Light gage structural steel framing has become increasingly popular with architects and structural engineers because of its high strength, low weight, non-combustibility, dimensional stability and flexibility in fabrication and erection. It can be used both as the main structural system for low rise buildings, and as the back-up for many curtainwall systems.

A particular advantage is its adaptability to job and site conditions. Prefabrication into panels can be accomplished either at the job site or the contractor’s shop; and, of course, traditional piece-by-piece construction is readily done. Even better, all of this is possible without recourse to expensive additional equipment.

While considerable information on steel framing fabrication is available from manufacturers and suppliers, the Metal Lath/Steel Framing Association has long felt the need to bring this together in more useful and basic form. This document — prepared by the Association’s Technical Committee — has been designed to meet that need. While it is primarily directed at the contractor, particularly those who are considering entry into the field, we hope that it will be of equal use to already active contractors and to architects and structural engineers. We invite comments from the whole building team.
Steel framing normally can be handled and transported without expensive equipment. A forklift and flat bed truck will usually suffice.

I. MATERIAL ARRIVAL:

A. Truck unloading.

It is assumed that job requirements call for a full truck load of material. The delivering carrier — whether a common carrier, a steel hauler, or the framing manufacturer — will probably use a flat bed truck or trailer.

The material will be either bundled or palletized. Pallets will generally be approximately 2’ wide x 2’ high x the length of the material (from 8’ long to a maximum of 40’). Weight will generally not exceed 4,000 pounds.

A forklift can handle most unloading jobs quite easily. A spreader-beam with end slings can also be used with a crane, which can be any size from a small cherry-picker to a 50-ton mobile (if one is on the job and advance arrangements for its use are made).

Instead of a crane, some shops may have an overhead bridge crane or monorail available. A sideloader may also be used instead of a forklift.

II. MATERIAL HANDLING:

A. At the job-site.

As the material is unloaded, it can be spotted conveniently around the site.

1. If the structure is single story on a concrete slab, the material can be located approximately where it will be used.
2. If the building is going to be two to four stories high, the material for the upper floors can be stacked around the building where it will be used later, floor by floor.
3. For curtainwall applications, mid- or high-rise, it can be hoisted to its appropriate floor by the boom crane, or taken up the freight or construction elevator. A small dollie or wagon may be required to get the material from the elevator to its usage area.

The material will be either job-site fabricated into panels, or installed a piece at a time. In either event, special equipment is usually not required.

If panelized on a slab or floor, the panels can be tilted into place by hand. If the panels are oversize, or have to be attached to outside supports, a portable crane may be needed. Panels for low-rise buildings can be hoisted into place by a forklift with extendable forks, or lifted by a small boom (cherry-picker).

B. In the Shop.

Material that goes to a shop is either going to be cut to length or fabricated. Assuming the material will be panelized, it can be spotted in the fabrication area while unloading.

1. In either case, the material can be moved from the storage area to the saw by a forklift or an overhead crane.
2. The feed into a saw is generally from a conveyor, roller type stands, or table. The cut lengths continue from the saw on roller stands and can be stockpiled on material wagons. Movement to the wagons will be by hand.
3. Wagons are then moved to the assembly area, consisting of table top jigs, where the cut pieces are fabricated into panels. Again, handling is by hand.

III. TRANSPORTATION:

A. Job-site.

Once material is unloaded at the job-site, further transporting is rarely required.

B. Shop.

Shop-fabricated material must be moved from the shop to the job-site. The distance is generally short; however, it can vary from a few miles to many.

C. Drayage considerations.

In helping to arrive at a decision as to what transporting equipment will be needed, the following seven factors should be carefully considered and evaluated:

1. Panel finish:
   a. If the panel is free of collateral materials (insulation, metal lath and plaster, etc.), it can be easily transported flat. If not, vertical shipment is usually called for.

2. Transporting distance:
   a. Short haul (0-50 miles)
   b. Medium haul (50-100 miles)
   c. Long haul (100 + miles)

Usually not practical, particularly if the loads are over-sized (see 3 & 4 below), or the job-to-shop route is through a congested urban area. A long haul through a rural or suburban area, on the other hand, may be justifiable.

