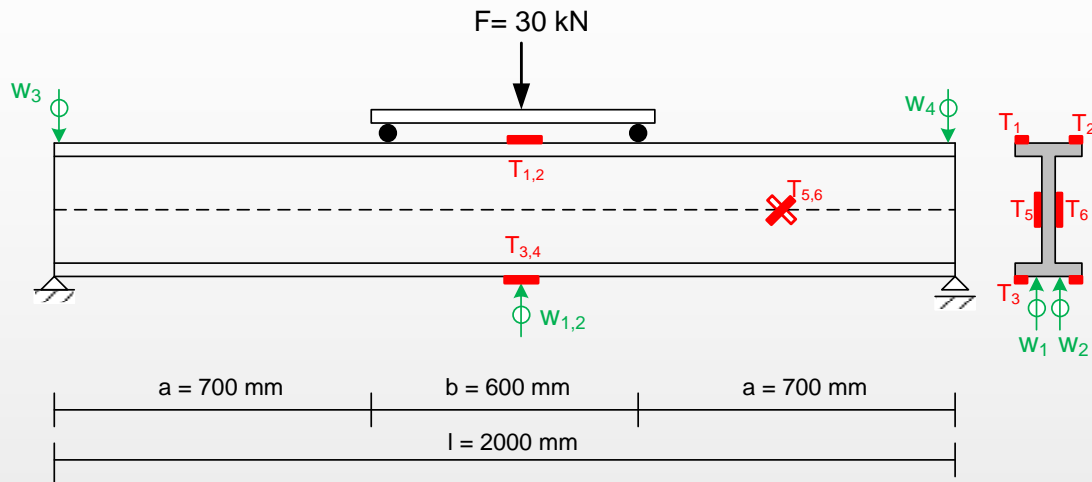




## 2. LABORATORIJSKE VJEŽBE

# SAVIJANJE ČELIČNOG NOSAČA

## SAVIJANJE ČELIČNOG "I" NOSAČA



NP I200

$$l = 200 \text{ mm}$$

$$I_y = 21,42 \cdot 10^6 \text{ mm}^4$$

$$S_y = 1,25 \cdot 10^5 \text{ mm}^3$$

$$t = 7,5 \text{ mm}$$

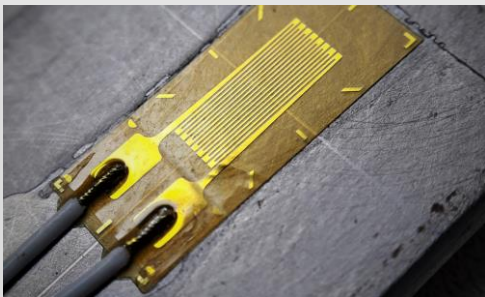
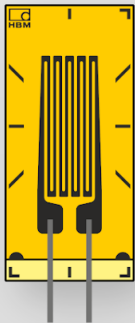
$$h = 200 \text{ mm}$$

