Høgskolen i Østfold
Avdeling for ingeniørfag

EKSAMENSOPPGAVE

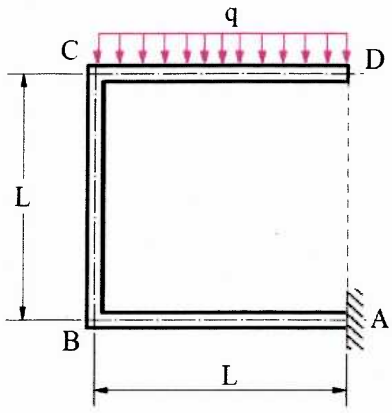
Emne: IRF11211 Mekanikk II
Lærer/telefon: Steinar Heidenberg Myrvold

Grupper:	**Dato:** 16 desember 2015	**Tid:** 0900 - 1100
Antall oppgavesider: 2 (inkludert forside)	**Antall vedleggsider: 4**	
Sensurfrist: 15 januar 2016		
Hjelpemidler: Skrivesaker, kalkulator, tekniske tabeller, godkjent arbeidsmappe utleveres på test, forutsatt at den tidligere er innlevert til administrasjon/ faglærer		
KANDIDATEN MÅ SELV KONTROLLERE AT OPPGAVESETTET ER FULLSTENDIG		

Dersom du savner opplysninger som er nødvendige for at du skal kunne løse oppgavene, bruker du symboler eller rimelige verdier med begrunnelse. Oppgi alle svar i SI enheter hvis annet ikke er spesifisert.

Oppgave 1 : Enhetslast- og kraftmetoden

Gitt en ramme ABCD, er belastet med en jevnt fordelt kraft mellom C og D. Stivheten er EI, og denne er konstant over hele rammen.



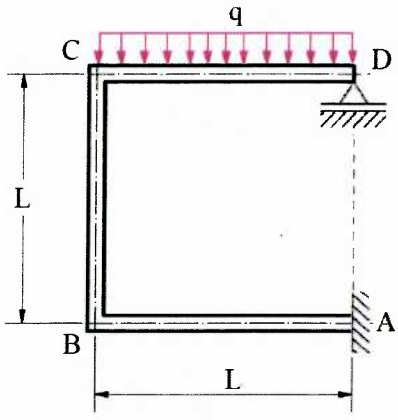
a) Tegn momentdiagram for rammen og beregn ekstremalverdiene.

b) Beregn vertikal forskyving δ_{Dv} for punktet D.

c) Beregn horisontal forskyving δ_{Dh} for punktet D.

d) Beregn total forskyving δ_D for punktet D.

Vi setter inn ett opplager i punktet D, som vist på figuren ved siden av.



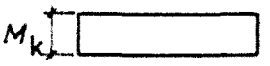
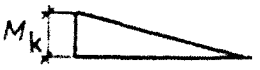
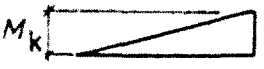
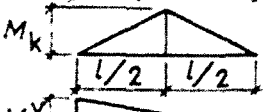
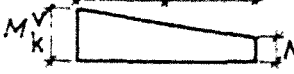
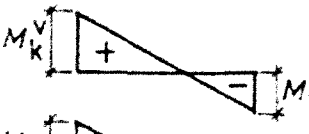
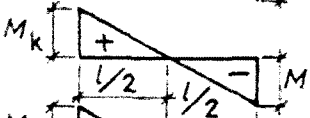
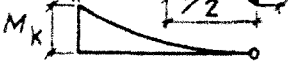
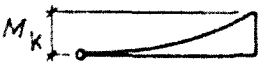
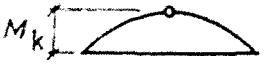
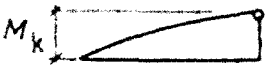
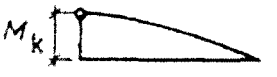
e) Beregn opplagerkraften i D.