3. Panel size:
   a. 8’ high x X’ long (single story or in-fill curtainwall; floor to beam, column to column).
   b. 8’ wide x X’ high (3 story curtainwall by-pass).
   c. 8’ wide (standard truck bed).
   d. Oversize panels — may require over-the-road permits.

4. Permits (check local and state regulations):
   a. Overwidth
      Up to 8’ no problem
      8’ to 10’ permit only ($15 to $50, depending on state).
      10’ to 12’ permit plus lead car.
      12’ to 14’ permit plus lead and tail car (Freight rate approx. 200% of normal).
   b. Overlength
      Up to 4’ permissible with red flag.
      Over 4’ permit plus additional tail lights
   c. Overheight
      Up to 13’ or 14’ (from ground) permissible depending on state.
      Over 13’ or 14’ requires permit and careful route selection to avoid most underpasses.
d. Restrictions
   All permits are limited from dawn to dusk, no
   weekends, no holidays.

5. Weight of the panels:
   a. Not usually prohibitive since a steel framed panel
      (unfinished) will weigh only around 2 pounds per
      sq. ft.
   b. Volumetric space is usually filled before weight
      limitations are reached.

6. Number of trips:
   If a large number of trips or oversized loads are re-
   quired through a congested area, the freight expense
   may be prohibitive and job-site fabrication should be
   considered.

7. Job-site conditions:
   a. Ample space — panels could be delivered and stock
      piled in advance of erection.
   b. Restricted space — panels may have to be erected
      off the truck as they are delivered.

D. Vehicle selection:
   Once an evaluation has been made to satisfy the con-
   siderations covered in C above, and depending on available
   equipment, the actual vehicle will fall into one of the fol-
   lowing categories:
   1. Flat bed trailer (with a pick-up truck).
   2. Regular flat bed truck (16' to 20' bed).
   3. Tractor and semi-trailer
      flat bed — 36' to 50').
   4. Lowboy tractor-trailer.
      Item 1 above is recommended for small panels, a
      short haul distance and a relatively small job. Item 2
      should be considered for a medium haul distance, aver-
age size panels and a small or medium sized project.
      For a large project requiring several loads on a
      medium or long haul, with possible oversized panels, a
      tractor-trailer rig would be ideal.
      A lowboy tractor-trailer is generally recommended
      for semi-finished panels, oversized panels, or oversized
      panels that are going to be transported vertically.

IV. SUMMARY:
   The first determination the contractor has to make is whether
   to fabricate on-site or in his shop. Factors influencing this
decision will depend on:

A. Size of the project:
   1. Actual physical size
      a. Single story
      b. Low-rise
      c. High-rise
   2. Amount of light-gage steel framing required.

B. Available Facilities:
   1. Adequate shop
   2. Available equipment

Ingenious workmen have developed some very innovative
methods of handling and transporting light gage steel fram-
ing. These methods are usually adopted to suit job condi-
tions or to utilize equipment they have at their disposal.
Contractors should be alert for such possibilities and en-
courage their development by both foreman and craftsman.
Saving time and movement will pay big dividends.

SHOP LAYOUT AND FIXTURES

The fabrication of light gage steel framing wall and floor
panels consists of cutting the members to length, fitting the
sections together, and fastening the sections by welding or
screw attachment. Often fabricators may go one step further
and attach the exterior sheathing or insulation board onto the
panel.
   Fabrication of the panels at a fabricating shop often offers
many advantages over site fabrication. Some of these are:

A. Site conditions may be such that room for the fabrica-
tion of panels and storing of materials is not available.
   Some jobs require the panels to be erected right from
   the panel transporting truck.
B. Shop fabrication of panels can commence while site
   work and footings are being poured. Therefore, the
   panels can be ready for erection as soon as the founda-
tion or slabs are ready to receive the panels.
C. Shop fabrication can continue through bad weather.
D. Fabrication costs often are lower. Workers are more pro-
ficient in a shop environment, where an assembly-line
   type system can be readily established.
E. Quality of workmanship is often better. Shop welding
   in a controlled atmosphere is superior to field welding,
especially with the Gas Metal Arc Welding (GMAW)
process.

