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Planning , Analyzing and Designing of Shopping Complex By Using STAAD Pro

T.Subramani[1], R. Sathiyaraj[2], K.Ravikumar[3], M.Manivannan[4], R.Gopalsamy[5]

[1]Professor & Dean, Department of Civil Engineering, VMKV Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, India

[2] Assistant Professor, Department of Civil Engineering, VMKV Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, India

[3,4,5]UG Student, , Department of Civil Engineering, VMKV Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, India

ABSTRACT

Planning analysis and designing of Shopping mall With Car Parking Building is our study which is propose at Salem dt. The Shopping mall consists of a Underground Floor Parking ,Power saving room ,Fire and safety , Security room .In Ground Floor Ladies toilet ,Gents toilet ,ATM , Bonquet Hall, Reception , Foot wear shop .In First Floor Market ,Beauty parlour, Home appliances ,Checking room ,Book shop. Drafting method for design the plan is by Auto cad .The framed type of construction is used for the construction and the designing of structure is carried out by limit state method with the IS 456: 2000 code book. The plan and structural elements such as slab, beam, column and footings are designed using limit state method in STAAD Pro and the reinforced details has been designed using the above software. This project helps us in exploring knowledge about planning, analyzing and designing a Shopping Mall Building.

Keywords: Planning, Analysis, Designing and Shopping Mall

1. INTRODUCTION

A shopping mall is, a form of grocery store, is a self-service store offering a wide variety of food and household merchandise, organized into departments. It is larger in size and has a wider selection than a traditional grocery store, also selling items typically found in a convenience store, but is smaller and more limited in the range of merchandise than a hypermarket or big-box store. The shopping complex typically comprises meat, fresh produce dairy, and baked goods departments, along with shelf space reserved for canned and packaged goods as well as for various non-food items such as household cleaners, pharmacy products and pet supplies. Most shopping mall also sell a variety of other household products that are consumed regularly, clothes, and some stores sell a much wider range of non-food products.

2. MANUAL DESIGN

2.1 Design of Simply Supported Two Way Slab

f_{ck} = 25 N/mm^2
f_y = 415 N/mm^2
Room size = 12.8 x 10 m
Support = 300 mm
Thickness of slab = 200mm

2.1.1 Load Calculation

Consider 1m width of slab

Live load = 4 KN/m^2
Self weight of slab = 1 x b x D x unit weight
= 1 x 1 x 0.2 x 25
= 5 KN/m^2
Weight of floor finish = 1x 1 x 0.05 x 20
= 1.0 KN/m^2

Total load = 10 KN/m
Design load = 6.75 x 1.5
= 15 KN/m

2.1.2 Main Reinforcement

2.1.2.1 For Shorter Span (Maximum Moment In Shorter Span)

M_x = 0.87 f_yA_{st} d (1- f_yA_{st} / f_{ck}bd)
69.95 x 10^6 = 0.87 x 415 x A_{st} x 180(1- 415 x A_{st} / 25 x 1000 x 180)
A_{st}min = 1211.74 mm^2

2.1.3 Spacing

Assume 20 mm dia bars
S = a_{st}/A_{st} x b = 314.15 /1211.74 x 1000
= 259.25 mm say 250 mm
3d = 3 x 180= 540 mm
300 mm c/c
Provide 20 mm dia bars @ spacing 150 mm c/c distance.

2.1.4 Check for Deflection

Assume 12 mm dia
Ast_{pro} = (a_{st}/ s) x b = (113.09/300) x 1000
= 376.96 mm^2
% of steel = $100A_{st}$/ bd
= 100 x 376.96 / 1000 x 180
= 2.09%
Fs = 0.58 x f_yA_{streq}/A_{stpro}
= 0.58 x 415 x 1211.74/ 376.96
= 773.73
M.F =1.50
d_{avi} = span/(B_V x MF)
=10180 / 32 x 1.50= 197.5 mm
d_{req}< d_{pro}
Hence Design is Safe.
Figure 1 shows the reinforcement detailing of slab.

