



**SRM VALLIAMMAI ENGINEERING COLLEGE**

Approved by AICTE | Affiliated to Anna University | Accredited by NBA  
'A' Grade Accreditation by NAAC | ISO 9001 : 2015 Certified

[ An Autonomous Institution ]



***DEPARTMENT OF CIVIL ENGINEERING***  
**ACADEMIC YEAR: 2025-2026**

**LAB MANUAL**

**1903712-COMPUTER AIDED DESIGN AND DRAFTING  
LABORATORY**

*2019 Regulation*

VII Semester B.E. Civil Engineering

**LAB MANUAL**

**(2025-2026 ACADEMIC YEAR)**

Prepared by:

1. Mr. G.R.Iyappan / AP-Civil

## **GENERAL INSTRUCTIONS**

**The following instructions should be strictly followed by students in the CAD Lab:**

- Students should wear lab coat in CAD lab.
- Students are advised to enter the CAD lab WITH FORMAL SHOES ONLY.
- They are not supposed to move the systems and monitors.
- They should enter in the login name and password assigned to each student.
- Students are advised to complete their record work before the next class.
- Students are asked to logout from their area and switch off the computers before leaving the lab.
- Students can access the printers through lab technician.
- Students have free access to use the computers and software available in the lab.
- During the laboratory hours, accessing the internet is strictly prohibited.
- Computer games are strictly prohibited in the CAD lab.

# SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University, Chennai, 'A'  
Grade Accredited by NAAC, NBA Accredited, ISO 9001: 2015 Certified)

## B.E. CIVIL ENGINEERING REGULATIONS – 2019

### 1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To produce graduates who can understand their ethical, environmental as well as professional responsibilities so that they appreciate the impact of the engineering solutions which have sustainability over society and the nation.
2. To develop the graduates who will exhibit strong technical ability to create & synthesize data using relevant tools and concepts, for providing sustainable solutions to civil engineering problems and projects.
3. To equip the graduates with suitable skills making them industry ready when they leave the portals of the Institute and to become a competent distinguished Professional Civil Engineer.
4. To produce students who can exhibit attitude, professionalism, ability to communicate with team members and adapt to the latest technology by engaging themselves in life-long learning

### 2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Civil Engineering Graduates will exhibit ability to:

| PO | Graduate Attribute    | Programme Outcome  |
|----|-----------------------|--|
| 1  | Engineering knowledge | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.   |
| 2  | Problem analysis      | Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| 3  | Design/development of | Design solutions for complex engineering problems  |

|    |  |   |
|----|--|---|
|    | solutions                                  | and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.  |
| 4  | Conduct investigations of complex problems | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions   |
| 5  | Modern tool usage                          | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.   |
| 6  | The engineer and society                   | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice   |
| 7  | Environment and sustainability             | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.   |
| 8  | Ethics                                     | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice   |
| 9  | Individual and team work                   | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings  |
| 10 | Communication                              | Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions |
| 11 | Project management and finance             | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments  |
| 12 | Life-long learning                         | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change  |

### 3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Civil Engineering program the student will have following Program specific outcomes

1. Establish a Civil Engineering career in industry, government or academic field and achieve professional expertise as appropriate.
2. Execute innovation and excellence in Civil engineering problem solving and design in global and societal contexts.
3. Commit to lifelong learning and professional development in the Civil Engineering field to stay updated in technology, research topics and contemporary issues.
4. Understand the fundamentals of Civil Engineering in commercial contexts and in expediting construction projects.

### 4. PEO / PO Mapping:

| PROGRAMM<br>E<br>EDUCATIONA<br>L<br>OBJECTIVES | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |    |    |    | PROGRAM<br>SPECIFIC<br>OUTCOME<br>S |   |   |   |
|--|--------------------|---|---|---|---|---|---|---|---|----|----|----|-------------------------------------|---|---|---|
|  | 1                  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1                                   | 2 | 3 | 4 |
| I  | 3                  | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3  | 1  | 3  | 3                                   | 3 | 1 | 1 |
| II   | 2                  | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2  | 3  | 3  | 2                                   | 2 | 3 | 3 |
| II<br>I  | 1                  | - | - | 3 | 3 | 3 | 1 | 1 | 3 | -  | 2  | 1  | 1                                   | 3 | - | 3 |
| IV   | 3                  | - | - | 1 | 3 | 3 | 3 | - | 3 | 3  | 2  | 3  | 3                                   | 3 | - | 1 |

**Contribution:**

**1. Reasonable**

**2. Significant**

**3. Strong**

## **B.E. CIVIL ENGINEERING**

### **Vision**

To produce competent and quality engineers by imparting knowledge, excellence and global perspectives in Civil Engineering to our students and to make them ethically strong professional engineers to build our nation.

### **Mission**

**M1:** To produce outstanding graduates with high technical knowledge to serve the nation.

**M2:** To impart value based education.

**M3:** To provide solution to the challenges in the field of Civil Engineering.

## **1903712      COMPUTER AIDED DESIGN AND DRAFTING LABORATORY**

**L T PC**

**0 0 4 2**

### **OBJECTIVES:**

- To introduce the students to draft the plan, elevation and sectional views of buildings using computer software.
- Students will be familiar with features of Building Information Modelling.
- To impart knowledge and skill relevant to drafting and design the R.C.C framed structure using computer software.
- To impart knowledge of drafting and design the Industrial structures.
- To impart knowledge of analysis and detailing of water tank by using software.

### **LIST OF EXPERIMENTS**

1. Draw a Plan, Elevation and sectional view of Load Bearing and framed structures.
2. Building Information Modeling.
3. Drafting and analysis of R.C.C. framed structures.
4. Drafting and analysis of Industrial buildings.
5. Analysis and Design of circular and rectangular RCC water tanks.

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

- Draft the plan, elevation and sectional view of the buildings.
- Able to know about the Building Information Modelling.
- Draw the structural detailing of RCC elements.
- Draft the plan, elevation and sectional view of Industrial structures.
- Draw the structural detailing of RCC water tanks.

### **TEXT BOOKS:**

1. Sikka V.B., —A Course in Civil Engineering Drawing, 4<sup>th</sup> Edition, S.K.Kataria and Sons, 2015.
2. George Omura, —Mastering in AutoCAD 2005 and AutoCAD LT 2005, BPB Publications, 2000.
3. Krishnamurthy, D., —Structural Design & Drawing — Vol. II and III, CBS Publishers, 2010.
4. Sarma.T.S, Design of R C C Buildings using STAAD Pro V8i with Indian Code IS456-2000.

## REFERENCE BOOKS:

1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, BIM Handbook: A Guide to building information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc., 2011.
2. Marimuthu V.M., Murugesan R. and Padmini S., Civil Engineering Drawing-I, Pratheeba Publishers, 2008.
3. Verma.B.P, Civil Engineering Drawing and House Planning, Khanna Publishers, 2010.
4. RAM/STAAD Solution centre, Structural analysis and design of tank structures in STAAD. Pro 2007.

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   |   |   |   |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|---|---|---|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 | 3 | 4 |   |
| 1  | 1  | 1 | - | - | 2 | - | - | - | 1 | -  | -  | -  | -   | - | - | - | 2 |
| 2  | 1  | - | - | - | 3 | - | - | - | - | 2  | -  | -  | 2   | - | 1 | - | - |
| 3  | -  | 3 | 3 | 3 | 2 | - | - | 1 | - | -  | -  | -  | 2   | 3 | - | - | - |
| 4  | -  | 2 | 2 | 3 | 1 | 1 | 2 | - | - | -  | 3  | -  | 2   | 3 | 1 | - | - |
| 5  | 1  | - | - | 2 | 3 | 1 | - | - | - | 1  | -  | 2  | 2   | - | 1 | - | - |

Computer Aided Drafting is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings in different fields of engineering and sciences. In the fields of mechanical or aeronautical engineering, the drawings of machine components and the layouts of them are prepared. In the field of civil engineering, plans and layouts of the buildings are prepared. In the field of electrical engineering, the layouts of power distribution system are prepared. In all fields of engineering use of computer is made for drawing and drafting.

The use of CAD process provides enhanced graphics capabilities which allows any designer to

- Conceptualize his ideas
- Modify the design very easily
- Perform animation
- Make design calculations
- Use colors, fonts and other aesthetic features.

#### ***REASONS FOR IMPLEMENTING A CAD SYSTEM***

- 1. Increases the productivity of the designer:** CAD improves the productivity of the designer to visualize the product and its component, parts and reduces the time required in synthesizing, analyzing and documenting the design
- 2. Improves the quality of the design:** CAD system improves the quality of the design. A CAD system permits a more detailed engineering analysis and a larger number of design alternatives can be investigated. The design errors are also reduced because of the greater accuracy provided by the system
- 3. Improves communication:** It improves the communication in design. The use of a CAD system provides better engineering drawings, more standardization in the drawing, and better documentation of the design, few drawing errors and legibility.
- 4. Create data base for manufacturing:** In the process of creating the documentation for these products, much of the required data base to manufacture the products is also created.
- 5. Improves the efficiency of the design:** It improves the efficiency of the design process and the wastage at the design stage can be reduced.

### ***APPLICATION OF CAD:***

There are various processes which can be performed by use of computer in the drafting process.

**Autoated drafting:** This involves the creation of hard copy engineering drawings directly from CAD data base. Drafting also includes features like automatic dimensioning, generation of cross – hatched areas, scaling of the drawing and the capability to develop sectional views and enlarged views in detail. It has ability to perform transformations of images and prepare 3D drawings like isometric views, perspective views etc.,

**Geometric modeling:** concerned with the computer compatible mathematical description of the geometry of an object. The mathematical description allows the image of an object to be displayed and manipulated on a graphics terminal through signals from the CPU of the CAD system. The software that provides geometric modeling capabilities must be designed for efficient use both by computer and the human designer.

### ***BENEFITS OF CAD:***

The implementation of the CAD system provides variety of benefits to the industries in design and production as given below:

- Improved productivity in drafting
- Shorter preparation time for drawing
- Reduced man power requirement
- Customer modifications in drawing are easier
- More efficient operation in drafting
- Low wastage in drafting
- Minimized transcription errors in drawing
- Improved accuracy of drawing
- Assistance in preparation of documentation
- Better designs can be evolved
- Revisions are possible
- Colours can be used to customize the product
- Production of orthographic projections with dimensions and tolerances
- Hatching of all sections with different filling patterns

- Preparation of assembly or sub assembly drawings
- Preparation of part list
- Machining and tolerance symbols at the required surfaces.
- Hydraulic and pneumatic circuit diagrams with symbols
- Printing can be done to any scale

### ***LIMITATIONS OF CAD***

- 32 – bit word computer is necessary because of large amount of computer memory and time
- The size of the software package is large
- Skill and judgment are required to prepare the drawing
- Huge investment

### ***CAD SOFTWARES***

The software is an interpreter or translator which allows the user to perform specific type of application or job related to CAD. The following softwares are available for drafting.

