

PP NORDICA DENMARK

Introduktion af løsninger med fiberarmeret beton

PP Nordica Danmark ApS

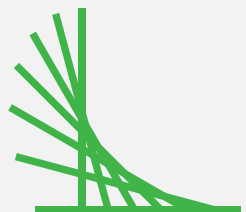
Agenda



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Oplægget er delt i to sektioner

1. Om fibre og anvendelsesområder v/Ejnar Skov
2. Beregning og dokumentation miljøvaredeklaration v/ Daniel Fester Henningsen



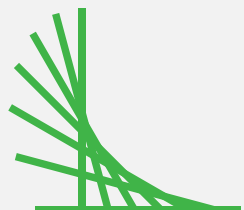
Lidt kort om mig



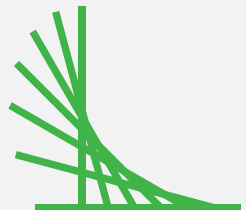
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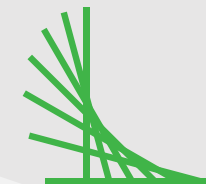
Har været i byggebranchen i mere end 40 år

- Har arbejdet i betonbranchen de seneste 22 år, hvoraf 15 år med salg af beton
- De seneste 7 år som salgskonsulent i firmaet PP Nordica.



- Hvad er PP-Nordica?
 - Handelsselskab
 - Leveret fibre til byggebranchen siden 2008
 - Leverer primært kun fibre til betonleverandører *)
 - Samarbejdspartner ADFIL Belgien
 - Fibrene produceres i Belgien
 - PP Nordica Group:
 - PP Nordica Danmark
 - PP Nordica Sveden
 - PP Nordica Norge
 - PP Baltic (Litauen)
 - PP Polan





Fiberalderen

Fibre er forholdsvis "nyt" i byggebranchen (siden 2008)
i forhold til:



Træ



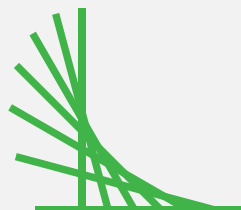
Mursten

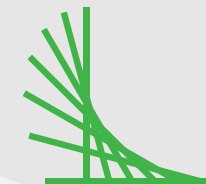


Beton



Armeringsstål





Fibre og betonreparationer

- Fibre indgår ikke meget til betonrenoveringer
- Manglende kendskab til fibrenes anvendelsesmuligheder
- Flere får øjnene op for vore fiberløsninger
- I dag er der fokus på:

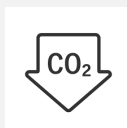
• Arbejdsmiljøet



• Byggehastighed



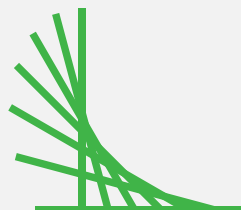
• Bæredygtighed



• Økonomi



Så det er her **DURUS EasyFinish** kommer ind i billedet

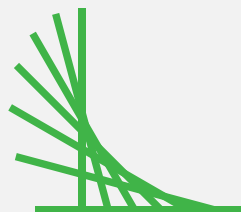


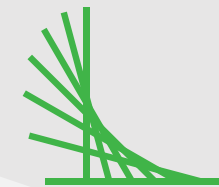
Fibre i betonapplikationer



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- Hvad er fibre/fiberarmeret beton
- Hvor bliver de anvendte
- Hvorfor anvende fiberarmeret beton
- Eksempler på hvor fibre anvendes
- Indsigt og inspiration til hvor fibre kan indtænkes i betonrenoveringer





Fiberarmeret beton

Hvad er fiberarmeret beton?



Beton

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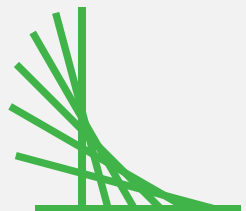


Fibre

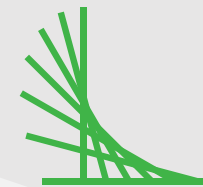
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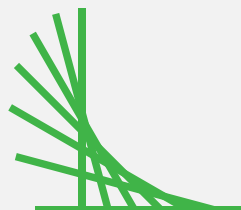
Fiberarmeret beton



Eksempler på fiberarmeret beton



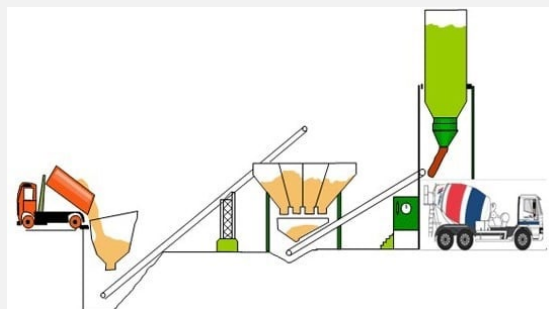
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Fibertilsætning



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Fibrene tilsættes betonen på betonfabrik

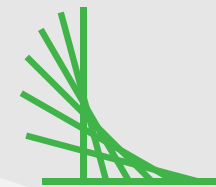
Færdigarmeret beton på leveret byggepladsen



Alternativt tilsættes fibrene betonen i blandemaskine

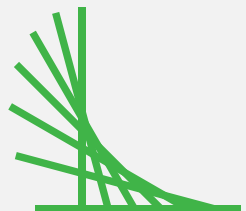
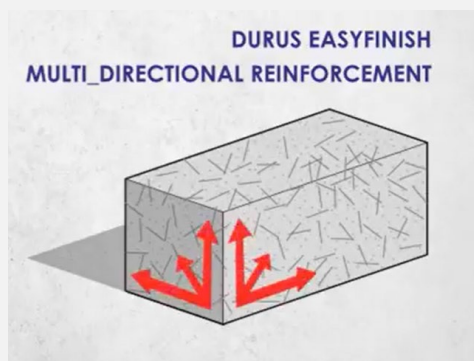
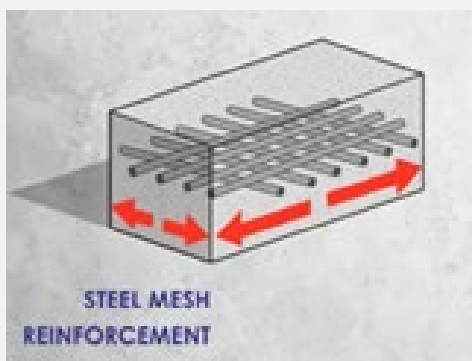
Færdigarmeret beton/mørtel



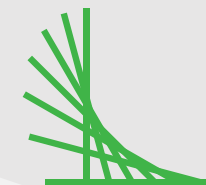


Fiberarmeret beton

- Virker 3-dimensionelt til hele betonmatrixen
- Virker i hele konstruktionens tværsnit



Fibertyper



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2 fibertyper:



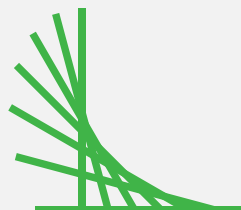
Mikrofibre:

- DURUS Crackstop Ultra
- DURUS Ignis



Makrofibre:

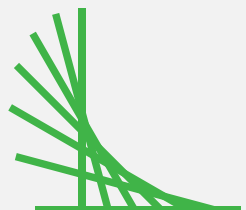
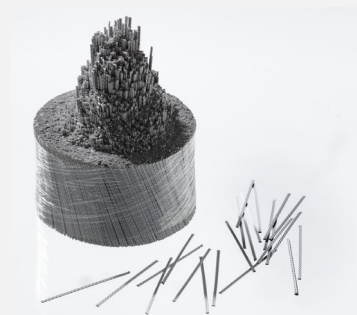
- DURUS EasyFinish
- DURUS EasyShut

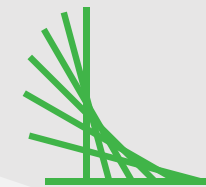


MAKROFIBRE

- Durus® EasyFinish konstruktionsfibre

- Fibrene er produceret af ekstruderet polypropylen
- Produceret af Jomfru råmateriale
- DURUS EasyFinish er 40 mm lang
- Dosering typisk mellem 2- 6 kg/m³
- Ca. 70.000 fibre pr. kg.
- Indfarvede grå
- Densitet på: 0,91
- EN 14889 Part 2





Hvordan anvendes fibre

- Erstatning for konventionel stålarmering



Stålarmering

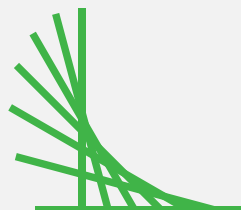


EasyFinish fibre

eller

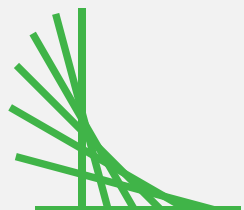
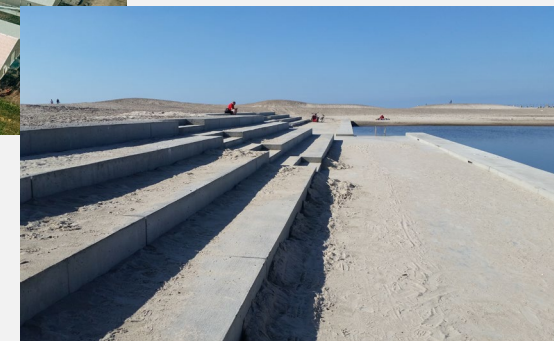


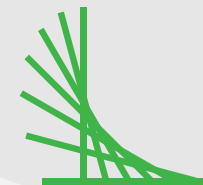
Kompositløsning



Bygge-applikationer

- Boliger
- Industri
- Landbrug
- Maritime anlæg
- Meget andet





Primære anvendelsesområder

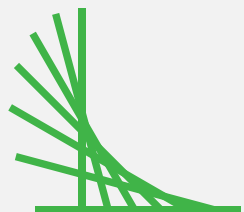
- Stribefundamenter



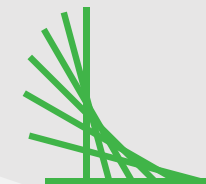
- Punktfundamenter



- Terrændæk



Anvendelsesområder

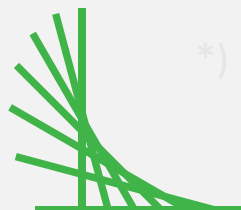


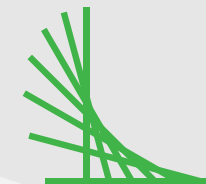
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- Bundplader*)
- Overbeton/påstøbninger
- Vægge*)
- Bjælker og søller*)
- Plader og dæk*)



*) kompositløsninger

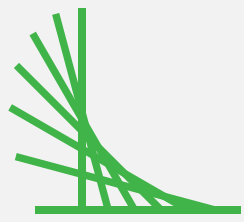




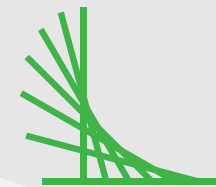
Nemt, enkelt og hurtigt

Fordel og egenskaber:

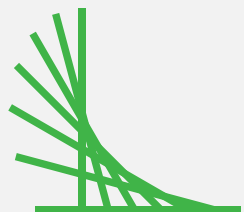
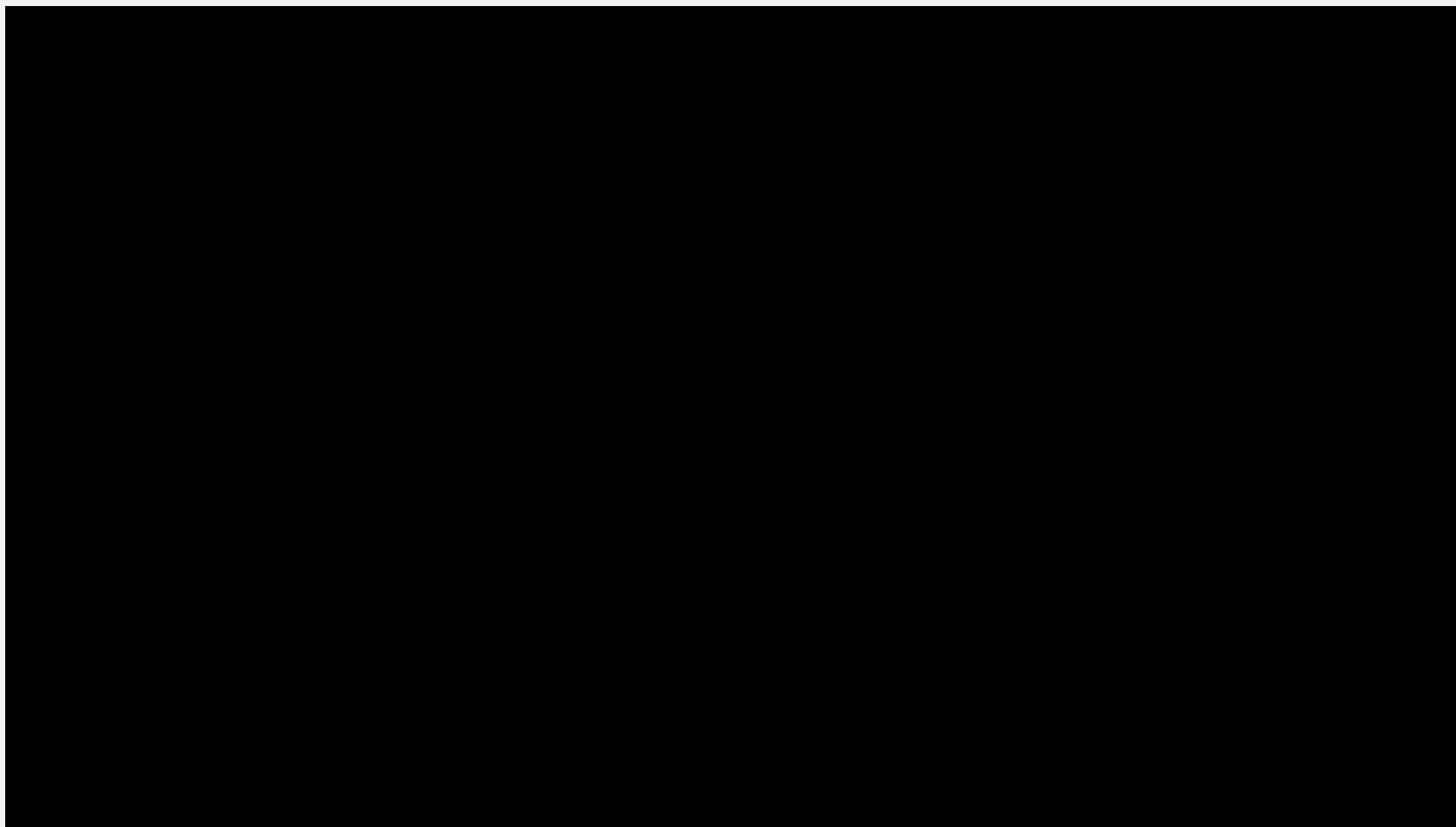
- Armering og støbning i én arbejdsgang
- Ingen yderligere bearbejdning
- Garanteret korrekt placering
- Ingen korrosion (ingen dæklagskrav)
- Bedre arbejdsmiljø og sikkerhed
- Bæredygtighed og genanvendelse
- Bedre økonomi
- Fordele i forhold til stålfibre



