



ARCTIC BURPS KILLED CAPITALISM

DESIGNED IN AOTEAROA (NEW ZEALAND), MADE FOR THE WORLD

alightmouse

OPEN SOURCE PROJECTS

EST 2013. AOTEAROA (NZ)

presents

A GREENHOUSE FULL'A BUCKMINSTER

AN OPENSOURCE DOCUMENT, 1ST EDITION RELEASE

"A Greenhouse Full'a Buckminster" a 9.5sq/m home food production unit. That aims to use 95-99% less water than standard agricultural practices, produces food for up to 4 people. Year round, lowering your cost of living while looking Bad Ass.

MAIN STRUCTURE
Drawings



ALIGHTMOUSE LTD, EST 2013, CHRISTCHURCH NEW ZEALAND

**"You never change things by fighting the existing reality.
To change something, build a new model that makes the existing model obsolete"**

general notes

1; roof vent cap, "allows warm air to be passively extracted while sucking in cool air from the vent pipes at the base of the greenhouse.

2; butyl rubber finished cladding over plywood, insulation with max R rated insulation for a 70mm depth.

3; 6-8mm twin wall polycarbonate glazing. Lighter, Safer & Cheaper than glass, can be cut with a craft knife (box cutter) and has an R rating that is equivalent to double glazed glass windows.

4; reflective foil lining to interior to aid with light distribution. Plywood lining in behind would also be great also, especially if you would like to fix cabling for lights, additional hooks or shelves to the interior.

5; small rainwater water collection, filter and sump. This allows the water that will go into the main 'aquaponics' tank and grow beds to be tested for PH, Ammonia, Nitrate and Nitrite levels, prior to adding. Sediments are also filter here.

6; grow beds; all for 300mm deep growing substrate.

7; fish, oh glorious fish! who's waste feeds the plants. In a 1200litre tank.

8; storage; for maintenance item (non electrical)

9; floor vent; helps pull cool fresh air into the greenhouse. This could be rigged up with small fans for mechanical ventilation or just used passively.

10; 900-1200mm ceiling fan; with timer, which allows for even air circulation at times when needed. also helps with mould prevention on windows due to condensation.

11; overflow to field drain or outdoor 'botanical cell'.

12; drain, plugged until needed.

13; water storage tank with first flush diverter from roof. 3000L would be good to store.

14; Warm Air from the greenhouse

15; any building that collects rain water.

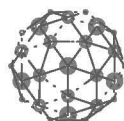
16; embanked soil; ensure greenhouse is 250mm minimum of the existing ground to ensure water table never rises above the floor.



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info; greenhouse overview

A0.00

general notes

1; the dome should be orientated towards the most sun. these plans were drawn for those in the southern hemisphere, hence why it is drawn with the windows facing due north. if you are in the northern hemisphere then one should orient the dome glazing south.

the sun diagram shown showing the position of the sun was done using coordinates specific to christchurch, new zealand.

I used www.sunearthtools.com to obtain the sunrise and sunset position locations specific to my area, its a free and a helpful tool.

2; the finished floor level should be minimum 225mm from the cleared ground level outside, soil can then be bantered up to the sides. this is to prevent flood and moisture damage. It would be wise to do some research and find out if any flood planes are in your area, because 225mm might not actually be enough.

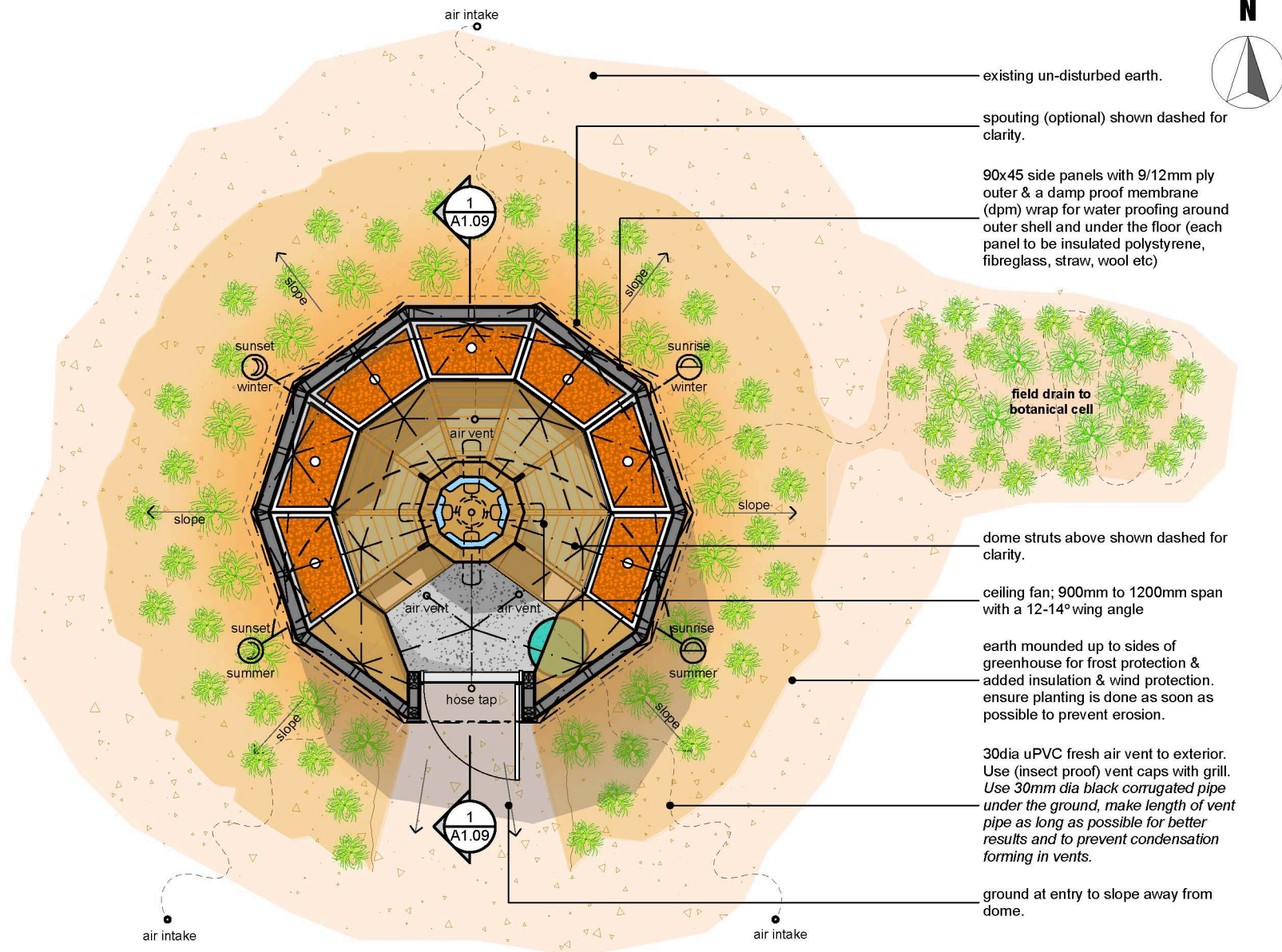
3; planting small tussocks to front, make sure to confirm max growing size prior to planting to avoid unnecessary maintenance.

4; the air vents should be 30mm diameter and should be able to be plugged from the inside when not needed or not in use. the exterior vents should have insect proof mesh to prevent the vents becoming loaded with cobwebs or nests etc. refer to the note for pipe type & length

5; the optional drain should be 30mm diameter and is an appropriate to have just in case the greenhouse floods via leaky hose etc or if you have an aquaponics system. have the drain go to a tap outside the front so that a hose can be connected and the water can be drained to any desired location.

5; before construction starts, ensure that you have followed the necessary planning requirements regarding the building location, ground bearing capacity and corresponding foundation type as well as followed and adhered to any guidelines that might apply to you.

while you might not need a consent or planning permission for this type of build, it is still a good idea to ensure you do the job right and avoid any potential liabilities and building requirements.



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plan; basic layout

A1.00

foundation notes

1; The foundation type shown is, in a sense, a generic one. the width, depth and reinforcing shown is based on a standard nzs:3604 foundation type which is used for residential properties. It is advised that anyone who wishes to build this greenhouse consult with a builder, draughtsman, architect, structural engineer and local authority before construction takes place. There are several 'site specific' factors which may mean you require a specific foundation type. It is the owner/builders responsibility that the foundation type and construction is suitable to the building location. be responsible.

2; If you plan to build on a hill site, have a high water table, have a site susceptible to lateral spread and/or liquefaction during an earthquake. Then you might want to consult a structural engineer, or at least a builder and your local authority. A 'penetrometer test' can determine the bearing depth of the soil in the area you wish to build. (these items may not apply to everyone, but it is worth investigating before construction begins.)

