

MiTek GUIDE to
POSISTRUT
Floor **CASSETTES**



2016 - ISSUE 1



creating the **advantage**

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PosiStrut and Timberwebs make equally good cassettes

PREFACE

The PosiStrut Floor System is an engineered timber/steel hybrid product. Each PosiStrut joist is specifically designed for a particular job and application before it is manufactured to an exact length that requires no further cutting or modification on site. Because they are custom designed and made, they are able to incorporate a wide range of specific requirements, such as support conditions, load conditions and floor penetrations.

The use of PosiStrut in Australia has continued to grow year by year since it was introduced in 1996. Between 2012 and 2013, MiTek participated in an FWPA research project on prefabricated floor cassette systems, and from there MiTek continued to work with truss fabricators to develop the application further.

This MiTek Guide is a compilation of the general information to date, although there is still much in the pipeline still being developed. This Guide provides designers, users and installers of PosiStrut cassette floor systems with the basic tools and information to construct modular floor systems, which is a steadily growing technology in Australia.

This Guide should be read in conjunction with MiTek PosiStrut Floor & Roof Installation Instructions, as it contains important information that is not duplicated in this MiTek Guide.

For further information and assistance, please contact the MiTek engineers in your state.

Section 1: Detailing Considerations

Set Out Optimisation

Although any floor can be divided into cassette segments, the method is particularly suited to floor plans which are rectangular, with support walls suited to joist spans, which contain multiples of similar or identical cassettes. Complexities such as beam pockets and corner cut outs can be accommodated where necessary.

Detailing begins with a logical division of the floor area into convenient cassette segments to suit prefabrication, transportation and lifting. Consider the optimum direction for spanning the PosiStruts and how the floor is to be divided into a series of rectangular cassettes. Repetition of identical cassettes is preferable over having too many individually unique panels.

The most convenient cassettes are typically about 3.0m wide by approximately 6.0m or so long (refer to spans in PosiStrut manual). The 3.0m width is mainly governed by optimum limits of transportation; however 2.7m fits most typical floor sheet dimensions and minimises waste. Most PosiStruts span the length of the cassettes. The exceptions are balcony floors which span between a beam and the building and other small infill floor cassettes. Whereas larger cassettes are more efficient because they require fewer lifts and fewer joints, smaller panels may be preferable for sites with restricted access to minimise crane capacity.

The locations of the following items should be noted prior to detailing:

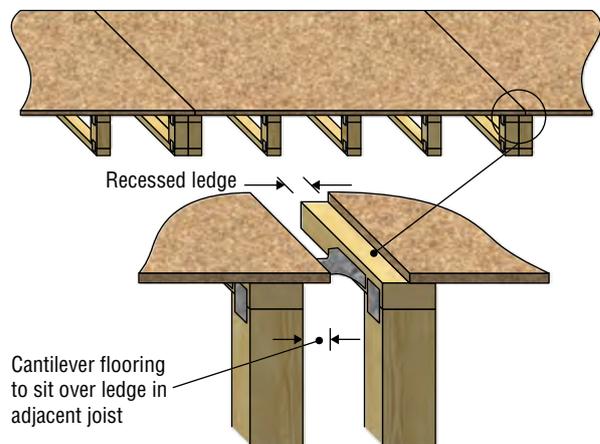
- Floor penetrations for plumbing and other services, to avoid locating floor trusses directly beneath them.
- Internal load bearing walls, bracing walls and long parallel walls where additional joists, beams or blocking may be required.
- Ducting and other services that run perpendicular to the floor trusses, in order to form web layouts that create continuous voids and chases to accommodate them. Architects and HVAC suppliers should note that chases that run through the joists should be located as close as possible to the centre between supports, and should be avoided within 25% of the span to the supports, unless they are flexible ducting that fit naturally within the gaps between the vee-shaped webs.
- Recessed floor areas and step down floor levels.

Methods of Joining Cassettes

It is important for there to be some connection between cassettes to provide continuity thereby minimising differential deflection and bounce. There are several methods of forming and joining the sides of cassettes together. It is essential for the floor sheathing joint to be fully glued and nailed on site to prevent squeaking.

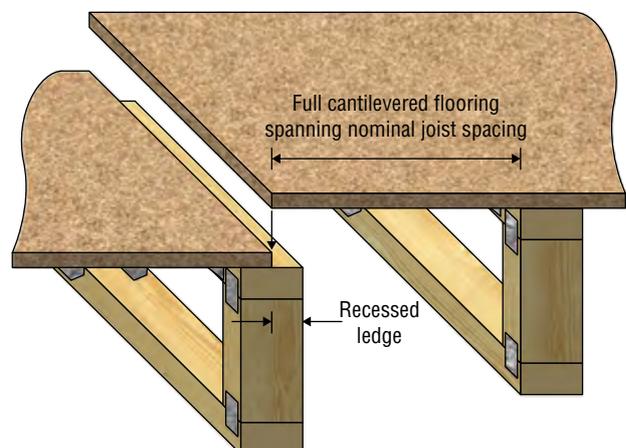
1. Simple Overlap

A joist is located along the edges of the cassette on both sides. The flooring is cantilevered over one side and is recessed half the joist width on the opposite side to receive and support the cantilevered flooring from the adjacent cassette. The main disadvantage of this method is the cost incurred by introducing double joists every cassette width apart.



