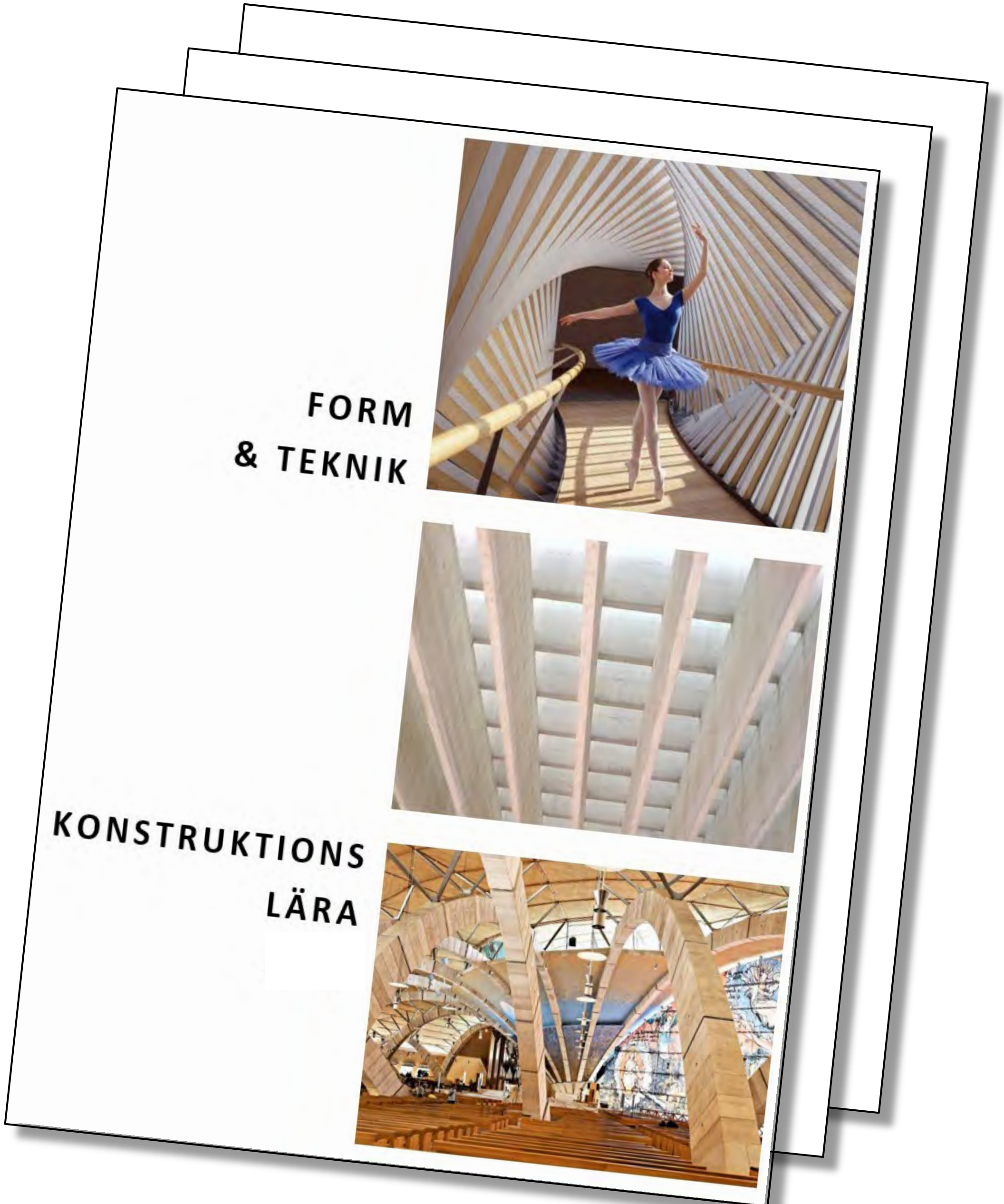


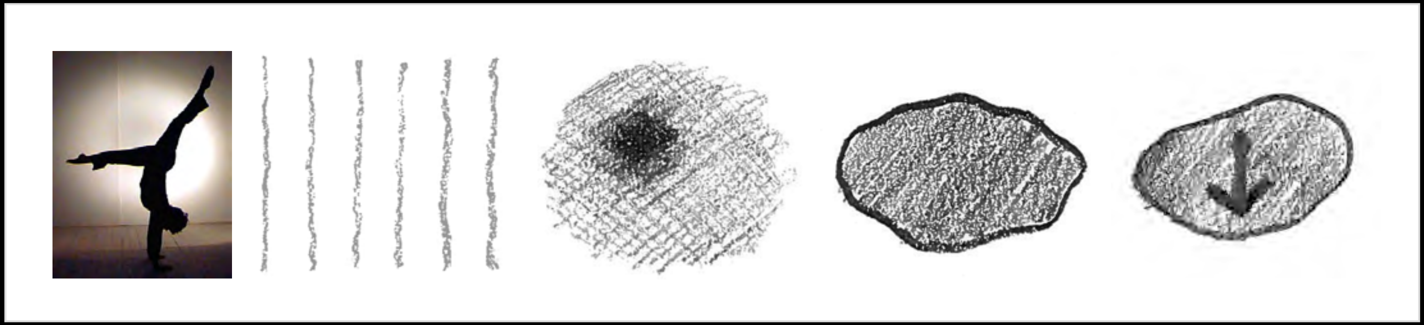
Undervisningskoncept
dialog om begrepp
och fenomen
iterativ process

Föreläsning med
invävda övningsuppgifter
Grupparbete
Seminarium

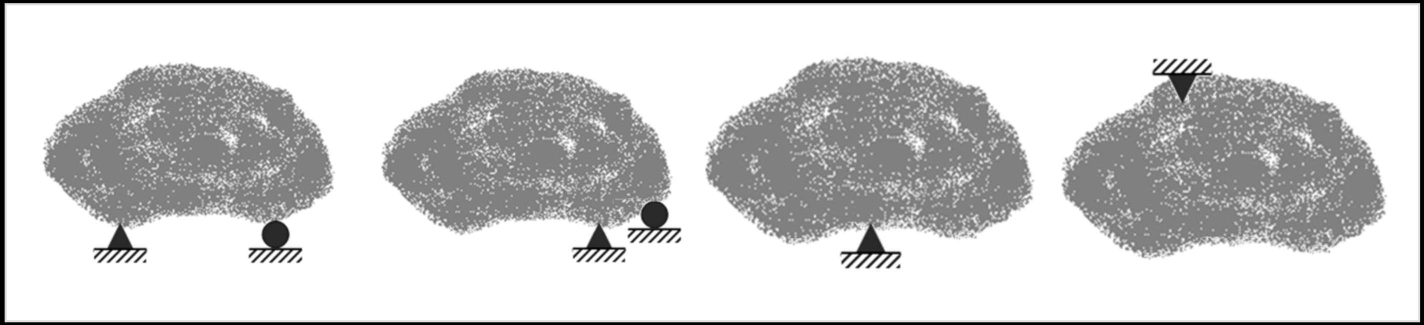
Kursbok
Lärobok
mer om den på nästa föreläsning

STRUKTURERS GRAMMATIK

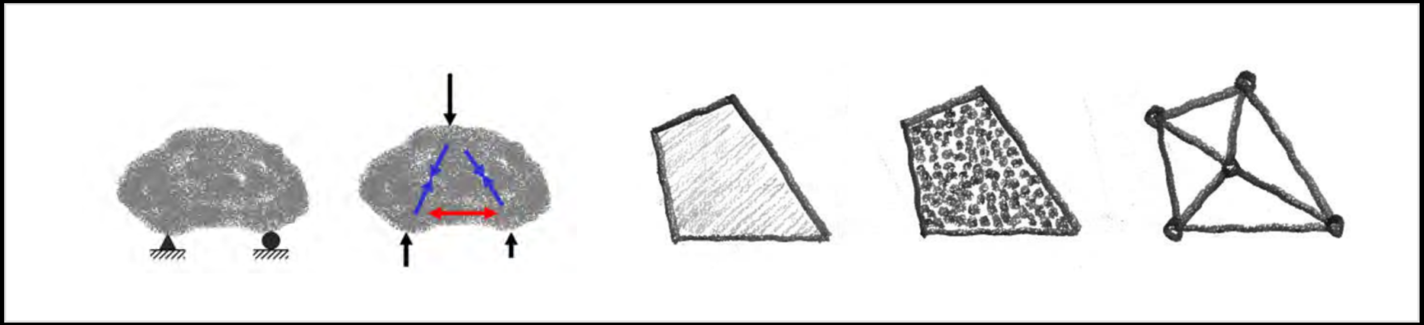
MÄNNISKA
gravitationen
som livsmiljö



MATERIELL
KROPP
balans
stabilitet
rörelse

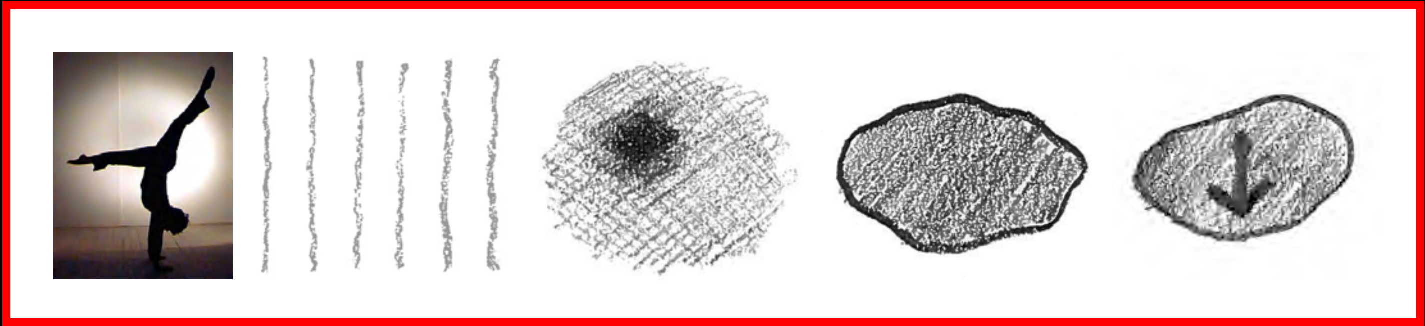


STRUKTUR
topologi
inre stabilitet
kraftmönster
effektivitet

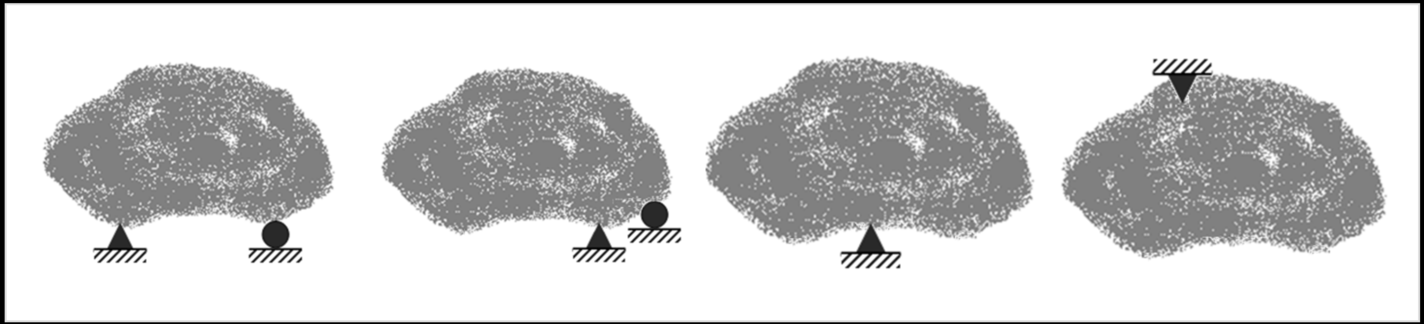


STRUKTURERS GRAMMATIK

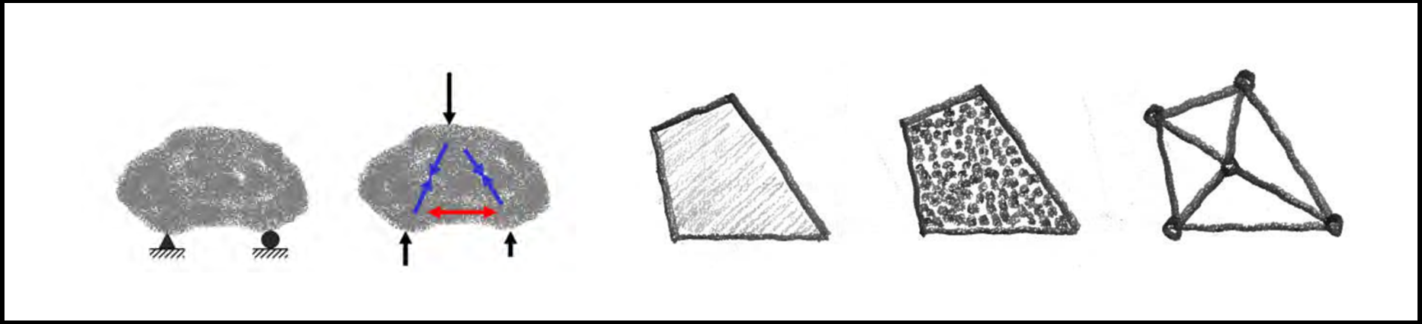
MÄNNISKA
gravitationen
som livsmiljö

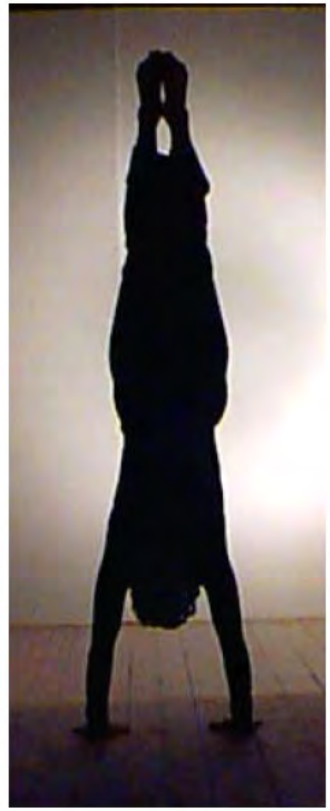


MATERIELL
KROPP
balans
stabilitet
rörelse



STRUKTUR
topologi
inre stabilitet
kraftmönster
effektivitet

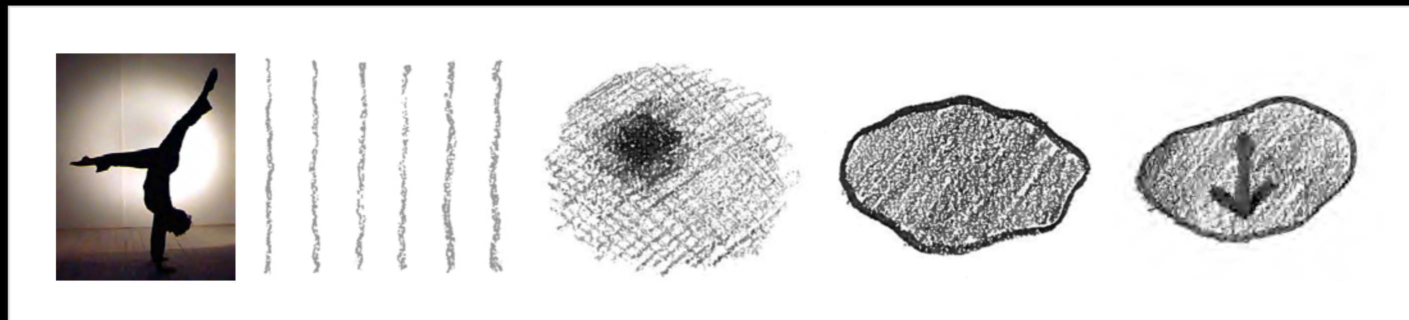




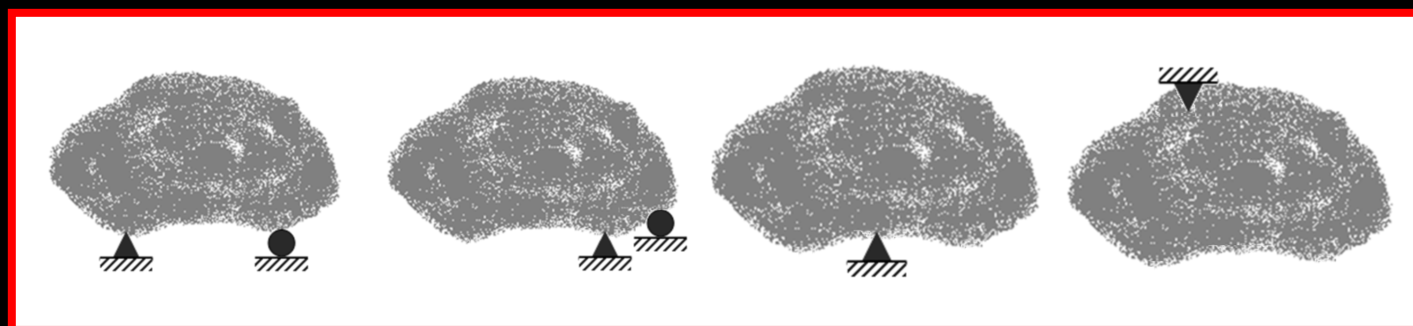
Kraft
att i balans bära
ett helt liv

STRUKTURERS GRAMMATIK

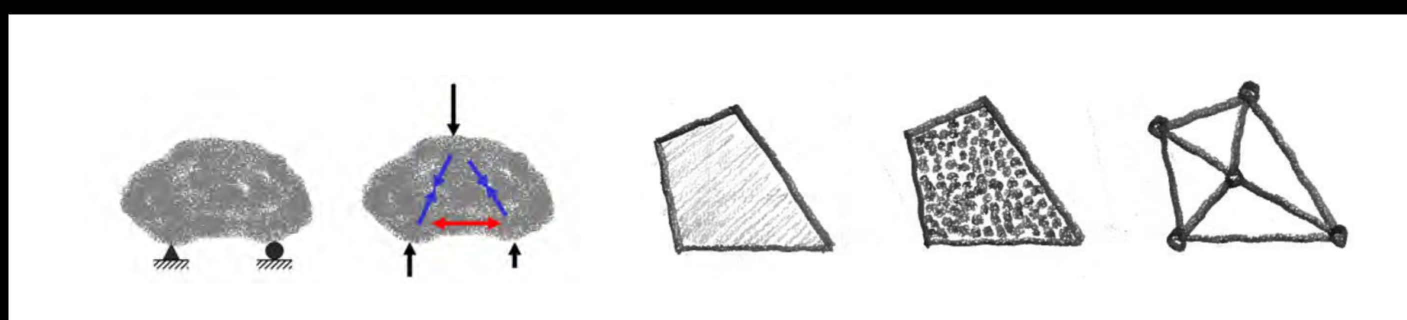
MÄNNISKA
gravitationen
som livsmiljö

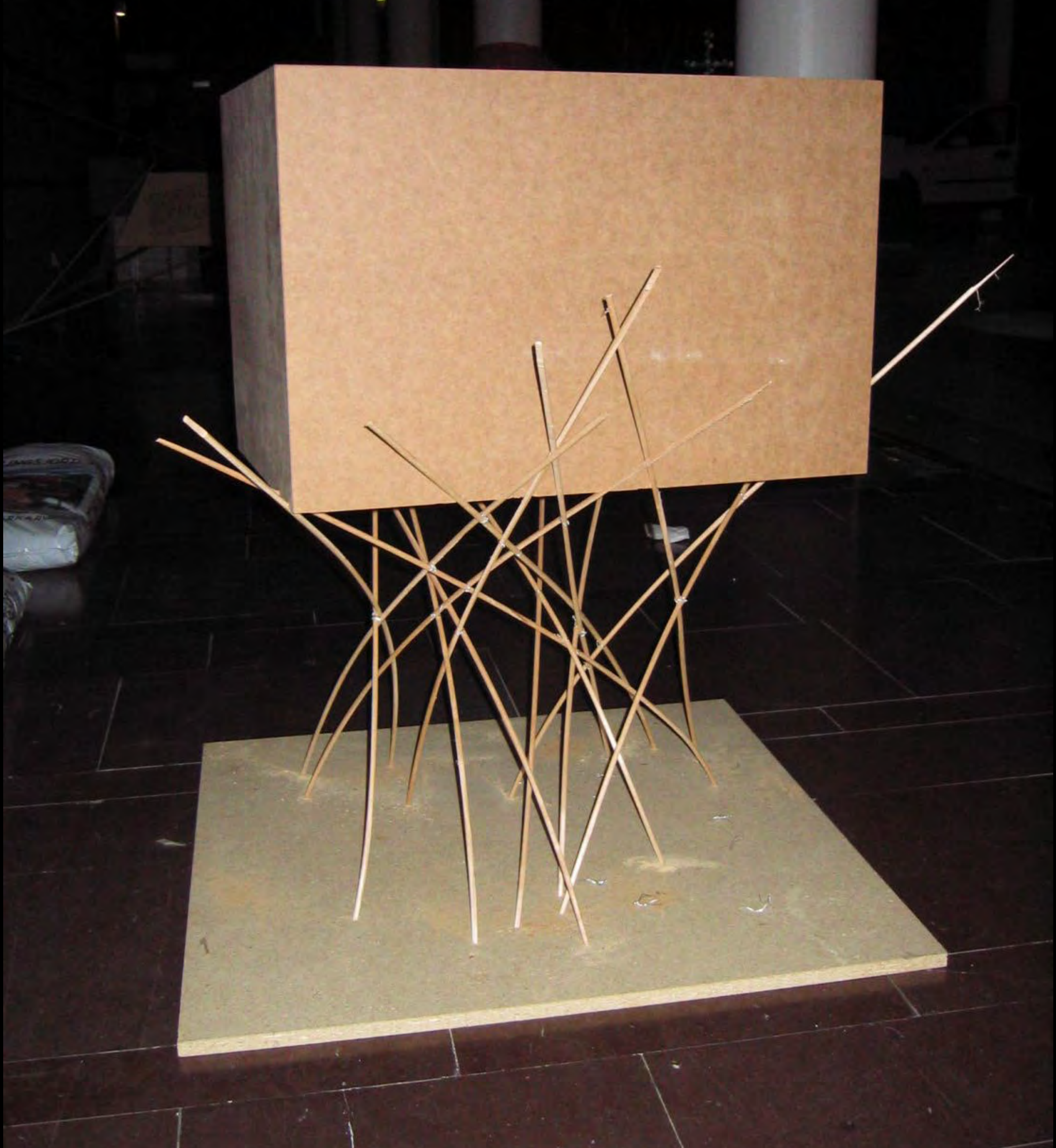


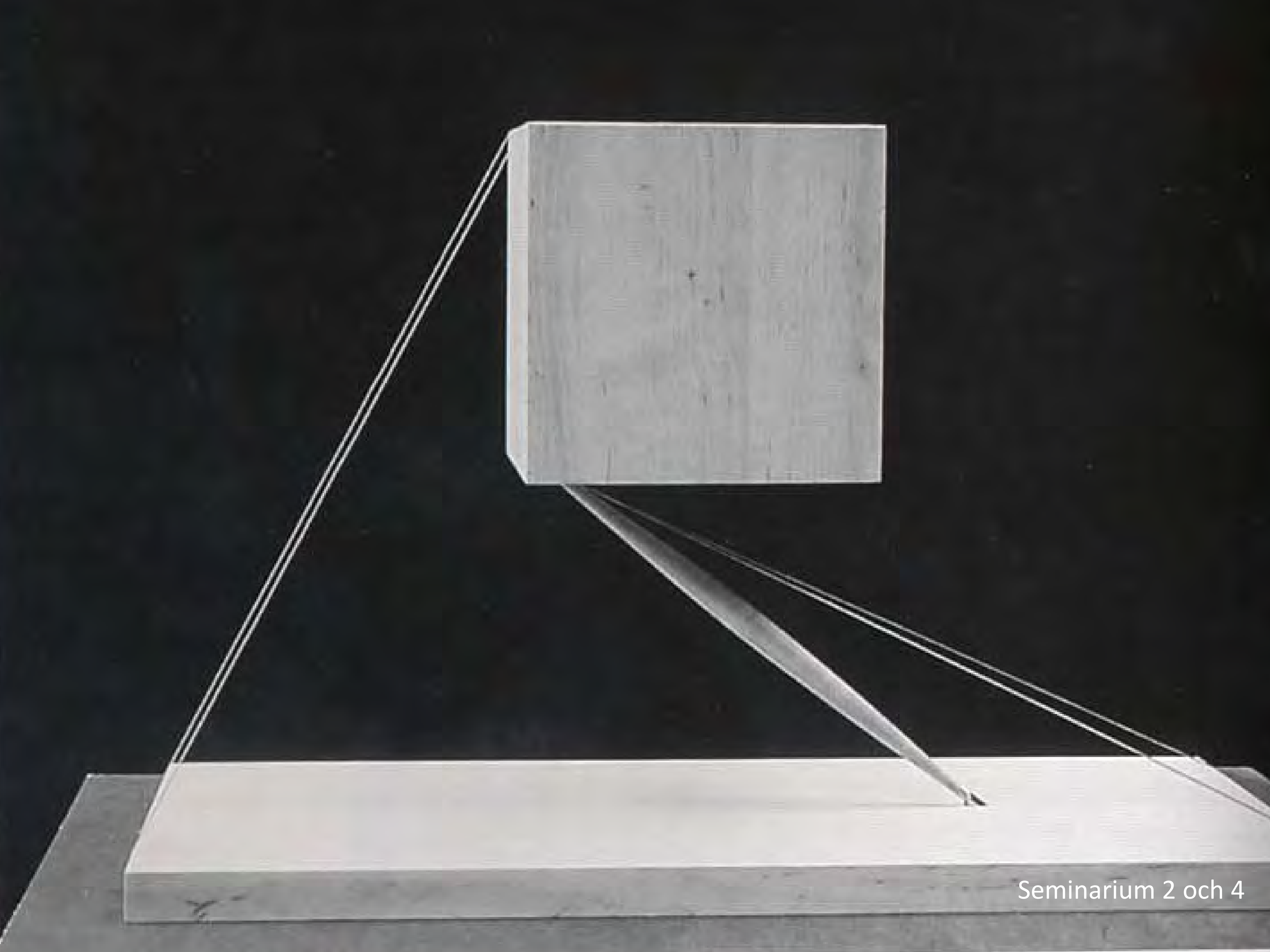
MATERIELL
KROPP
balans
stabilitet
rörelse