- AUTOCAD
- Pro – E
- CATIA
- MS OFFICE
- PAINT
- ANSYS
- MSc. NASTRAN
- IDEASSOLID WORKS
- HYPERMESH
- FLUENT – GAMBIT

The above software is used depending upon their application.

### ***AUTO CAD***

Auto CAD package is suitable for accurate and perfect drawings of engineering designs. The drawing of machine parts, isometric views and assembly drawings are possible in AutoCAD. The package is suitable for 2D and 3D drawings.

**EX.NO:02**  
**DATE:**

**STUDY EXERCISE – CONVENTIONS & SYMBOLS**

| <b>Sl. No.</b> | <b>Term</b>           | <b>Abbreviation</b> |
|----------------|-----------------------|---------------------|
| 1.             | Aggregate             | Agg                 |
| 2.             | Approximate           | Approx              |
| 3.             | Asbestos cement       | asb/cem             |
| 4.             | At                    | @                   |
| 5.             | Air Conditioner       | A/C                 |
| 6.             | Brick work            | BWK                 |
| 7.             | Brick on edge         | BOE                 |
| 8.             | Building              | Bldg                |
| 9.             | Bench mark            | BM                  |
| 10.            | Cast-iron             | CI                  |
| 11.            | Cement concrete       | CC                  |
| 12.            | Centre to centre      | c to c, c/c         |
| 13.            | Cement mortar         | CM                  |
| 14.            | Coarse rubble masonry | CR                  |
|                | Random rubble masonry | RR                  |

|                |                       |                     |
|----------------|-----------------------|---------------------|
| 15.            |                       |                     |
| <b>Sl. No.</b> | <b>Term</b>           | <b>Abbreviation</b> |
| 16.            | Column                | COL                 |
| 17.            | Concrete              | CONC                |
| 18.            | Corrugated            | CORR                |
| 19.            | Cross-section         | CS                  |
| 20.            | Cupboard              | CB                  |
| 21.            | Collapsible gate      | CG                  |
| 22.            | Door                  | D                   |
| 23.            | Damp proof course     | DPC                 |
| 24.            | Diameter              | dia,                |
| 25.            | European water closet | EWC                 |
| 26.            | Figure                | Fig.                |
| 27.            | Finished floor level  | FFL                 |
| 28.            | Floor trap            | FT                  |
| 29.            | Flushing cistern      | FC                  |
|                | Fresh air inlet       | FAI                 |

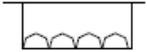
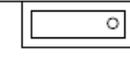
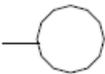
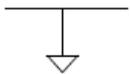
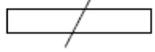
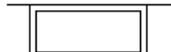
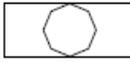
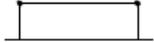
|                |                                |                     |
|----------------|--------------------------------|---------------------|
| 30.            |                                |                     |
| 31.            | Full supply level              | FSL                 |
| <b>Sl. No.</b> | <b>Term</b>                    | <b>Abbreviation</b> |
| 32.            | Full tank level                | FTL                 |
| 33.            | First floor                    | FF                  |
| 34.            | Floor level                    | FL                  |
| 35.            | Flush out latrine              | FOL                 |
| 36.            | Galvanized                     | Galv                |
| 37.            | Galvanized iron                | GI                  |
| 38.            | Grease trap                    | GRT                 |
| 39.            | Ground level                   | GL                  |
| 40.            | Grills                         | G                   |
| 41.            | Gully trap                     | GT                  |
| 42.            | Height                         | Ht                  |
| 43.            | Indian water closet            | IWC                 |
| 44.            | Imperial (standard) wire gauge | SWG                 |

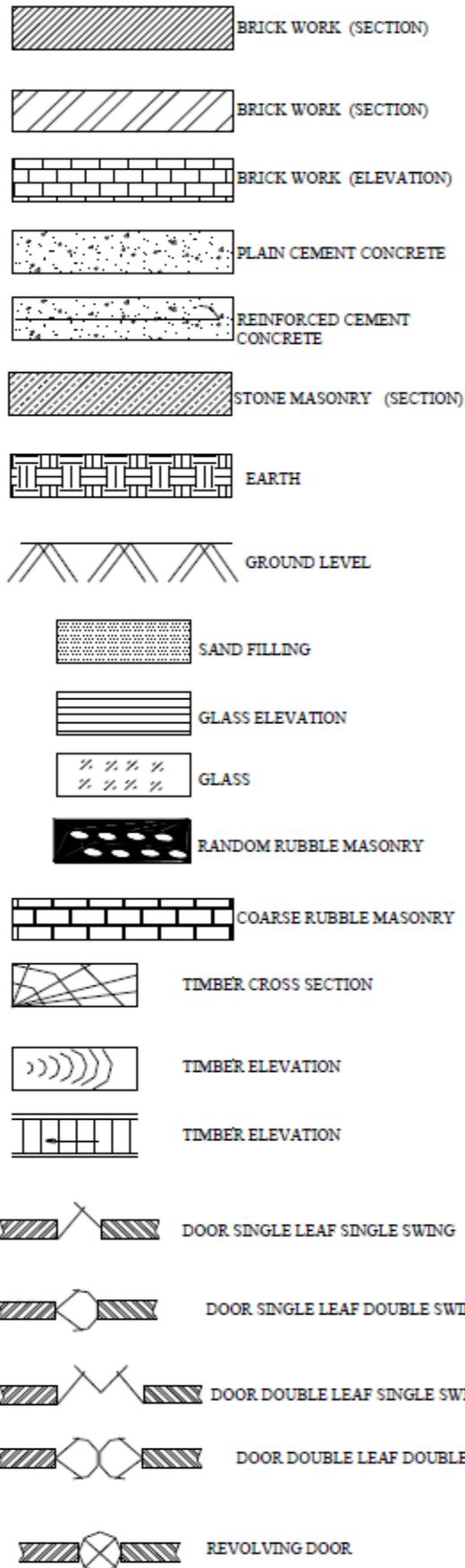
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|----------------|---------------------|---------------------|
| 45.            | Inspection chamber  | ICH, IC             |
| 46.            | Intercepting trap   | IT                  |
| <b>Sl. No.</b> | <b>Term</b>         | <b>Abbreviation</b> |
| 47.            | Joist               | J                   |
| 48.            | Jolly work          | JW                  |
| 49.            | Kilo                | K                   |
| 50.            | Kilogram            | KG                  |
| 51.            | Kilometer           | KM                  |
| 52.            | Litre               | LT.                 |
| 53.            | Level crossing      | LC                  |
| 54.            | Low water level     | LWL                 |
| 55.            | Lime mortar         | LM                  |
| 56.            | Lime concrete       | LC                  |
| 57.            | Maximum flood level | MFL                 |
| 58.            | Maximum water level | MWL                 |
| 59.            | Manhole             | MH                  |

|                |                                  |                     |
|----------------|----------------------------------|---------------------|
| 60.            | Maximum                          | Max                 |
| 61.            | Mild steel                       | MS                  |
| 62.            | Millimeter                       | mm                  |
| <b>Sl. No.</b> | <b>Term</b>                      | <b>Abbreviation</b> |
| 63.            | Minimum                          | MIN                 |
| 64.            | Not to scale                     | NTS                 |
| 65.            | Number                           | No.                 |
| 66.            | Overhead tank                    | OHT                 |
| 67.            | Plain cement concrete            | PCC                 |
| 68.            | Plinth level                     | PL                  |
| 69.            | Prestressed concrete             | PCONC               |
| 70.            | Radius                           | Rad                 |
| 71.            | Rainwater pipe                   | RWP                 |
| 72.            | Rolled section / Rolling shutter | RS                  |
| 73.            | Rolled steel joist or I-section  | RSJ OR I            |
| 74.            | Reinforced Cement Concrete       | RCC                 |

|               |                       |                     |
|---------------|-----------------------|---------------------|
| 75.           | Ribbed tor steel      | RTS                 |
| 76.           | Stone ware pipe       | SWP                 |
| 77.           | Surki mortar          | SM                  |
| 78.           | Sink                  | S                   |
| <b>Sl.No.</b> | <b>Term</b>           | <b>Abbreviation</b> |
| 79.           | Soil pipe             | SP                  |
| 80.           | Standard              | Std                 |
| 81.           | Septic tank           | ST                  |
| 82.           | Switch                | Sw                  |
| 83.           | Ventilator            | V                   |
| 84.           | Vent pipe             | VP                  |
| 85.           | Wash basin            | WB                  |
| 86.           | Water closet          | WC                  |
| 87.           | Window                | W                   |
| 88.           | Window cum ventilator | W/V                 |
| 89.           | Water level           | WL                  |

## SYMBOLS

|  |  |  |  |
|--|--|--|--|
| <br>1. Light plug                   | <br>11. Immersion heater                    | <br>21. Exhaust fan             | <br>31. Urinal stall                    |
| <br>2. Power plug                   | <br>12. Bell point                          | <br>22. Fan regulator           | <br>32. Indian type WC                  |
| <br>3. Meter                        | <br>13. Bell                                | <br>23. Rectangular bath        | <br>33. Stop valve or sluice valve      |
| <br>4. Light bracket                | <br>14. Buzzer                              | <br>24. Bidet                   | <br>34. Fire extinguisher               |
| <br>5. Fluorescent light (single)   | <br>15. Telephone instrument point internal | <br>25. Shower head             | <br>35. Fire hydrant                    |
| <br>6. Fluorescent light (double) | <br>16. Fire alarm push                   | <br>26. Wall lavatory basin  | <br>36. Pump                          |
| <br>7. One-way switch             | <br>17. Aerial                            | <br>27. Corner lavatory basin | <br>37. Gully                         |
| <br>8. Two-way switch             | <br>18. Ceiling fan                       | <br>28. Plain kitchen sink    | <br>38. Manhole or inspection chamber |
| <br>9. Intermediate switch        | <br>19. Bracket fan                       | <br>29. WC                    | <br>39. Rainwater outlet              |
| <br>10. Electric unit heater      | <br>20. Tower rail                        | <br>30. Urinal corner hung    | <br>40. Refrigerator                  |



