ONE WAY SLAB DESIGN (S1-A)

School: Isabela State University - City of Ilagan Campus
Course: Department of Civil Engineering
Prepared by: Ricky John C. Guittu
Submitted to: Engr. Cesar B. Vallejo

Project Title: Modern Farm House
Project Location: District 2, Gamu, Isabela
Sheet Content: One Way Slab Design
Slab: S1-A (One End Continuous)

DESIGN CRITERIA AND SERVICE LOADS

f_c' =	20.7	MPa	Compressive Strength of Concrete
f_y =	276	MPa	Yield Strength of Steel Bars
γ_c =	23.5	KN/m^3	Unit Weight of Concrete
β =	0.85		Reduction Factor
L =	1.7	m	Length of Span

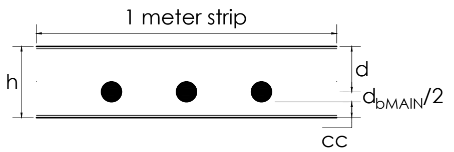
LL =	1.9	KPa	Live Load (Basic Floor Area)
$DL_{FLOOR\ FINISH}$ =	5	KPa	Floor Finish (Ceramic Tile on 25 mm Bed)
$DL_{CEILING}$ =	0.05	KPa	Ceiling Finish (Acoustical Fiber Board)
d_{bMAIN} =	12	mm	Diameter of Main Bars
d_{bTEMP} =	10	mm	Diameter of Temperature Bars

SLAB DIMENSION AND DETAILS

NSCP 2015 407.3.1, Minimum Slab Thickness for One End Continuous: L/24
407.3.1.1.1: For fy other than 420 MPa, the expression shall be multiplied by [0.4 + fy/700]

h_{min} = L/24 [0.4 + (fy/700)]
h_{min} = 56.262 mm
say **h_{min} = 150 mm**

Effective depth of the stair slab considering 1 meter strip:



b =	1000	mm	1 meter strip of stair slab
cc =	20	mm	Concrete Cover

d = h_{min} - cc - $d_{bMAIN}/2$
d = 124 mm

DEAD LOAD, LIVE LOAD, AND FACTORED UNIFORM LOAD

A. Dead Load

W_{slab} = h_{min} (b) (γ_c)
W_{slab} = 3.525 KPa

W_{DL} = W_{slab} + $DL_{FLOOR\ FINISH}$ + $DL_{CEILING}$
W_{DL} = 8.575 KPa

B. Live Load

W_{LL} = LL
W_{LL} = 1.900 KPa

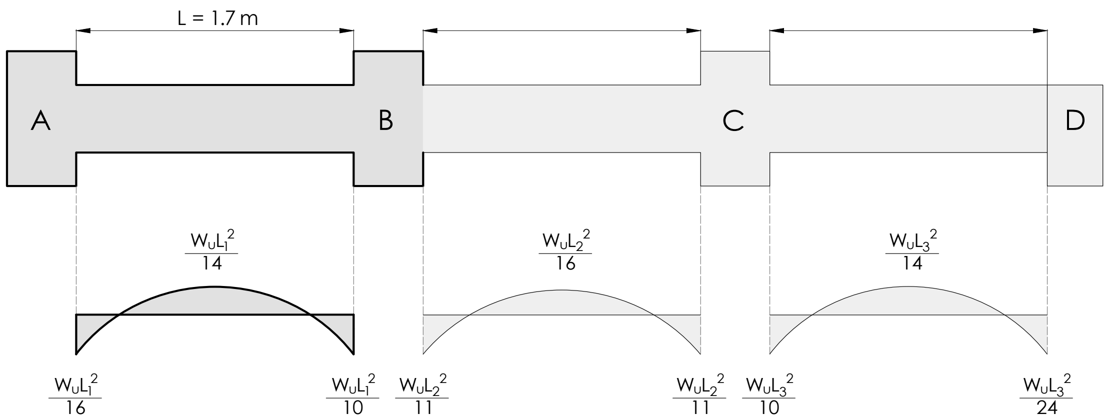
c. Factored Uniform Load

W_u = $1.2W_{DL} + 1.6W_{LL}$
W_u = 13.330 KPa
W_u = 13.330 KN/m

MOMENT CAPACITY AND STEEL RATIO (AT END SUPPORT)

According to NSCP 2015 406.5.2, for slabs with L NOT exceeding 3m:

L = 1.7 m Span Length



A. Moment Capacity

$M_u = W_uL^2/16$

M_u = 3.210 KN-m

B. R_n

$M_u = \phi R_n bd^2$

R_n = 0.2319855

C. STEEL RATIO (ρ)

ρ_{min} = 1.4/fy

ρ_{min} = 0.005072

$\rho_{min} = \sqrt{(fc')}/4(fy)$

ρ_{min} = 0.004121

$$\rho_{max} = \frac{[(0.003 + fy/Es)]}{[0.008]} \; \frac{[(\beta)\,(0.85)\,(fc')\,(600)]}{[fy\,(fy+600)]}$$

ρ_{max} = 0.020320

$$\rho_{actual} = \frac{0.85(fc')}{fy} \; \frac{[1-\sqrt{1-(2Rn)}]}{0.85(fc')}$$

ρ_{actual} = 0.000846 < ρ_{min} **not ok!**

< ρ_{max}

Therefore, use **ρ_{min} = 0.005072**

REINFORCEMENTS

A. Spacing of 12mm Main Bars:

$A_s = \rho bd$

A_s = 628.986 mm^2

$A_{bar} = (\pi/4)(d_{bMAIN}{}^2)$

A_{bar} = 113.097 mm^2

S = $(A_{bar}/A_s)(1000)$

S = 179.809128 mm^2

say S = 170 mm^2

B. Spacing of 10mm Temperature Bars:

A_s = 0.002bh

A_s = 300 mm^2

$A_{bar} = (\pi/4)(d_{bTEMP}{}^2)$

A_{bar} = 78.540 mm^2

S = $(A_{bar}/A_s)(1000)$

S = 261.799388 mm^2

say S = 260 mm^2

Maximum Spacing according to NSCP 2015 Specifications:

