http://www.block.arch.ethz.ch/eq/

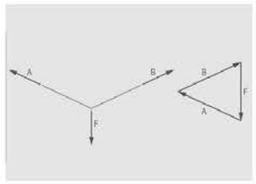
Tragwerksentwurf II

Structural Design II

Philippe Block

Tragwerksentwurf
Structural Design

1. Gleichgewicht
1. Equilibrium



2. Graphische Statik
2. Graphic statics

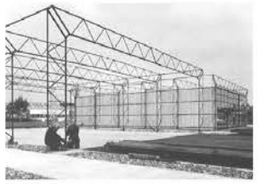
3. Seile
3. Cables

4. Bogen
4. Arches

5. Bogen-Seil
5. Arch-cables

Tragwerksentwurf I
Structural Design I

Tragwerksentwurf II
Structural Design II



6. Fachwerke
6. Trusses

7. Balken
7. Beams

8. Rahmen
8. Frames

9. Platten
9. Plates

10. Stützen
10. Columns

Rahmen
Frames

>> Vom Bogen und Balken zum Rahmen
From arches and beams to frames

Dreigelenkrahmen
Three-hinged frames

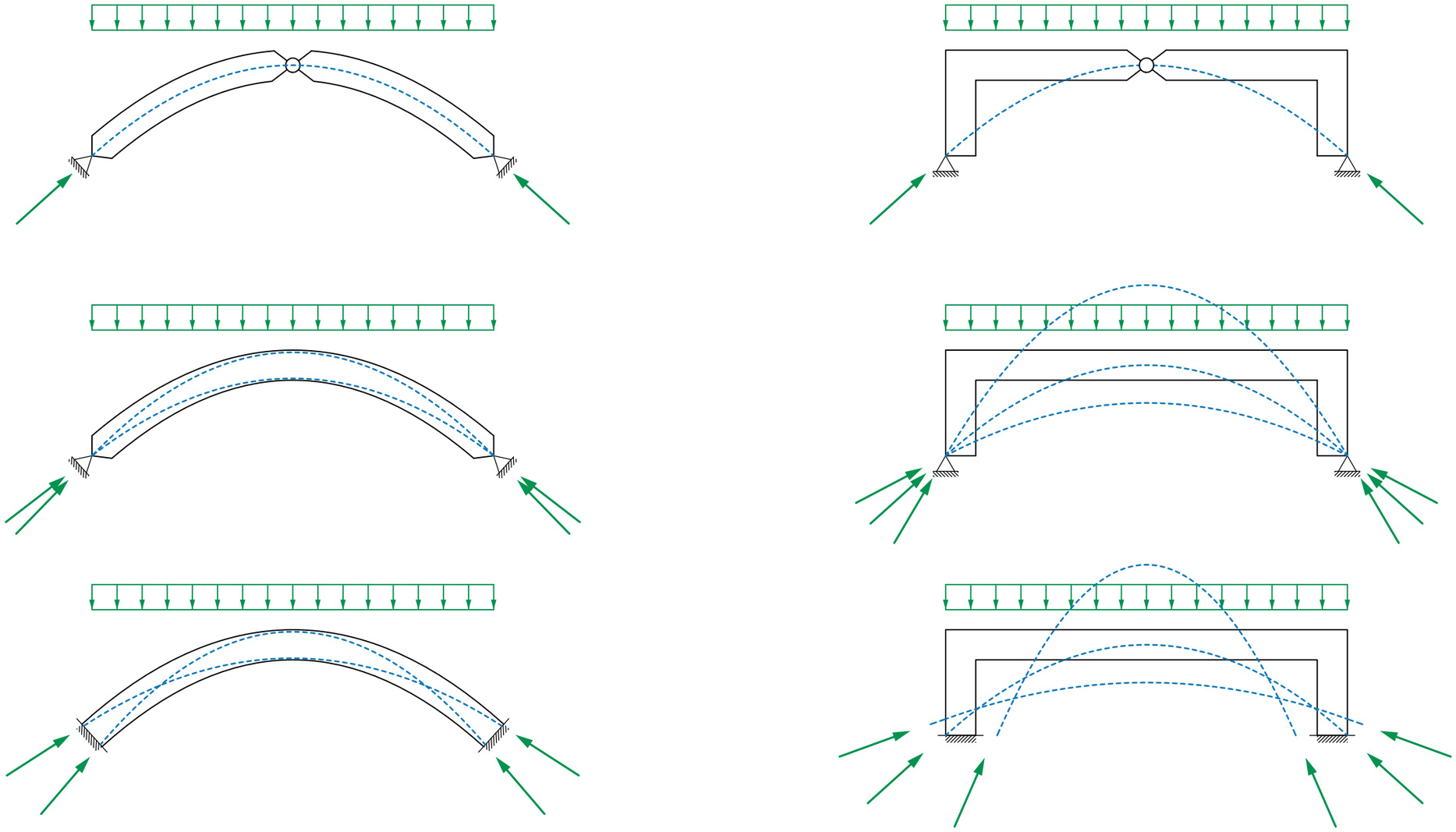
Zweigelenkrahmen
Two-hinged frames

Rahmen ohne Gelenke
Frames without hinges

Rahmenecke
Frame corner

Fallbeispiele
Case studies

Zusammengesetzte Rahmen
Compound frames



Rahmen
Frames

Vom Bogen und Balken zum Rahmen
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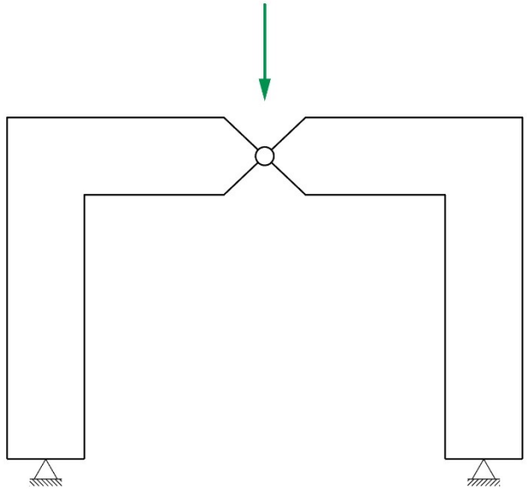
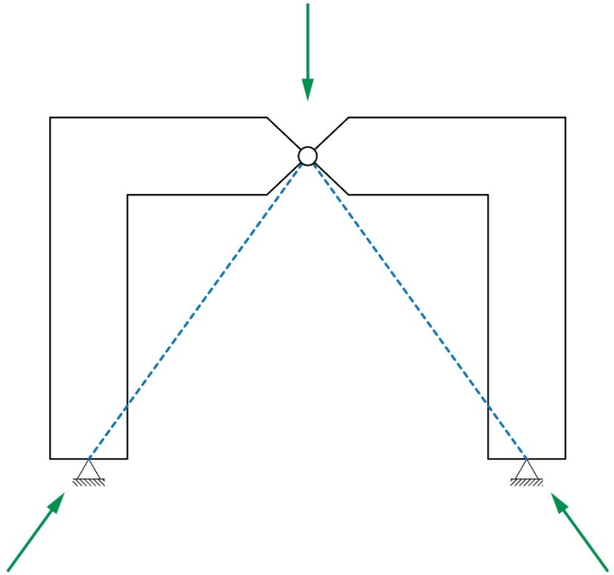


Lageplan 1:100
Form diagram 1:100

Kräfteplan 1 cm ≙ 1 kN
Force diagram 1 cm ≙ 1 kN



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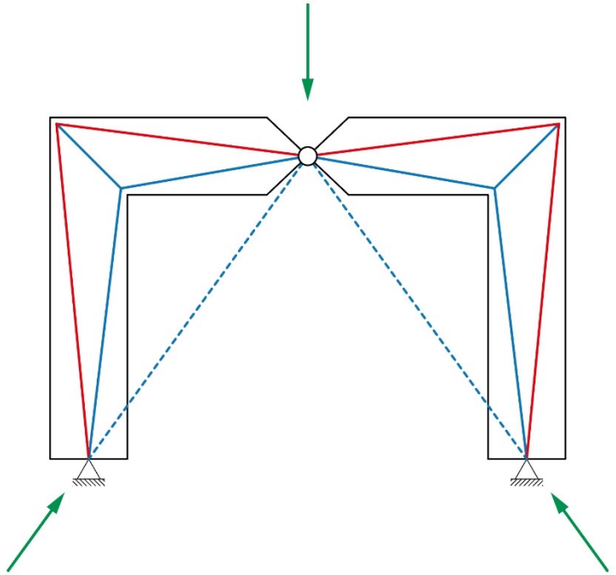

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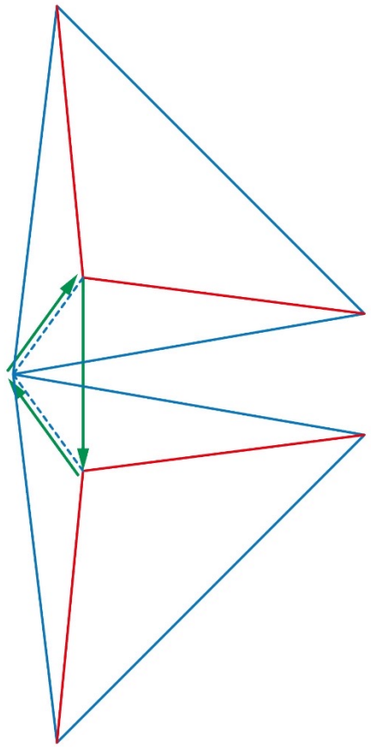

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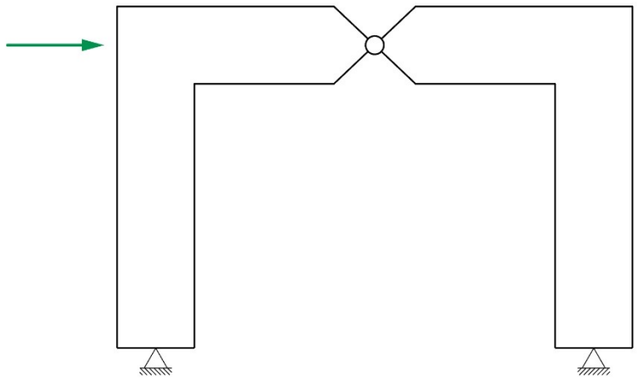

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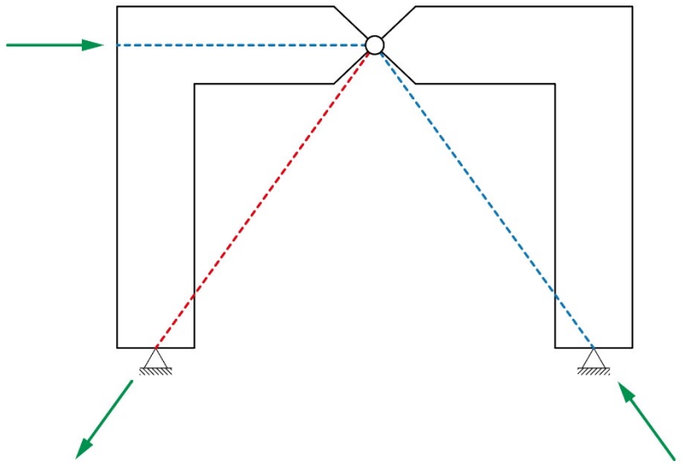

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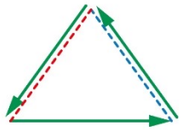

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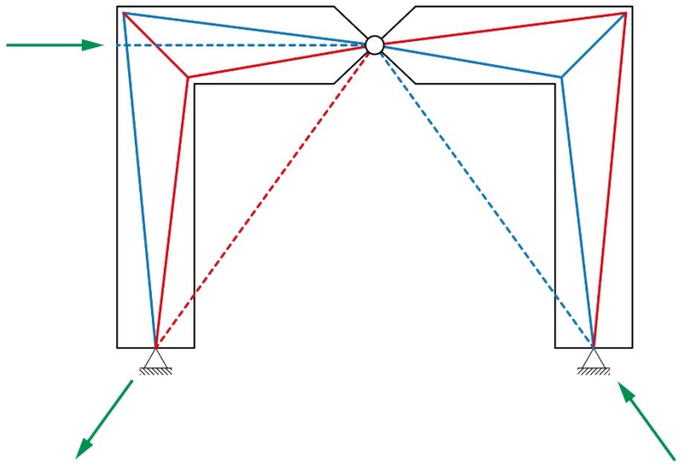

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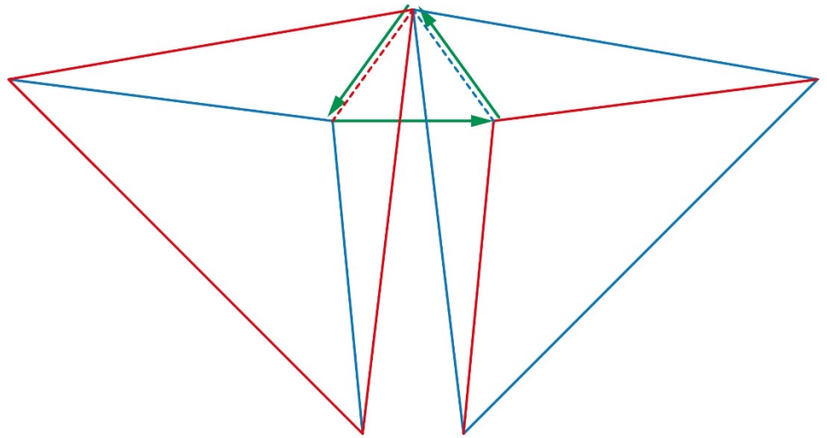

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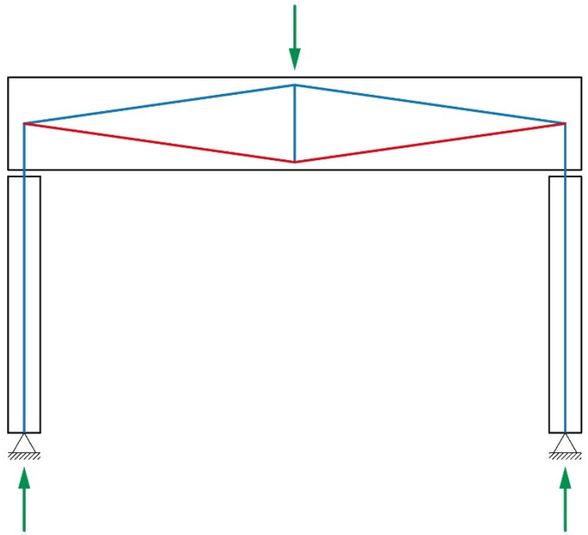
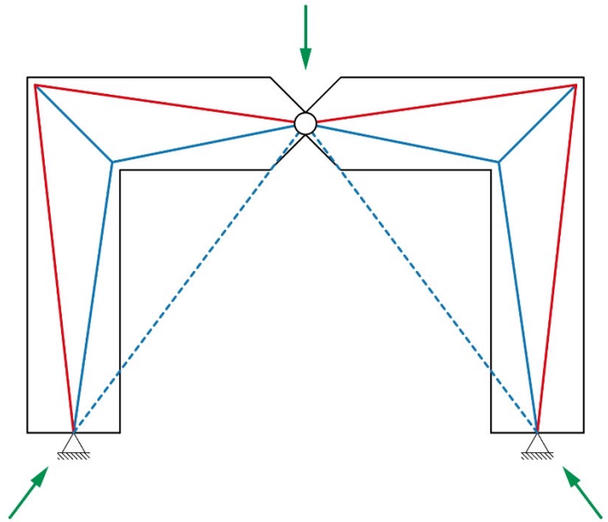
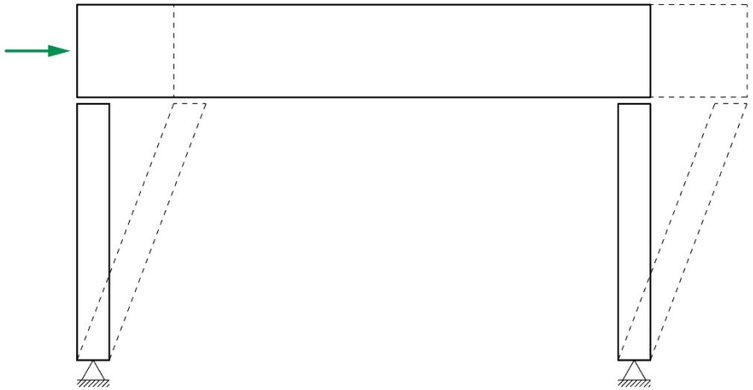
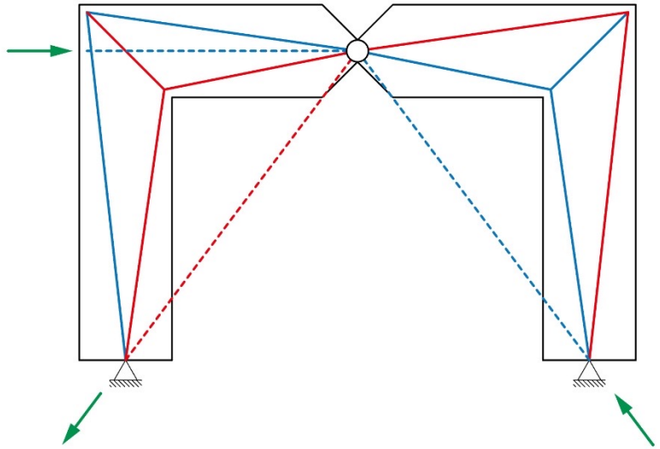