## STUDY EXERCISE – AUTOCAD COMMANDS

|           |   |
|-----------|---|
| ARC       | Creates an arc  |
| AREA      | Calculates the area and perimeter of objects or of defined areas                        |
| ARRAY     | Creates multiple copies of objects in a pattern   |
| BHATCH    | Fills an enclosed area or selected objects with a hatch pattern                         |
| BLOCK     | Creates a block definition from objects you select                                      |
| BOUNDARY  | creates a region or a polyline from an enclosed area                                    |
| BOX       | Creates a three-dimensional solid box   |
| BREAK     | Erases parts of objects or splits an object in two                                      |
| CAL       | Evaluates mathematical and geometric expressions  |
| CHAMFER   | Bevels the edges of objects   |
| CIRCLE    | Creates a circle  |
| COPY      | Duplicates objects  |
| DIST      | Measures the distance and angle between two points                                      |
| DIVIDE    | Places evenly spaced point objects or blocks along the length or perimeter of an object |
| DONUT     | Draws filled circles and rings  |
| ELLIPSE   | Creates an ellipse or an elliptical arc   |
| ERASE     | Removes objects from a drawing  |
| EXPLODE   | Breaks a compound object into its component objects                                     |
| EXPORT    | Saves objects to other file formats   |
| EXTEND    | Extends an object to meet another object  |
| EXTRUDE   | Creates unique solid primitives by extruding existing two-dimensional objects           |
| FILLET    | Rounds and fillets the edges of objects   |
| GRID      | Displays a dot grid in the current viewport   |
| GROUP     | Creates a named selection set of objects  |
| HATCH     | Fills a specified boundary with a pattern   |
| HELP (F1) | Displays online help  |
| ID        | Displays the coordinate values of a location  |
| IMPORT    | Imports files in various formats into AutoCAD   |
| INSERT    | Places a named block or drawing into the current drawing                                |
| LEADER    | Creates a line that connects annotation to a feature                                    |
| LENGTHEN  | Lengthens an object   |
| LIMITS    | Sets and controls the drawing boundaries and grid display                               |
| LINE      | Creates straight line segments  |
| LINETYPE  | Creates, loads, and sets linetypes  |
| LIST      | Displays database information for selected objects                                      |
| LTSCALE   | Sets the line type scale factor   |
| MLINE     | Creates multiple parallel lines   |

|           |   |
|-----------|---|
| MOVE      | Displaces objects a specified distance in a specified direction             |
| MTEXT     | Creates multiline text  |
| NEW       | Creates a new drawing file  |
| OFFSET    | Creates concentric circles, parallel lines, and parallel curves 12          |
| OPEN      | Opens an existing drawing file  |
| OPTIONS   | Customizes the AutoCAD settings   |
| ORTHO     | Constrains cursor movement  |
| OSNAP     | Sets object snap modes  |
| PEDIT     | Edits polylines and three-dimensional polygon meshes                        |
| PLAN      | Displays the plan view of a user coordinate system                          |
| PLINE     | Creates two-dimensional polylines   |
| PLOT      | Plots a drawing to a plotting device or file                                |
| POINT     | Creates a point object  |
| POLYGON   | Creates an equilateral closed polyline                                      |
| QUIT      | Exits AutoCAD   |
| RECTANG   | Draws a rectangular polyline  |
| REDRAW    | Refreshes the display in the current viewport                               |
| REGEN     | Regenerates the drawing and refreshes the current viewport                  |
| REGION    | Creates a region object from a selection set of existing objects            |
| ROTATE    | Moves objects about a base point  |
| SAVE      | Saves the drawing under the current file name or a specified name           |
| SCALE     | Enlarges or reduces selected objects equally in the X, Y, and Z directions  |
| SKETCH    | Creates a series of freehand line segments                                  |
| SNAP      | Restricts cursor movement to specified intervals                            |
| SPHERE    | Creates a three-dimensional solid sphere                                    |
| SPLINE    | Creates a quadratic or cubic spline (NURBS) curve                           |
| SPLINEDIT | Edits a spline object   |
| STRETCH   | Moves or stretches objects  |
| SUBTRACT  | Creates a composite region or solid by subtraction                          |
| TEXT      | Displays text on screen as it is entered                                    |
| TIME      | Displays the date and time statistics of a drawing                          |
| TORUS     | Creates a donut-shaped solid  |
| TRIM      | Trims objects at a cutting edge defined by other objects                    |
| U         | Reverses the most recent operation  |
| UNDO      | Reverses the effect of commands   |
| UNION     | Creates a composite region or solid by addition                             |
| UNITS     | Controls coordinate and angle display formats and determines precision      |
| XLINE     | Creates an infinite line  |
| XPLODE    | Breaks a compound object into its component objects                         |
| ZOOM      | Increases or decreases the apparent size of objects in the current viewport |

### **Starting the drawing**

The figures we do in engineering are fitted into a template. In ACAD we manually draw a template known as drawing sheet in two different formats.

The size of the drawing sheet is **ISO A4 210 X 297.**

**Polar Array:** In this, an object is arranged in a circular shape.

**At the command prompt:** type ARRAYPOLAR or select the option from MODIFY toolbar. Then select object to be arrayed. Then select the center point of array. By default, a six items array is created. The No. of items can be changed by selecting the Items option. Angle between the two items can also be changed.

### **Result:**

Thus the Auto CADD Comments is studied successfully.

## **A RESIDENTIAL BUILDING WITH SINGLE BED ROOM**

### **Aim:**

To draw the following views with complete dimension for a residential building with single bed room (R.C.C flat roof)

1. Plan at window sill level.
2. Section on ABCD.
3. Front elevation.

### **Specifications:**

The following specification correspond to the line plan of a house with single bed room and attached bathroom with R.C.C flat roof.

#### **1. Foundation:**

The foundation for all main walls and verandah retaining walls will be CC 1:4:8 mix, 1000 wide and 200 thick laid at 1100 below ground level. The masonry footing will be in BW in CM 1:6, the 1<sup>st</sup> footing being 700x400 and the 2<sup>nd</sup> being 400 x 500 for all walls and verandah retaining walls.

#### **2. Basement:**

The basement will be in BW in CM 1:6, 200 wide and 600 high above GL for all main walls and verandah retaining walls is filled with clean sand to a depth of 450. A D.P.C in CM 1:3, 20 thick will be provided for all walls at basement level.

#### **3. Super structure:**

All walls will be in B.W in CM 1:5, using 1<sup>st</sup> class B.W, 200 thick. The height of all walls will be 3000 above F.L. the height of roof at verandah portion will be 2700. The partition wall in WC and bath 100 thick in BW in CM 1:5 using country bricks and carried up to a height of 2100. One brick pillar 200x400 will be provided in the verandah. All walls including basement will be plastered smooth and CM 1:4 externally and 1:6 internally for 12.5 thick. Parapet walls, 200 thick and 600 high will be provided all round.

#### **4. Roofing:**

The roofing will be of R.C.C 1:1.5:3 mix, 125 thick flat slab over the rooms and the verandah. A weathering course, 75 thick consists of two course of flat tiles set in CM 1:3 mixed with crude oil will be provided with slab.

#### **5. Doors, windows,etc.,:**

- D1-panelled door: 1100x 2100
- D2-panelled door: 900x 2100
- W1-panelled Window: 1200 x 1200

W2-Glazed Window: 1500 x 1200  
V1-Ventilator glazed: 900 x 450  
V2-Ventilator glazed: 1500 x 450  
J – R.C. Jolly: 2400 x 1200  
CB-cupboard: 300 depth  
S-shelf: 200 depth

**6. Lintel:**

All internal wall openings will be provided with R.C.C lintels, 1:1.5:3 mix; 150 thick. All external openings will be provided with R.C.C lintel – cum-sunshade, 1:1.5:3 mix, 450 wide and 150 thick and 600 wide R.C.C lofts shall be provided in bed, kitchen and utility.

**7. Flooring:**

The flooring will be in CC 1:4:8, 130 thick and plastered smooth with CM 1:3, 20 thick.

**8. Steps:**

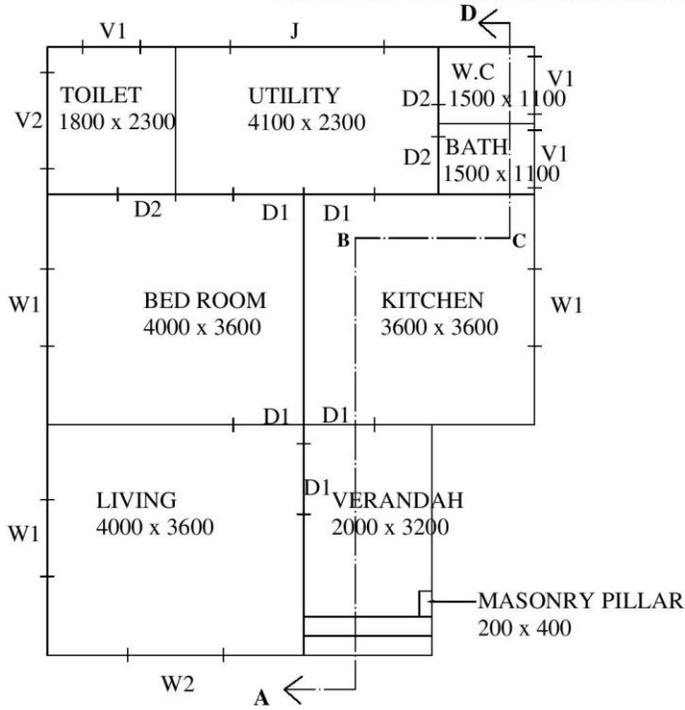
Steps will be in brick walk in CM 1:5 laid on 800 x150 thick CC 1:4:8 footing. Rise 200, Tread 300.

Note:

1. Any other dimensions found necessary may be assumed suitably making clear indications of the same.
2. All dimensions indicated are in millimeter.