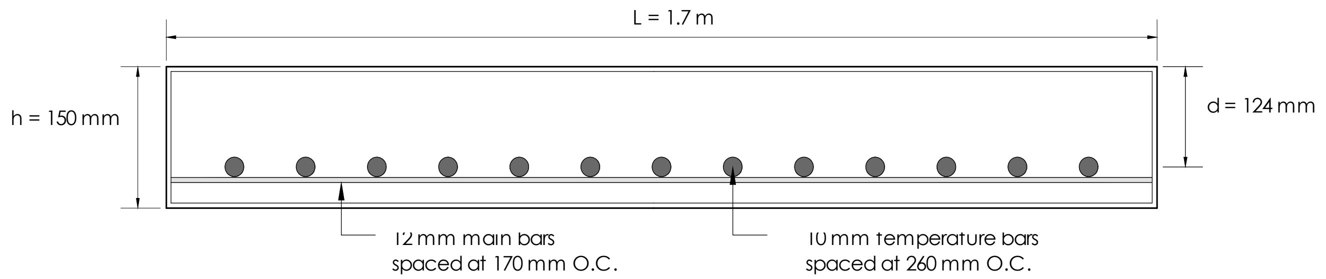
A.	3h =	450	mm
B.		450	mm

A.	5h =	750	mm
B.		450	mm

Therefore, use 12 mm Main Steel Bars spaced at 170 mm O.C.

Therefore, use 10 mm Temperature Steel Bars spaced at 260 mm O.C.

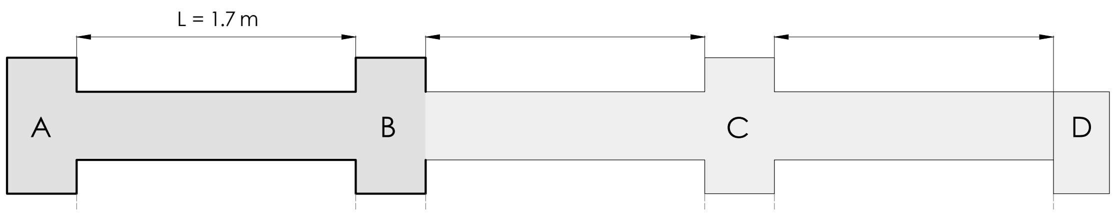
SLAB DETAILING

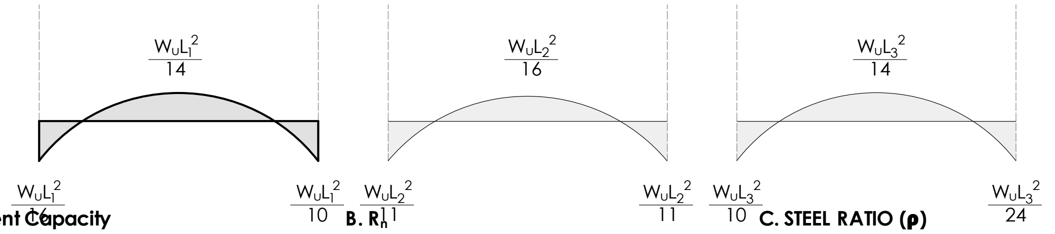


MOMENT CAPACITY AND STEEL RATIO (AT MIDSPAN)

According to NSCP 2015 406.5.2, for slabs with L NOT exceeding 3m:

L = 1.7 m Span Length





A. Moment Capacity

$M_u = W_uL^2/14$

$\mathbf{M_u =}$ **2.752 KN-m**

B. R_n

$M_u = \phi R_n bd^2$

$\mathbf{R_n =}$ **0.1988447**

C. STEEL RATIO (ρ)

$\rho_{min} = 1.4/fy$

$\rho_{min} =$ **0.005072**

$\rho_{min} = \sqrt{(fc')}/4(fy)$

$\rho_{min} =$ **0.004121**

$$\rho_{max} = \frac{[(0.003 + fy/Es)]}{[0.008]} \; \frac{[(\beta)\ (0.85)\ (fc')\ (600)]}{[fy\ (fy+600)]}$$

$\rho_{max} =$ **0.020320**

$$\rho_{actual} = \frac{0.85(fc')}{fy} \; \frac{[1-\sqrt{1-(2Rn)}]}{0.85(fc')}$$

$\rho_{actual} =$ **0.000725** $< \rho_{min}$ **not ok!**

$< \rho_{max}$

Therefore, use $\rho_{min} =$ **0.005072**

REINFORCEMENTS

A. Spacing of 12mm Main Bars:

$A_s = \rho bd$

$\mathbf{A_s =}$ **628.986 mm²**

$A_{bar} = (\pi/4)(d_{bMAIN}^2)$

$\mathbf{A_{bar} =}$ **113.097 mm²**

$S = (A_{bar}/A_s)(1000)$

$S = 179.809128\ mm^2$

say S = 170 mm²

Maximum Spacing according to NSCP 2015 Specifications:

A. 3h = 450 mm

B. 450 mm

Therefore, use 12 mm Main Steel Bars spaced at 170 mm O.C.

B. Spacing of 10mm Temperature Bars:

$A_s = 0.002bh$

$\mathbf{A_s =}$ **300 mm²**

$A_{bar} = (\pi/4)(d_{bTEMP}^2)$

$\mathbf{A_{bar} =}$ **78.540 mm²**

$S = (A_{bar}/A_s)(1000)$

$S = 261.799388\ mm^2$

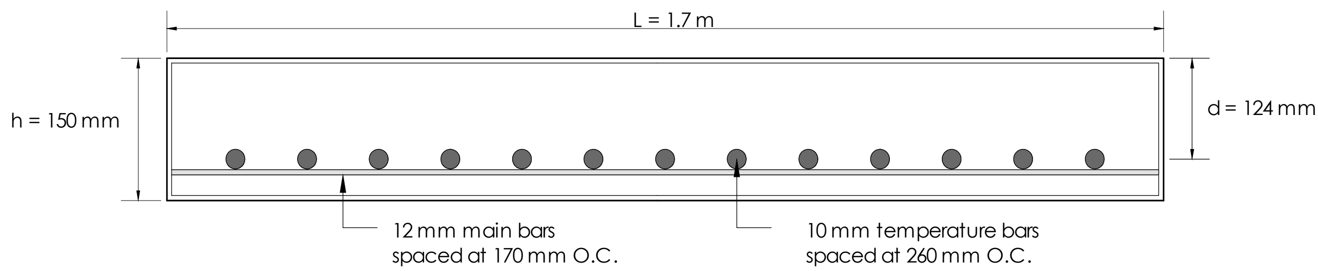
say S = 260 mm²

A. 5h = 750 mm

B. 450 mm

Therefore, use 10 mm Temperature Steel Bars spaced at 260 mm O.C.

