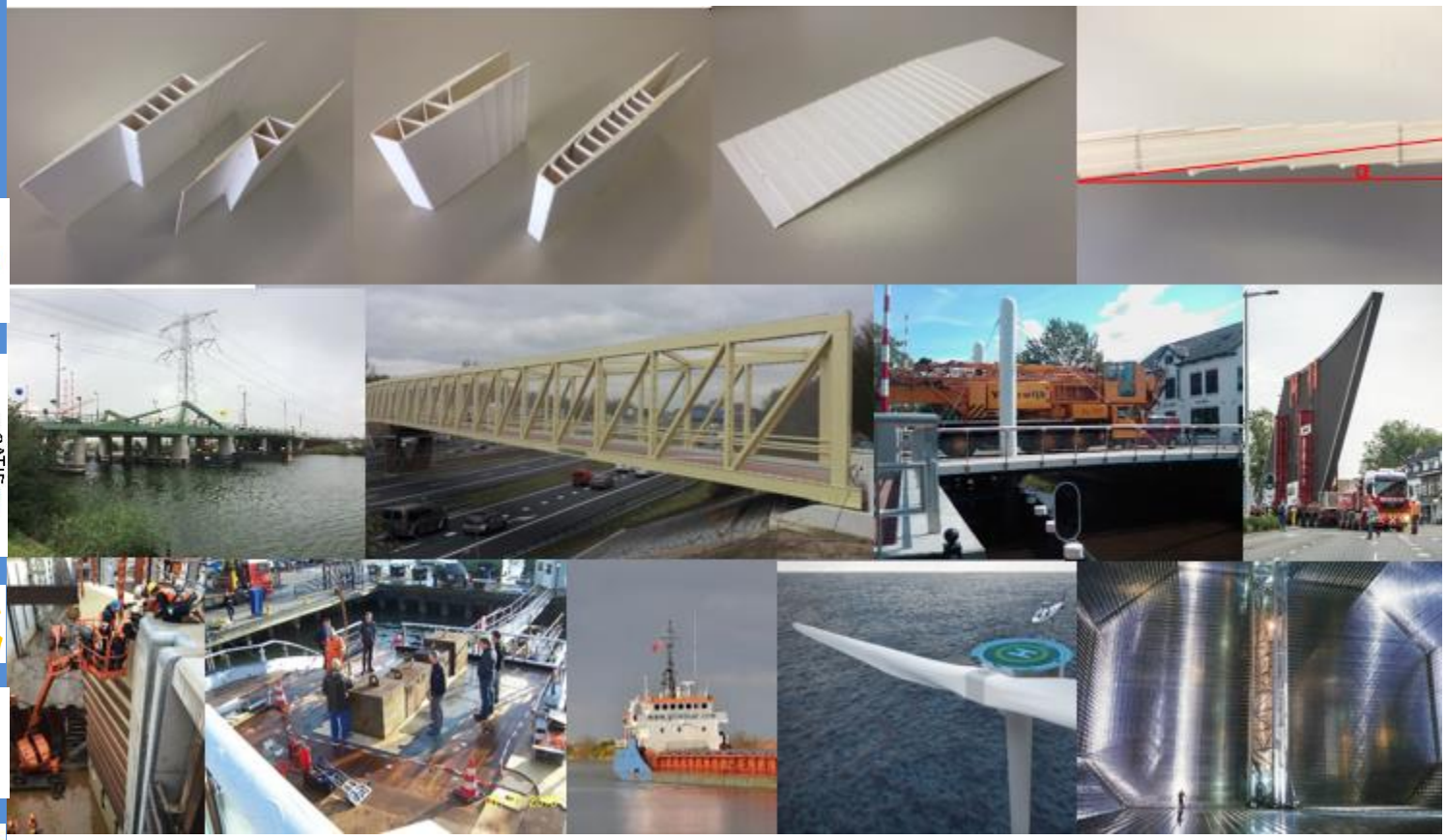
The essence of InfraCore Inside®

A brief introduction



The essence of InfraCore Inside®

InfraCore Inside looks and feels like a sandwich structure, but it has a more direct descent from beams, in fact multi-beam plates.

The following slides give an introduction into the essence of the InfraCore Technology: how it functions, the mechanical behaviour, the benefits as compared to sandwiches and multi-beam plates.

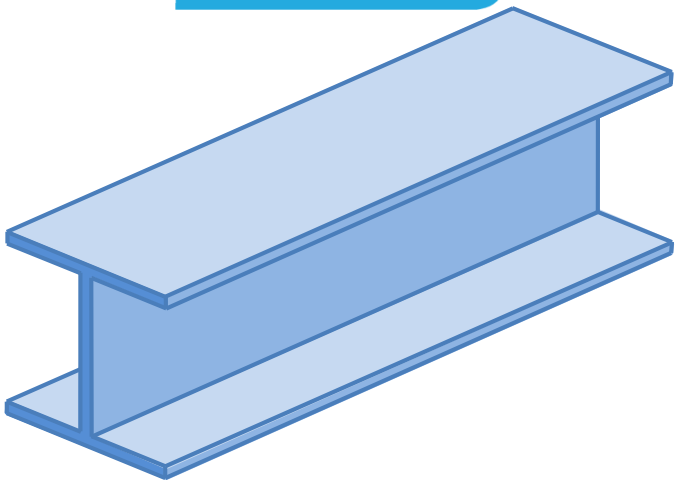
The essence of InfraCore Inside®

All the InfraCore Inside concepts described hereafter are protected by patents.

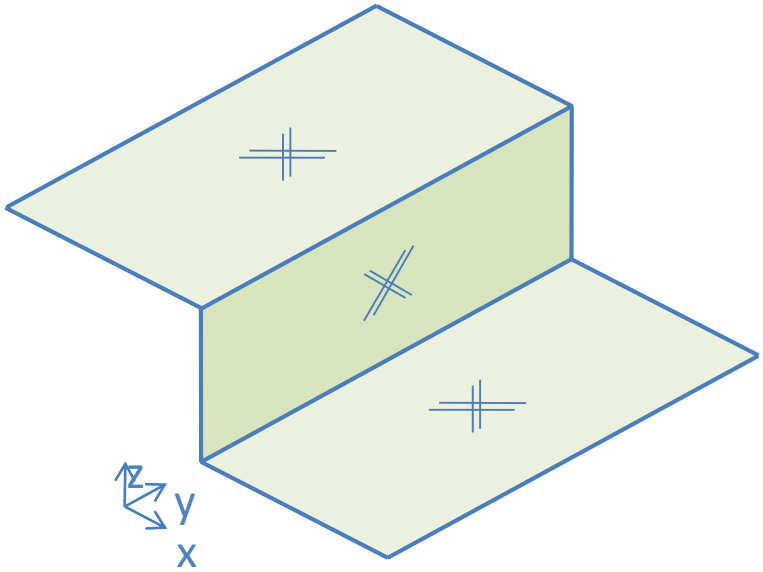
For licensing of this technology, please contact InfraCore Company

InfraCore company

InfraCore inside



Steel beam:
Two flanges, connected by a web



Glass Fibre Fabric beam:
Two flanges, connected by a web
One layer of ±45° fabric

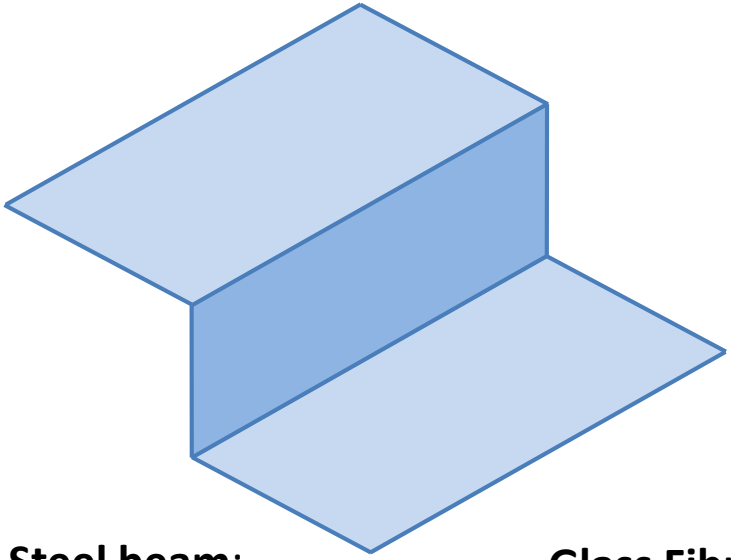
RAMSSES

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

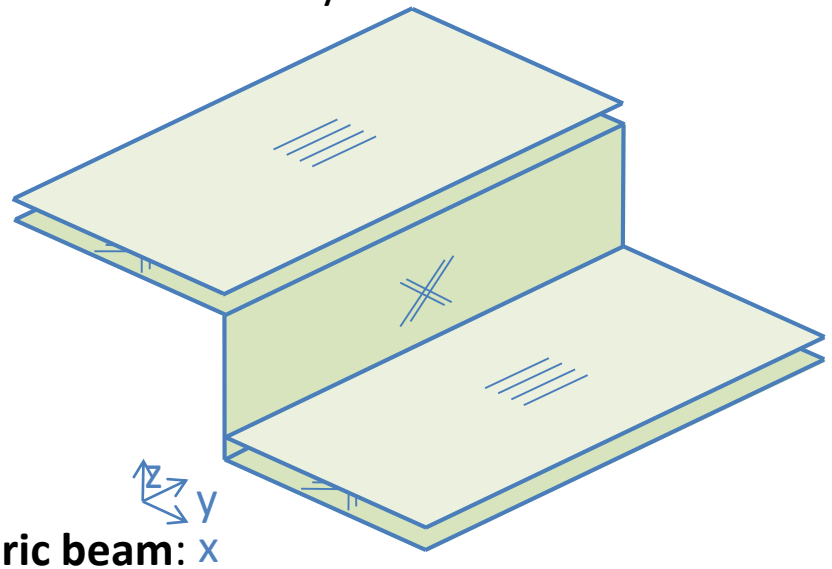
CompositesNL

E-LASS

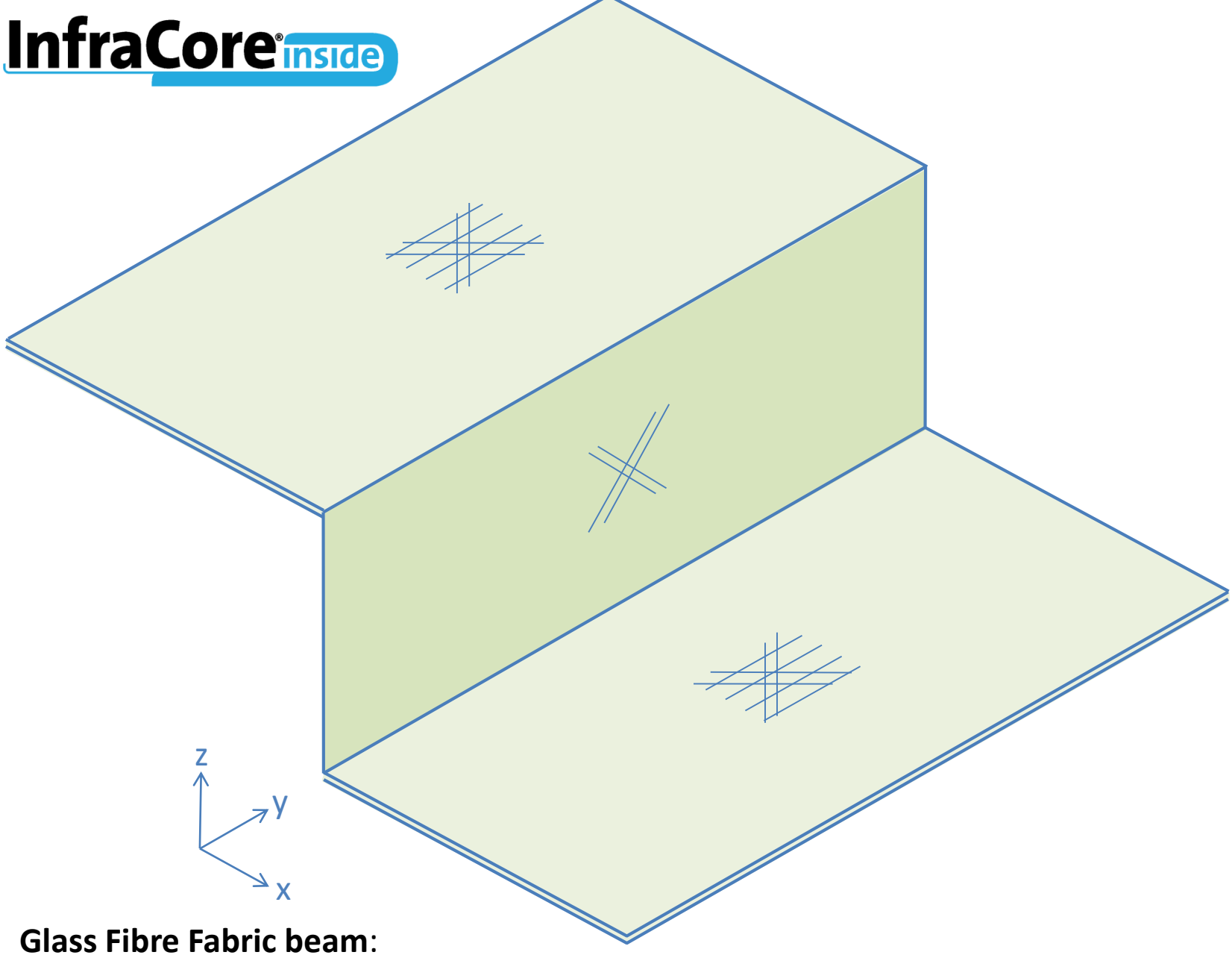
FiberCore europe



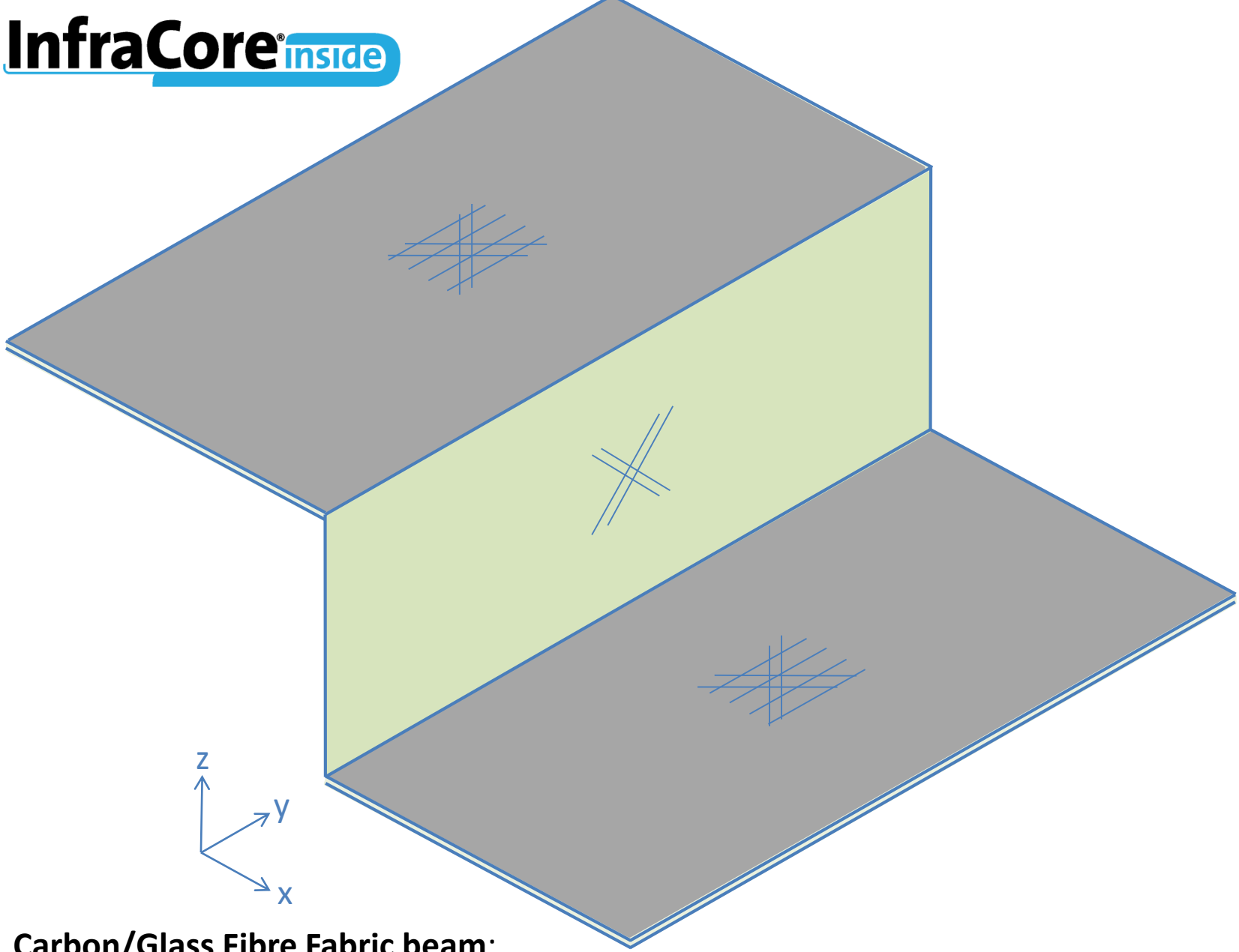
Steel beam:
Two flanges, connected by a web



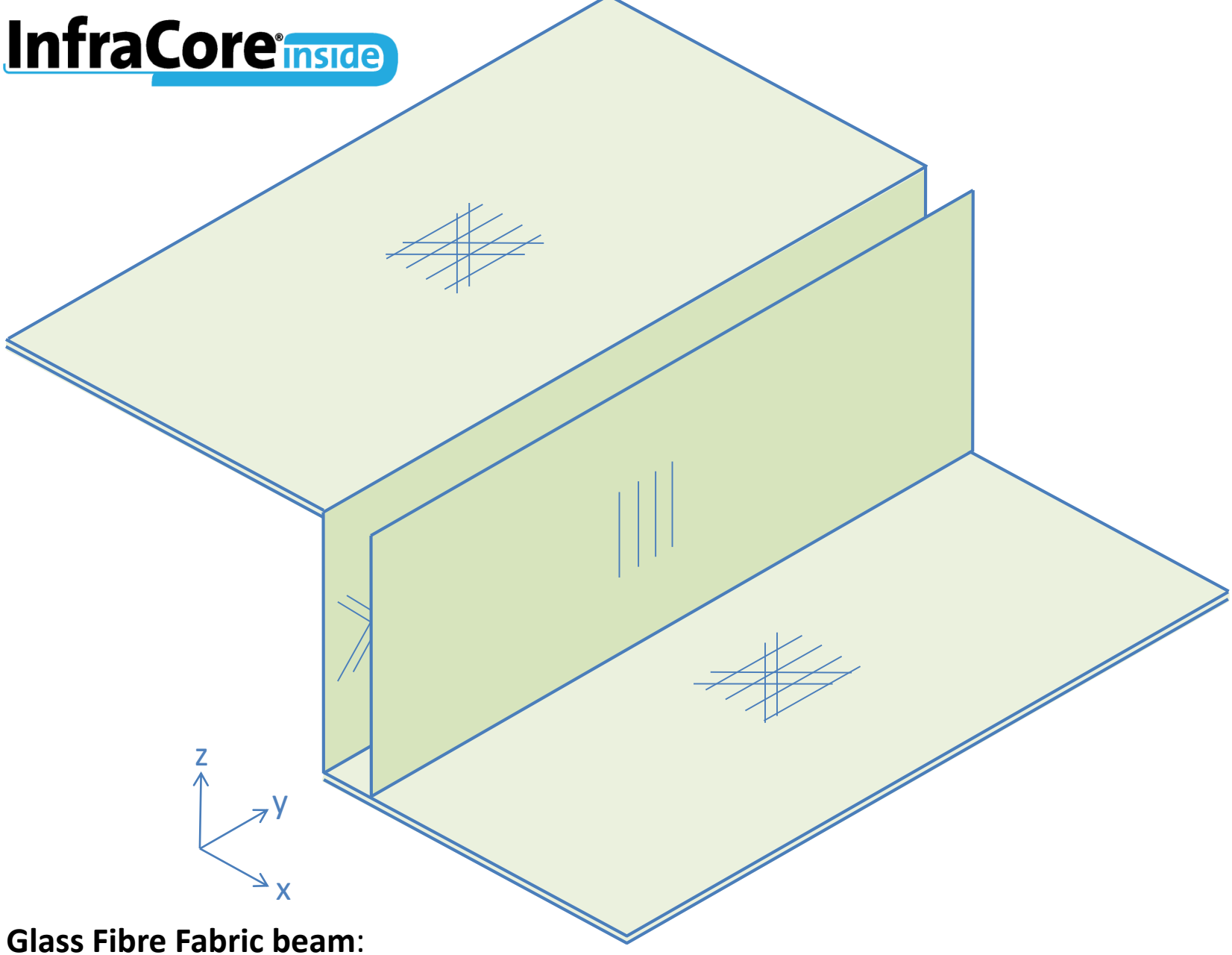
Glass Fibre Fabric beam:
Two flanges, connected by a web
One layer of ±45° fabric + one layer of 0° fabric on flanges



Glass Fibre Fabric beam:
Two flanges, connected by a web
Flanges 0°/ ±45° fabric, web ±45° fabric



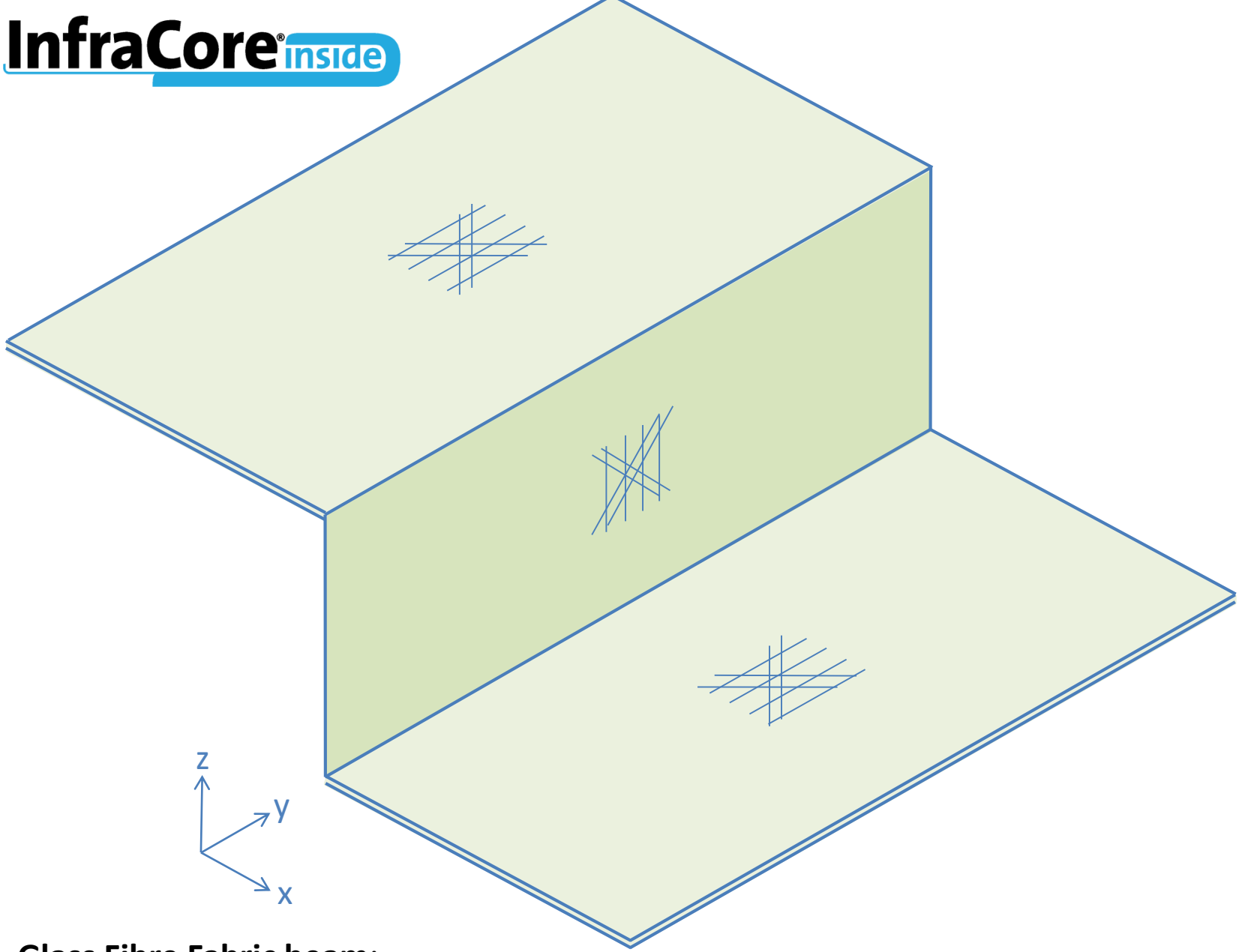
Carbon/Glass Fibre Fabric beam:
Two flanges, connected by a web
Flanges 0° carbon/ ±45° glass fabric, web ±45° glass fabric



Glass Fibre Fabric beam:

