Design of Open Sports Stadium in Dravidian University, Kuppam

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Abstract - In this growing world as civil engineering student needs to be fully aware of structural elements and safety parameters before and during execution of project. This project focuses on analysis and design of open sports stadium for Dravidian university. The design is done by limit state method the guideline followed under IS 456-2000 and IS 800:2007. The present project deals with following features cricket, kabbadi, area, etc... All the structural elements are designed as per codal provision using staad pro. The cost of project is 1.35 crores. We here to propose an open sports stadium in Dravidian university. Because lack of ground to play sports. We got required area is 13.34 acres by chain survey, in that site we are going to design individual sports through AUTOCAD, and REVIT(3D) and designing of pavilion in STAAD PRO. The sports mentioning in that area are cricket, football, hockey, volley ball, kabaddi, basketball and shuttle. The area required for cricket is (3.278 acres), the area required for football is (2.03acres), the area required for hockey (1.4acrs), the area required for basketball is (0.1acrs), the area required for volley ball is (0.04acrs) and the area required for kabaddi (0.03acrs), the area required for shuttle (0.02acrs). In the remaining area providing gallery, parking and for future purpose.

Keywords-survey, planning, Auto Cad, Revit.

I. INTRODUCTION

An open sports stadium is a place containing of multiple sports. Stadium consists of multiple sports like cricket, football, hockey, basketball, volleyball, kabaddi, and shuttle. Stadium contains of an area 13.34 acre. The capacity of stadium is 3080 people and it also a future expandable stadium. Stadiums are firstly introduced by Greeks. Galleries are provided to sit and see the sports. Each gallery contains a seating capacity of 280 was provided at each sport and some sports contains two to more galleries. And at the side of stadium parking is provided in an area of 0.6 acre. Multi-purpose stadiums have many different types of customers, including sponsors, employees, suppliers and the communities in which they operate. The need for facilities and safety management has been regarded as the most important aspects in public facilities, especially in an outdoor stadium during emergency situations such as demonstration, fire, terrorist attacks. This study will provide essential information to assist the management to manage their sport facilities. It covers the planning aspect and operational principles that encourage use of facilities without overlooking the spectator's safety consideration. There are many factors that need to be considered which influence the management of sport facility. Therefore, public safety is a major issue in heavily used public facilities. The competence and effective action in the management of spectators in outdoor stadium facilities must replace.

With the ever increasing growth of the sport business sector's importance over the last few years, the need has emerged to urgently turn professional sports clubs into corporate businesses

II. LITERATURE REVIEW

1. HANWEN LIAO (2006)-A framework for evaluating Olympic urban development for sustainability was written by Hanwen Liao. This thesis includes a systematic collection of data with an assessment of factors defining environmental sustainability. The evaluation frame work considers nine themes (e.g. Energy consumption, Water consumption, etc.) and is based on a multi- criteria assessment method. This assessment is focused on the existing urban structures and circumstances without any specific and retrospective sports facilities evaluation.

2.PETERSCHOLLMEIER(2004)- 'Die Bewerbung um die Spiele der XXVIII Olympiad 2004' ('Application for the Games of the XXVIII Olympiad 2004') by Peter Scholl Meier is a comprehensive historic review of the election process in general and a detailed analysis of the election process for the Olympic Games in 2004. The complex criteria for the election of Athens are thoroughly analysed and discussed within the historic context. Scholl Meier's assessment of the election concludes that the reasons why Athens was selected in the 106. IOC Session was not only based on rational, technical and economic criteria but also on "Emotional Criteria, which become particularly important, in case the applicants like Athens and Rome are not 18 fundamentally different."32 Another important conclusion is that the continuous modifications of election procedures are required due to the increasing level of complexity for hosting the Games as well as the economic impact for the Host City and the IOC. Peter Anthony

Haxton has emphasized the role of community involvement with regard to the Olympic Games in his thesis ‘The perceived role of community involvement in the Mega-Event hosting process: a case study of the Atlanta 1996 and Sydney 2000 Olympic Games.’33 He summarizes that “the concept of hosting an Olympics is often prompted by the perception that doing so will provide an opportunity to promote economic development and urban redevelopment, fast track the development of sporting facilities and other infrastructure and provide a legacy of sport and recreation opportunities for locals. All of these perceived benefits are promoted as contributing to overall community development, one of the major aims of mega-event hosting. Following the floating of the initial idea, the model suggests that concept initiators examine the proposed host city/region to determine the compatibility of hosting the Olympics with the history, culture and values of the potential host community. If considered compatible a preliminary situation analysis may be undertaken and used, for example, to determine levels of community support and the facilities and infrastructure required to successfully host the Games. In addition, a preliminary feasibility study, examining aspects such as the potential economic, social, cultural and environmental impacts, may also be prepared. Such a study also serves as a rough assessment of the affordability or profitability of hosting the Games. As with the impacts of mega-events the opportunities created as a result of hosting a mega-event may be perceptible for many years, even decades, to come. Examples of opportunities created as a result of hosting an Olympic Game include the long-term use of sporting facilities and related infrastructure.

