4.3.7 Vertical Support Plates (See Figure 4.18.)

Use vertical support splice plates for additional support of extended vertical runs. (See Section 4.2.4)

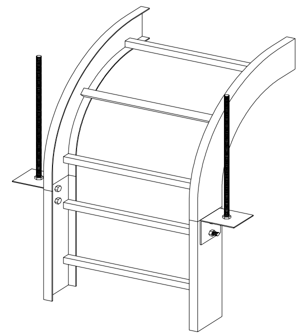


Figure 4.18
VERTICAL SUPPORT PLATES

4.3.8 Step-down Splice Plates (See Figure 4.19.)

Use step-down splice plates when connecting cable trays of different heights.

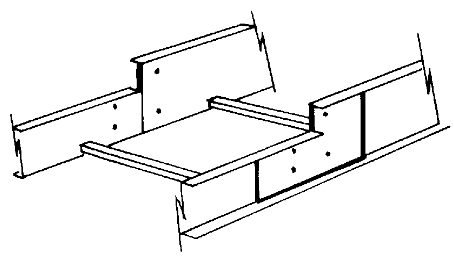


Figure 4.19
STEP-DOWN SPLICE PLATES

4.3.9 End Plates (See Figure 4.20.)

For dead-end closure indicating termination of cable tray run use end plates.

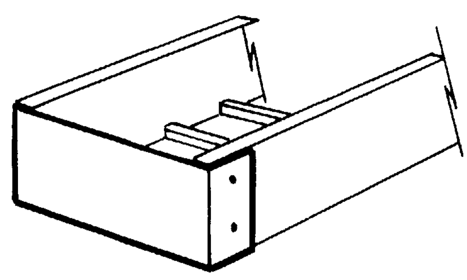


Figure 4.20
END PLATE

4.3.10 Single Rail Cable Tray Fitting Connectors (See Figures 4.21A through 4.21D)

Single rail cable trays typically use connector plates in lieu of radius fittings.

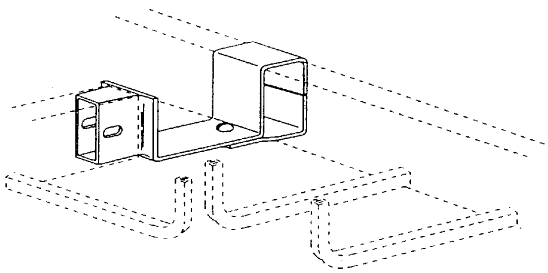


Figure 4.21A
HORIZONTAL TEE OR 90° CONNECTOR

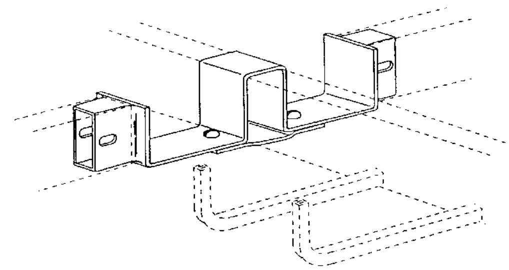


Figure 4.21B
HORIZONTAL CROSS CONNECTOR

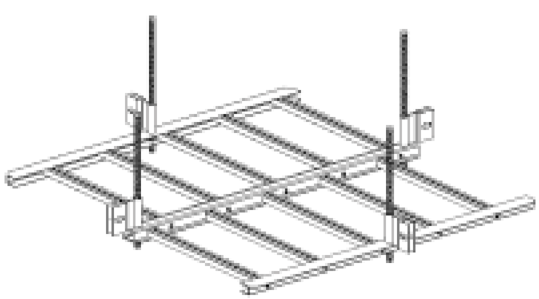


Figure 4.21C
HORIZONTAL HUB

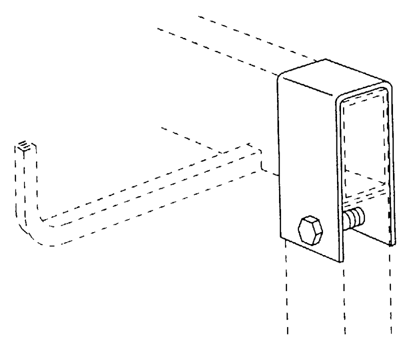


Figure 4.21D
VERTICAL TEE OR 90° CONNECTOR

4.4 FITTINGS INSTALLATION (See Section 4.4.3 for single rail and wire mesh cable trays)

4.4.1 Recommended Support Locations for Fittings
(unless otherwise recommended by the manufacturer)

Horizontal Elbow Support (See Figure 4.2.2)

Supports for horizontal cable tray fittings should be placed within 600 mm (2 ft) of each fitting extremity, and as follows:

a. 90° supports at the 45° point of arc.
b. 60° supports at the 30° point of arc.
c. 45° supports at the 22-1/2° point of arc (except for the 300 mm (12 in.) radii).
d. 30° supports at the 15° point of arc (except for the 300 mm (12 in.) radii).

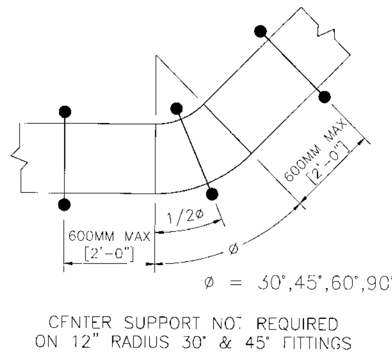


Figure 4.22
HORIZONTAL ELBOWS

Horizontal Tee Support (See Figure 4.23)

Place horizontal tee supports within 600 mm (2 ft) of each of the three openings connected to other cable tray items for the 300 mm (12 in.) radius. On all other radii, at least one additional support should be placed under each side rail at the horizontal tee, preferably as shown.

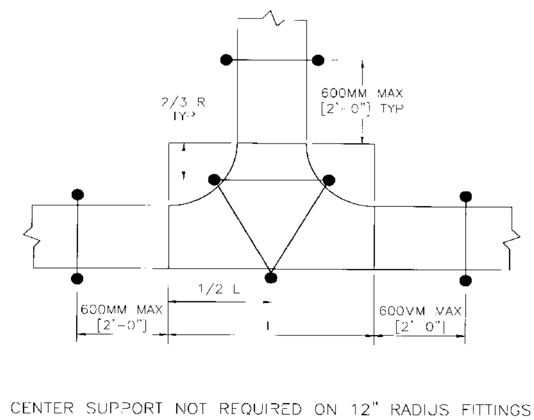


Figure 4.23
HORIZONTAL TEE

Horizontal Wye Support (See Figure 4.24)

Place horizontal wye supports within 600 mm (2 ft) of each of the three openings connected to other cable tray items, and at 22-1/2° point of the arc adjacent to the side branch.

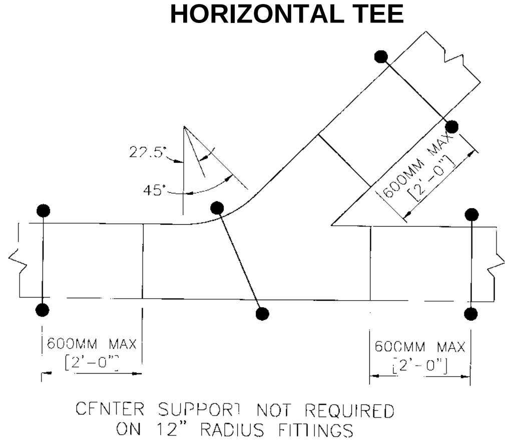


Figure 4.24
HORIZONTAL WYE

Horizontal Cross Support (See Figure 4.25)

Place horizontal cross support within 600 mm (2 ft) of each of the four openings connected to other cable tray items for the 300 mm (12 in.) radius. On all other radii, at least one additional support should be placed under each side rail of the horizontal cross, preferably as shown.

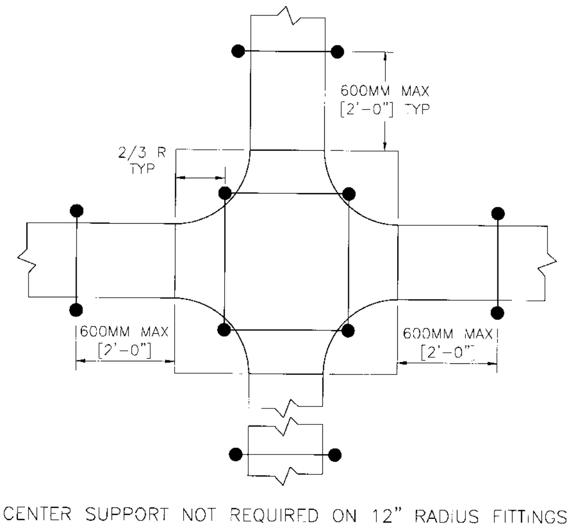


Figure 4.25
HORIZONTAL CROSS

Reducer Support (See Figure 4.26)

Place reducer supports within 600 mm (2 ft) of each fitting extremity.