To fabricate light gage structural framing systems econom-
ically and successfully, a fabricator should have an adequately
equipped shop.
   Figure 1 shows a typical shop layout with equipment and
supplies conveniently located and planned for efficient move-
ment of materials. Here are some general and basic recommen-
dations:

A. Establish proper in-process flow. When planning your
assembly and fabrication shop, materials must move
smoothly and rapidly from one station to the next.
B. Avoid delays or bottlenecks in the flow of product by
placing tools, framing materials, and supplies close to the
work tables and within easy reach of workers.
C. Timing is important in that assembly and fabrication
proceed with the needs of the job. For example, balance
the fabrication to meet the speed of erection.

Figure 1
IN GENERAL, YOU’LL NEED THE FOLLOWING SPACE, EQUIPMENT, AND TOOLS IN SETTING UP A FABRICATION SHOP:

A. Approximately 2,400 square foot (minimum) of floor space plus a yard to store materials and panels.
B. Raw storage area approximately 8’ x 32’ plus one horizontal rack.
C. Panel storage area approximately 12’ x 40’ minimum.
D. Jig fixtures. For commercial construction, recommended size is 12’-0” wide by 32’-0” to 40’-0” long. For residential construction, recommended size is 9’-6” wide by 32’-0” long.
E. Each table is fitted with four DE-STA-CO type fitting clamps or air/hydraulic cylinders to hold the track section seated properly over the studs.
F. Two MIG welders per fixture table with .045 wire, rectifiers, wire feeder guns and spot-time attachments.
G. Over-head track to mount the wire-feeder and spot timer.
H. One 3,200 R.P.M. radial arm saw fitted cutting blade.
I. One forklift with a boom to move panels.
J. 30 ft. roller conveyor in 10 ft. sections.
K. Vise grips
L. Canvas shields for weld flash protection.
M. Paint touch-up equipment.
N. Miscellaneous tools as required.

The fixture tables are the keys to successful assembly and fabrication. To minimize the investment, build them yourself from light gage steel framing materials.

Figures 2 and 3 show a fixture table extendable from 7'6'' to 12'6'' in width x 32'-0'' long. This table should meet the requirements of most residential and commercial construction.

CUTTING

Light gage steel framing components may be ordered cut to length; however, some cutting by the contractor will probably be necessary for most projects.

The most efficient means of cutting is a radial arm saw fitted with either a friction type blade (280 - 300 teeth) or a reinforced abrasive cut-off wheel. The blade should be a minimum of 14” in diameter and 1/8” thick. The radial arm saw should produce 7.5 horsepower at 3,400 revolutions per minute.

Hand cutting should be done with a 3 horsepower, worm drive, hand-held circular saw equipped with a reinforced abrasive cut-off wheel. Power hack saws and band saws may also be used; however, they are usually too inefficient to be used on large projects.

Care must be exercised in the use of all cutting equipment. Blades should be shielded to prevent accidents, contain sparks, and protect the worker in case of blade fracture.
WELDING

For any structural member to perform to its design capacity, it is critical that strong, uncomplicated, economical connections be used to secure it.

Welding is widely accepted as being the best, the most economical and the most practical way to join steel to steel. Overlapping of pieces being joined is not necessary, and the thickness of the weld area can be held to the thickness of the member to either side.

Welding Processes

There are more than 40 methods for joining metals by fusion, with or without the help of added metal. Of these methods, four lend themselves to the fastening of light gage steel framing components. They are Shielded Metal — Arc Welding (SMAW); Gas Metal — Arc Welding (GMAW); Resistance Spot Welding (RSW); and Resistance Projection Welding (RPW). The first two are fusion welds, and the remaining two are resistance welds.

Fusion Welding

1. SMAW is an arc-welding process wherein the arc supplies the heat needed to melt the base metal surfaces being joined and the filler metal, which then fuse together. The filler metal is provided by a consumable coated electrode which establishes the arc and gradually melts away, filling the joint. The shielding is accomplished by the melting of the coating on the electrode. Recommended filler metals for the SMAW process are:

   - AWS E-6012 or AWS E-6013 (Mild Steel Electrode)
   - AWS E-Cu Al - A2 (Aluminum - Bronze Electrode)
   - AWS E-Cu Si (Silicon - Bronze Electrode)

   The equipment required for SMAW (stick welding), consists of a 200 amp, “hot box” electric welder. A welder like this requires 220-volt electrical service and costs approximately $150.