Two flanges, connected by a web

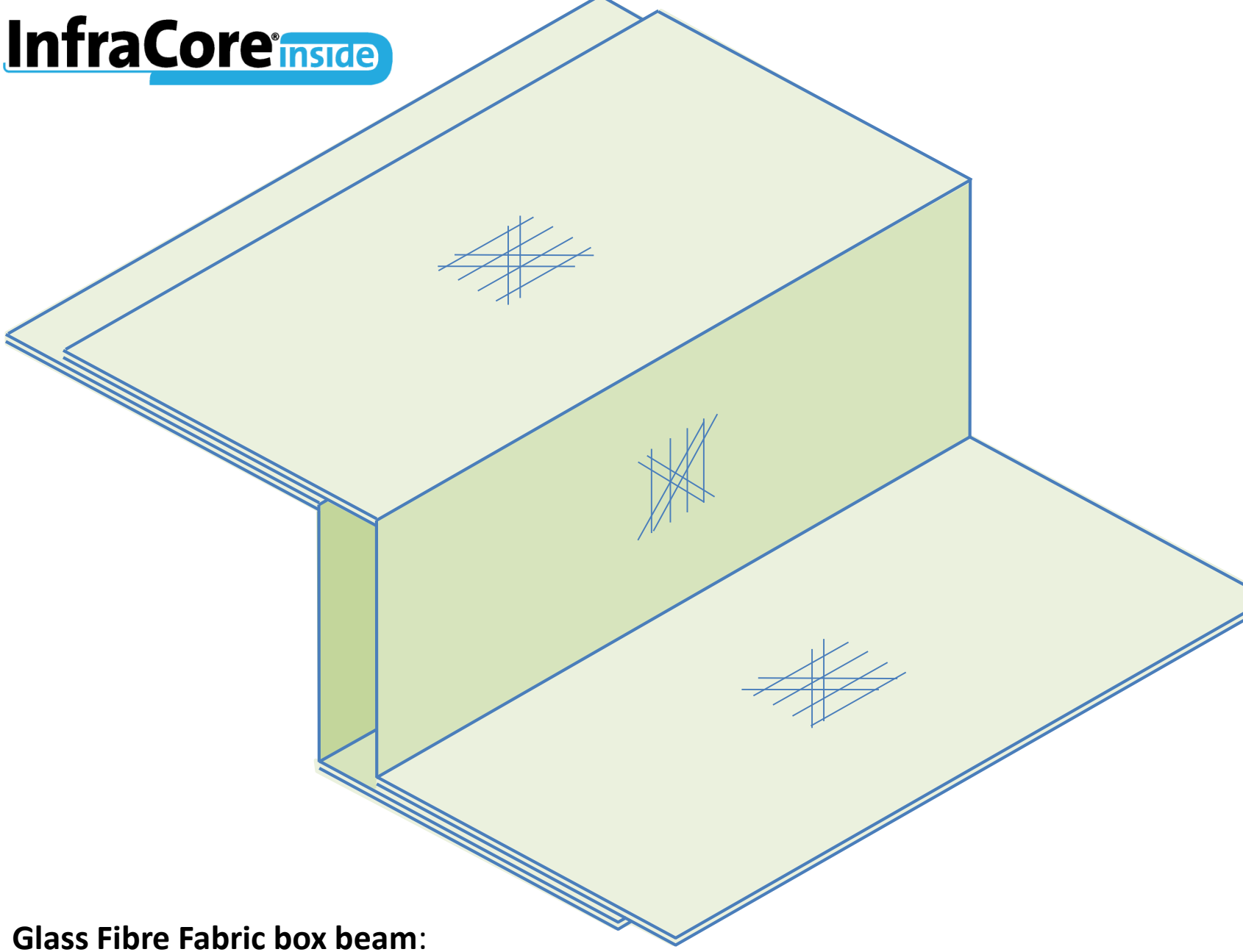
Flanges 0°/ ±45° fabric, web ±45° fabric + one layer op 90° fabric



Glass Fibre Fabric beam:

Two flanges, connected by a web

Flanges 0°/ ±45° fabric, web 90°/±45° fabric



Glass Fibre Fabric box beam:

Flanges, connected by webs

Flanges 0°/ ±45° fabric, webs 90°/±45° fabric

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InfraCore inside

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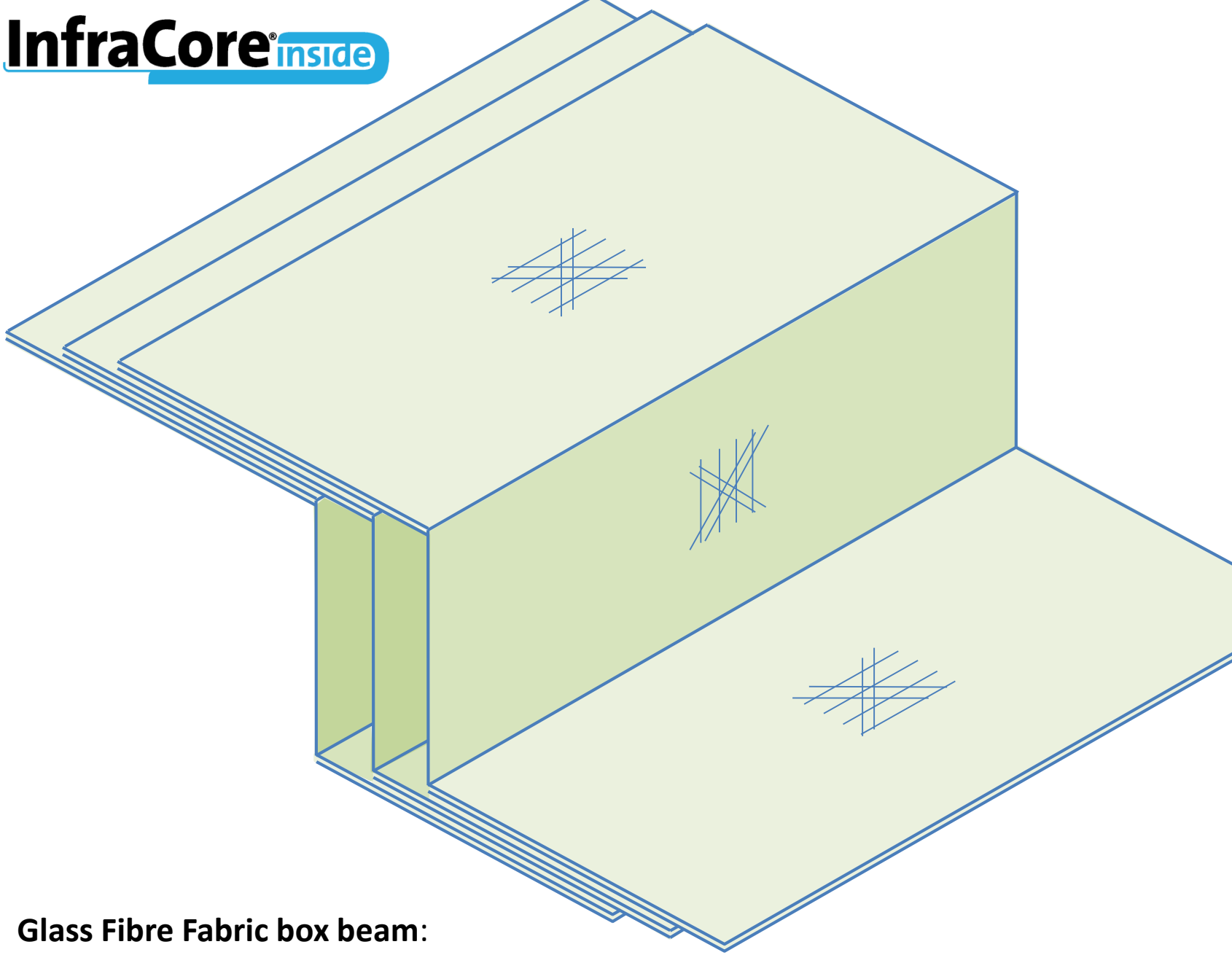

Glass Fibre Fabric box beam:

Flanges, connected by webs

Flanges 0°/ ±45° fabric, webs 90°/±45° fabric

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InfraCore inside

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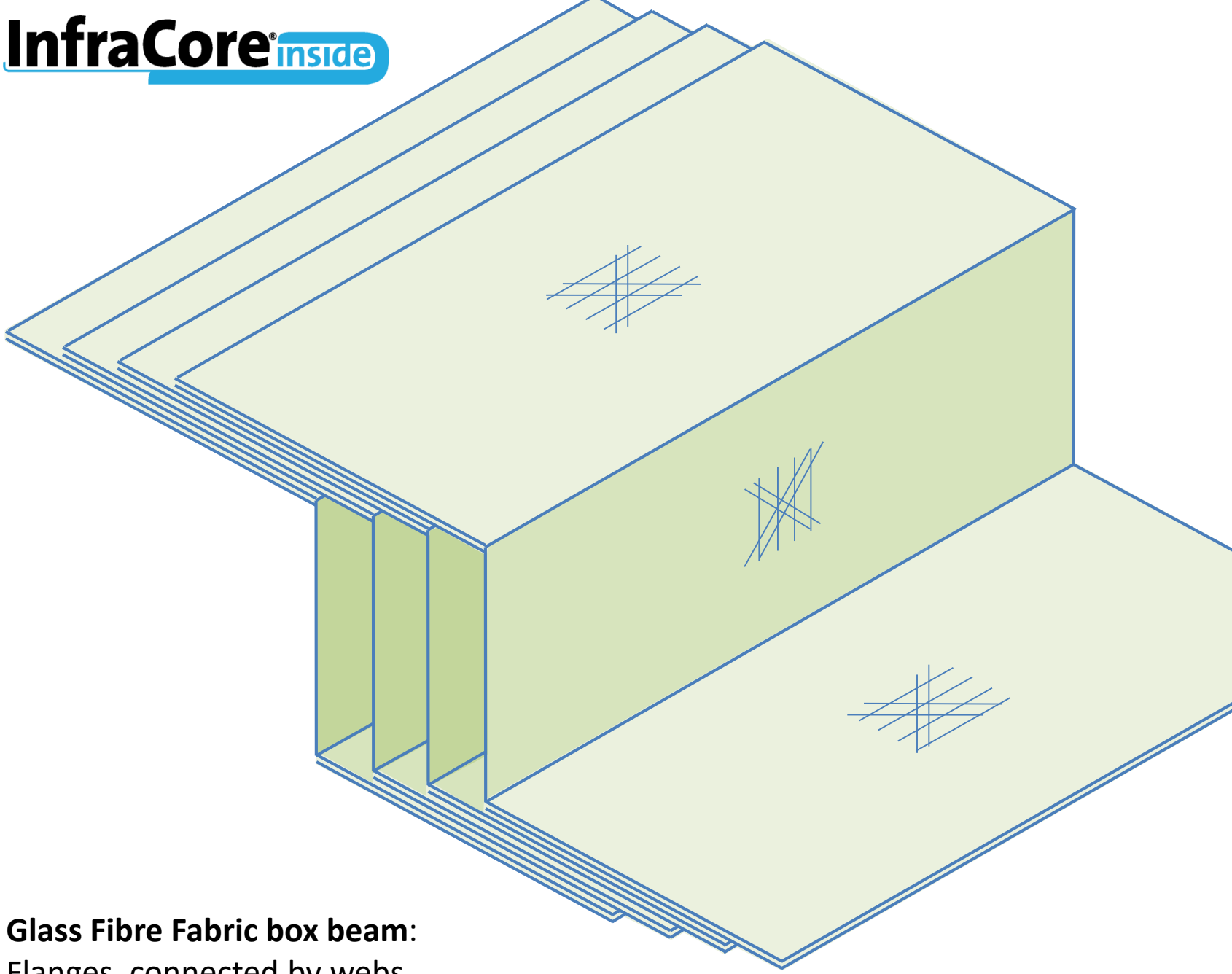

Glass Fibre Fabric box beam:

Flanges, connected by webs

Flanges 0°/ ±45° fabric, webs 90°/±45° fabric

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InfraCore® inside

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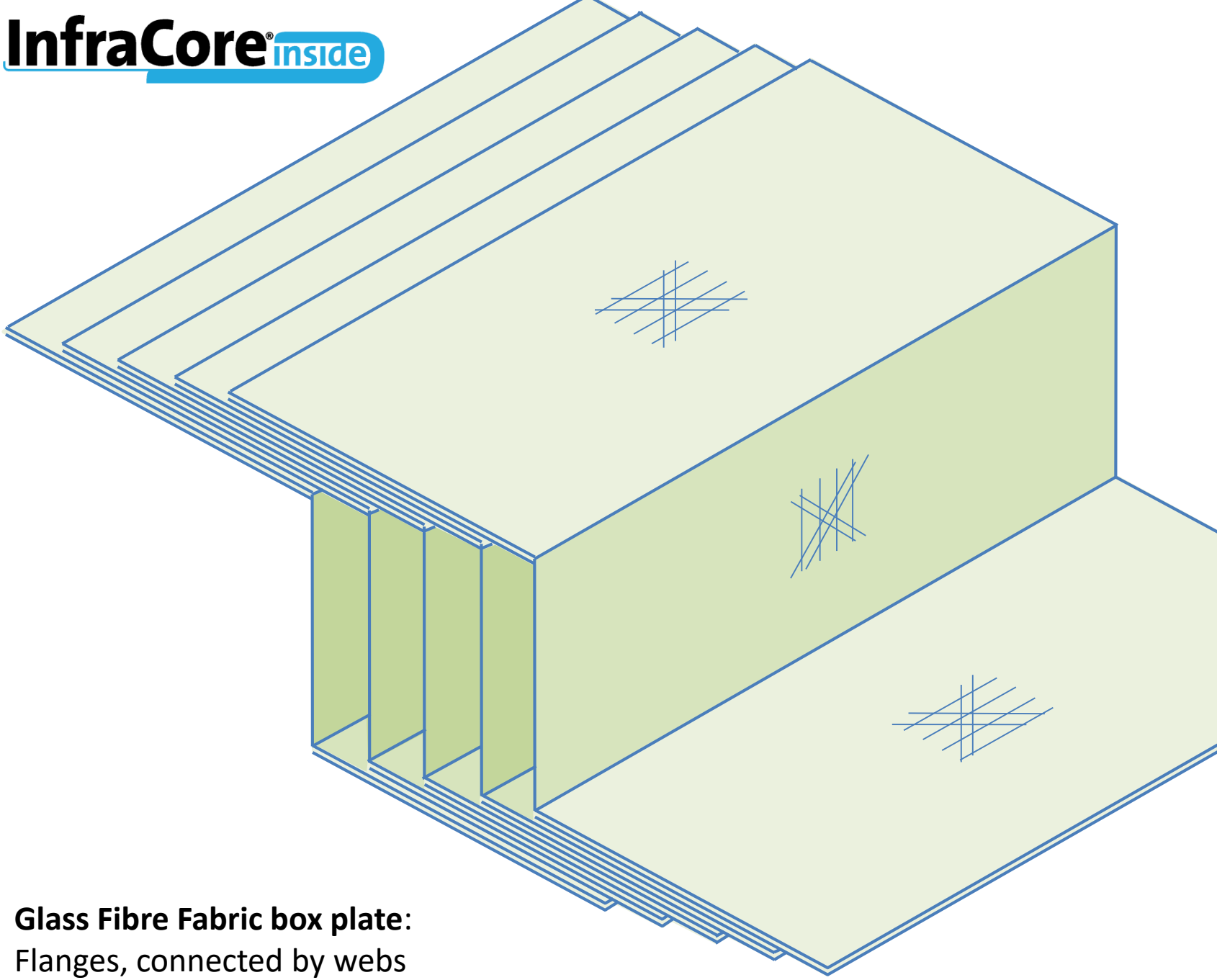
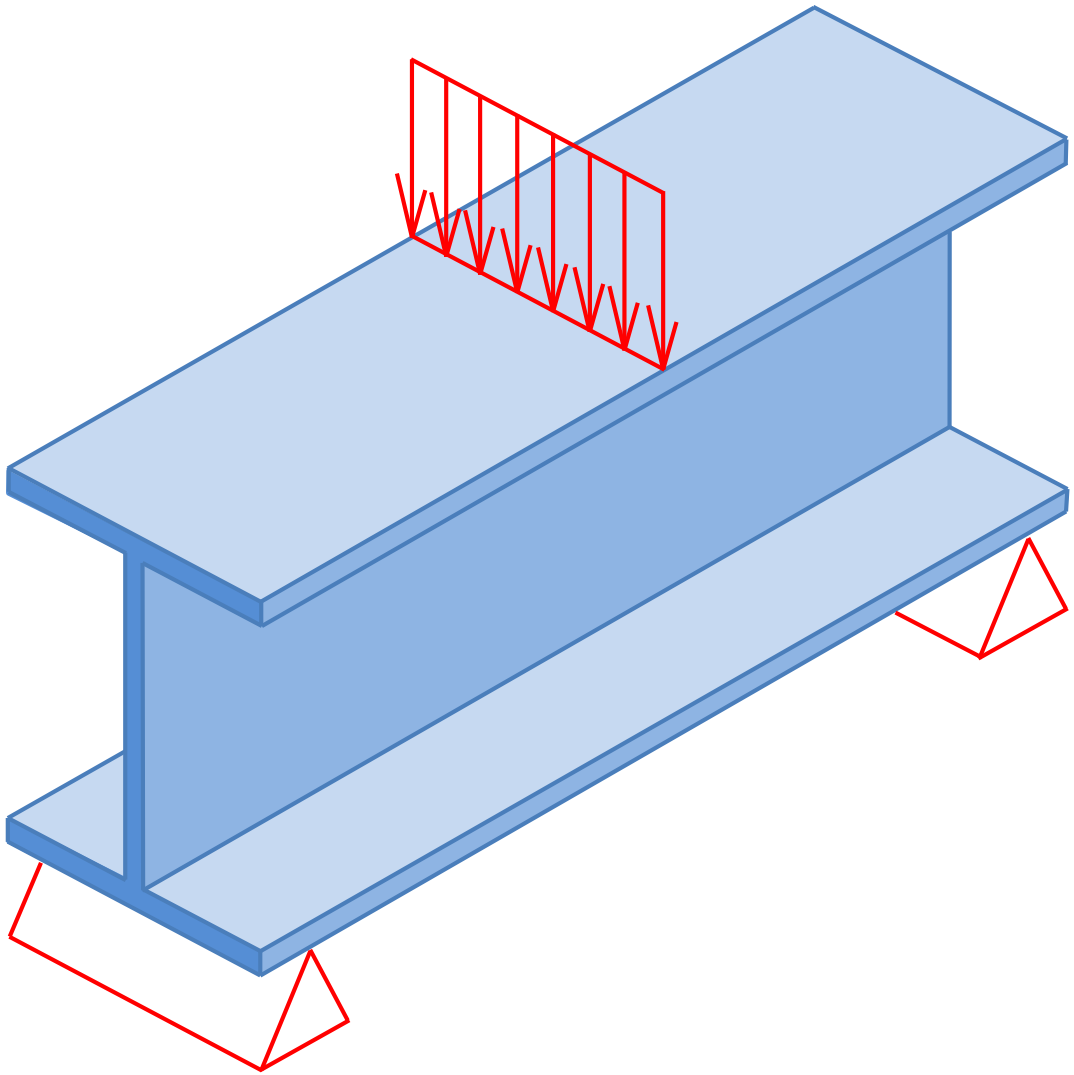


Glass Fibre Fabric box plate:

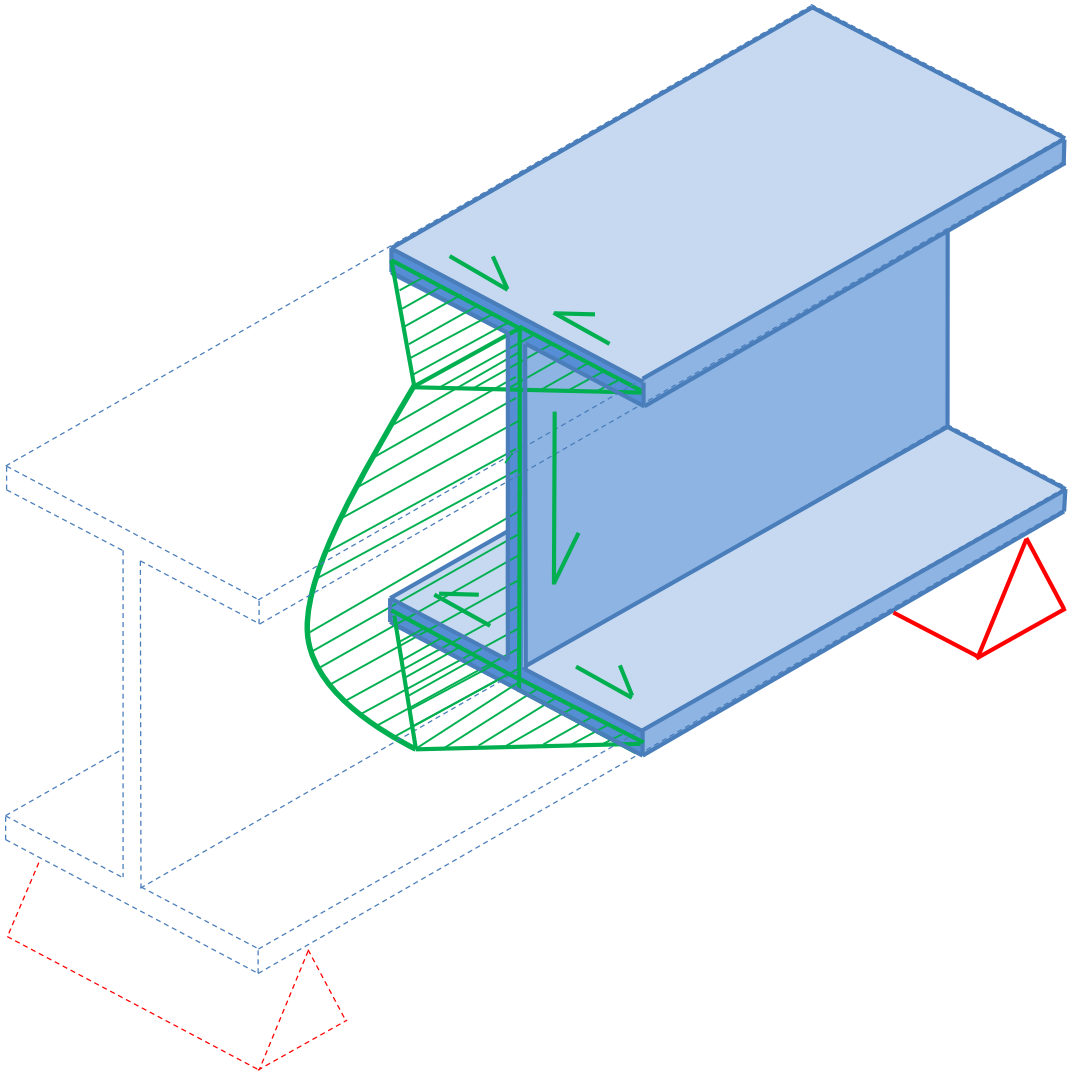
Flanges, connected by webs

Flanges 0°/ ±45° fabric, web 90°/±45° fabric



Steel beam

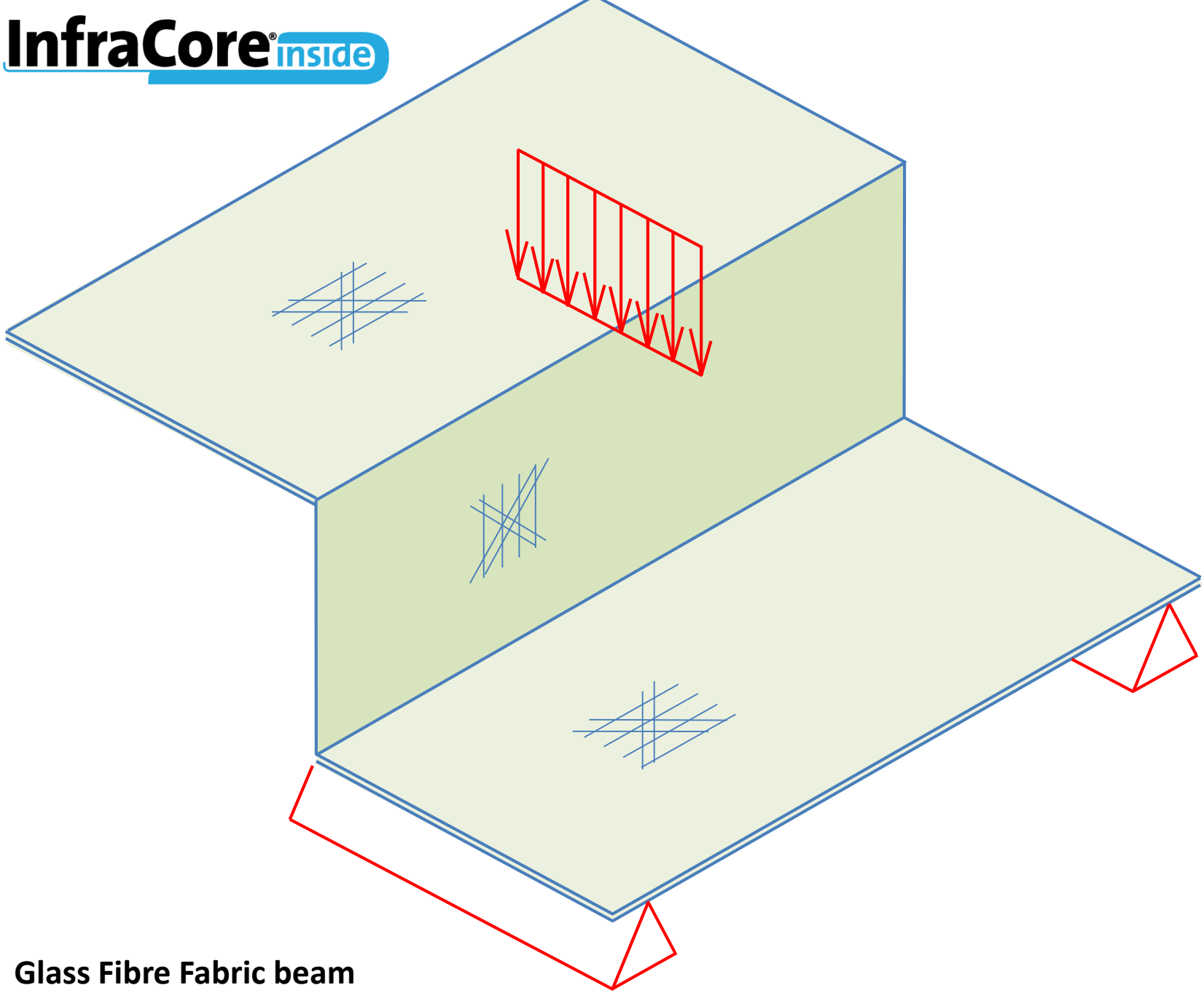
Loaded in three-point bending



Steel beam

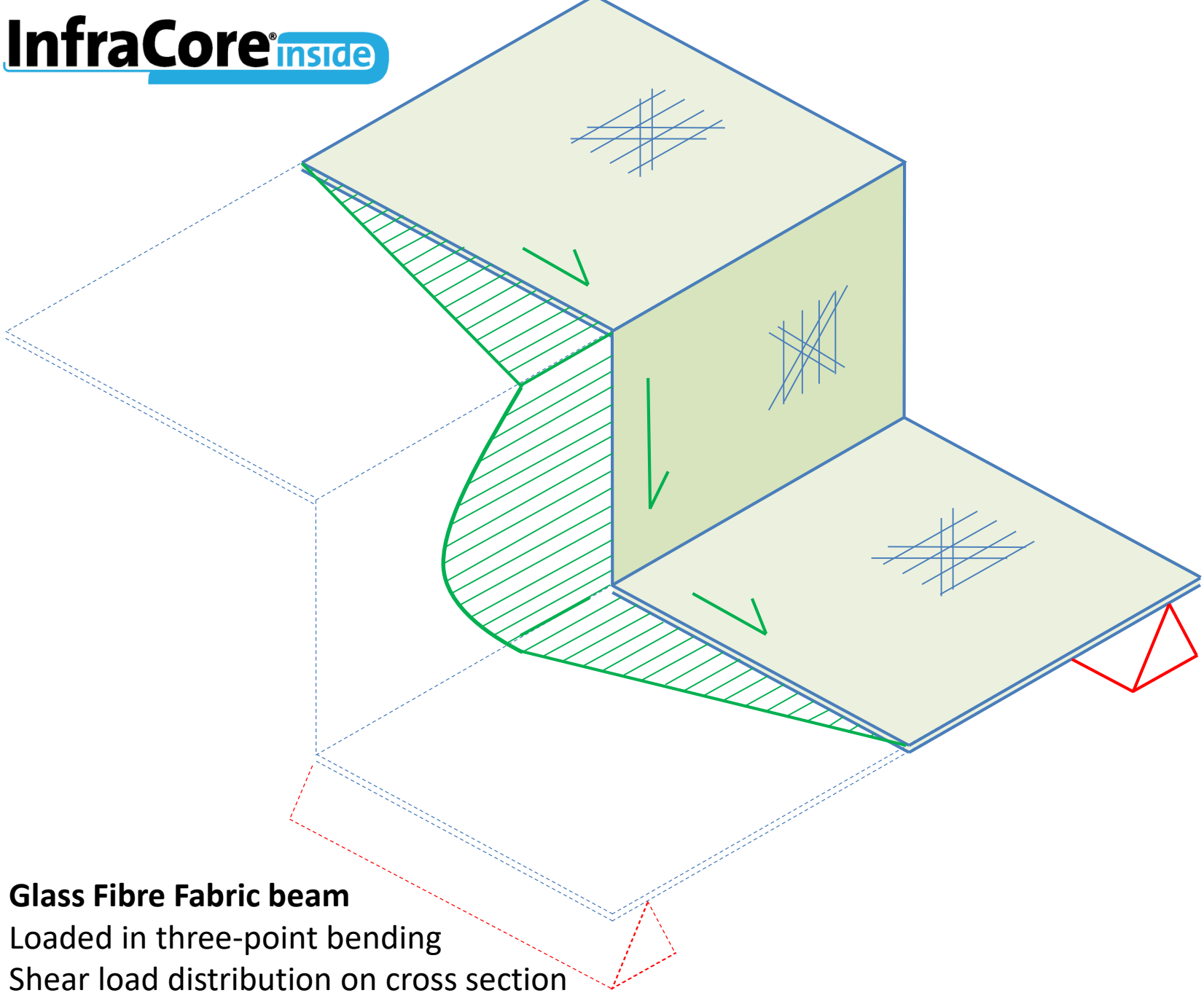
Loaded in three-point bending

Shear load distribution on cross section



Glass Fibre Fabric beam

Loaded in three-point bending

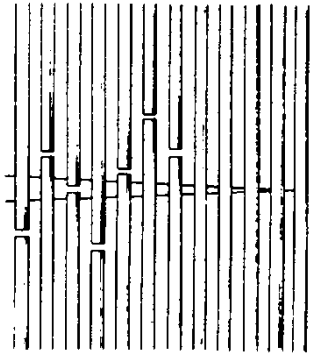


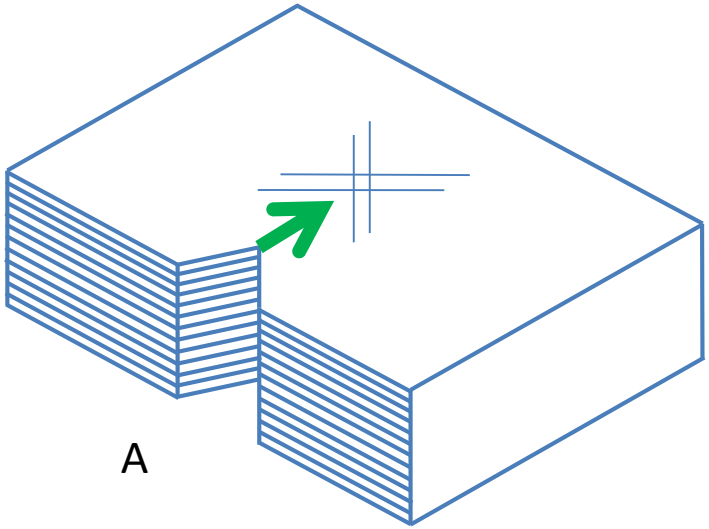
Glass Fibre Fabric beam

Loaded in three-point bending

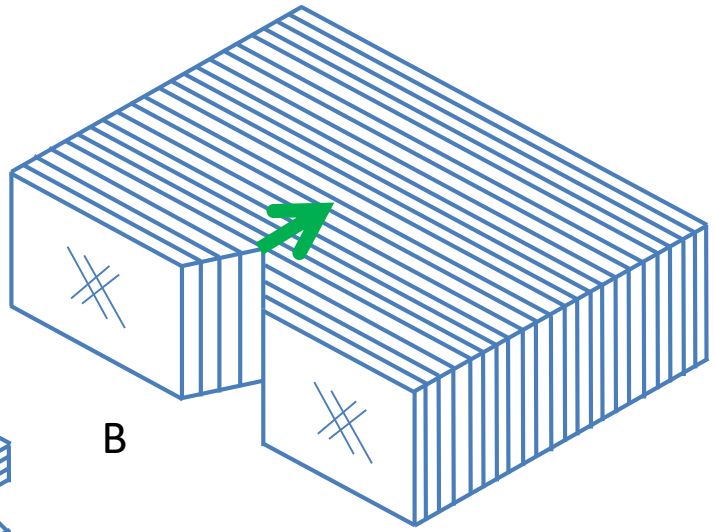
Shear load distribution on cross section

Continuous transfer of shear loads





A



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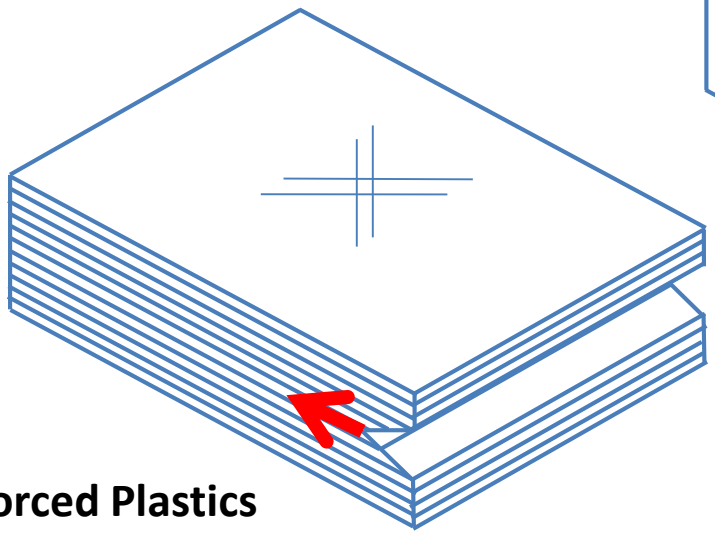


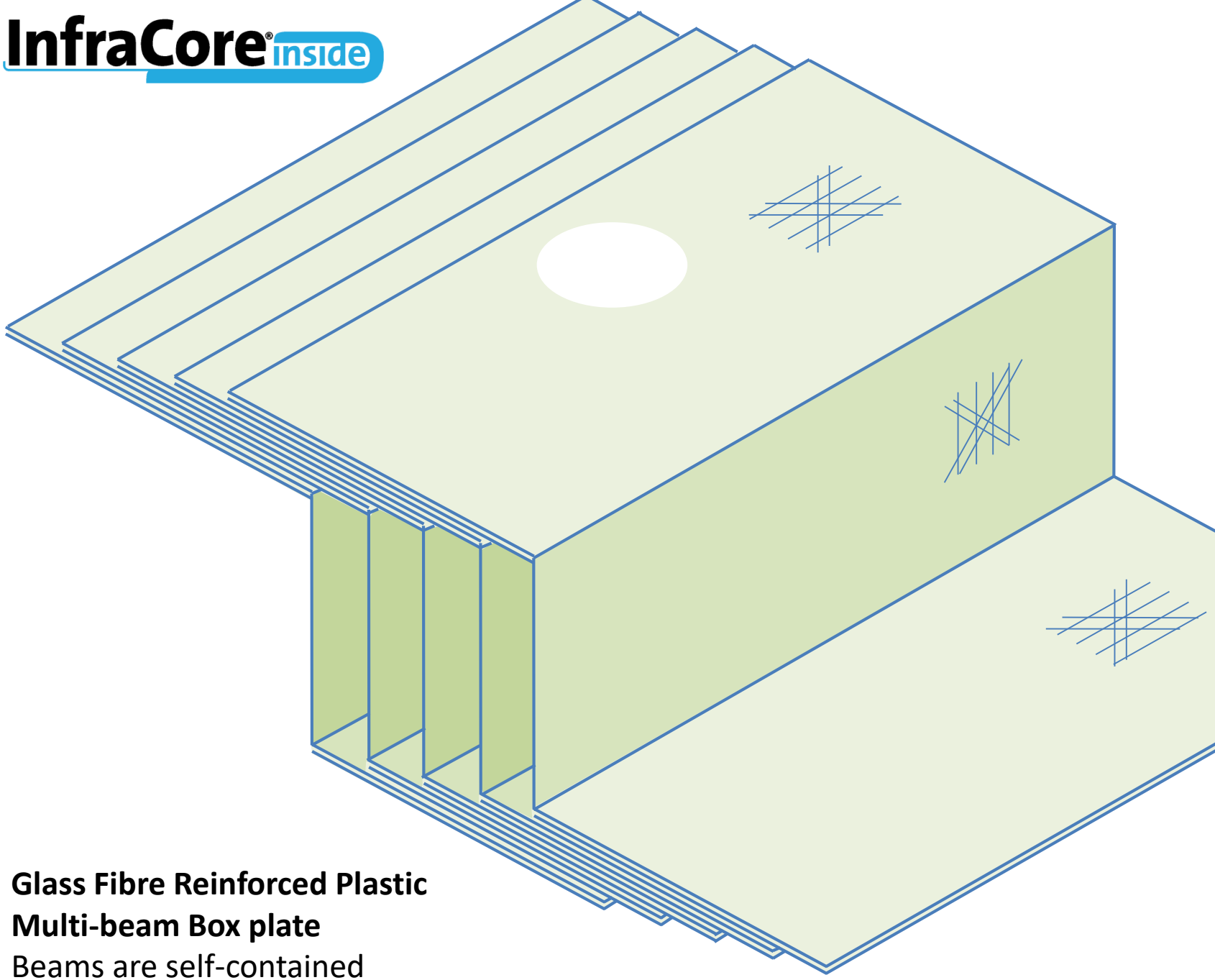
C

Fibre Reinforced Plastics

Non-homogeneous, layered material

Fibres act as crack arrestors

Vulnerable to cracking between fibre layers (“interlaminar cracking”)



Glass Fibre Reinforced Plastic
Multi-beam Box plate
Beams are self-contained
Little shear transfer between beams

Impact damage may occur: local delamination

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InfraCore® inside

RAMSSES

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

CompositesNL

E-LASS

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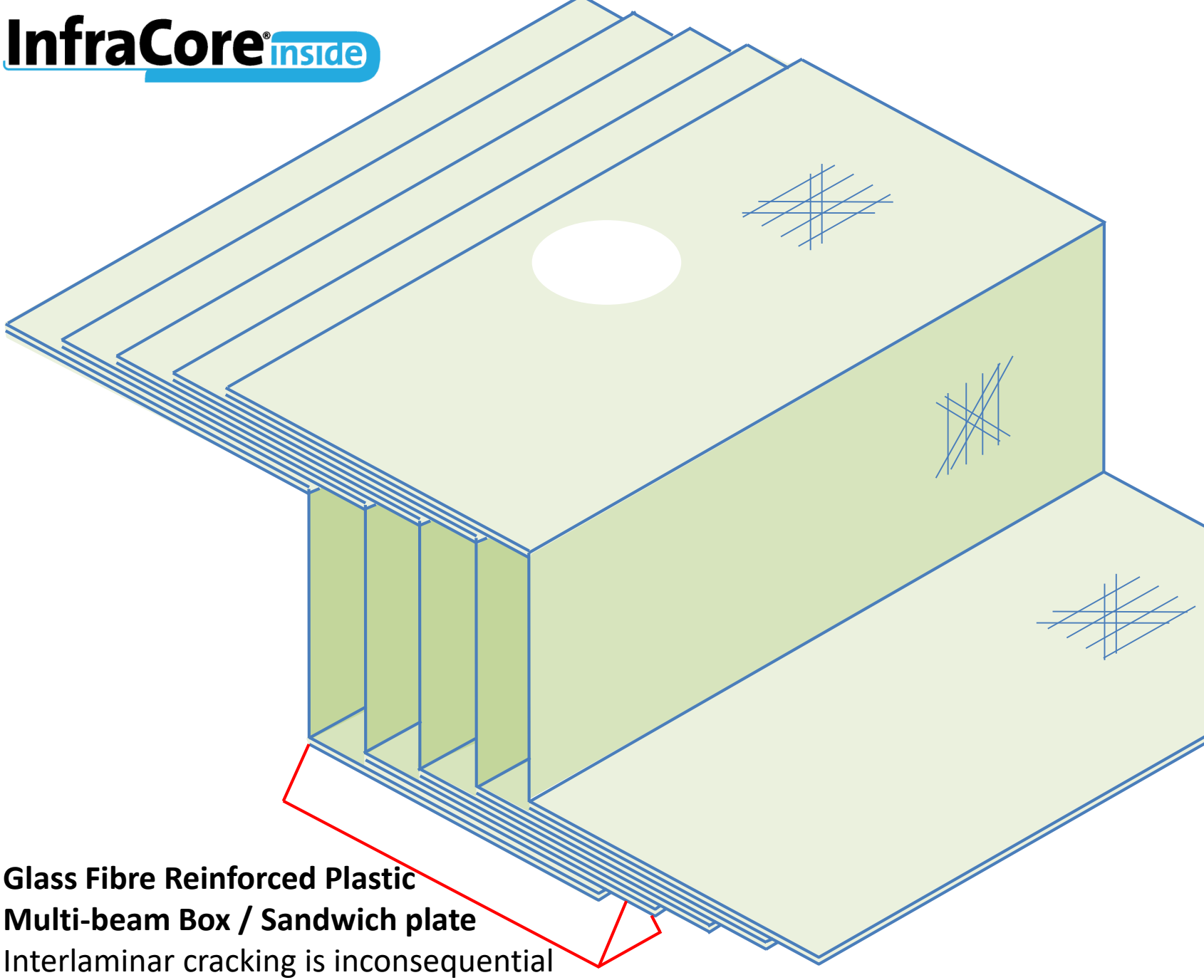
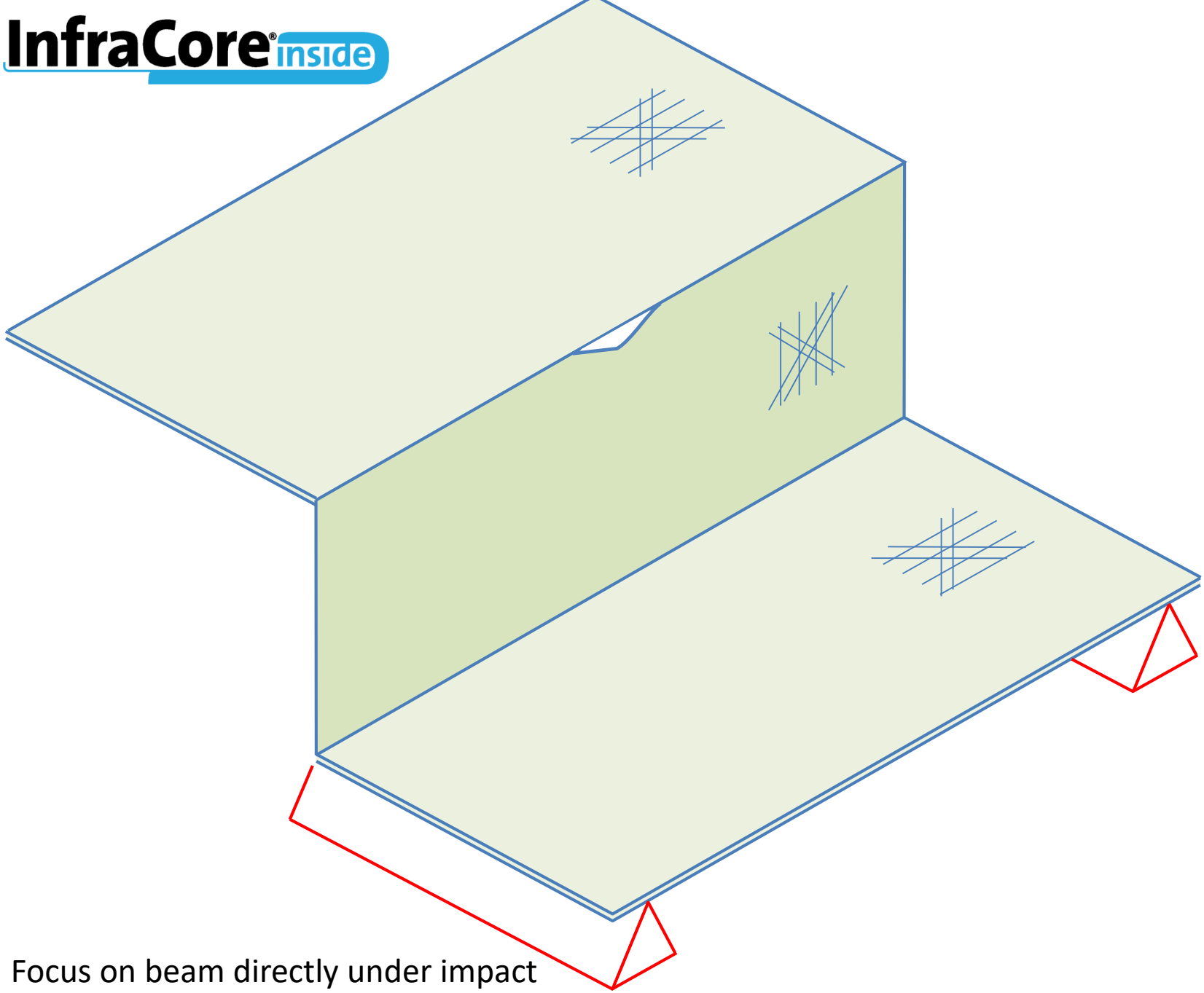
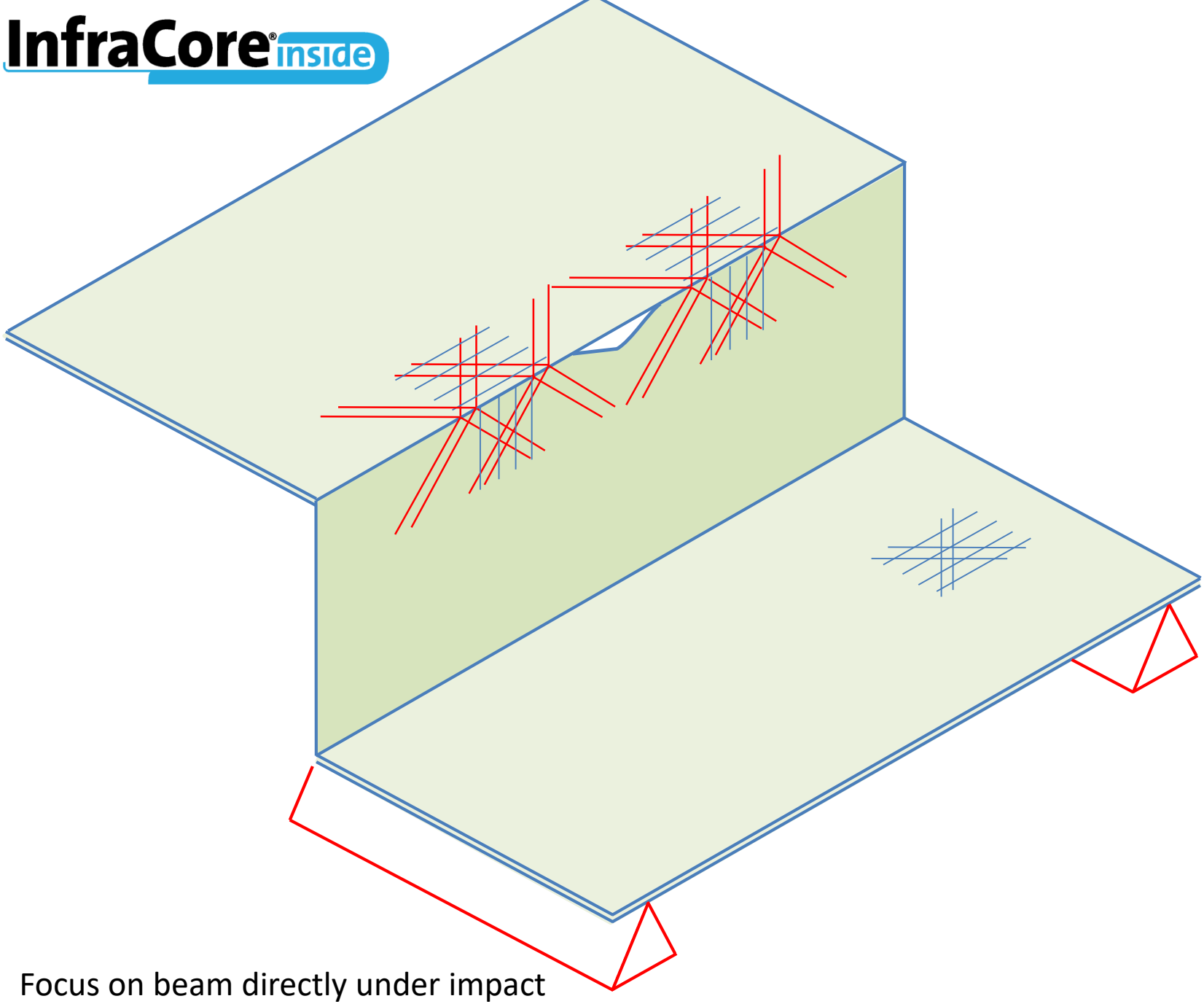


Glass Fibre Reinforced Plastic
Multi-beam Box / Sandwich plate
Interlaminar cracking is inconsequential
No skin-core debonding, no damage growth