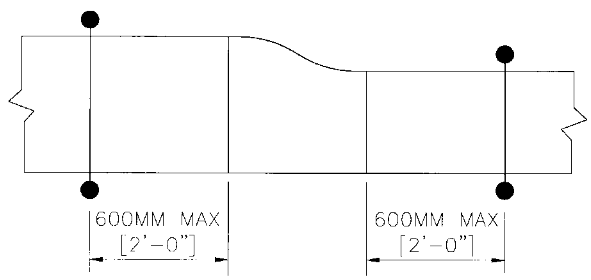


Figure 4.26
REDUCER

Vertical Cable Tray Elbows (See Figure 4.27)
Vertical cable tray elbows at the top of runs should be supported at each end. At the bottom of runs, they should be supported at the top of the elbow and within 600 mm (2 ft) of the lower extremity of the elbows.

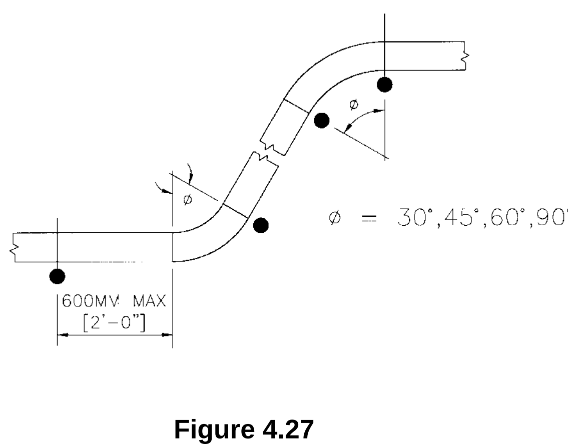


Figure 4.27
VERTICAL ELBOWS
(Side View)

Vertical Cable Tray Tees (See Figure 4.28)

Vertical cable tray tees should be supported within 600 mm (2 ft) of each fitting extremity.

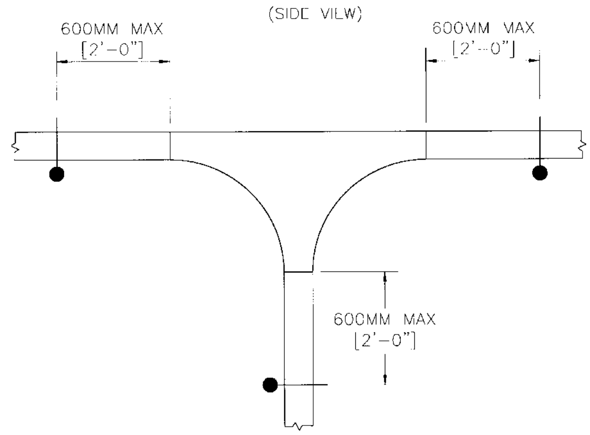


Figure 4.28
VERTICAL TEE
(Side View)

4.4.2 Extended Vertical Runs

4.4.2.1 Cable Support Fittings

(See Figures 4.29 and 4.30.)

These fittings are recommended for use at the top of long vertical runs of heavy cable to support the cables.

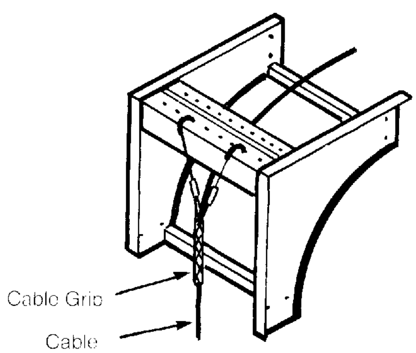


Figure 4.29
VERTICAL CABLE SUPPORT

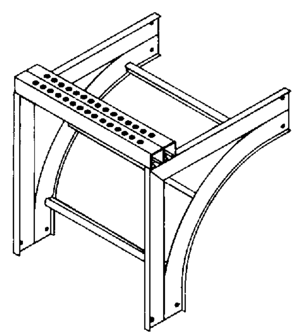


Figure 4.30
VERTICAL CABLE SUPPORT

4.4.2.2 Securing and Allowing for Expansion

Extended Vertical runs of cable tray that require accommodation for expansion may require some installation modifications. If the system is outdoor and supporting a sizable cable load each section of cable tray may need to be securely attached to the structure with a heavy duty bolt through hold down clamp. This connection should be at the midpoint of each cable tray section with each end being positioned with a guide clamp. All sections should be spaced apart, enough to allow for any possible expansion, without splice plates and should be grounded using an EGC connected to each section with a listed clamp.

4.4.3 Recommended Support Locations for Single Rail and Wire Mesh Cable Trays

Single rail and wire mesh cable trays have alternate support configurations. Consult manufacturer for details.

4.5 FIELD MODIFICATIONS

Eventually it will be necessary to field cut the cable tray because the length of the cable tray required will be less than standard length. If there are many cuts to be made in a given area, waste can be prevented by making a cut list, which can be used to calculate the most efficient use of the standard sections.

Cable tray field modifications shall be made by qualified personnel only.

4.5.1 **Marking** (See Figures 4.31and 4.32)

Using a square that reaches across the width of the cable tray, gauge off the edge of one side rail and mark both flanges (Figure 4.31). Next, position the square as shown in (Figure 4.32) and mark the web of the rail. Marking can be done with a scribe, marking pen, or a pencil.

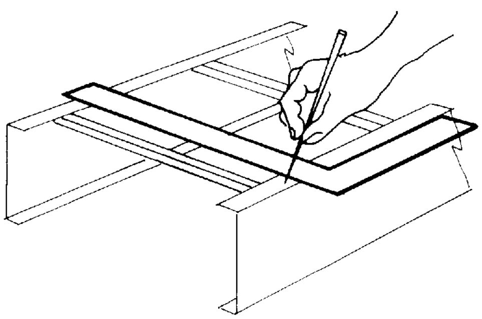


Figure 4.31
MARKING OF THE FLANGES

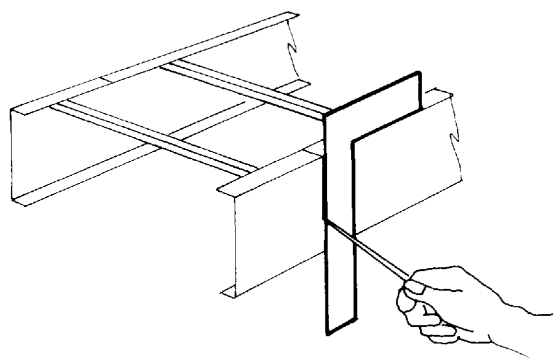


Figure 4.32
MARKING THE WEB OF THE RAIL

4.5.2 Cutting

The cut can be made using a hand held hack saw, carbide tipped circular saw, diamond dusted blades (fiberglass only), hand-held band saw, offset bolt cutters or high speed grinder (wire mesh only). It is important to get a square cut to ensure a good splice connection. Cable tray manufacturers offer jigs and other devices to aid in field cutting (Figure 4.33). After cutting, smooth the cut edges to remove any burrs. Fiberglass material should be cut with a carbide tipped circular saw or a diamond dusted blade.

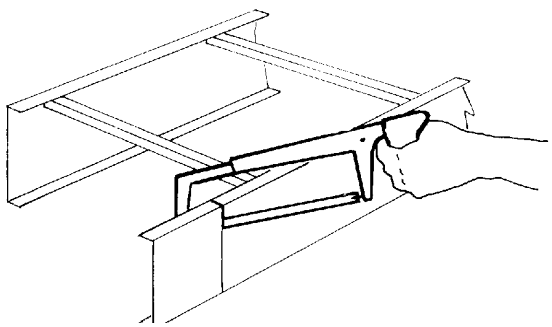


Figure 4.33A
CUTTING WITH HAND-HELD HACKSAW

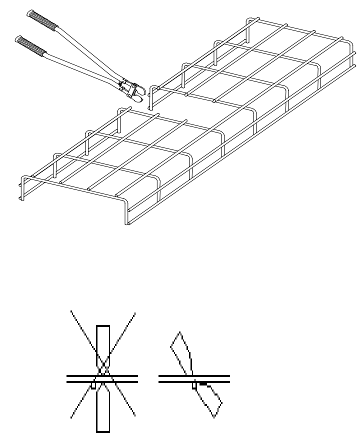


Figure 4.33B
CUTTING WITH BOLT CUTTERS

4.5.3 Drilling (See Figures 4.34 through 4.36.)

Holes for splice plates must be drilled in field-cut cable trays. The most common method of locating the hole positions is to use a splice plate as a template. Drill jigs (Figure 4.34) are also available. A short piece of side rail that is punched with the standard factory hole pattern can be bolted to the splice plate to serve as a stop that rests against the end of the field-cut side rail (Figure 4.35). Clamp the splice plate to the rail and drill through the splice plate holes and the side rail (Figure 4.36). The correct drill size is dependent on the hardware supplied with the cable tray. Match the holes that exist in the cable tray. After drilling, remove burrs.

