

Timber Sketch Book

June 2012

Section: 1:50 @ A3

typical roof rafters
50x175mm at 600 c/c
Span 3.0m
note possible snow
drift loading

glulam framing to
flat roof
165x270mm C27
cantilever out to
pick up wall

typical glulam
tie beams
115x225mm C27

glulam columns
to edge of corridor
165x180mm C27 fire board
215x225mm C27 exposed

glulam tie beam
115x225mm C27

BCI floor joists
241/9005 d=241mm
300mm centres

roof design data:
DL 0.75 kN/m²
IL 0.75 kN/m²

floor design data:
DL 2.50 kN/m² under floor heating + screed
IL 3.00 kN/m² classrooms + offices
4.00 kN/m² corridors + lecture theatre

timber roof joists
90x150mm C16 at 600 c/c
Span 2.3m

glulam roof purlins
115x225mm C27
Span 4.1m
spacing 2.3m

glulam bowstring truss
215x270mm C27
Span 8.5m
Spacing 4.1m

bridon spiral strand
cable 616mm
1m below & rafter

OSB or plywood floor
plate acting as stressed
skin to provided
building stability
dried and screwed to
floor beams.
OSB3 12mm thick

BCI floor joists
241/9005 d=241mm
300mm centres
Span 3.75m
Supporting heavy floor
finishes and imposed load

glulam floor beam
2nd 190x405mm C27
1 hr fire design
Span 8.5m
spacing 4.1m

750x750x400mm
mass concrete
base with H.D.
bolts
GEN3 concrete
subject to S.I.
results

1250x1250x600mm
mass concrete base
with cast in H.D. bolts
to timber frame
GEN3 concrete
subject to site investigation
results

200mm thick r.c. ground
bearing slab built off
compacted sub-base
typical A593 mesh
subject to ground
investigation results
and movement joints.

glulam column C27
240x405mm
continuous over 2 storeys
1 hr fire design
spacing 4.1m

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SKO

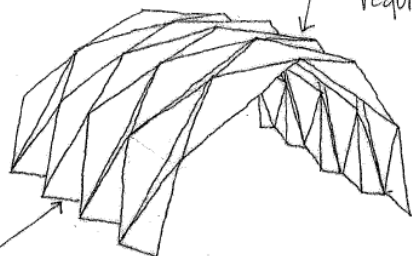
Job No: 5712
Job Title: SmartLIFE
1:50 @ A3

Date: Dec 2004
Ref: SECTION

Iso:

n.t.s.

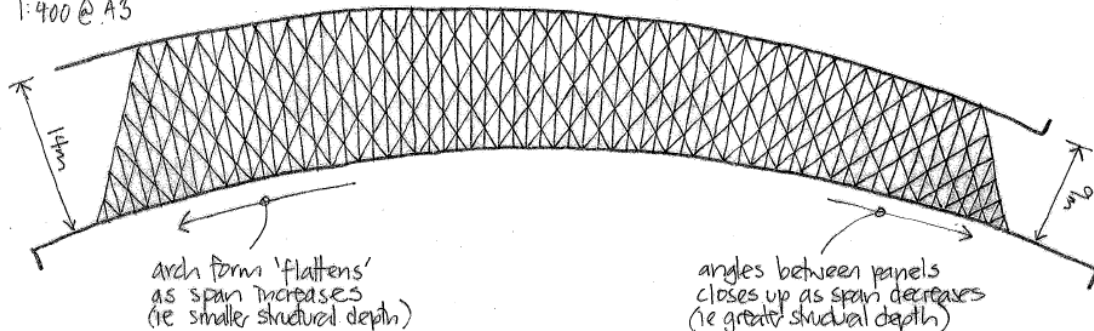
barrel arch structure
requires buttress/ties



- option ① solid timber 'plates' hinged together
option ② steel/timber 3D trusses + infill panels

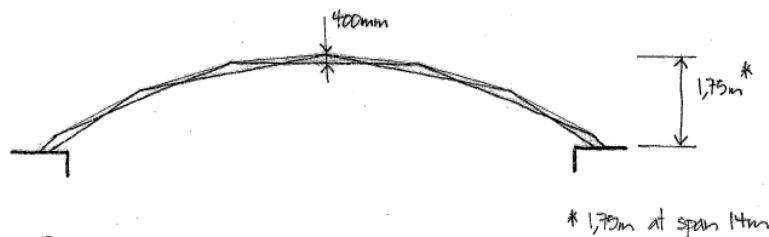
Plan:

1:400 @ A3

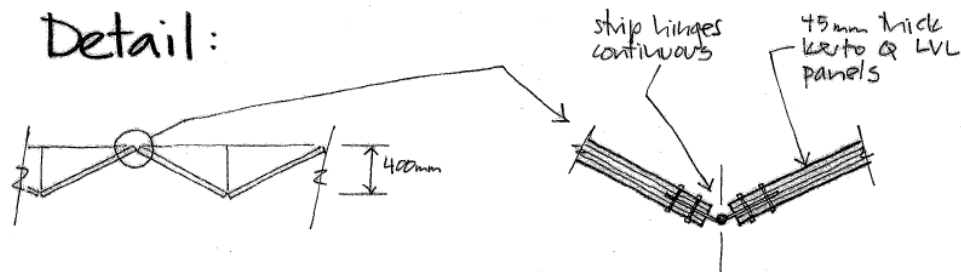


roof area $\approx 14.5m \times 70m$
 $= 1000m^2$

Section:



Detail:



Calcs:

arch span 14m
arch rise 1.75m

loading: DL 1.0 kN/m²
IL 0.75 kN/m²

arch forces:

axial load $\approx (1.75 \cdot 14^2/8) \cdot 1.75 = 24.5 \text{ kN/m}$

bending $\approx (0.75 \cdot 7^2/8) = 5.6 \text{ kNm/m}$

Design:

LVL thickness for axial load $= \frac{24.5 \text{ kN/m} \times 2}{5 \text{ N/mm}^2} = 10 \text{ mm}$
(x2 load for buckling $l_e = 7m$)

LVL thickness for bending $= \frac{5.6 \text{ kNm/m} \times 6}{400 \text{ mm}^2 \times 10 \text{ N/mm}^2} \cdot \frac{1}{2} = 10 \text{ mm}$

20mm
x2 for
fixings
= 40mm
LVL panels

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NAPP Building, Cambridge

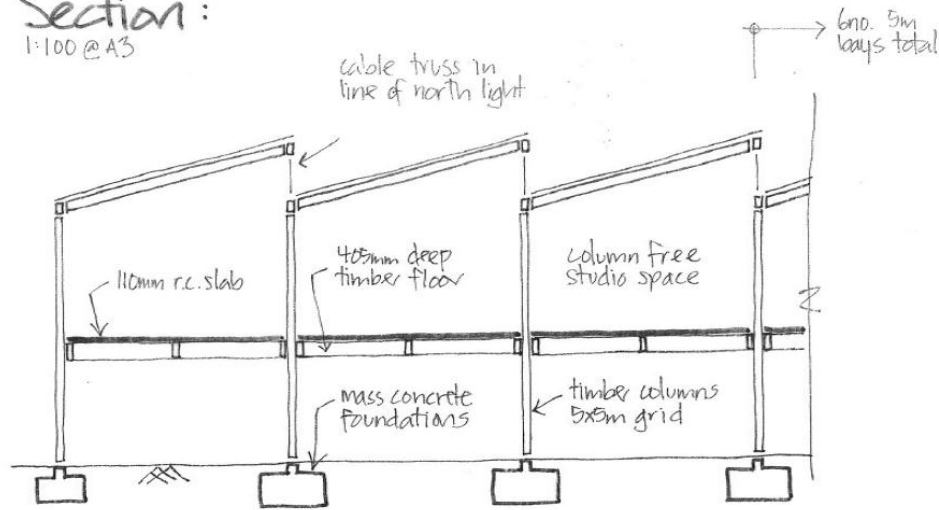
Outline Roof Scheme (creased paper barrel)