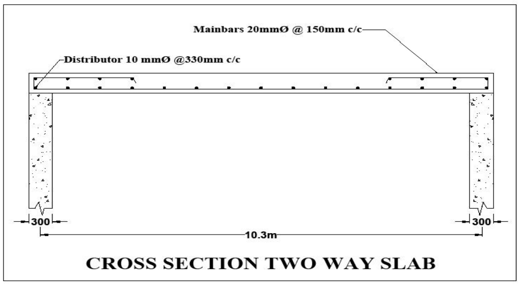


Figure 1 Reinforcement detailing of slab

2.2 Design of Simply Supported Beam

2.2.1 Available Data

Center to center distance l_{eff} = 12.3 m
B = 300 mm,
d = 560 mm
D = 600 mm (assumption)
F_y = 415 N/mm^2
f_{ck} = 25 N/mm^2

Q =3.45
$\%A_{st}$ =1.197%

2.2.2 Load Calculation

Self weight of beam = b x D x unit Weight
= 0.3 x 0.6 x 25 = 4.5 KN/m
Slab floor finish = perpendicular distance x tk x unit Weight
= 4.8x 0.05 x 20 = 6 KN/m
Slab self Weight = 4.8x 0.15 x 25 = 18 KN/m
Wall load = 0.3x 3.5 x 19 = 19.95 KN/m
Total load = 48.45 KN/M
Factored load = 45.6 x 1.5 F_d= 72.67 KN/m

2.2.3 Reinforcement

Ast_1 = M_{ulim}/(0.87 x fy x (d-0.42 $X_{uMaximum}$))
= 324.57 x 10^6/ (0.87 x 415 x (600-0.42 x 0.48 x 600)
Ast_1 = 1876.60 mm^2
Ast_1 =M_{UA}/(0.87 X fy x (d-d’))
= 62.31 x 10^6/(0.87 x415 x (600-40))
Ast_2 = 308.17 mm^2
Total Ast =Ast_1+Ast_2
Ast = 2184.77 mm^2
Provide 20 mm dia bars
ast = 314.16 mm^2
NOS =Ast/ast=2184.77 / 314.16 =7 nos
Ast = 7 x π x 20^2/4=2199.11 mm^2
Provide 7nos of 20mm dia bars as tension reinforcement

2.2.4 Check for Stiffness

%Ast = 100Ast/bd = 100 x 2199.11/(30 x 600)
% Ast = 1.22
Fs = 0.58Fy (Ast_{req}/Ast_{pro})
= 0.58x415x (2184.77 /2199.11)
= 240 Curve MF = 0.8
d_{avi} = span/(B_V x MF)
d = 12300 /32x0.8 = 480 mm
Hence design is safe.
Figure 2 shows the Reinforcement details of the beam.

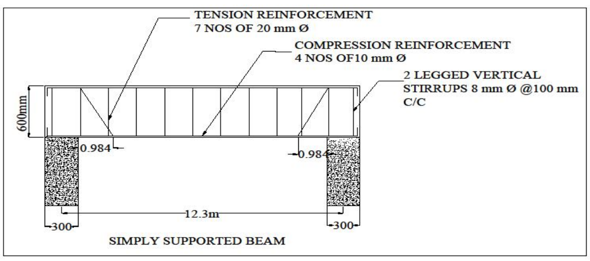


Figure 3 Reinforcement details of beam

2.3 Design of Square Column

2.3.1 Available Data

Size of column = 500 x 500 mm
f_{ck} = 25 N/mm^2
f_y = 415 N/mm^2

2.3.2 Load Calculation

2.3.2.1 Slab

Weight of slab (1) = L x B x D x unit Weight
= 6 x 4.65 x 0.2 x 25 = 139.5 KN
Weight of slab (2) = L x B x D x unit Weight
= 6 x 4.7 x 0.2 x 25 = 141 KN
Weight of slab ff (1) = L x B x D x unit Weight
= 6 x 4.65 x 0.05 x 20 = 27.9KN
Weight of slab ff (2) = L x B x D x unit Weight
= 6 x 4.7 x 0.05 x 20 = 28.2 KN
Live load (1) = 6 x 4.65 x 4 =111.6 KN
Live load (2) = 6 x 4.7 x 4 =112.8KN

2.3.2.2 Beam

Beam (1) = L x B x D x unit Weight
= 6 x 0.3 x 0.6 x 25 = 27 KN
Beam (2) = 4.7 x 0.3 x 0.6 x 25 = 24.15 KN
Beam (3) = 4.65 x 0.3 x 0.60 x 25 = 20.92 KN

