DESIGN AND ANALYSIS OF AN INDOORSTADIUMBYUSING STAAD PRO

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***Abstract*— In this growing world, as a civil engineering student one needs to be fully aware of structural elements andthe safety parameters before and during execution of project. Indoor stadium is a closed area which is usually used for indoor sports like basketball, ice hockey, volleyball etc., Indira Gandhi Arena (New Delhi), Dandamudi Indoor Stadium(Vijayawada), Saroornagar Indoor Stadium (Hyderabad) etc., are the examples of indoor stadiums. Indoor stadium isusuallydesignedtoaccommodatemultitudenumberofspectators,s othesittingarrangementisprovidedforthat.**

This project mainly deals with analysis and design of Indoor stadium consists of G+2 floors using STAAD PRO. The ground floor consists of volleyball court, the first floor consists of badminton court and the second floor consists ofyoga, carroms, table tennis, gym and office room. The guidelines being followed are as per IS 456:2000. All the structural elements are designed as per codal provisions, STAAD PRO and AUTOCAD features contains powerful graphical interface with modelling, analytical, and design procedures. It is quick and very easy for simple structures. It can handle the largest and most complex building models.

Planning analysis and designing of indoor stadium is our project which is to propose at Salem. Stadium for badminton & basket ball four court hall with 113 x 70 . Dimensions with ground floor only. The entire plan is about 7910 sq.m. There is some space left around the building for parking of cars. The plan also gives details of arrangement of various furniture like chairs, sofa etc. The indoor stadium consists of a Stage, Separate rest rooms for both , Separation of VIP BLOCK, Office ,Two wheeler & four wheeler parking's are providing in separate. Book shop & boutique shop, Gymnasium Practice hall. Drafting method for design the plan is by AutoCAD. The framed type of construction is used for the construction and the designing of structure is carried out by limit state method with the IS 456: 2000 code book. The plan and structural elements are designed using staad pro and AutoCAD. This study explained about necessary and designing purpose of indoor stadium.

Keywords: Planning, Analysis, Designing and Indoor Stadium.

INTRODUCTION

A modern stadium is a place or venue for (mostly) outdoor sports, concerts, or other events and consists of a field or stage either partly or completely surrounded by a structure designed to allow spectators to stand or sit and view the event. His first stadiums to be built in the modern era were basic facilities, designed for the single purpose of fitting as many spectators in as possible.

Now a days everyone is using mobile phones. They are sitting in the same room and playing games, using social media, browsing net. They are becoming lazy and neglecting the fitness of body. They have an intention toplay games or sports but they don't have suitable place forplayingandplayersalso.That'swhywe proposedthisproject.

An Indoor Stadium is an enclosed area. It is composed of large open space surrounded on most or all sides by tiered seating for spectators, and may be covered by a roof. ThefirstindoorarenawasMadisonSquareGardeninNewYork city. It was completed in 1890 to replace a convertedrailroadterminalthathadbeenusedforpubliceventssince1 874.

The principle objective of this project is to Plan, analyze and design of an educational building manually and alsocomparethemanuallyobtainedresultswiththeresultsobtained by using the STAAD Pro software. We proposeuseM30concreteandFe415barsforallstructuralcomponent s like slabs, beams, columns and Foundation. We've used the AUTO CAD for effective representation oftheplans.

Thuswefeelthatstructurefulfilsthebasicrequirementsofgooddesi gningandplanningbyusingeffectivelyeveryinchofspaceavailablean dalsojustifiesitsnamebyincreasingthe beautyoflandscape.

The indoor stadium is a covered or a not covered enclosed area, often circular or oval shaped, designed to showcase theatre, musical performances, or sporting events. It is composed of large open space surrounded on most or all sides by seating for spectators. The key feature of an indoor stadium is that the event space is the lowest point, allowing for maximum visibility. College indoor stadium is an important indicator to measure universities physical education, its function not only is required to meet college sports education , sports events undertaking, but also it should provide social services for mass sports activities development An Indoor stadium is a group of sports facilities.

The sports facilities are of indoor kind for e.g. table tennis, carom, chess, gymnasium etc. sports are the integral part of the student life so it is the essential requirement of good educational institution. It makes institution reputation higher and also increases the financial status. The design guide provides design principles to achieving an appropriately high quality stadium development that makes a positive contribution to the public environment.

The stadium sites is ideally suited for its intended use, being large, flat and also close enough to the city to be identified with its center and to facilitate excellent access to all modes of transport. Furthermore this site being close to the railway station, defining a major route into the city, provides an ideal setting for building that by virtue of its scale and function alone

will become a major land mark and make a positive contribution to the urban form and image of the college. Indoor stadium solve all the problems and limitations inherent in outdoor stadium. You do not have to skip games because of the weather and you can play in comfort in a controlled environment.