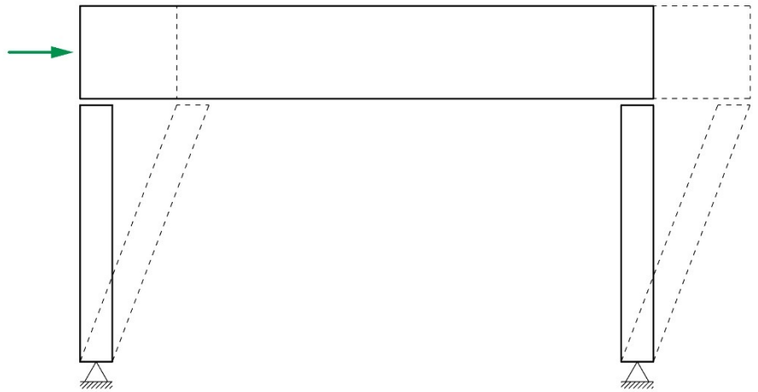


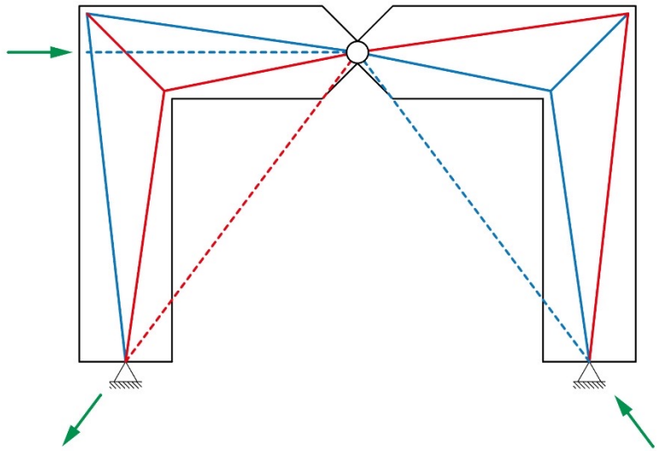


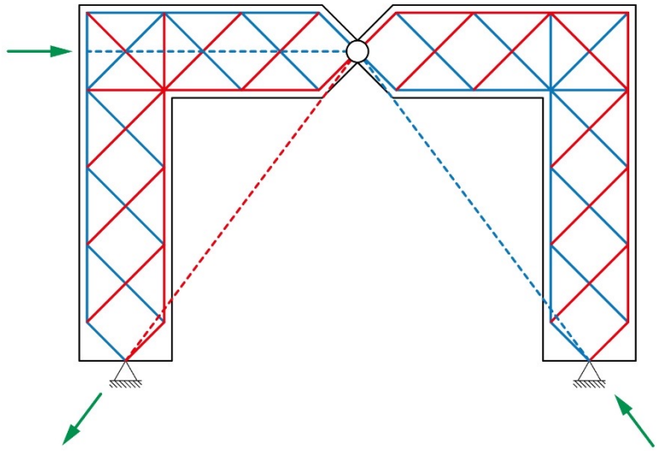


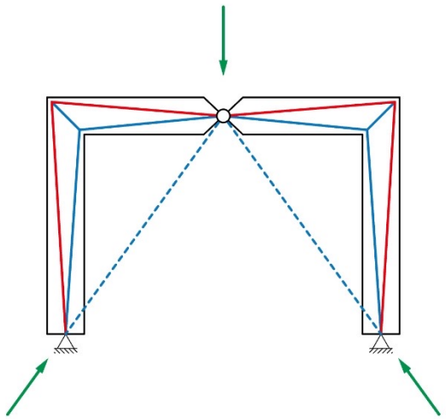
Dreigelenkrahmen

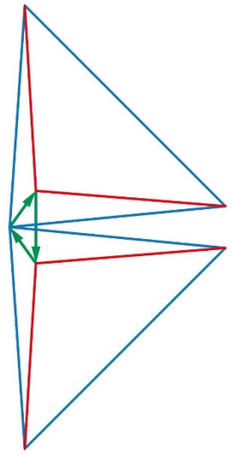
Three-hinged frames

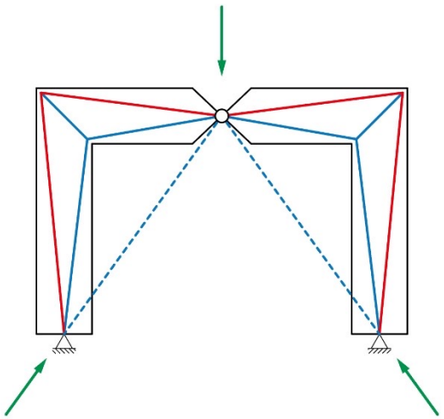


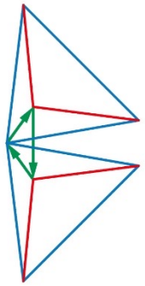


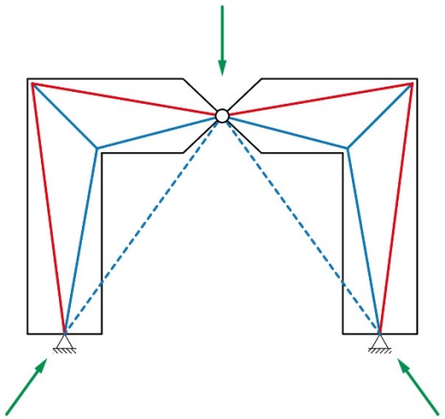


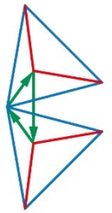


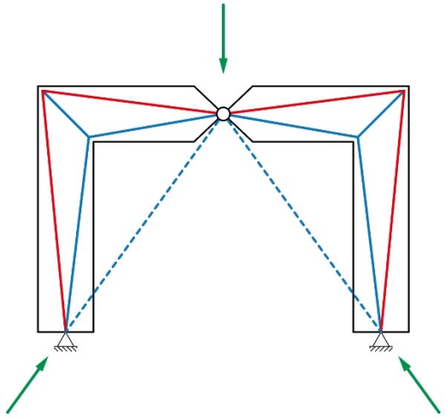


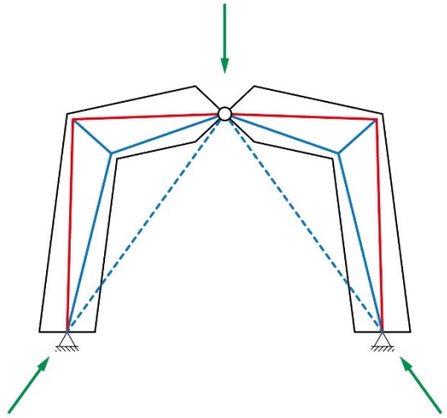


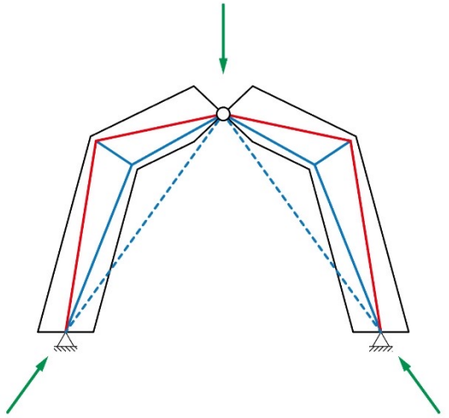


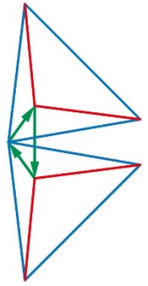


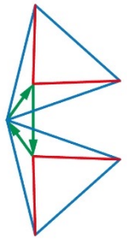


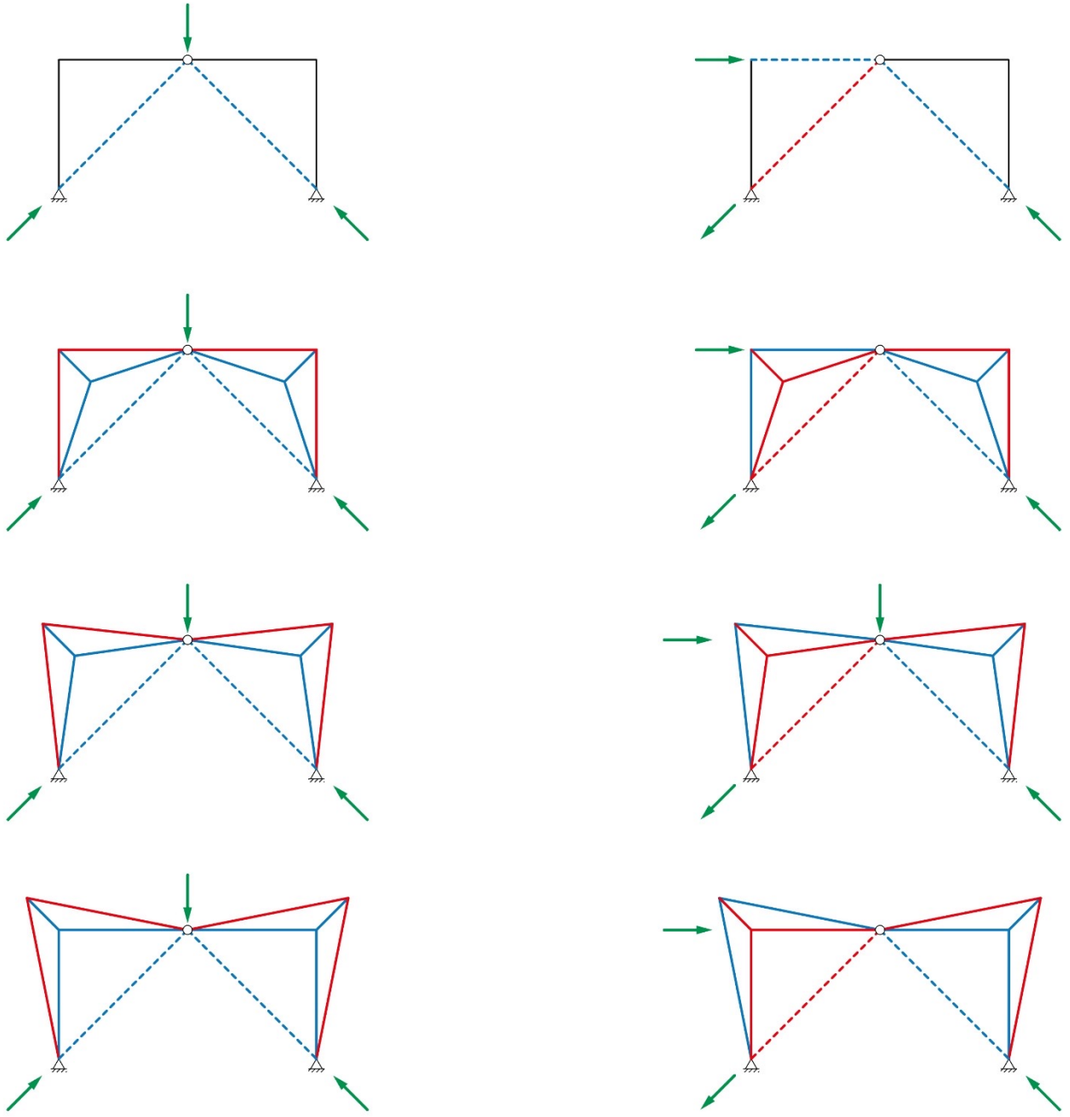


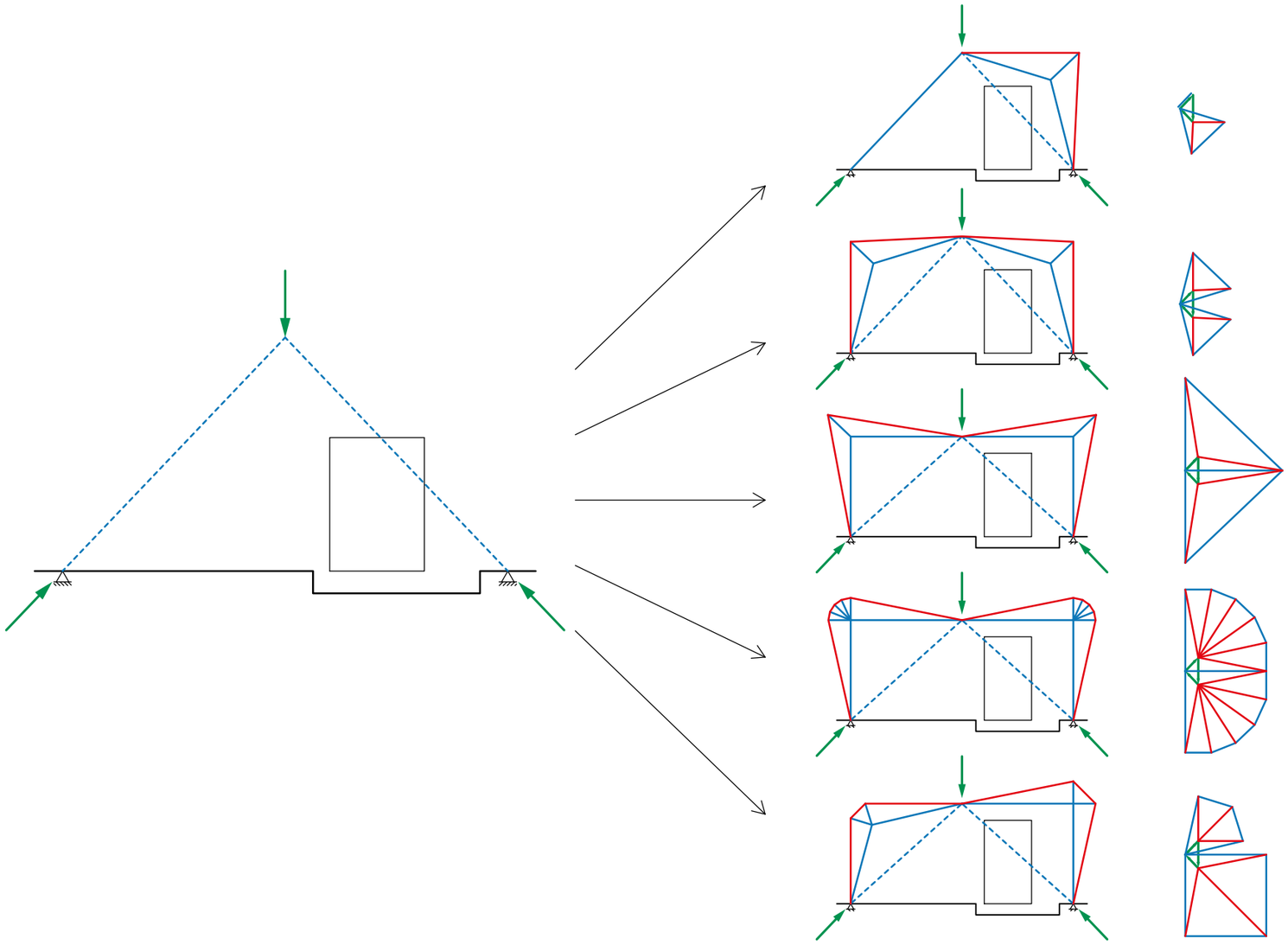




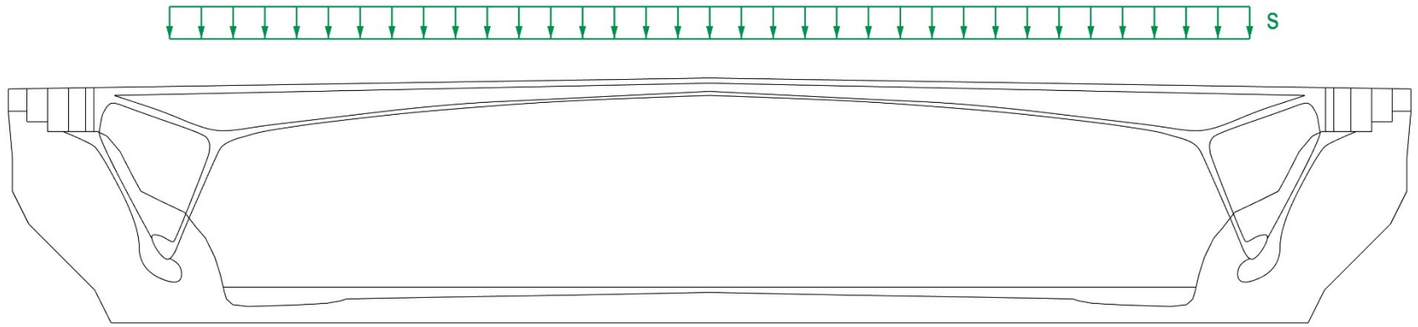








Silvano Zorzi: Brücke über den Tagliamento, Pinzano, Italien, 1969



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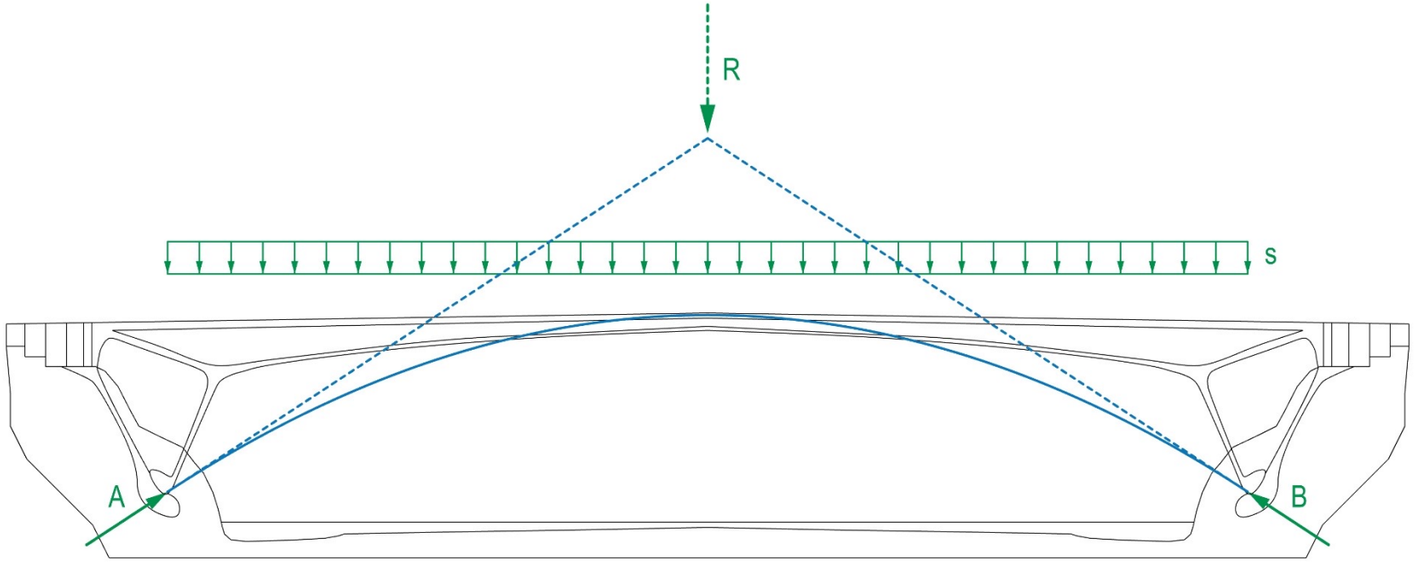

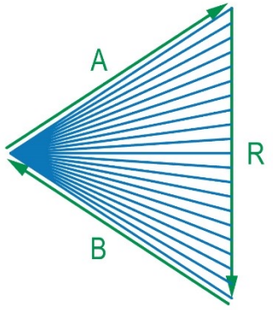

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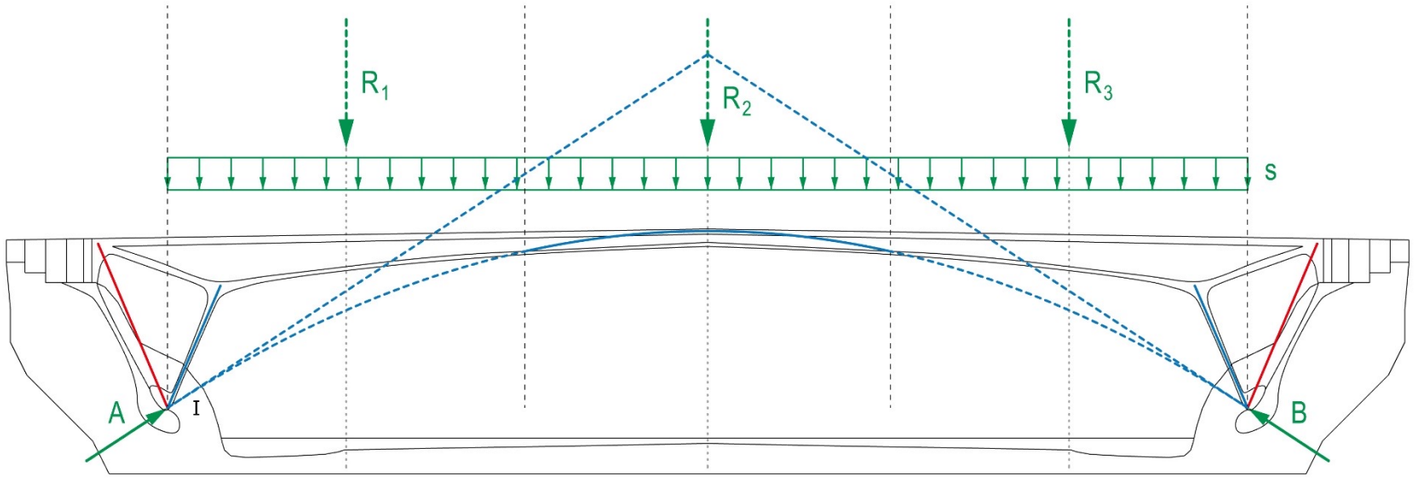

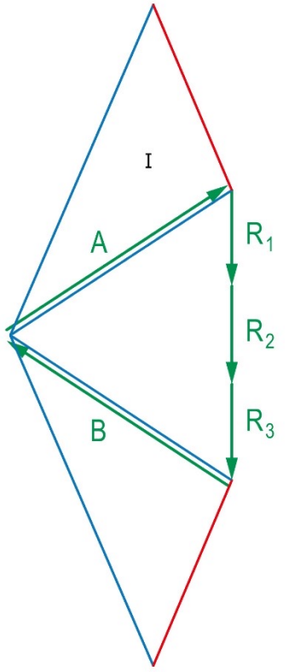

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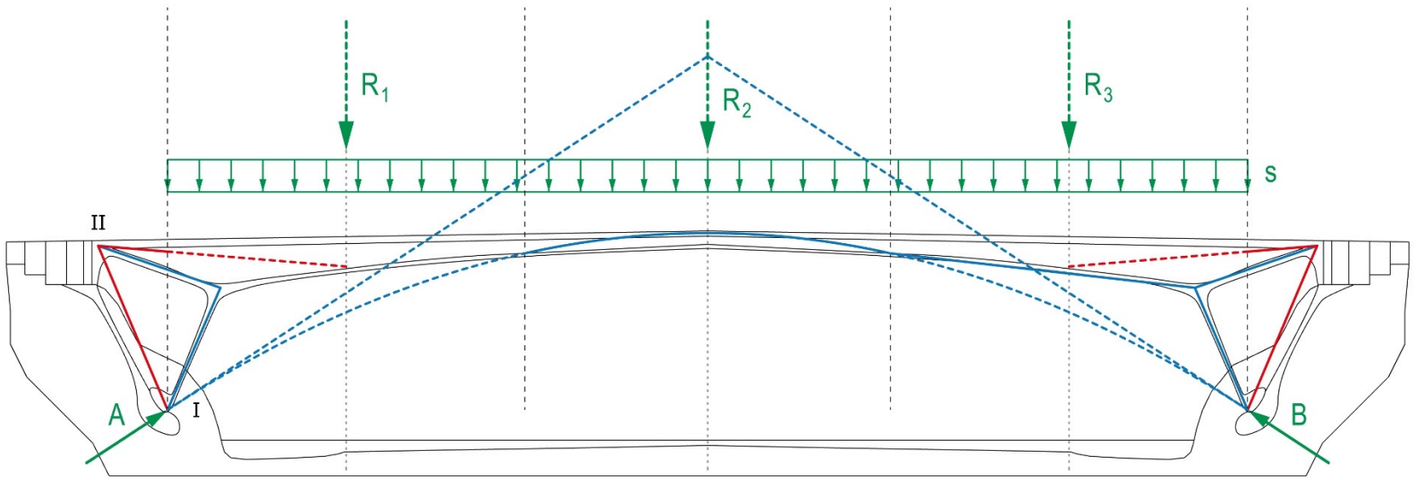

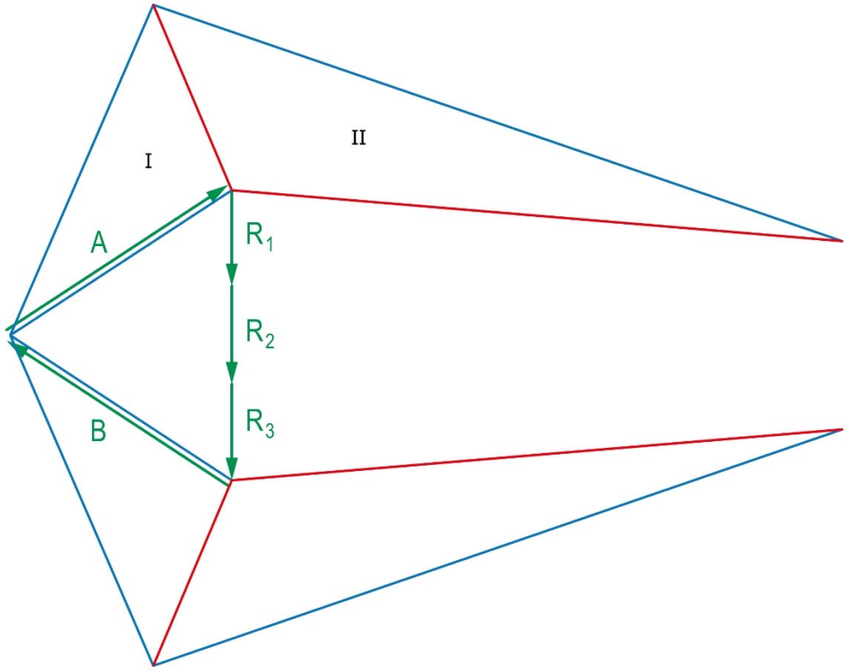

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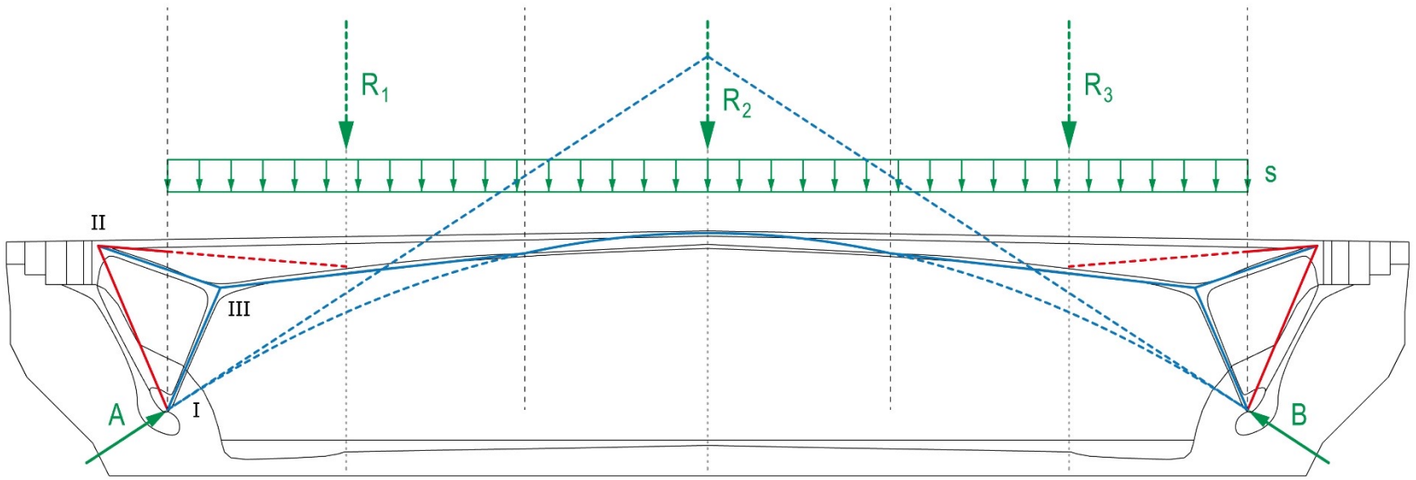

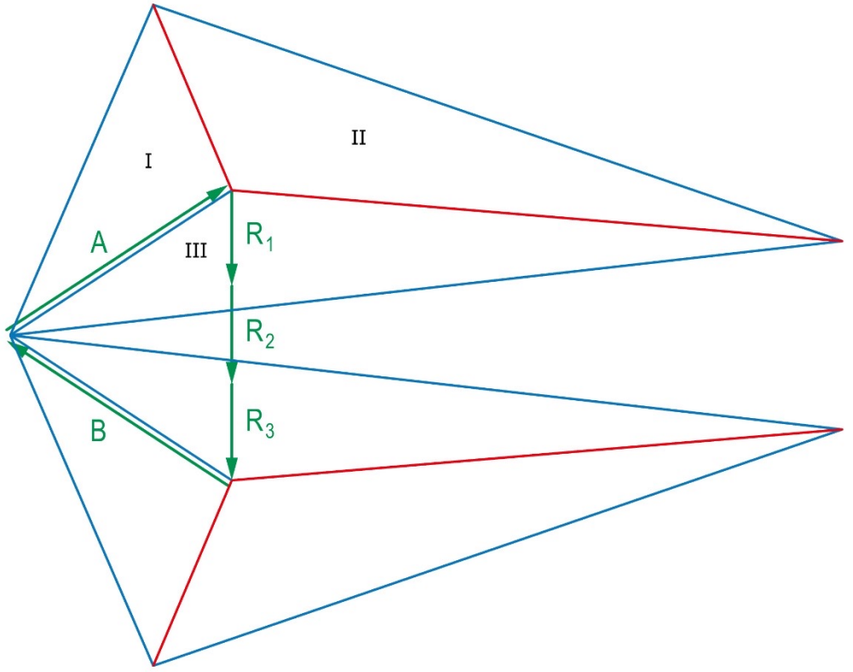

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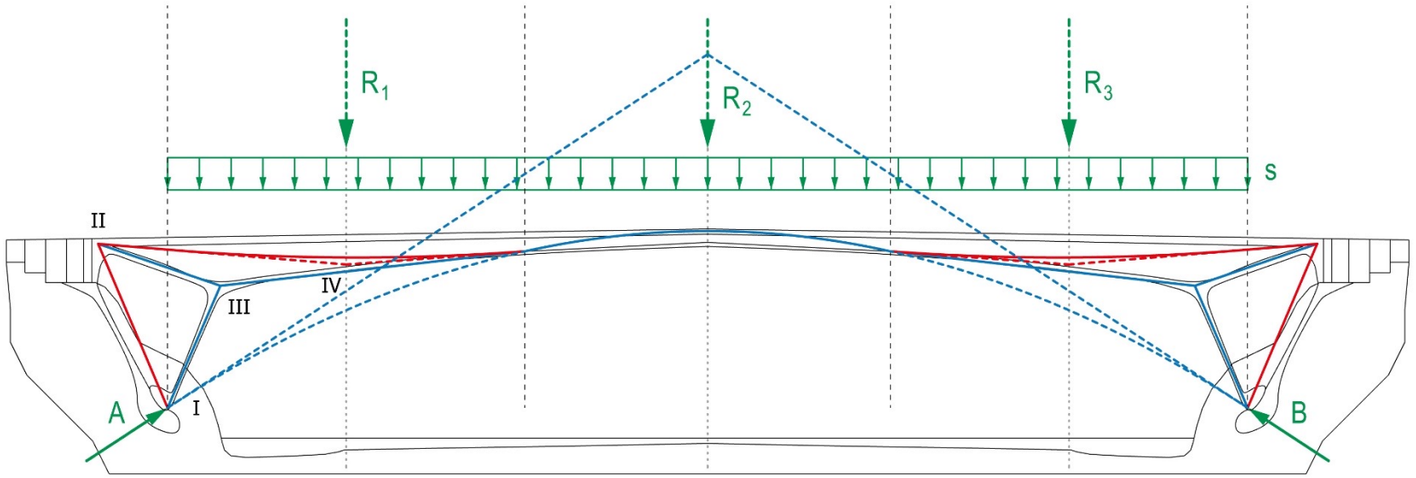

