



TECHNICAL SPECIFICATION & SCOPE OF WORKS

PROPOSED PLANTING MATERIAL
PRODUCTION LABORATORY
BUILDING

OWNER: DEPT. OF AGRICULTURE REGIONAL FIELD UNIT VI

PROJECT: BA...

ENGR. NINIA PALMA MAQUILLA

PROFESSIONAL REG. NO. 137600090 - CIVIL ENGINEER
10/10/2017

OWNER: DEPARTMENT OF AGRICULTURE – REGIONAL FIELD UNIT VI

SPECIFICATIONS

I. General Description of the Work

The work to be done and executed shall include the furnishing of labor and materials, equipments and specialized works in the construction of the residential building completely as shown in the drawing, reflected in the detailed estimates and as specified herein.

Proportion of Concrete

All concrete works shall be done in strict accordance with the DPWH Specification of concrete and the revised proportioning as follows:

- Use class A (1 : 2 : 4) concrete mixtures, unless otherwise specified, for all footings, beams, columns, steps and floors
- Use class B (1 : 2.5 : 5) concrete mixtures, unless otherwise specified, for all thicker than 0.10m steps on fill, floor slabs on fill, catch basins, and other works of similar nature.
- Use class B (1 : 3) concrete mixtures, unless otherwise specified for mortars and plasters used for CHB walls, catch basins, septic tank walls and other similar structures.

II. Consistency of Mixtures

The quantity of water to be used in all concrete mixtures shall be 6.0 to 6.25 gallons per bag of cement, unless otherwise specified and permitted by the Supervising Engineer.

IV. Curing

Use water curing by keeping the forms sufficiently wet at all times. Concrete surfaces not protected by forms shall be protected from the loss of surface moisture by covering them with craft papers, quilts or barisps. Concrete shall be kept thoroughly wet within the duration of the curing period, which shall be not less than 7 days.

V. Reinforcing Steel Bars

Reinforcing steel bars shown in the plan shall be deformed bars in accordance with the metal reinforcing requirements of the standard specifications for buildings, highways, bridges, and other structures as adopted by the government.

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VI. Wood Forms

Wood forms shall be sound, of good quality, free from large/loose knots, and otherwise suitable for facilitating finishing exposed concrete as specified.

VII. Walls and Partitions

Exterior Walls shall be made of 100mm CHB, smooth plastered at both sides, unless otherwise specified. It shall be reinforced with 10mm diameter deformed bars with horizontal spacing of 600mm. And spaced at every 3 layers vertically or otherwise specified in the plan and or by the supervising engineer. Interior wall shall be CHB 100mm partition or glass partition as specified in the plan and/or by the supervising engineer.

VIII. Ceiling

All ceilings shall be made of 1/4mm Marine Plywood supported by 50mm x 50mm good lumber or metal frames or its equivalent hard wood spaced at 0.60m on centers both ways or metal frame or otherwise specified in the plans and/or by the supervising engineer.

IX. Footings, Foundations and Walls

The bottom of all excavations for footings and foundations shall be undisturbed earth, at least 0.80m from the natural ground line, properly leveled off, tamped and approved by Civil Engineer. Excavations shall be totally free from water during the pouring of concrete.

Exterior walls shall be 100mm CHB laid at a depth of not less than 0.80m from the natural ground line, unless otherwise specified.

X. Concrete Floor and Steps on Fill

The earth or sand fill shall be laid to a uniform grade below the elevation of the finished floors, being placed in the layers not exceeding 15cm in thickness, each layer being thoroughly wetted and tamped. The said fill shall be made as the concrete walls and foundations have set sufficiently.

Slabs on fill shall be 100mm thick concrete reinforced with 10mm diameter RSB at 600mm on centers both ways or as specified in the plans and/or by the supervising engineer.

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XI. Doors and Windows

Main and exit door shall be paneled type unless otherwise specified. Bedrooms, Kitchen and service doors shall be flush type plywood constructed with finished thickness of 50mm, unless otherwise specified.

All exterior doors shall be made of water proofed marine plywood on wood studs.

All toilets doors shall be made of PVC.

Windows shall be Analok sliding window with 3/4" bronze glass/French window 1 3/4" mahogany or as otherwise specified in the plan and/or by the supervising engineer.

XII. Lumber

All kind of lumber for construction use shall be of good quality, free from knots and other defects.

Unless otherwise specified, all lumber shall be mahogany or other equivalent hardwoods.

XIII. Roofing

Long span/Twin-Rib Roofing materials and accessories shall be used for all roofing materials or as specified in the plans and/or by the supervising engineer.

