Tafeln

entnommen aus:

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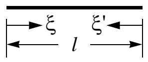
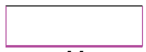
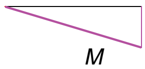
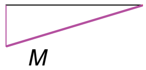
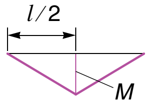
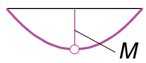
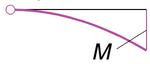
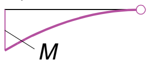
Tafel A1 ω-Funktionen

$\xi = \frac{x}{l}$ $\xi' = \frac{x'}{l}$ 	 M	 M	 M	 $l/2$, M	 quadr. Parabel, M	 quadr. Parabel, M	 quadr. Parabel, M
$EI_c \cdot w =$	$\frac{1}{2}Ml^2\frac{I_c}{I}\omega_R$	$\frac{1}{6}Ml^2\frac{I_c}{I}\omega_D$	$\frac{1}{6}Ml^2\frac{I_c}{I}\omega'_D$	$\frac{1}{12}Ml^2\frac{I_c}{I}\omega_\Delta$	$\frac{1}{3}Ml^2\frac{I_c}{I}\omega_{P1}$	$\frac{1}{12}Ml^2\frac{I_c}{I}\omega_{P2}$	$\frac{1}{12}Ml^2\frac{I_c}{I}\omega'_{P2}$
	$\omega_R = \xi - \xi^2$	$\omega_D = \xi - \xi^3$	$\omega'_D = \xi' - \xi'^3$	$\omega_\Delta = 3\xi - 4\xi^3$	$\omega_{P1} = \xi - 2\xi^3 + \xi^4$	$\omega_{P2} = \xi - \xi^4$	$\omega'_{P2} = \xi' - \xi'^4$

An den mit einem Kreis (○) gekennzeichneten Punkten muss eine horizontale Tangente vorliegen ($V = 0$)!

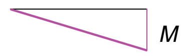
In den nachfolgenden Tafeln sind die ω -Funktionen für unterschiedliche äquidistante Teilungen ausgewertet.

Tafel A2 Rechteck, 10^4 – fache ω_R – Werte

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	2500											 M $\frac{1}{2}Ml^2\frac{I_c}{I}\omega_R$ $\omega_R = \xi - \xi^2$		
3	2222	2222												
4	1875	2500	1875											
5	1600	2400	2400	1600										
6	1389	2222	2500	2222	1389									
7	1224	2041	2449	2449	2041	1224								
8	1094	1875	2344	2500	2344	1875	1094							
9	988	1728	2222	2469	2469	2222	1728	988						
10	900	1600	2100	2400	2500	2400	2100	1600	900					
11	826	1488	1983	2314	2479	2479	2314	1983	1488	826				
12	764	1389	1875	2222	2431	2500	2431	2222	1875	1389	764			
13	710	1302	1775	2130	2367	2485	2485	2367	2130	1775	1302	710		
14	663	1224	1684	2041	2296	2449	2500	2449	2296	2041	1684	1224	663	
15	622	1156	1600	1956	2222	2400	2489	2489	2400	2222	1956	1600	1156	622

Tafel A3 Dreieck 1, 10^4 – fache ω_D – Werte

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	3750													
3	2963	3704												
4	2344	3750	3281											
5	1920	3360	3840	2880										
6	1620	2963	3750	3704	2546									
7	1399	2624	3499	3848	3499	2274								
8	1230	2344	3223	3750	3809	3281	2051							
9	1097	2112	2963	3567	3841	3704	3073	1866						
10	990	1920	2730	3360	3750	3840	3570	2880	1710					
11	902	1758	2524	3156	3606	3832	3787	3426	2705	1578				
12	828	1620	2344	2963	3443	3750	3848	3704	3281	2546	1464			
13	765	1502	2185	2786	3277	3632	3823	3823	3605	3141	2403	1365		
14	711	1399	2044	2624	3116	3499	3750	3848	3772	3499	3007	2274	1279	
15	664	1310	1920	2477	2963	3360	3650	3816	3840	3704	3390	2880	2157	1203



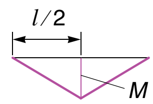
$\frac{1}{6}Ml^2\frac{l_c}{l}\omega_D$

$\omega_D = \xi - \xi^3$

Die ω'_D-Werte ergeben sich, indem die Zeilen der *Tafel A3* von rechts nach links abgelesen werden.