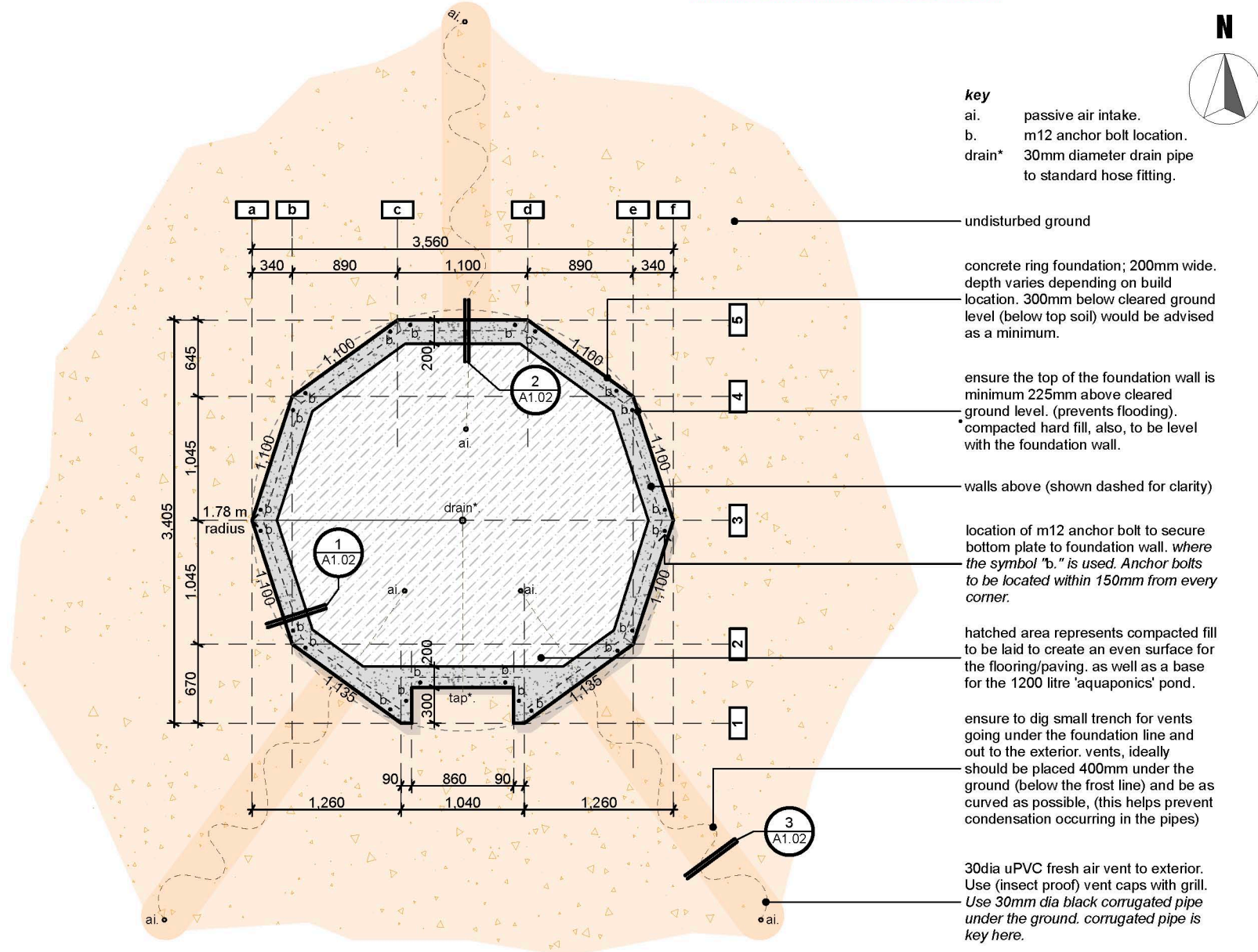
3; make sure your damp proof membrane is taped around the vent pipes and is laid under the foundation. **refer details on A1.01**

4; *The drain in the centre of the greenhouse is optional and only applies to those who wish to have an 'aquaponics' system and also wish to have a drain, in the event the entire system needs emptying or disassembling. This makes it easier to use this water elsewhere if needed.

5; check if your build location is in a flood plane. if it is in a flood plane, then you may have to build the greenhouse in a higher location, if possible, or make the finished floor level higher.

6; if you running power under ground from another location, then during the excavation work is the best time to do this. be sure to use a qualified electrician if you are undertaking any electrical work.

7; please refer to A1.12 for an alternative block foundation detail.



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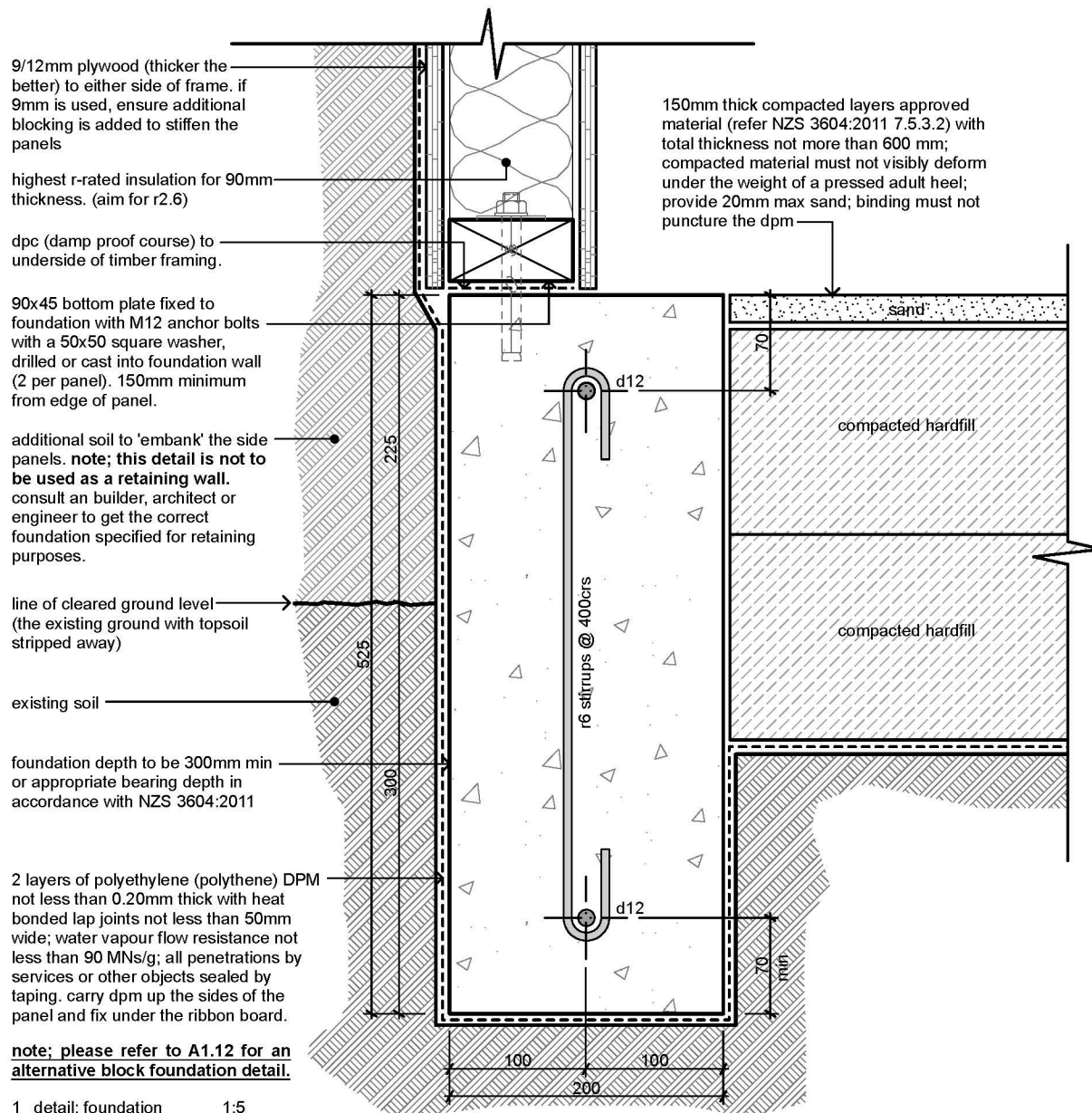


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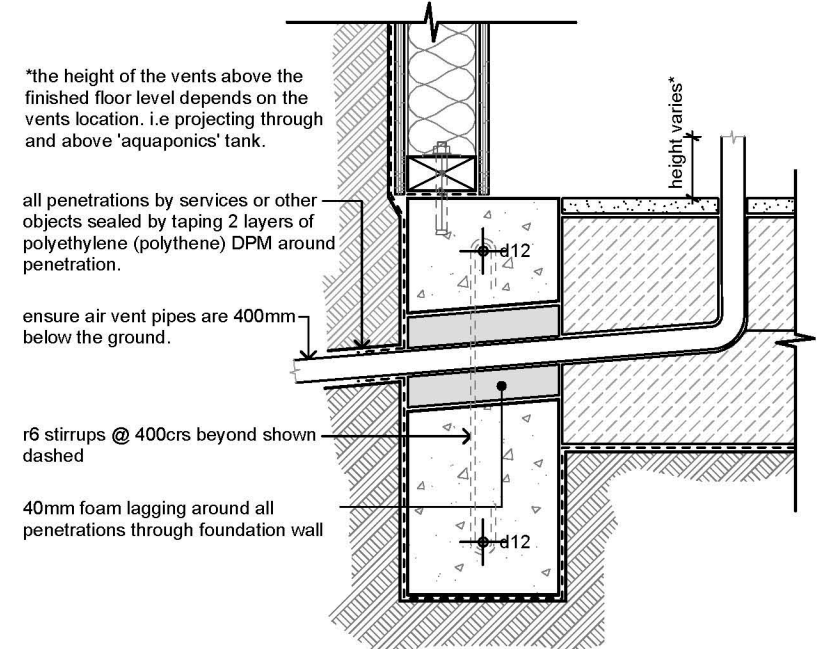
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plan; foundation, setout & services

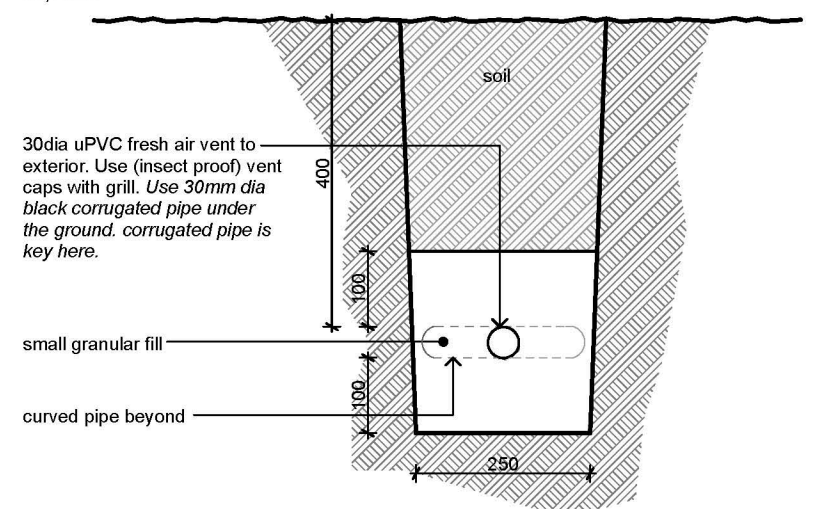
A1.01



1 detail; foundation 1:5
ref; A1.01



2 detail; foundation penetration 1:10
ref; A1.01

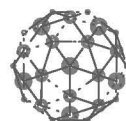


3 detail; air vent trench 1:10
ref; A1.01

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**details; foundation &
services**

