STRUCTURAL DESIGN TO SUPERSTRUCTURE TERRACED APARTMENTS @ TAS-SELLUM GHADIRA

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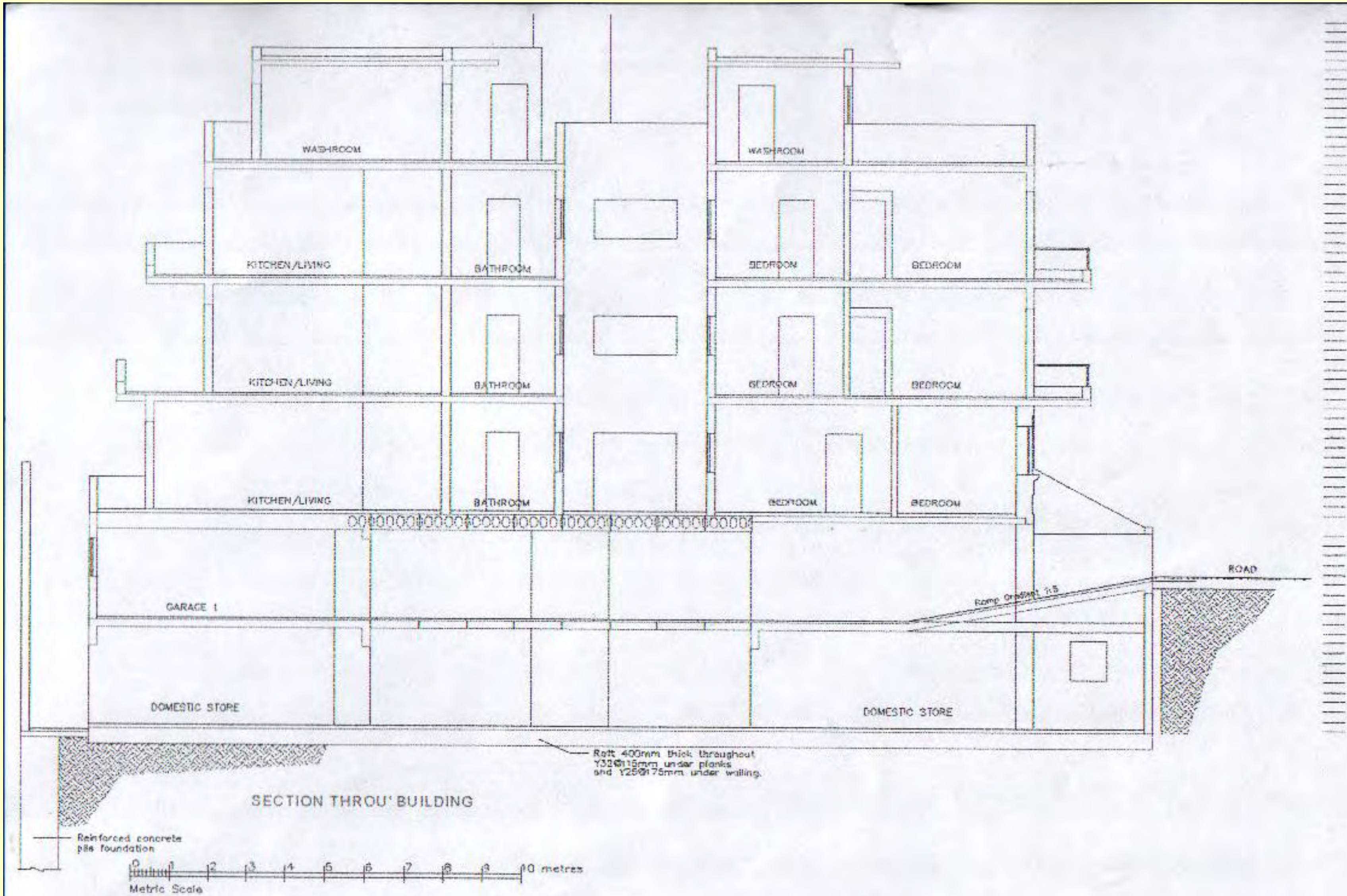
BICC – CPD 22/04/05

