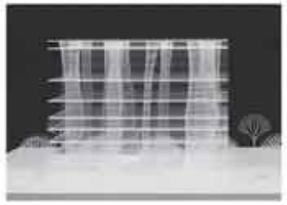
Tragwerksentwurf III

Structural Design III

Joseph Schwartz · Philippe Block



Architektur und Tragwerk

Architecture and Structure

1. Stahl

1. Steel

2. Stahlbeton

2. Reinforced concrete

3. Holz

3. Timber

4. Mauerwerk

4. Masonry

5. Konstruktiondetails

5. Construction details

Tragwerksentwurf III

Structural Design III

Tragwerksentwurf IV

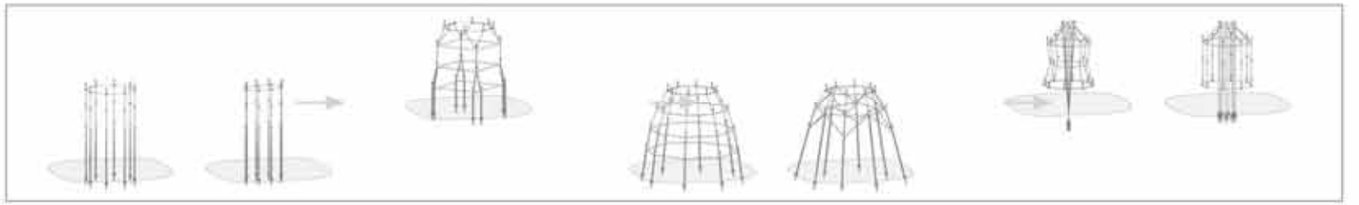
Structural Design IV

Entwerfen von Tragwerken I

Design of structures I

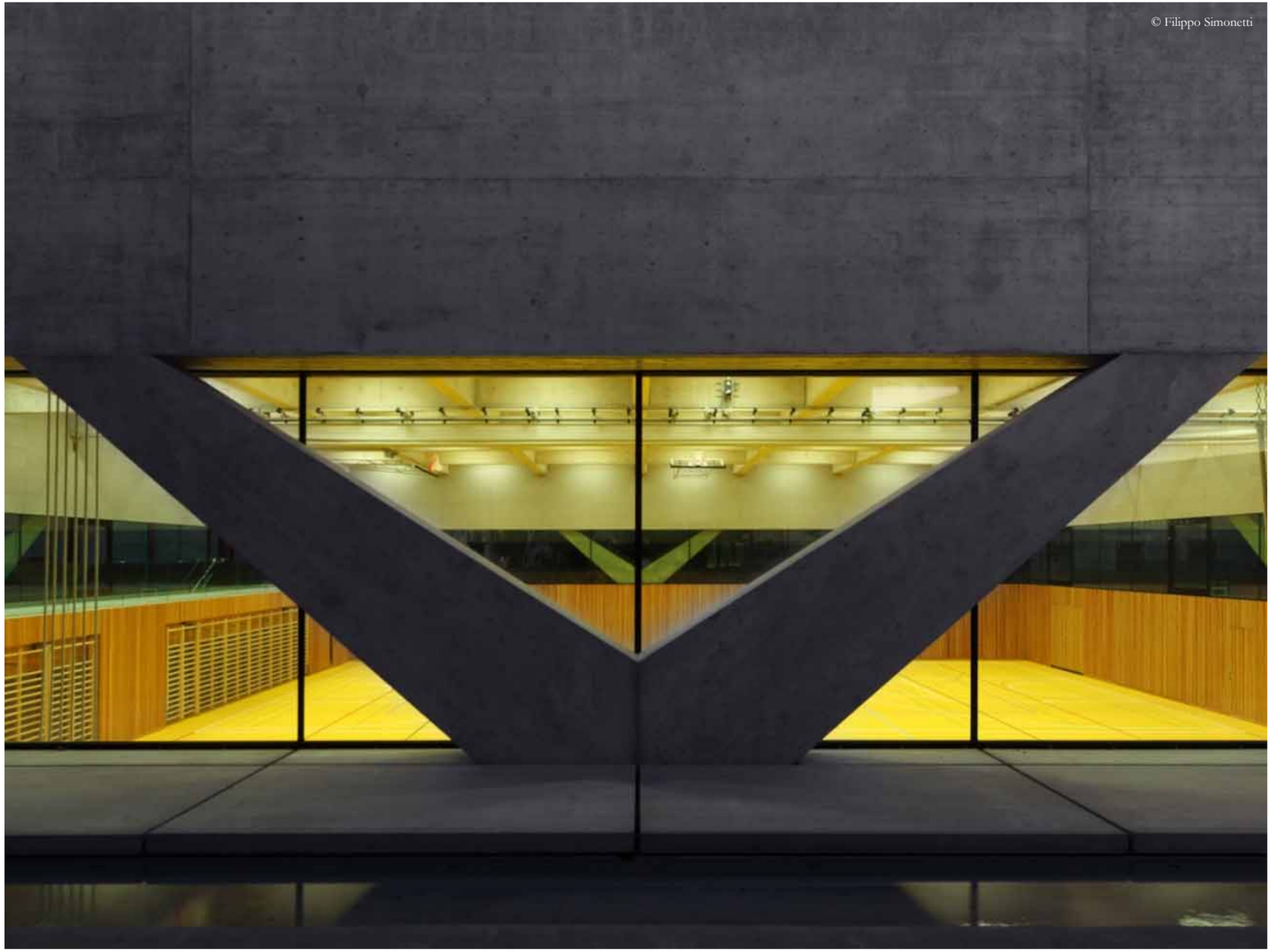
Entwerfen von Tragwerken II

Design of structures II



Entwurfsprojekt

Design project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"Reinforced concrete embodies the potential
to pour stones with any form, which are
superior to the natural stones due to their
capability of tensile strength"

Pier Luigi Nervi

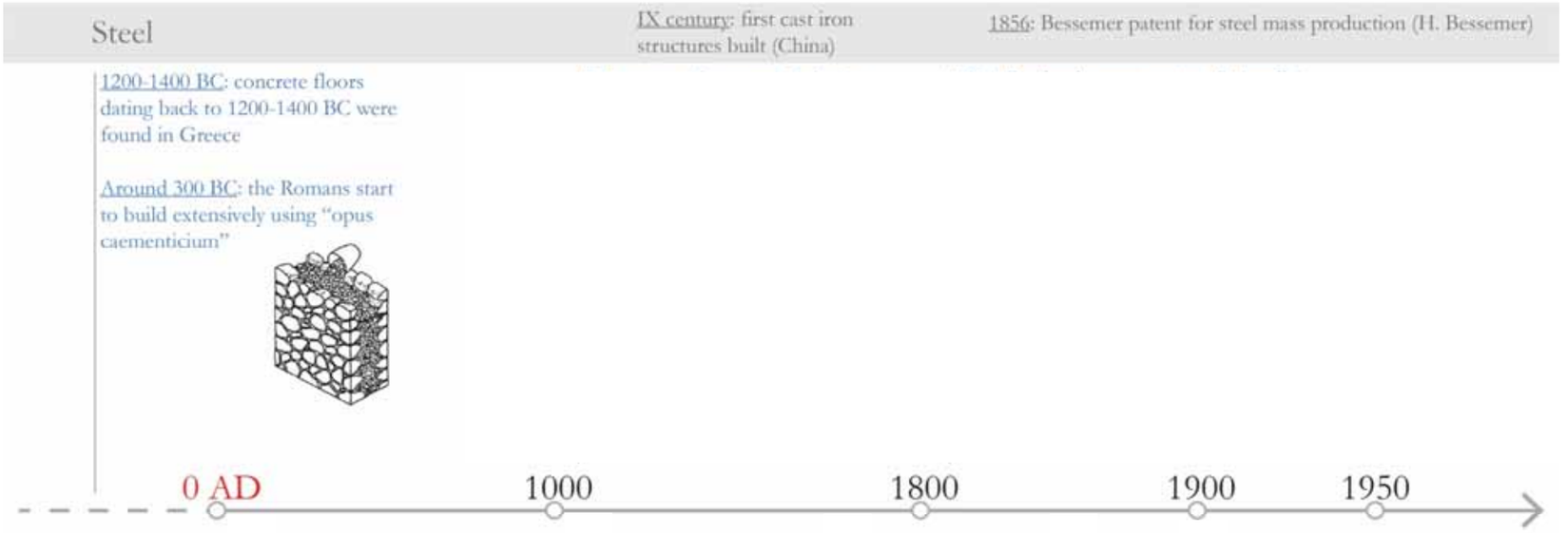
Stahlbeton
Reinforced Concrete

Steel

IX century: first cast iron structures built (China)

1856: Bessemer patent for steel mass production (H. Bessemer)

Concrete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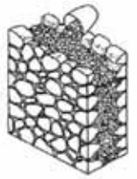

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113-125 AD: Pantheon, Rome

Concrete

Pantheon, Rome, 113-125 AD

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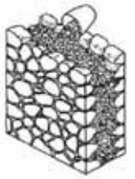

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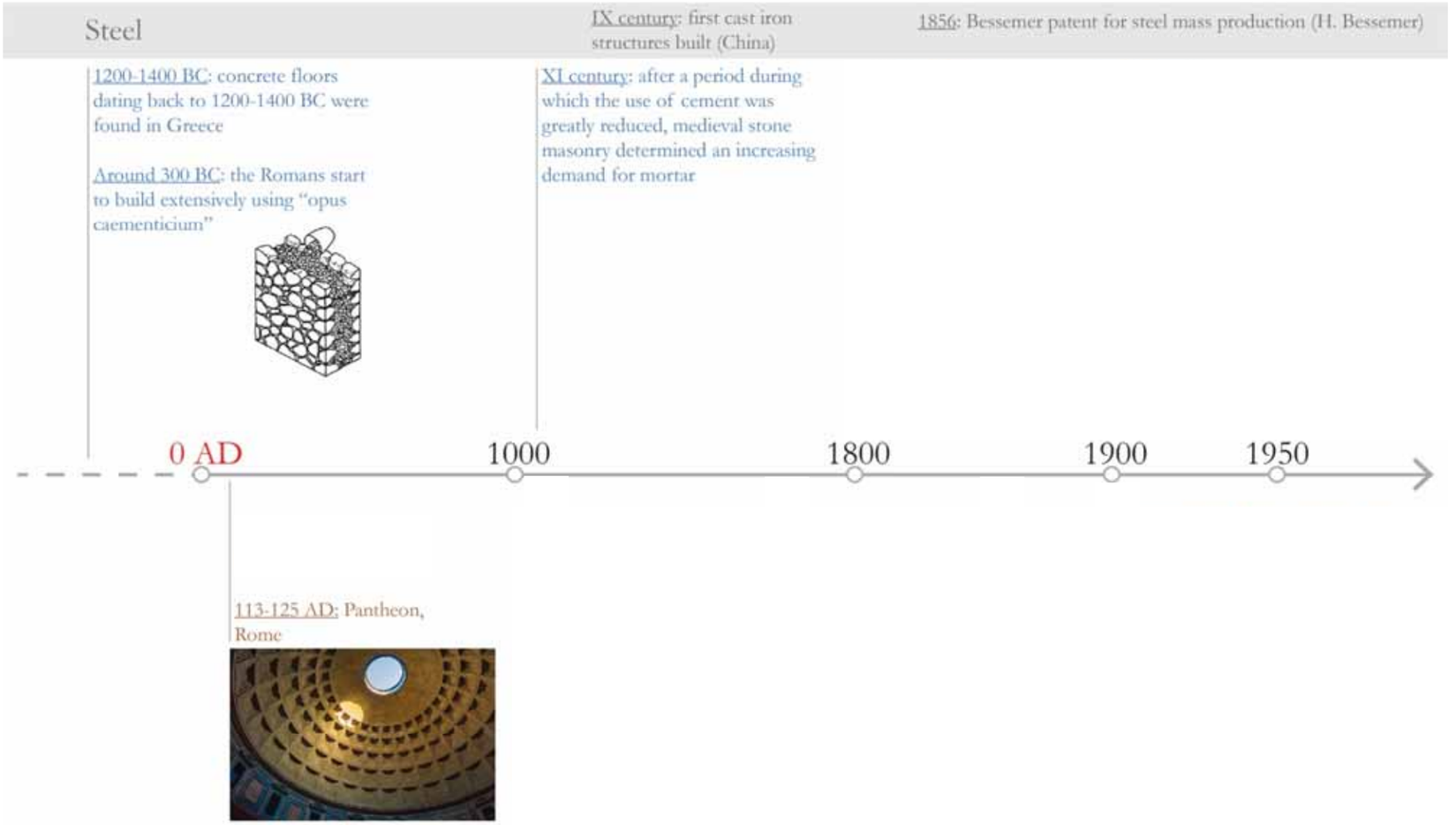
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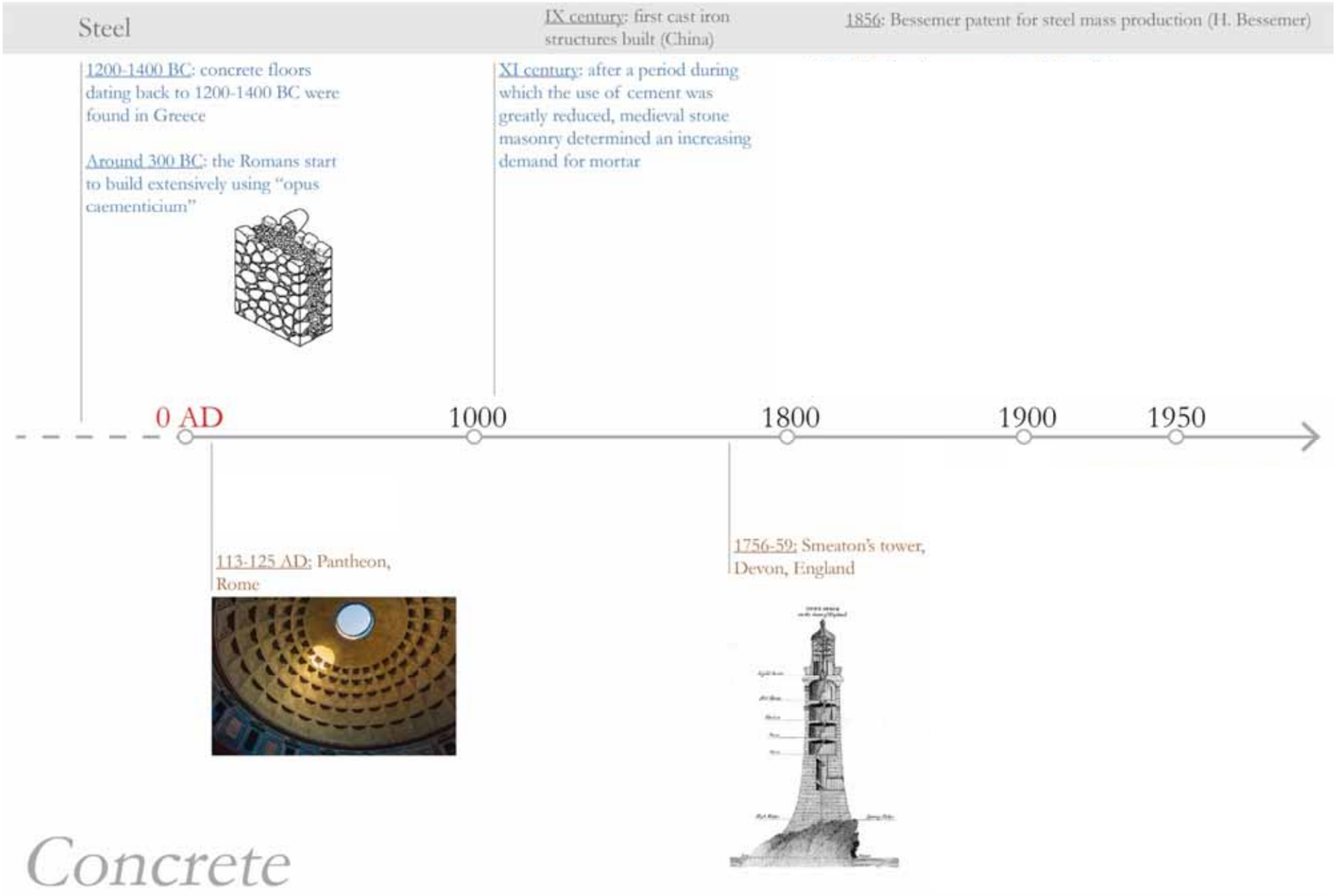
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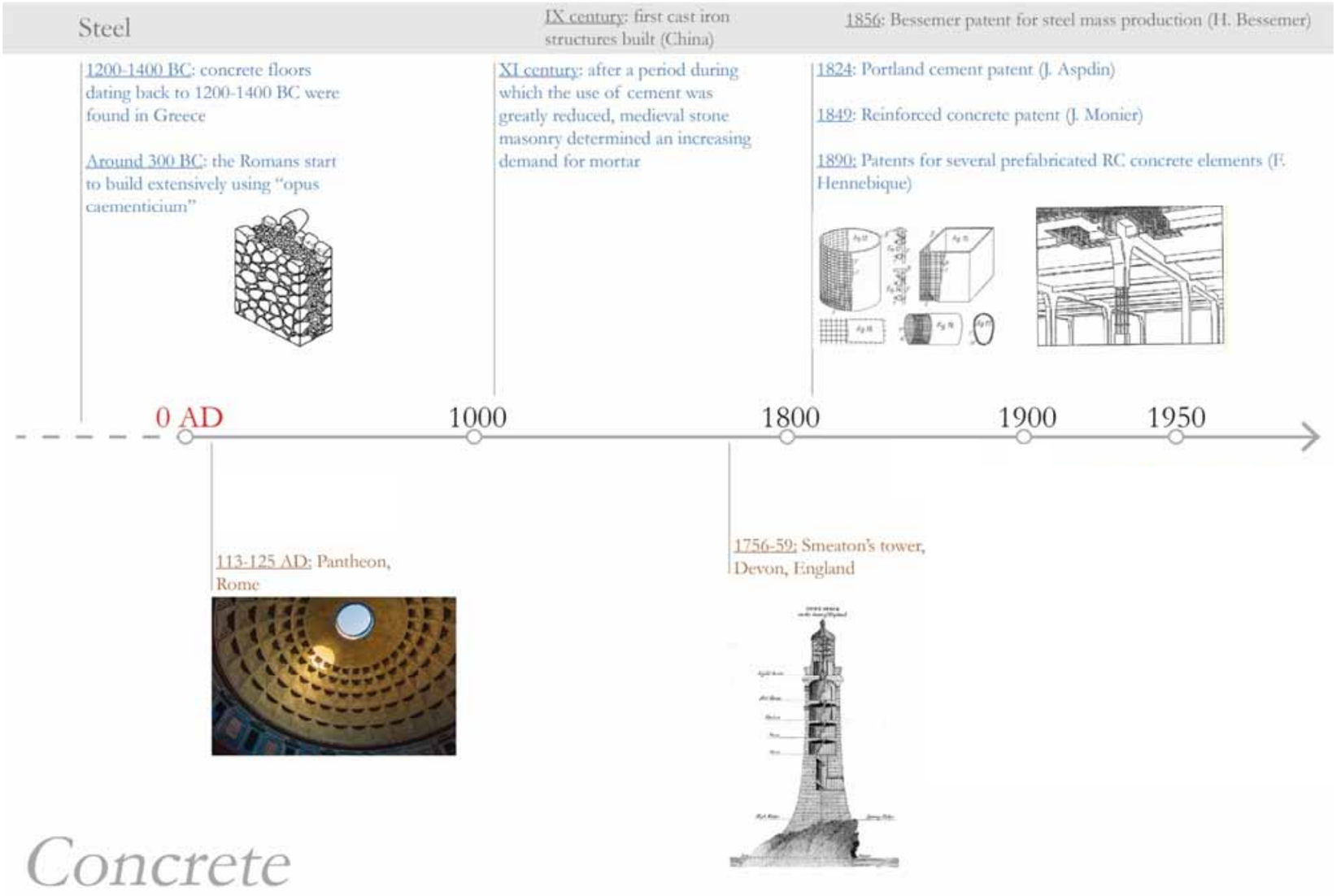
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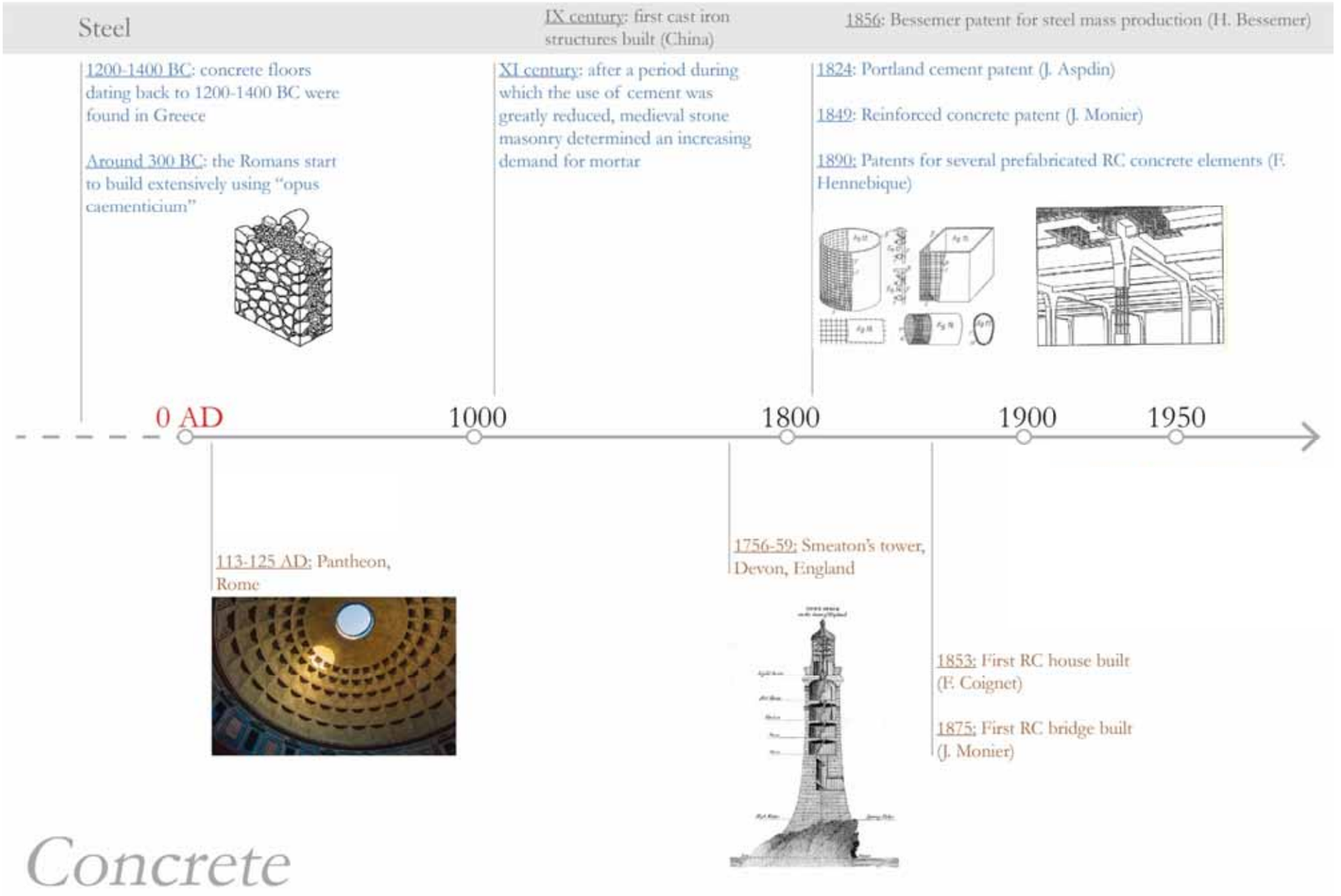
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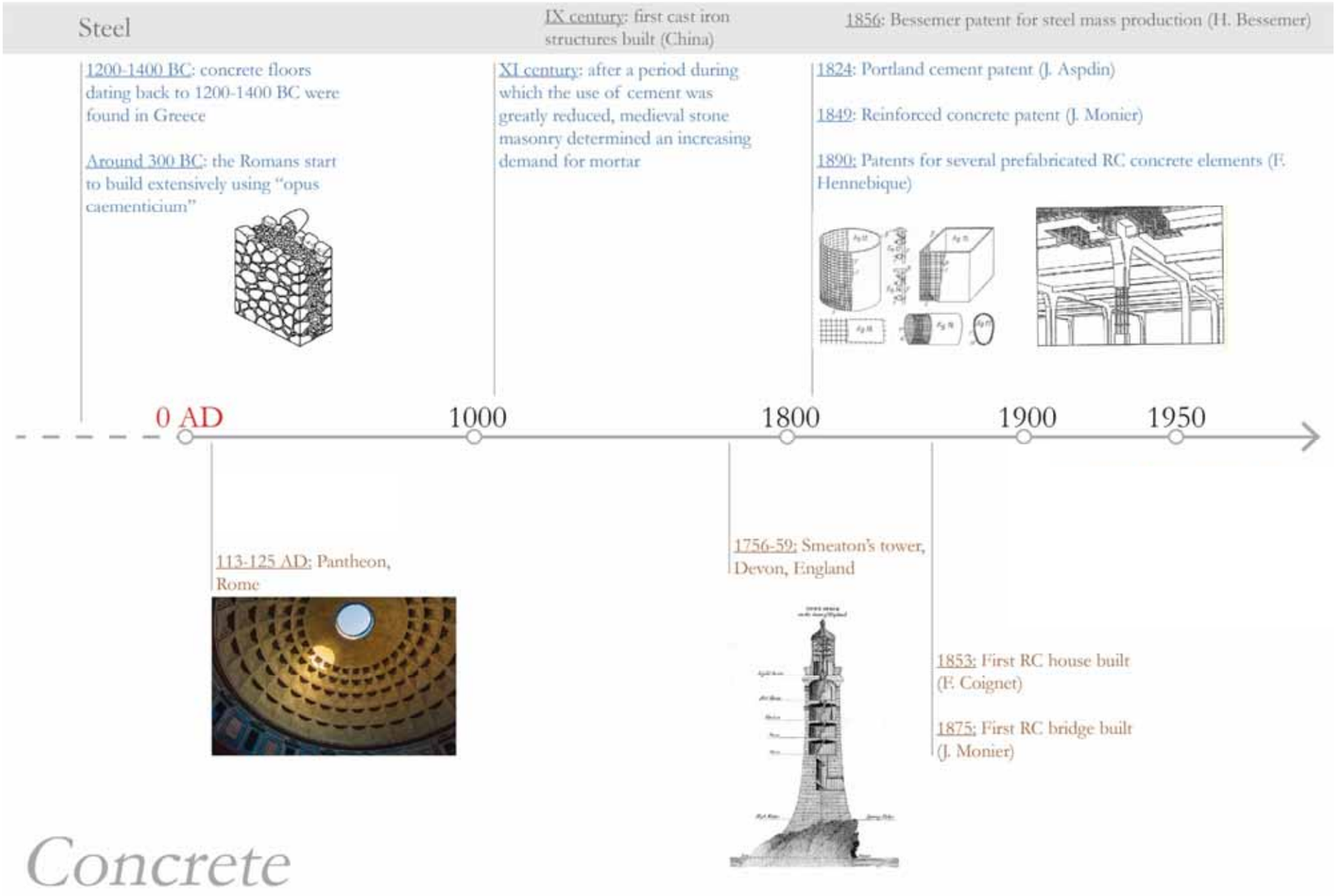
1875: First RC bridge built (J. Monier)
Concrete

Chazalet Bridge, Chazalet, 1875, Joseph Monier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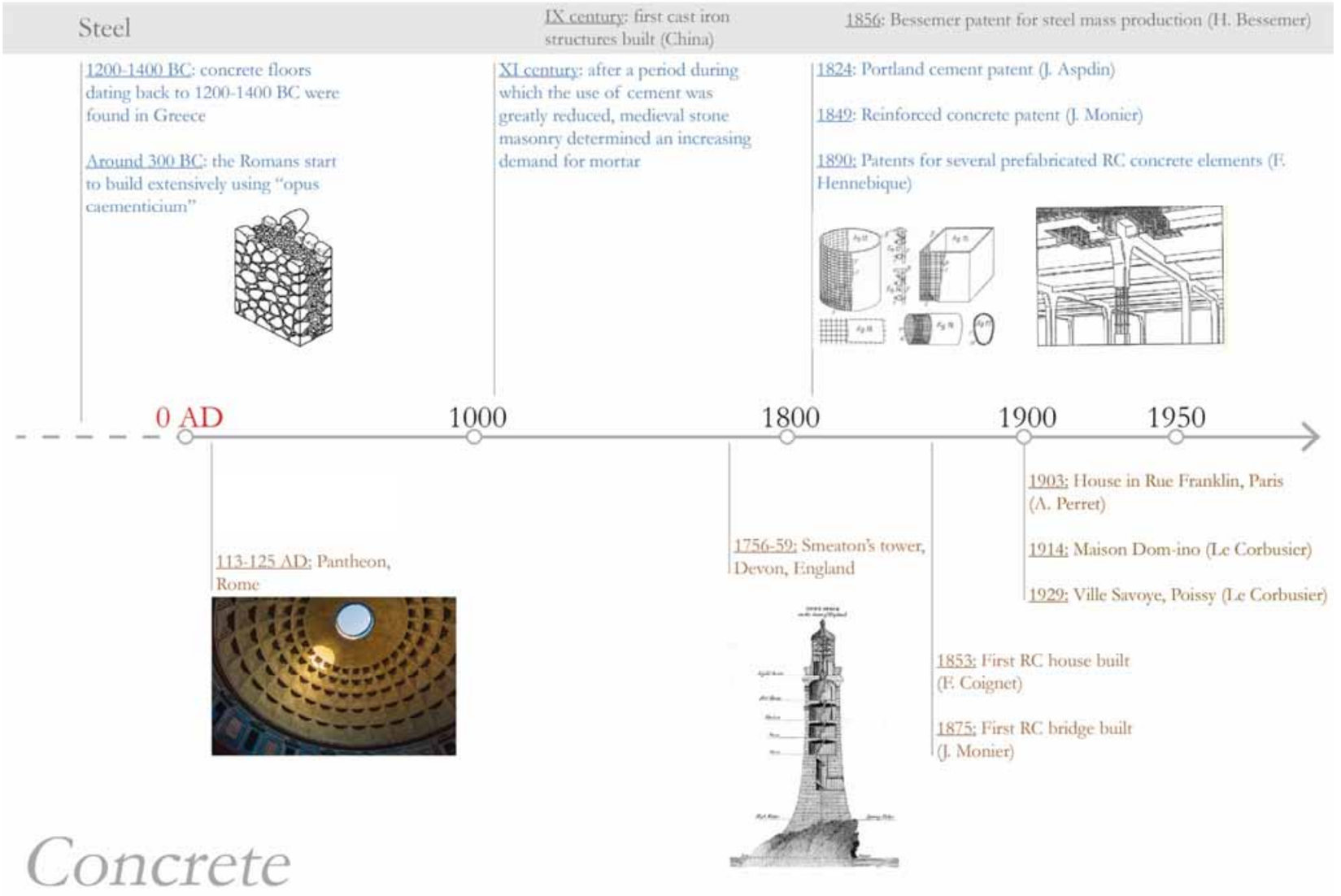
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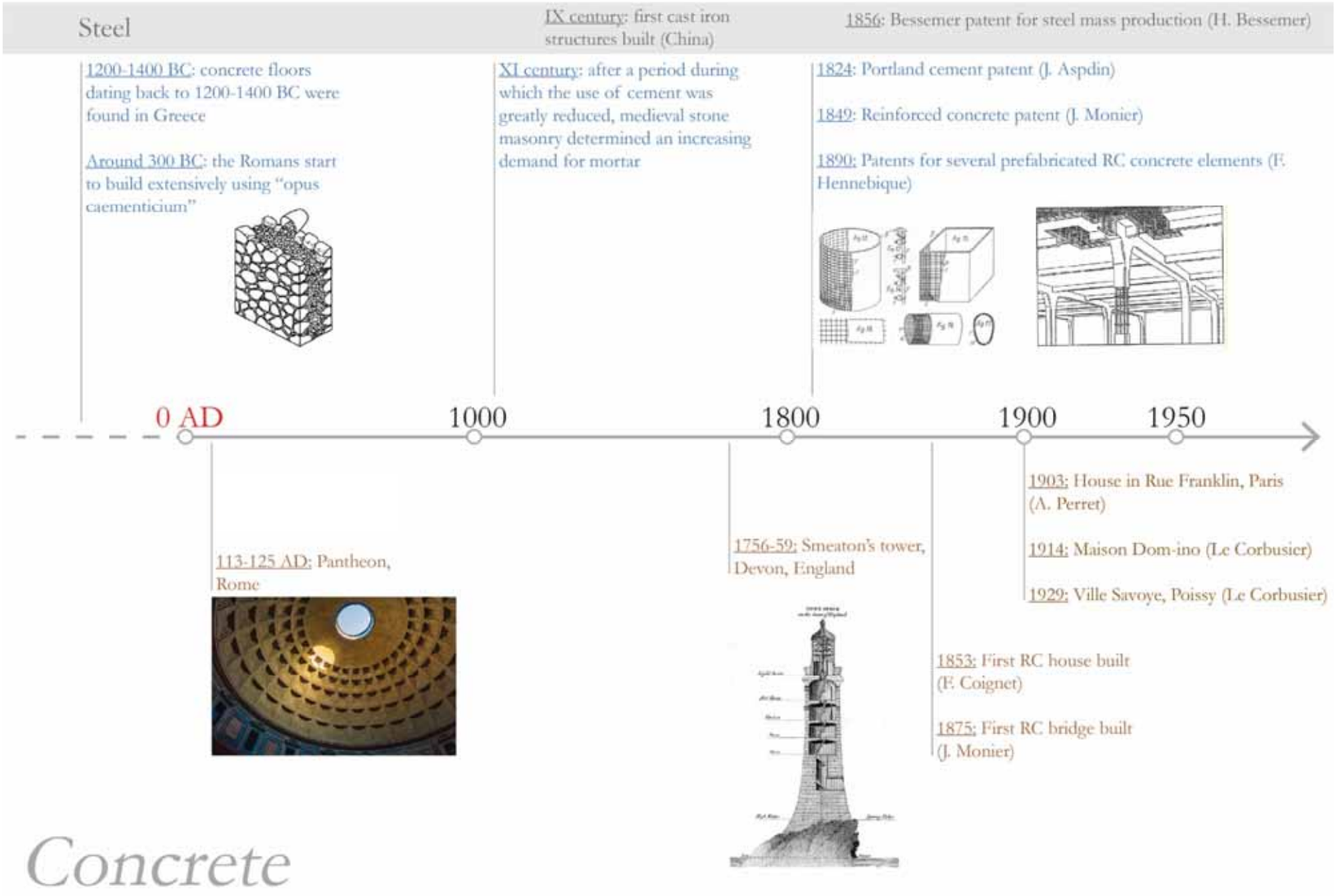
Ville Savoye, Poissy, 1929, arch. Le Corbusier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Le Corbusier
1955: Notre Dame du Haut

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Kenzō Tange
1964: St.Mary Cathedral

Concrete

St. Mary, Tokyo, 1964, arch. Kenzo Tange

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Palazzetto dello Sport, Rome, 1967, Pier Luigi Nervi

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Ponte sul Basento, Potenza, 1976, Sergio Musmeci

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Vitra Fire Station, Weil am Rhein, 1993, arch. Zaha Hadid

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2006: Crematorium

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Meiso no Mori Municipal Funeral Hall, Gifu, 2006, arch. Toyo Ito

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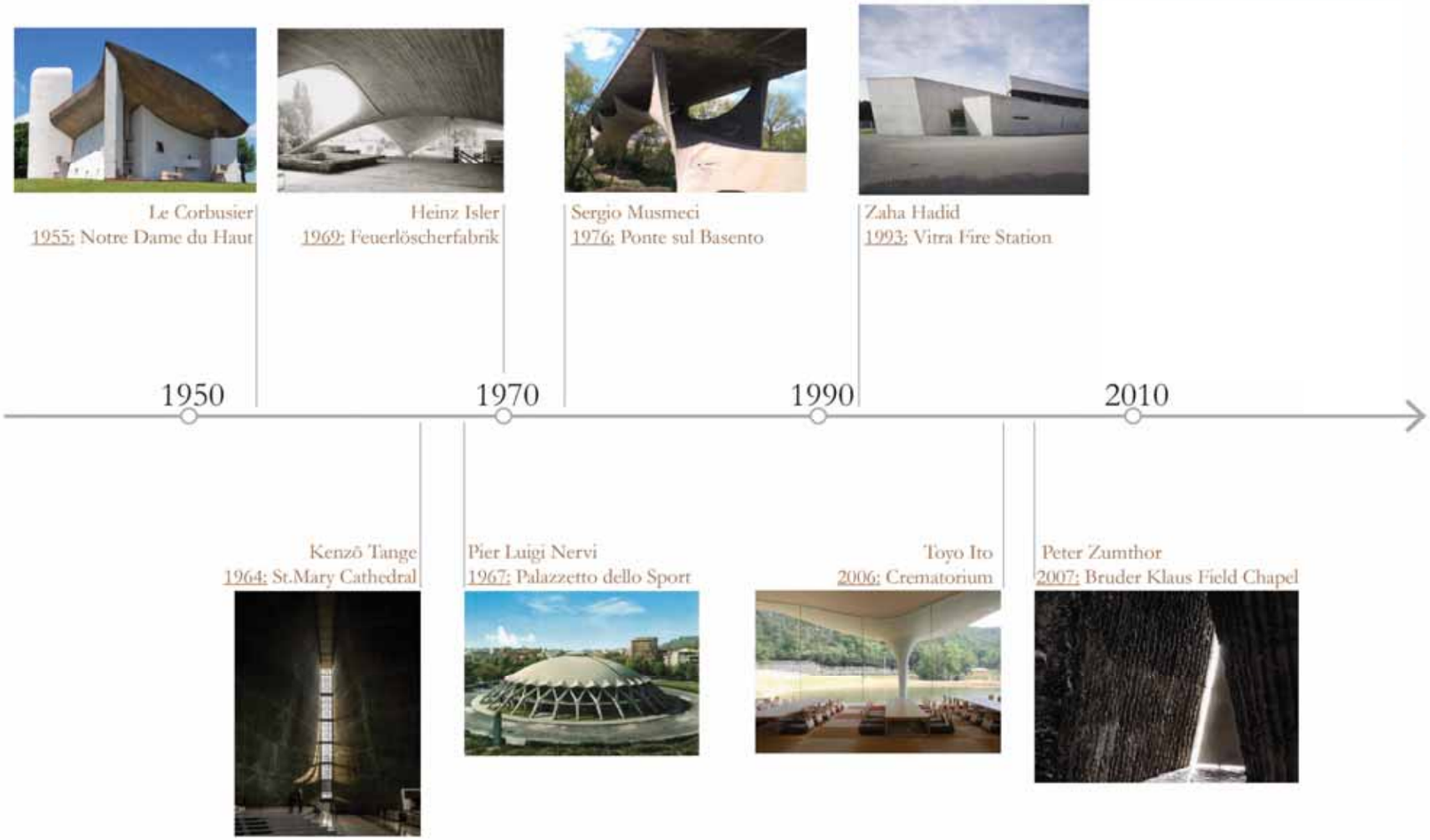
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Peter Zumthor
2007: Bruder Klaus Field Chapel
Concrete

Functionally integrated funicular floor for NEST HiLo, 2019, Block Research Group

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Block Research Group
2017: 3D-printed floor system

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Concrete

Stahlbeton
Reinforced Concrete


© Beard
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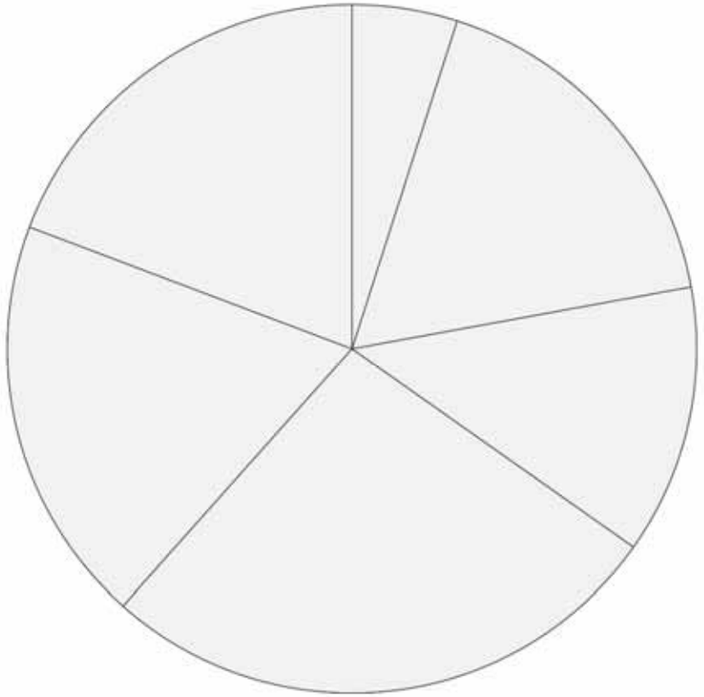
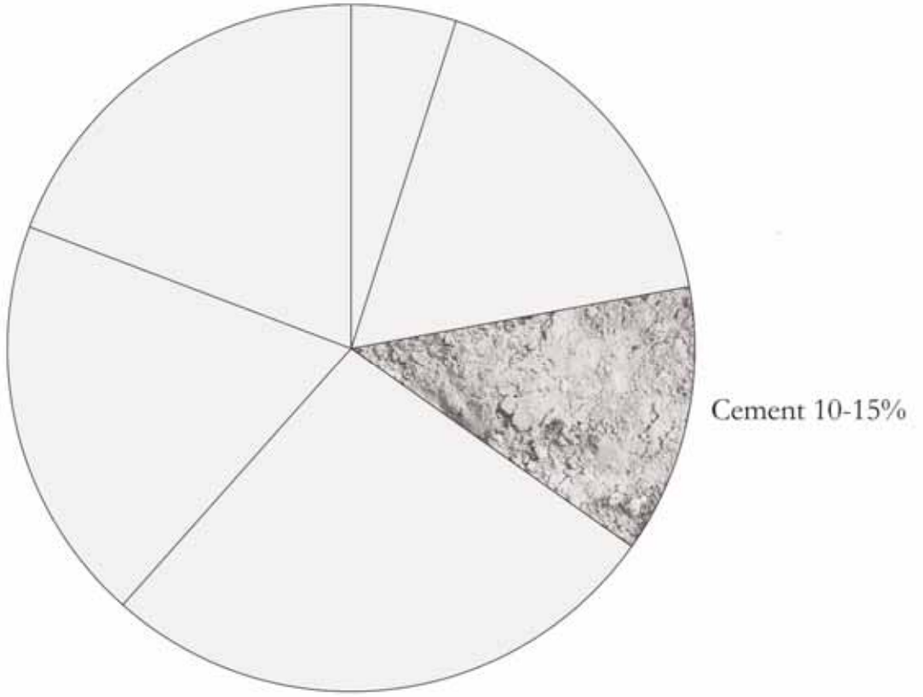


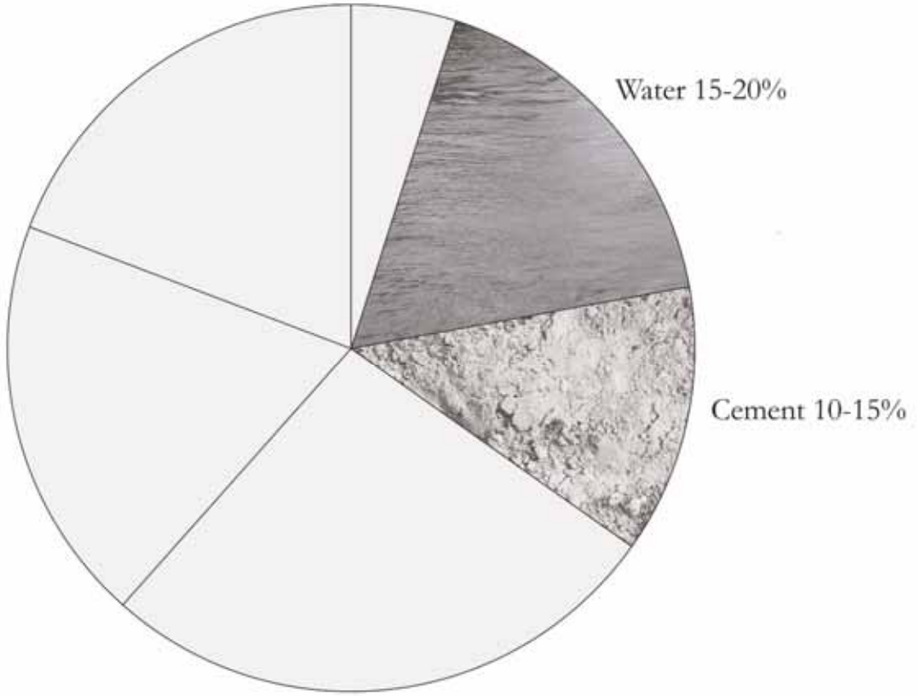
Zusammensetzung des Betons
Concrete composition



- Hydraulischer Zement (meist Portlandzement): chemische Reaktion zwischen trockenen Bestandteilen und Wasser
  Hydraulic cement (most common Portland cement): chemical reaction between dry ingredient and water

- Gemisch aus Kalkstein und Ton (Zementklinker)
  Mixture of limestone and clay (cement clinker)

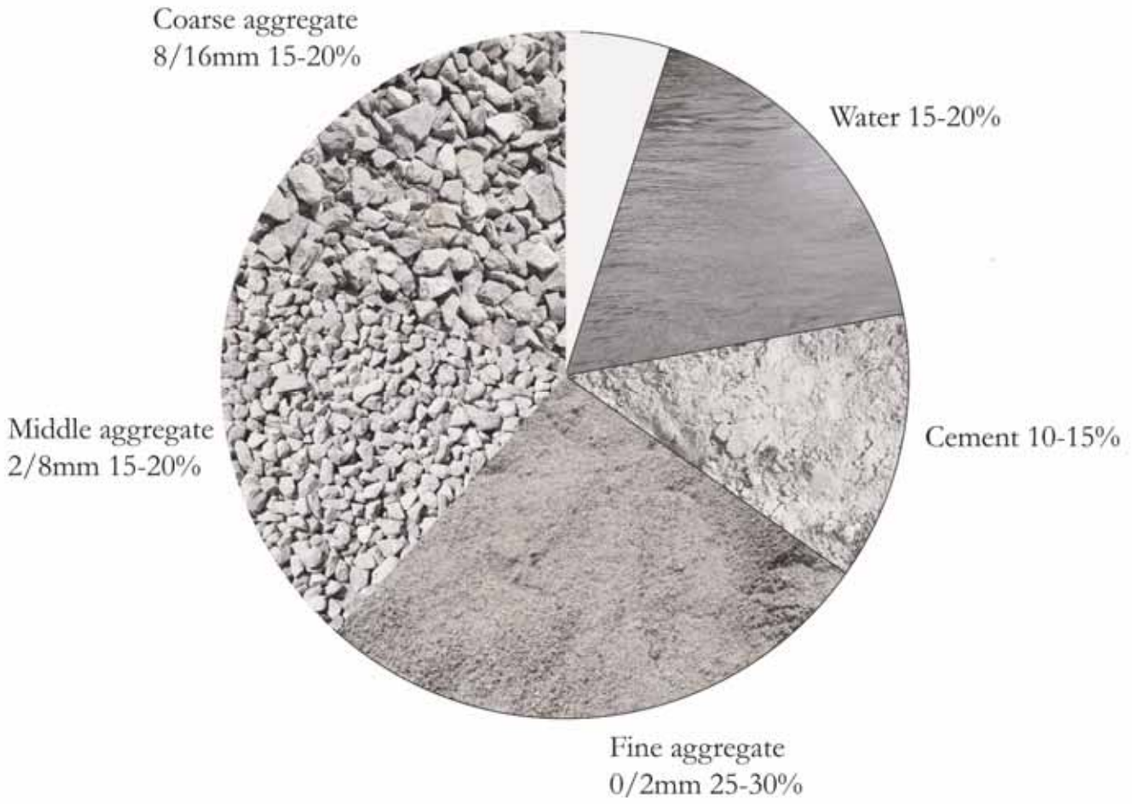
Zusammensetzung des Betons
Concrete composition



- Bearbeitbarkeit
  Workability

- Chemische Reaktion zwischen trockenen Bestandteilen und Wasser
  Chemical reaction between dry ingredient and water

Zusammensetzung des Betons
Concrete composition

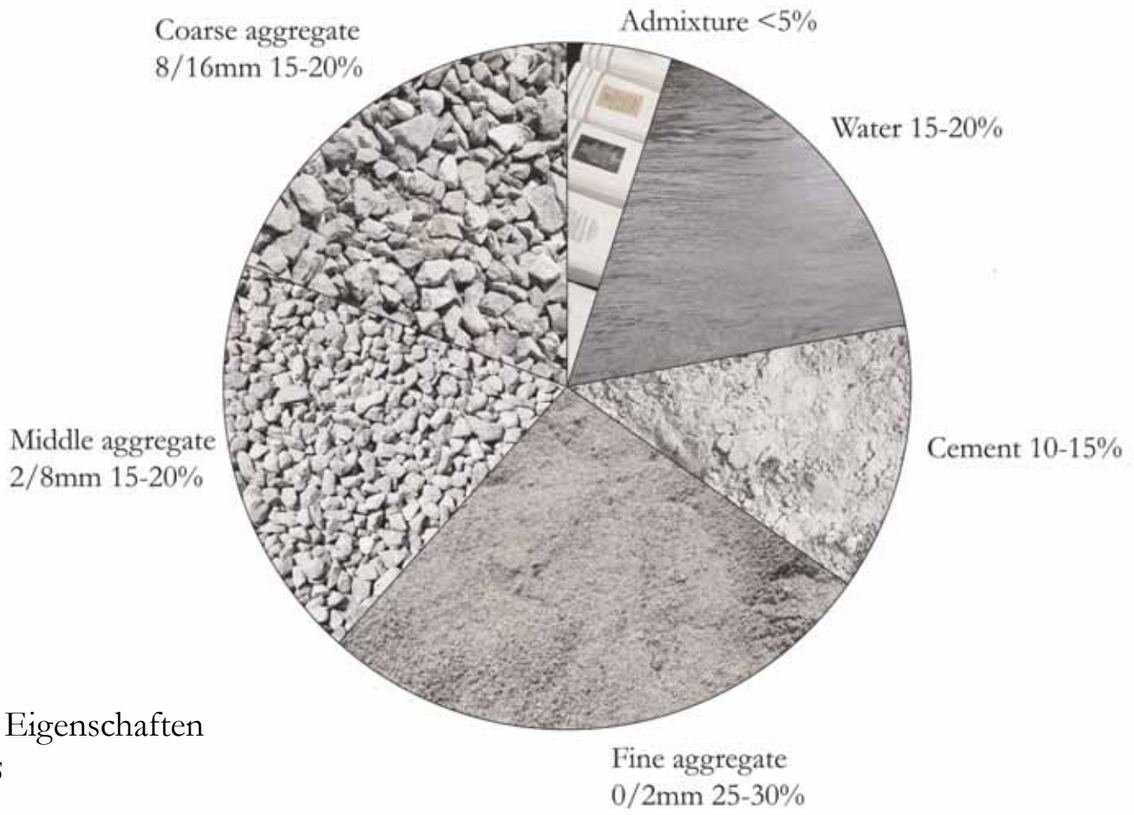


- Bearbeitbarkeit
  Workability

- Dichte von Beton
  Density of concrete

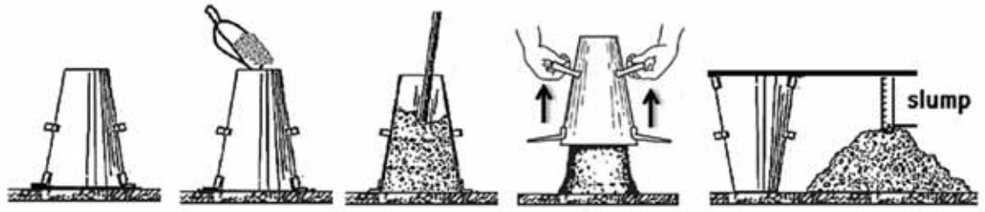
- Chemische Reaktion zwischen trockenen Bestandteilen und Wasser
  No segregation of the mixture

Zusammensetzung des Betons
Concrete composition

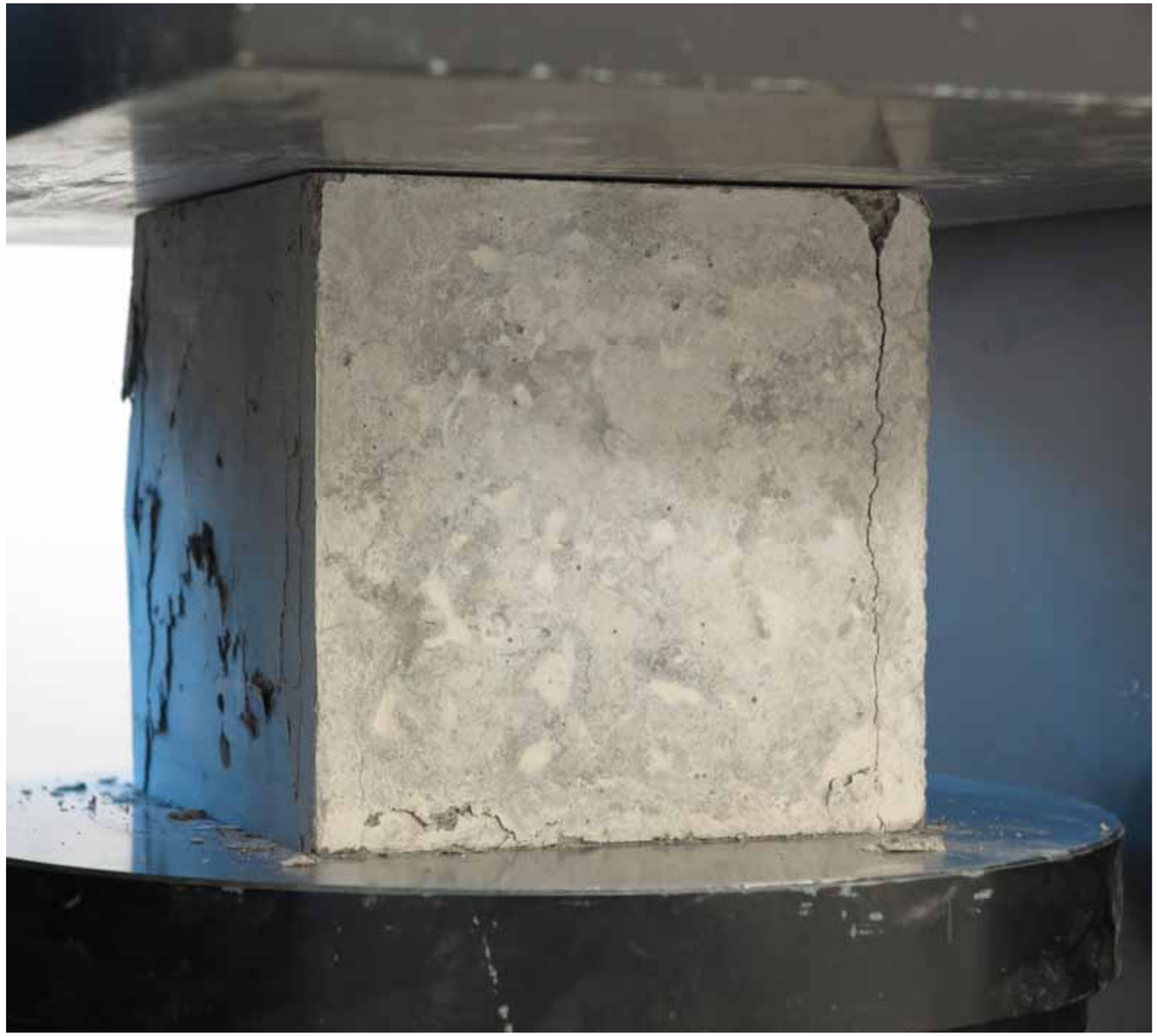


- Bearbeitbarkeit
  Workability
- Verbesserung der mechanischen Eigenschaften
  Improvement of mechanical properties
- Dichte des Betons
  Density of concrete
- Verringerung der Wärmeentwicklung während des Aushärtungsprozesses
  Reduction of heat during the curing process