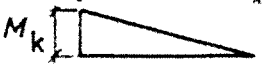
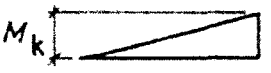
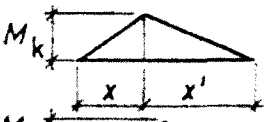
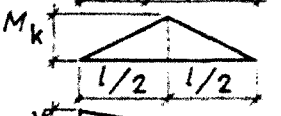
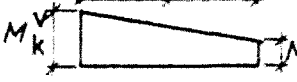
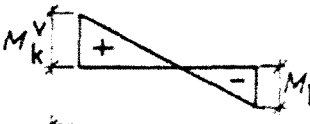
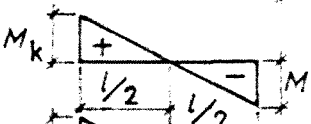
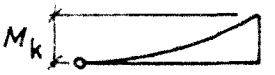
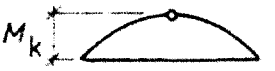
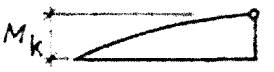
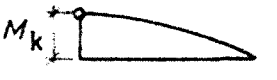
VEDLEGG 1: Integrasjonstabeller

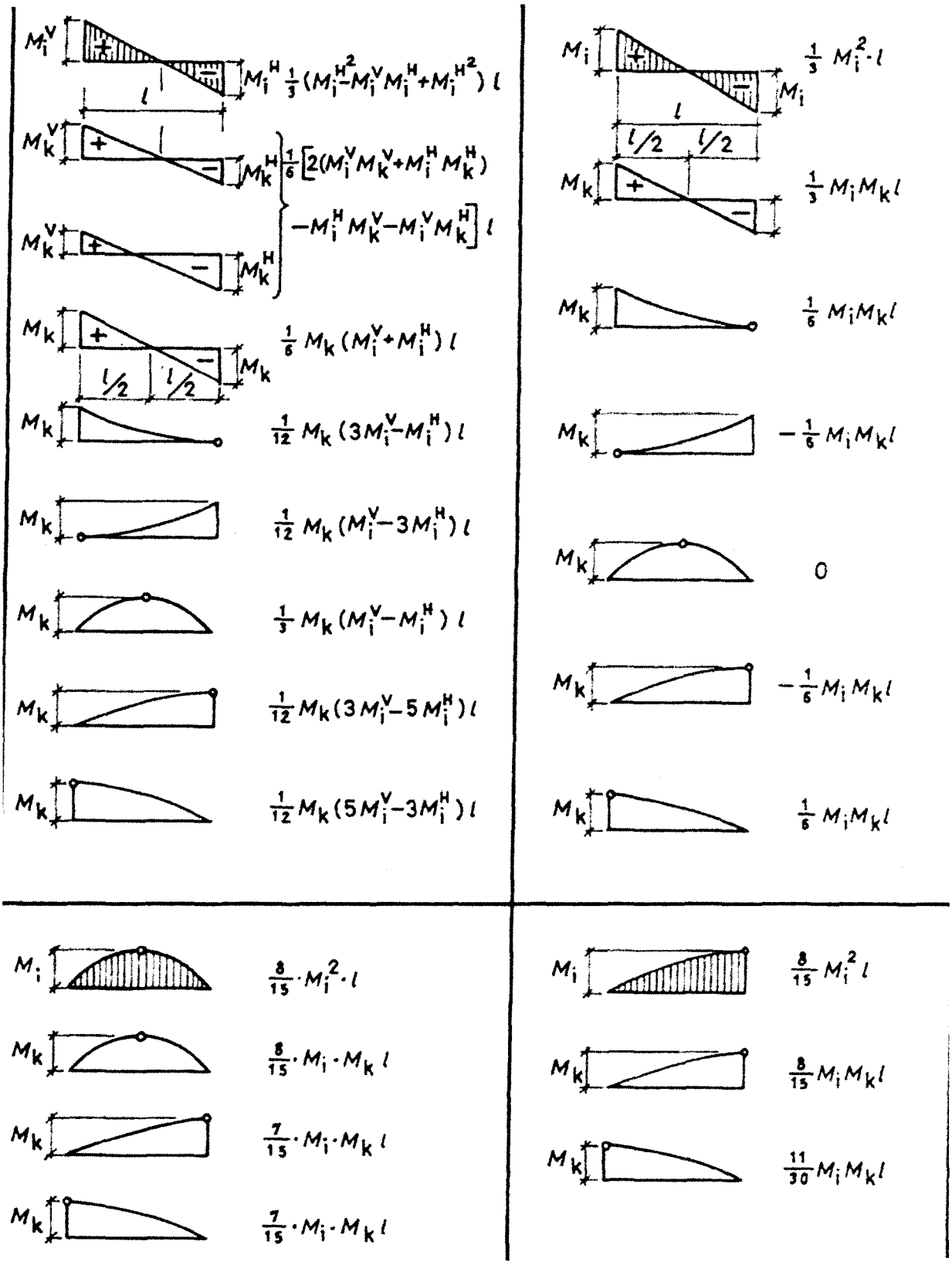
5.10 Integrasjonstabeller

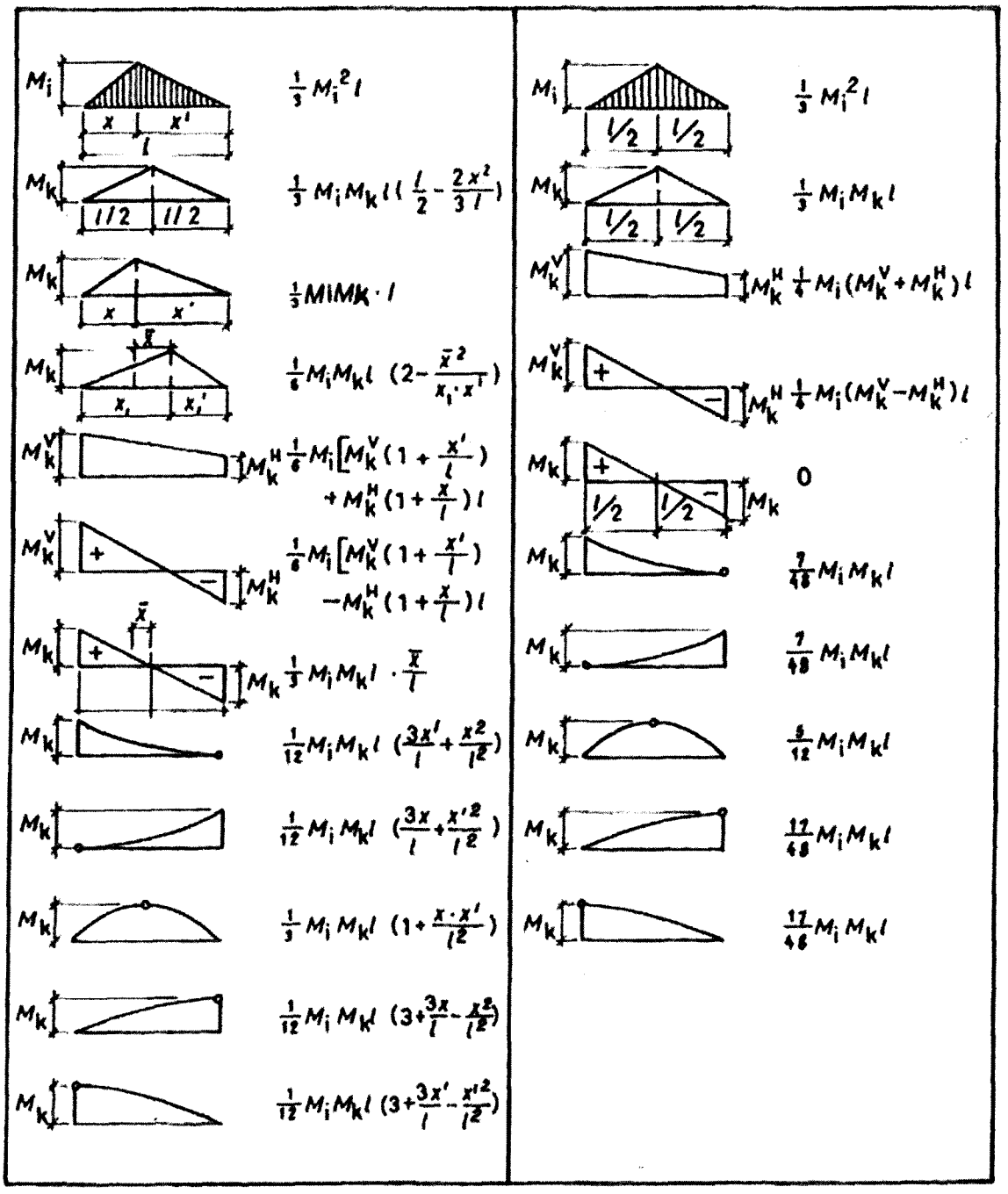
Med konstant treghetsmoment får en:

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

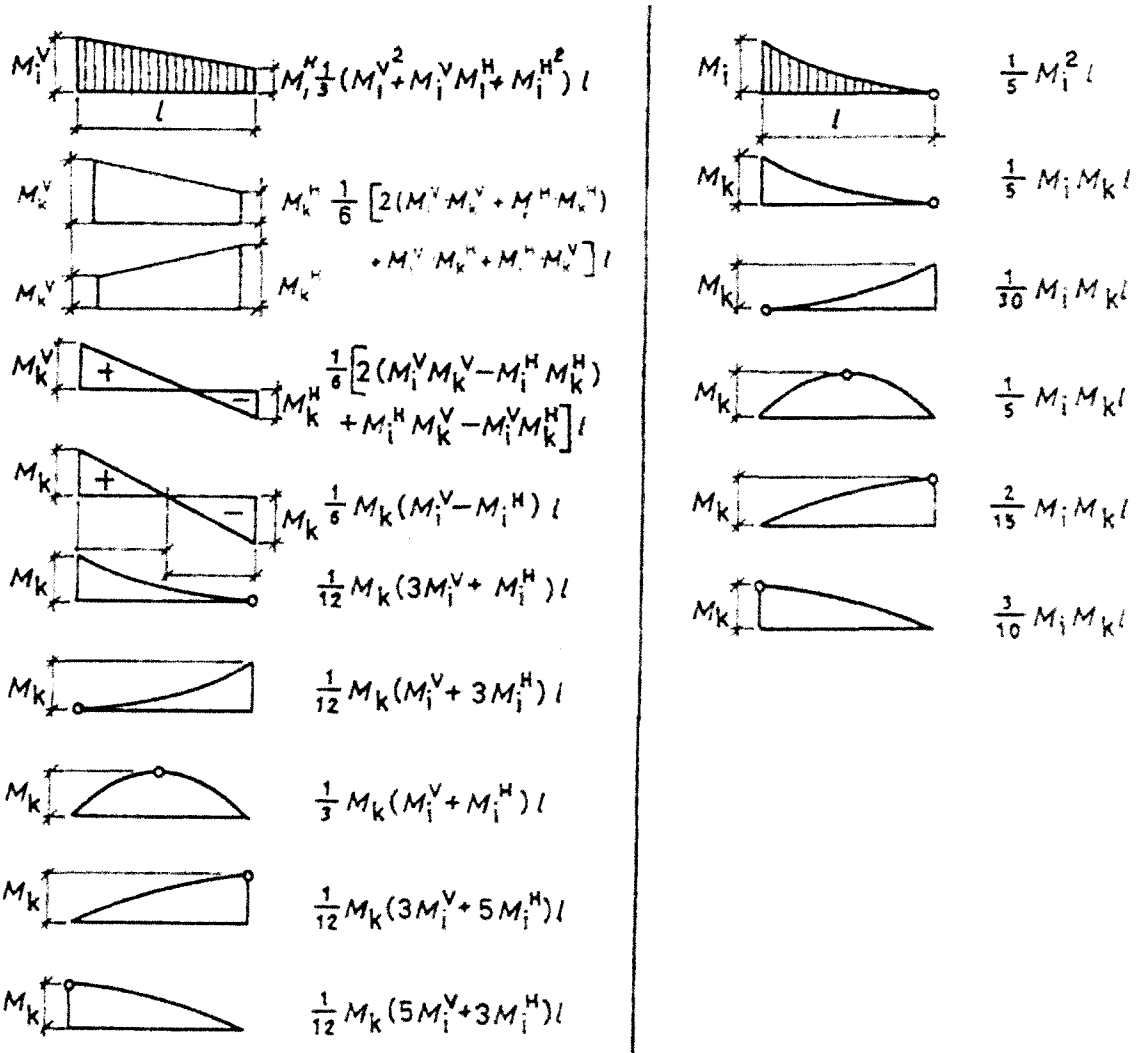
	$M_i^2 l$
	$M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i M_k l$
	$\frac{1}{2} M_i (M_k^V + M_k^H) l$
	$\frac{1}{2} M_i (M_k^V - M_k^H) l$
	0
	$\frac{1}{3} M_i M_k l$
	$\frac{1}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$
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

