



Building *with* steel

Part 2: Now you're underway

In the second of our three part series, we discuss the practical construction aspects of building a steel framed home. This is meant as a general guide only - you should always follow your designer's specifications and frame supplier's instructions and seek expert advice and help along the way.

Humans used to live in caves and similar geological formations. Caves are natural structures and may be over- or under-designed, with whatever features nature has provided. Houses, on the other hand, are engineered structures. Everything in them is there for a purpose, whether it be structural, functional or aesthetic. The frame supplier normally takes responsibility for the structural engineering of the frame.

When it comes to the structure, nothing should be left to chance; it should be properly designed, installed, finished, protected and maintained. Everything depends on the structure - the security, comfort and amenity of its occupants as well as its investment value. Building the structure correctly is never an extravagance, and cutting corners is always a mistake.

Footings

Accuracy is always beneficial in construction - remember that your ability to compensate for previous inaccuracies is not guaranteed

throughout the project, so getting it right at every step will save you a lot of time and angst later on!

The most common footing types supporting steel framed construction are concrete slab-on-ground, and steel or concrete stumps or brick piers on concrete pad footings.

Concrete slabs are designed to support building weight (dead load), provide hold down and resistance to overturning, resist termite entry and provide a trafficable floor for occupancy. We won't cover concrete slabs here, except to say that slab design and construction is basically identical for all types of construction.

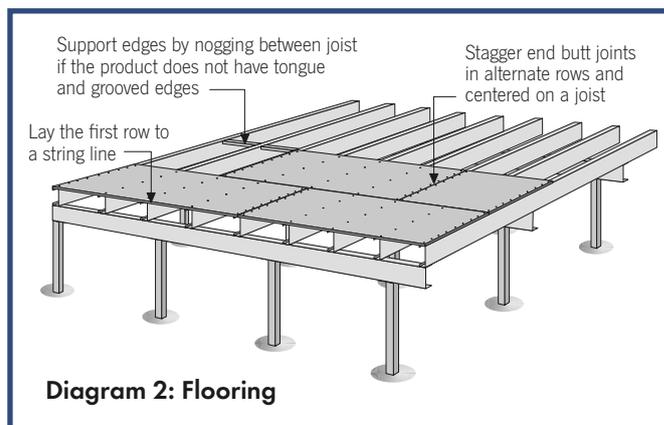
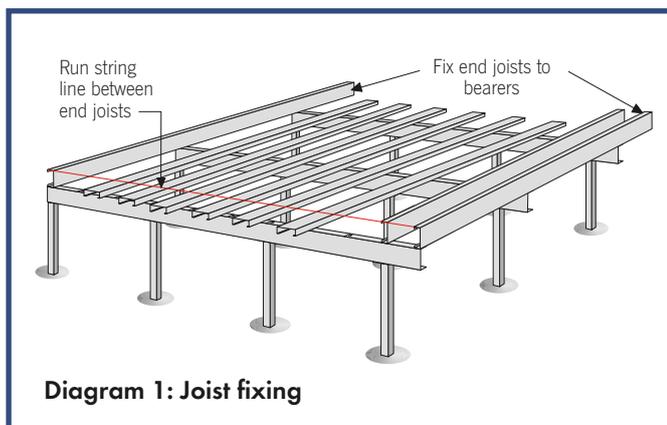
Concrete strip and pad footings with piers or stumps (posts) must perform the same support, hold down and overturning resistance as a concrete slab. They are used with suspended floor construction, i.e. where there is a subfloor space. Footings of this type are normally set out to a grid with a regular spacing, based on the spanning capacity of the floor bearers used in the design. The steel stump supplier will provide recommended installation details for

stumps, including the required accuracy of set out where stumps are not adjustable in height.

Floor framing

With the footings in place, the next step is to install the floor framing. The most common steel floor framing system consists of C-section bearers spanning between posts with C- or top-hat section joists laid over the bearers. Floor system manufacturers will provide all required installation instructions.

To save time and effort later, it is a good idea to mark out the positions of the floor joist on the bearers before lifting into place, particularly if the top of the bearers will be above eye line after they are fixed to the supports. Sort the bearers for size, length and location. Lay them beside each other, keeping the ends flush, and mark out the positions of the floor joist on the first bearer. Transfer these positions to the other bearers using a square. The bearers can now be laid out beside the posts in accordance with the manufacturers or fabricators drawings.



Depending on the particular system, the bearers may be bolted or screwed to the posts. The bearers are placed onto the support posts one at a time, checking that they are correctly positioned as shown on the structural plans. For bolted systems, mark the positions of the bolt holes in the posts onto the bearers, and drill the appropriate size holes in the bearers. Place back on to supports, insert the bolts (including any required washers) and tighten. For screw fixed systems, check the positioning as described above and fix with the specified screws. Repeat these procedures until all bearers are fixed in place.

Joist fixing is generally quite straightforward. Sort the joists for size, length and location and place them, on their flat, into their approximate positions. Joist spacing is determined by the spanning capacity of the joists and of the strip or sheet flooring that will be fixed to them. Starting with the end joists, check that both ends of the joist are flush with the bearers or have the required cantilever. Using the specified connections fix both end joists to the bearers, and run a string line between these joists. Continue fixing the other joists using the string line to keep the ends in line. See **diagram 1**.