Zusammensetzung des Betons
Concrete composition

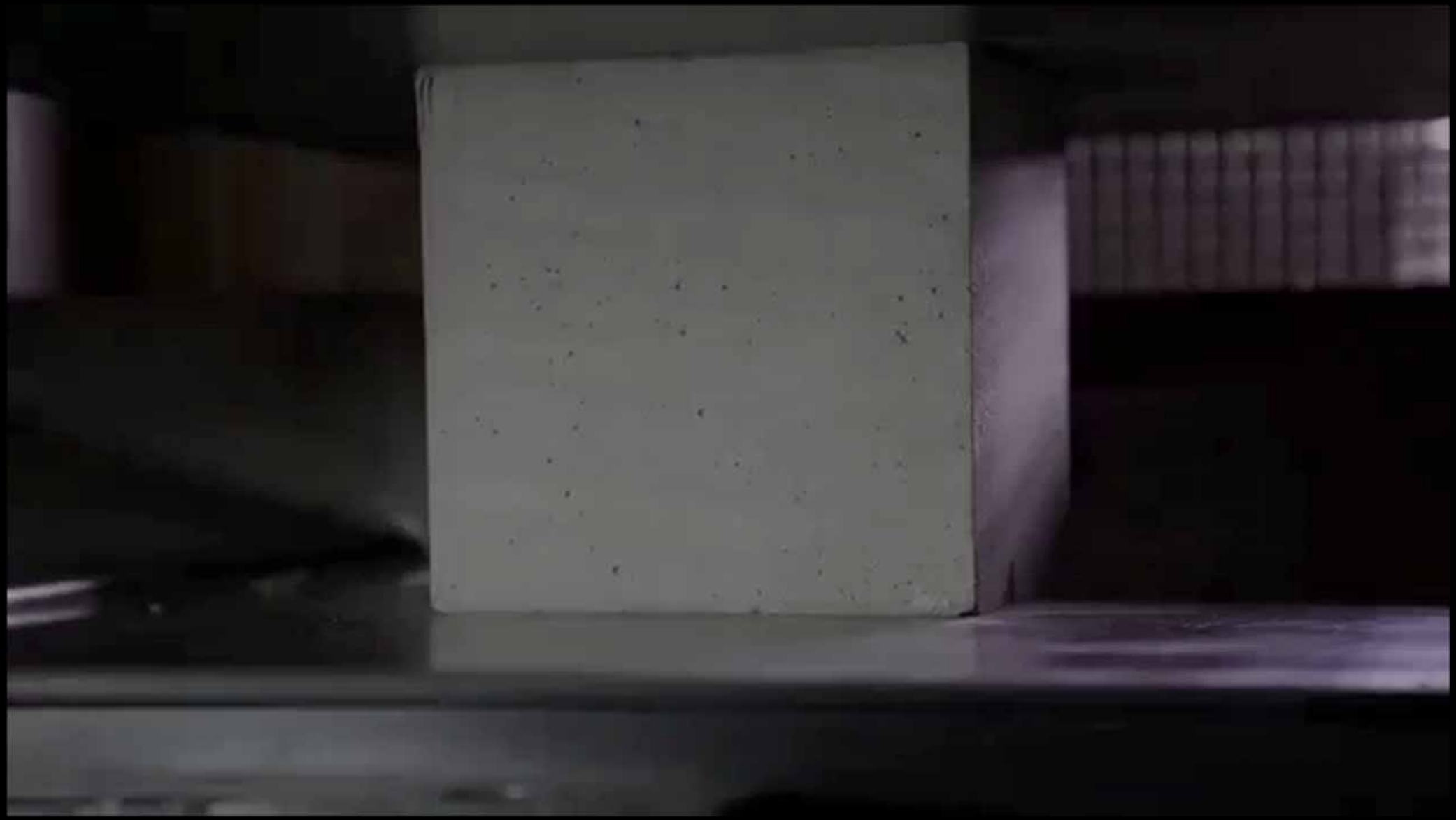


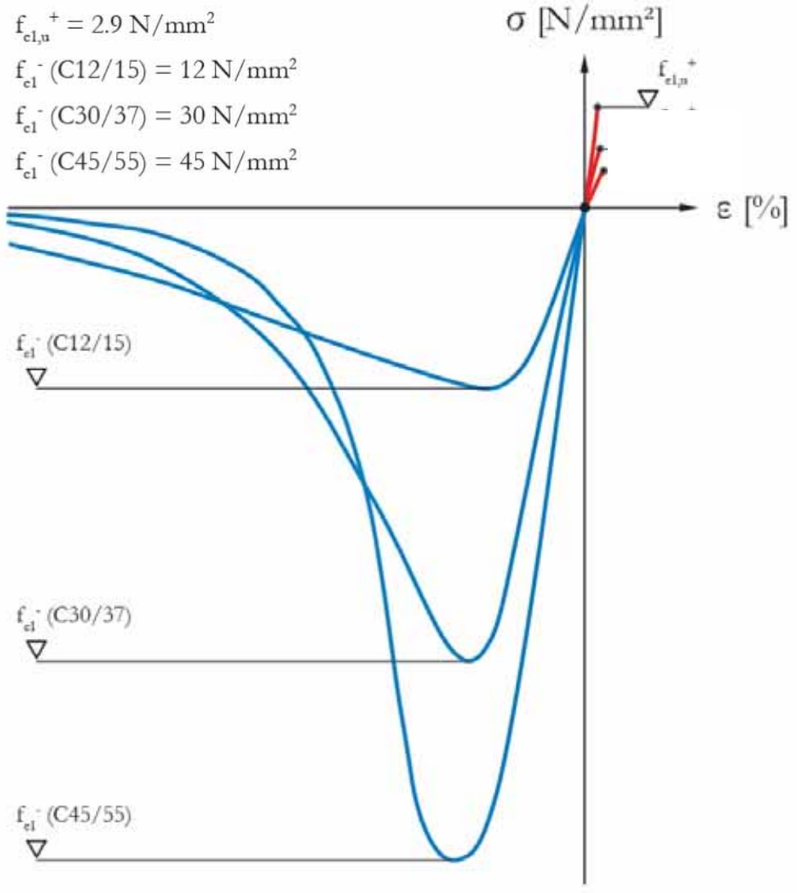
Prüfung der Konsistenz des Betons (Setzverhalten)
Concrete slump test



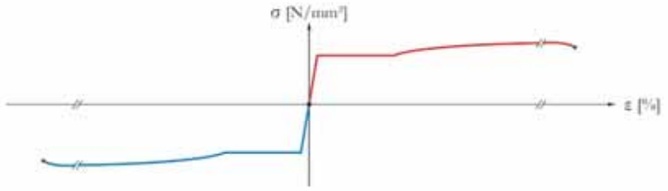
Druckversuch am Betonwürfel
Compression test

Druckversuch am Betonwürfel
Compression test

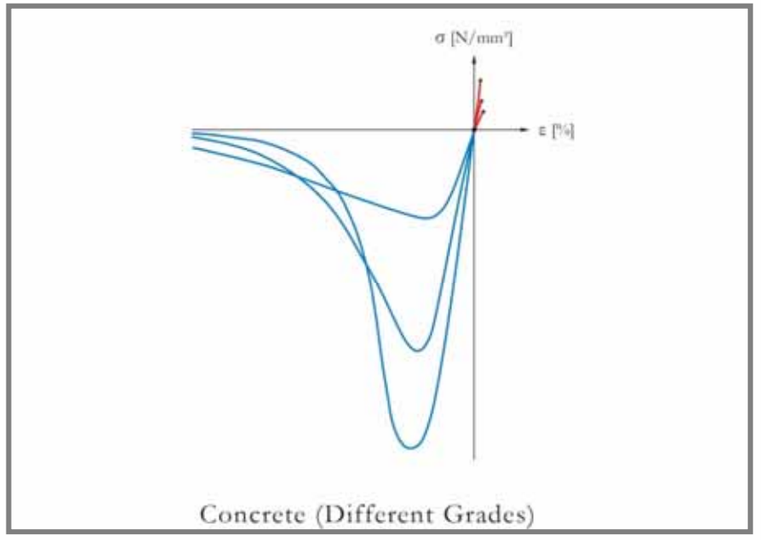




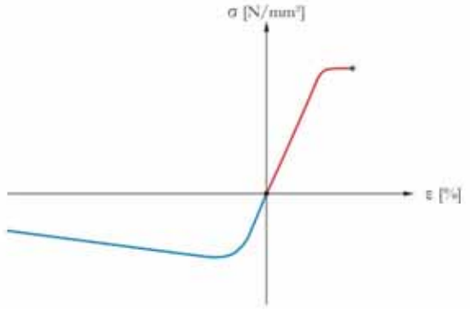
Beton, Spannungs-Dehnungs-Diagramm
Concrete, stress-strain diagram



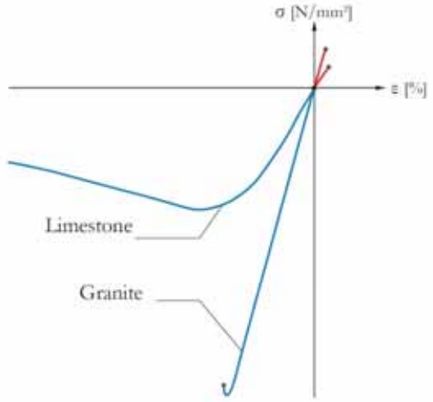
Steel (S235)



Concrete (Different Grades)



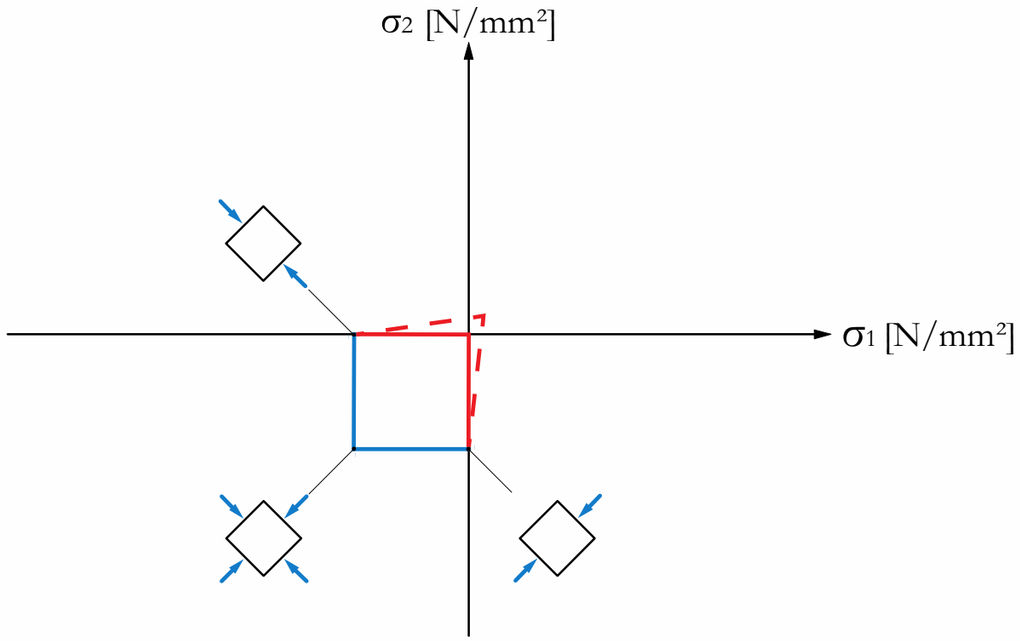
Timber (Fir Wood)

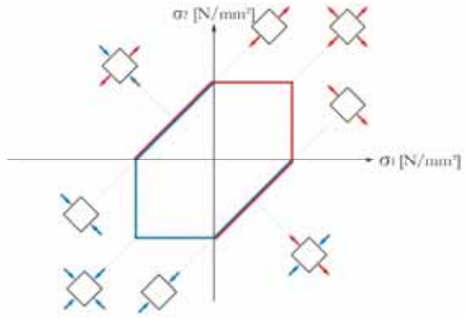


Masonry (Limestone & Granite)

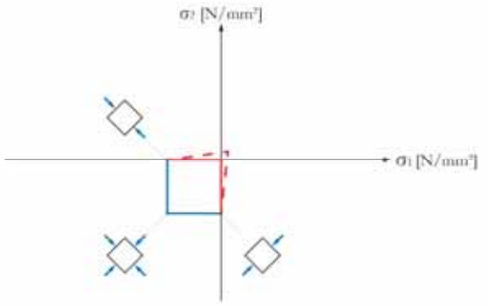
Spannungs-Dehnungs-Diagramm der wichtigsten Baumaterialien
Stress-strain diagrams for the main structural materials


σ1
σ2
Different
Stress directions

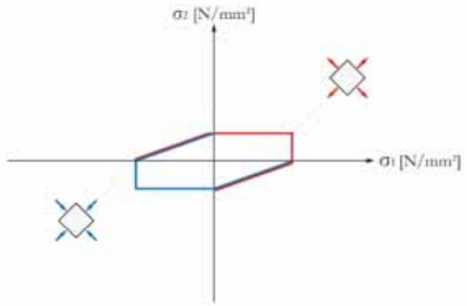

σ2 [N/mm²]
σ1 [N/mm²]



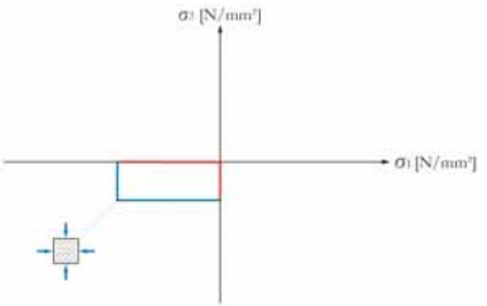
Steel (S235)



Concrete

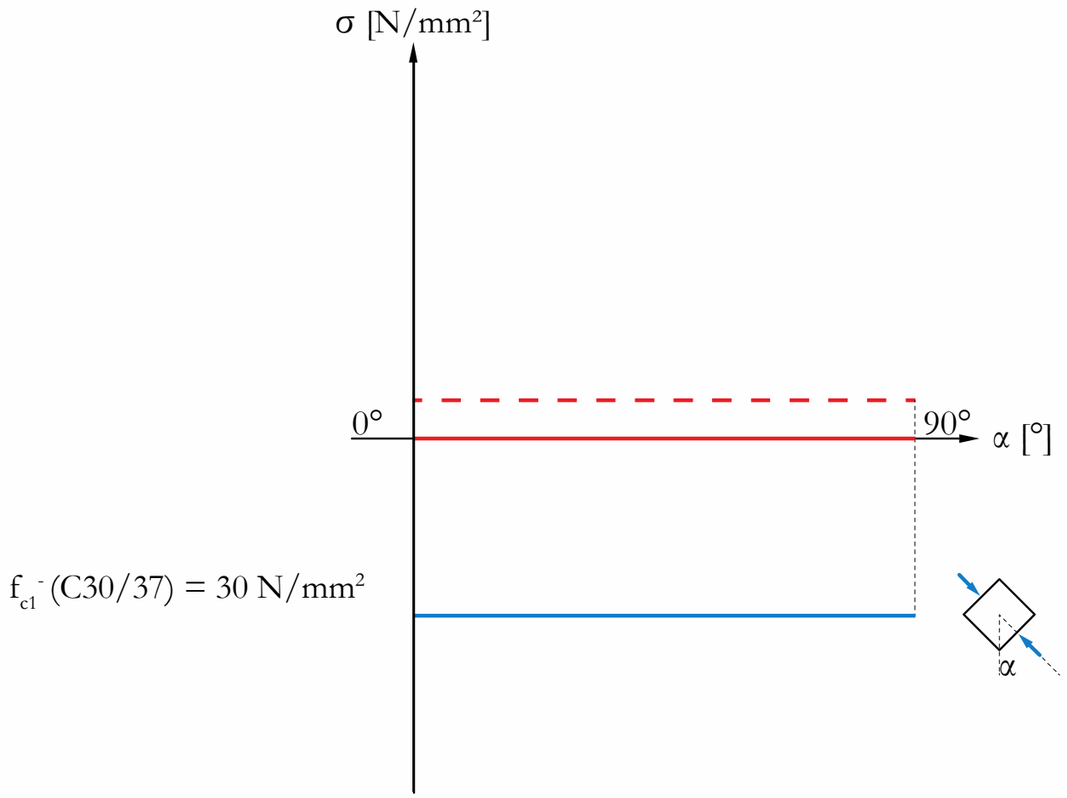


Timber (Fir Wood)

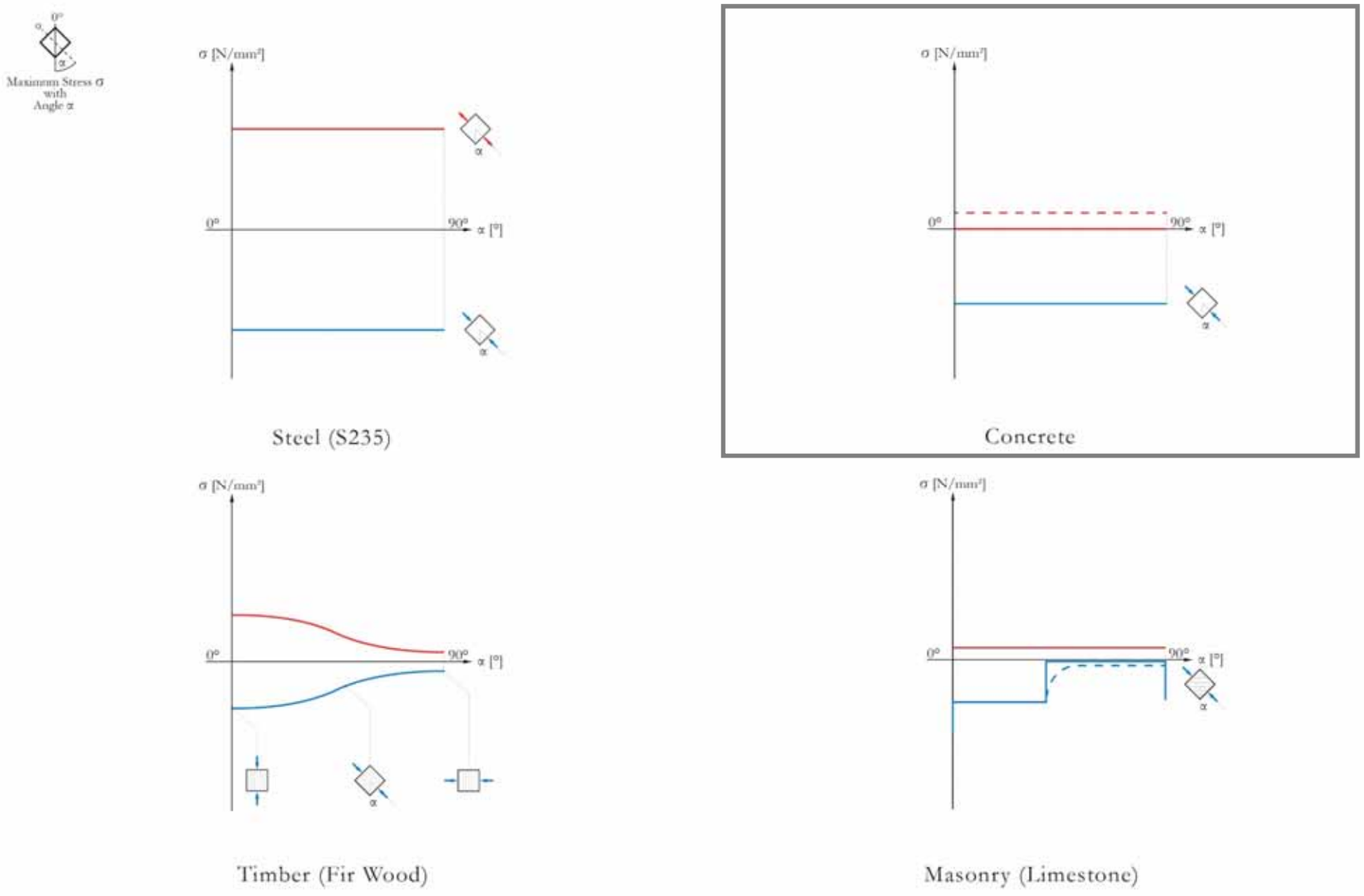


Masonry (Limestone)

Bruchbedingungen für die wichtigste Baumaterialien
Failure criteria for the main structural materials



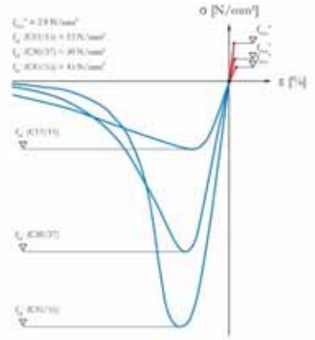
Beton, Veränderung der Festigkeit in Abhängigkeit der Spannungsrichtung
Concrete, strength variation according to the stress angle



Strength variation according to the stress angle

Veränderung der Festigkeit in Abhängigkeit der Spannungsrichtung

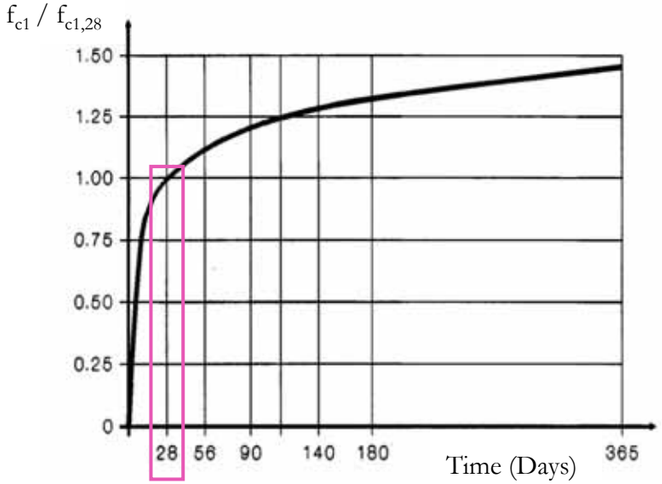
Strength variation according to the stress angle



Concrete type										
C	12/15	16/20	20/25	25/30	30/37	35/45	40/50	45/55	50/60	.../...
LC	12/13	16/18	20/22	25/28	30/33	35/38	40/44	45/50	50/55	.../...
f_c^- [N/mm²]	Cylindric compressive strength									
C/LC	12	16	20	25	30	35	40	45	50	> 50
f_c^+ [N/mm²]	Average tensile strength									
C	1,6	1,9	2,2	2,6	2,9	3,2	3,5	3,8	4,1	> 4,1

Beton	C 12/15	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60	C .../...
$f_{c,d}^-$ [N/mm²]	8,0	10,5	13,5	16,5	20,0	22,0	24,0	26,0	28,0	Gl. (2)

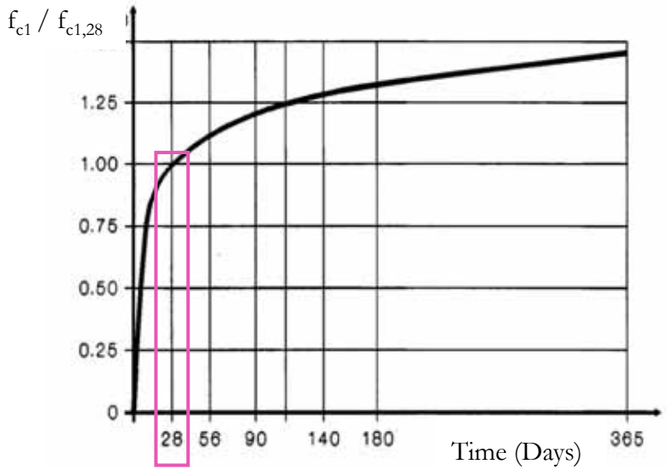
Druck- und Zugfestigkeit von Beton. Charakteristische Werte (oben) und Bemessungswerte (unten) (SIA 262)
Compressive and tensile strength of concrete. Characteristic values (above) and design values (below) (SIA 262)

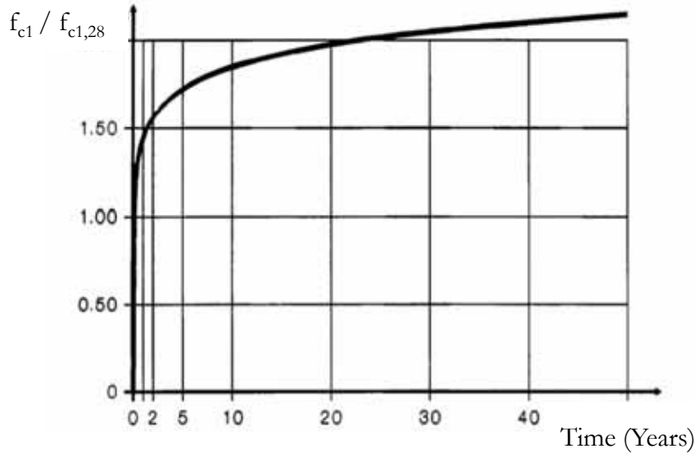


f_{c1} = compressive strength

$f_{c1,28}$ compressive strength 28 days after pouring

Veränderung der Betondruckfestigkeit in Funktion der Zeit
Variation of concrete compressive strength over time





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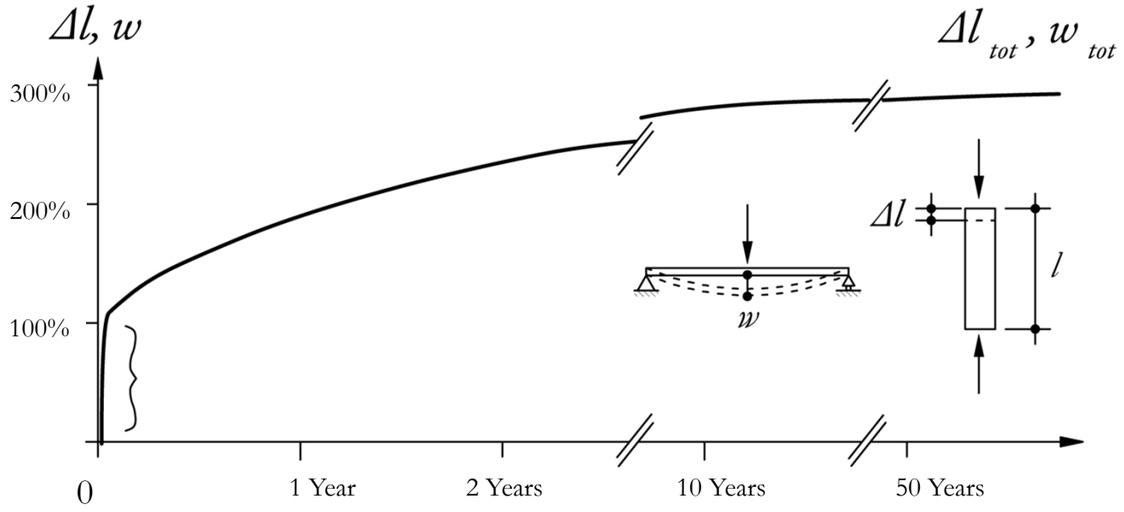
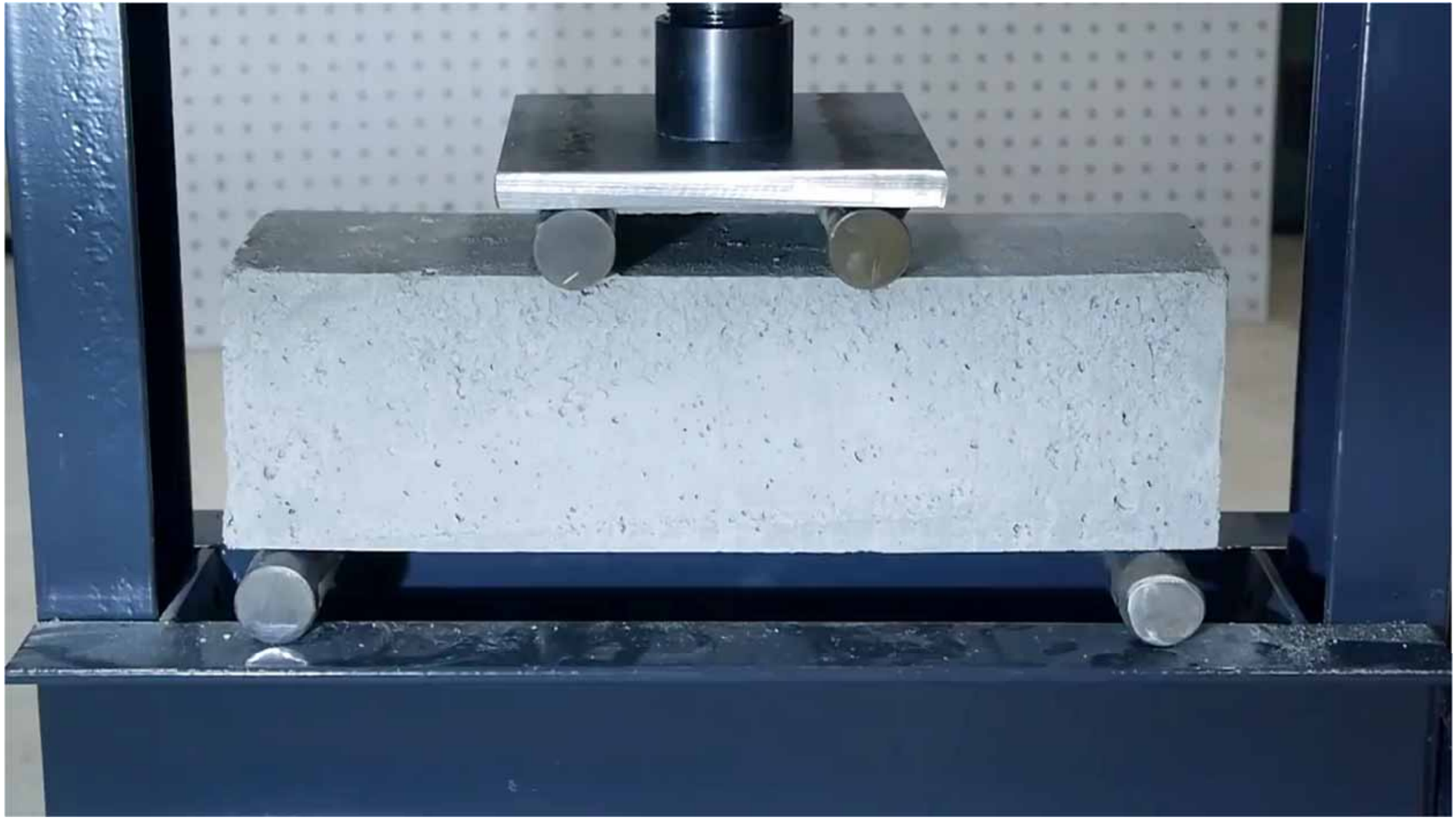
Veränderung der Betondruckfestigkeit in Funktion der Zeit
Variation of concrete compressive strength over time



Langzeit-Verformungen (Kriechen)
Long-term deformation (creep)



Biegeversuch
Bending test

Smooth rebar
10 mm

Threaded rebar
12 mm

Threaded rebar
24 mm

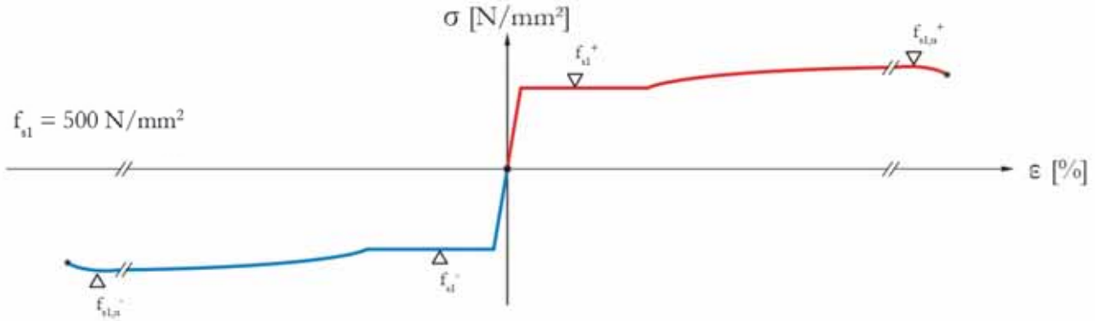
Threaded rebar
40 mm

Herkömmlicher Betonstahl (Bewehrungsstäbe)

Conventional Steel rebars (reinforcing bars)

Live Demo
Bewehrungsstäbe
Steel Rebars

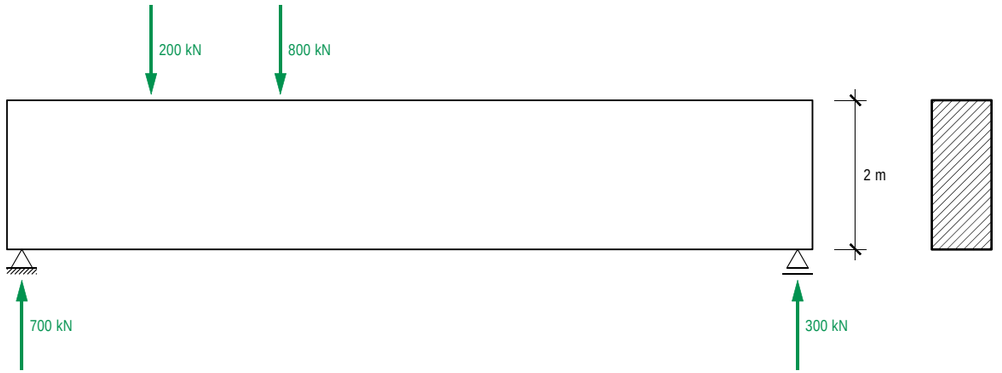
Stahlbewehrung einer Decke
Steel reinforcement for a slab

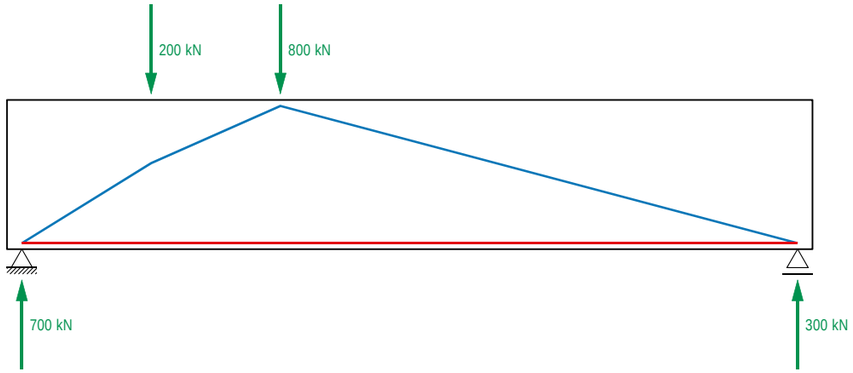


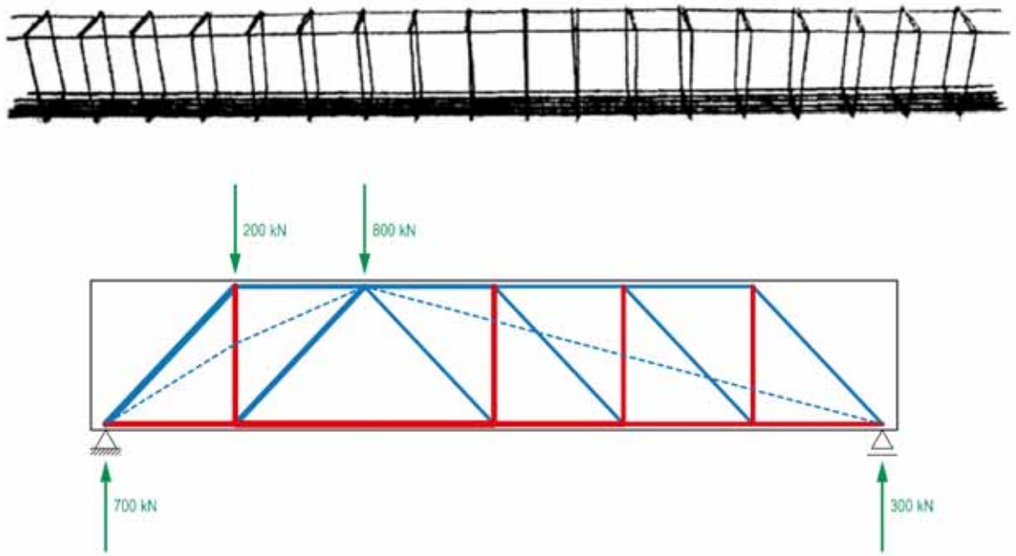
Steel Type	**Use**	**f_{s1} [N / mm²]**
B500A	Roll, Mesh	500
B500B	Rebar, Roll, Mesh	500
B450C	Rebar, Roll, Mesh	≥ 450 ≤ 550

Verschiedene Stahlsorten für die Bewehrung
Different steel types for reinforcement

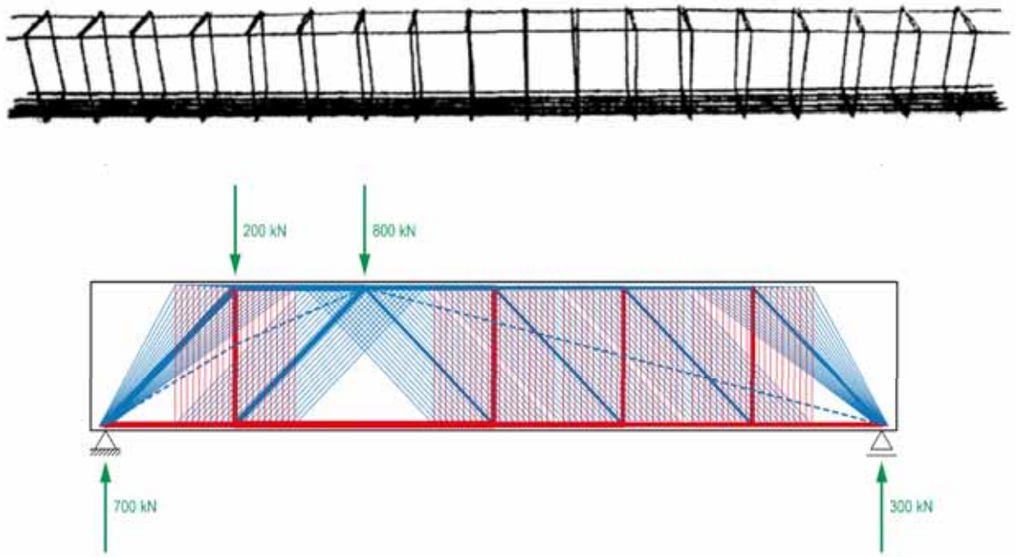
+


200 kN
800 kN
2 m
700 kN
300 kN

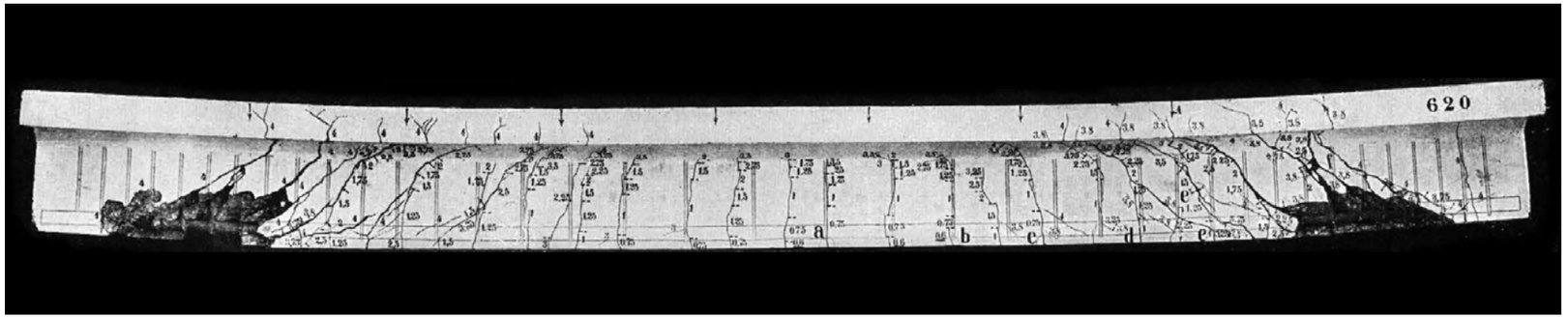

200 kN
800 kN
700 kN
300 kN



Fachwerkmodell für Stahlbetonträger
Truss Model for Reinforced Concrete Beam



Fachwerkmodell für Stahlbetonträger
Truss Model for Reinforced Concrete Beam



Stahlbetonträger bei Versagen
Reinforced Concrete Beam at Failure

Stahlbeton
Reinforced Concrete

Einführung
Introduction

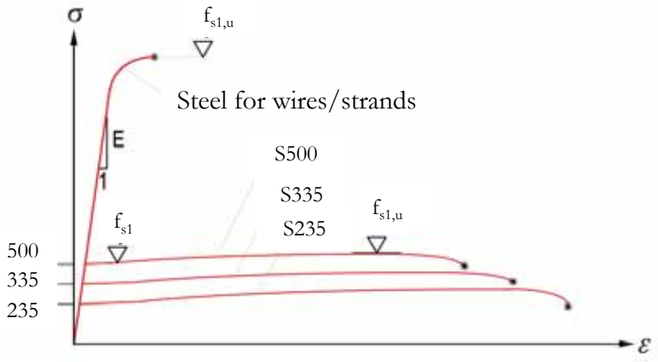
Mechanische Eigenschaften
Mechanical Properties

>> Bautechnologie
Building Technologies

Fallstudie: Palestra Doppia
Case Study: Palestra Doppia

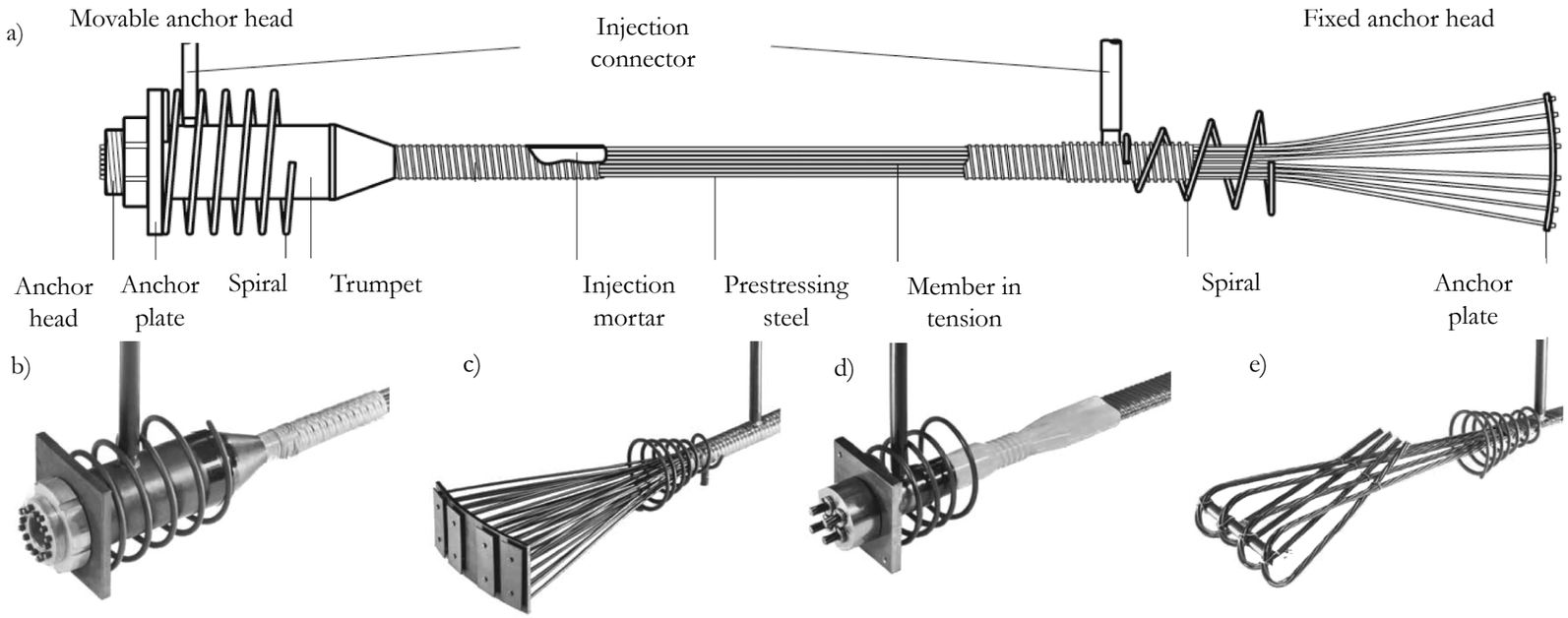
Ausgewählte Projekte
Selected Projects

Vorspannung von Spanngliedern
Post-tensioning tendons



Steel Type	$F_{s1,d}$ [N / mm²]
Y1860	1390
Y1770	1320
Y1670	1250
Y1570	1130
Y1230	940
Y1100	780
Y1030	720

Mechanische Eigenschaften verschiedener Baustahlsorten für Vorspannungen
Mechanical properties of different structural steel types for prestressing



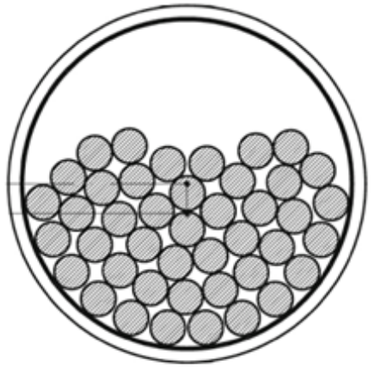
a) Prestressing with wires: fixed anchor head b) and movable anchor head c)

Prestressing with strands: fixed anchor head d) and movable anchor head e)

Spannglied für Vorspannung
Post-tensioning tendon

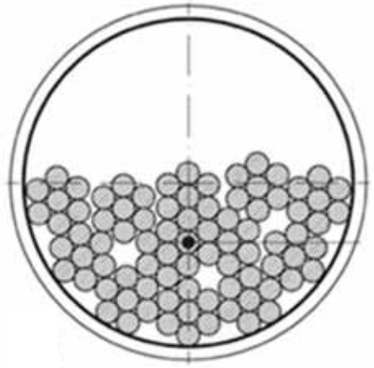
Cold drawn steel,
round prestressing steel with smooth surface

Nominal diameter		ø 7 mm
Cross section surface	A_p	38.48 mm^2
Yield strength	$f_{p,d}$	1250 N/mm^2



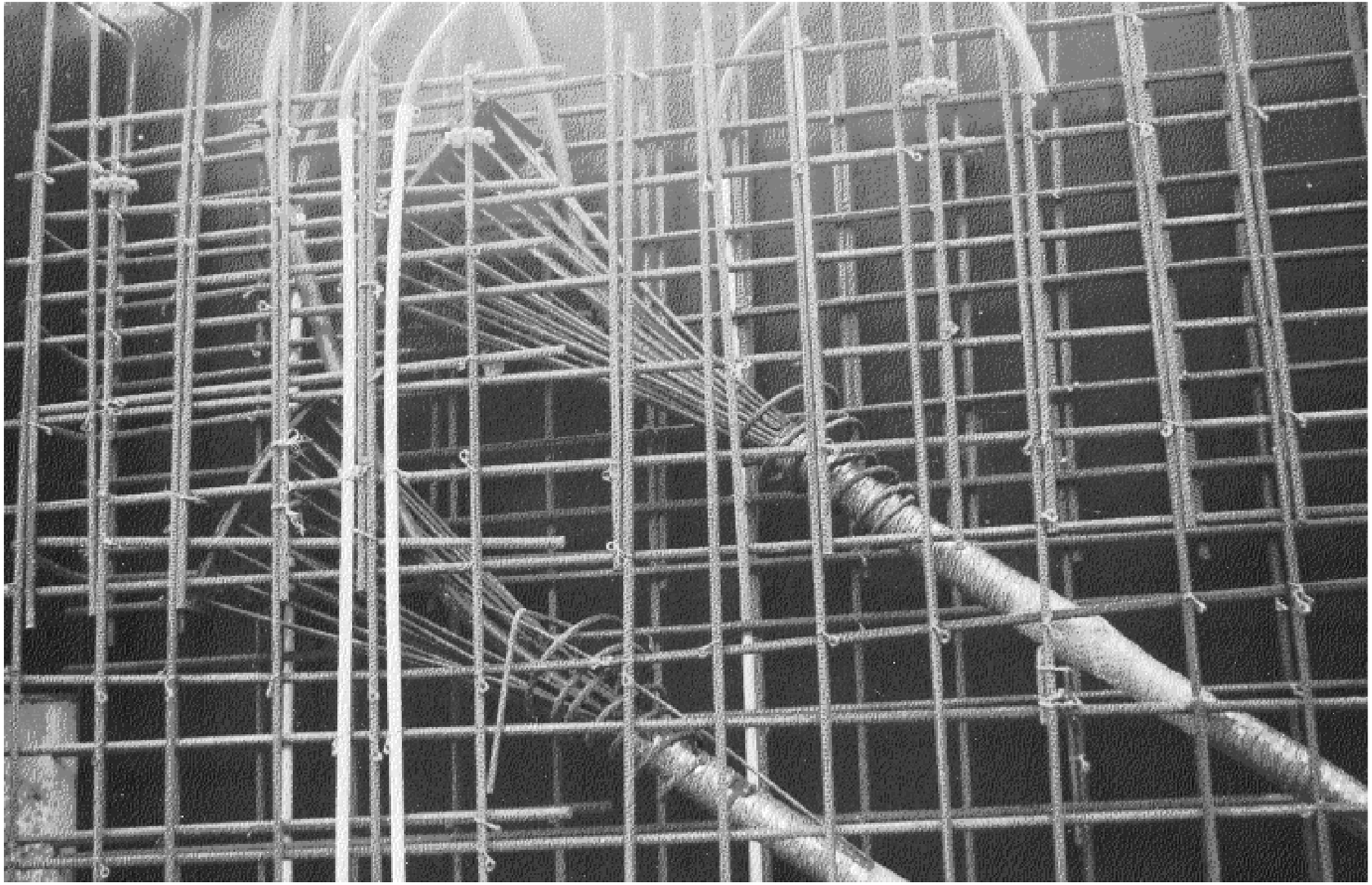
Prestressing steel wires,
Twisted together from 7 wires

Nominal diameter	ø	15.7 mm
Cross section surface	A_p	150 mm^2
Yield strength	$f_{p,d}$	1320 N/mm^2

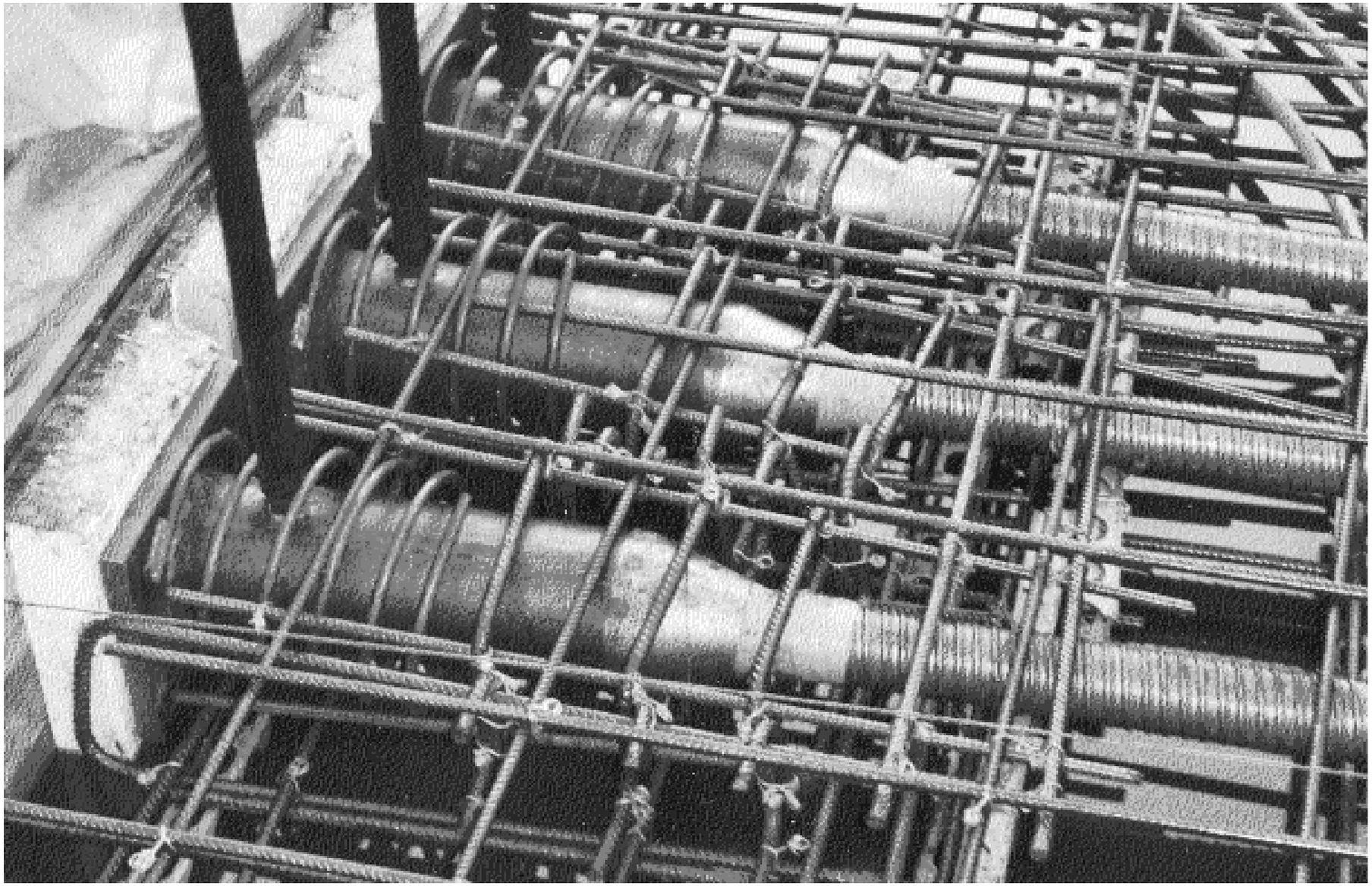


Vorspannen mit Drähten - Einzeldraht
Prestressing with strands – single strand

Vorspannen mit hydraulischem Pressen.
Prestressing with hydraulic jack



Vorspannen mit Drähten: fester Ankerkopf
Post-tensioning with wires: fixed anchor head

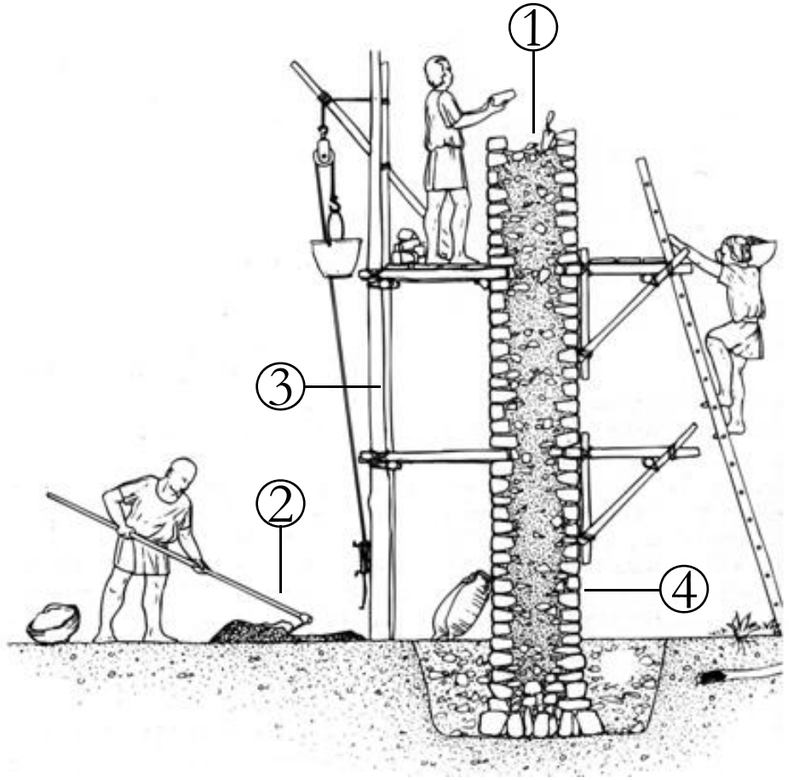


Vorspannen mit Drähten: beweglicher Ankerkopf
Post-tensioning with wires: movable anchor head