Tafel A4 Dreieck 2, 10^4 – fache ω_Δ – Werte

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	10000													
3	8519	8519												
4	6875	10000	6875											
5	5680	9440	9440	5680										
6	4815	8519	10000	8519	4815									
7	4169	7638	9708	9708	7638	4169								
8	3672	6875	9141	10000	9141	6875	3672							
9	3278	6228	8519	9822	9822	8519	6228	3278						
10	2960	5680	7920	9440	10000	9440	7920	5680	2960					
11	2697	5214	7370	8986	9880	9880	8986	7370	5214	2697				
12	2477	4815	6875	8519	9606	10000	9606	8519	6875	4815	2477			
13	2289	4470	6431	8066	9263	9914	9914	9263	8066	6431	4470	2289		
14	2128	4169	6035	7638	8892	9708	10000	9708	8892	7638	6035	4169	2128	
15	1988	3905	5680	7241	8519	9440	9935	9935	9440	8519	7241	5680	3905	1988

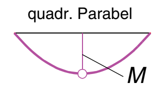


$\frac{1}{12}Ml^2\frac{l_c}{l}\omega_\Delta$

$\omega_\Delta = 3\xi - 4\xi^3$

Tafel A5 Parabel 1, 10^4 – fache ω_{P1} – Werte

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	3125													
3	2716	2716												
4	2227	3125	2227											
5	1856	2976	2976	1856										
6	1582	2716	3125	2716	1582									
7	1374	2457	3049	3049	2457	1374								
8	1213	2227	2893	3125	2893	2227	1213							
9	1085	2027	2716	3079	3079	2716	2027	1085						
10	981	1856	2541	2976	3125	2976	2541	1856	981					
11	895	1709	2377	2850	3094	3094	2850	2377	1709	895				
12	822	1582	2227	2716	3021	3125	3021	2716	2227	1582	822			
13	760	1471	2090	2584	2927	3103	3103	2927	2584	2090	1471	760		
14	707	1374	1967	2457	2823	3049	3125	3049	2823	2457	1967	1374	707	
15	661	1289	1856	2338	2716	2976	3108	3108	2976	2716	2338	1856	1289	661

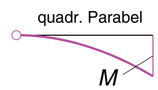


$\frac{1}{3} M l^2 \frac{I_c}{I} \omega_{P1}$

$\omega_{P1} = \xi - 2\xi^3 + \xi^4$

Tafel A6 Parabel 2, 10^4 – fache ω_{P2} – Werte

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	4375													
3	3210	4691												
4	2461	4375	4336											
5	1984	3744	4704	3904										
6	1659	3210	4375	4691	3511									
7	1424	2791	3948	4648	4540	3174								
8	1248	2461	3552	4375	4724	4336	2888							
9	1110	2198	3210	4054	4603	4691	4118	2646						
10	999	1984	2919	3744	4375	4704	4599	3904	2439					
11	908	1807	2672	3462	4119	4569	4724	4475	3701	2261				
12	833	1659	2461	3210	3865	4375	4675	4691	4336	3511	2106			
13	769	1533	2279	2987	3627	4162	4544	4720	4626	4191	3335	1971		
14	714	1424	2122	2791	3409	3948	4375	4648	4721	4540	4046	3174	1851	
15	666	1330	1984	2616	3210	3744	4192	4524	4704	4691	4441	3904	3025	1745

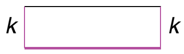
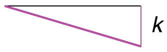
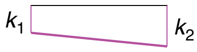
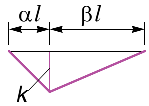
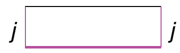
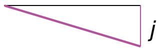
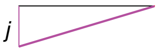
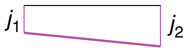
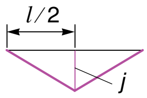
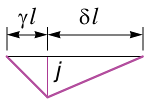
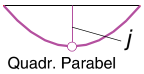
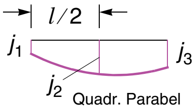
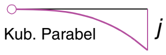
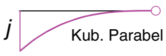
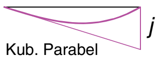
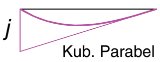


$\frac{1}{12} M l^2 \frac{I_c}{I} \omega_{P2}$

$\omega_{P2} = \xi - \xi^4$

Die ω'_{P2} -Werte ergeben sich, indem die Zeilen der *Tafel A6* von rechts nach links abgelesen werden.

