Die Statik im Stahlbetonbau

Beyer, Kurt

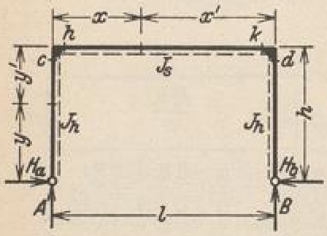
Berlin [u.a.], 1956

61. Rahmentabellen

61. Rahmentabellen.

Einfach statisch unbestimmte Rahmen.

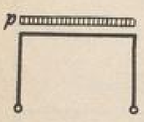
Tabelle 43. Symmetrischer Rahmen mit geradem Riegel.



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

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

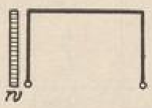
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



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

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

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

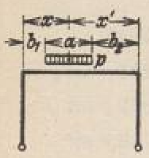


$$\Phi = \frac{1}{2\,\mu}(6 + 5\,\varkappa),$$

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

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

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



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

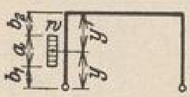
$$A = p\,a\,\xi', \qquad B = p\,a\,\xi,$$

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

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

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

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



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

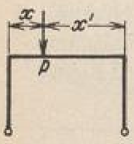
$$A = -B = -w\,a\,\frac{\eta}{\lambda},$$

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

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

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

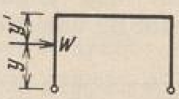
$b_2 = 0$: $\quad \Phi = \frac{1}{2\,\mu}\left[6 + 5\,\varkappa - \varkappa\left(1 - \frac{a}{h}\right)^2\right].$



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

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

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



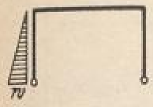
$$\Phi = \frac{1}{\mu}\,[3\,(1 + \varkappa) - \varkappa\,\eta^2],$$

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

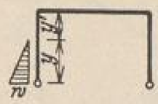
$$H_{a,b} = -\frac{W}{2}\,(1 \pm 1 - \eta\,\Phi),$$

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

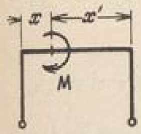
$y = h$: $\quad H_{a,b} = \mp\frac{W}{2}, \qquad M_{c,d} = \pm\frac{W\,h}{2}.$



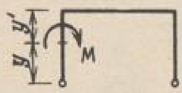
$$\Phi = \frac{7\varkappa}{10\mu},$$
$$A = -B = -\frac{w\,h^2}{6\,l},$$
$$H_{a,b} = -\frac{w\,h}{12}(2 \pm 3 - \Phi),$$
$$M_{c,d} = \frac{w\,h^2}{12}(\pm 1 - \Phi).$$



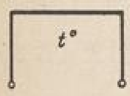
$$\Phi = \frac{\varkappa}{10\mu}(10 - 3\eta^2),$$
$$A = -B = -\frac{w\,y^2}{6\,l},$$
$$H_{a,b} = -\frac{w\,h}{12}\eta[3 \pm 3 - \eta(1 + \Phi)],$$
$$M_{c,d} = \frac{w\,h^2}{12}\eta^2(\pm 1 - \Phi).$$



$$\Phi = \frac{3}{2\mu}(\xi'^2 - \xi^2),$$
$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = \frac{\mathsf{M}}{h}\Phi,$$
$$M_{c,d} = -\mathsf{M}\,\Phi,$$
$$x = 0: \quad \Phi = \frac{3}{2\mu},$$
$$M_h = \mathsf{M}\left(1 - \frac{3}{2\mu}\right).$$

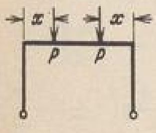


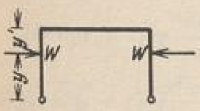
$$\Phi = \frac{3}{\mu}[1 + \varkappa(1 - \eta^2)],$$
$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = \frac{\mathsf{M}}{h}\frac{\Phi}{2},$$
$$M_{h,k} = \frac{\mathsf{M}}{2}(1 \pm 1 - \Phi),$$
$$y = 0: \quad \Phi = \frac{3}{\mu}(1 + \varkappa),$$
$$y' > 0: \quad M_c = M_h.$$

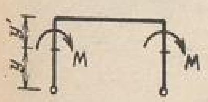


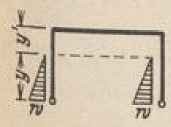
$$A = B = 0, \qquad H_{a,b} = \frac{3}{\mu}\frac{E J_s}{h^2}\alpha_t t, \qquad M_{c,d} = -\frac{3}{\mu}\frac{E J_s}{h}\alpha_t t.$$

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

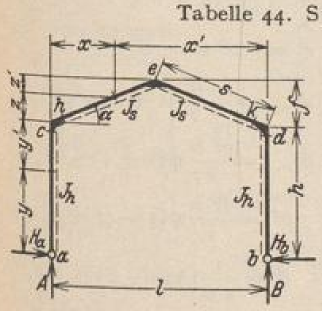
$$H_{a,b} = 2K(a + c\,\Phi),$$

für zwei antimetrische Einzelwirkungen

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

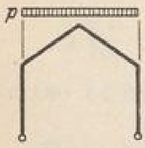
Dasselbe gilt für die Eckmomente. Diese Beziehungen gelten auch für die folgenden symmetrischen Rahmenformen.

Tabelle 44. Symmetrischer Rahmen mit gebrochenem Riegel.



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

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



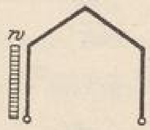
$$\Phi = \frac{8 + 5\varphi}{4\mu},$$

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

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

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

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



$$\Phi = \frac{1}{4\mu}[6(2 + \varphi) + 5\varkappa],$$

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

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

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

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

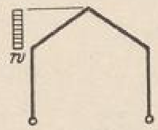
$$\Phi = \frac{8 + 5\varphi}{4\mu},$$

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

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

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

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



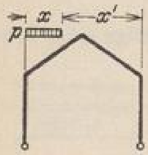
$$\Phi = \frac{\varphi}{8\mu}(4 + 3\varphi),$$

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

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

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

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



$x \leqq l/2$

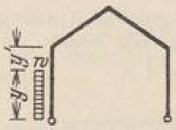
$$\Phi = \frac{\xi^2}{\mu}\left[\frac{3}{2}(2 + \varphi) - \xi(2 + \varphi\xi)\right],$$

$$A = \frac{pl}{2}\xi(2 - \xi), \qquad B = \frac{pl}{2}\xi^2,$$

$$H_{a,b} = \frac{pl}{4}\lambda\Phi,$$

$$M_{c,d} = -\frac{pl^2}{4}\Phi,$$

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



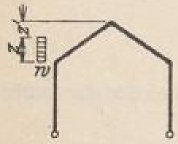
$$\Phi = \frac{1}{4\mu}[6(2 + \varphi + \varkappa) - \varkappa\eta^2],$$

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

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

$$M_{c,d} = \frac{wh^2}{4}\eta^2(1 \pm 1 - \Phi).$$

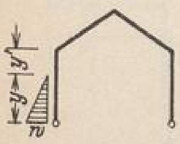
$$M_e = \frac{wh^2}{4}\eta^2[1 - (1 + \varphi)\Phi]$$



$$\Phi = \frac{\varphi}{8\mu}\{\zeta^2(4 + 3\varphi\zeta) + 2\zeta'[2(3 + 2\varphi) + \varphi\zeta(1 + \varphi\zeta)]\},$$

$$A = -B = -wz\frac{2h + z}{2l}, \qquad H_{a,b} = -\frac{wf}{2}\zeta(\pm 1 + \Phi),$$

$$M_{c,d} = \frac{wfh}{2}\zeta(\pm 1 + \Phi), \qquad M_e = -\frac{wfh}{2}\zeta\left[\varphi\left(1 - \frac{\zeta}{2}\right) - (1 + \varphi)\Phi\right].$$



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

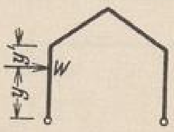
$$A = -B = -\frac{wy^2}{6l},$$

$$H_{a,b} = -\frac{wh}{12}\eta[3 \pm 3 - \eta(1 - \Phi)],$$

$$M_{c,d} = \frac{wh^2}{12}\eta^2[\pm 1 + \Phi],$$

$$M_e = -\frac{wh^2}{12}\eta^2[\varphi - (1 + \varphi)\Phi],$$

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



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

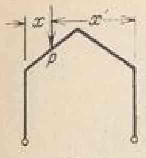
$$A = -B = -W\frac{y}{l},$$

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

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

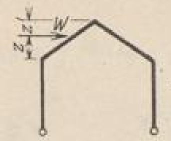
$$M_e = \frac{Wh}{2}\eta[1 - (1 + \varphi)\Phi],$$

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

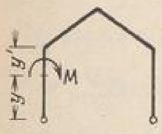


$x \leqq l/2$

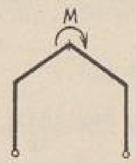
$$\Phi = \frac{\xi}{\mu}\left[\frac{3}{2}(2+\varphi) - \xi(3+2\varphi\xi)\right],$$
$$A = P\xi', \qquad B = P\xi,$$
$$H_{a,b} = \frac{P}{2}\lambda\Phi,$$
$$M_{c,d} = -\frac{Pl}{2}\Phi,$$
$$M_e = \frac{Pl}{2}[\xi - (1+\varphi)\Phi].$$



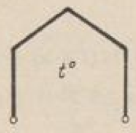
$$\Phi = \frac{\varphi}{2\mu}\zeta'^2[3(1+\varphi) - \varphi\zeta'],$$
$$A = -B = -W\frac{h+z}{l},$$
$$H_{a,b} = -\frac{W}{2}(\pm 1 + \Phi),$$
$$M_{c,d} = \frac{Wh}{2}(\pm 1 + \Phi),$$
$$M_e = -\frac{Wh}{2}[\varphi\zeta' - (1+\varphi)\Phi],$$
$$z = f: \quad \Phi = 0, \quad M_e = 0.$$



$$\Phi = \frac{3}{2\mu}[2+\varphi+\varkappa(1-\eta^2)],$$
$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = \frac{\mathsf{M}}{2h}\Phi,$$
$$M_{h,k} = \frac{\mathsf{M}}{2}(1 \pm 1 - \Phi),$$
$$M_e = \frac{\mathsf{M}}{2}[1 - (1+\varphi)\Phi],$$
$$y = 0: \qquad \Phi = \frac{3}{2\mu}(2+\varphi+\varkappa),$$
$$y = h: \qquad \Phi = \frac{3}{2\mu}(2+\varphi),$$
$$M_e = -\frac{3}{4\mu}\mathsf{M}(2+\varphi).$$

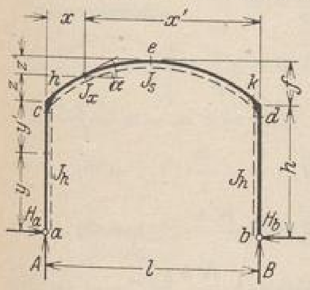


$$A = -B = -\frac{\mathsf{M}}{l},$$
$$H_{a,b} = 0, \qquad M_{c,d} = 0,$$
$$M_e = \mp\frac{\mathsf{M}}{2}\left.\begin{matrix}\text{links}\\ \text{rechts}\end{matrix}\right\}\text{ von } e.$$



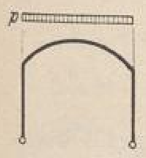
$$A = B = 0,$$
$$H_{a,b} = \frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_{c,d} = -\frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h}\alpha_t t,$$
$$M_e = M_{c,d}(1+\varphi).$$

Tabelle 45. Symmetrischer Rahmen mit parabolisch gekrümmtem Riegel.

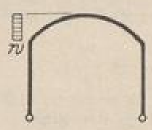


$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \lambda = \frac{l}{h}, \quad \frac{J_s}{J_x\cos\alpha} = 1,$$
$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varphi = \frac{f}{h}, \quad \varkappa = \frac{h}{l}\,\frac{J_s}{J_h},$$
$$\omega_R = \xi - \xi^2, \qquad \mu = 5(3+2\varkappa) + 4\varphi(5+2\varphi).$$

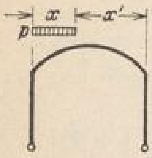
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



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



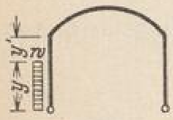
$$\Phi = \frac{4}{7}\,\frac{\varphi}{\mu}(7+6\varphi),$$
$$A = -B = -\frac{wf(2h+f)}{2l},$$
$$H_{a,b} = -\frac{wf}{2}(\pm 1 + \Phi),$$
$$M_{c,d} = \frac{wfh}{2}(\pm 1 + \Phi),$$
$$M_e = -\frac{wfh}{2}\left[\frac{\varphi}{2} - (1+\varphi)\Phi\right].$$



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

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

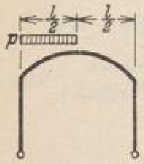
$$M_{c,d} = -\frac{p\,l^2}{4}\,\Phi\,, \qquad x \leqq \frac{l}{2}: \qquad M_e = \frac{p\,l^2}{4}\,[\xi^2 - (1+\varphi)\,\Phi]\,.$$



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

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

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



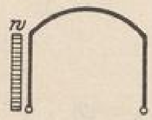
$$\Phi = \frac{2}{\mu}\,(5+4\,\varphi)\,,$$

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

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

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

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



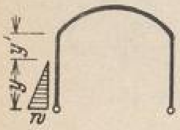
$$\Phi = \frac{5}{2\,\mu}\,(6 + 5\,\varkappa + 4\,\varphi)\,,$$

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

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

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

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

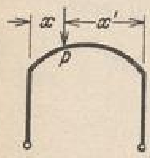


$$\Phi = \frac{1}{2\,\mu}\,\{10\,[3\,(1+\varkappa) + 2\,\varphi] - 3\,\varkappa\,\eta^2\}\,,$$

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

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

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



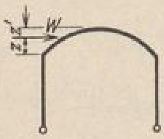
$$\Phi = \frac{5}{\mu}\,\omega_R\,[3 + 2\,\varphi\,(1+\omega_R)]\,,$$

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

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

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

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



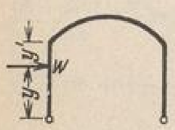
$$\Phi = 2\,\frac{\varphi}{\mu}\,\zeta'^{\frac{3}{2}}\,[5(1+\varphi) - \varphi\,\zeta']\,,$$

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

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

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

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



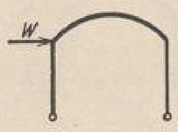
$$\Phi = \frac{5}{\mu}\,[3\,(1+\varkappa) + 2\,\varphi - \varkappa\,\eta^2]\,,$$

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

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

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

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



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

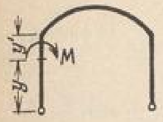
$$A = -B = -W\,\frac{h}{l}\,,$$

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

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

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

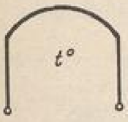
$$\Phi = \frac{5}{\mu}\,[3\,(1 + \varkappa) + 2\,\varphi - 3\,\varkappa\,\eta^2]\,,$$



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

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

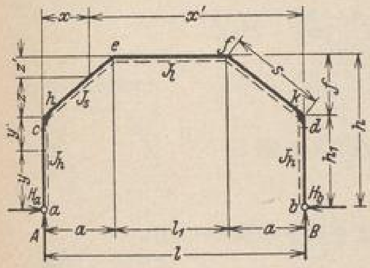
$$y = 0: \quad \eta = 0\,, \qquad y' = 0: \quad \eta = 1\,, \qquad M_e = -\frac{M}{2}\,\Phi\,.$$



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

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

Tabelle 46. Symmetrischer Rahmen mit mehrfach gebrochenem Riegel.



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

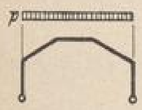
$$\xi' = \frac{x'}{l}\,, \qquad \eta' = \frac{y'}{h_1}\,, \qquad \zeta' = \frac{z'}{f}\,, \qquad \lambda' = \frac{l_1}{l}\,,$$

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

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

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

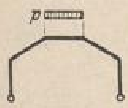
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



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

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

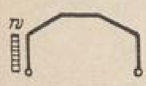
$$M_{c,d} = -\frac{p\,l^2}{2}\,\psi\,\Phi\,, \qquad M_{e,f} = \frac{p\,l^2}{2}\,[\lambda\,(1 - \lambda) - \Phi]\,.$$



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

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

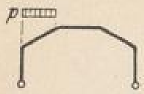
$$M_{c,d} = -\frac{p\,l\,l_1}{2}\,\psi\,\Phi\,, \qquad M_{e,f} = \frac{p\,l\,l_1}{2}\,(\lambda - \Phi)\,.$$



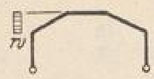
$$\Phi = \frac{1}{4\,\mu}\,\{4\,\varphi\,[3\,(1 + \varkappa_1) - \psi'] + 6\,(1 + \varkappa_1 + \psi) + 3\,\varkappa_2\,\psi\}\,,$$

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

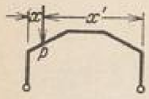
$$M_{c,d} = -\frac{w\,h_1^2}{4}\,(1 \mp 1 - \psi\,\Phi)\,, \qquad M_{e,f} = -\frac{w\,h_1^2}{4}\,(1 + 2\,\varphi \mp \lambda' - \Phi)\,.$$



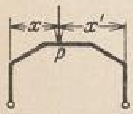
$$\Phi = \frac{1}{4\mu}(5 + 3\psi + 6\varkappa_1),$$
$$A = \frac{p\,a}{2}(2 - \lambda), \qquad B = \frac{p\,a}{2}\lambda,$$
$$H_{a,b} = \frac{p\,a^2}{4\,h_1}\psi\,\Phi,$$
$$M_{c,d} = -\frac{p\,a^2}{4}\psi\,\Phi,$$
$$M_{e,f} = \frac{p\,a^2}{4}(1 \pm \lambda' - \Phi).$$



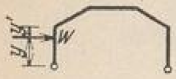
$$\Phi = \frac{1}{4\mu}[3(1 + 2\varkappa_1) + \psi],$$
$$A = -B = -w\,f\,\frac{(2\,h_1 + f)}{2\,l},$$
$$H_{a,b} = -\frac{w\,f}{2}\left(\pm 1 + \frac{\psi'}{2}\Phi\right),$$
$$M_{c,d} = \frac{w\,f\,h_1}{2}\left(\pm 1 + \frac{\psi'}{2}\Phi\right),$$
$$M_{e,f} = -\frac{w\,f^2}{4}\left[1 \mp \lambda'\left(1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



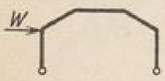
$$x \leqq a, \qquad \Phi = \frac{1}{2\mu}\left[3(1 + \psi + \varkappa_1) - \frac{\xi}{\lambda}\left(3\psi + \psi'\frac{\xi}{\lambda}\right)\right],$$
$$A = P\xi', \qquad B = P\xi, \qquad H_{a,b} = \frac{P\,l}{2\,h_1}\xi\,\psi\,\Phi,$$
$$M_{c,d} = -\frac{P\,l}{2}\xi\,\psi\,\Phi, \qquad M_{e,f} = \frac{P\,l}{2}\xi(1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



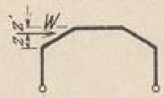
$$a \leqq x \leqq a + l_1, \qquad \Phi = \frac{1}{2\mu}\left[\lambda(2 + \psi) + 3\frac{\varkappa_1}{\lambda'}(\omega_R - \lambda^2)\right],$$
$$A = P\xi', \qquad B = P\xi, \qquad H_{a,b} = \frac{P\,l}{2\,h_1}\psi\,\Phi,$$
$$M_{c,d} = -\frac{P\,l}{2}\psi\,\Phi, \qquad M_{e,f} = \frac{P\,l}{2}\{[1 \pm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