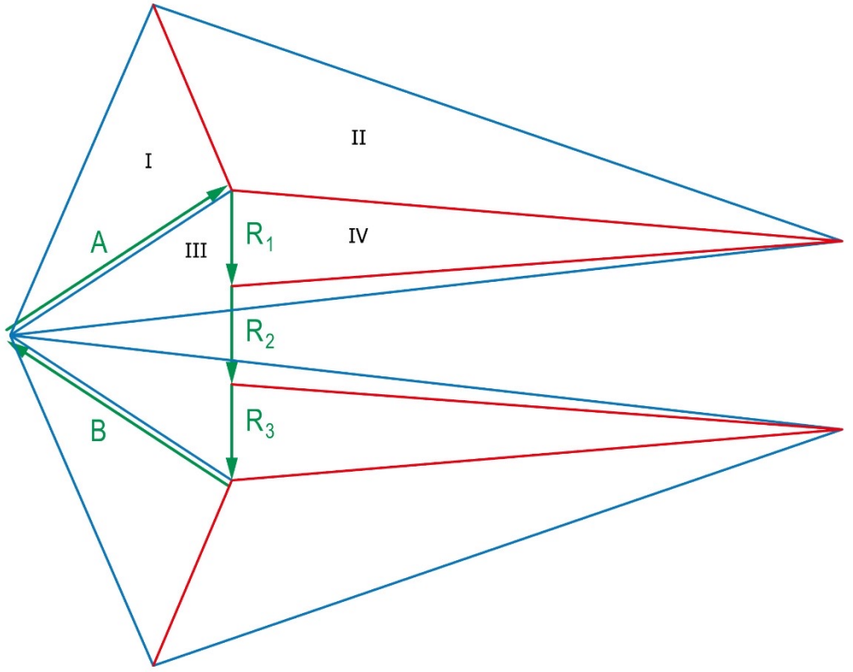

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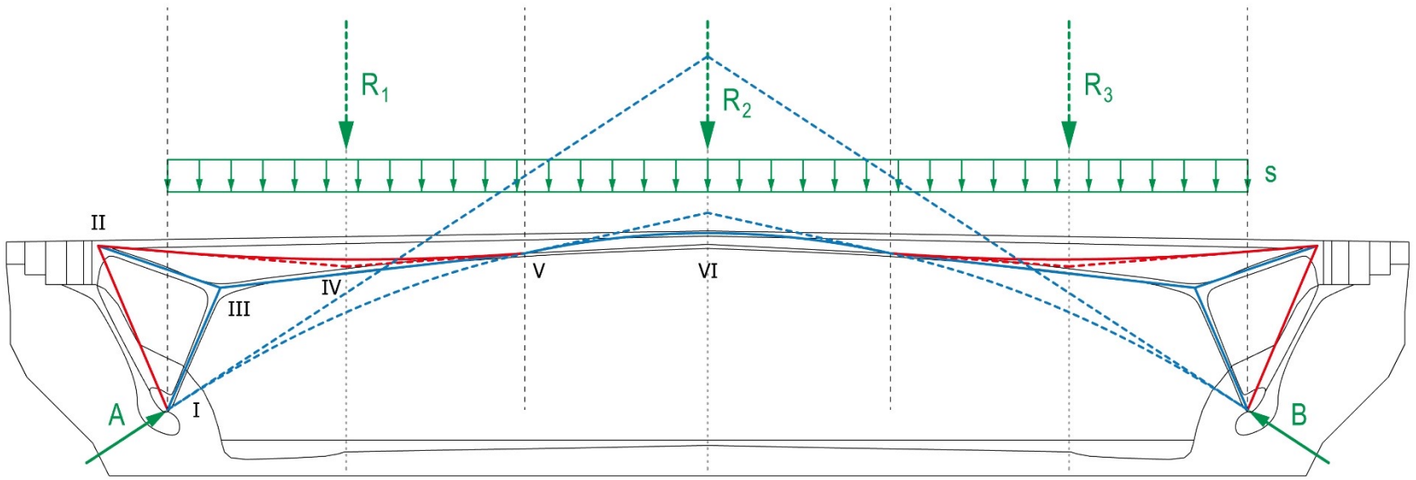

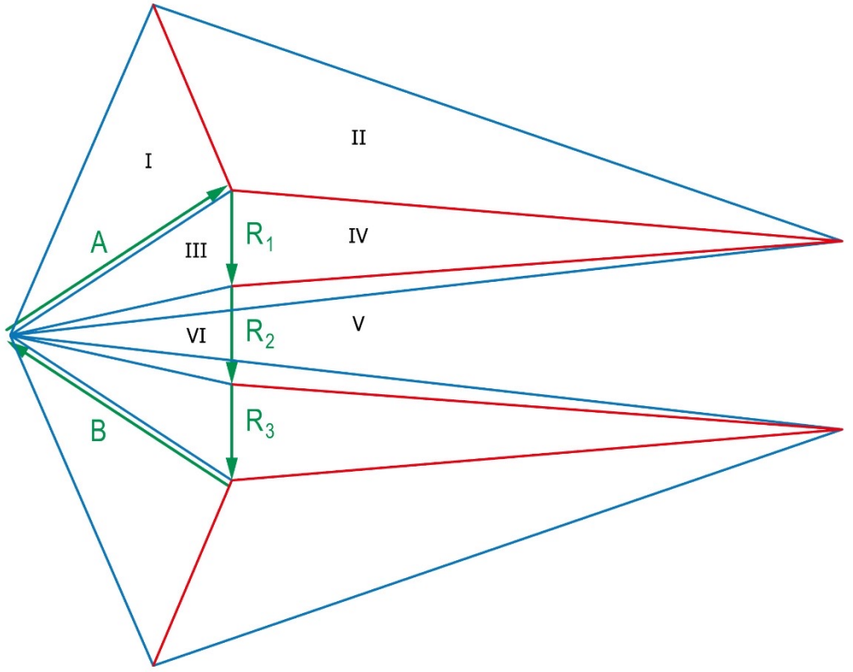

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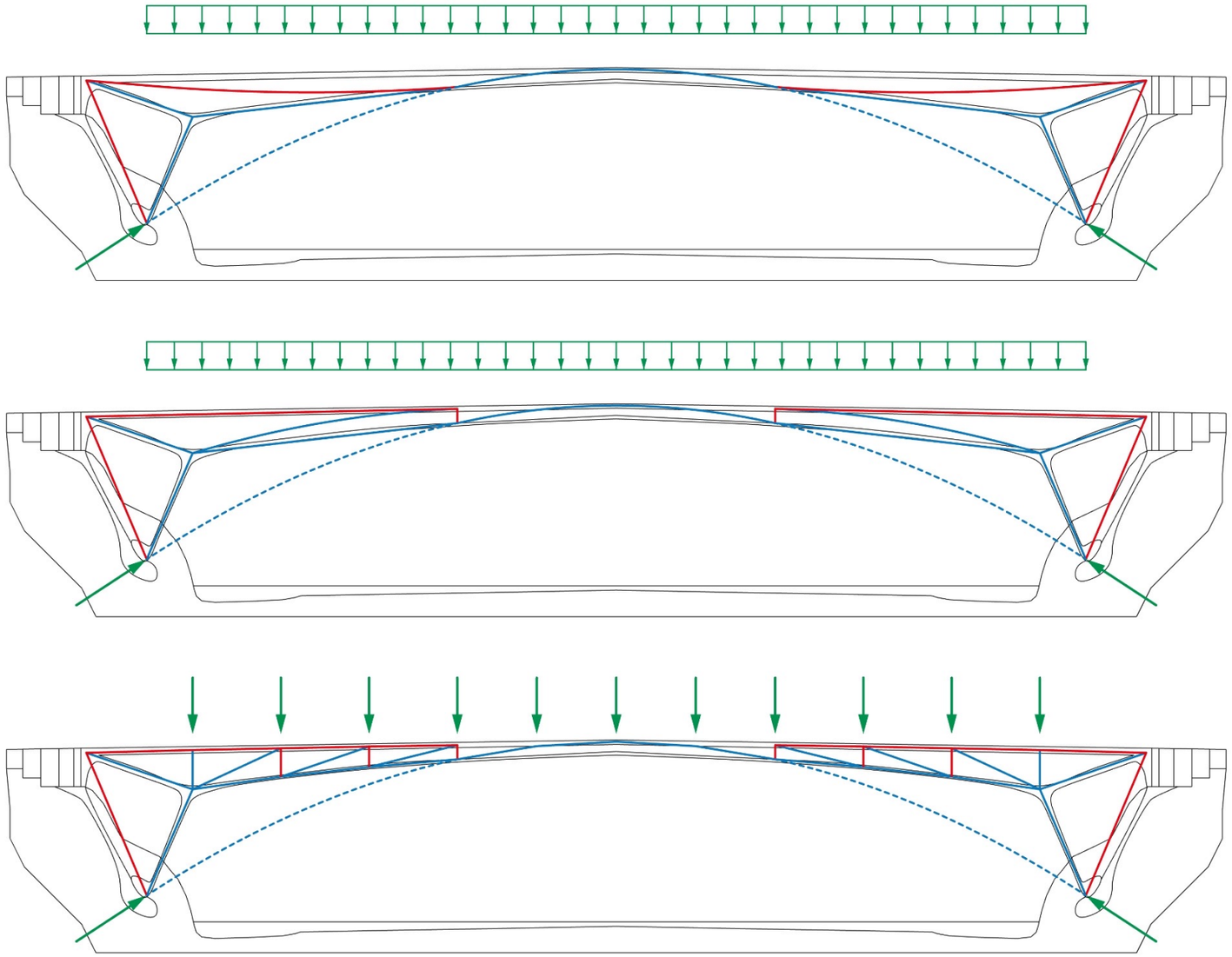
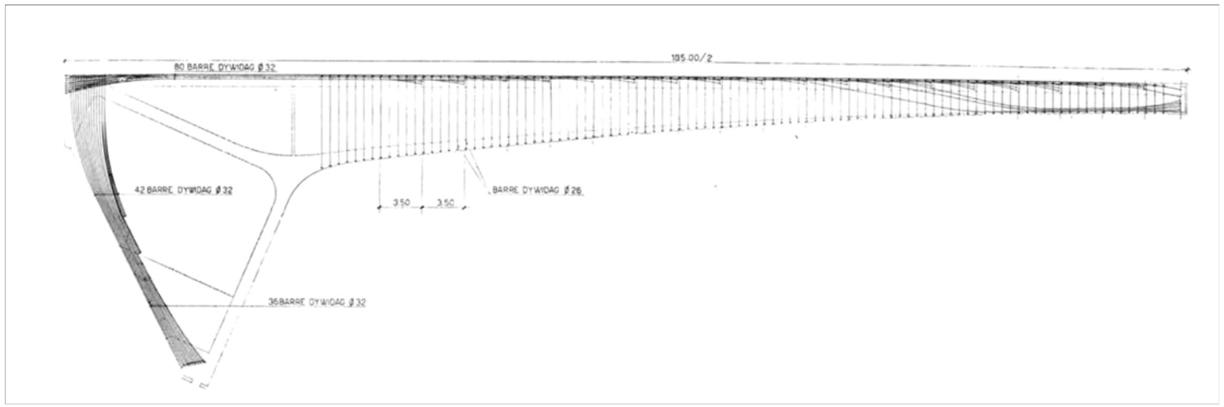
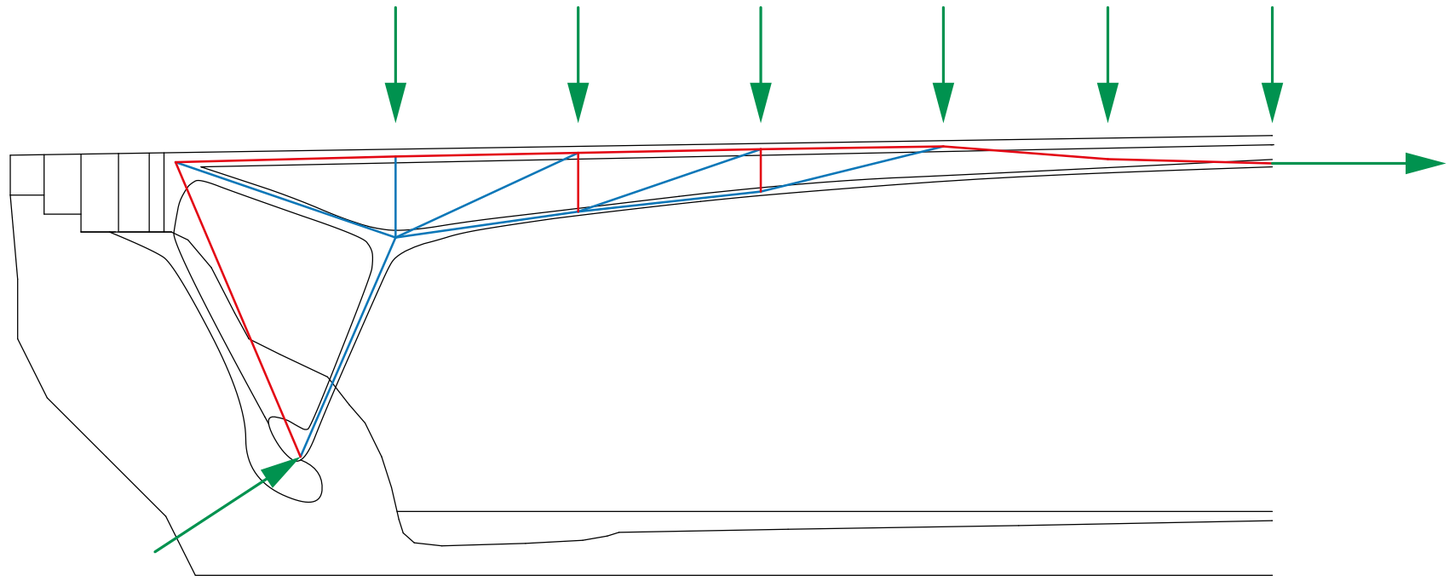






Silvano Zorzi: Brücke über den Tagliamento, Pinzano, Italien, 1969

Rahmen
Frames

Vom Bogen und Balken zum Rahmen
From arches and beams to frames

Dreigelenkrahmen
Three-hinged frames

>> Zweigelenkrahmen
Two-hinged frames

Rahmen ohne Gelenke
Frames without hinges

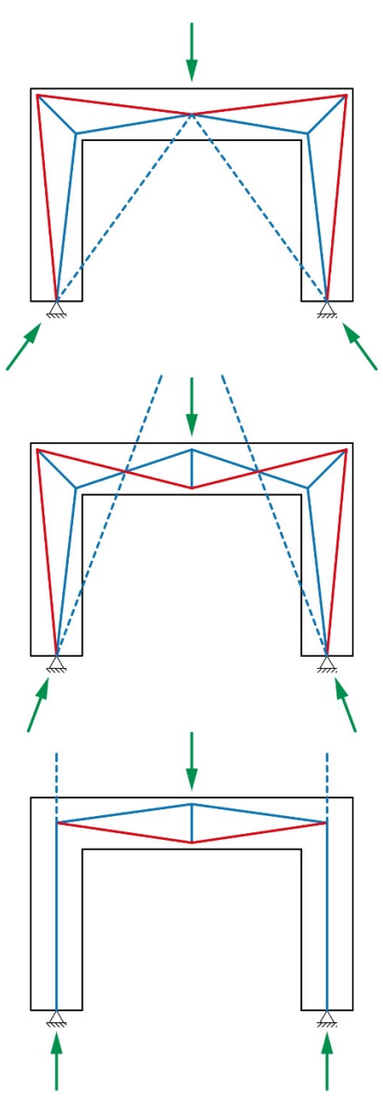
Rahmenecke
Frame corner

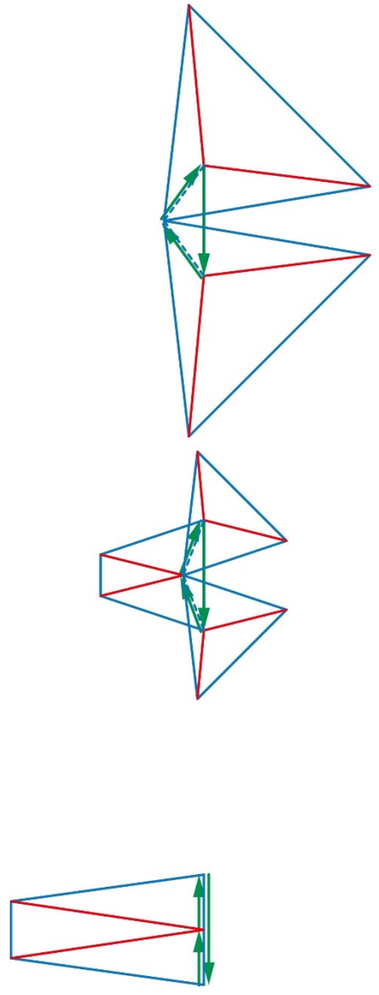
Fallbeispiele
Case studies

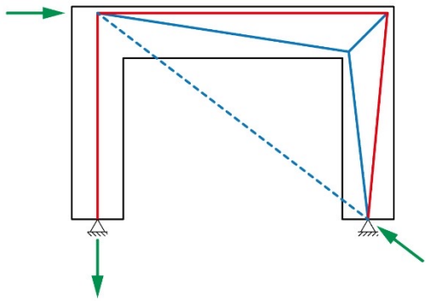
Zusammengesetzte Rahmen
Compound frames

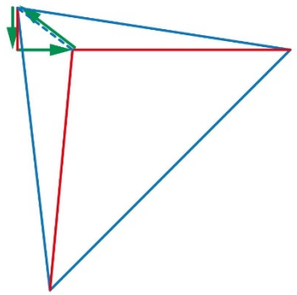
Zweigelenkrahmen

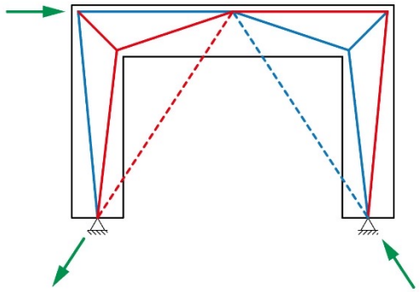
Two-hinged frames

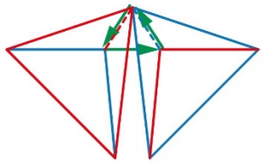


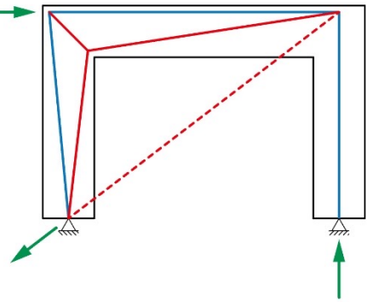


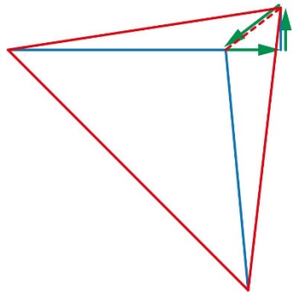


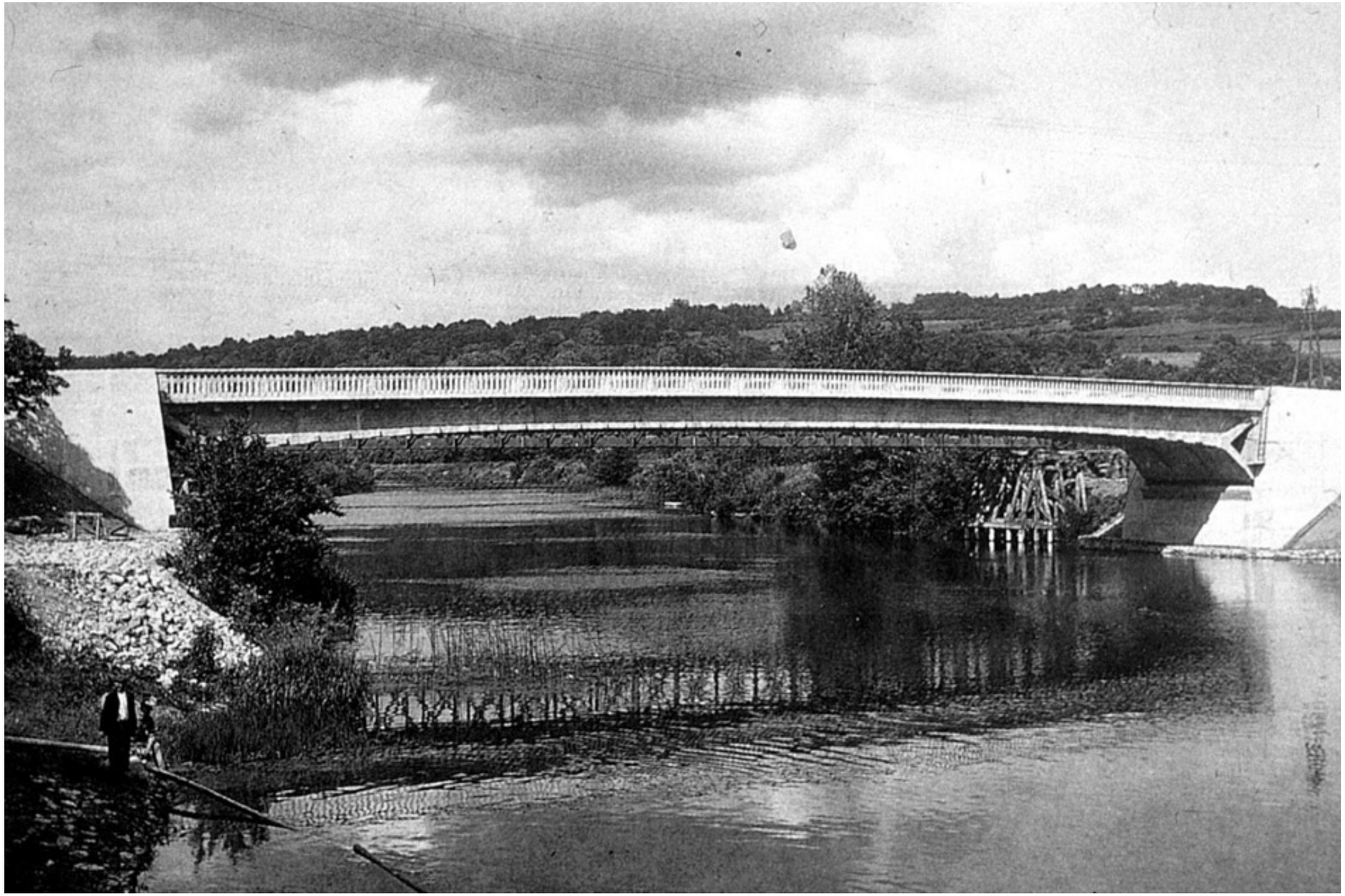




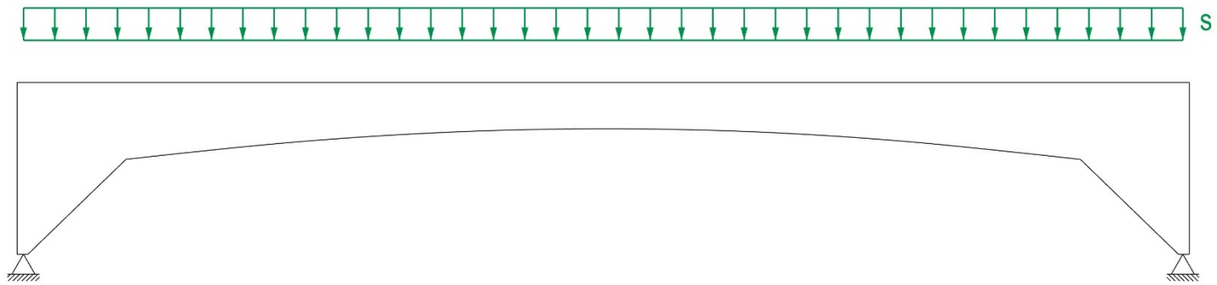






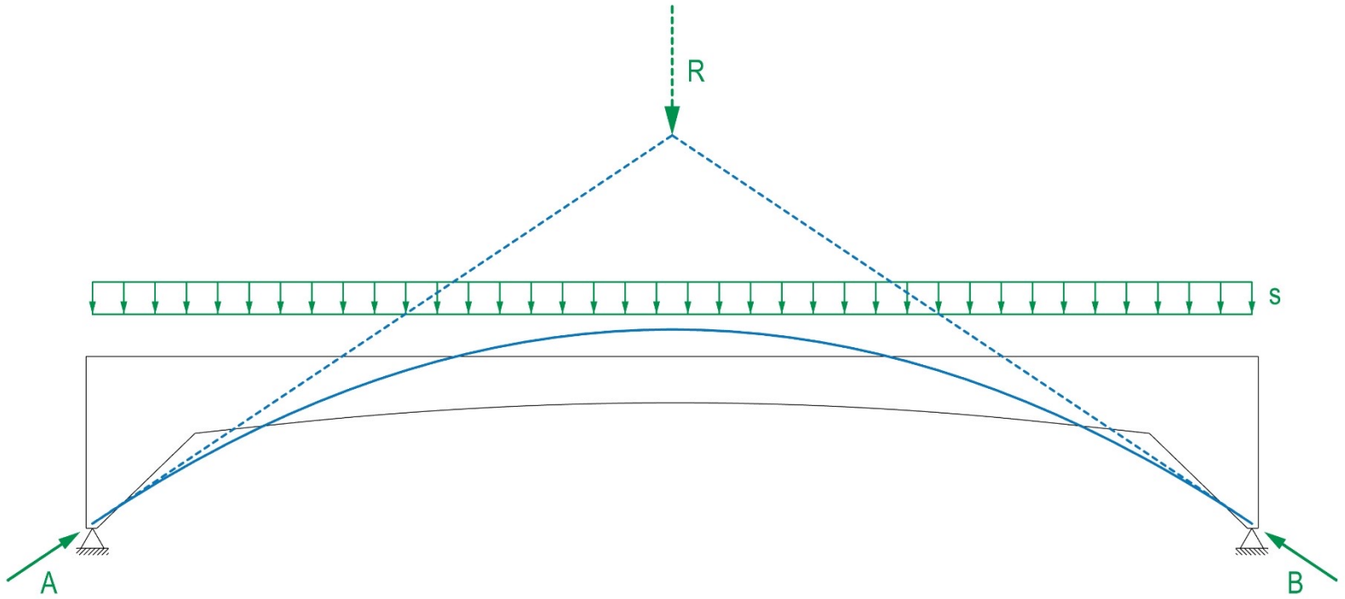


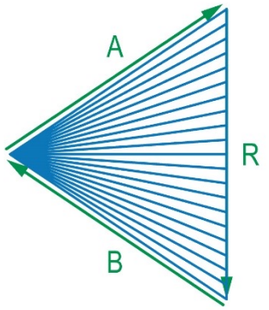
Eugene Freyssinet: Brücke über die Marne, Luzancy, 1946