Tafel A7 Werte der Integrale $\int M_j M_k dx = l \cdot$ Tafelwert

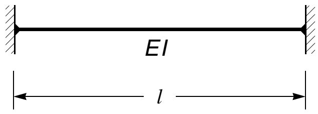
		1	2	3	4	5
						$\int j^2 dx$
1		jk	$\frac{1}{2}jk$	$\frac{1}{2}j(k_1+k_2)$	$\frac{1}{2}jk$	j^2
2		$\frac{1}{2}jk$	$\frac{1}{3}jk$	$\frac{1}{6}j(k_1+2k_2)$	$\frac{1}{6}jk(1+\alpha)$	$\frac{1}{3}j^2$
3		$\frac{1}{2}jk$	$\frac{1}{6}jk$	$\frac{1}{6}j(2k_1+k_2)$	$\frac{1}{6}jk(1+\beta)$	$\frac{1}{3}j^2$
4		$\frac{1}{2}k(j_1+j_2)$	$\frac{1}{6}k(j_1+2j_2)$	$\frac{1}{6}\left[j_1(2k_1+k_2) + j_2(k_1+2k_2)\right]$	$\frac{1}{6}k\left[j_1(1+\beta) + j_2(1+\alpha)\right]$	$\frac{1}{3}(j_1^2+j_1j_2+j_2^2)$
5		$\frac{1}{2}jk$	$\frac{1}{4}jk$	$\frac{1}{4}j(k_1+k_2)$	$\frac{jk}{12\beta}(3-4\alpha^2)$ $\beta \geq \alpha$	$\frac{1}{3}j^2$
6		$\frac{1}{2}jk$	$\frac{1}{6}jk(1+\gamma)$	$\frac{1}{6}j\left[k_1(1+\delta) + k_2(1+\gamma)\right]$	$\frac{jk}{6\beta\gamma}(2\gamma-\gamma^2-\alpha^2)$ $\gamma \geq \alpha$	$\frac{1}{3}j^2$
7		$\frac{2}{3}jk$	$\frac{1}{3}jk$	$\frac{1}{3}j(k_1+k_2)$	$\frac{1}{3}jk(1+\alpha\beta)$	$\frac{8}{15}j^2$
8		$\frac{1}{3}jk$	$\frac{1}{4}jk$	$\frac{1}{12}j(k_1+3k_2)$	$\frac{1}{12}jk(1+\alpha+\alpha^2)$	$\frac{1}{5}j^2$
9		$\frac{1}{3}jk$	$\frac{1}{12}jk$	$\frac{1}{12}j(3k_1+k_2)$	$\frac{1}{12}jk(1+\beta+\beta^2)$	$\frac{1}{5}j^2$
10		$\frac{1}{6}k(j_1+4j_2+j_3)$	$\frac{1}{6}k(2j_2+j_3)$	$\frac{1}{6}\left[j_1k_1+2j_2(k_1+k_2) + j_3k_2\right]$	$\frac{1}{6}k\left[j_1\beta+2j_2+j_3\alpha - \alpha\beta(j_1-2j_2+j_3)\right]$	$\frac{1}{15}\left[2(j_1^2+4j_2^2+j_1^2) + 2j_1j_2+2j_2j_3-j_1j_3\right]$
11		$\frac{1}{4}jk$	$\frac{1}{5}jk$	$\frac{1}{20}j(k_1+4k_2)$	$\frac{1}{20}jk(1+\alpha)(1+\alpha^2)$	$\frac{1}{7}j^2$
12		$\frac{1}{4}jk$	$\frac{1}{20}jk$	$\frac{1}{20}j(4k_1+k_2)$	$\frac{1}{20}jk(1+\beta)(1+\beta^2)$	$\frac{1}{7}j^2$
13		$\frac{1}{4}jk$	$\frac{2}{15}jk$	$\frac{1}{60}j(7k_1+8k_2)$	$\frac{1}{20}jk(1+\alpha)\left(\frac{7}{3}-\alpha^2\right)$	$\frac{8}{105}j^2$
14		$\frac{1}{4}jk$	$\frac{7}{60}jk$	$\frac{1}{60}j(8k_1+7k_2)$	$\frac{1}{20}jk(1+\beta)\left(\frac{7}{3}-\beta^2\right)$	$\frac{8}{105}j^2$

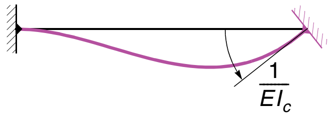
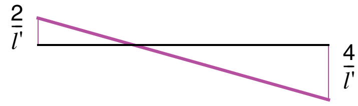
An den mit einem Kreis (○) gekennzeichneten Punkten muss eine horizontale Tangente vorliegen ($V = 0$)!

