Freeman Design and Surveying Consultancy Ltd Rockingham House, 92 Church Street, Swinton, Rotherham, S64 8DQ	Project Proposed Bungalow, St Georges Road, Barnsley				Job Ref. FC2024.170	
	Section Raft Foundation				Sheet no./rev. 1	
	Calc. by RF	Date 14/11/2024	Chk'd by	Date	App'd by	Date

NOTES FOR BUILDERS AND DEVELOPERS/CLIENT

1. **These works will need to comply with CDM 2015 and the client must appoint either the builder or other suitably qualified parties to act as 'Principal Designer' as required under the Act.**
2. **The builder must carry suitable insurances for the works, prepare a specific risk assessment and have expertise in undertaking the operations required to satisfactorily complete these works in a safe manner at all times.**
3. **Where parts of an existing structure are to be modified then such parts must be fully supported until such time as the new permanent structure is in place. Walls may require needle propping both sides using props of suitable size and capacity and to be supported of solid ground (not timber joists or other suspended construction). Allowance must be made for temporary propping against wind loads where necessary.**
4. **Steel or timber beams may require fire protection (min 30mins) subject to the specification.**
5. **Where new structure sits into a party wall then the 'Party Wall Etc. Act' will most likely apply and all necessary steps will need to be entered into in formally notifying neighbours of the works as required under the Act. The Architect to advise as necessary.**
6. **All dimensions for structural components must be measured on site and not taken from these calculations (eg. beam/column lengths). Lengths must allow for adequate bearing onto supports.**
7. **Any deviation from the drawings must be brought to the attention of Freeman Consultancy as these may affect design assumptions.**

Introduction:

The following works involve the construction of a single storey dwelling. These calculations justify a raft foundation to be adopted. The calculations are prepared from drawings and measurements by White Agus Ltd.

A raft solution is proposed to deal with ground conditions to cope with a potential fault line as identified in a recent site investigation report by Lyons CMC. The raft will be designed to limit ground bearing pressures to less than 75Kn/m^2 and span a notional 3.0m soft spot.

Loading:

Roof:

Tiles on timbers + insulation = 0.85Kn/m^2
Plasterboard + skim = 0.15Kn/m^2
Services = 0.10Kn/m^2
Total Dead Load = 1.10Kn/m^2
Imposed Load = 0.60Kn/m^2 (snow)
0.25Kn/m^2 (ceiling where applicable)

Ground Floor:

65mm screed on insulation = 1.80Kn/m^2 dead
Floor slab: 3.54Kn/m^2
Imposed = 1.50Kn/m^2

Walls:

100mm blockwork + plaster = 2.0Kn/m^2

102mm brickwork = 2.10Kn/m^2

100mm partition + plaster = 0.50Kn/m^2

A raft foundation is to be adopted to to keep ground bearing pressures within a range of 75-100Kn/m^2

Assume an edge beam profile as shown on Detail 1.

Slab weight say 0.15 ×23.6 = 3.54Kn/m^2

Imposed load 1.5Kn/m^2 2.5Kn/m^2 (Garage)

Edge beam weight say 8.0Kn/m (0.75×0.45×23.6)

Consider Front/Rear Walls:

Wall 2.75×(2.1+2.0) = 11.30Kn/m dead

Ground Floor: 3.0/2 × 5.34 = 8.01Kn/m dead

3.0/2 × 1.50 = 2.25Kn/m imp

Roof: 11.5/2 × 1.10 = 6.33Kn/m dead

11.5/2 × (0.60+0.25) = 4.90Kn/m imp

Fnd = 8.0Kn/m dead

Hence total DL = 33.64Kn/m Total IL = 7.15Kn/m

BM = (33.64×1.4)+(7.15×1.6)×3.0^2/10 = 52.68Knm

SF = 58.54×3.0/2 = 87.8Kn

RC SLAB DESIGN (BS8110)