$$E = 2,1 \cdot 10^5 \text{ MPa}$$

$$\nu = 0,3$$

## MJERNI INSTRUMENTI

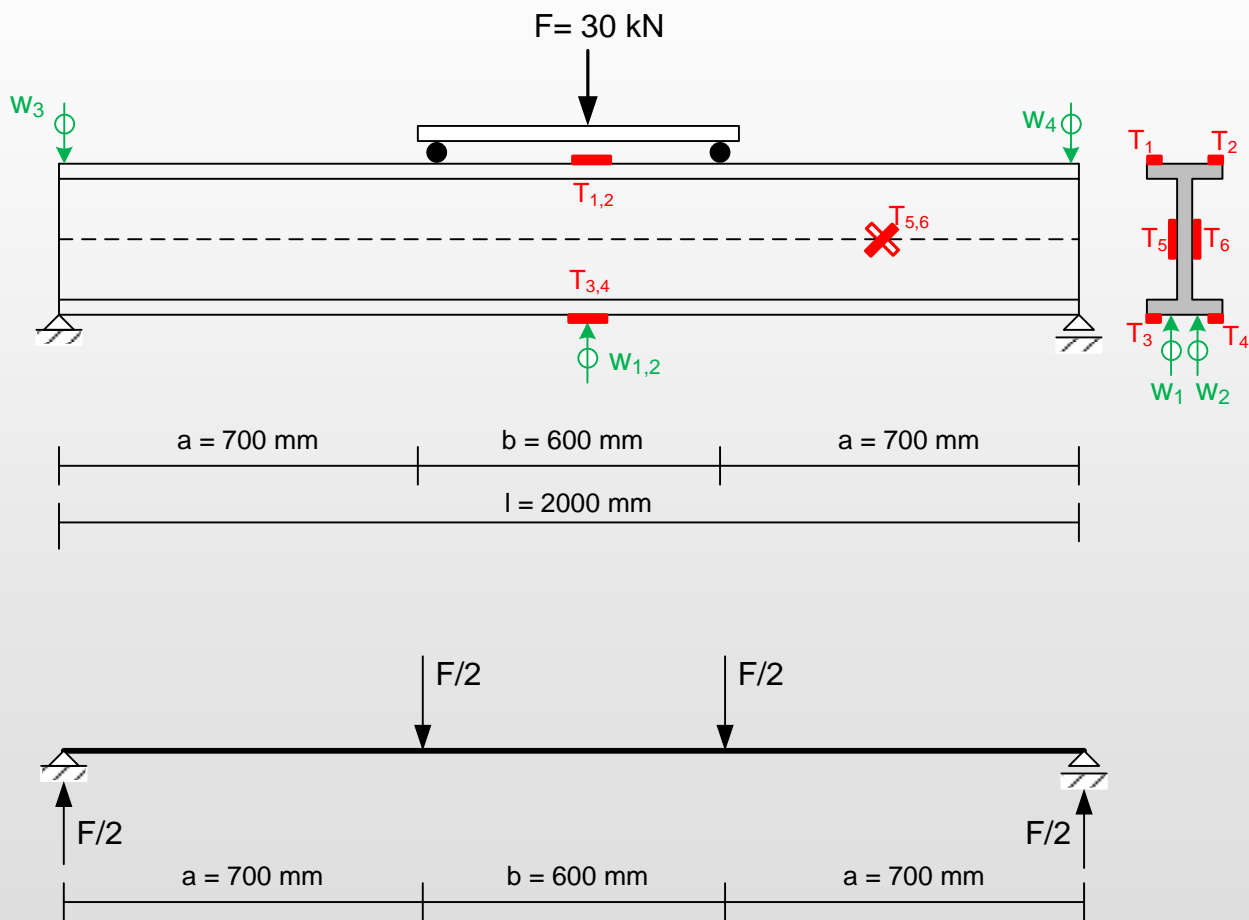
Elektrootporni tenzometar



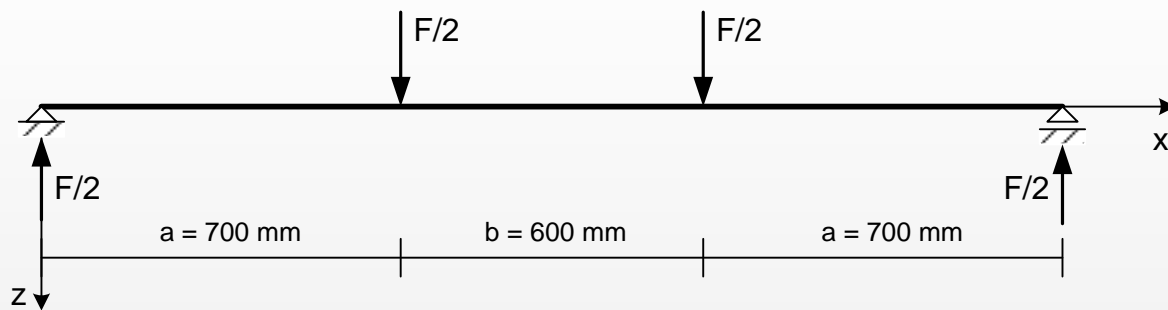
LVDT (Linear Variable Differential Transformer)



