

# Tragwerksentwurf III

# Tragwerksentwurf III

## Kraft - Form - Material

### Modellbildung

1 Gleichgewicht  
Bogen- und Seil-  
tragwerke, Material



2 Bogenseil-  
Tragwerke  
Fachwerke



3 Balken  
Variation  
Traglast



### Modellapplikation

4-5 Stahlbetonbau  
Studio in Locarno  
Livio Vacchini



6-7 Stahlbau  
Haus R 128  
Werner Sobek



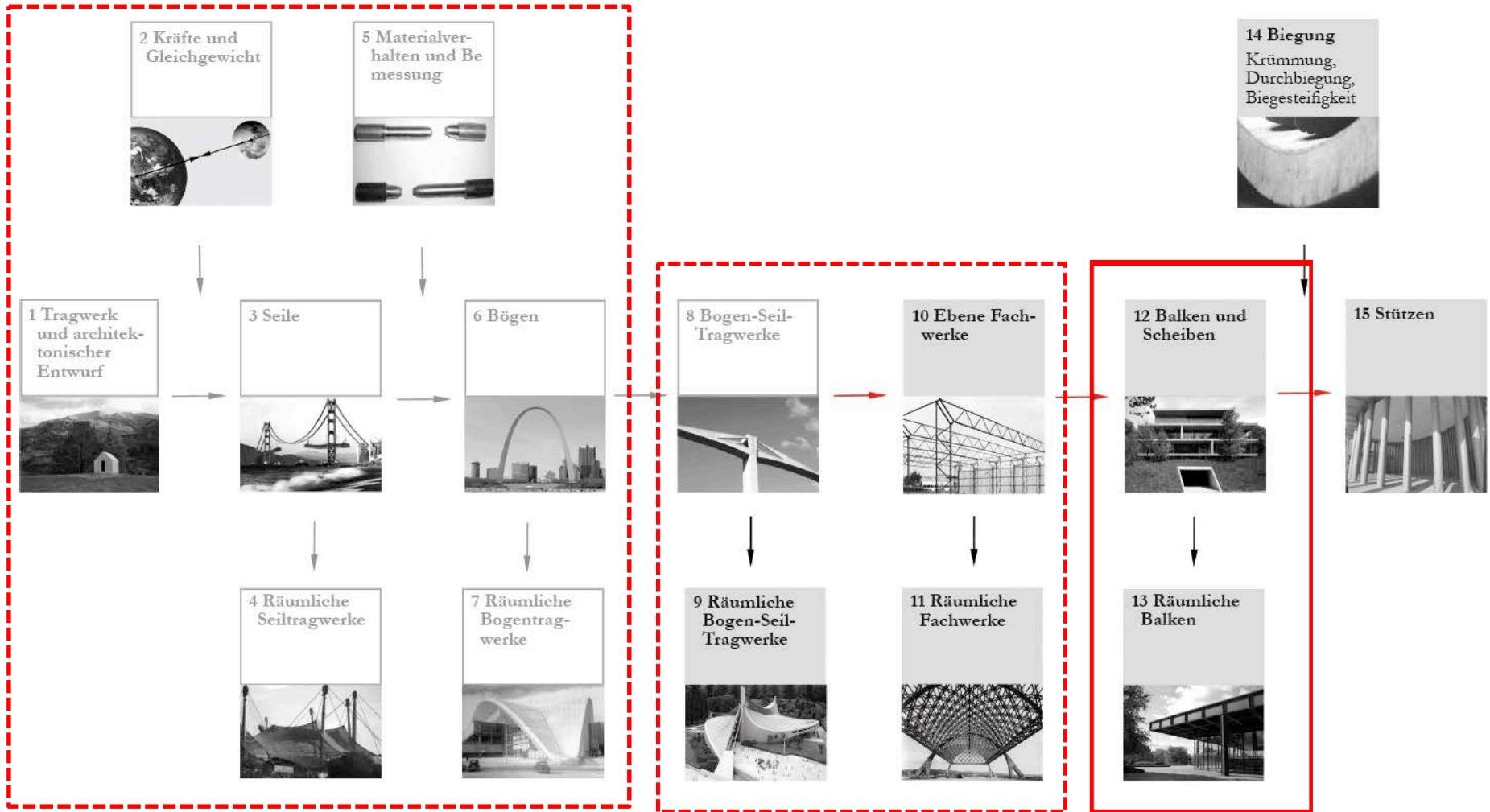
8-9 Holzbau  
Ziegelwies  
Burkhalter Sumi



10-11 Mauerwerk  
Stadttor Isny  
Peter Zumthor



3. Semester im Überblick



# Inhalt

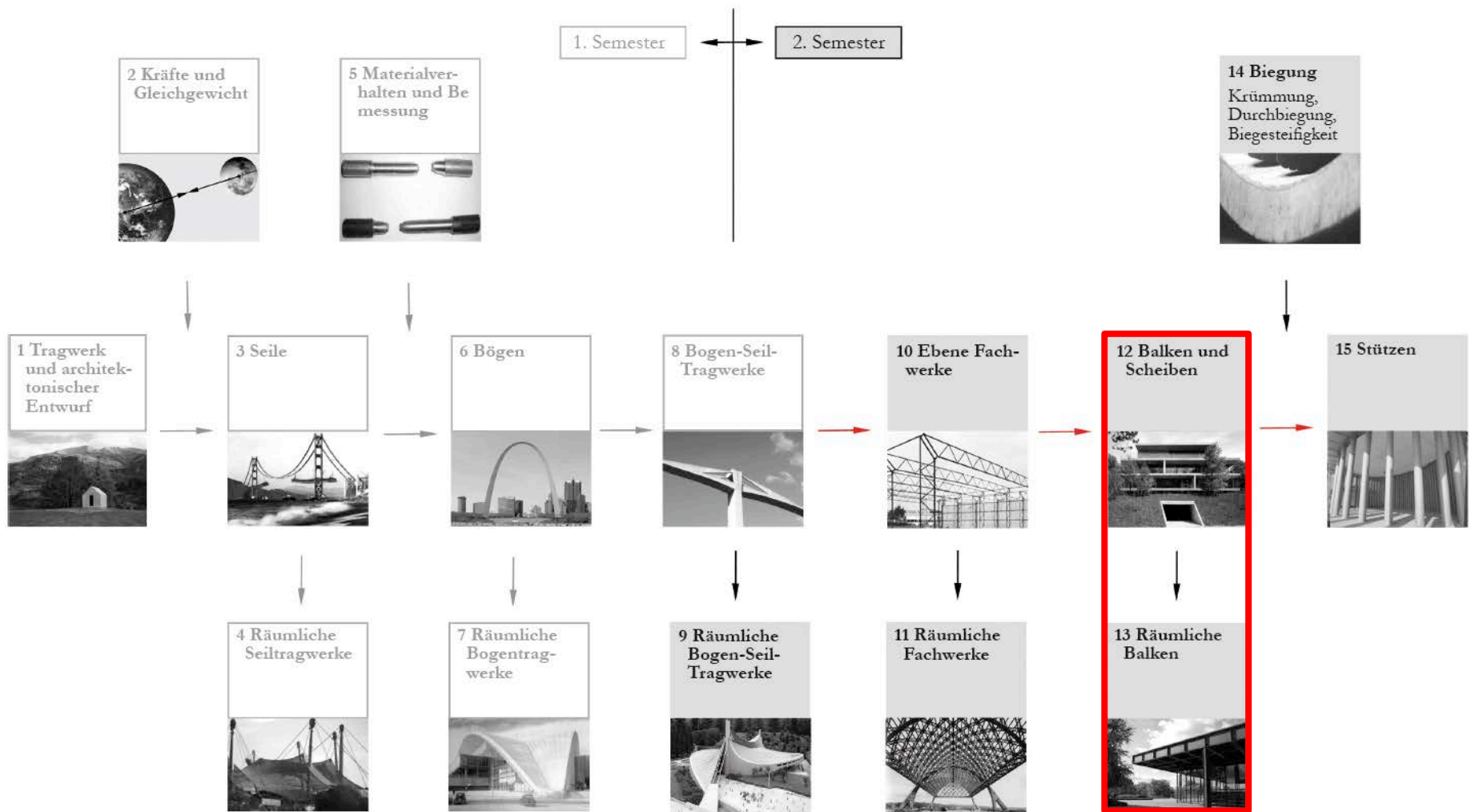
Tragverhalten eines Balkens

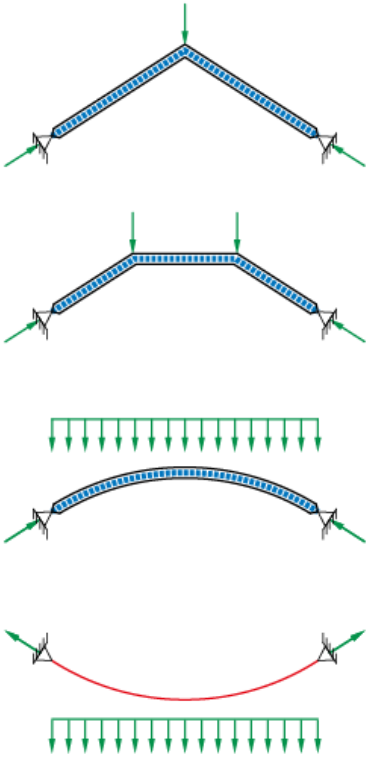
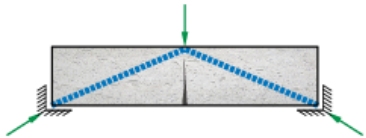
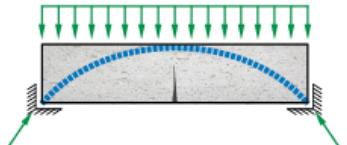
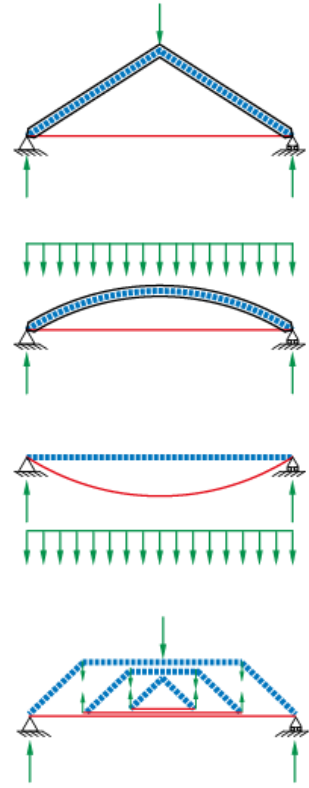
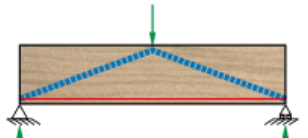

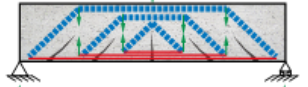
Rahmen

Scheiben

Balkenroste

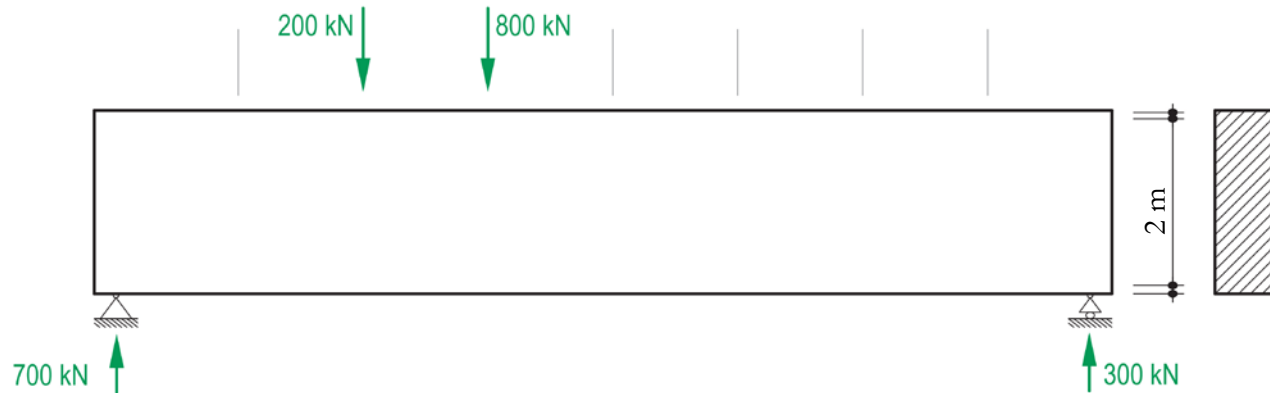
Platten



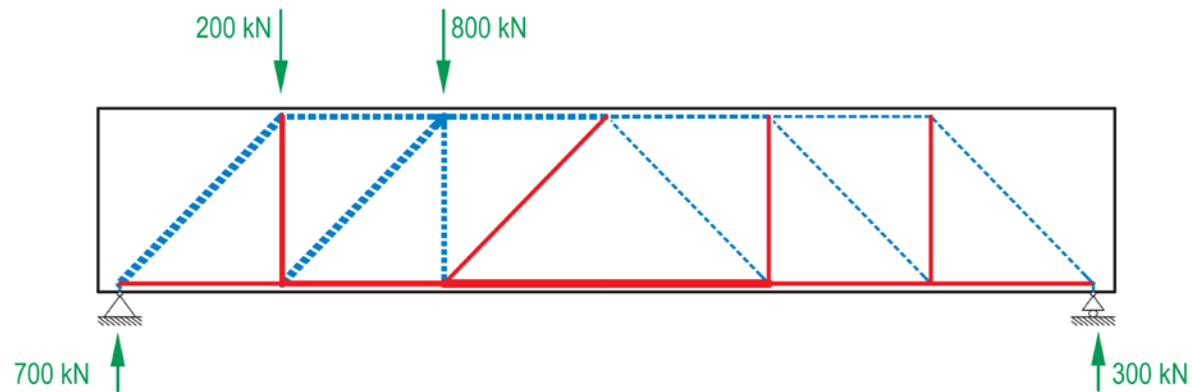
Bogen, Seil		Bogen-Seiltragwerk	
Als äusseres Tragwerk	Als inneres Tragwerk	Als äusseres Tragwerk	Als inneres Tragwerk
	 <p>Beton, gerissen</p>  <p>Beton, gerissen</p>		 <p>Holz</p>  <p>Beton, vorgespannt</p>  <p>Beton, gerissen</p>
<p>Bogen, Seil, Membran, Schale</p>	<p>Membranwirkung</p>	<p>Bogen-Seiltragwerk Fachwerk Raumfachwerk</p>	<p>Balken Balkenroste Platten</p>