2.3.2.3 Wall

Wall load (1) = L x B x H x unit Weight
= 4.65 x 0.3x 3.5 x 19 = 93.7 KN
Wall load (2) = 4.7 x 0.3 x 3.5 x 19 = 92.7 KN

2.3.2.4 Column

Self weight of column = L x B x H x unit Weight
= 0.5 x 0.5 x 3.5 x 25 =21.87 KN
Sum of all above loads = 841.34 KN
No of floor consideration = 833.47 x2 = 1682.68 KN say 1670

2.4 Transverse Reinforcement

2.4.1 Minimum Diameter

1/4 x dia = 1/4 x 16 = 4mm
Not less than 6mm

2.4.2 Pitch

LLD = 500 mm
16 x 16 =260mm
300mm
Provide 6 mm dia laterals at 260mm c/c

2.4.3 Result

Size of column = 500x 500 mm
Longitudinal reinforcement = 6 nos of 16mm dia bars
Transverse reinforcement = 6mm dia at 260 mm c/c
Figure 4 shows the Reinforcement detail of R.C.C. square Column.

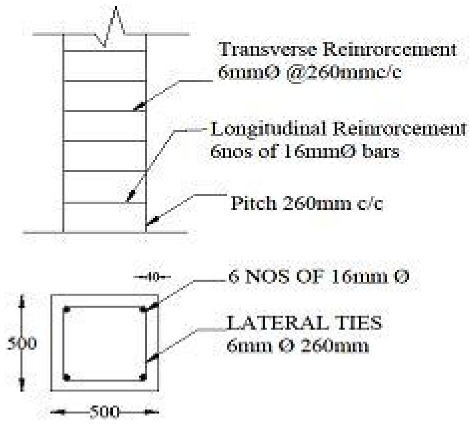


Figure 4 Reinforcement Detail of R.C.C. Square column

2.5 Design of Isolated Rectangular Footing

2.5.1 Available Data

Size of column = 500 x 500 mm
Safe bearing capacity = 150 KN/m^2
f_{ck} = 25 N/mm^2
f_y = 415 N/mm^2

2.5.2 Size of Footing

Axial load of footing = 150KN
Assume the self Weight of footing as10%of the column load
W1 = 10/100 x1670
= 167 KN
Total load on soil = 1670 + 167 = 1837KN
Area of footing required = total load /sbc
= 1837 /150
= 12.25m^2
Since it is a square column
B x L = 12.25m^2
B x (B) = 12.25m^2
B^2 =12.24
$= \sqrt{12.241}$ = 3.5
B = 3.5
L = 3.5m
Area of footing = 3.5 x 3.5 = 12.25 m^2

2.5.3 Check for Shear

2.5.3.1 Transverse Shear

V_u = fo x length x (3.25 -0.5)
= 224.94 x 3.5x 2.75
= 2165.05 KN
τ_v = V_u/bd = 2165.05 x 10^3/ 3500x 500
τ_v = 1.2 N/mm^2
$\%A_{st}$ =100A_{st}/bd =100 x 4704/ (3500x 500)
= 0.28 %
τ_c = 0.34N/mm^2
$K\tau_c$ = 1 x 0.34 = 0.34N/mm^2
$\tau_v > K\tau_c$ Not ,Safe in shear

2.5.4 Check for SBC of Soil

Column load = 1670 KN
Weight of footing = 3.5x 3.5 x 1.12 x 25=343 KN
Total load on soil =2013 KN
Pressure on soil = 2013/ (3.5x 3.5)=164.33 KN/m^2

164.33 KN/m^2< 200 KN/m^2

Hence safe.

Figure 5 shows the Reinforcement detailing of footing.

