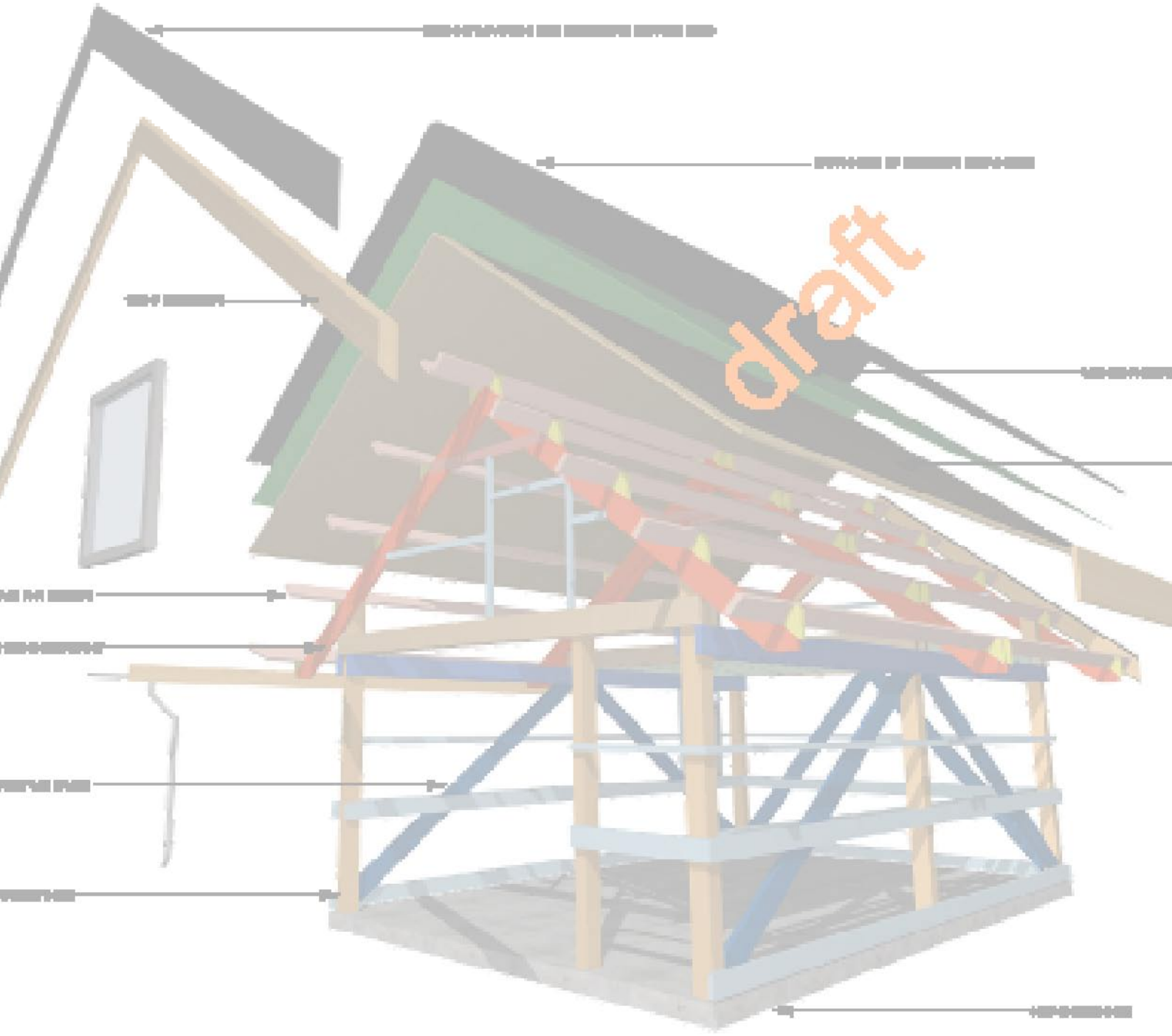
Scottish Borders Woodland Partnership
Project 2: Construction and Sustainable Development using Local Timber



Sub-project 8: New Fabrications

Final Report, November 2009

Gaia Architects
North Woods Construction Ltd.

Aim

Undertaken under the heading of 'Demonstration', this project was developed to exploit the willingness of some of the Borders-based sawmills to expand their range of product outputs.

Introduction

During the early stages of Project 2 a number of visits to and discussions with local sawmills took place to find out what milling equipment was being used, timber products formed, storage capacity etc. Through these visits it became apparent that a small number of these mills were making products to sell either from the mill gate or through retail outlets.

Following exchanges with the nine sawmills operating in the Borders three of the mills expressed a specific interest in expanding their range and output using local timber. One mill, Agraspark, made a specific approach following a South Scotland Sawmillers' Forum (SSSF) meeting at Borders Forest Trust in January 2008.

Clearly such development would help to meet the objectives of Project 2, and to address that interest two possible project approaches were developed for discussion with the client:

1) work with Agraspark and help develop at least two new product designs. The designs suggested were for a small post and beam shed/garage design and a bus shelter. Agraspark had a range of outdoor furniture designs that proved popular but this used very small amounts of timber so was considered inappropriate to develop any further. It was recognised that developing two post and beam designs with a sawmill would have synergy with the then concurrent Post and Beam Project and help to disseminate the results of that project.

2) Develop two generic post and beam designs on paper with specification and fabrication methodology and then distribute these to the interested sawmills that had been identified. This would be followed up with discussion visits to the sawmills to facilitate development of the design for their specific needs.

Project costs would only be in consultants time and some consumables to enable sawmills to make small test joints. These consumables would be the same as for the post and beam project.

ANTICIPATED OUTPUTS
2 new products developed from local timber.
Facilitation of at least 3 local businesses
Increased use of local timber

Following detailed discussion with the client, a combination of the two possible approaches was developed. This included working with two specific sawmills – Agraspark and Roxburgh & Lothian Estates – to design products which the sawmills had identified as being most productive in terms of responding to market requirement and meeting their own needs for small buildings.

Project Development

Following a market review of the Borders demographic, and analysis of building types likely to be in demand the consultants initially developed designs for a bus shelter and for a large garage.

These were presented to the partner sawmills for their comment. Their immediate response was that both their own needs and the demand of their own markets would not require designs such as these. Following further discussions it was agreed that the consultants should prepare outline designs for a small garage/large shed, and stables.

The consultants' role included the followings tasks:

- preparing outline design concepts for discussion with the two sawmills
- revision of the drawings as necessary to suit the sawmills' requirements
- submission of the designs to a structural engineer to obtain structural certification for the generic designs
- preparation of cutting lists for the two designs.

In order to maximize the resale value of the designs the consultants specifically decided to work within certain parameters. This included:

- limiting the floor area of the buildings to 30m2 in order to be below the standard 32m2 threshold above which Planning Permission is normally required[1]
- designing the wall and roof frames so they could be retrospectively insulated in order to maximize the number of functions for the buildings
- use of repetitive frame elements to allow future expansions of any of the buildings
- use of sawn, rectangular profile timber sections and standard sizes for all elements to minimize cost
- designing the buildings to sit on concrete pads, with concrete floor slabs as required.

Should Planning Permssion be required, the design drawings have been developed by the consultants to be suitable for submission as part of a planning application.

Project outcomes

Both of the resulting designs for the buildings are simple and straightforward. Each has a recognisable form that should not cause any issue where planning permission is required.

Appendix 1 contains design and structural engineering drawings, and a cutting list for the garage.

Appendix 2 contains design and structural engineering drawings, and a cutting list for the stable.

Although the consultants were working with Agraspark and Lothian and Roxburgh Estates, the two sawmills are aware that the design remains copyright of Scottish Borders Council and, as such, any other third party has the right to take the information presented with this report to construct their own garage or stable.

However, the designers and Scottish Borders Council accept no liability whatsoever for the construction of these buildings.

1 The requirement for Planning Permission should be checked with Local Authorities prior to starting ANY development.

Conclusions

As none of the designs have been built, it remains to be seen how successful each of these are. However, based on the detailed discussions with the two sawmills, and the market type within the Scottish Borders region, it is hoped that there will be uptake of the designs in the near future.

Scottish Borders Council support

Scottish Borders Council assisted with the project in the following ways:

- Funding of the consultants to:
  - visit the sawmills before, during and after the design period
  - prepare outline designs for the buildings
  - develop designs in collaboration with the sawmills
  - prepare full packages of information, including cutting lists and structural engineer's drawings for both buildings.
- Funding the structural engineer to prepare structural drawings for both buildings.

Scottish Borders Council, Gaia Architects and North Woods Construction Ltd would like to thank the project partners for their generous assistance on this project.

Elizabeth Willink, Agraspark, Longnewton, Scottish Borders

Peter Darling, Lothian and Roxburgh Estates, Jedburgh, Scottish Borders

McKay and Partners, Structural Engineers, Selkirk, Scottish Borders

Appendix 1.

Garage

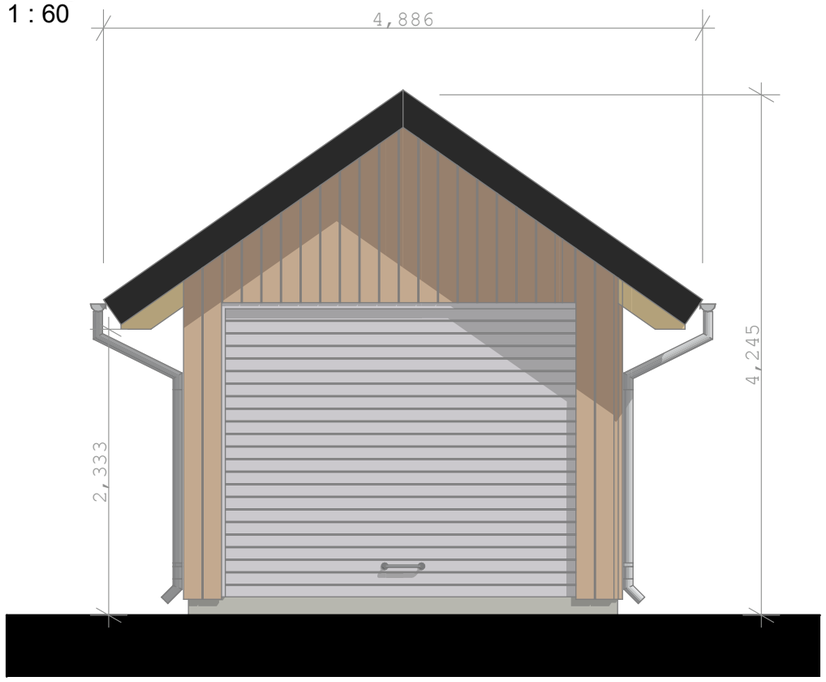
a. Design drawings (4no. A3)

b. Structural engineer's drawings (1no. A3)

