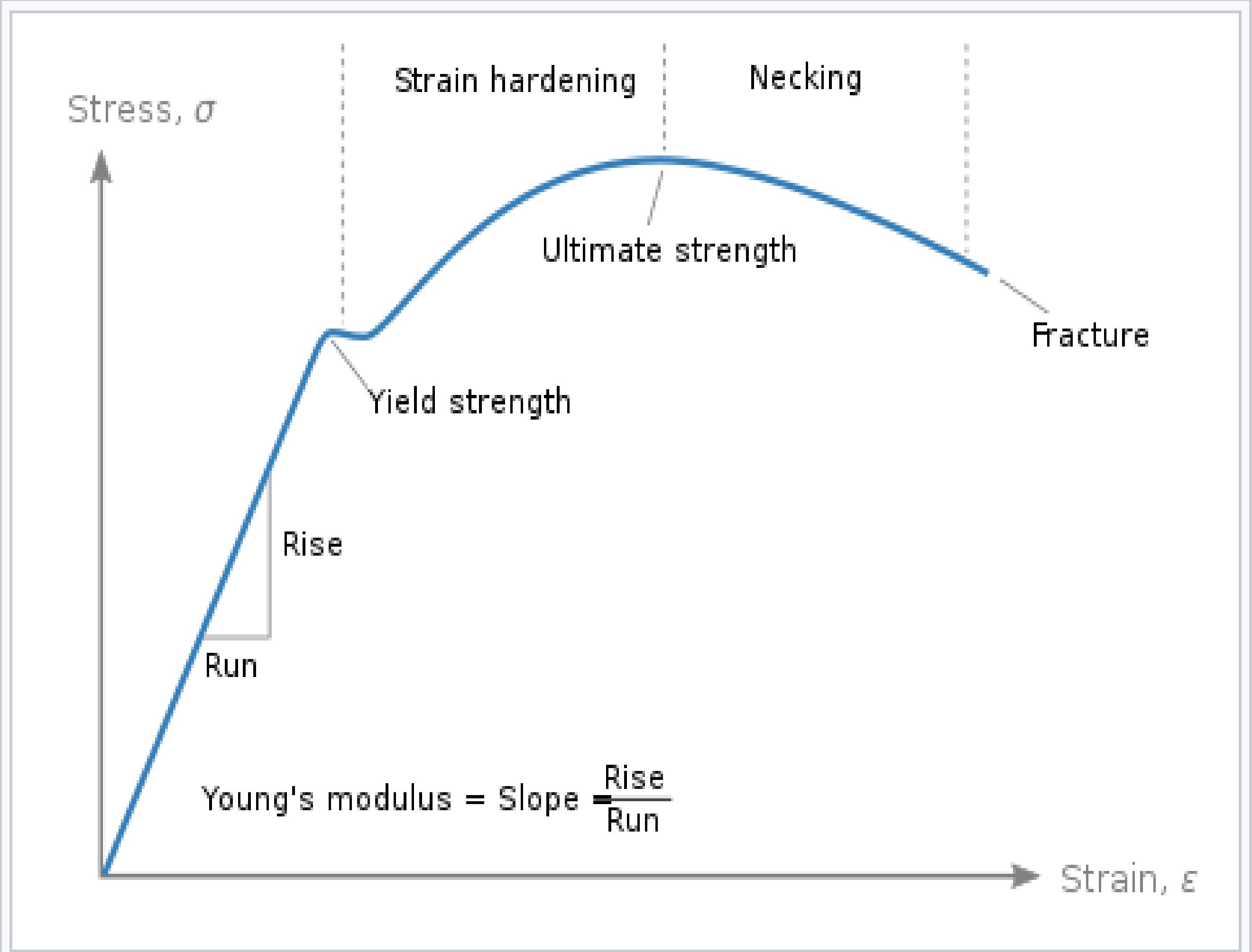
