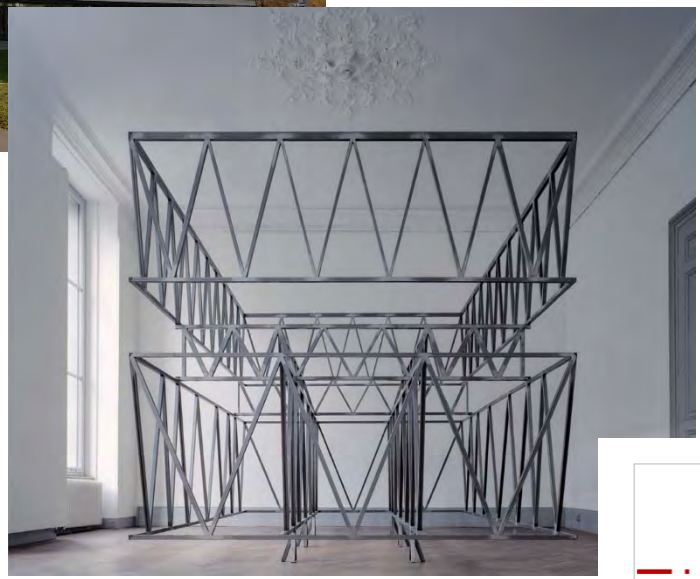
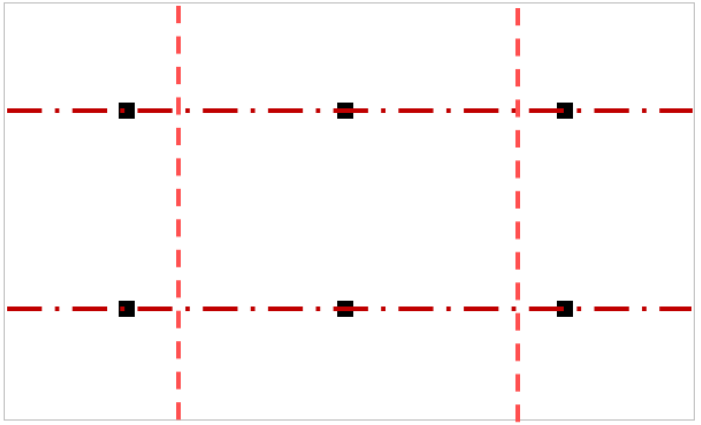
Linan, bågen och fackverket

Kroppar och strukturer

logisk ordning

vertikal last





Vertikala stöd

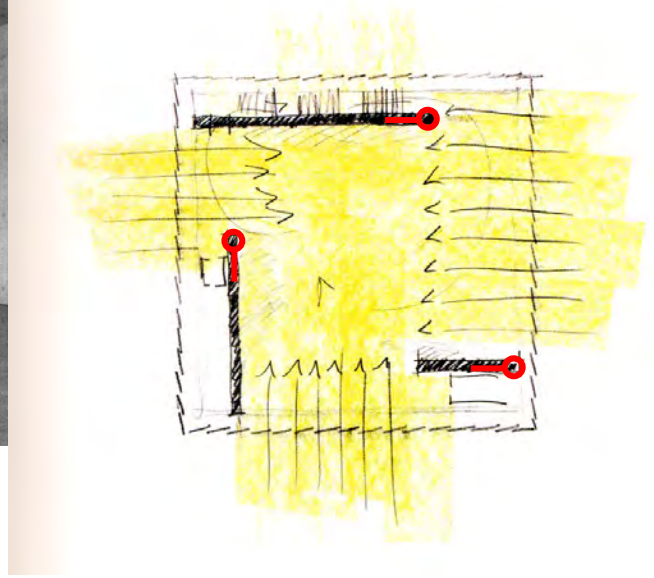
Primärbalkar

Sekundärbalkar

Kroppar och strukturer

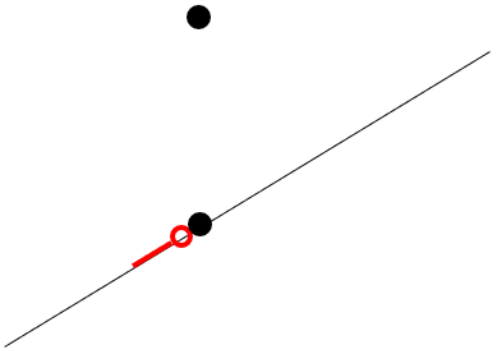
logisk ordning

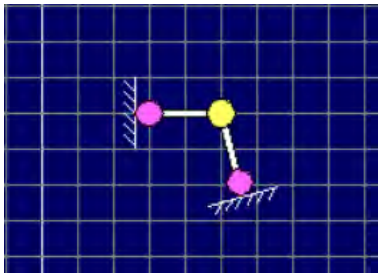
horisontell last

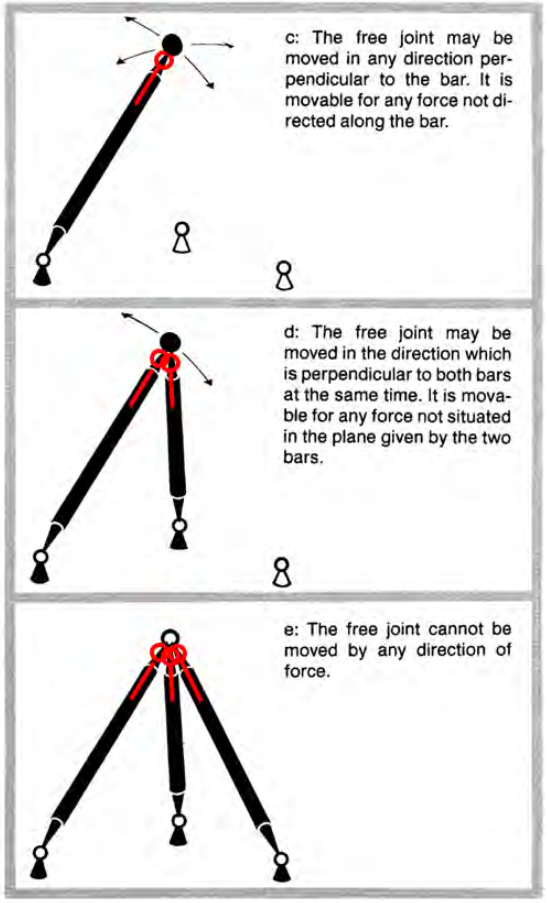


Kroppar och strukturer

rummets dimensioner



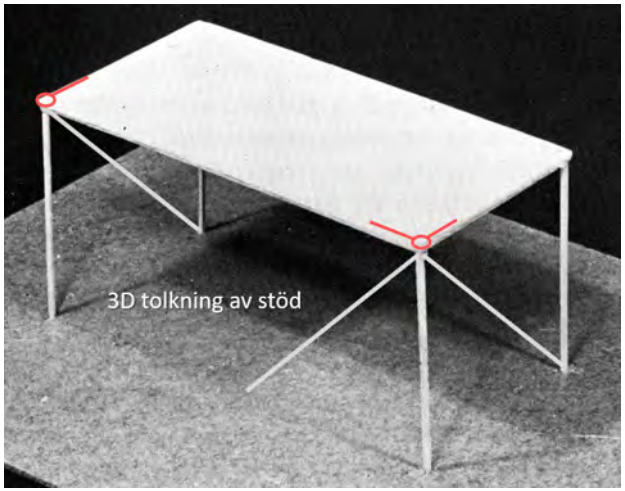


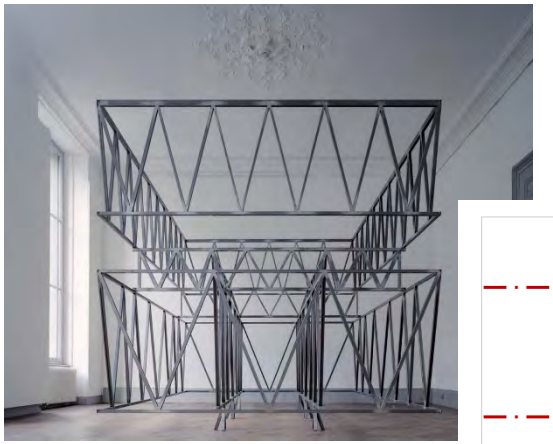


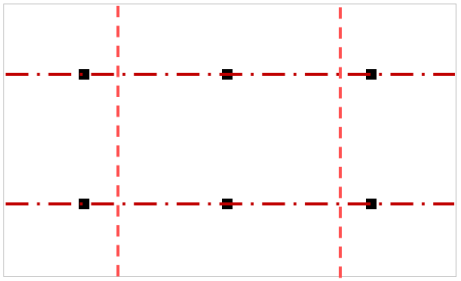
En punkt i olika rumsliga dimensioner

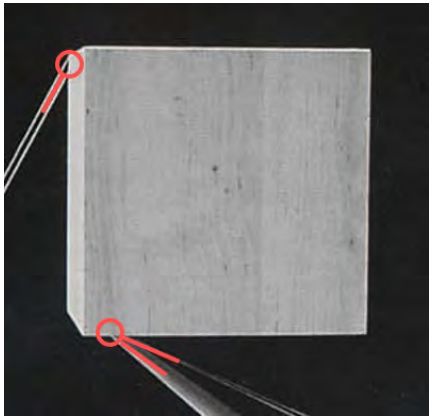
Kroppar och strukturer

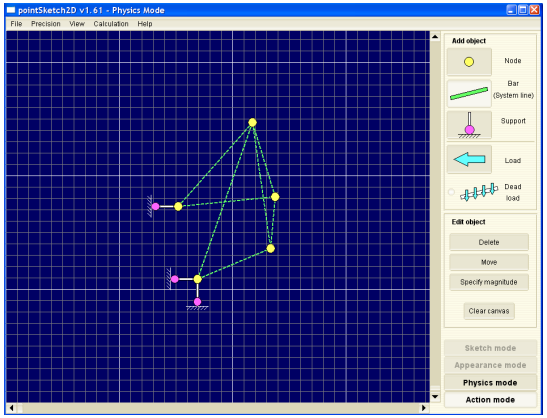
representationer







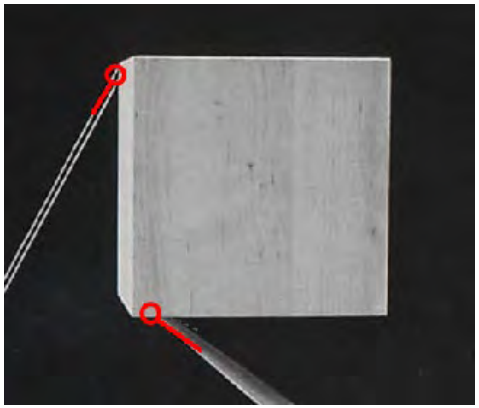




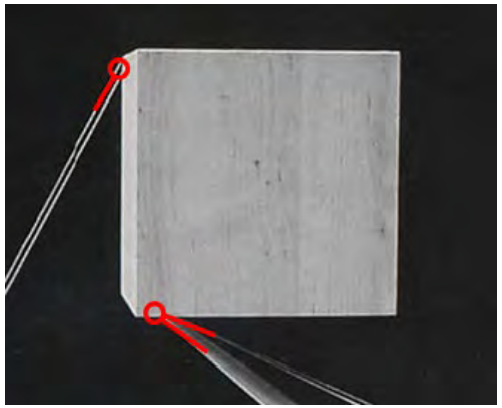
En 3D kropp avläst i ett 2D plan

Kroppar och strukturer

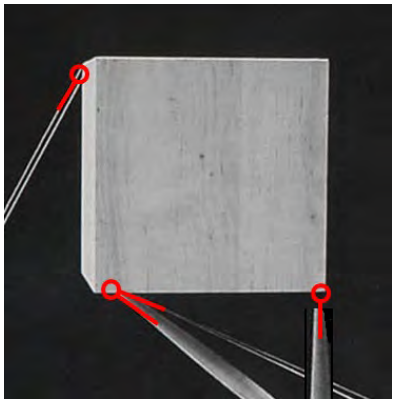
yttre stabilitet



mekanism



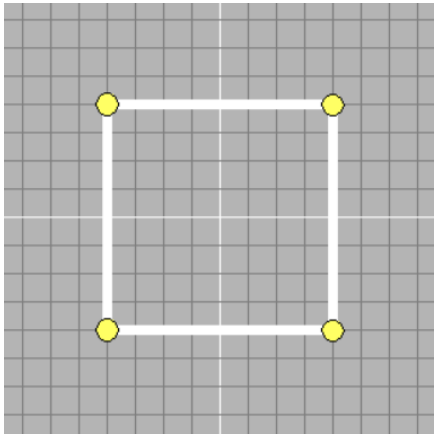
statiskt bestämd

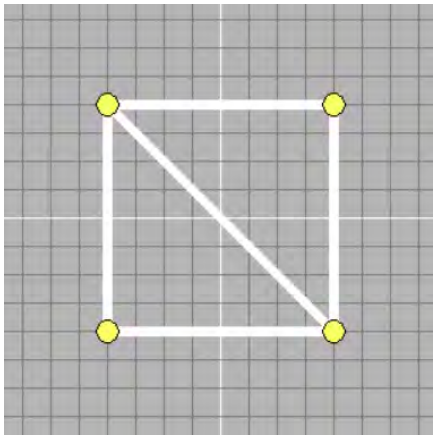


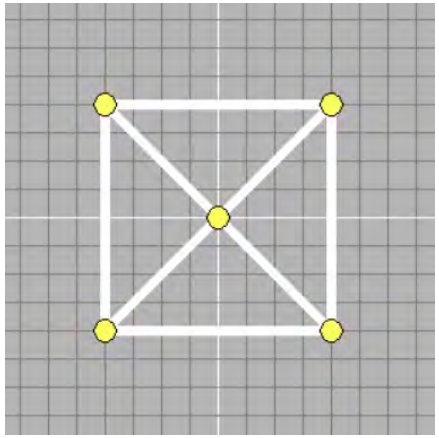
statiskt obestämd

Kroppar och strukturer

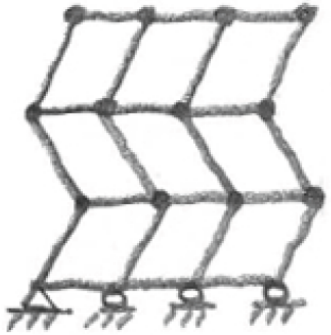
inre stabilitet

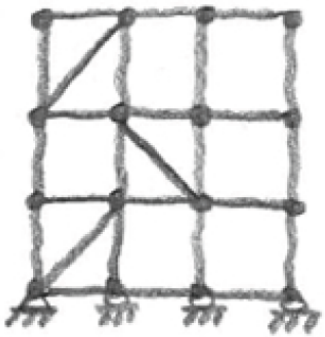






mekanism – statiskt bestämd – statiskt obestämd

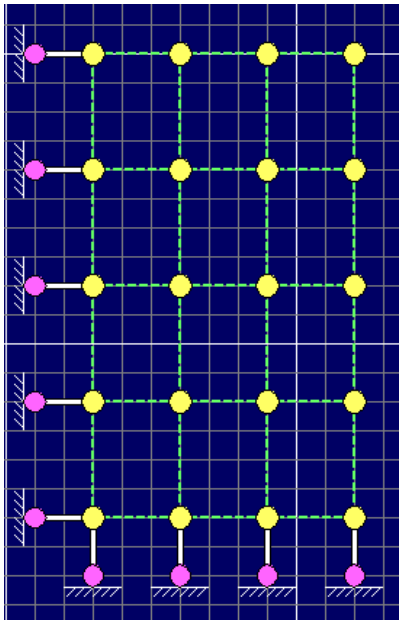


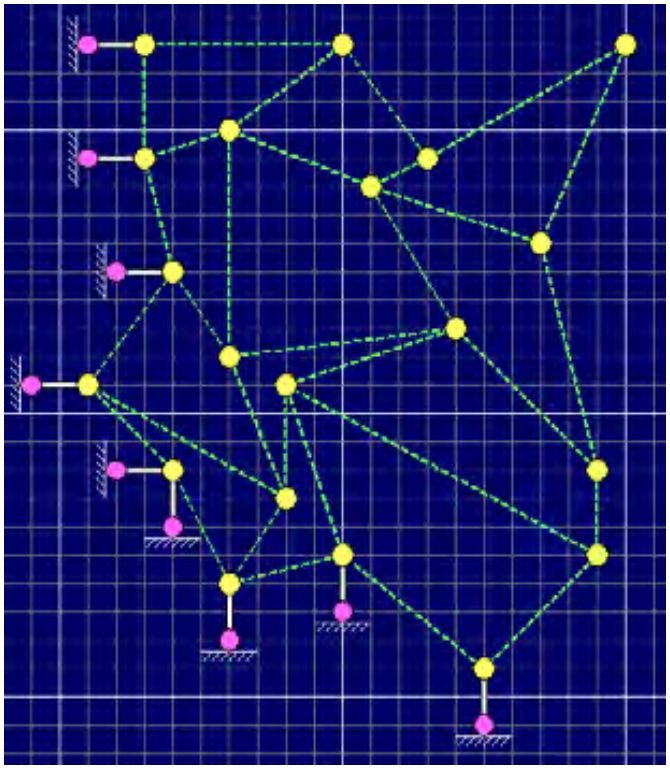


inre element kan bytas mot yttre stöd

Kroppar och strukturer

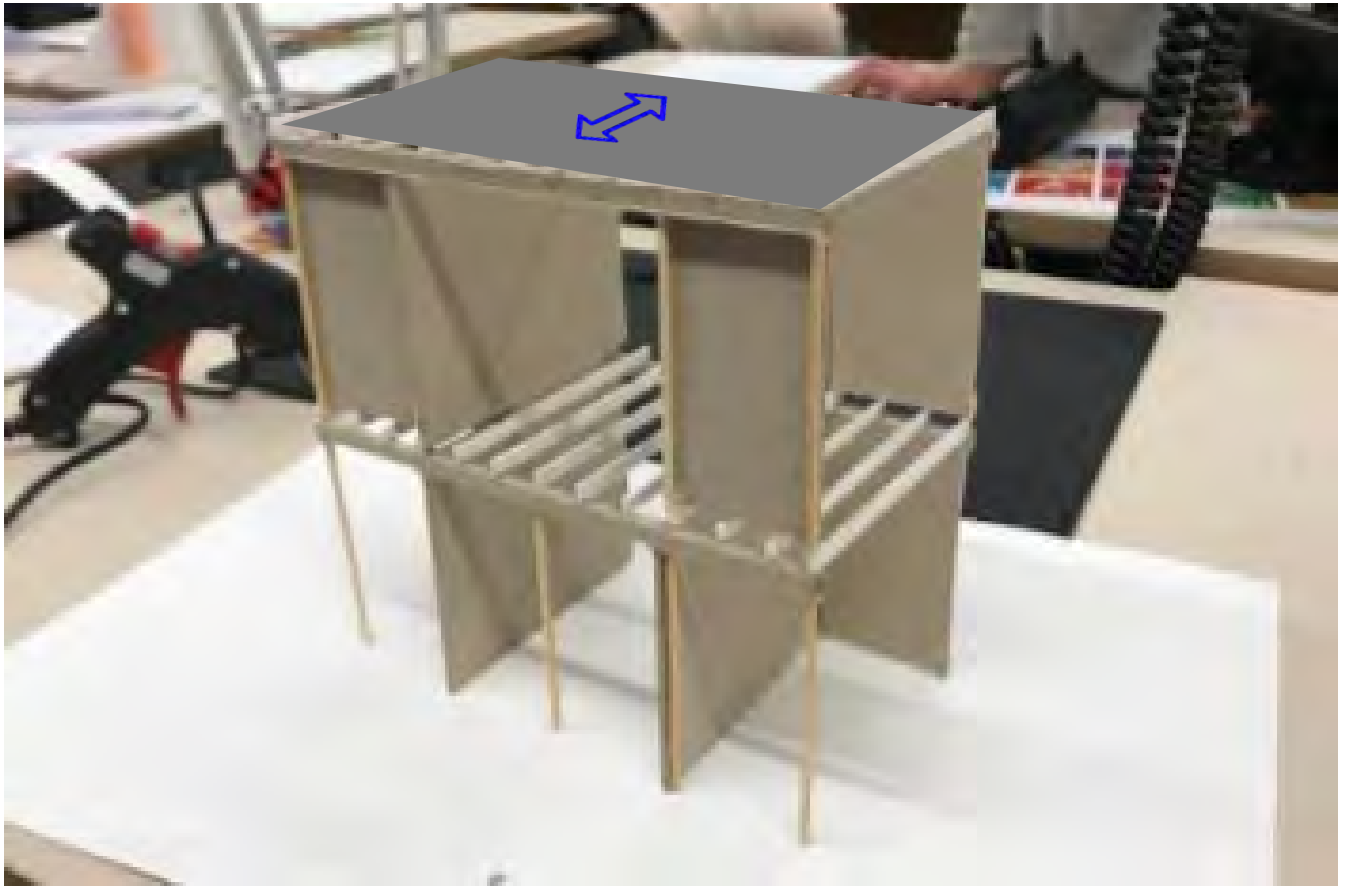
begreppet topologi





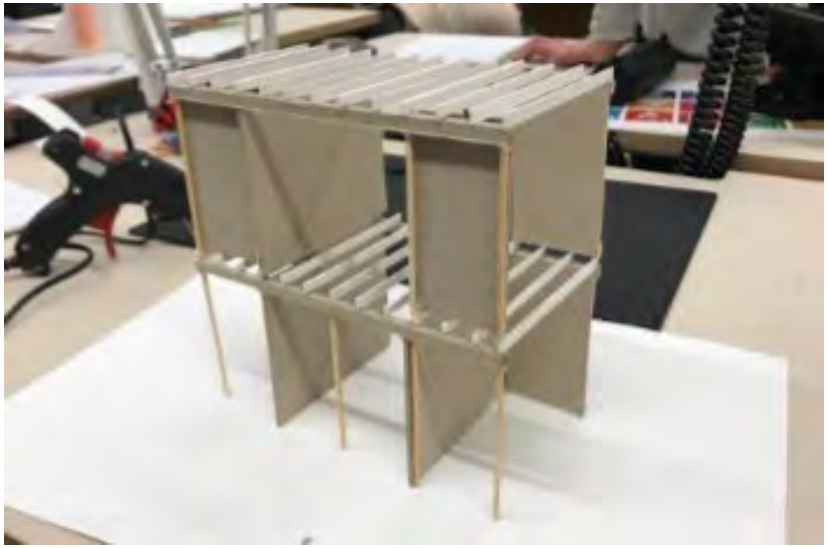
Kroppar och strukturer

strukturelement

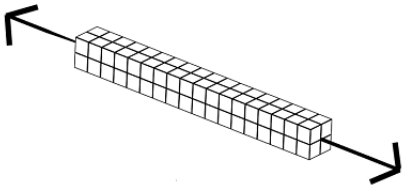


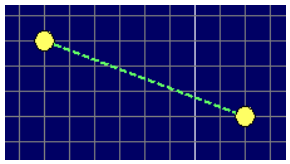
stänger, balkar, (plattor) och skivor

fyra grundtyper av kroppar som bygger en struktur

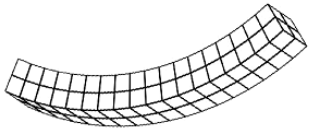


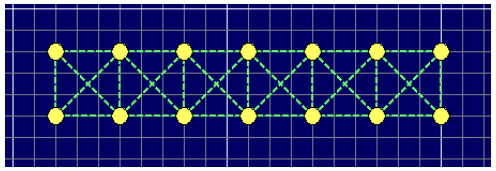
Stång



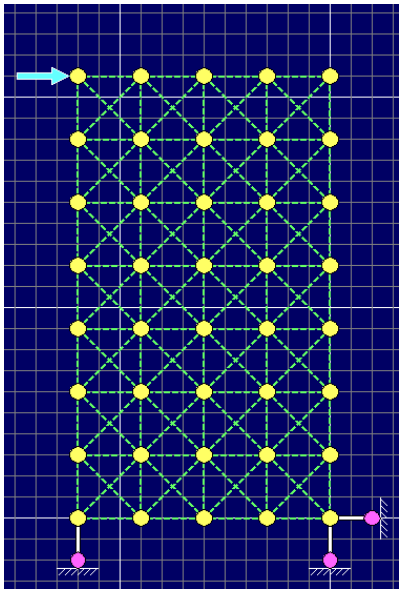


Balk



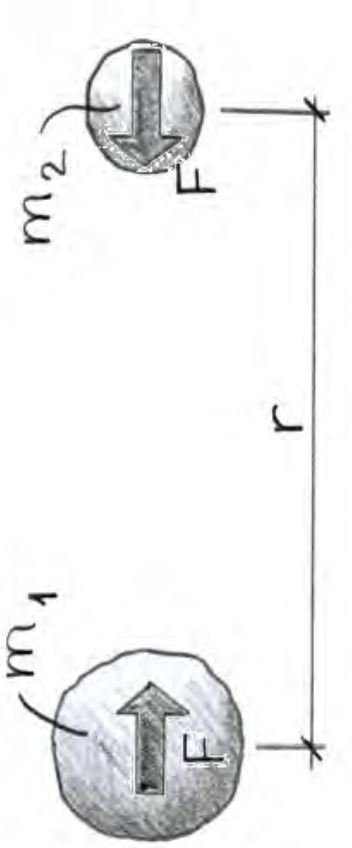


Skiva



Krafter

om krafters ursprung - och gravitationen

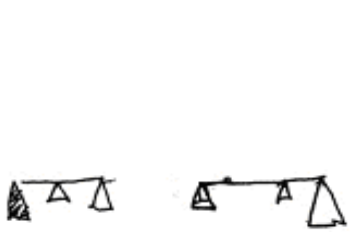


Newtons gravitationslag

$F = G\,(m_1\,m_2 / r^2)$

Tyngdkraft

$F = mg$



Tyngdpunkt, lodlinje, stödyta

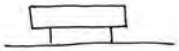
Krafter

om krafters ursprung - och gravitationen

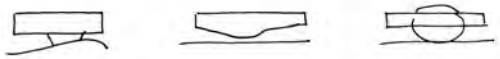
DAY TWO

If a weight suspended above the earth should somehow levitate, the risk-answer must lie in the breaking of symmetry.

I sketched out various solutions, trying to set the mass 'free'.



Columns were stuck well underneath to give a feeling of free edge.

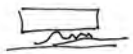


In some cases the ground came up to disguise the support.

In other instances raking columns initiated oblique lines to take away the feeling of direct support.

I tried top hung support as well but that felt alien and inappropriate for the site.

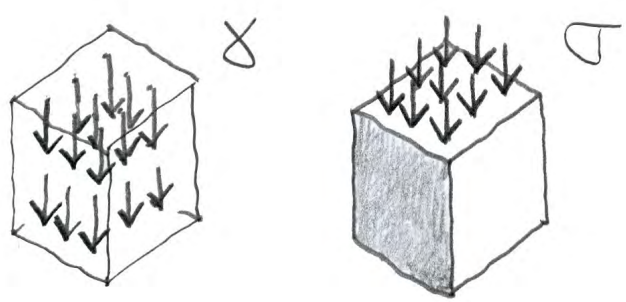
None of the ideas really satisfied. I still felt confined. The picture of the site kept imposing its own dynamic, challenging a better solution. No matter how the columns were placed beneath the load the generic concept of table came back, and with it the imprint of an 'anchor' killing off the ambition.

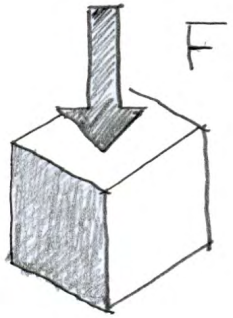


Gravitationen som referensram

Krafter

om hur krafter uppträder och representeras





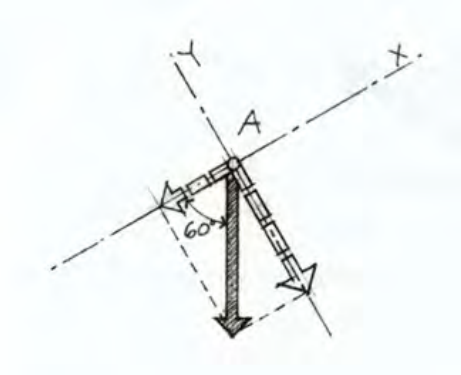
Verkliga krafter

volymkraft gravitation

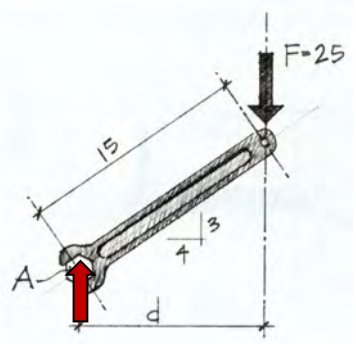
ytkraft elektromagnetism

Förenklat kraftbegrepp

kraftresultant



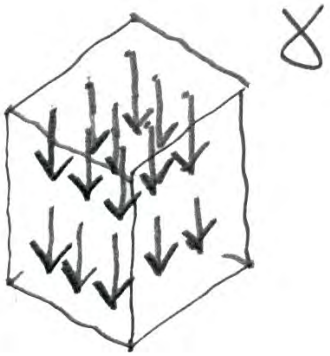
kraftkomposanter

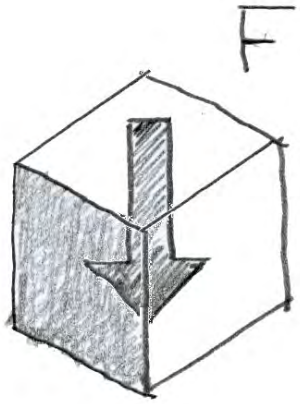


kraftpar / moment

Tyngdkraft

(genererad av gravitation)



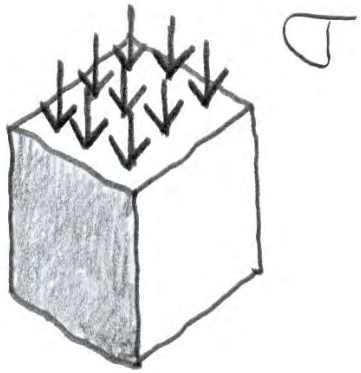


Tunghet $\gamma = \rho g$

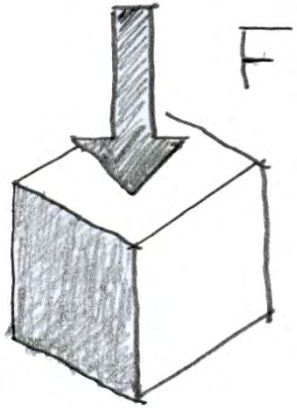
Tyngd $F = mg$

Ytkrafter

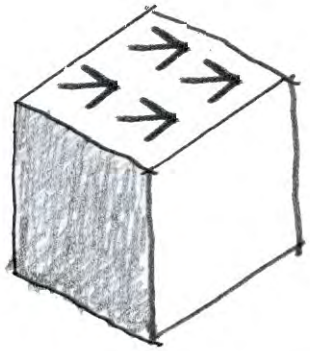
(genererade av elektromagnetism)



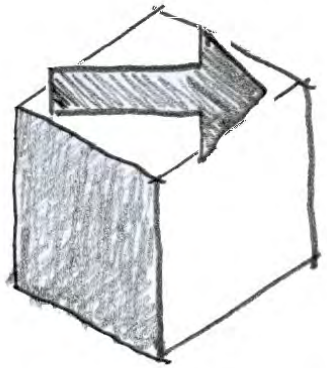
Normalspänning



Normalkraft



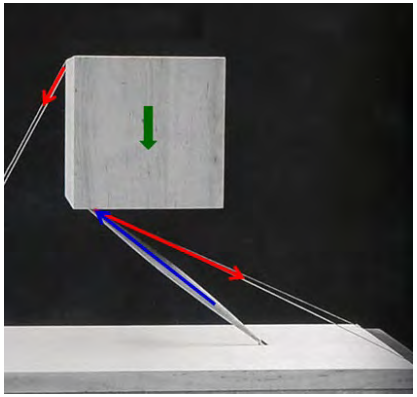
Skjuvspänning
Friktion



Tvärkraft
Friktionskraft

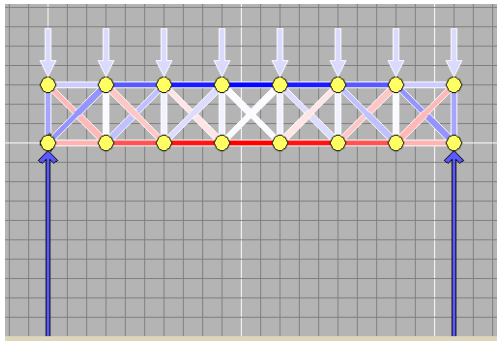
Sortering av krafter - sammanfattning

Seminarium 3 och 4

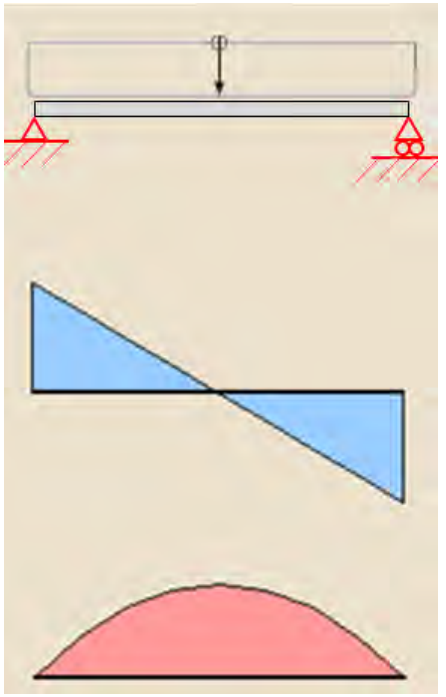


Yttre krafter
tyngd, stödkrafter

Seminarium 5, 6 och 7



Inre krafter
tryck/drag

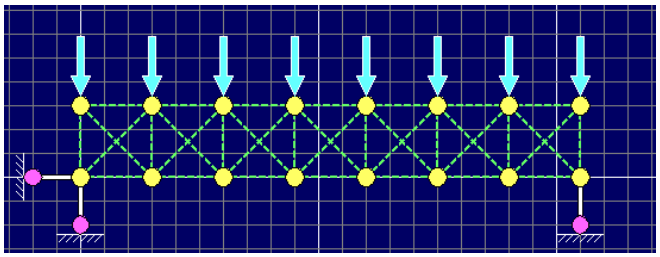


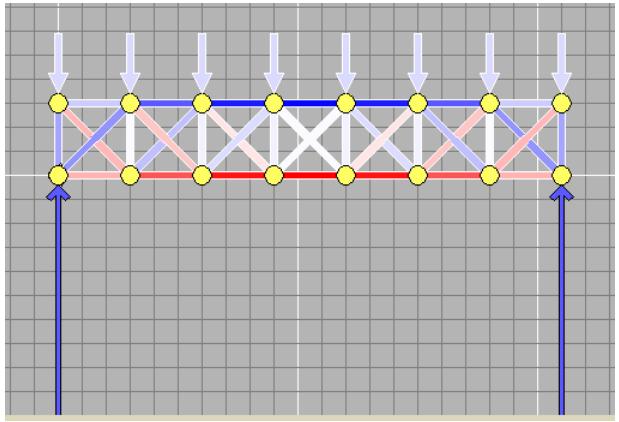
Inre krafter
(ingenjörsföreklingar)
normalkraft
tvärkraft, böjmoment

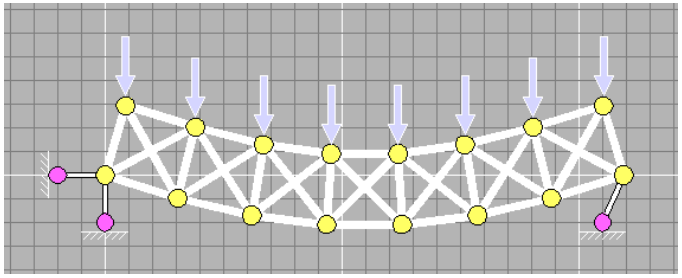
Krafter

om hur krafter uppträder och representeras

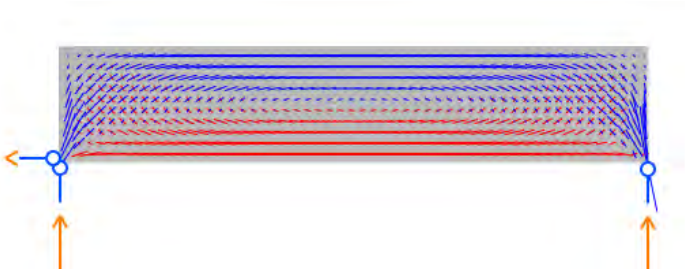
PointSKETCH





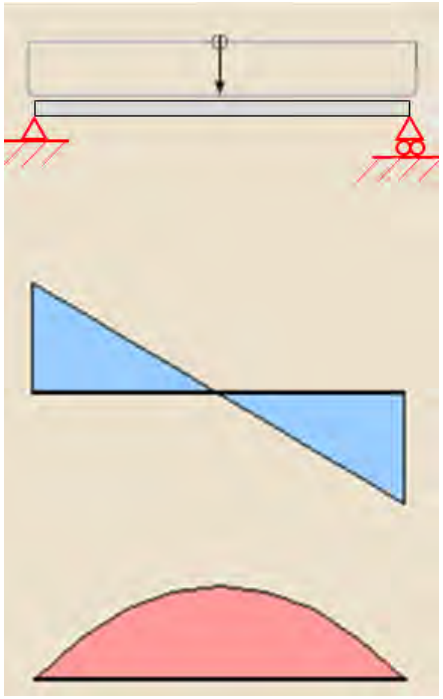


ForcePAD



1D strukturmekanik

ingenjörens
förenklade kraftbegrepp
(tvärkraft, moment)