Vorgefertigte und vorgespannte Betonbalken

Precast and pre-tensioned concrete beams

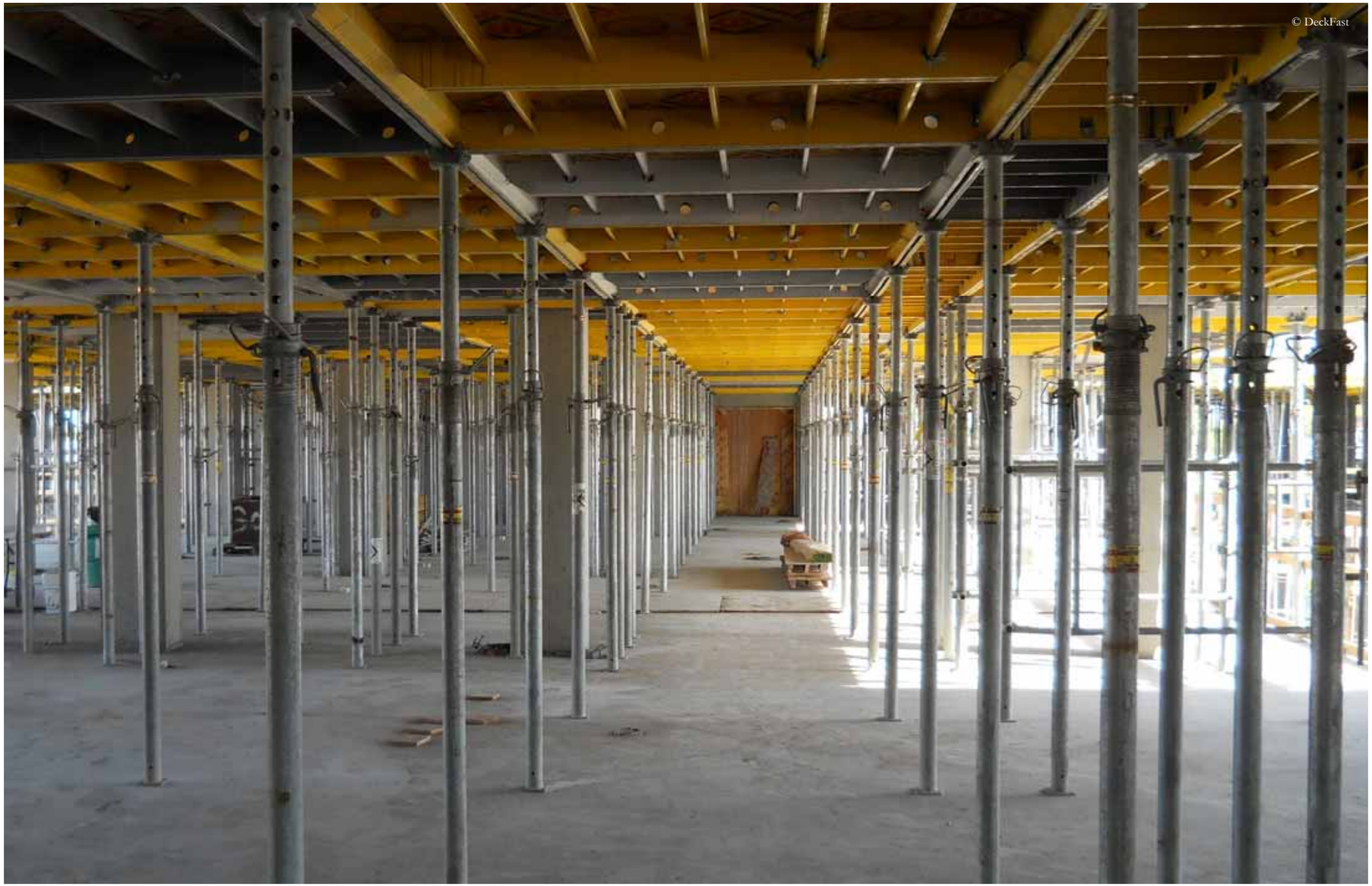
Vorgefertigte Betonbalken
Precast concrete slab components



1 Opus Caementitium
2 Preparation of the mortar
3 Scaffolding
4 Formwork (masonry walls)

Opus caementitium

Wiederverwendbare Schalung für Wände
Reusable formwork for walls



Schalungen und provisorische Stützen für Betonbodenplatten

Formwork and temporary supports for concrete floor slabs

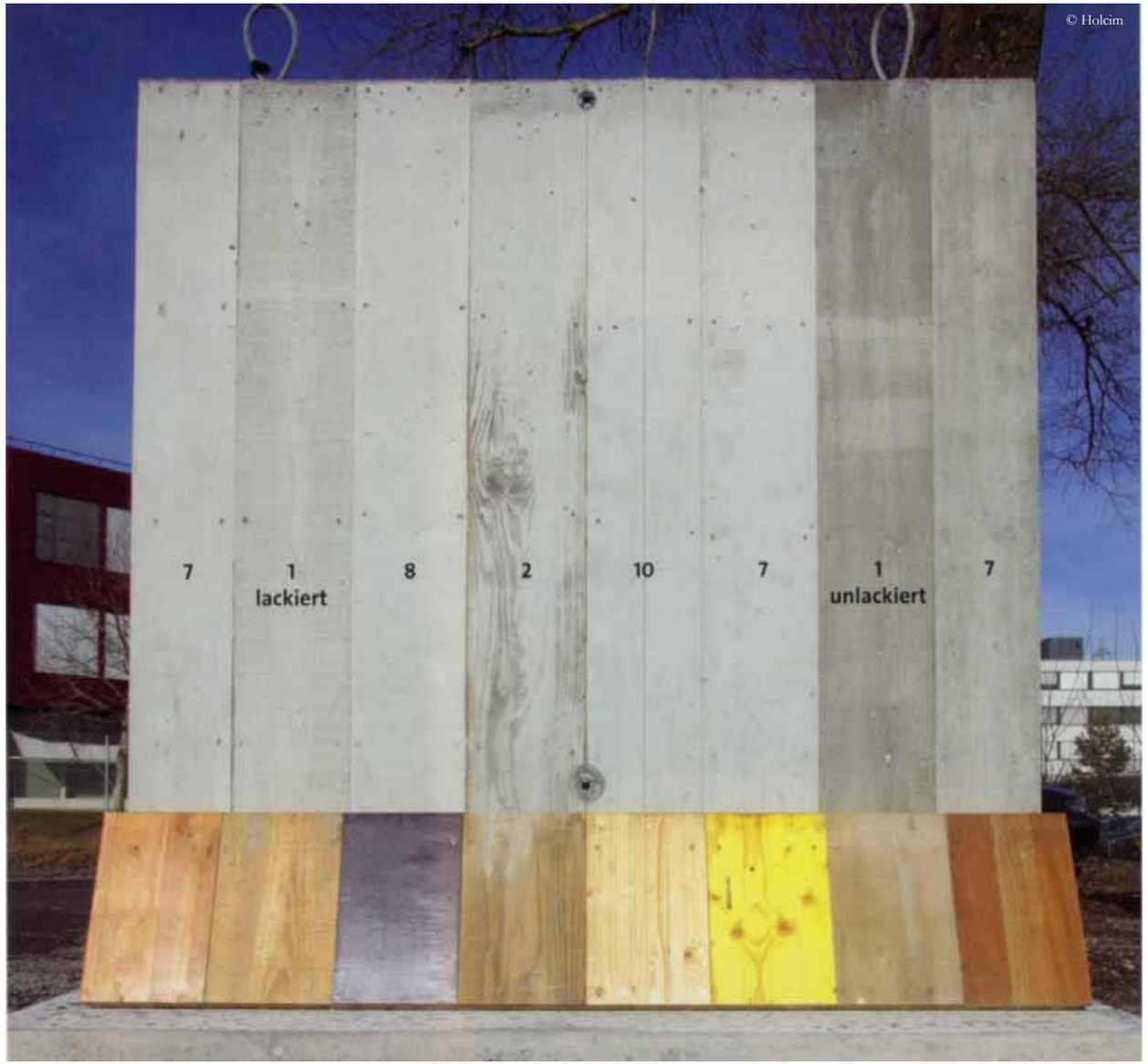
Spezielle Schalungen
Special formwork

Betongießen
Concrete pouring

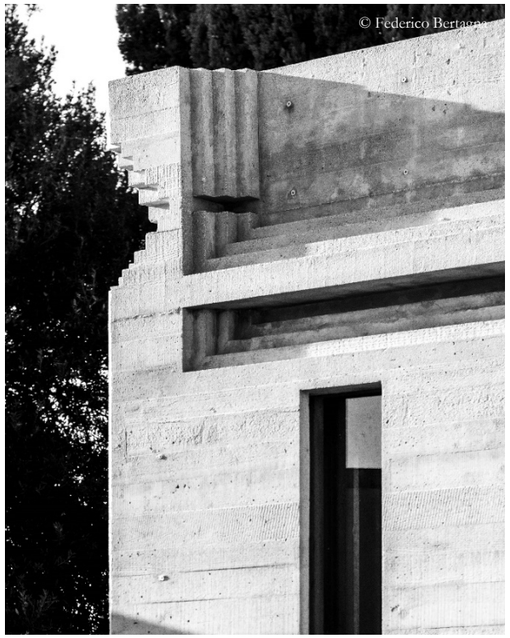
Flexible formwork system (HiLo, 2017, Block Research Group)

Shotcrete (HiLo, 2017, Block Research Group)

Flexible formwork system (HiLo, 2017, Block Research Group)



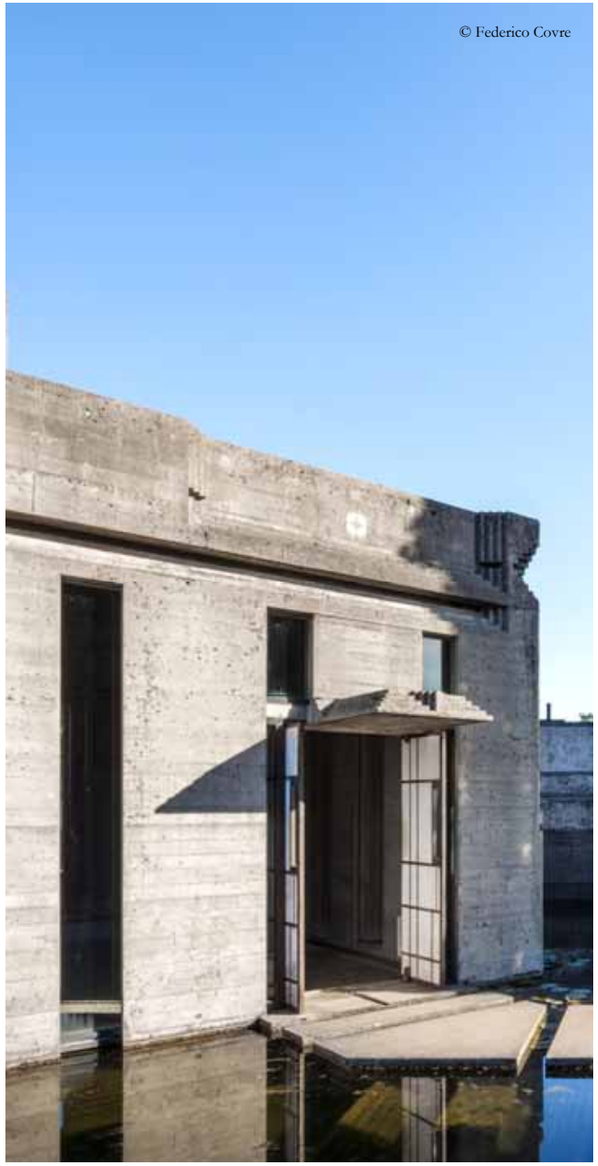
Schalungstypologien und die daraus resultierenden Oberflächen
Formwork typologies and their resulting surfaces



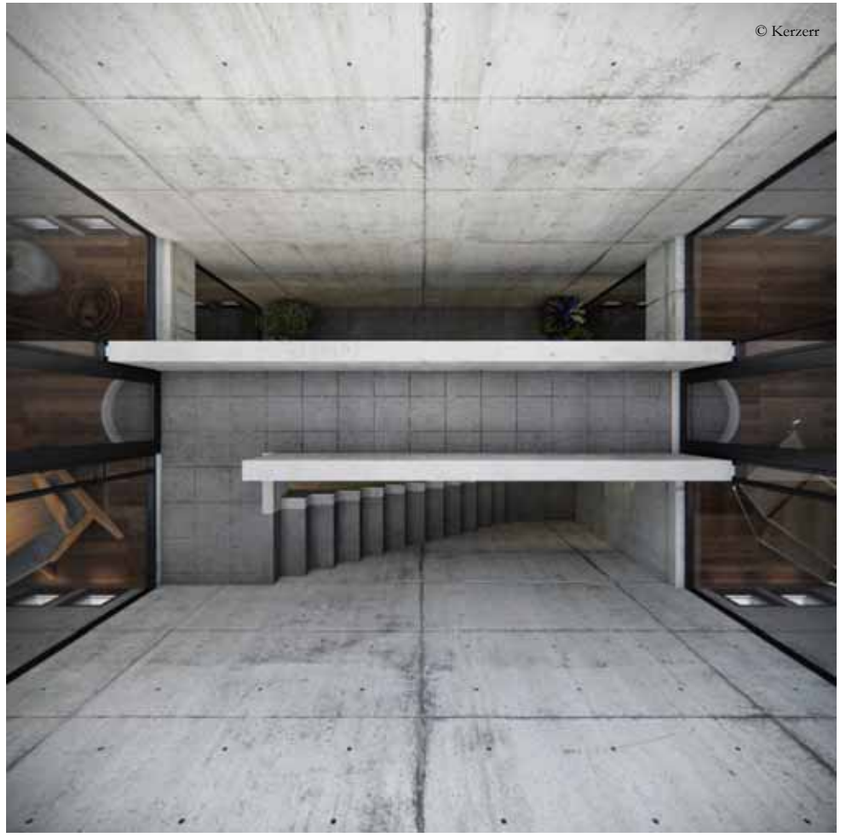
Grob
Rough

Uniform
Uniform

Poliert
Polished



Brion cemetery, San Vito d'Altivole, 1978, arch. Carlo Scarpa



Azuma House, Osaka, 1976, arch. Tadao Ando

Kunstmuseum Lichtenstein, Vaduz, 2000, arch. Morger, & Degelo, Christian Kerez, eng. Frey & Schwartz

Surface polishing (Kunstmuseum Lichtenstein, 2000, arch. Morger, & Degelo, Christian Kerez, eng. Frey & Schwartz

Karbonisierung des Betons
Carbonation

Karbonisierung (Ponte sul Basento, 1976, Sergio Musmeci)
Carbonation (Ponte sul Basento, 1976, Sergio Musmeci)

Karbonatisierung an einer Stahlbetonstütze
Carbonation on a reinforced concrete column

Betonabtrag mittels
Hydrojetting-Technik
Hydro demolition

Chemische Verbindungen
Chemical compounds

Ersatz von Bewehrungsstäben
Rebars substitution

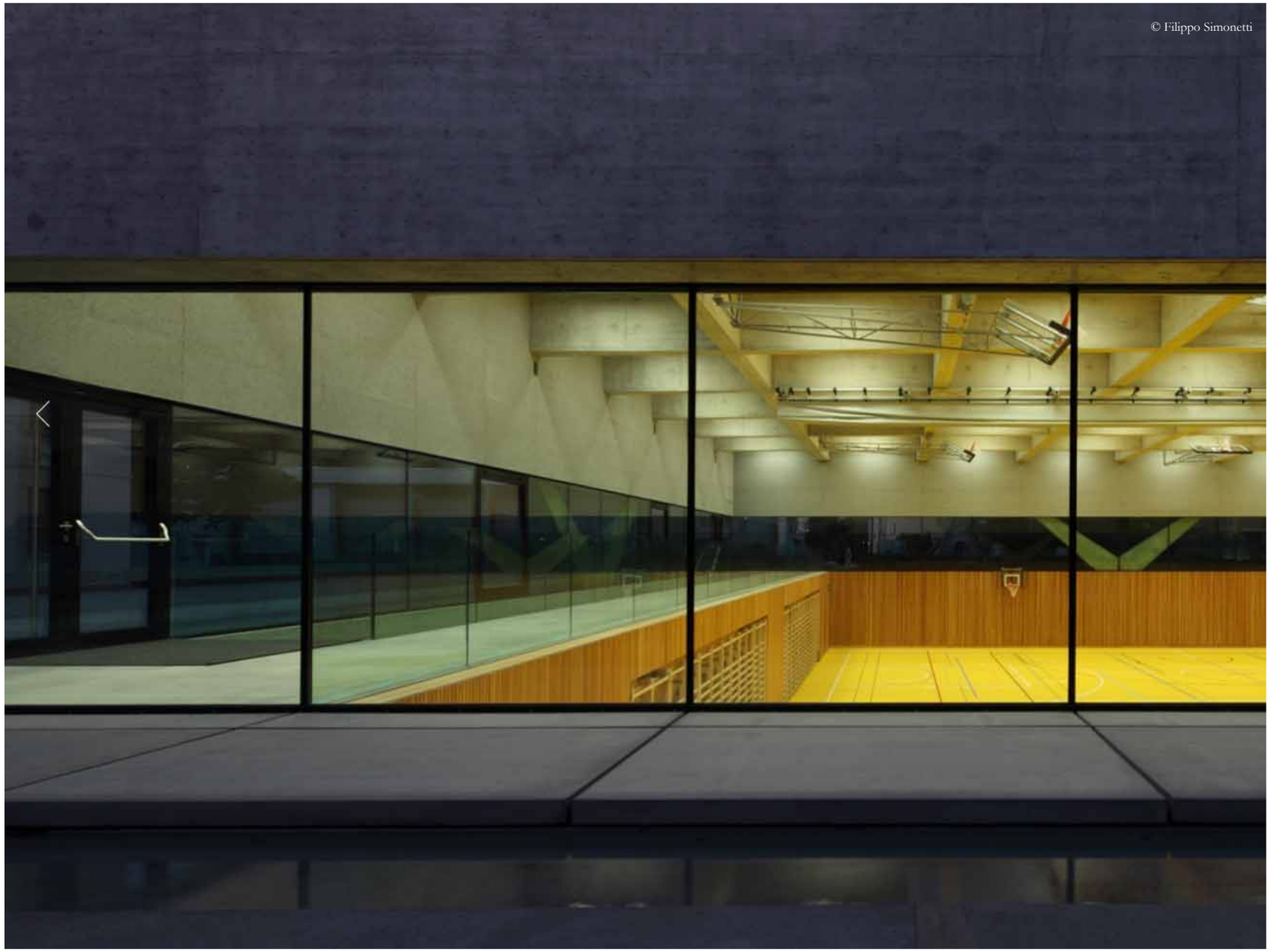
Stahlbeton
Reinforced Concrete

Palestra Doppia

Chiasso, 2011

Architect: Baserga Mozzetti

Engineer: Pedrazzini Guidotti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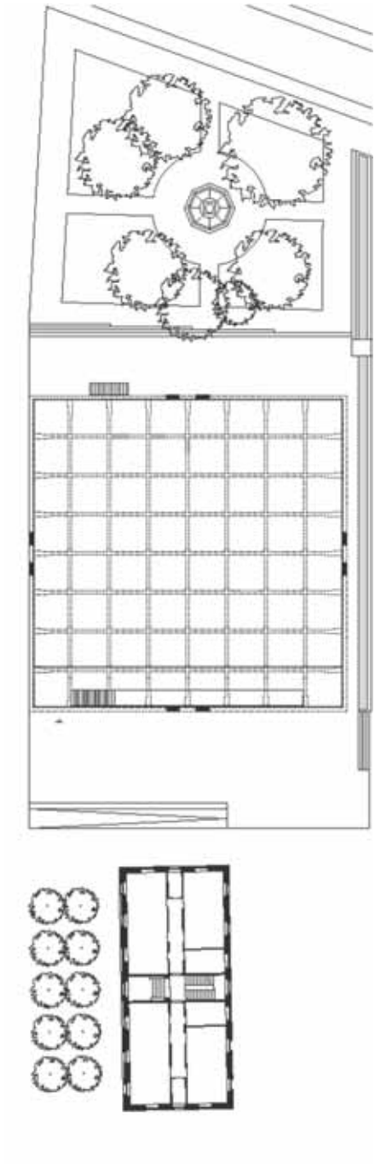
"To express [the] duality between the plinth and the main body of the building, the volume of the hall is detached from the plinth and suspended above it by a clear structure supported on four single bearing points."

Mario Rinke

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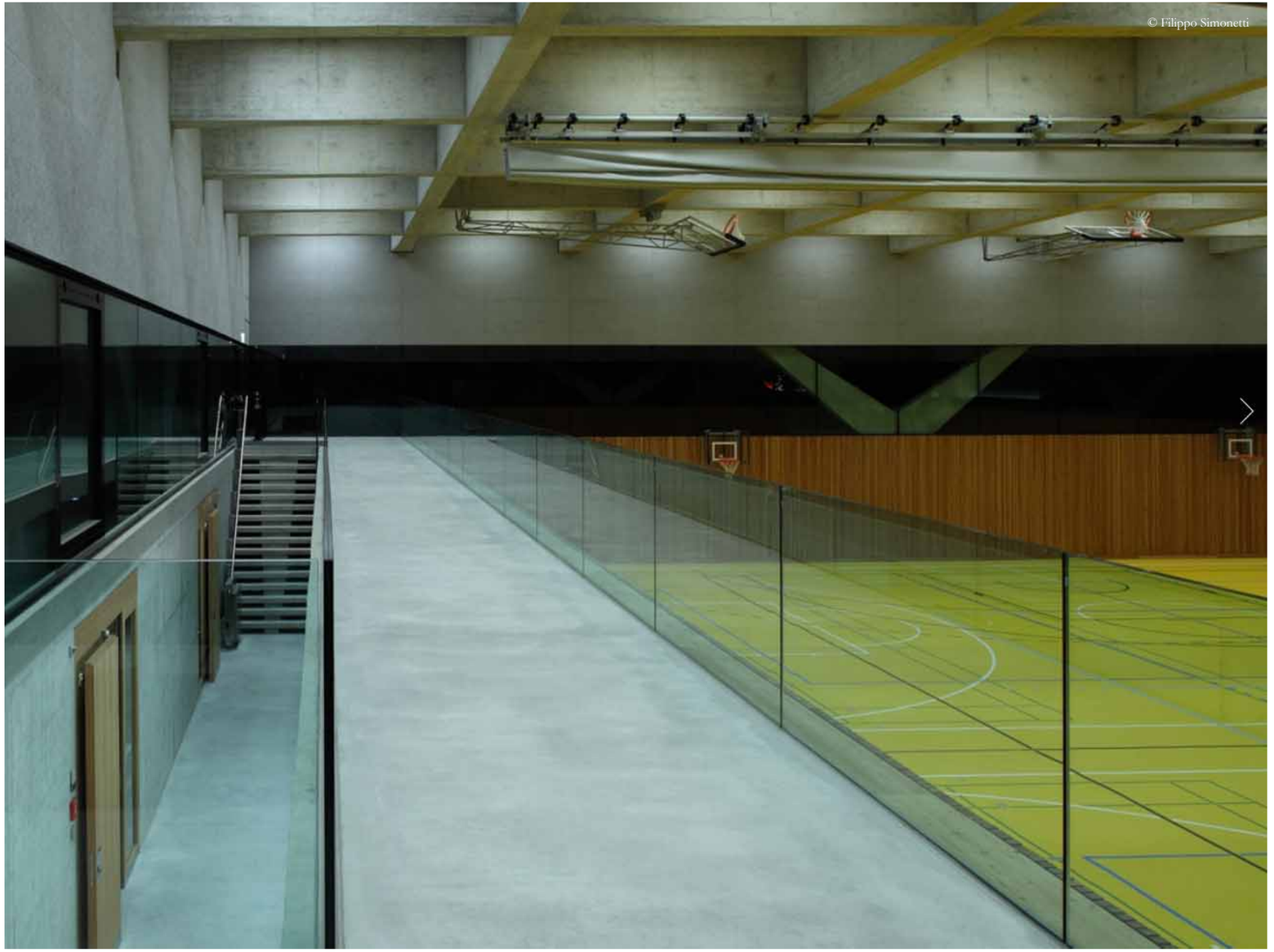
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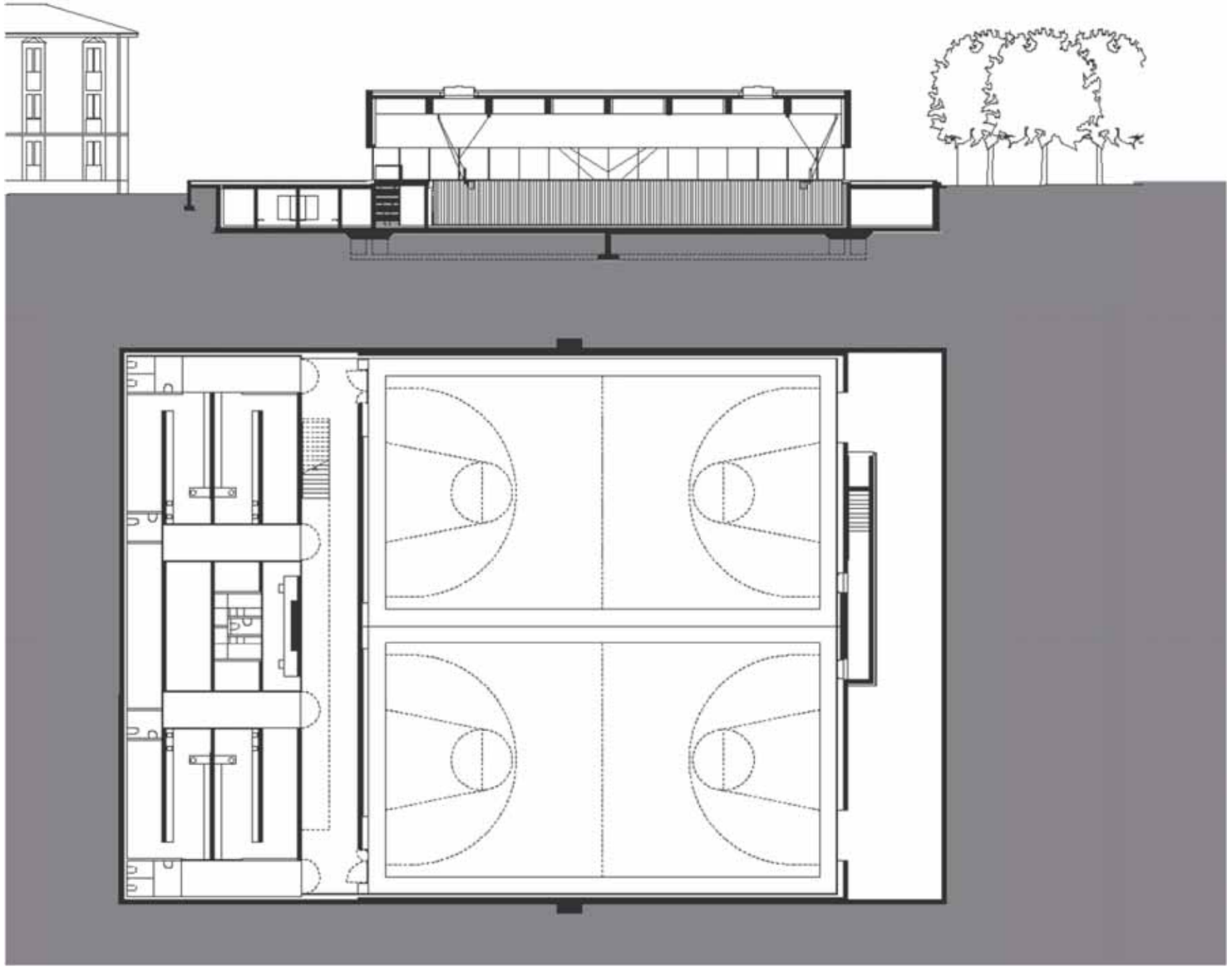
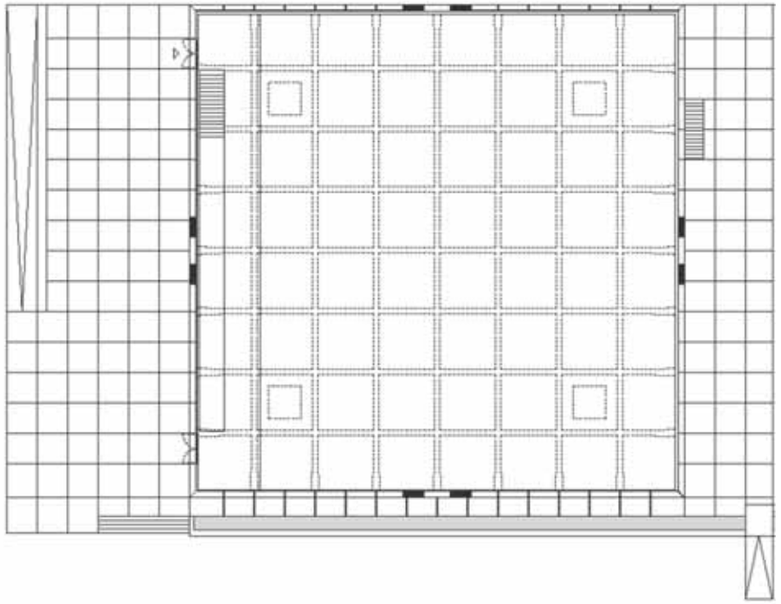
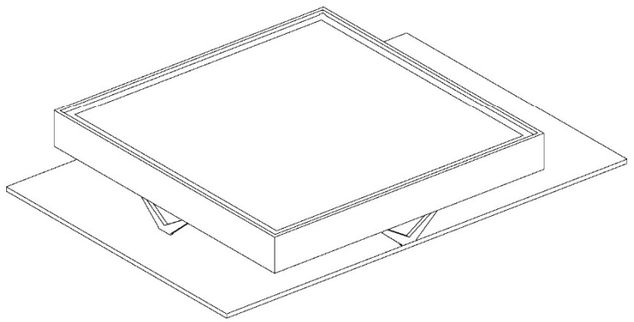


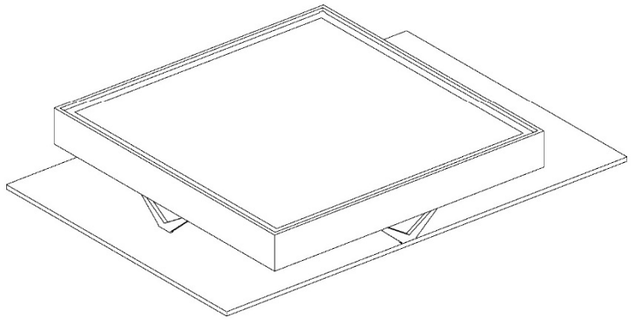
Grundriss und Schnitt
Floorplan and section



Kassettendach
Coffered Roof



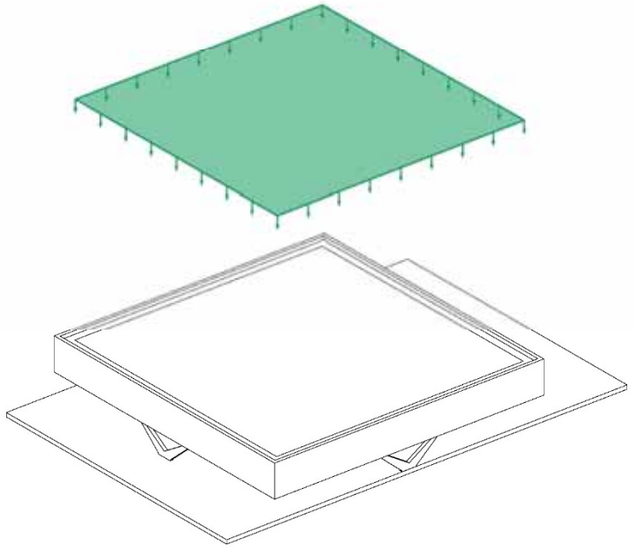
Reinforced Concrete
$\varrho = 25\ kN/m^3$



Reinforced Concrete
$\varrho = 25\ kN/m^3$

Roof slab (32.8 x 32.8 x 0.3 m)

Dead loads (self-weight)
$g_{slab} = 0.3\ m \cdot 25\ kN/m^3 =$
$= 7.5\ kN/m^2$



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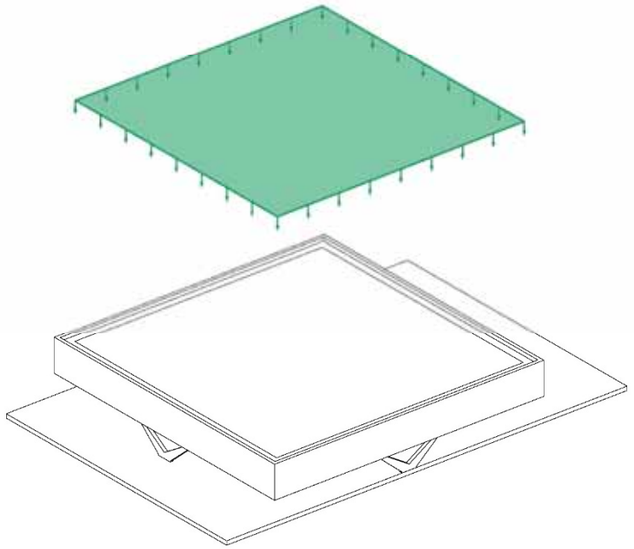
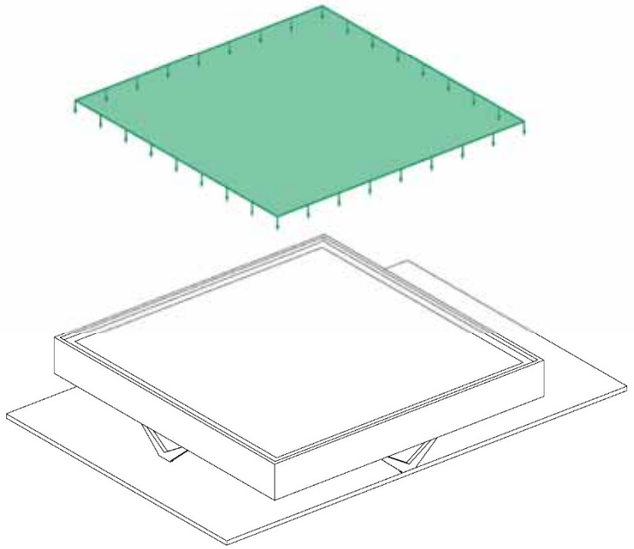
$= 7.5\ kN/m^2$

Live loads (snow)
$q_{snow} = 1.0\ kN/m^2$





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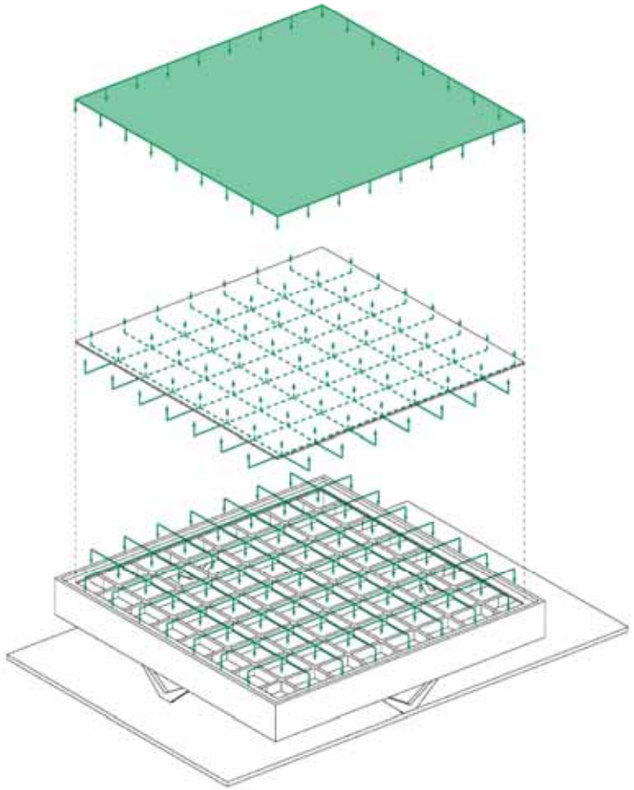
$q_{snow} = 1.0\ kN/m^2$

$q_{d,slab} = 1.35 \cdot g + 1.5 \cdot q_{snow}$
$= 11.6\ kN/m^2$



Reinforced Concrete
$\varrho = 25\ kN/m^3$

Roof slab (32.8 x 32.8 x 0.3 m)

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$g_{slab} = 0.3\ m \cdot 25\ kN/m^3 =$
$= 7.5\ kN/m^2$

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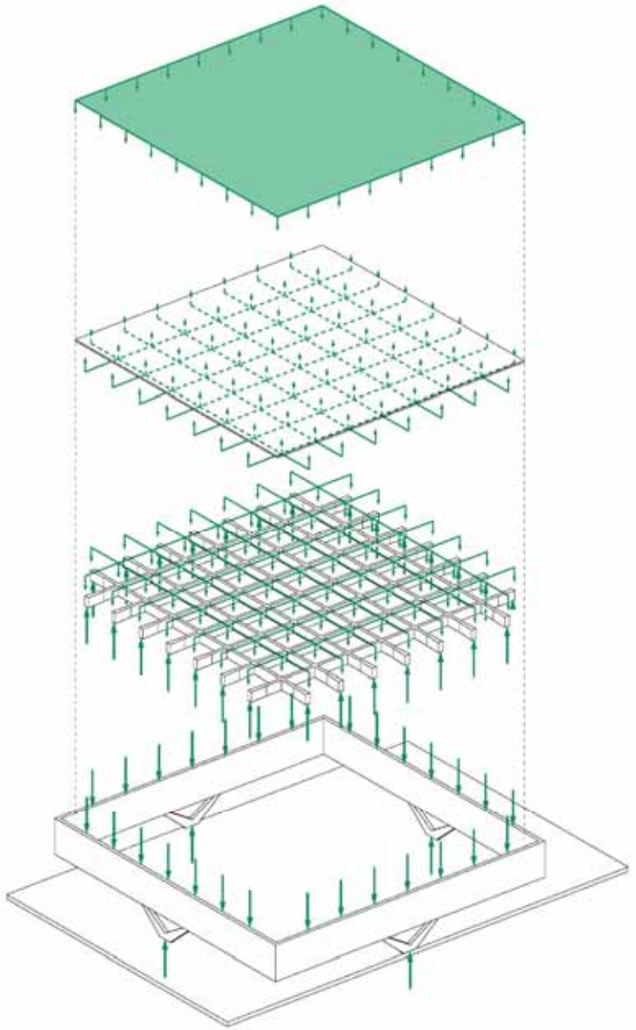
$q_{d,slab} = 1.35 \cdot g + 1.5 \cdot q_{snow}$
$= 11.6\ kN/m^2$



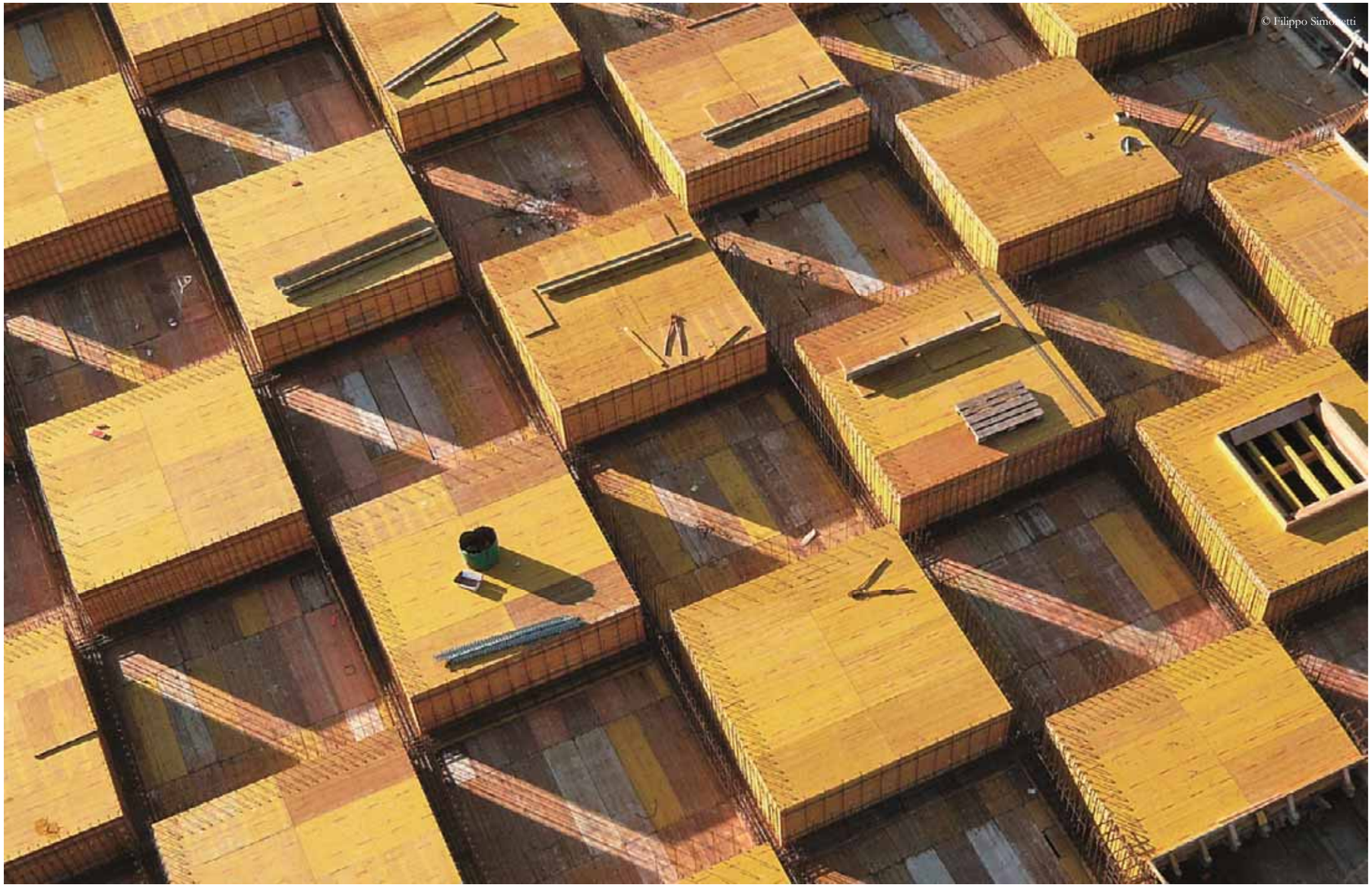
Reinforced Concrete
$\varrho = 25\ kN/m^3$

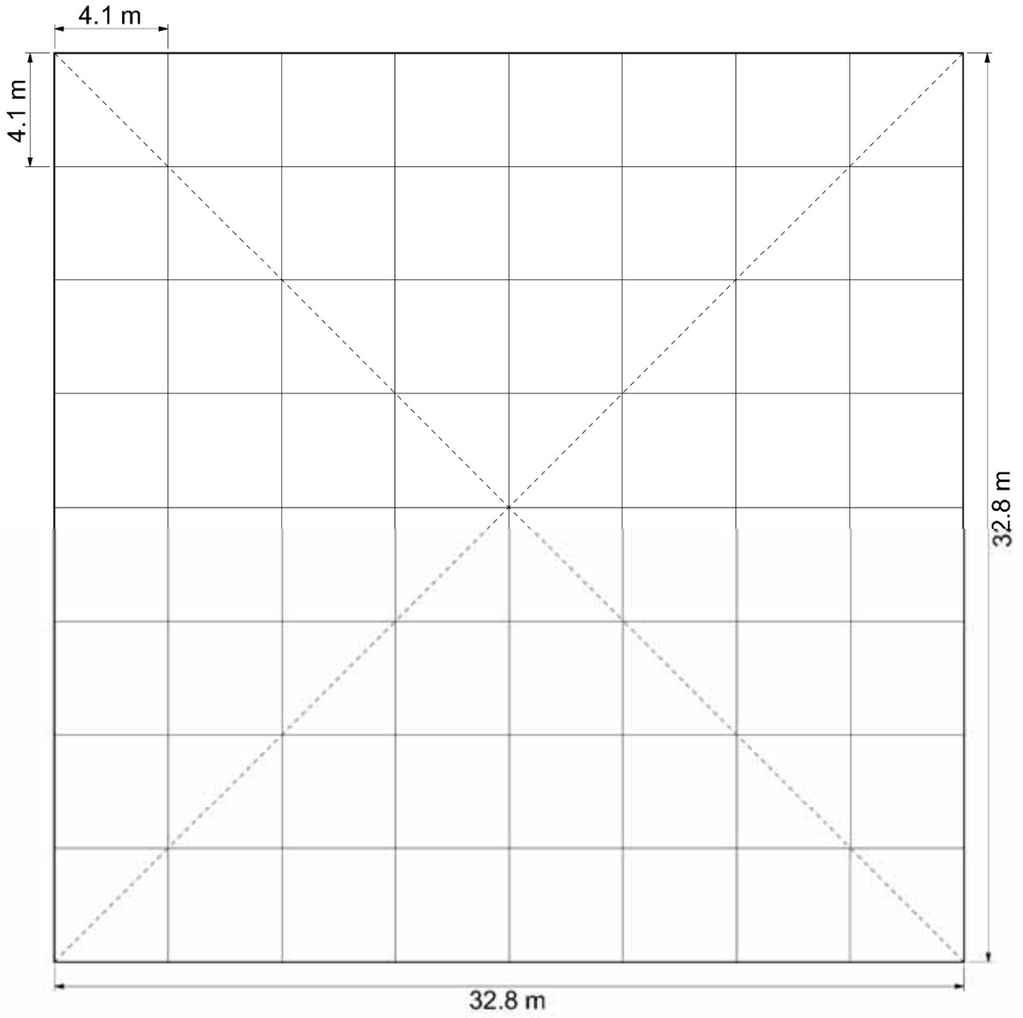
Roof slab (32.8 x 32.8 x 0.3 m)

Dead loads (self-weight)
$g_{slab} = 0.3\ m \cdot 25\ kN/m^3 =$
$= 7.5\ kN/m^2$

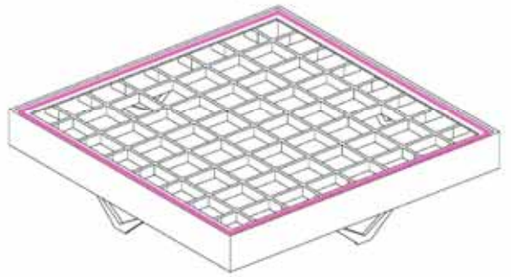
Live loads (snow)
$q_{snow} = 1.0\ kN/m^2$

