LECTURE #9 :
3.11 MECHANICS OF MATERIALS F03

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- Review Trusses : Part 2
- Trusses Part 3 :

Energy Approach (Castigliano's theorum)

Review Lecture #8 : Trusses Part 2

2. TRUSSES : Defined *statically determinate* and *statically indeterminate*

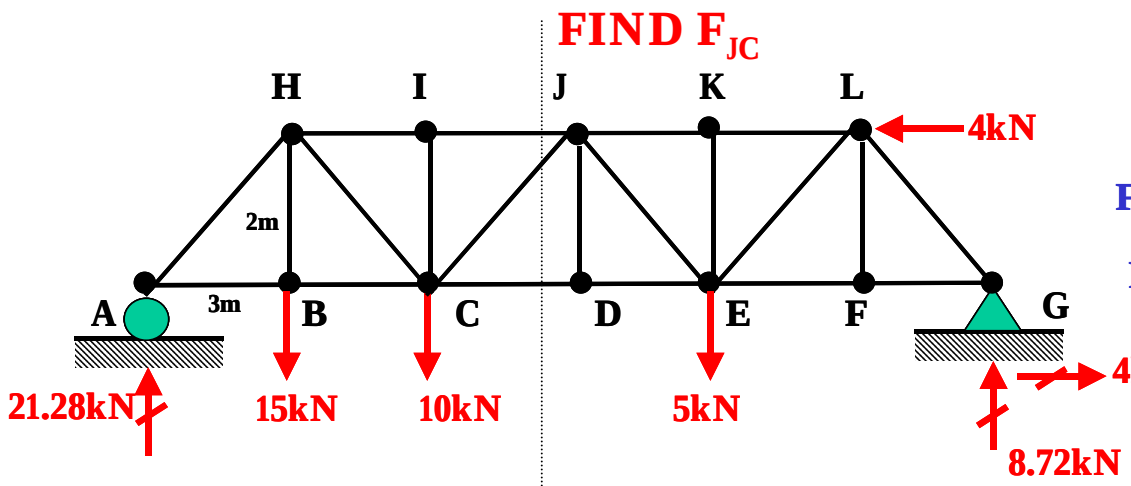
STATICALLY DETERMINATE : can solve the problem using just the (1) equations of static equilibrium

STATICALLY INDETERMINATE : besides the (1) equations of static equilibrium, you also need
(2) compatibility equations (geometrical continuity, e.g. deformations)
(3) constitutive equations (material properties, e.g. Hooke's law)

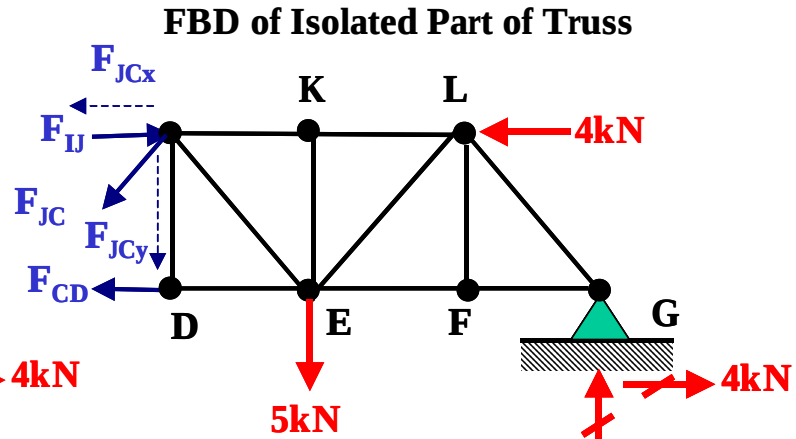
B. To determine *member forces* :

METHOD OF SECTIONS : advantage : force is any member can be found directly from an analysis of a section of the truss which has cut that member; don't have to go from joint to joint

1. Draw a free-body diagram of the entire truss
2. Determine support reactions using the equations of static equilibrium
3. Identify members to be analyzed
4. Cut an imaginary section of through the members of interest (maximum three)
5. Isolate smaller part of truss, consider it as a single body in equilibrium, and draw free-body diagram
6. Write and solve equations of static equilibrium for diagram drawn in step 5*