Hammertest

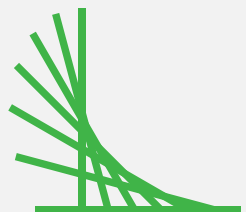


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Korrosion

Modstandsdygtig over for rust (PP fibre ruster ikke)

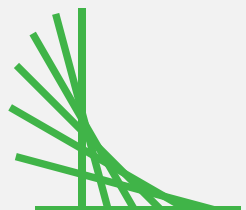


MIKROFIBRE

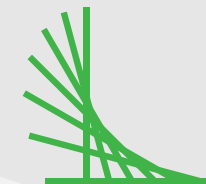


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- DURUS Crackstop® Ultra
- DURUS IGNIS®



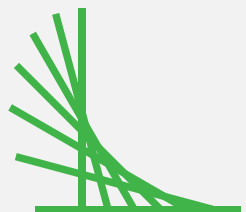
MIKROFIBRE



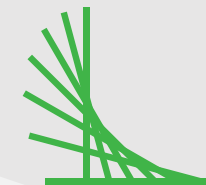
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DURUS Crackstop mikrofibre (Monofilament) Fibre

- Fibrene er produceret af ekstruderet polypropylen
- Produceret af Jomfru råmateriale
- Længde 12 - 18mm
- Diameter 18 – 32 micron
- Dosering typisk mellem 300 gr.- 1200 gr. kg/m³
- 720 million fibre pr Kg
- Densitet på: 0,91
- EN 14889 Part 2



Plastisk svind

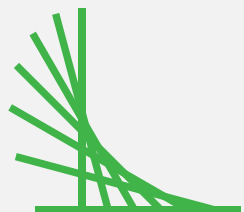


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Crackstop absorberer 4 – 5 gange sin egen vægt

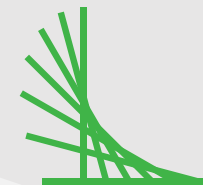


Eksempler på udtørringssvindrevner

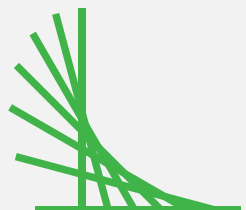


Brandsikring

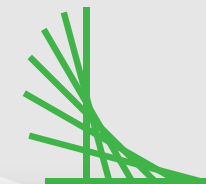
- Passiv brandsikring
- DURUS IGNIS



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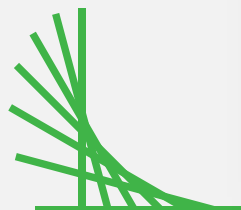
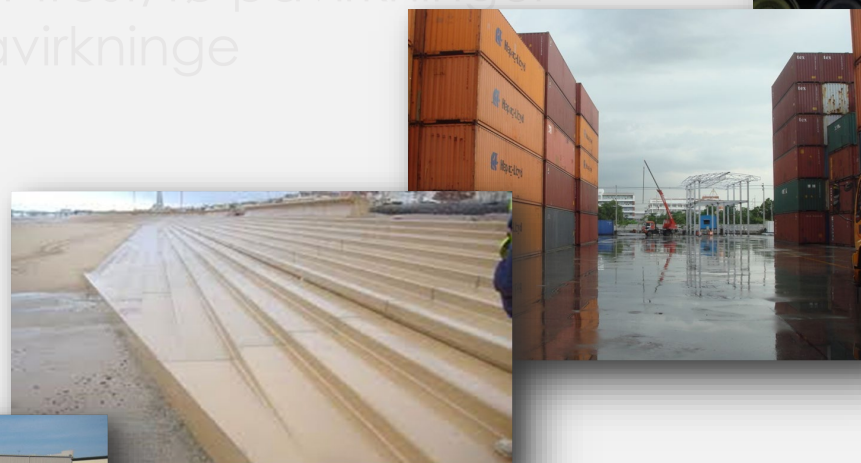


Egenskaber

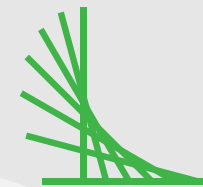


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- Forstærker slitage og slagfastheden
- Reducerer plastisk svind
- Formindsker frost/tø påvirkninger
- Kemiske påvirkninger



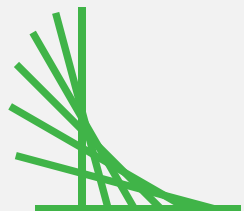
Slagtest med armeringsjern



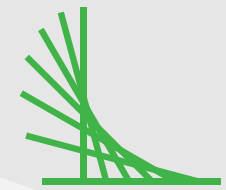
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Flise armeret med Y16 mm pr. 200 mm



