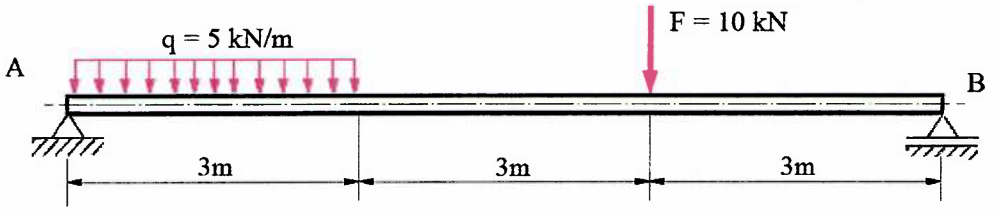
Eksamen: Deleksamen 2 (Fasthetslære)

Fag: IRM20015 Mekanikk 2 **Lærer: Steinar M. Heidenberg**

Grupper: Maskin	**Dato:** 14.12.2015	**Tid:** 9.00 – 12.00
Antall oppgavesider: 2	**Antall sider vedlegg: 0**	
Sensurfrist: 13.01.2016		
Hjelpemidler: INGEN bortsett fra tekniske tabeller og kalkulator. Det er tillatt med egne notater i tekniske tabeller, men ikke løse ark eller lapper.		
KANDIDATEN MÅ SELV KONTROLLERE AT OPPGAVESETTET ER FULLSTENDIG		

Oppgave 1

Bjelken AB er belastet med an jevnt fordelt last q = 5 kN/m og en punktbelastning F = 10 kN. Se figuren under.



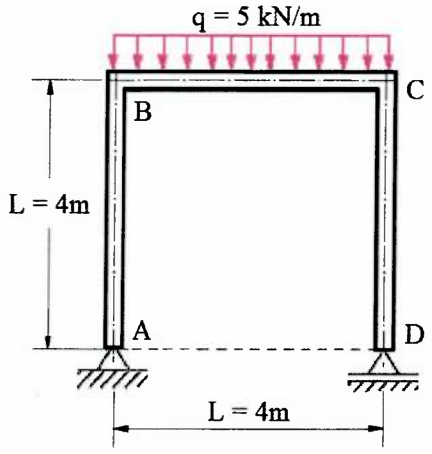
a) Tegn skjærkraftdiagram og momentdiagram for bjelken. (Du kan bruke de utregningsmetodene du selv ønsker i a og b spørsmålet.)

b) Beregn avstanden fra opplager A og ut til det punktet hvor momentet er størst på bjelken.

c) Sett inn momentfunksjonene i intervallene (løpene moment).
$\{0 < X < 3\}$; $\{3 < X < 6\}$; $\{6 < X < 9\}$

Oppgave 2

Gitt en statisk bestemt ramme ABCD, er belastet med en jevnt fordelt last q = 5 kN/m. Stivheten er EI, og denne er konstant over hele rammen. Se figuren til høyere.

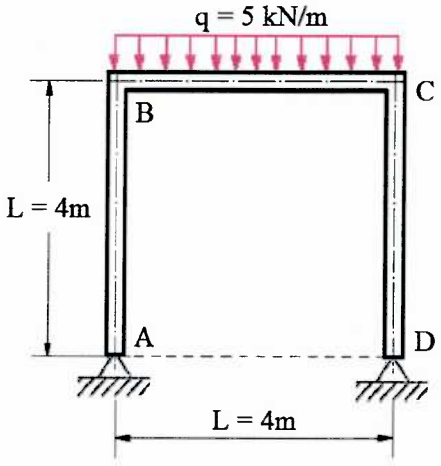


a) Tegn momentdiagram for rammen og beregn ekstremalverdiene. Legg ved beregningene.

b) Beregn forskyving δ_C for punktet C.

c) Beregn forskyving δ_D for punktet D.

Vi bytter nå glidelageret i punktet D, i forrige oppgave til et fastlager. Se ny figur på høyre side.