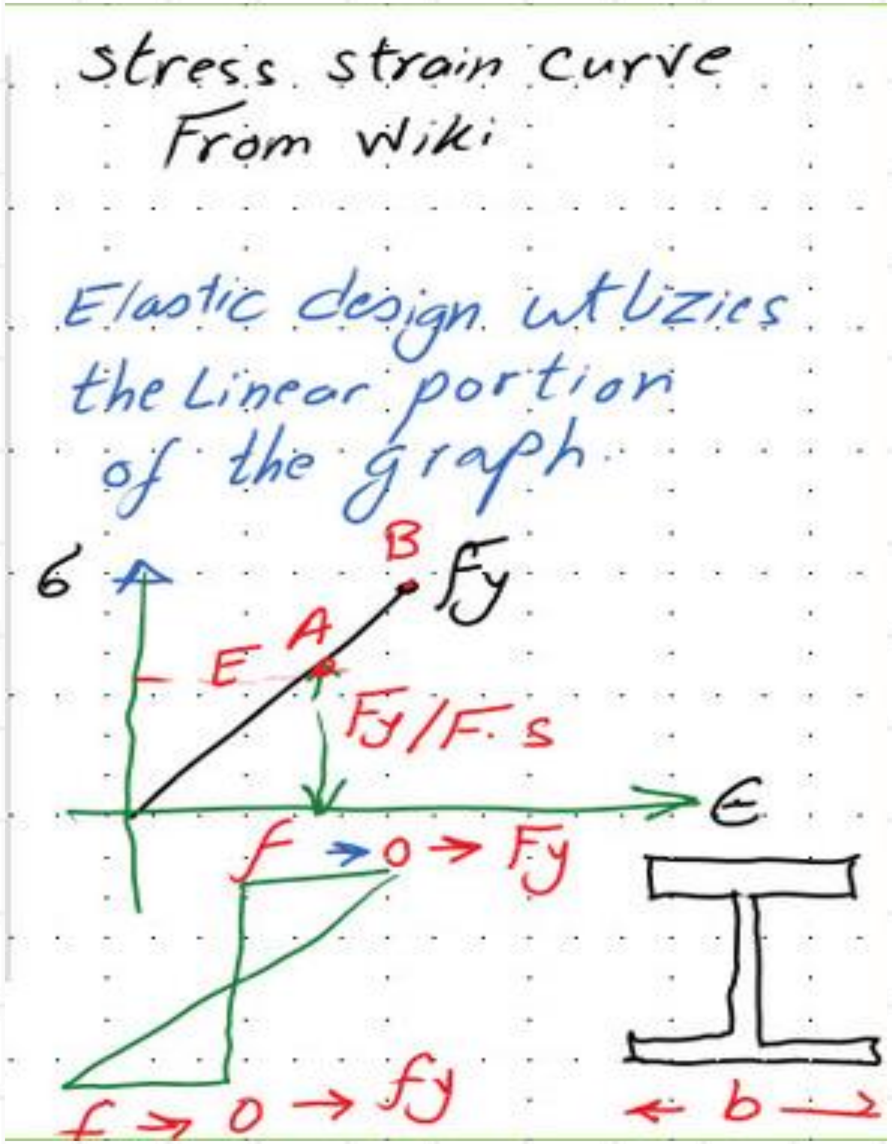


