
SØJLER I HØJHUSE

1


SØJLER I HØJHUSE
HVEM ER DEN BETONHJERNE?
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Ramboll, High Rise DK
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Senior Chief Specialist,
Fagchef for Beton i Byggeri DK
MSc. Ph.D.
RAMBØLL
Source: Foto fra UNICON Facebook
Department of Civil Engineering
Tim Gudmand-Hoyer
Lars Zenke Hansen
Stability of Concrete Columns
Volume 1

2

HVAD ER SPECIELT FOR SØJLER I HØJHUSE

- Skal udføres i højden
- Gentages mange gange efter hinanden opefter
- Ofte store spring i søjlelængder
- Store kræfter
- Ofte ønske om ens tværsnit

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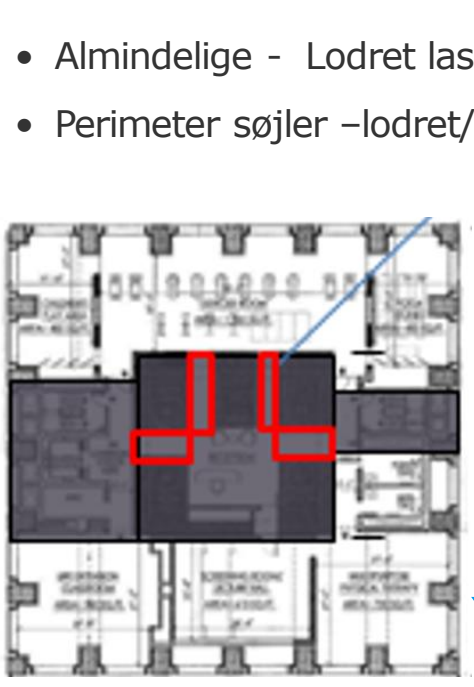
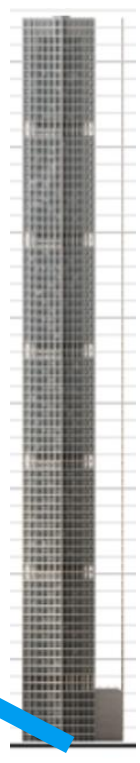
Kilde: https://www.qualityengineersguide.com/a-guide-on-how-to-construct-a-reinforced-concrete-column https://en.wikipedia.org/wiki/Climbing_formwork

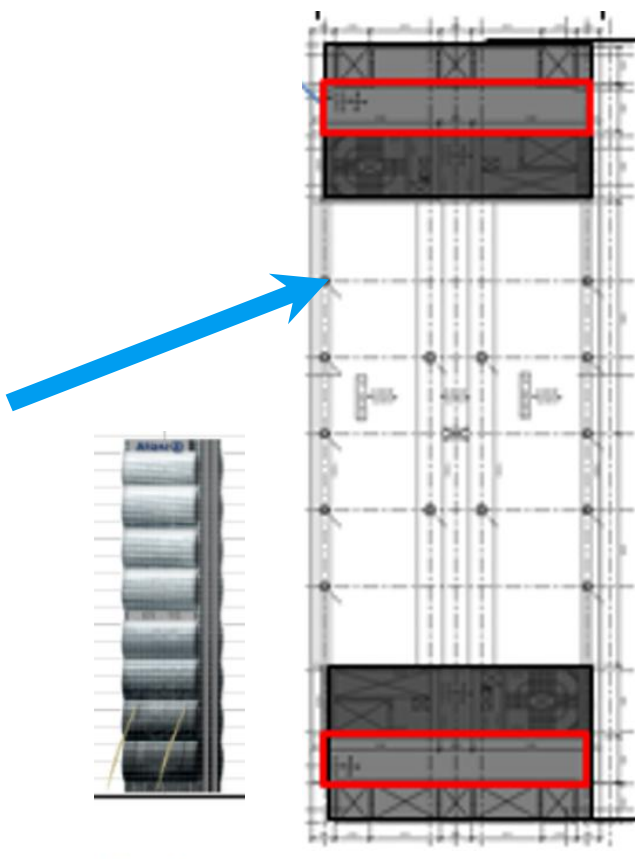
3

HVILKE BELASTNINGER

- Almindelige - Lodret last
- Perimeter søjler –lodret/ramme







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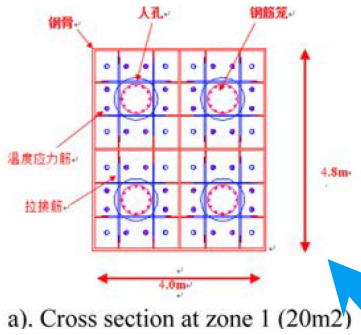
432 Park Avenue