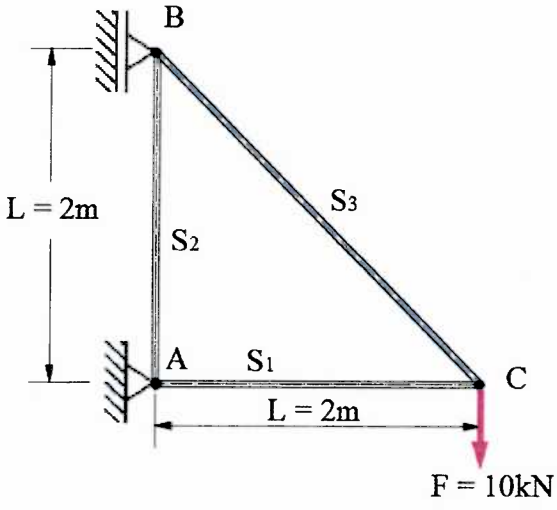


d) Beregn opplagerkreftene i A og D.

e) Tegn komplett momentdiagram for hele rammen.

Oppgave 3

Fagverket ABC har målene som er vist på tegningen til høyre. Tverrsnittsarealet på alle stavene er 100 mm^2. Materialet i stavene har E-modul 210 000 MPa.



a) Finn stangkreftene i fagverket.

b) Beregn forskyvingen ΔB i punkt B.

c) Beregn forskyvingene ΔC_x og ΔC_y samt totalforskyvingen ΔC i punktet C

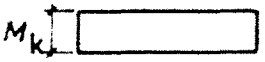
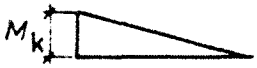
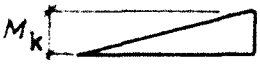
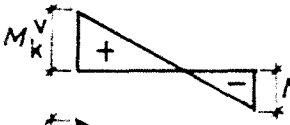
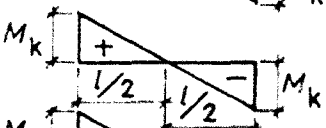
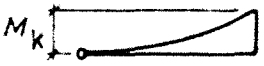
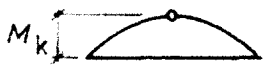
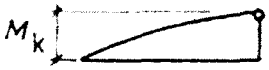
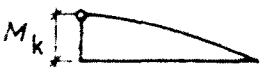
Høgskolen i Østfold
Avdeling for ingeniørfag

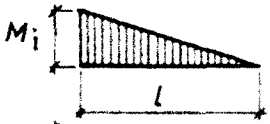
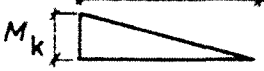
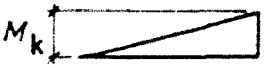
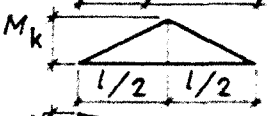
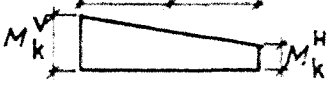
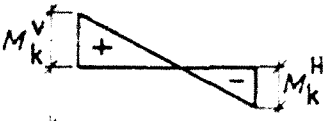
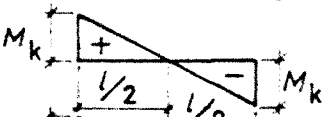
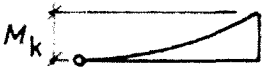
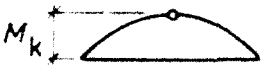
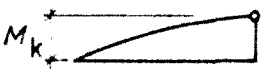
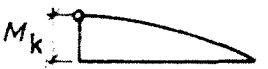
VEDLEGG : Integrasjonstabeller

