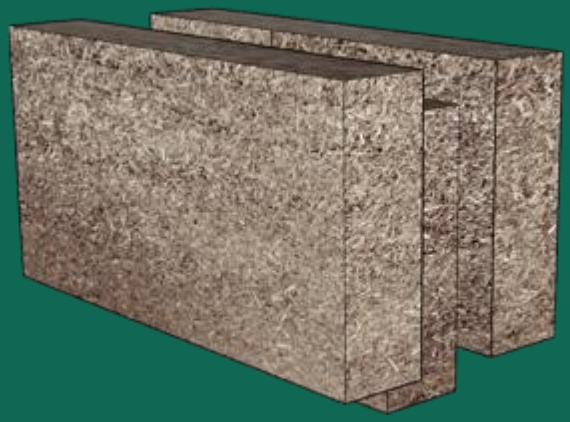
HEMPBLOCK®
INTERNATIONAL



HempBLOCK LB 300

LOAD-BEARING HEMPCRETE BLOCK SYSTEM

INSTALLATION MANUAL

NOVEMBER 2025

TRANSFORMING CONSTRUCTION *Naturally*

CodeMark Australia | CMI Certification Certificate CM40371

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TABLE OF CONTENTS

Disclaimer:

This is a general introduction to suggested safety protocols. This is related only to construction with HempBLOCKs, not a full construction safety protocol by any means. At all times work according to the local safety regulations. Work must be supervised by licensed professionals at all times.

1. USEFUL LINKS

1.1 WEBSITE

Please visit the HempBLOCK websites:

https://hempblockinternational.com/ https://hempblockaustralia.com/

https://hempblockhomes.com/

1.2 QUICK GUIDE

This document provides a non-technical overview with links documents & videos

Client here for further technical details where the information is updated as required

1.3 FAQS

https://hempblockaustralia.com/frequently-asked-questions/

1.4 YOUTUBE CHANNEL

For dozens of useful HempBLOCK videos and shorts:
https://www.youtube.com/@hempblockinternational

A photo galley of HempBLOCK homes in their various state of construction:
https://hempblockhomes.com/

2. WHAT IS HEMPBLOCK?

2.1 THE HEMPBLOCK BUILDING SYSTEM

The HempBLOCK building system consists of:

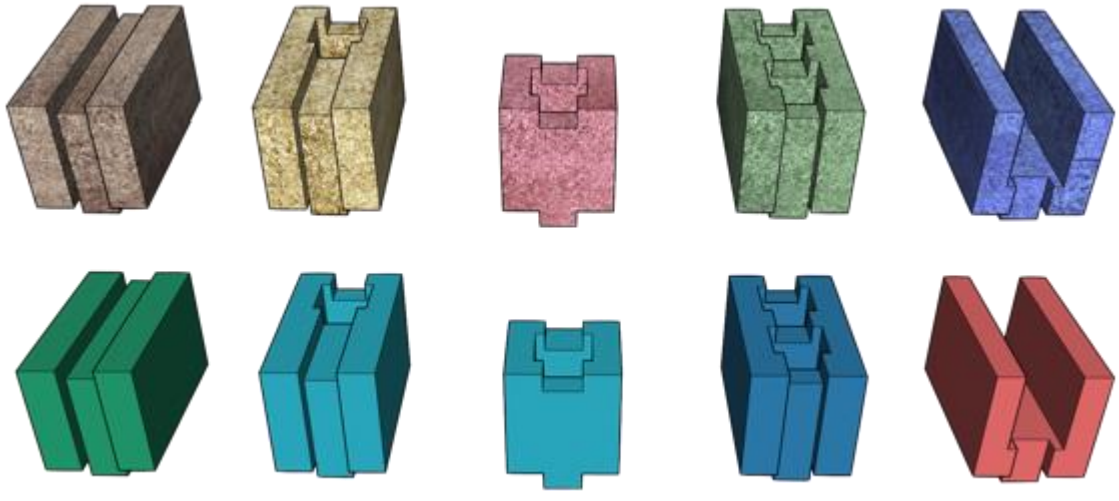
- A proprietary HempBLOCK load-bearing structure.
- Tongue-and-groove, interlocking LB 300 HempBLOCKs, a non-loadbearing, insulating, dry stacked, friction fit inner and outer wall cladding.
- Walls are generally finished with lime render inside and out but may be sided or clad. Plasterboard can be used on interior walls.

2.2 THE BLOCKS

HempBLOCK LB 300 tongue-and-groove interlocking hempcrete blocks are made of all-natural ingredients:

- Hemp wood and
- Natural prompt cement (a unique clay-rich **lime** binder).
- *Or* a proven and tested lime binder

2.3 LEDGEND OF COLOURED BLOCKS USED IN THIS MANUAL



Standard Block | Column Block | Half Column Block | Double Column Block | U or Lintel Block

2.4 LOAD-BEARING SYSTEMS

Three different load-bearing systems are available, selected depending on engineering and local material availability:

1. A post-and-beam system, with steel posts connected to the floor and roof by steel sleeves, and steel, fibre-reinforced polymer (FRP), or timber beams and lintels.
2. A post-and-beam system with FRP posts and sleeves and FRP or timber beams and lintels. This is the preferred method as it is simple and fast to construct, non-corrosive, non-conductive and long lasting.
3. Steel-reinforced concrete posts and beams, cast using the HempBLOCKs as formwork.

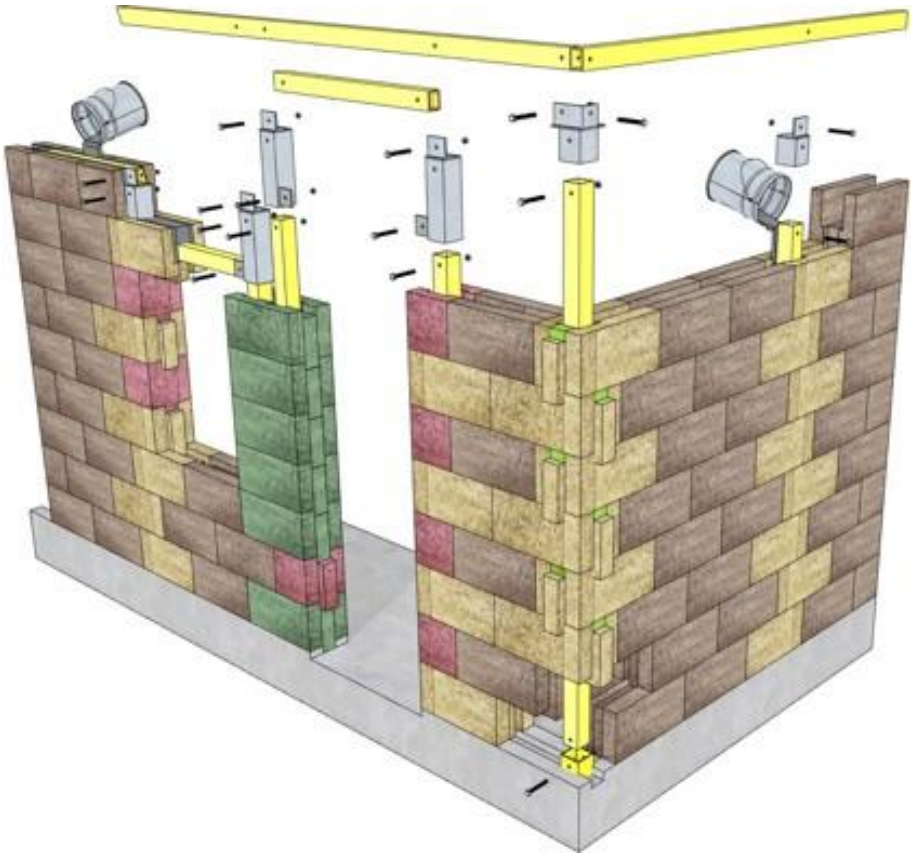


Figure 1 - Patented HempBLOCK post and beam system

2.5 EASE OF CONSTRUCTION

HempBLOCK building integrates easily into existing building practices:

- Only 3 components of the wall;
  - 1: HempBLOCKs
  - 2: Loadbearing post and beam system
  - 3: Lime render
- No additional skills or specialist equipment are required.
- HempBLOCKs are supplied palletised and ready to use.
- Interlocking LB 300 HempBLOCKs do not require glue or mortar and are up to 70% faster to install than other walling construction materials.
- The proprietary HempBLOCK load-bearing structure is incorporated into the walls during construction.
- All parts will arrive on site as a kit form.

The system offers flexible and versatile design options.

HempBLOCK International can assist customers with architectural design and engineering services. They also provide training courses for builders and owner builders.

People can subscribe through this link for a comprehensive 3 day practical on-site training session where all aspects of the building method are highlighted. An online theory test based on this installation manual needs to be completed successfully prior to attending the training.

Upon completion of the training, participants will receive a certificate that can be used to show the authorities their competency in installing this walling system.

2.6 ENVIRONMENT AND PERFORMANCE

The high-performance HempBLOCK system delivers a durable and comfortable living environment through:

- Climate regulation: HempBLOCKs moderate internal temperature and relative humidity. The bricks are hygroscopic and vapor permeable, ensuring a stable and comfortable environment.
- Energy efficiency: The insulated and regulated internal environment significantly reduces climate control energy consumption and costs.
- Sound proofing: HempBLOCKs have excellent acoustic performance.

- Absorption of atmospheric CO_2, both when the hemp is grown and during the subsequent 'petrification' of the blocks over the next 100 years or more.
- Providing excellent durability.
- Fire resistance.
- Termite and mould resistance.

2.7 MADE IN EUROPE

HempBLOCK is produced in eastern France (French certification). HempBLOCK International is the exclusive distributor of *BIOSYS* and *MULTICHANVRE* blocks, rebranded as HempBLOCK in the USA, Canada, UK, Australia, New Zealand, South Africa, and other countries and territories.

HempBLOCK is building-code compliant for Australia (Australian certification) Europe and the USA.

3. TECHNICAL SPECS

3.1 HEMPBLOCK LB 300 DIMENSION

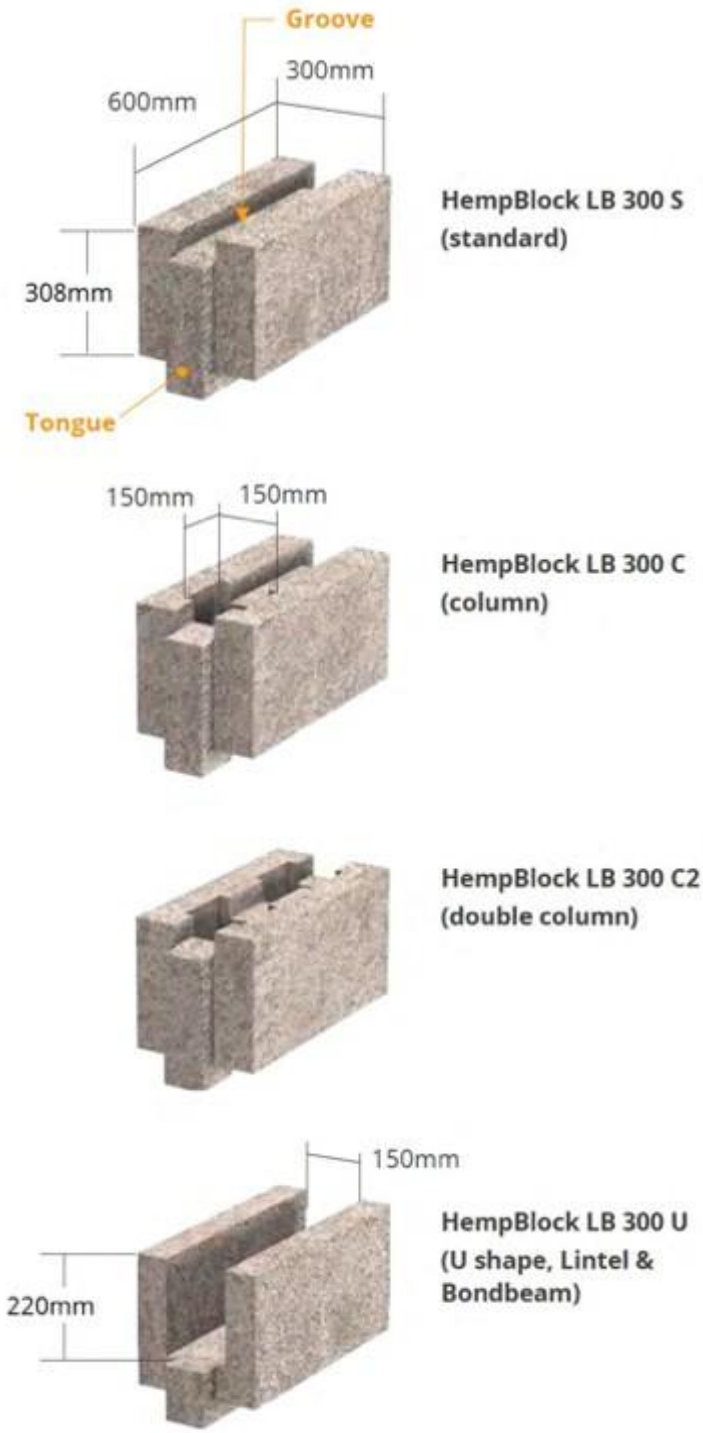


Figure 2 - HempBLOCK LB 300 dimensions

Dimensions for HB series HempBLOCKs (mortared) are given in the Appendix of this manual.

3.2 HEMPBLOCK LB 300 SPECIFICATIONS

HempBLOCK LB 300	
Dimensions	300 mm x 308 mm x 600 mm
Weight	18.8 to 21kg
Efficiency Wall thickness	5.4 blocks/m^2 300 mm plus render thickness
Thermal resistance (m^2K/W λ sec) Thermal conductivity	4.61 m^2K/W (300 mm thickness) 0.065 W/m·k
Acoustic resistance	Rw (C;Ctr) - 43 (-1;-2) dB
Reaction to fire classification Fire Resistance Level (FRL)	B-s1, d0 (when using steel reinforced concrete) 180 / 180 / 180 with inner and outer render
Resistance to impact	Excellent
Dew point Air quality	None A+
Water buffer value Water vapor permeability	2.35 g/(m^2·%RH) μ < 35
Sequestering CO_2	0.889 kg/m^2 of wall
Life duration	minimum 100 years with 56 kg CO_2 stored per 1 m^2 of wall
Mould and termite resistance Volatile Organic Compounds (VOCs)	Resistant Nil
Diffusion equivalent thickness, Sd	0.6 m (relative humidity 100%) to 1.2 m (relative humidity 0%)
Airtightness	0.30 $m^3/h·m^2$

4. SAFETY

Always work according to the local safety regulations.

Work must always be supervised by a licensed professional.

Each worker must have a valid construction induction card (*White Card in Australia*) before starting work on a construction site.

This safety information is a general introduction to suggested safety protocols and relates only to construction with HempBLOCKs. This is not a comprehensive construction safety protocol.

4.1 WORKING SAFELY AT HEIGHTS

- Ensure all ladders, planks, and scaffolding are stable and comply with local safety regulations: *Fixed platforms walkways stairways and ladders*.
- Prefabricated scaffold systems should be all the same type. Do not mix components unless the mixing of components has been approved by the manufacturer: Ensure you check their *Guidelines for scaffolding*.
- Use double planks on scaffolding joined with plank joining clamps, to provide a stable surface on which to lay blocks and to reduce the risk of blocks falling.
- Do not lean ladders against a wall that is not finished with a load-bearing system. To prevent injury to yourself or your fellow workers, follow local safety standards and ensure each wall is stable before proceeding.
- For Australia: work in accordance with Safe Work Australia code of practice here
- For The USA: work in accordance with safety code of practice here
- For Canada: work in accordance with the Canadian code of practice here
- For UK: work in accordance with the UK code of practice here

4.2 CUTTING AND DRILLING SAFELY

While cutting or drilling any materials:

- Only authorised and trained staff who have had the appropriate safety induction should use cutting tools.
- Follow all safety protocols and local guidelines when using any cutting device.
- Follow all safety recommendations when using a bandsaw; information is available here: HSE - Narrow band saws - Safe working practices
- Follow all safety recommendations when using a chainsaw; for Australia refer to *Chainsaws – Guide to safe working practices* and ALEP – Operate and Maintain chainsaws

While cutting or drilling any materials, wear appropriate PPE:

- Wear eye protection and ear protection.
- Wear long sleeves and pants while cutting blocks.
- A Class P1 dust mask is the minimum requirement, but a Class P3 mask is recommended for optimal safety, especially if there is no breeze.

4.3 LIFTING SAFELY

- It is advised to wear protective gloves when handling HempBLOCKs, as they are abrasive.
- Note the weight of the blocks: standard blocks weigh 21 kg (46 lb).
- Be aware that wet blocks are both heavier and more easily broken.
- Use a wide step ladder to get the top blocks off the pallet.
- Grasp the block firmly with both hands, supporting it from underneath. Do not grab it by the tongue or on one half of the groove.
- This video shows how to pass a HempBLOCK.
- If you notice that a block is cracked, be cautious as it may break when handled. Note that broken blocks can still be used, as detailed further on in this manual.
- Bags of mortar and lime render weigh 25 kg (55 lb). Lift with caution.
- For further information on manual tasks, as a guide you can refer to the local Safe Work code of practice Hazardous manual tasks

4.4 WORKING SAFELY WITH LIME RENDER AND LIME MORTAR

Anyone handling lime render and lime mortar must receive clear instructions about working safety with lime products.

- Freshly mixed lime render is **caustic**.
- Avoided contact with both wet and dry product.
- Lime in contact with moisture can **irritate or burn** the skin, eyes, and lungs.
- Keep a diluted vinegar–water solution in a **safety wash bottle** on site, to wash any areas affected by lime paste or dust.
- Keep **eye-wash pods/capsules** on site for first aid in case of an eye splash.

Safety information can be found in these manufacturers' lime render datasheet and ready mixed mortar datasheet.

Avoid contact with skin

- Wear long sleeves and pants, rubber gloves, face and eye protection.

Avoid contact with eyes

- Eye protection is essential to prevent liquid lime, that may splash during mixing, from coming into contact with the eyes.

Do not breathe lime dust

- Prolonged exposure and inhalation of lime dust can cause serious health damage.
- Do not breathe lime dust while transporting, mixing, or sieving the product.
- Use a respirator while mixing.
- Dispose of empty bags appropriately.

5. TOOLS

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

5.1 CUTTING HEMPBLOCKS

Blocks can be cut using a range of sawing tools and using the instructions below;

- A wide handsaw is suitable for trimming block tongues.
- For cutting through full blocks, an electric chainsaw is recommended, with a minimum blade length of 400 mm (16”). (A petrol operated chainsaw is not recommended, due to their weight, noise, and pollution considerations.)
- A double-blade sword saw is also suitable.
- Set up a cutting table with space for the saw blade to pass through the block.
- If the site has suitable high-amperage cabling and safety switches and equipment storage space, a bandsaw is a fast and precise option. Cutting clearance of at least 350 mm (13.8”) is required, and a dust extractor is recommended.
- See a short movie here for demonstration of some cutting techniques.

Figure 3 - Tools for cutting HempBLOCKs

Figure 3.1 - Tools for cutting HempBLOCKs

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

5.2 CUTTING CONCRETE STARTER BLOCKS

Cut concrete starter blocks with a water-cooled brick saw.

5.3 DRILLING HEMPBLOCKS

Holes for bolts and fasteners can be drilled using a wide spade drill bit.

Figure 4 - Drilling HempBLOCKs

5.4 CUTTING AND DRILLING FRP

If fibre-reinforced polymer (FRP) is used:

- Cut these using
  - A metal handsaw, or
  - A hand-held angle grinder fitted with a fibre-cutting blade, or
  - A drop saw (mitre saw) fitted with a fibre-cutting blade.
- Drill bolt holes using segmented diamond hole saws, diameter 12 to 18 mm.

Figure 5 - Cutting and drilling FRP

5.5 CUTTING STEEL POSTS AND BEAMS

If steel posts and beams are used:

- Cut and drill these with standard tools.
- Drill using a sharp drill bit at slow speed (noting that coolant may be needed,)

5.6 SHAPING HEMPBLOCKS

Use a large rasp to:

- Round wall corners for aesthetic effect and to simplify render application.
- Shave a block down if the block is too large for its intended use.
- Adapt the height of the grooves of a block or adapt the height of the tongue of the block placed on top of or against the grooved block.

Other points to note when shaping blocks:

- If the height of the groove-side of a block is shaved down, the tongue of the block locking into it must also be shortened.
- In some instances, the edge on the base of the tongue is rounded in the moulding process. To create a sharp edge so the next connecting block fits snug, use a handsaw to cut away the rounding edges.

Figure 6 - Shaving the edge of the tongue

You can make a simple rasp from a toothed endplate and a piece of timber railing. See this video.

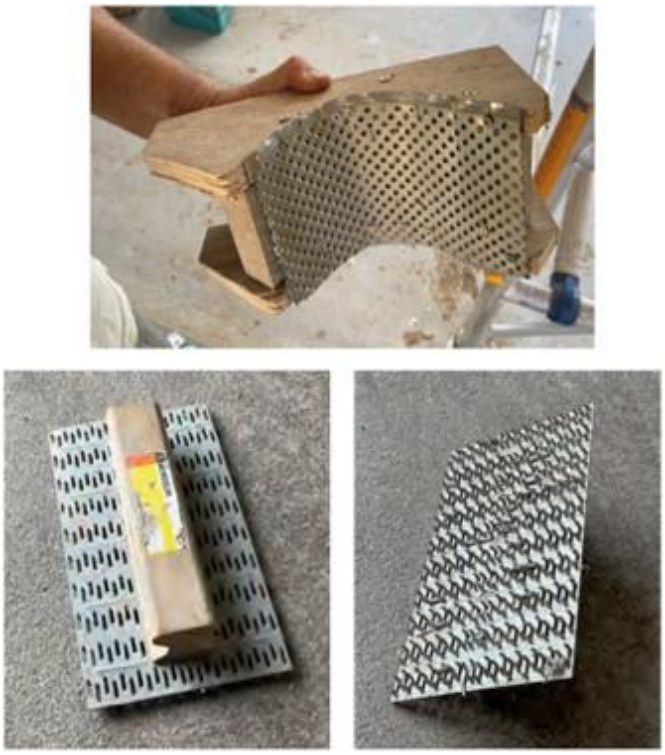


Figure 7 - Rasps

5.7 DEBRIS REMOVAL

After cutting and drilling, use a hand brush or air blower to remove debris and ensure that the blocks will interlock tightly. It is recommended that multiple brushes or blowers (or an air compressor with a nozzle) are available at the wall construction site.

Figure 8 - Air blowers

5.8 SHOVEL

Use a bark shovel or snow shovel for moving debris and dust.

Figure 9 - Shovel

5.9 BANGER PLATE AND HAMMER

Buffers or *banger plates* are recommended to help with interlocking the blocks. The dimensions given in the design below will ensure the plate sits flush with the block. Use a 1.5 kg (3 pound) dead blow hammer. (A rubber hammer is not recommended.)

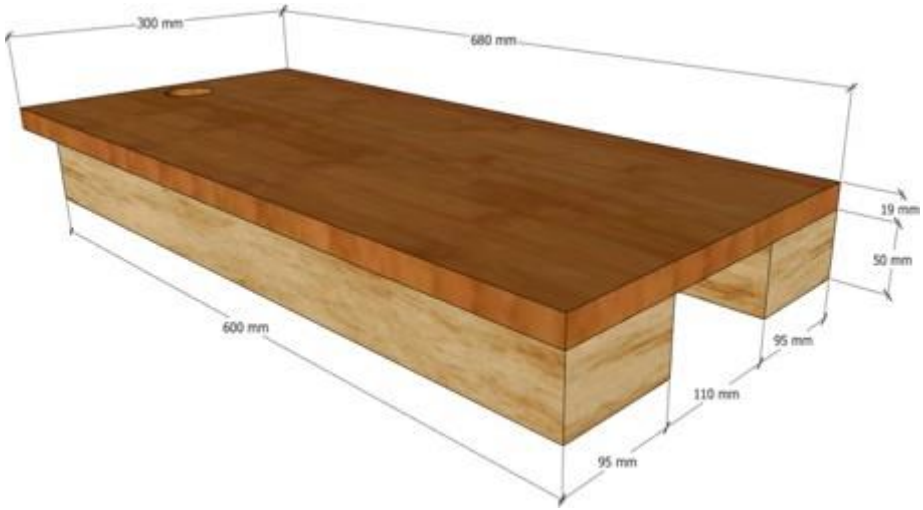


Figure 10 - Banger plate and hammer

5.10 MOVING BLOCKS

HempBLOCKs are palletised and come on a truck or container.

Ensure there is clear access to the property and secure and sufficient room for the container truck or truck to unload the pallets.

Unload with a forklift or similar machine that can handle 850 kg for a double stacked pallet or 850 kg for a pallet of lime render or mortar.

Take care whilst unloading. Stay clear of pallets that are being unloaded from a truck or container.

The pallets are to be treated with care as they may need to be moved a few times.

Once unloaded from the container, move the pallets of HempBLOCKs with a forklift, tractor or a pallet jack. Ensure the jack's fork width matches the pallet. The pallets have a different grip on the front and back than on the sides. Please be diligent with unloading and moving the pallets. When giving instruction to the forklift driver, mention the need to be cautious!

