



||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust ®

ADHICHUNCHANAGIRI UNIVERSITY

BGS INSTITUTE OF TECHNOLOGY,

B.G. Nagara-571448.

DEPARTMENT OF CIVIL ENGINEERING

LABORATORY MANUAL



FOURTH SEMESTER CIVIL ENGINEERING

COMPUTER AIDED DESIGN LAB-II

SUBJECT CODE –18CVL46

Prepared By,

Manjula K

Assistant Professor

Dept. of Civil Engg,

BGSIT

Dept. of Civil Engg, BGSIT

BGS INSTITUTE OF TECHNOLOGY

Vision

BGSIT is committed to the cause of creating tomorrow's engineers by providing quality education and inculcating ethical values.

Mission

- Imparting quality technical education by nurturing a conducive learning environment.
- Offering professional training to meet industry requirements.
- Providing education with a moral - cultural base and spiritual touch.

DEPARTMENT OF CIVIL ENGINEERING

Vision, Mission, PEOs and PSOs of the Department

Vision

Producing technically competent and Environmental friendly Civil Engineering Professionals to cope with the societal challenges.

Mission

- Imparting quality education and professional ethics by proficient faculty.
- Providing infrastructure to meet the requirements of curriculum, research and consultancy.
- Motivating towards higher education and entrepreneurship.
- Promoting interaction with design and construction industries.

Program Education Objectives

PEO 1: Graduates will be pursuing successful career & higher education.

PEO 2: Graduates will be able to design safe, economical & sustainable Civil Engineering structures conforming to standards.

PEO 3: Graduates will display professional ethics to work in a team & lead the team by effectively communicating the ideas.

PEO 4: Graduates will practice lifelong learning.

Programme Specific Outcomes

PSO 1: Graduates will be able to analyse, design and execute the Civil Engineering structures effectively for the sustainable development

PSO 2: Graduates will acquire critical thinking abilities and technical skills for the usage of modern tools in development of Civil Engineering structures.

PSO 3: Graduates will be able to get opportunities for their professional growth, demonstrate communication and aptitude skills to face the challenges and needs of our society.

PROGRAM OUTCOME

The program leading to Degree in Civil Engineering aims to provide students with a strong theoretical and practical background in relevant engineering streams. A graduate in Civil Engineering is expected to attain the capability to analyze, design, execute and acquire skills necessary to function in Government Departments, Academic institutions, Construction industries, Research and Development organizations.

Program Outcomes are

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the 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 modeling 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 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.

|| Jai Sri Gurudev||
Sri Adichunchanagiri Shikshana Trust (R)
ADICHUNCHANAGIRI UNIVERSITY
BGS Institute of Technology

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

18CVL46	Course Code	COMPUTER AIDED BUILDING PLANNING & DRAWING II	Course Title	IV	Semester
02	Credits	1 – 0 – 2 – 2	L – T – P – TL*	42 Hours	Teaching Period
100 Marks	Total	60 Marks	SEE*	40 Marks	CIE*
*NOTE: L – Lecture; T – Tutorial; P – Practical; TL – Total; CIE – Continuous Internal Evaluation; SEE – Semester End Examination					

<p>Course Learning Objectives: This course will enable students to;</p> <ol style="list-style-type: none"> 1. Achieve skill sets to prepare computer aided engineering 2D and 3D drawings. 2. Understand the details of construction of different civil structural elements. 3. To understand concept of SFD and BMD. 	Number of Lecture Hours/Week
<p>Experiments: Module 1 Following drawings are to be prepared for the data given using AutoCAD</p> <ol style="list-style-type: none"> 1. Submission Drawings for Approval. 2. Preparation of Layout Development Plan. 3. Layouts of Water Treatment Plant, Rainwater Harvesting. <p>Module 2 3D Commands of AutoCAD</p> <ol style="list-style-type: none"> 1. Use 3D commands to generate 3D view from 2D drawing 2. Prepare 3D drawings – 3D Solids – Sphere , box, cylinder, cone, wedge 3. Perform rendering/shading on 3D drawings – Hide, render and shade of 3D drawings <p>Module 3 Use of EXCEL in Civil Engineering Problems Use of spread sheet for the following civil engineering problems</p> <ol style="list-style-type: none"> 1. SFD and BMD for Cantilever and simply supported beam subjected to uniformly distributed and uniformly varying load acting throughout the span 2. Computation of earthwork 3. Design of horizontal curve by offset method 	03 = (1 Hour Instruction + 2 Hours Laboratory)