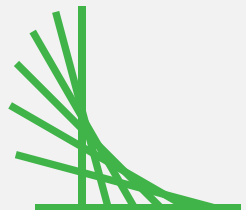
Slagtest med Crackstop fibre



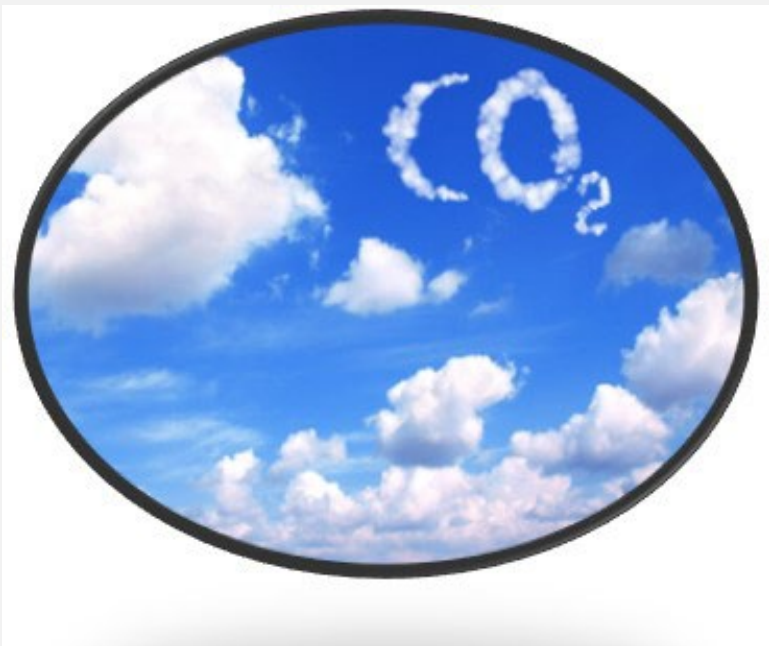
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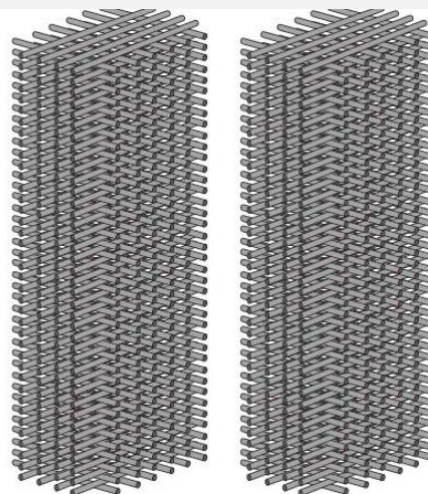
Flise armeret med Crackstop fibre (kun 1 stk. Y16 mm som løftejern)



Bæredygtig armeringsløsning



- Mindre CO₂ udledning
- Reducerer CO₂ udledning fra 60 – 90% i forhold til stålarmering

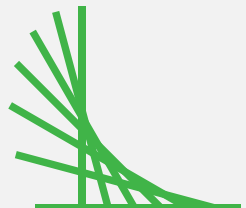


ARMERINGSBEHOV / 1000 m²

172 STÅLNET / 12.5 TON

1 PALLE / 504 KG

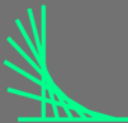
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Analyserne er foretaget af COWI og 3. parts verificeret af hhv. Rambøll og Aalborg Universitet.

CO₂ beregningsprogram

Sag: Vrå Dampvaskeri
Sagsansvarlig: ES
Beregning af CO₂ udledning
Beregningstype: Cradle to Gate

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Fiber reinforced solutions

Terrændæk

Input	Værdi	Enhed
Længde af gulvterrændæk	50	m
Bredde af gulvterrændæk	20	m
Tykkelse af gulvterrændæk	0,2	m
Armeringsnet i underside (2350 mm x 5000 mm)	Y8H50	
Armeringsnet i overside (2350 mm x 5000 mm)	Y8H50	
Overlap ved brug af armeringsnet	15	%
Dosering af DURUS EasyFinish i beton	3	kg/m ³
Dosering af stålfibre i beton	25	kg/m ³
Type af CO ₂ -udledning	Cradle to Gate	

Armeringsnet vs. EF fibre
5467 kg CO₂ = 82%

CO₂-udledning

	Armeringsnet	Stålfibre	DURUS EasyFinish
Udledning af CO ₂ i kg	6637	3855	1170
Besparelse af CO ₂ -udledning af fibre i procent af armeringsnet		42%	82%
Besparelse af CO ₂ -udledning af plastfibre i procent af stålfibre			79%

Areal dækket af ét armeringsnet	12	m ²
Areal dækket af ét armeringsnet, korrigeret for overlap	8	m ²
Vægt af ét armeringsnet i underside	63	kg
Vægt af ét armeringsnet i overside	63	kg
Anvendt antal armeringsnet i alt	236	stk.
Anvendt antal armeringsnet i overside	118	stk.
Anvendt antal armeringsnet i underside	118	stk.
Anvendt mængde armeringsnet (underside), korrigeret for overlap	7458	kg
Anvendt mængde armeringsnet (overside), korrigeret for overlap	7458	kg
Anvendt mængde armeringsnet (i alt), korrigeret for overlap	14915	kg
Anvendt mængde stålfibre	5000	kg
Anvendt mængde DURUS EasyFinish	600	kg
Volumen af beton	200	m ³

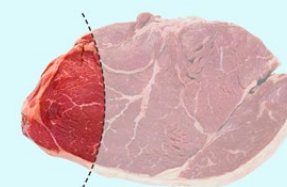
2685 kg CO₂ = 70%
Stålfibre vs. EF fibre

1 kg CO₂ = 1 liter letmælk



~ 5467 liter mælk

1 kg CO₂ = 1/3 bøf

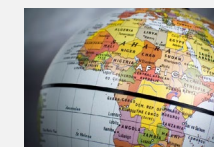


~ 1825 bøffer

1 kg CO₂ = 8,5 km biltur



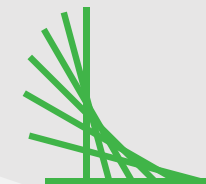
~ 46470 km



40.000 km

Kilde: Samvirke

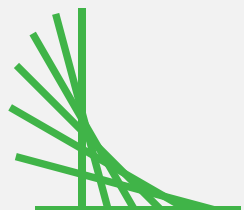
Genanvendelse

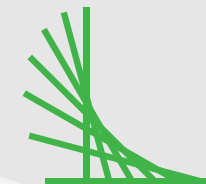


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Genanvendelse af fibre fra knust beton:

- Vejfyld
- Genbrugsbeton
- Genbrugsplast





Makrofibre til reparationer

MAKROFIBRE

DURUS EasyFinish:

- > 30 mm lagtykkelse
- Fokus på reducere af svind

DURUS EasyShut:

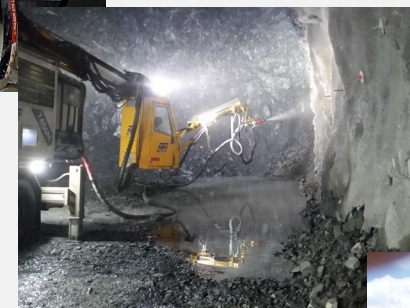
- Sprøjtebeton / Fjeldsikring

Fordele:

- Nem bearbejdning
- Ingen rust
- Hurtig
- Øget sundhed
- Bedre arbejdsmiljø
- CO₂ reducerende
- Prisbesparende



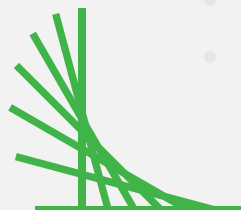
Overbeton



Fjeldsikring



Sprøjtestøbning





Mikrofibre til reparationer

MIKROFIBRE

DURUS Crackstop::

- Små reparationer
- Reparationer < 30 mm lagtykkelse
- Reducering af plastisk svind

DURUS Ignis.