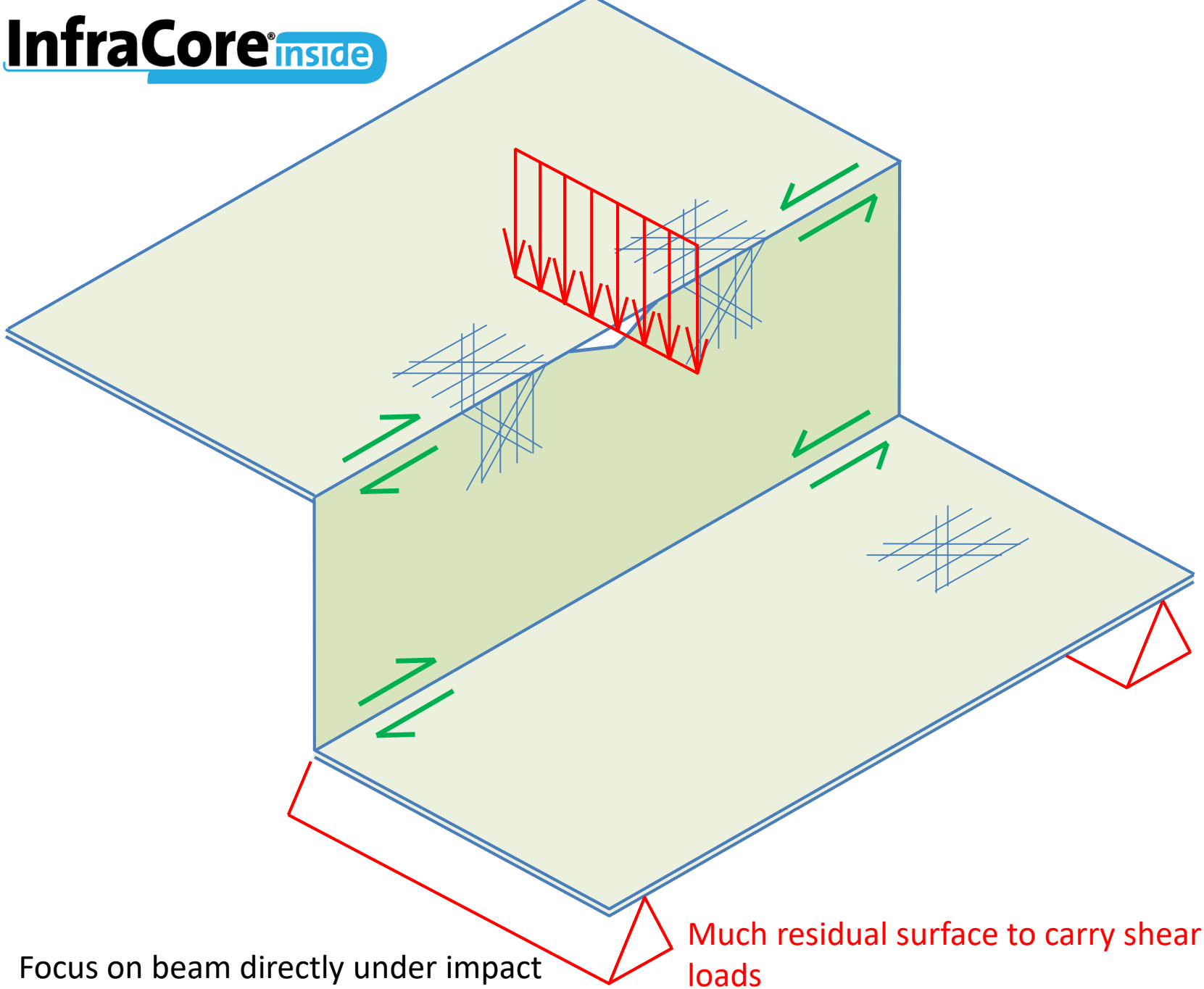
Focus on beam directly under impact

A crack in flange-web zone may occur



Focus on beam directly under impact

Crack will not grow, constricted by fibres



Focus on beam directly under impact

Beam can carry load despite crack

Much residual surface to carry shear loads

Stable situation

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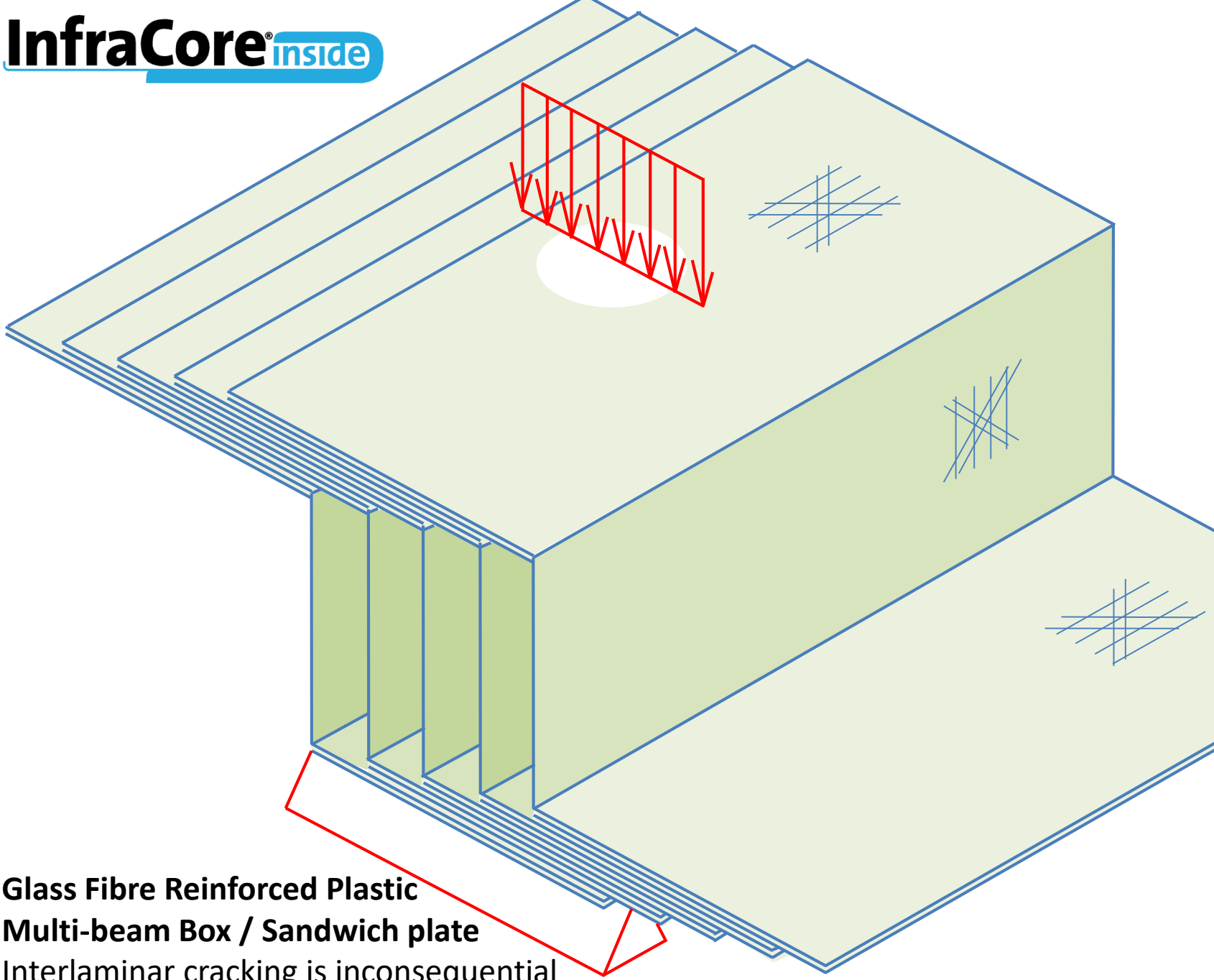

Glass Fibre Reinforced Plastic
Multi-beam Box / Sandwich plate
Interlaminar cracking is inconsequential
No skin-core debondng → EXTREMELY ROBUST

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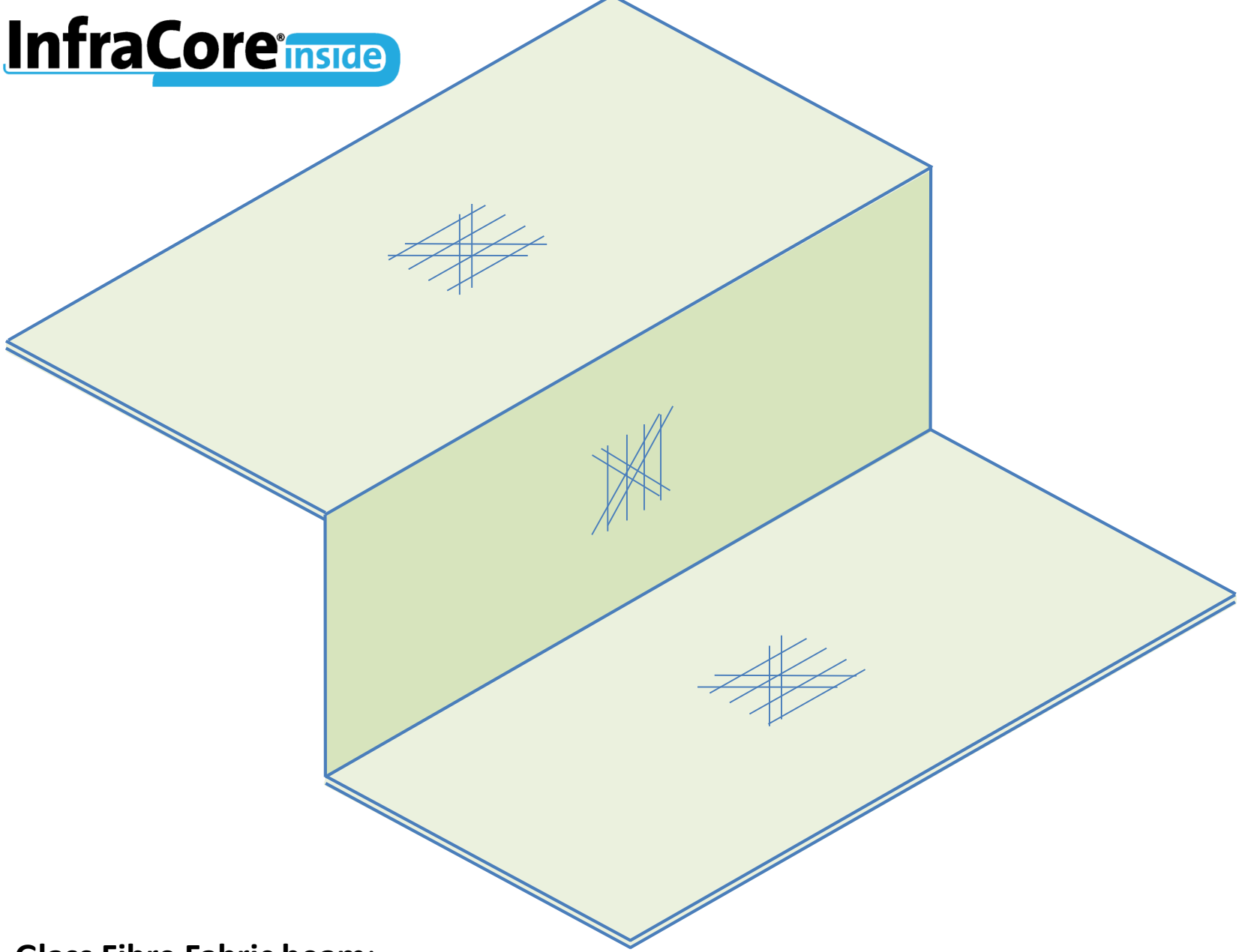
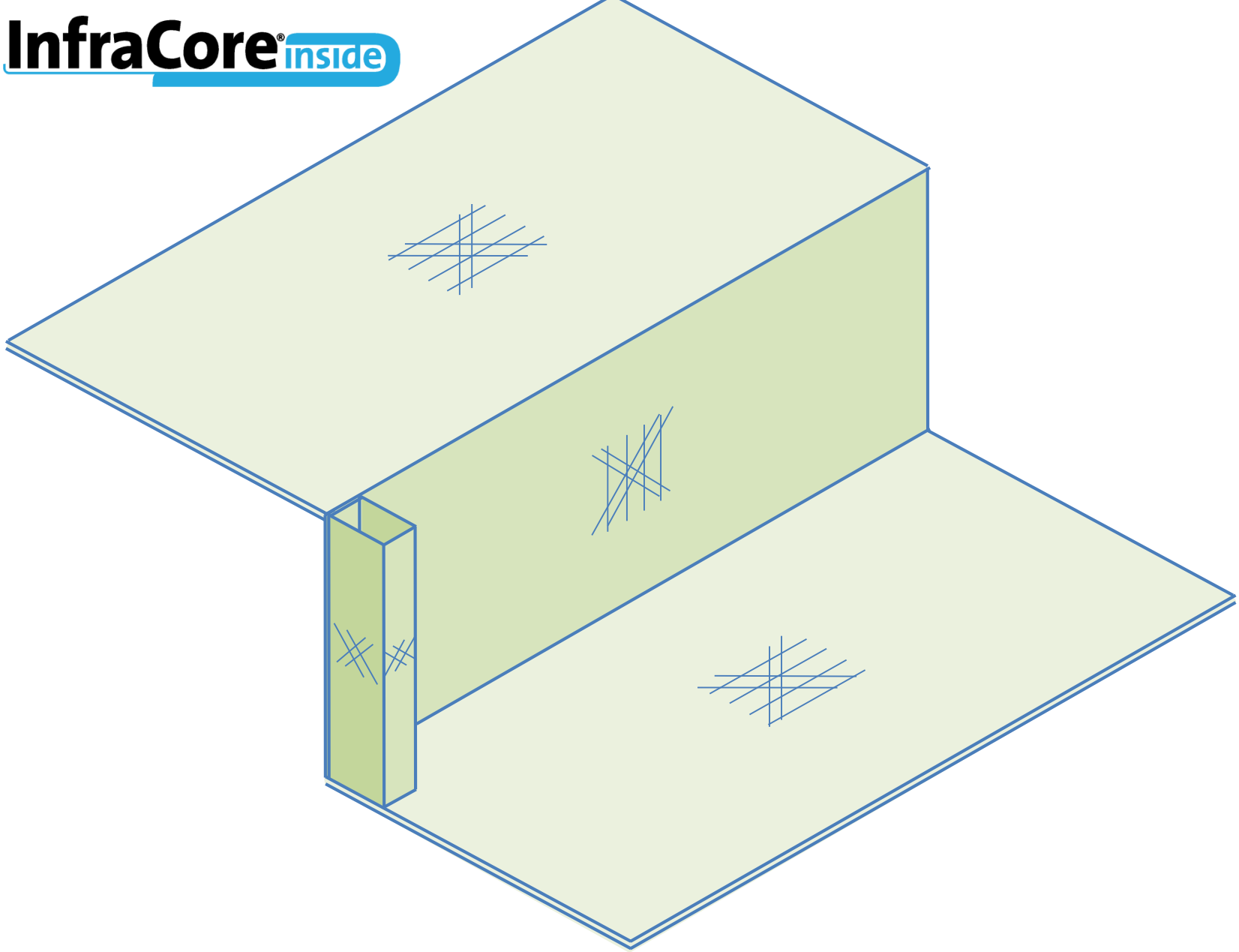


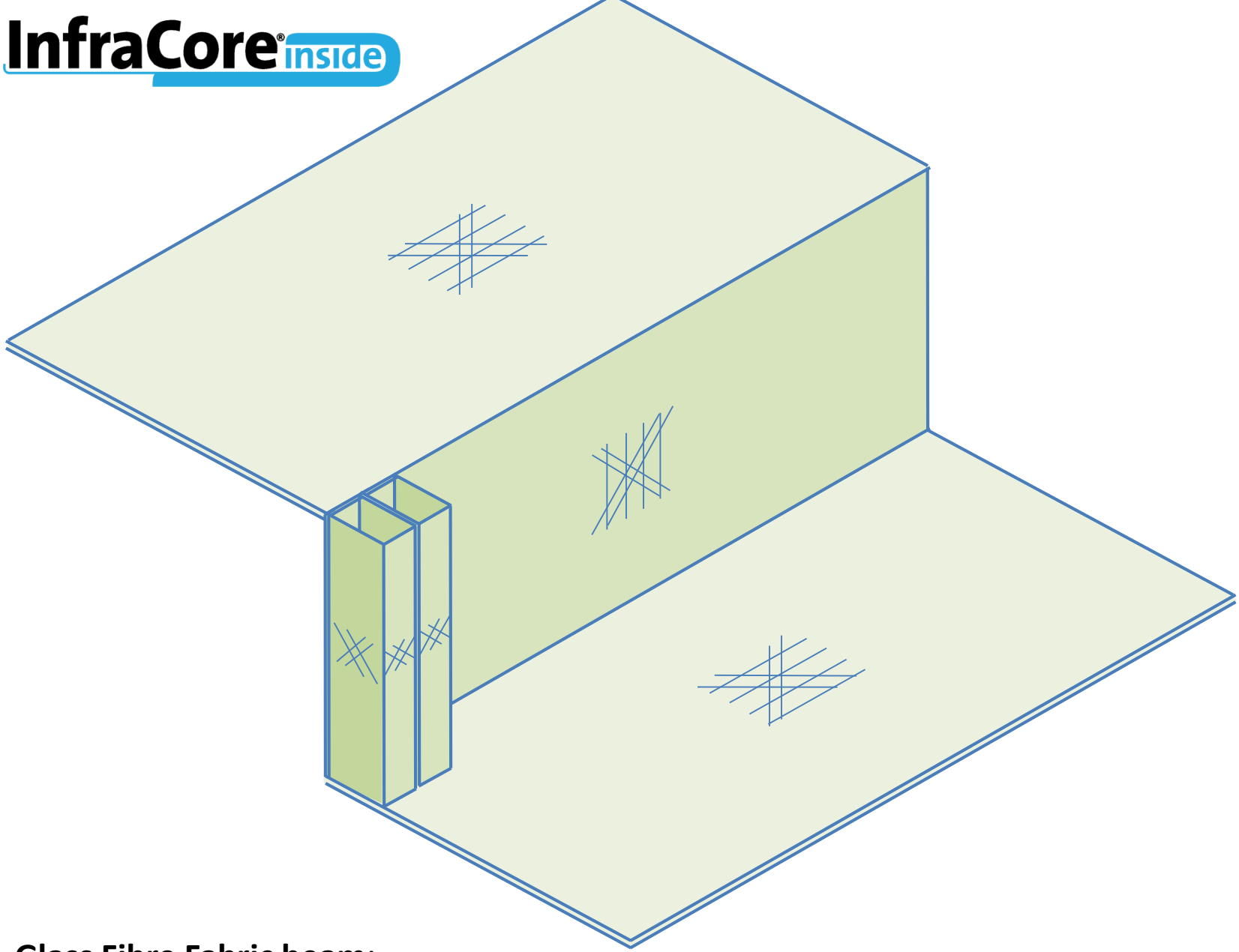
Glass Fibre Fabric beam:

Two flanges, connected by a web

Flanges 0°/ ±45° fabric, web 90°/±45° fabric



Glass Fibre Fabric beam:
Add shear webs perpendicular to main webs
Made of ±45° fabric in box configuration



Glass Fibre Fabric beam:

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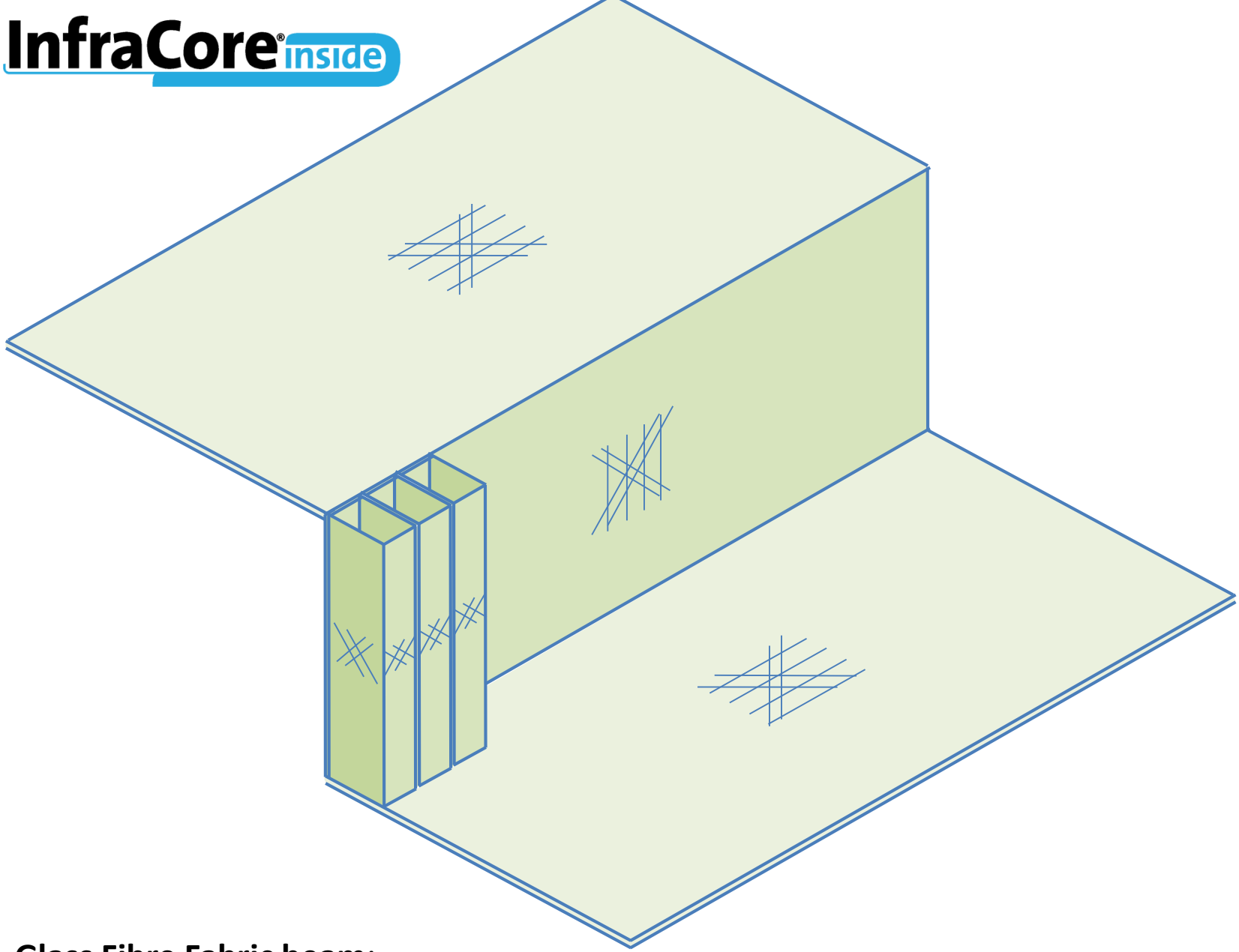

Glass Fibre Fabric beam:

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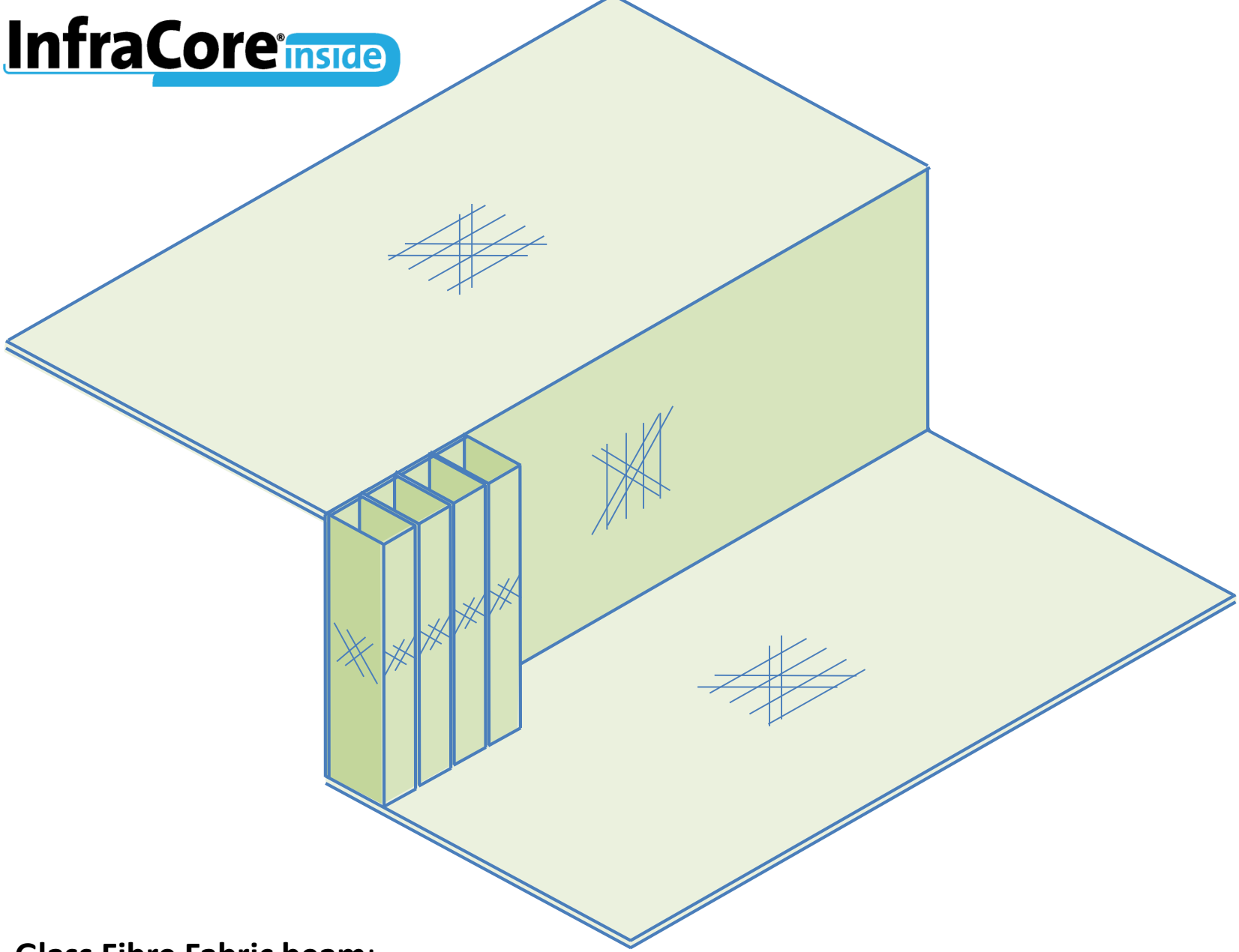