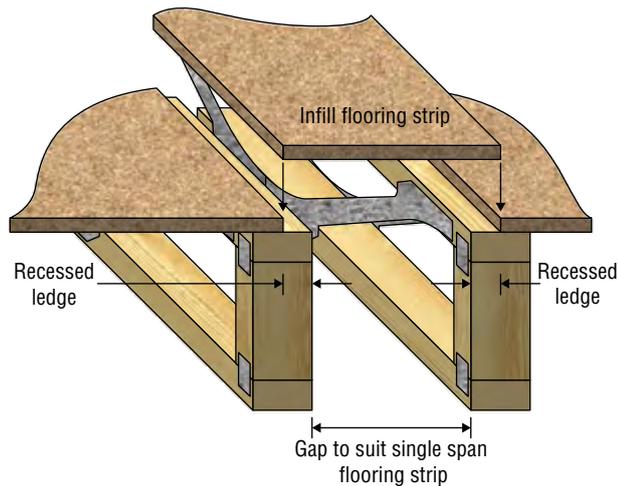
2. Full Cantilevered Flooring

This is similar to the simple overlapping method but with a much larger cantilevered flooring along one edge so the nominal joist spacing is maintained between cassettes. Additional care should be taken during transport and handling to avoid damaging the cantilevered flooring.



3. Infill Floor Panel

The flooring is recessed half the joist width on both sides of the cassette. The cassettes are installed with a gap about half joist spacing between them. The top of the gap is covered with a flooring strip. The advantage of this system is the absence of cantilevered flooring which may be prone to damage during transport and handling. It is also easier to adjust and accommodate any lack of squareness in the building. The drawback is having more closely spaced joists every cassette width apart because the infill flooring forms a simple span between joists, and the additional care required to lay the cassette accurately so the strip fits neatly in between.



Fabrication Requirements

Effective jigging is an important requirement for prefabrication to ensure dimensional accuracy in all directions, versatility to accommodate different joist sizes and spacing, and automation to maximise production efficiency. They range from primitive temporary jigs devised for occasional or one off jobs, to basic entry model equipment, to fully dedicated, automated systems. These can be discussed in detail with manufacturing equipment engineers at MiTek.

Consideration should also be given as to how the finished cassettes are to be lifted off the jigs and handled around the production plant.

1. Squareness

It is essential that cassettes are square and of perfect size, as when they are fitted on site, any irregularity of shape and size will be compounded with every cassette joint. One way of achieving squareness is to trim the edges of the flooring accurately after they have been laid and fixed on the PosiStruts.

2. Crossing Members (Strongbacks and Ties)

Strongbacks are ideally pre-fixed to each cassette before they are delivered. A short length of strongback splicing may be loosely attached to be slipped into position after the cassettes are installed into position. See also strongbacks in Section 4. It is important to consistently attach the strongback to the same side of the vertical web in all cassettes, so they line up for splicing later on.

90x35 ribbon plates or ties should ideally be fixed to each end of the cassette to act as a lifting beam and help keep the cassette flat during lifting. A header beam may also be fitted where there is a corner cut away for a floor opening. If one or more ends of the header beam has to be supported on site, consideration has to be given to how this may be safely achieved during installation.

3. End Bracing

Where cross bracing is required at the ends of PosiStruts supported on the bottom chord, they may be installed at pre-fabrication stage.



4. Floor Sheeting

The direction of floor sheets should be perpendicular to the joists. Where the sheet does not extend the full width of the cassette, the joints should be staggered.

5. Tolerance

Consideration should be given to the actual size of cassettes, taking into account the potential deviation of support locations on site from the construction drawings. This is especially so when cassettes are top chord supported between two walls or beams, which may not be perfectly spaced apart, or perfectly parallel and square, or may have swollen with moisture. The optimum combined gap between the ends of joists and supports at both ends is 12mm. Laid too tightly side by side, any variation in the thickness of PosiStruts may compound the displacement of the final floor cassette. Hence, detailing side by side contact of joists between cassettes is undesirable. One possible approach is to install the cassettes inwards from both sides and to have a small gap for a final infill floor panel to be fitted in.