Lageplan 1:100
Form diagram 1:100

Kräfteplan 1 cm ≙ 1 kN
Force diagram 1 cm ≙ 1 kN





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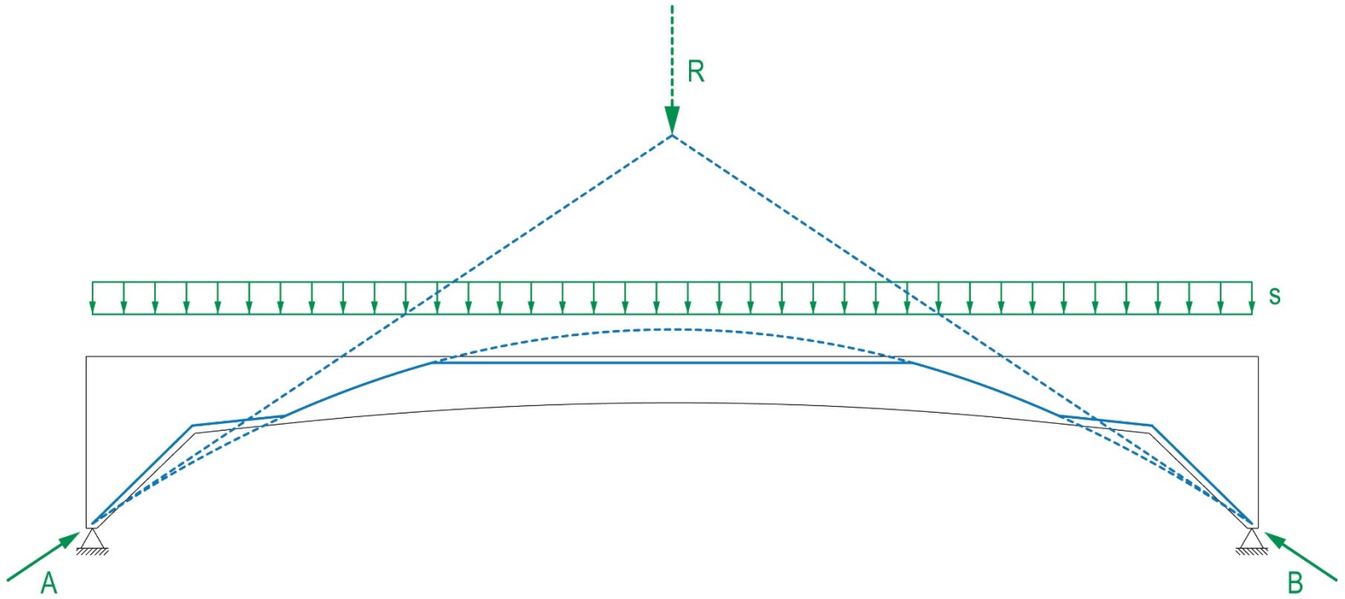

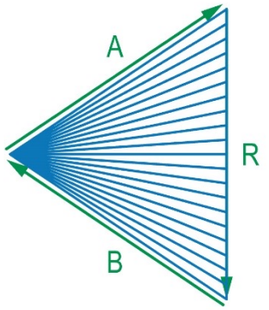

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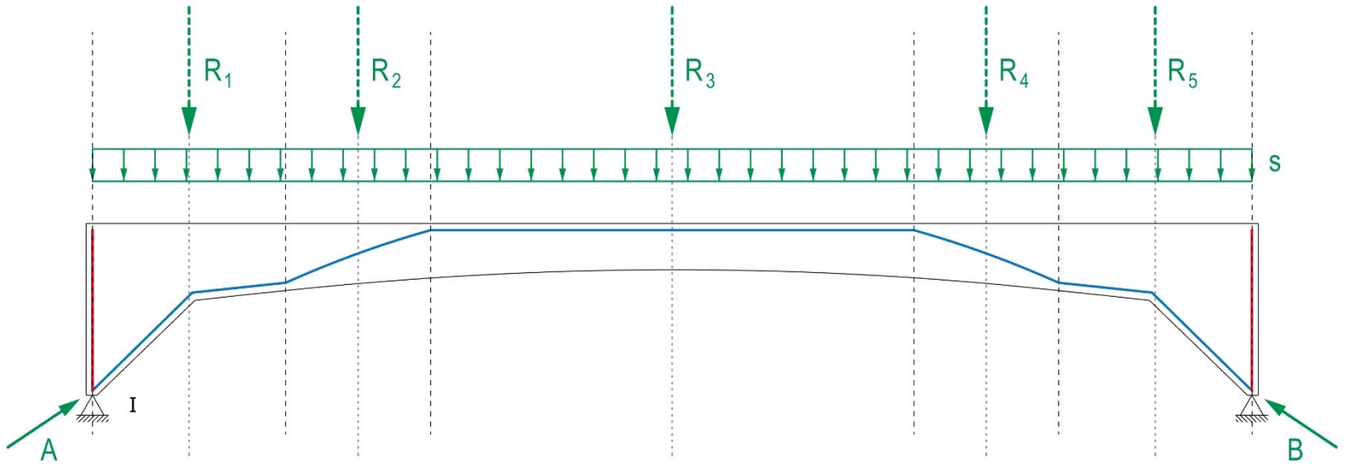

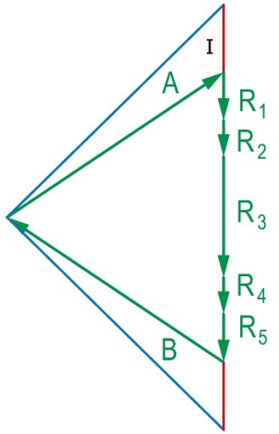

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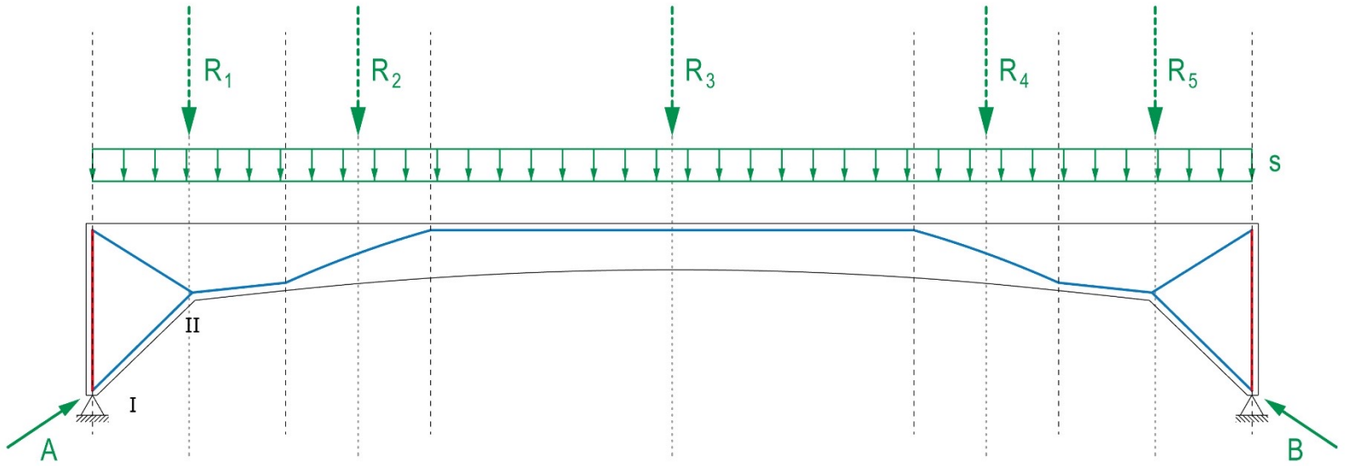

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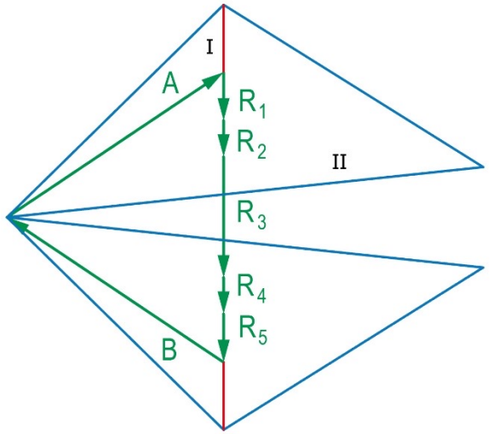

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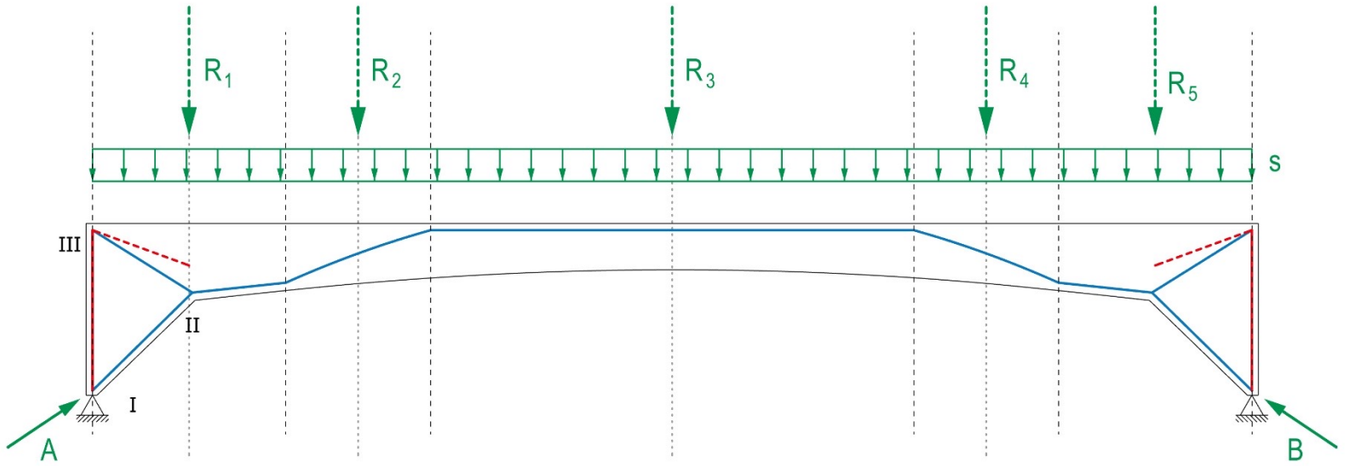

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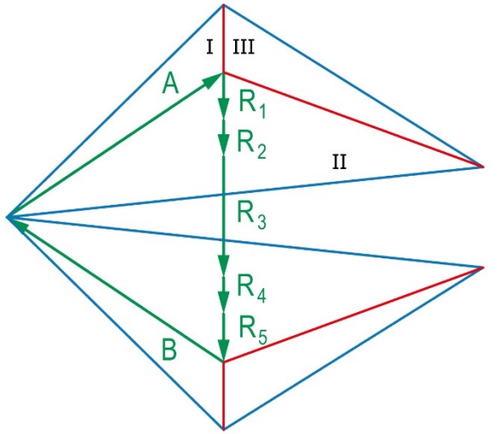
Form diagram 1:100



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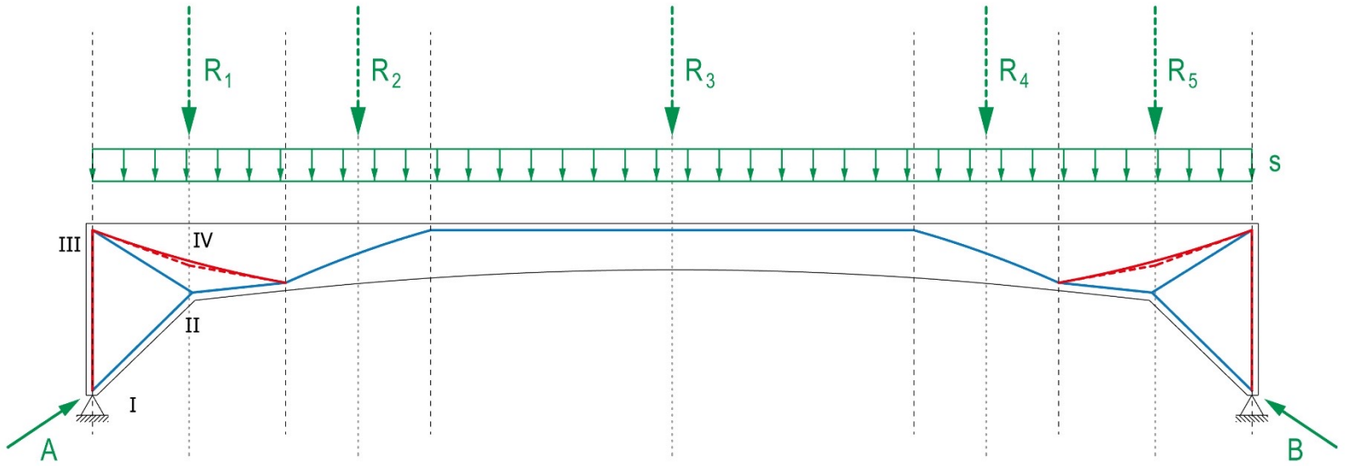

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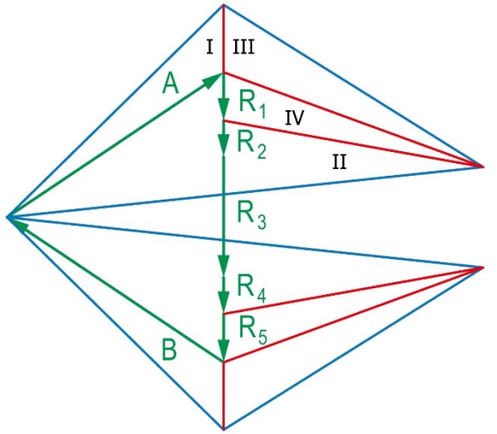

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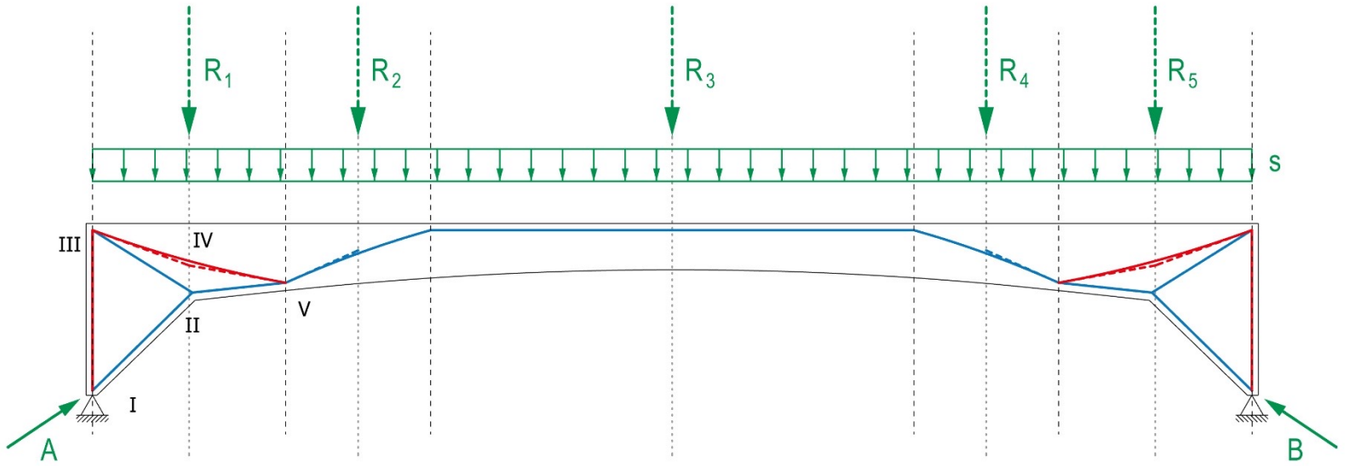

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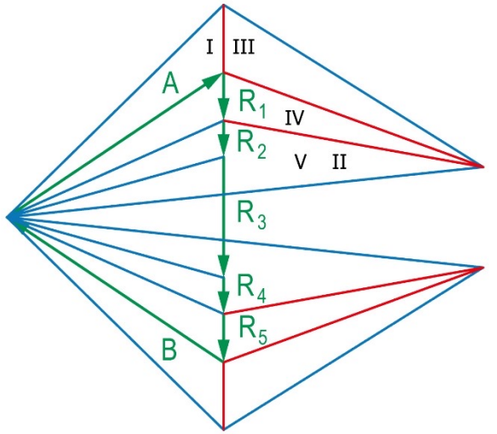

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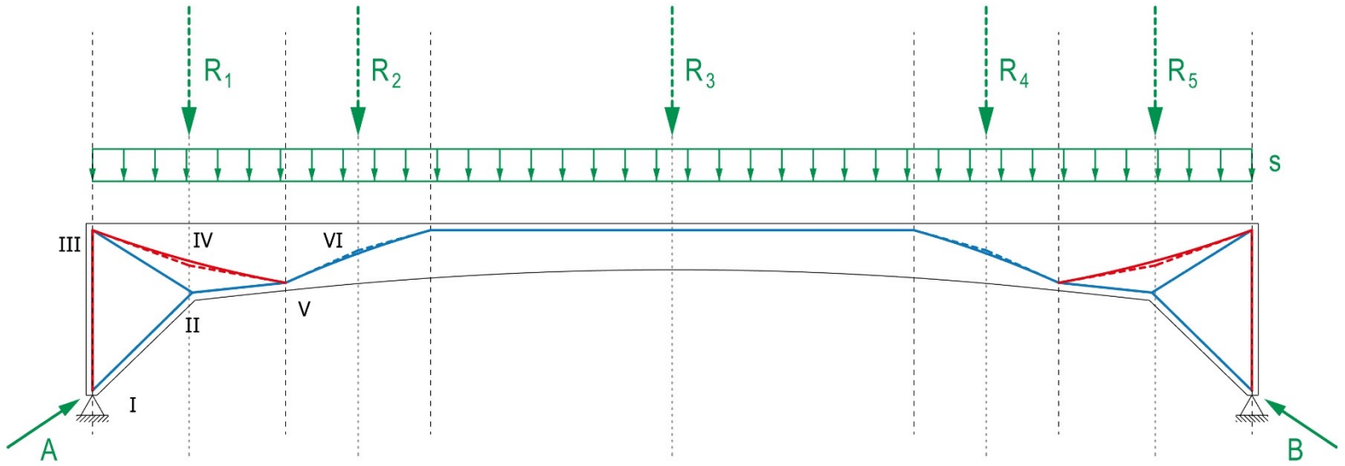

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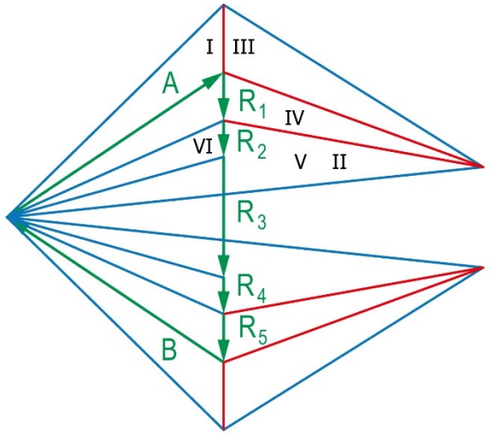

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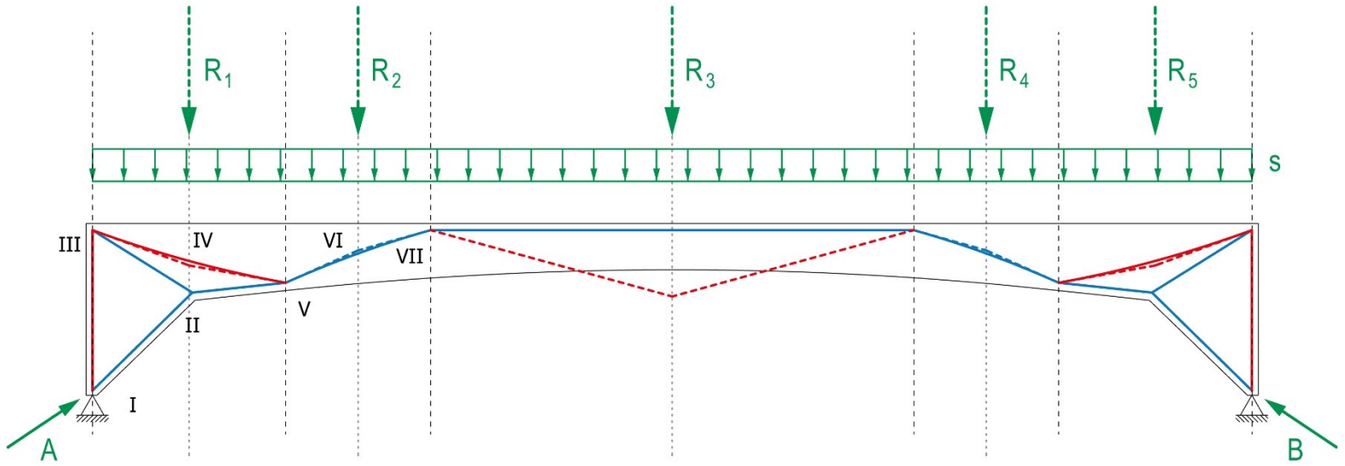

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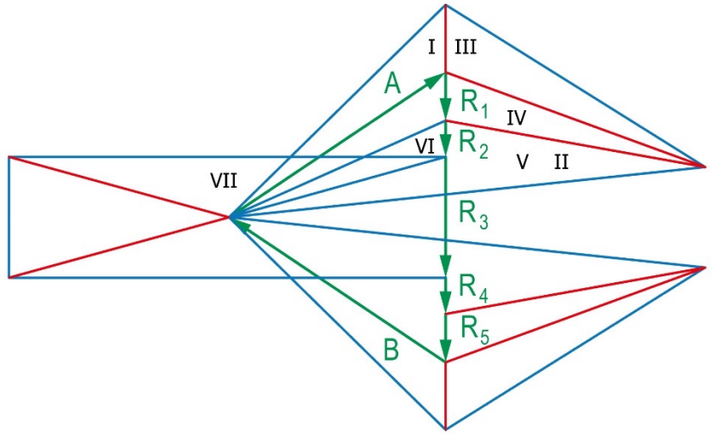

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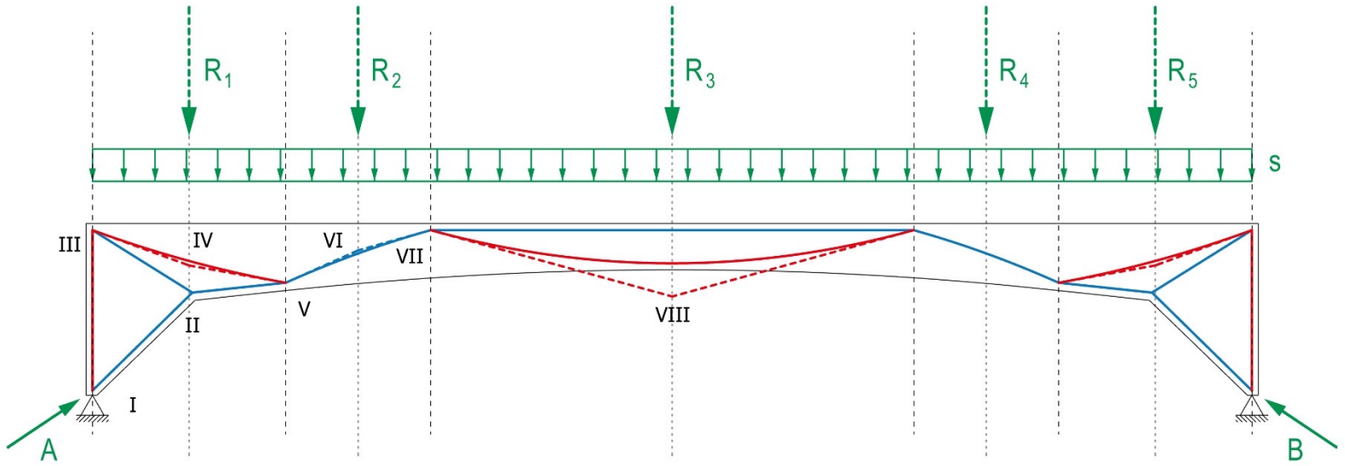

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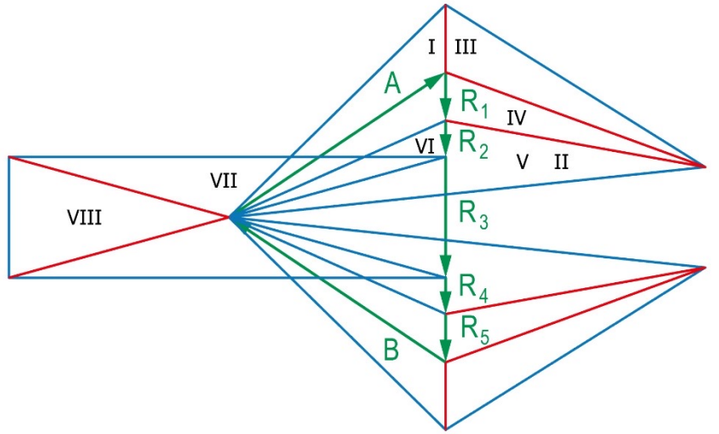