The Recent advances in science and technology, as well as increasing demands for sports and show buildings and facilities, have sparked new development across the globe. Modern stadiums are distinguished by their universality in terms of the ability to host international sporting events and cultural activities. The goal of providing optimum comfort for spectators tends to be associated with fulfilling the needs of sports technology. One part of the job is to cover stands from sunshine and rain by including sheds, canopies, and roofs into the stadium's structural design. Stadiums are the grand platforms on which legends are born and fans get excitement and inspiration. Stadiums, as fascinating and significant buildings, not only enable but also enhance great shows via strong architecture and creative engineering. Structural designers have been under pressure in recent years to create the most practical, technically innovative, and architecturally renowned sports facilities. The most efficient way to track the technical development of modern stadiums throughout this time period is to look at improvements in the design of their structural roof systems. The stadium should be modified to shield spectators from rain and blinding light in the event of a strong şun. Although some pretty continuous steady sunlight is typical, şhade provided by the roof should be accessible to all open areas for at least a portion of the game, which is not always feasible. The stadium should be built such that all parameters are essentially comfortable, sâfe, and şecure, and that eâch and every individual has a clear view of the court. The arrangement of seating is provided is continuous the maximum seating can be eâsily placed in stadium. In recent days, many research scholars have worked on the cover or roofed stadium

OBJECTIVES OF THE STUDY

The objective of the structural design is to plan a structure which meets the basic requirements. The project is to design an auditorium with a large span without compromising safety.

Safety: It's has been the prime requirement of structural design and construction that a structure shall be so designed that it will not collapse in any way during its expected life span.

Strength and stability: Besides strength, ductility of structure is also nowadays considered to be an additional desired quality from a view point that if at all failure occurs, it should not be sudden but should give prior warning of its probable occurrence so as to enable one to minimize the consequences of collapse ad avoid loss of human life.

Economy: The economy shall be of material by optimum utilization of its strength or it may be the economy of cost of construction as well of cost of maintenance and repairs.

Aesthetic: The structure should not only be safe, durable but should also give a pleasing appearance. Feasibility, practicable and Acceptability: The structure has to be so designed that the proposed solution is feasible, practicable and acceptable.

To Develop the 3D Model of an Outdoor Stadium Structure with Truss and Shell roof Covering system.

To determine the behavior of the stadium structure under Static and Dynamic loading using STAAD. Pro V8i SS6 software.

To Design the components of the Outdoor Stadium Structure.

The primary objective of this project is to gain sufficient knowledge in analysis, and design of building. Our project deals with the Design and Analysis of an indoor stadium which was done using Auto CAD and Staad Pro. It is a reinforced concrete framed structure consisting of G+2. The ground floor consists of volleyball court, the first floor consists of badminton court and the second floor consists of yoga, caroms, table tennis, gym and office room. IS 456:2000 codes is the basic code for general construction in concrete structures, hence all the structural members are designed using limit state method in accordance with the IS 456:2000 code and design aids.

LITERATURE REVIEW

As per Kerala Municipal Building rule the building is of Group D occupancy classification (Assembly buildings) [1]. KMBR suggests that the Maximum Permissible Coverage (percentage of plot area) is 40%. Maximum permissible F.A.R without additional fee is 1.50 and Maximum permissible F.A.R with additional fee is 2.50. The maximum height of the building or part thereof shall not exceed twice the width of the street abutting the plot plus twice the width of the yard from the building to the abutting street and this height may further be increased proportionately at the rate of 3 metres for every 50 cms. by which the building or the corresponding portion or floor of the building is set back from the building line. For buildings of group D occupancy classification, off-street- parking spaces for motor cars shall be provided with one parking space for every or fraction of 25 seats of accommodation. Theplanning, design and installation of lifts shall be in accordance with Part VIII, Building services, Section 5, Lift, Elevators and Escalators in National Building Code of India, 1983[2]. FINA (Federal Internationale de Nation) [3] specifies that the race course of the Olympic standard swimming pool is 50m and width of 25m. A minimum depth of 1.48 yards must be maintained from about 1 yard out from one end of pool to about 6 yards from the opposite wall in pools that use starting blocks. A depth of at least 1.09 yards is required everywhere else in the pool. It should have a minimum of 8 lanes, each of 2.73 yards wide and a buffer of at least 0.22 yards.

Analysis& Design of sports complex using staad.pro Sachin P Dyavappanavar ,Maheshkumar VS, Abhishek GJ, Chethan GN (IJIRSET) The design process of structural planning and design requires not only imagination and conceptual thinking but also sound knowledge of science of structural engineering besides the knowledge of practical aspects. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety. In the present study G+1 building is designed (Slabs, Beams, Columns and Footings) staad.pro's software. In order to design them, it is important to first obtain the plan of the particular building that is, positioning of the particular rooms, that they serve their respective purpose and also suiting to the requirement and comfort of the users. Thereby depending on the suitability; plan layout of beams and the position of columns are fixed. Thereafter, the loads are calculated namely the dead loads, which depend on the unit weight of the materials used (concrete, brick) and the live loads, which according to the code IS:456- 2000 and HYSD BARS Fe500 as per IS:875- 1987 part II. Safe bearing capacity of soil is adopted as 140KN/m2.

