

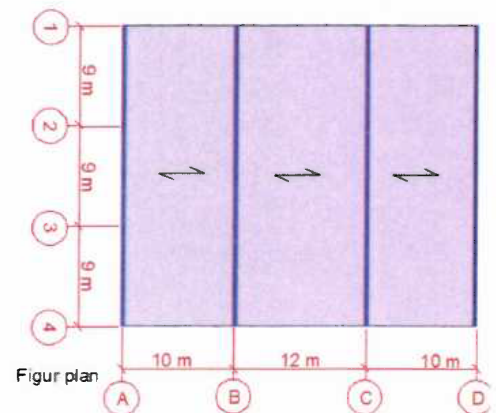
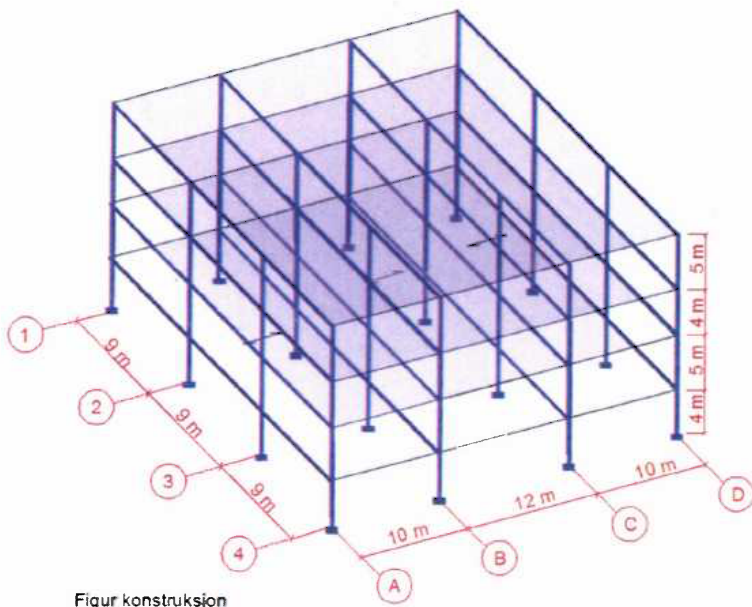
1
Høgskolen i Østfold
Avdeling for ingeniørfag

EKSAMENSOPPGAVE

Emne: IRB21512 - Konstruksjonsteknikk 1
Lærer/telefon: Geir Flote)

Grupper: 2. bygg	Dato: 14.12.2015	Tid: 09:00-13:00
Antall oppgavesider: 3	Antall vedleggsider: 4	
Sensurfrist: 13.01.2016		
Hjelpemidler: NS-EN 1990, NS-EN 1991-1-1, NS-EN 1991-1-3, NS-EN 1991-1-4, utdelt lommekalkulator		
KANDIDATEN MÅ SELV KONTROLLERE AT OPPGAVESETTET ER FULLSTENDIG		

Oppgave 1: Lastkombinasjoner (35 %)



Et næringsbygg skal bygges i Lillesand kommune i Aust-Agder fylke.

Byggeplassen ligger på 50 moh. Bygget har flatt tak.

Bygget oppføres i **fire** etasjer (4 m og 5 m etasjehøyder) med søyler innspent i bunnen, bjelker (9 m spenn) med ledd mot søylene, og hulldekker som bærer som enveisplater mellom bjelkene (10 m og 12 m spenn). Dekkene er fritt opplagt på bjelkene. Se figurene over.

Bruk de oppgitte systemmålene. Det er ikke nødvendig å ta hensyn til at søylene blir kortere på grunn av dekkene.

Taket skal beregnes for snølast samt egyptyngden fra takoppbygging (tekking og isolasjon) over hele taket i tillegg til hulldekkets egyptyngde.

Det skal beregnes nyttelast for forretningsarealer i 2. etasje, nyttelast for kontorarealer i 3. etasje og nyttelast for boligarealer i 4. etasje

Gulvet i 1. etasje utføres som støpt gulv direkte på grunnen, og vil ikke belaste konstruksjonen. Vind og ulykkeslaster utelates.