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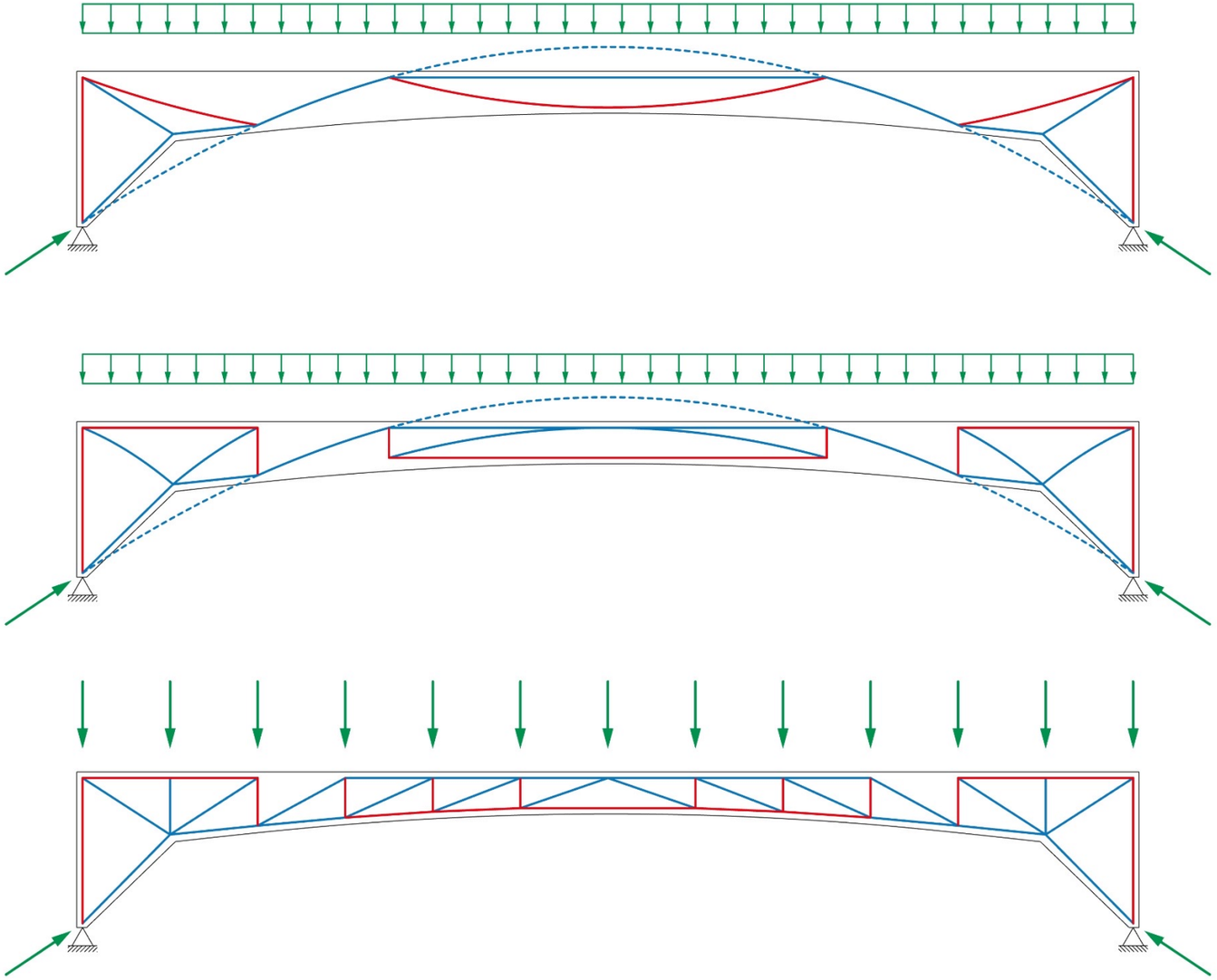


Rahmen
Frames

Vom Bogen und Balken zum Rahmen
From arches and beams to frames

Dreigelenkrahmen
Three-hinged frames

Zweigelenkrahmen
Two-hinged frames

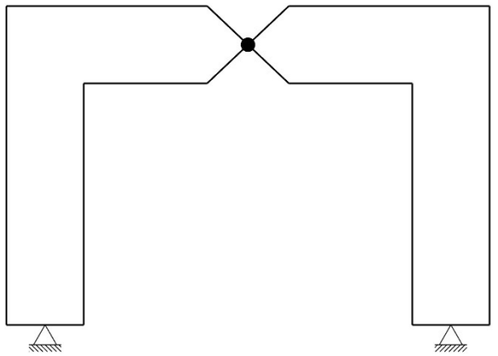
>> Rahmen ohne Gelenke
Frames without hinges

Rahmenecke
Frame corner

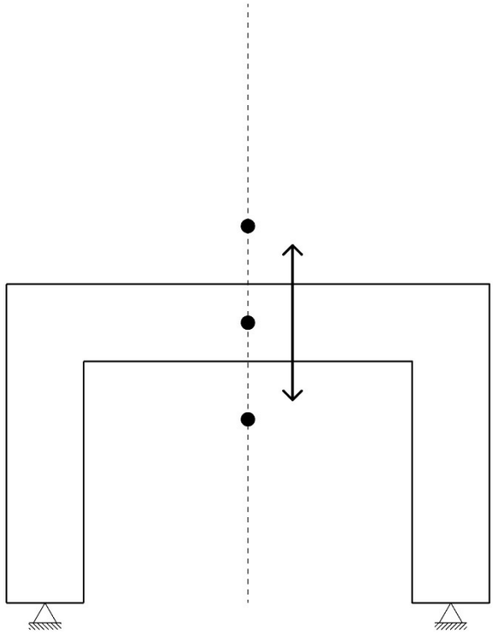
Fallbeispiele
Case studies

Zusammengesetzte Rahmen
Compound frames

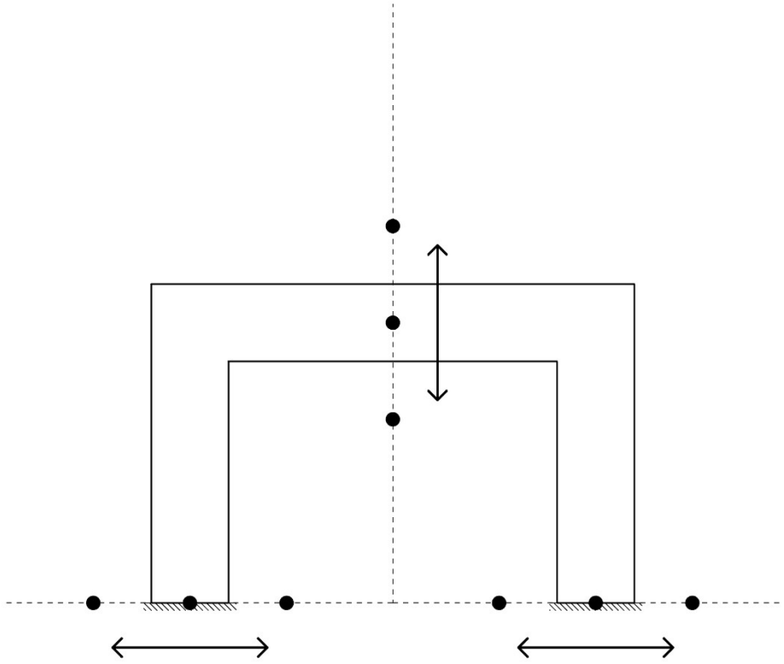
Dreigelenkrahmen
Three-hinged frame

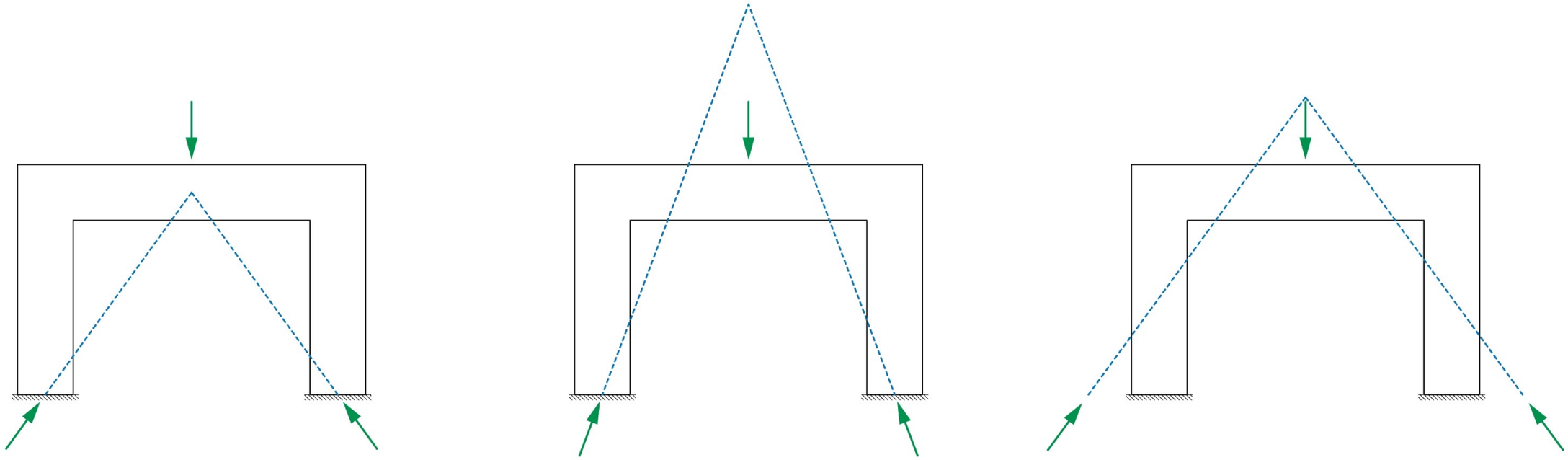


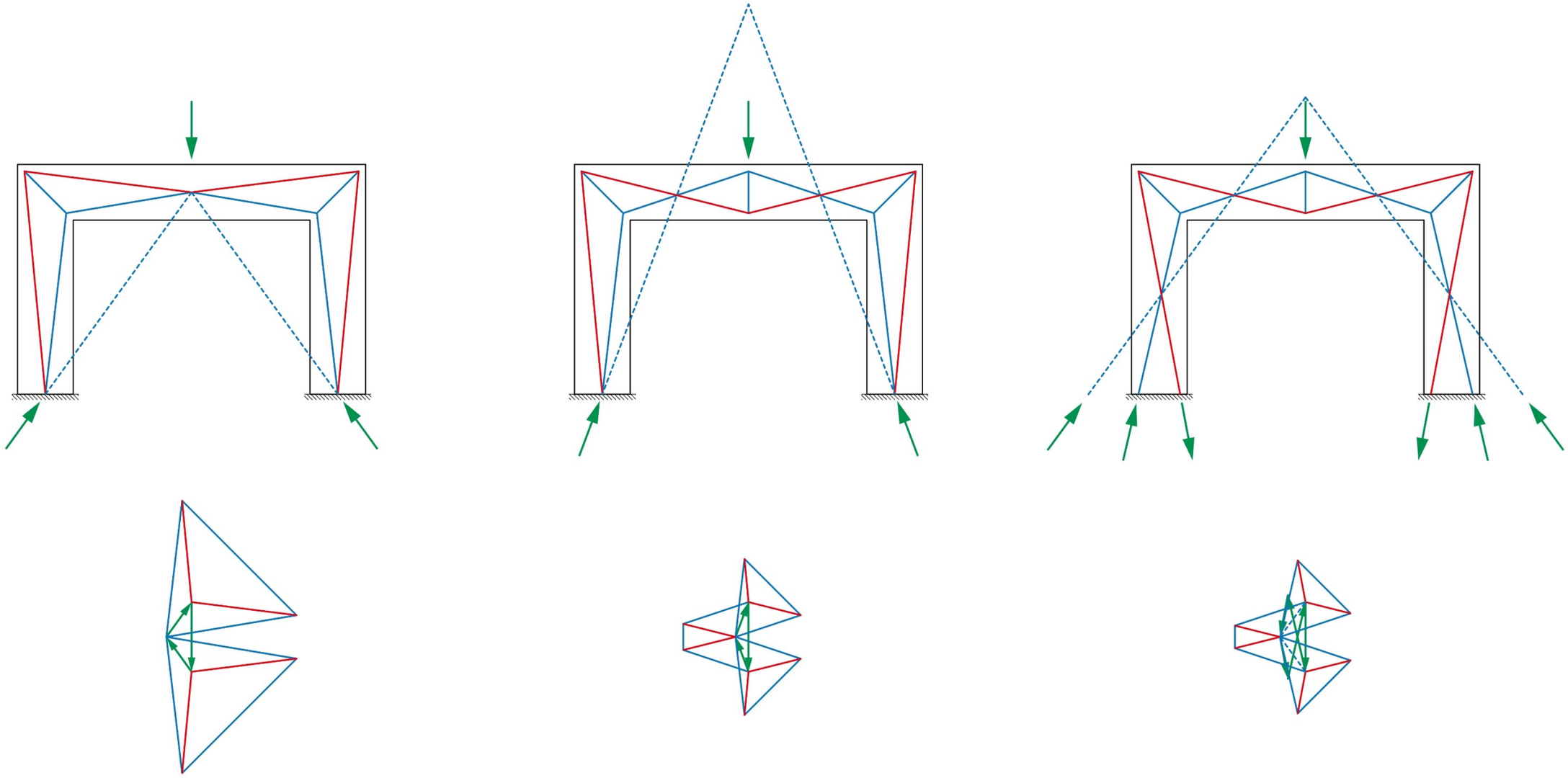
Zweigelenkrahmen
Two-hinged frame



Rahmen ohne Gelenke
Frame without hinges







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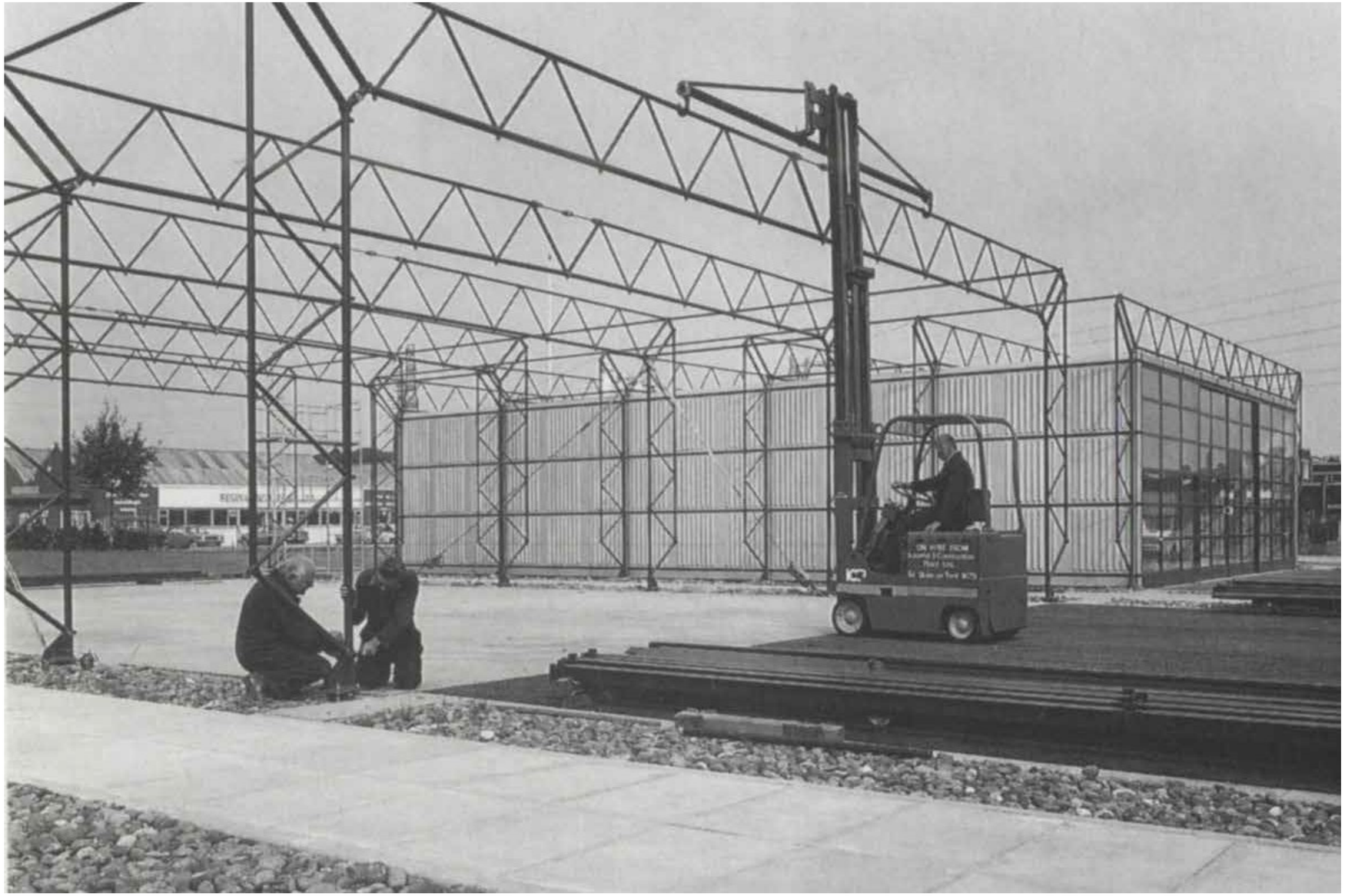
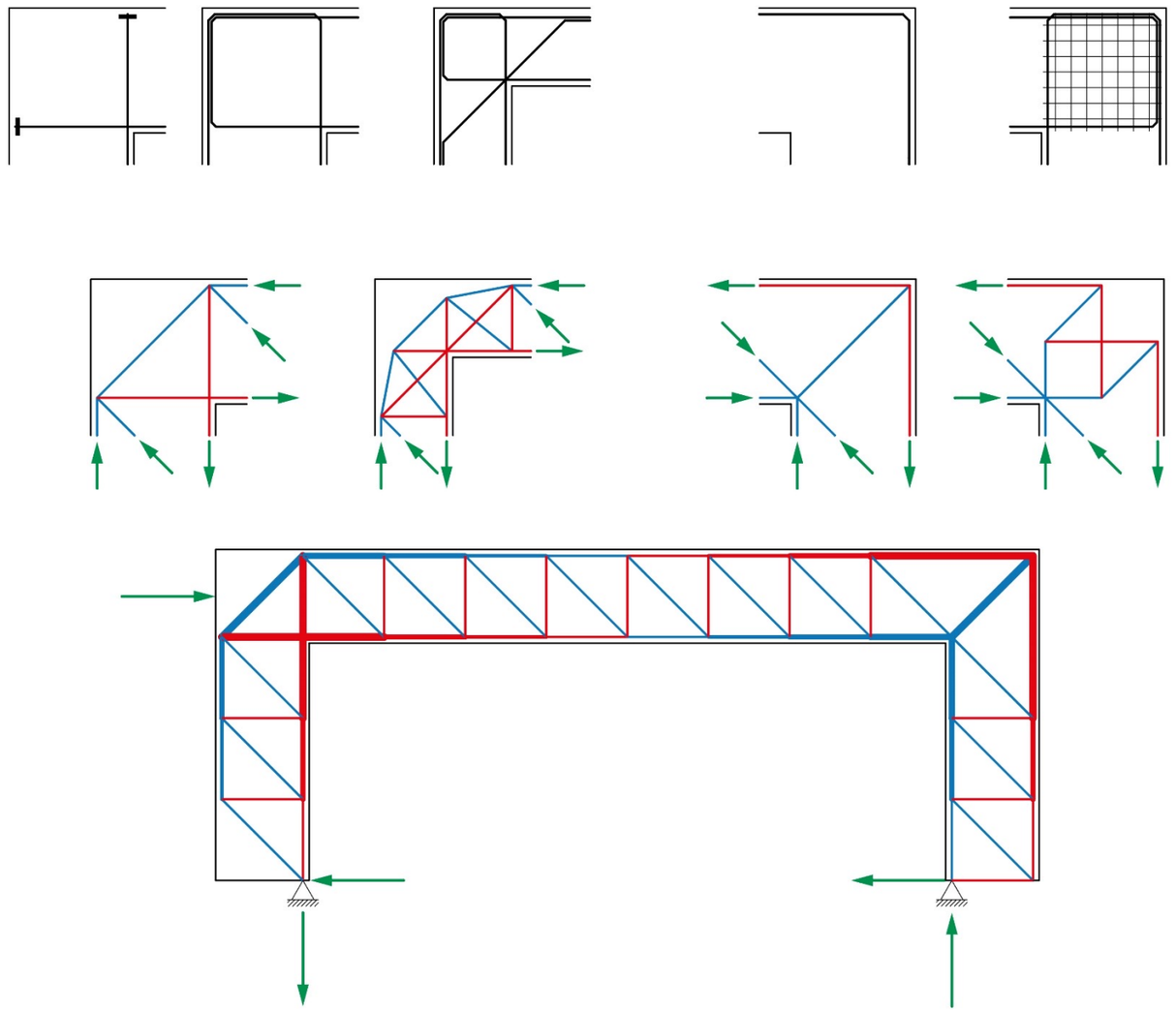


Patera Gebäude, Stoke-on-Trent

Studio Vacchini: Sportausbildungszentrum Mülimatt, Brugg/Windisch, 2010



Bewehrung der Rahmenecke in Stahlbeton

L. Mies van der Rohe: Crown Hall IIT, Chicago, 1956

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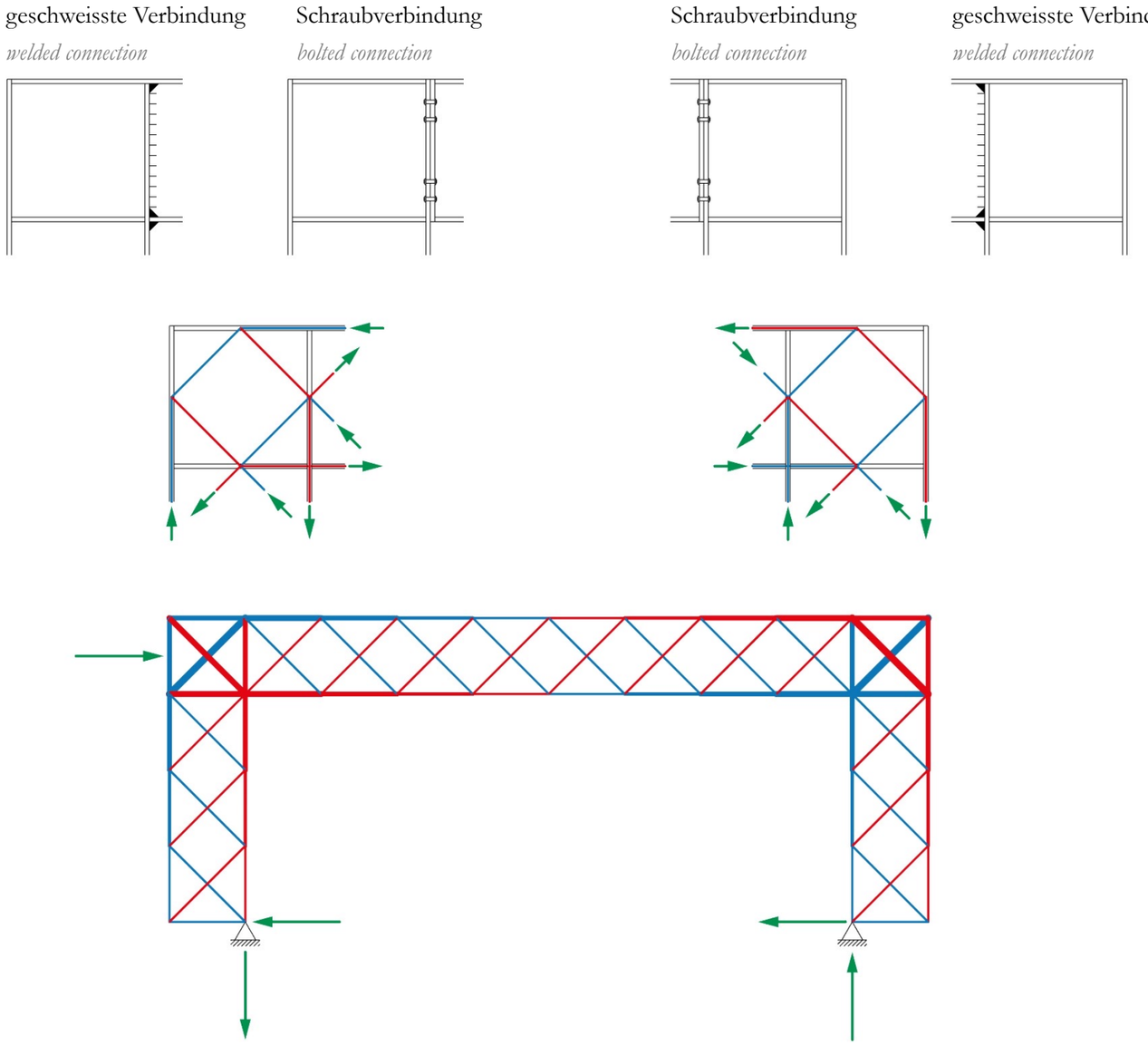