Seismic Analysis of Indoor auditorium DilipanboseS, Aravindan S (JCEE) The project titled "Seismic analysis of Indoor Auditorium" has been taken up with an objective to determine the seismic response and behavior of an Auditorium constructed in Chennai area. Even though Chennai is considered as least prone to major earthquake, it is expected that a structure would survive major earthquakes without collapse that might occur unexpectedly during

the life of the building. It should also be noted that after the Bhuj earthquake, Indian Standard IS: 1893 was revised and Chennai city was upgraded from zone II to zone III which leads to a substantial increase of the design ground motion parameters. Hence, this project presents an exploratory analysis of the seismic performance of multistorey buildings system built in the specified area with a comparative study of the structures under past major earthquakes.

Seismic Analysis & design of multistory building using staad.pro. Rinkesh R Bhandarkar, Utsav M Ratanpara(IJEDR) ETABS issue, for analysis and design for building systems. Staad.pro features are contain powerful graphical interface coupled with unmatched modeling, analytical, and design procedures, all integrated using a common database. It is quick and very easy for simple design and analysis of indoor stadium using staad.pro software 2017-18 department of civil engineering, sce bangalore Page 11 structures. It can handle the largest and most complex building models. Staad.pro mainly offers following types of analysis: (a) Linear (b) Nonlinear (c) Pushover Analysis (d) PΔ Effect Analysis This program has been thoroughly tested and used in using the program. However, all the user accepts and understands that no warranty is expressed by the developers or the distributors on the accuracy or the reliability of the program. This program is a very useful tool for the design check of concrete structures.

Design & analysis of Multistorey building under static & dynamic loading condition using staad.pro Balaji UA, SelvarasanB(IJTRA) In this project a residential of G+2 multi-story building is studied for earth quake loads using staad.pro. .Assuming that material property is linear static and dynamic analysis are performed. These non-linear analysis are carried out by considering severe seismic zones and the behavior is assessed by taking types II soil condition. Different response like, displacements, base shear are plotted.

METHODOLOGY

Building planning is mostly done by architects. But even Engineers some time have to perform this job. Hence knowledge of building planning in its board prospective is essential for all the civil engineers also. There may be two conditions of planning for a architect or engineer.

When site plan is given

When site plan is yet to be decided in the latter case, architect can show his full competence by suitably selecting the site, orientation, planning and designing the building.

The plan and detailing was drawn using Auto CAD. An Indoor Stadium consists of G+2. The floor height of Ground Floor and First Floor is 8.5 m. The Floor Height of Second Floor is 4.2m. The height of the parapet wall is 1m.The staircase is provided including lift with enough space.

Planning of Indoor Stadium: The proposed building with ground floor plan and reinforced concrete framed type of construction is adopted. The proposed stadium is to accommodate 2500 persons. 2.2 Foundation Earth work excavation for foundation for all column footings will be excavated and will be in cement concrete 1:1:2 mix, 3200 mm wide and 4800 mm thick laid at 2480 mm below ground level. The masonry footings will be in brickwork in cement mortar 1:6. The footing size is 3200 x 4800 mm. The foundation concrete for framed structure, all main wall and footing of cement concrete of 1:1:2 mix, will be provided. 2.3 Basement The basement will be in 1st class brick work in cement mortar 1:5, and 300 mm thick above ground level for all walls. The basement will be filled with clean sand to a depth of 300 mm. A damp proof course in cement mortar 1:3, 20 thick will be provided for all walls at basement level. 2.4 Sand Filling in Basement The basement filled up with clean sand to a depth of 300mm and it should be compacted with water as per standard specifications.

LimitstateofdesignwasadoptedandGeneralCodeofpracticeforbuilding(IS:4562000)&Codeofpracticeforseismicdesign(IS:1893-2002)was followed.

StructuraldesignandanalysisareperformedbyusingSTAADPROV8i&S TAADFOUNDATIONv8software.

AnalysisusingSTAAD.Pro

STAAD.Pro, the most popularstructural engineering software product for3D model generation,analysis anddesign.Ithasanintuitive,user-friendlyGUI,visualizationtools,powerfulanalysis anddesignfacilities.

The Software Release Report for STAAD.Pro V8i contains detailed information on additions and changes that havebeen implemented since the release of STAAD.Pro 2007 build 03. This document should be read in conjunction withallotherSTAAD.Promanuals,includingtheRevisionHistorydocum ent.

It workson“FiniteElementmethod”

STAAD.Prohasbeenenhanced sothatthemodelSTDdatafilecan bemanagedon aProjectWiseserver.

Description:

Fourintegration functionalitieshavebeen added.Theseare

Opena STAADmodel froma Project Wiserepository.

Savealocal STAADmodel intoa ProjectWiserepository.

Updateanexistingmodel from Project Wise.

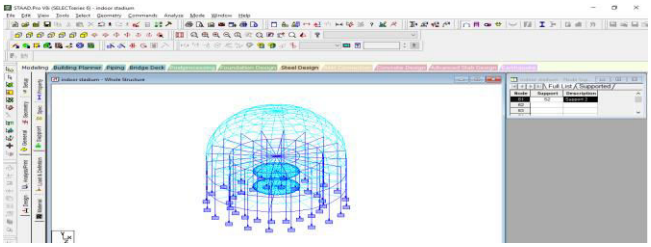
Reviewmodelproperties(meta-data)whichhasbeenopenedfroma Project Wiserepository.