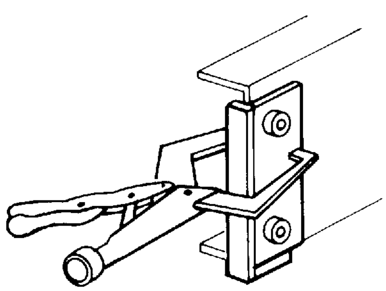


Figure 4.34
DRILLING WITH USE OF DRILL JIGS

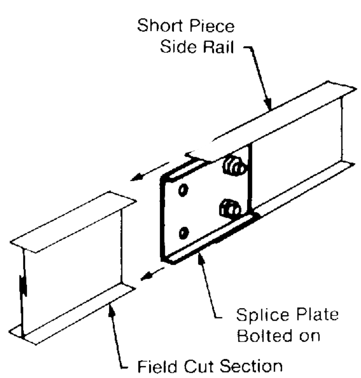


Figure 4.35
DRILLING WITH USE OF PUNCHED SIDE RAIL

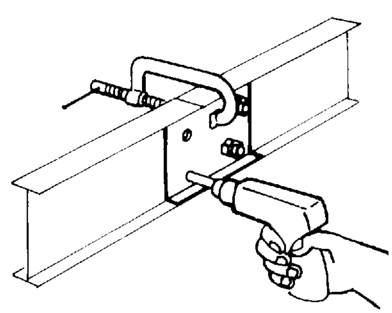


Figure 4.36
DRILLING WITH USE OF CLAMP AND SIDE RAIL

4.5.4 Finish Touch Up

Cable trays that have a hot dip galvanized coating applied after fabrication need to be retouched after cutting, drilling, or deburring or if the coating gets damaged. These cutting operations leave bare metal edges that will begin to corrode immediately. Cable trays made from mill galvanized steel do not need to be touched up because they are not designed to be used in heavily corrosive atmospheres and have bare metal edges inherent in their design. Aluminum cable trays do not need to be touched up.

Touch up of the galvanized finish must be done according to ASTM A 780, *Repair of Damaged Hot-Dip Galvanized Coatings*. Use an approved zinc-rich galvanizing material that meets the requirements of ASTM A 780. If it is not noted on the product label as to whether the material meets ASTM A 780, the material specification sheet should be obtained from the galvanizing material supplier. The paint can be applied by brushing or spraying. Always paint 13 mm (1/2 in.) to 25 mm (1 in.) beyond the bare area to prevent undercutting by corrosion.

After cutting of fiberglass cable trays, seal cut edges with manufacturer's recommended sealant.

Other protective coatings that are cut or damaged must be touched up with compatible coatings.

4.5.5 Wire Mesh Fittings Fabrication

Fittings are field fabricated from straight sections on-site with an offset bolt cutter and wrench, or high speed grinder.

Horizontal or vertical bends, tees, and crosses are fabricated by notching out segments of side rail grids and overlapping and connecting parallel wires by means of a connector.

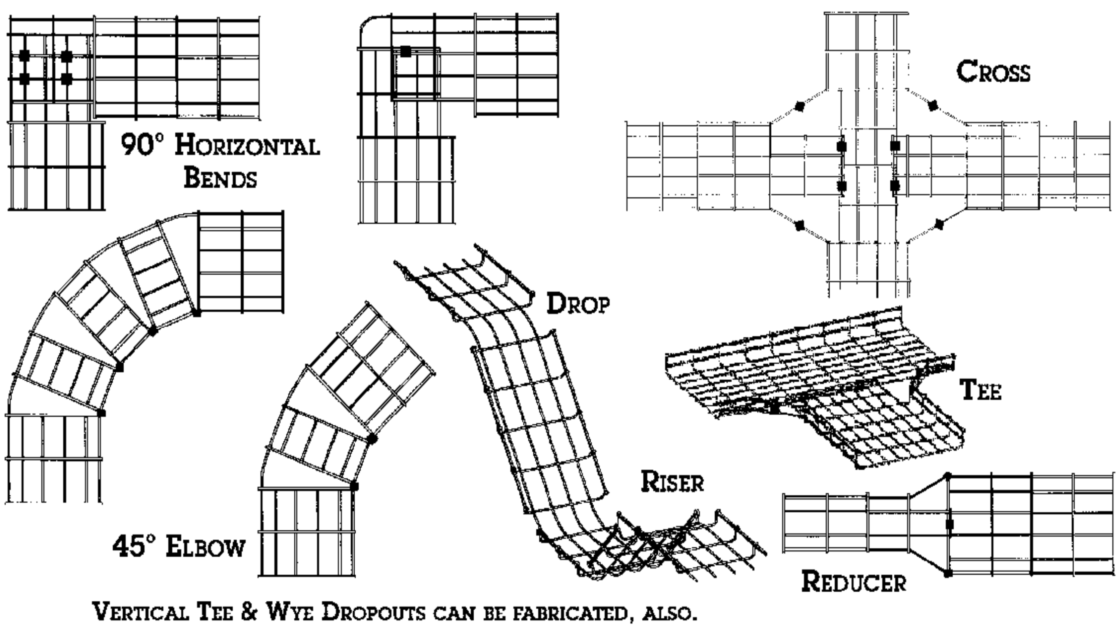


Figure 4.38
TYPICAL WIRE MESH FITTINGS—FIELD FABRICATED

4.6 ACCESSORIES

4.6.1 Barrier Strips (See Figures 4.39 through 4.46.)

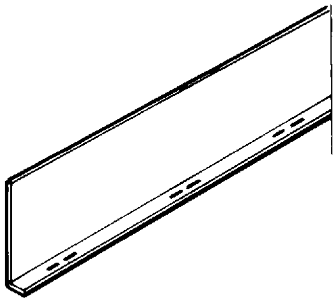


Figure 4.39
BARRIER STRIP–
STRAIGHT SECTION

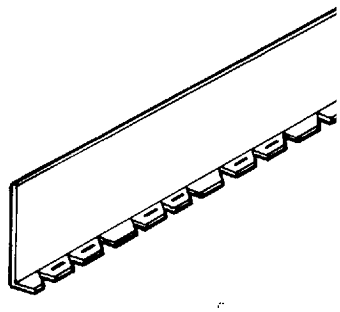


Figure 4.40
BARRIER STRIP–
HORIZONTAL FITTING

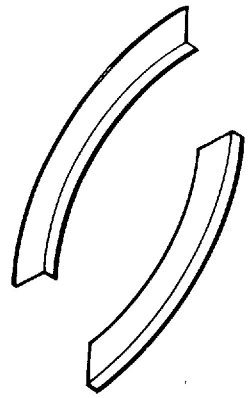


Figure 4.41
BARRIER STRIP–
VERTICAL FITTING

Barrier strips are sometimes used to separate cables within a cable tray as required by the National Electrical Code® (NEC®).

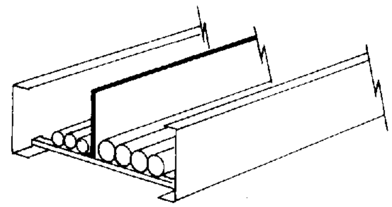


Figure 4.42
BARRIER STRIP APPLICATION

Barrier strips are installed by placing them at the desired location, then fastening them down with the hardware provided, or bonded with adhesive (fiberglass only). This connection should be made at approximately every 900 mm (3 ft)

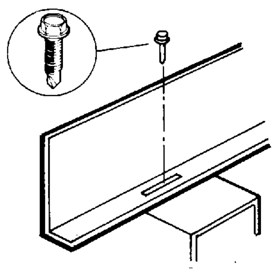


Figure 4.43
BARRIER STRIP ATTACHMENT,
SELF-DRILLING AND SELF-TAPPING SCREW

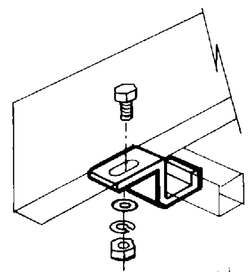


Figure 4.44
BARRIER STRIP ATTACHMENT,
BARRIER CLIP

Barrier strips along a cable tray run may be connected using a barrier strip splice.