Figure 11 - Pallet jack

5.11 MIXING AND MOVING PERLITE

You will need a cement mixer and flexible plastic buckets. 40 litre buckets are ideal.

Figure 12 - Concrete mixer and bucket

6. DESIGNING A HEMPBLOCK BUILDING

The HempBLOCK walling system offers flexible and versatile design options for interior and exterior walls and partitions. The HempBLOCK International team can assist with **design and engineering support and services**, and builders' training courses. HempBLOCK has a separate *Architect's Manual* available upon request.

6.1 FLOOR

The architect and engineer will design the foundations and floor structure. HempBLOCK walls can be erected on:

- concrete floors,
- suspended slabs,
- strip footings, and
- timber floors.

6.2 SECOND STORY FLOOR

The second floor of a HempBLOCK building can be designed as either a timber joist or a concrete floor construction.

6.3 WALL-FLOOR SET OUT

To let rainwater runoff drop past the edge of the floor, the wall is best set about **10 to 25 mm** out from the floor edge.

This means the wall overhangs the floor slab, and the floor slab is smaller than the outside dimensions of the wall.

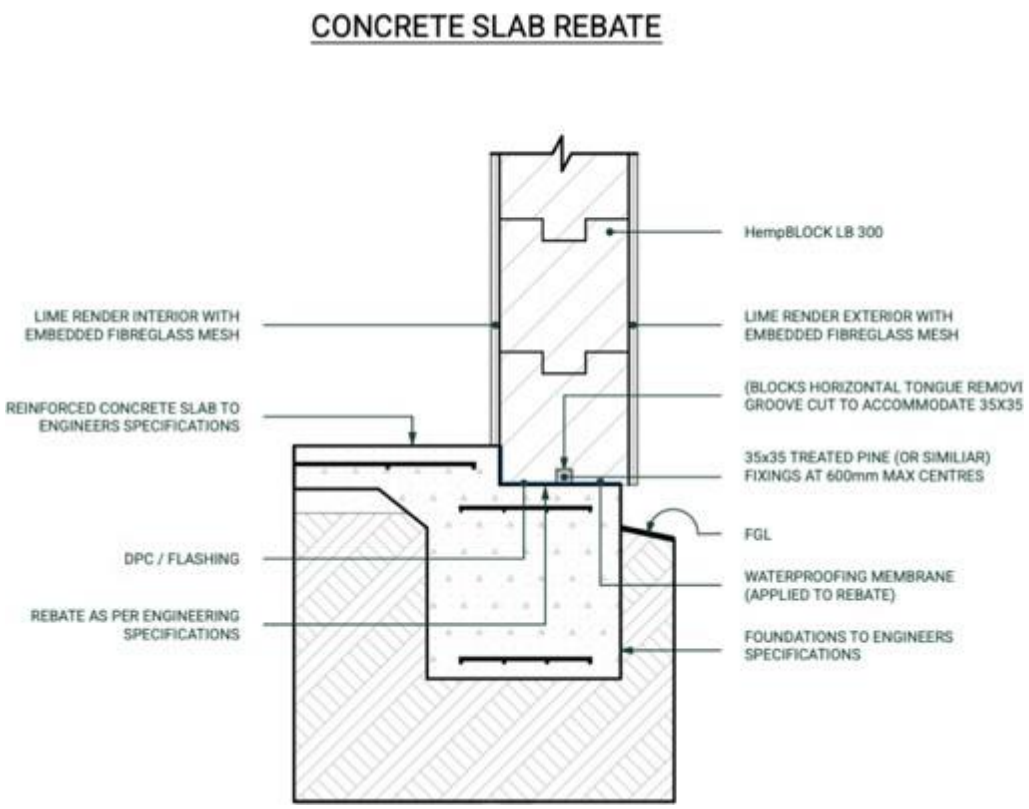


Figure 13 - Wall set out

6.4 HEMPBLOCK LIMITATIONS

- HempBLOCKs cannot be used as retaining wall blocks.
- Hempcrete is not suitable for underground conditions or for use in constant contact with soil, or water.

6.5 LOAD-BEARING SYSTEMS

HempBLOCK International designers will select and design the load-bearing system:

1. Steel posts and sleeves with steel, FRP, or timber lintels and beams.
2. FRP posts with steel connecting plates, combined with FRP, steel, or timber lintels and beams. This system is lightweight, strong, and cost efficient compared to steel sections. Find more information in this FRP Design Guide.
3. Steel-reinforced concrete posts and beams, cast in situ, using the HempBLOCKs as formwork (for use with concrete sub floors only).

Buildings with steel or FRP posts and beams may be designed with additional diagonal steel bracing, K-bracing or horizontal truss braces, encased in HempBLOCKs. Depending on the design, these bracing systems are installed either before, during, or after the blocks are laid. The timber used for lintels and beams would typically be laminated veneer lumber (LVL) or hardwood.

It is useful to get a 3D model produced showing the wall positions and post spacing. The HempBLOCK International team can assist with 3D modelling. This is part of the engineering documentation.

6.6 PERLITE CEMENT MIX

When building with the proprietary FRP post and beam system, a perlite - cement mix is used to fill the spaces around the load-bearing members to fill all remaining wall cavities.

Perlite is made from heat-treated, natural, mined volcanic ash. Perlite aggregate mixed with cement, water, and a small amount of plasticiser makes a lightweight insulating perlite cement mix that is cost effective and easy to prepare. A perlite cement mix is five times lighter than traditional concrete and uses a third of the cement. Refer to this manufacturers' Perlite brochure.

6.7 NOTES ON STARTER BARS

If the chosen design has a **concrete slab floor and steel-reinforced concrete post and beam system**, the starter bars can be attached to the concrete floor slab reinforcement, or they can be chemically anchored in predrilled holes with a fast-setting concrete glue ('ChemSet') during the wall construction phase.

It is important to position the starter bars accurately along the slab edge, to match the column block positions. Look for the details on the technical drawings provided by the HempBLOCK International team engineer.

6.8 NOTES ON THE REBATE

When using a **concrete floor and steel or FRP posts**, the floor slab will be designed with a rebate. The floor surface must be as level as possible where the steel feet will be fitted. This will be noted on the engineering drawings.

6.9 CONCRETE STARTER BLOCKS

Using concrete starter blocks as a base on which to build the first course of HempBLOCKs is another option:

- The starter blocks need to be mortared onto the slab edge. They will raise the first block 50 mm plus the mortar thickness above the concrete floor level.
- Having the concrete starter blocks laid by a skilled block-layer ensures that the HempBLOCK walls can easily be built in the correct position, and that the first course of HempBLOCKs will not require modification.
- The additional costs of purchasing and shipping, cutting, laying, and insulating the starter blocks may not make this the best option.

6.10 FLOOR TONGUE

HempBLOCK International has developed a fast, easy system on which to build the first course of HempBLOCKs, using a wooden floor tongue.

See a short movie here how to cut it and here demonstrating one way to attach a wooden tongue to a concrete slab .

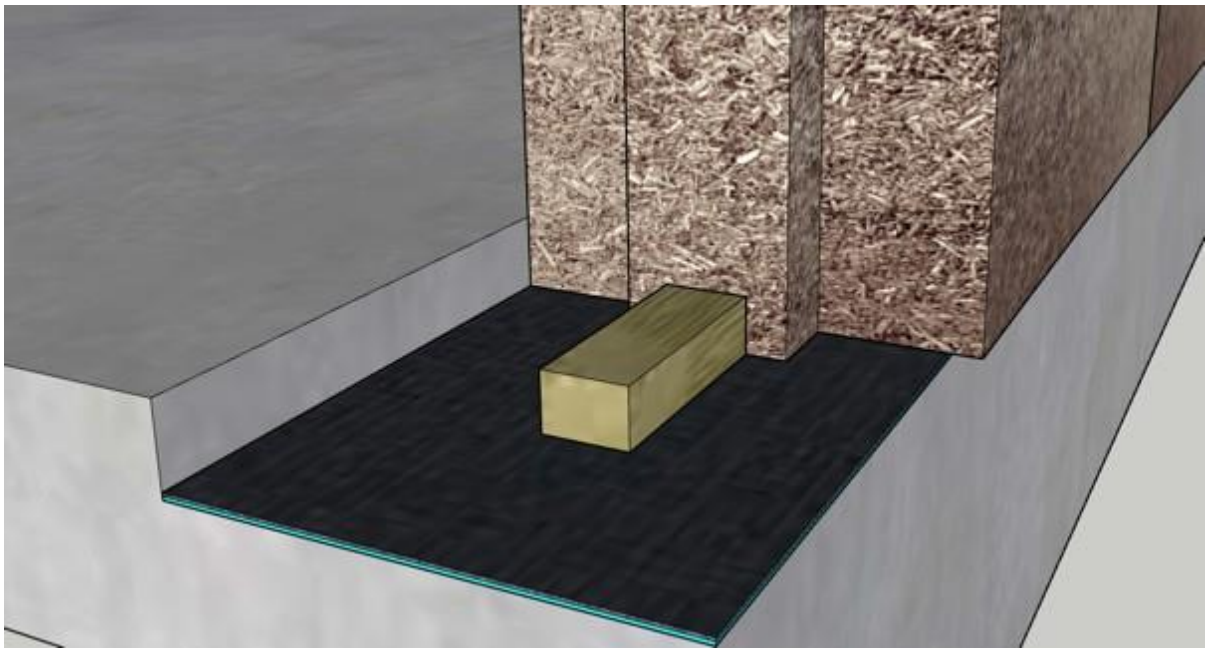


Figure 14 - Wooden floor tongue

6.11 BOND BEAM

To support roof or second floor loads, walls are fitted with a ring or bond beam. They are embedded into U-HempBLOCKs, running around the entire outer wall perimeter. This bond beam can be horizontal or run up sloping walls and can be continued along interior walls. To avoid extra installation of window lintels (headers) it is most efficient to combine the lintels and ring beam in one HempBLOCKs course. This is something to be taken note of during the design phase.

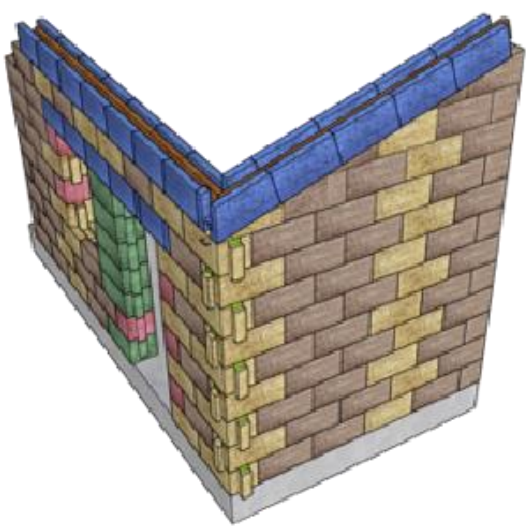


Figure 15 - Bond beams before perlite infill

6.12 WALL HEIGHTS

If the building walls are designed with eight courses of standard HempBLOCKs topped by a bond beam cast into U-HempBLOCKs (totalling nine blocks the total wall height will be 2895 mm above the floor rebate level.

Wall heights with the concrete starter block installed are illustrated below:

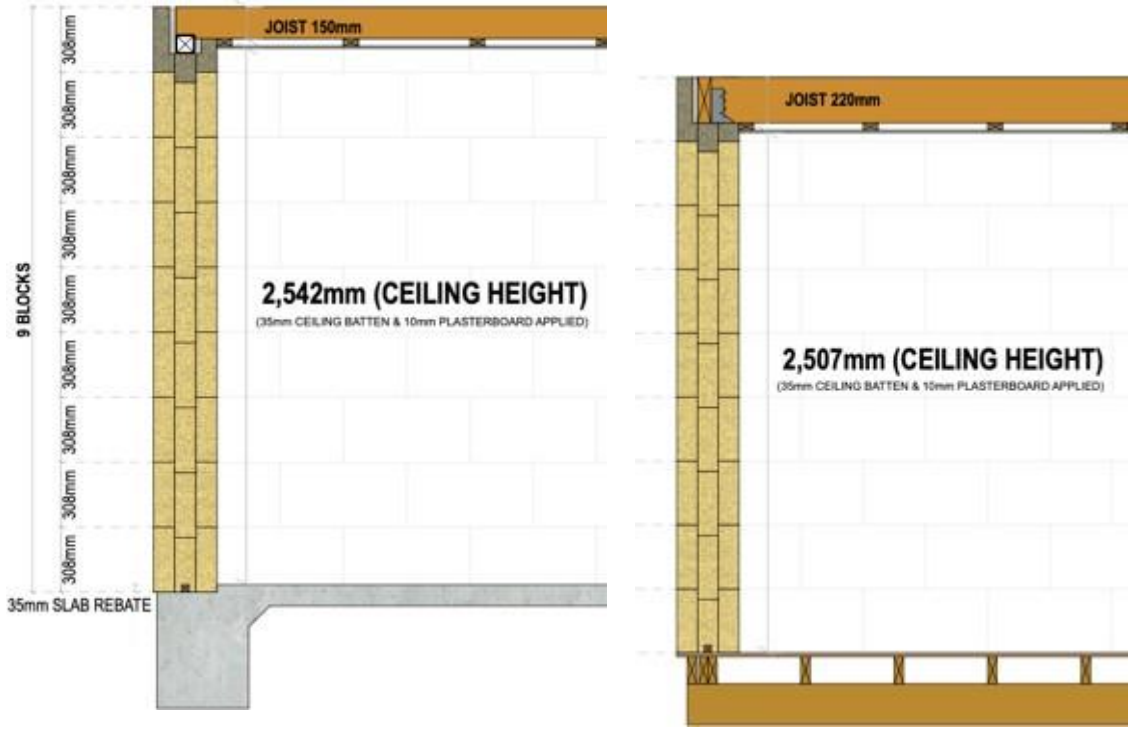


Figure 16 - Wall heights

6.13 INTERIOR WALLS

Interior walls of HempBLOCK buildings can be built from:

- LB 300 HempBLOCKs, which can be load bearing and offer good thermal and sound insulation and are fast and easy to erect without any specialised skilled labor or block layers.
- HB series HempBLOCKs that are mortared.
- Standard timber framing in combination with the HB series or other traditional materials.

6.14 INSULATION

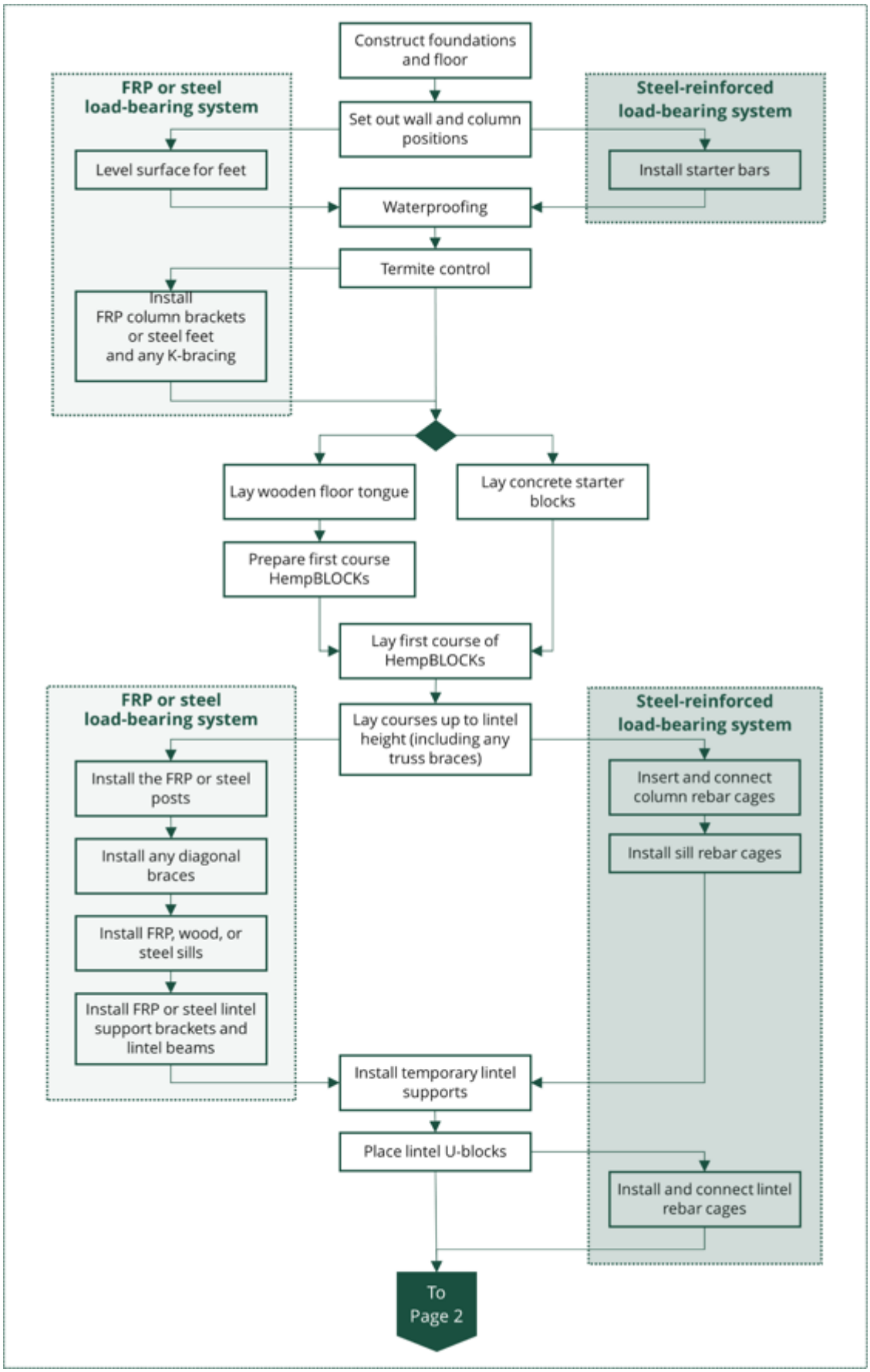
HempBLOCK walls have excellent heat insulation properties. In addition, hempcrete rubble and offcuts can be used to insulate the ceiling and subfloor cavities. Hempcrete sub-floor cladding on external timber floors also acts as a fire retarding barrier.

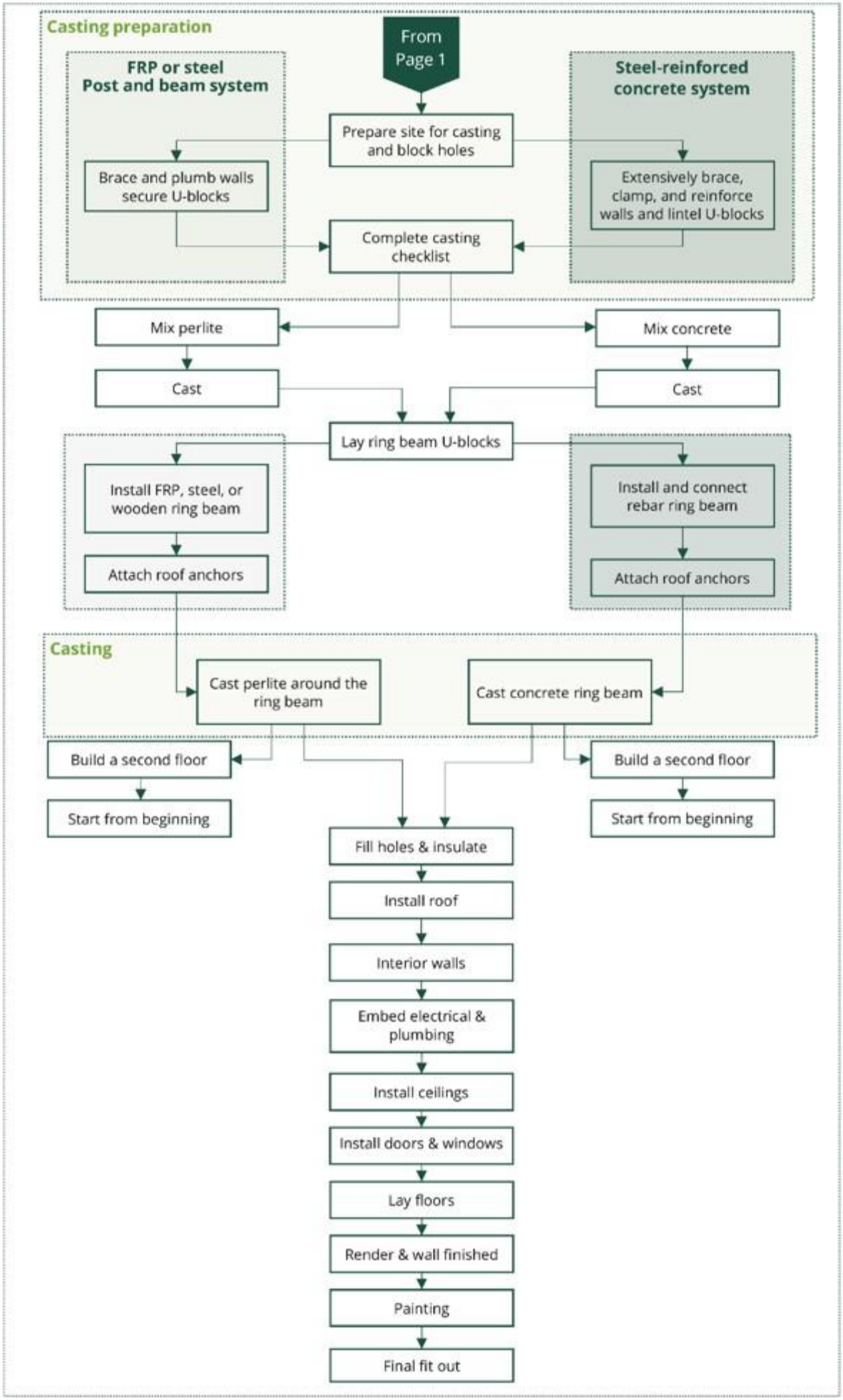
LB 300 HempBLOCK walls do not require additional batt insulation or stud walls. However, in very severe cold climates the LB 300 can be easily thickened with a layer of HB blocks to achieve higher insulation values.
See chart below:

Thickness	Thermal resistance (dry)		Thickness
(mm)	m².K/W	Btu/h/ft/°F	(inches)
100	1.54	8.7	3.9
150	2.30	13.1	5.9
200	3.07	17.4	7.9
300	4.61	26.2	11.8
400	6.14	34.9	15.7
600	9.22	52.3	23.6

Figure 17 - HempBLOCK insulation values

7. HEMPBLOCK BUILDING FLOWCHART




Casting preparation
From Page 1
FRP or steel Post and beam system
Steel-reinforced concrete system
Prepare site for casting and block holes
Brace and plumb walls secure U-blocks
Extensively brace, clamp, and reinforce walls and lintel U-blocks
Complete casting checklist
Mix perlite
Mix concrete
Cast
Cast
Lay ring beam U-blocks
Install FRP, steel, or wooden ring beam
Attach roof anchors
Install and connect rebar ring beam
Attach roof anchors
Casting
Cast perlite around the ring beam
Cast concrete ring beam
Build a second floor
Start from beginning
Build a second floor
Start from beginning
Fill holes & insulate
Install roof
Interior walls
Embed electrical & plumbing
Install ceilings
Install doors & windows
Lay floors
Render & wall finished
Painting
Final fit out

8. FLOOR PREPARATION

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

8.1 FOUNDATIONS AND FLOORS FOR HEMPBLOCK CONSTRUCTION

Foundations and floors need to be constructed in accordance with the engineer's specifications. This may be a concrete floor, suspended slab, strip footings, or a timber floor.

Figure 18 - Concrete floor

Figure 19 - Fire resistant magnesium board floor

Figure 20 - Tongue, stanchion on timber floor

8.2 FOR STEEL OR FRP POSTS - LEVEL THE SURFACE

For a concrete floor with steel or FRP posts, the floor surface where the steel feet will be fitted must be level. Use *levelling compound* to level uneven surfaces.

8.3 SET OUT THE WALL AND COLUMN POSITIONS

The outside surface of the wall must be **set out 10 to 25 mm** from the outside edge of the floor, so that rainwater will run down the wall away from the floor surface, and to therefore eliminate water seeping between the floor and the bottom of the block.

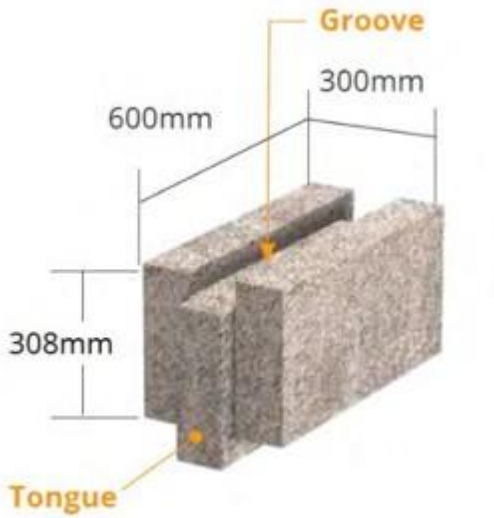


Figure 21 - HempBLOCK HB 300 dimensions

On an elevated floor (with no rebate) making sure the line is accurate and clear. The line would then be 275-285 mm from the edge.

