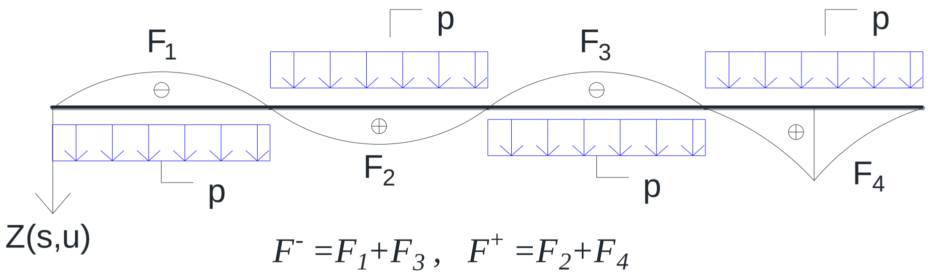
Određivanje mjerodavnog položaja opterećenja

Zavisi od vrste pokretnog opterećenja!

a) Jednako podeljeno pokretno opterećenje
*Proizvoljne dužine



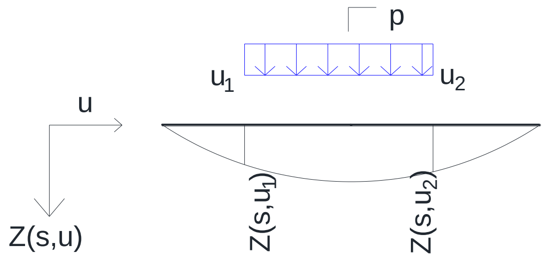
$minZ=p*F^-$

$maxZ=p*F^+$

$F^- = F_1 + F_3$, $F^+ = F_2 + F_4$

Vrednost uticaja u nosaču *Zp* usled jednako podeljenog opterećenja *p* duž čitave uticajne linije *Zp=maxZ+minZ.*

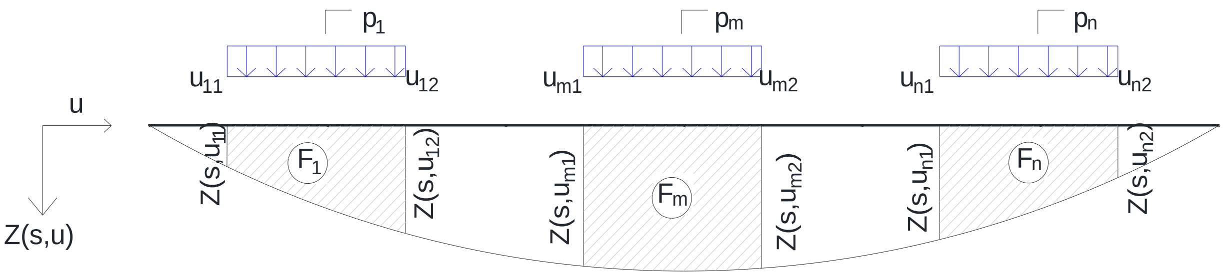
*Konačne dužine



Kriterijum za mjerdavan položaj:

$Z(s,u_1) = Z(s,u_2)$

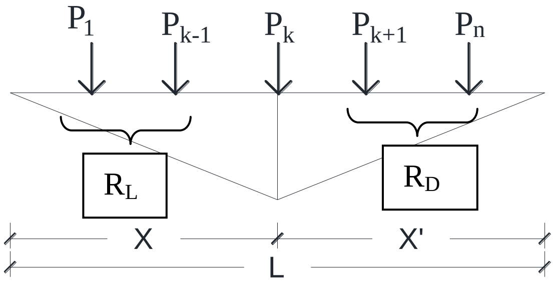
b) Niz jednako podeljenih opterećenja proizvoljnog intenziteta, konačne dužine na međusobnim razmacima koja se tokom vremena ne mjenjaju



Kriterijum za mjerdavan položaj:

$$\sum_{m=1}^{n} p_m Z(s,u_{m1}) = \sum_{m=1}^{n} p_m Z(s,u_{m2})$$

c) Pokretni sistem vezanih koncentrisanih sila



Za mjerodavan položaj sistema sila jedna od sila mora biti nad temenom uticajne linije (P_k).