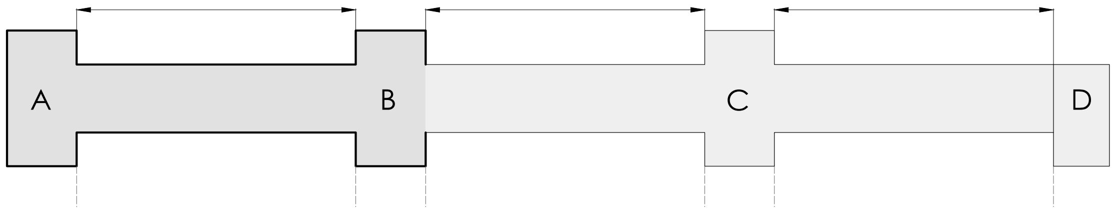
SLAB DETAILING

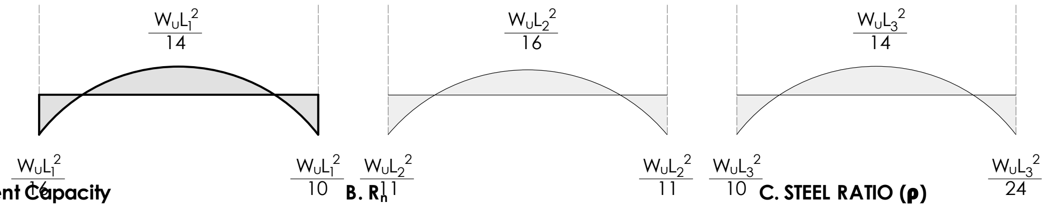


MOMENT CAPACITY AND STEEL RATIO (AT CONTINUOUS SUPPORT)

According to NSCP 2015 406.5.2, for slabs with L NOT exceeding 3m:

L = 1.7 m Span Length





A. Moment Capacity

$M_u = W_uL^2/10$

$\mathbf{M_u =}$ **3.210 KN-m**

B. R_n

$M_u = \phi R_nbd^2$

$\mathbf{R_n =}$ **0.2319855**

C. STEEL RATIO (ρ)

$\rho_{min} = 1.4/fy$

$\rho_{min} =$ **0.005072**

$\rho_{min} = \sqrt{(fc')}/4(fy)$

$\rho_{min} =$ **0.004121**

$\rho_{max} = \frac{[(0.003 + fy/Es)]}{[0.008]} \cdot \frac{[(\beta)\ (0.85)\ (fc')\ (600)]}{[fy\ (fy+600)]}$

$\rho_{max} =$ **0.020320**

$\rho_{actual} = \frac{0.85(fc')}{fy} \cdot \frac{[1-\sqrt{1-(2Rn)}]}{0.85(fc')}$

$\rho_{actual} =$ **0.000846** $< \rho_{min}$ **not ok!**

$< \rho_{max}$

Therefore, use $\rho_{min} =$ **0.005072**

REINFORCEMENTS

A. Spacing of 12mm Main Bars:

$A_s = \rho bd$

$\mathbf{A_s =}$ **628.986 mm²**

$A_{bar} = (\pi/4)(d_{bMAIN}{}^2)$

$\mathbf{A_{bar} =}$ **113.097 mm²**

$S = (A_{bar}/A_s)(1000)$

$S = 179.809128\ mm^2$

say S = 170 mm²

B. Spacing of 10mm Temperature Bars:

$A_s = 0.002bh$

$\mathbf{A_s =}$ **300 mm²**

$A_{bar} = (\pi/4)(d_{bTEMP}{}^2)$

$\mathbf{A_{bar} =}$ **78.540 mm²**

$S = (A_{bar}/A_s)(1000)$

$S = 261.799388\ mm^2$

say S = 260 mm²

Maximum Spacing according to NSCP 2015 Specifications:

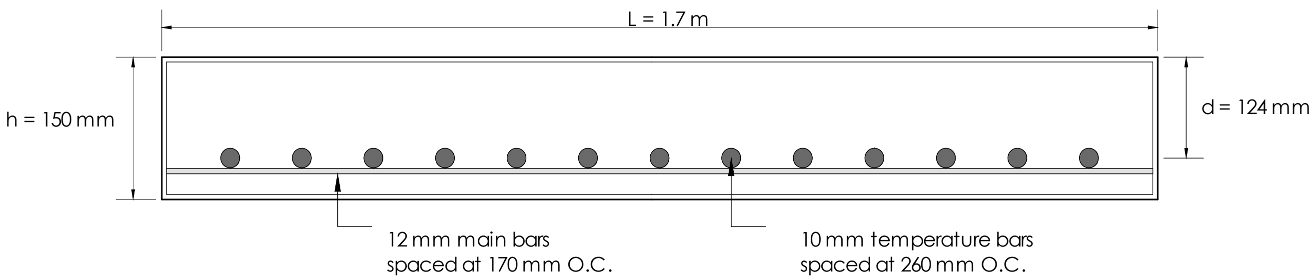
A.	3h =	450	mm
B.		450	mm

A.	5h =	750	mm
B.		450	mm

Therefore, use 12 mm Main Steel Bars spaced at 170 mm O.C.

Therefore, use 10 mm Temperature Steel Bars spaced at 260 mm O.C.