3. BIRTE BERLEMANN AND MITCHELL RHODES -They examine the primary question “In what way could the IOC contribute to a global movement to a socio-economic sustainability?”35 and concludes with recommendations for the International Olympic Committee (IOC). The authors state that “the ideals and values of Olympism and social sustainability are partly overlapping and complimentary. With worldwide networks firmly established, the IOC is well positioned to take a leading role in helping move society towards sustainability and potentially leave a legacy to humanity even greater than that of the Olympic Games and Olympism. While the opportunity for such leadership role 19 exists, there is little evidence to support that the IOC will become systemic and use its influences to help move society towards sustainability. If the decline of societal and environmental capacity continues, at some point in the future, conditions will be such that the staging of the Olympic Games will be difficult or even impossible.

4.DAVID CHERNUSHENKO’S- Running an environmentally, socially and economically responsible organization’, is a "comprehensive guide to managing sport organizations of all types and sizes in a more responsible manner. This book, sponsored by the United Nations Environment programme, takes up the torch from 'Greening our Games', David Chernushenko's 1994 book, which introduced many in the sporting world to the concept of sustainable sport."37 The author summarizes that “In 1992, the Sydney bid committee was persuaded by environmental groups, spearheaded by Greenpeace, to develop a ‘Green Games’ bid, using the environment as an unique selling point to IOC voters. The bid featured innovative facility designs, notably an Athletes Village that was solar-powered, conserved resources, use of non-toxic and recycled materials, wisely use of land and profiled leading environmental technologies. A set of ‘Environmental Guidelines for the Summer Olympic Games’ was developed by a team of experts including Greenpeace, alternative power and waste experts, sustainable building designers, academics and government regulators. The Guidelines were submitted as part of the bid, with Sydney committing to implement them, if it won. Sydney won, by a mere two votes, over notoriously polluted Beijing. IOC President Juan Antonio Samaranch later observed, ’The Olympic Games in the year 2000 were awarded to the city of Sydney, Australia, partly because of the consideration they gave to environmental matters’.” In chapter ‘Lessons from Sustainable Sports Forerunners’ Chernushenko states that “Sydney 2000 took the boldest possible approach, announcing far-reaching intentions to pursue sustainable development in all aspects of planning, construction and operations- and paid the price: very high public expectations. Subject to the most intense scrutiny imaginable sign of public and professional interest, as well as local and international concerns- the legacy for the city, for the region and for the cause’ of promoting sustainable development has been a positive one overall. That Sydney 2000 achieved or partially achieved most of its goals is remarkable. Notable benefits of the Games include such ‘bricks and mortar’ accomplishments as rehabilitated sites, facilities that use relatively little energy and water, successful integration of sustainable design features, innovative materials and renewable energy systems. Arguably even more important is the contribution of the Games to the spread of 20 awareness and knowledge among a range of professional and trades people, suppliers, regulators and the public. This knowledge has been underscored by a wealth of practical experience gained and retained by many of the hands-on participants in planning, construction and operations.

5.NATALIE ESSIG’S- This a thesis, which was subsequently published as a book in 2010, analysing the practicability and measurability of sustainability aspects with regard to competition facilities of the Olympic

Games. The thesis evaluates whether "Olympic Games and their sports facilities are a 'Greenwash Marketing Tool' or could be termed as 'sustainable'. The definition, assessment and measurement of 'Sustainability of Olympic Games' is surveyed. Essig's intention is to verify if existing planning and assessment methods are a sufficient basis for the planning, construction and operation of ecological, economic and social Olympic venues or if only a common and mandatory assessment tool can promote and assure sustainable building performance of Olympic venues. The dissertation reviews 12 case studies of the modern Olympic Summer and Winter Games in chapter 'Olympic competition venues and sustainable planning concepts. Furthermore, environmental evaluations, reports and guidelines of different Non-Government Organizations (NGOs) as well as such for applicant and candidate cities established by the IOC in the 1990s are investigated. International assessment methods like BREEAM, LEED and DGNB are evaluated with regard to criteria and applicability for Olympic sports facilities."40 In chapter 'Evaluation and certification of sustainable building quality regarding Olympic competition venues: Procedures for implementation of sustainable sports facilities' Essig concludes her resume with four theses. "The first thesis states that Olympic Games cannot be considered sustainable because of the high additional environmental burden on the host city. Only a reduction of the extent of the Olympic construction activity (competition venues) is a guarantee for success for future sustainable Olympic Games. The second thesis concludes that lack of regulations and criteria on the part of the IOC for sustainable Olympic sports venues in the Olympic bid process impede an implementation of ecologic, economic and social sports facilities at an international level. The third thesis explains that only development of evaluation criteria for sustainable Olympic sports venues regarding functionality, sustainability, design and consecutive usage would enable measurability of sustainability of Olympic sports venues. The fourth thesis reveals that only a mandatory adoption of a standardized international seal of approval for 21 assessment and certification of sustainable building quality of Olympic sports venues by the IOC leads to effective implementation of sustainable sports venue architecture on international level."41 In accordance with Essig's findings a bespoke Evaluation Matrix for the specific assessment of sports facilities for the Olympic Games has been developed in this thesis. Furthermore, practical recommendations leading to a more sustainable legacy of the Olympic Games derived from lessons learned through insights of the case studies evaluations are compiled.

