

**The Lightweight
Steel Frame
House Construction
Handbook**

Chapter Nine
Final Items



Introduction

This chapter discusses final items, including avoiding common problems and troubleshooting.

A complete set of chapter checklists has been included as a reference guide. These checklists reference Part 9 of the Building Code and have been modelled on municipal guidelines. While care has been taken to ensure accuracy, these guidelines are for convenience only, and **do not**, replace the Building Code. The CSSBI is not liable for errors or oversights resulting from the checklist information. It is the builder's responsibility to consult the Building Code, in order to ensure safe and proper construction.

Avoiding Common Problems

It is always recommended that problems be avoided in the first place through careful planning and best practice. Solutions are sometimes available to remedy problems, but these are often far costlier than avoiding problems at the outset.

Damaged or Bent Materials

Damaged or bent materials must never be used for loadbearing applications. Cut or bent flanges, bends, holes and any other type of damage may significantly weaken members. Always discard loadbearing members which have been damaged. In cases where a material is non-loadbearing and the damage does not affect its capacity to perform as it should, it is up to the builder's discretion whether the material is acceptable.

Chemical Reactions with Metals

Certain metals, when in contact with each other, may produce a chemical reaction. This can cause corrosion of the less active metal, which will diminish its performance. All steel framing members contain a metallic coating of zinc or 55% aluminum + zinc. However, to avoid galvanic reactions with dissimilar metals, steel framing should not come into contact with copper. This includes all flashing and all plumbing pipes. Copper plumbing pipes must always be isolated from steel framing with grommets and standoffs. It is also important to avoid contact between galvanized metal and fresh concrete or mortar. Galvanized coatings contain zinc, which is highly reactive with alkalis and will deteriorate to some degree upon contact with fresh concrete or mortar. The reaction is limited, due to a corrosive film that forms on the outer layer of the zinc. Zinc will not react with dry, seasoned concrete or mortar.

Construction with Wood and Steel

When framing with steel it is possible that wood may still be used for some applications. Always remember when combining wood and steel that wood will shrink but steel will not.

Members Out-Of-Line

If, for some reason, a stud and joist do not line up within the limits stipulated in Figure 1.1, then there are two possible solutions both illustrated in Figure 9.1:

- Add a horizontal piece of stud below the out-of-line joist to act as lintel to transmit the load to the two neighbouring studs; or
- Add a stud below the out-of-line joist to carry the load down to the foundation. In this case, if the joist is a second or third storey floor joist it is necessary to continue adding studs and web stiffeners below each other down to the foundation. Do not simply add one stud and transfer the problem to the track of the floor below.

