# Cable Tray Selection Process

## Selection Process

A number of basic decisions must be made before a cable tray system can be specified. UNIVERSAL has developed a simple seven-step process to guide you in the process:

1. Select Material and Finish
2. Select the Tray Load Class
3. Select the Tray Type
4. Select the Tray Size
5. Select the Fittings
6. Consider Deflection
7. Electrical Grounding Capacity

Each step is described in detail below. For many applications, however, you may also have to take the following into account:

• Weight of the installation, which affects the cost of the support structure and the ease of installation.

• Corrosion resistance of the material is one of the most important selection criteria. Cable tray materials may not respond the same way in different environments. Chemicals or combinations of chemicals have corrosion effects on some materials that can be compounded by temperature or even the speed at which the corrosive elements contact the cable tray. For example, some grades of stainless steel may be resistant to salt water at high flow rates (perfect for heat exchangers), while exhibiting some corrosion pitting in standing salt water. Only the designer can quantify the various elements that affect the corrosion resistance of the cable tray system in a specific application. While UNIVERSAL can provide guidance, the designer is responsible for the final selection. For more information, see "Corrosion" section.

• Galvanic effect can cause corrosion even if the cable tray material is resistant to its chemical environment. Dissimilar metals in contact (e.g., aluminum tray on steel supports or bare copper bonding conductor in aluminum tray) in the presence of an electrolyte are susceptible to galvanic effect. If there is a hazard of galvanic corrosion, it may be possible to isolate the tray system from other metals instead of using a more expensive type of tray that would resist corrosion in a given application.

• Melting point and flammability rating are primarily concerns for non-metallic tray. Local building codes may restrict the use of a given product if certain performance levels are not met. Check with the appropriate inspection authorities before specifying the product.

• Relative cost varies dramatically, including material costs that float with the commodity index. For example, stainless steel prices may vary significantly according to daily changes in the market.

• Thermal expansion must also be taken into account on a long cable run, especially in areas where temperature variation is extreme. Expansion connectors may be required if the temperature differential is 25°F. Two bonding jumpers are required for every pair of splice plates for grounding continuity

# Selection Steps

## 1 Select Material and Finish

The most suitable material and finish for your application will depend on cost, the potential for corrosion, and electrical considerations. UNIVERSAL offers cable tray systems fabricated from corrosion-resistant steel, stainless steel and aluminum alloys along with corrosion-resistant finishes, including zinc, PVC and epoxy. Special paint is also available.
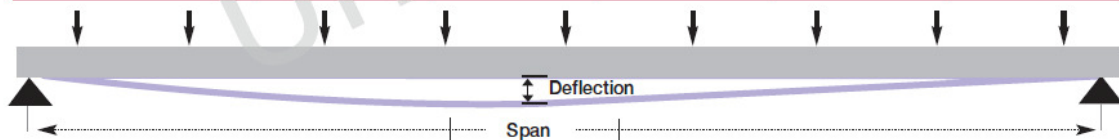
## 2 Select the Tray Class / Load Capacity (loading)

The standard classes of cable trays, as related to their maximum design loads and to the associated design support spacing based on a simple beam span requirement, shall be designated in accordance with Table 1. Please note the load ratings in Table 1 are those most commonly used.

Costs vary between different load classes. Since labor and coupling costs are similar for a given length of tray, the heavier classes are more cost-effective on a load length basis. The designer should therefore specify the lightest class of tray compatible with the weight requirements of the cable tray.

TABLE 1 Load / Span Class Designation

| LOAD kg/m | (lb/ft) | SPAN, m (ft) 2.4 (8) | 3.0 (10) | 3.7 (12) | 4.9 (16) | 6.0 (20) |
|---|---|---|---|---|---|---|
| 37 | (25) | – | A | – | – | – |
| 67 | (45) | – | – | – | – | D |
| 74 | (50) | 8A | – | 12A | 16A | 20A |
| 97 | (65) | – | C | – | – | – |
| 112 | (75) | 8B | – | 12B | 16B | E or 20B |
| 149 | (100) | 8C | – | 12C | 16C | 20C |
| 179 | (120) | – | D | – | – | – |
| 299 | (200) | – | E | – | – | – |



Deflection

Span

## **2** Select the Tray Class / Load Capacity (cont'd)

Cable Loads: . . . . . . . . . . The cable load is the total weight, expressed in (kg/m), of all the cables that will be placed in the cable tray.

