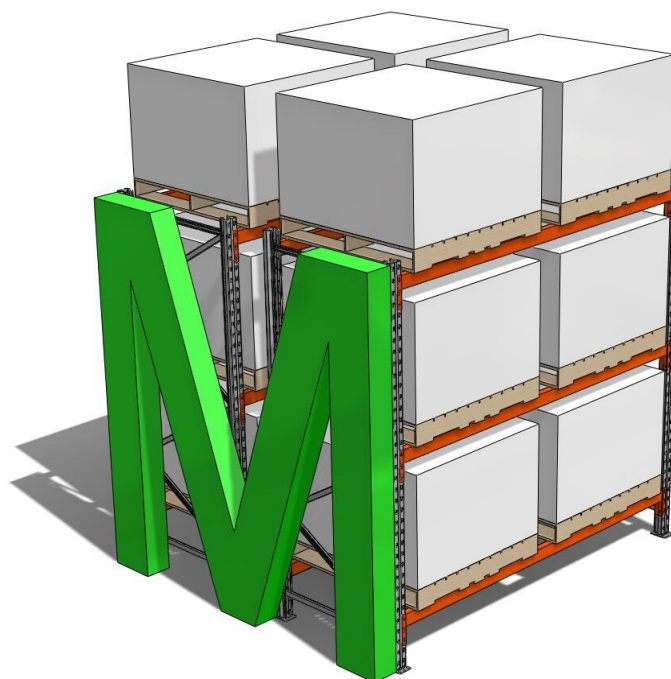


MACRACK

SELECTIVE RACK INSTALLATION GUIDE



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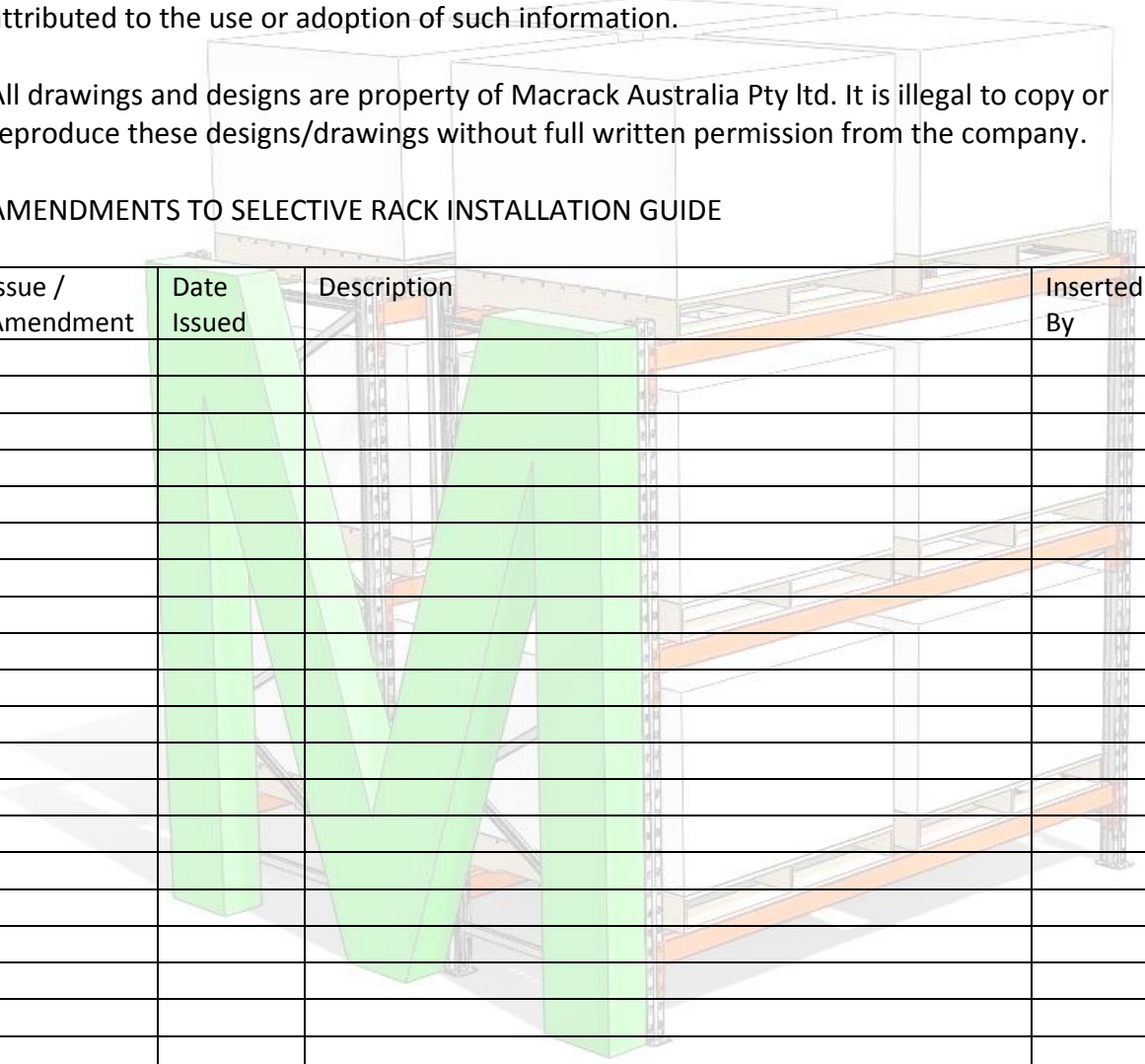
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AMENDMENTS TO SELECTIVE RACK INSTALLATION GUIDE



Issue / Amendment	Date Issued	Description	Inserted By

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PURPOSE

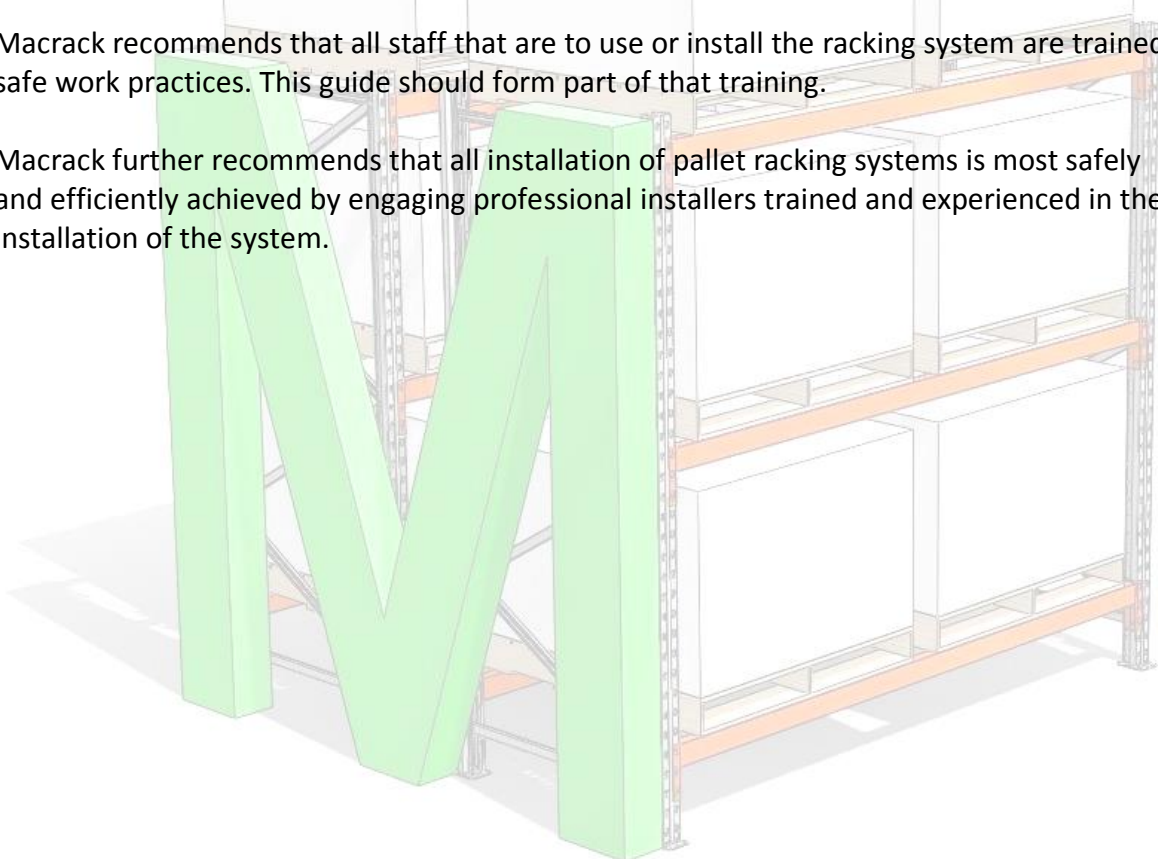
This guide provides advice on the installation of selective pallet racking. This guide is intended to be read by all persons working with and responsible for selective racking installation.