Allianz Tower

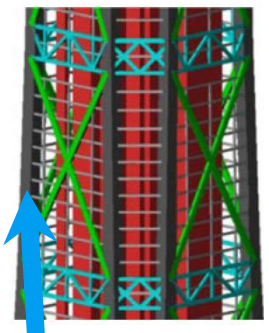
4

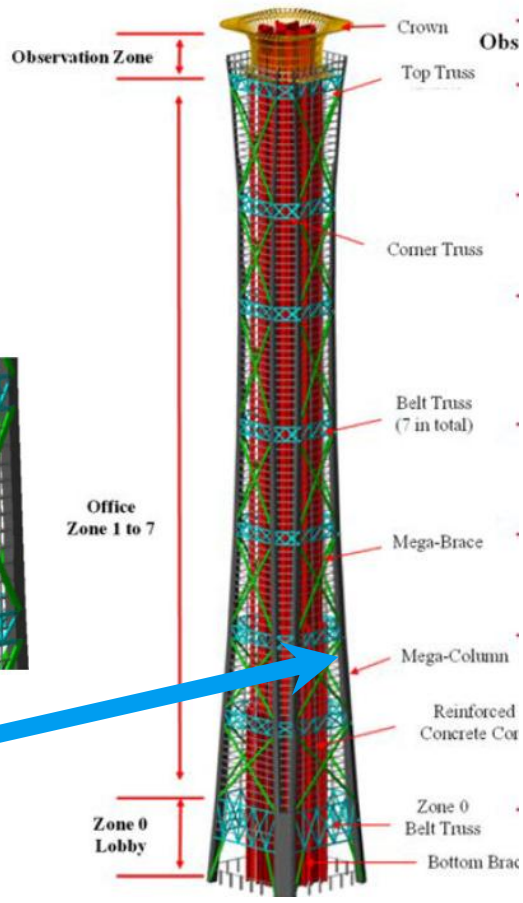
HVILKE TYPER OG BELASTNINGER

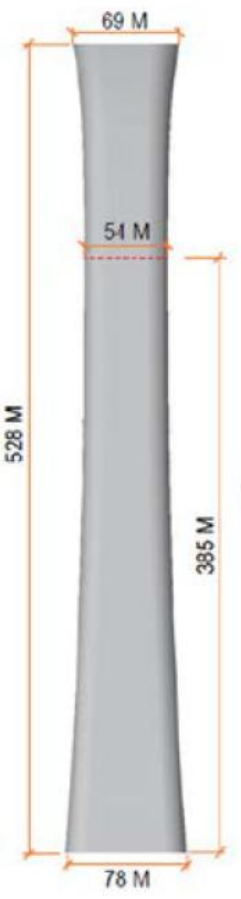
- Almindelige - Lodret last
- Perimeter søjler –lodret/ramm
- Megasøjler Specielle søjler



a). Cross section at zone 1 (20m2)







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Kilde: The-structural-design-of-china-zun-tower-beijing

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DESIGNPARAMETRE

- Materialer

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Kilde: CTBUH_ResearchReport_2018

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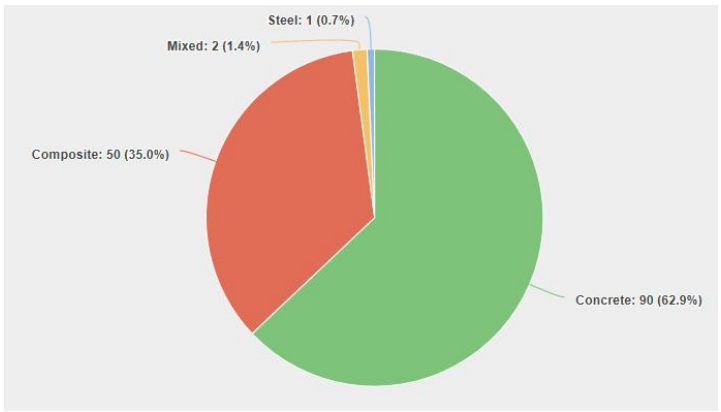
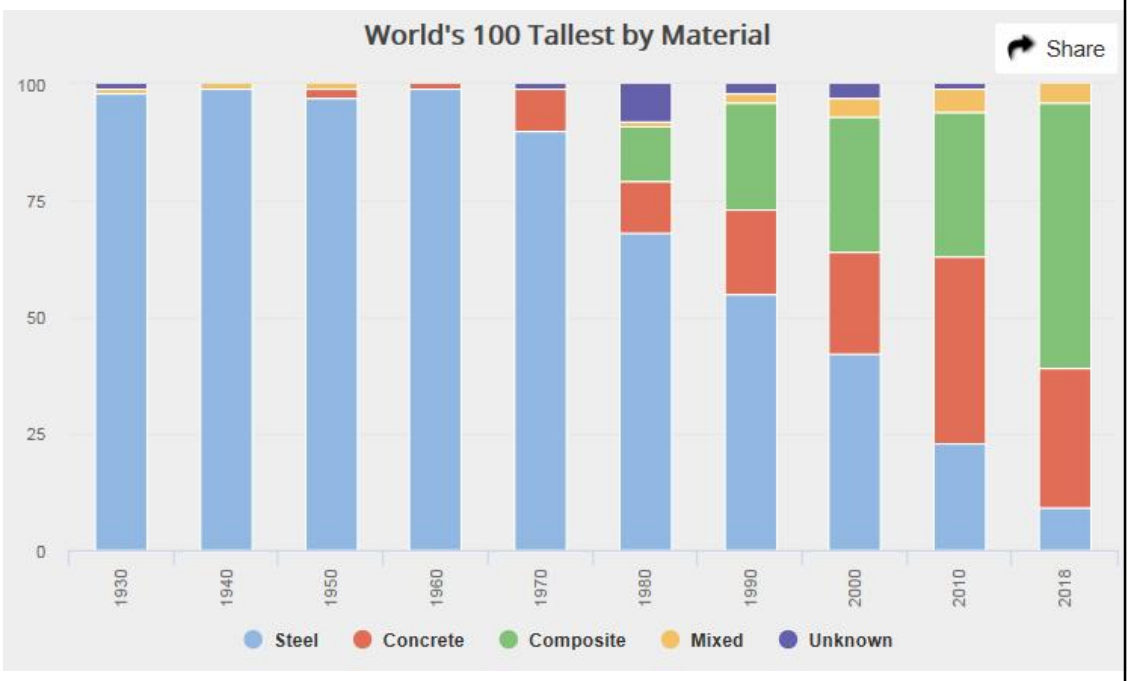
HVILKE MATERIALE