BUILDINGS ON HAZARDOUS GROUND


WASHROOM
WASHROOM
KITCHEN/LIVING
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BEDROOM
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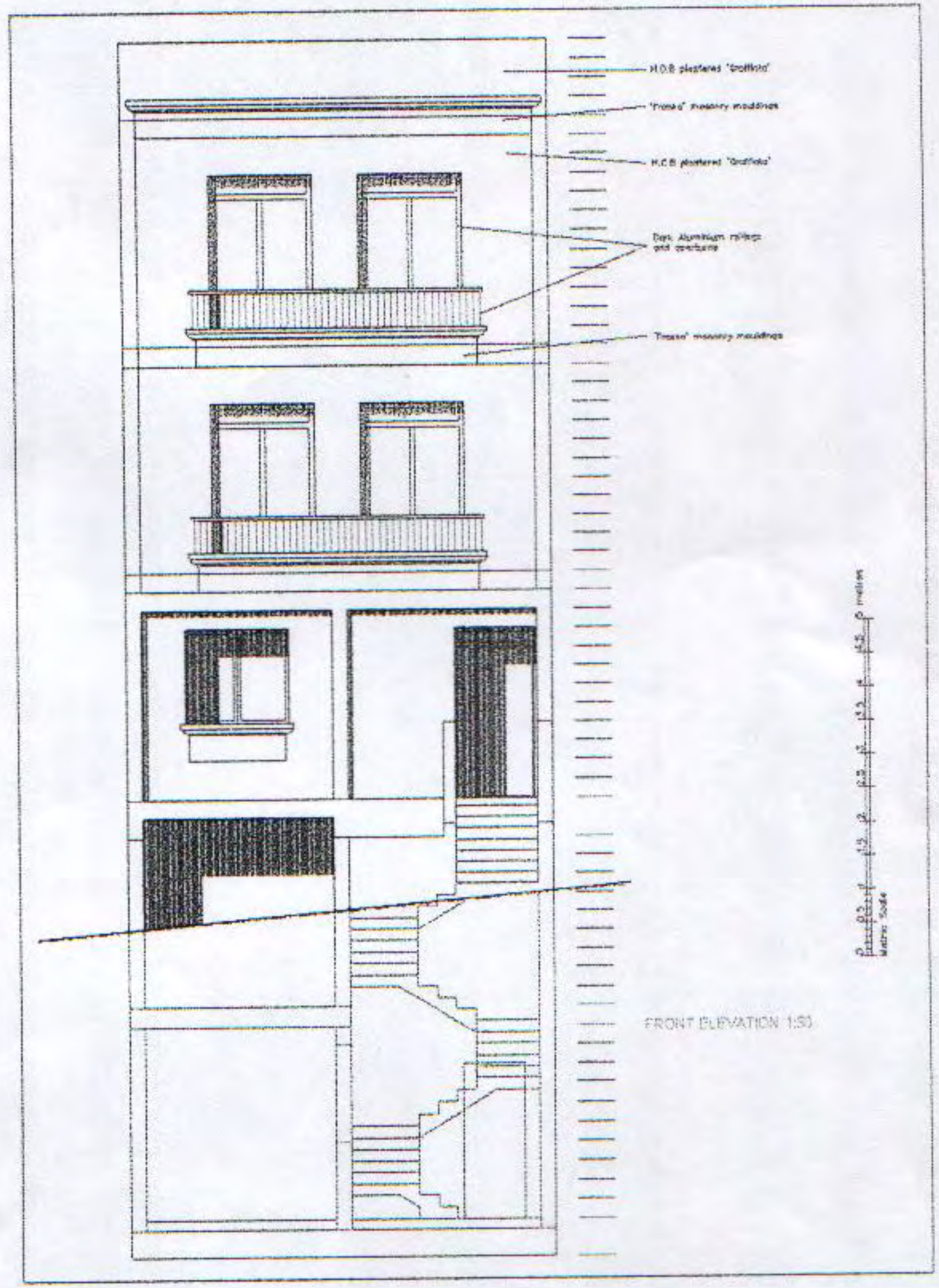
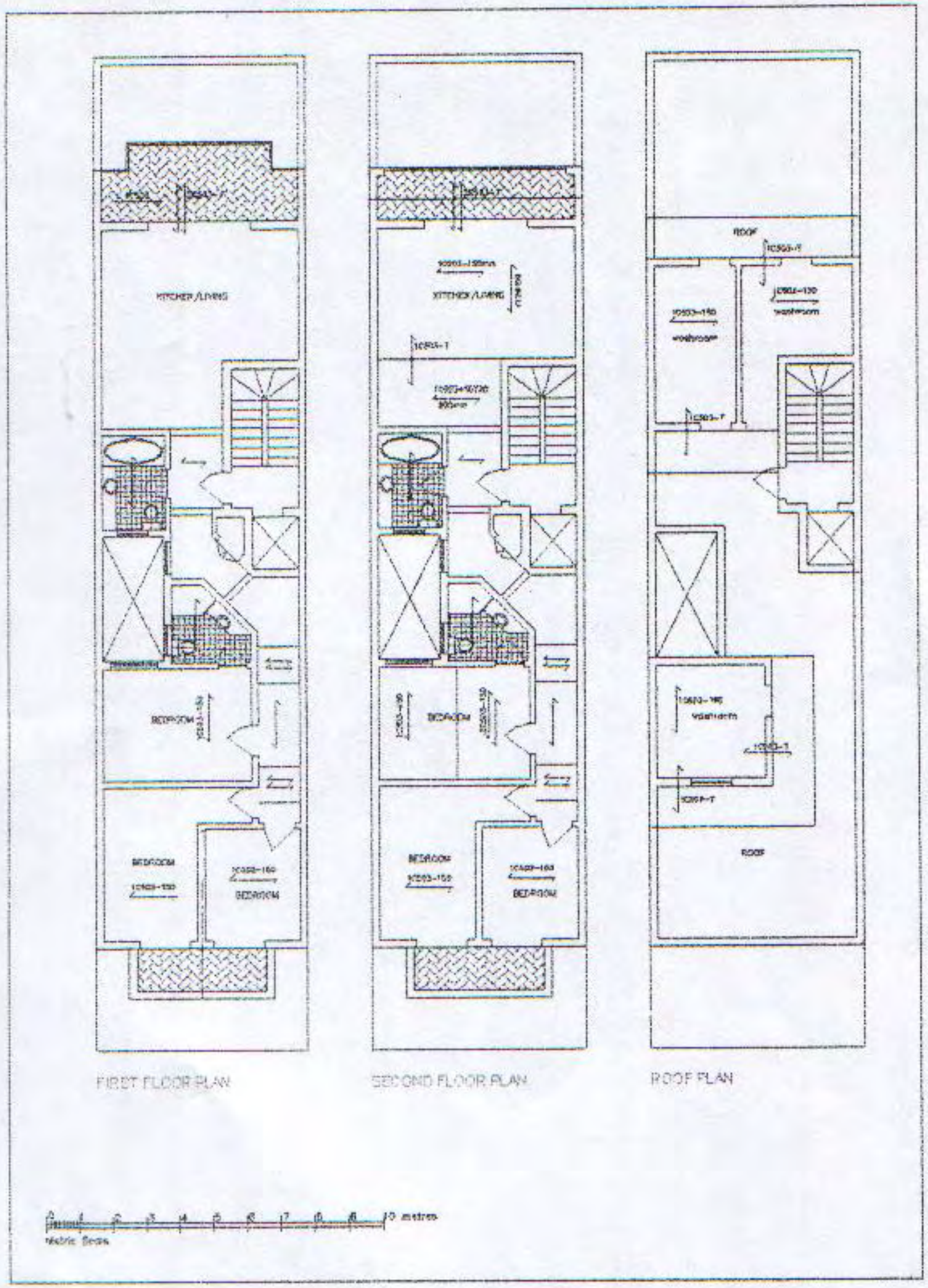
BEDROOM
KITCHEN/LIVING
BATHROOM
BEDROOM
BEDROOM
GARAGE 1
ROAD
Ramp gradient 1:5
DOMESTIC STORE
DOMESTIC STORE
Raft 400mm thick throughout
Y32@115mm under planks
and Y25@175mm under walling.
SECTION THROU' BUILDING
Reinforced concrete
pile foundation
0 1 2 3 4 5 6 7 8 9 10 metres
Metric Scale