# Innere Kräfte in Balken

Balken mit äusseren Kräften

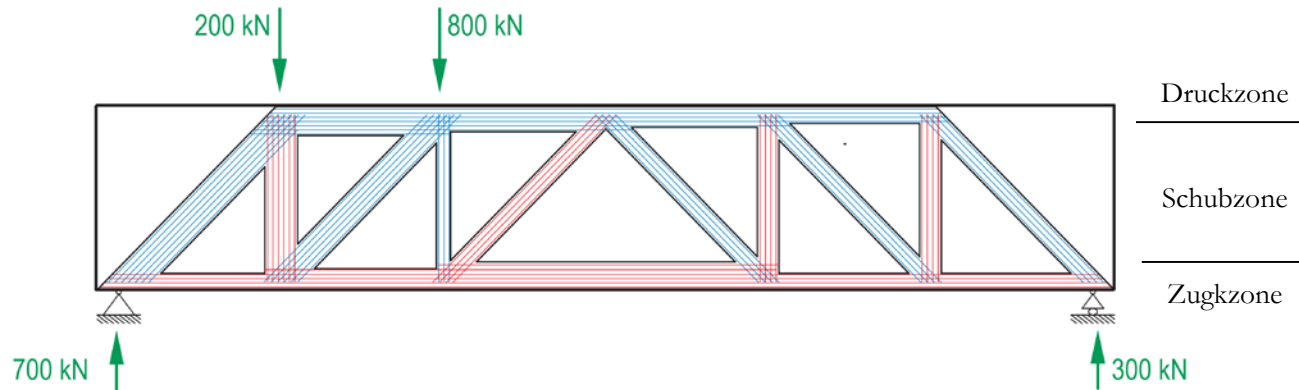


Balken mit eingeschriebenem Fachwerk

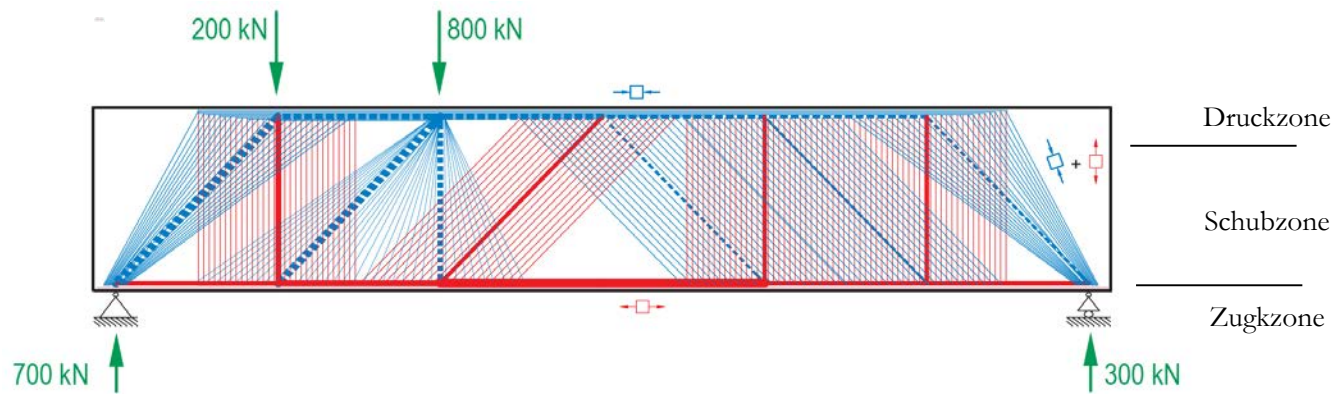


# Innere Kräfte in Balken

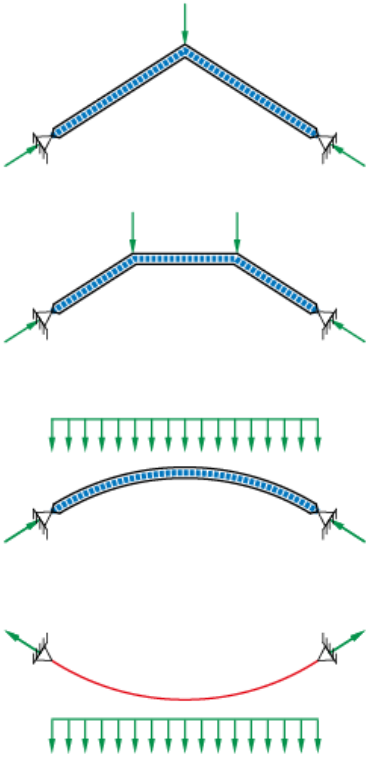
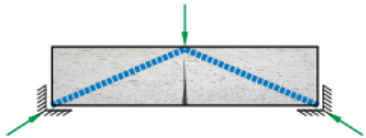
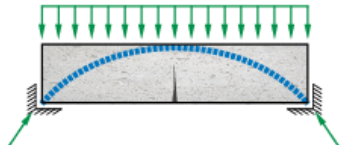
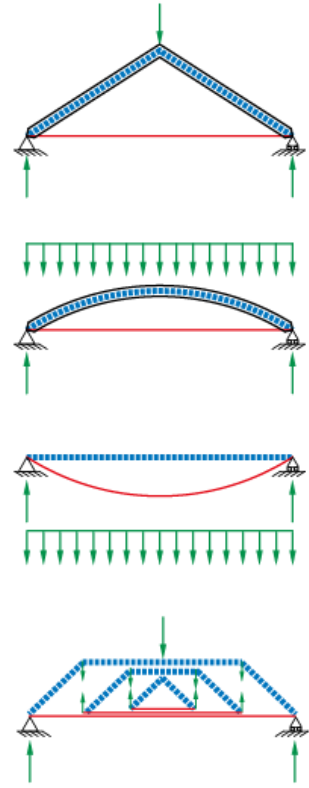
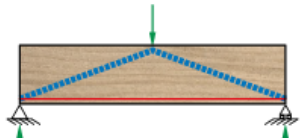
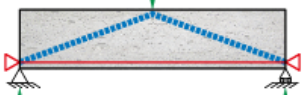
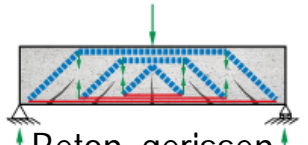
## Spannungsfeld im eingeschriebenen Fachwerk



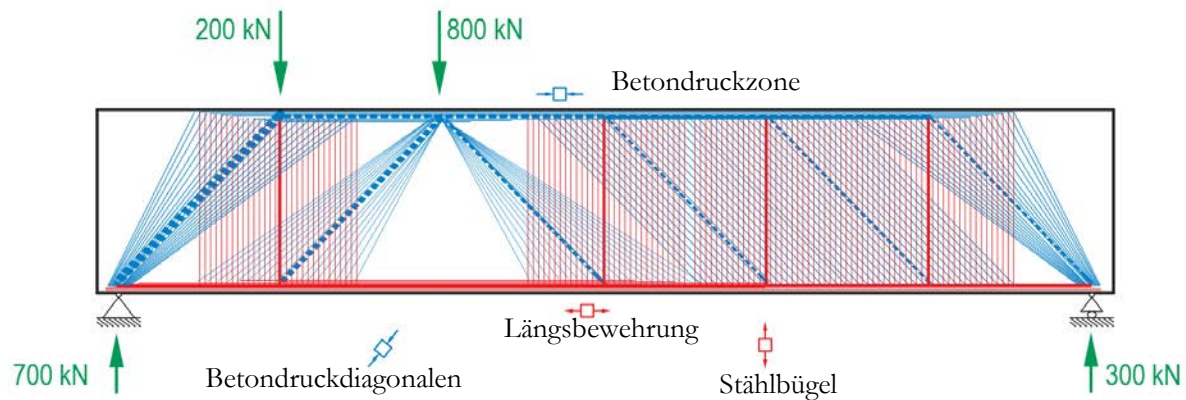
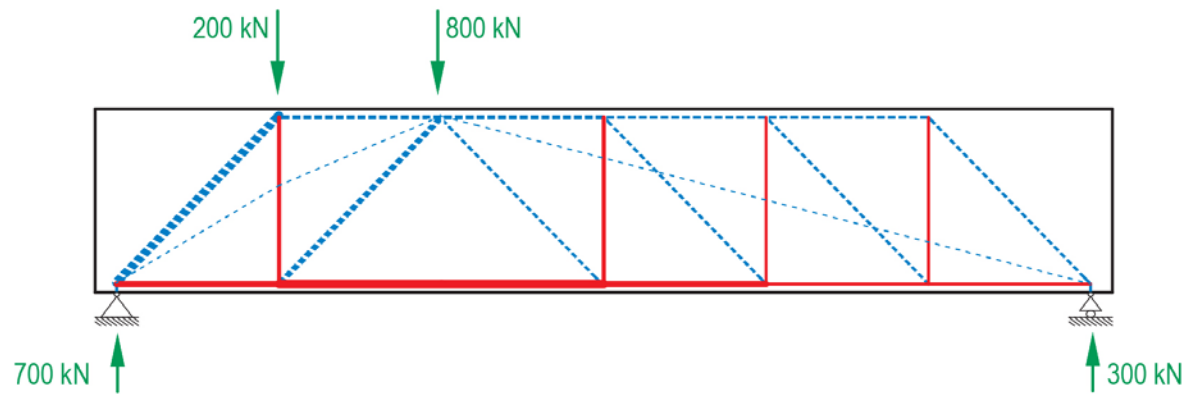
## Spannungsfeld im Balken

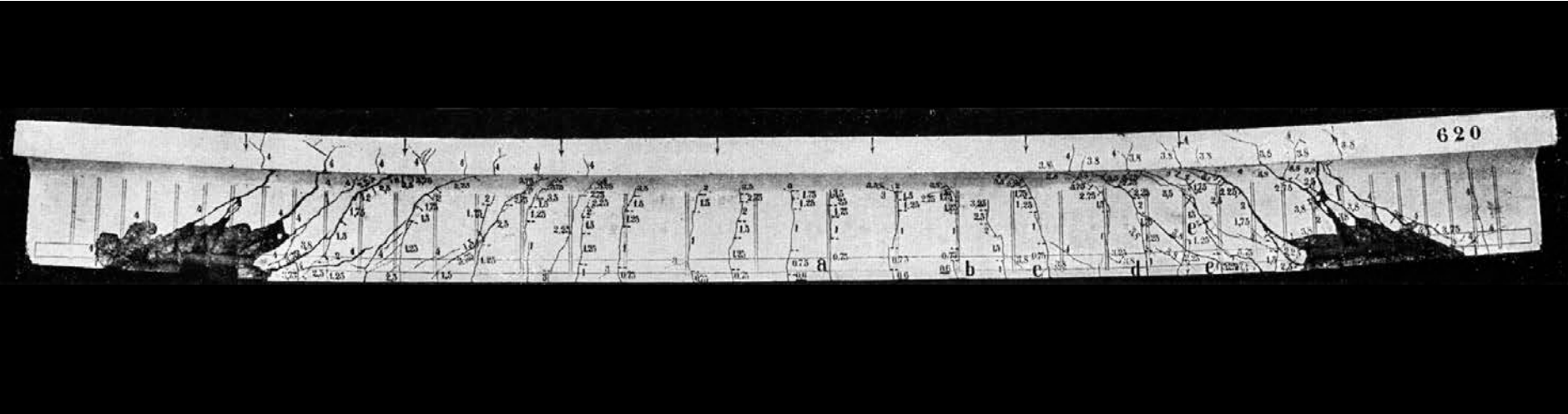




Bogen, Seil		Bogen-Seiltragwerk	
Als äusseres Tragwerk	Als inneres Tragwerk	Als äusseres Tragwerk	Als inneres Tragwerk
	 <p>Beton, gerissen</p>  <p>Beton, gerissen</p>		 <p>Holz</p>  <p>Beton, vorgespannt</p> <div style="border: 2px solid red; padding: 5px;">  <p>Beton, gerissen</p> </div>
<p>Bogen, Seil, Membran, Schale</p>	<p>Membranwirkung</p>	<p>Bogen-Seiltragwerk Fachwerk Raumfachwerk</p>	<p>Balken Balkenroste Platten</p>

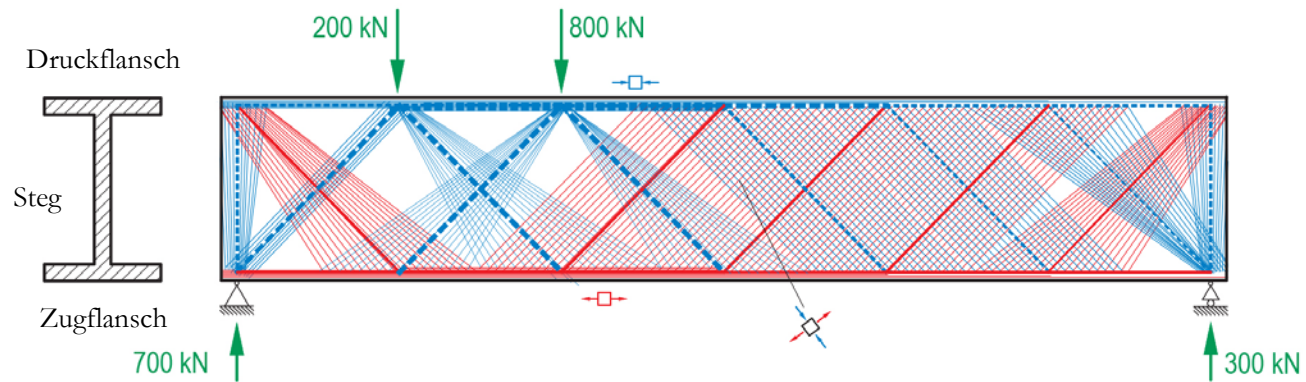
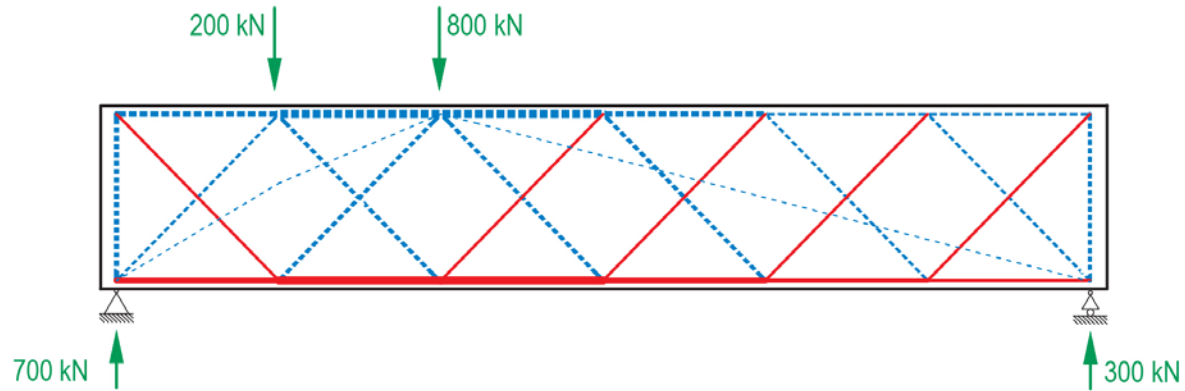
# Innere Kräfte in Stahlbetonträgern mit Bügeln