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Kilde: CTBUH_ResearchReport_2018

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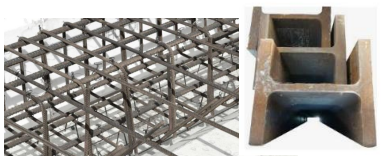
HVILKE MATERIALE

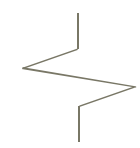


40 1

6 1

8

5 1



0,3 1

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Kilde: CTBUH_ResearchReport_2018

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STYRKER - TENDENSER

Ingalls
Cincinnati, Ohio
1903
16-story, height
2000PSI 14MPa

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Kilde: https://www.slideshare.net/yasinengin/examples-of-structures-of-super-highstrength-concrete-in-engineering and THE INGALLS BUILDING IN CINCINNATI AND ITS PLACE IN STRUCTURAL HISTORY

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DESIGNPARAMETRE

- Form

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Kilde: CTBUH_ResearchReport_2018

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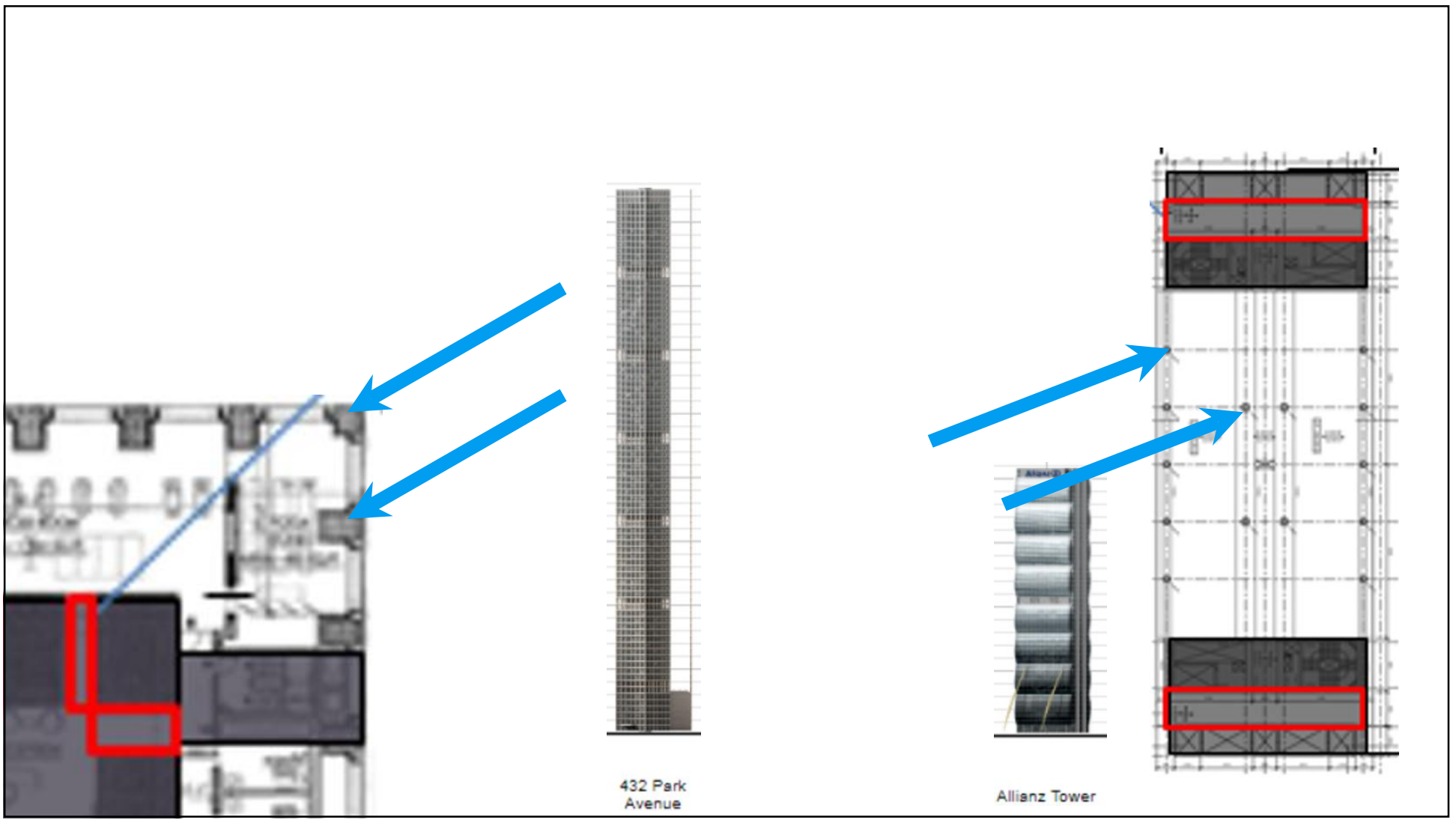