$q_{d,slab} = 1.35 \cdot g + 1.5 \cdot q_{snow}$
$= 11.6\ kN/m^2$

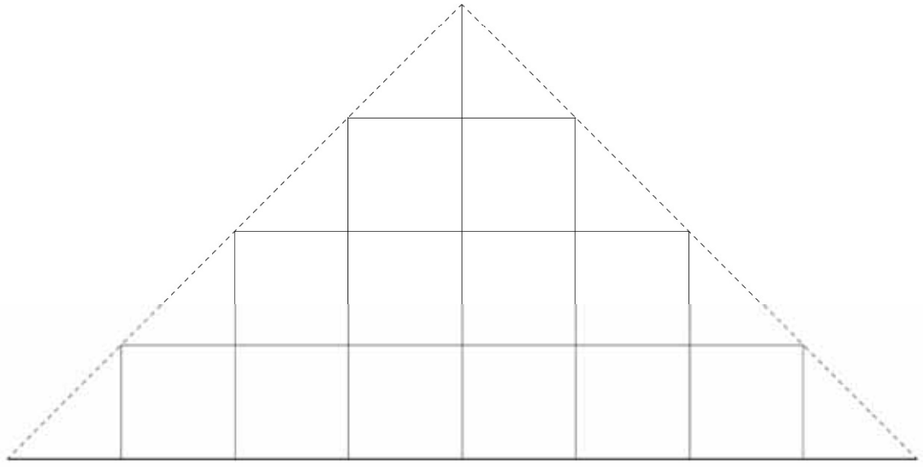

© Filippo Simonetti

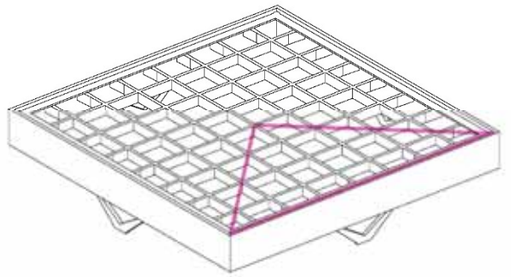


Tributary areas

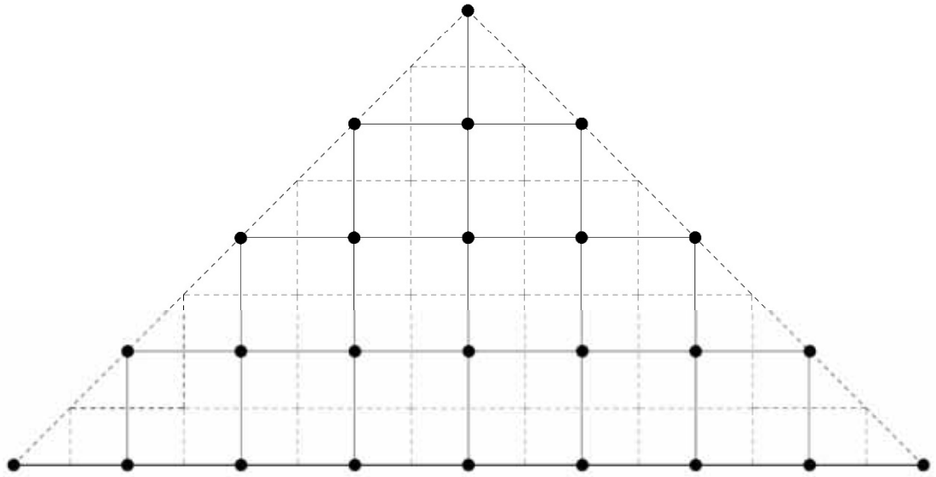


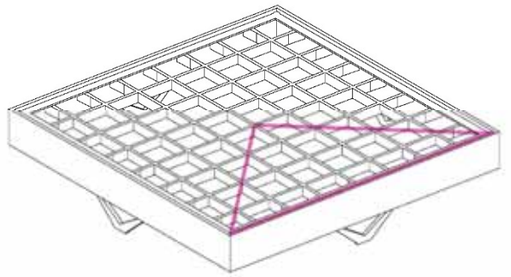
Tributary areas





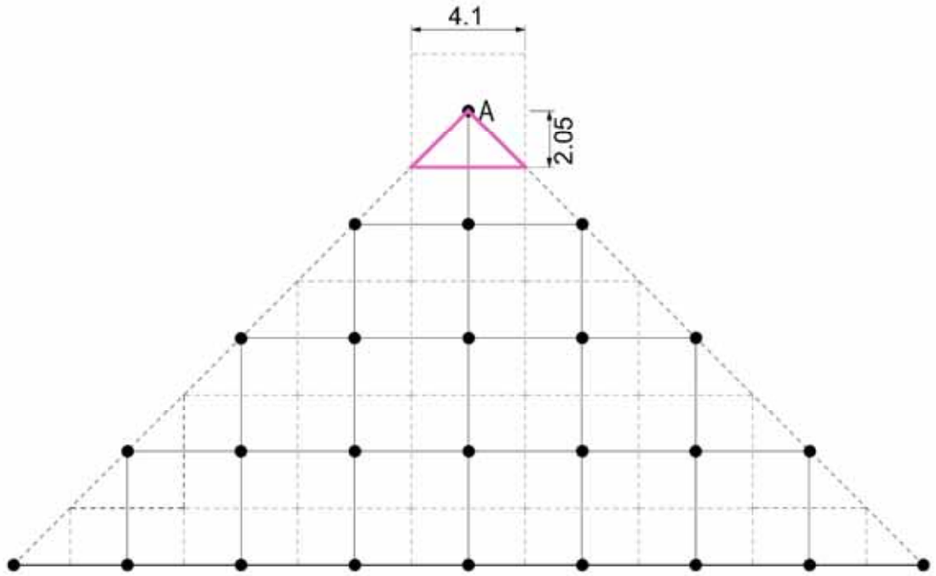
Tributary areas

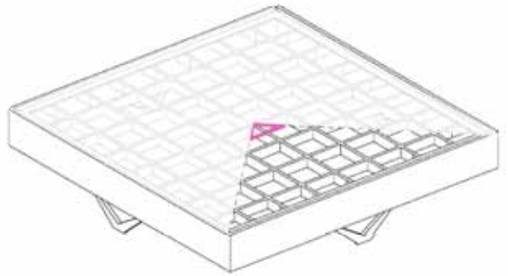




Tributary areas

$A = (4.1 \cdot 2.05)/2 = 4.2\ m^2$

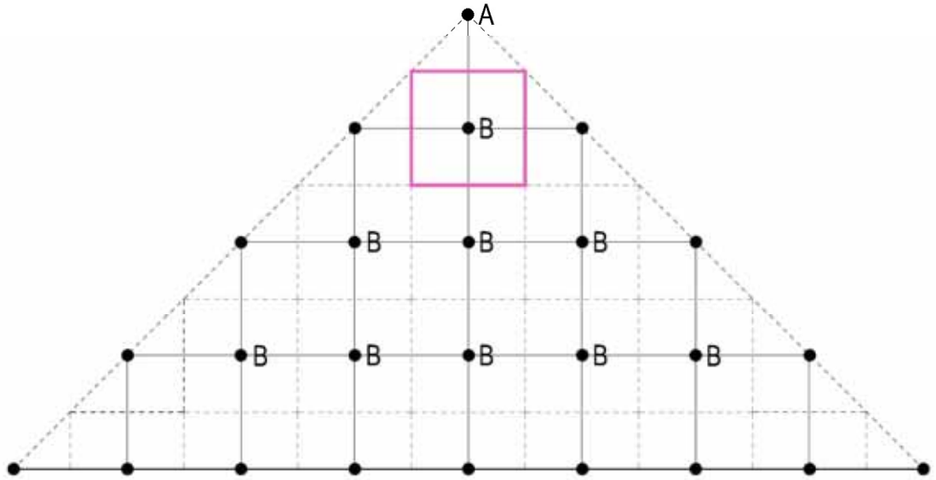


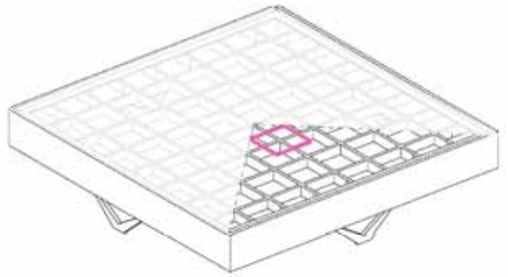


Tributary areas

$A = (4.1 \cdot 2.05)/2 = 4.2\ m^2$

$B = 4.1 \cdot 4.1 = 16.8\ m^2$



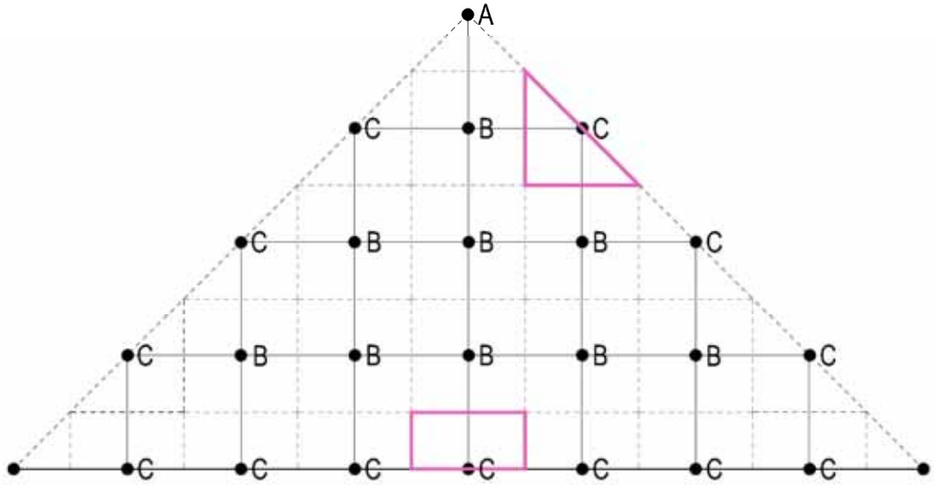


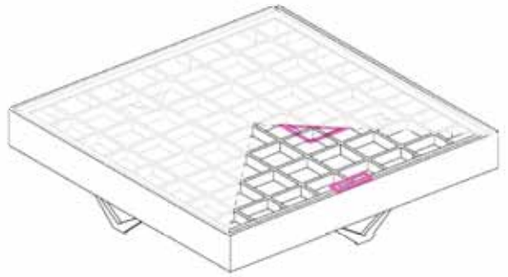
Tributary areas

$A = (4.1 \cdot 2.05)/2 = 4.2\ m^2$

$B = 4.1 \cdot 4.1 = 16.8\ m^2$

$C = 4.1 \cdot 2.05 = 8.4\ m^2$





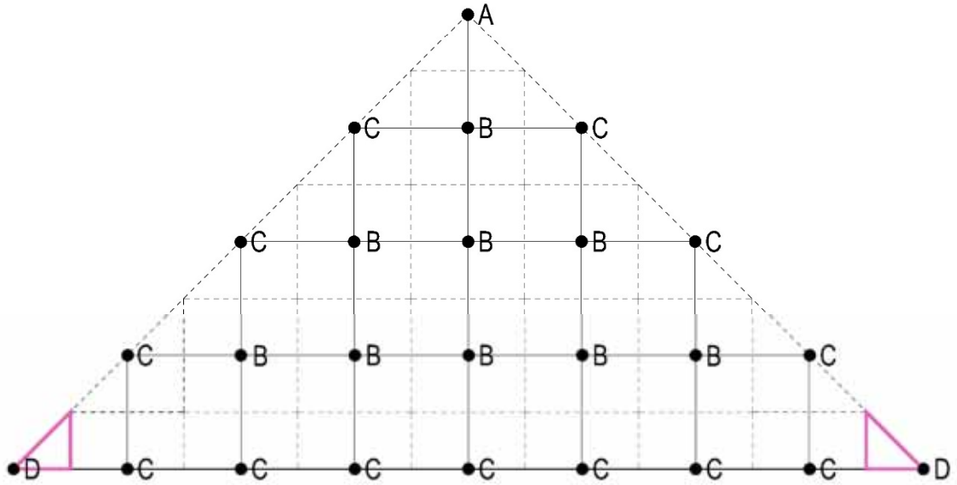
Tributary areas

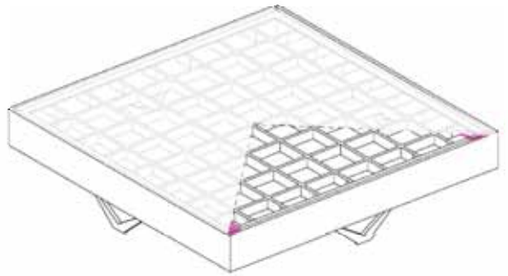
A = (4.1 · 2.05)/2 = 4.2 m²

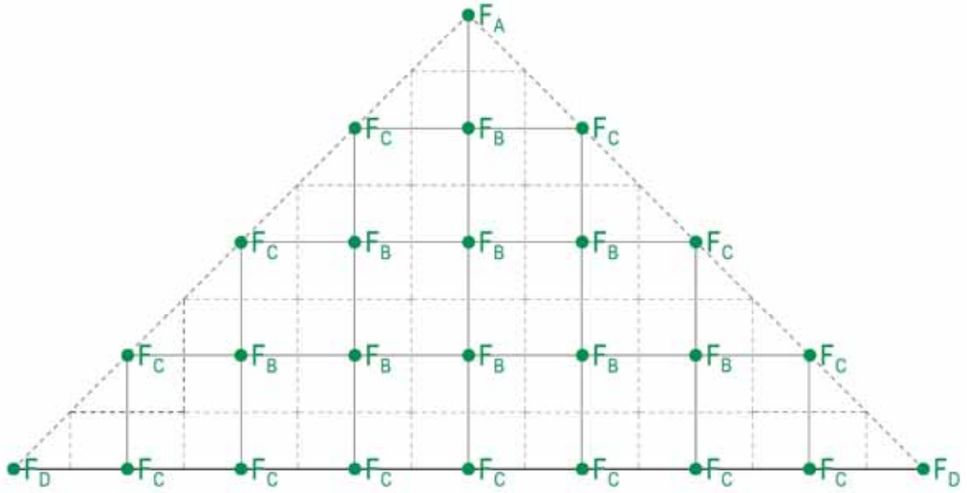
B = 4.1 · 4.1 = 16.8 m²

C = 4.1 · 2.05 = 8.4 m²

D = (2.05 · 2.05)/2 = 2.1 m²







Tributary areas

$A = (4.1 \cdot 2.05)/2 = 4.2\ m^2$

$B = 4.1 \cdot 4.1 = 16.8\ m^2$

$C = 4.1 \cdot 2.05 = 8.4\ m^2$

$D = (2.05 \cdot 2.05)/2 = 2.1\ m^2$

Repartition of slab loads on nodes

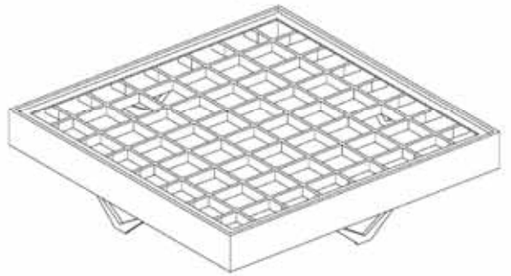
$q_{d,slab} = 11.6\ kN/m^2$

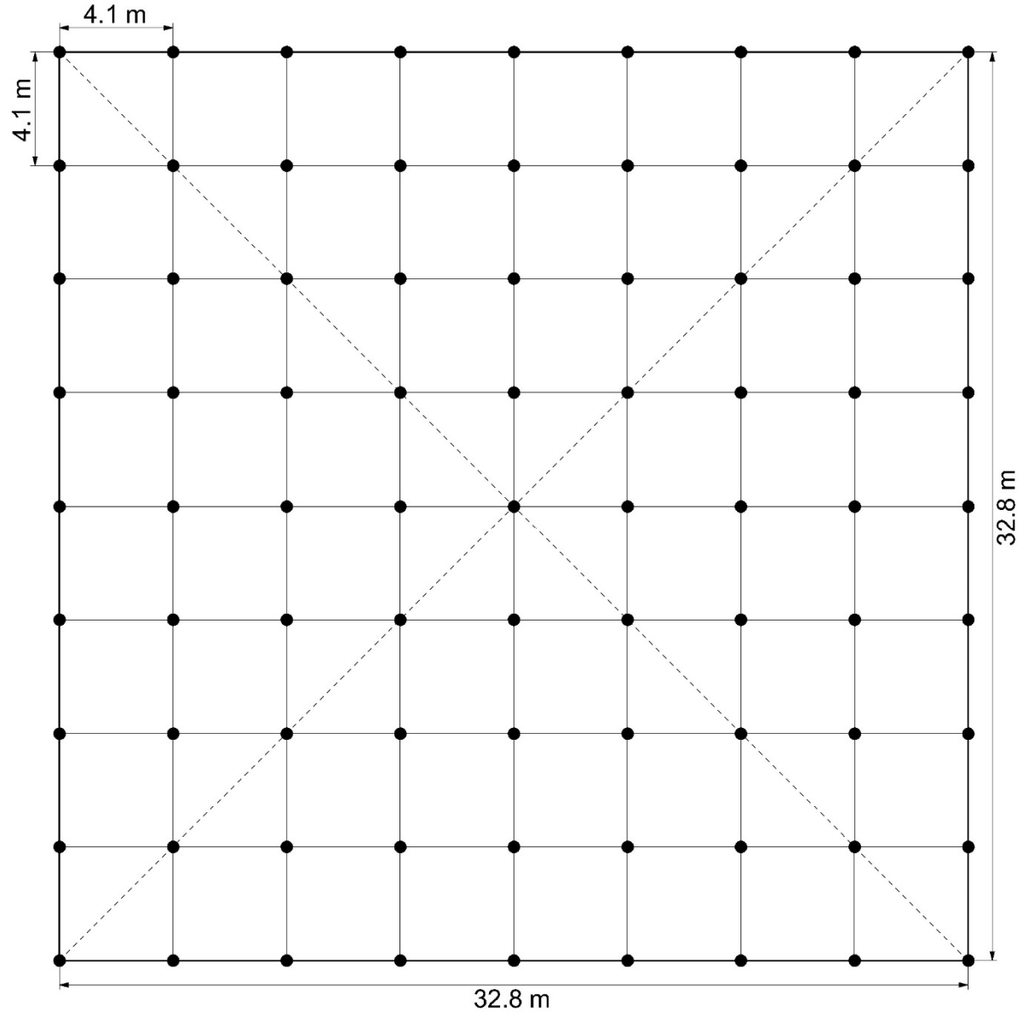
$F_A = A \cdot q_{d,slab} = 48.7\ kN$

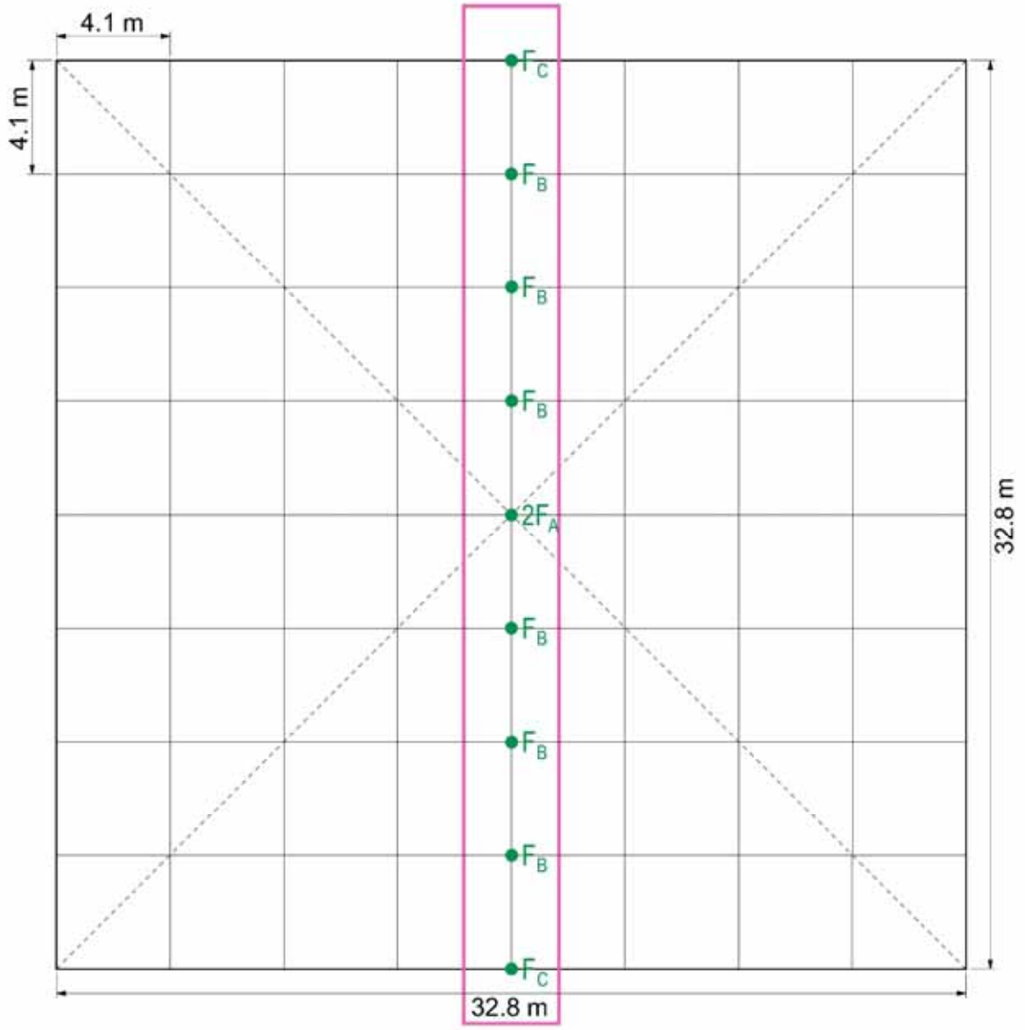
$F_B = B \cdot q_{d,slab} = 194.9\ kN$

$F_C = C \cdot q_{d,slab} = 97.4\ kN$

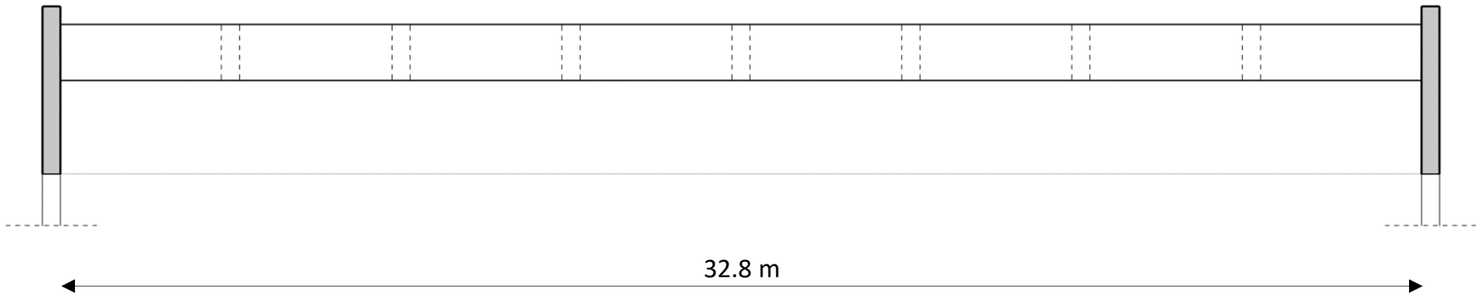
$F_D = D \cdot q_{d,slab} = 24.4\ kN$




4.1 m
4.1 m
32.8 m
32.8 m


4.1 m
4.1 m
F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
32.8 m
32.8 m

Beam (32.8 x 1.0 x 0.35 m)

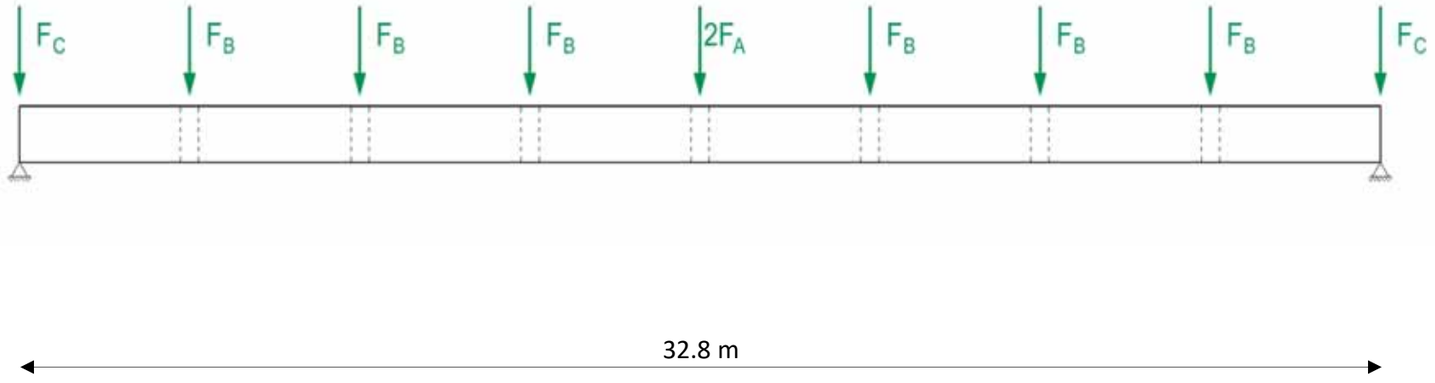


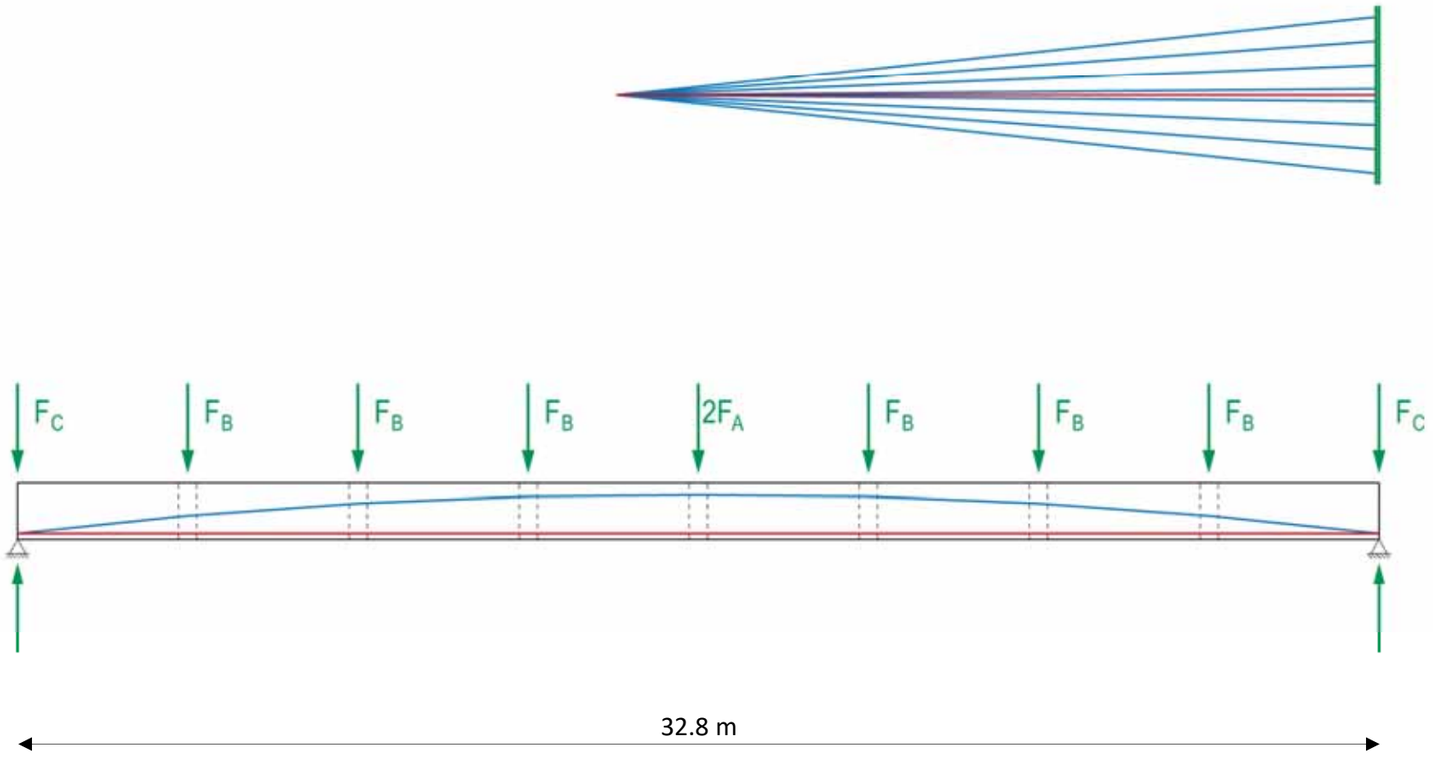
Beam (32.8 x 1.0 x 0.35 m)

$F_A = A \cdot q_{d,slab} = 48.7$ kN

$F_B = B \cdot q_{d,slab} = 194.9$ kN

$F_C = C \cdot q_{d,slab} = 97.4$ kN




F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
32.8 m

Beam (32.8 x 1.0 x 0.35 m)

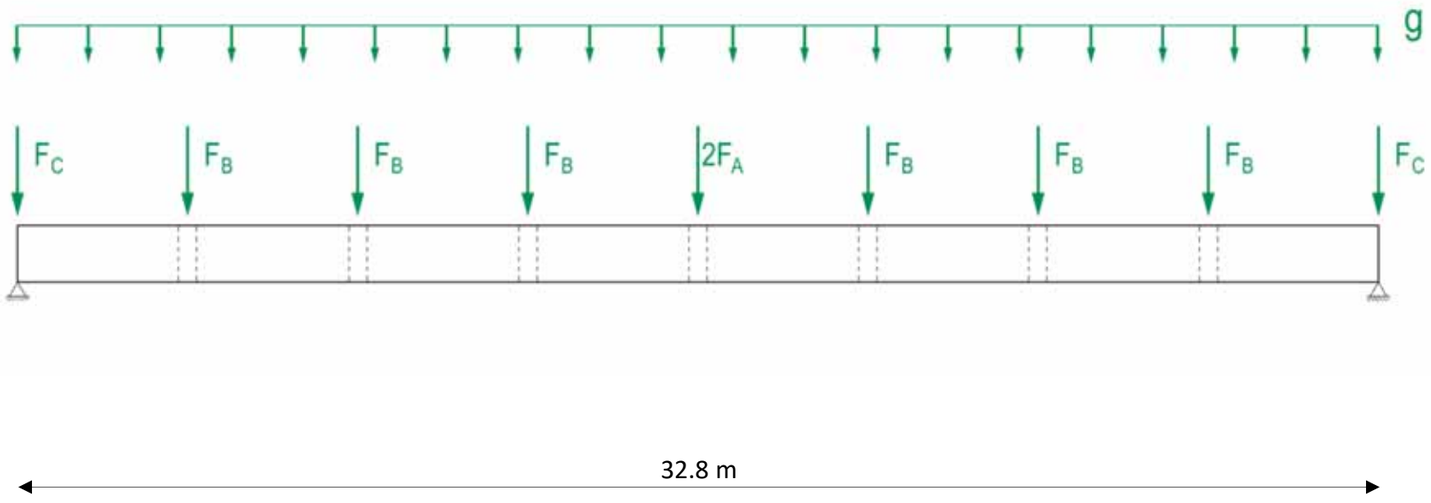
$F_A = A \cdot q_{d,slab} = 48.7$ kN

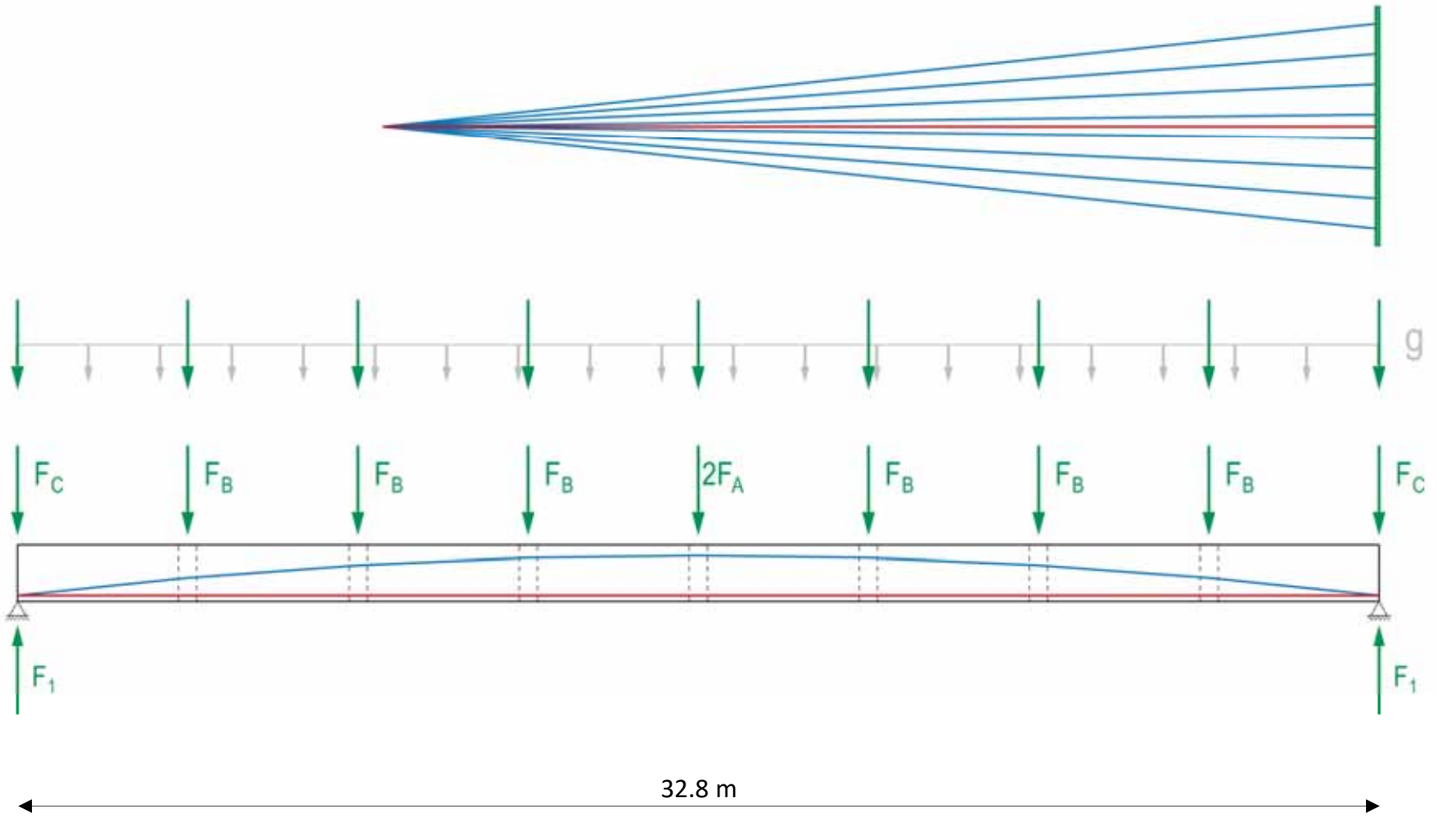
$F_B = B \cdot q_{d,slab} = 194.9$ kN

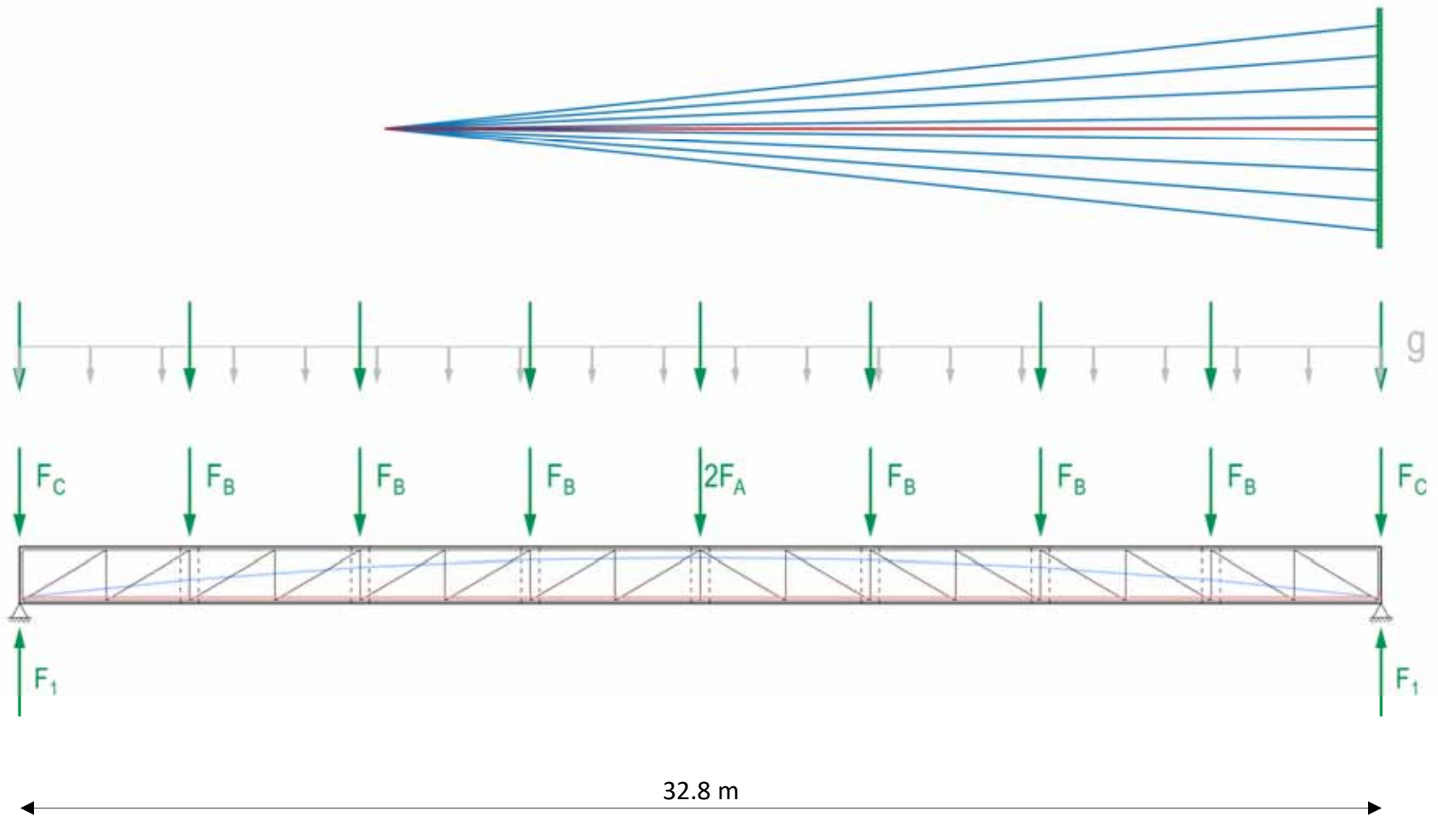
$F_C = C \cdot q_{d,slab} = 97.4$ kN

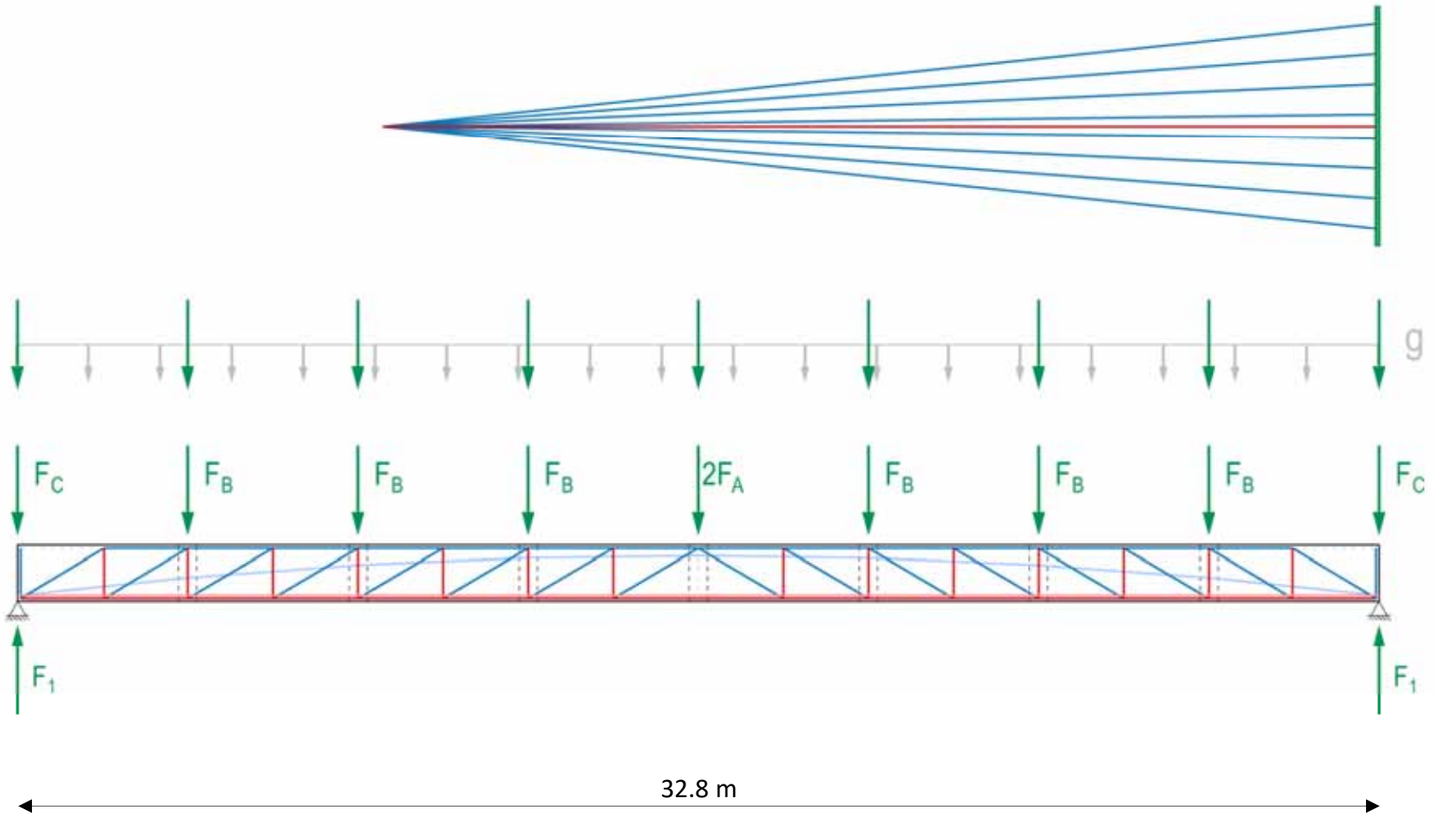
$g_{beam} = (1.0 \text{ m} \cdot 0.35 \text{ m}) \cdot 25 \text{ kN/m}^3 =$
$= 8.8$ kN/m

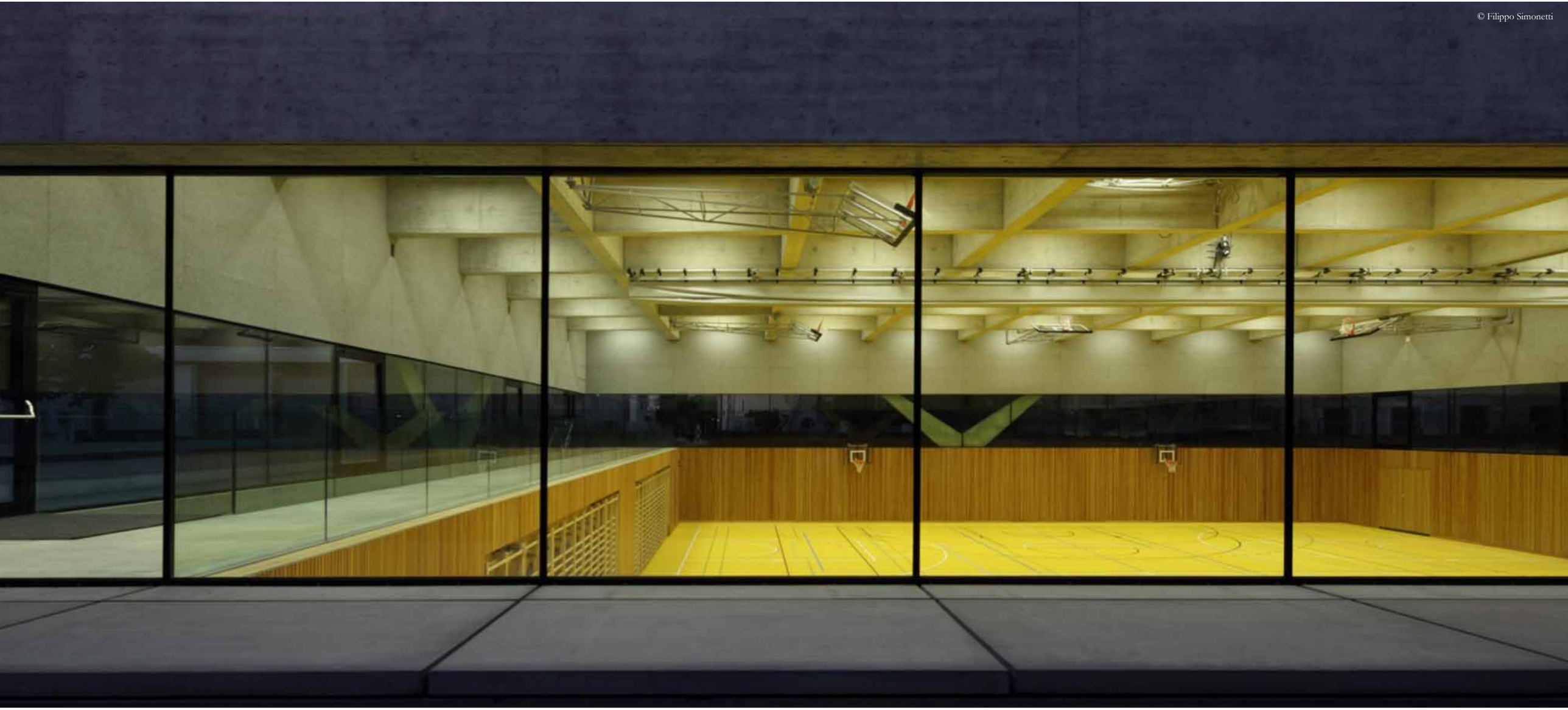
$q_{d,facade} = 1.35 \cdot g_{beam} = 11.8$ kN/m




g
F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
F_1
F_1
32.8 m


g
F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
F_1
F_1
32.8 m


g
F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
F_1
F_1
32.8 m


© Filippo Simonetti

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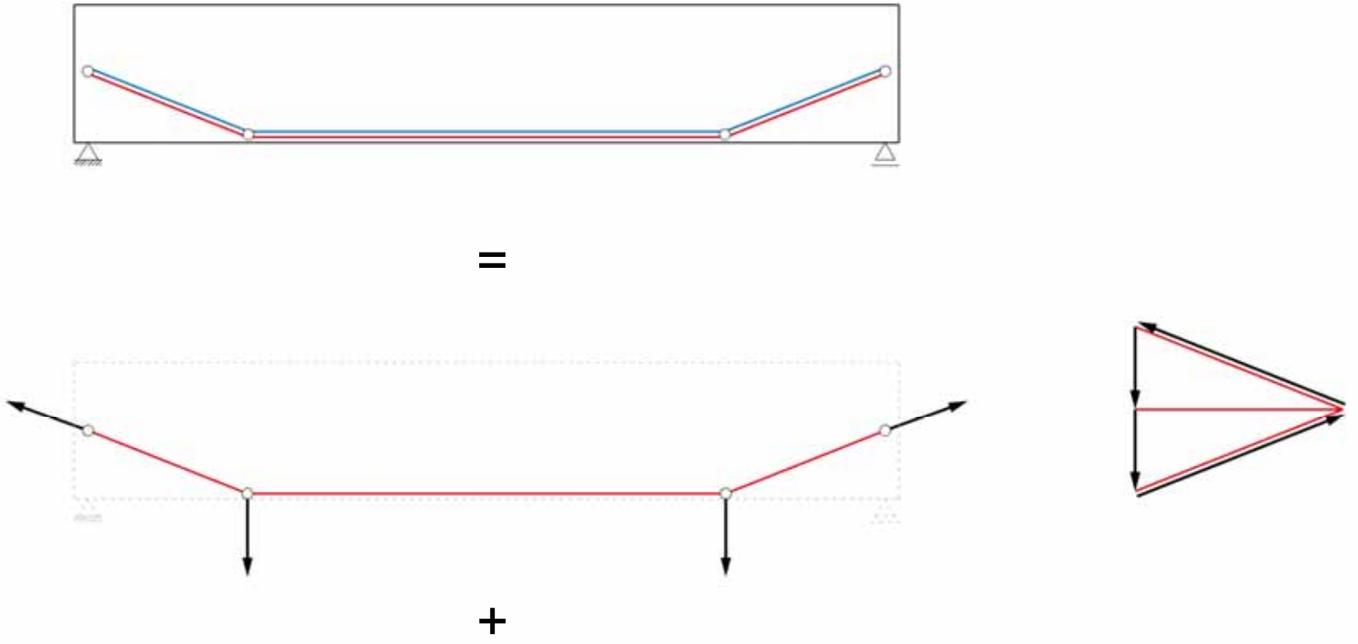

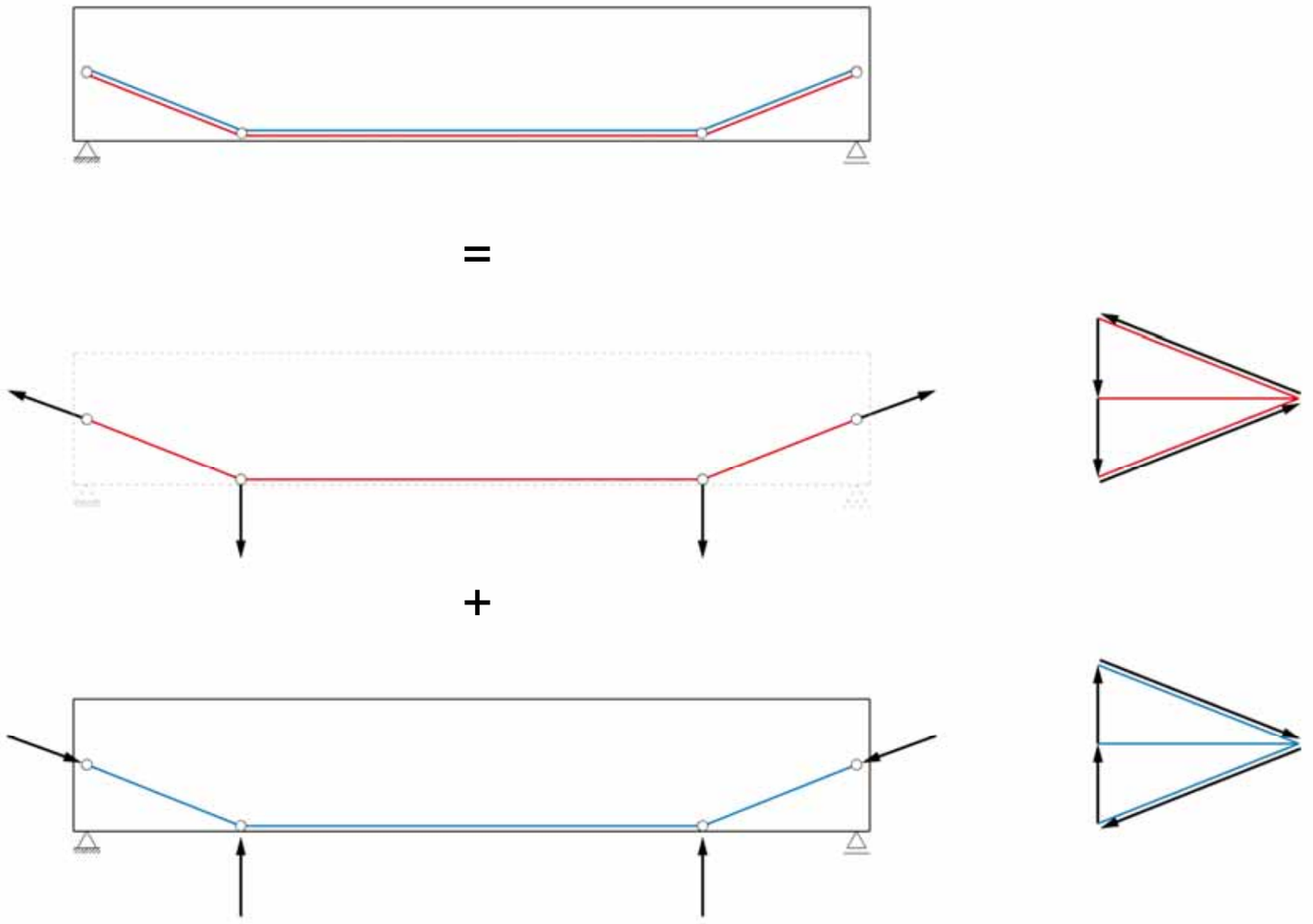

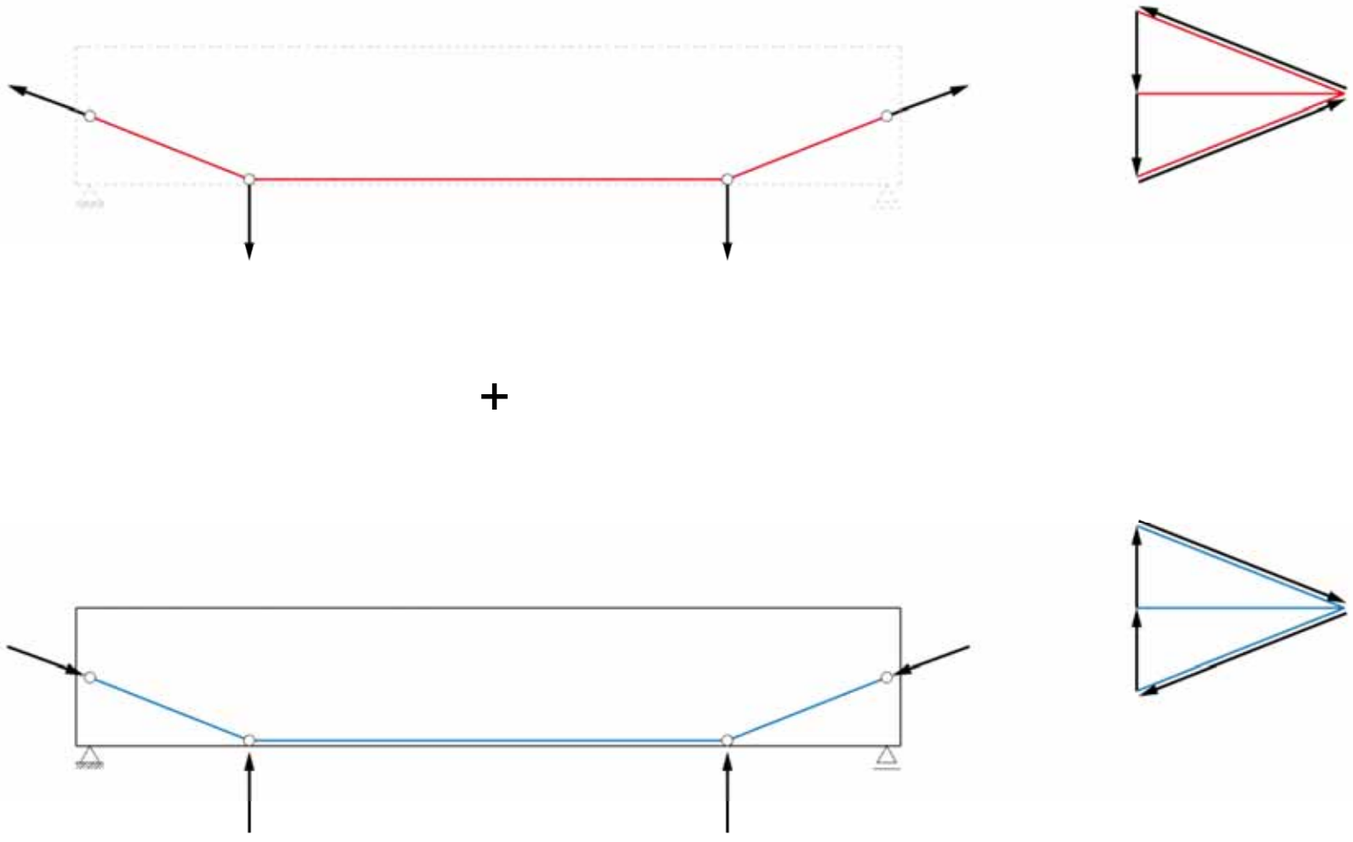

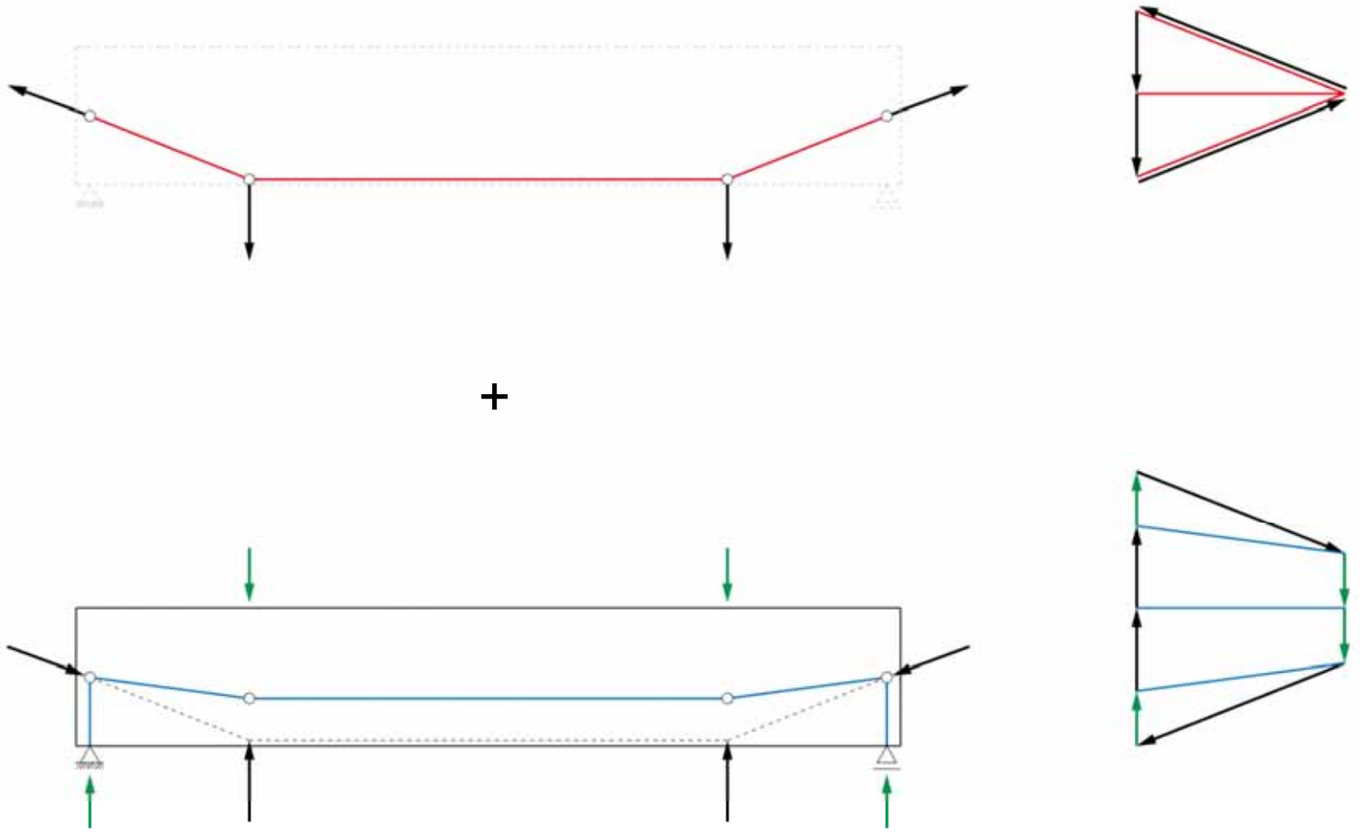

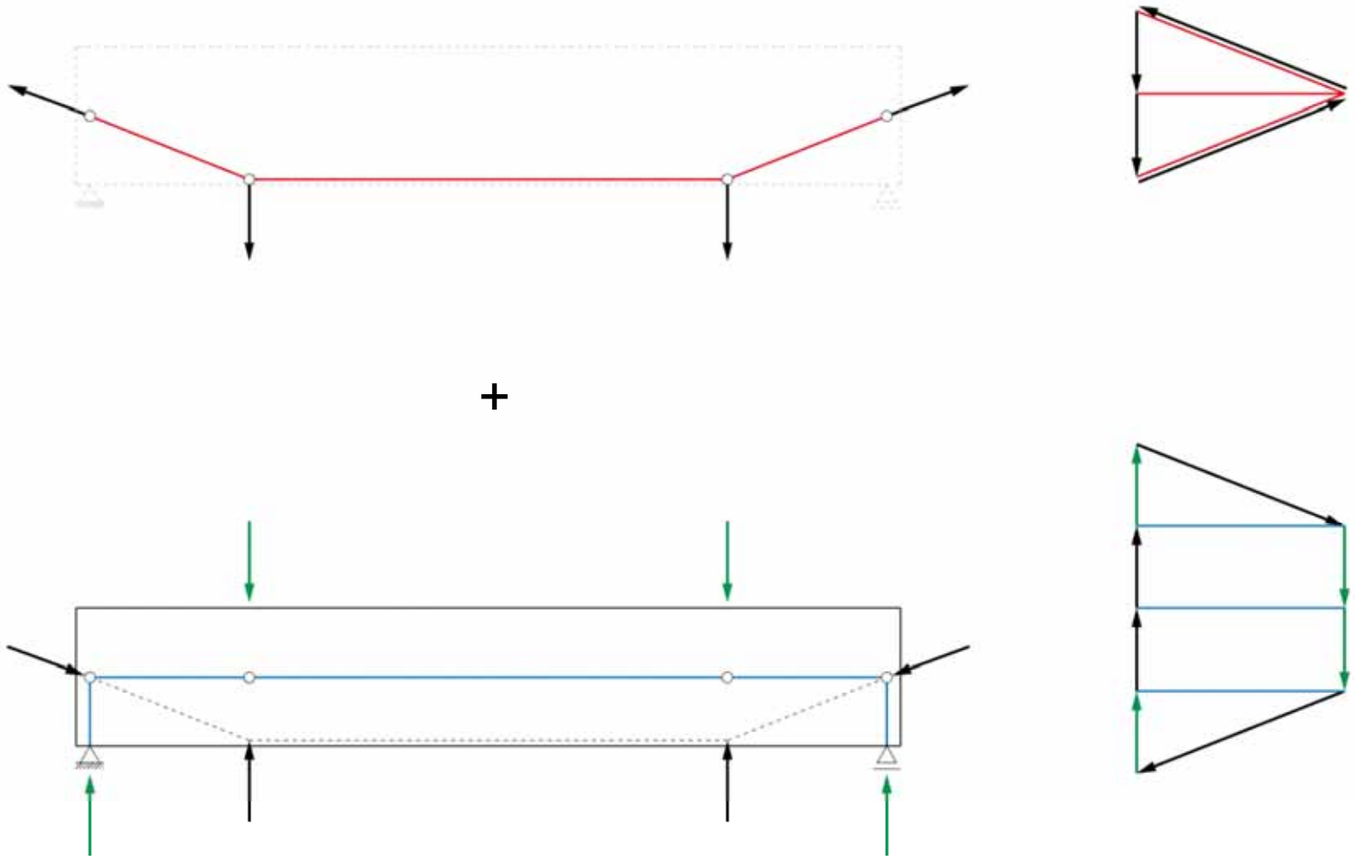

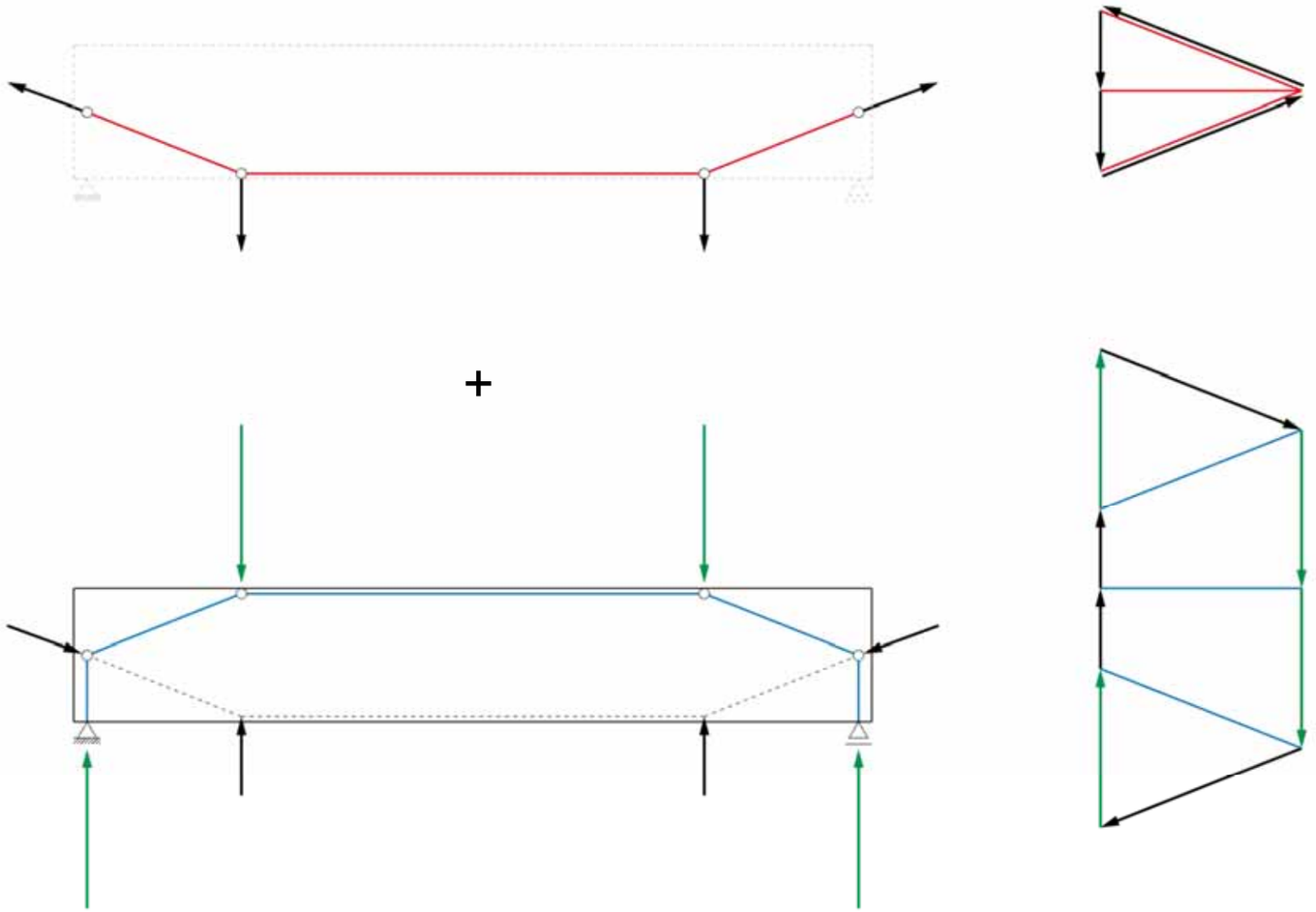

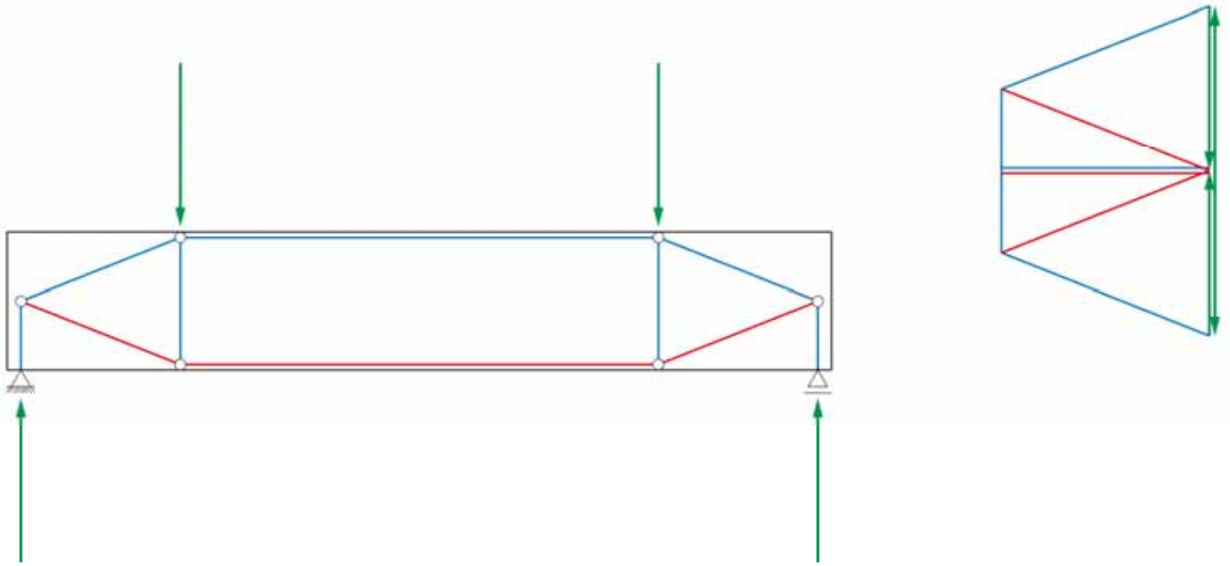

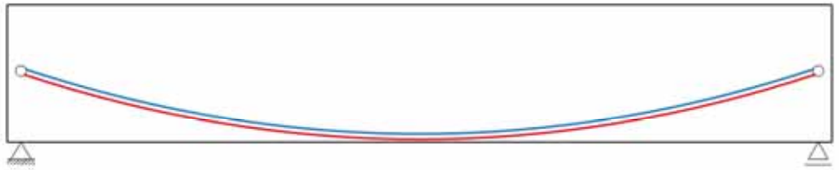

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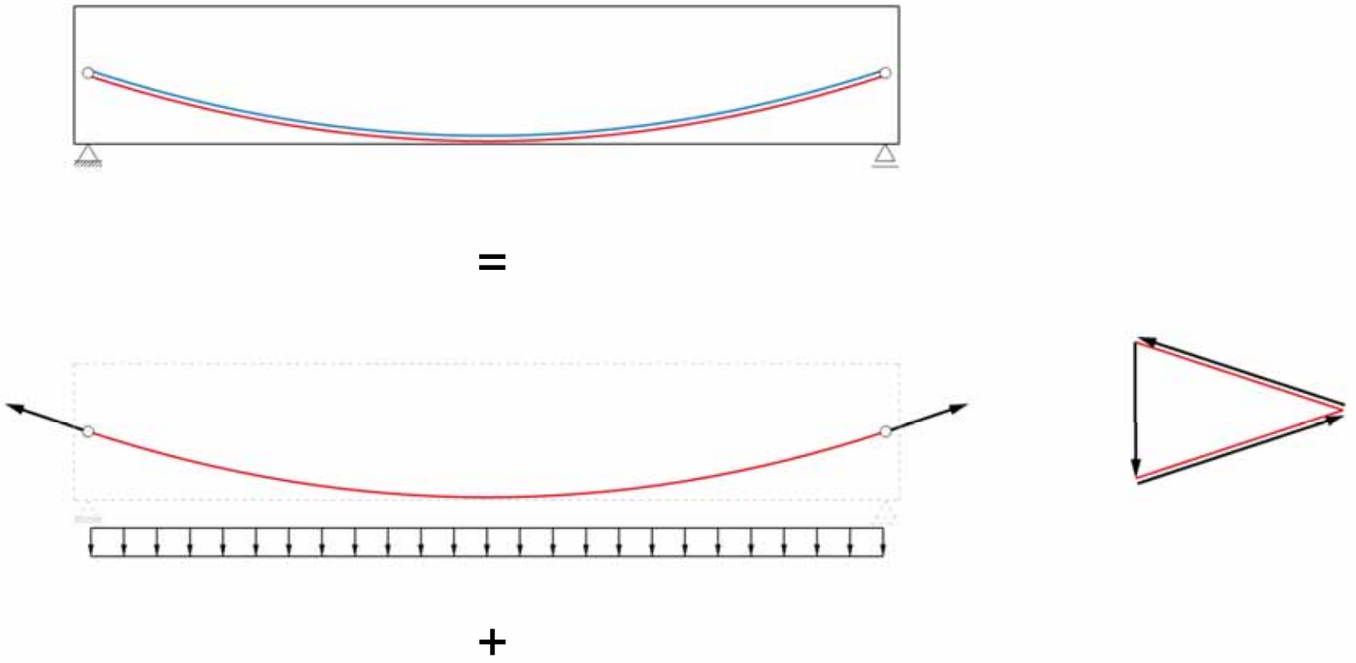