STRUKTUR
topologi
inre stabilitet
kraftmönster
effektivitet



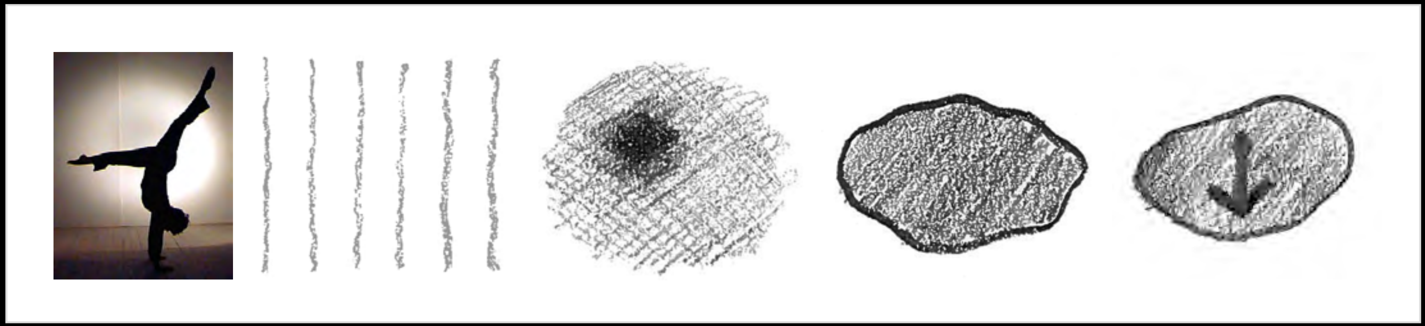




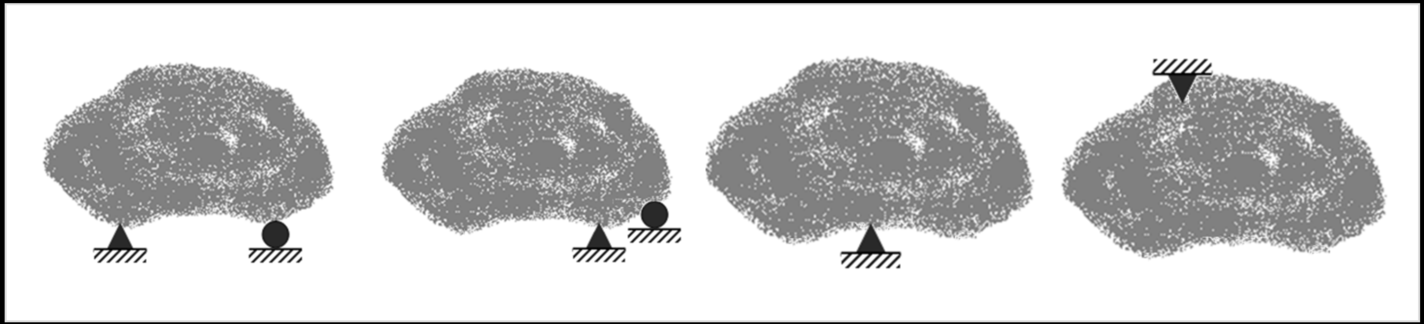
Seminarium 2 och 4

STRUKTURERS GRAMMATIK

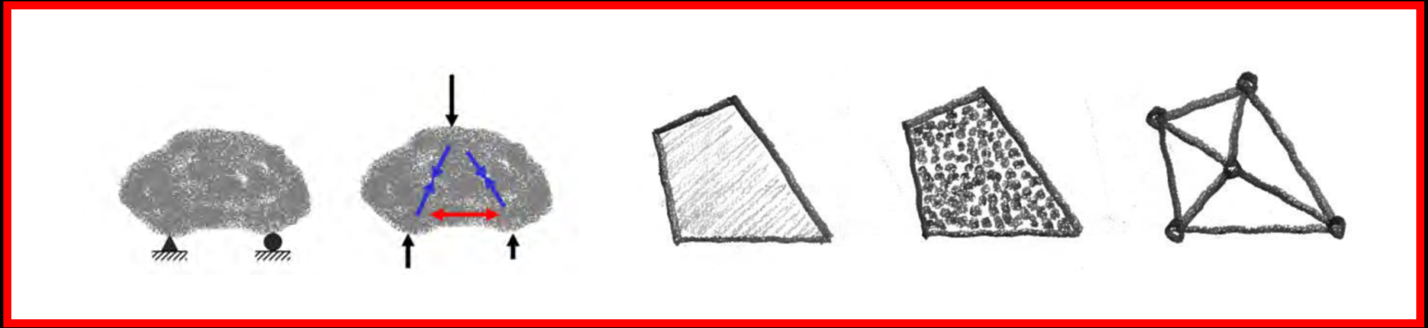
MÄNNISKA
gravitationen
som livsmiljö

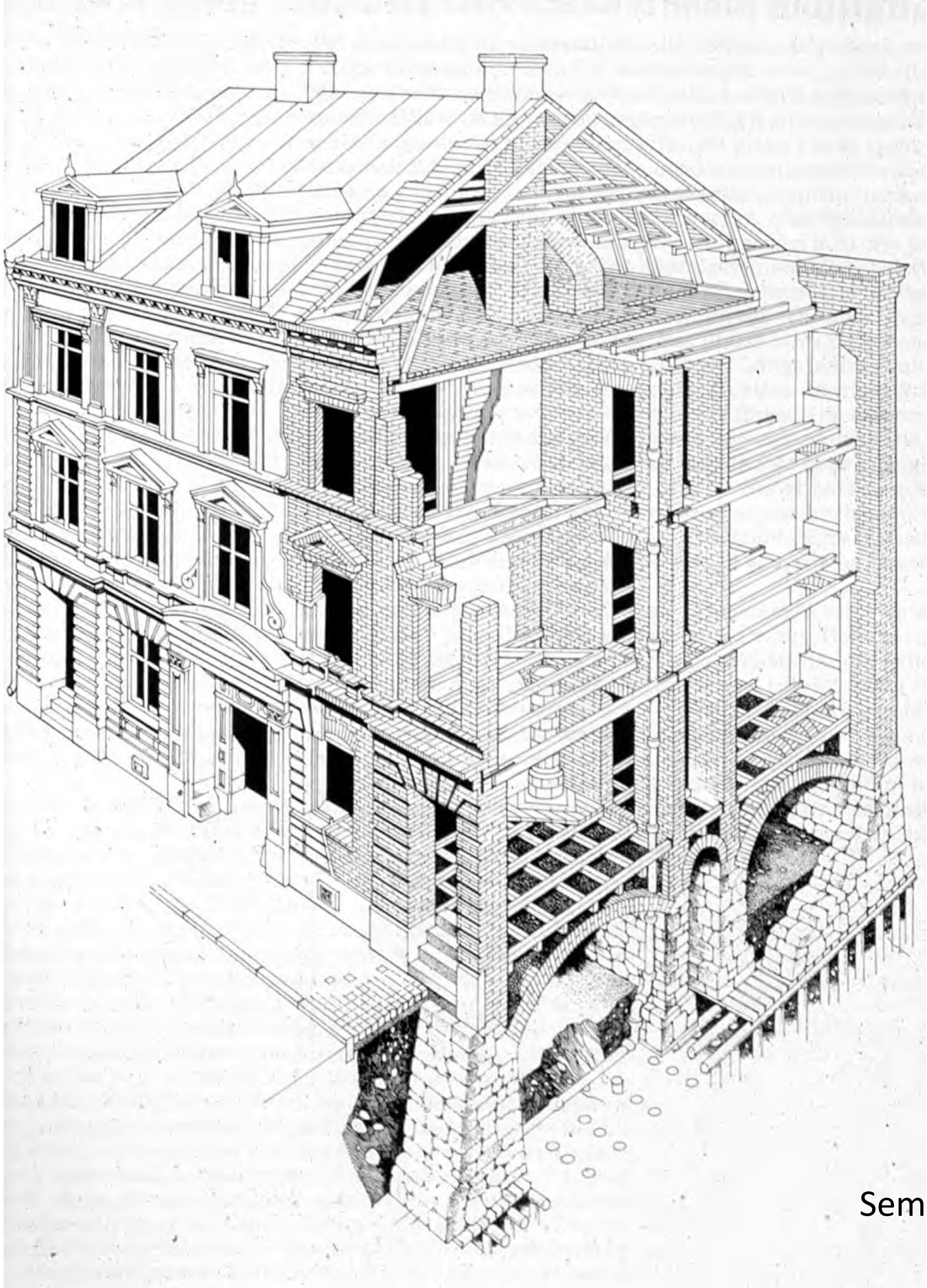


MATERIELL KROPP
balans
stabilitet
rörelse



STRUKTUR
topologi
inre stabilitet
kraftmönster
effektivitet

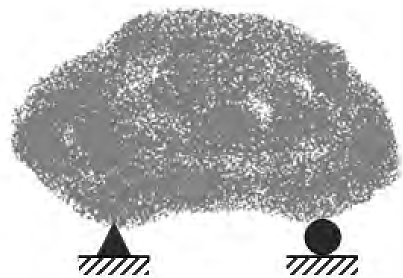


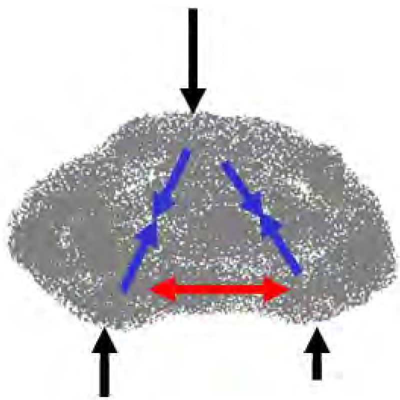


Seminarium 1, 4, 5, 6 och 7

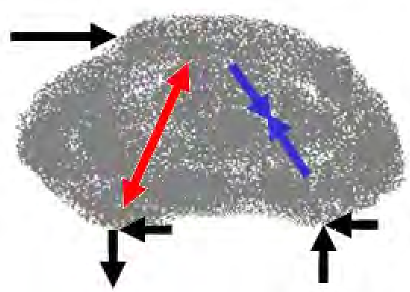
Byggnaden som bärande system - om att forma och läsa strukturer

Tre uppgifter för en byggnad …

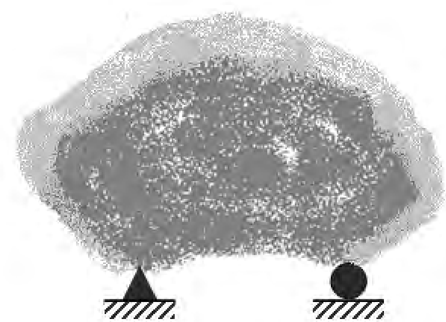




Att bära
vertikala laster

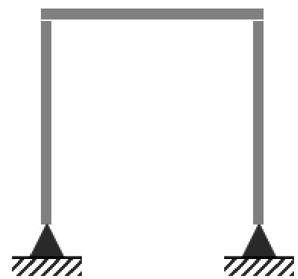


Att bära
horisontella laster

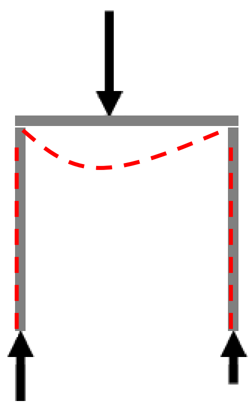


Att kunna röra sig
temperatur- och fuktlast

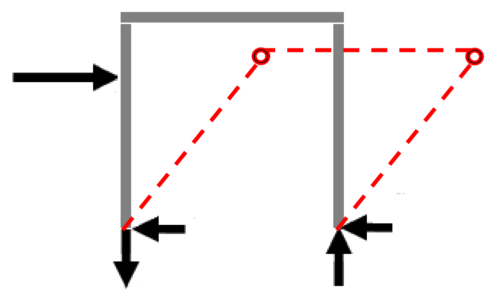
… tolkade på en vanlig byggnadsdel



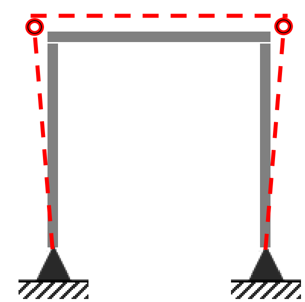
Balk fritt upplagd
på två pelare



Vertikala laster



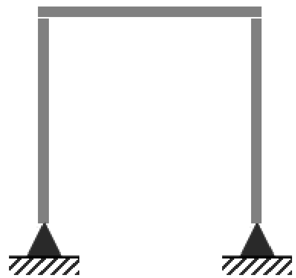
Horisontella laster

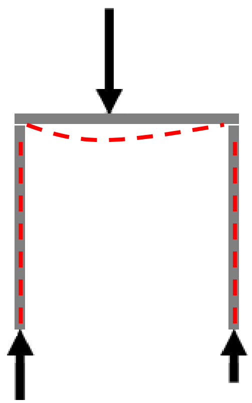


Temperatur
och fuktlast

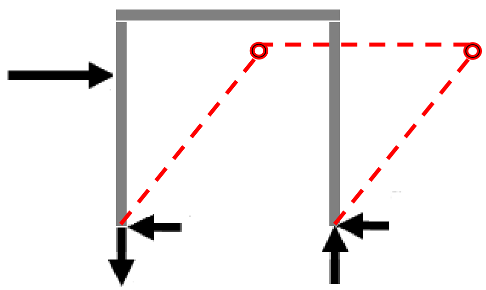
Mekanism!

Vi börjar med vertikala laster oftast ”formgivande”



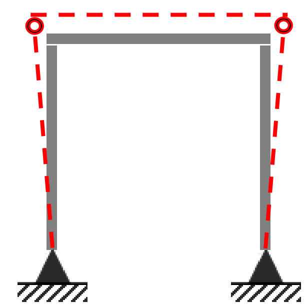


Vertikala laster



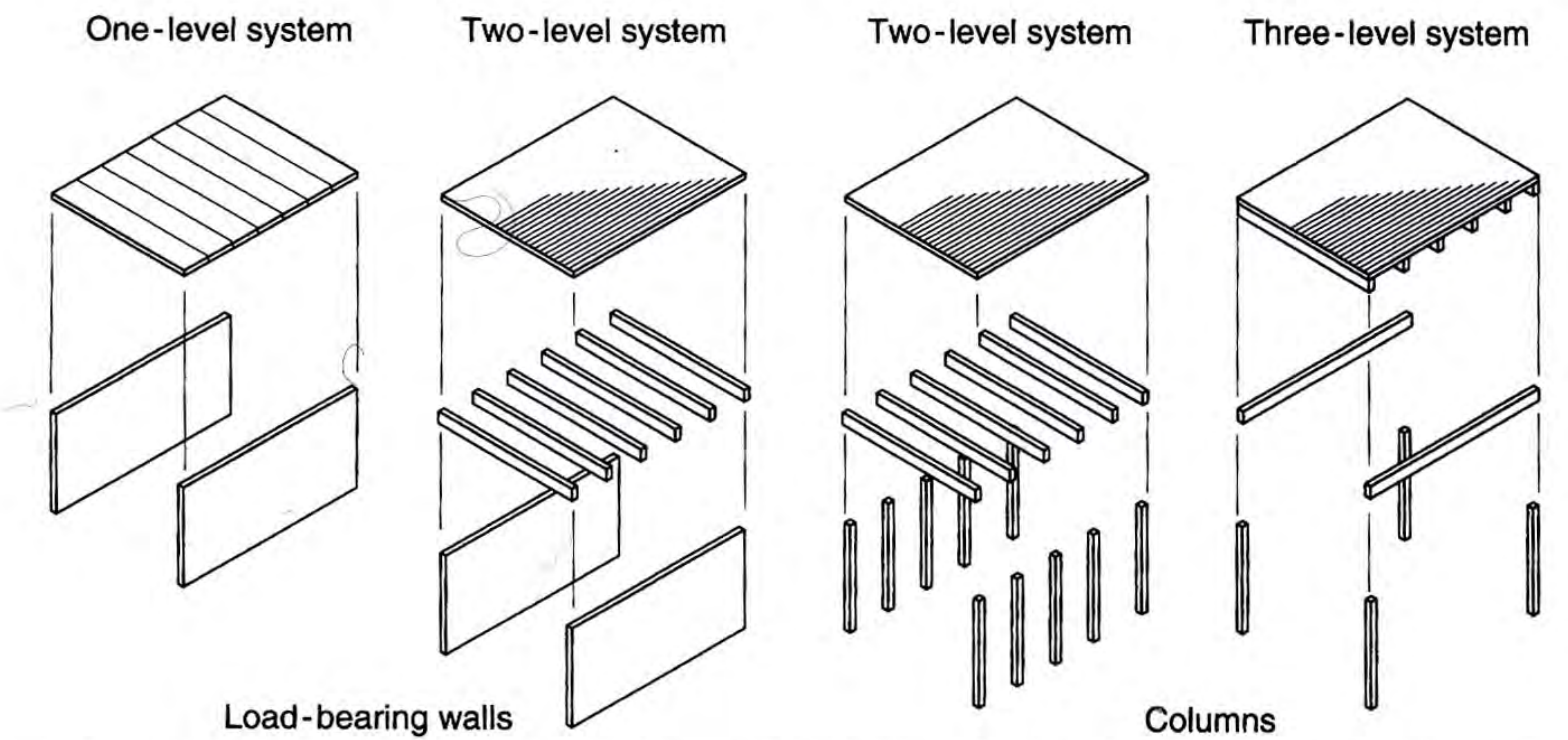
Horisontella laster

Mekanism!

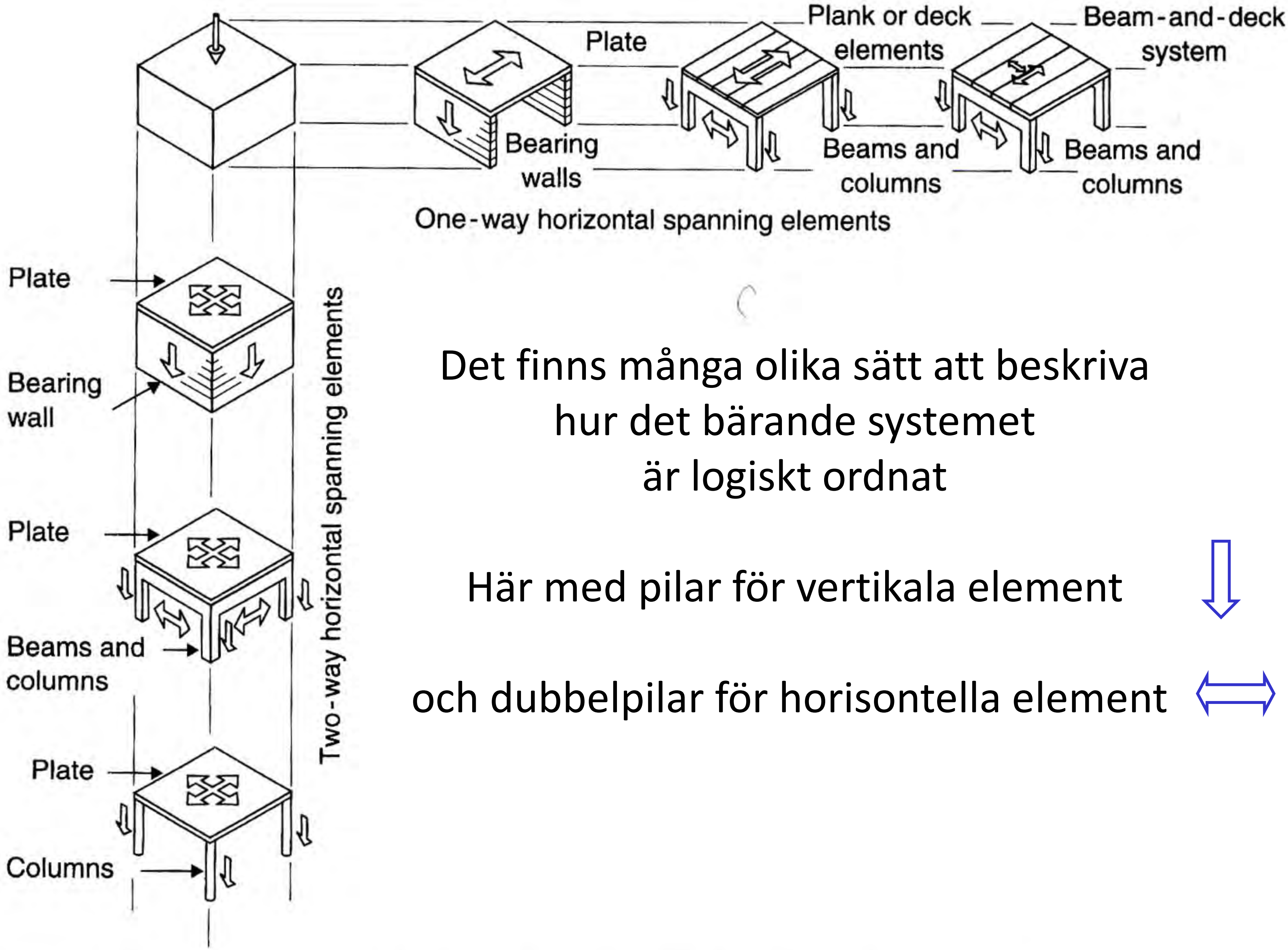


Temperatur och fuktlast

Att ordna strukturen för vertikal last



(a) Common types of horizontal spanning systems (one-, two-, and three-level systems) used in relation to different types of load-bearing wall and columnar vertical support systems.



Det finns många olika sätt att beskriva hur det bärande systemet är logiskt ordnat

Här med pilar för vertikala element ⇩

och dubbelpilar för horisontella element ⇔

Mies van der Rohe

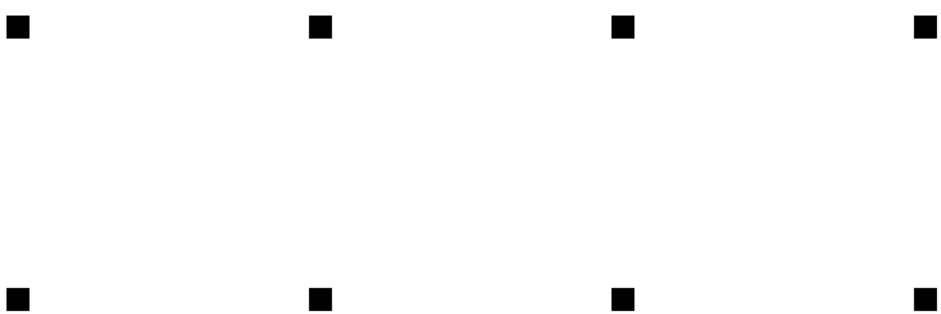
Crown Hall 1950-56
Illinois Institute of Technology

Innehåller sektionerna för arkitektur, stadsplanering och design

'Less is More'

I en plan
kan strukturens inre ordning beskrivas:

- Vertikala stöd

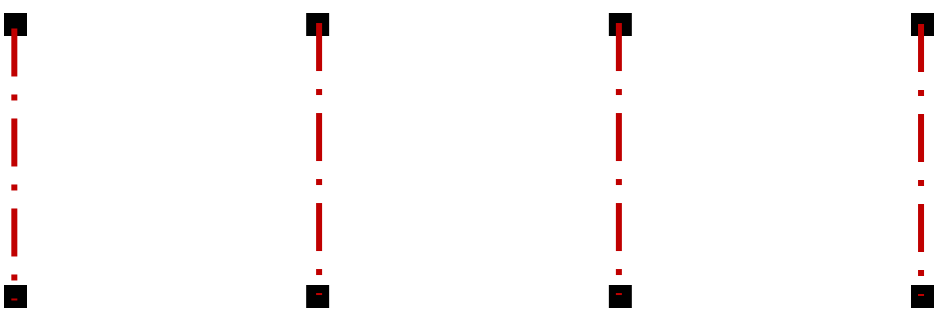


I en plan
kan strukturens inre
ordning beskrivas:

■ Vertikala stöd

— · — Primärbalkar

”systemlinje”
representerar
balken

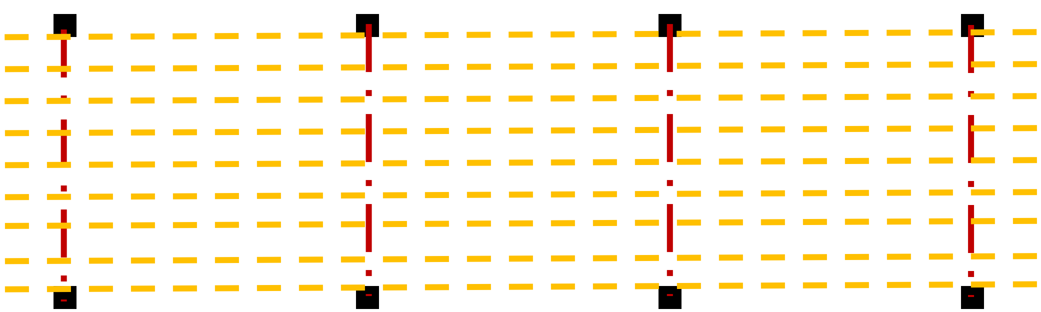


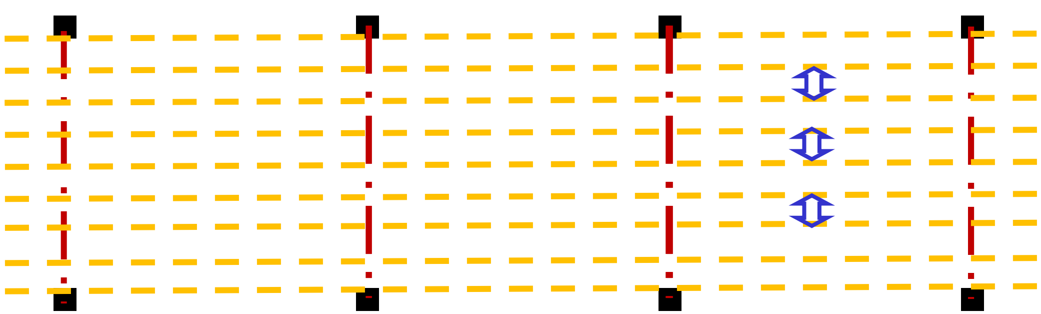
I en plan
kan strukturens inre
ordning beskrivas:

■ Vertikala stöd

Primärbalkar

Sekundärbalkar





I en plan
kan strukturens inre
ordning beskrivas:

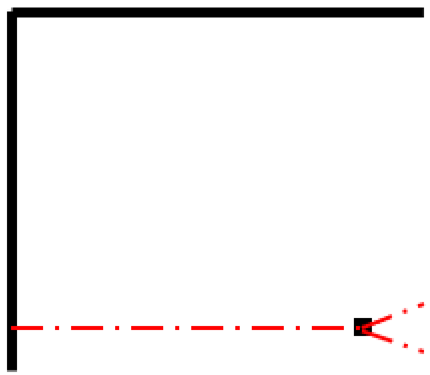
- Vertikala stöd
- Primärbalkar
- Sekundärbalkar
- 3:e ordningens balkar, etc.
- högsta ordningen


För horisontell last (vind)

Det nordiska ljuset

Sverre Fehn

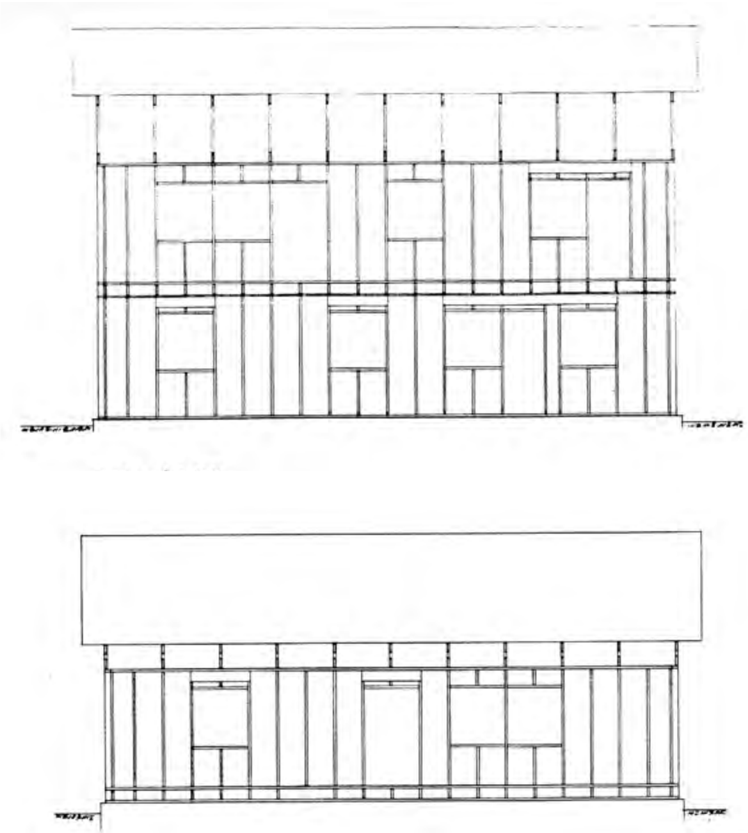
Skandinaviska paviljongen Biennalen i Venedig 1962