6. Factory Lifting and Handling

A factory with an overhead gantry may use the lifting points in the cassette for general lifting, handling, stacking and moving the cassette around the factory floor. A suitable trolley may also be used for moving cassettes from the factory to the yard. A forklift may also be used to move cassettes around

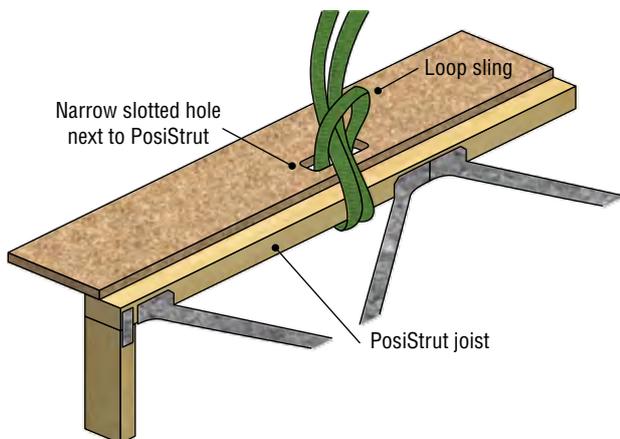
the premises, provided the prongs are long enough to support most, if not all of the PosiStruts in the cassette, and spaced wide enough to safely balance the cassette. However, a forklift on its own may not be suitable for lifting and handling specialised cassettes, like those containing beam pockets. A more versatile method is to have a wide frame forklift accessory with multiple prongs, which may also be used on cassettes with beam pockets.



Multiple prong forklifts are ideal lifting devices

7. Site Lifting Points

Lifting points are normally located at each corner of a rectangular cassette no more than 25% of the span in from the ends, and be centred around the centre of gravity. Marks may be made on the cassette to assist the rigger locate the slings. Alternatively, a small round, oblong or slotted hole may be cut adjacent to the boundary PosiStrut (or a pair of holes on each side of the next PosiStrut joist in) and a short circular sling used to wrap around the top chord of the PosiStrut at each corner. The low cost fabric sling may be retrieved after installation for reuse at a later time, or discarded as a disposable item.



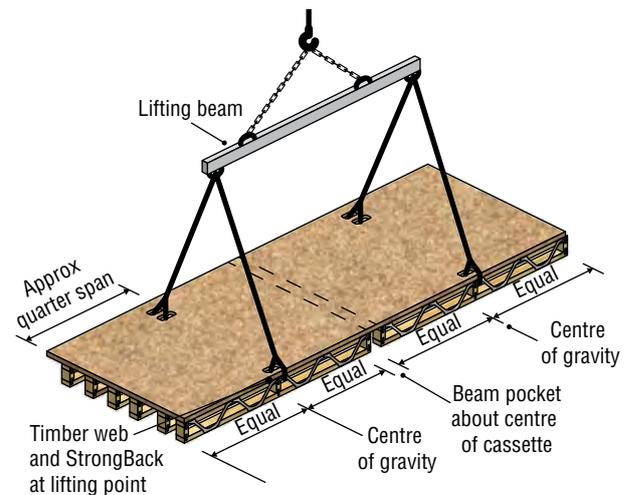
Where a sling is wrapped around the outer joist as shown, the recessed flooring edge should be located in the direction of laying the cassettes, so that the slings do not get trapped in between cassettes.

Specialized Cassette Shapes

Cassettes which are not simple rectangles comprising full span joists may require special detailing.

1. Beam Pockets

- a. Where the cassette has a beam pocket through the PosiStruts, in a line close to mid-span of the cassette, four lifting points may be used. The lifting points on each corner should be located as closely as possible (within 300mm) to the centre of gravity of each portion of the cassette. A vertical timber web and strongback should be located close to this line. A lifting beam is also necessary so that the straps do not pull the cassette inwards and bend the PosiStrut top chord over the beam pocket.

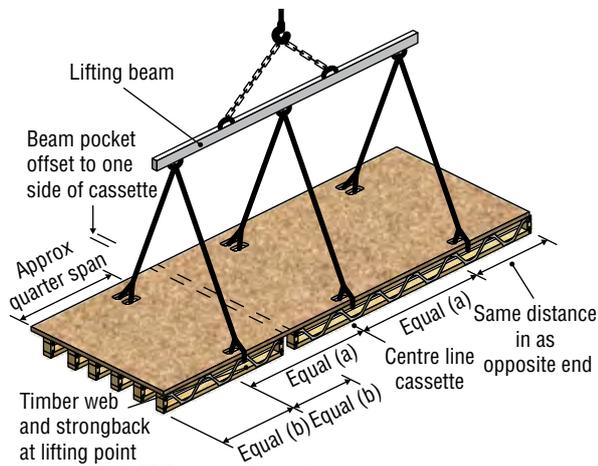


Lifting points for cassettes with centre beam pocket



Beam pocket in cassette

- b. Where the beam pocket is offset to one side of the cassette length, six lifting points will be required. The centre pair is to be located along the centre of gravity of the cassette. The outer pair on the short panel should be located as close as possible to the middle of that internal span, and the outer pair on the other end should be located at the same distance in, so that all lifting points are balanced around the centre of gravity of the entire cassette. A lifting point should not be located at the beam pocket because the strap will be trapped between the support and the top chord of the cassette when it is installed. A lifting beam is also necessary in this case.