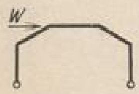
$$\Phi = \frac{1}{2\mu}\{\varphi[3(1 + \varkappa_1) - \psi'] + 3\eta'(1 + \varkappa_1 + \psi) + \varkappa_2\,\psi\,\eta'^2(3 - \eta')\},$$
$$A = -B = -W\frac{y}{l}, \qquad H_{a,b} = -\frac{W}{2}(\pm 1 + \psi\,\Phi),$$
$$M_{c,d} = -\frac{W\,h_1}{2}(1 - \eta \mp \eta - \psi\,\Phi), \qquad M_{e,f} = -\frac{W\,h_1}{2}(1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



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

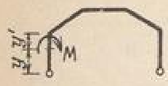


$$\Phi = \frac{\zeta'}{2\mu}(3\varkappa_1 + 3\zeta' - \psi'\zeta'^2),$$
$$A = -B = -W\frac{h_1 + z}{l},$$
$$H_{a,b} = -\frac{W}{2}(\pm 1 + \psi'\Phi),$$
$$M_{c,d} = \frac{W\,h_1}{2}(\pm 1 + \psi'\Phi),$$
$$M_{e,f} = -\frac{W\,f}{2}\left[\zeta' \mp \lambda'\left(\frac{1}{\psi'} - \zeta'\right) - \Phi\right].$$



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

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



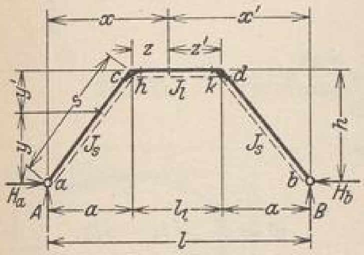
$$\Phi = \frac{3}{2\mu}\left[1 + \varkappa_1 + \psi + \varkappa_2 \psi (1 - \eta^2)\right],$$

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

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

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

Tabelle 47. Symmetrischer Zweigelenkrahmen mit schrägen Pfosten:

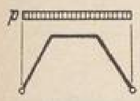


$$\xi = \frac{x}{l}, \qquad \eta = \frac{y}{h}, \qquad \zeta = \frac{z}{l_1}, \qquad \lambda = \frac{a}{l},$$

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

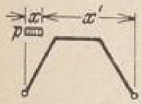
$$\nu = \frac{l}{h}, \qquad \varkappa = \frac{l_1}{s}\,\frac{J_s}{J_1}, \qquad \mu = 1 + \frac{3}{2}\varkappa.$$

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



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

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



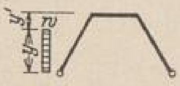
$$\Phi = \frac{1}{4\mu}\left[6(1 + \varkappa) - \frac{\xi^2}{\lambda^2}\right],$$

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

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

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

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



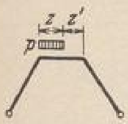
$$\Phi = \frac{1}{4\mu}\left[6(1 + \varkappa) - \eta^2\right],$$

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

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

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

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



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

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

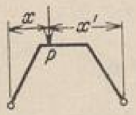
$$H_{a,b} = \frac{pl_1}{2}\zeta\nu\Phi, \qquad M_{c,d} = \frac{pll_1}{2}\zeta\left[\lambda(1 \pm \lambda'\zeta') - \Phi\right].$$

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

$$A = B = \frac{pl_1}{2},$$

$$H_{a,b} = \frac{pl_1}{2}\nu\Phi,$$

$$M_{c,d} = +\frac{pl_1 l}{2}(\lambda - \Phi).$$

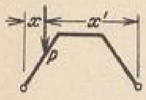


$$\Phi = \frac{1}{2\mu}\left[2\lambda + 3\frac{\varkappa}{\lambda'}(\omega_R - \lambda^2)\right],$$

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

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

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



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

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

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

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

$0 < x \leqq a$

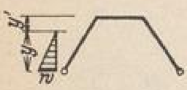
$$\Phi = \frac{\eta'}{2\mu}\left[3(\varkappa + \eta') - \eta'^2\right],$$

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

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

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

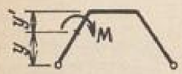
$y = h:\quad \eta = 1,\qquad \eta' = 0,\qquad \Phi = 0.$



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

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

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



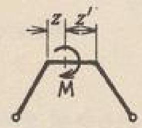
$$\Phi = \frac{3}{2\mu}(1 + \varkappa - \eta^2),$$

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

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

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

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



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

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

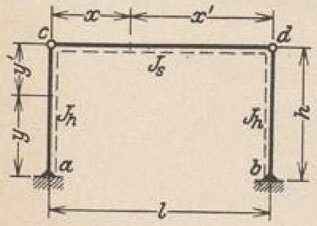
$$H_{a,b} = \frac{M}{h}\Phi,$$

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

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

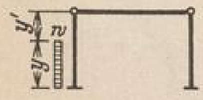
$$A = B = 0, \qquad H_{a,b} = \frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h^2}\,\alpha_t\,t, \qquad M_{c,d} = -\frac{3}{2\mu}\,\frac{l}{s}\,\frac{EJ_s}{h}\,\alpha_t\,t.$$

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



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

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

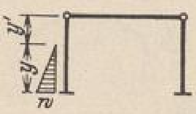


$$\Phi = \frac{1}{4}\,\eta\,(4 - \eta),$$

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

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

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

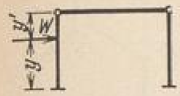


$$\Phi = \frac{3}{20}\,\eta\,(5 - \eta),$$

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

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

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

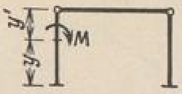


$$\Phi = \frac{\eta}{2}(3-\eta),$$

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

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

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

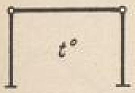


$$\Phi = \frac{3}{2}(1-\eta'^2),$$

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

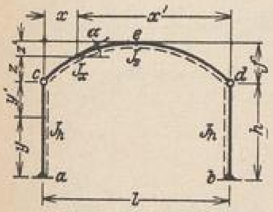
$$M_{a,b} = -\frac{M}{2}\,[1 \pm 1 - \Phi],$$

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



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

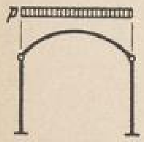
Tabelle 49. Symmetrischer Rahmen mit parabolisch gekrümmtem Riegel, Gelenke an den Traufpunkten.



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

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

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

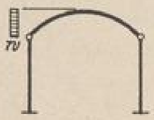


$$\Phi = \frac{4}{\nu},$$

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

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

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

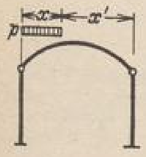


$$\Phi = \frac{24}{7}\,\frac{\varphi}{\nu},$$

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

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

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



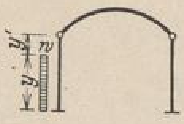
$$\Phi = \frac{\xi^2}{\nu}\,[5 - \xi^2(5 - 2\xi)],$$

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

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

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

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



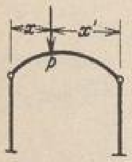
$$\Phi = \frac{5}{4\mu}\,\eta\,(4 - \eta),$$

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

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

$$M_e = -\varphi M_b,$$

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

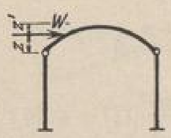


$$\Phi = \frac{5}{\nu}\,\omega''_P,$$

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

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

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

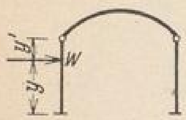


$$\Phi = \frac{\varphi}{\nu}\,\zeta'^{\frac{3}{2}}(5 - \zeta'),$$

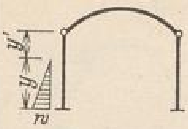
$$H_{c,d} = \frac{W}{2}(\mp 1 - \Phi),$$

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

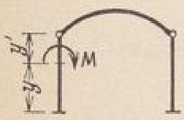
$$M_e = -\frac{W f}{2}(\zeta' - \Phi).$$



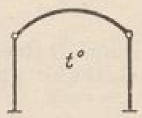
$$\Phi = \frac{5}{2\mu}\eta(3-\eta),$$
$$H_{c,d} = \frac{W}{2}\eta\Phi,$$
$$M_{a,b} = -\frac{Wh}{2}\eta[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$
$$y = h: \quad \eta = 1, \quad \Phi = \frac{5}{\mu}.$$



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

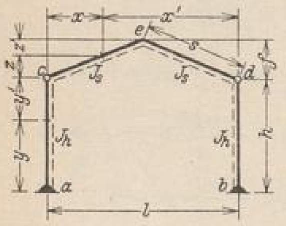


$$\Phi = \frac{15}{2\mu}(1-\eta'^2),$$
$$H_{c,d} = \frac{\mathsf{M}}{2h}\Phi,$$
$$M_{a,b} = -\frac{\mathsf{M}}{2}[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$
$$y = h: \quad \Phi = \frac{15}{2\mu}.$$

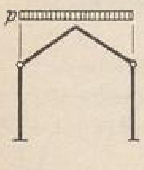


$$H_{c,d} = \frac{15}{2\mu}\lambda\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_{a,b} = \frac{15}{2\mu}l\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_e = -\varphi M_{a,b}.$$

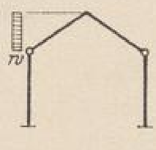
Tabelle 50. Symmetrischer Rahmen mit gebrochenem Riegel, Gelenke in den Traufpunkten.



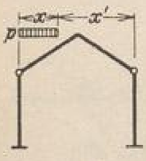
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \lambda = \frac{l}{h},$$
$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varphi = \frac{f}{h},$$
$$\varkappa = \frac{s}{h}\frac{J_h}{J_s}, \quad \mu = 1 + \varkappa\varphi^2, \quad \nu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



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

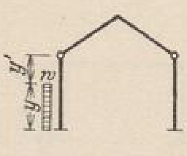


$$\Phi = \frac{3\varphi}{4\nu},$$
$$H_{c,d} = -\frac{wf}{4}(\pm 2 + \Phi),$$
$$M_{a,b} = -\frac{w \cdot f \cdot h}{4}[\pm 2 + \Phi],$$
$$M_e = -\frac{wf^2}{4}(1-\Phi).$$

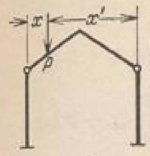


$x \leqq \frac{l}{2}$

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

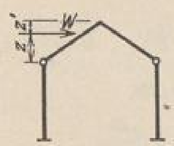


$$\Phi = \frac{\eta}{4\mu}(4-\eta),$$
$$H_{c,d} = \frac{wh}{4}\eta^2\Phi,$$
$$M_{a,b} = -\frac{wh^2}{4}\eta^2[1 \pm 1 - \Phi]$$
$$M_e = -\varphi M_b,$$
$$y = h: \quad \eta = 1, \quad \Phi = \frac{3}{4\mu}.$$

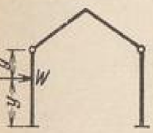


$x \leq \frac{l}{2}$

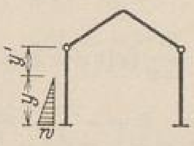
$$\Phi = \frac{\xi(3 - 4\xi^2)}{2\nu},$$
$$H_{c,d} = \frac{P}{2}\lambda\Phi,$$
$$M_{a,b} = \frac{Pl}{2}\Phi,$$
$$M_e = \frac{Pl}{2}(\xi - \varphi\Phi).$$



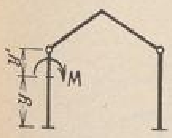
$$\Phi = \frac{\varphi}{2\nu}\zeta'^2(3 - \zeta'),$$
$$H_{c,d} = -\frac{W}{2}(\pm 1 + \Phi),$$
$$M_{a,b} = -\frac{Wh}{2}(\pm 1 + \Phi),$$
$$M_e = -\frac{Wf}{2}(\zeta' - \Phi).$$



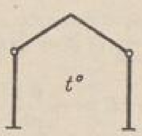
$$\Phi = \frac{\eta}{2\mu}(3 - \eta),$$
$$H_{c,d} = \frac{W}{2}\eta\Phi,$$
$$M_{a,b} = -\frac{Wh}{2}\eta[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$
$y = h$: $\eta = 1$, $\Phi = \frac{1}{\mu}$.



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

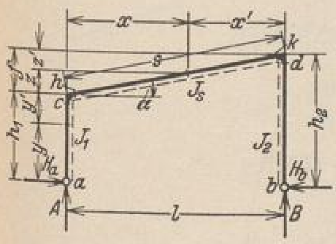


$$\Phi = \frac{3}{2\mu}(1 - \eta'^2),$$
$$H_{c,d} = \frac{\mathsf{M}}{2h}\Phi,$$
$$M_{a,b} = -\frac{\mathsf{M}}{2}[1 \pm 1 - \Phi],$$
$$M_e = -\varphi M_b,$$
$y = h$: $\Phi = \frac{3}{2\mu}$.

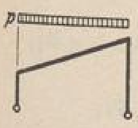


$$H_{c,d} = \frac{3}{2\mu}\lambda\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_{a,b} = \frac{3}{2\mu}l\frac{EJ_s}{h^2}\alpha_t t,$$
$$M_e = -\varphi M_{a,b}.$$

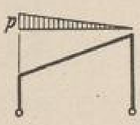
Tabelle 51. Unsymmetrischer Rahmen mit geradem Riegel.



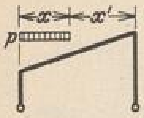
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h_1}, \quad \zeta = \frac{z}{f}, \quad \varphi_1 = \frac{f}{h_1},$$
$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h_1}, \quad \zeta' = \frac{z'}{f}, \quad \varphi_2 = \frac{f}{h_2},$$
$$\lambda_1 = \frac{h_1}{h_2}, \quad \nu_1 = \frac{l}{h_1}, \quad \varkappa_1 = \frac{h_1}{s}\frac{J_s}{J_1},$$
$$\lambda_2 = \frac{h_2}{h_1}, \quad \nu_2 = \frac{l}{h_2}, \quad \varkappa_2 = \frac{h_2}{s}\frac{J_s}{J_2},$$
$$\mu = \lambda_1(1 + \varkappa_1) + 1 + \lambda_2(1 + \varkappa_2),$$
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



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



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



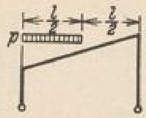
$$\Phi = \frac{\xi^2}{8\mu}\left[\nu_1(2-\xi^2)+\nu_2(2-\xi)^2\right],$$

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

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

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

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

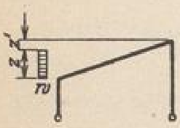


$$A = \frac{3}{8}p\,l, \qquad B = \frac{1}{8}p\,l,$$

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

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

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

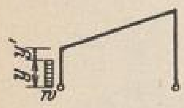


$$\Phi = \frac{1}{4\mu}\{4\,[1 + 2\,\lambda_1(1 + \varkappa_1)] + \varphi_2\zeta\,[2\,(3 + \varphi_1) - 4\,\zeta - \varphi_1\zeta^2]\},$$

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

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

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

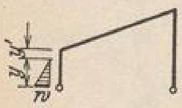


$$\Phi = \frac{1}{4\mu}\{2\,[1 + \lambda_1(2 + 3\,\varkappa_1) - \lambda_1\varkappa_1\eta^2]\},$$

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

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

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

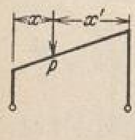


$$\Phi = \frac{1}{30\,\mu}\{10 + \lambda_1[20 + 3\,\varkappa_1(10 - \eta^2)]\},$$

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

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

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



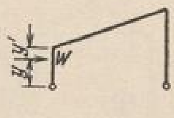
$$\Phi = \frac{1}{2\mu}(\nu_1\omega_D + \nu_2\omega_D'),$$

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

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

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

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



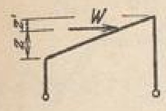
$$\Phi = \frac{1}{\mu}\{1 + \lambda_1[2 + \varkappa_1(3 - \eta^2)]\},$$

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

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

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

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

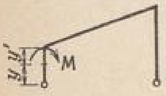


$$\Phi = \frac{1}{\mu}\left[1 + 2\lambda_1(1 + \varkappa_1) + (1 - \lambda_1)\omega'_D + (\lambda_2 - 1)\omega_D\right],$$

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

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

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



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

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

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

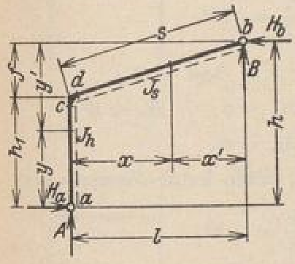
$$y = 0: \quad \Phi = \frac{1}{2\mu}(2 + \lambda_2 + 3\varkappa_1),$$

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

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

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

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



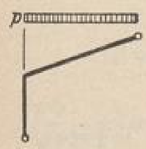
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{y}{h_1}, \quad \varphi = \frac{f}{h}, \quad \varrho = \frac{f}{l},$$

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

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

$M_d = M_c$, wenn nicht besonders angegeben.

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

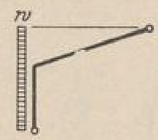


$$\Phi = \frac{1}{4\mu},$$

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

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

$$M_c = -\frac{pl^2}{2}\Phi.$$

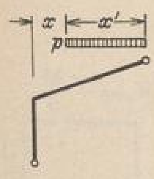


$$\Phi = \frac{\varkappa + \psi^2}{4\mu},$$

$$A, B = \pm\frac{wh_1}{2}\nu(\psi + \Phi),$$

$$H_{a,b} = \frac{wh_1}{2}\left(\mp\frac{1}{\varphi'} + \psi + \Phi\right),$$

$$M_c = -\frac{wh_1^2}{2}\Phi.$$

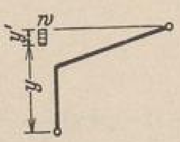


$$\Phi = \frac{1}{2\mu}\left(\xi'^2 - \frac{1}{2}\xi'^4\right),$$

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

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

$$M_c = -\frac{pl^2}{2}\Phi.$$



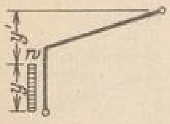
$$\Phi = \frac{1}{2\mu}\left(\zeta'^2 - \frac{1}{2}\zeta'^4\right),$$

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

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

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

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



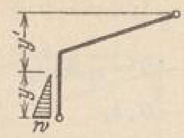
$$\Phi = \frac{\varkappa}{2\mu}\left(\zeta^2 - \frac{1}{2}\zeta^4\right),$$

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

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

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

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



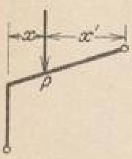
$$\Phi = \frac{\varkappa}{\mu} \zeta (10 - 3\zeta^2),$$

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

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

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

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

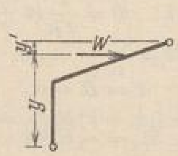


$$\Phi = \frac{1}{\mu}(\xi' - \xi'^3),$$

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

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

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

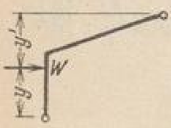


$$\Phi = \frac{1}{2\mu}(\zeta' - \zeta'^3),$$

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

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

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

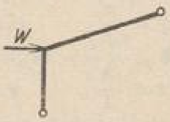


$$\Phi = \frac{\varkappa}{2\mu}(\zeta - \zeta^3),$$

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

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

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

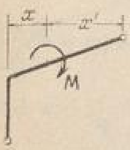


$$A = B = \pm W \varrho,$$

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

$$M_c = 0.$$

Es treten keine Momente auf.