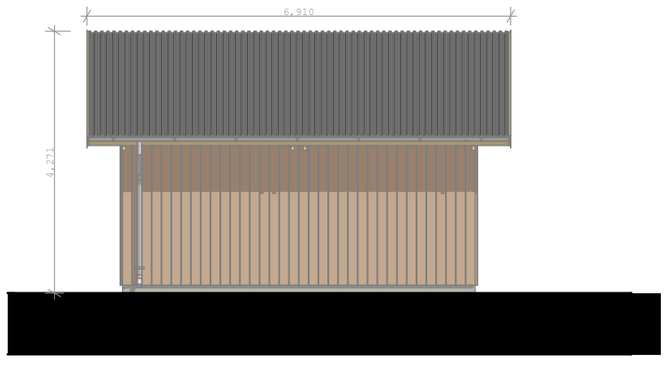
c. Cutting List (A4)

garage or shed : planning drawings (2)

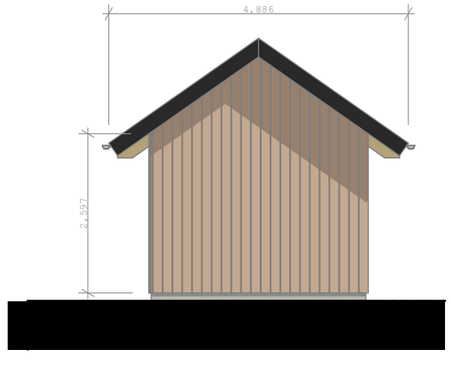
front gable elevation
1 : 60



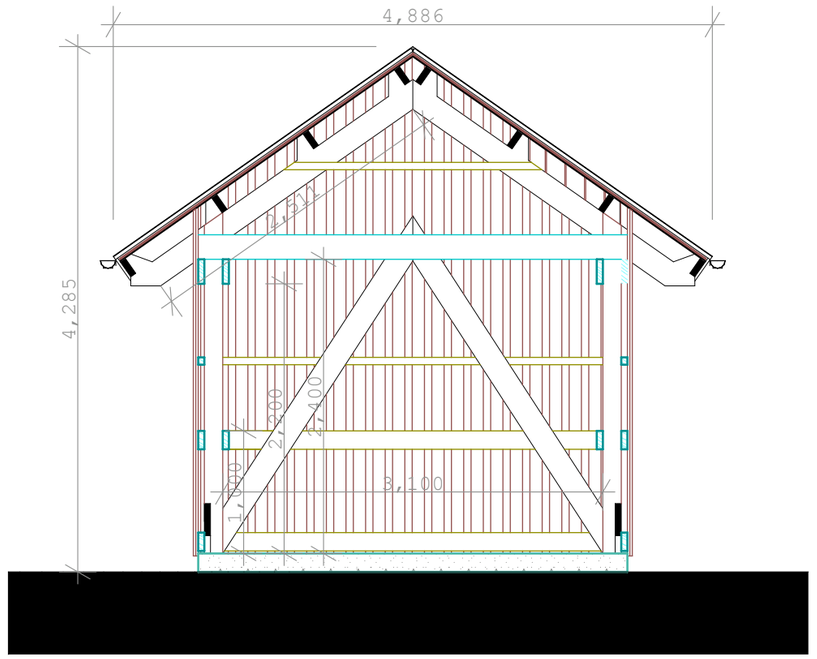
side elevation
1 : 100



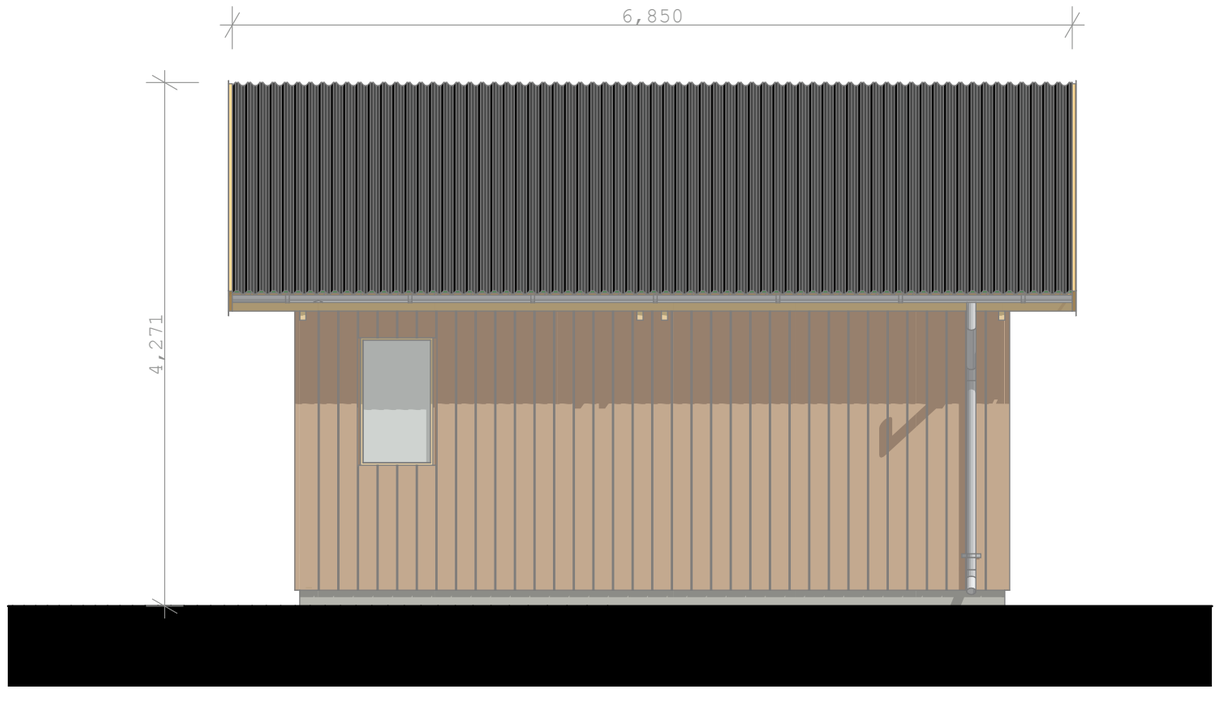
rear gable elevation
1 :100



section across short axis at 1 : 60



side elevation
1 : 60



notes for planning

This garage would normally require planning permission, but may be exempted Building Warrant as under 30sqm. However this is determined on a case by case basis and should be referred to Building Control. It would certainly require to be un-serviced to avoid Warrant.

Any wall less than 1 metre from a boundary may require to be inflammable, in which case a cladding of sheet steel for instance would be possible. This regulation may apply to sheds but usually not to garages. It is advisable to check on the specific circumstances with Building Control.

All planning drawings should note external materials proposed and their colours.

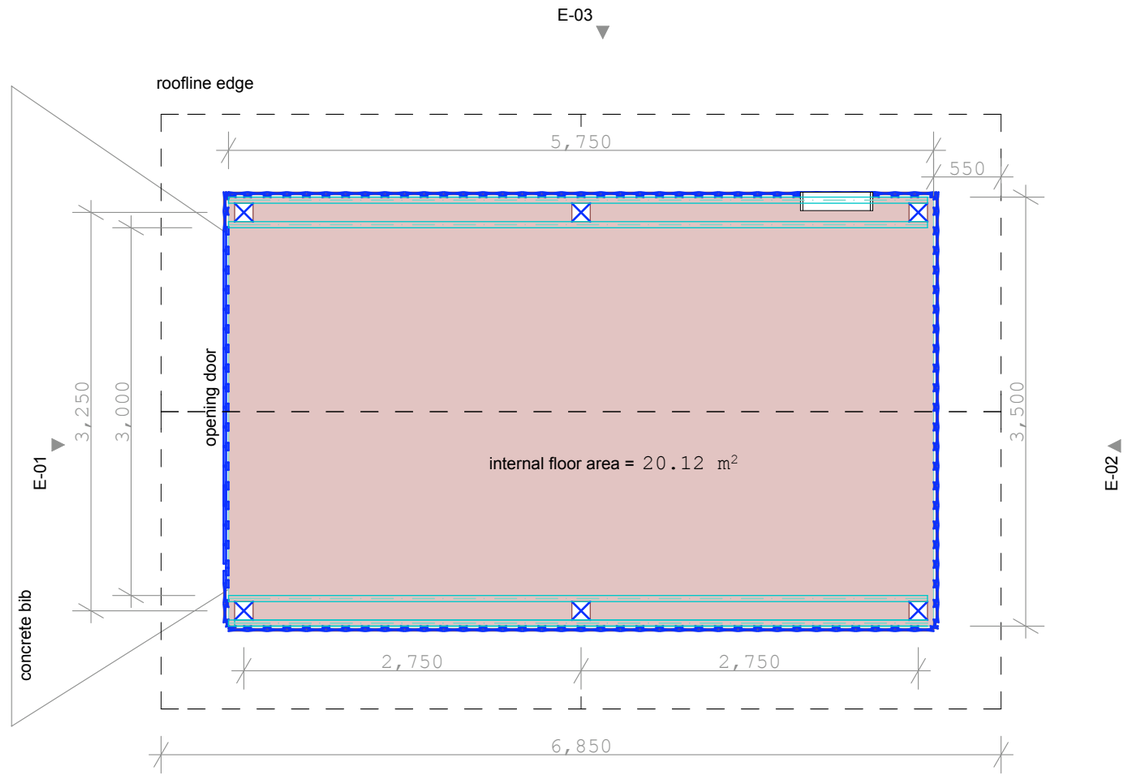
drawing no. : SBC/PP/02	date : 20.11.08
Planning 02	drawn by : BRP

A design under development as part of Scottish Borders Woodland Partnership - Construction & Sustainable Development using Local Timber project.

The design will be available to local timber fabricators and is intended to promote the use of locally grown timber. The shed, which could be smaller or larger than shown, can utilize Douglas fir, larch or oak in its construction.

garage or shed : planning drawings (1)

floorplan
scale 1 : 50



drawing no. : SBC/PP/01	date : 20.11.08
Planning 01	drawn by : BRP

design details

The building is designed as a single garage or shed. It is shown with a roller shutter door but could equally be constructed with double timber doors.

In structural terms, it is a timber post and beam structure with 6 posts giving 2 bays. It utilizes solid timber sections and simple through-bolted connections. There are three main frames, two forming the gables and one in the centre. Whilst the gable frames each have a pair of rafters, the central frame has a double cross beam and double rafters. The rafters support purlins which are sarked in solid timber boards although the sarking could be admitted. Substantial braces in all walls except the opening gable give the building its racking resistance. The 3D view shows half the area with a joisted loft though this could be omitted altogether or extended across the whole area. Floor joists are supported on sturdy double eaves beams.

The floor is concrete and has local thickenings under each of the six posts. The roof covering is shown as profiled sheet steel which would be laid on battens or on a draining waterproof membrane.

Structural timber would ideally be home-grown larch or Douglas fir. Cladding would ideally be home-grown larch or possibly treated pine. Oak could be used for the frame, the cladding or both.

