GUIDELINES PUBLICATION NO. MFMA-103

GUIDELINES FOR THE USE OF METAL FRAMING

2004 Revision

METAL FRAMING MANUFACTURERS ASSOCIATION

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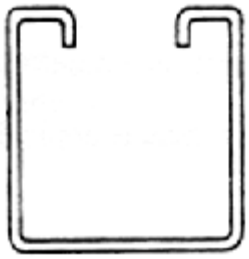
FOREWARD

This publication provides general guidelines for the use of continuous slot-channel metal framing and strut-type channel raceway, supplementing instructions of individual metal framing manufacturers. While it is not intended to be an all-inclusive document, it does highlight a number of important factors relative to the use of metal framing.



PROFILE OF TYPICAL METAL FRAMING CHANNEL

The safety of the total system involves the system designer, installer, and user. The manufacturer has limited or no control over factors such as environmental conditions, total system design, product selection and application, installation practices, and system maintenance. *Consequently, the Metal Framing Manufacturers Association (MFMA) disclaims all warranties, express and implied, associated with this Guideline publication.* The Guideline has been developed with a view towards promoting safety to persons and property when the metal framing system is properly selected and when installed as an electrical raceway, it shall be installed according to Article 384 of the National Electrical Code.

For additional information with regard to metal framing, see MFMA's *Metal Framing Standards Publication*, latest edition, as well as individual manufacturers' catalogs.

This Guideline has been developed in the public interest and is intended to promote a better understanding between the manufacturer and the user. It is intended to assist the user in selecting and obtaining the proper product for a particular need. However, as a matter of policy, MFMA neither renders decisions or opinions on questions relating to the selection and use of specific metal framing systems in individual situations, nor renders decisions or opinions on questions relating to compliance by specific metal framing manufacturers or their products with MFMA standards or guidelines. Any specific technical questions should be directed to MFMA members listed in Appendix A.

This Guideline discusses design and technology commonly seen in the metal framing industry today. It is neither intended as, nor should it be construed as, a statement against or an impediment to new metal framing design and technology as the industry continues to grow.

This Guideline will be reviewed and updated periodically. MFMA will continue to welcome written comments from interested parties at any time. All such comments should be addressed to :

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TABLE OF CONTENTS

		Page
SECTION 1	**GUIDELINES FOR DESIGN**	1
SECTION 2	**TYPES OF BEAMS AND LOADING**	2
	Simple Beam	2
	Cantilever Beam	2
	Point Loading	2
	Uniform Loading	2
	Column Loading	2
	Eccentric Loading	2
SECTION 3	**BRACING**	3
SECTION 4	**LOADING DURING INSTALLATION**	3
SECTION 5	**SAFETY FACTORS**	3
SECTION 6	**TEMPERATURE**	4
	Finishes	4
	Materials	4
	Electrical	4
	Installed Loads (Pipe)	4
	Dissimilar Materials	4
SECTION 7	**CHANNEL NUTS**	5
	Components	5
	Materials and Finishes	5
	Assembly	5
	Precautions	5
SECTION 8	**CONCRETE INSERTS**	6
	Application	6
	Types	6
	End Caps	6
	Concrete Seepage	6
	Installation	7
	Recommendations and Precautions	7
	Some Specific Recommendations	7
SECTION 9	**SWIVEL AND SWING FITTINGS**	8
SECTION 10	**SUPPORT**	8
	Channel Support from Beams	8
	Trapeze Support	8
	Channel Joiners	8
	Wall Brackets (Cantilevered Load)	8
	Nonmetallic Pipe or Conduit Support	8
SECTION 11	**ARCHITECTURAL AND MAINTENANCE PAINTING**	9
APPENDIX A	**MFMA MEMBER COMPANIES**	10

SECTION 1
GUIDELINES FOR DESIGN

There are many factors to be considered in the general design of metal framing systems. Some basic considerations that should be addressed during the design of any metal framing system are:

1.1 Scope and purpose of the system.

1.2 Applicable building codes, standards, and specifications that may preempt manufacturer's published design data.

1.3 Applicable electrical specifications such as the National Electrical Code, Underwriters Laboratories, Standard UL5B, MFMA, etc.

1.4 The environment (temperature, moisture, corrosive atmosphere, etc.) in which the system will be placed.

1.5 Loading, type, and magnitude.

1.6 Materials to be used in the system (steel, aluminum, etc.).

1.7 Selection and proper use of channel, fittings, accessories, and fasteners.

1.8 Deflection.

1.9 Lateral bracing.

1.10 Torquing of fasteners.

1.11 Selection of materials and finishes to prevent galvanic reaction between mating components.

Note for clause 1.12: *One company does not support the change "shall be permitted" for subclause 1.12 for the reason: In standard language, the word "shall" denotes a mandatory requirement, which cannot be in a section that starts with "…Some basic considerations should be addressed…" "Should" is the term for voluntary action or consideration. Since these are guidelines, we better remain with the word "used."*

1.12 Strut-type channel raceway used as an equipment grounding conductor, in accordance with NEC (National Electrical Code) Article 250.118(14).