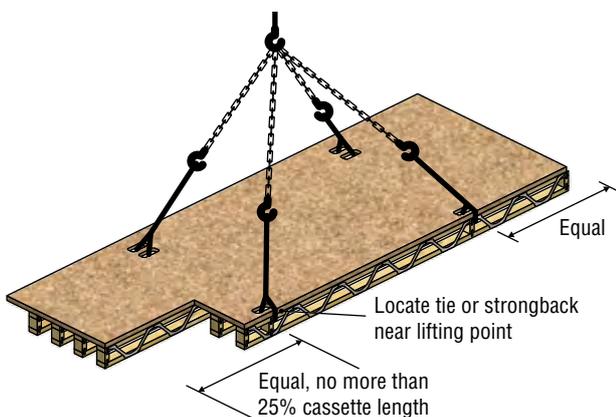
Lifting points for cassettes with off-centre beam pocket

c. The above methods of lifting suit a crane on site, and an overhead gantry in the factory. Where a gantry is unavailable or cannot be used, a method of lifting and handling in a manufacturing plant has to be devised without distorting or damaging the completed cassette. A forklift accessory with multiple prongs described earlier is a suitable option for this purpose.

2. Cutaway Corners

Cutaway corners to form stairwells and other floor penetrations may be incorporated into floor cassettes where necessary. The recommended locations of lifting points depend on the cut off ratio to the full span of the cassette. If the cut off is less than 25% of the span, the lifting points may all be located within the main body, with the cutaway section cantilevering past the lifting position.

Opposite the cutaway end, the lifting points should be located in the normal recommended location about 25% in from the end. The lifting points at the cutaway end should be located in the main body, at the same distance in from the ends. A tie or strongback should be located close to the lifting points at the cutaway end to support the PosiStruts in between. If the cutaway section is a greater percentage of the span, specific advice should be obtained from MiTek engineers



Lifting points for cassette with cutaway corner

Cassette Markings

Cassettes should be labelled with an ID that corresponds with their locations on the layout drawing. As most cassettes are simple rectangles, markings to indicate their orientation will help the installer place them in the correct direction. This could be something as simple as spray painting a colour at one end of every cassette, or drawing an arrow on the floor (although this is harder to see when the cassette is lifted into the air) to indicate North. If necessary, the edges could also be marked to line up with an equivalent marking on the adjacent cassette.

Markings to locate the position of internal walls and penetrations for services such as plumbing also help to prevent accidental drilling of holes into PosiStruts below.

If there are no clear lifting devices on the cassette, and a sling is to be placed around the cassette, the sling location could be indicated on the cassette to assist the rigger.

Site Documentation

The information supplied to site should include:

- Truss certificates.
- Floor cassette layout marking out the locations and orientation of the cassettes.
- The weights of cassettes and lifting points for the crane operator's assessment.
- Any specific instructions in addition to this general Guide.

The manufactured cassettes should be labelled in accordance with the drawing layout. Other markings could include orientation/direction, floor penetrations, locations of critical loads and walls.

Stacking Requirements

Cassettes may be stacked on top of each other with fillets across the joists to prevent overloading the floor sheeting. The fillets should ideally be located as close as possible to panel points, above and below. The fillets also allow slings or the prongs of forklifts to be inserted under the joists for lifting.

The stacking of cassettes onto the truck should be in the installation order if they are to be off-loaded onto the ground on site for installation at a later time, but if they are to be craned from the truck directly into position on the walls, they should be loaded on the truck in the reverse order of installation.



Stack cassettes on level ground

Section 2: Site Preparation

The success of prefabricated cassette floor systems is heavily dependent upon the timely execution of preparatory work on site. The supporting walls and beams, and all temporary bracing must be in place before the cassettes arrive on site. The temptation to finish off the final details of site preparation as the cassettes are being installed does not work and will result in costly delays as the cranes and trucks remain idle.

Risk Management

A suitable installation plan, risk assessment and work method should be carried out before construction begins. Some of the considerations include:

- Bracing of support structure before floor installation.
- Site access.
- Overhead power lines, trees and other obstructions.
- Crane and truck locations.
- Lifting method.
- Stage at which workers may step on the cassette floor or enter the space below.
- Floor openings, edges and safety barriers. Safety barriers may be fitted onto the cassette just prior to lifting them onto their supports.

Site Access and Ground Preparation

Before the cassettes are delivered, thought has to be given to the installation process. Sites with good access could use truck-mounted loader cranes to lift the cassettes into position, whereas restricted space sites may require mobile cranes. The required crane capacity has to be worked out depending on the reach.

For maximum efficiency, the cassettes should be lifted directly from the trucks onto their final resting place on the supporting structure. Good access for the trucks and a suitable standing location should be ready before they arrive.

If site preparation is expected to be incomplete when the cassettes are delivered, a clean and level surface on the ground should be prepared for the cassettes to be temporarily stacked.

Building Preparation

The supporting structure should be all up, plumbed, fully fixed, braced, stable and ready before the cassettes arrive. This is crucial so as not to hold up the crane, or bank up the trucks, or force double handling the cassettes by having to temporarily stack them on the ground to release the trucks. The supporting walls and beams must be accurately located as shown in the drawings, be square and match the dimensions of the prefabricated cassettes, especially if the cassettes have to be sandwiched in between supports. Considerable delays and costs may be incurred if the cassettes do not fit and last minute adjustments to cassettes or walls have to be made on the spot.