2. GMAW is an arc-welding process in which the arc is shielded by a chemically inert gas, such as Argon or CO₂. This process is often called inert-gas welding for short; or, more specifically, when a consumable metal electrode is used, metal inert-gas welding (MIG). In MIG welding, the electrode is mechanically fed into the arc. This type of welding is most economical for shop conditions. Recommended filler metals for GMAW are:

   - AWS E-7014 (Mild Steel Electrode)
   - Use CO₂, Argon-oxygen, or Argon-CO₂, shielding
   - AWS R-Cu Al - A2 (Aluminum - Bronze Electrode)
   - Use Argon gas.
   - AWS R-Cu Si - A (Silicon - Bronze Electrode)
   - Use Argon gas.

For GMAW (MIG welding), use a wirefeed welder with a capacity of 60-110 amps, and approximately 23 volts variable output. A welder like this requires 220-volt, three-phase electric service and costs approximately $1,800.

Resistance Welding

1. RSW is a resistance welding process wherein fusion is accomplished by clamping the parts to be joined under pressure using the electrodes. Current is then passed through the electrodes and fusion occurs due to the heat generated by the resistance of the metal to the electrical current. The size and shape of the individual welds are limited primarily by the size and contour of the electrodes and by the magnitude of the welding current.

2. RPW is a resistance welding process in which fusion occurs using the same principle as in RSW. The difference in these two processes lies in the fact that in RPW projections or embossments are pre-set into the base metals being joined and fusion occurs when the pieces are clamped together and charged with the electric current. RPW is mostly for shop fabrication and should conform to “Recommended Practices for Resistance Welding, Coated Low-Carbon Steels, AWS Cl. 3-70”.

Recommendations

GMAW is the most preferable process for shop fabricating for these reasons: no slag build-up, cleaner, faster, with no need to continually replace electrodes. It is also easier on the welder. Stick-welding (SMAW), while the most popular for field use, has some disadvantages. The heat is hard to control and requires constant adjustment as job and weather conditions change. Another drawback is a slug build-up which must be chipped away in order to inspect the weld quality.

Resistance welding (both RSW and RPW), has proven to be largely unsuccessful. In resistance welding, the electrodes must come in contact with base metals for the electrical current to flow. Any surface finish on the metal, such as red-oxide paint or galvanizing, prevents the electrodes from making proper and secure contact, resulting in a poor weld.

The coating on steel does not effect the weld quality in fusion welding; however, care should be taken when welding galvanized materials to provide adequate ventilation.

Design of Welded Connections

The purpose of any connection is to permit the structural member being joined to perform to its ultimate capacity. Therefore, all connections should be designed to transmit the maximum stress in the connected member with proper regard for eccentricity. If members are subject to reversals in stress, except if caused by wind or earthquake loads, the connection should be designed for the sum of the stress. Connections subject only to stresses from wind or earthquake loads may be portioned for stress 33-1/3 percent greater than those specified for dead and live load stresses, in accordance with A.I.S.I., Section 3.1.2.1.*

The American Welding Society (AWS) has published a chart of standard welding symbols. The information provided there requires an understanding of basic engineering fundamentals. It is important, therefore, that the design of structural connections be left to the Project Engineer.

Fusion Welds

The types of fusion welds generally used for connecting light gage steel framing components to each other, or to hot-rolled structural components, are fillet welds, butt welds, plug welds and arc-spot welds (puddle welds).

Fillet welds and plug welds are suitable whenever the metal being joined is lapped. With fillet welds, if the weld is parallel to the direction of the applied force, it is longitudinal; and if it is perpendicular, then it is transverse. Transverse welds are stronger, per inch of weld, than longitudinal welds because they are more uniformly stressed along the entire length of the weld. The strength of plug welds, per inch of weld (the length of the plug weld is considered to be the perimeter of the hole), is close to that of transverse welds.