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www.whitbybird.com

Rev	Description	Date	By	Chk
Scale: n.t.s.	Date: Nov 2004	Drawn: SSmith	Checked:	
Drawing No: 3662/14/006	Rev:			

Section:

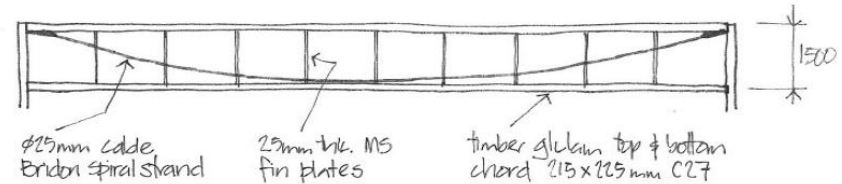
1:100 @ A3



Cable Truss:

1:100 @ A3

15m span

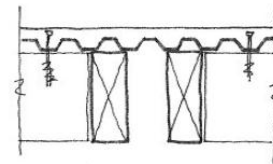


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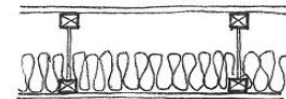
n.t.s.

floor DL 4 kN/m² IL 4 kN/m²

roof



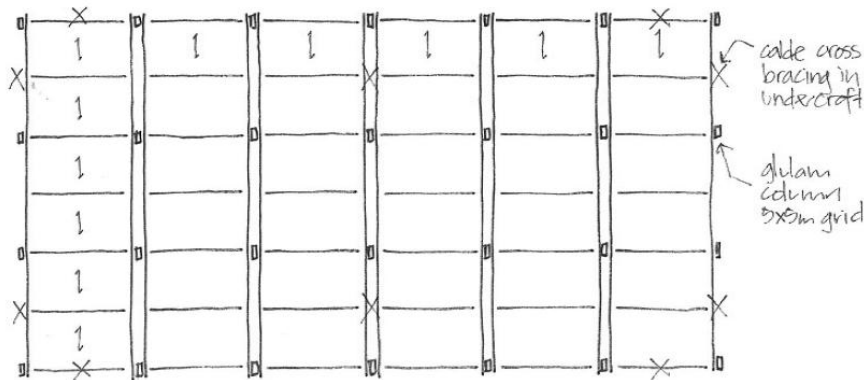
timber/concrete composite
110mm betavibo
165 x 405 mm glulam C27



19mm structural grade roof decking
roof 'I' joists BCI
OR
50 x 225 mm @ 400 mm C16 joists

Plan:

1:200 @ A3 5m x 5m column grid to u/s of first floor
r.c. suspended floor span 4.5m onto glulam beams



Notes:

1. Mass concrete foundations FNDZ 1.4x1.4x0.7m internal / 1.0x1.0x0.9m perimeter
2. Ground bearing r.c. slab to undercroft workshop. 175mm FNDZ A193 mesh built off compact type 1 sub-base 175mm thk.
3. Carpark buildup 30+50 thk asphalt + binder and 300 thk type 1
4. Timber stud walls/facade 150 x 38mm studs at 400mm c/c.

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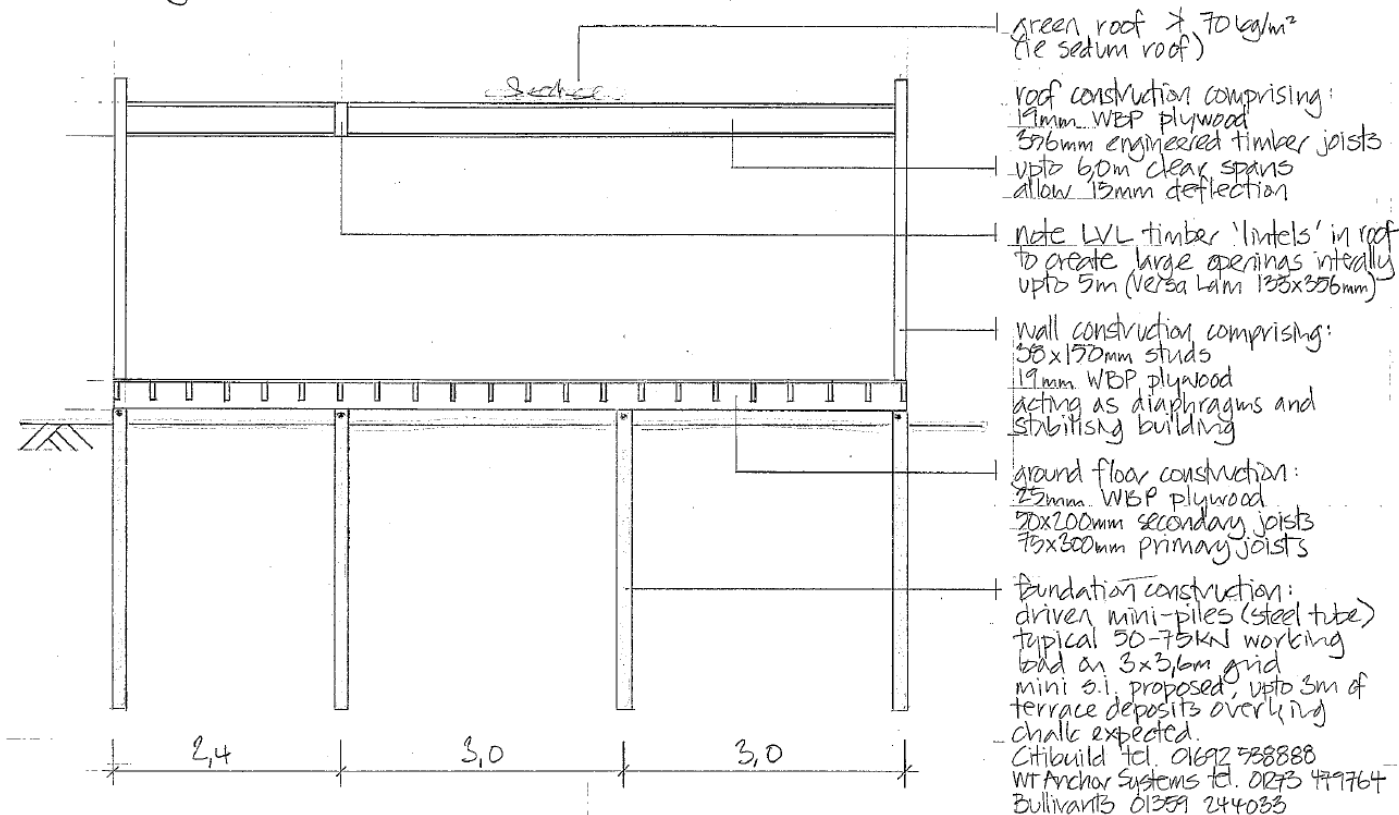
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Scroop Terrace Extension