FRONT ELEVATION 1:50


KITCHEN/LIVING
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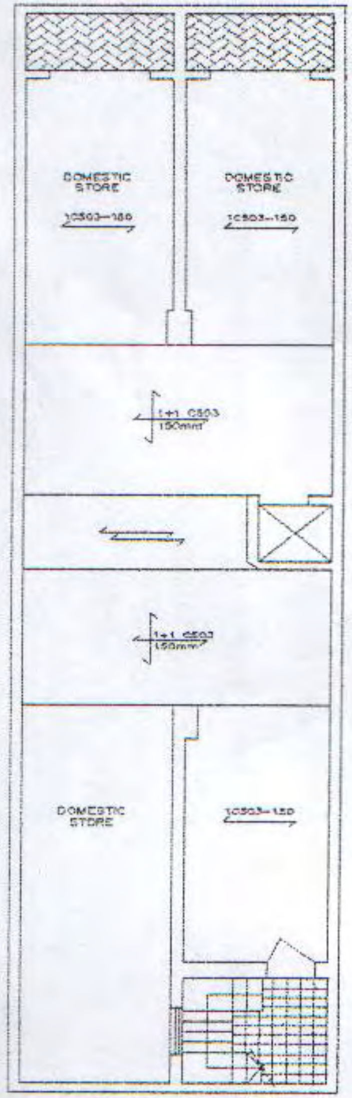
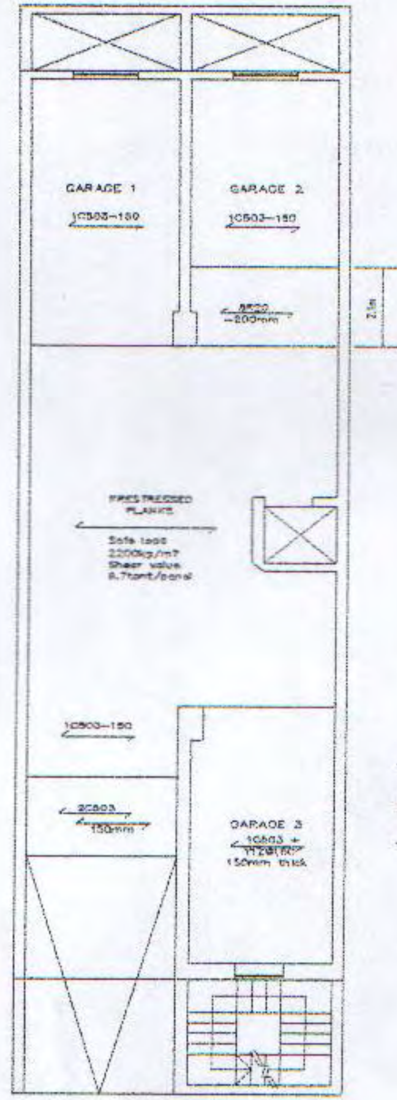
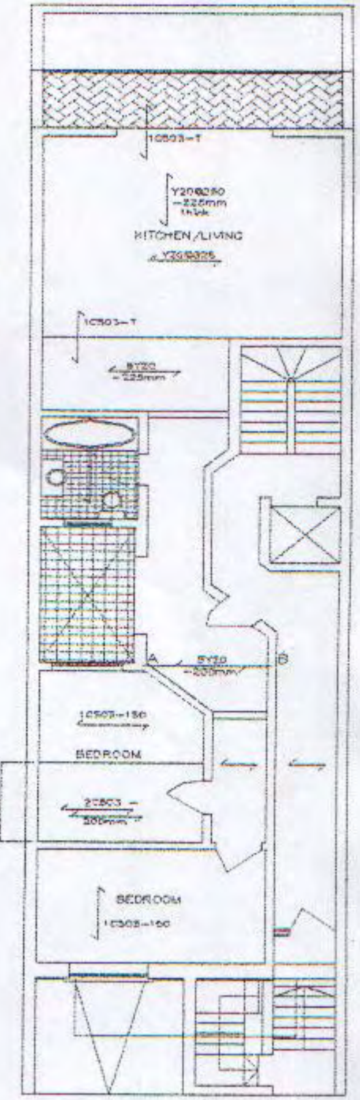
washroom
washroom
washroom
ROOF
FIRST FLOOR PLAN
SECOND FLOOR PLAN
ROOF PLAN
10 metres
Metric Scale