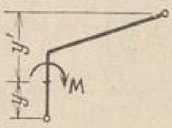
$$\Phi = \frac{\omega'_M}{2\mu},$$

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

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

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

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



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

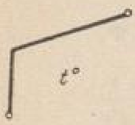
$$A, B = \pm \frac{\mathsf{M}}{l} \psi \left(1 - \frac{\Phi}{\varphi}\right),$$

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

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

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

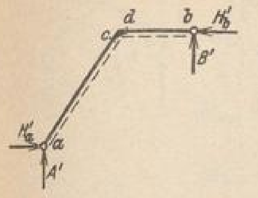
$$y = h_1: \quad \Phi = \frac{\varkappa}{\mu}, \quad M_c = -\frac{\mathsf{M}}{\mu}.$$



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

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

Tabelle 53. Halbrahmen mit waagerechtem Riegel.

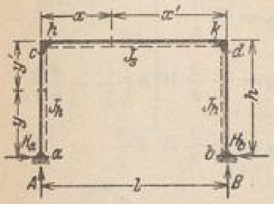


Mit den Werten A, B, $H_{a,b}$, M der Tabelle 52 für den mit seiner Belastung um 90° gedrehten Halbrahmen ergibt sich:

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

Dreifach statisch unbestimmte Rahmen.

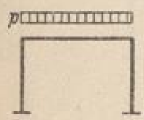
Tabelle 54. Symmetrischer Rahmen mit geradem Riegel.



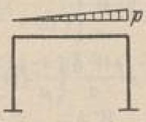
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \omega \text{ Tabelle 22 S. 116}, \quad \varkappa = \frac{h}{l}\frac{J_r}{J_h},$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \mu = 2 + \varkappa, \quad \nu = 1 + 6\varkappa.$$

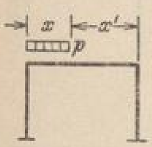
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



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

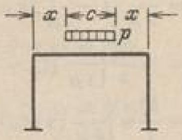


$$H_{a,b} = \frac{1}{8\mu}\frac{p l^2}{h}, \quad M_{a,b} = \frac{p l^2}{120}\left(\frac{5}{\mu} \pm \frac{1}{\nu}\right), \quad M_{c,d} = -\frac{p l^2}{120}\left(\frac{10}{\mu} \mp \frac{1}{\nu}\right).$$



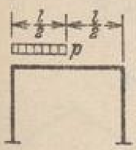
$$\Phi = \frac{1}{\mu}(3\xi^2 - 2\xi^3), \quad H_{a,b} = \frac{1}{4}\frac{p l^2}{h}\Phi,$$

$$M_{a,b} = \frac{p l^2}{12}\left(\Phi \mp \frac{3}{\nu}\omega_R^0\right), \quad M_{c,d} = -\frac{p l^2}{12}\left(2\Phi \pm \frac{3}{\nu}\omega_R^0\right).$$

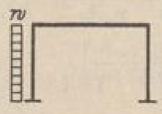


$$\Phi = \frac{1}{2\mu}(3\zeta - \zeta^3), \quad H_{a,b} = \frac{1}{4}\frac{p l^2}{h}\Phi, \quad M_{a,b} = \frac{p l^2}{12}\Phi,$$

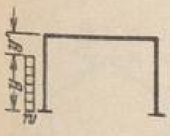
$$\zeta = \frac{c}{l}. \quad M_{c,d} = -\frac{p l^2}{6}\Phi.$$



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



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

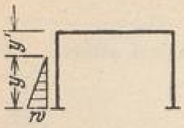


$$\Phi = \frac{1}{2} - \omega_\varphi',$$

$$H_{a,b} = -\frac{w h}{4}\left\{2\eta \pm 2\eta - \eta^2 - \frac{1}{\mu}\left[\varkappa\omega_\varphi - (1+\varkappa)\Phi\right]\right\},$$

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

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



$$H_{a,b} = -\frac{w\,h}{40}\,\eta\left\{10 \pm 10 - \frac{\eta^2}{\mu}\left[5\,(1+\varkappa) - \eta\,(1+2\,\varkappa)\right]\right\},$$

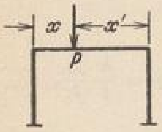
$$M_{a,b} = +\frac{w\,h^2}{40}\,\eta^2\left[\frac{\eta}{3\,\mu}\,(1+\varkappa)\,(5-3\,\eta) + \frac{5}{3}\,\eta - \frac{10}{3} \mp \left(\frac{10}{3} - \frac{5\,\varkappa}{\nu}\,\eta\right)\right],$$

$$M_{c,d} = -\frac{w\,h^2}{40}\,\varkappa\,\eta^3\left[\frac{1}{3\,\mu}\,(5-3\,\eta) \mp \frac{5}{\nu}\right].$$

$y = h$:

$$H_{a,b} = -\frac{w\,h}{40}\left[7 \pm 10 + \frac{2}{\mu}\right],$$

$$M_{a,b} = -\frac{w\,h^2}{40}\left[\frac{8+3\,\varkappa}{3\,\mu} \pm 5\left(\frac{2}{3} - \frac{\varkappa}{\nu}\right)\right], \qquad M_{c,d} = -\frac{w\,h^2}{40}\,\varkappa\left[\frac{2}{3\,\mu} \mp \frac{5}{\nu}\right].$$

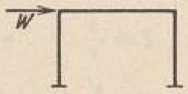


$$\Phi = \frac{1}{\nu}\,(1 - 2\,\xi),$$

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

$$M_{a,b} = \frac{P\,l}{2}\,\omega_R\left(\frac{1}{\mu} \mp \Phi\right),$$

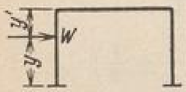
$$M_{c,d} = -\frac{P\,l}{2}\,\omega_R\left(\frac{2}{\mu} \pm \Phi\right).$$



$$H_{a,b} = \mp\frac{W}{2},$$

$$M_{a,b} = \mp\frac{3}{2}\,W\,h\left(\frac{1}{3} - \frac{\varkappa}{\nu}\right),$$

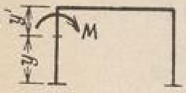
$$M_{c,d} = \pm\frac{3}{2}\,W\,h\,\frac{\varkappa}{\nu}.$$



$$H_{a,b} = -\frac{W}{2}\left\{1 \pm 1 - \eta - \frac{1}{\mu}\left[\varkappa\,\omega_D - (1+\varkappa)\,\omega_D'\right]\right\},$$

$$M_{a,b} = -\frac{W\,h}{2}\left\{\frac{1}{\mu}\left[(1+\varkappa)\,\omega_D' - \varkappa\,\omega_R\right] \pm \eta\left(1 - 3\,\eta\,\frac{\varkappa}{\nu}\right)\right\},$$

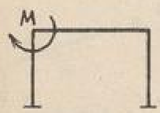
$$M_{c,d} = -\frac{W\,h}{2}\,\varkappa\,\eta^2\left[\frac{1}{\mu}\,(1-\eta) \mp \frac{3}{\nu}\right].$$



$$H_{a,b} = \frac{\mathsf{M}}{2\,h}\left\{1 - \frac{1}{\mu}\left[\varkappa\,\omega_M + (1+\varkappa)\,\omega_M'\right]\right\},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left\{\frac{1}{3\,\mu}\left[(3+2\,\varkappa)\,\omega_M' + \varkappa\,\omega_M\right] \pm \left(1 - 6\,\eta\,\frac{\varkappa}{\nu}\right)\right\}$$

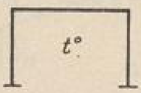
$$M_{h,k} = \frac{\mathsf{M}}{2}\,\varkappa\left\{\frac{1}{3\,\mu}\left[2\,\omega_M + \omega_M'\right] \pm \frac{6}{\nu}\,\eta\right\}.$$



$$H_{a,b} = \frac{3}{2\,\mu}\,\frac{\mathsf{M}}{h},$$

$$M_{a,b} = \frac{\mathsf{M}}{2}\left[\frac{1}{\mu} \mp \frac{1}{\nu}\right],$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\,\varkappa\left[\frac{1}{\mu} \pm \frac{6}{\nu}\right].$$



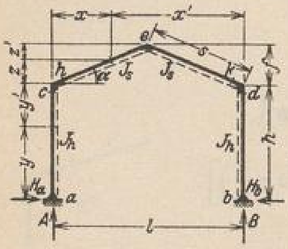
$$\Phi = \frac{3}{\mu}\,\frac{E\,J_s}{h}\,\alpha_t\,t,$$

$$H_{a,b} = \frac{2\,\varkappa+1}{\varkappa}\,\frac{\Phi}{h},$$

$$M_{a,b} = \frac{\varkappa+1}{\varkappa}\,\Phi,$$

$$M_{c,d} = -\Phi.$$

Tabelle 55. Symmetrischer Rahmen mit gebrochenem Riegel.



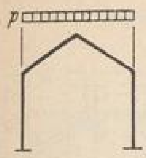
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \lambda = \frac{l}{h}, \quad \varphi = \frac{f}{h},$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varkappa = \frac{h}{s}\,\frac{J_s}{J_h}, \quad \varrho = \frac{3}{2}\,\frac{\varkappa-\varphi}{\varkappa+\varphi^2},$$

$$\mu = 4\,(1+\varkappa) - 2\,\varrho\,(\varkappa-\varphi), \qquad \psi_1 = 2\,\frac{(1+\varkappa)}{\varkappa-\varphi},$$

$$\nu = 2 + 6\,\varkappa, \qquad \psi_2 = \frac{3}{2}\,\frac{2+\varkappa+\varphi}{\varkappa+\varphi^2} = (\psi_1 - 1)\,\varrho.$$

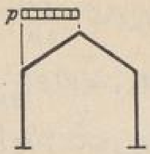
$M_{h,k} = M_{c,d}^{*}$, wenn nicht besonders angegeben.



$$H_{a,b}=\frac{p\,l}{24}\,\frac{\varrho\lambda}{\mu}\,(5\,\varphi\,\psi_1+8)\,,$$

$$M_{a,b}=\frac{p\,l^2}{24\,\mu}\,[5\,\varphi\,\psi_2+8\,(\varrho-1)]\,,$$

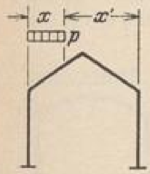
$$M_{c,d}=-\frac{p\,l^2}{24\,\mu}\,(5\,\varphi\,\varrho+8)\,.$$



$$H_{a,b}=\frac{p\,l}{48}\,\frac{\lambda\varrho}{\mu}\,(5\,\varphi\,\psi_1+8)\,,$$

$$M_{a,b}=\frac{p\,l^2}{96}\left\{\frac{2}{\mu}\,[5\,\varphi\,\psi_2+8\,(\varrho-1)]\mp\frac{3}{\nu}\right\}$$

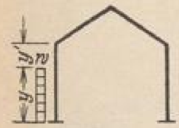
$$M_{c,d}=-\frac{p\,l^2}{96}\left[\frac{2}{\mu}\,(5\,\varphi\,\varrho+8)\pm\frac{3}{\nu}\right].$$



$$H_{a,b}=\frac{p\,l}{6}\,\frac{\varrho\lambda}{\mu}\,\xi^2\,[(\varphi\,\psi_1\,(3-2\,\xi^2)+2\,(3-2\,\xi)]\,,$$

$$M_{a,b}=\frac{p\,l^2}{6}\,\xi^2\left\{\frac{1}{\mu}\,[\varphi\,\psi_2\,(3-2\,\xi^2)+2\,(3-2\,\xi)\,(\varrho-1)]\mp\frac{3}{\nu}\,\xi'^2\right\};$$

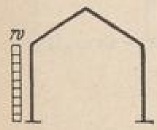
$$x\leqq\frac{l}{2}:\quad M_{c,d}=-\frac{p\,l^2}{6}\,\xi^2\left\{\frac{1}{\mu}\,[\varphi\,\varrho\,(3-2\,\xi^2)+2\,(3-2\,\xi)]\pm\frac{3}{\nu}\,\xi'^2\right\}.$$



$$H_{a,b}=-\frac{w\,h}{2}\,\eta\left\{\pm1+1-\frac{\varkappa\varrho}{6\,\mu}\,\eta^2\,[\psi_1\,(4-\eta)-4]\right\},$$

$$M_{a,b}=\frac{w\,h^2}{12}\,\eta^2\left\{\frac{\varkappa}{\mu}\,\eta\,[\psi_2\,(4-\eta)-4\,(\varrho-1)]-3\mp\left(3-6\,\eta\,\frac{\varkappa}{\nu}\right)\right\},$$

$$M_{c,d}=-\frac{w\,h^2}{12}\,\varkappa\,\eta^3\left\{\frac{1}{\mu}\,[\varrho\,(4-\eta)-4]\mp\frac{6}{\nu}\right\}.$$

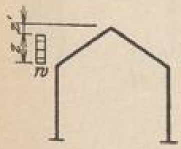


$$H_{a,b}=-\frac{w\,h}{2}\left[\pm1+1-\frac{\varkappa\varrho}{6\,\mu}\,(3\,\psi_1-4)\right],$$

$$M_{a,b}=\frac{w\,h^2}{12}\left\{\frac{\varkappa}{\mu}\,[3\,\psi_2-4\,(\varrho-1)]-3\mp\left(3-6\,\frac{\varkappa}{\nu}\right)\right\},$$

$$M_{c,d}=-\frac{w\,h^2}{12}\,\varkappa\left[\frac{1}{\mu}\,(3\,\varrho-4)\mp\frac{6}{\nu}\right].$$

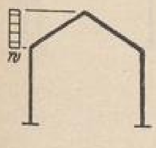
$$\Phi_1=1+\zeta'+\zeta'^2\,,\qquad\Phi_2=(1+\zeta')\,(1-\zeta'^2)\,,$$



$$H_{a,b}=-\frac{w\,f}{2}\,\zeta\left\{\pm1+\frac{\varphi\,\varrho}{6\,\mu}\,[(3\,\varphi\,\psi_1+4)\,\Phi_1-\varphi\,\psi_1\,\zeta'^3]\right\},$$

$$M_{a,b}=-\frac{w\,f^2}{24}\left\{\frac{2}{\mu}\,[3\,\varphi\,\psi_2+4\,(\varrho-1)]\,\Phi_1+\varphi\,\varrho\left(1-\frac{2\,\psi_1}{\mu}\right)\zeta'^3\pm\left[\frac{12}{\varphi}-\frac{3}{\nu}\left(12\,\frac{\varkappa}{\varphi}-\Phi_2\right)\right]\right\}$$

$$M_{c,d}=\frac{w\,f^2}{24}\,\zeta\left[\frac{2}{\mu}\,(3\,\varphi\,\varrho+4)\,\Phi_1-\varphi\,\varrho\,\zeta'^3\pm\frac{3}{\nu}\left(12\,\frac{\varkappa}{\varphi}-\Phi_2\right)\right].$$



$$H_{a,b}=-\frac{w\,f}{2}\left[\pm1+\frac{\varphi\,\varrho}{6\,\mu}\,(3\,\varphi\,\psi_1+4)\right],$$

$$M_{a,b}=-\frac{w\,f^2}{24}\left\{\frac{2}{\mu}\,[3\,\varphi\,\psi_2+4\,(\varrho-1)]\pm\left[\frac{12}{\varphi}-\frac{3}{\nu}\left(12\,\frac{\varkappa}{\varphi}-1\right)\right]\right\},$$

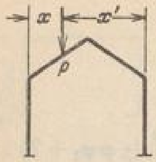
$$M_{c,d}=\frac{w\,f^2}{24}\left[\frac{2}{\mu}\,(3\,\varphi\,\varrho+4)\pm\frac{3}{\nu}\left(12\,\frac{\varkappa}{\varphi}-1\right)\right].$$

$y=h:\quad\eta=1$

$$H_{a,b}=-\frac{w\,h}{4}\,\eta\left\{\pm1+1-\frac{\varkappa\varrho}{15\,\mu}\,\eta^2\,[\psi_1\,(5-\eta)-5]\right\},$$

$$M_{a,b}=\frac{w\,h^2}{120}\,\eta^2\left\{\frac{2\,\varkappa}{\mu}\,\eta\,[\psi_2\,(5-\eta)-5\,(\varrho-1)]-10\mp\left(10-15\,\frac{\varkappa}{\nu}\,\eta\right)\right\},$$

$$M_{c,d}=-\frac{w\,h^2}{120}\,\varkappa\,\eta^3\left\{\frac{2}{\mu}\,[\varrho\,(5-\eta)-5]\mp\frac{15}{\nu}\right\}.$$

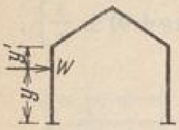


$x \leqq \frac{l}{2}$

$$H_{a,b} = P\,\frac{\varrho\lambda}{3\mu}\,\xi\,[\varphi\,\psi_1\,(3 - 4\,\xi^2) + 6\,\xi'],$$

$$M_{a,b} = P\,l\,\xi\left\{\frac{1}{3\mu}\,[\varphi\,\psi_2\,(3 - 4\,\xi^2) + 6\,(\varrho - 1)\,\xi'] \mp \frac{1}{\nu}\,\xi'\,(\xi' - \xi)\right\},$$

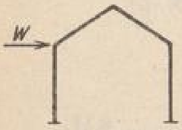
$$M_{c,d} = -\,P\,l\,\xi\left\{\frac{1}{3\mu}\,[\varphi\,\varrho\,(3 - 4\,\xi^2) + 6\,\xi'] \pm \frac{1}{\nu}\,\xi'\,(\xi' - \xi)\right\}.$$



$$H_{a,b} = -\,\frac{W}{2}\left\{\pm 1 + 1 - \frac{2\,\varkappa\,\varrho}{3\mu}\,\eta^2\,[\psi_1\,(3 - \eta) - 3]\right\},$$

$$M_{a,b} = \frac{W\,h}{2}\,\eta\left\{\frac{2\,\varkappa}{3\mu}\,\eta\,[\psi_2\,(3 - \eta) - 3\,(\varrho - 1)] - 1 \pm \left(\frac{3}{\nu}\,\varkappa\,\eta - 1\right)\right\},$$

$$M_{c,d} = -\,\frac{W\,h}{6}\,\varkappa\,\eta^2\left\{\frac{2}{\mu}\,[\varrho\,(3 - \eta) - 3] \mp \frac{9}{\nu}\right\}.$$



$$H_{a,b} = -\,\frac{W}{2}\left[\pm 1 + \frac{2\,\varphi\,\varrho}{3\mu}\,(2\,\varphi\,\psi_1 + 3)\right],$$

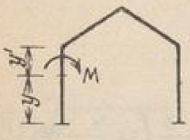
$$M_{a,b} = -\,\frac{W\,h}{2}\left\{\frac{2\,\varphi}{3\mu}\,[2\,\varphi\,\psi_2 + 3\,(\varrho - 1)] \mp \left(\frac{3\,\varkappa}{\nu} - 1\right)\right\},$$

$$M_{c,d} = \frac{W\,h}{2}\left[\frac{2\,\varphi}{3\mu}\,(2\,\varphi\,\varrho + 3) \pm \frac{3\,\varkappa}{\nu}\right].$$

$$H_{a,b} = -\,\frac{W}{2}\left\{\pm 1 + \frac{2\,\varphi\,\varrho}{3\mu}\,\zeta'^2\,[\varphi\,\psi_1\,(3 - \zeta') + 3]\right\},$$

$$M_{a,b} = -\,\frac{W\,h}{2}\left\{\frac{2\,\varphi}{3\mu}\,\zeta'^2\,[\varphi\,\psi_2\,(3 - \zeta') + 3\,(\varrho - 1)] \pm \left[1 - \frac{1}{\nu}\,(3\,\varkappa - \varphi\,(2 - \zeta)\,\omega_R(\zeta))\right]\right\},$$

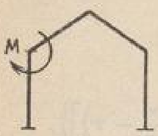
$$M_{c,d} = \frac{W\,h}{2}\left\{\frac{2\,\varphi}{3\mu}\,\zeta'^2\,[\varphi\,\varrho\,(3 - \zeta') + 3] \pm \frac{1}{\nu}\,[3\,\varkappa - \varphi\,(2 - \zeta)\,\omega_R(\zeta)]\right\}.$$



$$H_{a,b} = \frac{\mathrm{M}}{h}\,\frac{\varkappa\,\varrho}{\mu}\,\eta\,[\psi_1\,(2 - \eta) - 2],$$

$$M_{a,b} = \frac{\mathrm{M}}{2}\left\{\frac{2\,\varkappa\,\eta}{\mu}\,[\psi_2\,(2 - \eta) - 2\,(\varrho - 1)] - 1 \mp \left(1 - 6\,\eta\,\frac{\varkappa}{\nu}\right)\right\},$$

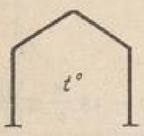
$$M_{h,k} = -\,\mathrm{M}\,\varkappa\,\eta\left\{\frac{1}{\mu}\,[\varrho\,(2 - \eta) - 2] \mp \frac{3}{\nu}\right\}.$$



$$H_{a,b} = \frac{\mathrm{M}}{h}\,\frac{\varkappa\,\varrho}{\mu}\,(\psi_1 - 2),$$

$$M_{a,b} = \frac{\mathrm{M}}{2}\left\{\frac{2\,\varkappa}{\mu}\,[\psi_2 - 2\,(\varrho - 1)] - 1 \mp \left[1 - \frac{6\,\varkappa}{\nu}\right]\right\},$$

$$M_{h,k} = -\,\mathrm{M}\,\varkappa\left[\frac{1}{\mu}\,(\varrho - 2) \mp \frac{3}{\nu}\right].$$

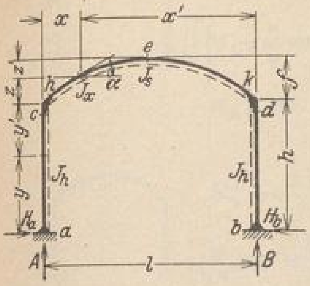


$$H_{a,b} = \varrho\left(2\,\frac{\varrho}{\mu} + \frac{1}{\varkappa - \varphi}\right)\frac{l}{s}\,\frac{E\,J_s}{h^2}\,\alpha_t\,t,$$

$$M_{a,b} = \varrho\left[\frac{2}{\mu}\,(\varrho - 1) + \frac{1}{\varkappa - \varphi}\right]\frac{l}{s}\,\frac{E\,J_s}{h}\,\alpha_t\,t,$$

$$M_{c,d} = -\,\frac{2\,\varrho}{\mu}\,\frac{l}{s}\,\frac{E\,J_s}{h}\,\alpha_t\,t.$$

Tabelle 56. Symmetrischer Rahmen mit parabolisch gekrümmtem Riegel.