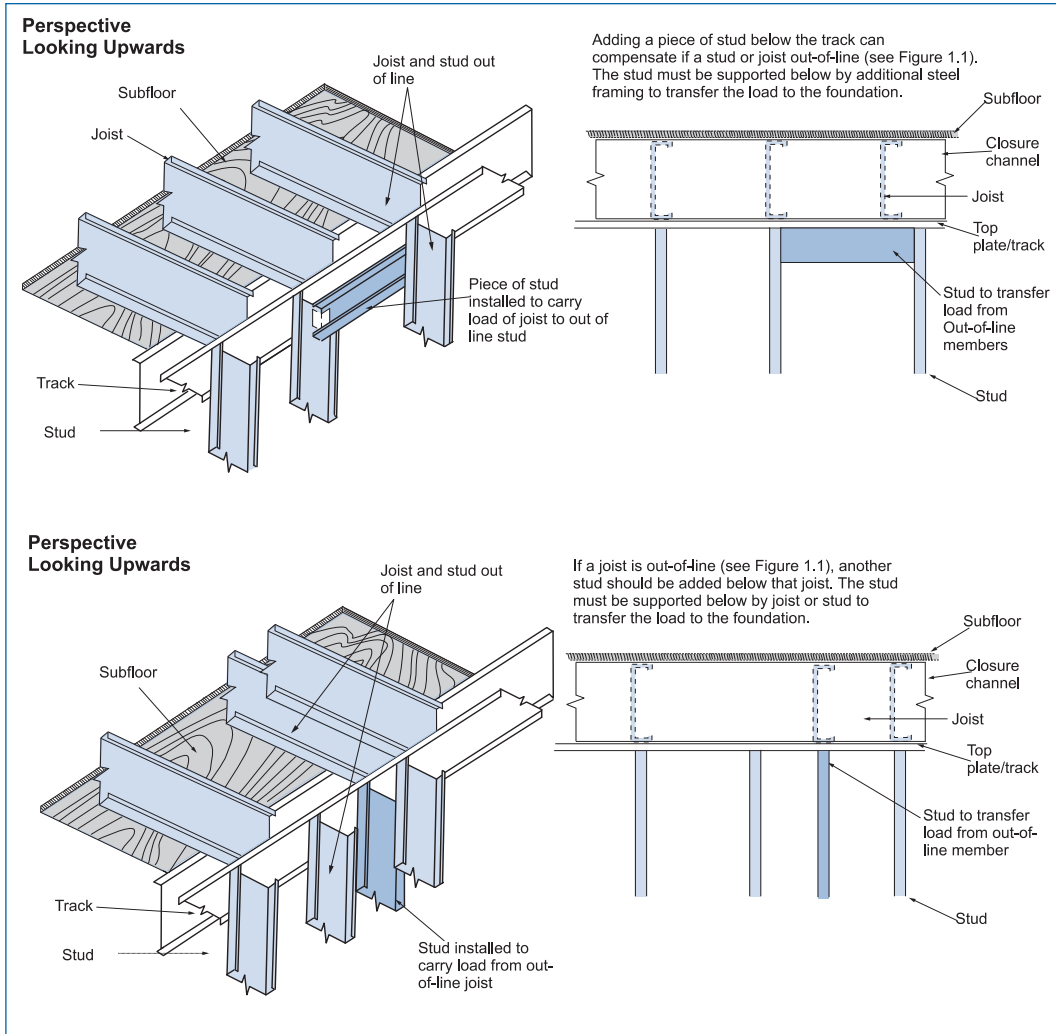


Figure 9.1

Out-of-line Members

Strapping out Walls

In some cases, there may not be sufficient space for a pipe to run through a wall. For instance, in cases where a vertical duct and a horizontal pipe need to run through the same wall section. Usually this type of problem can be avoided by planning ahead. One solution is to 'strap out' to create some additional space in which the pipe can run. See Figure 9.2

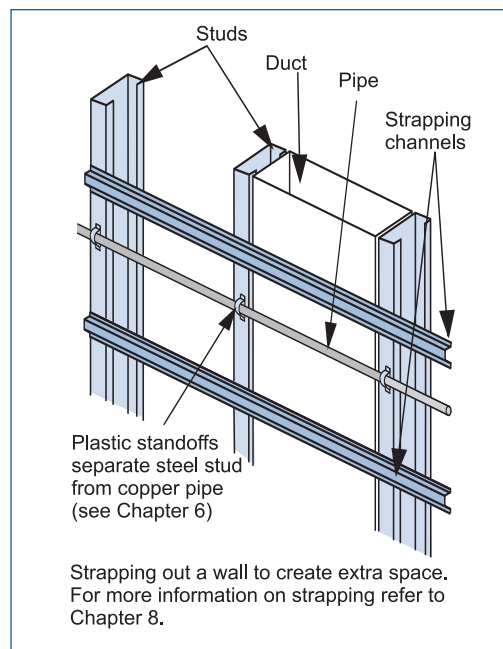


Figure 9.2

Strapping out Walls

Chapter 1: Getting Started Checklist			
		Y	N
Pre-Planning	Set up meeting with building official		
	Set up meeting with manufacturer		
	Set up meeting with designer		
	Set up meeting with electrical inspector		
Manufacturer	Cut list		
	Delivery Schedule		
	Accessories - clip angles, web stiffeners, strapping, blocking, fasteners, grommets, standoffs		
Trades	Qualify all trades for steel construction		
	Ensure proper layout for HVAC and plumbing stacks, toilet traps		