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab h = **450** mm

Cover to tension reinforcement resisting sagging c_b = **35** mm

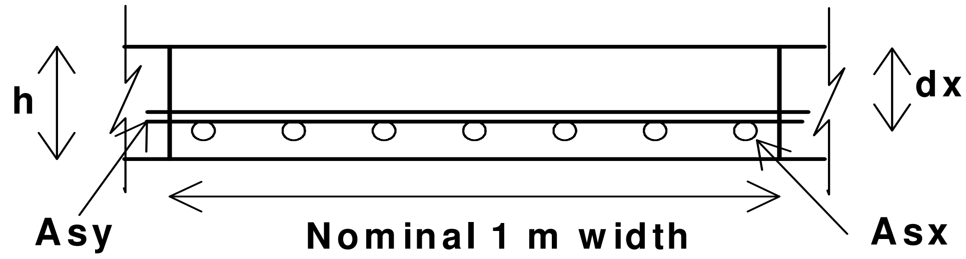
Trial bar diameter D_{tryx} = **10** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **410** mm

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **35** N/mm^2



One-way spanning slab
(simple)

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) m_{sx} = **52.7** kNm/m

CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)

Design sagging moment (per m width of slab) m_{sx} = **52.7** kNm/m

Moment Redistribution Factor β_{bx} = **1.0**

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.009**

$K'_x = \min (0.156 , (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2))$ = **0.156**

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

$z_x = \min ((0.95 \times d_x),(d_x\times(0.5+\sqrt{(0.25-K_x/0.9)})))$ = **390** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **46** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **311** mm^2/m

Tension steel

Provide 10 dia bars @ 100 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx}$ = **785** mm^2/m ×0.7 = 550mm^2 + 4 wires A252 = 102mm^2 = 652mm^2

Area of outer tension steel provided sufficient to resist sagging

TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 10 dia bars @ 100 centres

$A_{sy\_prov} = A_{sy}$ = **785** mm^2/m

Check min and max areas of steel resisting sagging

Total area of concrete A_c = h = **450000** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **585** mm^2/m

$A_{st\_max} = 4 \% \times A_c$ = **18000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **785** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **785** mm^2/m

Area of inner steel provided (sagging) OK

SHEAR RESISTANCE OF CONCRETE SLABS (CL 3.5.5)

Outer tension steel resisting sagging moments

Depth to tension steel from compression face d_x = **410** mm

Area of tension reinforcement provided (per m width of slab) A_{sx_prov} = **785** mm^2/m

Design ultimate shear force (per m width of slab) V_x = **88** kN/m

Characteristic strength of concrete f_{cu} = **35** N/mm^2

Applied shear stress

$v_x = V_x / d_x$ = **0.21** N/mm^2

Check shear stress to clause 3.5.5.2

$v_{allowable} = \min ((0.8\ N^{1/2}/mm) \times \sqrt{(f_{cu})}, 5\ N/mm^2) =$ **4.73** N/mm^2

Shear stress - OK

Shear stresses to clause 3.5.5.3

Design shear stress

f_{cu_ratio} = if (f_{cu} > 40 N/mm^2 , 40/25 , f_{cu}/(25 N/mm^2)) = **1.400**

$v_{cx} = 0.79\ N/mm^2 \times \min(3,100 \times A_{sx\_prov} / d_x)^{1/3} \times \max(0.67,(400\ mm / d_x)^{1/4}) / 1.25 \times f_{cu\_ratio}^{1/3}$

v_{cx} = **0.40** N/mm^2

Applied shear stress

v_x = **0.21** N/mm^2

No shear reinforcement required

Adopt 7 T10 bars from B785 mesh + 4 bars A252 – Ast = 652mm^2 > 585mm^2

Slab:

BM = ((5.34×1.4)+(1.50×1.6))×3.0^2/8 = 8.88Knm/m

SF = ((5.34×1.4)+(1.50×1.6))×3.0/2 = 14.8Kn/m

RC SLAB DESIGN (BS8110)

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab h = **150** mm

Cover to tension reinforcement resisting sagging c_b = **35** mm

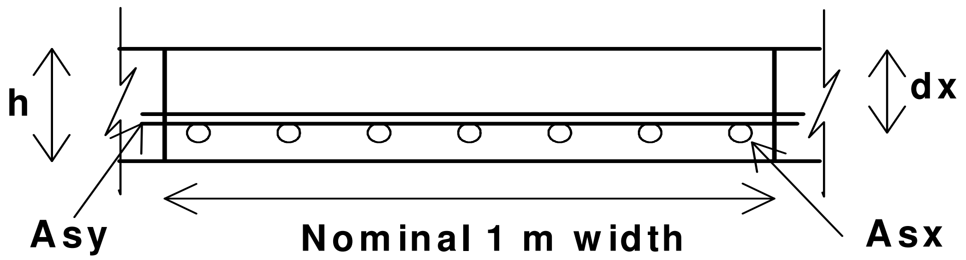
Trial bar diameter D_{tryx} = **8** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **111** mm

