POTENTIAL ENERGY APPROACH

ONE OF VARIATIONAL METHODS. THE OTHER IS VIRTUAL STRAIN APPROACH

- GALERKIN-BUBNOV, PRIMARILY A LEAST-SQUARED, WEIGHTED RESIDUAL APPROACH.

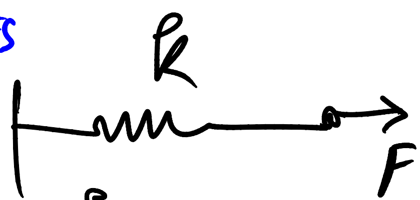
POT. ENE. $\Pi = U + \Omega$

Π → TOT. POT. ENE.

U → STRAIN (DEFORMATION) ENERGY

Ω → DUE TO WORK OF FORCES

FORCES → VOLUMETRIC (BODY) FORCES
→ SURFACE TRACTION
→ EXTERNAL FORCES

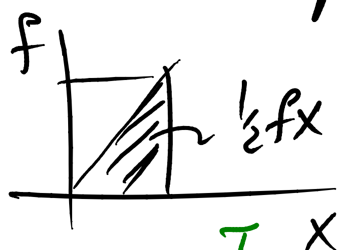


$U = \frac{1}{2} f \cdot x \qquad f = kx$

$U = \frac{1}{2} k x^2$

$U = \frac{1}{2} \{x\}^T [k] \{x\}$

$\quad (1 \times 4) \quad (4 \times 4) \quad (4 \times 1)$



$\frac{1}{2} [k] \{x\}^T \{x\}$

$(4 \times 4)(4 \times 1)(4 \times 1)$

1×4

OBJECTIVE:

DEFINE A KINEMATICALLY ADMISSIBLE DISP. FIELD SUCH THAT TOTAL POTENTIAL ENERGY OF SYSTEM IS MINIMIZED

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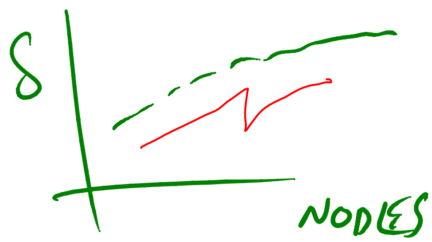
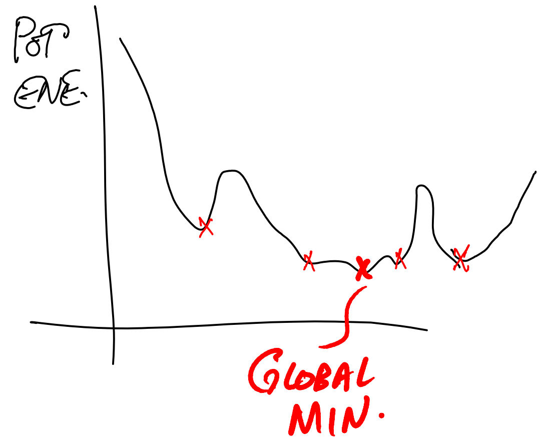
DISP. FIELD THAT MEETS B.C. REQUIREMENTS, AND DOES NOT PRODUCE DISCONTINUITY OF SLOPE, WARPAGE, GAPS, etc.





USE SMALL (VIRTUAL) PERTURBATION

$$\delta d_1, \delta d_2, \ldots, \delta d_n$$

FORM VIRTUAL POT. ENERGY:

$$\delta \Pi_p = \frac{\partial \Pi_p}{\partial d_1}\delta d_1 + \frac{\partial \Pi_p}{\partial d_2}\delta d_2 + \cdots + \frac{\delta \Pi_p}{\partial d_n}\delta d_n$$

GOAL IS TO MINIMIZE

$$\frac{\partial \Pi_p}{\partial d_i} = 0 \qquad i = 1, 2, \cdots, n$$

IF $\frac{\partial \Pi_p}{\partial i} = 0$ THEN CONDITION OF FULL EQUILIBRIUM.