Die Statik im Stahlbetonbau

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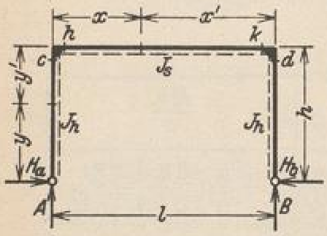
Berlin [u.a.], 1956

Einfach statisch unbestimmte Rahmen

61. Rahmentabellen.

Einfach statisch unbestimmte Rahmen.

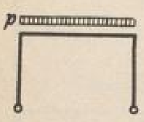
Tabelle 43. Symmetrischer Rahmen mit geradem Riegel.



$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \varkappa = \frac{h}{l}\frac{J_s}{J_h}, \quad \lambda = \frac{l}{h},$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \mu = 3 + 2\varkappa, \quad \omega_R = \xi - \xi^2.$$

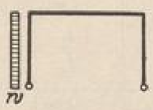
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$A = B = \frac{p\,l}{2},$$

$$H_{a,b} = \frac{\lambda}{4\mu}\,p\,l,$$

$$M_{c,d} = -\frac{p\,l^2}{4\mu}.$$

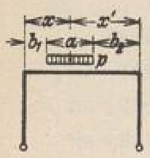


$$\Phi = \frac{1}{2\mu}(6 + 5\varkappa),$$

$$A = -B = -\frac{w\,h^2}{2\,l},$$

$$H_{a,b} = -\frac{w\,h}{2}\left(1 \pm 1 - \frac{1}{2}\Phi\right),$$

$$M_{c,d} = \frac{w\,h^2}{4}\,(1 \pm 1 - \Phi)$$



$$\Phi = \frac{\lambda}{2\mu}\left[3\,\omega_R - \left(\frac{a}{2\,l}\right)^2\right],$$

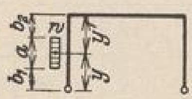
$$A = p\,a\,\xi', \qquad B = p\,a\,\xi,$$

$$H_{a,b} = p\,a\,\Phi,$$

$$M_{c,d} = -p\,a\,h\,\Phi,$$

$b_1 = 0$ oder $b_2 = 0$: $\Phi = \frac{\lambda}{4\mu}\frac{a}{l}\left(3 - 2\frac{a}{l}\right)$,

$b_1 = b_2$: $\Phi = \frac{\lambda}{8\mu}\left(3 - \frac{a^2}{l^2}\right)$.



$$\Phi = \frac{1}{\mu}\left\{3\,(1 + \varkappa) - \varkappa\left[\eta^2 + \left(\frac{a}{2\,h}\right)^2\right]\right\},$$

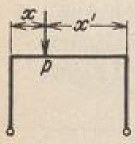
$$A = -B = -w\,a\,\frac{\eta}{\lambda},$$

$$H_{a,b} = -\frac{w\,a}{2}\,(1 \pm 1 - \eta\,\Phi),$$

$$M_{c,d} = \frac{w\,a\,h\,\eta}{2}\,(1 \pm 1 - \Phi),$$

$b_1 = 0$: $\Phi = \frac{1}{2\mu}\left[6\,(1 + \varkappa) - \varkappa\,\frac{a^2}{h^2}\right]$,

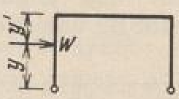
$b_2 = 0$: $\Phi = \frac{1}{2\mu}\left[6 + 5\varkappa - \varkappa\left(1 - \frac{a}{h}\right)^2\right]$.



$$A = P\,\xi', \qquad B = P\,\xi,$$

$$H_{a,b} = \frac{3\,\lambda}{2\mu}\,P\,\omega_R,$$

$$M_{c,d} = -\frac{3}{2\mu}\,P\,l\,\omega_R.$$



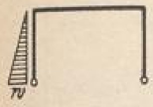
$$\Phi = \frac{1}{\mu}\,[3\,(1 + \varkappa) - \varkappa\,\eta^2],$$

$$A = -B = -W\,\frac{y}{l},$$

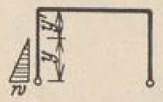
$$H_{a,b} = -\frac{W}{2}\,(1 \pm 1 - \eta\,\Phi),$$

$$M_{c,d} = \frac{W\,h}{2}\,\eta\,(1 \pm 1 - \Phi),$$

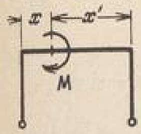
$y = h$: $H_{a,b} = \mp\frac{W}{2}$, $\quad M_{c,d} = \pm\frac{W\,h}{2}$.



$$\Phi = \frac{7\varkappa}{10\mu},$$
$$A = -B = -\frac{w h^2}{6l},$$
$$H_{a,b} = -\frac{w h}{12}(2 \pm 3 - \Phi),$$
$$M_{c,d} = \frac{w h^2}{12}(\pm 1 - \Phi).$$

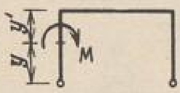


$$\Phi = \frac{\varkappa}{10\mu}(10 - 3\eta^2),$$
$$A = -B = -\frac{w y^2}{6l},$$
$$H_{a,b} = -\frac{w h}{12}\eta[3 \pm 3 - \eta(1 + \Phi)],$$
$$M_{c,d} = \frac{w h^2}{12}\eta^2(\pm 1 - \Phi).$$



$$\Phi = \frac{3}{2\mu}(\xi'^2 - \xi^2),$$
$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = \frac{\mathsf{M}}{h}\Phi,$$
$$M_{c,d} = -\mathsf{M}\Phi,$$

$x = 0$: $\quad \Phi = \dfrac{3}{2\mu},$
$$M_h = \mathsf{M}\left(1 - \frac{3}{2\mu}\right).$$



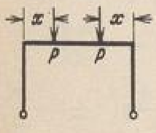
$$\Phi = \frac{3}{\mu}[1 + \varkappa(1 - \eta^2)],$$
$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = \frac{\mathsf{M}}{h}\frac{\Phi}{2},$$
$$M_{h,k} = \frac{\mathsf{M}}{2}(1 \pm 1 - \Phi),$$

$y = 0$: $\quad \Phi = \dfrac{3}{\mu}(1 + \varkappa),$

$y' > 0$: $\quad M_c = M_h.$

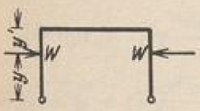
$$A = B = 0, \qquad H_{a,b} = \frac{3}{\mu}\frac{E J_s}{h^2}\alpha_t t, \qquad M_{c,d} = -\frac{3}{\mu}\frac{E J_s}{h}\alpha_t t.$$

Zwei symmetrische oder antimetrische Einzelwirkungen.



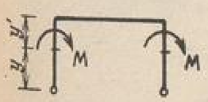
Der allgemeine Ausdruck für die horizontalen Gelenkkräfte infolge einer Einzelwirkung hat die Form

$$H_{a,b} = K(a \pm b + c\,\Phi)$$



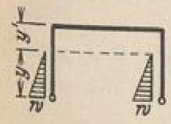
Damit ergibt sich für zwei symmetrische Einzelwirkungen

$$H_{a,b} = 2K(a + c\,\Phi),$$



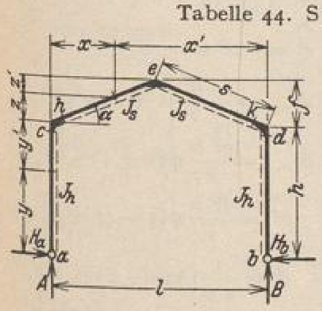
für zwei antimetrische Einzelwirkungen

$$H_{a,b} = \pm 2Kb.$$



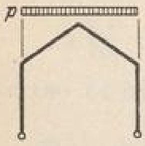
Dasselbe gilt für die Eckmomente. Diese Beziehungen gelten auch für die folgenden symmetrischen Rahmenformen.

Tabelle 44. Symmetrischer Rahmen mit gebrochenem Riegel.

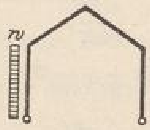


$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \lambda = \frac{l}{h},$$
$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varphi = \frac{f}{h},$$
$$\varkappa = \frac{h}{s}\frac{J_s}{J_h}, \quad \mu = 3 + \varkappa + \varphi(3 + \varphi).$$

$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.

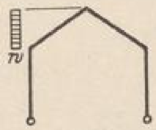


$$\Phi = \frac{8 + 5\varphi}{4\mu},$$
$$A = B = \frac{p\,l}{2},$$
$$H_{a,b} = \frac{p\,l}{8}\lambda\,\Phi,$$
$$M_{c,d} = -\frac{p\,l^2}{8}\Phi,$$
$$M_e = \frac{p\,l^2}{8}[1 - (1 + \varphi)\,\Phi].$$

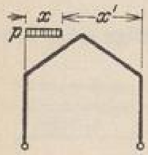


$$\Phi = \frac{1}{4\mu}[6\,(2 + \varphi) + 5\,\varkappa],$$
$$A = -B = -\frac{w\,h^2}{2\,l},$$
$$H_{a,b} = -\frac{w\,h}{2}\left(1 \pm 1 - \frac{\Phi}{2}\right),$$
$$M_{c,d} = \frac{w\,h^2}{4}(1 \pm 1 - \Phi),$$
$$M_e = \frac{w\,h^2}{4}[1 - (1 + \varphi)\,\Phi].$$

$$\Phi = \frac{8 + 5\varphi}{4\mu},$$
$$A = \frac{3}{8}p\,l, \qquad B = \frac{1}{8}p\,l,$$
$$H_{a,b} = \frac{p\,l}{16}\lambda\,\Phi,$$
$$M_{c,d} = -\frac{p\,l^2}{16}\Phi,$$
$$M_e = \frac{p\,l^2}{16}[1 - (1 + \varphi)\,\Phi].$$