APPLICATION

This guidance applies to the installation of static selective pallet racking. Additional safety and/or technical requirements may be required for cantilever, drive-in, double-deep, pallet-live, push-back or other specialised racking. All advice is of a general nature and applicable in conjunction with the requirements of relevant Australian Standards. It is not designed to replace Australian Standards on racking nor Occupational Health and Safety standards and recommendations.

Macrack recommends that all staff that are to use or install the racking system are trained in safe work practices. This guide should form part of that training.

Macrack further recommends that all installation of pallet racking systems is most safely and efficiently achieved by engaging professional installers trained and experienced in the installation of the system.



GENERAL SELECTIVE RACKING INFORMATION

Selective racking for products on pallets should be designed specifically for the size, shape and weight of the products being stored. The racking design should be compatible with the pallets and the materials handling equipment in use within the workplace. Aisle width should be matched to the turning circle of the forklift or other materials handling equipment used to put-away, replenish or pick. Steel storage racking should be designed and installed in accordance with Australian Standard 4084 – 2012 as a minimum.

Selective pallet racking is designed to hold large numbers of pallets in a limited amount of space. The installation of this type of racking requires attention to detail and adherence to specified tolerances. Selective pallet racking is engineered to withstand large forces when installed correctly but incorrect installation can reduce the carrying capacity dramatically.

Selective Racking – A Definition

Selective pallet racking comprises pairs of horizontal beams supported by vertical uprights. Uprights are arranged in pairs – each pair of uprights being made into a rigid frame by bracing linking the two uprights. Uprights and beams are available in a range of sizes and grades to suit the load intended.

Pairs of beams can be placed at any height on the upright at 76.2mm (3 inch) increments. Lower levels which are accessible by hand can be formed into heavy duty shelving, where board or mesh is installed across the beams to create a storage platform.

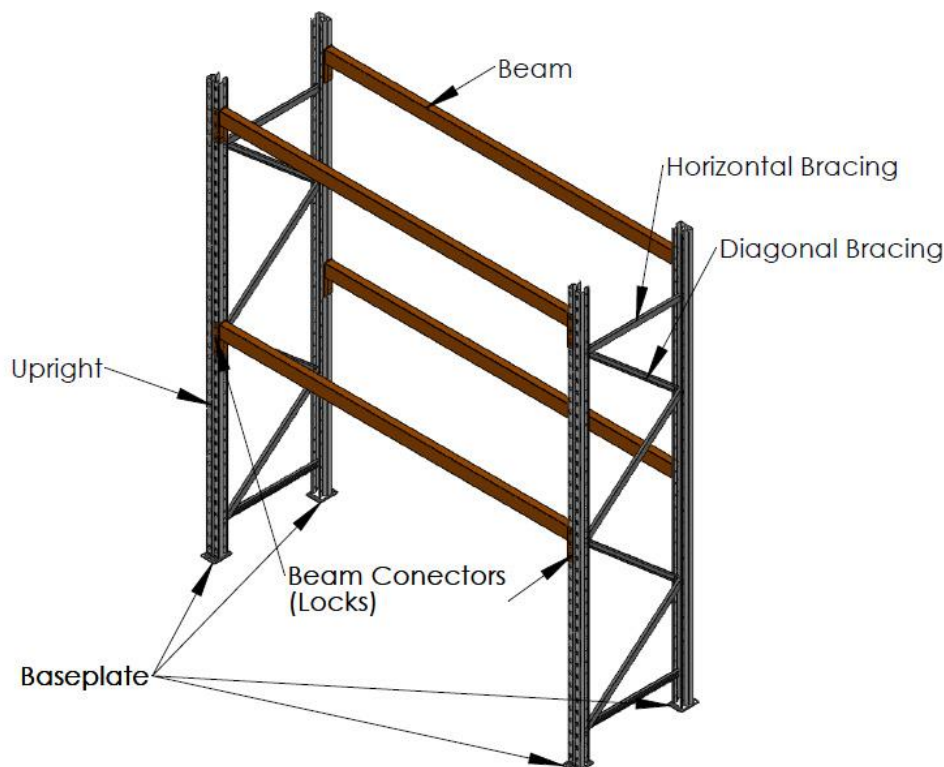


Figure 1 Isometric View of a Selective Rack

Racks are generally arranged into long runs to maximise space and utilise both sides of the frame. By aligning two runs back-to-back (double-entry) fork trucks can enter product to both sides which will reduce the amount of aisles needed and hence save warehouse floor space.