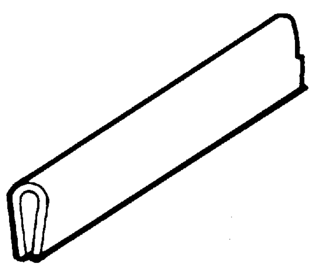


Figure 4.45
BARRIER STRIP SPLICE BARRIER

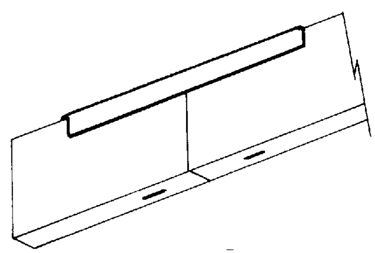


Figure 4.46
STRIP SPLICE – INSTALLED

4.6.2 Drop Outs (See Figures 4.47 through 4.49.)

The drop-outs and drop-out bushings provide a smooth surface to protect the cable insulation as it exits the cable tray.

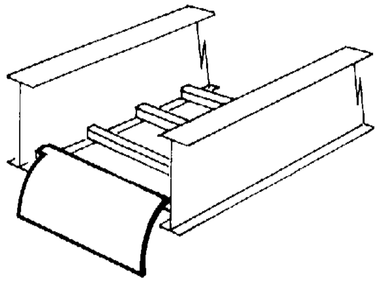


Figure 4.47
LADDER DROP-OUT

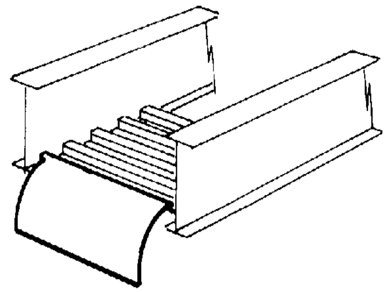


Figure 4.48
TROUGH DROP-OUT

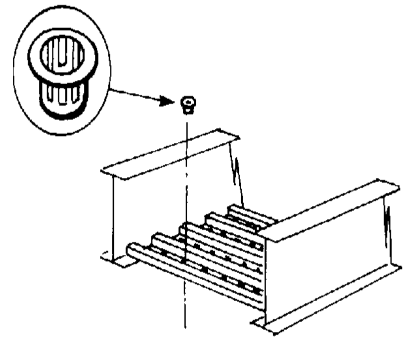


Figure 4.49
TROUGH DROP-OUT BUSHING

4.6.3 Cable Channel-to-Cable Tray

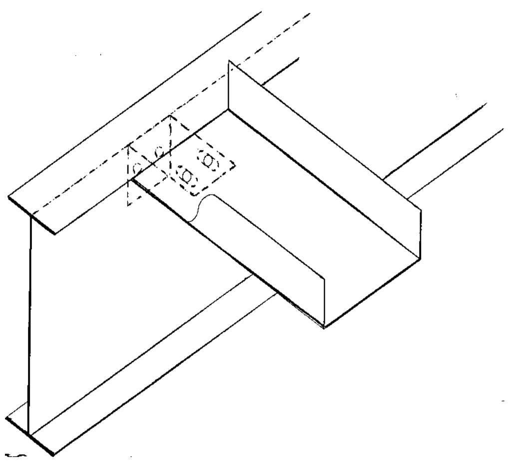


Figure 4.50
CABLE TRAY TO CHANNEL

Figure 4.50 Attachment of a channel cable tray in this method maintains the electrical requirements, bolted mechanical connection, and provides a practical method of dropping tray cables to equipment. Wire mesh systems may also be a wise consideration for supporting cable drops.

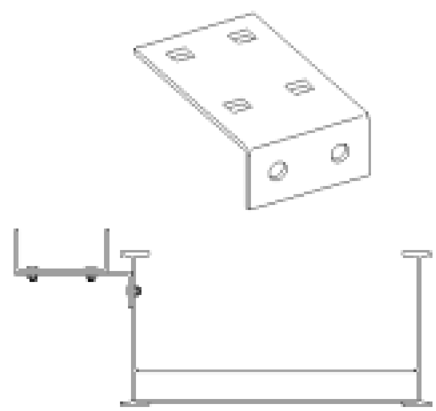


Figure 4.51
CHANNEL TO LADDER TRAY BRACKET

Figure 4.51 A channel cable tray can be added to an existing cable tray system using this method to add additional approved cabling systems. Refer to the loading information of the existing cable tray system to confirm that any additional loading will not surpass the stated loading capacity.

4.6.4 Conduit-to-Cable Tray Adaptors (See Figures 4.52 through 4.54.)

These adaptors provide for attachment of conduit that terminates at a cable tray run. If a connector is not UL listed, it only provides a mechanical connection, not an electrical connection. In order to make an electrical connection, an equipment grounding conductor must be run from the conduit to the cable tray. When using a conduit system to exit or enter a cable tray system verify the proper conductor installation.

Tray rated cables are required for cable tray installation so using a channel cable tray system or wire mesh system for exits may be more convenient and economical.

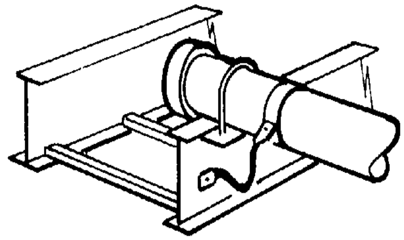


Figure 4.52
INSTALLED CONDUIT TO CABLE TRAY ADAPTER

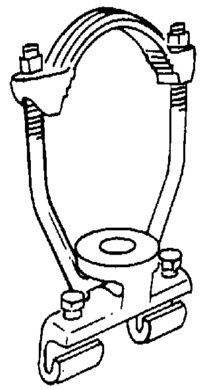


Figure 4.53
SWIVEL CONDUIT TO CABLE TRAY ADAPTER

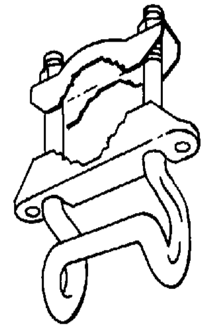


Figure 4.54
CONDUIT TO CABLE TRAY ADAPTER

4.6.5 Covers and Clamps (See Figures 4.55 and 4.56.)

Examples of cable tray covers are provided below:

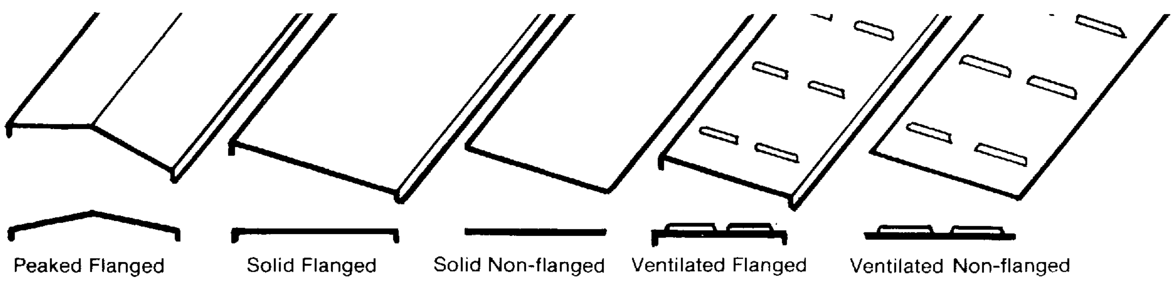


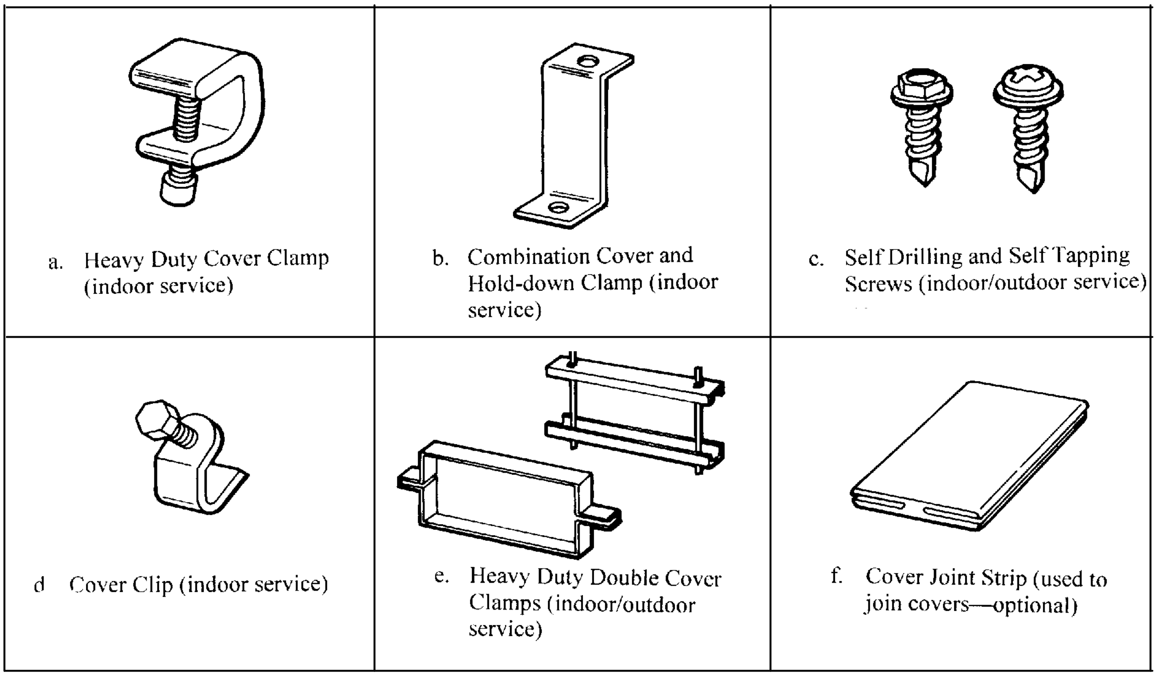
Figure 4.55
CABLE TRAY COVERS

4.6.5.1 Covers are typically added to a cable tray system when addition cable protection is required. It is important to consider that tray rated cables have mechanical and UV protection built into their construction making the sound use of covers uncommon. It is recommended to install covers the first six feet of a cable tray system extending vertically from a floor penetration. If a cable tray system passes under an open walkway the cables should be protected from possible falling objects in the immediate area. Should a cable tray system be temporary subjected to falling debris a temporay cover should be used and removed after the need. Cover installation also has merit in certain environmental air handling area installations. Refer to local codes for project requirements.

The addition of covers to a cable tray system inhibits the systems merits of cable access. This could be important issue for future needs to add, mark or remove cabling. In the case of power cables the addition of covers may require the conductors to be derated and affect the loading of the cable tray system.

As a general statement installing covers on outdoor cable tray systems is not common practice. Should they be required, proper attachment is required to protect them from the force of the wind.

When specifying covers for a system make sure the material and finish is clearly stated to satisfy the installation need and environment.



a. Heavy Duty Cover Clamp (indoor service)

b. Combination Cover and Hold-down Clamp (indoor service)

c. Self Drilling and Self Tapping Screws (indoor/outdoor service)

d Cover Clip (indoor service)

e. Heavy Duty Double Cover Clamps (indoor/outdoor service)

f. Cover Joint Strip (used to join covers—optional)

Figure 4.56
CABLE TRAY COVER CLAMPS AND ACCESSORIES

NOTE—Special consideration should be given in regards to wind loading for outdoor applications.

Table 4-3 provides information on the required spacing for cover clamps

Table 4-3
QUANTITY OF STANDARD COVER CLAMPS REQUIRED

Straight section, 1.8 m (6 ft.)	4 pieces
Straight section, 3.0 m (10 ft.) and 3.7 m (12 ft.)	6 pieces
Horizontal/vertical bends	4 pieces
Tees	6 pieces
Crosses	8 pieces

NOTE—When using the heavy duty cover clamp shown in Figure 4.56e, only half the quantity of pieces are required.

4.7 GROUNDING AND BONDING

Metal cable trays must be grounded and electrically continuous systems per NEC Article 392.7 For specific areas requiring bonding for electrical continuity, refer to Figures 4.57 through 4.60.

NOTE—Non-metallic cable trays do not serve as a conductor.

NOTE—It is recommended that wire mesh cable trays not be used as an equipment grounding conductor.

NOTE—Although permitted by the NEC, it is recommended due to the unique nature of the wire mesh, fittings are manufactured in the field from straight sections by cutting away the current carrying structural wires, reducing the current-carrying capability of the system. As such, the use of wire mesh cable trays as an equipment grounding conductor is not recommended. If the wire mesh cable tray is to be used as an equipment grounding conductor, then the installation of a ground wire is recommended. If a wire mesh cable tray is supporting cable with a built-in equipment grounding conductor or control or signal cables, then the tray should have a low impedance path to a non-system ground to reduce noise and remove induced or stray currents. A separate grounding cable attached to the wire mesh cable tray is not usually required.

4.7.1 Cable Tray Used as an Equipment Ground Conductor (EGC) (See Figures 4.57 through 4.60)

The use of aluminum and steel cable trays is permitted as an Equipment Grounding Conductor per NEC Article 392 when labeled and marked with the available cross sectional area. (See Table 4-4.) If the cable tray is to be used as an EGC, bonding jumpers must be installed on both side rails at the locations illustrated in Figures 4.57 through 4.60, unless the splice plates meet the electrical continuity requirements of NEMA VE 1. See Table 4-5 for minimum sizes of grounding conductors.

If the connectors are UL Classified bonding jumpers or a continuous ground are not required.

It is not necessary to install bonding jumpers at standard rigid aluminum or galvanized steel splice plate connections or offset reducing splice plate connections or any UL Classified connectors.

For rigid splice plate connections of materials and finishes other than aluminum or galvanized steel, bonding jumpers may be required. For example, stainless steel splice plates may require bonding jumpers depending UL Classification.

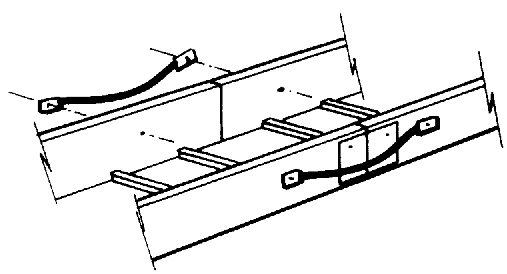


Figure 4.57
EXPANSION SPLICE PLATES

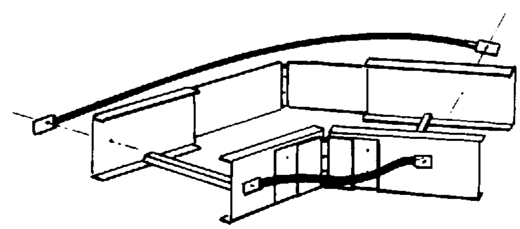


Figure 4.58
HORIZONTAL ADJUSTABLE SPLICE PLATES

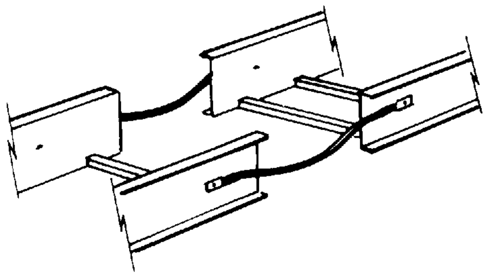


Figure 4.59
DISCONTINUOUS SEGMENTS

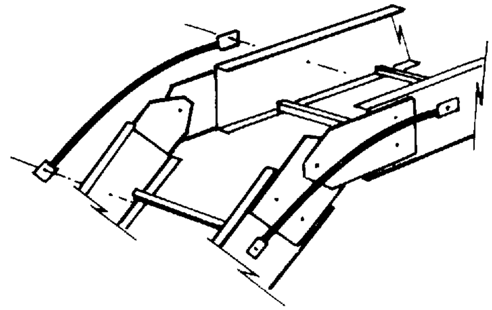


Figure 4.60
CABLE TRAY SECTIONS VERTICAL ADJUSTABLE SPLICE PLATE

NOTE—Article 392.6 clearly states that a cable tray system is to be electrically continuous but does not have to be mechanically continuous. This is an important issue to installing cable tray systems safely and economically. The gap between sections is restricted to 1.8 m (6 ft), the cables are to be fastened to the cable tray prior to and after the transition, and protected by guarding or location. The electrical connection between segments can be maintained with properly sized bonding jumpers or ground wire. Fully understanding this concept and employing it at awkward intersections can increase the efficiency of a cable tray system and insure a safe installation.