5.10 Integrasjonstabeller

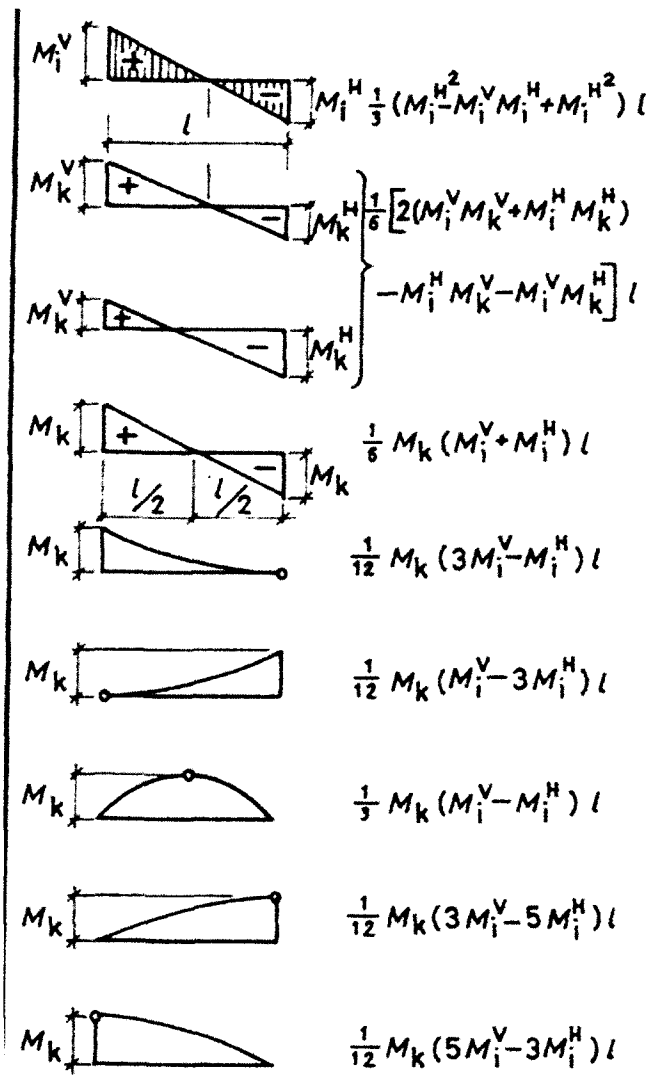
Med konstant treghetsmoment får en:

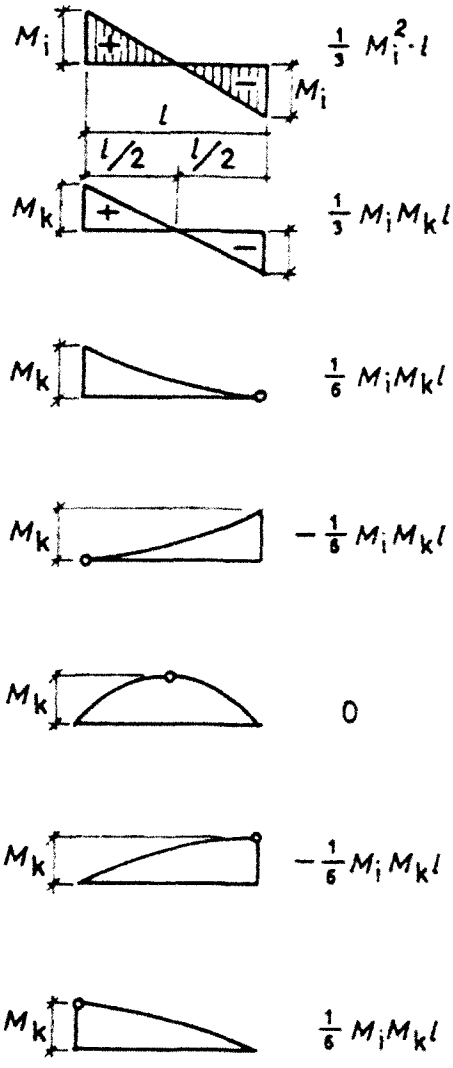
$$EI \cdot \delta_{ik} = \int_0^l M_i \cdot M_k \cdot dx \quad \text{og} \quad EI \cdot \delta_{ii} = \int_0^l M_i^2 \cdot dx.$$