1.12 Strut-type channel raceway shall be permitted as an equipment grounding conductor, in accordance with NEC (National Electrical Code) Article 250.118(14).

Safety is a design consideration. DO NOT EXCEED MANUFACTURER'S RECOMMENDATIONS.

SECTION 2
TYPES OF BEAMS AND LOADING

2.1 SIMPLE BEAM

A simple beam is one that is supported only at both ends.

2.2 CANTILEVER BEAM

A cantilever beam is one that is rigidly attached at one end and is completely free at the other end.

2.3 POINT LOADING

When a concentrated load is placed on or attached to a beam in a particular location, it can be considered as a point load. Examples of point loads are; a man standing on a beam, a load supported from a beam with a chain, one beam crossing and supported by another beam, etc.

2.4 UNIFORM LOADING

When a distributed load has a relatively constant value over a portion of the span or the entire beam length, it is said to be uniformly loaded over that portion of the span. An example of uniform loading is a shelf with equally heavy boxes placed continuously on it.

2.5 COLUMN LOADING

Column loading consists of an axial load applied through the centroid (center of gravity) of a compression member. For a given load, the column height, column material, and column configuration must be considered.

2.6 ECCENTRIC LOADING

Eccentric loading exists when a column is loaded through an axis other than the cenroidal (center of gravity) axis. This type of column loading is most often the case. An example would be the legs of a table.

SECTION 3
BRACING

3.1 Metal framing systems should have adequate lateral, seismic, and sway bracing to withstand all static and dynamic loading conditions to which the system may be subjected.

3.2 Some factors that affect bracing are weight of system, length of bracing, section properties, type of material, usage, connections, load, size of systems, etc.

3.3 Bracing should be spaced based on the manufacturer's recommendations for the service condition.

3.4 Consideration must be given to whether bracing elements will be in tension, compression, torsion, or combination(s) thereof.

SECTION 4
LOADING DURING INSTALLATION

In the design of any system, consideration should be given to the loads that may be imposed on the system during installation as well as those when the system is complete. It is not unusual for temporary loading during installation to be substantially greater and of a different nature than that when the system is complete. These may vary with the loading and installation. While not limited to these, the following are examples of some of these temporary conditions:

4.1 The pulling of wire through conduit or cable tray.

4.2 The cantilevering of loads between supports.

4.3 The support of structures before permanent bracing is in place.

4.4 Loading due to environmental factors such as wind, snow, temperature change, etc., that may not be significant in the finished installation.

4.5 Equipment installation causing temporary non-uniform distribution of load on supports.

4.6 Accidental impact such as bumping with a forklift or the dropping of equipment.

SECTION 5
SAFETY FACTORS

5.1 When tests are used to determine the maximum design load, the manufacturer's published data will often include a safety factor. The safety factor usually is defined by the manufacturer as the ratio of the ultimate load to the maximum design load.

5.2 Recommended loads of manufacturers must never be exceeded.

5.3 The loads of 5.1 and 5.2 have been developed through either calculations or testing and have been determined for the safety of both the user and the manufacturer.

SECTION 6
TEMPERATURE

6.1 FINISHES

Channel finish usually will limit the maximum temperature to which a metal framing system should be exposed. Elevated temperatures may cause deterioration. Consult manufacturer for suitability of specific finishes.

6.2 MATERIALS

When channel is used at temperatures above 300°F (149°C), the manufacturer should be consulted for the corrected modulus of elasticity, allowable stress, and guidance in support and joining to allow for expansion.

6.3 ELECTRICAL

Strut-type channel raceway shall be installed in accordance with the National Electrical Code, Article 384, as a minimum requirement.

6.4 INSTALLED LOADS (PIPE)

Piping should be properly clamped, guided, and anchored to allow for thermal expansion and elimination of vibration that will cause pipe to move in an undesirable manner.

6.5 DISSIMILAR MATERIALS

Differential expansion of dissimilar materials should be considered.

SECTION 7
CHANNEL NUTS

The channel nut provides the gripping power needed to complete a rigid metal framing connection.

7.1 COMPONENTS

The channel nut often consists of two components; the nut and an optional retaining device. Since the channels and nuts come in many variations, it is important to select the proper combination.

7.1.1 The typical channel nut is designed to be inserted through the channel slot and then turned 90° into place. Care must be taken to ensure proper alignment of the nut within the channel. The most common nut sizes are for 1/4", 3/8" and 1/2" bolts; however, other sizes are available.