Passiv brandsikring

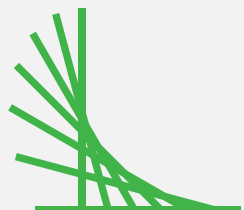
Kombinationsløsninger:



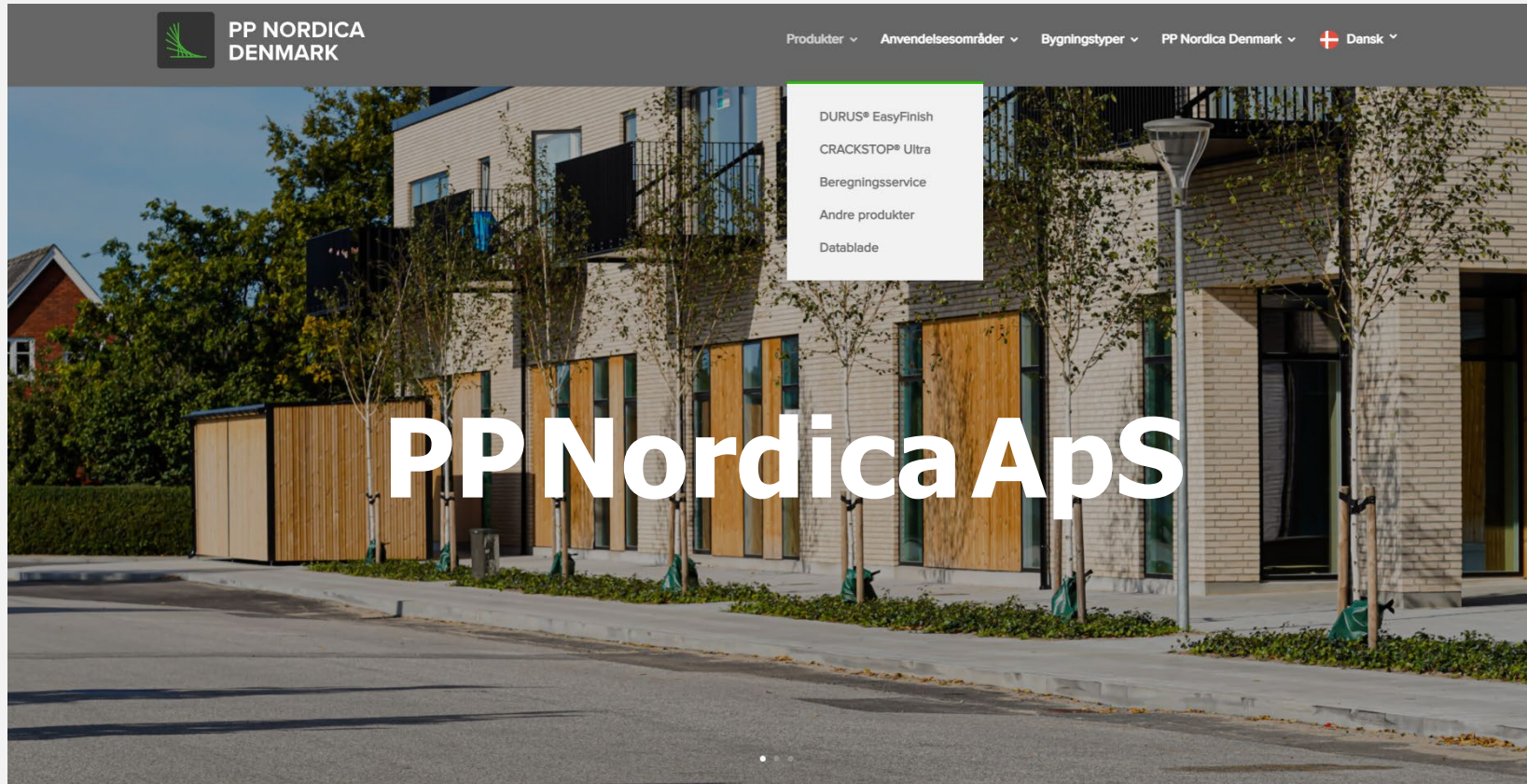
Sallingsundbroen



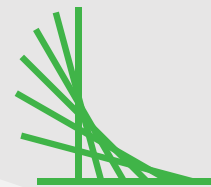
Farøbroen



Hjemmeside

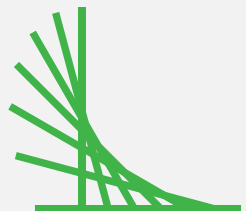


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Mød os på vores stand





