Die Statik im Stahlbetonbau

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Berlin [u.a.], 1956

Tabellen für die Schnittkräfte am symmetrischen Dreigelenkbogen

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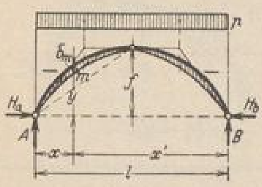
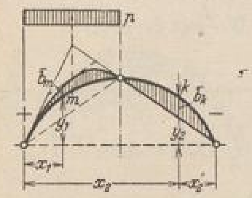
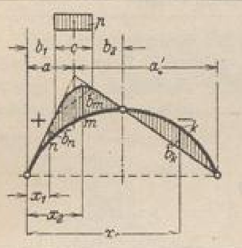
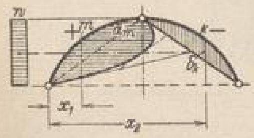
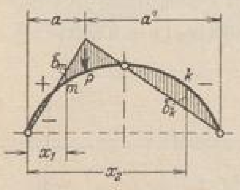
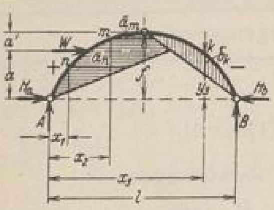
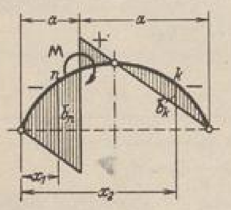
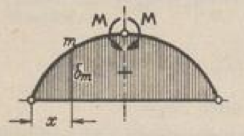
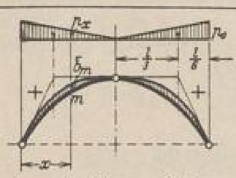
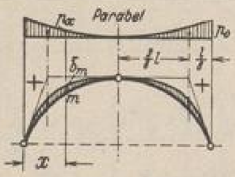
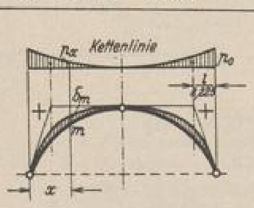
Tabelle 9. Schnittkräfte am symmetrischen Dreigelenkbogen.

$$\frac{x}{l}=\xi,\qquad \frac{x'}{l}=\xi',\qquad \xi-\xi^2=\omega_R,\qquad \xi-\xi^3=\omega_D;\qquad \frac{y}{f}=\eta,\qquad \frac{y'}{f}=\eta'.$$

Belastung*	Auflagerdruck	Biegungsmoment
	$A=B=\frac{pl}{2}$ $H_a=H_b=\frac{pl^2}{8f}$	$M_m=\frac{pl^2}{8}(4\omega_R-\eta)$ Für Parabelbogen: $M_m=0$
	$A=\frac{3}{8}pl$ $B=\frac{1}{8}pl$ $H_a=H_b=\frac{pl^2}{16f}$	$M_m=\frac{pl^2}{16}(8\omega_{R_1}-2\xi_1-\eta_1)$ $M_k=\frac{pl^2}{16}(2\xi_2'-\eta_2)$
	$A=\frac{pca'}{l}$ $B=\frac{pca}{l}$ $H_a=H_b=\frac{pca}{2f}$	$M_n=\frac{pca}{2}\left(2\frac{a'}{a}\xi_1-\eta_1\right)$ $M_m=\frac{pca}{2}\left(2\frac{a'}{a}\xi_2-\eta_2-\frac{(x_2-b_1)^2}{ac}\right)$ $M_k=\frac{pca}{2}(2\xi_3'-\eta_3)$
	auch gültig für $b_1=0$ oder $b_2=0$	
	$A=-\frac{wf^2}{2l}$ $B=\frac{wf^2}{2l}$ $H_a=-\frac{3}{4}wf$ $H_b=\frac{1}{4}wf$	$M_m=-\frac{wf^2}{2}\left(\xi_1-\frac{3}{2}\eta_1+\eta_1^2\right)$ $M_k=\frac{wf^2}{4}(2\xi_2'-\eta_2)$
	$A=P\frac{a'}{l}$ $B=P\frac{a}{l}$ $H_a=H_b=P\frac{a}{2f}$	$M_m=P\frac{a}{2}\left(2\frac{a'}{a}\xi_1-\eta_1\right)$ $M_k=P\frac{a}{2}(2\xi_2'-\eta_2)$
Sonderfall $a=\frac{l}{2}$	$A=B=\frac{P}{2}$ $H_a=H_b=\frac{Pl}{4f}$	$M_m=P\frac{l}{4}(2\xi_1-\eta_1)$