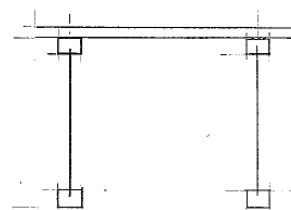
Structural Engineering Scheme

Rev	Description	Date	By	Chk
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Drawing No.:	00020/SL/001	Checked:	Smith	Rev:

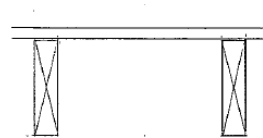
Building Section 1:50



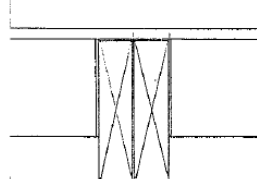
ROOF:



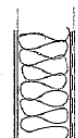
FLOOR:



FLOOR:



WALL:



prefabricated wall panels
comprising:
50x150mm studs at
400mm c/c
19mm WBP ply internal
acting as diaphragm

engineered timber roof
50mm deep joists
at 400mm c/c
base BCI 356x450s
tel. 01494 424222

traditional timber floor
50x200mm secondaries
at 400mm c/c
grade C24
typical span 3,6m

traditional timber floor
2nd. 75x300mm primaries
at 3000mm c/c
grade C24
typical span 3,0m

Shelford Church
Whitby Bird & Partners

Notes:

design information:

roof
live load 60 kg/m^2
sedum roof 70
roof build up
(insulation, ply, joists
and pb ceiling) 60

 190 kg/m^2

floor
live load 300 kg/m^2
floor build up
(insulation, ply, joists) 60

 360 kg/m^2

note: building use and hence
floor live load to be agreed
with building control

wall
cladding 25 kg/m^2
wall build up
(insulation, studs,
ply and pb) 50

 75 kg/m^2

note that proposals have been
developed with severe access
issue in mind, hence i.w.
construction & no dig foundations

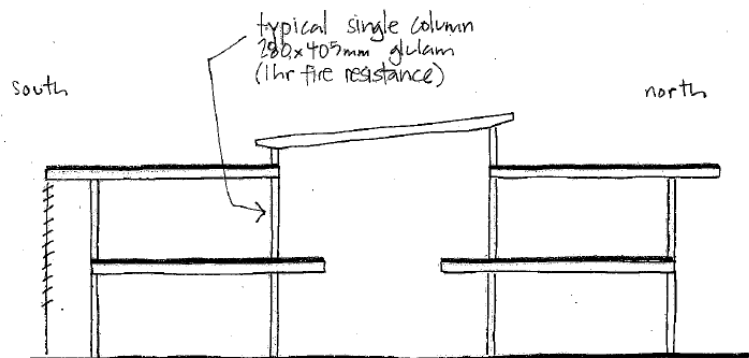
other:

1. preservative treatment to
ground floor timbers
2. review options for panelisation
of floor & wall construction
3. save 100mm in depth of
ground floor by steel beams
galvanised
4. mini s.i. or trial pile req'd
to confirm foundations

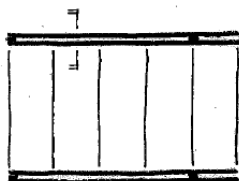
structure overview
2568/SK/002

July 02
85m

Section:



option A



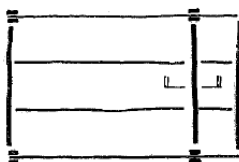
8,0 x 6,0m grid

twin beams clamped each side of columns $d = 765\text{mm}$

8 pieces per bay $4,95\text{m}^3$ timber

*(Int floor option $d = 585\text{mm}$)

option B



8,0 x 6,0m grid

uniform beam sizes throughout $d = 630\text{mm}$

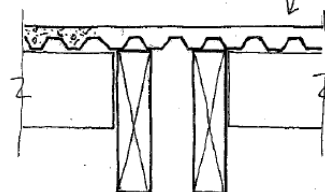
8 pieces per bay $5,75\text{m}^3$ timber

*(Int floor option $d = 540\text{mm}$)

* Int floor option = timber floor deck

Details:

option A



Alternative floor:

tarmac/bison 75mm
pc planks



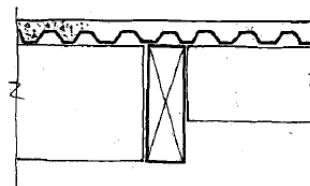
130mm Holorib Concrete Floor

140x405mm Glulam Secondary Joists
at 1000mm c/c

190x765mm Glulam Primary Beams
2no. at 6000mm c/c

note: for 8,0 x 4,5m grid timber depths
reduce to 360mm + 675mm

option B



130mm Holorib Concrete Floor

190x630mm Glulam Secondary Joists
at 2000mm c/c

190x630mm Glulam Primary Beams
at 8000mm c/c

Design Data:

1. All timber is exposed and section sizes allow for 1 hour fire resistance

2. Design loads:

raised floor + services	50 kg/m^2
concrete floor	275 kg/m^2
timber	25 kg/m^2
line load	250 kg/m^2
partitions	100 kg/m^2

3. Reductions in floor depths can be achieved using Int concrete Holorib

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Janus House 50 St Andrews Street
Cambridge CB2 3AH

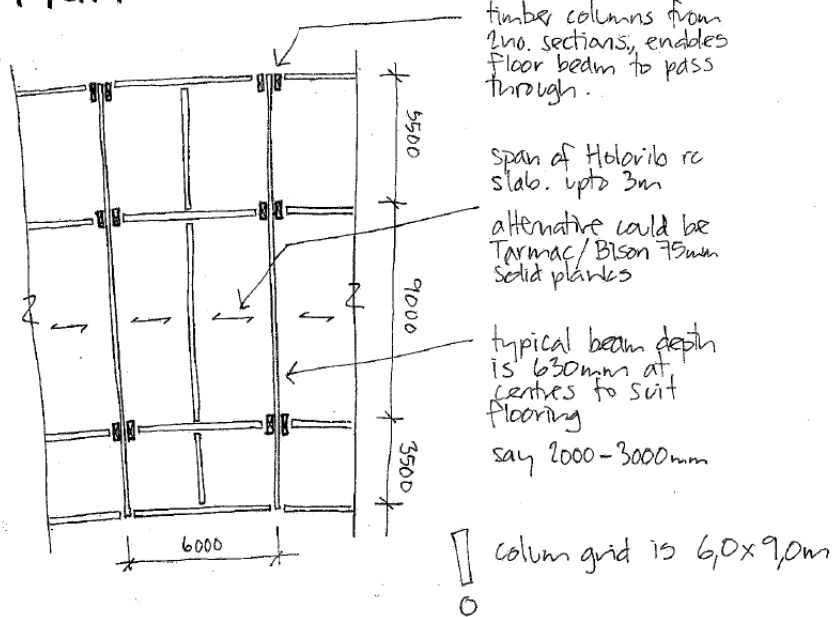
tel +44 (0)1223 369 220 fax +44 (0)1223 356 215
email: cambridge@whitby-bird.co.uk www.whitbybird.com