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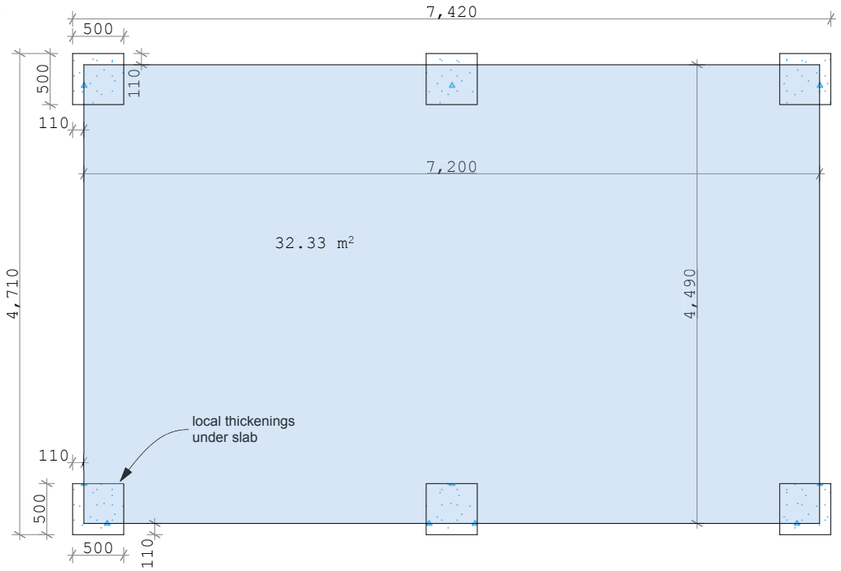
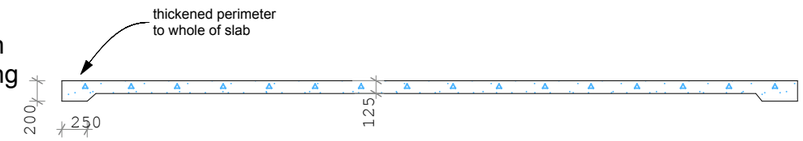
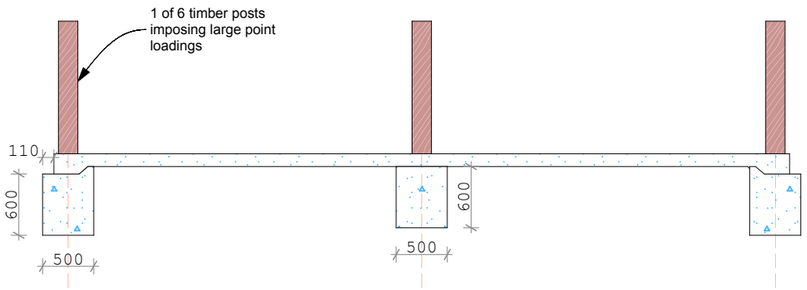
main slab
in plan



main slab in
section along
centre



main slab at
perimeter



Notes for engineer

These drawings are lifted from another very similar project but with slightly different slab dimensions. All concrete dimensions shown are for that particular site and building and were not based on structural engineering calculations. However the layout and principles for the buiding under consideration are proposed to be the same.

Each of the six posts has a local thickening under it, poured as mass concrete. If the slab can be poured at the same time, there is no reinforcing bar connection between the pockets and the slab. If poured separately there would need to be bent bars inserted to keep slab and pockets as one structure.

The slab must have a perimeter depth of 200mm to provide 150mm minimum clearance of timber cladding from FGL. The depth of the rest of the slab, which should include a steel reinforcing grid, will be determined by the need to support a car and light industrial use. It can be assumed that the walls do not bear on the slab at all and the whole weight of the building therefore bears through the 6 posts.

The fixing of the six posts to the slab needs to be considered and usually utilizes a couple of steel angles or possibly a shoe. Whatever, it needs to be designed to allow fixing after the posts (and frames) are erected and nudged into final position.

drawing no. : SBC/ENG/02	date : 20.11.08
Engineering 02	drawn by : BRP

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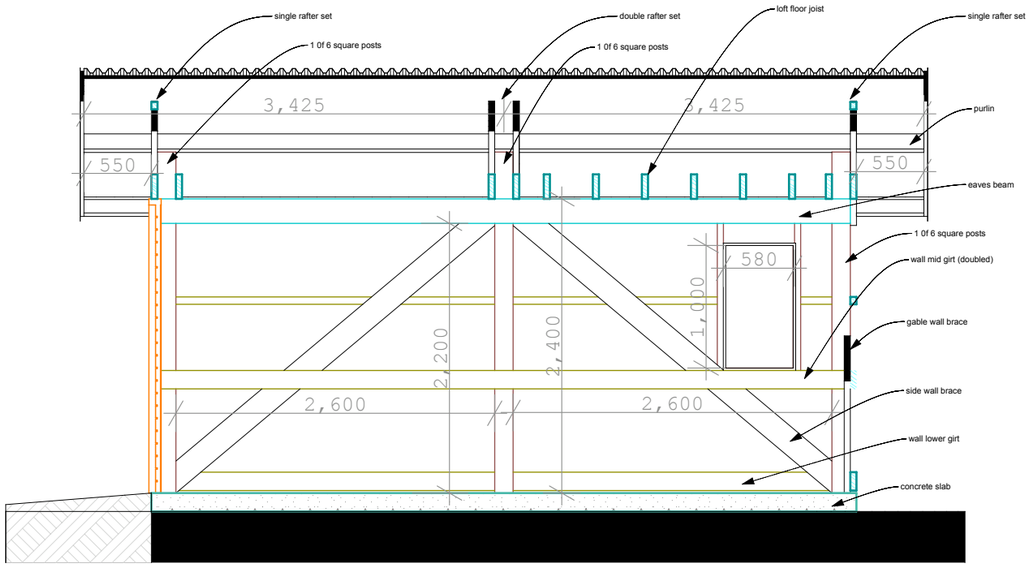
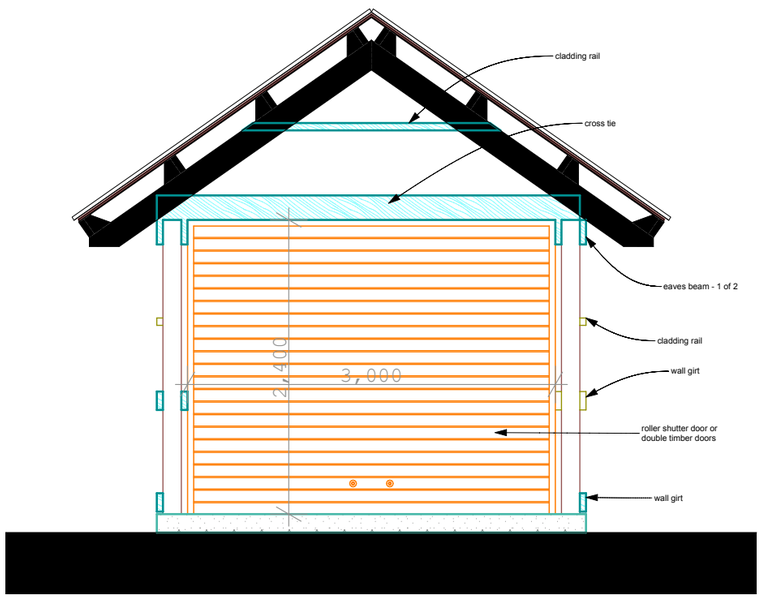
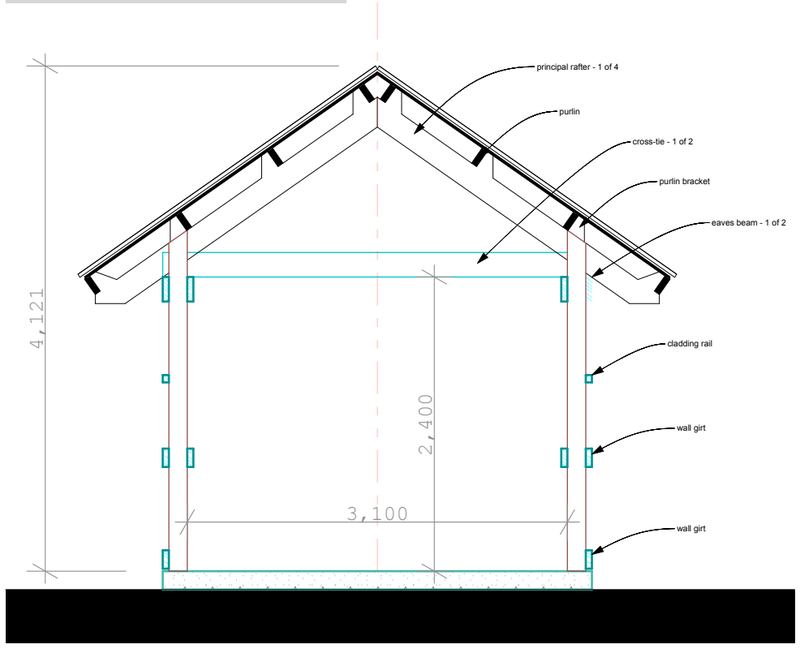
long section showing side wall



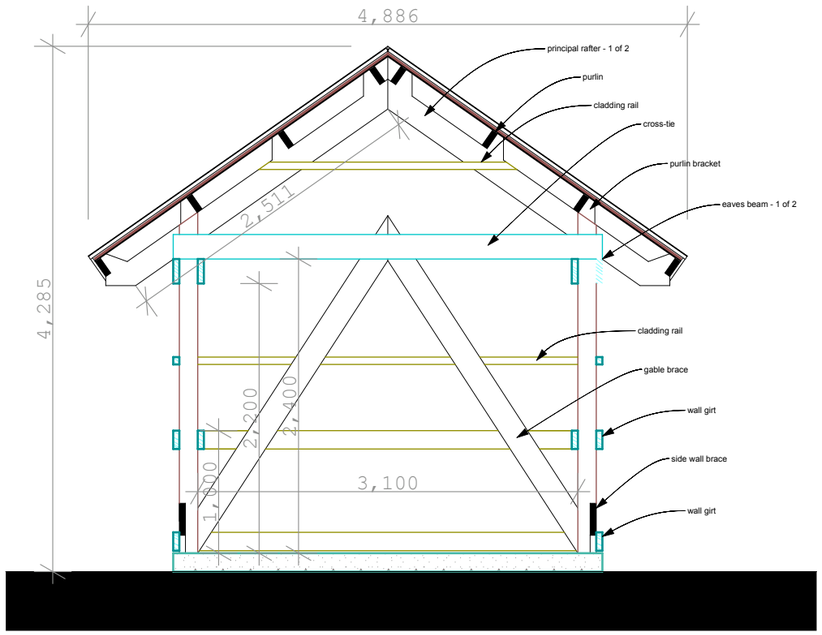
frame 1 (gable opening)



frame 2 (middle)



frame 3 (end gable)



Notes for engineer

This post and beam structure is designed for ease of construction. It can easily be stick built from the bottom up or the three frames can be made up 'on the deck' and raised individually.

All connections will idealy be made with through bolts and coach screws. Rigidity is easily conferred on the side walls and end gable by large diagonal braces. The full opening in the front gable presents more of a challenge. This might possibly involve steel flitch plate connectors at post tops but this is not a preferred option.

The purlins are each in two halves which meet exactly mid-span between the two rafters of the central frame. They are supported by timber angle brackets coach screwed to each rafter in advance of raising.

Sarking would be an option but is proposed in 150 x 18mm boards (to optimize use of local timber) which would not be part of the structure.

The roof covering should be assumed as 0.7mm profiled sheet steel screwed into the purlins through any sarking and membrane.

