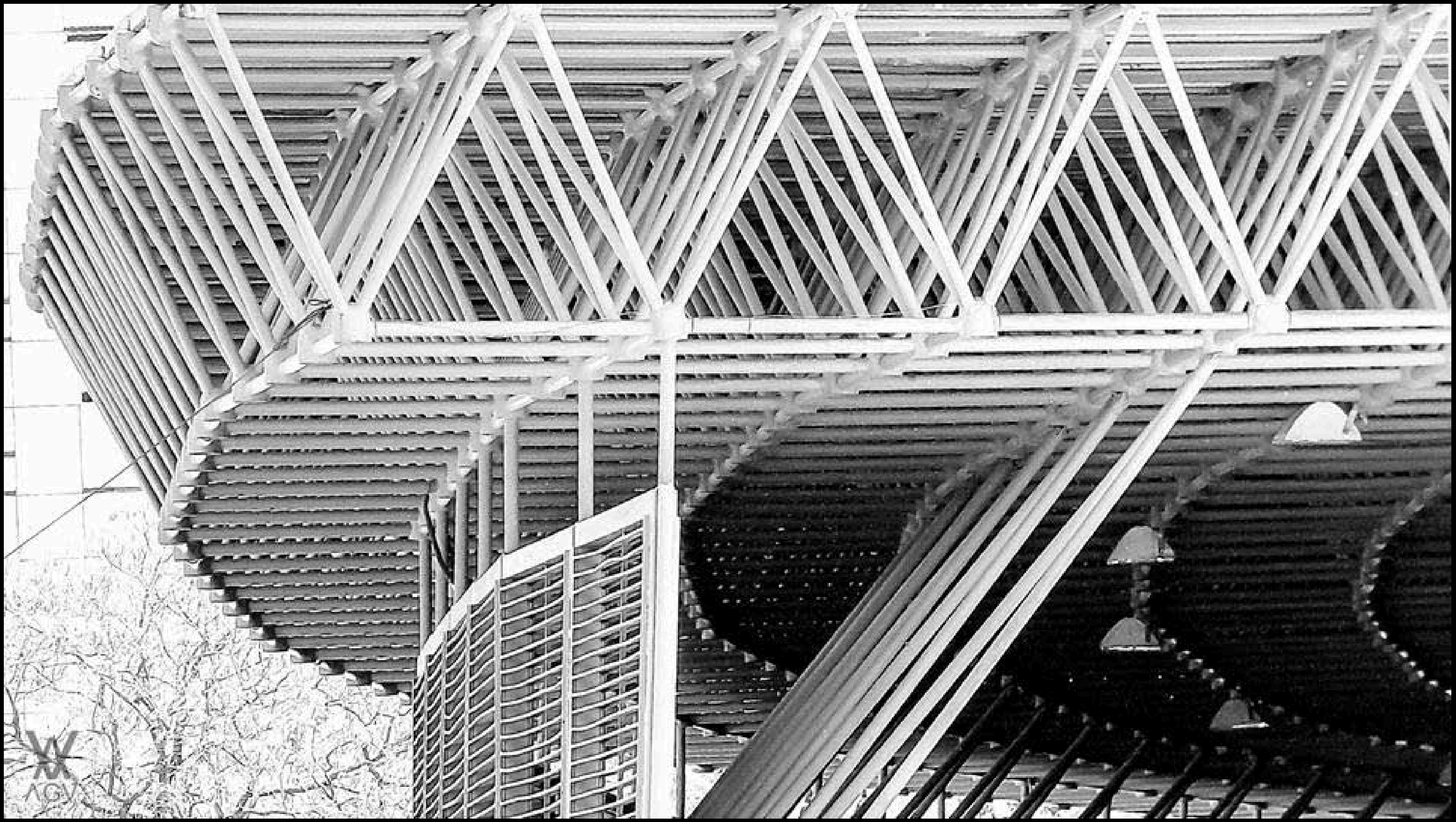
RETICULADOS PLANOS Y ESPACIALES



estructuras 4e

Sistemas Reticulados Planos | Reticulados Espaciales

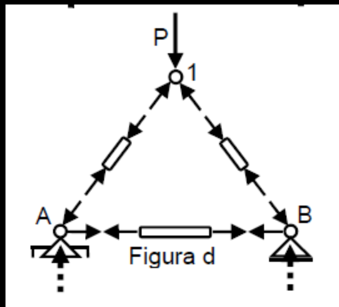
Mecanismo de Estructuras Trianguladas

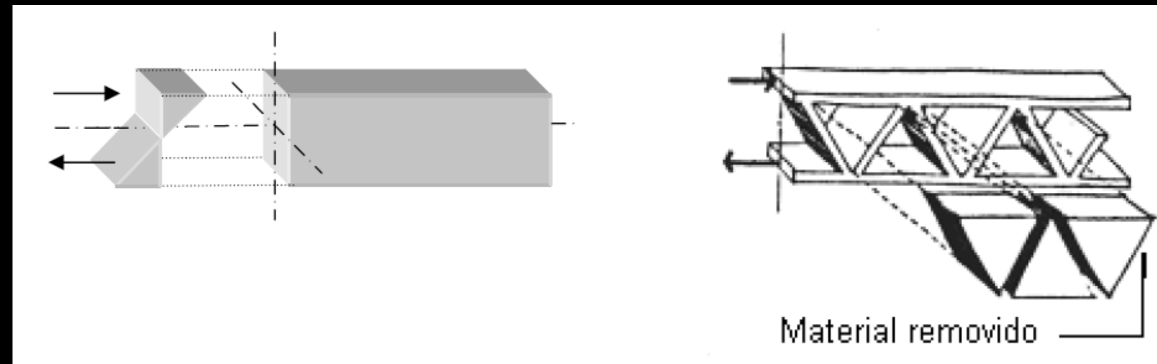
Solicitaciones en las Barras

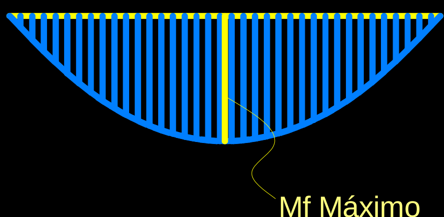
Análisis de Obras

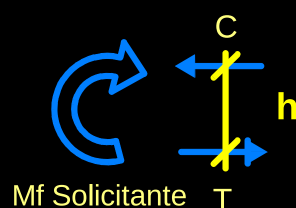
- Posibilidades de Diseño
- Uniones
- Detalles

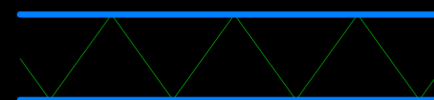
Aplicación a diferentes Tipologías Estructurales



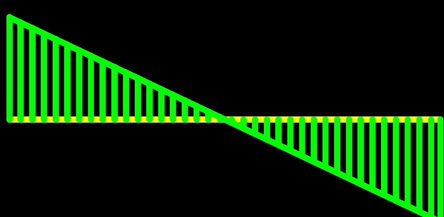


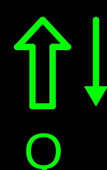


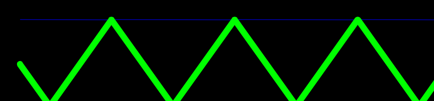




$$T \text{ ó } C = \frac{Mf_{max}}{h}$$



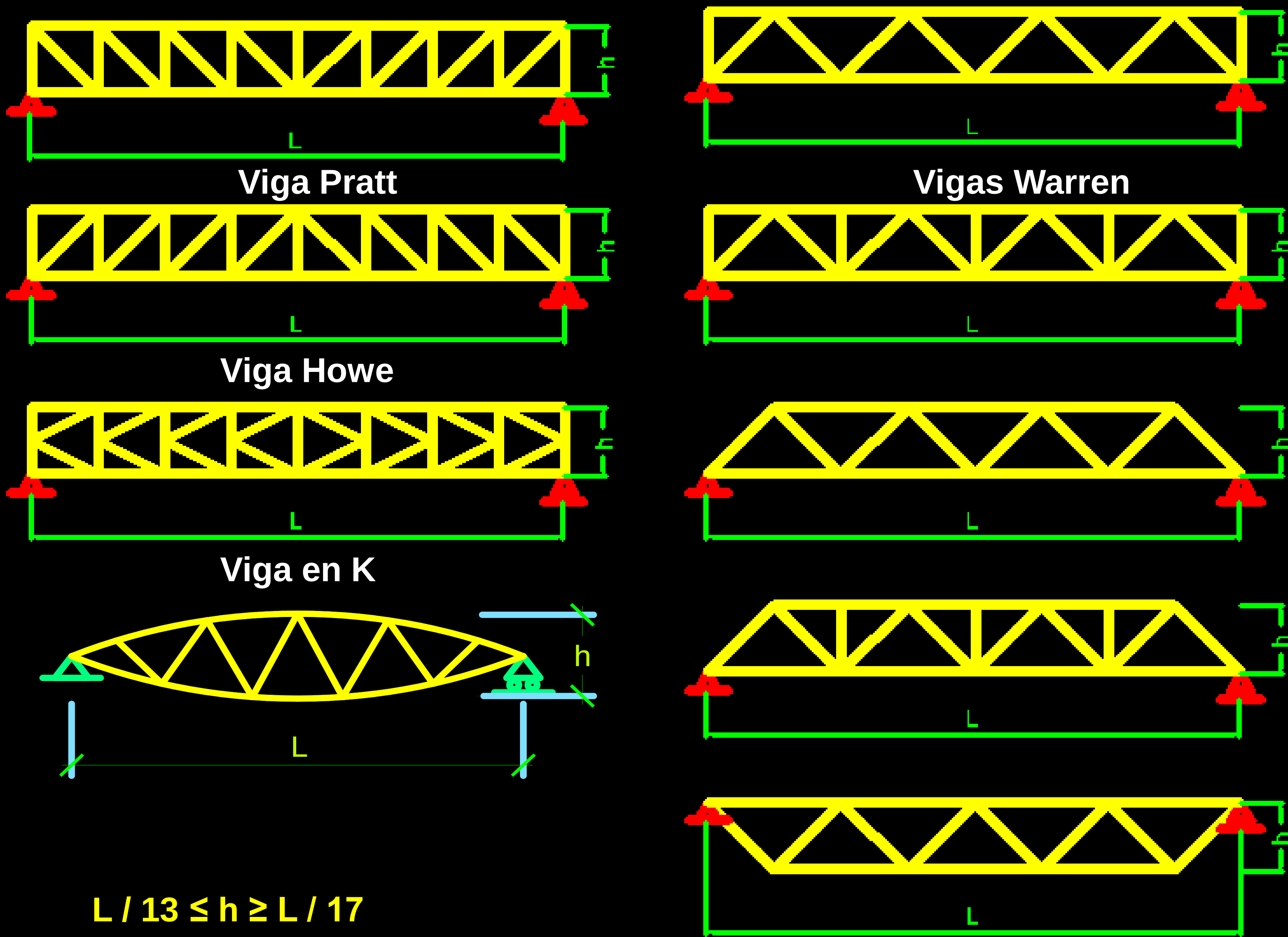




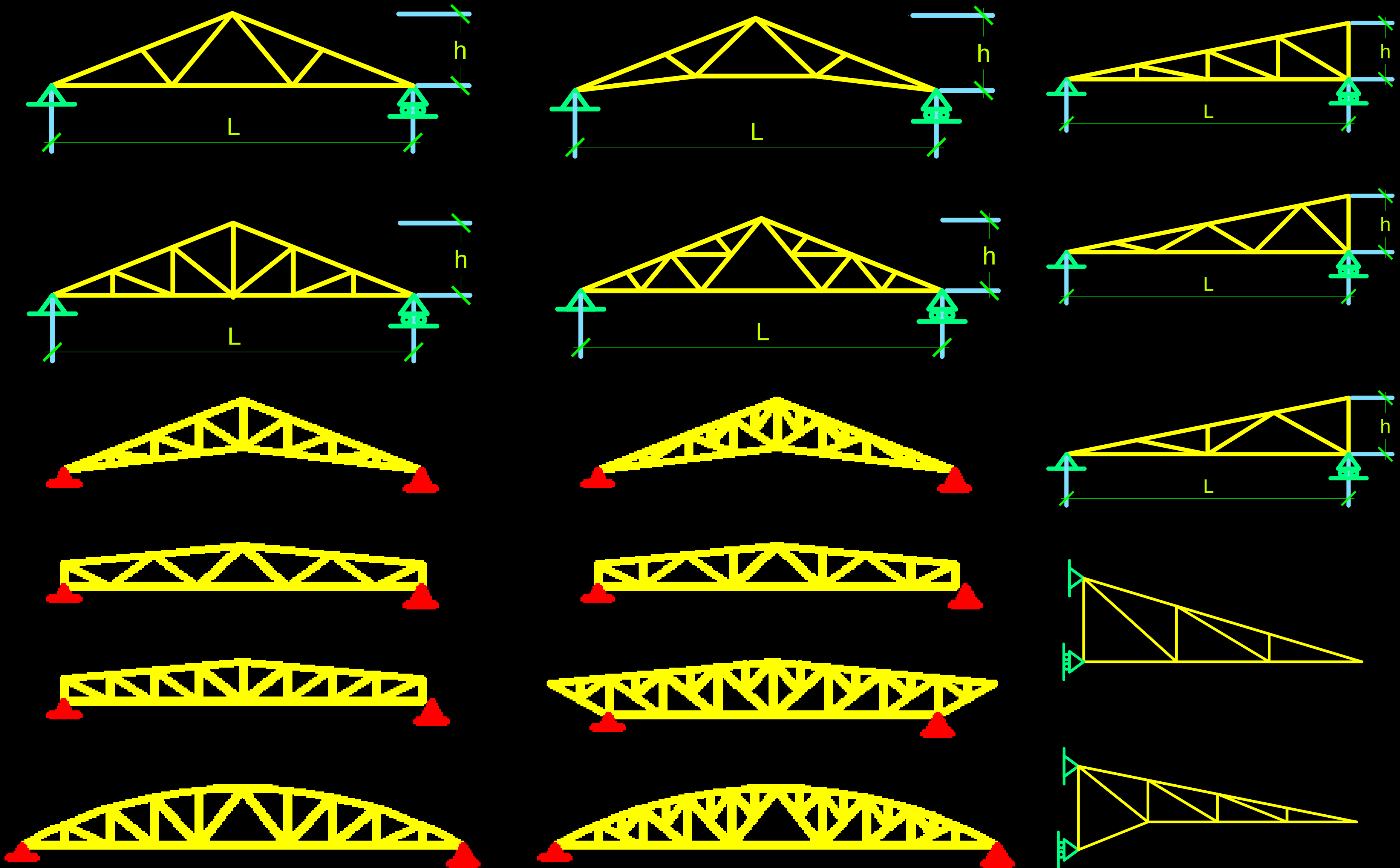
$$Q = \text{Proy } D$$

$$Q = D \times \cos \beta$$

En los sistemas reticulados se reemplaza el trabajo a flexión por esfuerzos axiales de tracción y compresión en las barras.