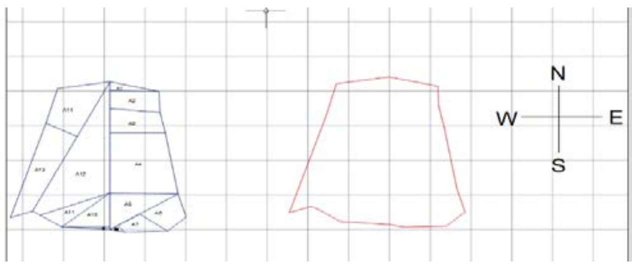
6.UWE FITSCHEN'S- Publication with the title 'Umwelt management ausgewählter Gross veranstaltungen-Effective Umwelts Hutz Oder Greenwashing?' ('Environmental management of selected mega events-effective environmental protection or Greenwashing?') examines concepts for environmental management in mega events based on the evaluation of the Sydney Olympic Games 2000, Athens Olympic Games 2004 and the World Cup 2006 in Germany. He concludes that "concepts for environmental management at mega events are partly utilized to ensure environmental protection but also exploited for Greenwashing. The concept of the Sydney Olympics can be considered as mostly successful and Greenwashing is only marginally implemented, whereas at the Athens Olympics the environment protection concept is considered ineffective despite of good intentions with a significant Greenwashing component."

III. METHODOLOGY

1. SITE SELECTION - A site was selected in Dravidian university which is suitable for **DESIGN OF OPEN SPORTS STADIUM**. The site contains an area of 8.23 acres is perfectly suitable for the design of sports stadium is possible to arrange multiple sports in that area. This site is located in Dravidian university which is nearer to taluka of kuppam.

We visited the site and surveyed the area and then we decided to do the design project in that area which is suitable for the multiple sports.

Fig.4. 1 Satellite view of location of ground in Dravidian University



Area of plan in AUTOCAD

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2. SITE ANALYSIS OF SPORTS STADIUM

Taking the soil in Dravidian University ground at highest depth for soil bearing test is 1.23 mts. Soil has been taken at three different places with three samples at different depths.

S.NO	SAMPLE	DEPTH(m)	DIRECTION
1	Sample-1	1.06	East
2	Sample-2	1.23	West
3	Sample-3	1.12	North

3. AREA SURVEY BY USING CHAIN SURVEYS

Sighting a ranging rod by the cross-staff. The area should be calculated by the perpendicular method.

4. AREA CALCULATIONS

$A_1 = 357.89\ m^2$

$A_2 = 1702.4\ m^2$

$A_3 = 2083.34\ m^2$

$A_4 = 6689.3\ m^2$

$A_5 = 2204.48\ m^2$

$A_6 = 1476.37\ m^2$

$A_7 = 1009.14\ m^2$

$A_8 = 32.86\ m^2$

$A_9 = 150\ m^2$

$A_{10} = 90.49\ m^2$

$A_{11} = 52.15\ m^2$

$A_{12} = 14.4\ m^2$

$A_{13} = 6196.95\ m^2$

$A_{14} = 1855.72\ m^2$

$A_{15} = 7299.4\ m^2$

$A_{16} = 5718.24\ m^2$

$A_{17} = 3794.55\ m^2$

Total area = 40,727.68 m^2

= 10.064 acres

5. LEVELS OF GROUND

Taking levels by using dumpy level. Taking the height of instrument at each point.

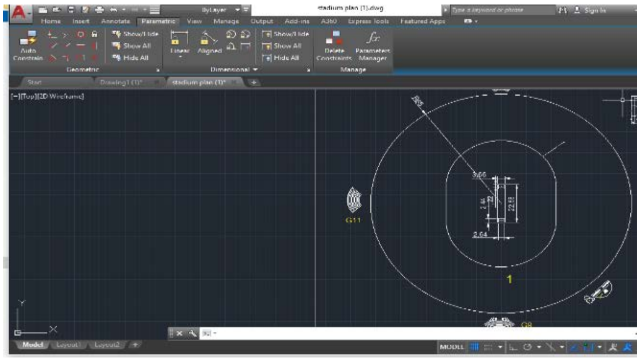
Taking the staff readings by through the dumpy level.

LEVELS OF GROUND AT DIFFERENT POSITIONS

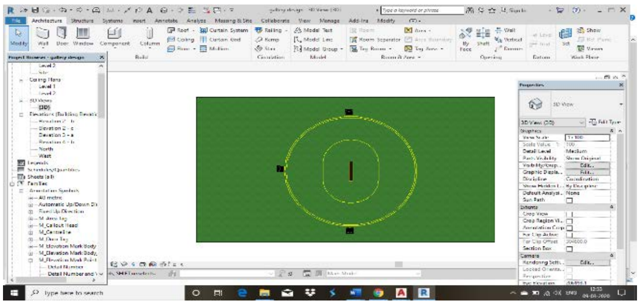
S.NO	HEIGHT OF INSTRUMENT (mts)	BACK SIGHT (mts)	INTERMEDIATE SIGHT (mts)	FORE SIGHT (mts)
1	1.6	0.645		
			0.985	
				0.29
2	1.4	0.15		
				0.185
3	1.65	0.245		
			0.95	
			1.31	
				2.15
4	1.8	0.93	1.19	
			1.085	
				1.38
5	1.25	0.7		
			1.695	
				2.08
6	1.2	1.96		
			1.585	
			1.94	
				1.67
7	1.6	1.55	2.3	
			1.65	
				1.11