Loads:

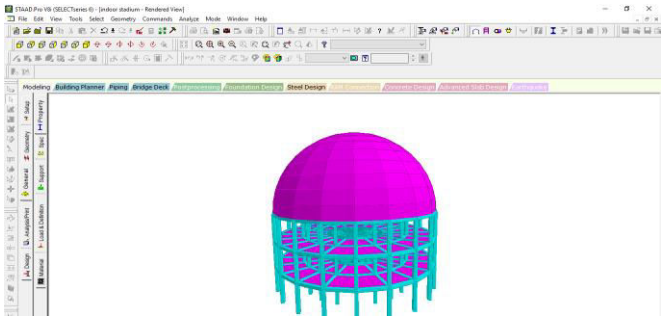
The loads considered for the design of terminal building are live load, dead load, Roof load, seismic load, wind load and hydrostatic load for water tanks.

Live load:

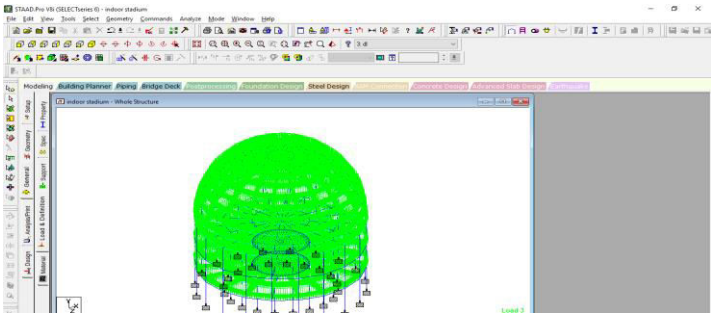
The live load is considered for the design from Indian standard code IS: 875 (part2).



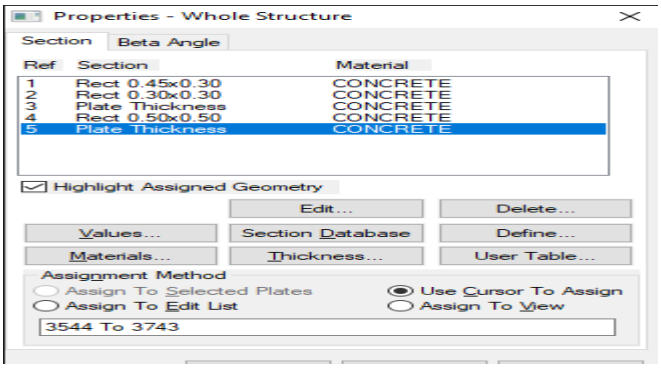
WHOLE STRUCTURE



3D RENDERED VIEW



DEAD LOAD



PROPERTIES

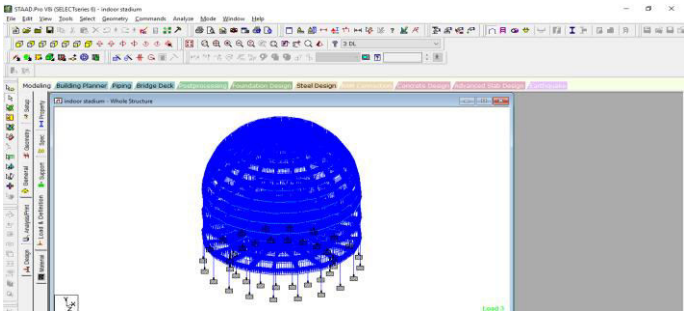
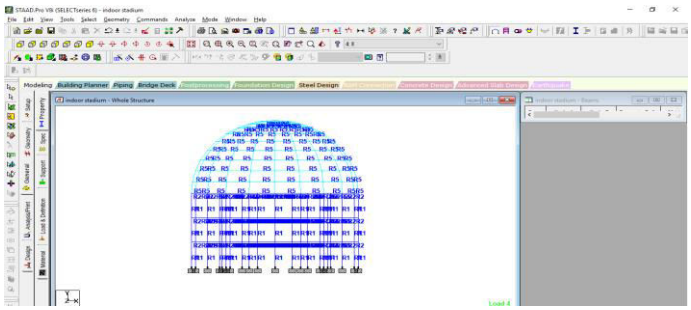
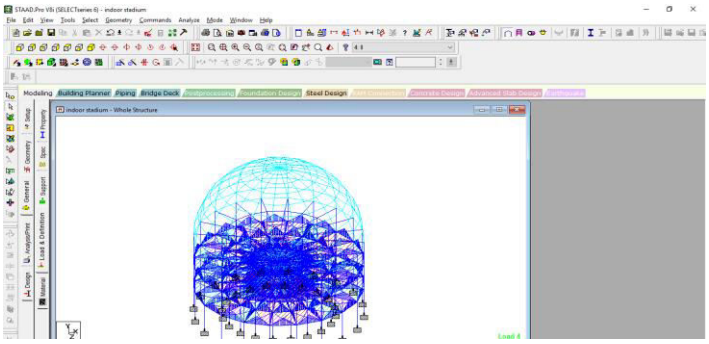