Longhurst Offices, Boston

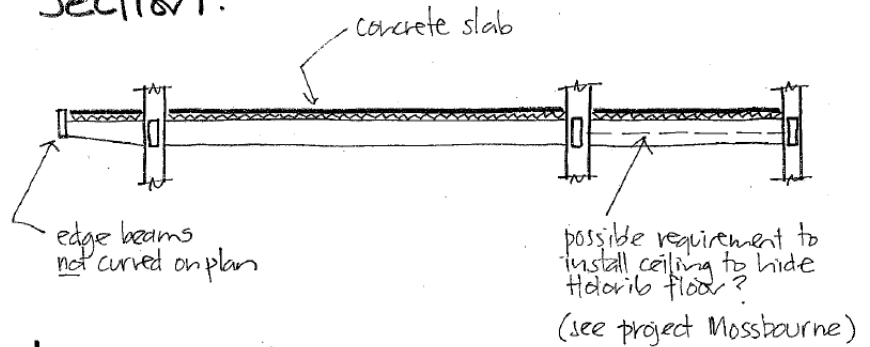
Timber frame Options

Rev	Description	Date	By	Chk
Scale:	1:200 @ 43	Date:	nov 2003	Drawn:
Drawing No:	3360/SK/001	Checked:	SSmith	Rev:
				A

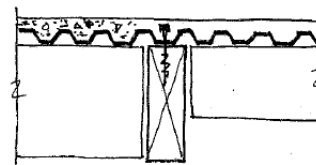
Plan:



Section:



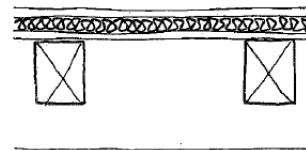
Ideas:



timber glulam/LVL frame with insitu concrete slab

timber and concrete can act composite using shear studs

timber fire engineered for upto 1hr exposure (charring protection)



all timber lightweight frame and floor

'ships' galleon construction with large section floor rafters supporting plywood or LVL floor deck.

see project UoC faculty of Education in Cambridge

Structure self weight 25% - 45% of steel or r.c. scheme

Notes:

- design loads: floor live 3.0+1.0 kN/m²
finishes 0.85
(raised floor, services)
- materials: C27 softwood
(species tbc)
- glulam timber sections would be fire engineered but may still need spread of flame treatment.

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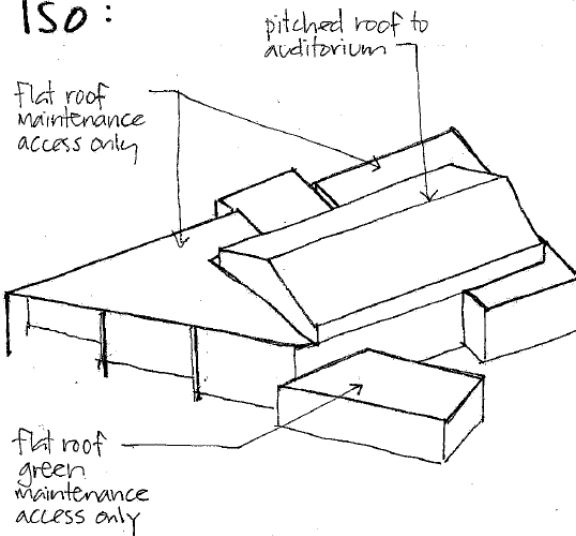
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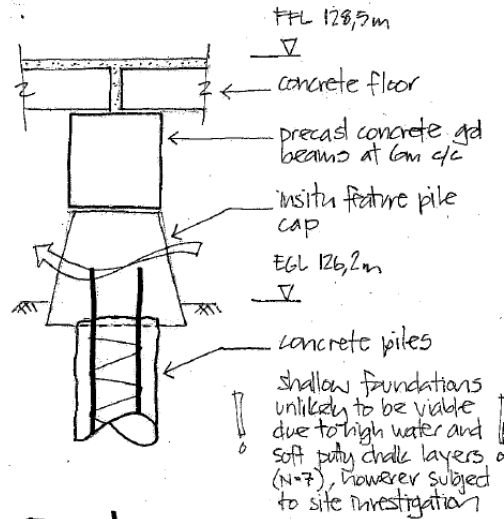
Outline Structure Scheme [timber frame]

Rev	Description	Date	By	Chk		
Scale:	1:200 @ A3	Date:	Oct 2004	Drawn:	SSm	Checked:
Drawing No.: 3662/SK/004						Rev:

Is0:



Foundations:



Concrete Floor (req'd for heavy finishes)

typical 'beam & block' with screed DL 5,00
 ie Tarmac 200PT Pocklington S468 200mm deep IL 400

high load areas 'pc plank' with screed DL 5,00 +
 ie Tarmac 200 'wide slab' 200mm deep IL 7,90 +

Ground Beams (pc or galvanised steel beams)

Industry standard precast ground beams 450mm x
 ie Bullivants or Van Elle

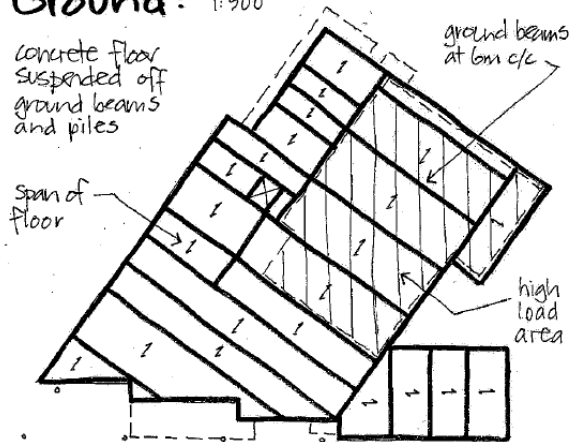
Piles (CFA or CHD piles into chalk)

prelim load take down:

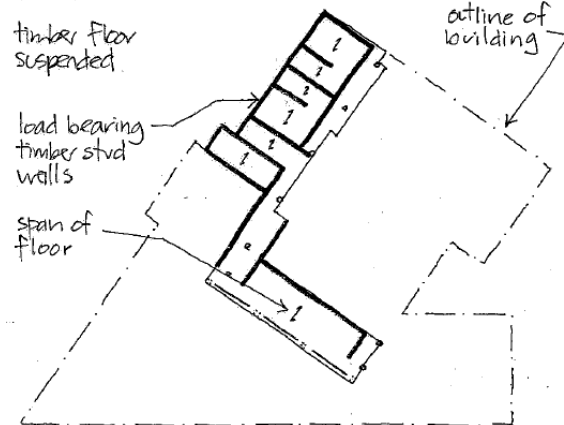
grd beams 500m	2500kN/0 kN
grd area 1400m ²	7000kN/7000kN
1st area 300m ²	300kN/1100kN
roof 1500m ²	1700kN/1190kN
perimeter 200m	200kN/0kN

allow for:
 125 no. piles
 average load 250kN
 ie 450mm L=8000

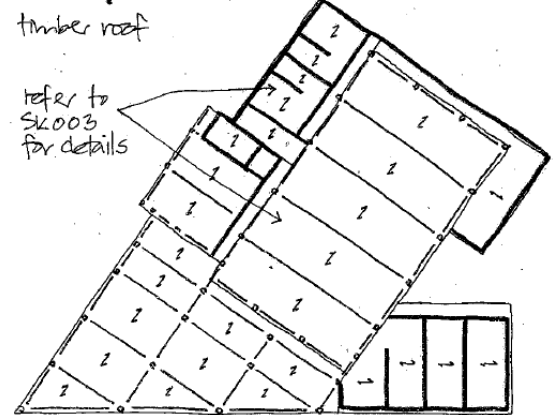
Ground: 1:500



First: 1:500



Roof: 1:500



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Riverbank Theatre, Marlborough

Structure Outline (sheet 1)

Rev	Description	Date	By	Chk		
Scale:	1:500@A3	Date:	October 04	Drawn:	Smith	Checked:
Drawing No.: 3450/SK/002					Rev.	