A1.02

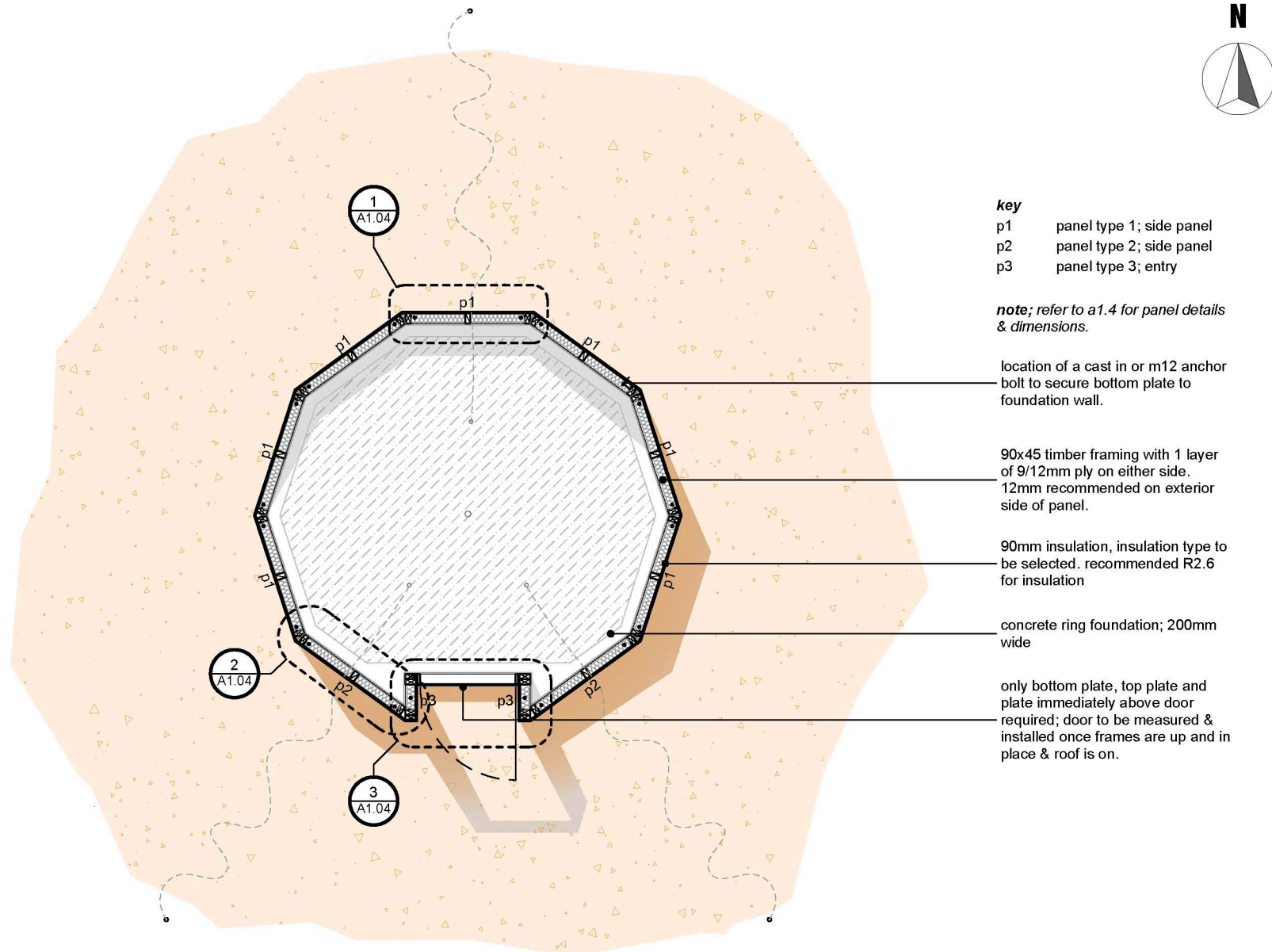
base panel notes

1; The door to the dome should be measured up, made and installed, only after the dome frame is assembled and the cladding is on. It would also be a good idea to have a fly screen on the door also. Extra cost but it allows for optional ventilation during the warmer months.

2; install the insulation only after the dome has been enclosed. To ensure that any moisture has had time to evaporate. ensure wires services are also installed before insulating.

3; The base frame is made up of 90x45mm timber members, with 9-12mm ply to the exterior and interior lining. This offers adequate bracing and stiffening to the base structure.

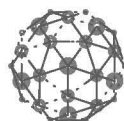
4; *The drain in the centre of the greenhouse is optional and only applies to those who wish to have an 'aquaponics' system and also wish to have a drain, in the event the entire system needs emptying or disassembling. This makes it easier to use this water elsewhere if needed.



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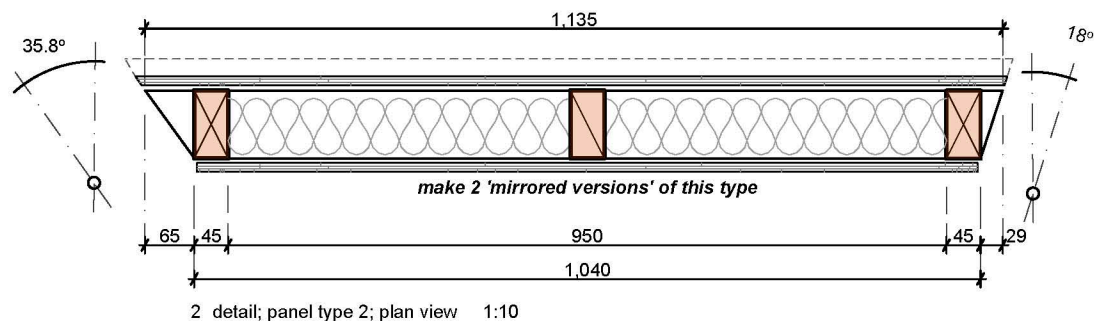
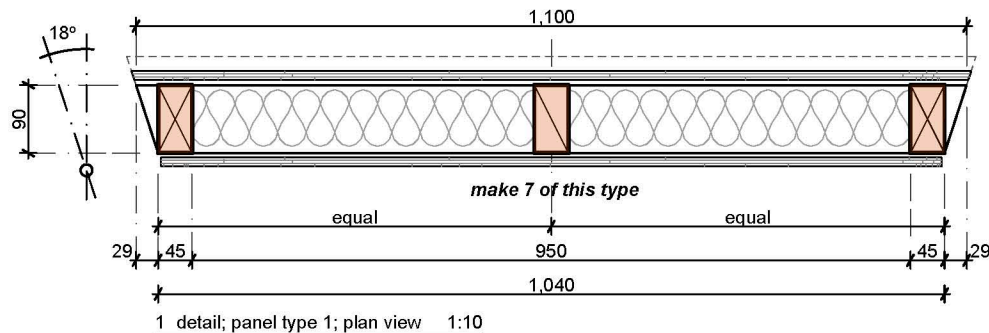


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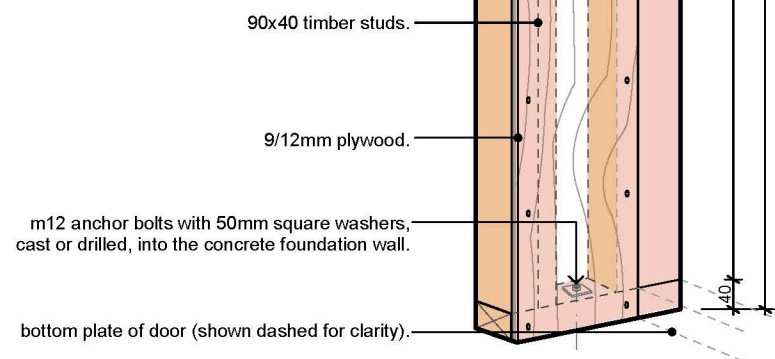
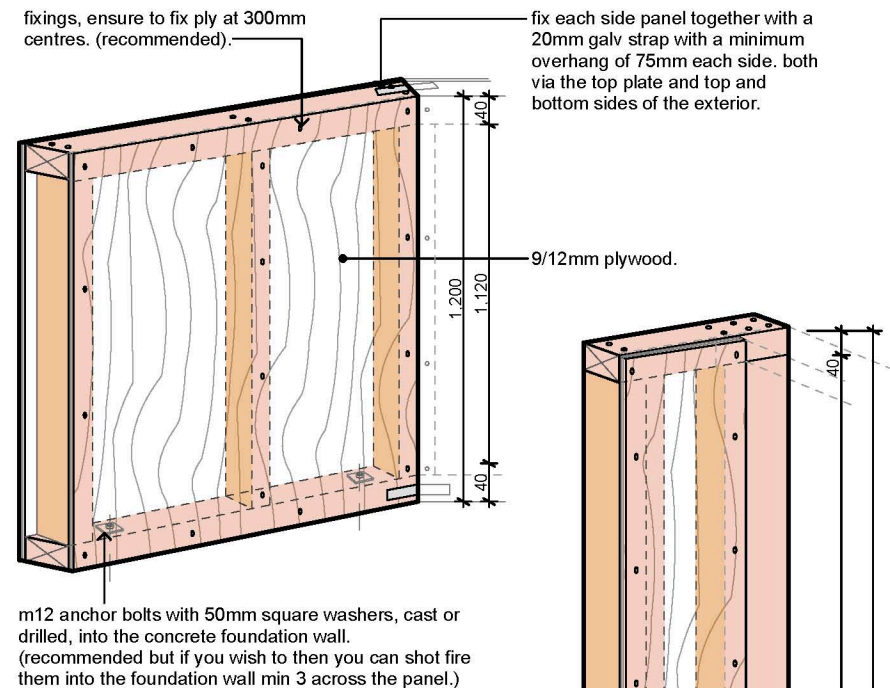
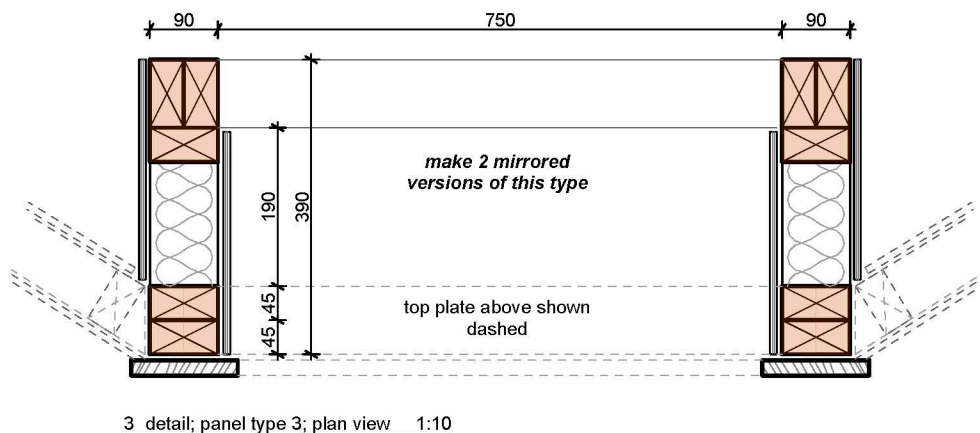
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plan; base framing plan