Wind Loads: . . . . . . . . . . The additional loading to be considered is the effect of the impact pressure normal to the side rail.

This loading is determined by the following formula:
$$W_p = 0.00256 \times V_2 \times H/12$$
Where:
$W_p$ = loading due to the wind (lbs/linear foot)
$V$ = wind velocity (mph)
$H$ = Height of the side rail (inches)

It is important to note that cable tray is not designed to support personnel. The user should display appropriate warnings to prevent the use of cable tray as walkways.

### Concentrated Loads
A concentrated static load is not included in the Table 1. Some user applications may require that a given concentrated static load be imposed over and above the working load.

Such a concentrated static load represents a static weight applied on the centerline of the tray at midspan. When so specified, the concentrated static load may be converted to an equivalent uniform load (We) in kilograms/metre (pounds/linear foot), using the following formula, and added to the static weight of cable in the tray:

$$W_e = 2 \times (\text{concentrated static load, kg (lb)}) / \text{Span length, m (ft)}$$

## **3** Select the Tray Type

Cable tray is available with three styles of bottom:

Ladder Cable Tray is a prefabricated structure consisting of two longitudinal siderails connected by individual transverse members.

Ventilated Cable Tray is a prefabricated structure consisting of a ventilated bottom within integral or separate longitudinal siderails, with no openings exceeding 4 in. in a longitudinal direction.

Solid Bottom Cable Tray is a prefabricated structure without openings in the bottom.

Ladder tray is most often used because of its cost-effectiveness. The designer has a choice of four nominal rung spacings: 6, 9, 12, and 18 inches. The greatest rung spacing compatible with an adequate cable bearing surface area should be selected. Heavy power cables often require greater cable bearing area due to the possibility of creep in the jacket material of the cable. If this is a concern, consult the cable manufacturer. This condition may require the use of ventilated tray, which also offers additional mechanical protection for the cables.

Local building codes may require totally enclosed cable tray systems under certain conditions. The designer should verify these before specifying the type of tray to be used.

# 4 Select the Tray Size

The width or height of a cable tray is a function of the number, size, spacing and weight of the cables in the tray.
Available nominal widths are 6, 9, 12, 18, 24, 30, 36 and 42 inches.

When specifying width, it is important to remember that the load rating does not change as the width increases. Even with six times the volume, a 36 in. wide tray cannot hold any more weight than a 6 in. wide tray. If the load rating of the tray permits, cable can be piled deeper in the tray. Most tray classes are available in a nominal 3-1/2, 4, 5, 6 and 7 inches (8 inch height also available as a special - see appendix). Cable ties or other spacing devices may be used to maintain the required air space between cables.

# 5. Select the Fittings

Fittings are used to change the size or direction of the cable tray. The most important decision to be made in fitting design concerns radius. The radius of the bend, whether horizontal or vertical, can be 12, 24, 36 or 48 in., or even greater on a custom basis. The selection requires a compromise with the considerations being available space, minimum bending radius of cables, ease of cable pulling, and cost. The typical radius is 24 in. Fittings are also available for 30°, 45°, 60°, and 90° angles. When a standard angle will not work, field fittings or adjustable elbows can be used. It may be necessary to add supports to the tray at these points.