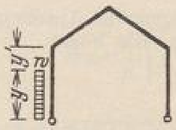


$$\Phi = \frac{\varphi}{8\mu}(4 + 3\,\varphi),$$
$$A = -B = -w\,f\,\frac{2\,h + f}{2\,l},$$
$$H_{a,b} = -\frac{w\,f}{2}(\pm 1 + \Phi),$$
$$M_{c,d} = \frac{w\,f\,h}{2}(\pm 1 + \Phi),$$
$$M_e = -\frac{w\,f\,h}{2}\left[\frac{\varphi}{2} - (1 + \varphi)\,\Phi\right].$$

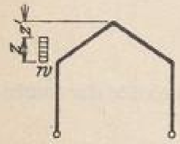


$x \leqq l/2$

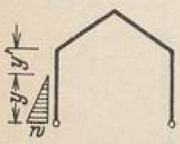
$$\Phi = \frac{\xi^2}{\mu}\left[\frac{3}{2}(2 + \varphi) - \xi\,(2 + \varphi\,\xi)\right],$$
$$A = \frac{p\,l}{2}\xi\,(2 - \xi), \qquad B = \frac{p\,l}{2}\xi^2,$$
$$H_{a,b} = \frac{p\,l}{4}\lambda\,\Phi,$$
$$M_{c,d} = -\frac{p\,l^2}{4}\Phi,$$
$$M_e = \frac{p\,l^2}{4}[\xi^2 - (1 + \varphi)\,\Phi].$$



$$\Phi = \frac{1}{4\mu}[6\,(2 + \varphi + \varkappa) - \varkappa\,\eta^2],$$
$$A = -B = -\frac{w\,y^2}{2\,l},$$
$$H_{a,b} = -\frac{w\,h}{2}\eta\left(1 \pm 1 - \frac{\eta}{2}\Phi\right),$$
$$M_{c,d} = \frac{w\,h^2}{4}\eta^2\,(1 \pm 1 - \Phi).$$
$$M_e = \frac{w\,h^2}{4}\eta^2\,[1 - (1 + \varphi)\,\Phi]$$

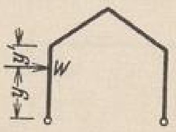


$$\Phi = \frac{\varphi}{8\mu}\{\zeta^2\,(4 + 3\,\varphi\,\zeta) + 2\,\zeta'\,[2\,(3 + 2\,\varphi) + \varphi\,\zeta\,(1 + \varphi\,\zeta)]\},$$
$$A = -B = -w\,z\,\frac{2\,h + z}{2\,l}, \qquad H_{a,b} = -\frac{w\,f}{2}\zeta\,(\pm 1 + \Phi),$$
$$M_{c,d} = \frac{w\,f\,h}{2}\zeta\,(\pm 1 + \Phi), \qquad M_e = -\frac{w\,f\,h}{2}\zeta\left[\varphi\left(1 - \frac{\zeta}{2}\right) - (1 + \varphi)\,\Phi\right].$$



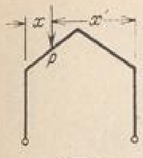
$$\Phi = \frac{1}{2\mu}\left[\varphi\,(3 + 2\,\varphi) - \varkappa + \frac{3}{10}\varkappa\,\eta^2\right],$$
$$A = -B = -\frac{w\,y^2}{6\,l},$$
$$H_{a,b} = -\frac{w\,h}{12}\eta\,[3 \pm 3 - \eta\,(1 - \Phi)],$$
$$M_{c,d} = \frac{w\,h^2}{12}\eta^2\,[\pm 1 + \Phi],$$
$$M_e = -\frac{w\,h^2}{12}\eta^2[\varphi - (1 + \varphi)\,\Phi],$$

$y = h$: $\quad \eta = 1, \quad \Phi = \frac{1}{2\mu}\left[\varphi\,(3 + 2\,\varphi) - \frac{7}{10}\varkappa\right].$



$$\Phi = \frac{1}{2\mu}[3\,(2 + \varphi + \varkappa) - \varkappa\,\eta^2]$$
$$A = -B = -W\,\frac{y}{l},$$
$$H_{a,b} = -\frac{W}{2}(1 \pm 1 - \eta\,\Phi),$$
$$M_{c,d} = \frac{W\,h}{2}\eta\,(1 \pm 1 - \Phi),$$
$$M_e = \frac{W\,h}{2}\eta\,[1 - (1 + \varphi)\,\Phi],$$

$y = h$: $\quad \eta = 1, \quad \Phi = \frac{1}{2\mu}[3\,(2 + \varphi) + 2\,\varkappa].$



$x \leqq l/2$

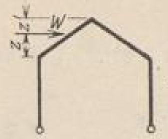
$$\Phi = \frac{\xi}{\mu}\left[\frac{3}{2}(2+\varphi) - \xi(3+2\varphi\xi)\right],$$

$$A = P\xi', \qquad B = P\xi,$$

$$H_{a,b} = \frac{P}{2}\lambda\Phi,$$

$$M_{c,d} = -\frac{Pl}{2}\Phi,$$

$$M_e = \frac{Pl}{2}[\xi - (1+\varphi)\Phi].$$



$$\Phi = \frac{\varphi}{2\mu}\zeta'^2[3(1+\varphi) - \varphi\zeta'],$$

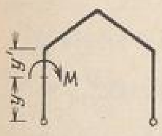
$$A = -B = -W\frac{h+z}{l},$$

$$H_{a,b} = -\frac{W}{2}(\pm 1 + \Phi),$$

$$M_{c,d} = \frac{Wh}{2}(\pm 1 + \Phi),$$

$$M_e = -\frac{Wh}{2}[\varphi\zeta' - (1+\varphi)\Phi],$$

$z = f$: $\Phi = 0$, $M_e = 0$.



$$\Phi = \frac{3}{2\mu}[2+\varphi+\varkappa(1-\eta^2)],$$

$$A = -B = -\frac{\mathsf{M}}{l},$$

$$H_{a,b} = \frac{\mathsf{M}}{2h}\Phi,$$

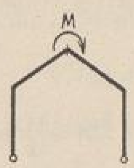
$$M_{h,k} = \frac{\mathsf{M}}{2}(1 \pm 1 - \Phi),$$

$$M_e = \frac{\mathsf{M}}{2}[1 - (1+\varphi)\Phi],$$

$y = 0$: $\Phi = \frac{3}{2\mu}(2+\varphi+\varkappa)$,

$y = h$: $\Phi = \frac{3}{2\mu}(2+\varphi)$,

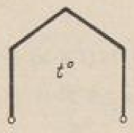
$$M_e = -\frac{3}{4\mu}\mathsf{M}(2+\varphi).$$



$$A = -B = -\frac{\mathsf{M}}{l},$$

$$H_{a,b} = 0, \qquad M_{c,d} = 0,$$

$M_e = \mp\frac{\mathsf{M}}{2}$ links / rechts von e.



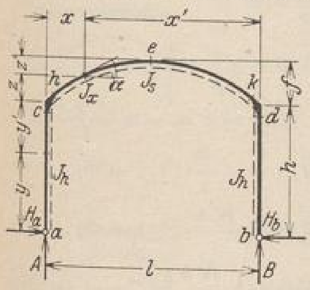
$$A = B = 0,$$

$$H_{a,b} = \frac{3}{2\mu}\frac{l}{s}\frac{EJ_s}{h^2}\alpha_t t,$$

$$M_{c,d} = -\frac{3}{2\mu}\frac{l}{s}\frac{EJ_s}{h}\alpha_t t,$$

$$M_e = M_{c,d}(1+\varphi).$$

Tabelle 45. Symmetrischer Rahmen mit parabolisch gekrümmtem Riegel.

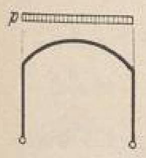


$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \lambda = \frac{l}{h}, \quad \frac{J_s}{J_x\cos\alpha} = 1,$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varphi = \frac{f}{h}, \quad \varkappa = \frac{h}{l}\frac{J_s}{J_h},$$

$$\omega_R = \xi - \xi^2, \qquad \mu = 5(3+2\varkappa) + 4\varphi(5+2\varphi).$$

$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



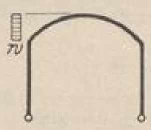
$$\Phi = \frac{2}{\mu}(5+4\varphi),$$

$$A = B = \frac{pl}{2},$$

$$H_{a,b} = \frac{pl}{8}\lambda\Phi,$$

$$M_{c,d} = -\frac{pl^2}{8}\Phi,$$

$$M_e = \frac{pl^2}{8}[1 - (1+\varphi)\Phi].$$



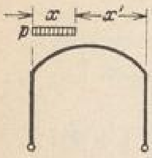
$$\Phi = \frac{4}{7}\frac{\varphi}{\mu}(7+6\varphi),$$

$$A = -B = -\frac{wf(2h+f)}{2l},$$

$$H_{a,b} = -\frac{wf}{2}(\pm 1 + \Phi),$$

$$M_{c,d} = \frac{wfh}{2}(\pm 1 + \Phi),$$

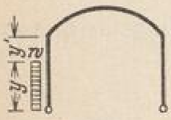
$$M_e = -\frac{wfh}{2}\left[\frac{\varphi}{2} - (1+\varphi)\Phi\right].$$



$$\Phi = \frac{\xi^2}{\mu}\,[5\,(3+2\,\varphi) - 10\,\xi\,(1+\varphi\,\xi) + 4\,\varphi\,\xi^3]\,,$$

$$A = \frac{p\,x}{2}\,(2-\xi)\,, \qquad B = \frac{p\,x}{2}\,\xi\,, \qquad H_{a,b} = \frac{p\,l}{4}\,\lambda\,\Phi\,,$$