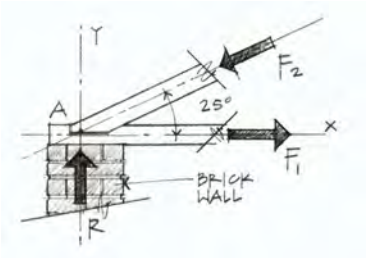


Krafter

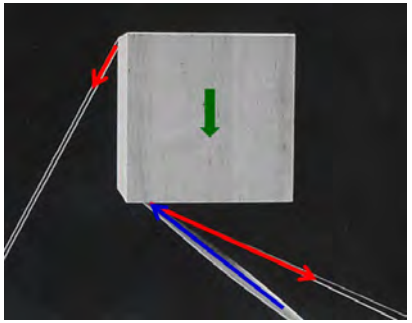
om krafter i balans

Tyngdpunkt – den punkt kring vilken alla tyngder balanserar

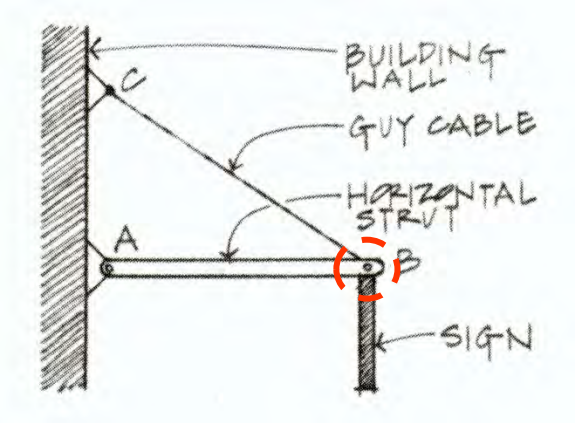
Partikel-jämvikt

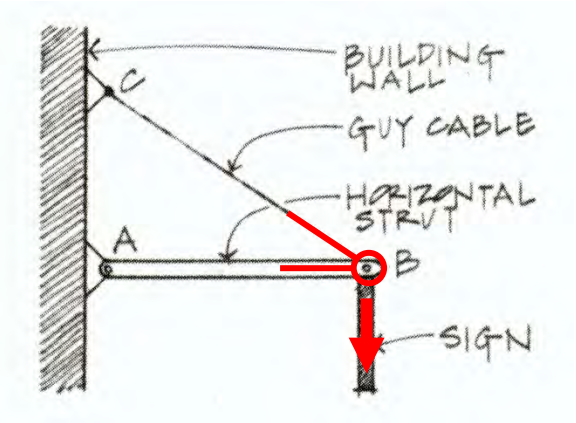


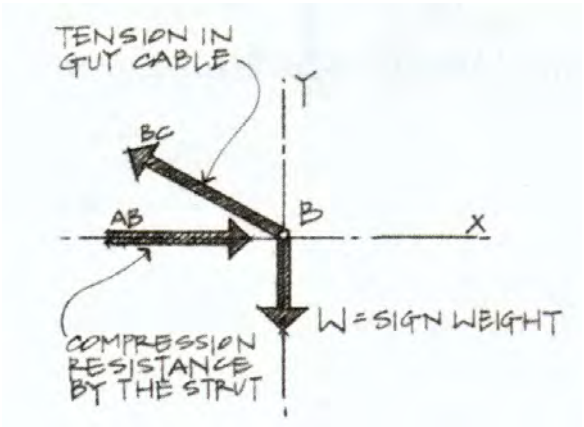
Stelkropps-jämvikt

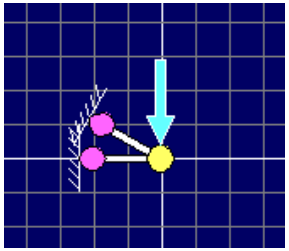


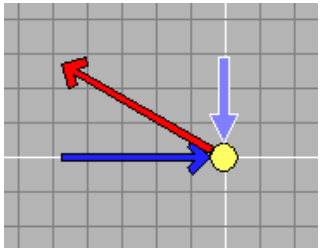
Partikeljämvikt







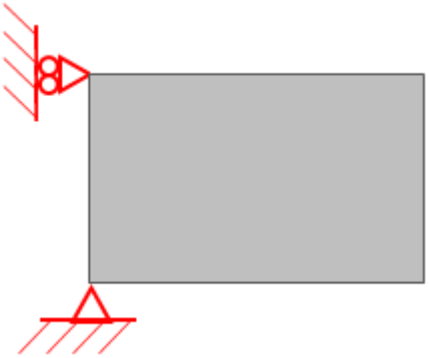


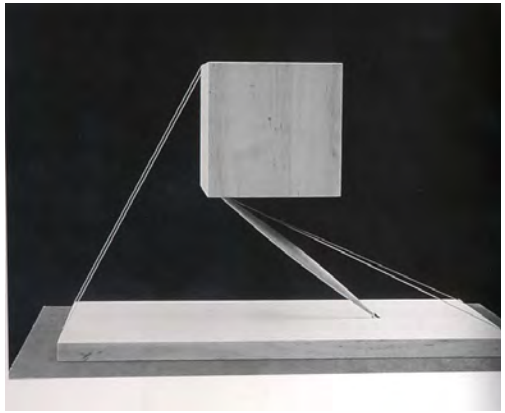


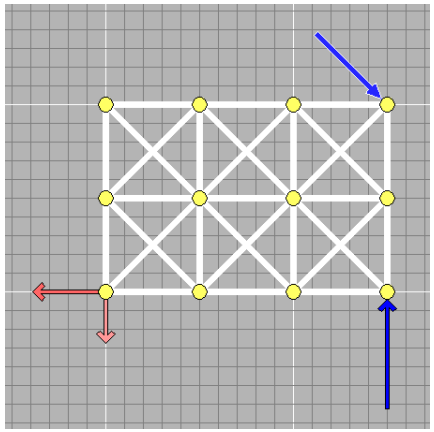
Friläggning

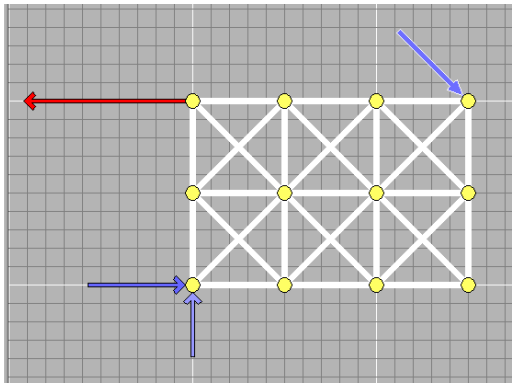
Jämvikt
(grafisk jämvikt)

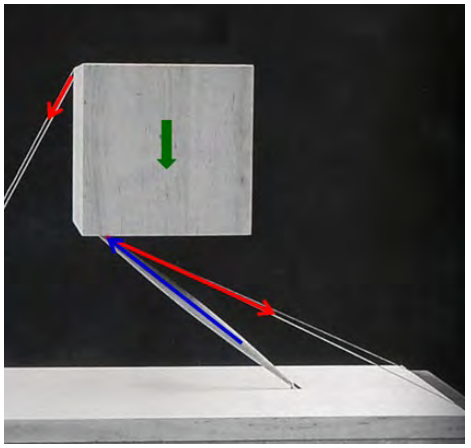
Stelkroppsjämvikt





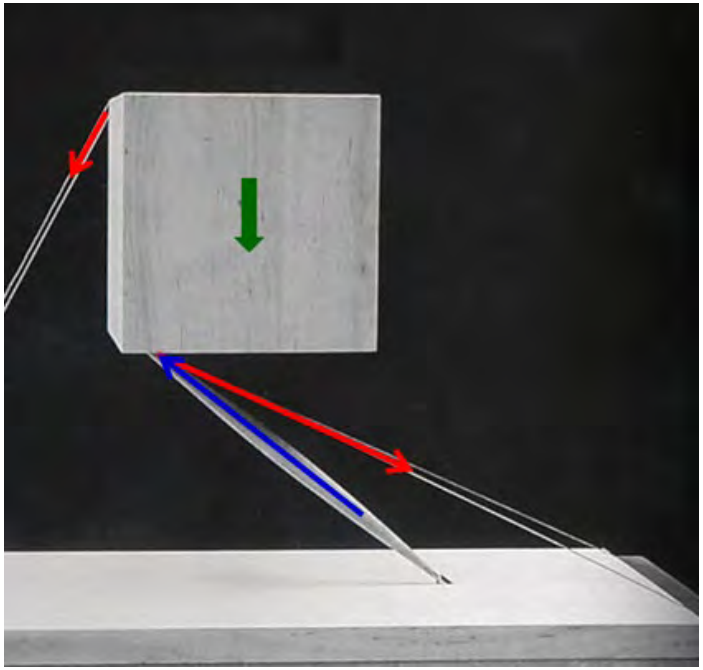


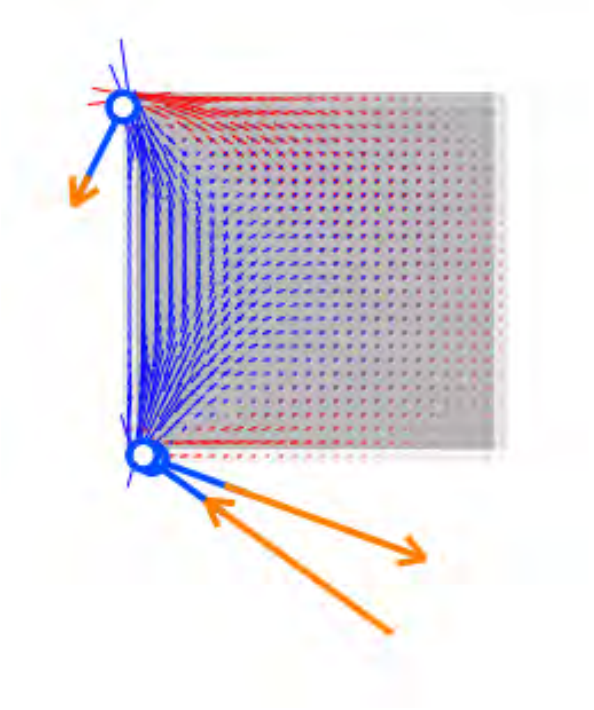




Krafter – kroppar och strukturer

yttre och inre krafter



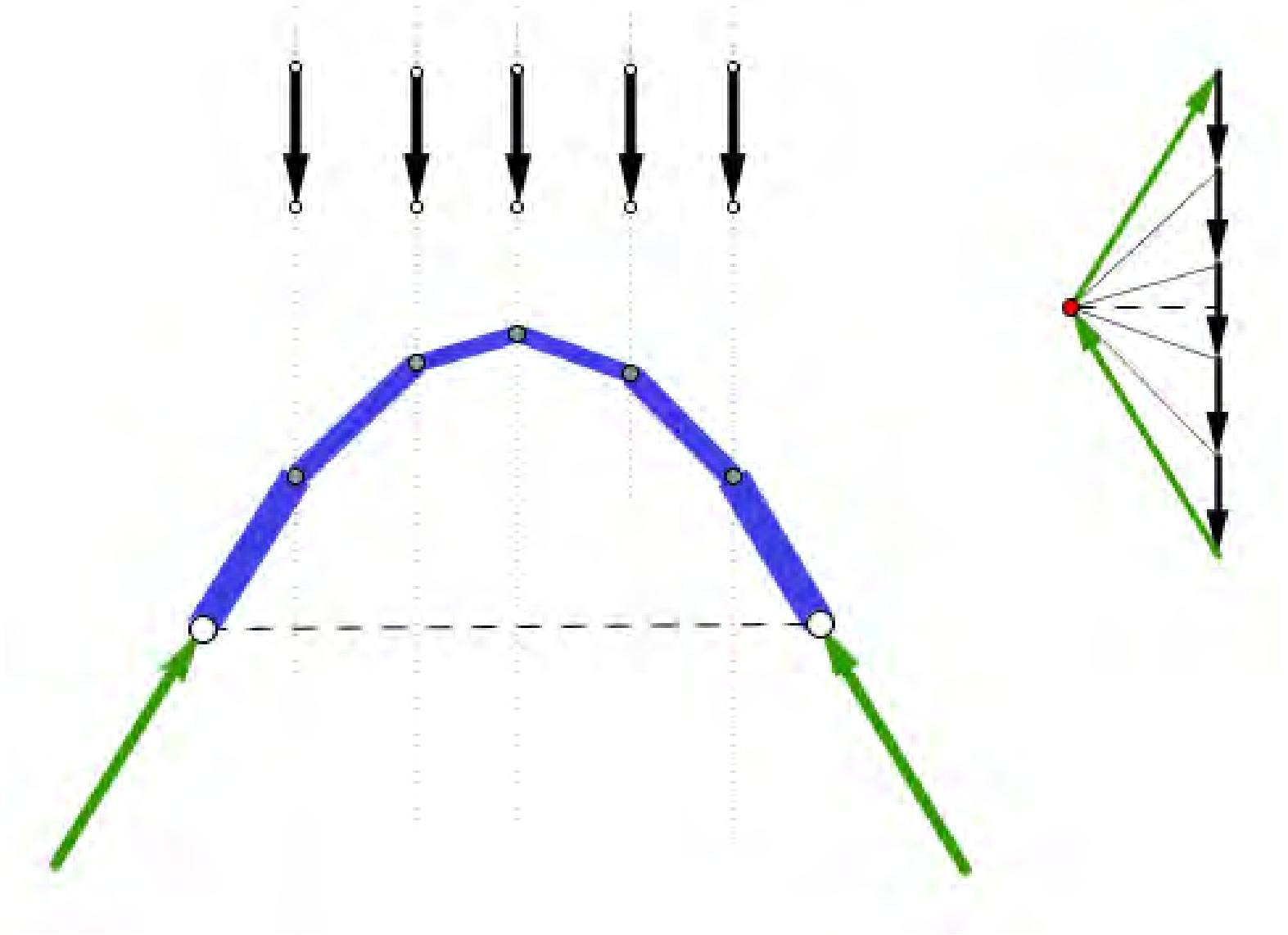


YTTRE KRAFTER
belastar
stödjer

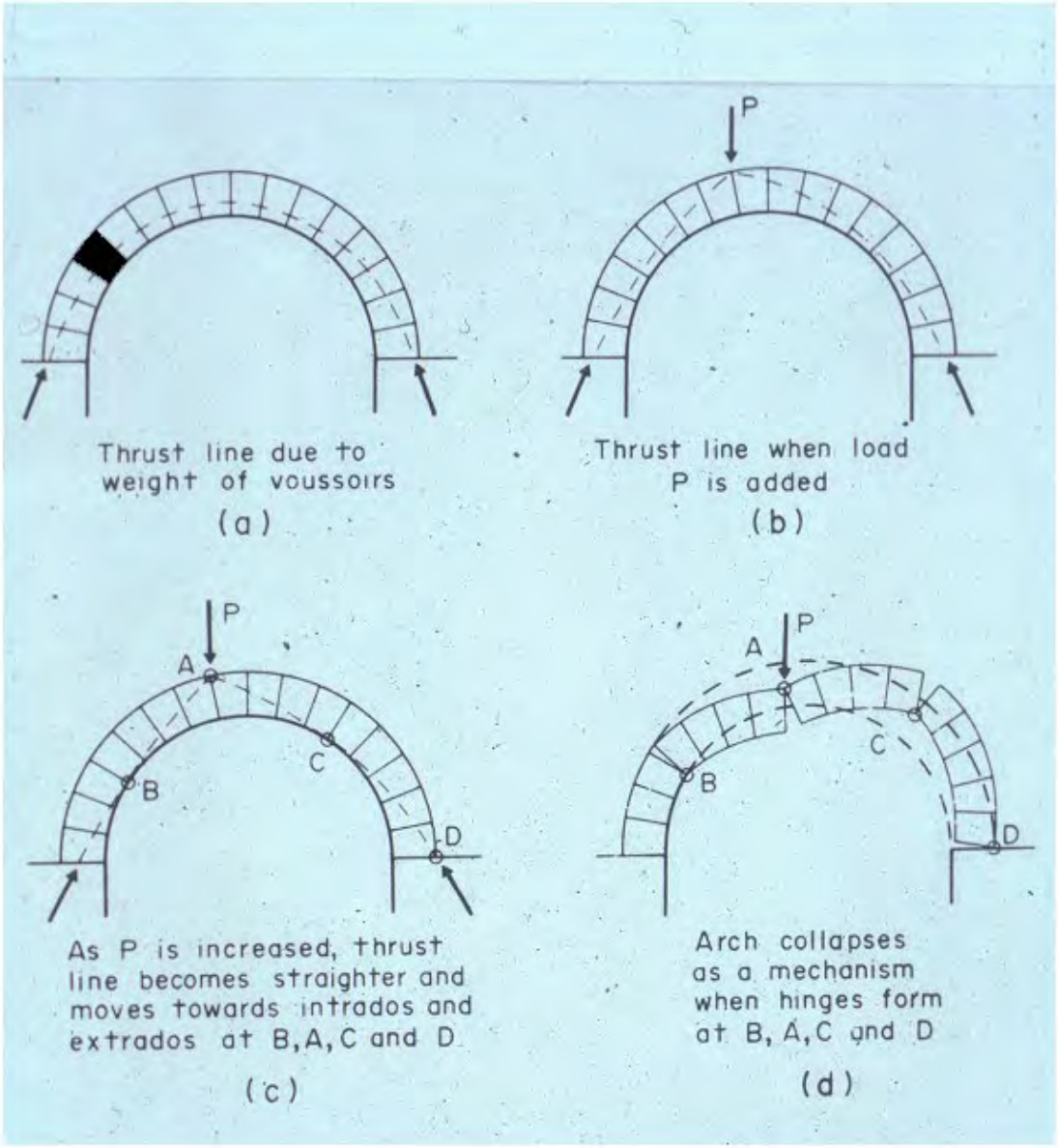
INRE KRAFTER
ger
inre motstånd

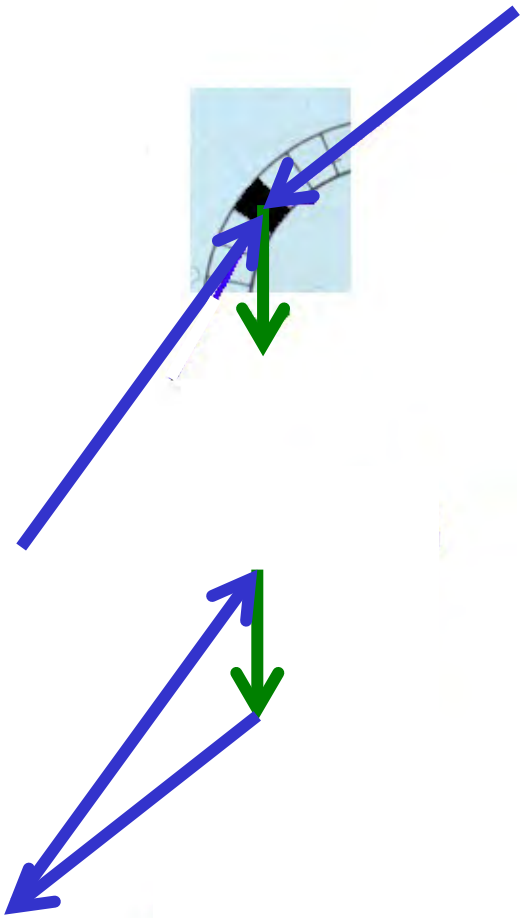
Krafter – kroppar och strukturer

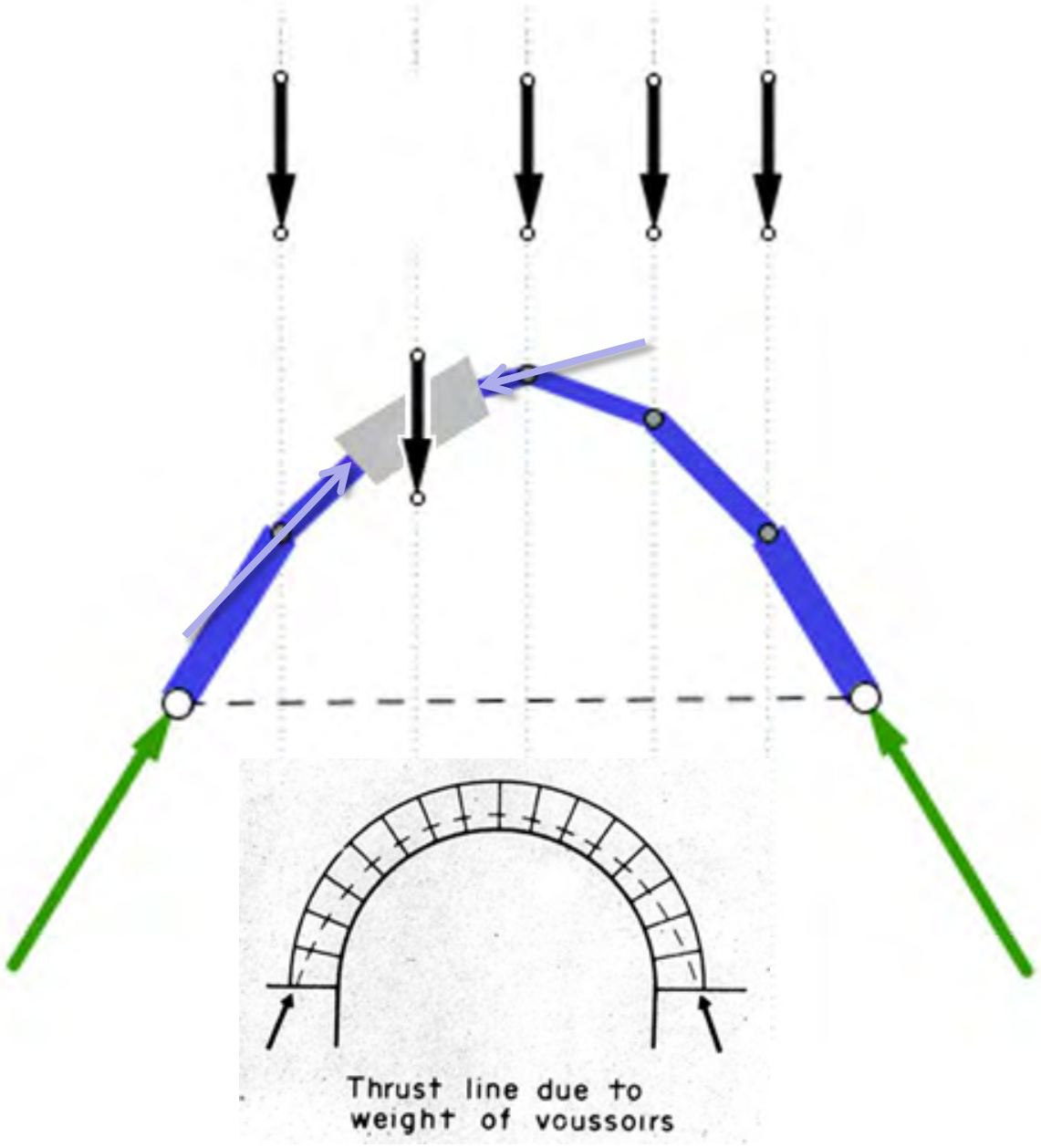
yttre och inre krafter i en båge



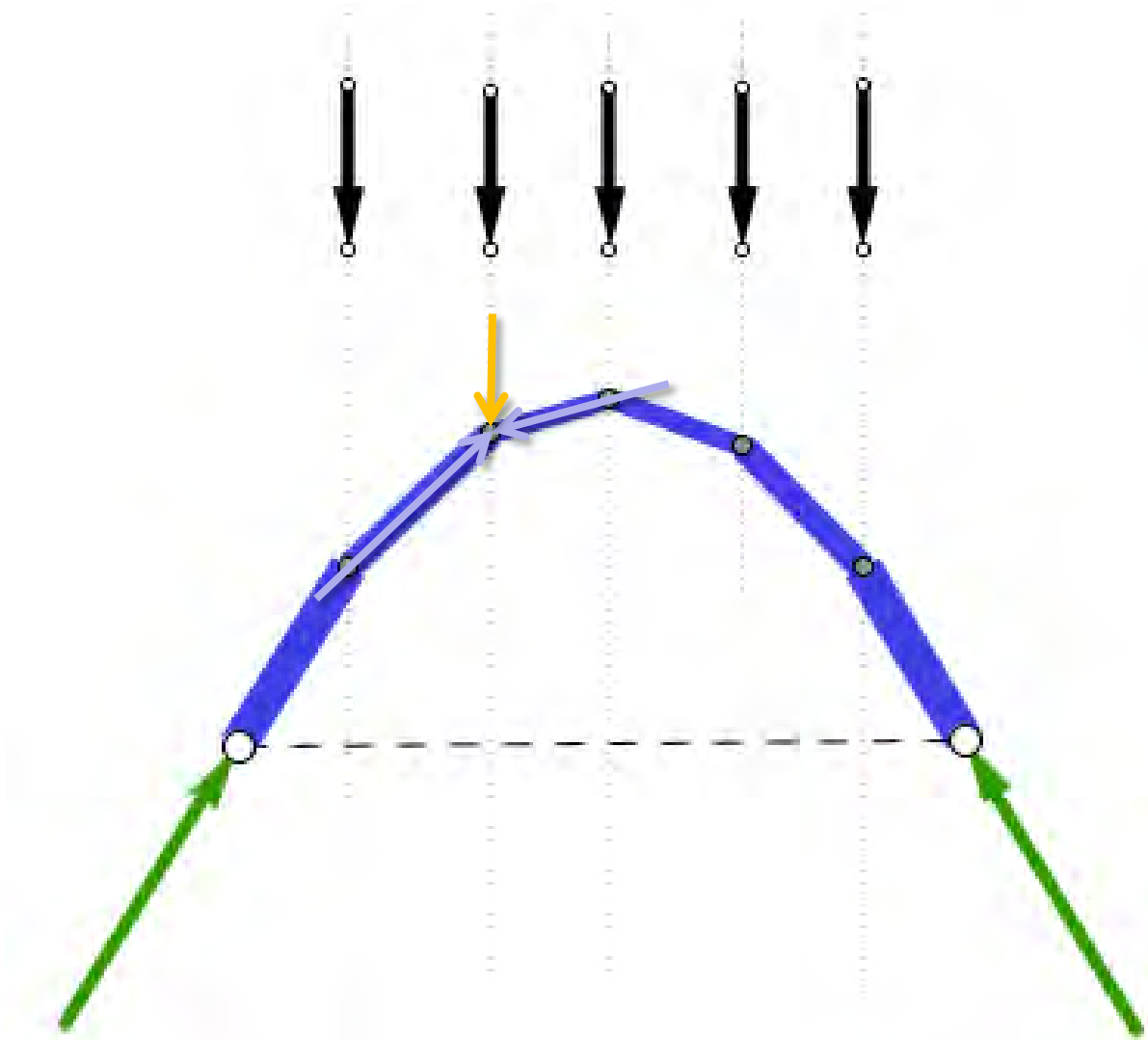
Trycklinjen – illustrerar kraftjämvikter

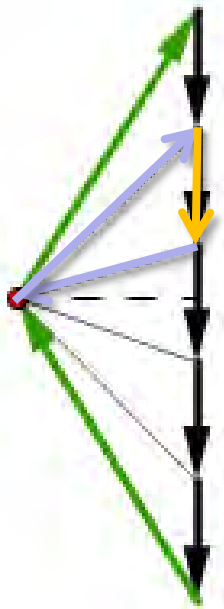




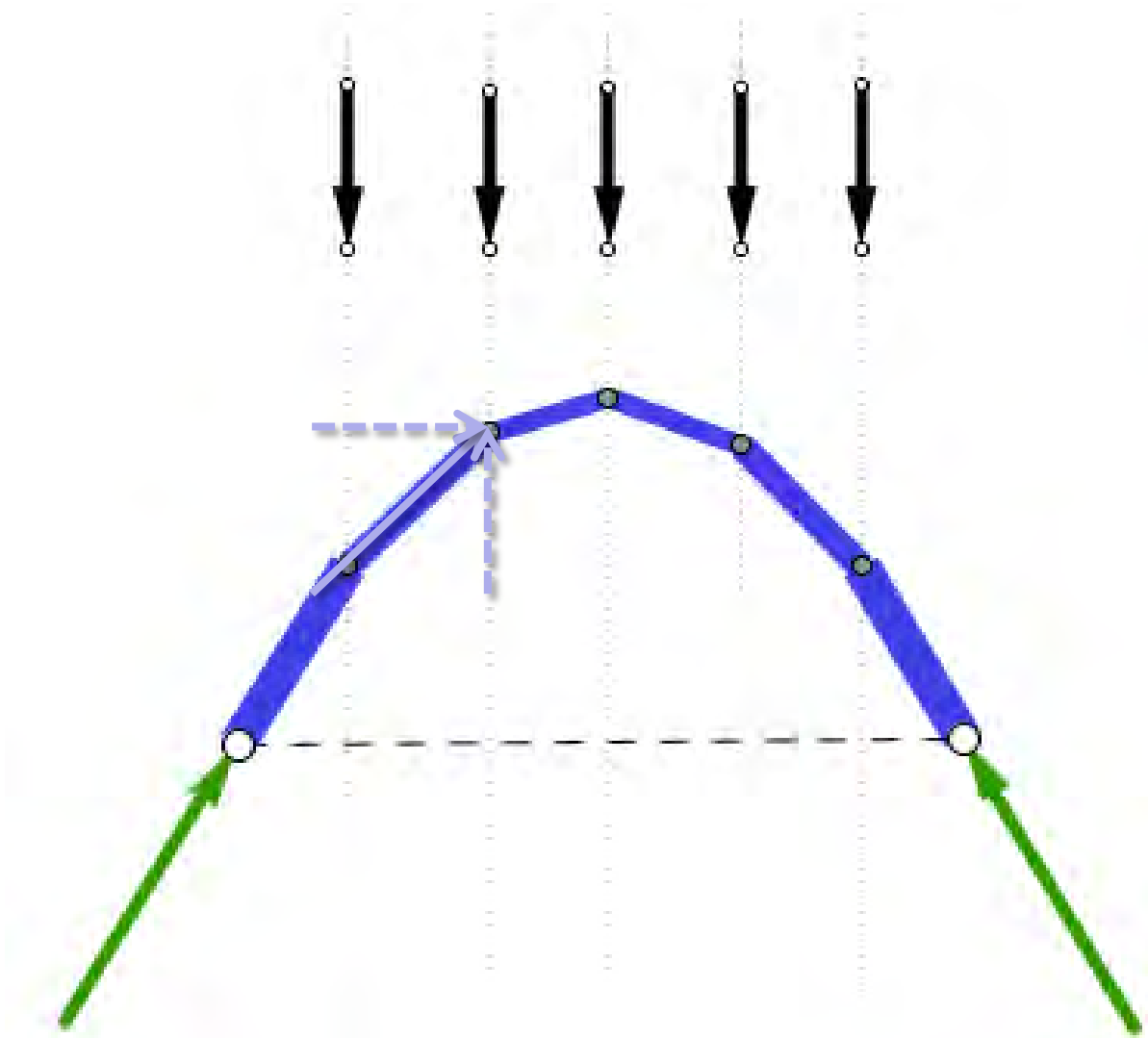


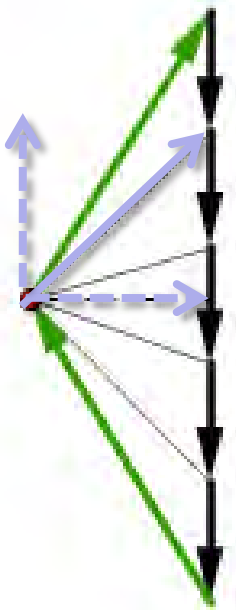
Trycklinje och jämvikt



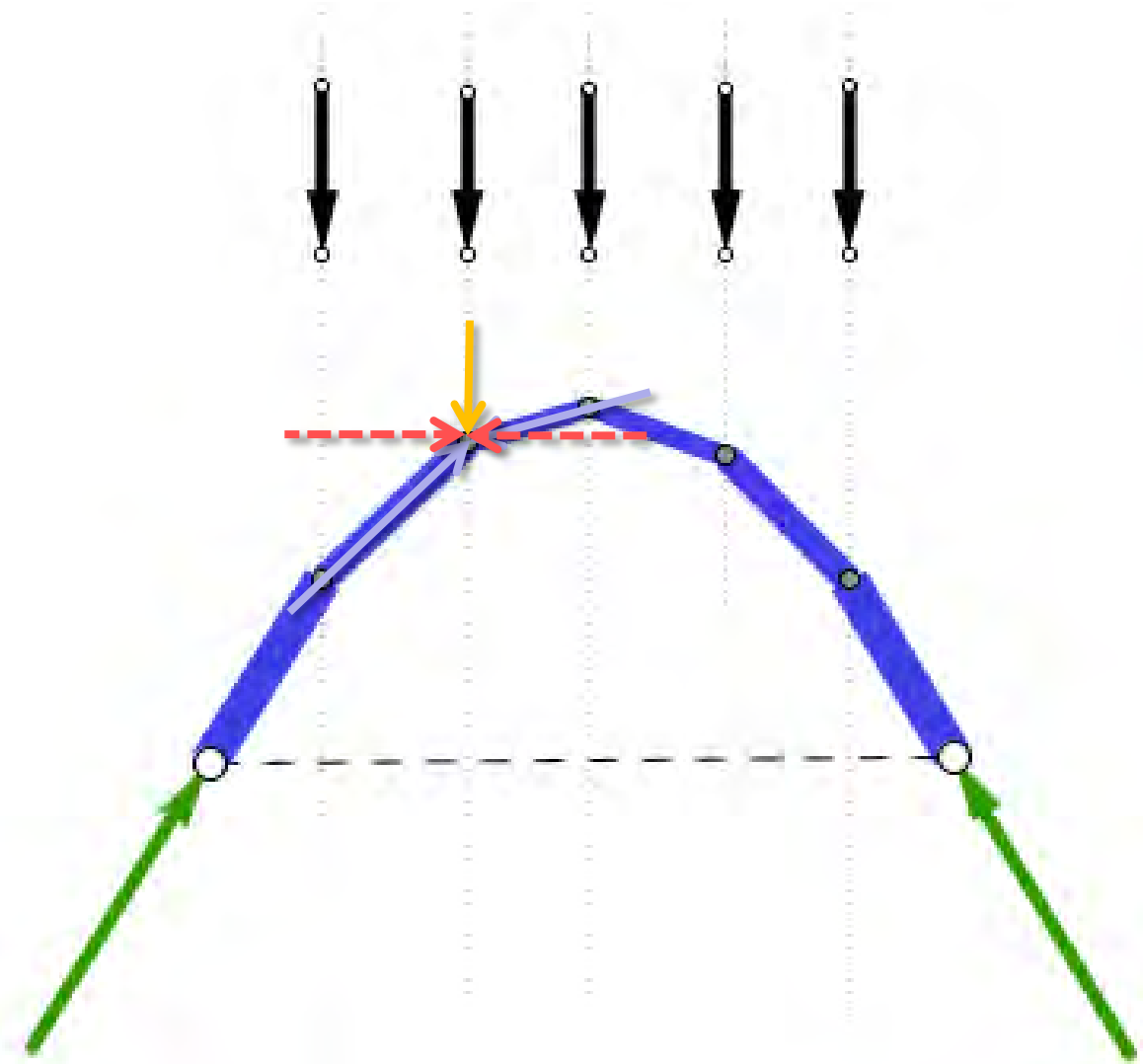


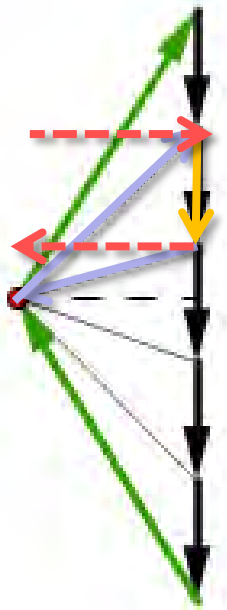
Grafisk jämvikt



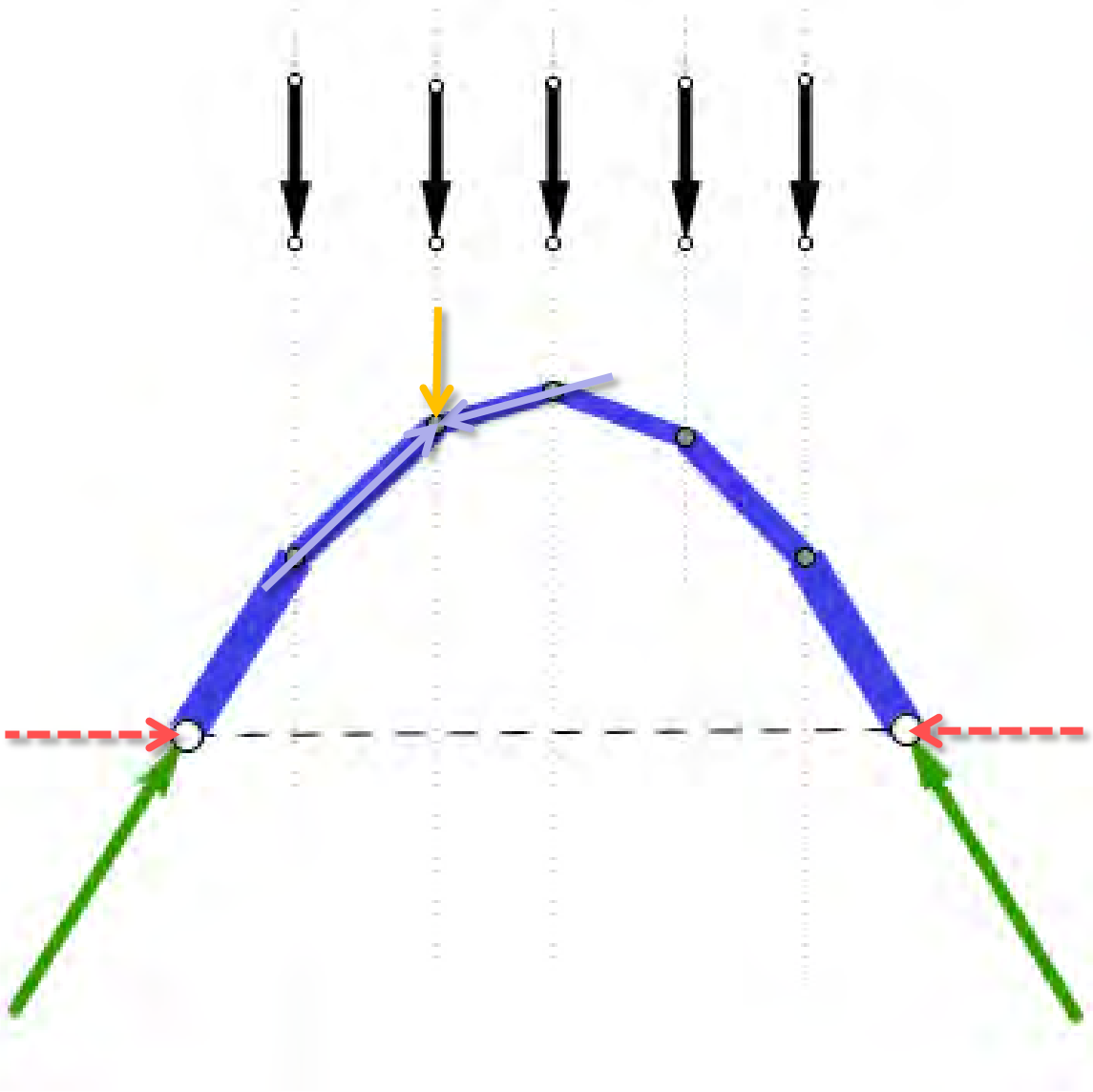


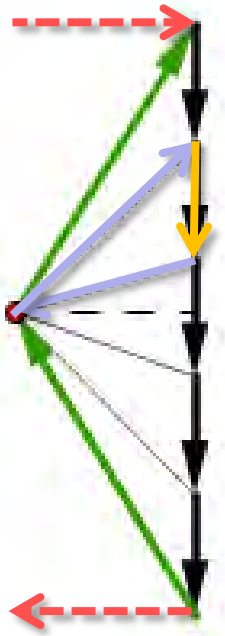
Vertikal och horisontell komposant





Horisontella komposanter i jämvikt



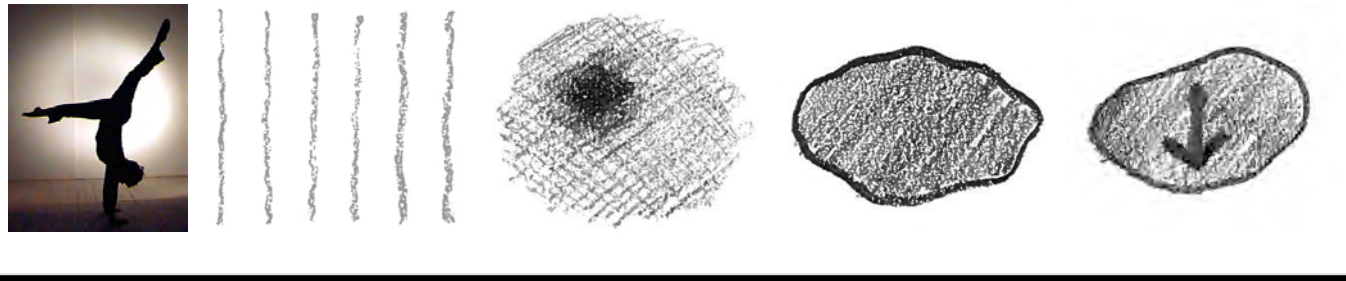


Horisontella komposanter i jämvikt

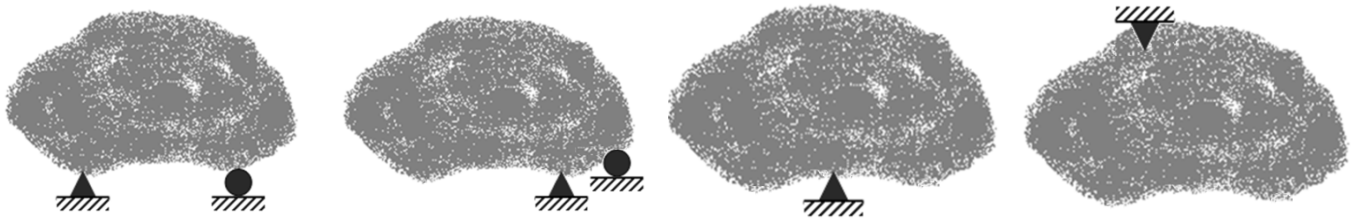
Linan, bågen och fackverket

STRUKTURERS GRAMMATIK

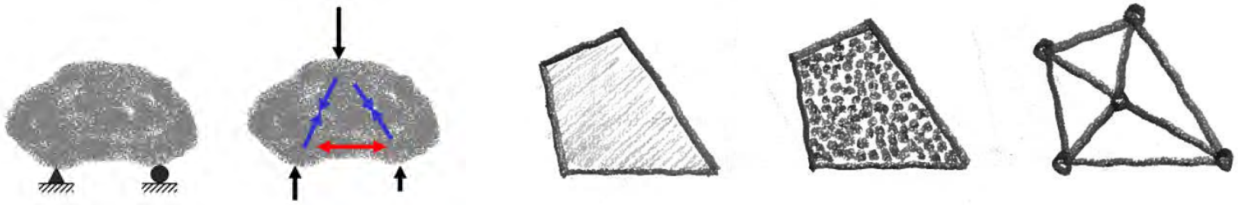
MÄNNISKA
gravitationen
som livsmiljö



MATERIELL
KROPP
balans
stabilitet
rörelse



STRUKTUR
topologi
inre stabilitet
kraftmönster
effektivitet



Linbärverk

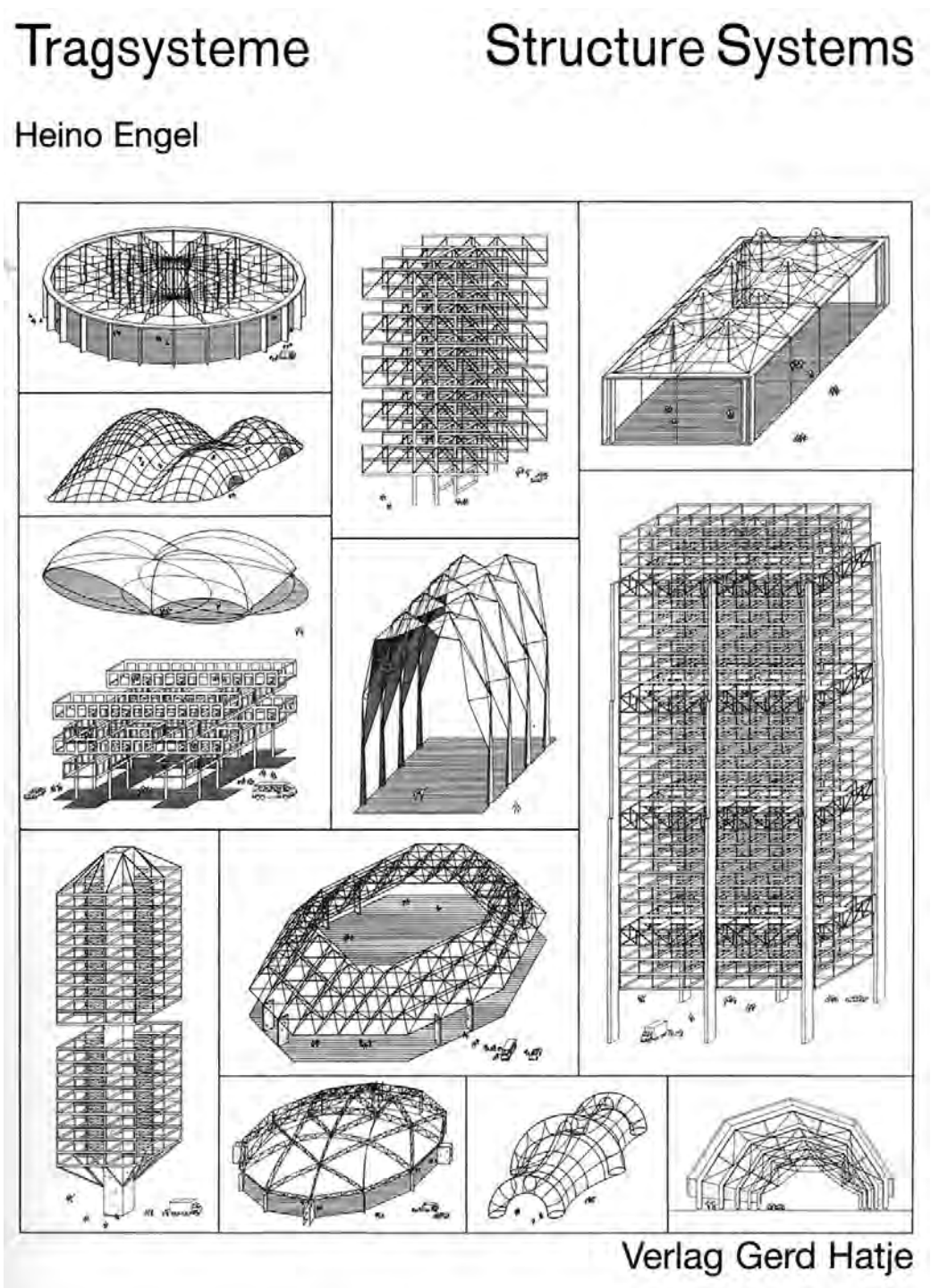
Bågar, valv och kupoler

Fackverk

Gemensamt för dessa bärverkstyper

är att de bär genom partikeljämvikter

och stångverkan (tryck/drag)