On the floor with the rebate, mark out the positions of the window and door openings on the floor and then mark the position of the column blocks relative to the windows and doors (as detailed in the engineer's plans or the 3D model). Note that if interior walls are to be built from HempBLOCKs, there may be interior columns.

Measure and check the spacing of the posts and any steel bracing elements, and ensure the walls are positioned correctly and marked clearly.

Figure 22 - Marking out walls and column positions

Figure 23 - Completed wall

8.4 FOR STEEL-REINFORCED CONCRETE SYSTEM - INSTALL STARTER BARS

For a concrete floor with steel-reinforced concrete posts and beams, the starter bars may already have been pre-installed as part of the concrete floor construction. If not, install the starter bars at each marked column position now.

At each position, working exactly as detailed in the engineer's specifications:

- Drill holes and use chemical anchor glue (ChemSet) to secure the starter bars. Rough the surface and remove all dust, to ensure good adhesion of the concrete posts that will be cast later.
- Cap the bars for safety.
- Always use the correct PPE.

Figure 24 - Starter bars

8.5 WATERPROOFING

Next, for both concrete and wooden floors, waterproof using a waterproof compound or concrete sealer and damp-proof course (DPC) membrane, according to the engineer's specifications.

- Ensure the surface is clean and dry before starting.
- Use a primer if required by the manufacturer's instructions.
- Waterproof the surfaces on the floor where the external and internal walls will be built, including the rebate and including timber floor edges.
- Use DPC membrane with a minimum rating of D80 Shore.

8.6 TERMITE CONTROL

For concrete floors, if required by building regulations, a pest control contractor will now install a termite barrier according to local codes. Termites do not eat the HempBLOCKs but may still travel over or under them. Depending on the material and system used, the termite barrier could also function as a damp-course membrane.

If a wooden floor tongue is to be used, discuss installation of it with the pest control contractor, as this can help with the activation of the termite barrier.

Figure 25 - Waterproofing and termite proofing in one

8.7 FOR STEEL OR FRP POSTS - INSTALL THE STEEL FEET OR BRACKETS

When using steel or FRP posts as part of the load-bearing system, the steel feet, stanchions or brackets are installed now at each marked column position.

- Re-mark the column positions, as detailed in the engineering plans. On wooden floors, the bolt positions should be above the joists or joist noggins.
- Place the steel feet or brackets in position and ensure they are in line. Use packers to make sure they are plumb.
- Fix them down using concrete screws or chemical anchor (ChemSet) bolts in concrete, or appropriate screws or bolts in wood, or as specified by the engineer.
- Take photographs of the connections or have the engineer check them.
- Tape the top opening of the steel feet closed with thin, clear, wide packaging tape, to keep debris and water out. The tape must be thin enough to be easily pierced by the post, when it is later lowered down through the wall.

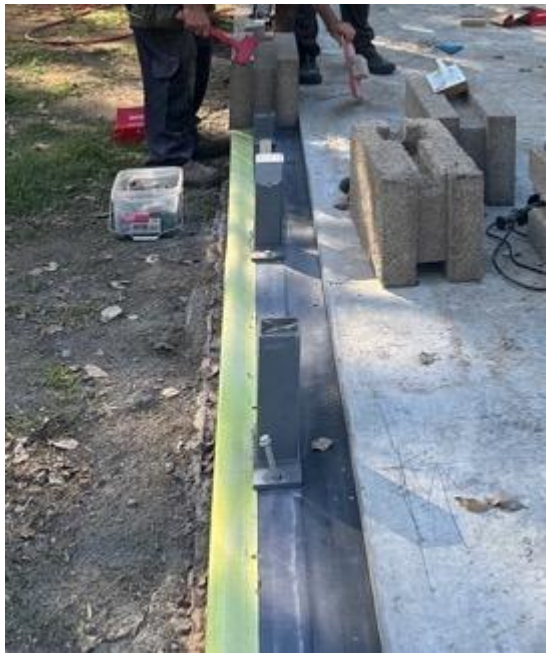


Figure 26 - Steel foot (stanchion) installation

Figure 27 - Steel foot (stanchion) installation

8.8 IF K-BRACING IS SPECIFIED, INSTALL IT NOW

If the design uses K-bracing in the load-bearing system, it is installed now, before building the walls.

- Mark the K-brace positions, as detailed in the engineer's drawings.
- Place the K-brace in position and ensure it is plumb, level, and square. Use packers where necessary.
- Fix the braces down using concrete screws or chemical anchor (ChemSet) bolts as per the engineer's specification.
- Take photographs of the connections or have the engineer check them.

Figure 28 - K-brace installation

8.9 LAY THE WOODEN FLOOR TONGUE

For both concrete and wooden floors, the wooden floor tongue is installed now.

- Seal the 300 mm floor perimeter
- Mark out the wooden floor tongue position between the steel stanchions. Remember the HempBLOCKs are 300 mm deep and are set out by 15 to 25 mm from the outside edge of the floor.
- Use treated pine or hardwood, approximately 30 x 35 mm, or as specified by the engineer.
- If interior walls are to be built from HempBLOCKs, lay wooden floor tongue for these.
- Skip the door openings and allow sufficient space around the stanchions for the posts to be installed, as detailed on the engineer's drawings.
- Secure the wooden floor tongue to the floor as specified by the engineer, (typically at 150 to 200mm intervals):
    - On a concrete floor, drill through both the wood and concrete and use appropriate fasteners. See a short installation video here.
    - On wood, use galvanised, treated, or stainless-steel self-drilling screws or nails.

Figure 29 - Installation of the wooden floor tongue

8.10 CONCRETE STARTER BLOCKS (IF USED)

For concrete floors, if concrete starter blocks are included in the design, a block-layer will now lay them.

- Mark out the starter block inside edge, **75 to 85 mm** in from the edge of the floor with a brickie's line. Please note; engaging a specialised brick layer will ensure this process is done correctly and executed fast.
- The blocks must be laid straight, in line, and level.
- Where necessary, cut the blocks to suit the wall layout. Cut them with a water-cooled brick saw. Always use the correct PPE.
- Concrete starter blocks weigh approximately 6.5 kg (14.3 lb) each.

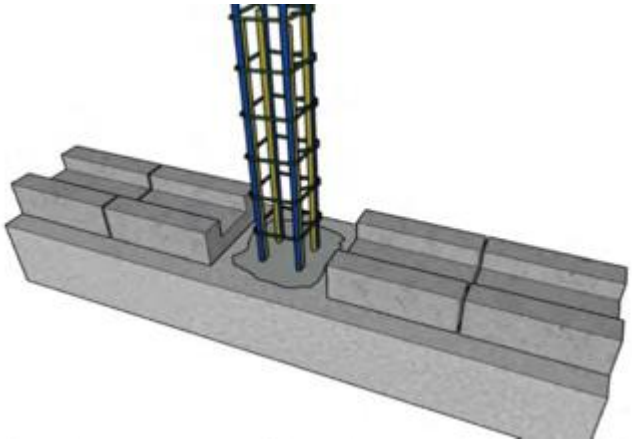


Figure 30 - Concrete starter blocks

9. STORING, HANDLING, AND CUTTING HEMPBLOCKS

REMINDER: Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

9.1 STORING AND MOVING HEMPBLOCK ON THEIR PALLETS

The HempBLOCKs will be delivered on wooden pallets of either 18 blocks in three layers of 6 or 24 blocks in four layers of 6 blocks. Organise to have them delivered onto or as close as possible to the work area.

See a video here of a HempBLOCK delivery.

Storing HempBLOCKs:

- Preferably store the HempBLOCK on a raised floor, for ease of handling and to prevent pallet deterioration due to direct contact with the soil.
- Store HempBLOCKs in a dry, covered area, or cover them with tarpaulins if they will be exposed to the elements for longer periods.
- The blocks are resistant to rain, sun, and snow, but avoid prolonged exposure (two to three months, depending on weather conditions).
- Cut slots in the wrapping to allow ventilation and prevent mold forming between the plastic and the blocks, especially if the blocks are stored for longer periods of time.

If the blocks are stored any distance away from the work area:

- Move the pallets with a forklift tractor.
- Keep the wrapping on the pallets, to keep the blocks secured together while being moved.

9.2 BROKEN BLOCKS

Do not discard broken HempBLOCKs. Keep broken blocks neatly stacked and sorted on a pallet, as they can still be used:

- Broken blocks can be glued back together.

- Half blocks will be needed and can be created from broken blocks.
- Offcuts will be needed while building the walls.
- Hempcrete rubble mixed with a binder can be used for filling holes.
- Hempcrete rubble is used for insulation in ceilings and sub-floor cavities.

9.3 HANDLING HEMPBLOCKS

Wear protective gloves when handling HempBLOCKs.

HempBLOCK weights for dry blocks:

- Standard blocks: 21 kg (46 lb)
- Column blocks: 18.8 kg (41 lb)
- U-blocks: 17.2 kg (38 lb)

Note: Wet blocks will have an increased weight.
Use a step ladder to get to the top blocks on a pallet.

Handle HempBLOCKs carefully to avoid breakage:

- Grasp the block firmly with both hands, supporting from under the block. Do not grab a block by the tongue or on one half of the groove.
- Handle column blocks with greater care and take care not to crush the hollow section.
- Lift U-blocks by grasping the middle part. If you lift them by the wings, they are in danger of breaking.
- Be aware that wet blocks are both heavier and more easily broken.
- If you notice that a block is cracked, be cautious as it may break when handled.

Figure 31 - How to pass a HempBLOCK

This video shows how to pass a *HempBLOCK the right way around.*

9.4 CUTTING BLOCKS

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

While building with HempBLOCKs, you will need to cut blocks. Half-blocks will be needed, you may need to splice a block or cut it so a column block can be fitted around a post. And other modified blocks may be required.

Always use the correct equipment: refer to the Tools chapter of this manual:

- A wide handsaw is suitable for trimming block tongues.
- To cut and shape blocks, an electric chainsaw is recommended, although a double-blade sword saw can be used.
- Reciprocal saws with short sturdy blades are handy for smaller cuts.
- A bandsaw is excellent for some tasks. Refer to the earlier Tools chapter for more details on saw recommendations and specifications.
- Always use the correct PPE.

To cut a block to size:

- Set up a cutting table with space for the saw blade to pass through the block.
- Measure and mark out cuts with a pencil or wax crayon, a tape measure, and a set square.
- When working on a block, place it on the cutting table with the tongue up or sidewards.
- Keep a stack of offcuts, as they will be needed during building. Offcuts can also be used as insulation in floor or roof spaces.

Figure 32 - Cutting table

To cut a 150 × 150 mm column hole in a standard block:

- Mark out the square on the tongue side of the block
- Lay the block on the ground and make the initial plunge cuts
- Move the block onto the cutting table and finish the hole

Figure 33 - Cutting a column hole

This video shows how to cut a column hole in a standard block.

Alternatively, a concrete hole saw (below) can be used. This tool is particularly handy to cut the unused other halve of column blocks.

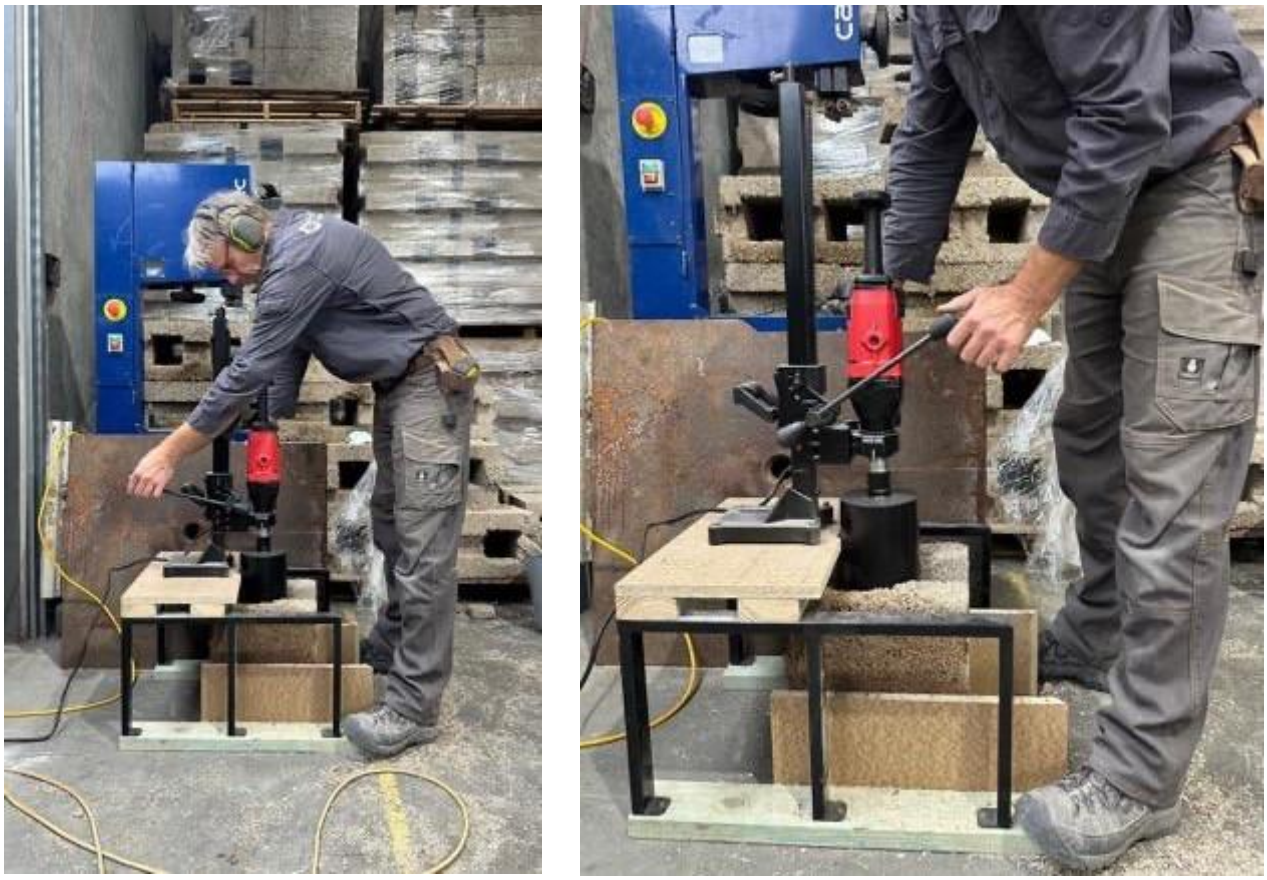


Figure 34 - Cutting a hole with a concrete hole saw

This video shows how to cut a block in half using a bandsaw.

Figure 35 - Cutting a block over long

9.5 CREATING A TONGUE GROOVE

The chainsaw will help to create the groove you need for the tongue. A wall chaser tool is a handy tool when the width and depth match the width of the timber. Always work on a comfortable height with electric cutting tools.

Figure 36 - Creating a tongue groove

9.6 DRILLING BLOCKS

Use a wide spade drill bit or similar to create large holes for bolts and fasteners to pass through the HempBLOCKs.

See tool section (link here to it)

9.7 GLUEING BLOCKS

HempBLOCKs can be glued with thick glue compounds such as:

- A high strength construction adhesive in a tube (eg. *Liquid Nails*)
- Lime-based mortar
- Silicone sealers.

Blocks will need to be glued when:

- Fixing broken blocks
- Filling gaps with pieces of hempcrete
- Encasing steel reinforcing with modified HempBLOCKs
- Bonding interior walls to the exterior wall
- Bonding U-blocks when building a sloping wall

10. ERECTING WALLS

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

10.1 THE FIRST COURSE OF HEMPBLOCKS WITH A FLOOR TONGUE

Most building designs use a wooden floor tongue. Prepare the first layer of blocks as flows:

- Use the 3D model to determine how many standard and how many column blocks are needed for the first course of HempBLOCKs. These will be positioned on the wooden floor tongue on the floor.

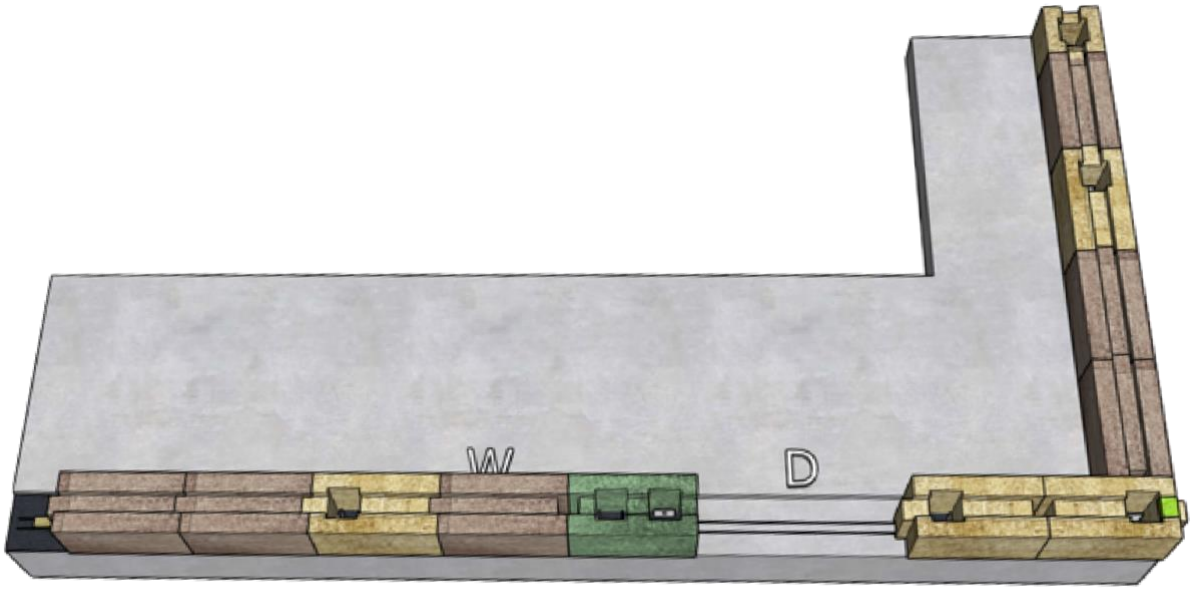


Figure 37 - First course of HempBLOCKs

- Cut off the bottom tongues of these blocks. Use a standard handsaw or refer to the section above on cutting blocks. Keep the offcuts for later use.
- Check the width and depth of the wooden floor tongue material, which would typically be 30 mm x 35 mm.
- On each block, where the tongue was removed, mark out and create a groove to accommodate the wooden floor tongue, using a wall chaser, angle grinder, or chain saw.

10.2 LAYING THE FIRST COURSE OF HEMPBLOCKS

The first layer of blocks will be either:

- The blocks modified in the previous step (for a wooden floor tongue) or
- Unmodified blocks (if concrete starter blocks are installed).

Plan how the wall will be built:

- Make sure to keep easy access for passing HempBLOCKs from outside to inside the building envelope.
- Ensure there is enough bracing material available to support the walls as they are built.

Lay the first course:

- Make sure the floor surface is clean and rubble free.
- Remember the wall has an overhang from the edge of the floor.
- Begin by establishing two of the building corners with the correct column blocks.
- Make sure the column blocks are centred over the starter bars, stanchions, or brackets.
- Once the corner blocks are in position, lay the first course of blocks.
- Use a banger plate, and dead blow hammer if required, to push the blocks tight against each other. (Refer to the Tools section of this manual for banger plate details.)

Figure 38 - Building corners

- Keep the blocks from having rubble in between them so they fit tightly.
- You will need to be able to see the brackets or feet where the posts connect at floor level. Cut square sections or round holes (with a hole saw) out of the bottom of the column blocks for access. Keep the cut-out pieces to fill the holes at a later stage.

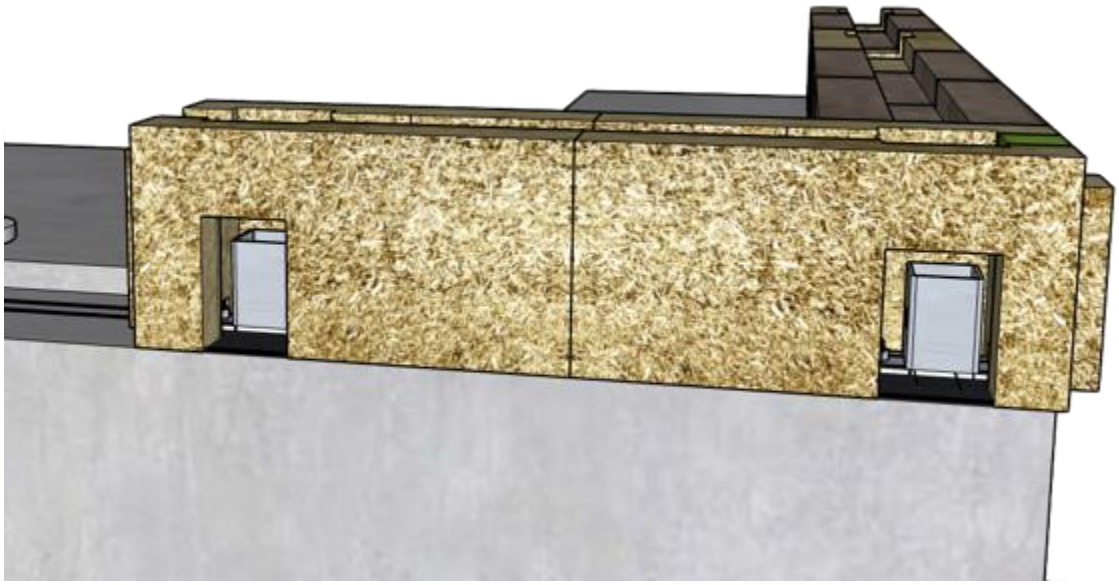


Figure 39 - Cutting out access holes

- Blocks can be cut if required; refer to the section above on cutting blocks.
- The corners of the second row of blocks will need to be modified as explained in the section below.
- Refer to the section further below on encasing a K-brace, if applicable.

10.3 MODIFYING BLOCKS AND FILLING GAPS

The **principle** when modifying blocks is to adapt the blocks so that they interlock at the sides, top, and bottom as much as possible:

- If two blocks meet at their groove (female, non-tongue ends), use a HempBLOCK offcut to fill the vertical void, to lock the blocks together and improve insulation. Tongue offcuts are ideal for this or use hempcrete rubble to fill the void.
- Whenever two male ends meet, cut both tongues off. You may use some glue in between. When a block is placed in the course above, on top of these two blocks, they will be locked together by its tongue.
- Whenever there is a large gap, fill it with a fillet of offcut HempBLOCK or hempcrete rubble. Do not compress in such a way that the blocks separate.

Figure 40 - Filling the void at two grooves

10.4 MODIFYING CORNER BLOCKS

At each corner, several blocks will need to be modified:

- At the corner, there will be a gap between the corner blocks. Fill it with an offcut.

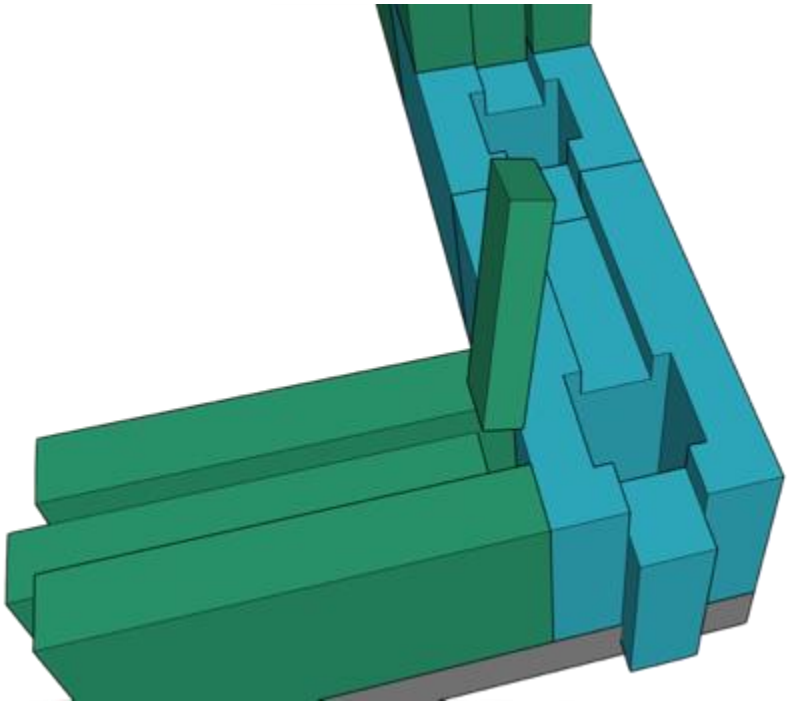


Figure 41 - Filling the gap at a corner

- The corner block will need a groove cut into the top (marked **red**), for the *bottom tongue* of the block going on top of it. But only the inner part !