Uslov za opasan položaj:

$$\frac{R}{L} > \begin{cases} \frac{R_L}{X} \\ \frac{R_D}{X'} \end{cases}, \qquad R = \sum_{m=1}^{n} P_m$$

Sračunavanje vrijednosti uticaja

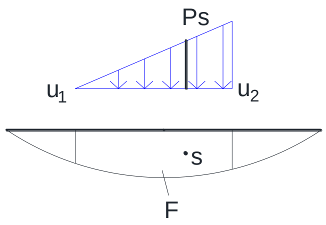
Koncentrisana sila: $Zs = P \cdot Z(s,u)$

Sistem koncentrisanih sila: $Zs = \sum_{m=1}^{n} P_m \cdot Z(s,u_m)$

Raspodeljeno opterećenje:

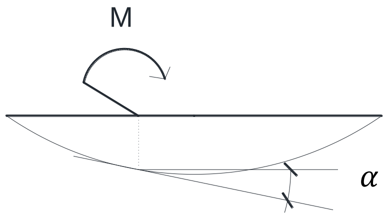
- Jednako podeljeno opterećenje $Zs = p \cdot F$
- Linearno promenjivo opterećenje $Zs = Ps \cdot F$

s-težište uticajne površine



Koncentrisani moment: $Zs = M \cdot tg\alpha$

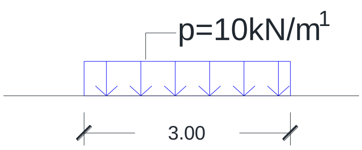
α-ugao koji horizontala zaklapa sa tangentom ispod momenta

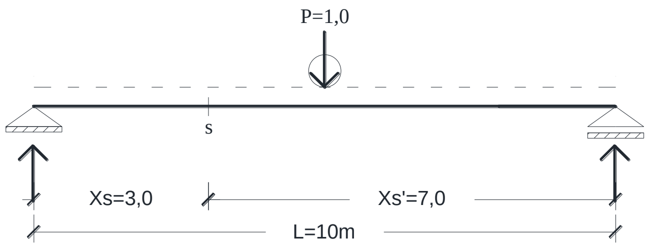


Zadatak: *Za neposredno opterećenu prostu gredu prema skici odrediti ekstremne vrijednosti momenta savijanja u presjeku s usled datih šema pokretnog opterećenja.*

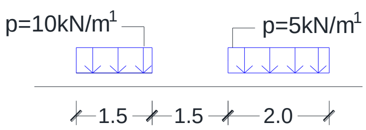
a)

b)

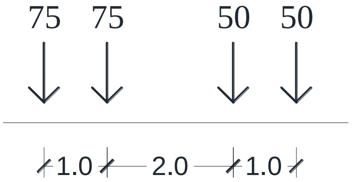




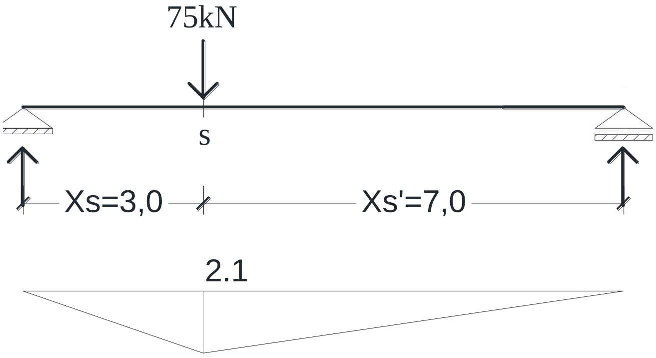
c)



d)



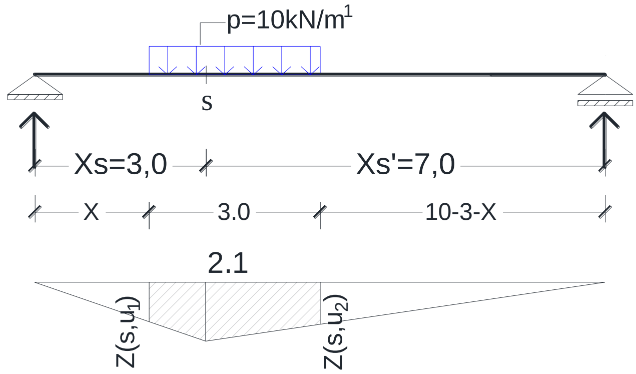
a)



$$minMs = 0$$
$$maxMs = P \cdot Z(s,u) = 75 \cdot 2,1 = 157,5kNm$$

b)

Da bi opterećenje bilo u mjerodavnom položaju mora biti zadovoljen sledeći uslov: $Z(s,u_1) = Z(s,u_2)$