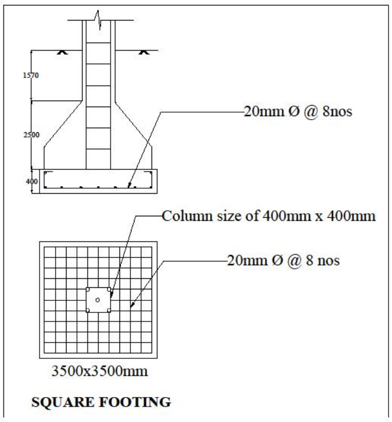


Figure 5 Reinforcement detailing of footing

2.6 Design of Staircase

Vertical height = 4 m = 4000 mm
Rise = 150 mm
Tread = 250 mm

2.6.1 Size of Staircase

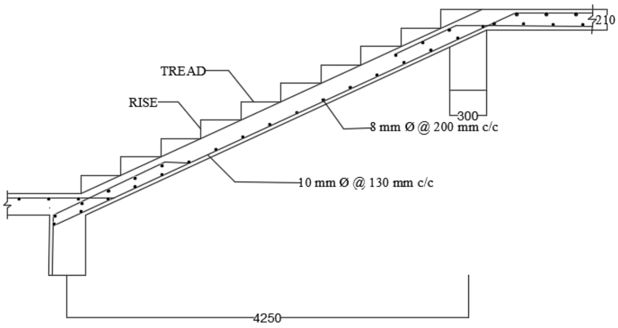
Number of rise = 4000/150 =26 nos
Number of flight = 2 nos
Rise per flight = 13 nos
Number of tread = 13-1 = 12 nos
Landing of going = 12 x 250 = 3000 mm
Weight of landing = (4000-3000)/2 = 500 mm

2.6.2 Load Calculation

Assume waist slab thickness = 150 mm

Self weight of waist slab = 1 x 0.15 x 0.25 x 25 = 3.75 KN/m
Plain area = W_s x $((R^2+T^2)/T^2)^{(1/2)}$
= 3.75 x $((0.15^2+0.25^2)/0.25^2)^{(1/2)}$
= 4.37 KN/m
Weight of step per m^2 = 0.5 x 0.15 x 0.25 x 25 = 0.46 KN/m
Load of step per meter length = 0.46 x 1000/2 = 1.84 KN/m
Assume floor finish = 0.8 KN/m
Live load = 4.5 KN/m

Figure 6 shows the Reinforcement detailing of stair case.



STAIRCASE

Figure 6 Reinforcement detailing of Stair case

3. STAAD REPORT

Figure 7 shows the whole structure.

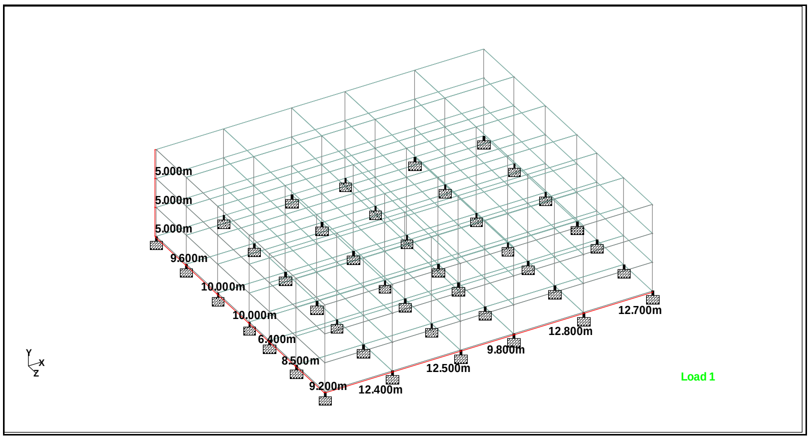


Figure 7 Whole Structure

Figure 8 shows the 3D Rendering view.

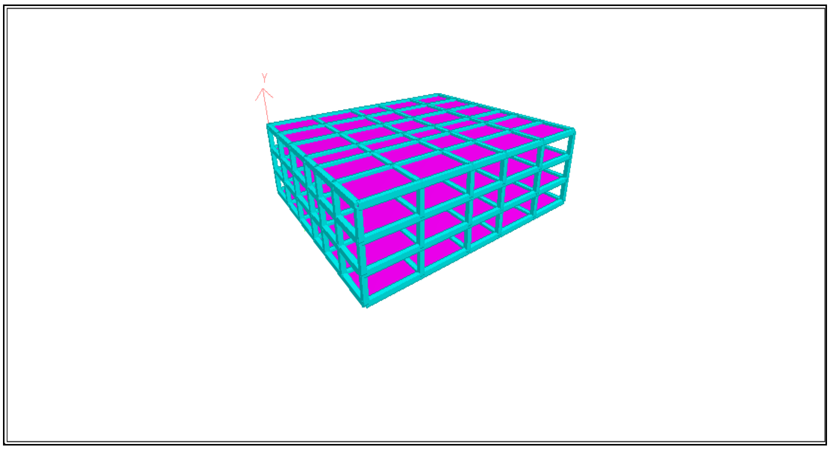


Figure 8 3D Rendered view

Figure 9 shows the plate in normal fill.