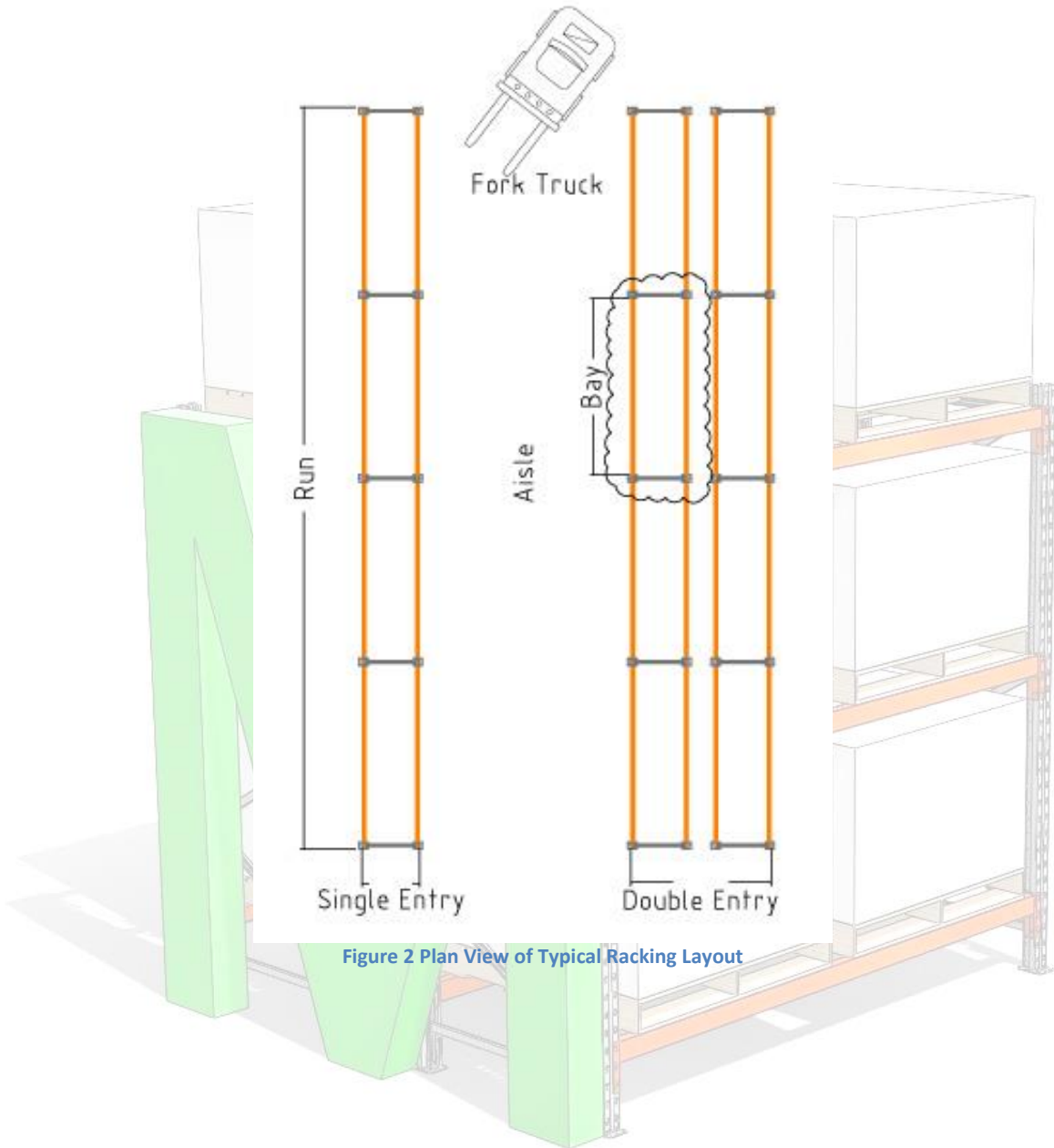


Figure 2 Plan View of Typical Racking Layout

COMMON TERMINOLOGY

The following are common terms for selective pallet racking:

Term	Definition
2 way entry pallet	A pallet with only fork access on two sides.
4 way entry pallet	A pallet with fork access on all four sides
Asian Pallet	The 1100x1100mm square pallet is the most common Asian size.
Australian Standard Pallet	The most common type of pallet within Australia. These are 1168x1168mm (46"x46") and generally made of hardwood, but some softwood pallets are now coming into use from the major manufacturers.
Bay	A portion of rack comprising one pair of frames and all levels of beams between those frames.
Bay Depth	The dimension from face-of-upright to face-of-upright in a particular frame.
Bay load	The total SWL of all unit loads supported by rack within a bay (not including any loads directly placed on the floor).
Beam	A steel support for loads (generally pallets) that has locking connectors welded at either end. The button rivets in each locking connector fit securely into the keyholes punched in uprights.
Beam level	A single pair of beams at a specific height within a bay of racking.
Bracing	Diagonal and horizontal channel sections approx 40mm wide and of a variety of lengths fitted between two uprights so that the whole assembly forms a rigid frame.
Button Rivet	Rivets fixed to locks (Locking Connectors) that then fit into the keyholes punched into the face
Column Guard	A method of protecting individual uprights. Various designs are available.
Design clearances	These spaces are left clear intentionally to allow the safe placement and removal of unit loads in the rack. These spaces are above, behind, and on both sides of the unit load.
Drive slowly	Travelling at a speed not exceeding 2km/h.
Euro Pallet	A pallet common in Europe and gaining acceptance in other parts of the world. 800x1200mm and 1000x1200mm are the two common European sizes.
Face of Upright	That plane of the upright that has the keyholes punched into it.
Floor fixing	A chemical or mechanical anchor (or bolt) joining floor and components.
Fork lift truck (FLT)	A FLT has elevating forks used to place pallets on levels within a bay.
Frame	An assembly of two uprights connected together by horizontal and diagonal bracing into a rigid structure. Baseplates are included as part of a frame.

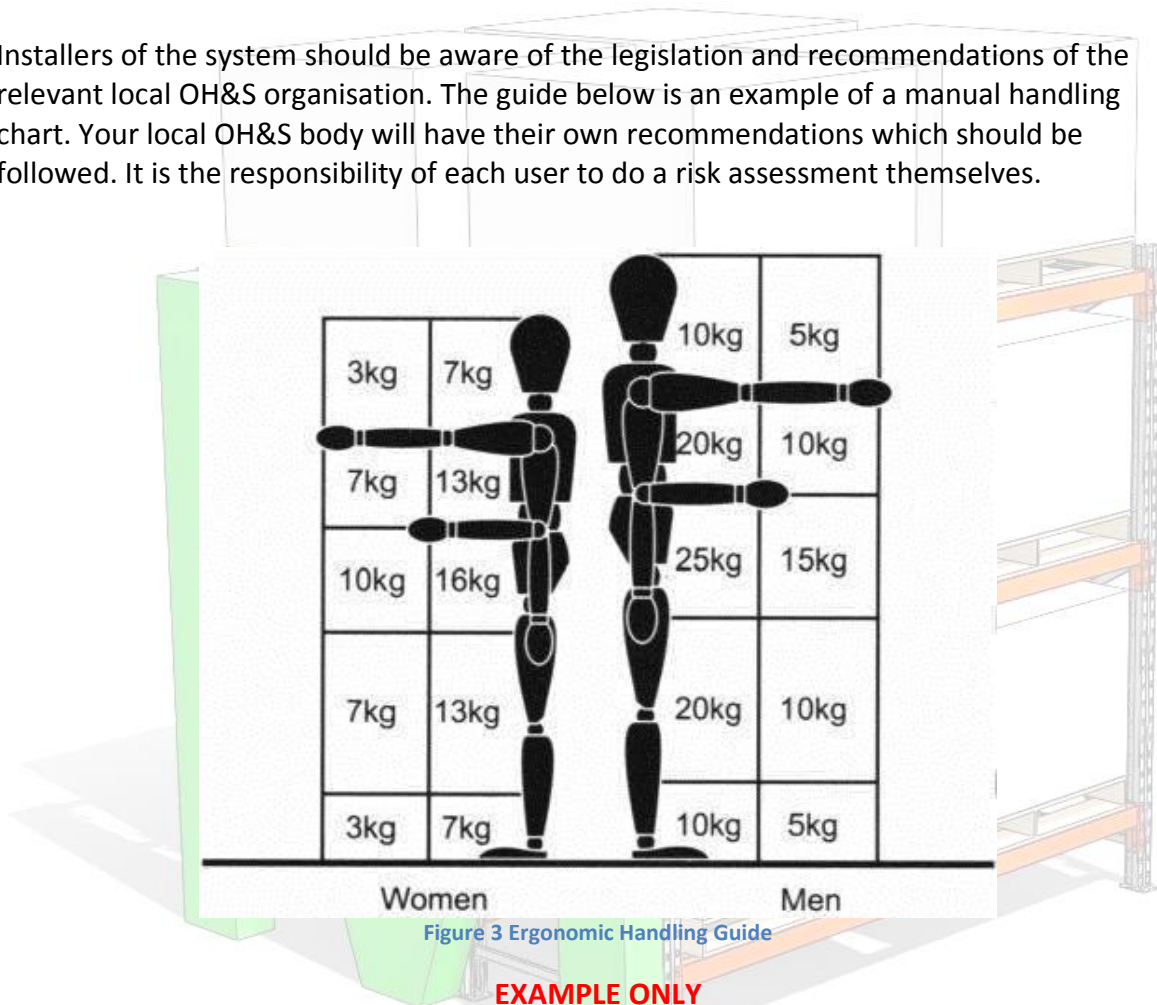
Level	A single storage level within a bay of racking.
Locking Connector (Locks)	These are welded at each end of a every beam. The button rivets in each locking connector fit securely into the keyholes punched in uprights.
Mesh Deck	Heavy steel wire sheets bent to sit snugly on beam levels. These may or may not have a number of additional stiffeners welded to them to increase SWL.
Narrow aisle racking	Pallet racking arranged in runs that are only sufficiently wide to allow access by the FLT plus a small clearance. The FLT must be a special type to allow only hand picking (eg Stock Picker) or be able to place a pallet without having to turn (eg Turret Truck). Once in the aisle the vehicle is generally not manually steered but is guided.
OH&S	Occupational Health and Safety – a moral and often statutory requirement throughout Australia.
Particle Board Support	Various designs of steel supports that fit between beams to increase the UDL of a deck of particle board.
Rack Depth	The dimension from outside-face-of-upright to outside-face-of-upright in double –entry rack.
Run	
Safe Working Load (SWL)	The maximum capacity of the component or assembly described.
Safety Pin	A bent steel pin with a flattened end that fits through a locking connector once a beam is installed.It prevents accidental lifting and removal of the lock that it is fitted to.
Selective pallet racking (APR)	Selective pallet racking comprises pairs of horizontal beams connected supported by vertical uprights. Uprights are arranged in pairs – each pair of uprights being made into a rigid frame by bracing linking the two uprights.
Standard aisle racking	Pallet racking arranged in runs with aisles that allow a FLT to make 90° turns in a single motion to squarely face a bay to access levels. Aisles will usually be three to four metres wide.
Structural Rack Protector	A very heavy duty rack protector usually bolted to the floor at the end of each run.
Uniformly Distributed Load (UDL)	The maximum evenly distributed load for a component or assembly. This assumes a load is evenly distributed and if it is not the loading does not apply.
Unit load	The mass of a single unit in the rack This is usually a single pallet.
Upright	The major vertical steel structural support. Bracing is bolted between pairs of uprights to form frames.
Zinc Clips	Bright steel Z shaped sheet steel approx 50mm long that prevents particle board sliding off beams.