* Sections mentioned here and later from A.I.S.I. are taken from the A.I.S.I. Cold-Formed Steel Design Manual - Part 1 “Specification for the Design of Cold-Formed Steel Structural Members”, 1968 edition.
Fillet welds and plug welds should be positioned so that they are subject to shearing stress only. The allowable shear may be computed by multiplying the allowable weld shear stress by the throat area of the weld. However, the throat thickness dimension shall not exceed the thickness of the thinnest member being connected. Permissible shear stress values for fusion welds are given in A.I.S.I., Section 4.2.1.

Allowable shearing force per inch of weld based on full thickness penetration are as follows:

<table>
<thead>
<tr>
<th>Design Thickness(t)</th>
<th>Throat Area 0.707 x t x 1&quot;</th>
<th>Weld In Shear (Lbs. Per Lineal Inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0478</td>
<td>0.0339</td>
<td>460</td>
</tr>
<tr>
<td>.0598</td>
<td>0.0420</td>
<td>570</td>
</tr>
<tr>
<td>.0747</td>
<td>0.0530</td>
<td>720</td>
</tr>
<tr>
<td>.1046</td>
<td>0.0707</td>
<td>960</td>
</tr>
</tbody>
</table>

Butt welds are considered to be as strong as the lower grade or base metals being joined for both tension and compression stress. This is provided the weld penetrates 100 percent of the section and the yield strength of the filler metal meets or exceeds the yield strength of the base metal. Stresses due to eccentric loading should be combined with the primary stresses.

**Resistance Welds**

In the design of resistance welds, both spot and projection welding are used mostly for shop welding with light gage steel framing. Permissible shear strength per spot weld is given in A.I.S.I., Section 4.2.2, and is based on AWS “Recommended Practices for Resistance Welding.” Spot welds should only be used where the weld is subjected to shear stresses. The allowable shear per spot weld shall be as follows:

<table>
<thead>
<tr>
<th>Thickness of Thinnest Outside Sheet, In.</th>
<th>Allowable Shear Strength per Spot, kips</th>
<th>Thickness of Thinnest Outside Sheet, in.</th>
<th>Allowable Shear Strength per Spot, kips</th>
</tr>
</thead>
<tbody>
<tr>
<td>.010</td>
<td>0.050</td>
<td>.080</td>
<td>1.075</td>
</tr>
<tr>
<td>.020</td>
<td>0.125</td>
<td>.094</td>
<td>1.375</td>
</tr>
<tr>
<td>.030</td>
<td>0.225</td>
<td>.109</td>
<td>1.65</td>
</tr>
<tr>
<td>.040</td>
<td>0.350</td>
<td>.125</td>
<td>2.00</td>
</tr>
<tr>
<td>.050</td>
<td>0.525</td>
<td>.188</td>
<td>4.00</td>
</tr>
<tr>
<td>.060</td>
<td>0.725</td>
<td>.250</td>
<td>6.00</td>
</tr>
</tbody>
</table>

(The above values are based upon “Recommended Practices for Resistance Welding”, C1.1-66, American Welding Society, 1966 and apply to pulsation welding as well as spot welding.)

If tensile strength of spot welding is required, it can either be obtained from tests or from empirical formulas for tensile and shear strengths proposed by Henschkel.**


**OTHER FASTENING SYSTEMS**

While we recommend welding as the safest — and most economical — method of assembling steel framing components, there are other methods available, particularly for the attachment of collateral materials.

1. **Bolts.** Steel studs and joists are not pre-punched with fastener holes, threaded or unthreaded. As a result, nuts and bolts aren’t generally used with this system. The major exception would be anchor bolts employed to fasten stud tracking to concrete foundations or floors.

2. **Screws.** Self-tapping screws can be an alternative to welding for some jobs. You will want to follow the recommendation of the framing manufacturer — in consultation with the architect — in using this system. While not always ideal for assembling the frame itself, screws are the most common way of attaching collateral materials. In one motion, the screw drills its own hole and securely fastens metal, wood, drywall, decking, facings, lath, electrical and mechanical components, and clips and accessories to the steel framing and to other structural members of the system.

Doing the job are hand-held screw guns that operate at 2,500 RPM on 115-volt power. Screws come in a variety of head styles to fit the total range of requirements . . . with zinc or cadmium plating to meet the needs of the application environment . . . screws are also available with sealing washers to resist moisture and corrosive atmospheric conditions.