SLAB DETAILING



DESIGN OF CONCRETE STAIRWAY

School: Isabela State University - City of Ilagan Campus
Course: Department of Civil Engineering
Prepared by: Ricky John C. Guittu
Submitted to: Engr. Cesar B. Vallejo

Project Title: Modern Farm House
Project Location: District 2, Gamu, Isabela
Sheet Content: Concrete Stairway Design

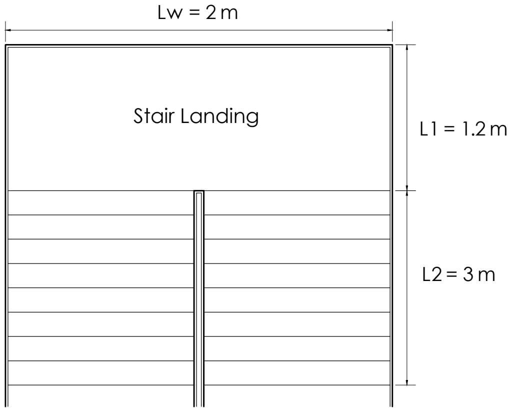
DESIGN CRITERIA AND SERVICE LOADS

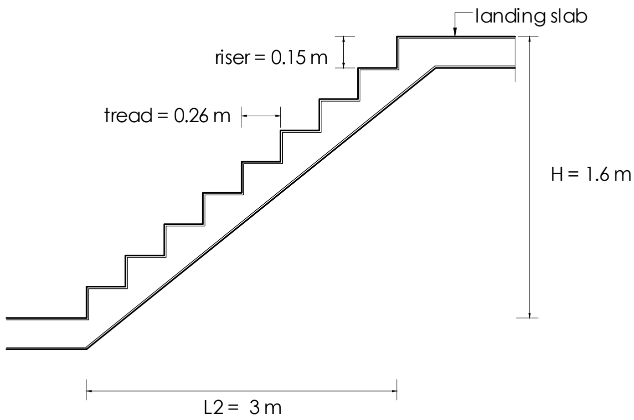
f_c' =	21	MPa	Compressive Strength of Concrete
f_y =	276	MPa	Yield Strength of Steel Bars
γ_c =	23.5	KN/m^3	Unit Weight of Concrete
β =	0.85		Reduction Factor
d_{bMAIN} =	16	mm	Diameter of Main Bars
LL =	1.9	KPa	Live Load
MLL =	0	KPa	Miscellaneous Live Load
$DL_{FLOOR\ FINISH}$ =	0	KPa	Dead Load
$DL_{MISCALLANEOUS}$ =	0	KPa	Miscellaneous Dead Load
d_{bTEMP} =	10	mm	Diameter of Temperature Bars

STAIR DIMENSION AND DETAILS

Lw =	2	m	
L_1 =	1.2	m	Length of Landing Slab
L_2 =	3	m	Length of Stairway
H =	1.6	m	Height of Stairway
t =	0.26	m	Length of Tread (run)
r =	0.15	m	Height of riser (rise)

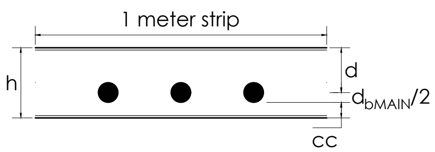
Minimum slab thickness for simply supported slab according to NSCP 2015:





h_{min} = L2/20 [0.4 + (fy/700)]
h_{min} = 0.12 m
h_{min} = 120 mm

Effective depth of the stair slab considering 1 meter strip:



b =	1000	mm	1 meter strip of stair slab
cc =	20	mm	Concrete Cover

d = h_{min} - cc - d_{bMAIN}/2
d = 92 mm

DEAD LOAD, LIVE LOAD, AND FACTORED UNIFORM LOAD

A. Dead Load

W_{step} = 1/2 (r) (γ_c)
W_{step} = 1.763 KPa

W_{slab} = h/t $\sqrt{(r^2 + t^2)}$ (γ_c)
W_{slab} = 3.256 KPa

W_{DL} = W_{step} + W_{slab} + $DL_{FLOOR\ FINISH}$ + $DL_{MISCALLANEOUS}$
W_{DL} = 5.018 KPa

B. Live Load

W_{LL} = LL + W_{MLL}
W_{LL} = 1.900 KPa

c. Factored Uniform Load

W_u = 1.2W_{DL} + 1.6W_{LL}
W_u = 9.061784 KPa
W_u = 9.062 KN/m

MOMENT CAPACITY AND STEEL RATIO

A. Moment Capacity

$M_u = W_u L^2/8$

M_u = 10.195 KN-m

B. ω

$M_u = \phi\, fc' b d^2 \omega (1 - 0.59\omega)$

ω = 0.0602302

Rn = 1.3382833

C. STEEL RATIO (ρ)

$\rho_{min} = 1.4/fy$

ρ_{min} = 0.005072

$\rho_{min} = \sqrt{fc'}/4(fy)$

ρ_{min} = 0.004151

$$\rho_{max} = \frac{[(0.003 + fy/Es)]}{[0.008]} \quad \frac{[(\beta)\ (0.85)\ (fc')\ (600)]}{[fy\ (fy+600)]}$$

ρ_{max} = 0.020615

$\rho_{actual} = \omega fc'/fy$

ρ_{actual} = 0.004583 $< \rho_{min}$ **not ok!**

$< \rho_{max}$

Therefore, use **ρ_{min} = 0.005072**

REINFORCEMENTS

A. Spacing of 12mm Main Bars:

$A_s = \rho_{actual} bd$

A_s = 466.667 mm^2

$A_{bar} = (\pi/4)(d_{bMAIN}^2)$

A_{bar} = 201.062 mm^2

$S = (A_{bar}/A_s)(1000)$

S = 430.846992 mm^2

say S = 430 mm^2

B. Spacing of 10mm Temperature Bars:

$A_s = 0.002bh$

A_s = 240 mm^2

$A_{bar} = (\pi/4)(d_{bTEMP}^2)$

A_{bar} = 78.540 mm^2

$S = (A_{bar}/A_s)(1000)$

S = 327.249235 mm^2

say S = 320 mm^2

Maximum Spacing according to NSCP 2015 Specifications:

A.	3h =	360	mm
B.		450	mm

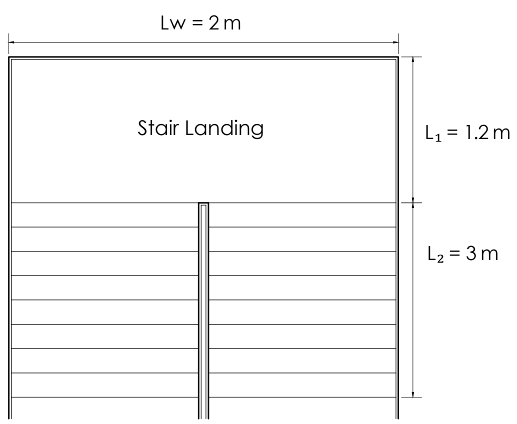
A.	5h =	600	mm
B.		450	mm

Therefore, use 16 mm Main Steel Bars spaced at 360 mm O.C.

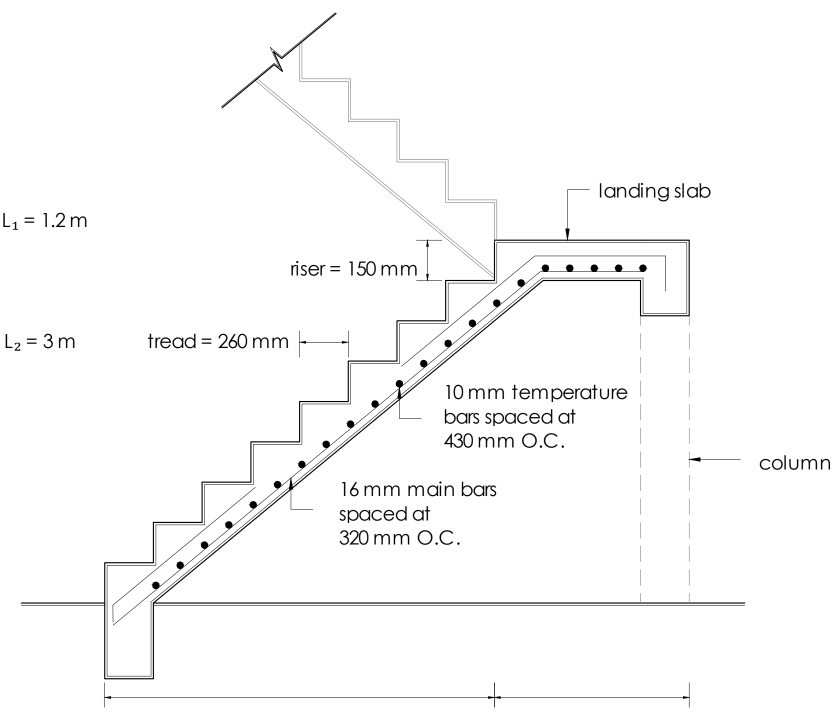
Therefore, use 10 mm Temperature Steel Bars spaced at 320 mm O.C.

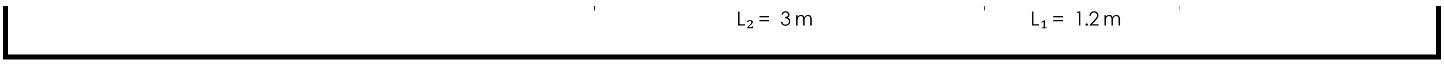
STAIRS PLAN AND DETAILING

PLAN



DETAILING




$L_2 = 3\,m$
$L_1 = 1.2\,m$

BEAM DESIGN (12101)

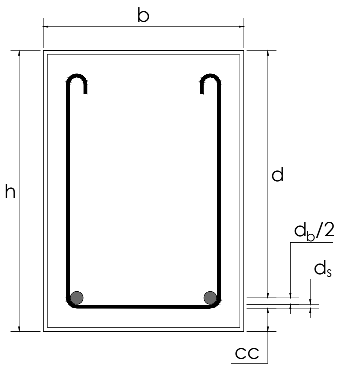
School: Isabela State University - City of Ilagan Campus
Course: Department of Civil Engineering
Prepared by: Ricky John C. Guittu
Submitted to: Engr. Cesar B. Vallejo

Project Title: Modern Farm House
Project Location: District 2, Gamu, Isabela
Sheet Content: Beam Design
Beam: 12101

DESIGN CRITERIA AND SERVICE LOADS

f_c' =	20.7	MPa	Compressive Strength of Concrete
f_y =	276	MPa	Yield Strength of Steel Bars
β =	0.85		Reduction Factor
$M_{uSUPPORT}$ =	16.45	KN-m	Moment at Support
$M_{uMIDSPAN}$ =	29.01	KN-m	Moment at Midspan

BEAM DIMENSION AND DETAILS



Assumed beam dimensions:

b =	250	mm	Base of Beam
h =	350	mm	Total Depth of Beam
cc =	40	mm	Concrete Cover
d_b =	16	mm	Diameter of Main Bars
d_s =	10	mm	Diameter of Stirrups

Effective depth of the beam:

$d = h_{min} - cc - d_s - d_b/2$

d = 292 mm

STEEL RATIO (AT SUPPORT)

A. Moment at Support

$M_{uSUPPORT}$ = 16.45 KN-m

B. R_n

$M_u = \phi R_n b d^2$

R_n = 0.8574675

C. STEEL RATIO (ρ)

ρ_{min} = 1.4/fy

ρ_{min} = 0.005072

$\rho_{min} = \sqrt{(fc')}/4(fy)$

ρ_{min} = 0.004121

$$\rho_{max} = \frac{[(0.003 + fy/Es)]}{[0.008]} \quad \frac{[(\beta)\ (0.85)\ (fc')\ (600)]}{[fy\ (fy+600)]}$$