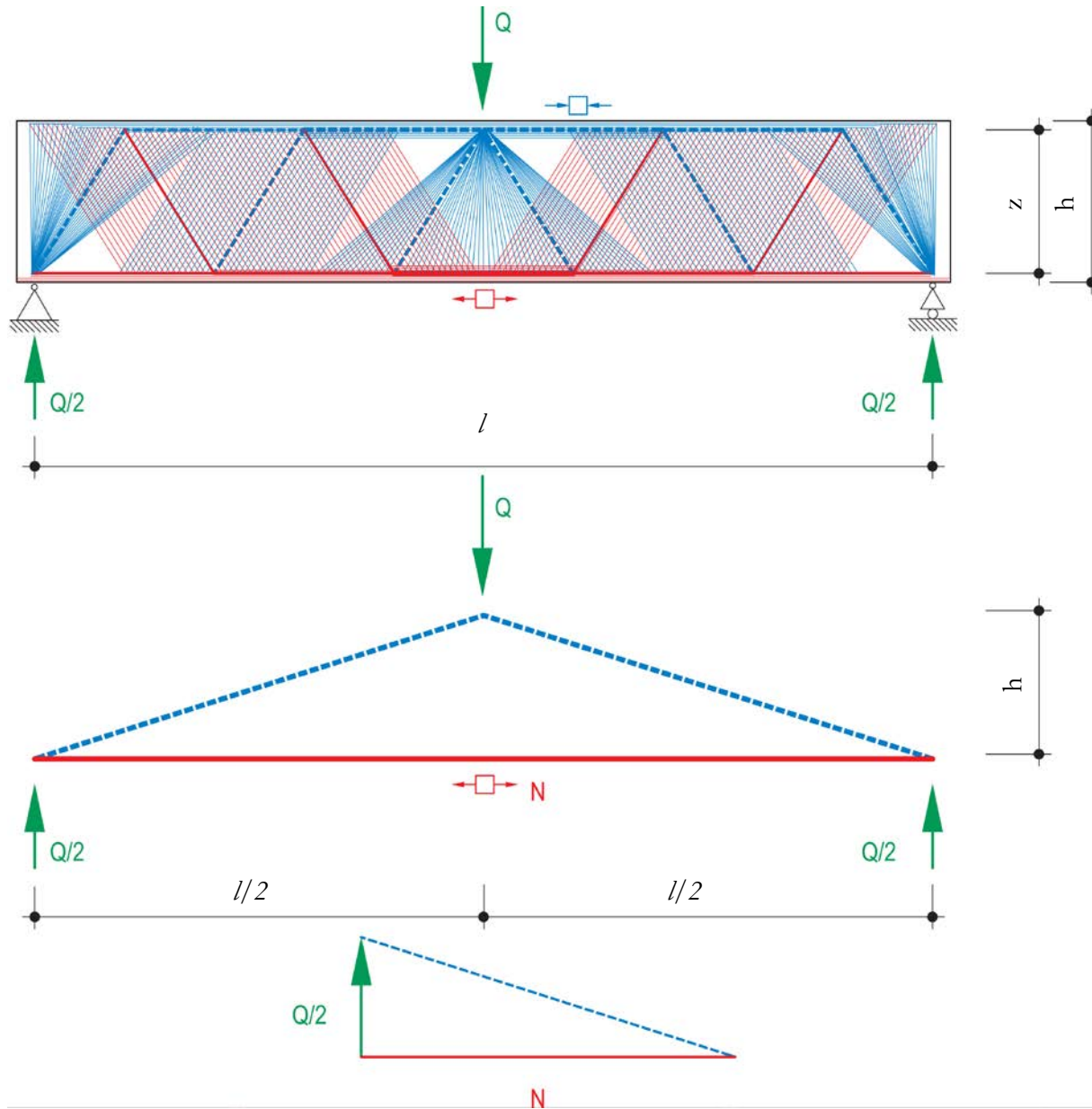


Stark beanspruchter Versuchsbalken aus Stahlbeton

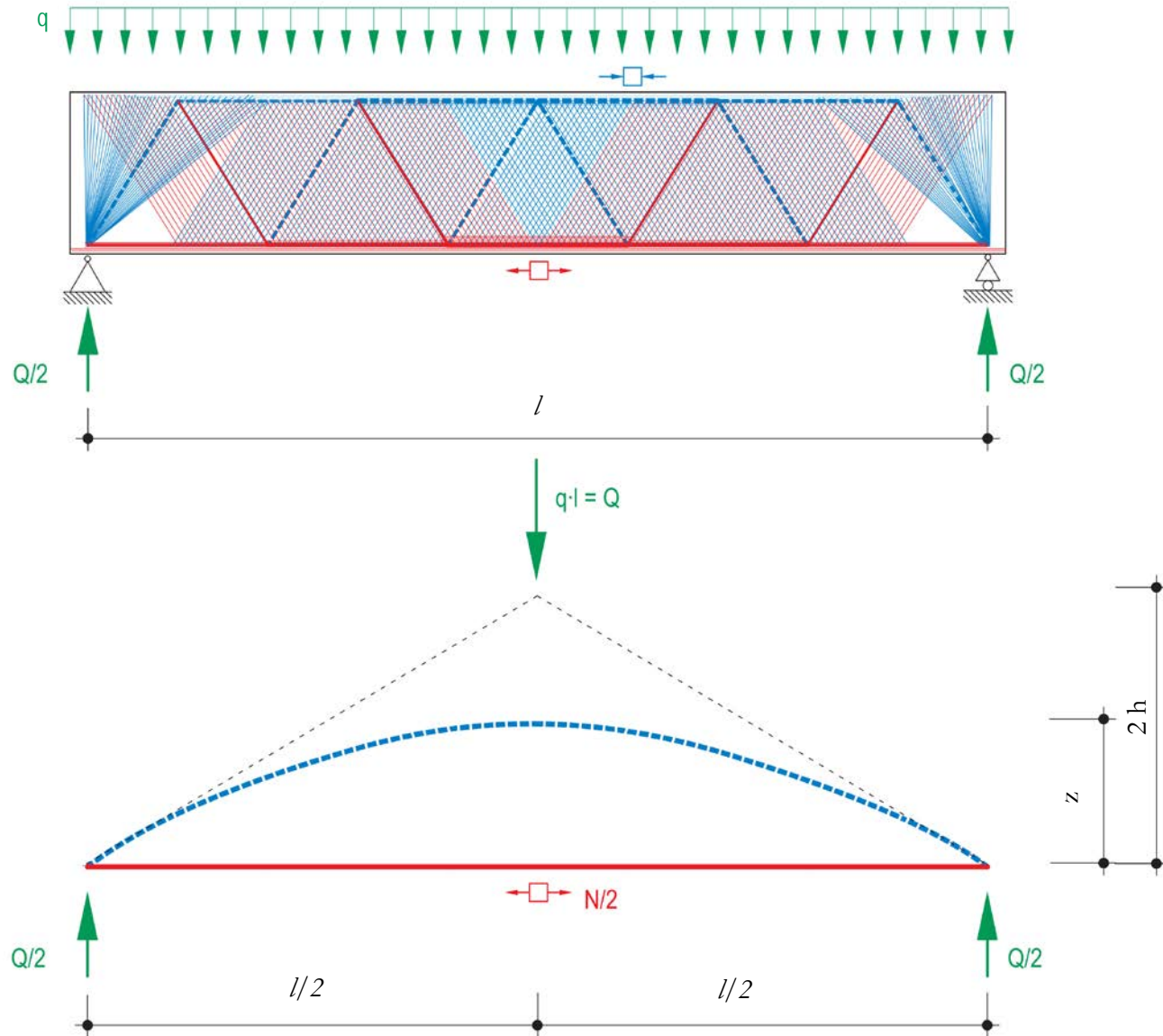
# Innere Kräfte in Stahlträgern



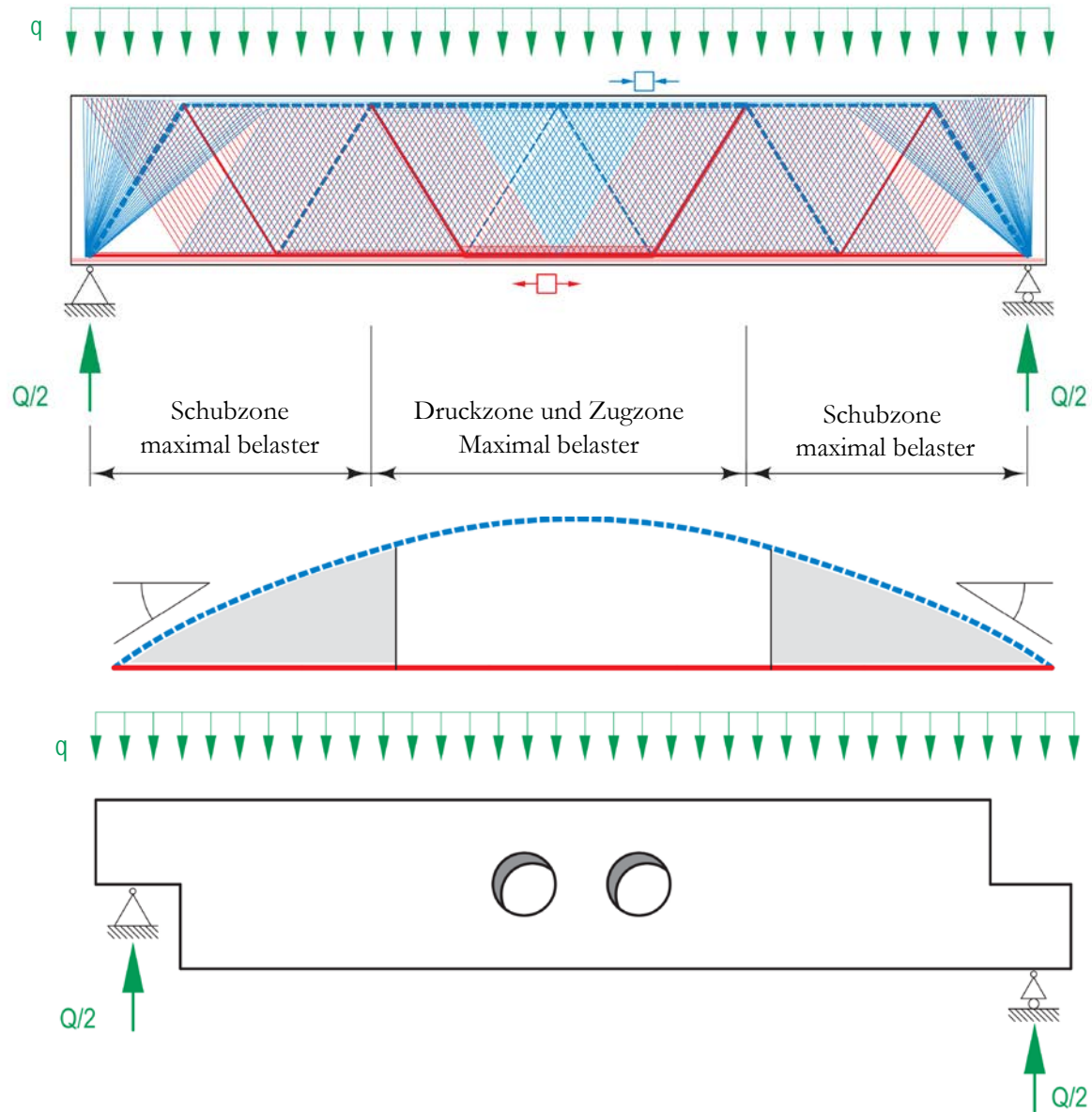
# Einfacher Balken aus Stahl unter konzentrierter Belastung



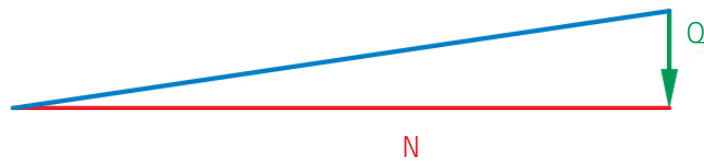
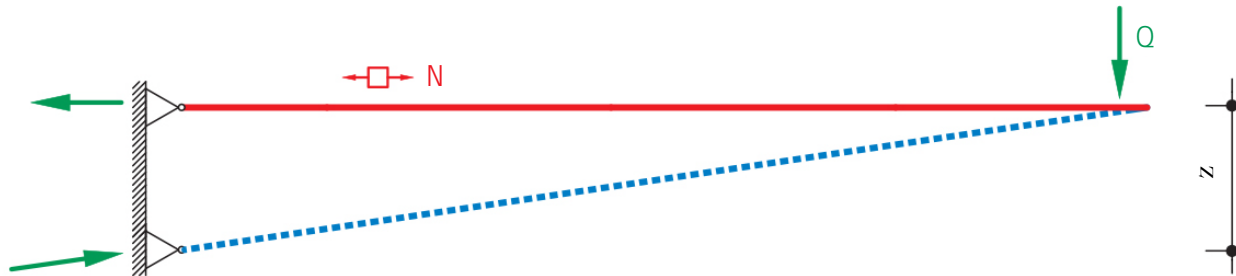
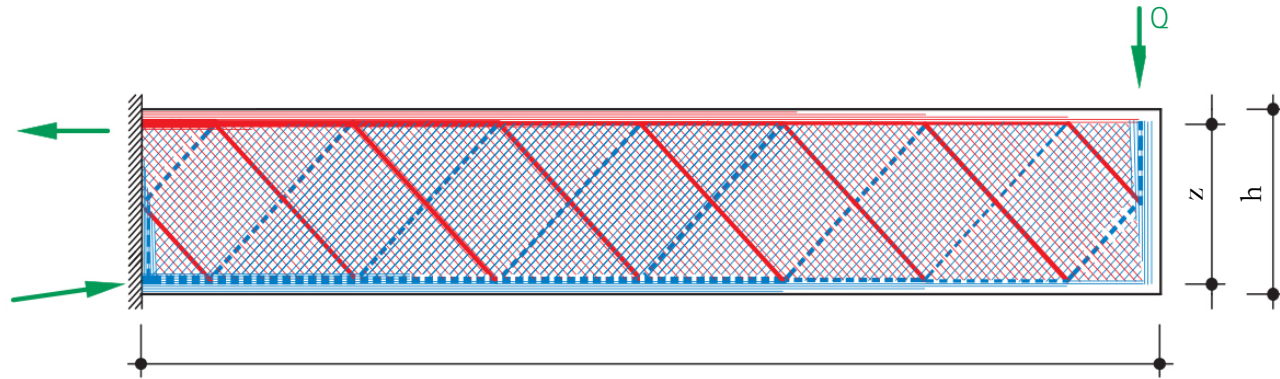
# Einfacher Balken aus Stahl unter verteilter Belastung



