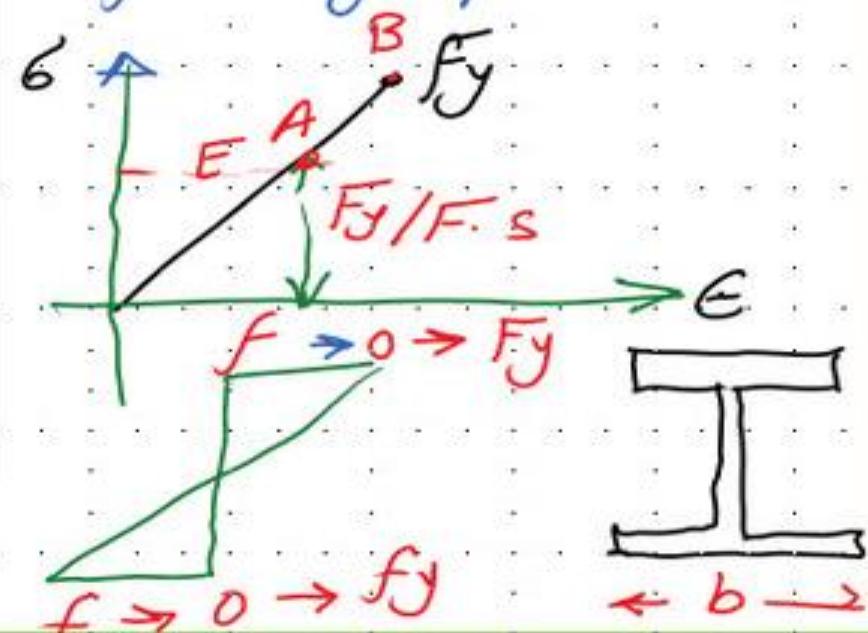
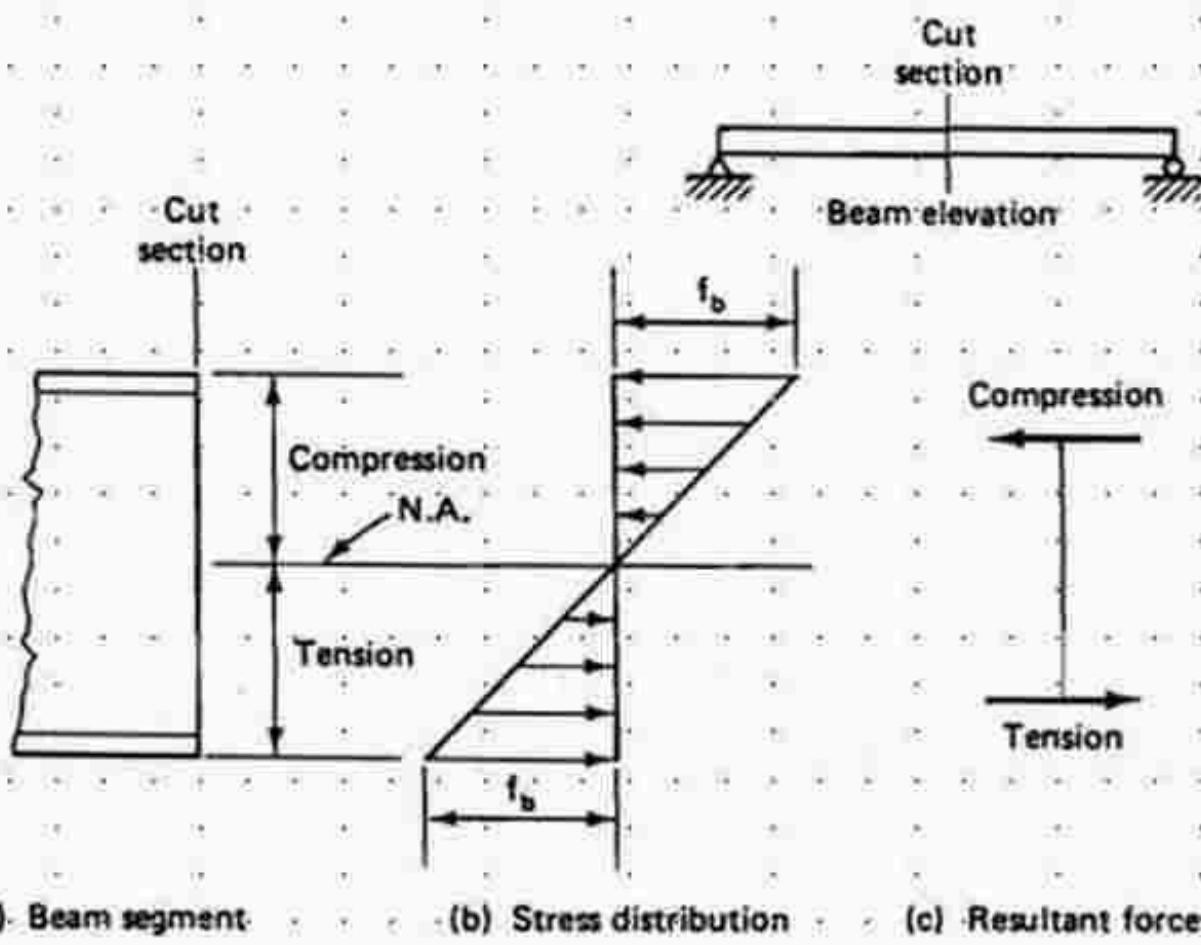


stress strain curve
From wiki

Elastic design utilizes
the Linear portion
of the graph



APPLIED STRUCTURAL
STEEL by L. SPIEGEL



(a) Beam segment

(b) Stress distribution

(c) Resultant forces

FIGURE 4-4 Stress-moment relationships.