Stress-strain curve typical of a low carbon steel.



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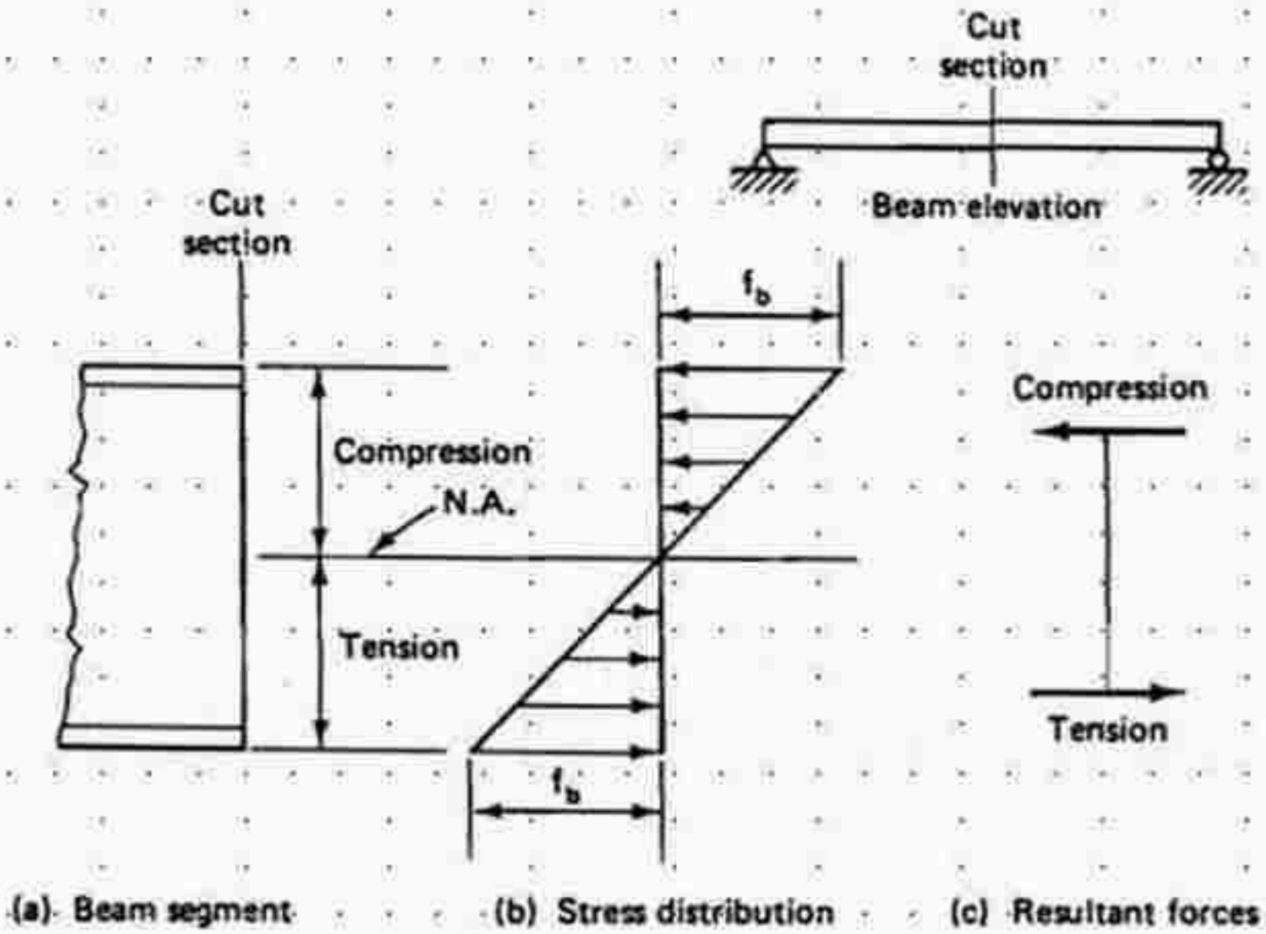

FIGURE 4-4 Stress-moment relationships.

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ALLOWABLE BENDING STRESS

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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

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

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

Applied structural steel by L spiegel

Then

$$M_R = F_b S$$

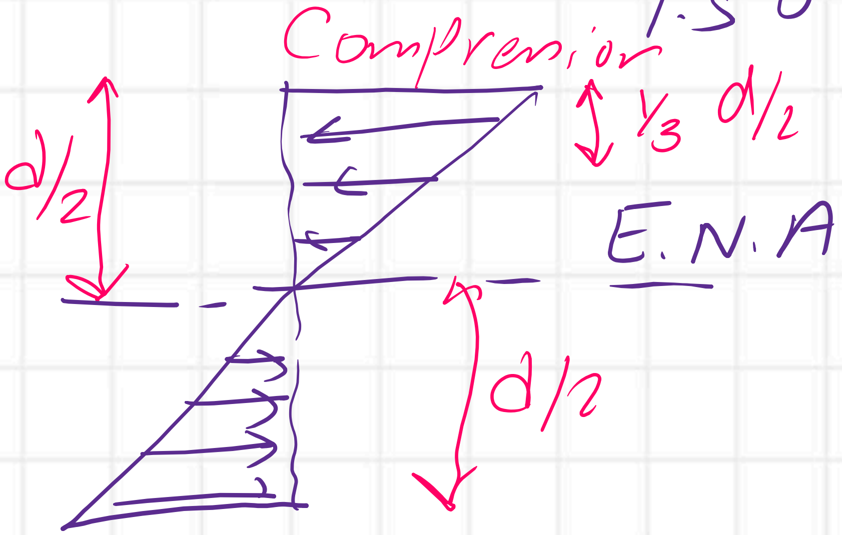
In this text M_R is defined as the bending strength or allowable moment f
beam cross section. We consider this definition to be applicable for any valu