4. Design of super elevation
<p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Know the procedures of submission of drawings and Develop working and submission drawings for building. 2. Apply basic CAD command to develop 3D drawings using AutoCAD. 3. Know the basics of Excel to solve Civil Engineering Problems. <p>Program Objectives</p> <ul style="list-style-type: none"> • Engineering knowledge • Problem analysis • Interpretation of data <p>Question paper pattern:</p> <ul style="list-style-type: none"> • There will be two full questions from Module 1 with each full question carrying forty marks. Students have to answer any one question. • There will be two full questions from Module 2 with each full question carrying thirty marks. Students have to answer any one question. • There will be two full questions from Module 3 with each full question carrying thirty marks. Students have to answer any one question. <p>Textbooks:</p> <ol style="list-style-type: none"> 1. Computer Aided Design Laborator- Dr M.N.Shesha Prakash, Dr.G.S.Suresh, Lakshmi Publications 2. CAD Laboratory- M.A.Jayaram, D.S.Rajendra Prasad- Sapna Publications 3. AUTOCAD 2002- Roberts JT, -BPB publications 4. AUTOCAD 2004- Sham Tickoo, A beginner's Guide, Wiley Dreamtech India Pvt Ltd., 5. Learning Excel 2002- Ramesh Bangia, -Khanna Book Publishing Co (P) Ltd., 6. Microsoft Excel- Mathieson SA, Starfire publishers.

CO & PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	3	2	1	1	-	-	1	2
CO2	3	1	-	-	3	-	-	-	-	-	-	2
CO3	3	3	2	1	2	-	-	-	-	-	-	2

CO & PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	-	2	2
CO3	2	2	2

Module1

Sanction drawing:

A working plan having the following additional drawings/ details is referred as SanctionPlan

1. Location map
2. Key plan
3. Details having ward no., corporation division, details of In-charge Engineer, owner's name and present address.
4. Details of Sanctioning Authority along with the space for seal and signature of approval.
5. Details of plot area, built up area, plinth area and FAR (approved and proposed).

Mandatory instructions:

1. Basement/ Stilt floor/ GF and part of ground floor where car parking is shown is reserved for parking purpose only and shall not be converted to any other purpose.
2. Necessary ducts for telephone cables, cubicles at ground level for postal services and space for dumping garbage within the premises shall be provided.
3. Licence and approved plans shall be displayed in a conspicuous place of the licensed premises.
4. The applicant shall ensure that the Rainwater Harvesting Structures are provided and maintained in good condition for storage of water for non-potable purposes or recharge of ground water at all times having a minimum total capacity mentioned in the bye-laws 32(a).
5. Employment of child labour in the construction activities is strictly prohibited.

Exercise

Prepare the submission drawing (sanction drawing) of stilt with two storey residential building with access to terrace including all details and statements as per the local by- laws for a site of (9 x 12) m.

