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PLANNING, ANALYSIS & DESIGN OF RESIDENTIAL BUILDING G+5 (USING SOFTWARE'S)

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Abstract : In civil engineering we planned bigger projects like dams, bridges, apartments, culverts etc. In our project is about planning, analysis & design of residential building in this we include site investigation and we are calculating the soil bearing capacity of the soil so we can design and plan for the residential apartment so we are considering software for planning and design for the residential building, auto cad is used for the layout plans, and staad pro is used for the structural design. The components we are considering for the g+5 apartment are layout plans, plinth beams, stair case, slabs, beams, columns, footings, column layout.

By investigating, also we plots structural members in AutoCAD software then by calculating load considerations we designed the structural design by placing loads in staad pro software the we made analysis for the whole structural members and we have taken basic samples of soil and comparing the design with manual and software.

***Index Terms* – AUTOCAD, STAAD PRO.**

I. INTRODUCTION

The planning, analysis of g+5 apartment we are using AutoCAD and staad pro software for planning and load consideration for the staad pro, so the basic floor plans we are drawn in AutoCAD the load diagrams and load considerations due to this the structural members are been analysis in the staad pro software. A G+5 apartment building has a study structure designed to support multiple floors. It may utilize materials such as concrete, steel, or a combination of both for stability and durability. For planning and analysis of design of residential building g+5(using software) identifying sites based on factors considering core cutter, soil compaction, liquid limit & plastic limit by these experiments the soil condition has been calculated.