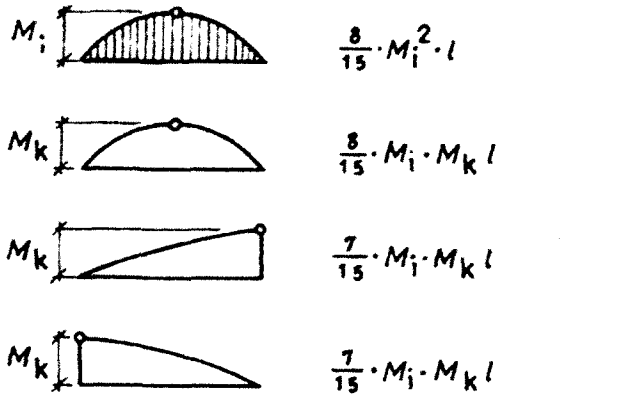
	$M_i^2 l$
	$M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i (M_k^V + M_k^H) l$
	$\frac{1}{2} M_i (M_k^V - M_k^H) l$
	0
	$\frac{1}{3} M_i M_k l$
	$\frac{1}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$

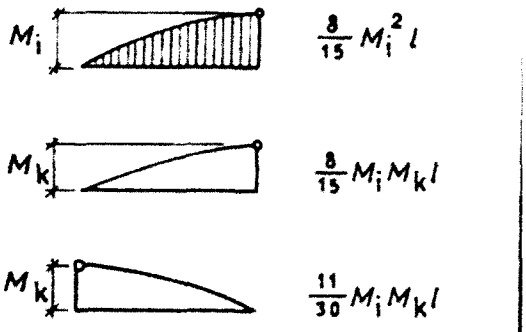
	$\frac{1}{3} M_i^2 l$
	$\frac{1}{3} M_i M_k l$
	$\frac{1}{6} M_i M_k l$
	$\frac{1}{6} M_i M_k l \ (1+\frac{x'}{l})$
	$\frac{1}{4} M_i M_k l$
	$\frac{1}{6} M_i (2M_k^V + M_k^H) l$
	$\frac{1}{6} M_i (2M_k^V - M_k^H) l$
	$\frac{1}{6} M_i M_k l$
	$\frac{1}{4} M_i M_k l$
	$\frac{1}{12} M_i M_k l$
	$\frac{1}{3} M_i M_k l$
	$\frac{1}{4} M_i M_k l$
	$\frac{5}{12} M_i M_k l$