Strukturer sorterade efter hur form möter last

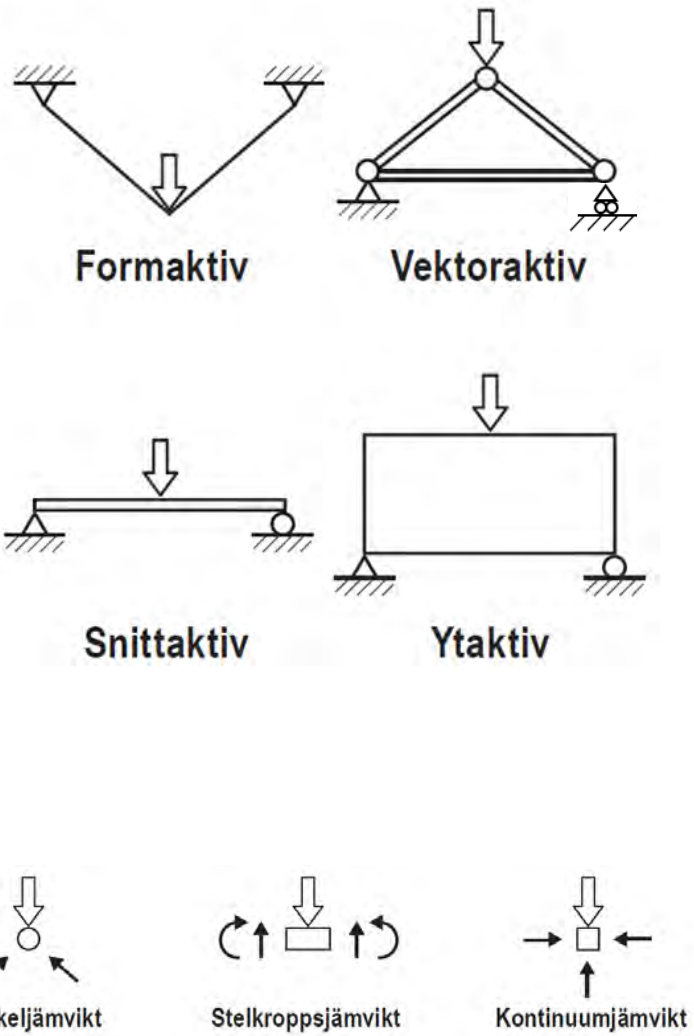
Heino Engel
Structural Systems

Formaktiva strukturer
(linan, bågen)
Vektoraktiva strukturer
(fackverket)
Snittaktiva strukturer
(balken, ramen)
Ytaktiva strukturer
(skivan)

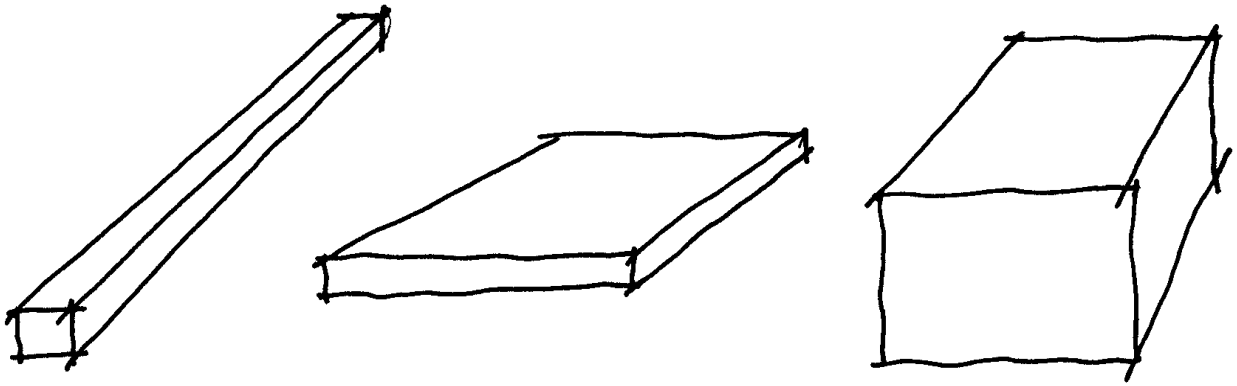
Einteilung der Tragsysteme im Bauen

Classification of structure systems in building

Kriterium Criterion		Prototyp prototype	Kräfte forces	Merkmal feature	Mechanik der Kraftumlenkung mechanics of redirection of forces
1	FORM	Stützbogen funicular arch Hängeseil suspension cable Kreisring circular ring Ballon balloon	Druck oder Zug compression or tension	Stützlinie thrust line Kettenlinie catenary Kreis circle	formaktiv form-active
2	VEKTOR VECTOR	Dreieckbinder triangular truss Fachwerkträger trussed beam	Druck und Zug compression and tension	Dreieckverband triangulation	vektoraktiv vector-active
3	QUERSCHNITT CROSS SECTION	Balken beam Rahmen frame Platte flat slab	Biegung Schnittkräfte bending section forces	Querschnittprofil sectional profile	schnittaktiv section-active
4	FLÄCHE SURFACE	Scheibe plate gefaltete Platte folded slab Zylinderschale cylindrical shell	Membrankräfte membrane stresses	Flächenform surface shape	flächenaktiv surface-active

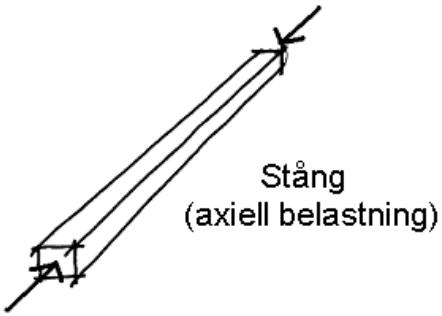


Strukturelement sorterade efter kroppens dimensioner …

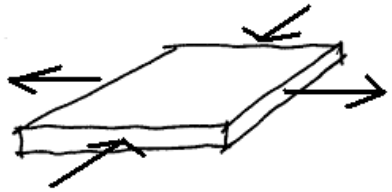


1-dim	2-dim	3-dim
Stång Balk	Skiva Platta	Solid

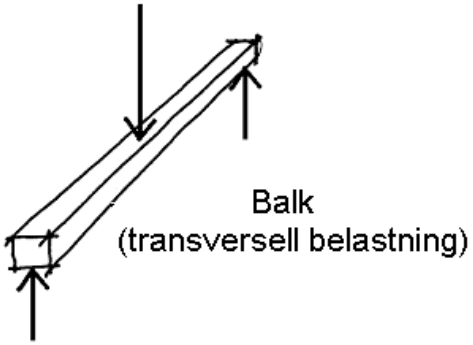
… och hur last är riktad relativt dessa dimensioner



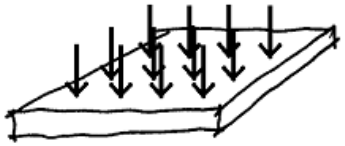
Stång
(axiell belastning)



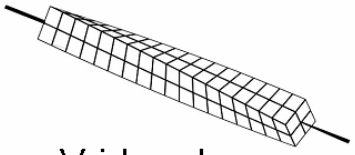
Skiva
(belastning i planet)



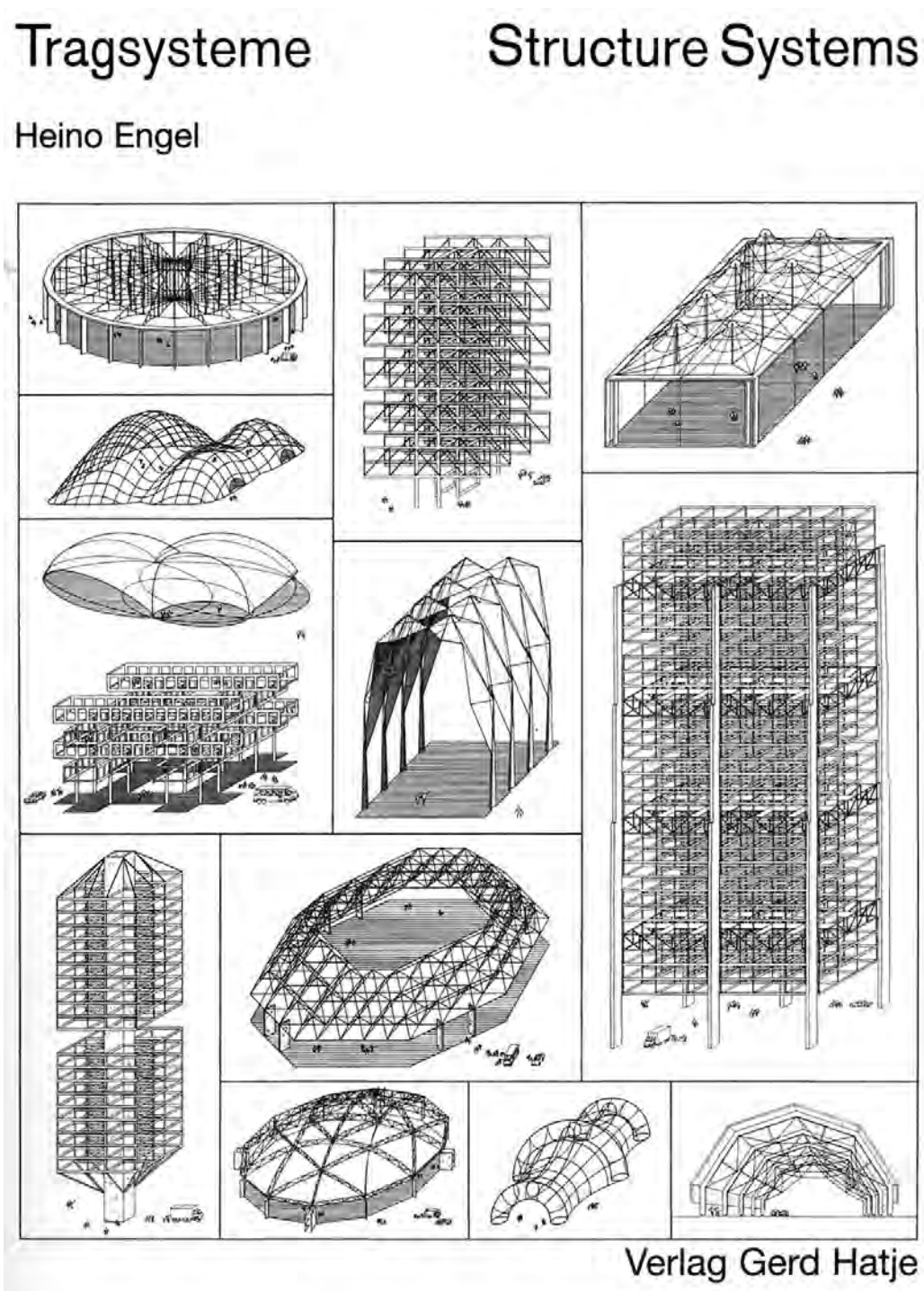
Balk
(transversell belastning)



Platta
(belastning vinkelrätt planet)



Vrid-verkan
(vridande belastning)



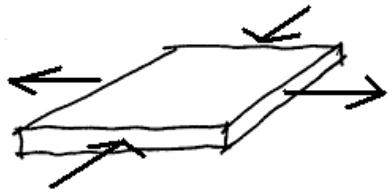
Strukturer sorterade efter hur form möter last

Heino Engel
Structural Systems

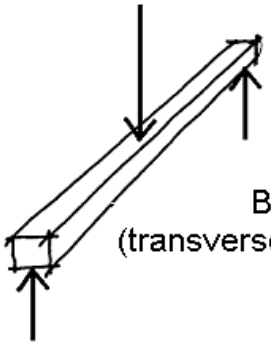
Formaktiva strukturer
(linan, bågen)
Vektoraktiva strukturer
(fackverket)
Snittaktiva strukturer
(balken, ramen)
Ytaktiva strukturer
(skivan)

en sten i en båge eller
en länk i en kedja

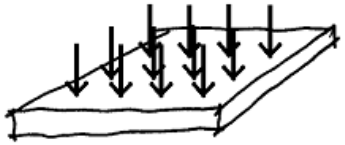
Stång
(axiell belastning)



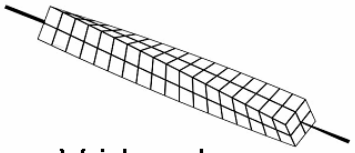
Skiva
(belastning i planet)



Balk
(transversell belastning)



Platta
(belastning vinkelrätt planet)



Vrid-verkan
(vridande belastning)

Nomadtält Persien

The architect Richard Horden is preoccupied with lightness

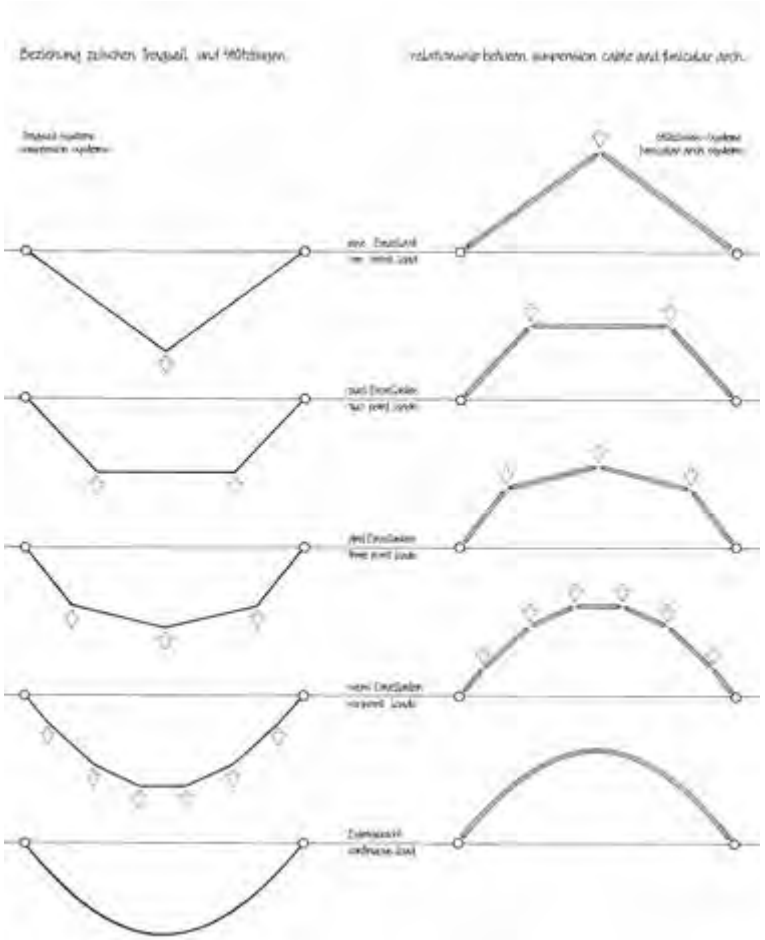
Horden explores materials and techniques of fabrication
to create structures that minimize weight
and are readily transportable.


Storebæltsbroen
The world's third longest main span (1.6 km)
and the longest outside of Asia

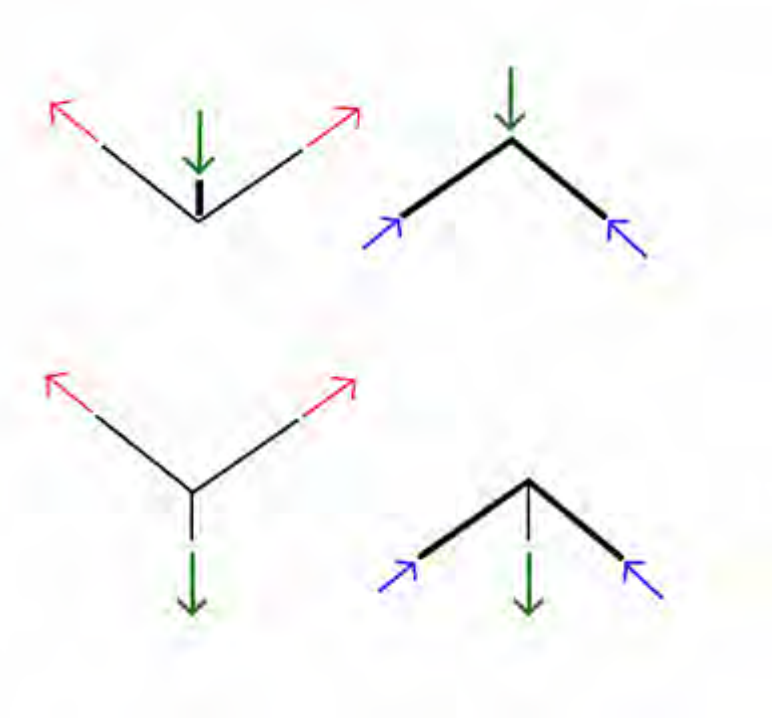
Federal Reserve Bank
Minneapolis

Broadgate Exchange House
London

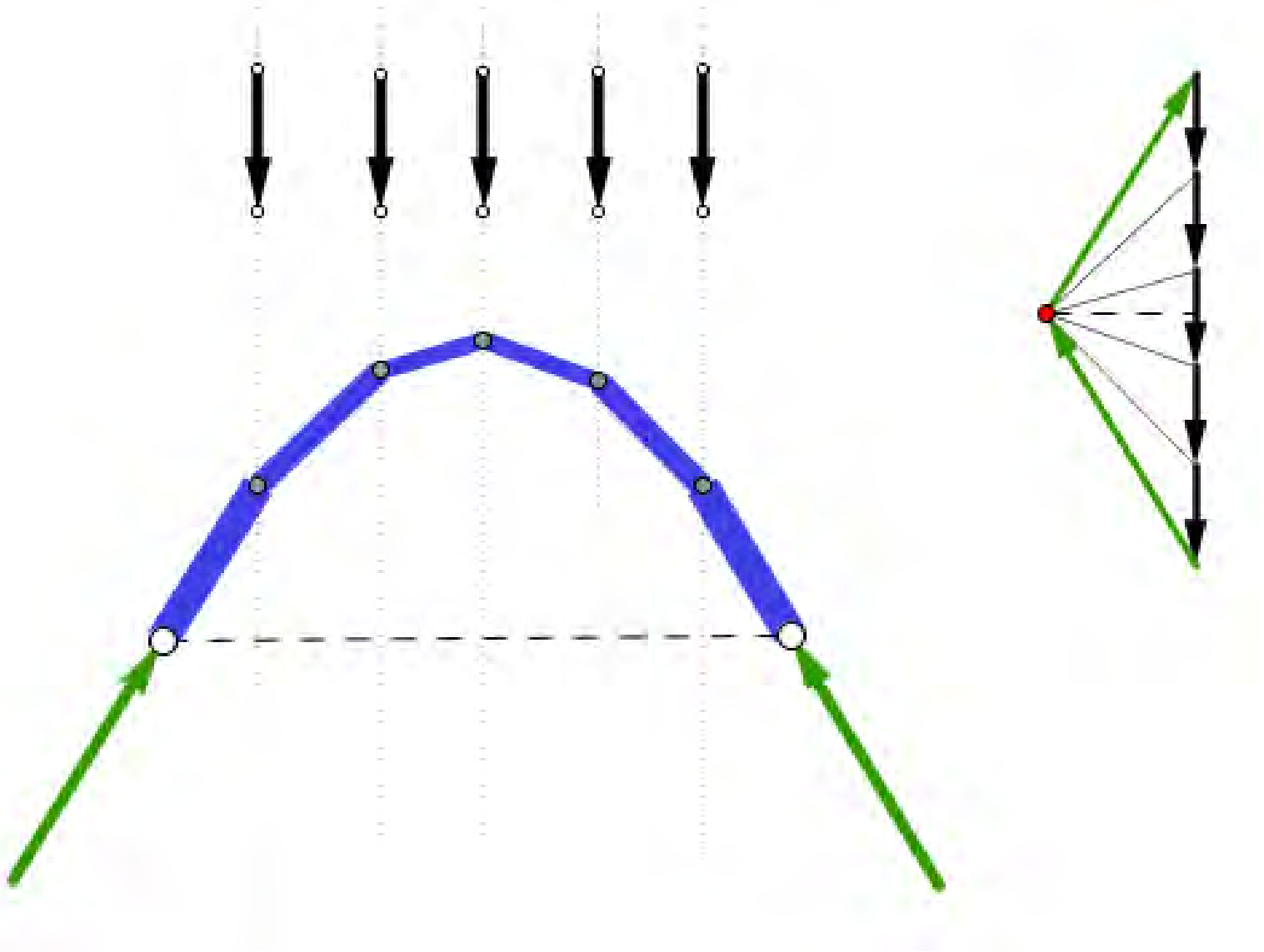
Linan och bågen
(kedjekurvan och trycklinjen)



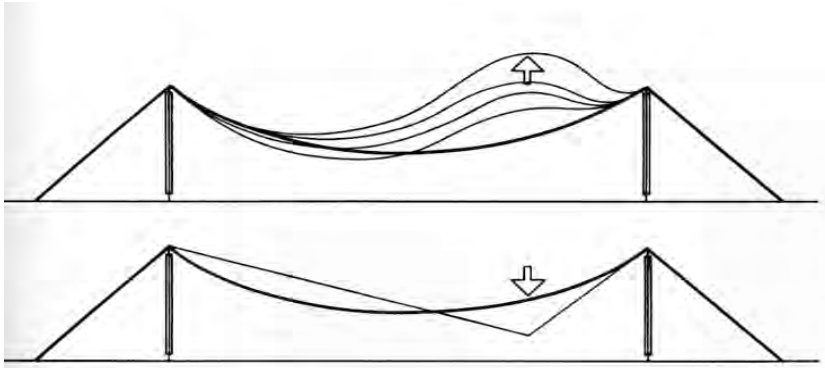
Grundläggande mekanism



Partikeljämvikt
Strukturen bär den yttre kraften
genom rent drag eller rent tryck

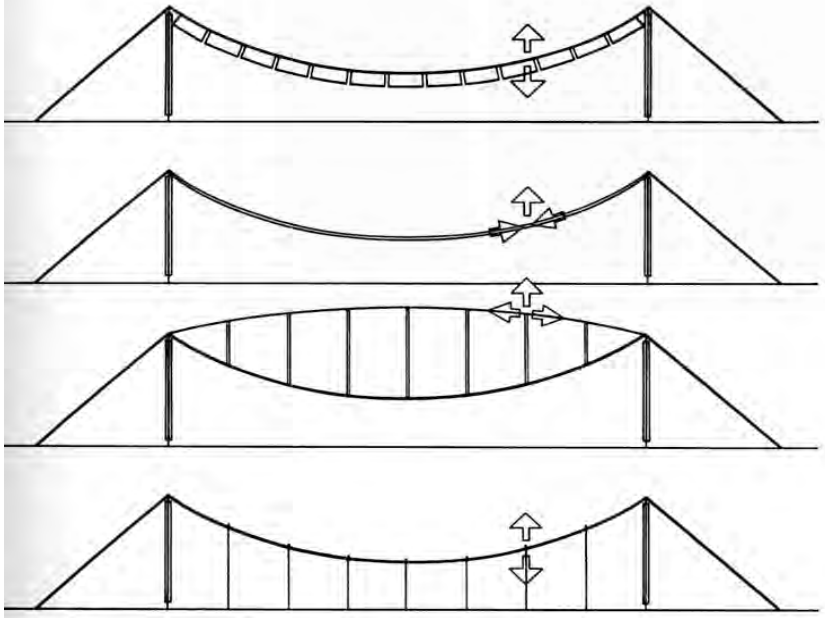


Linkonstruktioner



Kritische Verformungen des Tragseiles
critical deflections of the suspension cable

Wegen seines geringen Eigengewichtes im Verhältnis zur Spannweite und wegen seiner Flexibilität ist das Tragseil sehr anfällig für: Windsog, Schwingungen, antimetrische und bewegliche Lasten
due to its small dead weight in relation to its span and because of its flexibility, the suspension cable is very susceptible to: wind uplift, vibrations, asymmetrical and moving loads



Stabilisierung des Tragseiles
stabilization of suspension cable

Erhöhung des Eigengewichtes — increase of dead weight

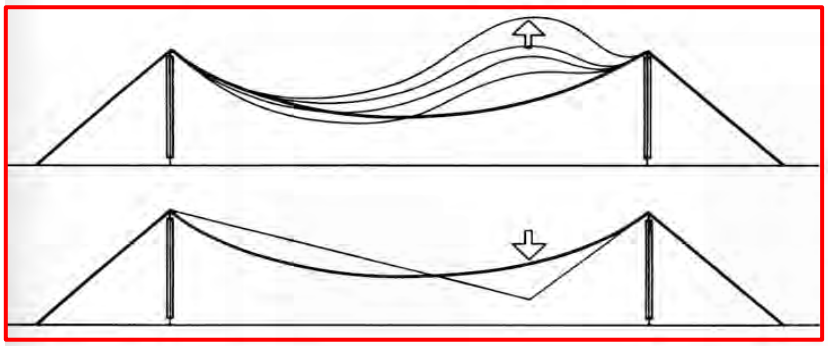
stiffening through construction as inverted arch (or shell)
Versteifung durch Ausbildung als umgekehrter Bogen (oder Schale)

spreading against cable with opposite curvature
Verspannung mit gegensinnig gekrümmten Seil

fastening with transverse cables anchored to ground
Verspannung mit bodenverankerten Querseilen

Problem

Lätta och därmed instabila för tillfälliga belastningar



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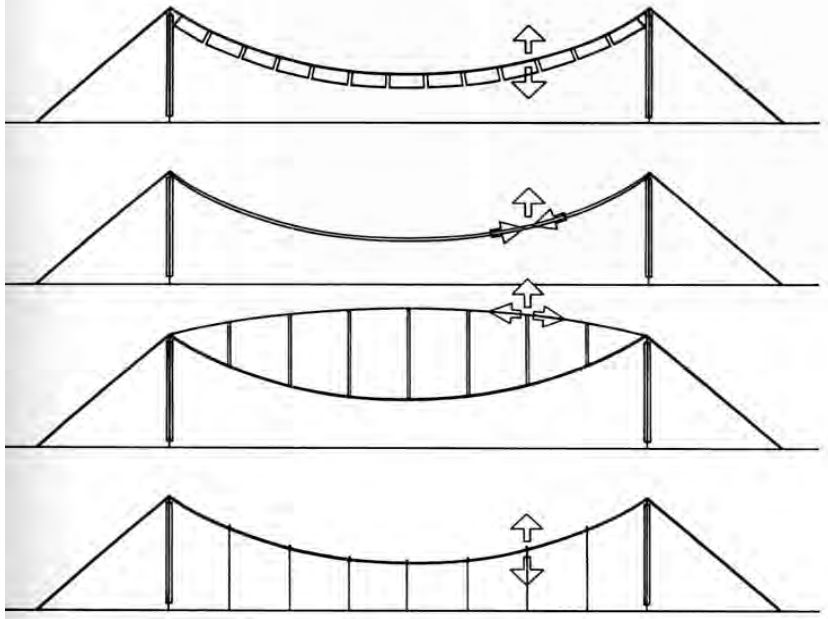

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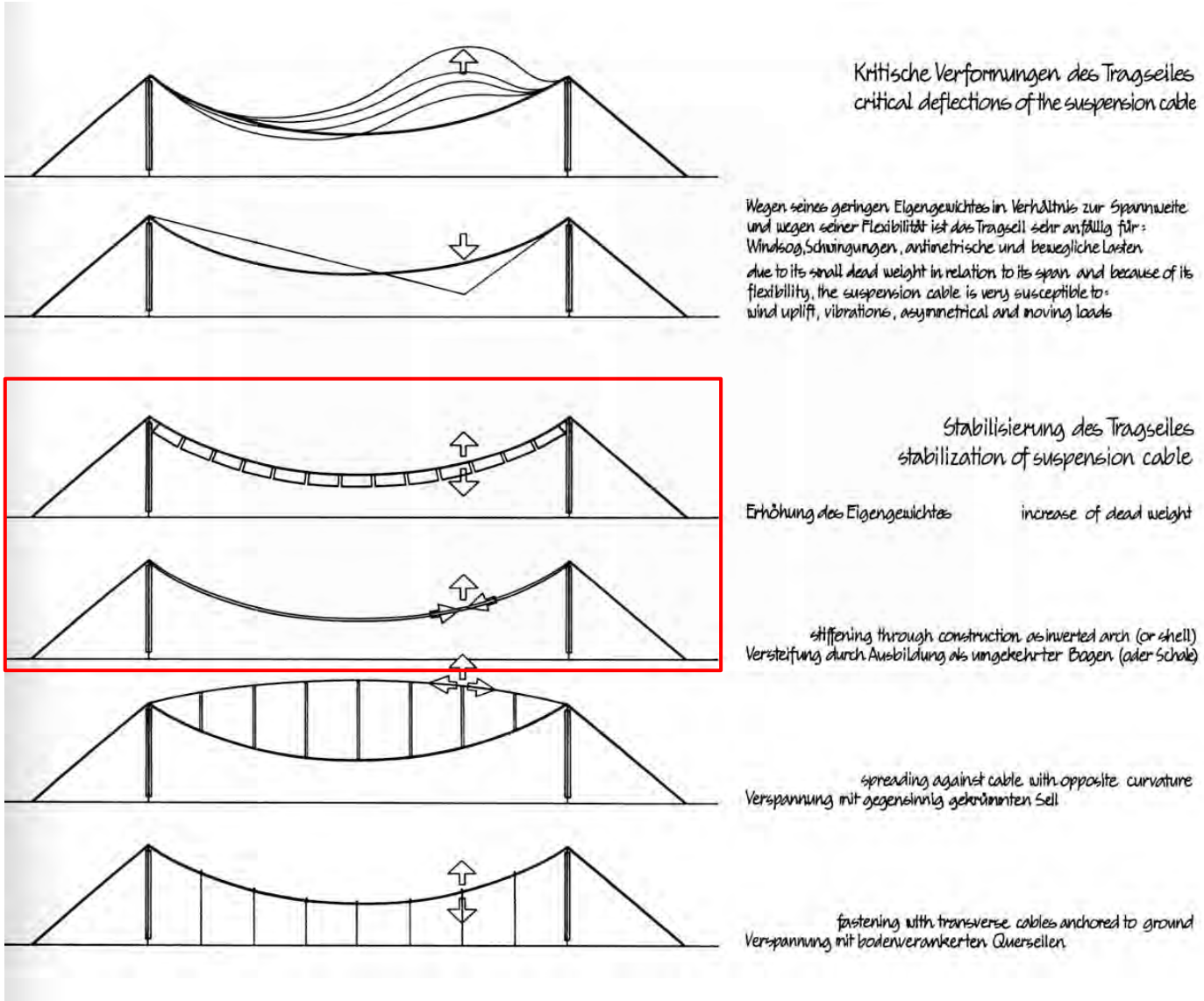
fastening with transverse cables anchored to ground
Verspannung mit bodenverankerten Querseilen

Stabilisering

Genom extra tyngd, lokal böjstyvhet, …

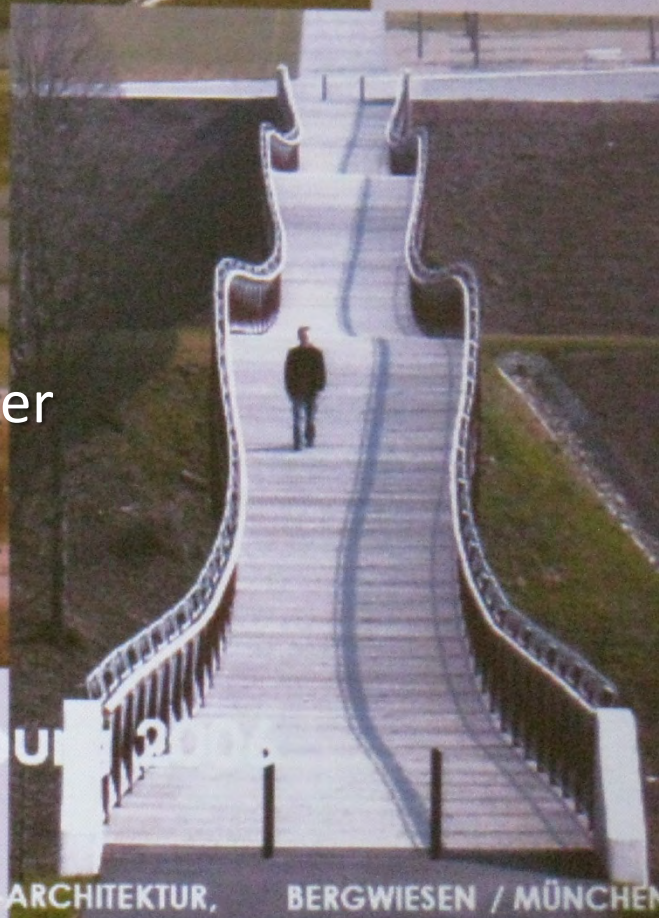


Älvsborgsbron

Fackverket under brobanan ger böjstyvhet som kan fördela lokala punktlaster

Drachenschwanzbrücke i Ronneburg

- Linbärverk i limträ
- Tvärsnittet har en höjd som ger böjstyvhet
  och lokalt en kapacitet att sprida ut punktlaster
- Stöden är rörliga i sin bas med kapacitet
  för linan att anpassa formen efter yttre laster

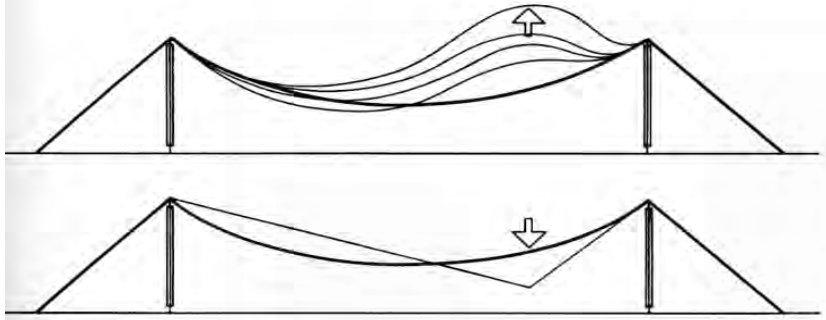


60 x 70 m²

Alvaro Sisa, Cecil Balmond
Expo 2000, Lissabon, Portugal

Hängande betongtak
Hur är det möjligt?