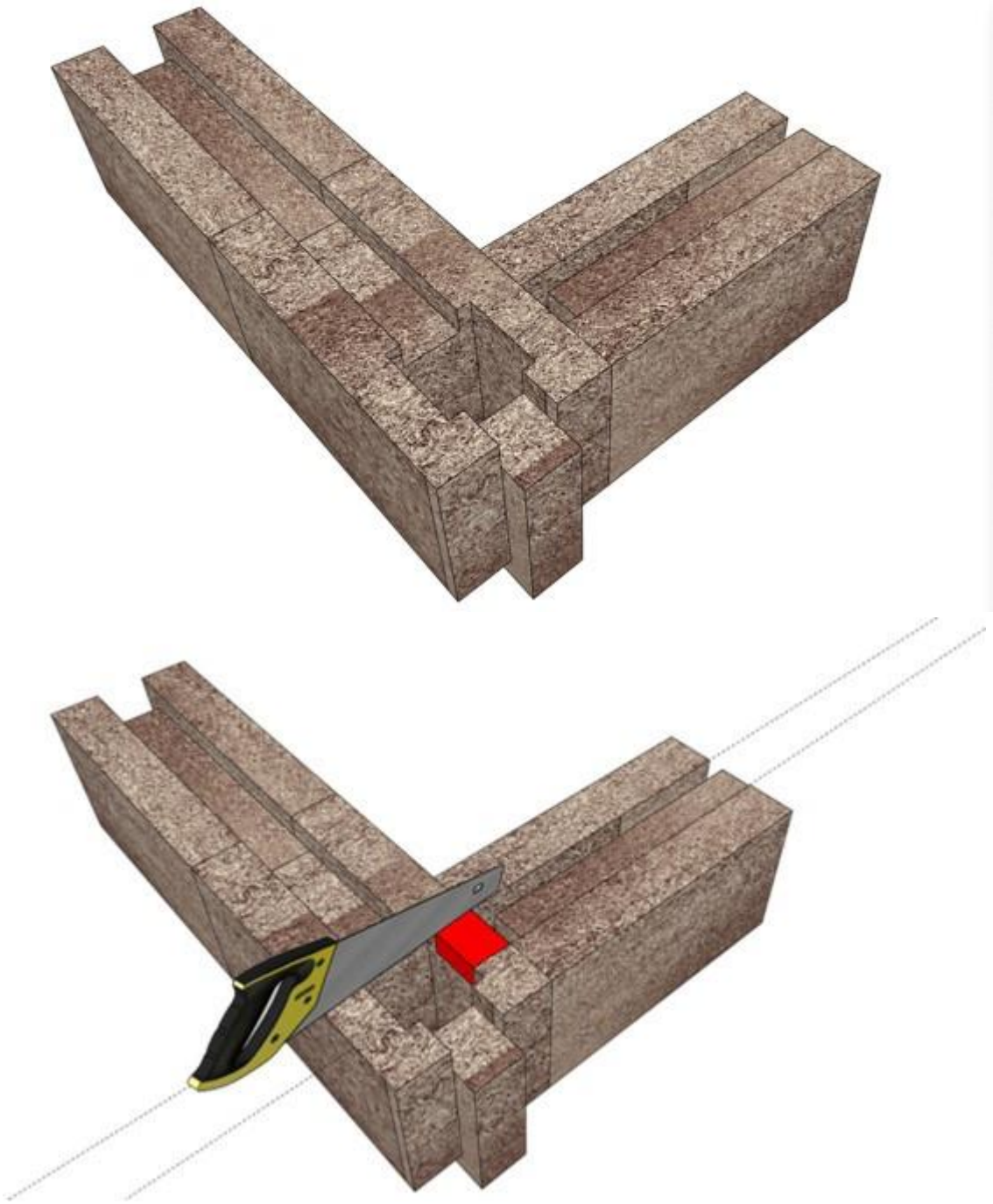


Figure 42 - Cutting a groove at a corner

- The corner block of the next course will need the far end part of its *bottom tongue* removed.

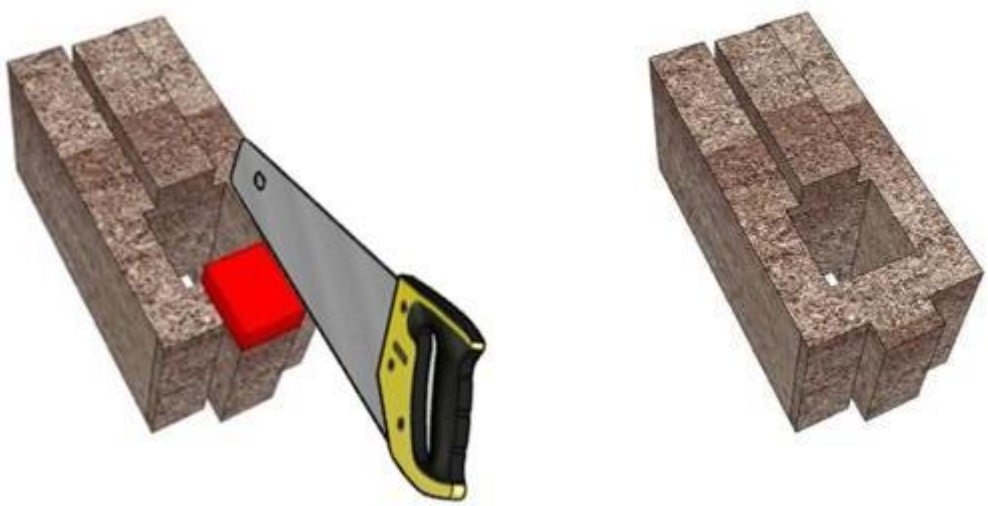


Figure 43 - Modifying the next corner block

- Once the corner block of the next course is in place, there will be a gap which must be filled.
- The piece cut off in the previous step can be used. Fit it tightly or use some glue.
- Make sure the piece is only as long as it needs to be not to hinder the perlite flow later on.

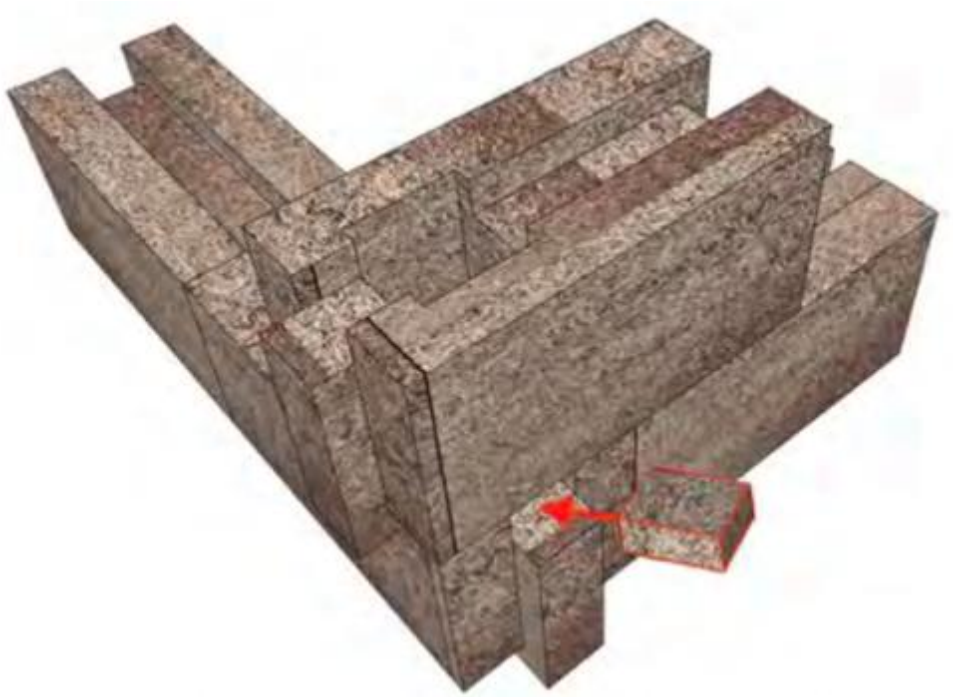


Figure 44 - Filling a corner gap

10.5 LAYING HEMPBLOCK COURSES UP TO LINTEL HEIGHT

Build successive courses according to the engineer's drawings, up to **lintel height** (header height).

Use a stretcher **bond**, with the vertical joints of one course falling midway between the vertical joints of the course below it.

Figure 45 - Stretcher bond

Vertical joints are generally secured by a **tongue-and-groove** connection, and the bottom tongue of each course will be securely locked into the groove of the course below.

Keep the walls **plumb, level, and square**:

- As the wall is built using the interlocking system, the blocks may tend to shift slightly.
- Regularly check all three axes of the walls: to ensure they are plumb, level, and square.
- Begin checking at a corner, and then keep the building true, working from that corner.
- After finishing the first course, you can install a masonry guide system or string line. Alternatively, after laying three courses, secure a true post at the corner. See figure 38.
- Use of a plumb bob is recommended.
- At a corner, plumb is measured from the side of the HempBLOCK, past the heads of the underlying block. Do not measure from the tongue, as the dimensions at the tongue side of the blocks can be irregular.
- Use shims or window packers or shave down high spots on both the top and bottom block with a saw or scraper, if needed.

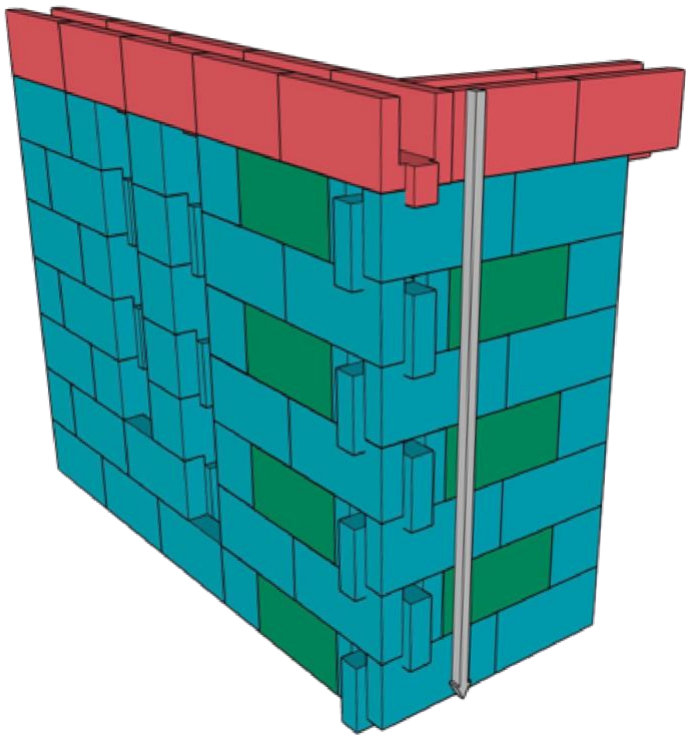


Figure 46 - Correct way to check if corners of walls are plumb

Notes on stacking HempBLOCKs:

- Refer to the sections above with videos on **handling** and cutting blocks**.**
- Use a **hand blower or hand broom** to clean debris from the top and bottom connecting surfaces of each brick before trying to interlock them.
- Place the new block with the edge approximately 1/5 from the bottom against the previously placed block and the other corner on the bottom block. Push down firmly on the connecting end and thrust on the new connecting edge. Once they are interlocked you can further the connection by using the banger plate and **dead blow hammer** whenever required to lock the blocks together. (Refer to the Tools section of this manual for special tool details.)

Figure 47 - Interlocking the tongue and groove blocks

- Trim the blocks whenever necessary.
- Ensure the **vertical voids in the column blocks** align as accurately as possible, as the posts will be installed through them.
- Refer to the sections below on encasing K-braces and horizontal truss braces if applicable.
- When the walls reach five to six rows high, place **safety struts** to protect them from being pushed over by winds before completion.
- Wind can pose a serious **safety risk**. Secure the walls thoroughly.
- These videos show useful building techniques: HempBLOCK wall time lapse and Stacking HempBLOCKs.

Figure 48 - Stacking blocks

10.6 INTERIOR WALLS

The building designer will specify interior walls built from:

- The LB 300 HempBLOCKs covered in this manual, or
- HB series mortared HempBLOCKs, or
- Standard timber frames or other traditional materials.

The engineer will supply details of all structural wall components.

Seal the floor under the interior HempBLOCK walls.

If the interior walls are to be built from LB 300 HempBLOCKs, install wooden floor tongues (or concrete starter blocks). A bond beam may be used to bond the top of the walls, encased in the U blocks (shown in red below; more details about ring/bond beams later in this manual.)

HempBLOCKs interior walls can be 'zipped in' during wall construction:

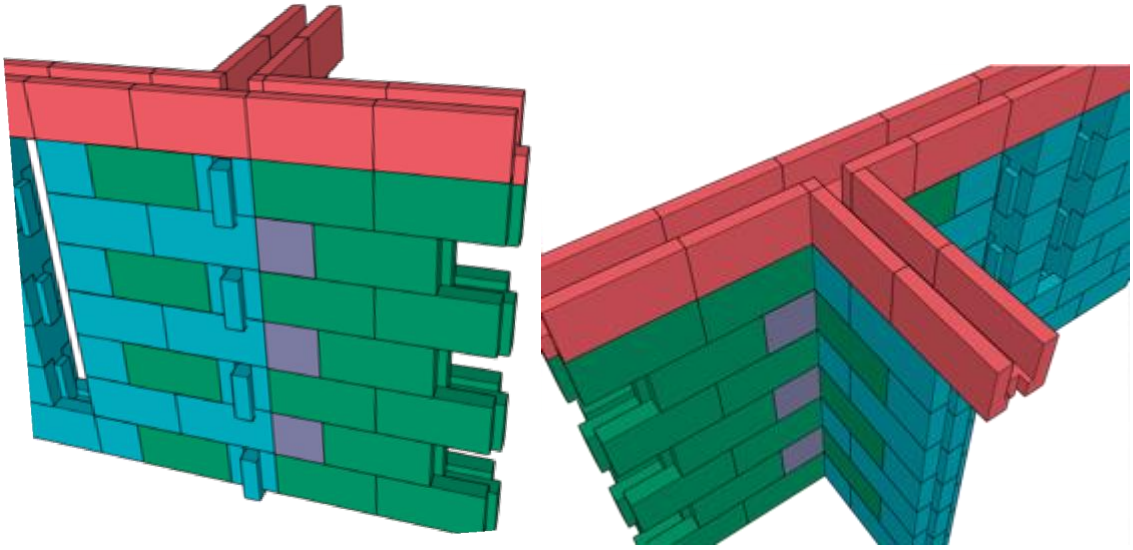


Figure 49 - Zipping interior walls

Alternatively, the interior walls can simply be laid against the exterior wall:

- If there is a post at the beginning of the wall, this will secure its position.
- The joint can be glued.
- A wooden tongue can be screwed and glued on the receiving wall that secures the position of the connecting wall.
- The render and incorporated mesh will also secure the joining walls.

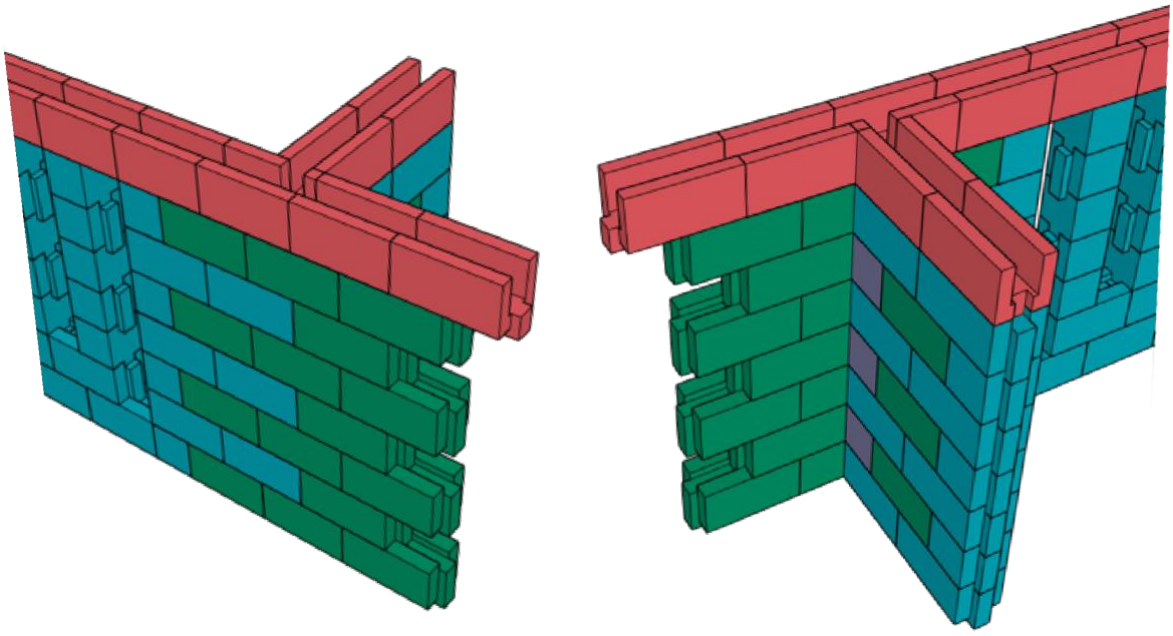


Figure 50 - Laying an interior wall against an exterior wall

10.7 ENCASING A K-BRACE

If welded steel elements or K-braces are being used, they are bolted to the floor before the walls are built. To encase them with HempBLOCKs, use the following techniques:

- Cut a column HempBLOCK in half lengthwise. Refer to the section above on cutting blocks, which includes a video about cutting a block in this way.
- Carefully mark and remove material until the block fits around the K-brace. Leave about 20 mm clearance around the uprights.
- Fix the halves around the frame element, using a thick glue to re-join the two half HempBLOCKs.
- Now secure them with long screws and additional glue. Remove the screws later, once the glue has dried.
- Continue with the next course in a similar way. The higher block should be held together by the groove of the block below.

Figure 51 - Encasing a K-brace

10.8 INSTALLING HORIZONTAL TRUSS BRACES

If horizontal truss braces are being used with steel or fibre-reinforced polymer (FRP) posts, they are installed between the courses as the wall is built.

Prepare the horizontal trusses:

- Typically, two or three horizontal trusses connect two adjacent posts.
- The materials will be specified by the engineer, typically a steel 100 x 70 x 5 mm angle brace on each side of the post.
- Prepare the horizontal truss elements by predrilling the screw holes.

Figure 52 - Horizontal truss braces

Preparation before you place the horizontal trusses:

- Shave the thickness of the steel angle from the height and enlarge the groove of the block (marked **red**) that will support the bracing element. This is best done before stacking the blocks.

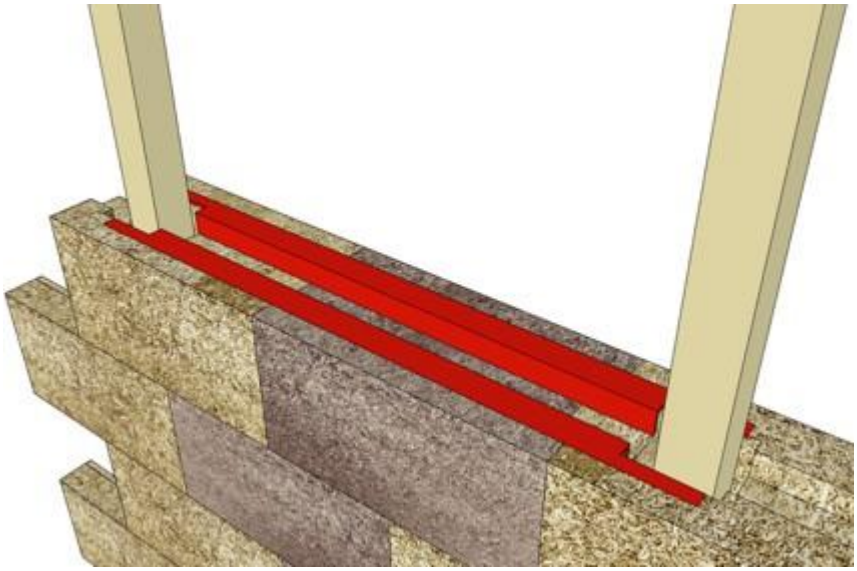


Figure 53 - Preparing for horizontal bracing elements

- Cut away some more material (marked **red**) to make the column hole bigger. This will allow the perlite mix to flow freely around the post and to drop into the block cavity.

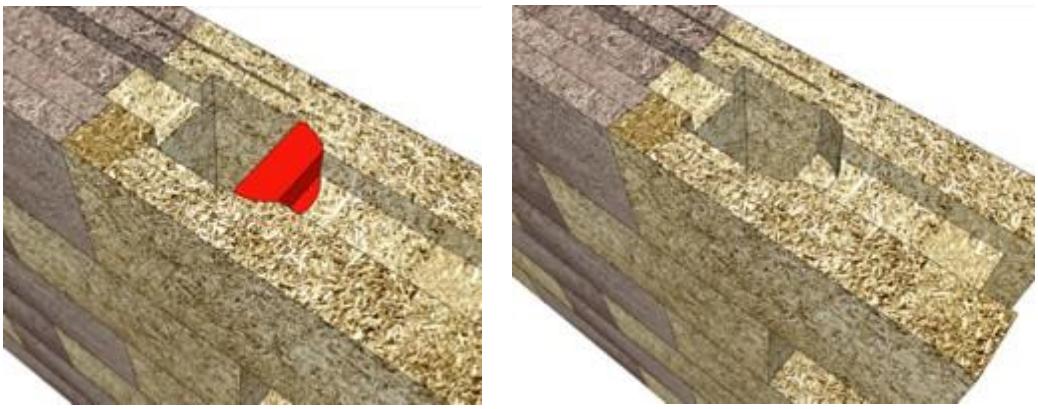


Figure 54 - Preparing for horizontal bracing elements

- Lastly, cut the column block where the angles will be screwed to the post later and keep the offcuts to fill the same hole later. This is also best done before stacking the blocks.

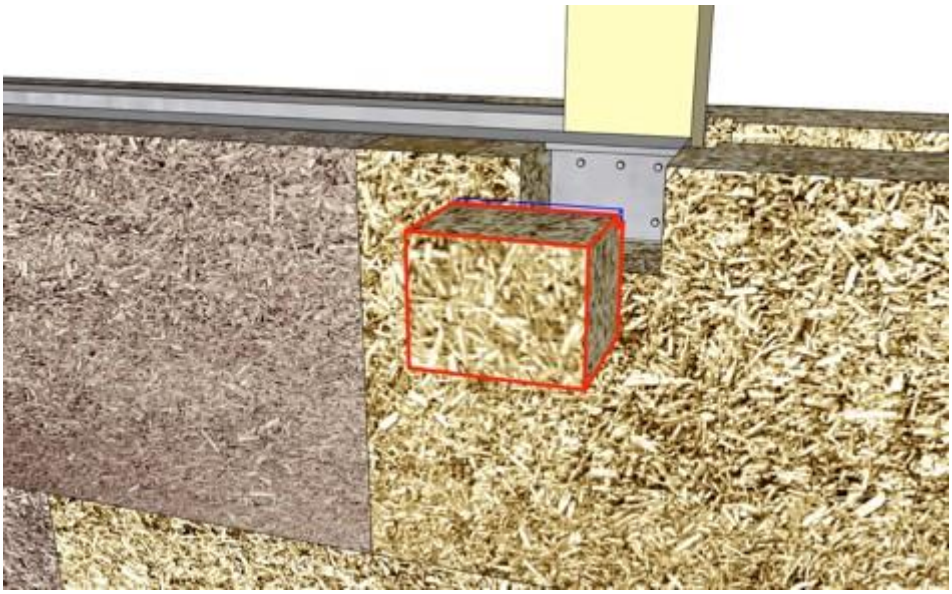


Figure 55 - Preparing for horizontal bracing elements

- Lay the angles in place.
- Ensure there is enough space between the brackets and the post, so that when the posts are inserted later, the post will be able to slide between the angles easily.
- When laying the next course, there should be no need to modify the HempBLOCKs that will be placed on top.
- Repeat this process as specified by the engineer.
- When the wall has come to the height where the posts can be entered, lower them down carefully with a guide to direct the post in between the angle brackets.