ALLOWABLE BENDING STRESS

In dealing with beam problems, it is necessary to have an understanding of the specified allowable bending stress F_b , the maximum bending stress to which a beam should be subjected. The ASDS treats this topic in Section F1.1. Neglecting later complications, the basic allowable bending stress (in both tension and compression) to be used for most rolled shapes is

$$F_b = 0.66F_y$$

where F_y is the material yield stress. For a member to qualify for an allowable bending stress F_b of $0.66F_y$, it must have an axis of symmetry in, and be loaded in, the plane of the web. An important condition associated with the use of this value for F_b is the *lateral support* of the compression flange. The compression flange

From the flexure formula, the resisting moment M_R can be calculated by substituting F_b for f_b , and M_R for M :

$$F_b = \frac{M_R c}{I} = \frac{M_R}{S}$$

Then

$$M_R = F_b S$$

In this text M_R is defined as the bending strength or allowable moment for beam cross section. We consider this definition to be applicable for any value

Applied structural
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ASD - Allowable stress design (Historical background)

$$F.S = 1.50$$

$$f = \frac{F_y}{\rho g}$$

Compression \downarrow

E.N.A

The diagram illustrates a trapezoidal channel with a central vertical wall. The left side shows a vertical wall with a height of $d/2$. The right side shows a trapezoidal channel with a height of $d/2$. Arrows indicate flow direction and velocity profiles.

Tension

Sx: Elastic section Modulus

$$f = \frac{M y}{J}$$

$$y_{c,T} = \frac{2}{3}d \Rightarrow M = C y_{c,T} = T y_{c,T} = \frac{bd^2}{6} f$$

Case of a Rectangle

Moment - M

A hand-drawn diagram of a trapezoidal channel. The vertical height of the channel is labeled d_1 in blue. The top width is labeled b in red. The bottom width is labeled f in red. The left side of the channel is a vertical purple line, and the right side is a red line. The bottom of the channel is a horizontal red line. A vertical blue line is drawn on the left side, and a horizontal blue line is drawn across the channel at a height of d_2 from the bottom. The distance from the bottom to the top is labeled $d_1 - d_2$ in blue.

$$\begin{array}{c}
 \text{Diagram: A beam of height } d \text{ is divided into three horizontal segments. The top segment is } d/6 \text{ high, the middle segment is } d - \frac{d}{3} = \frac{2d}{3} \text{ high, and the bottom segment is } d/6 \text{ high. The beam is subjected to a uniformly distributed load } f \text{ acting downwards. The reaction forces at the supports are } \frac{1}{2} f b d \text{ each, acting upwards. The reaction force at the left support is } \frac{1}{2} f b d \text{ and the reaction force at the right support is } \frac{1}{2} f b d. \\
 \text{Equation: } C = \frac{1}{2} f b d \frac{d}{2} \\
 \text{Equation: } d - \frac{d}{3} = \frac{2d}{3} \\
 \text{Equation: } T = \frac{1}{2} f b d
 \end{array}$$

$$\Rightarrow S_x = \frac{bd^3}{12} \left(\frac{2}{d} \right) = \frac{bd^2}{6}$$

$$f = \frac{My}{I} \quad \Rightarrow \quad S_x = \frac{bd^3}{12} \left(\frac{2}{d} \right)$$

$$M = S_x \cdot f$$

$$\text{For } f = \frac{F_y}{1.5}$$

$$M = S_x (0.66) F_y$$

For Non Compact section

$$M = S_x (0.6) F_y$$

Allowable Bending moment
Symmetric Section

Compact Section

Page 98

Reference : Applied structural steel Design

LEONARD SPIEGEL

structural analysis
II
S.S. Bhavikatti

12.2 DEFINITIONS OF PLASTIC HINGE AND PLASTIC MOMENT CAPACITY

Plastic Hinge

It is a section at which all the fibres have yielded, and hence for any further load rotation takes place at the section without resisting any additional moment.

Plastic Moment Capacity

Plastic moment capacity of a section may be defined as the moment which makes all the fibres at that section to yield and thereby form a plastic hinge.