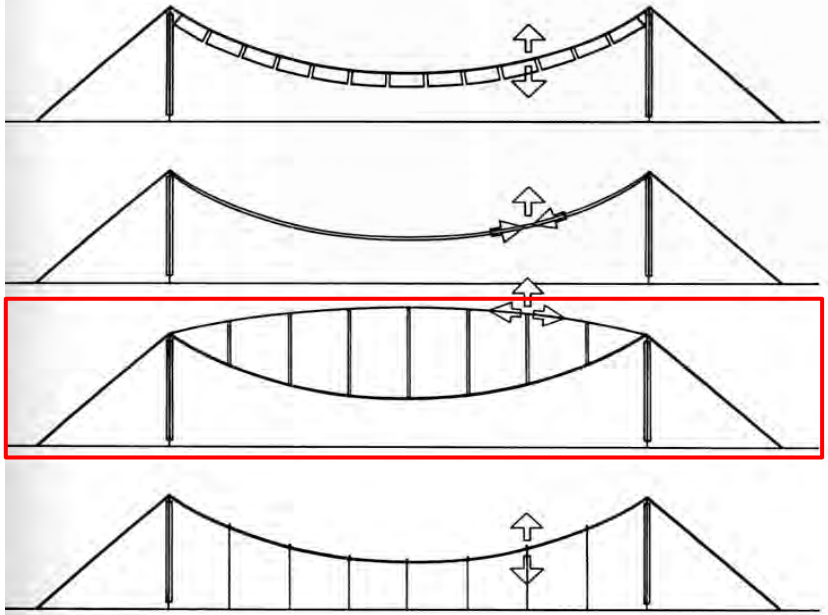
Betongens tyngd stabiliserar



Kritische Verformungen des Tragseiles
critical deflections of the suspension cable

Wegen seines geringen Eigengewichtes im Verhältnis zur Spannweite und wegen seiner Flexibilität ist das Tragseil sehr anfällig für: Windsog, Schwingungen, antimetrische und bewegliche Lasten

due to its small dead weight in relation to its span and because of its flexibility, the suspension cable is very susceptible to: wind uplift, vibrations, asymmetrical and moving loads



Stabilisierung des Tragseiles
stabilization of suspension cable

Erhöhung des Eigengewichtes — increase of dead weight

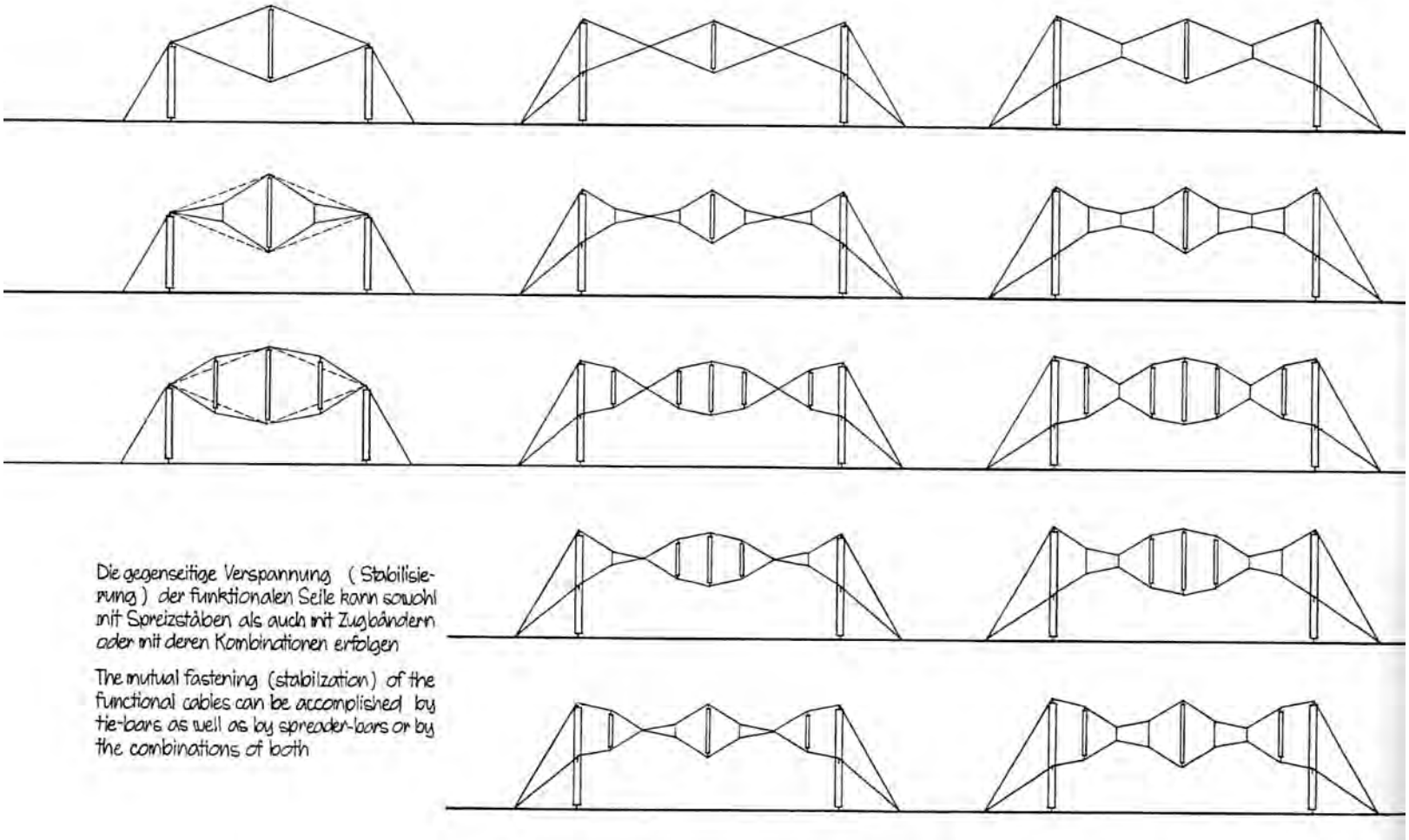
stiffening through construction as inverted arch (or shell)
Versteifung durch Ausbildung als umgekehrter Bogen (oder Schale)

spreading against cable with opposite curvature
Verspannung mit gegensinnig gekrümmten Seil

fastening with transverse cables anchored to ground
Verspannung mit bodenverankerten Querseilen

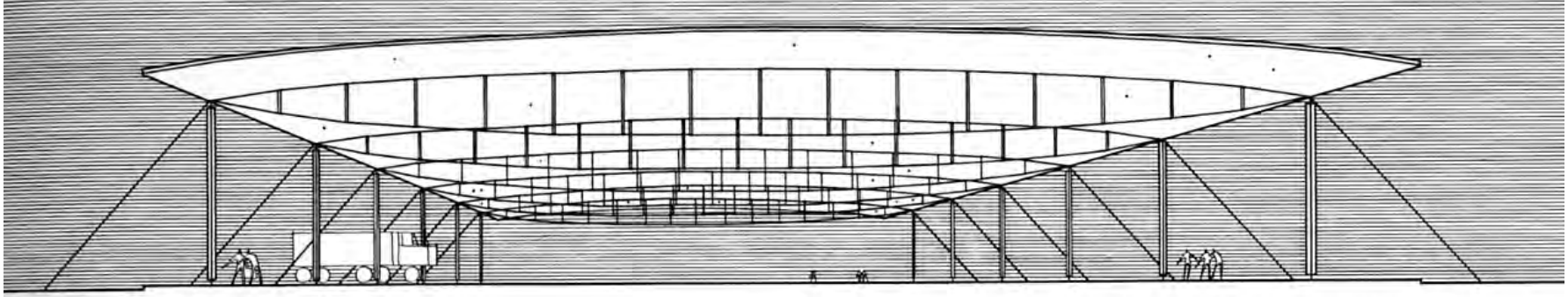
Verspannungssysteme zur Stabilisierung der Funktionsseile
Zugband- und Spreizstab-Kombinationen

Fastening systems for stabilization of functional cables
Combinations of tie-bar and spreader-bar



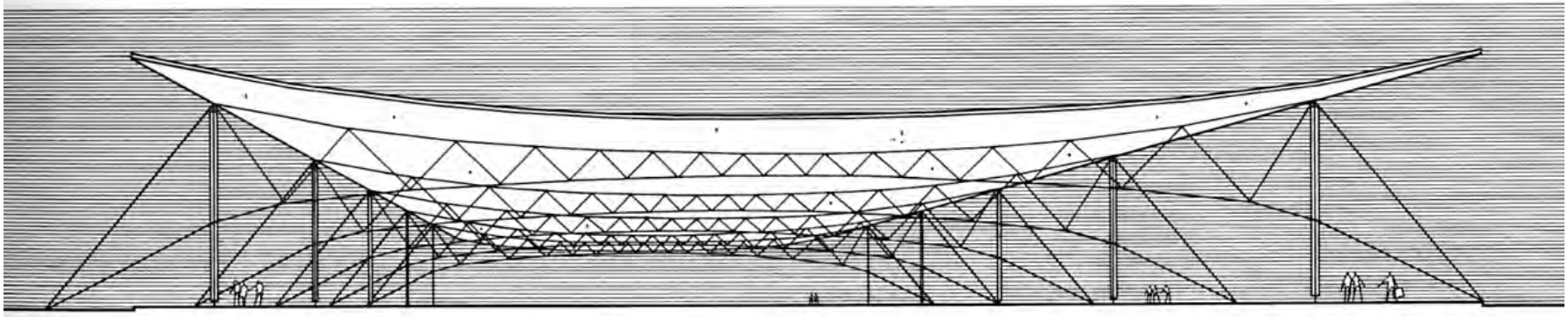
Die gegenseitige Verspannung (Stabilisierung) der funktionalen Seile kann sowohl mit Spreizstäben als auch mit Zugbändern oder mit deren Kombinationen erfolgen

The mutual fastening (stabilization) of the functional cables can be accomplished by tie-bars as well as by spreader-bars or by the combinations of both



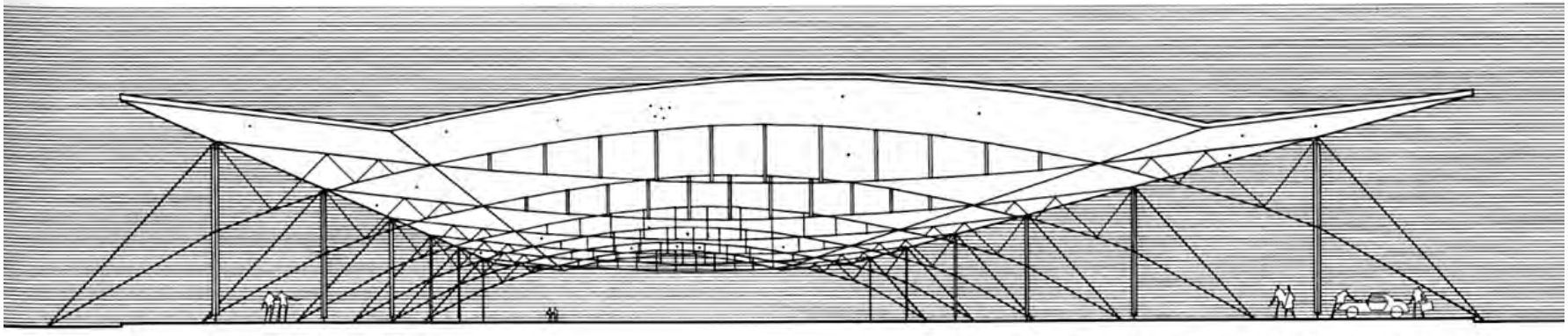
Stabilisierungsseil über Tragseil

stabilization cable above suspension cable



Stabilisierungsseil unter Tragseil

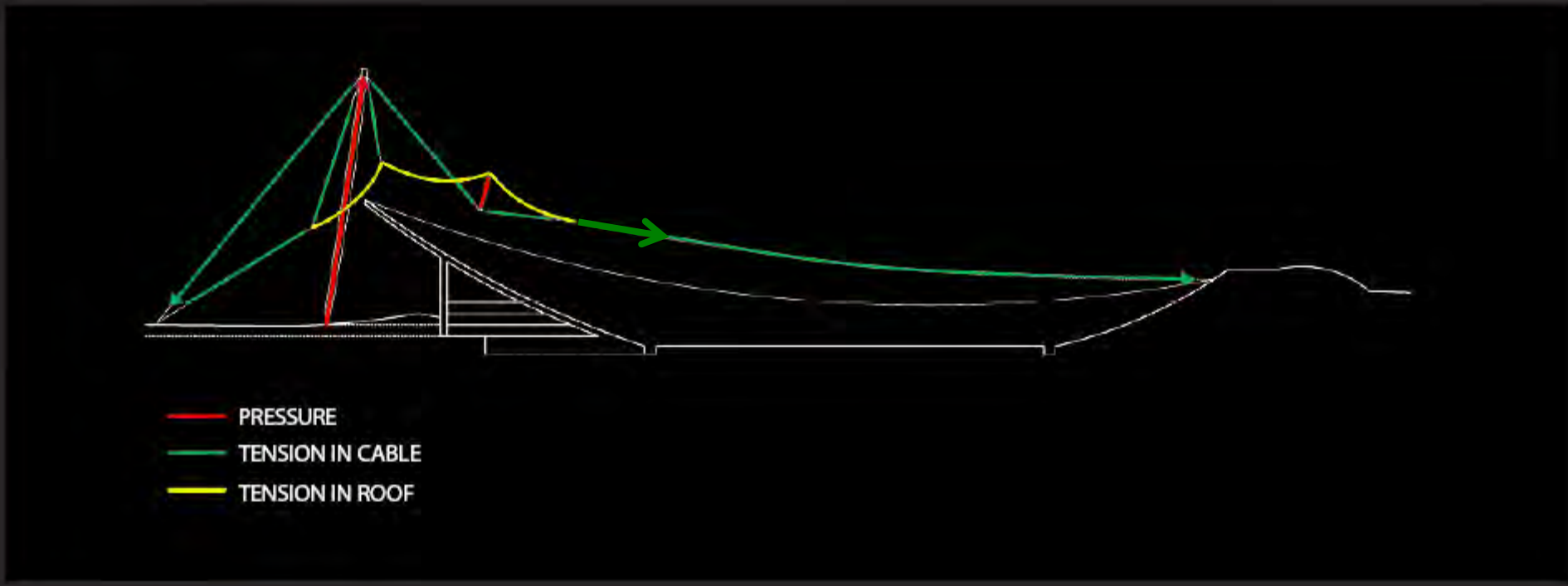
stabilization cable under suspension cable

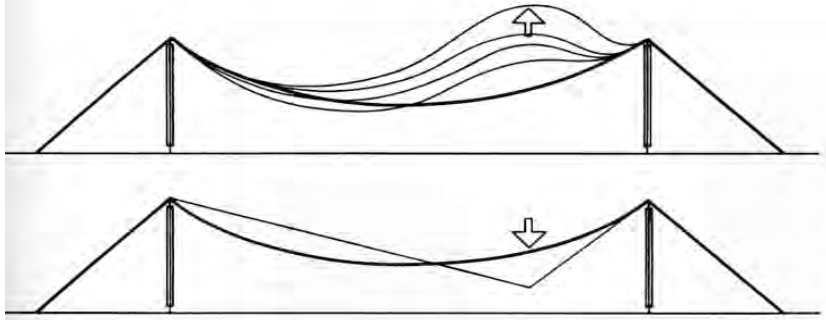


Stabilisierungsseil teils über teils unter Tragseil

stabilization cable partly above partly below suspension cable

Das berühmte «Strumpfmodell» des Wettbewerbs um das Olympiagelände in München 1972. Die Zeltdächer plante dann der Ingenieur Frei Otto, die Idee kam aber aus der Schweiz: von Heinz Isler.


PRESSURE
TENSION IN CABLE
TENSION IN ROOF



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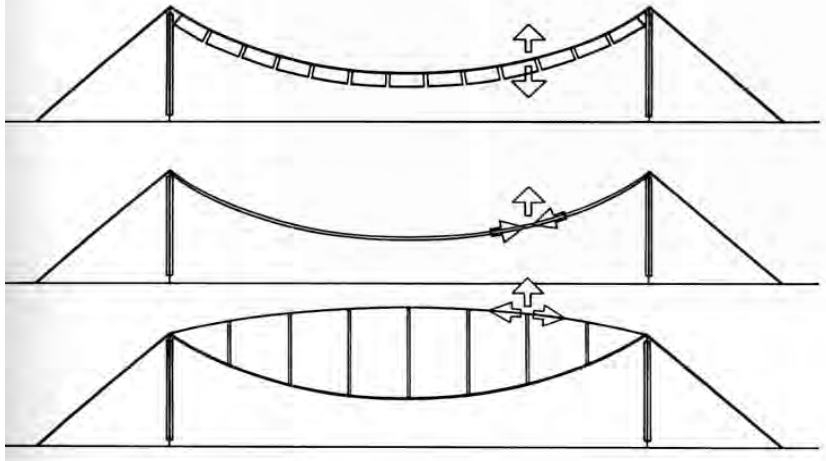

Stabilisierung des Tragseiles
stabilization of suspension cable

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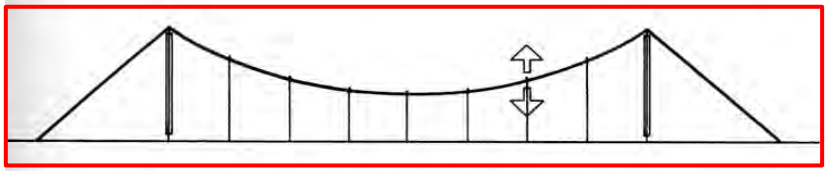


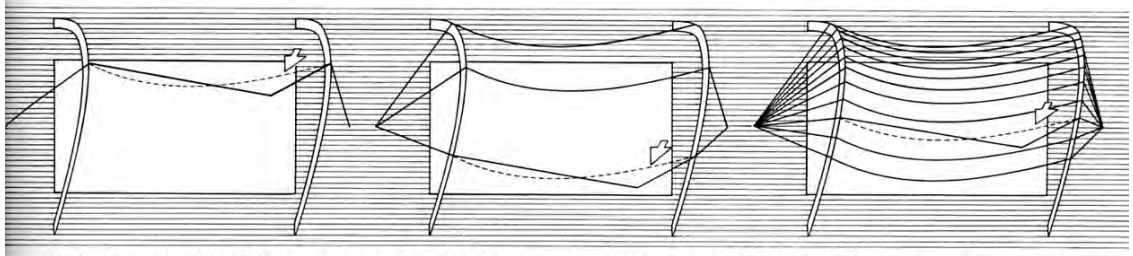
Verspannung mit bodenverankerten Querseilen — fastening with transverse cables anchored to ground

Vorgespannte Systeme mit querlaufenden Stabilisierungseilen

Entwicklung vom einfachen Tragseil zum gegensinnig gekrümmten Seilnetz

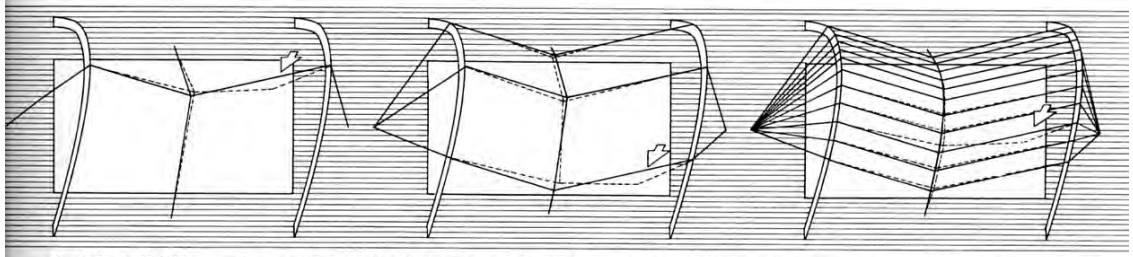
prestressed systems with transverse stabilization cables

development from simple suspension cable to the cable net with opposite curvature



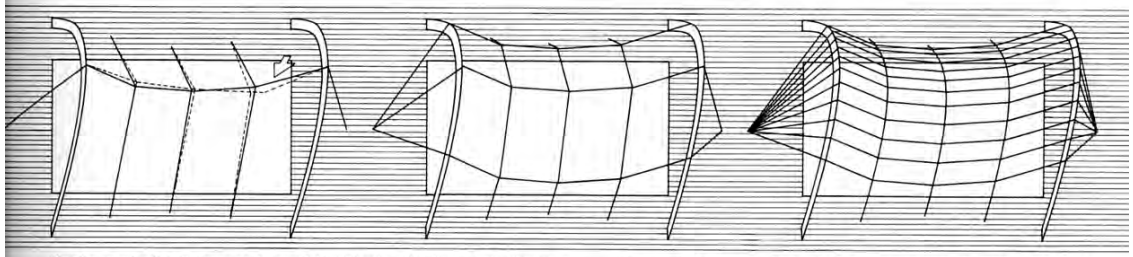
Einzellast verursacht größere Deformation, die sich nur auf betroffenes Seil erstreckt

single load causes major deflection that remains localized to the cable under load



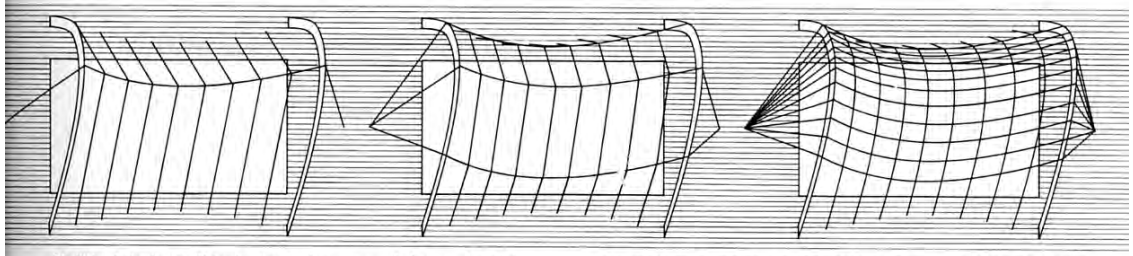
Querlaufendes Stabilisierungsseil spannt Tragseil und verhindert größere Deformation

transverse stabilization cable stresses suspension cable and resists deflection



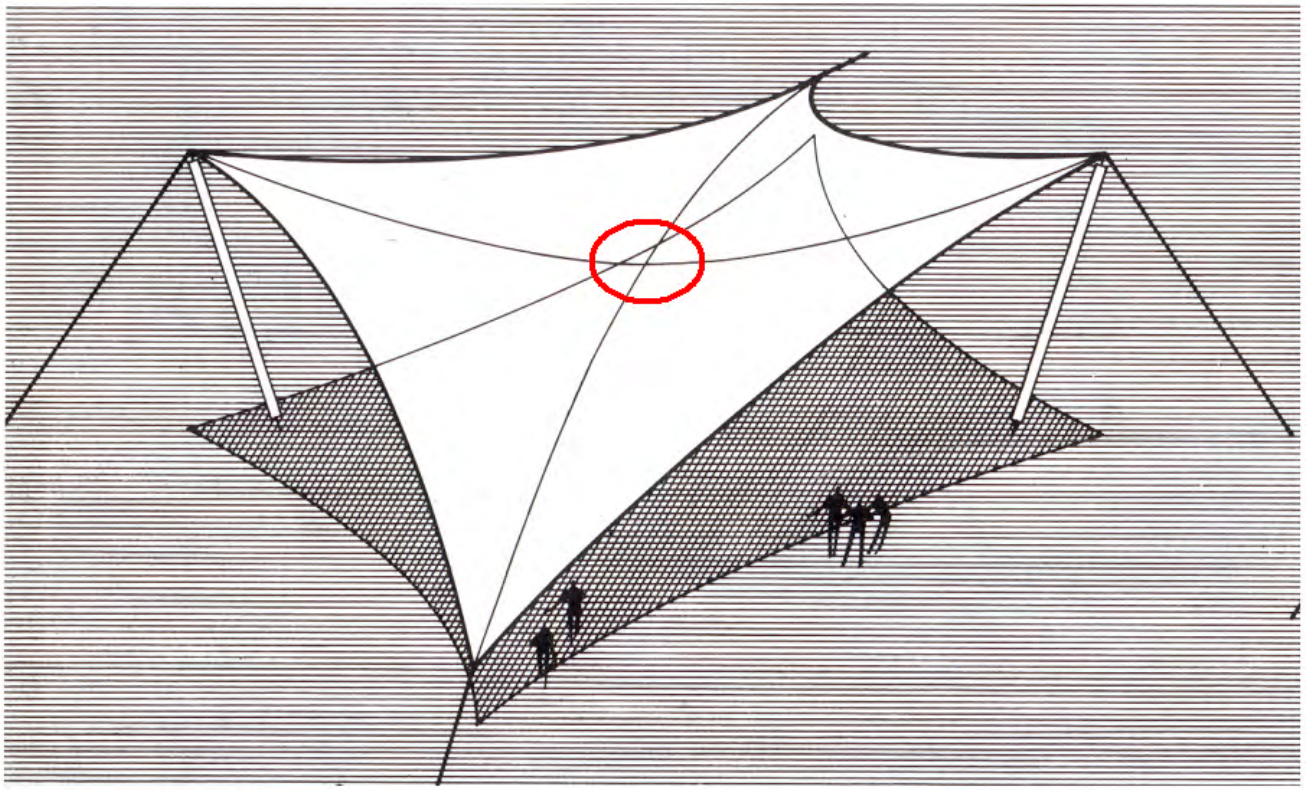
Verflechtung der Stabilisierungsseile verstärkt Widerstandskraft gegen Einzellasten

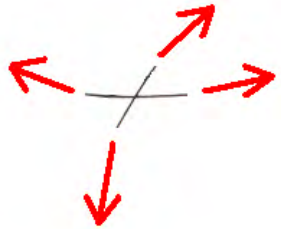
increase of stabilization cables strengthens resistance against point loads



Sämtliche Seile sind am Widerstandsmechanismus gegen Verformung beteiligt

all the cables are participating in the mechanism of resisting single load deflection





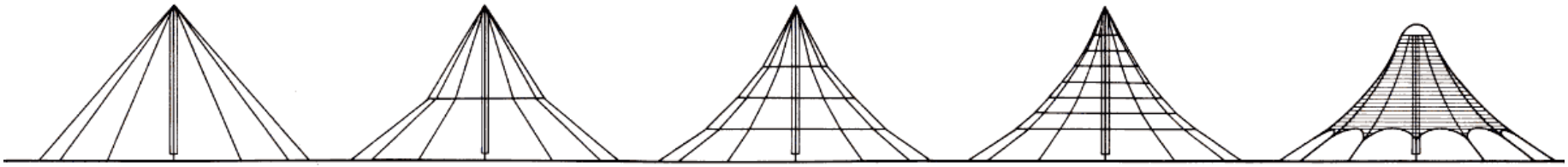
Partikel-jämvikt

Zeltsysteme mit innerer Unterstützung durch Druckstäbe

Systeme mit Buckelflächen

tent systems with interior support through compression members

systems with hunched surfaces



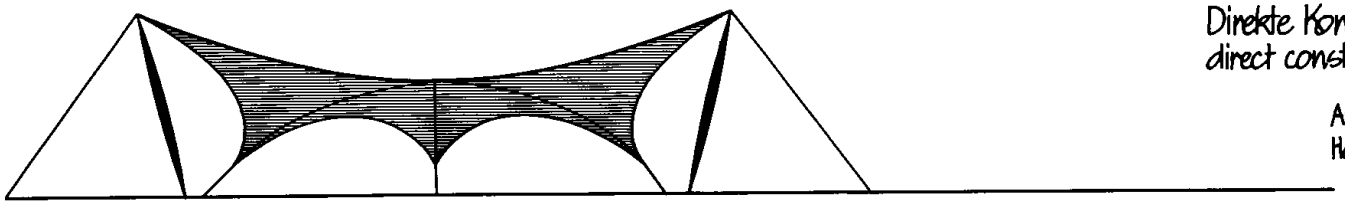
Ableitung der Buckelfläche vom kegelförmigen Seilnetz

Durch Einschnürung mit horizontalen Ringseilen wird Widerstandsfähigkeit gegen asymmetrische Lasten erhöht. Verdichtung der Ringseile und Meridianseile führt zur Zeltmembrane. Wegen Konzentration der Kräfte im Hochpunkt muß Fläche des Hochpunktlagers verbreitert werden. Es entsteht die Buckelfläche

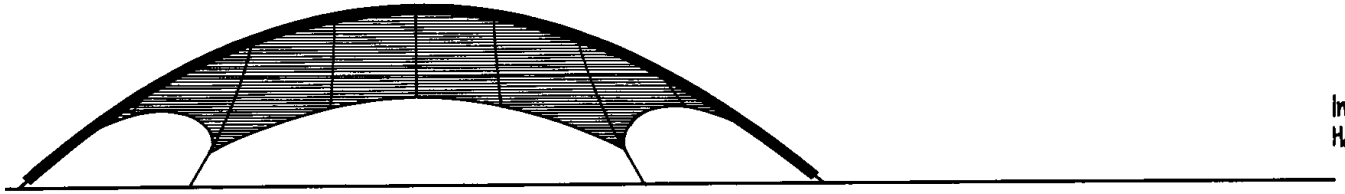
derivation of hunched surface from cone-shaped cable net

through indentation with horizontal ring cables resistance against asymmetrical loads is increased. condensation of circular and meridional cables leads to the tent membrane. because of concentration of forces in the high point the top must be flattened for enlargement of surface. the form becomes hunched

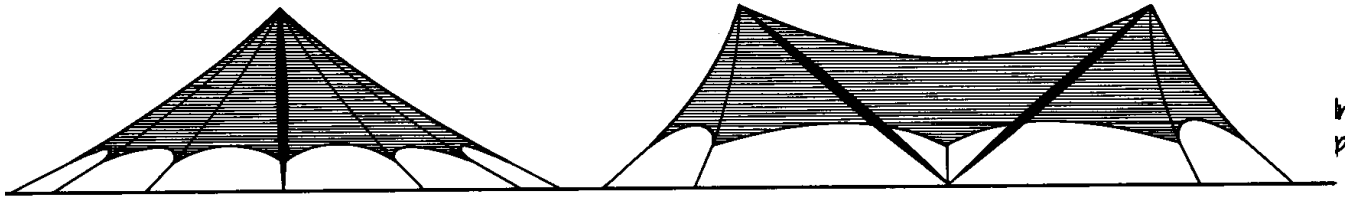
Direkte Konstruktionssysteme für Hochpunkte
direct construction systems for high points



Außenstützen für peripherisch angeordnete Hochpunkte / exterior supports for high points arranged peripherally

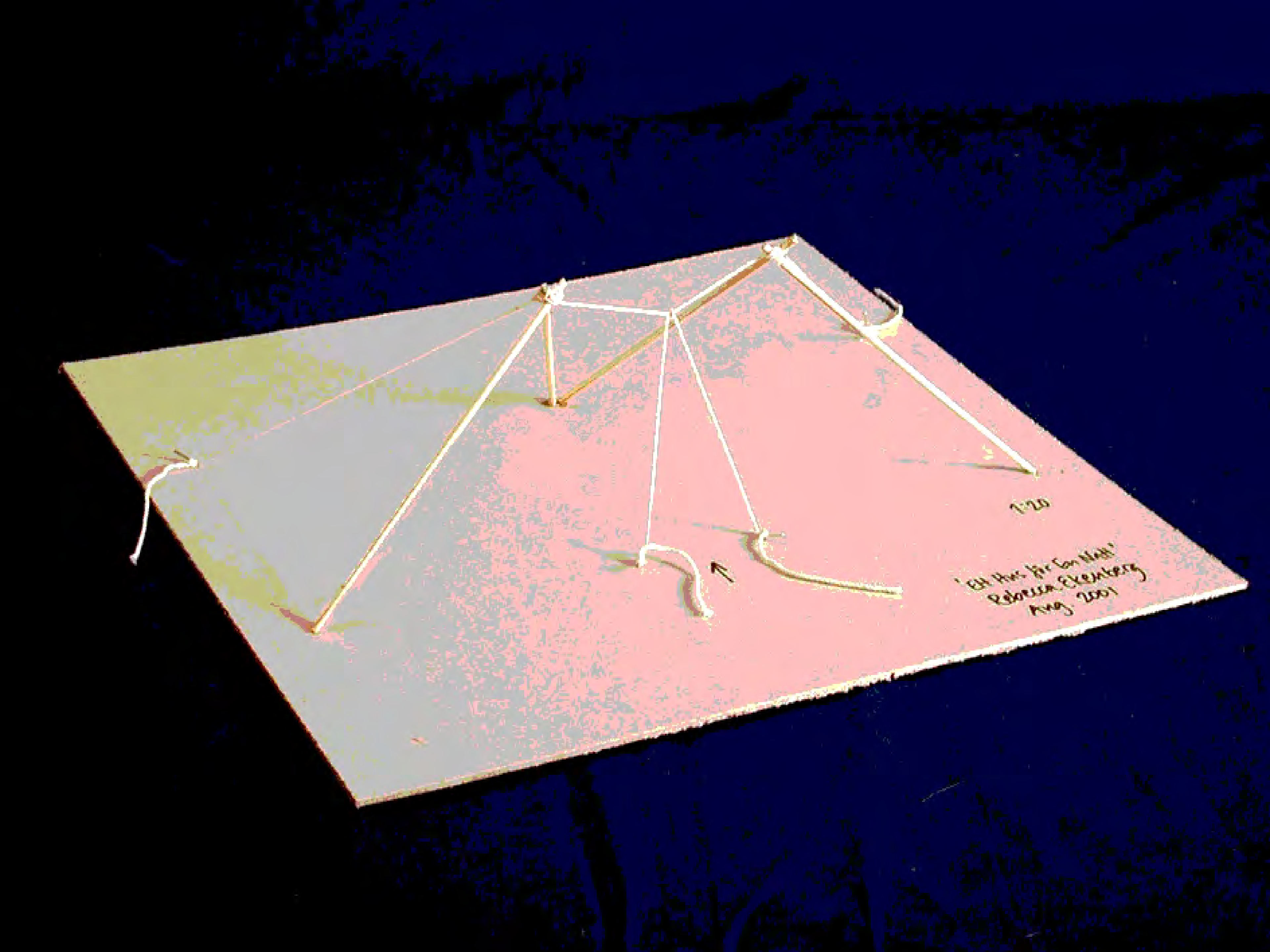


Innenbogen für axial (linear) angeordnete Hochpunkte / interior arch for high points arranged axially

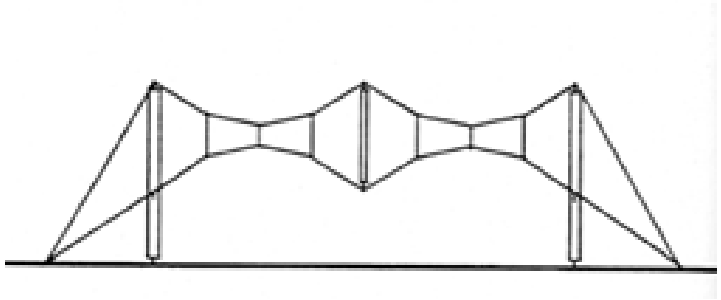


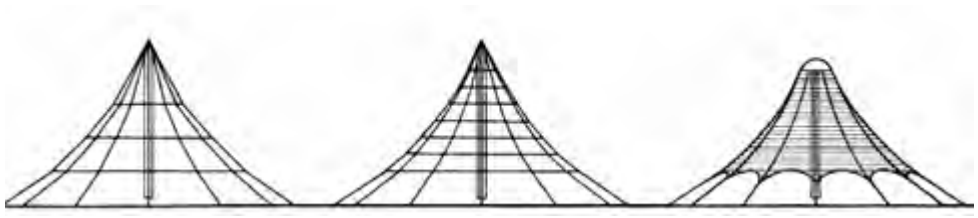
Innenstützen für mittig angeordnete Hochpunkte / interior supports for high points arranged centrally

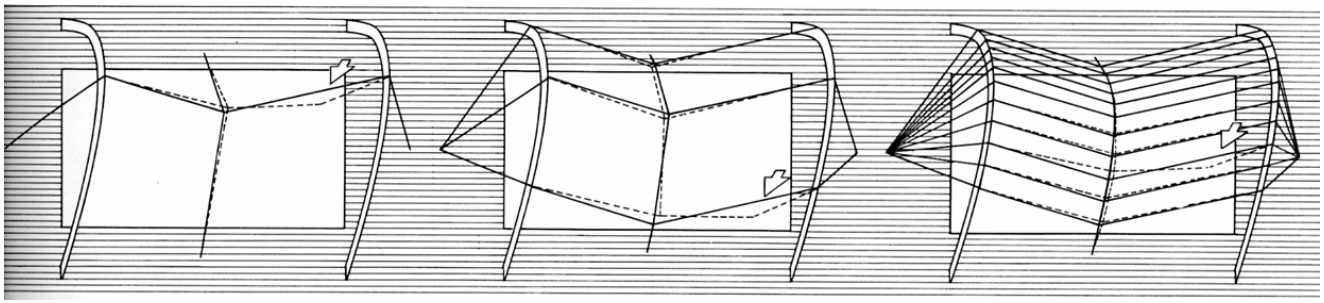
Außenstützen für mittig angeordnete Hochpunkte / exterior supports for high points arranged centrally


1:20
Rebecca Ekenberg
Aug. 2001

1. Samspelet mellan kraft och form





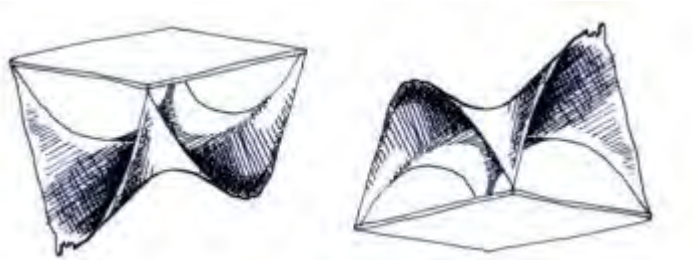


Figurerna ovan visar hur form och kraft samspelar.

Illustrera detta samspel genom att i figurerna visa partikeljämvikter i punkter där linor möter varandra. Visa jämvikter med hjälp av kraftpilar.
Använd rött för drag och blått för tryck

Från drag till tryck

Heinz Isler



Das berühmte «Strumpfmodell» des Wettbewerbs um das Olympiagelände in München 1972. Die Zeltdächer plante dann der Ingenieur Frei Otto, die Idee kam aber aus der Schweiz: von Heinz Isler.

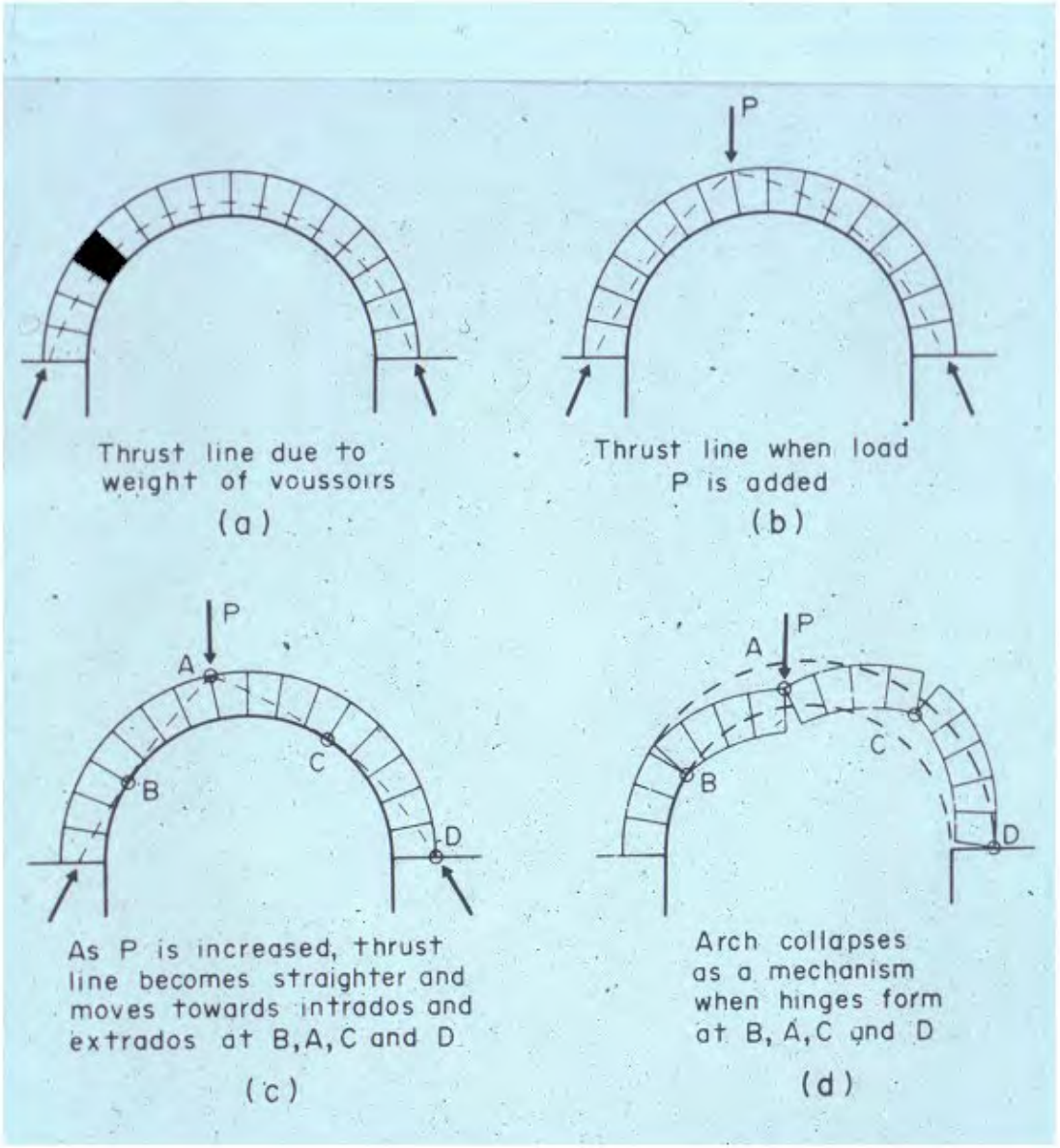
Isler-skal

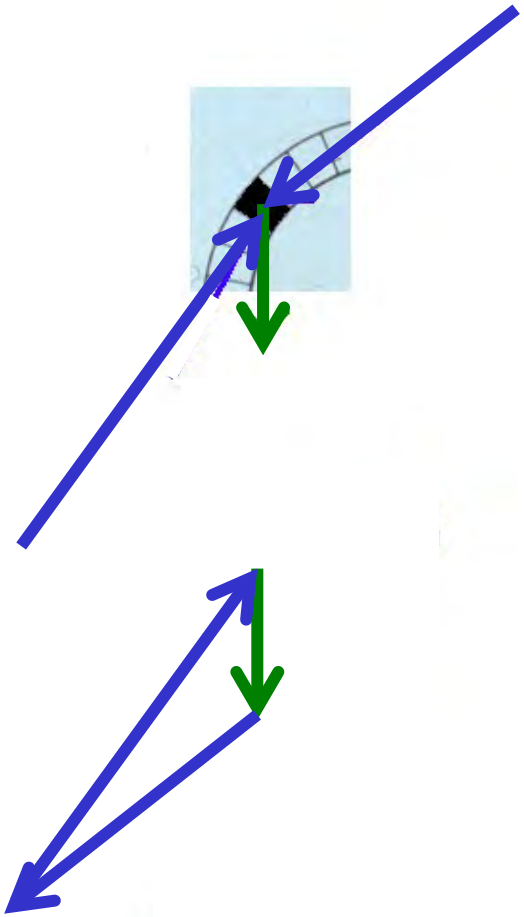
Basento bridge, Potenza, by Sergio Musmeci

Modello in neoprene per il ponte sul Basento.