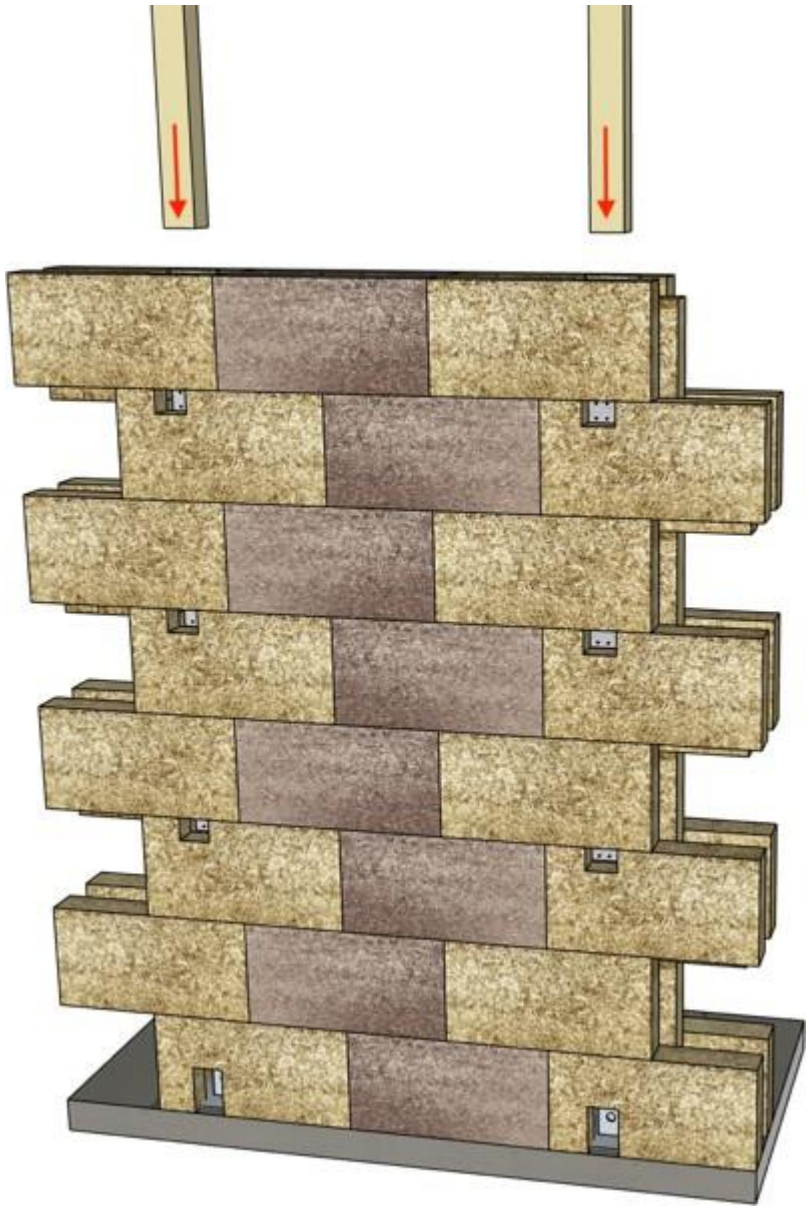


Figure 56 - Installing posts in a bracing wall

- Follow the procedure to secure the posts to the floor brackets and the bracing angles to the posts.
- Check and take photos.
- Fill the holes in the wall surface with the offcuts that were removed earlier.

11. PREPARING POSTS, SILLS, AND LINTELS FOR A STEEL OR FRP LOAD-BEARING SYSTEM

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

11.1 STORAGE AND SAFETY: FRP COMPONENTS

FRP is a glass fibre infused polymer through a pultrusion method. The posts are lightweight, very resilient, will not rust, are flexible and fire resistant and do not conduct heat or electricity. If you are using Fibre Reinforced Polymer (FRP) for the load-bearing system:

Storage:

- Some of these products should generally not be exposed to direct UV light for extended periods unless they are painted. They are designed to be embedded into the walls away from daylight and are not UV resistant for longer periods of time. Check with the manufacturer.
- Keep the products covered by the supplied plastic coverings.

Cutting and drilling:

- Use a metal handsaw, or a hand-held angle grinder fitted with a fiber-cutting blade, or a drop saw (miter saw) fitted with a fiber-cutting blade and respirator.
- Drill bolt holes using segmented diamond hole saws, diameter 12–16 mm.
- Always use the correct PPE.
- **Do not inhale fiber dust** and wear long sleeves to reduce the chance of skin irritation.

11.2 JOINING COMPONENTS

When joining load-bearing components:

- Only use the specified fasteners, self-drilling tec screws, pop rivets or nuts and bolts.
- Use washers as per engineering specifications.
- Do not over-tighten bolts.

- Where pop rivets are required, use only the specified pop rivets.
- Bolted connections in hollow sections are either secured by a tube insert or an anti-crush element. Use inserts where directed.
- Note the bolt diameter required of the inserts.

Figure 57 - Anti crush inserts

11.3 PREPARING AND INSTALLING STEEL OR FRP POSTS

Once the walls reach lintel (header) height, the load-bearing posts are lowered down from the top of the wall:

- Prepare the posts: Cut to length and drill all the bolt holes, as specified in the engineer's drawings.
- Use a drilling jig to ensure holes are parallel.
- You will need to be able to see the brackets or feet where the posts connect to them at floor level. Measure to find the exact positions and cut square sections out of the bottom column blocks for access with a reciprocating saw.
- Following all safety guidelines for working at heights, lower each post into position from the top through the column blocks.
- Secure the post in a plumb position.
- Connect the post to the floor bracket or steel foot with the fasteners specified by the engineer.
- If you have horizonal bracing trusses, slide the post between the truss brackets and connect both posts to the floor brackets or steel feet first. Then connect the truss brackets to the posts, one at the time. Ensure that this does not cause the posts to move out of plumb.
- Ensure the posts are plumb and centred in the column block holes.
- Take photographs of the connections or have the engineer check them.

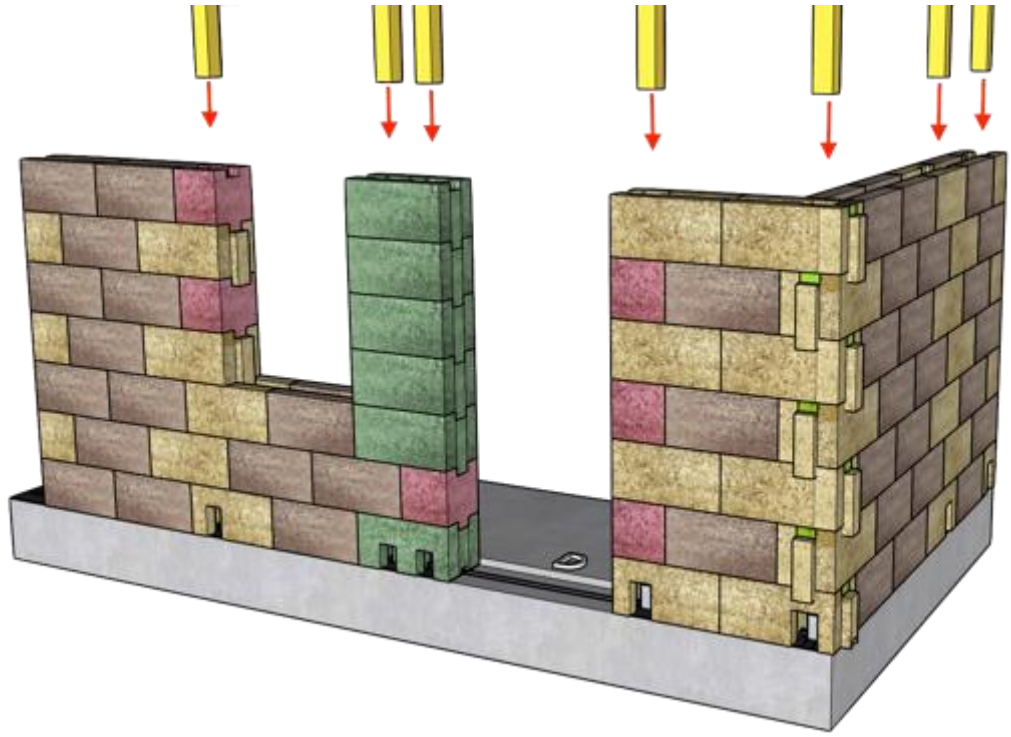


Figure 58 - Lowering the posts into position

11.4 INSTALLING DIAGONAL BRACES

If diagonal braces are being used with steel or fibre-reinforced polymer (FRP) posts, these are installed after the wall has been built up to ring beam stage after the posts lowered in:

- Diagonal braces connect the bottom of one post with the top of the next post on the ring beam.
- A steel angle brace will be specified in the engineer's drawings, typically 50 x 50 x 5 mm with steel bolts, washers, and nuts.
- Measure and cut the angle brace to size and drill the bolt holes as specified.
- Measure and mark out the position of a 70 mm wide groove, to be cut into the HempBLOCKs for the brace.
- Cut the channel with a chainsaw, straight and approximately 110 mm deep. Be careful not to damage the steel or FRP posts.
- Clear the debris, to form a clean channel.
- Bolt the brace to the posts, top and bottom.
- Take photographs of the connections and have the engineer check them before proceeding.
- The channel will later be filled with perlite mix.
- Place formwork where needed, preparing for the pouring of perlite mix.

Figure 59 - A diagonal braces

11.5 SILLS FOR STEEL OR FRP POST SYSTEMS

Install the windowsills according to the engineers' drawings.

- Use the materials specified by the engineer.
- Screw them to the posts with brackets, as specified.
- Where necessary, open a hole in the HempBLOCK material to make space to place the connectors and use the required tools.

Figure 60 - Installing windowsills

11.6 INSTALLING LINTELS (HEADERS) FOR STEEL OR FRP SYSTEMS

After installing the posts, any horizontal braces, and windowsills, before placing lintels, the perlite mix is cast into the column block cavity around the posts.

It is optional to install the lintel at this step, as long as the perlite can easily be cast down the cavities.

- Identify the type of lintel brackets or plates, according to the engineer's drawings.
- Fix the brackets to the posts using the screws, bolts, washers, and nuts specified by the engineer.

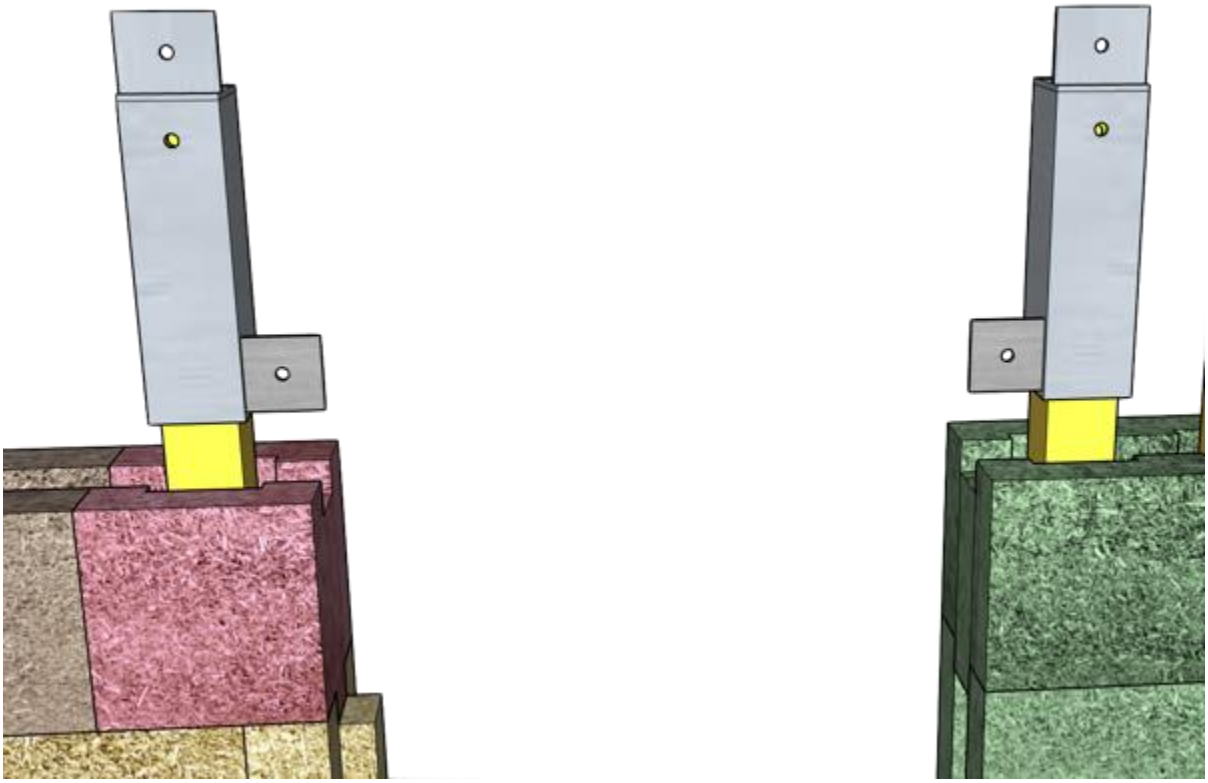


Figure 61 - Installing the lintel brackets

Option 1: Sometimes lintels and the ring beam and are combined. This will be shown on the engineer's drawings. In this case, the ring beam elements and lintel beams will connect to the same brackets at the same level. Refer to the section on ring beams further on in this manual for more details.

- Now prepare the lintels. Measure and cut them to length and drill bolt holes as specified.
- Prepare the lintels by creating a *key* using screws or dovetail timbers to ensure a bond between the lintel beam and the perlite mix inside the U block.

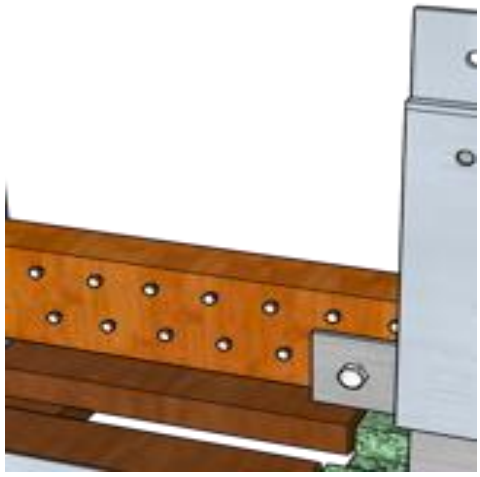


Figure 62 - Lintel 'key' for perlite infill

- Next step is to install the lintel block supports
- Install the U or lintel blocks.
- Ensure the posts are still centered, plumb and centered in the column blocks (blue).

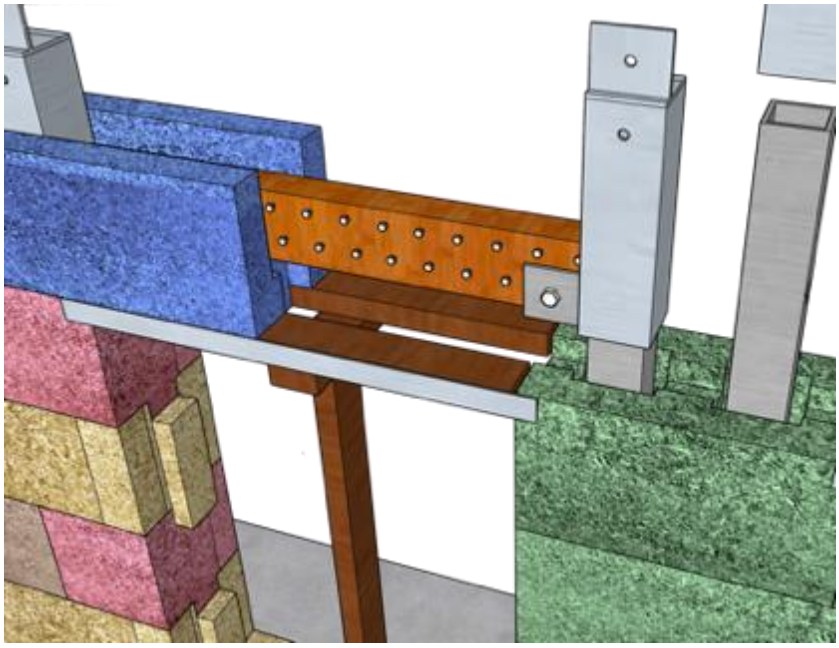


Figure 63 - Installing the lintel in the U blocks

Option 2: The lintel itself can also support the Lintel block.

- The standard would be a 100 x 100 lintel of steel, FRP or timber, as per engineers' specifications.
- The lintel supports the blocks, so no need for angles to support the top window blocks, but if the window span is large you will need to strut the lintel in the middle until all works on the wall are done.
- Use column or standard blocks with a groove cut in it that is the size of the lintel.
- Use the brackets and fasteners specified by engineers.

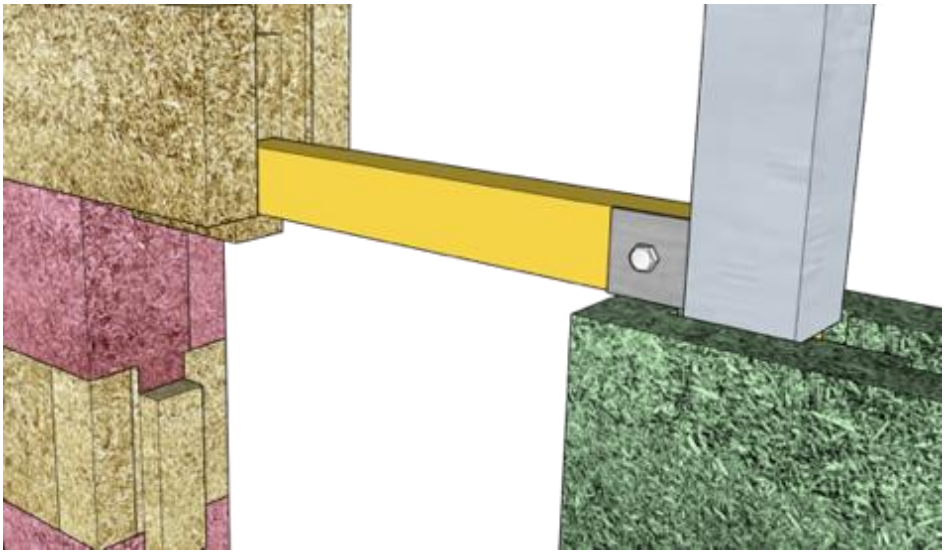


Figure 64 - FRP window lintel supporting blocks

Figure 65 - Lintel (header) supporting blocks

11.7 BRACING A STEEL OR FRP SYSTEM WALL BEFORE CASTING

Although steel and FRP post load-bearing systems have the strength of their load-bearing posts, the voids between the posts and the HempBLOCKs must be filled with a **perlite mix** to seal the blocks together, secure the lintel and ring beams, and create a reinforced system.

Temporary support is required for the columns and lintels while the voids are filled, to ensure the wall remains plumb and that there is no risk of the walls falling. Depending on what is being cast each session, check the following points:

- Add temporary bracing at each (or most) of the column positions and all corners, taking account of the length of the wall and whether there are additional bracing elements inside the wall.
- Refer to this video on bracing a wall for details.
- Check there are sufficient supports and props on each lintel. (Refer to the U-blocks section further on for details)
- Box up the top edges of all U-blocks with clamps, braces, wire, screws, or custom-made blocks. Refer to this video showing U-block bracing.
- Check all areas, particularly columns and U-blocks, for any cracked blocks, as these could split and cause a blowout during casting.
- Ensure all the walls are straight and plumb before continuing.

Figure 66 - Bracing and checking a wall for plumb before casting perlite

12. EMBED THE FRP OR STEEL COLUMNS WITH A PERLITE-CEMENT MIX

Now the columns are ready to be embedded:
After **completing the pre-casting checklist**, cast the perlite into the prepared cavities:

- Create the Perlite mix
- Use buckets to carry the mixture to where it is required. Form the bucket to create a spout, to pour the mixture into the narrow cavities.
- Follow all safety guidelines for working at heights.
- Pour the perlite mix into the wall voids that are to be filled this session:
    - In through the top of the column blocks
    - Into the lintel U-blocks and sills
- Always ensure the groove of any top HempBLOCK that will still be used is not accidentally filled.
- Wet the holes before pouring.
- Gently spraying the cavities with a water mist will allow the perlite to flow more easily, especially in very dry weather.
- Pour the perlite into the column voids until full
- Gently push the perlite with a rod to help it flow down the voids and into all the spaces without trapping air. Be **cautious**, as using force may cause a blowout. **Do not vibrate**.
- Continually check for blowouts while pouring.
- Ensure the top surfaces of the perlite mix are flat and level, as another course of blocks will be placed on top of this layer.
- Once the voids are all filled, use excess perlite mix to fill other holes around the building, such as grooves cut for braces. Remove rubble or debris and blow out with an air blower before filling.
- Allow two days for the mix to set sufficiently before continuing work above it.

13. U-BLOCKS

13.1 TEMPORARY LINTEL SUPPORTS

U-shaped lintel HempBLOCKs will be filled with the perlite mix or concrete, embedding the lintel beams or rebar cages. These U-blocks must be safely supported by temporary supports until the perlite mix or concrete has cured.

The support system must be well secured and stabilized, so collect all required materials before proceeding:

- For each door or window opening:
  - Two aluminium or steel L-brackets, 70 to 100 mm longer than the opening, or
  - Timber or steel supports or T's, cut exactly to the height of the bottom of the U-block and secured against the tongue of the U-blocks. T supports of jacks are made of framing timber.
  - Alternatively, expandable header support bars can be used
- Steel or timber builders' props, acro props, or shoring jacks.
- Secure the jacks to eliminate the risk of them falling.

Figure 67 - Aluminum support angle

13.2 INSTALLING LINTEL BLOCK SUPPORTS (IF CASTING LINTELS SEPARATELY)

Install the supports as shown in the images below:

- The two timber or steel supports must be flush with the top of the top column blocks.
- The tongue of the U-block will go between the timber or steel supports, so ensure the gap between them is at least 100 mm and is centred.
- Cut small notches near the top of the top column blocks to accommodate the thickness of equal angle brackets, so they are flush with the blocks on either side.
- Ensure the supports are strong and secure. The top of each prop must support the full width of the assembly, and the foot must be well supported.

Figure 68 - Installing temporary supports

- Apply a releasing agent, such as wax or oil, to all steel surfaces that will come in contact with the perlite mix or concrete, to prevent it bonding to the steel.

Figure 69 - Applying releasing agent

13.3 PLACING THE U-BLOCKS

Now place the U-shaped lintel HempBLOCKs:

- Position the U-blocks with the tongues on the temporary jacks
- Leave the tongues on the U-blocks.
- Check that the outer U-blocks on each lintel both have at least 70mm of support from the adjacent column block.
- If the U-block must go over a post, measure and cut a 150 mm x 150 mm hole through it. Refer to the section in this manual on cutting blocks for a video on how to cut this hole.

Note: Sometimes the lintels and the ring beam are combined. Refer to the section on ring beams further on in this manual for details.

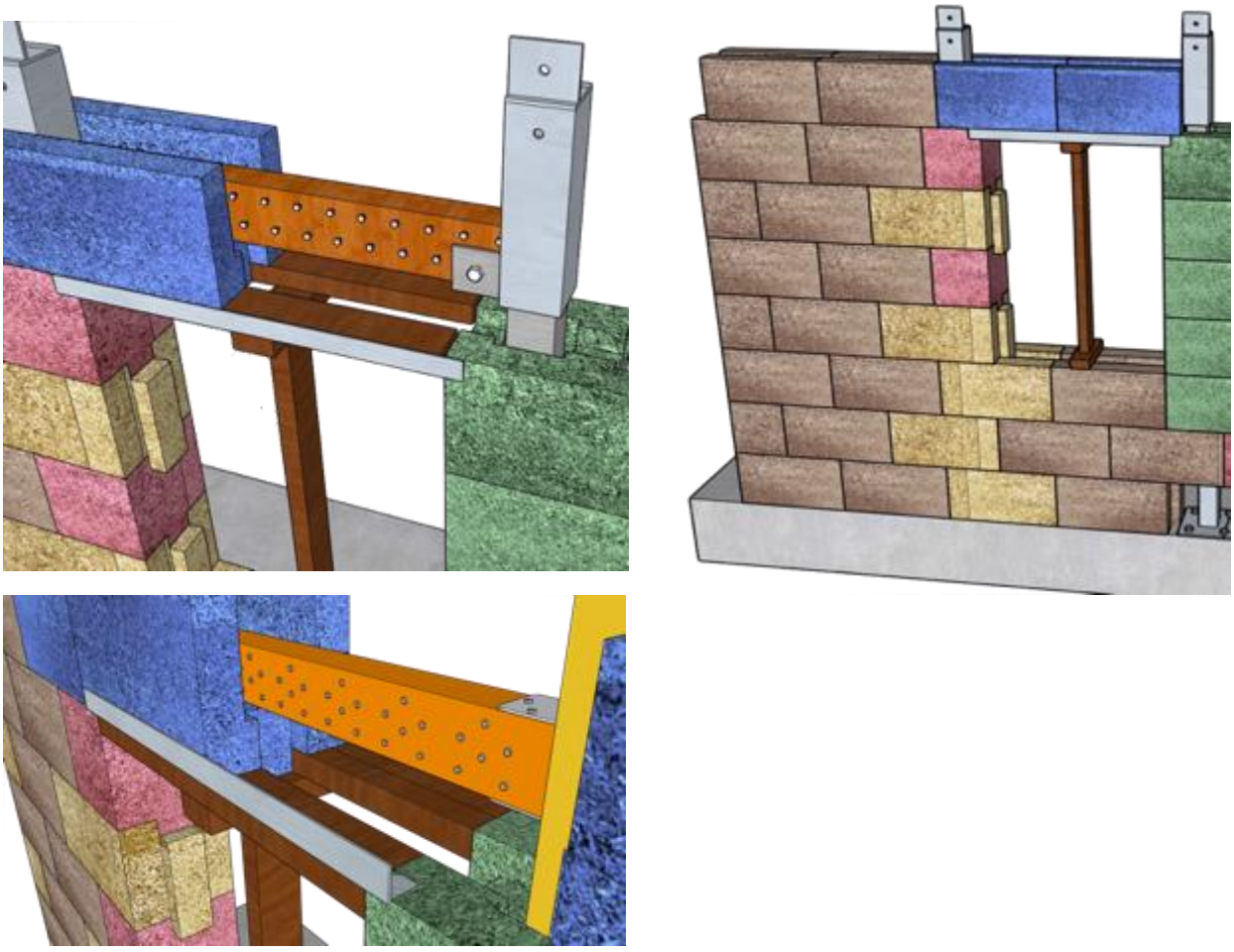


Figure 70 - Placing U-blocks

Figure 71 - Placing U-blocks

For steel or FRP systems, take photographs of the connections or have the engineer check them.