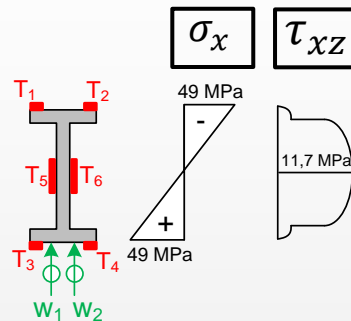
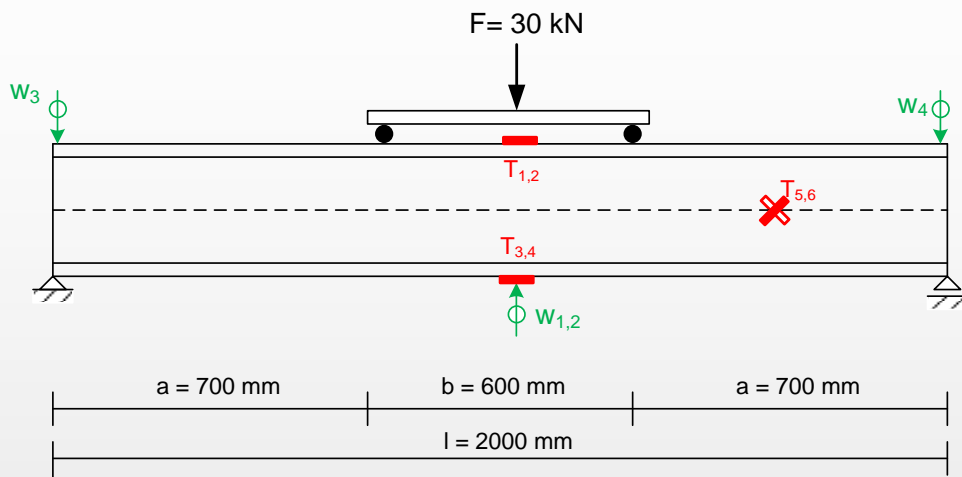
## SAVIJANJE ČELIČNOG "I" NOSAČA



## SAVIJANJE ČELIČNOG "I" NOSAČA



## SAVIJANJE ČELIČNOG "I" NOSAČA – Računski postupak



NP I200

$l = 200 \text{ mm}$   
 $I_y = 21,42 \cdot 10^6 \text{ mm}^4$   
 $S_y = 1,25 \cdot 10^5 \text{ mm}^3$   
 $t = 7,5 \text{ mm}$   
 $h = 200 \text{ mm}$   
 $E = 2,1 \cdot 10^5 \text{ MPa}$   
 $\nu = 0,3$

Normalna naprezanja:

$$\sigma_{x,max,min} = \pm \frac{M_{y,max}}{I_y} \cdot \frac{h}{2}$$

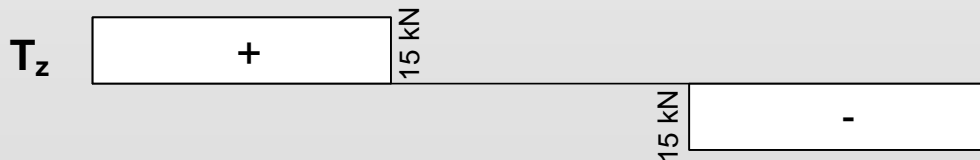
$$= \frac{10,5 \cdot 10^6}{21,42 \cdot 10^6} \cdot \frac{200}{2} = \pm 49 \text{ MPa}$$

Posmična naprezanja:

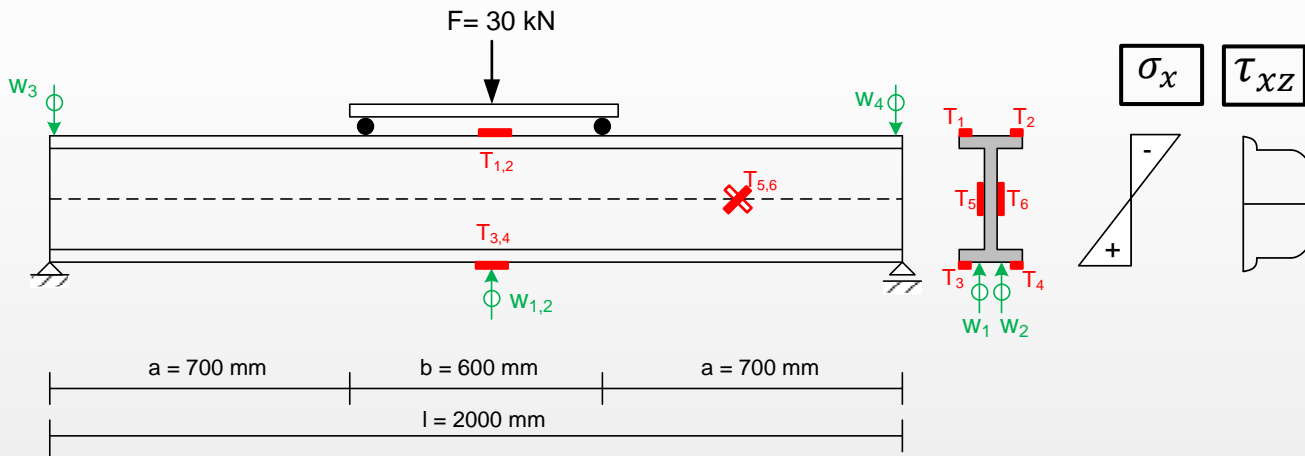
$$\tau_{xz} = \frac{T_z \cdot S_y}{I_y \cdot b}$$