# Bereiche maximaler interner Beanspruchung

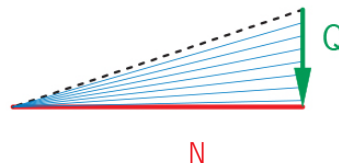
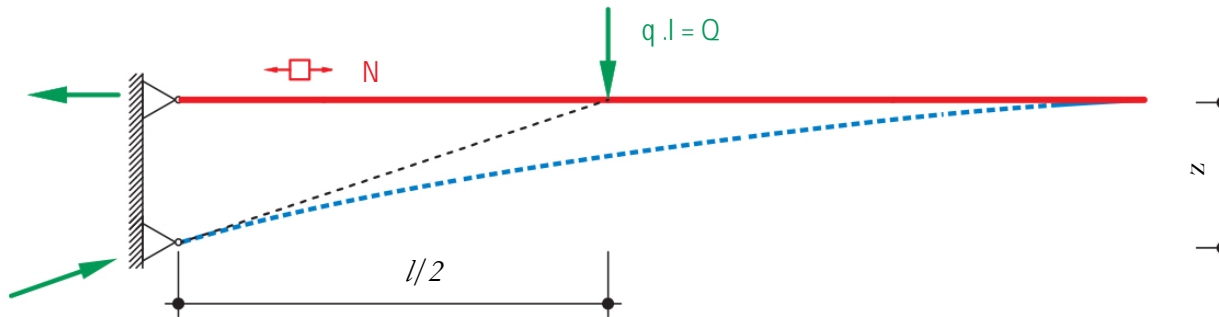
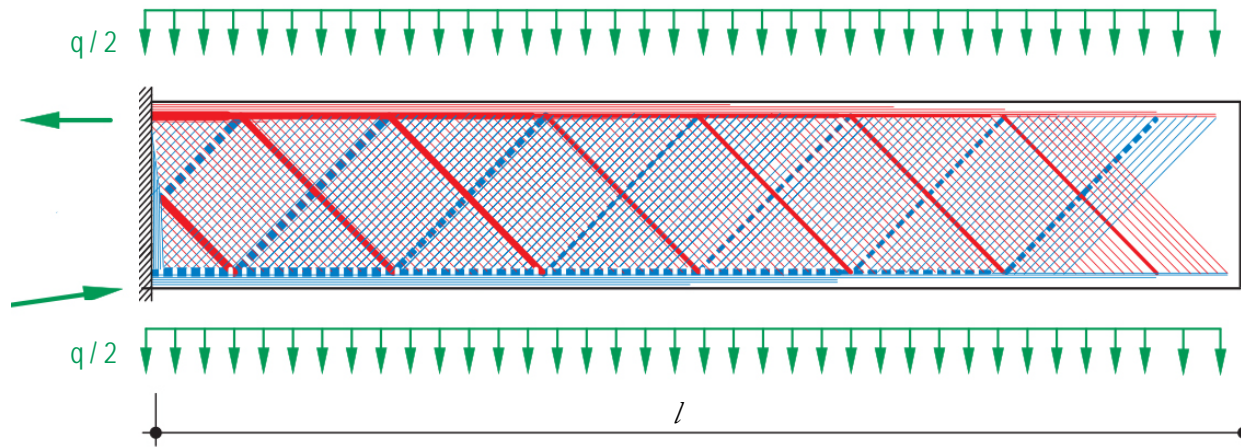


# Balkenartige Konsole unter konzentrierter Belastung

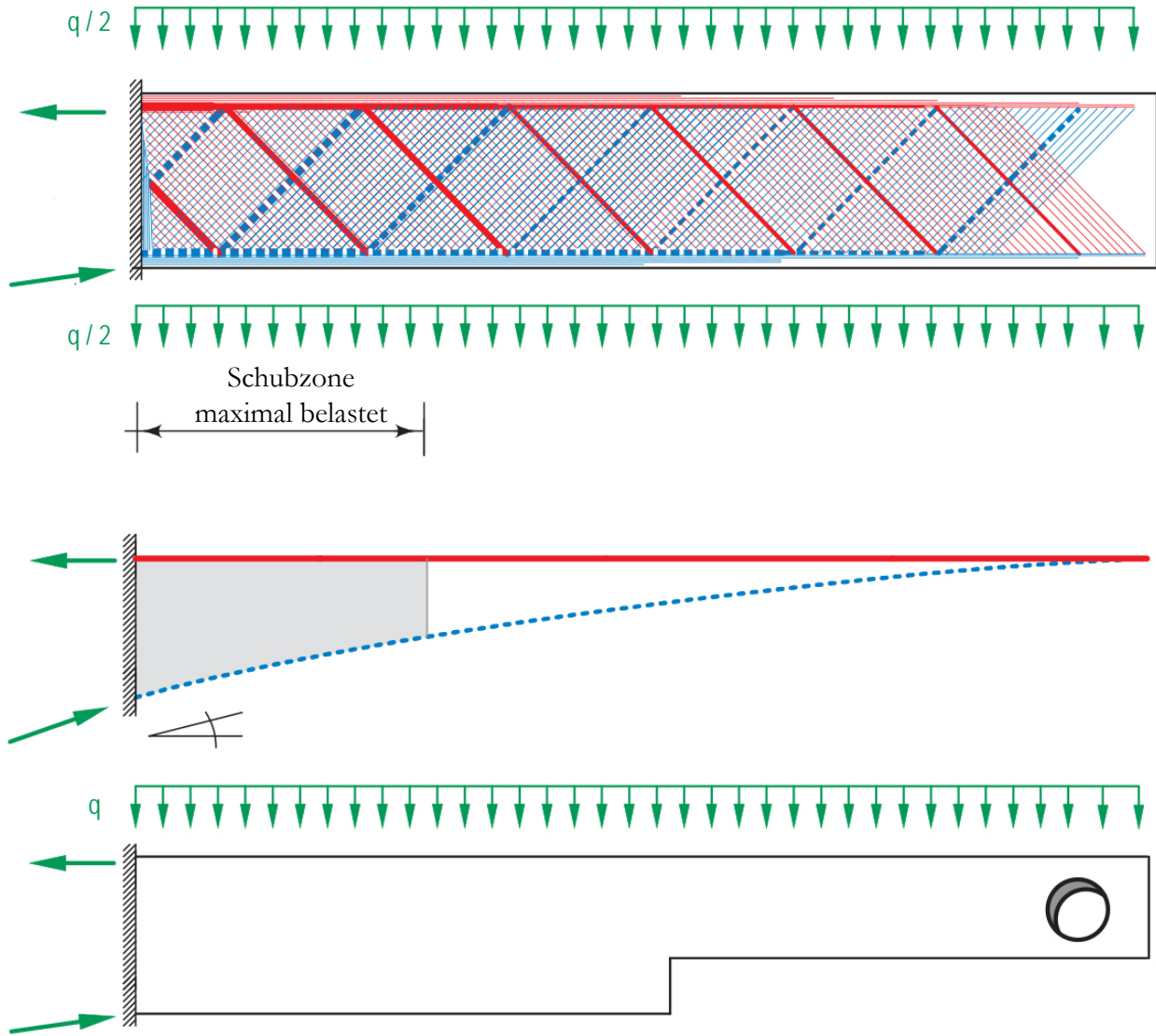


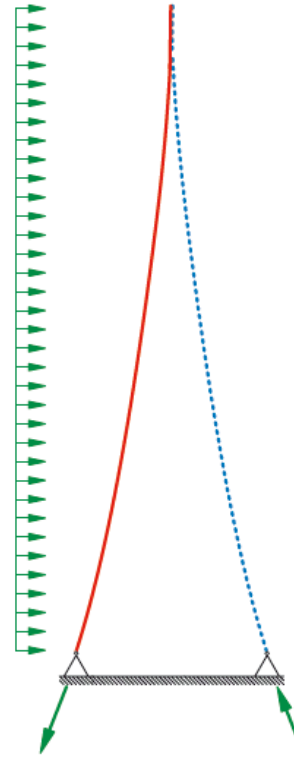
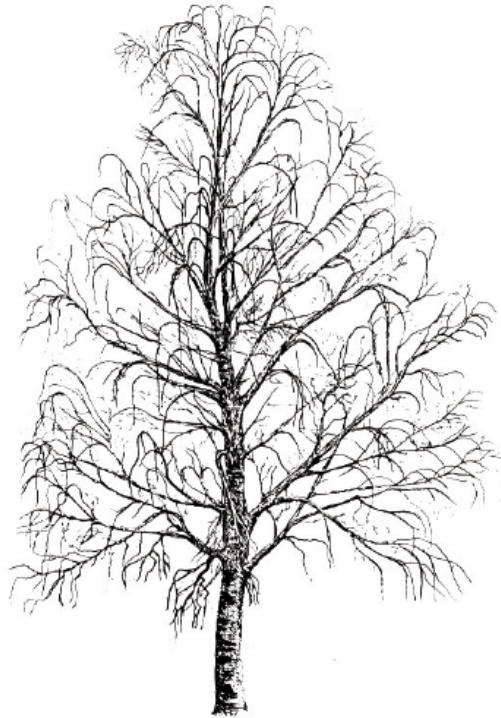


# Balkenartige Konsole unter verteilter Belastung



# Bereiche maximaler interner Beanspruchung





Canadian National Tower, Toronto, 1973 – 76  
Arch.: John Andrews & Webb Zerafa Menkes Housden Partnership,  
Ing.: Nicolet, Dressel and Ass. & Bruno Thürlimann

# Inhalt

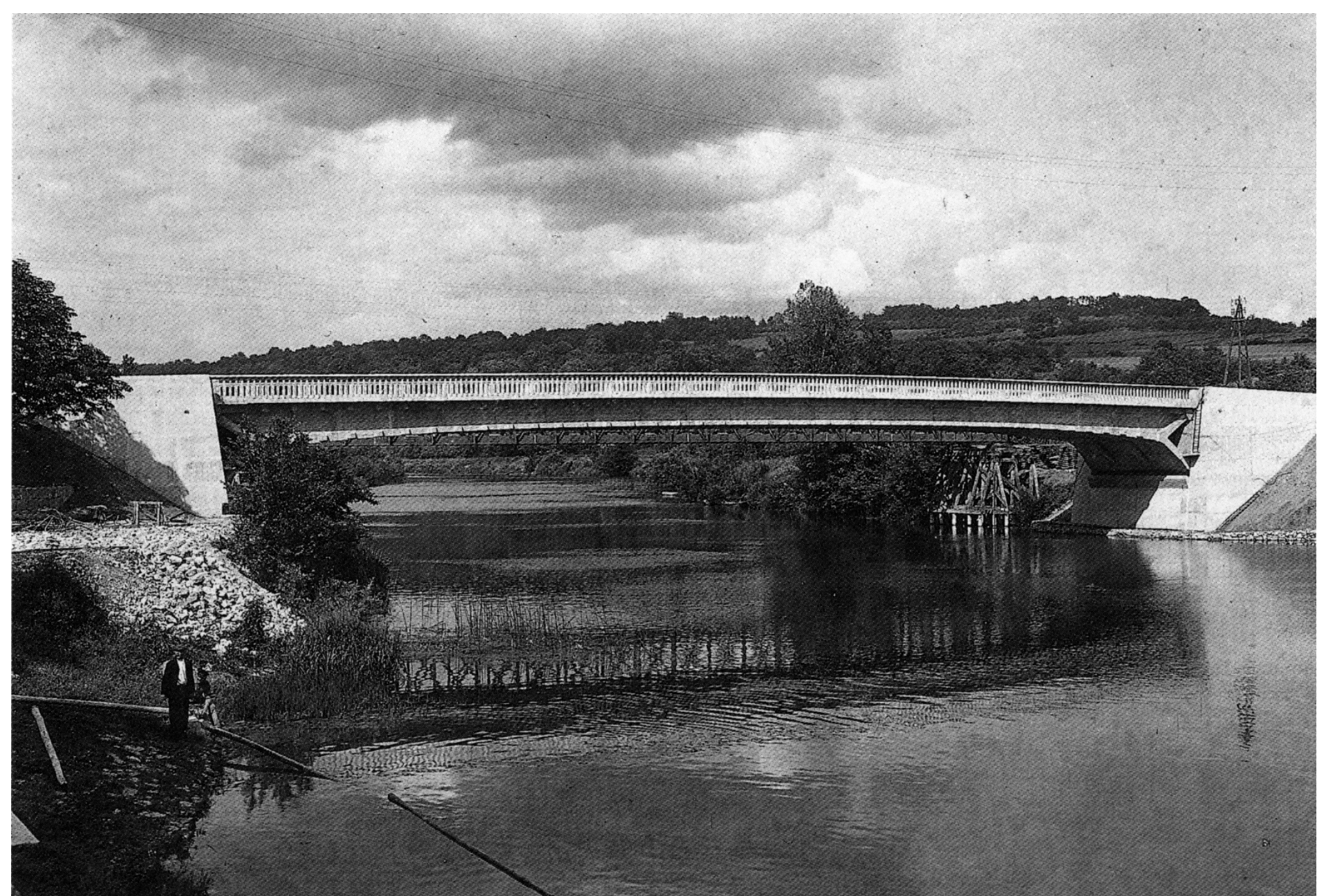
Tragverhalten eines Balkens

Rahmen

Scheiben

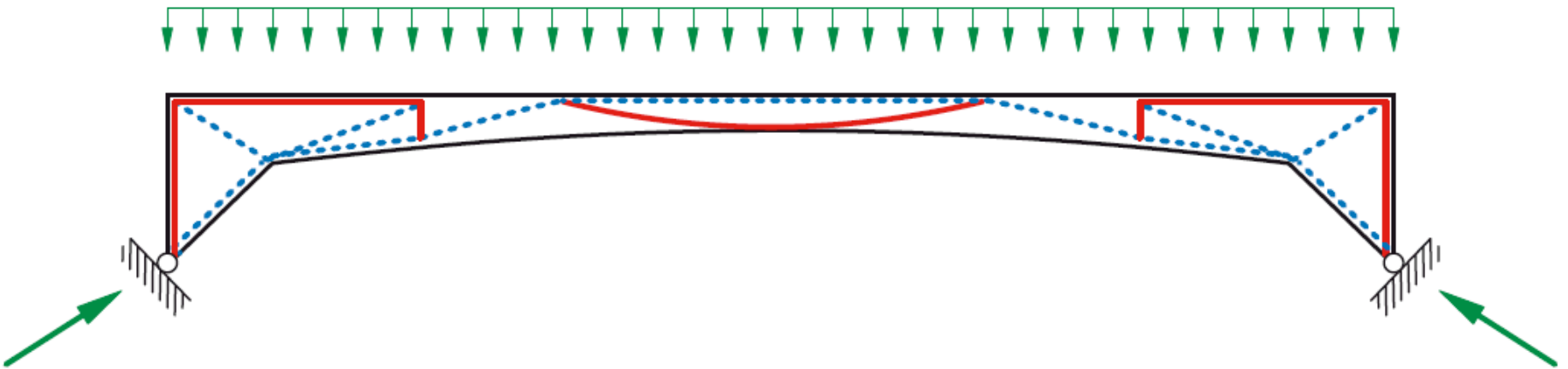
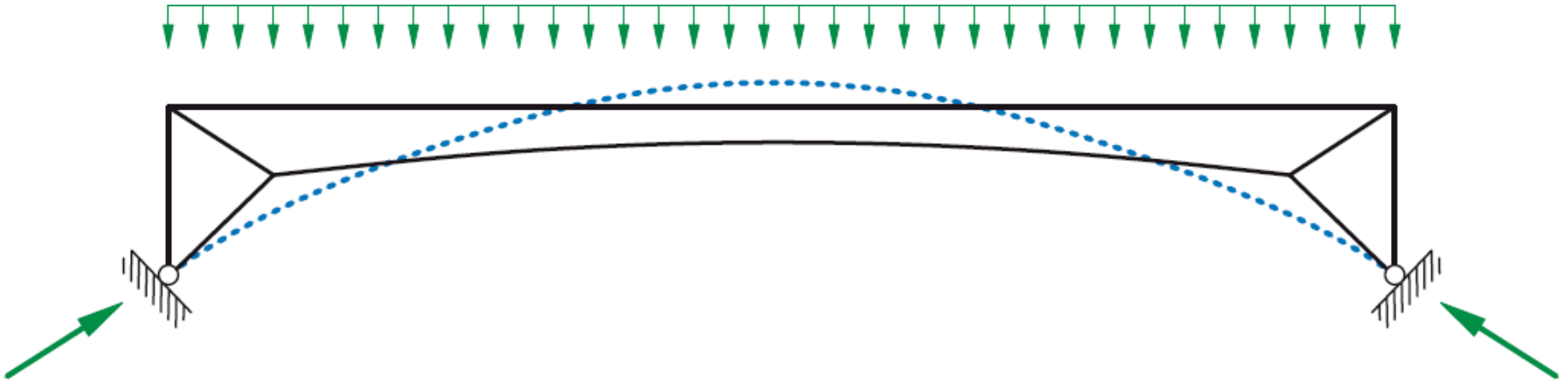
Balkenroste