4.7.2 Cable Trays with Separate Equipment Grounding Conductor Installed (See Figure 4.61.)

When a separate EGC cable is installed in or on cable tray, it may be bonded to the cable tray with a grounding clamp. Ground clamp styles include bolted lug types that require drilling the cable tray side rail and clamp-on styles that work like a beam clamp. One UL Listed grounding clamp should be used on each (straight omit) section of cable tray. Installing a separate EGC at areas where the cable tray is not mechanically continuous or where non UL Classified connectors are installed maintains the system electrical requirements without the use of bonding jumpers. This could be an important tip where gaps surpass the length of traditional bonding jumpers.

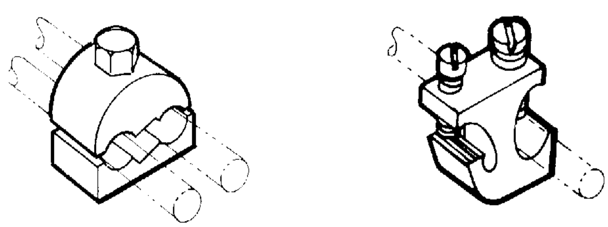


Figure 4.61
GROUNDING CLAMPS

Bare copper EGC cable should not be used in or on aluminum cable tray. Bonding jumpers are not required if the separate EGC is properly bonded to all equipment.

4.7.3 Check for Properly Sized EGC or Bonding Jumpers

4.7.3.1 Power Applications

Bonding jumpers or separate EGC shall be sized according to NEC Articles 250 and 392. Note that NEC Table 392-7(B) is the actual circuit breaker trip setting and not the maximum allowable. If the maximum ampere rating of the cable tray is not sufficient for the protective device to be used, the cable tray cannot be used as an EGC, and a separate EGC must be included in each cable or attached to the cable tray.

4.7.3.2 Non-Power Applications

Cable tray systems containing conductors outside the scope of NEC Article 250 (such as communications, data, signal cables, etc.) still require proper bonding and grounding for system operation and performance.

Metal trays containing these conductors shall be electrically continuous, via listed connectors or the use of an insulated #10 (minimum) stranded bonding jumper.

Electrical continuity across field fabricated wire mesh fittings can be accomplished using listed wire mesh tray connectors and following manufacturer's installation instructions.

4.7.3.3 Mixed Systems

When power conductors are installed in metallic cable tray with non-power conductors, the bonding and grounding requirements shall be as in 4.7.3.1.

NOTE—Power and non-power cables should be separated with a fixed metal barrier.

Table 4-4
METAL AREA REQUIREMENTS FOR CABLE TRAYS USED AS EQUIPMENT GROUNDING CONDUCTORS (NEC TABLE 392-7(B))

Maximum Fuse Ampere Rating, Circuit Breaker Ampere Trip Setting or Circuit Breaker Protective Relay Ampere Trip Setting for Ground-Fault Protection of any Cable Circuit In the Cable Tray System	Minimum Cross-Sectional Area of Metal* in square Inches	
	Steel Cable Trays	Aluminum Cable Trays
60	0.20	0.20
100	0.40	0.20
200	0.70	0.20
400	1.00	0.40
600	1.50**	0.40
1000	--	0.60
1200	--	1.00
1600	--	1.50
2000	--	2.00**

For SI units: 1 square inch = 645 square millimeters.

* Total cross-sectional area of both side rails for ladder or trough cable trays or the minimum cross-sectional area of metal in channel cable trays or cable trays of one-piece construction.

** Steel cable trays shall not be used as equipment grounding conductors for circuits with ground-fault protection above 600 amperes. Aluminum cable trays shall not be used as equipment grounding conductors for circuits with ground-fault protection above 2000 amperes.

NOTE—See Section 4.7.3.1 to select separate EGC.

Table 4-5
MINIMUM SIZE EQUIPMENT GROUNDING CONDUCTORS
FOR GROUNDING RACEWAY AND EQUIPMENT (NEC TABLE 250-122)

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc. Not Exceeding (Amperes)	Wire Size AWG or kcmil	
	Copper Wire Size	Aluminum or Copper-Clad Aluminum
15	14 AWG	12 AWG
20	12	10
30	10	8
40	10	8
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250 kcmil
1600	4/0	350
2000	250 kcmil	400
2500	350	600
3000	400	600
4000	500	800
5000	700	1200
6000	800	1200

*See installation restrictions in NEC Article 250.

4.7.4 How to Install Bonding Jumpers (See Figure 4.62.)

Types of typical jumpers (always size jumpers to meet above NEC tables) include insulated, bare, and braided or laminated.

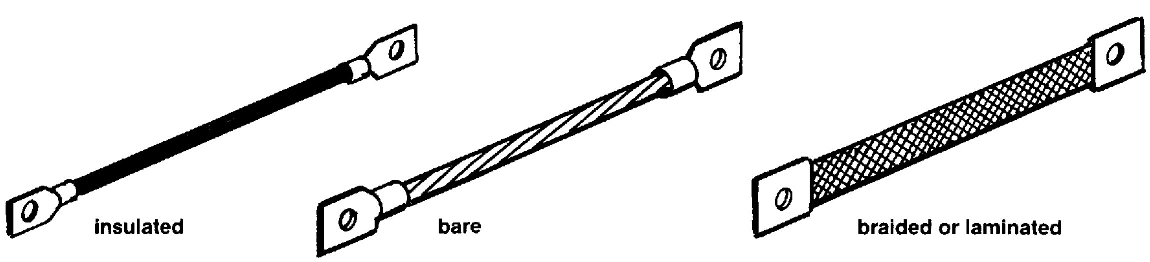


Figure 4.62
BONDING JUMPERS

Drill holes in side rail 50 mm (2 in.) from each end of the splice plate so the jumper will span the discontinuity. Do not use splice plate bolt locations to connect jumper to cable tray.

Place screw head on inside of cable tray, put jumper on outside of cable tray, add flat washer, and locknut, and tighten.

4.8 BONDING TO BUILDING STEEL AND EARTH

Metallic cable trays shall be bonded to building steel and earth as supplemental grounding for ground fault protection and signal grounding (“noise” prevention). The tray shall be bonded to building steel and earth, at least every 18 m (60 ft). This is only required when the cable tray system is not inherently bonded (connected) to building steel and earth through metallic support systems.

Section 5
INSTALLATION OF CABLE

The text of this section has been provided by NEMA wire and cable manufacturers. The Metal and Nonmetallic Cable Tray Section hereby acknowledges the Wire and Cable Section's cooperation and contribution.

5.1 GENERAL

This section offers some general guidelines or rules of thumb on the installation of cable in cable tray. This information is not intended to replace the recommendations of the cable manufacturer. The manufacturer of the product is the best source for information on the product, its use, and installation practices.

5.2 HANDLING AND STORAGE

To avoid personal injury or damage to the cable and reels, follow guidelines below on handling and storage of cable upon receipt at the job site.

a. Inspect all reels upon receipt for proper material and any type of damage. Be sure to note any damage on the receiving papers.

b. Do not allow the reels to drop from the delivery truck during the unloading process. When a forklift is used, the forks must support both reel flanges. Reels can be hoisted by lifting on a metal shaft of sufficient size and strength placed through the center hole of the reel. Handling equipment must not come in contact with the cable.

c. Reels may be marked with a directional arrow and phrase such as "Roll This Way" to indicate the proper direction to roll the reel. Reels should only be rolled in the direction shown, or in the direction opposite to the direction that the cable is wrapped on the reel. Rolling reels in the wrong direction can cause the cable to loosen on the reel, which may cause problems during cable de-reeling or installation. Do not allow reels to roll uncontrolled as they may roll into objects, damaging the cable or causing personal injury. When rolling reels down inclines, the incline should be as gradual as possible, and control of the reel must be maintained.

d. Use care when choosing a location for cable storage. The temperature of the storage location should be -10°C (14°F) or higher. Select an area that is remote from construction activity, where the cable will be protected from equipment, falling objects, excessive heat, or cold, chemicals, etc., resulting in potential damage. Cable reels should be stored indoors on a dry surface or, if stored outdoors, placed on suitable dunnage of sufficient size to support the reel weight without sinking or allowing the reels to come in contact with moisture. Reels stored outside (prior to and after installation) should be covered with weatherproof material to protect reels and cable from sunlight and moisture, and cable ends must be kept sealed and should remain fastened to the reel flange to prevent them from laying on the ground. Reels should never be stored or stacked on their sides. Store reels on their flanges, properly chocked to prevent rolling. Be sure to allow enough room between reels to allow access to the reels for removal.