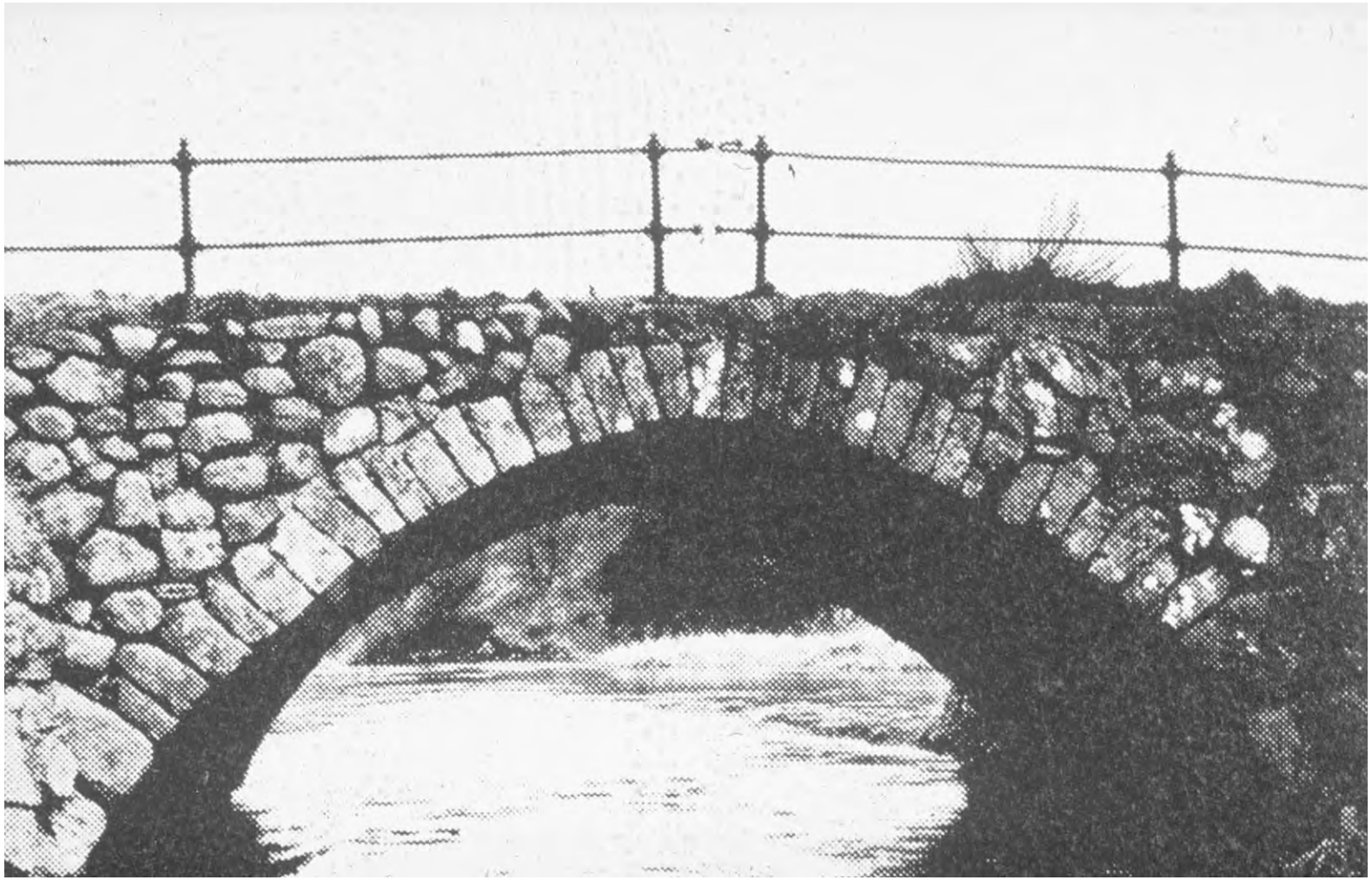

Wasserfallbrücke, Flims
Efterspända dragband
i räckets underkant
ger extra tyngd

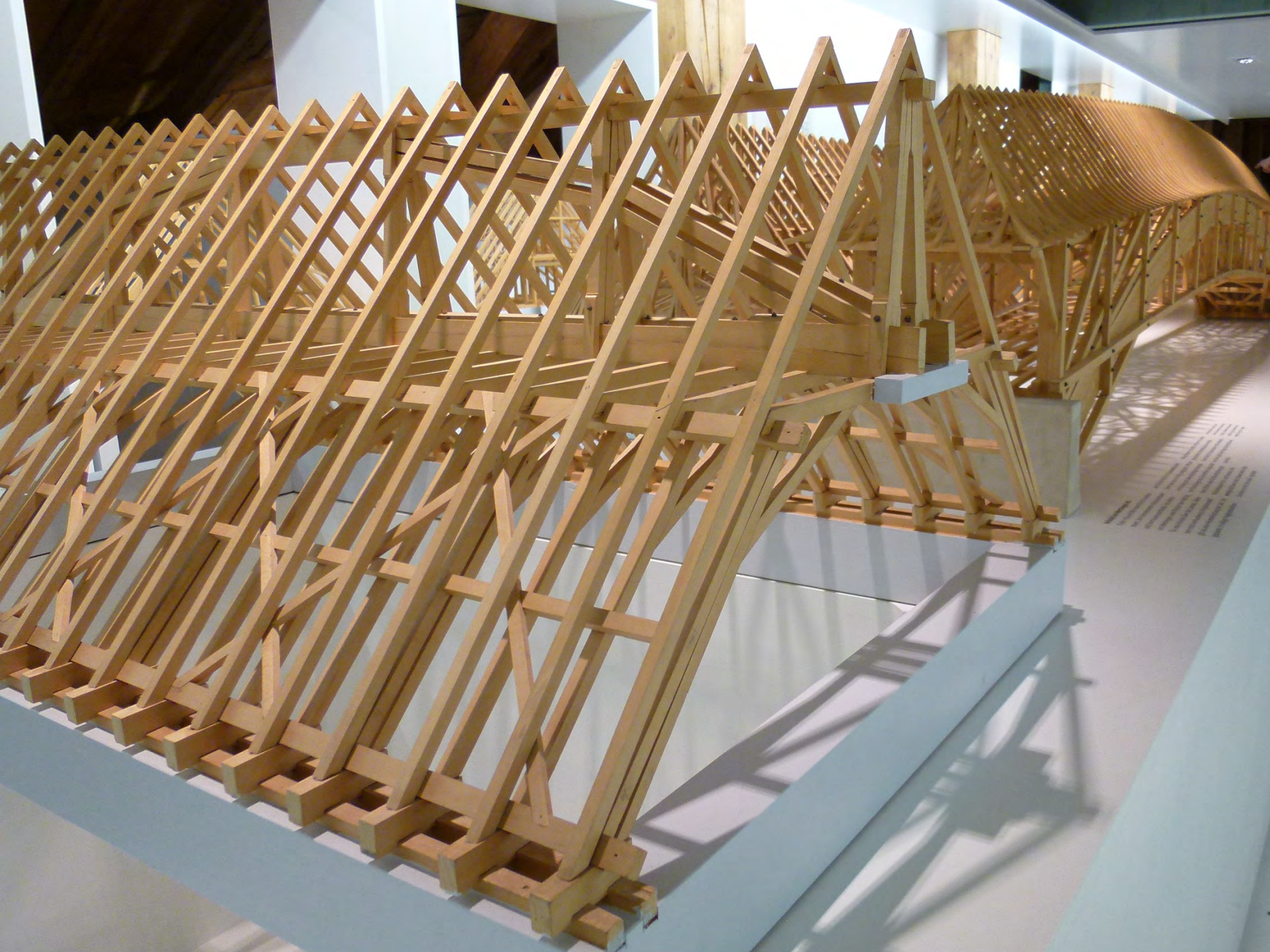
Mer om trycklinjen

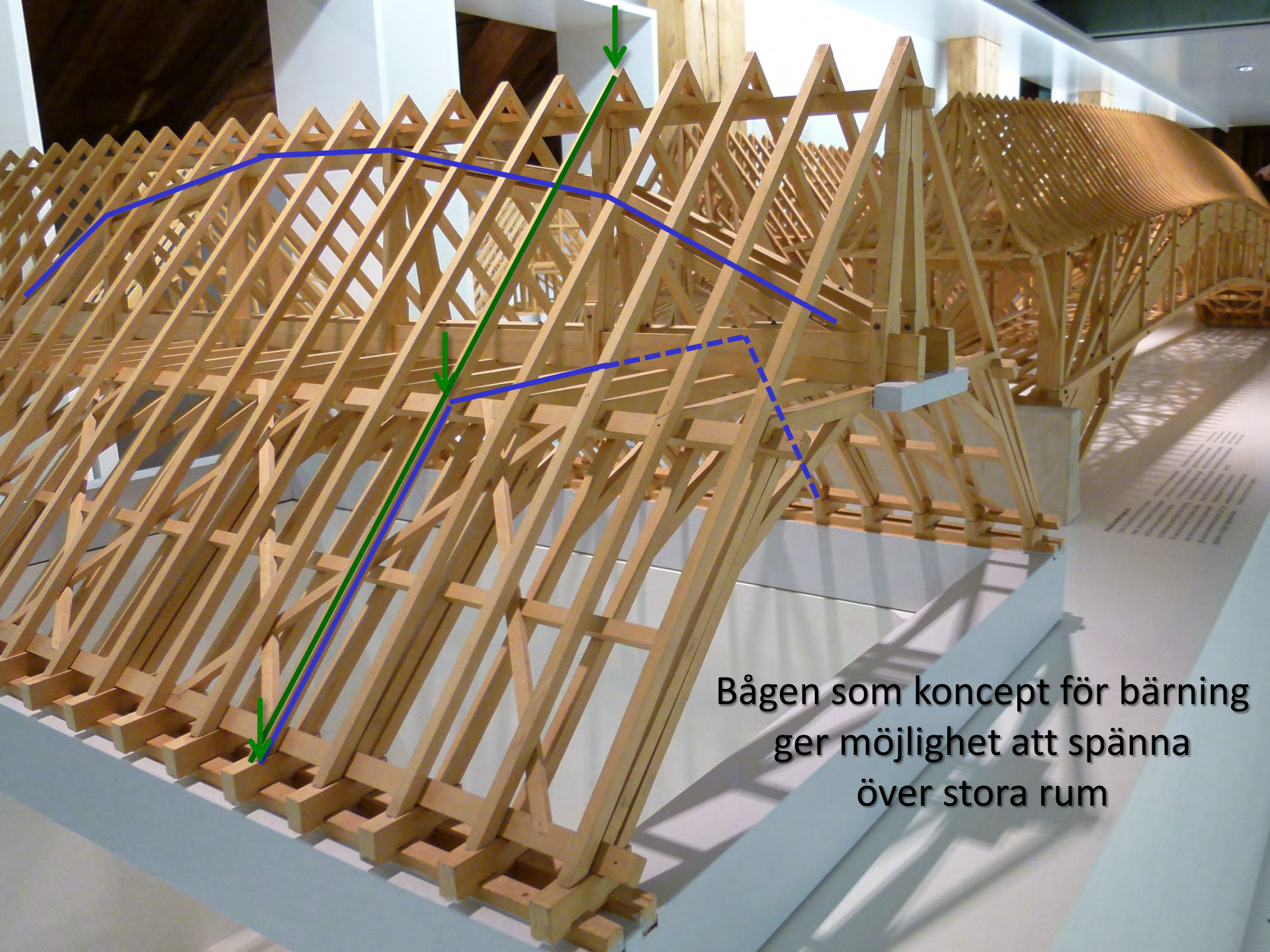


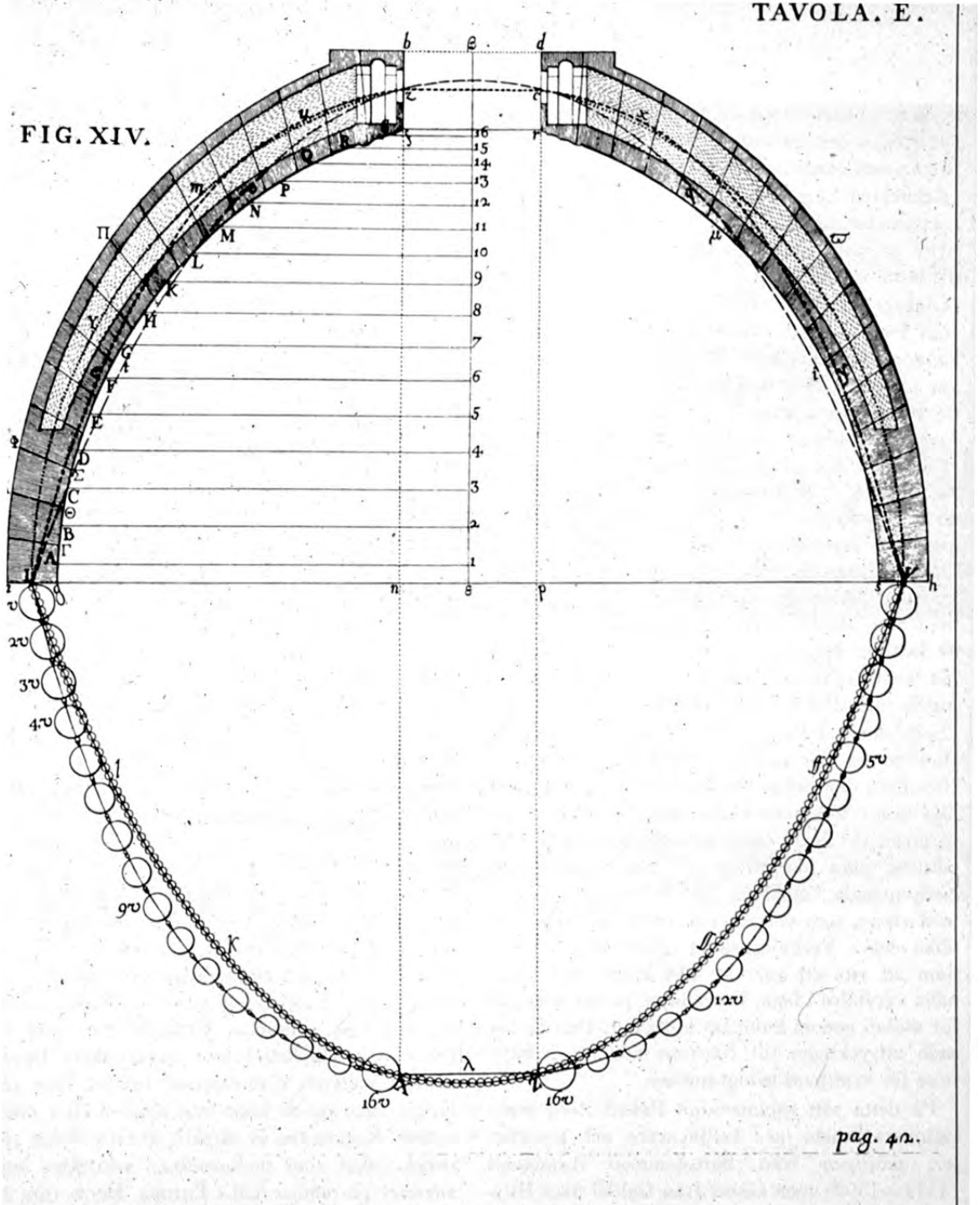


Stenarnas tyngd gör trycklinjen stabil



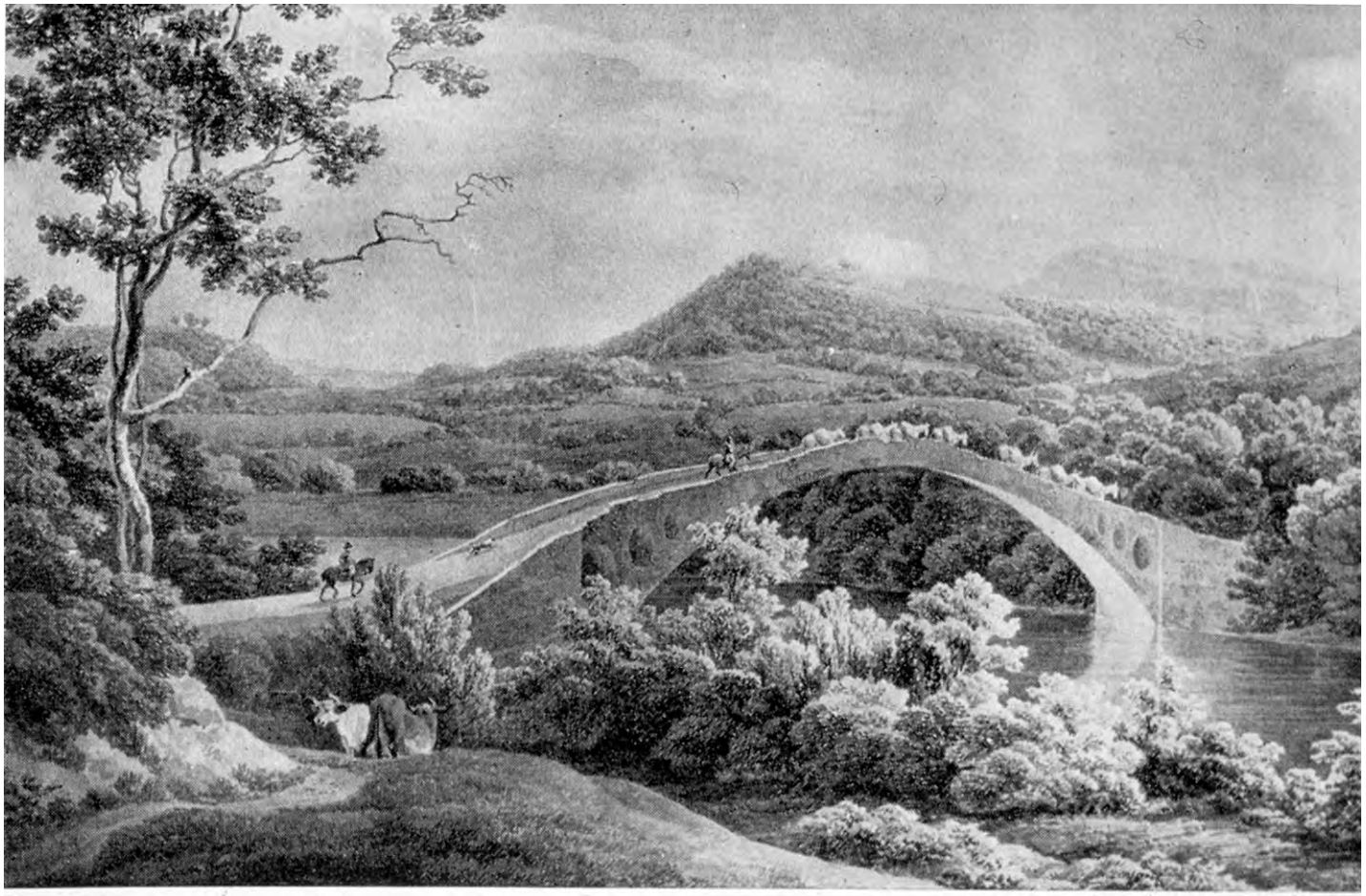



Bågen som koncept för bärning
ger möjlighet att spänna
över stora rum

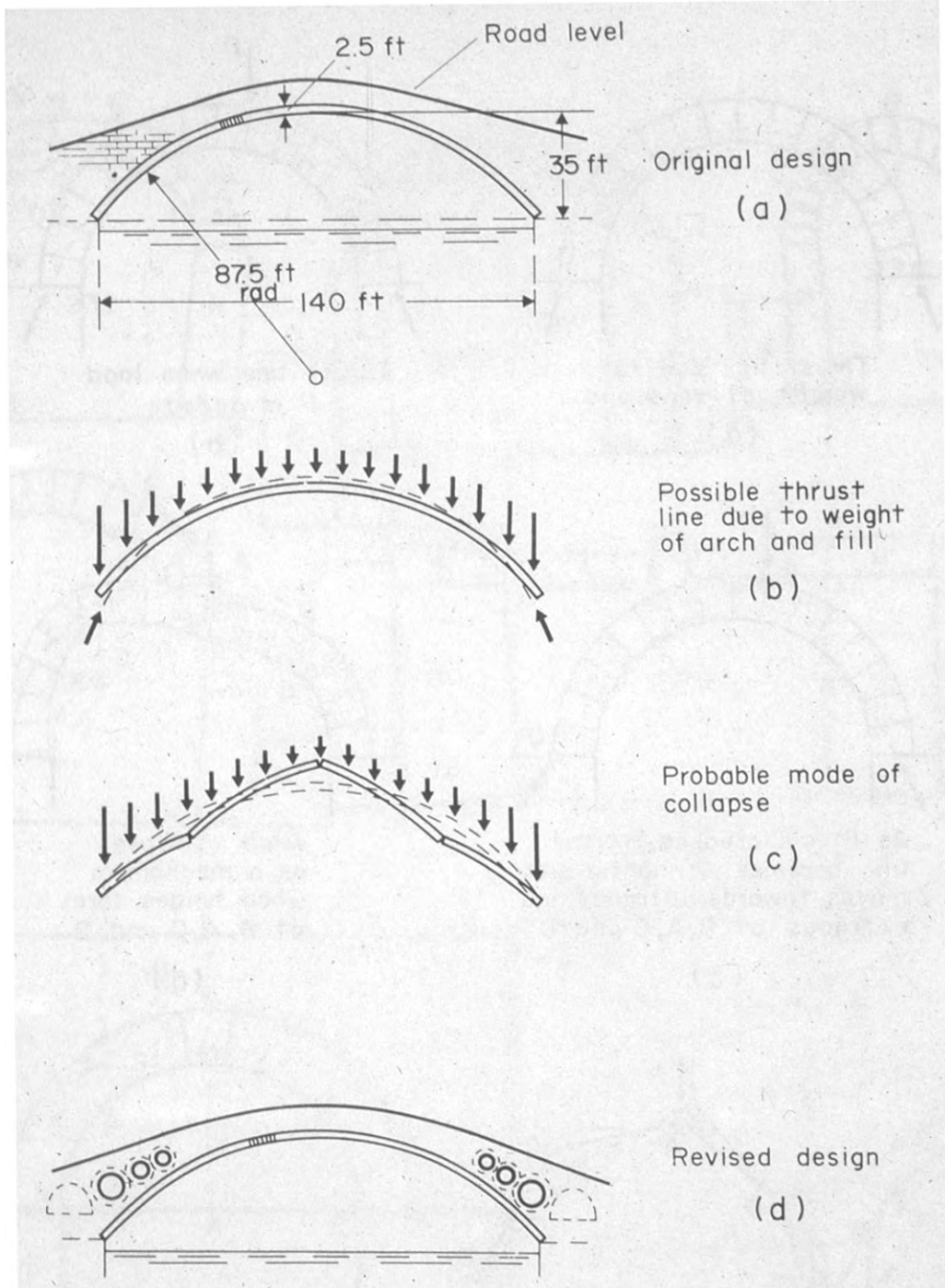


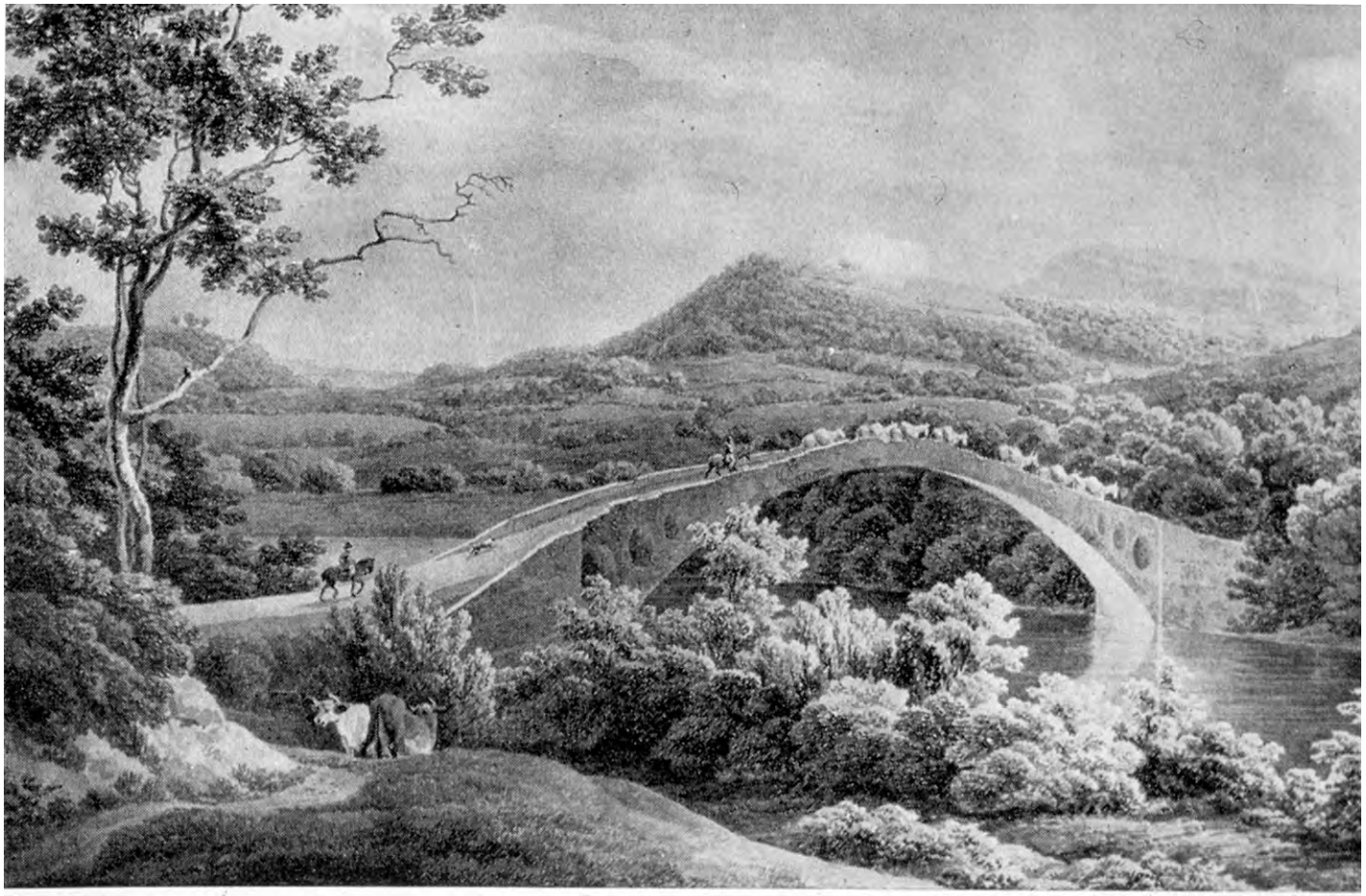
Peterskyrkans kupol
Michelangelo

Analyserad av
Poleni 1748



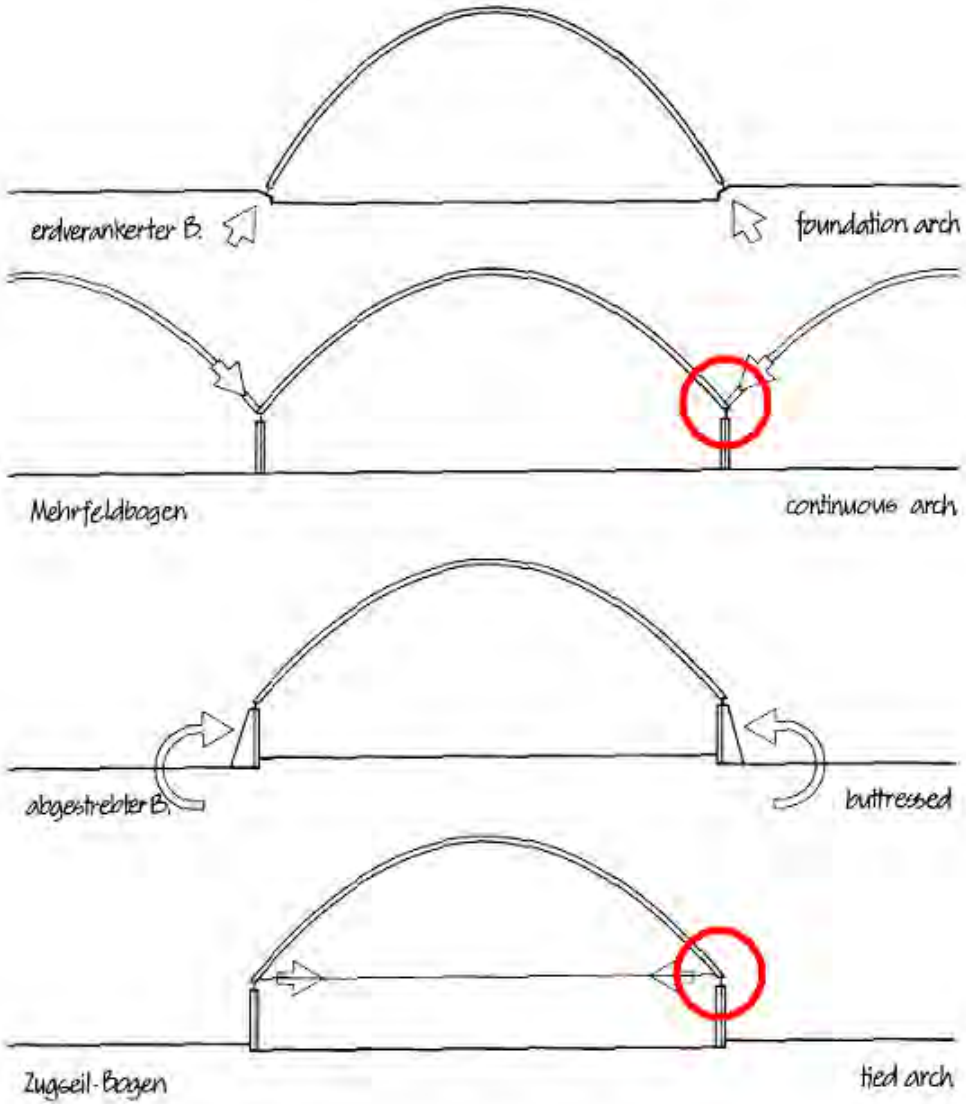
Edwards' fjärde bro, Pont-y-Ty-Prydd, vid Pontypridd 1756. Akvarell av Rooker,

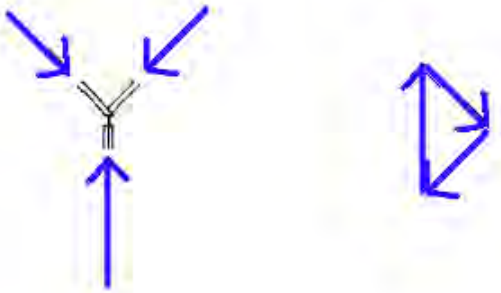

2.5 ft
Road level
35 ft
Original design
(a)
87.5 ft
rad
140 ft
Possible thrust line due to weight of arch and fill
(b)
Probable mode of collapse
(c)
Revised design
(d)



Edwards' fjärde bro, Pont-y-Ty-Prydd, vid Pontypridd 1756. Akvarell av Rooker,

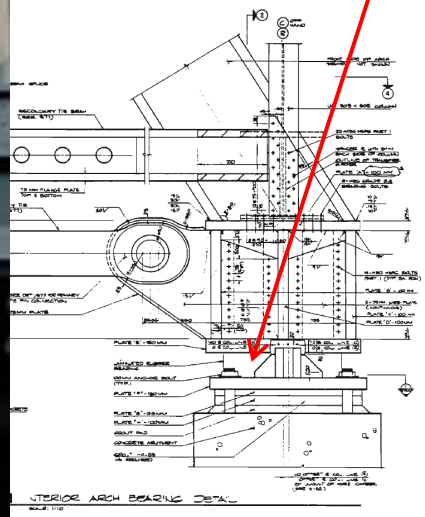
Yttre eller inre stöd?



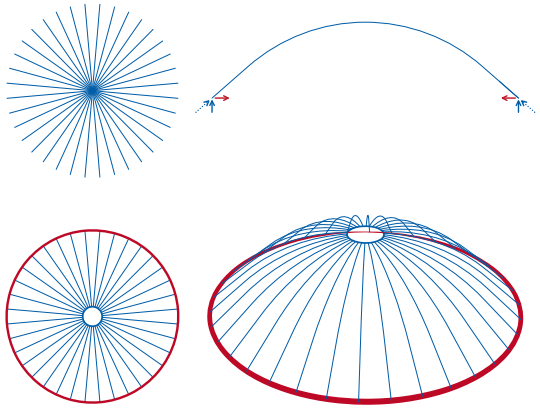


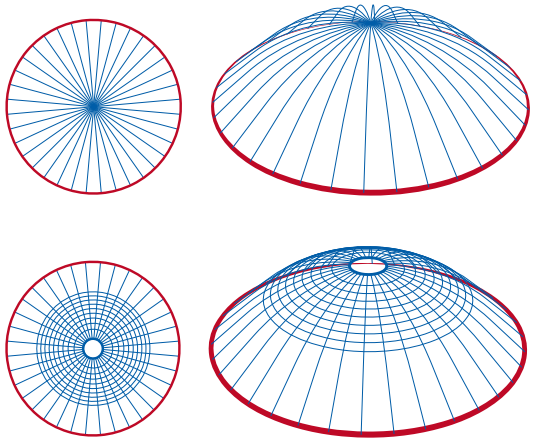
Broadgate Exchange House
London
SOM

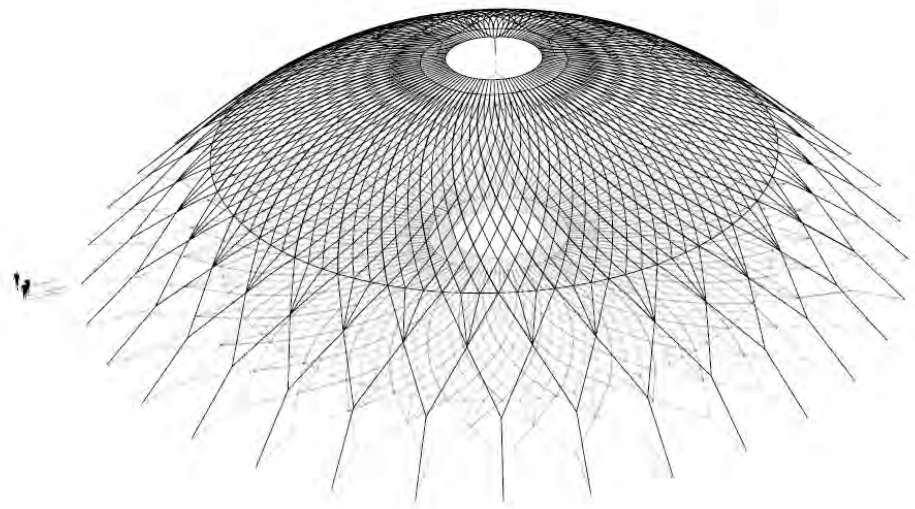
Laminerat gummi



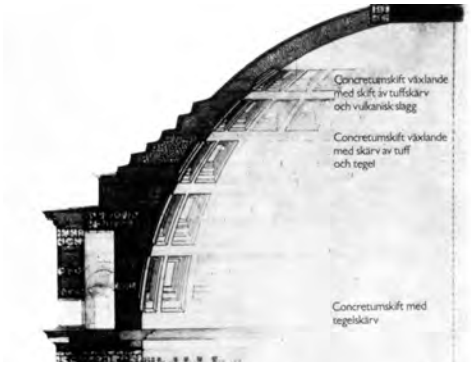

3D kan kupoler kan ibland göras tunnare än 2D bågar

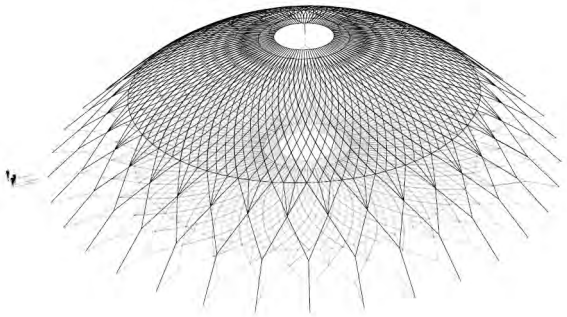




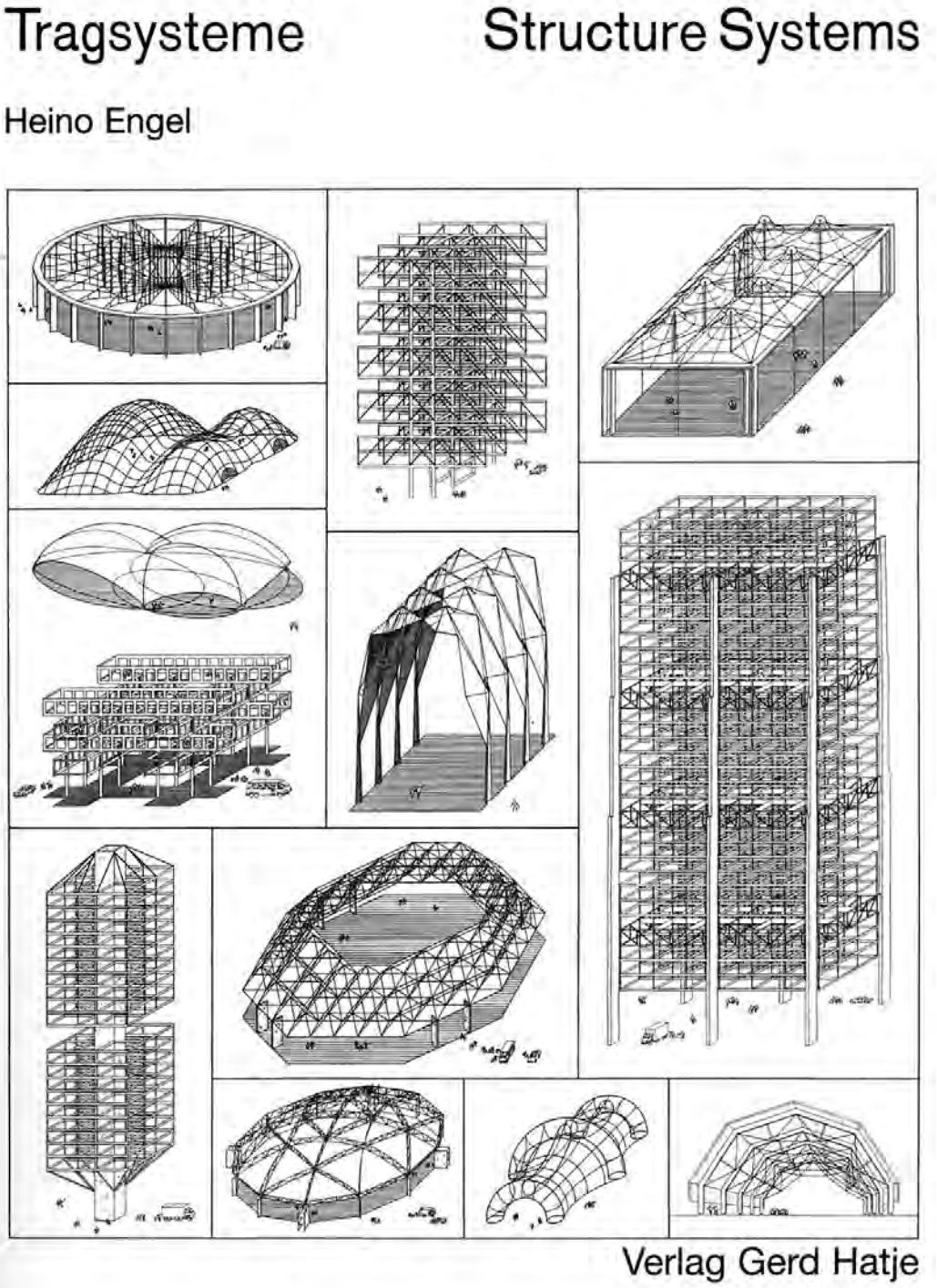


2. Bågen, valvet och kupolen





Bilderna ovan visar kända och okända bågar, valv och kupoler – Stenvalvbro över Saxån, Pontypridd, Broadgate Exchange House, Pantheon, Palazetto dello Sport, Wasserfall brücke. Välj en av dem (eller en egen bild av en båge, ett valv eller en kupol) och förklara hur den fungerar med hjälp av skisser, bilder och begrepp:
yttre last, *trycklinje*, *geometrisk form*, *kraftjämvikt*, *horisontalkrafter i stöd*.