13.4 SAFETY STRUTS

Place safety struts on incomplete long walls and lintels, to secure them.

Figure 72 - Safety struts on incomplete walls

13.5 PREPARING THE RING BEAM OF A STEEL OR FRP POST AND BEAM SYSTEM

The next course of blocks above the lintels is usually the ring beam. Install a course of U-blocks following the instructions above for Laying courses above filled U-blocks and then install the load-bearing system into them. For steel post and FRP load-bearing systems, install the ring beam members:

- Prepare the steel, timber, or FRP ring beam members.
- Install the brackets, as specified.
- Use the bolts, washers, and nuts or specified screws to attach the ring beam members to the posts.
- Where necessary, make holes in the HempBLOCKs to make space to fit the fasteners.
- Take photographs of the connections or have the engineer check them.

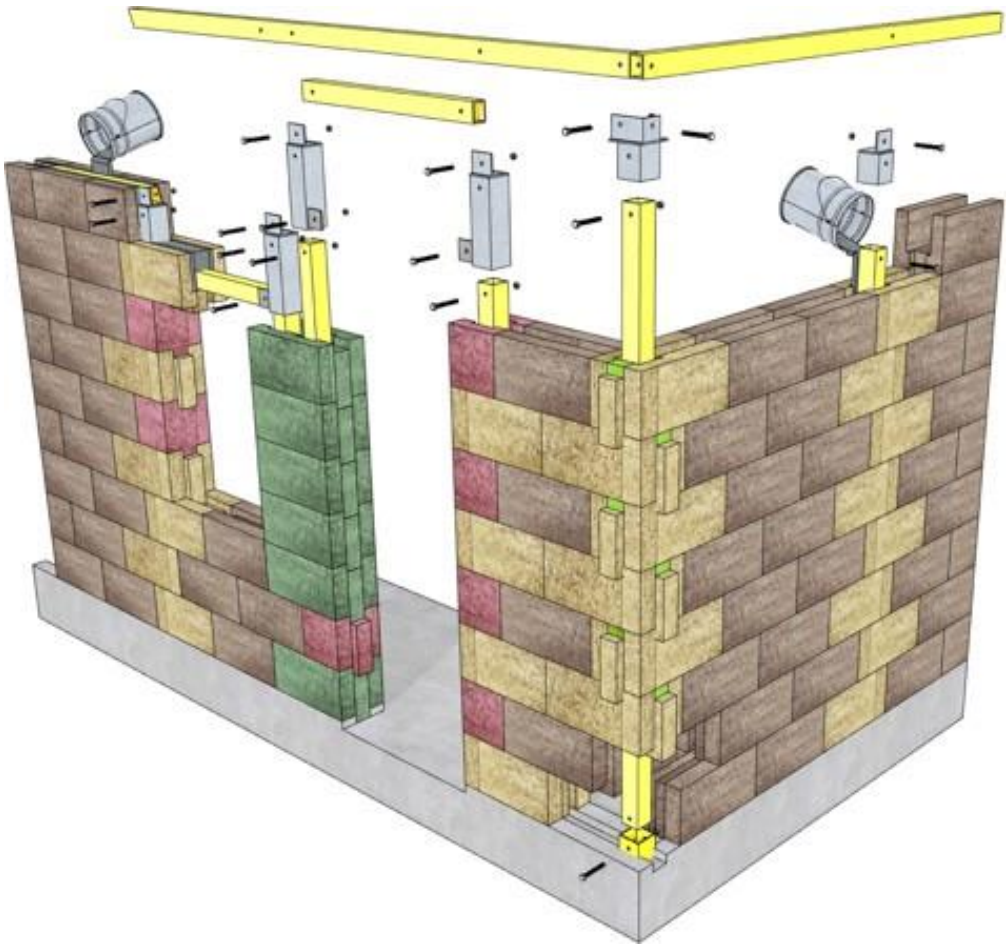


Figure 73 - FRP ring beams in a post system

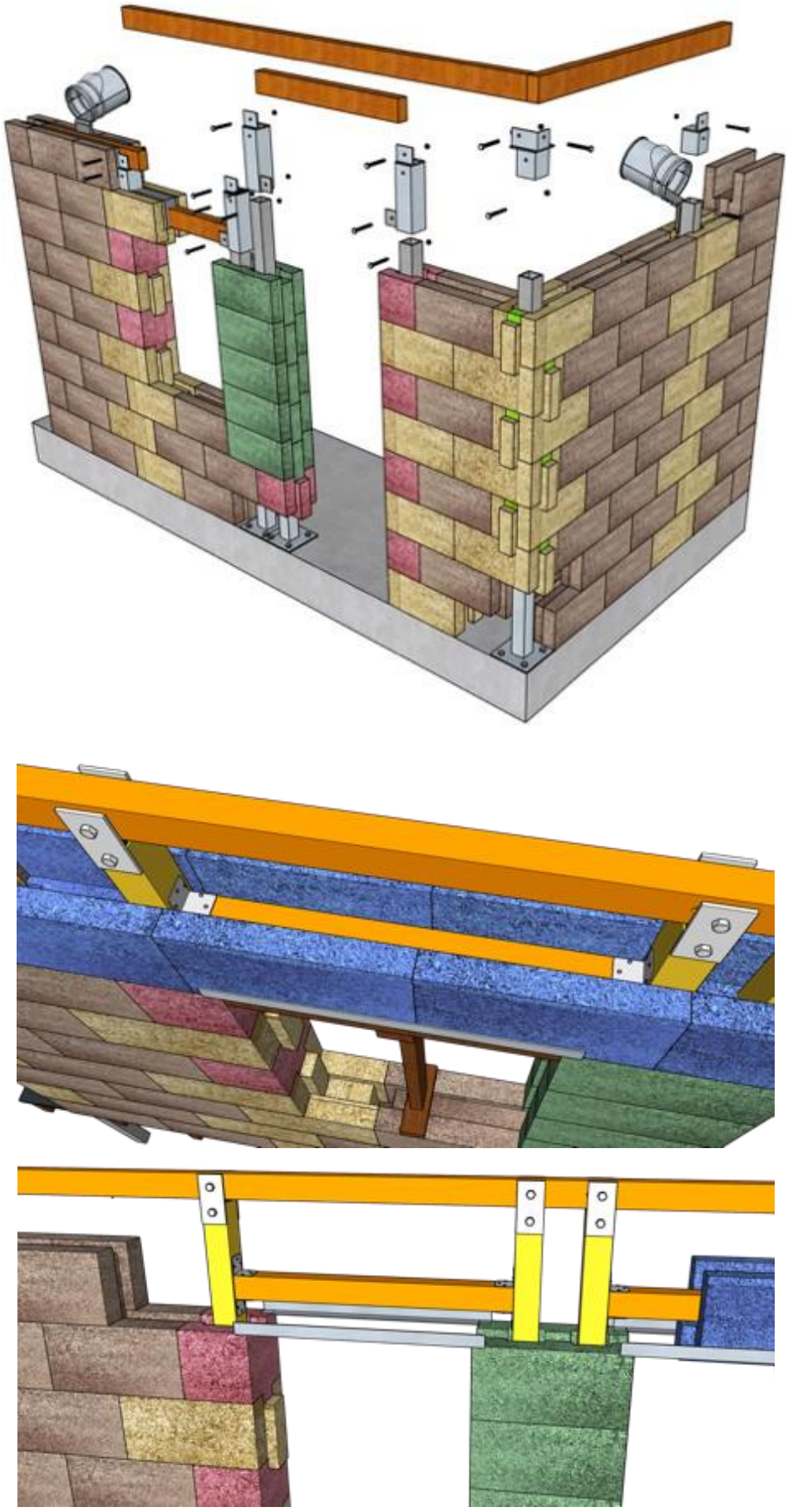


Figure 74 - Rings beams in a post system

13.6 ROOF ANCHOR BRACKETS AND TIE DOWNS IN STEEL OR FRP POST AND BEAM SYSTEMS

For Steel and FRP load-bearing systems, install roof anchors before casting perlite mix into the ring beam U-blocks in accordance with the engineer's specifications:

- Attach the specified brackets for the roof rafters or trusses.
- The use of Burmon brackets, (pictured below), is recommended, as this is simpler than using traditional *triple grips*. Here, steel strips are shown fixed around the brackets, connecting them to the ring beam.
- Take photographs of the connections or have the engineer check them.

Figure 75 - Burman roof anchor brackets

13.7 MAKING A PERLITE – CEMENT MIX

When mixing and using cement, always use the correct PPE and follow safety protocols. Avoid inhalation or skin contact of cement dust.

For a steel or FRP post and beam system, the voids around the posts, lintels and beams are filled with a perlite cement mix. Correct component specs and mix ratios are crucial, to ensure the perlite mix flows correctly and sets at the right pace.

- A fine grade perlite (1 to 3 mm) is preferable, as it flows easily into gaps.
- Plasticiser is added to increase workability.
- Use compliant Portland cement.
- Clean water

Mix the perlite in a volume ratio of 1 to 5:

- One volume part of cement
- Five parts of perlite
- Plasticiser
- Water

Hint

How to get the mix ratio right for a medium to bigger mixer (120 litres):

- Cut a cement bag in half.
- Empty one part in a temporary bucket.
- Fill the empty (half) bag with perlite.
- Empty this into a large (100 litre) rubber container.
- Repeat so you have five half-bags of perlite in the rubber container.
- Mark a line inside the bucket at the top of the perlite.
- Now you know how much 5 x the volume of half a bag of cement is.
- Cut the cement bags so you have half bags of cement each time, to mix with the perlite measured in the marked container.

Perlite mixing method:

- Put the water into the mixer
- Add the plasticiser (20 ml or approximately a capful or one squeeze out of a dishwashing soap container)
- Add the cement
- Add the perlite
- Mix for about 3 minutes until the right consistency is achieved: a flowing, cream-like consistency
- Count the total buckets of water.
- Add additional water using the shower setting on the hose nozzle to get it to the right consistency.
- Correct mix consistency is crucial.

Figure 76 - Mixing and placing a perlite-cement mix

14. PREPARING REBAR CAGES TO CREATE POSTS FOR STEEL-REINFORCED CONCRETE SYSTEMS

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

- Make the column rebar cages, as specified in the engineer's drawings by tying the ligatures to the rebars.

Figure 77 - Making steel cages

- Rebar wheel spacers can be added to help keep the rebar cage centered inside the cavity - see below.

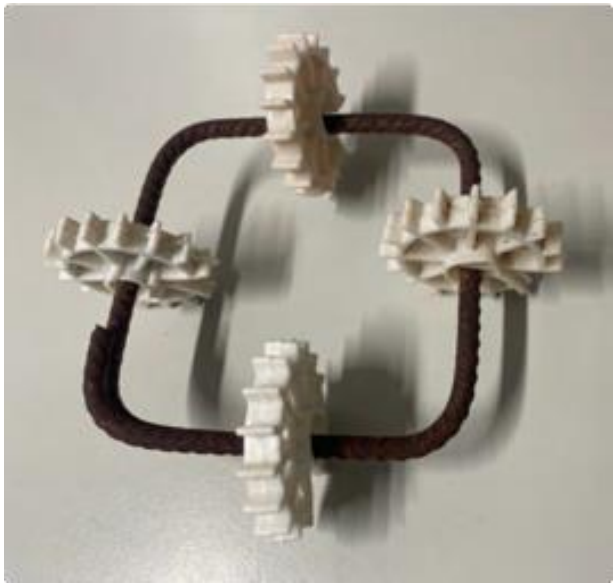


Figure 78 - Spacer wheels

- You will need to be able to see the starter bars at floor level, to connect the cages and to clear the rubble from the lower part of the column. Find the exact positions and cut holes in the bottom column blocks for access. (If concrete starter blocks are used, this step is not necessary.)
- Following all safety guidelines for working at heights, insert each cage slowly into the void of the column blocks. Make sure the cage goes *over* the starter bars and does not touch the sides of the column blocks.
- Use rebar tie wire to attach the column cage to the starter bars, following engineering specifications.
- Take photographs of the connections or have the engineer check them.

Figure 79 - The steel reinforced system

Figure 80 - Steel cage (10mm rebar only)

Figure 81 - Slab preparation of steel reinforced concrete system

15. PREPARATIONS FOR POURING CONCRETE FOR STEEL-REINFORCED POST AND BEAM SYSTEMS

Always follow the safety protocols given in the Safety chapter of this manual work according to safety regulations, and use the correct PPE,

15.1 PREPARING FOR CASTING

Before casting **concrete**, start by preparing the site for casting:

- Identify all cavities that must be filled and prepare scaffolding and platforms to access these.
- Remove all rubble and debris from the voids.
- Blow out dust and finer particles with an air blower.
- Find and block any holes through which the poured perlite mix, or concrete might escape. It will pour out through any gaps that have not been properly sealed.
- This includes holes cut through the bottom of column blocks when making connections, and holes for connecting trusses, sills, and lintels to columns. Check both sides of the walls.
- Block small holes with builder's expanding foam or temporary timber formwork.

- Block gaps between lintel U-blocks with builder's expanding foam. Block large holes using temporary formwork such as timber propped into position or plywood screwed to the blocks.

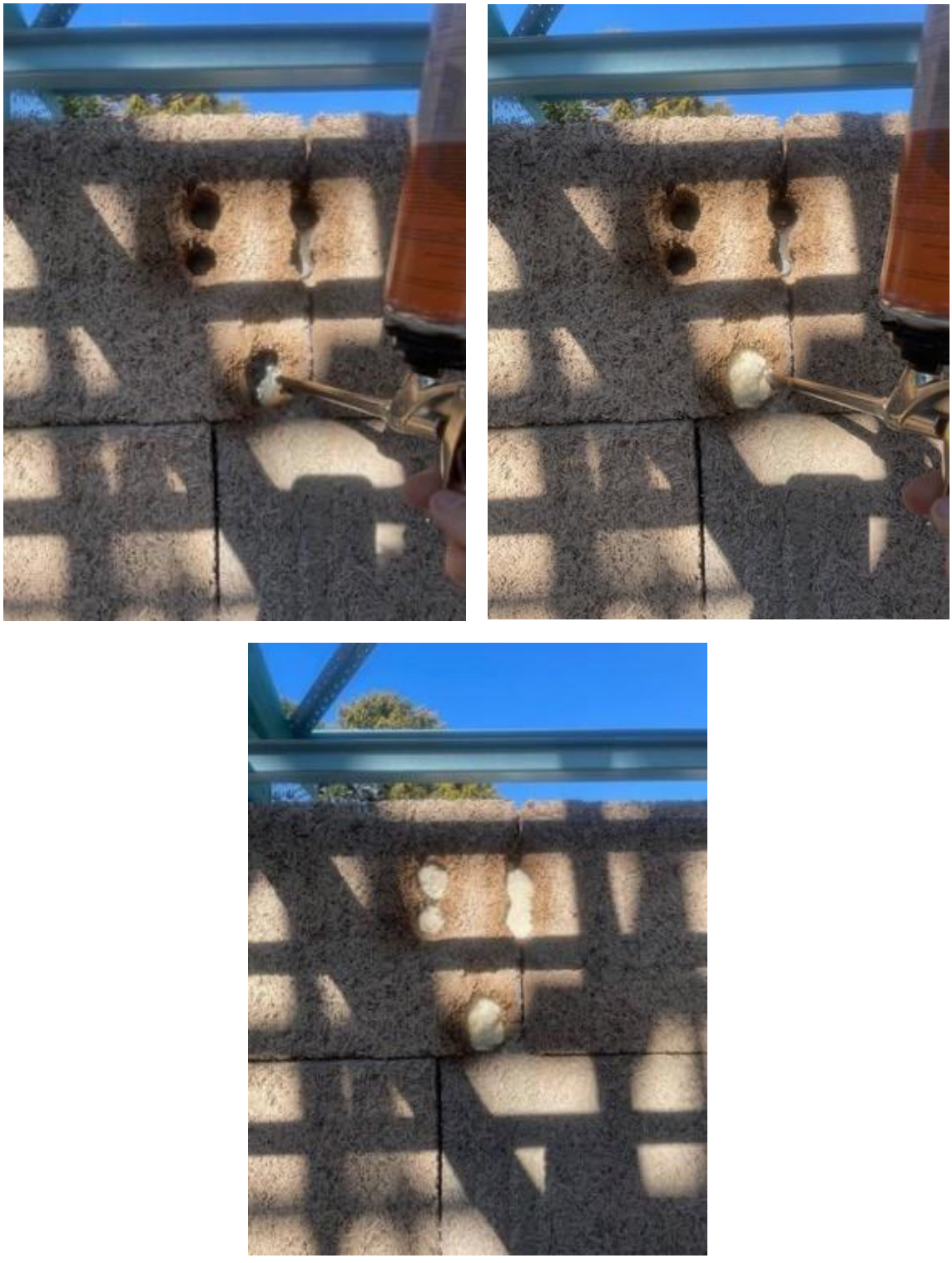


Figure 82 - Sealing holes with expandable foam

Figure 83 - Blocking of the inspection holes

15.2 BRACING AND FORMING UP A STEEL REINFORCED CONCRETE SYSTEM WALL

For a steel reinforced concrete load-bearing system, the columns have little strength before the concrete is cured, and the whole structure needs to be very well braced and formed up during casting and curing. This step must be carried with sufficient and suitable bracing materials to safely avoid blowouts. Depending on what is being cast each session, check the following points:

- Refer to this video about boxing up before concrete.
- Use a timber framework, clamped and strutted back to the floors of the outer and inner walls.
- Add struts and bracing at each column position and all external and internal corners.
- Use boards at least 200 mm wide at each column position, covering the width of the post inside the wall. Wire the boards on each side of the wall together with the appropriate wire through the wall. Cut the wires short, so they do not leave a mark in the render at a later stage.
- Ensure the boxing around the lower section of the columns is strong, especially where inspection holes were cut through the blocks, as the wet concrete will place significant pressure here.
- Check there are sufficient supports and props on each lintel. (Refer to the U-blocks section for details.)

- Box up the top edges of all U-blocks with clamps, braces, wire, screws, or custom-made blocks. Refer to this video showing U-block bracing.
- Check all areas, particularly columns and U-blocks, for any cracked blocks, as these could split and cause a blowout during casting.
- Check to have threaded bars, such as rafter rods, to be protected with tape against concrete splash.
- Ensure all the walls are straight and plumb before continuing.
- Check walls for plumb during casting as they may have moved by leaning on them etc.
- If casting the next pour later, make sure the top of the older layer is clean of debris by using a vacuum cleaner to clear it out.

Figure 84 - Bracing a steel reinforced concrete system before casting

Figure 85 - Bracing a steel reinforced concrete system before casting

Figure 86 - Bracing a steel reinforced concrete system before casting

15.3 PRE-CASTING CHECKLIST – CONCRETE

Before pouring concrete
Check that secure scaffolding and platforms are in place, for safe access to all points where concrete is to be poured.
Check the following have been inspected by the engineer or certifier. Take photos if instructed to do this.
• All columns, sills, and lintels (headers) being cast in this session have the correct rebar cages in place.
• All rebar cages are centred on the block voids.
• All rebar cages are attached correctly at starter bar level.
• All rebar connections at column, lintels, and sills are correct.
• Check there are sufficient temporary lintel supports and that these are firm and secure. (If lintels are being cast in this session)
• Blow out any debris at the bottom of the column block openings before boxing it up. • Check that all holes through which concrete could escape have been closed.
Check for cracked blocks.
Check all walls are straight.
Check all walls are plumb.
Check site conditions. Do not proceed with casting while the HempBLOCKs are soaked from rain. The blocks must be as dry as possible. – other than the voids that will be pre-wet beforehand.
Concrete mixture
Check concrete is to spec, slump, and ratios are correct

16. PREPARING LINTEL CAGES AND SILLS FOR STEEL-REINFORCED CONCRETE SYSTEMS

Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

16.1 LINTEL CAGES FOR STEEL-REINFORCED CONCRETE SYSTEMS

For steel-reinforced concrete systems, the lintel cages are installed after the U-blocks have been placed in position:

- Cut the cages for each lintel to reach the outer edges of the posts. Cut the materials to size and adhere to the overlaps specified by the engineer.
- Place each cage inside the U-blocks, ensuring that it overlaps fully with the column cages, as shown in the engineer's drawings.
- Keep a minimum of 50 mm clearance from the inside of the U block cavity to the bottom of the cage.
- Use steel ties to connect the lintel cages to the column cages, according to the engineering specifications. (Image below with block removed for clarity).
- Now install rods that will tie down the roofing rafters; hooked them into the cage as specified. Place tape around threads, to keep them clean.
- Refer to this video showing the steel cage lintel before concrete fill.
- Take photographs of the connections or have the engineer check them.

Note: Sometimes the lintels and the ring beam are combined. Refer to the section on ring beams further on in this manual for details.

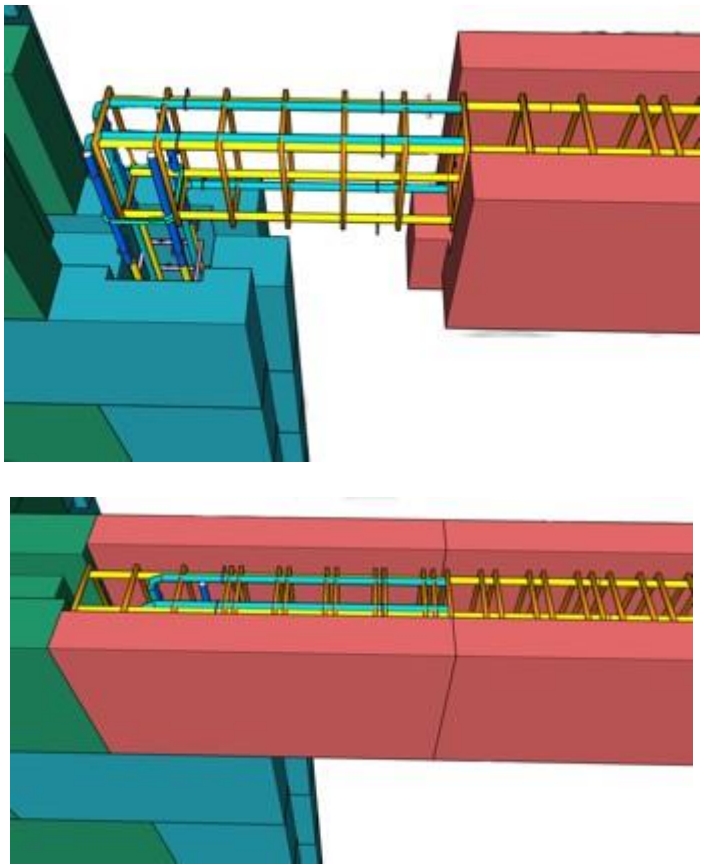


Figure 87 - Preparing lintel cages

16.2 SILLS FOR STEEL REINFORCED CONCRETE SYSTEMS

Install the steel reinforced windowsills:

- Make the sill cages according to the engineer's drawings, typically two rebars connected to the posts placed on a concrete chair.
- These are placed in a groove created in the sill HempBLOCKs.
- Where necessary, open holes either side of the window of the HempBLOCKs to connect the rebar to the posts.

Figure 88 - Steel reinforced window sill

16.3 PREPARING CONCRETE

For a steel reinforced concrete system, concrete is cast around the rebar cages. Correct mix ratios are crucial, to ensure the concrete flows correctly and sets at the right pace.

- Prepare concrete with mix ratios and materials as specified by the engineer.
- Do a slump test if required.
- Concrete is cast in three or four stages, so that the lower first cast of the columns is set partially before more concrete is added on top.
- If the concrete sets too slowly, the columns will have a greater blowout risk.
- Concrete that is too wet will create a high blowout risk.
- For larger projects, to prevent cold joints in the concrete fill, use a concrete pump.
- It is important that the concrete has the correct slump.

16.4 CASTING CONCRETE

After **completing the pre-casting checklist**, cast the concrete into the prepared cavities:

- Wet the holes before pouring.
- Gently spraying the cavities with a water mist will allow the concrete to flow more easily, especially in very dry weather.
- Use buckets to carry the mixture to where it is required. Bend the bucket to create a spout, to pour the mixture into the narrow cavities.
- You can use a concrete pump, but caution there as the concrete comes down the hose with great speed which may cause blow outs.
- Follow all safety guidelines for working at heights.
- Pour the concrete into the wall voids. Fill in the following stages;
    - posts
    - sills
    - lintels (in most cases)
- Always ensure the groove of any top HempBLOCK that will still be used remains clear of concrete.
- Pour the concrete into the column voids in height increments of approximately 1 meter (3 feet). Work around the perimeter of the walls allowing two days' setting time before pouring again into each column.

- Gently push the concrete with a rod to help it flow down the voids and into all the spaces without trapping air. Be **cautious**, as using force may cause a blowout. **Do not vibrate** the perlite mix or concrete.
- Continually check for blowouts while pouring.
- Ensure the top surfaces of the concrete is flat and level, as another course of blocks will go on top of this.
- Allow two days for the concrete to set sufficiently before continuing work above it.