IV. COURTS OF ALL SPORTS

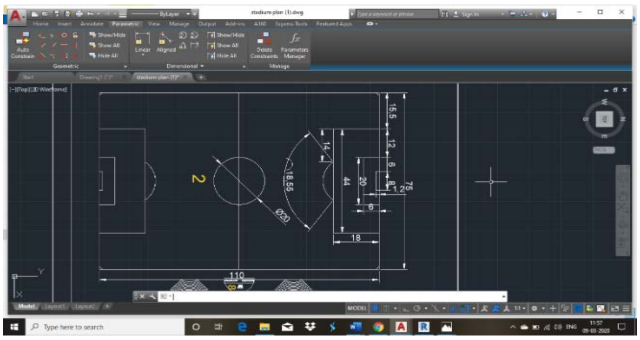
1. CRICKET - Cricket is an outdoor sport. The father of cricket **"WILLIAM GILBERT GRACE"** (July 1848-october 1915). He was an English amateur cricketer who was important in the development of sport and is widely considered one of its greatest players ever. The history beginning 16th century and it was originated in "**SOUTH EAST ENGLAND"** and now it becomes a national sport and it is spread to globally 18th-20th century. It is a bat and ball game played between two teams of around 11 players on both the teams. The rectangular pitch dimensions 22.56 Mt on the field. The international matches have been played since 1844. It is a second popular sport in the world. Around the 3.278 acres of land required to design cricket stadium.



Cricket Ground in Auto Cad

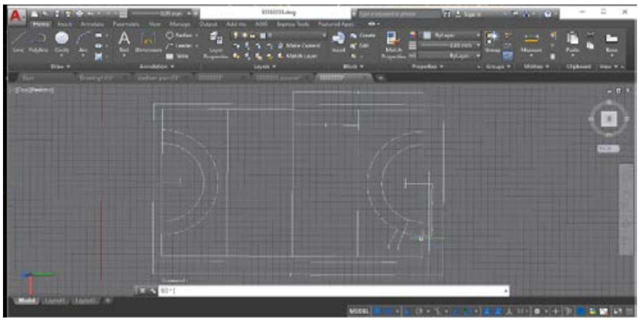


2. FOOT BALL - Football is an outdoor sport. The father of football is **"EBENEZER COBB MORLEY"** (16thAugust 1831-20th November 1924). The area required to design the football is 2.03 acres. The number of players required to play football is 11 members in each team.



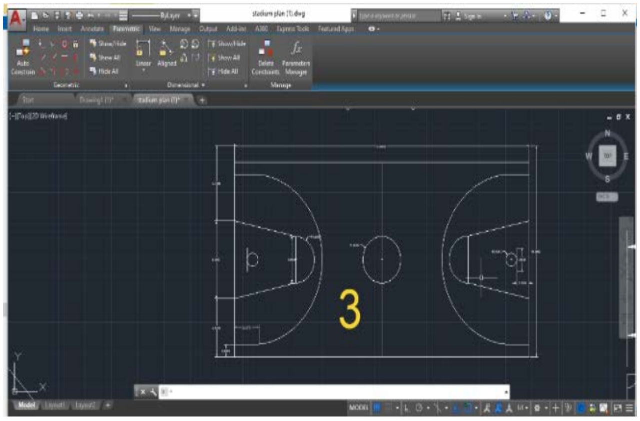
Football Court

3.HOCKEY - Hockey is an outdoor sport due to heavy area required to play. The father of hockey is **"SUTHERLAND"** 1870.The area required to design hockey 1.4 acres. Players required to play hockey in each team is 11 members.



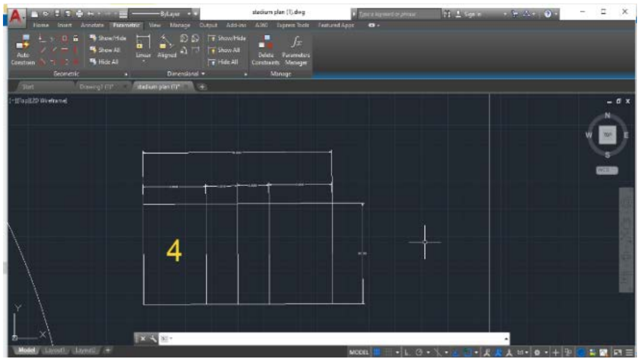
Hockey Court

4. BASKETBALL - Basketball is an outdoor sport which is used to play with 5 members in each team. The father of basketball is **"JAMES NAISMITH"** and he introduced the sport in the year 1981.the area required to design basketball 0.1 acres.



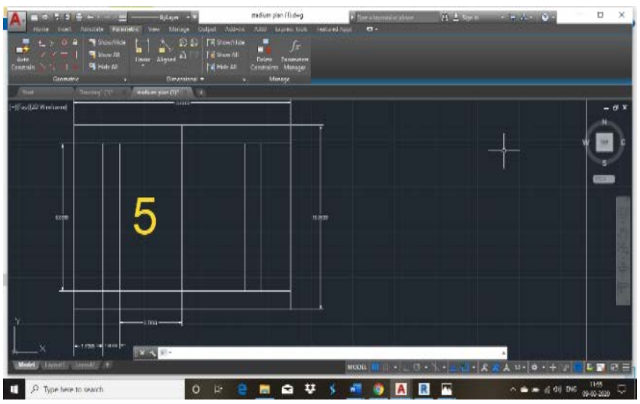
Basketball court

5. VOLLEYBALL - Volleyball is an outdoor game. the father of **"WILLIAM MORGAN"** (23 January 1870) the area required to design volleyball 0.04 acres. The numbers of players required to play volley ball 6 members with two teams.