XIV. Hardware

Nails, bolts, and nuts shall be of standard sizes and of good quality. Door hinges, doorknobs, locks and other hardware accessories shall be good quality.

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Plumbing

All plumbing installations shall be done in strict compliance of the plumbing code of the locality and of the National Plumbing Code of the Philippines under the supervision of a competent Master Plumber.

Philippine standard fixtures for all toilet and baths shall be used unless otherwise specified.

Use PVC materials for all sewer piping and joints and uPVC for all water lines.

The drainage pipes shall in no case be less than 100mm diameter.

The VTR pipe shall have a slope of 2%.

Vertical-to-horizontal and horizontal-to-horizontal connections shall be made of long radius and flaring provided as follows:

- Use Y and 45 degrees fitting for vertical-to-horizontal connections.
- Use long sweep elbow on horizontal changes.

XV. Painting and Varnishing

All exterior and interior walls, ceilings and other exposed surfaces shall be plain painted at both sides unless otherwise as specified in the plans and/or by the supervising engineer.

Paints and varnishes shall be fire retardant quality or mixture.

Paints to be used shall be of good quality and standard, which shall be applied strictly in accordance with the manufacturer's specifications.

Use flat paints or flat varnish for all walls and ceilings unless otherwise specified.

XVI. Finishing

All column exterior finish, shall be layered with decorative stones as per specified in the plans and/or by the supervising engineer.

XVII. Electrical

All electrical installations shall be in accordance with the Philippine Electrical Code under a supervision of a Competent Master Electrician or Professional Electrical Engineer.

PROJECT TITLE: PLANT PRODUCTION MATERIAL LABORATORY BUILDING

OWNER: DEPARTMENT OF AGRICULTURE – REGIONAL FIELD UNIT VI

SCOPE OF WORK

The scope of work to be done shall be based on the Technical specifications and Detailed estimates.
This is described as follows:

Item#	WORK TITLE	WORK DESCRIPTION
PRE	DEMOBILIZATION MOBILIZATION	Removing the existing structure. Removing of stack house, Purchasing of material, etc.
I	FOUNDATION	Lay-out and staking, Excavation, Rebers fabrication, pouring of concrete. This includes the site boundary relocation if the property line is not been established
II	CONCRETE COLUMNS	Fabrication of reber's, Fabrication of forms, Erection of scaffolding, Pouring of concrete.
III	CHB WALLS	Laying of CHB at exterior portion.
IV	SLABS ON FILLS	Preparation of sub-grade and base course, Laying of RSB, Pouring of concrete.
V	ROOF BEAMS	Erection of forms scaffolding and staging, Fabrication and laying of RSB, Pouring of concrete.
VI	ROOF and ROOF FRAMING	Fabrication and installation of roof frame, laying of rook and accessories.
VII	FORMWORKS and SCAFFOLDINGS	Fabrication, erection and demolition of the formworks as needed.
VIII	CEILING WORKS	Laying of ceiling joist, Fixing of boards
IX	DOUBLE WALL PARTITION	Installation of joist, Fixing of boards.
X	DOORS and WINDOWS	Fabrication and installation of doors and windows and their accessories.
XI	FINISHING and TILE WORKS	Roughing and finishing of laid CHB, Floor topping and laying of tiles at GR and KIT, Preparation of surface and laying of tiles at living area and wood tiles at bedrooms.
XII	KITCHEN CABINETS, CLOSETS	Fabrication and fixing of kitchen cabinets, Fabrication and fixing of closets.
XIII	PAINTING, VARNISHING	Painting of all interior and exterior surfaces of the building.
XIV	PLUMBING	Installation of drainage and water supply pipes, excavation and making of septic vault, Fixing of toilet and kitchen fixtures.
XV	ELECTRICAL	Lay-out of electrical conduits and wirings, Fixing of electrical fixtures.
POST	DEMOBILIZATION	Clearing and cleaning, Demolition of temporary structures.

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Project: PLANTING MATERIAL PRODUCTION LABORATORY
Owner: DEPT. OF AGRICULTURE REGIONAL FIELD UNIT VI
Location: DA-ILOILO ROS, Bangga Dama, Sta. Barbara, ILOILO

STRUCTURAL ANALYSIS

- I. Structural Analysis of Truss Members
- II. Structural Analysis of Slabs
- III. Structural Analysis of Beams
- IV. Structural Analysis of Column
- V. Structural Analysis of Footing
- VI. Seismic Analysis

Prepared by:


N-NIA P. OMARMAQUILLA

Civil Engineer

PRC NO.:

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TIN NO.:

931-704-910

PIR NO.:

6780029

Place Issued:

Potongan, Iloilo

Date Issued:

01/03/2024

I. Structural Analysis of Truss Members

A. Truss

(see plan for details)

a m = 1.00
b, m = 1.25
bay, m = 4.00

Tributary Area, m² = 4.000

Wind load, P_w

$$P = C_e C_q Q_s I$$

$$= 2.237$$

$$C_e = 1.13$$

$$C_q = 1.32$$

$$Q_s = 1.50$$

$$I = 1.00$$

$$P_w, KN = 8.950$$

$$\text{say } 9.00KN$$

Dead loads

$$D_{top}, KN = 2.307$$

$$\text{say } 2.40KN$$

$$D_{bot}, KN = 2.920$$

$$\text{say } 3.00KN$$

a) roofing

$$\text{unit wt} = 0.08 \text{ KPa}$$

$$\text{wt}, KN = 0.307$$

b) purlins

$$\text{unit wt} = 0.50 \text{ KPa}$$

$$\text{wt}, KN = 2.000$$

c) truss

$$\text{unit wt} = 0.40 + 0.014(6) \text{ KPa}$$

$$\text{wt}, KN = 1.920$$

d) ceiling

$$\text{unit wt} = 0.25 \text{ KPa}$$

$$\text{wt}, KN = 1.000$$

member	combined stresses, KN	section required
TOP/BOTTOM CHORD	47.11	2pc - 4mmx45mm angle bar
WEB MEMBER	37.91	2pc - 4mmx45mm angle bar

DESIGN & ANALYSIS OF TOP & BOTTOM CHORD

$$P_{axial}, KN = 47.11$$

$$10.592 \text{ kips}$$

$$\text{Length of Member, m} = 1.25$$

$$4.1 \text{ feet}$$

TRY 2 PCS - 4mmx45mm Angle Bar

Properties of One Angle

$$A_g, \text{ in}^2 = 0.541$$

$$S_x, \text{ in}^3 = 0.120$$

$$\text{wt per foot, lb/ft} = 1.243$$

$$\text{kip/ft} = 0.0012$$

CHECK:

$$f_a/F_a + f_b/F_b \leq 1.0$$

where:

$$F_a = 0.60 F_y$$

$$F_y = 36 \text{ ksi}$$

$$\frac{19.5786}{21.60}$$

+

$$\frac{0.26119}{23.76}$$

$$\leq 1.0$$

$$F_b = 0.66 F_y$$

$$0.908$$

+

$$0.010993$$

$$\leq 1.0$$

$$f_a, \text{ ksi} = P/A = 19.57857$$

$$0.908$$

+

$$0.010993$$

$$\leq 1.0$$

$$M, \text{ kip-in} = PL^2/8 = 0.031342$$

$$0.917$$

+

$$0.010993$$

$$\leq 1.0$$

$$f_b, \text{ ksi} = M/S_x = 0.261185$$

$$0.917$$

+

$$0.010993$$

$$\leq 1.0$$

$$f_b, \text{ ksi} = M/S_x = 0.261185$$

$$0.917$$

+

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+

$$0.010993$$

$$\leq 1.0$$

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$$0.917$$

+

$$0.010993$$

$$\leq 1.0$$

$$f_b, \text{ ksi} = M/S_x = 0.261185$$

$$0.917$$

+

$$0.010993$$

$$\leq 1.0$$

$$f_b, \text{ ksi} = M/S_x = 0.261185$$

Therefore, use 2 pcs - 4mmx45mm Angle Bar for top and bottom chord.

DESIGN & ANALYSIS OF VERTICAL, WEB AND DIAGONAL MEMBERS

$P_{\text{axial}}, \text{KN} = 37.91$ 8.523 kips
 $\text{Length of Member, } m = 1.60$ 5.248 feet
 TRY 2 PCS - 4mmx45mm Angle Bar Properties of One Angle
 $A_g, \text{in}^2 = 0.541$ $S_x, \text{in}^3 = 0.120$
 $\text{wt per foot, lb/ft} = 1.243$
 $\text{kip/ft} = 0.0012$

CHECK:

$$f_a/F_a + f_b/F_b \leq 1.0$$

where:

$$F_a = 0.60 F_y$$

$$F_y = 36 \text{ ksi}$$

$$F_b = 0.66 F_y$$

$$\frac{15.7538}{21.6}$$

+

$$\frac{0.42793}{23.76}$$

$$\leq 1.0$$

$$0.729$$

+

$$0.018010$$

$$\leq 1.0 \quad M, \text{ kip-in} = PL^2/8 = 0.051351$$

$$f_b, \text{ ksi} = M/S_x = 0.427926$$

$$0.747 \leq 1.0$$

(section is safe)

$$P, \text{ kips} = A_g(0.60 F_y)$$

$$= 11.586$$

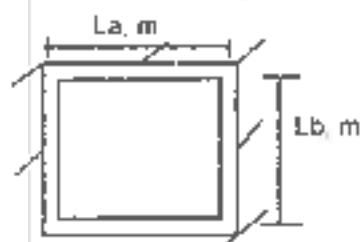
$$> 8.523$$

(section is safe)