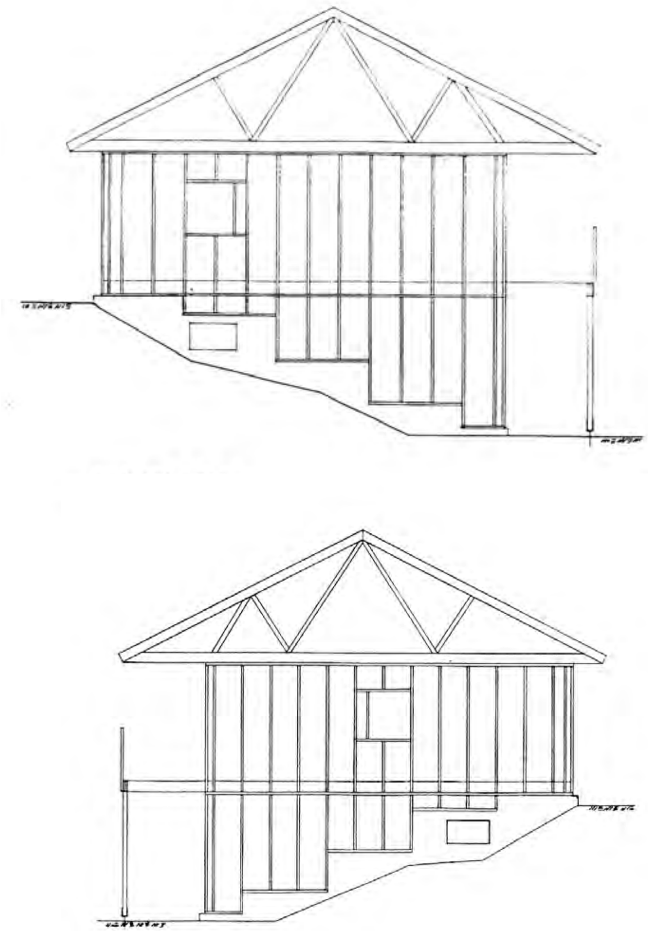
Grov tumregel för en balk H/L = 1/20

Om att bryta en lastväg - avväxling

En vanlig villa

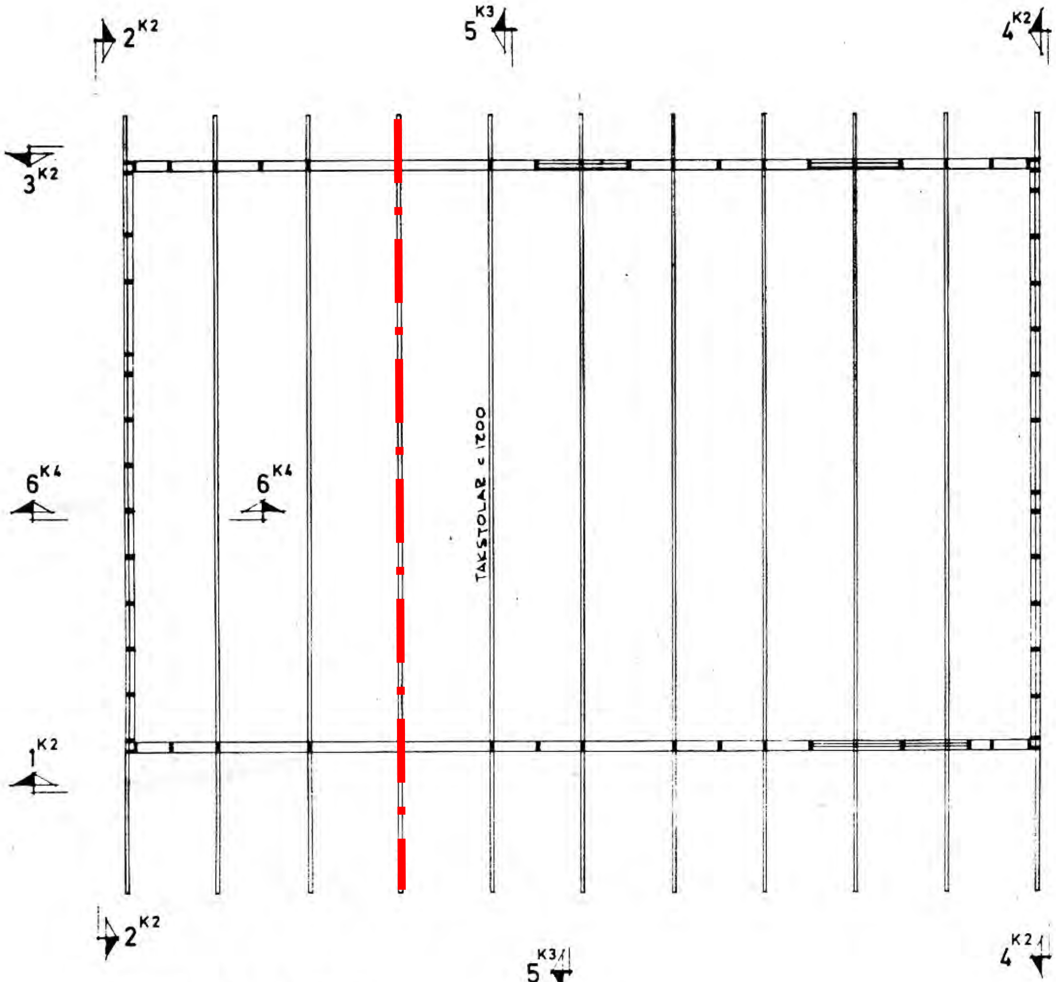


3 - 3 (1:50) 1:100

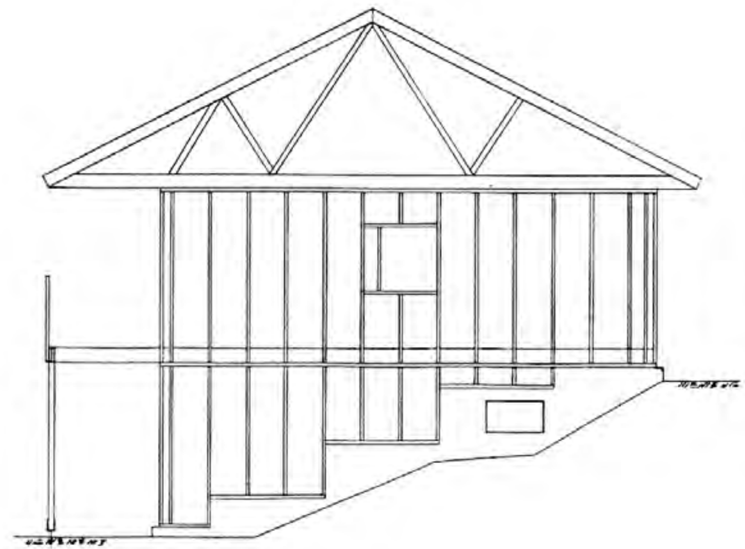


4 - 4 (1:50) 1:100

Takstolen är en primärbalk …

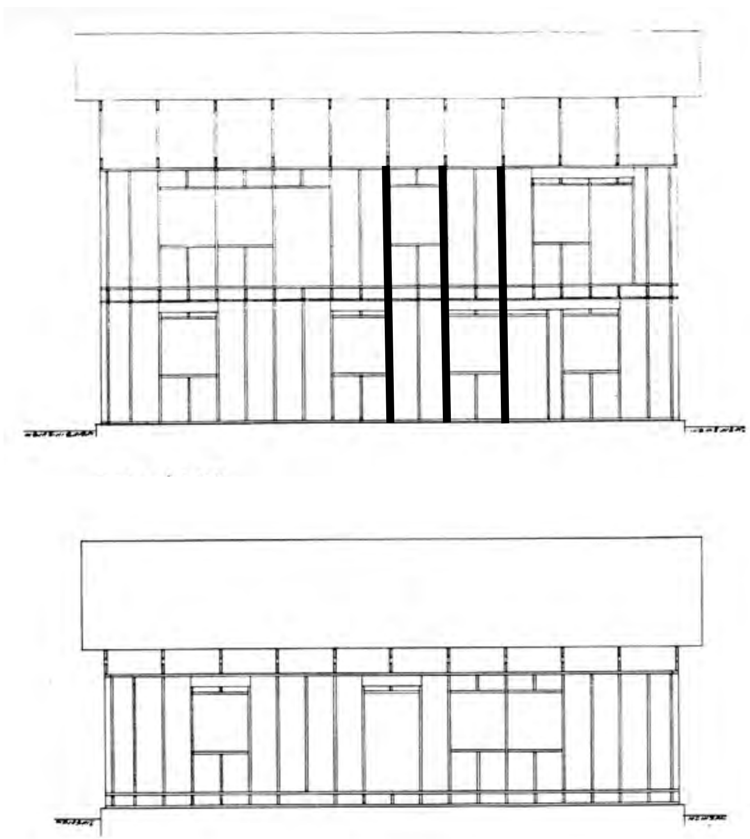


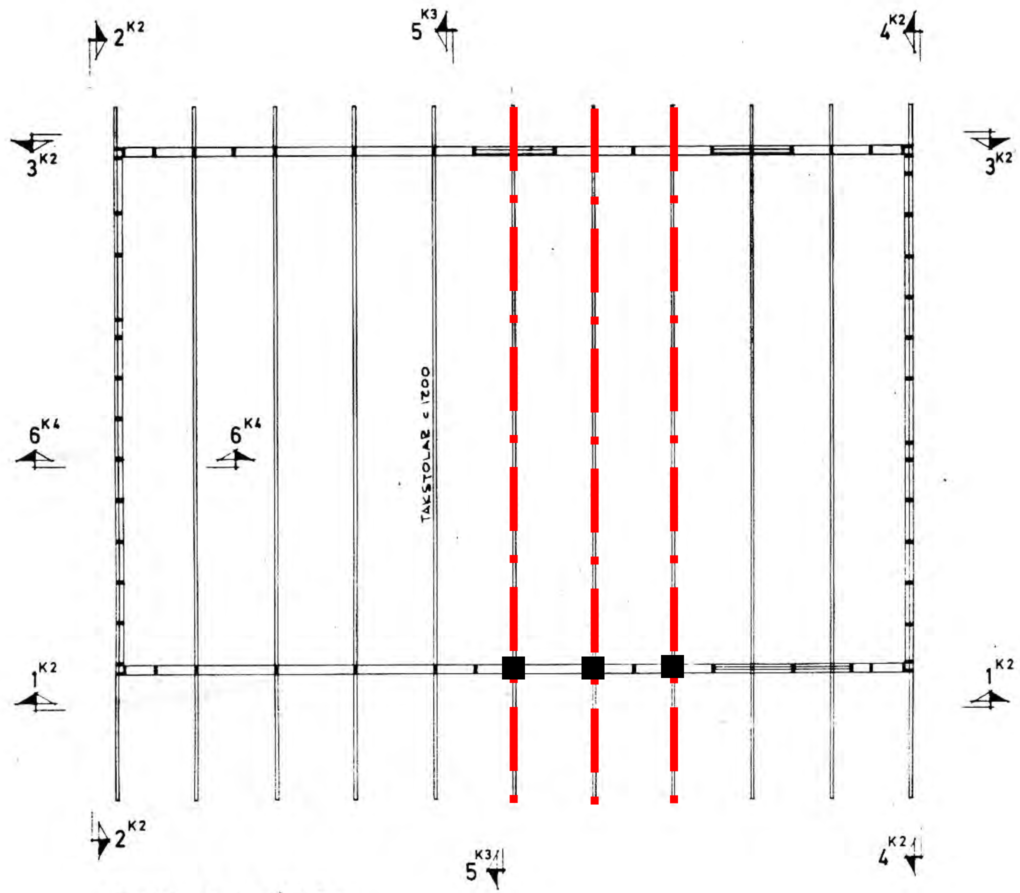
TAKPLAN (1:50) 1:100



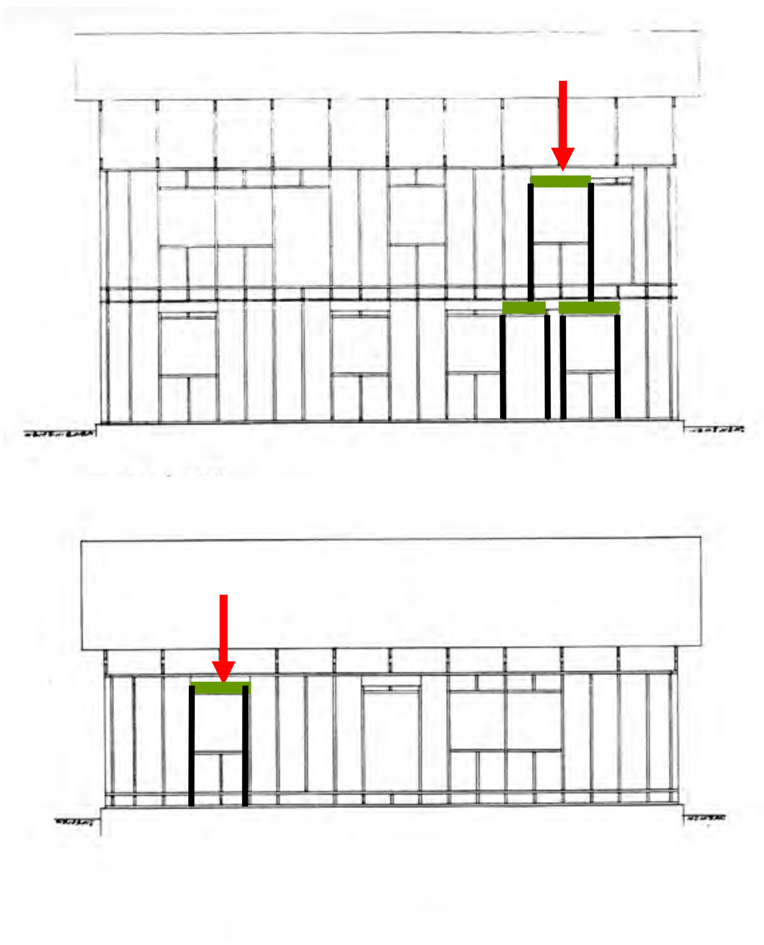
4 - 4 (1:50) 1:100

…som vilar på vertikala reglar

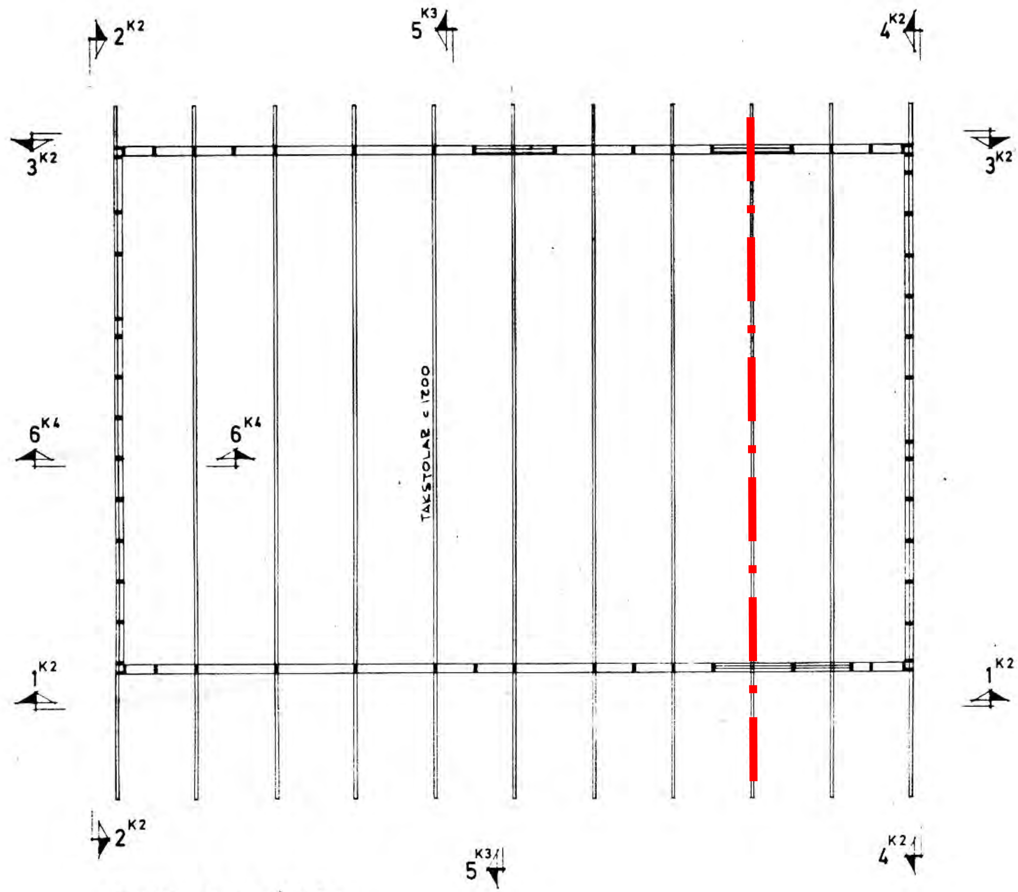




Avväxling

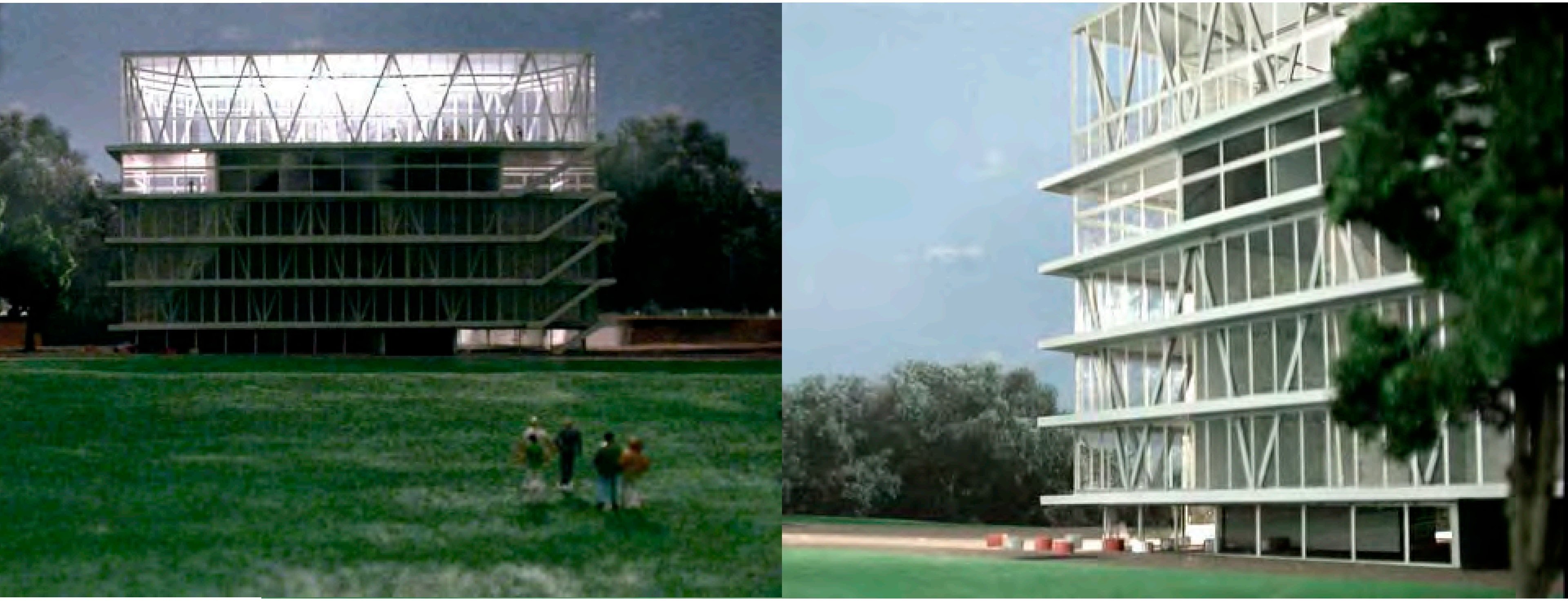


3 - 3 (1:50) 1:100



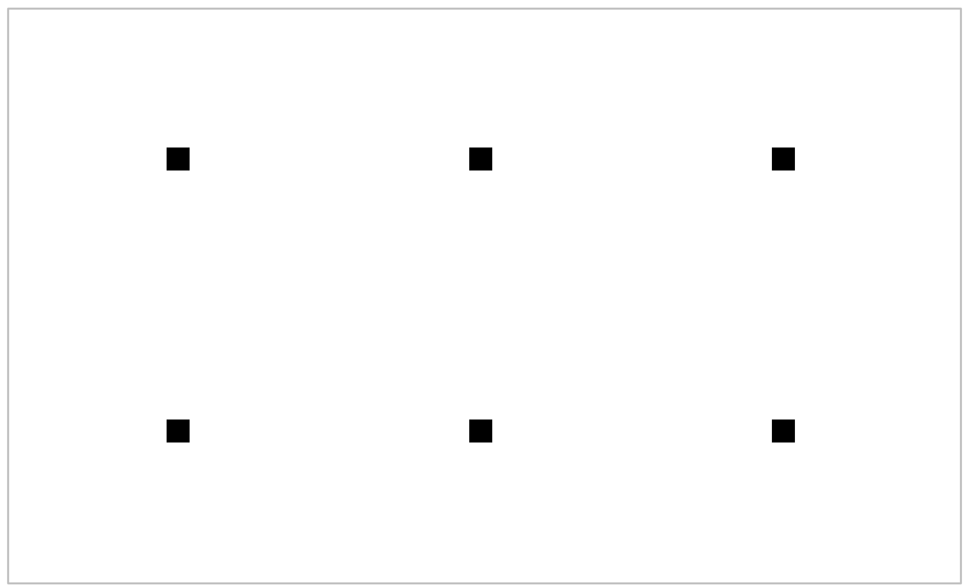
TAKPLAN (1:50) 1:100

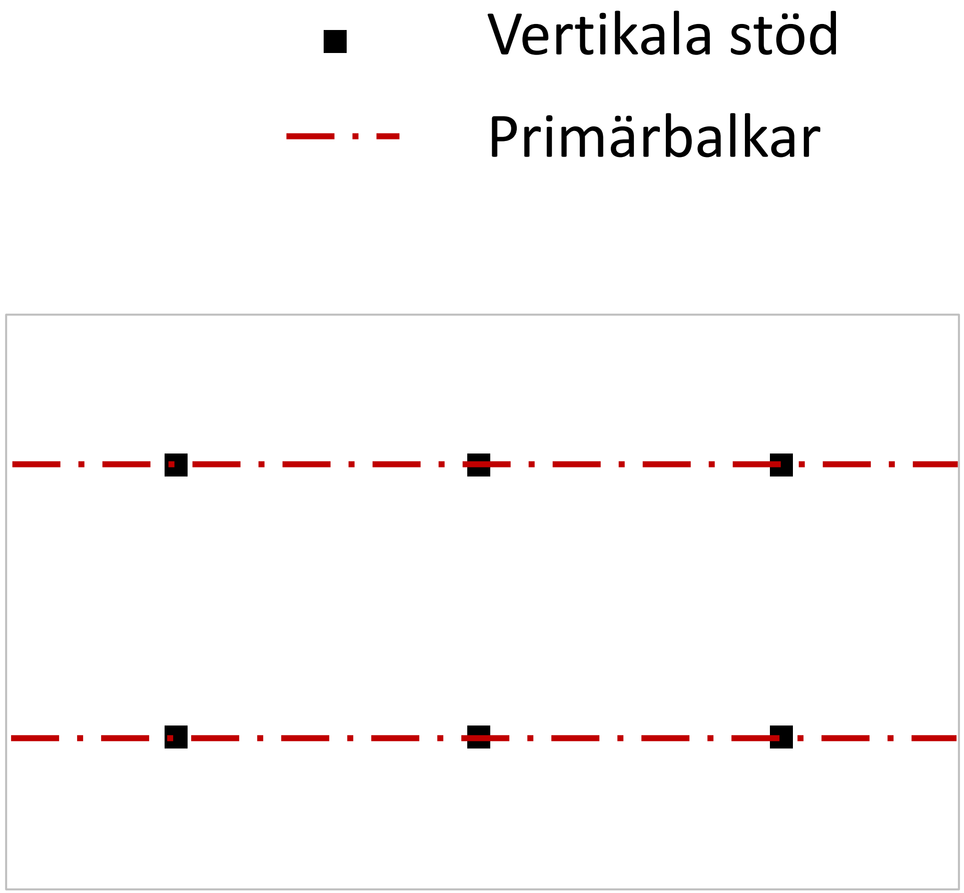
Schulhaus Leutschenbach

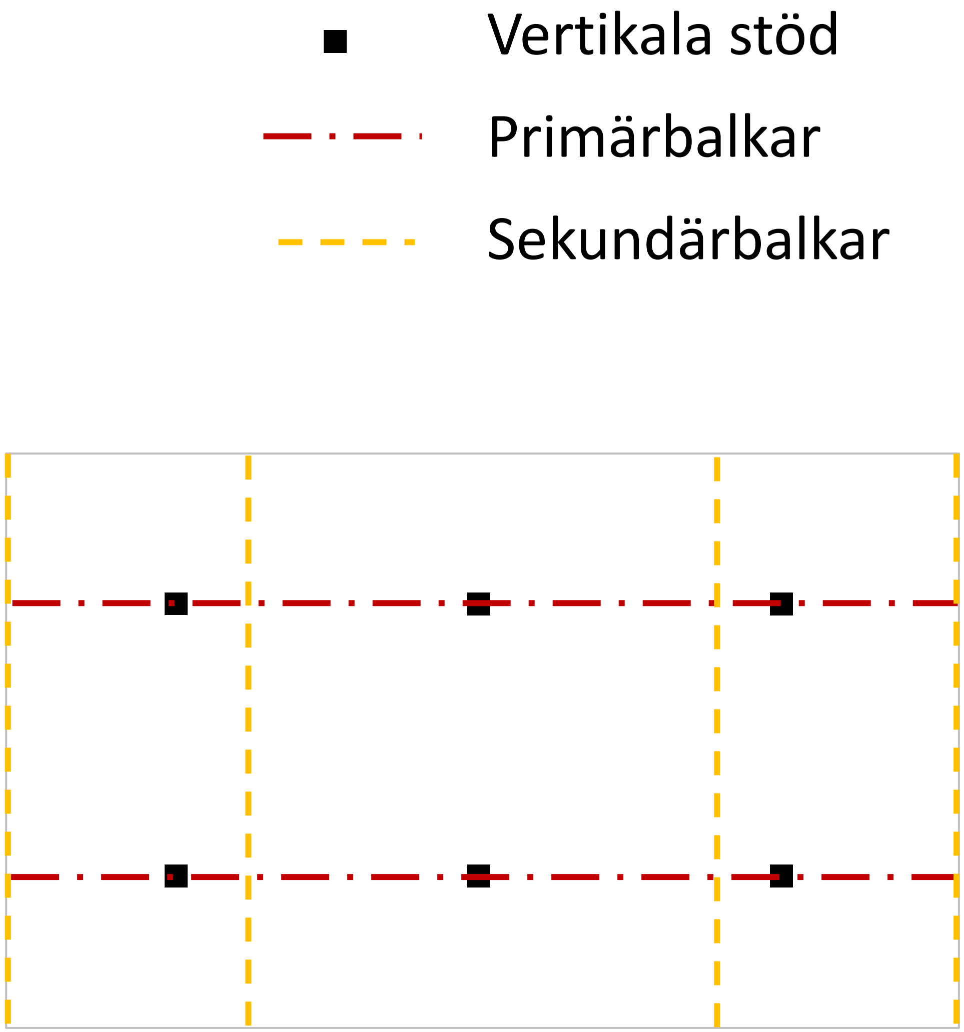


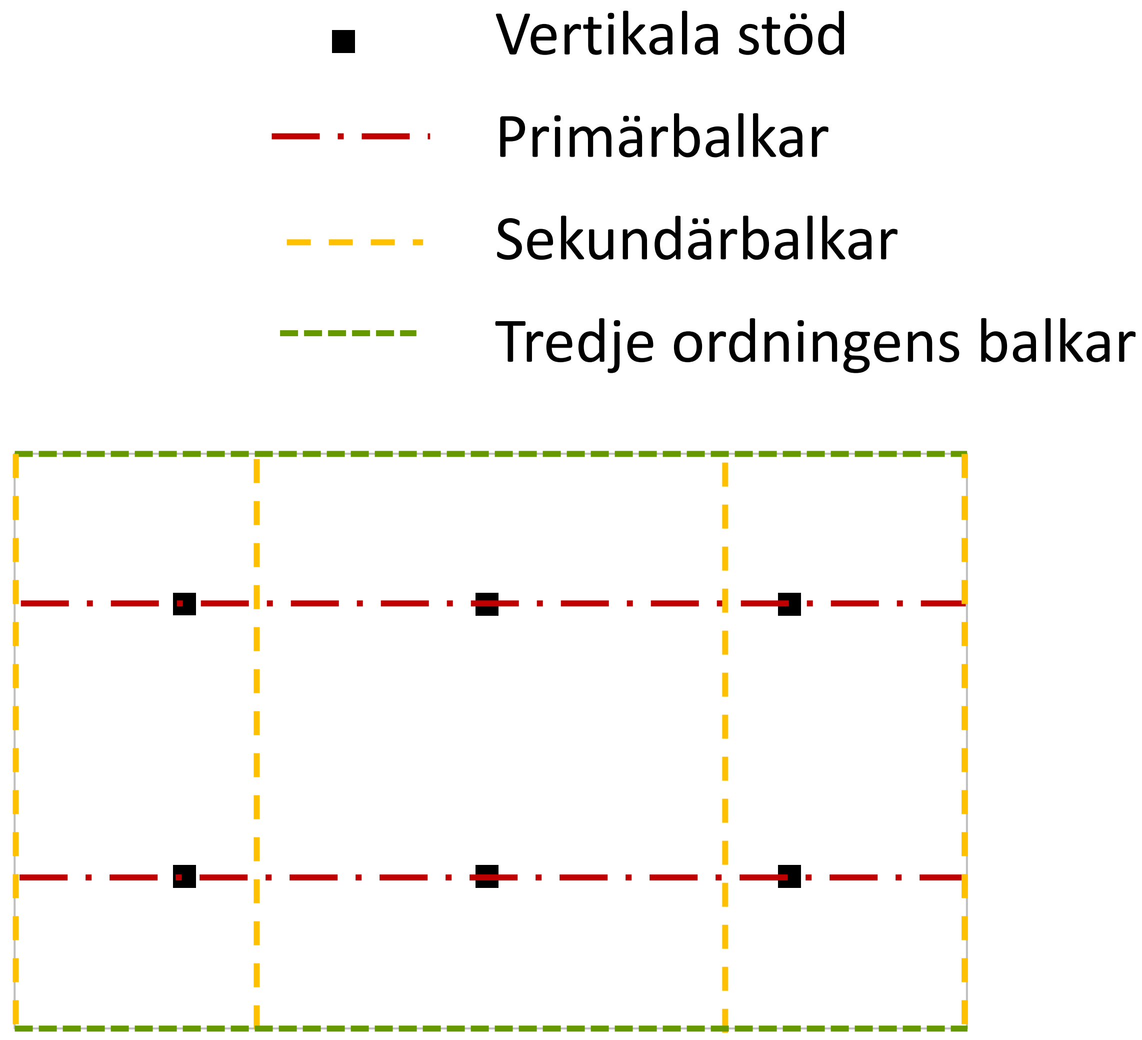
Christian Kerez, Architekt ETH/SIA, Zürich