A1.03



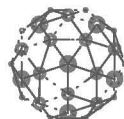
note; panel type 1 & 2 have the same height, but only one end matches the "panel type 1" end angle (18°). **ensure when constructing panel type 2 that each panel is a reflection or mirror of the other.** (this only applies to panel 2). use the same fixing methods and layout as panel 1.



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details; base frames

A1.04

dome strut notes

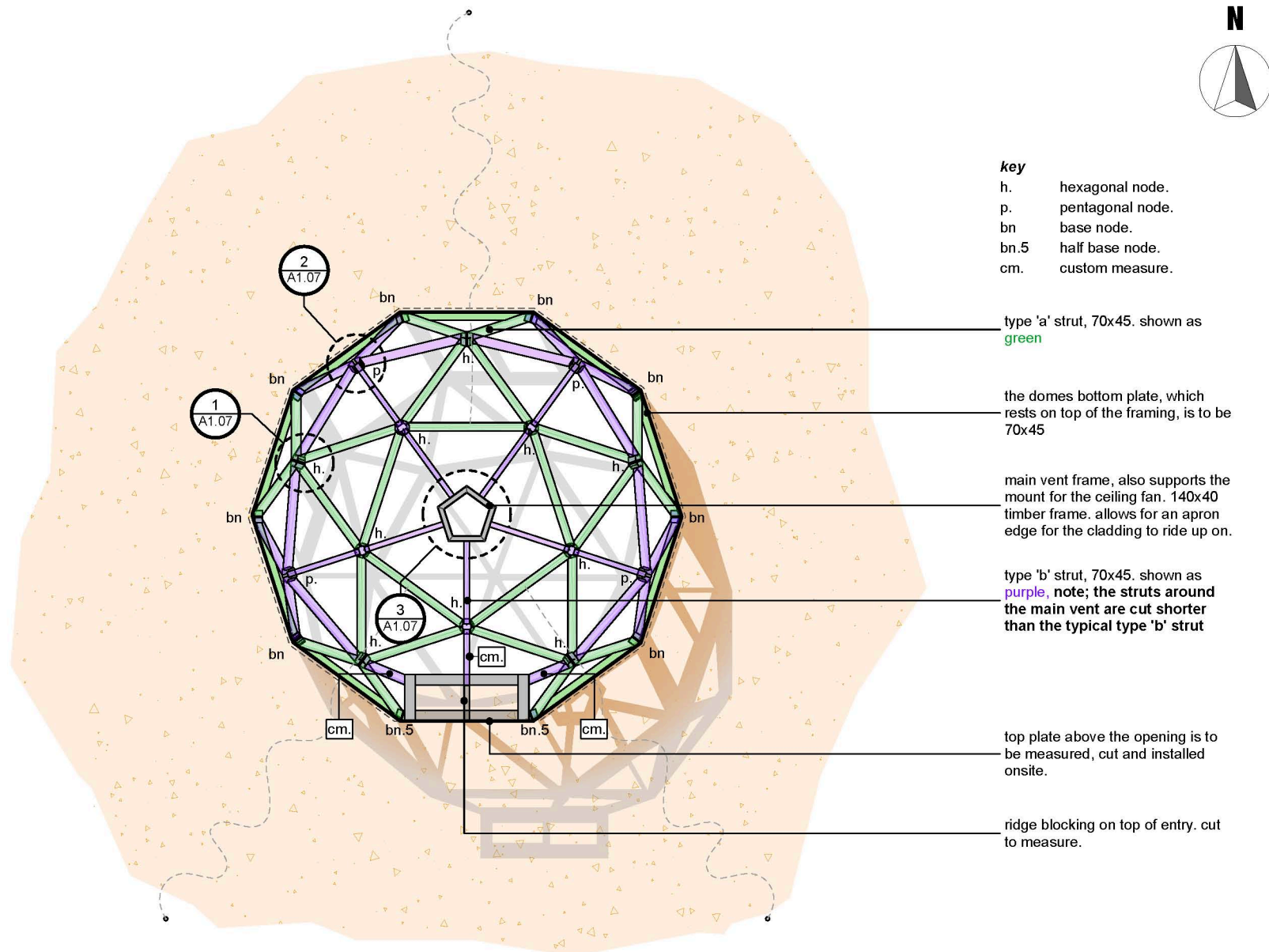
1; setting the 'base nodes' in the correct position will probably be the trickiest part of the dome building process. See the details on A1.05 for base node placement positions.

2; when nailing the struts and nodes together it is best to assemble the entire dome with just one nail fixing from each strut to node connection. (this allows the structure to be a little more flexible when assembling). After the entire dome structure is assembled, simply add another nail to each connection and the structure will stiffen up dramatically.

3; it is recommended that the 1st strut fixing hole is predrilled prior to fixing. (only to the strut, not the node) so that the timber does not split when fixing.

4; the entire structure is timber. species, treatment & finish of the timber is up to you. ask a builder what is most suitable to your particular design & fit out. i.e chemically treated timber i.e H1.2 treated, rated to a standard residential house, baked timber, untreated timber with a paint finish that it suitable for wet areas. (suitable for a humid environment.) i.e mould resistant water based enamel paint. etc.

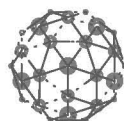
5; all of the struts noted can be cut to size as per these plans. however, to allow for a margin of error during installation. there are a few struts which i've noted to be measured, cut and installed on site.



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plan; strut layout

A1.05

node & strut notes

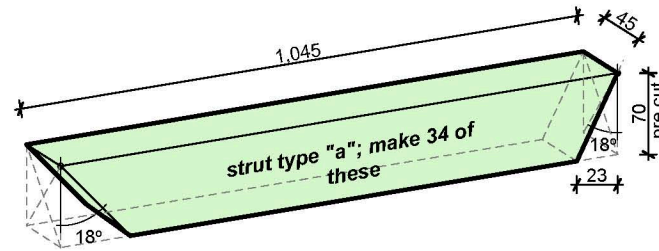
1; the hexagonal nodes are not 'perfect'. while the difference is only minor, it does effect the angles at which each strut projects out. also notice the letters 'A' & 'B' on the inside of the 'h' type node diagrams. they represent the strut type in which it connects to.

2; a 1:1 scale of these nodes are at the back of the shell drawings. be ensure to print these out with no 'scaling' if you plan to use the cutting templates.

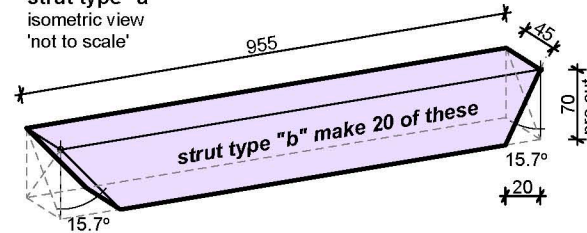
3; the pentagonal nodes 'p' are the same dimension all the way around. there is little hassle with this node when it comes to orientating it to the correct side.

4; refer to A1.06 for fixing details

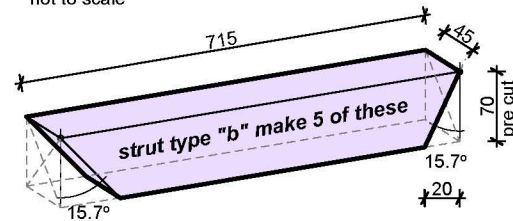
5; when cutting out each of these members, be sure to mark each strut or node type with either a colour or mark to distinguish it from differing members. i.e label strut type 'b' with a daub of purple paint or write 'b' on it somewhere noticeable. this will ensure the assembly process is smooth.