Solution: Refer Fig.1.1

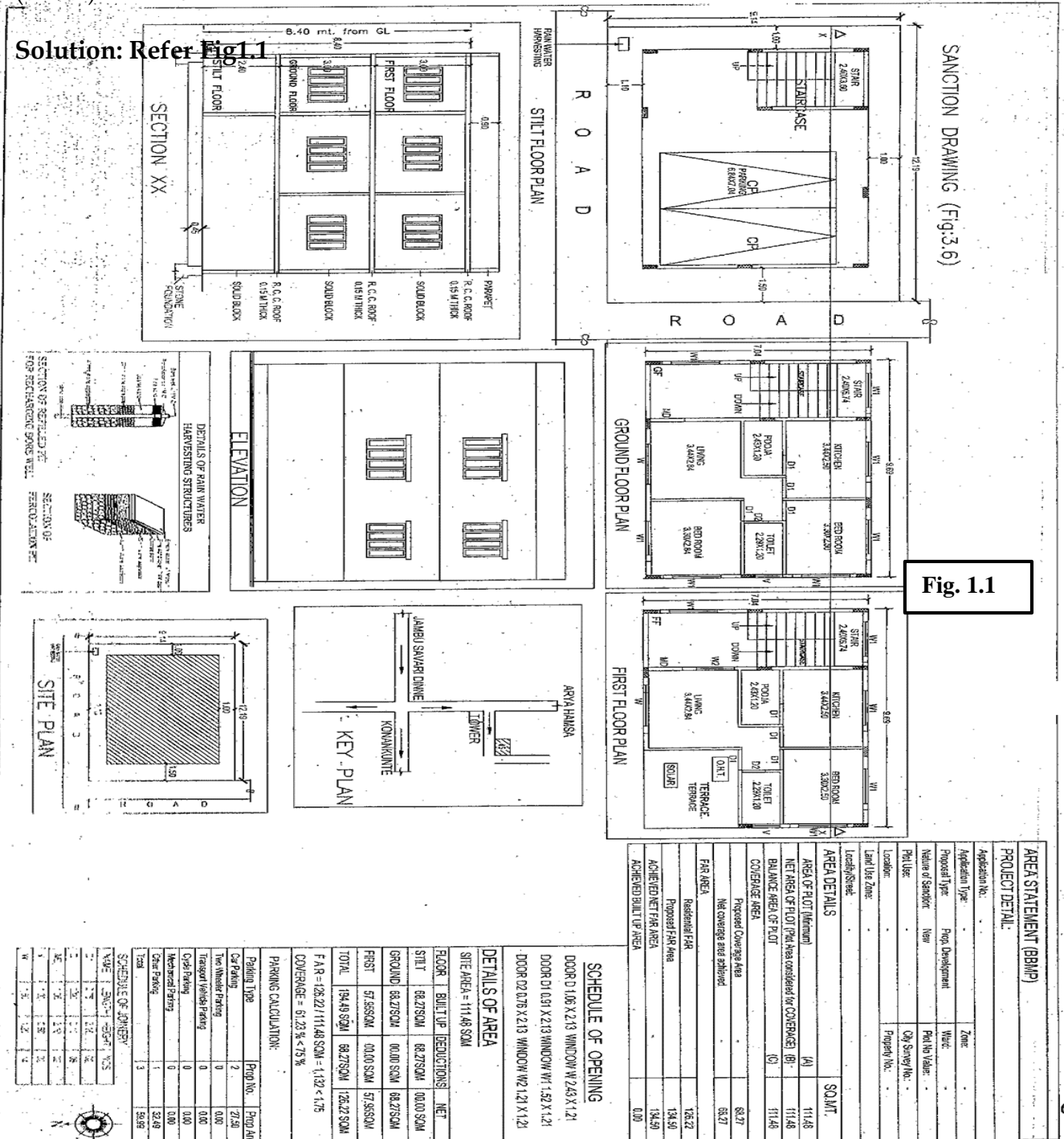
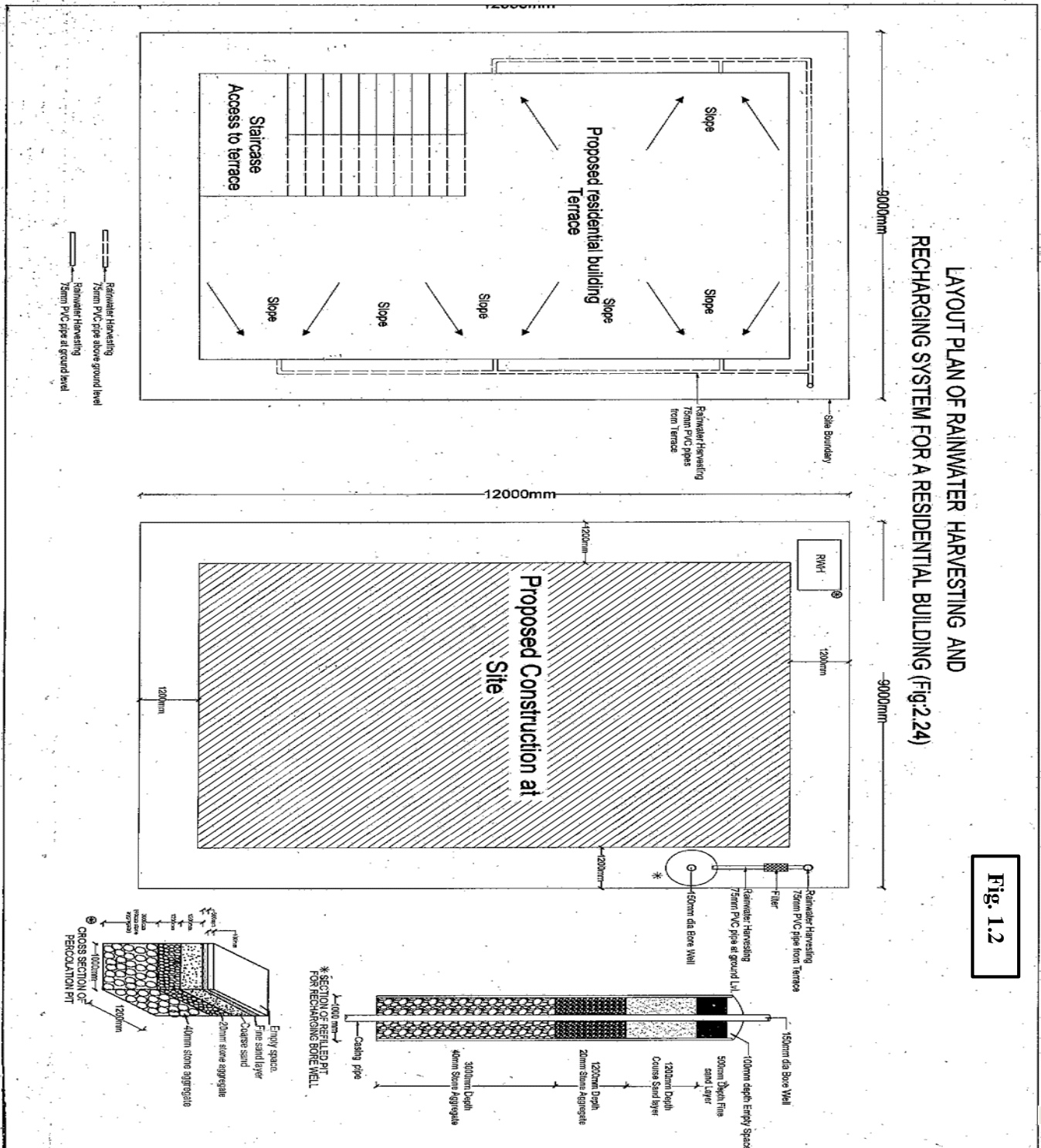