- Vertikala stöd




Vertikala stöd
Primärbalkar


Vertikala stöd
Primärbalkar
Sekundärbalkar

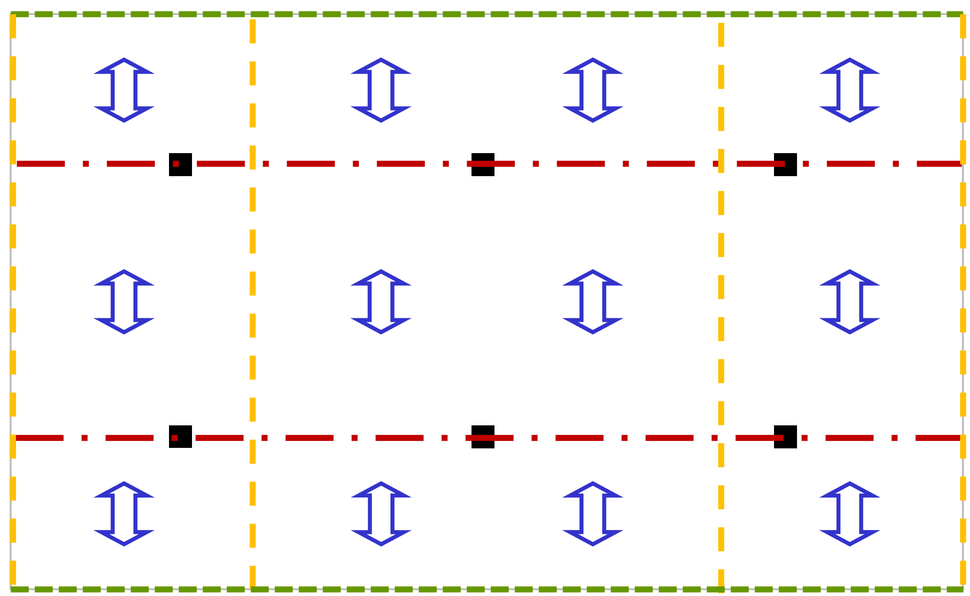

Vertikala stöd
Primärbalkar
Sekundärbalkar
Tredje ordningens balkar

Vertikala stöd

Primärbalkar

Sekundärbalkar

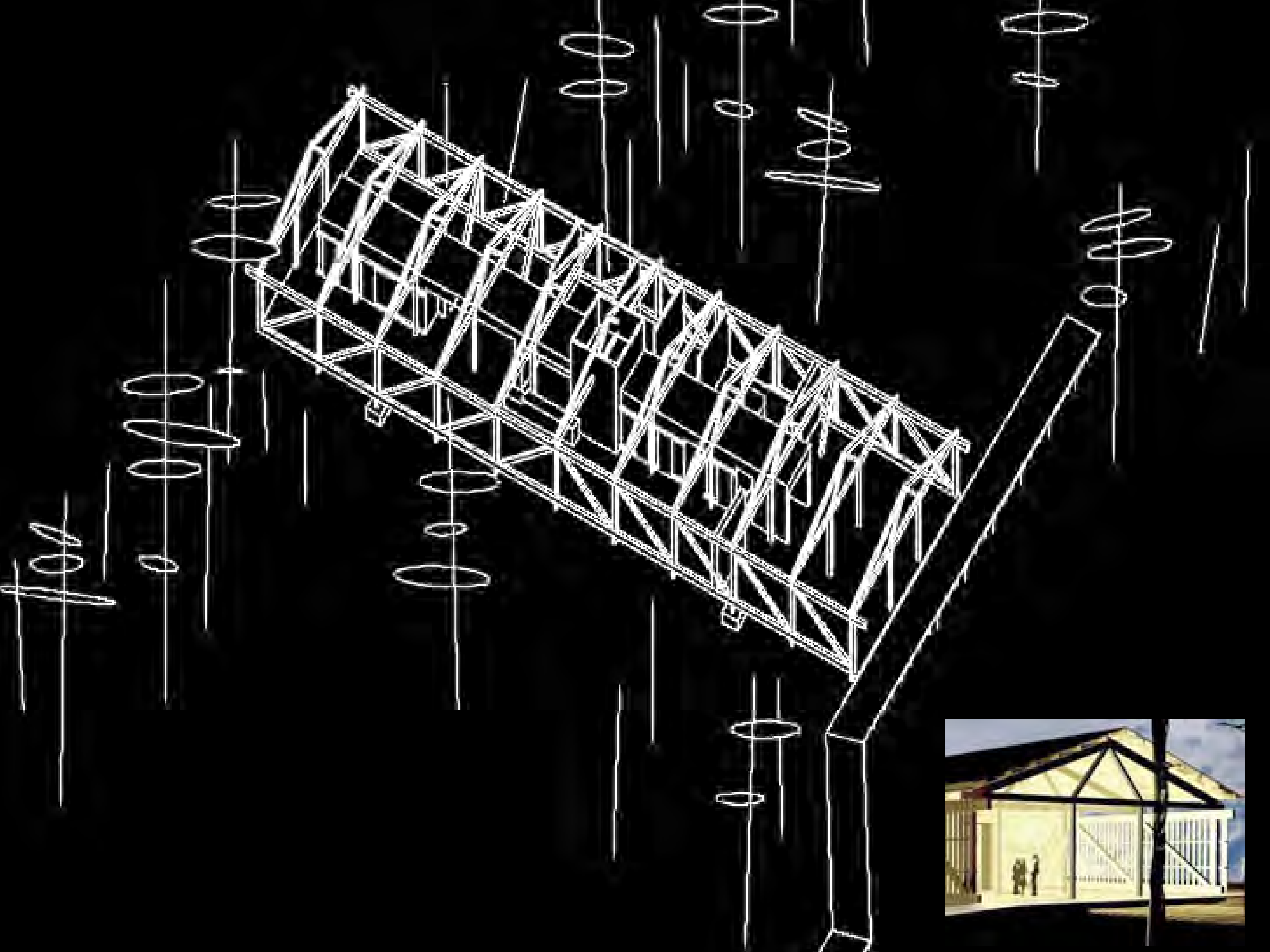
Tredje ordningens balkar

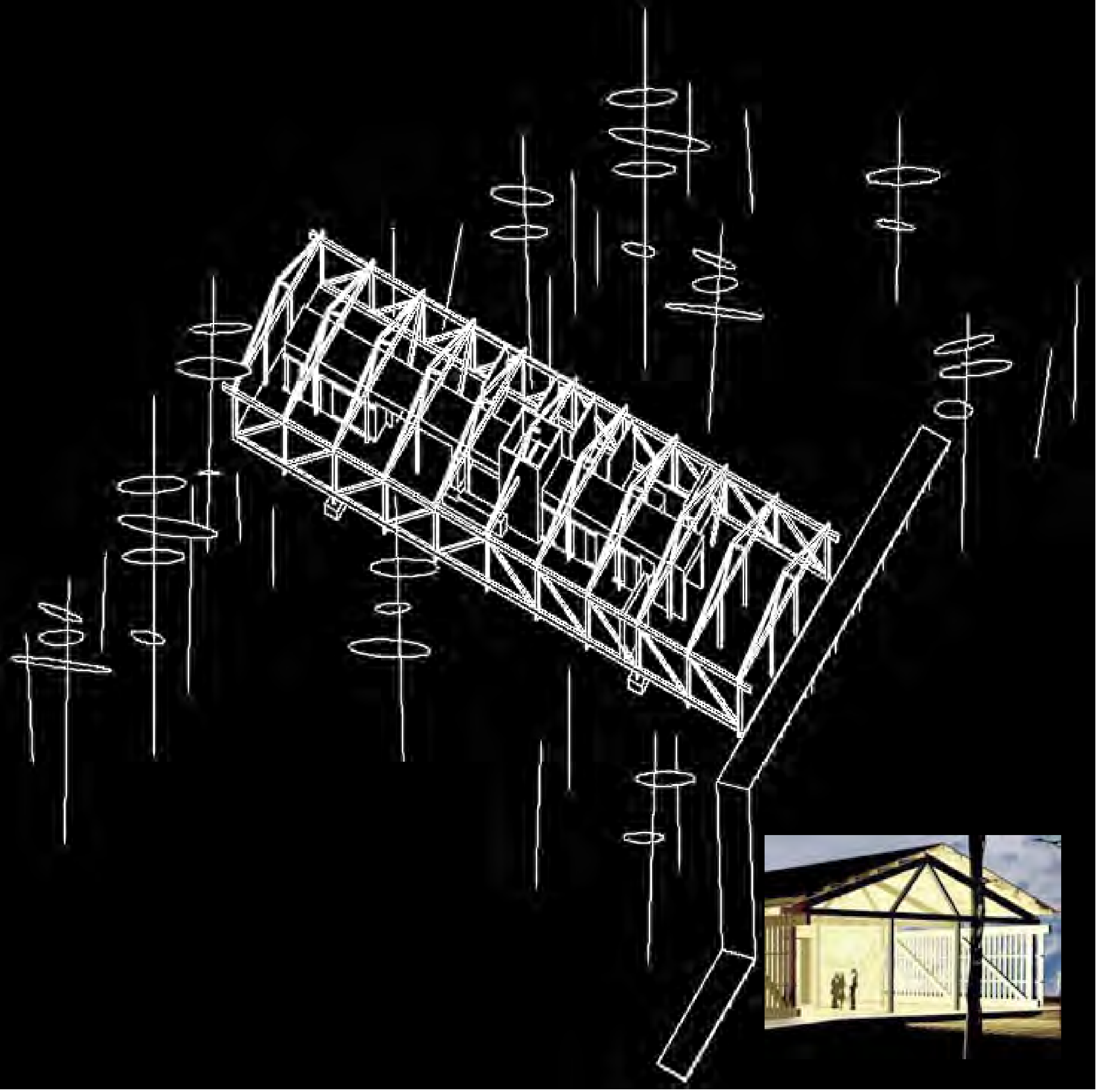


Vertikal bärning kan vara tryckt eller dragen

Store mosse

Ulla Antonsson
Mattias Lind
Per Andreasson





Takplan
Bottenbjälklag
Sektion

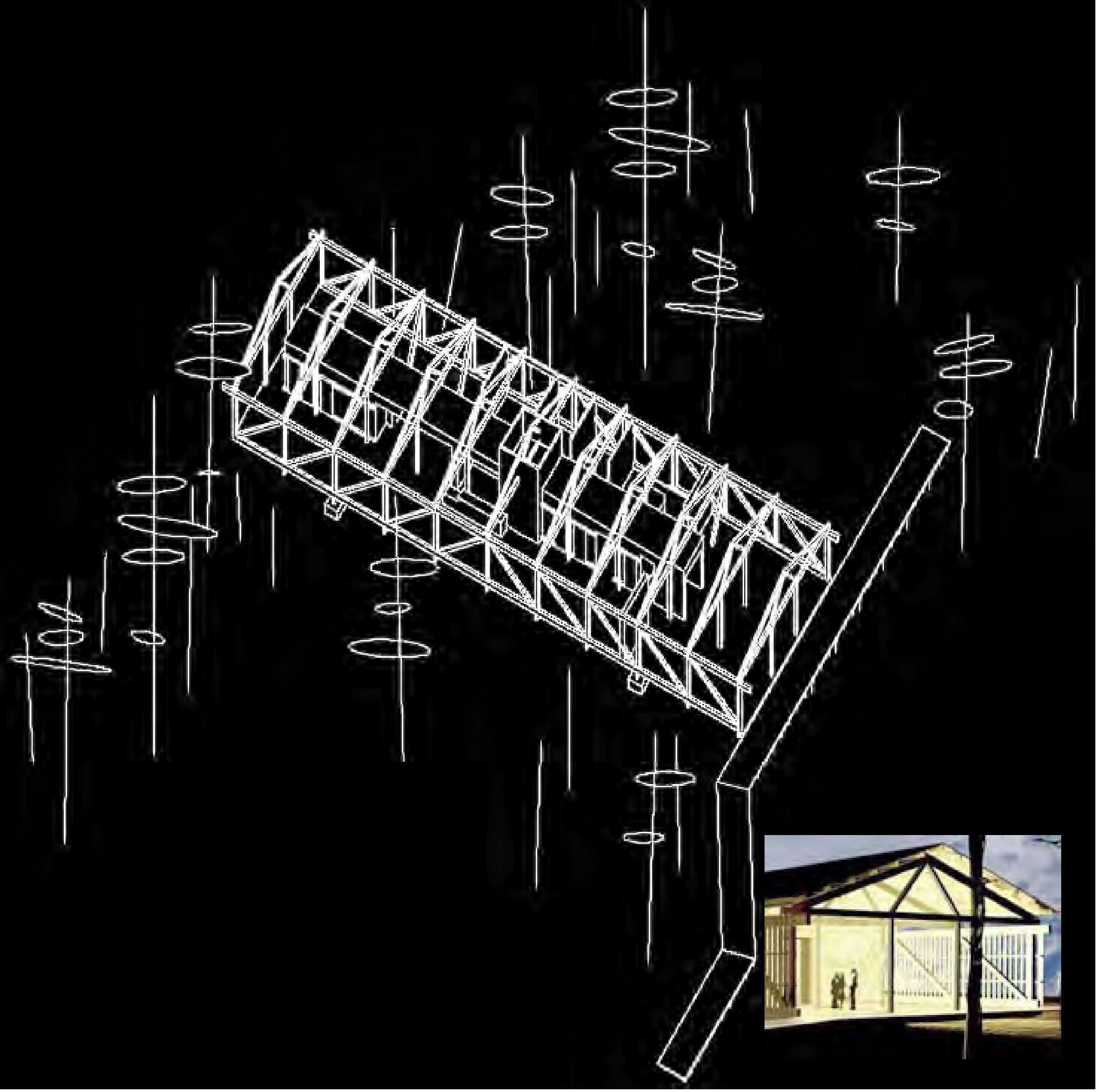
■ Vertikalt stöd underifrån

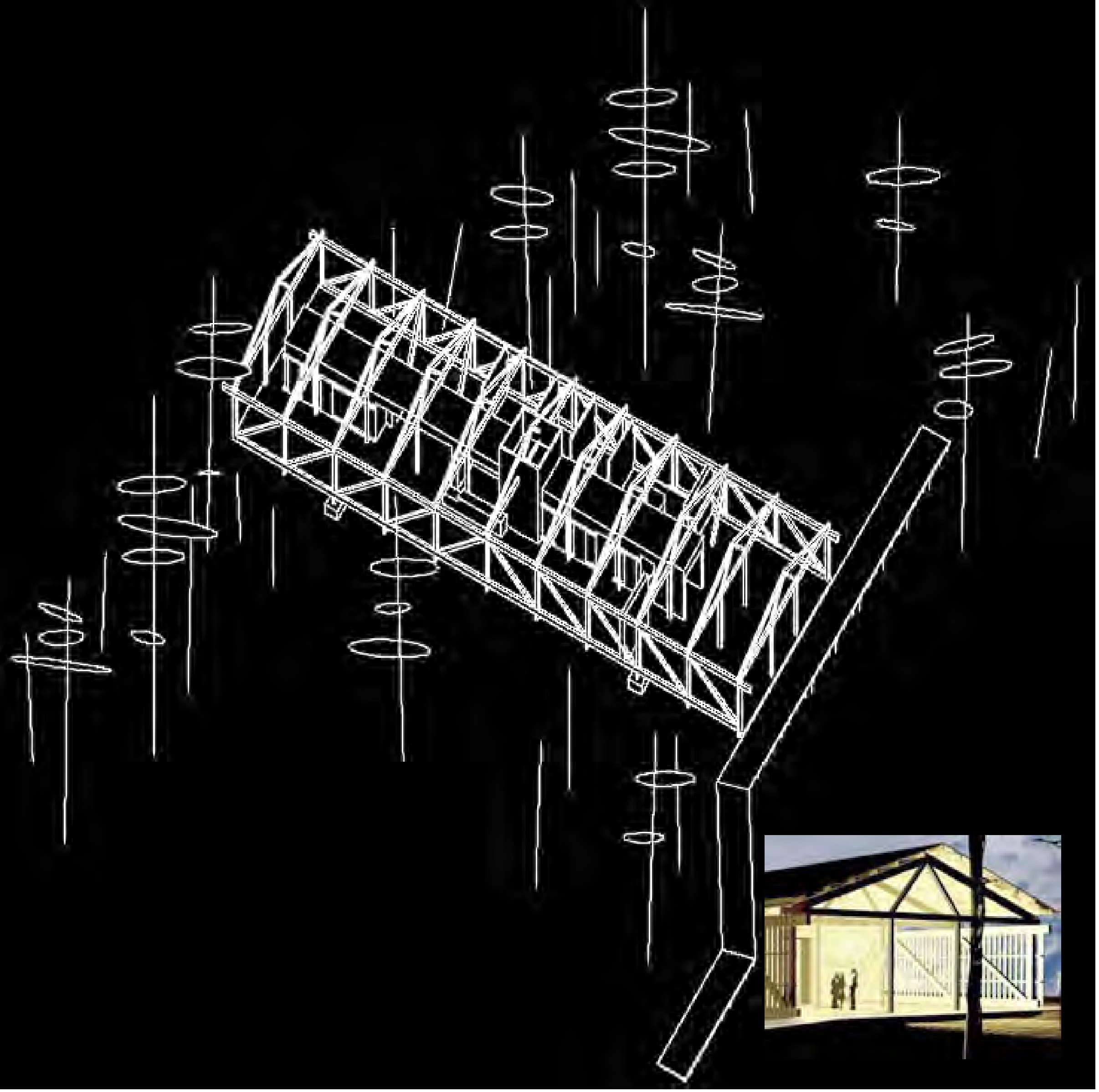
● Vertikalt stöd ovanifrån

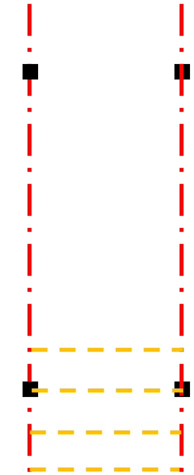
Primärbalk

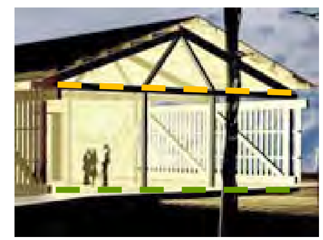
Sekundärbalk

osv….









Takstolarna blir sekundärbalkar
vilar bara på ytterväggarna

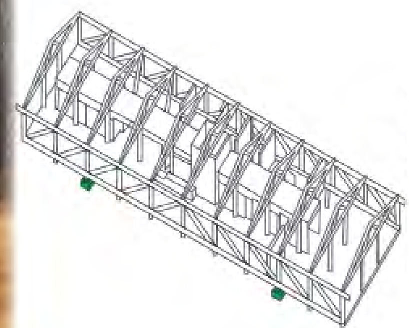
Golvbjälkarna blir 3:e ordn. bärning.
Vilar på ytterväggarna
och hänger samtidigt i takstolarna

Att sila mygg
Lagd lagg ligger

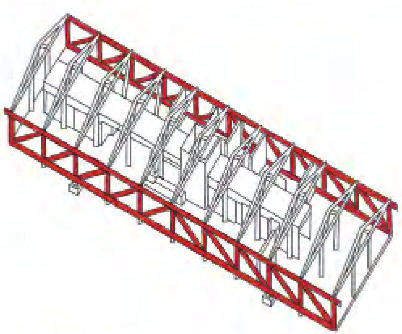
Store Mosse Naturrum

Vid Värnamo ligger Store mosse naturum, där man kan få information om nationalparken och lära sig mer om naturen runt omkring. De som ritat byggnaden är Ulla Antonsson m. fl. från White arkitekter. Byggnaden är tänkt att ge ett flytande intryck för att ge uppmärksamheten till naturen. Vid analyseringen av konstruktionen kommer vi att använda oss av några av de begrepp vi gått igenom tidigare i läroboken.

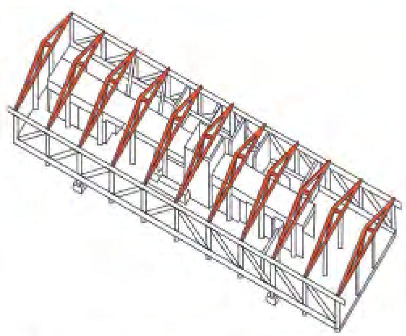
Nedan kommer vi förklara de bärande elementen hos Store Mosse. Vi har då använt oss utav olika färger för att illustrera det bärande systemet. Det som är grönt är vertikala stöd, det röda är primärbalkar, det orangea är sekundärbalkar och de gula är den tredje ordningens balkar.



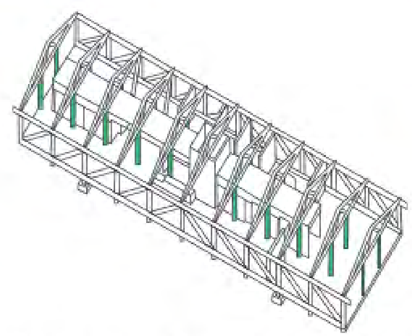
Väggarna vilar på en plintgrund av fyra stycken vertikala stöd. I ett vanligt hus skulle fler plintar krävas men på grund av konstruktionen av Store Mosse har de lyckats plocka bort större delen av plintgrunden.



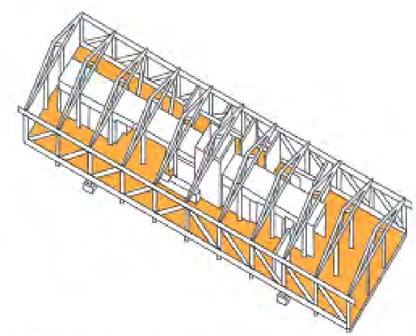
Långsidornas väggar är uppbyggda i ett fackverksmönster. Detta fackverksmönster bidrar till att väggarna kan agera som två stycken bärande primärbalkar.



På dessa väggar vilar i sin tur takstolarna. Takstolarna kommer att fungera som sekundärbalkar i detta fallet.

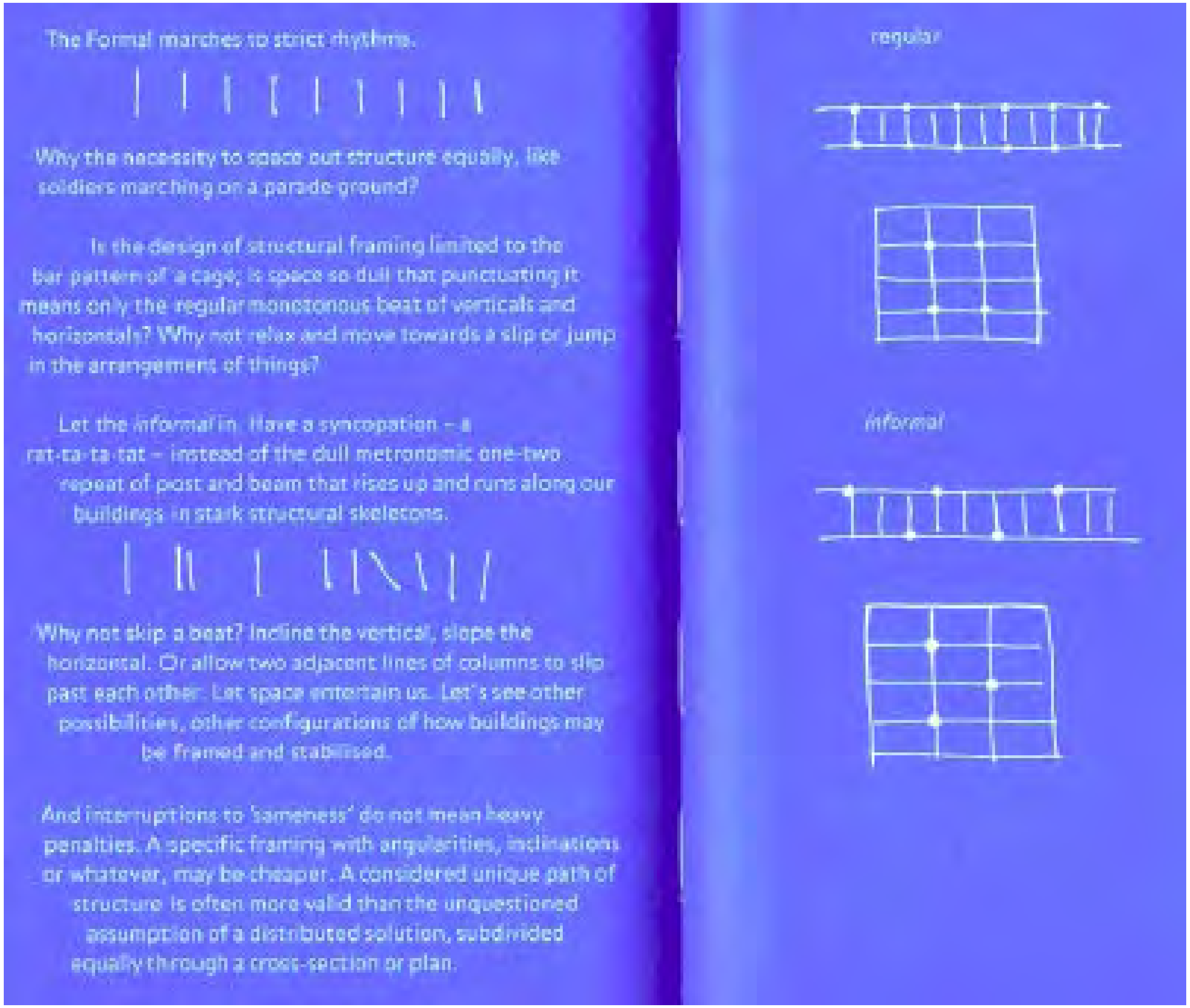


Från takstolarna går det vertikala stöd ner mot golvet som drar upp detta. De vertikala stöden kommer, till skillnad från plintarna som agerar i tryck, jobba i drag.



I detta fall kommer golvet bli den tredje ordningens balkar. Detta sätt att konstruera byggnaden har gjort det möjligt att plocka bort en del av plintgrunden och ge byggnaden ett mer flytande intryck.

Cecil Balmond   Informal



The Formal marches to strict rhythms.

Why the necessity to space out structure equally, like soldiers marching on a parade ground?

Is the design of structural framing limited to the bar pattern of a cage; is space so dull that punctuating it means only the regular monotonous beat of verticals and horizontals? Why not relax and move towards a slip or jump in the arrangement of things?

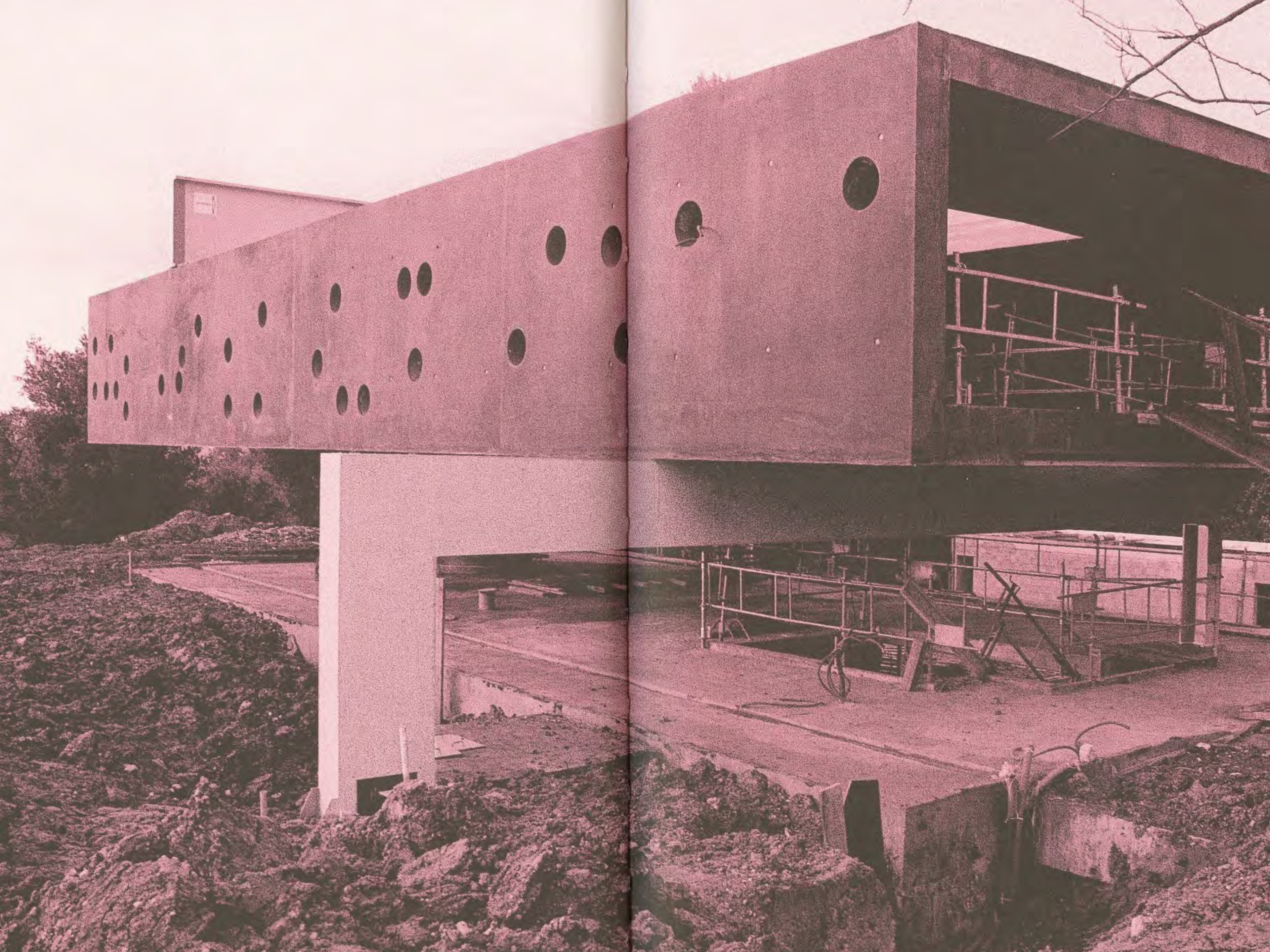
Let the *informal* in. Have a syncopation – a rat-ta-ta-tat – instead of the dull metronomic one-two repeat of post and beam that rises up and runs along our buildings in stark structural skeletons.

Why not skip a beat? Incline the vertical, slope the horizontal. Or allow two adjacent lines of columns to slip past each other. Let space entertain us. Let's see other possibilities, other configurations of how buildings may be framed and stabilised.

And interruptions to 'sameness' do not mean heavy penalties. A specific framing with angularities, inclinations or whatever, may be cheaper. A considered unique path of structure is often more valid than the unquestioned assumption of a distributed solution, subdivided equally through a cross-section or plan.

regular

informal

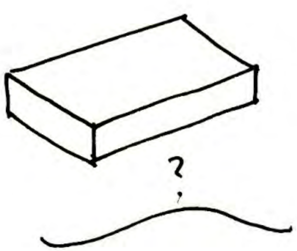


Rem Koolhaas phones me. As usual the voice is urgent, full of convictions and ambitions, the language poised beautifully on extreme polarities. He has an unusual request, to make a villa in Bordeaux 'fly'.

The project is on a fantastic site with panoramic views over the rich, wine-laden city stretching along the river.

Rem says the client is seriously disabled from a recent car accident but is fighting back, determined to have a new life. And the house has to be a special one that can accommodate his needs with those of his wife and two children. They have a large town house, but now under different circumstances the family wants a new villa, up on the cliff edge, overlooking the city.

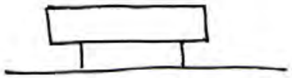
And I had that reaction when one first hears of a project – the immediate excitement, a new challenge and with it the start up fear – will it succeed?



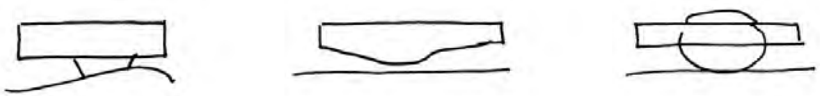
In the event, the answer was quite unexpected.

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'.

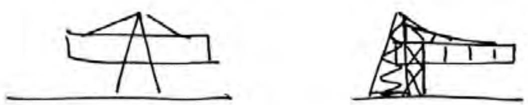


Columns were stuck well underneath to give a feeling of free edge.



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

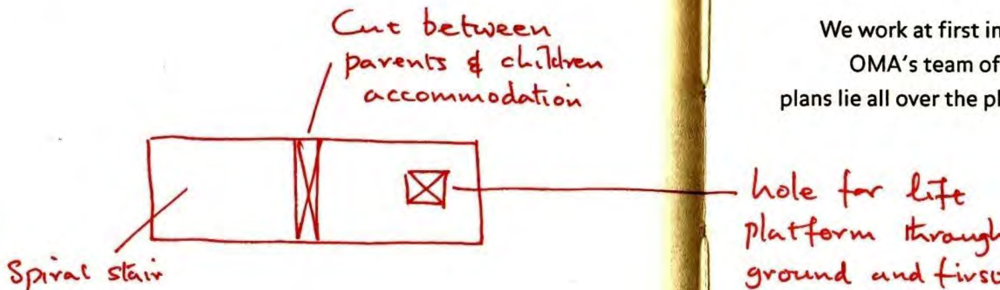
In other instances raking columns initiated oblique lines to take away the feeling of direct support.

