VISVESVARAYA TECHNOLOGINAL UNIVERSITY

BELAGAVI

A report on

"COMPUTER AIDED DETAILING OF STRUCTURES"
(17CVL77)
Submitted by

Name :

USN :

DEPARTMENT OF CIVIL ENGINEERING
B.G.S INSTITUTE OF TECHNOLOGY
B.G.NAGAR-571448
2020-2021

B G S INSTITUTE OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING

INSTITUTE VISION AND MISSION

Vision
- BGSIT is committed to the cause of creating tomorrow's engineers by providing quality education 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 VISION AND MISSION

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 EDUCATIONAL OBJECTIVES
1. Graduates will be pursuing successful career & higher education.
2. Graduates will be able to design safe, economical & sustainable civil engineering structures conforming to standard
3. Graduates will display professional ethics to work in a team & lead the team by effectively communicating the ideas.
4. Graduates will practice lifelong learning.

PROGRAM OUTCOMES [PO's]

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, 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 t h e 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 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 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.

PROGRAMME SPECIFIC OUTCOMES

1. Graduates will be able to analyse, design and execute the civil Engineering structures
Effectively for the sustainable development.
2. Graduates will acquire critical thinking abilities and technical skills for the usage of modern tools in development of Civil Engineering structures.
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.

Course Title: COMPUTER AIDED DETAILING OF STRUCTURES				
As per Choice Based Credit System (CBCS) scheme]				
SEMESTER:VII				
Subject Code	17CVL77		**IA Marks**	40
Number of Lecture Hours/Week	03 (1I+2D)		**Exam Marks**	60
Total Number of Lecture Hours	40		**Exam Hours**	03
	CREDITS –02		**Total Marks- 100**	

Course objectives: This course will enable students to

- Be aware of the Scale Factors, Sections of drawings,
- Draft the detailing of RC and Steel Structural member.

RBT LEVEL   L1,L2,L3

Module -1 Detailing of RCC Structures

- Beams – Simply supported, Cantilever and Continuous.
- Slab – One way, Two way and One-way continuous.
- Staircase – Doglegged
- Cantilever Retaining wall
- Counter Fort Retaining wall
- Circular Water Tank, Rectangular Water Tank.

Module -2 Detailing of Steel Structures

1. Connections – Beam to beam, Beam to Column by Bolted and Welded Connections.
2. Built-up Columns with lacings and battens
3. Column bases and Gusseted bases with bolted and welded connections.
4. Roof Truss – Welded and Bolted
5. Beams with Bolted and Welded
6. Gantry Girder

Course outcomes: After studying this course, students will be able to:

4. Prepare detailed working drawings

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

1. Two questions shall be asked from each Module.
2. One full question should be answered from each Module.
3. Each question carries 40 marks.

Text Books:

1. N Krishna Raju, "Structural Design and Drawing of Reinforced Concrete and Steel", University Press
2. Krishna Murthy, "Structural Design and Drawing – Concrete Structures"¸ CBS Publishers, New Delhi

Reference Books:

1. SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards
2. IS 13920:2016,Ductile Design And Detailing Of Reinforced Concrete Structures Subjected To Seismic Forces - Code Of Practice, Bureau of Indian Standard

Rubrics of Internal Assessment: (Total 40 Marks)

Sl.No.	Description	Marks
1	<u>Continuous Evaluation (30)</u> a. Observation Write-up and Punctuality (Drawing Rough sketch for given details) b. Conduction of Experiment and output (Creating drawing using AUTOCAD) c. Viva Voce d. Record Write-up	05 10 05 10
2	Internal Test (10)	10
	Total	40

Course Outcomes

After Studying this course, students will be able to

1. Drawing and detailing of different RCC structural elements as per relevant code provisions.
2. Drawing and detailing of different Steel structural elements as per relevant code Provisions
3. Prepare Bar bending schedule for different RCC Structural elements
4. Calculate Steel quantity for different Steel Structural elements.