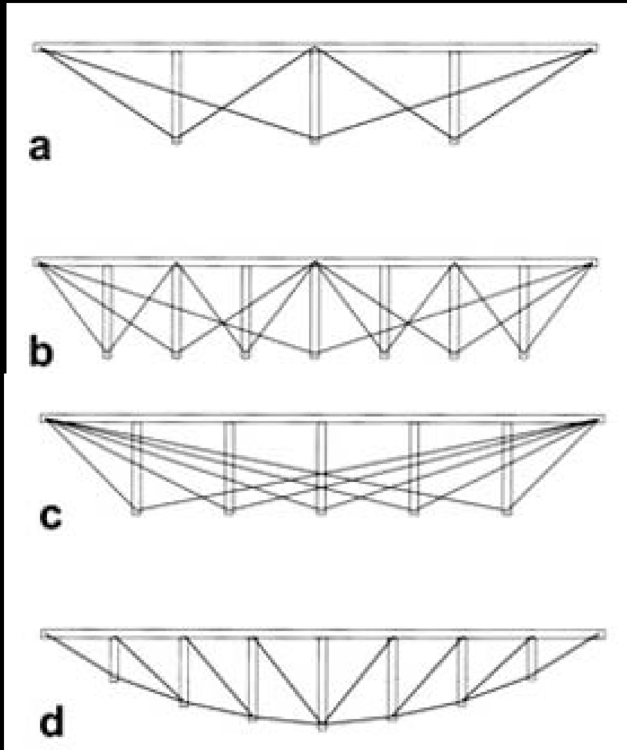


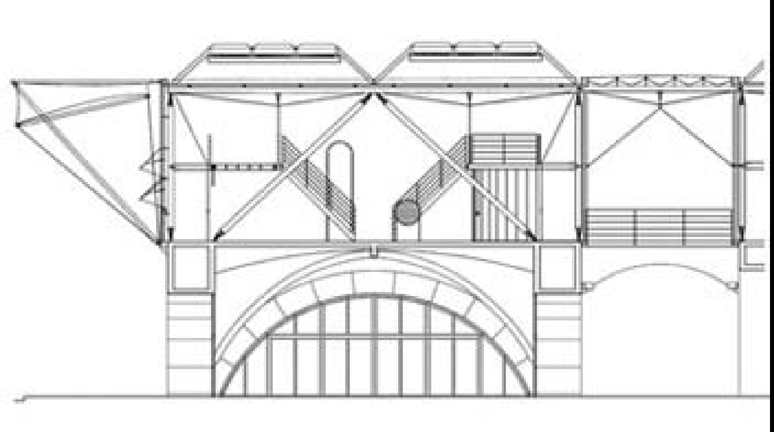
EJEMPLOS DE ESTRUCTURAS TRIANGULADAS

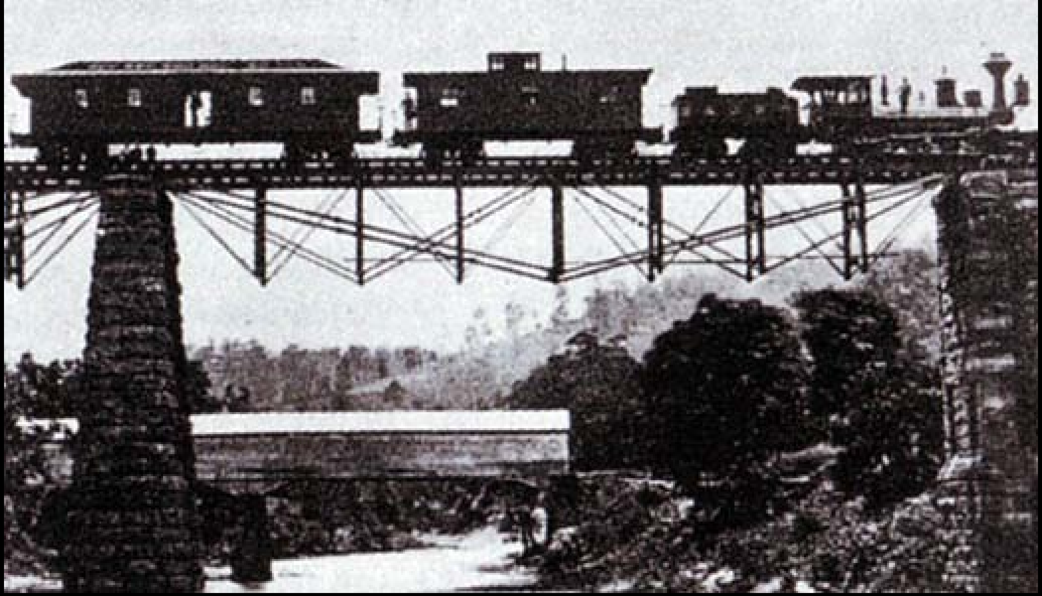


h ≥ L / 8

EJEMPLOS DE ESTRUCTURAS TRIANGULADAS

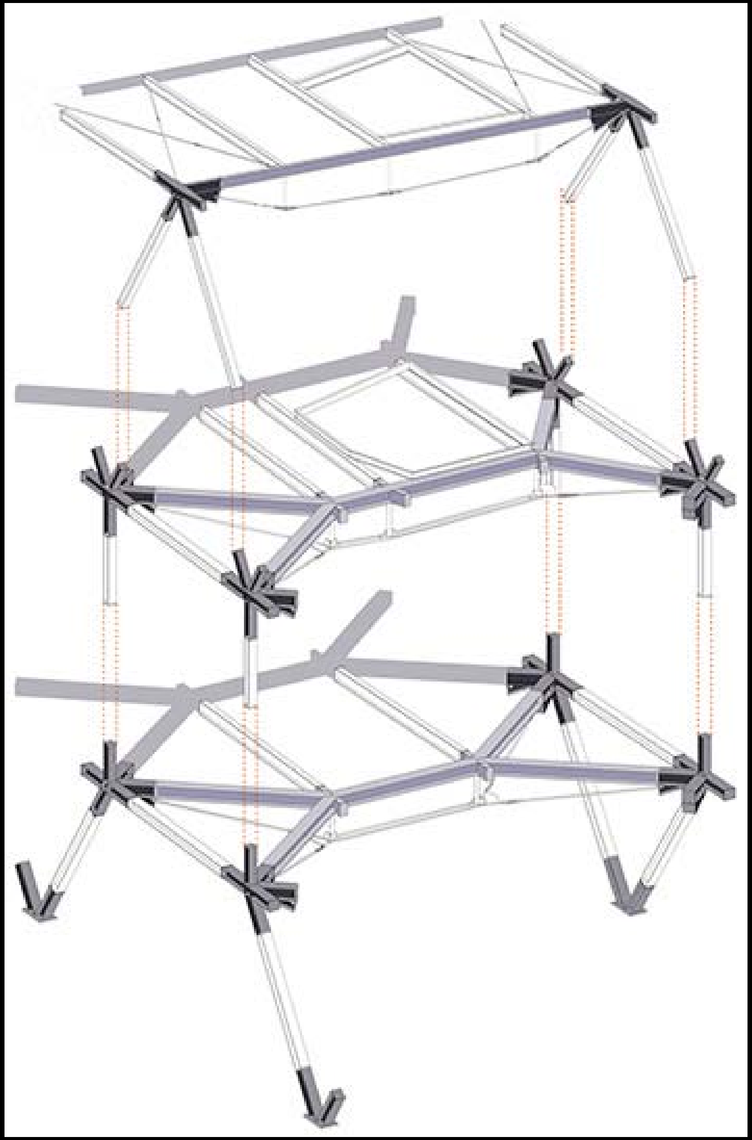


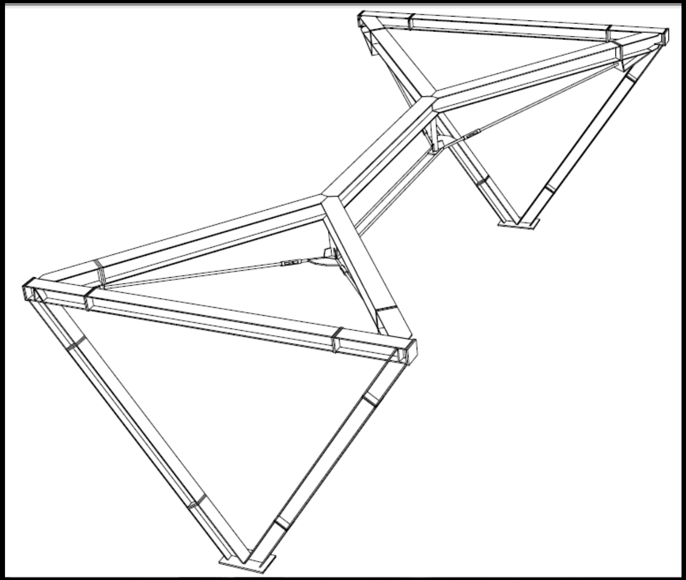




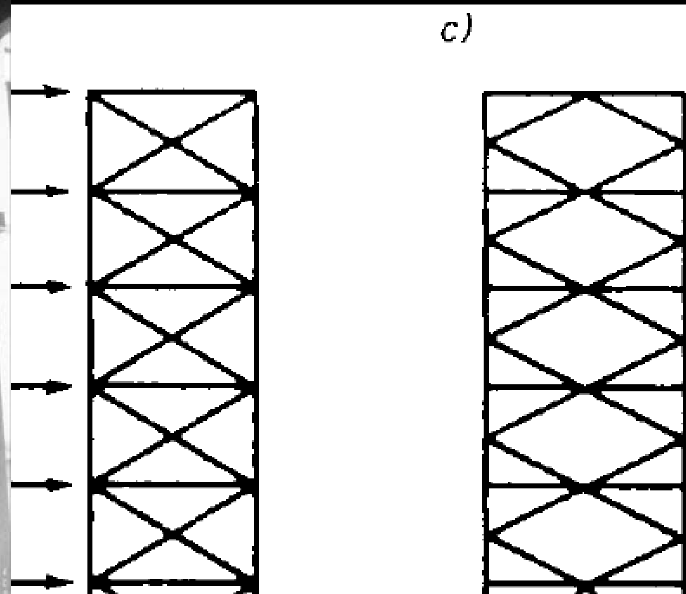
VIGAS ATIRANTADAS

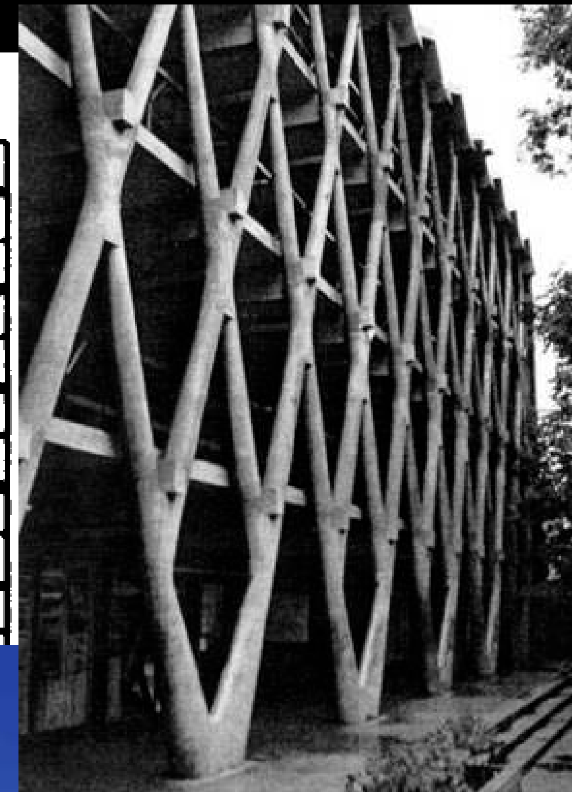
NAVE INDUSTRIAL PARA DIAGONAL 80

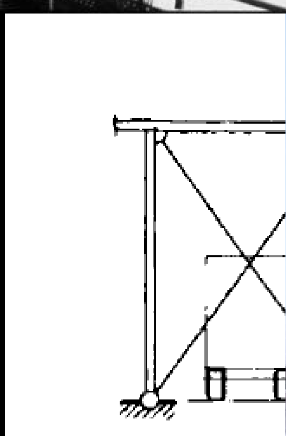


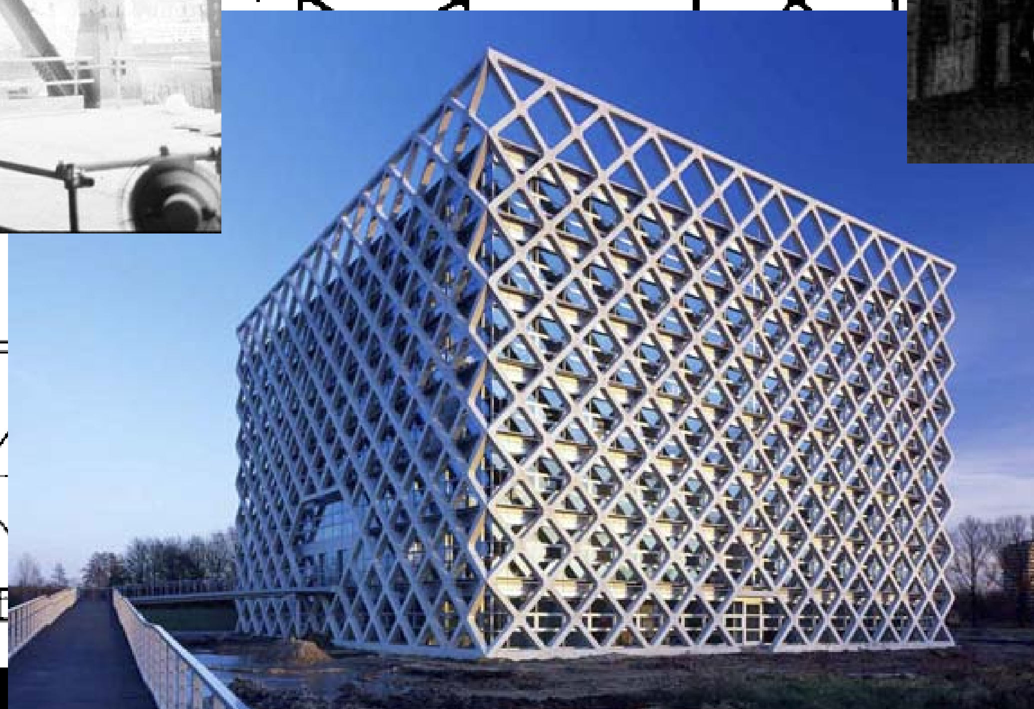


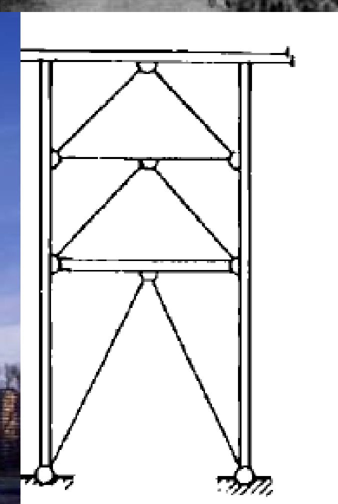
Madrid, España, 2006 - AMID [cero9] C. Díaz Moreno + E. García Grinda


c)