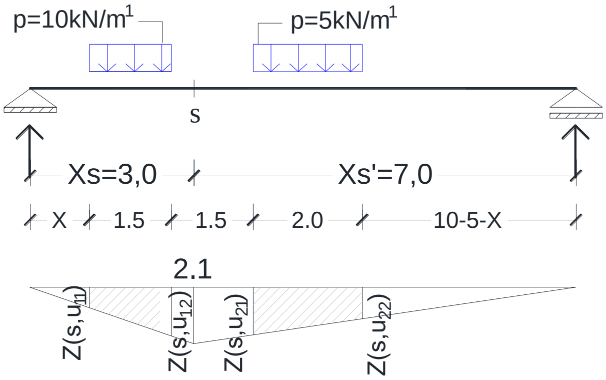
$$\frac{Z(s,u_1)}{X} = \frac{2,1}{3} \rightarrow Z(s,u_1) = 0,7X$$
$$\frac{Z(s,u_2)}{7-X} = \frac{2,1}{7} \rightarrow Z(s,u_2) = 2,1 - 0,3X$$

$$2,1 - 0,3X = 0,7X \rightarrow X = 2,1m$$
$$Z(s,u_1) = 0,7X = 1,47m = Z(s,u_2)$$

$$maxMs = p \cdot F = 10 \cdot \left(\frac{1,47 + 2,1}{2}\right) \cdot 3 = 53,55\ kNm$$

c)

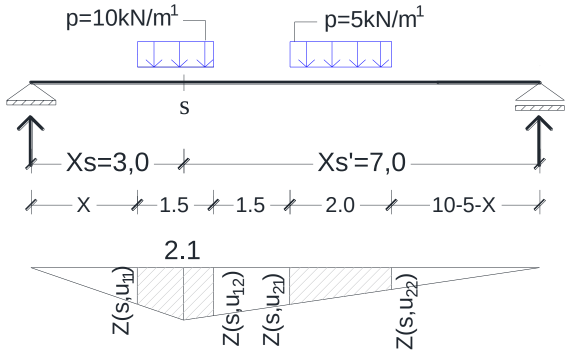
Da bi opterećenje bilo u mjerodavnom položaju mora biti zadovoljen sledeći uslov:
$$\sum_{m=1}^{n} p_m Z(s,u_{m1}) = \sum_{m=1}^{n} p_m Z(s,u_{m2})$$



I položaj: $0 \leq X_1 \leq 1.5$

$$p_1 \begin{cases} Z(s,u_{11}) = \frac{2,1}{3}X \\ Z(s,u_{12}) = \frac{2,1}{3}(X+1.5) \end{cases}$$
$$p_2 \begin{cases} Z(s,u_{21}) = \frac{2,1}{7}(7-X) \\ Z(s,u_{22}) = \frac{2,1}{7}(5-X) \end{cases}$$

$$10\frac{2,1}{3}X + 5\frac{2,1}{7}(7-X) = 10\frac{2,1}{3}(X+1.5) + 5\frac{2,1}{7}(5-X) \rightarrow 0 = 7,5$$
$$\textit{nerealno rešenje, nije mjerodavan položaj!}$$



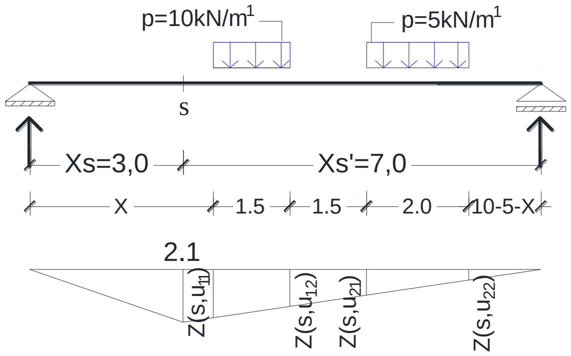
II položaj: $1,5 \leq X_2 \leq 3,0$

$$p_1 \begin{cases} Z(s,u_{11}) = \frac{2,1}{3}X = 1,575 \\ Z(s,u_{12}) = \frac{2,1}{7}(8.5 - X) = 1,875 \end{cases}$$

$$p_2 \begin{cases} Z(s,u_{21}) = \frac{2,1}{7}(7 - X) = 1,425 \\ Z(s,u_{22}) = \frac{2,1}{7}(5 - X) = 0,825 \end{cases}$$

$$10\frac{2,1}{3}X + 5\frac{2,1}{7}(7 - X) = 10\frac{2,1}{7}(8.5 - X) + 5\frac{2,1}{7}(5 - X) \rightarrow 10X = 22,5 \rightarrow X = 2,25m$$

$$maxMs = \sum_{m=1}^{n} P_m \cdot F_m = 10 \cdot \left(\frac{1,575 + 2,1}{2} + \frac{1,875 + 2,1}{2}\right) \cdot 0,75 + 5 \cdot \left(\frac{1,425 + 0,825}{2}\right) \cdot 2$$
$$= 39,94\ kNm$$