BGS INSTITUTE OF TECHNOLOGY, B G NAGAR
DEPARTMENT OF CIVIL   ENGINEERING

COURSE OUTCOMES, PSO AND CO-PO-PSO MAPPING

Staff Name: Shankar Lingegowda G K   **Sem : VII Semester.**

COURSE CODE: 17CVL77
SUB NAME   : Computer Aided Detailing of Structures

Course Outcomes (CO's)

CO1	Drawing and detailing of different RCC structural elements as per relevant code provisions.
CO2	Drawing and detailing of different Steel structural elements as per relevant code Provisions
CO3	Prepare Bar bending schedule for different RCC Structural elements
CO4	Calculate Steel quantity for different Steel Structural elements.

Programe Specific Outcomes (PSO's)

PSO 1	Graduates will be able to analyze, 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.

CO-PO-PSO Mapping

CO/PO'S	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	P010	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	1	-	1	1	1	-	-	3	3	3
CO2	3	3	3	-	2	1	-	1	1	1	-	-	3	3	3
CO3	3	3	3	-	2	1	-	1	1	1	-	-	3	3	3
CO4	3	3	3	-	2	1	-	1	1	1	-	-	3	3	3

PROGRAM OUTCOMES [PO's]

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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C O N T E N T S

SL.NO.	DESCRIPTION	Page No.	MARKS OBTAINED				
			5	10	5	10	TOTAL
MODULE 1. DETAILING OF RCC STRUCTURES							
BEAMS							
1	Simply Supported Beam						
2	Cantilever Beam						
3	Continuous Beam						
SLABS							
4	One way Slab						
5	Two Way Slab						
6	One Way Continuious Slab						
STAIRCASE							
7	Dog Legged Staircase						
RETAINING WALL							
8	Cantilever Retaining Wall						
9	Counter Fort Retaining Wall						
WATER TANKS							
10	Circular Water tank with Flexiable Base						
11	Circular Water tank with Rigid Base						
12	Rectangular Water Tank						
MODULE 2. DETAILING STEEL STRUCTURES							
CONNECTIONS							
13	Beam to Beam Connection						
14	Beam to Column Connection						
BUILT-UP COLUMNS							
15	Built up Column with Lacings						
16	Built up Column with Battens						
COLUMN BASES							
17	Slab Base						
18	Gusseted Base						
ROOF TRUSS							
19	Roof Truss with only Gravity Loads						
20	Roof Truss with with Wind Loads.						
GIRDERS							
21	Plate Girder						
AVERAGE OF EXERCISE PROBLEMS FOR 30 MARKS							
TEST - 10 MARKS							
IA MARKS AWARDED FOR 40							

B.G.S INSTITUTE OF TECHNOLOGY

[Affiliated to VTU, Belgaum; Approved by AICTE, New Delhi and Recognized by Govt. of Karnataka]

BG Nagar, Nagamangala Taluk, Mandya – 571448
2020-21

DEPARTMENT OF CIVIL ENGINEERING

CERTIFICATE

This is to certify that Mr/Ms ………………………………………………………………………

USN ………..……………………………… a bonafide student of 7th Semester, Civil

Engineering and has satisfactorily completed the course of experiments in

COMPUTER AIDED DETAILING OF STRUCTURES (17CVL77) as

prescribed by the **VISVESRAYA TECHNOLOGICAL UNIVERSITY** Belagavi,

Karnataka during the academic year 2020-21.

40
IA Marks awarded

Signature of the Staff in Charge

Head of the Department

Name of the Examiners   Signature with Date

1. ………………………………..   ………………………………………..

2. ………………………………..   ………………………………………..

COMPUTER AIDED DETAILING OF STRUCTURES (17CVL77)
MODULE 1.
DETAILING OF RCC STRUCTURES

1. SIMPLY SUPPORTED BEAM

A simply supported beam of size 300 x 500 mm, clear span 5m supported on walls of 230mm.

Main reinforcement are 4#-16mm dia with 2 numbers are cranked at 1m from center of the support. Stirrups holders (anchor bars) are 2 numbers of 12mm dia.

Shear reinforcement are 2 legged 8mm dia stirrups at 250 mm c/c in the central 2m   span   and   2L-8mm stirrups at 150mm c/c in the remaining   portion.

Assume M20 concrete, Grade of steel Fe415, suitable cover.

Using AUTOCAD draw the following views
a. Longitudinal Section
b. Cross Section at Centre.
c. Cross Section at mid span.