II. AUTOCAD FILES

Fig 1.1 floor 1

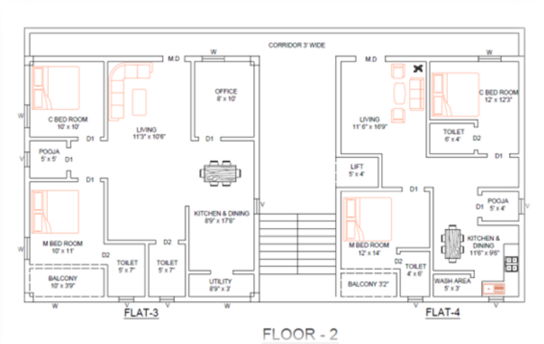

Fig 1.2 floor 2

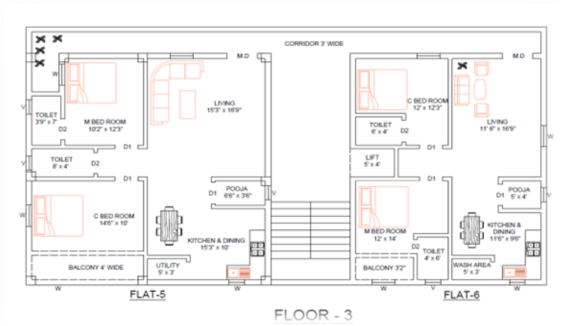

Fig 1.3 floor 3

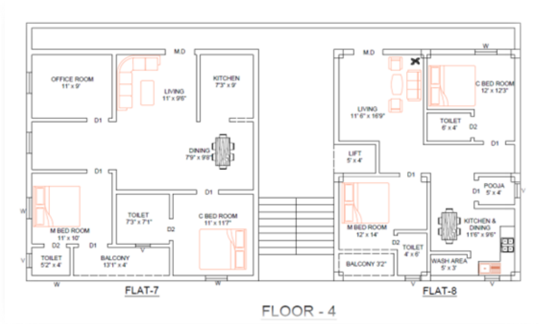

Fig 1.4 floor 4

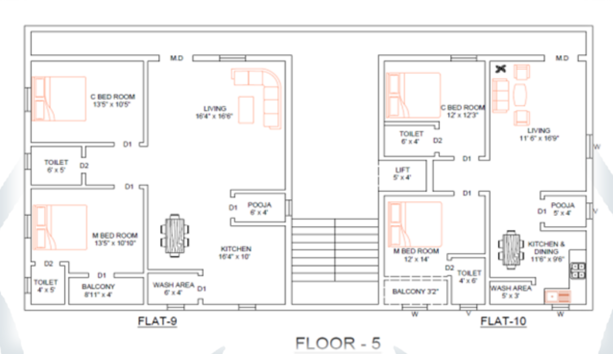

Fig 1.5 floor 5

FLAT 1 - 1116 sqft.
FLAT 2 - 936.9 sqft
FLAT 3 - 1116 sqft
FLAT 4 - 936.9 sqft
FLAT 5 - 1116 sqft
FLAT 6 - 936.9 sqft
FLAT 7 - 1116 sqft
FLAT 8 - 936.9 sqft
FLAT 9 - 1116 sqft
FLAT 10 - 936.9 sqft

2.1 STAAD PRO

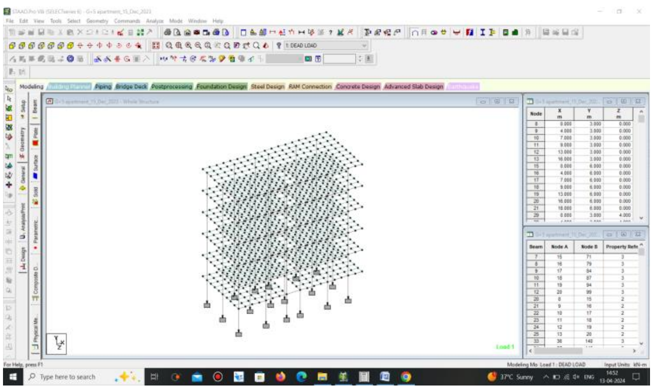

Fig 2.1

B E A M N O. 7 D E S I G N R E S U L T S:-
M25 Fe415 (Main) Fe415 (Sec.)
LENGTH: 1000.0 mm SIZE: 230.0 mm X 300.0 mm COVER: 25.0 mm
SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 250.0 mm 500.0 mm 750.0 mm 1000.0 mm

TOP 344.48 202.26 127.19 0.00 0.00
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)
BOTTOM 0.00 127.19 127.19 127.19 127.19
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION 0.0 mm 250.0 mm 500.0 mm 750.0 mm 1000.0 mm

TOP 5-10í 3-10í 2-10í 2-10í 2-10í
REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)
BOTTOM 2-10í 2-10í 2-10í 2-10í 2-10í
REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)
SHEAR 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í 2 legged 8í
REINF. @ 110 mm c/c @ 110 mm c/c @ 110 mm c/c @ 110 mm c/c @ 110 mm c/c
----
SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 495.0 mm AWAY FROM START SUPPORT
VY = 39.91 MX = 0.23 LD= 4
Provide 2 Legged 8í @ 110 mm c/c

LIVE LOAD = 5KN/M

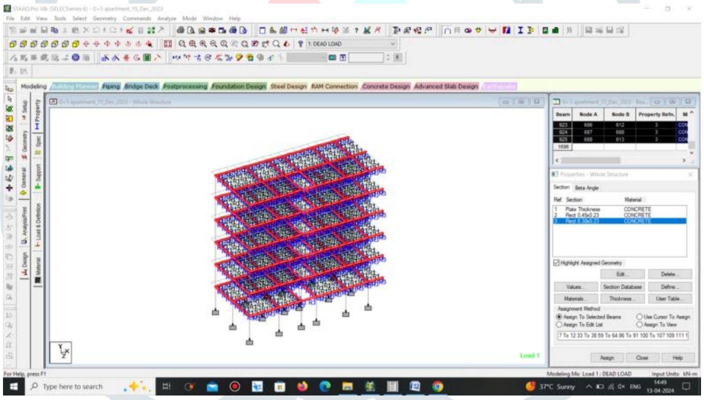

Fig 2.2

COLUMNS

C O L U M N N O. 24 D E S I G N R E S U L T S:-
M25 Fe415 (Main) Fe415 (Sec.)
LENGTH: 3000.0 mm CROSS SECTION: 230.0 mm X 450.0 mm COVER: 40.0 mm
** GUIDING LOAD CASE: 4 SHORT(Z) /BRACED LONG(Y)
C:\ REQD. STEEL AREA : 949.63 Sq.mm.
REQD. CONCRETE AREA: 102550.38 Sq.mm.
MAIN REINFORCEMENT: Provide 12 - 12 dia. (1.31%, 1357.17 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT: Provide 8 mm dia. rectangular ties @ 190 mm c/c
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1449.26 Muz1 : 69.08 Muy1 : 32.32
INTERACTION RATIO: 0.95 (as per Cl. 39.6, IS456:2000)
SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 4
Puz: 1571.53 Muz: 87.10 Muy: 39.22 IR: 0.7