17. CASTING THE LINTELS (HEADERS)

Next, fill the lintel and sill cavities, following the same procedure detailed in the section above on casting.

- Note:
  - For a steel or FRP post and beam system, the **voids around the beam members are filled with perlite mix**.
  - For a steel reinforced concrete system, the **rebar cages are cast in concrete.**
- Prepare the site for casting, following all steps detailed in the casting section, including preparing safe scaffolding, blowing out debris and blocking holes.
- Box up the top edges of the U-blocks with clamps, braces, wire, screws, or custom-made blocks.
- Block the gaps between the lintel U-blocks with builder's expanding foam
- Complete the pre-casting checklist.
- Prepare and check the perlite mix or concrete.
- Pour the perlite mix or concrete into the lintel and sill U-blocks, ensuring it completely surrounds the load-bearing system.
- Level the top surfaces.
- Allow two days setting time before continuing work above here.

Figure 89 - Casting the lintel

18. RING BEAMS

Typically, the walls up to and including the lintel (header) level are eight blocks high. Above this, the next layer (ninth block) will typically be the ring or bond beam, onto which the roof will be attached. The ring beam runs uninterrupted around the top of the perimeter of the building, in U-blocks. Other designs may have sloping walls or gables above the lintels.

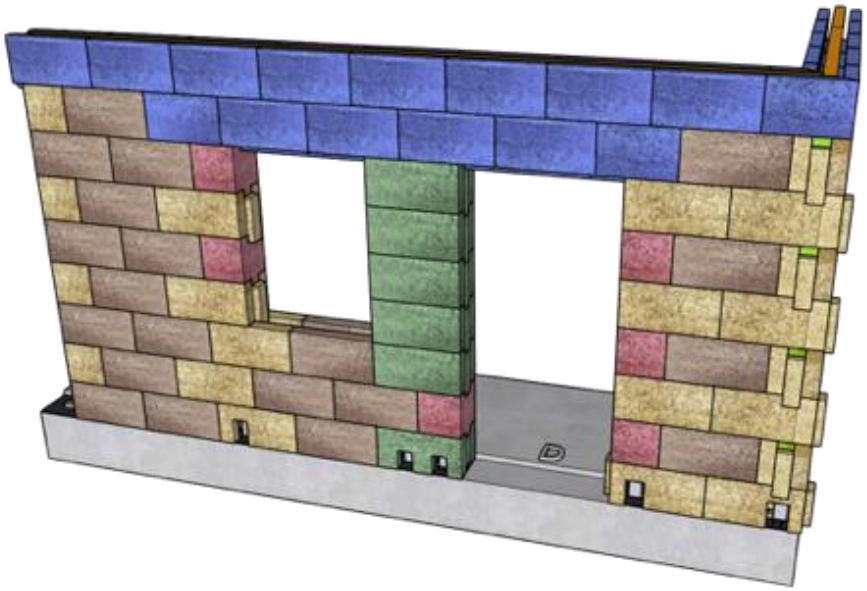


Figure 90 - Lintel and ring beam

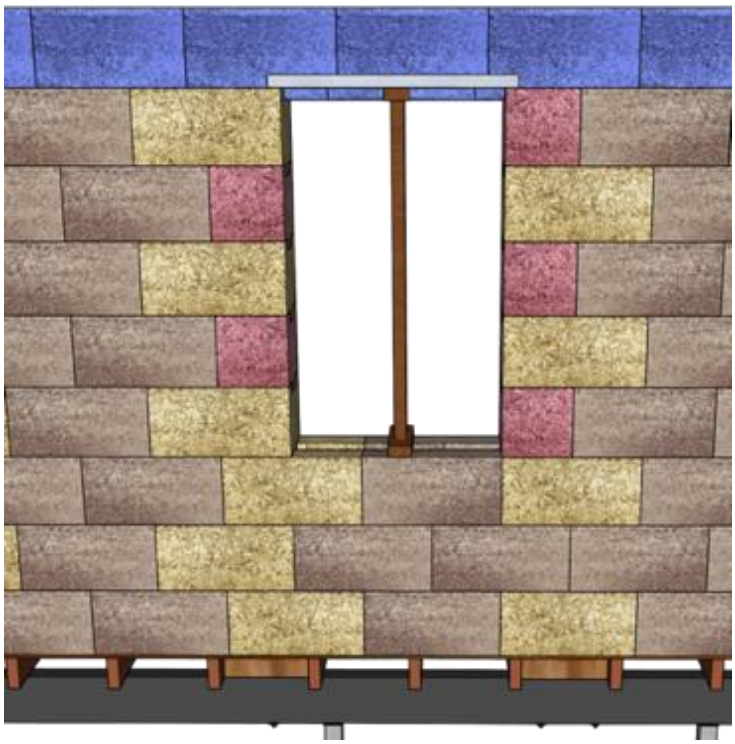


Figure 91 - Combined lintel and ring beam

18.1 SLOPED RING BEAM

A sloping ring beam is created like a standard ring beam but in a slope or angle. Refer to the section further below for instruction on how to build the sloping wall.

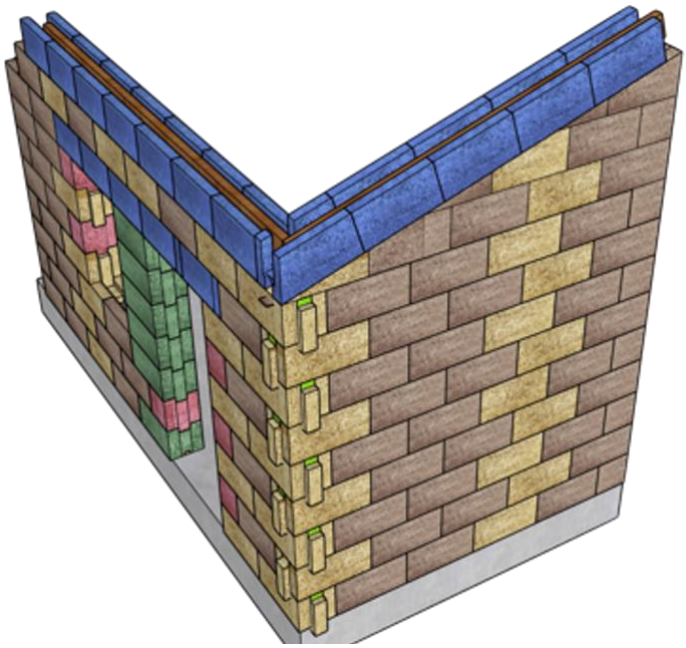


Figure 92 - Sloping ring beam

18.2 INTERIOR LOAD-BEARING WALLS WITH BOND BEAMS

For loadbearing interior HempBLOCK walls, the ring beam may be specified to continue along the top of the load-bearing interior walls.

They will be connected as per engineering's specifications.

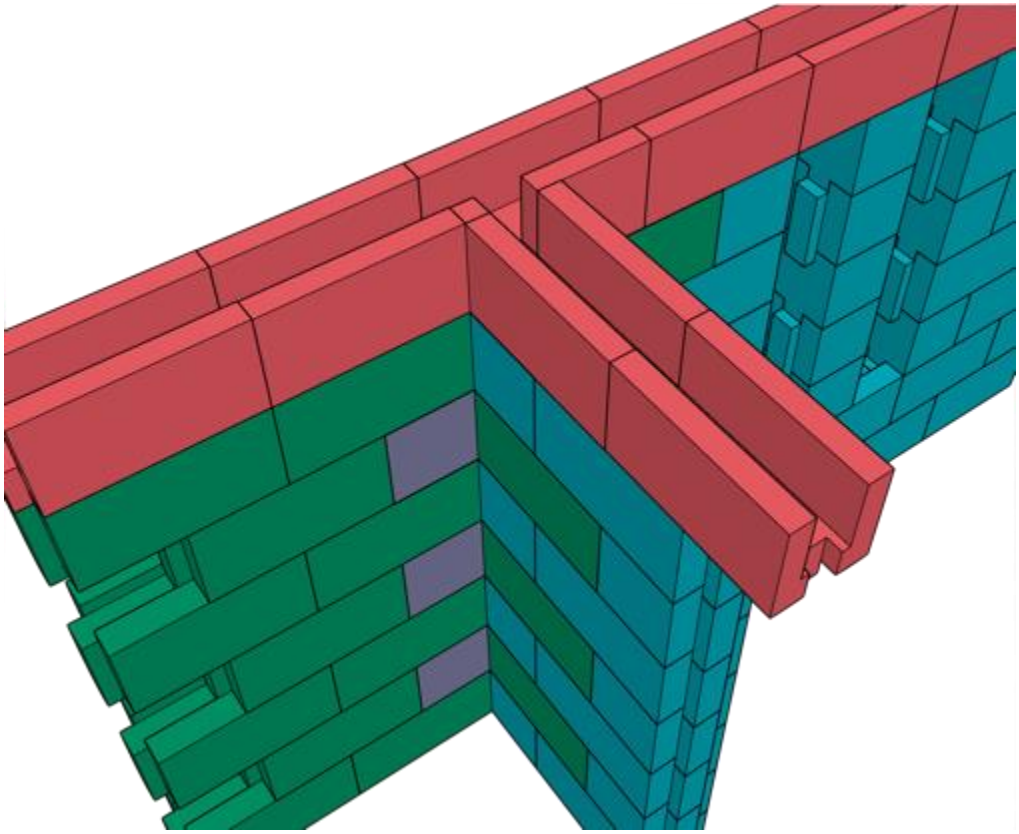


Figure 93 - Interior load-bearing walls

18.3 LAYING COURSES ON TOP OF THE RING BEAM OR LINTELS

Two days after casting the lintels (headers), the perlite or concrete should have hardened sufficiently to continue with the next course of HempBLOCKs:

- The course above the lintel blocks is usually a course of U-blocks or additional HempBLOCKs
- Cut the bottom tongues of this next course of blocks off.
- If the lintel beam protrudes above the lintel U-blocks, cut a groove in the new block (that will be placed on top. The new block must fit flush onto the block below it.

- Bond the new course of blocks in place with adhesive. Refer to the section on glueing blocks for adhesive options.
- When a block must fit over a post, measure and cut a 150 mm x 150 mm hole through it. Refer to the section in this manual on cutting blocks for a video on how to cut this hole.

Figure 94 - Column cut out of a U block

18.4 INSTALLING RING BEAM CAGES FOR A STEEL-REINFORCED CONCRETE SYSTEM

The course of blocks above the lintels is usually the ring beam. Install a course of U-blocks following the instructions above for Laying courses above filled U-blocks and then install the ring beam steel cages:

- Prepare the cages for the ring beam.
- Place the cages inside the U-blocks, ensuring they are linked correctly with the column cages.
- Connect the ring beam cages to the column cages with the required steel connecting rebars using steel ties, according to the engineering specifications.
- Below are typical rebar connection details.
- Install the roof tie connections, typically brackets or rods attached to the cage at the correct intervals, as specified by the engineer.
- Take photographs of the tied connections or have the engineer check them.

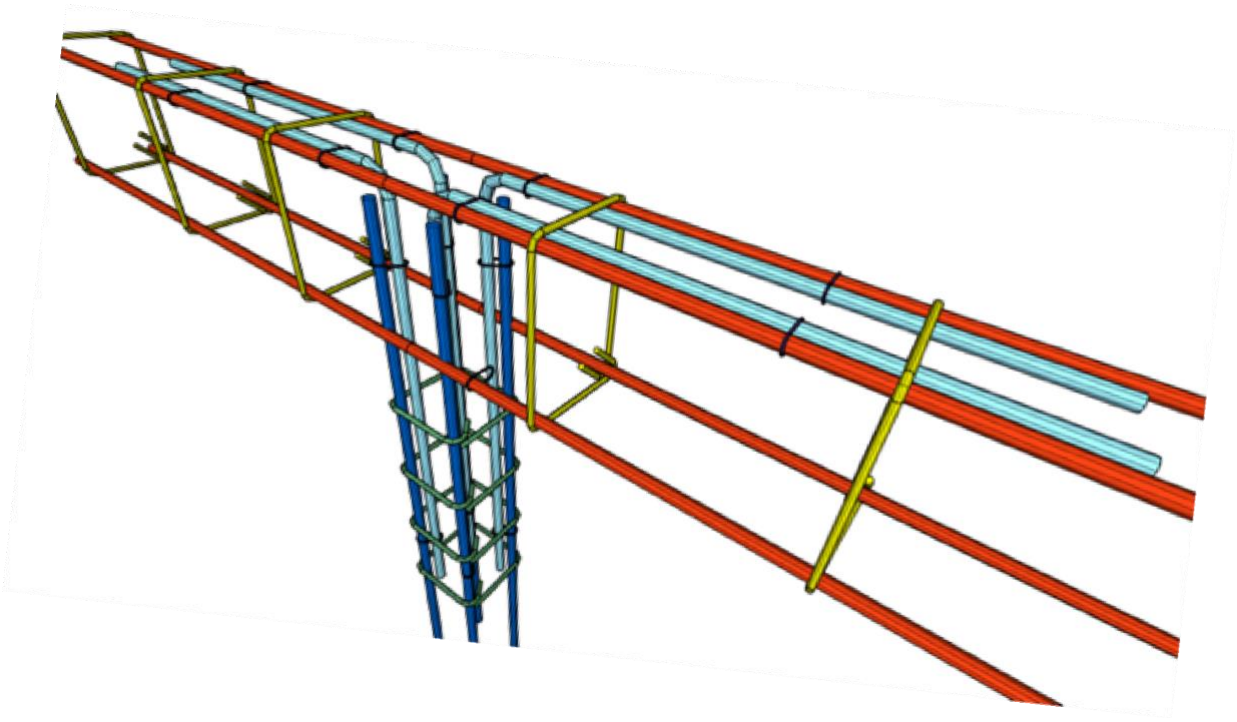


Figure 95 - T junction

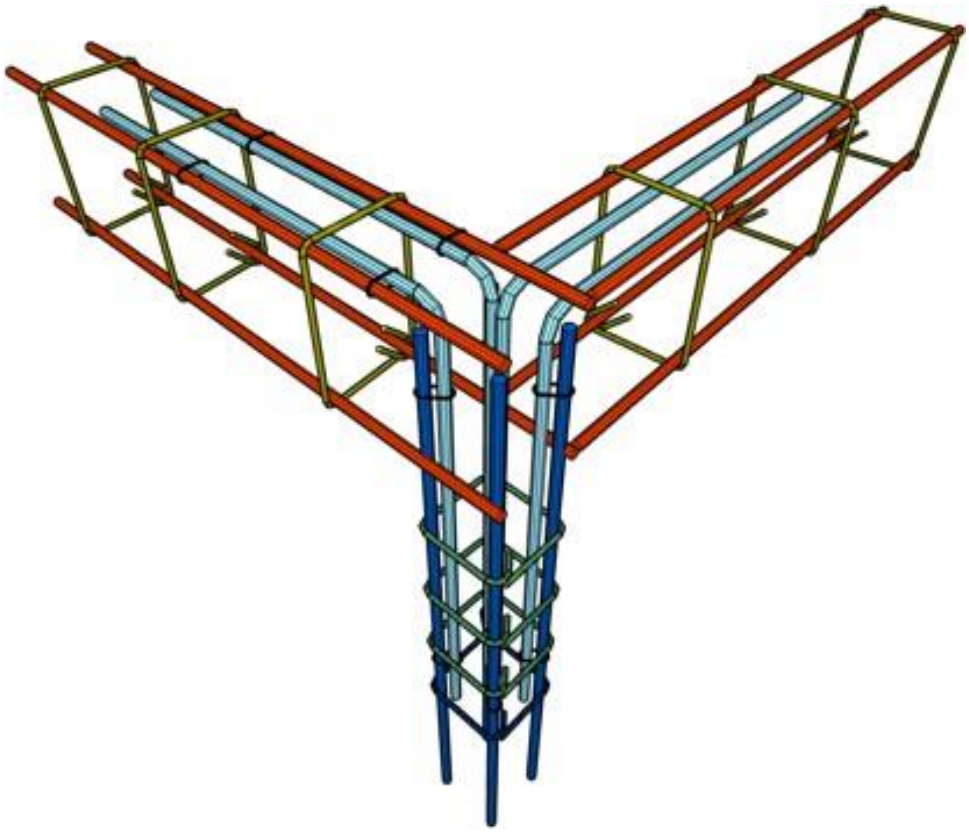


Figure 96 - Corner junction

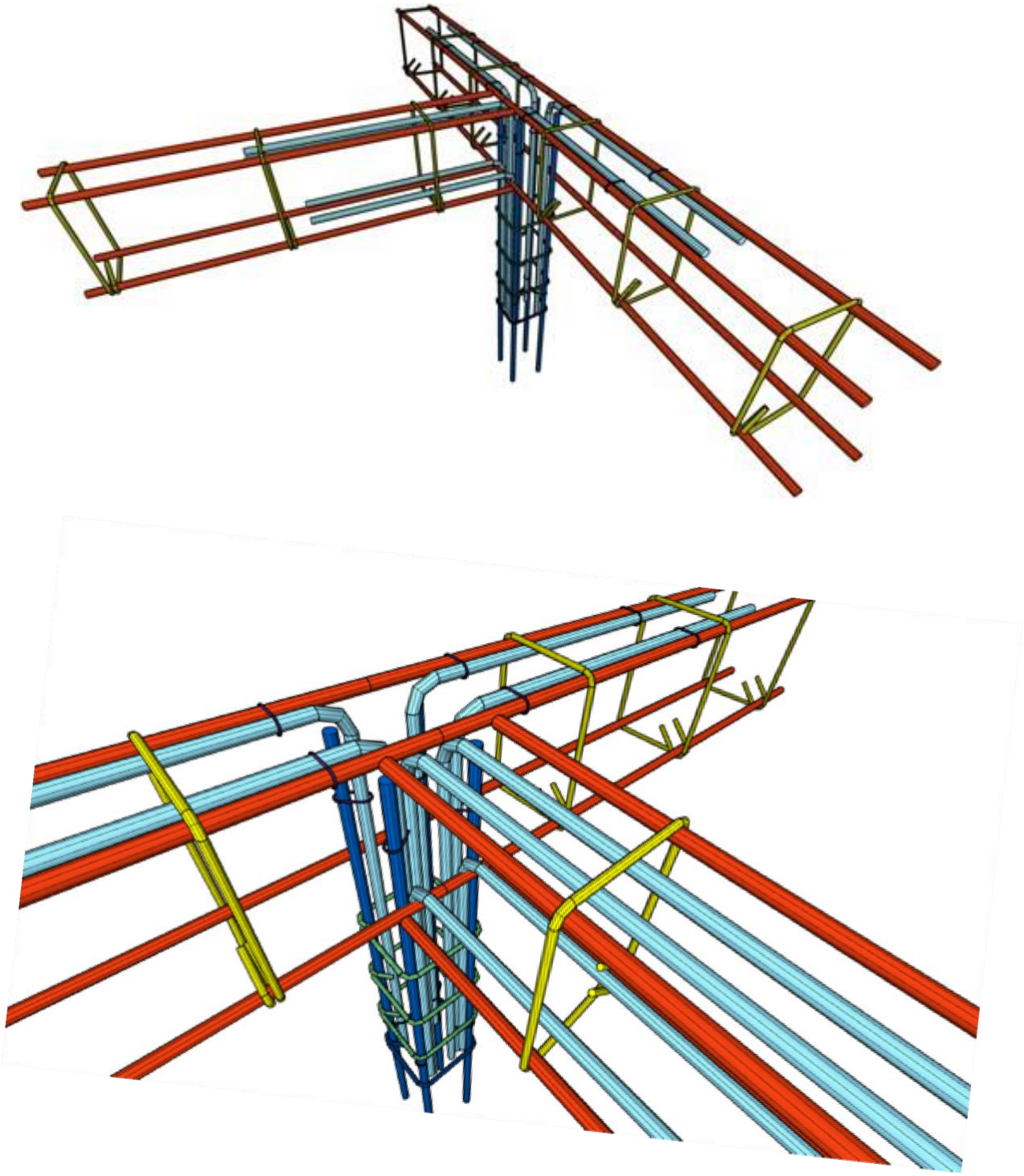


Figure 97 - 3-way junction

Figure 98 - Ring beam cages

18.5 CASTING THE RING BEAM

Next, fill the ring beam cavities, following the procedure detailed in the section above on casting.

- Prepare the site for casting, following all steps detailed in the casting section, including preparing safe scaffolding, clearing out debris and blocking holes.
- Box up the top edges of the U-blocks with clamps, braces, wire, screws, or custom-made timber bracing blocks.
- Complete the pre-casting checklist.
- Prepare and check the concrete.
- Pour the concrete into the ring beam U-blocks, ensuring it completely surrounds the load-bearing system.
- Level the top surface.
- Allow two days setting time before continuing work above here.

Figure 98 - Casting concrete with a concrete boom pump

19. SLOPING AND GABLE WALLS

When the design includes a sloping wall, a ring beam must be installed at the top of the slope. There are two methods of doing this:

A: The blocks of the wall are cut at the appropriate angle. Ensure the chainsaw is kept level and perpendicular to the wall. The finished wall angle needs to be minus 308 mm in depth. Then a groove can be cut in the top of the wall to accommodate for the U block, *or*

B: As above but without cutting a groove. Instead cut the tongue of the U blocks and glue them on.

C: Cut the slope at the finished angle. When the top ring beam is *not* deep, a groove can be cut to accommodate for the ring beam. This groove will need to be deeper and wider than the ring beam allowing at least 25 mm of perlite to grout the structural member.

- If a U-block must go over a post, carefully measure and cut a 150 x 150 mm hole through it, taking note that the hole must be vertical when the block is on the slope. Refer to the section in this manual on cutting blocks for a video on how to cut post holes in a U block.

Always prepare safe scaffolding and follow all safety guidelines for working at heights.

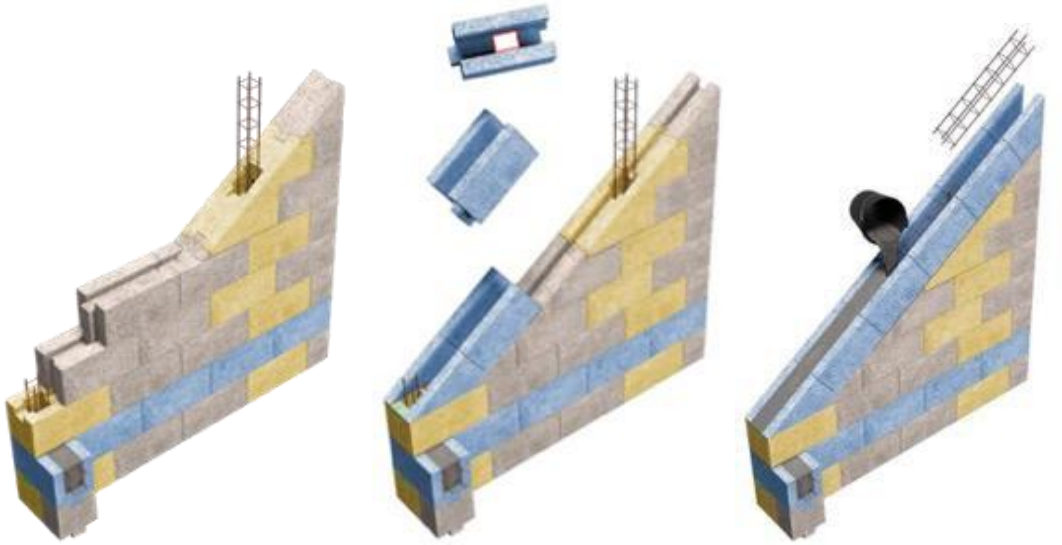


Figure 100 - Sloping wall with a cut groove that house the U blocks

PREPARE AND CAST THE SLOPING WALL BEAM

Now cast the sloping beam:

- **For a steel** or **FRP post and beam system**,
    - install the steel, timber, or FRP beams and roof anchors into the U-blocks, following the same steps as for the steel or FRP ring beam:
    - cast perlite mix following the same steps as for casting a ring beam.
- **For a steel reinforced concrete system**,
    - Prepare, place, and connect the cages and roof anchors according to the engineering specifications. following the same steps as for the steel-reinforced ring beam:
    - cast concrete following the same steps as for casting a ring beam.
- **Allow two days setting time before continuing work.**

20. BUILDING A SECOND FLOOR

20.1 CASTING A SECOND FLOOR

To build a second floor, **follow the engineering specifications.**

In this example of a steel reinforced concrete system, the concrete upper floor system is installed at the same time as the first ring beam:

1. Cut away the inside wing of the U-blocks, to allow continuity between the ring beam and the cast floor.
2. Install the ring beam reinforcing cages, as specified by the engineer.
3. Place struts along all the U-blocks.
4. Install the precast concrete beams.
5. Install the floor blocks and reinforcing.
6. Pour the slab and ring beam at the same time.

A similar method can be followed for a timber second floor, with floor joists hanging in saddles or resting on top of the ring beam.

Figure 101 - Casting a concrete second floor system

20.2 HEMPBLOCK WALLS ON THE SECOND FLOOR

Build the upper walls following the engineering drawings and specifications:

- Build the second floor, as described above.
- Cut off the bottom tongues of the first course of blocks.
- Bond this course of blocks in place with adhesive. Refer to the section on glueing blocks for adhesive options.
- If desired, this first course of already-modified blocks can be trimmed to size, so that the standard blocks used above them will end at the desired ceiling height.