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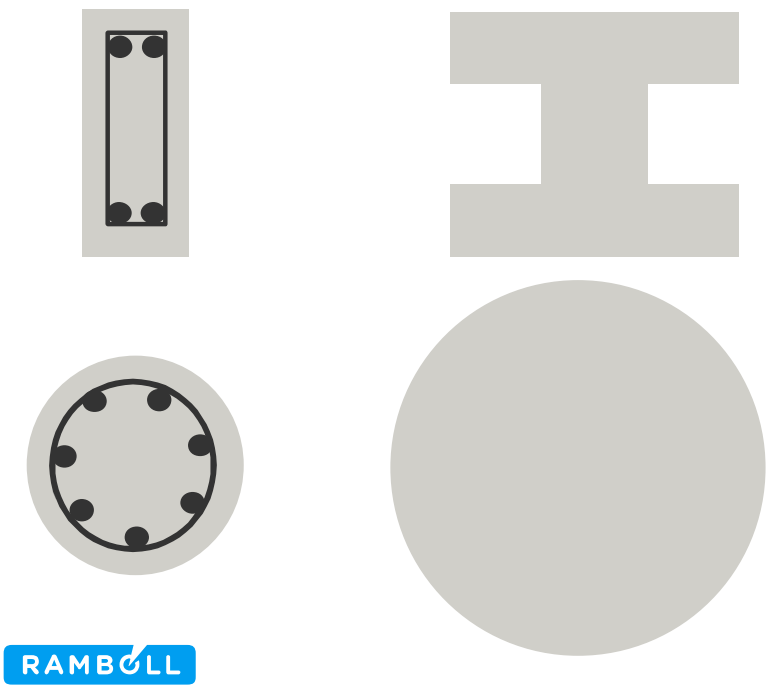
- Form



Kilde: CTBUH_ResearchReport_2018

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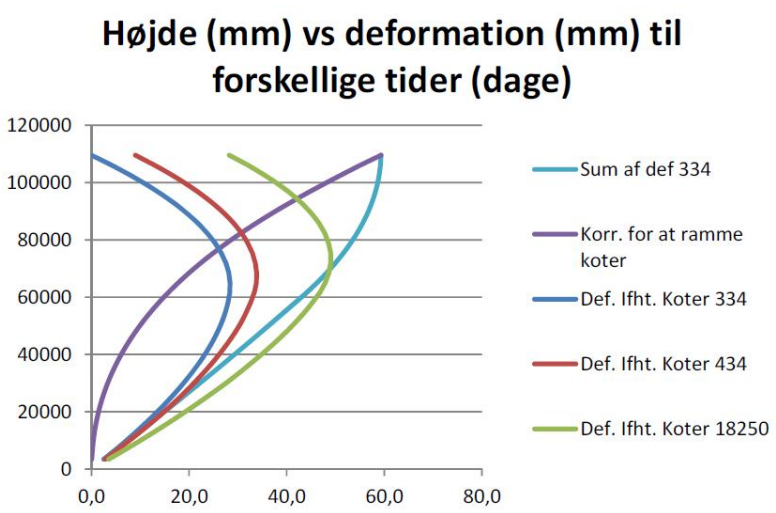
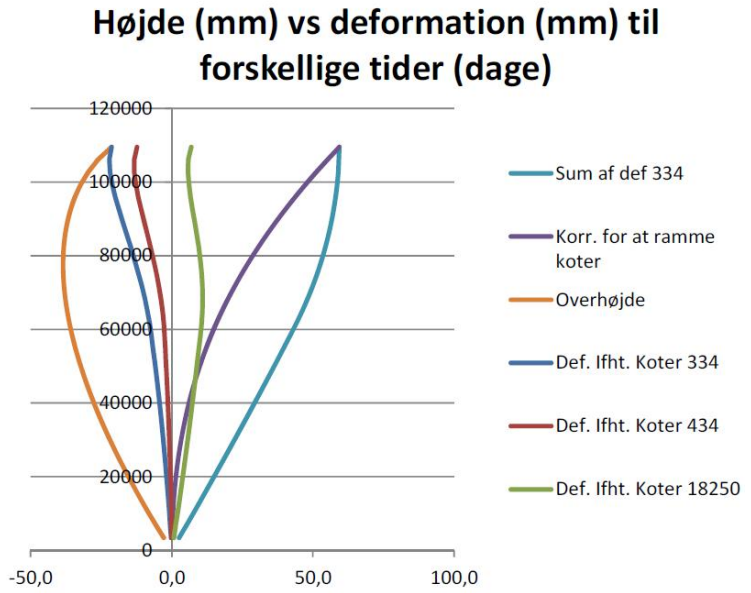
DEFORMATIONER





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Kilde: Statiske beregninger Bohrs Tårn