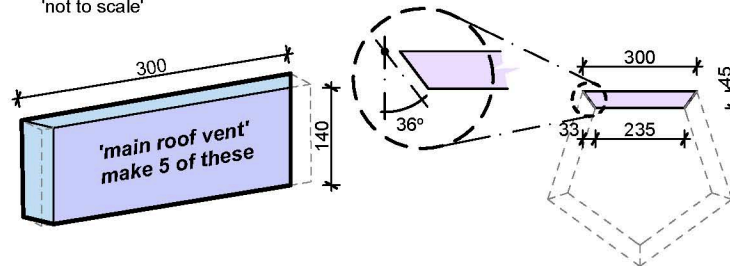
strut type "a"
isometric view
'not to scale'



strut type "b"
isometric view
'not to scale'

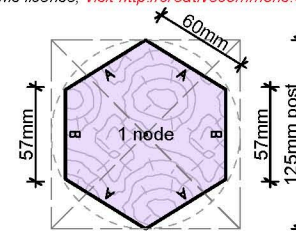


shorter type "b" strut for around the main roof vent
isometric view
'not to scale'

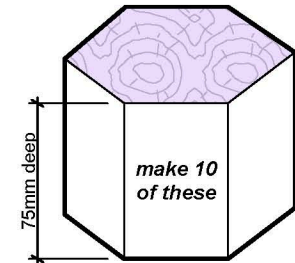
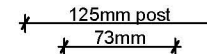


main roof vent frame
isometric view
'not to scale'

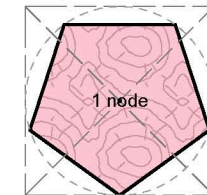
main roof vent frame
plan view 1:20



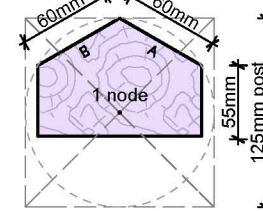
node type "h"
hexagonal node
typical cross section



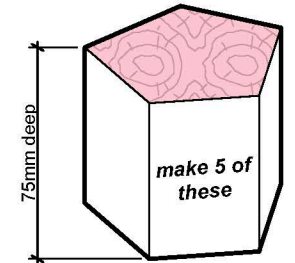
node type "h."
oblique view



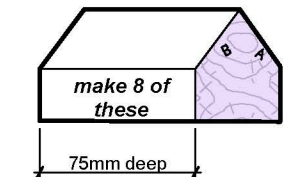
node type "p"
pentagonal node
typical cross section



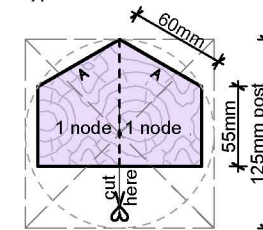
node type "bn"
half hexagonal node
typical cross section



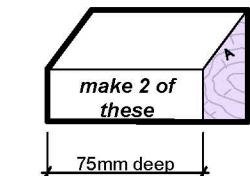
node type "p."
oblique view



node type "bn"
oblique view



node type "bn.5"
quarter hexagonal node
typical cross section

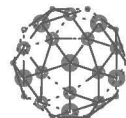


node type "bn.5"
oblique view

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details; nodes & struts

A1.06

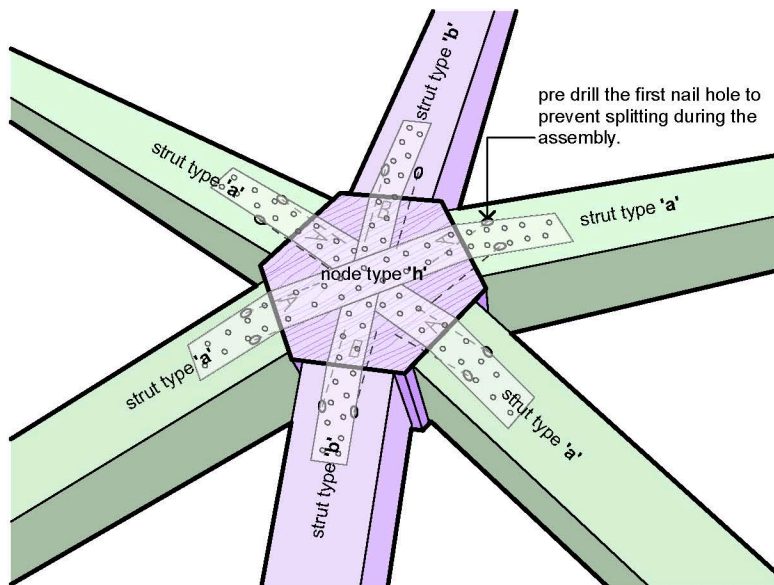
strut fixing notes

1; the **strapping** is 25mm galv and comes with holes pre punched for nailing. they are not necessarily required but are recommended. Buy roles of the strapping and cut with 'tin snips' or buy pre-cut nail straps.

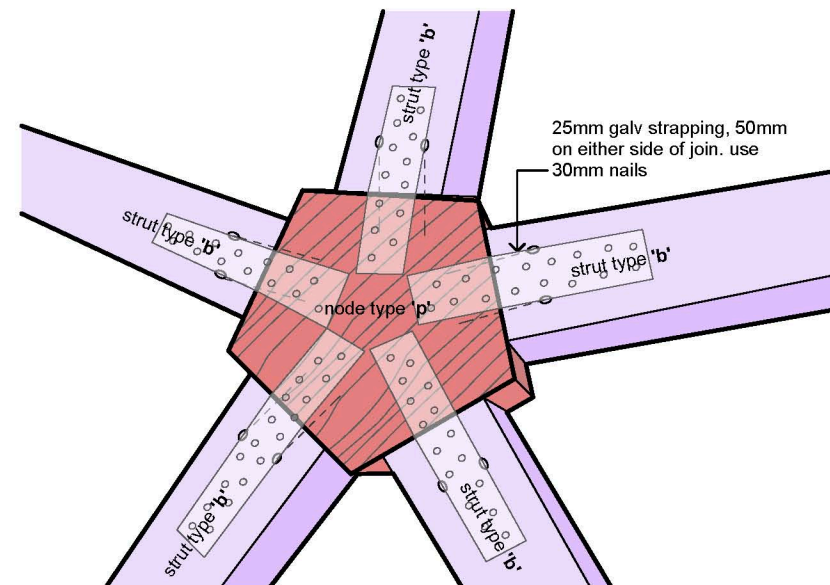
2; be sure to not **split the timber** when **nailing**; it is easy to do, but it can also depend on the timber species you use. pre drill if need be.

3; take note of the **node orientation**. particularly with the 'h' type node. ensure that you connect the right with strut with the right node face.

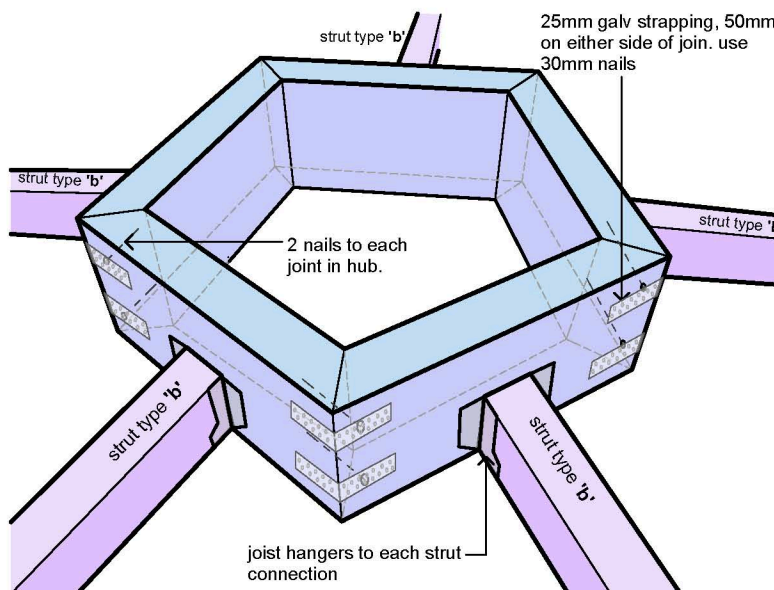
4; **joist hangers** for the main hub are to be 70mm in height minimum. (matches the depth of the struts).



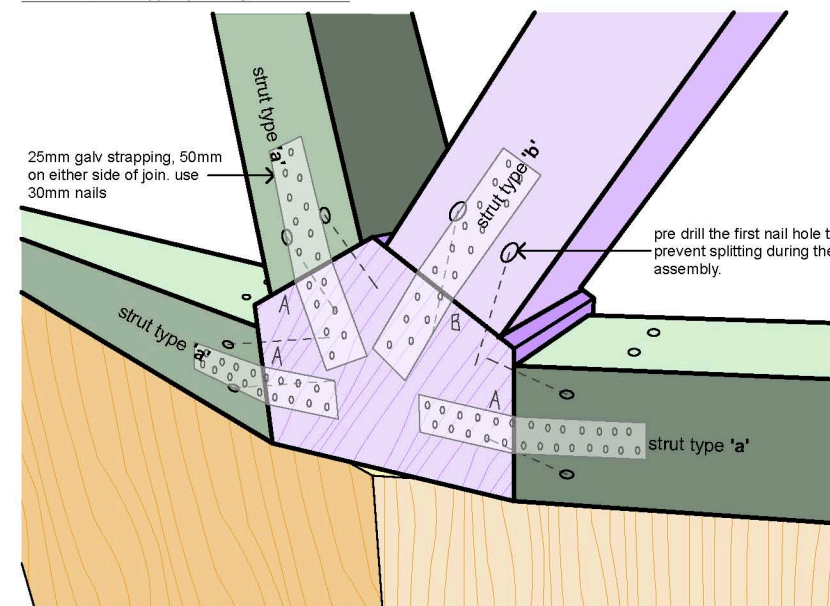
1 detail; node type 'h' fixing



2 detail; node type 'p' fixing



3 detail; main vent frame

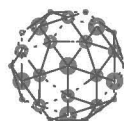


4 detail; base node

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details; node fixings

A1.07

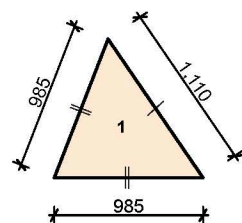
dome roof notes

1; each panel should be cut to measure. yes its a slower process, but it will be better and allow for a more weather tight envelope. doing it this way also allows for margin off error due to the nature of working with timber. where measurements are not always down the nearest mm. however, there are panel types and sizes noted below, for guidance.

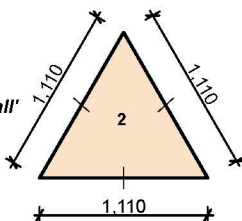
2; the dome exterior cladding drawn here is only one of many options which you have available to you. this option is not necessarily the easiest to fastest to construct but it is however uniform in the fixing and the detailing.