Wall girts provide structure and support for cladding and must all therefore remain in the same plane to the exterior wall elevations. Whilst it may be necessary to coach screw some of these, others may be simply nailed. Timberlok self drilling screws are often preferred over coach screws that need piloting. From experience, great rigidity is conferred by fixing all cladding rails and wall girts to braces wherever they intersect.

The concrete base and founds are dealt with on a separate drawing.

drawing no. : SBC/ENG/01	date : 20.11.08
Engineering 01	drawn by : BRP

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Scottish Borders COUNCIL

Gaia Architects

Generic post & beam garage or large shed
Timber quantities only

Item	Quantity	dimensions					
		height mm	width mm	length mm	unit volume m3	gross volume m3	notes
main frame							
post	6	150	150	2800	0.063	0.378	
central cross tie	2	200	50	3500	0.035	0.07	double
gable cross tie	2	200	50	3500	0.035	0.07	one in each gable frame
side walls							
base girt	4	200	50	2825	0.02825	0.113	
eaves beam	8	200	50	2825	0.02825	0.226	doubles, one each side of post
cladding rails	10	100	50	2825	0.014125	0.14125	
diagonal brace	4	200	50	3600	0.036	0.144	
rear gable							
cladding rails	5	100	50	3400	0.017	0.085	
cladding rails	2	100	50	3000	0.015	0.03	
diagonal brace	2	200	50	3100	0.031	0.062	
front gable							
cladding rails	2	100	50	3000	0.015	0.03	
roof					0	0	
rafter	8	175	50	2850	0.0249375	0.1995	double at central frame, singles at each gable : length depends on desired overhang
purlin	16	200	50	3425	0.03425	0.548	length depends on desired overhang
purlin haunch	32	200	50	200	0.002	0.064	
diagonal brace	4	175	25	3500	0.0153125	0.06125	
gable barge board	4	200	25	2850	0.01425	0.057	non-structural ; length depends on desired overhang
optional storage deck							
joist	4	200	50	3500	0.035	0.14	this allows only half of area floored
cladding							
cladding boards long	102	150	18	2900	0.00783	0.79866	wide board on narrow board pattern as drawn ; many others possible ; cladding could be between 18 and 22 mm thickness
cladding boards long	102	60	18	2900	0.003132	0.319464	
cladding boards short	30	150	18	1700	0.00459	0.1377	NB. approximate cladding quantities
cladding boards short	30	60	18	1700	0.001836	0.05508	
TOTALS						3.729904	
excluded							sarking boards which appear in some drawings are excluded

North Woods Construction Ltd

Gaia Architects

Appendix 2.

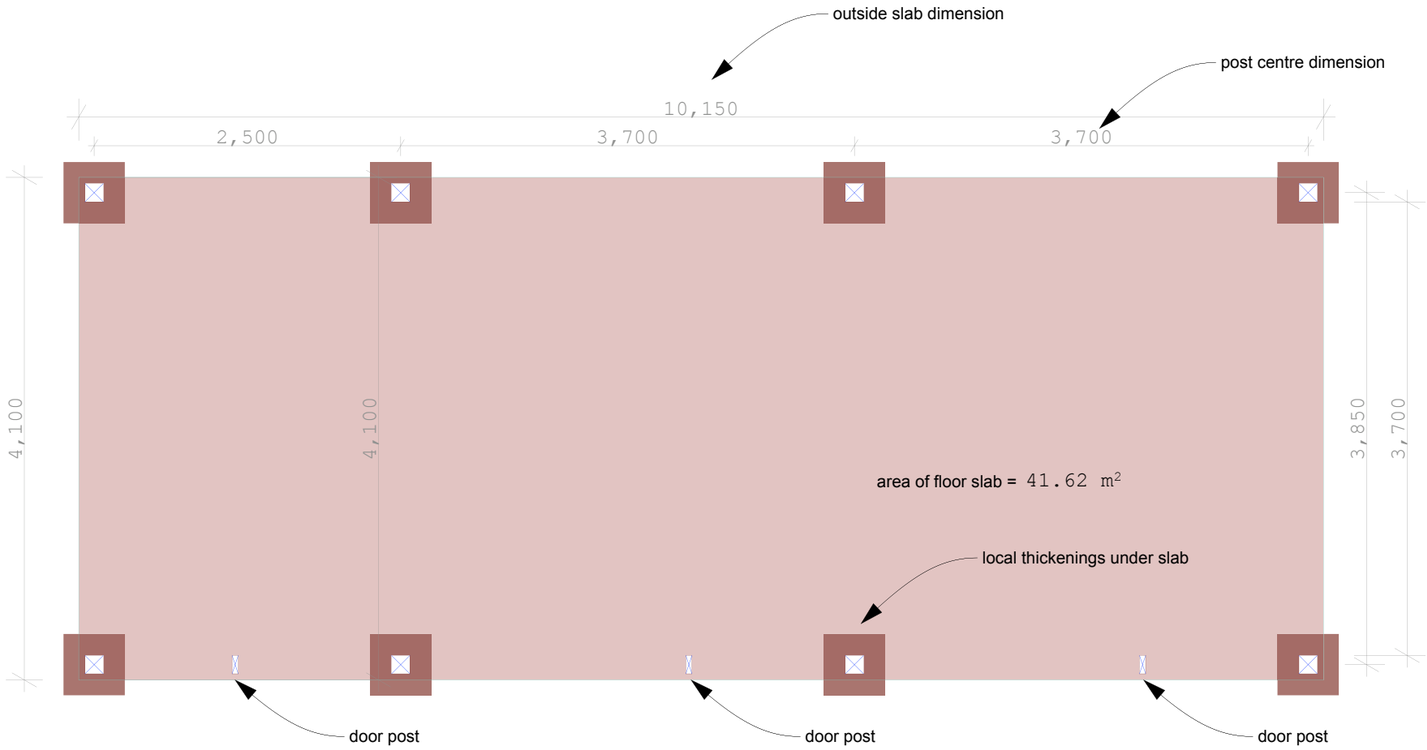
Stables

a. Design drawings (5no. A3)

b. Structural engineer's drawings (1no. A3)

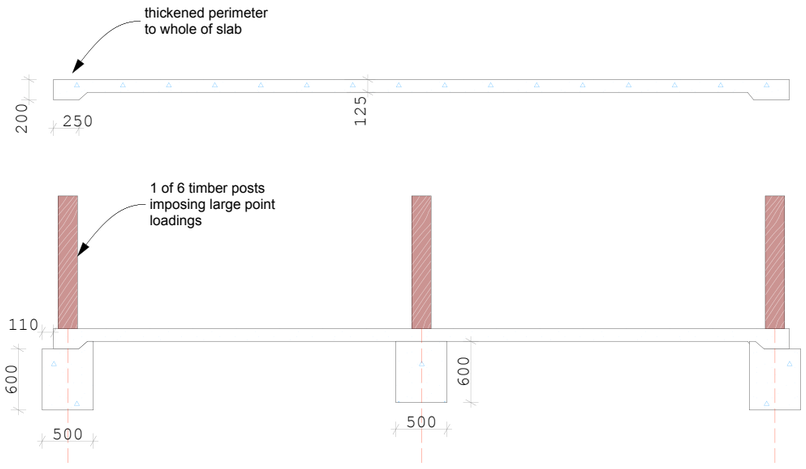
c. Cutting List (A4)

main slab
in plan



main slab in
section through
long axis

main slab at
perimeter



Notes for engineer

The concrete slab should have a perimeter depth of 200mm to provide 150mm minimum clearance of timber cladding from FGL. The depth of the rest of the slab, which should include a steel reinforcing grid, will be determined by the need to support light agricultural use without vehicular access. It can be assumed that the walls do not bear on the slab at all and the whole weight of the building therefore bears through the 8 posts.

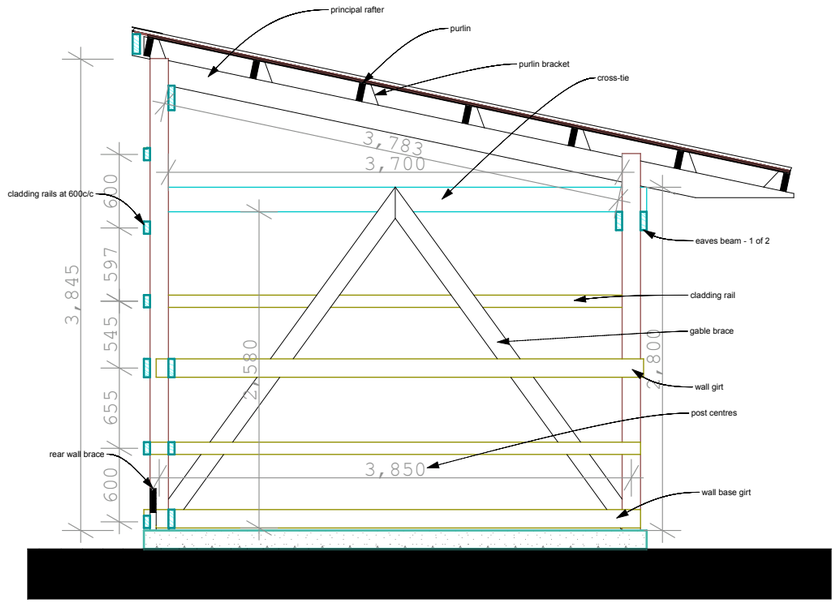
Each of the eight posts has a local thickening under it, poured as mass concrete. The dimensions of these thickenings shown on the drawing are notional and need to be engineered to minimum sizes. If the slab and pockets can all be poured in one go they will form a single mass. If poured separately, there may be need of reinforcing bar connections between the pockets and the slab.

The fixing of the six posts to the slab needs to be considered and could utilize a couple of steel angles or possibly a shoe. Whatever, it needs to be designed to allow fixing after the posts (and frames) are erected and nudged into final position.

drawing no. : SBC/ST/04	date : 22.01.09
Engineering 02	drawn by : BRP

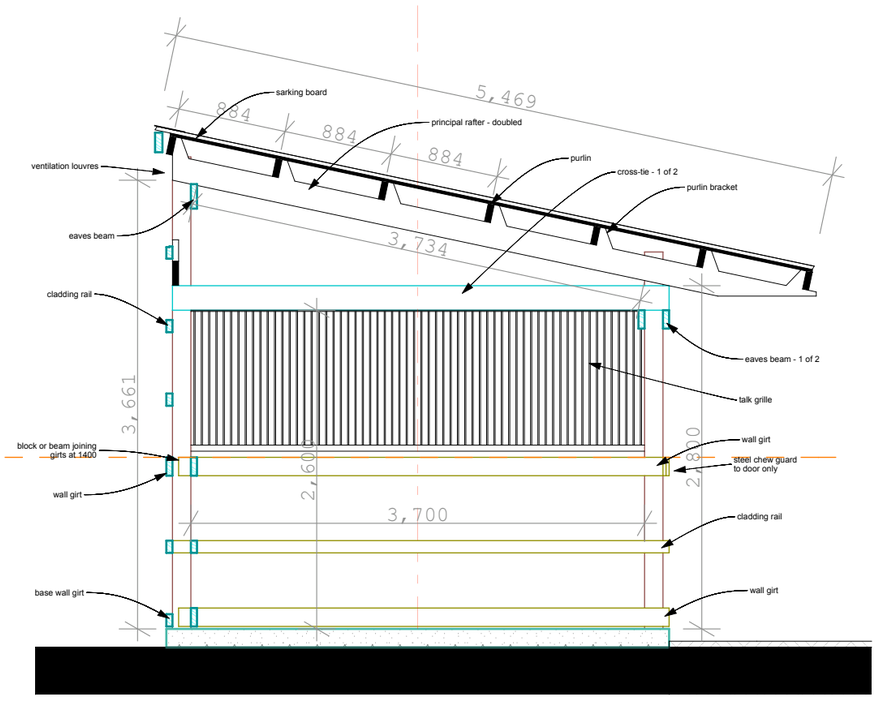
A design under development as part of Scottish Borders Woodland Partnership - Construction & Sustainable Development using Local Timber project.

