

## Design Features of Roof of Weightlifting Stadium

**Soumya RAY**  
Project Manager  
Consulting Engineering  
Services (India) Pvt. Ltd.  
New Delhi, India  
[soumya.ray@jacobs.com](mailto:soumya.ray@jacobs.com)



**Arindam BASU**  
Dy. General Manager  
Consulting Engineering  
Services (India) Pvt. Ltd.  
New Delhi, India  
[arindam.basu@jacobs.com](mailto:arindam.basu@jacobs.com)



**B C ROY**  
Senior Executive Director  
Consulting Engineering  
Services (India) Pvt. Ltd.  
New Delhi, India  
[bidhan.roy@jacobs.com](mailto:bidhan.roy@jacobs.com)



### SUMMARY

The XIX Commonwealth Games initiated construction of several new stadiums. The basic feature of these stadiums was to provide large column free spaces, typically with long span steel roof. The paper describes the Weightlifting stadium in the Jawaharlal Nehru Stadium Complex. Weightlifting stadium, which for legacy use was planned as an auditorium that too needed a column free space accommodating 2,500 people. The paper deals with the salient aspects of design of long span steel structures for the facility.

**Keywords:** Long span curved roof, Steel Structure, basement car parking.

### 1. Introduction

The weight lifting events of the Commonwealth Games 2010 were planned at a separate facility with the Jawaharlal Nehru Stadium Complex in New Delhi. Due to the proximity of this additional facility to the main stadium, it was necessary that it does not visually impose on the iconic main structure in the complex. It was then conceived with the architectural form of a drop of dew. The seating capacity of 2,500 including two level underground parking with holding capacity of 200 cars were the salient demands in locating and dimensioning the structure.

### 2. Basic Structural Idiom and Features

The outer cover of the stadium has been formed with doubly curved aluminium sheet, supported by the steel structure from underneath. The steel structure has two main trusses of length 110m forming the central spine to which eleven transverse open web trusses are joined, forming the basic skeleton. All of these frames start off as curved box sections at the ground floor level and change into open web trusses above the false ceiling. Each box column is provided with a pinned base, and is supported on RCC structure which forms the basement.

### 3. Geometry and Design Aspects

The shape of the roof was conceived with an unique idea of dew drop which required a doubly curved roof. The curved roof was formed with top aluminium standing seam roof sheeting which is supported on curved steel trusses. The basic geometry of this steel structure is formed with two main trusses of 110m, forming the central spine and 11 cross trusses connecting to the main trusses spanning maximum 80m.



To reduce the depth of trusses space frame action is considered, to maintain compatibility both main and transverse girder (trusses) share the load

These frames start off as curved box sections at the ground floor level and change into open web trusses above the false ceiling. This is aesthetically more pleasing than open trusses and so the open trusses were hidden above false ceiling. The frame-truss combination offered double benefits – structural economy, as closed box sections are costlier and difficult to fabricate, and aesthetic advantage

#### **4. Sectional Property and Connections**

The open web trusses were formed with built up I sections. These sections were developed with steel plates to obtain compact section with enough lateral moment of inertia so that it can span the spacing between the struts unbraced. Grade of steel used for development of this section are of high grade E350 as per IS 2062.

As the main trusses and transverse trusses are long enough to be brought to site from fabrication yard in one piece, splicing connections were required. These splicing details were designed with bolted connection.

#### **5. Access to the Roof**

The auditorium and stage portion of the roof required complex lighting arrangements. The height of bottom chord of trusses were too high for these fittings, and so they required catwalk system which could house those lighting and public address system arrangements and at the same time also provide access.

#### **6. Double basement car parking**

As this stadium is located in proximity to main JNS stadium, it was envisaged that car parking would become a problem in legacy use. It is also worth to have a dedicated parking facility for this auditorium. For this purpose, a double basement car parking was planned below the entrance to the stadium covered with 700 mm earth cushion at top.

#### **7. Conclusion**

The weightlifting stadium after its completion in August 2010 successfully hosted the weightlifting events for Commonwealth Games 2010. The stage portion needed some modification for using it as auditorium. A additional false aluminium lightweight space faming will be installed over the stage for catering to stage lighting for legacy use.