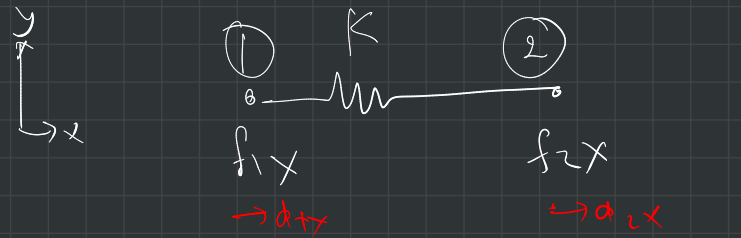
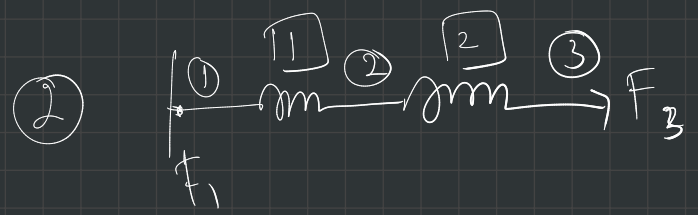
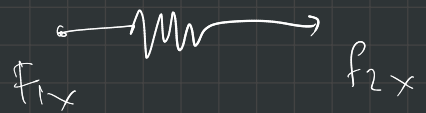
Komputasi Vibrasi (2022/3/4) #2

① Matrik kekakuan





Utk Elemen 1



$$F = k \cdot d$$

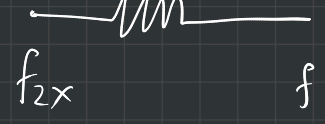
$$\begin{bmatrix} F_1 \\ F_2 \end{bmatrix} = \begin{bmatrix} k & -k \\ -k & k \end{bmatrix} \begin{bmatrix} d_{1x} \\ d_{2x} \end{bmatrix}$$

→ Elemen 1 : ① & ②
2 : ② & ③

$$\begin{bmatrix} f_{1x} \\ f_{2x} \end{bmatrix} = \begin{bmatrix} k_1 & -k_1 \\ -k_1 & k_1 \end{bmatrix} \begin{bmatrix} d_{1x} \\ d_{2x} \end{bmatrix}$$

(1)

Elemen 2



(2)

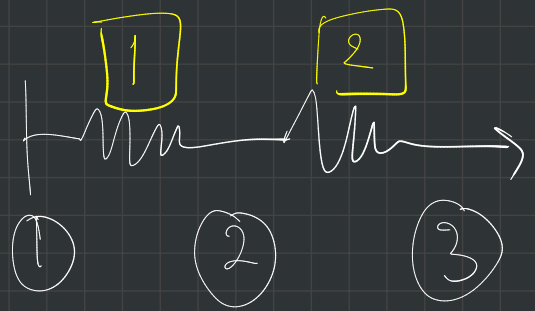
$$\begin{bmatrix} f_{2x} \\ f_{3x} \end{bmatrix} = \begin{bmatrix} k_2 & -k_2 \\ -k_2 & k_2 \end{bmatrix} \begin{bmatrix} d_{2x} \\ d_{3x} \end{bmatrix}$$

$$\begin{bmatrix} f_{1x} \\ f_{2x} \\ f_{3x} \end{bmatrix} = \begin{bmatrix} k_1 & -k_1 & 0 \\ -k_1 & k_1+k_2 & -k_2 \\ 0 & -k_2 & k_2 \end{bmatrix} \begin{bmatrix} d_{1x} \\ d_{2x} \\ d_{3x} \end{bmatrix}$$

↓

Matrik kekakuan Global

Langkah diatas disebut dg: Penggabungan elemen = matrik



3 node

↓

K 3 x 3

$$\begin{bmatrix} f_{1x} \\ f_{2x} \\ f_{3x} \end{bmatrix} = \begin{bmatrix} 1 & 0 & \\ 0 & 2 & \end{bmatrix} \begin{bmatrix} d_{1x} \\ d_{2x} \\ d_{3x} \end{bmatrix}$$