Glass Fibre Fabric beam:

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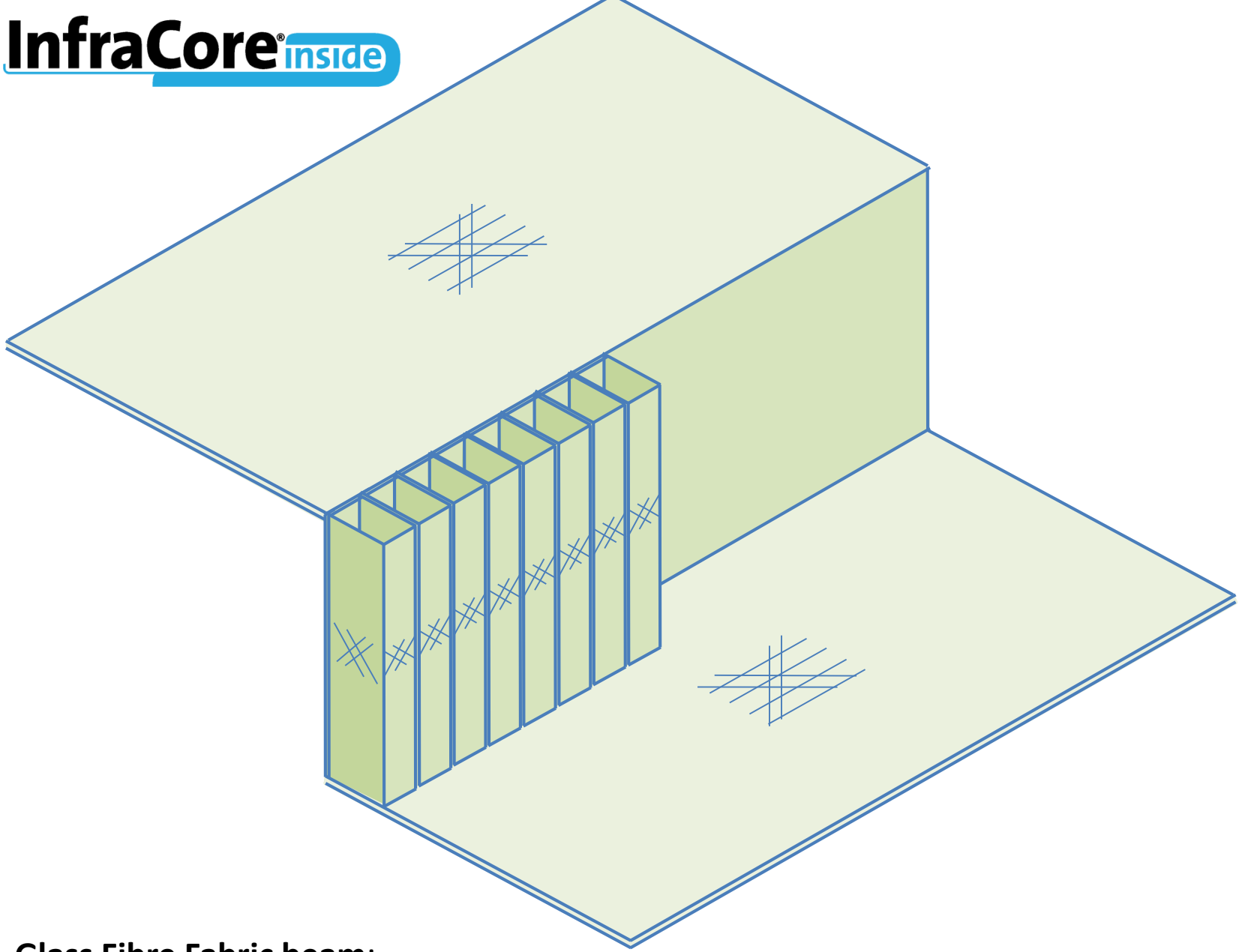

Glass Fibre Fabric beam:

Add shear webs perpendicular to main webs

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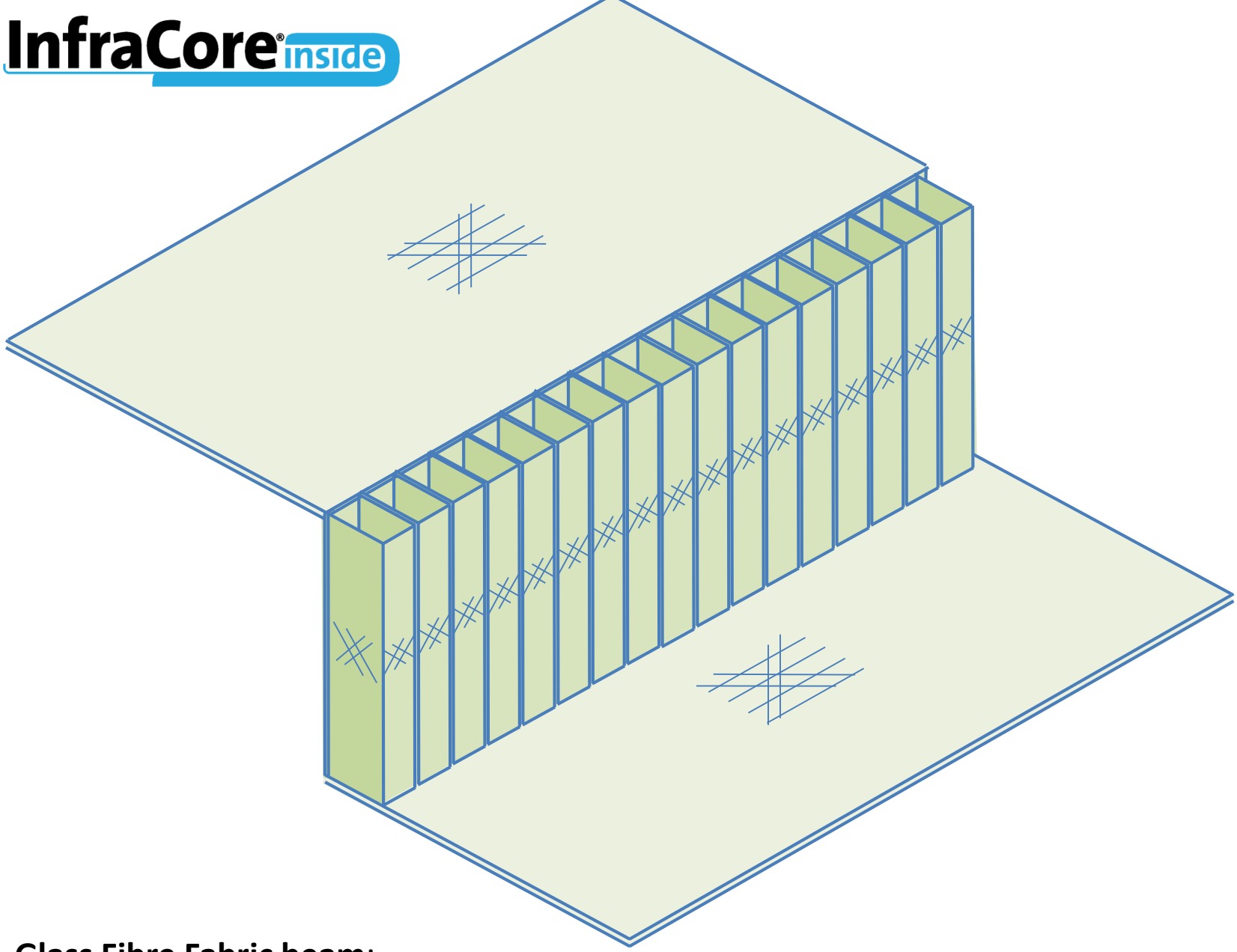
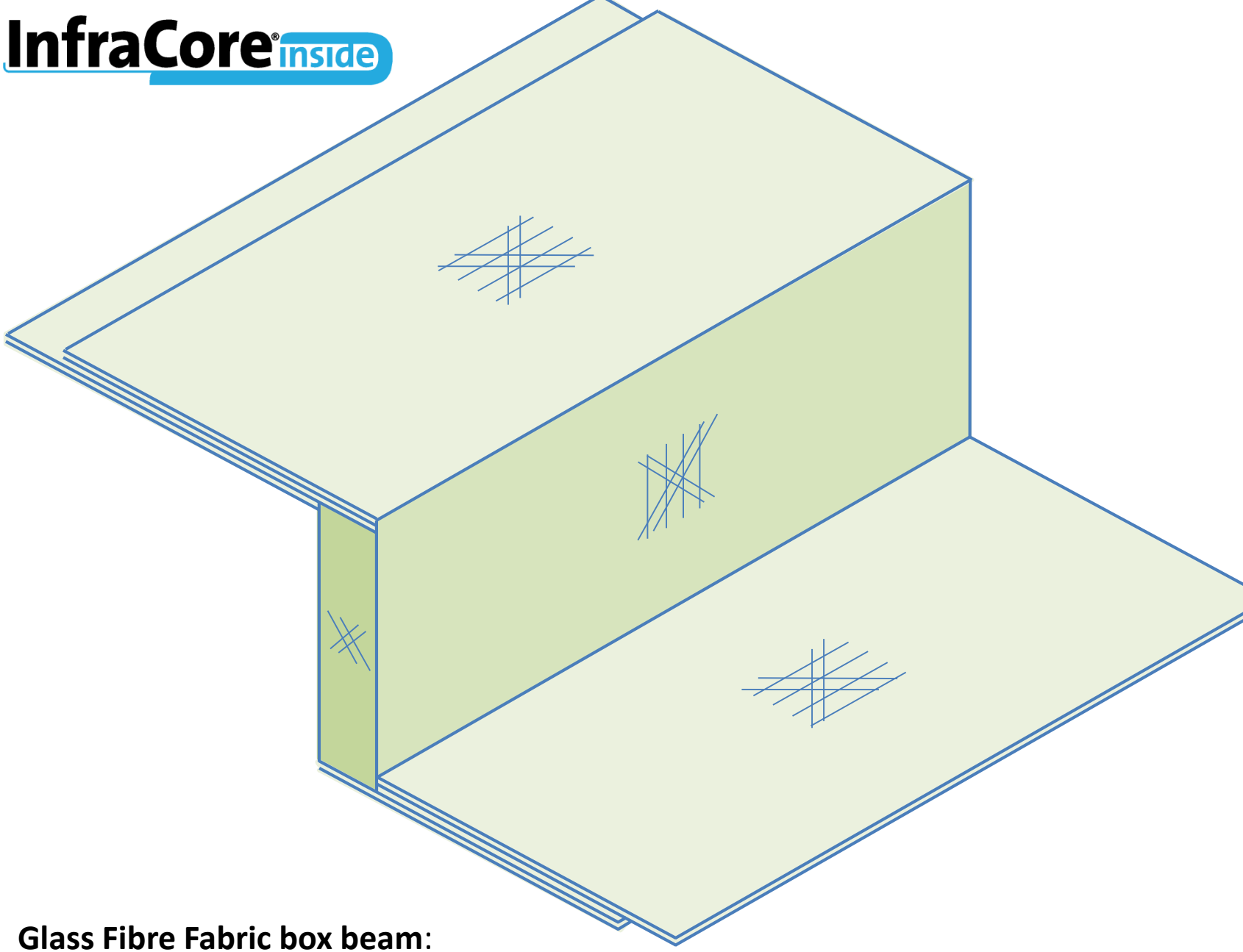


Glass Fibre Fabric beam:

Add shear webs perpendicular to main webs

Made of ±45° fabric in box configuration



Glass Fibre Fabric box beam:

Flanges, connected by webs

Flanges 0°/ ±45° fabric, webs 90°/±45° fabric, cross-webs ±45° fabric

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RAMSSES

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CompositesNL

E-LASS

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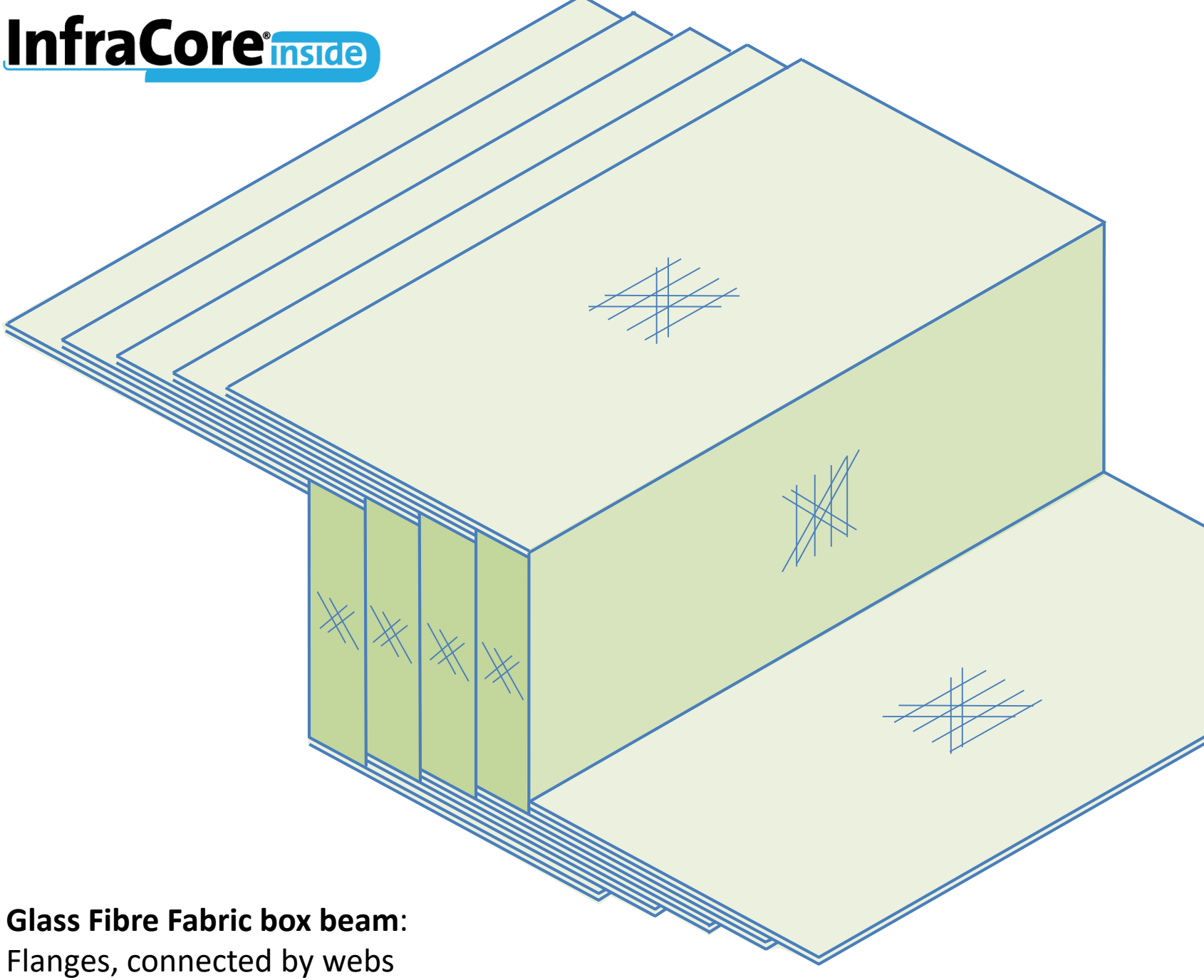
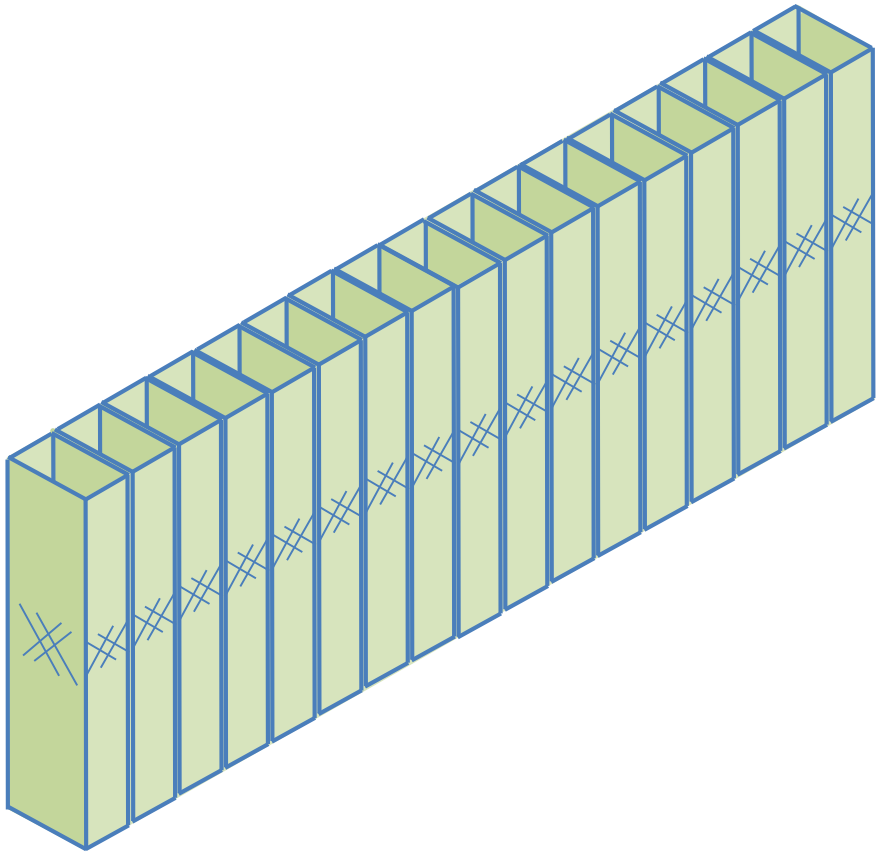


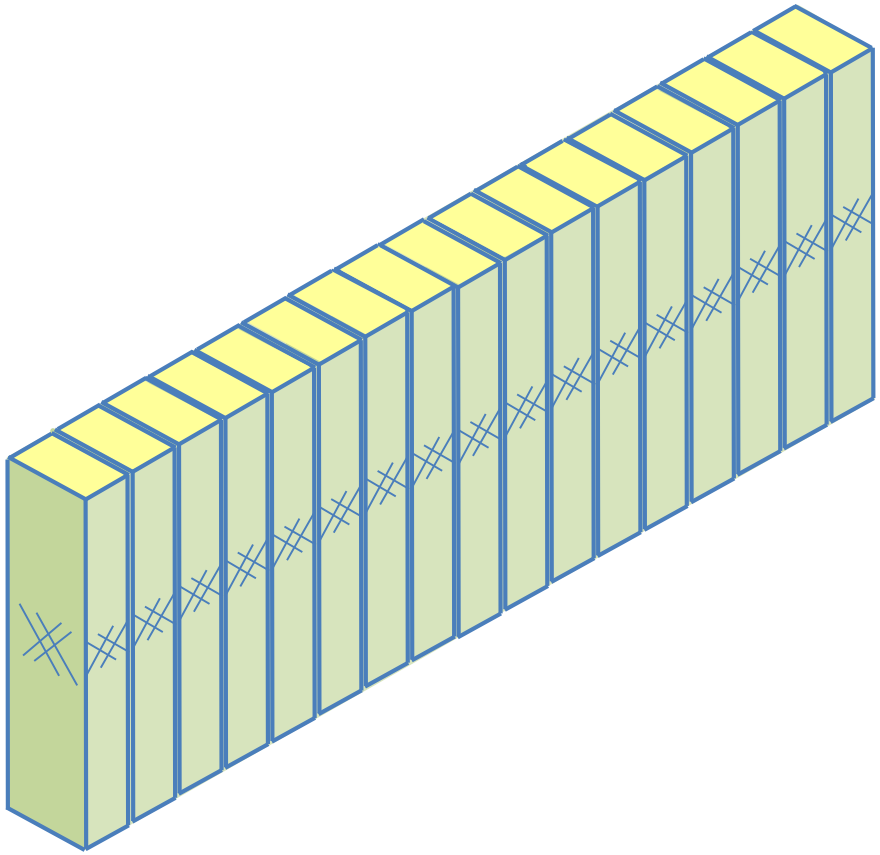
Glass Fibre Fabric box beam:

Flanges, connected by webs

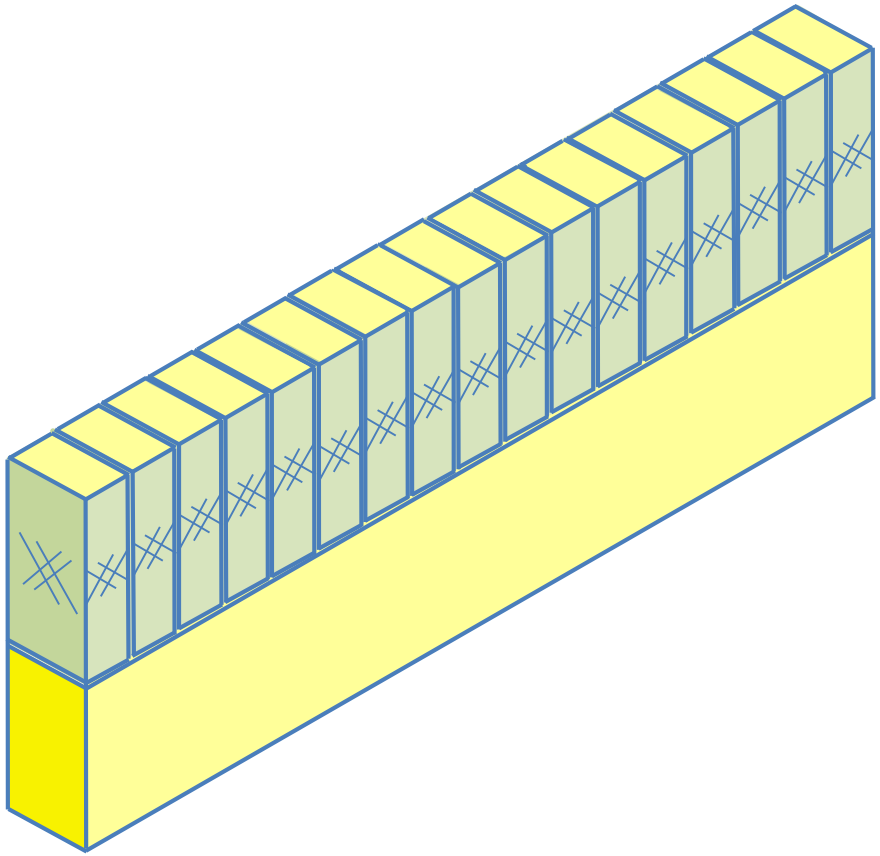
Flanges 0°/ ±45° fabric, webs 90°/±45° fabric, cross-webs ±45° fabric