The design will be available to local timber fabricators and is intended to promote the use of locally grown timber. The shed, which could be slightly smaller or larger than shown, can utilize Douglas fir, larch, Scots pine or oak in its construction. These drawings constitute an engineered design solution suitable for C16 home-grown softwood. *It is very important to note that if any dimensions are changed (especially increased) a structural engineer will need to check if it impacts upon timber dimensions and joint details.*



WK-05 gable frame and wall from inside

(with linings removed)



WK-03 partition frame between loose boxes

(with linings removed)

Notes for engineer

This post and beam structure is designed for ease of construction. It can easily be stick built from the bottom up or the four frames can be made up 'on the deck' and raised individually.

All connections will idealy be made with through bolts and 'Timberlok' (or equivalent) self-drilling, high tensile steel fixings. Rigidity is easily conferred on the gable walls and rear elevation by large diagonal braces. Internal sheathing in 12mm ply/OSB (omitted in these drawings) will also add considerably to racking resistance.

Support for the internal kick-boarding has been deliberately separated from the cladding rails/main structural supports by 50mm - the depth of the diagonal bracing on external walls. By inserting some 50mm blocks, the two members can act together to provide considerable structural rigidity in the lower part of the building where horses tend to lean. The plywood over the top of the two members at 1400mm forms a box-like member, again of considerable strength whilst also protecting key structure from chewing horses.

The purlins may be broken into three lengths, joining over the double rafters of the two intermediate frames. They are supported by timber angle brackets coach screwed to each rafter in advance of raising.

Sarking is essential to providing support for a waterproof membrane and is proposed in 150 x 18mm boards (to optimize use of local timber) which would not be part of the structure.

The roof covering should be assumed as 0.7mm profiled sheet steel screwed into the purlins through any sarking and membrane.

Wall girts/cladding rails provide structure and support for cladding and must all therefore remain in the same plane to the exterior wall elevations. It is anticipated that these will be fixed with Timberlok type screws for speed and structural strength. From experience, great rigidity is conferred by fixing all cladding rails and wall girts to braces wherever they intersect.

The concrete base and founds are dealt with on a separate drawing.

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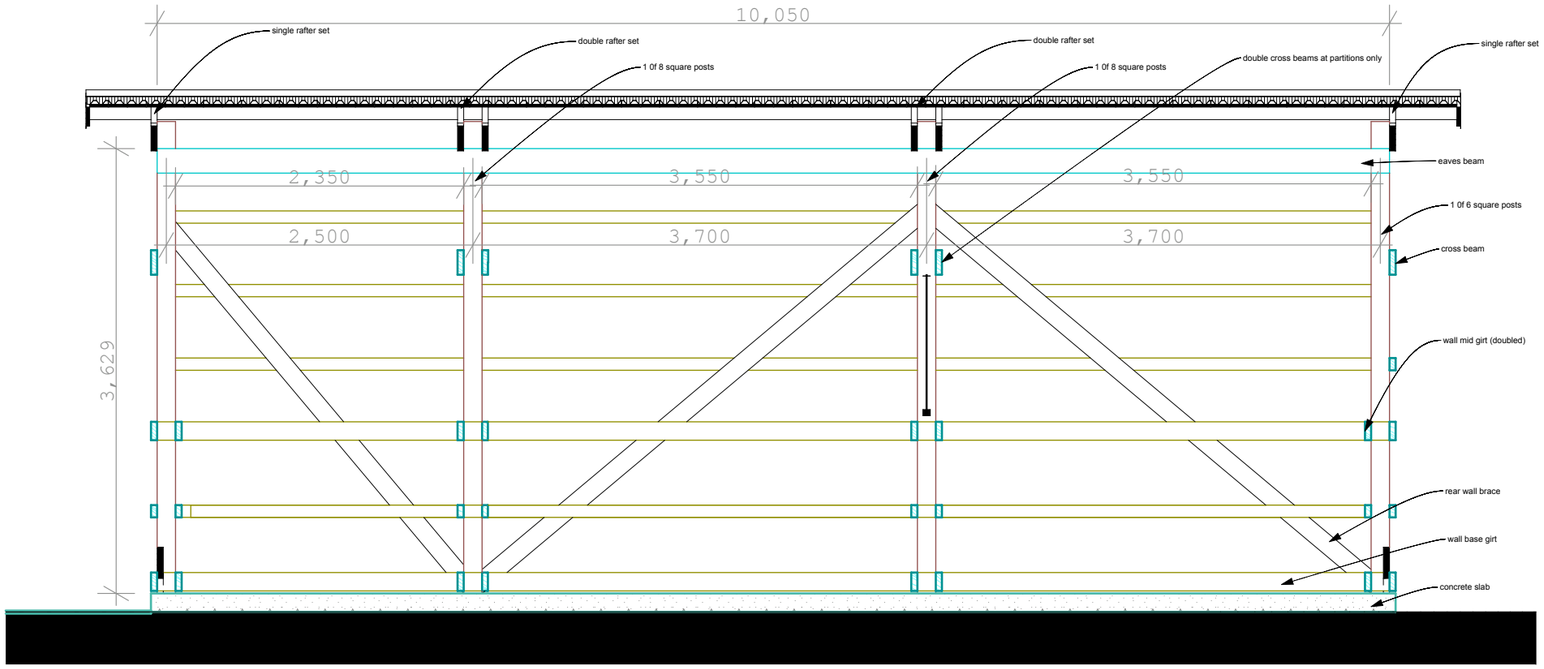
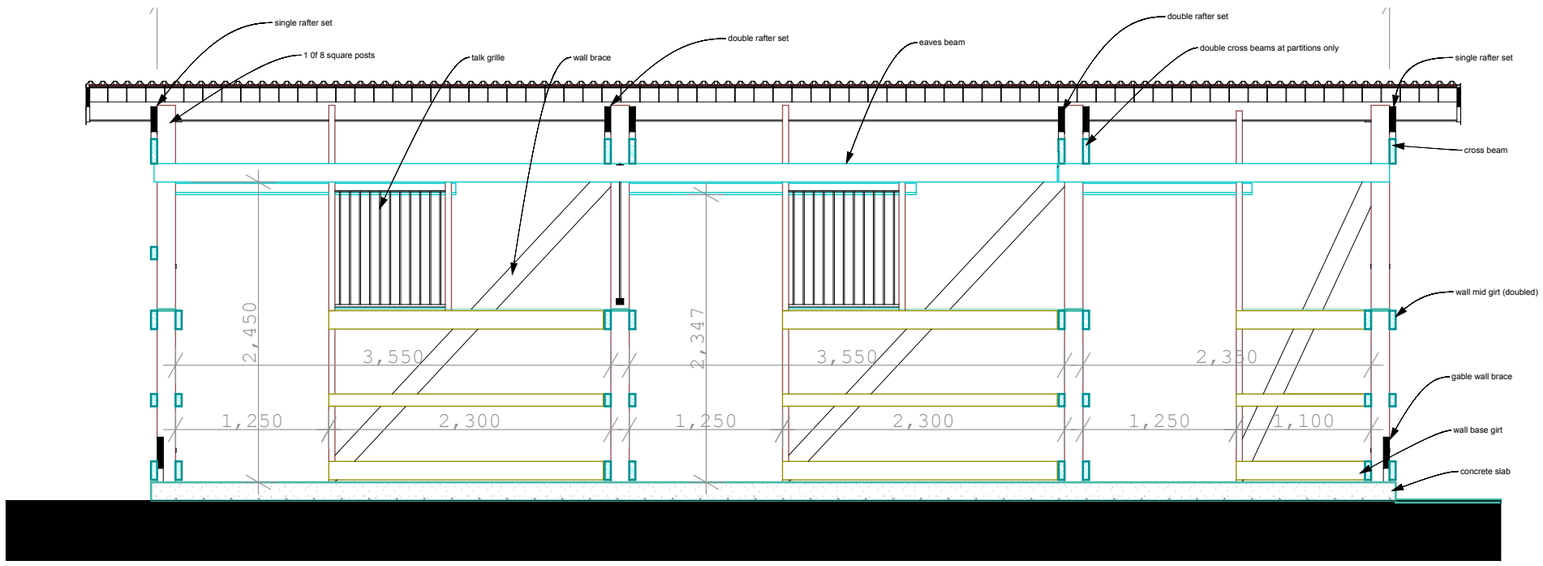
drawing no. : SBC/ST/04	date : 22.01.09
Engineering 02	drawn by : BRP

WK-04 long section showing rear wall
(with linings removed)





WK-08 front wall frame from inside
(with linings removed)

Notes for engineer

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Support for the internal kick-boarding has been deliberately separated from the cladding rails/main structural supports by 50mm - the depth of the diagonal bracing on external walls. By inserting some 50mm blocks, the two members can act together to provide considerable structural rigidity in the lower part of the building where horses tend to lean. The plywood over the top of the two members at 1400mm forms a box-like member, again of considerable strength whilst also protecting key structure from chewing horses.

The purlins may be broken into three lengths, joining over the double rafters of the two intermediate frames. They are supported by timber angle brackets coach screwed to each rafter in advance of raising.

Sarking is essential to providing support for a waterproof membrane and is proposed in 150 x 18mm boards (to optimize use of local timber) which would not be part of the structure.

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Wall girts/cladding rails provide structure and support for cladding and must all therefore remain in the same plane to the exterior wall elevations. It is anticipated that these will be fixed with Timberlok type screws for speed and structural strength. From experience, great rigidity is conferred by fixing all cladding rails and wall girts to braces wherever they intersect.

