

Design Features of IG Stadium

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SUMMARY

The XIX Commonwealth Games saw the upgradation of existing stadiums as well the construction of several new stadiums with long span steel roof to provide column free spaces. This paper describes the unique aspects of retrofitting a very large and complex steel roof structure of 155 m diameter, including state-of-the-art design and construction, namely, the roof of Indira Gandhi Stadium which was completed in 1982. It also highlights the necessity of considering non-linear analysis, especially considering the construction stages to arrive at reliable and accurate results.

Keywords: Long span roof, rehabilitation; construction stages

1. Indira Gandhi Stadium:

Indira Gandhi Gymnastic (IG) Stadium was built during the ASIAN Games, New Delhi held in 1982. When it was built, it was one of the biggest indoor stadiums, with a roof diameter of about 155m. The roof is supported by 8 concrete pylons and 16 ties, giving it an elegant shape. The roof, besides providing protection from the elements, also supports HVAC ducts, a network of catwalks which hold sports lighting, PA system, and a 100 ton load of retractable screen to divide the whole arena into two halves.

In 2006, when plans for upgrading the structure for the Commonwealth Games 2010 was mooted, was almost 25 years old and had started showing signs of aging. The roof has a long history of leakage during rainy season. In addition, there were signs of rusting in many members, which required urgent attention.

2. Design Approach for IG Stadium- Gymnastic

The roof geometry was studied in detail and in discussions a consensus emerged that the problem of water leakage was due to the roof having both radial and circumferential slopes... It was decided to steepen the roof slope and eliminate the cross slopes to improve the rate of water drainage from the roof.

Only to a very limited extent, design and fabrication drawings showing the general arrangement of then existing roof were available. To evaluate the structural condition of the stadium roof, it was decided to create a computer model and simulate the original construction stages to validate the model against previously recorded deflections. After model validation, a stress check could be carried out to decide on the members requiring retrofit.

To simulate the construction sequence, many construction stages obtained from other reference [1] were analyzed using Larsa 2000 with full geometric nonlinearities.

Roof live load was taken as per IS-875 to be equal to 43 Kg/m² for a slope of 16°. This was further reduced to two-thirds for the main trusses i.e., 28.67 Kg/m², and then rounded off to 30 Kg/m².

With above analysis it was seen that some of existing members were getting overstressed in the (Dead+ Live + Temperature) load case. Thus it was decided to strengthen the overstressed members and reduce loads if possible.

The removal of the nonstructural members, as architectural enhancements, on top of central core would reduce 50MT. The central screen weighing about 100 t was deemed unnecessary by the



client. Lightweight roof insulation replaced the existing insulating boards. Aluminium HVAC ducts were used in lieu of the defunct steel ducts. The proposed arrangement of new members to be added after unloading the roof structure so that the new combination acts in a composite manner for loads added after construction.

A new analysis was carried out with this concept, keeping the first previous stages same as of previous analysis. Then the roof was unloaded by removing various components. Then, members requiring retrofitting are modified and roof members required to re-slope are added on and analysis is continued.

The member design was checked in accordance with IS:800:1984 and rechecked with AISC LRFD code. The cold form purlins were checked as per IS:801. To reduce the weight of the roof, high strength cold formed purlins were used in place of the existing hot rolled sections.

3. Concluding Remark

During dismantling, the existing connections were studied and accordingly new connections were designed for fixing new members with existing members. The whole erection procedure damaged the existing catwalk system and fresh new catwalks were fabricated and installed. These catwalks carry the load of sports lighting, PA system and HVAC ducts, whose new designs are lighter than the older systems. Whole construction of roof got completed well before games and the stadium was very much appreciated during the games.

4. Reference:

“Indraprastha Sports Complex, Evolution, Design & Construction Management” by Dr. P Ray Chaudhuri & Er. V P Chetal

5. Acknowledgement:

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