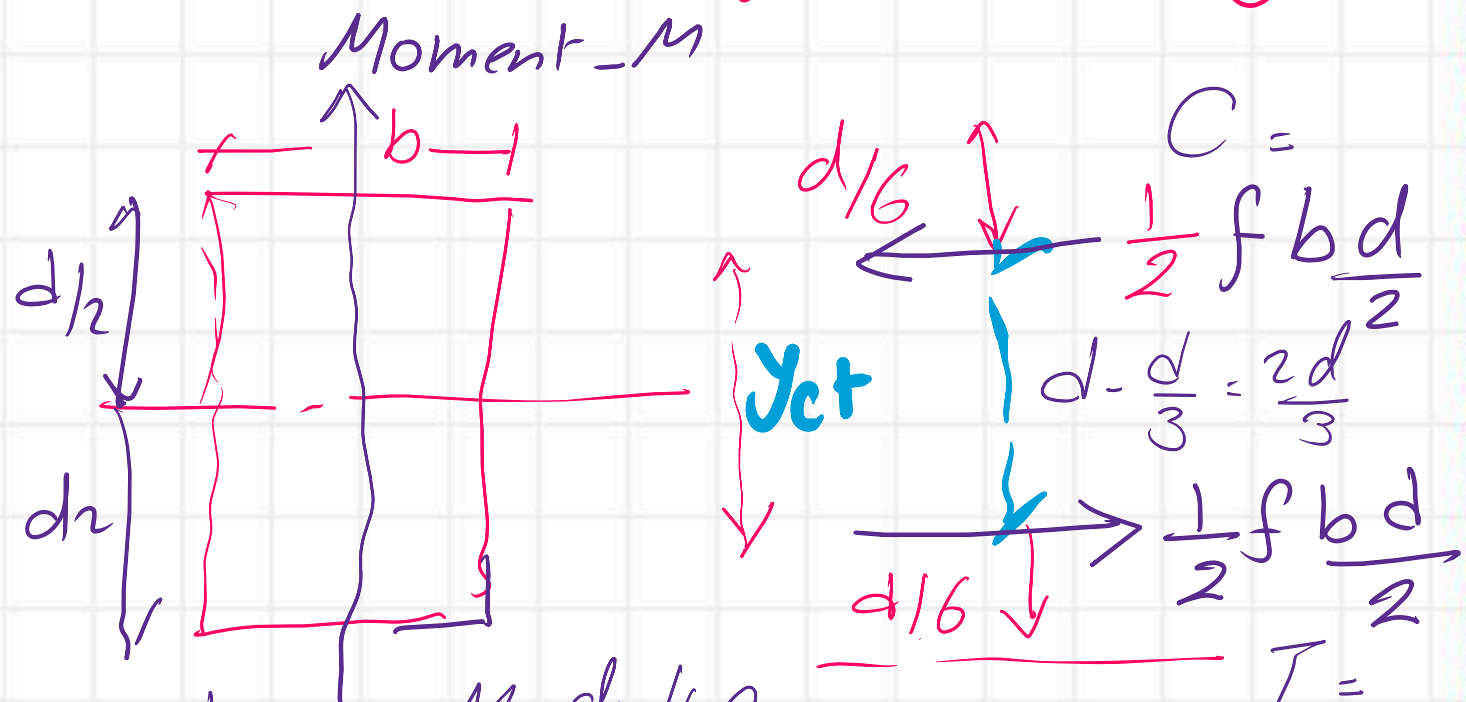
ASD : Allowable stress design (Historical Background)

$$F.S = 1.50$$

$$f = \frac{F_y}{1.50}$$

Case of a Rectangle





Sx : Elastic section Modulus

$$\leftarrow f \rightarrow$$

$$f = \frac{My}{I} \qquad \frac{I}{y} \Rightarrow S_x = \frac{bd^3}{12}\left(\frac{2}{d}\right) = \frac{bd^2}{6}$$

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

M allowable Bending moment

$M = S_x \cdot f$

Symmetric Section

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

Compact section

$M = S_x (0.66) F_y$

For Non Compact section

$M = S_x (0.6) F_y$

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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.