Strukturer sorterade efter hur form möter last

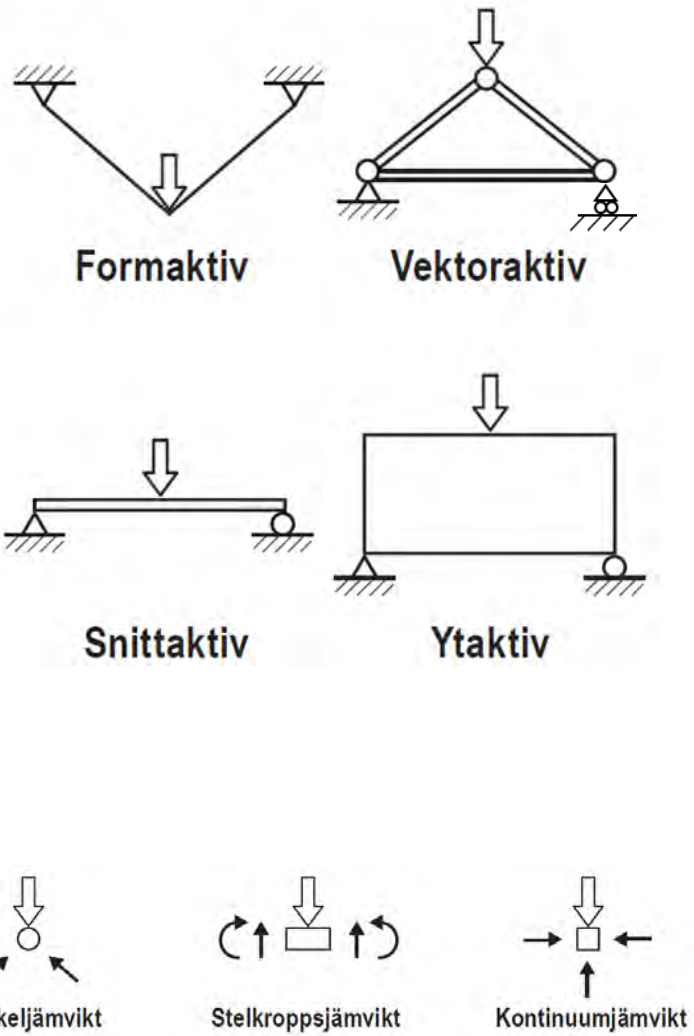
Heino Engel
Structural Systems

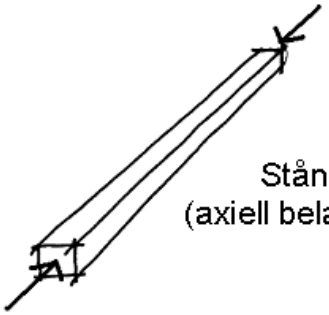
Formaktiva strukturer
(linan, bågen)
Vektoraktiva strukturer
(fackverket)
Snittaktiva strukturer
(balken, ramen)
Ytaktiva strukturer
(skivan)

Einteilung der Tragsysteme im Bauen

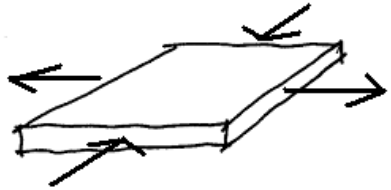
Classification of structure systems in building

Kriterium Criterion		Prototyp prototype	Kräfte forces	Merkmal feature	Mechanik der Kraftumlenkung mechanics of redirection of forces
1	FORM	Stützbogen funicular arch Hängeseil suspension cable Kreisring circular ring Ballon balloon	Druck oder Zug compression or tension	Stützlinie thrust line Kettenlinie catenary Kreis circle	formaktiv form-active
2	VEKTOR VECTOR	Dreieckbinder triangular truss Fachwerkträger trussed beam	Druck und Zug compression and tension	Dreieckverband triangulation	vektoraktiv vector-active
3	QUERSCHNITT CROSS SECTION	Balken beam Rahmen frame Platte flat slab	Biegung Schnittkräfte bending section forces	Querschnittprofil sectional profile	schnittaktiv section-active
4	FLÄCHE SURFACE	Scheibe plate gefaltete Platte folded slab Zylinderschale cylindrical shell	Membrankräfte membrane stresses	Flächenform surface shape	flächenaktiv surface-active

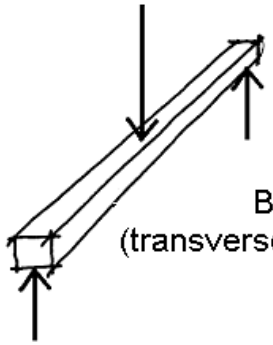




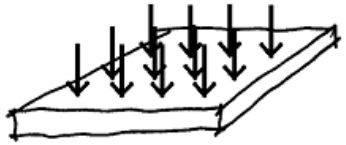
Stång
(axiell belastning)



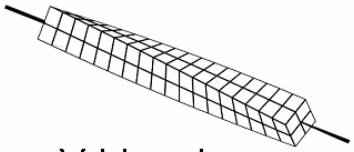
Skiva
(belastning i planet)



Balk
(transversell belastning)

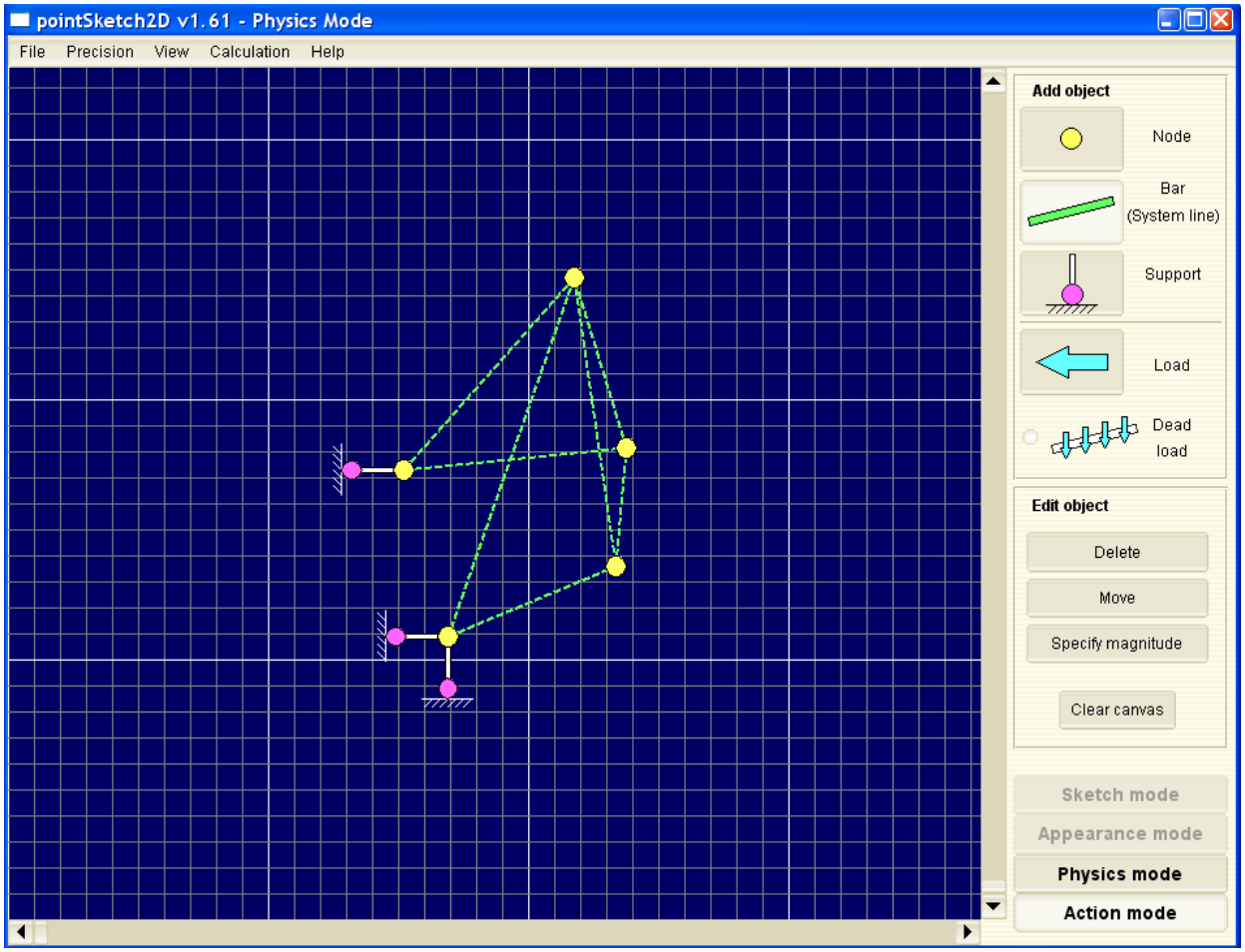


Platta
(belastning vinkelrätt planet)



Vrid-verkan
(vridande belastning)

pointSketch – 2D vektoraktiva strukturer



Kroppars verkningssätt

yttre stabilitet
rörelsemönster
kraftbalanser

Strukturers verkningssätt

inre stabilitet
kraftmönster
tryck/drag

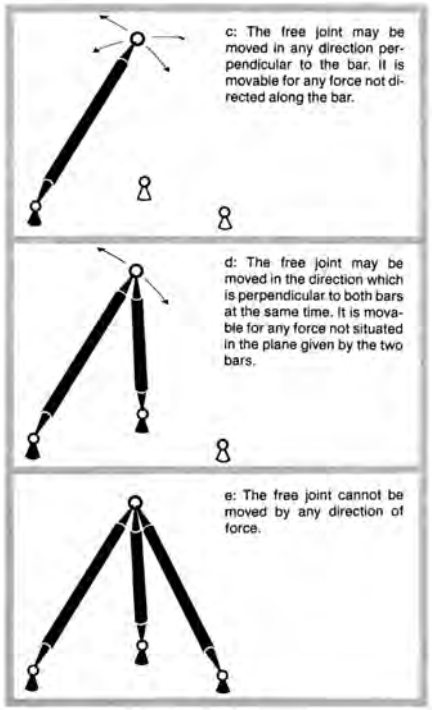
För alla konstruktionstyper och former i 2D

utom linkonstruktioner

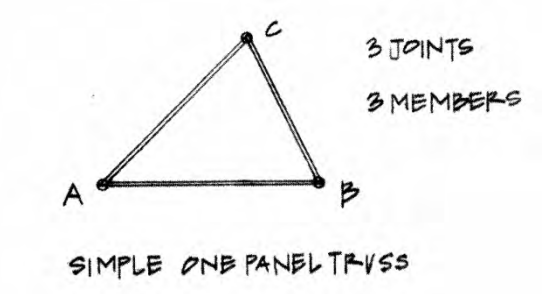
Stänger och fackverk

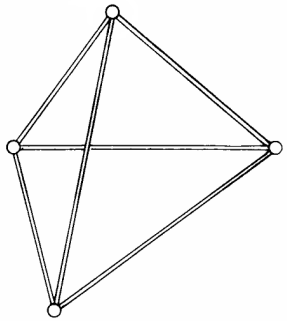
uppbyggnad
stabila grundformer
beståndsdelar

Uppbyggnad



Stabila grundformer





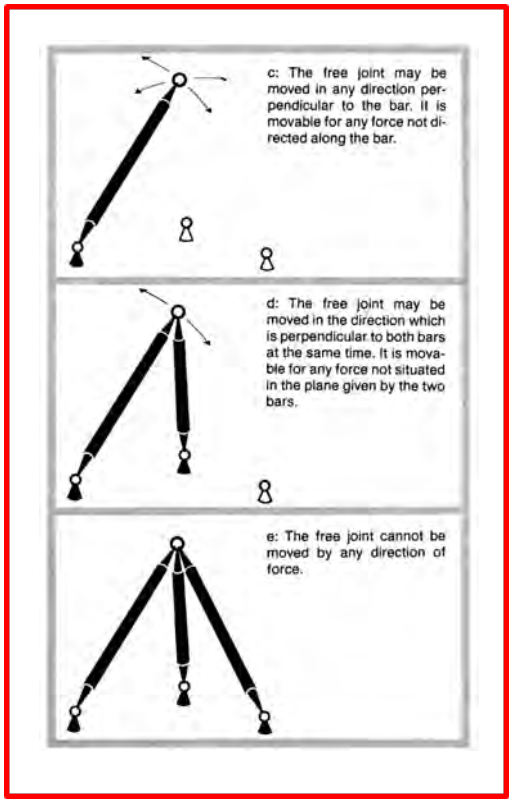
Beståndsdelar

Stång
(styvhet EA/L)

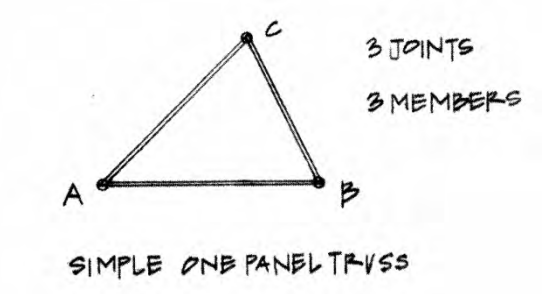
Knutpunkt
(friktionsfri led)

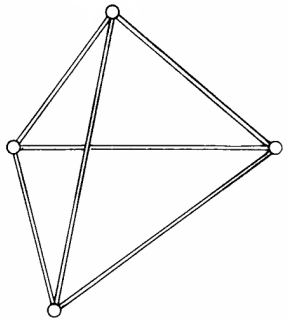
Systemlinje

Uppbyggnad



Stabila grundformer



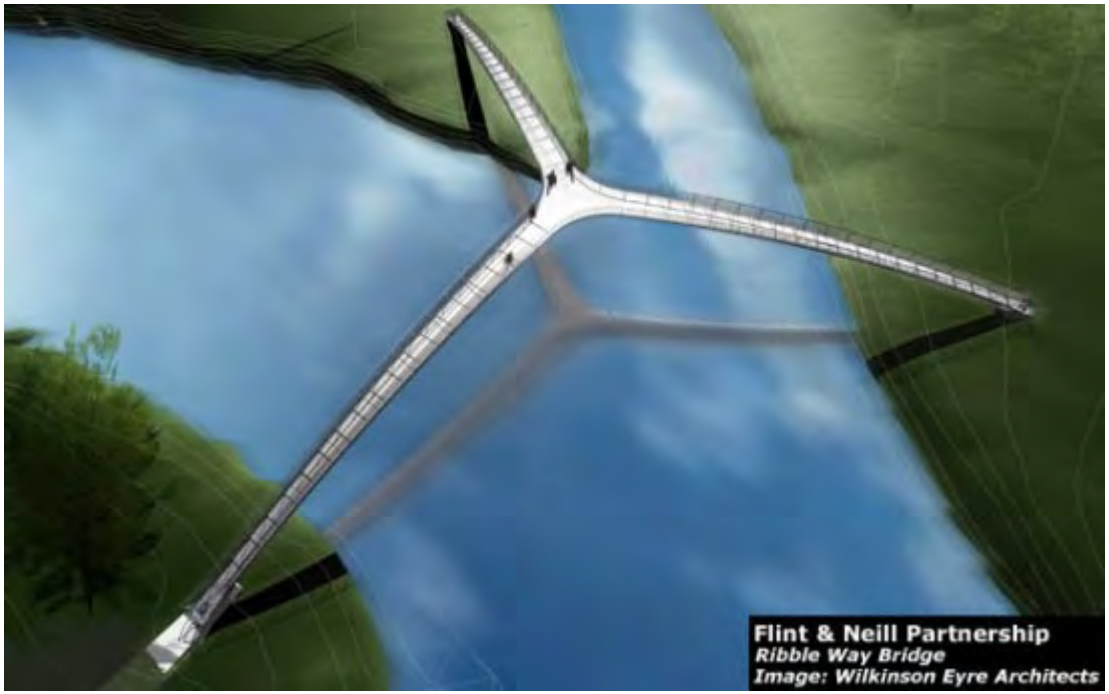


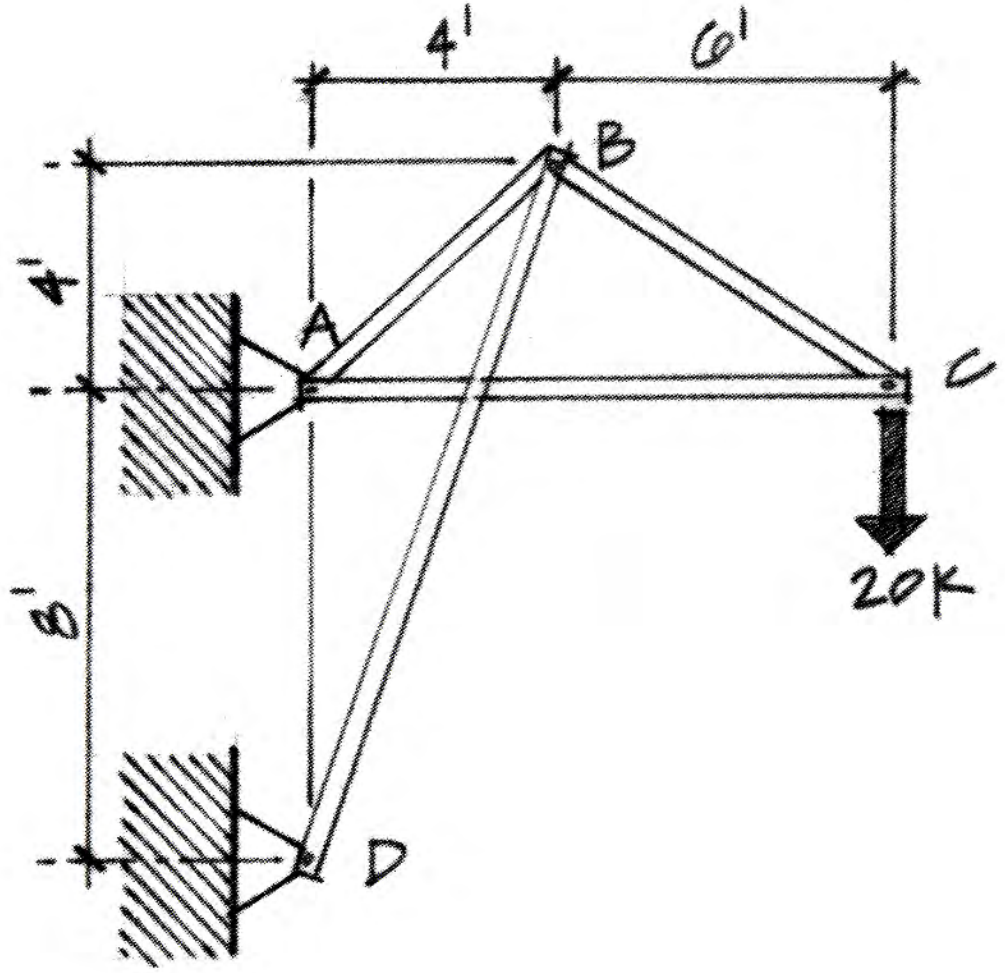
Beståndsdelar

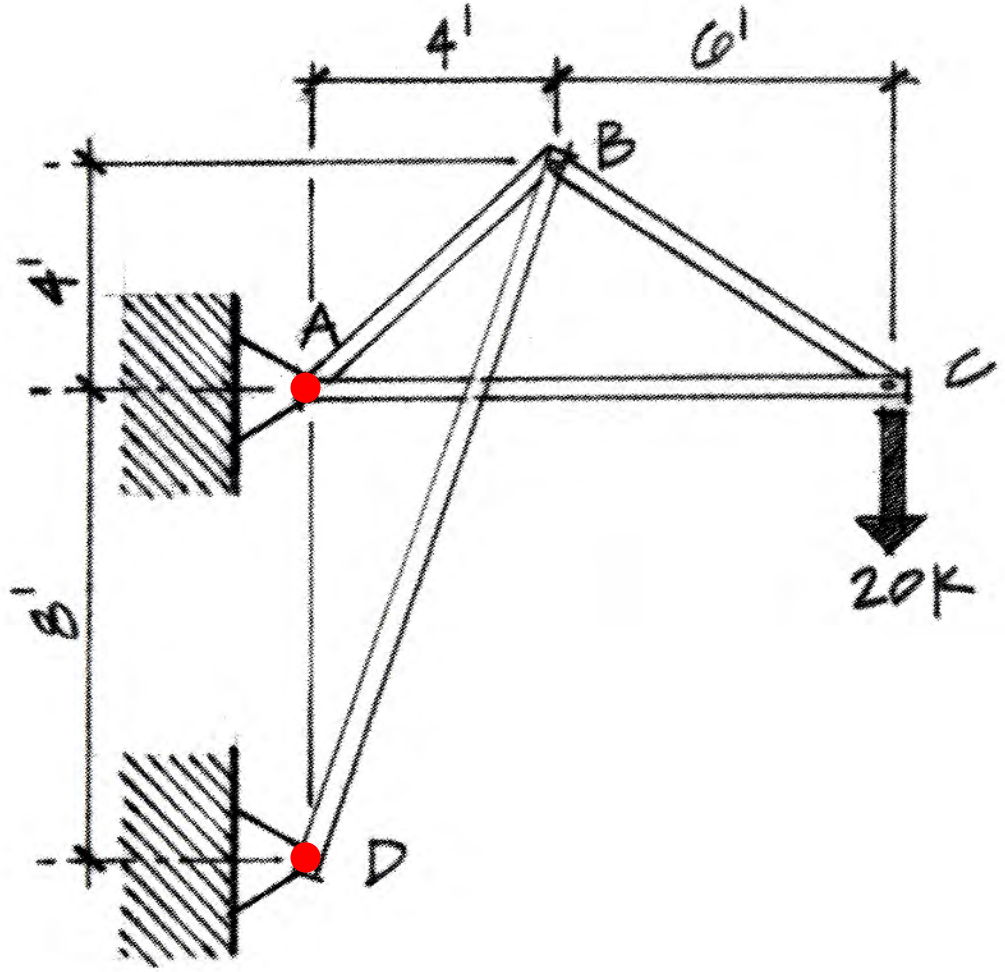
Stång
(styvhet EA/L)

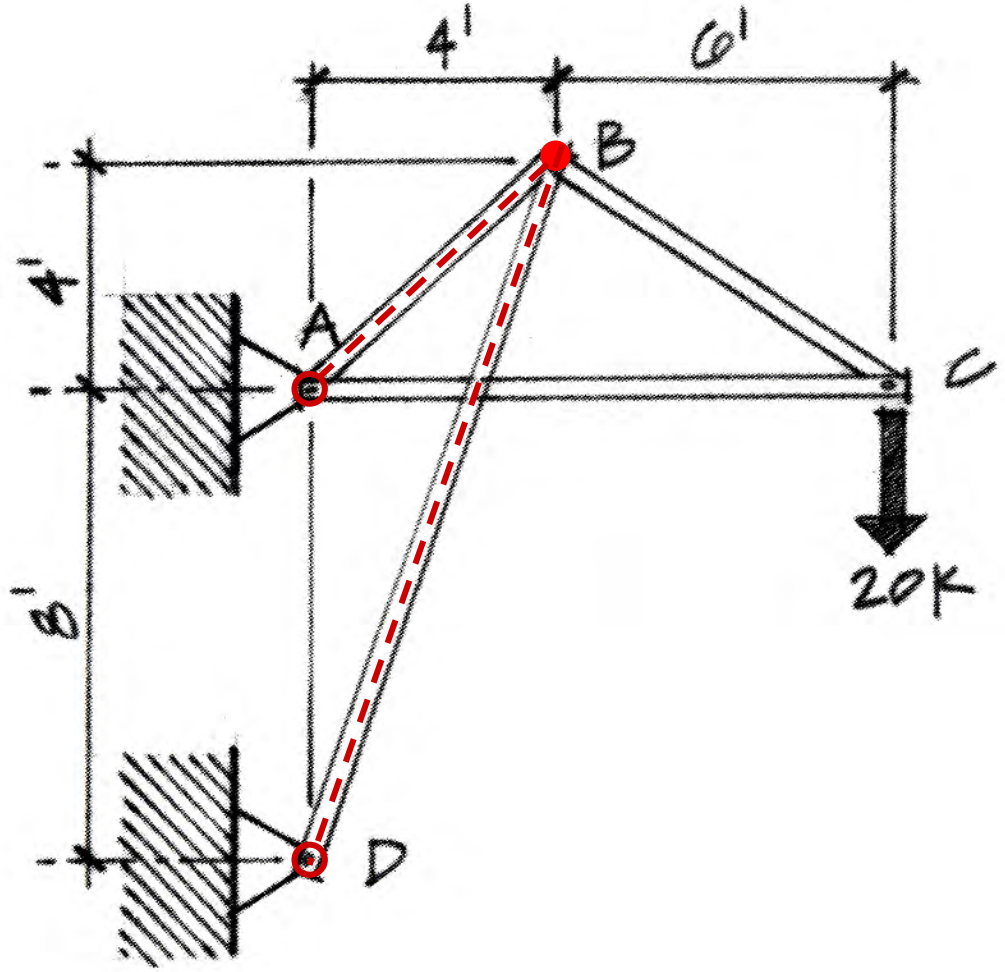
Knutpunkt
(friktionsfri led)