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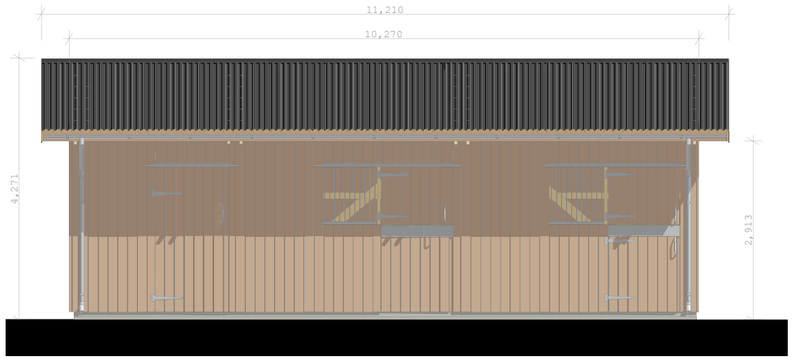
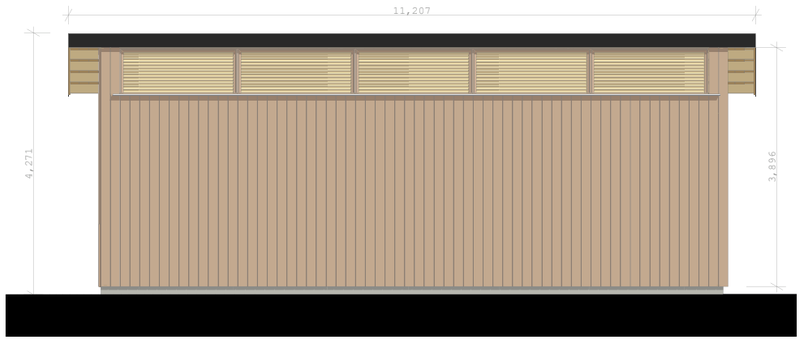
drawing no. : SBC/ST/03	date : 22.01.09
Engineering 01	drawn by : BRP

stables : planning drawings (2)

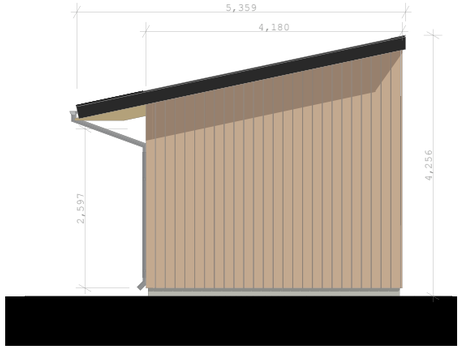
front elevation E-04
1 : 100



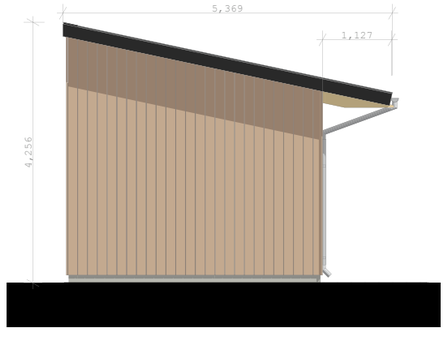
rear elevation E-03
1 :100



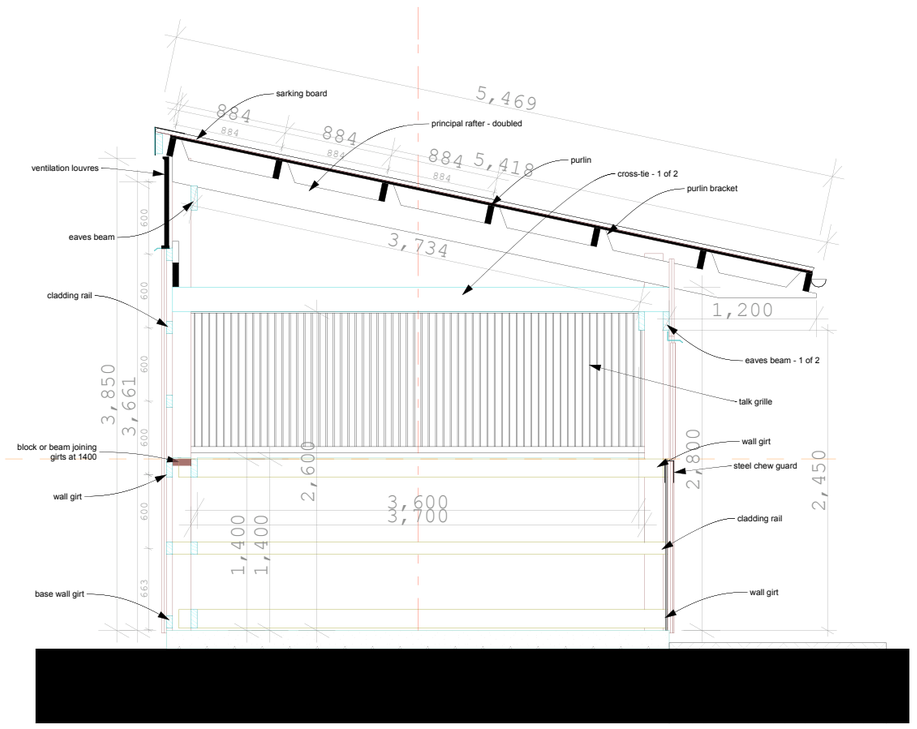
side elevation E-02
1 : 100



side elevation E-01
1 : 100



section across short axis at 1 : 50



notes for planning

These stables would normally require planning permission and Building Warrant though may be built as an agricultural building under Permitted Development Order in some circumstances. Agricultural buildings are generally exempt from Building Warrant but must still meet structural Building Regulations.

Any wall less than 1 metre from a boundary may require to be inflammable, in which case a cladding of sheet steel for instance would be possible. It is advisable to check on the specific circumstances with Building Control.

All planning drawings should note external materials proposed and their colours.

A design under development as part of Scottish Borders Woodland Partnership - Construction & Sustainable Development using Local Timber project.

The design will be available to local timber fabricators and is intended to promote the use of locally grown timber. The shed, which could be slightly smaller or larger than shown, can utilize Douglas fir, larch, Scots pine or oak in its construction. These drawings constitute an engineered design solution suitable for C16 home-grown softwood. *It is very important to note that if any dimensions are changed (especially increased) a structural engineer will need to check if it impacts upon timber dimensions and joint details.*

drawing no. : SBC/ST/02	date : 22.01.09
Planning 02	drawn by : BRP

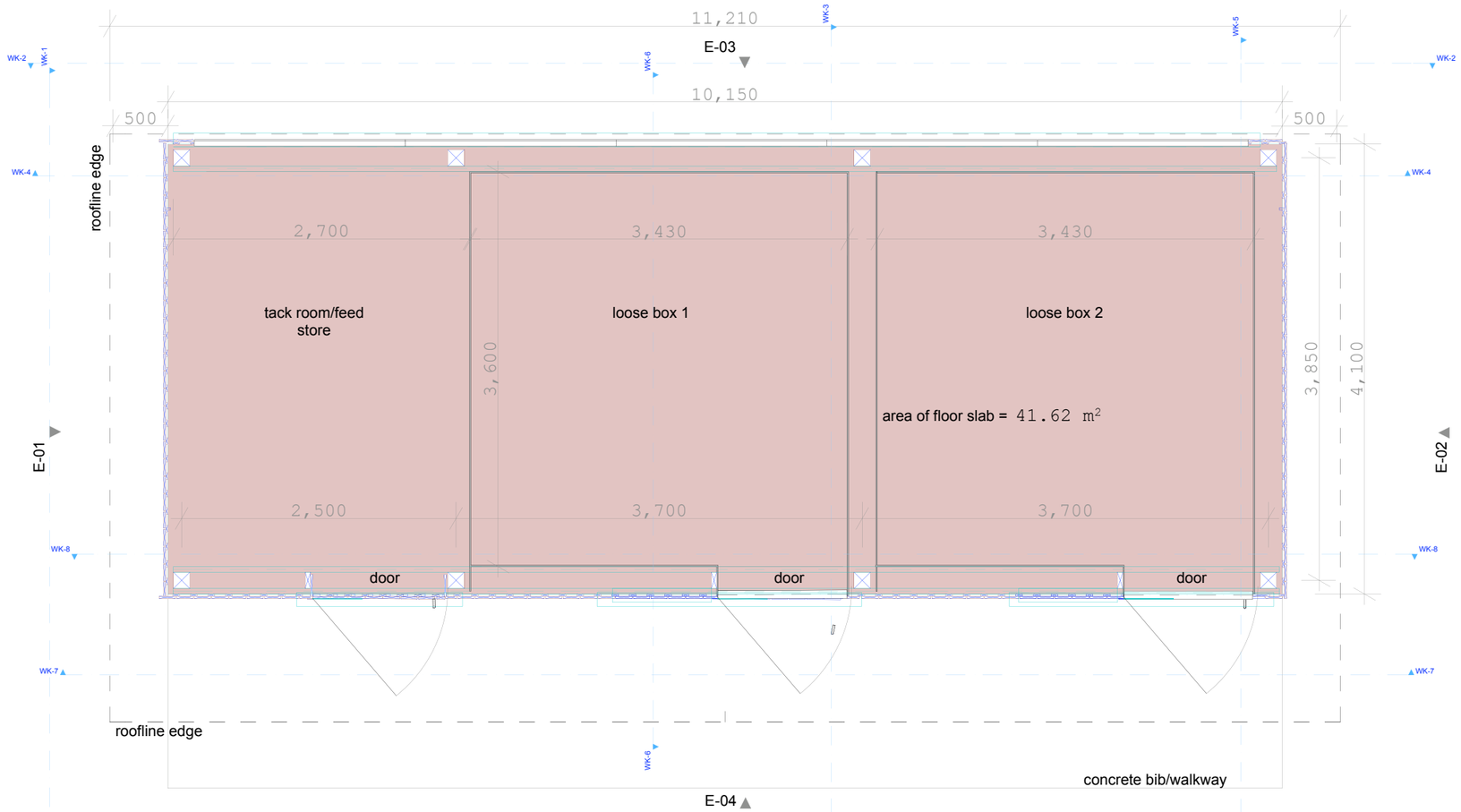
stables : planning drawings (1)

interior looking towards tack room

interior looking towards right gable

view of front from SE

floorplan
scale 1 : 50



design details

The stables unit comprises two loose boxes and a tack room and/or feed store each with its own external door. All the lower structure to 1400mm is protected internally by easily replaced kick-boarding which is drawn here as 12mm plywood or OSB. The top of the beams at 1400mm is also protected by sheathing which is used to stiffen the structure at this height. The tack room could also be sheathed internally but this is not shown here. There is a talk grille between the two stables internally above 1400mm manufactured from galvanized steel and matching the grilles to the front unglazed 'windows'. Doors will be solid in two parts, the lower with kick-boarding, as is common to all stables. A high level continuous timber-louvred ventilator is provided at the top of the rear wall.

In structural terms, it is a timber post and beam structure with 8 posts giving 3 bays. The two loose boxes are in wider bays than the tack room to meet standard stable dimensions. (3.6 x 3.6 internally is a standard size though this design provides 3.6 x 3.4). It utilizes solid timber sections and simple through-bolted and screwed connections. There are four main frames, two forming the gables and two forming partition walls. Whilst the gable frames each have a single rafter, the central frames have a double cross beam and double rafters. The rafters support purlins which are sarked in solid timber boards essential to supporting a waterproof, breathable membrane protecting the interior from condensation. Substantial braces in all walls give the building racking resistance which is further assisted by the internal sheathing.

The floor is concrete and has local thickenings under each of the eight posts. The roof covering is shown as profiled sheet steel which would be laid on battens or on a draining waterproof membrane.

Structural timber would ideally be home-grown larch or Douglas fir. Cladding would ideally be home-grown larch or possibly treated pine. Oak could be used for the frame, the cladding or both.

