

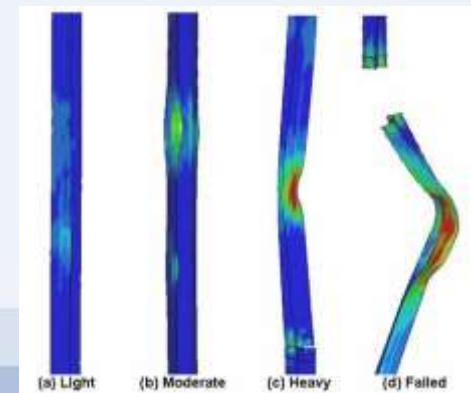
# NEEDHAM'S METHOD

FOR DETERMINING THE  
CRIPPLING STRESS

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# Columns

- It is a member of a structure which is subjected to axial compressive load.
- The failure of a column may be due to:
  - Direct Compressive Stress
  - Buckling Stress
  - Combination of direct compressive and buckling stress



What is Crippling Stress?!!!



- If the lateral dimensions of the column is very small compared to its length, then the failure may occur due to bending (also known as buckling or crippling).
- The load at which the column buckles is the crippling load, and the corresponding stress is known as **Crippling stress**.
- Crippling stress for a thin column is found using Euler's Column Theory.

# Needham's Method - Importance

- The Euler's theory could just give a solution for a thin column.
- And it was very difficult to find the crippling stress for different structural members.
- Through extensive tests, Needham formulated an empirical equation to find out the crippling stress of structural elements.

# Needham's Method - Highlights

- Some of the main points to be noted in Needham's method for determining crippling stress:
  - The structural member section is divided into simple Angular Elements.
  - Crippling failure strength of the structural member is equal to the Sum of crippling failure strength of the angular elements.

# Crippling stress for an angular section

Fig 1 shows a structural member. The crippling stress for the member can be found by dividing the structure into angular elements as in Fig 2. The semi-empirical formula for finding the crippling stress of the structure:

$$\sigma_c = \frac{k_e (E_c \sigma_{cy})^{(1/2)}}{\left[ \frac{b'}{t} \right]^{(3/4)}}$$

where  $\sigma_c$  - Crippling stress  
 $E_c$  - Compressive Modulus of Elasticity  
 $\sigma_{cy}$  - Material compressive yield stress  
 $k_e$  - A constant depending upon condition of angular edges  
 $b'/t = \frac{(a+b)}{2t}$

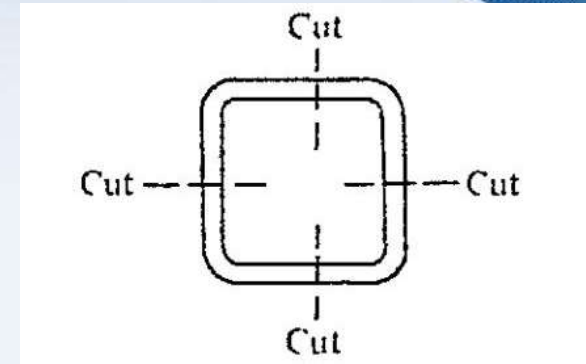


Fig 1

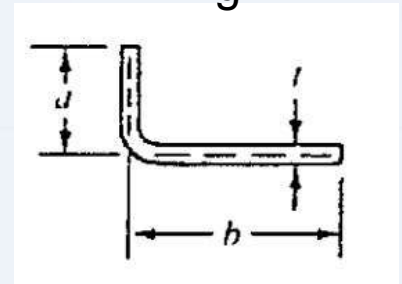


Fig 2

| Support condition | $k_e$ |
|-------------------|-------|
| One edge free     | 0.342 |
| Two edge free     | 0.316 |

# Crippling stress for actual member

- The crippling stress for actual member is found out by summing up all the crippling stress of angular elements.

$$\sigma_{CS} = \frac{\sum \sigma_{ci} A_i}{\sum A_i}$$

where  $\sigma_{ci}$  - 'i'th angle crippling stress

$A_i$  - 'i'th angle cross-section

$\sigma_{CS}$  - Member section crippling stress

THANK YOU