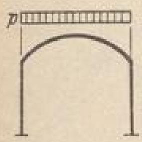
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \zeta = \frac{z}{f}, \quad \varphi = \frac{f}{h}, \quad \frac{J_s}{J_x \cos\alpha} = 1,$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \zeta' = \frac{z'}{f}, \quad \varkappa = \frac{h}{l}\frac{J_s}{J_h}, \quad \varrho = \frac{5}{2}\frac{3\varkappa - 2\varphi}{5\varkappa + 4\varphi^2},$$

$$\mu = 3(1 + 2\varkappa) - \varrho(3\varkappa - 2\varphi), \quad \psi_1 = 3\frac{1 + 2\varkappa}{3\varkappa - 2\varphi},$$

$$\nu = 1 + 6\varkappa, \quad \psi_2 = (\psi_1 - 1)\varrho,$$

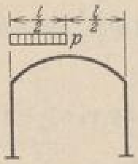
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$H_{a,b} = \frac{p l^2}{20 h}\frac{\varrho}{\mu}(4\varphi\psi_1 + 5),$$

$$M_{a,b} = +\frac{p l^2}{20\mu}[4\varphi\psi_2 + 5(\varrho - 1)],$$

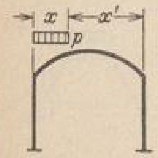
$$M_{c,d} = -\frac{p l^2}{20\mu}(4\varphi\varrho + 5).$$



$$H_{a,b} = \frac{p l^2}{40 h}\frac{\varrho}{\mu}[4\varphi\psi_1 + 5],$$

$$M_{a,b} = +\frac{p l^2}{40}\left\{\frac{1}{\mu}[4\varphi\psi_2 + 5(\varrho - 1)] \mp \frac{5}{8\nu}\right\},$$

$$M_{c,d} = -\frac{p l^2}{40}\left[\frac{1}{\mu}(4\varphi\varrho + 5) \pm \frac{5}{8\nu}\right].$$

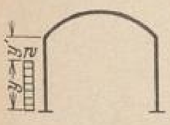


$$\Phi_1 = (5 - 5\xi^2 + 2\xi^3), \quad \Phi_2 = (3 - 2\xi),$$

$$H_{a,b} = \frac{p l^2}{20 h}\frac{\varrho}{\mu}\xi^2[2\varphi\psi_1\Phi_1 + 5\Phi_2],$$

$$M_{a,b} = +\frac{p l^2}{20}\xi^2\left\{\frac{1}{\mu}[2\varphi\psi_2\Phi_1 + 5(\varrho - 1)\Phi_2] \mp \frac{5}{\nu}\xi'^2\right\},$$

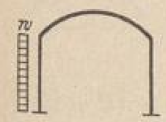
$$M_{c,d} = -\frac{p l^2}{20}\xi^2\left\{\frac{1}{\mu}[2\varphi\varrho\Phi_1 + 5\Phi_2] \pm \frac{5}{\nu}\xi'^2\right\}.$$



$$H_{a,b} = -\frac{w h}{2}\eta\left\{1 \pm 1 - \frac{\varkappa\varrho}{4\mu}\eta^2[\psi_1(4 - \eta) - 4]\right\},$$

$$M_{a,b} = +\frac{w h^2}{4}\eta^2\left\{\frac{\varkappa\eta}{2\mu}[\psi_2(4 - \eta) - 4(\varrho - 1)] - 1 \mp \left(1 - 2\eta\frac{\varkappa}{\nu}\right)\right\},$$

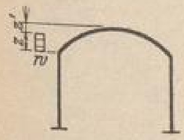
$$M_{c,d} = -\frac{w h^2}{4}\varkappa\eta^2\left\{\frac{1}{2\mu}[\varrho(4 - \eta) - 4] \mp \frac{2}{\nu}\right\}.$$



$$H_{a,b} = -\frac{w h}{2}\left[1 \pm 1 - \frac{\varkappa\varrho}{4\mu}(3\psi_1 - 4)\right],$$

$$M_{a,b} = +\frac{w h^2}{4}\left\{\frac{\varkappa}{2\mu}[3\psi_2 - 4(\varrho - 1)] - 1 \mp \left(1 - \frac{2\varkappa}{\nu}\right)\right\},$$

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

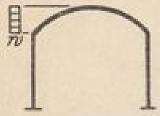


$$\Phi_1 = \left(1 - \zeta'^{\frac{5}{2}}\right), \quad \Phi_2 = \left(1 - \zeta'^{\frac{7}{2}}\right),$$

$$H_{a,b} = -\frac{w f}{2}\left\{\pm\zeta + \frac{4}{5}\frac{\varphi\varrho}{\mu}\left[(\varphi\psi_1 + 1)\Phi_1 - \frac{1}{7}\varphi\psi_1\Phi_2\right]\right\},$$

$$M_{a,b} = -w f^2\left\{\frac{2}{5\mu}\left[(\varphi\psi_2 + \varrho - 1)\Phi_1 - \frac{\varphi\psi_2}{7}\Phi_2\right] \pm \zeta\left[\frac{1}{2\varphi} - \frac{1}{8\nu}\left(12\frac{\varkappa}{\varphi} - 1 + \zeta'^2\right)\right]\right\},$$

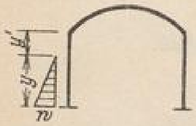
$$M_{c,d} = w f^2\left\{\frac{2}{5\mu}\left[(\varphi\varrho + 1)\Phi_1 - \frac{\varphi\varrho}{7}\Phi_2\right] \pm \frac{1}{8\nu}\zeta\left[12\frac{\varkappa}{\varphi} - 1 + \zeta'^2\right]\right\}.$$



$$H_{a,b} = -\frac{w f}{2}\left[\pm 1 + \frac{4}{5}\,\frac{\varphi\varrho}{\mu}\left(\frac{6}{7}\varphi\psi_1 + 1\right)\right],$$

$$M_{a,b} = -w f^2\left\{\frac{2}{5\mu}\left[\frac{6}{7}\varphi\psi_2 + (\varrho - 1)\right] \pm \left[\frac{1}{2\varphi} - \frac{1}{8\nu}\left(12\frac{\varkappa}{\varphi} - 1\right)\right]\right\},$$

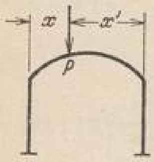
$$M_{c,d} = w f^2\left[\frac{2}{5\mu}\left(\frac{6}{7}\varphi\varrho + 1\right) \pm \frac{1}{8\nu}\left(12\frac{\varkappa}{\varphi} - 1\right)\right].$$



$$H_{a,b} = -\frac{w h}{4}\eta\left\{1 \pm 1 - \frac{\varkappa\varrho\eta^2}{10\mu}\left[\psi_1(5-\eta) - 5\right]\right\},$$

$$M_{a,b} = +\frac{w h^2}{40}\eta^2\left\{\frac{\varkappa\eta}{\mu}\left[\psi_2(5-\eta) - 5(\varrho - 1)\right] - \frac{10}{3} \mp \left(\frac{10}{3} - 5\eta\frac{\varkappa}{\nu}\right)\right\},$$

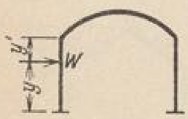
$$M_{c,d} = -\frac{w h^2}{40}\varkappa\eta^3\left\{\frac{1}{\mu}\left[\varrho(5-\eta) - 5\right] \mp \frac{5}{\nu}\right\}.$$



$$H_{a,b} = \frac{P l}{2 h}\,\frac{\varrho}{\mu}\left(2\varphi\psi_1\omega_P'' + 3\omega_R\right),$$

$$M_{a,b} = +\frac{P l}{2}\left\{\frac{1}{\mu}\left[2\varphi\psi_2\omega_P'' + 3(\varrho - 1)\omega_R\right] \mp \frac{1}{\nu}(\xi' - \xi)\,\omega_R\right\},$$

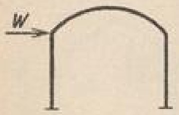
$$M_{c,d} = -\frac{P l}{2}\left[\frac{1}{\mu}\left(2\varphi\varrho\omega_P'' + 3\omega_R\right) \pm \frac{1}{\nu}(\xi' - \xi)\,\omega_R\right].$$



$$H_{a,b} = -\frac{W}{2}\left\{1 \pm 1 - \frac{\varkappa\varrho}{\mu}\eta^2\left[\psi_1(3-\eta) - 3\right]\right\},$$

$$M_{a,b} = +\frac{W h}{2}\eta\left\{\frac{\varkappa\eta}{\mu}\left[\psi_2(3-\eta) - 3(\varrho - 1)\right] - 1 \mp \left(1 - 3\eta\frac{\varkappa}{\nu}\right)\right\},$$

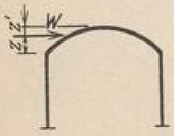
$$M_{c,d} = -\frac{W h}{2}\varkappa\eta^2\left\{\frac{1}{\mu}\left[\varrho(3-\eta) - 3\right] \mp \frac{3}{\nu}\right\}.$$



$$H_{a,b} = -\frac{W}{2}\left[1 \pm 1 - \frac{\varkappa\varrho}{\mu}(2\psi_1 - 3)\right],$$

$$M_{a,b} = +\frac{W h}{2}\left\{\frac{\varkappa}{\mu}\left[2\psi_2 - 3(\varrho - 1)\right] - 1 \mp \left(1 - 3\frac{\varkappa}{\nu}\right)\right\},$$

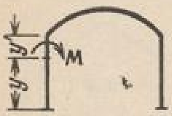
$$M_{c,d} = -\frac{W h}{2}\varkappa\left[\frac{1}{\mu}(2\varrho - 3) \mp \frac{3}{\nu}\right].$$



$$H_{a,b} = -\frac{W}{2}\left\{\pm 1 + \frac{2}{5}\,\frac{\varphi\varrho}{\mu}\zeta'^{\frac{3}{2}}\left[\varphi\psi_1(5-\zeta') + 5\right]\right\},$$

$$M_{a,b} = -W f\left\{\frac{\zeta'^{\frac{3}{2}}}{5\mu}\left[\varphi\psi_2(5-\zeta') + 5(\varrho - 1)\right] \pm \left[\frac{1}{2\varphi} - \frac{1}{8\nu}\left(12\frac{\varkappa}{\varphi} - 1 - 2\zeta' + 3\zeta'^2\right)\right]\right\},$$

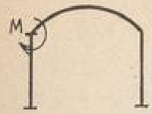
$$M_{c,d} = W f\left\{\frac{\zeta'^{\frac{3}{2}}}{5\mu}\left[\varphi\varrho(5-\zeta') + 5\right] \pm \frac{1}{8\nu}\left[12\frac{\varkappa}{\varphi} - 1 - 2\zeta' + 3\zeta'^2\right]\right\}.$$



$$H_{a,b} = \frac{3}{2}\,\frac{\mathsf{M}}{h}\,\frac{\varkappa\varrho}{\mu}\eta\left[\psi_1(2-\eta) - 2\right],$$

$$M_{a,b} = +\frac{\mathsf{M}}{2}\left\{\frac{3\varkappa\eta}{\mu}\left[\psi_2(2-\eta) - 2(\varrho - 1)\right] - 1 \mp \left(1 - 6\eta\frac{\varkappa}{\nu}\right)\right\},$$

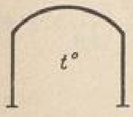
$$M_{c,d} = -\frac{3}{2}\mathsf{M}\varkappa\eta\left\{\frac{1}{\mu}\left[\varrho(2-\eta) - 2\right] \mp \frac{2}{\nu}\right\}.$$



$$H_{a,b} = \frac{3}{2}\frac{\mathsf{M}}{h}\frac{\varkappa\varrho}{\mu}(\psi_1 - 2),$$

$$M_{a,b} = +\frac{\mathsf{M}}{2}\left\{\frac{3\varkappa}{\mu}[\psi_2 - 2(\varrho - 1)] - 1 \mp \left(1 - 6\frac{\varkappa}{\nu}\right)\right\},$$

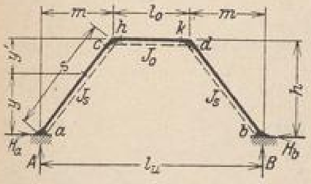
$$M_{h,k} = -\frac{3}{2}\mathsf{M}\varkappa\left[\frac{1}{\mu}(\varrho - 2) \mp \frac{2}{\nu}\right].$$



$$H_{a,b} = \frac{3\varrho\psi_1}{\mu}\frac{EJ_s}{h^2}\alpha_t t,$$

$$M_{a,b} = +\frac{3\psi_2}{\mu}\frac{EJ_s}{h}\alpha_t t, \qquad M_{c,d} = -\frac{3\varrho}{\mu}\frac{EJ_s}{h}\alpha_t t.$$

Tabelle 57. Symmetrischer Rahmen mit schrägen Pfosten.

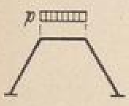


$$\eta = \frac{y}{h}, \qquad \lambda_1 = \frac{m}{l_u}, \qquad \lambda' = \frac{l_o}{l_u}, \qquad \varkappa = \frac{l_o}{s}\frac{J_s}{J_0},$$

$$\eta' = \frac{y'}{h}, \qquad \lambda_2 = \frac{m}{l_o}, \qquad \lambda'' = \frac{l_u}{l_o}, \qquad \mu = 1 + 2\varkappa,$$

$\nu = \varkappa\lambda'^2 + 2(1 + \lambda' + \lambda'^2)$, ω Tabelle 22, S. 116.

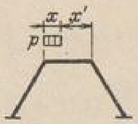
$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben.



$$H_{a,b} = \frac{p\,l_0^2}{4h}\left(\frac{\varkappa}{\mu} + 2\lambda_2\right),$$

$$M_{a,b} = \frac{p\,l_0^2}{12}\frac{\varkappa}{\mu},$$

$$M_{c,d} = -\frac{p\,l_0^2}{6}\frac{\varkappa}{\mu}.$$



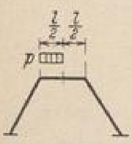
$$\Phi = \frac{\omega_R}{\nu}[\lambda'^2\varkappa\omega_R - 2\lambda_1(2 + \lambda')],$$

$$\psi = 3\xi^2 - 2\xi^3,$$

$$\xi = \frac{x}{l_0}, \quad \xi' = \frac{x'}{l_0} \qquad H_{a,b} = \frac{p\,l_0^2}{4h}\left(\frac{\varkappa}{\mu}\psi + 2\lambda_2\xi\right),$$

$$M_{c,d} = -\frac{p\,l_0^2}{4}\left(\frac{2\varkappa}{3\mu}\psi \pm \Phi\right),$$

$$M_{a,b} = \frac{p\,l_0^2}{4}\left[\frac{\varkappa}{3\mu}\psi \mp (2\lambda_2\omega_R + \lambda''\Phi)\right].$$

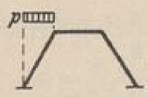


$$\Phi = \frac{1}{8\nu}[\lambda'^2\varkappa - 8\lambda_1(2 + \lambda')],$$

$$H_{a,b} = \frac{p\,l_0^2}{8h}\left(\frac{\varkappa}{\mu} + 2\lambda_2\right),$$

$$M_{a,b} = \frac{p\,l_0^2}{8}\left[\frac{\varkappa}{3\mu} \mp (\lambda_2 + \lambda''\Phi)\right],$$

$$M_{c,d} = -\frac{p\,l_0^2}{8}\left(\frac{2\varkappa}{3\mu} \pm \Phi\right).$$

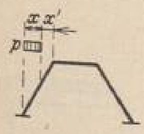


$$\Phi = \frac{2 - \lambda_1}{\nu},$$

$$H_{a,b} = \frac{p\,m^2}{4h}\left(1 - \frac{\varkappa}{2\mu}\right),$$

$$M_{a,b} = -\frac{p\,m^2}{4}\left[\frac{1 + 3\varkappa}{6\mu} \pm (1 - \Phi)\right],$$

$$M_{c,d} = -\frac{p\,m^2}{4}\left(\frac{1}{6\mu} \mp \lambda'\Phi\right).$$

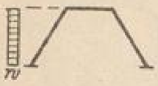


$$\Phi = \frac{\xi^3}{\nu}(2 - \lambda_1\xi), \qquad \psi = \frac{1}{2} - \omega_\varphi',$$

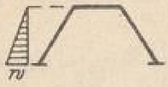
$$H_{a,b} = \frac{p\,m^2}{4h}\left\{\frac{1}{\mu}[\omega_\varphi - (1 + \varkappa)\psi] + \xi^2\right\},$$

$$\xi = \frac{x}{m}, \quad \xi' = \frac{x'}{m} \qquad M_{a,b} = -\frac{p\,m^2}{4}\left\{\frac{1}{3\mu}[(2 + 3\varkappa)\psi - \omega_\varphi] \pm (\xi^2 - \Phi)\right\},$$

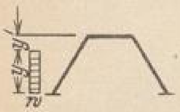
$$M_{c,d} = -\frac{p\,m^2}{4}\left[\frac{1}{3\mu}(2\omega_\varphi - \psi) \mp \lambda'\Phi\right].$$