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REFERENCE

| TYPE   | DESCRIPTION          | SIZE      |
|--------|----------------------|-----------|
| D1     | Panelled Door        | 1100x2100 |
| D2     | Panelled Door        | 900x2100  |
| W1     | Panelled Window      | 1200x1200 |
| W2     | Glazed Window        | 1500X1200 |
| V1     | Ventilator ( glazed) | 900x450   |
| V2     | Ventilator ( glazed) | 1500x450  |
| J      | R.C.Jolly            | 2400x1200 |
| CB     | Cup Board            | 300 depth |
| S      | Shelf                | 200 depth |
| Steps: |                      |           |
|        | Rise                 | 200       |
|        | Tread                | 300       |

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LINE PLAN

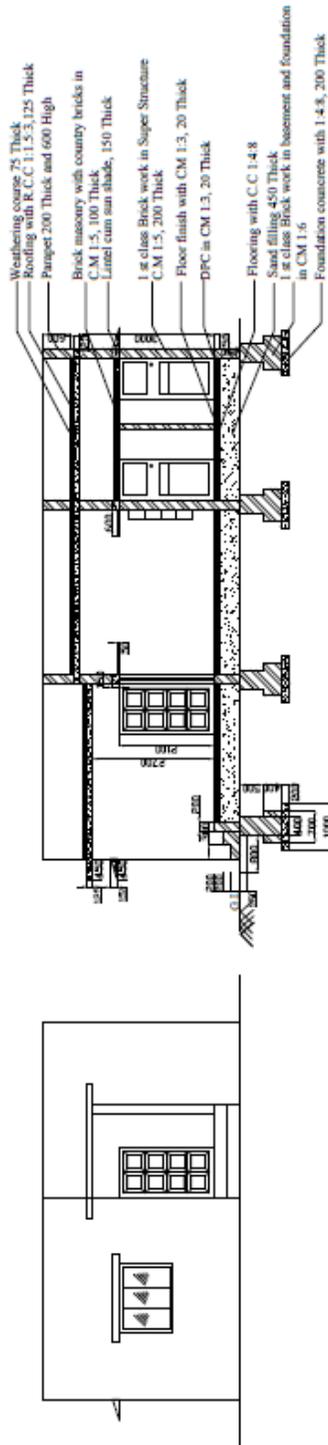
ALL DIMENSIONS ARE IN mm

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

## Results

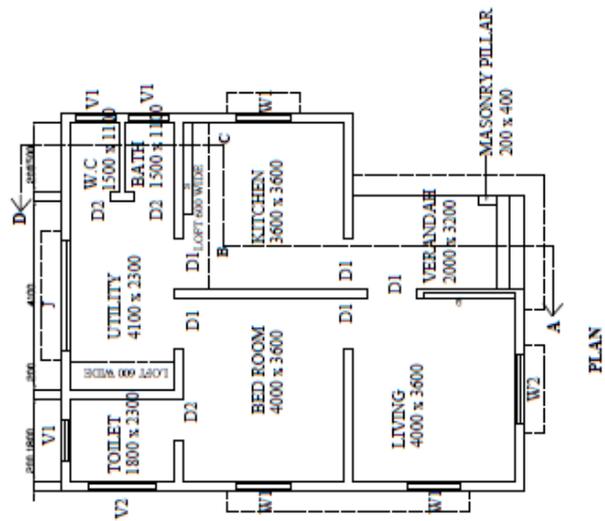
Thus The Residential Building With Single Bed Room Is Studied Successfully.

A RESIDENTIAL BUILDING WITH SINGLE BED ROOM

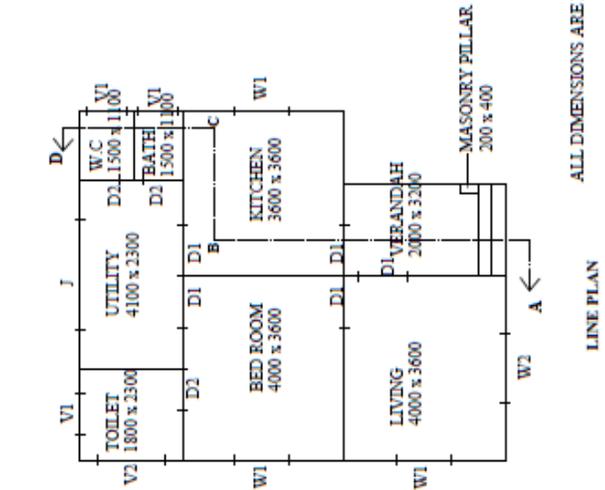


ELEVATION

SECTION ABCD



PLAN



ALL DIMENSIONS ARE IN mm

REFERENCE

| TYPE | DESCRIPTION      | SIZE       |
|------|------------------|------------|
| D1   | Painted Door     | 1100x2100  |
| D2   | Painted Door     | 2000x2100  |
| W1   | Painted Window   | 1200x1200  |
| W2   | Painted Window   | 1500x1200  |
| V1   | Vertical Glazing | 2000x1200  |
| V2   | Vertical Glazing | 1500x1200  |
| J    | R.C.C. Joist     | 2400x1200  |
| CB   | Chip Board       | 100 length |
| S    | Slab             | 200 length |
|      | Steps            |            |
|      | Base             | 200        |
|      | Finish           | 100        |

## **RESIDENTIAL BUILDING WITH LOAD BEARING WALLS AND FLAT ROOF**

### **Aim:**

To draw to a suitable scale the following views with complete dimensions and details for residential building (R.C.C flat roof)

1. Plan at window sill level.
2. Front elevation
3. Sectional elevation on EFGH
4. Section at EFGH.

### **Specifications:**

The following specifications correspond to a residential building.

#### **1. Foundation:**

The depth of foundation will be 750 mm below ground level. The concrete course at the base of the foundation will be 100 mm wide and 150 mm deep. The footings will be of brick masonry with 1st class brick in cement mortar (1:4). Width of 1st and 2nd footings will be 500 mm and 700 mm respectively and each having thickness of 300 mm.

#### **2. Plinth:**

The plinth height will be 450 mm, above ground level. Thickness of wall in plinth will be 300 mm. A D.P.C. will be provided 50 mm thick in C.M. 1:3.

#### **3. Superstructure:**

The wall in super structure will be 1st class brick in C.M. 1:6. Thickness of all walls will be 300 mm except the partition wall between W.C. and bath, which will be 200 mm thick. All exterior windows and the verandah opening will be having a chajja projection of 600 mm. The kitchen will be having shelves (as shown in the line sketch) in there tier. Projection of shelves will be 450 mm beyond the wall. A cooking platform of 750 mm width will be provided at a height of 750 mm from floor level. Width of the sink will be 450 mm. Size of the cupboard will be 1050 mm x 300 mm x 2100 m. The verandah opening will be 2250 mm. Height of wall for the court yard is 2300 mm.

#### **4. Roofing:**

Roofing will be of R.C.C. (1:2:4) 125 mm thick. Provide lime terrace of thickness 100 mm over the roof slab. The parapet height will be 450 mm. Copping will except for dinning space, kitchen, W.C. and bath which in turn will be having ceiling height of 3150 mm. Ceiling height for verandah will be 3000 mm.

#### **5. Flooring:**

Provide patent stone flooring of 25 mm thickness over 100 mm thick rammed khoa over sand filling.

#### **6. Steps :**

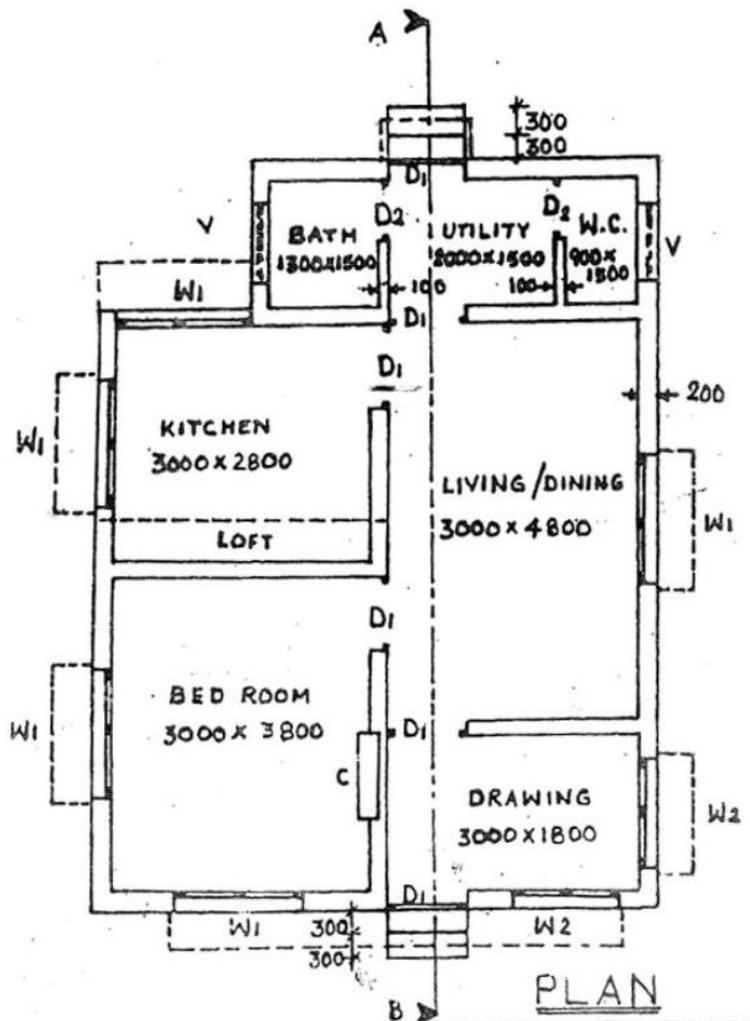
Rise 150 mm and Tread 200 mm. Door and window frame is 100 mm x 75 mm

**7. Size of doors and window :**

- D - 1000 mm x 2100 mm
- D1 - 750 mm x 2100 mm
- D2 - 1100 mm x 2100 mm
- D3 - 600 mm x 2100 mm
- D4 - 1200 mm x 2100 mm
- W - 1800 mm x 1200 mm
- W1 - 1500 mm x 1200 mm
- W2 - 900 mm x 1200 mm
- W3 - 600 mm x 900 mm

**Note:**

1. Any other dimensions found necessary may be assumed suitably making clear indications of the same.
2. All dimensions are in millimetres.



## LIBRARY BUILDING WITH R.C.C FLAT ROOF

### Aim:

To draw the following views with complete dimension for a residential building with two bed room (R.C.C flat roof)

1. Plan at window sill level.
2. Section on XY.
3. Front elevation.

### Specifications:

The following specifications correspond to the line plan of a LIBRARY BUILDING.

#### 1. Foundation:

The foundation for all main walls will be in CC 1:4:8 mix, 900 wide and 300 thick, laid at 1000 below ground level. The masonry footing will be in BW in CM 1:6, the 1<sup>st</sup> footing being 700x300 and the 2<sup>nd</sup> being 400 x 400 for all main walls

#### 2. Basement:

The basement will be in BW in CM 1:5, 200 wide and 600 high in rubble masonry above GL for all main walls. The basement will be filled with clean sand to a depth of 450. A D.P.C in CM 1:3, 20 thick will be provided for all walls at basement level.

#### 3. Super structure:

All walls will be in BW in CM 1:5, using 1<sup>st</sup> class BW, 200 thick. The height of all walls will be 3600 above F.L. Pillars 300x300 are provided in the building. All walls including basement will be plastered smooth and CM 1:4 externally and 1:6 internally for 12.5 thick. Parapet walls, 200 thick and 450 high will be provided all round.

#### 4. Roofing:

The roofing will be of R.C.C 1:1.5:3 mix, 125 thick flat slab over the rooms. A weathering course, 75 thick will be provided over the slab.

#### 5. Doors, windows, etc.:

- D- Door: 1200x 2100
- D1- Door: 900x 2100
- W1- Window: 1500 x 1200
- W2- Window: 1000 x 1200

#### 6. Lintel:

All external openings will be provided with R.C.C lintel – cum-sunshade, 1:1.5:3 mix, 450 wide and 150 thick.