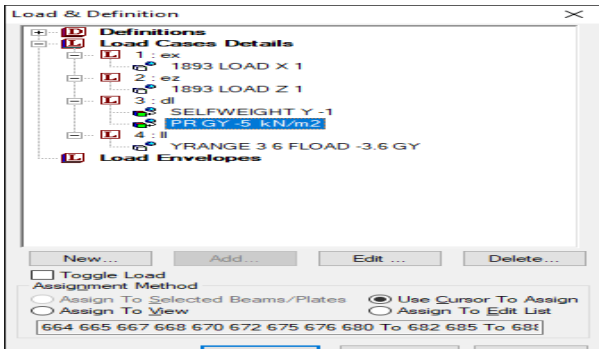
PLATE LOAD



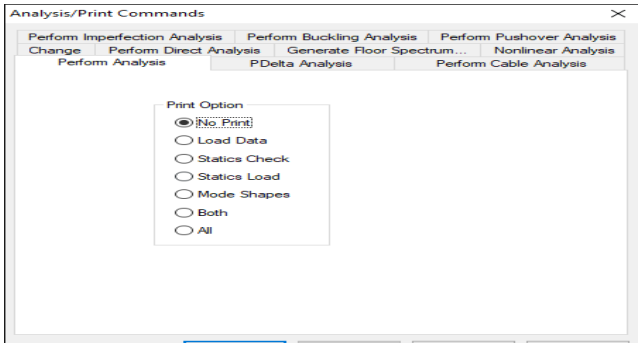
PROPERTIES ASSIGNED



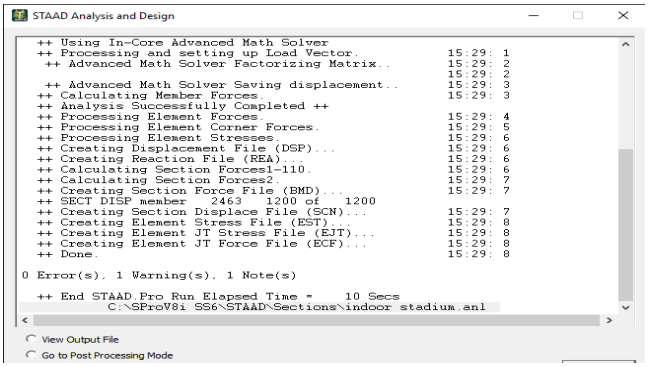
LIVE LOAD



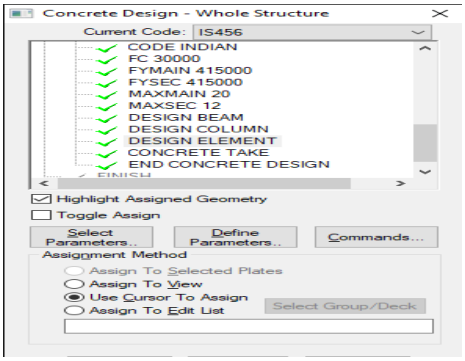
LOADS



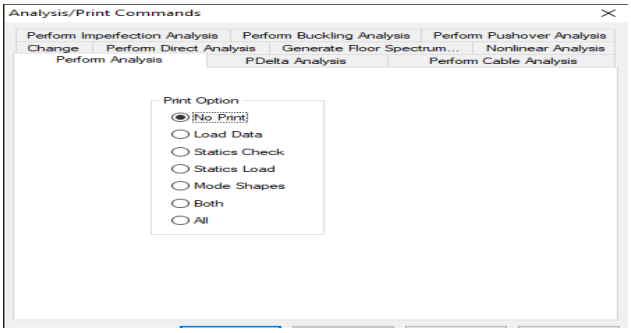
ANALYSIS



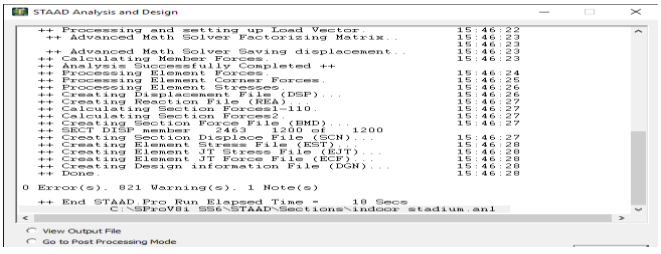
ANALYSED



CONCRETE DESIGN PARAMETERS



PERFORM ANALYSIS



DESIGN ANALYSIS

RESULTS AND DISCUSSIONS

DISUSSION

We chosen the particular location that is Vijayawada for Planning, Analyzing and Designing of indoor Stadium. Indoor Stadium is consists of Ground floor plus Two storeys. Ground Floor for Badminton Court, Second Floor for Volleyball Court and Top floor is for small games like caroms, Table Tennis, Yoga Room and Office Room. We calculated Final End moments manually by using Kanis Method and calculated bending moment, shear force, and displacement by using STAAD PRO Software and we also Designed the beams , columns by Manual and by using STAAD PRO Software and compared the both the results.

We calculated Final End Moments in Longitudinal and Lateral Directions by using kanis method and we got maximum Positive and Negative Final End Moments as 80.74 KN-m and 85.92 KN-m Respectively.

By using STAAD PRO Software we got maximum Positive and Negative Final End Moments as

135.24 KN-m and 89.190 KN-m

Maximum Positive and Negative Shear force we got in the STAAD PRO Software is 118.51 KN and

111.48 KN

Maximum Downward Deflection we got in STAAD PRO Software is 6.720mm.