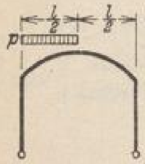
$$M_{c,d} = -\frac{p\,l^2}{4}\,\Phi\,, \qquad x \leq \frac{l}{2}: \qquad M_e = \frac{p\,l^2}{4}\,[\xi^2 - (1+\varphi)\,\Phi]\,.$$



$$\Phi = \frac{5}{2\,\mu}\,\{2\,[3\,(1+\varkappa) + 2\,\varphi] - \varkappa\,\eta^2\}\,,$$

$$A = -B = -\frac{w\,y^2}{2\,l}\,, \qquad H_{a,b} = -\frac{w\,h}{2}\,\eta\left(1 \pm 1 - \frac{\eta}{2}\,\Phi\right),$$

$$M_{c,d} = \frac{w\,h^2}{4}\,\eta^2\,(1 \pm 1 - \Phi)\,, \qquad M_e = \frac{w\,h^2}{4}\,\eta^2\,[1 - (1+\varphi)\,\Phi]\,.$$



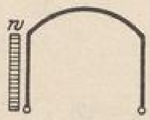
$$\Phi = \frac{2}{\mu}\,(5+4\,\varphi)\,,$$

$$A = \frac{3}{8}\,p\,l\,, \qquad B = \frac{1}{8}\,p\,l\,,$$

$$H_{a,b} = \frac{p\,l}{16}\,\lambda\,\Phi\,,$$

$$M_{c,d} = -\frac{p\,l^2}{16}\,\Phi\,,$$

$$M_e = \frac{p\,l^2}{16}\,[1 - (1+\varphi)\,\Phi]\,.$$



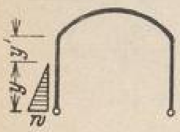
$$\Phi = \frac{5}{2\,\mu}\,(6 + 5\,\varkappa + 4\,\varphi)\,,$$

$$A = -B = -\frac{w\,h^2}{2\,l}\,,$$

$$H_{a,b} = -\frac{w\,h}{2}\left(1 \pm 1 - \frac{\Phi}{2}\right),$$

$$M_{c,d} = +\frac{w\,h^2}{4}\,(1 \pm 1 - \Phi)\,,$$

$$M_e = +\frac{w\,h^2}{4}\,[1 - (1+\varphi)\,\Phi]\,.$$

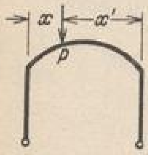


$$\Phi = \frac{1}{2\,\mu}\,\{10\,[3\,(1+\varkappa) + 2\,\varphi] - 3\,\varkappa\,\eta^2\}\,,$$

$$A = -B = -\frac{w\,y^2}{6\,l}\,, \qquad H_{a,b} = -\frac{w\,h}{4}\,\eta\left(1 \pm 1 - \frac{\eta}{3}\,\Phi\right),$$

$$M_{c,d} = \frac{w\,h^2}{12}\,\eta^2\,(1 \pm 1 - \Phi)\,, \qquad M_e = \frac{w\,h^2}{12}\,\eta^2\,[1 - (1+\varphi)\,\Phi]\,,$$

$$y = h: \qquad \eta = 1\,, \qquad \Phi = \frac{1}{2\,\mu}\,[10\,(3+2\,\varphi) + 27\,\varkappa]\,.$$



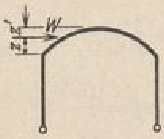
$$\Phi = \frac{5}{\mu}\,\omega_R\,[3 + 2\,\varphi\,(1+\omega_R)]\,,$$

$$A = P\,\xi'\,, \qquad B = P\,\xi\,,$$

$$H_{a,b} = \frac{P}{2}\,\lambda\,\Phi\,,$$

$$M_{c,d} = -\frac{P\,l}{2}\,\Phi\,,$$

$$x \leq \frac{l}{2}: \qquad M_e = \frac{P\,l}{2}\,[\xi - (1+\varphi)\,\Phi]\,.$$



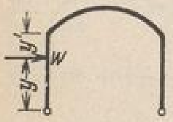
$$\Phi = 2\,\frac{\varphi}{\mu}\,\zeta'^{\frac{3}{2}}\,[5\,(1+\varphi) - \varphi\,\zeta']\,,$$

$$A = -B = -W\,\frac{h+z}{l}\,,$$

$$H_{a,b} = -\frac{W}{2}\,(\pm 1 + \Phi)\,,$$

$$M_{c,d} = \frac{W\,h}{2}\,(\pm 1 + \Phi)\,,$$

$$M_e = -\frac{W\,h}{2}\,[\varphi\,\zeta' - (1+\varphi)\,\Phi]\,.$$



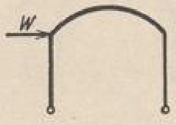
$$\Phi = \frac{5}{\mu}\,[3\,(1+\varkappa) + 2\,\varphi - \varkappa\,\eta^2]\,,$$

$$A = -B = -W\,\frac{y}{l}\,,$$

$$H_{a,b} = -\frac{W}{2}\,(1 \pm 1 - \eta\,\Phi)\,,$$

$$M_{c,d} = \frac{W\,h}{2}\,\eta\,(1 \pm 1 - \Phi)\,,$$

$$M_e = \frac{W\,h}{2}\,\eta\,[1 - (1+\varphi)\,\Phi]\,.$$



$$\Phi = 2\,\frac{\varphi}{\mu}\,(5 + 4\,\varphi)\,,$$

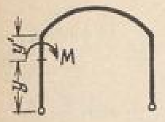
$$A = -B = -W\,\frac{h}{l}\,,$$

$$H_{a,b} = -\frac{W}{2}\,(\pm 1 + \Phi)\,,$$

$$M_{c,d} = \frac{W\,h}{2}\,(\pm 1 + \Phi)\,,$$

$$M_e = -\frac{W\,h}{2}\,[\varphi - (1+\varphi)\,\Phi]\,.$$

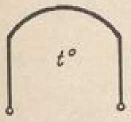
$$\Phi = \frac{5}{\mu}\,[3\,(1+\varkappa) + 2\,\varphi - 3\,\varkappa\,\eta^2]\,,$$



$$A = -B = -\frac{\mathsf{M}}{l}\,, \qquad H_{a,b} = \frac{\mathsf{M}}{2\,h}\,\Phi\,,$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\,(1 \pm 1 - \Phi)\,, \qquad M_e = \frac{\mathsf{M}}{2}\,[1 - (1+\varphi)\,\Phi]\,,$$

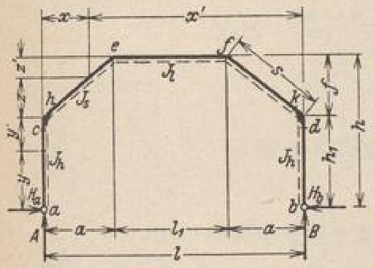
$$y = 0: \quad \eta = 0\,, \qquad y' = 0: \quad \eta = 1\,, \qquad M_e = -\frac{\mathsf{M}}{2}\,\Phi\,.$$



$$A = B = 0\,, \qquad H_{a,b} = \frac{15}{\mu}\,\frac{E\,J_s}{h^2}\,\alpha_t\,t\,.$$

$$M_{c,d} = -\frac{15}{\mu}\,\frac{E\,J_s}{h}\,\alpha_t\,t\,, \qquad M_e = M_{c,d}\,(1+\varphi)\,.$$

Tabelle 46. Symmetrischer Rahmen mit mehrfach gebrochenem Riegel.



$$\xi = \frac{x}{l}\,, \qquad \eta = \frac{y}{h_1}\,, \qquad \zeta = \frac{z}{f}\,, \qquad \lambda = \frac{a}{l}\,,$$

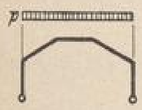
$$\xi' = \frac{x'}{l}\,, \qquad \eta' = \frac{y'}{h_1}\,, \qquad \zeta' = \frac{z'}{f}\,, \qquad \lambda' = \frac{l_1}{l}\,,$$

$$\psi = \frac{h_1}{h}\,, \qquad \varphi = \frac{f}{h_1}\,, \qquad \varkappa_1 = \frac{l_1}{s}\,\frac{J_s}{J_r}\,,$$

$$\psi' = \frac{f}{h}\,, \qquad \nu = \frac{l}{h}\,, \qquad \varkappa_2 = \frac{h_1}{s}\,\frac{J_s}{J_h}\,,$$

$$\mu = \psi^2\,(1+\varkappa_2) + 1 + \psi + \frac{3}{2}\,\varkappa_1\,.$$

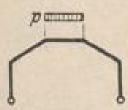
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$\Phi = \frac{1}{4\,\mu}\,[2\,\lambda\,(2+\psi+\varkappa_1) - \lambda^2\,(3+\psi+2\,\varkappa_1) + \varkappa_1]\,,$$

$$A = B = \frac{p\,l}{2}\,, \qquad H_{a,b} = \frac{p\,l^2}{2\,h_1}\,\psi\,\Phi\,,$$

$$M_{c,d} = -\frac{p\,l^2}{2}\,\psi\,\Phi\,, \qquad M_{e,f} = \frac{p\,l^2}{2}\,[\lambda\,(1-\lambda) - \Phi]\,.$$



$$\Phi = \frac{1}{4\,\mu}\,\{2\,\lambda\,[2\,(1+\varkappa_1) + \psi] + \varkappa_1\}\,,$$

$$A = B = \frac{p\,l_1}{2}\,, \qquad H_{a,b} = \frac{p\,l_1}{2}\,\frac{l}{h_1}\,\psi\,\Phi\,,$$

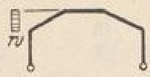
$$M_{c,d} = -\frac{p\,l\,l_1}{2}\,\psi\,\Phi\,, \qquad M_{e,f} = \frac{p\,l\,l_1}{2}\,(\lambda - \Phi)\,.$$

$$\Phi = \frac{1}{4\,\mu}\,\{4\,\varphi\,[3\,(1+\varkappa_1) - \psi'] + 6\,(1+\varkappa_1+\psi) + 3\,\varkappa_2\,\psi\}\,,$$