## 7. Flooring:

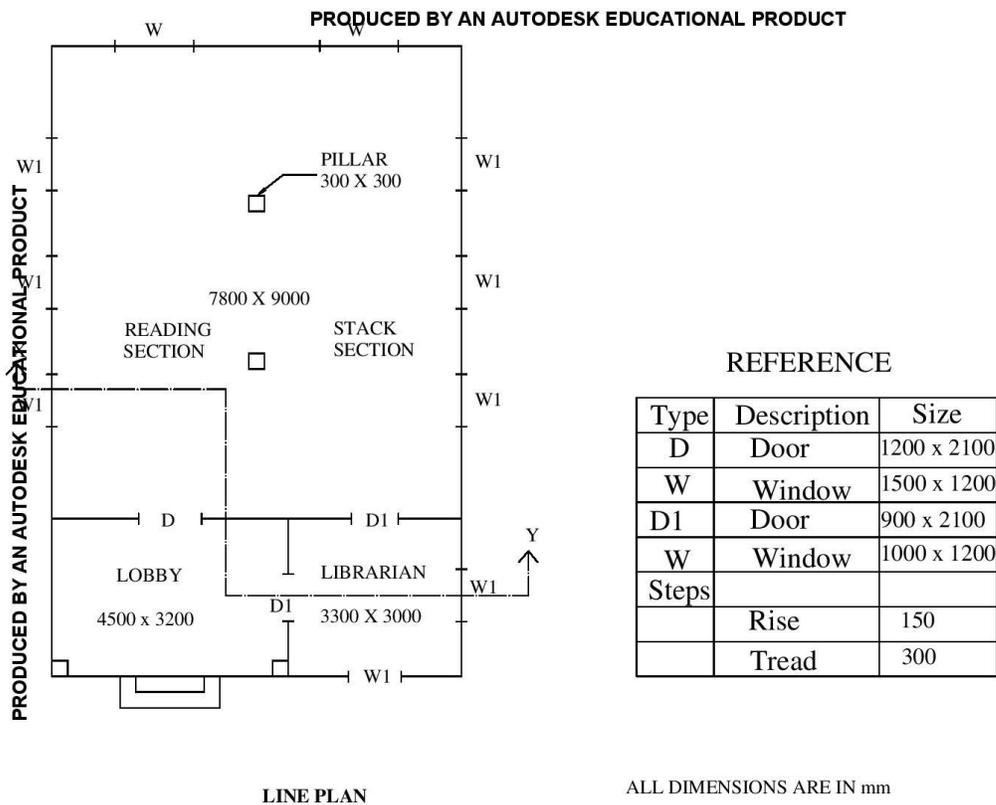
The flooring will be in CC 1:4:8, 150 thick and plastered smooth with CM 1:3, 20 thick.

## 8. Steps:

Steps will be in brick walk in CM 1:5 laid on 800 x 150 thick CC 1:4:8 footing. Rise 200, Tread 300.

### Note:

1. Any other dimensions found necessary may be assumed suitably making clear indications of the same.
2. All dimensions indicated are in millimeter.

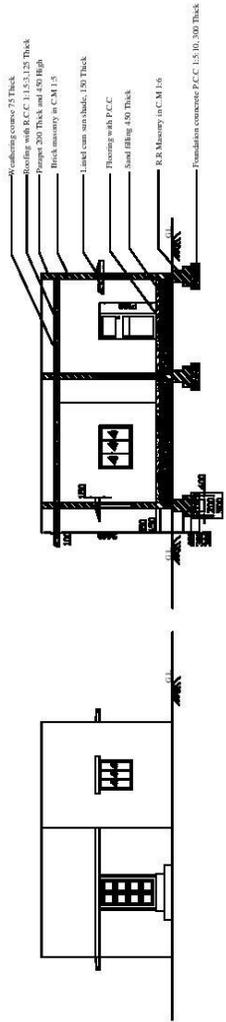


## Results

Thus The **Library Building With R.C.C Flat Roof** Is Studied Successfully.

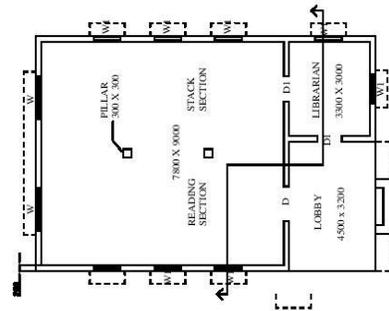
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A. LIBRARY BUILDING WITH R.C.C FLAT ROOF

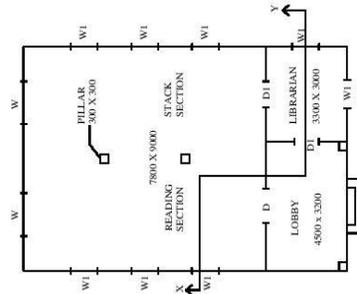


ELEVATION

SECTION XY



PLAN



LINE PLAN

| Type  | Description | Size        |
|-------|-------------|-------------|
| D     | Door        | 1200 x 2100 |
| W     | Window      | 1500 x 1200 |
| DT    | Door        | 900 x 2100  |
| W     | Window      | 1000 x 1200 |
| Steps | Rise        | 150         |
|       | Tread       | 300         |

ALL DIMENSIONS ARE IN mm

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## RESIDENTIAL BUILDING WITH LOAD BEARING WALLS AND PITCHED ROOF

**Aim:**

To draw the plan, section and elevation of a residential building had a pitched roof.

**Specification:****1. Foundation:**

For all main walls the foundation will be in cement concrete 1:4:8 mix, 900X300 laid at 1200 below the ground level. The masonry footing will be in brick work in cement mortar 1:5. The first footing being 600X450 and second footing being 500X450 for all main walls.

**2. Basement:**

The basement will be in brick work in cement mortar 1:5 400X450 above the ground level for all walls and inside filled with clean sand to a depth of 300. A damp proof course in cement mortar 1:3, 20 mm thick will be provided for all walls at basement level.

**3. Super structure:**

For all main walls super structure will be in brick work with cement mortar 1:5, 200 mm thick. The height of the walls will be 2800 and raised to the required height with the slope. All the walls including basement will be plastered with cement mortar 1:4 externally and 1:6 internally for 12.5 mm thick.

**4. Roofing:**

The slope of the roof will be  $30^{\circ}$ . The roofing will be with couple roof covered by Mangalore tiles laid on country wood reepers of size 50 mm X 12.5 mm @150 mm c/c. the reepers are nailed to common rafter of size 50mmX 100 mm @750 mm c/c. the lower end of the common rafters will be resting on wall plates of size 150mmX100mm and the end of the end of common rafter will be fixed with eaves board 25mm X200mm.

The eaves projection will be 450 mm beyond the outer face of walls. Mortar borders 200mm wide and 150 mm thick will be provided at suitable spacing.

**5. Lintel:**

For all opening RCC lintel 150 mm thick with 1:2:4 mix will be provided. Lofts 75mm thick and 450mm wide will be provided in the kitchen cum dining.

**6. Flooring:**

The flooring will be in cement mortar 1:3, 20 mm thick over flooring concrete 1:5:10 of 130 mm thick.

**7. Steps:**

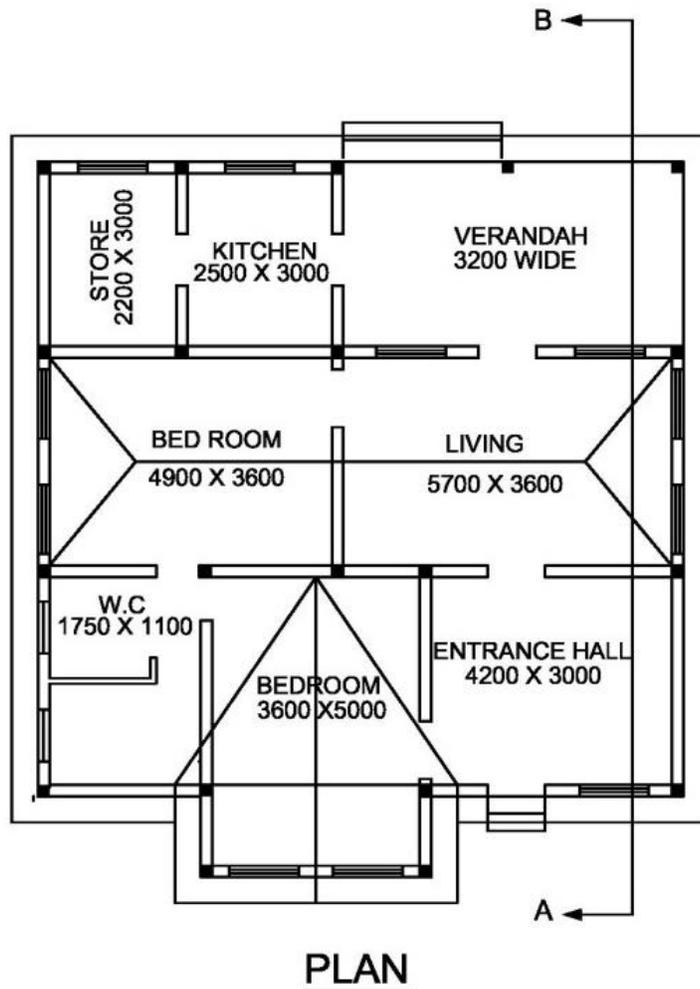
Steps will be in brick work in cement mortar 1:5 laid over a cement concrete bed 1:5:10, 100mm thick. Rise will be 150 mm and tread 300 mm.

**8. Doors and windows:**

D – Paneled door – 1000X 2100

- D1 – Paneled door – 900x2100
- D2 – Paneled door – 750x2100
- W – Glazed window – 1200 X1350
- V – Ventilator – 900x600

**RESIDENTIAL BUILDING WITH LOAD BEARING WALLS AND PITCHED ROOF**



**Results**

Thus The Residential Building With Load Bearing Walls And Pitched Room Is Studied Successfully.

## INTRODUCTION-STAAD Pro

**Aim:**

To study the introduction about STAAD Pro

**Overview:**

STAAD-Standard Analyze and

Design Company name –Bentley

Version- STAADV8i.

STAAD or (STAAD Pro) is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda, CA. In late 2005, Research Engineer International was bought by Bentley Systems. An older version called STAAD-III for windows is used by Iowa State University for educational purposes for civil and structural engineers. The commercial version STAAD Pro is one of the most widely used structural analysis and design software. It supports several steel, concrete and timber design codes. It can make use of various forms of analysis from the traditional 1st order static analysis, 2nd order p-delta analysis, geometric nonlinear analysis or a buckling analysis. It can also make use of various forms of dynamic analysis from modal extraction to time history and response spectrum analysis.

In recent years it has become part of integrated structural analysis and design solutions mainly using an exposed API called Open STAAD to access and drive the program using a VB macro system included in the application or other by including open STAAD functionality in applications that themselves include suitable programmable macro systems. Additionally STAAD Pro has added direct links to applications such as RAM Connection and STAAD Foundation to provide engineers working with those applications which handle design post processing not handled by STAAD Pro itself.