A checklist of the areas to be ready before cassette delivery includes:

- Crane – this must be in position and ready to lift the cassettes off the trucks as soon as they arrive.
- Access – the trucks must have ready access on to the site and have an area to park whilst the cassettes are offloaded. If possible, there should be sufficient space for subsequent trucks to temporarily wait until the truck ahead is offloaded.
- Walls – they must be accurately located, square, plumbed, fixed to the slab, connected to each other and adequately braced.
- Beams – they must be in position accurately and fully fixed to their supports.
- Ribbon plates and waling plates - they must be in position accurately and fully fixed to their supports.
- Temporary bracing – there must be sufficient bracing to secure the structure against collapse after the cassettes have been installed, even if a storm appears.
- Cassette locating marks or blocks on top of supports – they must be ready to guide the installers for locating the cassettes. Short timber blocks nailed on top of the walls to rest the cassette against is an ideal method of positioning the cassettes.



Incomplete site preparation results in truck queues

Section 3: Site Lifting Requirements

The equipment for lifting depends on access, space, reach and other site conditions. It is generally more efficient to lift them from the truck and immediately place them onto their final positions on the walls. Temporarily stacking them on the ground unnecessarily takes up site space and creates double handling.

The fabricator can provide the approximate weight for each cassette but for general purposes, floor truss cassettes with strongbacks, crossing members and one layer of standard flooring commonly weigh approximately 30-40 kg/sqm, and more if they have been exposed to rain. The maximum cassette size is typically about 7.0 m x 3.0 m and conservatively weighs no more than 800 kg with normal floor sheeting.

This guide contains most of the standard requirements for the lifting of floor cassettes, and reference should be made to the designer's documentation for other specific information, such as

- Specific lifting points and weight of each cassette.
- Layout plans for cassette locations and orientations. Take note of ID labels on each cassette and any markings which denote direction and alignments for positioning.
- Lifting beams, if required.
- Specific instructions.



A stack of cassettes may not be lifted unless bearers are used.

Cassettes must be lifted singly and not in a stack unless lifting bearers are used under the cassettes and according to specific details provided by the designer. Likewise, additional material or weights should not be placed on the cassettes during lifting unless it is approved by the designer. Pre-fitting safety barriers is an exception.

Lifting Methods

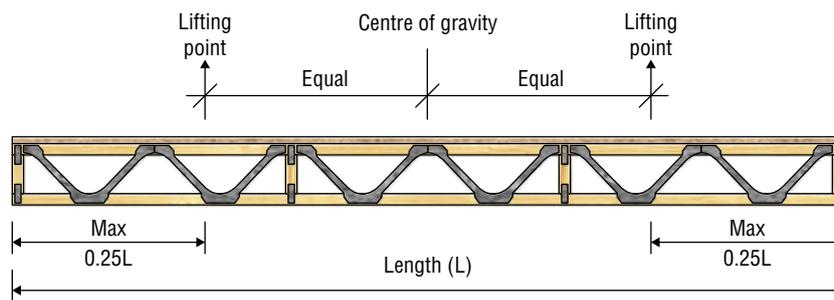
Most standard rectangular cassettes may generally be lifted with 4 slings attached to a single lifting hook. A lifting beam is usually not required unless

- The slings are simply wrapped around the bottom chord, to prevent them from sliding towards the middle of the cassette, or
- When an angle 60° or greater cannot be formed by the sling without it, or
- When the cassettes contain beam pockets, or other special conditions, or
- As stipulated by the cassette designer.

The following describe the most common lifting methods currently employed on simple rectangular cassettes. However, there are other possibilities depending on cassette sizes and shape, content and level of finish of cassettes, site splicing methods and other specific site conditions and requirements. These can be developed between the builder, crane operator, cassette manufacturer and MiTek engineers.

Sling Location

The slings should generally be located no more than quarter span from each end, and be balanced around the centre of gravity. The angle of the sling to the horizontal is not to be less than 60°.

