



# TECHNICAL DATA

## TYPES OF BEAM LOADING

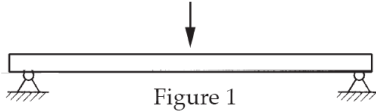


Figure 1

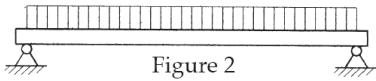


Figure 2

### Beam Loading –

Beams are loaded in several ways, as shown below.

#### Concentrated Load –

Also known as a point load, this type of load is applied at one point along the span of the beam. See Figure 1. A beam may have multiple concentrated loads along its span.

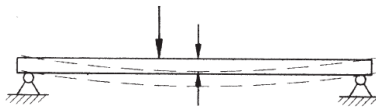
#### Uniform Load –

This is a load spread evenly over a length of the beam's span. See Figure 2. It may cover the entire span or only a portion.

#### Combined Load –

Concentrated loads and uniform loads may be carried simultaneously by a beam, arranged in any combination.

## BEAM DEFLECTION



### Deflection –

Deflection is the amount of displacement, or sag, experienced by a load-carrying beam. All loaded beams will deflect to a greater or lesser degree, depending upon:

- △ The size and placement of loads
- △ The beam material
- △ The manner of supporting the beam
- △ The stiffness of the beam

PHD provides deflection values for beams of various spans in the tables accompanying each channel shape. When determining the deflection of a strut, the rule of thumb observed by the industry is that a deflection of  $1/240$ th of the beam's span is acceptable.

The following table of beam formulas contains factors to be applied when analyzing a strut/beam in various configurations. These factors account for the difference in deflection that will be experienced by beams mounted in various configurations and subject to various types of loads.

Also included in the tables of channel information are values for the Moment of Inertia (I) and Section Modulus (S) of the channel. These values are given for both the X-X and Y-Y axis of the channel. They are measures of the stiffness of the beam's cross-sectional shape, and are used to calculate deflection. Deflection decreases as I and S increase. The Modulus of Elasticity (E), listed below I and S, is a measure of the beam material's resistance to bending. Again, as E increases, deflection decreases.

## SAFETY FACTOR

### Safety Factor –

The design loads given for strut beam loads are based on a simple beam condition using allowable stress of 25,000 psi. This allowable stress results in a safety factor of 1.68. This is based upon a virgin steel minimum yield strength of 33,000 psi cold worked during rolling to an average yield stress of 42,000 psi.

Aluminum typically has an elastic modulus which is  $1/3$  that of steel even though they may have identical strength. As a result, the deflection of aluminum channel will be three times that of steel channel under equal loading. In areas where structures will be subject to general viewing, deflection can produce a displeasing effect. To the untrained eye, a sagging channel may appear to be a result of poor design or excessive loading. This is not usually the case. Many properly designed channel installations will show a noticeable deflection at their designed loads. In areas where cosmetics are not important, deflection should not be a factor. Designing an entire installation based on minimal deflection could result in an over designed structure. This translates into increased material and installation cost. Where cosmetics are important, it may be necessary to limit the deflection to an aesthetically pleasing amount. This "acceptable deflection" amount is typically given as a fraction of the span.  $1/240$  span deflection is typically the limit where the amount of deflection appears negligible. For example, a beam span of 240" would be allowed 1" ( $240/240$ ) of deflection at the mid point. A 120" span would only be allowed  $1/2$ " ( $120/240$ ) of deflection. The maximum load for the channel must be limited in order to remain under these deflection requirements. The allowable load resulting in  $1/240$  span deflection is posted in the beam load chart for each channel size.

For even more stringent deflection requirements, an allowable load is listed in the beam load charts which results in  $1/360$  span deflection. This amount of deflection is sometimes used for beams in finished ceilings that are to be plastered.