ρ_{max} = 0.020320

$$\rho_{actual} = \frac{0.85(fc')}{fy} \quad \frac{[1-\sqrt{1-(2Rn)}]}{0.85(fc')}$$

ρ_{actual} = 0.003186 $< \rho_{min}$ $< \rho_{max}$ **ok!**

Therefore, use **ρ_{min} = 0.005072**

REINFORCEMENTS

A. Area of Steel Bars

$A_s = \rho bd$

A_s = 370.290 mm²

$A_{bar} = (\pi/4)(d_b^2)$

A_{bar} = 201.062 mm²

B. Number of Steel Bars

$N_{16} = A_s/A_{bar}$

N_{16} = 1.8416707 pieces

say N_{16} = 2 pieces

C. Spacing of 16 mm Diameter Steel Bars

b = N(16) + 2(ds) + 2(cc) + 1(S)

250 = 2(16) + 2(10) + 2(40) + 1(S)

S = 118.000 mm

say S = 115 mm

Therefore, use 2 pieces of 16 mm Diameter Steel Bars spaced at 115 mm O.C.

INVESTIGATION OF THE MOMENT CAPACITY (AT SUPPORT)

A. Stress acting on Steel Bars

$A_{sACTUAL} = N_{16}\,(\pi/4)\,(d_b^2)$

$\mathbf{A_{sACTUAL} =}$ **402.12386 mm²**

$C = T$

$0.85f'c\,ab = A_{sACTUAL}fy$

a = 25.231 mm

$a = \beta c$

c = 29.684 mm

$fs = 600\,\dfrac{[(d-c)]}{c}$

fs = 5302.193 MPa > fy = 276 MPa
> 1000 MPa

B. Strain of Steel Bars

$\dfrac{\varepsilon_U}{c} = \dfrac{\varepsilon_t}{d-c}$

$\varepsilon_t =$ **0.026511** > 0.005

Therefore, use $\phi =$ **0.9**

C. Moment Capacity of the Beam (at Support)

$M_{uCAPACITY} = \phi A_{sACTUAL}fy\,(d - a/2)$

$\mathbf{M_{uCAPACITY} =}$ **27.907 KN-m** **> M_u = 16.45 KN-m**

Safe!

STEEL RATIO (AT MIDSPAN)

A. Moment at Midspan

$M_{uMIDSPAN} = \boxed{29.01}$ KN-m

B. R_n

$M_u = \phi R_n bd^2$

$\mathbf{R_n =}$ **1.5121661**

C. STEEL RATIO (ρ)

$\rho_{min} = 1.4/fy$

$\rho =$ **0.005072**

$\rho_{min} = \sqrt{(f'c)}/4(fy)$

$\rho_{min} =$ **0.004121**

$\rho_{max} = \dfrac{[(0.003 + fy/Es)]}{[0.008]}\;\dfrac{[(\beta)\,(0.85)\,(f'c)\,(600)]}{[fy\,(fy+600)]}$

$\rho_{max} =$ **0.020320**

$\rho_{actual} = \dfrac{0.85(f'c)}{fy}\;\dfrac{[1-\sqrt{1-(2Rn)}]}{0.85(f'c)}$

$\rho_{actual} =$ **0.005737** $< \rho_{min}$ **ok!**
$< \rho_{max}$

Therefore, use $\rho_{min} =$ **0.005737**

REINFORCEMENTS

A. Area of Steel Bars

$A_s = \rho bd$

$\mathbf{A_s =}$ **418.801 mm²**

$A_{bar} = (\pi/4)\,(d_b^2)$

$\mathbf{A_{bar} =}$ **201.062 mm²**

B. Number of Steel Bars

$N_{16} = A_s/A_{bar}$

$N_{16} =$ 2.0829474 pieces

say N_{16} = 3 pieces

C. Spacing of 16 mm Diameter Steel Bars

b = N(3) + 2(ds) + 2(cc) + 2(S)

250 = 3(16) + 2(10) + 2(40) + 2(S)

S = 51.000 mm

Say S = 50 mm

Therefore, use 3 pieces of 16 mm Diameter Steel Bars spaced at 50 mm O.C.

INVESTIGATION OF THE MOMENT CAPACITY (AT MIDSPAN)

A. Stress acting on Steel Bars

$A_{sACTUAL} = N_{16}\,(\pi/4)\,(d_b^2)$

$\mathbf{A_{sACTUAL} =}$ **603.185789 mm²**

$C = T$

$0.85f'c\,ab = A_{sACTUAL}fy$

a = 37.847 mm

B. Strain of Steel Bars

$\dfrac{\varepsilon_U}{c} = \dfrac{\varepsilon_t}{d-c}$

$\varepsilon_t =$ **0.016674** > 0.005

Therefore, use $\phi =$ **0.9**

C. Moment Capacity of the Beam (at Support)

$M_{uCAPACITY} = \phi A_{sACTUAL}fy\,(d - a/2)$

$\mathbf{M_{uCAPACITY} =}$ **40.915 KN-m** **> M_u = 29.01 KN-m**

Safe!