$$\tau_{xz,max} = \frac{T_{z,max} \cdot S_y}{I_y \cdot t}$$

$$= \frac{15 \cdot 10^3 \cdot 1,25 \cdot 10^5}{21,42 \cdot 10^6 \cdot 7,5} = 11,7 \text{ MPa}$$



## SAVIJANJE ČELIČNOG "I" NOSAČA – Eksperimentalni postupak



NP I200

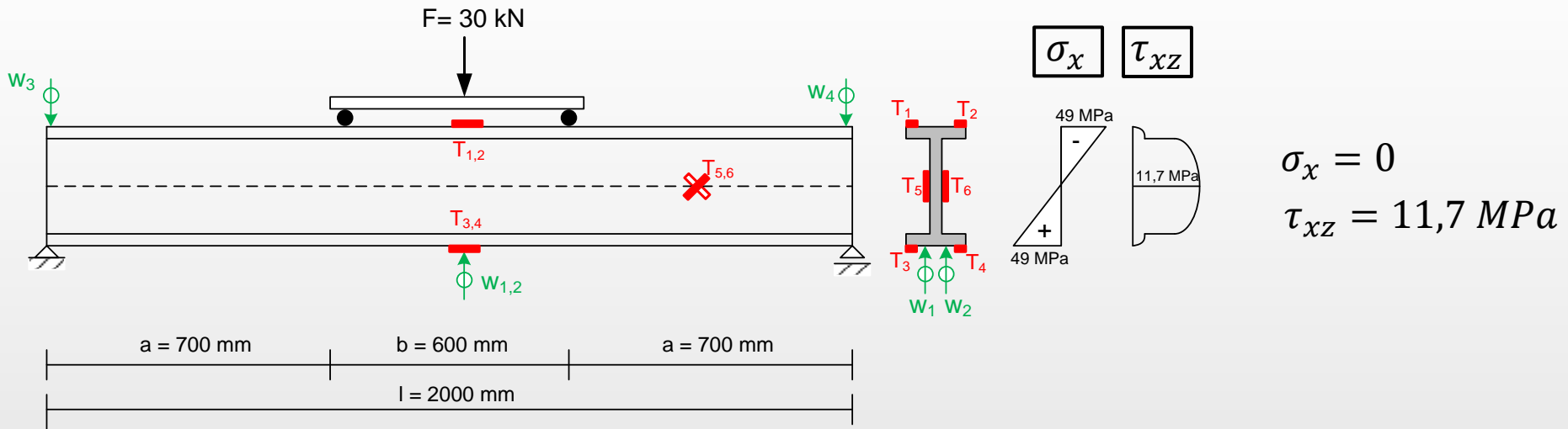
$l = 200 \text{ mm}$   
 $I_y = 21,42 \cdot 10^6 \text{ mm}^4$   
 $S_y = 1,25 \cdot 10^5 \text{ mm}^3$   
 $t = 7,5 \text{ mm}$   
 $h = 200 \text{ mm}$   
 $E = 2,1 \cdot 10^5 \text{ MPa}$   
 $\nu = 0,3$

- Normalna naprezanja računamo preko Hook-ovog zakona
- Mjerimo relativne deformacije na mjernim mjestima T<sub>1</sub> do T<sub>4</sub>

$$\sigma_{x,max} = \pm \varepsilon \cdot E$$

## SAVIJANJE ČELIČNOG "I" NOSAČA

### Glavna naprezanja na mjestu T<sub>5,6</sub> – Računski postupak



Iznos:

$$\sigma_{1,2} = \frac{\sigma_x}{2} \pm \frac{1}{2} \sqrt{\sigma_x^2 + 4\tau_{xz}^2}$$

$$\sigma_1 = \tau_{xz} = 11,7 \text{ MPa}$$

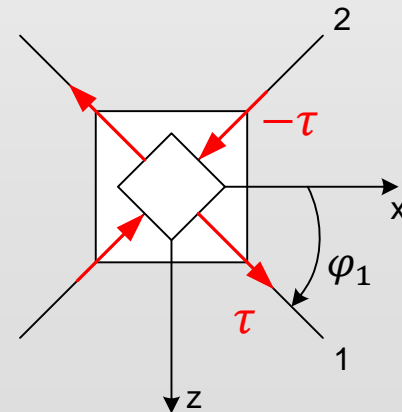
$$\sigma_2 = -\tau_{xz} = -11,7 \text{ MPa}$$