Fig. 1.1

Layout plan of rain water recharging and harvesting system

Exercise 1.2

Draw a layout plan of rainwater harvesting and recharging system for a (9m x 12m) area residential building leaving setback of 1.20m on all four sides as per bye laws. Show a cross section details for recharging pit.



Module 2

3- D DRAWINGS

The commands used while drawing 3D solids are briefly discussed in the beginning.

The major commands used are:

- **Pedit** - To join the individual poly line segments
- **Explode** - To break the joined part into individual entities
- **Extrude** - To add thickness to the object and create a solid
- **Union** - To unite two solids and form a union
- **Intersect** - To form an intersection of two solids
- **Shade** - This displays a flat - shaded image of the drawing in the current viewport.

SHADE removes hidden lines and displays a shaded picture of the drawing

- **Rotate 3D** - This moves objects about a three dimensional space
- **Revolve** - This creates a solid by revolving a two - dimensional object about an axis
- **Region** - This creates a region object from a selection set of existing objects. Regions are two dimensional areas.
- **View ports** - Splits the screen into a number of ports. Enables us to have a multi viewing of the object at the same time.

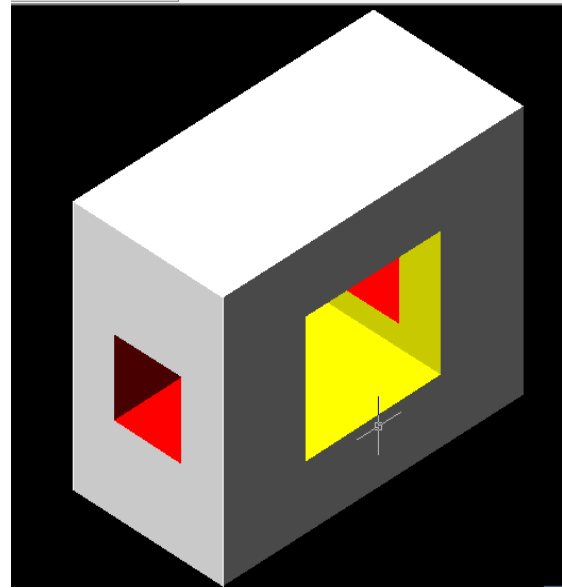
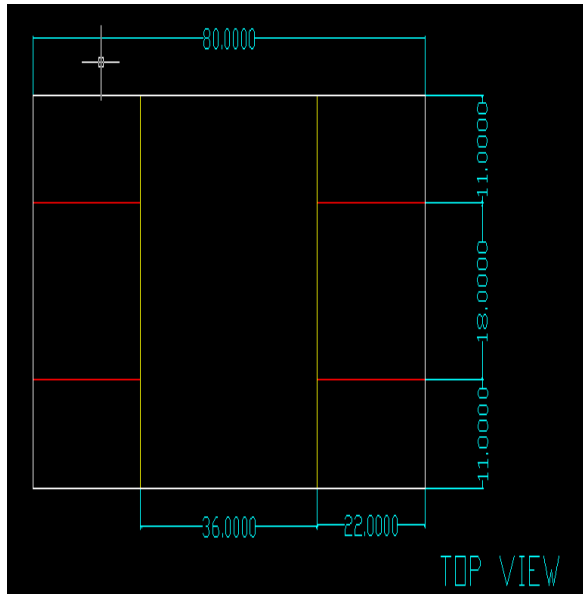
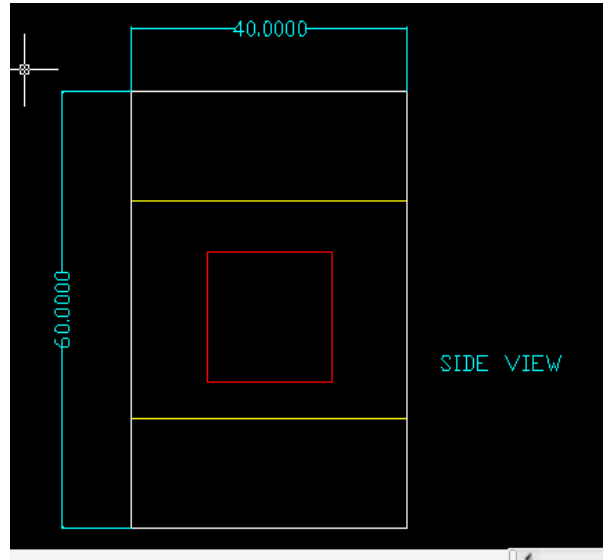
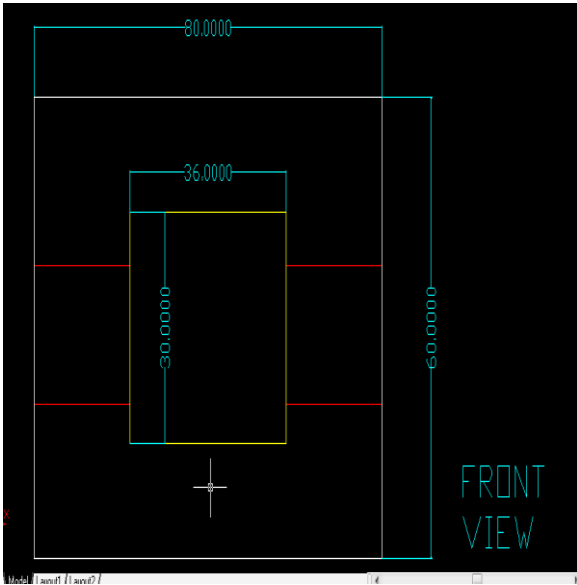
VIEW pull down menu _ **View ports**

- **3D ORBIT** - Allows us to rotate the object on a 3 dimensional axis.

VIEW pull down menu _ **3D orbit**

- **3D VIEWS** - Allows us to visualize the views of object.

VIEW pull down menu - **3D view**



PROCEDURE:

STEP 1: Set your screen to SW ISOMETRIC VIEW.