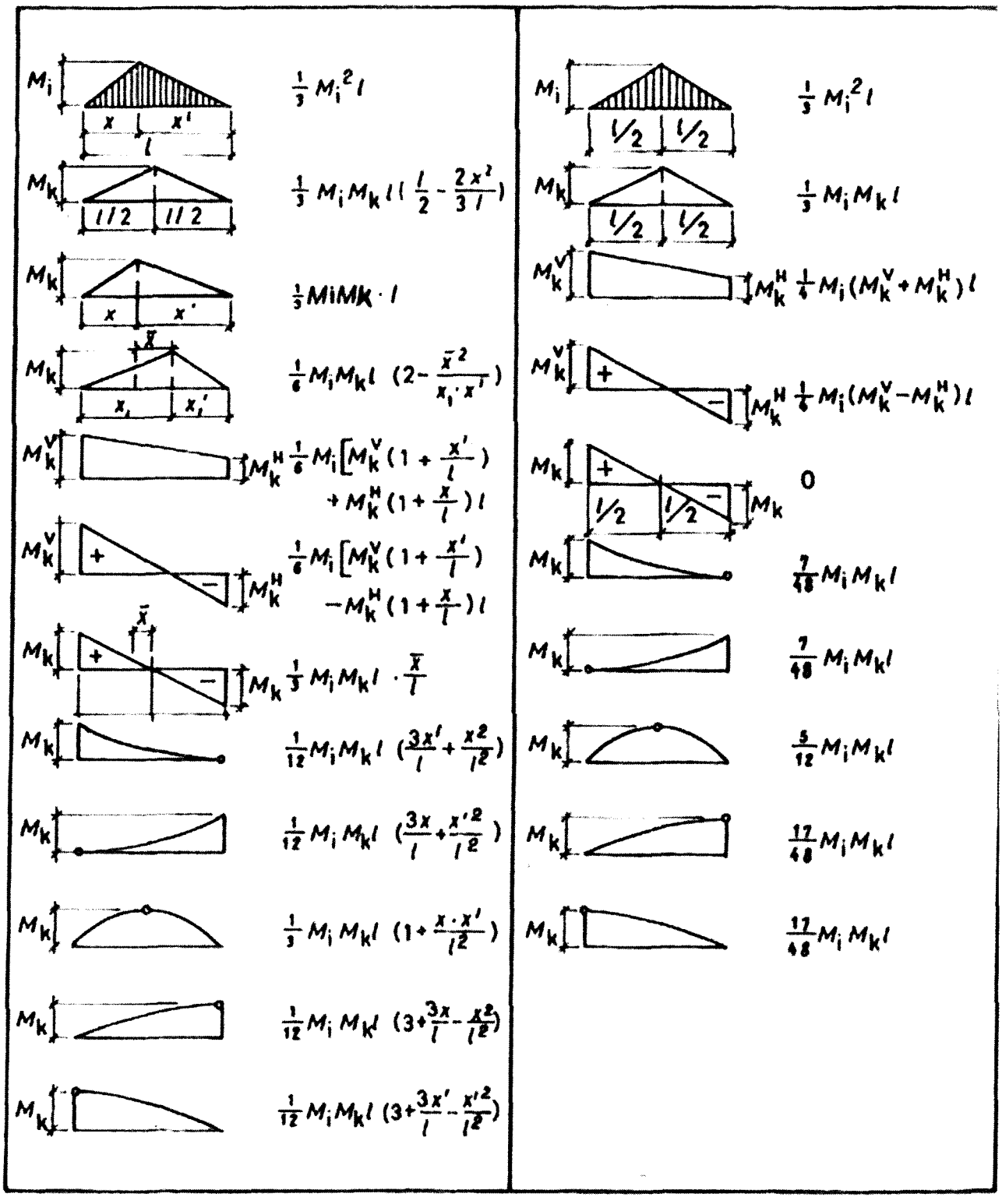
Høgskolen i Østfold
Avdeling for ingeniørfag



