

Example 4

①



$$v(0) = 0, v'(l) = 0$$

$$v(l) = 0, v''(l) = 0$$

BCs: $v(0) = 0 \rightarrow c_1 + c_4 = 0$

$$v'(0) = 0 \rightarrow c_2\beta + c_3 = 0$$

$$v(l) = 0 \rightarrow c_1 \cos\beta l + c_2 \sin\beta l + c_3 l + c_4 = 0$$

$$v''(l) = 0 \rightarrow -c_1\beta^2 \cos\beta l - c_2\beta^2 \sin\beta l = 0$$

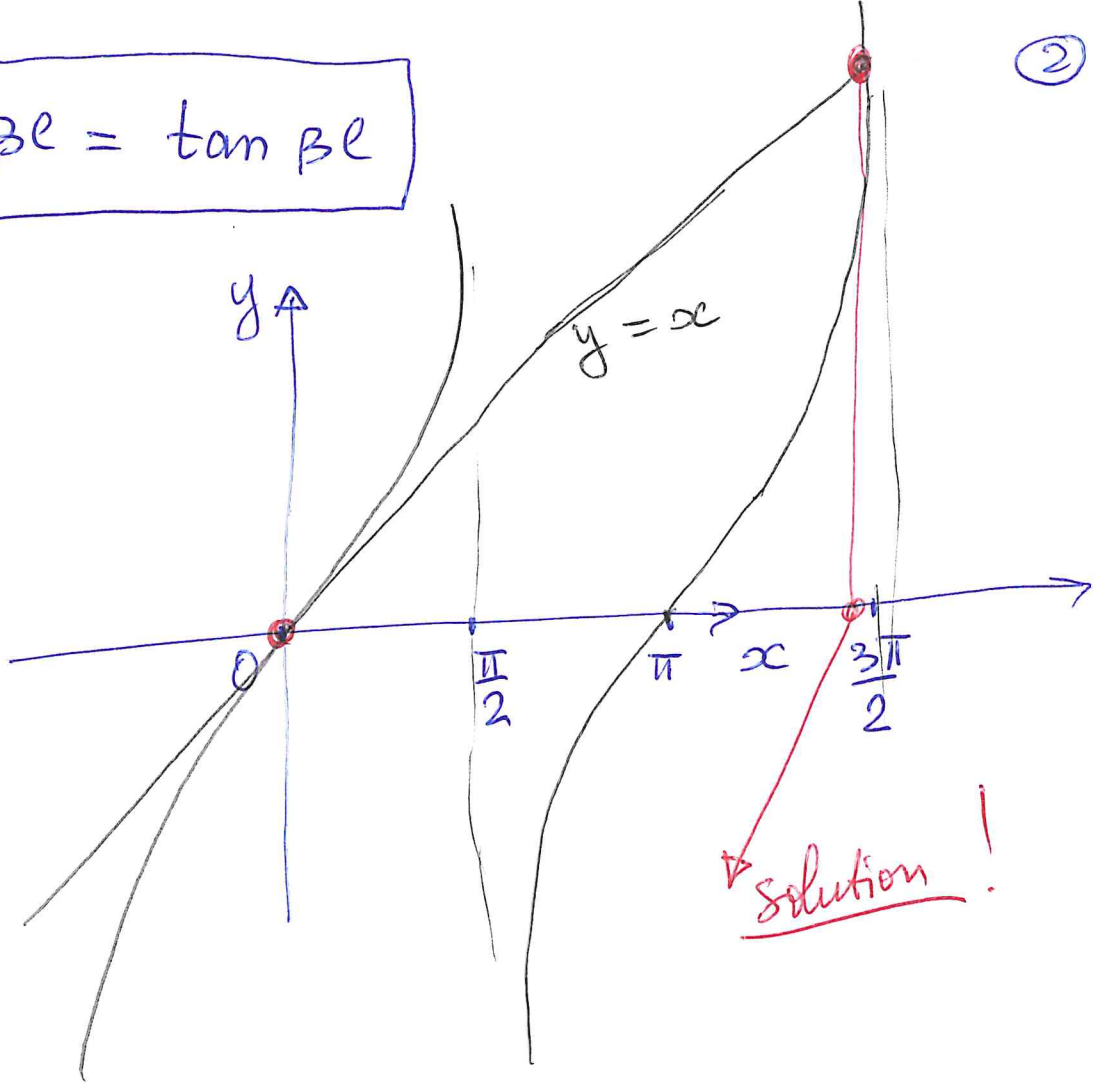
$$c_4 = -c_1, c_3 = -c_2\beta$$

$$\begin{cases} c_1 [\cos\beta l - 1] + c_2 [\sin\beta l - \beta l] = 0 \\ c_1 \cos\beta l + c_2 \sin\beta l = 0 \end{cases}$$

$$(\cos\beta l - 1) \sin\beta l - \cos\beta l (\sin\beta l - \beta l) = 0$$

$$-\sin\beta l + \cos\beta l \beta l = 0$$

$$\beta l = \tan \beta l$$



$$x^* : x = \tan x$$

$$P = P_c \equiv \frac{x^{*2}}{l^2} EI$$