COMMON RISKS AND HAZARDS OF INSTALLATION

Pallet racking systems can be very hazardous to install. Risks at every stage should be evaluated carefully and either eliminated or minimised to an acceptable level. Some of the more common stages when a risk assessment is warranted are discussed below. Every installation and/or site differs and each needs to be assessed on its own merits.

Manual Handling

Installers of the system should be aware of the legislation and recommendations of the relevant local OH&S organisation. The guide below is an example of a manual handling chart. Your local OH&S body will have their own recommendations which should be followed. It is the responsibility of each user to do a risk assessment themselves.



DETERMINE YOUR OWN REQUIREMENTS IN ACCORDANCE WITH LOCAL LAWS AND CONDITIONS.

Materials

Selective pallet racking is an industrial system. As such installers should be aware that some sharp edges and steel splinters may be present whilst installing. Some materials may have a thin coat of a petroleum based product as a result of the manufacturing process, or to protect the material from corrosion.

Installation Area

The installation area should be isolated from other personnel and vehicles. Bear in mind that should a frame or beam fall it may travel some distance beyond its' original position. The installation area should be checked for hazards in general. It should be clear and clear of obstacles.

Frame Assembly Area

Frame materials should be placed as close to the frame assembly area as possible to minimise manual handling. FLT access is desirable to ensure that manual handling is minimised.

Assembly – Frames

There are possible pinch points to consider. A danger of electrocution exists if power tools are used to assemble frames. Materials may fall either pre-assembly or stacks of completed frames may collapse if not properly secured. All electrical tools should be used in conjunction with a RCD unit.

Assembly – Standing Frames and Installing Beams

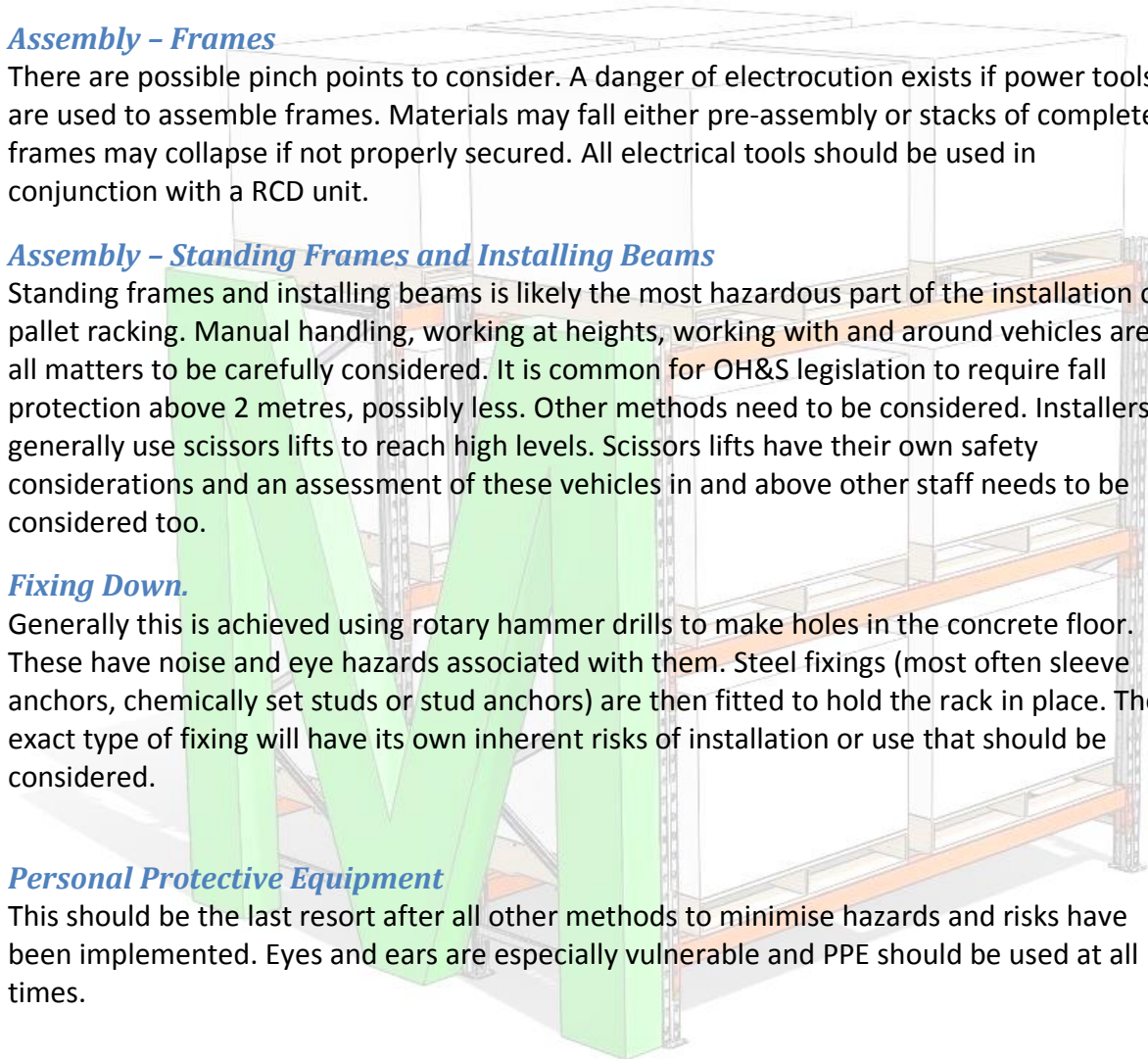
Standing frames and installing beams is likely the most hazardous part of the installation of pallet racking. Manual handling, working at heights, working with and around vehicles are all matters to be carefully considered. It is common for OH&S legislation to require fall protection above 2 metres, possibly less. Other methods need to be considered. Installers generally use scissors lifts to reach high levels. Scissors lifts have their own safety considerations and an assessment of these vehicles in and above other staff needs to be considered too.

Fixing Down.

Generally this is achieved using rotary hammer drills to make holes in the concrete floor. These have noise and eye hazards associated with them. Steel fixings (most often sleeve anchors, chemically set studs or stud anchors) are then fitted to hold the rack in place. The exact type of fixing will have its own inherent risks of installation or use that should be considered.

Personal Protective Equipment

This should be the last resort after all other methods to minimise hazards and risks have been implemented. Eyes and ears are especially vulnerable and PPE should be used at all times.



INSTALLATION

Clear the assembly and Installation Areas

Clear the area for installation and assembly. To avoid double handling or excessive handling the assembly area should be outside the installation area but with ready access to the installation area.

Materials Check

Inspect components for correct quantity and or damage. Do not use any damaged components.