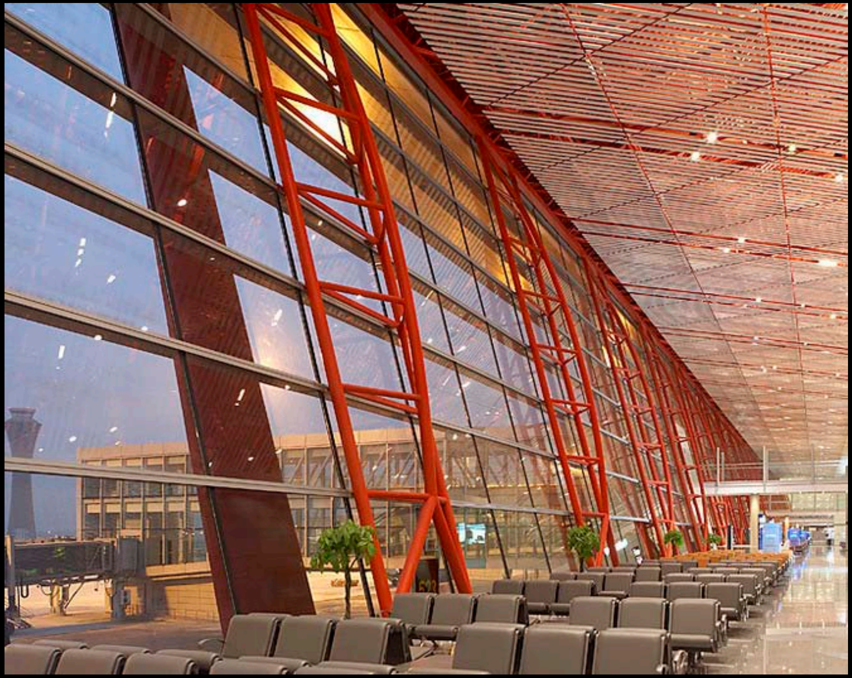


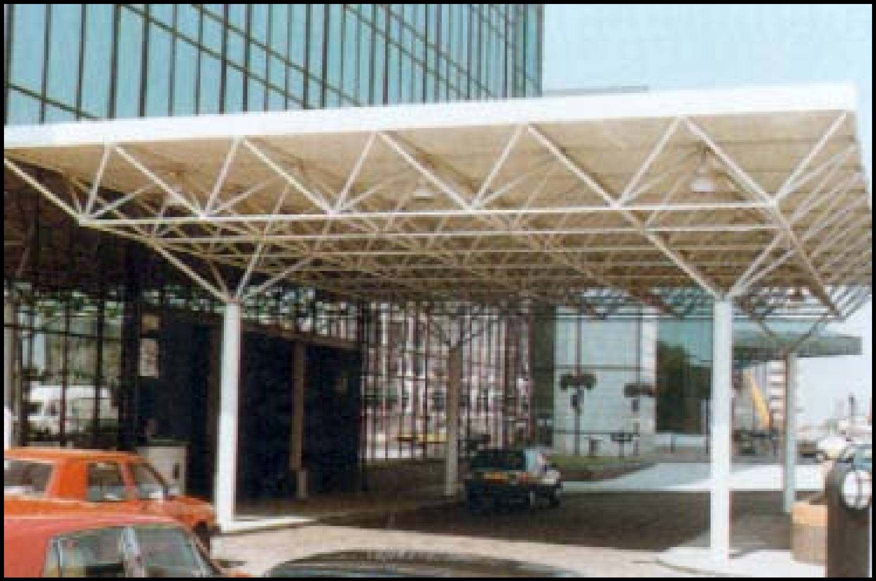






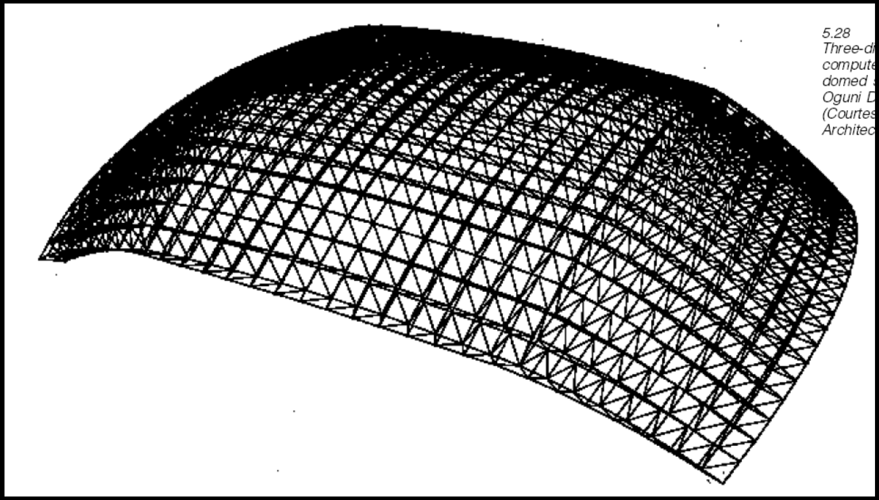
ESTRUCTURA DE ENVOLVENTES LATERALES





RETICULADOS ESPACIALES PLANOS

CUPULA GEODESICA RETICULADA DE UNA CAPA

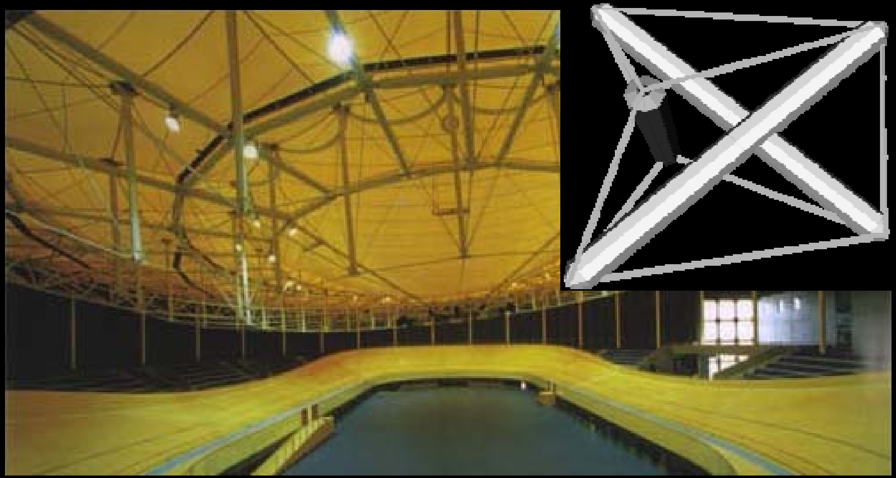


SUPERFICIE DE DOBLE CURVATURA CONFORMADA POR RETICULADO DE DOS CAPAS

PORTICOS RETICULADOS PLANOS

ARCOS RETICULADOS TRIDIMENSIONALES

ESTRUCTURAS PLEGADAS CON PLANOS MATERIALIZADOS POR RETICULADOS



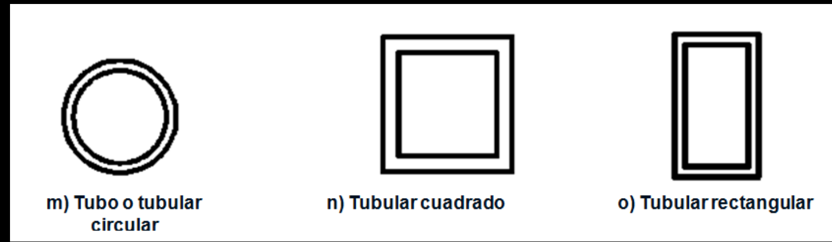
TENSEGRITY – TRIANGULACION ESPACIAL DE CABLES CONTINUOUS Y PUNTALES

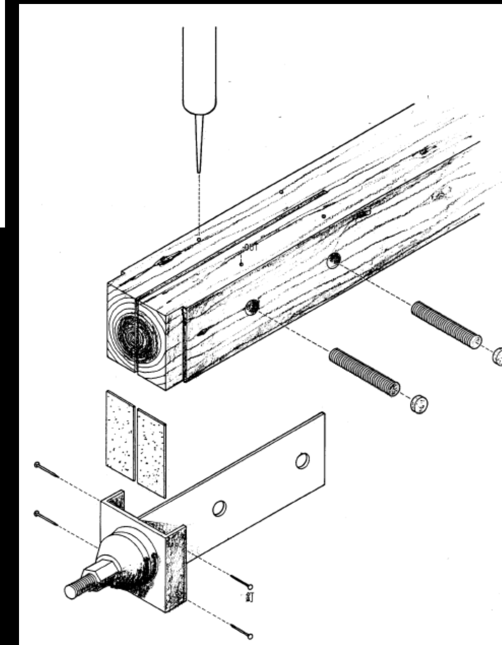
PUENTE DE LA PAZ SOBRE BOW RIVER

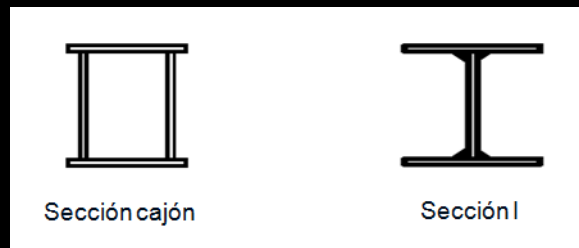
Calgary, Canadá, 2012 - Arq. Santiago Calatrava

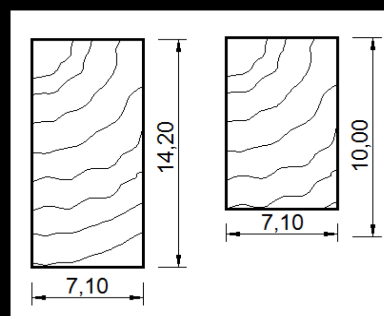
PASARELA PEATONAL SOBRE EL RIO DIANPU

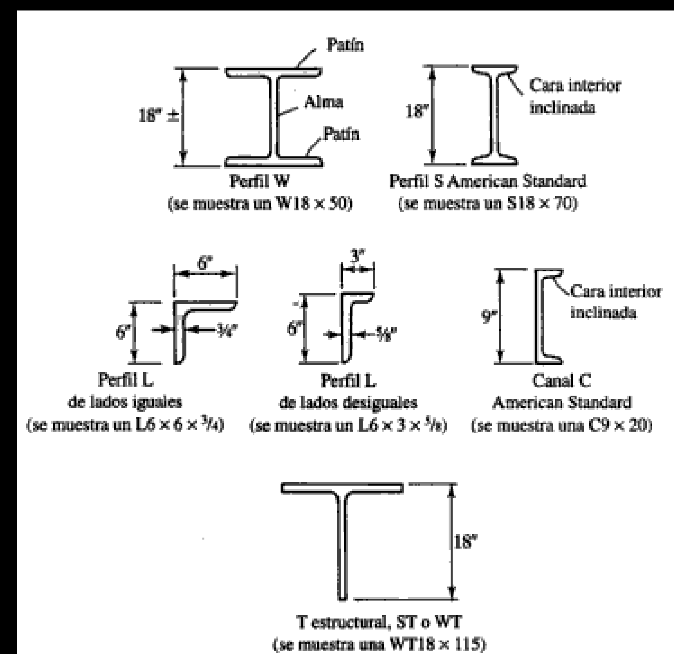
Shangai, 2008 - Ing. Pedro Pablo Arroyo



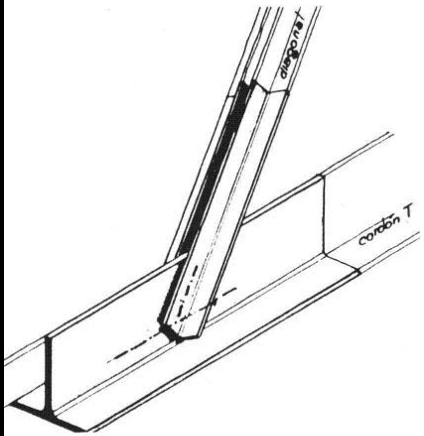


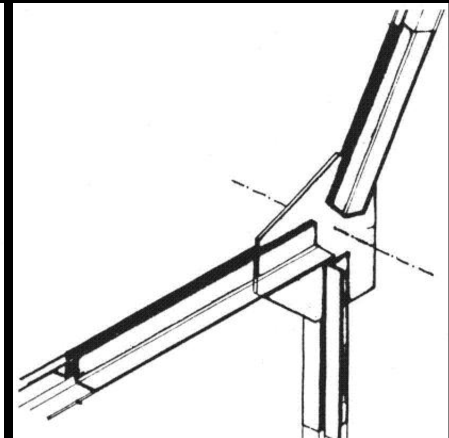


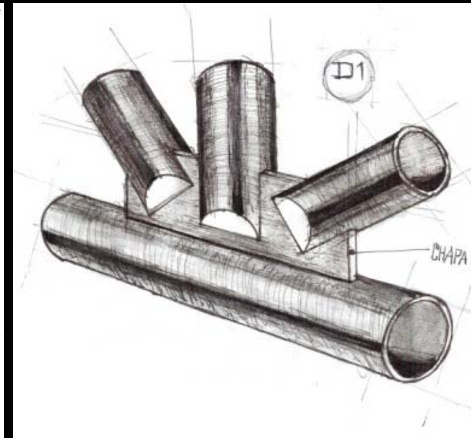


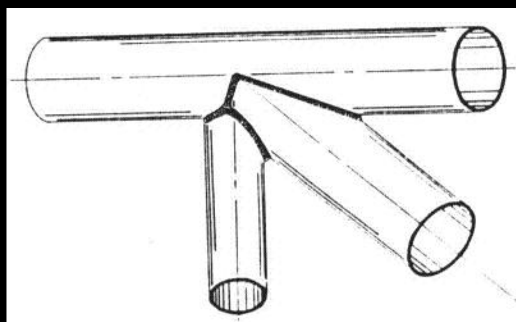


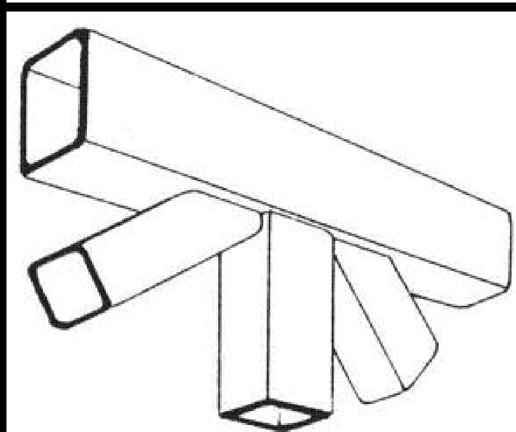
SECCIONES UTILIZADAS

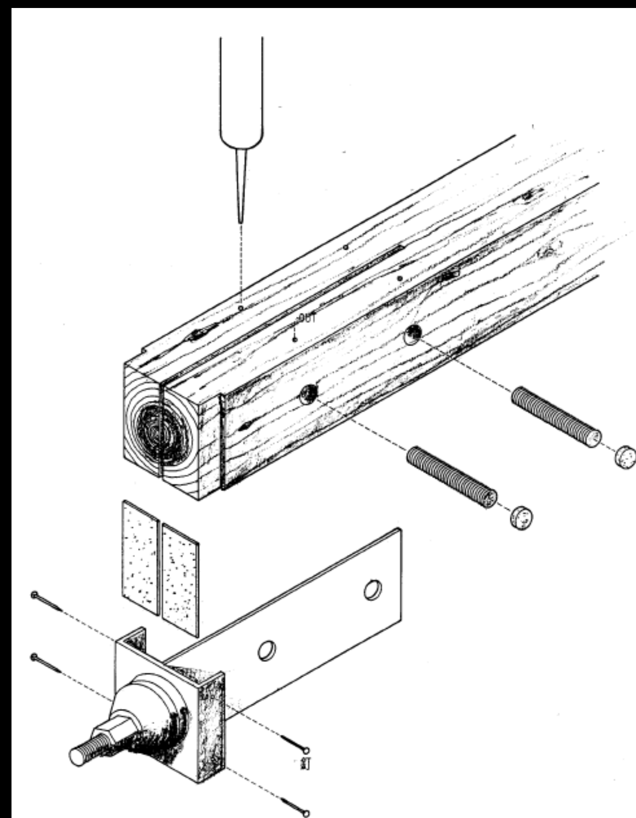

diagonal
cordon T

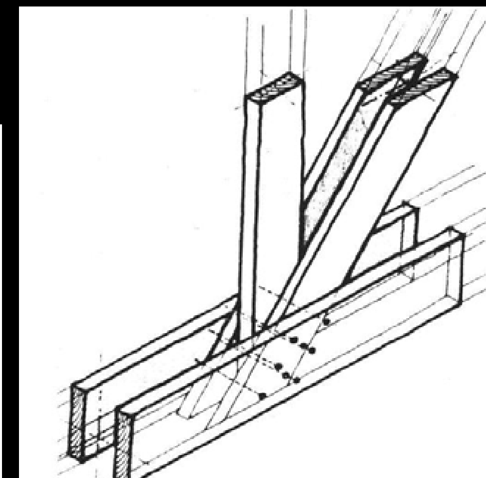


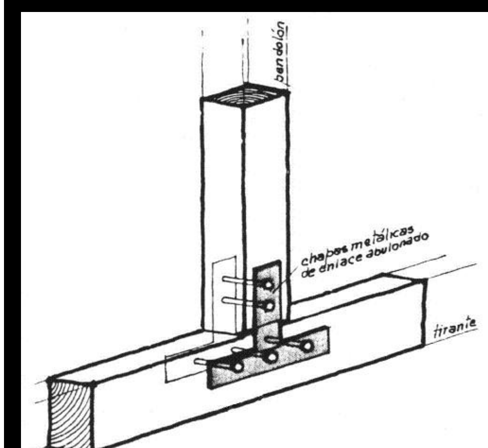

D1
CHAPA










bandolón
chapas metálicas
de enlace abulonado
tirante

UNIONES

SOLICITACIONES

CALCULO SIMPLIFICADO

- Calculo gráfico de esfuerzos en barras.
  Método de Cremona.

- Calculo analítico de esfuerzos en barras.
  Método de Ritter.

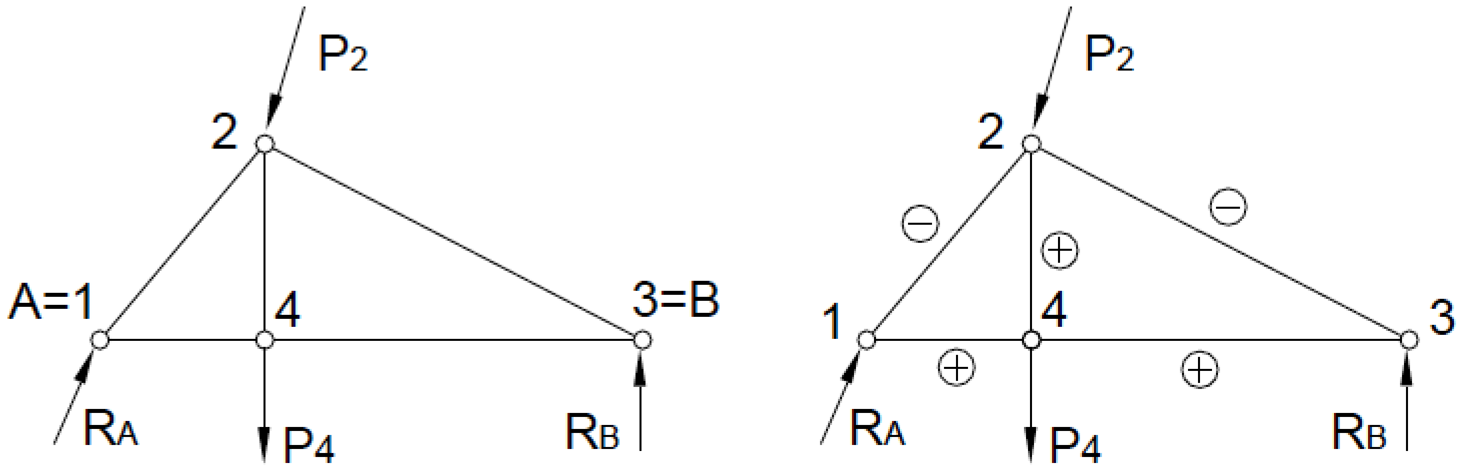
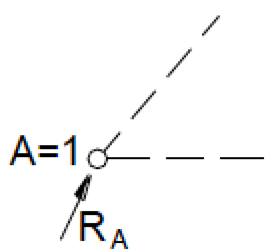
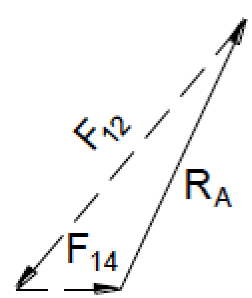
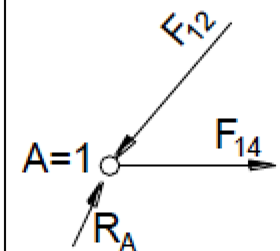
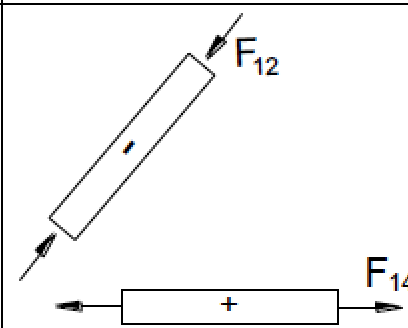
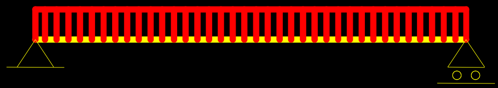
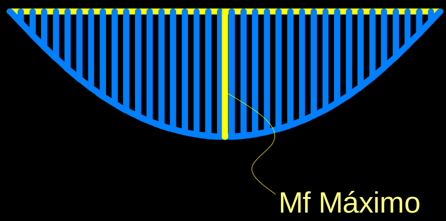
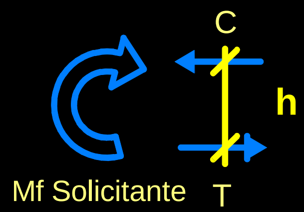