2.   **CANTILEVER BEAM**

The cantilever beam of span 2m having width of 230mm and depth varies   from 400 mm at support and 150 mm at free end.

Main reinforcement consists of 4#- 16mm in the tension zone, in that 2#-16mm are curtailed at 1m.

Shear reinforcement are 2L#8mm vertical stirrups @ 150mm c/c near   Column and @   250 mm c/c for remaining portion.

Assume M20 concrete, Grade of steel Fe415, suitable cover.

Using AUTOCAD draw the following views
a. Longitudinal Section
b. Cross Section at Centre.
c. Cross Section at mid span.

3.   CONTINUOUS BEAM

A Rectangular beam of size 230 x 500   is continuous over number of columns spaced at 4.5 m c/c. The width of the support is 300mm.

Main Reinforcement

Mid span or +ve steel are 4#-20mm dia

Support or –ve steel are 4# 20mm dia

Shear Reinforcement

2L -8# Vertical Stirrups @ 150mm c/c near column for a distance of 1m from support and 300mm c/c in the remaining portion.

Using AUTOCAD draw the following views
a. Longitudinal Section
b. Cross Section at support section
c. Cross Section at edge Section

4. ONE WAY SLAB

A one way slab system has been provided for a hall of internal dimensions 3 m x 7 m. Supported on 230 mm wall thickness. Slab thickness is 150mm.

Main reinforcement consists of 10mm dia @ 150mm c/c.

Distribution steel consists of   8mm   dia   @ 300mm c/c.

Draw using AUTO CAD
a. Plan showing reinforcements particulars
b. Cross section along shorter span
c. Cross section along longer span.
d. Prepare Bar Bending Schedule.

5. __TWO WAY SLAB__

A rectangular slab is provided over a room of internal dimension of 4m x 5m and simply supported on 230 mm thick wall. Slab thickness is 150mm.

Reinforcements along short span- #10 @150mm c/c
Reinforcements along longer span- #10@250mm c/c

Draw using AUTO CAD

      a. Plan showing reinforcements particulars
      b. Cross section along shorter span
      c. Cross section along longer span.
      d. Prepare Bar Bending Schedule.

6. ONE WAY CONTINUOUS SLAB

A One Way Continuous slab has the following details

Thickness of slab = 150 mm

Centre to center to distance between the supports = 4m

Mid Span steel (+ve steel) consists of 10mm @ 270mm c/c

Support Steel (-ve) consists of 10mm @ 230 mm c/c

Distribution Steel consists of 8mm @ 270 c/c.

Assume effective = 20 mm and Fe 415 steel and M20 Concrete.

Draw using AUTO CAD
   a. Cross Section of the Beam.
   b. Plan showing the reinforcement.

7. DOG LEGGED STAIR CASE:

Dog legged stair case is to be detailed with the following particulars

a. Clear dimension of stair case = 4.48mX2.1m
b. The floor to floor height is 3.2m
c. Width of each thread = 250mm
d. Width of each rise = 160mm
e. Thickness of waist slab = 150mm
f. Width of flight = 1m
g. All round wall = 230mm
h. Both flight are supported at thee end of landing on 230mm wall (landing and flight span in the same direction)
i. The first flight start from plinth level
j. Main steel for each flight = #12mm @ 120mm center to center
k. Distribution steel for each flight = #8mm @ 200mm center to center
l. Use M20 concrete and Fe415 steel
   Draw using AutoCAD
   a. Plan of staircase
   b. Sectional elevation of the ground flight
   c. Sectional elevation of the 1st flight

8. CANTILEVER RETAINING WALL

A cantilever type retaining wall as following details.

a. The height of stem above GL is 5.7 m and the embankment is horizontal at its top.
b. The depth of foundation = 1.25m.
c. Stem dimensions are:
   - Top width = 200 mm.
   - Bottom width = 400 mm.
   - Reinforcement consists of 16mm dia @ 65mm c/c upto 1.9m and above 1.9m upto 3.8m 16mm dia @ 130mm c/c.
d. The base slab is 3.75m, toe projection is 1.25m and heel projection is 2.12m and depth of base slab is 710mm.
e. The toe slab reinforcement consists of 12mm dia @ 160mm and distribution steel is 10mm dia @ 110mm c/c.
f. The distribution steel of stem is 10mm dia @ 110mm c/c.
g. The heel slab reinforcement consist of 12mm @ 130mm c/c and distribution steel is 10m @ 90mm c/c.
h. Assume M20 grade of concrete and Fe415 steel.
i. Assume any data required suitably

Draw the following using AUTOCAD

a. C/S of retaining wall showing all the reinforcement.
b. L/S elevation of retaining wall showing reinforcement in stem.
c. Bottom flange showing the reinforcement in toe and heel.