Set Out

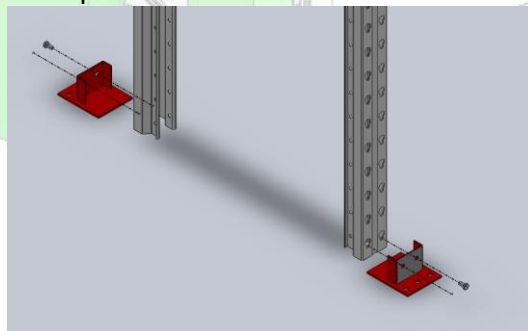
Check the overall dimensions against the drawing. Deal with any discrepancies immediately. Mark datum points for the start of each run and one face of each run. As a minimum an adequate tape measure, a marking pen and a chalk line is required to achieve this.

Frame Assembly

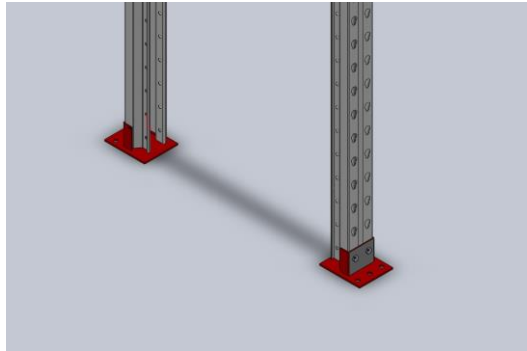
You will need

- The drawing of the frame.
- You will need a suitable bench or saw horses longer than the width of the frame.
- A wrench and socket for the bolt or nut.
- A spanner to hold the other end of the bolt or nut.

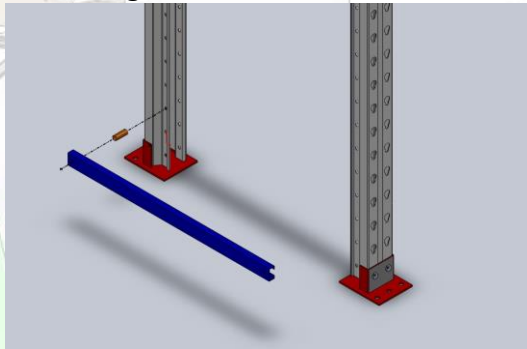
- 1) Ensure that you understand the frame drawing. This includes which component fits where and with which hardware. Consult Macrack if you have any doubts.
- 2) To begin the assembly of a frame, lay two uprights horizontally with the open sections facing each other. The distance between the uprights should be approximately the same as the finished frame. It is best if saw horses or a suitable bench is used to allow for easy access and installation of the other components at a good working height. The uprights must match each other directionally – that is - the bottom of the keyway must point in same direction for both.



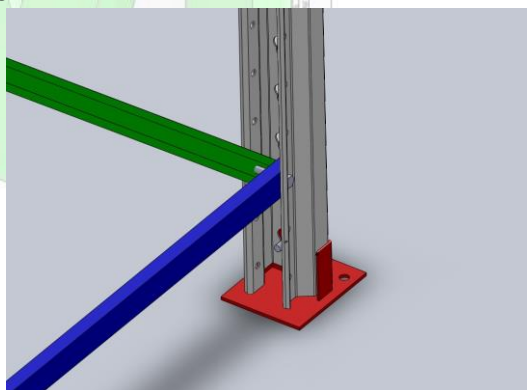
- 3) Install the baseplates using the hardware noted on the frame drawing.



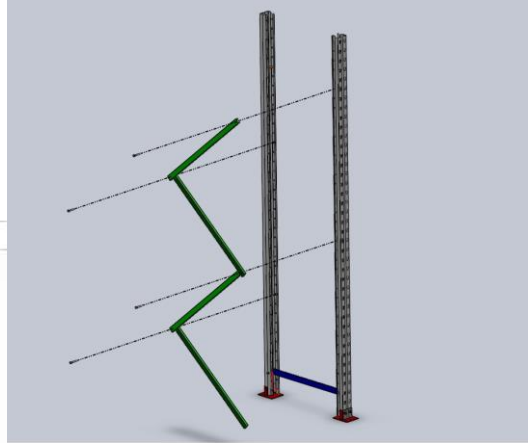
- 4) Install the lower-most horizontal brace. Place a horizontal (the shorter of the two bracing lengths) so that it spans between the uprights at the designated distance from the baseplate end. The open side should face up. Standing at the bottom and looking up the frame bolt in the left end only of the horizontal brace. You will note that the bracing only occupies half the available space in the upright section. Use a bracing tube to prevent it moving about on the bolt within the upright section. Bolts are only finger tight at this stage.



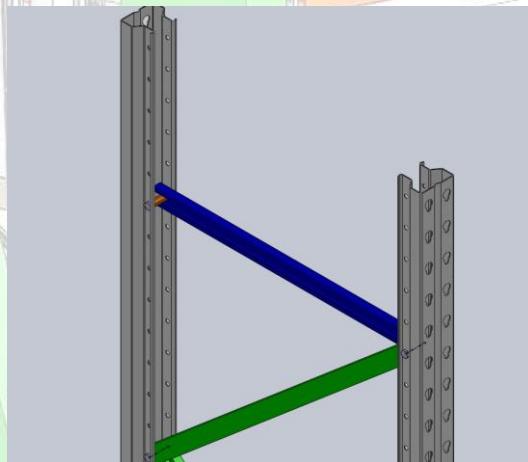
- 5) The other end of the first horizontal brace is bolted in together with one end of the first diagonal brace. The bolt is shared between the first horizontal and the first diagonal brace. The open side of the C section is reversed to the previous horizontal brace and this faces down.



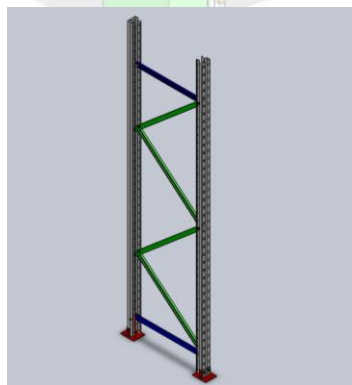
- 6) At this stage you should ensure that the uprights are visually as square to each other as possible. This will assist with the installation of the remaining bracing. Install the remaining bracing at the designated points. Each piece of bracing shares a bolt with the next piece. And the open side of the bracing is reversed each time another piece is installed. Again, all should be only finger tight.



- 7) The last piece will be a horizontal brace that will need a bracing tube as did the first horizontal brace.



- 8) Tighten up all the bracing bolts ensuring that the upright section is not crushed.
- 9) Tighten the baseplate bolts whilst ensuring that the baseplate is pushed snugly up against the bottom of the upright.