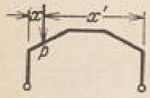
$$A = -B = -\frac{w\,h_1^2}{2\,l}\,, \qquad H_{a,b} = -\frac{w\,h_1}{2}\left(\pm 1 + \frac{\psi}{2}\,\Phi\right)\,,$$

$$M_{c,d} = -\frac{w\,h_1^2}{4}\,(1 \mp 1 - \psi\,\Phi)\,, \qquad M_{e,f} = -\frac{w\,h_1^2}{4}\,(1 + 2\,\varphi \mp \lambda' - \Phi)\,.$$

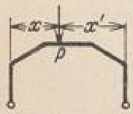
$$\Phi = \frac{1}{4\mu}(5 + 3\psi + 6\varkappa_1),$$
$$A = \frac{p\,a}{2}(2 - \lambda), \qquad B = \frac{p\,a}{2}\lambda,$$
$$H_{a,b} = \frac{p\,a^2}{4\,h_1}\psi\,\Phi,$$
$$M_{c,d} = -\frac{p\,a^2}{4}\psi\,\Phi,$$
$$M_{e,f} = \frac{p\,a^2}{4}(1 \pm \lambda' - \Phi).$$



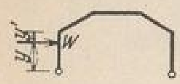
$$\Phi = \frac{1}{4\mu}[3(1 + 2\varkappa_1) + \psi],$$
$$A = -B = -w\,f\,\frac{(2\,h_1 + f)}{2\,l},$$
$$H_{a,b} = -\frac{w\,f}{2}\left(\pm 1 + \frac{\psi'}{2}\Phi\right),$$
$$M_{c,d} = \frac{w\,f\,h_1}{2}\left(\pm 1 + \frac{\psi'}{2}\Phi\right),$$
$$M_{e,f} = -\frac{w\,f^2}{4}\left[1 \mp \lambda'\left(1 + \frac{2}{\varphi}\right) - \Phi\right].$$



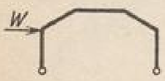
$$x \leqq a, \qquad \Phi = \frac{1}{2\mu}\left[3(1 + \psi + \varkappa_1) - \frac{\xi}{\lambda}\left(3\psi + \psi'\frac{\xi}{\lambda}\right)\right],$$
$$A = P\,\xi', \qquad B = P\,\xi, \qquad H_{a,b} = \frac{P\,l}{2\,h_1}\xi\,\psi\,\Phi,$$
$$M_{c,d} = -\frac{P\,l}{2}\xi\,\psi\,\Phi, \qquad M_{e,f} = \frac{P\,l}{2}\xi(1 \pm \lambda' - \Phi).$$



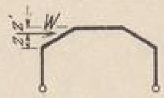
$$a \leqq x \leqq a + l_1, \qquad \Phi = \frac{1}{2\mu}\left[\lambda(2 + \psi) + 3\,\frac{\varkappa_1}{\lambda'}(\omega_R - \lambda^2)\right],$$
$$A = P\,\xi', \qquad B = P\,\xi, \qquad H_{a,b} = \frac{P\,l}{2\,h_1}\psi\,\Phi,$$
$$M_{c,d} = -\frac{P\,l}{2}\psi\,\Phi, \qquad M_{e,f} = \frac{P\,l}{2}\{[1 \pm (1 - 2\,\xi)]\,\lambda - \Phi\}.$$



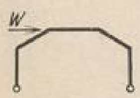
$$\Phi = \frac{1}{2\mu}\{\varphi[3(1 + \varkappa_1) - \psi'] + 3\,\eta'(1 + \varkappa_1 + \psi) + \varkappa_2\,\psi\,\eta'^2(3 - \eta')\},$$
$$A = -B = -W\frac{y}{l}, \qquad H_{a,b} = -\frac{W}{2}(\pm 1 + \psi\,\Phi),$$
$$M_{c,d} = -\frac{W\,h_1}{2}(1 - \eta \mp \eta - \psi\,\Phi), \qquad M_{e,f} = \pm\frac{W\,h_1}{2}(1 + \varphi - \eta \mp \lambda'\,\eta - \Phi).$$



$$\Phi = \frac{\varphi}{2\mu}[3(1 + \varkappa_1) - \psi'],$$
$$A = -B = -W\frac{h_1}{l},$$
$$H_{a,b} = -\frac{W}{2}(\pm 1 + \psi\,\Phi),$$
$$M_{c,d} = \frac{W\,h_1}{2}(\pm 1 + \psi\,\Phi),$$
$$M_{e,f} = -\frac{W\,h_1}{2}(\varphi \mp \lambda' - \Phi).$$

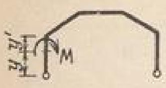


$$\Phi = \frac{\zeta'}{2\mu}(3\varkappa_1 + 3\zeta' - \psi'\zeta'^2),$$
$$A = -B = -W\frac{h_1 + z}{l},$$
$$H_{a,b} = -\frac{W}{2}(\pm 1 + \psi'\Phi),$$
$$M_{c,d} = \frac{W\,h_1}{2}(\pm 1 + \psi'\Phi),$$
$$M_{e,f} = -\frac{W\,f}{2}\left[\zeta' \mp \lambda'\left(\frac{1}{\psi'} - \zeta'\right) - \Phi\right].$$



$$A = -B = -W\frac{h}{l},$$
$$H_{a,b} = \mp\frac{W}{2},$$
$$M_{c,d} = \pm\frac{W\,h_1}{2},$$
$$M_{e,f} = \pm\frac{W\,h}{2}\lambda'.$$

$$A = B = 0,$$
$$H_{a,b} = \frac{3}{2\mu}\,\frac{l}{s}\,\frac{E\,J_s}{h^2}\,\alpha_t\,t,$$
$$M_{c,d} = -H_{a,b}\,h_1,$$
$$M_{e,f} = -H_{a,b}\,h.$$



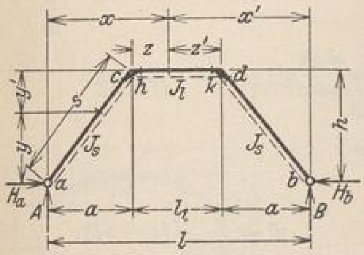
$$\Phi = \frac{3}{2\mu}\left[1 + \varkappa_1 + \psi + \varkappa_2\,\psi\,(1 - \eta^2)\right],$$

$$A = -B = -\frac{M}{l}, \qquad H_{a,b} = \frac{M}{2h}\,\Phi,$$

$$M_{h,k} = \frac{M}{2}(1 \pm 1 - \psi\,\Phi), \qquad M_{e,f} = \frac{M}{2}(1 \pm \lambda' - \Phi),$$

$$y = 0:\quad \Phi = \frac{3}{2\mu}\left[1 + \varkappa_1 + \psi\,(1 + \varkappa_2)\right], \qquad y = h:\quad \Phi = \frac{3}{2\mu}(1 + \varkappa_1 + \psi). \qquad M_e = -\frac{M}{2}\,\psi\,\Phi.$$

Tabelle 47. Symmetrischer Zweigelenkrahmen mit schrägen Pfosten:

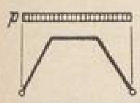


$$\xi = \frac{x}{l}, \qquad \eta = \frac{y}{h}, \qquad \zeta = \frac{z}{l_1}, \qquad \lambda = \frac{a}{l},$$

$$\xi' = \frac{x'}{l}, \qquad \eta' = \frac{y'}{h}, \qquad \zeta' = \frac{z'}{l_1}, \qquad \lambda' = \frac{l_1}{l},$$

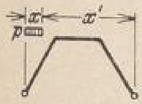
$$\nu = \frac{l}{h}, \qquad \varkappa = \frac{l_1}{s}\,\frac{J_s}{J_1}, \qquad \mu = 1 + \frac{3}{2}\varkappa.$$

$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$\Phi = \frac{1}{4\mu}\left[2\,\lambda\,(2 + \varkappa) - \lambda^2(3 + 2\varkappa) + \varkappa\right],$$

$$A = B = \frac{p\,l}{2}, \qquad H_{a,b} = \frac{p\,l}{2}\,\nu\,\Phi; \qquad M_{c,d} = \frac{p\,l^2}{2}\left[\lambda(1 - \lambda) - \Phi\right].$$



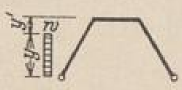
$$\Phi = \frac{1}{4\mu}\left[6\,(1 + \varkappa) - \frac{\xi^2}{\lambda^2}\right],$$

$$A = \frac{p\,x}{2}(1 + \xi'), \qquad B = \frac{p\,x}{2}\,\xi,$$

$$H_{a,b} = \frac{p\,l}{4}\,\xi^2\,\nu\,\Phi,$$

$$M_{c,d} = \frac{p\,l^2}{4}\,\xi^2(1 \pm \lambda' - \Phi),$$

$$x = a:\quad \xi = \lambda, \qquad \Phi = \frac{1}{4\mu}(5 + 6\varkappa).$$



$$\Phi = \frac{1}{4\mu}\left[6\,(1 + \varkappa) - \eta^2\right],$$

$$A = -B = -\frac{w\,y^2}{2\,l},$$

$$H_{a,b} = -\frac{w\,h}{2}\,\eta\left(1 \pm 1 - \frac{\eta}{2}\,\Phi\right),$$

$$M_{c,d} = \frac{w\,h^2}{4}\,\eta^2(1 \pm \lambda' - \Phi),$$

$$y = h:\quad \eta = 1, \qquad \Phi = \frac{1}{4\mu}(5 + 6\varkappa).$$

$$\Phi = \frac{1}{4\mu}\left\{4\,\lambda + \varkappa\left[6\,\lambda + \lambda'\,\zeta\,(3 - 2\,\zeta)\right]\right\},$$

$$A = \frac{p\,z}{2}(1 + \lambda'\,\zeta'), \qquad B = \frac{p\,z}{2}(1 - \lambda'\,\zeta'),$$