**Advantages:**

1. Easy to use interface,
2. Conformation with the Indian Standard Codes,
3. Versatile nature of solving any type of problem,
4. Accuracy of the solution.

STAAD Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD Pro is the professional's choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles

and much more.

STAAD Pro consists of the following:

***The STAAD Pro Graphical User Interface:***

It is used to generate the model, which can then be analyzed using the STAAD engine. After analysis and design is completed, the GUI can also be used to view the results graphically.

***The STAAD analysis and design engine:***

It is a general-purpose calculation engine for structural analysis and integrated Steel, Concrete, timber and aluminum design.

To start with we have solved some sample problems using STAAD Pro and checked the accuracy of the results with manual calculations. The results were to satisfaction and were accurate. In the initial phase of our project we have done calculations regarding loadings on buildings and also considered seismic and wind loads.

Structural analysis comprises the set of physical laws and mathematics required to study and predicts the behavior of structures. Structural analysis can be viewed more abstractly as a method to drive the engineering design process or prove the soundness of a design without a dependence on directly testing it.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behavior.

The aim of design is the achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and adequate resistance to the effects of seismic and wind. Structure and structural elements shall normally be designed by Limit State Method. Account should be taken of accepted theories, experiment and experience and the need to design for durability. Design, including design for durability, construction and use in service should be considered as a whole. The realization of design objectives requires compliance with clearly defined standards for materials, production, workmanship and also maintenance and use of structure in service.

The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes. The minimum requirements pertaining to the structural safety of buildings are being covered by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, and other external

loads, the structure would be required to bear. Strict conformity to loading standards recommended in this code, it is hoped, will not only ensure the structural safety of the buildings which are being designed.

Structural engineering is the branch of civil engineering that deals with the analysis and Design of structure that will support or resist the stresses, forces and loads. Throughout the history, Civil engineers have made an important contribution to improve the environment by designing and Construction major structures and facilities. The profession requires a lot of accuracy because most of the time; the final result of any project will directly or indirectly affect people's lives and safety. As a Result, software usage in this industry reduces the complexity of loss of challenging projects.

Many changes happened to the requirements of structural analysis due to the introduction of Computer software. In the past, the required skill for analysis was the capability to simplify the Complex structural systems so they could be analyzed by hand. This meant that an analyst would have a number of methods which might be applied to a specific problem. The choice of which Method to use was very important, since the incorrect choice could mean that the solution was Impossible by hand due to the requirement of large number of equations to be solved. On the other Hand, analysis process recently has an array of powerful computer programs which can handle most.

### ***Structural problems that an engineer is likely to face:***

Nowadays, software of structural design is used mostly for the analytical purpose in the detailed design phase, and becoming more versatile. They are being applied to all phases of the Design process, from the generation of design conceptions (design topologies, or layouts), through Preliminary design (design shape specification), and finally in the detailed process (sizing of Structure members).

Therefore, structural software can be defined as software which employed mostly by civil Engineers to prototype and analyze architectural designs to meet their professional objectives. Structural software gives the opportunity to visualize different structure's components on screen. These components such as: footings columns, beams, joists, rafters and the like. Calculation and data Analysis for a wide range of building elements are the most important part of these programs. Also Engineers required to know what type of loads are the components weighing. By applying this Software, structural engineers accomplish more than they ever could before, both in quantity and Quality STAAD program:

STAAD (Structural Analysis and Design Program) is a general structural and design program With applications primarily in the building industry-commercial buildings, bridges and highway Structures, industrial structures, chemical plant structures, dams, retaining walls, turbine foundations, Culverts and other embedded structures.

STAAD supports several steel, concrete and timber Design codes. It offers various analysis methods such as the traditional 1st order static analysis, 2<sup>nd</sup> Order P-delta analysis, geometric nonlinear analysis and the buckling analysis. It can also analyze Various type of dynamic analysis starts from model extraction to time history and response spectrum analysis. STAAD is fast, efficient, easy to use and accurate platform, conformation with many Standard codes and qualified to solve any type of problem. These features had made the STAAD the Professional's choice. Today, STAAD is one of the most popular structural engineering software Products.

Methods in STAAD Pro:

- Snap and grid method
- Structural wizard
- Excel method
- DXF method
- STAAD editor method

***Snap and grid method:***

Open STAAD Pro> snap node/ beam >  
edit. Plane X-Y

Angle of plane: Y-Y Grid

origin

|   |   |   |
|---|---|---|
| X | Y | Z |
| 0 | 0 | 0 |

In this you can change the values and spacing of the coordinates. Snap and grid method>snap node beam> to create.

***Structural wizard:***

Geometry>run structural wizard>model type( frame model)> bay frame> transfer> yes> close.

***Excel sheet method:***

To create node and member

***DXF method:***

To import the file from AutoCAD format to STAAD format

- a) Draw in AutoCAD> save> file type: AutoCAD 2007/LT 2007 DXF\*(dxf)> save> close.

b) Open STAAD Pro> file> import> select required file> ok.

**Translation repeat:**

To create building from a single member

Translation repeat>choose global direction >no.of steps required> default step spacing> link steps>open base> ok.

**Circular repeat:**

Select the member > geometry> circular repeat> choose the axis of rotation (Y)> total angle  $360^0$ >type the required no.of steps>select node> link steps> open base> ok.

**Mirror:**

Select the member> go to mirror> select mirror plane (X-Y OR X-Z)> select node > ok.

**Rotate:**

Go to rotate> type the required angle> select node> represent the node in the diagram> copy/move> ok.

**Geometry:**

Add beam> from point to point> between midpoints>by perpendicular direction> add curve beam.

**Insert node:**

Select member> add new point>Midpoint/ add n points>type the required distance> ok.

### **Result:**

Thus the introduction about STAAD Pro is studied successfully.

## ANALYSIS AND DESIGN OF MULTI STORY BUILDING

### Aim:

To create and analyze the multi storey building by using STAAD Pro

### Software required:

STAAD PRO V8i

### Procedure in STAAD Pro:

#### Preprocessing:

##### 1. Create model

- a) New project> plane> length units as m> force units as KN>type the file name as multi storey building>next> add beam.
- b) Geometry> run structural wizard> frame model> bay frame>type the length as 12.6, no.of bays along length as 3, height as 12.6, no. of bays along height as 4> apply & transfer the model to STAAD Pro screen.

##### 2. Property

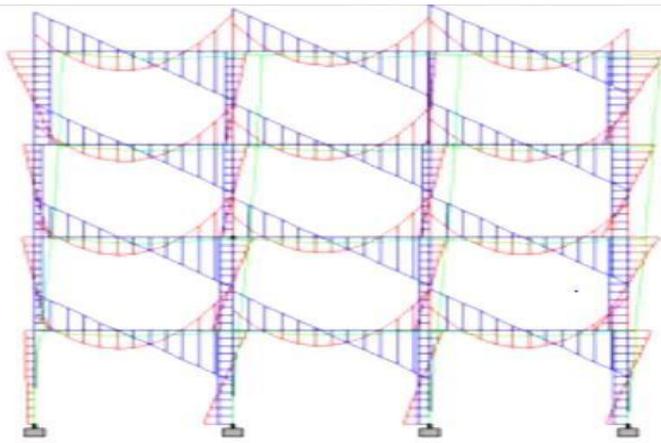
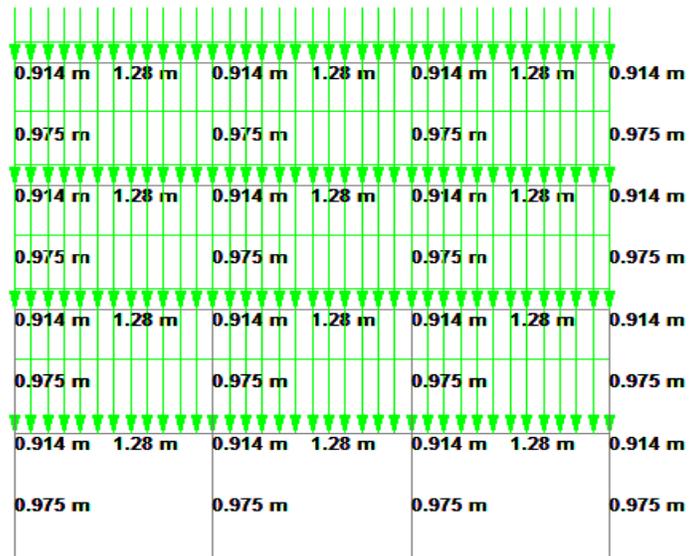
- a) General> property> define> rectangular>0.35x 0.23> add> close
- b) Select rectangular and assign to view.

##### 3. Support

Support> fixed support> select the bottom nodes> assign selected nodes.

##### 4. Loads

- a) Load and definition> load case detail> add>change the title as DL>add> then change LL> add> WL> add> close.
- b) Select DL> add> member load> uniform load> type W1 as -40KN/m <add.
- c) Select LL > add> member load> uniform load> type W1 as -20KN/m <add.
- d) Select WL > add> nodal load> type X as 25> add> type X as 20> add> type X as 15> add> type X as 10> add>close>Select DL> click select > member parallel to x direction> assign selected beams.
- e) Similarly, click select > member parallel to x direction> assign selected beams.
- f) WL> select node cursor> select the particular node> assign selected node.
- g) For load combinations, go to load case details> add> define combination> type name as DL+LL> FOS as 1.5>in available load case, select DL & LL and send it other side> add. Select DL & LL and send it other side> add.



Load F : Torsion : Shear Y : Bending Z : Bending Y : Displacement

- a) Then similarly type name as DL+LL+WL>FOS as 1.5>in available load case, select DL, LL & WL and send it other side> add. Select DL, LL& WL and send it other side> add.
- b) Then similarly type name as DL+LL-WL>FOS as 1.5>in available load case, select DL, LL & WL and send it other side>add. Select DL & LL and send it other side>add. After that select WL and send it other side>add.
- c) Then similarly type name as DL+LL+WL>FOS as 1.2>in available load case, select DL, LL & WL and send it other side> add. Select DL, LL& WL and send it other side> add.

#### 5. Design parameters

- a) Design concrete> IS 456>define parameter> give  $F_c$  as 20000 KN/m<sup>2</sup> for M20 concrete > $F_c$  as 30000 KN/m<sup>2</sup> for M30 concrete>add>  $F_y$  as 415000 KN/m<sup>2</sup>> add> select> ratio as 3>add.
- b) Then go to commands>design beam> add>design column> add>take off > close.
- c) Select  $F_c$ > select entire structure using cursor> assign it to selected beams> similarly do it for  $F_y$  and ratio then assign it.
- d) For beams > select the beams parallel to x direction and for columns column parallel to y direction and then assign it.