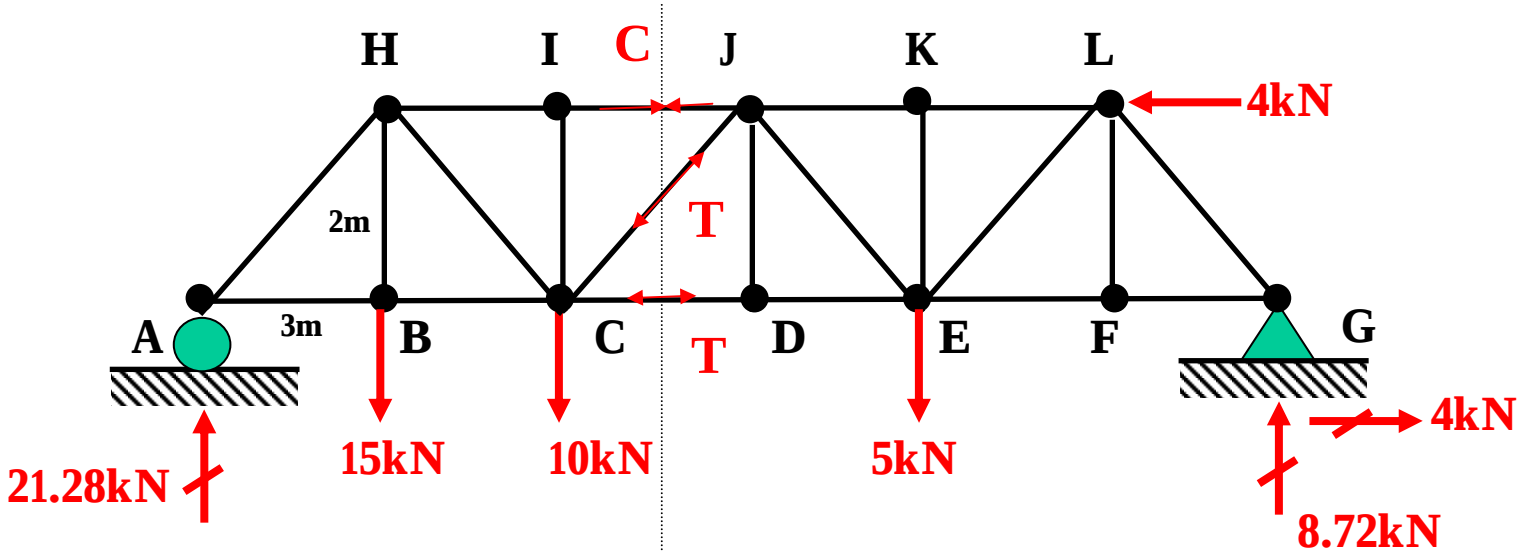
cut through member of interest



$F_{JC} \Rightarrow \Sigma F_y = 0$

$F_{JC} = 6.71$ kN

Free Body Diagrams : Review



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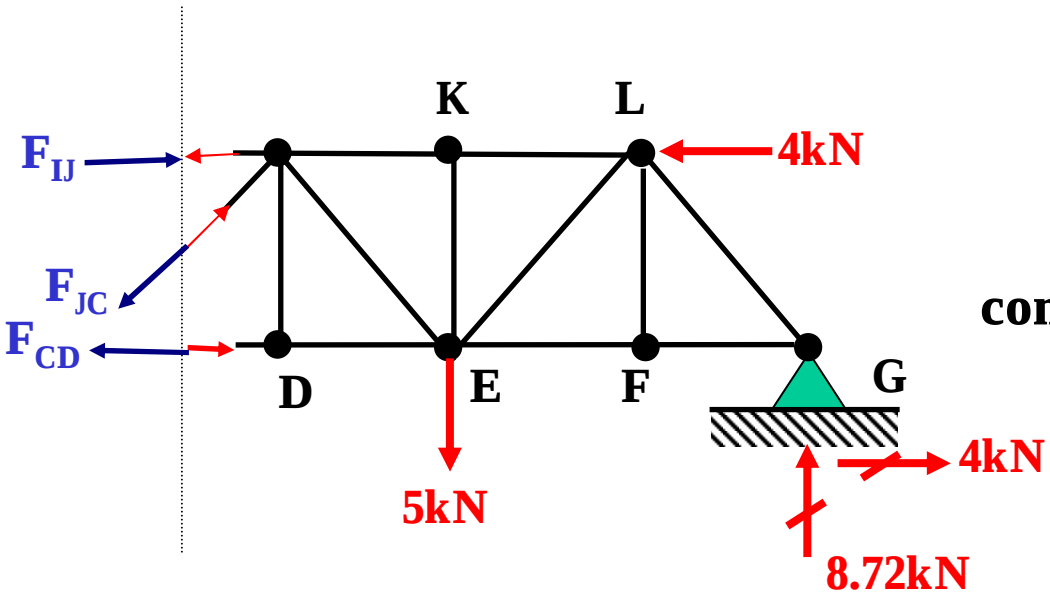