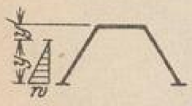
$$\Phi = \frac{2-\lambda_1}{\nu},$$
$$H_{a,b} = -\frac{w\,h}{4}\left(1 \pm 2 + \frac{\varkappa}{2\,\mu}\right),$$
$$M_{a,b} = -\frac{w\,h^2}{4}\left[\frac{1+3\varkappa}{6\,\mu} \pm (1-\Phi)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{4}\left(\frac{1}{6\,\mu} \mp \lambda'\,\Phi\right).$$



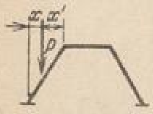
$$\Phi = \frac{1}{\nu}(5-2\,\lambda_1),$$
$$H_{a,b} = \frac{w\,h}{40}\left(\frac{1}{\mu} - 8 \mp 10\right),$$
$$M_{a,b} = -\frac{w\,h^2}{40}\left[\frac{2\,\varkappa}{3\,\mu} + 1 \pm \left(\frac{10}{3} - \Phi\right)\right]$$
$$M_{c,d} = -\frac{w\,h^2}{40}\left(\frac{2}{3\,\mu} \mp \lambda'\,\Phi\right).$$



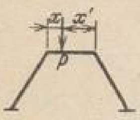
$$\Phi = \frac{\eta^3}{\nu}(2-\lambda_1\,\eta), \qquad \omega''_\varphi = \frac{1}{2} - \omega'_\varphi,$$
$$H_{a,b} = \frac{w\,h}{4}\left\{\frac{1}{\mu}\left[\omega_\varphi - (1+\varkappa)\,\omega''_\varphi\right] - 2\,\eta \mp 2\,\eta + \eta^2\right\},$$
$$M_{a,b} = -\frac{w\,h^2}{4}\left\{\frac{1}{3\,\mu}\left[(2+3\,\varkappa)\,\omega''_\varphi - \omega_\varphi\right] \pm (\eta^2 - \Phi)\right\},$$
$$M_{c,d} = -\frac{w\,h^2}{4}\left\{\frac{1}{3\,\mu}\left[2\,\omega_\varphi - \omega''_\varphi\right] \mp \lambda'\,\Phi\right\}.$$



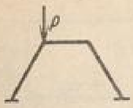
$$\Phi = \frac{\eta}{\nu}(5-2\,\lambda_1\,\eta),$$
$$H_{a,b} = \frac{w\,h}{40}\,\eta\left\{\frac{\eta^2}{\mu}\left[5\,(1+\varkappa) - \eta\,(2+\varkappa)\right] - 10 \mp 10\right\},$$
$$M_{a,b} = \frac{w\,h^2}{40}\,\eta^2\left[\frac{\eta}{3\,\mu}(1+\varkappa)(5-3\,\eta) + \frac{5}{3}\,\eta - \frac{10}{3} \mp \left(\frac{10}{3} - \Phi\right)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{40}\,\eta^2\left[\frac{\eta}{3\,\mu}(5-3\,\eta) \mp \lambda'\,\Phi\right].$$



$$\Phi = \frac{\xi^2}{\nu}(3-2\,\lambda_1\,\xi),$$
$$H_{a,b} = \frac{P\,m}{2\,h}\left\{\frac{1}{\mu}\left[\omega_D - (1+\varkappa)\,\omega'_D\right] + \xi\right\},$$
$$\xi = \frac{x}{m} \qquad M_{a,b} = -\frac{P\,m}{2}\left\{\frac{1}{\mu}\left[(1+\varkappa)\,\omega'_D - \omega_R\right] \pm (\xi - \Phi)\right\},$$
$$\xi' = \frac{x'}{m} \qquad M_{c,d} = -\frac{P\,m}{2}\left[\frac{1}{\mu}(\omega_D - \omega_R) \mp \lambda'\,\Phi\right].$$



$$\Phi = \frac{1-2\,\xi}{\nu}\left[\lambda'^2\,\varkappa\,\omega_R - \lambda_1\,(2+\lambda')\right],$$
$$H_{a,b} = \frac{P\,l_0}{2\,h}\left[\frac{3\,\varkappa}{\mu}\,\omega_R + \lambda_2\right],$$
$$\xi = \frac{x}{l_0} \qquad M_{a,b} = \frac{P\,l_0}{2\,h}\left\{\frac{\varkappa}{\mu}\,\omega_R \mp \left[\lambda_2\,(1-2\,\xi) + \lambda''\,\Phi\right]\right\},$$
$$\xi' = \frac{x'}{l_0} \qquad M_{c,d} = -\frac{P\,l_0}{2}\left(\frac{2\,\varkappa}{\mu}\,\omega_R \pm \Phi\right).$$



$$\Phi = \frac{2+\lambda'}{v},$$

$$H_{a,b} = \frac{P\,m}{2\,h},$$

$$M_{a,b} = \mp \frac{P\,m}{2}\,(1-\Phi),$$

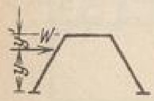
$$M_{c,d} = \pm \frac{P\,m}{2}\,\lambda'\,\Phi.$$

$$\Phi = \frac{2+\lambda'}{v},$$

$$H_{a,b} = \mp \frac{W}{2},$$

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

$$M_{c,d} = \pm \frac{W\,h}{2}\,\lambda'\,\Phi.$$



$$\Phi = \frac{\eta^2}{v}\,(3-2\,\lambda_1\,\eta), \qquad H_{a,b} = \frac{W}{2}\left\{\frac{1}{\mu}\,[\omega_D - (1+\varkappa)\,\omega_D'] - \eta' \mp 1\right\},$$

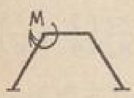
$$M_{a,b} = -\frac{W\,h}{2}\left\{\frac{1}{\mu}\,[(1+\varkappa)\,\omega_D' - \omega_R] \pm (\eta - \Phi)\right\},$$

$$M_{c,d} = -\frac{W\,h}{2}\left[\frac{1}{\mu}\,(\omega_D - \omega_R) \mp \lambda'\,\Phi\right].$$

$$\Phi = \frac{6\,\eta}{v}\,(1-\lambda_1\,\eta), \qquad H_{a,b} = -\frac{\mathsf{M}}{2\,h}\left\{\frac{1}{\mu}\,[(1+\varkappa)\,\omega_M' + \omega_M] - 1\right\},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left\{\frac{1}{3\,\mu}\,[(2+3\,\varkappa)\,\omega_M' + \omega_M] \pm (1-\Phi)\right\},$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\left[\frac{1}{3\,\mu}\,(2\,\omega_M + \omega_M') \pm \lambda'\,\Phi\right].$$



$$\Phi = \frac{6}{v}\,(1-\lambda_1),$$

$$H_{a,b} = \frac{3}{2}\,\frac{\mathsf{M}}{h}\,\frac{\varkappa}{\mu},$$

$$M_{a,b} = \frac{\mathsf{M}}{2}\left[\frac{\varkappa}{\mu} \mp (1-\Phi)\right],$$

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

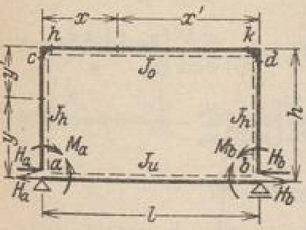
$$\Phi = \frac{3}{\mu}\,\frac{l_u}{h}\,\frac{E\,J_s}{s}\,\alpha_t\,t,$$

$$H_{a,b} = \frac{2+\varkappa}{h}\,\Phi,$$

$$M_{a,b} = (1+\varkappa)\,\Phi,$$

$$M_{h,k} = -\Phi.$$

Tabelle 58. Geschlossener, symmetrischer Rechteckrahmen.

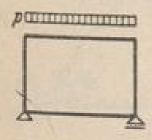


$$\xi = \frac{x}{l}, \qquad \eta = \frac{y}{h}, \qquad \varkappa_o = \frac{h}{l}\,\frac{J_o}{J_h}, \qquad \varkappa_u = \frac{h}{l}\,\frac{J_u}{J_h},$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \mu = (2+\varkappa_o) + \frac{3+2\,\varkappa_o}{\varkappa_u}, \quad v = 1 + 6\,\varkappa_o + \frac{\varkappa_o}{\varkappa_u}.$$

$M_{h,k} = M_{c,d}$, wenn nicht besonders angegeben. ω Tabelle 22 S. 116.

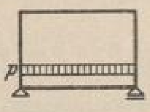
Gleichmäßige Temperaturänderung erzeugt keine Schnittkräfte.



$$H_{a,b} = \frac{p\,l}{4}\,\frac{l}{h}\,\frac{1+\varkappa_u}{\mu\,\varkappa_u},$$

$$M_{a,b} = \frac{p\,l^2}{12\,\mu},$$

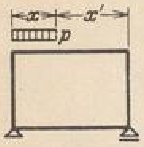
$$M_{c,d} = -\frac{p\,l^2}{12}\,\frac{3+2\,\varkappa_u}{\mu\,\varkappa_u}.$$



$$H_{a,b} = \frac{p\,l}{4}\,\frac{l}{h}\,\frac{1+\varkappa_o}{\mu\,\varkappa_u},$$

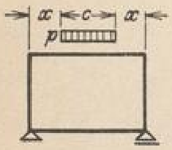
$$M_{a,b} = \frac{p\,l^2}{12}\,\frac{3+2\,\varkappa_o}{\mu\,\varkappa_u},$$

$$M_{c,d} = -\frac{p\,l^2}{12\,\mu}\,\frac{\varkappa_o}{\varkappa_u}.$$



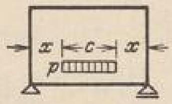
$$\Phi = 3\,\xi^2 - 2\,\xi^3\,,$$
$$H_{a,b} = \frac{p\,l}{4}\,\frac{l}{h}\,\frac{1+\varkappa_u}{\mu\,\varkappa_u}\,\Phi\,,$$
$$M_{a,b} = \frac{p\,l^2}{4}\left(\frac{1}{3\,\mu}\,\Phi \mp \frac{1}{\nu}\,\omega_R^2\right),$$
$$M_{c,d} = -\frac{p\,l^2}{4}\left(\frac{3+2\,\varkappa_u}{3\,\mu\,\varkappa_u}\,\Phi \pm \frac{1}{\nu}\,\omega_R^2\right).$$
$$x = \frac{l}{2}:\qquad \Phi = \frac{1}{2}\,,\qquad \omega_R^2 = \frac{1}{16}\,.$$

$$\Phi = 3\,\xi^2 - 2\,\xi^3\,,$$
$$H_{a,b} = \frac{p\,l}{4}\,\frac{l}{h}\,\frac{1+\varkappa_o}{\mu\,\varkappa_u}\,\Phi\,,$$
$$M_{a,b} = \frac{p\,l^2}{4}\left(\frac{3+2\,\varkappa_o}{3\,\mu\,\varkappa_u} \pm \frac{\varkappa_o}{\varkappa_u}\,\frac{1}{\nu}\,\omega_R^2\right),$$
$$M_{c,d} = -\frac{p\,l^2}{4}\,\frac{\varkappa_o}{\varkappa_u}\left(\frac{1}{3\,\mu}\,\Phi \mp \frac{1}{\nu}\,\omega_R^2\right).$$
$$x = \frac{l}{2}:\qquad \Phi = \frac{1}{2}\,,\qquad \omega_R^2 = \frac{1}{16}\,.$$



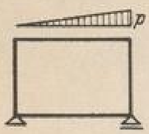
$$\zeta = \frac{c}{l}$$

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

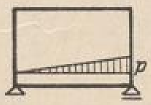


$$\zeta = \frac{c}{l}$$

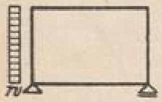
$$\Phi = \frac{1}{2}\,(3\,\zeta - \zeta^3)\,,$$
$$H_{a,b} = \frac{p\,l}{4}\,\frac{l}{h}\,\frac{1+\varkappa_o}{\mu\,\varkappa_u}\,\Phi\,,$$
$$M_{a,b} = \frac{p\,l^2}{12}\,\frac{3+2\,\varkappa_o}{\mu\,\varkappa_u}\,\Phi\,,$$
$$M_{c,d} = -\frac{p\,l^2}{12}\,\frac{1}{\mu}\,\frac{\varkappa_o}{\varkappa_u}\,\Phi\,.$$



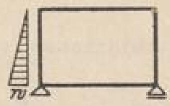
$$H_{a,b} = \frac{p\,l}{8}\,\frac{l}{h}\,\frac{1+\varkappa_u}{\mu\,\varkappa_u}\,,$$
$$M_{a,b} = \frac{p\,l^2}{120}\left(\frac{5}{\mu} \pm \frac{1}{\nu}\right),$$
$$M_{c,d} = -\frac{p\,l^2}{120}\left(\frac{5}{\mu}\,\frac{3+2\,\varkappa_u}{\varkappa_u} \mp \frac{1}{\nu}\right).$$



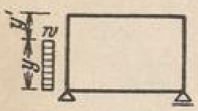
$$M_{a,b} = \frac{p\,l^2}{120}\left(\frac{5}{\mu}\,\frac{3+2\,\varkappa_o}{\varkappa_u} \mp \frac{\varkappa_o}{\varkappa_u}\,\frac{1}{\nu}\right),$$
$$M_{c,d} = -\frac{p\,l^2}{120}\,\frac{\varkappa_o}{\varkappa_u}\left(\frac{5}{\mu} \pm \frac{1}{\nu}\right),$$
$$H_{a,b} = \frac{p\,l}{8}\,\frac{l}{h}\,\frac{1+\varkappa_o}{\mu\,\varkappa_u}\,.$$



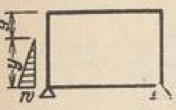
$$\Phi = \frac{\varkappa_o}{\varkappa_u}\,\frac{1+2\,\varkappa_u}{\nu}\,,$$
$$H_{a,b} = \frac{w\,h}{4}\left[-1+\frac{1}{2\,\mu}\,\frac{\varkappa_o-\varkappa_u}{\varkappa_u} \mp 2\right],$$
$$M_{a,b} = -\frac{w\,h^2}{4}\left[\frac{3+\varkappa_o}{6\,\mu} \pm (1-\Phi)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{4}\left[\frac{\varkappa_o}{\varkappa_u}\,\frac{3+\varkappa_u}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



$$\Phi = \frac{5}{\nu}\,\frac{\varkappa_o}{\varkappa_u}\,(2+3\,\varkappa_u)\,,$$
$$M_{a,b} = -\frac{w\,h^2}{120}\left[\frac{8+3\varkappa_o}{\mu} \pm (10-\Phi)\right],$$
$$M_{c,d} = -\frac{w\,h^2}{120}\left[\frac{\varkappa_o}{\varkappa_u}\,\frac{7+2\varkappa_o}{\mu} \mp \Phi\right],$$
$$H_{a,b} = \frac{w\,h}{120}\left[\frac{1}{\mu}\left(7\,\frac{\varkappa_o}{\varkappa_u} - \varkappa_o - 8\right) - 20 \mp 30\right].$$



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

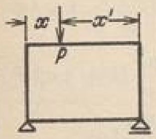


$$\Phi = \frac{5}{\nu}\,\frac{\varkappa_o}{\varkappa_u}\,(2 + 3\,\eta\,\varkappa_u)\,,$$

$$H_{a,b} = \frac{w\,h}{120}\,\eta\left\{\frac{\eta}{\mu}\left[10\left(\frac{\varkappa_o}{\varkappa_u} - \varkappa_o - 2\right) + 15\,\eta\,(1 + \varkappa_o) - 3\,\eta^2\left(1 + 2\,\varkappa_o + \frac{\varkappa_o}{\varkappa_u}\right)\right] + 10\,\eta - 30 \mp 30\right\},$$

$$M_{a,b} = -\frac{w\,h^2}{120}\,\eta^2\left\{\frac{1}{\mu}\left[10\,(2 + \varkappa_o) - 5\,\eta\,(3 + 2\,\varkappa_o) + 3\,\eta^2\,(1 + \varkappa_o)\right] \pm (10 - \Phi)\right\},$$

$$M_{c,d} = -\frac{w\,h^2}{120}\,\eta^2\left\{\frac{\varkappa_o}{\mu\,\varkappa_u}\left[10 + 5\,\eta\,\varkappa_u - 3\,\eta^2\,(1 + \varkappa_u)\right] \mp \Phi\right\}.$$



$$\Phi = \frac{1 - 2\,\xi}{\nu}\,,$$

$$H_{a,b} = \frac{3}{2}\,\frac{P\,l}{h}\,\frac{1 + \varkappa_u}{\mu\,\varkappa_u}\,\omega_R\,,$$

$$M_{a,b} = \frac{P\,l}{2}\,\omega_R\left[\frac{1}{\mu} \mp \Phi\right],$$

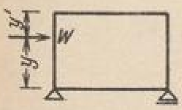
$$M_{c,d} = -\frac{P\,l}{2}\,\omega_R\left[\frac{3 + 2\,\varkappa_u}{\mu\,\varkappa_u} \pm \Phi\right].$$

$$\Phi = \frac{1 - 2\,\xi}{\nu}\,\frac{\varkappa_o}{\varkappa_u}\,,$$

$$H_{a,b} = \frac{3}{2}\,\frac{P\,l}{h}\,\frac{1 + \varkappa_o}{\mu\,\varkappa_o}\,\omega_R\,,$$

$$M_{a,b} = \frac{P\,l}{2}\,\omega_R\left[\frac{3 + 2\,\varkappa_o}{\mu\,\varkappa_u} \pm \Phi\right],$$

$$M_{c,d} = -\frac{P\,l}{2}\,\omega_R\left[\frac{\varkappa_o}{\mu\,\varkappa_u} \mp \Phi\right].$$



$$\Phi = \frac{\eta}{\nu}\,\frac{\varkappa_o}{\varkappa_u}\,(1 + 3\,\eta\,\varkappa_u)\,,$$

$$H_{a,b} = \frac{W}{2}\left\{\frac{1}{\mu}\left[(1 + \varkappa_u)\,\frac{\varkappa_o}{\varkappa_u}\,\omega_D - (1 + \varkappa_o)\,\omega_D'\right] + \eta - 1 \mp 1\right\},$$

$$M_{a,b} = -\frac{W\,h}{2}\left\{\frac{1}{\mu}\left[(1 + \varkappa_o)\,\omega_D' - \varkappa_o\,\omega_R\right] \pm (\eta - \Phi)\right\}.$$

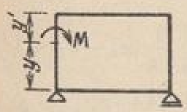
$$M_{c,d} = -\frac{W\,h}{2}\left\{\frac{\varkappa_o}{\mu\,\varkappa_u}\left[(1 + \varkappa_u)\,\omega_D - \varkappa_u\,\omega_R\right] \mp \Phi\right\}.$$

$y = h$: $\Phi = \frac{\varkappa_o}{\varkappa_u}\,\frac{1 + 3\,\varkappa_u}{\nu}$,

$$H_{a,b} = \mp\frac{W}{2}\,,$$

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

$$M_{c,d} = \pm\frac{W\,h}{2}\,\Phi.$$



$y > 0$

$$\Phi = \frac{1}{\nu}\,\frac{\varkappa_o}{\varkappa_u}\,(1 + 6\,\eta\,\varkappa_u)\,,$$

$$H_{a,b} = -\frac{\mathsf{M}}{2\,h}\left\{\frac{1}{\mu}\left[(1 + \varkappa_o)\,\omega_M' + \varkappa_o\,\frac{1 + \varkappa_u}{\varkappa_u}\,\omega_M\right] - 1\right\},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left\{\frac{1}{3\,\mu}\left[(3 + 2\,\varkappa_o)\,\omega_M + \varkappa_o\,\omega_M\right] \pm (1 - \Phi)\right\},$$

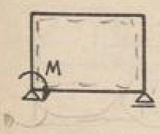
$$M_{hk} = \frac{\mathsf{M}}{2}\left\{\frac{\varkappa_o}{3\,\mu\,\varkappa_u}\left[(3 + 2\,\varkappa_u)\,\omega_M + \varkappa_u\,\omega_M'\right] \pm \Phi\right\}.$$

$y = h$:

$$H_{a,b} = \frac{3}{2}\,\frac{\mathsf{M}}{h}\,\frac{1 + \varkappa_u}{\mu\,\varkappa_u}\,,$$

$$M_{a,b} = \frac{\mathsf{M}}{2}\left(\frac{1}{\mu} \mp \frac{1}{\nu}\right),$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\left[\frac{\varkappa_o}{\varkappa_u}\,\frac{2 + \varkappa_u}{\mu} \mp \left(\frac{1}{\nu} - 1\right)\right],$$



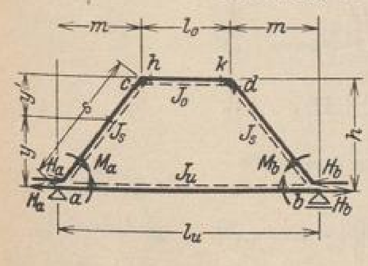
$$H_{a,b} = \frac{3}{2}\,\frac{\mathsf{M}}{h}\,\frac{1 + \varkappa_o}{\mu\,\varkappa_u}\,,$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left[\frac{2 + \varkappa_o}{\mu} \pm \left(1 - \frac{\varkappa_o}{\nu\,\varkappa_u}\right)\right],$$

$$M_{c,d} = -\frac{\mathsf{M}}{2}\,\frac{\varkappa_o}{\varkappa_u}\left[\frac{1}{\mu} \mp \frac{1}{\nu}\right],$$

M_a am Riegel.