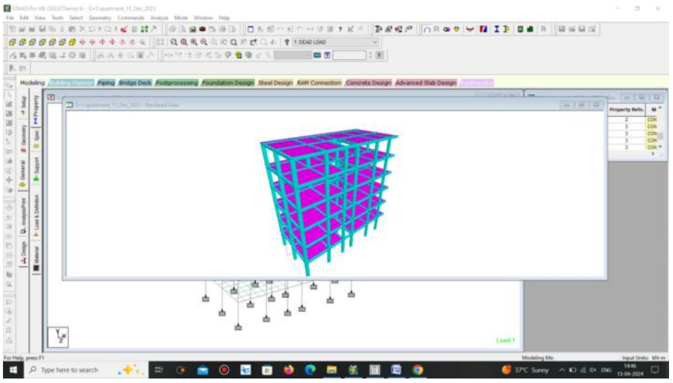

Fig 2.3

MANUAL DESIGN

OVERALL SLAB OF BUILDING

20.5 * 11.10
Imposed load = 5 kN/m².
Hoor Finish = 1 kN/m².
Fck = M25 N/mm².
fy = fe 415 N/ m m².
(ly)/(lx) = 11.10/20.5 = 0.5 < 2

Thickness of slab:
Assume eff depth of d = Span/ 40 = 20.5/40 = 512.5 ~ 520
d=520mm
D = 540 mm.

Effective span:
lx = 20.5+0.52 = 21.02.
ly = 11.10 + 0.52 = 11.62
(Iy)/(Ix) = 11.62/21.02 = 0.55 < 2

Loads:-
Self wt. of slab = 0.54x25 = 13.5 KN/m .
L.L = 5KN/m
F.F = $1KN/m^2$
= $1KN/m^2$
Factored load = 1.5*19.5 = $29.25KN/m^2$

Design moments & Shear Force:-
$\alpha x = 0.072$
$\alpha y = 0.06$
Mux = αx Wlx² = 0.078x29.25 * 21.02 = 49.75 kN.m
Muy = αy Wlx^2 =0.06*29.25*21.02=36.89kN.m
Vv = Wul / 2 = (29.25 * 21.02)/2 = 307.61 KN

Min depth required:
Mux = 0.138 fck bd^2
$47.95 * 10^3 = 0.138 * 25 * 1000d^2$
d = 372 < 520mm

Reinforcement: - 'x' - direction.
Mux = 0.87 fy Astd $[1-\frac{fy\ Ast}{fck\ bd}]$
$47.95 * 10^3 = 0.87*415 *Ast *520\ [1-\frac{415\ Ast}{25*1000*520}]$
Ast = $2554.0mm^2$
Using 24 mm dia of bars
Spacing S =($\pi/4 * 24^2/2554*1000$) =177 ~ 180mm .
Provide #10mm @ 180 c/c.

Along y' underline direction:
d = 520-20 =500mm
$36.89 * 10^3 = 0.87 * 415Ast * 500 = [1-\frac{fe\ 415\ Ast}{25*1000*500}]$
Ast = $2043.4mm^2$
Using 20 mm dia bars.
S = $(\pi/4)*20^2 /2043.4*1000$ = 153.74~163mm
Provide #10 mm φ@160c/c.