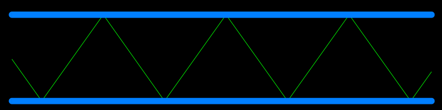
fig. 17

NUDOS	DIAGRAMA DE CUERPO LIBRE	POLÍGONO DE FUERZAS	ACCIÓN SOBRE EL NUDO	ACCIÓN SOBRE LA BARRA
A=1				

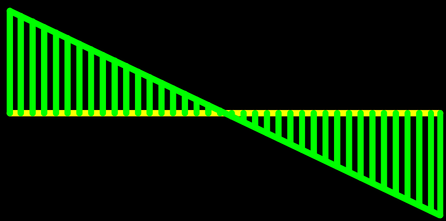


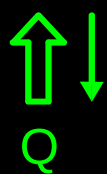


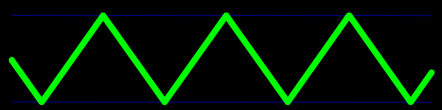




$$T \text{ ó } C = \frac{Mf_{max}}{h}$$

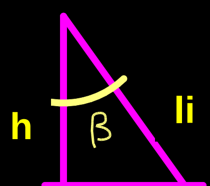






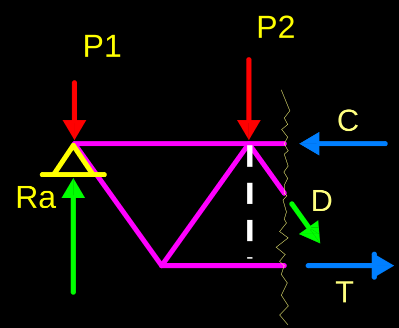
$$Q = \text{Proy } D$$

$$Q = D \times \cos \beta$$

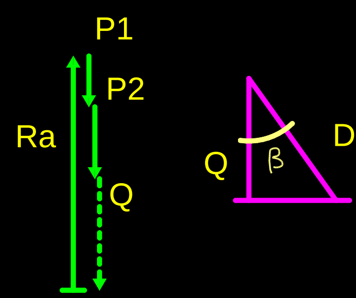


$$h = li \times \cos \beta$$

$$D = li = \frac{h}{\cos \beta}$$



$$D = \frac{Q}{\cos \beta}$$



En los sistemas reticulados se reemplaza el trabajo a flexión por esfuerzos axiales de tracción y compresión en las barras.

CALCULO SIMPLIFICADO

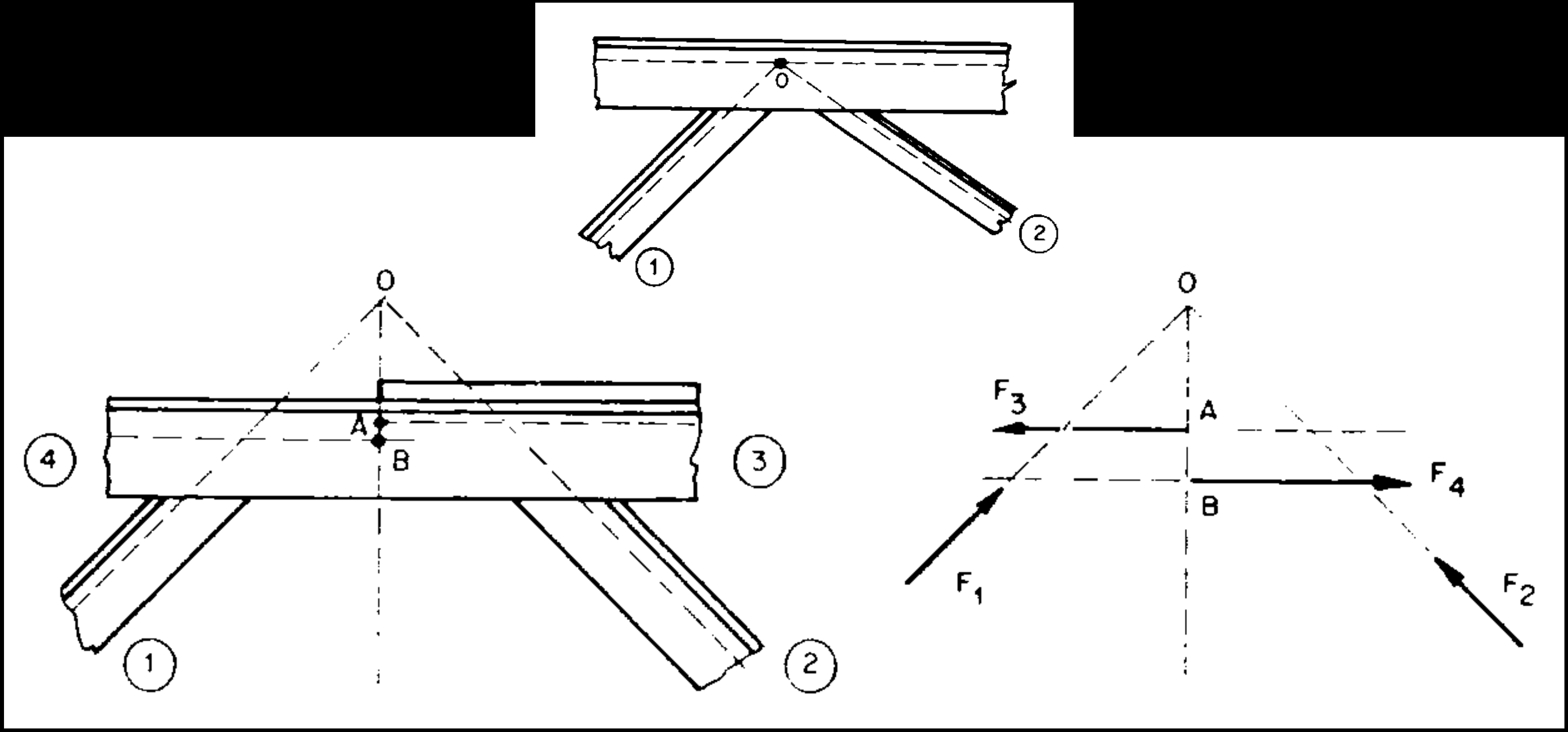
HIPOTESIS

- Los ejes de las barras que concurren a un nudo deben coincidir en un único punto.

CALCULO SIMPLIFICADO

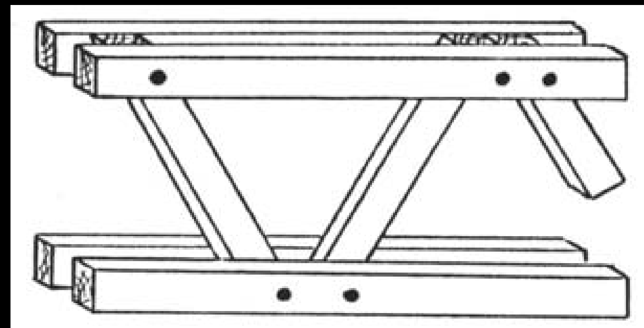
HIPOTESIS

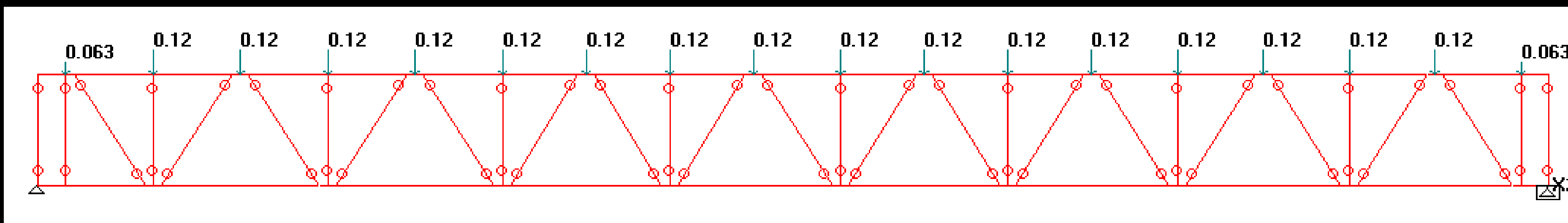
•**Los ejes de las barras que concurren a un nudo deben coincidir en un único punto.**

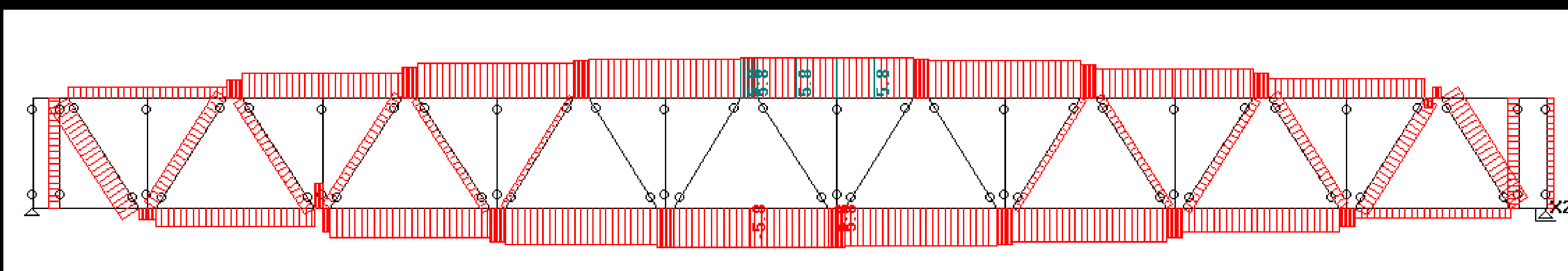


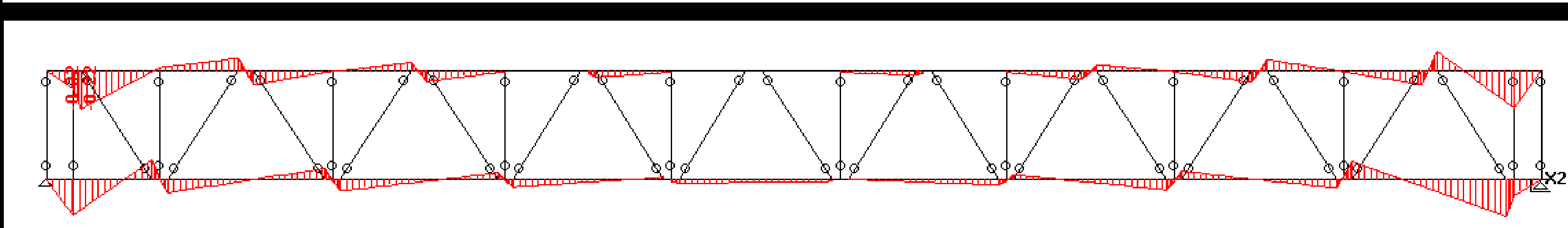
Galeria Monasterio Cartujo Dean Funes

Galeria Monasterio Cartujo Dean Funes









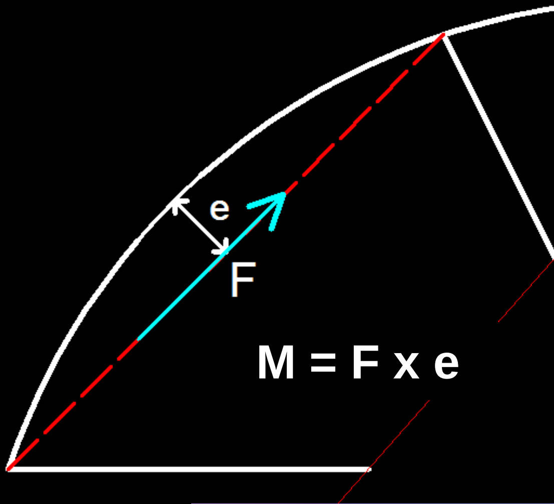
CALCULO SIMPLIFICADO

HIPOTESIS

- Los ejes de las barras que concurren a un nudo deben coincidir en un único punto.

- Las barras se consideran rectas

IAN THORPE AQUATIC CENTRE



Sydney, Australia , 2001/2007 - Harry Seidler & Associates

CALCULO SIMPLIFICADO

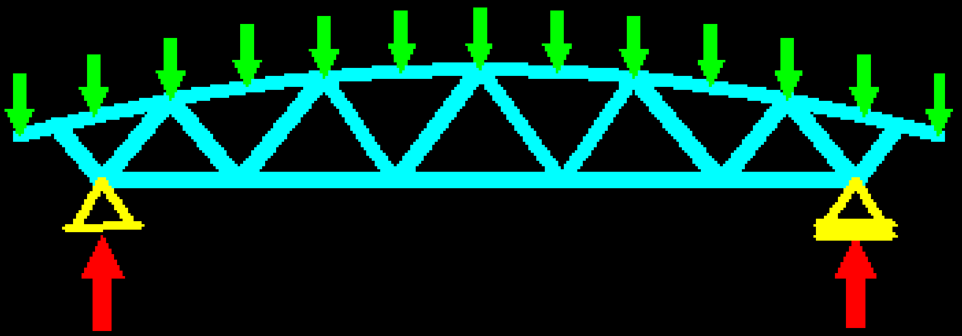
HIPOTESIS

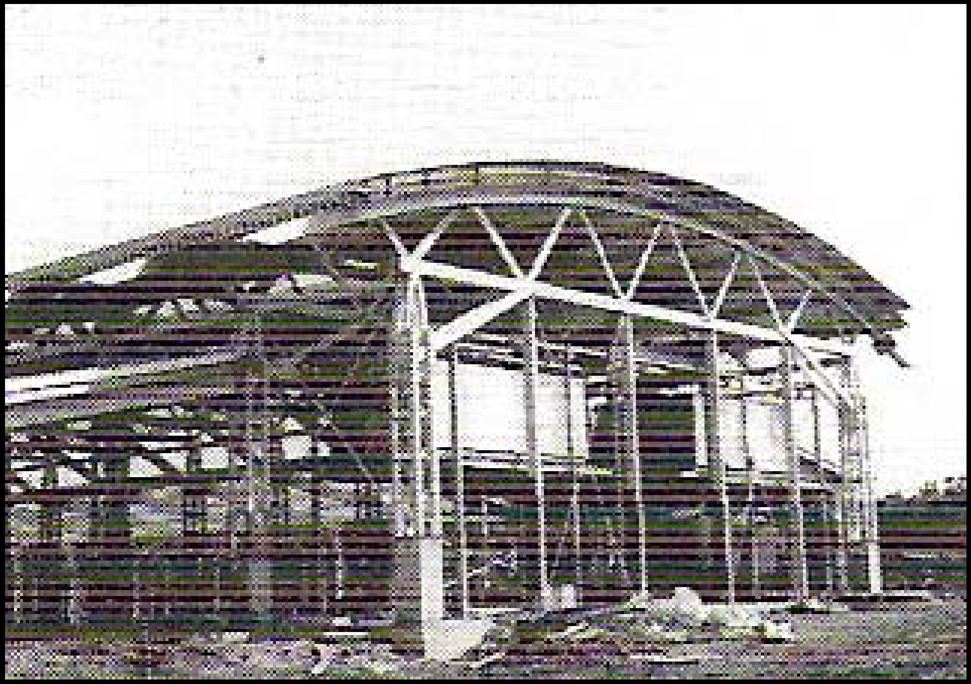
•Los ejes de las barras que concurren a un nudo deben coincidir en un único punto.

•Las barras se consideran rectas.

•Las cargas deben estar aplicadas en los nudos.