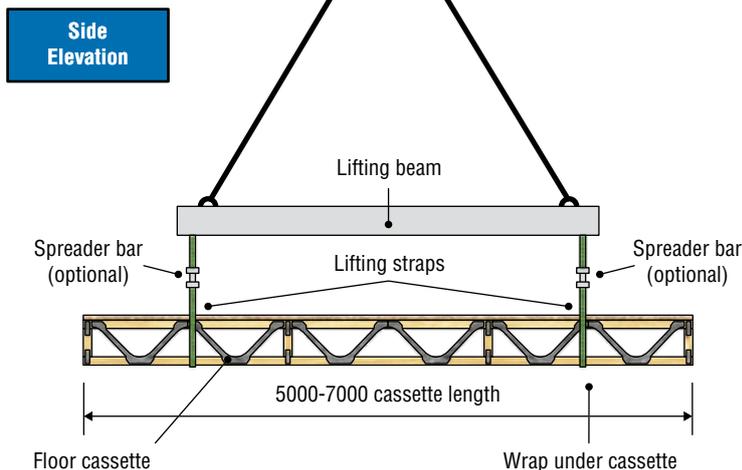
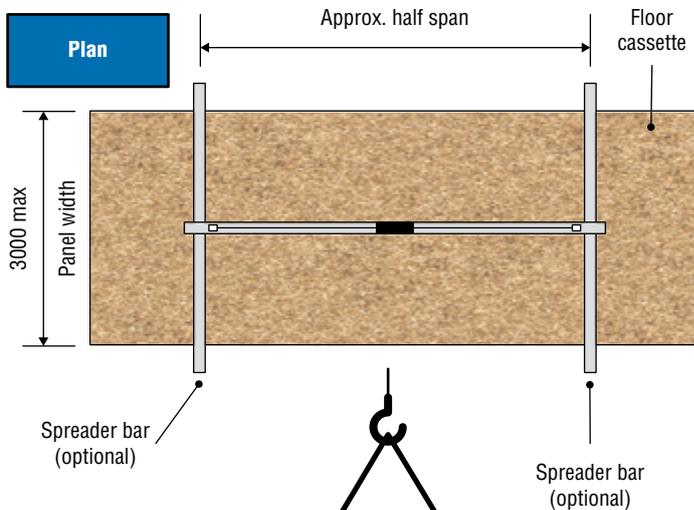
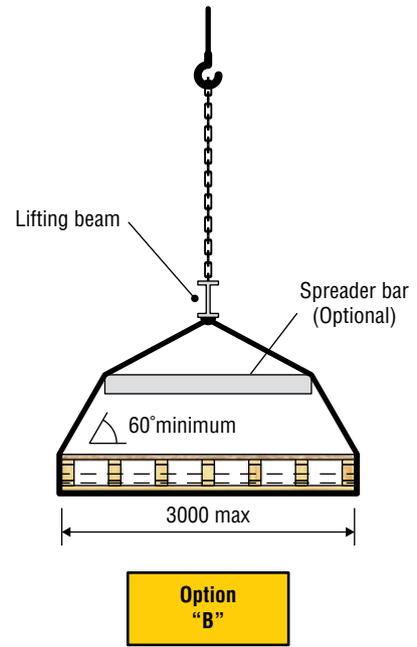
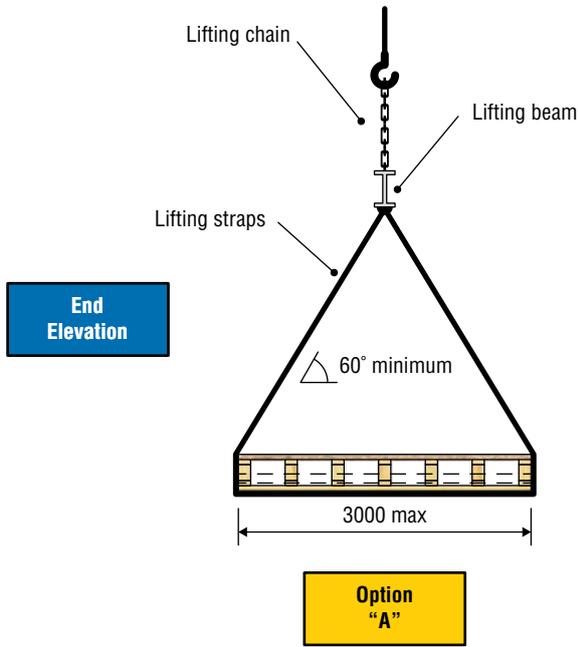


Optimum location of lifting points

1. Wrap Around Bottom Chord

The slings may be simply wrapped around the bottom of the cassette or under the top chord of the edge PosiStrut before going under the bottom of the remaining PosiStruts in the middle. If the cassette is particularly small and light, say under 150 kg, the sling may be used to wrap under the top chords of all PosiStruts, if preferred. If the sling is used to wrap around the top chord of the outer PosiStruts,

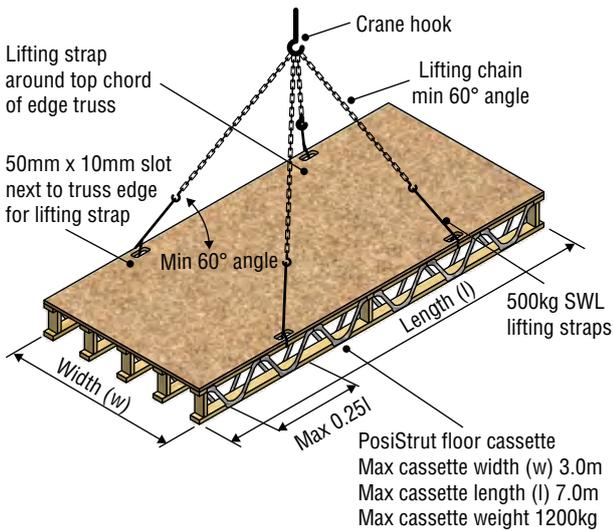
a soft fabric sling is preferred over a steel chain to avoid damaging the PosiStrut webs. If the sling is to wrap under all PosiStrut bottom chords, a lifting beam will be required to prevent the sling sliding along the bottom. This method is only suitable when the flooring does not cantilever but finishes square or recessed with the joist on each side, so that the slings do not crush the edge of the flooring.