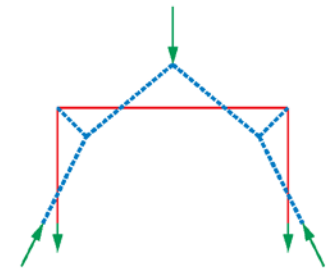
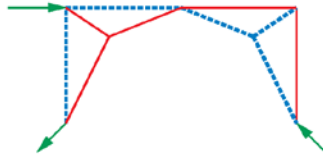
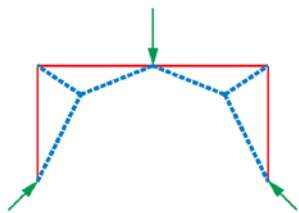
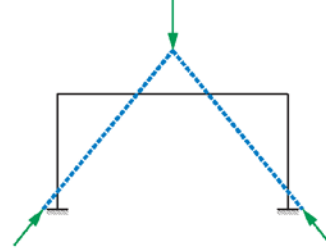
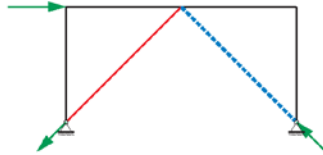
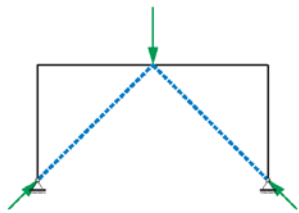
Platten



Brücke über die Marne, Luzancy, 1946, Arch. & Ing.: Eugene Freyssinet

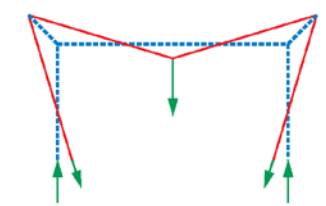
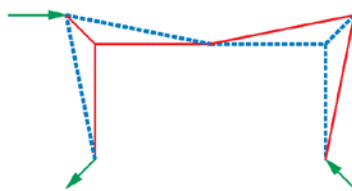
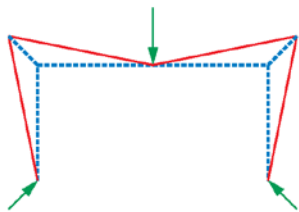
# Zweigelenkrahmen



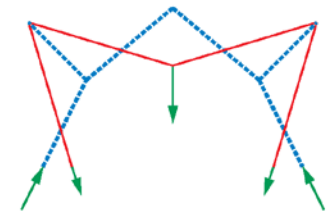
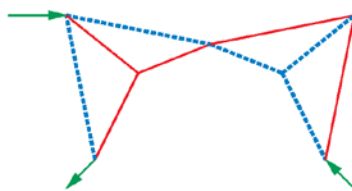
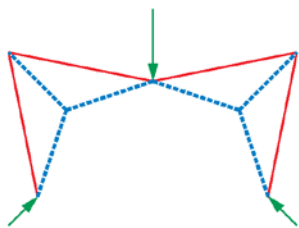


...

→ unterschiedliche  
Lösungen von  
analogem Typus



...



...

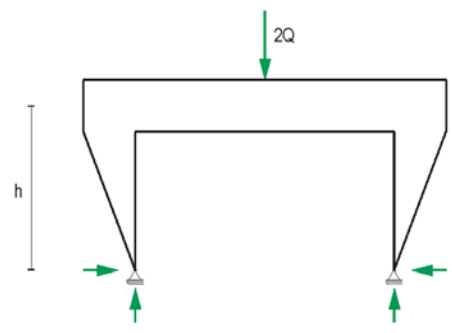
⋮

Kombination von Konsolen

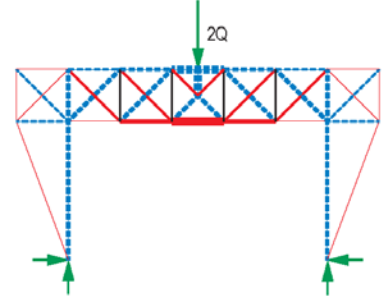
⋮

unterschiedliche Lösungen für innere Kräfte

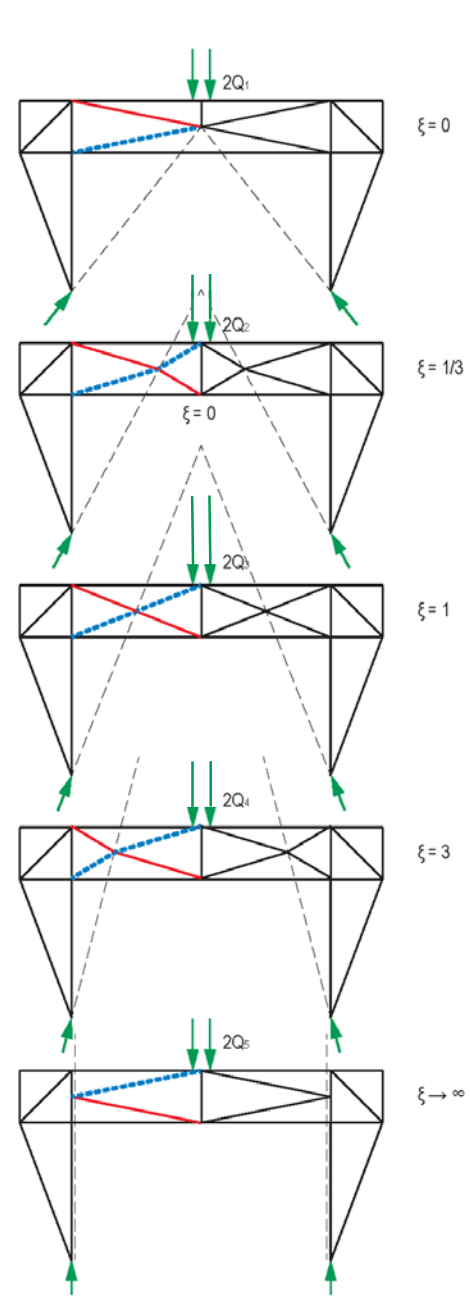
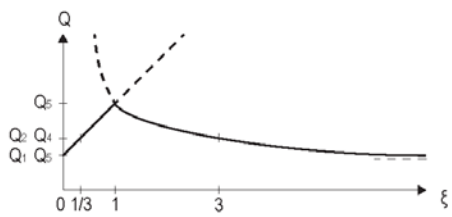
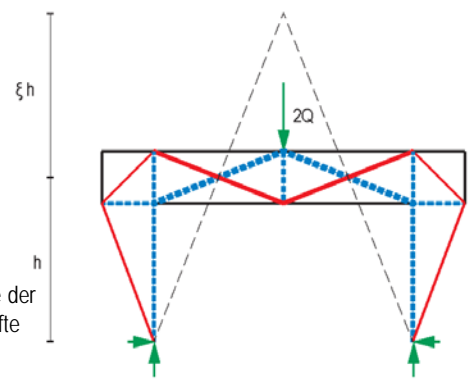
2-Gelenkrahmen