LOWER BASEMENT PLAN



UPPER BASEMENT PLAN



GROUND FLOOR PLAN

0 1 2 3 4 5 6 7 8 9 10 metres
Metric Scale

BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Project: Tas-Sellum Apartment Blk.	Job ref:
	Part of Structure: Upper Floor Slabs	Sheet No. PO 1 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05

Ref:	Calculations	Output
	LOADINGS TO BS8110:-	
	concrete slab 0.15 $24kN/m^3$ $\overset{1.4}{=>}$ $5.04kN/m^2$	
	finish 0.10 $18kN/m^3$ $\overset{1.4}{=>}$ $2.52kN/m^2$	
	LL $1.5kN/m^2$ $\overset{1.6}{=>}$ $2.40kN/m^2$	
	≈ $10.0kN/m^2$	
	for each 25mm extra thickness at floor slab	
	add 0.025.24 $\overset{1.4}{=>}$ $0.85kN/m^2$	
	Design of Internal Bedroom slab at 2nd floor	
	taking washroom concrete b/w walling	ℓ_e => 3.5m
	wt of walling 1.0kN/m/fil x 10crs $\overset{1.4}{=>}$ 14kN/m	
	spread over 0.3L x 2 + 0.225m	
	=> 0.3.3.5.2 + 0.225 => 2.325m	
	say 2.1m (width of C503)	
	loading inclusive of partition load	
	= 10kNsqm + 14KN/m / 2.1m => 16.67kN/m	
	BM => $16.67 \times 3.5^2/8$ => 25.5kN.m/m	d => 150 -
	k => $M/bd^2.f_{cu}$ => $25.5/1.125^2.20$ => 0.082	20 - 5
	a_1 => Z/d => 0.9Z => 0.9 x 125 => 112.5mm	=> 125
	A_s => $M/(0.87f_y)Z$ => 25.5 / 0.87 x 460 x 112.5 => $566mm^2/m$	
	Deflection check	
	Modification factor for M/bd^2 => 2 is 1.47	
	as steel stress is 0.58.460 566/1010 => $150N/mm^2$	
	span / df_1 => 3500(12 x 5 x 1.47) => 19 < 20 ok	

BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Project Tas-Sellum Apartment Blk.			Job ref:
	Part of Structure Upper Floor Slabs			Sheet No. PO 2 / 1
	Drawing ref:	Done by: DHC	Chkd By:	Date 03/05
Ref:	Calculations			Output

DESIGN OF 2ND FLOOR SLAB TAKING WASHROOMS AT REAR

2 way panel 6m x 4m ℓ_y / ℓ_x => 6/4 => 1.5

span / d => 28 d => 4000/28 => 143mm

Output: h => 143 + 20 + 5 => 168mm say 180mm

Total loading from washroom construction

roof slab 4m x 3m x 10kN/m^2 => 120kN

1.4

partition 9m x 1Kn/m/fil x 11crs => 139kN

259kN

Total u.d.l on this 2nd floor slab

10kN/m^2 + 0.85kN/m^2 + 259kN / 6m / 4m => 21.65kN/m^2

for 2-way spanning α_{sx} => 0.104 α_{sy} => 0.046

M_{sx} => 0.104.21.65.4^2 => 36kNm/m

Output: d => 180 - 20 - 10 => 150

M_{sy} => 0.046.21.65.4^2 => 15.93kN.m/m

k => $M/bd^2.f_{cu}$ => 36/1.150^2.20 => 0.067

a_1 => Z/d => 0.91 => 0.91 x 150 => 136.5mm

A_s => $M/(0.87f_y)Z$ => 36/0.87 x 460 x 150 => 600mm^2/m

Deflection check

Modification factor for M/bd^2 => 1.6 is 1.18

span / d.f_1 => 4000 / 150 x 1 x 18 => 22.6 > 20

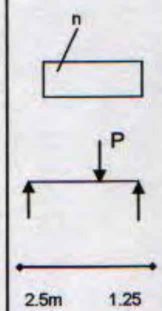
Modification factor required at 1.33 so increase

A_s to 754mm^2 / m to give a steel stress of

0.58 x 460 x 600 / 754 => 212N/mm^2

	Project: Tas-Sellum Apartment Blk.	Job ref:
BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Part of Structure: Upper Floor Slabs	Sheet No. PO 3 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

BEAM STRIP 3.75M TAKING 2-WAY LOADING



ℓ_e => 0.3.375m => 1.125m

P => 10kN/m^2.2m + (10crs 1kN/m/fil) 1.4 => 34kN/m

n => 21.65kN/m^2.2m + 10.85kN/m^2.2m => 65kN/m

BM => (34.2.5.125/3.75)2 + 65 x 3.75^2/8 => 171.kN.m/m

k => M/bd^2.f_{cu} => 171/2.170^2.20 => 0.148

d => 2000 - 20 - 10 => 170mm

a_1 => Z/d => 0.78 Z => 0.78.170 => 132mm

A_s => M/(0.87f_y)Z => 171/0.87.460.170 => 2513mm^2/m

i.e IC503 + 6.4Y - 20/m

V => 65kN x 3.75m/2 + 34kN x 2 x 25 / 3.75 => 145kN

τ => 2513/1.170 => 1.48% v_c => 0.94N/mm^2

v => 145kN / 1m.170mm => 0.35N / mm^2 < 0.94N/mm^2 ✓

Design of Ground Floor Kitchen Slab taking PIERS

2-Way panel 6m x 5.5m

ℓ_y / ℓ_x => 6 / 5.5 => 1.09

α_{sx} => 0.074 α_{sy} => 0.061

span / d => 28 d => 5,500 / 28 => 196mm

h => 196 + 20 + 5 => 221 say 225mm

PIER LOADING :-

2nd flr. (2+1.5)m x 3m x 21.65kN/m^2 => 227kN

1st flr. (2 + 2.25m) x 3m x 10.85kN/m^2 => 138kN

365kN

	Project Tas-Sellum Apartment Blk.	Job ref:
BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Part of Structure Upper Floor Slabs	Sheet No. PO 4 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