Edge Strip:
Ast = 0.12%

0.12/(100) 1000×540 = 648.
Using 16mm dia
S = (π/4)*16^2 /648*1000 = 310
Similar to 300mm
Provide # 16mm φ@300 c/c
Check for deflection:
l/d ratio = 20% of mid span
Pt = ((π/4)*20^2 /290 * 540)* 1000 = 2.0%
l/d ratio = 1.6 * 20 = 32
l/d provided = 210.2/540 = 0.38<3.2.
Hence deflection is 8g / c -0.38 3.2.

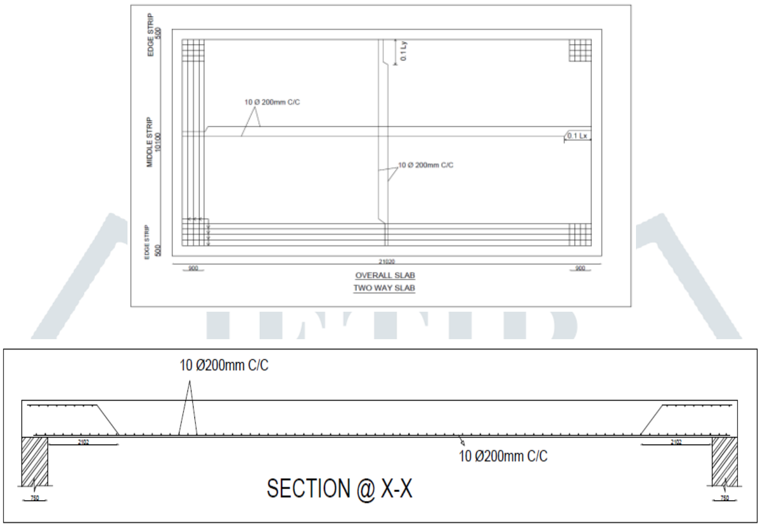

Fig 2.4

12) Simply Supported rectangular Beam
Clear span =9m
Imposed load = 30 KN/m
Width = 300 mm
Fck = M25 N/mm^2
Fe = 415 N/mm^2
1. Depth of Beam:-
l/12 to 1/15
d = 9000/12 = 750mm
D= 800mm.
2. Effective Span:
center to center supports = 9+ 0.3 = 9.3m
clear span +d = 9+0.75 = 9.75m.
Eff span = 9.3 m.
3. Loads per meter length of beam :
self at of beam = Area x length x Ut wt of RCC = 0.3 * 0.80 * 1 * 25 = 6 KN/m.
Imposed load = 30 KN/m.
Total load =36 KN/ m
Factored load = 1.5 * 36 = 54 KN/m.
Factored BM Mu = Wul^2/ 8 = (54 * $(9.3)^2$)/8 = 583.80 KN.m = 583.80x10^6 N .m
4. Depth required:
Min depth required to resist BM
Mu = Mu limit
Mu = 0.138 fck bd^2
583.80*10^2 =0.138 x25x300xd
d = 751.03mm > 750mm
5. Tension Reinforcement:-
Mu = 0.87 fy Ast d $[1 - \frac{fy\ Ast}{fck\ bd}]$
583.80*10^6 = 0.87* 415 *Ast * 800 $[1 - \frac{415*Ast}{25*300*800}]$
Ast = 2200.2 mm^2
Provide 20 mm dia
ast = $\frac{\pi}{4} * \emptyset^2$ = π*20^2/4 = 314.16 mm^2
No. of bars required S=Ast/ast = 2200.2/314.6 = 7.06 no's.
Provide 6 # 20 mm dia.
Ast provide = 6 * 316.16 = 1884.96 mm²

6. Check for deflection:

SSB basic valve 1/d = 20

Modification factor for Tension

% of steel = 1884.96*100/300*800 = 0.78.

fs =0.58*fy* [$\frac{Area\ of\ steel\ required}{Ast\ provide}$]

0.58 x 415 [2200.2/1884.96]

fs = 280.95 N/mm²

Modification factor= 1.2

Max l/d ratio =1.2×20 = 24.

l/d = 9300/800 = 11.6 = 11.6 < 24

Hence deflection is safe.