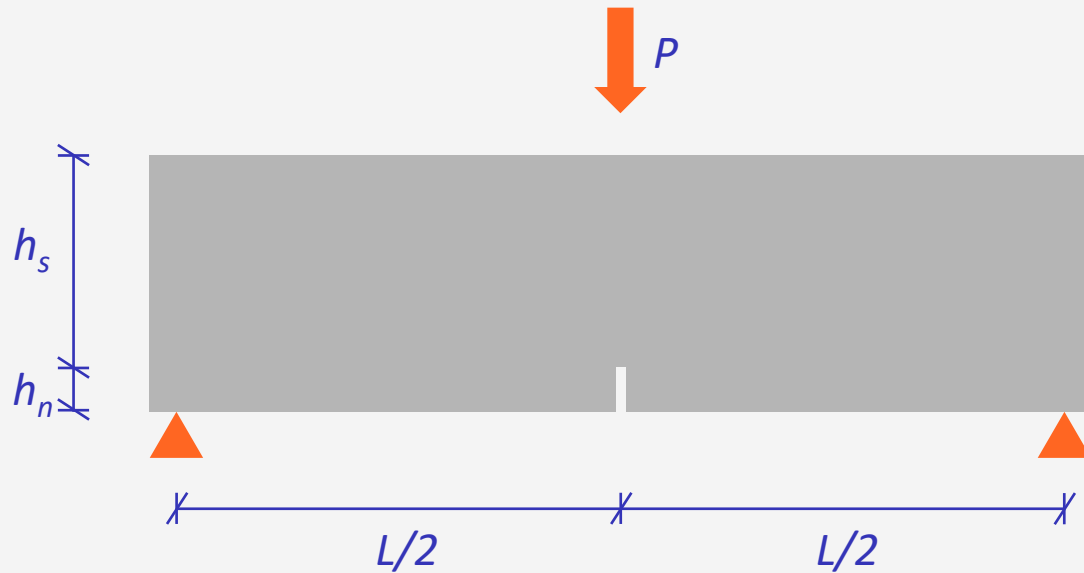
Betonreparation og - renovering

Dansk Betonforening

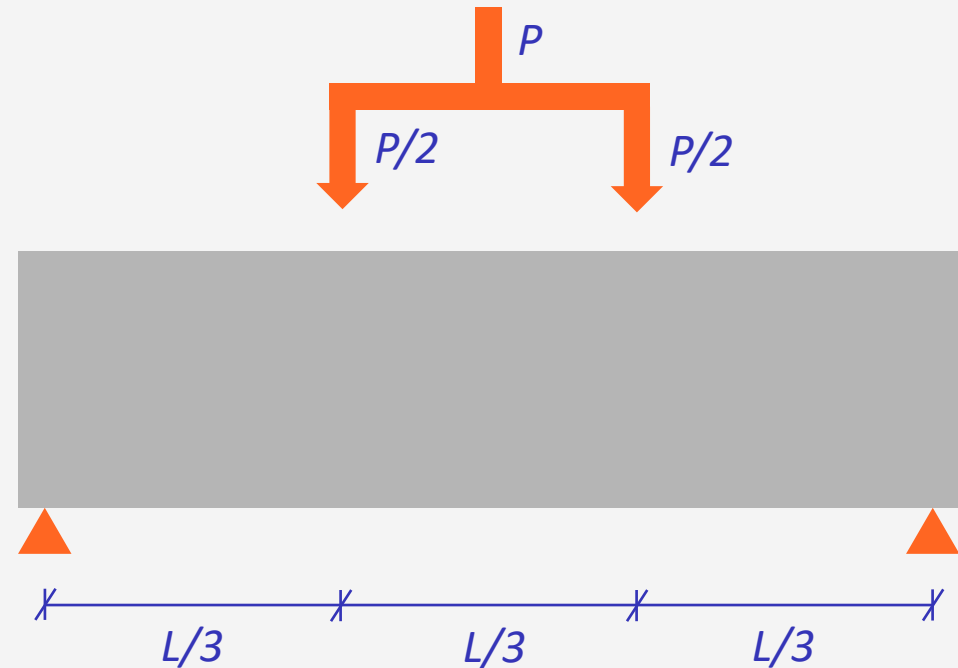


Standardized tests

- 3- and 4-point bending tests

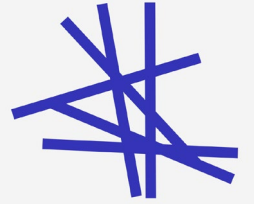


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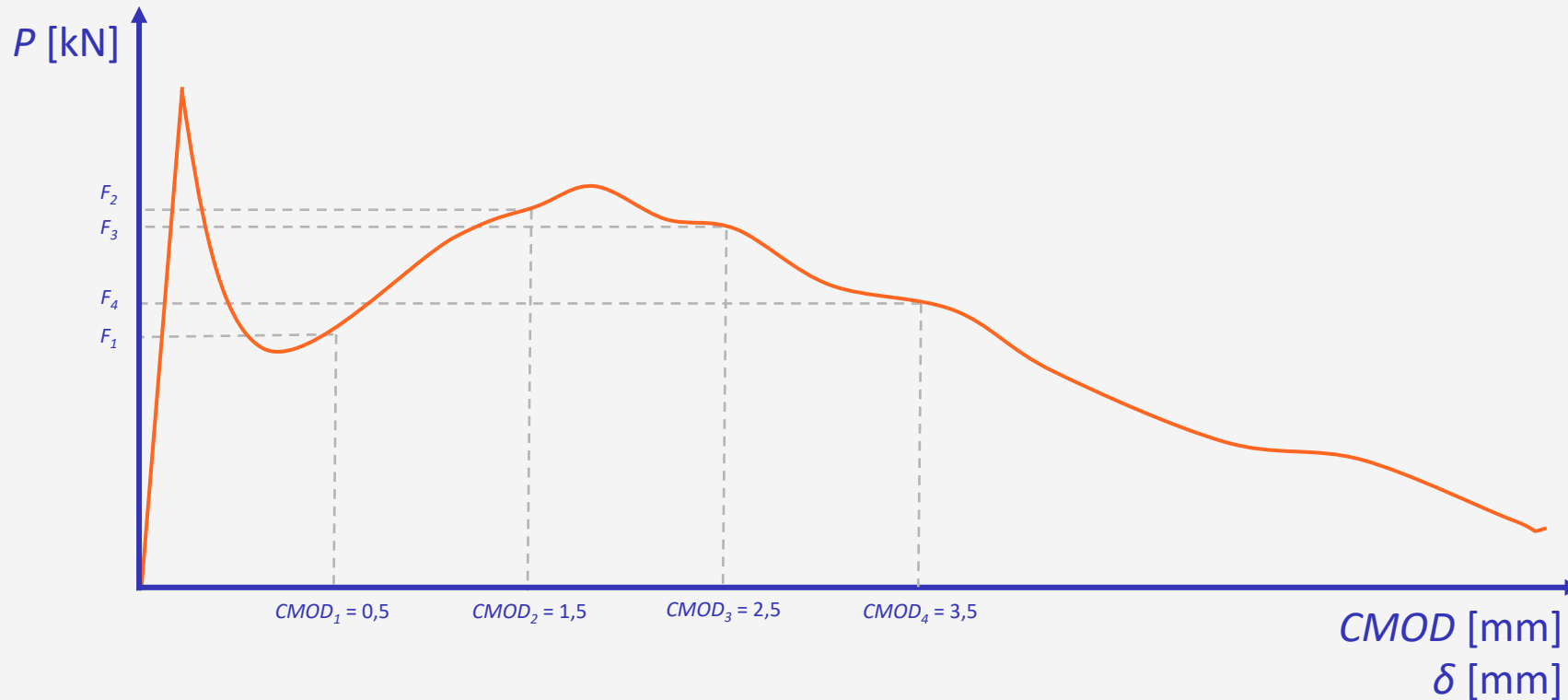