Smjer:

$$\text{tg } \varphi_1 = \frac{\tau_{xz}}{\sigma_1}$$

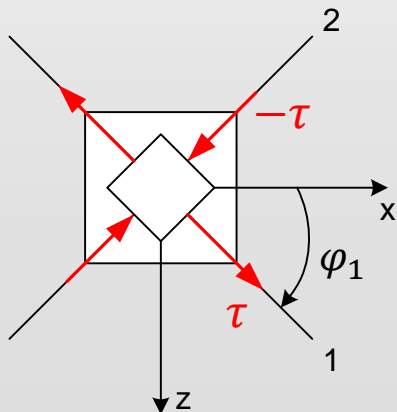
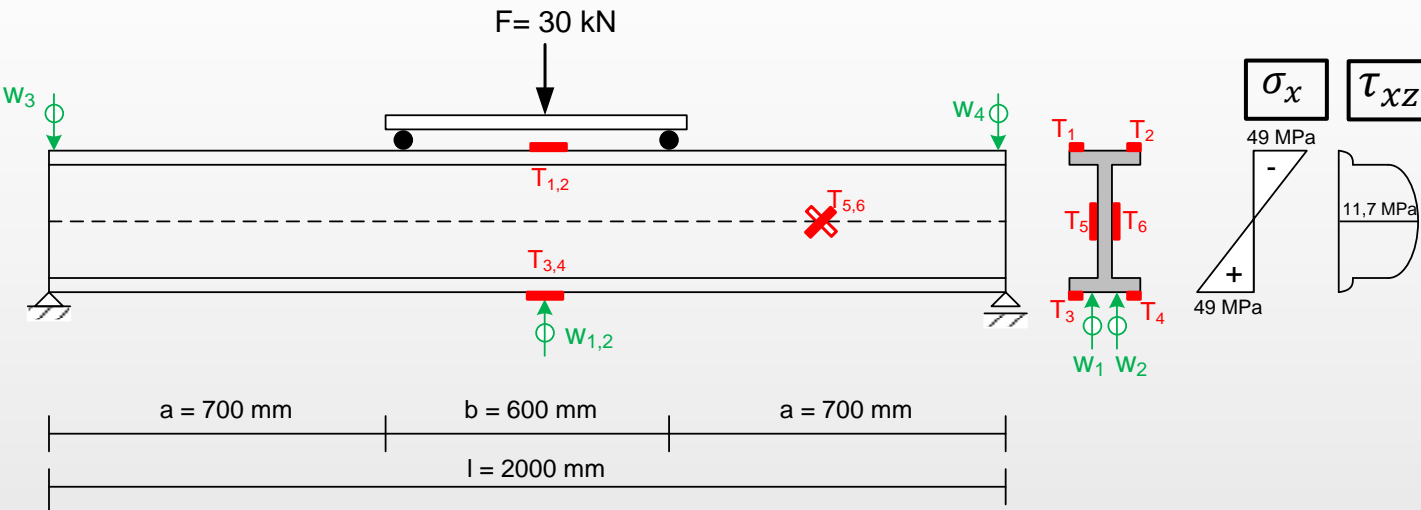
$$\varphi_1 = 45^\circ$$

$$\varphi_2 = -45^\circ$$



## SAVIJANJE ČELIČNOG "I" NOSAČA

### Glavna naprezanja na mjestu T<sub>5,6</sub> – Eksperimentalni postupak



Mjerimo deformacije  $\varepsilon_1 = -\varepsilon_2$  (na mjernim mjestima T<sub>5</sub> i T<sub>6</sub>)

$$\sigma_1 = \frac{E}{1 - \nu^2} (\varepsilon_1 + \nu \varepsilon_2)$$

$$\sigma_1 = \frac{E}{1 - \nu^2} (\varepsilon_1 - \nu \varepsilon_1) = \frac{E}{1 + \nu} \varepsilon_1$$

$$\varepsilon_1 = \varepsilon_{5,6}$$

$$\sigma_{1,2} = \pm \frac{E}{1 + \nu} \varepsilon_{5,6}$$