Ast = 6 * π/4 * 20^2 = 1885 mm^2

Asc = 2* π/4 *16^2 = 402.1 mm^2

d'/d = 40/750 = 0.05 < 0.2

7. Depth of Neutral axis:

0.36 fck b. xu + fsc Asc = 0.87 fy Ast

0.36 * 25 * 300 * Xu + 354.2 * 402.1 = 0.87*415 *1885

Xu = 199.31 mm.

Lim depth of Neutral axis Xu max = 0.48 d = 0.48*750* 360 mm.

Xu < Xu max

8. Moment of Resistance :

Mu = 0.36 fck b Xu max (d-0.42 Xu max) + fsc. Asc (d-d')

= 0.36 * 25 * 300 * 360(750 - 0.42 * 360) + 354.7 * 402.1(750 - 60) = 683.15x10^6 N.mm = 683.15 KN.m

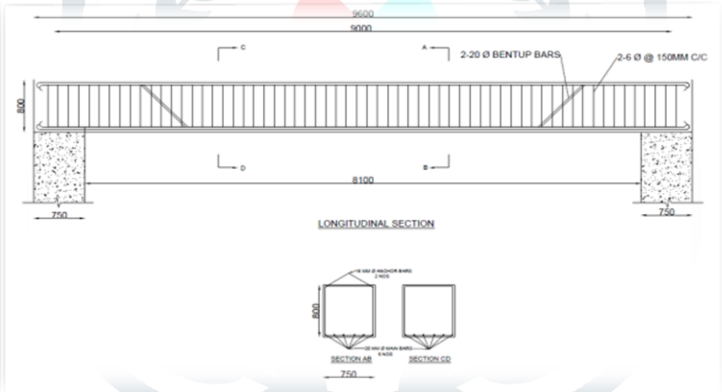

Fig 2.5

3.1 METHODOLOGY

We developing a conceptual design for the g+5 apartment the number of units floor plans , parking facilities building force and regulations as structural engineering the building structure considering factors like dead load, live load, load bearing capacity, foundation details. The construction process to ensure approved plans specification into quality standards. We implementing floor plans, load considerations, structural members by using software by taking quality assurance and control measure. By analyzing load considerations in STAAD pro software the errors we got zero.

4. RESULT

4.1 Reinforcement details

Column sizes = 750 x 800 mm

Reinforcement: - Provide 16mm bars @250mm c/c.

STAIR CASE:

Torsional Reinforcement = Provide 12 mm at 120 mm at c/c

Distribution reinforcement = Provide 8mm bars of 160mm c/c.

LINTEL AND SUNSHADE:

Torsion reinforcement = Provide 4-12mm bars.

Design shear reinforcement = Using 8mm, 2 legged, Fe 250 Steel Stirrups.

CANTELIVER SLAB:

Distribution reinforcement = Hence provide 8mm bars at 230 mm c/c in transverse direction.

OVERALL SLAB OF G+5 APARTMENT:

Reinforcement along X direction = Provide #10 mm @ 180 c/c.

Reinforcement along y direction = Provide #10mm @ 160 c/c.

Depth of slab = 300mm.

FLAT 1 TWO WAY SLAB: 9700 X1100 mm
Reinforcement along x direction = Provide 10mm # @ 200mm c/c.
Reinforcement along y direction = Provide 10mm # @ 200mm c/c.
Depth of slab = 300 mm
FLAT 2 TWO WAY SLAB: 7800 X 1100 mm
Reinforcement along x direction = Provide 10mm # @ 200mm c/c.
Reinforcement along y direction = Provide 10mm # @ 200mm c/c.
Depth of slab = 300 mm.
SIMPLY SUPPORTED RECTANGULAR BEAM:
Clear span = 9 m
Torsion reinforcement = 6 # 20 mm dia.
Compression reinforcement = 2 # 20 mm dia.
SIMPLY SUPPORTED BEAM SHEAR:
Shear resistance of bent up bars = V_{usb} =301611 N.
Provide 2 legged 6 mm stirrups @ 150mm c/c throughout span of beam.