total udL on this ground floor slab

$10kN/m^2 + 0.85kN/m^2 \times 3 + (2in\ No \times 365kN)/6m/5.5m$

=> 34.67kN/sqm

M_{sx} => $0.074.35kN/m^2 5.5^2$ => 78.35kN.m/m

d => 225 - 20 - 10 => 190

M_{sy} => $0.061.35kN/m^2 5.5^2$ => 64.58kN.m/m

k => $M/bd^2.f_{cu}$ => $78.35/1.190^2.20$ => 0.1085

k => $M/bd^2.f_{cu}$ => $64.58/1.190^2.20$ => 0.089

a_1 => Z/d => 0.86 ¢ 0.89

Z => 0.86.190 => 163mm 0.89.190 => 169mm

A_s => $M/(0.87f_y)Z$

=> 78.35 / (0.87.460) / 163 => 1201sqmm/m — Y20 @ 250 ($1260mm^2/m$)

=> 64.58 / (0.87.460) / 169 => 955sqmm / m — Y20 @ 325 ($969mm^2/m$)

Deflection Check

Modification factor f_1 for M/bd^2 => 2.17 is 1.05

span / d f_1 => 4000 / 190.1.05 => 20 ✓

<u>Beam strip 3.75m taking 2-WAY Loading:-</u>

u.d.ℓ => $35kN/m^2.5.5m/3 + (10 + 0.85.3)\ kN/m^2.2m$

=> 89.27kN/m

BM => $90kN/m^2 . 3.75^2/8$ => 158kNm

k => $M/bd^2.f_{cu}$ => $158 / 2.190^2.20$ => 0.109

a_1 => Z/d => 0.86

Z => 0.86.190 => 163mm

A_s => $M/(0.87f_y)$ Z => 158/(0.87.460)/163 => $2422mm^2/m$ 8Y20

BICC Building Industry Consultative Council	Project: Tas-Sellum Apartment Blk.			Job ref:
	Part of Structure: Upper Floor Slabs			Sheet No. PO 5 / 1
	Drawing ref:	Done by: DHC	Chkd By:	Date 03/05
Ref:	Calculations			Output

BEAM STRIP A - B @ GROUND FLOOR 2.75m

Load/m 10kN/m^2 6m / 2 x 2 floors + (10crs 0.9)1.4

=> 72.6kN/m

BM => 75kN/m . 2.75^2/8 => 70.9Nm

k => M/bd^2.f_{cu} => 70.9 / 1.170^2.20 => 0.123

a_1 => Z/d => 0.83 Z => 0.83.170 => 141mm

A_s => M/(0.87f_y)Z => 70.9 / 0.87.460.141 => 1256mm^2

R_A => R_B => 75kN/m.275m/2 => 103kN

Output: d => 200 - 20 - 10 => 170

DESIGN OF END STAIRWELL WALLING

SUPPORTED AT UPPER BASEMENT - 3.0M

due to arching effects loading from ground floor only
load / m => 35kN/m.5.75m/3 + (1.35.10.00)1.4
+ (10kN/sqm + 3.0.85kN/sqm) => 111.5kN/m

BM => 115kN/m . 3^2 / 8 => 129kNm

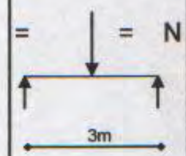
k => M/bd^2.f_{cu} => 129 / 2.1.170^2.20 => 0.106

a_1 => Z/d => 0.87 Z => 0.87.170 => 148mm

A_s => M/(0.87f_y)Z => 129/0.87.460.148 => 2176mm^2

BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Project: Tas-Sellum Apartment Blk.	Job ref:
	Part of Structure: Upper Basement Slab	Sheet No. PO 6 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

DESIGN OF CORRIDOR WALL SUPPORTED BY GARAGE 3



N => 10kN/m^2.3m / 2 x 2flrs + (0.9kN/m/fil.15crs)1.4

=> 48.9kN/m

BM => 50kN/m .3m / 4 + 10kN/m^2 x 3^2 / 8 => 48.75kN.m/m

k => M/bd^2.f_{cu} => 0.156

a_1 => Z/d => 0.775 Z => 0.775.125 => 97mm

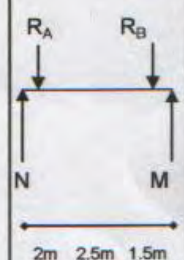
A_s => M/(0.87f_y) Z => 48.75 / 0.87.460.97 => 1255mm^2/m

V => 50kN/m / 2 + 10kN/m^2 x 3m / 2 => 40kN/m

r => 1255 / 1.125 => 1% V_c => 0.86N/mm^2

v => 40kN/m / 1m.125mm => 0.32N / mm^2 √

PRESTRESSED PLANKS 6.0m



amended R_A and R_B torn PO5

=> 7.5N/m (2.75m / 2 + 1m) => 178kN

R_M => 180kN (2m + 4.5m) / 6m => 195kN

BM_{MAX} => 195.1.5m => 292.5kN

or (360 - 195) x 2.0m => 330kN.m

to convert to equivalent udℓ

BM => Wℓ^2 / 8

w => 8.330 / 6^2 => 73.33kN/m

this loading is spread over 3 planks

u.d.ℓ => 73.33kN/m / 3.6m => 20.37kN/m^2

PRECAST BEARINGS (Building Regulations UK)

PRECAST CONCRETE floors bearing on supporting walls would be acceptable without any peripheral tie for 5 storey houses, provided the bearing width is at least 50% of the solid wall or inner leaf thickness (not not less than 90mm).