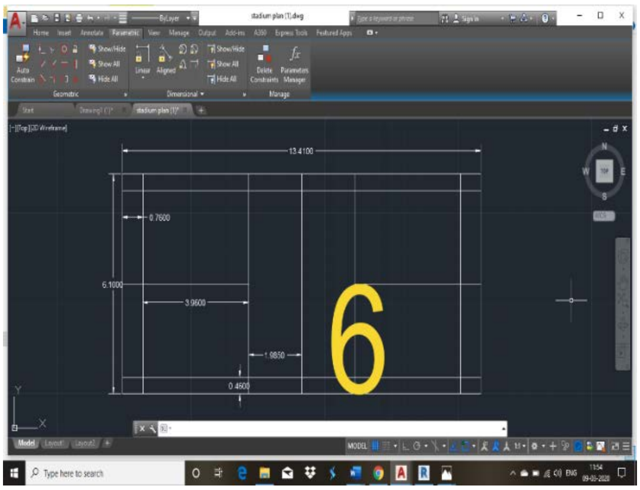
Volleyball Court

6. KABADDI - Kabaddi is an outdoor game. The father of kabaddi is **"SUNDAR RAM"** (1979). The area required to design **KABADDI COURT** is 0.03 acres. the numbers of players required to play two teams of 12 players.

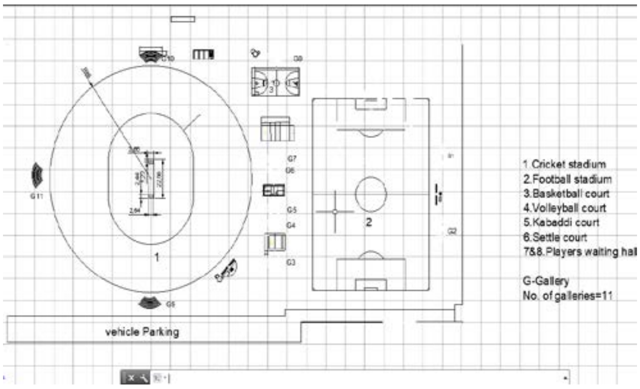


Kabaddi Court

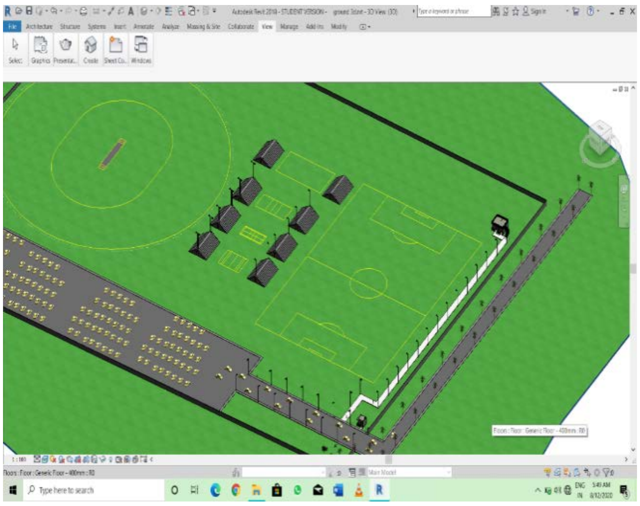
7. SHUTTLE - Shuttle is an outdoor game. The father of Shuttle is **"GEORGE MUELLER"** (27 September 1805). The area required to design Shuttle court is 0.02 acres. The numbers of players required to play shuttle 2 or 4 members.