9. COUNTER FORT RETAINING WALL

The details of Counterfort retaining wall is as below

a. The height of the stem is = 6.46m.
b. Spacing of counterfort = 3m c/c.
c. The embankment is horizontal t its top.
d. The stem dimension are
   Top width = 350mm.
   Bottom width = 350mm.
e. Reinforcement consisting of main steel #12mm @ 290mm c/c,
   distribution steel #10mm @ 200mm c/c.
f. The base slab width = 4.9m.
   Toe projection = 1.25m.
   Heel projection = 3.3m.
   Depth of base slab = 540mm.
g. The toe slab reinforcement consist of main steel 12mm @ 130mm c/c,
   distribution reinforcement of 10mm @ 150mm c/c.
h. Heel reinforcement consist of 12mm @ 220mm c/c, distribution steel
   10mm dia @ 150mm c/c.
   Assume M20 grade of concrete. HYSD bars
   Assume any data required suitably

   Draw using AUTOCAD

   a.   Cross section between the counterforts.
   b.   Cross section through the counterfort.
   c.   Cross section plan.

10. CIRCULAR WATER TANK WITH FLEXIBLE BASE

The circular water tank with flexible base has following details

1. Depth of water tank is = 4m.
2. Diameter of water tank is 11.3m.
3. Assume free board of = 200mm.
4. Thickness of wall = 170mm.
5. Effective cover = 30mm.
6. Hoop steel reinforcement from bottom 1m height is #16mm @ 130mm c/c.
7. Hoop steel reinforcement from bottom next 1m height is #16mm @ 180mm c/c.
8. Hoop steel for next 1m height from bottom is 16mm @ 270mm c/c.
9. Hoop steel for remaining height (1m) is 12mm dia @ 230mm c/c.
10. Base slab thickness = 150mm.
11. Reinforcement for base slab is 10mm dia @ 170mm c/c in the form of mesh.
12. Use M20 concrete Fe415 steel.

Assume any missing data suitably

Draw the following using AUTOCAD

  i.   C/S of the tank.
 ii.   Half plan through wall.
iii.   Half plan through base slab.

11. CIRCULAR WATER TANK WITH RIGID BASE

Circular water tank has following details

1. Internal diameter = 10m.
2. Height = 4m.
3. Thickness of wall = 170m.
4. Assume free board of = 250mm.
5. Effective cover is = 30mm.
6. Hoop steel of 12mm @ 140mm c/c upto a depth = 0.6H = 2.4m from top.
7. Bending or cantilever steel of 10mm dia @ 160mm c/c upto a height of 0.4H = 1.6m from bottom.
8. Distribution steel of #8mm dia @ 100mm c/c.
9. Haunch steel = (150 x 180) mm with 8mm dia bar @ 200mm c/c.
10. Base slab thickness = 150mm.
11. Reinforcement for base slab = #10mm 2@ 150mm c/c.

Draw the following view using AUTOCAD

i. C/S of the water tank.
ii. Draw half plan through wall.
iii. Half plan through base slab.

12. RECTANGULAR WATER TANK

The details of rectangular water tank are as follows

a. The dimensions of the water tank are 6 x 4 x 3.5m assume the free board is 0.17m.
b. The thickness of the wall is = 220mm.
c. The effective cover is = 50mm.
d. The horizontal steel for long wall is #16mm @ 80mm c/c.
e. The horizontal steel for short wall is #16mm @ 190mm c/c.
f. The vertical steel for short wal is #12mm @ 140mm c/c.
g. The corner steel consists of #16mm @ 200mm c/c, the base wall thickness 150mm.
h. The reinforcement for #10mm @ 150mm c/c @ top and bottom of the slab.

Assume suitably any data required.