BS 8100 recommends min bearing on steel of 40mm and an allowance for construction inaccuracies of 3mm/metre. Considering a 6.0m span construction tolerance adds up to 18mm.

So adding a clearance of 10mm on either side & allowing 5mm for first, suggests a bottom flunge bearing length of 55mm.

Select beams with minimum width of top flunge 180mm where supporting pre-cast slabs on 2 sides and 230mm where supporting pre-cast slabs at the floor edge.

	Project	Job ref:
BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Tas-Sellum Apartment Blk.	
	Part of Structure: Upper Basement Slab	Sheet No. PO 7 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

slab loading with partitions $17kN/m^2$ -
concrete slab $5kN/m^2$
$12kN/m^2$

sate loading (equivalent) on slabs
$(20.372kN/m^2 + 12kN/m^2)$ / 1.45 => **2200kg/m**

Vertical shear on planks assumed over 2 units
V => $(195kN / 2.4m + 12kN/m^2 \times 3m)$ / 1.5
=> 80.86kN/m x 1.2m
=> **9.7 tonf / panel**

b_C => 80.86kN/m x 1.45 / 1m . $3.6N / mm^2$
=> 32.5mm (bearing to be provided @ 125mm

Check Party-Wall to take Prestressed Planks

V_{ult} from plank is 80.86kN/m $\overset{1.45}{=>}$ 117kN/m
acting on a triangular stress distribution
creating an eccentraity of
e => 225/2 - 1/3.125 => 70.83mm

Total loading of party-wall at level of planks
N => $(5kN/m^2 + 14kN/m^2 + 17kN/m^2.3$ flr) 3m.1m
+ (1.35kN/m/fil.48crs) 1.4 => 300kN/m

Table 1 - Mortar mixes from BS5628 Pt 1

Mortar designation	Types of mortar (proportion by volume)		Mean compressive strength at 28 days (N/mm^2)	
	Cement: lime: sand	Cement: sand with plasticiser	Preliminary (laboratory) tests	Site tests
(i)	1:0 to ¼: 3	-	16.0	11.0
(ii)	1:1/2:4 to 41/2	1:3 to 4	6.5	4.5
(iii)	1:1:5 to 6	1:5 to 6	3.6	2.5
(iv)	1:2:8 to 9	1:7 to 8	1.5	1.0

The inclusion of lime in our mortars is to be advocated as it improves workability, water retention and bonding properties. Lime mortar is softer and less rigid than cement, and can accommodate slight movement and settlement. Lime is more porous and allows the wall to breathe, reducing the effects of rising damp. Lime mortar takes longer to achieve strength and so limits the speed of rate of laying.

Table 2 gives the strengths of Maltese Mortars from tests carried out by Debattista (1985)

MORTAR CONSTITUENTS	PROPORTION BY VOLUME	COMPRESSIVE STRENGTH 28DAYS-N/mm^2	FLEXURAL STRENGTH	W/C
Cement, Carolline Sand, Fine Globigerina sand	1:2:10	1.86 (iv)	0.58	3.5
Cement, Carolline Sand, Fine Globigerina Sand	1:2:6	4.48 (iii)	1.30	2.0
Cement, carolline Sand, Coarse Globigerina sand	1:3:12	0.92	0.20	4.4
Cement, White lime, carolline Sand, course globigerina sand	1:1.14:2:4	1.43	0.29	2.5
White lime, fine globigerina sand	1:2	1.32	0.56	2.1

Table 3 - Characteristic Compressive stress f_k of 225mm thick masonry N/mm^2 for specified crushing strength – as per BS 5638 pt 1

Mortar Designation	***Globigerina***				***Coralline***
	Compressive Strength of Unit (N/mm^2)				
	15	***17.5***	***20***	***35***	***75****
I	8.6	9.6	10.6	16.3	27.4
II	7.6	8.4	9.2	13.4	22.6
III	7.2	7.7	8.3	12.2	
IV	6.3	6.8	7.4	10.4	

** as per BS 5628 pt2* *(Source: Structural Integrity Handbook BICC)*

Cachia (1985) noted in testing highest franka crushing value of 32.9N/mm^2 and the corresponding lowest at 15N/mm^2

Table 4 - Characteristic Compressive stress f_k of 180mm thick masonry N/mm2 for specified crushing strength – as per BS 5628 pt1

Mortar Designation	*Globigerina*				*Coralline*
	Compressive Strength of Unit (N/mm²)				
	15	***17.5***	***20***	***35***	***75****
I	9.9	11.0	12.2	18.7	31.6
II	8.7	9.6	10.5	15.4	24.8
III	8.2	8.8	9.5	14.0	
IV	7.2	7.8	8.5	12.0	

* *as per BS5628 pt2* (Source: Structural Integrity Handbook BICC)

Table 5 - Characteristic Compressive stress f_k of 225 thick concrete hollow blockwork in N/mm²

Mortar Designation	***Compressive Strength of Unit (N/mm²)***							
	2.8	***3.5***	***5.0***	***7.0***	***10***	***15***	***20***	***35***
I	2.0	2.5	3.6	4.4	5.1	6.3	7.4	11.4
II	2.0	2.5	3.6	4.2	4.8	5.6	6.4	9.4
III	2.0	2.5	3.6	4.1	4.7	5.3	5.8	8.5
IV	2.0	2.5	3.1	3.7	4.1	4.7	5.2	7.3

