Principle of superposition.

1. linear system

$F(x_1+x_2) = F(x_1)+F(x_2)$

2. 큰 변형 X.

$$\begin{bmatrix} \delta_B = \delta_{B_1}+\delta_{B_2} \\ \theta_B = \theta_{B_1}+\theta_{B_2} \end{bmatrix}$$

Derivation of castigliano's theorem

→ linear elastic system.

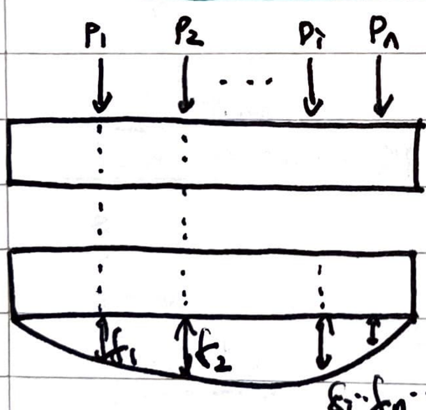
$\boxed{\delta_i = \frac{\partial U}{\partial P_i}}$

Changing energy = Causing force × δ

1. The increas in loads (P_i) will cause a small increase dU 선형성.
2. This increas in strain energy (dU) may be expressed.

$dU = \frac{\partial U}{\partial P_i} \times dP_i$

The rate of change of U with respect to P_i
×
The small increase in P_i



중첩법 적용 $P_1 \rightarrow \delta_1 \rightarrow dU_1$

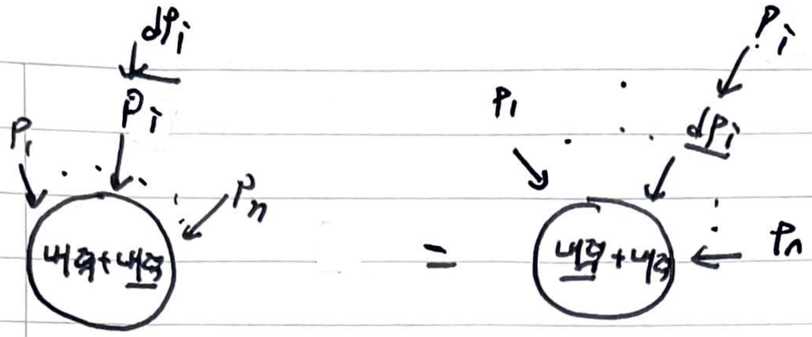
$P_2 \rightarrow \delta_2$ [additional work. $dP_i \times \delta_i$]

$\vdots$

$$U + dU = \cancel{U} + \frac{\partial U}{\partial P_i} \cdot dP_i = \cancel{U} + (dP_i \times \cancel{\delta_i})/2 + dP_i \times \delta_i$$

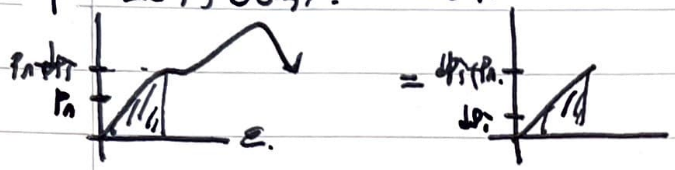
Too small

요약: 변형에너지 U 하중P에 대하여 미분 → 처짐



탄성가관물체에 대하여 등식 성립. 〈순서 상관 X〉.

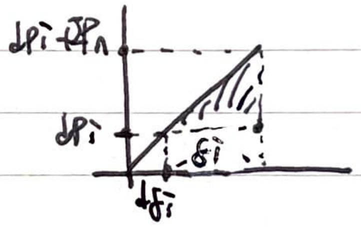
〈보존력, 탄성력〉. → 선형적.



$\delta_1 = \delta_2$.

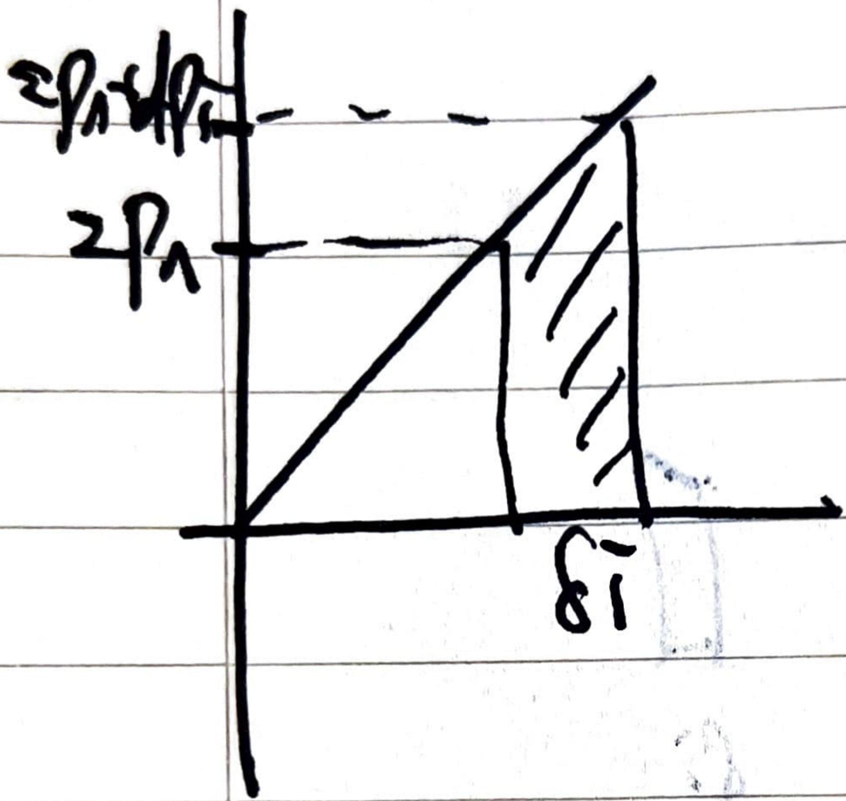
$$U = \left[\cancel{U_1} = f(P_1, P_2 \cdots, P_n)\right] + \left[\frac{\partial U}{\partial P_i} \cdot dP_i\right]$$

$$= \frac{1}{2} \cancel{dP_i \cdot d\delta_i} + \cancel{U_1} + dP_i \cdot \delta_i$$



$\delta_i = \partial U / \partial P_i$ → 처짐은 변형E를 하중에 대해 미분한 것.

increase in loads (Pi) will cause a small increase dU



$2P_1+dP_1$
$2P_1$
δI