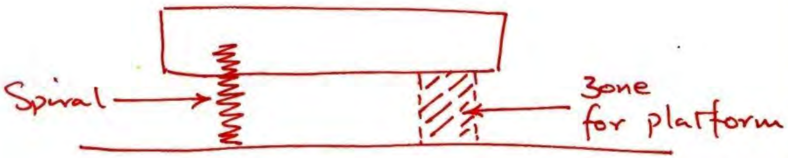


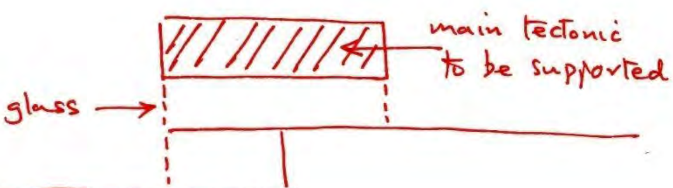
I tried top hung support as well but that felt alien and inappropriate for the site.

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.

Generic Issues







We meet in Bordeaux. The setting is something else – a hotel designed by Jean Nouvel overlooking the fields of Floriac, just a few miles outside the city.

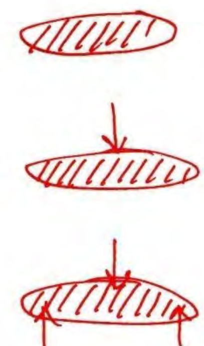
We work at first in a ground floor reception room. No one seems to be about. OMA's team of Jerry and François are here and sketches of the site and ground plans lie all over the place. They outline the brief to me.

A family house, for husband and wife, plus two children. The design must give access to the disabled person, to release the full potential of the house. The principle tectonic is to be a box, up in the air, where the bedrooms will be located. Below this are the living spaces, surrounded by glass. The glass may open out onto the landscape and vanish; below the living space is a partial basement, cut into the earth on one side but open to an entry courtyard on the other. There is to be a special lift, a moving part of the house really to reach all levels.

INTERROGATION:

To ask a mass to levitate is not a new question; there is always an architectural demand for a lightness of being, *tabula rasa* visions with nothing to account for gravity. Structure in these situations simply gets in the way, becoming an enemy of promise.

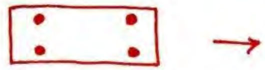
But gravity is a tyrant. Its pull cannot be avoided, and the usual response for supporting a load in the air is to configure legs to hold the weight up from below. There is a directness of purpose to this configuration but there is also a complacency to look for nothing else.



Something else was needed.

The idea of *launch* came to mind, to energise the building as momentum. Two lateral moves broke with symmetry.

Move one:



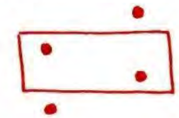
what if the supports in plan are displaced beyond the boundary, well outside the box?

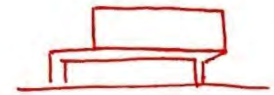
Move two:

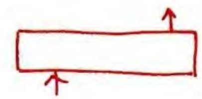
what if the supports 'flip' in elevation, one top hung, one bottom fixed?

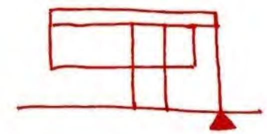
Suddenly we had the dynamic we wanted. The side-way shifts in plan and jumps in elevation brought a skewed tension to the solution. They stretched the concept of balance to the edge of the predictable, towards a moment of instability, setting up a precise danger point.

At one end the box sits on a shelf beam. At the other end its weight hangs off a roof girder, precarious and scary. The cable that restores balance is placed outside the plan, mimicking the movement of the displaced column at the shelf support end. Each cross-section is the reverse of the other.









A contradiction is offered in how the load is perceived. The solution pulls one way and then the other. The weight of the box is both supported from the ground and hung up in the air, in plan and elevation the exaggerations deny any conventional reading of balance.

The idea of a table is destroyed. Instead, the dynamic is *launch.*

In my mind's eye I already saw the villa flying.

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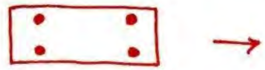
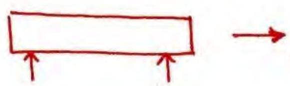


what if the supports in plan are displaced beyond the boundary, well outside the box?

Move two:



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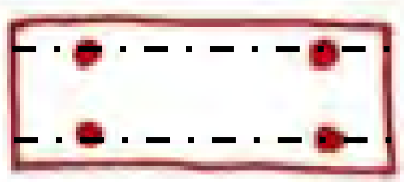

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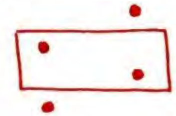

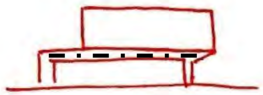

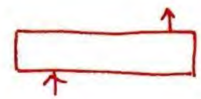

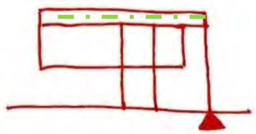

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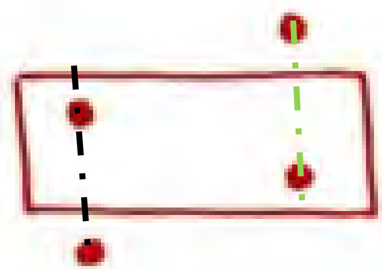
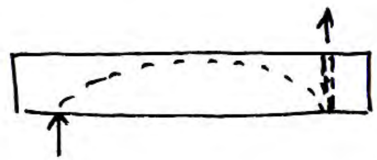
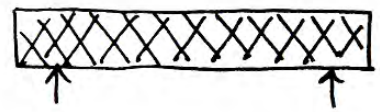


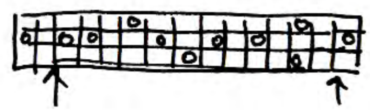
The roof and floor spanned 11 metres onto longitudinal wall beams. These beams in turn had two supports, and cantilevered beyond them at each end. Though thin in section the depth of these walls gave adequate stiffness and the gable ends of the box could be kept open if needed. On the wall beams, lines of principal stress were marked so that holes could be cut out without complications to the structural action.

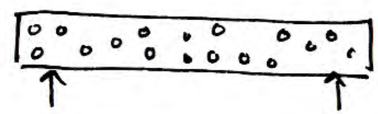
Keep it simple – that was the aim.

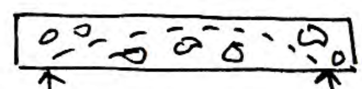


A grid was plotted on the wall elevation to allow a random solution. Rem speculated that small porthole-like windows scattered throughout the elevation would look terrific. We floated small circles, like soap bubble experiments, through the elevation as we tried various punctuations – low level portholes for the client in a wheelchair, and high level vista points for the others. Views were calculated and prescribed. A beautiful drawing, like a wind rose, took shape in OMA's office.

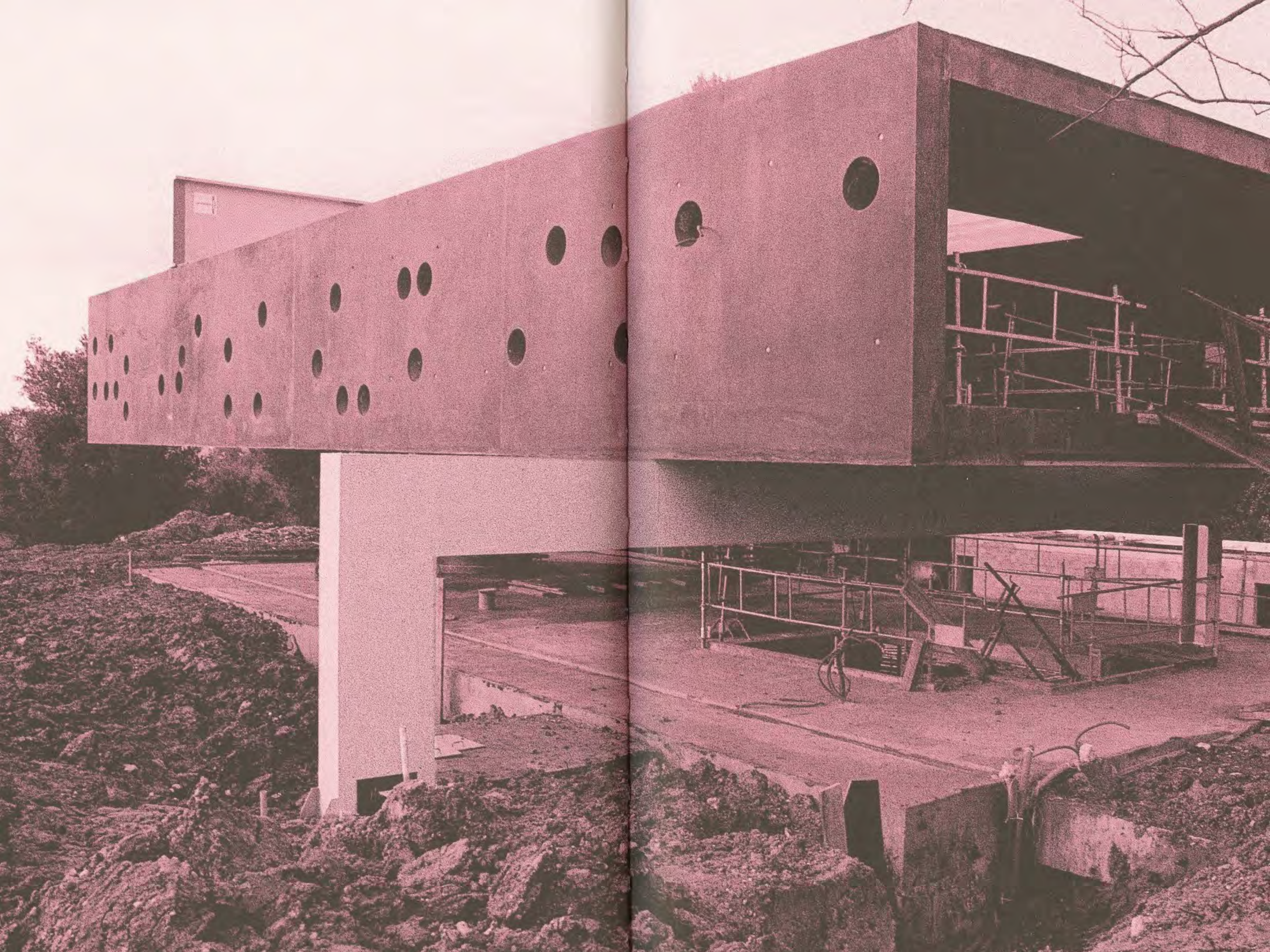


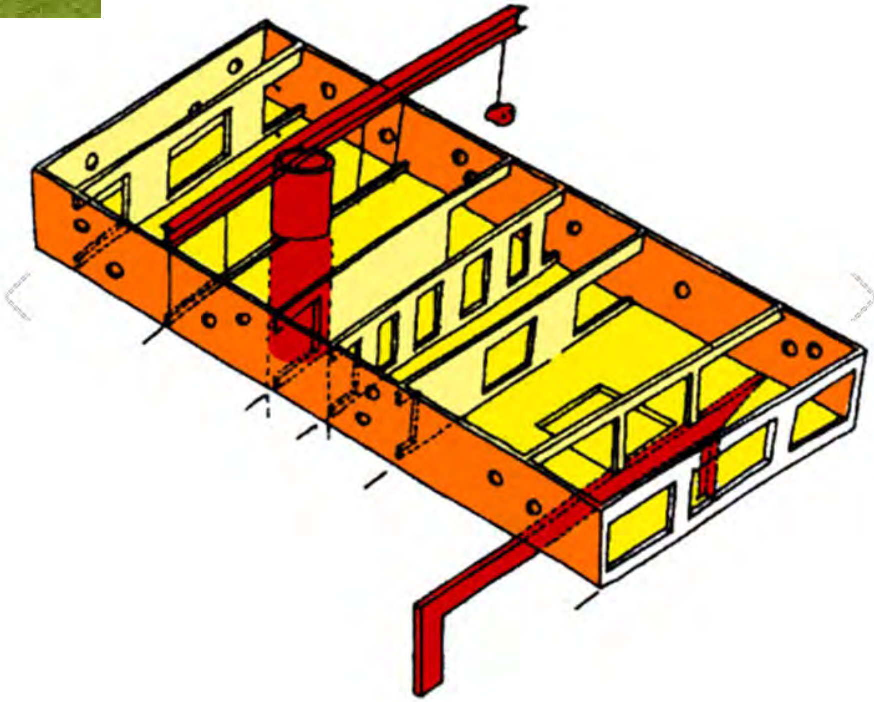






The design, we thought, was progressing well. The shape, size and configuration were solved, the materiality agreed: we were into the 'Avant Projet Détaillé' stage of design, prior to tender.





http://www.svtplay.se/k-special

Cecil Balmond
Informal

XIX

When entering a design there are several stages to unravel; a composition field, pattern, the choice of connectivity, geometry and, finally, material.

The overlaps to structure are:

Compositional Field
Pattern
Connectivity
Geometry
Material

Metaphor
Network
System
Proportion

Configuration
Form

Structure

XX

Something dramatic happens when we contemplate the analysis of 'structure'. The world loses its substance: walls, columns, floors and beams shrink and dematerialise to leave an imprint on a small skeletal drawing. The structure becomes just lines connecting nodes – a virtual diagram. The line has no real thickness and the node no size, they are mathematically dimensionless entities of point and line. Precisely because a framework has no substance we can give it any properties we like: weight, area, stiffness etc. Armed with such properties the structural diagram becomes a potent machine, waiting for a set of actions.

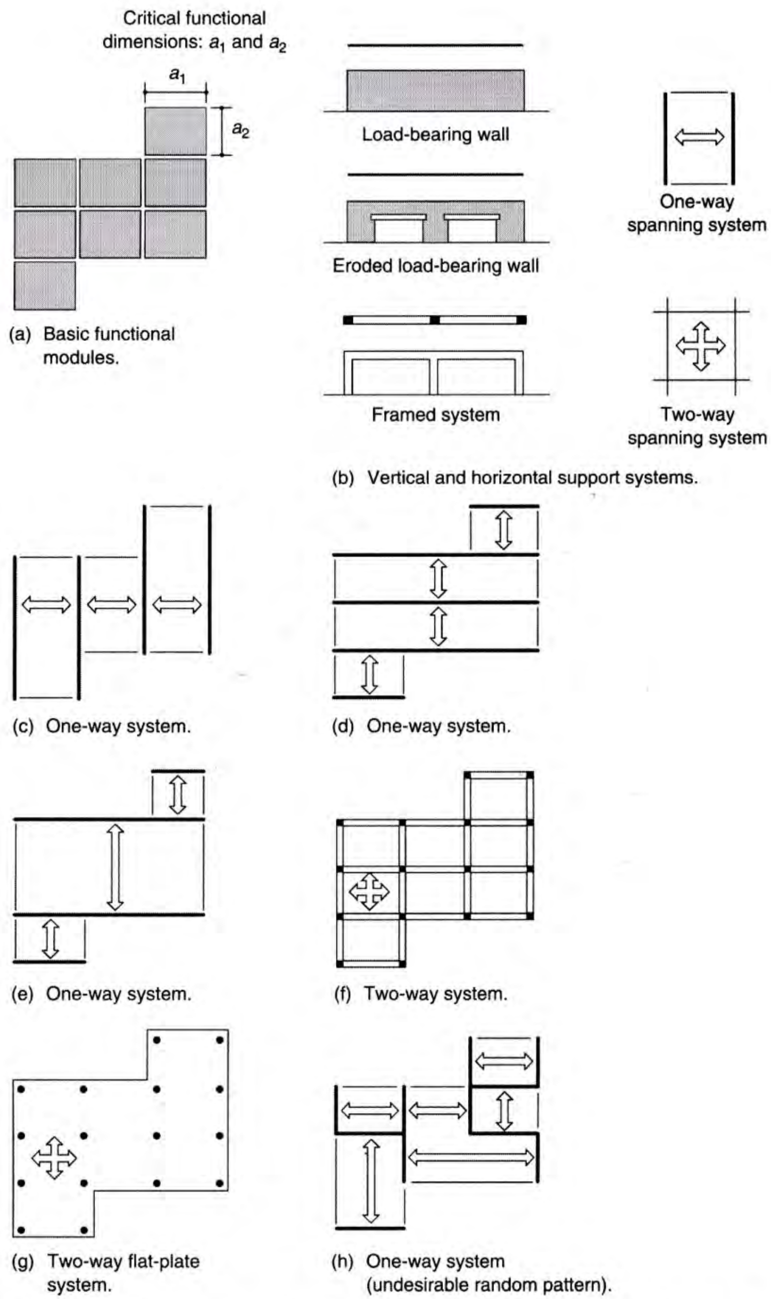
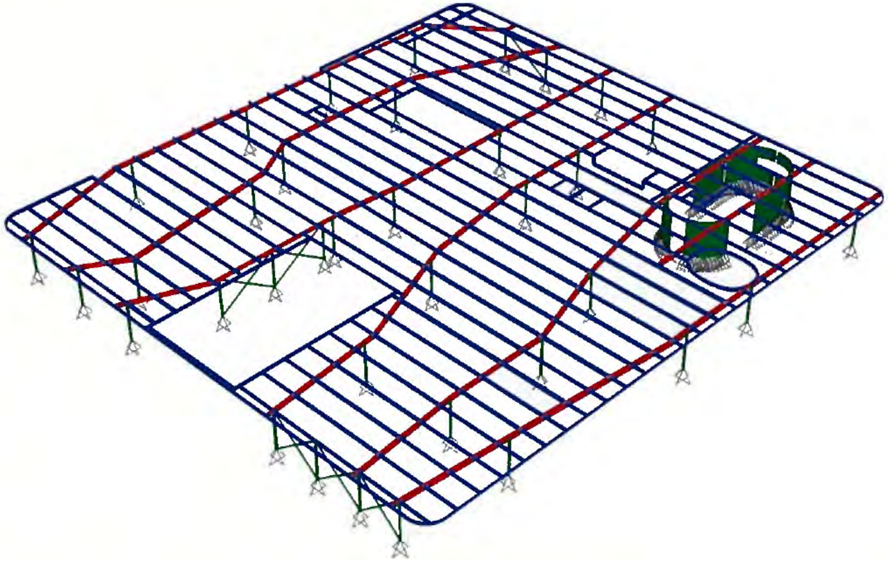


Figure 13.12 Vertical support patterns. Most buildings can be fitted with many different types of structural patterns that correspond to different building configurations and functional needs.

Samma plan men olika organisation av den bärande strukturen

Vilka symboler används här för

Vertikala stöd
Primärbalk
Sekundärbalk
...?



Glass Pavilion
Toledo Museum of Art
Ohio

Sendai Mediatheque
Toyo Ito

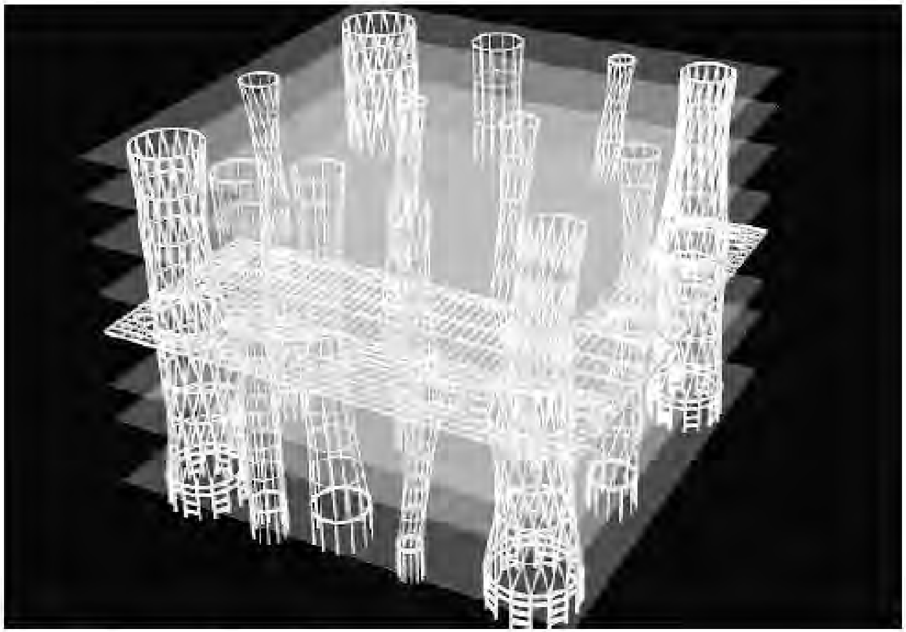


Fig. 3: Structural model

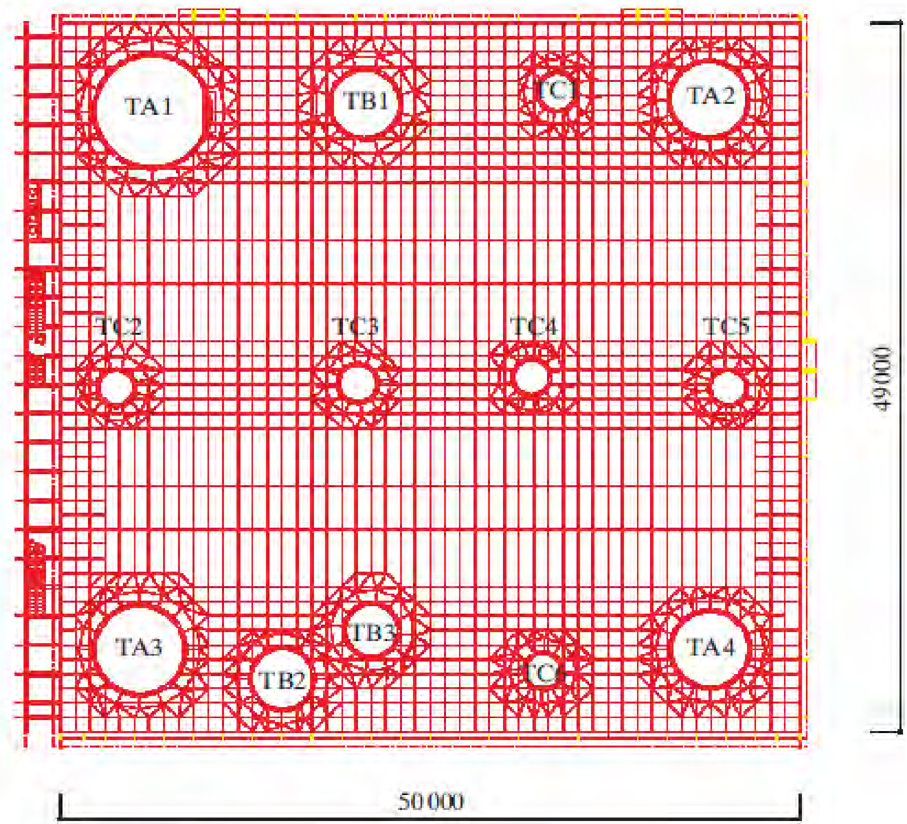


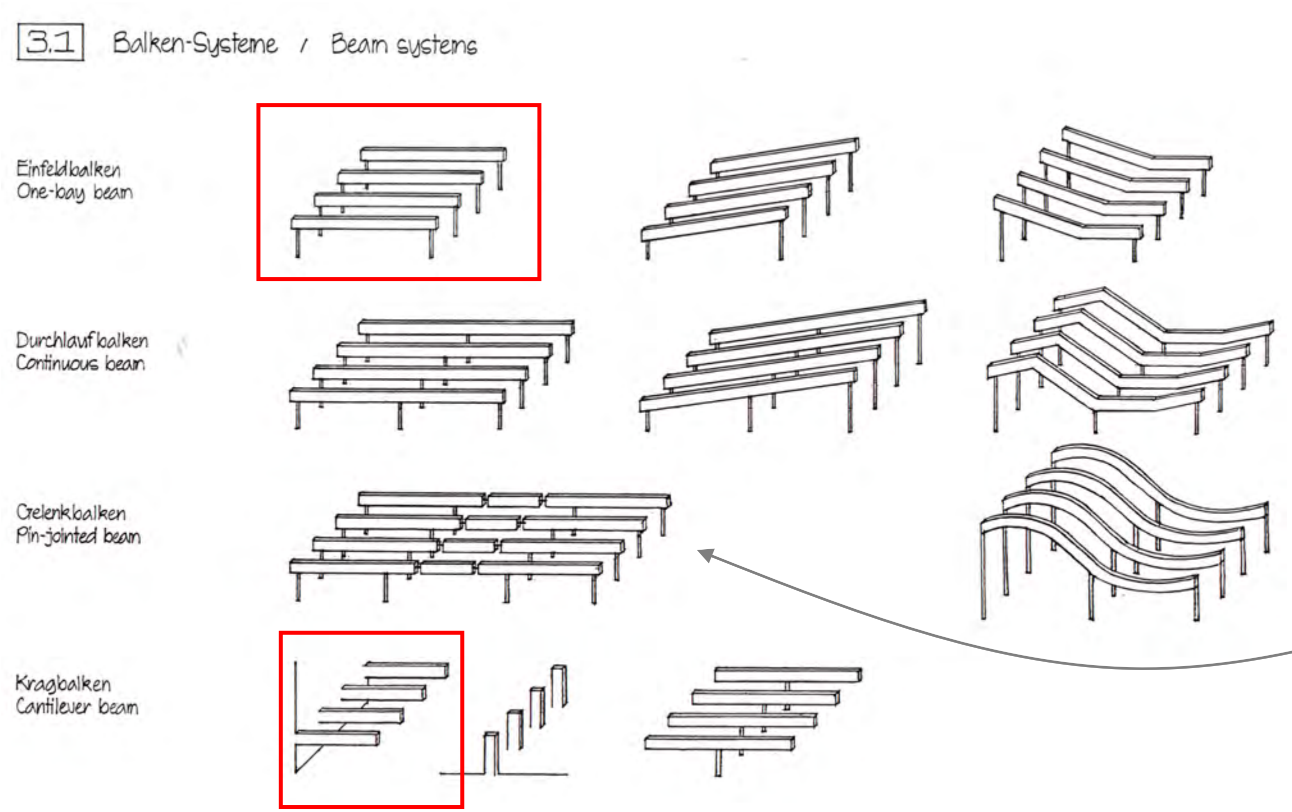
Fig. 4: Floor plan


A2 Bevarande och omvandling
Kvarnbyn

A2 Bevarande och omvandling

Vad är en ”balk” ?