Soil samples:

Core cutter	1.39 g/cc
Soil compaction	moisture content =6.2%
Liquid limit	34%
Plastic limit	0.17

4.2 COMPARING SHEAR FORCE AND BENDING MOMENT: MANUAL DESIGN

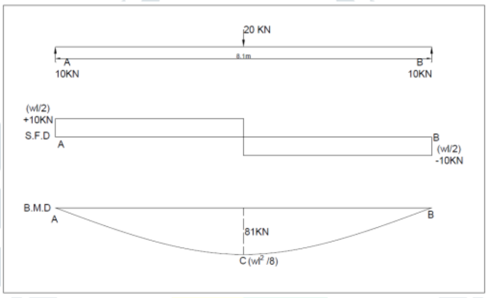

Fig 4.1

SHEAR FORCE CALCULATION:-

Shear force at A_L = 0

Shear force at $A_{r\,=}$ +10 KN

Shear force at C_L= 10 KN

Shear force at C_R= 10-20 = -10 KN

Shear force at B_L = -10 KN

Shear force at B_R = -10 + 10 =0

BENDING MOMENT CALCULATION:-

X =L/2 BM = $WL^2/8$ = 10 X $8.1^2/8$ = 81 KN

X =L BM = $WL^2/2$ - $WL^2/2$ = 0 KN

SOFTWARE DESIGN FOR SHEAR FORCE & BENDING MOMENT DIAGRAM:

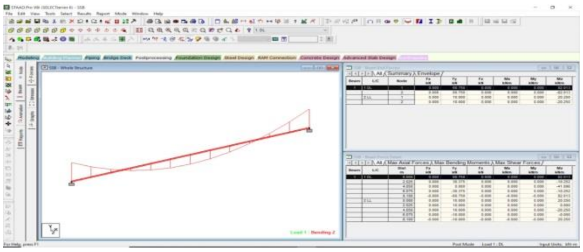

Fig 4.2

BENDING MOMENT :

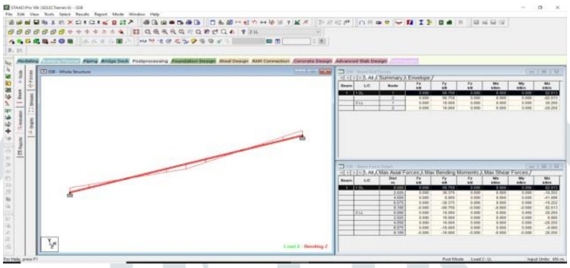

Fig 4.3

4.3 COMPARING OF MANUAL & SOFTWARE OVERALL

STAAD PRO:

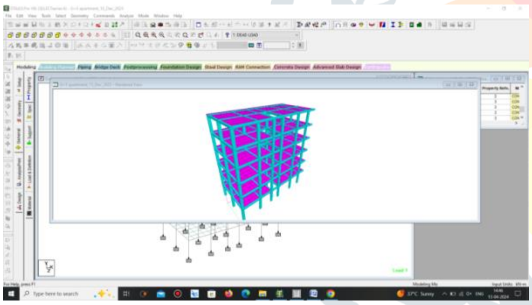

Fig 4.4

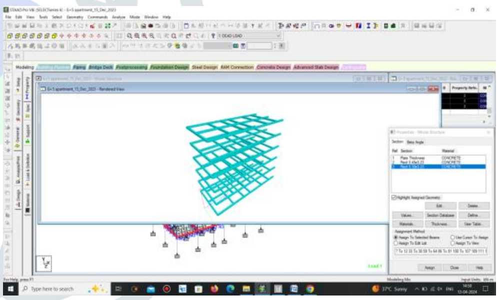

Fig 4.5

4.4 CONCLUSION

In conclusion, the design for the G+5 apartment building represents the layout plans and floor diagrams of the g+5 building due to this the total 5 floors and one community center has been designed in the AutoCAD and the staad pro design which forms the whole structure of the g+5 design and simply supported beams which includes shear force and bending moment and also load considerations which outcomes zero errors. The safety measures have been taken while planning the AutoCAD and staad pro designs have to input the units properly in AutoCAD and load considerations in staad pro design.

4.5 REFERENCES

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