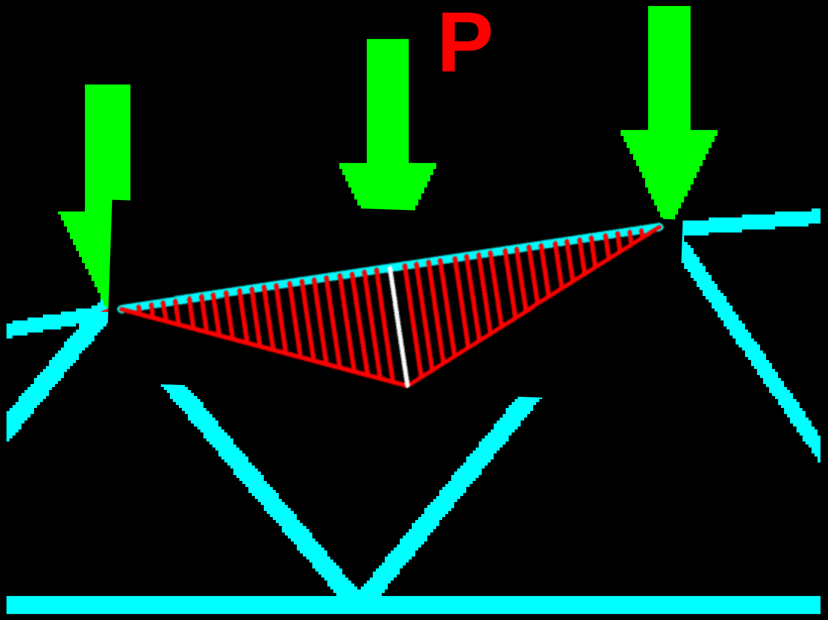
PISCINA CUBIERTA EN SHERINGHAM





1998, UK - Will Alsop

PISCINA CUBIERTA EN SHERINGHAM



$$M = \frac{P \times L}{4}$$

1998, UK - Will Alsop

CALCULO SIMPLIFICADO

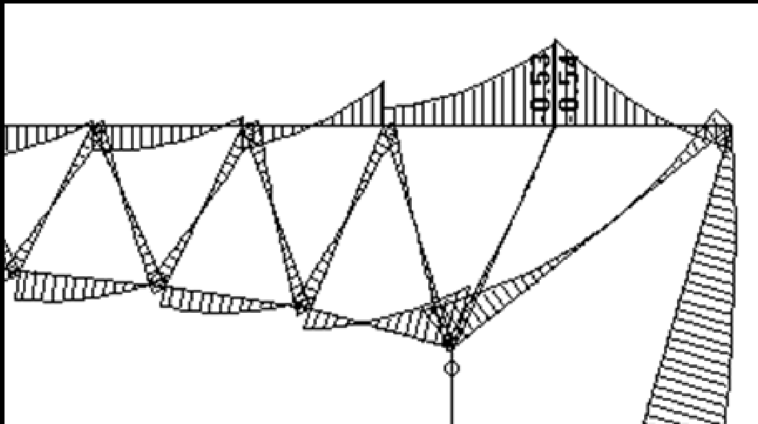
HIPOTESIS

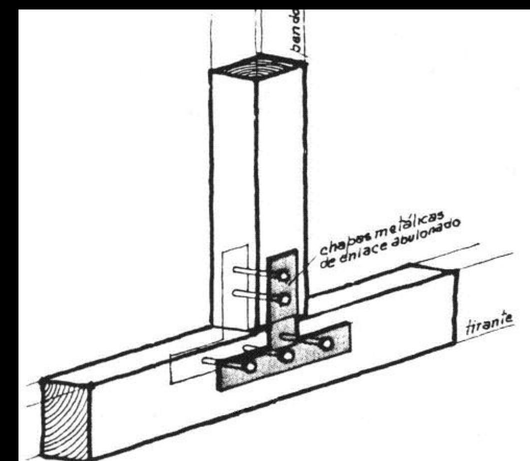
- Los ejes de las barras que concurren a un nudo deben coincidir en un único punto.

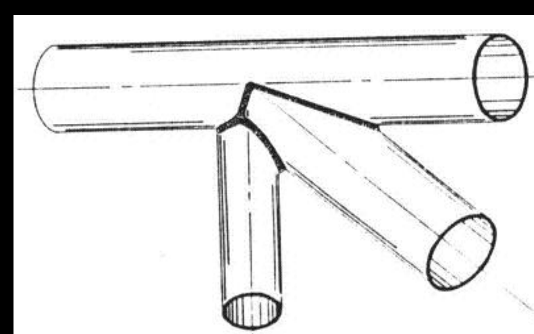
- Las barras se consideran rectas

- Las cargas deben estar aplicadas en los nudos.

- Se considera que todos los nudos serán articulados.