2. Lifting Straps Off Top Chord

Short looped straps may be factory fitted on each cassette for convenient lifting on site. The lifting points should ideally be as close as possible to lines of crossing members such as strongbacks or ribbon plates. This method alleviates the need for crane operators to ascertain the lifting points on site. The crane hook should have chains of equal length on it to engage each of the lifting straps.

Note:
for rectangular shaped cassettes only
(Excluding beam pockets or non-rectangular shapes)



Lifting points for standard rectangular cassette



Cassettes should be lifted one at a time

3. Lifting Eyes

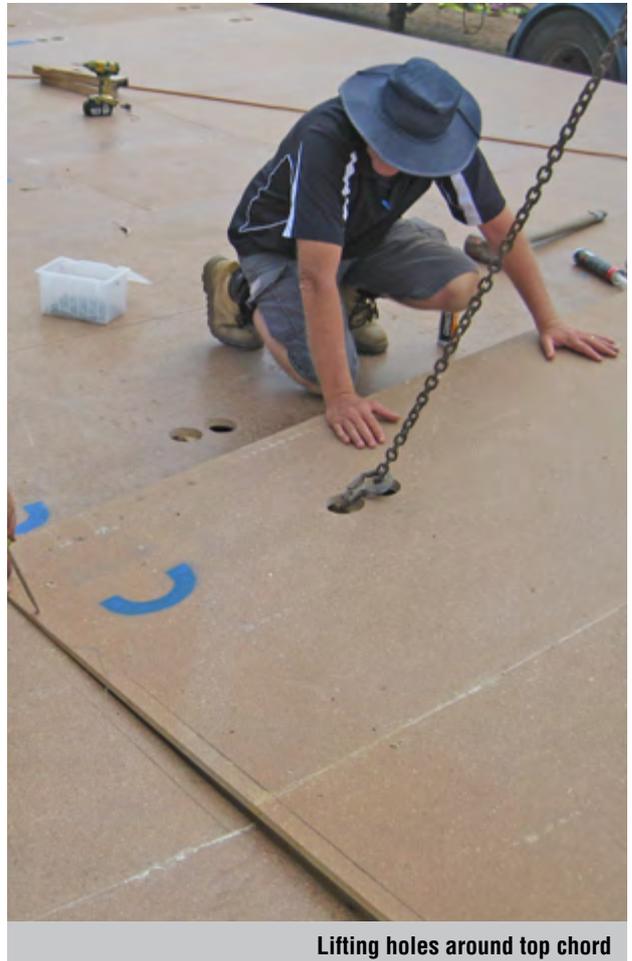
Short looped straps may be factory fitted on each cassette for convenient lifting on site.

- Limit of cassette size and weight, rectangular and small corner cutaways.
- Lifting methods, specific instructions for cassettes with beam pockets, or large corner cutaways.
- Placement against blocks, right orientations, minimum bearing, maximum gaps for top chord support.

A method of lifting with the use of lifting eyes is also under development at MiTek.



Lifting eye through top chord



Lifting holes around top chord

Section 4: Post-Installation Finishing

Reference should be made to the MiTek booklet entitled "Guidelines for the PosiStrut Floor & Roof Installation Instructions" for general installation requirements.

PosiStruts are engineered structural components and should not be modified on site without the manufacturer's approval.

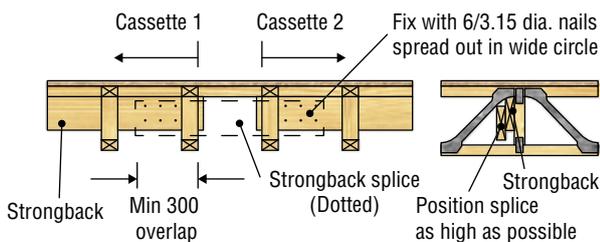
Fixing

The cassettes should be nailed off to supports to secure them firmly into position.

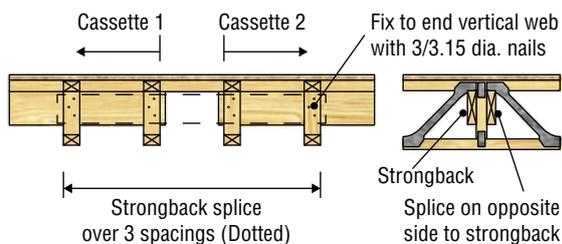
Strongbacks

Every line of strongback is to be spliced in the gap between cassettes. Some of the methods of splicing strongbacks are shown below. Strongbacks are also to be strutted off end walls and over every crossing internal wall with short jack studs and props to enhance floor stiffness. Non-loadbearing walls may be used for this purpose.