Therefore, use 2 pcs - 4mmx45mm Angle Bar for vertical, web and diagonal members

II. Structural Analysis of Slabs

A. SECOND FLOOR SLAB (WITH OR W/O STEELDECK)



Data and Specifications:

$$f_c, \text{ MPa} = 20.70$$

$$f_y, \text{ MPa} = 275$$

$$\text{steel} = 12 \text{ mm} \varnothing \text{ RSB}$$

$$DL, \text{ KPa} = 1.00$$

$$LL, \text{ KPa} = 4.00$$

$$\gamma_c, \text{ Unit wt of concrete, KN/m} = 23.50$$

$$A_b, \text{ mm}^2 = 113.10$$

$$L_b, \text{ m} = 4.300$$

$$L_a, \text{ m} = 2.800$$

$$\rho_{\text{min}} = 0.005$$

$$m = L_a/L_b$$

$$= 0.65$$

$$< 2.0$$

Two way slab

$$\text{say } h, \text{ mm} = 125$$

$$= 0.125$$

$$d, \text{ mm} = h - \text{cover}$$

$$\text{cover, mm} = 25$$

$$= 100$$

$$m = 0.85$$

CASE 9

$$= 5.513$$

$$= 6.800$$

$$W_u = 12.313 \text{ KN/m}$$

Loads

$$W_d = 1.40(23.5(h) + DL) \times 1$$

$$W_l = 1.7(LL) \times 1$$

$$\text{SHORT SPAN, } L_a = 2.800$$

$$C_a^- = 0.063$$

$$C_{ad}^+ = 0.034$$

$$C_{aL}^+ = 0.054$$

$$M_a^- = 8.012$$

$$M_{ad}^+ = 1.094$$

$$M_{aL}^+ = 3.475$$

$$M_{a+} = 4.569$$

Note

All moment in KN-m

$$M = CW_u L^2$$

$$\phi = 0.90$$

$$b, \text{ mm} = 1 \text{ m strip} = 1000$$

$$\text{LONG SPAN, } L_b = 4.300$$

$$C_b^- = 0.008$$

$$C_{bd}^+ = 0.005$$

$$C_{bL}^+ = 0.009$$

$$M_b^- = 1.821$$

$$M_{bd}^+ = 0.379$$

$$M_{bL}^+ = 3.073$$

$$M_{b+} = 3.453$$

$$A_s, \text{ mm}^2 = \rho b d$$

$$N = A_s/bd$$

$$S_{req'd}, \text{ mm} = 1 \text{ m strip}/N$$

	$M_{a+1/3}$	$M_{a\bullet}$	M_{a-}	M_{b+}	$M_{b+1/3}$
M_{du} , KN-m	1.5230	4.569	8.012	3.453	1.1509
$M_{du}/\phi b d^2$	24.543	73.630	129.111	55.641	18.547
ρ	0.005	0.005	0.005	0.005	0.005
A_s	500	500	500	500	500
N	4.421	4.421	4.421	4.421	4.421
$S_{req'd}$, mm	452.4	452.4	452.40	452.4	452.4
S_{adopt} , mm	200	200	200	200	200

Adopt spacing for short and long span of slab as specified on the plan with 12mm ϕ reinforcing bars.

CHECK MOMENT CAPACITY OF SLAB

At support (short & long span)

$$M_u = \phi f_c b d^2 w (1 - 0.59w) \quad (\text{KN-m})$$

$$= 13.3757$$

$$w = \rho f_y / f_c$$

$$= 0.0751$$

$$\rho = 0.0057$$

$$> 4.569 \quad \text{KN-m}$$

$$> 8.012 \quad \text{KN-m}$$

Therefore, use 12mm ϕ RSB for short and long span as specified on the plan.