Table 6 - Characteristic Compressive stress f_k of 150 thick concrete hollow blockwork in N/mm²

Mortar Designation	***Compressive Strength of Unit (N/mm²)***							
	2.8	***3.5***	***5.0***	***7.0***	***10***	***15***	***20***	***35***
I	2.6	3.2	4.6	5.4	5.9	6.7	7.4	11.4
II	2.6	3.2	4.6	5.2	5.5	6.0	6.4	9.4
III	2.6	3.2	4.6	5.1	5.3	5.6	5.8	8.5
IV	2.6	3.2	4.1	4.5	4.7	5.0	5.2	7.3

Table 6 – Blockwork Characteristic Strength f_k Data

Blockwork type mm	***Average Characteristic Strength N/mm2***	***Average Coefficient of variation %***	***Period***	***Best Year %***	***Worst Year %***
115	5.86	18.23	1991 1994	1992 13.37%	1991 25.29%
150	7.51	16.25	1991 1996	1993 12.58%	1991 20.28%
225 singlu	7.50	13.01	1991 -1996	1993 9.43%	1996 19.61%
225 dobblu	8.67	12.93	1991 -1996	1995 10.92%	1996 14.86%

Source: Grech (1997)

An important concept to introduce is shell bedding, with mortar laid on the 2 outer edges only. The design strength should be reduced by the ratio of the bedded area to the gross area.

LOAD BEARING PROPERTIE OF MASONRY WALL PANELS

a) The horizontal bed joins should be filled completely with mortar. Incompletely filled bed joints may reduce the strength of masonry panels by 33%. Failure to fill vertical joints has little effect on the compressive strength but are undesirable for weather and force, exclusion and sound insulation.

b) Mortar bed joints should not be thicker than 10mm. Bedjoints of 16 –19mm thickness, result in a reduction of compressive strength of up to 25% as compared with 10mm thick joints.

c) Before laying mortar the block is to be well wetted to reduce its suction rate, plus a proportion of lime in the mortar mix will help the mortar mix to retain its water. A high absorbent block will result in a weaker mortar, with a resulting weaker wall panel.

Table7 - Partial Safety factors γ_m for material strength for normal design loads.

Material	*Special Category*	*Normal Category*	*BS 5628*
Masonry			
Compression	2.5	3.1	Pt1
Compression/flexure	2.0	2.3	Pt 2
Flexure	2.8	3.5	Pt1
Shear	2.5	2.5	Pt1
Shear	2.0	2.0	Pt 2
Bond	1.5	1.5	Pt2
Strength of steel	1.15	1.15	Pt 2
Wall ties	3.0	3.0	Pt 1

Table 8 - Design axial loads for various wall types

Material	*Crushing strength N/mm2*	*Mortar type IV KN/m*	*Mortar type III KN/m*	*Mortar type II KN/m*
225 franka	20	537	602	
225 qawwi	75			1640
180 franka	20	493	551	
150 franka	20	469	522	
225 block dobblu	8.5	283	319	
225 block singlu	7	268	297	
150 block	7	217	246	
115 block	5	163	185	
225 infilled block	15	457	522	551
225 infilled block with 12mm bar at 225 centres	15			944
225 infilled block with 20mm bar at 225 centres	15			1206

The above table demonstrates the low load bearing capacity of concrete b/w of crushing strength 7N/mm^2, as being approximately 50% for equivalent thick franka of crushing strength 20N/mm^2.
(Source – Structural Integrity Handbook BICC)

	Project Tas-Sellum Apartment Blk.	Job ref:
BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Part of Structure Party Wall Stability	Sheet No. PO 8 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

thus 117kN/m has an eccentricity of 28.75mm

with (300kN/m - 117kN/m) => 183 acting centrally

resultant e_x => 117.70.83 / 300 => 27.62mm

according to BS5628 (masonary code)

stress reduction factor ß due to slenderness

e/t => 27.62 / 225 => 0.12

h_{eff} / t_{ef} => 0.85.2450 / 225 => 9.25

ß => 0.84

f_m => 300/1m.225mm => 1.33N/mm^2

f_{all} => 7.4N/mm^2 x 0.84 / 3 => 2.07N/mm^2

Total loading on Party Wall :-

Garage L.L 2.5kN/m^2

Garage Floor Loading 10kN/m^2 + (1.5) 1.6 => 12.4kN/m^2

ΣN => 300kN/m + 12.4kN/m^2.3m

+ (1.35kN/m/fil.20crs)1.4 => 375kN/m

f_m => 375 / 1m .225mm => 1.66N/mm^2

note that this party-wall is loaded from one side only

STABILITY

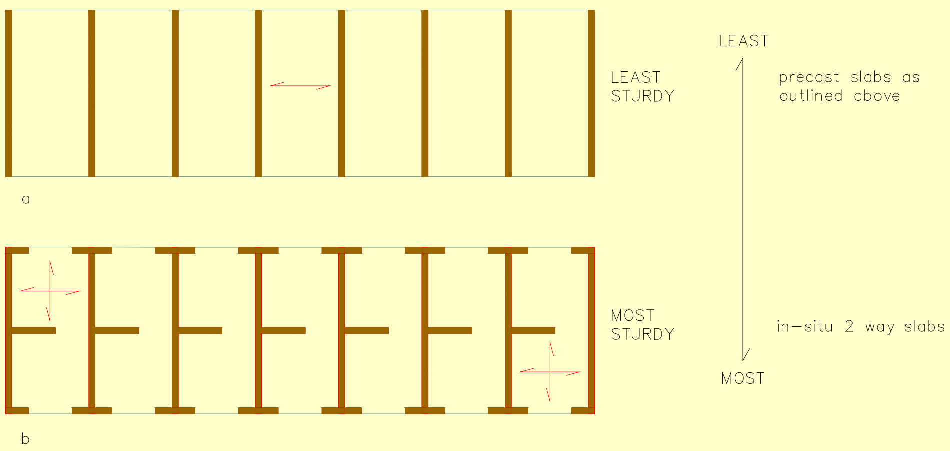


FIG 1

THE EXTENT OF DAMAGE SHOULD NOT BE DISPROPORTIONATE TO ITS CAUSE

BS 5628 specifies the minimum lateral load at 1.5% of the total characteristic DL above that level.