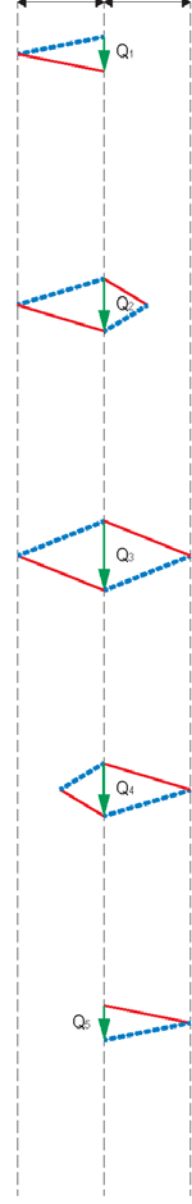
Tragwirkung schematisch



Resultierende der inneren Kräfte

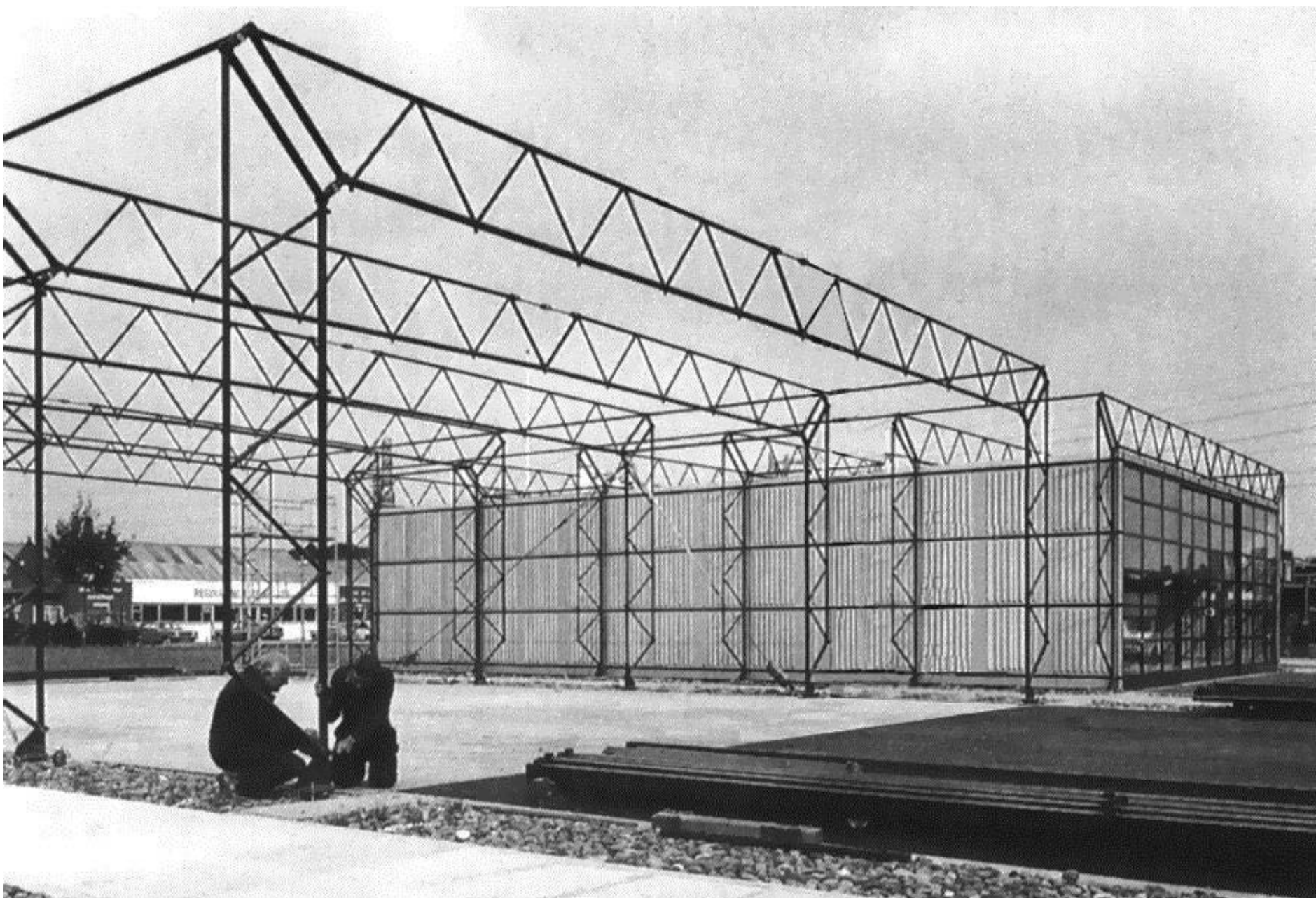


Widerstand der Flanche

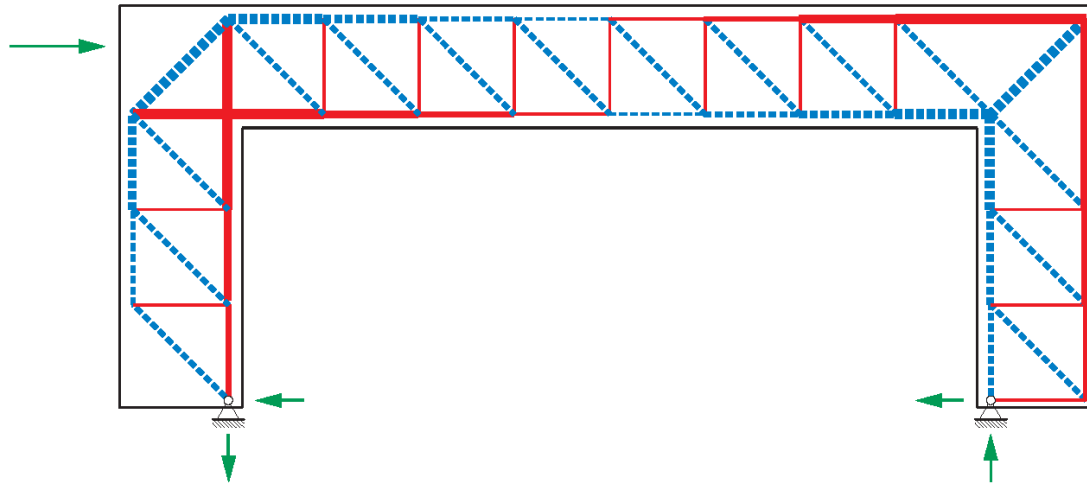
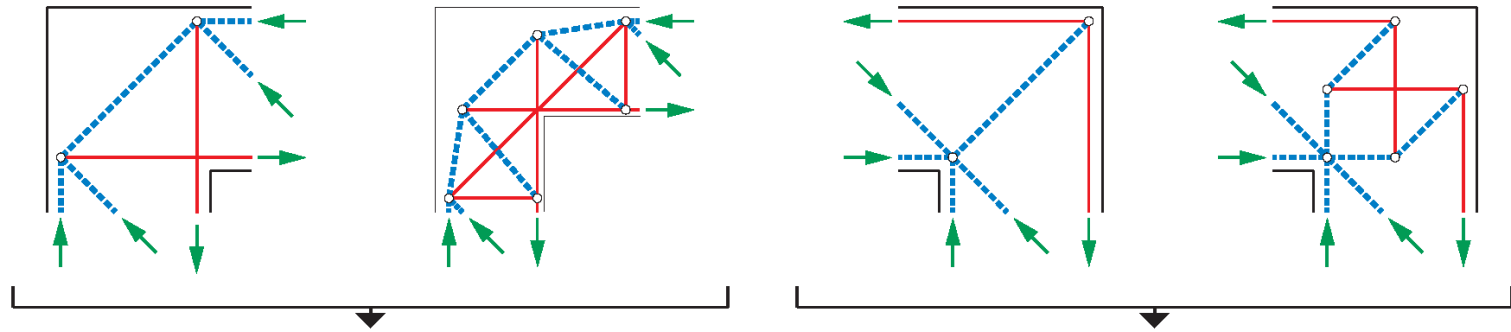
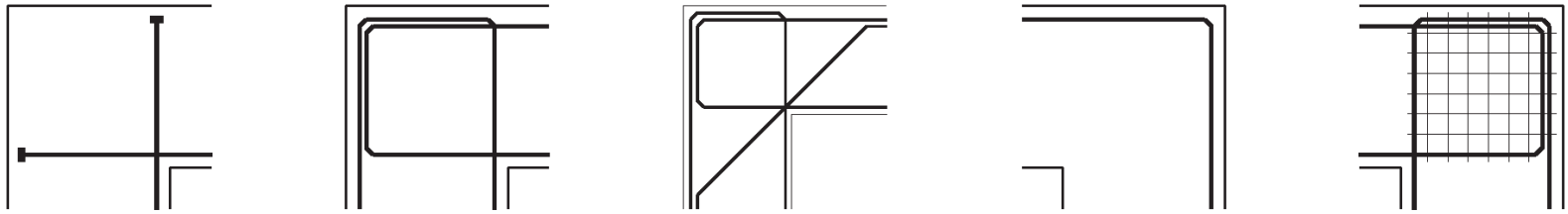


Traglastermittlung durch Variation





Patera Building, Stoke on Trent

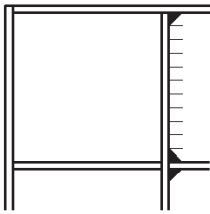


Bewehrung der Rahmenecke in Stahlbeton

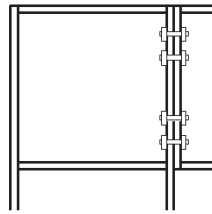


Studio Vacchini: Sportausbildungszentrum Mulimatt in Brugg

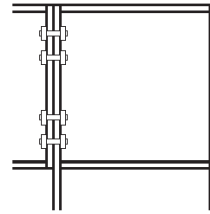
Schweissverbindung



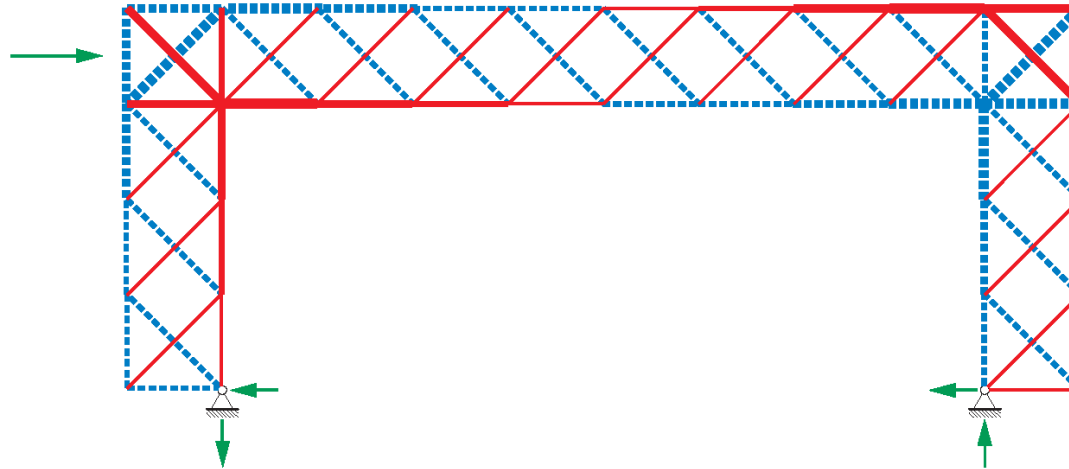
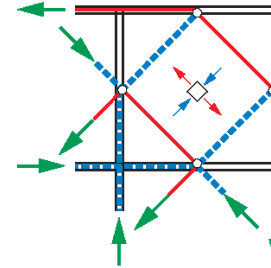
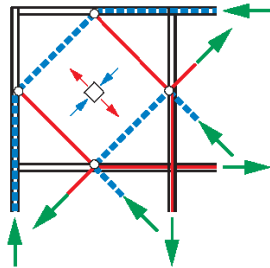
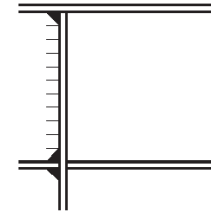
Schraubverbindung



Schraubverbindung



Schweissverbindung



Ausbildung der Rahmenecke in Stahl



L. Mies van der Rohe: Crown Hall IIT in Chicago



L. Mies van der Rohe: Crown Hall IIT in Chicago



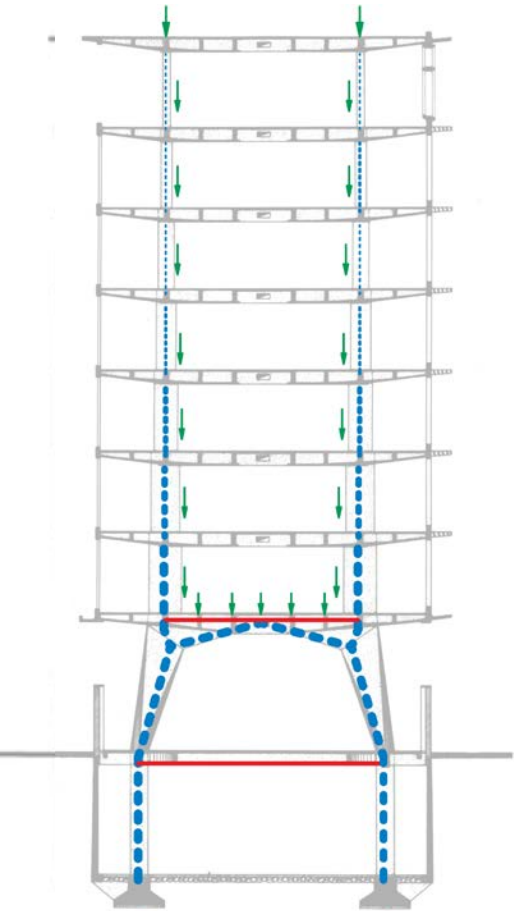
L. Mies van der Rohe: Crown Hall IIT in Chicago



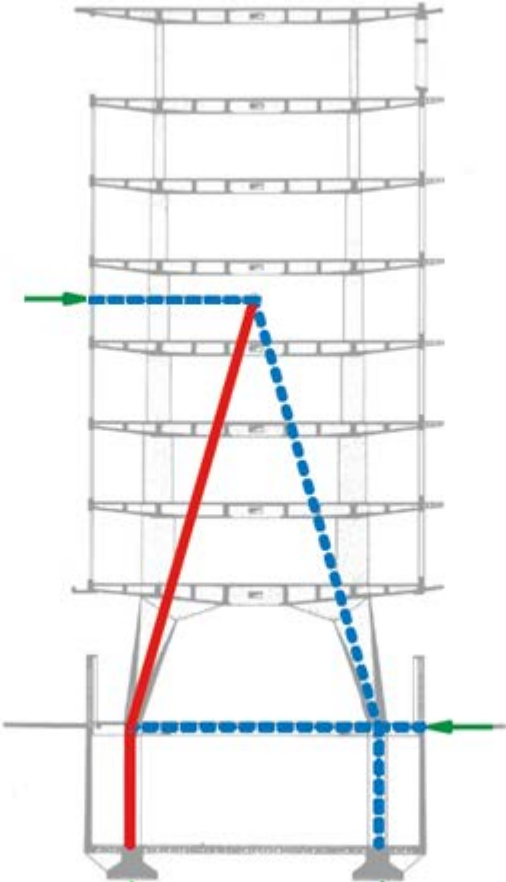
Hauptsitz, UNESCO, Paris, 1957, Arch.: Marcel Breuer und Bernhard Zehrfuss, Ing.: Pier Luigi Nervi