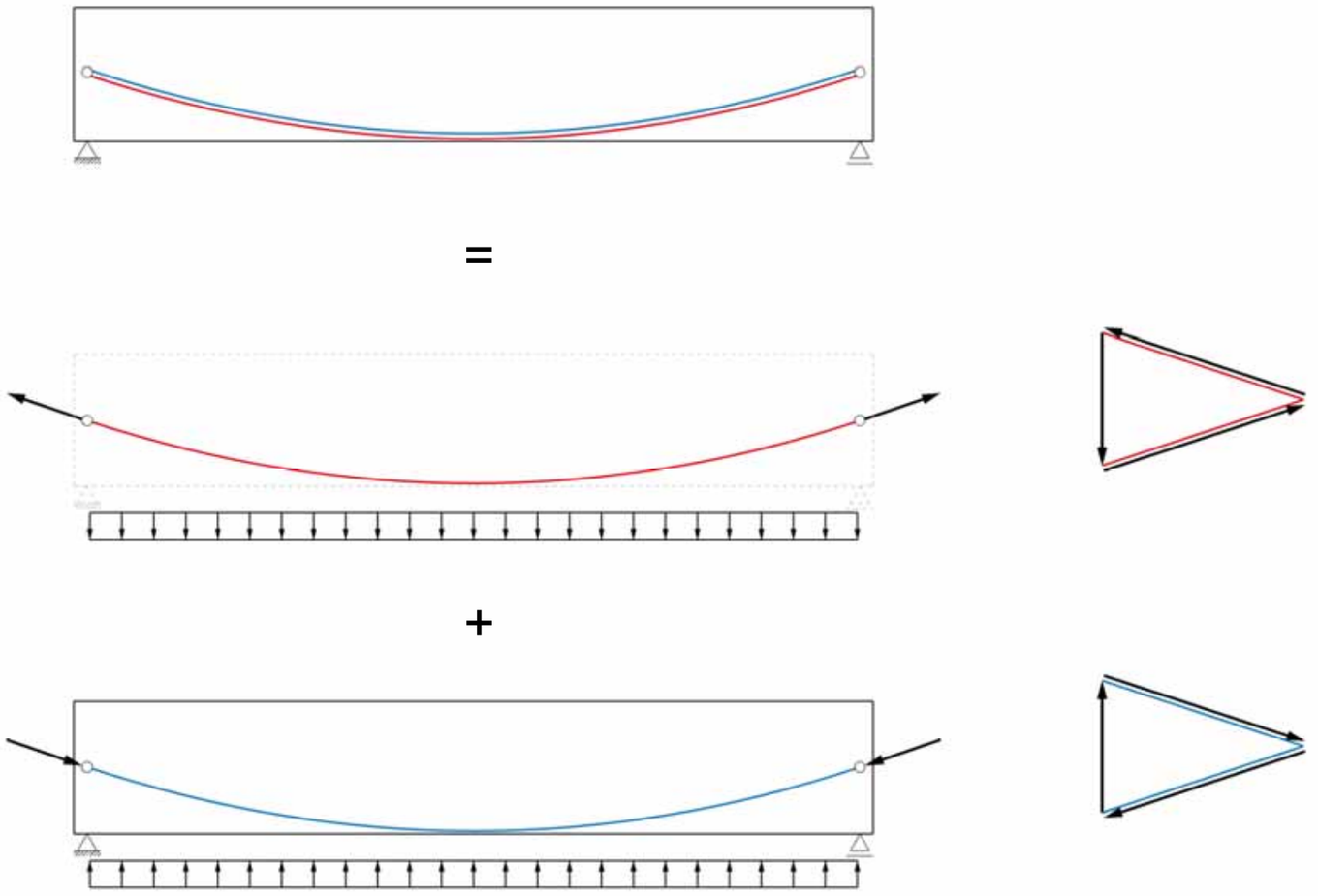

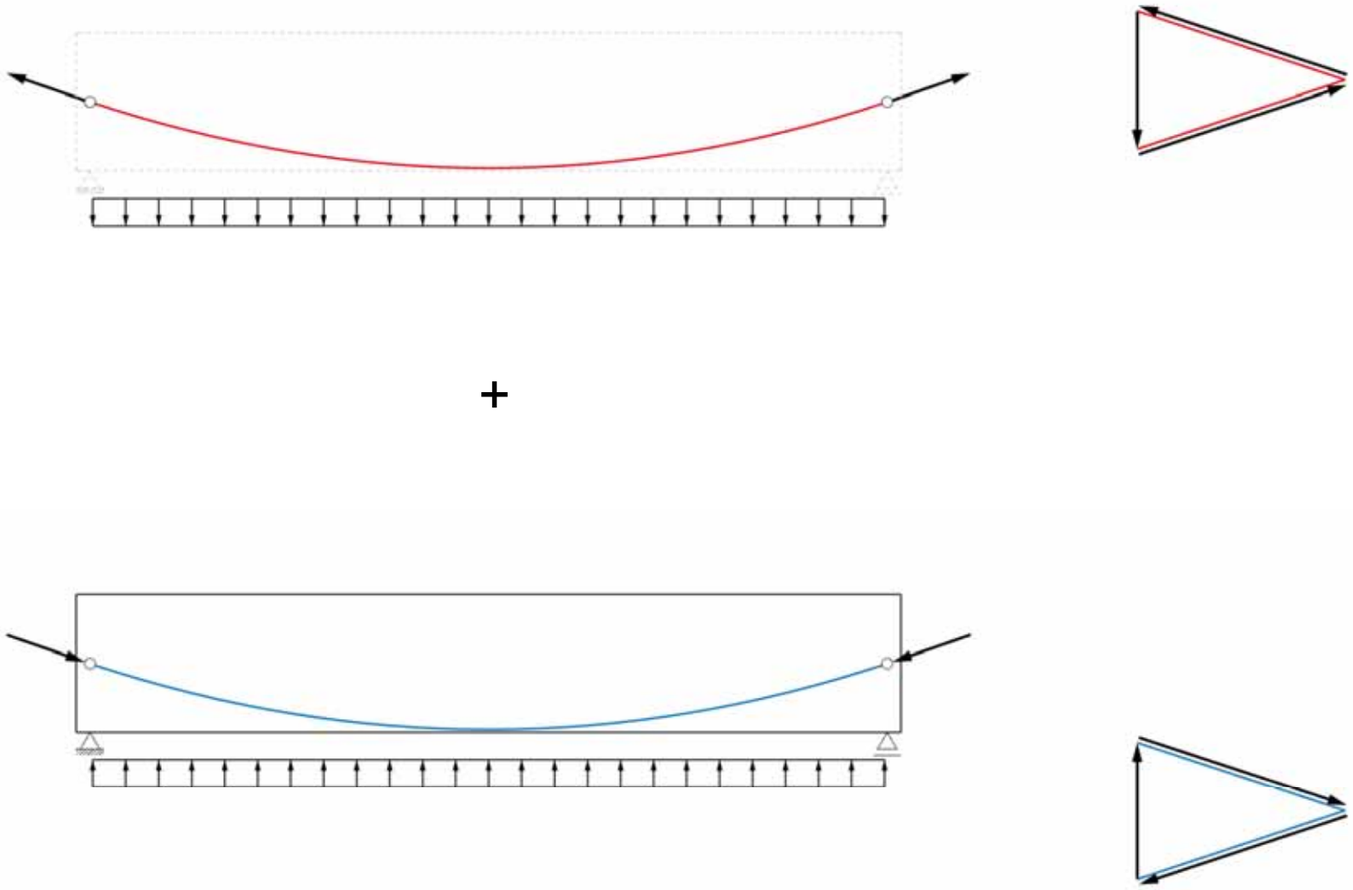

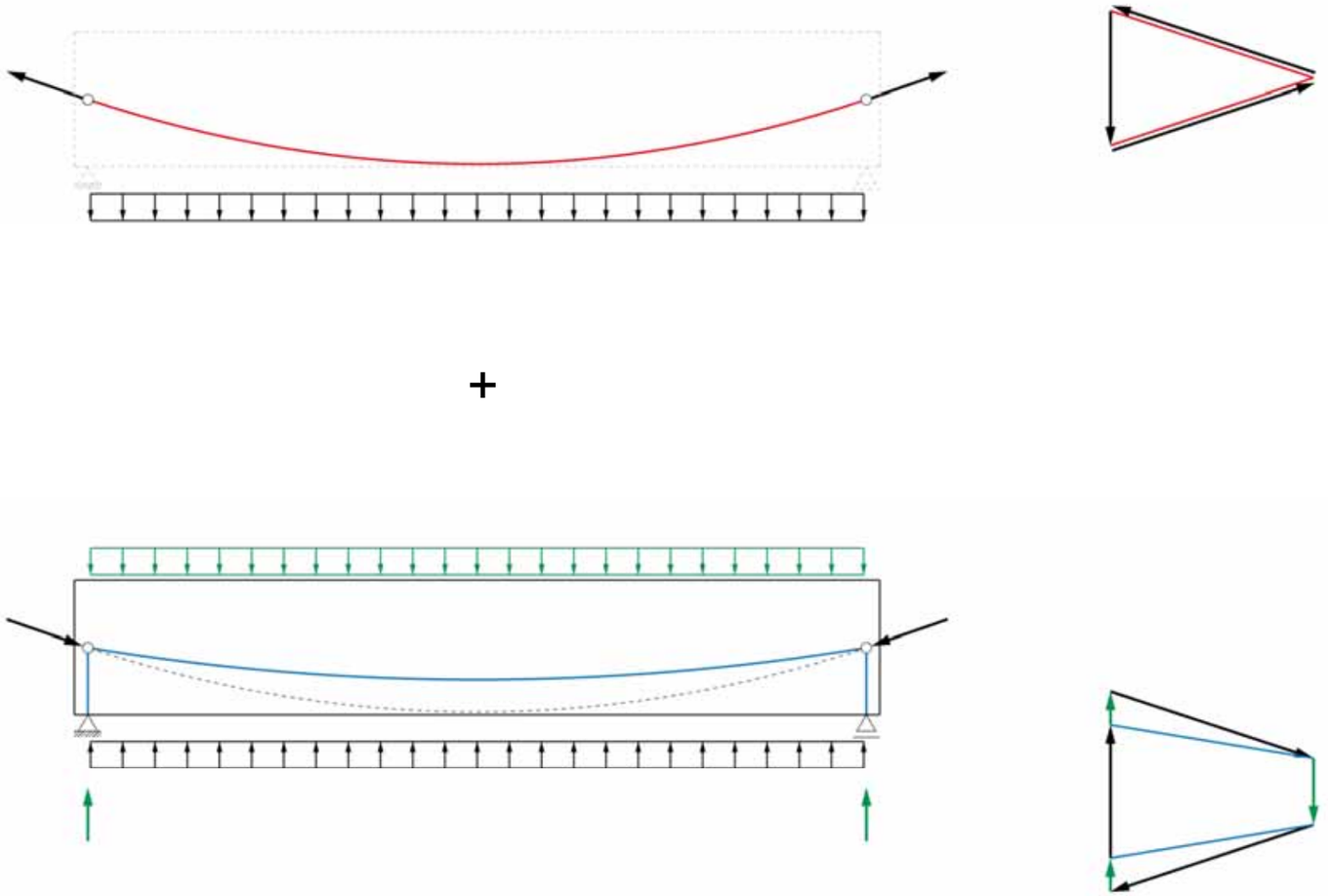

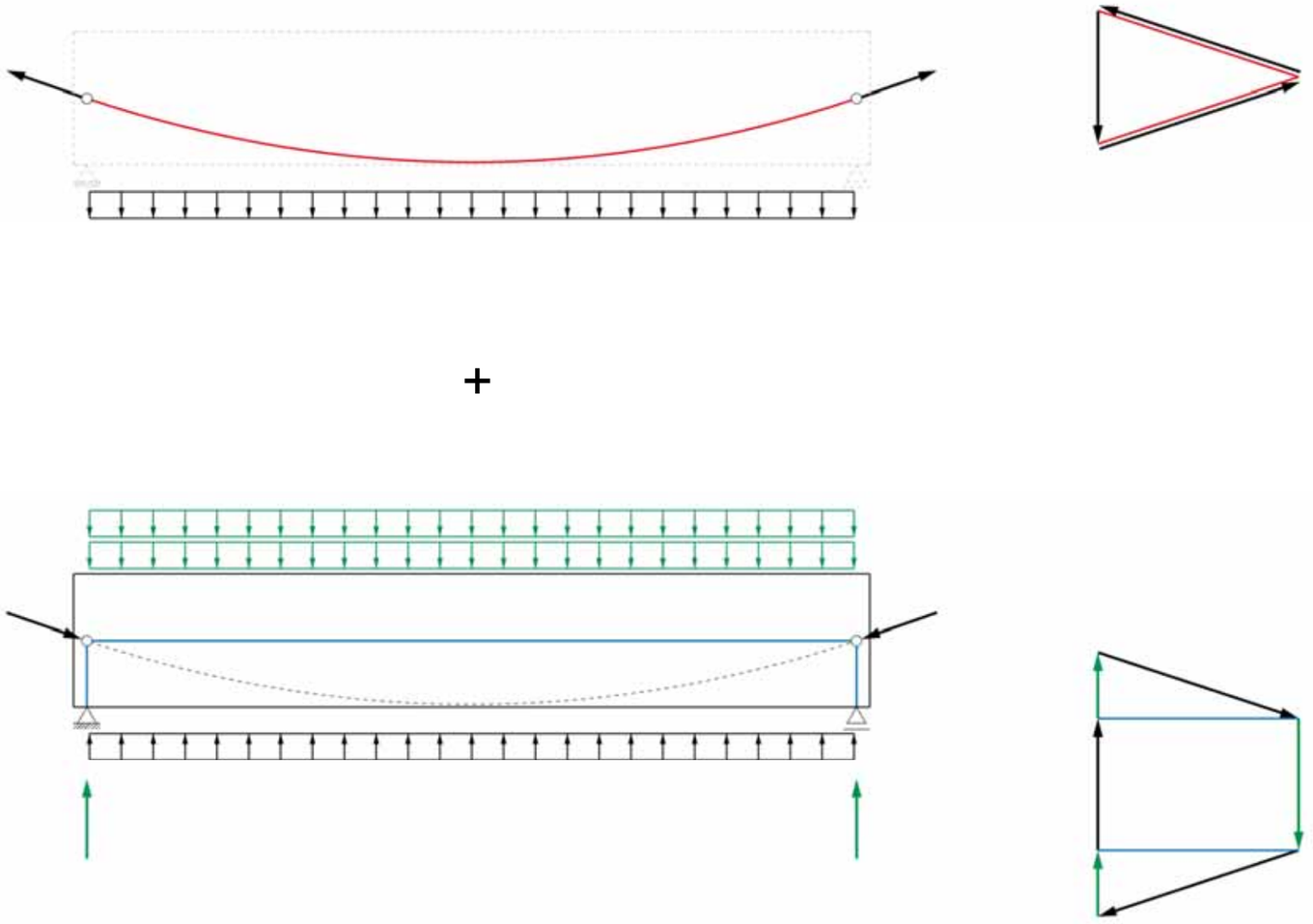

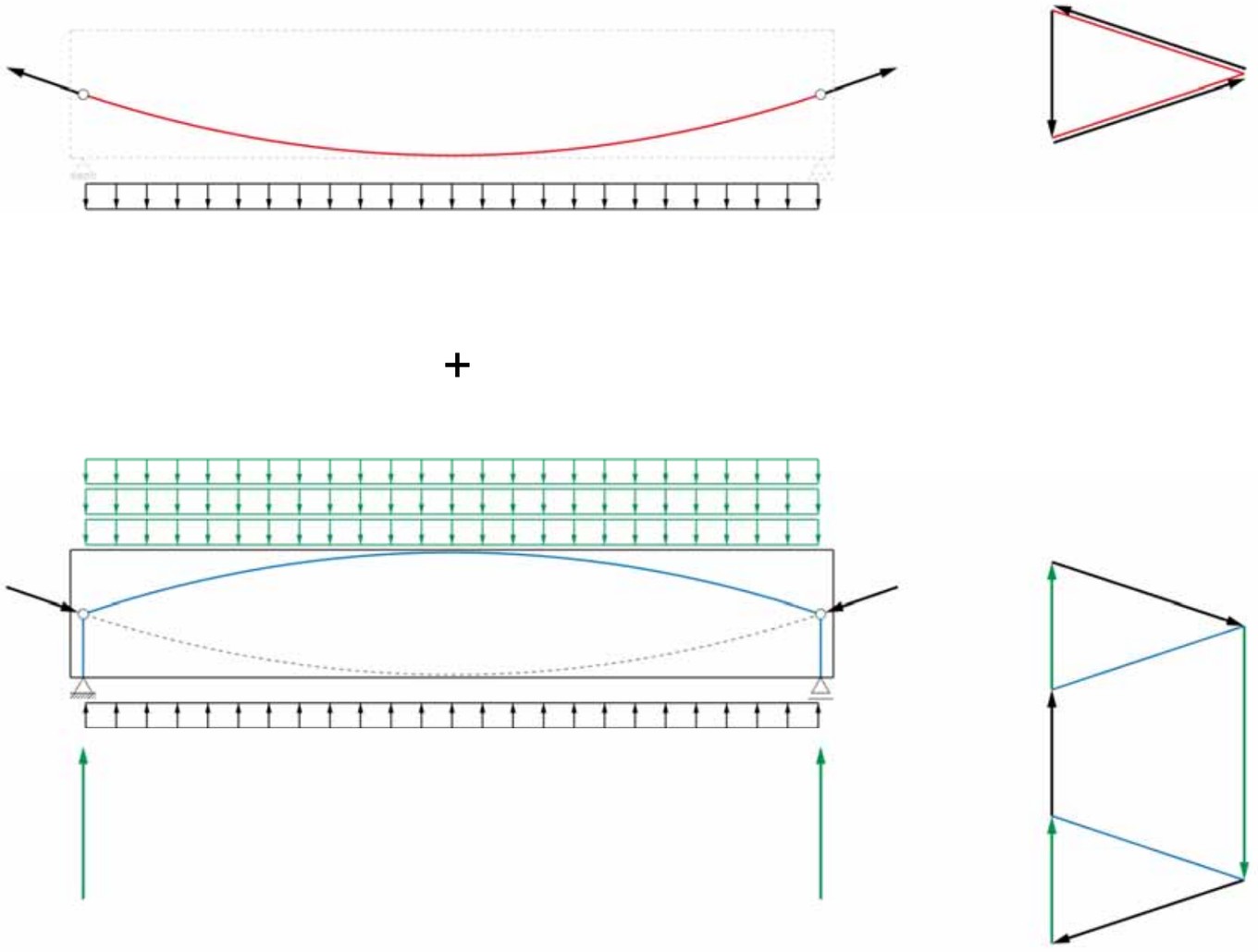

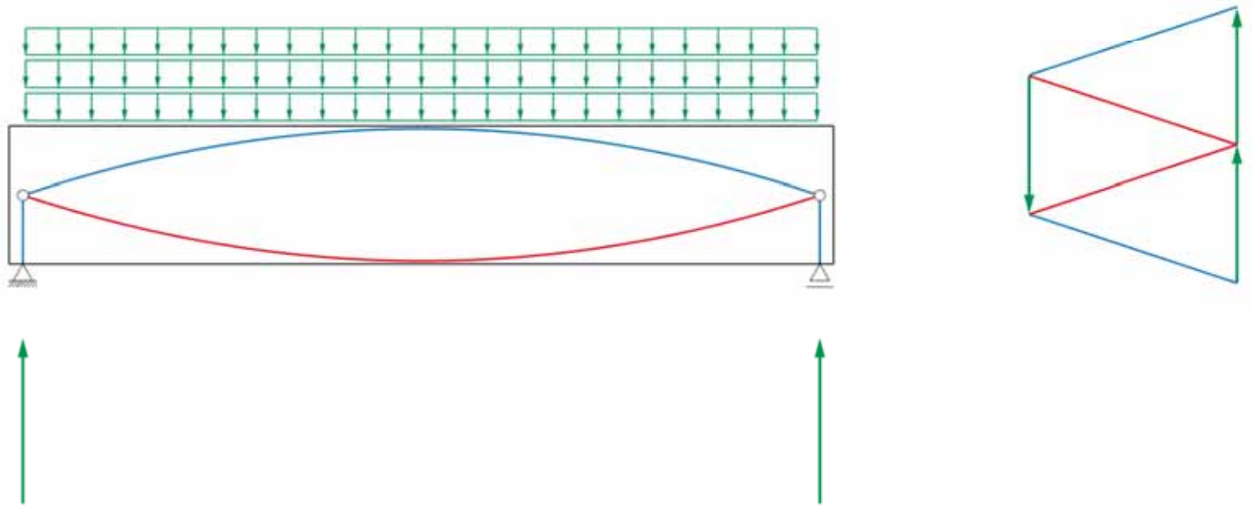

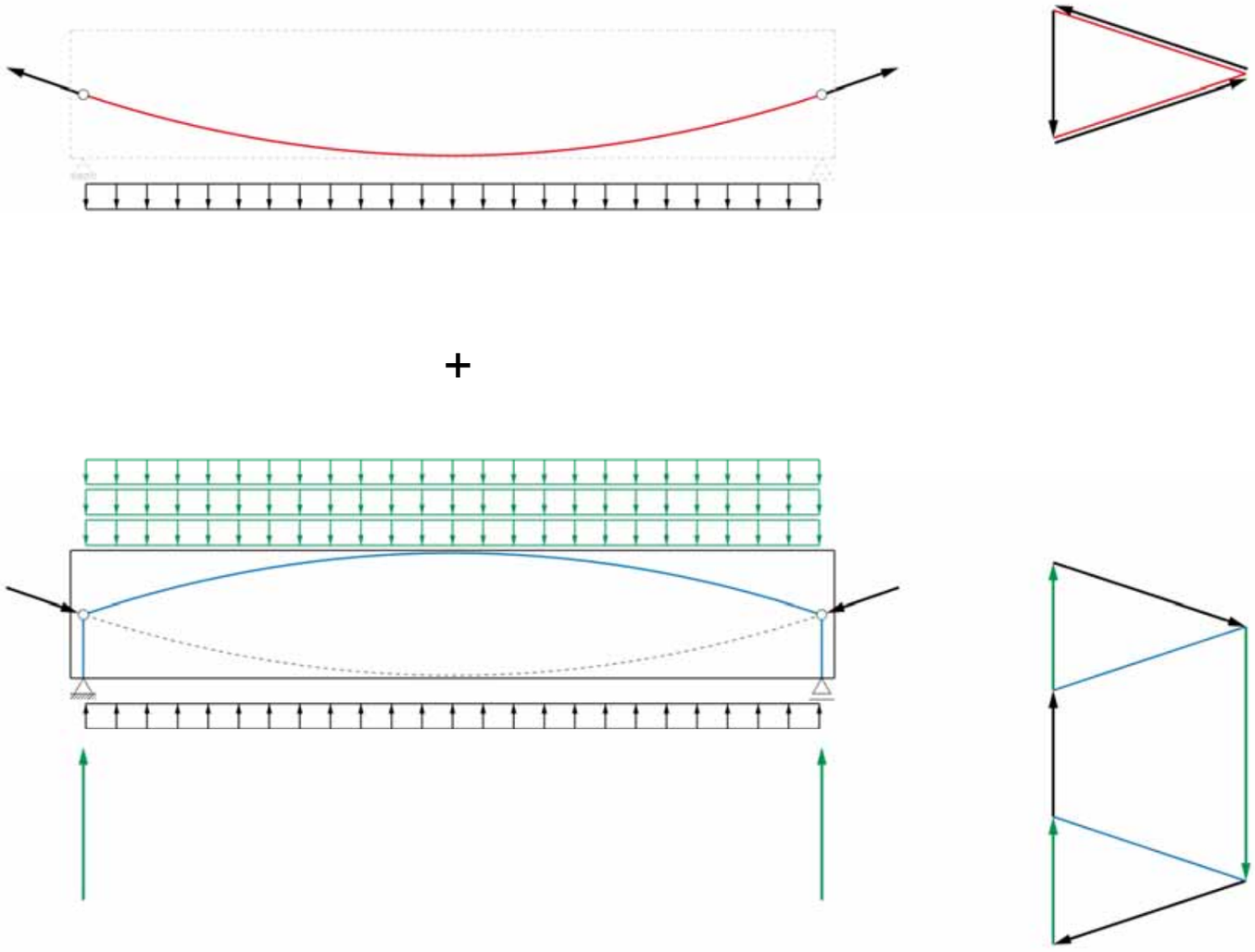

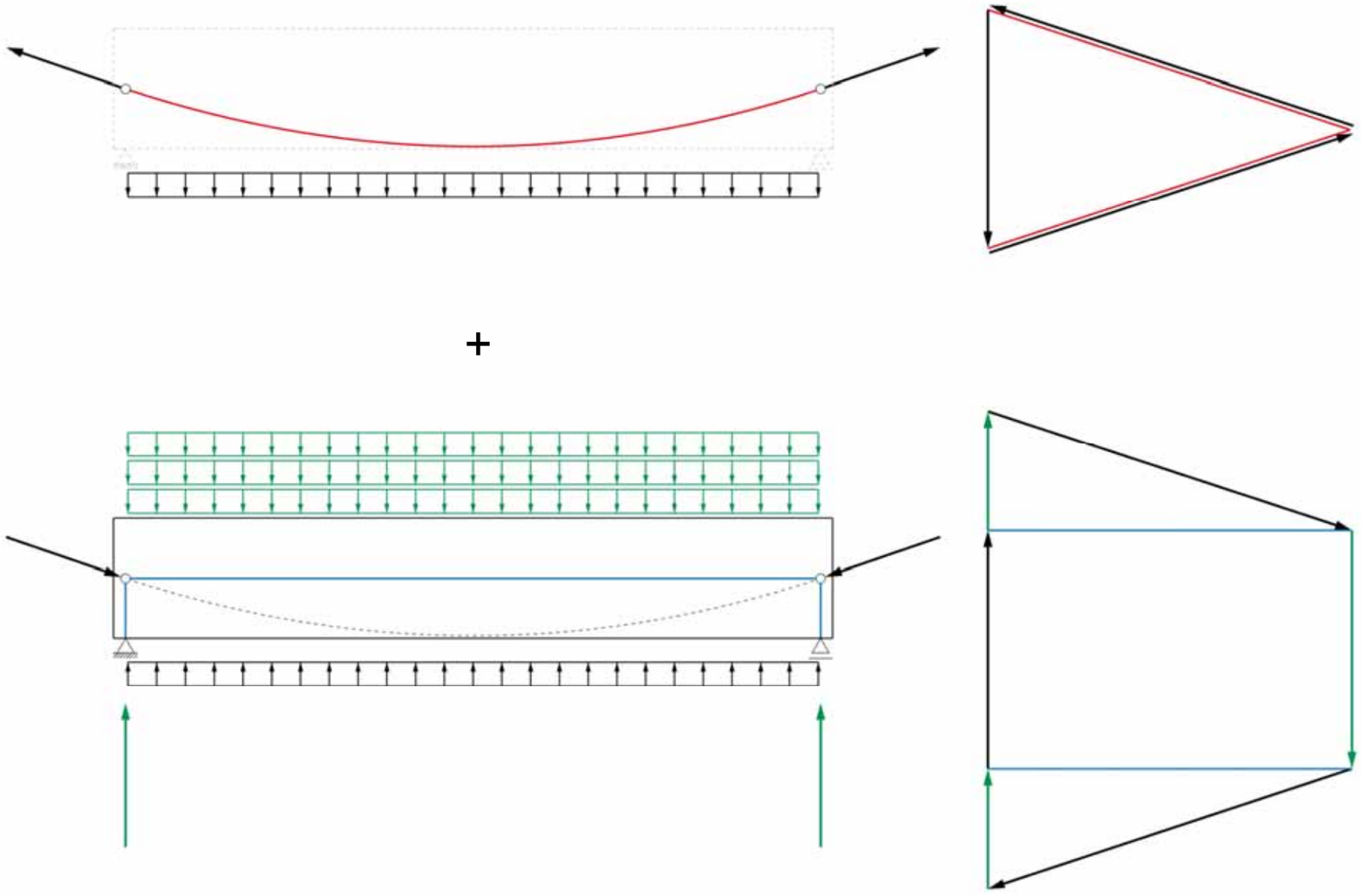

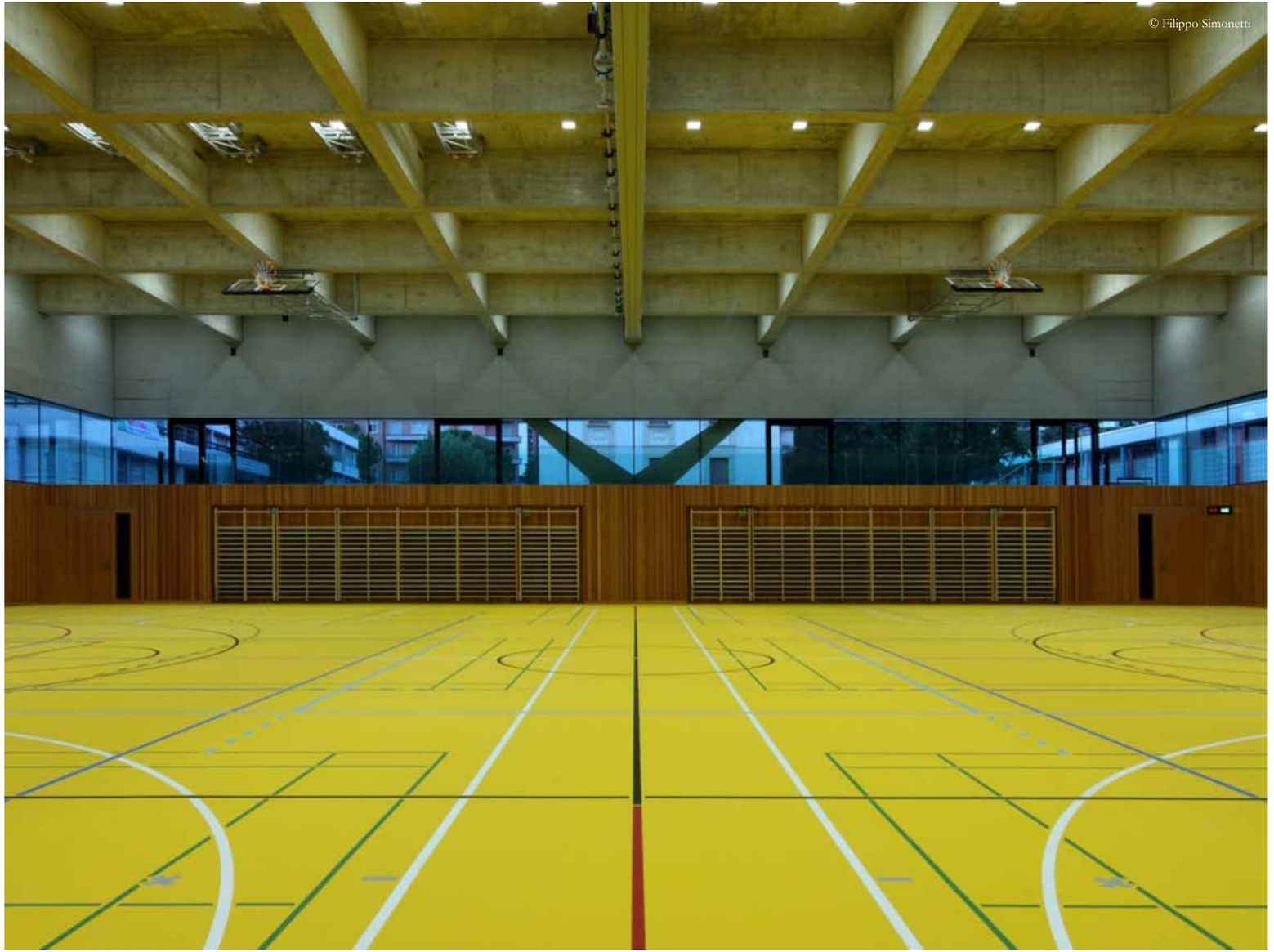
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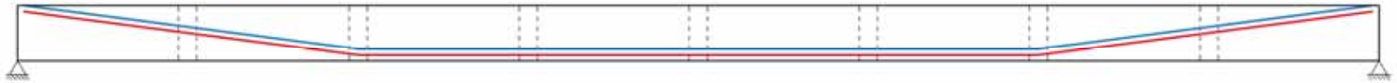

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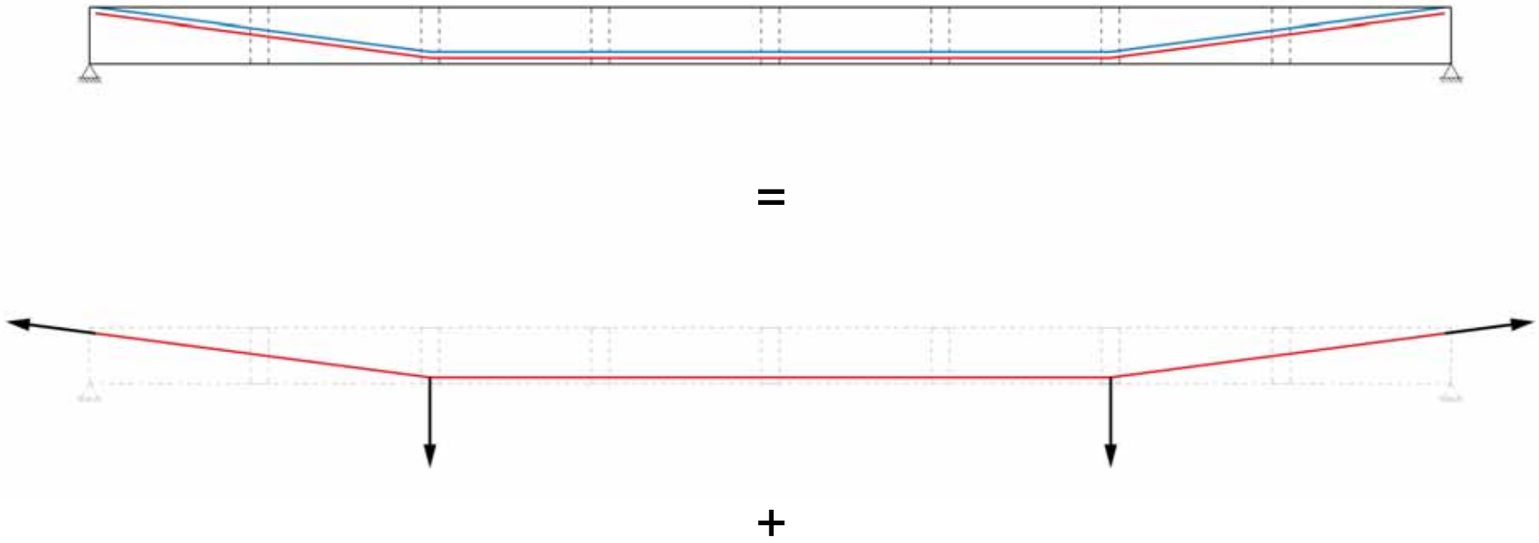

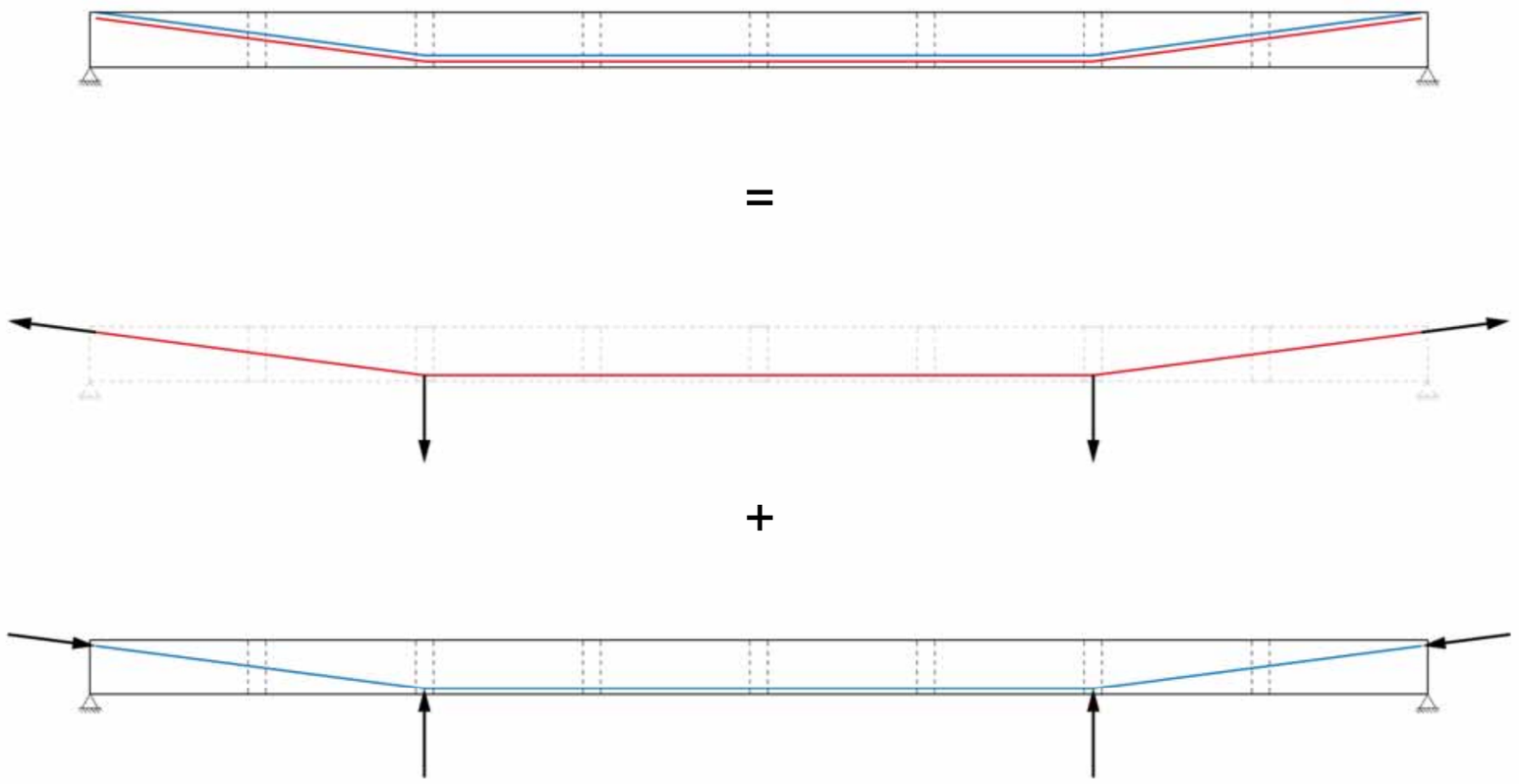

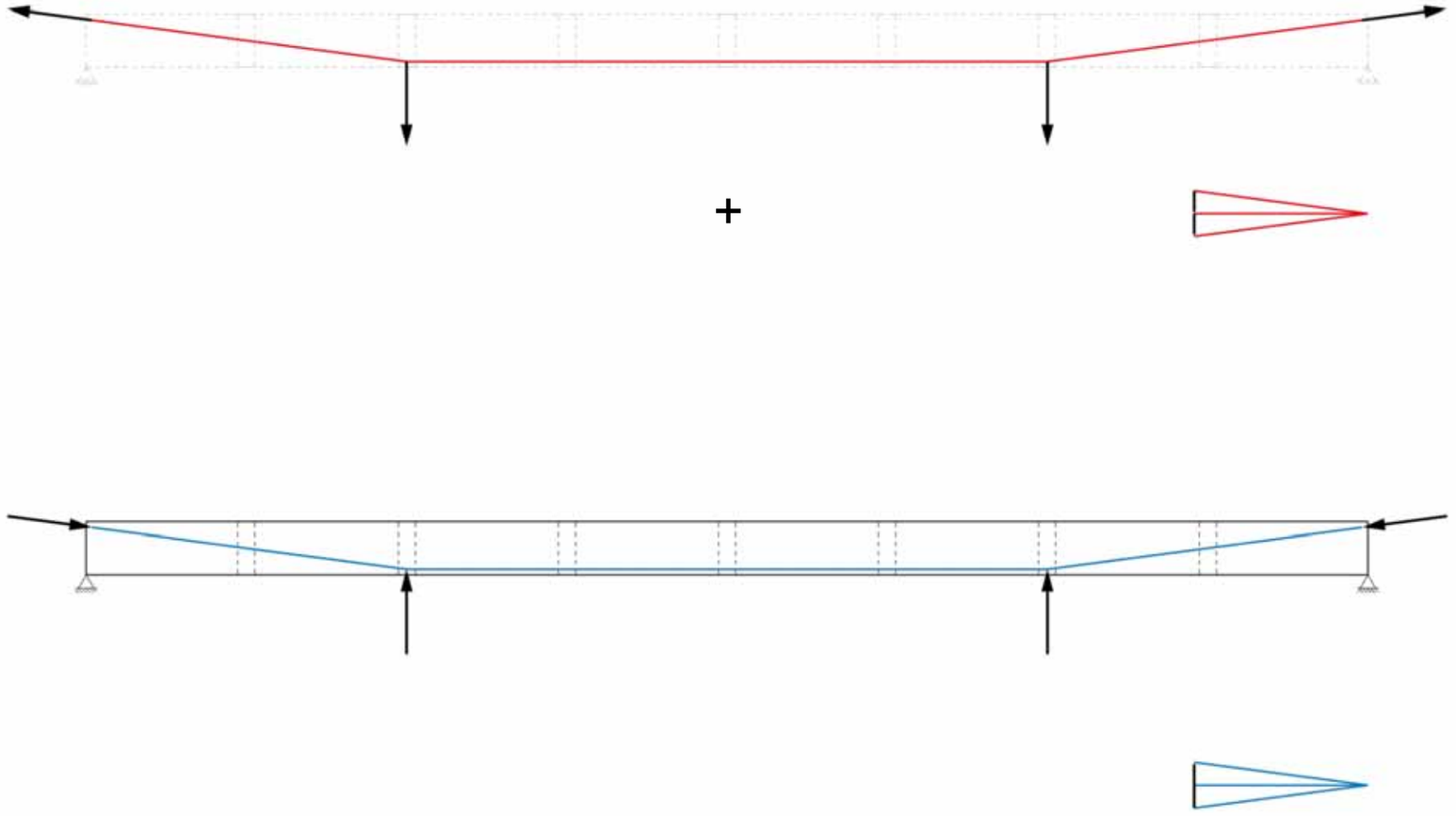

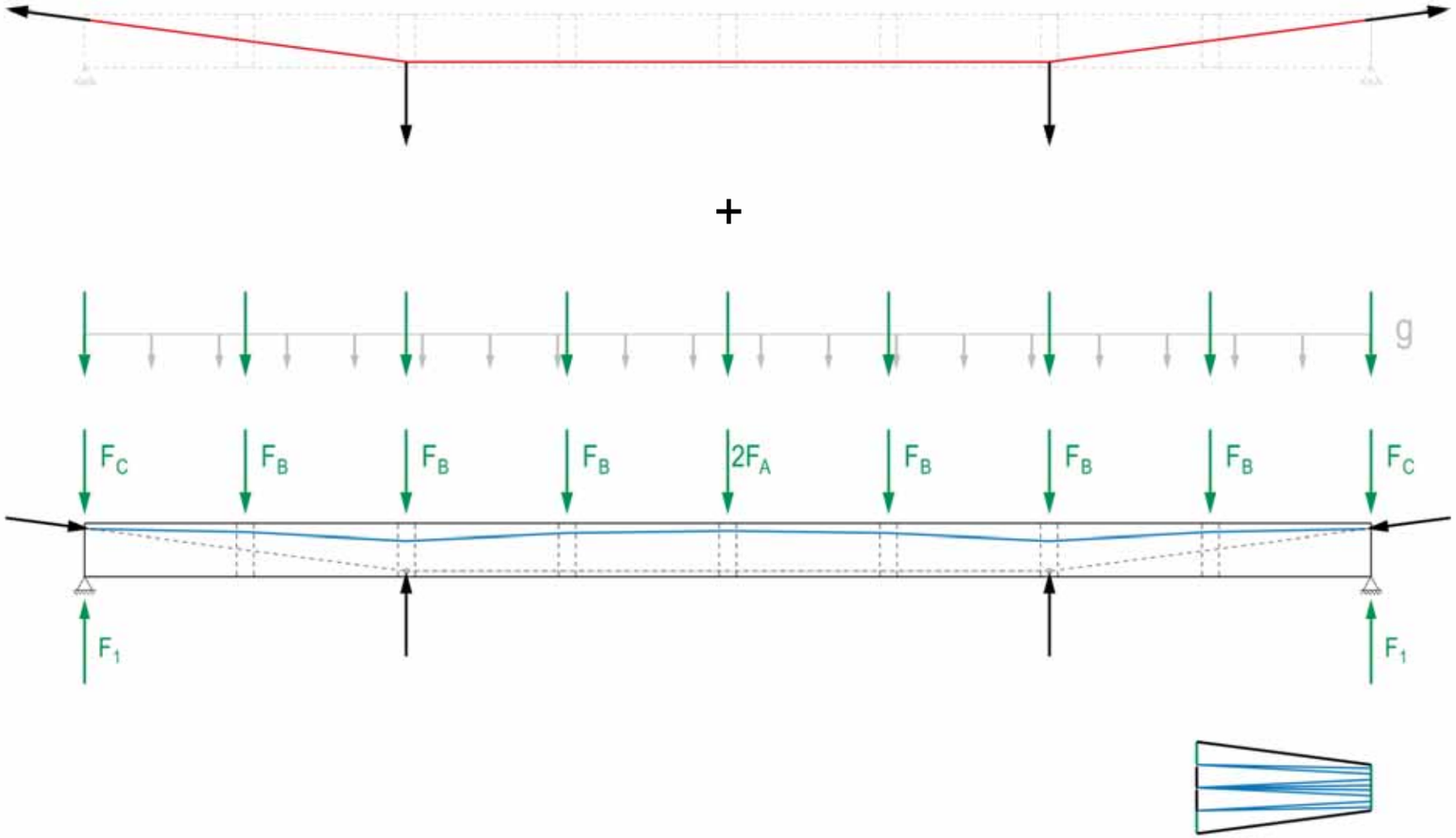
+
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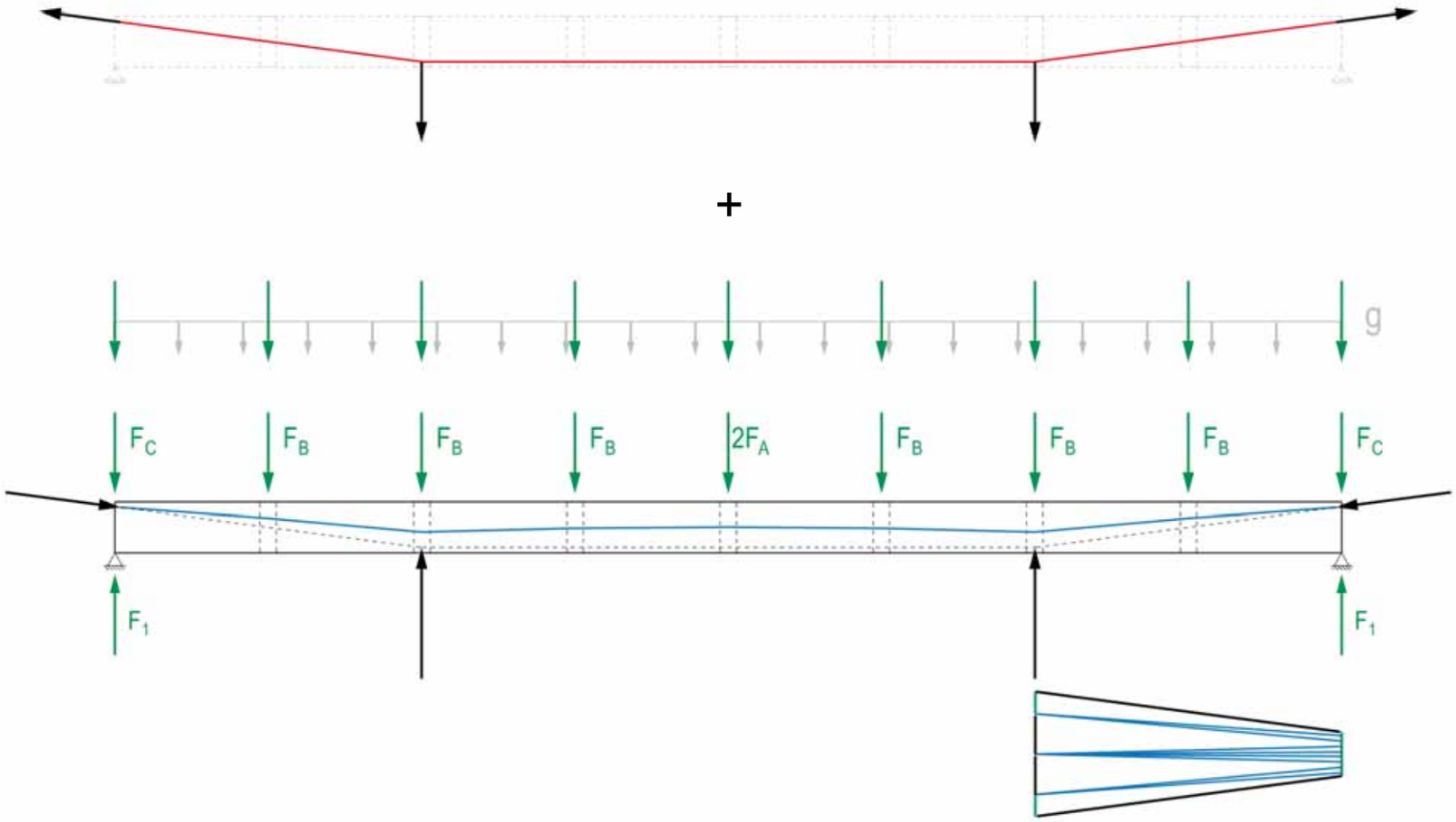
F_1