3; the dome is colour coded and type coded to show the 2 different panel sizes, as well as the separate materials

type 1; panel
isosceles triangle
make 15 of these in
plywood & 10 in 'twin
wall' polycarbonate
glazing

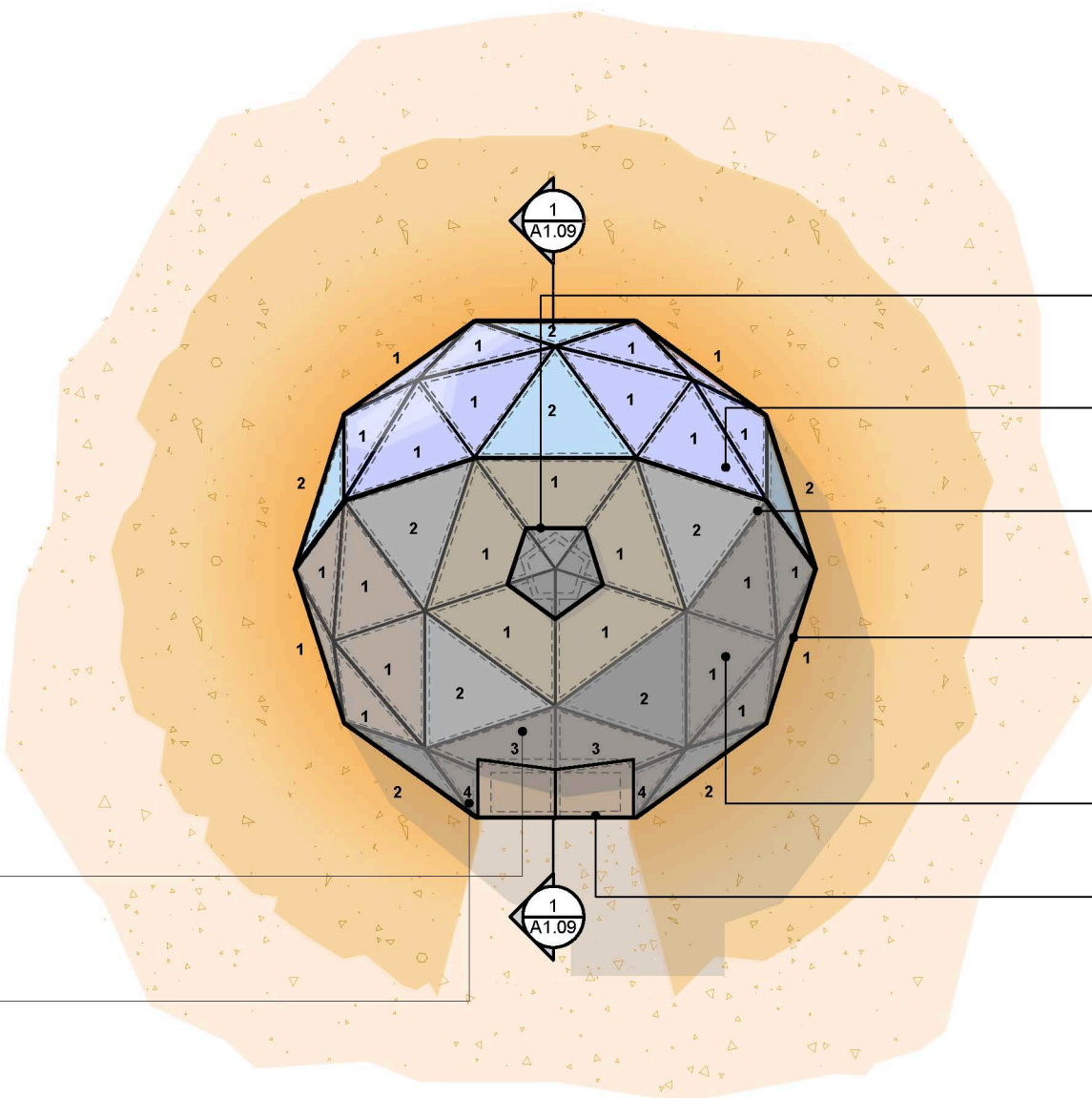


type 2; panel
equilateral triangle
make 6 of these in
plywood & 4 in 'twin wall'
polycarbonate glazing



type 3; panel is an altered type 1 panel. create a triangle panel with the Type 1 dimensions then custom measure & cut to suit.
make 2 of these in plywood

type 4; panel is an altered type 1 panel. create a triangle panel with the Type 1 dimensions then custom measure & cut to suit.
make 2 of these in plywood (make 1x "type 1" panel and cut in half)



key

- 1 'type 1' panel.
- 2 'type 2' panel.
- dome framing under.

selected passive vent. this usually remains fixed open the entire time. fit with mesh to stop birds & insects from entering.

6/8mm twin wall polycarbonate, use screws to fix to struts (recommended) with rubber washers.

ensure to apply 'window flashing tape' over all sheet joints before applying membrane cladding.

spouting for water collection (optional). if you wish to collect rainwater and drain into the dome it is advised that you have a designated collection tank with an overflow to an exterior soak pit or garden.

9/12mm ply with a butyl membrane cladding, seal each joint with flashing tape with all tape joins overlapping by 50mm min.

9/12mm ply over entry; fall to either side of ridge. custom measure and cut to suit.

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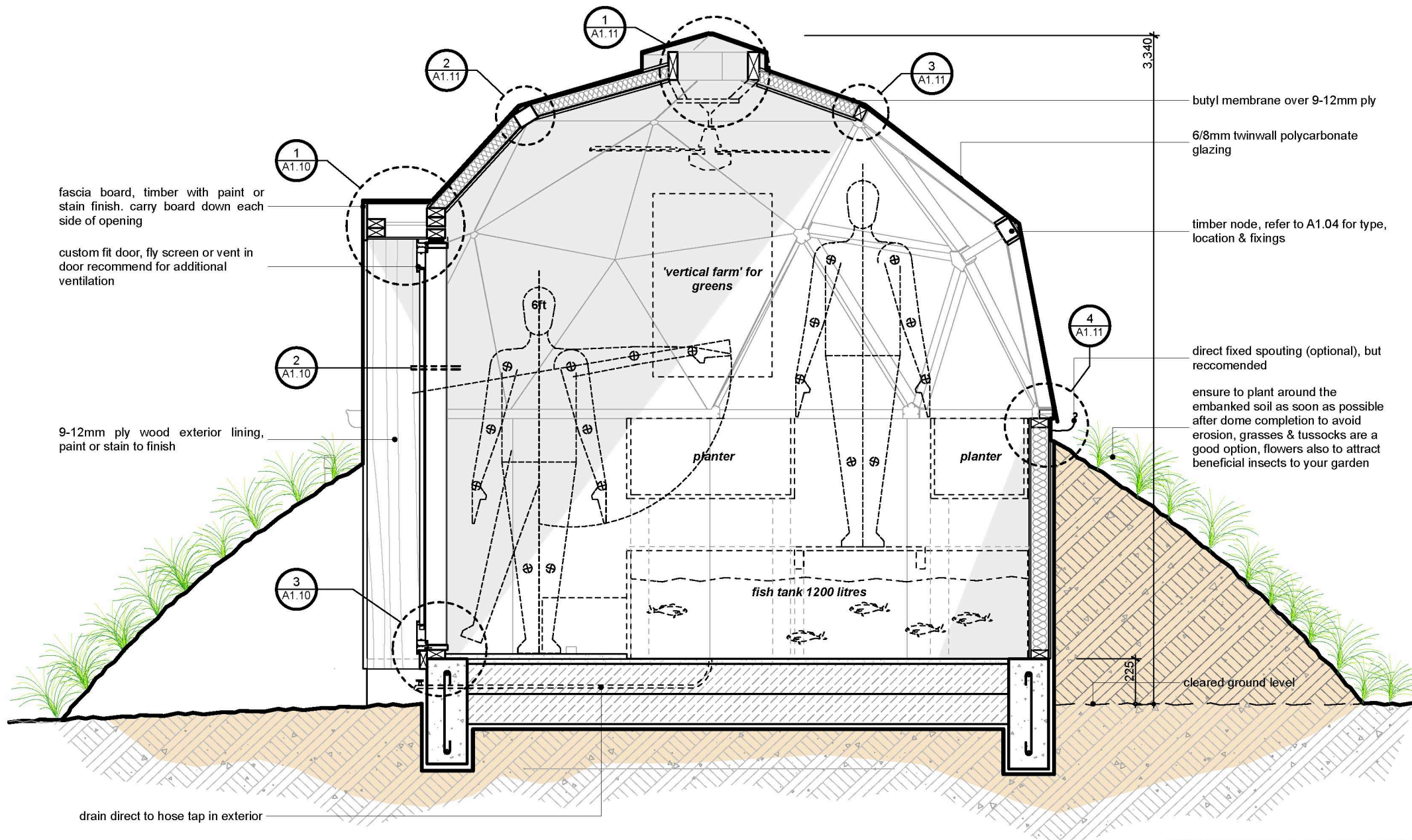


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i/1	04.05.15	Initial	Web Release
r/1	20.07.15	Revision & Addition	Set; July 2015
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plan; roof cladding