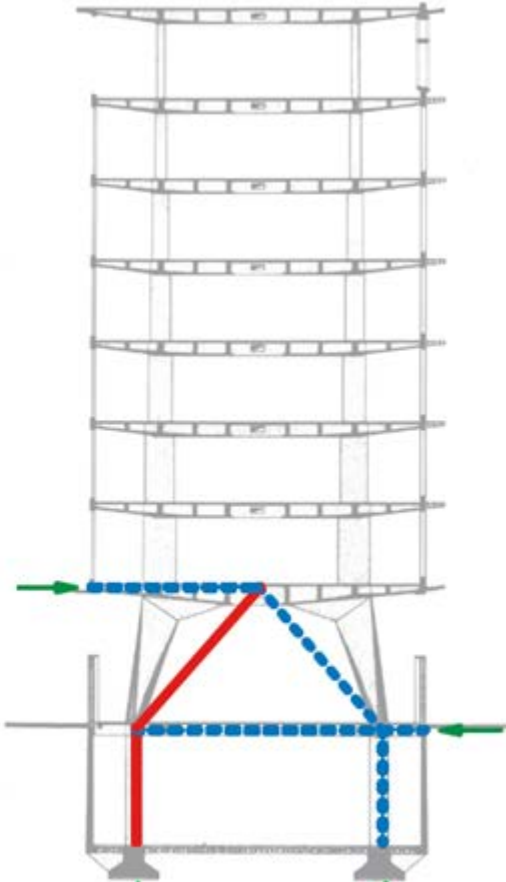
# Innere Kräfte im Tragwerk



a) Unter ständigen Lasten

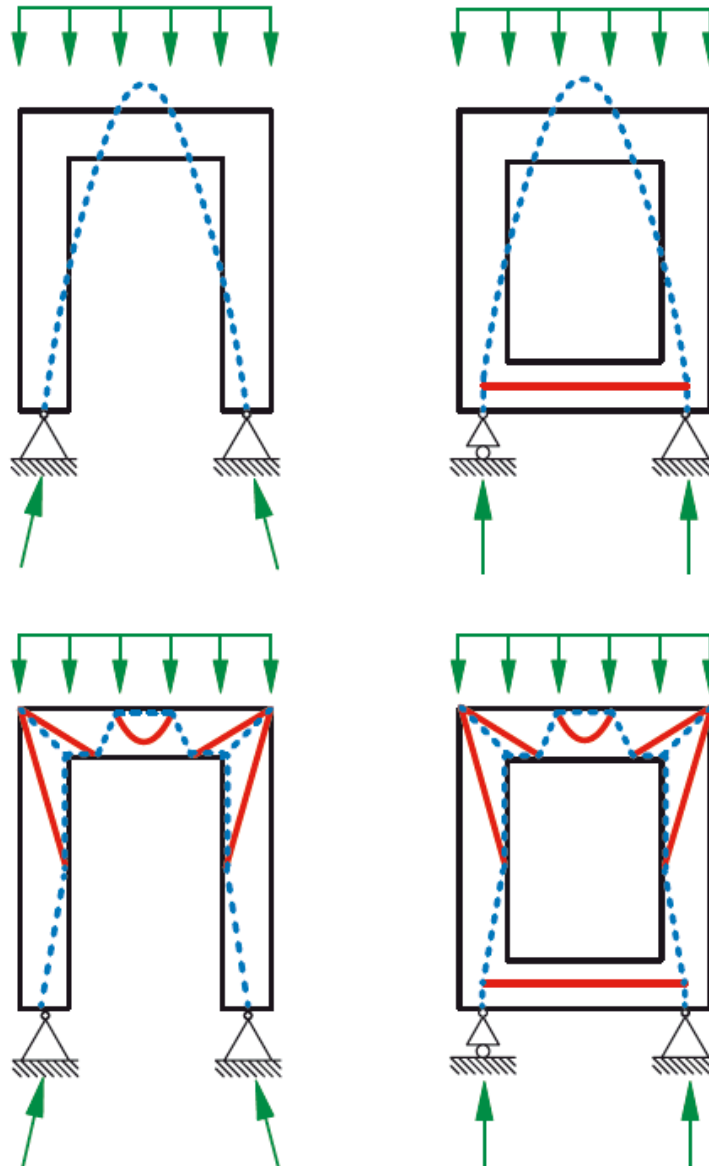


b) Unter horizontalen Einwirkungen im Schwerpunkt

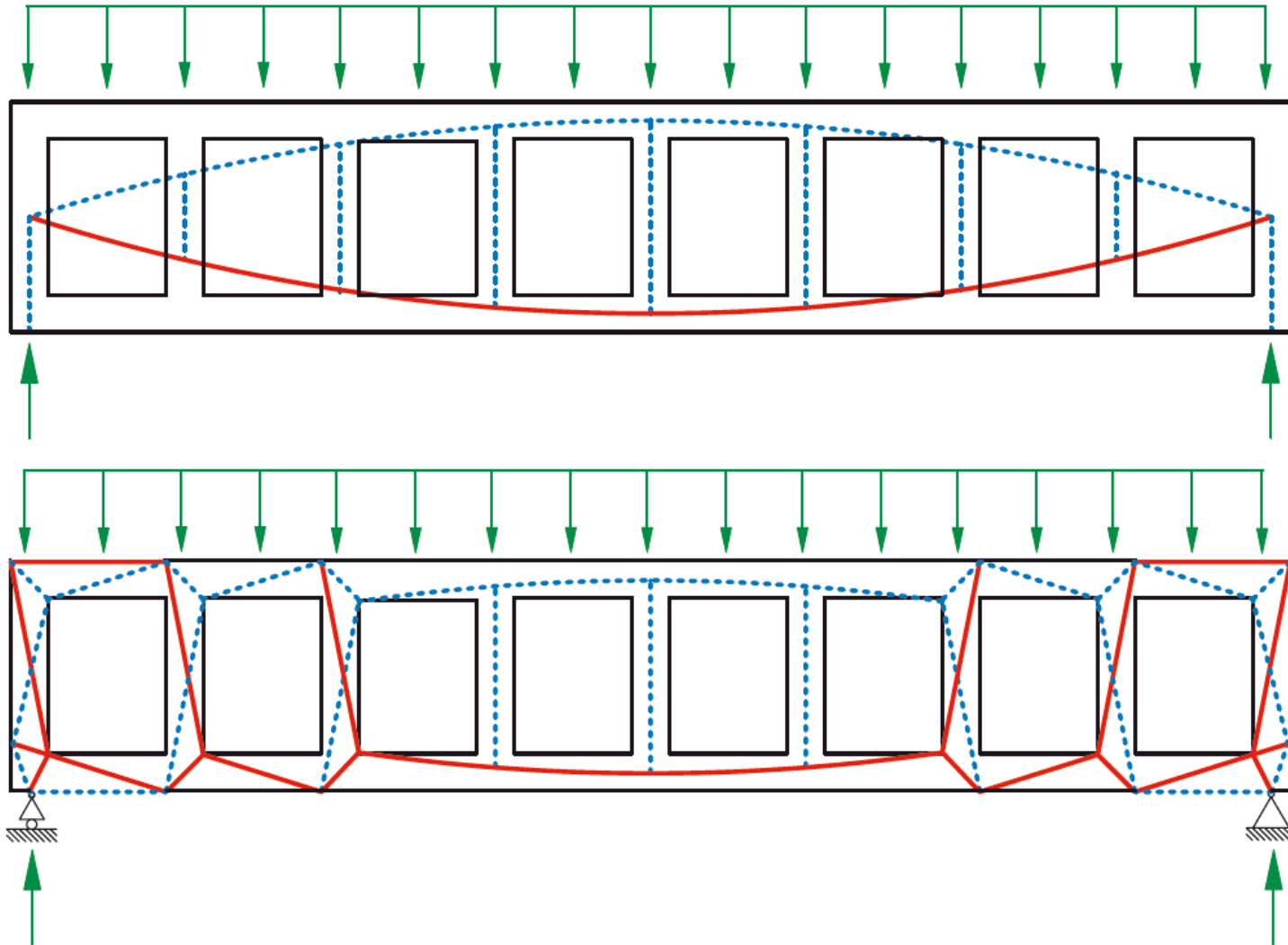


c) Unter horizontalen Einwirkungen unterhalb des Schwerpunktes

# Drucklinie und innere Kräfte in Rahmen



# Drucklinie und innere Kräfte in Rahmen (Vierendeel-Träger)





Bürohaus La Ferriera, Locarno, 2003, Arch.: Livio Vacchini, Ing.: Andreoutti + Partners

# Inhalt

Tragverhalten eines Balkens

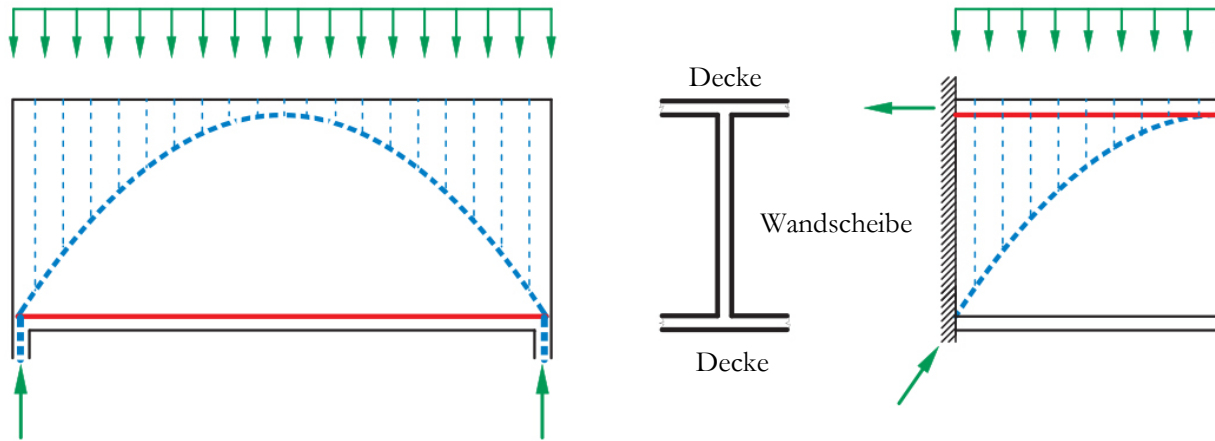
Rahmen

Scheiben

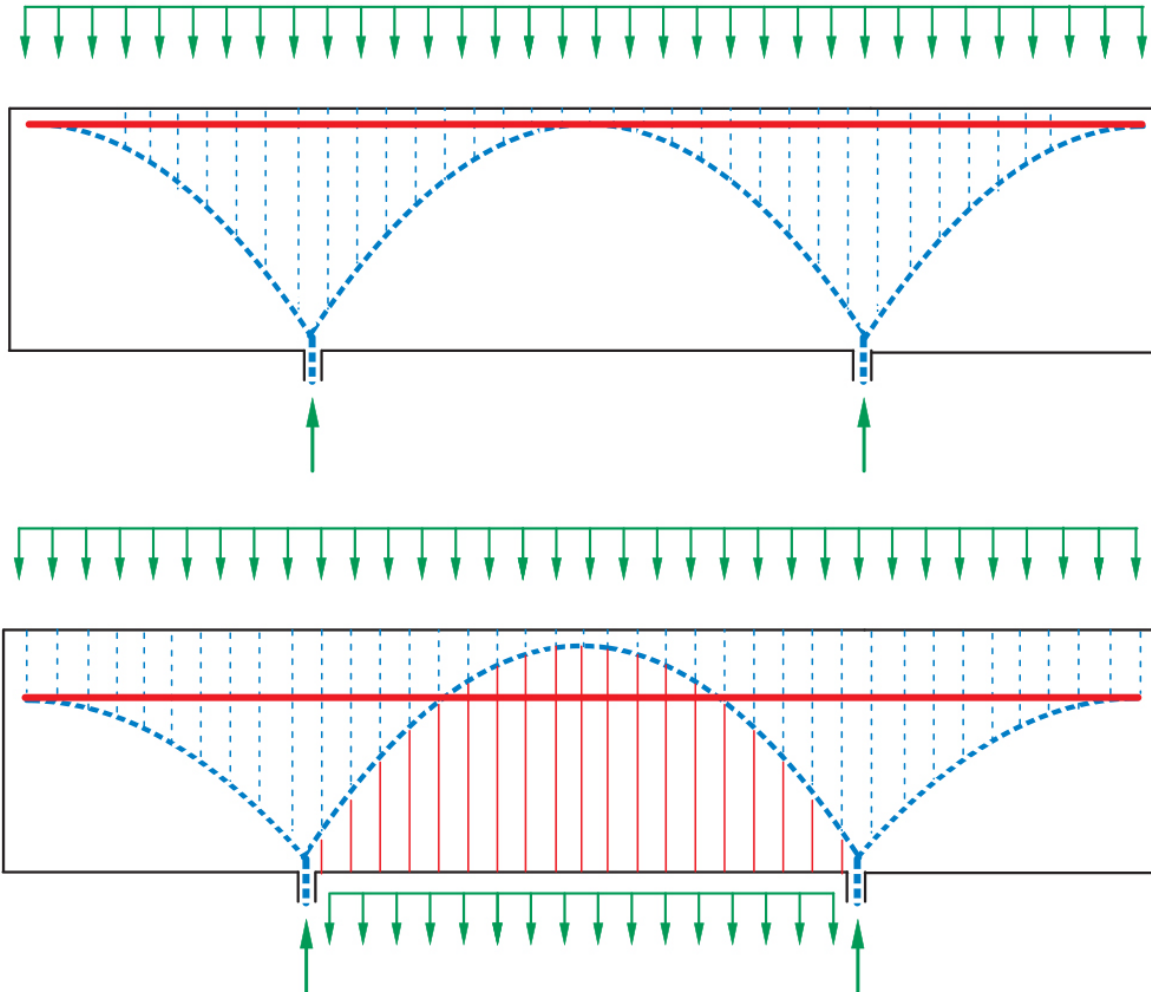
Balkenroste

Platten

# Innere Kräfte in einfachen Wandscheiben



# Innere Kräfte in zusammengesetzten Wandscheiben

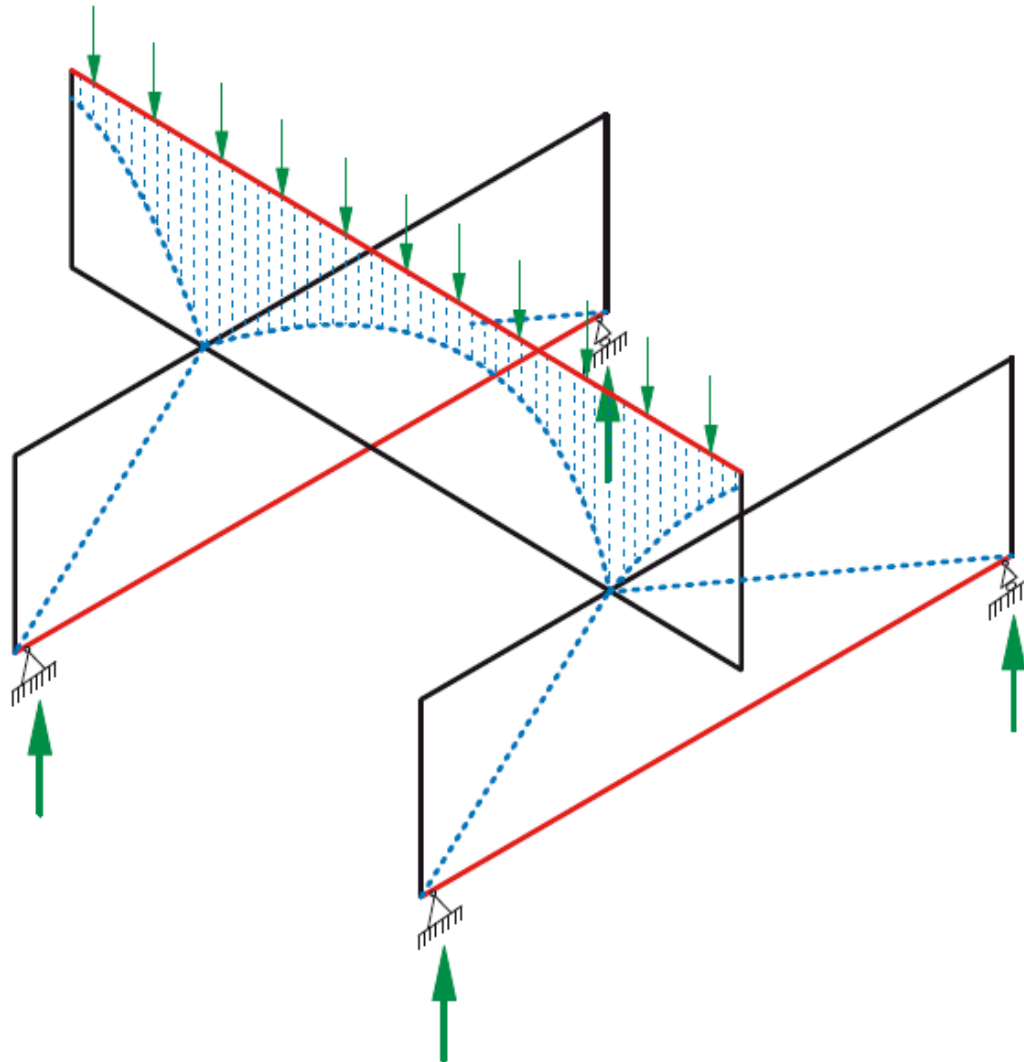




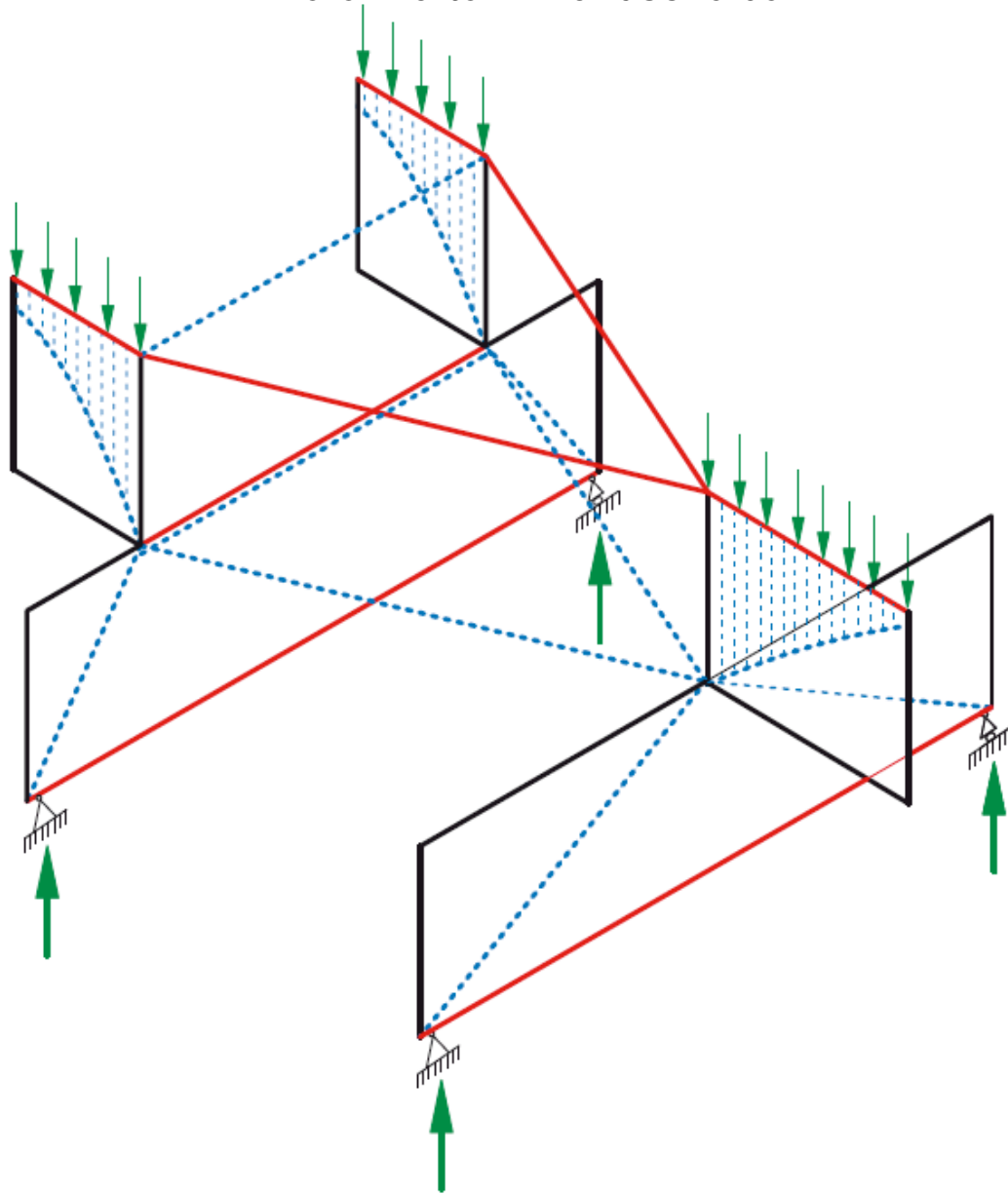
Mehrfamilienhaus Forsterstrasse, Zürich, 2003, Arch.: Christian Kerez, Ing.: Joseph Schwartz