-0.53
-0.54

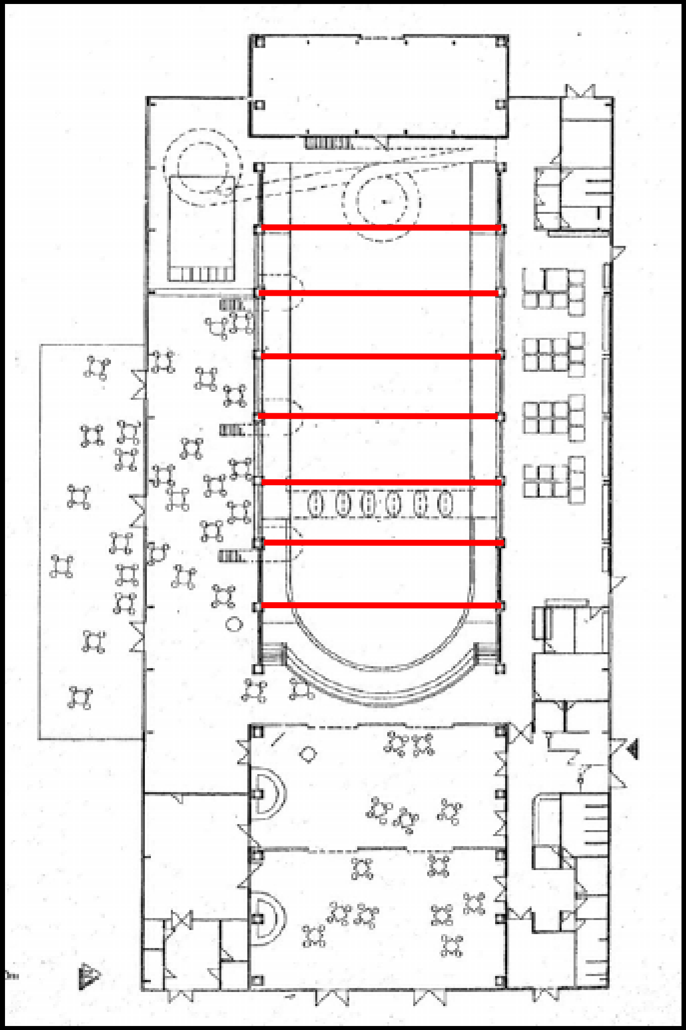

chapas metálicas
de enlace abulonado
tirante

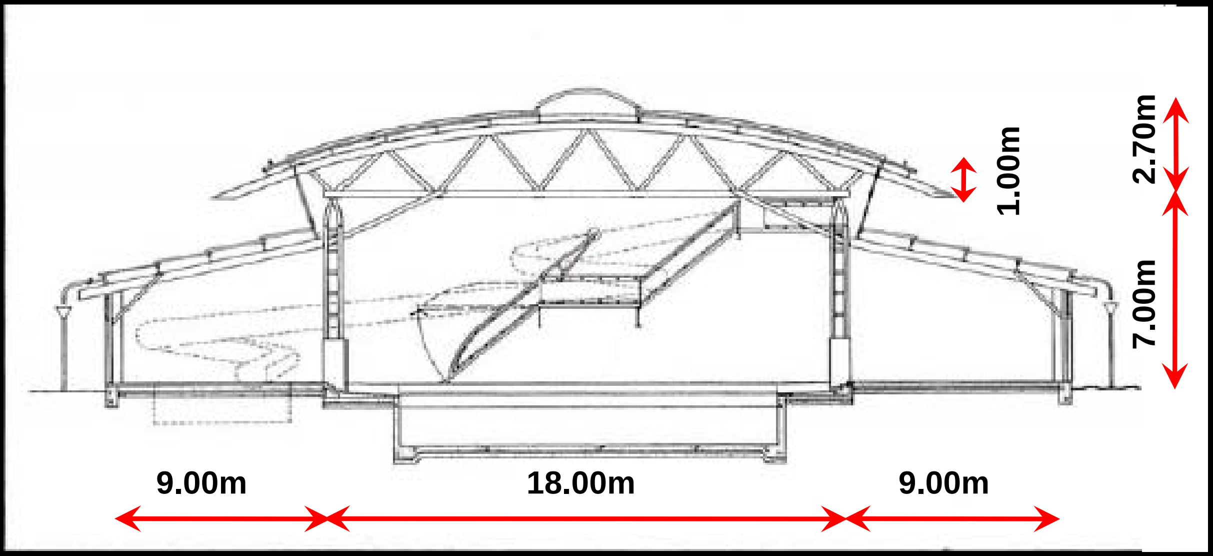


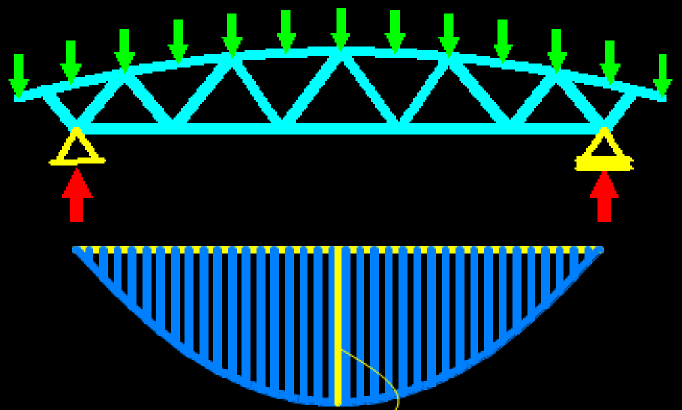
ISOSTATICAS

ESTRUCTURAS SEGÚN LOS VINCULOS

PISCINA CUBIERTA EN SHERINGHAM





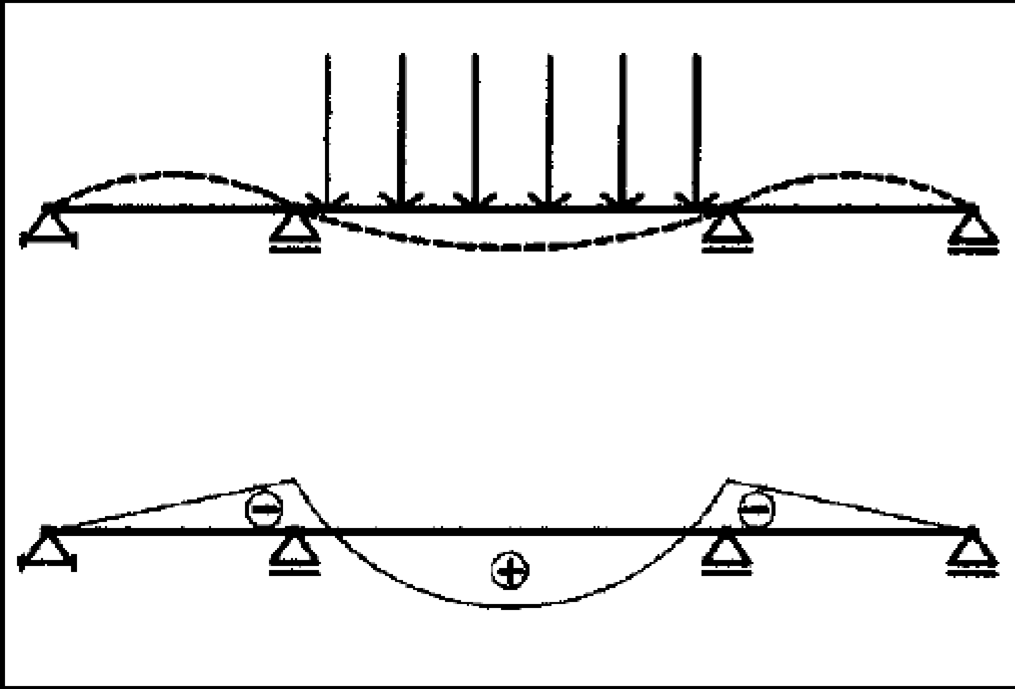


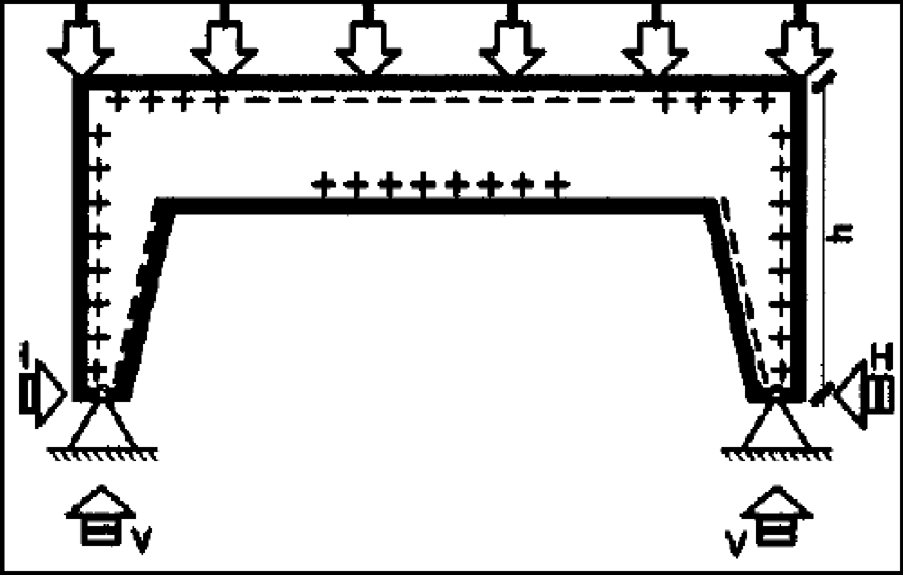
Estructura principal cada 5 metros

1998, UK - Will Alsop

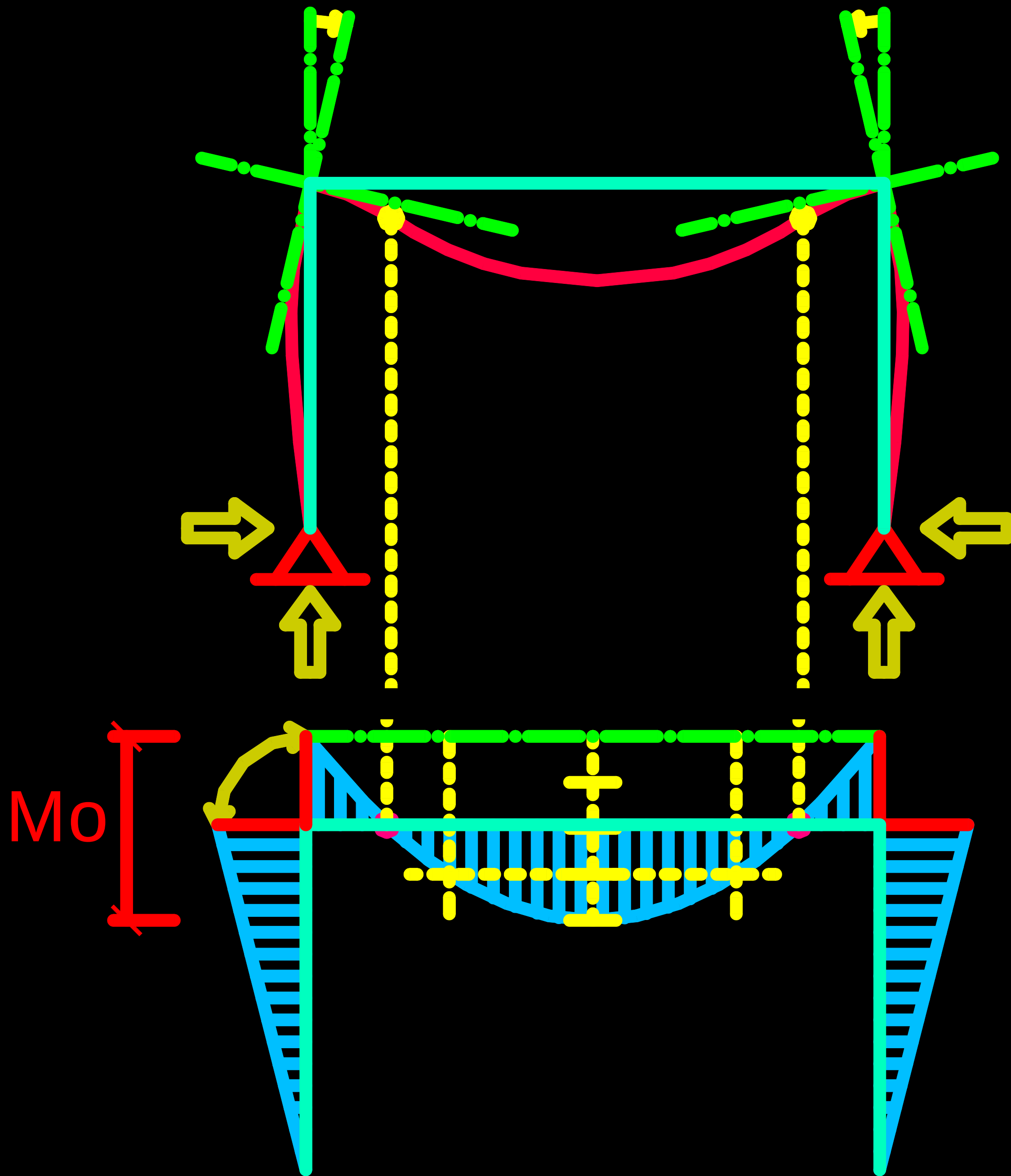
HIPERESTATICAS

ESTRUCTURAS SEGÚN LOS VINCULOS





Pórtico



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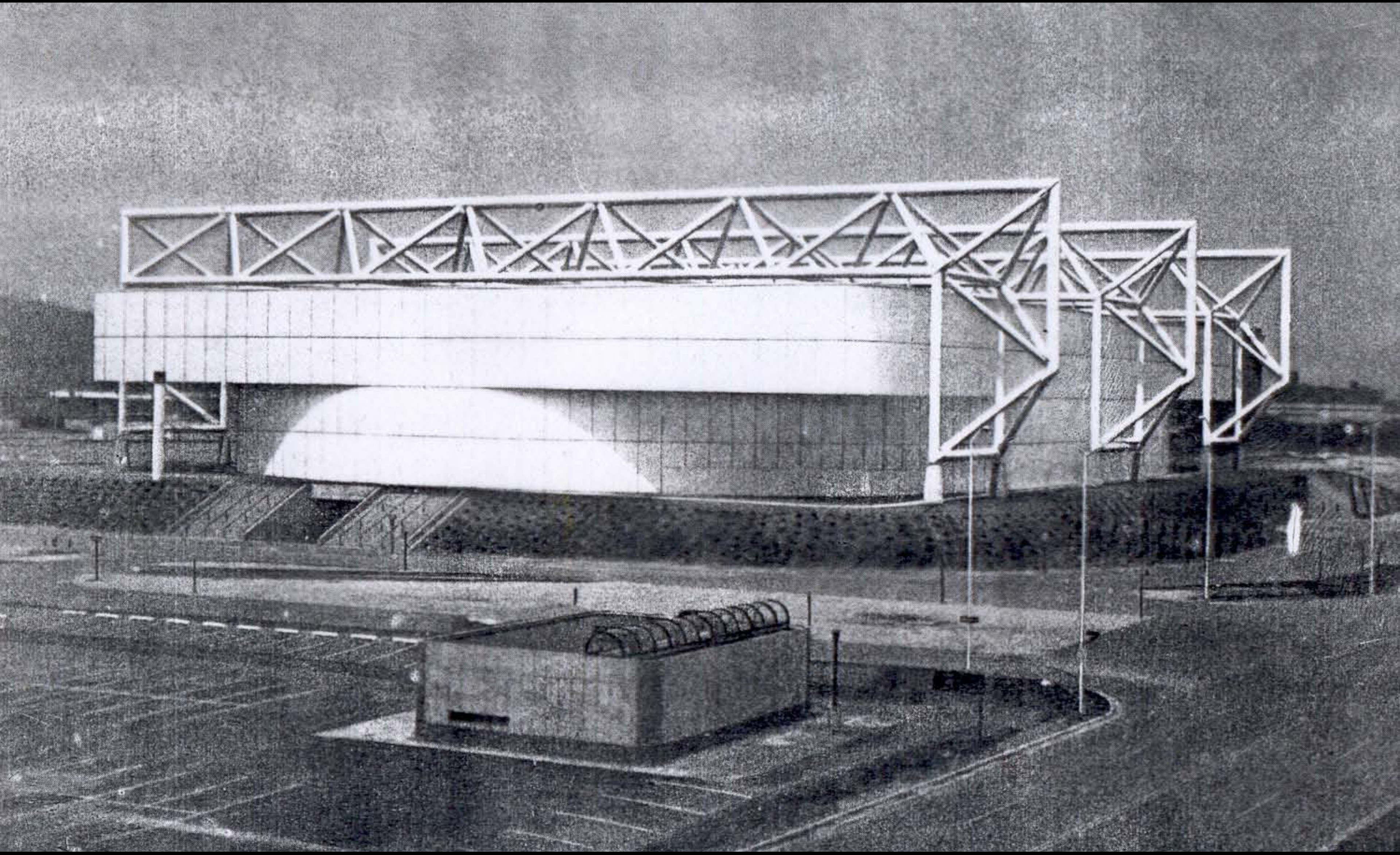
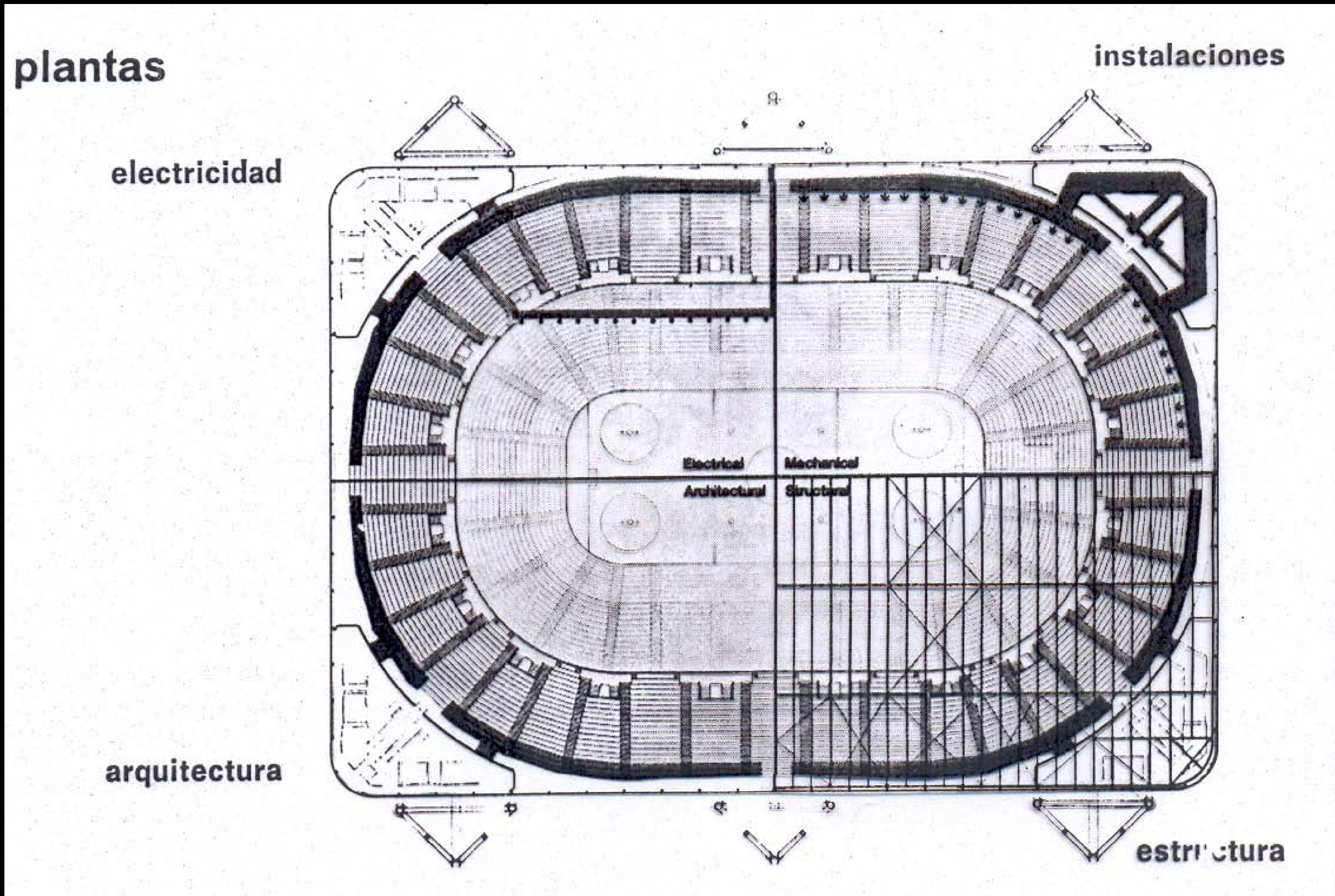


Kansas, USA, 1974 – Murphy & Asoc.

ESTADIO KEMPER EN KANSAS CITY



Kansas, USA, 1974 – Murphy & Asoc.

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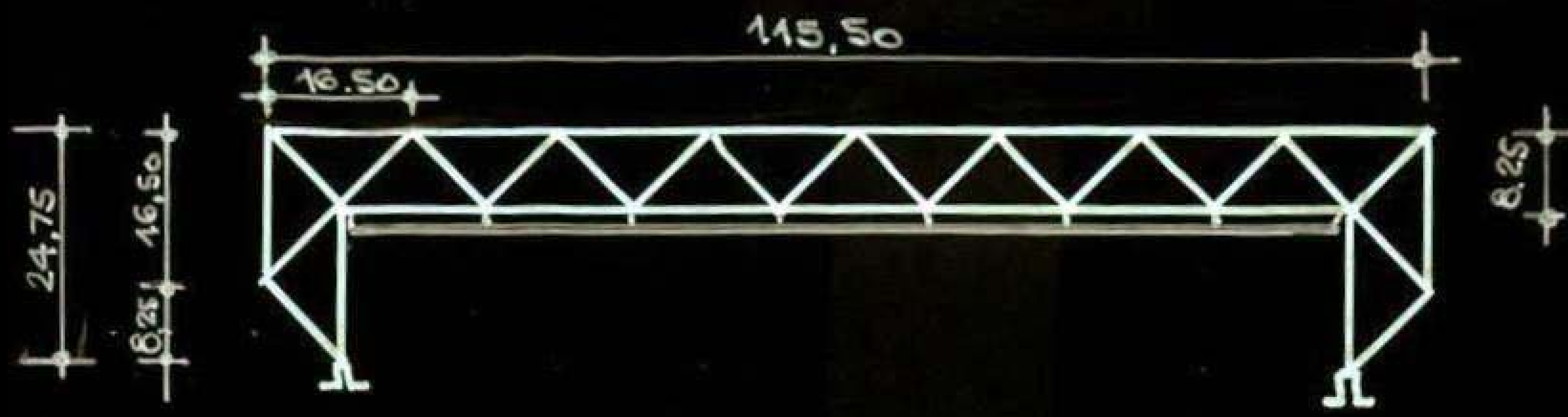
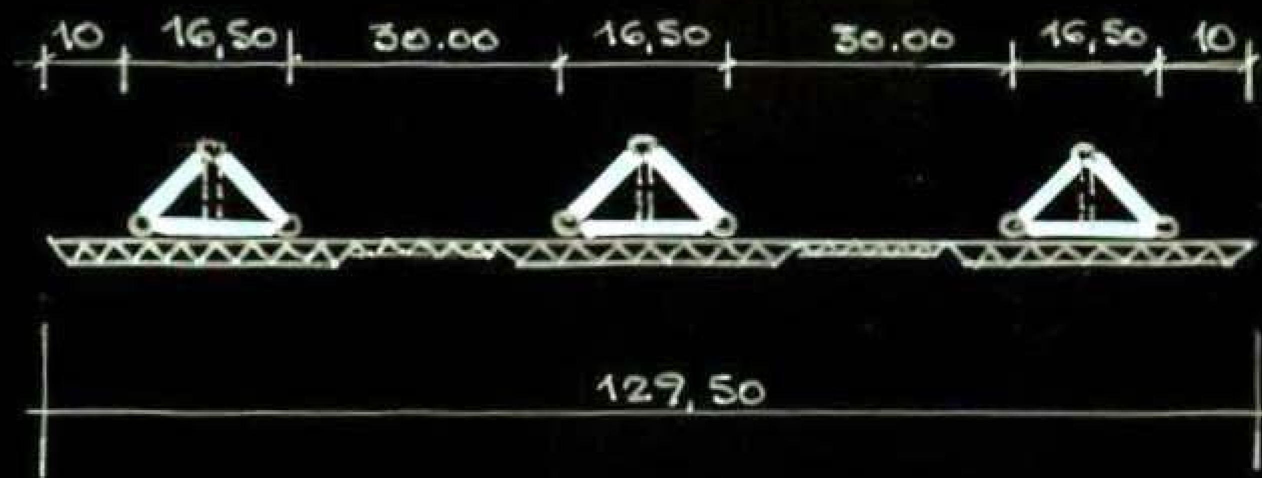
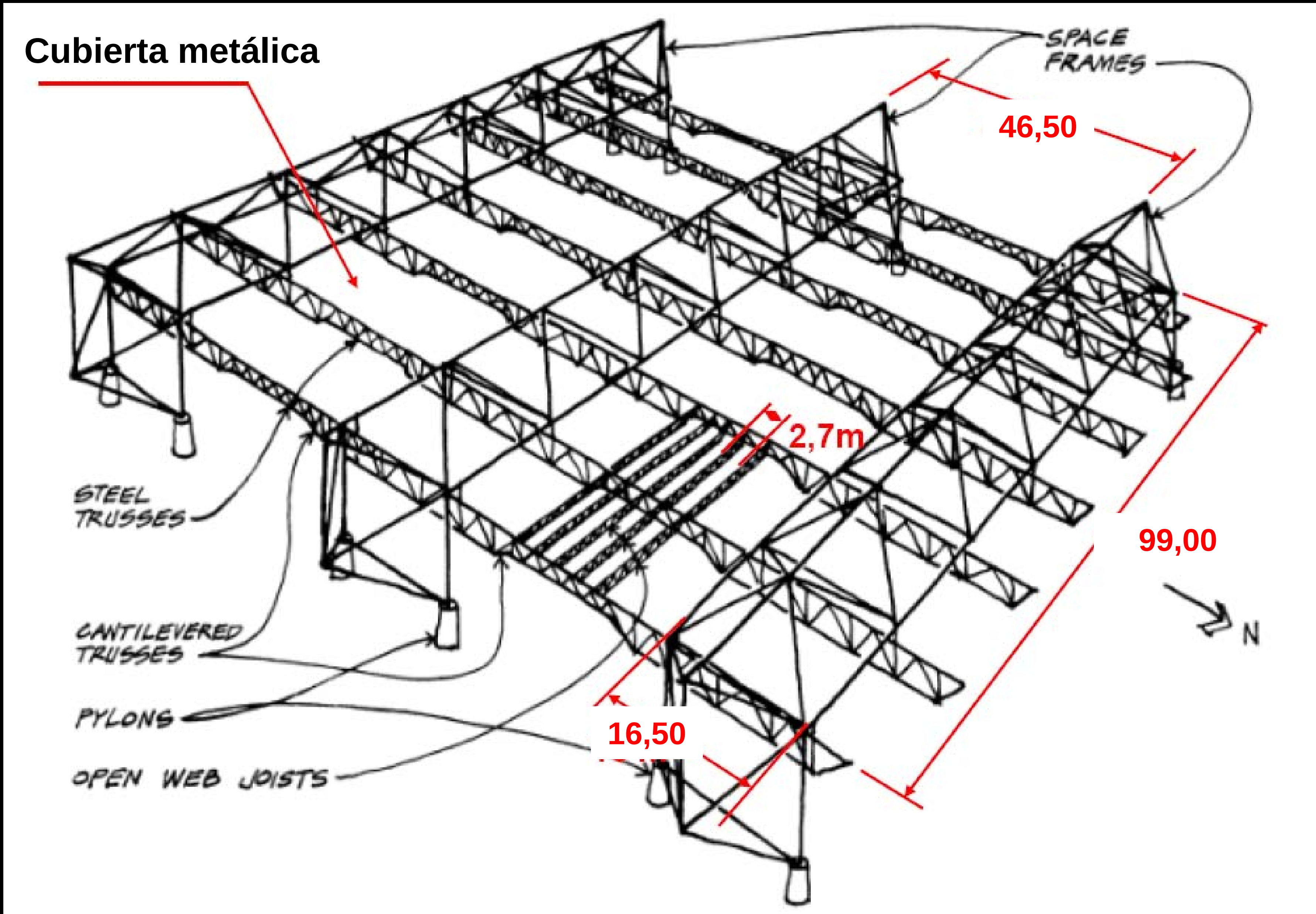




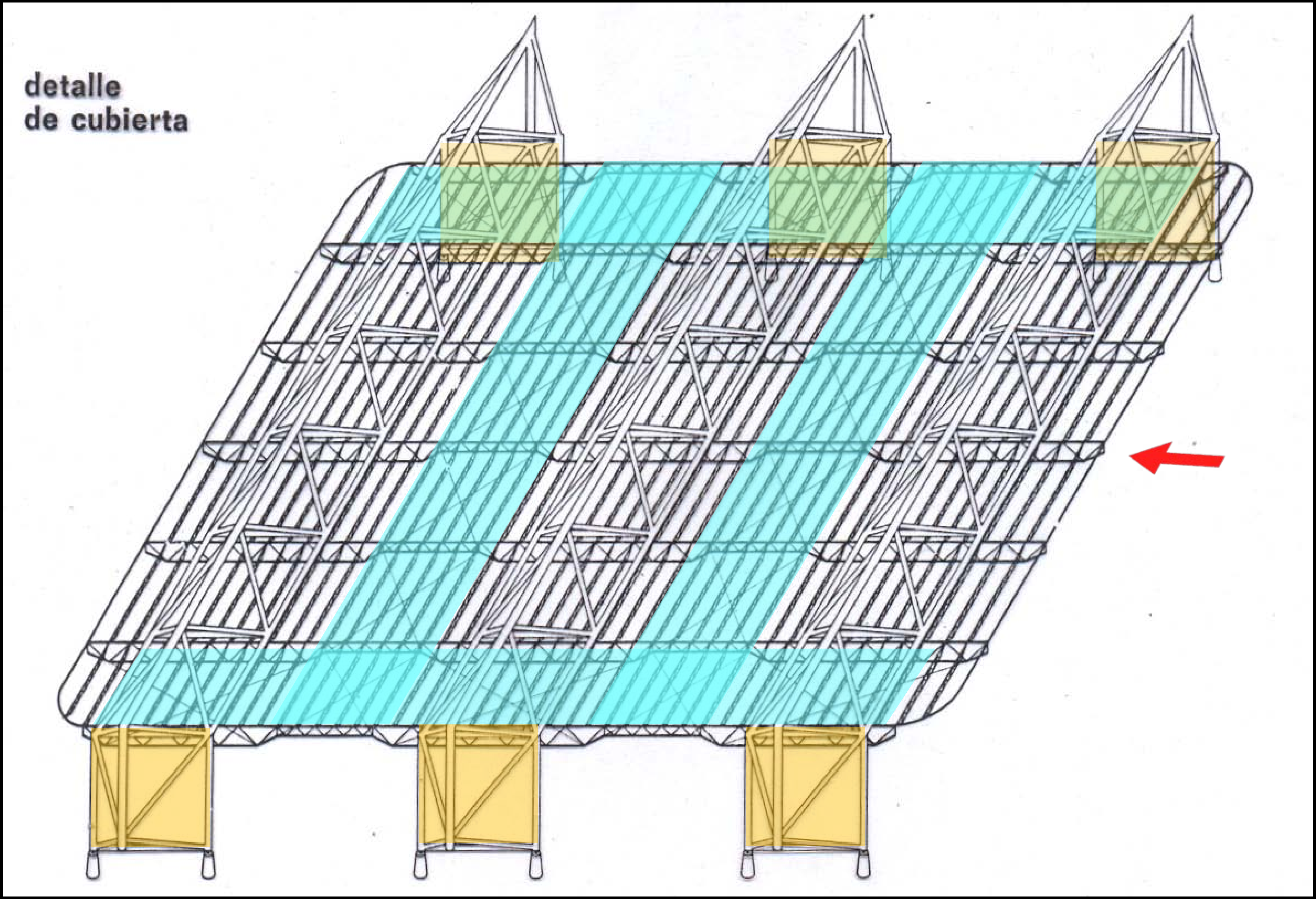
Kansas, USA, 1974 – Murphy & Asoc.