5.3 CABLE TRAY PREPARATION

Prior to installing cable in the cable tray, examine cable paths to ensure all areas are free of debris that may interfere with the cable's installation. The cable tray should never be used as a walkway.

5.4 CABLE PULLING CONSIDERATIONS (See Figure 5.1)

Most cable installations require the use of cable pulling tools.

a. On horizontal straight runs, the cables generally ride on rollers mounted in or on the cable tray (See Figure 5.4). These rollers should be properly spaced dependent on the size and weight of the cable to prevent the cable from sagging and dragging in the cable tray during the pull. Contact the cable manufacturer for information regarding proper roller spacing.

b. On horizontal bends and vertical pulls, the cables are generally run through pulleys or sheaves to maintain a minimum bending radius (See Figures 5.5 and 5.6). Pulleys and sheaves must be of sufficient diameter to prevent pinching the cable between the pulley flanges. Each cable will have a minimum bending radius that must be maintained to prevent damage to the cable. Contact the cable manufacturer for the proper minimum bending radius. Multiple pulling tools may be required at one bend to maintain this radius. Be careful with the entry and exit angle of the cable at the pulling tool, as this angle can exceed the bending radius.

c. Due to the length of some cable pulls and the cable weight, a great deal of force can be applied to the pulleys on horizontal and vertical bends. These pulleys should be anchored to the structural steel and not to the cable tray due to the force that can be applied during pulling. Do not pull down on the horizontal rollers, as they are not designed for this purpose, and damage could result to the cable or cable tray.

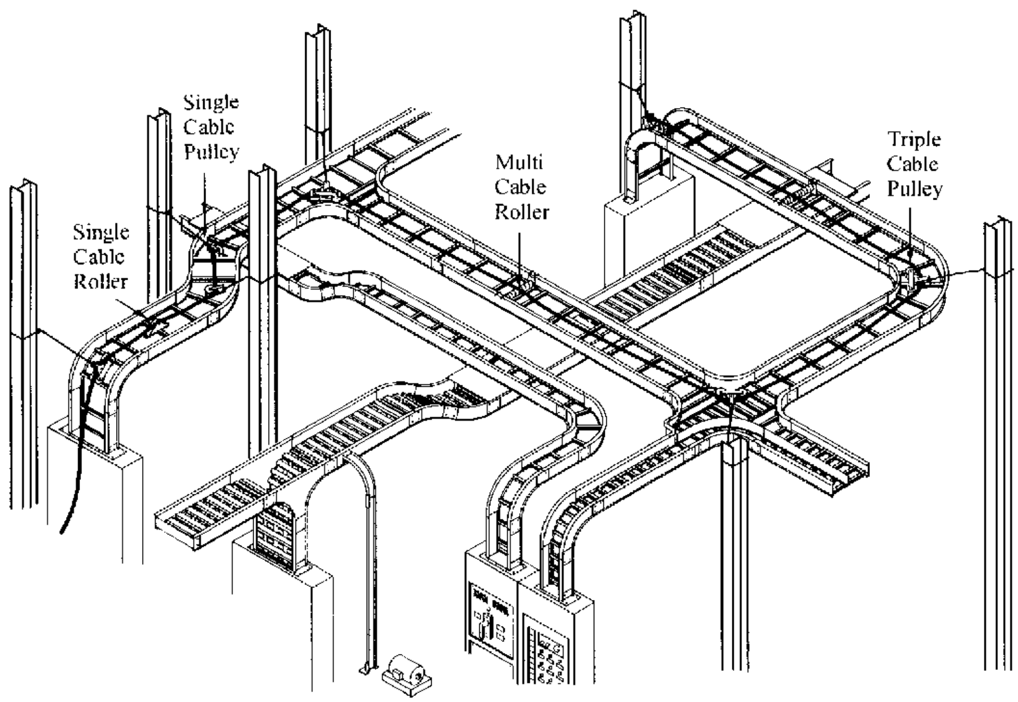


Figure 5.1
CABLE INSTALLATION

5.5 PULLING THE CABLE

Larger cables will usually require a basket grip and/or pulling eye to be attached to the leading end of the cables metallic conductor(s). If your cable does not have a pulling eye attached by the manufacturer, contact the cable manufacturer for information on field installation of a pulling eye and/or basket grip (see Figures 5.2 and 5.3). Where pulling attachments are used on the conductors, cover them with rubber-like or plastic tapes to prevent scoring of the cable trays and installation sheaves during a conductor pull. The reel will generally be placed on reel jacks with an axle of sufficient size and strength to allow the reel to turn freely with a minimum of friction. Since cables have pulling tension restrictions, a dynamometer may be installed at the pulling end and the readings recorded with every pull to assure that the cable's maximum pulling tension is not exceeded. Communications should be established between the pulling end of the run and the reel end of the run. The cable should be pulled at a constant speed during the pull. Contact the cable manufacturer for maximum pulling tension and cable pulling speed. Be sure to have adequate personnel available at the reel end to aid in feeding the cable, watching to prevent cables from getting crossed and for reel braking if necessary. Be sure to pull enough cable to allow for removal of pulling eyes or basket grips and resealing of the cable ends and connections. Once the cable is installed, the cable must be removed from the pulling devices and laid in the cable tray. Do not allow the cables to drop in the cable tray as this may damage the cable and/or the cable tray. If cable connections will not be made immediately, the pulling eye or basket grip should be removed and all cable ends resealed to prevent moisture from entering the cable.

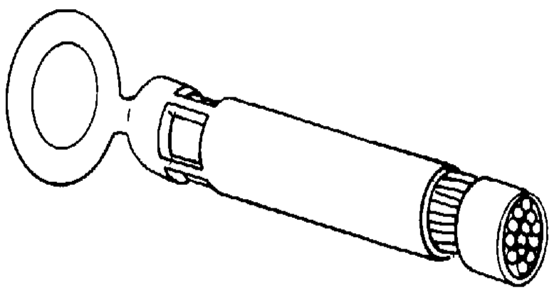


Figure 5.2
PULLING EYE

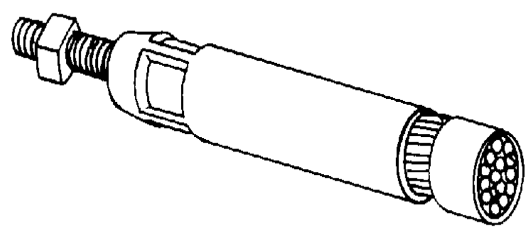


Figure 5.3
PULLING BOLT

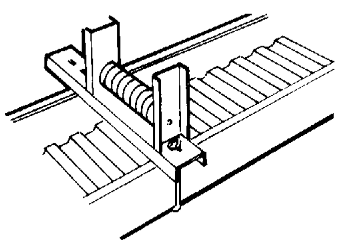


Figure 5.4
STRAIGHT ROLLER (TOP MOUNTED)

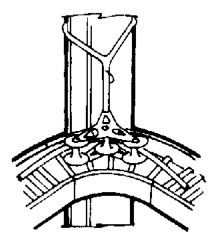


Figure 5.5
TRIPLE PULLEY GUIDE

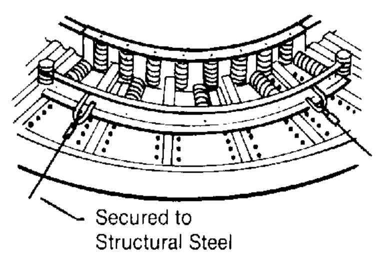


Figure 5.6
90° ROLLER

5.6 FASTENING OF CABLES

a. Cables may be fastened to the cable tray by means of cable clamps or cable ties (See Figures 5.7 and 5.8). Generally, cables are fastened every 450 mm (18 in.) on vertical runs. Although not required by the NEC, single conductor cables can be fastened on horizontal runs to maintain spacing, prevent movement due to a fault current magnetic forces, and insure that the cable is confined within the cable fill area. When using cable clamps, the clamps should be sized correctly and only tightened enough to secure the cable without indenting the jacket. The same precaution should be observed with cable ties, and they should be applied with a pressure limiting device.

b. Extremely long vertical drops introduce a new set of problems requiring special considerations. The weight per meter (foot) of the cable multiplied by the number of meters (feet) in the vertical drop will, in many cases, exceed the load carrying capacity of the cable tray component, such as the one or two rungs supporting this weight, and could exceed the allowable cable tension. The cable weight should be supported in such a manner as to prevent damage to the cable tray or cable during this type of installation. As the cable is installed, intermediate supports should be installed on the vertical drop to break the cable load into segments supported at multiple places.
c. Off shore installations may require stainless steel cable ties, or stainless cable banding depending on the cable positioning.