We designed Continuous slab by manual and found out the Reinforcement to be provided in the slab

We got 10mm bars at 150mm c/c spacing along X-axisat Supports

We got 10mm bars at 150mm c/c spacing along X-axis at Mid Span

We got 10mm bars at 150mm c/c spacing along Y-axisat Supports

We got 10mm bars at 150mm c/c spacing along Y-axis at Mid Span

We got 8mm dia bars 200mm c/c spacing asTorsional Reinforcement

We designed T Beam by manual calculations and found out the Reinforcement provided in the Beam as 12no's 32mm dia bars in tension zone and Shear Reinforcement as 2legged 8mm dia stirrups @ 80mm c/c spacing.

In STAAD PRO Software we got reinforcement provided in Tension Zone as 7 no's 10mm dia bars and in Compression Zone as 7 no's 10mm dia bars.

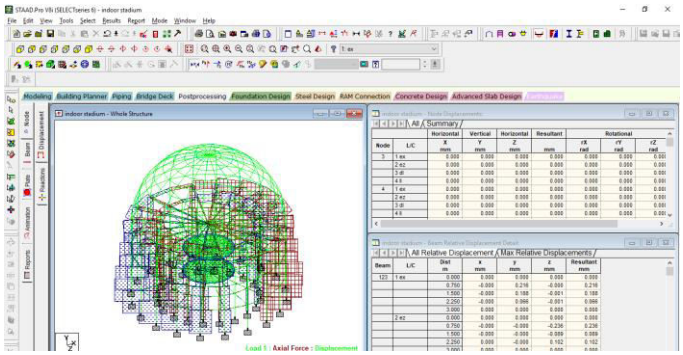
In column design by manual calculations we got reinforcement details as 8no's 18mm dia bars and 5mm dia lateral ties provided at 280mm c/c spacing.

In STAADPRO Software we got the reinforcement details as

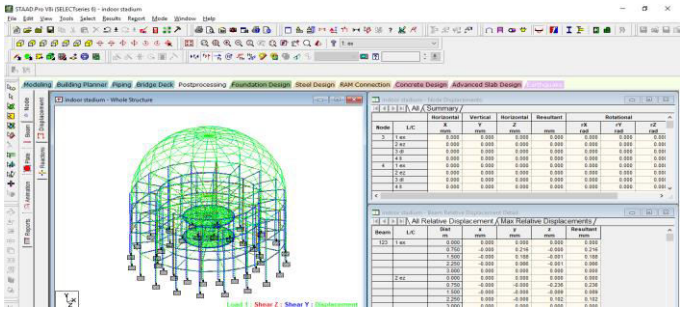
In Ground floor 12no's 25mm dia bars are provided.

In 1st Floor 12no's 16mm dia bars are provided.

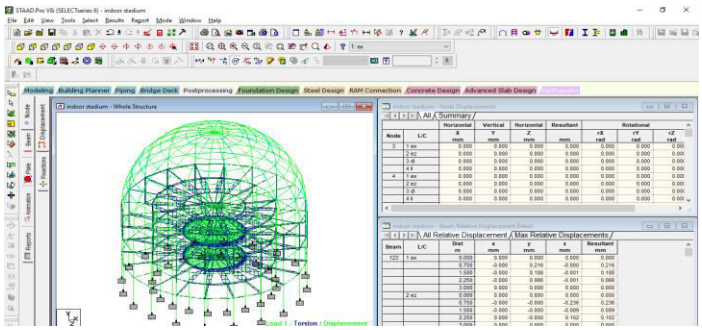
In 2nd Floor 12no's 8no's 12mm dia bars are provided.