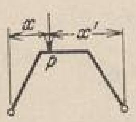
$$H_{a,b} = \frac{p\,l_1}{2}\,\zeta\,\nu\,\Phi, \qquad M_{c,d} = \frac{p\,l\,l_1}{2}\,\zeta\left[\lambda(1 \pm \lambda'\,\zeta') - \Phi\right].$$

$$\Phi = \frac{1}{4\mu}\left[4\,\lambda\,(1 + \varkappa) + \varkappa\right],$$

$$A = B = \frac{p\,l_1}{2},$$

$$H_{a,b} = \frac{p\,l_1}{2}\,\nu\,\Phi,$$

$$M_{c,d} = +\frac{p\,l_1\,l}{2}(\lambda - \Phi).$$

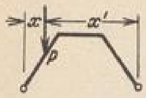


$$\Phi = \frac{1}{2\mu}\left[2\,\lambda + 3\,\frac{\varkappa}{\lambda'}(\omega_R - \lambda^2)\right],$$

$$A = P\,\xi', \qquad B = P\,\xi,$$

$$H_{a,b} = \frac{P}{2}\,\nu\,\Phi,$$

$$a \leqq x \leqq a + l_1 \qquad M_{c,d} = \frac{P\,l}{2}\left\{\left[1 \pm (1 - 2\,\xi)\right]\lambda - \Phi\right\}.$$



$$\Phi = \frac{1}{2\mu}\left[3(1+\varkappa) - \frac{\xi^2}{\lambda^2}\right],$$

$$A = P\xi', \qquad B = P\xi,$$

$$H_{a,b} = \frac{P}{2}\,\xi\,\nu\,\Phi,$$

$$M_{c,d} = \frac{Pl}{2}\,\xi(1 \pm \lambda' - \Phi).$$

$0 < x \leqq a$

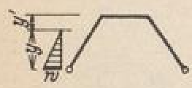
$$\Phi = \frac{\eta'}{2\mu}\left[3(\varkappa + \eta') - \eta'^2\right],$$

$$A = -B = -W\frac{y}{l},$$

$$H_{a,b} = -\frac{W}{2}(\pm 1 + \Phi),$$

$$M_{c,d} = -\frac{Wh}{2}\left[\eta' \mp \eta\lambda' - \Phi\right],$$

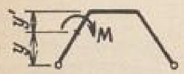
$y = h$: $\eta = 1$, $\eta' = 0$, $\Phi = 0$.



$$\Phi = \frac{1}{2\mu}(10 - 3\eta^2), \qquad A = -B = -\frac{wy^2}{6l}.$$

$$H_{a,b} = -\frac{wh}{120}\eta(30 \pm 30 - 10\eta - \eta\Phi), \qquad M_{c,d} = \frac{wh^2}{120}\eta^2(\pm 10\lambda' - \Phi),$$

$y = h$: $\eta = 1$, $\Phi = \frac{7}{2\mu}$.



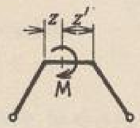
$$\Phi = \frac{3}{2\mu}(1 + \varkappa - \eta^2),$$

$$A = -B = -\frac{\mathsf{M}}{l},$$

$$H_{a,b} = \frac{\mathsf{M}}{2h}\Phi,$$

$$M_{h,k} = \frac{\mathsf{M}}{2}(1 \pm \lambda' - \Phi),$$

$y = 0$: $\Phi = \frac{3}{2\mu}(1 + \varkappa)$.



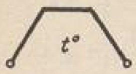
$$\Phi = \frac{3}{4}\frac{\varkappa}{\mu}(1 - 2\zeta),$$

$$A = -B = -\frac{\mathsf{M}}{l},$$

$$H_{a,b} = \frac{\mathsf{M}}{h}\Phi,$$

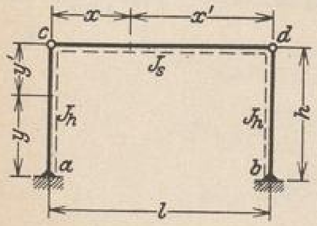
$$M_{c,d} = -\mathsf{M}(\pm\lambda + \Phi),$$

$z = 0$: $\Phi = \frac{3\varkappa}{4\mu}$.



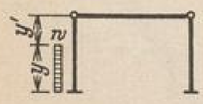
$$A = B = 0, \qquad H_{a,b} = \frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h^2}\,\alpha_t t, \qquad M_{c,d} = -\frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h}\,\alpha_t t.$$

Tabelle 48. Symmetrischer Rahmen mit geradem Riegel, Gelenke an den Traufpunkten.



$$\xi = \frac{x}{l}, \qquad \eta = \frac{y}{h}, \qquad \lambda = \frac{l}{h}.$$

$$\xi' = \frac{x'}{l}, \qquad \eta' = \frac{y'}{h}.$$

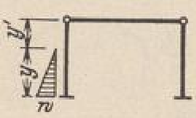


$$\Phi = \frac{1}{4}\eta(4 - \eta),$$

$$H_{c,d} = \frac{wh}{4}\eta^2\Phi,$$

$$M_{a,b} = -\frac{wh^2}{4}\eta^2\left[1 \pm 1 - \Phi\right],$$

$y = h$: $\eta = 1$, $\Phi = \frac{3}{4}$.

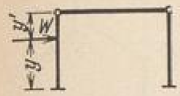


$$\Phi = \frac{3}{20}\eta(5 - \eta),$$

$$H_{c,d} = \frac{wh}{12}\eta^2\Phi,$$

$$M_{a,b} = -\frac{wh^2}{12}\eta^2\left[1 \pm 1 - \Phi\right],$$

$y = h$: $\eta = 1$, $\Phi = \frac{3}{5}$.

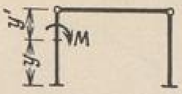


$$\Phi = \frac{\eta}{2}(3-\eta),$$

$$H_{c,d} = \frac{W}{2}\eta\,\Phi,$$

$$M_{a,b} = -\frac{W\,h}{2}\eta\,[1 \pm 1 - \Phi],$$

$$y = h: \quad \eta = 1, \quad \Phi = 1.$$

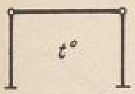


$$\Phi = \frac{3}{2}(1-\eta'^2),$$

$$H_{c,d} = \frac{\mathsf{M}}{2\,h}\Phi,$$

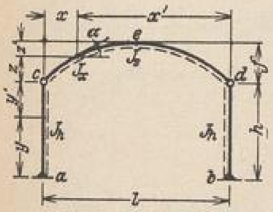
$$M_{a,b} = -\frac{\mathsf{M}}{2}[1 \pm 1 - \Phi],$$

$$y = h: \quad \Phi = \frac{3}{2}.$$



$$H_{c,d} = \frac{3}{2}\lambda\frac{E\,J_h}{h^2}\alpha_t t, \qquad M_{a,b} = \frac{3}{2}l\frac{E\,J_h}{h^2}\alpha_t t.$$

Tabelle 49. Symmetrischer Rahmen mit parabolisch gekrümmtem Riegel, Gelenke an den Traufpunkten.



$$\xi = \frac{x}{l}, \qquad \eta = \frac{y}{h}, \qquad \zeta = \frac{z}{f}, \qquad \lambda = \frac{l}{h},$$

$$\xi' = \frac{x'}{l}, \qquad \eta' = \frac{y'}{h}, \qquad \zeta' = \frac{z'}{f}, \qquad \varphi = \frac{f}{h},$$

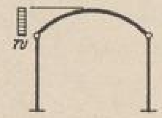
$$\frac{J_s}{J_x\cos\alpha} = 1, \qquad \varkappa = \frac{l\,J_h}{h\,J_s}, \qquad \mu = 5 + 4\varkappa\varphi^2, \quad \nu = \frac{\mu}{\varkappa\varphi}.$$

$$\Phi = \frac{4}{\nu},$$

$$H_{c,d} = \frac{p\,l}{8}\lambda\,\Phi,$$

$$M_{a,b} = \frac{p\,l^2}{8}\Phi,$$

$$M_e = \frac{p\,l^2}{8}(1-\varphi\,\Phi).$$

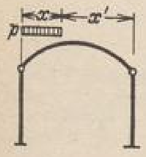


$$\Phi = \frac{24}{7}\frac{\varphi}{\nu},$$

$$H_{c,d} = -\frac{w\,f}{4}(\pm 2 + \Phi),$$

$$M_{a,b} = -\frac{w\,f\,h}{4}(\pm 2 + \Phi),$$

$$M_e = -\frac{w\,f^2}{4}(1-\Phi).$$



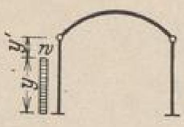
$$\Phi = \frac{\xi^2}{\nu}[5 - \xi^2(5-2\xi)],$$

$$H_{c,d} = \frac{p\,l}{4}\lambda\,\Phi,$$

$$M_{a,b} = \frac{p\,l^2}{4}\Phi,$$

$$x \leqq \frac{l}{2}: \quad M_e = \frac{p\,l^2}{4}(\xi^2 - \varphi\,\Phi).$$

$$x = \frac{l}{2}: \quad \Phi = \frac{1}{\nu}.$$



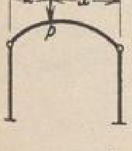
$$\Phi = \frac{5}{4\,\mu}\eta\,(4-\eta),$$

$$H_{c,d} = \frac{w\,h}{4}\eta^2\,\Phi,$$

$$M_{a,b} = -\frac{w\,h^2}{4}\eta^2\,[1 \pm 1 - \Phi],$$

$$M_e = -\varphi\,M_b,$$

$$y = h: \quad \eta = 1, \quad \Phi = \frac{15}{4\,\mu}.$$

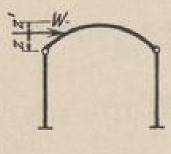


$$\Phi = \frac{5}{\nu}\omega''_P,$$

$$H_{c,d} = \frac{P}{2}\lambda\,\Phi,$$

$$M_{a,b} = \frac{P\,l}{2}\Phi,$$

$$x \leqq \frac{l}{2}: \quad M_e = \frac{P\,l}{2}(\xi - \varphi\,\Phi).$$

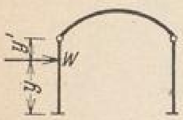


$$\Phi = \frac{\varphi}{\nu}\zeta'^{\frac{3}{2}}(5-\zeta'),$$

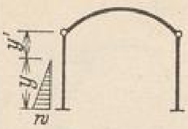
$$H_{c,d} = \frac{W}{2}(\mp 1 - \Phi),$$

$$M_{a,b} = -\frac{W\,h}{2}(\pm 1 + \Phi),$$

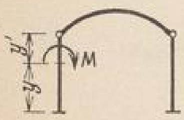
$$M_e = -\frac{W\,f}{2}(\zeta' - \Phi).$$