Karakteristiske egyptyngder for konstruksjonselementer:

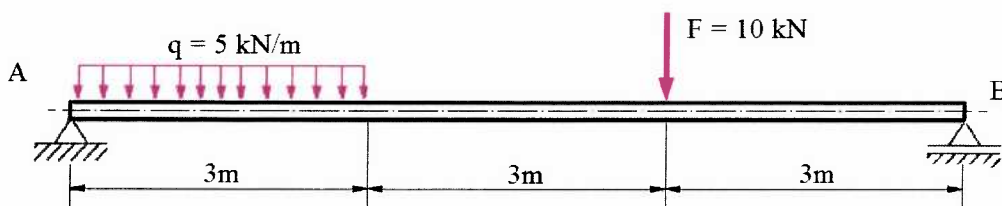
Bjelker:	0,35 kN/m
Søyler:	0,40 kN/m
Hulldekker:	2,60 kN/m ²
Takoppbygging:	0,50 kN/m ²

- Bergen snølast på taket. Anta $C_e = 1,0$ og $C_t = 1,0$.
- Beregn dimensjonerende reaksjonskraft i **bruddgrensetilstand** i bunnen av søylen i **1. etasje i akse C2**.
- Beregn dimensjonerende moment for **karakteristisk bruksgrensetilstand** for **bjelken i taket i akse B / 3-4**.

Oppgave 2 : Statisk bestemt system (20 %)

Bjelken AB er belastet med en jevnt fordelt last $q = 5 \text{ kN/m}$ og en punktbelastning $F = 10 \text{ kN}$. Se figuren under.

- Beregn reaksjonskreftene i **A** og **B**.
- Tegn skjærkraftdiagram og momentdiagram for bjelken.



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Oppgave 3: Kraftmetoden (45%)

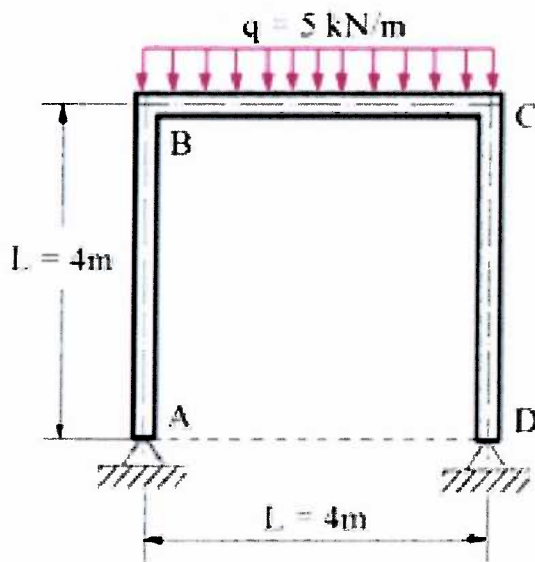
Gitt en statisk ubestemt ramme ABCD. Se figuren under.

Rammen er belastet med en jevnt fordelt last $q = 5 \text{ kN/m}$ mellom punktene B og C.

Høyde = Bredder = $L = 4 \text{ m}$.

Stivheten EI er konstant over hele rammen.

- Beregn resulterende reaksjonskrefter i A og D.
- Tegn resulterende momentdiagram for hele rammen.



Formler:


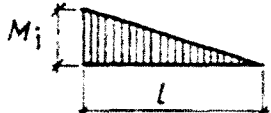
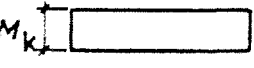

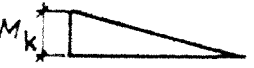
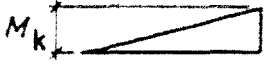
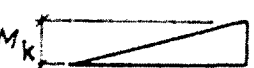


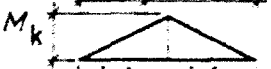

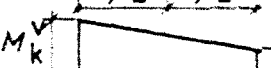

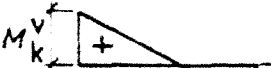


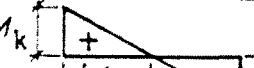
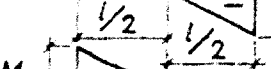