Plan:

1:250 @ A3

0 5 10m

building stability provided by plywood diaphragm decking to all walls, floors and roofs

timber stud load bearing walls 38x150mm C16 at 400mm c/c

possible requirement for blackwork lift shaft

typical roof beam 215x540mm
column 240x240mm
glulam frame supporting roof and walls

outline of 1st floor

span of roof

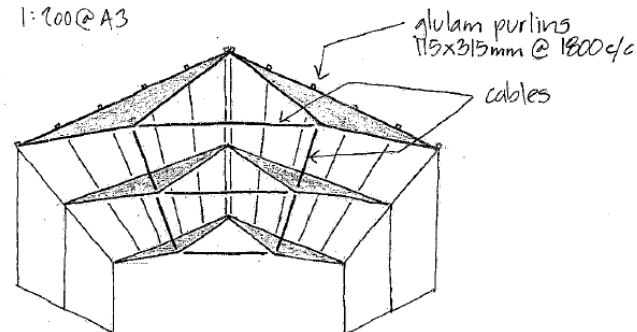
glulam roof purlins 119x315mm @ 1800 c/c

timber cable truss over auditorium see section

span of roof

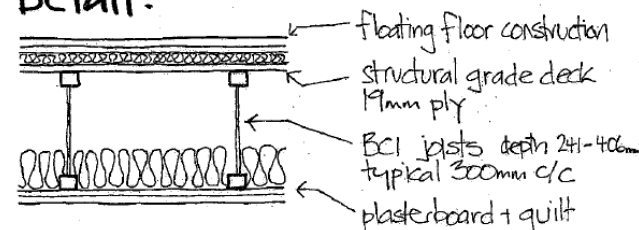
Section: through auditorium

1:200 @ A3



main roof cable trusses at 6000 c/c tapered glulam or LVL depth max. 900mm

Detail:



(floor buildup approx. 80kg/m²)

Flat Roof: [typical] BCI 302/500S span 6m DL 1,00
IL 0,75
[green] BCI 241/900S span 4,5m DL 4,00
IL 0,75

Floor: [typical] BCI 302/900S span 5,5m DL 1,00
IL 4,00
[plant] BCI 406/900S span 4,0m DL 1,00
IL 7,50

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Riverbank Theatre, Marlborough

Structure Outline (sheet 2)

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Rev	Description	Date	By	Chk

Scale: 1:250 @ A3	Date: October 04	Drawn: SSmitz	Checked:
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Drawing No.: 3450/SK/003	Rev:
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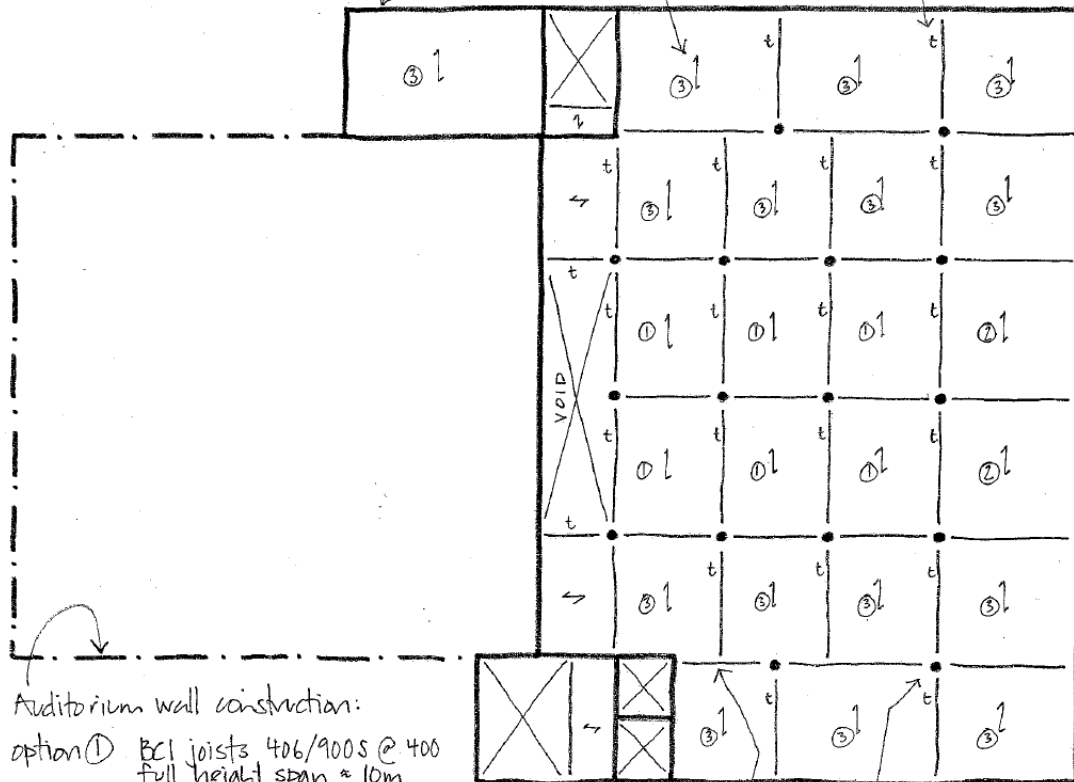
Plan: first floor

1:200 @ A3

timber stud wall
see note 3.

span of timber I
joist floor note 2.

glulam tie
beam note 6.



Auditorium wall construction:

option ① BCI joists 406/900S @ 400
full height span ~ 10m

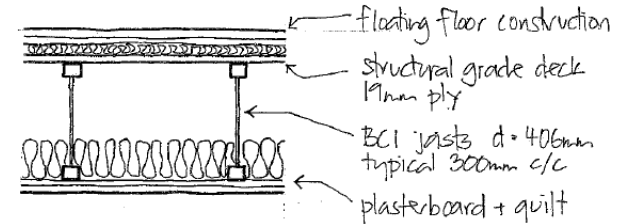
option ② glulam framing with 150x38mm
infill stud panels
240x450mm glulam columns at
4.5m centres, 140x225mm horizontal
rails at 3rd height points

glulam beam
215x985mm
1 hr fire thro' charring
primary beam 30kN

glulam column
240x405mm
1 hr fire thro' charring
grd floor DL 100kN SL
1 L 300kN SL

Details:

Section thro' floor (nts)



(floor buildup approx. 80 kg/m²)

Notes:

1. floor imposed loads:
 - typical 4,0 kN/m²
 - performance space 5,0 kN/m²
2. key to floor joists:
 - ① 406/900S BCI @ 300 span 6m 5 kN/m²
 - ② 406/600S BCI @ 300 span 6m 4 kN/m²
 - ③ 406/450S BCI @ 300 span 5.5m 4 kN/m²
3. load bearing timber stud walls using 150x38mm at 400mm c/c C16 grade
4. plywood deck to floors and skin to walls to act as stability diaphragms.
5. C27 timber grade to glulam primary beams at columns. Class 0 spread of flame treatment possible, required by building control.
6. glulam sizes:
 - typical beam (primary) 215x985mm
 - typical beam (tie) 80x405mm
 - typical column 240x405mm (or 215x495mm)