Ausführung der Rahmenecke in Stahl

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Zusammengesetzte Rahmen
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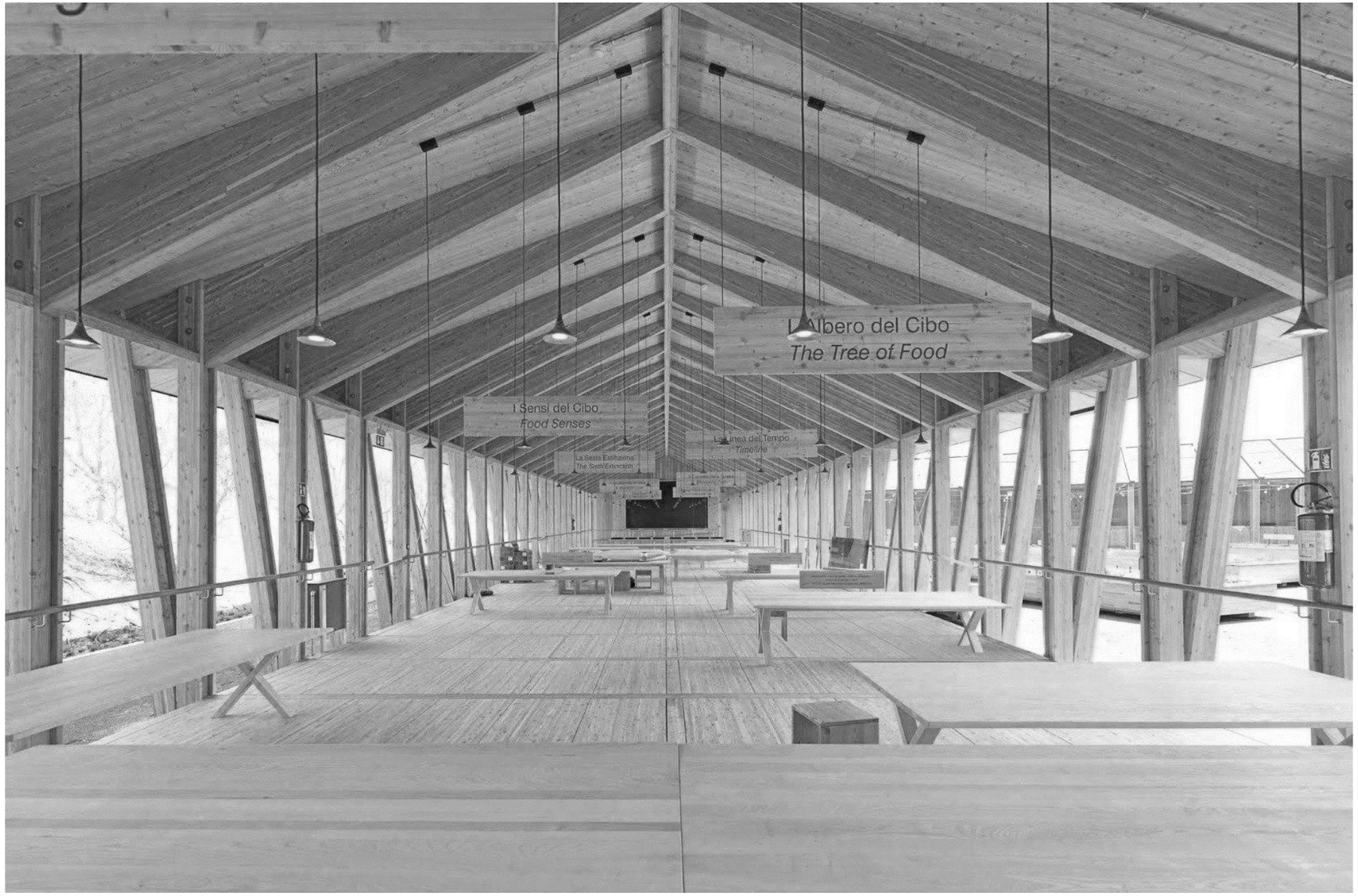
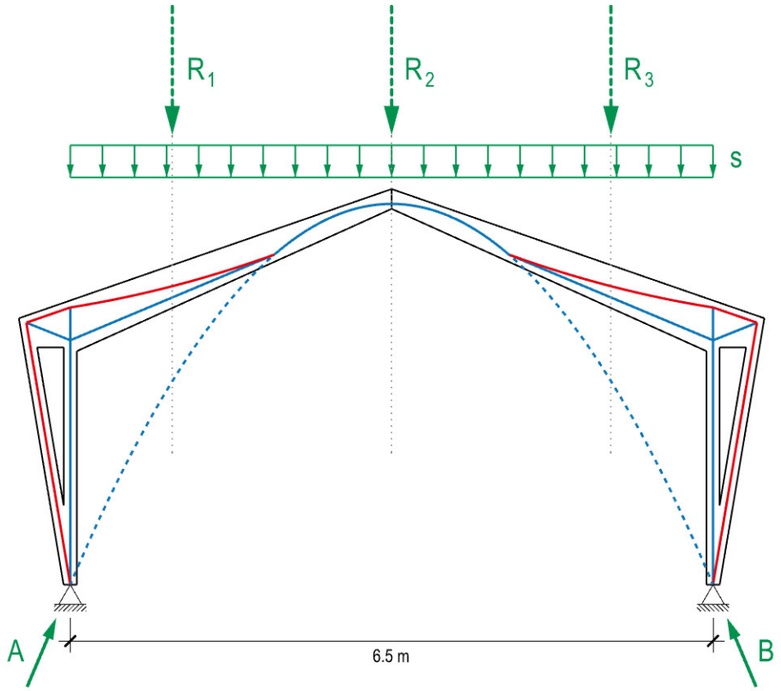
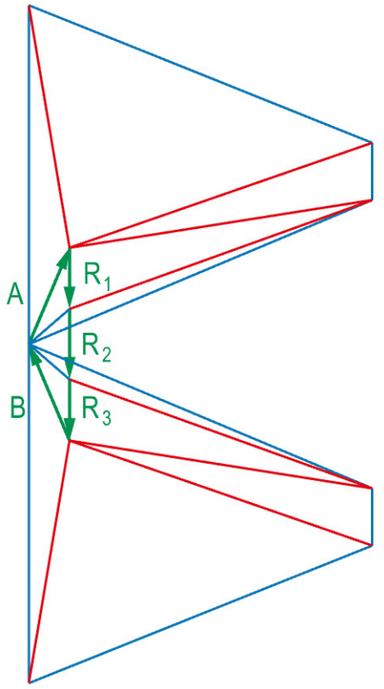


Herzog & de Meuron: Slow Food Pavilion, Mailand, 2015


R1
R2
R3
s
A
B
6.5 m


A
B
R1
R2
R3

Affonso Eduardo Reidy: Museu de Arte Moderna, Rio de Janeiro, 1954

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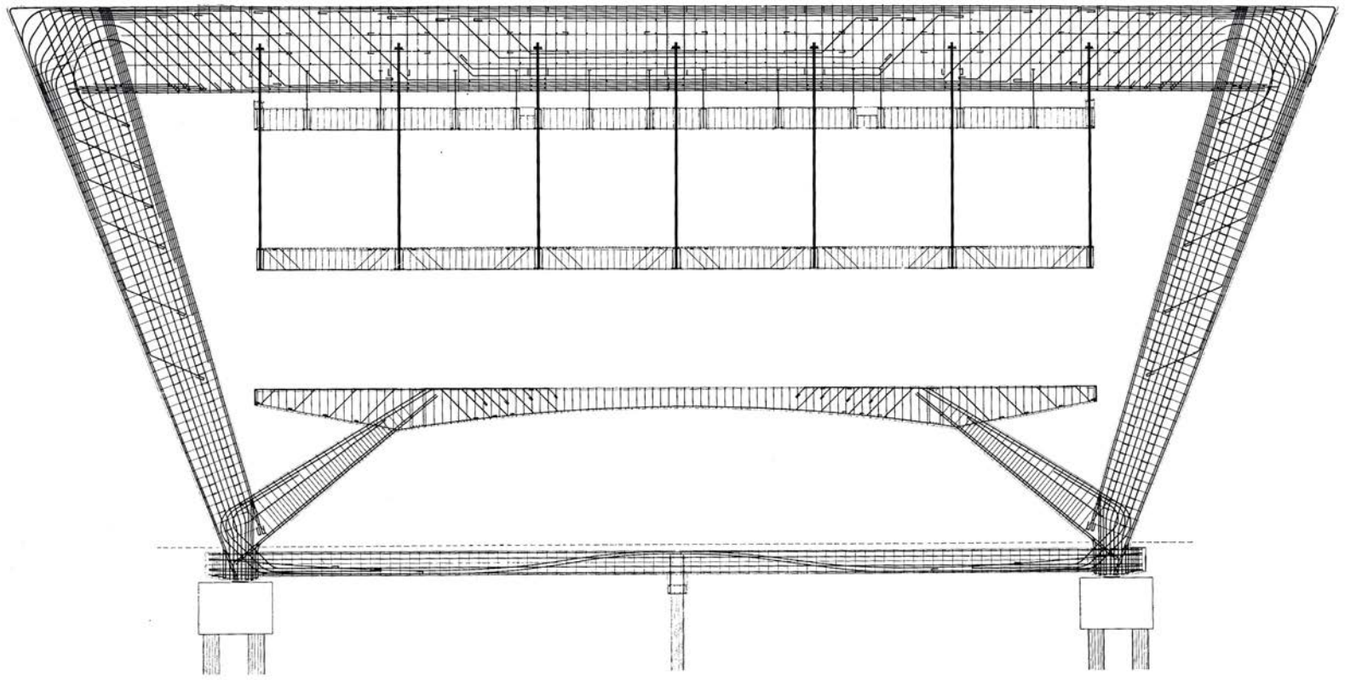
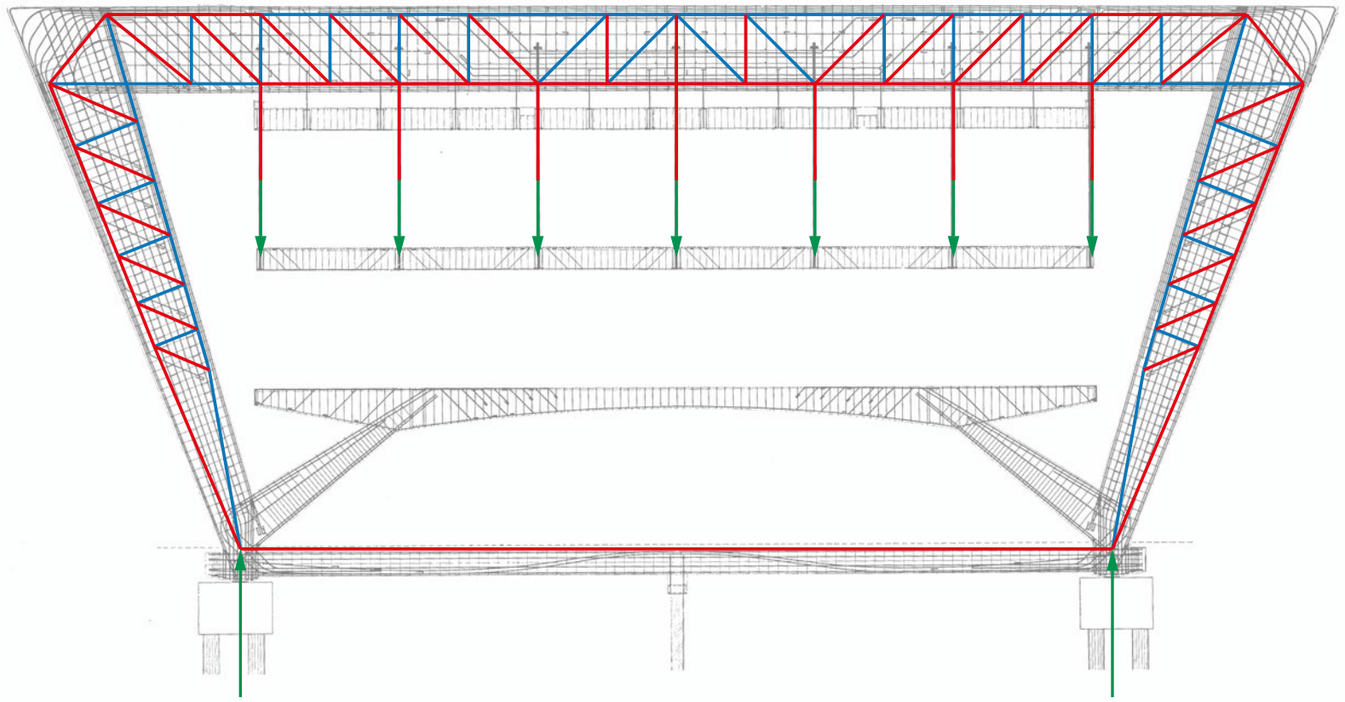


Affonso Eduardo Reidy: Museu de Arte Moderna, Rio de Janeiro, 1954

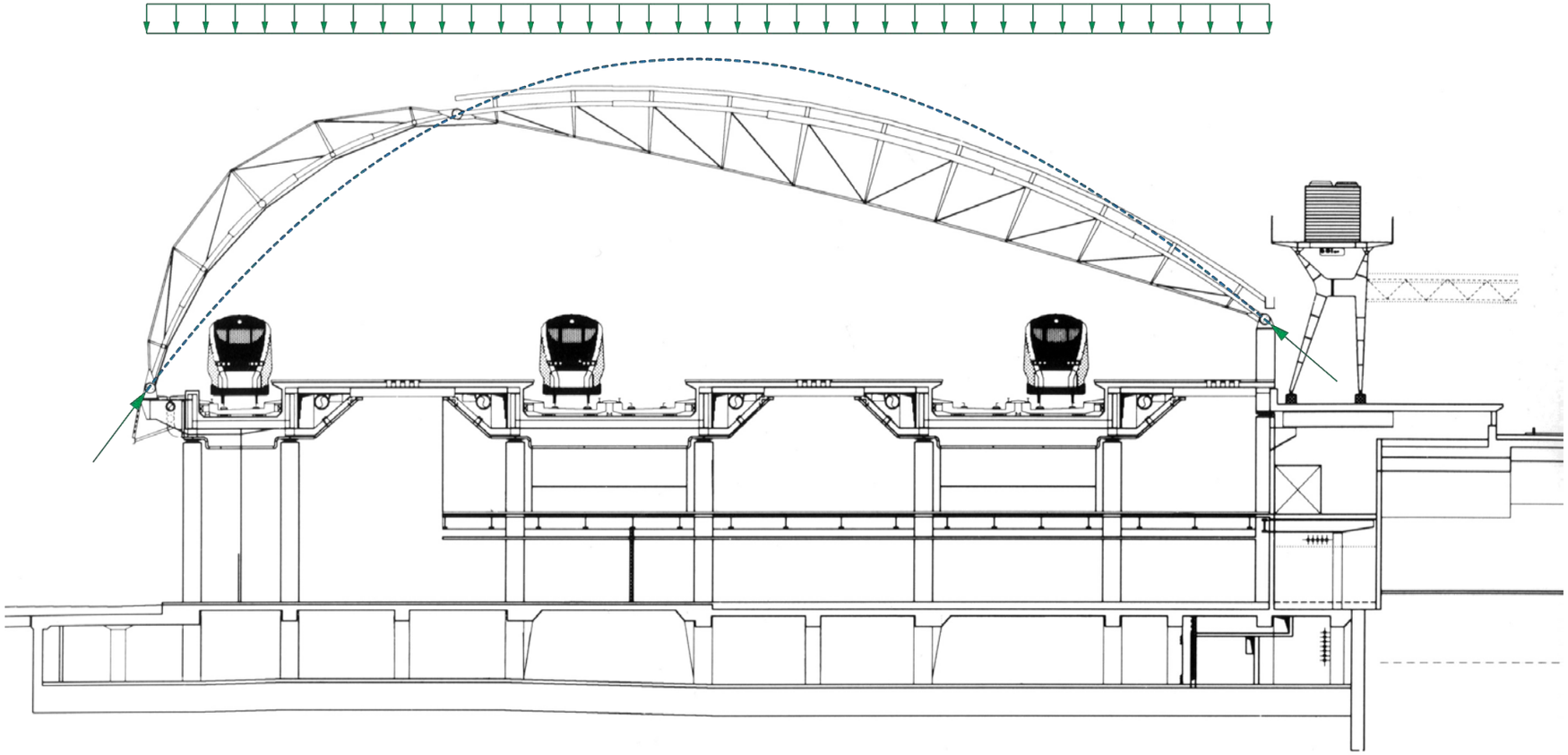
Layout of the reinforcement bars



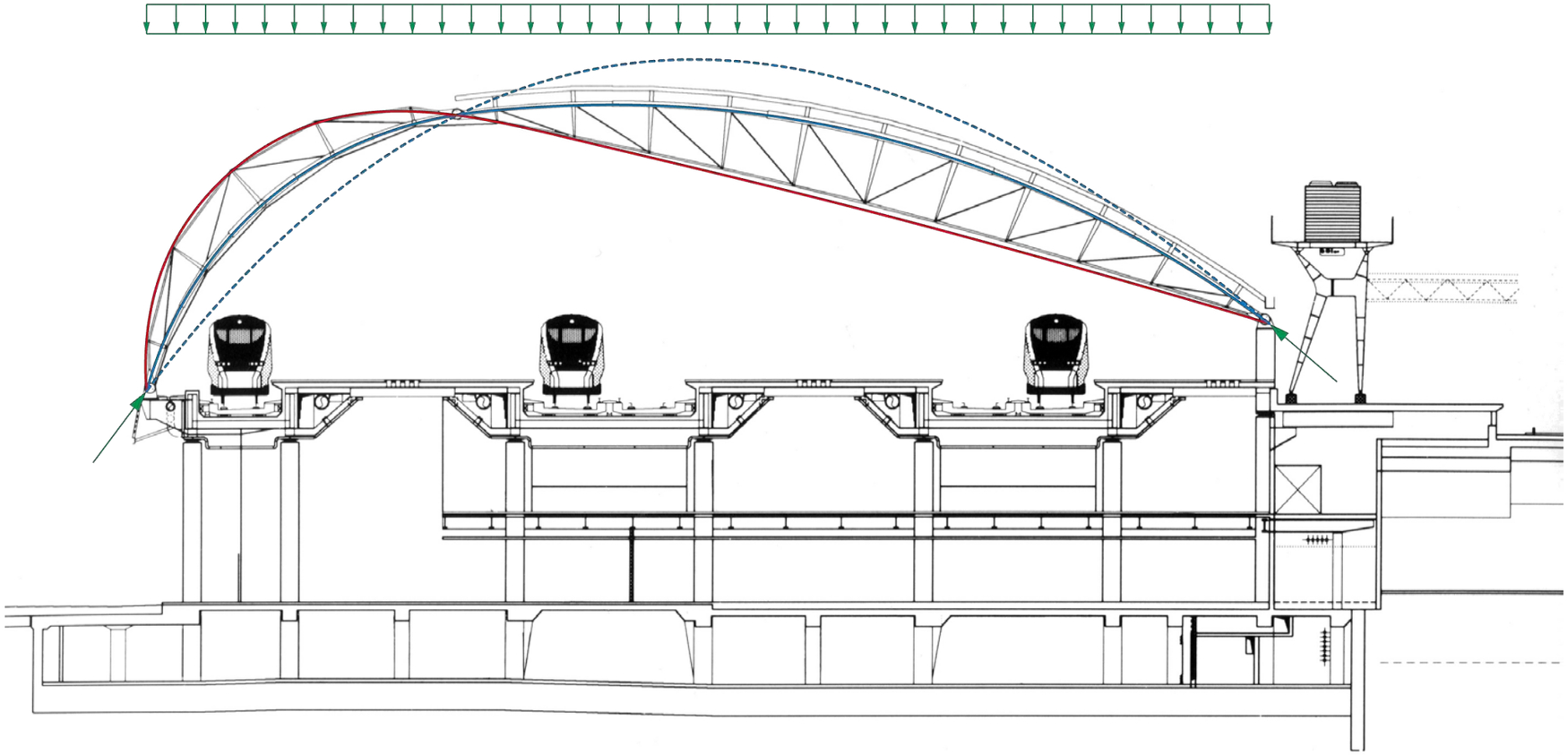
Affonso Eduardo Reidy: Museu de Arte Moderna, Rio de Janeiro, 1954

Layout of the reinforcement bars

Sir Nicholas Grimshaw (Arch.) und Anthony Hunt (Ing.): Waterloo International Terminal, London, 1993

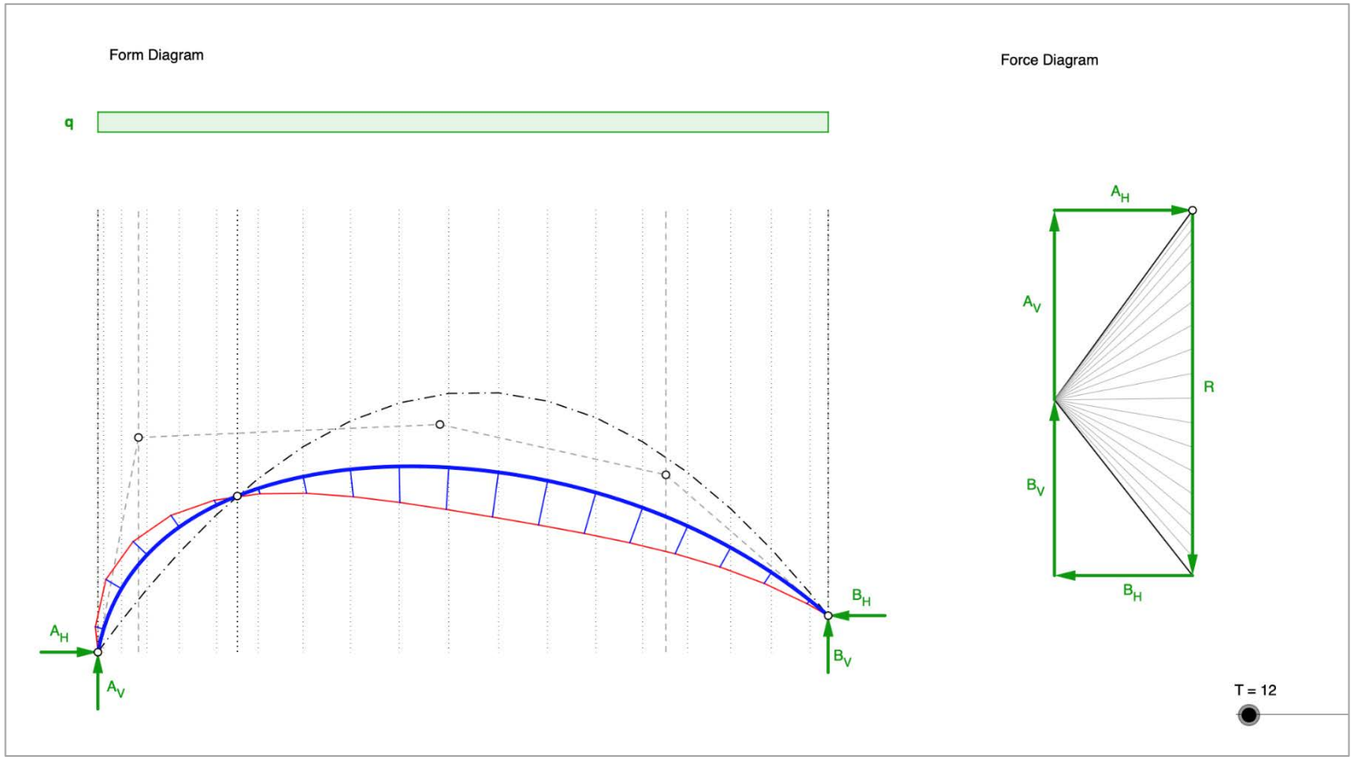


Sir Nicholas Grimshaw (Arch.) und Anthony Hunt (Ing.): Waterloo International Terminal, London, 1993

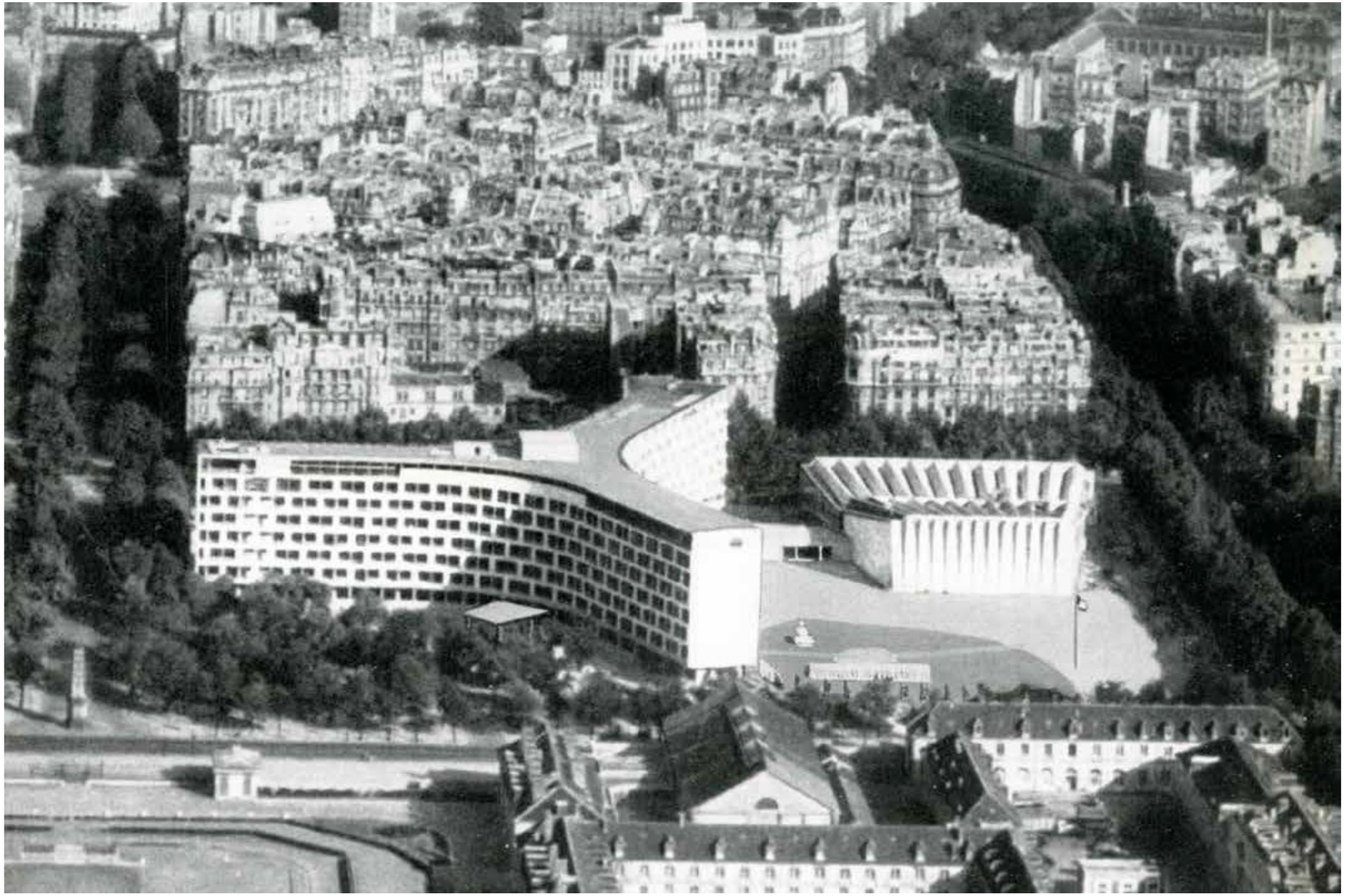


Sir Nicholas Grimshaw (Arch.) und Anthony Hunt (Ing.): Waterloo International Terminal, London, 1993