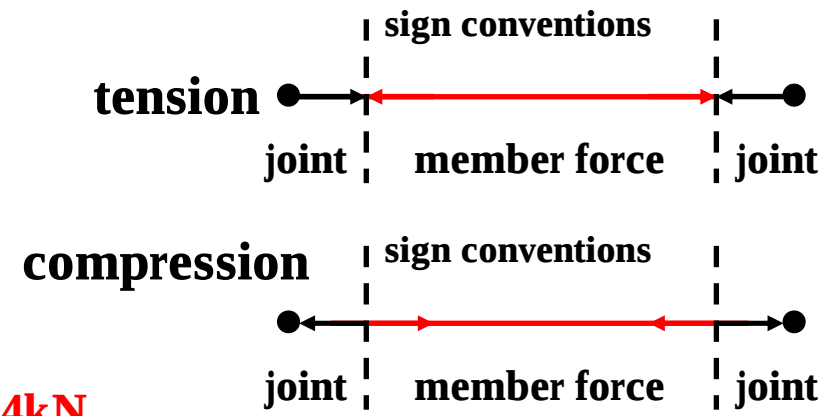
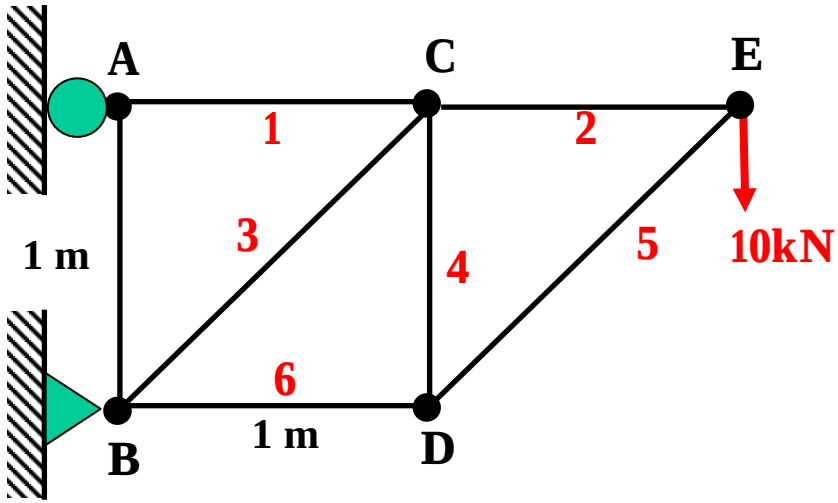




Elastic Strain Energy for Solving Deflections in Truss Problems

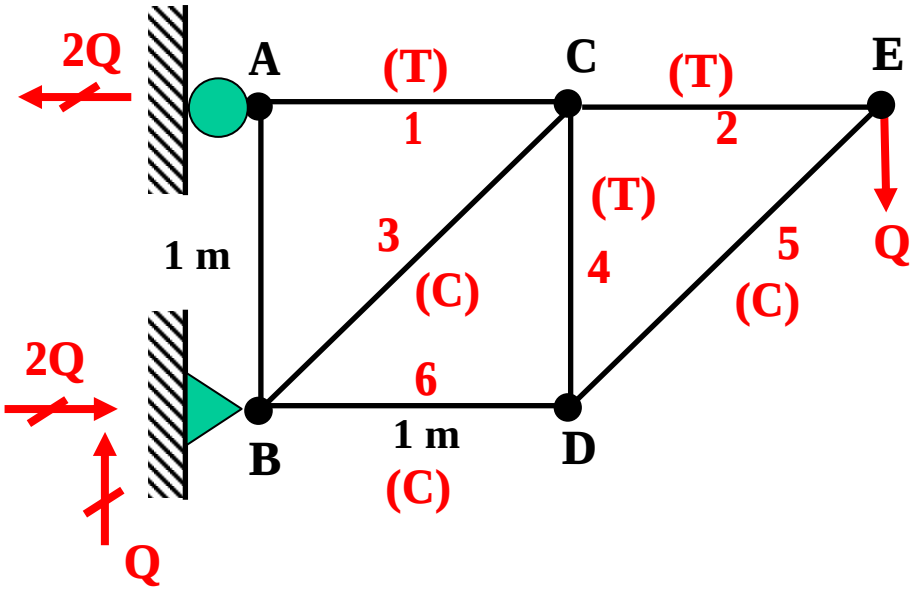
Castigliano's Theorum for Solving Deflections in Truss Problems