Tabelle 59. Geschlossener, symmetrischer Trapezrahmen.



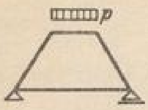
$$\eta = \frac{y}{h}\,,\quad \lambda_1 = \frac{m}{l_u}\,,\quad \lambda' = \frac{l_o}{l_u}\,,\quad \omega \text{ Tabelle 22 S. 116.}$$

$$\eta' = \frac{y'}{h}\,,\quad \lambda_2 = \frac{m}{l_o}\,,\quad \lambda'' = \frac{l_u}{l_o}\,,\quad \varkappa_o = \frac{l_o}{s}\,\frac{J_s}{J_o}\,,\quad \varkappa_u = \frac{l_u}{s}\,\frac{J_s}{J_u}\,,$$

$$\mu = (2 + 3\,\varkappa_o)\,(2 + 3\,\varkappa_u) - 1\,,\qquad \nu = \varkappa_o\,\lambda'^2 + \varkappa_u + 2\,(1 + \lambda' + \lambda'^2)\,,$$

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

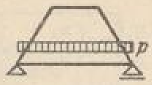
Gleichmäßige Temperaturänderung erzeugt keine Schnittkräfte.



$$H_{a,b}=\frac{p\,l_o^2}{2\,h}\left[\frac{3}{2}\frac{\varkappa_o}{\mu}\varkappa_o(1+\varkappa_u)+\lambda_2\right],$$

$$M_{a,b}=\frac{p\,l_o^2}{4}\frac{\varkappa_o}{\mu},$$

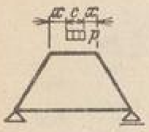
$$M_{c,d}=-\frac{p\,l_o^2}{4}\frac{\varkappa_o}{\mu}(2+3\,\varkappa_u).$$



$$H_{a,b}=\frac{3}{4}\frac{p\,l_u^2}{h}\frac{\varkappa_u}{\mu}(1+\varkappa_o),$$

$$M_{a,b}=\frac{p\,l_u^2}{4}\frac{\varkappa_u}{\mu}(2+3\,\varkappa_o),$$

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



$$\Phi=\tfrac{1}{2}(3\,\zeta_o-\zeta_o^3),$$

$$H_{a,b}=\frac{p\,l_o^2}{2\,h}\left[\frac{3\varkappa_o}{2\,\mu}(1+\varkappa_u)\Phi+\lambda_2\zeta_o\right],$$

$$M_{a,b}=\frac{p\,l_o^2}{4}\frac{\varkappa_o}{\mu}\Phi,$$

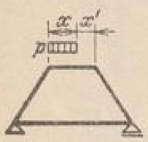
$$\zeta_o=\frac{c}{l_o}.\qquad M_{c,d}=-\frac{p\,l_o^2}{4}\frac{\varkappa_o}{\mu}(2+3\,\varkappa_u)\Phi.$$

$$\Phi=\tfrac{1}{2}(3\,\zeta_u-\zeta_u^3),$$

$$H_{a,b}=\frac{3}{4}\frac{p\,l_u^2}{h}\frac{\varkappa_u}{\mu}(1+\varkappa_o)\Phi,$$

$$M_{a,b}=\frac{p\,l_u^2}{4}\frac{\varkappa_u}{\mu}(2+3\varkappa_o)\Phi,$$

$$\zeta_u=\frac{c}{l_u}.\qquad M_{c,d}=-\frac{p\,l_u^2}{4}\frac{\varkappa_u}{\mu}\Phi.$$



$$\Phi=\frac{\omega_R}{\nu}[\lambda'^2\varkappa_o\,\omega_R-2\,\lambda_1(2+\varkappa_u+\lambda')],\qquad \psi=3\,\xi^2-2\,\xi^3,$$

$$H_{a,b}=\frac{p\,l_o^2}{4\,h}\left[\frac{3\varkappa_o}{\mu}(1+\varkappa_u)\,\psi+2\,\lambda_2\,\xi\right],$$

$$\xi=\frac{x}{l_o},\quad \xi'=\frac{x'}{l_o}.\quad M_{a,b}=\frac{p\,l_o^2}{4}\left[\frac{\varkappa_o}{\mu}\psi\mp(2\,\lambda_2\,\omega_R+\lambda''\Phi)\right],$$

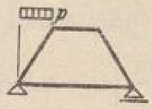
$$M_{c,d}=-\frac{p\,l_o^2}{4}\left[\frac{\varkappa_o}{\mu}(2+3\varkappa_u)\,\psi\pm\Phi\right].$$

$$\Phi=3\,\xi^2-2\,\xi^3,$$

$$H_{a,b}=\frac{3}{4}\frac{p\,l_u^2}{h}\frac{\varkappa_u}{\mu}(1+\varkappa_o)\,\Phi,$$

$$\xi=\frac{x}{l_u},\quad \xi'=\frac{x'}{l_u}.\quad M_{a,b}=\frac{p\,l_u^2}{4}\varkappa_u\left[\frac{2+3\varkappa_o}{\mu}\Phi\pm\frac{\omega_R^2}{\nu}\right],$$

$$M_{c,d}=-\frac{p\,l_u^2}{4}\varkappa_u\left[\frac{1}{\mu}\Phi\mp\frac{\lambda'}{\nu}\omega_R^2\right].$$



$$\Phi=\frac{1}{\nu}(2+\varkappa_u-\lambda_1),$$

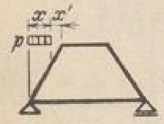
$$H_{a,b}=\frac{p\,m^2}{4\,h}\left[\frac{3}{2\,\mu}(\varkappa_u-\varkappa_o)+1\right],$$

$$M_{a,b}=-\frac{p\,m^2}{4}\left[\frac{1+3\varkappa_o}{2\,\mu}\pm(1-\Phi)\right],$$

$$M_{c,d}=-\frac{p\,m^2}{4}\left[\frac{1+3\varkappa_u}{2\,\mu}\mp\lambda'\Phi\right].$$

$$H_{a,b}=\frac{3}{8}\frac{p\,l_u^2}{h}\frac{\varkappa_u}{\mu}(1+\varkappa_o),\qquad M_{a,b}=\frac{p\,l_u^2}{120}\varkappa_u\left[\frac{15}{\mu}(2+3\,\varkappa_o)\mp\frac{1}{\nu}\right],$$

$$M_{c,d}=-\frac{p\,l_u^2}{120}\varkappa_u\left[\frac{15}{\mu}\pm\frac{\lambda'}{\nu}\right].$$

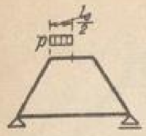


$$\Phi=\frac{\xi^2}{\nu}[\varkappa_u+\xi(2-\lambda_1\xi)],\qquad \psi=\frac{1}{2}-\omega'_\varphi,$$

$$H_{a,b}=\frac{p\,m^2}{4\,h}\left\{\frac{3}{\mu}[(1+\varkappa_u)\,\omega_\varphi-(1+\varkappa_o)\,\psi]+\xi^2\right\},$$

$$\xi=\frac{x}{m},\qquad \xi'=\frac{x'}{m}.\qquad M_{a,b}=-\frac{p\,m^2}{4}\left\{\frac{1}{\mu}[(2+3\,\varkappa_o)\,\psi-\omega_\varphi]\pm(\xi^2-\Phi)\right\},$$

$$M_{c,d}=-\frac{p\,m^2}{4}\left\{\frac{1}{\mu}[(2+3\,\varkappa_u)\,\omega_\varphi-\psi]\mp\lambda'\Phi\right\}.$$

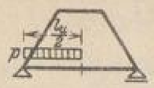


$$\Phi = \frac{1}{8\nu}\left[\lambda'^2 \varkappa_o - 8\lambda_1(2+\varkappa_u+\lambda')\right],$$

$$H_{a,b} = \frac{p\,l_o^2}{8\,h}\left[\frac{3\,\varkappa_o}{\mu}(1+\varkappa_u) + 2\,\lambda_2\right],$$

$$M_{a,b} = \frac{p\,l_o^2}{8}\left[\frac{\varkappa_o}{\mu} \mp (\lambda_2 + \lambda''\,\Phi)\right],$$

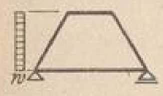
$$M_{c,d} = -\frac{p\,l_o^2}{8}\left[\frac{\varkappa_o}{\mu}(2+3\varkappa_u) \pm \Phi\right].$$



$$H_{a,b} = \frac{3}{8}\,\frac{p\,l_u^2}{h\,\mu}\,\varkappa_u(1+\varkappa_o),$$

$$M_{a,b} = \frac{p\,l_u^2}{8}\,\varkappa_u\left[\frac{2+3\,\varkappa_o}{\mu} \pm \frac{1}{8\,\nu}\right],$$

$$M_{c,d} = -\frac{p\,l_u^2}{8}\,\varkappa_u\left[\frac{1}{\mu} \mp \frac{\lambda'}{8\,\nu}\right].$$



$$\Phi = \frac{1}{\nu}(2+\varkappa_u-\lambda_1),$$

$$H_{a,b} = \frac{w\,h}{4}\left[\frac{3}{2\,\mu}(\varkappa_u-\varkappa_o) - 1 \mp 2\right],$$

$$M_{a,b} = -\frac{w\,h^2}{4}\left[\frac{1+3\,\varkappa_o}{2\,\mu} \pm (1-\Phi)\right],$$

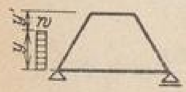
$$M_{c,d} = -\frac{w\,h^2}{4}\left[\frac{1+3\,\varkappa_u}{2\,\mu} \mp \lambda'\,\Phi\right].$$

$$\Phi = \frac{1}{3\,\nu}\left[5(3+2\,\varkappa_u) - 6\,\lambda_1\right],$$

$$H_{a,b} = \frac{w\,h}{120}\left[\frac{3}{\mu}(7\,\varkappa_u - 8\varkappa_o - 1) - 20 \mp 30\right],$$

$$M_{a,b} = -\frac{w\,h^2}{40}\left[\frac{3+8\,\varkappa_o}{\mu} \pm \left(\frac{10}{3}-\Phi\right)\right],$$

$$M_{c,d} = -\frac{w\,h^2}{40}\left[\frac{2+7\,\varkappa_u}{\mu} \mp \lambda'\,\Phi\right].$$

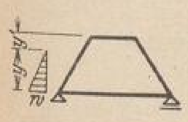


$$\Phi = \frac{\eta^2}{\nu}\left[\varkappa_u + \eta(2-\lambda_1\,\eta)\right], \qquad \psi = \frac{1}{2} - \omega'_\varphi,$$

$$H_{a,b} = \frac{w\,h}{4}\left\{\frac{3}{\mu}\left[(1+\varkappa_u)\,\omega_\varphi - (1+\varkappa_o)\,\psi\right] + \eta^2 - 2\,\eta \mp 2\,\eta\right\},$$

$$M_{a,b} = -\frac{w\,h^2}{4}\left\{\frac{1}{\mu}\left[(2+3\,\varkappa_o)\,\psi - \omega_\varphi\right] \pm (\eta^2-\Phi)\right\},$$

$$M_{c,d} = -\frac{w\,h^2}{4}\left\{\frac{1}{\mu}\left[(2+3\,\varkappa_u)\,\omega_\varphi - \psi\right] \mp \lambda'\,\Phi\right\}.$$

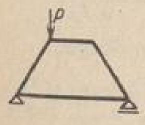


$$\Phi = \frac{1}{\nu}\left[10\,\varkappa_u + 3\,\eta(5-2\,\lambda_1\,\eta)\right],$$

$$H_{a,b} = \frac{w\,h}{120}\,\eta\left\{\frac{3\,\eta}{\mu}\left[10(\varkappa_u - 2\,\varkappa_o - 1) + 15\,\eta(1+\varkappa_o) - 3\,\eta^2(2+\varkappa_o+\varkappa_u)\right] + 10\,\eta - 30 \mp 30\right\},$$

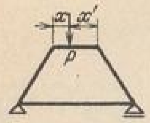
$$M_{a,b} = -\frac{w\,h^2}{120}\,\eta^2\left\{\frac{3}{\mu}\left[10(1+2\,\varkappa_o) - 5\,\eta(2+3\,\varkappa_o) + 3\,\eta^2(1+\varkappa_o)\right] \pm (10-\Phi)\right\},$$

$$M_{c,d} = -\frac{w\,h^2}{120}\,\eta^2\left\{\frac{3}{\mu}\left[10\,\varkappa_u + 5\,\eta - 3\,\eta^2(1+\varkappa_u)\right] \mp \lambda'\,\Phi\right\}.$$



$$\Phi = \frac{1}{\nu}(2+\varkappa_u+\lambda'), \qquad H_{a,b} = \frac{P\,m}{2\,h}(2\,\Phi - 1),$$

$$M_{a,b} = \mp\frac{P\,m}{2}\left[1-\Phi\right], \qquad M_{c,d} = \pm\frac{P\,m}{2}\,\lambda'\,\Phi.$$

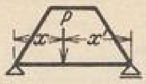


$$\Phi = \frac{1 - 2\xi}{\nu}\left[\lambda'^2 \varkappa_o \omega_R - \lambda_1 (2 + \varkappa_u + \lambda')\right],$$

$$\xi = \frac{x}{l_o}, \quad \xi' = \frac{x'}{l_o}. \qquad H_{a,b} = \frac{P\,m}{2\,h}\left[\frac{9\,\varkappa_o}{\mu\,\lambda_2}(1 + \varkappa_u)\,\omega_R + 1\right],$$

$$M_{a,b} = \frac{P\,l_o}{2}\left\{\frac{3\,\varkappa_o}{\mu}\,\omega_R \mp [\lambda_2 (1 - 2\,\xi) + \lambda''\Phi]\right\},$$

$$M_{c,d} = -\frac{P\,l_o}{2}\left[\frac{3\,\varkappa_o}{\mu}(2 + 3\,\varkappa_u)\,\omega_R \pm \Phi\right].$$

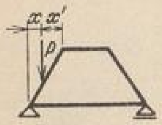


$$\Phi = \frac{1 - 2\,\xi}{\nu},$$

$$\xi = \frac{x}{l_u}, \quad \xi' = \frac{x'}{l_u}. \qquad H_{a,b} = \frac{9\,P\,l_u}{2\,h}\,\frac{\varkappa_u}{\mu}(1 + \varkappa_o)\,\omega_R,$$

$$M_{a,b} = \frac{P\,l_u}{2}\,\varkappa_u\,\omega_R\left[\frac{3}{\mu}(2 + 3\,\varkappa_o) \pm \Phi\right],$$

$$M_{c,d} = -\frac{P\,l_u}{2}\,\varkappa_u\,\omega_R\left[\frac{3}{\mu} \mp \lambda'\Phi\right].$$

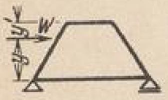


$$\Phi = \frac{\xi}{\nu}\left[\varkappa_u + \xi\,(3 - 2\,\lambda_1\,\xi)\right],$$

$$H_{a,b} = \frac{P\,m}{2\,h}\left\{\xi + \frac{3}{\mu}\left[(1 + \varkappa_u)\,\omega_D - (1 + \varkappa_o)\,\omega_D'\right]\right\},$$

$$M_{a,b} = -\frac{P\,m}{2}\left\{\frac{3}{\mu}\left[(1 + \varkappa_o)\,\omega_D' - \omega_R\right] \pm (\xi - \Phi)\right\},$$

$$\xi = \frac{x}{m}, \quad \xi' = \frac{x'}{m}. \qquad M_{c,d} = -\frac{P\,m}{2}\left\{\frac{3}{\mu}\left[(1 + \varkappa_u)\,\omega_D - \omega_R\right] \mp \lambda'\Phi\right\}.$$



$$\Phi = \frac{\eta}{\nu}\left[\varkappa_u + \eta\,(3 - 2\,\lambda_1\,\eta)\right],$$

$$H_{a,b} = \frac{W}{2}\left\{\frac{3}{\mu}\left[(1 + \varkappa_u)\,\omega_D - (1 + \varkappa_o)\,\omega_D'\right] + \eta - 1 \mp 1\right\},$$

$$M_{a,b} = -\frac{W\,h}{2}\left\{\frac{3}{\mu}\left[(1 + \varkappa_o)\,\omega_D' - \omega_R\right] \pm (\eta - \Phi)\right\},$$

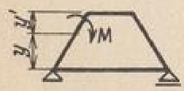
$$M_{c,d} = -\frac{W\,h}{2}\left\{\frac{3}{\mu}\left[(1 + \varkappa_u)\,\omega_D - \omega_R\right] \mp \lambda'\Phi\right\}.$$

$y = h$: $\Phi = \frac{1}{\nu}(2 + \varkappa_u + \lambda')$,

$$H_{a,b} = \mp\frac{W}{2},$$

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

$$M_{c,d} = \pm\frac{W\,h}{2}\,\lambda'\Phi.$$



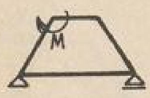
$y > 0$.

$$\Phi = \frac{1}{\nu}\left[\varkappa_u + 6\,\eta\,(1 - \lambda_1\,\eta)\right],$$

$$H_{a,b} = \frac{\mathsf{M}}{2\,h}\left\{1 - \frac{3}{\mu}\left[(1 + \varkappa_u)\,\omega_M + (1 + \varkappa_o)\,\omega_M'\right]\right\},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left\{\frac{1}{\mu}\left[(2 + 3\,\varkappa_o)\,\omega_M' + \omega_M\right] \pm (1 - \Phi)\right\},$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\left\{\frac{1}{\mu}\left[(2 + 3\,\varkappa_u)\,\omega_M + \omega_M'\right] \pm \lambda'\Phi\right\}.$$

