

EFFECTIVE LENGTH

We can rewrite eqn 4.3 to account for different end conditions

$$P_{cr} = \frac{\pi^2 EA}{\left(\frac{KL}{r}\right)^2}$$

where "KL" is the eff. length

KL is the distance between points of inflection in the defl. shape

f (support conditions @ end of the column, brace points in the middle)

AISC Table C4.7.1, p 16.1-570

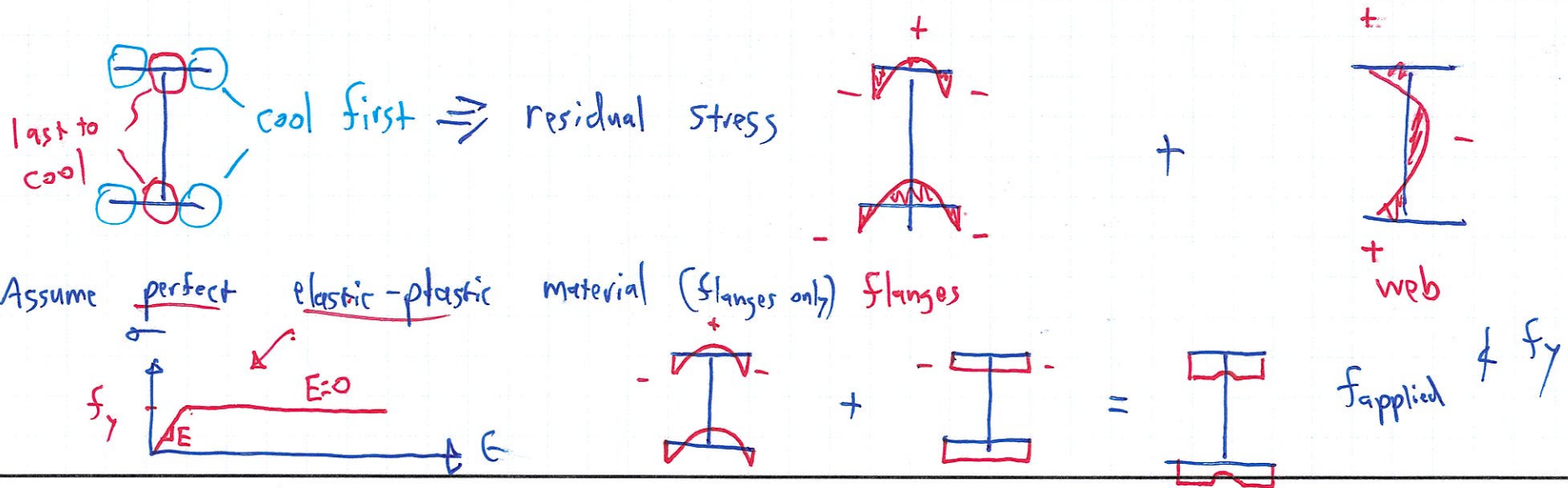
* For 446 use k-design

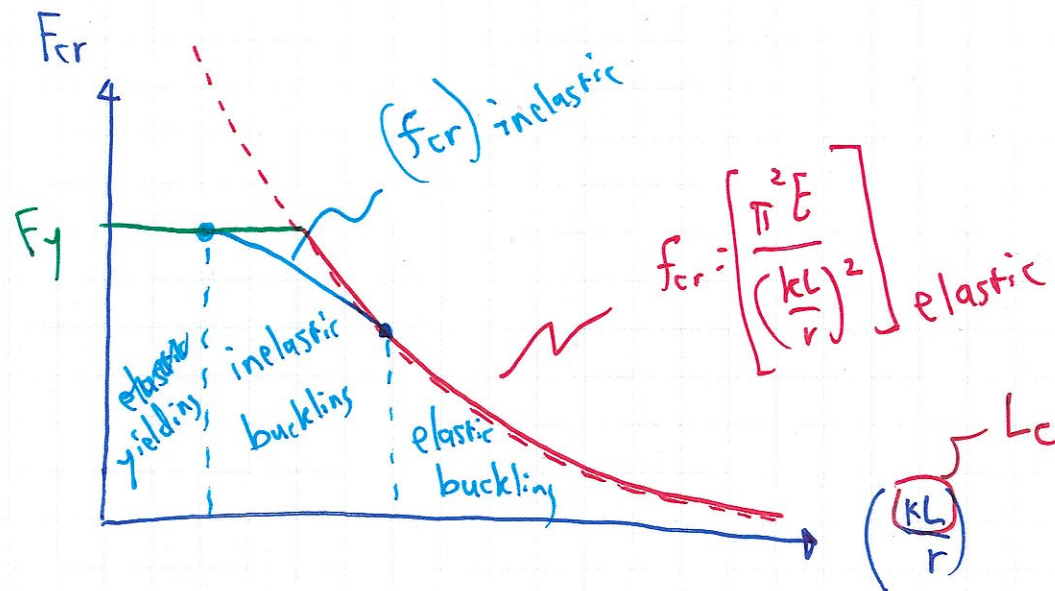
REAL COLUMNS

- Not Initially straight
- Initial "residual stresses" exist before load is applied
- f_{actual} & f_y in the cross-section