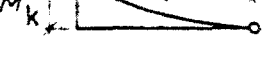

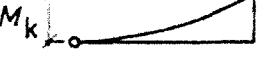

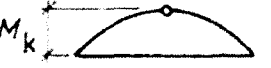

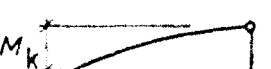
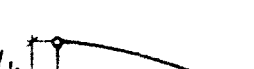
$$\delta_{10} + \delta_{11} \cdot X_1 = 0$$

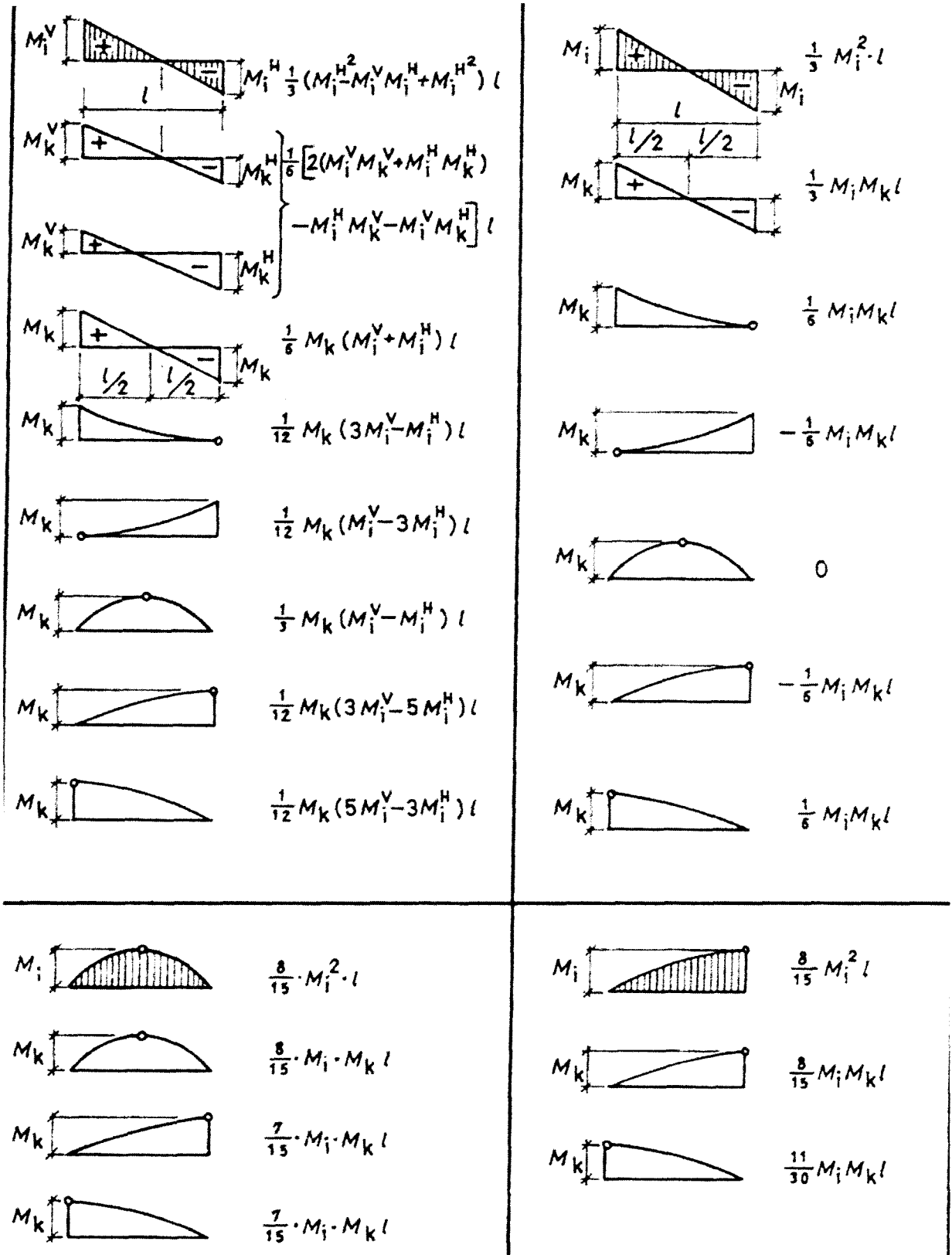
$$M_0 = \frac{qL^2}{8}$$

VEDLEGG : Integrasjonstabeller**5.10 Integrasjonstabeller**

Med konstant treghetsmoment får en:

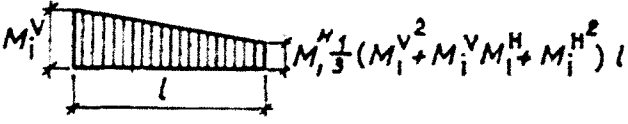
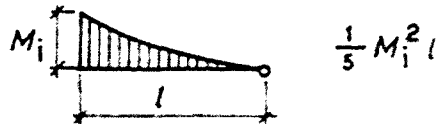
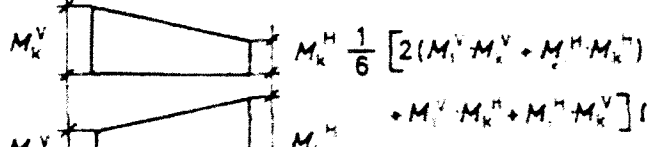
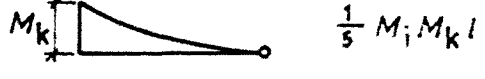
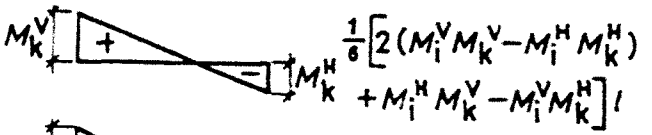

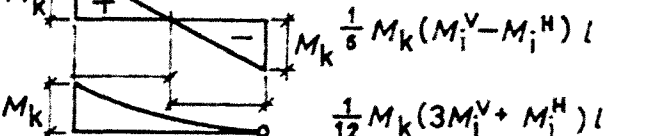

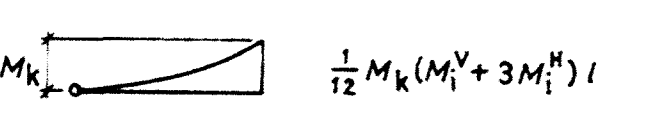

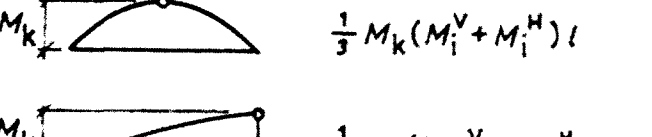

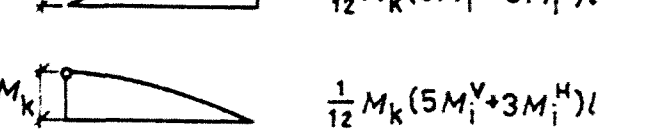



$$EI \cdot \delta_{ik} = \int_0^l M_i \cdot M_k \cdot dx \quad \text{og} \quad EI \cdot \delta_{ii} = \int_0^l M_i^2 \cdot dx.$$

	$M_i^2 l$		$\frac{1}{3} M_i^2 l$
	$M_i M_k l$		$\frac{1}{3} M_i M_k l$
	$\frac{1}{2} M_i M_k l$		$\frac{1}{6} M_i M_k l$
	$\frac{1}{2} M_i M_k l$		$\frac{1}{6} M_i M_k l (1 + \frac{x'}{l})$
	$\frac{1}{2} M_i M_k l$		$\frac{1}{4} M_i M_k l$
	$\frac{1}{2} M_i M_k l$		$\frac{1}{8} M_i (2M_k^V + M_k^H) l$
	$\frac{1}{2} M_i (M_k^V + M_k^H) l$		$\frac{1}{6} M_i (2M_k^V - M_k^H) l$
	$\frac{1}{2} M_i (M_k^V - M_k^H) l$		$\frac{1}{6} M_i M_k l$
	0		$\frac{1}{4} M_i M_k l$
	$\frac{1}{3} M_i M_k l$		$\frac{1}{12} M_i M_k l$
	$\frac{1}{3} M_i M_k l$		$\frac{1}{3} M_i M_k l$
	$\frac{2}{3} M_i M_k l$		$\frac{1}{4} M_i M_k l$
	$\frac{2}{3} M_i M_k l$		$\frac{5}{12} M_i M_k l$
	$\frac{2}{3} M_i M_k l$		



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

Tabell 21

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

Tabell 22