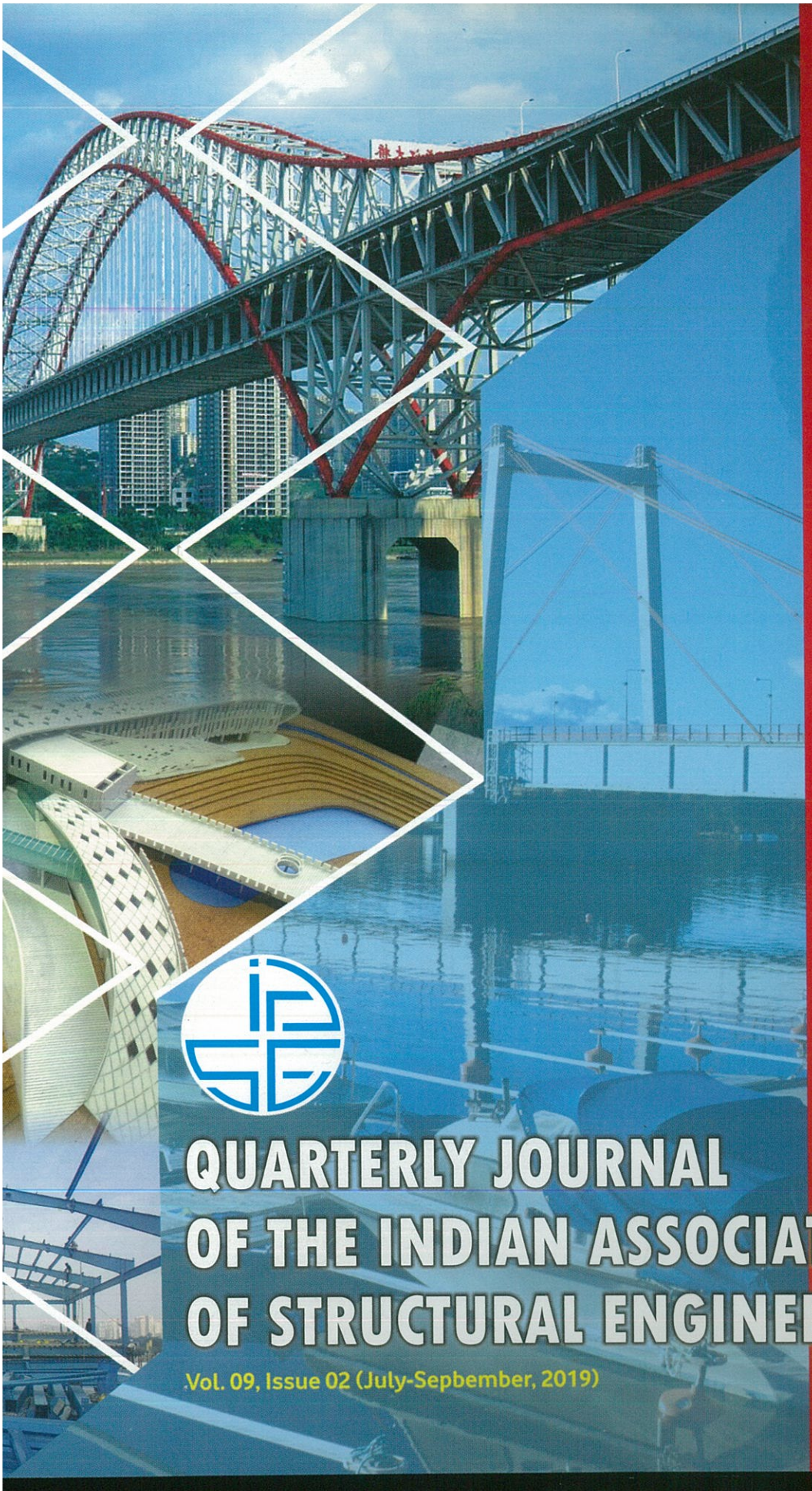


SED

STRUCTURAL ENGINEERING DIGEST

QUARTERLY JOURNAL OF THE INDIAN ASSOCIATION OF STRUCTURAL ENGINEERS

Vol. 09, Issue 02 (July-Sepbember, 2019)

ASTER PUBLIC SCHOOL, GREATER NOIDA

Nitesh Agrav

Nitesh Agrawal
General Manager
Skeleton Consultants Pvt. Ltd.