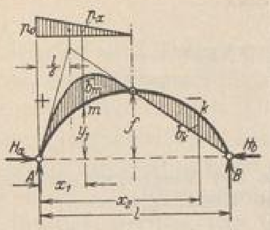
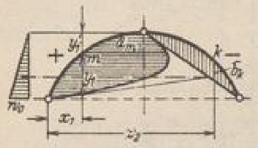
* Die Momente sind dargestellt durch $\bar{b}=\frac{M}{H_b}$, $\bar{a}=\frac{M}{B}$.

Tabelle 9 (Fortsetzung).

Belastung	Auflagerdruck	Biegungsmoment
	$A = -W\frac{a}{l}$ $B = W\frac{a}{l}$ $H_a = -W\frac{a'+f}{2f}$ $H_b = W\frac{a}{2f}$	$M_n = -W\frac{a}{2}\left(2\xi_1 - \frac{a'+f}{a}\eta_1\right)$ $M_m = -W\frac{a}{2}\left(2\xi_2 - \frac{a'+f}{a}\eta_2 + 2\frac{y_2-a}{a}\right)$ $M_k = W\frac{a}{2}(2\xi_3' - \eta_3)$
Sonderfall $a = f$	$A = -B = -W\frac{f}{l}$ $H_a = -H_b = -\frac{W}{2}$	$M_n = -W\frac{f}{2}(2\xi_1 - \eta_1)$
	$A = -\frac{\mathsf{M}}{l}$ $B = \frac{\mathsf{M}}{l}$ $H_a = H_b = \frac{\mathsf{M}}{2f}$	$M_n = -\frac{\mathsf{M}}{2}(2\xi_1 + \eta_1)$ $M_k = \frac{\mathsf{M}}{2}(2\xi_2' - \eta_1)$
	auch gültig für $a = 0$ oder $a = \frac{l}{2}$	
	$A = B = 0$ $H_a = H_b = -\frac{\mathsf{M}}{f}$	$M_m = \mathsf{M}\,\eta$
 $p_x = p_0\,\lvert(1 - 2\xi)\rvert$	$A = B = \frac{p_0 l}{4}$ $H_a = H_b = \frac{p_0 l^2}{24 f}$	$M_m = \frac{p_0 l^2}{24}[2\xi + 4(\omega_D' - \omega_D) - \eta]$
 $p_x = p_0(1 - 4\omega_R)$	$A = B = \frac{p_0 l}{6}$ $H_a = H_b = \frac{p_0 l^2}{48 f}$	$M_m = \frac{p_0 l^2}{48}[8\omega_R(1 - 2\omega_R) - \eta]$
	$A = B = \frac{p_0 l}{2}\left(\frac{\mathfrak{Sin}\,\alpha}{\alpha} - 1\right) = \frac{1}{6{,}3452}p_0 l$ $H_a = H_b = \frac{p_0 l^2}{4f}\left(\frac{1}{\alpha^2} - \frac{1}{2}\right) = \frac{1}{52{,}1989}\frac{p_0 l^2}{f}$	$M_m = \frac{p_0 l^2}{4}\left[\frac{2}{\alpha^2} - 2\omega_R - \frac{1}{\alpha^2}\mathfrak{Cof}\,\alpha(2\xi - 1) - \left(\frac{1}{\alpha^2} - \frac{1}{2}\right)\eta\right]$

$p_x = p_0[\mathfrak{Cof}\,\alpha(2\xi - 1) - 1]$, $\alpha = \mathfrak{Ar}\,\mathfrak{Cof}\,2 = 1{,}3169$.

Tabelle 9 (Fortsetzung).