Castigliano's Theorum for Solving Deflections in Truss Problems



FIND DISPLACEMENT OF JOINT E

Castigliano's Theorum for Solving Deflections in Truss Problems

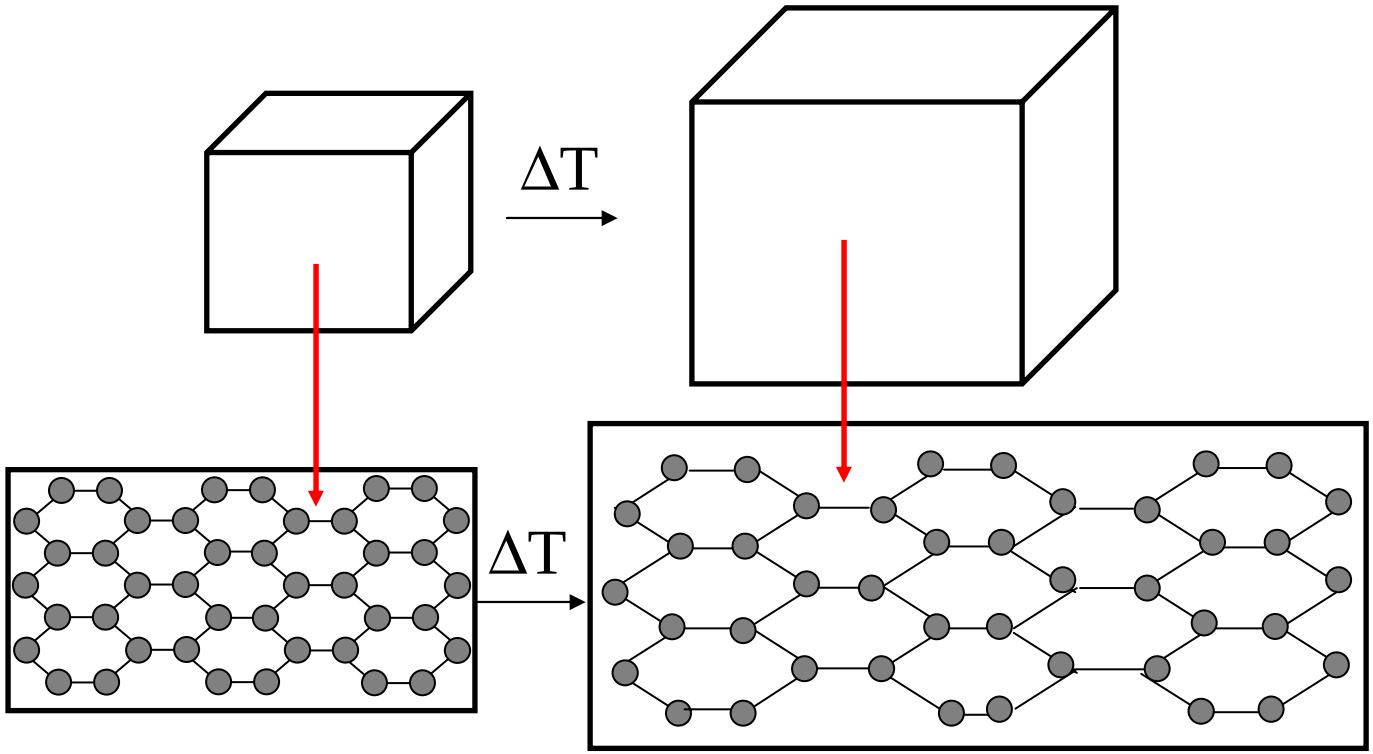


MAKE TABLE OF VALUES FOR EACH TRUSS MEMBER

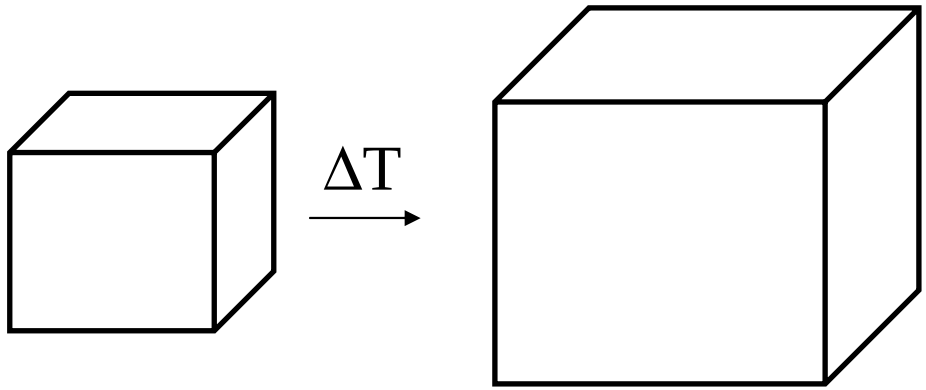
SUM COLUMN 4 FROM PREVIOUS CHART CREATED

$$\delta_Q = \frac{dU_{TOTAL}}{dQ} = \sum_{i=1}^{n} \frac{P_i L_i}{A_i E_i} \frac{dP_i}{dQ}$$