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **35** N/mm^2



One-way spanning slab
(simple)

<u>ONE WAY SPANNING SLAB (CL 3.5.4)</u>

<u>MAXIMUM DESIGN MOMENTS IN SPAN</u>

Design sagging moment (per m width of slab) m_{sx} = **8.9** kNm/m

<u>CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)</u>

Design sagging moment (per m width of slab) m_{sx} = **8.9** kNm/m

Moment Redistribution Factor β_{bx} = **1.0**

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.021**

$K'_x = \min (0.156 , (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2))$ = **0.156**

Outer compression steel not required to resist sagging

<u>One-way Spanning Slab requiring tension steel only (sagging) - mesh</u>

$z_x = \min ((0.95 \times d_x),(d_x \times (0.5+\sqrt{(0.25-K_x/0.9)})))$ = **105** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **12** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **194** mm^2/m

Tension steel

<u>Use A252 Mesh</u>

$A_{sx\_prov} = A_{sl}$ = **252** mm^2/m $A_{sy\_prov} = A_{st}$ = **252** mm^2/m

$D_x = d_{sl}$ = **8** mm $D_y = d_{st}$ = **8** mm

Area of tension steel provided sufficient to resist sagging

<u>Check min and max areas of steel resisting sagging</u>

Total area of concrete $A_c = h$ = **150000** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **195** mm^2/m

$A_{st\_max} = 4\ \% \times A_c$ = **6000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **252** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **252** mm^2/m

Area of inner steel provided (sagging) OK

SHEAR RESISTANCE OF CONCRETE SLABS (CL 3.5.5)

Outer tension steel resisting sagging moments

Depth to tension steel from compression face d_x = **111** mm

Area of tension reinforcement provided (per m width of slab) A_{sx_prov} = **252** mm^2/m

Design ultimate shear force (per m width of slab) V_x = **15** kN/m

Characteristic strength of concrete f_{cu} = **35** N/mm^2

Applied shear stress

$v_x = V_x / d_x$ = **0.13** N/mm^2

Check shear stress to clause 3.5.5.2

$v_{allowable} = \min((0.8\ N^{1/2}/mm) \times \sqrt{(f_{cu})}, 5\ N/mm^2)$ = **4.73** N/mm^2

Shear stress - OK

Shear stresses to clause 3.5.5.3

Design shear stress

f_{cu_ratio} = if (f_{cu} > 40 N/mm^2 , 40/25 , f_{cu}/(25 N/mm^2)) = **1.400**

$v_{cx} = 0.79\ N/mm^2 \times \min(3,100 \times A_{sx\_prov} / d_x)^{1/3} \times \max(0.67,(400\ mm / d_x)^{1/4}) / 1.25 \times f_{cu\_ratio}^{1/3}$

v_{cx} = **0.59** N/mm^2

Applied shear stress

v_x = **0.13** N/mm^2

No shear reinforcement required

Hence: Adopt 150mm thk slab reinforced with A252 mesh top and btm:

Ground Bearing Pressure:

Total unfactored load = 41Kn/m

41.0/0.75 = 55Kn/m^2 < 75Kn/m^2 Hence satisfactory:

NOTE Building Control to approve sub-strate:

By inspection adopt same section for all edge conditions:

Consider Internal wall between lounge/bed 3:

Wall 2.5×(2.0) = 5.0Kn/m dead

Ground Floor: 3.0/2 × 5.34 = 8.01Kn/m dead

3.0/2 × 1.50 = 2.25Kn/m imp

Roof: 11.5/2 × 1.10 = 6.33Kn/m dead

11.5/2 × (0.60+0.25) = 4.90Kn/m imp

Fnd = 8.0Kn/m dead

Hence total DL = 27.34Kn/m Total IL = 7.15Kn/m

BM = (27.34×1.4)+(7.15×1.6)×3.0^2/10 = 44.75Knm

SF = 58.54×3.0/2 = 75.6Kn

RC SLAB DESIGN (BS8110)