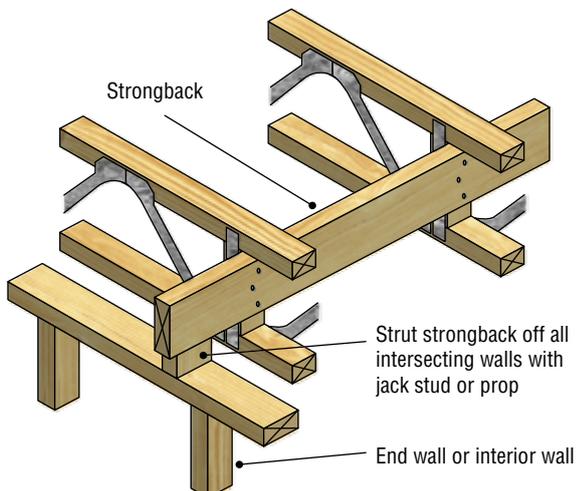
Type A: Splice on same side as strongback



Type B: Splice on opposite side as strongback



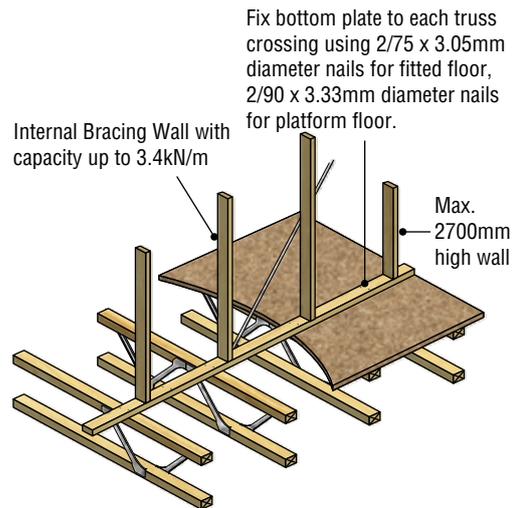
Strongback Strutted Off Walls



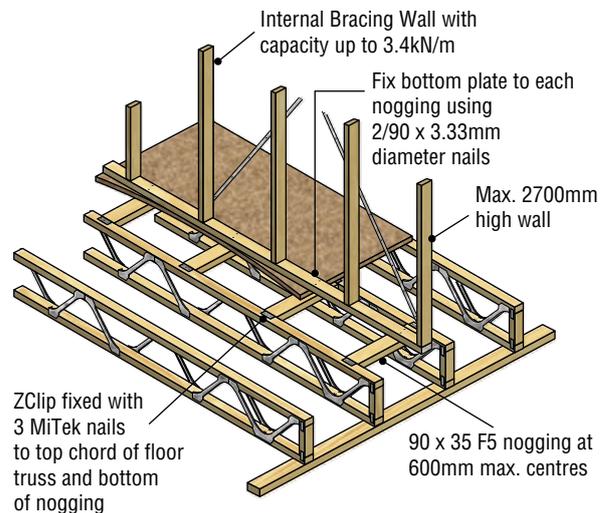
Walls on Top of Floor

Internal non-loadbearing walls perpendicular to the floor trusses are to be nominally fixed to each joist according to AS1684. Long lengths of parallel walls should be nogged in between joists below to provide support and facilitate fixing.

The ends of internal non-loadbearing bracing wall panels rated up to 3.4kN/m and 2.7m high may use the following details. Braced walls with bracing capacity and height exceeding this limit requires specific design.



Braced walls perpendicular to trusses with bracing capability up to 3.4kN/m



Braced walls parallel to trusses with bracing capability up to 3.4kN/m

Holes and Gaps in Floor

Small holes and gaps between cassettes may be ignored if they are sufficiently small not to interfere with the finished floor cladding, or if a second sheet of flooring is to be laid over the floor. Larger holes and gaps may be plugged with firm but pliable plastic slugs or filled with suitable putty.



Narrow gaps between cassettes may be filled with strip flooring later

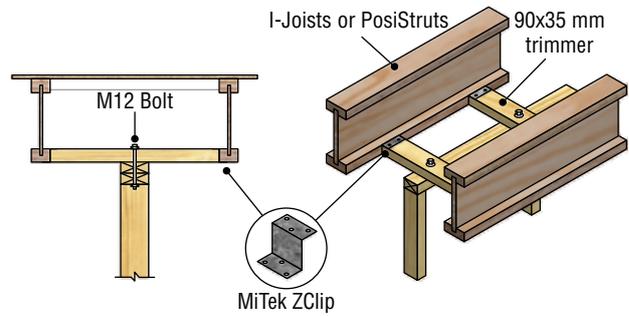
Walls Underneath Floor

Every wall underneath a strongback is to be used to strut it, refer to section on strongbacks.

The floor system is also to be connected to the top of internal bracing walls for shear transfer. This is done by fitting 90x35 MGP12 trimmers to the floor trusses with Z-Clips and bolting it to the bracing wall with an M12 bolt. Refer to AS1684 section J6 for additional details.



Small holes are easily plugged



Z-Clip detail to transfer lateral forces to internal bracing walls

Bracing

Bracing or blocking between PosiStrut floor trusses over supports should be installed if they are not already factory fitted.



Cassette floors should not be loaded with pre-nailed wall frames more than 1.5m deep



Larger holes are harder to plug

Important References:

- MiTek PosiStrut Floor and Roof Installation Instructions. • AS1684 Residential Timber Framed Construction.

For more information about MiTek's PosiStrut Floor Cassettes or any other MiTek products or your nearest licensed MiTek fabricator, please call your local state office or visit: mitek.com.au



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