Arbeitsgleichung des Prinzips der virtuellen Kräfte:

$$\bar{1} \cdot \delta' = \frac{I_c}{I}\int M\bar{M}\,dx + \frac{I_c}{A}\int N\bar{N}\,dx + EI_c\left\{\int \bar{N}\alpha_T T_0\,dx + \int \bar{M}\alpha_T\frac{\Delta T}{h}\,dx + \sum\frac{\bar{F}F}{k_F} + \sum\frac{\bar{M}M}{k_M} - \sum\bar{C}c - \sum\bar{M}_E\varphi\right\}$$

Tafel A8 Einheitsverformungszustände des Drehwinkelverfahrens

<table>
<tr><th></th><th>Grundelement</th><th>Verformungszustand</th><th>Stabendmomente</th></tr>
<tr><td>1</td><td rowspan="3">

$l' = l \cdot \frac{I_c}{I}$</td><td>
</td><td>
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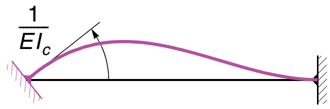
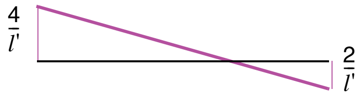
<tr><td>2</td><td>
</td><td>
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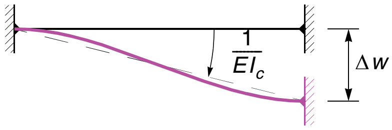
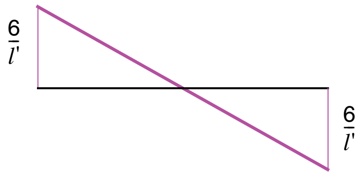
<tr><td>3</td><td>
</td><td>
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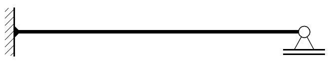
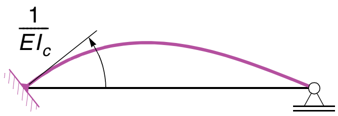
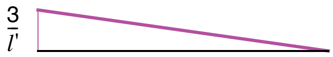
<tr><td>4</td><td rowspan="2"></td><td>
</td><td>
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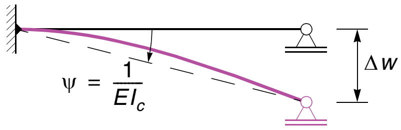
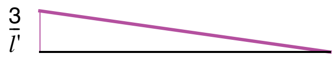
<tr><td>5</td><td>
</td><td>
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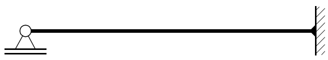
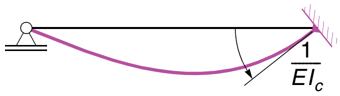
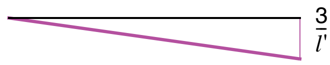
<tr><td>6</td><td rowspan="2"></td><td>
</td><td>
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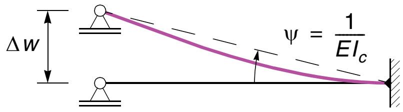
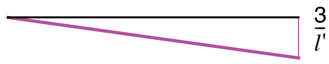
<tr><td>7</td><td>
</td><td>
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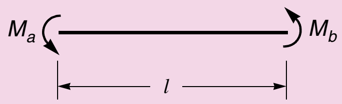
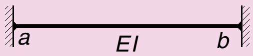
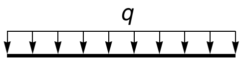
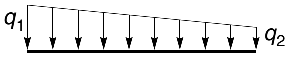
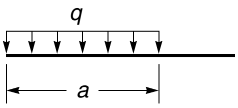
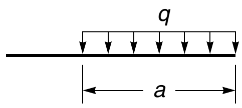
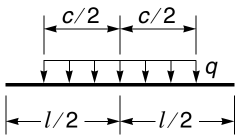
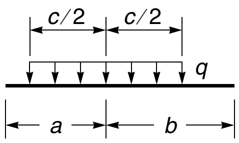
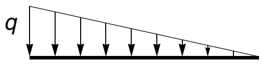
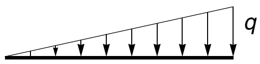
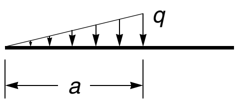
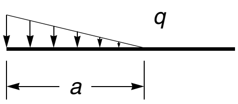
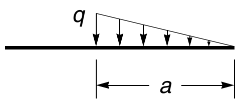
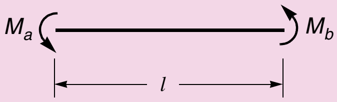
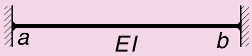
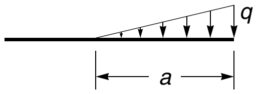
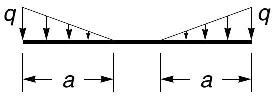
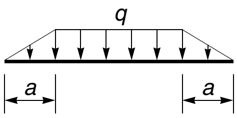
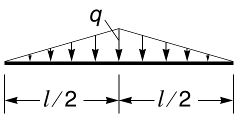
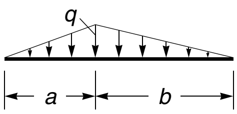
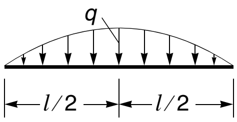
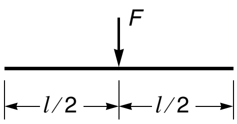
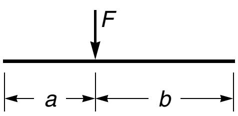
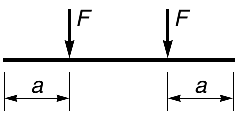
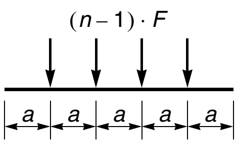
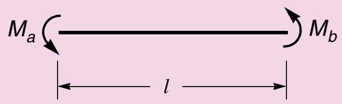
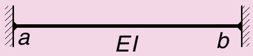
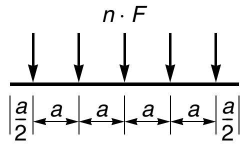
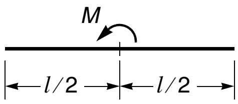
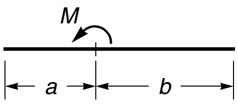
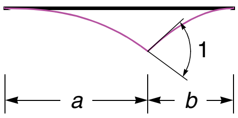
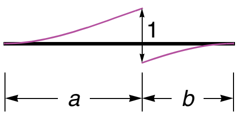
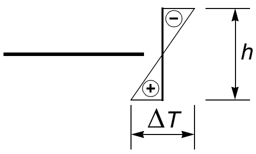
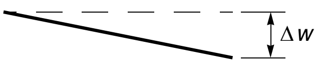
Tafel A9 Volleinspannmomente $\alpha = \frac{a}{l} \quad \beta = \frac{b}{l} \quad \gamma = \frac{c}{l}$