Chapter 2: Foundations Checklist		Y	N
Top of Foundation Walls	Top of foundation walls are level, or have been chipped and grouted to provide a level surface		
	A sill gasket, mortar bed or double row of non-hardening caulking has been installed between all framing members and the foundation		
Wood Sill Plate	Anchor bolts are a minimum diameter of 13 mm (1/2 in) bolts spaced at a maximum 2400 mm (94 in) o.c.		
	If closure channel is fastened to the wood sill plate by means of a steel plate, the steel plate is fastened with 4-#8 screws to the closure channel and 4- 10d or 6-8d common nails connect the steel plate to the wood sill		
	The closure channel can be fastened with screws through the flange to the sill plate		
Direct Bearing Anchorage	If using anchor bolts and clip angles, the clip angle is fastened with 8- #8 screws to the rim joist and bolted to the foundation, they are spaced according to the required anchor bolt spacing, at most every 2400 mm (94 in) o.c.		
	If using anchor ties, they have been installed and spaced according to manufacturer's directions, at a spacing no greater than 2400 mm (94 in) o.c.		
Nested Track and Stud Sill Plate	Anchor bolts are a minimum diameter of 13 mm (1/2 in) bolts spaced at a maximum 2400 mm (94 in) o.c.		
	If closure channel is fastened to the wood sill plate by means of a steel plate, the steel plate is fastened with 4-#8 screws to the closure channel and 4-#8 screws connect the steel plate to the sill plate		
	The closure channel can be fastened with screws through the flange to the sill plate		
Openings in Foundation Walls	All openings have had a header designed from the appropriate Member Selection Tables (Appendix A) or have structural windows installed		

Chapter 3: Floors Checklist			
		Y	N
Beams	All built-up lightweight steel beams (excluding header and trimmer configurations for openings) have been engineered		
	All structural steel beams have been selected according to building code		
	Steel beams bear no less than 89 mm (3 1/2 in) at end supports		
	Supports for steel beams meet Part 9 requirements, or have been engineered		
	Web stiffeners are installed in all joists where they bear on a beam below		
	Continuous joists supported by steel beams have been fastened with a clip angle screwed to the joist web and attached with 2 fasteners to the beam		
	Lapped joists supported on a steel beam have a clip angle installed between them fastened to through both joists with screws and to the beam below with 2 fasteners		
Closure Channels	The closure channel is of the same depth as the joists		
	The closure channel is at least 1.09 mm thick		
Joist Installation	Floor joists have been selected from the appropriate Member Selection Table		
	All floor joists are in-line with the studs below		
	The closure channel is not spliced within 75 mm (3 in) of a joist		
	Each joist is installed with a web stiffener at each end fastened with 2 -#10 screws to the closure channel and 3-#10 screws to the joist web		
	Any inaccessible spaces, such as double perimeter joists have had insulation added during framing		
	Knockouts line up		
	All joist webs face the same direction		
Web Stiffeners	Joists are installed from below and not walked on until the subfloor has been secured		
	Web stiffeners are installed at each location along the joist where it rests on a loadbearing stud wall, beam or foundation, and at joist locations supporting loadbearing walls or concentrated loads from above		
Blocking and Bracing	Web stiffeners are fastened on either side of the joist with 3-#10 screws to the joist web and 2-#10 screws to the closure channel (where present)		
	Solid blocking is installed between joists at a maximum spacing of 2400 mm (94 in)		
	Flat strap or notch channel bridging must be fastened to the bottom flange of each joist using at least 1 - #8 screw		
	Bridging straps should be at least 38 mm wide by 0.879 mm thick (1-1/2 in x 0.0346 in) and spaced not more than 2400 mm (94 in) from each support or other rows of bridging		
	The ends of the steel strapping should be fastened to the blocking with at least 4 - #8 screws. Alternatively, the strap can be anchored directly to the exterior wall		

Chapter 3: Floors Checklist			Y	N
Cantilevers	Where floor joists cantilever out beyond a support such as in the case of balconies or bay windows details have been engineered			
	Ensure air barrier continuity is maintained at all floor cantilevers			
	Exterior insulation in place to prevent thermal bridging			
Subfloor	The subfloor is fastened to the flanges of joists using #8 x 1-1/4 in (31 mm) bugle-head screws spaced 152 mm (6 in) o.c. along the sheet edges and 12 305 mm (12 in) o.c. in the field			
	Subfloors must conform to the NBCC Table 9.23.14.5.A			
Floor Openings	All header and trimmer members have been selected from the appropriate Member Selection Tables			
	All built-up sections should be made from members of equal thickness, and fastened together at least every 610 mm (24 in) o.c.			
	The sections used in built-up members must be continuous lengths, unless their purpose is non-structural (i.e. closing off rough openings).			
	Headers are fastened to trimmer joists using clip angle connections selected from Figure 3.30 "Header Connections for Floor Openings" and Figure 3.33 "Connections for Floor Openings"			
	Tail joists are fastened to stairwell headers using a clip angle connector with 3 - #10 screws per angle leg			