Preparing for Installation of the First Bay

You will need

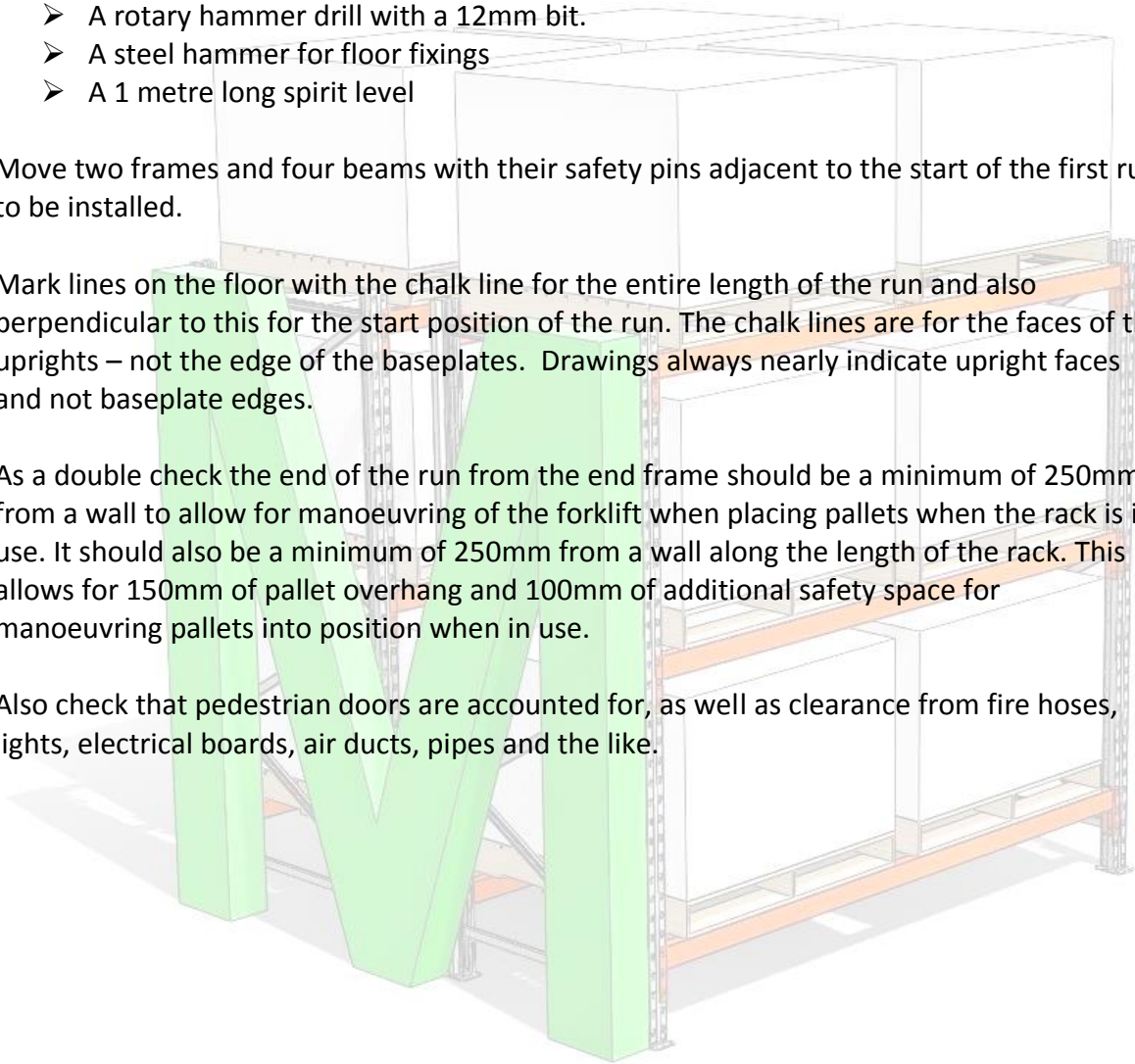
- The set out drawing
- Two frames
- Two beams
- Safety pins for the two beams
- A rubber mallet
- A tape measure
- A rotary hammer drill with a 12mm bit.
- A steel hammer for floor fixings
- A 1 metre long spirit level

Move two frames and four beams with their safety pins adjacent to the start of the first run to be installed.

Mark lines on the floor with the chalk line for the entire length of the run and also perpendicular to this for the start position of the run. The chalk lines are for the faces of the uprights – not the edge of the baseplates. Drawings always nearly indicate upright faces and not baseplate edges.

As a double check the end of the run from the end frame should be a minimum of 250mm from a wall to allow for manoeuvring of the forklift when placing pallets when the rack is in use. It should also be a minimum of 250mm from a wall along the length of the rack. This allows for 150mm of pallet overhang and 100mm of additional safety space for manoeuvring pallets into position when in use.

Also check that pedestrian doors are accounted for, as well as clearance from fire hoses, lights, electrical boards, air ducts, pipes and the like.



Standing the First Frame

Standing up frames can be achieved manually if the frames are very light and short. You will need to assess the hazards and risks for your particular frames before proceeding. Professional installers use a FLT and a special jig to stand frames as they increase in height and/or weight.

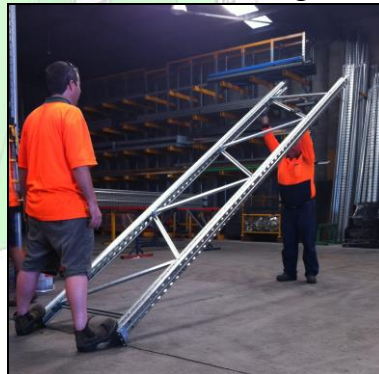
If the frames are very short and light the following method may be used to stand frames if you have assessed the risk and deemed it acceptable.

A minimum of two people are required. Place the frame with the baseplates in their approximate final desired position.

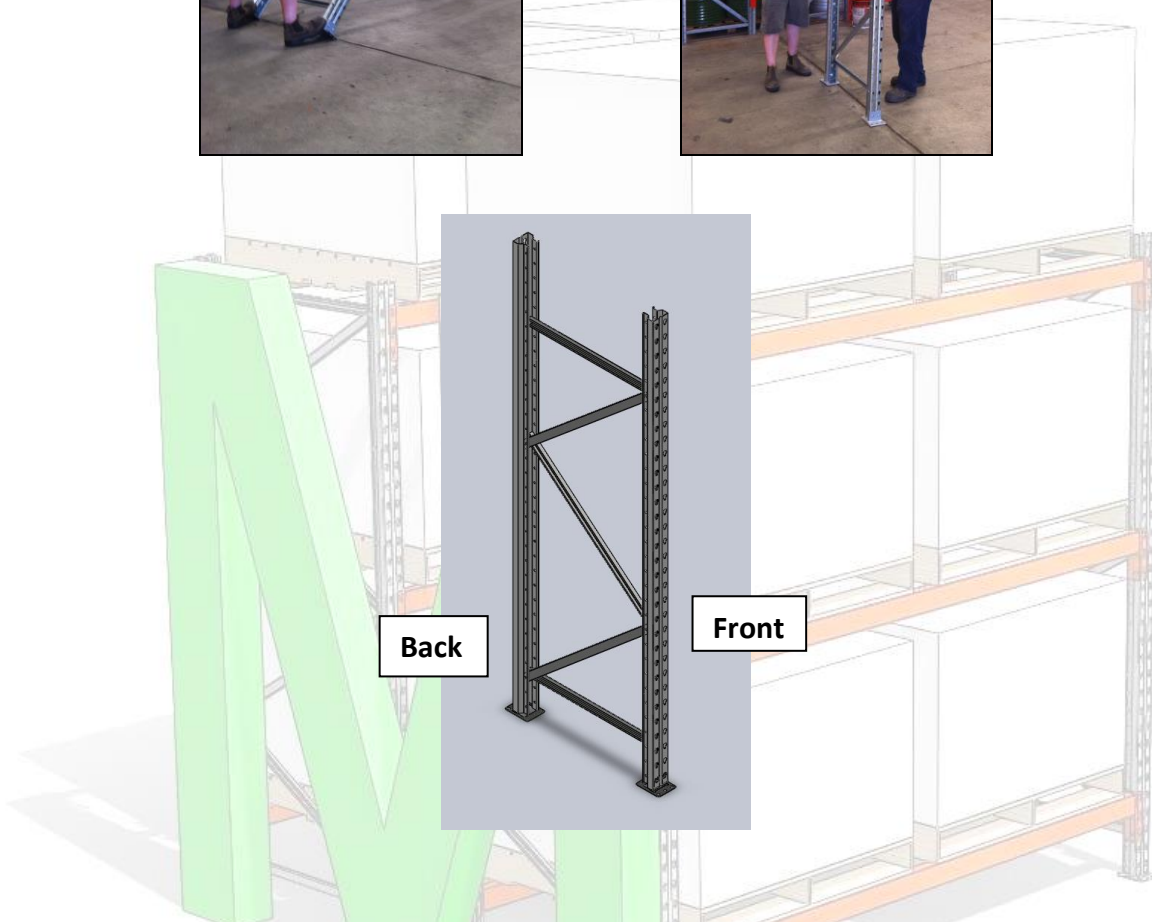
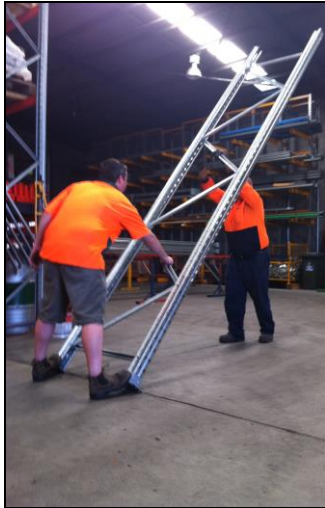
- 1) 'Person A' stands at the baseplate end of the frame facing along the length to the top.
- 2) 'Person A' places the balls of their feet on the baseplates with his/her heels on the ground. This will prevent the base of the frame from sliding or otherwise moving. Non-slip safety boots are important for this person.