Shuttle Court



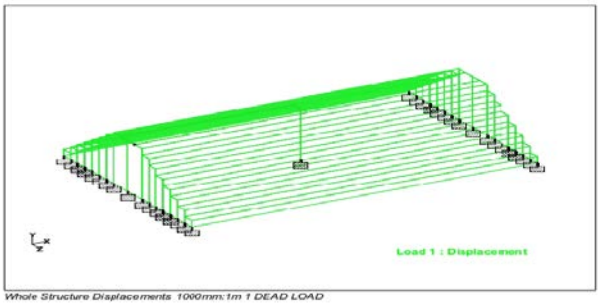
Total Plan in Auto Cad



Total Plan in Revit 3d

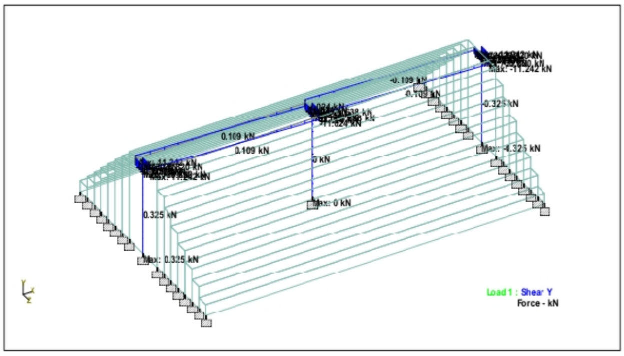
V. ANALYSIS OF OPEN SPORTS STADIUM

1. MODELLING



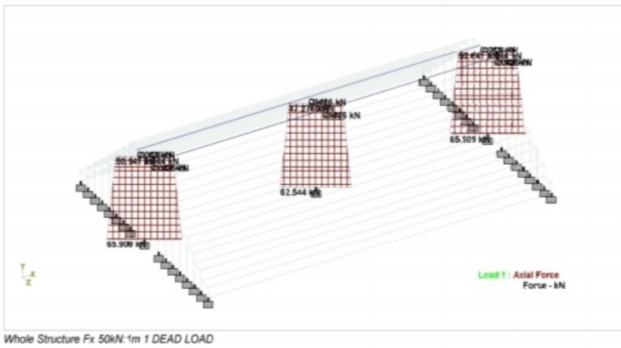
3D modelling in Staad Pro

2. LIVE LOAD



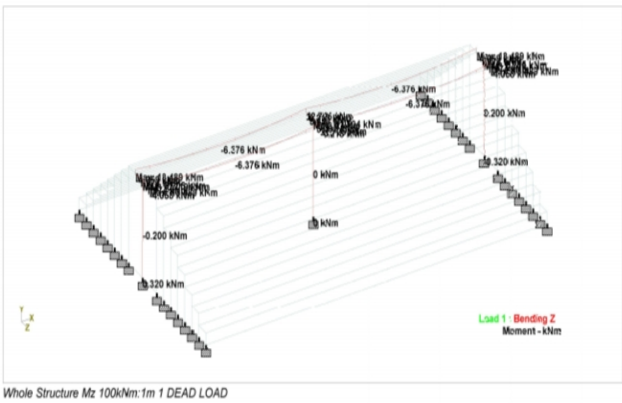
2. Live load

3. DEAD LOAD



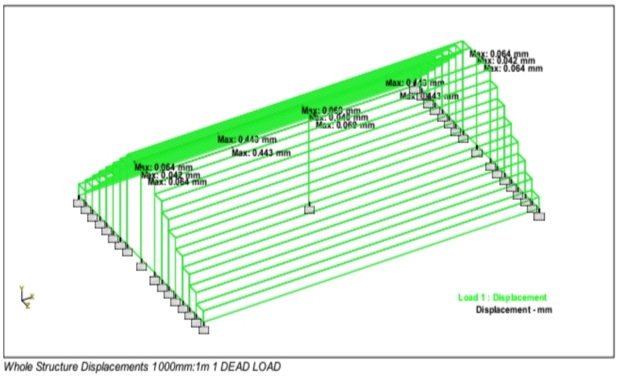
3. Dead Load

4. BENDING MOMENT



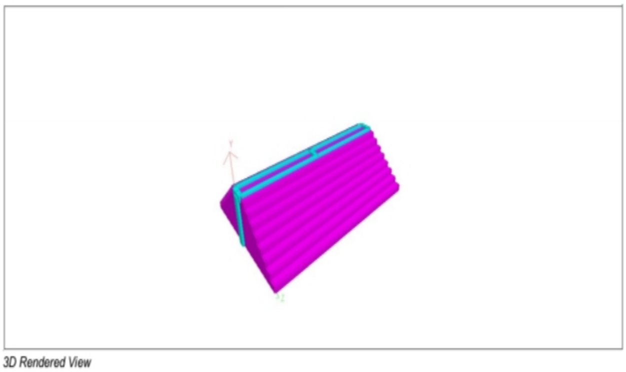
4. Bending Moment

6.5. BEAM STRESS



5. Beam Stress

6. 3D RENDERING



7. 3D Rendering

DESIGN OF OPEN SPORTS STADIUM

DESIGN OF BEAM-A beam is a structural element or member which primarily carries loads applied lateral to its longitudinal axis. These loads cause a reaction at its supports and shear force and bending moment along the beam.

Manual Design of beam

Size of beam =300x400 mm

Length = 7000 mm

Fck = 25 N/mm^2

Fy =415 N/mm^2

Loadings

Self-weight of beam = 3.18 KN/m^2

Wall load = 30.59 KN/m^2

Load from slab

S.W = 25x0.1 =2.5 KN/m^2

Live load = 3 KN/m^2

Floor finish =1 KN/m^2

Total load = 9.68 KN/m^2

Floor load = 1.5x9.68 = 14.52 KN/m^2

Bending moment

$M = \frac{14.52 \times 7 \times 7}{8} = 88.935$ KN-m

Shear force = $\frac{14.52 \times 7}{2} = 50.82$ KN

Tension Reinforcement

M_u limit = 186 KN-M

$M_u < M_u$ limit

Hence the beam is under reinforced condition.

Area of steel reinforcement

Ast = 631.46mm^2

Minimum reinforcement

Ast_{min} = 261.19 mm^2

$Ast > Ast_{min}$

Provide 10 mm bars

Ast = $\frac{\pi}{4} \times 10^2 = 78.53$ mm^2

Spacing = $\frac{78.53}{631.46} \times 1000 = 135$ mm

No. of bars = $\frac{631.46}{78.53} = 8$ bars.

