

Chap 2 Energy Method

(1) principle of Minimum Total Potential Energy (PMTPE)

(정의) 기하학적 경계조건을 만족시키는 모든 admissible displacement 중에서 actual displacement가 potential π 를 최소 만든다.

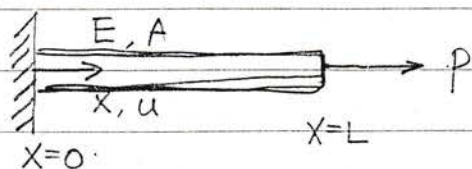
total potential π 는

$$\pi = U - W$$

U = internal strain energy
or internal work

W = external work

(예) 1-d bar



E = Young's Modulus
= constant

A = 단면적 = constant

U = internal work

$$= \int_V \frac{1}{2} \epsilon_{xx} \sigma_{xx} dv = \frac{1}{2} \int_0^L \epsilon_{xx} E \epsilon_{xx} A dx$$

$$= \frac{1}{2} \int_0^L EA \left(\frac{\partial u}{\partial x} \right)^2 dx$$

if $u = ax \rightarrow \frac{\partial u}{\partial x} = a$

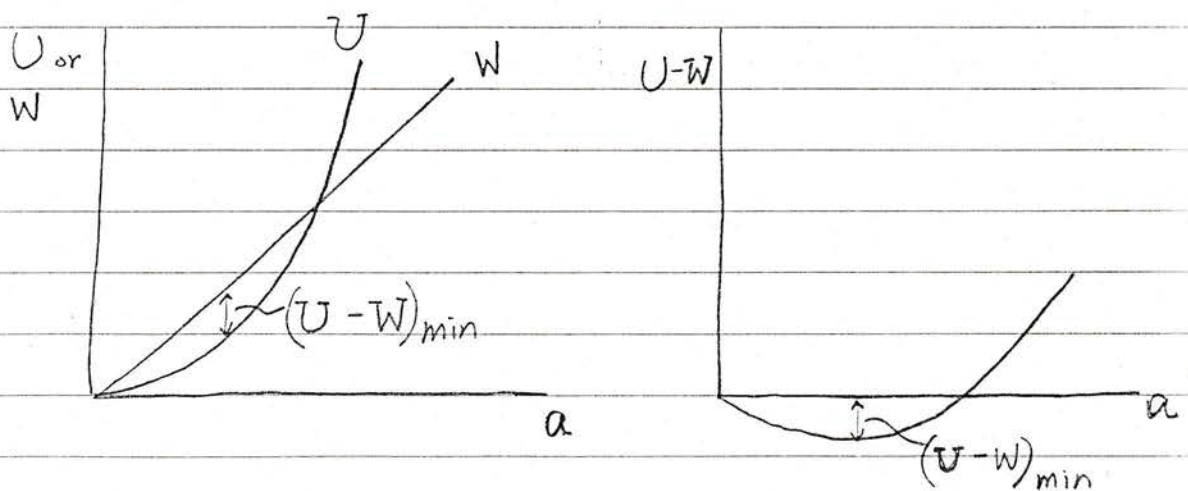
Then $U = \left[\frac{1}{2} \right]_0^L EA dx a^2$
 $= a^2 \text{에 비례}$

$W = \text{external work}$

$= P(u)_{\text{at } x=L}$

if $u = ax \rightarrow (u)_{\text{at } x=L} = aL$

Then $W = \left[P \cdot L \right] a = a \text{에 비례}$
 Constant

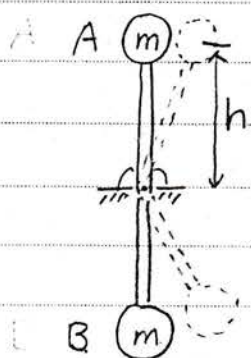


$\Pi = U - W$ 를 최소로 만드는 admissible displacement

$u \neq$ actual displacement.

(Note) admissible displacement = 경계조건을 만족시키는 displacement morning glory

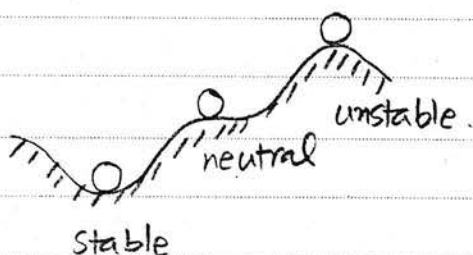
PMTPE 의 물리적 설명.



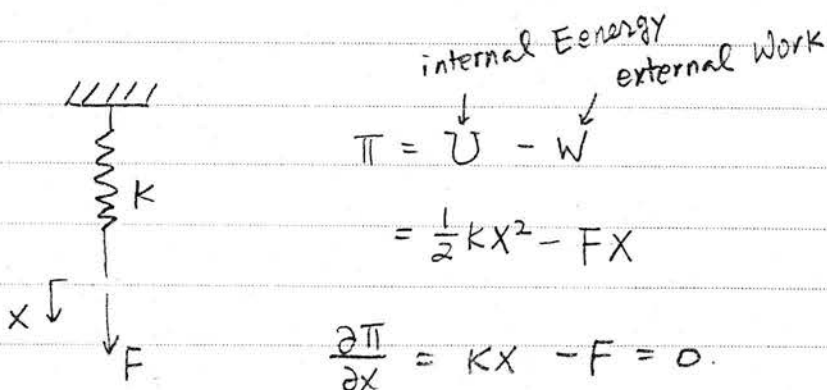
A : equilibrium, unstable
potential energy $\Pi = mgh$.

B : equilibrium, stable
 $\Pi = -mgh$.

에너지 보존 법칙 $(K.E) + (P.E) = \text{constant}$
 $T + \Pi = \text{const}$



세 구슬은 모두 equilibrium



internal Energy external Work

$$\Pi = U - W$$

$$= \frac{1}{2} KX^2 - FX$$

$$\frac{\partial \Pi}{\partial x} = KX - F = 0.$$