+
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F_B
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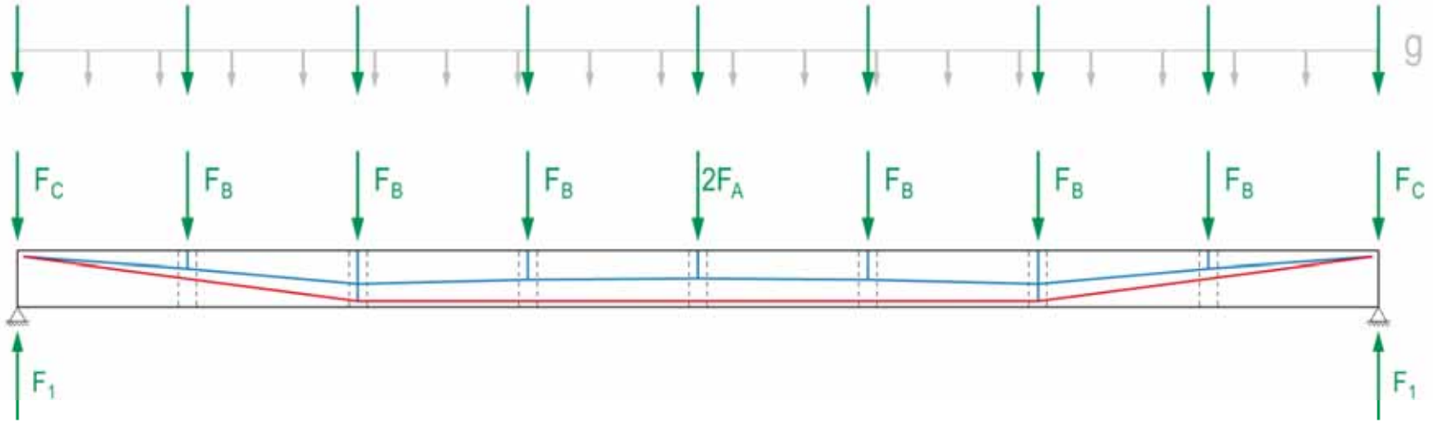
F_1
F_1


g
F_C
F_B
F_B
F_B
$2F_A$
F_B
F_B
F_B
F_C
F_1
F_1

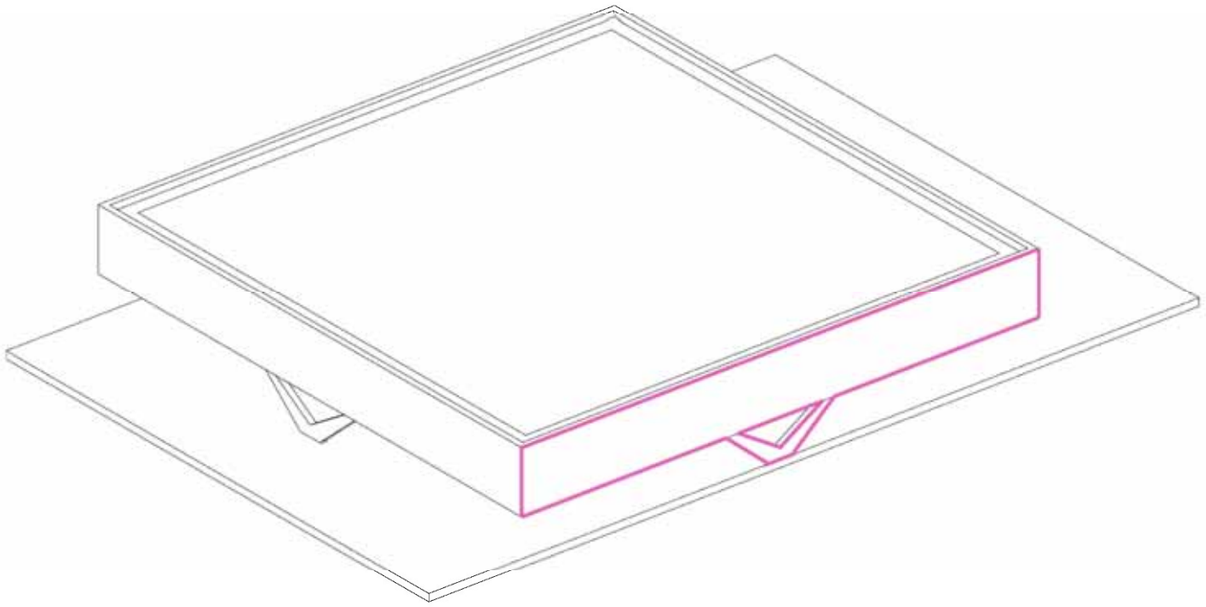
Position Vorspannseile Dachträger/Außenwand
Maßstab 1:200

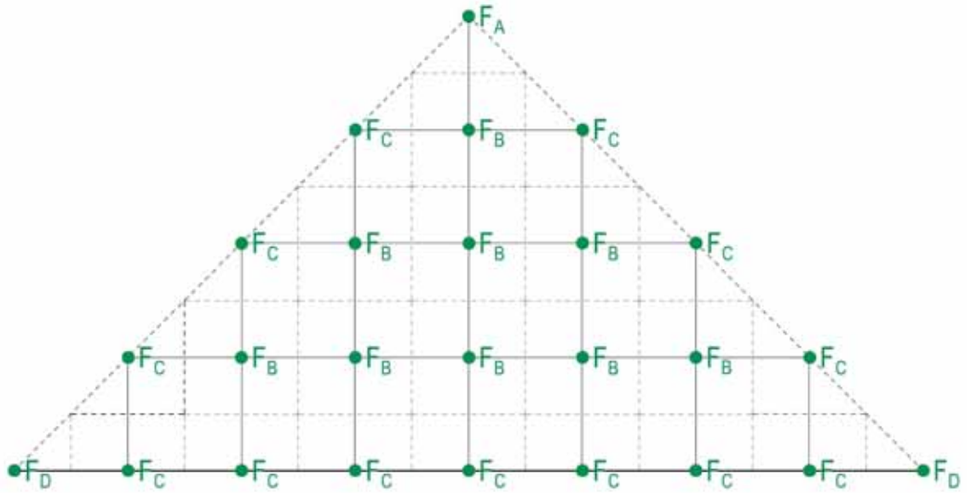
1 Dachträger
2 Spannseil Stahl in Hüllrohr Ø 116 mm
3 Spannseil Stahl in Hüllrohr Ø 91 mm
4 seitliche Spannseilverankerung
5 Stahlbeton-Wandscheibe
6 Spannseil Stahl in Hüllrohr Ø 73 mm

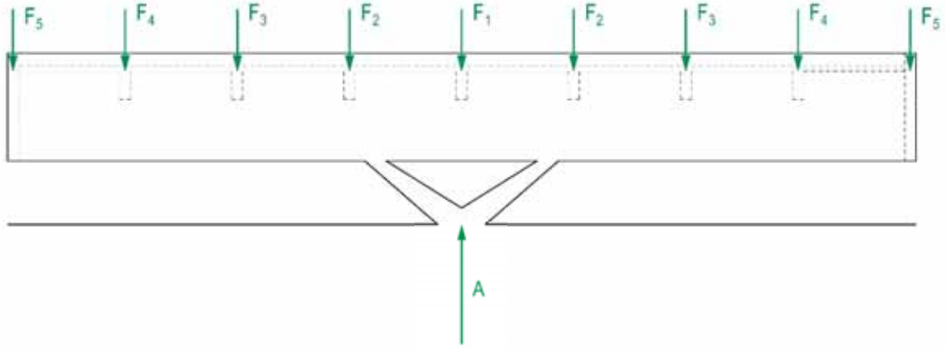
Pre-tension cables Roof beams/Exterior wall
Scale 1:200

1 roof beam
2 steel tension cable in Ø 116 mm tube
3 steel tension cable in Ø 91 mm tube
4 lateral tension-cable anchor
5 lateral reinforced-concrete slab
6 steel tension cable in Ø 73 mm tube

Vorspannen der Wand
Pretensioning of the wall







Loads from grid beams

$F_1 = F_A + 3 \cdot F_B + F_C = 730.8$ kN

$F_2 = 2 \cdot F_C + 2 \cdot F_B = 584.6$ kN

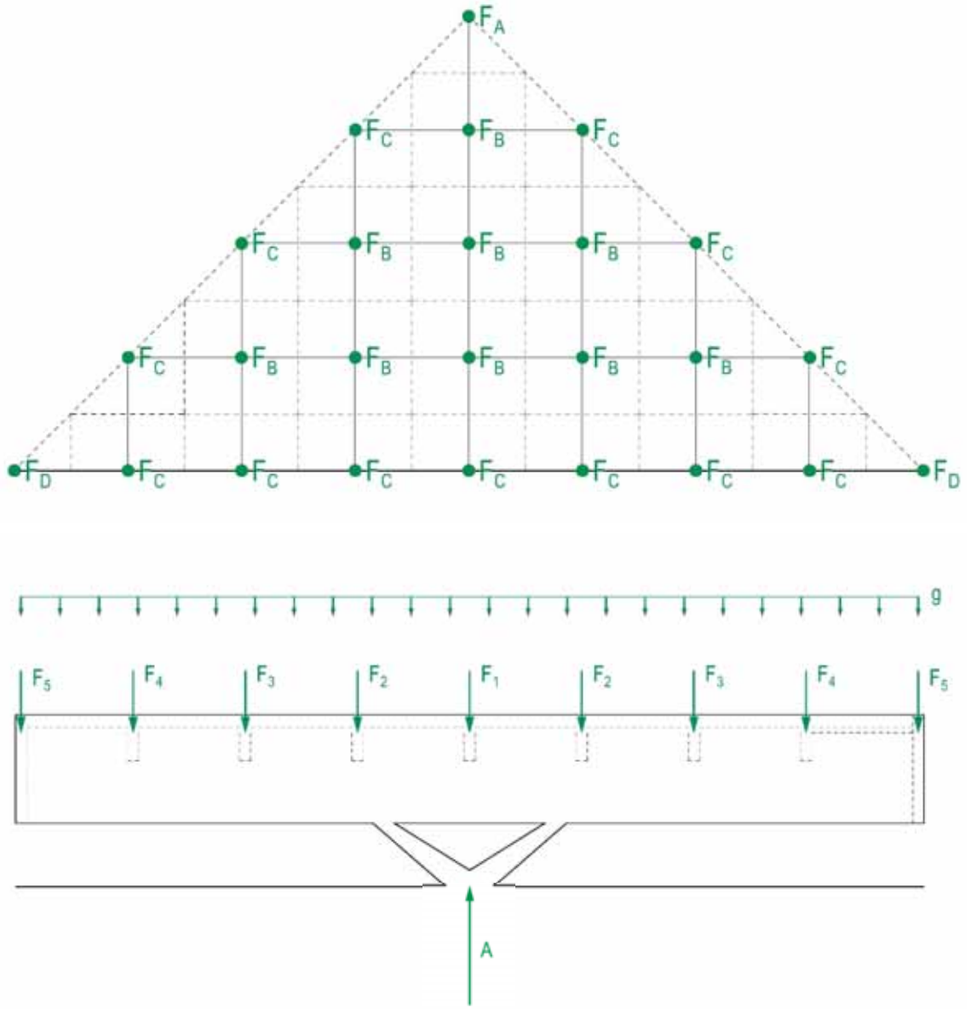
$F_3 = 2 \cdot F_C + F_B = 389.7$ kN

$F_4 = 2 \cdot F_C = 194.8$ kN

$F_5 = F_D = 24.4$ kN

Façade beam (33.2 x 3.9 x 0.4 m)

Dead loads (Grid beams + Self weight)



Loads from grid beams

$F_1 = F_s + 3 \cdot F_B + F_C = 730.8$ kN

$F_2 = 2 \cdot F_C + 2 \cdot F_B = 584.6$ kN

$F_3 = 2 \cdot F_C + F_B = 389.7$ kN

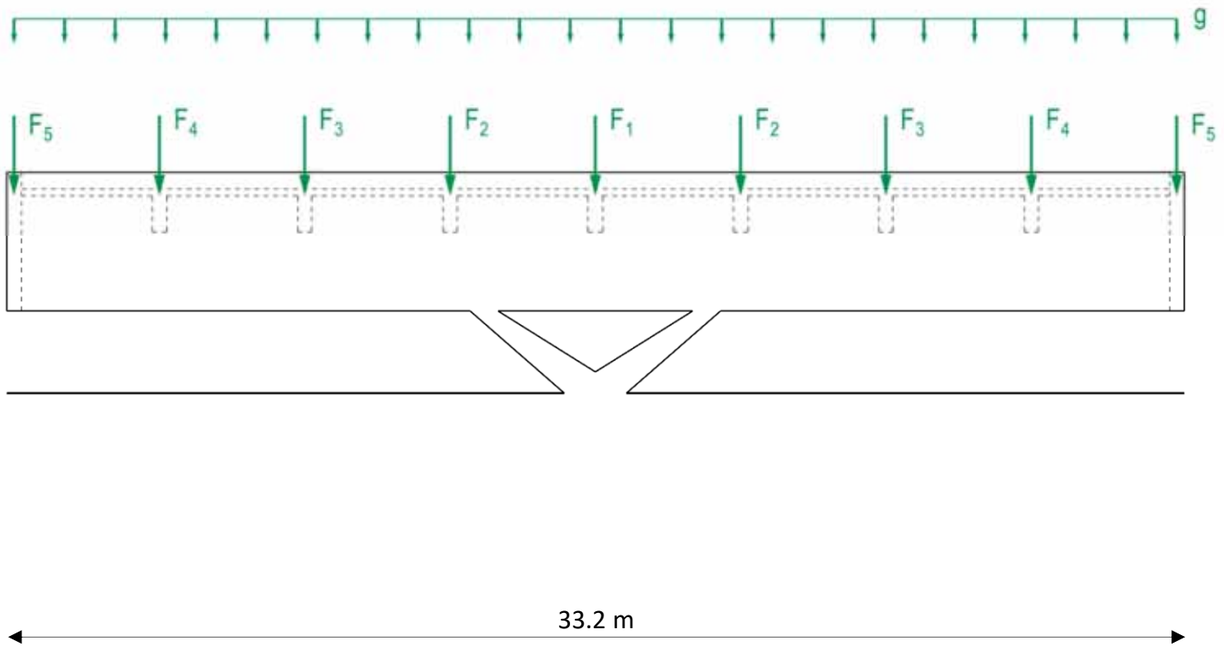
$F_4 = 2 \cdot F_C = 194.8$ kN

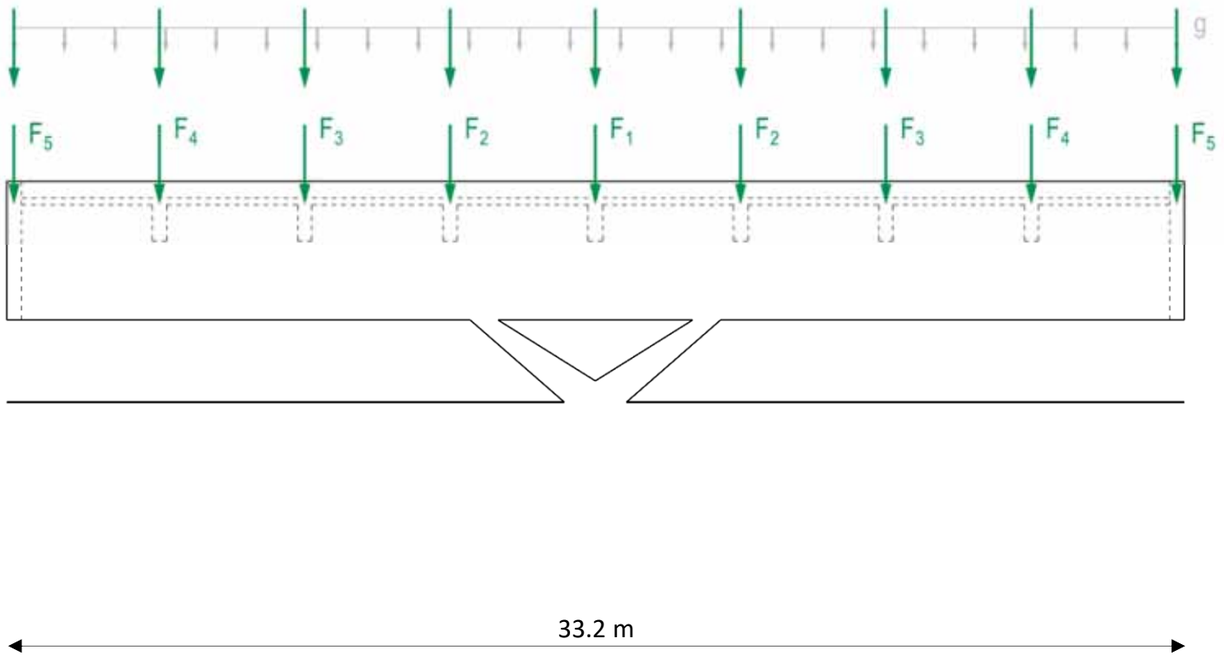
$F_5 = F_D = 24.4$ kN

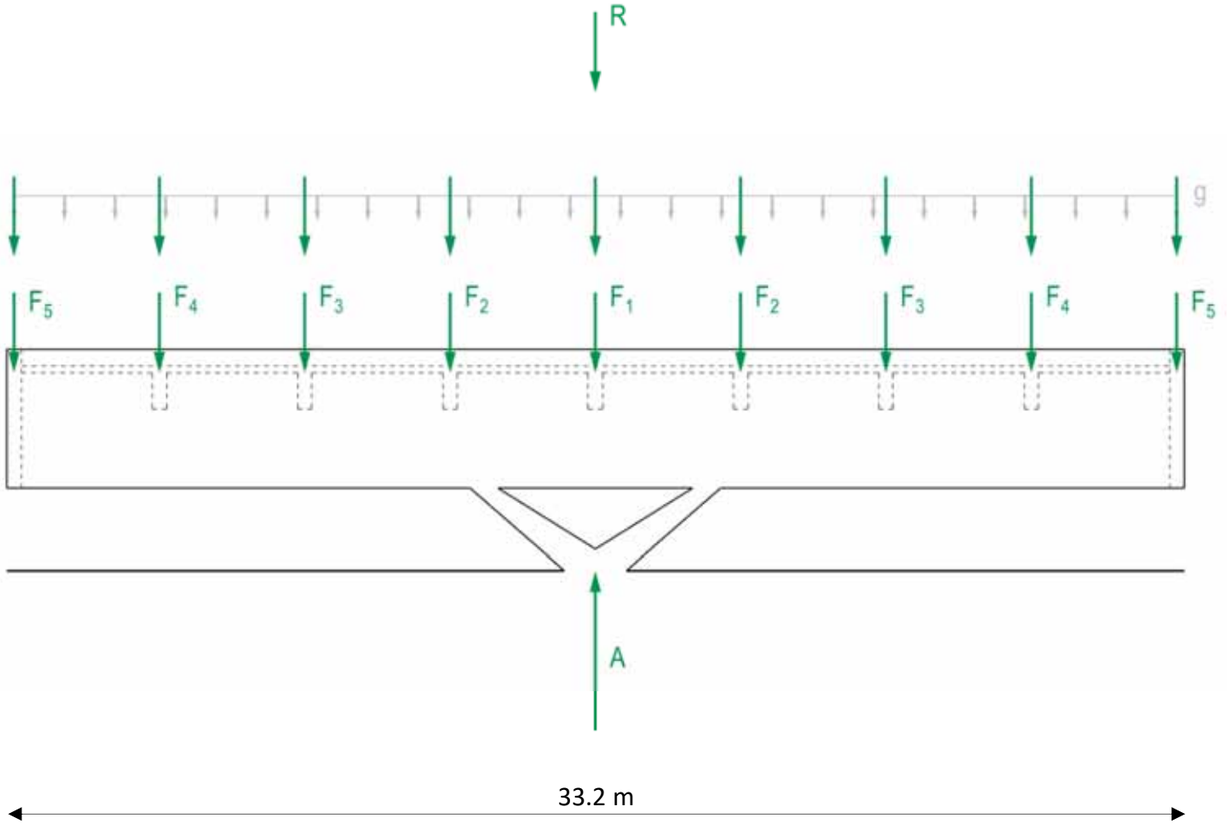
Façade beam (33.2 x 3.9 x 0.4 m)

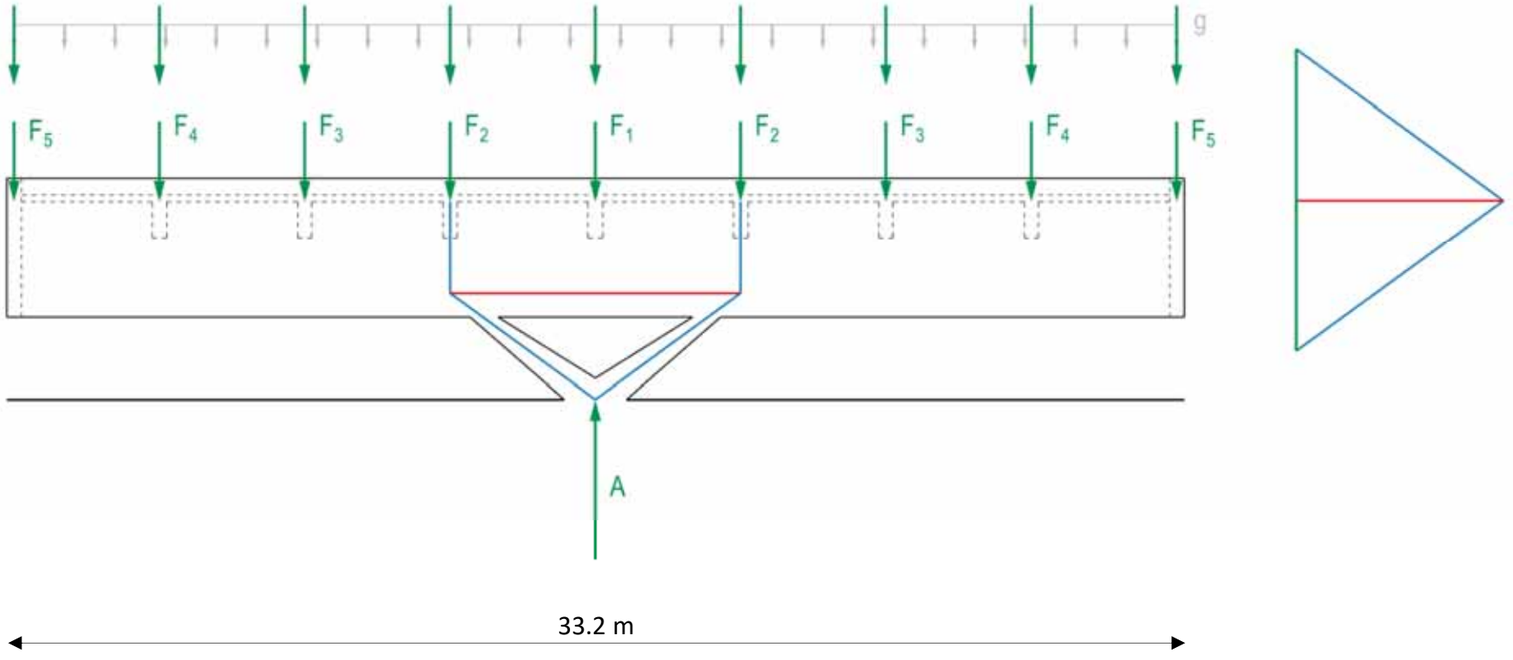
Dead loads (Grid beams + Self weight)
$g_{facade} = (3.9 \text{ m} \cdot 0.4 \text{ m}) \cdot 25 \text{ kN/m}^3 =$
$= 39$ kN/m

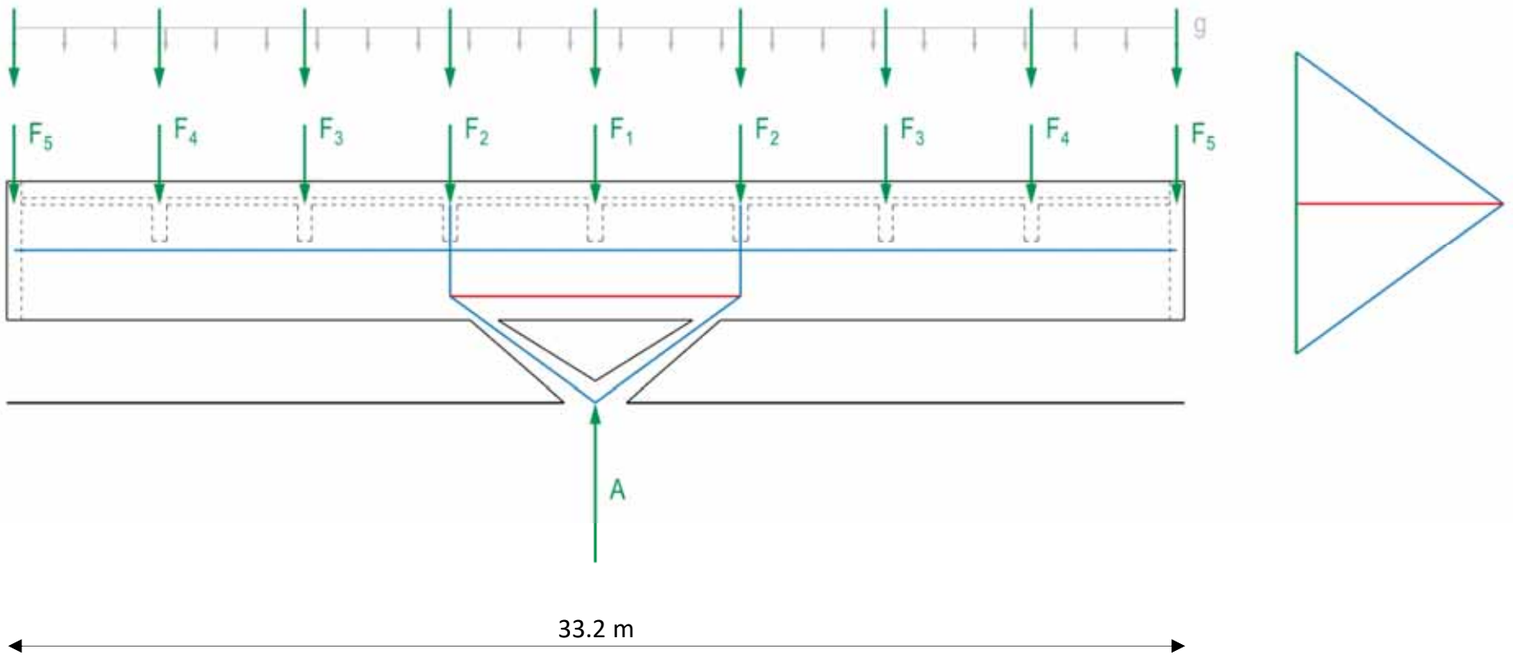
$q_{d,facade} = 1.35 \cdot g_{facade} = 52.7$ kN/m

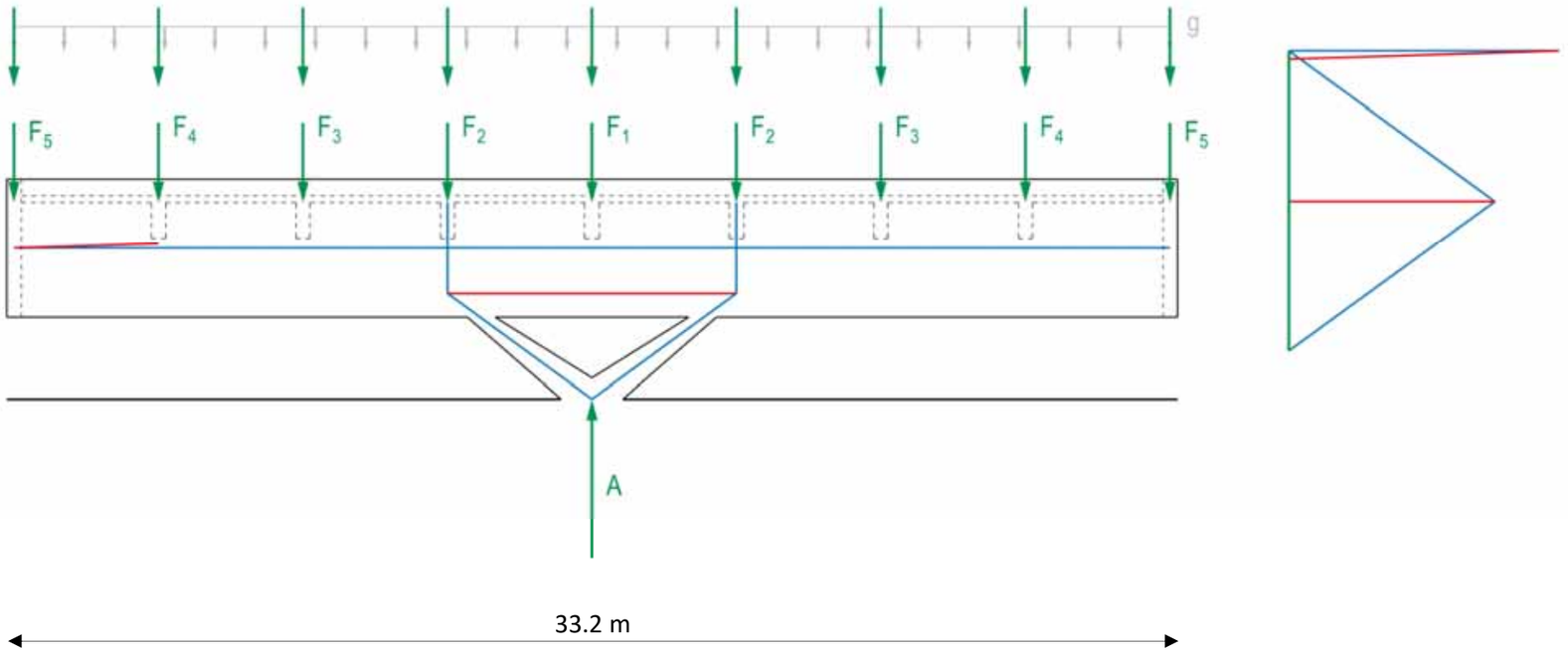

g
F5
F4
F3
F2
F1
F2
F3
F4
F5
33.2 m

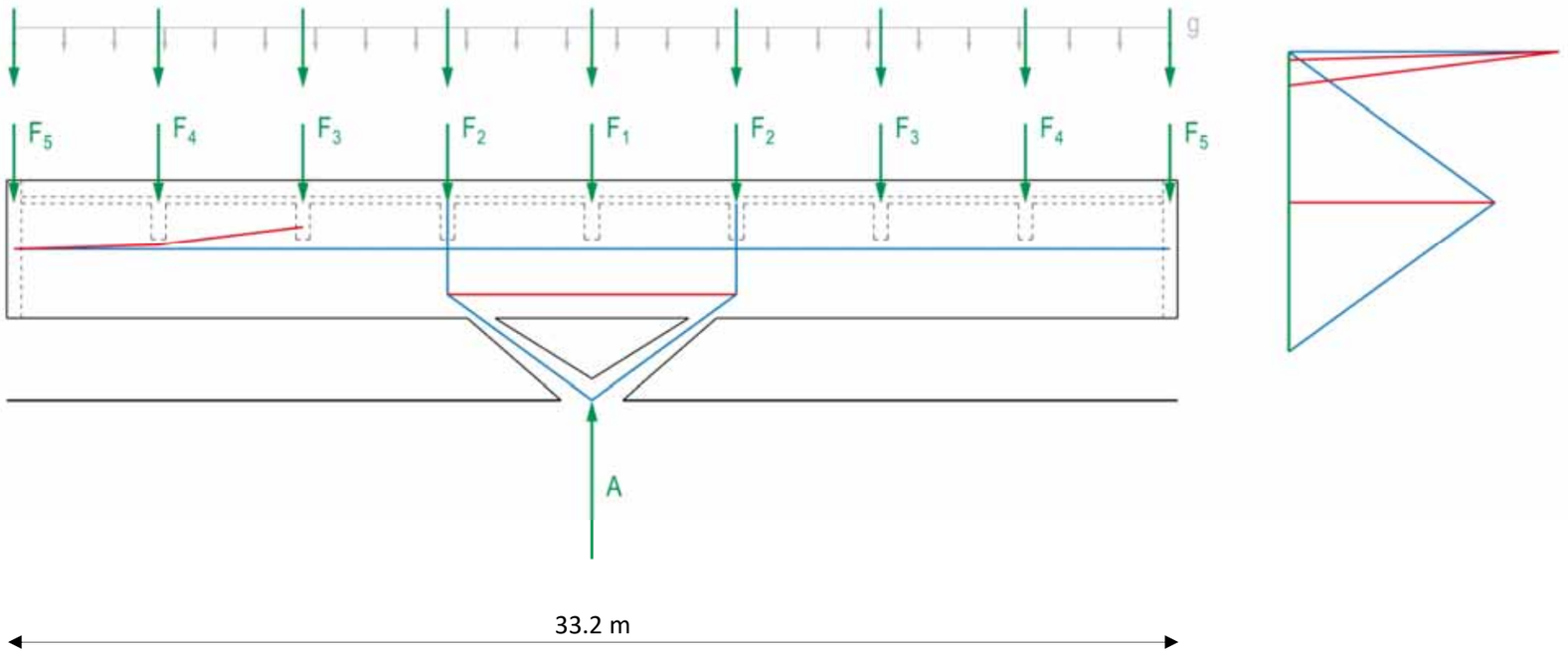

g
F5
F4
F3
F2
F1
F2
F3
F4
F5
33.2 m

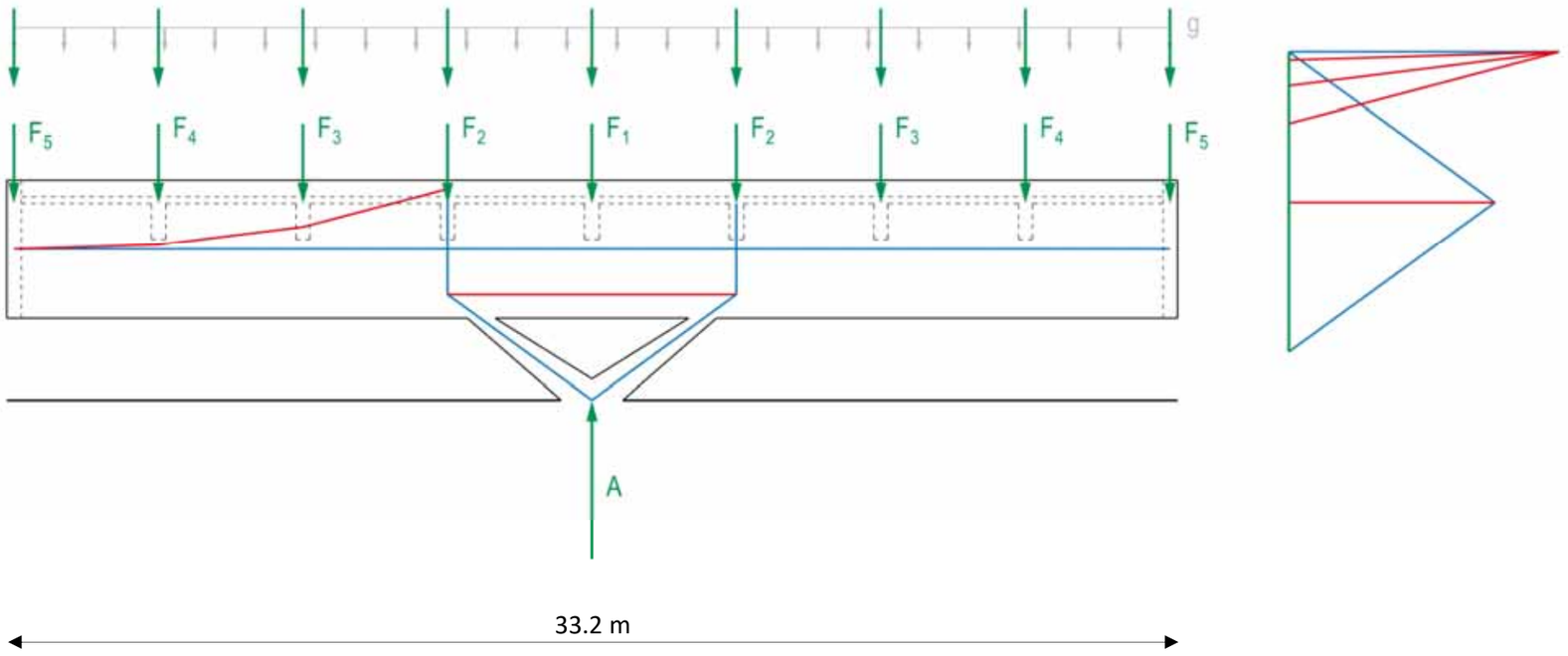

R
g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m

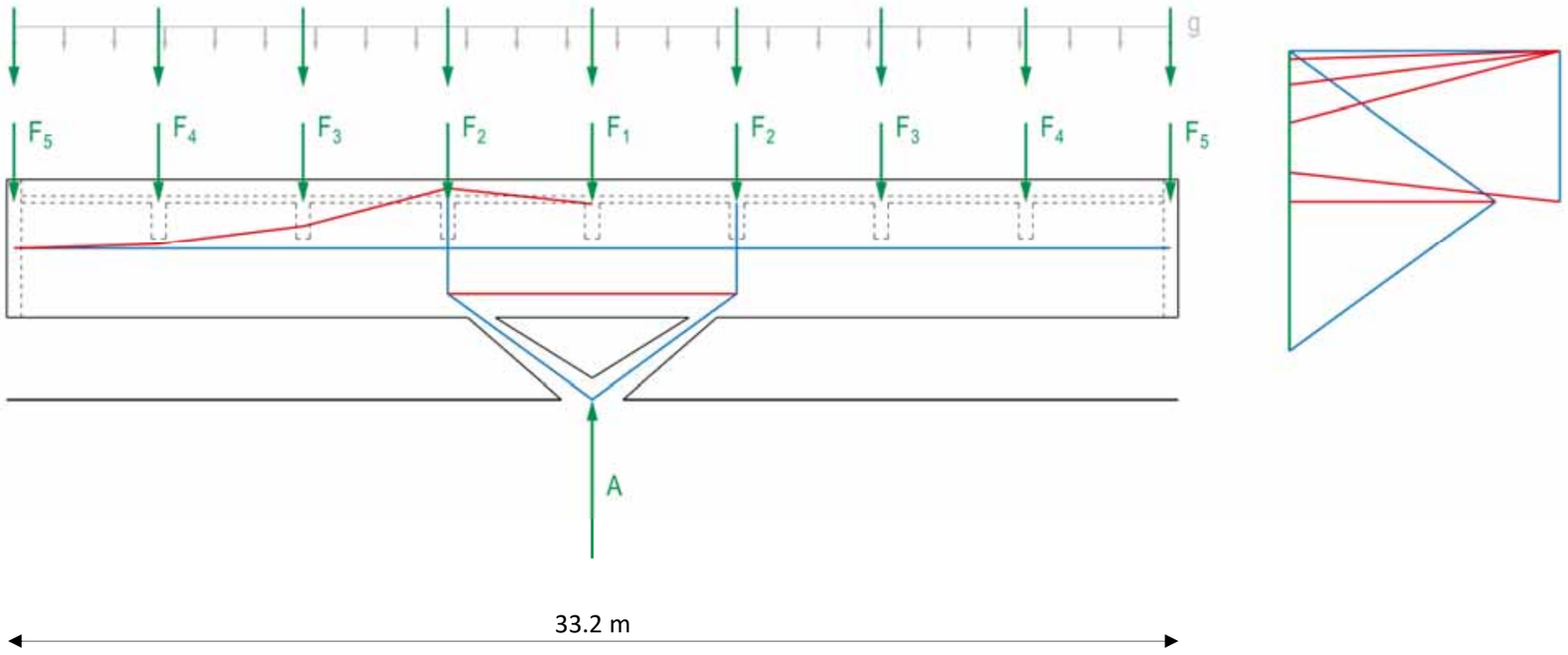

g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m

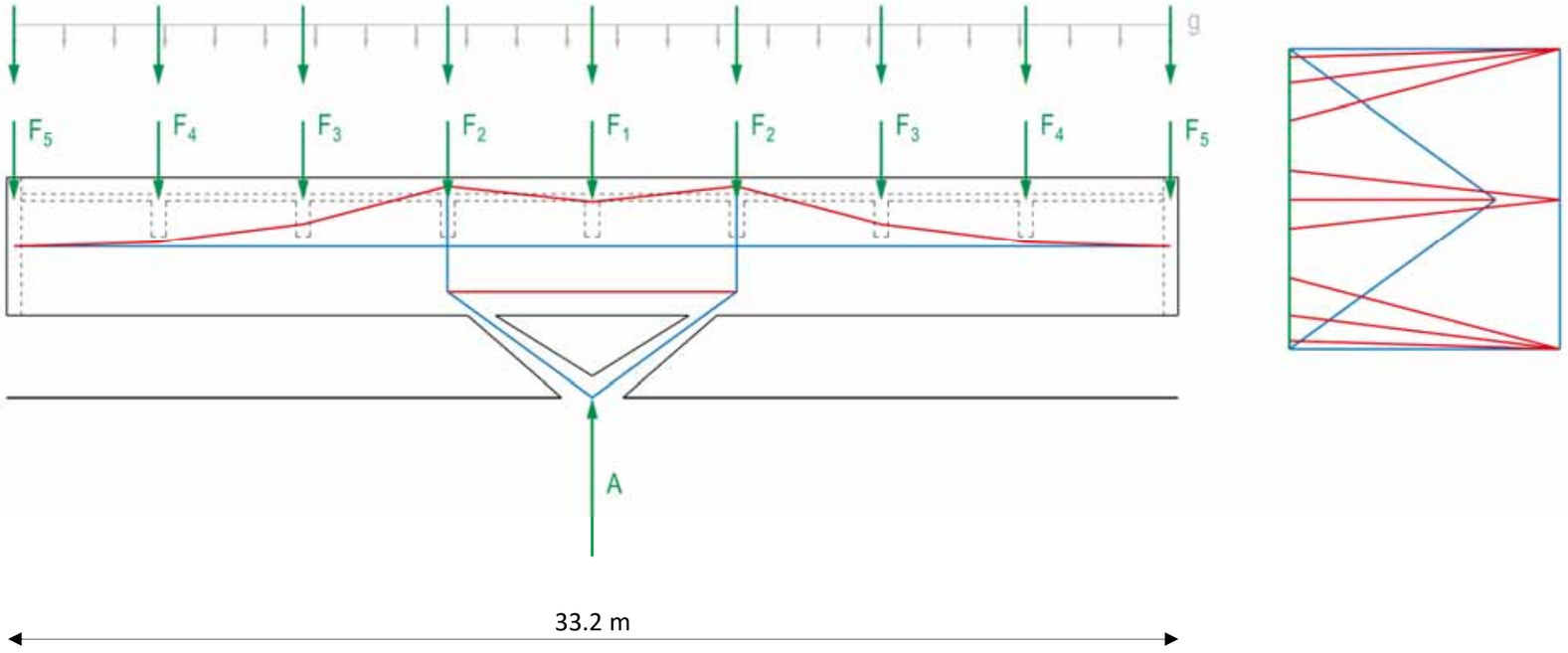

g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m


g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m


g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m


g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m


g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m

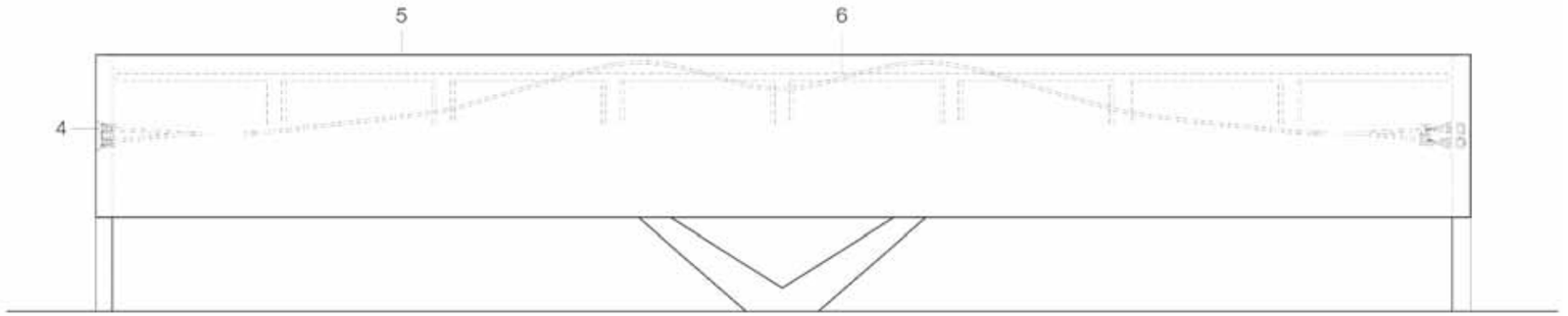

g
F5
F4
F3
F2
F1
F2
F3
F4
F5
A
33.2 m

Position Vorspannseile
Dachträger/Außenwand
Maßstab 1:200

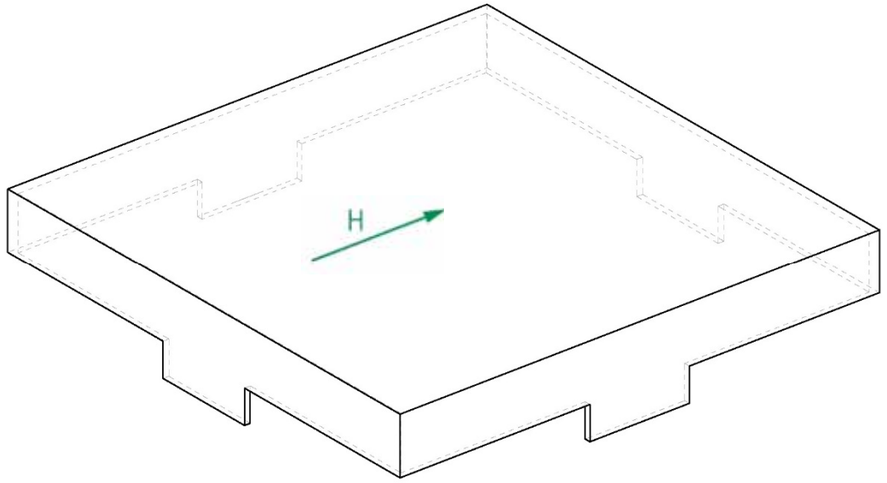
1 Dachträger
2 Spannseil Stahl in Hüllrohr Ø 116 mm
3 Spannseil Stahl in Hüllrohr Ø 91 mm
4 seitliche Spannseilverankerung
5 Stahlbeton-Wandscheibe
6 Spannseil Stahl in Hüllrohr Ø 73 mm

Pre-tension cables
Roof beams/Exterior wall
Scale 1:200

1 roof beam
2 steel tension cable in Ø 116 mm tube
3 steel tension cable in Ø 91 mm tube
4 lateral tension-cable
5 anchor lateral reinforced-concrete slab
6 steel tension cable in Ø 73 mm tube



Pretensioning of the wall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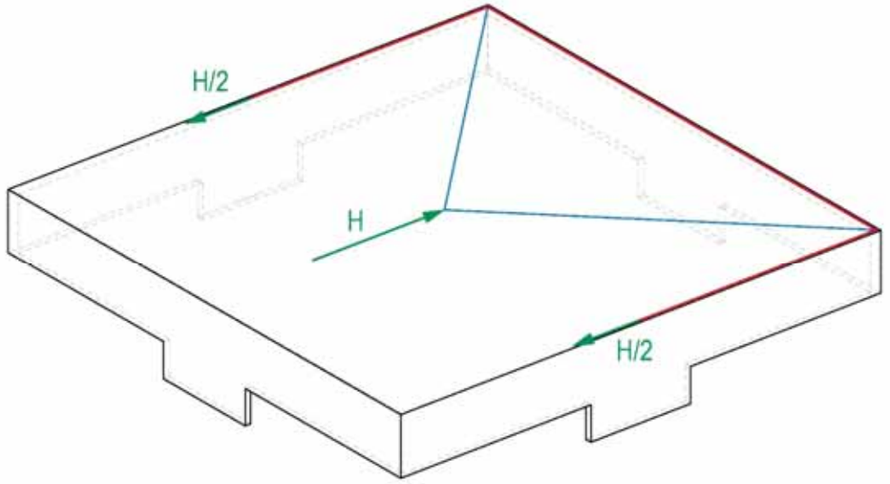
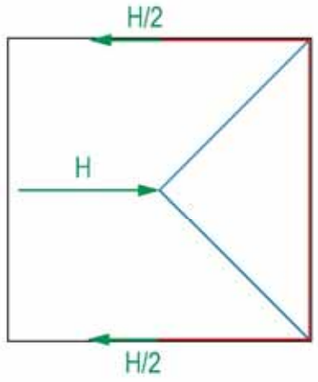

H/2
H
H/2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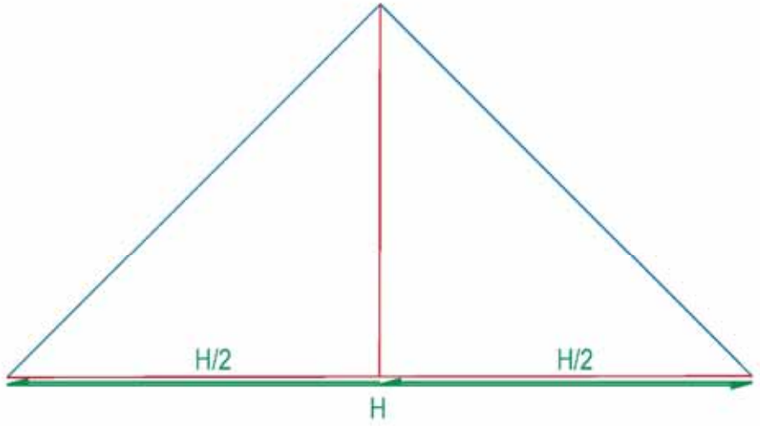
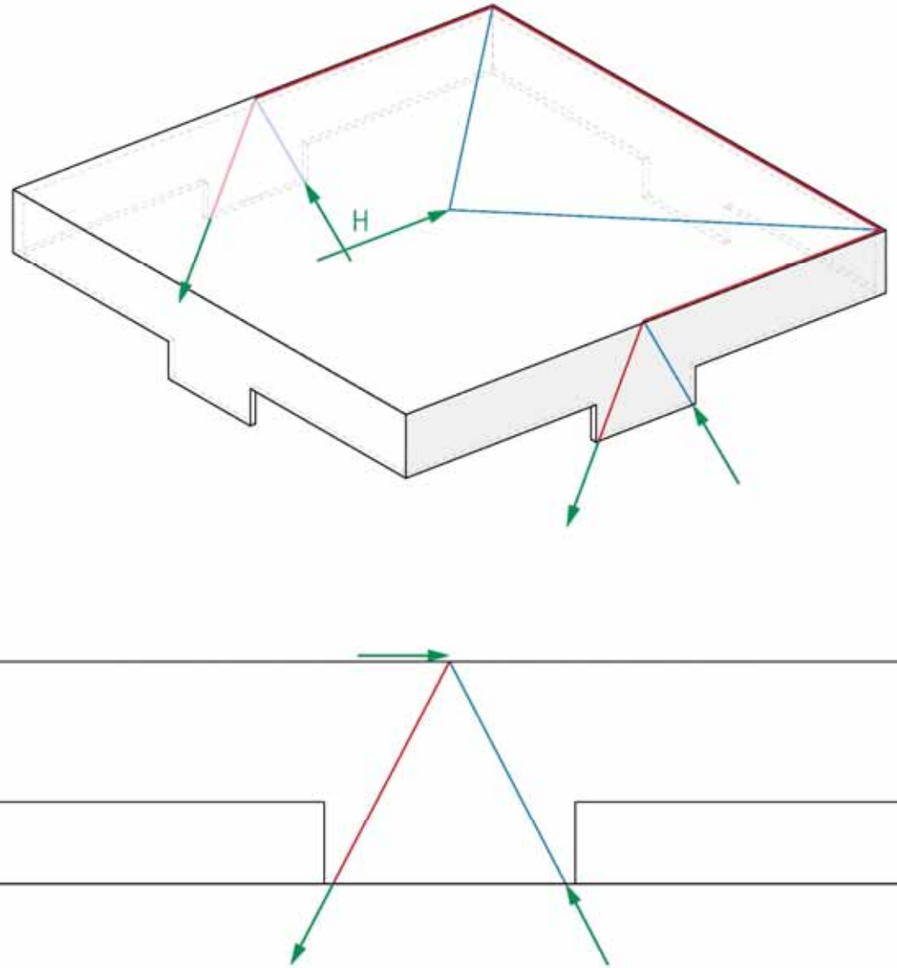
H
H/2