At midspan (short & long span)

$$M_u = \phi f_c b d^2 w (1 - 0.59w) \quad (\text{KN-m})$$

$$= 13.3757$$

$$w = \rho f_y / f_c$$

$$= 0.0751$$

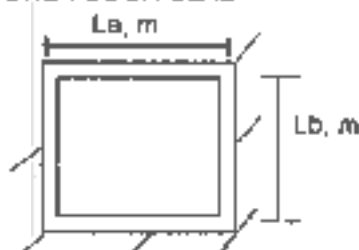
$$\rho = 0.0057$$

$$> 3.475 \quad \text{KN-m}$$

$$> 3.373 \quad \text{KN-m}$$

Therefore, use 12mm ϕ RSB for short and long span as specified on the plan

B GROUND FLOOR SLAB



Data and Specifications:

$$f_c, \text{ MPa} = 20.70$$

$$F_y, \text{ MPa} = 275$$

$$\text{steel} = 10\text{mm}\phi \text{ RSB}$$

$$DL, \text{ KPa} = 1.00$$

$$LL, \text{ KPa} = 2.00$$

$$\gamma_c, \text{ Unit wt. of concrete, KN/m} = 23.50$$

$$A_s, \text{ mm}^2 = 78.54$$

$$L_b, \text{ m} = 4.50$$

$$L_a, \text{ m} = 2.50$$

$$\rho_{min} = 0.005$$

$$d, \text{ mm} = h - \text{cover}$$

$$\text{cover, mm} = 25$$

$$m = L_a/L_b$$

$$= 0.56$$

$$< 2.0$$

Two way slab

$$\text{say } h, \text{ mm} = 100$$

$$= 0.100$$

Loads

$$W_d = 1.40(23.5(h) + DL) \times 1$$

$$W_l = 1.7(LL) \times 1$$

$$m = 0.55 \quad \text{CASE 9}$$

$$= 4.690$$

$$= 3.400$$

$$W_u = 8.090 \quad \text{KN/m}$$

SHORT SPAN, $L_s = 2.500$

$$C_a^- = 0.086$$

$$C_{ad+} = 0.037$$

$$C_{al+} = 0.063$$

$$M_{a-} = 4.348$$

$$M_{ad+} = 0.624$$

$$M_{al+} = 2.124$$

$$M_{a+} = 2.747$$

Note:

All moment in KN-m

$$M = CV_u L^2$$

$$C = 0.90$$

$$b, \text{ mm} = 1 \text{ m strip} = 1000$$

LONG SPAN, $L_b = 4.500$

$$C_b^- = 0.005$$

$$C_{bd+} = 0.003$$

$$C_{bl+} = 0.006$$

$$M_{b-} = 0.619$$

$$M_{bd+} = 0.164$$

$$M_{bl+} = 1.474$$

$$M_{b+} = 1.638$$

$$A_s, \text{ mm}^2 = \rho b d$$

$$N = A_s / b d$$

$$S_{req'd}, \text{ mm} = 1 \text{ m strip} / N$$

	Ma+/3	Ma+	Ma-	Mb+	Mb+/3
Mdu, KN-m	0.9157	2.747	4.348	1.638	0.5461
Mdu/Øbd²	26.23	78.70	124.57	46.93	15.84
ρ	0.005	0.005	0.005	0.005	0.005
As	375	375	375	375	375
N	1.592	1.592	1.592	1.592	1.592
S req'd, mm	628.32	628.32	628.32	628.32	628.32
S adopt, mm	300	300	300	300	300

Adopt spacing for short and long span of slab as specified on the plan with 10 mmØ reinforcing bars.

CHECK MOMENT CAPACITY OF SLAB

At support (short & long span)

$$Mu = \phi f_c b d^2 w (1 - 0.59w) \quad (\text{KN-m})$$

$$= 6.9903$$

$$w = \rho f_y / f_c$$

$$= 0.0696$$

$$\rho = 0.0052$$

$$> 2.747 \quad \text{KN-m}$$

$$> 4.348 \quad \text{KN-m}$$

Therefore, use 10 mmØRSB for short and long span as specified on the plan.

At midspan (short & long span)

$$Mu = \phi f_c b d^2 w (1 - 0.59w) \quad (\text{KN-m})$$

$$= 6.9903$$

$$w = \rho f_y / f_c$$

$$= 0.0696$$

$$\rho = 0.0052$$

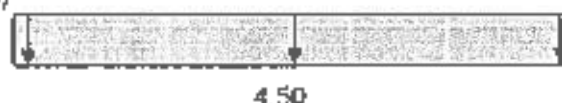
$$> 2.124 \quad \text{KN-m}$$

$$> 1.474 \quad \text{KN-m}$$

Therefore, use 10 mmØRSB for short and long span as specified on the plan.