Ett bärverk som bär last vinkelrätt sin egen utsträckning



Balktyper

Fritt upplagd balk
h = L/20

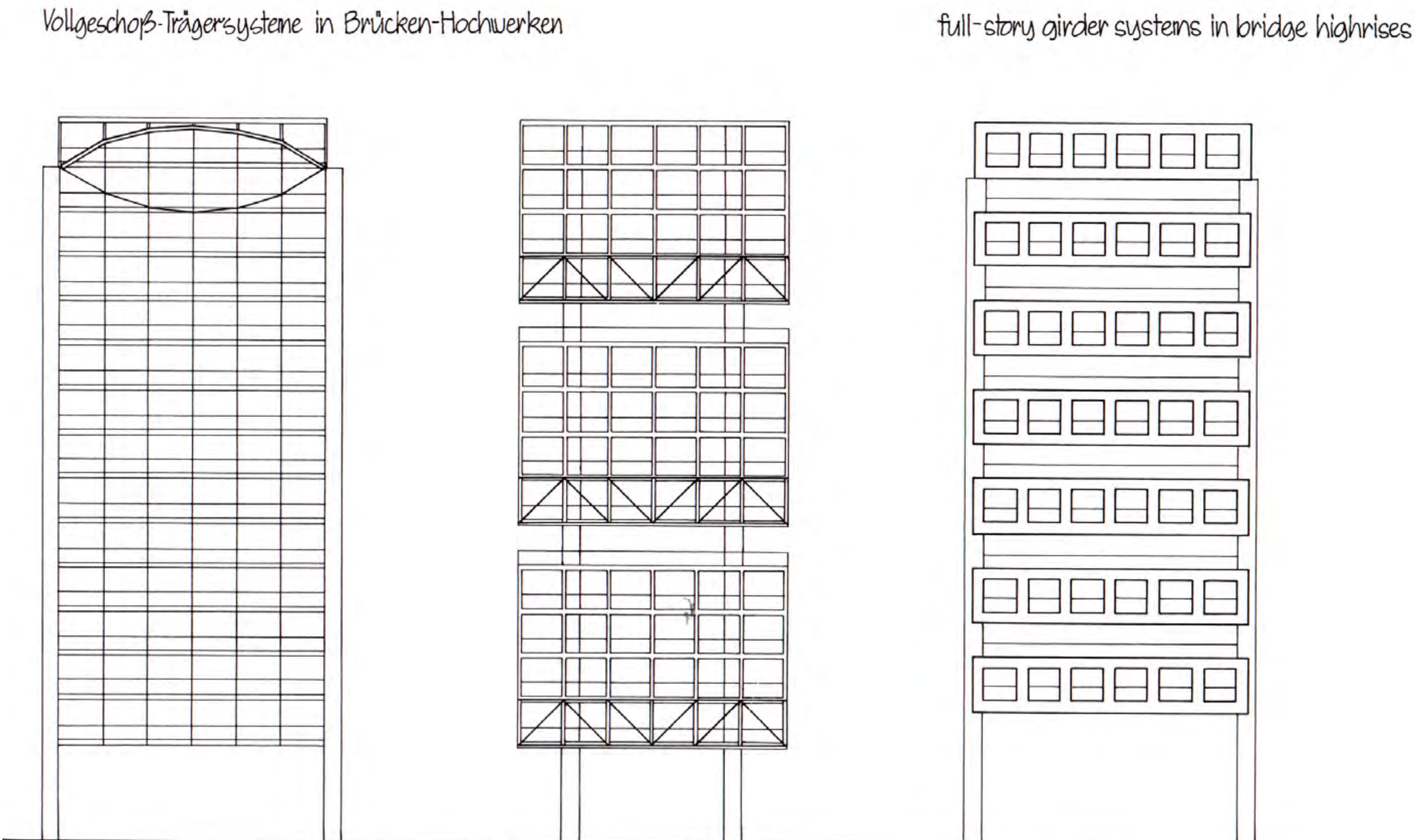
Kontinuerlig balk

Gerber-balk

Konsolbalk
h = L/10

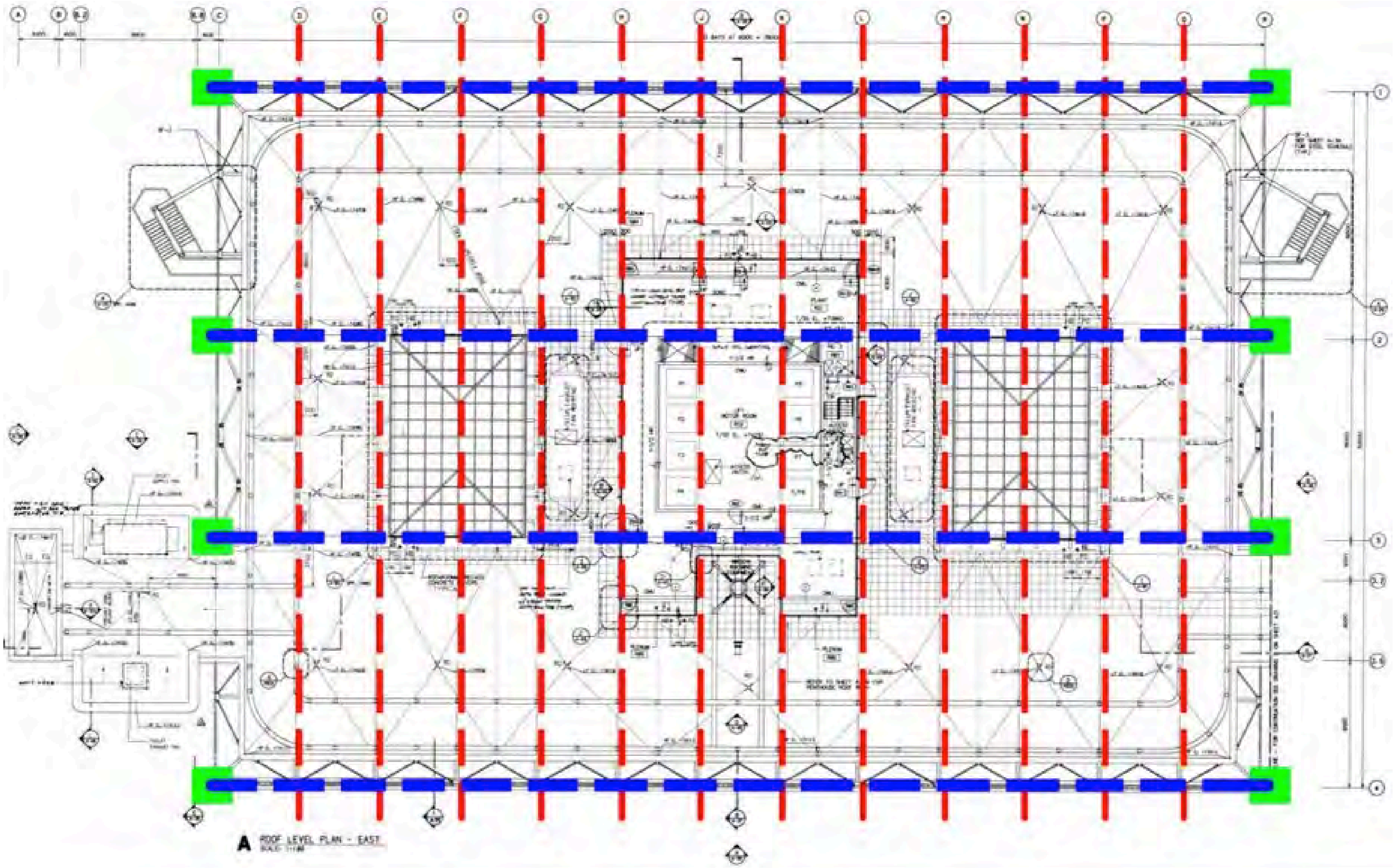
Exempel på bärverkstyper som fungerar som ”primärbalkar”

Bärverk som bär laster vinkelrätt sin egen utsträckning



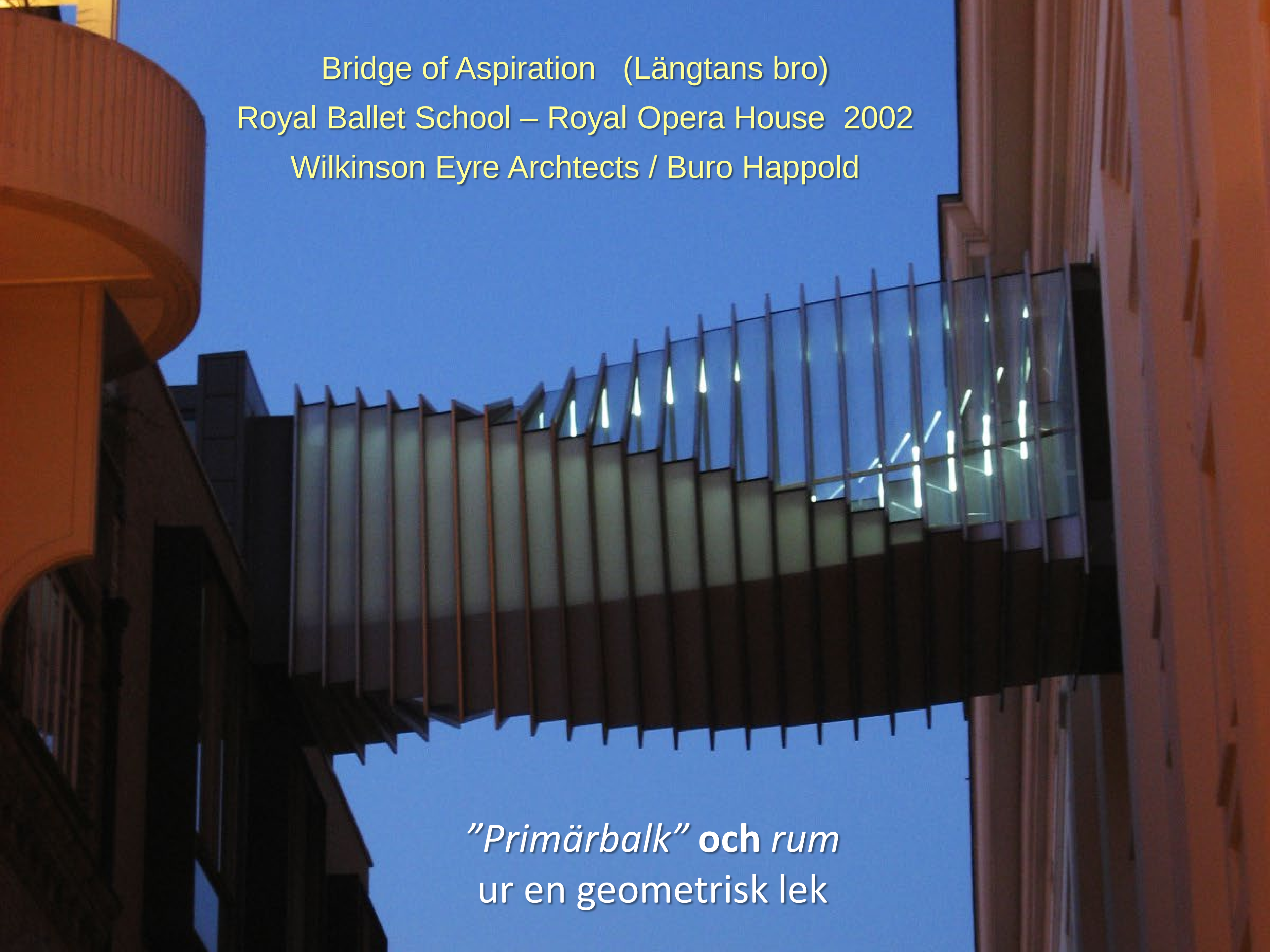
**Federal Reserve Bank
Minneapolis**

**Broadgate Exchange House
London**

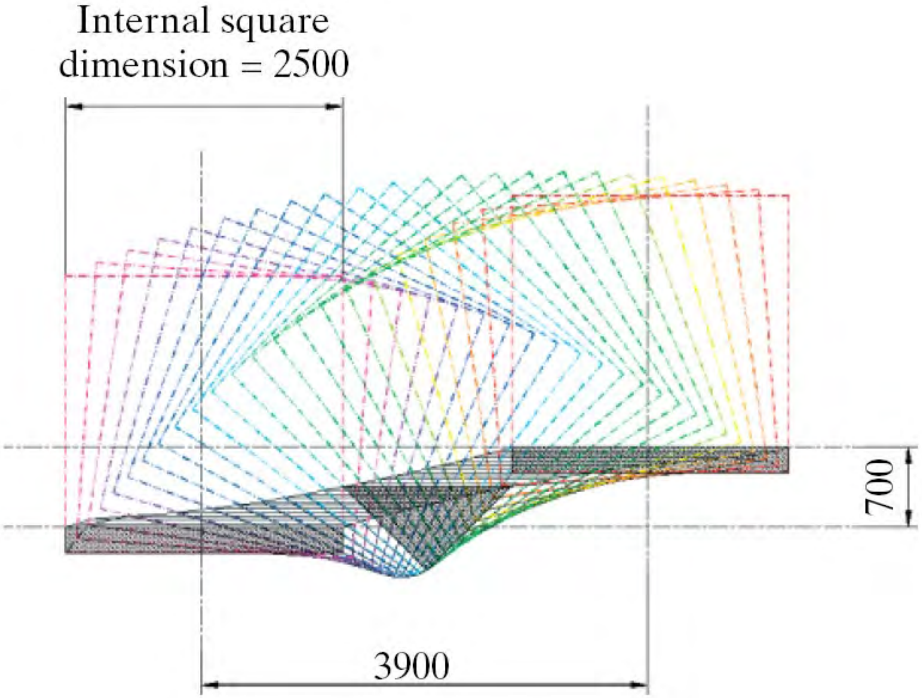


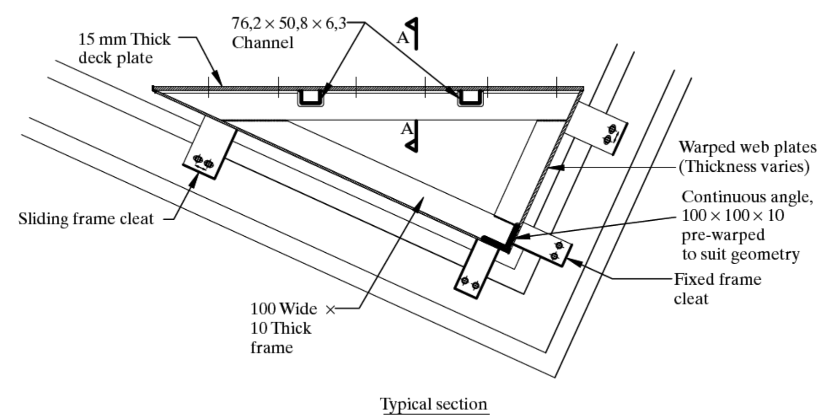
Broadgate Exchange House
London

”Sekundärbalken” **mellan** *konstruktion* **och** *rum*


Bridge of Aspiration (Längtans bro)
Royal Ballet School – Royal Opera House 2002
Wilkinson Eyre Archtects / Buro Happold
”Primärbalk” **och** *rum*
ur en geometrisk lek

Om växelspelet mellan konstruktion och rum/rörelse

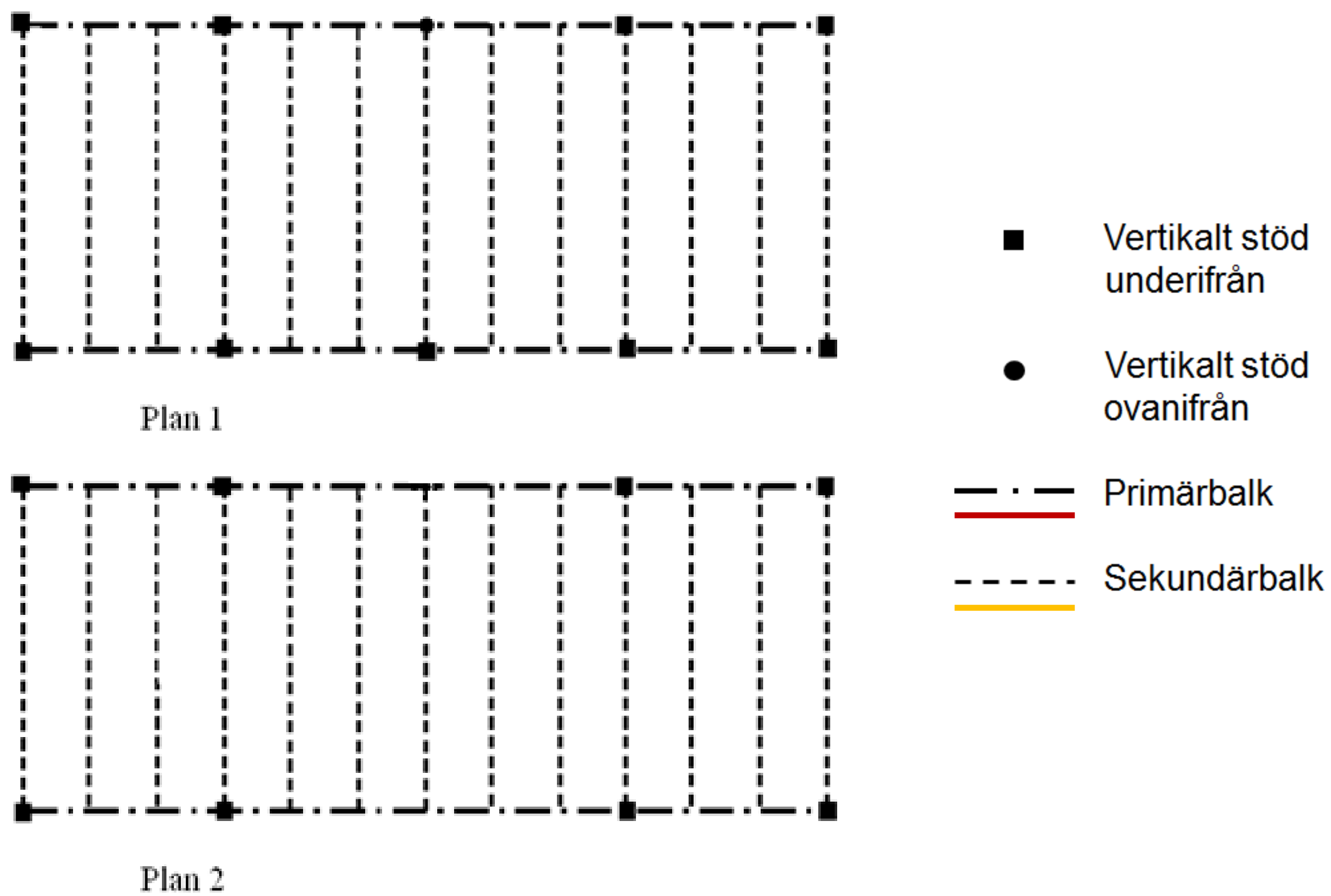




1. Exempel på vertikala laster

Ge exempel på olika vertikala laster som kan belasta en byggnad

2. Strukturer för vertikala laster



I figuren visas ett logiskt system för att bära vertikal last.

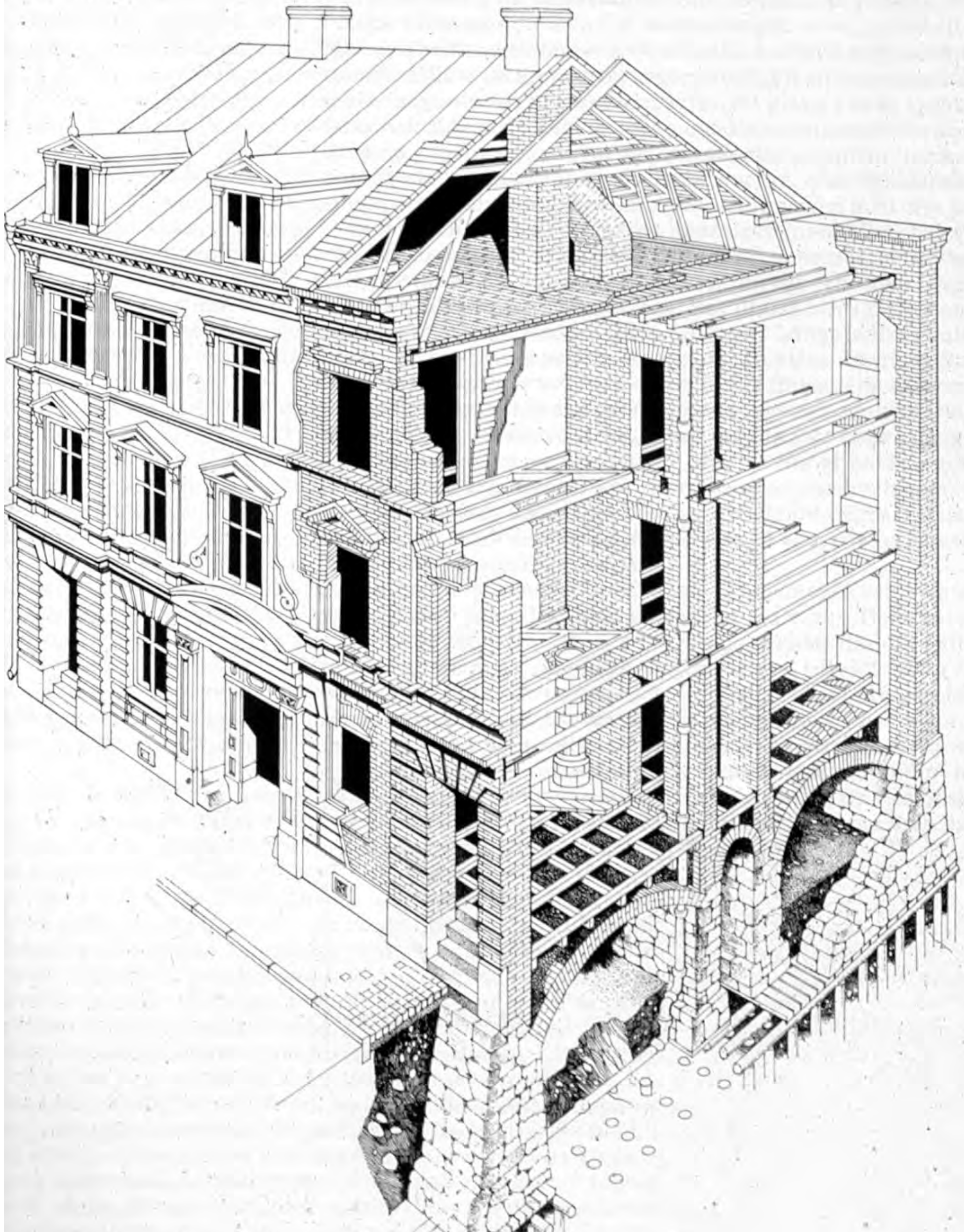
Rita en 3D skiss av det bärande systemet.
Resonera kring de olika ”balkarnas” höjd (H/L) relativt varandra.

3. Exempel

Välj två exempel och beskriv
det vertikalt bärande systemet.

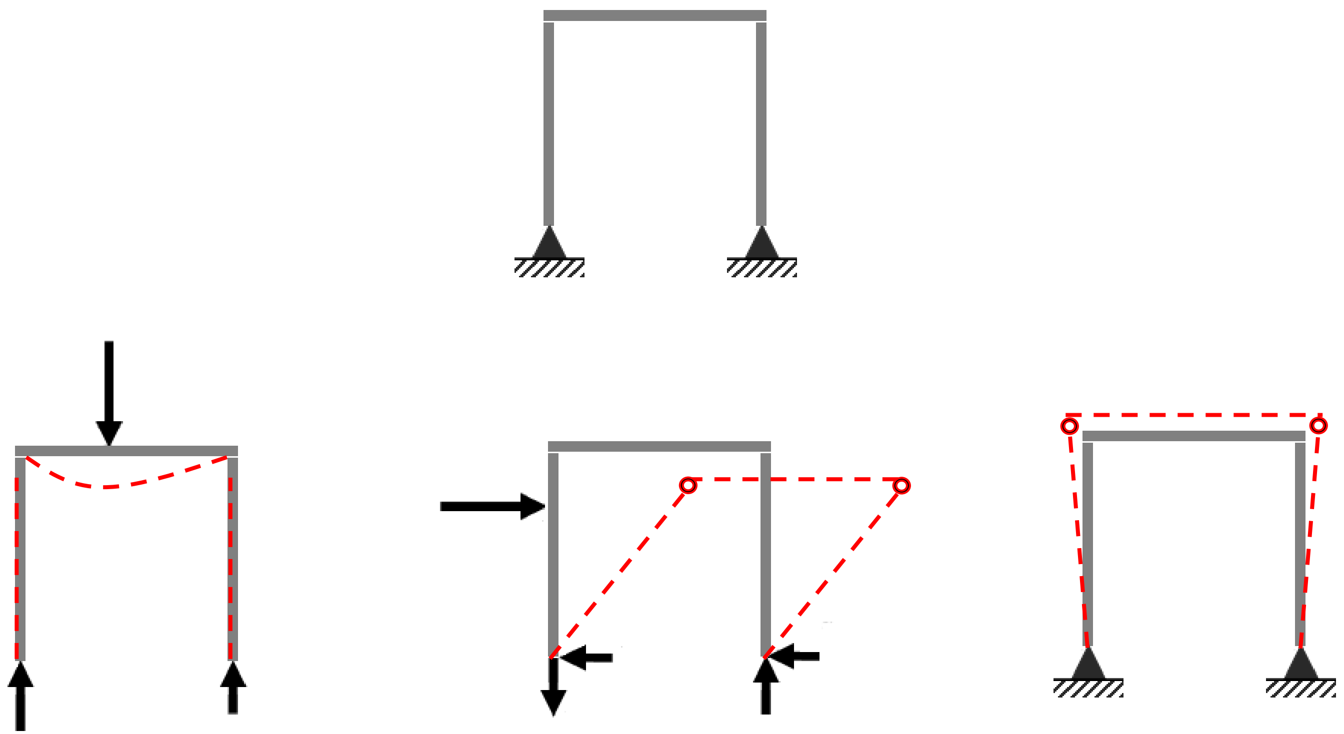
Till exempel
Store mosse
Den franska villan från Cecil Balmonds *Informal*
Kunsthaus Bregenz
Nils Ericsson-terminalen


28



Horisontella laster

Horisontella laster

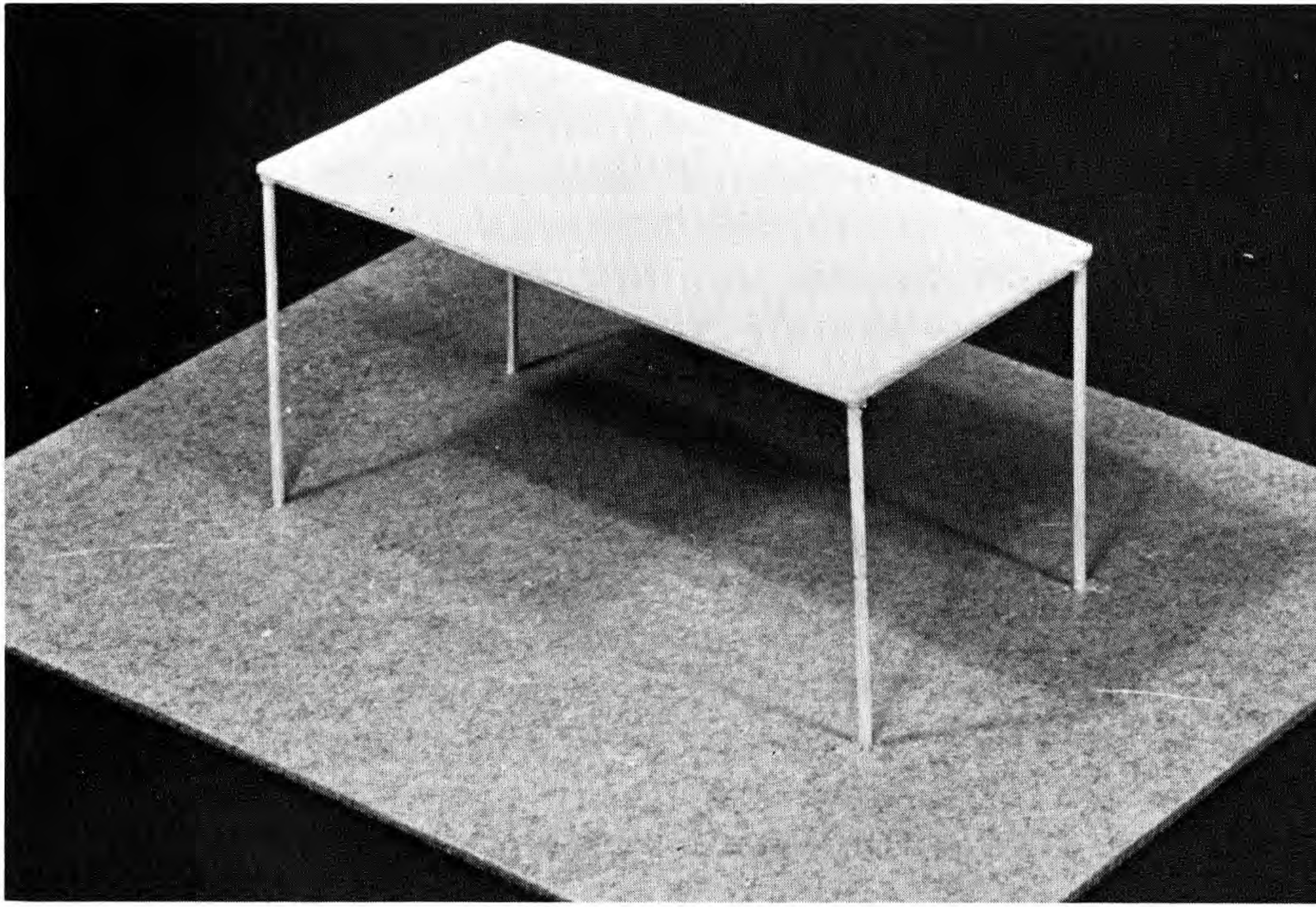


Vertikala laster

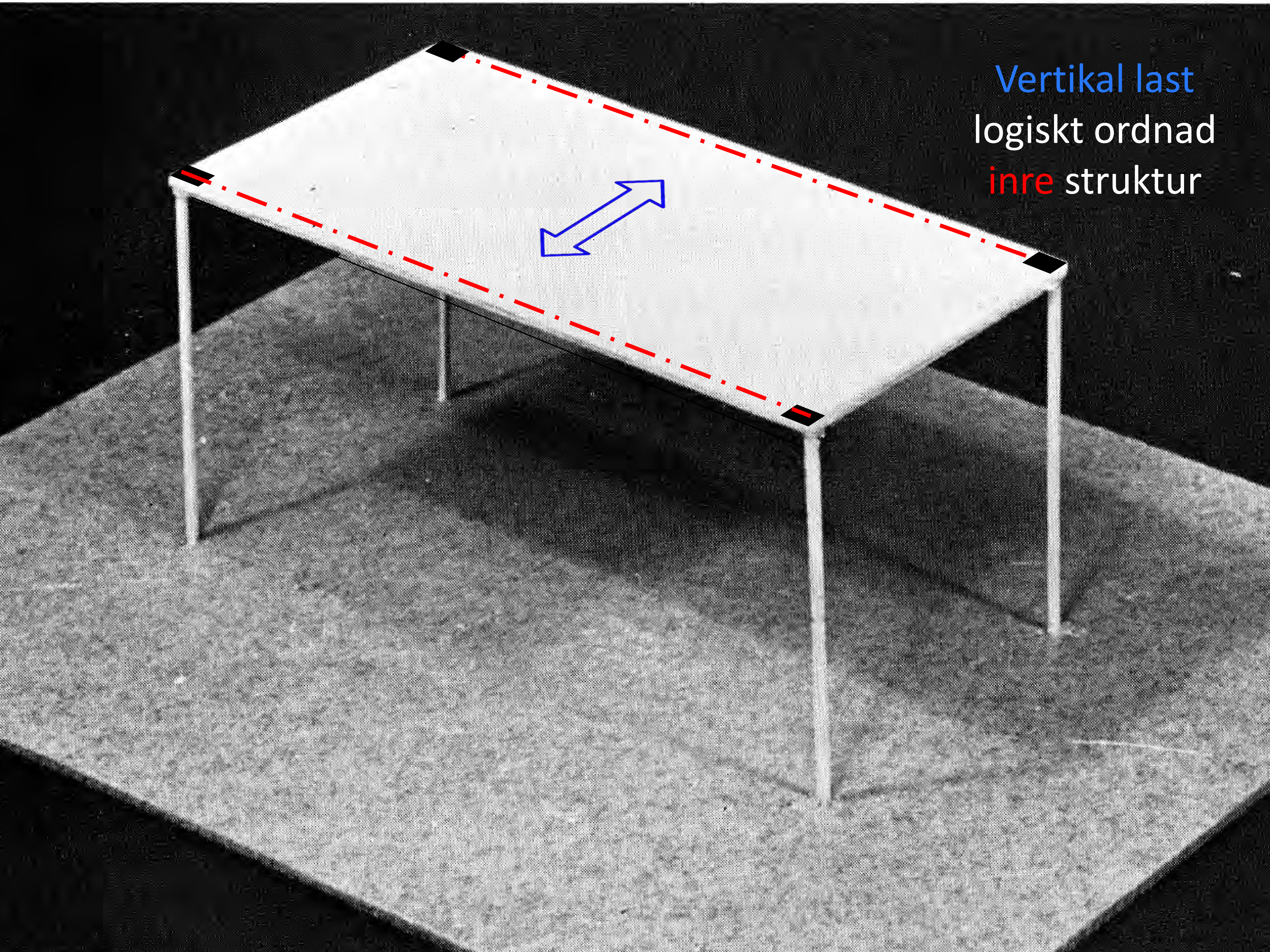
Horisontella laster

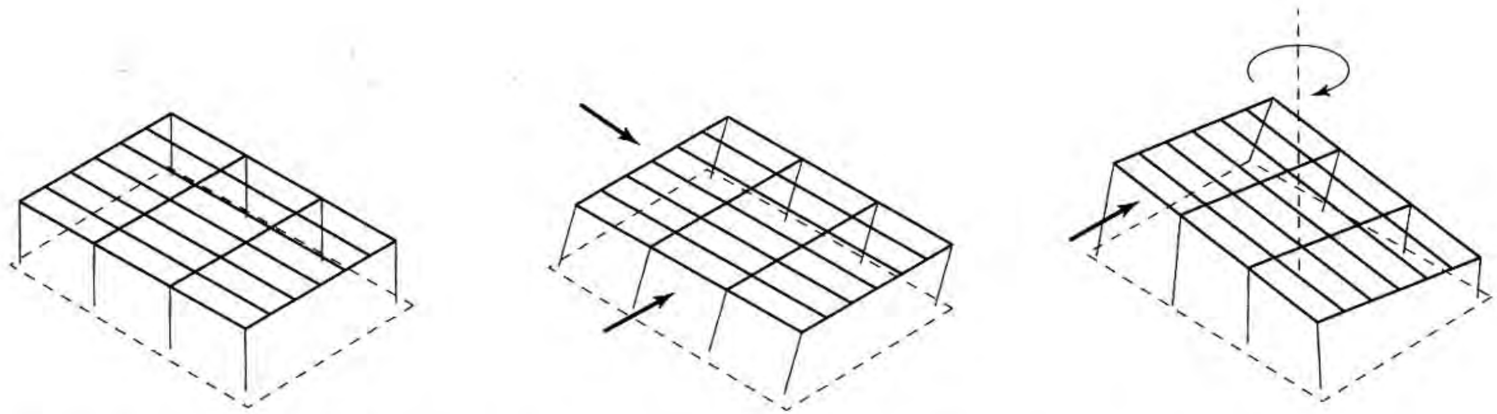
Mekanism!