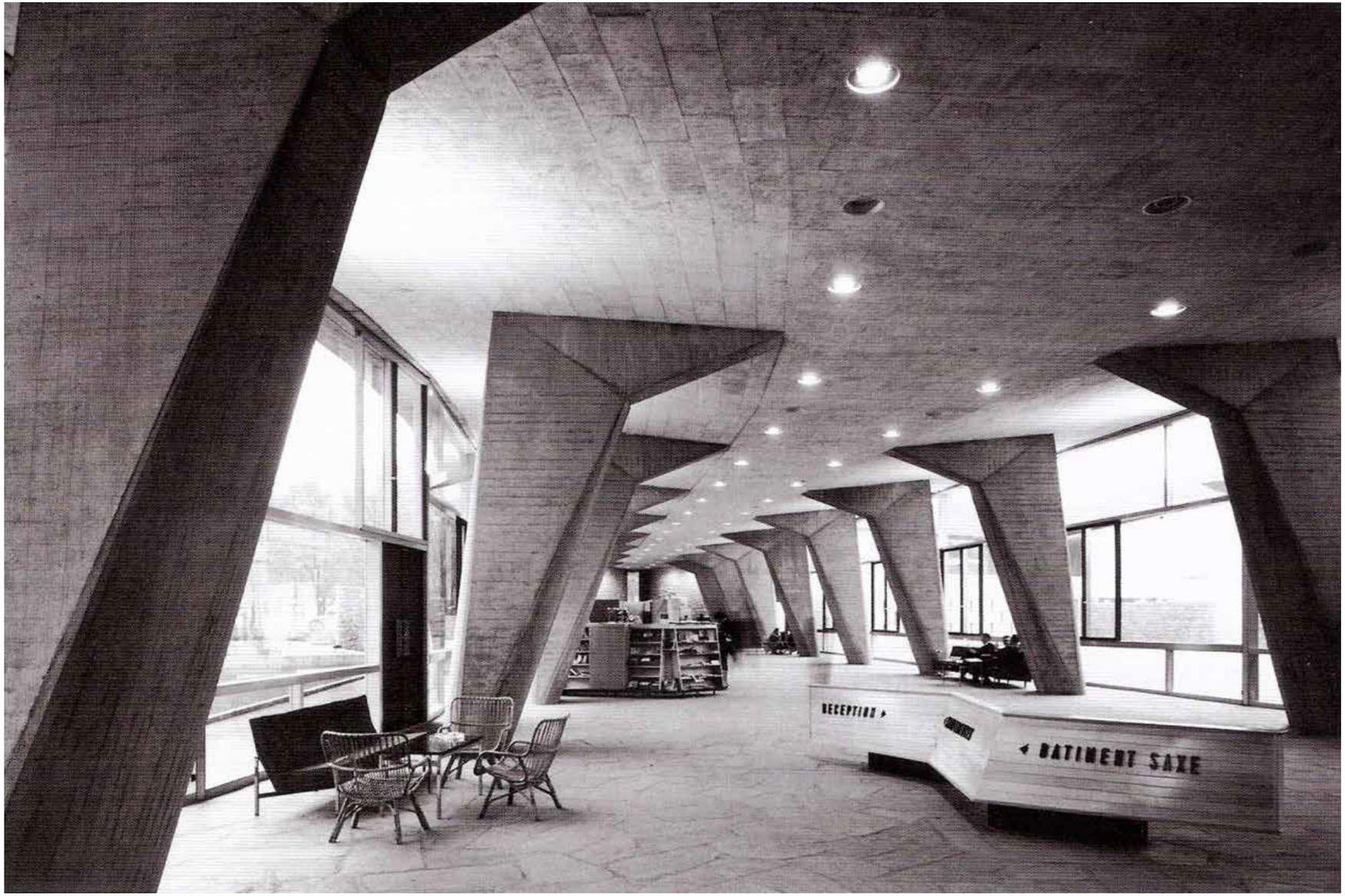
eQ: Free-form thrust lines



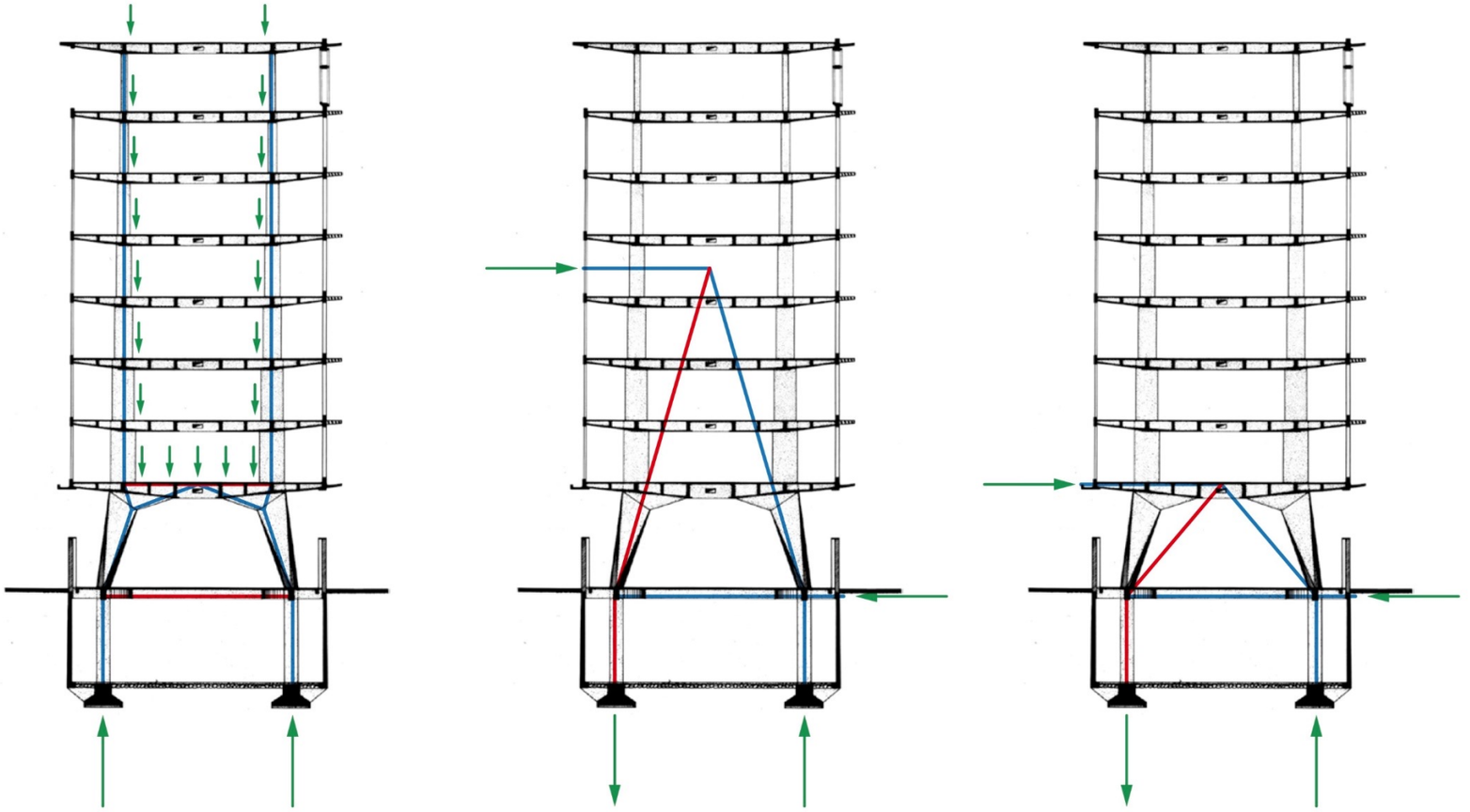
https://block.arch.ethz.ch/eq/drawing/view/45

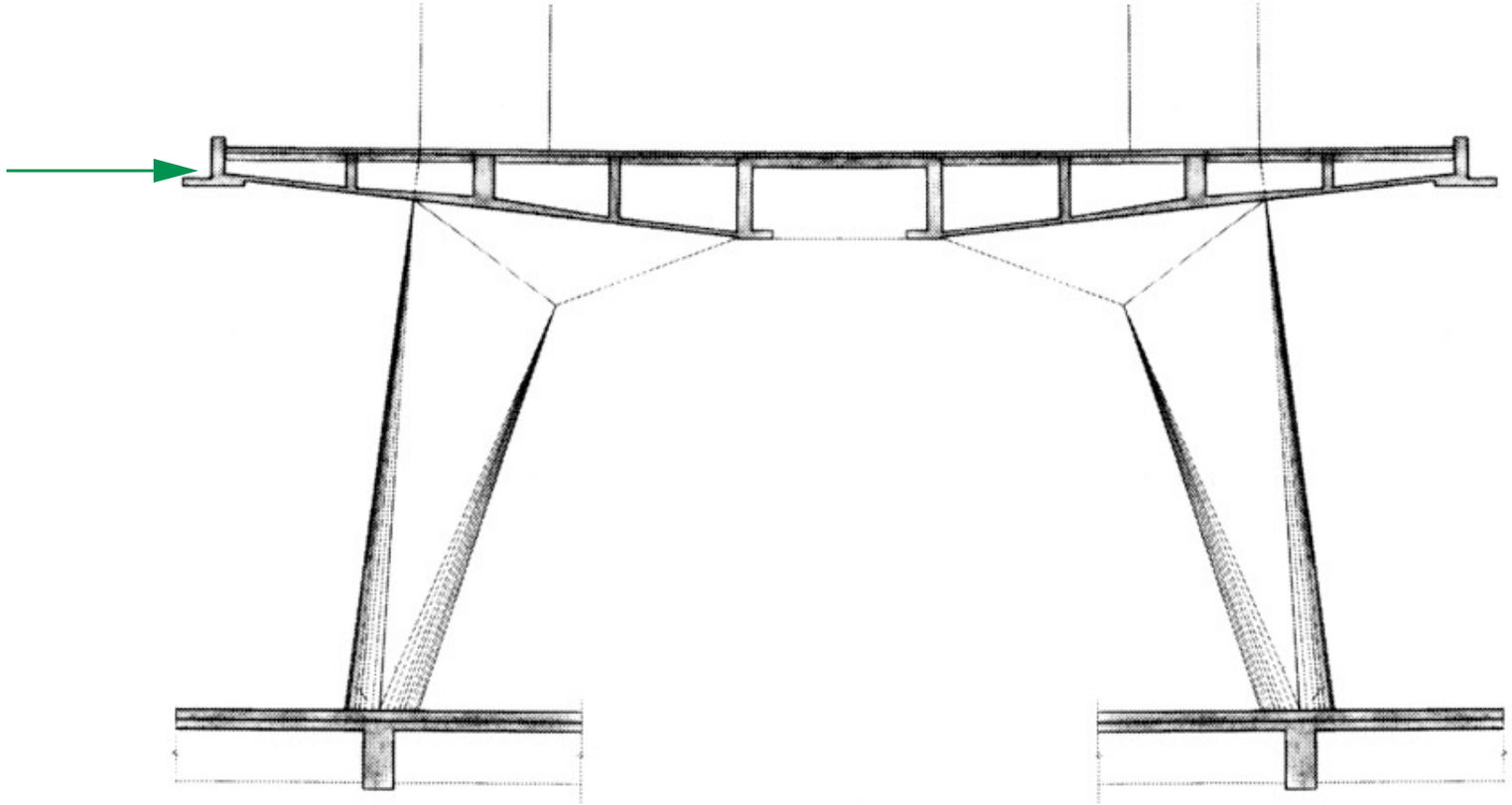


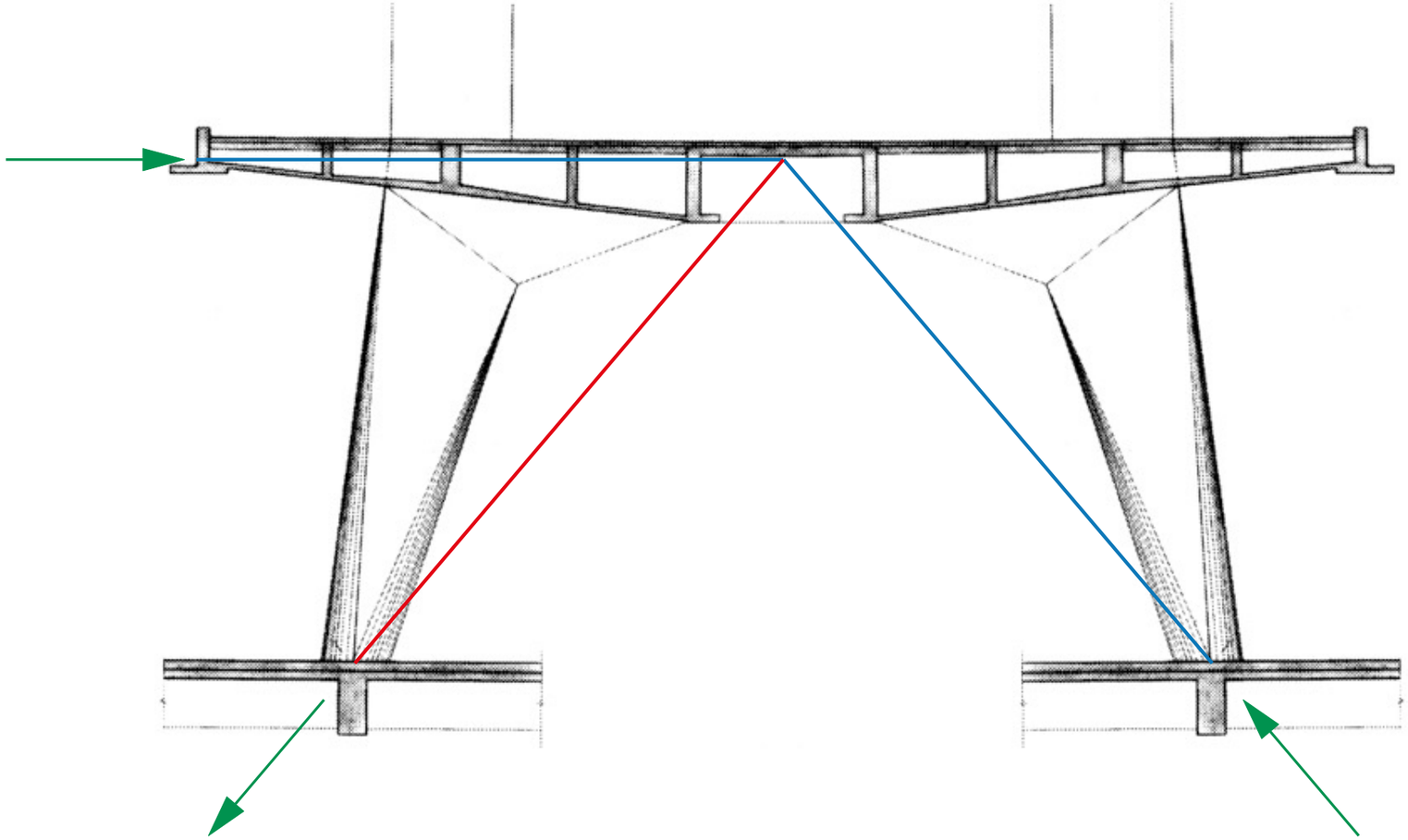
Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: UNESCO Hauptsitz, Paris, 1957

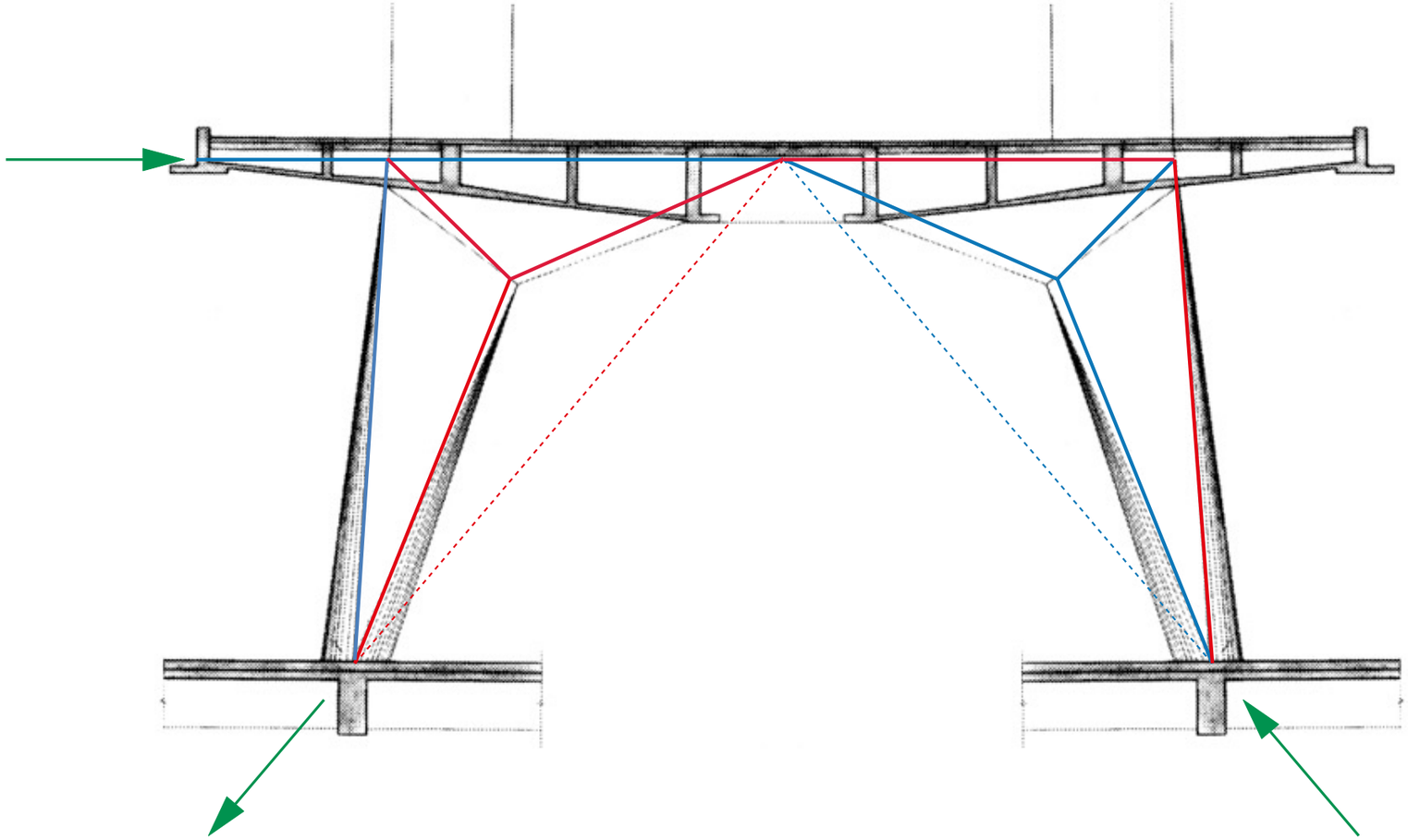


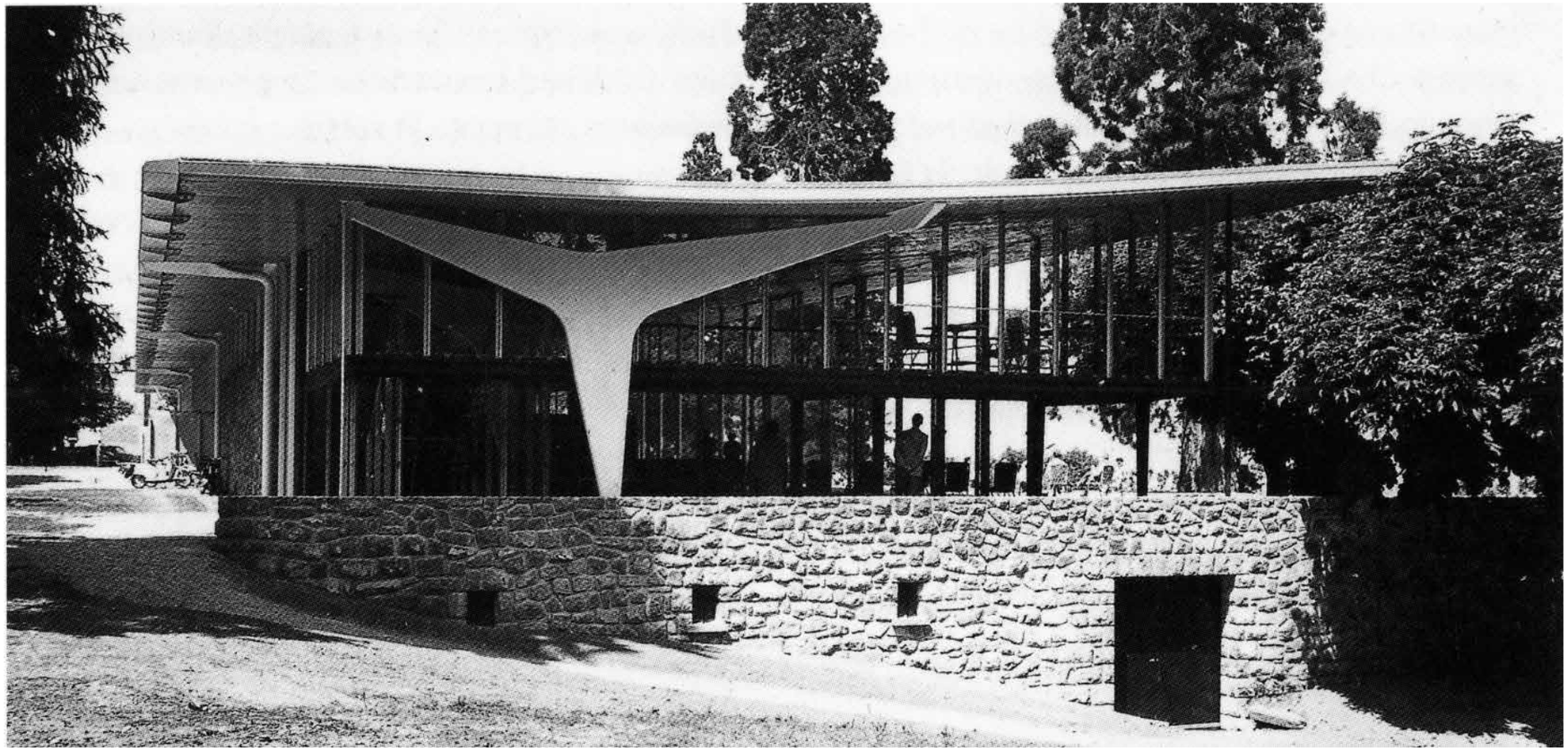
Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: UNESCO Hauptsitz, Paris, 1957



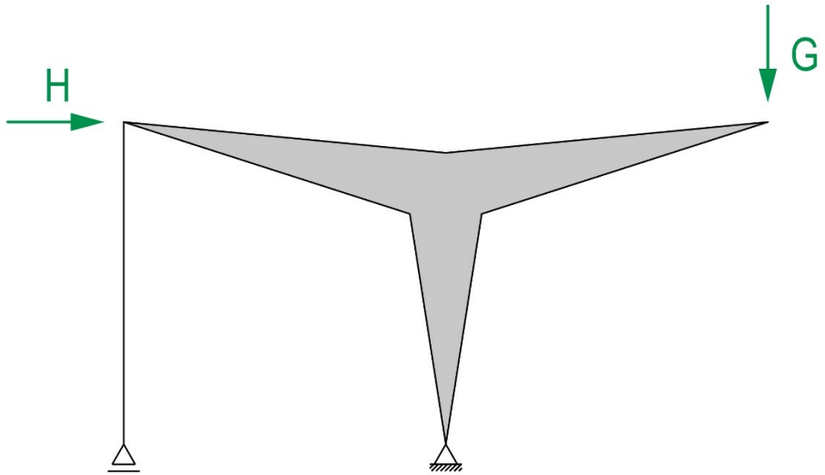








Maurice Novarina, Jean Prouvé: Trinkhalle der Quelle Cachat, Evian-les-Bains, 1956-58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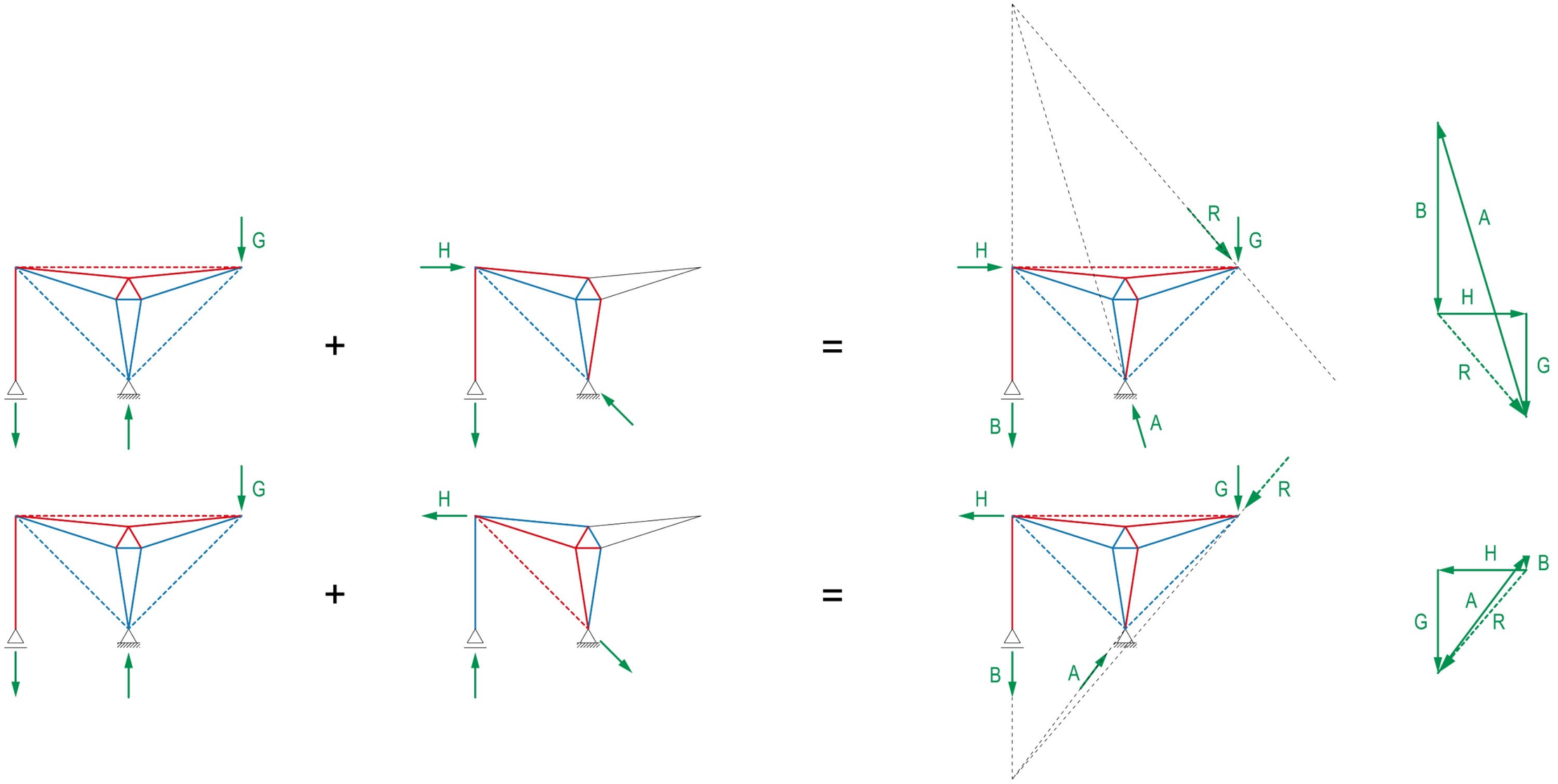
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Rahmen
Frames