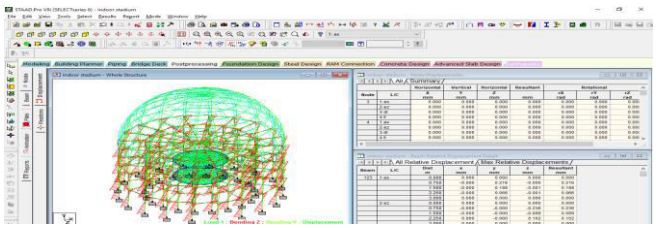
SF-X UNDER SESIMIC LOAD



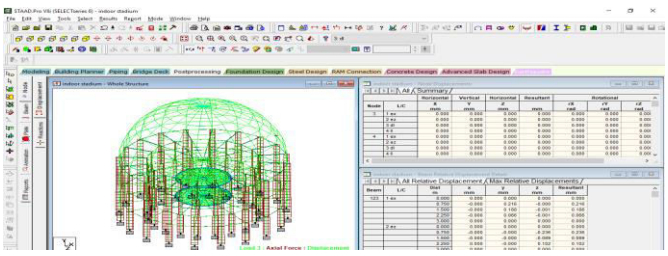
SF-Y,Z UNDER SESIMIC LOAD



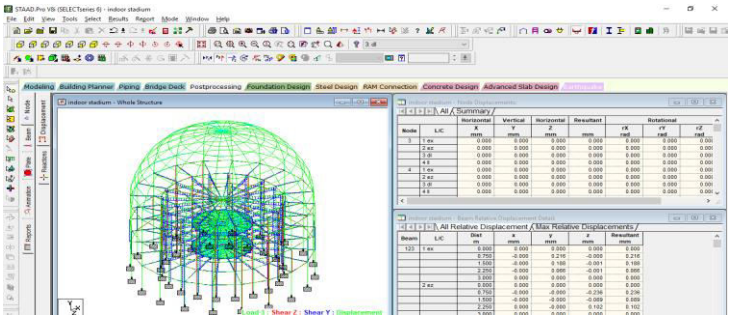
BM-X UNDER SESIMIC LOAD



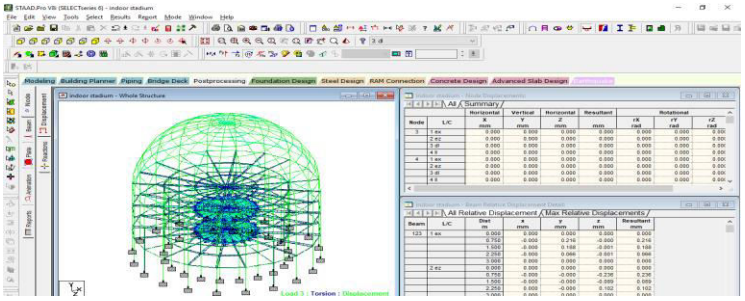
BM-Y,Z UNDER SESIMIC LOAD



SF-X UNDER DEAD LOAD



SF-Y,Z UNDER DEAD LOAD



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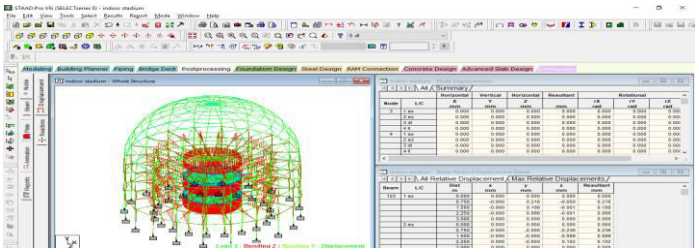
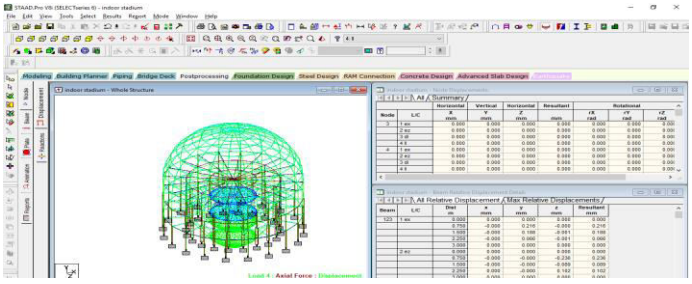
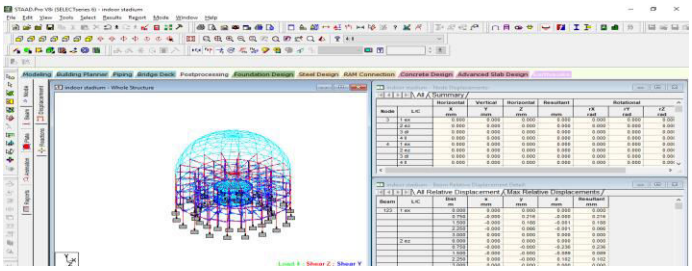