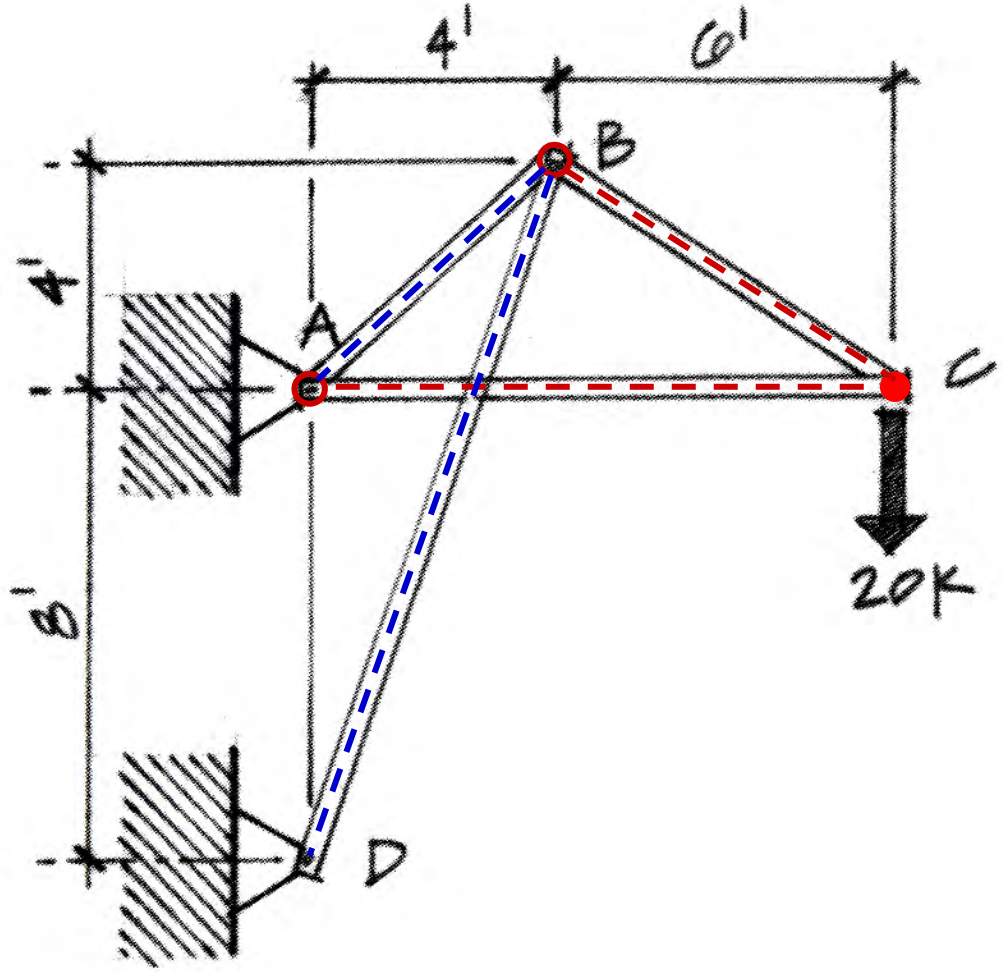
Systemlinje

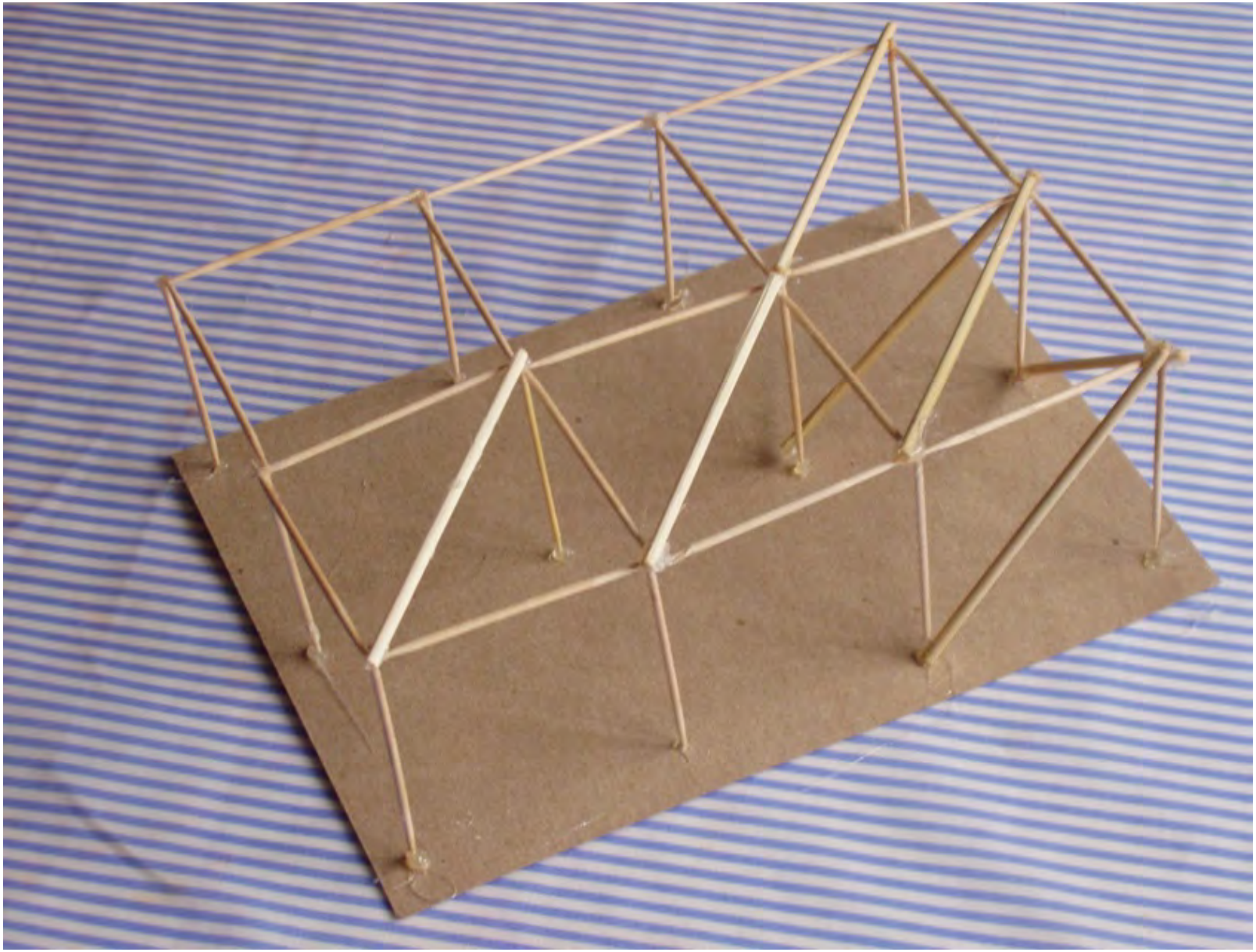

Flint & Neill Partnership
Ribble Way Bridge
Image: Wilkinson Eyre Architects

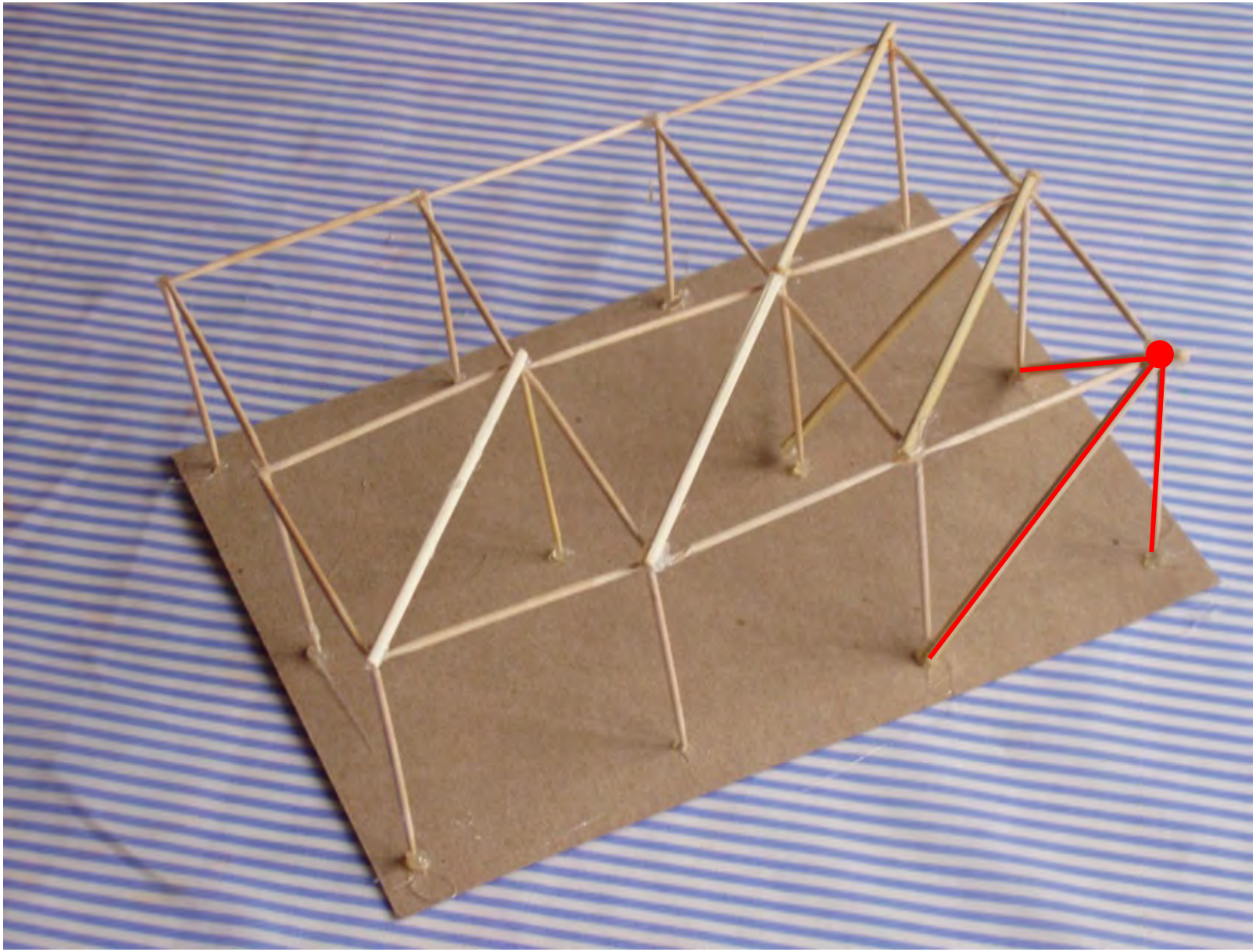

4'
6'
B
4'
A
C
8'
20K
D

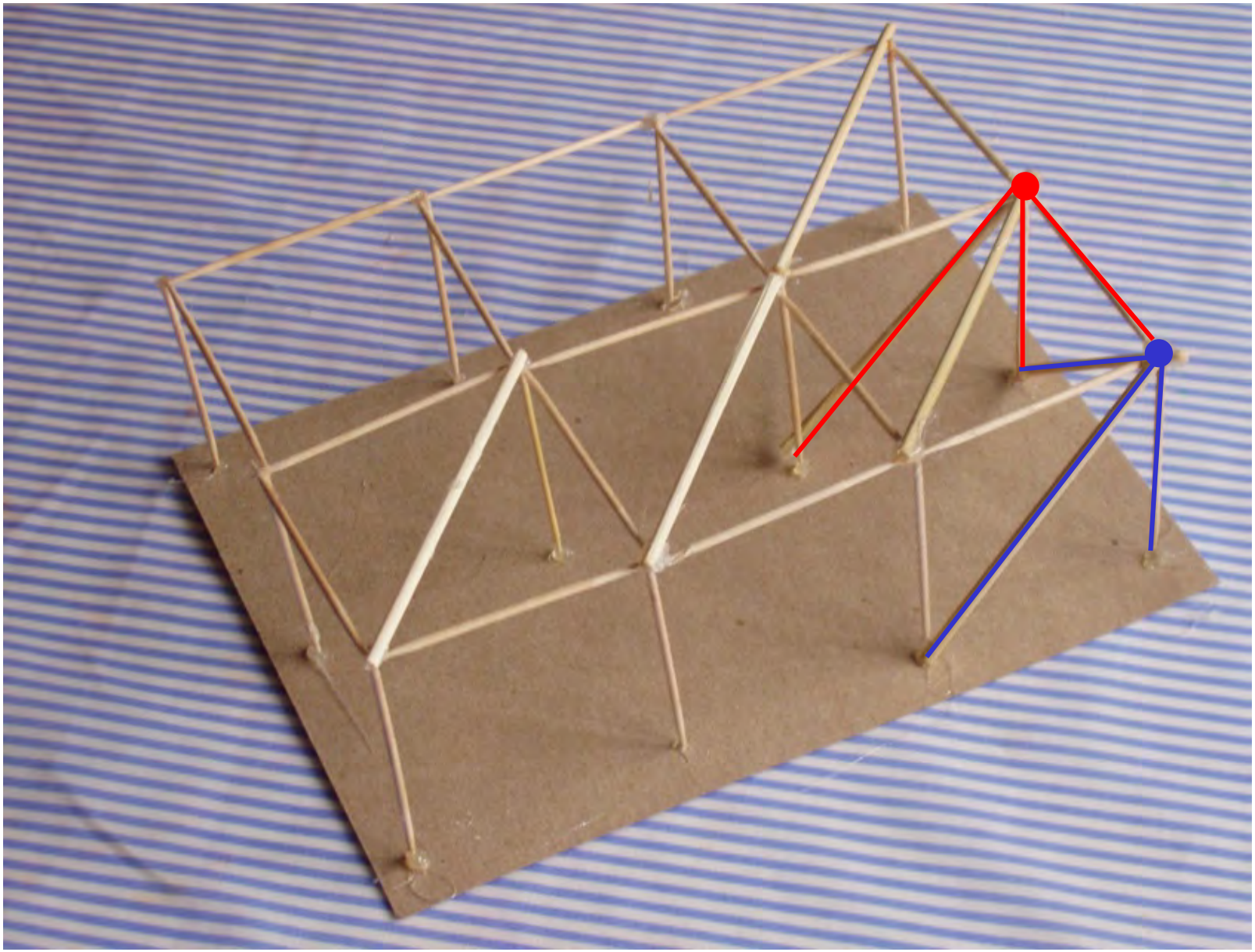

4'
6'
B
4'
A
C
8'
20K
D

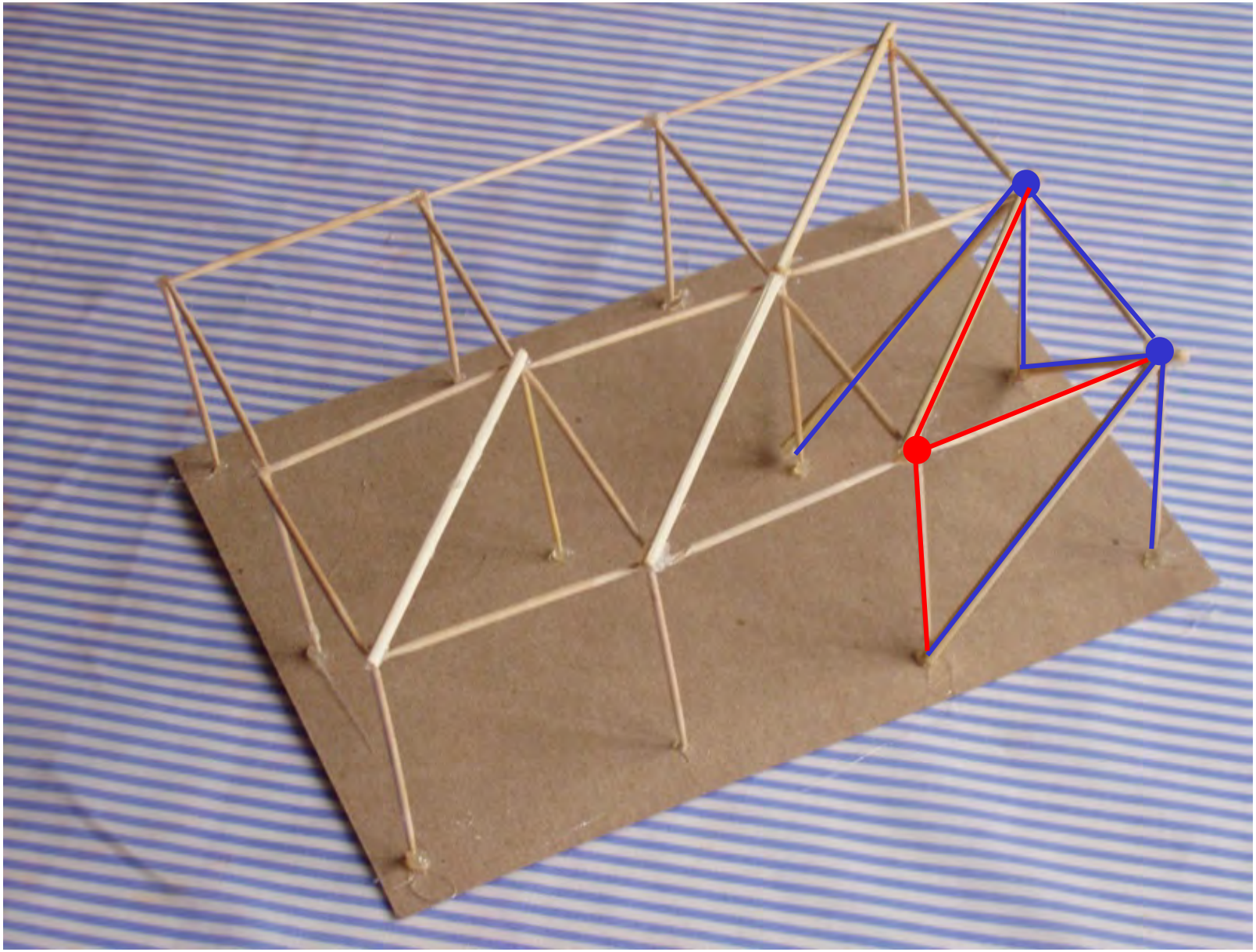

4'
6'
B
4'
A
C
8'
20K
D

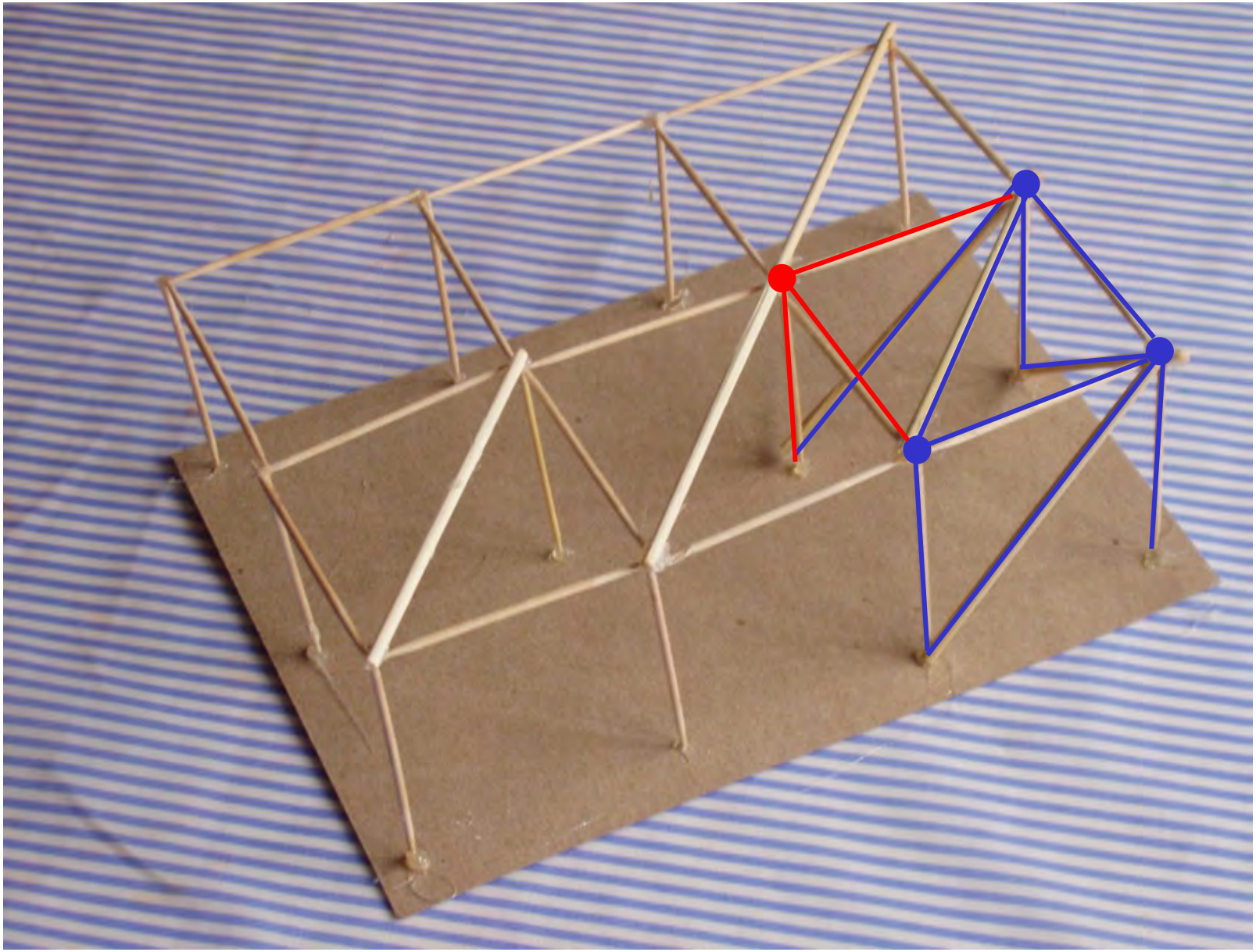

4'
6'
B
4'
A
C
8'
20K
D

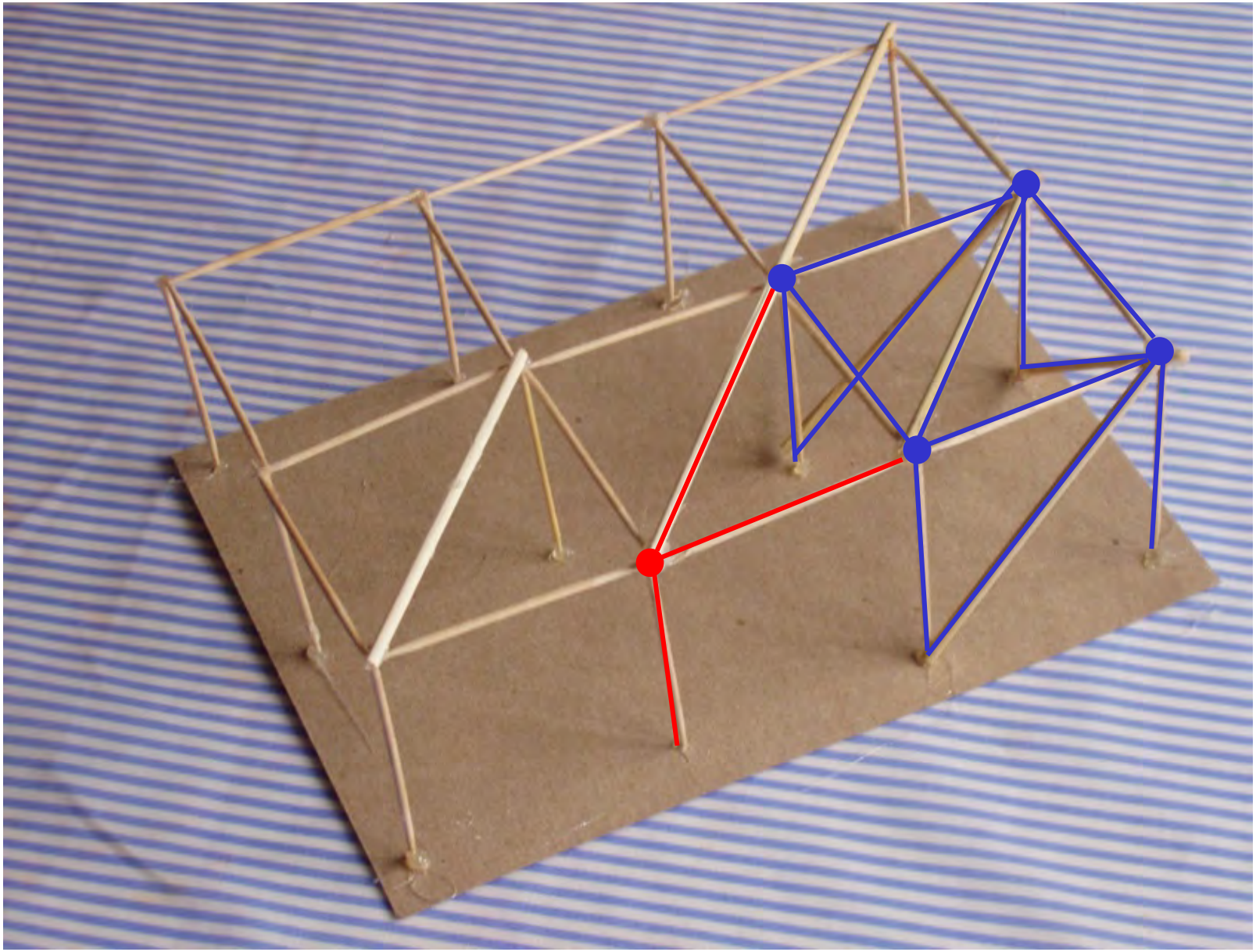


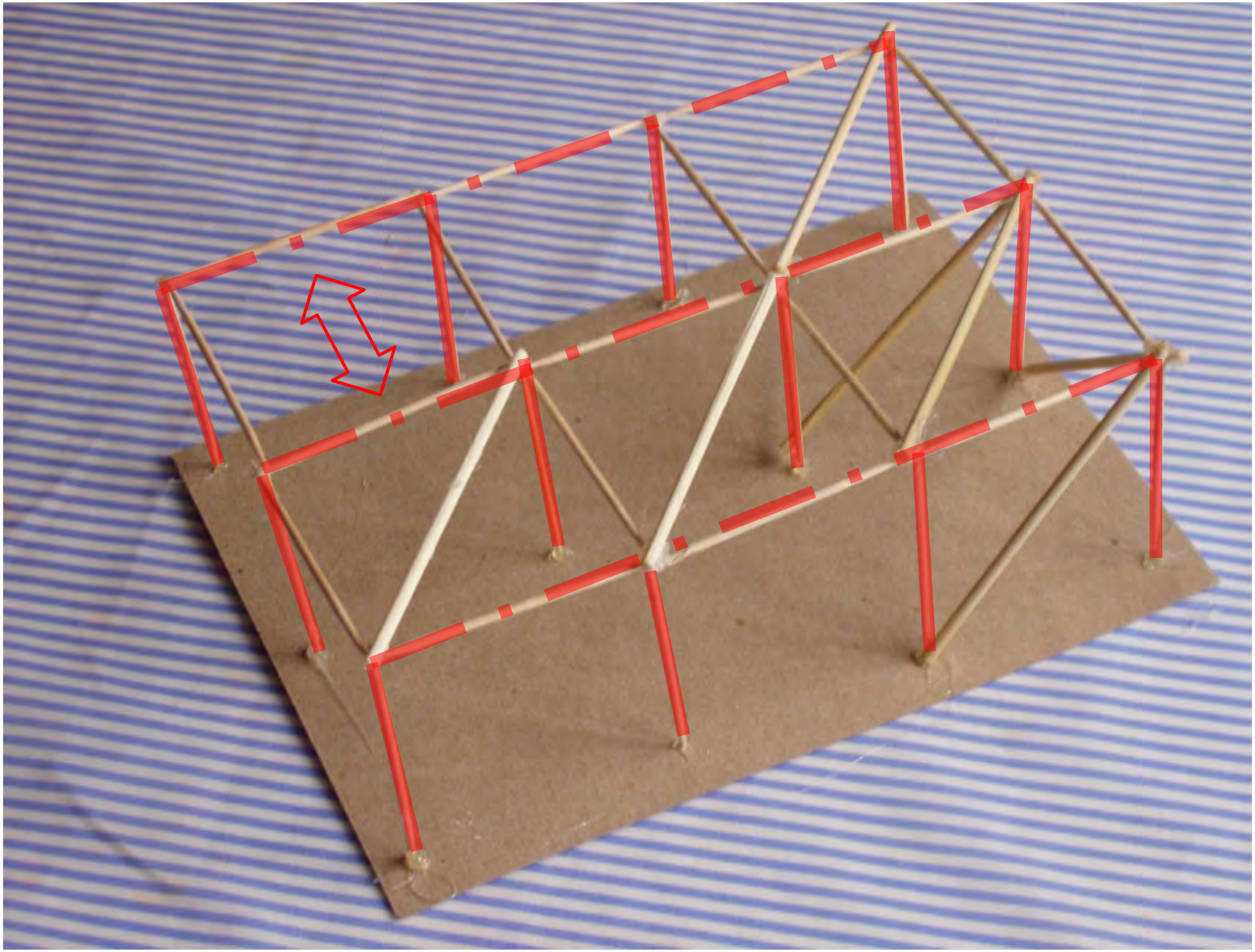


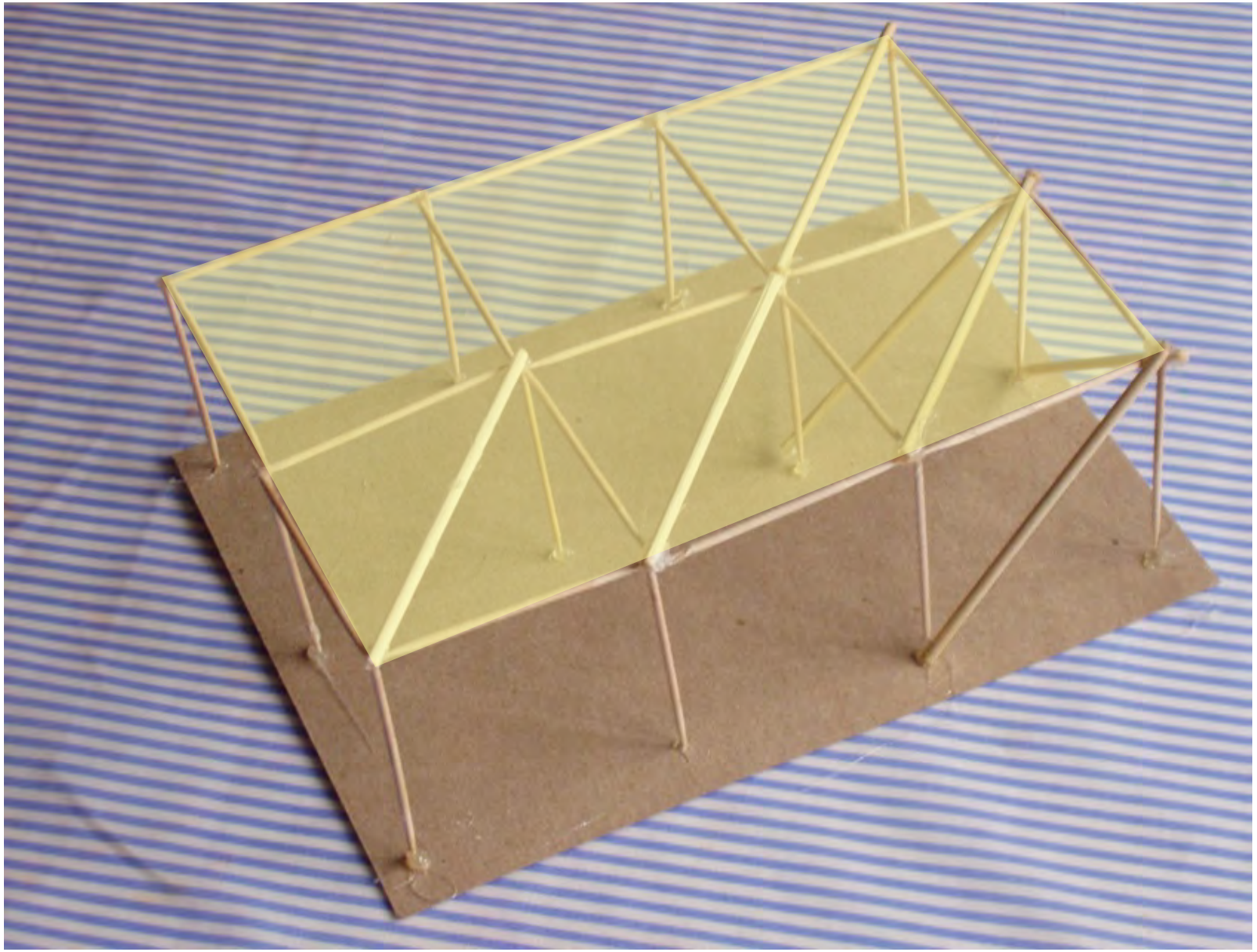


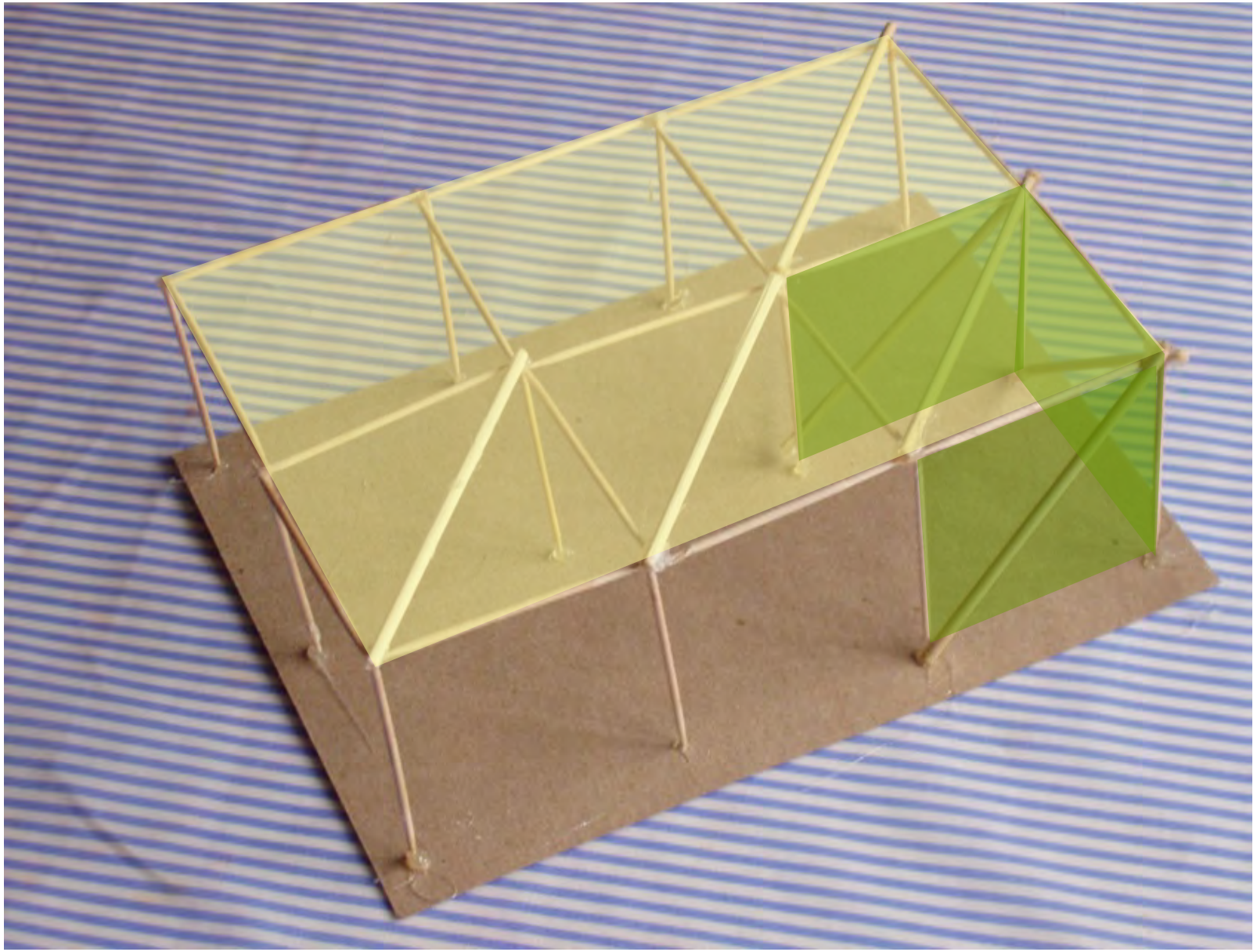


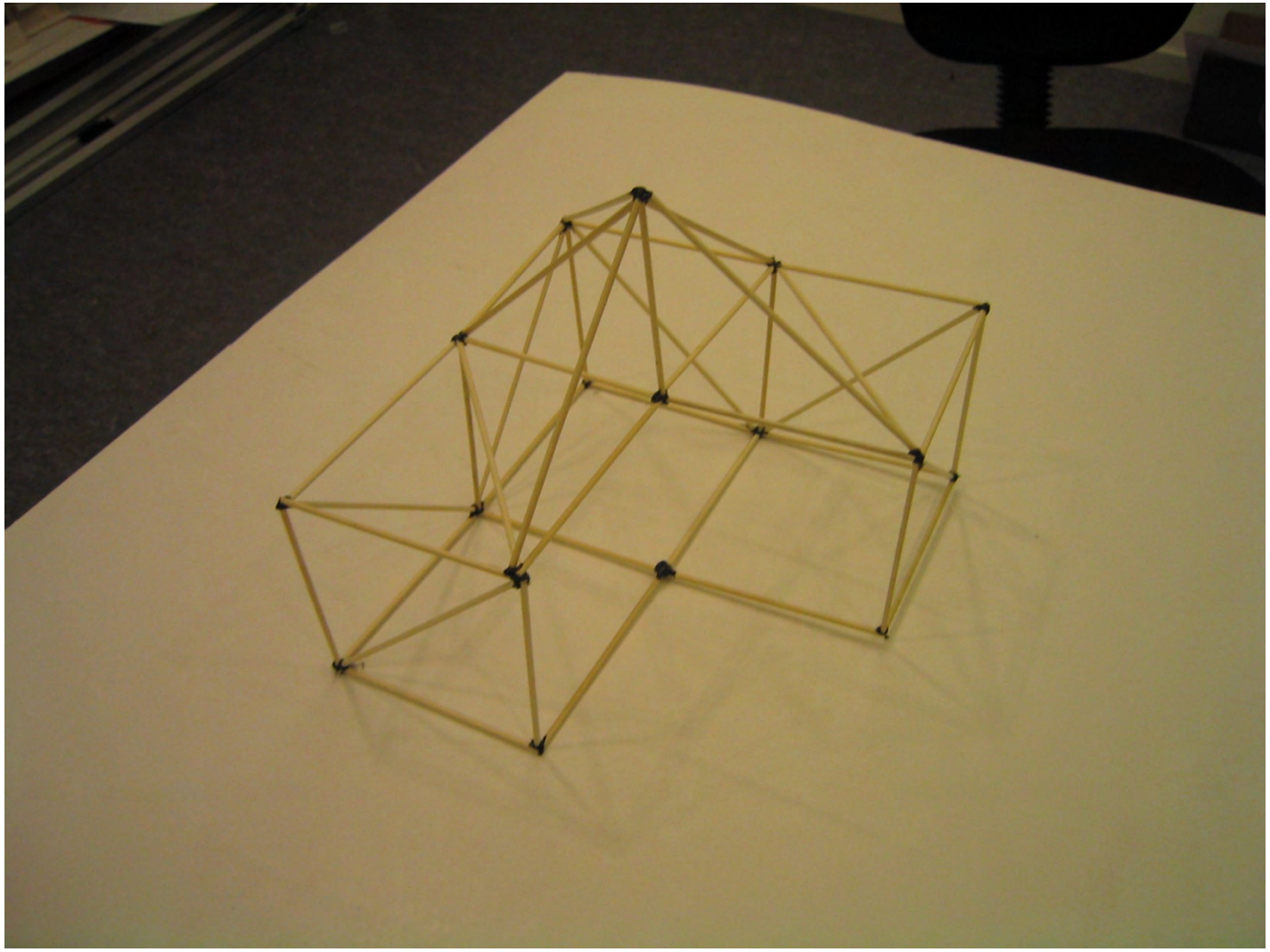












Nya ögon på glas 2013 – 1:a pris Chalmers

Ur juryns omdöme

Ett exempel på när en tydlig idé blir slagkraftig och illustrativ. Man lyfter fram och gestaltar glasets ”okända” egenskaper med en sinnrik dramaturgi.

Förslagsställare: Daniel Elis Karlsson och Pauline Algeröd, Chalmers.

Bärande möte

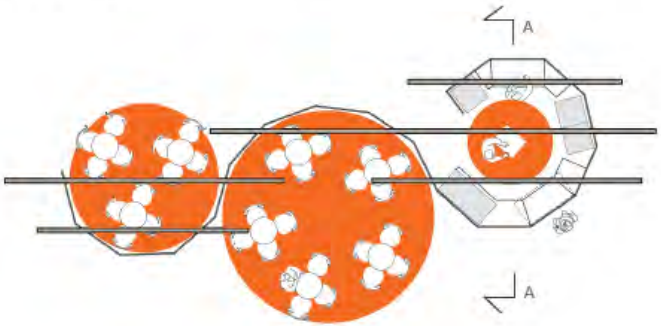
Den allmänna användningen av glas är för dekoration. Fönster, glaskonst och allmännyttiga vardagsföremål.

Vi förändrar synen på glaset genom att låta det bära. Det som vanligtvis är bärande, betongen, används dekorativt. Vi påvisar kraften som glaset besitter och med det dess möjligheter.
Genom glasets transparens förstärks upplevelsen av balkarnas tyngd och ökar kontrasten med de olika materialen.

Bärande möte

Första anblicken av cafet är långa, tunga och obehandlade betongbalkar som verkar flyta i luften. Vid närmare granskning av caféet ges den överraskande upptäckten att balkarna löper stadigt över flertalet glasskivor. Glasskivornas transparens gör att besökaren automatiskt får en genomsikt och överblick över de separerade cafédelarna.

En starkt iögonfallande orange möblering markerar mötesplatsen och förstärker genomsiktligheten

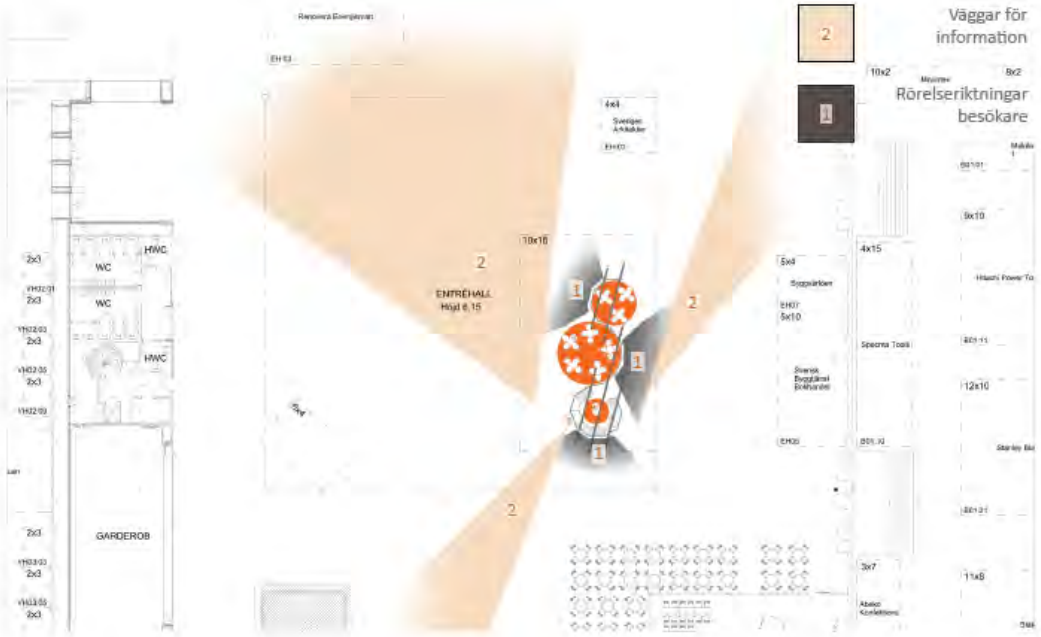


Plan 1:100

Cafét grundar sig i formen av kurva med tre rumsligheter. Väggarna är uppbyggda av likformiga transparanta glasskivor och bär robusta balkar av betong. Rummen definieras av det tunga bjälklaget och de bärande glasenheterna.

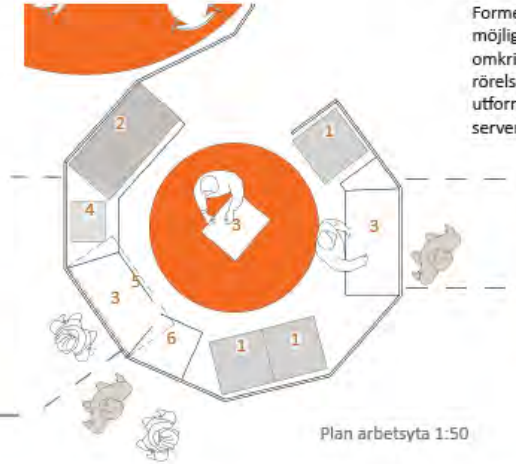
Fasad Väst 1:100

Sektion A-A 1:100



Omgivningsplan (ej skalenlig) 1:100

Här finns plats för 32 sittande gäster. Servering från två sidor. Möjlighet för upphängning av information finns på de konvexa utsidorna. Projektorer ersätter, den enligt programmet specificerade, 42 tums skärmen och visar rörlig information. Genom detta blir alla caféets ytor aktiverade.

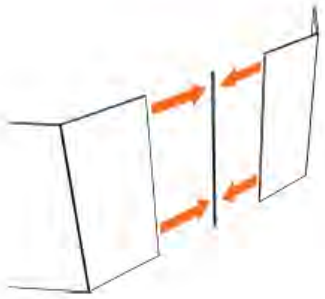


Plan arbetsyta 1:50

Formen och placeringen möjliggör ett möte från alla omkringliggande rörelseriktningar. Den runda utformningen tillåter servering från två sidor.

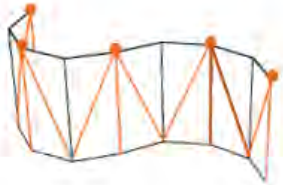
1. Kylskåp
2. Espressomaskin
3. Arbetsyta
3. Serveringsyta
4. Kassapparat
5. Disk för drycker
6. Diskho

1



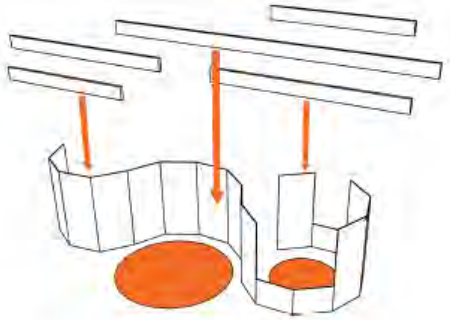
Klarlaminerade skyddsglasskivor, (B1200,D24,H2800mm) fogas ihop med hjälp av silikon.

2



Den bärande strukturen i konstruktionen uppkommer genom skivverkan i glasenheterna. Genom skivornas sammansättning och vinkel uppstår en stabil konstruktion. Varje hörn på en enhet kan ses som en punkt i rymden och får genom enheternas sammanfogning tre stöd och blir därmed statisk bestämd. Bilden ovan visar ett urval av punkter.

3

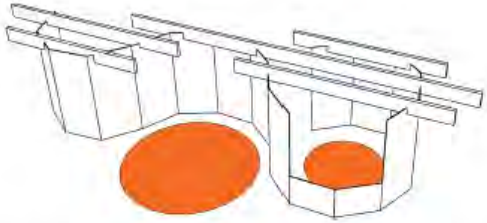


De avslutande punkterna i kedjan är inte statiskt bestämda. Dessa får istället stabilitet med hjälp av betongbalkarna. Genom att all stabilitet kommer utifrån skivverkan och balkarnas låsning behövs ej några stöttande tillägg, som exempelvis golvfenor.

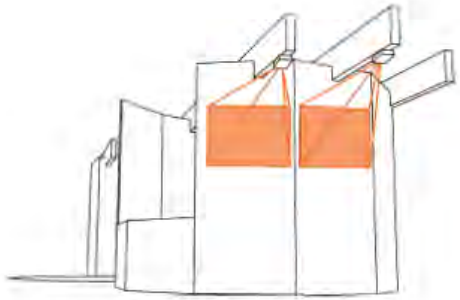
4

Betongbalkarna ger stabilitet och låser fast de yttersta skivorna. Där balkarna möter glas är betongen urfasad och gummibeklädd. Här får balkarna vila fritt.

5



Genom balkarnas låsning och skivornas vinkel fås en struktur som står stabilt utan några konstruktiva tillägg.



De utstickande balkarna används för att hålla projektorer. Möjligheter finns att projicera information mot en folieförsedd glasyta.

idéer om rum och material

begrepp som motiv

språng, vibrera, rytm, falla och upphäva

locka fram begreppet genom att pröva olika bilder, metaforer, fysiska experiment, …

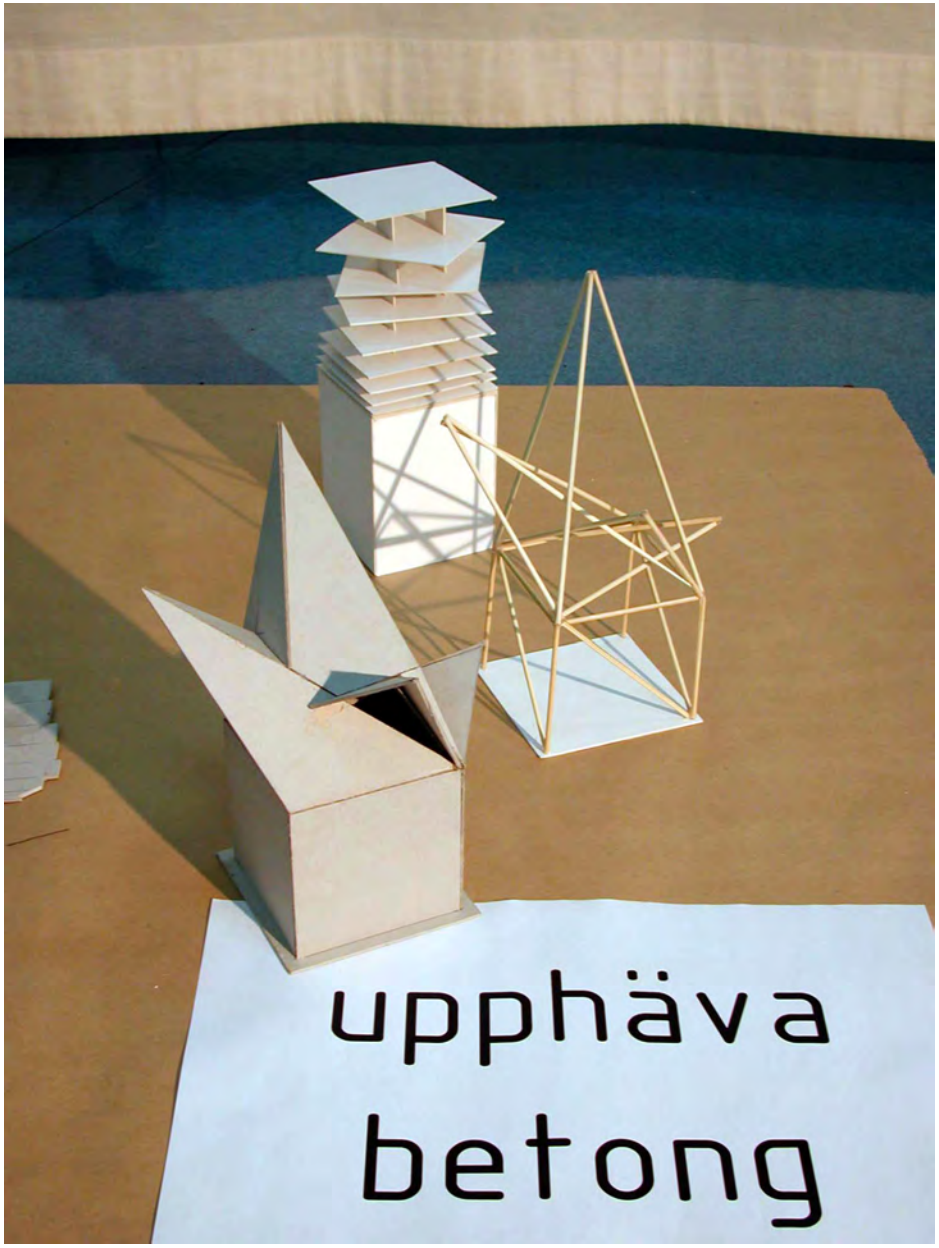
punkter i rymden

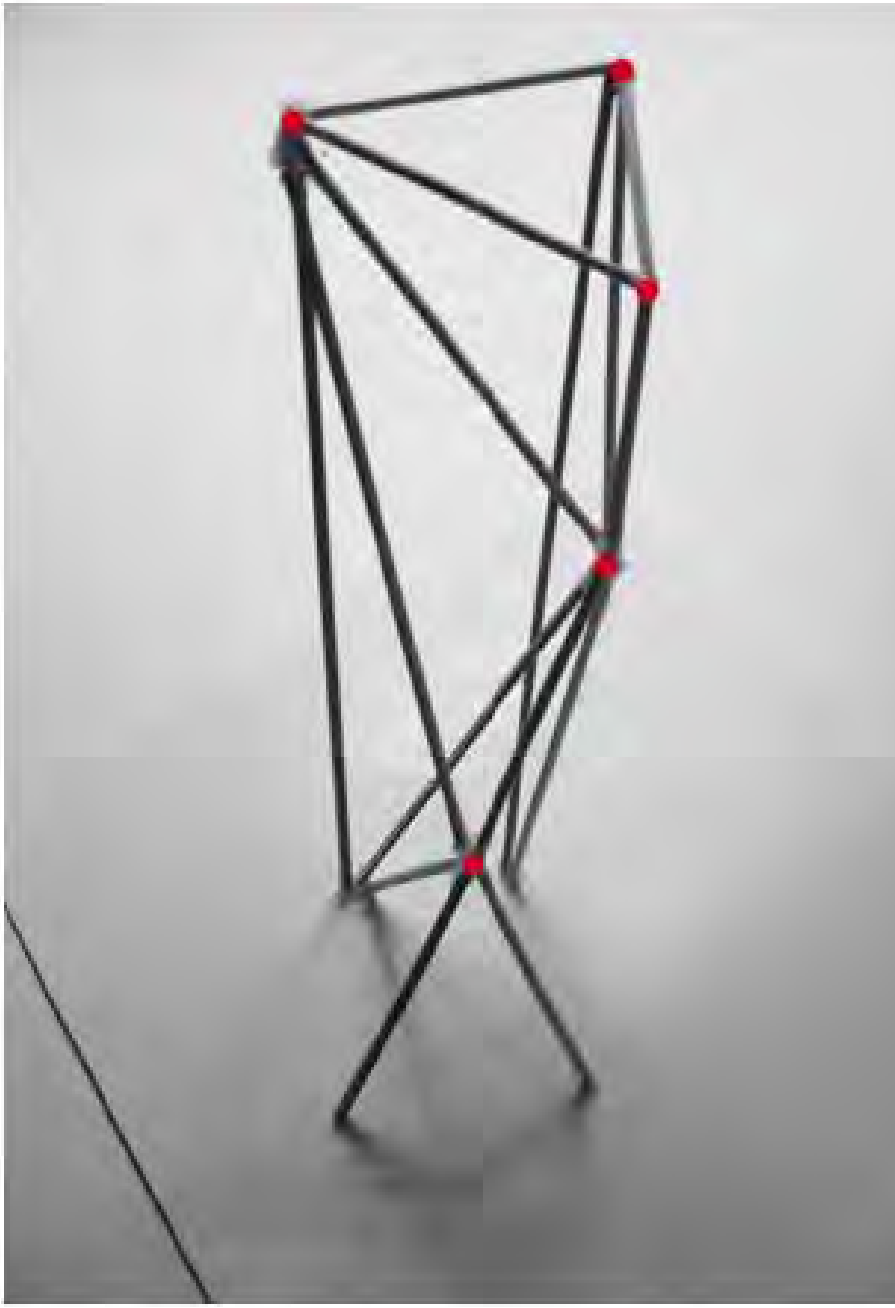
villkor för stabilitet
styvhet och vekhet
fästa punkter i rymden

material och rum

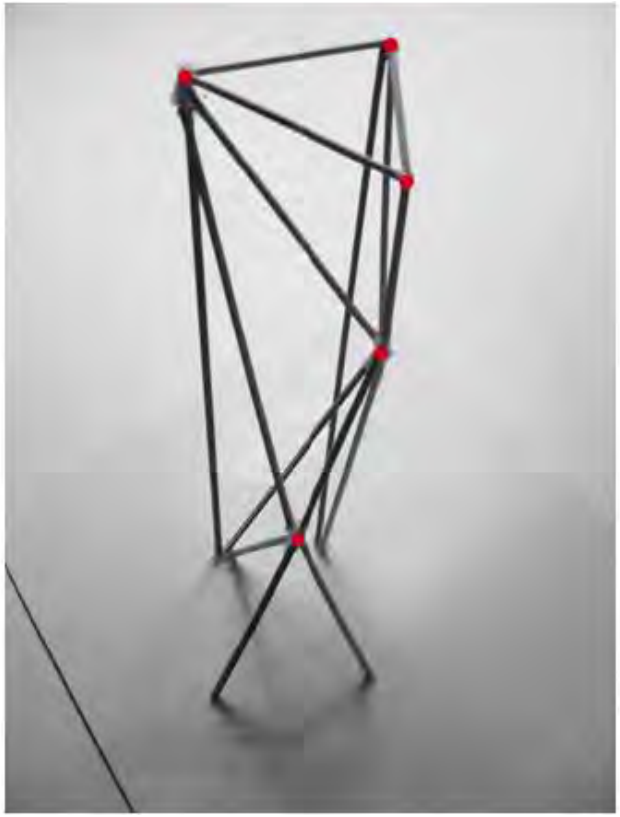
stål, trä, murverk, betong, glas

betrakta konstruktionen utifrån en bestämd belastning och avgör vilka delar som är tryckta respektive dragna
studera materialens egenskaper – draghållfasthet, tryckhållfasthet
utforma konstruktionen med hjälp av tilldelat material


upphäva
betong

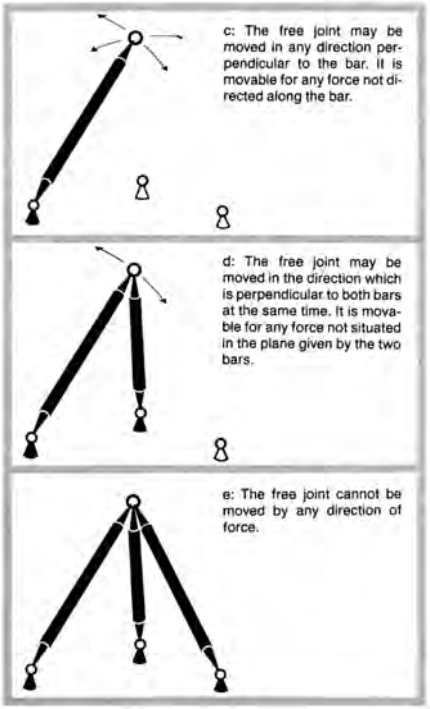


3. Att fästa punkter i rymden

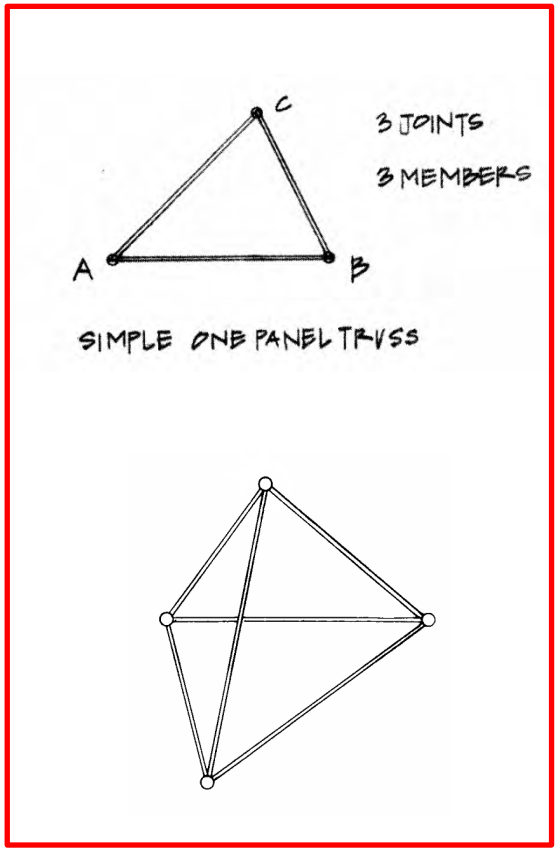


Utgå från ett ting, en händelse, en företeelse eller ett begrepp och fånga det/den i en skiss.
Reducera skissen till 4 – 6 väsentliga punkter.
Bygg en stabil fackverksmodell med hjälp av principen ”att fästa punkter i rymden”.
Använd grillpinnar och limpistol.
Finns något av utgångsidén kvar i den byggda fackverksmodellen?
Pröva att i tanken flytta punkter (jfr MOVE i pointSketch) – kan uttrycket skärpas?