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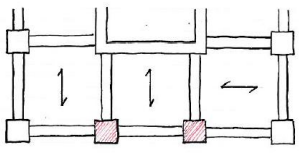
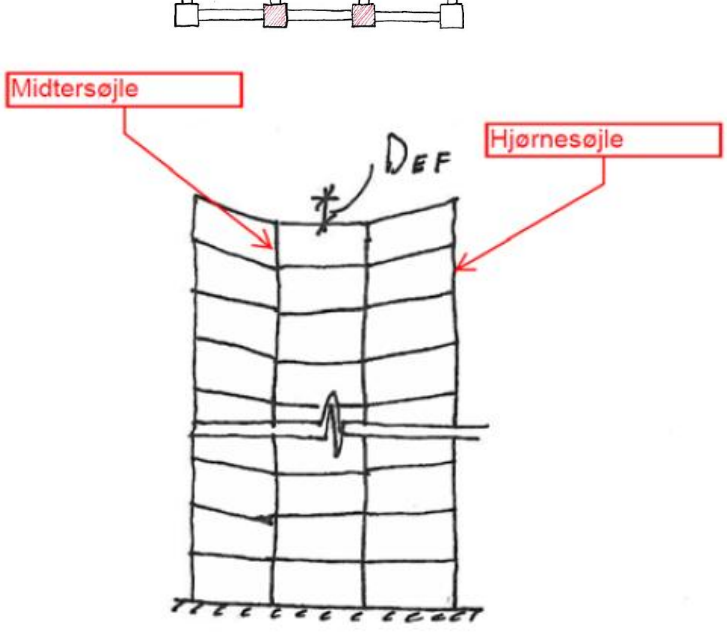
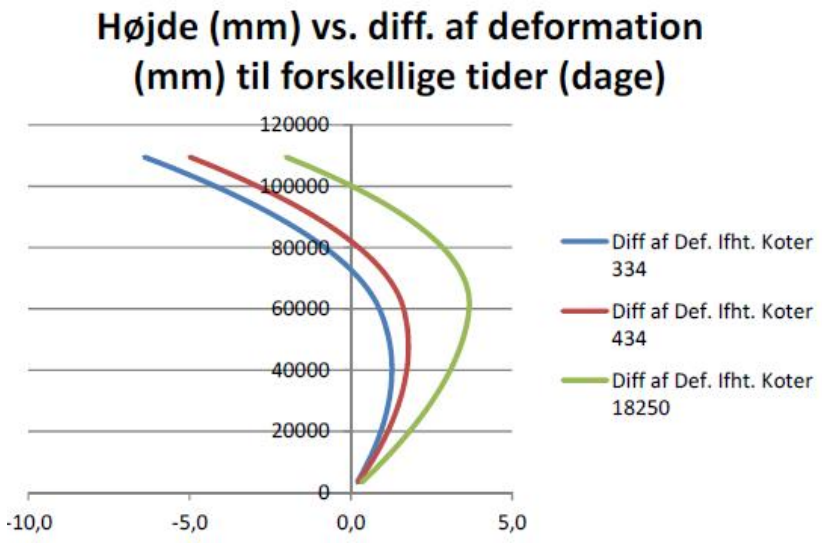
DEFORMATIONER







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Kilde: Statiske beregninger Bohrs Tårn

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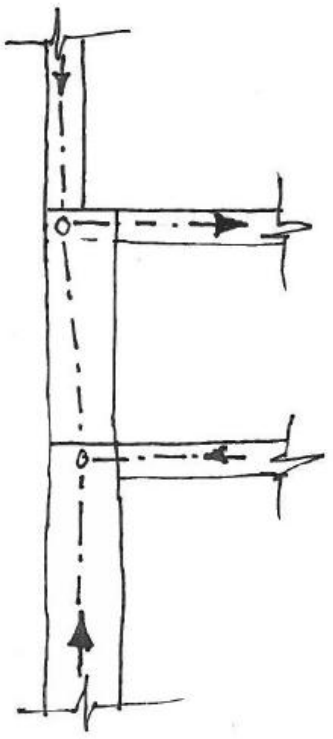
GEOMETRISKE VARIATIONER



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Kilde: Statiske beregninger Bohrs Tårn

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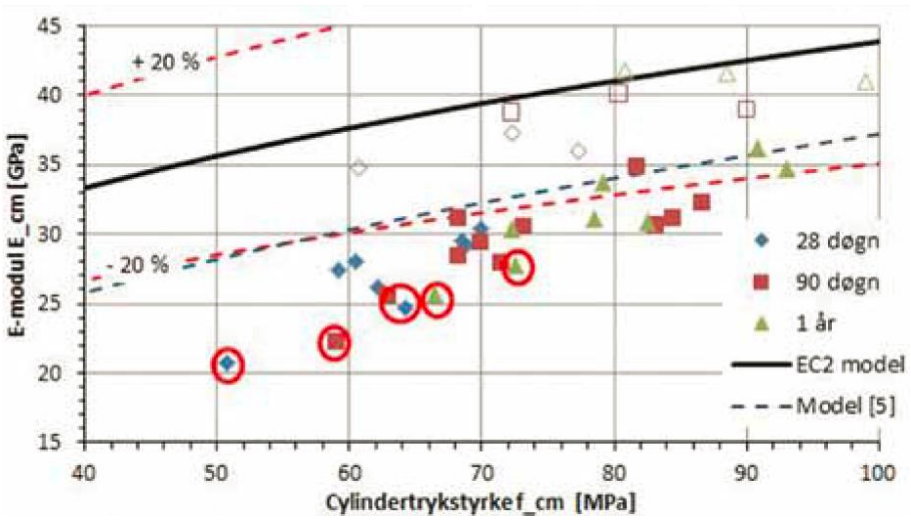
BETONSØJLER - DESIGNGRUNDLAG

- Eurocode 2:
- Styrke: Max 90MPa
- Armeringsmængde: max **4**%
- Tilslag: Mulighed for at øge stivheden