Belastung	Auflagerdruck	Biegungsmoment
	$A = \frac{5}{24} p l$ $B = \frac{1}{24} p l$ $H_a = H_b = \frac{p l^2}{48 f}$	$M_m = \frac{p l^2}{48} [2 \xi_1 + 8 (\omega'_{D_1} - \omega_{D_1}) - \eta_1]$ $M_k = \frac{p l^2}{48} (2 \xi'_2 - \eta_2)$
	$A = -\frac{w_0 f^2}{6 l}$ $B = \frac{w_0 f^2}{6 l}$ $H_a = -\frac{5}{12} w_0 f$ $H_b = \frac{1}{12} w_0 f$	$M_m = \frac{w_0 f^2}{12} [2 (\eta'_1 - \eta'^3_1) + \eta_1 - 2 \xi_1]$ $M_k = \frac{w_0 f^2}{12} (2 \xi'_2 - \eta_2)$

Die angegebenen Formeln gelten für jede symmetrische Bogenform $y = f(x)$. Sie sind daher auch auf beliebige symmetrische Dreigelenkrahmen anwendbar. Haben diese senkrechte Pfosten, so bedeutet y sinngemäß die Ordinate des betrachteten Querschnitts. Ein Beispiel sei hierfür angegeben:

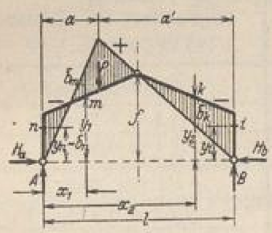
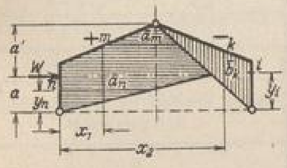
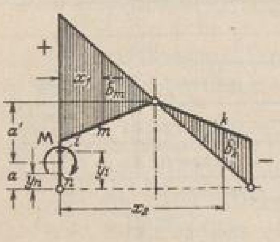
	$A = P \frac{a'}{l}$ $B = P \frac{a}{l}$ $H_a = H_b = P \frac{a}{2 f}$	$M_n = -P \frac{a}{2} \eta_n$ $M_m = P \frac{a}{2} \left(2 \frac{a'}{a} \xi_1 - \eta_1\right)$ $M_k = P \frac{a}{2} (2 \xi'_2 - \eta_2)$ $M_i = -P \frac{a}{2} \eta_i$
	$A = -W \frac{a}{l}$ $B = W \frac{a}{l}$ $H_a = -W \frac{a' + f}{2 f}$ $H_b = W \frac{a}{2 f}$	$M_n = W \frac{a' + f}{2} \eta_n$ $M_m = -W \frac{a}{2} \left(2 \xi_1 - \frac{a' + f}{a} \eta_1 + 2 \frac{y_1 - a}{a}\right)$ $M_k = W \frac{a}{2} (2 \xi'_2 - \eta_2)$ $M_i = -W \frac{a}{2} \eta_i$
	$A = -\frac{\mathsf{M}}{l}$ $B = \frac{\mathsf{M}}{l}$ $H_a = H_b = \frac{\mathsf{M}}{2 f}$	$M_n = -\frac{\mathsf{M}}{2} \eta_n$ $M_i = \frac{\mathsf{M}}{2} (2 - \eta_i)$ $M_m = \frac{\mathsf{M}}{2} (2 \xi'_1 - \eta_1)$ $M_k = \frac{\mathsf{M}}{2} (2 \xi'_2 - \eta_2)$

Tabelle 10. Schnittkräfte am symmetrischen Dreigelenkbogen.

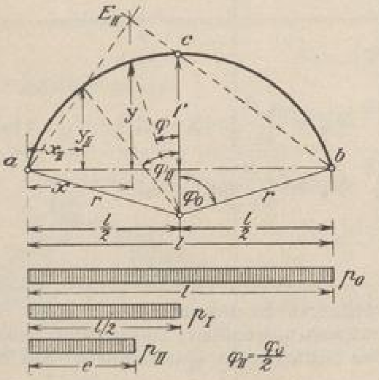
Gleichung der Bogenmittellinie:

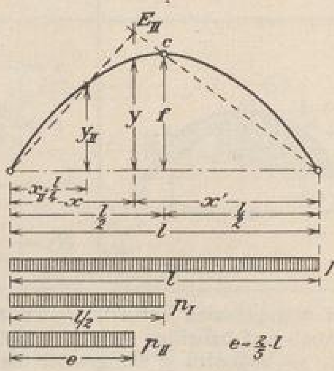
$$\text{Parabelbogen:}\quad y = \frac{4f}{l^2}\cdot(l\,x - x^2) = 4\,f\,\omega_R\,.$$

$$\text{Kreisbogen:}\quad x = \frac{l}{2} - r\cdot\sin\varphi;\quad y = f - (1 - \cos\varphi)\,r\,.$$