Uppbyggnad



Stabila grundformer

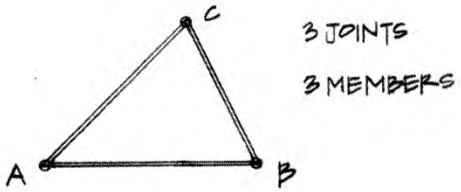


Beståndsdelar

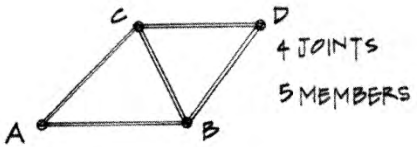
Stång
(styvhet EA/L)

Knutpunkt
(friktionsfri led)

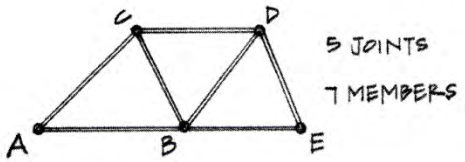
Systemlinje



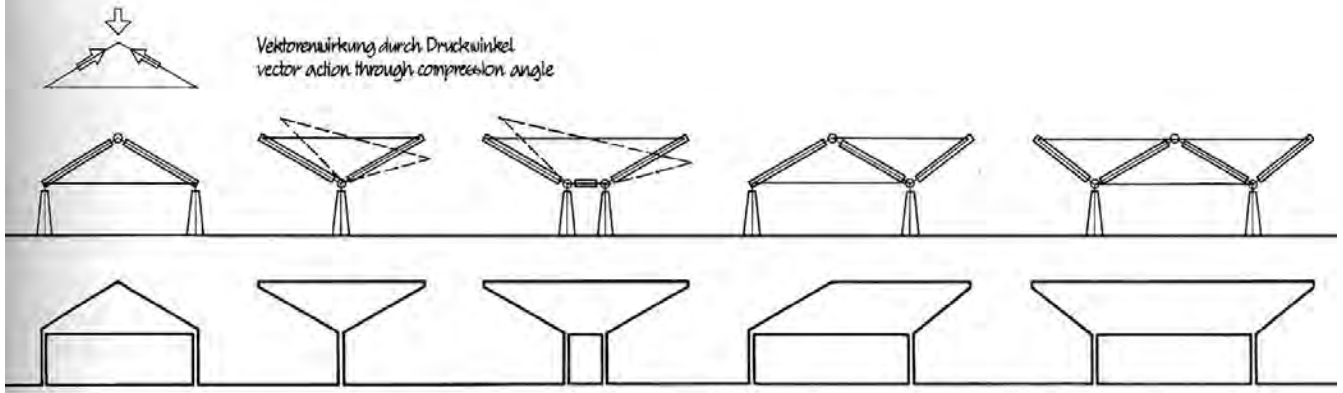
(a) SIMPLE ONE PANEL TRUSS



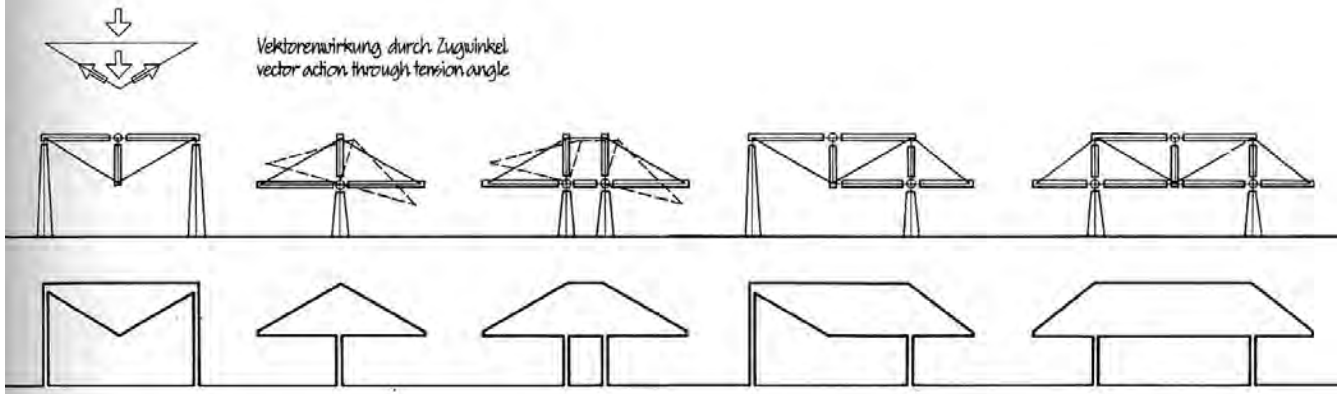
(b) TWO PANEL TRUSS



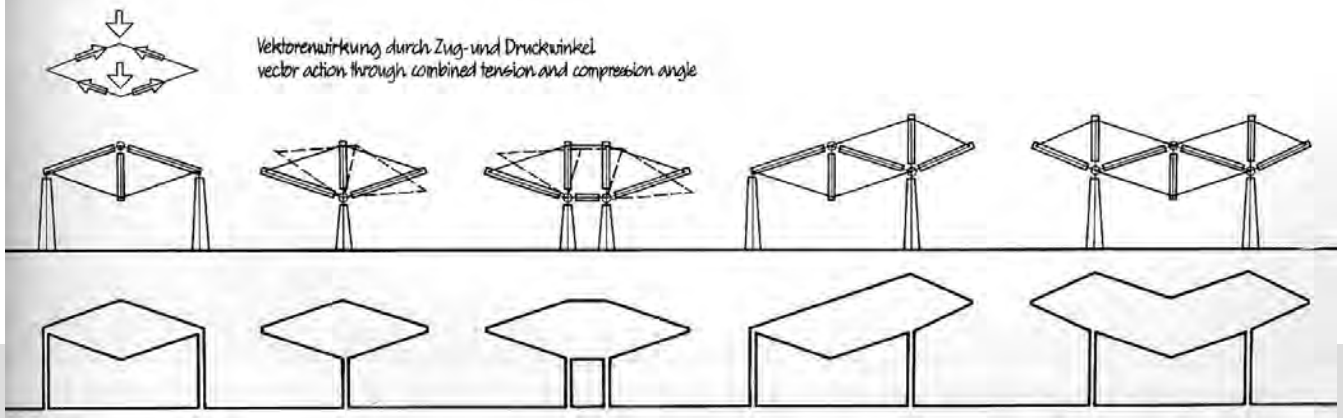
(c) THREE PANEL TRUSS



Vektorenwirkung durch Druckwinkel
vector action through compression angle



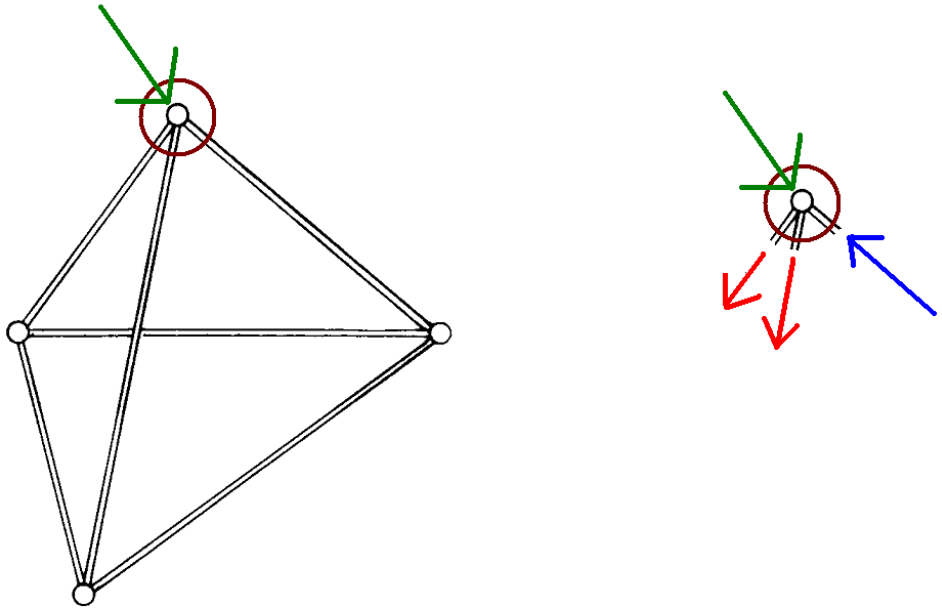
Vektorenwirkung durch Zugwinkel
vector action through tension angle



Vektorenwirkung durch Zug- und Druckwinkel
vector action through combined tension and compression angle

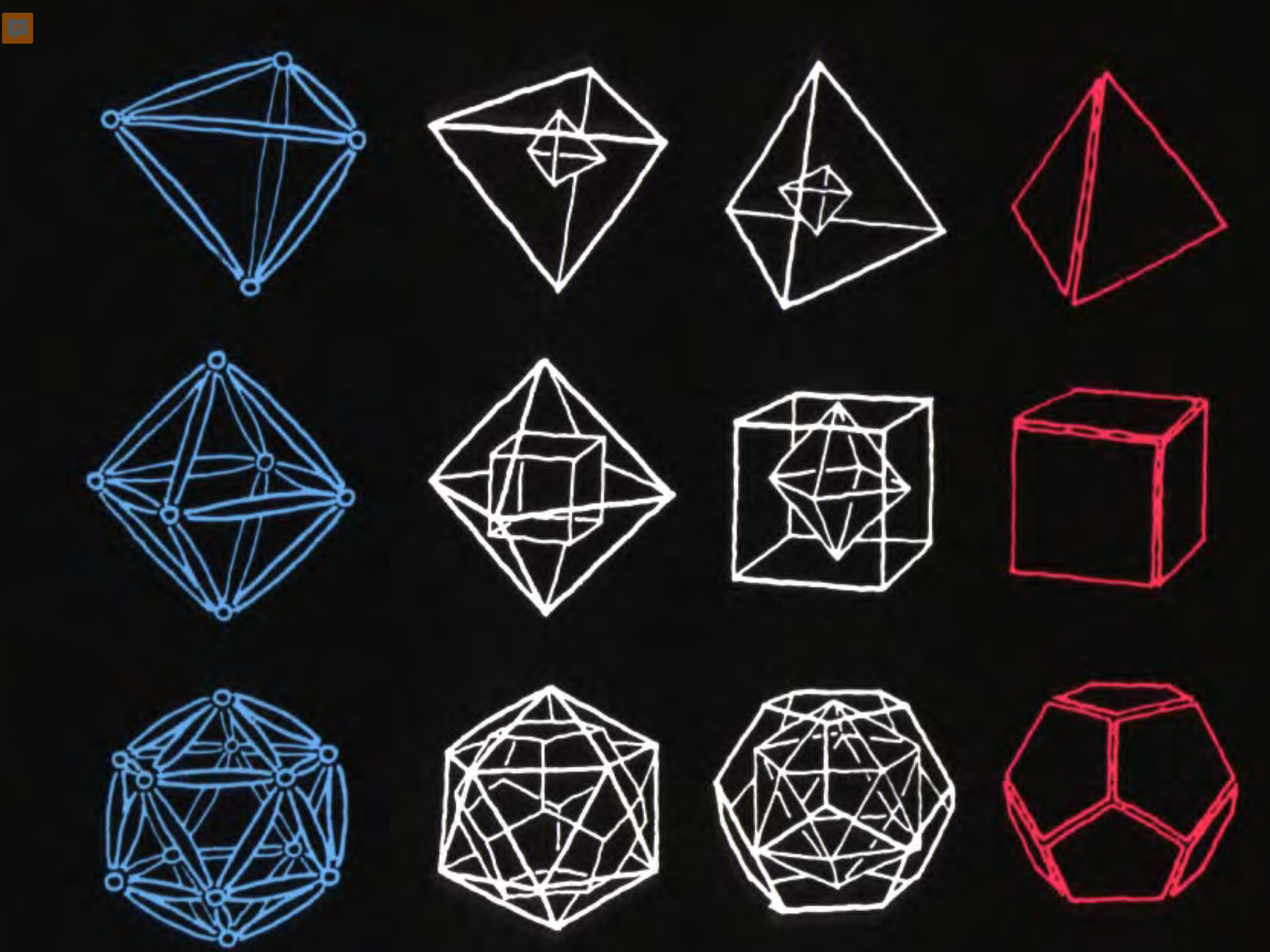
African volture

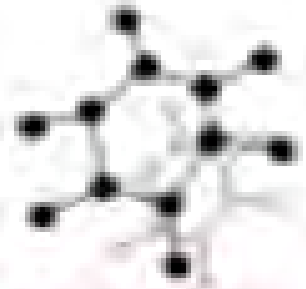
3D fackverk



Partikel-jämvikt
Strukturen bär den yttre kraften
med drag och tryck i knutpunkter


Ture Westers bilder
om strukturers morfologi

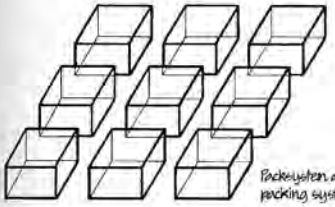




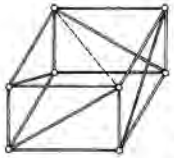
Nano-Gyroids: A Collaboration Between Architects & Crystallographers

Ebene Raumfachwerk-Systeme aus rechteckigen Prismen

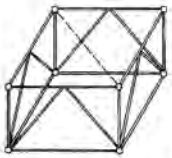
flat space truss systems composed of rectangular prisms



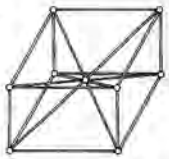
Packsysteme der Einheiten
packing system of units



type 1



type 2

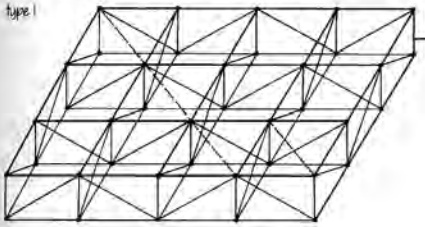


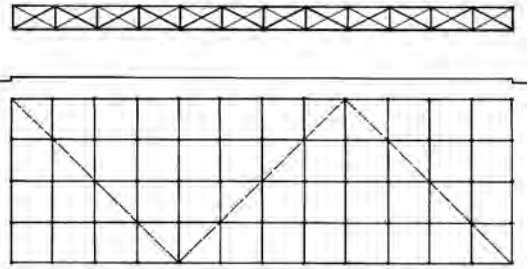
type 3

space units
Raumeinheiten

System mit einfacher Aussteifung der senkrechten Prismenseiten
system with single trussing of vertical prism faces

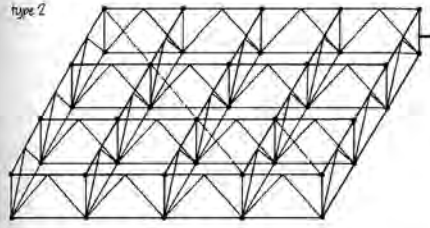
type 1

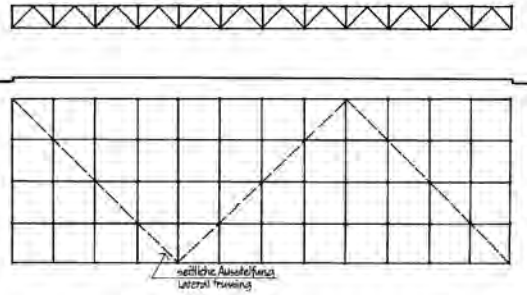




System mit doppelter Aussteifung der senkrechten Prismenseiten
system with double trussing of vertical prism faces

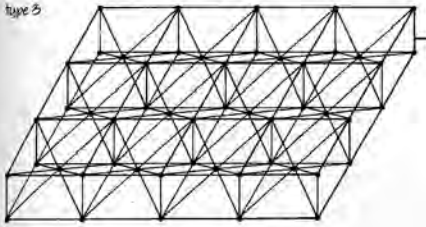
type 2

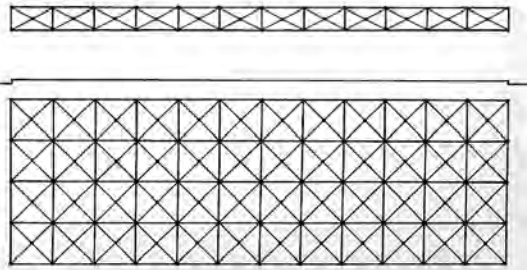




System mit kreuzweiser Aussteifung der diagonalen Prismenschnitte
system with crosswise trussing of diagonal prism sections

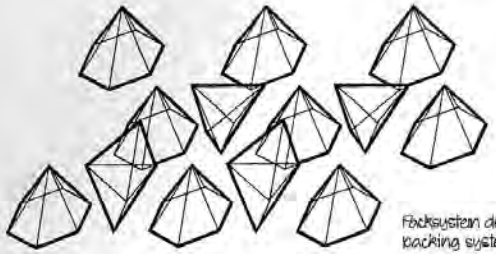
type 3



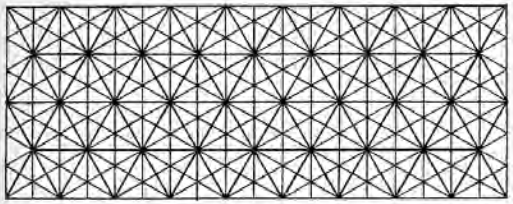


Ebenes Raumfachwerk-System auf Grundlage der Sechseck-Pyramide

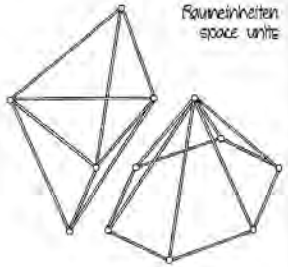
Flat space truss system based upon hexagonal pyramid

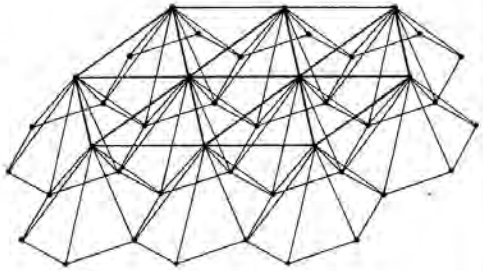


Packsystem der Einheiten
packing system of units



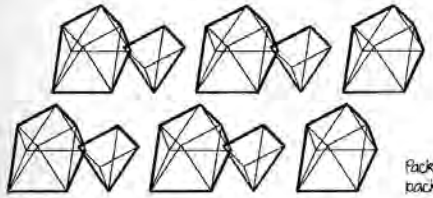
Raumeinheiten
space units



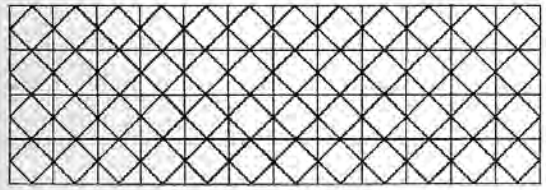


Ebenes Raumfachwerk-System aus zwei gedrehten Quadrat-Rastern

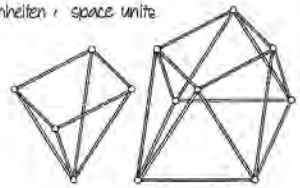
Flat space truss of two square grids with different coordinates

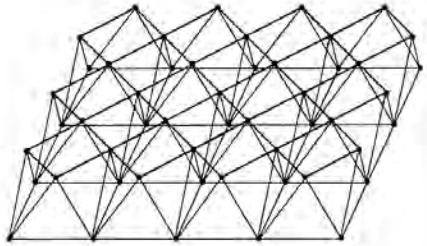


Packsystem der Einheiten
packing system of units

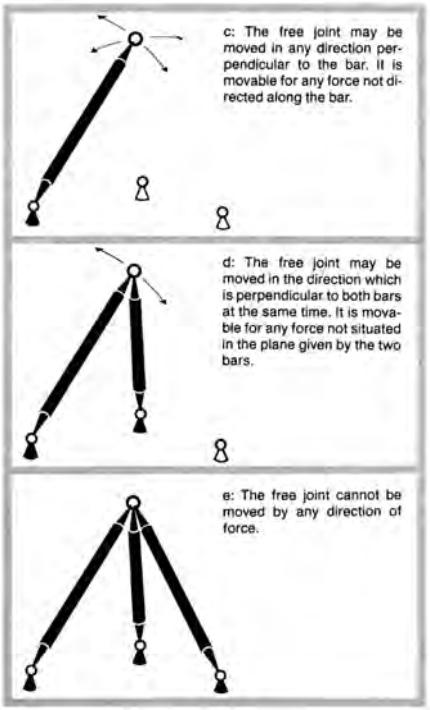


Raumeinheiten / space units

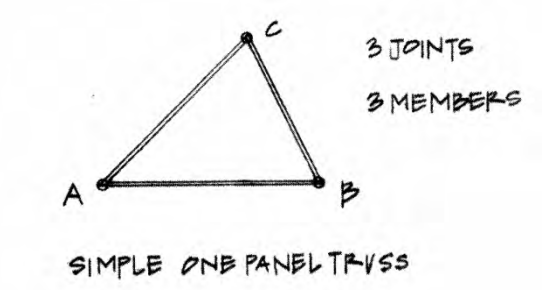


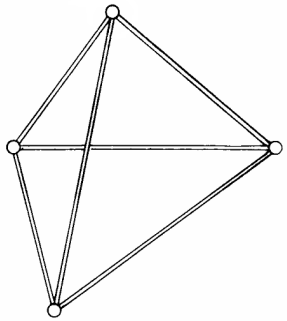


Uppbyggnad



Stabila grundformer



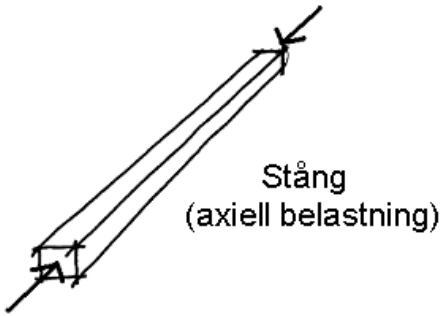


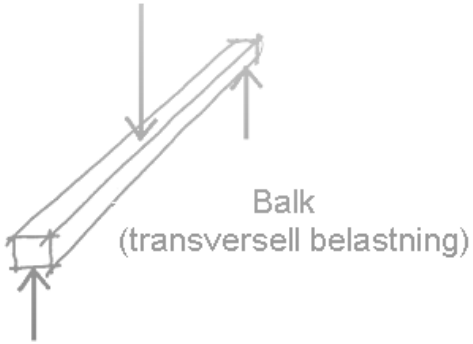
Beståndsdelar

Stång
(styvhet EA/L)

Knutpunkt
(friktionsfri led)

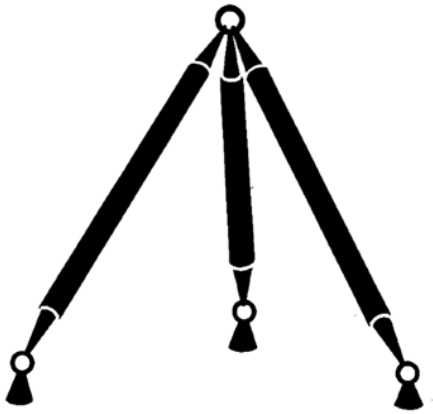
Systemlinje





Stång

Kraftbegrepp
- axiell belastning
- normalkraft
- (stångkraft)
- normalspänning
- tryck/drag



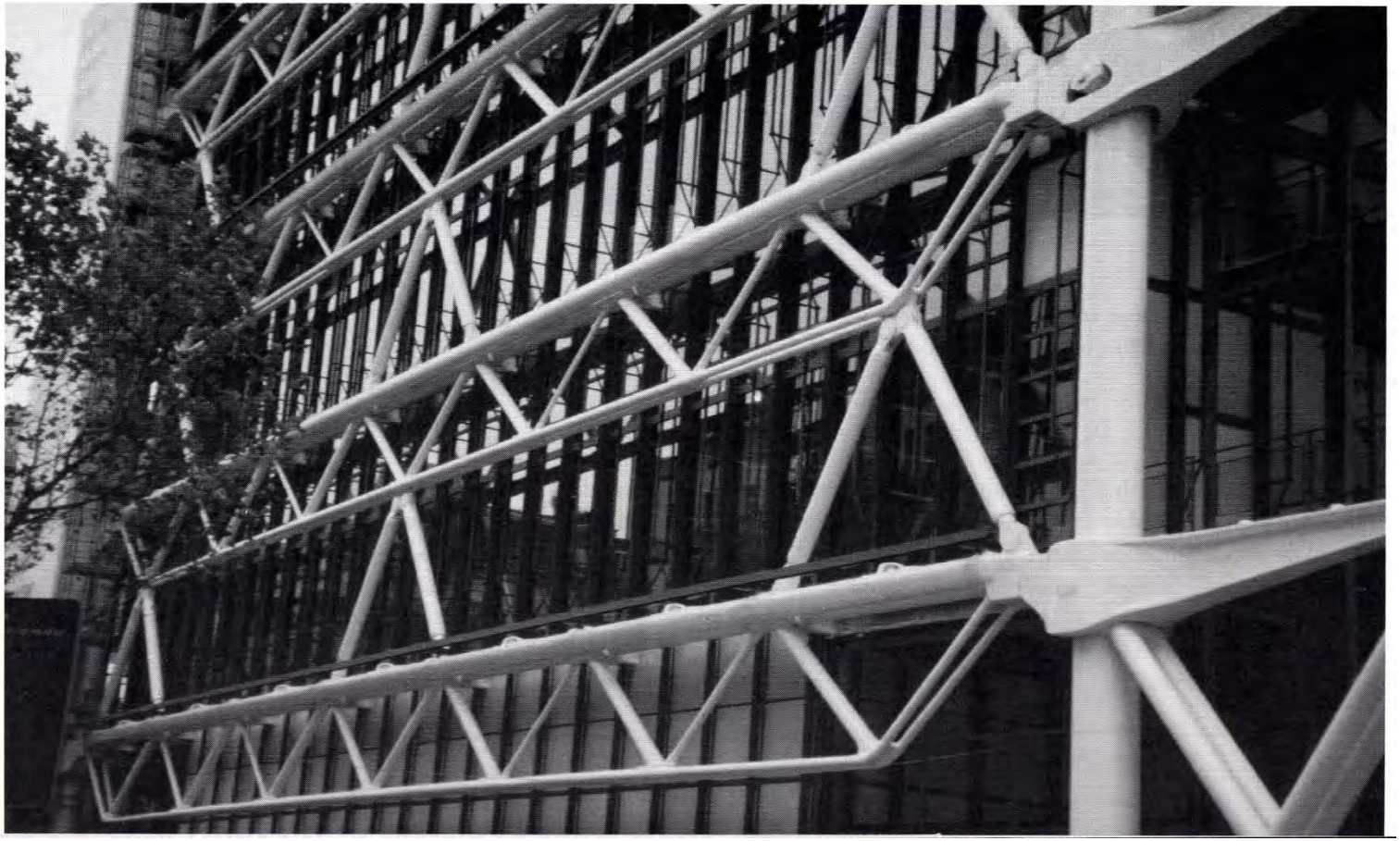
Systemlinje

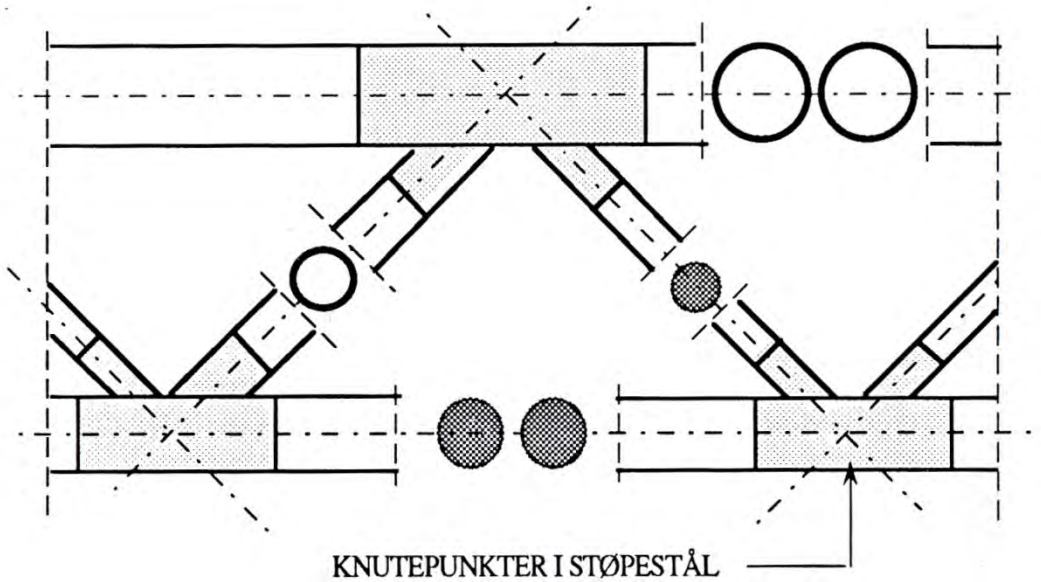
Styvhet EA/L
(motstånd mot deformation)
- E=elasticitetsmodul
- (materialets motstånd)
- A=tvärsnittsarea
- (tvärsnittsformens motstånd)
- L=längd

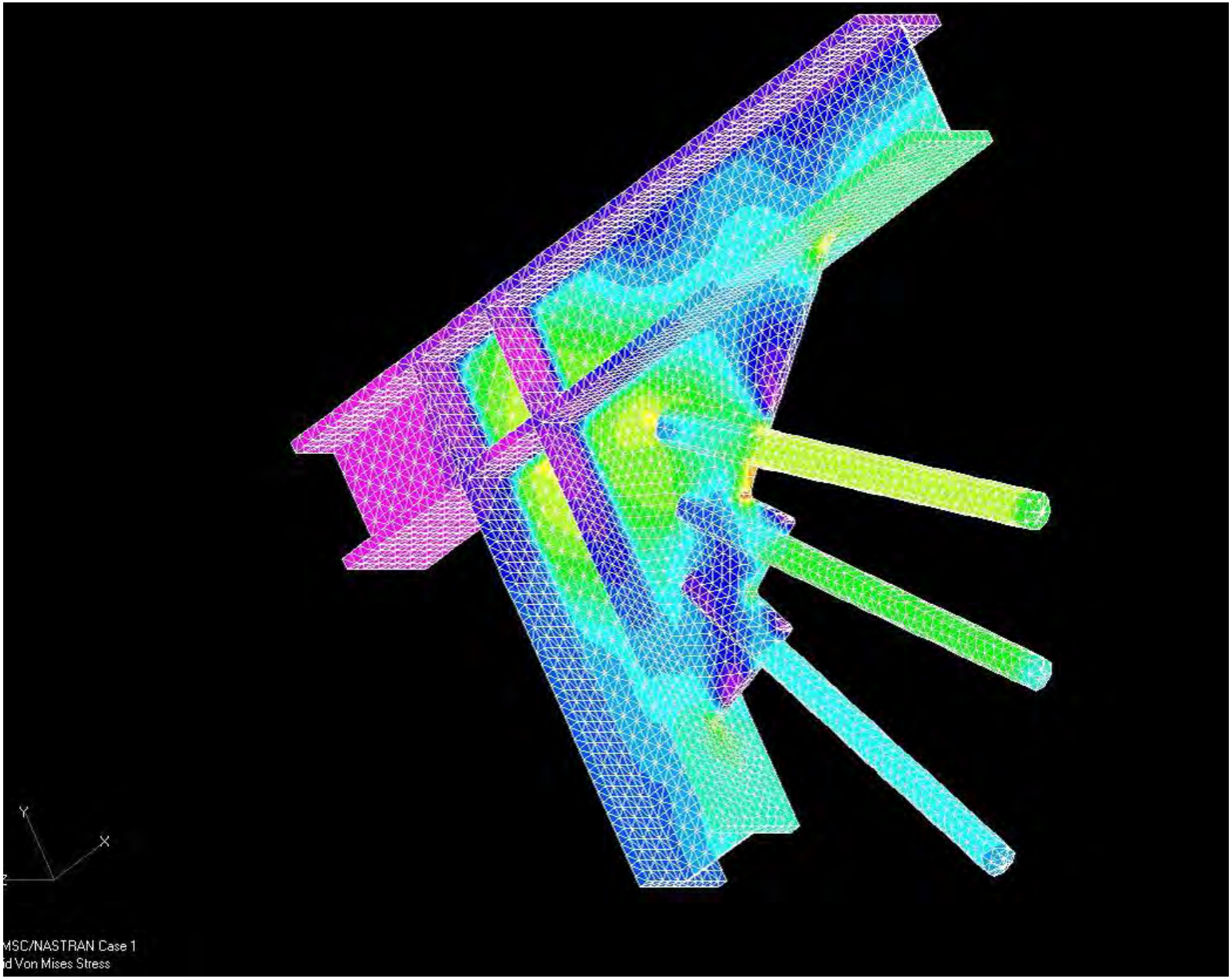
Knutpunkt

friktionsfri led
systemlinjer möts
last-angreppspunkt
partikeljämvikt

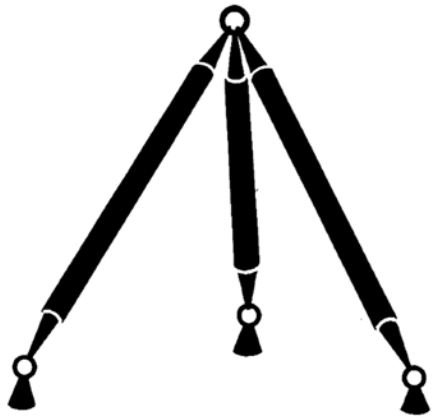
The floors and roof of the Centre Georges Pompidou in Paris are supported by Warren trusses 2.5 m (8.2 ft) deep that span 45 m (148 ft). Each top chord is a pair of 419 mm (16.5 in.) diameter steel tubes. A pair of 225 mm (9 in.) solid steel rods make up the bottom chord. Inverted vees of inclined struts between the trusses at midspan and near each support impart lateral stability to the entire frame in the short direction of the building. Stability in the long direction of the building is created by external cross bracing made of steel rods. Architect: Piano and Rogers. Structural engineer: Ove Arup and Partners. (Photo by Edward Allen.)




KNUTEPUNKTER I STØPESTÅL


Y
X
MSC/NASTRAN Case 1
d Von Mises Stress

4. Fackverket

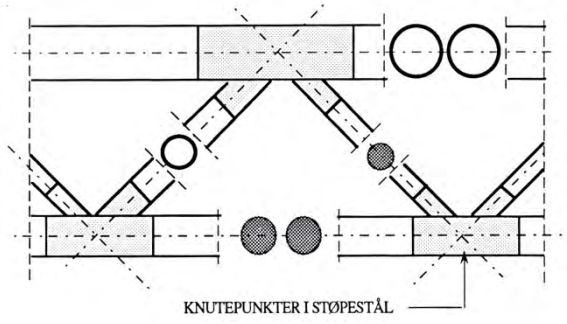


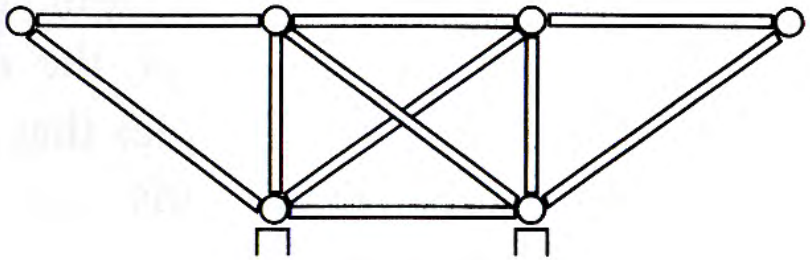
Beskriv vad ett fackverk är genom att utgå
från dess två grundläggande beståndsdelar *stång* och *knutpunkt*:

Visa i en figur vad en *stång* är och försök att illustrera
begreppen *materialstyvhet* E (elasticitetsmodul), *tvärsnittsarea* A,
längd L, *systemlinje*, *stångkraft* (normalkraft), samt *normalspänning*.

Visa i en figur vad en *knutpunkt* är och försök att illustrera
begreppet *friktionsfri led*, möten mellan *systemlinjer*,
angreppspunkt för *yttre last* samt *partikeljämvikt*.

5. Fackverket





Tag fram en bild av en konstruktion som du bedömer fungerar som ett fackverk.

Gör en 2D pointSketch-modell av fackverket.
Diskutera var den *yttre lasten* angriper,
hur den *friktionsfria leden* är utformad,
hur *systemlinjerna* möts i en knutpunkt/led,
hur kraftiga stängerna är beroende på de *inre krafternas* storlek,
hur stängerna är utformade beroende på om de är *tryckta* eller *dragna*.


Lina båge och fackverk – allt i ett!