructure in structural steel.

### Unanimously Steel

Since it is a fast-track project with time bound completion and due to the low soil bearing capacity

reported at site, structural steel was the unanimous choice. Being a light and high strength material, structural steel offers great degree of flexibility and sturdy behaviour.

### Structural Geometrics

The primary frame of the building comprises of special moment resisting steel beam-columns frame with cross bracings in vertical plane at suitable locations to resist the lateral force due to earthquake and wind. The floor system comprises of steel beam and joist with concrete slab over profiled metal deck sheet. The composite action of steel and concrete is utilised to optimise beam and joist design. Composite design helps in reducing the size of section, controlling deflection and achieving economy. Shear studs are placed at top of steel sections to transfer the shear force from slab to achieve composite behaviour.

# FACT FILE

Client: Sri Sathya Sai Charitable Trust

Architect: Ravi Associates

Structural Consultant: Skeleton Consultants P. Ltd.

Turnkey Contractor: Synergy Thrislington

Proof Consultant: Sterling Engineering

Steel Tonnage: 1000 MT (approx.)



The total design lateral forces are resisted by the columns-beam frames and bracings in proportion to their lateral stiffness at all the floor levels. Hollow tubular sections are preferred for cross bracing due to slenderness benefits resulting from higher radius of gyration. Moment resisting connections are considered for column-beam junction for rigid and stable behaviour and being lighter.

Steel columns are analysed as pinned at top of RC pedestal and support reaction at that location were considered for substructure design to make the substructure lighter. Through rigorous analysis and design iterations, the structural stability was ensured while satisfying the budgetary constraints as well as time constraints. Fire rating for the steel structure was ensured by the means of vermiculite coating used. All wall panels (external and internal) are Schnell wall panels, with 170mm thick.

## Steel Sections

The steel column-beam frame, having plate fabricated I section as well as all connection plates, are made of high strength steel having yield strength of 345MPa conforming to IS-2062. Hollow tubular sections are considered for cross bracings having yield strength of 310MPa.



## Challenges

There were quite a few complexities involved while designing this project. The shape of the building is heart shaped owing to which stress gets concentrated at the corner bend which results in rotational dynamic mode shape. Cross bracings at several locations were provided in line with architectural features to control the rotational mode and deflections.

Due to low soil bearing capacity, site located in seismic zone IV and being a hospital building with importance factor 1.5, primary concern was to keep the weight of superstructure light. The connection of steel columns and pedestals are designed as hinged and composite action of steel beam & concrete slab is utilised to make the foundations lighter.

## Salient Features

- Heart shaped plan: Unsymmetrical in mass and stiffness
- Curved periphery
- Building located in earthquake zone-IV with IF =1.5
- Composite design of beams and RC slab with proper shear studs anchorage
- Use of light weight Schnell



"With increased use of steel sections as primary members in buildings including high rise commercial and other usage, a fast track hospital project is a challenge of design. The plan shape resembling human heart required skills to control the dynamic behaviour. Our design team of Er. Nitesh Agrawal, Er. Anisha Annee & Joby Joseph made it possible to deliver the entire design in about a month's time. Concrete floor over metal deck connected to steel beams with shear studs helped economy of design through composite action. Fire resistance of main frame is achieved through vermiculite. In all a little more than 145000 sq. ft. built up area has been designed with less than 850MT steel sections. Integration of Schnell Walls with steel sections by Synergy team is sure to produce an excellent building".

**Er. (DR.) ABHAY GUPTA**

Director, Skeleton Consultants Pvt. Ltd.