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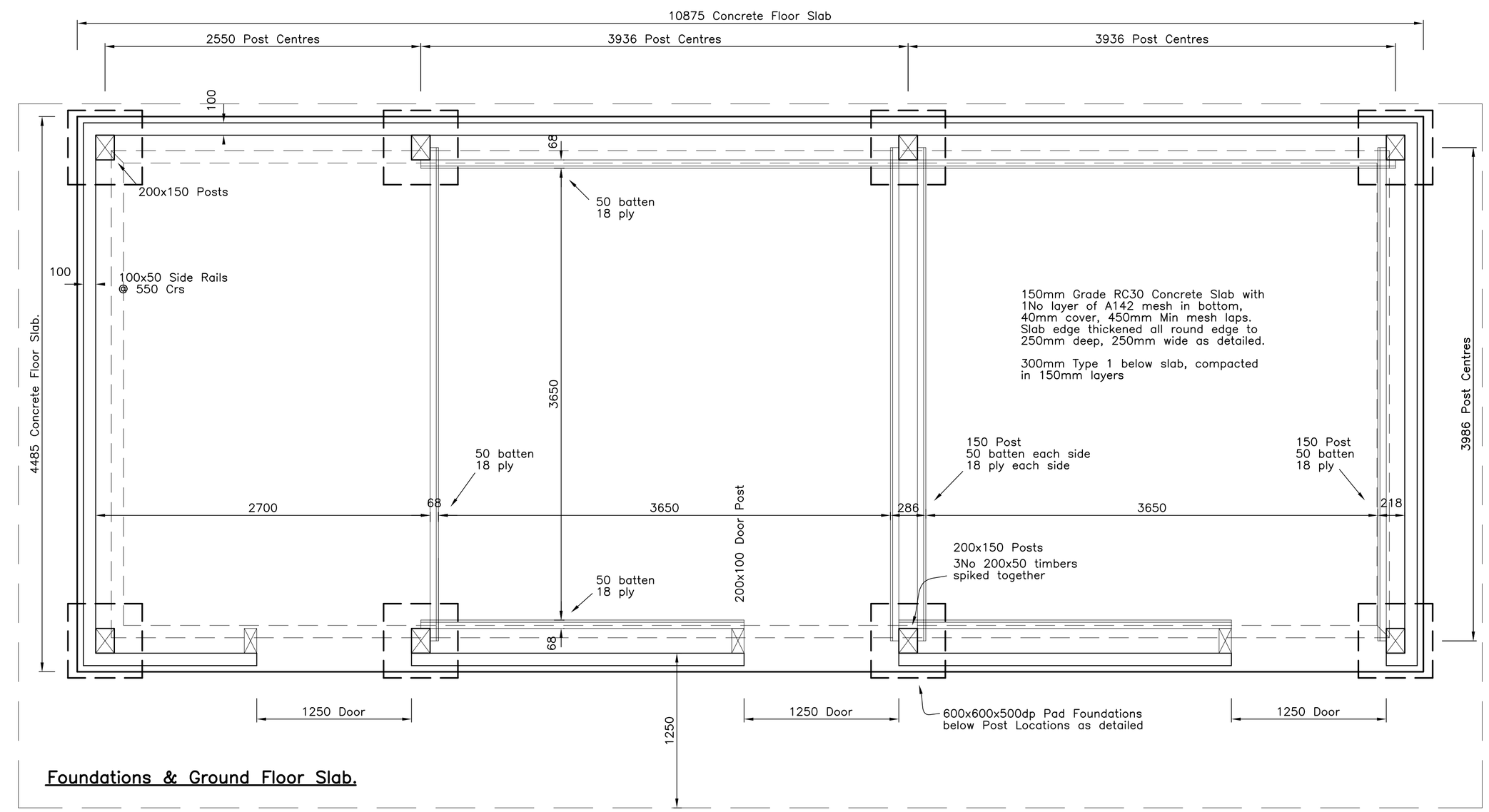
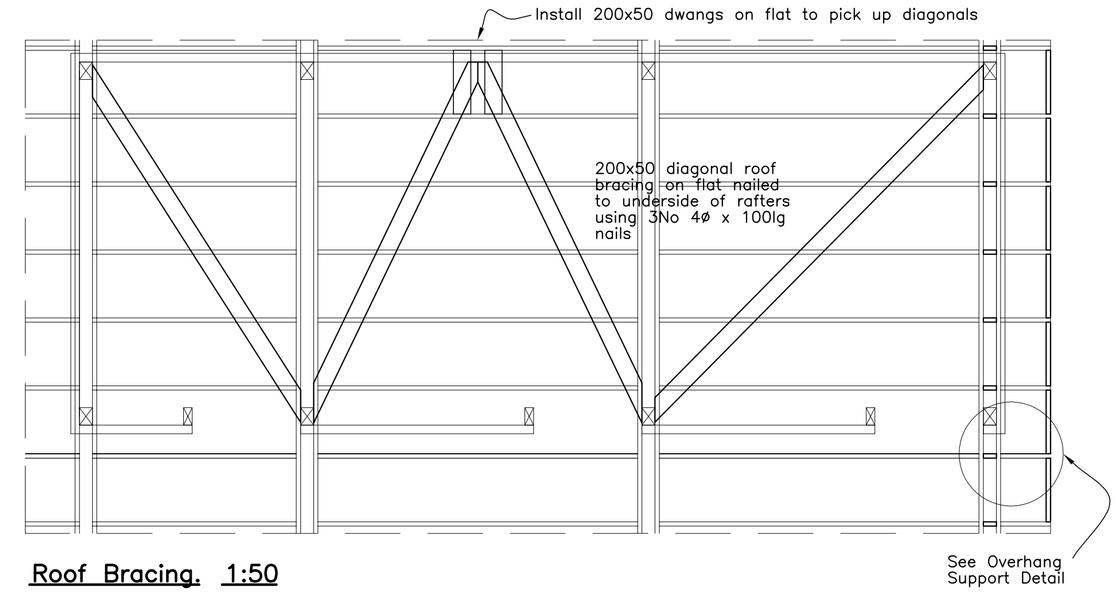
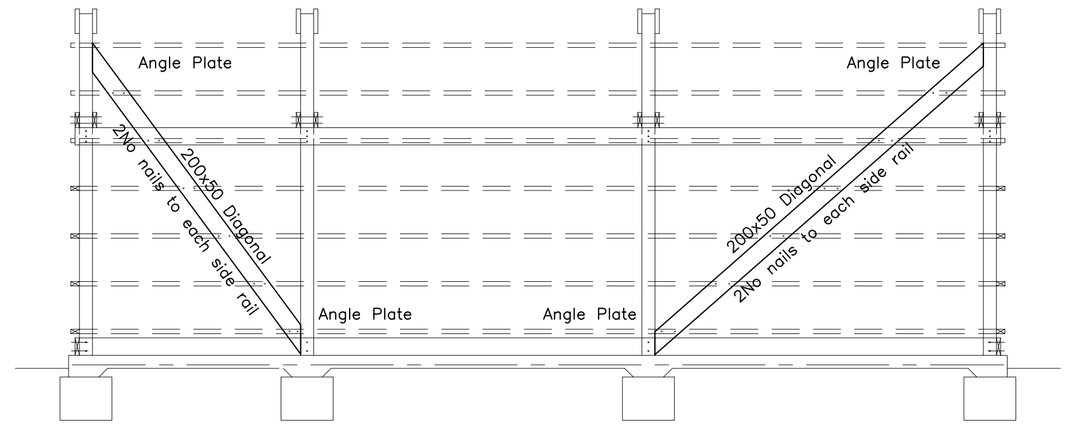
drawing no. : SBC/ST/01	date : 22.01.09
Stables Planning 01	drawn by : BRP



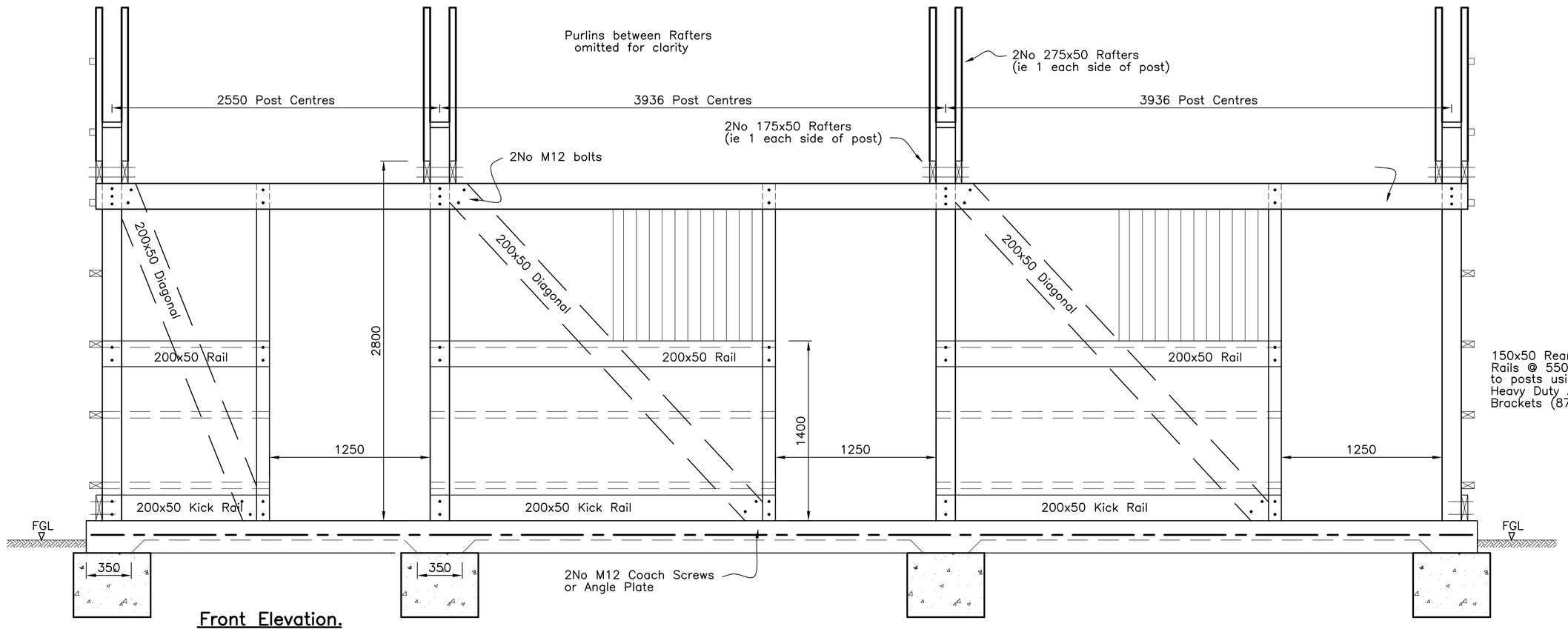
Foundations & Ground Floor Slab.