# Support Locations for Fittings



Horizontal Wye

Horizontal Elbow

Straight Reducer

Offset Reducer

Vertical Elbows

Vertical Tee
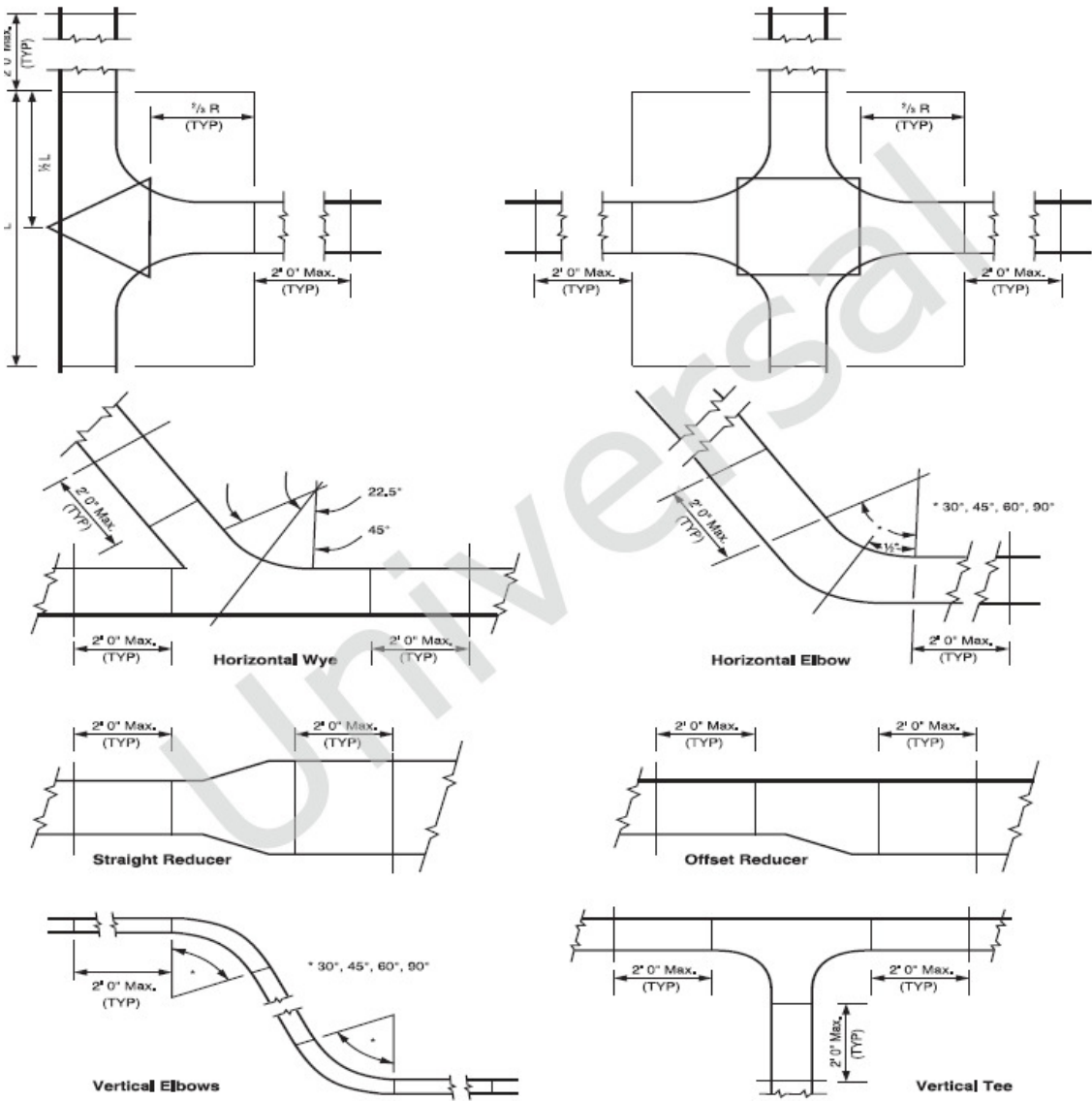
# 6. Consider Deflection

Deflection of the cable tray affects the appearance of an installation, but it is not a structural issue. In the case of non-metallic cable tray, deflection may be affected by elevated temperatures.

The load test is a simple beam, uniformly distributed load test. (see Figure 1.2) This type of test was initially selected because:

• It was easiest to test.
• It represents the worst case beam condition compared to continuous or fixed configurations. When consulting the manufacturer's catalog for deflection information, the designer must verify whether the data shown represents simple or continuous beam deflection. If continuous beam deflection is shown, the calculation factor should be given.
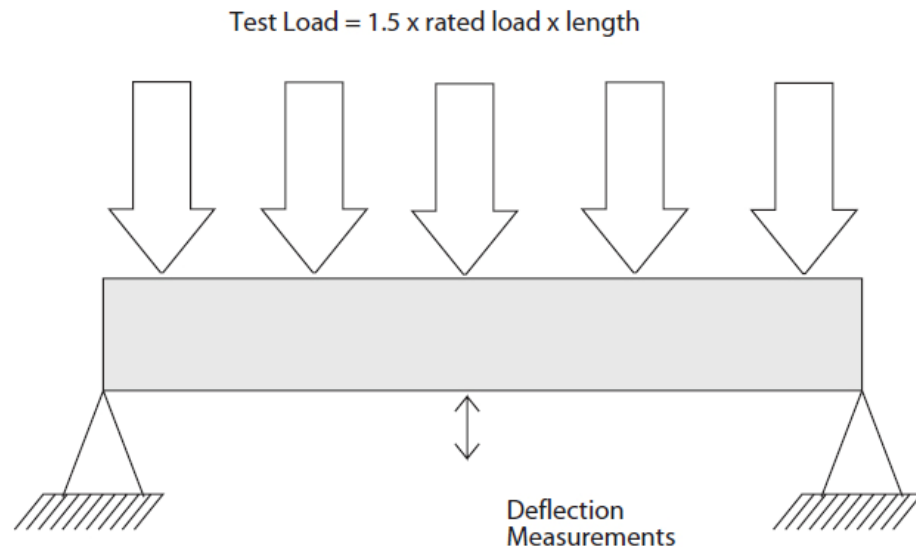
Test Load = 1.5 x rated load x length



Deflection Measurements

Figure 1.2

## Simple Versus Continuous Beam Deflection

Theoretical maximum deflection for a simple beam, uniformly distributed load may be calculated as:

$$.0130 \, w \, L \, / \, E \, I$$

Where: w = Load in lb/ft
L = Length in inches
E = Modulus of Elasticity
I = Moment of Inertia

The maximum deflection calculation for a continuous beam of two spans with a uniformly distributed load is:

$$.00541 \ w \ L \ / \ E \ I$$

A continuous beam of two spans therefore has a theoretical maximum deflection of only 42% of its simple beam deflection. As the number of spans increases, the beam behaves increasingly like a fixed beam, and the maximum deflection continues to decrease. As this occurs, the system's load carrying capability increases.