Thermal Expansion of Solid Materials



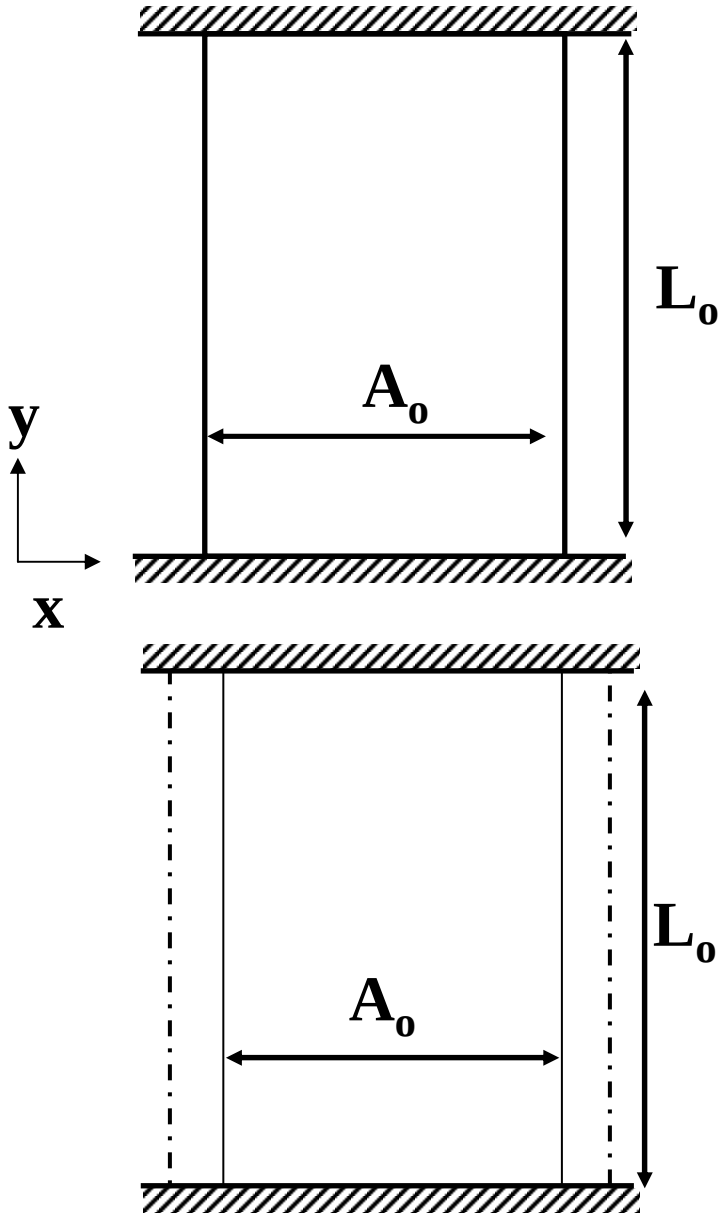
Linear Coefficient of Thermal Expansion



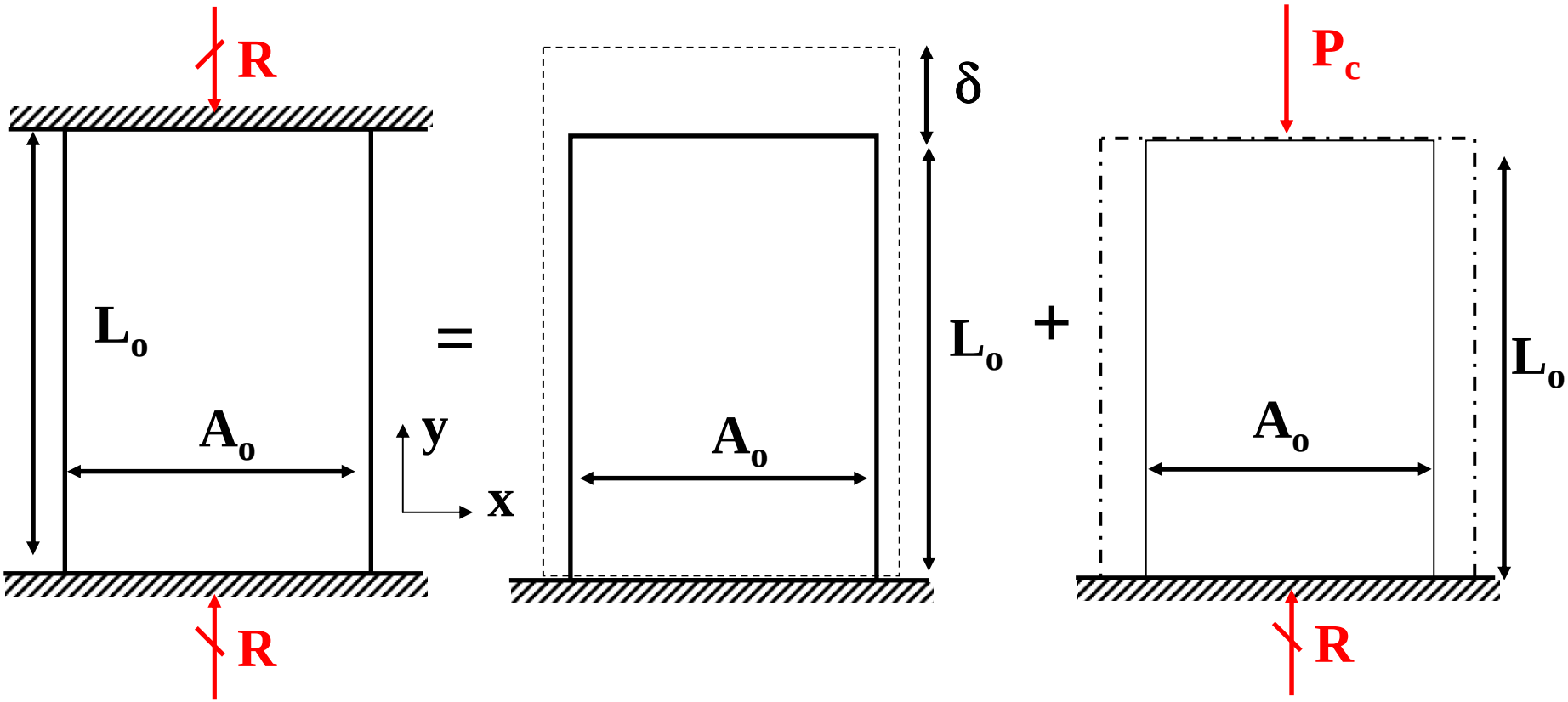
Linear Coefficient of Thermal Expansion Values for Various Materials

Material ($\alpha_{L(10^{-6}/^{o}F)}$)
Polymers : Nylon (40-80) Rubber (70-110) Polyethylene (80-160)
Brass (10.6-11.8)
Bronze (9.9-11.6)
Steel (5.5-9.9)
Rock (3-5)
Glass (3-6)
Titanium (4.5-6)
Concrete (4-8)
Tungsten (2.4)

Thermal Expansion : Sample Problem #1



Thermal Expansion : Sample Problem #1



Thermal Expansion : Sample Problem #1