FEM : 3D, Axisymetri

① Diskritasi : Elemen & Node
- garis
- 2D

② Fungsi interpolasi

③ Strain/displacement & Stress/Strain

$$\epsilon_x = \frac{du}{dx} \qquad \sigma_x = E\,\epsilon_x$$

hkm elastisitas

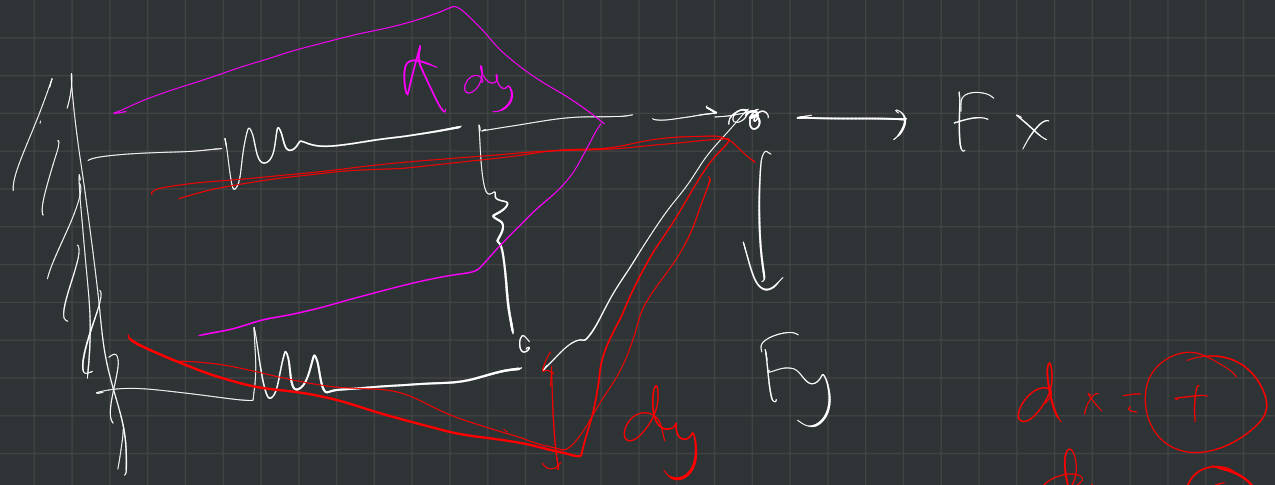
④ Matriks kekakuan

⑤ $\{F\} = [k]\{d\}$

⑥ Solusi dr ⑤

⑦ ϵ_x, σ_x

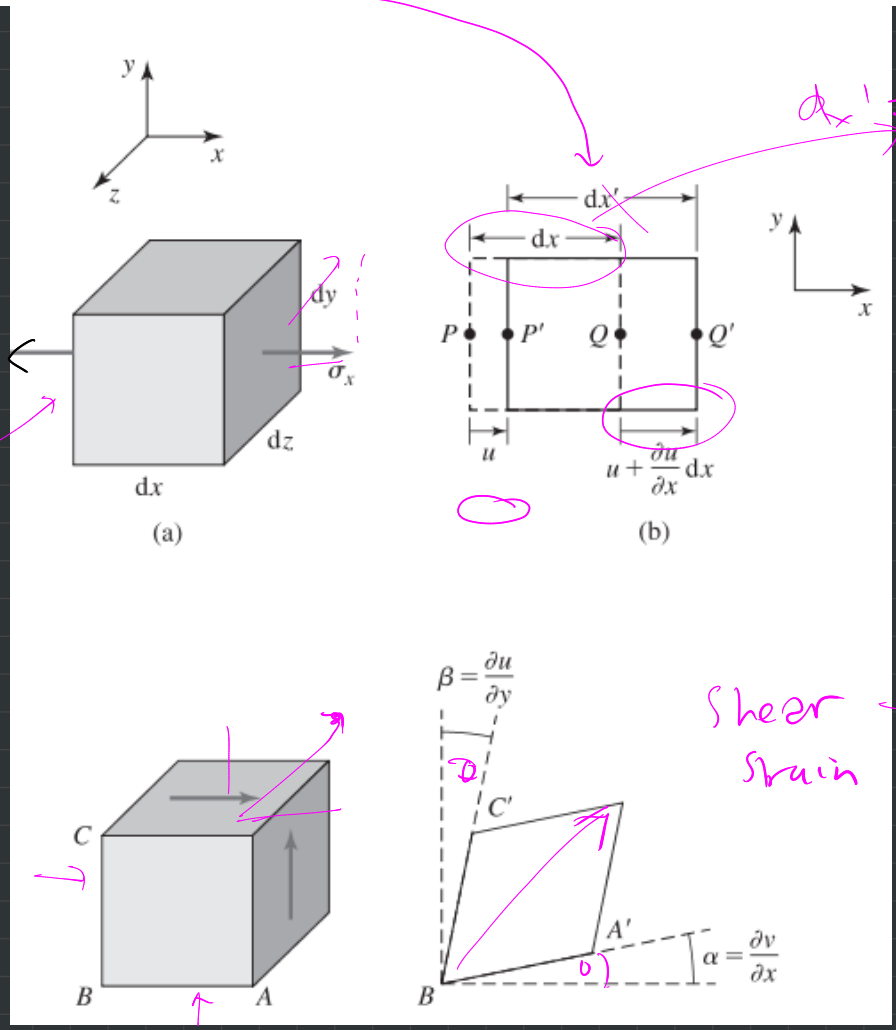
⑧ Interpretasi



$dx = (+)$

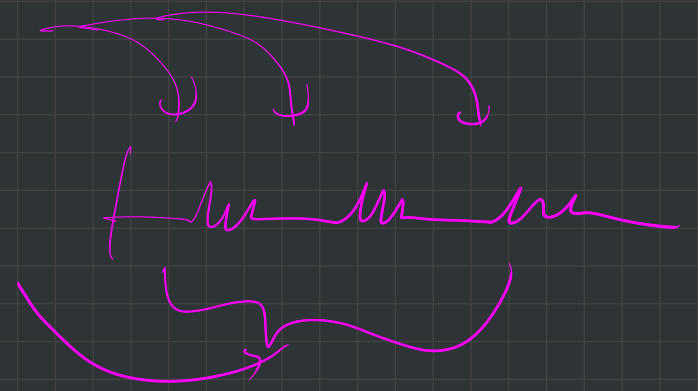
$dy = (-)$

$$dx' = dx + u_Q - u_P = dx + u + \frac{\partial u}{\partial x}dx - u = dx + \frac{\partial u}{\partial x}dx$$