$E = 29000$ ksi

$f_y = 36$ ksi

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

at Least = 10

$\frac{\epsilon_p}{\epsilon_y} = 10$

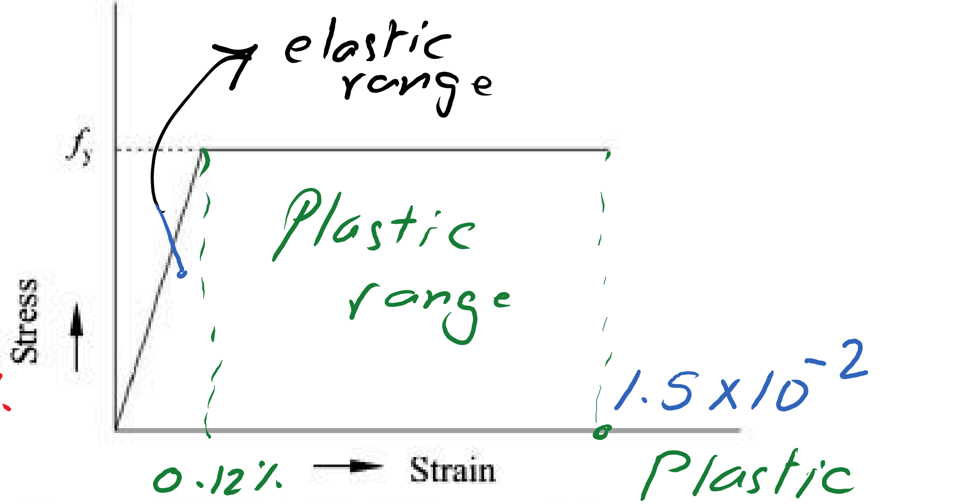

Figure 12.4: Idealized stress–strain curve.

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.

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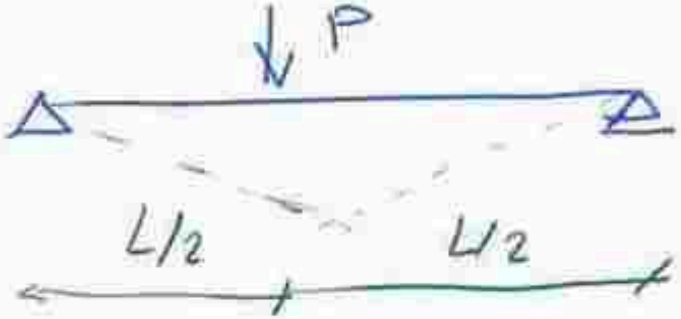
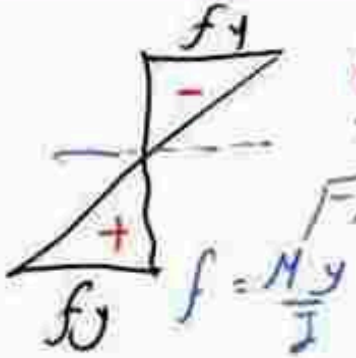
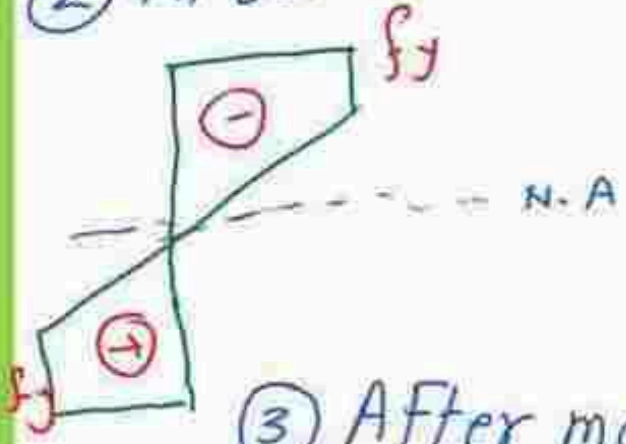
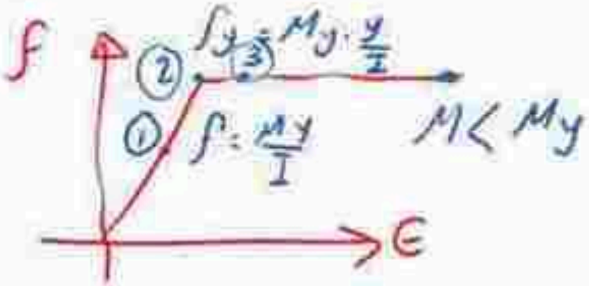




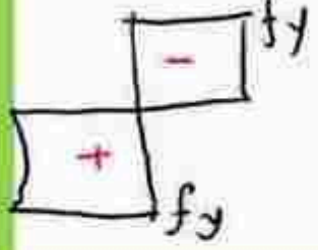
① within the elastic Limit, the stress varies linearly, the top, bottom Fibres will have stress = f_y

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.



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