Project Brief

1. Project and building use

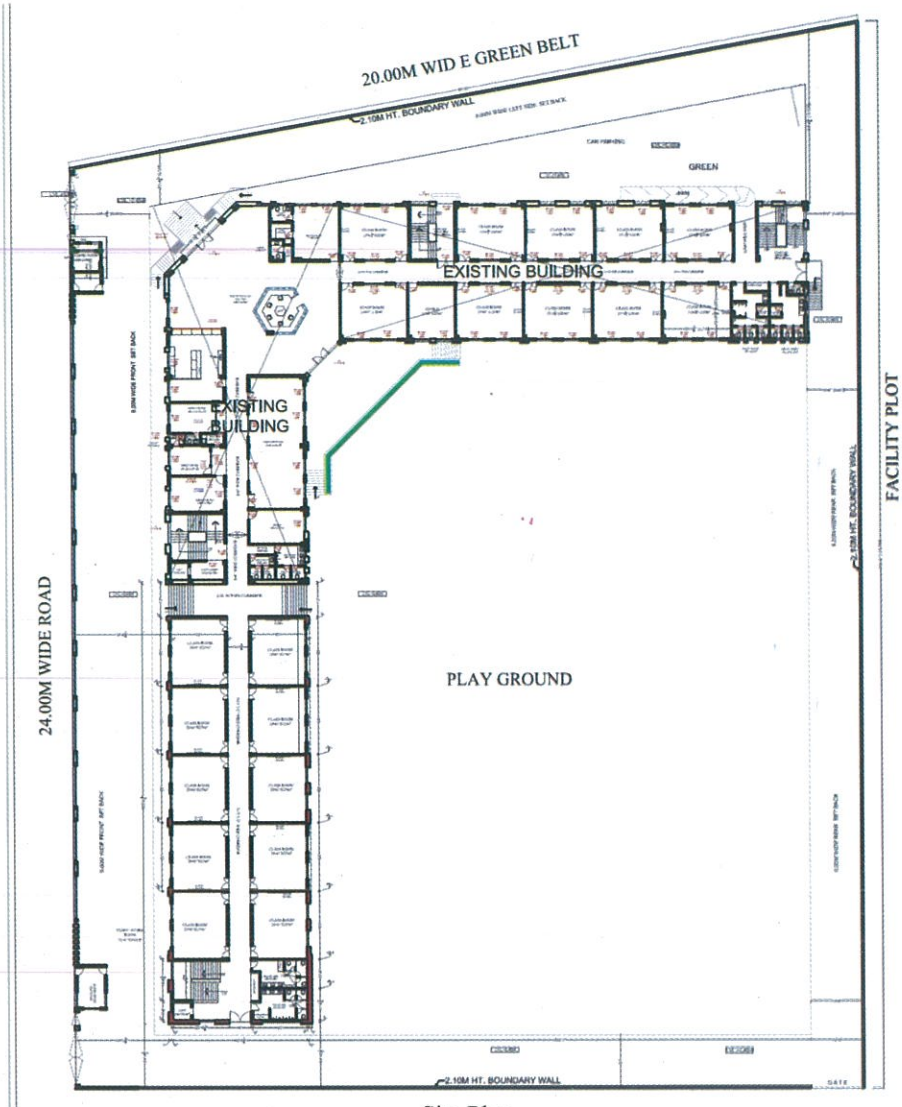
Aster public school is the extension of proposed sc building located at Greater Noida, Uttar Pradesh. proposed building is Basement+G+5 structure with provision of auditorium at the top. The proposed built-up is approximately 70000 sq. ft. This school will offer quality education, with modern technology and amen with good infrastructure.

It is a typical rectangular building having symmetrical p The structure is envisaged as a steel-concrete hybrid struc with substructure foundation & retaining walls in conc and superstructure in structural steel with all columns in right from base.

2. Structural Geometrical Features and struct System

The primary frame of the building comprises of sp moment resisting steel beam-columns frame with c bracings in vertical plane at suitable locations and also s portal bracings are provided at basement level to resist al lateral forces. The floor system comprises of steel beam joist with concrete slab over profiled metal deck sheet. composite action of steel and concrete is utilized to opti beam design. Composite design helps in reducing the si section, controlling deflection and achieving economy. S studs are placed at top of steel sections to transfer the s force from slab to achieve composite behaviour.

The total design lateral forces are resisted by the colu beam frames and bracings in proportion to their la stiffness at all the floor levels. Hollow tubular section preferred for cross bracings due to slenderness ber resulting from higher radius of gyration. Moment resi connections are considered for column-beam junctio rigid and stable behaviour.



Site Plan

Architectural Elevation view

Steel columns are analysed as fixed base over foundation along with retaining wall running along the periphery of the building. Through rigorous analysis and design iterations, the structural stability was ensured while satisfying the budgetary constraints as well as time constraints.

To reduce the dead weight on the building and foundation, precast hollow concrete block of density 6.5 kN/cum were used. Columns & Beams were also covered with these block to improve fire rating of the structure.

Internal Beam & Joist

Internal Bracings

3. Location and topographical Conditions

Location: - Building is situated in Gr. Noida

Seismic Zone : IV

4. Material used

4.1 Concrete Grade: M25

4.2 Structural Steel:

- Plate fabricated sections of yield strength 345 MPa as per IS 2062-2011.
- Hollow steel tubes of yield strength 310MPa.
- Joist yield strength 250 MPa or Cold formed sections of yield strength 345 MPa.
- All connection bolts shall be high tensile bolts of grade 8.8 confirming to IS-1367-III.