Flooring

Steel floor framing is an ideal substrate for all kinds of flooring material such as strip timber, structural particleboard, fibre cement and plywood. See **diagram 2**. These materials come in different thicknesses to suit different joist spacings. Most fixing is done with a combination of adhesive and screws or nails. For specific information on



fixing a particular flooring product, always follow the flooring product manufacturer's recommendations.

Wall framing

Wall locations are set out on the slab or platform using a chalk line, starting with the external walls. To compensate for possible differences in slab dimensions, it's best to mark the inside of the external wall frame positions. Continue on to the internal walls, checking constantly for squareness.

Where perimeter wall frames are placed on a concrete slab-on-ground, a durable impermeable membrane should be placed between the bottom plate of perimeter wall frames and the slab and extend up the weather side flange of the bottom plate. The membrane is not required beneath internal wall frames. The membrane may be the same as that used for damp-proof courses, a paintable bitumen product or a self-adhesive polyethylene.

To save time and effort later, it is a good idea to mark out the positions of the roof trusses on the top plates before

standing the frames. Any holes in the bottom plate that may be required for fixing to the slab/floor frame can also be made. To make the removal of the bottom plates in doorways easier after the frames are erected, cut the web of the bottom plate either side of the doorways using an angle grinder with a metal cutting disc or preferably with a power saw with a cold-cutting metal blade. See **diagram 3**.

When all wall locations are marked out and the frames prepared, place the frames near their required location as shown on the layout plan. Stand the frames commencing with an external corner, fixing them together as recommended by the frame supplier. This is typically done with self-drilling screws. Continue to work around the building adding one frame at a time, checking that each frame is aligned with the set out marks and plumb before proceeding to the next. On longer walls, temporary bracing is essential to stabilise the frames until the wall and roof framing is complete and fully braced.

The frames are then fixed down to the slab or floor using methods and spacings specified by the frame supplier.

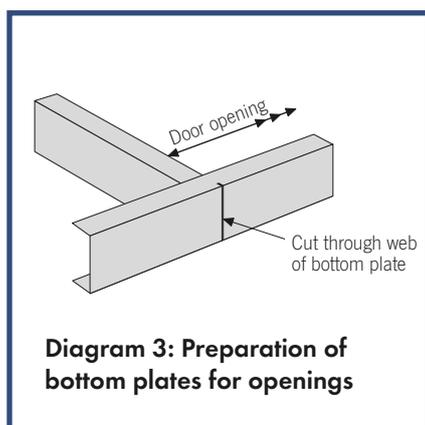
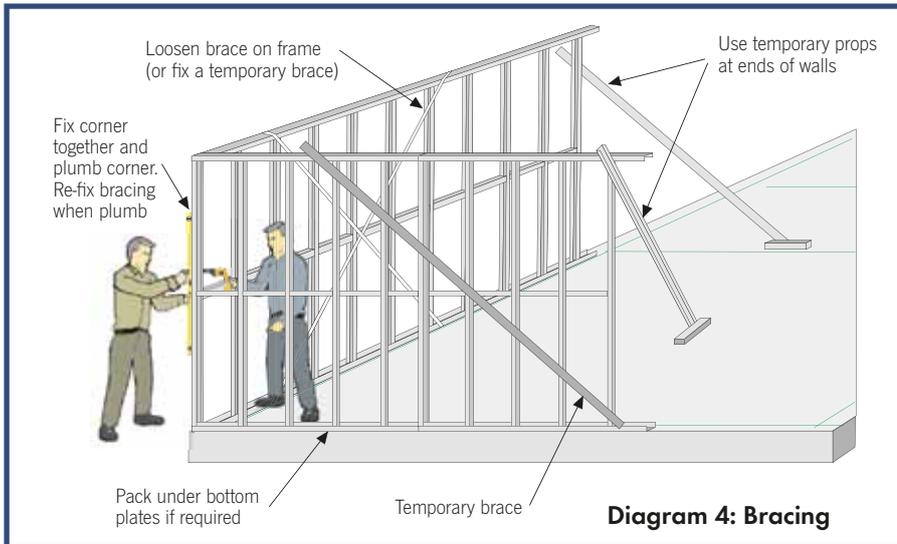


Diagram 3: Preparation of bottom plates for openings



Temporary bracing

Wall panels, roof panels and trusses help to stabilise each other in the finished frame structure. During construction, they may need temporary propping to prevent collapse and to ensure secure footing for installation workers. You should ensure that there is always sufficient support for the freestanding structure – wall panels and roof trusses – by adding temporary props or bracing as required. If in doubt, add more! Typically every wall panel or truss should be individually propped until it is secured to the permanent, fully braced structure. This is particularly important for long runs of walls, gable end walls or large truss spans.



The specifications will vary depending on the type of floor, type of roof and wind region. Particularly important are the fixings beside openings, at wall ends and corners, and where bracing straps or sections meet the bottom wall plates. Screw bolts are a common fixing method to concrete slabs as they are fast and reliable. Where a steel floor frame is used, self-drilling screws of the correct size and length are commonly used.