#### 6. Analysis

Analysis& print> add> close>analyze> run analyze> save> post processing> done.

#### Post-processing:

- a) In post-processing you have to see the deflection, bending moment, shear, axial forces, stresses and everything by turn on the particular specified icons for all the load combinations already given.
- b) Results> view value> beam results> maximum displacement> activate.
- c) You can also see the animations of displacement in it.

#### **Result:**

Thus the multi storey building is created and analyzed by using STAAD Pro.

#### **Outcome:**

At the end of this experiment, student acquires knowledge in creating and analyzing multi storey building using STAAD Pro.

## **ANALYSIS AND DESIGN OF CIRCULAR WATER TANK FIXED BASE**

### **Aim:**

To create and analyze the circular water tank with fixed base by using STAAD Pro

### **Software required**

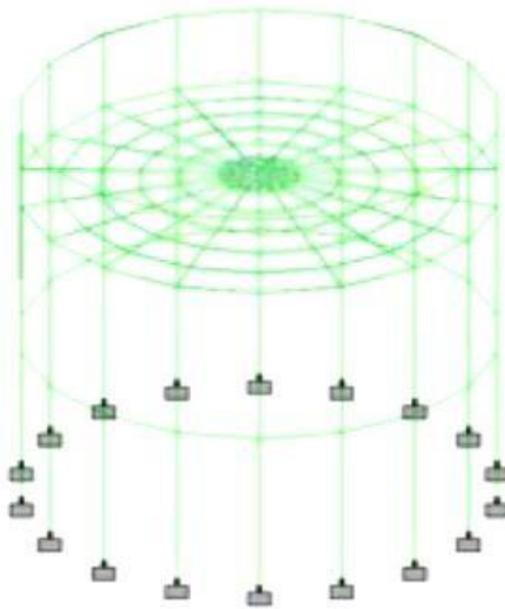
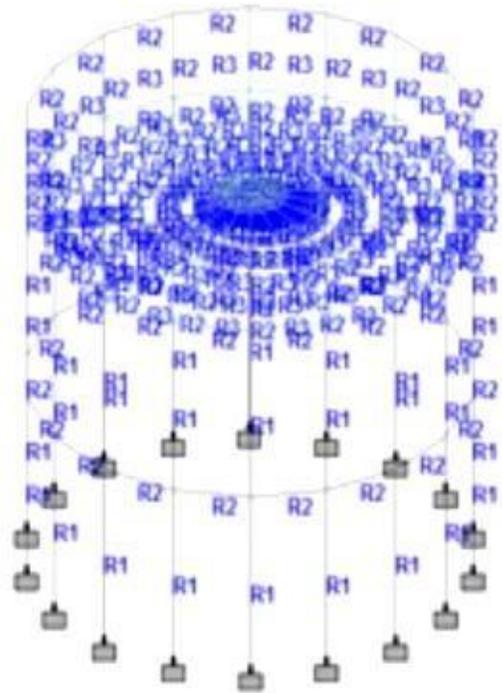
STAADPROV8i

### **Procedure in STAAD Pro:**

#### **Preprocessing:**

##### *1. Create model*

- a) New project> plane> length units as m> force units as KN>type the file name as circular water tank>next> add beam.
- b) Geometry> run structural wizard> frame model> reverse cylindrical model >type the length as 10m, no.of bays along length as 3, change the property in length as 4,4,2>radius as 5m no.of bays along periphery as 18> apply & transfer the model to STAAD Pro screen.
- c) Remove the bottom member by selecting and deleting it.
- d) Select front view and select the top horizontal beams of the tank> right click> new view> ok.
- e) Isometric view> add beam> create beam in its diameter> select beam> insert node> add midpoint> ok.
- f) Select node> copy > paste>change y distance as 0.5m> ok.
- g) Delete the created beam in its diameter
- h) Geometry> add beam> add the beam by cursor in between the centre and edge of circle.
- i) Select beam> select insert node> give n= 5> add n points> ok.
- j) Then select the entire beam>circular repeat>, select direction as Y, no.of steps= 18, link steps, open base>select the center node of the circle> ok.
- k) Top view> select the beams > delete.
- l) Create mesh at the center and give the division as 1> ok.
- m) Select all the beams> select fill floor grid with plates> thus the plates are created>select all beams in that and delete it.
- n) Select 4 node plates, create the plate for the side walls> fill floor grid with plates and make it as plate.



1. *Property*

- a) General> property> define> rectangular>0.3 x 0.23> add> close
- b) circular>0.3> add> close
- c) gotothickness>plateelementthickness>0.15.
- d) Select rectangular and assign the horizontal beams, Select circular and assign the vertical columns, select the plate by using plate cursor and assign it.

## 2. Support

Support> fixed support> select the bottom nodes> assign selected nodes.

## 3. Loads

- o) Load case detail> add>DL>add>close DL> add> pressure on full plate> global direction y>W1 = -20 KN/m<sup>2</sup>> add> close.
- p) Select the bottom plate using plate cursor and assign it.
- q) DL> add> plate load> hydrostatic >select plate < select the specified plate by using cursor>done> W1= -20 KN/m<sup>2</sup> (depending on the z- axis direction) and W2 =0.001>global y axis& local Z axis>close.

## 2. Design parameters

- a) Design concrete> IS 456>define parameter> give F<sub>c</sub> as 20000 KN/m<sup>2</sup> for M20 concrete > F<sub>y</sub> as 415000 KN/m<sup>2</sup>> add> close..
- b) Then go to commands>design beam> add>design column> add>take off > close.
- c) Select F<sub>c</sub>> select entire structure using cursor> assign it to selected beams> similarly do it for F<sub>y</sub> and ratio then assign it.
- d) For beams > select the beams parallel to x direction and for columns column parallel to y direction and then assign it.

## 3. Analysis

Analysis& print> add> close>analyze> run analyze> save> post processing> done.

### Post-processing:

- a) In post-processing you have to see the deflection, bending moment, shear, axial forces, stresses and everything by turn on the particular specified icons for all the load combinations already given.
- b) Results> plate rest contour> stress type MX> apply> close.
- c) You can also see the animations of displacement in it.

### **Result:**

Thus the circular water tank with fixed base is created and analyzed by using STAAD Pro.

### **Outcome:**

At the end of this experiment, student acquires knowledge in creating and analyzing the circular water tank with fixed base using STAAD Pro.

## RECTANGULAR WATER TANK WITH FIXED BASE

### Aim:

To create and analyze the rectangular water tank with fixed base by using STAAD Pro

### Software required:

STAAD PRO V8i

### Procedure in STAAD Pro:

#### Preprocessing:

##### 1. Create model

- a) New project> plane> length units as m> force units as KN>type the file name as rectangular water tank>next> add beam.
- b) Geometry> run structural wizard> frame model> bay frame>type the length as 4, no.of bays along length as 1, height as 10, no.of bays along height as 3>width as 4m >no.of bays along width ad 1 apply & transfer the model to STAAD Pro screen.
- c) Then change the characteristics bay along height as 4,4, 2
- d) Now apply and transfer the model to STAAD screen.

##### 2. Create plate

- a) Mesh> create mesh for plates> quadrilateral meshing> ok > apply.
- b) Similarly create mesh for all side walls.
- c) Then delete all the beam element in the water tank.

##### 3. Property

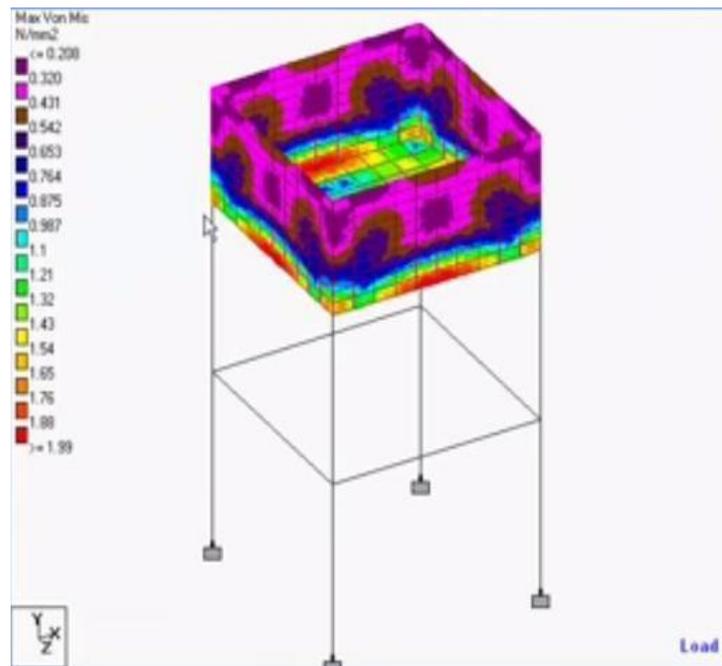
- a) General> property> define> rectangular>0.23 x 0.23> add> close
- b) Go to thickness> plate element thickness> 0.15.
- c) Select rectangular and assign to view, Select the plate by using plate cursor and assign it.

##### 4. Support

Support> fixed support> select the bottom nodes> assign selected nodes.

##### 5. Loads

- a) Load case detail> add>DL>add> close.
- b) DL> add> pressure on full plate> global direction y>W1 = -20 KN/m<sup>2</sup>> add> close.



- c) Select the bottom plate using plate cursor and assign it.
- d) DL> add> plate load> hydrostatic >select plate > select the specified plate by using cursor>done>  
 $W1 = -20 \text{ KN/m}^2$  (depending on the z- axis direction) and  $W2 = 0.001$ >global y axis& local Z axis>  
 close.
- e) Similarly give the load on the basis of z axis direction for all the side walls of the tanks.

#### 6. Design parameters

- a) Design concrete> IS 456>define parameter> give  $F_c$  as  $20000 \text{ KN/m}^2$  for M20 concrete >  $F_y$  as  $415000 \text{ KN/m}^2$ > add> close.

- b) Then go to commands>design beam> add>design column> add>take off > close.
- c) Select  $F_c$ > select entire structure using cursor> assign it to selected beams> similarly do it for  $F_y$  and ratio then assign it.
- d) For beams > select the beams parallel to x direction and for columns column parallel to y direction and then assign it.

#### 7. Analysis

Analysis& print> add> close>analyze> run analyze> save> post processing> done.

#### Post-processing:

- a) In post-processing you have to see the deflection, bending moment, shear, axial forces, stresses and everything by turn on the particular specified icons for all the load combinations already given.
- b) Results> plate rest contour> stress type MX> apply> close.
- c) Deflection and stresses acting in the water tank
- d) You can also see the animations of displacement in it.

#### **Result:**

Therefore the determination of shear force, bending moment and design of reinforced concrete, rectangular water tank and quantities of steel, concrete, reinforcement needed are formed by using STAAD.PRO.