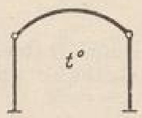
$$\Phi = \frac{5}{2\mu}\,\eta\,(3-\eta)\,,$$
$$H_{c,d} = \frac{W}{2}\,\eta\,\Phi\,,$$
$$M_{a,b} = -\frac{W\,h}{2}\,\eta\,[1 \pm 1 - \Phi]\,,$$
$$M_e = -\varphi\,M_b\,,$$
$$y = h:\quad \eta = 1\,,\quad \Phi = \frac{5}{\mu}\,.$$



$$\Phi = \frac{3\,\eta}{4\,\mu}\,(5-\eta)\,,$$
$$H_{c,d} = \frac{w\,h}{12}\,\eta^2\,\Phi\,,$$
$$M_{a,b} = -\frac{w\,h^2}{12}\,\eta^2\,[1 \pm 1 - \Phi]\,,$$
$$M_e = -\varphi\,M_b\,,$$
$$y = h:\quad \eta = 1\,,\quad \Phi = \frac{3}{\mu}\,.$$

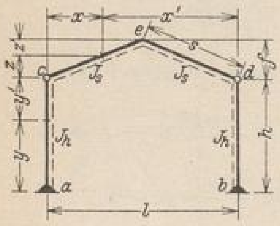


$$\Phi = \frac{15}{2\,\mu}\,(1-\eta'^2)\,,$$
$$H_{c,d} = \frac{\mathsf{M}}{2\,h}\,\Phi\,,$$
$$M_{a,b} = -\frac{\mathsf{M}}{2}\,[1 \pm 1 - \Phi]\,,$$
$$M_e = -\varphi\,M_b\,,$$
$$y = h:\quad \Phi = \frac{15}{2\,\mu}\,.$$

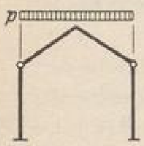


$$H_{c,d} = \frac{15}{2\,\mu}\,\lambda\,\frac{E\,J_s}{h^2}\,\alpha_t\,t\,,$$
$$M_{a,b} = \frac{15}{2\,\mu}\,l\,\frac{E\,J_s}{h^2}\,\alpha_t\,t\,,$$
$$M_e = -\varphi\,M_{a,b}\,.$$

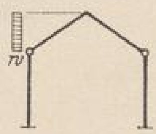
Tabelle 50. Symmetrischer Rahmen mit gebrochenem Riegel, Gelenke in den Traufpunkten.



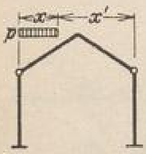
$$\xi = \frac{x}{l}\,,\quad \eta = \frac{y}{h}\,,\quad \zeta = \frac{z}{f}\,,\quad \lambda = \frac{l}{h}\,,$$
$$\xi' = \frac{x'}{l}\,,\quad \eta' = \frac{y'}{h}\,,\quad \zeta' = \frac{z'}{f}\,,\quad \varphi = \frac{f}{h}\,,$$
$$\varkappa = \frac{s}{h}\,\frac{J_h}{J_s}\,,\quad \mu = 1 + \varkappa\,\varphi^2\,,\quad \nu = \frac{\mu}{\varkappa\,\varphi}\,.$$



$$\Phi = \frac{5}{4\,\nu}\,,$$
$$H_{c,d} = \frac{p\,l}{8}\,\lambda\,\Phi\,,$$
$$M_{a,b} = \frac{p\,l^2}{8}\,\Phi\,,$$
$$M_e = \frac{p\,l^2}{8}\,(1 - \varphi\,\Phi)\,.$$

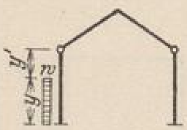


$$\Phi = \frac{3\,\varphi}{4\,\nu}\,,$$
$$H_{c,d} = -\frac{w\,f}{4}\,(\pm 2 + \Phi)\,,$$
$$M_{a,b} = -\frac{w\cdot f\cdot h}{4}\,[\pm 2 + \Phi]\,,$$
$$M_e = -\frac{w\,f^2}{4}\,(1 - \Phi)\,.$$

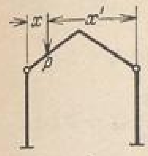


$$x \leqq \frac{l}{2}$$

$$\Phi = \frac{\xi^2\,(3 - 2\,\xi^2)}{2\,\nu}\,,$$
$$H_{c,d} = \frac{p\,l}{4}\,\lambda\,\Phi\,,$$
$$M_{a,b} = \frac{p\,l^2}{4}\,\Phi\,,$$
$$M_e = \frac{p\,l^2}{4}\,(\xi^2 - \varphi\,\Phi)\,,$$
$$x = \frac{l}{2}:\quad \Phi = \frac{5}{16\,\nu}\,.$$

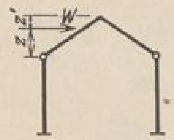


$$\Phi = \frac{\eta}{4\,\mu}\,(4 - \eta)\,,$$
$$H_{c,d} = \frac{w\,h}{4}\,\eta^2\,\Phi\,,$$
$$M_{a,b} = -\frac{w\,h^2}{4}\,\eta^2\,[1 \pm 1 - \Phi]$$
$$M_e = -\varphi\,M_b\,,$$
$$y = h:\quad \eta = 1\,,\quad \Phi = \frac{3}{4\,\mu}\,.$$

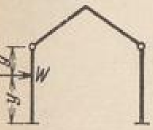


$x \leq \frac{l}{2}$

$$\Phi = \frac{\xi(3 - 4\xi^2)}{2\nu},$$
$$H_{c,d} = \frac{P}{2}\lambda\Phi,$$
$$M_{a,b} = \frac{Pl}{2}\Phi,$$
$$M_e = \frac{Pl}{2}(\xi - \varphi\Phi).$$

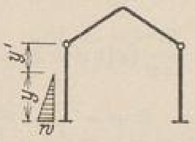


$$\Phi = \frac{\varphi}{2\nu}\zeta'^2(3 - \zeta'),$$
$$H_{c,d} = -\frac{W}{2}(\pm 1 + \Phi),$$
$$M_{a,b} = -\frac{Wh}{2}(\pm 1 + \Phi),$$
$$M_e = -\frac{Wf}{2}(\zeta' - \Phi).$$



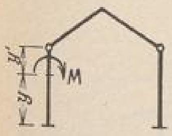
$$\Phi = \frac{\eta}{2\mu}(3 - \eta),$$
$$H_{c,d} = \frac{W}{2}\eta\Phi,$$
$$M_{a,b} = -\frac{Wh}{2}\eta[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$

$y = h$: $\eta = 1$, $\Phi = \frac{1}{\mu}$.



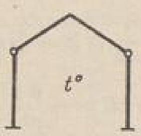
$$\Phi = \frac{3}{20\mu}\eta(5 - \eta),$$
$$H_{c,d} = \frac{wh}{12}\eta^2\Phi,$$
$$M_{a,b} = -\frac{wh^2}{12}\eta^2[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$

$y = h$: $\eta = 1$, $\Phi = \frac{3}{5\mu}$.



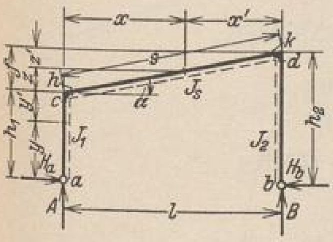
$$\Phi = \frac{3}{2\mu}(1 - \eta'^2),$$
$$H_{c,d} = \frac{M}{2h}\Phi,$$
$$M_{a,b} = -\frac{M}{2}[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$

$y = h$: $\Phi = \frac{3}{2\mu}$.



$$H_{c,d} = \frac{3}{2\mu}\lambda\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_{a,b} = \frac{3}{2\mu}l\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_e = -\varphi M_{a,b}.$$

Tabelle 51. Unsymmetrischer Rahmen mit geradem Riegel.