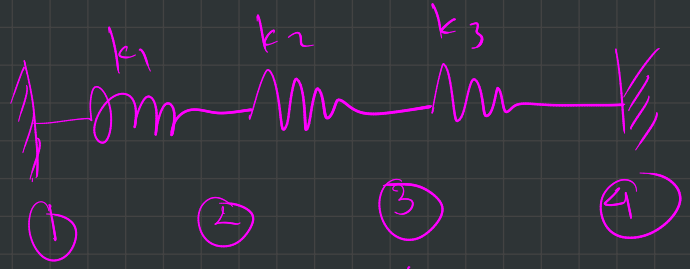
① MEH

② Matriks kekaburan ↔ lokal
Global



③ Tahapan MEH
① konsep
② komputasi

1000 lb/in 2000 lb/in 3000 lb/in

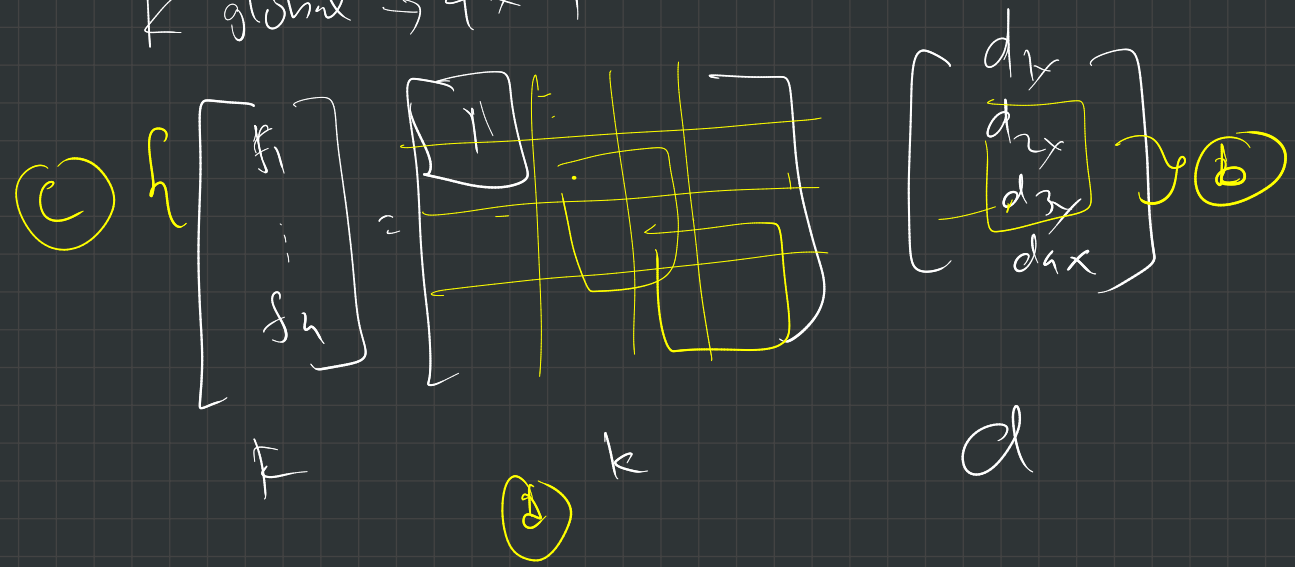


F_3 = 5000 lb

Dibuya :
a) Matrik kekakuan global
b) Displacement pd node (2) & (3)
c) Reaksi pd (1) & (2)
d) Gaya pd masing2 pegas
f_{p1}, f_k, f_{p3}

PR
(1) Manual

K global → 4 × 4



(2) Komputasi / Calfem

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11/3/2022