EC6 gives this at 1% of the combined vertical characteristic dead and imposed load at the particular floor divided by $\sqrt{h_{tot}}$

Their effect may be ignored if less onerous than other horizontal actions eg. wind

ACCIDENTAL DAMAGE

For buildings with 5 storeys or more & clear spans exceeding 9.00m:

BS 5628 pt 1 - Table 12 - 3 options given:

- option 1 based on members being able to withstand a pressure of $34KN/m^2$ in any direction
- option 3 prescribes horizontal & vertical ties as in BS 8110
- option 2 is a hybrid between options 1 & 3 where in masonry construction it may be difficult to provide vertical tying. Unless member defined as protected (can withstand pressure up to $34KN/m^2$) the effect of removing one vertical member at a time is to be considered.

TIEING PROVISIONS TO BS5628 pt 1

- Vertical Tie the greater of :

  $T = (34A/8000)\,(h/t)^2$ N   or 100KN/m length

  where A is the area in mm^2

- Horizontal Tile – in KN, is the lesser of:

  $F_t = 20 + 4\,N_s$ (where N_s is the no of storeys)

  or 60 KN

- Internal Ties in KN/m

  $f_t' = F_t\,\{(G_k+Q_k)/7.5\} \times L_a/5$

- External Wall or Column Tie in KN for columns & KN/m for walls is the lesser of

  $2F_t$ or $(L/2.5)\,F_t$

The tie force is based on shear strength or friction

ROBUSTNESS – Defined in EN 1991.1.7

"The ability of a structure to withstand events like fire, explosions, impact or the consequences of human error without being damaged to an extend disproportionate to the original cause".

Regardless of their height all buildings to be compliant with "Disproportionate Collapse". This removes the 5-storey limit.

BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Project Tas-Sellum Apartment Blk.			Job ref:
	Part of Structure Detailing for stability			Sheet No. PO 9 / 1
	Drawing ref:	Done by: DHC	Chkd By:	Date 03/05
Ref:	Calculations			Output

These requirements are outlined in Cℓ.37

of BS5628 (masonary Pt1) - design for accidental damage

to be compared to Cℓ 3.12.3.4 - Cℓ 3.12.3.5

BS 8110 Pt 1 - Concrete

BS 5628 subdivides bdgs into Category 1 & 2

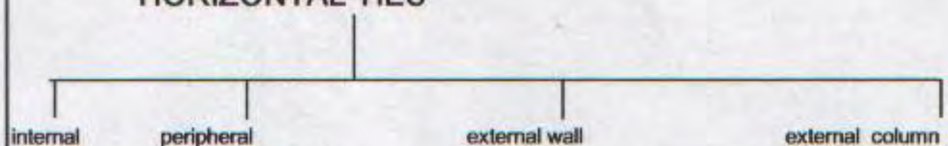
Category 2 is all buildings above

5 stories have to be further designed

for options 1 - 3

OPTION 2 requiring

HORIZONTAL TIES



where F_t = 20 + 4n or 60kN (lesser of)

F_t => 20 + 4.6 => 44kN (n is no. of stories)

VERTICAL TIE

T => (34A / 8000) (h/t^2) - kN — *Output:* or 100kN/m

T => (34.1000.225 / 8000) ($3000/225^2$) — *Output:* whichever is the greater

=> 170kN / m

BICC BUILDING INDUSTRY CONSULTATIVE COUNCIL	Project: Tas-Sellum Apartment Blk.	Job ref:
	Part of Structure: Detailing for stability	Sheet No. PO 10 / 1
	Drawing ref: Done by: DHC Chkd By:	Date 03/05
Ref:	Calculations	Output

VERTICAL TIE REINFORCEMENT

170kN/m / 460N/mm^2 => 369mm^2/m (1Y - 25 / plank)

PERIPHERAL TIE REINFORCEMENT - F_t

44kN / 460N/mm^2 => 95mm^2 (1Y - 12mm)

INTERNAL TIE REINFORCEMENT

F_t' => $F_t(g_k + q_k)$ / 7.5 x L_A/5 kN/m

=> 44 (5.4 + 2.0) / 7.5 x 6/5 => 52kN/m

A_s => 52kN/m / 460 N/mm^2 => 113mm^2/m (1Y -16mm / plank)

EXTERNAL WALL TIE

Tie Force => $2F_t$ => 88kN/m or

(h / 2.5)F_t => (3/25)44 => 53kN/m (lesser of)

f_v => 0.15 + 0.6g_a for grade IV mortar at the upper level

g_a => 50kN/m / 1m.0225m => 0.22N/mm^2

f_v => 0.15 + 0.6 x 0.22 => 0.282N/mm^2

Combined stear resistance on both surfaces

=> 2 $\left(\frac{0.282 \times 225\text{mm}}{1.25}\right)$ => 101.5kN/m

> 53kN/m no steel ties required