$\xi = \frac{x}{l}$, $\eta = \frac{y}{h_1}$, $\zeta = \frac{z}{f}$, $\varphi_1 = \frac{f}{h_1}$,

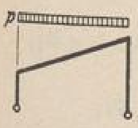
$\xi' = \frac{x'}{l}$, $\eta' = \frac{y'}{h_1}$, $\zeta' = \frac{z'}{f}$, $\varphi_2 = \frac{f}{h_2}$,

$\lambda_1 = \frac{h_1}{h_2}$, $\nu_1 = \frac{l}{h_1}$, $\varkappa_1 = \frac{h_1}{s}\frac{J_s}{J_1}$,

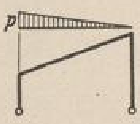
$\lambda_2 = \frac{h_2}{h_1}$, $\nu_2 = \frac{l}{h_2}$, $\varkappa_2 = \frac{h_2}{s}\frac{J_s}{J_2}$,

$$\mu = \lambda_1(1 + \varkappa_1) + 1 + \lambda_2(1 + \varkappa_2),$$

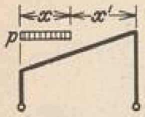
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$A = B = \frac{pl}{2},$$
$$H_{a,b} = \frac{pl}{8\mu}(\nu_1 + \nu_2),$$
$$M_c = -\frac{pl^2}{8\mu}(1 + \lambda_1),$$
$$M_d = -\frac{pl^2}{8\mu}(1 + \lambda_2).$$



$$A = \frac{pl}{3}, \quad B = \frac{pl}{6},$$
$$H_{a,b} = \frac{pl}{120\mu}(7\nu_1 + 8\nu_2),$$
$$M_c = -\frac{pl^2}{120\mu}(7 + 8\lambda_1),$$
$$M_d = -\frac{pl^2}{120\mu}(7\lambda_2 + 8).$$



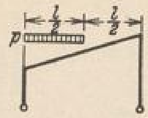
$$\Phi = \frac{\xi^2}{8\mu}\left[\nu_1(2-\xi^2)+\nu_2(2-\xi)^2\right],$$

$$A = \frac{p x}{2}(1+\xi'), \qquad B = \frac{p x}{2}\xi,$$

$$H_{a,b} = p l \Phi,$$

$$M_c = -p l^2 \frac{\Phi}{\nu_1},$$

$$M_d = -p l^2 \frac{\Phi}{\nu_2}.$$

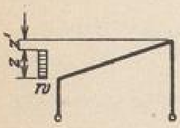


$$A = \frac{3}{8} p l, \qquad B = \frac{1}{8} p l,$$

$$H_{a,b} = \frac{p l}{128\mu}(7\nu_1 + 9\nu_2),$$

$$M_c = -\frac{p l^2}{128\mu}(7 + 9\lambda_1),$$

$$M_d = -\frac{p l^2}{128\mu}(7\lambda_2 + 9).$$

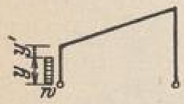


$$\Phi = \frac{1}{4\mu}\{4[1 + 2\lambda_1(1+\varkappa_1)] + \varphi_2\zeta[2(3+\varphi_1) - 4\zeta - \varphi_1\zeta^2]\},$$

$$A = -B = -\frac{w z}{2}\frac{2+\varphi_1\zeta}{\nu_1}, \qquad H_{a,b} = -\frac{w z}{2}(1 \pm 1 - \Phi).$$

$$M_c = \frac{w z}{2} h_1 (2 - \Phi), \qquad M_d = -\frac{w z}{2} h_2 \Phi,$$

$$z = f: \quad \zeta = 1, \qquad \Phi = \frac{\lambda_1}{4\mu}[6(2+\varphi_1) + \varphi_1^2 + 8\varkappa_1].$$

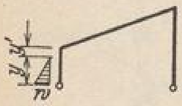


$$\Phi = \frac{1}{4\mu}\{2[1 + \lambda_1(2 + 3\varkappa_1) - \lambda_1\varkappa_1\eta^2]\},$$

$$A = -B = -\frac{w y^2}{2 l}, \qquad H_{a,b} = -\frac{w y}{2}(1 \pm 1 - \eta\Phi),$$

$$M_c = \frac{w y^2}{2}(1 - \Phi), \qquad M_d = -\frac{w y^2}{2}\lambda_2\Phi,$$

$$y = h: \quad \eta = 1, \qquad \Phi = \frac{1}{4\mu}[2 + \lambda_1(4 + 5\varkappa_1)].$$

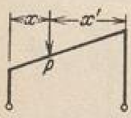


$$\Phi = \frac{1}{30\mu}\{10 + \lambda_1[20 + 3\varkappa_1(10 - \eta^2)]\},$$

$$A = -B = \frac{w y^2}{6 l}, \qquad H_{a,b} = -\frac{w y}{4}(1 \pm 1 - \eta\Phi),$$

$$M_c = \frac{w y^2}{12}(2 - 3\Phi), \qquad M_d = -\frac{w y^2}{4}\lambda_2\Phi,$$

$$y = h: \quad \eta = 1, \qquad \Phi = \frac{1}{30\mu}[10 + \lambda_1(20 + 27\varkappa_1)].$$



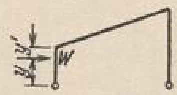
$$\Phi = \frac{1}{2\mu}(\nu_1\omega_D + \nu_2\omega_D'),$$

$$A = P\xi', \qquad B = P\xi,$$

$$H_{a,b} = P\Phi,$$

$$M_c = -P l \frac{\Phi}{\nu_1},$$

$$M_d = -P l \frac{\Phi}{\nu_2}.$$



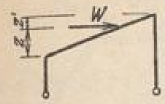
$$\Phi = \frac{1}{\mu}\{1 + \lambda_1[2 + \varkappa_1(3 - \eta^2)]\},$$

$$A = -B = -\frac{W y}{l},$$

$$H_{a,b} = -\frac{W}{2}(1 \pm 1 - \eta\Phi),$$

$$M_c = \frac{W y}{2}(2 - \Phi),$$

$$M_d = -\frac{W y}{2}\lambda_2\Phi.$$

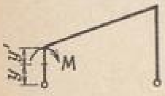


$$\Phi = \frac{1}{\mu}\left[1 + 2\lambda_1(1 + \varkappa_1) + (1 - \lambda_1)\,\omega'_D + (\lambda_2 - 1)\,\omega_D\right],$$

$$A = -B = -W\frac{h_1 + z}{l}, \qquad H_{a,b} = -\frac{W}{2}(1 \pm 1 - \Phi),$$

$$M_c = -H_a h_1, \qquad M_d = -H_b h_2,$$

$$z = 0: \quad \Phi = \frac{1}{\mu}\left[1 + 2\lambda_1(1 + \varkappa_1)\right].$$



$$\Phi = \frac{1}{2\mu}\left[2 + \lambda_2 + 3\varkappa_1(1 - \eta^2)\right],$$

$$A = -B = -\frac{\mathsf{M}}{l}, \qquad H_{a,b} = \frac{\mathsf{M}}{h_2}\Phi,$$

$$M_c = M_h = \mathsf{M}(1 - \lambda_1\Phi), \qquad M_d = -\mathsf{M}\Phi,$$

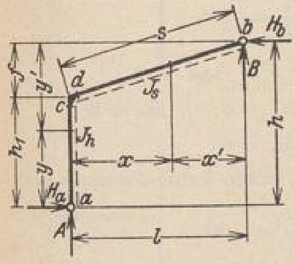
$$y = 0: \quad \Phi = \frac{1}{2\mu}(2 + \lambda_2 + 3\varkappa_1),$$

$$y = h: \quad \Phi = \frac{1}{2\mu}(2 + \lambda_2), \quad M_c = -\mathsf{M}\lambda_1\Phi.$$

$$A = B = 0, \qquad H_{a,b} = \frac{3}{\mu}\,\frac{l}{s}\,\frac{E J_c}{h_1^2}\,\alpha_t t,$$

$$M_c = -H_a h_1, \qquad M_d = -H_b h_2.$$

Tabelle 52. **Halbrahmen mit senkrechtem Pfosten.**



$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{y}{h_1}, \quad \varphi = \frac{f}{h}, \quad \varrho = \frac{f}{l},$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{y'}{f}, \quad \varphi' = \frac{h_1}{h}, \quad \varrho' = \frac{h_1}{l},$$

$$\nu = \frac{h}{l}, \quad \psi = \frac{f}{h_1}, \quad \varkappa = \frac{h_1}{s}\,\frac{J_c}{J_h}, \quad \mu = 1 + \varkappa.$$

$M_d = M_c$, wenn nicht besonders angegeben.

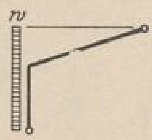
$\xi^2 - \frac{1}{2}\xi^4 = \omega_\varphi$, vgl. Tab. 22, S. 116.

$$\Phi = \frac{1}{4\mu},$$

$$A, B = \frac{p\,l}{2}\left(1 \pm \frac{\Phi}{\varphi'}\right),$$

$$H_{a,b} = \frac{p\,l^2}{2\,h_1}\Phi,$$

$$M_c = -\frac{p\,l^2}{2}\Phi.$$

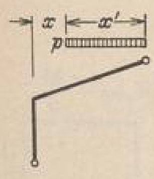


$$\Phi = \frac{\varkappa + \psi^2}{4\mu},$$

$$A, B = \pm\frac{w\,h_1}{2}\,\nu(\psi + \Phi),$$

$$H_{a,b} = \frac{w\,h_1}{2}\left(\mp\frac{1}{\varphi'} + \psi + \Phi\right),$$

$$M_c = -\frac{w\,h_1^2}{2}\Phi.$$

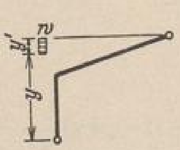


$$\Phi = \frac{1}{2\mu}\left(\xi'^2 - \frac{1}{2}\xi'^4\right),$$

$$A, B = \frac{p\,l}{2}\left[\xi' \mp \left(\omega_R - \frac{\Phi}{\varphi'}\right)\right],$$

$$H = \frac{p\,l^2}{2\,h_1}\Phi,$$

$$M_c = -\frac{p\,l^2}{2}\Phi.$$



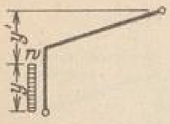
$$\Phi = \frac{1}{2\mu}\left(\zeta'^2 - \frac{1}{2}\zeta'^4\right),$$

$$A, B = \pm\frac{w\,f}{2}\,\varrho\left(\zeta'^2 + \frac{\Phi}{\varphi'}\right),$$