				
	Lastfall	M_a	M_b	M_a
1		$\frac{ql^2}{12}$	$-\frac{ql^2}{12}$	$\frac{ql^2}{8}$
2		$\frac{l^2}{60}(3q_1+2q_2)$	$-\frac{l^2}{60}(2q_1+3q_2)$	$\frac{l^2}{120}(8q_1+7q_2)$
3		$\frac{qa^2}{3}(1.5-2\alpha+0.75\alpha^2)$	$-\frac{qa^2}{3}\alpha(1-0.75\alpha)$	$\frac{qa^2}{8}(2-\alpha)^2$
4		$\frac{qa^2}{3}\alpha(1-0.75\alpha)$	$-\frac{qa^2}{3}(1.5-2\alpha+0.75\alpha^2)$	$\frac{qa^2}{8}(2-\alpha^2)$
5		$\frac{qlc}{24}(3-\gamma^2)$	$-\frac{qlc}{24}(3-\gamma^2)$	$\frac{qlc}{16}(3-\gamma^2)$
6		$qc\left[a\beta^2+\frac{\gamma^2}{12}(l-3b)\right]$	$-qc\left[b\alpha^2+\frac{\gamma^2}{12}(l-3a)\right]$	$\frac{qbc}{2}(1-\beta^2-0.25\gamma^2)$
7		$\frac{ql^2}{20}$	$-\frac{ql^2}{30}$	$\frac{ql^2}{15}$
8		$\frac{ql^2}{30}$	$-\frac{ql^2}{20}$	$\frac{7}{120}ql^2$
9		$\frac{qa^2}{3}(1-1.5\alpha+0.6\alpha^2)$	$-\frac{qa^2}{4}\alpha(1-0.8\alpha)$	$\frac{qa^2}{6}(2-2.25\alpha+0.6\alpha^2)$
10		$\frac{qa^2}{6}(1-\alpha+0.3\alpha^2)$	$-\frac{qa^2}{12}\alpha(1-0.6\alpha)$	$\frac{qa^2}{6}(1-0.75\alpha+0.15\alpha^2)$
11		$\frac{qa^2}{4}\alpha(1-0.8\alpha)$	$-\frac{qa^2}{3}(1-1.5\alpha+0.6\alpha^2)$	$\frac{qa^2}{6}(1-0.6\alpha^2)$