Temperatur
och fuktlast



1.1 Model table framework.


Vertikal last
logiskt ordnad
inre struktur



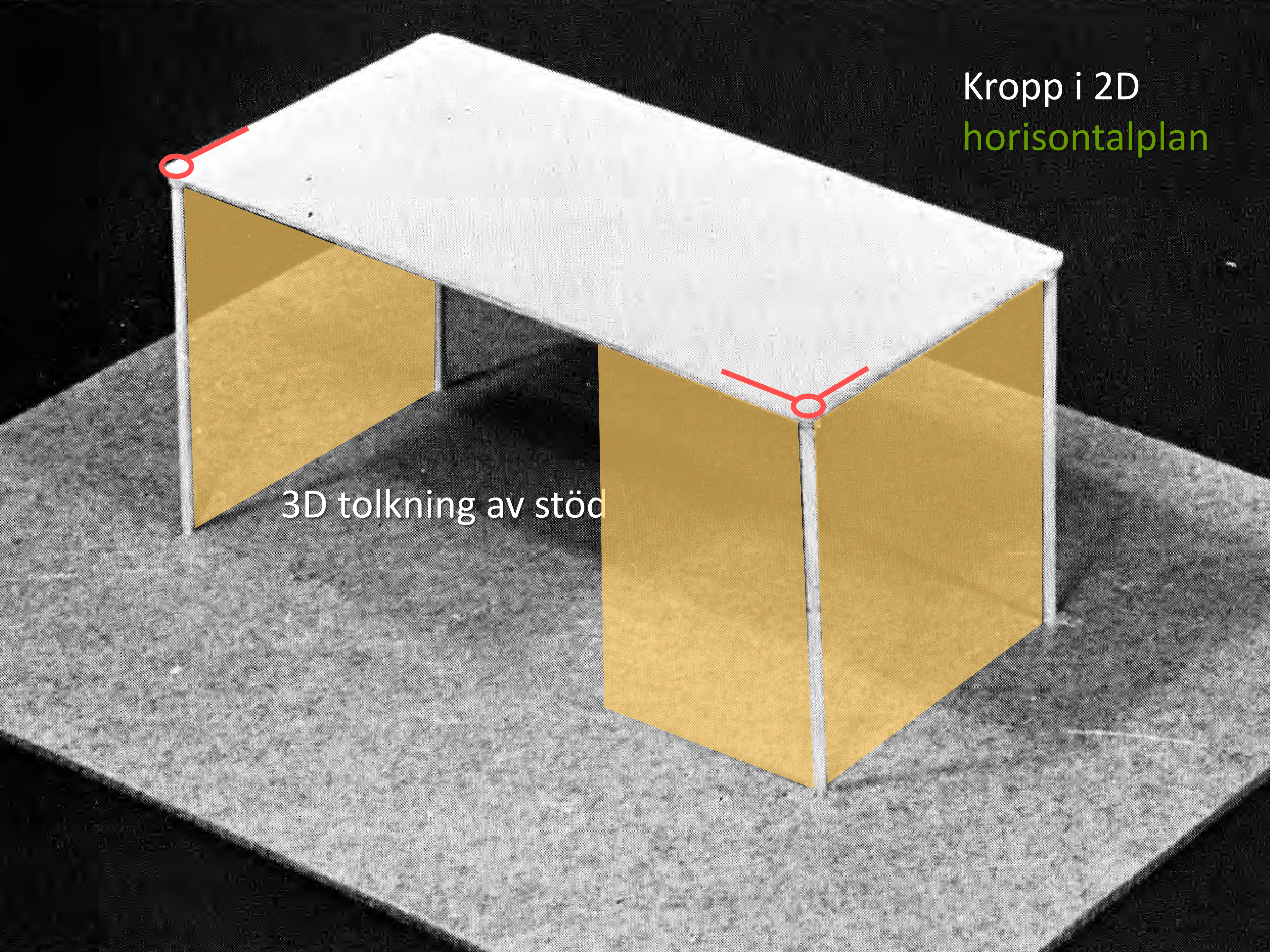
(a) Basic structure without lateral stability devices

(b) Major lateral deformations ("racking") due to horizontally-acting wind or earthquake loadings.

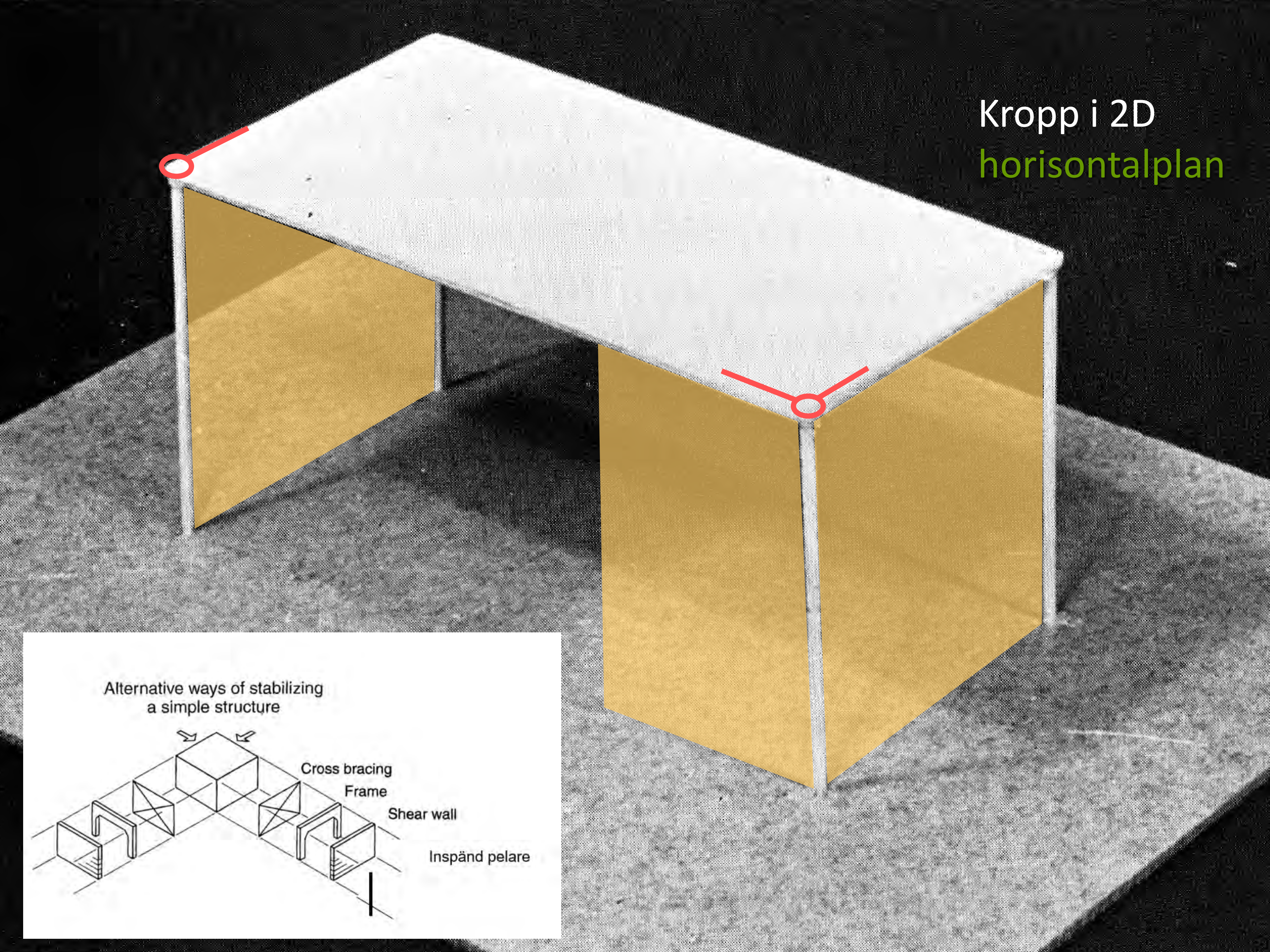
(c) Torsional deformations.

Figure 14.1 Typical effects of laterally acting wind or earthquake forces.


Nödvändigt antal stöd
för yttre stabilitet
och horisontell last?

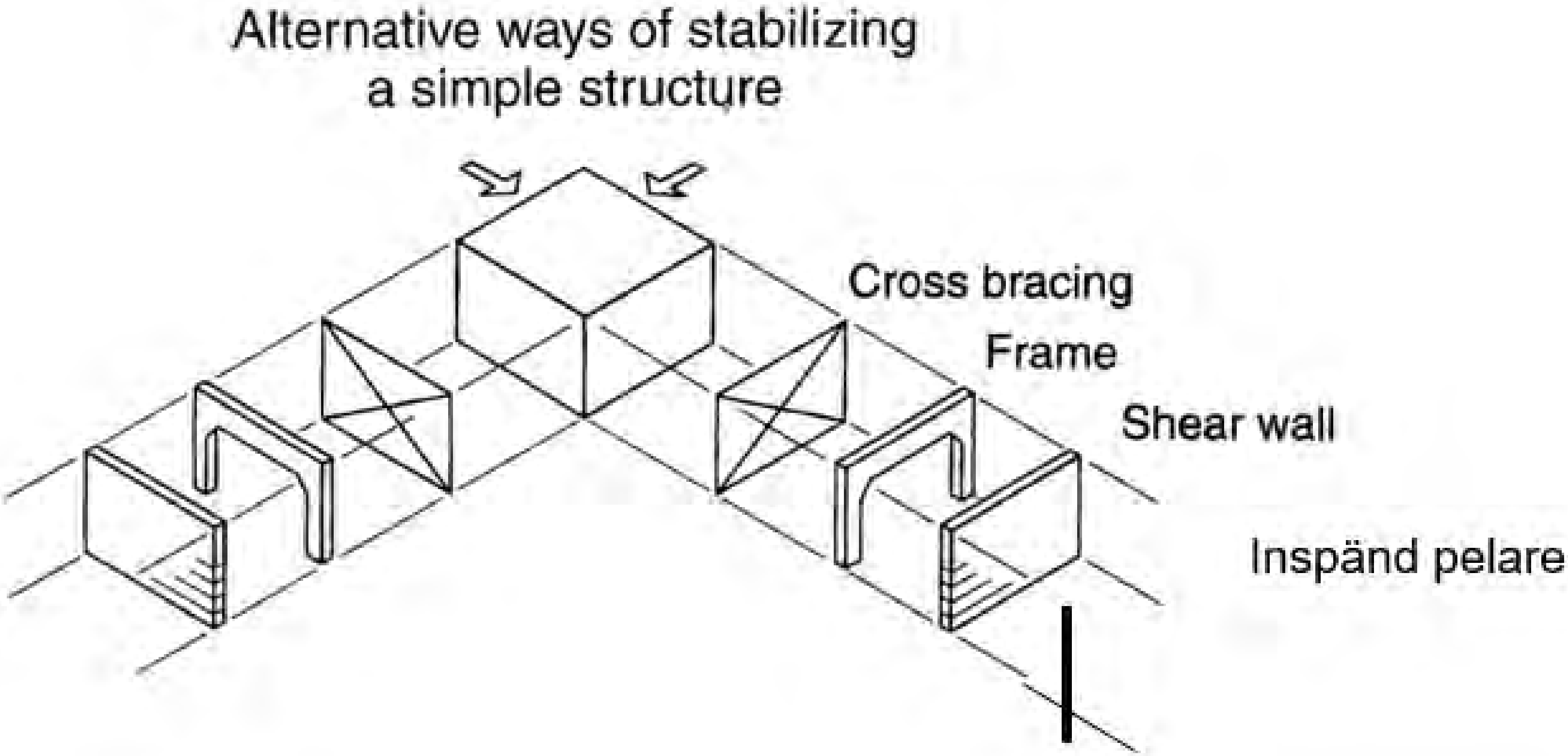

Kropp i 2D
horisontalplan
3D tolkning av stöd

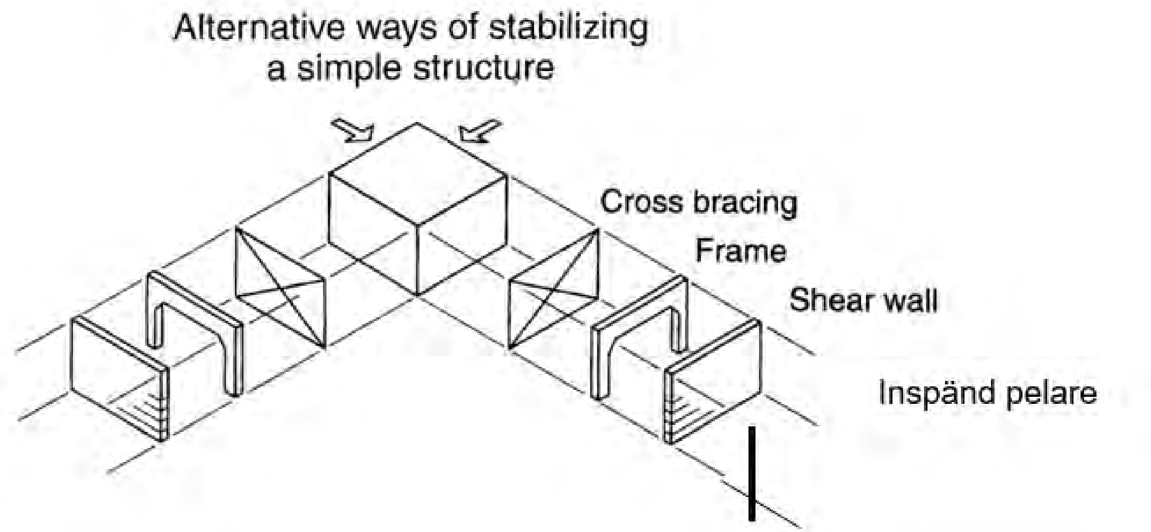

Kropp i 2D
horisontalplan
3D tolkning av stöd


Kropp i 2D
horisontalplan
Alternative ways of stabilizing
a simple structure
Cross bracing
Frame
Shear wall
Inspänd pelare

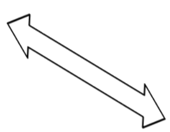

3D tolkning av stöd
Ram (frame) som stabiliserar

Olika strukturer för stabilisering (fyra grundtyper)

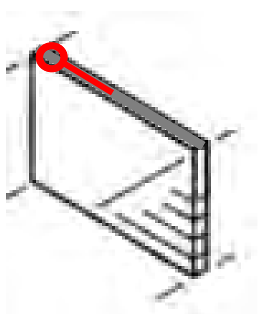




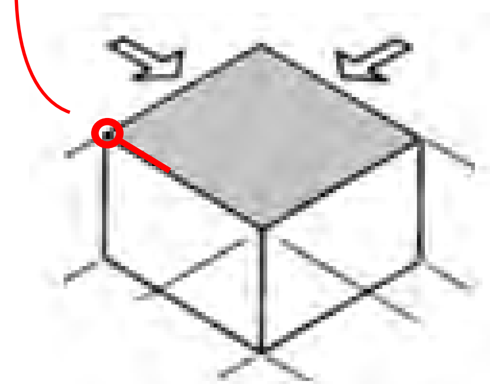
Symbol som visar
den låsta
rörelseriktningen



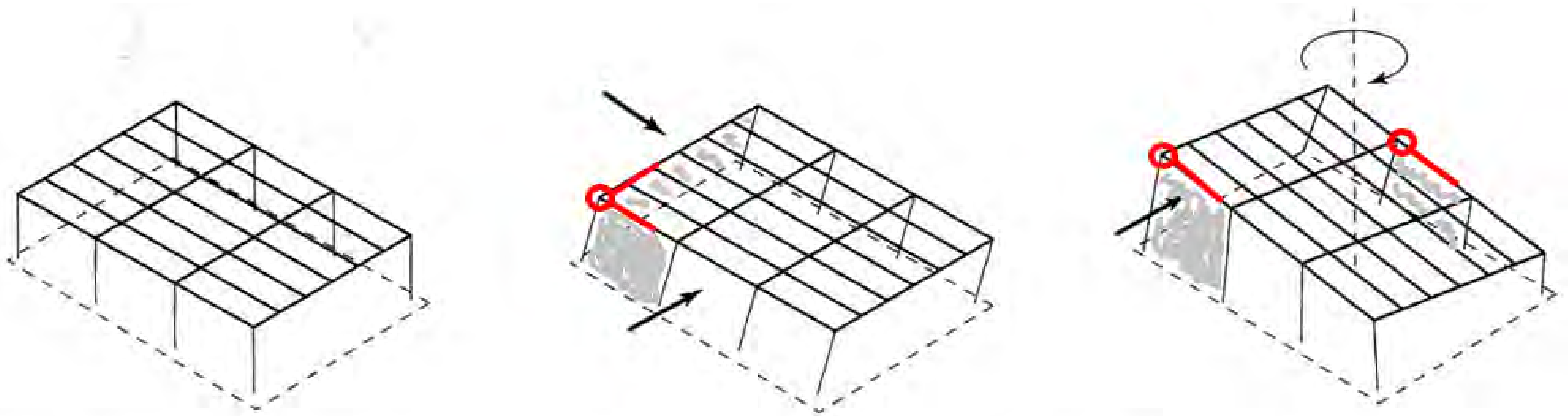
Riktning för förhindrad rörelse
av strukturens horisontella yta



Vägg som förhindrar rörelsen
och därmed stabiliserar strukturen
i denna riktningen



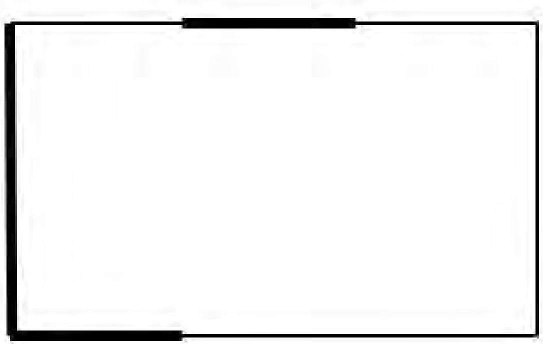
Tre stabiliserande väggar

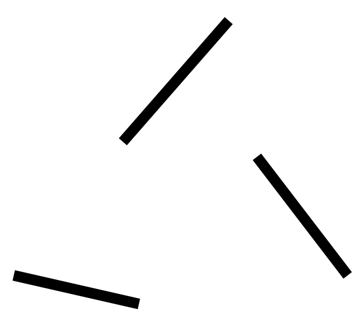


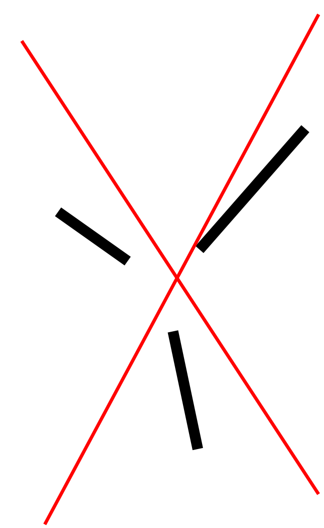
(a) Basic structure without lateral stability devices

(b) Major lateral deformations ("racking") due to horizontally-acting wind or earthquake loadings.

(c) Torsional deformations.





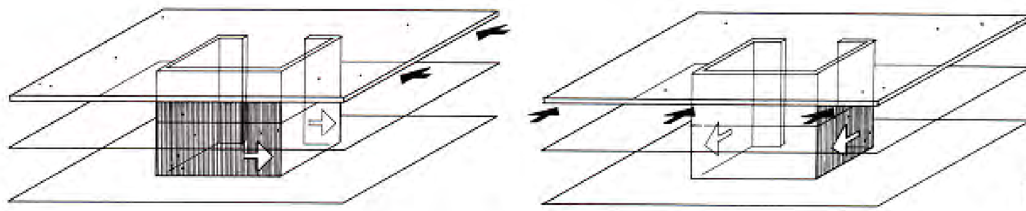


Windaufnahme in Längs- und Querrichtung

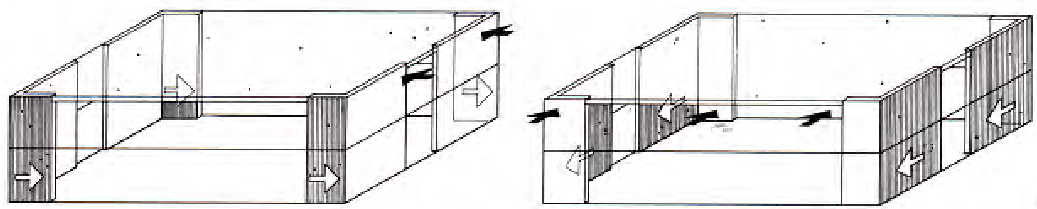
(bezogen auf Grundrisse der vorhergehenden Seite)

wind resistance in longitudinal and transverse direction

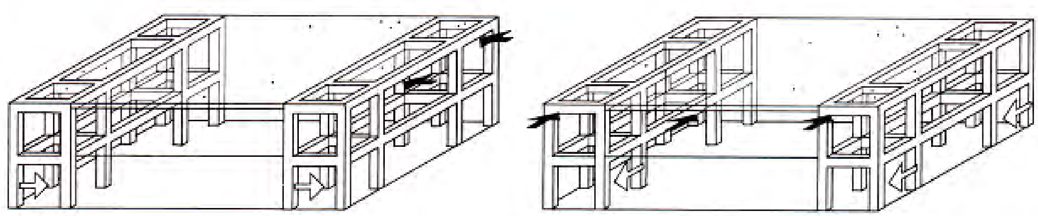
(related to floor plans of preceding page)



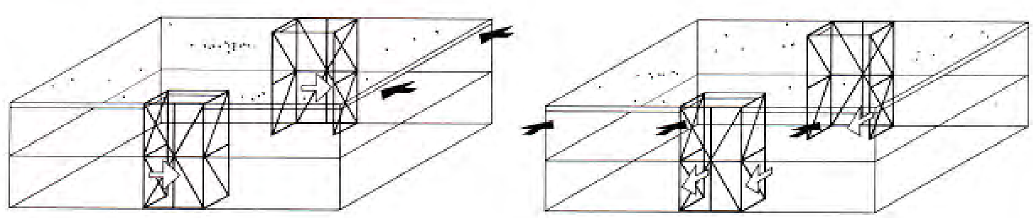
durch Zirkulationskern
through circulation core



durch Außenwände
through exterior walls

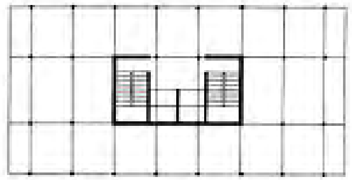


durch Rahmen
through frames

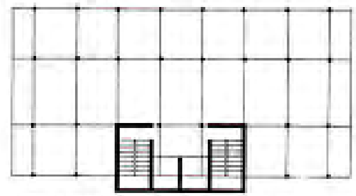


durch Fachwerk
through trussing

Tragelemente für Windversteifung
structural elements for wind bracing

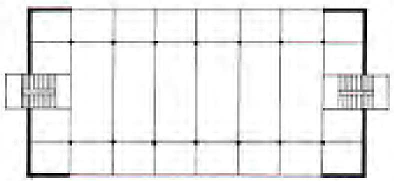


mittiger Kern — central core

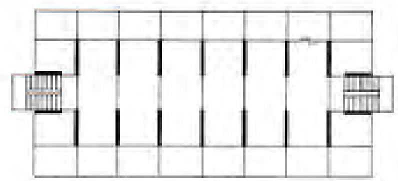


seitlicher Kern — one-sided core

Wände des Zirkulationskernes
walls of the circulation core

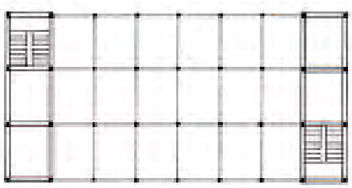


Außenwände — exterior walls

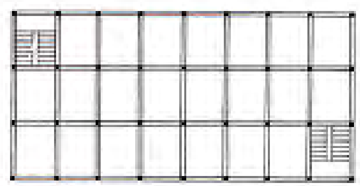


Trennwände — partition walls

Außenwände oder Trennwände
exterior walls or partition walls

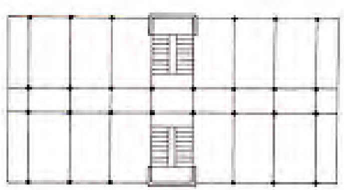


Endrahmen — end frames

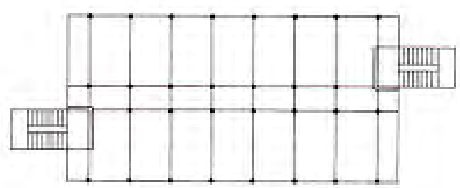


gesamtes Skelett — complete skeleton

Stützen und Träger (Rahmen)
posts and beams (frames)



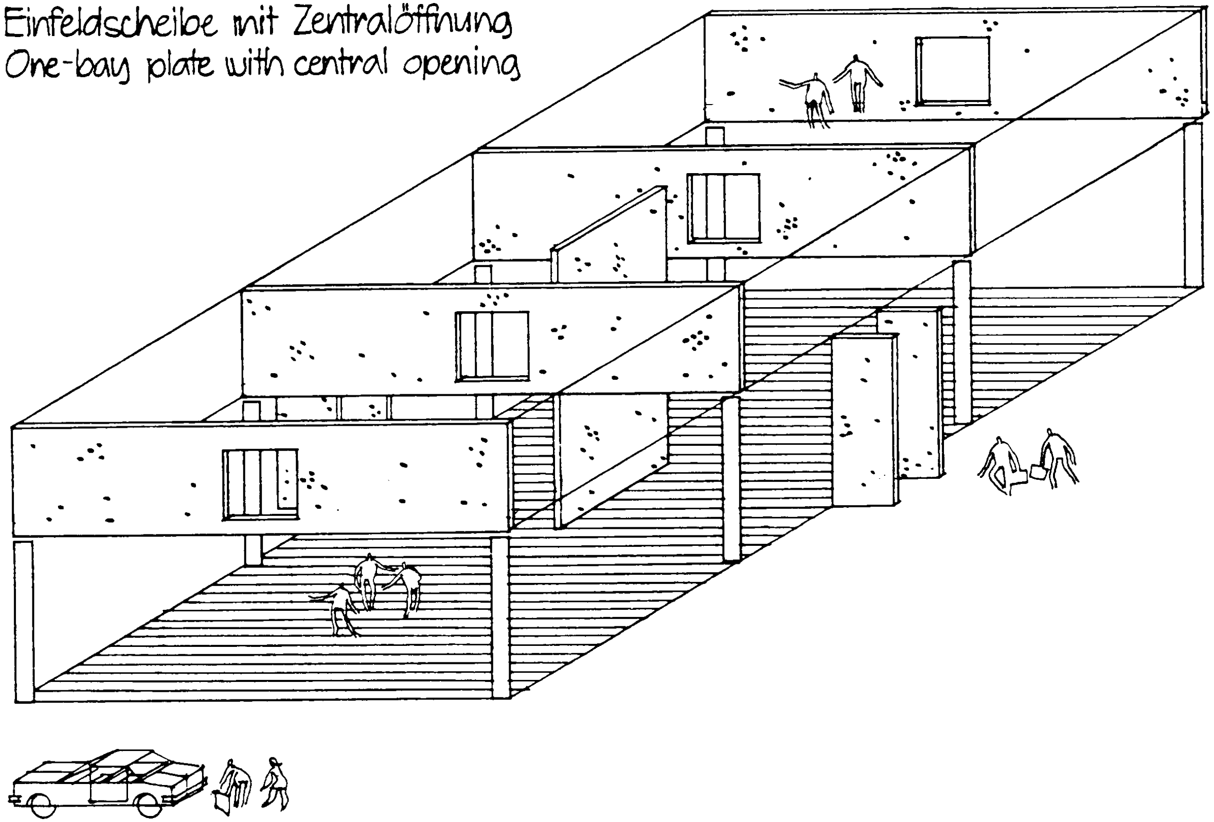
Zentrale Treppen — central stair walls



Stirnwand-Treppen — end wall stairs

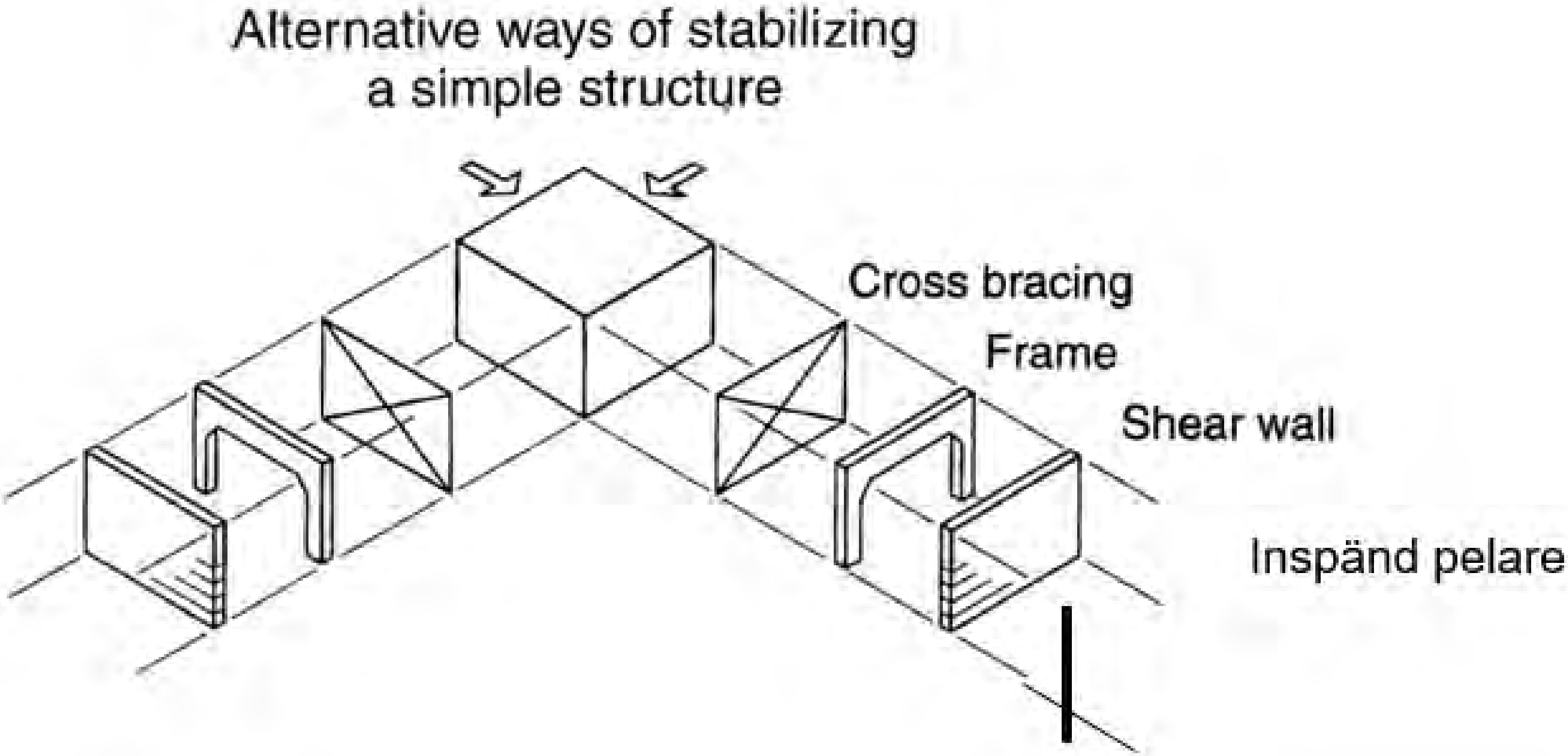
Teile der Treppenhaus-Wand
sections of staircase walls