In cyclonic areas where hold down requirements can be very large, your frame supplier will pay particular attention to the continuity of the load path from roof structure to foundations. This may involve specialised fastening arrangements for the wall frames.

Bracing

Bracing strength is critical to the structure both during and after construction. Bracing usually consists of a combination of methods such as metal strapping, sheet materials such as steel, fibre cement or plywood, and plasterboard lining. You will need to provide and fix all bracing as specified by the frame supplier. See **diagram 4**.

The final step in wall framing is to remove the bottom plates in doorways, a job made much easier if the plate webs have been pre-cut as described earlier.

Roof framing

There are two types of steel roof framing system in common use in Australia: panel systems and truss systems. Panel systems consist of ceiling panels and roof panels, and can be likened to 'inclined walls' in which the studs act as

ceiling joists or roof rafters. Truss systems are more familiar, with geometry generally similar to their timber counterparts.

Truss systems are installed by placing each truss at its 'station' on the wall plates, working to the roof layout plan provided by the fabricator. The first truss is temporarily propped and stabilised, and each subsequent truss is stabilised back to the previous one. See **diagram 5**. A temporary bottom chord brace is installed to ensure the trusses remain in place during construction.

Roof battens

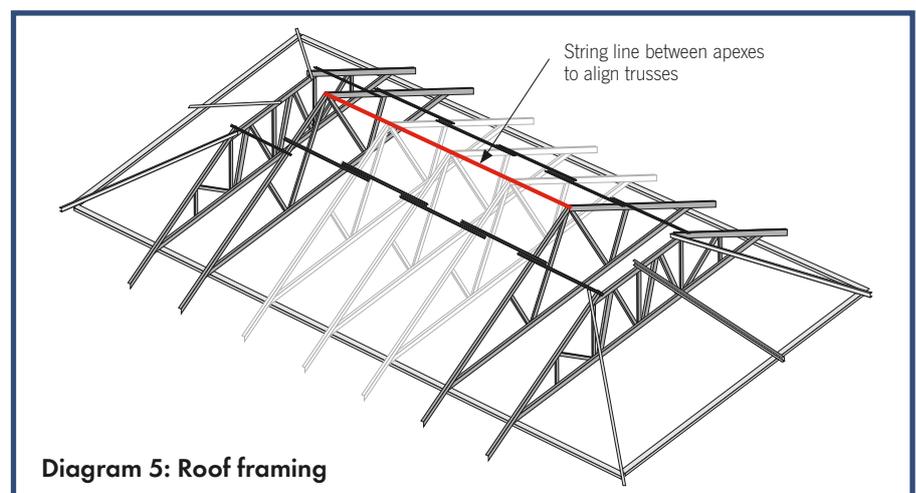
For safety and to save time and effort later, where a sheet roof is to be fitted it is a good idea to mark out the positions of the roof battens on the top chords of the trusses before lifting the trusses into place. With the roof structure in place, the battens can be set out to suit the roof cladding.

Housekeeping

On completion of each stage of construction, the area should be cleared and waste material disposed of safely and responsibly. Any excess materials should be stacked and stored to allow for use at a later date.

Self-drilling screws create steel 'swarf' as they drill. Whilst not hazardous in small quantities, when swarf gets into the wrong places it can mar the appearance of coated steel surfaces. It's a good idea to sweep away swarf progressively as you work, along with any discarded screws and small off-cuts, to minimise any adverse effects.

The channel shaped bottom plate of steel wall framing panels will tend to accumulate construction debris and should be kept clean during the works.



Safety

All electrically conductive sections of steel structural frames should be earthed in accordance with the requirements of the local electricity authority. As soon as practical in the frame erection process, a temporary earth should be established until the permanent earth is installed.

There are good battery powered screw guns and other tools that largely remove the need for using power leads. On all construction sites and with all forms of construction, electrical power leads should be kept in good condition and regularly checked. Wherever possible, leads should run overhead and not along the ground.

Guidance on safe methods of construction is available from your local workplace safety authority.

Required tools

As mentioned in the first article, the tools required for steel frame construction are familiar and readily available. This is what you're likely to need:

- A good quality battery screwdriver
- A small angle grinder
- A pair of articulated snips
- Several toggle clamps
- String lines and chalk lines
- A masonry drill (if building on a concrete slab)
- A good quality level at least one metre long
- General hand tools. ■

Part 3 of this series will cover finishing: fitting windows, doors, roofing, cladding and linings. Thanks to National Association of Steel Framed Housing Inc (NASH) for the editorial and diagrams, and to Technosteel Australia for the photographs.



• NASH

A good source of information on suppliers and technical information. Visit their website for up to date information on residential and low-rise steel framed construction. Training is offered at some TAFEs for tradespeople wishing to gain expertise with steel framing. These courses may be suitable for owner builders with some experience in building. 1800 656 986, www.nash.asn.au

• Technosteel Australia

Manufacturer of steel house frames, roof trusses and floor systems, mainly for the owner builder. 1300 553 457, www.technosteelaustralia.com



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