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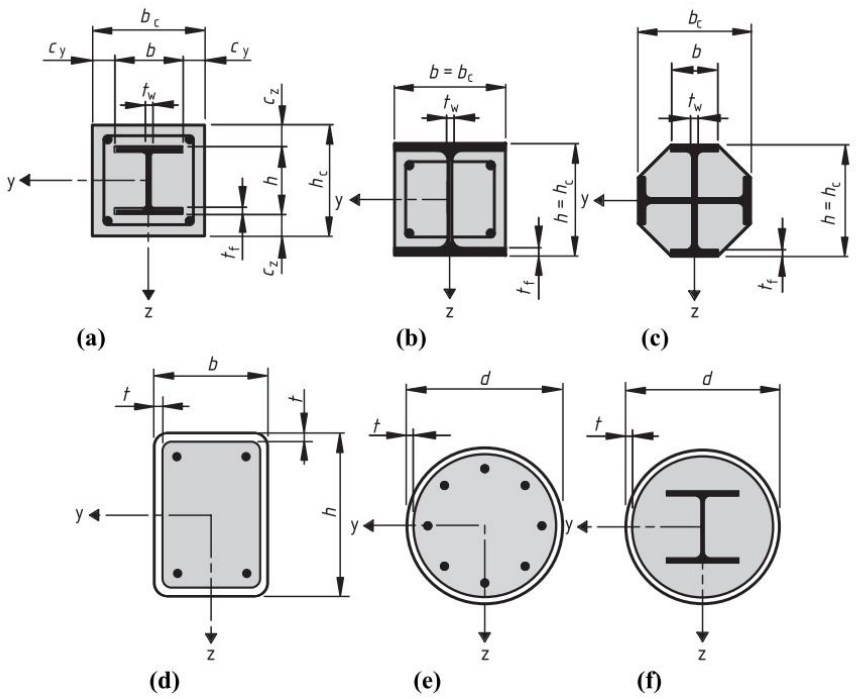
KOMPOSITSØJLER - DESIGNGRUNDLAG

- Eurocode 4:
- Betonstyrke: 20-**60**MPa ()
- Armerings styrke:

400-600MPa (som 1992-1-1)

- Konstruktions ståls styrke:

Max 460MPa



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KOMPOSITSØJLER - DESIGNGRUNDLAG

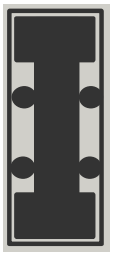
- Armeringsmængde:

(3) Længdearmeringen, der kan anvendes i beregningerne, bør ikke overstige 6 % af betonarealet.

(4) Stålets bidragsforhold, δ, bør opfylde følgende betingelse:

$$0{,}2 \le \delta \le 0{,}9$$

$$\delta = \frac{A_a\, f_{yd}}{N_{pl,Rd}}$$



hvor:

$N_{pl,Rd}$ er den plastiske bæreevne

$$N_{pl,Rd} = A_a\, f_{yd} + 0{,}85\, A_c\, f_{cd} + A_s\, \text{fsd} \qquad (6.30)$$

Formlen (6.30) gælder for betonindstøbte og delvist betonindstøbte ståltværsnit. For betonfyldte tværsnit kan koefficienten 0,85 erstattes med 1,0.

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- Form

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Kilde: CTBUH_ResearchReport_2018

KOMPOSITSØJLER - HYLDEVARER

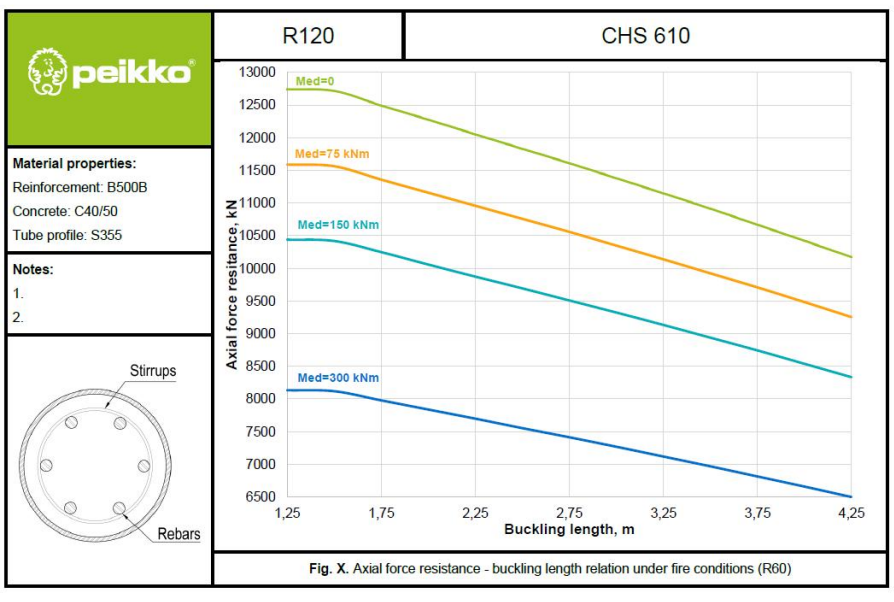
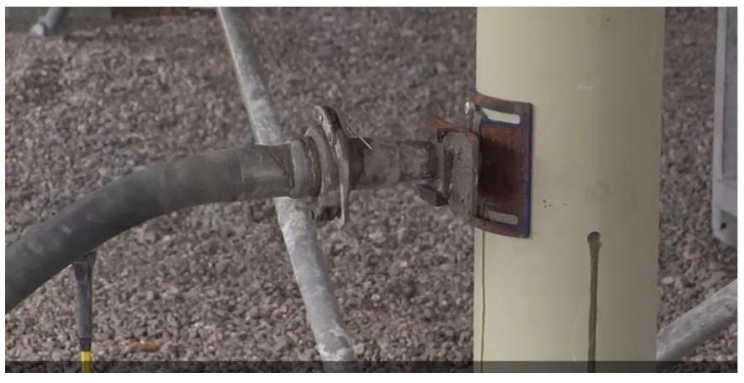