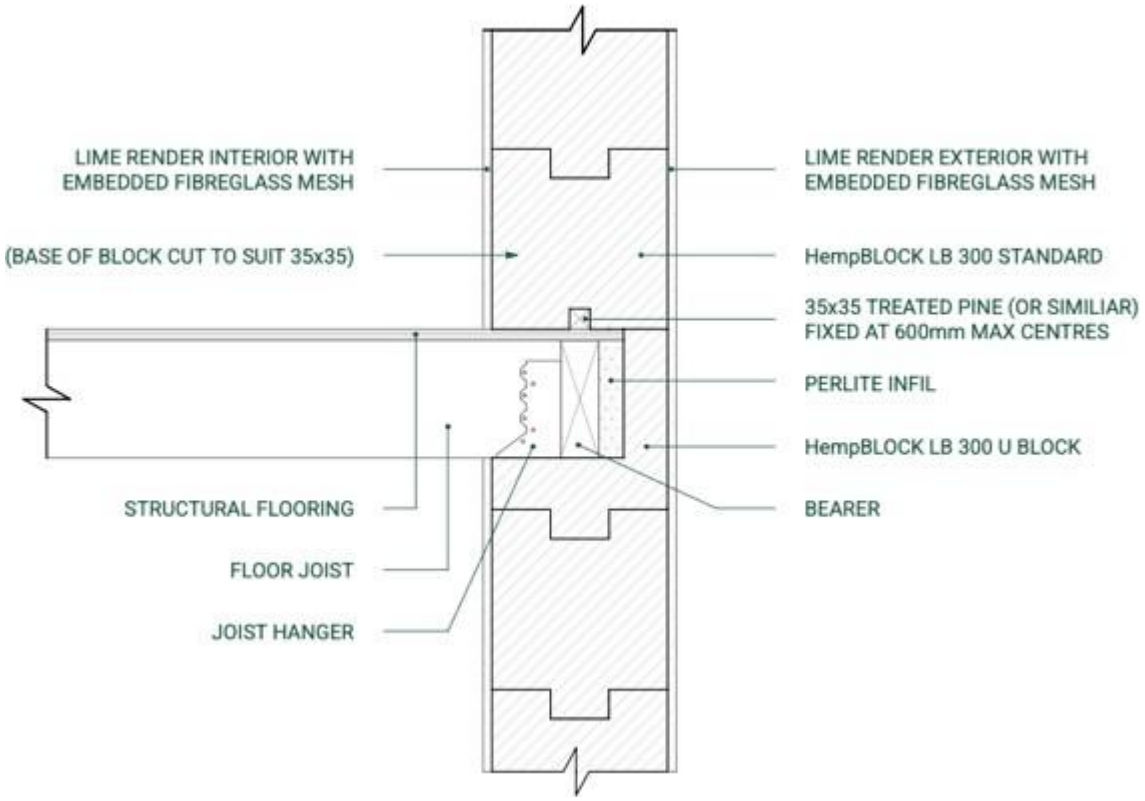


Figure 102 - Second floor wall diagram

21. ROOF

Once the ring beam and/or sloping wall beams are completed and set, the roof can be constructed using traditional roofing methods.

22. INTERIOR WALLS

Interior walls may be built from:

- Additional tongue-and-groove HempBLOCKs
- Non-tongue-and-groove HempBLOCKs, with a choice of the HB 150, 200, or 300 series, requiring lime mortar, or
- Standard timber frame or other traditional materials.

If interior walls are built now, connect each wall to the exterior walls as per chapter 10

23. CEILINGS

Install ceilings using standard construction methods.

If the ceiling cladding is engineered to support more than lightweight insulation, the building site hempcrete rubble and offcuts can be used to insulate the ceiling cavity. Ply sheeting (suggesting VOC free ply) is a good alternative to use. Consult with the installer and builder to ensure all electrical safety requirements are respected.

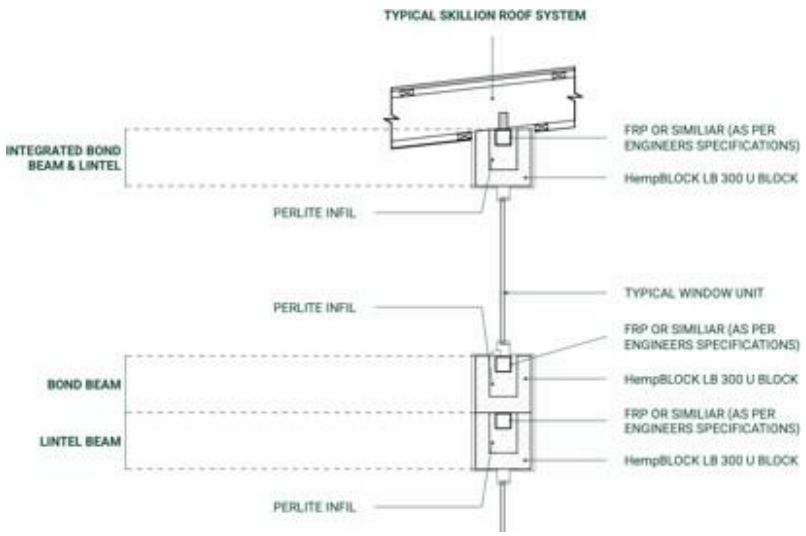


Figure 103 - Ceiling detail

24. SECOND FLOOR CONSTRUCTION

Install the selected flooring using standard construction methods.

If the sub-floor cavity (in between joists) is engineered to support more than lightweight insulation, use hempcrete rubble and offcuts to insulate the cavity. Hempcrete sub-floor cladding on external timber floors acts as a fire retarding barrier. Consult with the installer and builder to ensure all electrical safety requirements are respected.

25. EMBEDDING SERVICES IN THE WALLS

> Always follow the safety protocols given in the Safety chapter of this manual, work according to safety regulations, and use the correct PPE.

Electrical and other cables, plumbing, and HVAC systems are embedded into the HempBLOCK walls (unless the walls are to be battened and clad).

The installation and embedding of services must comply with local building codes.

Electrical

- Embed electrical conduits at least 50 mm into the wall surface.
- Electrical conduits, brackets, and sockets must be installed per the Local Construction Code.

Plumbing

- All copper, metal, and zinc pipes must be sleeved before being embedded.
- Water pipes must be clipped and lagged as per plumbing code.
- Embed pipes at least 50 mm into the wall surface, or as per local codes.
- Heat from hot water pipes will not affect the hempcrete.
- Although hempcrete is heat and fire-resistant, flues must be properly isolated to code.

Figure 104 - Embedding service ---------- and ----------Figure 105 - Embedding ducted services

Method for embedding services into a HempBLOCK wall:

- Mark the position of the cable or pipe and the services outlet box on the wall before cutting.
- Chase the groove into the wall with a chainsaw.
- Cut the hole for the services outlet box with a large, bladed drill bit, followed by a hammer and chisel.
- Attach mounting plates on or into the wall with galvanised timber screws.
- Mounting plates for services boxes that will be subject to frequent pulling and unplugging, such as power plugs, must be more securely fastened, with screws and additional reinforcing such as glue.
- The mounting boxes will later be covered with render and mesh to create a solid backing plate for the fitting.
- Once the services cable or pipe is in place, close the groove with hempcrete pieces, expanding foam, lime mortar, and/or the render being used.
- Larger service openings, such as sewer pipes that penetrate through the walls, can be repaired with expanding foam.

- This video gives more detail and useful tips on how to cut a groove in HempBLOCK wall for electrical and other services.
- Here is a video of a USA HempBLOCK home where installation of services is elaborated on.

Figure 106 - Embedding services into a HempBLOCK wall

26. DOORS, WINDOWS AND SHUTTERS

Install windows, doors, sills, and flashing in accordance with building codes.

- Windows can be positioned flush with the exterior or interior, or in the middle of the wall thickness.
- It is recommended that the window supplier measures the window opening sizes when the walls are finished with laying blocks, before rendering.
- Ensure the windows are manufactured with the correct attachments for connection to the HempBLOCK walls.
- The HempBLOCKs may have been laid to precisely fit the window frame. Alternatively, adjust the opening with a saw or rasp to ensure a minimal gap between the frame and the walls.
- Download this window detail PDF for suggested window head, jam, and sill details when using either aluminium or timber joinery.

- Stainless, galvanised, earthen, concrete, brick, or wooden sills can be used. Alternatively, angle the hempcrete sill surface to at least 15° and render over it.
- Fasten the window frame to the posts, sill, and header with appropriate long screws.
- Use the correct number of fasteners and sealants to comply with wind loading and building codes.

Flash and seal window openings from the outside in accordance with building codes. In the example below, there is a minimal gap between the window frame and the window opening, and silicone sealant and an aluminium strip are used to seal it:

- Put a line of sealant on the back of the aluminium strip.
- Clip the aluminium strip behind the lip of the window frame.
- Screw the aluminium strip to the wall with a long screw.
- The render will go over the aluminium strip, screw, and sealant, to double seal the gap.

Figure 107 - Sealing the window

Roller shutter and hinged shutter system installation:

Roller shutters can be installed when the window is flush with the interior of the building. Shutter configurations will differ. Follow the supplier installation guides.

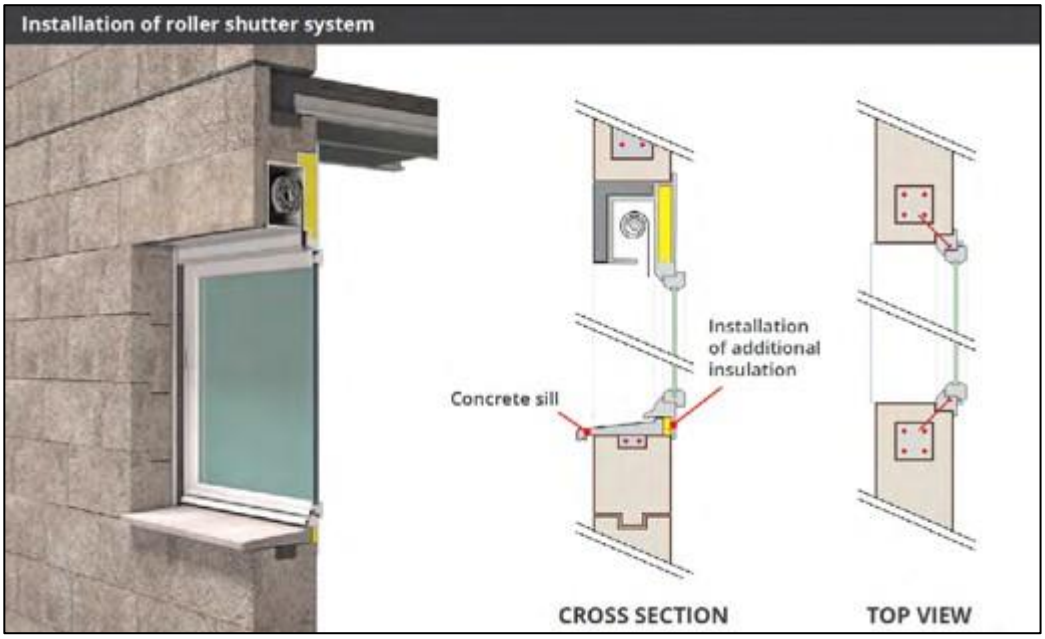


Figure 108 - Roller shutter installation

Shutters are secured back to the load bearing posts and beam system.

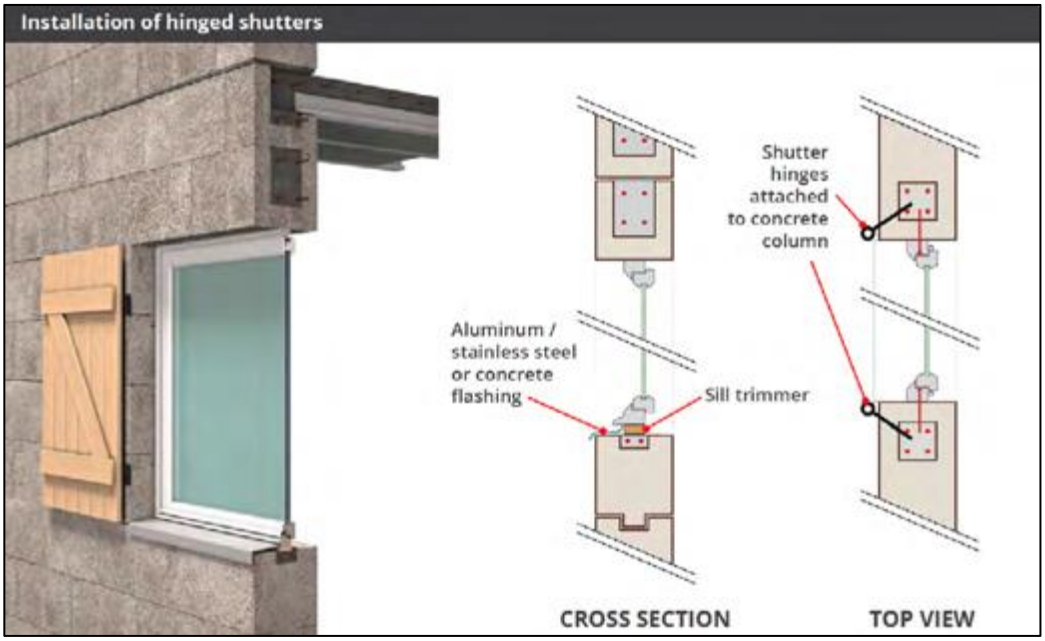


Figure 109 - Shutter installation

27. RENDERING AND WALL FINISHES

Always follow lime safety and general safety protocols in the Safety chapter of this manual, work according to safety regulations, and use correct PPE.

The standard finish for HempBLOCK walls is lime render (stucco), with at least one layer of mesh embedded in the first coat.

- Lime render is a coating made from lime, sand, and water.
- HempBLOCK International supplies quality premixed renders in a selection of colours. These require only mixing and the addition of water.
- The render coat is a waterproof yet breathable coating, protecting the external wall surface from the weather.
- The lime render enhances the walls' already excellent insulating qualities.
- For internal and external walls, the first coat of lime render is applied with an embedded pre-tensioned fiberglass mesh that helps to bind the wall surface.
- Lime and clay render finishes allow walls to **breathe** by permitting the passage of moisture vapor, so moisture is not trapped in the walls. A Portland cement plaster or acrylic finish is **not suitable**, as it traps moisture.
- A breathable water repellent can be applied to the finished lime render surfaces. This is typically a beeswax (or similar) solution, which causes rain or other water to spread out and flow off, rather than beading on the wall surface. Check that any selected product is breathable, non-toxic, and compatible with the lime render used.
- A breathable lime wash or breathable chalk paint may be applied internally.
- An alternative finish for internal walls is cladding.

It is recommended that an experienced and well-equipped professional renderer is contracted. They should be able to offer a variety of finishes. If you intend to apply the render yourself, seek professional guidance and training. Contact the HempBLOCK technical team for further advice.

Choose lime render products approved by HempBLOCK International and follow the manufacturer's instructions.

Render bag info:

Keep the bagged products stored dry, off the ground, and out of sunlight. Observe the use-by date of lime products. Bags of mortar and lime weigh 25 kg (55 lb): lift with caution. Dispose of empty bags appropriately.

27.1 PREPARATION BEFORE RENDING

Before rendering, prepare the walls:

- Ensure all sills and flashing on windows, doors, and other openings have been installed.
- If required, battens or noggins to support wall heavy hanging elements should be installed prior to rendering. They are generally embedded in the blocks and connected to the post and beam system.
- Fill large holes left in the walls after building and services installation with
    - HempBLOCK rubble combined with a lime binder or lime mortar, *or*
    - Hempcrete shavings combined with lime render.
    - Expandable foam.
- Seal and fill any smaller holes or crevices.
- If corners are to be rounded, this video shows how to shape the HempBLOCK corners using a rasp. (Refer to the tools section of this manual for rasp details.) Rounded corners are stronger, and rendering is faster and easier, as corners will not need to be edged with beads.
- Edge all unrounded corners with metal or plastic corner beads, as per the renderer's specifications.
- Remove loose particles from the walls with an air blower. The surface to be rendered should be solid and dust free.
- Apply tape and plastic or paper protection on the floors, ceilings, windows, and any surface that may come in contact with the render.
- Protect metal and plastic surfaces carefully, as wiping off these surfaces is most likely to create scratches.

Figure 110 - Rounded and beaded corners

27.2 RENDERING

Mesh and coat the complete inner and outer surfaces of the HempBLOCK walls with lime render:

- Generally, start outside as weather may interrupt workflow.
- A key, scratch, or stipple coat is not needed. The blocks provide excellent adhesion to the render.
- Apply a first render coat of thickness approximately 7 to 10 mm.
- Apply fiberglass or equivalent approved mesh. A 10 mm pre-tensioned mesh size enhances layer strength.
- Pre-cut the mesh to size. Overlaps must be at least 100 mm (4 inches).
- Embed the mesh in the first coat.
- Ensure all surfaces are properly meshed.

- Pay special attention to meshing above windows and doors and their surrounding areas, following the renderer's recommendations.
- For services outlets or mounting boxes, cover the backing plate with render and mesh to create a solid backing for the fitting.
- Render over window flashing strips to double seal these openings.
- First coat drying time is dependent on weather conditions. Once the first render coat has dried, apply a second coat of 3 to 5 mm thickness.
- If desired, apply a breathable water repellent to the finished lime render surfaces by spray or brush, according to the manufacturer's instructions.

Figure 111 - Rendering the first layer with mesh reinforcement

27.3 BATTENING OUT AND CLADDING

HempBLOCK walls can be finished with cladding or siding.

- Attach wooden battens to the HempBLOCKs, to create a framework to which the cladding materials can be attached.
- Cladding materials such as drywall, plasterboard, fiber cement sheeting, steel, or pine planks can be used.
- When a wall has been battened out and finished with cladding, the cladding can safely be painted with acrylic paints, as the HempBLOCK wall will be able to breathe behind the cladding.

Figure 112 - Battening out and cladding

To attach battens:

- Refer to this video showing how to clad a HempBLOCK wall.
- Use wall plugs, screws, and adhesive (preferably fast setting).
- Mark and drill holes into **both** the battens and the HempBLOCK wall.
- Squeeze adhesive into the holes.
- Press the plugs into the holes.
- Allow time for the adhesive to set.
- Apply adhesive to the back of the batten.
- Screw the batten to the wall.
- Once the adhesive is set, the wall is ready for sheeting.
- Another option is for the battens to be applied directly onto the finished HempBLOCK walls using an adhesive. Long screws can be used to hold them in place while the adhesive dries and then be removed later.
- **Do not use nails** to fasten the cladding sheets, as the percussion from driving the nails will loosen the battens from the HempBLOCKs. Use screws or a nail gun to install the cladding.

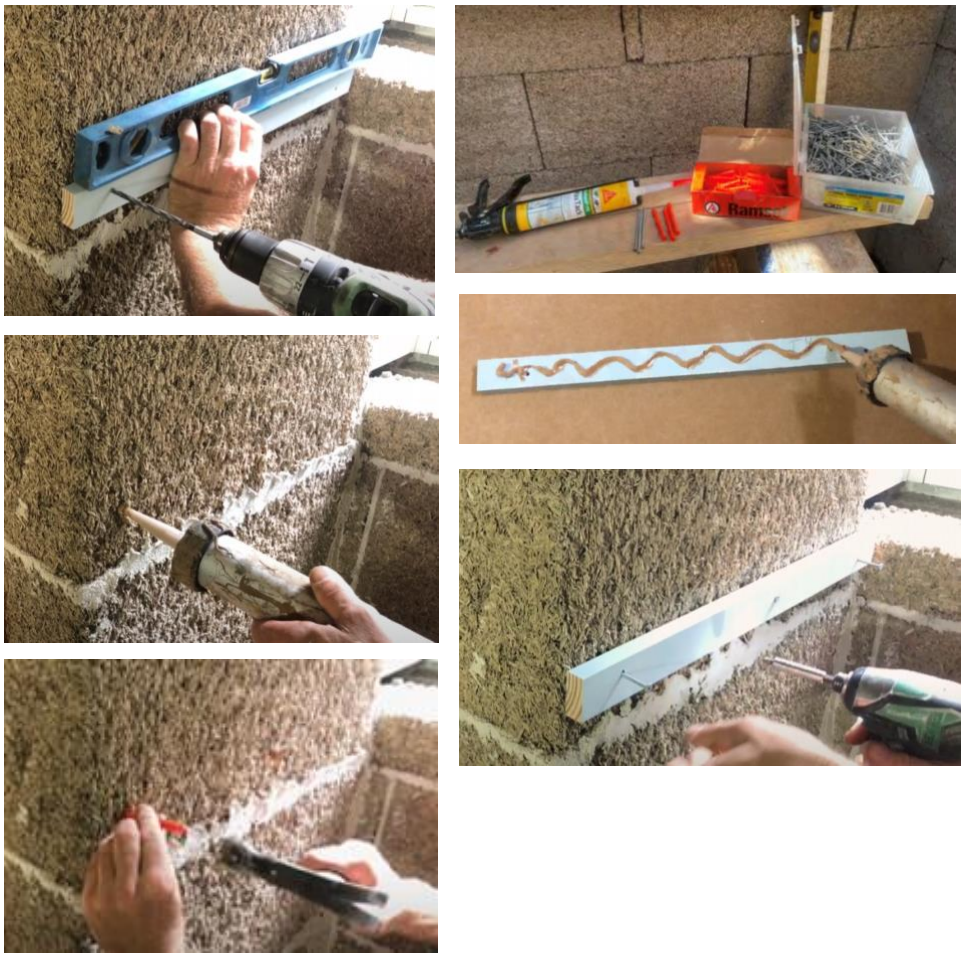


Figure 113 - Attaching battens

28. PAINTING

The lime render applied to the HempBLOCKs is breathable. A breathable lime wash or breathable chalk paint may be applied if desired. Allow the lime render to dry fully before coating and follow the manufacturer's instructions.

Plastic and acrylic type paints are not suitable for application to HempBLOCKs or lime wash.

Figure 114 - Sample chalk paint colours on a lime rendered fibre-cement backing

29. FINAL FIT-OUT

Install fixtures, cabinetry, and trim work.

If required, battens or noggins to support wall hanging elements should be installed prior to rendering.

Heavy loads can be fastened using rods with washers and plates, installed through the wall.

29.1 HB SERIES HEMPBLOCK DIMENSIONS

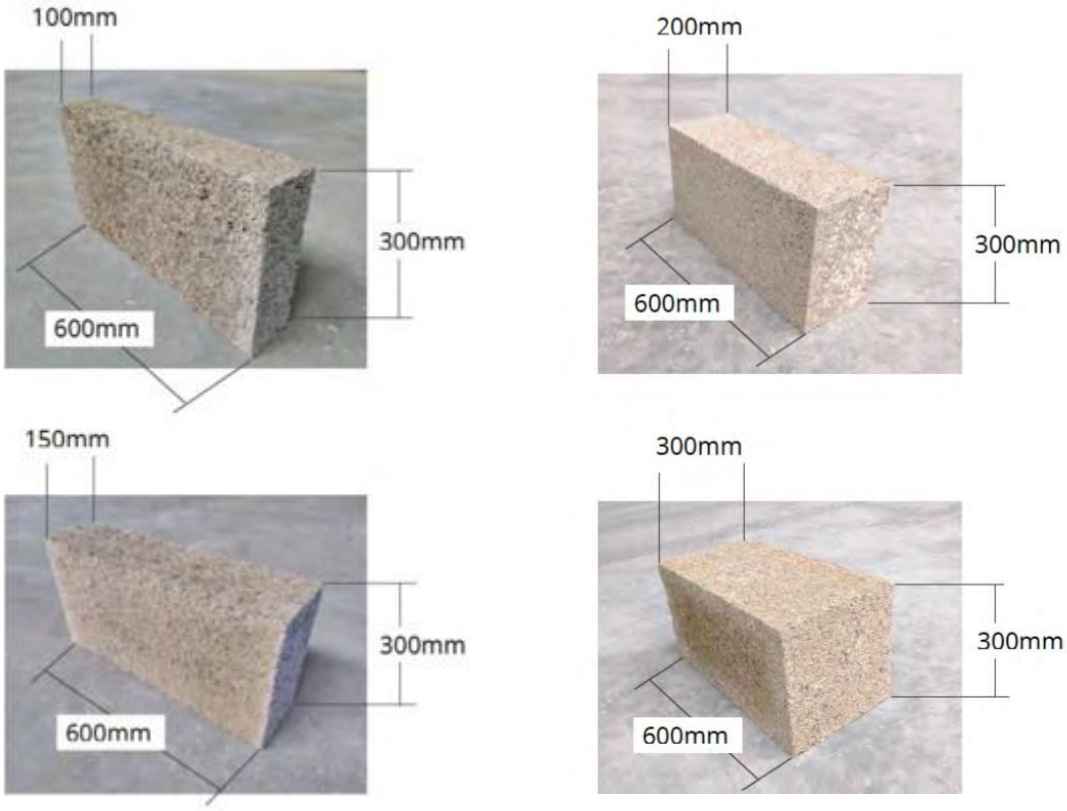


Figure 115 - HB Series HempBLOCKs

30. TABLE OF FIGURES