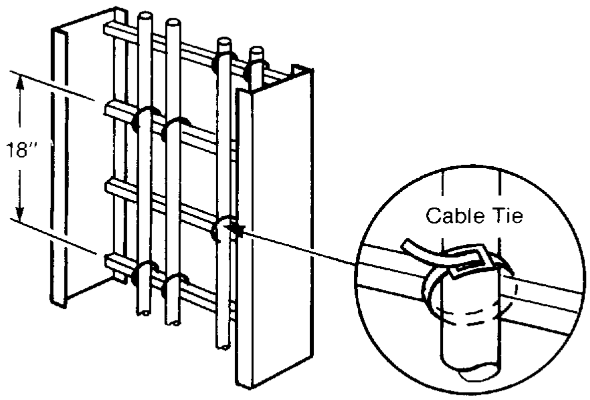


Figure 5.7
CABLE TIES – VERTICAL APPLICATION

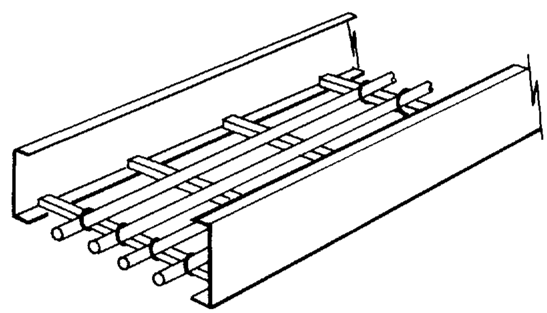


Figure 5.8
CABLE TIES – HORIZONTAL APPLICATION

5.7 PROTECTING INSTALLED CABLE

Once the cable is installed in an open cable tray system, care must be taken to protect the exposed cables from falling objects or debris that could cause damage to the cable. In areas where the cable tray is to be covered, the covers should be installed as soon as possible. Temporary protection for the cables and cable tray can be constructed of available wood or metal materials until the risk of damage is over.

Section 6
MAINTENANCE

WARNING—No electrical apparatus should be worked on while it is energized. When it is necessary to work in the vicinity of energized cables, all safety precautions should be followed, such as described in NFPA 70B. If cables are to be touched or moved, they should be de-energized.

6.1 INSPECTION

While cable tray is virtually maintenance free under normal conditions, inspection of the cable tray is recommended as part of the facility's routine maintenance schedule for electrical equipment. Cable tray should be inspected and serviced by qualified personnel.

Visual checks should be made for loose bolted connections at joints and bonding areas. Tighten all hardware in suspect areas.

Visual checks should be made for deposits of dust, foreign objects, and debris. These items should be removed to improve ventilation and reduce potential fire hazard.

Inspect cable tray after any severe weather including high winds, seismic disturbances, or other abnormal occurrences.

6.2 INACTIVE OR DEAD CABLES

It is considered good cable and wire management practice to remove inactive or dead cables from the cable tray wiring system. This practice opens capacity in the cable tray wiring system for future cable needs and eliminates the frustrations of electricians trying to establish the routing of an inactive cable.

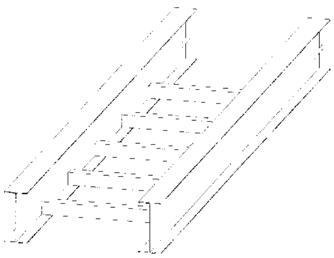
6.3 ADDING CABLES

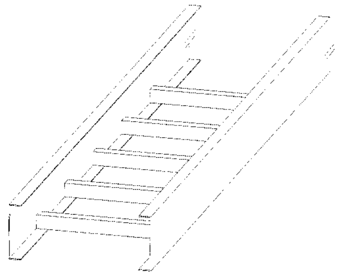
When additional cables are to be added to the cable tray wiring system, refer to NEC Article 392 for allowable fill and NEMA Standard VE 1 and FG 1 for allowable load. Check adequacy of supports before installing additional loads.

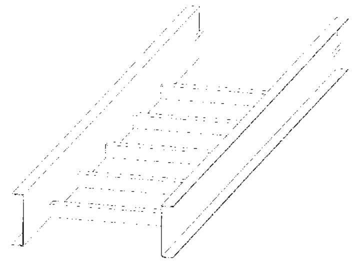
Follow cable manufacturer's recommended procedure for pulling and installing cables. (Also see Section 5 of this publication.)

Appendix A
TYPICAL CABLE TRAY TYPES

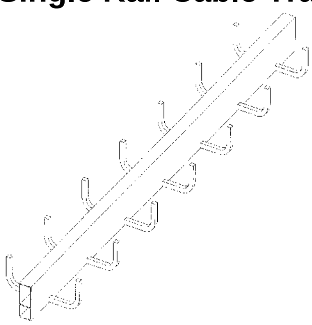
Cable Ladders

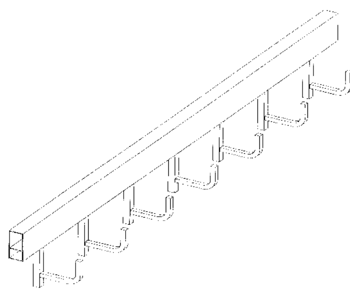

I- Beam

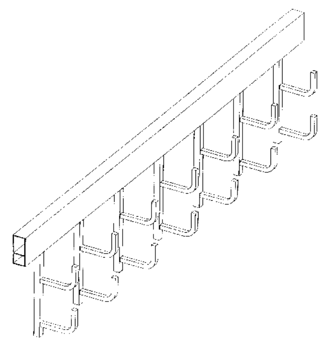

C-Channel Flange In


C-Channel Flange Out

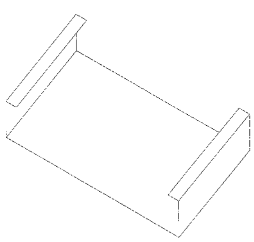
Single Rail Cable Trays

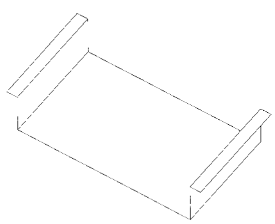

Center Rail Cable Tray

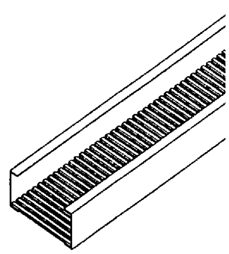

Single Tier Wall Mount

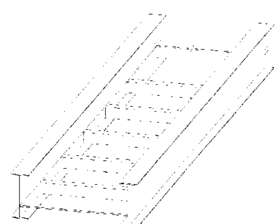

Multi-Tier Wall Mount

Solid Bottom Cable Trays

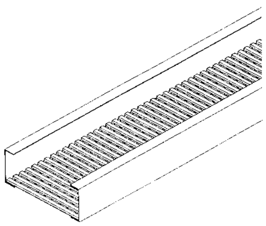

Pan Flange In


Pan Flange Out

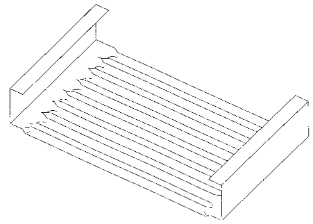

Corrugated Bottom


Solid Sheet on top of Ladder Rung

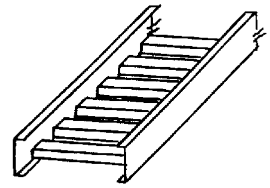
Trough (Ventilated Cable Trays)



Corrugated Bottom with Holes

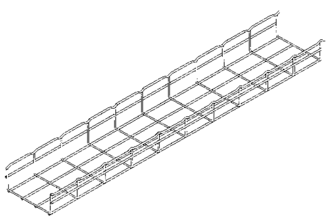


Pan with Louvers



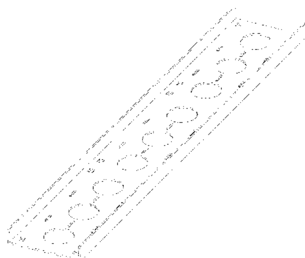
Tray with Close Rung Spacing

Wire Mesh Cable Tray

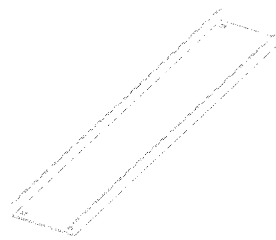


Wire Mesh

Channel Cable Trays



Ventilated Bottom



Solid Bottom

§