Belastungen:

p_0 = volle gleichförmige Belastung.
p_I = halbseitige gleichförmige Belastung.
p_{II} = Streckenlast über dem Abschnitt e der Einflußlinie des Biegungsmomentes in $x_{II} = l/4$ beim Parabelbogen und in $\varphi_{II} = \varphi_0/2$ beim Kreisbogen.





f/l	Kreis					Multi-plikator	Parabel, angenähert für Kreise mit $f/l = \psi \leqq 1/10$
	$1/2$	$1/3$	$1/4$	$1/6$	$1/8$		
x_{II}	0,1465	0,1995	0,2205	0,2365	0,2423	l	$l/4 = 0{,}2500\,l$
y_{II}	0,7071	0,7272	0,7360	0,7434	0,7466	f	$\frac{3}{4}f = 0{,}7500\,f$
e	0,2929	0,3543	0,3750	0,3890	0,3939	l	$\frac{2}{5}l = 0{,}4000\,l$
A_0	0,5000	0,5000	0,5000	0,5000	0,5000	pl	$p\,l/2 = 0{,}5000\,pl$
A_I	0,3750	0,3750	0,3750	0,3750	0,3750	pl	$\frac{3}{8}pl = 0{,}3750\,pl$
A_{II}	0,2500	0,2915	0,3047	0,3133	0,3163	pl	$\frac{8}{25}pl = 0{,}3200\,pl$
B_0	0,5000	0,5000	0,5000	0,5000	0,5000	pl	$p\,l/2 = 0{,}5000\,pl$
B_I	0,1250	0,1250	0,1250	0,1250	0,1250	pl	$\frac{1}{8}pl = 0{,}1250\,pl$
B_{II}	0,0429	0,0628	0,0703	0,0757	0,0776	pl	$\frac{2}{25}pl = 0{,}0800\,pl$
H_0	0,2500	0,3750	0,5000	0,7500	1,000	pl	$0{,}1250\,pl/\psi$
H_I	0,1250	0,1775	0,2500	0,3750	0,500	pl	$0{,}0625\,pl/\psi$
H_{II}	0,0429	0,0942	0,1406	0,2271	0,3104	pl	$0{,}0400\,pl/\psi$
M_0	− 0,0259	− 0,0110	− 0,0061	− 0,0027	− 0,0015	pl^2	0
M_I	0	+ 0,0094	+ 0,0124	+ 0,0142	+ 0,0149	pl^2	$+\frac{1}{64}pl^2 = +\,0{,}0156\,pl^2$
M_{II}	+ 0,0107	+ 0,0154	+ 0,0170	+ 0,0182	+ 0,0185	pl^2	$+\frac{3}{160}pl^2 = +\,0{,}01875\,pl^2$
Q_0	+ 0,0732	+ 0,0420	+ 0,0264	+ 0,0128	+ 0,0075	pl	0
Q_I	+ 0,0732	+ 0,0420	+ 0,0264	+ 0,0128	+ 0,0075	pl	0
Q_{II}	+ 0,0429	+ 0,0243	+ 0,0124	+ 0,0011	− 0,0035	pl	$-\,0{,}0100\,pl/\sqrt{1+(2\,\psi)^2}$
N_0	− 0,4268	− 0,4787	− 0,5722	− 0,7948	− 1,0326	pl	$-\,0{,}2500\,pl\sqrt{1+1/(2\,\psi)^2}$
N_I	− 0,2500	− 0,2534	− 0,2927	− 0,3996	− 0,5173	pl	$-\,0{,}1250\,pl\sqrt{1+1/(2\,\psi)^2}$
N_{II}	− 0,1036	− 0,1294	− 0,1634	− 0,2397	− 0,3191	pl	$-\,0{,}1600\,\psi pl\,[0{,}8750 + 1/(2\,\psi)^2]/\sqrt{1+(2\,\psi)^2}$