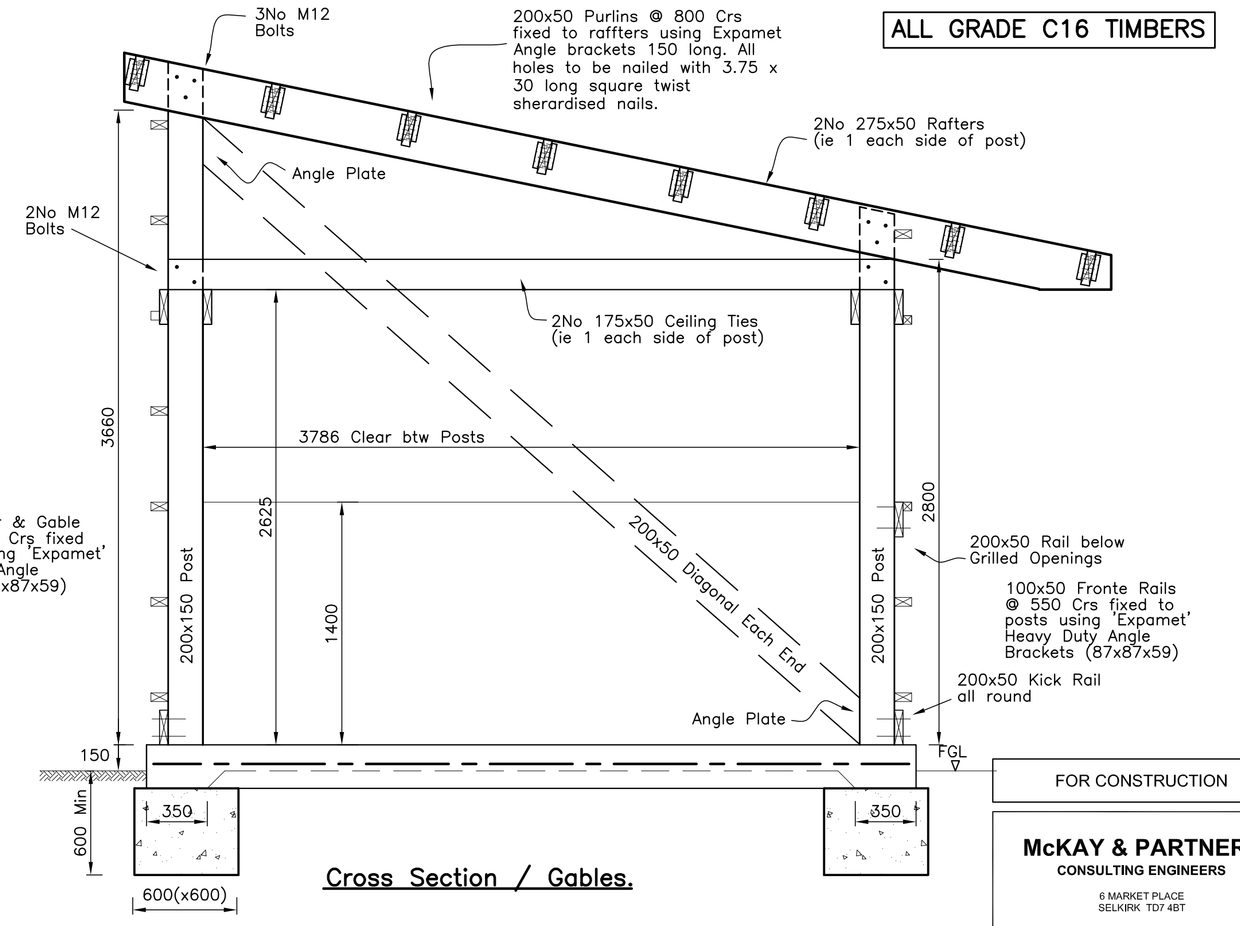
Roof Bracing. 1:50



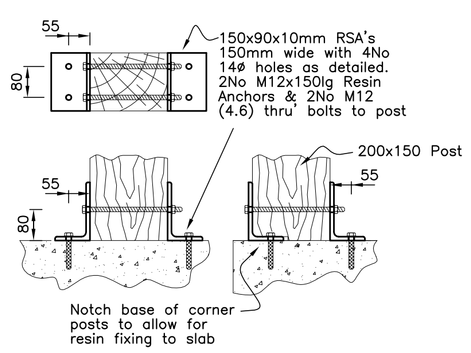
Rear Elevation Bracing. 1:50



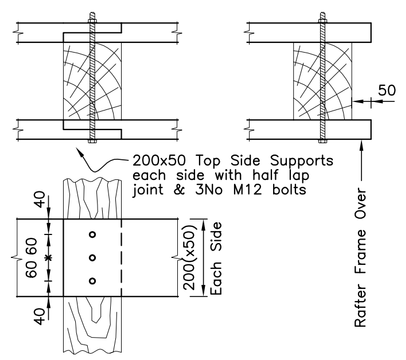
Front Elevation.



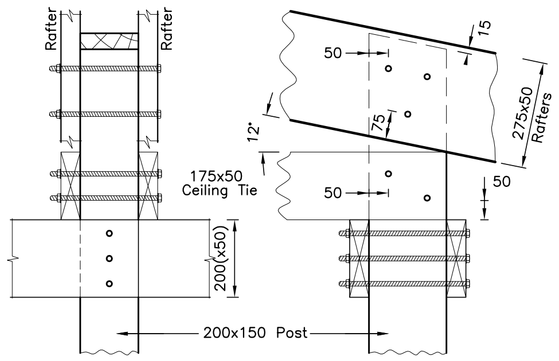
Cross Section / Gables.



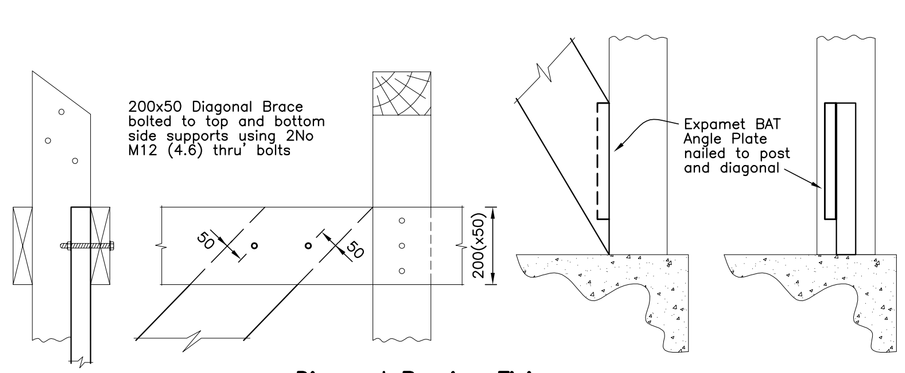
Post Base Fixing Details.



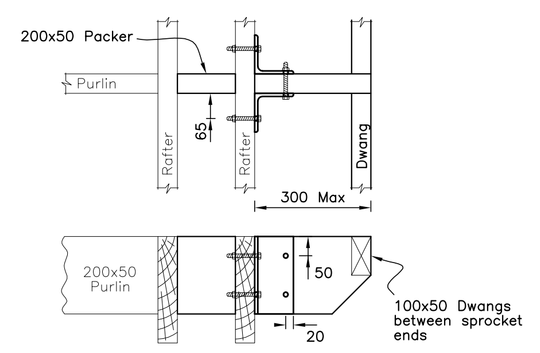
Side Support Fixing at Top of Post.



Rafter to Post Fixing.



Diagonal Bracing Fixings.



Gable Overhang Fixings.

FOR CONSTRUCTION

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SELKIRK TD7 4BT
TEL 01750 721726 FAX 01750 722752

GAIA
ARCHITECTS

POST & BEAM
STABLES

STRUCTURAL ARRANGEMENT
AND DETAILS

DRAWN	CHECKED	APPROVED
Mike Kelly	JK	JK
DATE	DATE	DATE
July 2009	July 2009	December 2009

SCALE 1:25, 1:10

DRAWING NUMBER 09/064/02

REVISION

Post & beam stables
Timber quantities only

Item	Quantity	dimensions					
		height mm	width mm	length mm	unit volume m3	gross volume m3	
main frame							
post rear	4	200	150	3850	0.1155	0.462	can be 3 pcs of 200 x 50 screw laminated
post front	4	200	150	3100	0.093	0.372	can be 3 pcs of 200 x 50 screw laminated
door post	3	200	100	2700	0.054	0.162	
cross tie	8	175	50	4200	0.03675	0.294	doubles in each of 4 frames
front wall							
base girt	1	200	50	6700	0.067	0.067	in 3 separate lengths
mid girt	1	200	50	6700	0.067	0.067	in 3 separate lengths
eaves beam main	4	200	50	4100	0.041	0.164	doubles, one each side of post
eaves beam tack room	2	200	50	2700	0.027	0.054	doubles, one each side of post
cladding rails	1	100	50	17400	0.087	0.087	in several lengths
diagonal brace main	2	200	50	3600	0.036	0.072	
diagonal brace tack room	1	200	50	2900	0.029	0.029	
rear wall							
base girt main	2	200	50	4100	0.041	0.082	in 3 separate lengths
base girt short	1	200	50	2700	0.027	0.027	
eaves beam main	4	200	50	4100	0.041	0.164	
eaves beam tack room	2	200	50	2700	0.027	0.054	
cladding rails main	12	100	50	4100	0.0205	0.246	
cladding rails tack room	6	100	50	2700	0.0135	0.081	
diagonal brace main	1	200	50	5300	0.053	0.053	
diagonal brace tack room	1	200	50	4400	0.044	0.044	
gable end walls							
diagonal brace	2	200	50	5250	0.0525	0.105	one at each end
base girt	2	200	50	4200	0.042	0.084	
cladding rails	12	100	50	4200	0.021	0.252	
tack room partition							
cladding rails	5	100	50	4200	0.021	0.105	to 2700 only
intermediate post	1	150	50	2700	0.02025	0.02025	to 2700 only
stable partition							
cladding rails	4	150	50	2700	0.02025	0.081	to 2700 only ; no. depends on visibility grilles
intermediate post	1	150	50	2700	0.02025	0.02025	to 2700 only
roof							
rafter	8	275	50	5900	0.081125	0.649	doubles

purlin main	16	200	50	4600	0.046	0.736	length depends on desired gable overhang
purlin tack room	8	200	50	3200	0.032	0.256	
purlin haunch	48	150	50	150	0.001125	0.054	
diagonal brace	1	200	50	6000	0.06	0.06	
diagonal brace	3	200	50	5000	0.05	0.15	
gable barge board	2	200	25	5900	0.0295	0.059	non-structural ; length same as rafters
rear barge board		200	25		0	0	
cladding							
cladding boards long	124	150	18	4000	0.0108	1.3392	wide board on narrow board pattern as drawn ; many others possible ; cladding could be between 18 and 22 mm thickness
cladding boards long	124	60	18	4000	0.00432	0.53568	
cladding boards short	50	150	18	3100	0.00837	0.4185	NB. approximate cladding quantities
cladding boards short	50	60	18	3100	0.003348	0.1674	
cladding tack rm partition	28	60	18	2700	0.002916	0.081648	to 2700 only
TOTALS						7.754928	
excluded	sarking boards ; a small quantity of 50 x 50 packers ; all plywood kick boarding ; doors ; visibility grilles ; all of which appear in some drawings						

North Woods Construction Ltd

Gaia Architects

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