12.3 ASSUMPTIONS

The following assumptions are made in plastic theory:

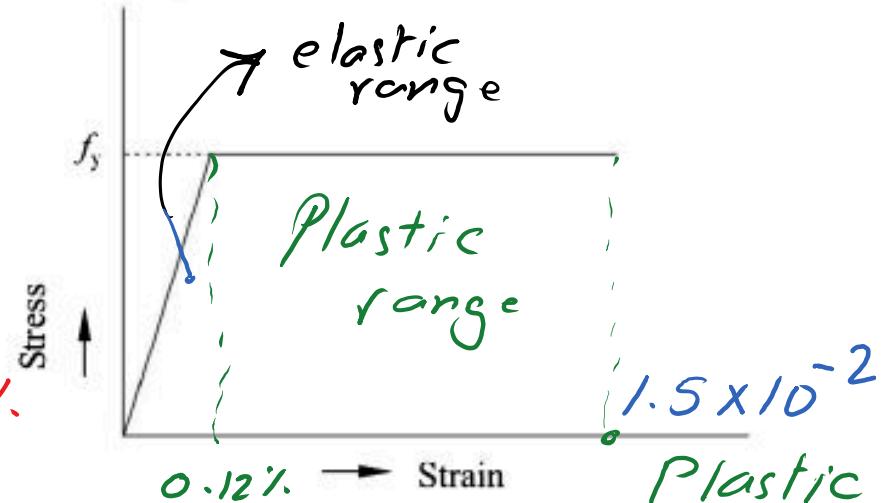
1. The stress-strain relationship is idealized to two straight lines as shown in Figure 12.4, *i.e.*, strain hardening effect is neglected.
2. Plane section before bending, remains plane even after bending, *i.e.*, shear deformation is neglected.

3. The relationship between compressive stress and compressive strain is the same as between tensile stress and tensile strain.

$$E = 29000 \text{ kN}$$

$$f_y = 36 \text{ kN}$$

$$\epsilon_y = \frac{f_y}{E} = \frac{36}{29000} = 0.12\%$$



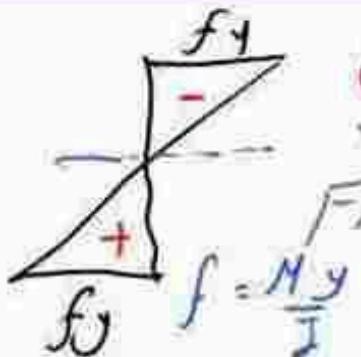
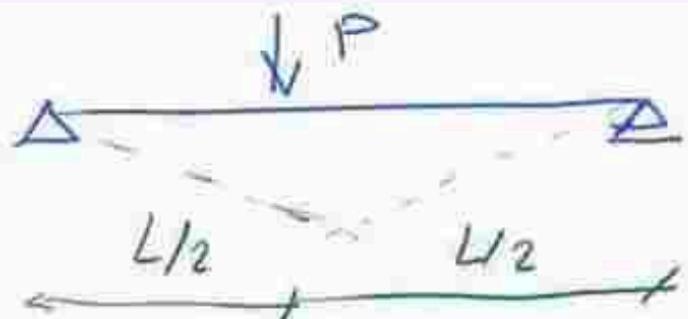
$$\frac{C_p}{E_y} = 10$$

Figure 12.4: Idealized stress-strain curve. Strain

4. Whenever a fully plastic moment is attained at any cross-section, a plastic hinge forms which can undergo rotation of any magnitude, but the bending moment remains constant at the fully plastic value.

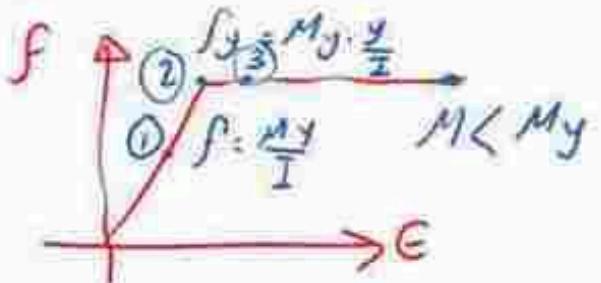
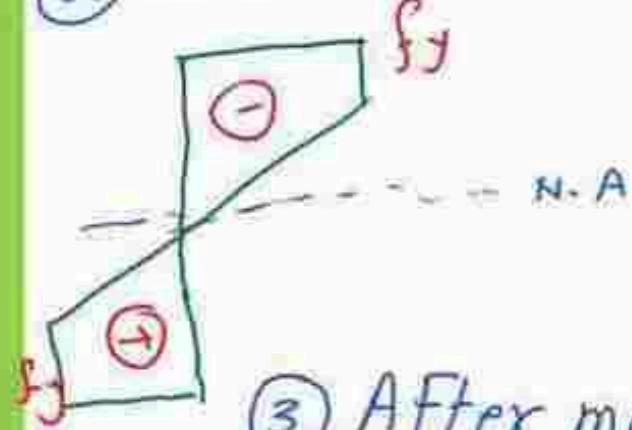
5. Effect of axial load and shear on fully plastic moment capacity of the section is neglected.

6. The deflections in the structure are small enough for the equations of statical equilibrium to be same as those for the undeformed structures.



① Within the elastic limit, the stress varies linearly, the top, bottom Fibres will have stress = f_y

② After increasing the Load, inner Fibres can be stressed to f_y



③ After more increase, the section can resist till all Fibres are stressed to f_y .