III. Structural Analysis of Beams

A. RB1 /RB (L = 4.50m)



Mu, Kn/m	26.733	26.733
Mdu/Øbd²	239.327	239.327
ρ	0.0050	0.0050
As	300.000	300.000
N	4.974	4.974
R, KN	35.643	35.643

Data and Specifications:

$$f_c, \text{ MPa} = 20.70$$

$$f_y, \text{ MPa} = 275$$

$$\text{size, } L, \text{ m} = 4.50$$

$$b, \text{ mm} = 200$$

$$d, \text{ mm} = 300$$

$$\text{cover, mm} = 85$$

$$\text{steel, } 16\text{mmØ RSB}$$

$$A_b, \text{ mm}^2 = 201.06$$

$$\text{span length, m} = 4.50$$

$$LL, \text{ KPa} = 6.00$$

$$DL, \text{ KPa} = 1.00$$

$$\phi = 0.90$$

$$d = 135$$

$$\rho_{min} = 0.005$$

$$\gamma_c, \text{ Unit wt. of concrete, KN/m} = 23.50$$

$$\phi = 0.85$$

Loads

$$LL, \text{ KN/m} = 1.70 \times LL (1)$$

$$DL, \text{ KN/m} = 1.4(\gamma_c \times d) (1\text{m/strip}) + b(1) + DL (1)$$

$$LL, \text{ KN/m} = 10.20$$

$$DL, \text{ KN/m} = 5.64$$

$$Wu = 15.84 \quad \text{KN/m}$$

CHECK FOR FREE DESIGN

$$\rho = A_s / bd$$

$$= 0.0166$$

$$> 0.005$$

$$< 0.028$$

$$\rho_{min}$$

$$\rho_{max}$$

(SECTION IS SAFE)

CHECK FOR ITS MOMENT CAPACITY

$$Mdu / \phi b d^2 = 583.20$$

$$\frac{Mu \times 1000}{19881000} =$$

$$19881000$$

$$Mu, \text{ KN/m} = 79.945$$

$$4.0212 \quad \text{kips}$$

$$4.0212$$

$$> 26.733$$

(SECTION IS SAFE)

CHECK FOR ITS SHEAR CAPACITY

$$\phi V_c, \text{ KN} = \phi \sqrt{f_c} b d / 5$$

$$= 17.403$$

$$Vu, \text{ KN} = 35.643$$

Therefore, provide 10mmØ stirrups 1 @

0.050m, 2 @ 0.075m, 2 @ 0.100m

rest at 0.150m on center each and to

mid-height

B. B1 (L = 4.50m)



Mu, KN/m	29.601	29.601
Mdu/Øbd²	194.701	194.701
ρ	0.0050	0.0050
As	350.000	350.000
N	4.974	4.974
R, KN	39.468	39.468

Data and Specifications:

f_c, MPa = 20.70

f_y, MPa = 275

size: L, m = 4.50

b, mm = 200

d, mm = 350

cover, mm = 65

steel: 16mmØ RSB

Ab, mm² = 201.06

span length, m = 4.50

LL, KPa = 7.00

DL, KPa = 1.00

Ø = 0.90

d = 135

ρ_{min} = 0.005

γ_c, Unit wt. of concrete, KN/m = 23.50

Ø = 0.85

CHECK FOR ITS SHEAR CAPACITY

ØV_c, KN = Ø√f_cbd/6

= 17.403

V_u, KN = 39.468

Therefore, provide 10mmØ stirrups 1 @

0.050m, 5 @ 0.100m,

rest at 0.150m on center each end to mid-height

Loads

LL, KN/m = 1.70 x LL (1)

DL, KN/m = 1.4(γ_c x d) (1m/strip) + b(1) + DL (1)

LL, KN/m = 11.90

DL, KN/m = 5.64

W_u = 17.54 KN/m

CHECK FOR FREE DESIGN

ρ = As/bd

= 0.0144

> 0.005

ρ_{min}

< 0.028

ρ_{max}

(SECTION IS SAFE)

CHECK FOR ITS MOMENT CAPACITY

Mdu/Øbd² = 510.70

3.5213

kips

Mu x 1000

=

3.5213

19881000

Mu, KN/m = 70.007

>

29.601

(SECTION IS SAFE)

C. TB (L = 4.50m)



Mu, KN/m	29.601	29.601
Mdu/Øbd²	265.009	265.009
ρ	0.0060	0.0060
As	360.000	360.000
N	4.974	4.974
R, KN	39.468	39.468

Data and Specifications:

f_c, MPa = 20.70

f_y, MPa = 275

size: L, m = 4.50

b, mm = 200

d, mm = 300

cover, mm = 65

steel: 16mmØ RSB

Ab, mm² = 201.06

span length, m = 4.50

LL, KPa = 7.00

DL, KPa = 1.00

Ø = 0.90

d = 135

ρ_{min} = 0.005

γ_c, Unit wt. of concrete, KN/m = 23.50

Ø = 0.85

CHECK FOR ITS SHEAR CAPACITY

ØV_c, KN = Ø√f_cbd/6

= 17.403

V_u, KN = 39.468

Therefore, provide 10mmØ stirrups 1 @

0.050m, 2 @ 0.075m, 2 @ 0.100m

rest at 0.150m on center each end to mid-height

Loads

LL, KN/m = 1.70 x LL (1)