3. **Nails.** Spiral-shank nails — case hardened and phosphate treated to etch their surface for increased holding power — are used predominantly to fasten plywood subfloors to the top flange of the steel joist. (After the nails pass through the wood and penetrate the flange, the screw threads make a quarter turn to cut a partial thread in the pierced steel, firmly connecting subfloor and joist.) Nails are also employed to fasten materials to nailable studs and joists, which consist of two rolled channel sections welded back to back, with nailing grooves for attachment of collateral materials.

4. **Adhesives.** Adhesives are optional when self-drilling screws are used in attaching plywood to steel joists, but are recommended when hardened screw-shank nails are employed for this application. With either fastening method, the long-term bonding efficiency of construction-type adhesives contributes to stable, non-squeaking floor assemblies, and acts as an acoustical insulator. Adhesives are also utilized in attaching drywall materials and paneling to steel studs, serving to eliminate some but not all of the need for mechanical fasteners.

5. **Power Driven Fasteners.** Powder-actuated fastening tools
use .22 or .23 caliber cartridges to provide the power load. For safety reasons, select a force-entry tool in which the power load cannot be fired unless the tool is first pressed firmly against the track web.

Correct fastener penetration is obtained by matching the energy level to the job. In the low-velocity model of this power tool, the force of the power load acts on a central piston which drives the fastener. In the standard-velocity model, the power load acts directly on the fastener head to drive it through the steel and into the concrete. The velocity of the fasteners can be changed to suit material densities by proper load selection and/or placing the fasteners at different depths in the barrel bore.

Usually used for attaching wall track to concrete slab.

6. **Wire Ties.** Wire tying is sometimes acceptable for attaching metal lath to framing components, but should never be used for joining framing components in load-bearing or curtainwall applications.

**ERECTION**

Before doing any fabrication or erection, the contractor will usually submit fabrication and erection drawings to the architect and obtain his approval. After approval, careful site measurements should be taken so that any variations from the original plans can be allowed for. Care should be exercised at all times to avoid unnecessary damage through careless unloading, handling and erection of steel framing. Of course, steel framing should be set level and true and in a workman-like manner. During erection, care should also be exercised to avoid application of construction loads that exceed the carrying capacity of the studs and/or joists. Here are some additional important tips and suggestions:

1. Make certain that you use equipment of adequate capacity.
2. Don’t depend on light gage framing to support any heavy equipment used in erection work.
3. All erection work must be level and to dimensions and elevations as indicated by plans, using leveling instruments and plumb bob. Report any discrepancies in plumbing or leveling to the architect.
4. Track must be securely anchored to the floor and overhead structure as indicated by plans, specifications, and code. Axially loaded studs must be seated squarely in the track, the stud web and flange abutting the track web, and all studs have to be plumbed, aligned, and securely attached to the flanges and webs of both upper and lower track. Studs must be positioned in track so as to be aligned directly below floor, roof, or ceiling framing members above. If not, headers must be provided.
5. Load bearing walls with steel studs and track must have a continuous, uniform base support underneath. Horizontal bridging, when required, should be installed before floor, roof or ceiling structure overhead is installed. The ends of the horizontal bracing must be securely anchored to suitable restraining columns or walls. Make welded connections by the fusion, resistance or fill process, in accordance with the latest recommended procedures and practices of the American Welding Society.
6. Provide stud walls at location indicated on plans as “Shear Walls” for frame stability and lateral load resistance. Then brace them as indicated on plans and specifications. Provide additional studs as needed to resist the vertical components as indicated on plans and specifications. Prefabricated panels and sub-assemblies must be square and may require bracing to resist racking. Exercise care in lifting prefabricated panels and sub-assemblies to prevent local distortion. When non-load bearing steel stud partitions abut underside or are attached to load-bearing structural frame, the non-load bearing studs must be attached with slip connections to relieve stress from deflection of major framing.
7. At the corners and intersections of stud walls, provide a minimum of 3 studs, located so as to provide surfaces for attachment of all interior and exterior facings. Provide jack studs between all track and window sills; between window and door headers and top track; and free standing stair rails and elsewhere to furnish structural support. Make sure they’re securely attached to supporting members.
8. Steel studs and joists must be installed and reinforced in accordance with the applicable load-span tables. Ends of load bearing studs must be attached with slip connections or are attached to load-bearing structural frame, the non-load bearing studs must be attached with slip connections to relieve stress from deflection of major framing.
9. Framing components must be cut so that they fit squarely against abutting members, and be held firmly in position until properly fastened in accordance with manufacturer’s specifications. Wire tying of framing components in structural applications is not permitted.
10. Size and space joists as shown on drawings. Provide additional joists or “blocking” adjacent to exterior and interior walls, openings and elsewhere as necessary to provide support for ceiling construction as indicated by plans and specifications. Provide an additional joist under parallel partitions where the partition length exceeds one-half the joist span and for all floor and roof openings which interrupt one or more span members, unless otherwise noted. The ends of the joist must be fixed to prevent rotation and buckling. Steel joists may also be attached to other steel joists using steel joist hangers and/or clip angles as specified by manufacturer’s specifications. The ends of the joists may be set in pockets formed in masonry block or concrete. These joists must be adequately reinforced, leveled, and grouted.
11. Both lateral and diagonal bracing must be provided for in accordance with the manufacturer’s specifications or recommendations. Lateral bracing prevents the stud from bending about the minor axis due to axial loads and also prevents flange rotation due to uniform wind loading. Sheathing and wall board attached to both sides of the studs, if properly designed, can provide for horizontal bracing and resist diaphragm action. However, during construction, before wall sheathing is applied, floors and walls are often loaded with construction loads, thereby necessitating lateral bridging. If the sheathing is not designed to resist diaphragm action, then diagonal bracing must be used to resist racking loads imposed by wind or earthquake. Diagonal bracing may be steel straps which are stressed in tension when resisting racking. The straps extend from the bottom of one stud to the top of another, preferably at 45 to 60 degrees from the horizontal. The angle at which the strap is installed significantly affects the strap’s ability to resist racking loads. Where required by the manufacturer’s load span tables, the joist must be bridged with horizontal steel strapping fastened to the bottom flange and secured to a positive restraint at the ends. Refer to manufacturer’s specifications for exact requirements for other suitable means of bridging.
12. During erection, steel cables with turn buckles may be installed in sufficient number to prevent distortion and damage to frame work due to wind or erection forces. These cables may also be used to plumb and align the work. The cables may be left in place until sufficient partitions have been placed to secure the lateral stability of the building.
13. **Splices in axially loaded studs are not permitted.**
14. Since the manufacturer cannot anticipate all of the various loadings which might be placed upon light-gage steel framing during the course of construction, the architect or project engineer should be consulted when necessary.
As an additional aid, the following is a checklist of equipment normally required for erecting steel framing:

1. **Hoisting**
   A. Fork-lift.
   B. Truck-mounted hydraulic crane with telescoping boom.
   C. Truck-mounted, cable-operated crane.
   D. On-slab winch type hoist.

2. **Framing Attachment**
   A. Welding equipment
   B. Bolting apparatus
   C. Power driven fasteners

3. **Safety Equipment**
   A. Barricades, fences and guardrails
   B. Adequate planking, platforms, and guardrails for open shafts
   C. Hard hats and safety glasses
   D. Ladders conforming to state, local, and applicable ladder safety codes.
   E. Scaffolding capable of supporting four times the expected load of men and material, guardrails on all exposed sides, and locking brakes.
   F. Safety belts when required.

### TECHNICAL BULLETINS AVAILABLE FROM ML/SFA

- Specifications for Metal Lathing & Furring, 16 pp.
- Curtainwall, 4 pp.
- Fire-rated Metal Lath/Steel Stud Curtainwalls, 2 pp.
- Metal Lath Curtainwall Specifications, 4 pp.
- Light Gage Steel Framing Specifications, 4 pp.
- Introduction to Steel Framing, 4 pp.
- Physical Property Selection Charts for Channel Studs Used in Exterior Wall Construction, 6 pp.

For copies of any of the above publications, write: Metal Lath/Steel Framing Association.