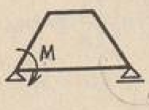


$$\Phi = \frac{1}{\nu}\left[\varkappa_u + 6\,(1 - \lambda_1)\right],$$

$$H_{a,b} = \frac{\mathsf{M}}{2\,h}\left[1 - \frac{3}{\mu}(1 + 2\,\varkappa_u - \varkappa_o)\right],$$

$$M_{a,b} = \frac{\mathsf{M}}{2}\left[\frac{3\,\varkappa_o}{\mu} \mp (1 - \Phi)\right],$$

$$M_{h,k} = \frac{\mathsf{M}}{2}\left[\frac{3}{\mu}(1 + 2\,\varkappa_u) \pm \lambda'\Phi\right].$$



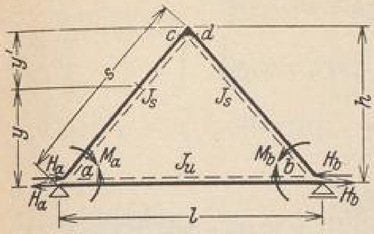
$$H_{a,b} = \frac{\mathsf{M}}{2\,h}\left[1 - \frac{3}{\mu}(1 + 2\,\varkappa_o - \varkappa_u)\right],$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left[\frac{3}{\mu}(1 + 2\,\varkappa_o) \pm \left(1 - \frac{\varkappa_u}{\nu}\right)\right],$$

M_a am Riegel,

$$M_{c,d} = -\frac{\mathsf{M}}{2}\left[\frac{3\,\varkappa_u}{\mu} \mp \lambda'\frac{\varkappa_u}{\nu}\right].$$

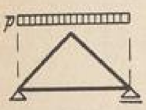
Tabelle 60. Geschlossener, symmetrischer Dreiecksrahmen.



$$\eta = \frac{y}{h}, \qquad \eta' = \frac{y'}{h}, \qquad \varkappa = \frac{l}{s}\,\frac{J_s}{J_u},$$

$$\mu = 3\,(1 + 2\varkappa), \qquad \nu = 2 + \varkappa.$$

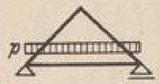
Gleichmäßige Temperaturänderung erzeugt keine Schnittkräfte.



$$H_{a,b} = \frac{3}{16}\,\frac{p\,l^2}{h}\,\frac{1}{\mu}\,(2 + 5\varkappa),$$

$$M_{a,b} = -\frac{p\,l^2}{16\,\mu},$$

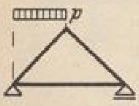
$$M_{c,d} = -\frac{p\,l^2}{16}\,\frac{1 + 3\varkappa}{\mu}.$$



$$H_{a,b} = \frac{3}{4}\,\frac{p\,l^2}{h}\,\frac{\varkappa}{\mu},$$

$$M_{a,b} = \frac{p\,l^2}{2}\,\frac{\varkappa}{\mu},$$

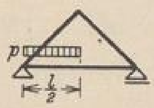
$$M_{c,d} = -\frac{p\,l^2}{4}\,\frac{\varkappa}{\mu}.$$



$$H_{a,b} = \frac{p\,l^2}{32\,h}\left(2 + \frac{3\varkappa}{\mu}\right)$$

$$M_{a,b} = -\frac{p\,l^2}{32}\left[\frac{1}{\mu} \pm \frac{1}{\nu}\right],$$

$$M_{c,d} = -\frac{p\,l^2}{32}\,\frac{1 + 3\varkappa}{\mu}.$$



$$H_{a,b} = \frac{3}{8}\,\frac{p\,l^2}{h}\,\frac{\varkappa}{\mu},$$

$$M_{a,b} = \frac{p\,l^2}{8}\,\varkappa\left(\frac{2}{\mu} \pm \frac{1}{8\,\nu}\right),$$

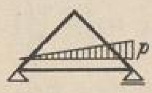
$$M_{c,d} = -\frac{p\,l^2}{8}\,\frac{\varkappa}{\mu}.$$

$$\zeta = \frac{c}{l}.$$

$$H_{a,b} = \frac{3}{8}\,\frac{p\,l^2}{h}\,\frac{\varkappa}{\mu}\,(3\,\zeta - \zeta^3),$$

$$M_{a,b} = \frac{p\,l^2}{4}\,\frac{\varkappa}{\mu}\,(3\,\zeta - \zeta^3),$$

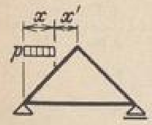
$$M_{c,d} = -\frac{p\,l^2}{8}\,\frac{\varkappa}{\mu}\,(3\,\zeta - \zeta^3).$$



$$H_{a,b} = \frac{3}{8}\,\frac{p\,l^2}{h}\,\frac{\varkappa}{\mu},$$

$$M_{a,b} = \frac{p\,l^2}{120}\,\varkappa\left(\frac{30}{\mu} \mp \frac{1}{\nu}\right),$$

$$M_{c,d} = -\frac{p\,l^2}{8}\,\frac{\varkappa}{\mu}.$$



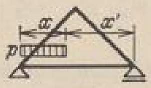
$$\Phi = \frac{1}{2} - \omega_\varphi',$$

$$\xi = \frac{2\,x}{l}, \qquad \xi' = \frac{2\,x'}{l},$$

$$H_{a,b} = \frac{p\,l^2}{16\,h}\left\{\xi^2 + \frac{3}{\mu}\,[(1 + \varkappa)\,\omega_\varphi - \Phi)]\right\},$$

$$M_{a,b} = -\frac{p\,l^2}{16}\left[\frac{1}{\mu}\,(2\,\Phi - \omega_\varphi) \pm \frac{1}{\nu}\,\Phi\right],$$

$$M_{c,d} = -\frac{p\,l^2}{16}\,\frac{1}{\mu}\,[(2 + 3\varkappa)\,\omega_\varphi - \Phi].$$

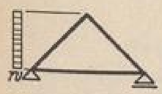


$$\Phi = 3\,\xi^2 - 2\,\xi^3,$$

$$H_{a,b} = \frac{3}{4}\,\frac{p\,l^2}{h}\,\frac{\varkappa}{\mu}\,\Phi,$$

$$M_{a,b} = \frac{p\,l^2}{4}\,\varkappa\left[\frac{2}{\mu}\,\Phi \pm \frac{1}{\nu}\,\omega_R^2\right],$$

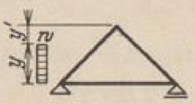
$$\xi = \frac{x}{l}, \quad \xi' = \frac{x'}{l}. \qquad M_{c,d} = -\frac{p\,l^2}{4}\,\frac{\varkappa}{\mu}\,\Phi.$$



$$H_{a,b} = \frac{w\,h}{4}\left[\frac{3\varkappa}{2\,\mu} - 1 \mp 2\right],$$

$$M_{a,b} = -\frac{w\,h^2}{8}\left[\frac{1}{\mu} \pm \frac{1}{\nu}\right],$$

$$M_{c,d} = -\frac{w\,h^2}{8}\,\frac{1 + 3\varkappa}{\mu}.$$

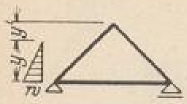


$$\Phi = \frac{1}{2} - \omega_\varphi',$$

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

$$M_{a,b} = -\frac{w\,h^2}{4}\left[\frac{1}{\mu}\,(2\,\Phi - \omega_\varphi) \pm \frac{1}{\nu}\,\Phi\right],$$

$$M_{c,d} = -\frac{w\,h^2}{4}\,\frac{1}{\mu}\,[(2 + 3\varkappa)\,\omega_\varphi - \Phi].$$



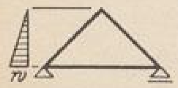
$$H_{a,b} = \frac{w\,h}{120}\,\eta\left\{\frac{3\,\eta}{\mu}\,[10\,(\varkappa - 1) + 15\,\eta - 3\,\eta^2\,\nu] + 10\,\eta - 30 \mp 30\right\},$$

$$M_{a,b} = -\frac{w\,h^2}{120}\,\eta^2\left\{\frac{3}{\mu}\,[10\,(1-\eta) + 3\,\eta^2] \pm \frac{1}{\nu}\,[20 - 15\,\eta + 3\,\eta^2]\right\},$$

$$M_{c,d} = -\frac{w\,h^2}{40}\,\frac{\eta^2}{\mu}\,[10\,\varkappa + 5\,\eta - 3\,(1+\varkappa)\,\eta^2].$$

$$H_{a,b} = \frac{w\,h}{120}\left[\frac{3}{\mu}\,(7\,\varkappa - 1) - 20 \mp 30\right],$$

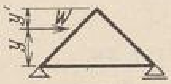
$$M_{a,b} = -\frac{w\,h^2}{40}\left(\frac{3}{\mu} \pm \frac{8}{3\,\nu}\right),$$



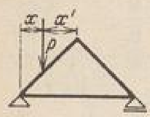
$$M_{c,d} = -\frac{w\,h^2}{40}\,\frac{2 + 7\,\varkappa}{\mu}.$$

$$H_{a,b} = \frac{W}{2}\left\{\frac{3}{\mu}\,[(1+\varkappa)\,\omega_D - \omega_D'] + \eta - 1 \mp 1\right\},$$

$$M_{a,b} = -\frac{w\,h}{2}\left[\frac{3}{\mu}\,(\omega_D' - \omega_R) \pm \frac{\omega_D'}{\nu}\right],$$



$$M_{c,d} = -\frac{w\,h}{2}\,\frac{3}{\mu}[(1+\varkappa)\omega_D - \omega_R].$$



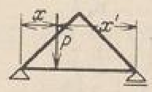
$$\xi = \frac{2\,x}{l}, \qquad \xi' = \frac{2\,x'}{l},$$

$$H_{a,b} = \frac{P\,l}{4\,h}\left\{\xi + \frac{3}{\mu}\,[(1+\varkappa)\,\omega_D - \omega_D']\right\},$$

$$M_{a,b} = -\frac{P\,l}{4}\left[\frac{3}{\mu}\,(\omega_D' - \omega_R) \pm \frac{\omega_D'}{\nu}\right],$$

$$M_{c,d} = -\frac{P\,l}{4}\,\frac{3}{\mu}\,[(1+\varkappa)\,\omega_D - \omega_R].$$

$$H_{a,b} = \frac{9}{2}\,\frac{P\,l}{h}\,\frac{\varkappa}{\mu}\,\omega_R,$$

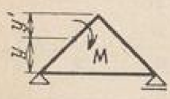


$$M_{a,b} = \frac{P\,l}{2}\,\varkappa\,\omega_R\left(\frac{6}{\mu} \pm \frac{1 - 2\,\xi}{\nu}\right),$$

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

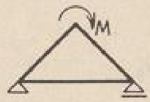
$$H_{a,b} = \frac{\mathsf{M}}{2\,h}\left\{1 - \frac{3}{\mu}\,[(1+\varkappa)\,\omega_M + \omega_M']\right\},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left[\frac{1}{\mu}\,(2\,\omega_M' + \omega_M) \pm \frac{1}{\nu}\,\omega_M'\right],$$



$$M_d = \frac{\mathsf{M}}{2}\,\frac{1}{\mu}\,[(2+3\varkappa)\,\omega_M + \omega_M'].$$

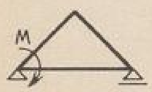
$y > 0$



$$H_{a,b} = 0,$$

$$M_{a,b} = \pm\frac{\mathsf{M}}{2\,\nu},$$

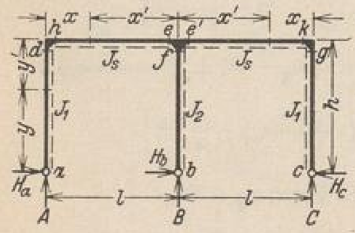
$$M_{c,d} = \mp\frac{\mathsf{M}}{2}.$$



$$H_{a,b} = \frac{9}{2}\,\frac{\mathsf{M}}{h}\,\frac{\varkappa}{\mu}, \qquad M_{c,d} = -\frac{3}{2}\,\mathsf{M}\,\frac{\varkappa}{\mu},$$

$$M_{a,b} = -\frac{\mathsf{M}}{2}\left[\frac{3}{\mu} \pm \frac{2}{\nu}\right], \qquad M_a \text{ am Riegel.}$$

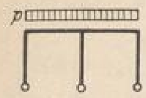
Tabelle 61. Symmetrischer, dreistieliger Rahmen mit geradem Riegel.



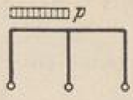
$$\xi = \frac{x}{l}, \quad \eta = \frac{y}{h}, \quad \varkappa_1 = \frac{h}{l}\,\frac{J_s}{J_1}, \quad \mu = 3 + 4\,\varkappa_1, \quad \alpha = 3 + 2\,\varkappa_1.$$

$$\xi' = \frac{x'}{l}, \quad \eta' = \frac{y'}{h}, \quad \varkappa_2 = \frac{h}{l}\,\frac{J_s}{J_2}, \quad \nu = 3 + \varkappa_1 + 2\,\varkappa_2,$$

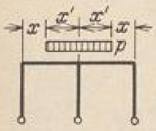
$M_{h,k} = M_{d,g}$, wenn nicht besonders angegeben.



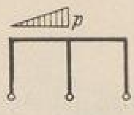
$$M_{d,g} = -\frac{p\,l^2}{4\,\mu},$$
$$M_{e,e'} = -\frac{p\,l^2}{4\,\mu}\,(1 + 2\,\varkappa_1),$$
$$M_f = 0.$$



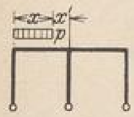
$$M_{d,g} = -\frac{p\,l^2}{8}\left[\frac{1}{\mu} \pm \frac{1}{\nu}\right],$$
$$M_{e,e'} = -\frac{p\,l^2}{8}\left[\frac{1 + 2\,\varkappa_1}{\mu} \pm \frac{1}{\nu}\right]$$
$$M_f = \frac{p\,l^2}{4\,\nu}.$$



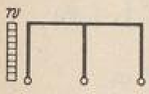
$$M_{d,g} = -\frac{p\,x'^2}{4\,\mu}\,\xi'\,(4 - 3\,\xi'),$$
$$M_{e,e'} = -\frac{p\,x'^2}{4\,\mu}\,[2\,\mu - 8(1+\varkappa_1)\,\xi' + \alpha\,\xi'^2],$$
$$M_f = 0.$$



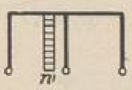
$$M_{d,g} = -\frac{p\,l^2}{40}\left[\frac{2}{\mu} \pm \frac{5}{2\,\nu}\right],$$
$$M_{e,e'} = \frac{p\,l^2}{120}\left[\frac{9 + 16\,\varkappa_1}{\mu} \pm \frac{15}{2\,\nu}\right],$$
$$M_f = \frac{p\,l^2}{8\,\nu}.$$



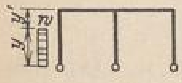
$$\Phi = \frac{1}{\nu}\,(3 - 2\,\xi), \qquad M_{e,e'} = -\frac{p\,x^2}{8}\left[\frac{1}{\mu}\,(4\,\varkappa_1 + 4\,\xi - \alpha\,\xi^2) \pm \Phi\right],$$
$$M_{d,g} = -\frac{p\,x^2}{8}\left[\frac{1}{\mu}\,(6 - 8\,\xi + 3\,\xi^2) \pm \Phi\right], \qquad M_f = \frac{p\,x^2}{4}\,\Phi.$$



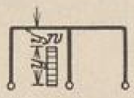
$$\Phi = \frac{1}{2\,\nu}\,(2\,\alpha + \varkappa_1),$$
$$M_{d,g} = -\frac{w\,h^2}{4}\left[\frac{\varkappa_1}{\mu} \mp \left(1 - \frac{1}{2}\,\Phi\right)\right],$$
$$M_{e,e'} = \frac{w\,h^2}{8}\left[\frac{\varkappa_1}{\mu} \mp \Phi\right],$$
$$M_f = \frac{w\,h^2}{4}\,\Phi.$$



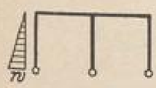
$$\Phi = \frac{1}{2\,\nu}\,(\alpha - \varkappa_2),$$
$$M_{d,g} = \pm\frac{w\,h^2}{4}\,[1 - \Phi],$$
$$M_{e,e'} = \mp\frac{w\,h^2}{4}\,\Phi,$$
$$M_f = \frac{w\,h^2}{2}\,\Phi.$$



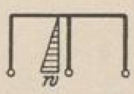
$$\Phi = \frac{1}{2\,\nu}\,[\varkappa_1\,(2 - \eta^2) + 2\,\alpha],$$
$$M_{d,g} = -\frac{w\,y^2}{8}\left[2\,\frac{\varkappa_1}{\mu}\,(2 - \eta^2) \mp (2 - \Phi)\right],$$
$$M_{e,e'} = \frac{w\,y^2}{8}\left[\frac{\varkappa_1}{\mu}\,(2 - \eta^2) \mp \Phi\right],$$
$$M_f = \frac{w\,y^2}{4}\,\Phi.$$



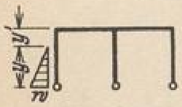
$$\Phi = \frac{1}{2\,\nu}\,[\alpha - \varkappa_2\,(2 - \eta^2)],$$
$$M_{d,g} = \pm\frac{w\,y^2}{4}\,[1 - \Phi],$$
$$M_{e,e'} = \mp\frac{w\,y^2}{4}\,\Phi,$$
$$M_f = \frac{w\,y^2}{2}\,\Phi.$$



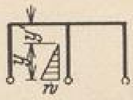
$$\Phi = \frac{3}{2\,\nu}\,(10 + 9\,\varkappa_1),$$
$$M_{d,g} = -\frac{w\,h^2}{120}\left[14\,\frac{\varkappa_1}{\mu} \mp (10 - \Phi)\right],$$
$$M_{e,e'} = \frac{w\,h^2}{120}\left[7\,\frac{\varkappa_1}{\mu} \mp \Phi\right],$$
$$M_f = \frac{w\,h^2}{60}\,\Phi.$$



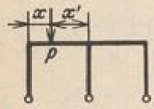
$$\Phi = \frac{1}{\nu}\,(7\,\varkappa_2 - 5\,\alpha),$$
$$M_{d,g} = \pm\frac{w\,h^2}{120}\,[10 + \Phi],$$
$$M_{e,e'} = \mp\frac{w\,h^2}{120}\,\Phi,$$
$$M_f = \frac{w\,h^2}{60}\,\Phi.$$



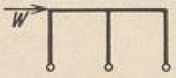
$$\Phi = \frac{3}{2\nu}\left[10(1+\varkappa_1) - \varkappa_1\eta^2\right],$$
$$M_{d,g} = -\frac{w y^2}{120}\left[2\frac{\varkappa_1}{\mu}(10 - 3\eta^2) \mp (10 - \Phi)\right],$$
$$M_{e,e'} = \frac{w y^2}{120}\left[\frac{\varkappa_1}{\mu}(10 - 3\eta^2) \mp \Phi\right],$$
$$M_f = \frac{w y^2}{60}\Phi.$$



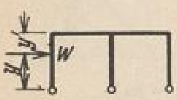
$$\Phi = \frac{1}{\nu}\left[5(\alpha - 2\varkappa_2) + 3\varkappa_2\eta^2\right],$$
$$M_{d,g} = \pm\frac{w y^2}{120}(10 - \Phi),$$
$$M_{e,e'} = \mp\frac{w y^2}{120}\Phi,$$
$$M_f = +\frac{w y^2}{60}\Phi.$$



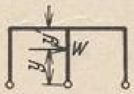
$$M_{d,g} = -\frac{3}{2} P l\,\omega_R\left[\frac{1}{\mu}\xi' \pm \frac{1}{2\nu}\right],$$
$$M_{e,e'} = -\frac{P l}{2}\omega_R\left[\frac{1}{\mu}(2\varkappa_1 + \alpha\xi) \pm \frac{3}{2\nu}\right],$$
$$M_f = \frac{3}{2}\frac{P l}{\nu}\omega_R.$$



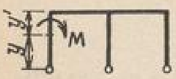
$$M_{d,g} = \pm\frac{W h}{2}\left(1 - \frac{\alpha}{2\nu}\right),$$
$$M_{e,e'} = \mp\frac{W h}{4}\frac{\alpha}{\nu},$$
$$M_f = \frac{W h}{2}\frac{\alpha}{\nu}.$$



$$\Phi = \frac{1}{2\nu}\left[\varkappa_1(1 - \eta^2) + \alpha\right],$$
$$M_{d,g} = -\frac{W y}{2}\left[2\frac{\varkappa_1}{\mu}(1 - \eta^2) \mp (1 - \Phi)\right],$$
$$M_{e,e'} = \frac{W y}{2}\left[\frac{\varkappa_1}{\mu}(1 - \eta^2) \mp \Phi\right],$$
$$M_f = W y\,\Phi.$$



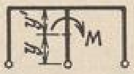
$$\Phi = \frac{1}{2\nu}\left[2\varkappa_2(1 - \eta^2) - \alpha\right],$$
$$M_{d,g} = \pm\frac{W y}{2}\left[1 + \Phi\right],$$
$$M_{e,e'} = \pm\frac{W y}{2}\Phi,$$
$$M_f = -W y\,\Phi.$$



$$\Phi = \frac{1}{2\nu}(\alpha - \varkappa_1\omega_M),$$
$$M_{hk} = +\frac{\mathsf{M}}{2}\left[2\frac{\varkappa_1}{\mu}\omega_M \pm (1 - \Phi)\right],$$
$$M_{e,e'} = -\frac{\mathsf{M}}{2}\left[\frac{\varkappa_1}{\mu}\omega_M \pm \Phi\right],$$
$$M_f = \mathsf{M}\Phi.$$

$y = h$: $\Phi = \frac{3}{2\nu}$, $\omega_M = 2$,

$y = 0$: $\Phi = \frac{3}{2\nu}(1 + \varkappa_1)$, $\omega_M = -1$.