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


M_i^V M_i^H $\frac{1}{3}(M_i^{H^2}-M_i^V M_i^H+M_i^{H^2})\,l$
l
M_k^V M_k^H $\frac{1}{6}[2(M_i^V M_k^V+M_i^H M_k^H)$
M_k^V M_k^H $-M_i^H M_k^V-M_i^V M_k^H]\,l$
M_k $\frac{1}{6}M_k(M_i^V+M_i^H)\,l$
$l/2$ $l/2$ M_k
M_k $\frac{1}{12}M_k(3M_i^V-M_i^H)\,l$
M_k $\frac{1}{12}M_k(M_i^V-3M_i^H)\,l$
M_k $\frac{1}{3}M_k(M_i^V-M_i^H)\,l$
M_k $\frac{1}{12}M_k(3M_i^V-5M_i^H)\,l$
M_k $\frac{1}{12}M_k(5M_i^V-3M_i^H)\,l$
M_i $\frac{1}{3}M_i^2\cdot l$
M_i
l
$l/2$ $l/2$
M_k $\frac{1}{3}M_i M_k l$
M_k $\frac{1}{6}M_i M_k l$
M_k $-\frac{1}{6}M_i M_k l$
M_k 0
M_k $-\frac{1}{6}M_i M_k l$
M_k $\frac{1}{6}M_i M_k l$
M_i $\frac{8}{15}\cdot M_i^2\cdot l$
M_k $\frac{8}{15}\cdot M_i\cdot M_k\,l$
M_k $\frac{7}{15}\cdot M_i\cdot M_k\,l$
M_k $\frac{7}{15}\cdot M_i\cdot M_k\,l$
M_i $\frac{8}{15}M_i^2\,l$
M_k $\frac{8}{15}M_i M_k l$
M_k $\frac{11}{30}M_i M_k l$


$\frac{1}{3} M_i^2 l$
$\frac{1}{3} M_i M_k l \left(\frac{l}{2} - \frac{2x^2}{3l}\right)$
$\frac{1}{3} M_i M_k \cdot l$
$\frac{1}{6} M_i M_k l \left(2 - \frac{\bar{x}^2}{x_1 \cdot x_1'}\right)$
$\frac{1}{6} M_i \left[M_k^V \left(1 + \frac{x'}{l}\right) + M_k^H \left(1 + \frac{x}{l}\right)\right] l$
$\frac{1}{6} M_i \left[M_k^V \left(1 + \frac{x'}{l}\right) - M_k^H \left(1 + \frac{x}{l}\right)\right] l$
$\frac{1}{3} M_i M_k l \cdot \frac{\bar{x}}{l}$
$\frac{1}{12} M_i M_k l \left(\frac{3x'}{l} + \frac{x^2}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(\frac{3x}{l} + \frac{x'^2}{l^2}\right)$
$\frac{1}{3} M_i M_k l \left(1 + \frac{x \cdot x'}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(3 + \frac{3x}{l} - \frac{x^2}{l^2}\right)$
$\frac{1}{12} M_i M_k l \left(3 + \frac{3x'}{l} - \frac{x'^2}{l^2}\right)$
$\frac{1}{3} M_i^2 l$
$\frac{1}{3} M_i M_k l$
$\frac{1}{6} M_i (M_k^V + M_k^H) l$
$\frac{1}{6} M_i (M_k^V - M_k^H) l$
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


$\frac{1}{3}(M_i^{V2} + M_i^V M_i^H + M_i^{H2})\,l$
$\frac{1}{6}[2(M_i^V M_k^V + M_i^H M_k^H) + M_i^V M_k^H + M_i^H M_k^V]\,l$
$\frac{1}{6}[2(M_i^V M_k^V - M_i^H M_k^H) + M_i^H M_k^V - M_i^V M_k^H]\,l$
$\frac{1}{6} M_k (M_i^V - M_i^H)\,l$
$\frac{1}{12} M_k (3M_i^V + M_i^H)\,l$
$\frac{1}{12} M_k (M_i^V + 3M_i^H)\,l$
$\frac{1}{3} M_k (M_i^V + M_i^H)\,l$
$\frac{1}{12} M_k (3M_i^V + 5M_i^H)\,l$
$\frac{1}{12} M_k (5M_i^V + 3M_i^H)\,l$
$\frac{1}{5} M_i^2\,l$
$\frac{1}{5} M_i M_k\,l$
$\frac{1}{30} M_i M_k\,l$
$\frac{1}{5} M_i M_k\,l$
$\frac{2}{15} M_i M_k\,l$
$\frac{3}{10} M_i M_k\,l$

Tabell 22