H/2
H/2
H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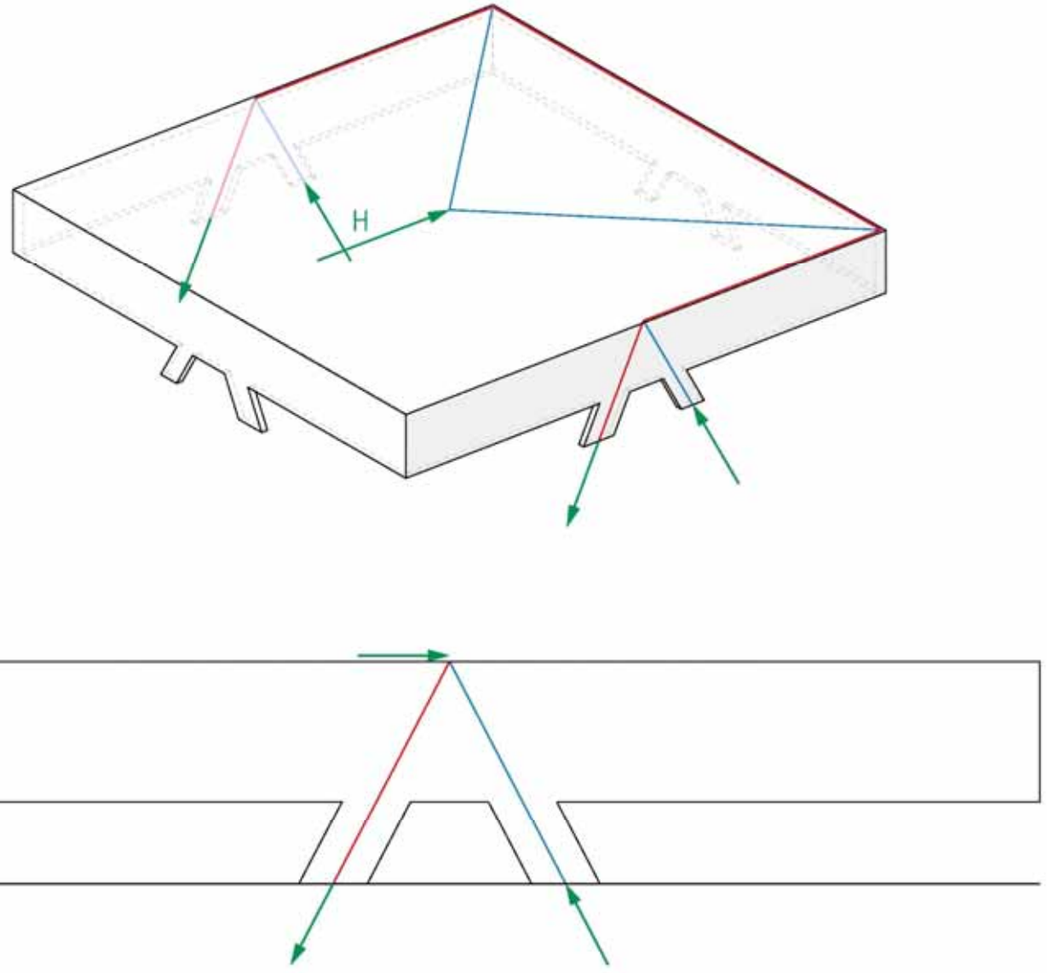
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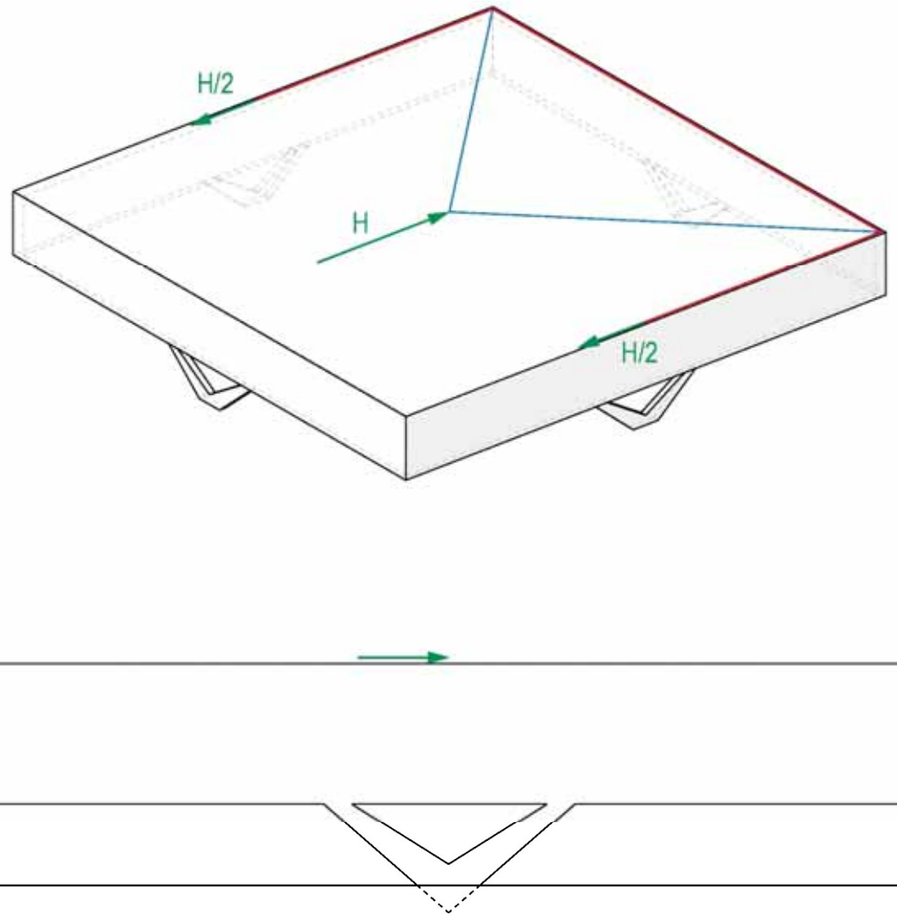
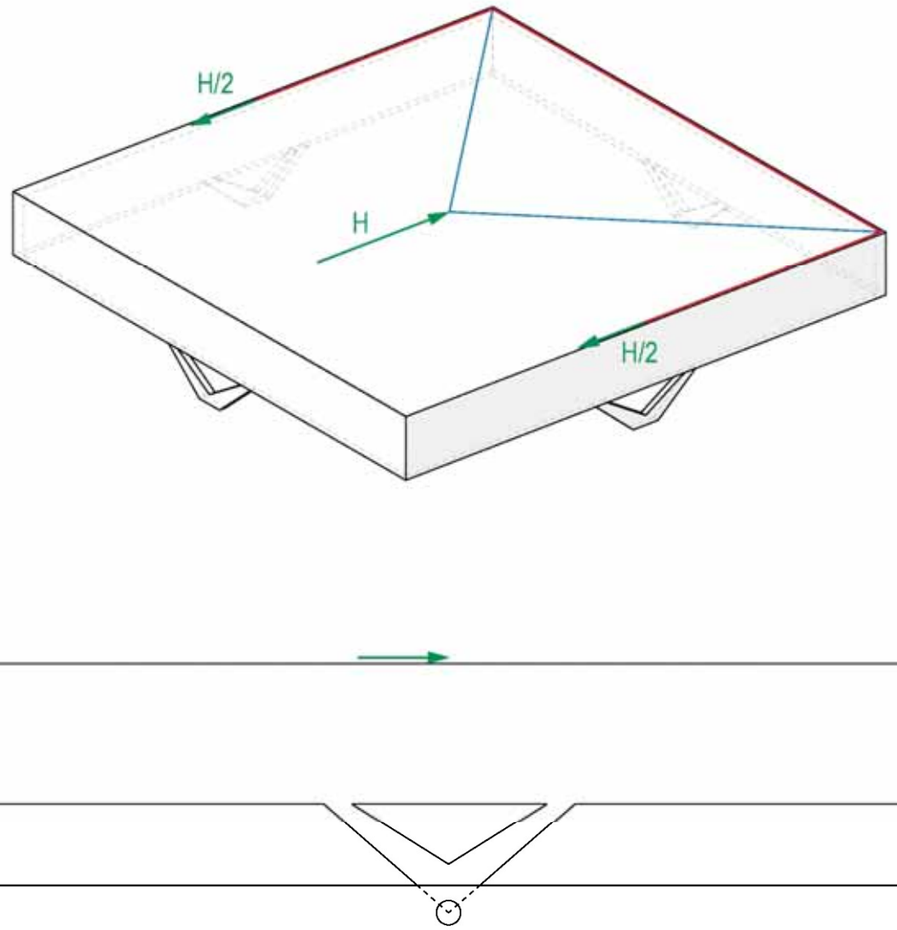
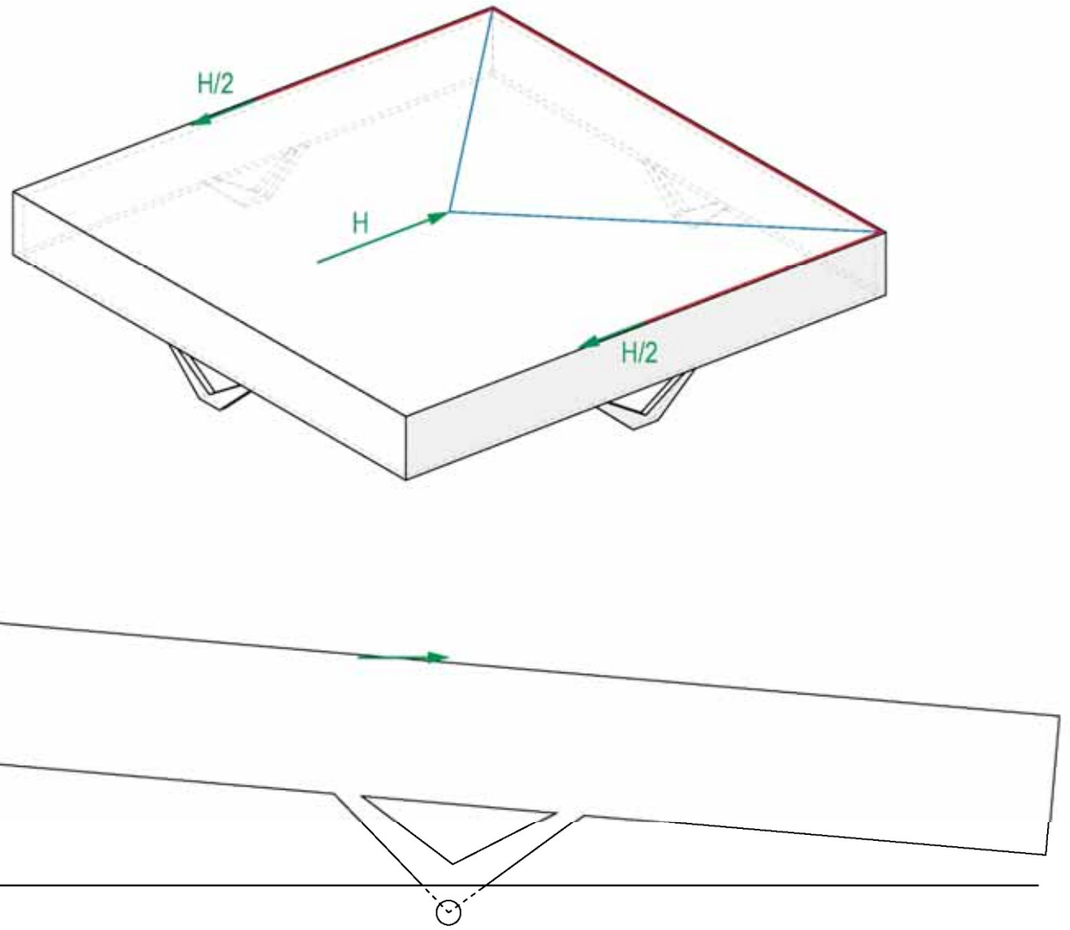
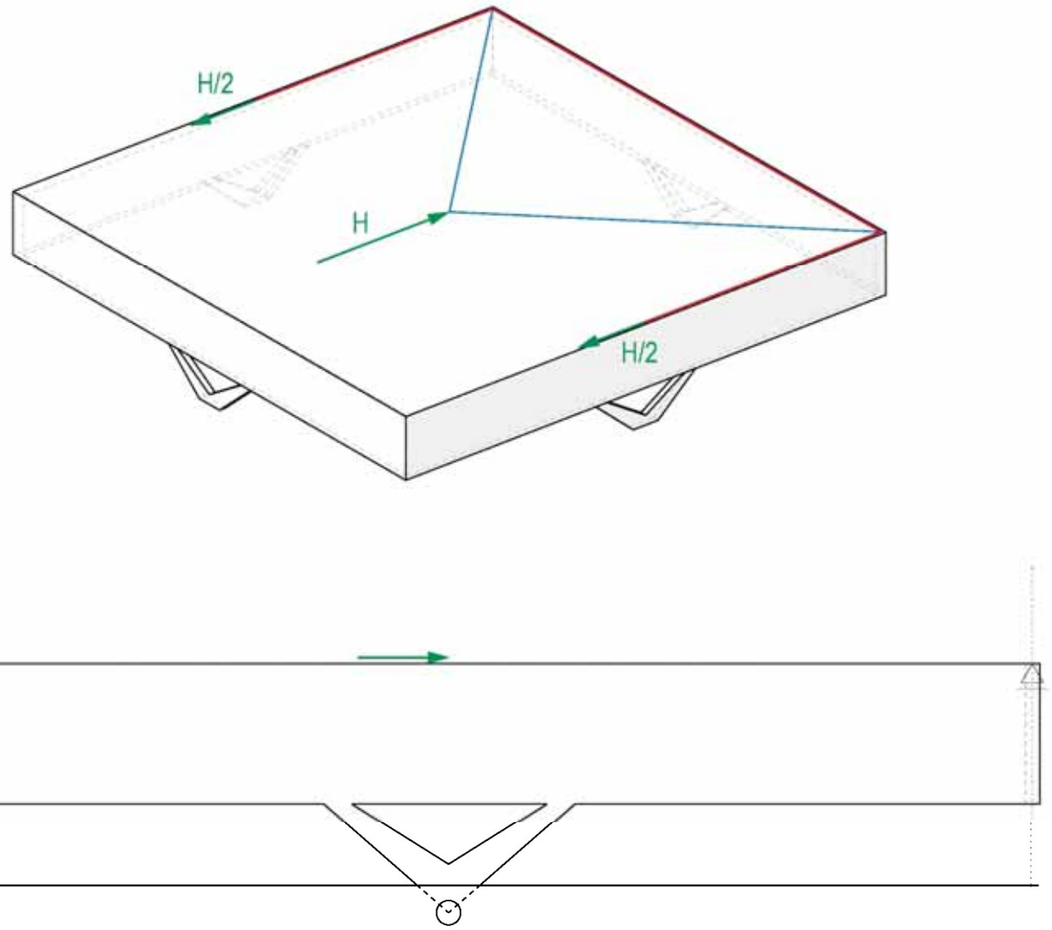

H/2
H
H/2


H/2
H
H/2


H/2
H
H/2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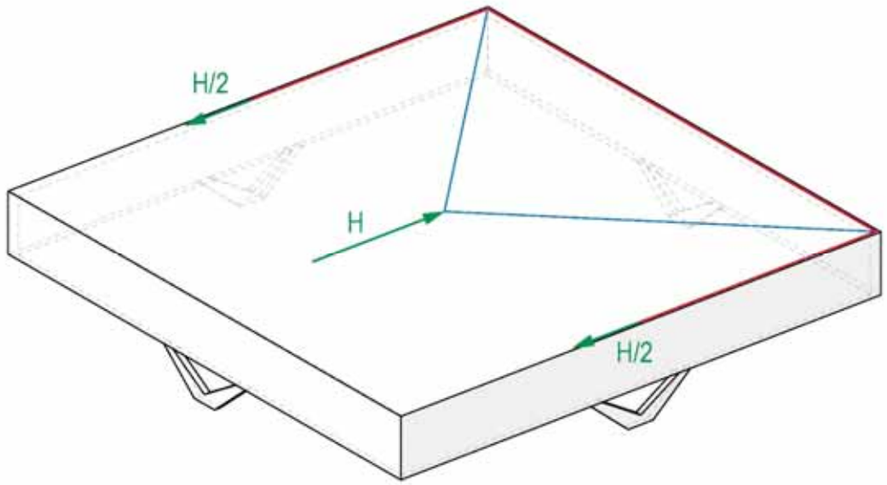
H
H/2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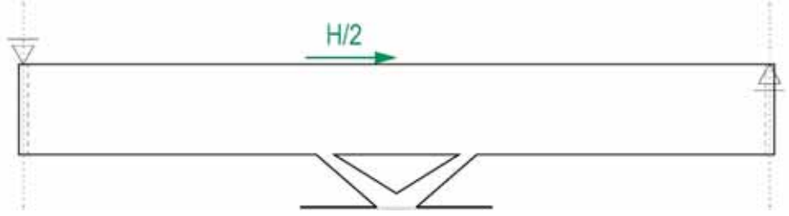
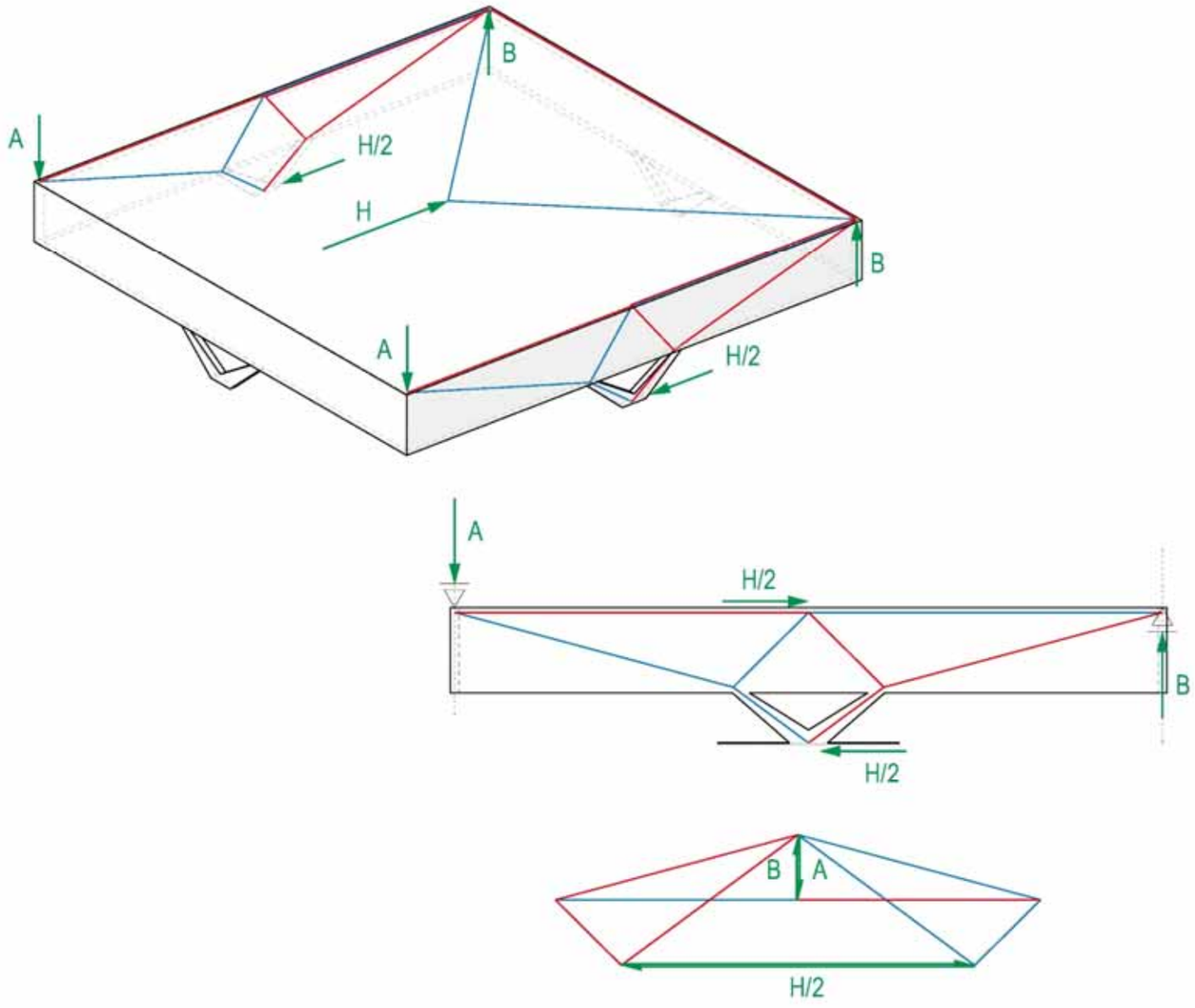
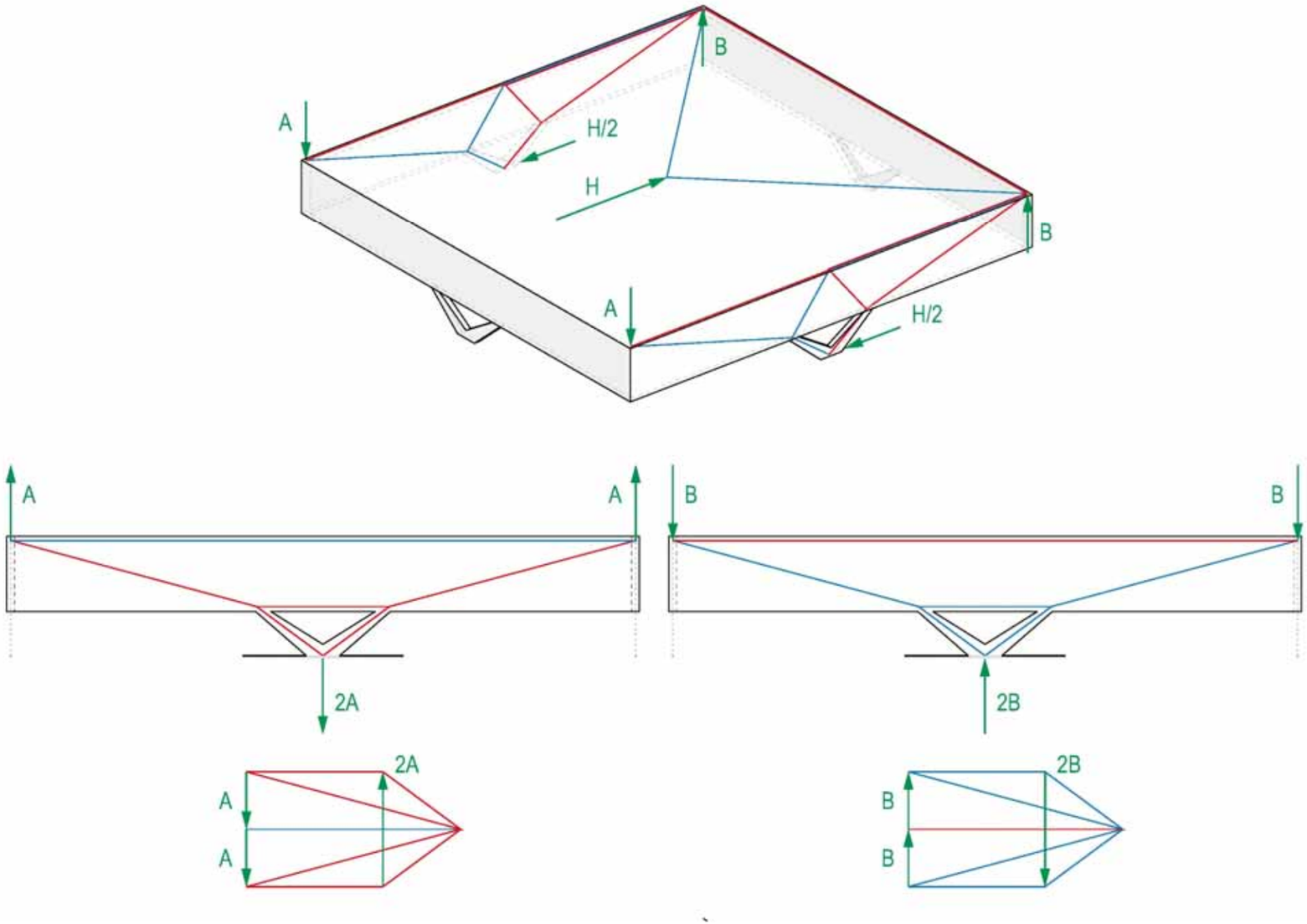
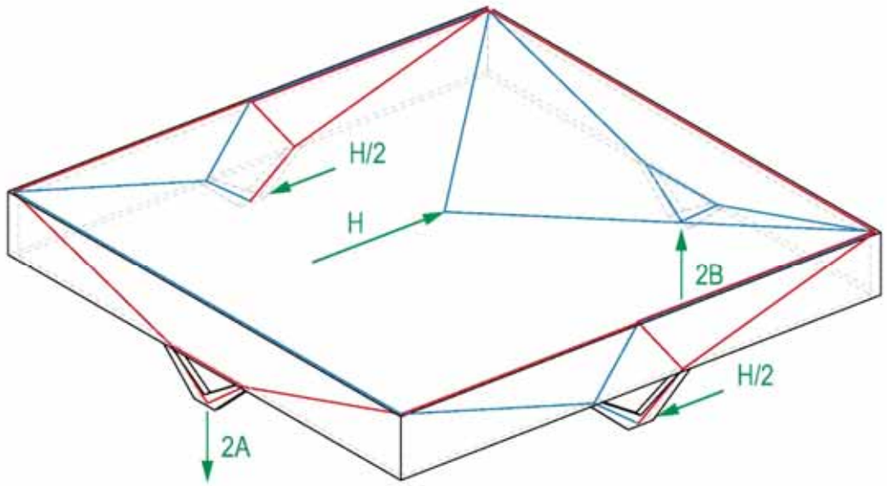
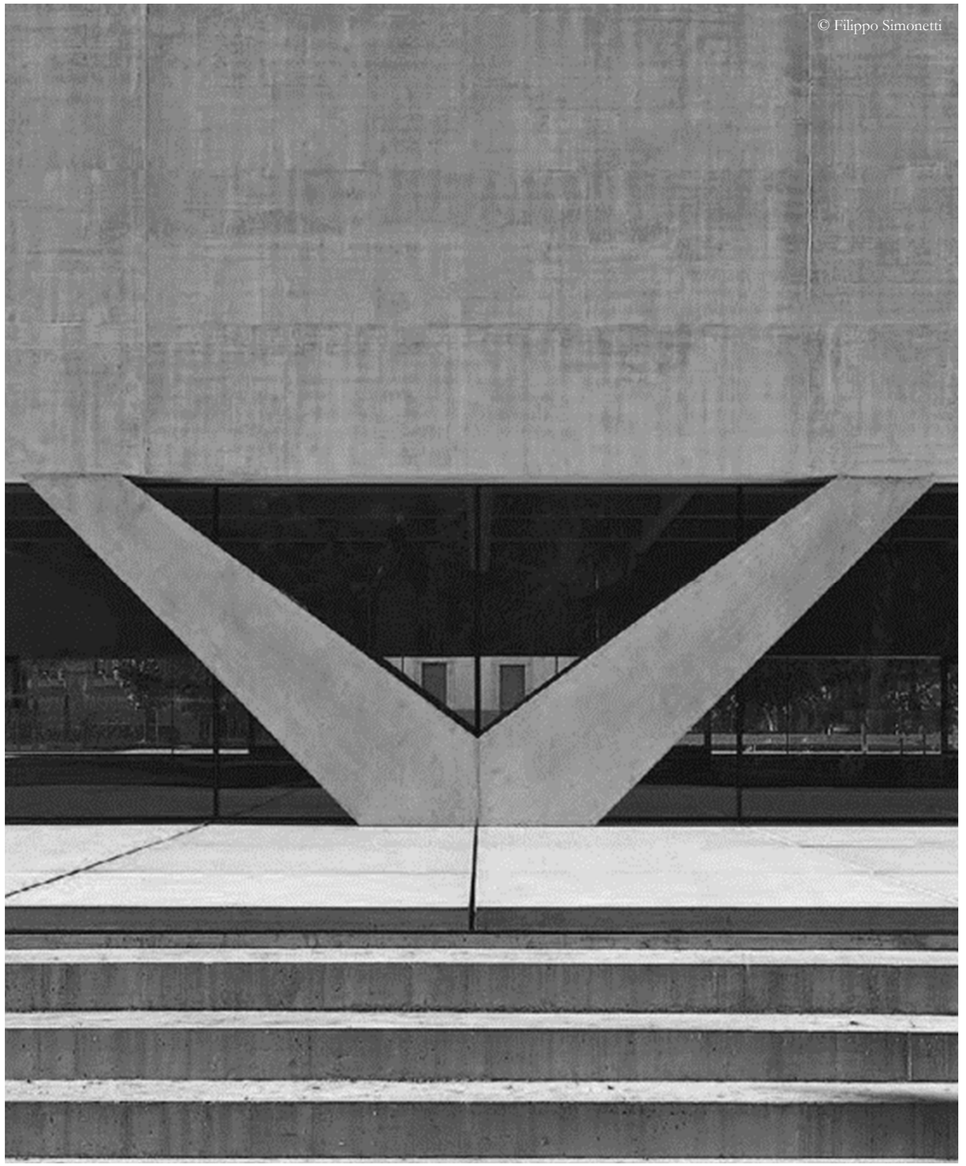
H
H/2

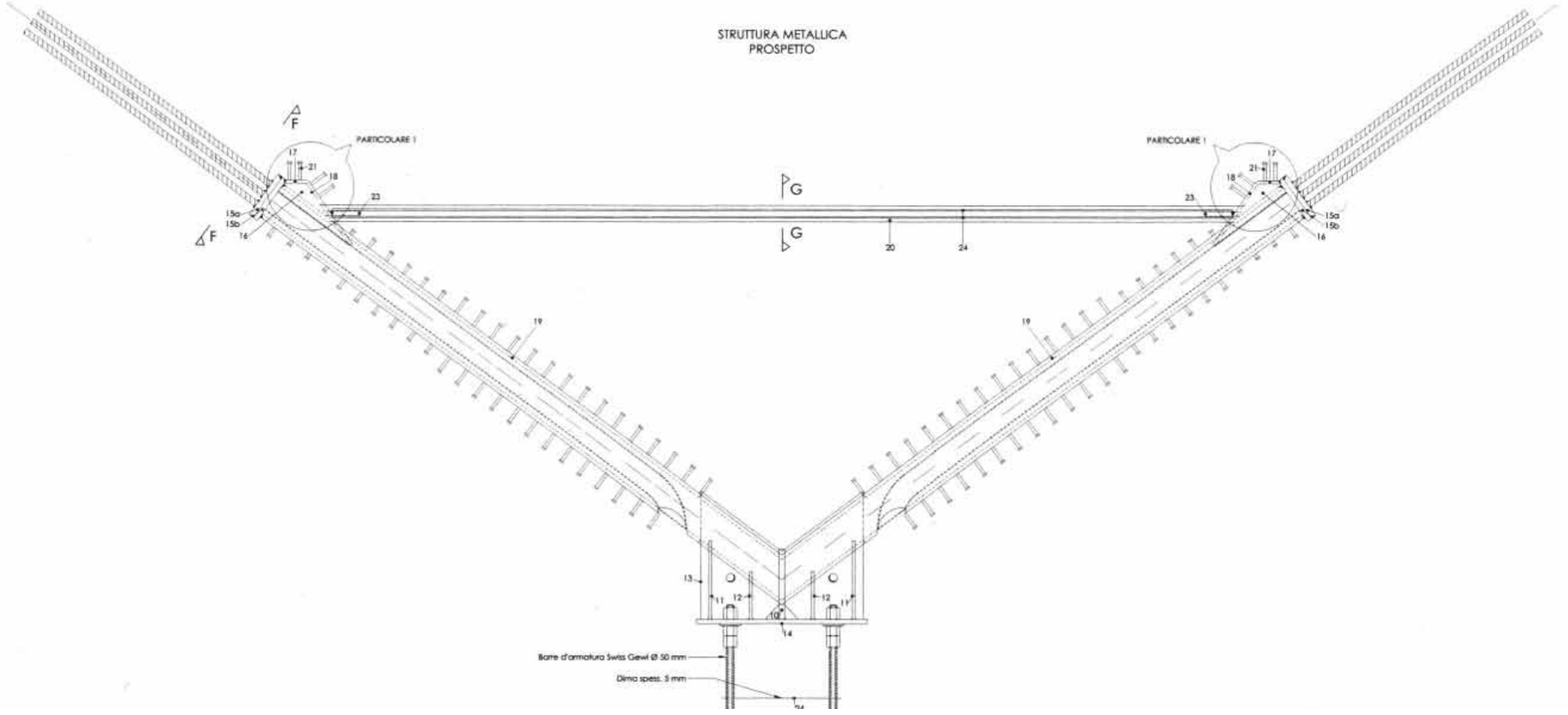

H/2


A
H/2
H
B
B
A
H/2
A
H/2
B
H/2
B
A
H/2

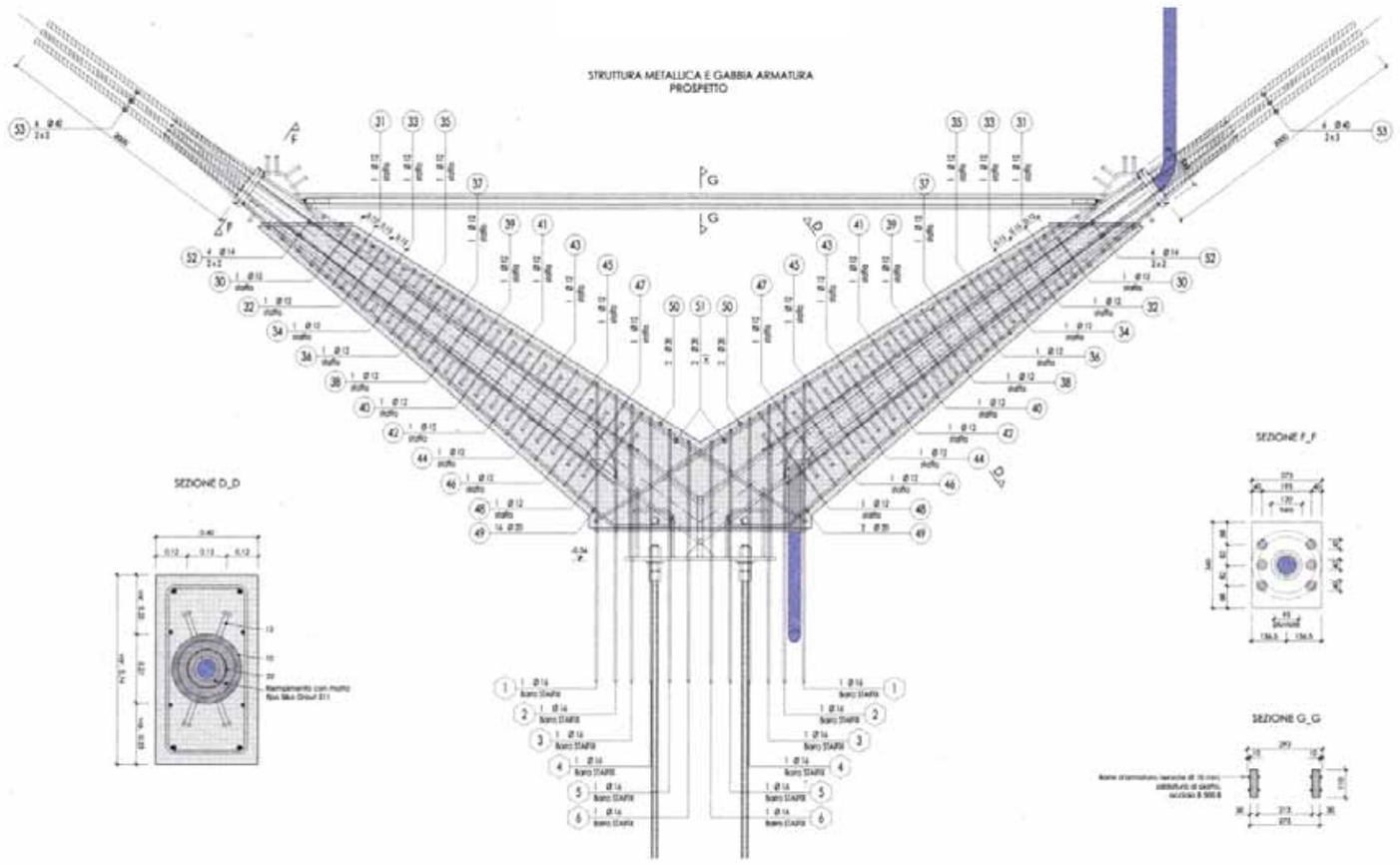

A
H/2
H
B
B
A
H/2
A
A
2A
2A
A
A
B
B
2B
2B
B
B


H/2
H
2B
H/2
2A


© Filippo Simonetti



Vorspannkabel in den Stützen
Pretension cables in the supports



Vorspannkabel in den Stützen
Pretension cables in the supports

Vorspannkabel in den Stützen
Pretension cables in the supports

Stahlbeton
Reinforced Concrete

2D ELEMENTS IN PLANE

2D ELEMENTS IN SPACE

3D STRUCTURES

2D ELEMENTS IN PLANE

Casa Minghetti Rossi
baserga mozzetti

2D ELEMENTS IN SPACE

Haus Forsterstrasse
Christian Kerez

3D STRUCTURES

Chapel in Valleaceron
Sancho-Madridejos Architecture Office

Casa Minghetti Rossi

Gordola, 2012

Architect: Baserga Mozzetti

Engineer: Pedrazzini Guidotti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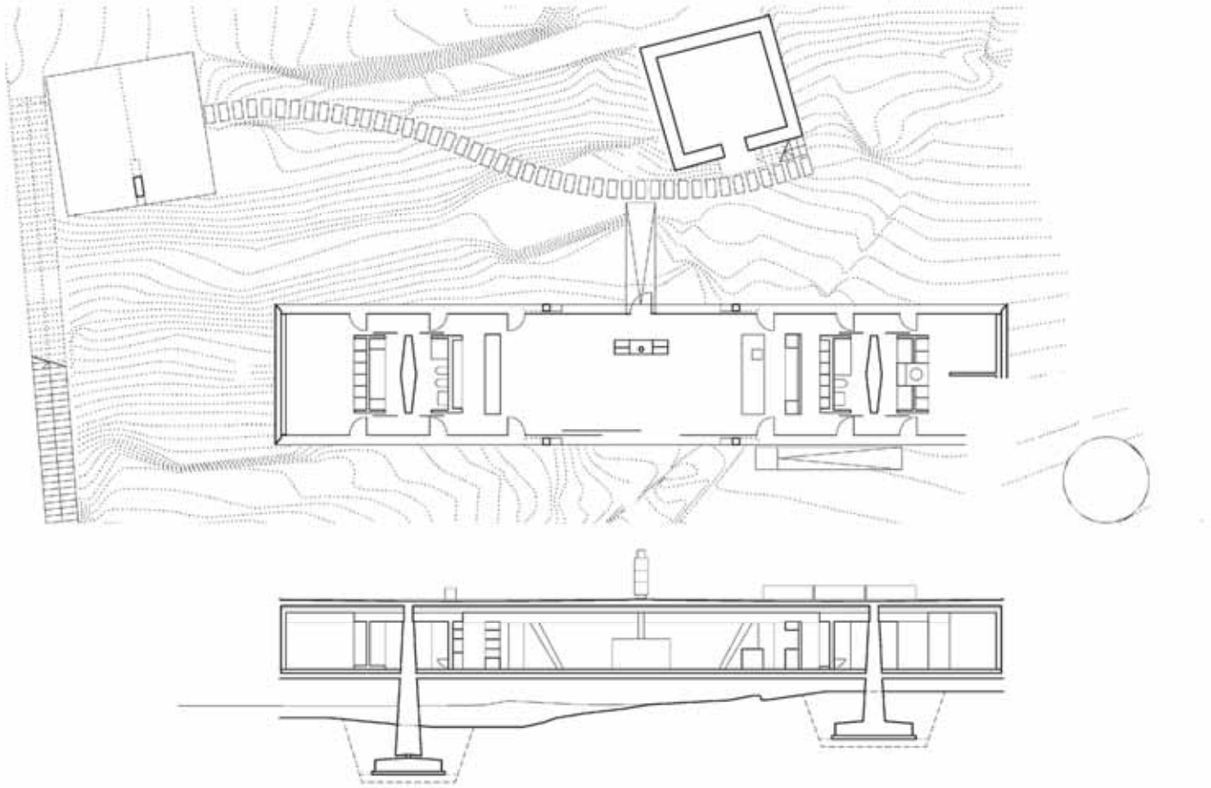
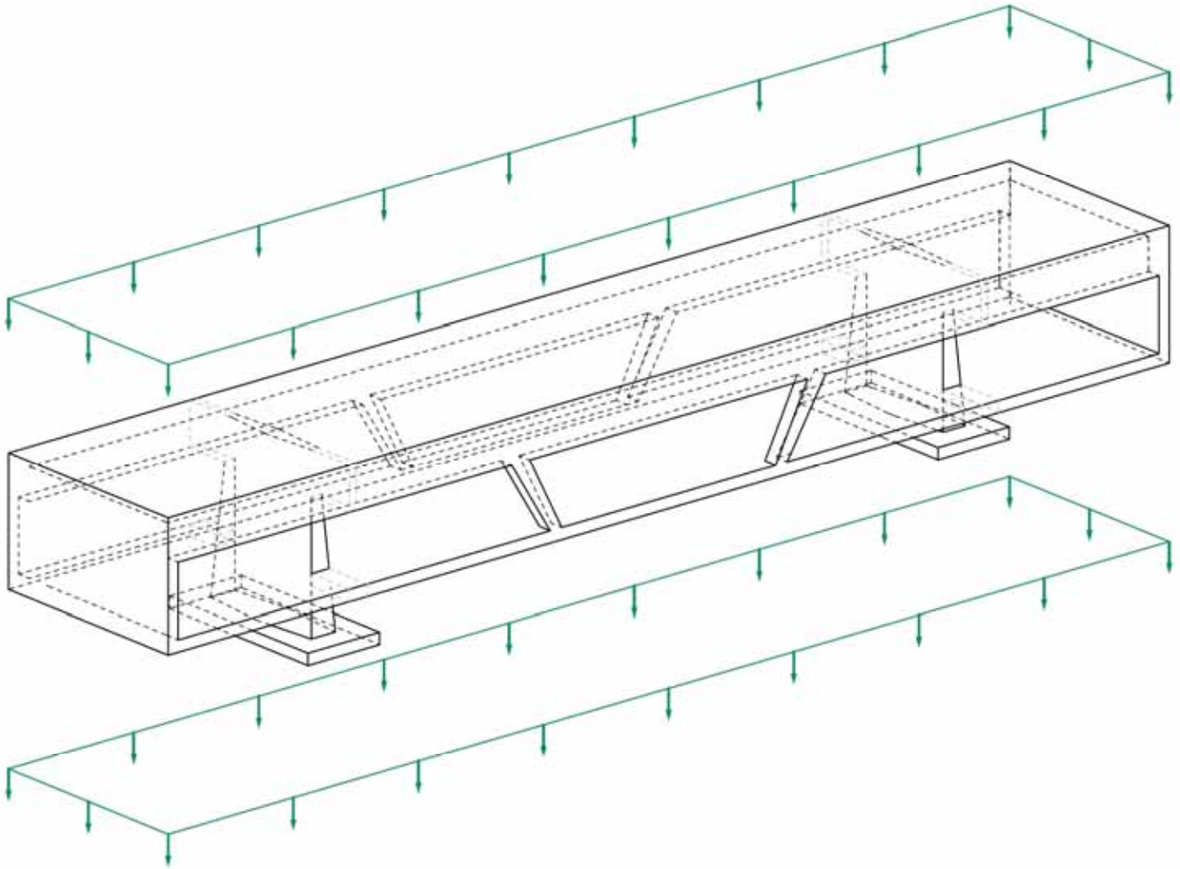
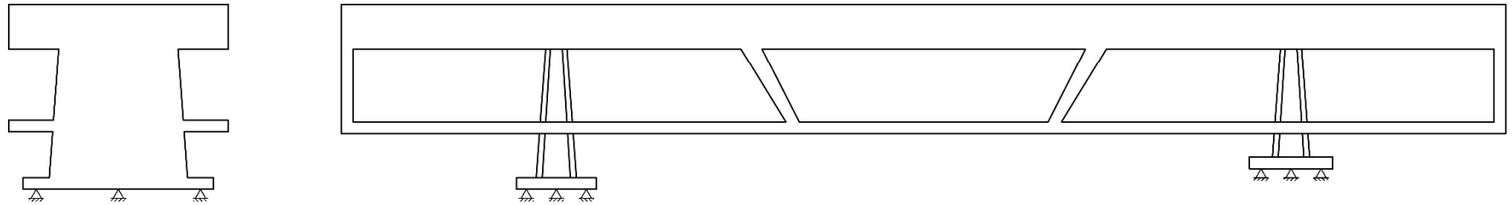
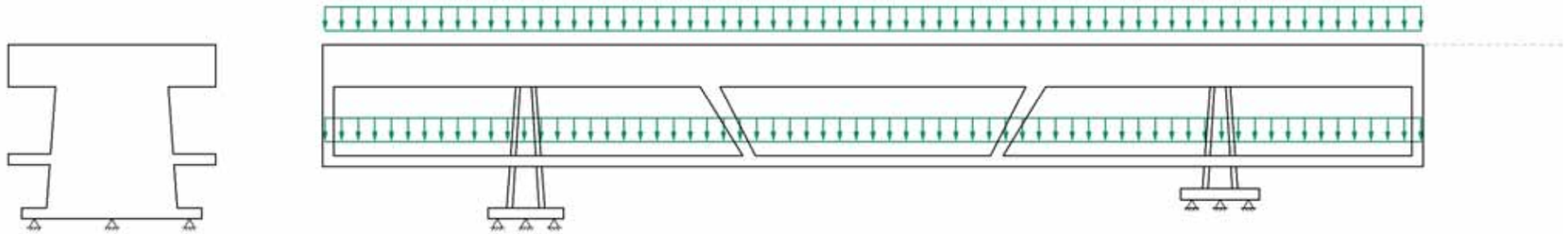