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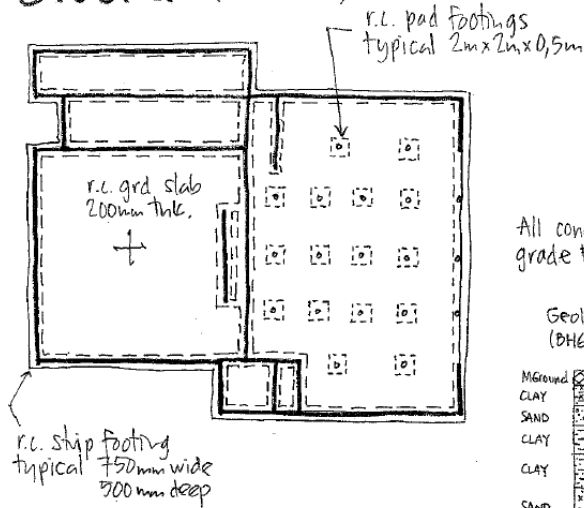
Bedford Campus Centre

Outline Structural Scheme - Timber

Rev	Description	Date	By	Chk
Scale:	1:200 @ A3	Date:	July 04	Drawn:
				SSmith
Drawing No:	3483/SU/001			Rev:

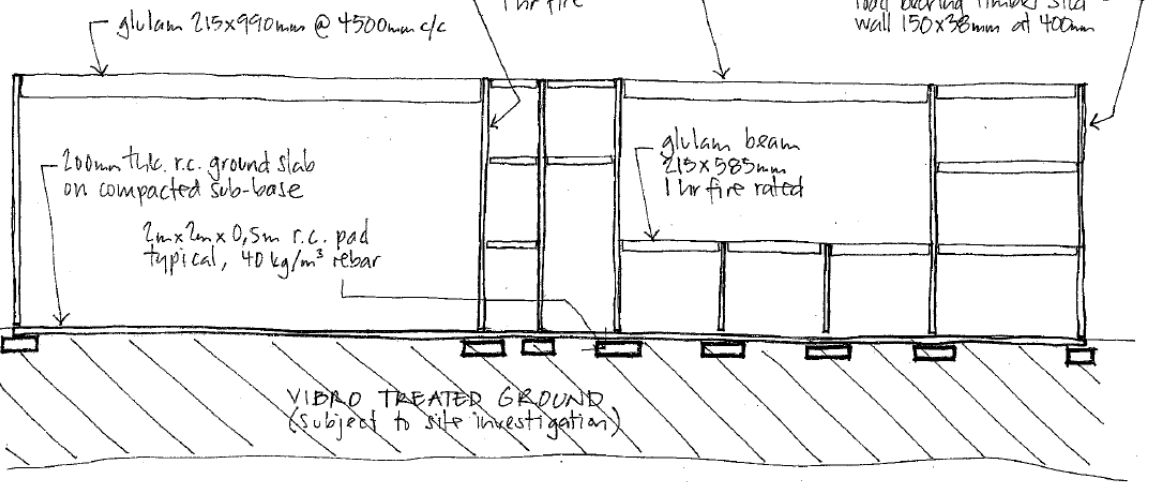
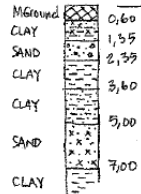
Ground: (1:500 @ A3)

Section: (1:200 @ A3)



All concrete grade FND2

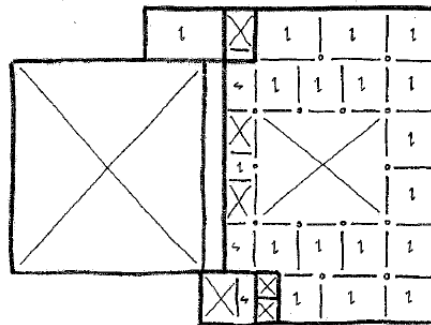
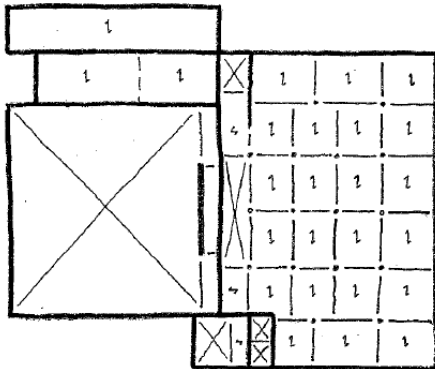
Geology: (DH6)



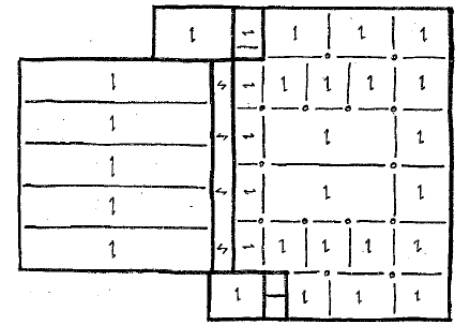
First: (1:500 @ A3)

Second: (1:500 @ A3)

Roof: (1:500 @ A3)



typical BCI roof joists 396mm 500S @ 600mm c/c span 6m



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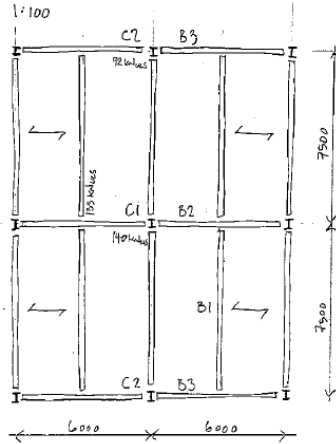
Bedford Campus Centre

Outline Structural Scheme - Timber

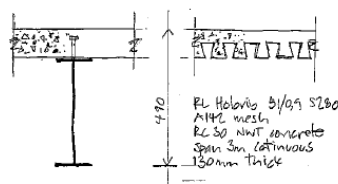
Rev	Description	Date	By	Chk
Scale:	1:200 / 1:500	Date:	July 04	Drawn:
Drawing No:	3483/SK/002	Checked:	SS:RL	Rev:

STEEL FRAME

PLAN:
1:100



DETAIL:
1:10



Beam ①
Secondary beam span 7.5m
550x123x59 UB S275
Floor studs 16mm L=95mm

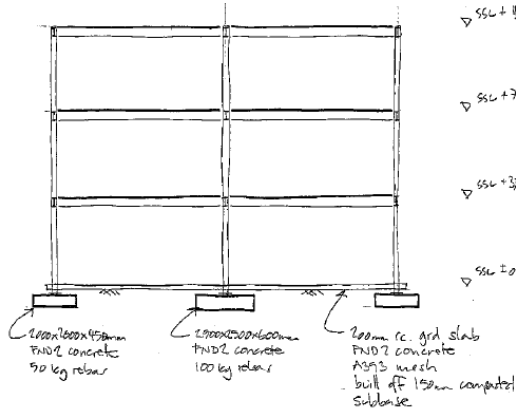
Beam ②
Primary beam span 6.0m
550x177x51 UB S275
Sleeve studs 16mm L=95mm
Additional floor T10-200

Beam ③
Edge beam span 6.0m
550x123x59 UB S275
Sleeve studs 16mm L=95mm
Additional floor T10-200

Column ①
203x203x71 UC S355

Column ②
203x203x76 UC S355

SECTION:
1:100

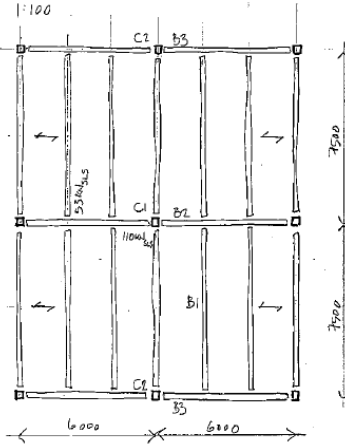


NOTES:

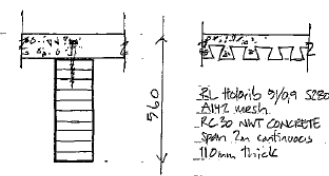
1. Steel frame beams and columns require fire protection (boarding or intumescent paint) to achieve 60min rating.
2. All steelwork delivered to site with 25micron zinc rich primer.
3. Floor is designed using steel/concrete composite action.
4. Approximate steel tonnage 21t (incl. allowance for connections)

TIMBER FRAME

PLAN:
1:100



DETAIL:
1:10



Beam ①
Secondary beam span 7.5m
165x450mm GL28 glulam
Floor studs 16mm L=160mm

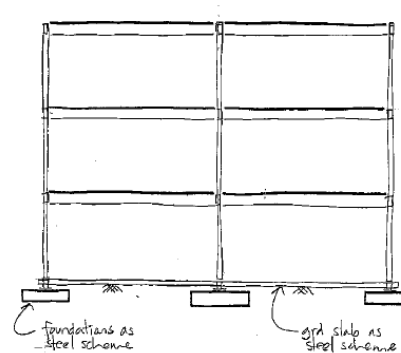
Beam ②
Primary beam span 6.0m
225x650mm GL28 glulam
Sleeve studs 16mm L=160mm

Beam ③
Edge beam span 6.0m
165x450mm GL28 glulam
Sleeve studs 16mm L=160mm

Column ①
360x360mm GL28 glulam

Column ②
315x315mm GL28 glulam

SECTION:
1:100



NOTES:

1. Timber frame elements achieve 60min fire resistance without additional protection.
2. Timber/concrete composite floor action and design is based on research carried out at Cambridge University.
3. Shear stud is 16mm coach bolt 160mm long in grade S35 steel, bolts are screwed into pre-drill 70mm deep holes.
4. Approximate timber volume 46m³

Notes

1. The structural frames drawn are for the purpose of a cost study. They are based on a hypothetical commercial office building in the UK. The building would be a 15m wide rectangular box with circular cores and risers positioned at the ends of the building. The building is 5 stories.
2. The steel frame design is based on a fairly typical 'holistic' concrete floor acting compositely with standard universal beam sections.
3. The timber frame design is based on a 'holistic' concrete floor acting compositely with glulam beams. The design of this floor system is based on research carried out at Cambridge University.
4. Design Loads:
Floor imposed load 30+ to 60%
raised floor
ceiling services 0.85 kN/m²
5. Foundation information is based on a typical safe allowable bearing pressure of 150 kN/m²
6. Building stability is achieved through braced cores and plate action of the floors.
7. Cladding to the building could vary. A floor edge load of 5kN/m has been allowed for in the design.
8. Beam connection loads are shown for steel ULS and timber SLS.

PRELIMINARY

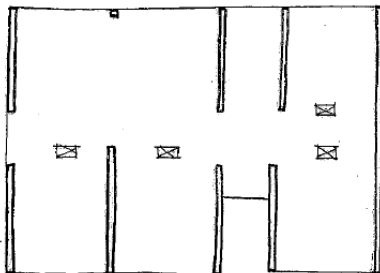
timber versus steel

unfurnished

structural bay study 7.5 x 6.0m grid

1:100 @ 1 April 2005 SSN
00070/SK/001 POI

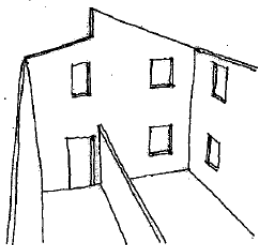
Plan:



Solid timber floor spanning between crosswalls 189mm thick.

Solid timber crosswalls support floor, party walls 2 separate leafs

Iso:



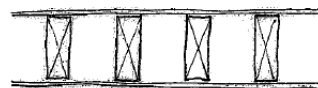
Floor:

Solid timber floor/wall panels

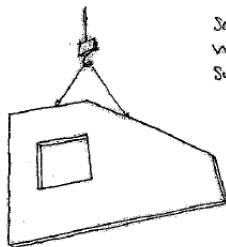


www.merk.de
(LENOBAU)

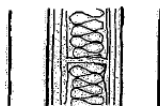
traditional timber panel option using solid or eng. timber sections



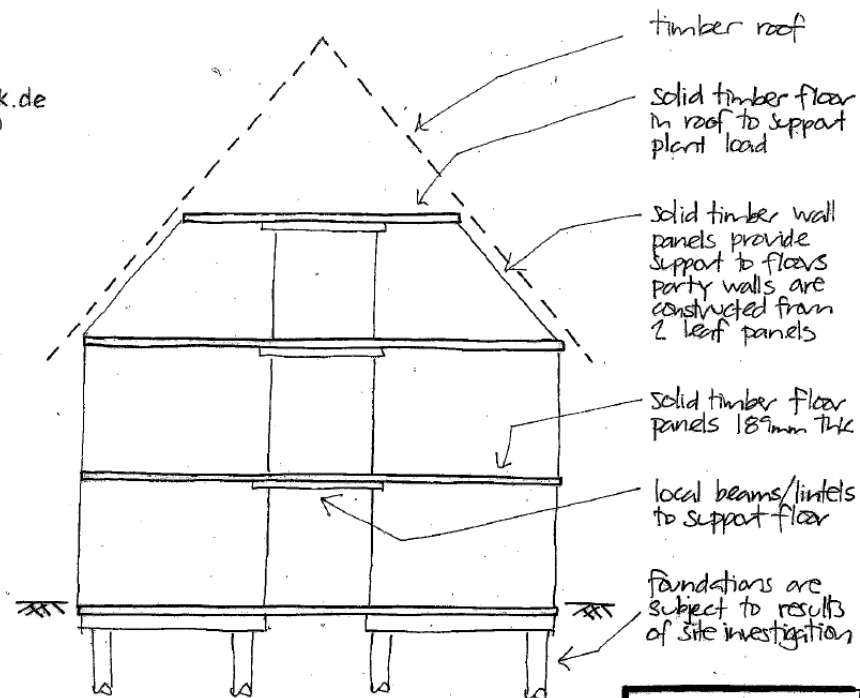
Walls:



Solid timber wall panels support floors



Section:



timber roof

Solid timber floor in roof to support plant load

Solid timber wall panels provide support to floors party walls are constructed from 2 leaf panels

Solid timber floor panels 189mm thick

local beams/lintels to support floor

Foundations are subject to results of site investigation

Notes:

design loads

live load accommodation areas
corridors etc.

1.5 kN/m²
3.0 kN/m²

dead load

finishes
bathroom pods

0.5 kN/m²
etc.

lightweight prefab frame solution which requires acoustic & thermal mass issues to be addressed.