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab h = **600** mm

Cover to tension reinforcement resisting sagging c_b = **40** mm

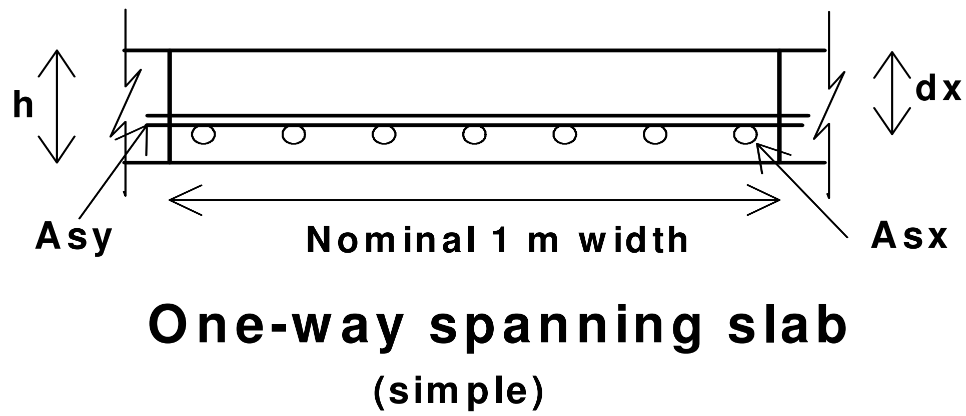
Trial bar diameter D_{tryx} = **10** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **555** mm

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **40** N/mm^2



ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) m_{sx} = **44.8** kNm/m

CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)

Design sagging moment (per m width of slab) m_{sx} = **44.8** kNm/m

Moment Redistribution Factor β_{bx} = **1.0**

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.004**

$K'_x = \min (0.156 , (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2))$ = **0.156**

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

$z_x = \min ((0.95 \times d_x),(d_x \times (0.5+\sqrt{(0.25-K_x/0.9)})))$ = **527** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **62** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **195** mm^2/m

Tension steel

Provide 10 dia bars @ 100 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx}$ = **785** mm^2/m 6 bars = 471mm^2

Area of outer tension steel provided sufficient to resist sagging

TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 10 dia bars @ 100 centres

$A_{sy\_prov} = A_{sy}$ = **785** mm^2/m

Check min and max areas of steel resisting sagging

Total area of concrete A_c = hx600 = 3600 mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = 468 mm^2/m

$A_{st\_max} = 4 \% \times A_c$ = **24000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **468** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **468** mm^2/m

Area of inner steel provided (sagging) OK

SHEAR RESISTANCE OF CONCRETE SLABS (CL 3.5.5)

Outer tension steel resisting sagging moments

Depth to tension steel from compression face d_x = **555** mm

Area of tension reinforcement provided (per m width of slab) A_{sx_prov} = **785** mm^2/m

Design ultimate shear force (per m width of slab) V_x = **76** kN/m

Characteristic strength of concrete f_{cu} = **40** N/mm^2

Applied shear stress

$v_x = V_x / d_x$ = **0.14** N/mm^2

Check shear stress to clause 3.5.5.2

$v_{allowable} = \min ((0.8\ N^{1/2}/mm) \times \sqrt{(f_{cu})}, 5\ N/mm^2)$ = **5.00** N/mm^2

Shear stress - OK

Shear stresses to clause 3.5.5.3

Design shear stress

f_{cu_ratio} = if (f_{cu} > 40 N/mm^2 , 40/25 , f_{cu}/(25 N/mm^2)) = **1.600**

v_{cx} = 0.79 N/mm^2 × min(3,100 × A_{sx_prov} / d_x)$^{1/3}$ × max(0.67,(400 mm / d_x)$^{1/4}$) / 1.25 × $f_{cu\_ratio}^{1/3}$

v_{cx} = **0.35** N/mm^2

Applied shear stress

v_x = **0.14** N/mm^2

No shear reinforcement required

<u>**Hence: Internal thickening 600mm wide x 600mm deep reinforced with B785 mesh top and btm:**</u>