ASTM C1609

Tests results

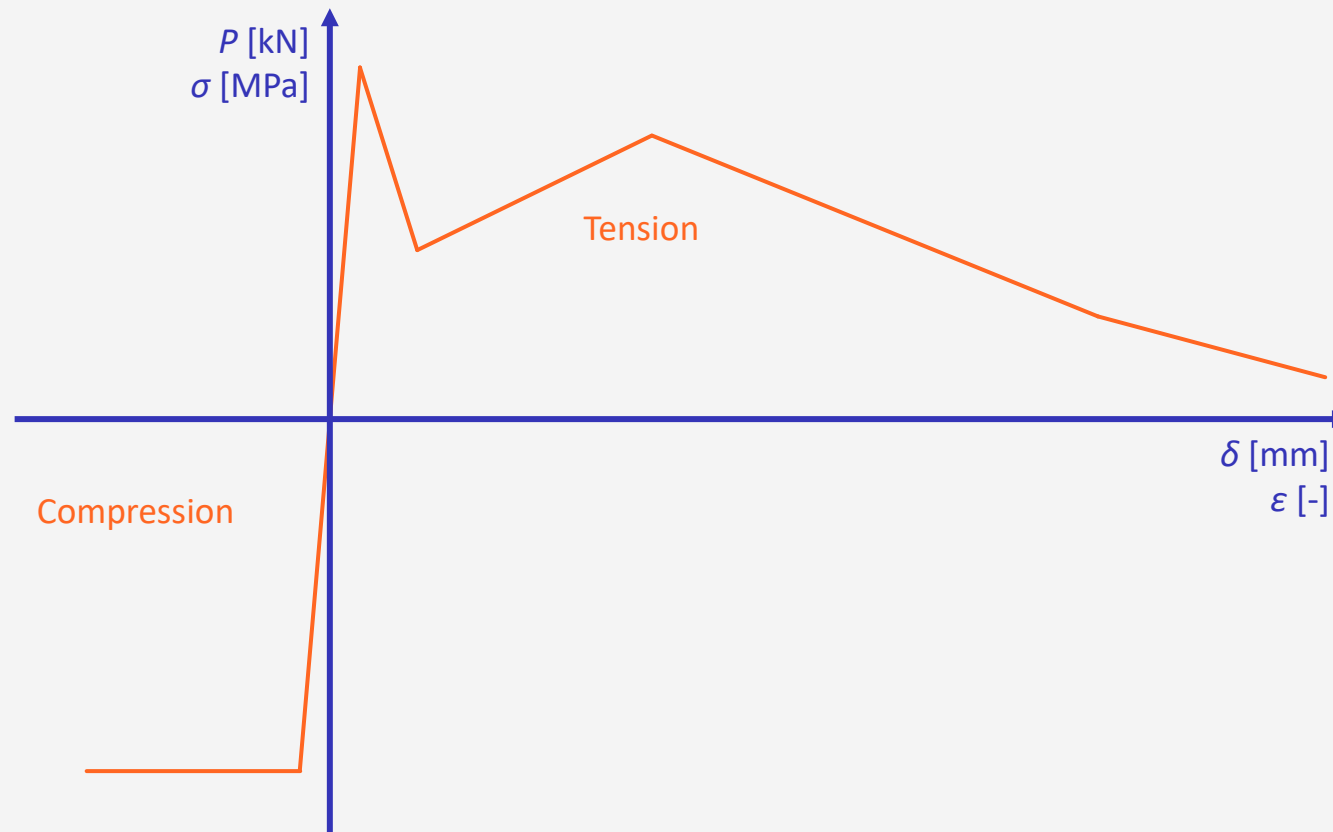


- Load and CMOD (Crack Mouth Opening Displacement)
- Residual Flexural Tensile Strength



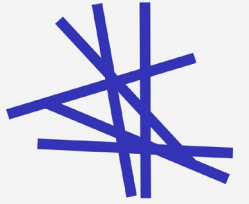
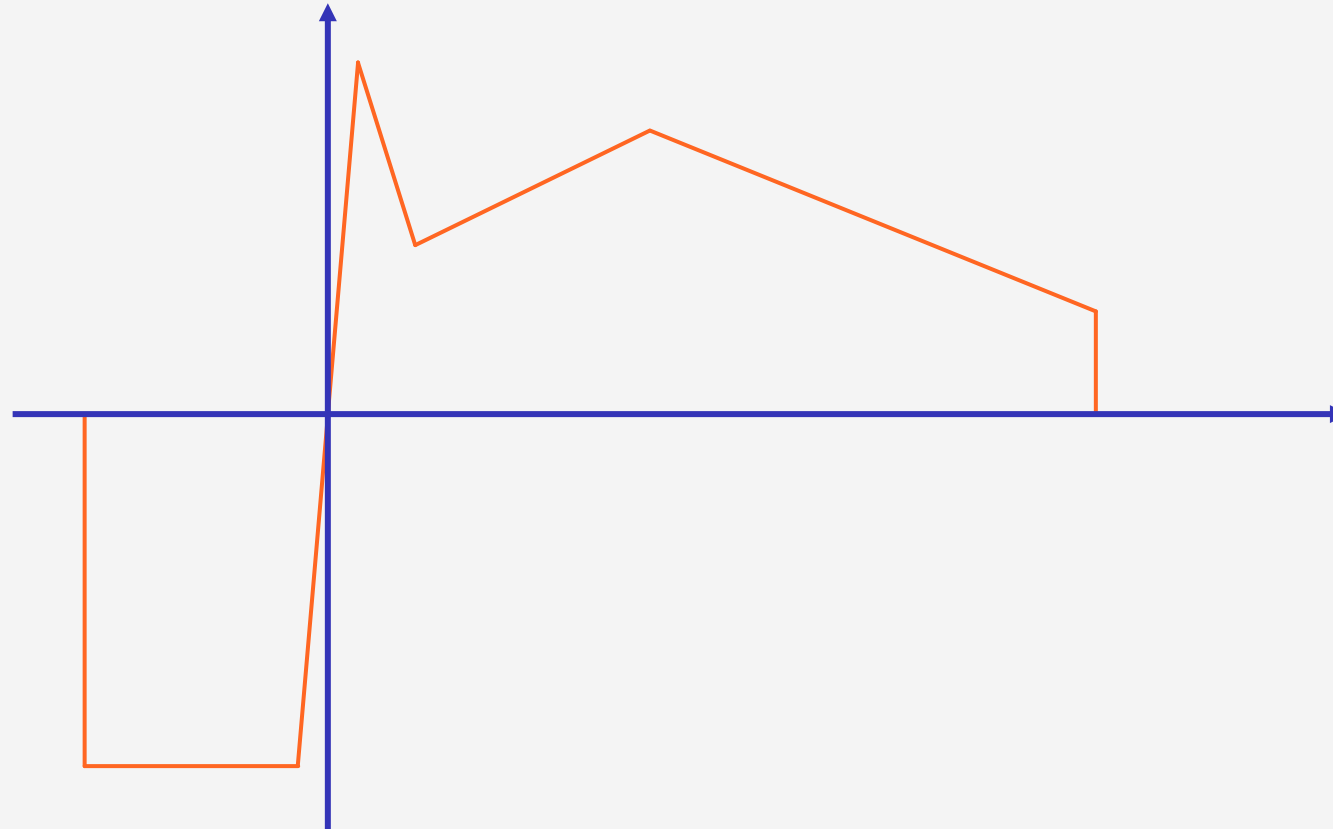
Stress-strain