DL, KN/m = 1.4(γ_c x d) (1m/strip) + b(1) + DL (1)

LL, KN/m = 11.90

DL, KN/m = 5.64

W_u = 17.54 KN/m

CHECK FOR FREE DESIGN

ρ = As/bd

= 0.0134

> 0.005

ρ_{min}

< 0.028

ρ_{max}

(SECTION IS SAFE)

CHECK FOR ITS MOMENT CAPACITY

Mdu/Øbd² = 479.57

3.3062

kips

Mu x 1000

=

3.3062

19881000

Mu, KN/m = 65.730

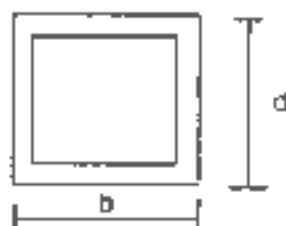
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29.601

(SECTION IS SAFE)

IV. Structural Analysis of Column

A. C1



Data and Specifications:

$$f_c, \text{MPa} = 20.70$$

$$f_y, \text{MPa} = 415$$

size:

$$b, \text{mm} = 200$$

$$d, \text{mm} = 300$$

Assume longitudinal steel: 1 - 6 %

$$p_g = 0.015$$

$$A_b, \text{mm}^2 = 201.06$$

$$P_u, \text{KN} = 397.06$$

$$\phi = 0.70$$

steel: 16mmØRSB

(maximum column load)

(for Tied Column)

$$P_u, \text{KN} = \phi(0.80)A_g(0.85f_c(1-p_g) + p_gf_y)$$

$$A_g, \text{mm}^2 = 16702.136$$

$$d^2 = 16702.14$$

$$d = 129.24$$

say

$$b = 200$$

$$d = 300$$

$$A_{st}, \text{mm}^2 = 900$$

$$N = 4.48$$

say 4 pcs

steel: 16mmØRSB

CHECK FOR ITS CAPACITY

$$P_u, \text{KN} = \phi(0.80)(0.85f_cA_g - A_{st}) + f_yA_{st}$$

$$P_u, \text{KN} = 791.484$$

$$> 397.06$$

(SECTION IS SAFE)

$$p = A_{st}/A_g$$

$$= 0.015$$

p_g is within the range (1 - 6 %)

(SECTION IS SAFE)

DESIGN OF TIES.

Spacing of ties: (smallest value)

$$a) \text{ 16 bar diameter, mm}$$

$$= 256$$

$$b) \text{ 48 tie diameter, mm}$$

$$= 480$$

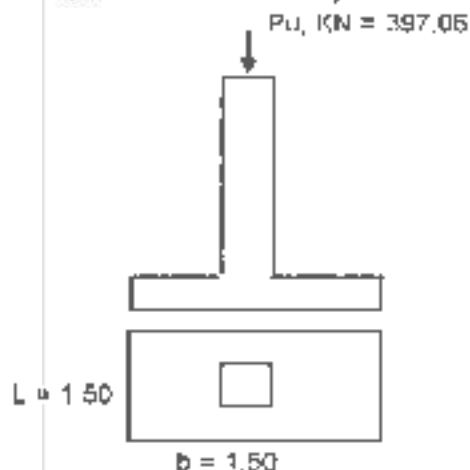
$$c) \text{ least column dimension, mm}$$

$$= 200$$

Therefore, use 10mmØ ties 3 @ 0.050m, 4 @ 0.100m, 5 @ 0.150m rest @ 0.200m O.C.

V. Structural Analysis of Footing

A. F1



Data and Specifications:

$$f_c, \text{MPa} = 20.70$$

$$f_y, \text{MPa} = 275$$

steel: 16mmØRSB

$$A_b, \text{mm}^2 = 201.06$$

$$P_u, \text{KN} = 397.06$$

$$L, \text{m} = 1.50$$

$$b, \text{m} = 1.50$$

$$t, \text{m} = 0.30$$

$$q_a, \text{KPa} = 50$$

$$\phi = 0.85$$

$$q_u, \text{KPa} = P_u/A$$

$$= 176.47$$

$$\gamma_c, \text{Unit wt of concrete, KN/m} = 23.50$$

Assume Factor of Safety = 1.50

(for maximum condition)

$$\text{Wt. of Footing, KPa} = 7.05$$

$$\text{Allowable Net Soil Pressure, } q_{all \text{ net}}, \text{KPa} = 82.85$$

$$\text{Equivalent ultimate load, KPa} = 124.43$$

$$> 150$$

(SECTION IS SAFE)