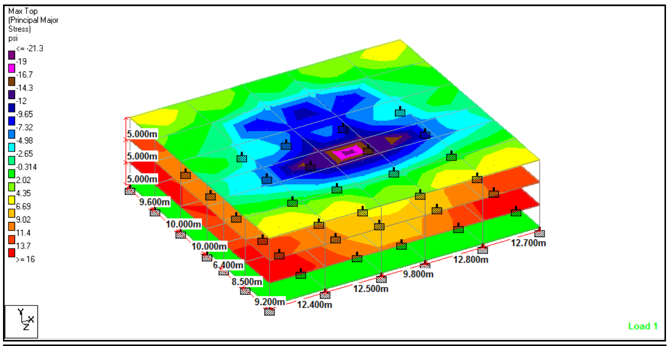


Figure 9 Plate in normal fill

Figure 10 shows the Plate in normal line.

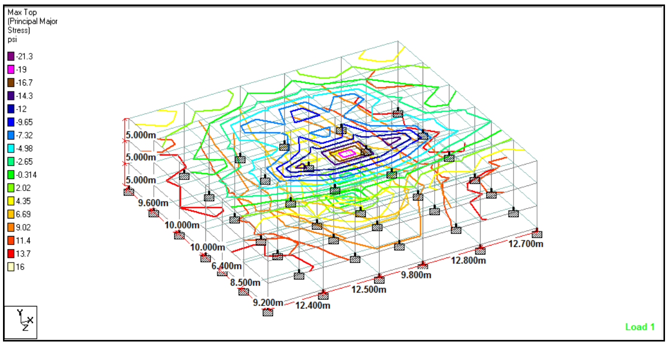


Figure 10 Plate in normal line

Figure 11 shows the concrete design diagram.

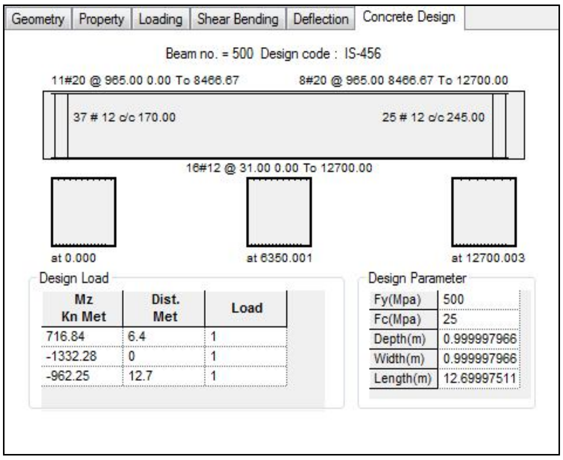


Figure 11 Concrete design diagram

Figure 12 shows the Concrete design in column.

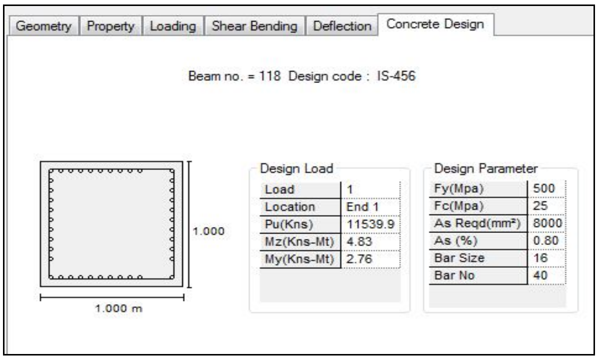


Figure 12 Concrete design in column

TOTAL VOLUME OF CONCRETE = 3599.5 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
10	279932
12	1057883
16	106462
20	118928
TOTAL =	1563205

Figure 13 shows the blue print of the building.