7.1.2 The purpose of the retaining device is to hold the channel nut in proper position during assembly. Once the bolt has been properly installed, the retaining device serves no further function.

7.2 MATERIALS AND FINISHES

For materials and finishes available, see manufacturer's literature.

7.3 ASSEMBLY

To achieve the manufacturer's rated design slip and pullout loads, a general fitting must be attached to the channel surface by a bolt and channel nut using the proper bolt (to the manufacturer's standard). All connections should be assembled using clean, dry components. The use of lubricants or torque sprays can cause excessively high bolt tension for a given torque resulting in damage to bolt, nut, and/or channel. The effects of over-torquing (excessive bolt tension) could include twisted bolt heads, bent or cracked nuts, crushed channel lips, or deformed fitting(s).

7.4 PRECAUTIONS

Special caution should be used in the following cases:

7.4.1 When a channel nut is placed near the end of a member, it has a lower ultimate pullout load. A good rule of thumb cuts the design load in half within the last one inch of the member.

7.4.2 Over-tightening of threaded rod against channel back will cause serious damage to channel lips, reducing load-carrying capacity and possibly causing premature failure.

7.4.3 When bolting through a pierced channel, over-torquing may crush the channel.

It must be emphasized that proper seating and torquing is essential to the performance of the channel nuts. A fastener that is not tightened to the manufacturer's recommended torque will not consistently meet the manufacturer's minimum published design loads. Design slip and pullout loads for channel nuts are determined by the manufacturer and must not be exceeded (see test methods in the applicable section of MFMA's *Metal Framing Standards Publication*, latest edition.)

SECTION 8
CONCRETE INSERTS

8.1 APPLICATION

Concrete inserts provide a pre-set support system in cast-in-place and precast concrete ceilings, walls, and floors. They provide flexibility of fasteners' size and location to attach equipment and accessories and may be integrated into framing systems for the support of piping, conduit, or cable tray. Concrete inserts are commonly used to support curtain and window walls in building structures.

8.2 TYPES

There are two types of inserts common to the metal framing industry, as well as special inserts developed by individual manufacturers for particular applications. The two standard types are "Continuous Slot Concrete Inserts" and "Spot Concrete Inserts."

8.2.1 Continuous Slot Concrete Insert

A Continuous Slot Concrete Insert is a channel having formed or attached anchors, which will support the insert within hardened concrete. The insert may be manufactured from various sizes of channel. The most common type has anchors with bent tabs punched out of the back of the channel. Other formed anchors may also be available. The integrated anchors may be omitted from inserts four inches through seven inches in length when end-cap anchors are used. Any insert less than four inches in length is regarded as a Spot Concrete Insert.

8.2.2 Spot Concrete Insert

The Spot Concrete Insert is for a single attachment point with limited or no adjustment.

8.2.3 Special Concrete Inserts

Special Concrete Inserts are in such variety that to generalize is impossible. The size, gauge, and material can be quite different from metal framing channel. The anchors can include welded reinforcing bar, bolt anchors and welded studs, and special roll-formed shapes. Other devices also may be available.

8.3 END CAPS

There are two basic types of end caps. One fits flush with the end of the insert and has no protrusions or extensions. Its sole function is to inhibit concrete seepage. The second type of end cap is used as an anchor in the concrete. This one-piece cap is formed with a bent tab that provides additional anchorage at the end of the insert.

8.4 CONCRETE SEEPAGE

The inside of the concrete insert must be kept clear for the proper installation of the channel nut. End caps and closures are available for use with continuous concrete inserts to inhibit seepage. Closure or fillers come in a variety of forms and materials such as metal, plastic, polystyrene foam, cardboard, tape, etc.

8.5 INSTALLATION

The user should confer with the engineering firm responsible for the design of the project to assure that the use of a particular insert is appropriate. The concrete insert manufacturer has no responsibility for the concrete design. Manufacturers' load ratings usually are based upon a concrete of 2,500 to 3,000 PSI design strength. Load ratings at other concrete design strengths may be available and the manufacturer should be consulted. Inserts must be surrounded by sufficient concrete to conform to design shear stress. The insert must be securely attached to the form before the concrete is poured. Continuous contact of concrete insert with form must be maintained to assure a flush, mounting surface. They must be used properly in accordance with the manufacturers' recommendation.

8.6 RECOMMENDATIONS AND PRECAUTIONS

Concrete inserts provide a fastening system to concrete that is unique, but they must be installed and used properly.

8.7 SOME SPECIFIC RECOMMENDATIONS

8.7.1 Proper sealing and attachment to the form work will keep the insert free from concrete and provide a flush finish surface.