III položaj: $3,0 \leq X_3 \leq 5,0$

$$40,5 = 33$$
$nerealno\ rešenje!$

Mjerodavan položaj je II.

d)

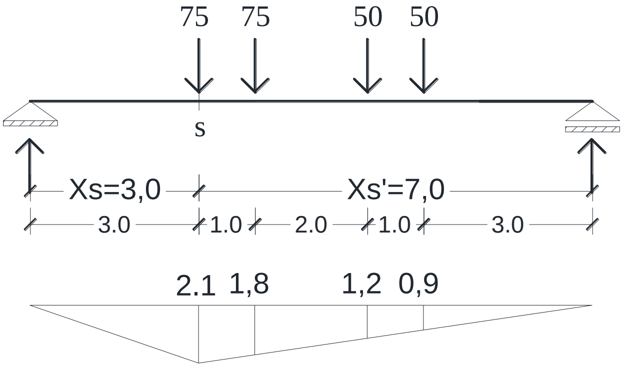
Da bi opterećenje bilo u mjerodavnom položaju mora biti zadovoljen sledeći uslov:

$$\frac{R}{L} > \begin{cases} \frac{R_L}{X} \\ \frac{R_D}{X'} \end{cases}$$

Predpostavljamo da je jedna sila mjerodava i nju postavljamo na maksimalnu ordinatu.

$$\frac{R}{L} = \sum_{m=1}^{n} P_m/L = \frac{75 + 75 + 50 + 50}{10} = 25kN/m^1$$

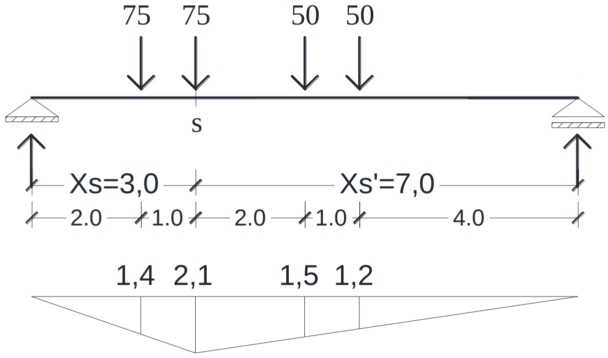
Sila P_1 iznad max ordinate



$$\frac{R_L}{Xs} = 0 < \frac{R}{L} = 25$$
$$\frac{R_D}{Xs'} = \frac{75 + 50 + 50}{7} = 25 = \frac{R}{L} = 25$$

$$maxMs = \sum_{m=1}^{n} P_m \cdot Z(s, u_m)$$
$$maxMs = 75(2{,}1 + 1{,}8) + 50(1{,}2 + 0{,}9) = 397{,}5kNm$$

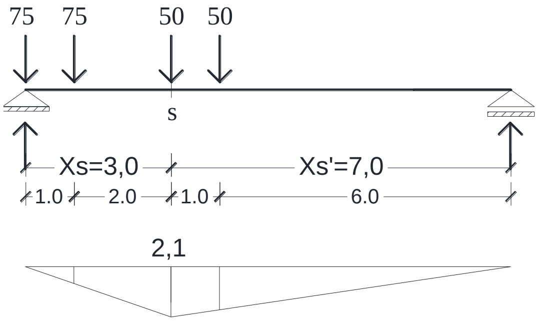
Sila P_2 iznad max ordinate



$$\frac{R_L}{Xs} = \frac{75}{3} = 25 = \frac{R}{L} = 25$$
$$\frac{R_D}{Xs'} = \frac{50 + 50}{7} = 14{,}29 < \frac{R}{L} = 25$$

$$maxMs = \sum_{m=1}^{n} P_m \cdot Z(s, u_m)$$
$$maxMs = 75(2{,}1 + 1{,}4) + 50(1{,}2 + 1{,}5) = 397{,}5kNm$$

Sila P_3 iznad max ordinate



$$\frac{R_L}{Xs} = \frac{75 + 75}{3} = 50 > \frac{R}{L} = 25$$

Nije mjerodavan položaj.

P_3 i P_4 nisu mjerodavne sile!

ZA DEFINISANI PRESJEK „S“ MJERODAVNE SILE SU P_1 I P_2.