ESTADIO KEMPER EN KANSAS CITY



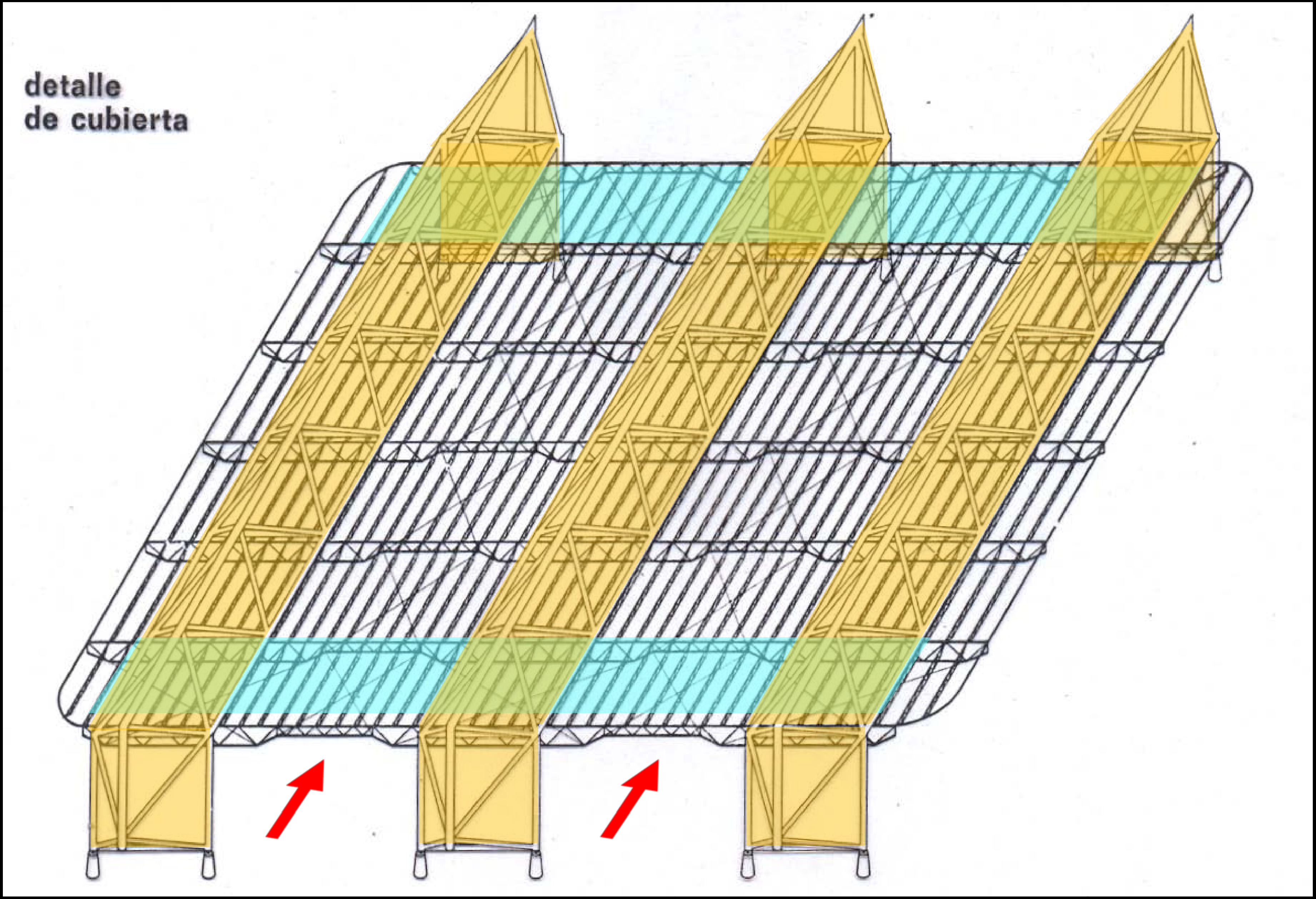
Kansas, USA, 1974 – Murphy & Asoc.

ESTADIO KEMPER EN KANSAS CITY



Kansas, USA, 1974 – Murphy & Asoc.

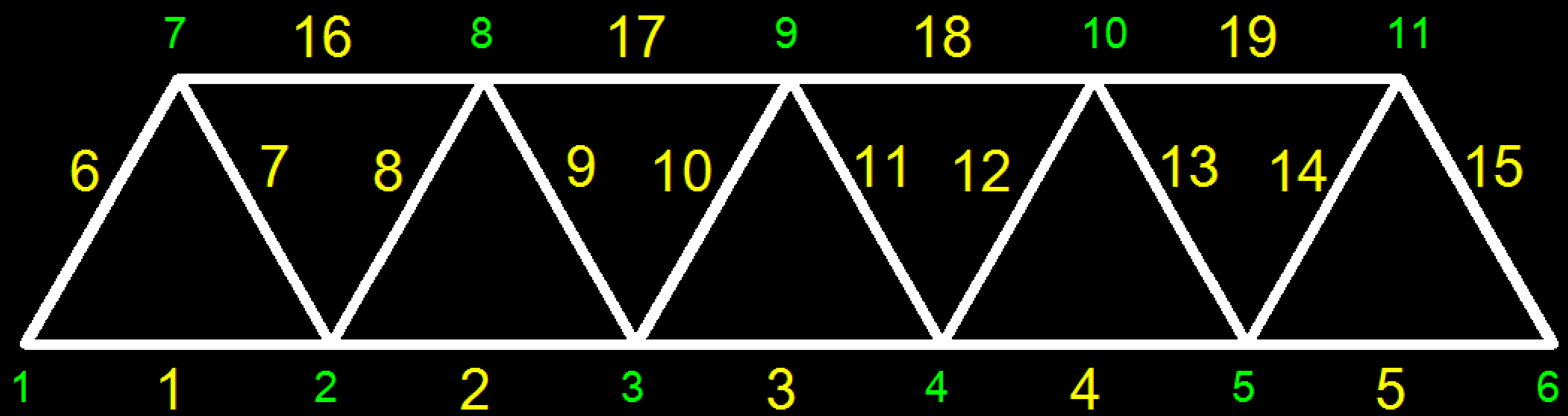
ESTADIO KEMPER EN KANSAS CITY



Kansas, USA, 1974 – Murphy & Asoc.