Core configurations:
Multi-box plate
±45° fabric



Core configurations:
Multi-box plate
±45° fabric + foam



Core configurations:
Multi-box plate
±45° fabric + foam

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InfraCore inside

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CompositesNL

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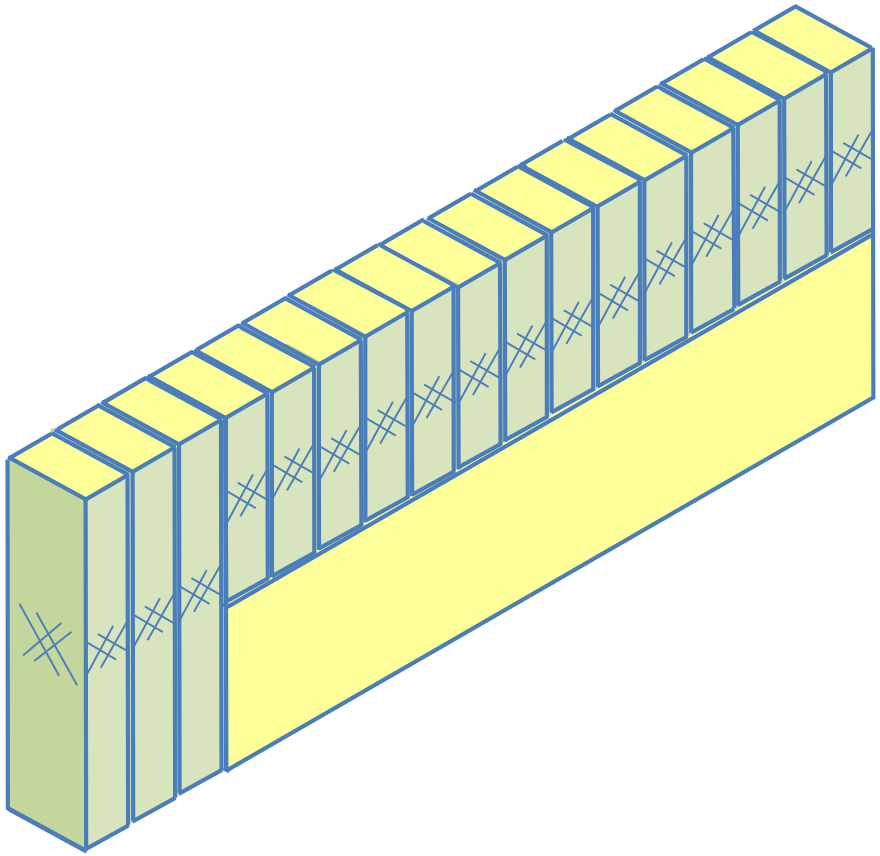
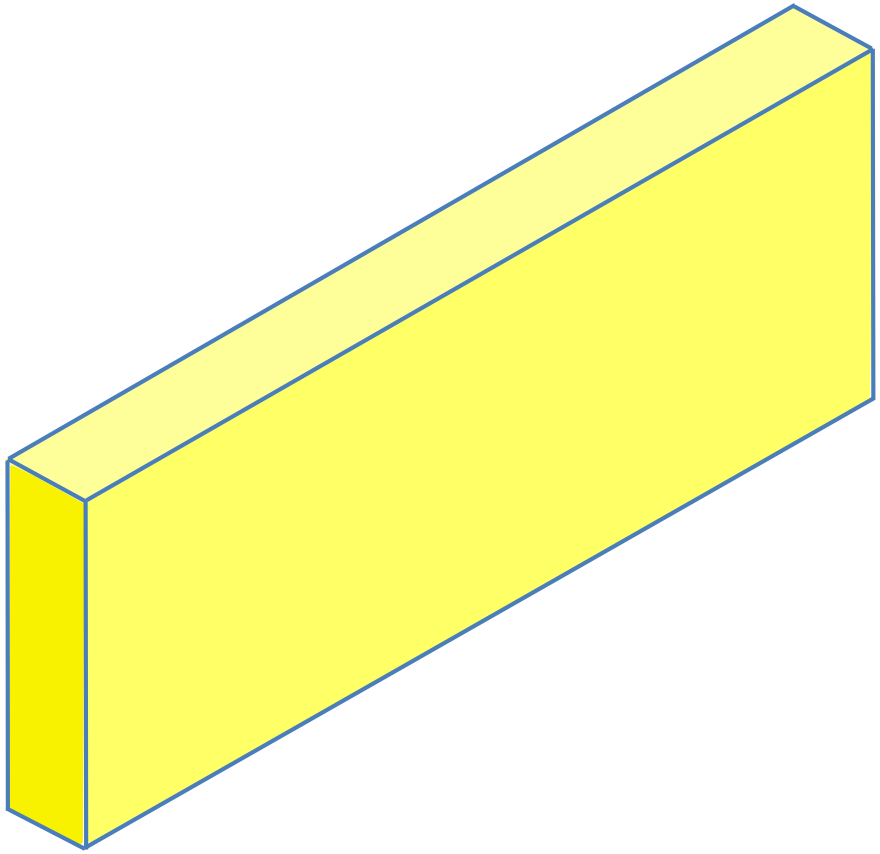


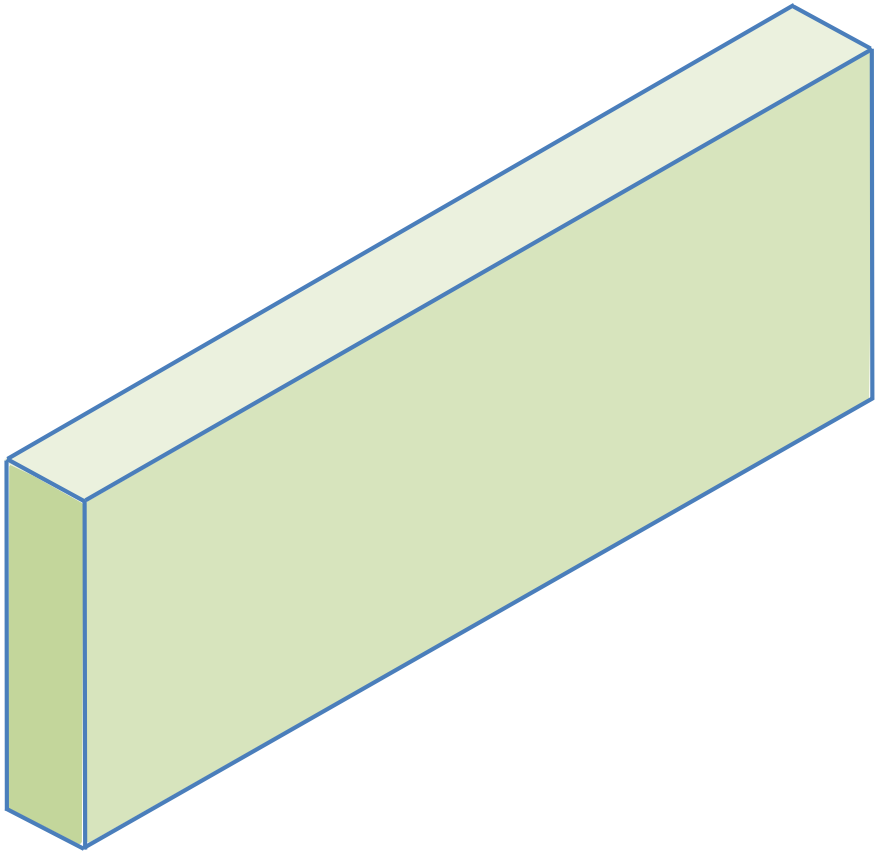
Core configurations:

Multi-box plate

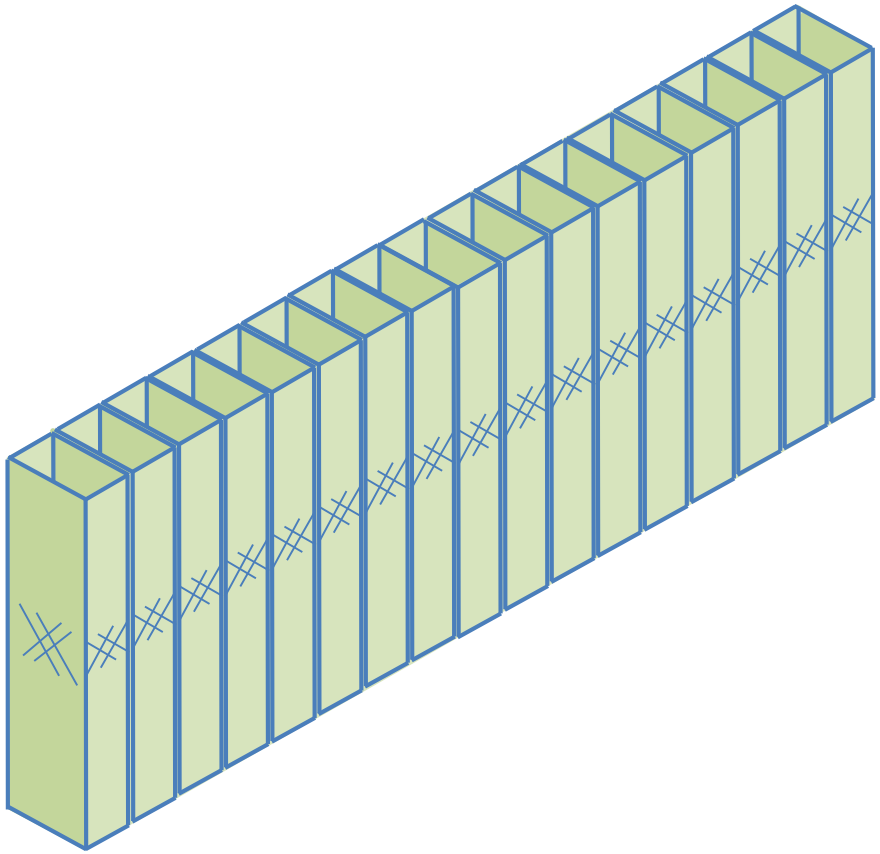
±45° fabric + foam



Core configurations:
Foam (lost mould core)



Core configurations:
Massive fibre reinforced plastic plate



Core configurations:
Multi-box plate
±45° fabric

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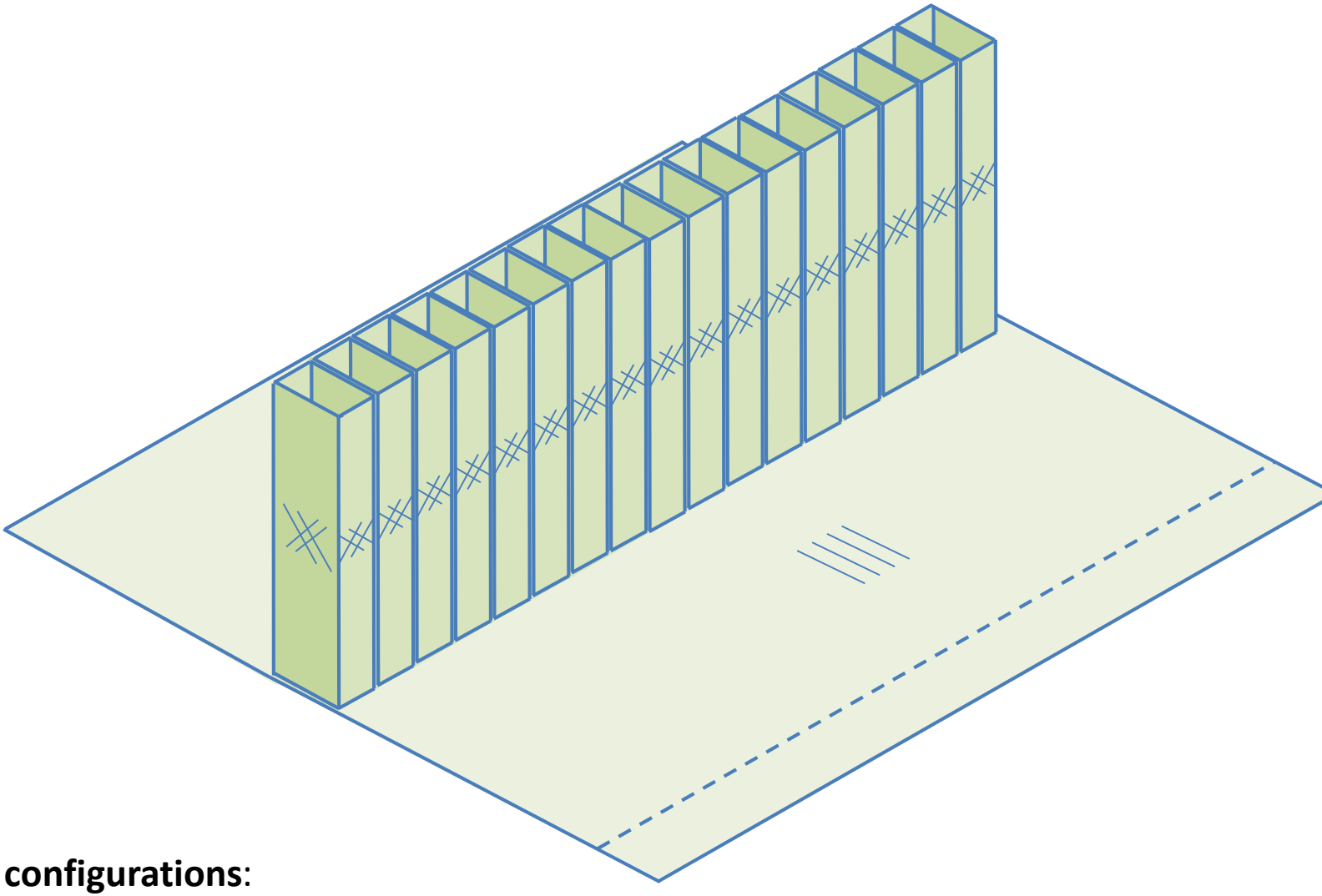
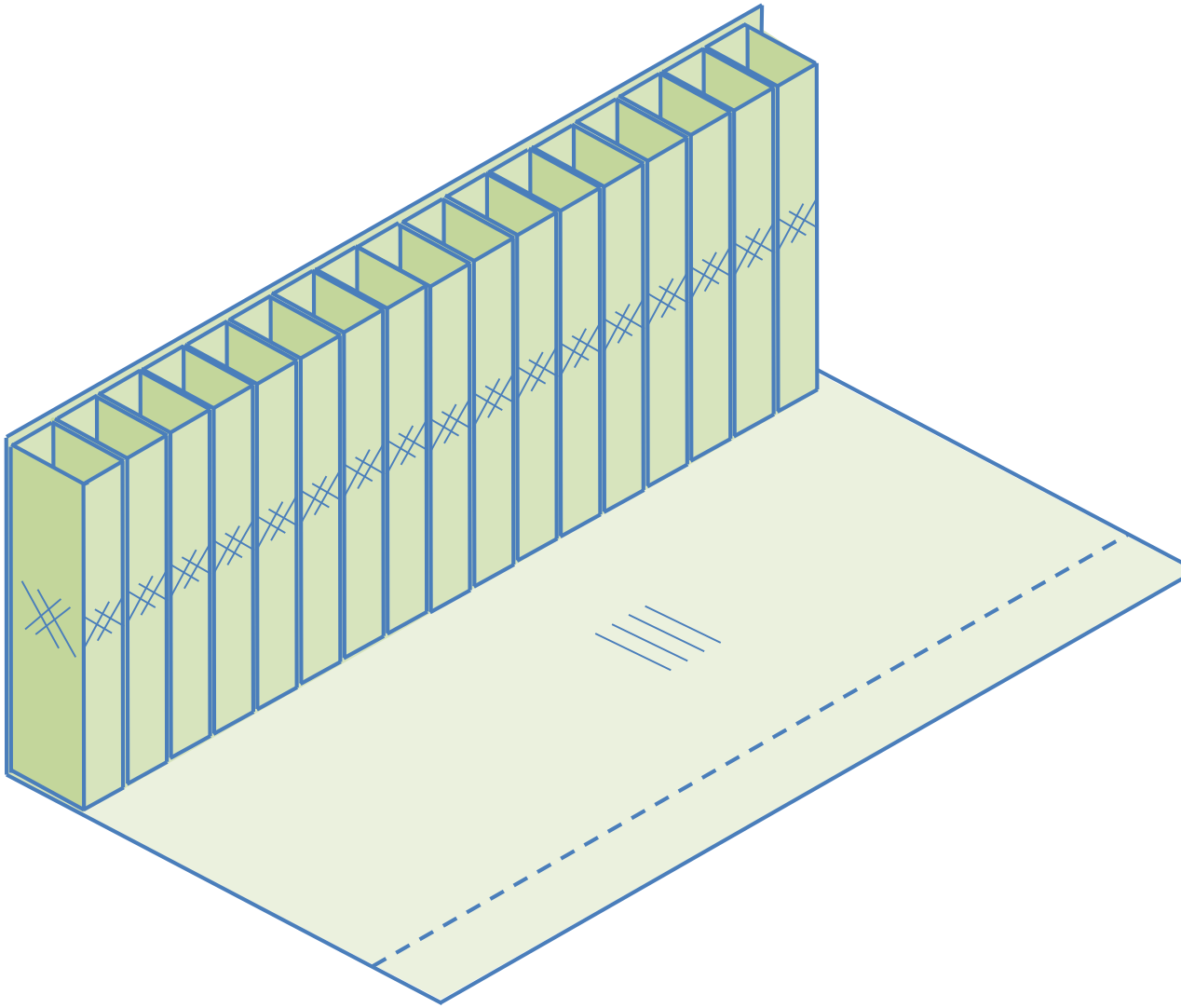


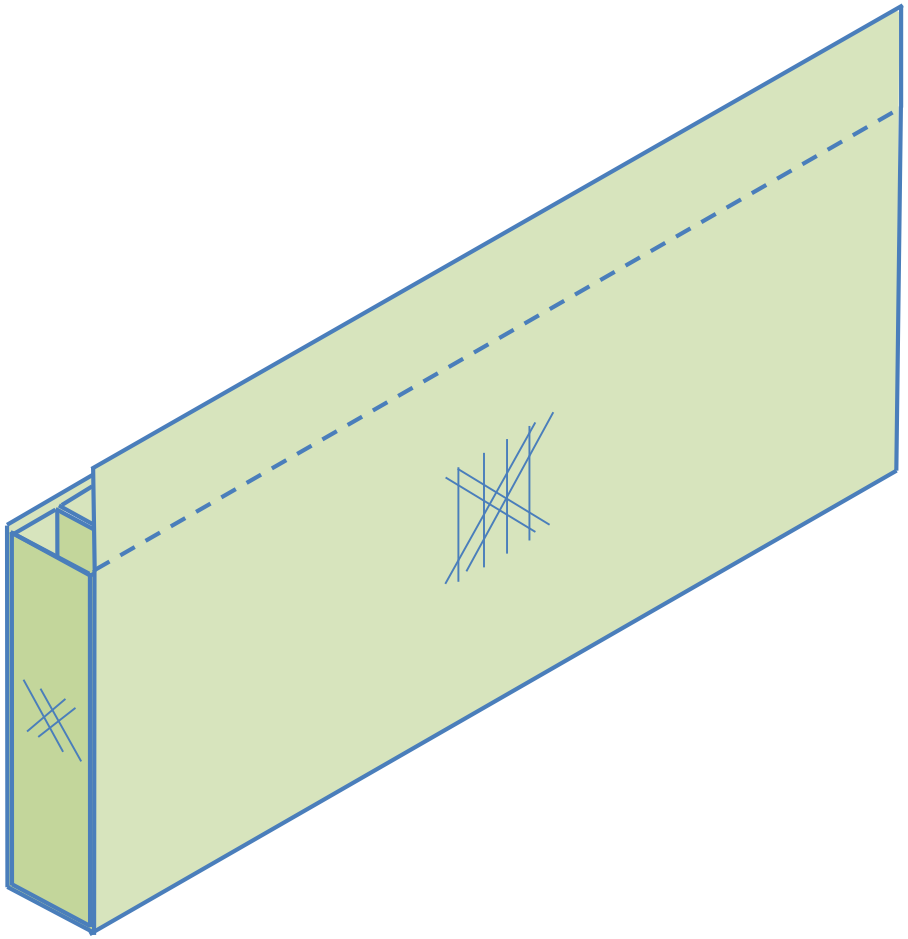
Core configurations:

Multi-box plate

±45° fabric + core wrap of 90° fabric



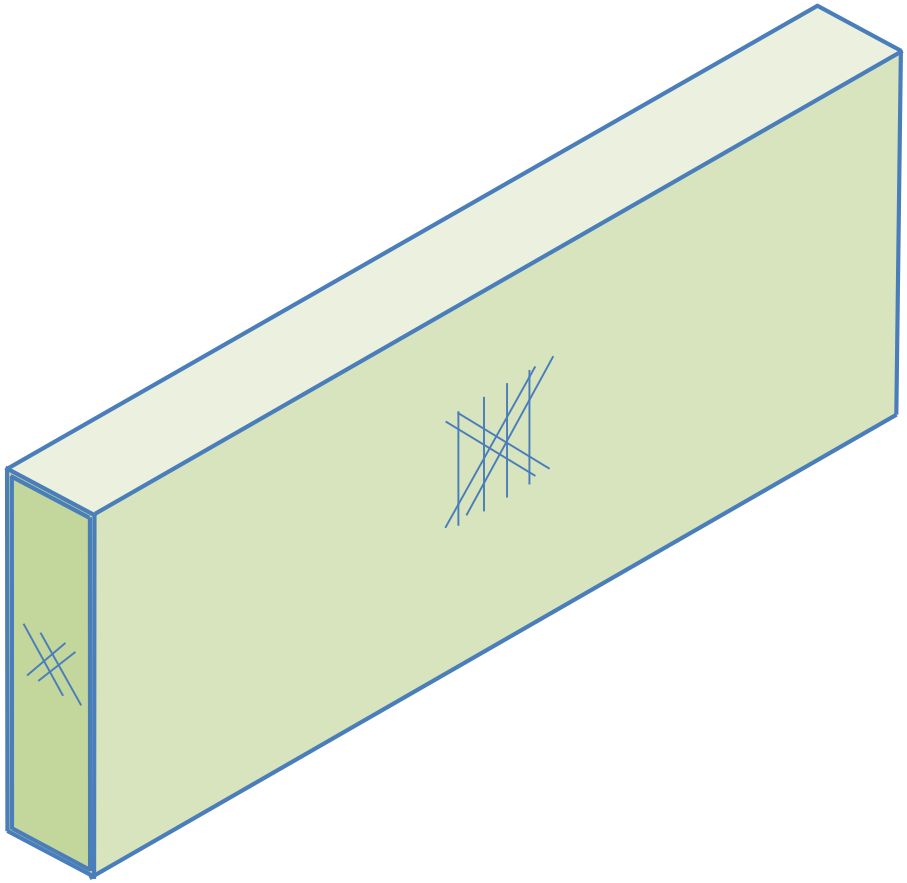
Core configurations:
Multi-box plate
±45° fabric + core wrap of 90° fabric



Core configurations:

Multi-box plate

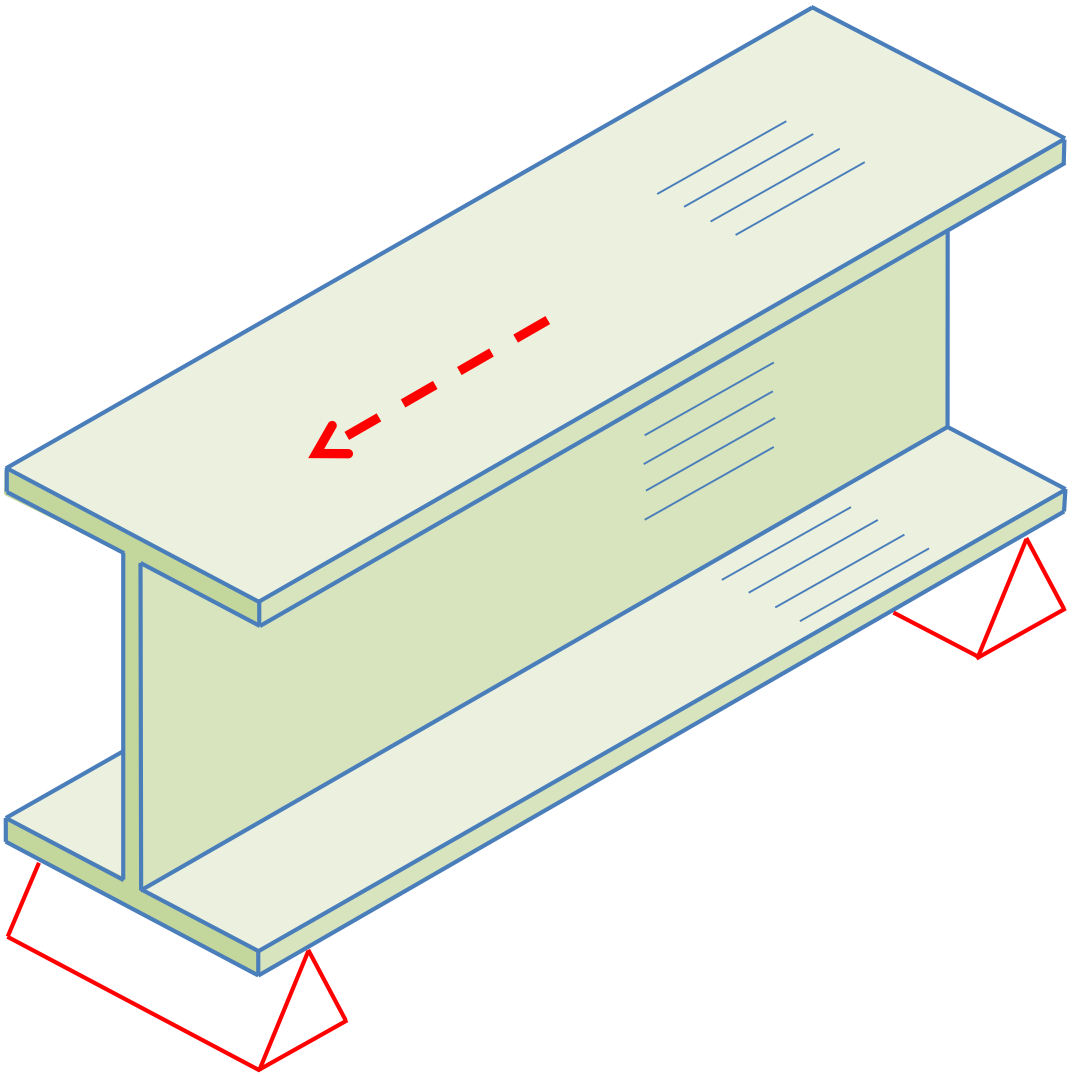
±45° fabric + core wrap of 90° fabric



Core configurations:

Multi-box plate

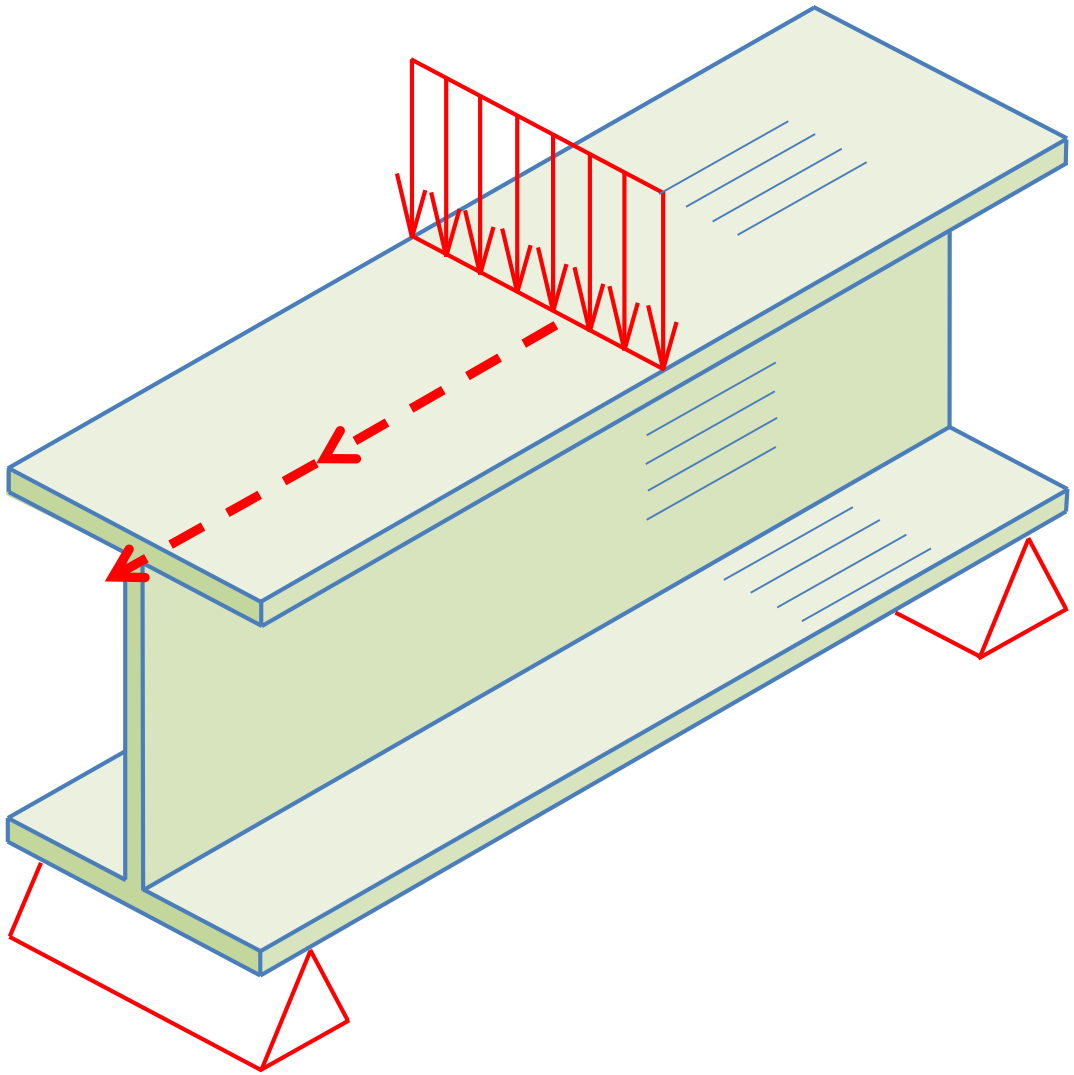
±45° fabric + core wrap of 90° fabric



GRP pultruded beam: Achilles heel

Supported in three-point bending

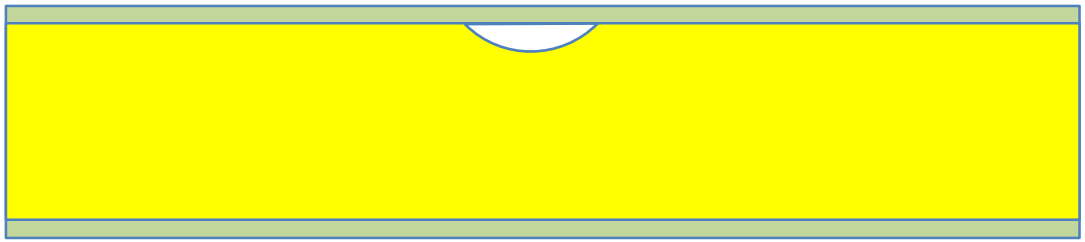
Impaced by hard object → flange-web crack initiation



GRP pultruded beam: Achilles heel

Loaded in three-point bending

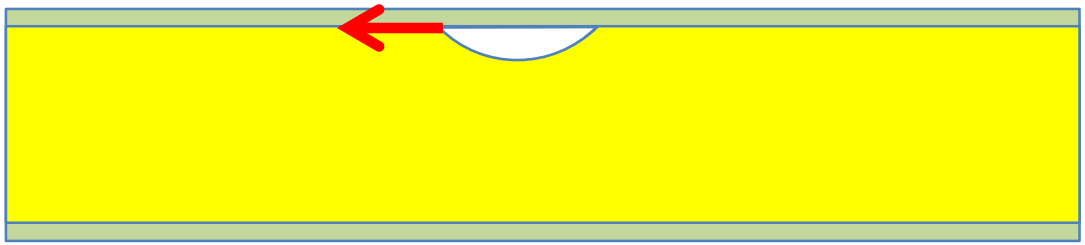
Unarrested crack growth → catastrophic failure



Classic sandwich: Achilles Heel

Two skins bonded on a core

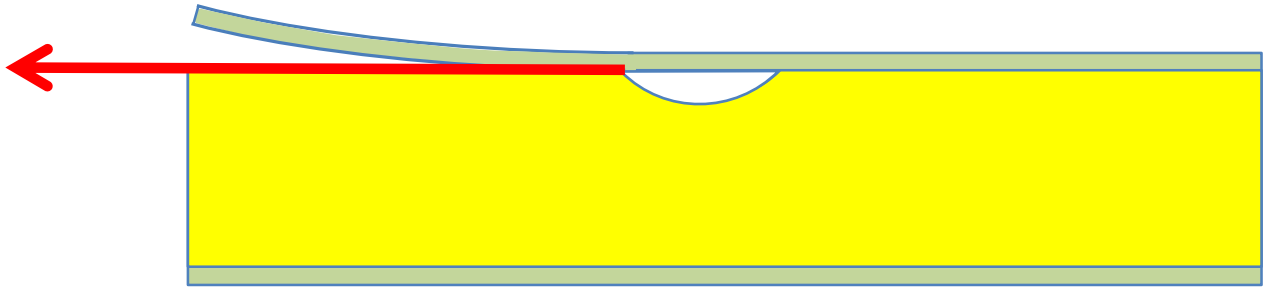
Impaced by hard object → skin-core debonding



Classic sandwich: Achilles Heel

Two skins bonded on a core

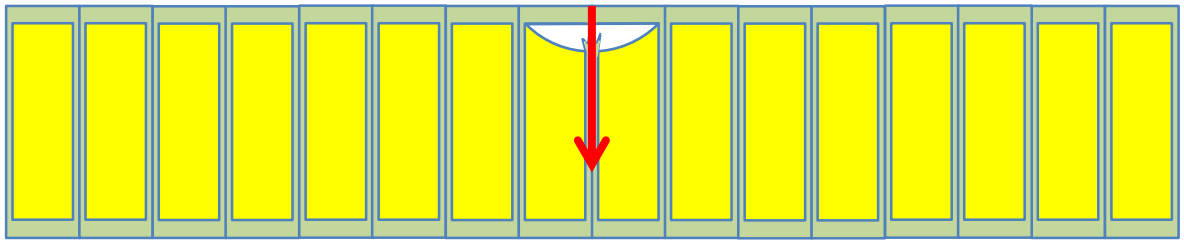
Crack growth caused by rolling loads



Classic sandwich: Achilles Heel

Two skins bonded on a core

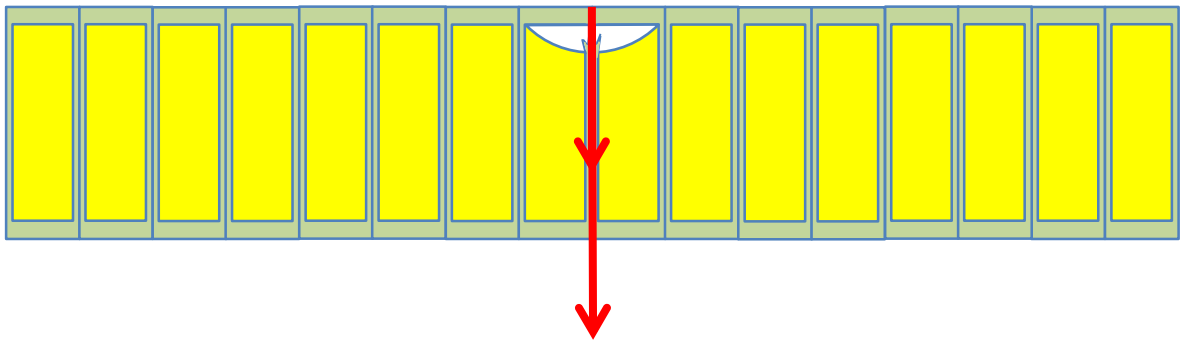
Catastrophic failure, due to unrestricted weak resin dominated fracture path



Multi beam plate: Achilles Heel

Many box beams bonded together

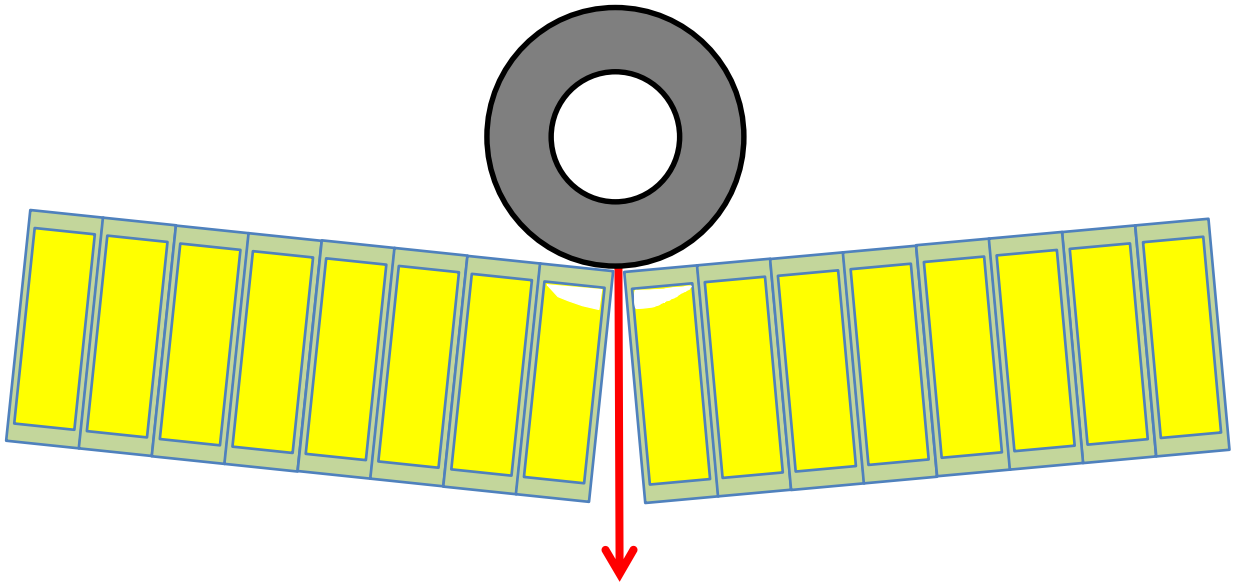
Impaced by hard object → crack in and between webs



Multi beam plate: Achilles Heel

Many box beams bonded together

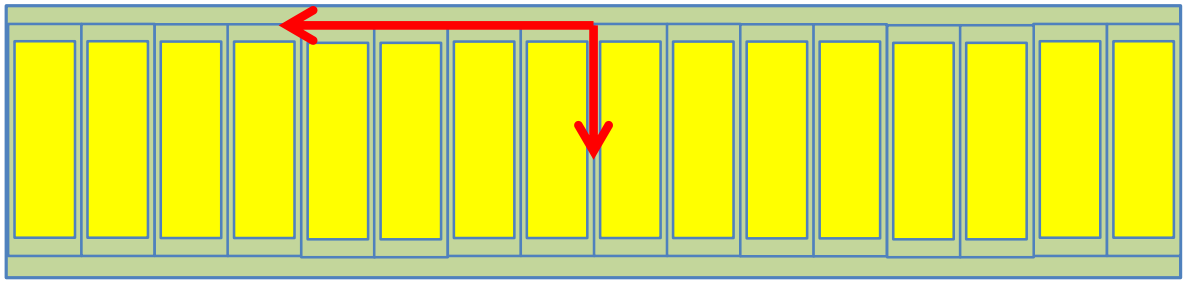
Crack growth caused by rolling loads



Multi beam plate: Achilles Heel

Many box beams bonded together

Failure, due to unrestricted weak resin dominated fracture path



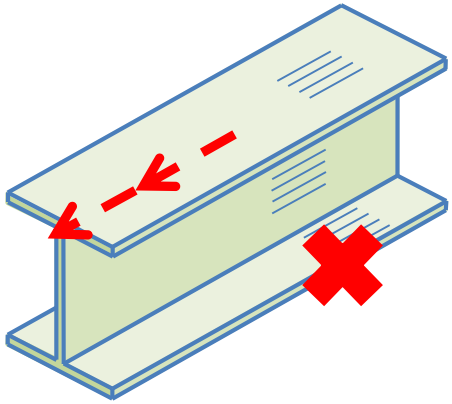
Multi beam plate: Achilles Heel

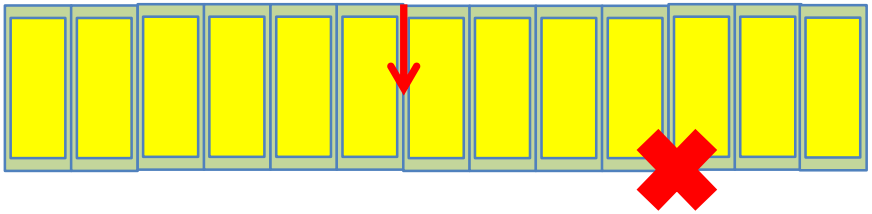
Many box beams bonded together, with additional deck layers

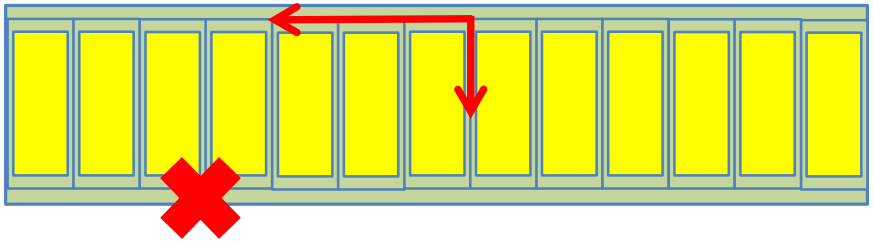
Impaced by hard object → <u>two</u> weak resin dominated fracture paths

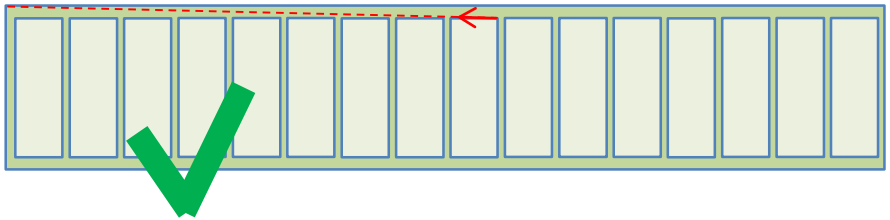
InfraCore company

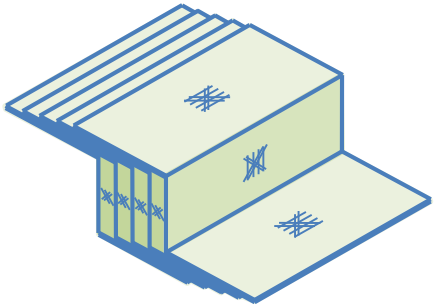
InfraCore inside











RAMSSES

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

CompositesNL

E-LASS

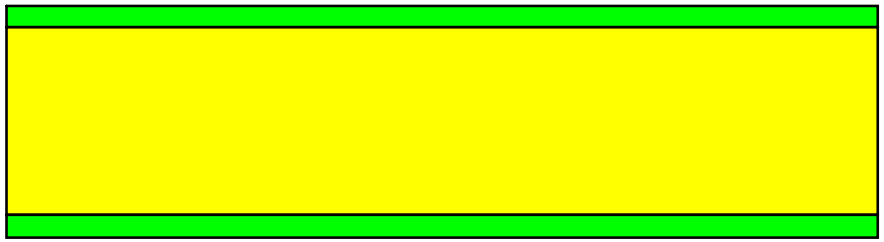
FiberCore europe

Glass Fibre Fabric box beam:

Extreme robustness

What is InfraCore Inside...

From classic sandwich to InfraCore...



InfraCore company

InfraCore® inside

What is InfraCore Inside...

RAMSSES

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

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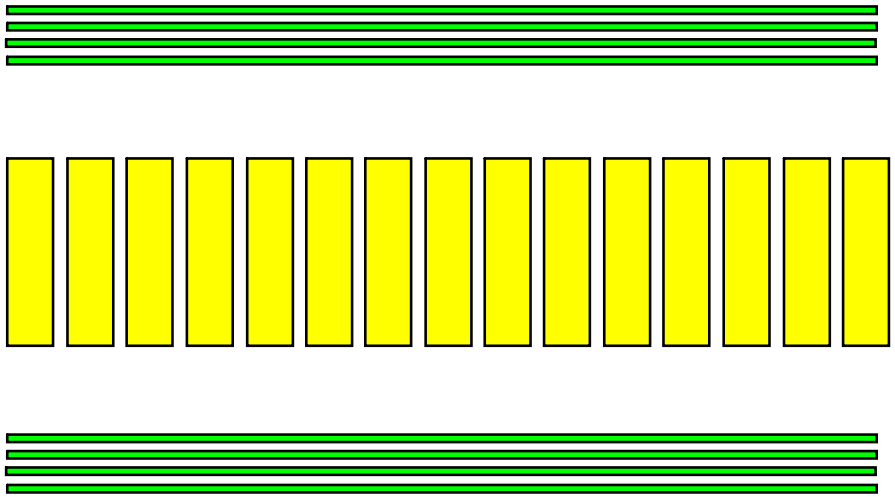
E-LASS

FiberCore europe

InfraCore company

InfraCore inside

What is InfraCore Inside...



RAMSSES

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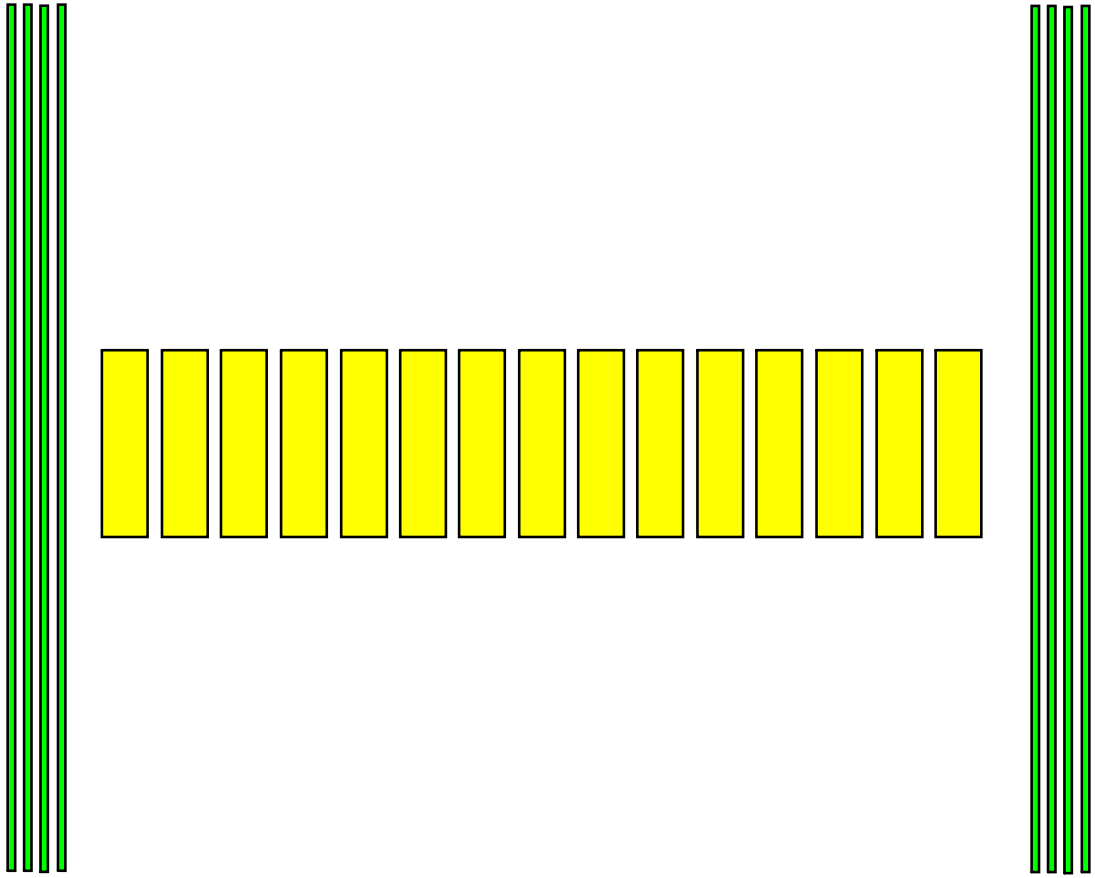
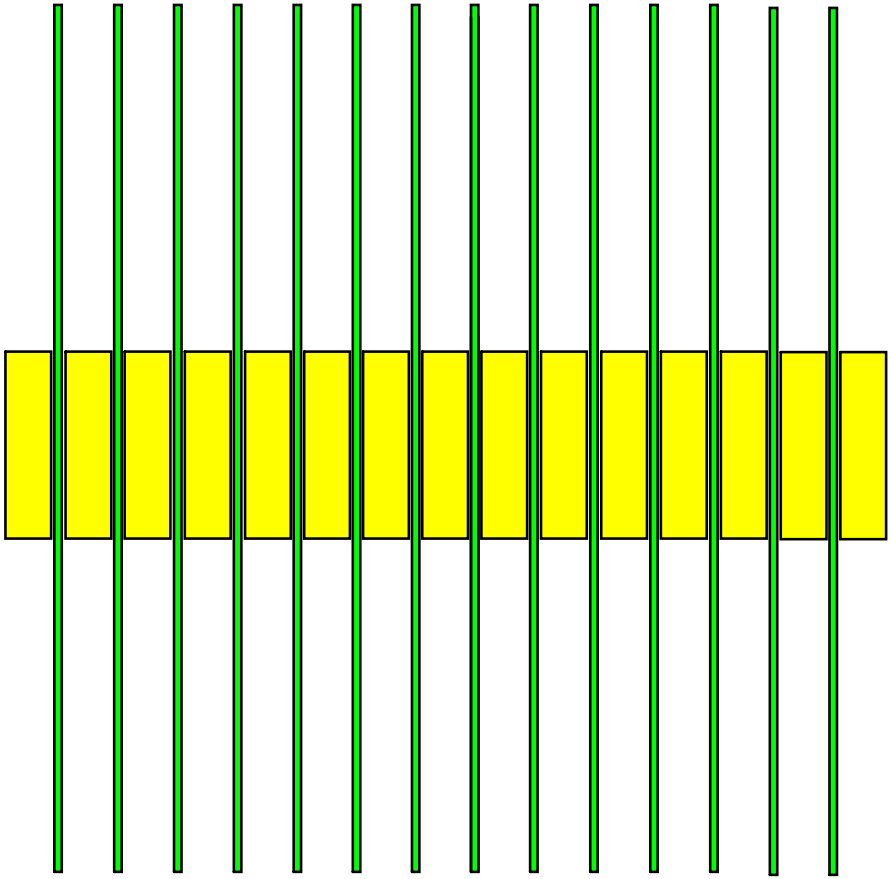
FiberCore europe

What is InfraCore Inside...