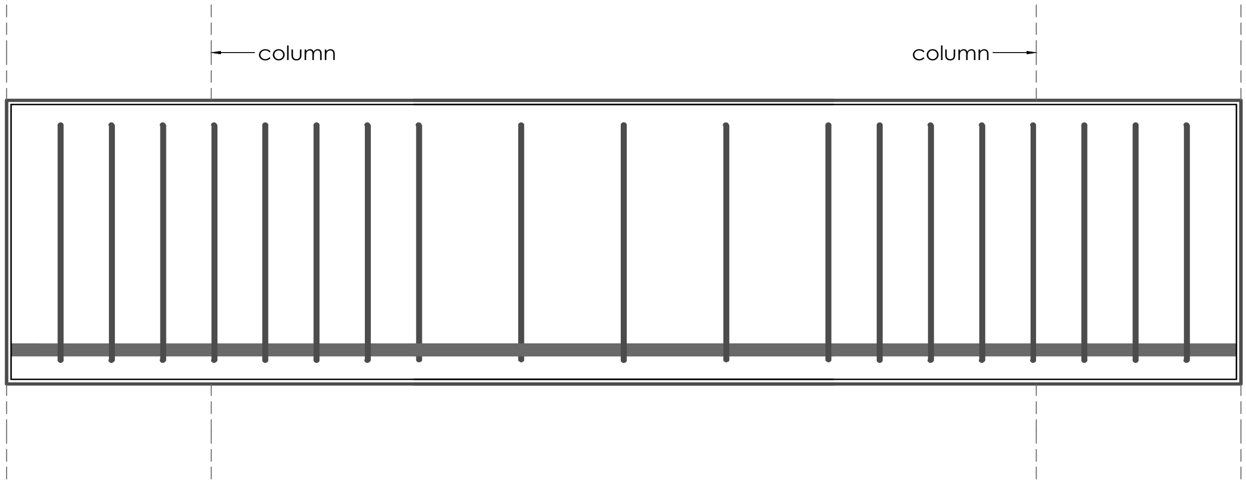
a = **β**c
c = 44.526 mm

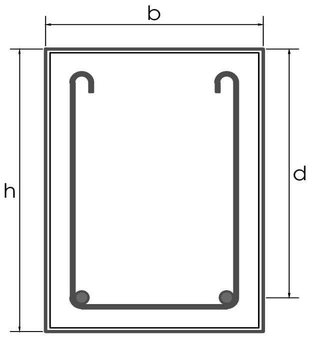
$$fs = 600\,\frac{[(d-c)]}{c}$$

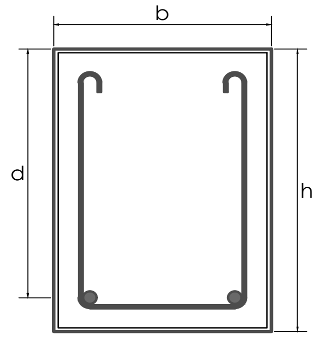
fs = 3334.795 MPa > fy = 276 MPa
> 1000 MPa

Therefore, use 250 x 350 mm beam dimensions.

BEAM PLAN AND DETAILING







WEB REINFORCEMENTS DESIGN (BEAM 12103)

School: Isabela State University - City of Ilagan Campus
Course: Department of Civil Engineering
Prepared by: Ricky John C. Guittu
Submitted to: Engr. Cesar B. Vallejo

Project Title: Modern Farm House
Project Location: District 2, Gamu, Isabela
Sheet Content: Web Reinforcements Design
Beam: 12103

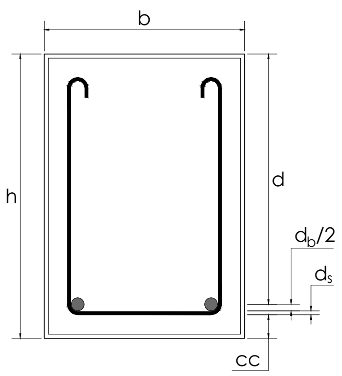
DESIGN CRITERIA AND SERVICE LOADS

fc' =	20.7	MPa	Compressive Strength of Concrete
fyt =	276	MPa	Yield Strength of Steel Bars for Stirrups
V_u =	210	KN	Ultimate Shear Strength
ϕ =	0.75		Reduction Factor for Shear

V_c = [0.17√(fc')bd]
V_c = 56.47 KN Shear Strength of Concrete

V_s = (V_u/ϕ) - V_c
V_s = 223.53 KN Shear Strength of Reinforcement

BEAM DIMENSION AND DETAILS



b =	250	mm	Base of Beam
h =	350	mm	Total Depth of Beam
cc =	40	mm	Concrete Cover
d_b =	16	mm	Diameter of Main Bars
d_s =	10	mm	Diameter of Stirrups

Effective depth of the beam:

d = h_{min} - cc - d_s - d_b/2
d = 292 mm

Area of Stirrups (A_v):

A_v = 2[(π/4)(d_s^2)]
A_v = 157.080 mm²

WEB REINFORCEMENTS

V_u =	210	KN	Ultimate Shear Strength
V_s =	223.53	KN	Shear Strength of Reinforcement
V_c =	56.47	KN	Shear Strength of Concrete
ϕ =	0.75		Reduction Factor for Shear

NSCP 2015 Provisions for Web Reinforcements:

Case 1

Vu ≤ (ϕVc/2)
210 KN > 21.18 KN *Stirrups are needed.*

Case 2

(ϕV_c/2) < V_u ≤ ϕV_c
21.18 KN < 210 KN > 42.36 KN *Not Satisfied!*

Spacing of stirrups:

A.
S = Avfyt / 0.062√(fc')b
S = 614.77 mm
say S = 610 mm

B.
S = Avfyt / 0.35b
S = 495.47 mm
say S = 495 mm

C.
S = d/2
S = 146.00 mm
say S = 145 mm

D.
S = 600 mm
say S = 600 mm

Case 3

3.1: V_s ≤ [.33√(fc')bd]
223.53 KN > 109.61 KN *Not satisfied!*

3.2: V_u ≤ 3ϕV_c

$210 \text{ KN} > 127.06 \text{ KN}$ *Not satisfied!*

Spacing of stirrups:

A.

$S = \frac{Avfyt}{0.062\sqrt{(fc')}b}$

S = 614.77 mm

say S = 610 mm

B.

$S = \frac{Avfyt}{0.35b}$

S = 495.47 mm

say S = 495 mm

C.

S = d/2

S = 146.00 mm

say S = 145 mm

D.

$S = \frac{Avfyt}{Vs}$

S = 193.96 mm

say S = 190 mm

Case 4

4.1: $[.33\sqrt{(fc')}bd] < V_s \leq [.66\sqrt{(fc')}bd]$

109.61 KN < 223.53 KN > 219.21 KN *Not satisfied!*

4.2: $3\phi V_c \leq V_u \leq 5\phi V_c$

127.06 KN < 210 KN < 211.77 KN *Satisfied!*

Spacing of stirrups:

A.

$S = \frac{Avfyt}{Vs}$

S = 193.96 mm

say S = 190 mm

B.