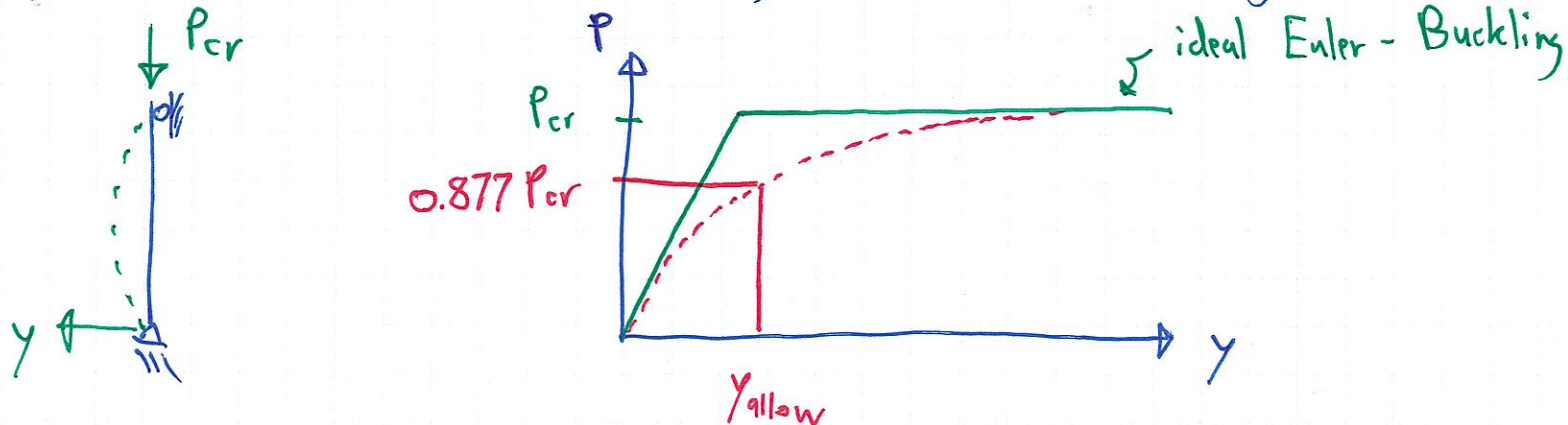
RESIDUAL STRESSES

- a result of the rolling process
- ~~differential~~ residual stress is caused by differential cooling
- the element that cools last, will have residual tension stress





- other factors that affect behavior, initial out-of-straightness



AISC PROVISIONS

CHAP E (Strength)

CHAP C (K-Values)

CHAP B (Local Buckling)

$$P_u \leq \phi_c P_n \leftarrow \text{Nominal Strength (Compression Only)}$$

Design. Comp. Strength

$$\phi_c P_n = 0.9 \underline{f_{cr}} A_g$$

E3 FLEXURAL BUCKLING OF MEMBERS W/OUT SLENDER ELEMENTS

$$a) \frac{KL}{r} \leq 4.71 \sqrt{\frac{E}{f_y}} \leftarrow \text{Inelastic Buckling} \quad \left(f_e \neq 0.44 f_y \right)$$