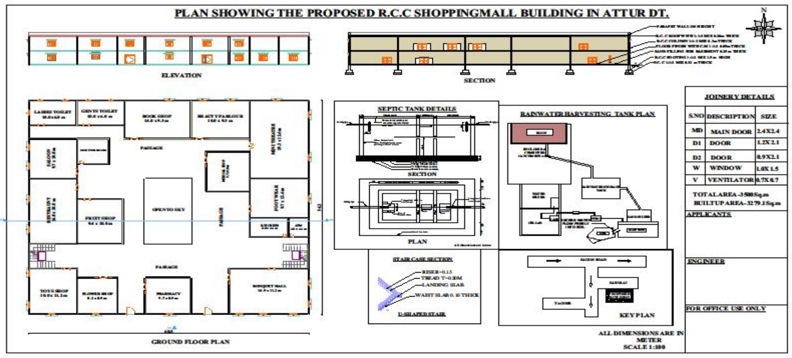


Figure 13 Blue Print

4. CONCLUSION

Our study concluded that application of software in Civil industry plays important role in our study. In our study Shopping Complex designed by adopting limit state method for analysis and design of structure. Time taken for doing this project is very less due to the application of the software. We bring extra accuracy in dimension and analysis part through our project. Our study concluded that application of software in Civil Engineering filed is quite good and comprehensive for further study of structural parameter.

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AUTHOR

Prof. Dr. T. Subramani Working as Professor and Dean of Civil Engineering in Vinayaka Missions Kirupananda Variyar Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, Tamilnadu, India. Having more than 28 years of Teaching experience in Various Engineering Colleges. He is serving as reviewer for many International Journals and also published 250 papers in International Journals. He has presented more than 100 papers in conferences, especially 70 in International and 30 National Level. He has authored 07 books. Guided more than 259 students in PG projects. Currently he is guiding 03 Ph.D., Research Scholars. He is serving as examiner and Valuer for B.E & M.E Degree Theory and Practical Examinations for Madras University, Periyar University, Anna University, Annamalai University and Vinayaka Missions Research Foundation [Deemed to be University]. He is Question paper setter and Valuer for UG and PG Courses of Civil Engineering in number of Universities. He is serving as Chairman of Board Of Studies (Civil Engineering), Vinayaka Missions Research Foundation [Deemed to be University], also a member of Board of studies in Periyar University. He is Life Fellow in Institution of Engineers (India) and Institution of Valuers. Life member in number of Technical Societies and Educational bodies like MISTE, MIGS, MIRC,ISRMTT, UWA, Salem District Small and Tiny Association (SADISSTIA), SPC – Salem Productivity Council. He has delivered much technical talk in various field. He is a Chartered Civil Engineer and Approved Valuer for many banks. He is a Licensed Building Surveyor in Salem City Municipal Corporation-Salem, and Licensed Civil Engineer in Salem Local Planning Authority- Salem. He is the recipient of many prestigious awards.

R. Sathiyaraj working as an Assistant Professor in VMKV Engg. College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, Tamilnadu, India . He has completed B.E., Civil Engineering in College of Engineering , Guindy and completed PG in Construction Management in National Institute of Construction Management and Research, Hyderabad. He's having more than 5 years of Teaching experience in Various Engineering Colleges and he guided many UG projects. He has attended more than 3 international conferences and submitted 2 international journals

K.Ravikumar completed his Diploma in the branch of Civil Engineering in Salem Polytechnic College, Salem, Tamil nadu, India and now he is perusing his B.E Degree in the branch of Civil Engineering at V.M.K.V. Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, Tamilnadu, India. Salem. He has well knowledge in AUTOCAD drawing. His hobbies are playing Basketball, Hockey and Cricket.

M.Manivannan completed his Diploma in the branch of Civil Engineering in Government Polytechnic College Krishnagiri, Tamilnadu, India and now he is perusing his B.E Degree in the branch of Civil Engineering at V.M.K.V. Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, Tamilnadu, India. Salem. He has well knowledge in AUTOCAD drawing. His hobbies are playing Basketball, Hockey and Cricket.

R.Gopalsamy completed his Diploma in the branch of Civil Engineering in Government Polytechnic College Krishnagiri, Tamilnadu, India and now he is perusing his B.E Degree in the branch of Civil Engineering at V.M.K.V. Engineering College, Vinayaka Missions Research Foundation (Deemed to be University), Salem, Tamilnadu, India. Salem. He has well knowledge in AUTOCAD drawing. His hobbies are playing Basketball, Hockey and Cricket