# Innere Kräfte in Wandscheiben

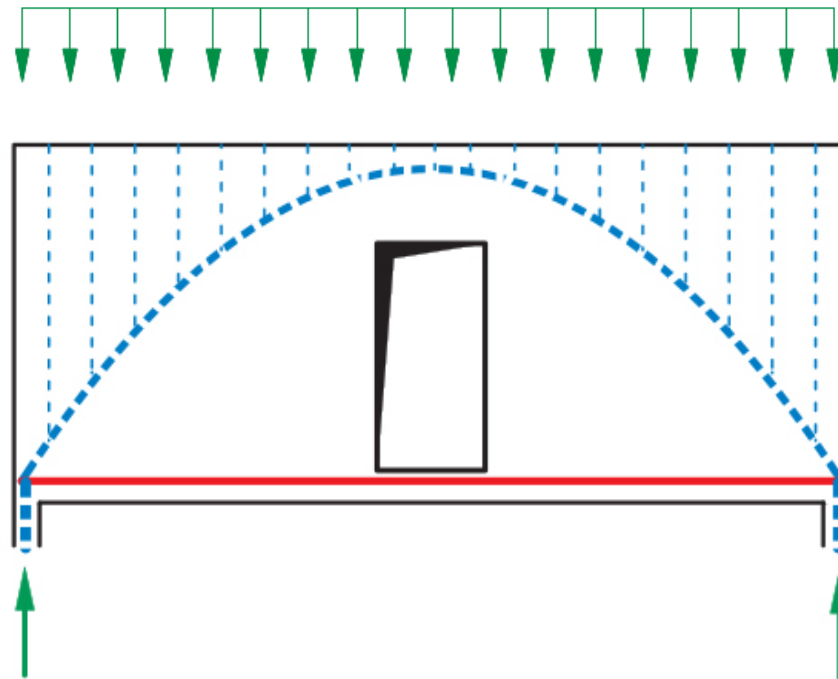


# Innere Kräfte in Wandscheiben



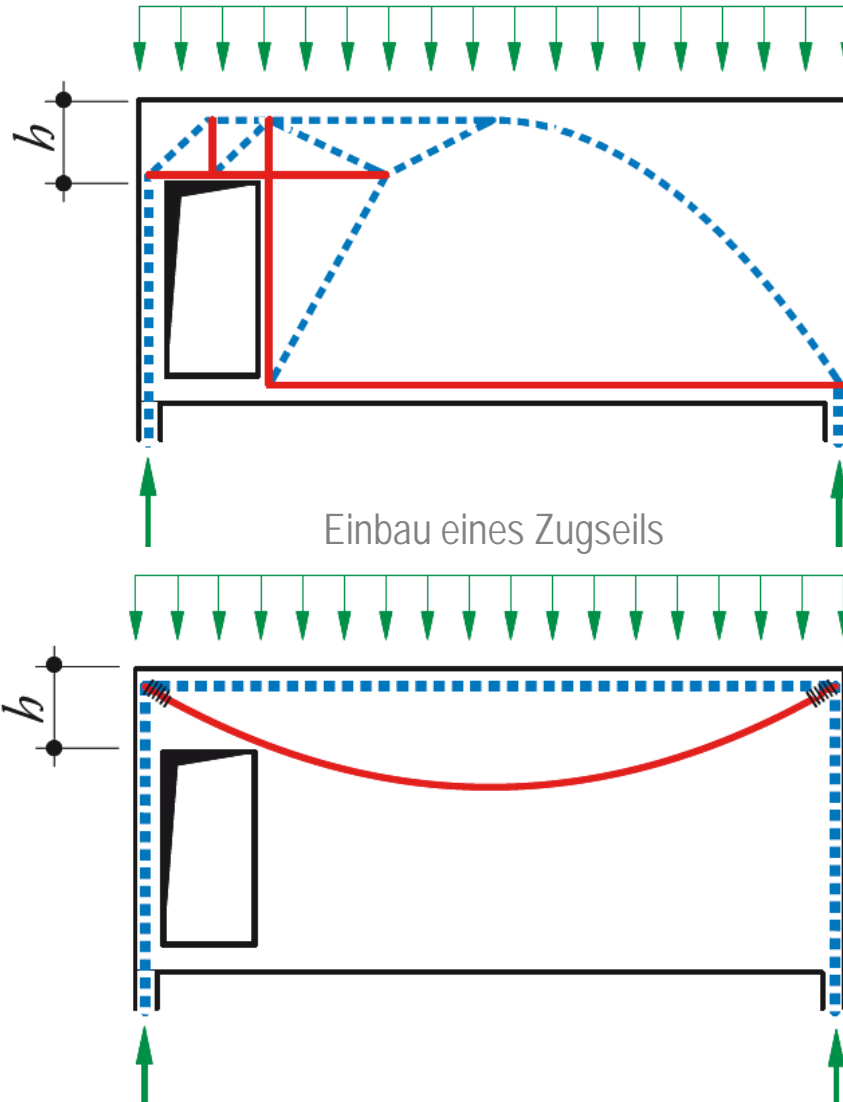
# Innere Kräfte in Wandscheiben

Vorteilhafte Lage von Aussparungen



# Innere Kräfte in Wandscheiben

Unvorteilhafte Lage einer Aussparung mit Türsturz als Konsole



# Inhalt

Tragverhalten eines einfachen Balkens

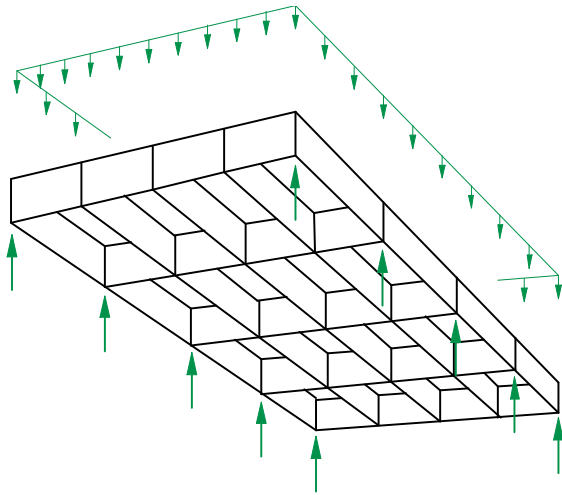
Rahmen

Scheiben

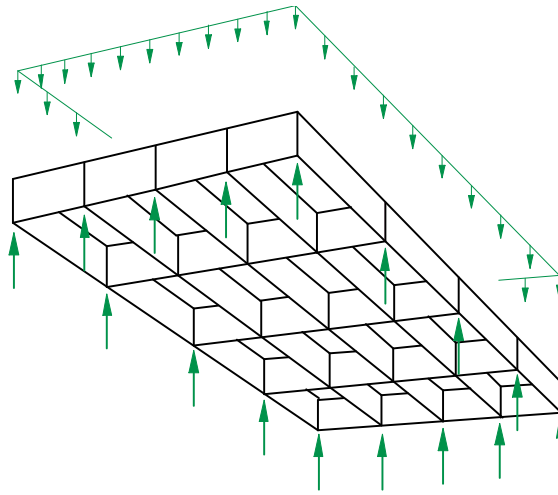
Balkenroste

Platten

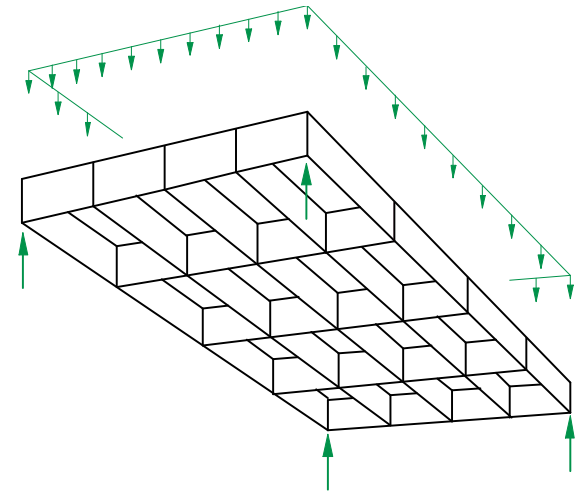
# Balkenroste



Mit Auflagern an zwei  
Seiten



Mit Auflagern an allen  
Seiten



Mit Auflagern nur in den  
Ecken



Mehrzweckhalle Losone, 1994 – 97, Arch.: Livio Vacchini, Ing.: R. Rossi



Neue Nationalgalerie, Berlin, 1965 – 68, Arch.: Ludwig Mies van der Rohe, Ing.: H. Dienst





Art Gallery, Yale University, New Haven, 1951 – 53, Arch.: Louis Kahn, Ing.: Henry A. Pfisterer



Kongresszentrum in Davos, Arch.: Heinrich Degelo, Ing.: Prof. Dr. Joseph Schwartz, 2010

# Inhalt

Tragverhalten eines einfachen Balkens

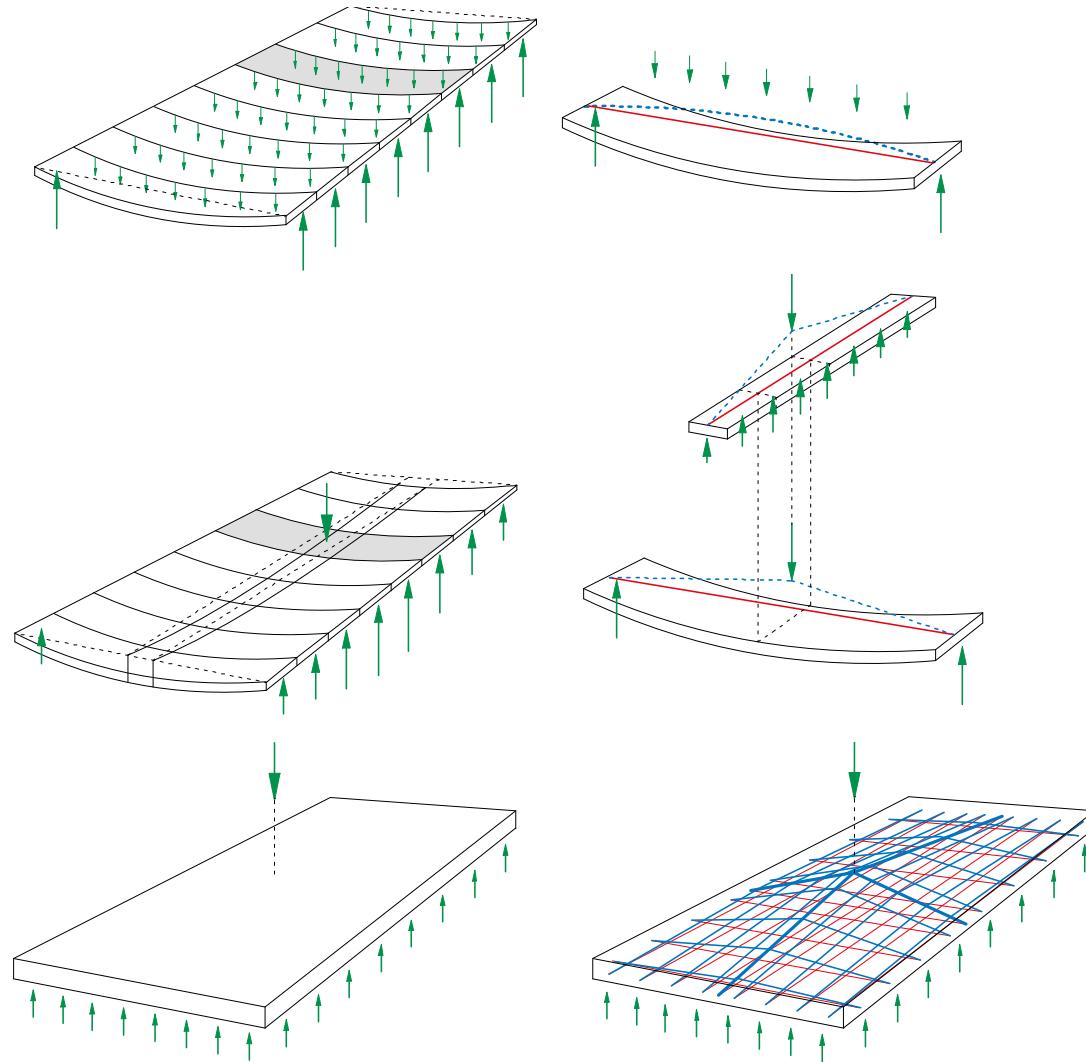
Rahmen

Scheiben

Balkenroste

Platten

# Tragverhalten einer Rechteckplatte





Villa Savoye, Poissy, 1926, Arch.: Le Corbusier & Pierre Jeanneret

Bogen, Seil		Bogen-Seiltragwerk	
Als äusseres Tragwerk	Als inneres Tragwerk	Als äusseres Tragwerk	Als inneres Tragwerk
	<p>Beton, gerissen</p> <p>Beton, gerissen</p>		<p>Holz</p> <p>Beton, vorgespannt</p> <p>Beton, gerissen</p>
<p>Bogen, Seil, Membran, Schale</p>	<p>Membranwirkung</p>	<p>Bogen-Seiltragwerk Fachwerk Raumfachwerk</p>	<p>Balken Balkenroste Platten</p>

# Ausblick Tragwerksentwurf III

## Kraft - Form - Material

### Modellbildung

1 Gleichgewicht  
Bogen- und Seil-  
tragwerke, Material



2 Bogenseil-  
Tragwerke  
Fachwerke



3 Balken  
Variation  
Traglast

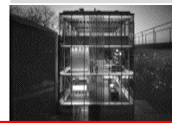


### Modellapplikation

4-5 Stahlbetonbau  
Studio in Locarno  
Livio Vacchini



6-7 Stahlbau  
Haus R 128  
Werner Sobek



8-9 Holzbau  
Ziegelwies  
Burkhalter Sumi



10-11 Mauerwerk  
Stadttor Isny  
Peter Zumthor



Ausblick 3. Semester