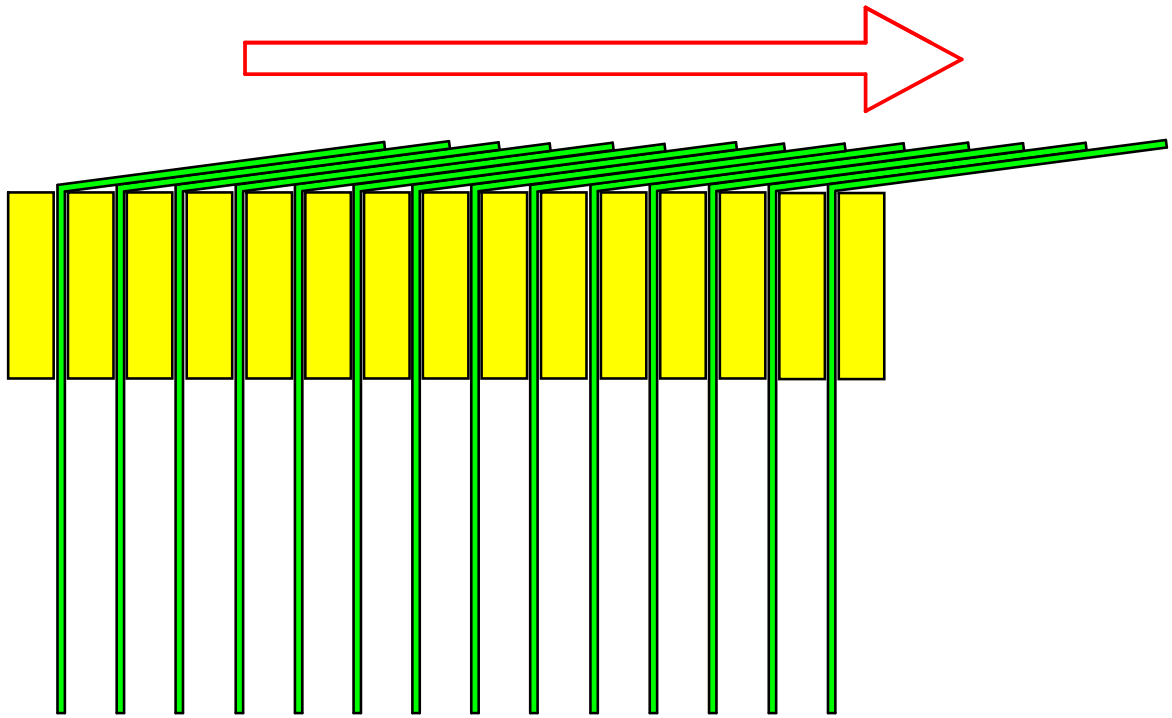
What is InfraCore Inside...



InfraCore company

InfraCore inside

What is InfraCore Inside...



RAMSSES

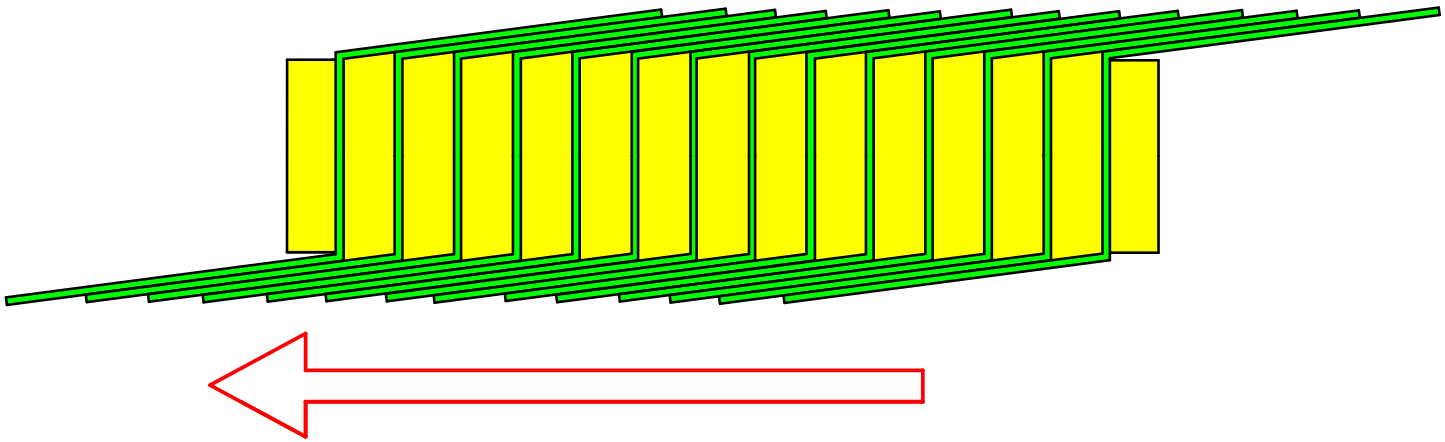
MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

CompositesNL

E-LASS

FiberCore europe

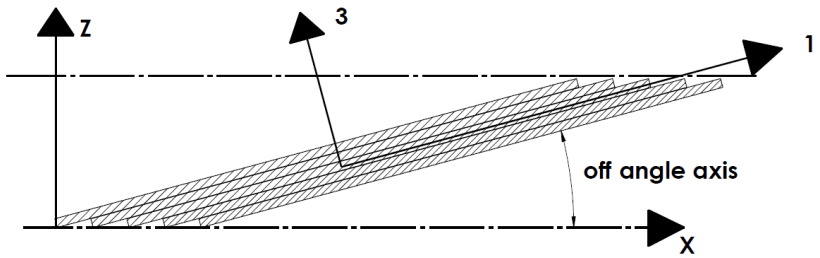
What is InfraCore Inside...



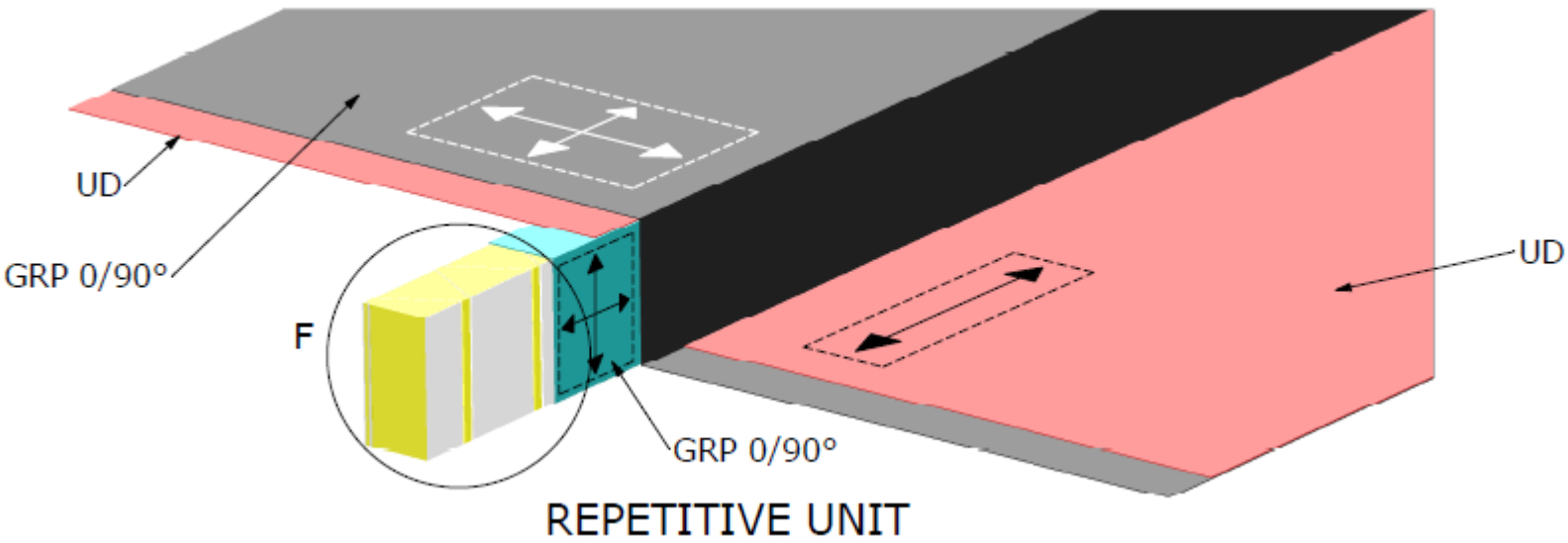
InfraCore Inside

- skin = in essence a new material
- through-the-thickness off-axis
- new name coined:

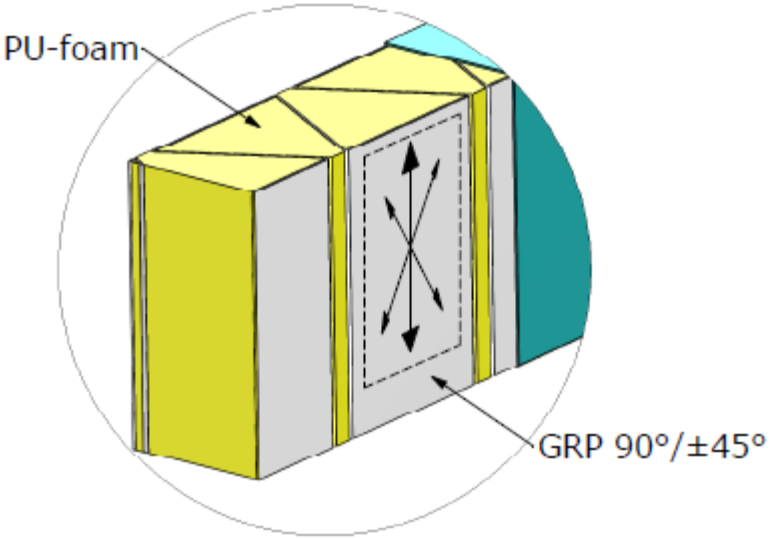
  “oblique layered composites”



- complete filled 6x6 compliance matrix
- to be fully modelled...



REPETITIVE UNIT

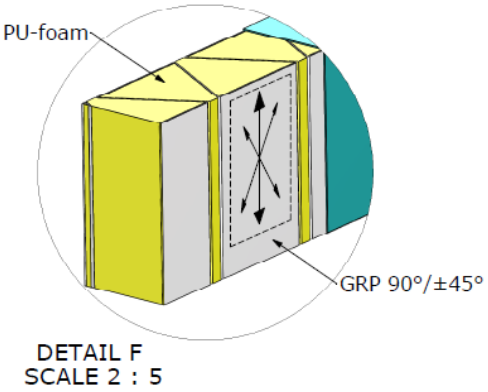


DETAIL F
SCALE 2 : 5

InfraCore company

InfraCore inside

What is InfraCore



RAMSSES

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

CompositesNL

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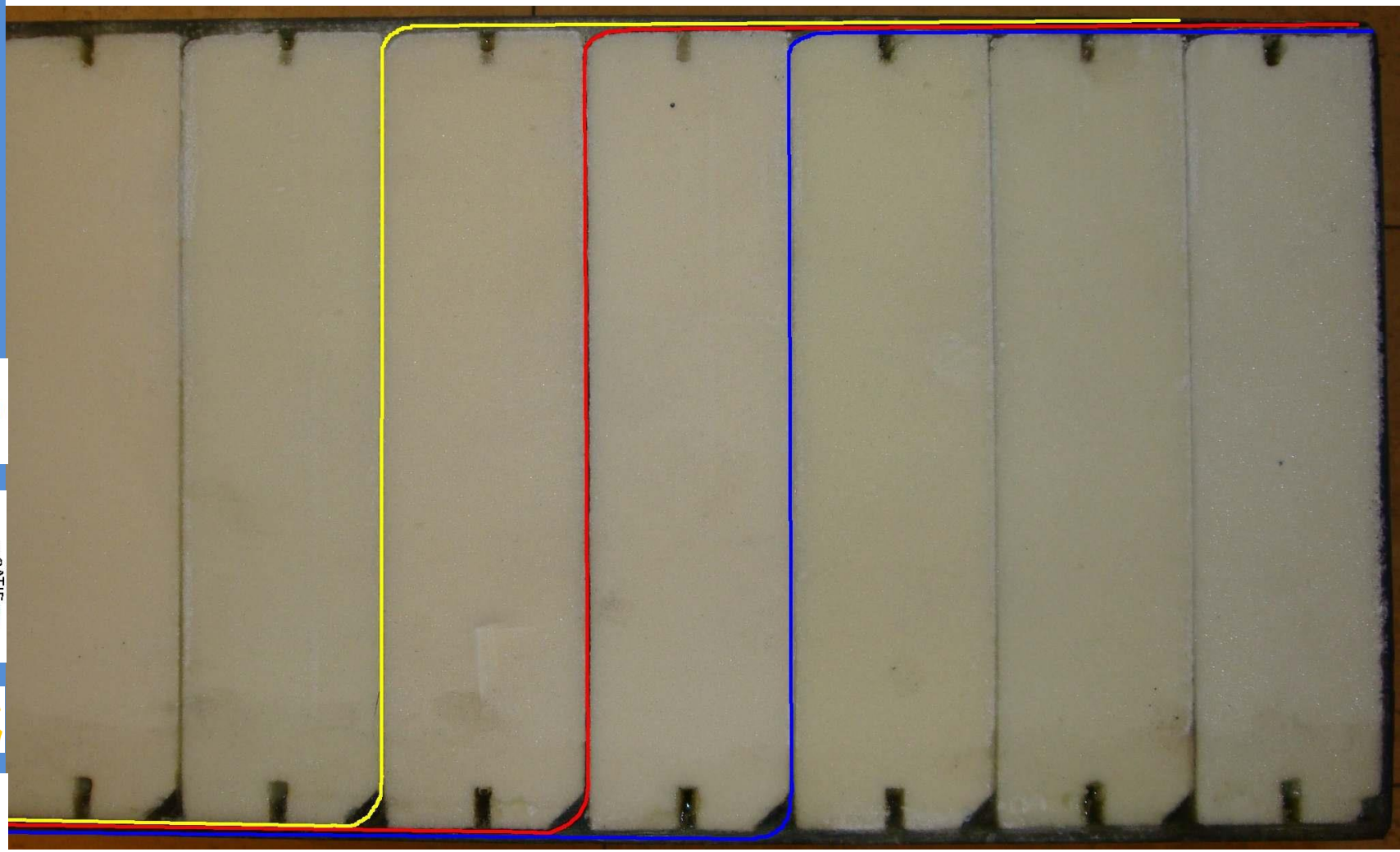
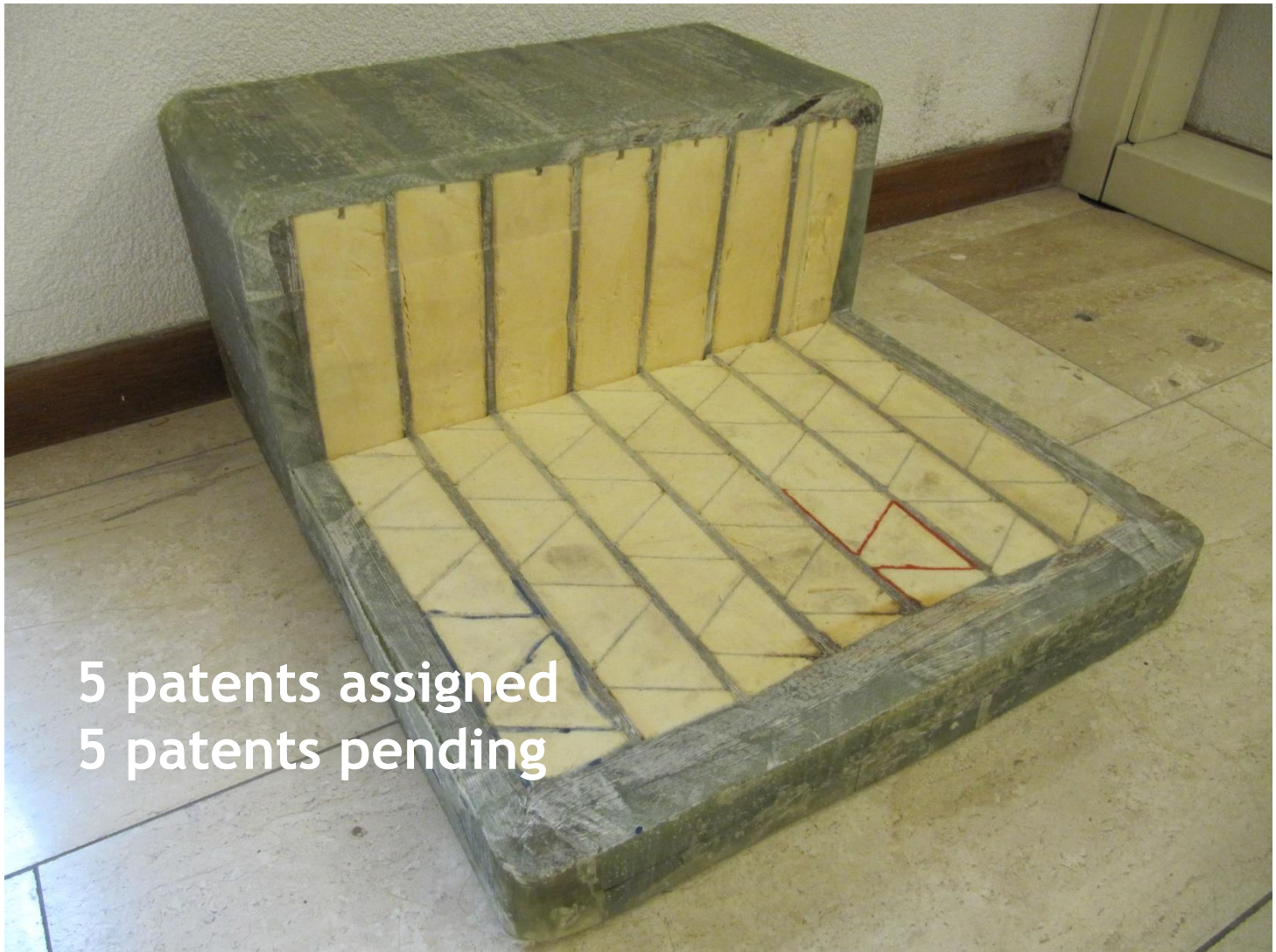
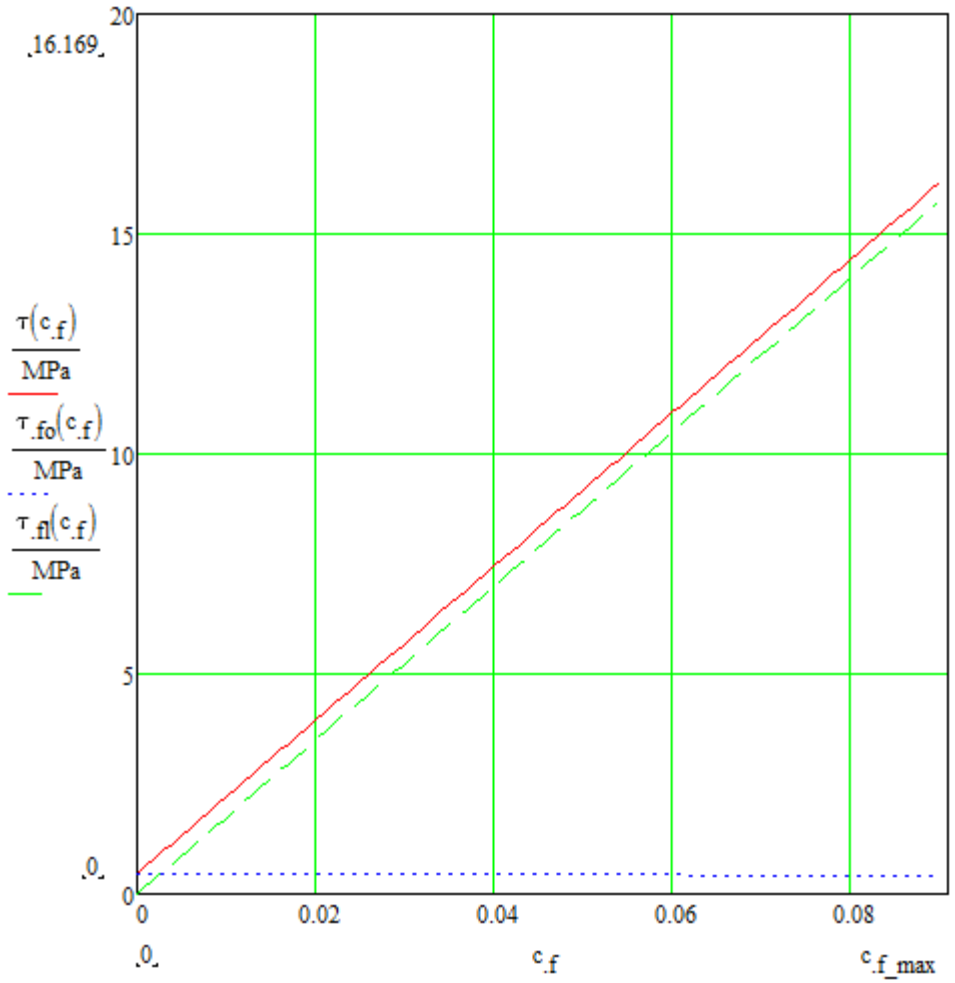
Cross section InfraCore light



Cross section InfraCore heavy



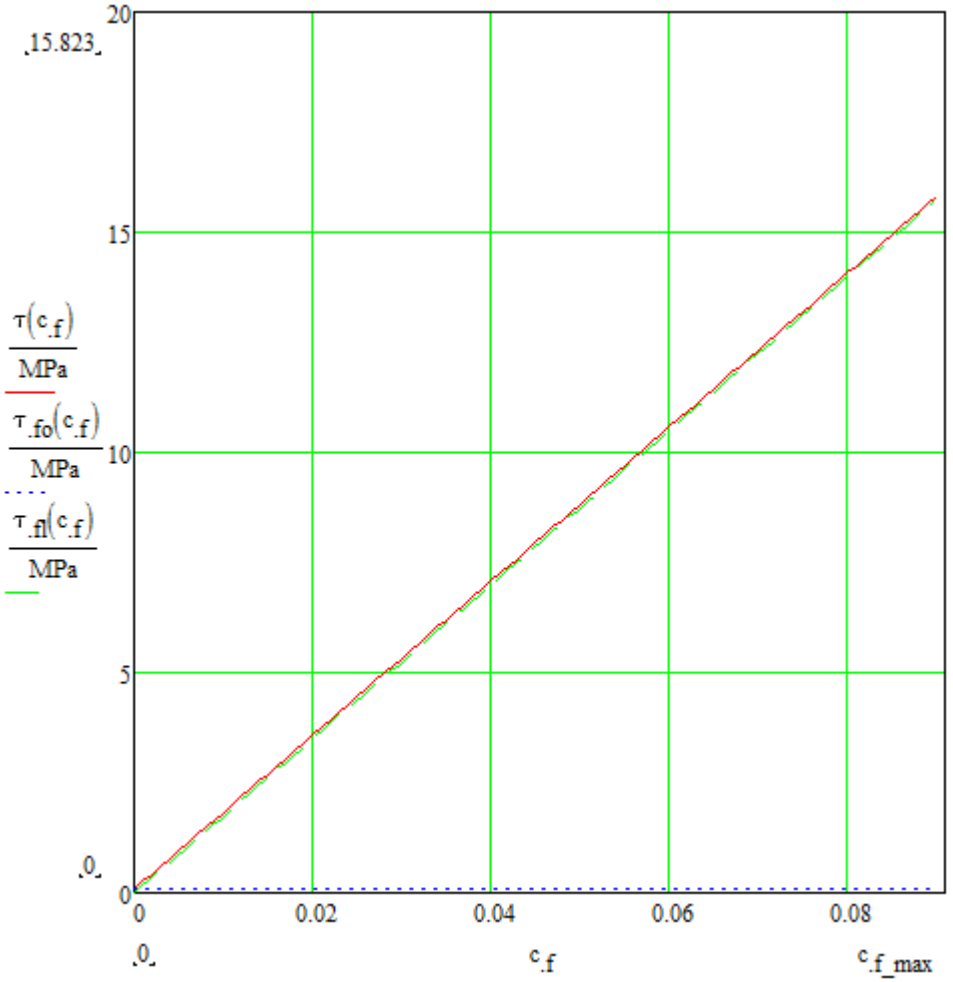
Foam contribution to InfraCore



InfraCore Inside, with

Airex T90 65 kg/m^3
constructive PET-foam

Foam contribution to InfraCore



InfraCore Inside, with

PU 35 kg/m^3 Nestaan, foam

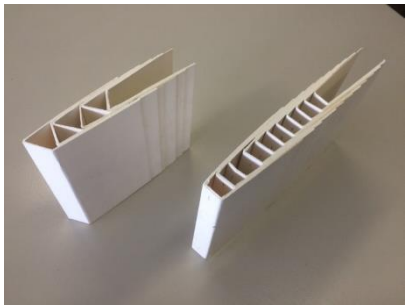
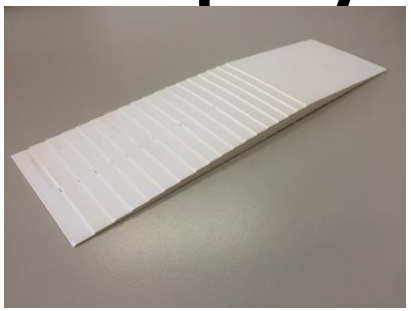
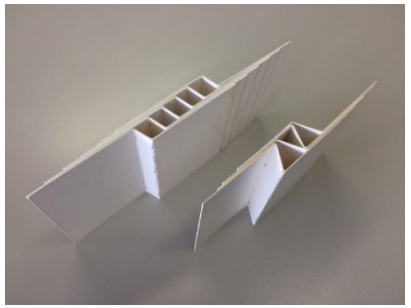
The essence of InfraCore Inside®

InfraCore Inside combines the advantages of sandwich structures and multi-beam plates, without the drawbacks.

This makes InfraCore Inside the product of choice for very robust heavy duty applications, such as bridges, lock gates, etc.

InfraCore Company

Contact

- Postal address: Oostdijk 25, 3077 CP Rotterdam/NL
- Office address: Fascinatio Boulevard 722
  2909 VA Capelle aan den IJssel/NL
- Email: info@infracore-company.com
- Internet: www.infracore-company.com
- Phone: 0031-624628868