#### **Outcome:**

At the end of this experiment, student acquires knowledge in creating and analyzing the rectangular water with fixed base by using STAAD Pro.

## **INTRODUCTION TO BIM**

Building Information Modeling (BIM) is a process of creating and managing 3D building data during its development. BIM is a complex multiphase process that gathers input from team members to model the components and tools that will be used during the construction process to create a unique perspective of the building process. The 3D process is aimed at achieving, savings through collaboration and visualization of building components into an early design process that will dictate changes and modifications to the actual construction process. It is a very powerful tool that when used properly will save money, time and simplify the construction process. Over the year the industry has commercialized BIM towards architectural related professionals, however, the real purpose and benefits of BIM relate to all construction industry professionals.

The 3D representation of the building and now used in roads and utilities too and is geared towards all construction professionals, and all of you are responsible for understanding the process and participate in providing input to the software. BIM makes a reliable digital representation of the building available for design decision making, high-quality construction document production, construction planning, performance predictions, and cost estimates. Not only, that BIM can also be used by the property owners, once the construction process has ended, to carefully monitor how the building is performing and to complete repairs efficiently. The building information modeling process covers geometry, space, light, geographic information, quantities, and properties of building components. BIM can be used to demonstrate the entire building life cycle, including the processes of construction and facility operation.

The BIM application process can be used during design and architecture process creating a clear picture used for better and more integrated designs. The software will be used to foresee problems and coordination between different contractors and as a way to generate construction documents and process that will later be implemented during the physical process. It is ideal when there are many trades executing at the same moment or when schedules are compressed. There are multiple applications for BIM so it can be used by the following groups:

- Architecture
- Sustainability
- Structures
- MEP

- Construction Management
- Utilities
- Road Construction
- Scheduling
- Property Management

Industry groups are trying to develop one standardized BIM model that can be used to integrate all different types of modeling systems. By doing this, they will facilitate the coordination and communication in the design-construction-operation team under one single platform. The purpose of this movement is to create a single data center, with multiple CAD and specs depending on the discipline that you are working for. All data will then come together allowing it to be used for take-offs, analysis, coordination and important project milestones. This effort will help standardize the process and will establish a base that can be used during the bidding process so everyone can be judged using some standard guidelines. The Building Smart Alliance, a council of the National Institute of Building Sciences, in Washington, D.C., is leading these efforts towards a National BIM Standard.

**Result:**

Thus the introduction about BIM is studied successfully.

## Exp.No:13

## TEE BEAM BRIDGE

### Aim:

To create and analyze tee- beam bridge by using STAAD Pro

Software required:

STAAD PRO V8i

Procedure in STAAD Pro:

### Preprocessing:

#### 1. Create model

- a) New project> space > length units as m> force units as KN>type the file name as tee beam bridge >next>add beam.
- b) Snap node/ beam> edit and create a beam for 20 m in x- axis and two 10 m column vertically in the span of the beam at a distance of 5m from the edge of the horizontal beam
- c) Translation repeat> global direction Z, no.of steps=3, spacing = 25m, link steps and open the base> ok.

#### 2. Create plate

Select mesh> create mesh by connecting the four corners of the slab of the bridge.

#### 3. Property

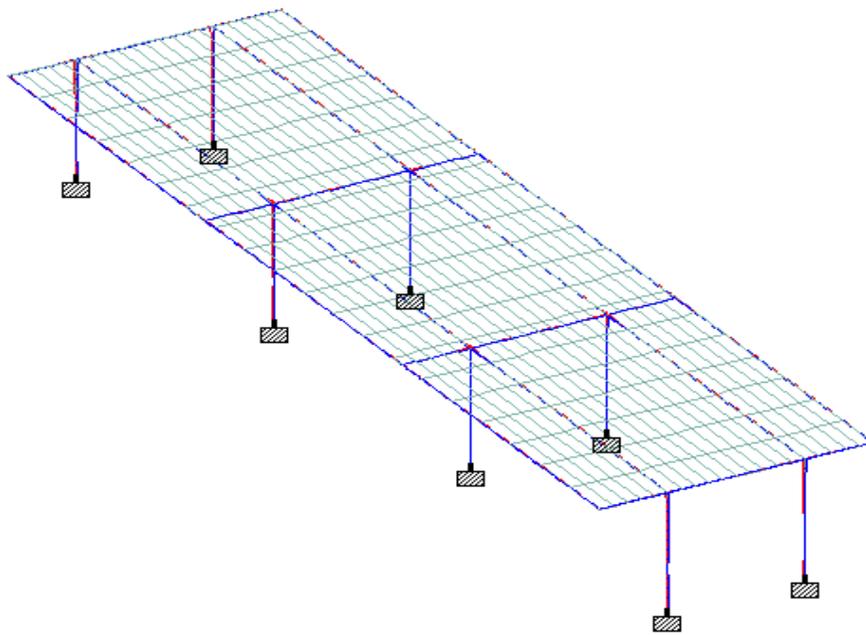
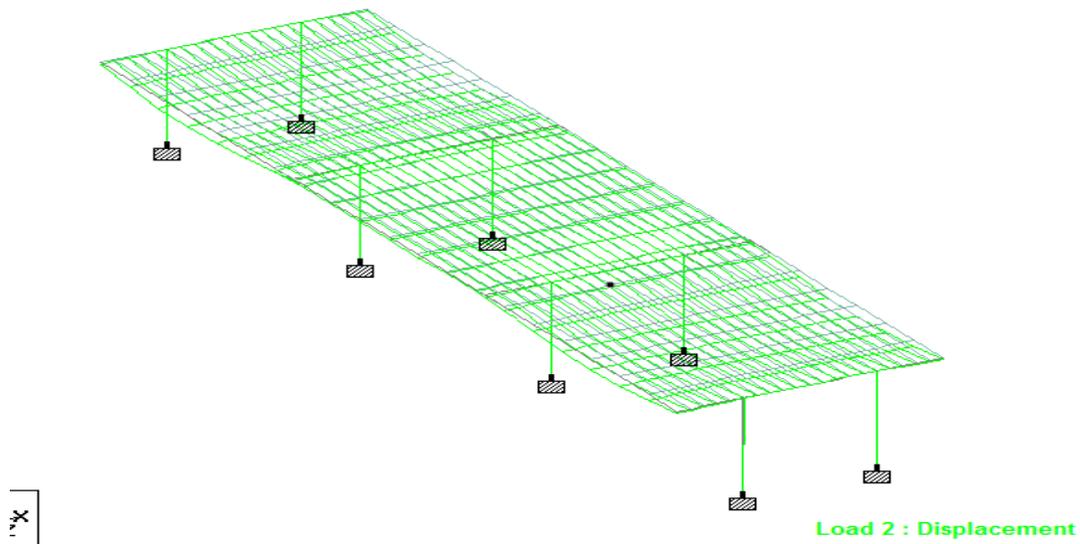
- a) General> property> define> rectangular>0.3 x 0.23> add> close
- b) Circular>0.3> add> close
- c) Go to thickness> plate element thickness> 0.15.
- d) Select rectangular and assign the horizontal beams, Select circular and assign the vertical columns, select the plate by using plate cursor and assign it.

#### 4. Support

Support> fixed support> select the bottom nodes> assign selected nodes.

#### 5. Loads

- a) Definition> vehicle definition>add>close.
- b) Load case 1> add>self weight> factor -1> add> close> assign to view> assign.
- c) Load case detail> add> load generation>no.of loads to be generated= 20, preferred load to be added=1>add>close.



### Bending stresses

d) Generate load > add > x coordinate = 10m > y - coordinate > 10m > x increment 0 > z coordinate 3m, z increment > 30 m > close.

### 6. Design parameters

a) Design concrete > IS 456 > define parameter > give  $F_c$  as  $20000 \text{ KN/m}^2$  for M20 concrete >  $F_y$  as  $415000 \text{ KN/m}^2$  > add > close.

b) Then go to commands > design beam > add > design column > add > take off > close.

- c) Select  $F_c$  > select entire structure using cursor > assign it to selected beams > similarly do it for  $F_y$  and ratio then assign it.
- d) For beams > select the beams parallel to x direction and for columns column parallel to y direction and then assign it.

### 7. Analysis

Analysis & print > add > close > analyze > run analyze > save > post processing > done.

#### **Post-processing:**

- a) In post-processing you have to see the deflection, bending moment, shear, axial forces, stresses and everything by turn on the particular specified icons for all the load combinations already given.
- b) Results > plate rest contour > stress type  $M_x$  > apply > close.
- c) You can also see the animations of displacement in it.

#### **Result:**

Thus the tee beam girder is created and analyzed by using STAAD Pro.

#### **Outcome:**

At the end of this experiment, student acquires knowledge in creating and analyzing the tee beam girder using STAAD Pro.

## VIVA QUESTIONS

- 1) List out the types of building symbols.
- 2) What are all the basic kinds of building?
- 3) What kinds of doors are available in buildings?
- 4) What is footing?
- 5) Define PCC and RCC
- 6) How to fix scale for a building.
- 7) Mention the dimension of title block
- 8) Write the dimension of A1,A2,A3,A4 Drawing sheets
- 9) What is section plane?
- 10) What is plinth level?
- 11) Define roof level
- 12) What is the height of the roof level for a residential building?
- 13) Write the dimension of riser and thread
- 14) What is the purpose of providing sun shade?
- 15) Mention the roof thickness for normal building
- 16) List out the commands involved in modify tool bar.
- 17) Why do we use mirror?
- 18) List out the commands involved arc tool bar.
- 19) Define plan of the building.
- 20) How to obtain section from plan?
- 21) How to obtain elevation?
- 22) How will you modify text command?
- 23) What is the purpose of using hatch command?.
- 24) What is the height of sill level?
- 25) What is load bearing structure?.
- 26) What are all the steps involved in site clearance?
- 27) How will you mark a site for setting out a foundation?
- 28) Define the term masonry.
- 29) Explain the sequence of operation in construction with an example.
- 30) What is composite masonry?
- 31) What are all the types of ashlar masonry?
- 32) Differentiate English bond and Flemish bond.
- 33) Write notes on zig-zag bond
- 34) Write notes on temporary shed
- 35) What are all the types of scaffolding?
- 36) Write notes on centring
- 37) Define dampness
- 38) What are all the causes of dampness?
- 39) What are all the types of damp proofing courses?
- 40) Write the fire protective requirement of the building
- 41) Explain the various types of foundation with neat sketches
- 42) Explain the various types of stone masonry with neat sketches
- 43) Make a comparison between stone masonry and brick masonry
- 44) What are all the different types of bonds in masonry
- 45) Explain the various types of flooring with neat sketches
- 46) Explain the various types of trusses with neat sketches
- 47) Explain the various types of roof finishes with neat sketches
- 48) Write notes on acoustic of the building
- 49) Write the step by step procedure of laying of brick.
- 50) What are all the various types of roof finishes?