Lage und Schnitt
Situation and section

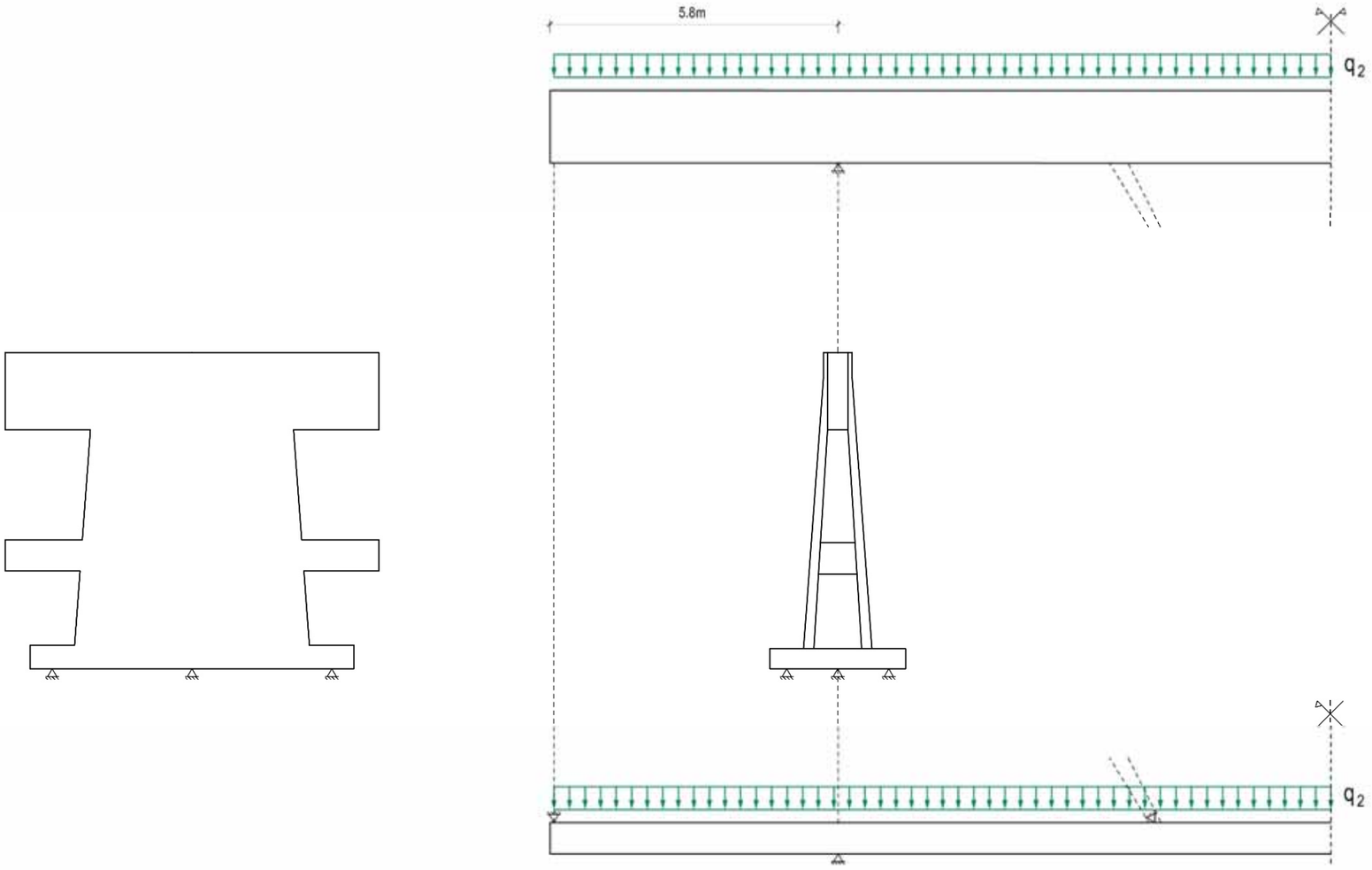


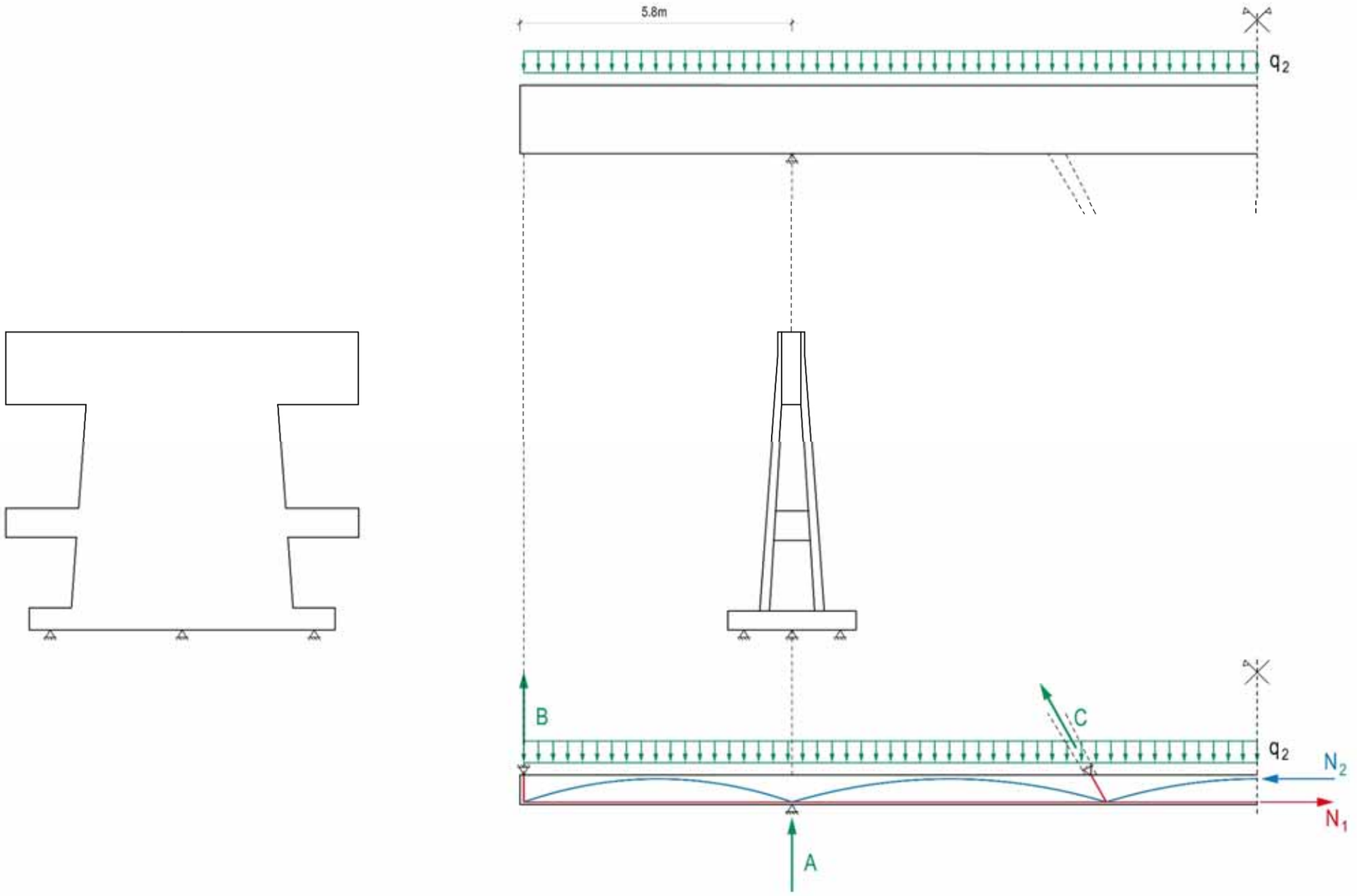
Vertikale Lasten
Vertical Loads

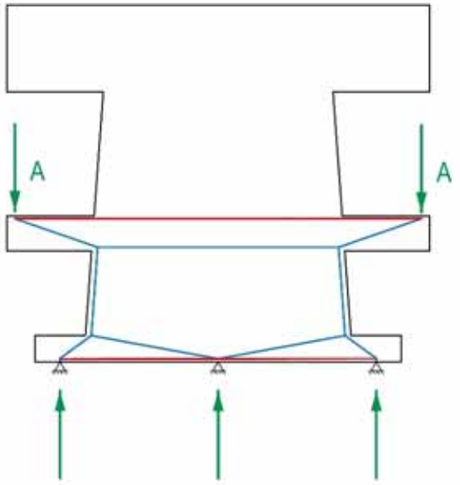


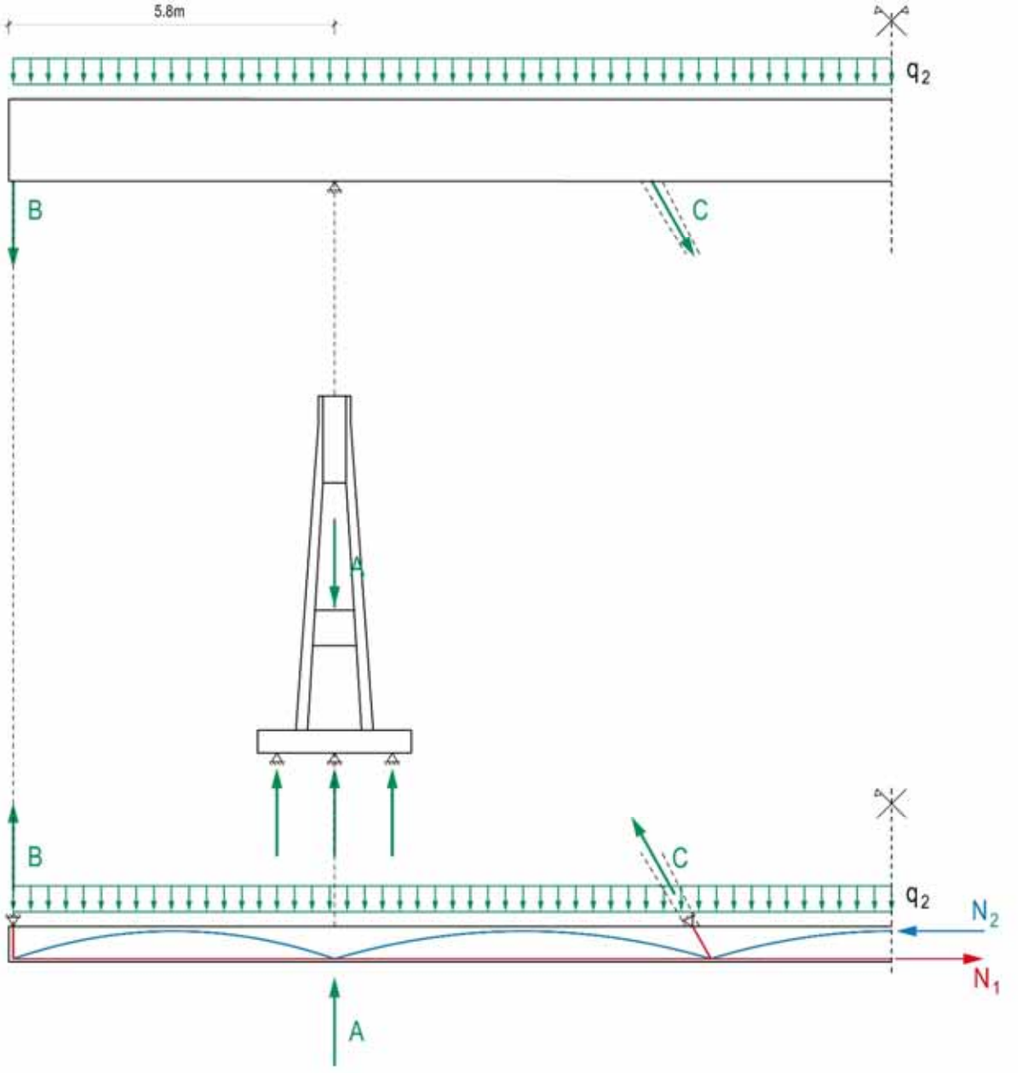


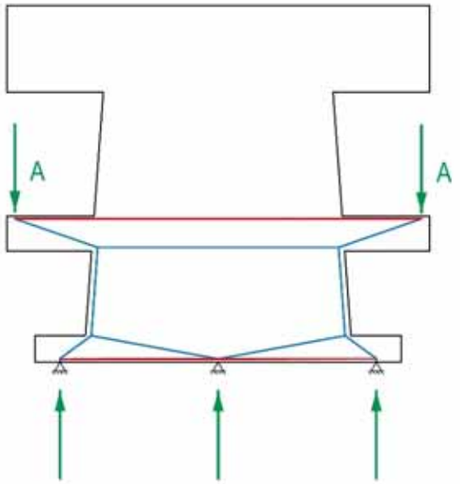
Vertikale Lasten
Vertical Loads

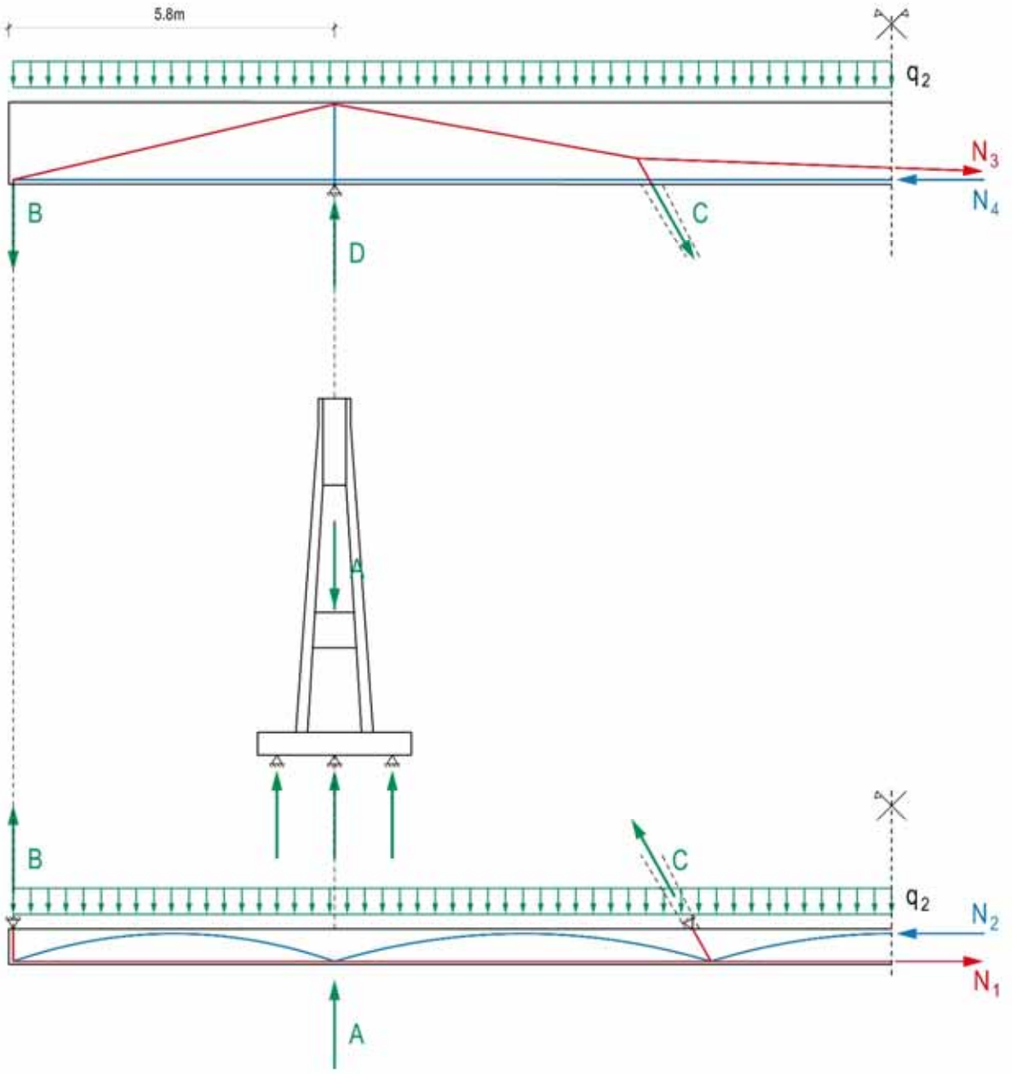

5.8m
q2
q2

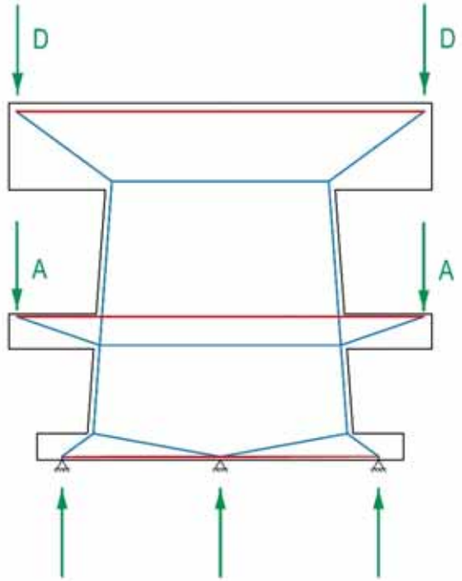

5.8m
q_2
B
C
q_2
N_2
N_1
A

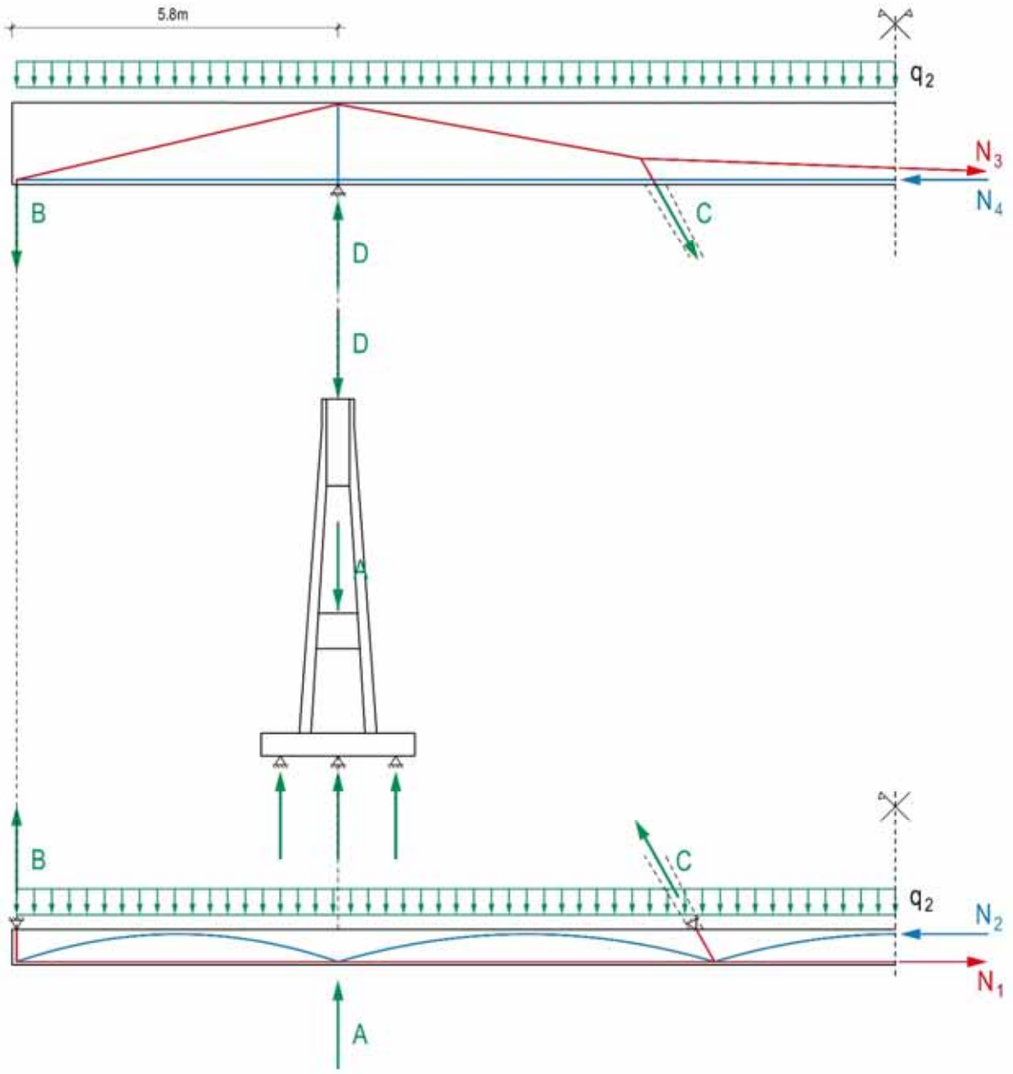

A
A

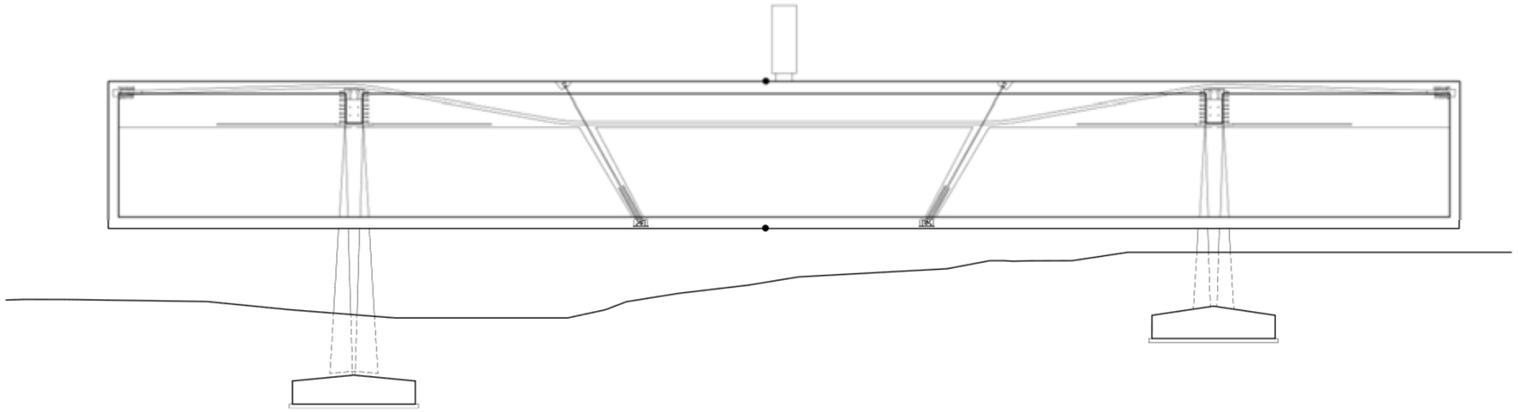

5.8m
q2
B
C
A
B
C
q2
N2
N1
A


A
A

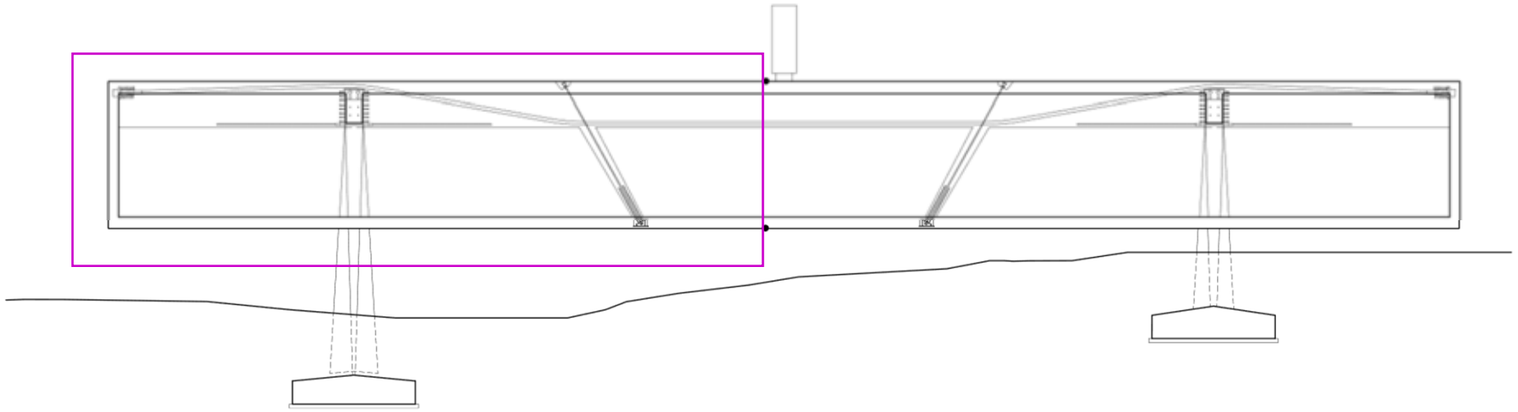

5.8m
q2
N3
N4
B
C
D
A
B
C
q2
N2
N1
A

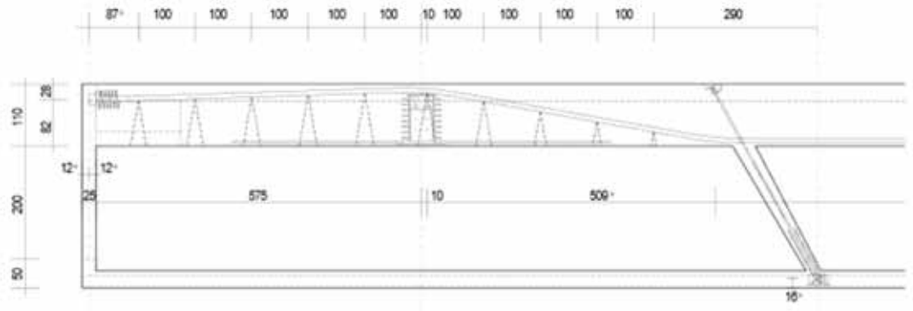

D
D
A
A


5.8m
q2
N3
N4
B
C
D
D
A
B
C
q2
N2
N1
A

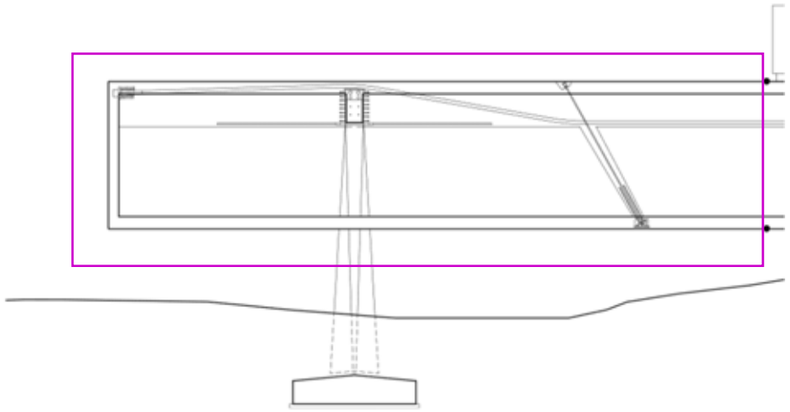


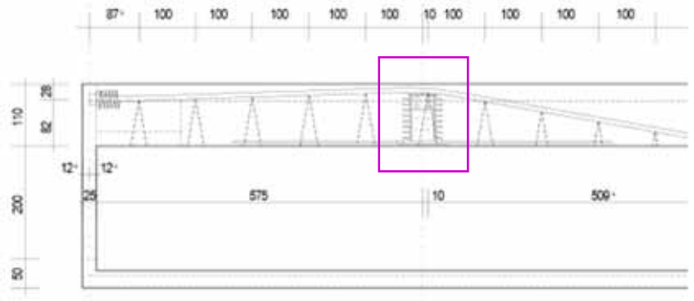
Vorspannkabel, Konstruktionsdetails
Post-tensioning cables, construction details



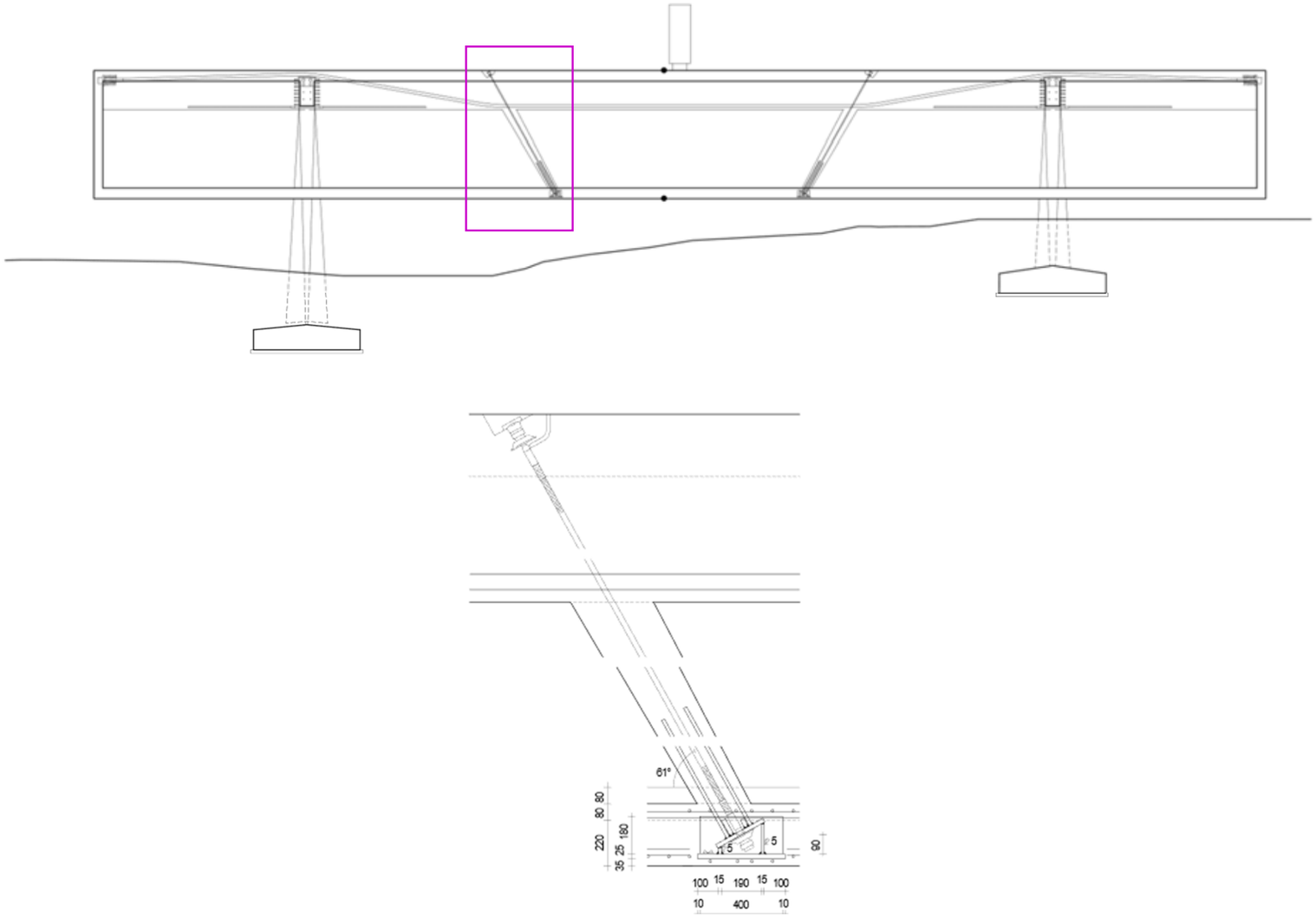


Vorspannkabel, Konstruktionsdetails
Post-tensioning cables, construction details





Vorspannkabel, Konstruktionsdetails
Post-tensioning cables, construction details



Vorspannkabel, Konstruktionsdetails
Post-tensioning cables, construction details


© Roman Walbeck

Forsterstrasse

Zürich, 2003

Architect: Christian Kerez

Engineer: Joseph Schwartz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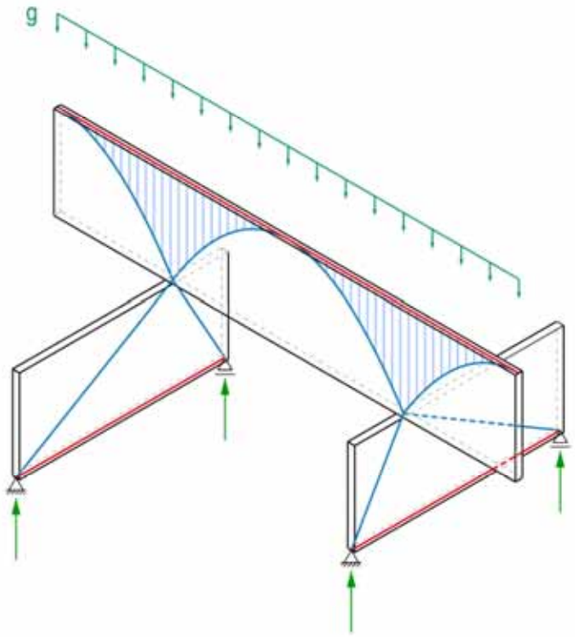
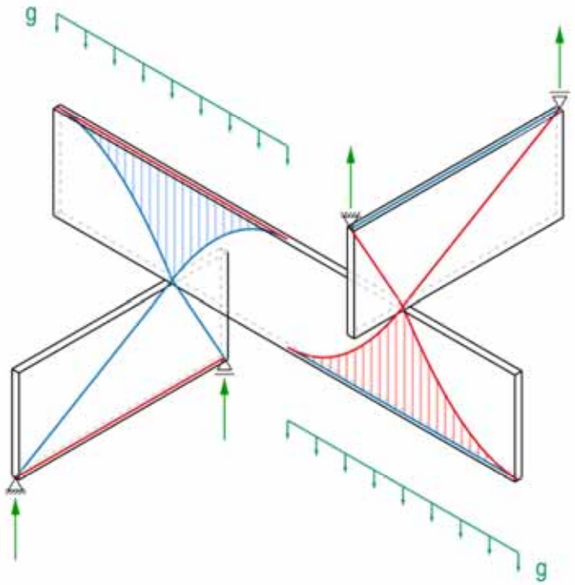
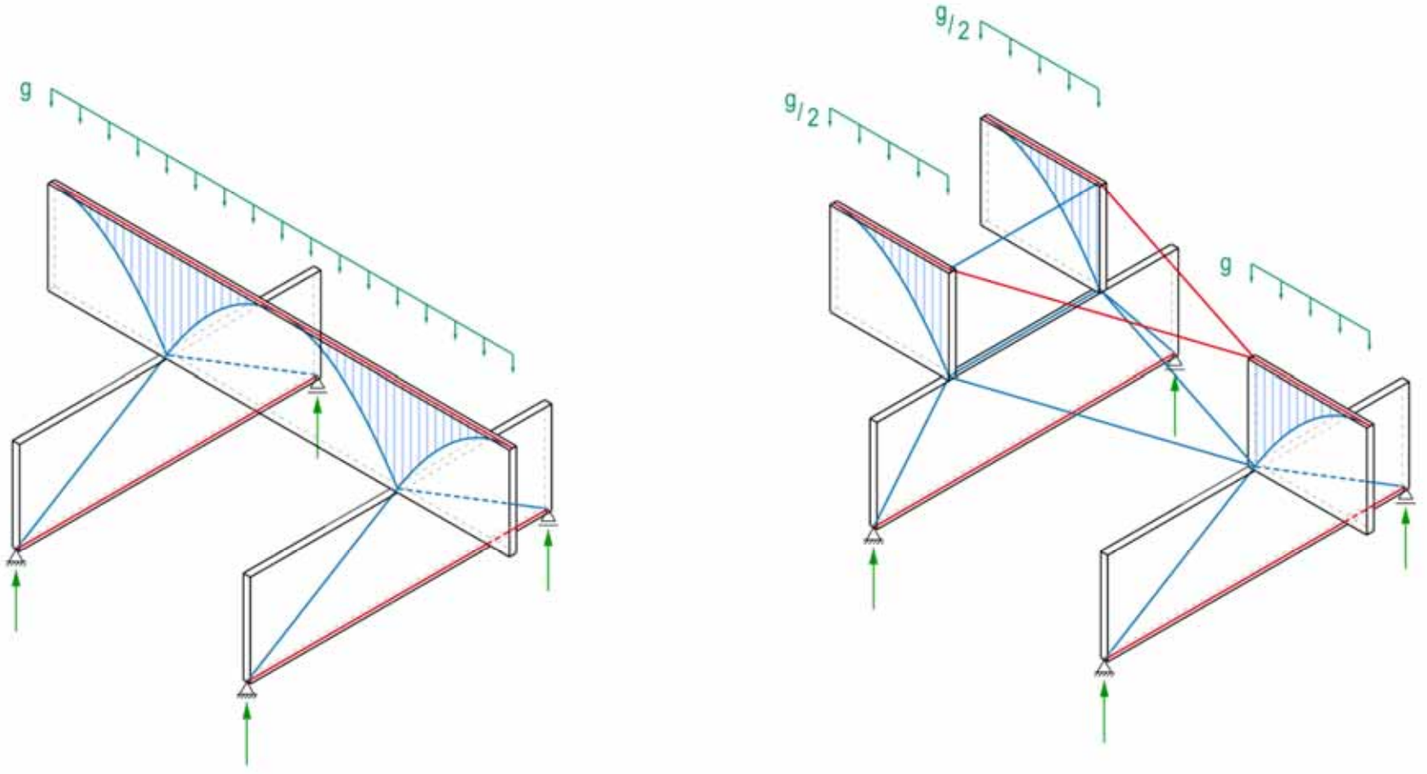
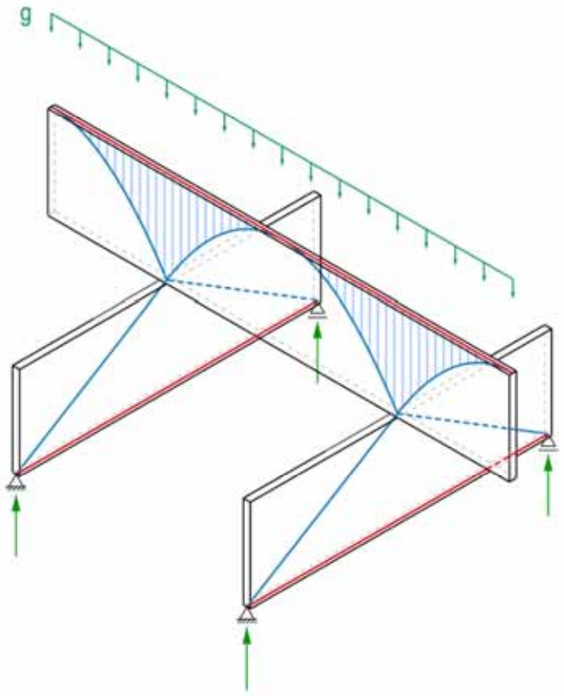


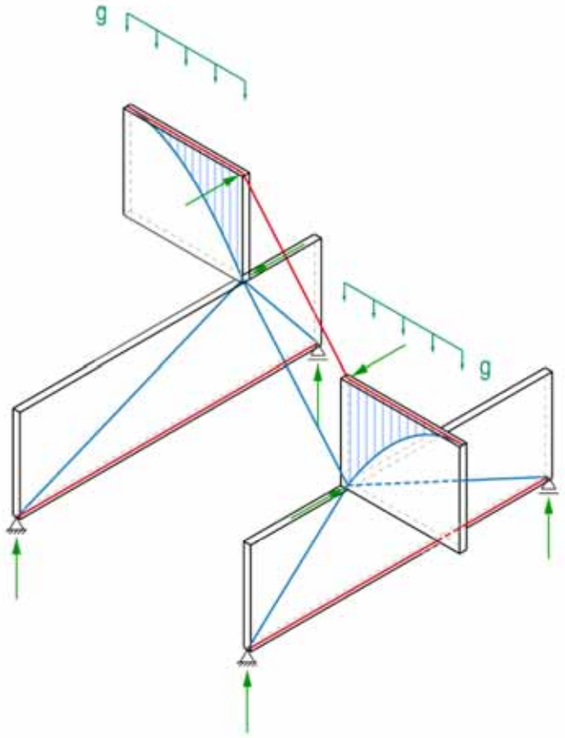


Stapelung der Wände
Stacking of walls

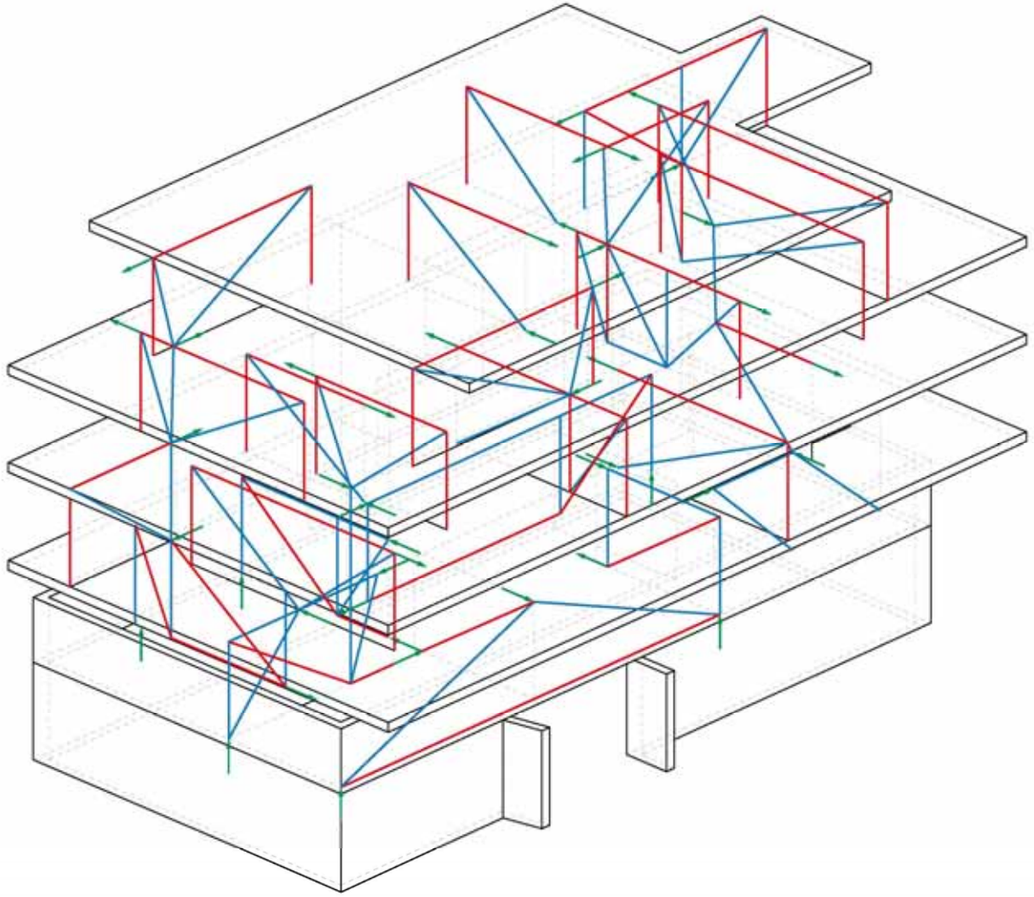


Stapelung der Wände
Stacking of walls





Stapelung der Wände
Stacking of walls



Axonometrische Ansicht
Axonometric view


© Walter Mair

Chapel in Valleaceron

Almadén (Spain), 2001

Architect: S.M.A.O. – Sancho-Madridejos Architecture Office

„The project at Valleaceron, apart from valuing the establishment of episodes in relation to path, vision and site, embodies a desire to draw us into the architectural space from this constructive sense of the fold, from its spatiality. The Chapel unit concentrates this aims in a radical way, almost in the form of a manifesto.“

Juan Carlos Sancho – Sol Madridejos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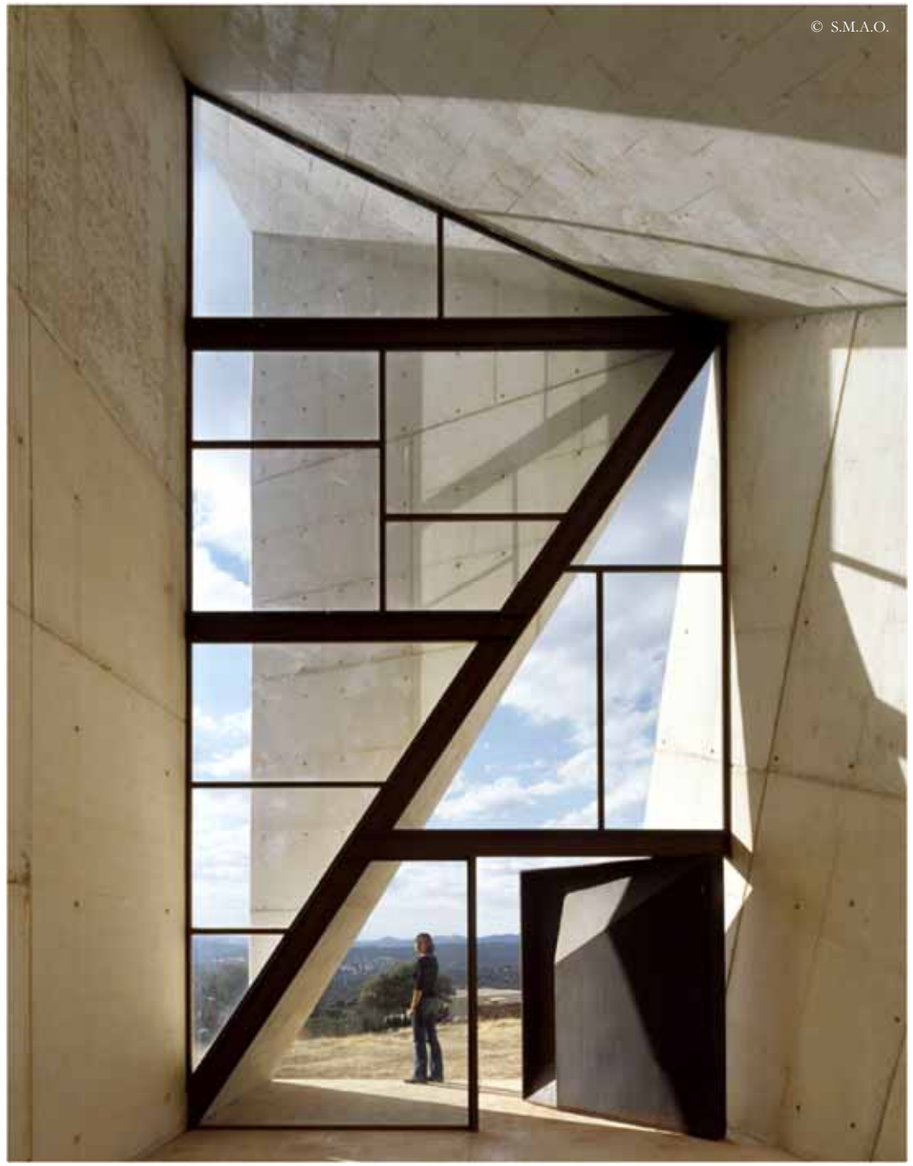
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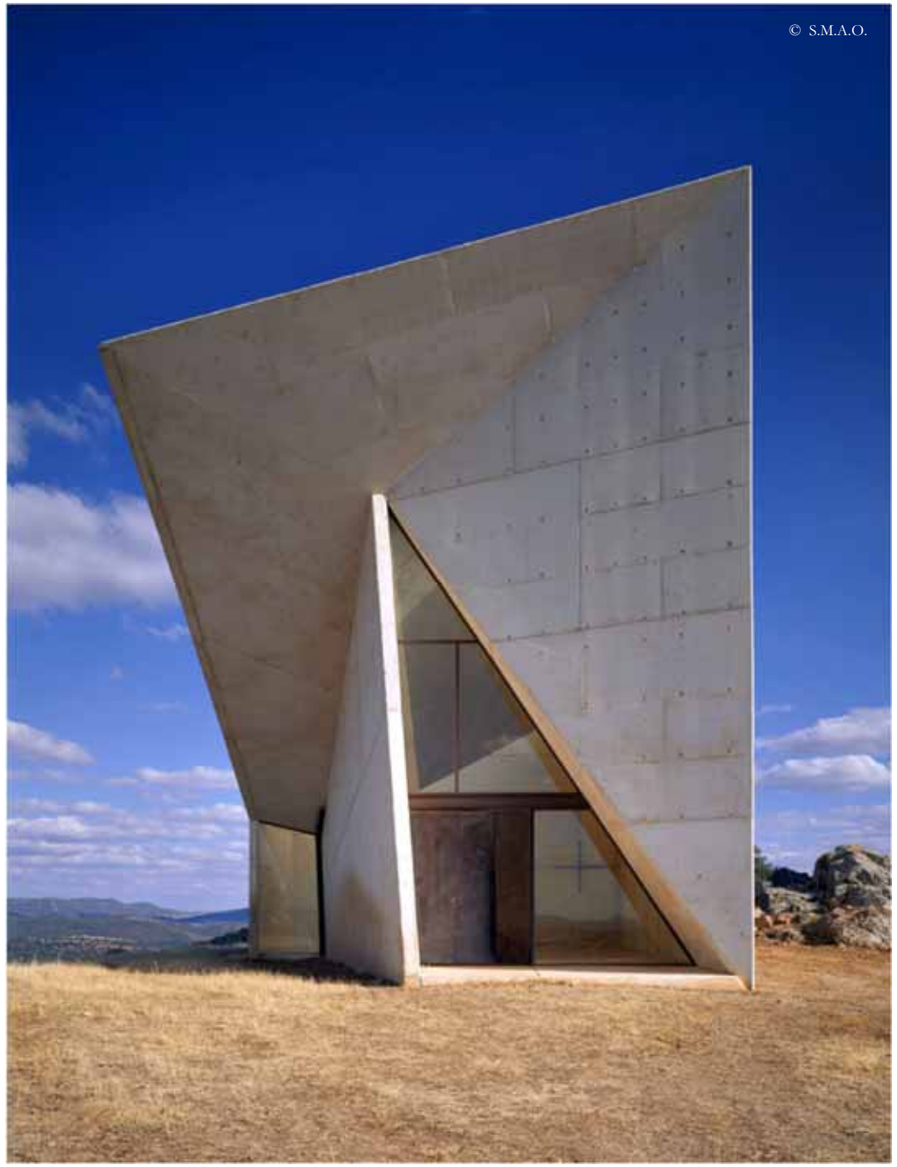
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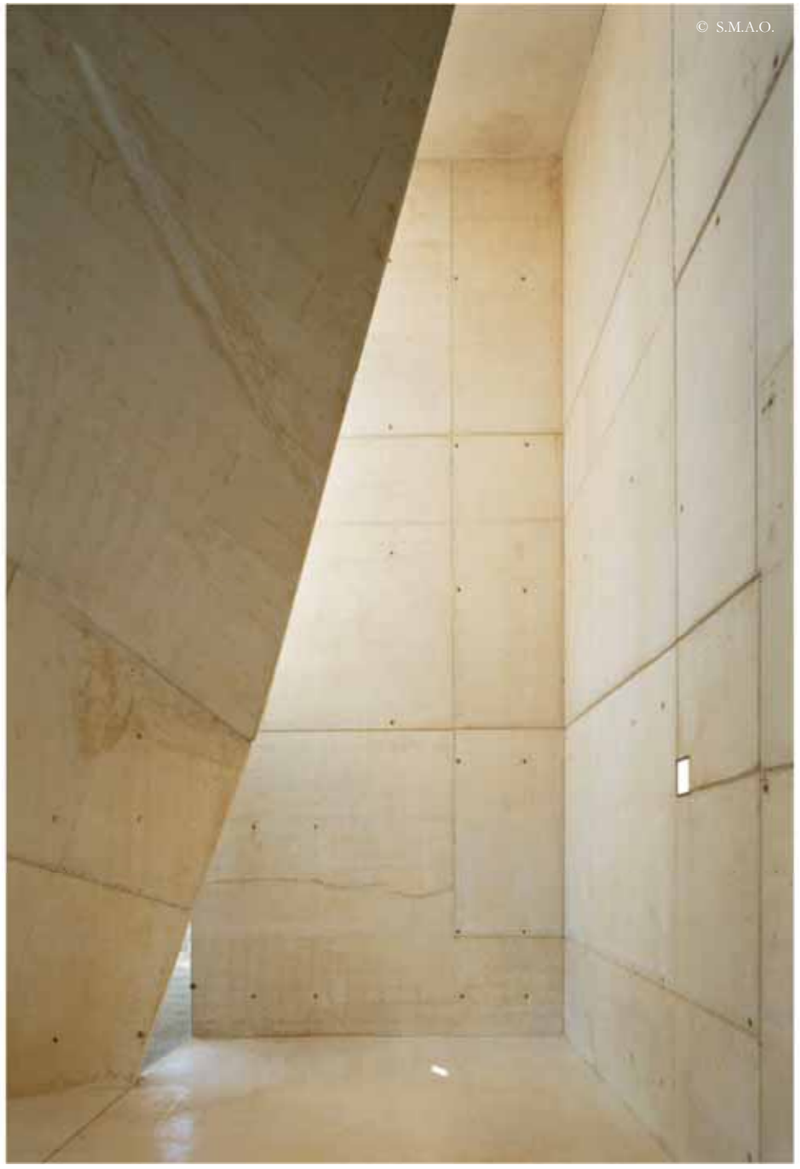
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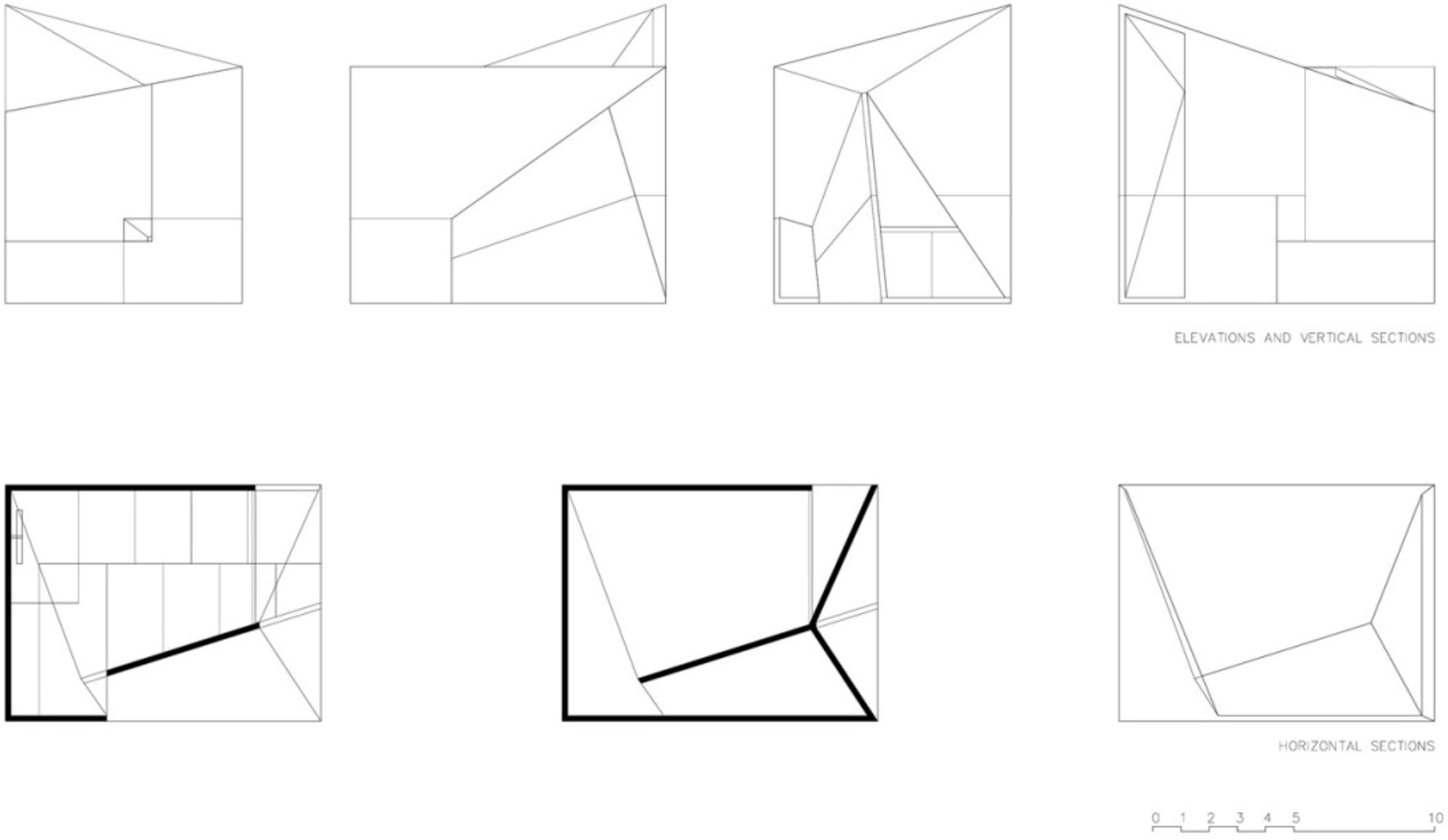
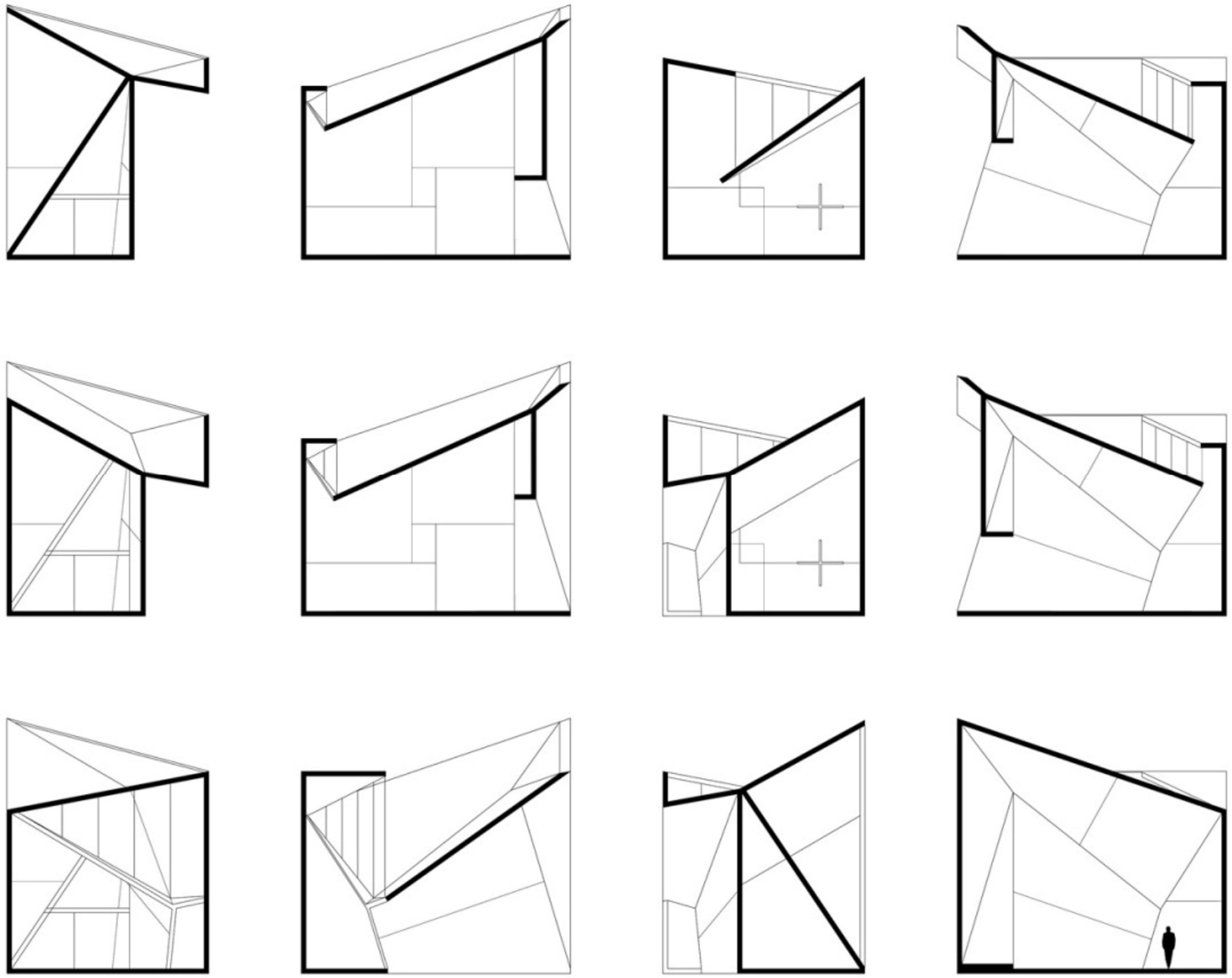
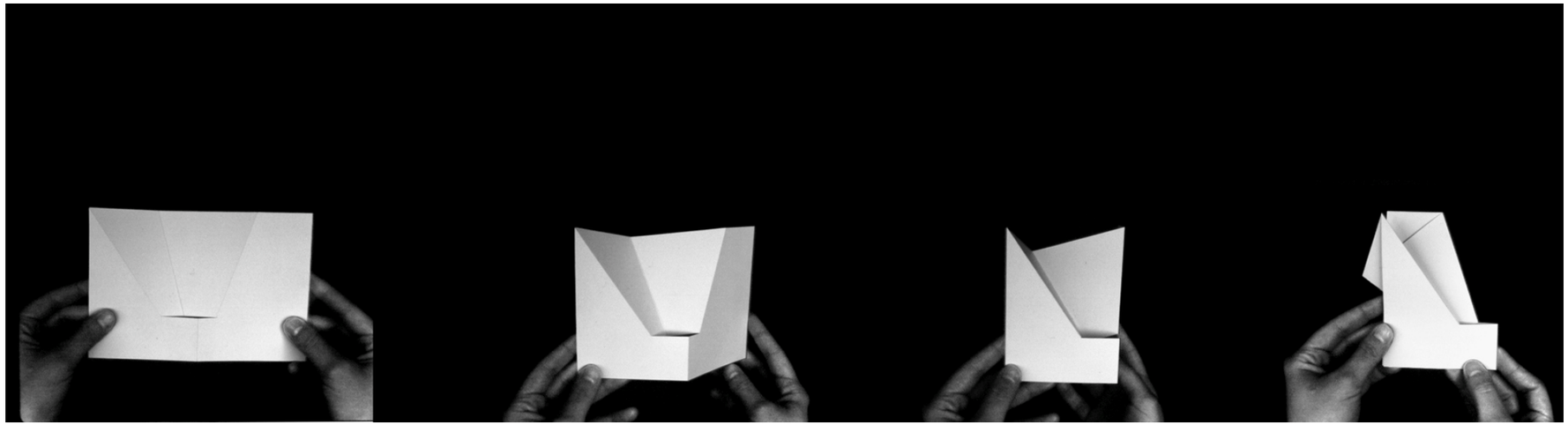


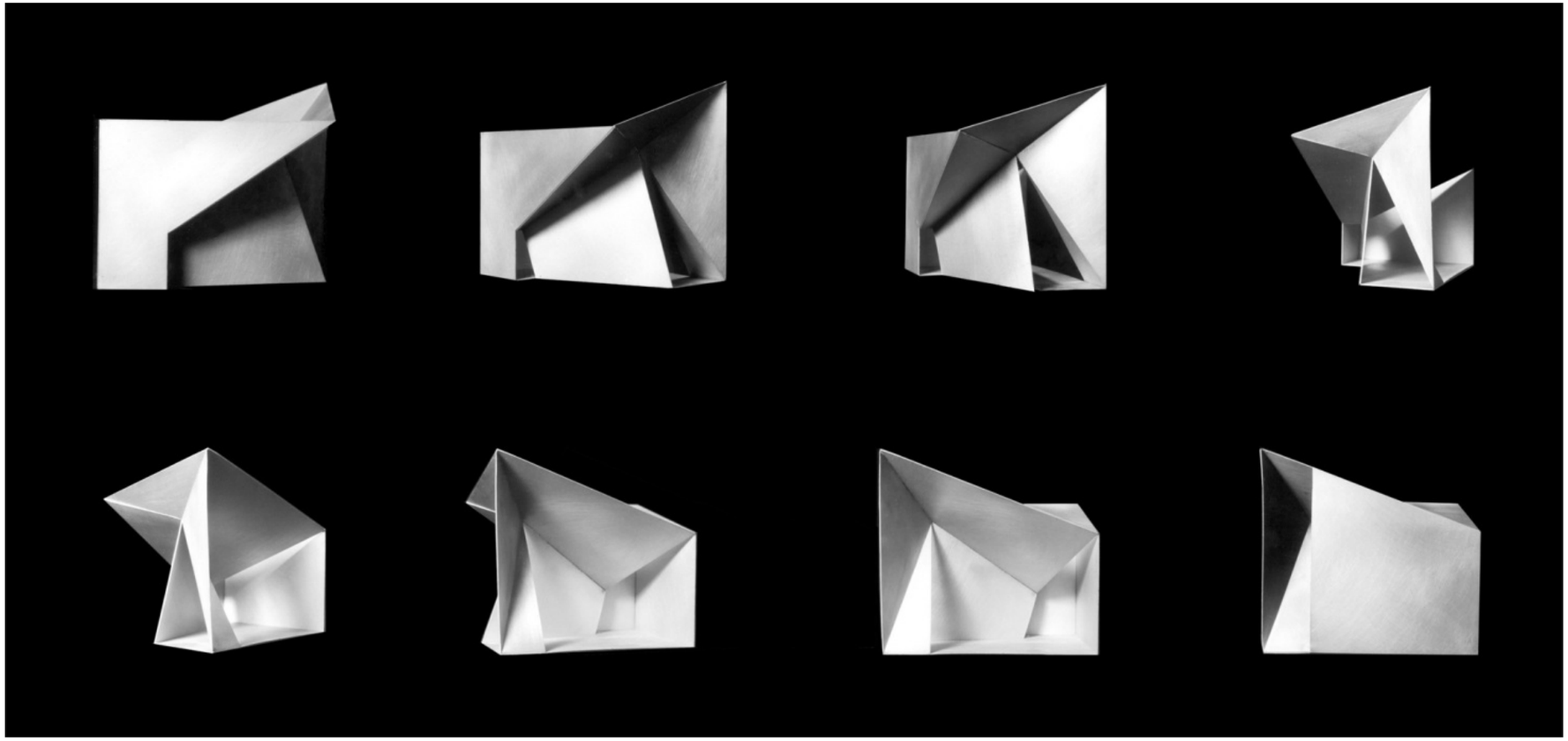
Schematische horizontale Schnitte
Schematic horizontal sections



Schematische Vertikalschnitte
Schematic vertical sections



Transformation durch Faltung
Transformation through folding



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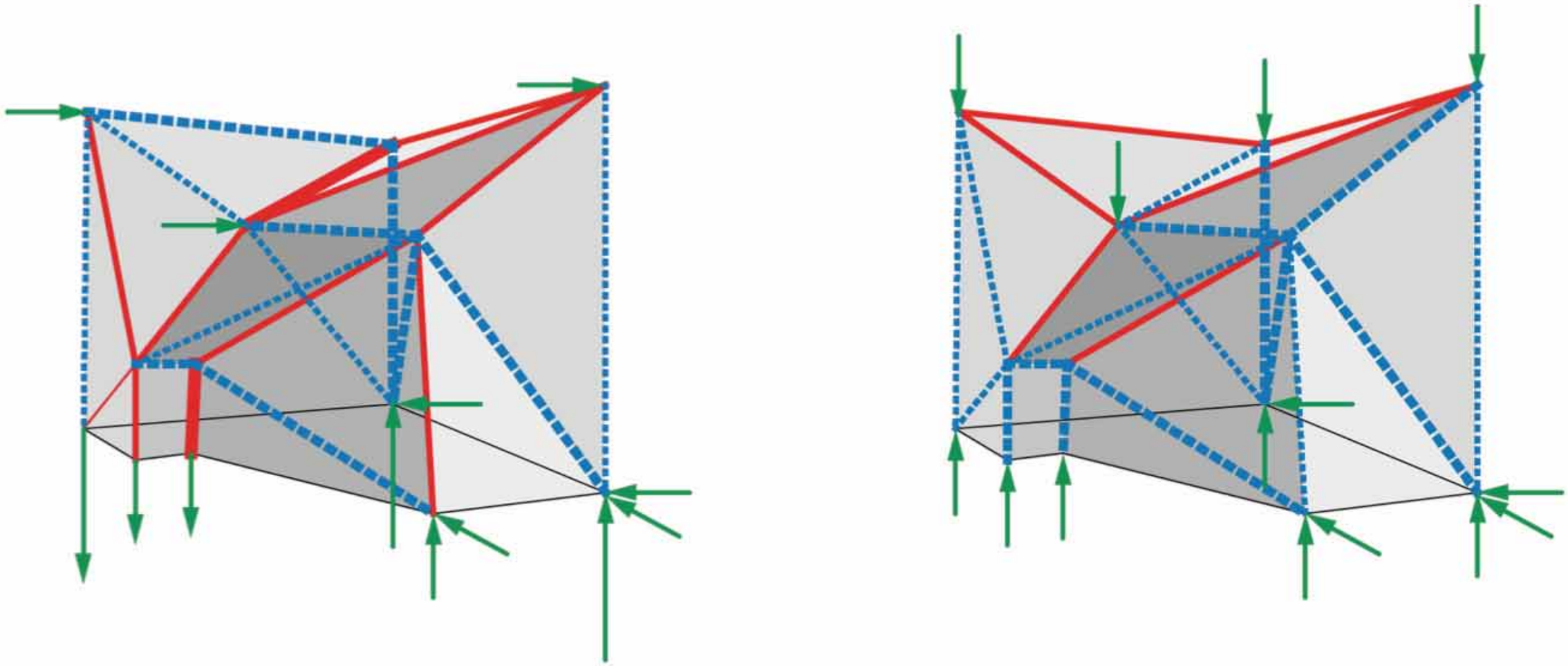

Strukturelles Diagramm der Kapelle unter horizontaler (links) und vertikaler Belastung (rechts)
Structural Diagram of the chapel under horizontal (left) and vertical loads (right)


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