Chapter 4: Wall Checklist			
		Y	N
Member Selection	Wall studs align with each other from one floor to another and with the floor joist or rafter above and/or below		
	Size, thickness and spacing of studs have been selected and installed as specified in the appropriate Member Selection Table (Appendix A)		
	Track sections are at least as thick as studs		
Splices	No loadbearing studs have been spliced without an engineered detail		
	No track sections have been spliced within 75 mm (3 in) of a stud.		
	All track section splices are attached with 4 screws on each side of the splice.		
Fasteners	The track acting as bottom plate has been fastened through the subfloor into the closure channel below with 1 -#8 screw at 305 mm (1 in) o.c.		
	Each stud fits snugly into the track and bears on the web of the track		
	Each stud is fastened with 1 -#8 screw per flange at top and bottom		
Holes	All pre-punched holes in studs are aligned		
	No pre-punched or field cut openings are located within 305 mm (12 in) of the top or bottom of the stud without an engineered detail		
	All holes in studs are located in the middle of the web		
	No hole in a stud is larger than 38 mm (1 1/2 in) wide and 102 mm (4 in) long without an engineered detail		
Inaccessible studs spaces	All inaccessible stud spaces (jamb studs, lintels, corners, etc.) have had insulation installed during framing		
Corners	Corner studs have been properly connected and framed		
Second Floor	The subfloor is secured before the second floor walls are framed		
Horizontal Strapping	The horizontal flat strapping is attached to every stud flange with at least 1 - #8 screw.		
	There is at least one row of strapping for every 1200 mm (48 in) of wall height on every loadbearing wall		
Diagonal Bracing	All exterior walls have the appropriate number of braces and have been installed according to Figure 4.12		
	Braces are located at each wall end and the angle to the horizontal does not exceed 60 degrees.		
	Braces are fastened to every crossing stud with at least 1-#8 screws		
	Braces are anchored to double studs at the upper end and the closure channel at the lower end with 11 -#12 screws at each		

Chapter 4: Wall Checklist			Y	N
Wall Openings	King and jack studs as well as lintels have been selected from the Member Selection Tables (Appendix A)			
	King and jack studs are the same size and thickness as the wall studs			
	The lintel members are fastened together with 2-#8 screws at 610 mm (24 in) o.c.			
	Jack and king studs have been fastened together with 2 fasteners side by side at a maximum spacing of 610 mm (24 in) o.c.			
Interior Loadbearing Walls	All interior loadbearing walls bear directly on to a floor beam, loadbearing wall or other engineered element			
	All interior loadbearing wall have the appropriate number of rows of horizontal bridging			
Non-loadbearing walls	The bottom track has been fastened with screws or nails spaced not more than 610 mm (24 in) with a fastener within 50 mm (2 in) of each end of the track			
	Fire-rated steel studs in non-loadbearing walls are installed so that a 12 mm (1/2 in) clearance between the top of the stud and the track is maintained			

Chapter 5: Roof Checklist			
		Y	N
Ceiling Joists	Ceiling joists have been selected from the appropriate Member Selection Table		
	All ceiling joists are in-line with the studs below		
	Top flanges of all ceiling joists are braced with bracing spaced according to the Member Selection Tables		
	Each joist is installed with a web stiffener at each end, fastened to the rafter and wall top plate		
	Any inaccessible spaces have had insulation added during framing		
	All knockouts line up		
Top Plates	Any combination or type of top plate other than a double wood top plate has been engineered		
Rafters	Wood rafters have been selected and installed according to building code		
	Steel rafters have been selected and installed according to engineered details		
	Rafters are "in-line", if not using a wooden double top plate		
Roof Joists	Steel roof joists have been selected from the appropriate Member Selection Tables and installed according to engineered details		
	Wood roof joists have been selected and installed according to building code		
Roof Trusses	(Wood or steel) Have been selected and installed according to manufacturer's or engineer's instructions		