# Simple vs. Continuous Beam Deflection



**Simple Beam**
Uniformly Distributed Load

**Maximum Deflection**
$$\frac{.0130 \ wL^4}{EI}$$

**Continuous Beam – Two Spans**
Uniformly Distributed Load

**Maximum Deflection**
$$\frac{.00541 \ wL^4}{EI}$$
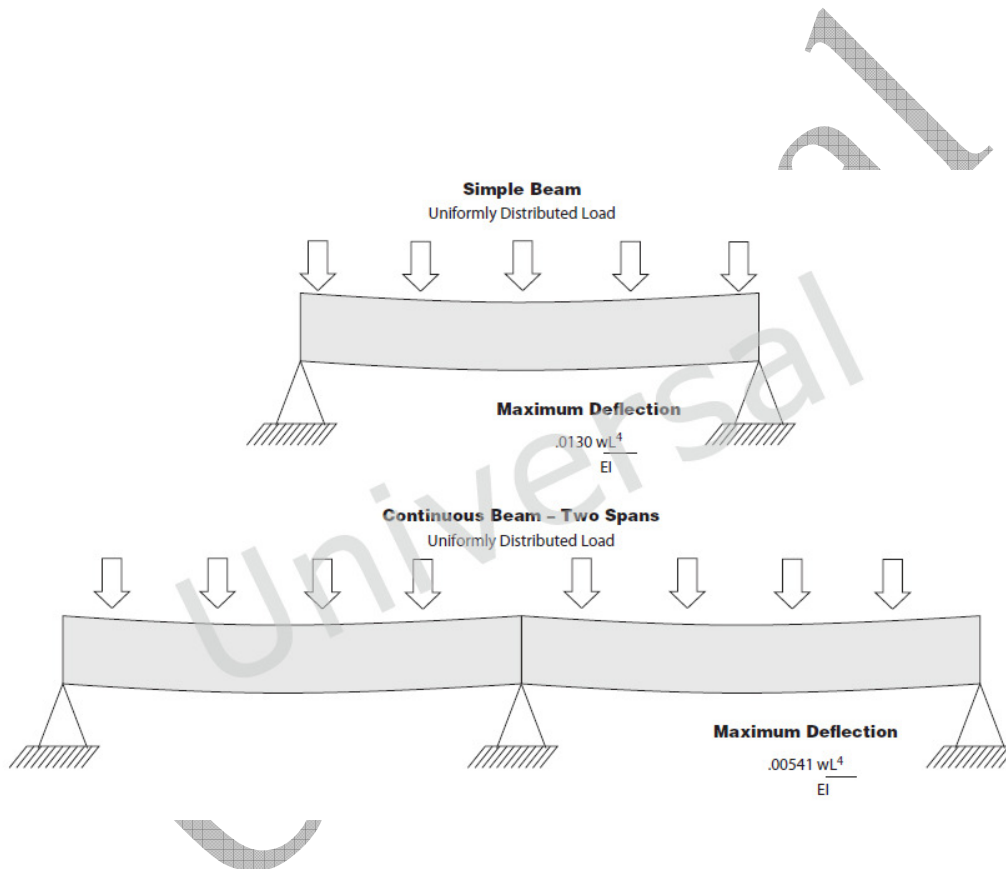
## Location of Couplings

Since different bending moments are created in each span, there is no simple factor to approximate deflection as the number of spans increases. It is possible to calculate these deflections at any given point by using second integration of the basic differential equation for beams. Testing shows that the center span of a three-tray continuous beam can deflect less than 10 % of its simple beam deflection.

## Couplers at Supports - Not Recommended



23 mm    12 mm    23 mm
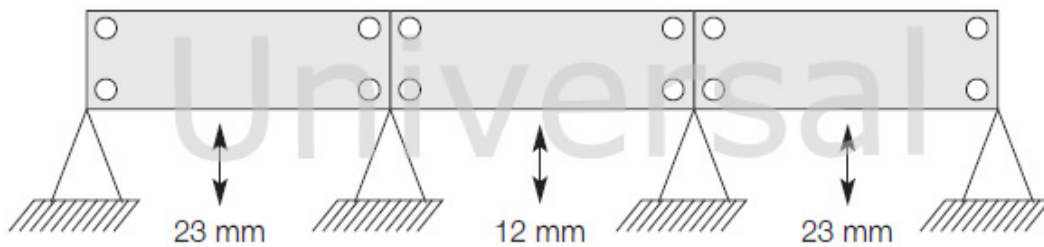
## Couplers at 1/4 Span From Supports - Ideal Layout



1/4 span

23 mm    3 mm    23 mm
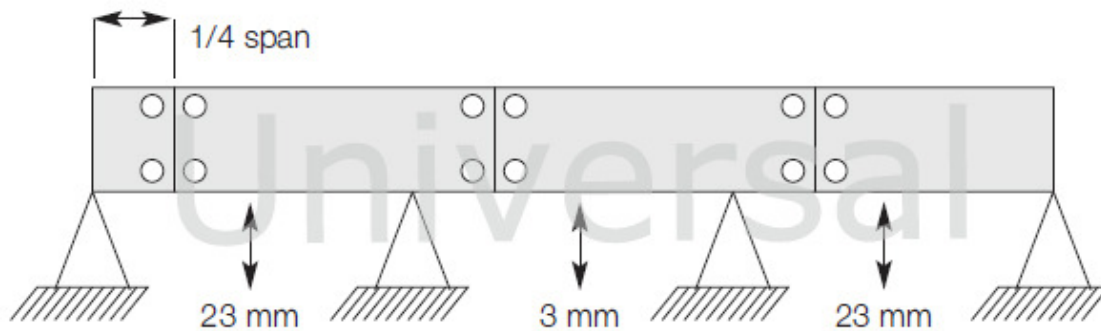
The support span should not be greater than the straight section length, to ensure no more than one splice is located between supports.

Location of Couplers. The location of the coupler dramatically affects the deflection of a cable tray

system under equal loading conditions. Testing indicates that the maximum deflection of the center span of a three-span tray run can decrease four times if the couplers are moved from one-quarter span to above the supports.

This can be a major concern for designers considering modular systems for tray and pipe racks.