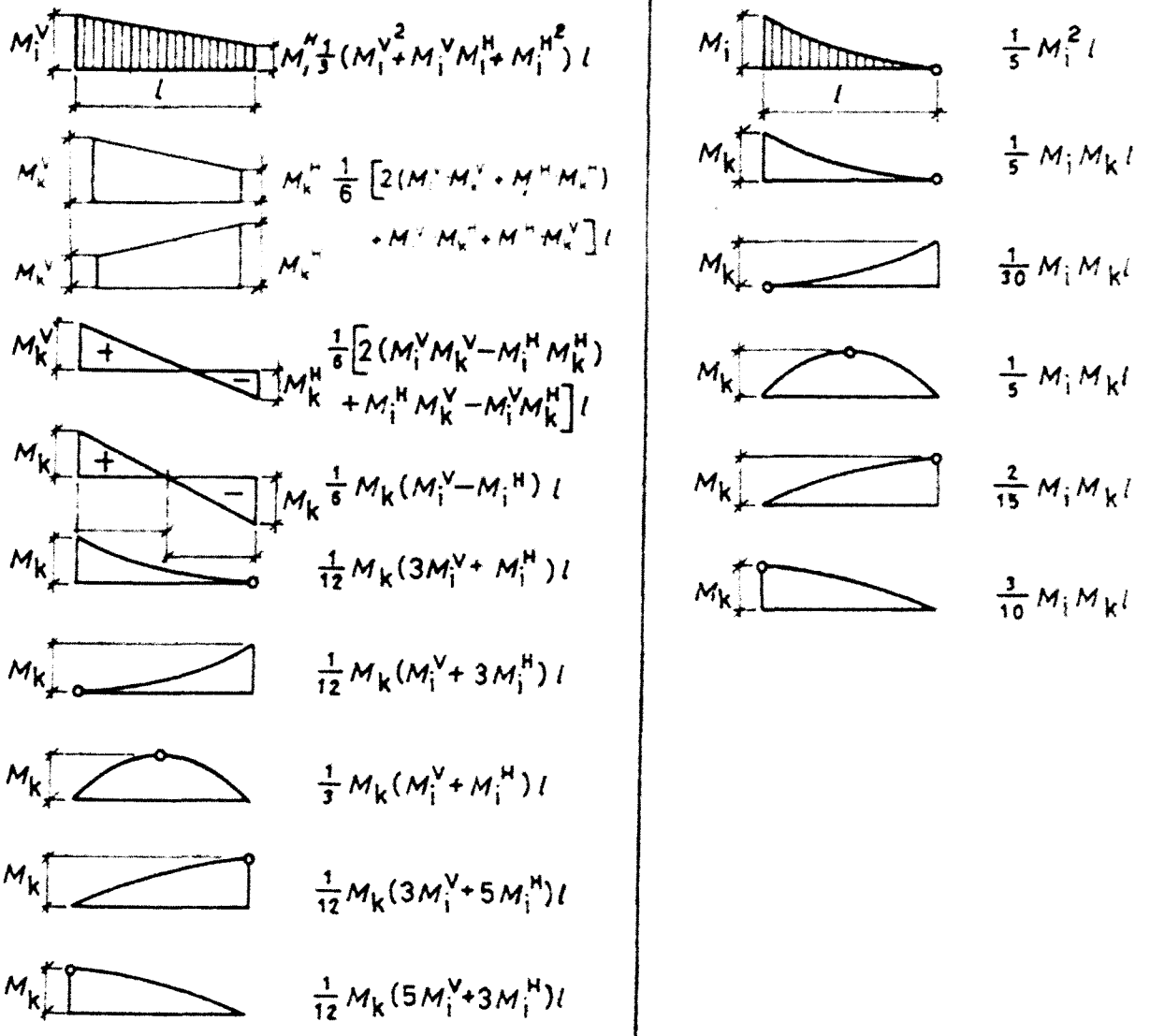







$\frac{1}{3} M_i^2 l$
$\frac{1}{3} M_i M_k l \left(\frac{l}{2} - \frac{2x^2}{3l}\right)$
$\frac{1}{3} M_i M_k \cdot l$
$\frac{1}{6} M_i M_k l \left(2 - \frac{\bar{x}^2}{x_1 \cdot x'}\right)$
$\frac{1}{6} M_i \left[M_k^V \left(1 + \frac{x'}{l}\right) + M_k^H \left(1 + \frac{x}{l}\right) l\right.$
$\frac{1}{6} M_i \left[M_k^V \left(1 + \frac{x'}{l}\right) - M_k^H \left(1 + \frac{x}{l}\right) l\right.$
$\frac{1}{3} M_i M_k l \cdot \frac{\bar{x}}{l}$
$\frac{1}{12} M_i M_k l \left(\frac{3x'}{l} + \frac{x^2}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(\frac{3x}{l} + \frac{x'^2}{l^2}\right)$
$\frac{1}{3} M_i M_k l \left(1 + \frac{x \cdot x'}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(3 + \frac{3x}{l} - \frac{x^2}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(3 + \frac{3x'}{l} - \frac{x'^2}{l^2}\right)$
$\frac{1}{3} M_i^2 l$
$\frac{1}{3} M_i M_k l$
$\frac{1}{4} M_i (M_k^V + M_k^H) l$
$\frac{1}{4} M_i (M_k^V - M_k^H) l$
0
$\frac{7}{48} M_i M_k l$
$\frac{7}{48} M_i M_k l$
$\frac{5}{12} M_i M_k l$
$\frac{17}{48} M_i M_k l$
$\frac{17}{48} M_i M_k l$

Tabell 21



Tabell 22