CHECKING

A) PUNCHING SHEAR

$$\begin{aligned}\text{Average } d, \text{ mm} &= 214 \\ \text{Ultimate Shear, } V_u \text{ (MN)} &= 0.1944 \\ \text{Required } V_n, \text{ MN} &= 0.229 \\ v, \text{ MPa} &= V_n/bd \\ &= 0.347\end{aligned}$$

$$\begin{aligned}v_{\text{allowable}}, \text{ MPa} &= \sqrt{f_c/3} \\ &= 1.517 \\ &> 0.347 \\ &\text{(SECTION IS SAFE)}\end{aligned}$$

B) FOR SHEAR

$$\begin{aligned}d, \text{ mm} &= 222 \\ V_u, \text{ MN} &= q_u(b)(y) \\ &= 0.020 \\ \text{Required } V_n, \text{ MN} &= V_u/\phi \\ &= 0.024 \\ v, \text{ MPa} &= V_n/bd \\ &= 0.039\end{aligned}$$

$$\begin{aligned}v_{\text{allowable}}, \text{ MPa} &= \sqrt{f_c/6} \\ &= 0.758 \\ &> 0.039 \\ &\text{(SECTION IS SAFE)}\end{aligned}$$

C) FOR MOMENT

$$\begin{aligned}M_u, \text{ KN} &= q_u(b)(x)(x/2) \\ M_u, \text{ KN} &= 0.0476 \\ \text{Try using 8 pcs 16mm}\phi\text{RSB} \\ A_s \text{ actual, mm}^2 &= 1608.50\end{aligned}$$

$$\begin{aligned}\rho_{\text{actual}} &= A_s/bd \\ &= 0.0145 \\ &> 0.005 \quad \rho_{\text{min}} \\ &< 0.028 \quad \rho_{\text{max}} \\ \rho_{\text{actual}} &\text{ is within the range} \\ &\text{(SECTION IS SAFE)}\end{aligned}$$

D) FOR DEVELOPMENT LENGTH, L_d

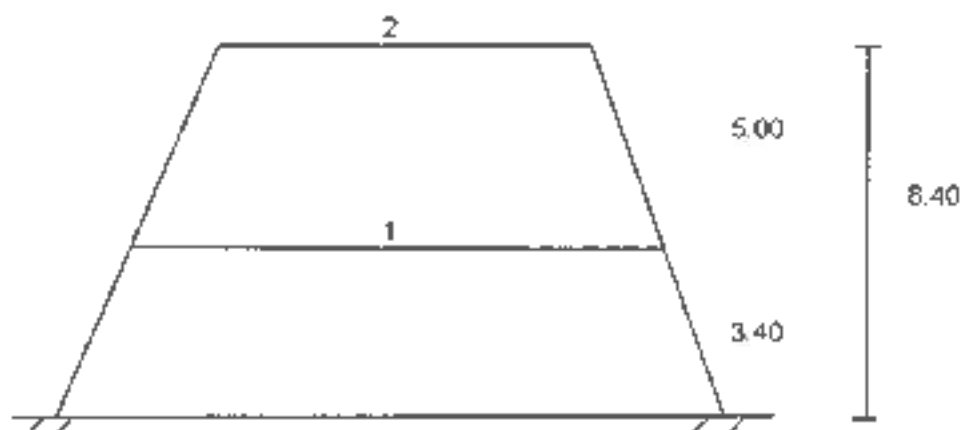
using 16mm ϕ RSB

$$\begin{aligned}L_d, \text{ mm} &= 0.02 A_b(f_y)/\sqrt{f_c} \\ &= 243.057\end{aligned}$$

$$\begin{aligned}< 600 \text{ mm} \\ &\text{(SECTION IS SAFE)}\end{aligned}$$

VI. Seismic Analysis

A. FRAME



B. WEIGHT OF STRUCTURE

LEVEL 1	KN
column	397.06
LEVEL 2	
column	397.06
slab	52.94
beam	78.93
	628.93

C. SEISMIC LOAD

level	W (KN)	h (M)	W x h	f	F	1.10F
1	397.06	0	0	0	0	0
2	526.93	6.40	4443.02	432.44	216.22	237.84
	925.99		4443.02			237.84

Base Shear, V

$V, KN = ZICW/R_w$

$V, KN = 432.44$

$V, KN = 432.44$

> 237.84

(SECTION IS SAFE)