Einfeldscheibe mit Zentralöffnung
One-bay plate with central opening



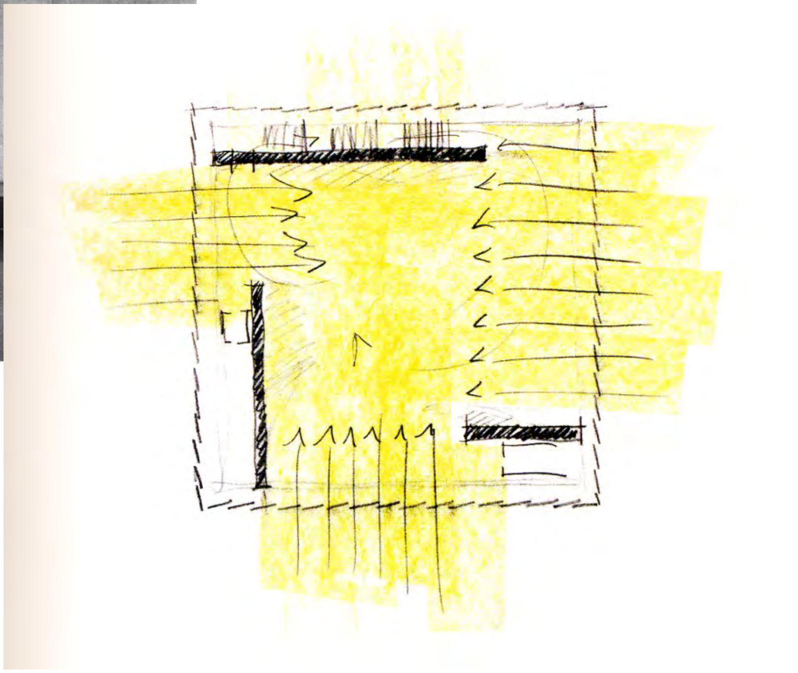

För horisontell last (vind)

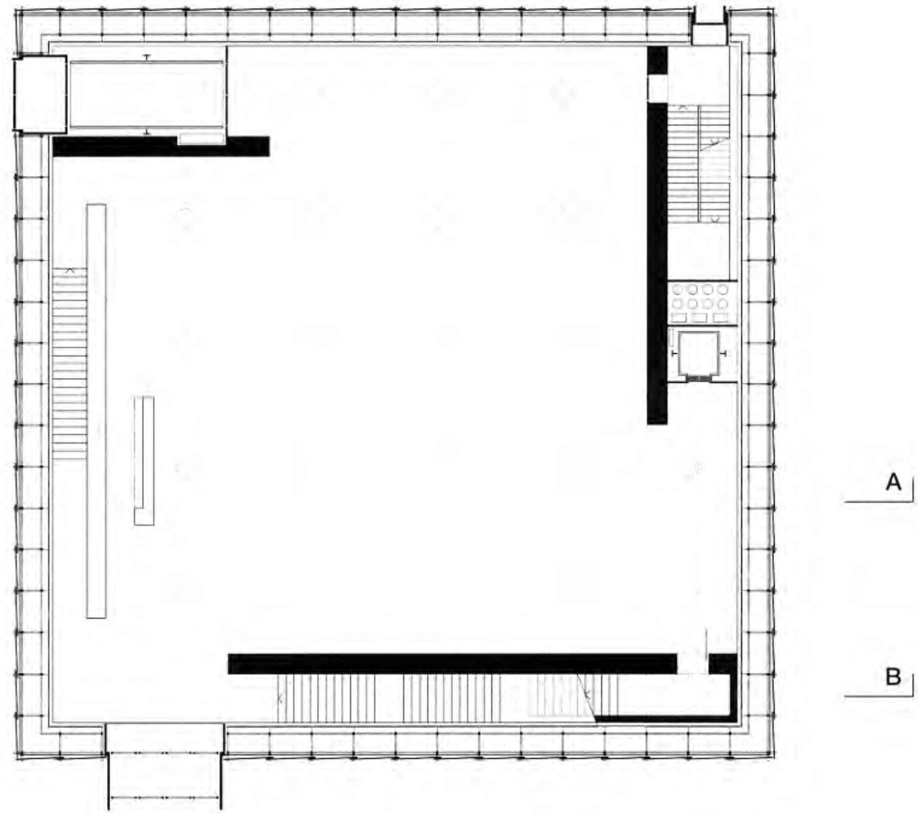
Olika strukturer för stabilisering (fyra grundtyper)



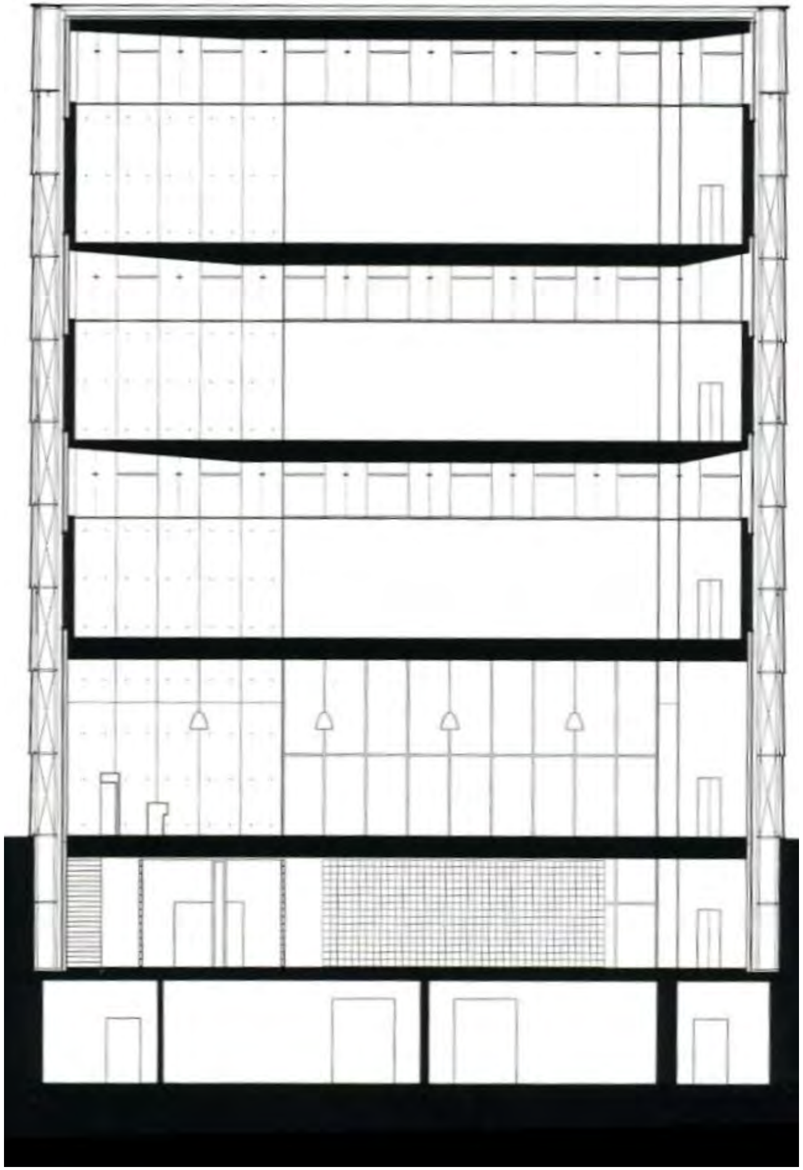
Kunsthaus Bregenz
Peter Zumthor

Byggnaden som
bärande system

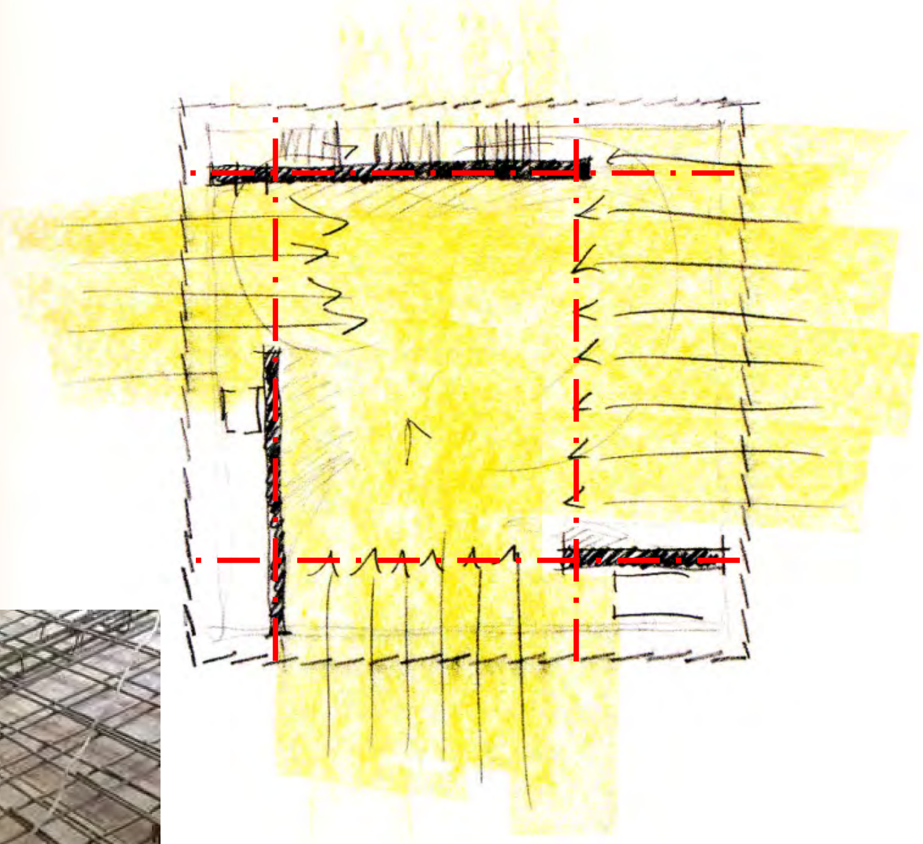




0 10



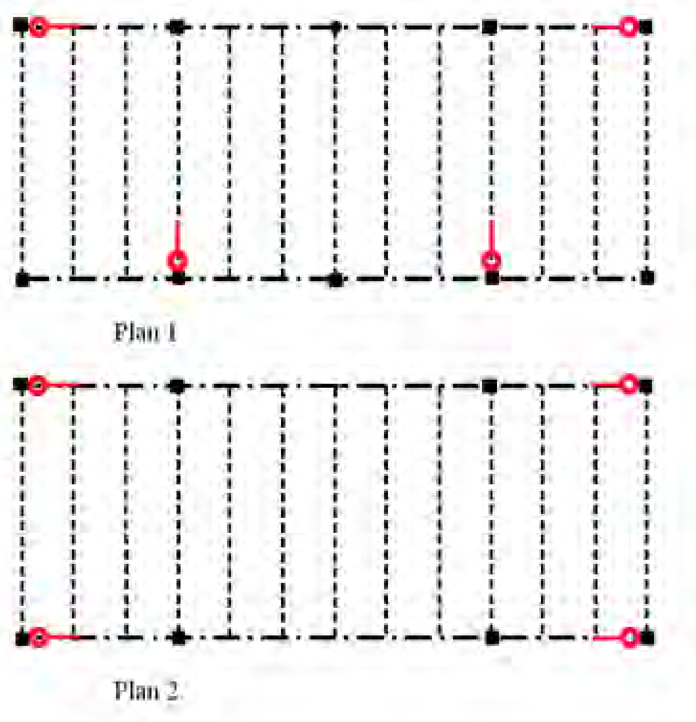
Skivan som stöd för vertikala laster

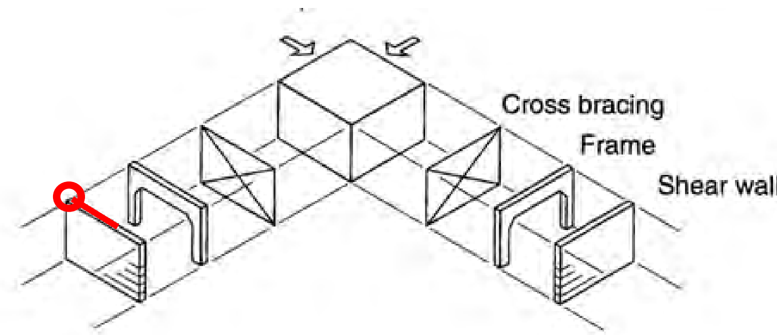


4. Exempel på horisontella laster

Ge exempel på olika horisontella laster som kan belasta en byggnad

5. Strukturer för horisontella laster

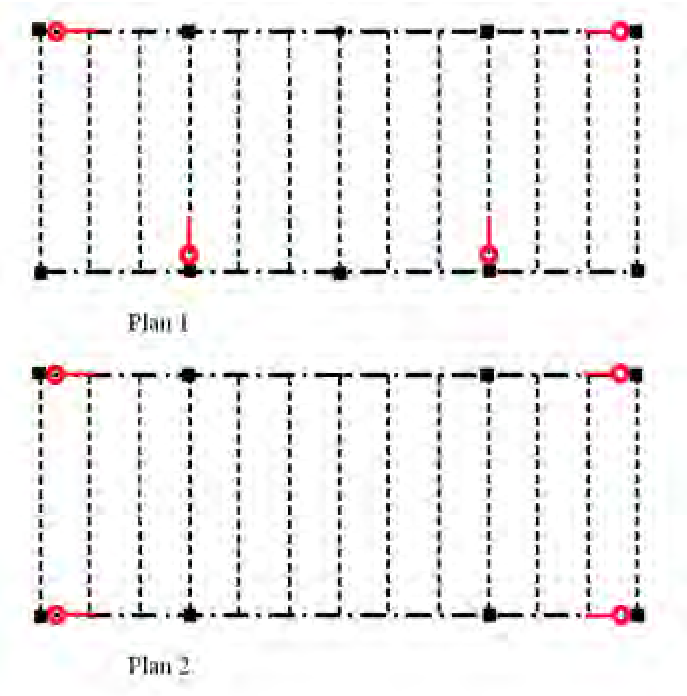




I figuren beskrivs ett bärande system i två plan.
De röda ”nycklarna” anger horisontella stöd.
Minst ett horisontellt stöd saknas.

Komplettera figuren med en nyckel så att horisontell stabilitet erhålls.

6. Strukturer för vertikala och horisontella laster



Bygg en fysisk modell av byggnaden med hjälp av:

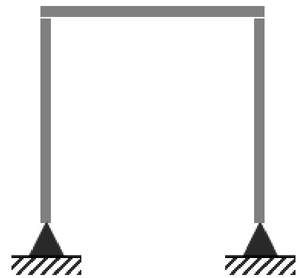
- 8 cm långa grillpinnar (pelare) får **inte** vara kontinuerliga mellan två våningar!
- dubbla 2 mm grå pappersark på högkant (primärbakar)
- enkla 1 mm horisontella vita pappersark (sekundärbalkar + högsta ordningens bärning)
- enkla 2 mm grå pappersark (stabiliserande väggar)
- sammanfoga med lim

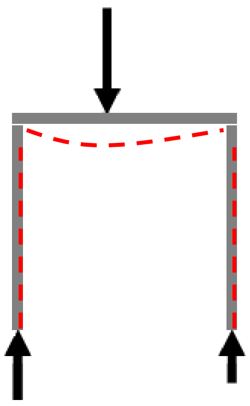
Känn med handen instabiliteten hos de *horisontella bjälklagen* innan de *stabiliserande väggarna* är på plats

7. Exempel

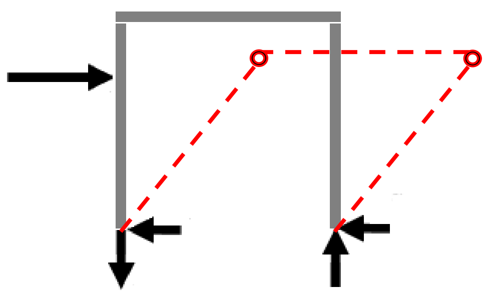
Välj samma två exempel som i uppgift 3 och beskriv det horisontellt bärande (dvs. stabiliserande) systemet med hjälp av nycklar.

Temperatur- och fuktlast



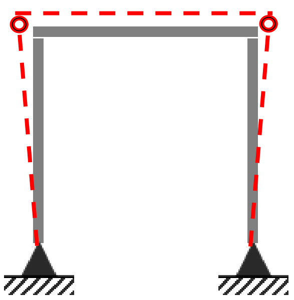


Vertikala laster



Horisontella laster

Mekanism!



Temperatur
och fuktlast

Karaktärisering av strukturer (Föreläsning 2)

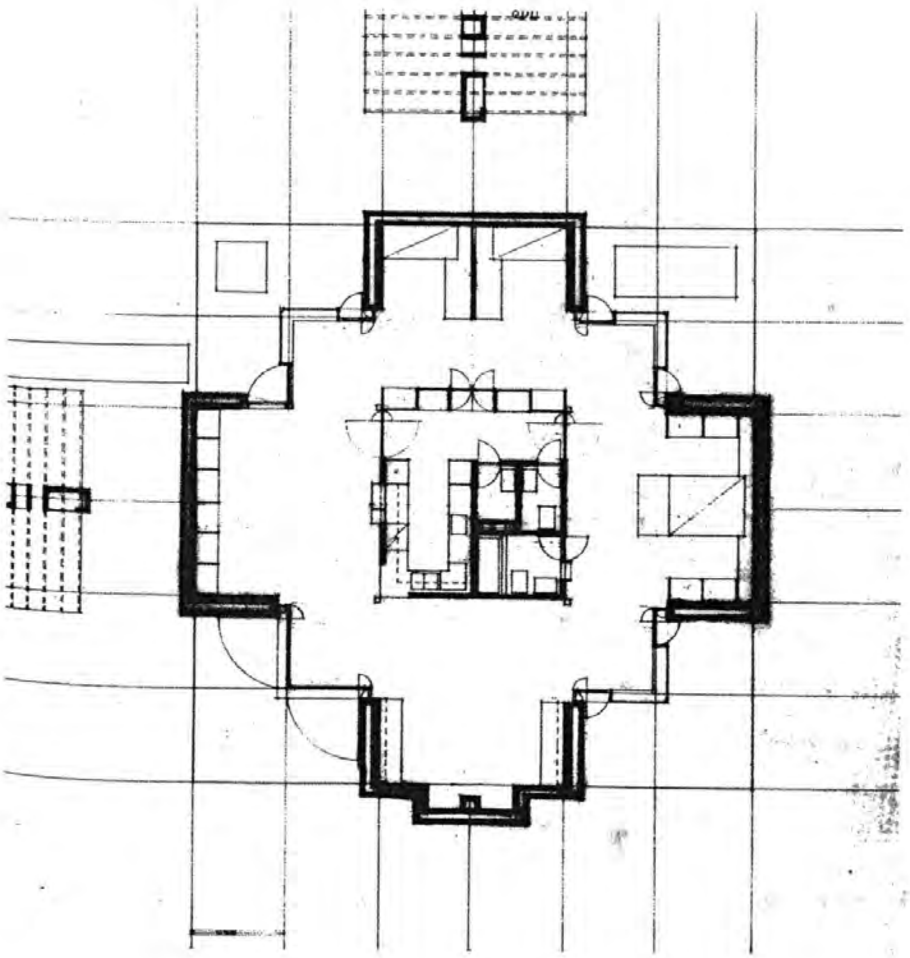
Mekanism
instabil

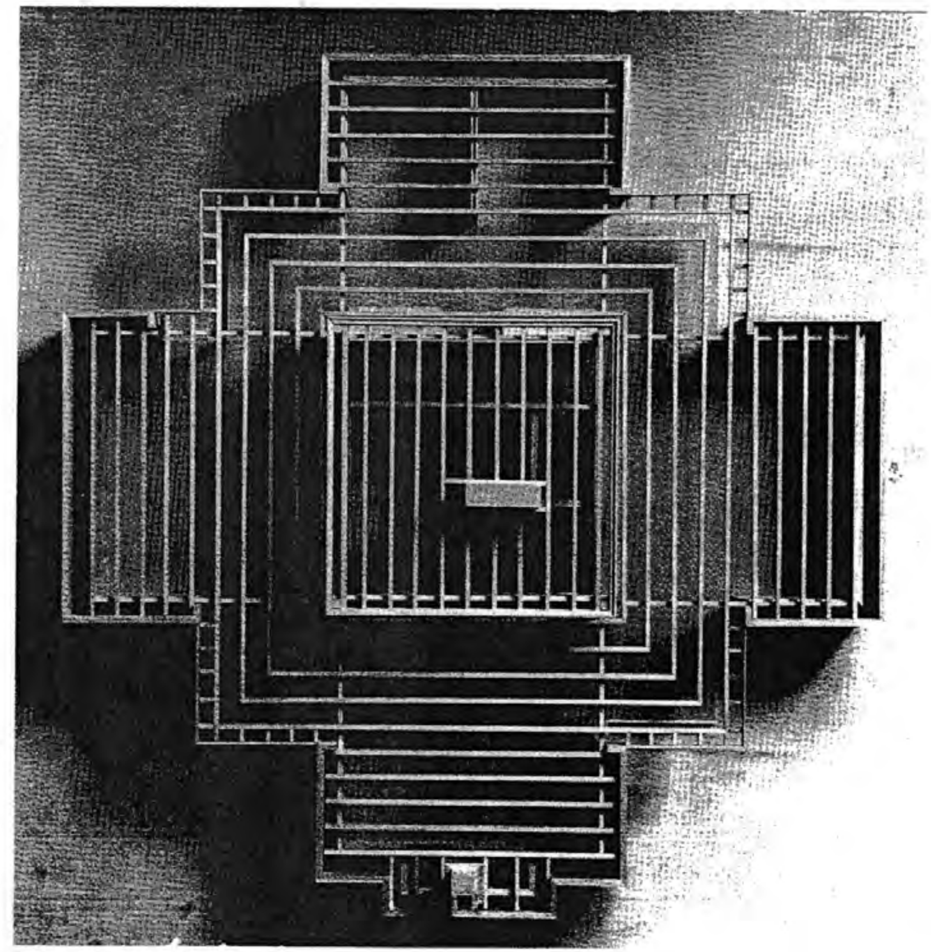
Statiskt bestämd
stabil
en lastväg
fri att expandera/krympa

Statiskt obestämd
stabil
flera lastvägar
inre tvång vid expansion/krympning

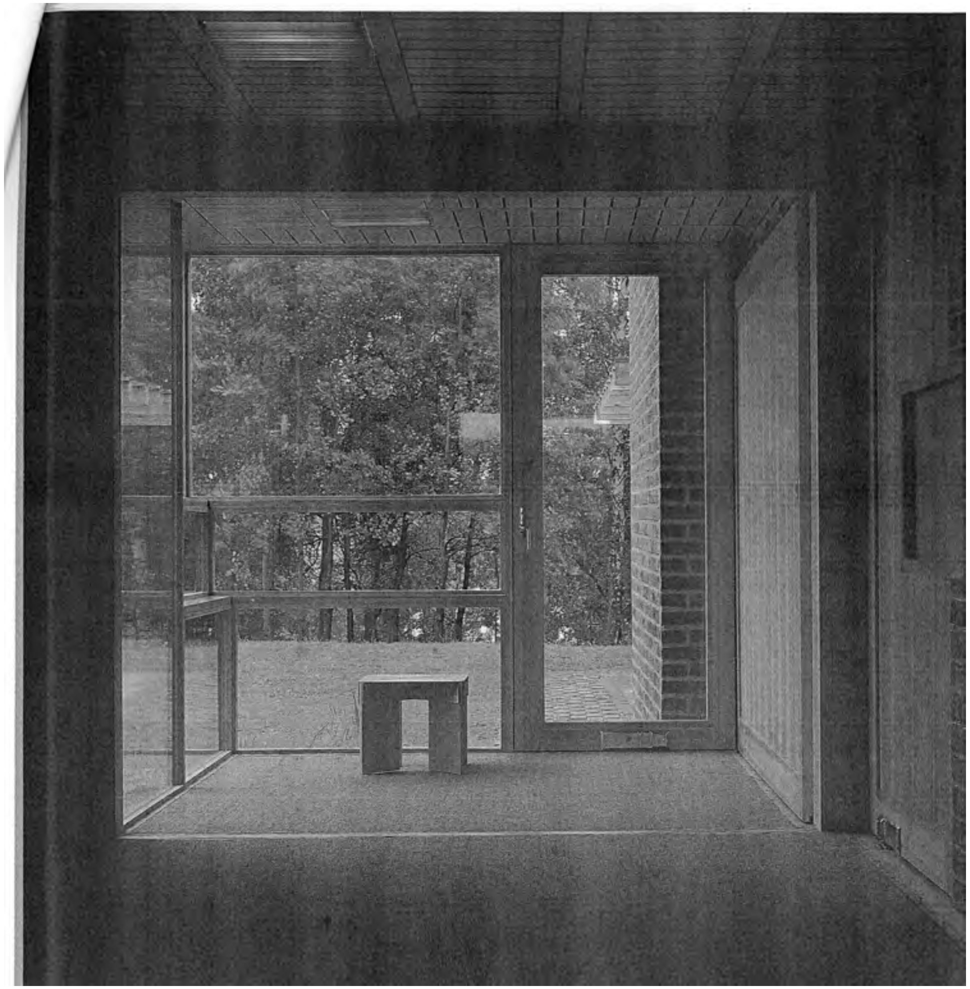
Sverre Fehn

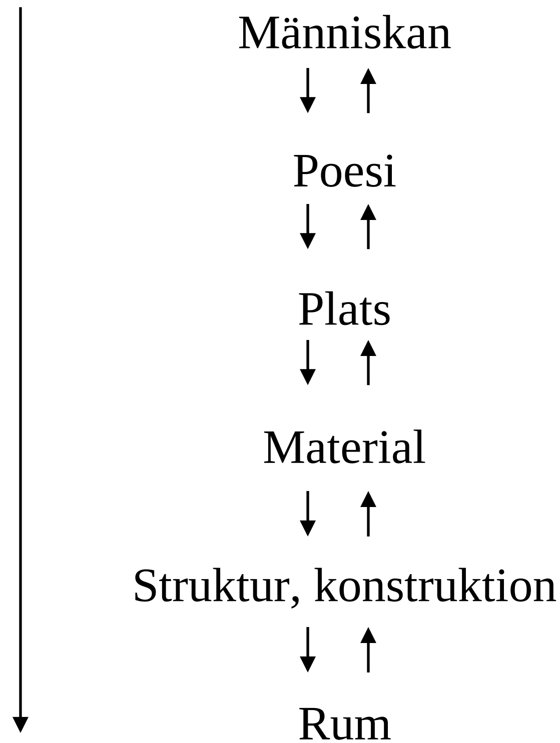
Villa Norrköping 1964





Samtliga fotografier Helena Bergengren




Människan
Poesi
Plats
Material
Struktur, konstruktion
Rum