Check for shear

$\tau_v = 0.398 = 0.4$

$P_t = 0.49$

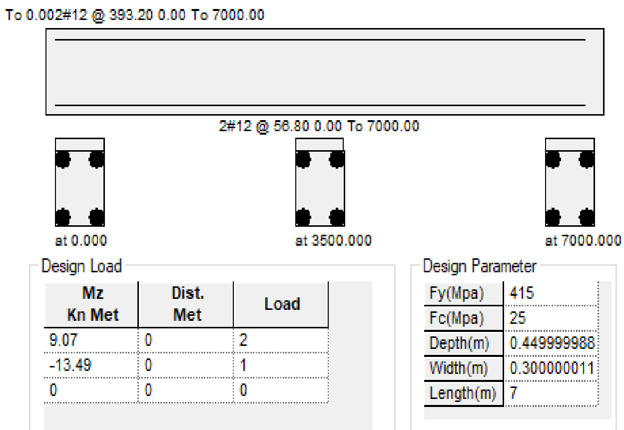
Check for moment

$M_u = 0.138\ fckbd^2$

d = 293.13

d < d (provided)

Hence safe in flexure.



8. Design of beam in Staad Pro

```
      ACI 318-11   BEAM  NO.    21   DESIGN RESULTS
      ===========================================

LEN -   500. MM  FY -  415.  FC -  25.  MPA, SIZE -  300. X  450. MMS

LEVEL    HEIGHT     BAR INFO       FROM        TO          ANCHOR
          (MM)                     (MM)       (MM)        STA   END
______________________________________________________________________

  1        57.     2 - 12MM         0.        500.        YES   YES
  2       393.     2 - 12MM         0.        500.        YES   YES


      B E A M  N O.   21 D E S I G N  R E S U L T S - SHEAR


** LOCATION FOR DESIGN FOR SHEAR AT START OF MEMBER    21 IS BEYOND
   THE MIDPOINT OF MEMBER. DESIGN FOR SHEAR AND TORSION NOT PERFORMED.


** LOCATION FOR DESIGN FOR SHEAR AT END OF MEMBER    21 IS BEYOND
   THE MIDPOINT OF MEMBER. DESIGN FOR SHEAR AND TORSION NOT PERFORMED.
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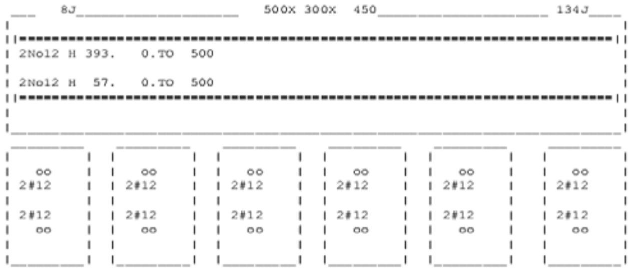


DESIGN OF COLUMN - A column may be defined as an element used primary to support axial compressive loads and with a height of at least three times its lateral dimensions.

The strength of column depends upon the strength of materials, shape and size of cross section, length and degree of proportional and dedicational restrains at its ends.

Manual design of column

Size of column = 450x450

Fck = 25 N/mm^2

Fy = 415 N/mm^2

Pu = 0.4Fck Ac + 0.67 Fy Ast

dg = Ac +Asc

Asc = 0.04 Ag

Ac = 0.99 Ag

Pu =2567.801 KN

P = 1711.86 KN

Ast = 2025 mm^2

Provide 20 mm

ast = 314.15 mm^2

No. of bars = $\frac{2025}{314.159}$ = 7 bars

Transverse Reinforcement

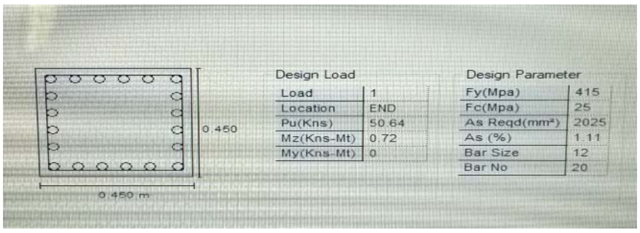
PHch = 300mm

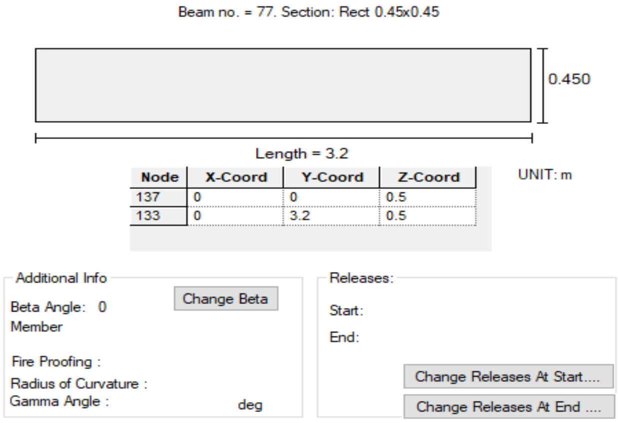
16x20 = 320 mm

Least dimension =450 mm

Diameter

Provide 8mm lateral ties.





9. Design of Column in Staad Pro