Vom Bogen und Balken zum Rahmen
From arches and beams to frames

Dreigelenkrahmen
Three-hinged frames

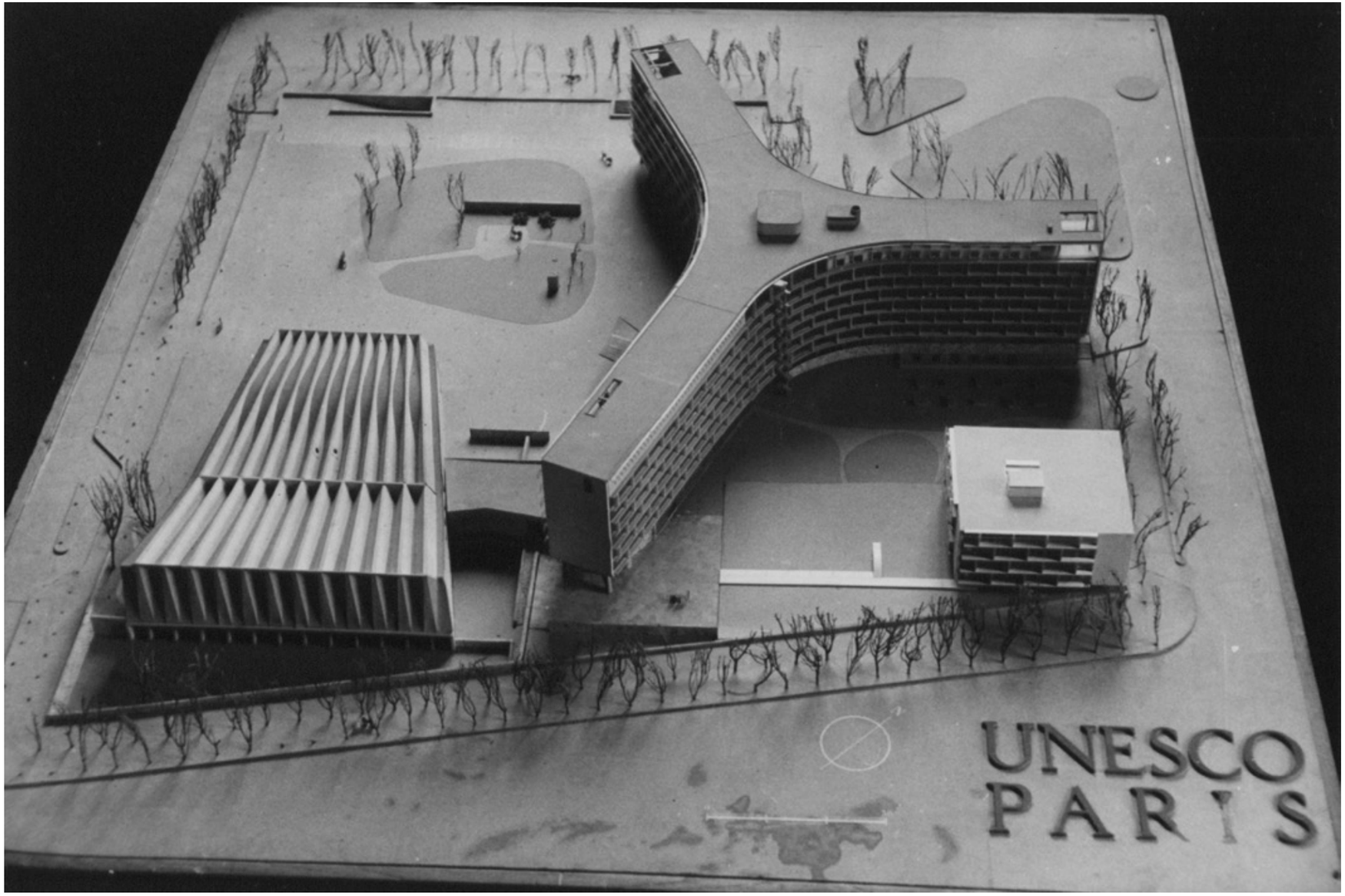
Zweigelenkrahmen
Two-hinged frames

Rahmen ohne Gelenke
Frames without hinges

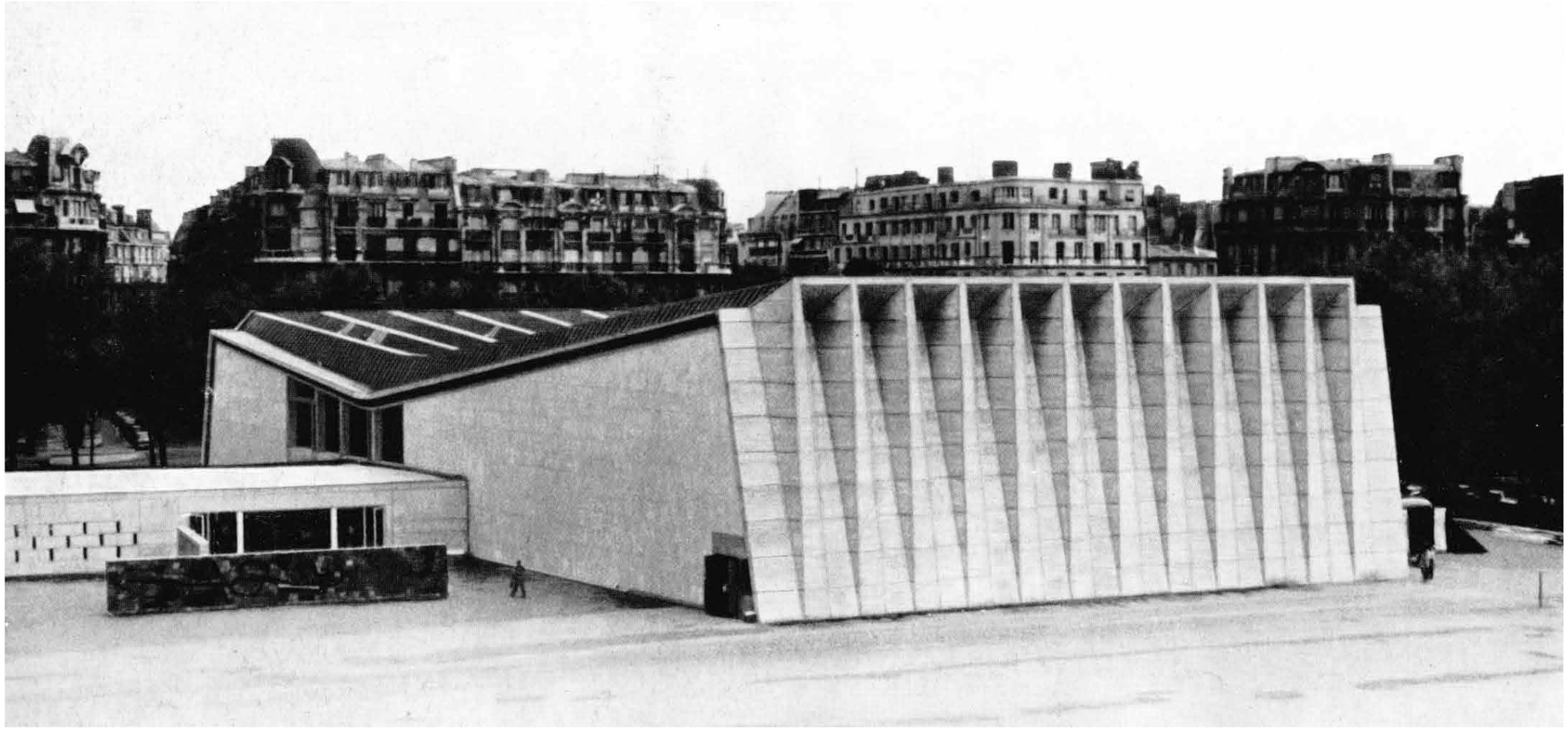
Rahmenecke
Frame corner

Fallbeispiele
Case studies

>> Zusammengesetzte Rahmen
Compound frames



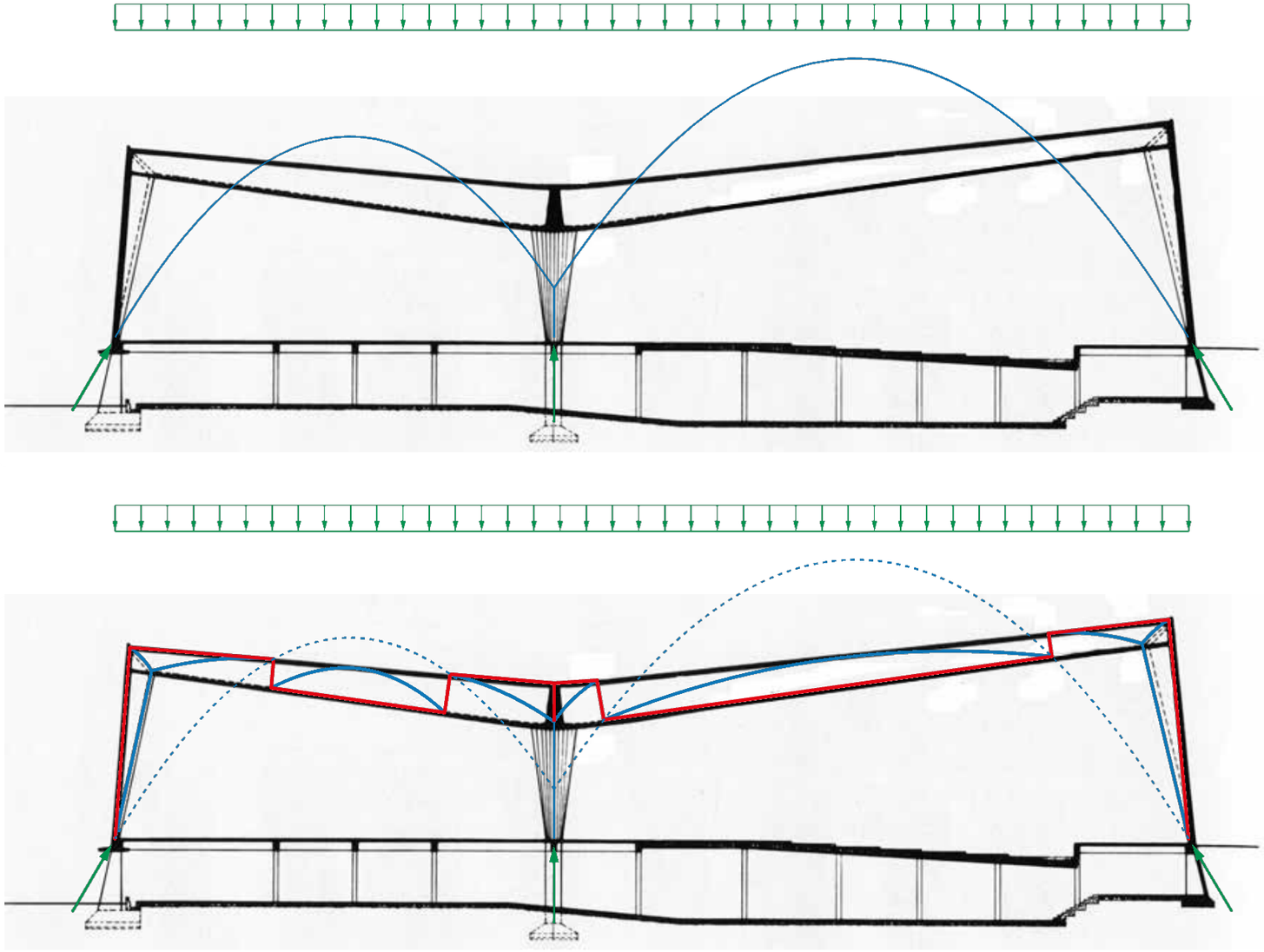
Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: UNESCO Hauptsitz, Paris, 1957

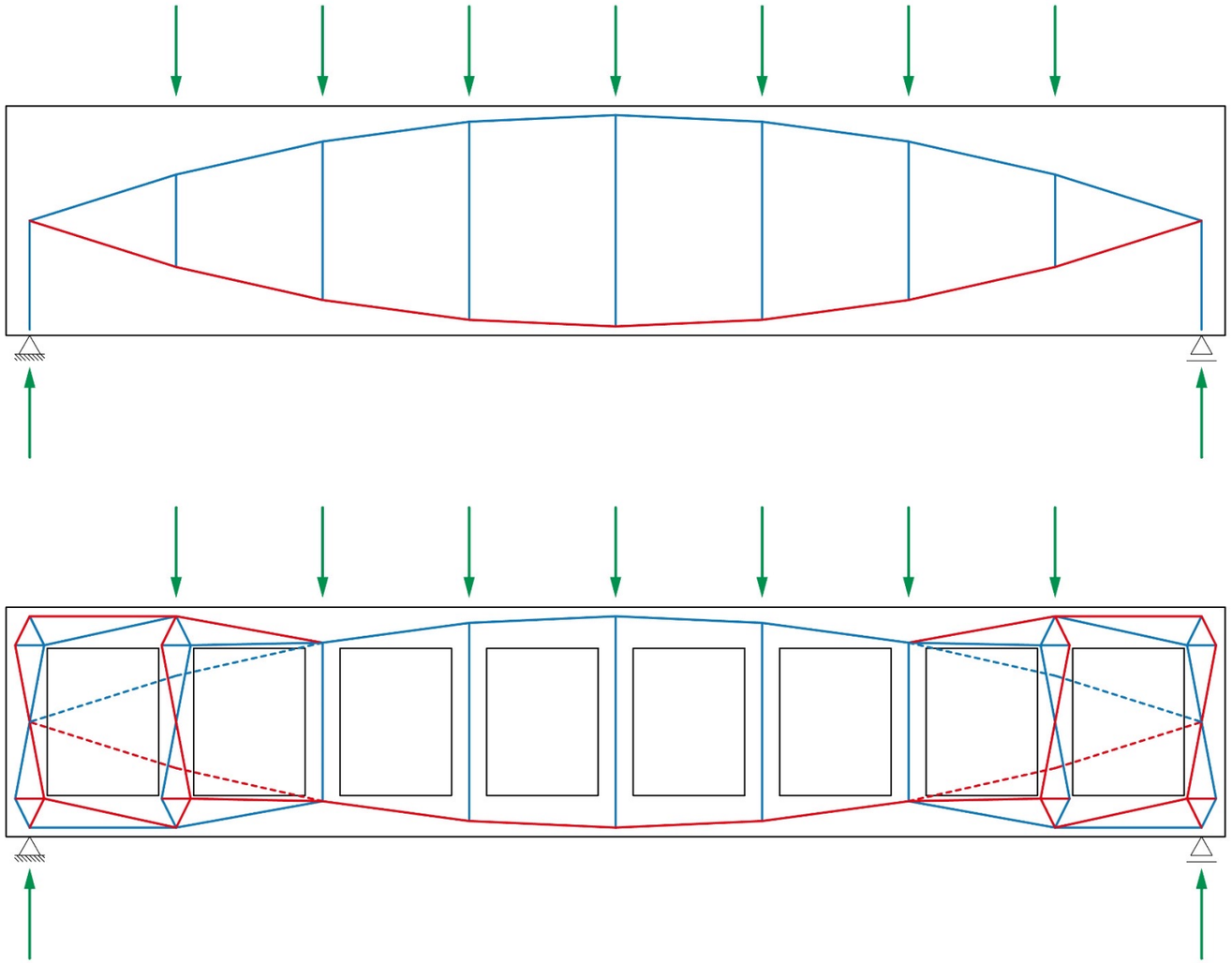


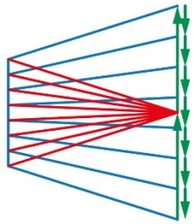
Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: Konferenzsaal, UNESCO, Paris, 1957

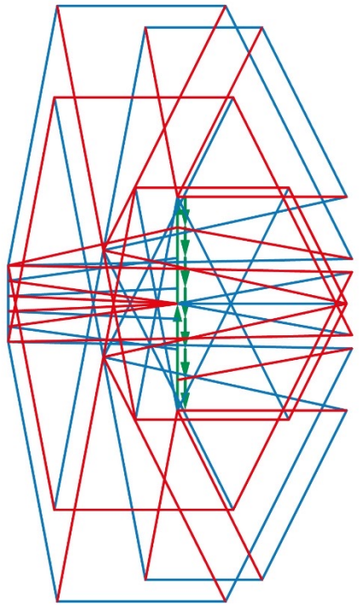
Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: Konferenzsaal, UNESCO, Paris, 1957

Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: Konferenzsaal, UNESCO, Paris, 1957



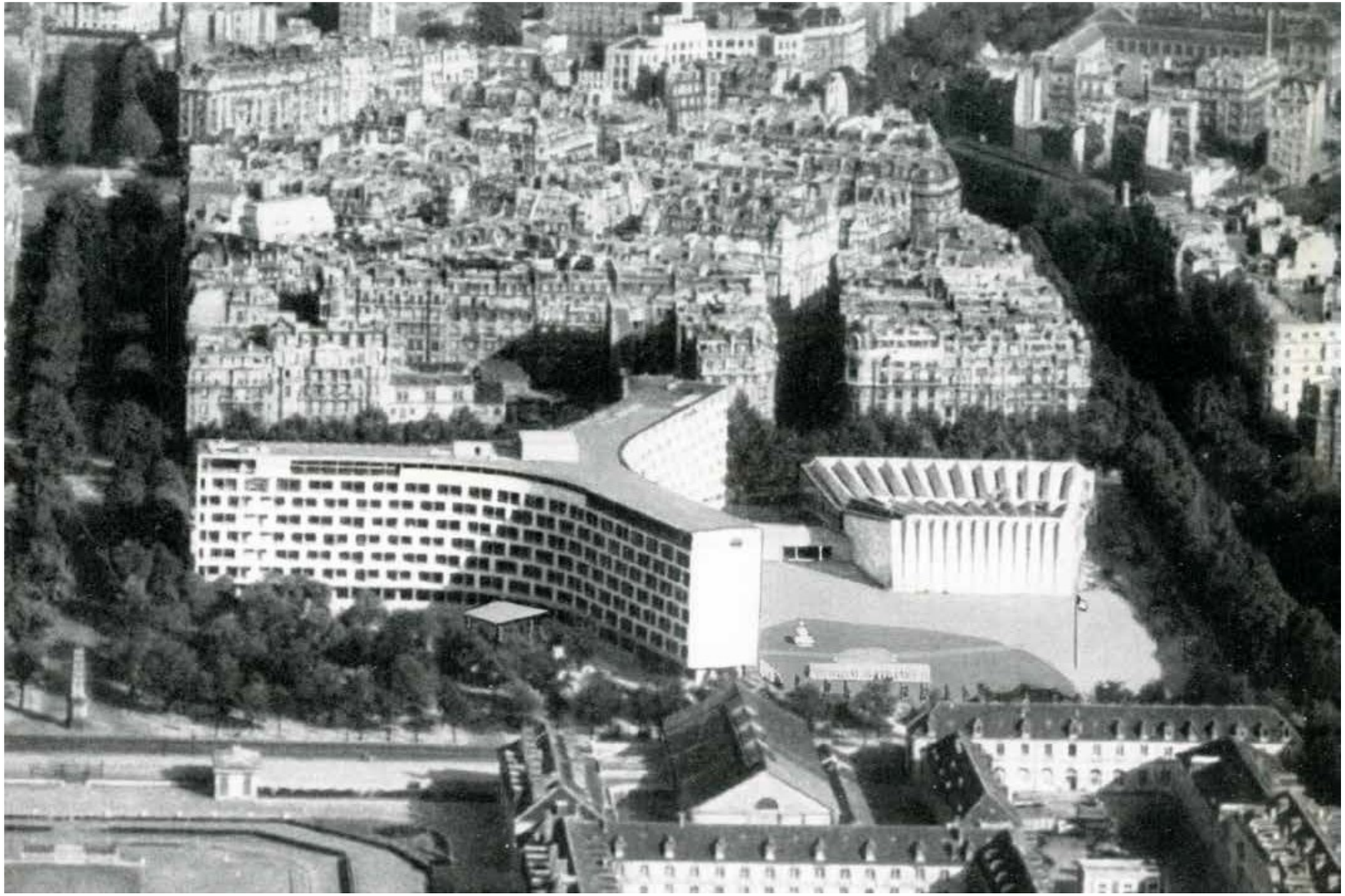
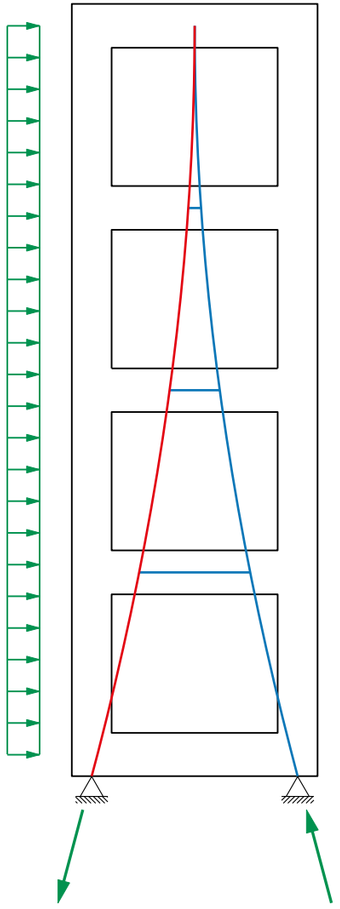
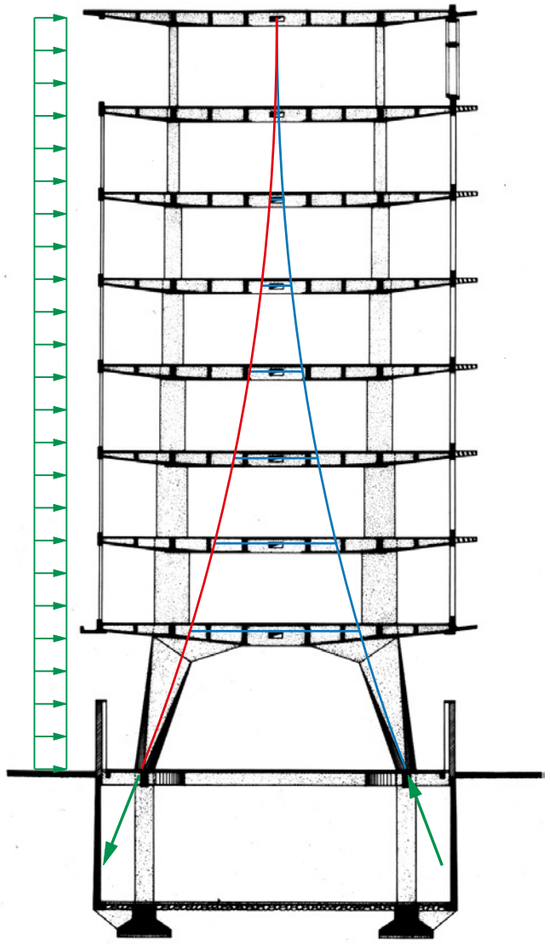






Kräftefluss in einer Scheibe (oben) und einem Vierendeelträger (unten)

Livio Vacchini, Andreotti + Partners: Bürohaus La Ferriera, Locarno, 2003



Marcel Breuer, Bernhard Zehrfuss, Pier Luigi Nervi: UNESCO Hauptsitz, Paris, 1957