8.7.2 If insert is recessed, provide shims between insert and finish surface.

8.7.3 Any temporary construction loading should not exceed design loading.

8.7.4 Single-point loading of continuous concrete inserts should not exceed manufacturer's per-foot load rating.

8.7.5 Concrete inserts should be protected against corrosion.

8.7.6 Over-tightening of threaded rod against insert back will cause serious damage to insert lips, reducing the load-carrying capacity and possibly causing premature failure.

8.7.7 Anchors or anchoring devices on concrete inserts should never be removed, bent, deformed, or otherwise altered. To do so can result in a serious hidden reduction in the insert's load-carrying capacity.

8.7.8 Concrete inserts should not be used for rigging, due to the potential for overload and damage.

SECTION 9
SWIVEL AND SWING FITTINGS

9.1 Swivel and swing fittings are used primarily for alignment or where movement can be expected after installation and a rigid connection would not be desirable. Swivel fittings are used where movement is within a single plane. Consideration should be given to resultant loads and care should be taken to see that manufacturer's recommended maximum angular movement is not exceeded in any direction.

9.2 While not limited to the following, these are examples of potential applications:

9.2.1 Supports in earthquake-prone areas.

9.2.2 Hanger rod or conduit drops from sloping roofs or ceilings.

9.2.3 Supports that may be subject to impacts or wind loading.

9.2.4 Long channel runs where alignment may be difficult.

SECTION 10
SUPPORT

10.1 CHANNEL SUPPORT FROM BEAMS

When channel is supported directly from beams, it should completely overlap the beam flange. Clamps always should be used in pairs and should be located as close to the beam flange as possible. In addition to load, consideration should be given to the channel depth as well as the beam-flange width and thickness in selecting channel-beam clamps.

10.2 TRAPEZE SUPPORT

It is suggested that the center-to-center distance between two pipes or conduits be sufficient to allow two couplings to be adjacent to each other as well as room for the fastening or clamping device.

10.3 CHANNEL JOINERS

Best practice is to locate joiners or couplings at points of minimum moment. This will usually be within one-third (1/3) of the span from supports.

10.4 WALL BRACKETS (CANTILEVERED LOAD)

Wall brackets usually are rated in inch-pounds of moment. It is important not to exceed this rating. To determine inch-pounds, calculate the load and determine the location of its center. The product of the total load, times the inches' distance from the wall to the center of the load, is the loading moment in inch-pounds. Consideration also should be given to the strength of fasteners or anchors being used.

10.5 NONMETALLIC PIPE OR CONDUIT SUPPORT

Consult manufacturer for support recommendations.

SECTION 11
ARCHITECTURAL AND MAINTENANCE PAINTING

The following are general steps that should be followed when an architectural or maintenance painting program is required. In all cases, the specific instructions of the channel manufacturer and paint manufacturer should be followed.

11.1 Determine type of surface to be painted (most manufacturers offer more than one finish or material). Some finishes and/or materials may not require architectural or maintenance painting.

11.2 The following is a list of more common surface finishes of channel and fittings:

11.2.1 Mill galvanized (pregalvanized).

11.2.2 Paint/prime coat.

11.2.3 Paint/finish coat.

11.2.4 Electrogalvanized with clear chromate.

11.2.5 Electrogalvanized with yellow chromate.

11.2.6 Hot dip galvanized after fabrication.

11.2.7 Unfinished carbon steel (oiled).

11.2.8 Stainless steel.

11.2.9 Mill finish aluminum.

11.2.10 Anodized aluminum.

11.2.11 Other non-metallic coatings.

11.3 Some surfaces are not readily paintable. Consult manufacturer for specific painting recommendations.

11.4 The application of architectural or maintenance coatings changes the dimensions of the channel and may affect the subsequent assembly of fittings and accessories.

11.5 Select finish to be applied considering manufacturer's recommendations and required resistance to corrosion, temperature, and environmental conditions.

11.6 Thoroughly clean surfaces per manufacturer's instructions. This is particularly important with unfinished carbon steel.

11.7 Prime coat surface as recommended by manufacturer. Some surfaces may not require prime coating.

11.8 Finish coat as recommended by manufacturer.

APPENDIX A
METAL FRAMING MANUFACTURERS ASSOCIATION
MEMBER COMPANIES
(Revised 07/16)

Allied Tube and Conduit/ Powerstrut
16100 S. Lathrop Ave.
Harvey, IL 60426

Cooper B-Line
509 West Monroe Street
Highland, IL 62249

Flex-Strut, Inc.
2900 Commonwealth Ave., NE
Warren, OH 44483

G-STRUT
4100 13th St., SW
Canton, OH 44710

Haydon Corporation
415 Hamburg Turnpike
Wayne, NJ 07470

Thomas & Betts Corporation
8155 T&B Boulevard
Memphis, TN 38125

Unistrut
35660 Clinton Drive
Wayne, MI 48184-2091

Wesanco, Inc.
14870 Desman Road
La Mirada, CA 90638