- Non-linear plastic response converted to bi-linear

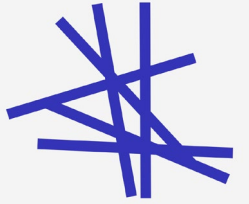


Stress-strain

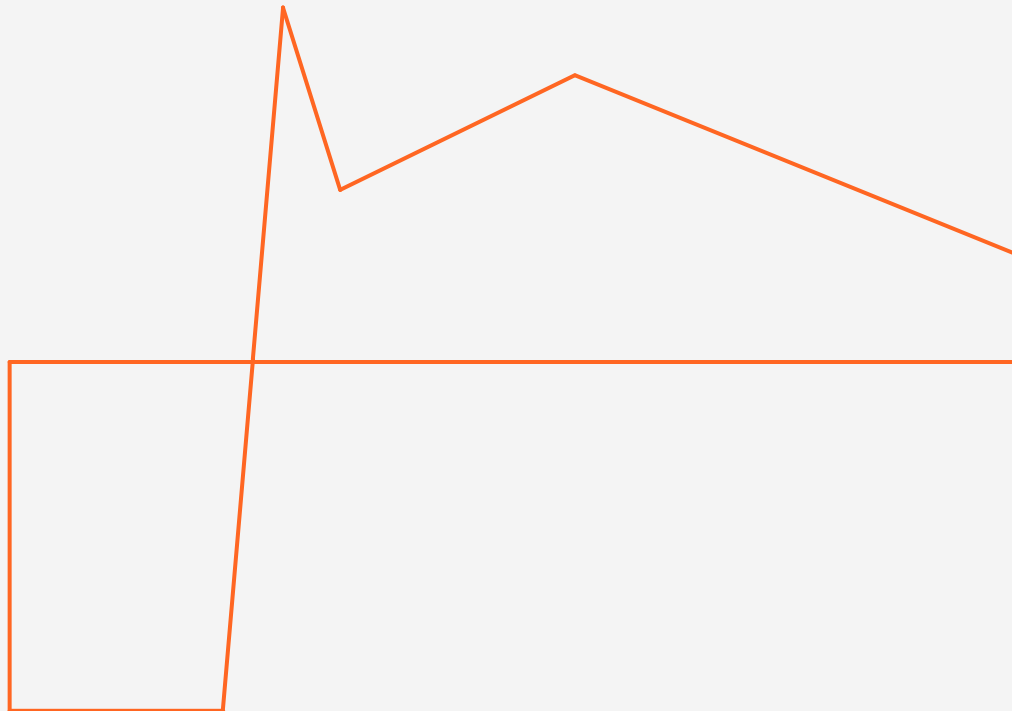
- Stress distribution of any given cross section from stress-strain curve



Stress-strain

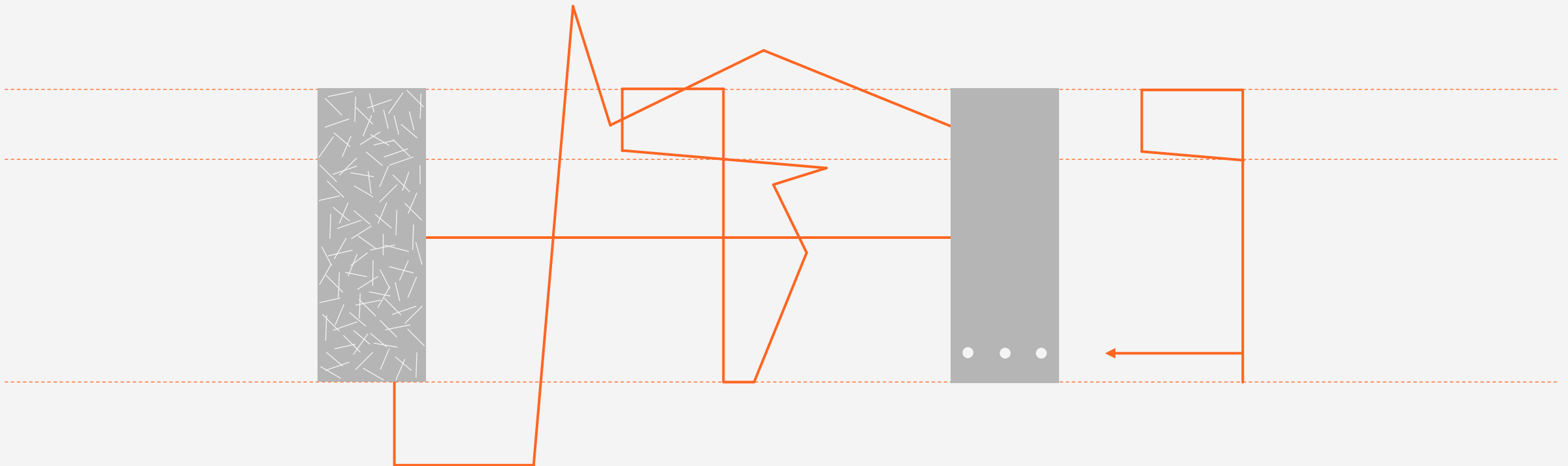


- Stress distribution of any given cross section from stress-strain curve

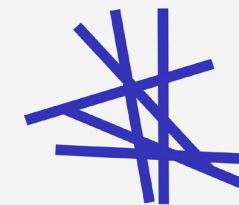


Stress-strain

- Stress distribution of any given cross section from stress-strain curve



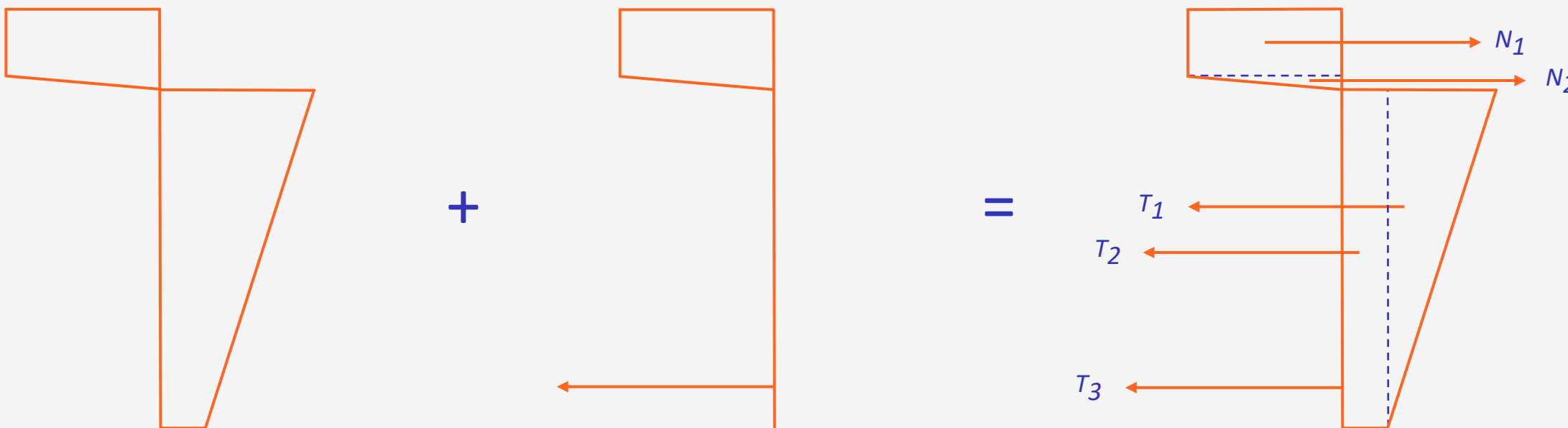
Constitutive laws

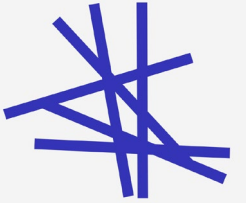


- Horizontal force equilibrium and bending moment equilibrium:

$$N_1 + N_2 = T_1 + T_2 + T_3$$

- Moment resistance from constitute laws (Moment around normal force):





Thank you for your
attention!

Questions?



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