Go to VIEW pull down menu.

Select 3D VIEWS and from the sub menu select SW ISOMETRIC VIEW.

STEP 2: Using RECTANGLE command draw the bottom rectangle of dimensions 80 X 60 and EXTRUDE it to a height of 40. We get the outside solid

To put the holes required on the front and the side of the solid,

STEP 3: Draw the inner rectangles and extrude them as per give dimensions

STEP 4: Subtract the inner solids from the outer one

We can use different colours to distinguish between the solids, so that it is easier to subtract.

STEP 5: Shading can be done to the wire frame model using commands in the **SHADE** tool bar.

The front, top and the side views of the figure can be obtained from the

View pull down menu _ **3D views** _ **Front view** etc.,

The model can be made to orbit using

View pull down menu _ **3D ORBIT**

Module 3

USE OF EXCEL IN CIVIL ENGINEERING PROBLEMS

1. A Cantilever beam is subjected to uniform load of 100 KN/Meter for the full span of 5meter. The beam is of uniform cross section and of the same material. Calculate Bending Moment and Shear Forces for every 0.5meter using Excel programming.

DEPARTMENT OF CIVIL ENGINEERING						
BGSIT, B.G.Nagara						
Date :						
A) CANTILEVER BEAM						
1) Intensity of UDL on full length				C7	KN/meter	
2) Span of the beam				C8	Meter	
3)Section XX from Cantilever End				C9	Meter	
B) CALCULATIONS						
Shear force at any section XX from Cantilever end				= C7*C9	KN	cell C10
Bending Moment at any section XX from Cantilever end				=C7*C9*C9/2	KN-Meter	Cell C11
C) RESULTS						
Shear force				= C10	KN	
Bending Moment				= C11	KN-Meter	

2. A Simply Supported beam of span 7.5 meter is subjected to UDL of 111.76 KN/M for the full span. Calculate Bending Moment and Shear Forces for every 0.5meter Excel programming.