S = d/4

S = 73.00 mm

say S = 70 mm

C.

S = 300 mm

say S = 300 mm

Case 5

5.1: $V_s > [.66\sqrt{(fc')}bd]$

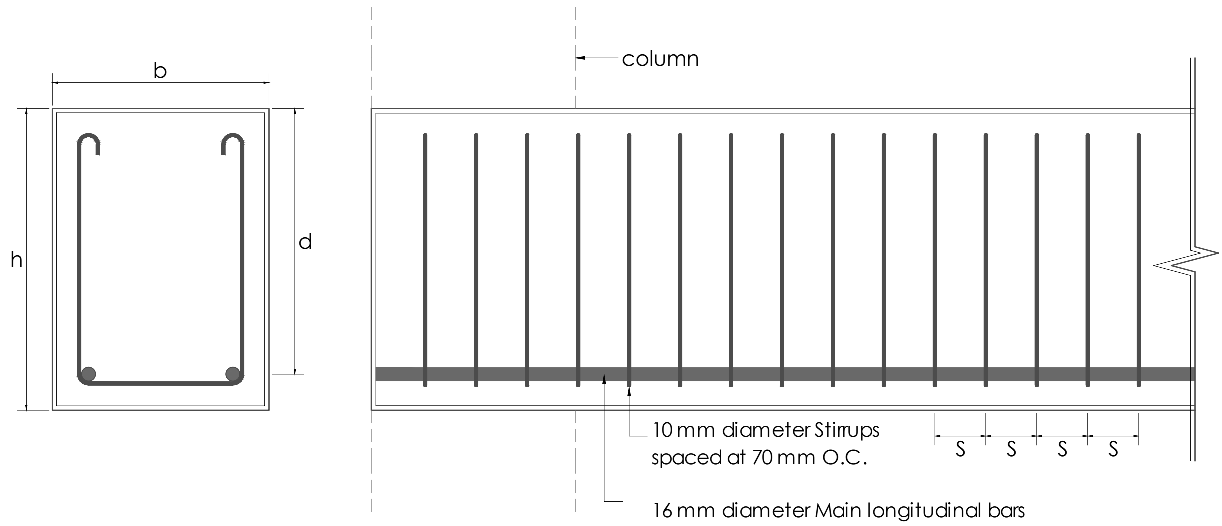
223.53 KN > 219.21 KN

5.2: $V_u > 5\phi V_c$

210 KN < 211.77 KN

Therefore, use 10 mm diameter Stirrups spaced at 70 mm O.C.

PLAN AND DETAILING



COLUMN DESIGN (C1)

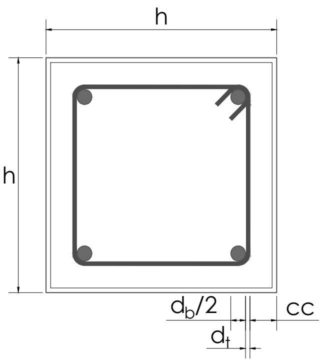
School: Isabela State University - City of Ilagan Campus
Course: Department of Civil Engineering
Prepared by: Ricky John C. Guittu
Submitted to: Engr. Cesar B. Vallejo

Project Title: Modern Farm House
Project Location: District 2, Gamu, Isabela
Sheet Content: Beam Design
Beam: C1

DESIGN CRITERIA AND SERVICE LOADS

fc' =	20.7	MPa	Compressive Strength of Concrete
fy =	276	MPa	Yield Strength of Steel Bars
P_u =	939.46	KN	Factored Axial Load
ϕ =	0.65		Reduction Factor

COLUMN DIMENSION AND DETAILS



Assumed column dimension:

h =	300	mm	Dimension of Tied Column
cc =	40	mm	Concrete Cover
d_b =	20	mm	Diameter of Longitudinal Bars
d_t =	10	mm	Diameter of Tie Wire

STEEL RATIO

A. Gross area of column (A_g)

$A_g = h^2$
$A_g = (300)(300)$
A_g = 90000 mm^2

B. STEEL RATIO (ρ_g)

$P_u = 0.80\phi\ [0.85fc'(A_g - \rho_g A_g) + fy\rho_g A_g]$
ρ_g = 0.00959 mm^2 < 0.01
< 0.08

C. AREA OF STEEL (A_{st})

$\rho_g = A_{st}/A_g$
A_{st} = 900.00 mm^2

Therefore, use ρ_g = **0.01**

REINFORCEMENTS

A. Number of Steel Bars

$A_{bar} = (\pi/4)(d_b^2)$
A_{bar} = 314.159 mm^2

$N_{20} = A_{st}/A_{bar}$
N_{20} = 2.86478898 pieces
say N_{20} = 4 pieces

B. Spacing of 20 mm diameter Main Bars

h = N(10) + 2(d_t) + 2(cc) + 1(S)
300 = 2(20) + 2(10) + 2(40) + 1(S)
S = 160.000 mm
say S = 160 mm

Max spacing for longitudinal bars:

S_{max} = 150 mm < S = 160 mm

Therefore, use S = 150 mm

C. Spacing of 10 mm diameter Tie Wires

1. S = 16(d_b)
S = 320 mm

2. S = 48(d_t)
S = 480 mm

3. S = least dimension
S = 300 mm

Therefore, use 4 pieces of 20 mm diameter Longitudinal Steel Bars spaced at 150 mm O.C.
Use 10 mm diameter Tie Wires spaced at 300 mm O.C.

INVESTIGATION OF THE AXIAL CAPACITY

A. Gross area of Column

A_g = 90000 mm^2

B. Actual Area of Steel

$A_{stACTUAL} = N_{20}(\pi/4)(d_b^2)$
$A_{stACTUAL}$ = 1256.6371 mm^2

C. Axial Capacity of the Column

$P_{uMAX} = 0.80\phi\ [0.85fc'(A_g - A_{st}) + fyA_{st}]$
P_{uMAX} = 992.301 KN > P_u = 939.46 KN

Therefore, SAFE!

COLUMN PLAN AND DETAILING