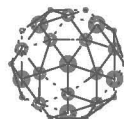
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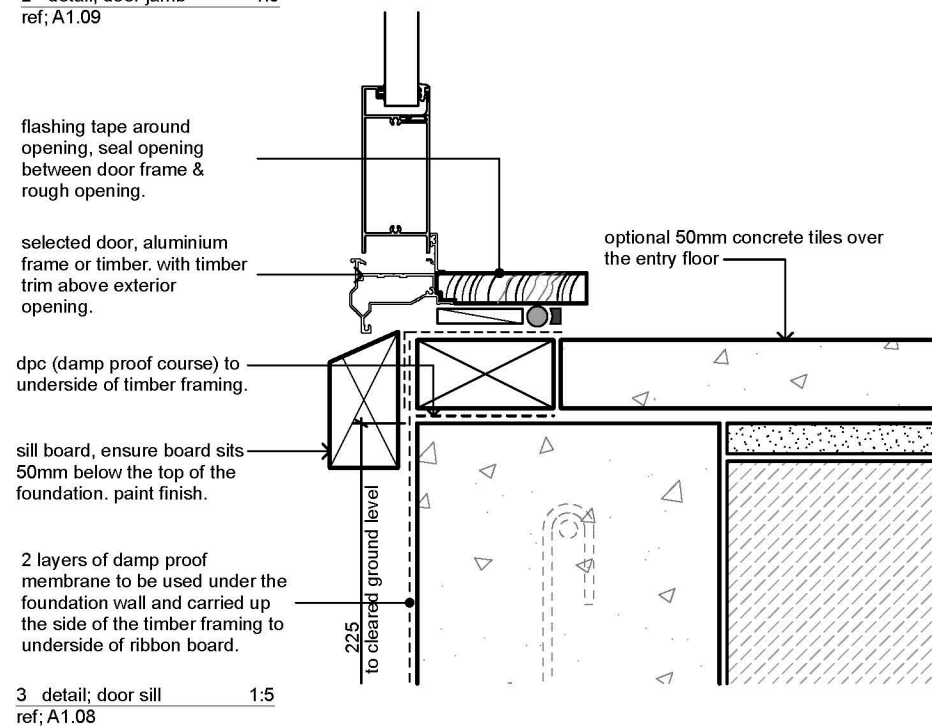
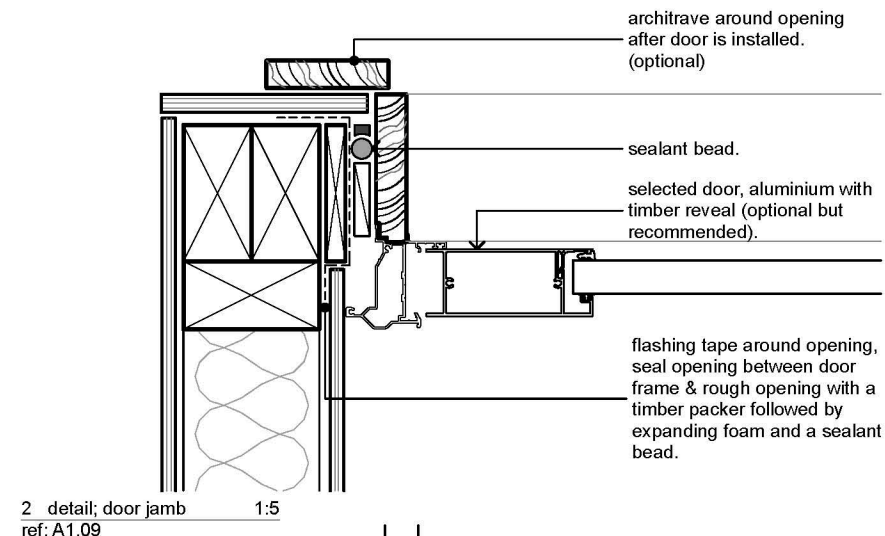
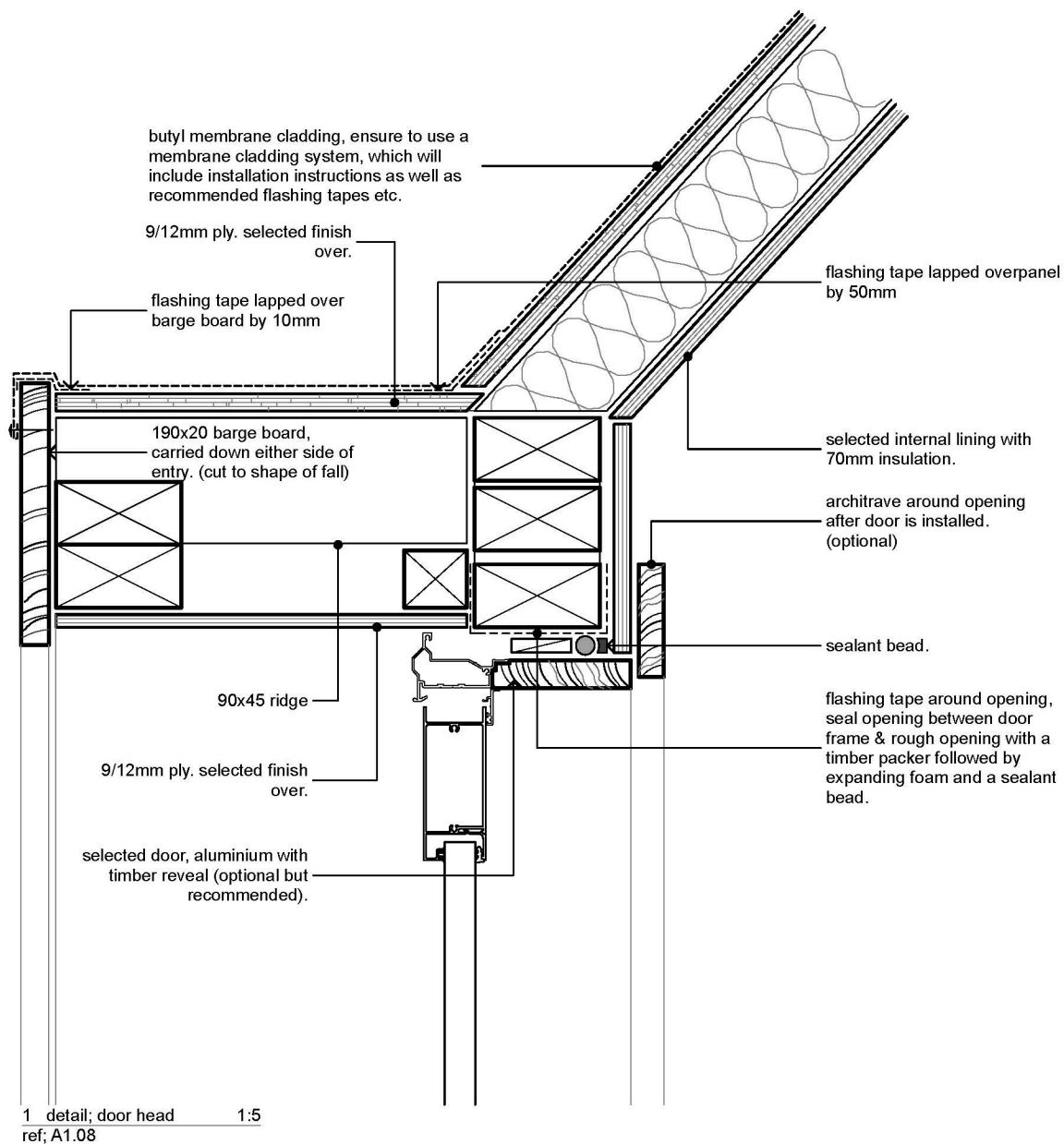


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cross section

A1.09



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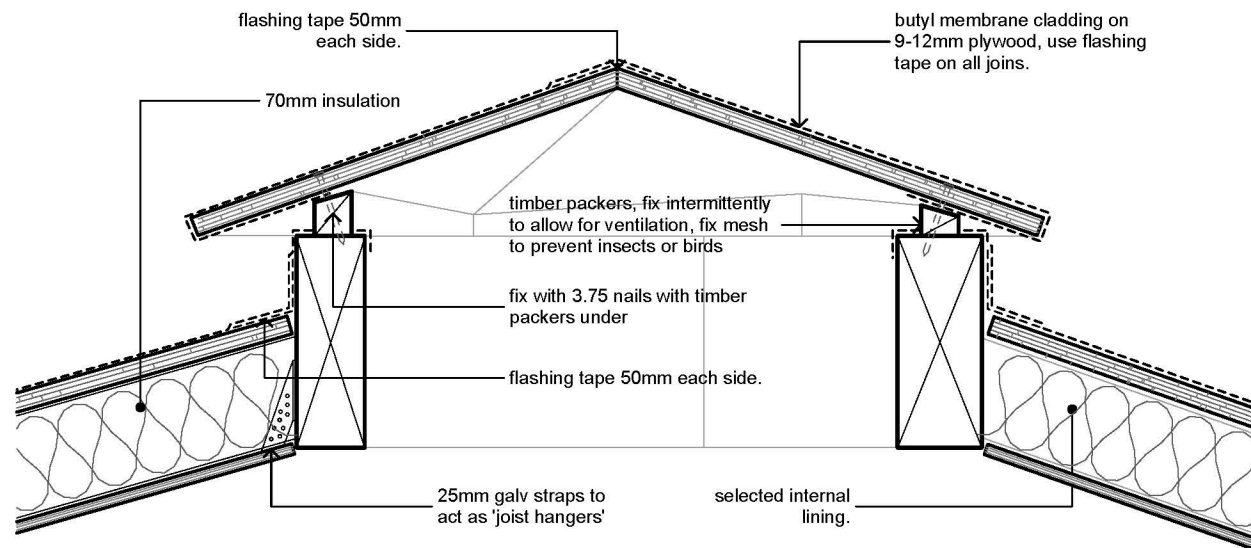


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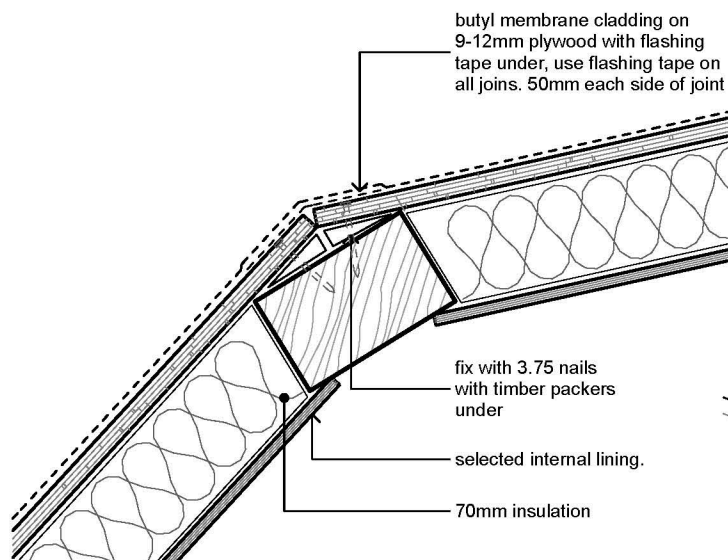
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details; door