- 3) The 'Person B' stands at the top of the frame facing the baseplates end of the frame. He/she picks up the frame and lifts to shoulder height.



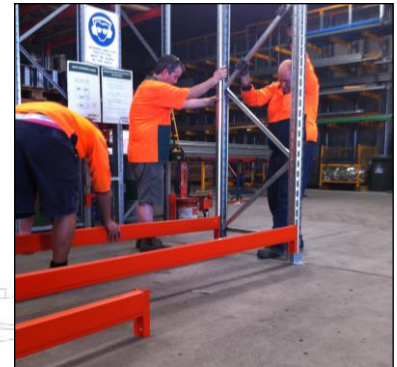
- 4) 'Person B' then pushes against the bracing and/or upright until the frame is vertical.



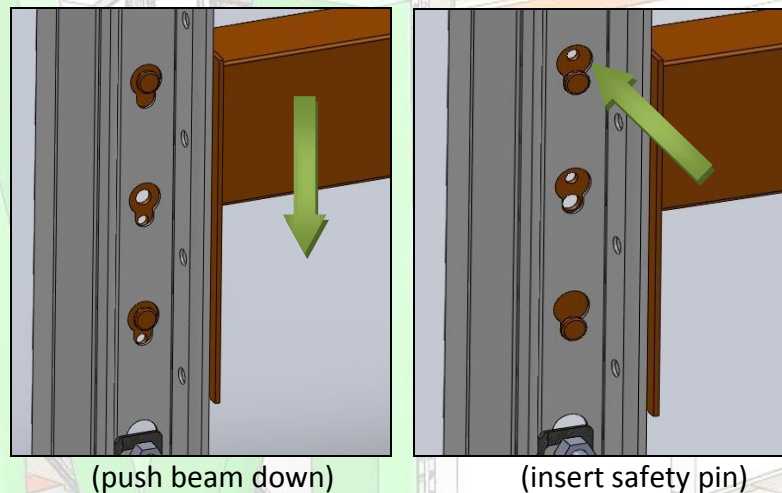
- 5) Front on the frame is where two diagonal braces first meet (from the bottom)
- 6) For slightly heavier frames experienced crews may replace 'Person A' and 'Person B' with two teams of two people in their place, increasing the anchoring of the baseplates at one end and reduce the lift weight per person at the other.
- 7) It is critical that the baseplates are not allowed to move during this process as the frame may become uncontrollable and fall. Again Macrack recommends that experienced installers are used to install racking.
- 8) For frames you have assessed as too heavy to lift manually a special jig and a FLT are required. These are used by professional installers trained and experienced in their use.

Installing the First Beams

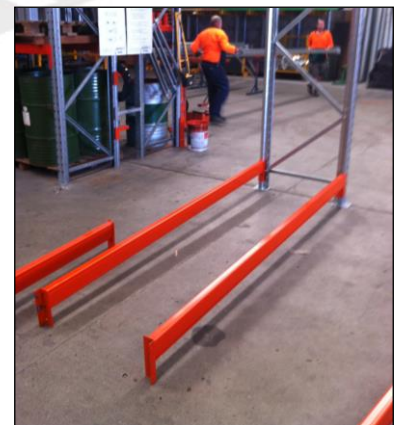
- 1) Once the first frame is standing and vertical it is not safe until a second frame is linked to it by a minimum of two beams. Two men should hold the frame vertical and stable at all times. Pick up a beam and hold it as horizontally as possible. Push the button rivets of the beam into the lowest free keyholes of the upright. The inside face of the beam connector should evenly meet the face of the upright. It is important to ensure that ALL the button rivets are through the face of the upright before pushing the beam down to engage the button rivets in the bottom of the keyholes.



- 2) Push the beam down in the keyholes of the upright until it is possible to insert a safety pin. Use a rubber mallet if needed to get beam into a fully down position. Check that all the button rivets are properly engaged in the bottom of the frame keyholes.



- 3) Install a second beam on the other side of the frame also at the lowest possible level.
- 4) Once fully engaged and a locking pin in place the people stabilising the frame may then allow the frame to lean so that the ends of the beams touch the floor and take some of the weight. They should continue to keep stabilising the frame until the second frame is securely installed.



Standing the Second Frame – Making the First Bay

- 1) Place and stand a second frame close to the free end of the first beam already installed in the first frame. One or more people should continue to stabilise the first frame and another one should stabilise this second frame once up.



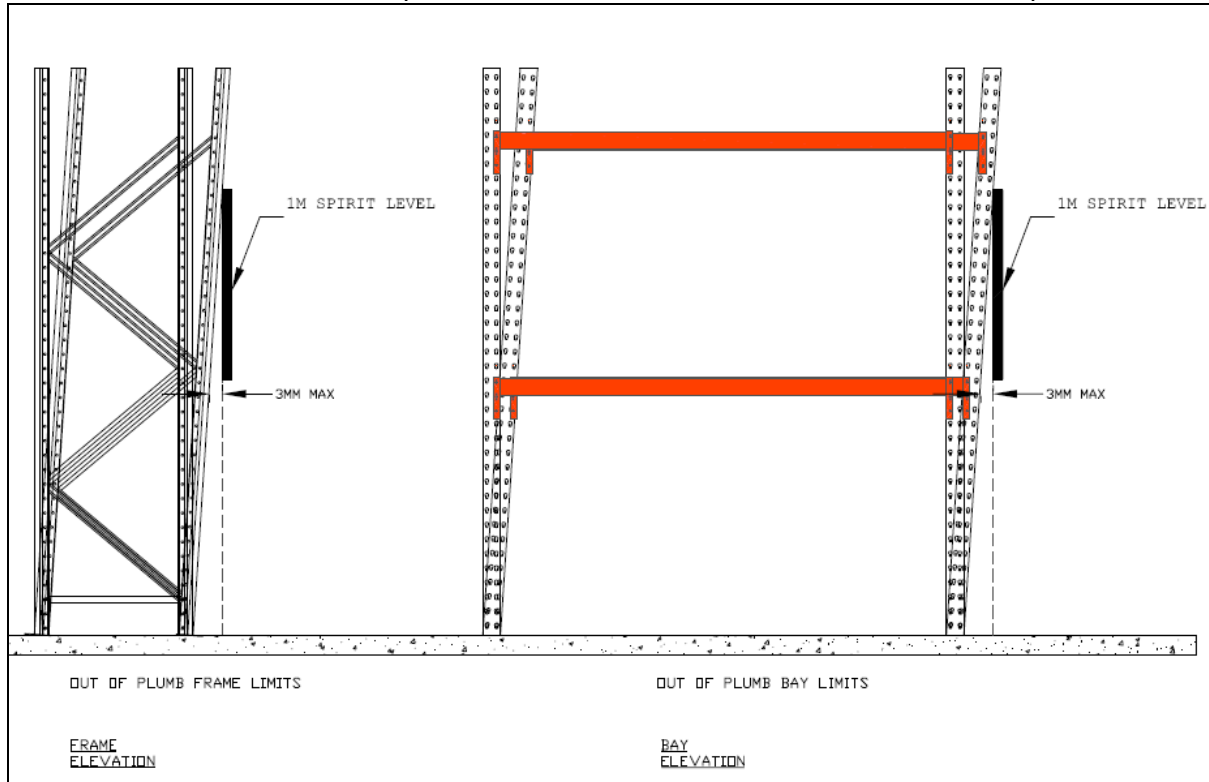
- 2) Move the second frame close to the free end of the beam. Another person then gradually raises and fits the beam into the second frame at the same lowest level as in the first frame. The assistance of the people stabilising the second frame will likely be needed to get the positioning of the second frame exactly correct to fit the beam.