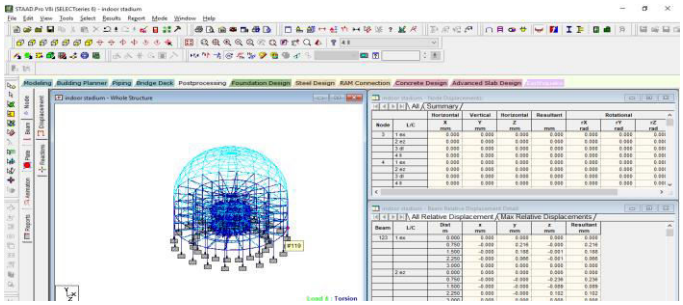
BM-Y,ZUNDER DEAD LOAD



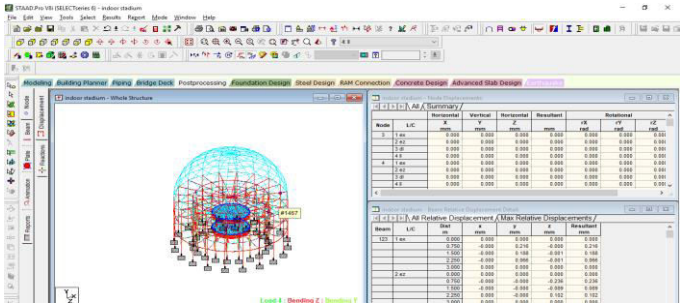
SF-X UNDER LIVE LOAD



SF-Y,Z UNDER LIVE LOAD



BM-X UNDER LIVE LOAD



BM-Y,Z UNDER LIVE LOAD

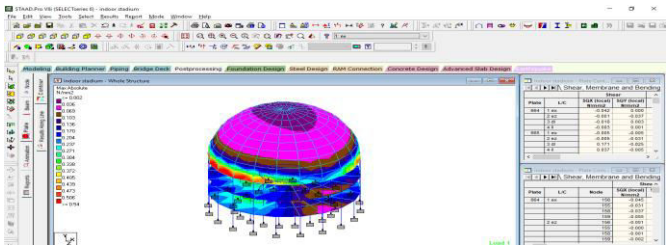


PLATE STRESSES UNDER SESIMIC

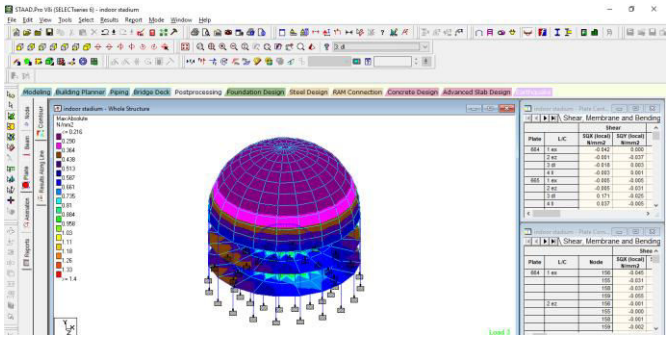


PLATE STRESSES UNDER DEAD LOAD

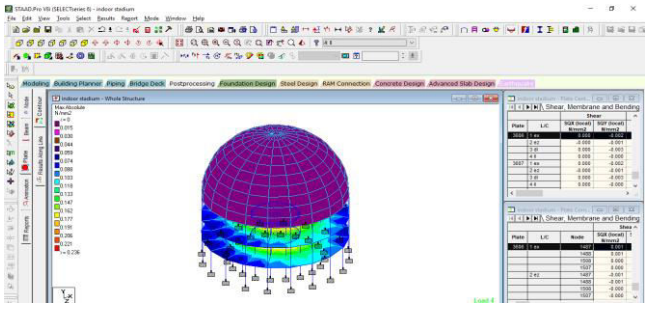
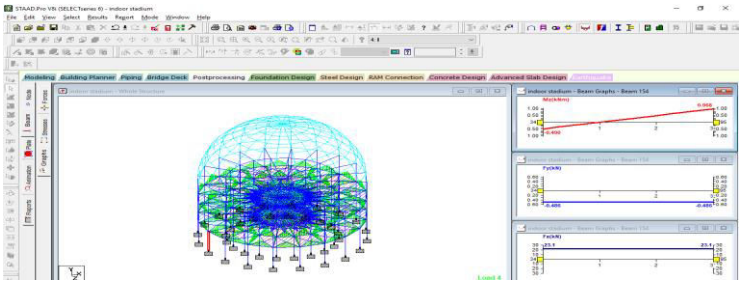
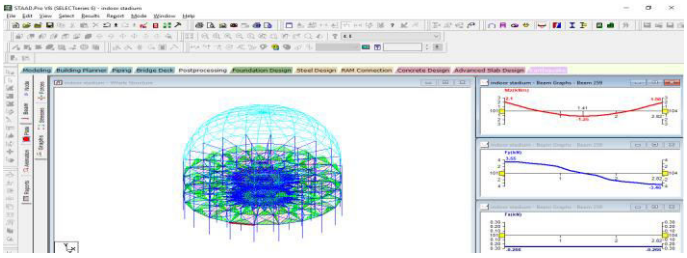


PLATE STRESSESUNDER LIVE LOAD

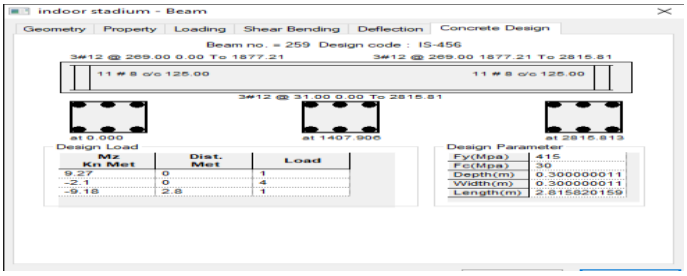


SF AND BM FOR MEMBER154

CONCRETE DESIGN FOR MEMBER154



SF AND BM FOR MEMBER259



CONCRETE DESIGN FOR MEMBER259

CONCLUSION

This research concluded that combination of AutoCAD and STAAD Pro gave as a perfect & accurate design as well as analysis report with low time consumption. Also we gave the advanced retrofitting technique for construction & and economical usage of materials, because the available qualified materials only used for this study.

In this Project we did Planning, Analysis and design for G + 3 Indoor Stadium.

Materials used are M30 grade Concrete and Fe415 steel.

Used AutoCAD 2017 for effective representation of drawings and STAAD PRO V8i Advanced Software which provides us a fast, efficient, easy to use and accurate platform for analyzing and designingstructure.

The design of Slab, Beam and Columns are done in Limit State Method which is safe at control of deflection and in all aspects.

It was observed that the bending moment values

Obtained from manual calculation is less than the 15% of total average of the bending moment values obtained from Staad PRO. Compared to manual Designs, STAAD PRO designs are more accurate.

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