5. Load and load combinations

5.1 Loads

5.1.1 Dead Load

The various loads to be carried by the structure are as follows:

- The self-weight of the beams, columns and slab.
- 50mm thk Floor Finish.
- 100mm thk PU foam insulation at terrace.
- 75mm thk Concrete above deck sheet.
- 0.8mm/1mm thk GI Metal deck sheet
- Gypsum false ceiling below joists.
- External & Internal Walls =150mm thk panel wall.

External Side View (1)

External Side View (2)

External finish

nposed Loads

:e (Accessible)	1.5	kN/m2
Room, Staff Room, and Green Room	3	kN/m2
'ay, Staircase and Lobbies	4	kN/m2
Room and Auditorium	5	kN/m2
Iachine Room	10	kN/m2

Vind Loads

ind pressure shall be calculated in accordance with pt.3-2015.

Vind Speed (V_b)	: 47 m/se
oefficient (k1)	: 1.0
ı Category	: Category 2.
ctor (k2)	: As per actual height
raphy factor (k3)	: 1.0 (Table 6.3.3)
ance factor for nic Region (k4)	: 1.0 (Table 6.3.4)

5.1.4 Seismic Load

Seismic Zone	: IV
Zone factor	: 0.24
Importance factor	: 1.2
Response reduction Factor	: 4
Damping Ratio	: 5 %

The natural period of building, for analysis purpose is calculated using following expression:

$T=0.080h^{0.75}$ for RC-Steel composite MRF structure.

5.2 Load Combinations

Serviceability Combination

- LOAD COMB DL+LL
- LOAD COMB DL±EQ)
- LOAD COMB DL+0.8LL±0.8EQ)
- LOAD COMB DL+WL
- LOAD COMB DL+0.8LL-0.8WL

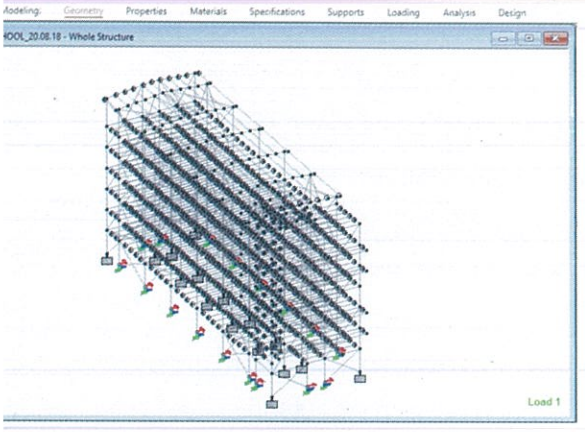
Strength Combination

- LOAD COMB 1.5(DL+LL)
- LOAD COMB 1.5(DL±EQ)
- LOAD COMB 1.2(DL+LL±EQ)
- LOAD COMB 0.9DL±1.5EQ
- LOAD COMB 1.5(DL+WL)
- LOAD COMB 1.2(DL+LL-WL)
- LOAD COMB 0.9DL+1.5WL

6. Analysis& Design

For analysis Staad. Pro V8i software was used. A 3 dimensional model was prepared and analysis was done for different load combination to achieve optimum section sizes of beams & columns.For Seismic analysis, linear dynamic analysis was performed. The design of Steel sections and connections have been done as per IS800-2007. Columns were considered fixed base at foundation level and all column-beam joints were taken rigid. Cross bracings were provided at some locations to take the lateral loads due to Earthquake/Wind. Floor has been design considering composite action between Steel beam and concrete slab thereby to provide rigid diaphragm at all

evels. For design of foundation, support reactions extracted from Staad model and design was done in-house developed spreadsheets. Design of ctions were design using in-house developed lsheets after extracting beam end forces from Staad . A 3D rendered image of Staad model is attached :



Staad model

Column Beam Joint

7. Challenges

There were quite a few complexities involved while designing this project. The locations of bracings were carefully chosen to satisfy design requirement for lateral forces due to Wind & Earthquake and aesthetics & functional requirement of building. The connection design of tubular columns & I beams was formulated such that its easy and fast for erection and does not need any cutting of sections. The gap between existing block and extension was detailed such that it allows movement between two blocks but keeps both block structurally disconnected. An auditorium of 15m clear span is planned at the top floor and building is designed to accommodate same.

Auditorium

FAST FACTS

Client: Aster Public School Noida
Architect: S.S. Bhatia & Associates
Structural Consultant: Skeleton Consultants Pvt. Ltd.
Turnkey Contractor: M/s Loom Crafts Shade Systems (P) Ltd Ghaziabad
Steel Consumption: 350 T (approx.)
Status: Complete