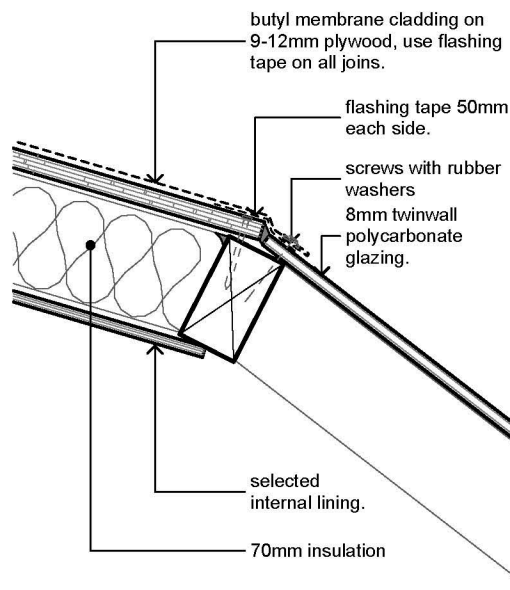
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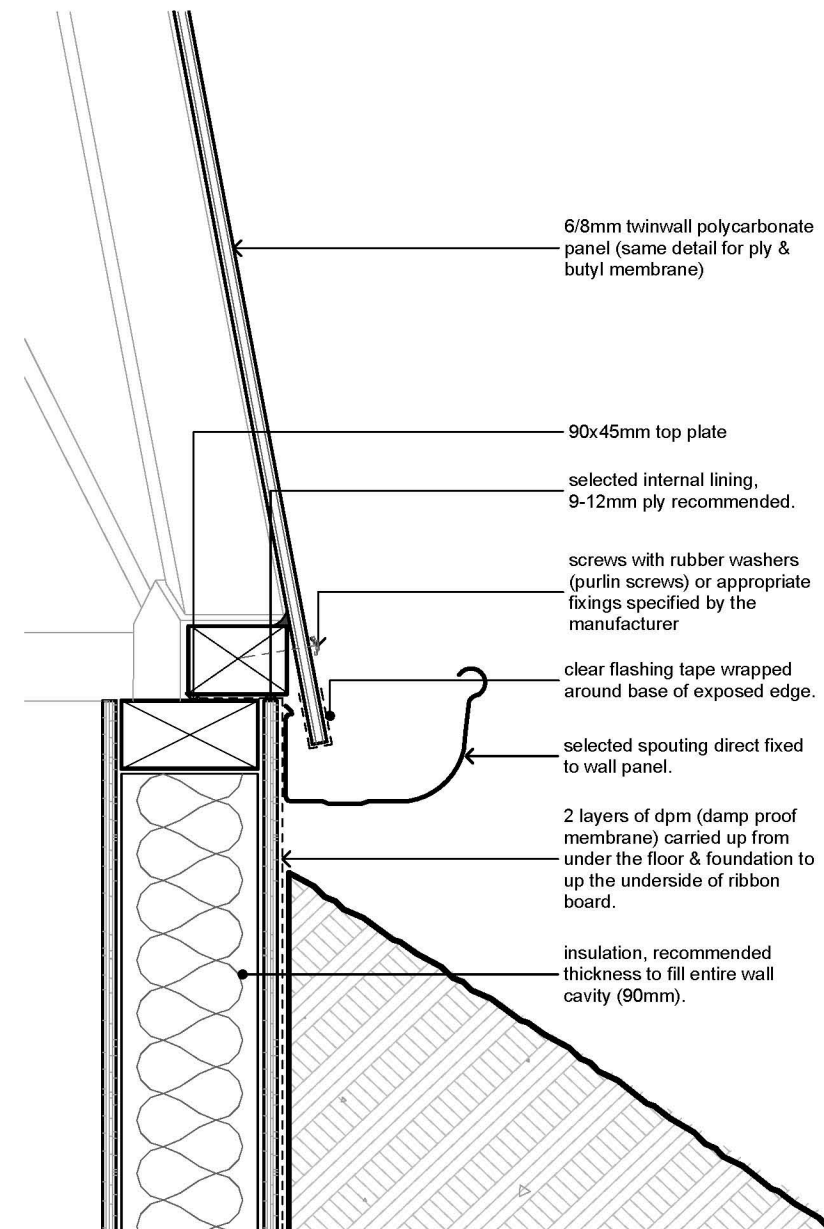
1 detail; main vent
ref; A1.09 1:5



2 detail; node
ref; A1.08 1:5



3 detail; roof to glazing junction
ref; A1.08 1:5



4 detail; dome edge
ref; A1.08 1:5

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← this way up —

n o t e s & r e c o m m e n d a t i o n s

f o u n d a t i o n s ;

as stated in the plans; the foundation & what you choose to build, is up to your discretion. the catch with foundations is that they are not very often considered to be a one size fits all.

your building site location, soil type & also the water table will determine how deep & how much reinforcing you may require.

not to mention if you are on a hill site with a slope then you may also require specific foundation design and even changing the wall panels to concrete block.

if you are on a flat site and are not worried about making the foundation a code compliant foundation that would mirror one similar to a house or accessory building then as stated on the foundation plan. a 100mm deep by 200mm wide concrete strip will suffice. if & only if, its purpose is to provide a level substrate to fix the panels to and act as a guide for the interior flooring.

i have provide only options; **its up to the builder/owners discretion to make the decision.**

t i m b e r & t i m b e r t r e a t m e n t s ;

the timber type & the level of treatment (if any) is purely up to you. if you can, buy timber that comes from a local source that is good at staying straight and is not prone to splitting when fixing or cutting.

"oregon" or "douglas fur" was the timber that was used on the prototype dome. which was a great timber for staying straight during construction. the downside was that it was prone to splitting when nailing or sometimes cutting.

hence why it would be wise to **pre drill all fixings in the struts.**

as for the treatments it is recommended (if you don't go with the standard exterior timber treatment) that you at least apply two coats of paint to the structural framing and panels on the exterior. (not including the polycarbonate).

f i x i n g s ;

some fixings have been specified on the plans; namely the strut fixings. any fixing that is exposed to the exterior air it is recommended that stainless steel fixings are used. as they are harder and less prone to corrosion. it is also recommended that one uses rubber washes also for the exterior fixings as this provides another layer of water proofing.

for interior fixings it is up to you what type and length, although a minimum 50-70mm fixing is recommended. galv or stainless steel.

e x t e r n a l c l a d d i n g ; p l y w o o d

it has been noted that 9-12mm plywood should be used for the exterior cladding; at least as a rigid air barrier. if you wish, you can clad over the ply with a cladding of your choice. be it butyl membrane or shingles, a green roof, metal or fibreglass etc.

what has been shown on the drawings, should, suffice in maintaining a waterproof envelope provided proper and adequate observation and maintenance is carried out.

one should be careful to observe and clean the dome and make sure that the sealants are working and that no water is leaking in. be sure to look at the manufacturers instructions with the sealants you use and make sure you use a sealant that is fit for the job.

as noted in fixings; stainless steel fixings with rubber washers should be used for the exterior.

the flashing tape for joints should also be of the grade that would suit windows. there are several brands that manufacturer such flashings tapes and they also come in a variety of widths.

be sure to follow the manufacturers instructions when applying the tape to joints.

e x t e r n a l c l a d d i n g ; g l a z i n g

8mm twin wall polycarbonate is the recommended for the glazing, while its not necessarily the cheapest form it provides a great r-value (has a slow thermal transfer) that is near equal to double glazed aluminium windows.

be sure to **measure and cut each panel once the structure is in place.**

i n t e r n a l f l o o r i n g

the internal flooring shown is only indicative; one has the option of choosing any type of flooring they wish. paving/cobble stone has been shown because of its ease in laying and, if need be, removing the event of maintenance.

pavers also have good thermal mass properties (not as good as water but still, not bad).

e l e c t r i c a l s y s t e m s

there is currently no specific electrical system shown apart from the ceiling fan; which is advised as this improves circulation and prevents mould growing when the humidity goes above normal.

it is recommended that one investigates there desired planting systems before building so pre-wiring can be done early and during the construction.

m i n i m u m r e c o m m e n d a t i o n s f o r s y s t e m s & e q u i p m e n t

growing systems can come in a variety of shapes, sizes and especially prices. one should choose their system based on a; what they want to grow b; how much they want to grow, c: how much time you want to dedicate to growing & maintenance & d: how much money you can spend.

however, whatever system you choose you still might benefit from having the following in your system

- temperature & humidity measuring equipment
- one ceiling fan for circulation
- 1x solar panelled extract fan (about 50-80\$)
- 1x small dehumidifier (recommended but not critical)

it is also handy to have a clipboard or pad to record the temperatures in the greenhouse dome. how many times you record the temperature a day is up to you. but it is recommend, to get the best idea of how the dome performs, if the temperature & humidity is recorded at least 2-3 times daily.

if you have the ability to do this electronically then that would save a lot of time.

p o s s i b l e g r o w i n g s y s t e m s t o r e s e a r c h

standard soil planters; min 300mm high

pro's - better than growing outside, cheapest to set up

con's - great hiding place for bugs & pests, harder to control humidity

hydroponics;

pro's - better than growing outside, faster growth than standard planters

con's - limited to leafy greens and fruiting plants, supplementing also required.

aquaponics;

pro's - better than growing outside, very fast growth, possible edible fish (more food). easy to maintain once system is up and running.

con's - more expensive

g e n e r a l n o t e s f o r " a g r e e n h o u s e f u l l a b u c k m i n s t e r "

these open source plans will be subject to development and revisions which will be revised every so often, or urgently when needed.

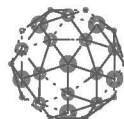
disclaimer ** "it is the builders & owners sole responsibility to ensure that the dome be built to local code requirements and in line with local building and safety standards."

by engaging and building the dome using these plans the builder/client acknowledges and agrees to the disclaimer above.

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notes & recomendations

A2.00