DEPARTMENT OF CIVIL ENGINEERING					
BGSIT, B.G.Nagara.					
Date :					
A) SIMPLY SUPPORTED BEAM					
1) Intensity of UDL on full length			D8	KN/meter	
2) Span of the beam			D9	Meter	Cell D9
3)Section XX from Left Support X			D10	Meter	
B) CALCULATIONS					
Left Support Reaction Ra			= D8*D9/2	KN	Cell D11
(Ra = UDL X SPAN / 2)					
Shear force at any section XX from			= D11-D10*D8	KN	cell D11
Left Support		SF= Ra - UDL x X			
Bending Moment at any section xx from Left support			=D11 * D10- D8*D10^2/2	KN-Meter	Cell D12
BMx = Ra x X - UDL x X ^2/2					
C) RESULTS					
Section from Left Support			=D10	Meter	
Shear force			=D11	KN	
Bending Moment			= D12	KN-Meter	

3. A Simply Supported beam of span 12.5 meter is subjected to UVL of 111.76 KN/M at center of span. Calculate Bending Moment and Shear Forces for every 0.5meter Excel programming

DEPARTMENT OF CIVIL ENGINEERING						
BGSIT, B.G.Nagara.						
Date :						
A) SIMPLY SUPPORTED BEAM						
1) Intensity of Uniformly Varying Load					D8	KN/meter
2) Span of the beam					D9	Meter
3)Section XX from Left Support A (Enter sec xx within half span only)					D10	Meter
B) CALCULATIONS						
Left Support Reaction Ra (Ra = 0.5 X UDL X SPAN /4)					= 0.5*D8*D9/2	KN
Shear force at any section XX from Left Support					= D11-D10*D8*0.5	KN
Bending Moment at any section XX from Left Support					=D11 * D10- 0.5*D8*D10*D10/3	KN-Meter
BMx = Ra x X - (0.5 x UDL x X x X/3)'						
C) RESULTS						
Section from Left Support					=D10	Meter
Shear force					=D12	KN
Bending Moment					= D13	KN-Meter

4. A Cantilever beam of span 12.5 meter is subjected to UVL of 121.234 KN/M at support of the cantilever beam. Calculate Bending Moment and Shear Forces for every 0.5meter using MS Excel.

DEPARTMENT OF CIVIL ENGINEERING							
ALLIANCE COLLEGE OF ENGINEERING AND DESIGN							
Date :	=TODAY()						
A) CANTILEVER BEAM							
1) Intensity of UVL at fixed support				C7	KN/meter		
2) Span of the beam				C8	Meter		
3)Section XX from Cantilever End				C9	Meter		
B) CALCULATIONS							
Shear force at any section XX from Cantilever end				= C7*C9*0.5	KN	cell C10	
Bending Moment at any section XX from Cantilever end				=C10*C9/3	KN-Meter	Cell C11	
C) RESULTS							
Shear force				= C10	KN		
Bending Moment				= C11	KN-Meter		

COMPUTATION OF EARTHWORK

1. Computation of Area

One of the main objectives of the surveying is to compute the areas and volumes. Generally, the lands will be of irregular shaped polygons. There are formulae readily available for regular polygons like, triangle, rectangle, square and other polygons. But for determining the areas of irregular polygons, different methods are used and they are

- Graphical method
- Co-ordinate method
- Planimeter

Out of these three methods, the co-ordinate method is popularly used, in land surveying for computing catchment area, drainage area, cross section of rivers, channels etc. Under this method the given area is split into two with a base line run at the centre.

There are two important rules available for the computation of area and they are

- a. Trapezoidal Rule
- b. Simpson's Rule

In trapezoidal rule, boundaries between the ends of ordinates are assumed to be straight. Thus the area enclosed between these line and the irregular boundary lines are considered as trapezoids.

Design Procedure for computation of area using excel spread sheet

The reduced level at various intervals is noted and reference RL for cutting or filling is to be fixed in order to determine the offsets at all the intervals. Using these offsets, the area is computed using trapezoidal or Simpson's rule. Let O_1, O_2, \dots, O_n be the offsets in meters and d be the interval in meter.

Trapezoidal Rule

$$A = d \left[\left(\frac{O_1 + O_n}{2} \right) + O_2 + O_3 + O_4 + \dots + O_{n-1} \right]$$

Simpson’s Rule:

This rule is applicable only when the number of divisions is even or the number of ordinates is odd sometimes one or both end ordinates may be zero.

$$A = \frac{d}{3} [O_1 + O_n + 4(O_2 + O_4 + \dots + O_{n-2}) + 2(O_3 + O_5 + \dots + O_{n-1})]$$

When there are even numbers of ordinates, the Simpson’s rule is applied for odd number of ordinates and the calculated area is represented as A₁ then the trapezoidal rule is applied for first and last ordinates to calculate the area A₂. Add A₁ and A₂ to compute the total area A.