$$H_{a,b} = \frac{w\,f}{2}(\mp\zeta' + \zeta' + \psi\Phi),$$

$$M_c = -\frac{w\,f^2}{2}\Phi,$$

$$y = h_1: \quad \zeta' = 1, \quad \Phi = \frac{1}{4\mu}.$$



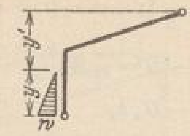
$$\Phi = \frac{\varkappa}{2\mu}\left(\zeta^2 - \frac{1}{2}\zeta^4\right),$$

$$A, B = \pm \frac{w\,h_1}{2}\,\varrho\left(\zeta^2 + \frac{\Phi}{\varphi}\right),$$

$$H_{a,b} = \frac{w\,h_1}{2}(\mp\zeta - \omega_R(\zeta) + \Phi),$$

$$M_c = -\frac{w\,h_1^2}{2}\,\Phi,$$

$$y = h_1:\quad \zeta = 1,\quad \Phi = \frac{\varkappa}{4\mu}.$$



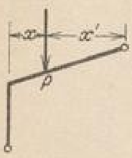
$$\Phi = \frac{\varkappa}{\mu}\,\zeta\,(10 - 3\zeta^2),$$

$$A, B = \pm \frac{w\,h_1}{120}\,\nu\,\zeta\,(20\,\varphi\,\zeta + \Phi),$$

$$H_{a,b} = \frac{w\,h_1}{120}\,\zeta\,(\mp 30 - 30 + 20\,\zeta + \Phi),$$

$$M_c = -\frac{w\,h_1^2}{120}\,\zeta\,\Phi,$$

$$y = h:\quad \zeta = 1,\quad \Phi = 7\,\frac{\varkappa}{\mu}.$$

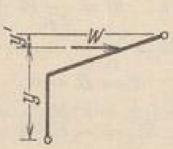


$$\Phi = \frac{1}{\mu}(\xi' - \xi'^3),$$

$$A, B = \frac{P}{2}\left[1 \mp \left(1 - 2\,\xi' - \frac{\Phi}{\varphi'}\right)\right],$$

$$H_{a,b} = \frac{P}{2}\,\frac{l}{h_1}\,\Phi,$$

$$M_c = -\frac{P\,l}{2}\,\Phi.$$

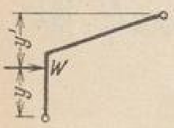


$$\Phi = \frac{1}{2\mu}(\zeta' - \zeta'^3),$$

$$A, B = \pm W\,\varrho\left(\zeta' + \frac{\Phi}{\varphi'}\right),$$

$$H_{a,b} = \frac{W}{2}(\mp 1 + 1 + 2\,\psi\,\Phi),$$

$$M_c = -W\,f\,\Phi.$$

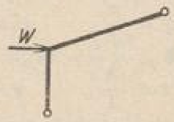


$$\Phi = \frac{\varkappa}{2\mu}(\zeta - \zeta^3),$$

$$A, B = \pm W\,\varrho\left(\zeta + \frac{\Phi}{\varphi}\right),$$

$$H_{a,b} = \frac{W}{2}[-1 \mp 1 + 2(\zeta + \Phi)],$$

$$M_c = -W\,h_1\,\Phi.$$



$$A = B = \pm W\,\varrho,$$

$$H_a = 0,\qquad H_b = W,$$

$$M_c = 0.$$

Es treten keine Momente auf.

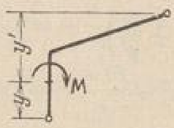
$$\Phi = \frac{\omega'_M}{2\mu},$$

$$A, B = \mp \frac{\mathsf{M}}{l}\left(1 - \frac{\Phi}{\varphi'}\right),$$

$$H_{a,b} = \frac{\mathsf{M}}{h_1}\,\Phi,$$

$$M_c = -\mathsf{M}\,\Phi,$$

$$x = l:\quad \Phi = -\frac{1}{2\mu}.$$



$$\Phi = \frac{\varkappa}{2\mu}\,\omega_M(\zeta),$$

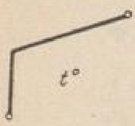
$$A, B = \pm \frac{\mathsf{M}}{l}\,\psi\left(1 - \frac{\Phi}{\varphi}\right),$$

$$H_{a,b} = \frac{\mathsf{M}}{h_1}(1 - \Phi),$$

$$M_c = \mathsf{M}\,\Phi,$$

$$y = 0:\quad \Phi = -\frac{\varkappa}{2\mu},$$

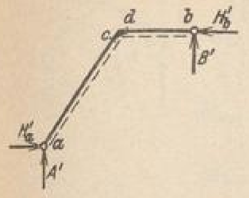
$$y = h_1:\quad \Phi = \frac{\varkappa}{\mu},\quad M_c = -\frac{\mathsf{M}}{\mu}.$$



$$\Phi = 3\,\frac{E\,J_c}{l\,s}\,\frac{1 + \nu^2}{\varrho'^2\,\mu}\,\alpha_t\,t.$$

$$A, B = \pm \nu\,\Phi,\qquad H_{a,b} = \Phi,\qquad M_c = -h_1\,\Phi.$$

Tabelle 53. Halbrahmen mit waagerechtem Riegel.

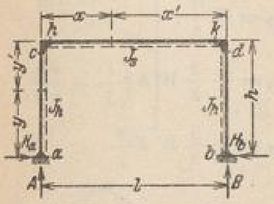


Mit den Werten A, B, $H_{a,b}$, M der Tabelle 52 für den mit seiner Belastung um 90° gedrehten Halbrahmen ergibt sich:

$$A' = H_b,$$
$$B' = -H_a,$$
$$H_a' = -B,$$
$$H_b' = A,$$
$$M_{c,n} = M_{d,e}.$$

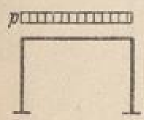
Dreifach statisch unbestimmte Rahmen.

Tabelle 54. Symmetrischer Rahmen mit geradem Riegel.

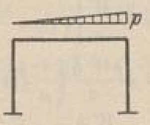


$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \omega \text{ Tabelle 22 S. 116}, \quad \varkappa = \frac{h}{l}\,\frac{J_r}{J_h},$$
$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \mu = 2 + \varkappa, \quad \nu = 1 + 6\varkappa.$$

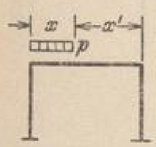
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



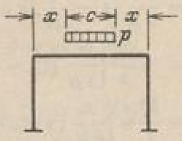
$$H_{a,b} = \frac{1}{4\mu}\,\frac{p\,l^2}{h},$$
$$M_{a,b} = \frac{p\,l^2}{12\,\mu},$$
$$M_{c,d} = -\frac{p\,l^2}{6\,\mu}.$$



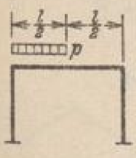
$$H_{a,b} = \frac{1}{8\,\mu}\,\frac{p\,l^2}{h},$$
$$M_{a,b} = \frac{p\,l^2}{120}\left(\frac{5}{\mu} \pm \frac{1}{\nu}\right),$$
$$M_{c,d} = -\frac{p\,l^2}{120}\left(\frac{10}{\mu} \mp \frac{1}{\nu}\right).$$



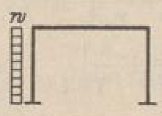
$$\Phi = \frac{1}{\mu}\,(3\,\xi^2 - 2\,\xi^3),$$
$$H_{a,b} = \frac{1}{4}\,\frac{p\,l^2}{h}\,\Phi,$$
$$M_{a,b} = \frac{p\,l^2}{12}\left(\Phi \mp \frac{3}{\nu}\,\omega_R^{\prime\prime}\right),$$
$$M_{c,d} = -\frac{p\,l^2}{12}\left(2\,\Phi \pm \frac{3}{\nu}\,\omega_R^{\prime\prime}\right).$$



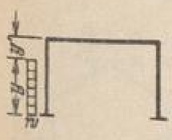
$$\Phi = \frac{1}{2\,\mu}\,(3\,\zeta - \zeta^3),$$
$$H_{a,b} = \frac{1}{4}\,\frac{p\,l^2}{h}\,\Phi,$$
$$M_{a,b} = \frac{p\,l^2}{12}\,\Phi,$$
$$\zeta = \frac{c}{l}. \qquad M_{c,d} = -\frac{p\,l^2}{6}\,\Phi.$$



$$H_{a,b} = \frac{1}{8\,\mu}\,\frac{p\,l^2}{h},$$
$$M_{a,b} = \frac{p\,l^2}{24}\left(\frac{1}{\mu} \mp \frac{3}{8\,\nu}\right),$$
$$M_{c,d} = -\frac{p\,l^2}{24}\left(\frac{2}{\mu} \pm \frac{3}{8\,\nu}\right).$$



$$H_{a,b} = -\frac{w\,h}{4}\left(1 \pm 2 + \frac{1}{2\,\mu}\right),$$
$$M_{a,b} = -\frac{w\,h^2}{4}\left[\frac{3+\varkappa}{6\,\mu} \pm \left(1 - \frac{2\,\varkappa}{\nu}\right)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{4}\,\varkappa\left(\frac{1}{6\,\mu} \mp \frac{2}{\nu}\right).$$



$$\Phi = \frac{1}{2} - \omega_\varphi',$$
$$H_{a,b} = -\frac{w\,h}{4}\left\{2\,\eta \pm 2\,\eta - \eta^2 - \frac{1}{\mu}\,[\varkappa\,\omega_\varphi - (1 + \varkappa)\,\Phi]\right\},$$
$$M_{a,b} = -\frac{w\,h^2}{4}\left\{\frac{1}{3\,\mu}\,[(3 + 2\,\varkappa)\,\Phi - \varkappa\,\omega_\varphi] \pm \eta^2\left(1 - 2\,\eta\,\frac{\varkappa}{\nu}\right)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{4}\,\varkappa\left[\frac{1}{3\,\mu}\,(2\,\omega_\varphi - \Phi) \mp a\,\frac{\eta^3}{\nu}\right].$$