```
     ACI 318-11   COLUMN  NO.    77   DESIGN RESULTS
     ===========================================

FY - 415.0  FC -  25.0 MPA,  SQRE SIZE - 450.0 X 450.0 MMS, TIED
        ONLY MINIMUM STEEL IS REQUIRED.
        AREA OF STEEL REQUIRED =   2025.0   SQ. MM

BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
----------------------------------------------------------

 20 - 12 MM              1.117        1       END     0.650
(PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
TIE BAR NUMBER   12 SPACING 192.00 MM


     ACI 318-11   COLUMN  NO.    78   DESIGN RESULTS
     ===========================================

FY - 415.0  FC -  25.0 MPA,  SQRE SIZE - 450.0 X 450.0 MMS, TIED
        ONLY MINIMUM STEEL IS REQUIRED.
        AREA OF STEEL REQUIRED =   2025.0   SQ. MM

BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
----------------------------------------------------------

 20 - 12 MM              1.117        1       END     0.650
(PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
TIE BAR NUMBER   12 SPACING 192.00 MM


     ACI 318-11   COLUMN  NO.    79   DESIGN RESULTS
     ===========================================

FY - 415.0  FC -  25.0 MPA,  SQRE SIZE - 450.0 X 450.0 MMS, TIED
        ONLY MINIMUM STEEL IS REQUIRED.
        AREA OF STEEL REQUIRED =   2025.0   SQ. MM


BAR CONFIGURATION       REINF PCT.   LOAD   LOCATION   PHI
----------------------------------------------------------

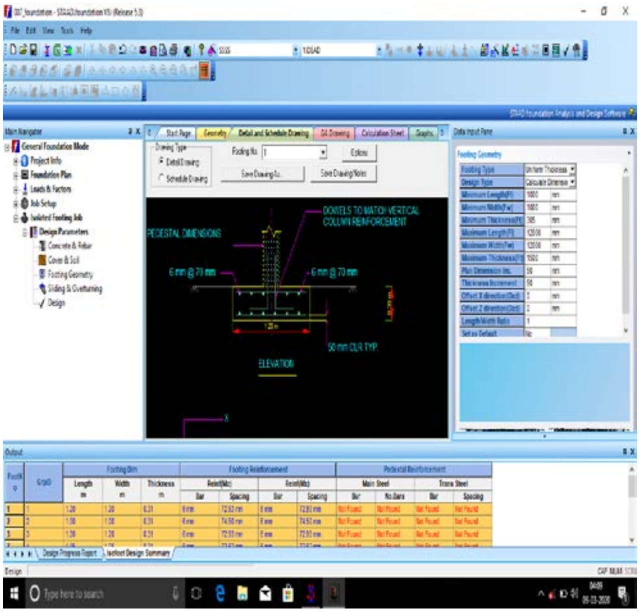
 20 - 12 MM              1.117        1       END     0.650
(PROVIDE EQUAL NUMBER OF BARS ON EACH FACE)
TIE BAR NUMBER   12 SPACING 192.00 MM
```

```
************** CONCRETE  TAKE OFF  **************
      (FOR BEAMS, COLUMNS AND PLATES DESIGNED ABOVE)
NOTE: CONCRETE QUANTITY REPRESENTS VOLUME OF CONCRETE IN BEAMS, COLUMNS, AND PLATES DESIGNED ABOV
      REINFORCING STEEL QUANTITY REPRESENTS REINFORCING STEEL IN BEAMS AND COLUMNS DESIGNED ABOVE
      REINFORCING STEEL IN PLATES IS NOT INCLUDED IN THE REPORTED QUANTITY.

TOTAL VOLUME OF CONCRETE =      45.7 CU.METER

 BAR SIZE        WEIGHT
  NUMBER        (in lbs)
 --------       --------
    12               680
               ------------
  *** TOTAL=         680
```

DESIGN OF FOOTINGS- Foundations are structural elements that transfer loads from the building or individual column to the earth. If these loads are to be properly transmitted, foundations must be designed to prevent excessive settlement or rotation, to minimize differential settlement and to provide adequate safety against sliding and overturning.



10. Design of Footing

VI. APPLICATIONS

- It is designed to be easily for multiple sports.
- The area required for this type of stadiums is less.
- The cost of construction is less while comparing with the single sports stadium.
- By the construction of this type of stadiums the area will be developed as rural area.
- Additionally, the jobs and sales will be increased in the surrounding area.
- Economically the area will be developed.
- During the time of zonal period the conduction of sports or events, sports persons didn't suffer to travel to another areas.
- Development of sports and sports authority in that stadium.
- We can save the time management.

VII. CONCLUSION

The analysis and design of structural components of open sports stadium is planned well with detailed analysis of beam, column, footing. The project concerns feasibility of construction with suitable soil condition. The structure was analysed using staad pro and it is safe to design. We have learnt lots of important thinks about construction. i.e. First, we visited the site and done survey in that area and we designed multi sports stadium with standard dimensions. We are giving proposal to Dravidian University, kuppam. This study is conducted in order to get information about the stadium facility and safety measures, and spectators safety awareness at the selected outdoor stadium in facilities management context. SBC test was found feasible for construction. REVIT is used for elevation of design. The structure is analysed with staad pro and is checked for safety. Design of open sports stadium is proposed with estimated cost.

VIII. REFERENCES

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