2. Computation of Volume

The computation of volumes of various quantities from the measurements done in the field is required in the design and planning on many engineering works. The volume of earth work is required for suitable alignment of road works, canal and sewer lines, soil and water conservation works, farm pond and percolation pond consent.

There are two important rules available for the computation of volume and they are

- a. Trapezoidal Rule
- b. Prismoidal Rule

Design Procedure for computation of volume using excel spread sheet

The areas at various intervals are given. Using these areas, the volume (V) is computed using trapezoidal or Prismoidal rule. Let A₁, A₂, A₃ ----- A_n be the areas in Sq. meters and h be the interval in meter.

Trapezoidal Rule

$$V = h \left[\left(\frac{A_1 + A_n}{2} \right) + A_2 + A_3 + A_4 + \dots + A_{n-1} \right]$$

Prismoidal Rule:

This rule is applicable only when the number of divisions is even or the number of areas is odd.

$$V = \frac{h}{3} [A_1 + A_n + 4(A_2 + A_4 + \dots + A_{n-2}) + 2(A_3 + A_5 + \dots + A_{n-1})]$$

When there are even numbers of areas, the Prismoidal rule is applied for odd number of areas and the calculated volume is represented as V_1 then the trapezoidal rule is applied for first and last areas to calculate the volume V_2 . Add V_1 and V_2 to compute total volume V .

DESIGN OF HORIZONTAL CURVE BY OFFSET METHOD

Design Procedure for horizontal curve by offset method using excel spread sheet

The program for design of horizontal curve by offset method is developed using excel spread sheet by considering the two controlling parameter radius of curve (R) and Deflection angle (Δ)

Controlling Parameter

Radius of Curve (R) = _____ m

Deflection angle (Δ) = _____ degrees

Output Parameter

Deflection angle (Δ_r) in radians

$$\Delta_r = \frac{\pi \Delta}{180}$$

Tangent Length (T)

$$T = R \tan \frac{\Delta_r}{2}$$

Length of Long Cord (L)

$$L = 2R \sin \frac{\Delta_r}{2}$$

Curve Length (l)

$$l = \frac{\pi R \Delta}{180} \quad \text{OR} \quad l = R \Delta_r$$

Mid Ordinate (O_o)

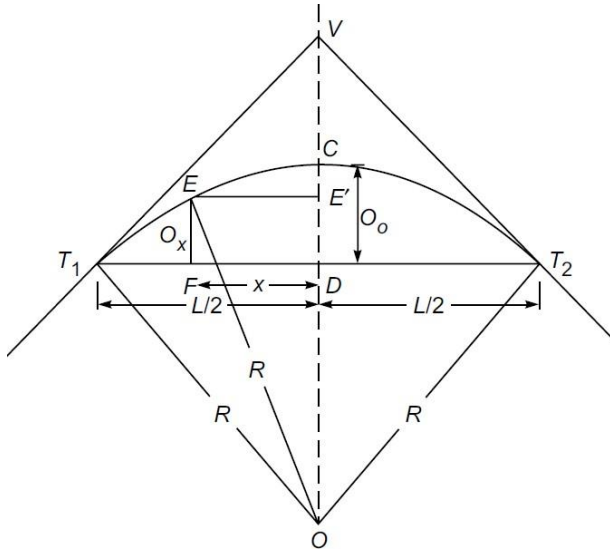
$$O_o = R \left(1 - \cos \frac{\Delta_r}{2}\right)$$

Methods used for horizontal curve setting by offset method

a) Offsets from long chord

b) Offsets from the tangents

a) Offsets from long chord



Mid Ordinate (O_o)

$$O_o = R \left(1 - \cos \frac{\Delta_r}{2} \right)$$

Offset (O_x)

$$O_x = \sqrt{R^2 - x^2} - (R - O_o)$$

Interval x

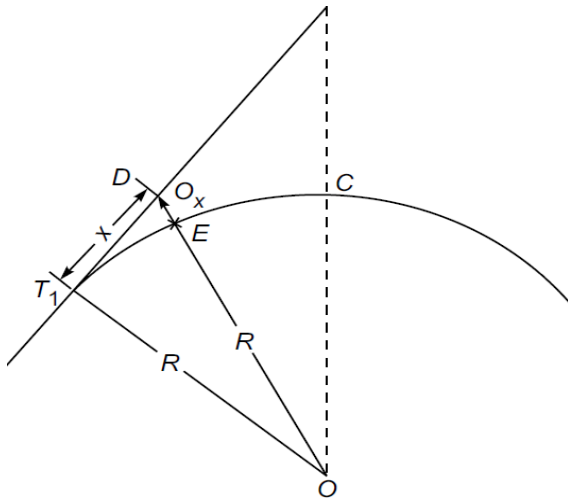
x is the distance from center of the curve

b) Offsets from Tangent

- i) Radial Offset
- ii) Perpendicular Offset

i) Radial Offset

If the centre of curve O is accessible from the points on tangent, this method of curve setting is possible.