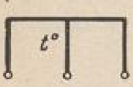


$$\Phi = +\frac{1}{2\nu}(\alpha + 2\varkappa_2\omega_M),$$
$$M_{d,g} = \pm\frac{\mathsf{M}}{2}(1 - \Phi),$$
$$M_{e,e'} = \mp\frac{\mathsf{M}}{2}\Phi,$$

$y' > 0$: $M_f = \mathsf{M}\Phi$,

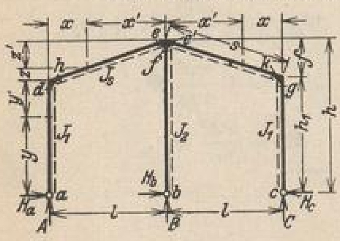
$y = h$: $\Phi = \frac{1}{2\nu}(2\nu - 3)$, $M_f = -\mathsf{M}(1 - \Phi)$,

$y = 0$: $\Phi = \frac{1}{2\nu}(\alpha - 2\varkappa_2)$.



$$M_{d,g} = -\frac{12 E J_s \alpha_t t}{\mu h}, \qquad M_{e,e'} = \frac{6 E J_s \alpha_t t}{\mu h}, \qquad M_f = 0.$$

Tabelle 62. Symmetrischer, dreistieliger Rahmen mit gebrochenem Riegel.

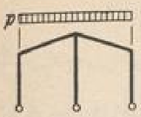


$\xi = \frac{x}{l}$, $\zeta = \frac{z}{f}$, $\varphi = \frac{f}{h}$, $\varphi' = \frac{h_1}{h}$, $\varphi'' = \frac{h}{h_1}$,

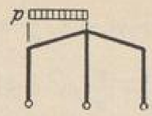
$\xi' = \frac{x'}{l}$, $\zeta' = \frac{z'}{f}$, $\varkappa_1 = \frac{h_1}{s}\frac{J_s}{J_1}$, $\varkappa_2 = \frac{h}{s}\frac{J_s}{J_2}$, $\mu = 3 + 4\varkappa_1$,

$\alpha = 2(1 + \varkappa_1) + \varphi''$, $\nu = 1 + 2\varkappa_2 + \varphi' + \varphi'^2(1 + \varkappa_1)$,

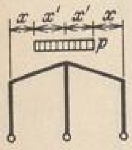
$M_{h,k} = M_{d,g}$, wenn nicht besonders angegeben.



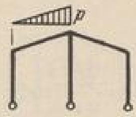
$$M_{d,g} = -\frac{p\,l^2}{4\,\mu}, \qquad M_{e,e'} = -\frac{p\,l^2}{4\,\mu}\left[1 + 2\,\varkappa_1\right], \qquad M_f = 0.$$



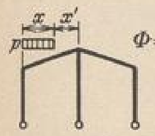
$$M_{d,g} = -\frac{p\,l^2}{8}\left[\frac{\varphi'(1+\varphi')}{2\,\nu}\right], \qquad M_{e,e'} = -\frac{p\,l^2}{8}\left[\frac{1+2\,\varkappa_1}{\mu} \pm \frac{1+\varphi'}{2\,\nu}\right], \qquad M_f = \frac{p\,l^2}{8}\,\frac{1+\varphi'}{\nu}.$$



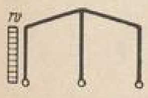
$$M_{d,g} = -\frac{p\,x'^2}{4\,\mu}\,\xi'\left[4 - 3\,\xi'\right],$$
$$M_{e,e'} = -\frac{p\,x'^2}{4\,\mu}\left[2\,\mu - 8\,(1+\varkappa_1)\,\xi' + (3 + 2\,\varkappa_1)\,\xi'^2\right],$$
$$M_f = 0.$$



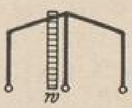
$$\Phi = \frac{8 + 7\,\varphi'}{\nu},$$
$$M_{d,g} = -\frac{p\,l^2}{120}\left[\frac{6}{\mu} \pm \frac{\varphi'}{2}\,\Phi\right],$$
$$M_{e,e'} = -\frac{p\,l^2}{120}\left[\frac{9 + 16\,\varkappa_1}{\mu} \pm \frac{1}{2}\,\Phi\right],$$
$$M_f = \frac{p\,l^2}{120}\,\Phi.$$



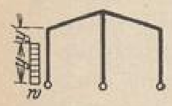
$$\Phi = \frac{1}{\nu}\left[3 - 2\,\xi - \frac{\varphi}{2}\,(\xi^2 + 4\,\xi')\right], \qquad M_{e,e'} = -\frac{p\,x^2}{8}\left\{\frac{1}{\mu}\left[4\,\varkappa_1 + 4\,\xi - (3 + 2\,\varkappa_1)\,\xi^2\right] \pm \Phi\right\},$$
$$M_{d,g} = -\frac{p\,x^2}{8}\left[\frac{1}{\mu}\,(6 - 8\,\xi + 3\,\xi^2) \pm \varphi'\,\Phi\right], \qquad M_f = \frac{p\,x^2}{4}\,\Phi.$$



$$\Phi = \frac{\varphi'}{2\,\nu}\,(2\,\alpha + \varkappa_1),$$
$$M_{d,g} = -\frac{w\,h_1^2}{4}\left[\frac{\varkappa_1}{\mu} \mp \left(1 - \frac{\varphi'}{2}\,\Phi\right)\right],$$
$$M_{e,e'} = \frac{w\,h_1^2}{8}\left[\frac{\varkappa_1}{\mu} \mp \Phi\right],$$
$$M_f = \frac{w\,h_1^2}{4}\,\Phi.$$

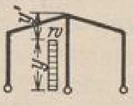


$$\Phi = \frac{1}{2\,\nu}\,(\varphi'^2\,\alpha - \varkappa_2),$$
$$M_{d,g} = \pm\frac{w\,h^2}{4}\,\varphi'\left[1 - \Phi\right],$$
$$M_{e,e'} = \mp\frac{w\,h^2}{4}\,\Phi,$$
$$M_f = \frac{w\,h^2}{2}\,\Phi.$$



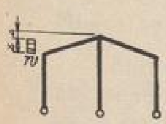
$$\eta = \frac{y}{h_1}, \qquad \eta' = \frac{y'}{h_1}.$$

$$\Phi = \frac{\varphi'}{2\,\nu}\left[\varkappa_1\,(2 - \eta^2) + 2\,\alpha\right],$$
$$M_{d,g} = -\frac{w\,y^2}{8}\left[2\,\frac{\varkappa_1}{\mu}\,(2 - \eta^2) \mp (2 - \varphi'\,\Phi)\right],$$
$$M_{e,e'} = \frac{w\,y^2}{8}\left[\frac{\varkappa_1}{\mu}\,(2 - \eta^2) \mp \Phi\right],$$
$$M_f = \frac{w\,y^2}{4}\,\Phi.$$

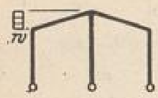


$$\eta = \frac{y}{h}, \qquad \eta' = \frac{y'}{h}.$$

$$\Phi = \frac{1}{2\,\nu}\left[\varphi'^2\,\alpha - \varkappa_2\,(2 - \eta^2)\right],$$
$$M_{d,g} = \pm\frac{w\,y^2}{4}\,\varphi'\left[1 - \Phi\right],$$
$$M_{e,e'} = \mp\frac{w\,y^2}{4}\,\Phi,$$
$$M_f = \frac{w\,y^2}{2}\,\Phi.$$



$$\psi = \frac{1}{2} - \omega'_\varphi, \qquad \Phi = \frac{1}{4\,\nu}\left(\omega_\varphi + \varphi'\,\psi + 2\,\frac{\varphi'^2}{\varphi}\,\alpha\,\zeta\right),$$
$$M_{d,g} = -\frac{w\,f^2}{2}\left[\frac{1}{2\,\mu}\,(2\,\psi - \omega_\varphi) \mp \frac{\varphi'}{\varphi}\,(\zeta - \varphi\,\Phi)\right],$$
$$M_{e,e'} = -\frac{w\,f^2}{2}\left[\frac{1}{2\,\mu}\left[2\,\omega_\varphi(1+\varkappa_1) - \psi\right] \pm \Phi\right], \qquad M_f = w f^2\,\Phi.$$



$$\Phi = \frac{1}{2\nu}\left(1 + \varphi' + 4\frac{\varphi'^2}{\varphi}\alpha\right),$$

$$M_{d,g} = -\frac{w f^2}{8}\left[\frac{1}{\mu} \mp \frac{\varphi'}{\varphi}(4 - \varphi\,\Phi)\right],$$

$$M_{e,e'} = -\frac{w f^2}{8}\left[\frac{1}{\mu} + \frac{2\varkappa_1}{\mu} \pm \Phi\right],$$

$$M_f = \frac{w \cdot f^2}{4}\Phi.$$

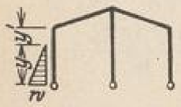
$$\eta = \frac{y}{h}, \quad \eta' = \frac{y'}{h}$$

$$\Phi = \frac{1}{\nu}\left[5(\varphi'^2\alpha - 2\varkappa_2) + 3\varkappa_2\eta^2\right],$$

$$M_{d,g} = \pm\frac{w y^2}{120}\varphi'[10 - \Phi],$$

$$M_{e,e'} = \mp\frac{w y^2}{120}\Phi,$$

$$M_f = +\frac{w y^2}{60}\Phi,$$

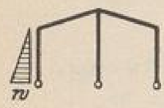


$$\eta = \frac{y}{h_1}, \quad \eta' = \frac{y'}{h_1}.$$

$$\Phi = \frac{\varphi'}{2\nu}\left[10(\alpha + \varkappa_1) - 3\varkappa_1\eta^2\right],$$

$$M_{d,g} = -\frac{w y^2}{120}\left[\frac{2\varkappa_1}{\mu}(10 - 3\eta^2) \mp (10 - \varphi'\Phi)\right],$$

$$M_{e,e'} = \frac{w y^2}{120}\left[\frac{\varkappa_1}{\mu}(10 - 3\eta^2) \mp \Phi\right], \qquad M_f = \frac{w y^2}{60}\Phi.$$

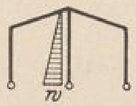


$$\Phi = \frac{\varphi'}{2\nu}(10\alpha + 7\varkappa_1),$$

$$M_{d,g} = -\frac{w h_1^2}{120}\left[14\frac{\varkappa_1}{\mu} \mp (10 - \varphi'\Phi)\right],$$

$$M_{e,e'} = \frac{w h_1^2}{120}\left[7\frac{\varkappa_1}{\mu} \mp \Phi\right],$$

$$M_f = \frac{w h_1^2}{60}\Phi.$$

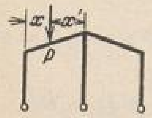


$$\Phi = \frac{1}{\nu}(7\varkappa_2 - 5\varphi'^2\alpha),$$

$$M_{d,g} = \pm\frac{w h^2}{120}\varphi'(10 + \Phi),$$

$$M_{e,e'} = \pm\frac{w h^2}{120}\Phi,$$

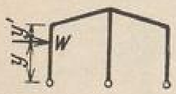
$$M_f = -\frac{w h^2}{60}\Phi.$$



$$M_{d,g} = -\frac{Pl}{2}\omega_R\left\{\frac{3}{\mu}\xi' \pm \frac{\varphi'}{2\nu}[3 - \varphi(1 + \xi')]\right\},$$

$$M_{e,e'} = -\frac{Pl}{2}\omega_R\left\{\frac{1}{\mu}[2\varkappa_1 + (3 + 2\varkappa_1)\xi] \pm \frac{1}{2\nu}[3 - \varphi(1 + \xi')]\right\},$$

$$M_f = \frac{Pl}{2}\frac{\omega_R}{\nu}[3 - \varphi(1 + \xi')].$$

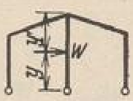


$$\Phi = \frac{\varphi'}{\nu}\left[\varkappa_1(1 - \eta^2) + \alpha\right],$$

$$M_{d,g} = -\frac{W y}{2}\left[2\frac{\varkappa_1}{\mu}(1 - \eta^2) \mp \left(1 - \frac{\varphi'}{2}\Phi\right)\right],$$

$$M_{e,e'} = \frac{W y}{2}\left[\frac{\varkappa_1}{\mu}(1 - \eta^2) \mp \frac{1}{2}\Phi\right],$$

$$M_f = \frac{W y}{2}\Phi.$$

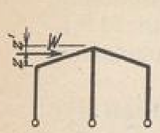


$$\Phi = \frac{1}{2\nu}\left[2\varkappa_2(1 - \eta^2) - \varphi'^2\alpha\right],$$

$$M_{d,g} = \pm\frac{W y}{2}\varphi'(1 + \Phi)$$

$$M_{e,e'} = \pm\frac{W y}{2}\Phi,$$

$$M_f = -W y \cdot \Phi.$$



$$\Phi = \frac{1}{2\nu}\left(\omega_D + \varphi'\omega'_D + \frac{\varphi'^2}{\varphi}\alpha\right),$$

$$M_{d,g} = -\frac{Wf}{2}\left[\frac{1}{\mu}(2\omega'_D - \omega_D) \mp \frac{\varphi'}{\varphi}(1 - \varphi\Phi)\right],$$

$$M_{e,e'} = -\frac{Wf}{4}\left[\omega_D + \frac{1}{\mu}(2\omega_D - \omega'_D) \pm 2\Phi\right],$$

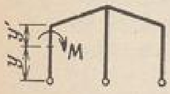
$$M_f = W f \Phi.$$

$z = 0$:

$$M_{d,g} = \pm\frac{W h_1}{2}\left(1 - \frac{\varphi'^2}{2\nu}\alpha\right),$$

$$M_{e,e'} = \mp\frac{W h_1}{4}\frac{\varphi'}{\nu}\alpha,$$

$$M_f = \frac{W h_1}{2}\frac{\varphi'}{\nu}\alpha.$$



$$\Phi = \frac{\varphi'}{2\nu}(\alpha - \varkappa_1\omega_M),$$

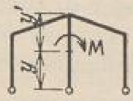
$$M_{h,k} = \frac{\mathrm{M}}{2}\left[2\frac{\varkappa_1}{\mu}\omega_M \pm (1 - \varphi'\Phi)\right],$$

$$\eta = \frac{y}{h_1},\quad \eta' = \frac{y'}{h_1}.\quad M_{e,e'} = -\frac{\mathrm{M}}{2}\left[\frac{\varkappa_1}{\mu}\omega_M \pm \Phi\right],$$

$$M_f = \mathrm{M}\Phi.$$

$$y = h_1:\quad \Phi = \frac{\varphi'}{2\nu}(2 + \varphi''),\quad \omega_M = 2.$$

$$y = 0:\quad \Phi = \frac{\varphi'}{2\nu}(\alpha + \varkappa_1),\quad \omega_M = -1.$$



$$\Phi = \frac{1}{2\nu}(2\varkappa_2\omega_M + \varphi'^2\alpha),$$

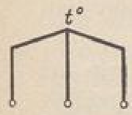
$$M_{d,g} = \pm\frac{\mathrm{M}}{2}\varphi'(1 - \Phi),$$

$$\eta = \frac{y}{h},\quad \eta' = \frac{y'}{h}.\quad M_{e,e'} = \mp\frac{\mathrm{M}}{2}\Phi,$$

$$y' > 0:\quad M_f = \mathrm{M}\Phi.$$

$$y = h:\quad \Phi = \frac{1}{2\nu}(4\varkappa_2 + \varphi'^2\alpha),\quad M_f = -\mathrm{M}(1 - \Phi).$$

$$y = 0:\quad \Phi = \frac{1}{2\nu}(\varphi'^2\alpha - 2\varkappa_2).$$



$$M_{d,g} = -\frac{12 E J_s l \alpha_t t}{\mu s h_1},$$

$$M_{e,e'} = \frac{6 E J_s \alpha_t t l}{\mu s h_1},\qquad M_f = 0.$$

62. Die räumliche Belastung des ebenen Tragwerks.

Während das ebene Tragwerk bei Belastung in der Symmetrieebene als Scheibe oder Scheibenverbindung angesehen und berechnet wird, ist bei allgemeinem Kraftangriff die räumliche Betrachtung von Träger, Stützung und Formänderung notwendig. Der Abschnitt eines Stabes besitzt in diesem Falle sechs Freiheitsgrade, so daß für die äußeren Kräfte sechs Gleichgewichtsbedingungen angeschrieben werden können. Die Verschiebung eines Querschnitts ist durch sechs geometrische Parameter, der Spannungszustand (σ_x, τ_{xy}, τ_{xz}) eines Querschnitts bei Annahme eines linearen Ansatzes für σ_x durch sechs Schnittkräfte (43) bestimmt.

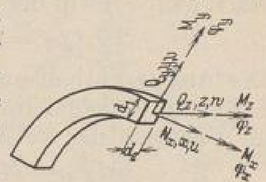


Abb. 581.

Die äußeren Kräfte werden in Komponenten zerlegt, die in der Trägerebene und senkrecht dazu angreifen. Der Beitrag jeder Gruppe zum Spannungs- und Verschiebungszustand darf nach dem Superpositionsgesetz getrennt angegeben werden. Die räumliche Belastung besteht daher nur aus Kräften winkelrecht zur Ebene des Tragwerks, für welche das Biegungsmoment M_z und die Querkraft Q_y Null sind, während die Verschiebungen u, v und die Verdrehung φ_z als klein gegen die Komponenten w, φ_x, φ_y vernachlässigt werden (Abb. 581).

Lösung A. Die ebenen Tragwerke des Bauwesens mit räumlichem Charakter sind, abgesehen von wenigen Ausnahmen, statisch unbestimmt. Der Spannungszustand kann daher ebenso wie in Abschn. 24 aus den Schnittkräften eines Hauptsystems entwickelt werden, an dem die statisch unbestimmten Schnittkräfte neben der