Using AUTOCAD, draw the following

i. Sectional plan through wall.
ii. Longitudinal sectional elevation through long wall.
iii. Longitudinal sectional elevation through short wall.

MODULE 2

DETAILING STEEL STRUCTURES

13. BEAM TO BEAM CONNECTION

The secondary beam ISMB 300 @ 461 N/m is to be joined to the main beam ISMB 400 @ 616 N/m. Two angles ISA 90*90*6 mm are used for connection .Three bolts of the diameter 20 mm are used to connect angles to the web of the ISMB 400.The flanges of the both beam are at the same level.

Draw using AUTOCAD

       1. Sectional elevation

       2. Side view showing all details.

14. BEAM TO COLUMN CONNECTION

A beam ISMB 400 @ 61.6 Kg/m. Using framed bolted connection. Size of cleat angle is ISA 150*115*12 mm.

 # 6-20 mm bolts in 2 rows is used to connect angle and beam.

#3- 20mm bolts for each angle to connect angle and column flange.

Use pitch= 60 mm, Edge distance = 35 mm

Draw using AutoCAD.

a) Front view

b) Side view

15. BUILT UP COLUMN WITH LACING

A built up column is composed of two ISLC 350 placed back to back at clear distance of 220mm.The column is provided with single lacing system consisting of 60mm*12mm flat at 45` and is connected by one 20mm diameter bolt at each end.

Using AUTOCAD draw the following showing all details

1. Elevation

2. Plan

16. BUILT UP COLUMN WITH BATTENS

A battened column consists of 2 ISMC 250 placed back to back @ 160mm. Draw using AUTOCAD the elevation and plan for the following details:

Size of the end batten 300*6 mm

Size of the intermediate batten 230*6 mm

Spacing of the batten 900 mm

Using 6 mm fillet weld for the connection in horizontal direction.

17. SLAB BASE

The details of slab base is as follows

ISHB 400 @ 77.4 Kg/cm^2 supported on slab base

Size of the slab base 900*500*30 mm

Size of the concrete base 1.5*1.5*1.0 m

Size of the cleat angle ISA 150*115*10 mm

Use 4# 24 dia bolts between angle and column flange

Provide 4 # 20 dia anchor bolts.

Using AUTOCAD draw the following

1. Plan
2. Elevation
3. Side View

18. GUSSETED BASE

A gusseted base is to be detailed for a column ISHB 450 @ 855N/m built up with one cover plate of size 300*12 mm at each flange. Size of base plate is 0.6m*1.0m*20mm.The gusset angles are 150*150*12mm. The gusset plates are 10 mm thick. Provide 16 numbers of bolts in 4 rows along each face of the column to connect flange of column, gusset plate and gusset angle. Provide nominal bolts to connect sides of the gusset plate and gusset angle.

Draw using AUTOCAD the following views.

1. Sectional elevation.

2. Side view.

19. ROOF TRUSS WITH ONLY GRAVITY LOADS ONLY

The center line diagram of the steel truss is shown in figure. The magnitude and nature of the force in different members of the truss are given in table. The size of the RC column supporting on truss is 300*300 mm. use M20 concrete for column Design the truss using bolted or welded connections. Also design anchor bolts for an uplift force of 15 KN @ each support

Draw the following using AutoCAD

1. Elevation of truss greater than half span
2. Enlarged view of apex joint of the truss
3. Enlarged view of the left support joint

20. ROOF TRUSS WITH WIND LOAD

Force in a member as dead load and live load and also wind load is given below. Take tension as positive and compression as negative. Design the truss and support given upward reaction at support is equal to 180 KN, uplift pressure as 50KN. Use M16 bolts for connections.

Using AUTOCAD draw the following

1. Half elevation of the truss
2. Enlarged view of apex joint of the truss
3. Enlarged view of end joint and intermediate joint

21. WELDED PLATE GIRDER

Design of welded plate girder for an effective span of 18 m to support a UDL of 60 KN/m in addition to a Pair of point load of magnitude 600 KN each @ 1/3 span.

Design the central section (Mid span) bearing stiffeners, intermediate stiffeners, their connections, curtailment of flange plate.

Draw the following using AUTOCAD sketches of

1. Half longitudinal section

2. C/S at center and support

3. Sectional plan support bearing stiffeners to an enlarged scale