- 3) Once the button rivets are engaged, pushed or hammered down, and the safety pin installed, repeat the installation of the second beam on the rear of the second frame.
- 4) The bay is self-supporting once both beams are fully engaged with locking pins installed and may be left to proceed to the next task.

Levelling

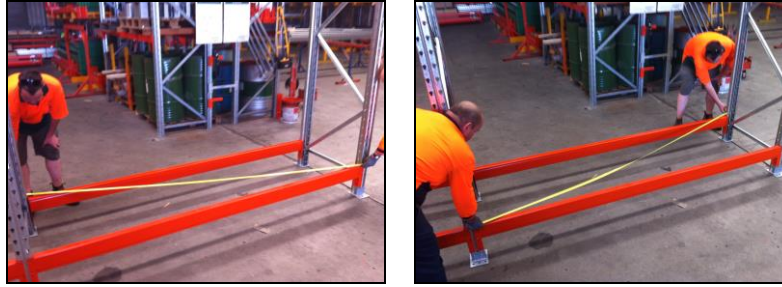
- 1) It is very important to level frames to ensure structural integrity and even loading on baseplates. Using a one metre spirit level check to ensure the frames are as close to plumb as possible in both directions. The maximum tolerances noted in AS4084 are indicated on the diagram below. Macrack recommends 1mm per metre out of plumb as a maximum. This is quite achievable with the thick and thin levellers provided.



- 2) The frames should be measured and then one man tilts over the frame slightly whilst another places levellers underneath to achieve plumb. It is critical that fingers and hands are NEVER placed under the upright and that levellers are slid in.

Squaring the Bay

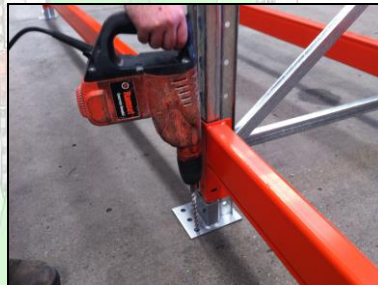
- 1) The frames are now lined up as accurately as possible with the baseline (as the starting point of the run) and the face line marked earlier with the chalk line.
- 2) Check the bay for square by measuring horizontally from corner to diagonally opposite corner across the bay at the level of the beams. The top corner of the connector is a convenient point for taking this measurement, but any points can be used so long as they are identical in each corner.



- 3) If the measurements differ gently move the frames until they are identical. Ensure that the frames remain on the face line along the run whilst performing this measurement or erroneous measurements will result. Likewise if the frames are not plumb erroneous measurements will also result.

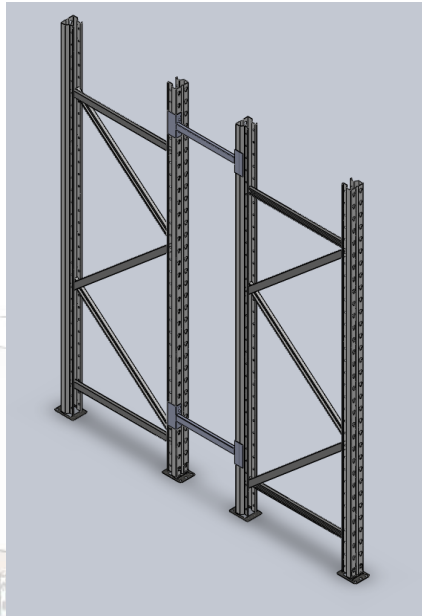
Fixing Down the First Frame

- 1) The first frame is now ready to be fixed down. Each frame is fixed down to the floor as specified on the drawing or installation package. Some racking requires more than one floor fixing per baseplate. Most often the fixings are 12mm diameter x 75mm long sleeve anchors. For these a 12mm hole will need to be drilled into the concrete slab for each fixing. Drill the hole using the holes in the baseplate of the frame in situ as a guide for placement.
- 2) A rotary hammer drill is recommended for this task.



- 3) Each hole should be at least 25mm deeper than the sleeve anchor itself. Drilling the extra 25mm allows for a little dust that may remain in the hole after drilling and also allows the sleeve anchor to be knocked down into the hole at the end of its life. Back the nut of the sleeve anchor off the thread until one thread is just showing inside the nut with the remaining thread of the bolt still engaged in the nut. This disengages to sleeve from the expansion bulb at the bottom of the bolt. In this configuration the sleeve anchor is easiest to fit as it then has as small an overall diameter as possible. It also avoids damage to the thread of the bolt whilst hammering in the sleeve anchor.
- 4) The holes should be as plumb as practicable. A long drill bit will assist in this by keeping the drilling machine itself away from the frame and baseplate.

Fitting Row Spacers



Row spacers join one run of racking to another, increasing the footprint of the racking system. Row spacers also align the uprights to make sure they don't creep or bend.

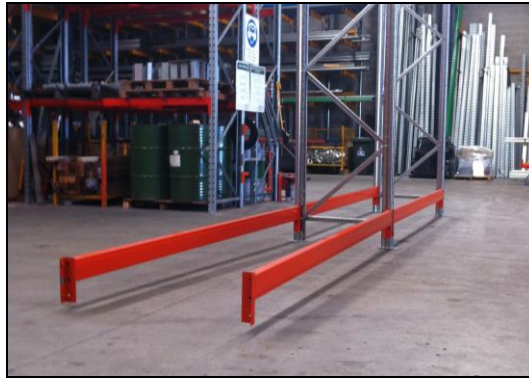
The row spacers should be placed in the system before everything is secured to the floor. Preferably, this should be done as each adjoining frame is stood. The amount of row spacers per pair of frames differs depending on how high the frame is.

Installing the Remaining Frames

- 1) You now have a single bay, square, plumb and fixed at one end. Two more beams can be fitted at one end only to the second frame, extending out into the second bay.



- 2) Once these are fully engaged at one end into the second frame and the locking pins fitted stand another frame as close as practicable to the free end of these beams. Fit the beams to secure frame.



- 3) Ensure that beams are fully engaged and the locking pins fitted before moving on to repeat the process with two more beams and another frame.
- 4) Repeat until the run is finished.
- 5) Check that frames are positioned correctly on the chalk line. Fit a second level of beams at the correct desired level. The second level of beams is needed to ensure that baseplates are very precisely placed prior to fixing down. If the second level of beams is not fitted then higher levels of beams can sometimes become difficult to fit.
- 6) Level all frames. Drill the chalk line side upright of the frame first and hammer in the floor fixing before proceeding to drill the hole(s) required for the rear upright of the frame. Wear eye and ear protection whilst using rotary hammer drills this ensures that the frame remains correctly positioned on a true line.
- 7) Once all fixings are in place they can be tightened. Ideally this is done with an impact wrench. Again, eye and ear protection should be worn.
- 8) The lowest level of beams can now be removed and used for higher levels.

Installing the Remaining Beams

A scissors lift may be used to lift personnel and beams up to the required levels. If using this method it is often best to install beams from the top level down until levels accessible by hand off the floor are reached. Then install the lowest levels by hand. Assess the hazards and risks for using the scissors lift. For example - personnel should never work in the area under a scissors lift at any time, and the load limit of the scissors lift should not be exceeded.

As an alternative method, the next layers of beams can be fitted by hand by two persons. As you proceed higher it will be necessary to use fall protection (usually safety harnesses) and a third person to pass up beams, or drive a FLT to lift beams up to the persons installing the beams. Regulations vary locally as to the exact height above which fall protection is required. Please ensure you are aware of your obligations for your location. Always fit safety pins as you go.

Fitting Load and Maintenance Signs



Load signs are a requirement under AS4084-2012. Under this standard only the manufacturer can certify and provide correct weight loadings for the racking system.

These signs are required to be placed in a visible area, a minimum of 2000mm off the ground and secured to the system with metal fasteners.