Fig. X. Axial force resistance - buckling length relation under fire conditions (R60)



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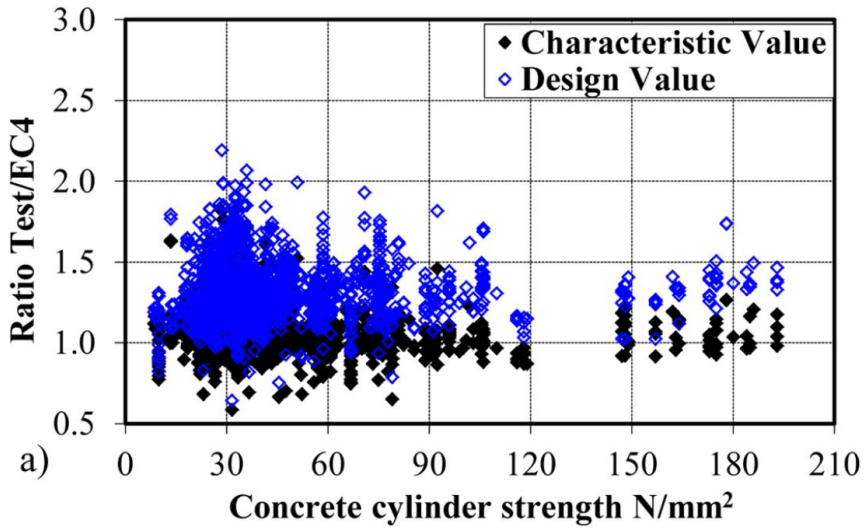
KOMPOSITSØJLER – KAN VI GÅ HØJERE OP I STYRKE?



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Kilde: Design-of-high-strength-concrete-filled-tubular-columns-for-tall-buildings

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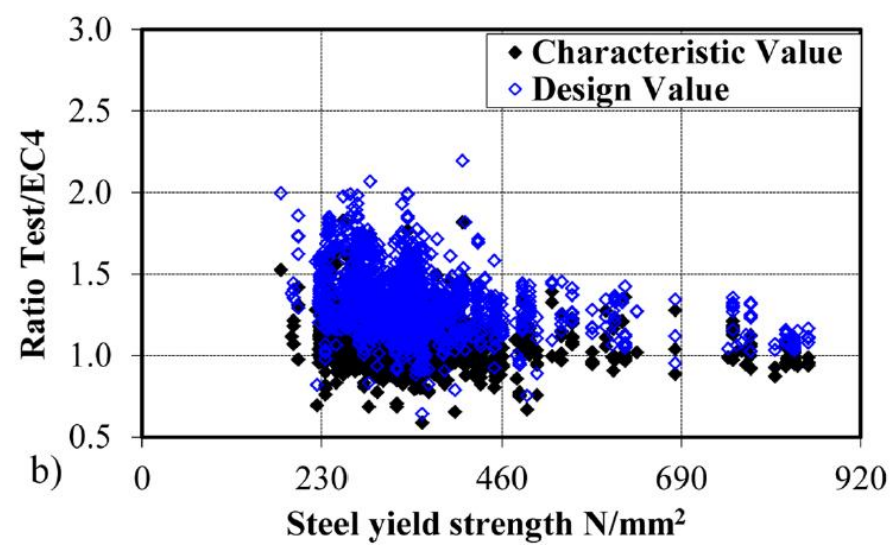
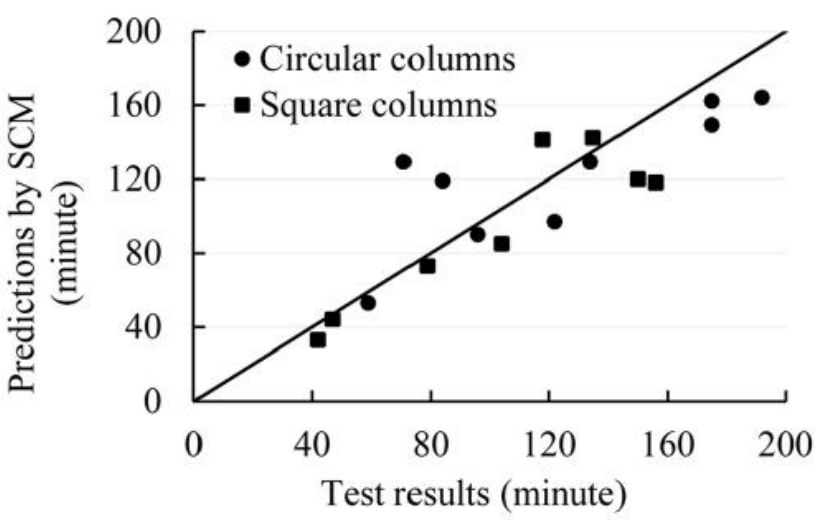
KOMPOSITSØJLER – KAN VI GÅ HØJERE OP I STYRKE?