Offset (O_x)

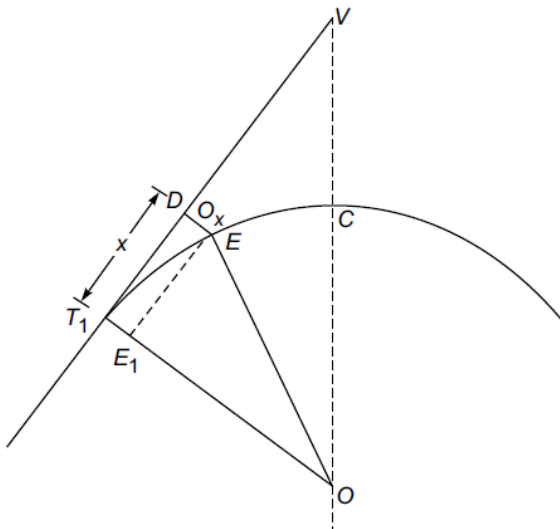
$$O_x = \sqrt{R^2 + x^2} - R$$

Interval x

x is the distance from center of the curve

ii) Perpendicular Offset

If the centre of a circle is not visible, perpendicular offsets from tangent can be set to locate the points on the curve.



Offset (O_x)

$$O_x = R - \sqrt{R^2 - x^2}$$

Interval x

x is the distance from center of the curve

Results: The curve is plotted in excel spread sheet using the charts for all these cases

DESIGN OF SUPERELEVATION

Definition of Superelevation

When a vehicle travels in a circular path or curved path, it is subjected to an outward force which makes a vehicle to overturn and skid due to Centrifugal force. To overcome this force and for safe travel of a vehicle, **the outer edge of the road is raised above the inner edge. This is known as superelevation or banking of road.**

Theory on superelevation

While designing the various elements of the road like superelevation, we design it for a particular vehicle called design vehicle which has some standard weight and dimensions. But in the actual case, the road has to cater for mixed traffic. Different vehicles with different dimensions and varying speeds ply on the road. For example, in the case of a heavily loaded truck with high centre of gravity and low speed, superelevation should be less, otherwise chances of toppling are more. Taking into practical considerations of all such situations, IRC has given some guidelines about the maximum and minimum superelevation etc. These are all discussed in detail in the following sections.

Design of Superelevation

For fast moving vehicles, providing higher superelevation without considering coefficient of friction is safe, i.e. centrifugal force is fully counteracted by the weight of the vehicle or superelevation. For slow moving vehicles, providing lower superelevation considering coefficient of friction is safe, i.e. centrifugal force is counteracted by superelevation and coefficient of friction. IRC suggests following design procedure:

Design Procedure using Excel Spread Sheet

The program for design of superelevation (e) is developed using excel spread sheet by considering the two controlling parameter radius of curve and design speed.

Control Parameter and Input Parameter required

Radius of Curve (R) in _____ m

Design Speed (V) in _____ KMPH

Output parameter is considered to check whether the design speed is safe or not

Converting the design speed V from **KMPH to m/s. {Radius is in m}**

$$\text{Design Speed (v)} = \frac{V}{3.6} \text{ m/s}$$

Check for Superelevation, by taking 75% of the design speed and lateral friction (f) = 0 using the expression.

$$e + f = \frac{V^2}{gR} \quad \text{Where g is the}$$

If $e \leq 0.07$, the design speed is safe problem ends and in case $e > 0.07$, the check should be done for lateral friction.

{For this IF Statement should written in excel spread sheet to known whether to end or continue the problem}

Check for Lateral Friction, by taking $e = 0.07$ of the design speed and full design speed using the expression.

$$e + f = \frac{V^2}{gR}$$

If $f \leq 0.15$, the design speed is safe problem ends and in case $e > 0.15$, the design speed should be reduced.

{For this IF Statement should written in excel spread sheet to known whether to end or continue the problem}

Reduced Design Speed (v_r) in m/s

$$v_r = \sqrt{(e + f)gR}$$

Reduced Design Speed (V_r) in KMPH

$$V_r = 3.6 * v_r$$

Once the design program is written, the program can be operated by changing the design speed (V) and Radius of Curve (R).