Tafel A9 Volleinspannmomente (Fortsetzung) $\alpha = \frac{a}{l}$ $\beta = \frac{b}{l}$ $\gamma = \frac{c}{l}$

				
	Lastfall	M_a	M_b	M_a
12		$\frac{qa^2}{12}\alpha(1-0.6\alpha)$	$-\frac{qa^2}{6}(1-\alpha+0.3\alpha^2)$	$\frac{qa^2}{12}(1-0.3\alpha^2)$
13		$\frac{qa^2}{6}(1-0.5\alpha)$	$-\frac{qa^2}{6}(1-0.5\alpha)$	$\frac{qa^2}{4}(1-0.5\alpha)$
14		$\frac{ql^2}{12}[1-\alpha^2(2-\alpha)]$	$-\frac{ql^2}{12}[1-\alpha^2(2-\alpha)]$	$\frac{ql^2}{8}[1-\alpha^2(2-\alpha)]$
15		$\frac{5}{96}ql^2$	$-\frac{5}{96}ql^2$	$\frac{5}{64}ql^2$
16		$\frac{ql^2}{30}(1+\beta+\beta^2-1.5\beta^3)$	$-\frac{ql^2}{30}(1+\alpha+\alpha^2-1.5\alpha^3)$	$\frac{ql^2}{120}(1+\beta)(7-3\beta^2)$
17		$\frac{ql^2}{15}$	$-\frac{ql^2}{15}$	$\frac{ql^2}{10}$
18		$\frac{F \cdot l}{8}$	$-\frac{F \cdot l}{8}$	$\frac{3}{16}F \cdot l$
19		$F \cdot a \cdot \beta^2$	$-F \cdot b \cdot \alpha^2$	$\frac{F \cdot a \cdot b}{2 \cdot l}(1+\beta)$
20		$F \cdot a(1-\alpha)$	$-F \cdot a(1-\alpha)$	$\frac{3}{2}F \cdot a(1-\alpha)$
21		$\frac{Fl}{12} \cdot \frac{n^2-1}{n}$	$-\frac{Fl}{12} \cdot \frac{n^2-1}{n}$	$\frac{Fl}{8} \cdot \frac{n^2-1}{n}$

Tafel A9 Volleinspannmomente (Fortsetzung) $\alpha = \frac{a}{l}$ $\beta = \frac{b}{l}$ $\gamma = \frac{c}{l}$

				
	Lastfall	M_a	M_b	M_a
22		$\frac{Fl}{24} \cdot \frac{2n^2+1}{n}$	$-\frac{Fl}{24} \cdot \frac{2n^2+1}{n}$	$\frac{Fl}{16} \cdot \frac{2n^2+1}{n}$
23		$\frac{M}{4}$	$\frac{M}{4}$	$\frac{M}{8}$
24		$M \cdot \beta(3\alpha - 1)$	$M \cdot \alpha(3\beta - 1)$	$\frac{M}{2} \cdot (1 - 3\beta^2)$
25		$\frac{2EI}{l}(3\beta - 1)$	$-\frac{2EI}{l}(3\alpha - 1)$	$\frac{3EI}{l}\beta$
26		$-\frac{6EI}{l^2}$	$-\frac{6EI}{l^2}$	$-\frac{3EI}{l^2}$
27		$EI \cdot \alpha_T \cdot \frac{\Delta T}{h}$	$-EI \cdot \alpha_T \cdot \frac{\Delta T}{h}$	$\frac{3}{2} \cdot EI \cdot \alpha_T \cdot \frac{\Delta T}{h}$
28		$\frac{6EI}{l^2} \cdot \Delta w$	$\frac{6EI}{l^2} \cdot \Delta w$	$\frac{3EI}{l^2} \cdot \Delta w$