Chapter 6: HVAC, Plumbing & Electrical Systems Checklist		Y	N
Builder	Open lintels		
	Accessible corners		
	Grommets installed in inaccessible corners		
	Framing members adequately deep to accommodate plumbing and ducts		
	No holes cut greater than the web depth minus 76 mm (3 in)		
	No holes within 305 mm (12 in) of bearing		
	All large holes are located in the centre of the web and are reinforced		
HVAC	Installed with screws not nails		
	Any cold air returns constructed in stud cavities have had the stud knock-outs sealed on the outside with aluminium tape		
	Only tracks in non-loadbearing walls have been cut to accommodate ducts		
Plumbing	Fixtures (i.e. wall hung urinal) have adequate support such as blocking		
	Plastic grommets have been used in all holes to separate pipes from framing members		
	Pipe supports have been fastened with #6 self piercing screws in non-loadbearing walls and #8 self-drilling screws in loadbearing walls		
	Pumps and other noisy systems have been isolated from framing		
Electrical	All plastic insulated wiring is insulated from framing with CSA approved grommets and stand-offs		
	All installations conform to local electrical Code		
	Protection plates have been installed where holes have been drilled within 30 mm (1 1/4 in) of the edge of the stud		

Chapter 7: Insulation, Air & Vapour Barriers Checklist			
		Y	N
Insulation	Insulation has been installed in every wall, floor and ceiling separating heated space from unheated space		
	Insulation levels meet any requirements from local building code and climate		
	At least 25% of the required R-value of the assembly is located on the exterior of the frame		
	Cavity insulation properly fills the C-profile of each stud		
	All closed box assemblies have been filled with insulation		
	All floor headers have insulation within the C-profile and rigid insulation on the exterior		
	All voids in perimeter assemblies and around windows and doors have been filled		
Air Barriers	The materials and installation of air barrier systems shall follow the requirements specified in NBCC Part 9		
	All wall, ceiling and floor assemblies which are thermally insulated must have a continuous air barrier		
	All penetrations such as doors, windows, electrical wiring or piping must be sealed		
Vapour Barriers	The materials and installation of vapour barrier systems shall follow the requirements specified in NBCC Part 9		
	All inboard/ outboard ratios have been carefully adhered to in cases where exterior rigid insulation has a water vapour permeance of less than 60 ng/Pa•s•m ²		

Chapter 8: Interior and Exterior Finishes Checklist		Y	N
Furring	All wood furring is selected and installed as per NBCC Part 9		
	All steel furring is selected and installed as per manufacturer's instructions		
Board Finishes	Sharp pointed drywall screws can be used to attach the drywall to the steel members up to 0.879 mm (0.0346 in) thick		
	For members thicker than 0.879 mm (0.0346 in), drill point screws are used to fasten drywall		
	The spacing of fasteners should be as per manufacturers instructions		
	Drywall is not used as bracing, therefore it can be installed either horizontally or vertically		
	Board finishes are applied to steel frames with sharp point or drill point (depending on member thickness) screws instead of nails, unless wood furring is used		
Cabinets	Cabinets may be fastened directly to loadbearing members, to wood or steel blocking fastened to loadbearing studs or to strapping fastened to loadbearing studs		
	Only shelving for closets may be attached to non-loadbearing studs		
	Cabinets are attached directly to loadbearing studs using #8 50 mm (2 in) self-drilling screws		
Other Fixtures	Any fixtures (towel racks, grab bars) must be fastened to blocking		
Flooring	Finish flooring is installed as per Part 9 of the NBCC and manufacturer's instructions		
Sheathing, Sheathing Paper and Flashing	Rigid insulating sheathing is required on every lightweight steel framed house (see Chapter 7), and installed using #8 drill point screws and washers		
	Structural sheathing and sheathing paper should be installed as dictated by Part 9 of the NBCC and as required for the exterior finishes being used		
	Flashing must be installed as per Part 9 of the NBCC		
	Flashing can be made of galvanized sheet steel or aluminum		
Exterior Finishes	All finishes should be installed without crushing the insulating sheathing		
	Finishes should be fastened with screws that penetrate the loadbearing studs or can be nailed to structural sheathing or wood strapping applied over the insulating sheathing		