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Trinity Hall Student Accommodation

Structural Scheme Timber

Rev	Description	Date	By	Chk			
Scale:	n.t.s.	Date:	Aug 2003	Drawn:	SSm	Checked:	
Drawing No.:	3171/SK/004					Rev:	

Section 1:100

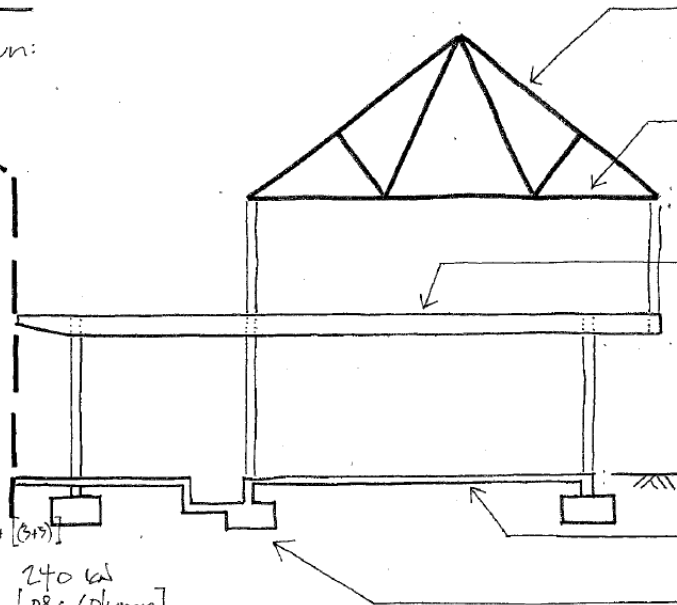
prelim load take down:

- 1 roof
dl 125 kg/m^2
sl 0.60
- 2 2nd
dl 125 kg/m^2
il 1.50
part. 1.00
- 3 cladding
dl 9.0 kg/m
- 4 1st
dl 170 kg/m^2
il 4.00
- 5 cladding
dl 10.0 kg/m

$$[(1+2) \times 4.5\text{m}] + [(4) \times 9.35\text{m}] + [(3+5)]$$

$$\Sigma = 75 \text{ kg/m} \approx 240 \text{ kN}$$

[per column]



3 no. steel roof trusses spanning 9.0m supporting roof construction and second floor construction trusses at approx. 3.2m centres maximum with allowance for central door opening

traditional timber floor construction to 2nd floor
7"x2" SC4 floor joists at 400mm centres dl $\neq 125 \text{ kg/m}^2$
il $\neq 1.50 \text{ kg/m}^2$
structural grade plywood floor decking forming horizontal diaphragm action at 2nd floor level

exposed timber frame forming columns, beams and floor joists. all timbers architecturally featured and timber sizes dimensioned for 1 hr fire case (ie no fire protection required)
LVL columns and main primary beams at 3.2m centres
traditional 9"x3" SC4 floor joists in pairs at 450mm
29mm structural grade plywood floor decking forming horizontal diaphragm at 1st floor level

timber cantilever helps cold bridge issue but not best suited to support of 'heavy' traditional cavity wall

in-situ r.c. ground bearing slab 250mm thk, built off hardcore sub-base

in-situ r.c. shallow strip & pad foundations subject to si. results and discussion with tree officer

Plan 1:100

exposed timber frame to first floor (LVL and SC4)

floor weight info:
timber floor 60 kg/m^2

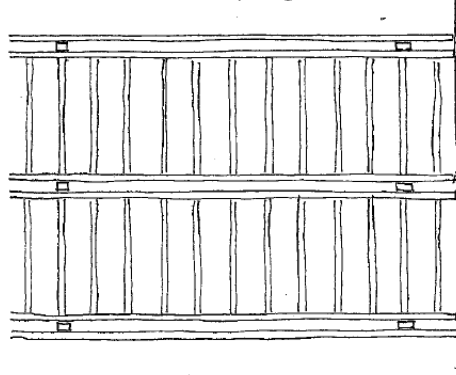
materials info:
columns
primary beams
floor joists

LVL
LVL
SC4

structure design info:
imposed floor load
raised floor + services
possible p.board
structure sw.

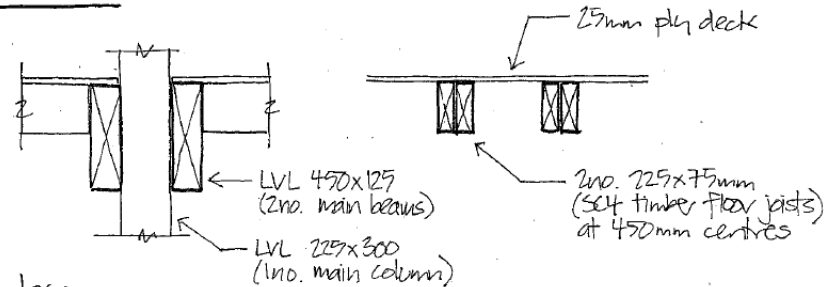
4.00 kg/m^2
 0.85 kg/m^2
 0.29 kg/m^2
 0.40 kg/m^2

(note: floor joist spacing shown indicative!)



7.50 1.60

1st Floor:



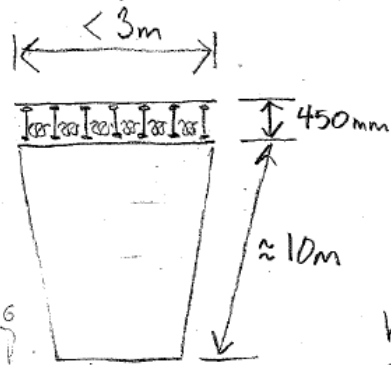
Notes:

1. maximum structural member weight $\approx 479 \text{ kg}$
(14m long LVL 450x125 mm beam)
2. no thermal mass

Whitty Bird & Partners
Tyndale House

2715/SK03
Structure Scheme May 02
Option (2) *SS*

Walls / Roof:

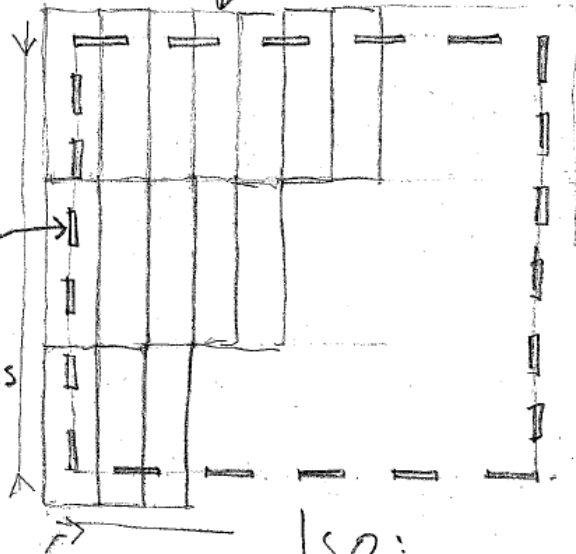


Insulated structural panel.
Structural ply or OSB
each side. LVL?

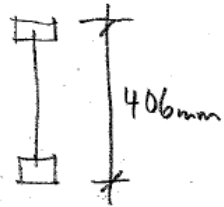
Plan:

layout of roof panels
say 3x10m?

hit/miss
3x10m
wall panels

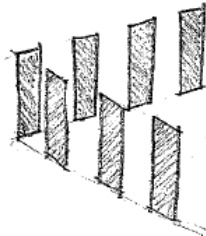
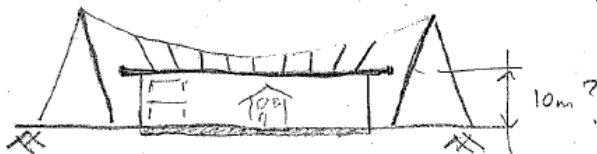


ISO:



BCI joists: 406/900s
@ 400mm c/c
tel. 01494 434222

Section:



Structural
Insulated
Panel [SIPS]
System
(Timber)