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Kilde: Design-of-high-strength-concrete-filled-tubular-columns-for-tall-buildings

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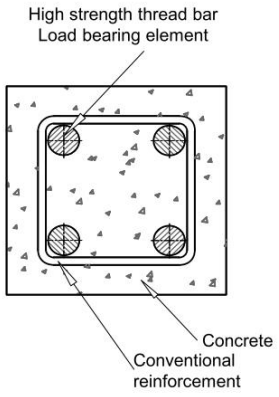
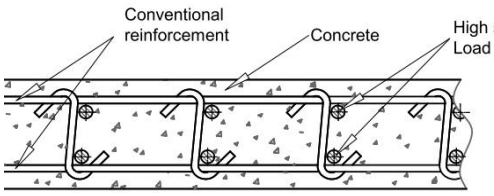
ANDRE SØJLER MED ETA GODKENDELSE

- ETA-13/0840
- Armering SAS670
- Betonstyrke op til C80
- Armeringsmængde: op til 20%



Column



Wall

EAD 160011-00-0301

April 2019

KIT FOR REINFORCED CONCRETE MEMBERS WITH HIGH STRENGTH REINFORCING STEEL BUT LIMITED TENSILE UTILISATION

Adopted European Assessment Document according to Regulation (EU) № 305/2011, Annex II 7.

EOTA

European Organisation for Technical Assessment www.eota.eu

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Kilde: EOTA file № 14-16-0011-03.01 og ETA-13/0840

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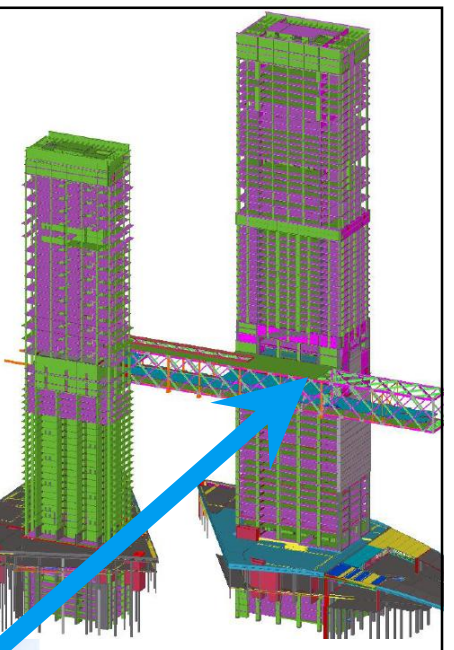
KOMPOSITSØJLER HVOR STORT?



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Kilde:Jens Fussinga foredrag DSBY2019 One Zablee

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KOMPOSITSØJLER I FREMTIDEN

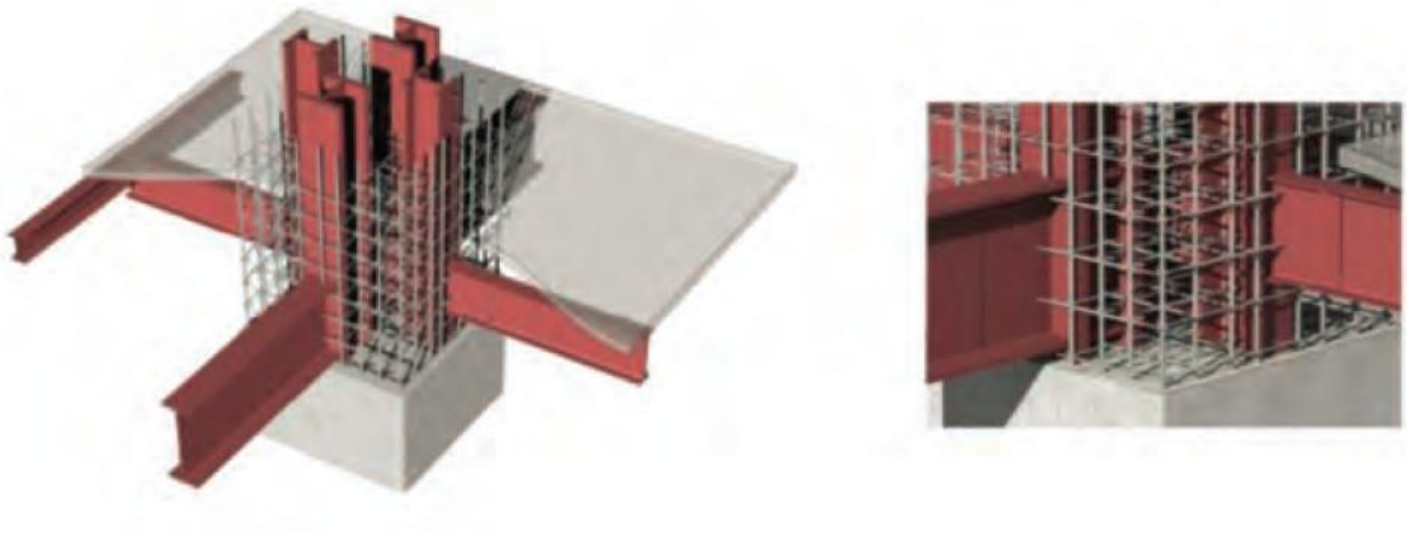

Figure 1. Mega-column with separate steel sections (Source: MKA)

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Kilde: Engineerin-properties-of-composite-mega-columns-with-separately-encased-hot-rolled-steel-profiles, Chen Tao

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JYSK
IKEA
MAXI ZOO
JOHS RASMUSSEN
RAMCYCLE
BENCHMARKING
UPCYCLING AND
RAMBØLL
COLLABORATION