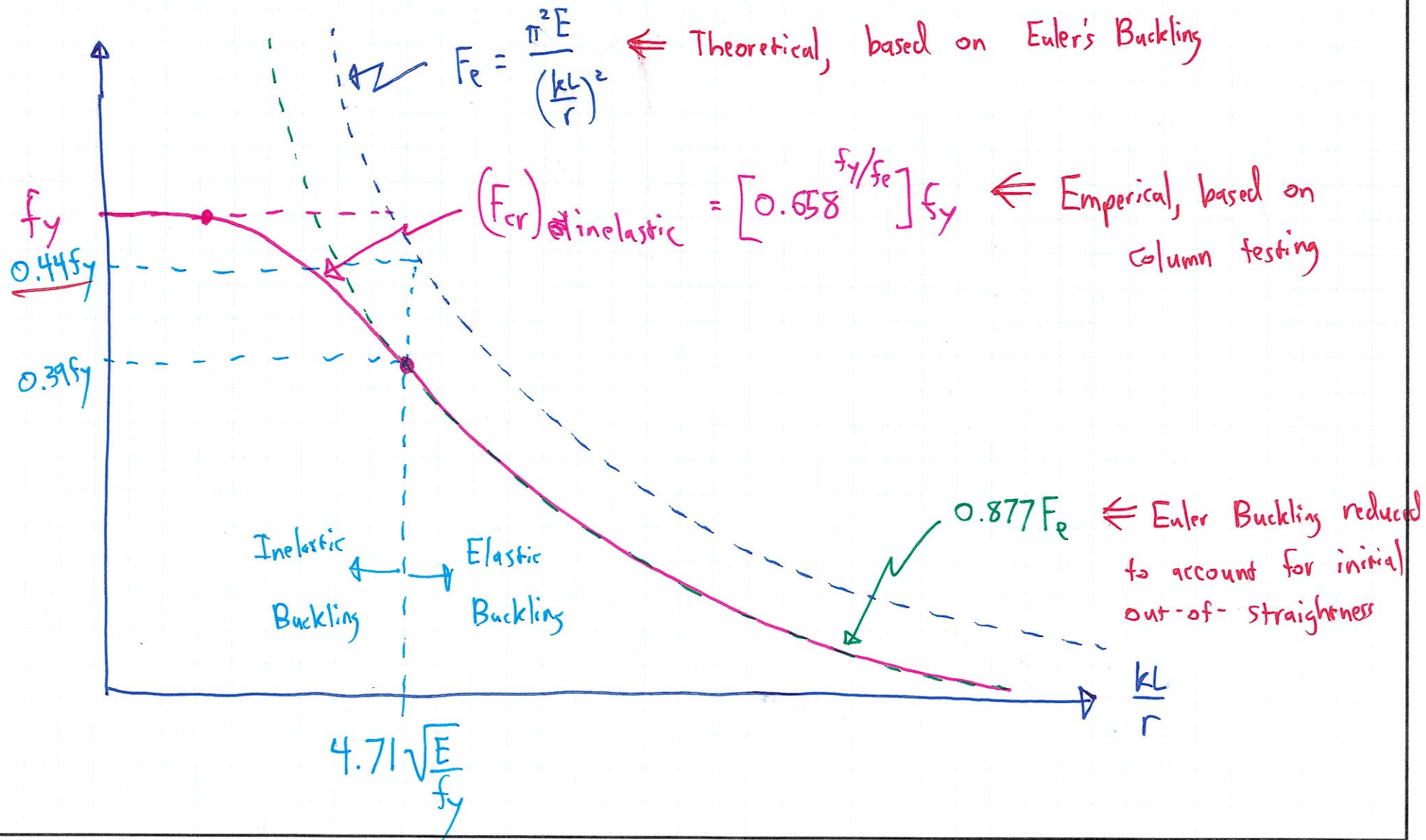
$$f_{cr} = \left[0.658^{\frac{f_y}{f_e}} \right] f_y \quad [E3-2]$$

$$b) \frac{KL}{r} > 4.71 \sqrt{\frac{E}{f_y}} \quad \leftarrow \text{Elastic Buckling}$$

$$(f_e < 0.44 f_y)$$

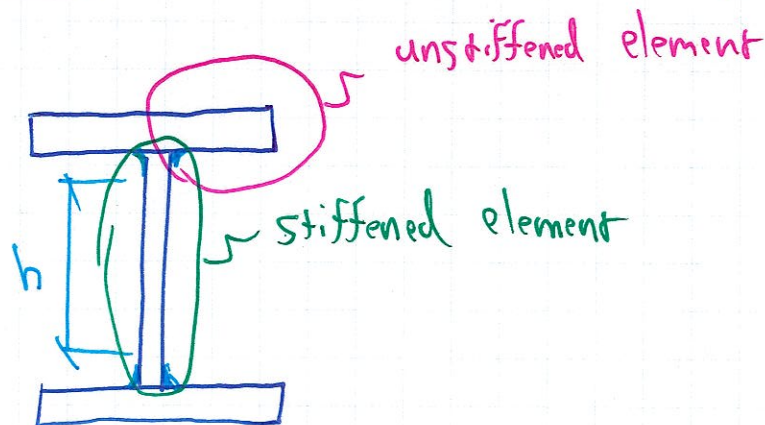
$$f_{cr} = 0.877 \phi f_e \quad [E3-3]$$

$$\text{where } \phi f_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2} \quad [E3-4]$$

COLUMN RESPONSE CURVE

SERVICEABILITY:

$\left(\frac{KL}{r}\right)_{\min}$ should not exceed 200 (prefer)

LOCAL BUCKLING: AISC MANUAL B4.1, pg 16.1-16 & 17

$\frac{b_f}{2t_f}$ & $\frac{h}{t_w}$ are sect. prop. in sect. tables

FLANGE: CASE #1 $\frac{b}{t} \leq 0.56 \sqrt{\frac{E}{f_y}} \Rightarrow \frac{b_f}{2t_f} \leq \frac{95}{\sqrt{f_y}}$

WEB: CASE #5 $\frac{h}{t_w} \leq 1.49 \sqrt{\frac{E}{f_y}} \Rightarrow \frac{h}{t_w} \leq \frac{254}{\sqrt{f_y}}$

If we meet both criteria, we can apply E3 for strength

There is also notation in sect. prop. that designate if a member is slender or not