ISOSTATICAS

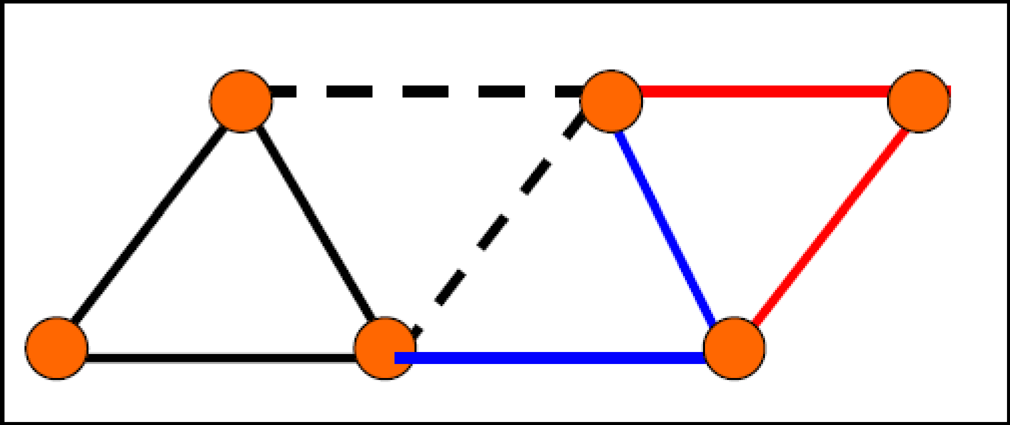
ESTRUCTURAS RETICULADAS DESDE EL PUNTO DE VISTA DE LA TRIANGULACION



$$N_{barras} = 2n - 3$$

$$N_{barras} = 2 \times 11 - 3 = 19$$

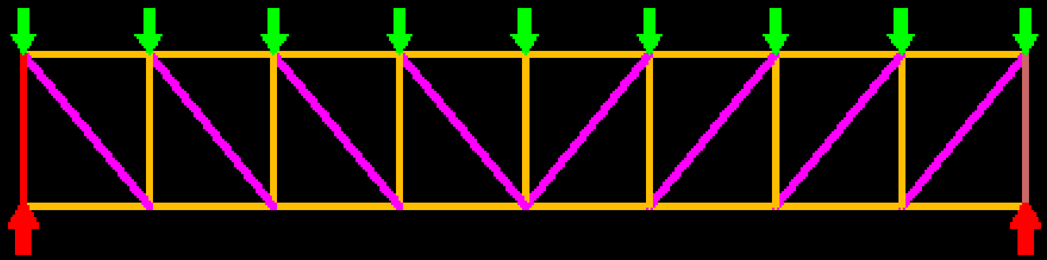
2 nuevas barras por cada nudo



HIPERESTATICAS

ESTRUCTURAS RETICULADAS DESDE EL PUNTO DE VISTA DE LA TRIANGULACION

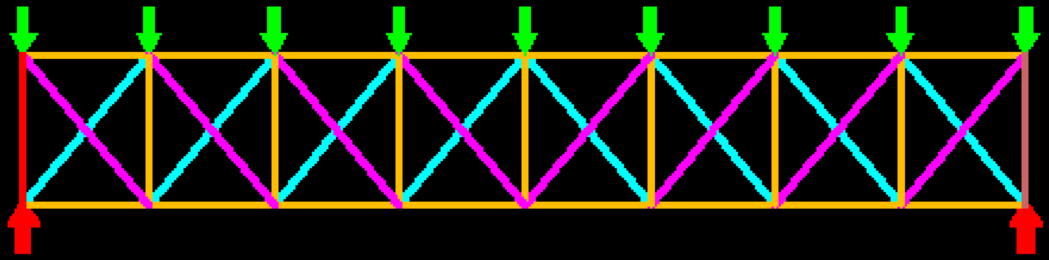
HIPERESTATICAS



VIGA RETICULADA

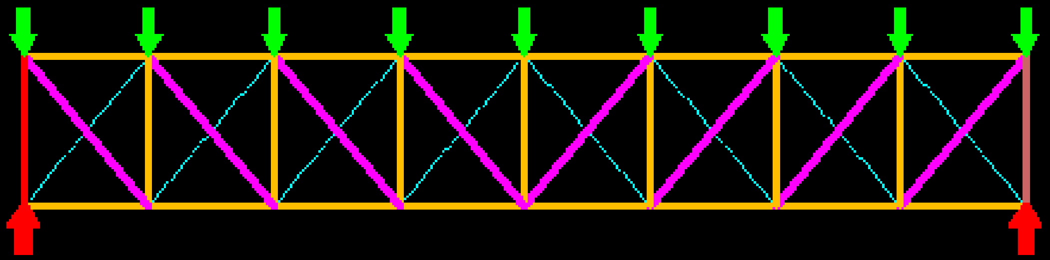
$N_{barras} = 2n - 3$

$N_{barras} = 2 \times 18 - 3 = 33$



VIGA RETICULADA DOBLE DIAGONAL

$N_{barras} = 41 > 2 \text{ X } 18 - 3 = 33$



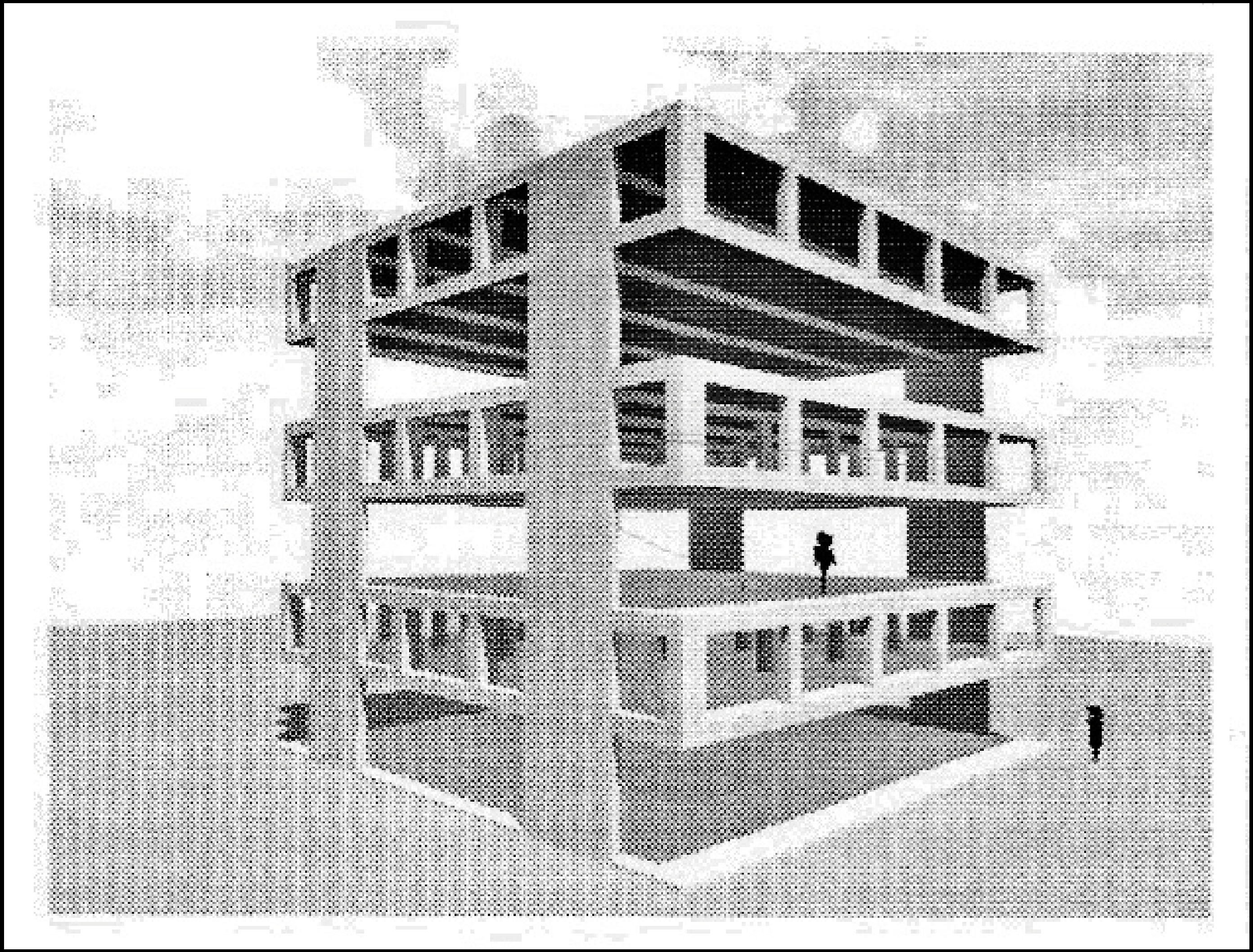
VIGA RETICULADA DOBLE DIAGONAL

SOLO DIAGONALES A TRACCIÓN

$N_{barras} = 2 \text{ X } 18 - 3 = 33$

ESTRUCTURAS RETICULADAS DESDE EL PUNTO DE VISTA DE LA TRIANGULACION

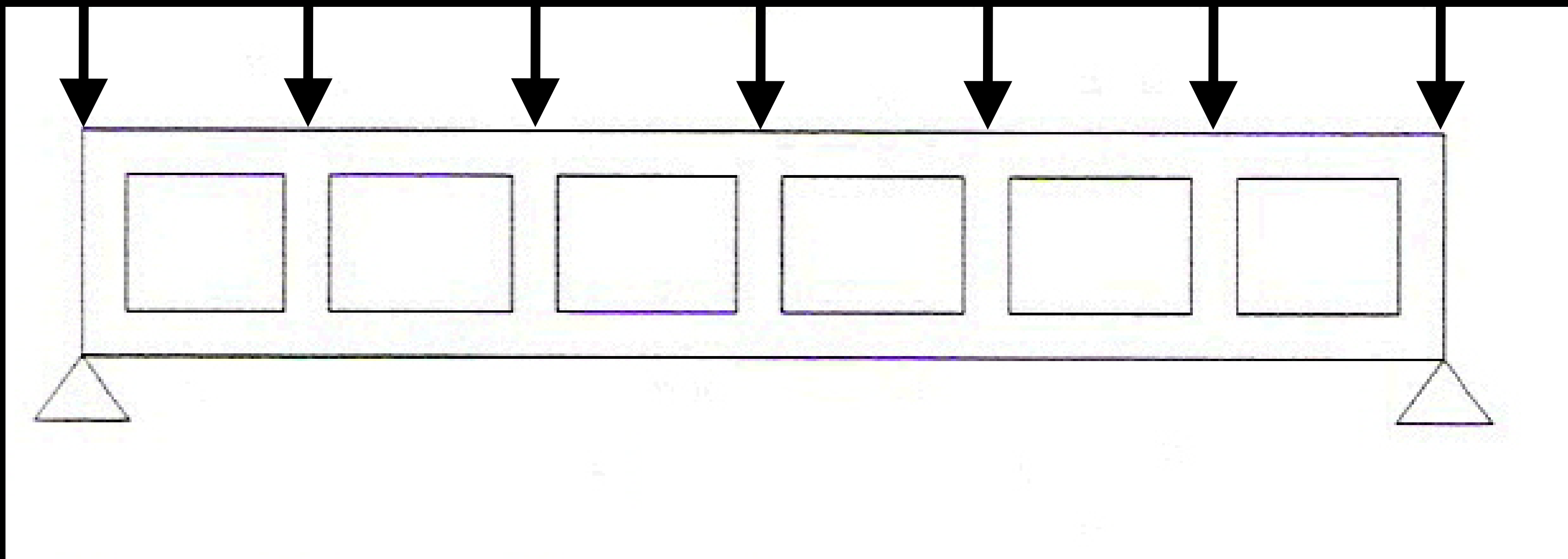
VIGA VIERENDEEL



SISTEMA DE TRANSICION

MECANISMO QUE POSEE LA CAPACIDAD PARA SOPORTAR ELEVADAS CARGAS Y SALVAR GRANDES LUCES, SIN AFECTAR LA TRANSPARENCIA DEL PLANO VERTICAL NI PROVOCAR UN INCREMENTO EXCESIVO DE SU PESO.

VIGA VIERENDEEL
VIGA RETICULADA CON DIAGONALES



SE SUPRIMEN LAS DIAGONALES DE LA VIGA RETICULADA Y SE INCREMENTAN LAS SECCIONES DE LAS MONTANTES PARA GENERAR NUDOS INDEFORMABLES.

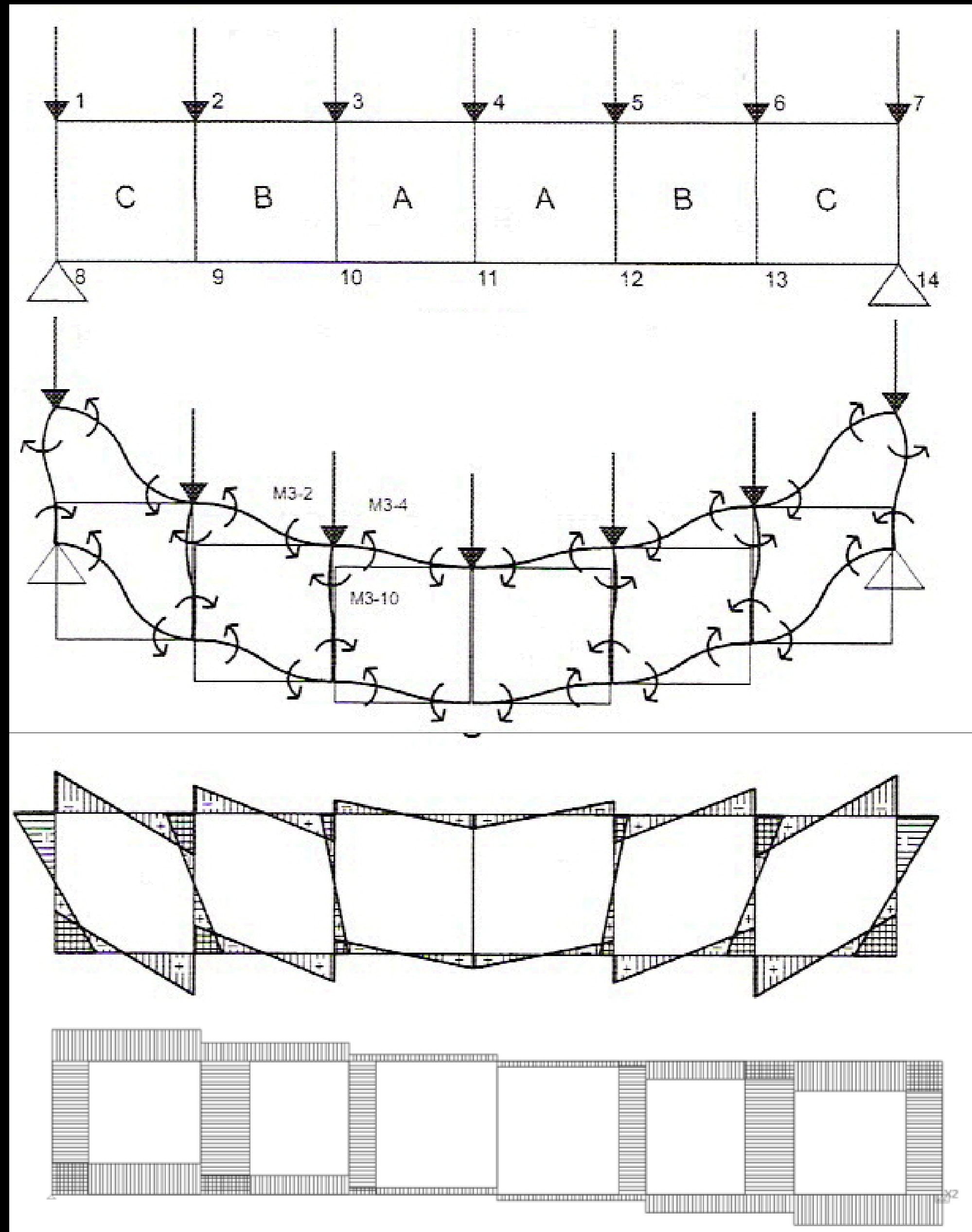
VIGA VIERENDEEL

Cargas Aplicadas

Deformada

Diagrama de Momentos Flectores

Diagrama de Esfuerzos de Corte



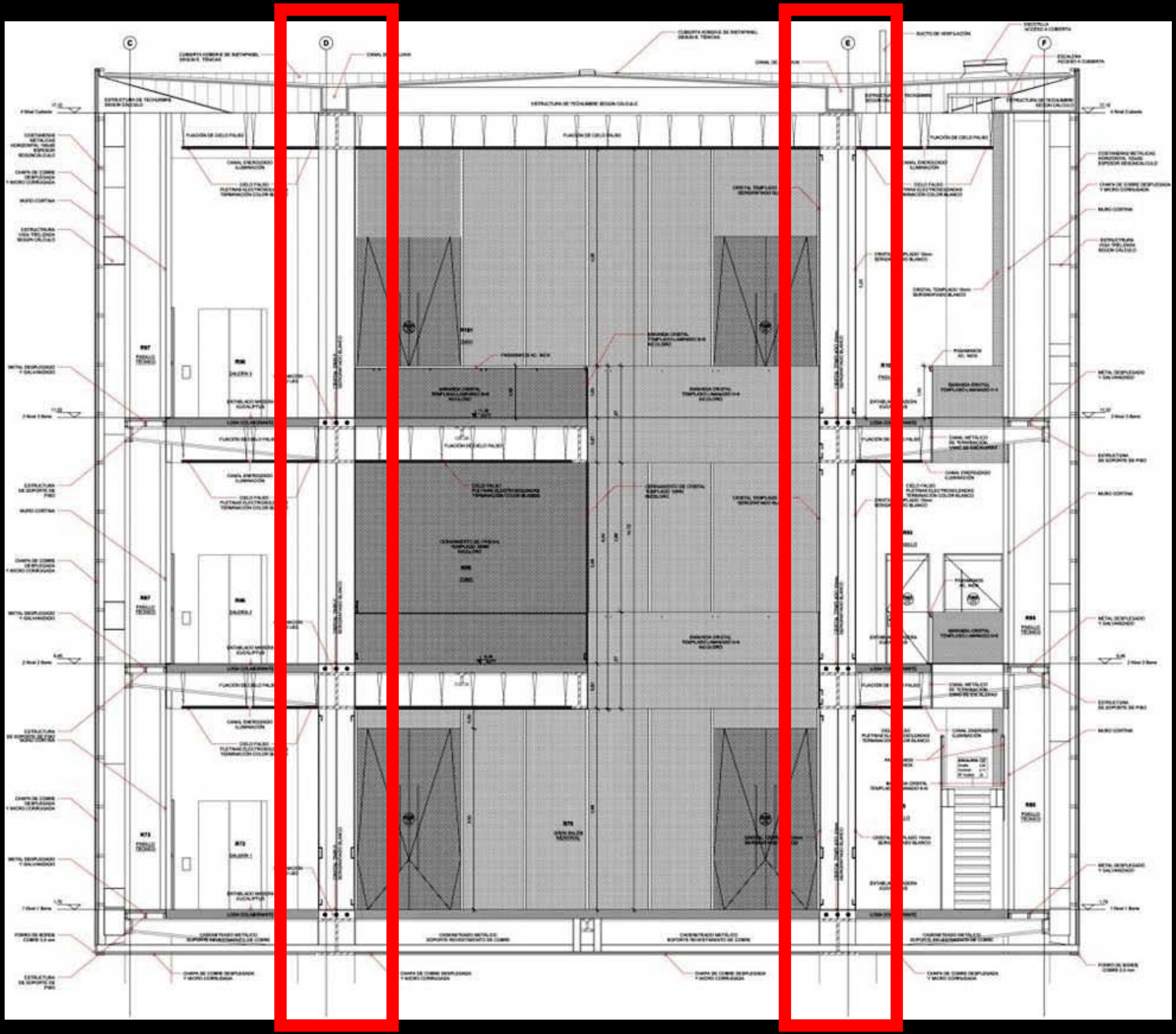
MUSEO DE LA MEMORIA

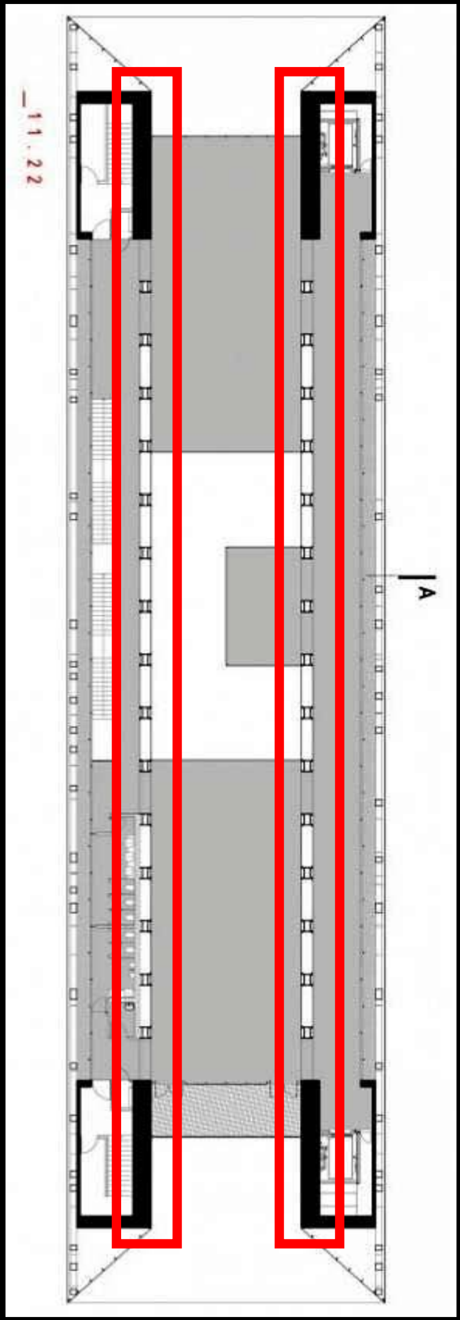
Santiago de Chile, 2009 – Estudio América

MUSEO DE LA MEMORIA

Santiago de Chile, 2009 – Estudio América

MUSEO DE LA MEMORIA





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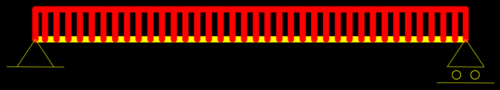
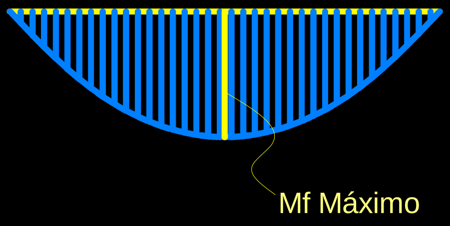
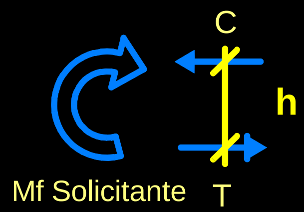
MUSEO DE LA MEMORIA

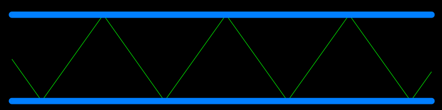
Santiago de Chile, 2009 – Estudio América

RETICULADOS ESPACIALES

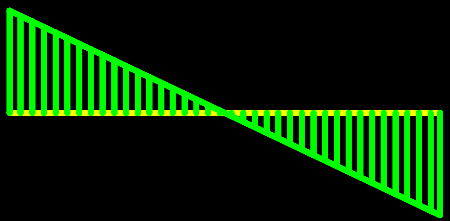


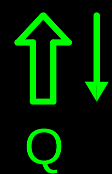


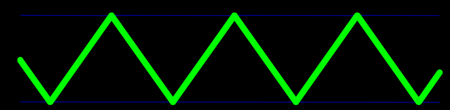




$$T \text{ ó } C = \frac{Mf_{max}}{h}$$

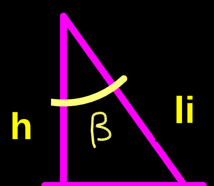






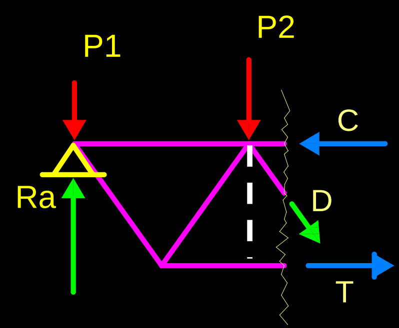
Q = Proy D

$$Q = D \times \cos \beta$$

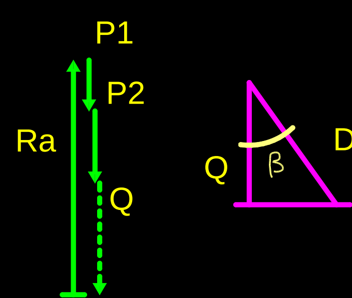


$$h = li \times \cos \beta$$

$$D = li = \frac{h}{\cos \beta}$$



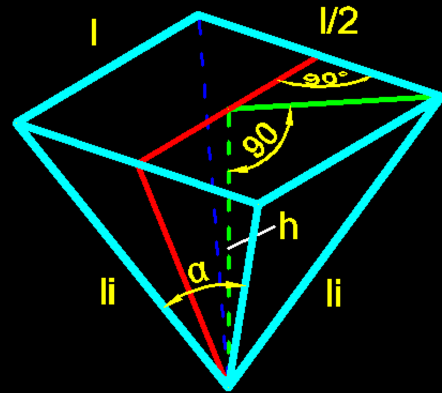
$$D = \frac{Q}{\cos \beta}$$



En los sistemas reticulados se reemplaza el trabajo a flexión por esfuerzos axiales de tracción y compresión en las barras.

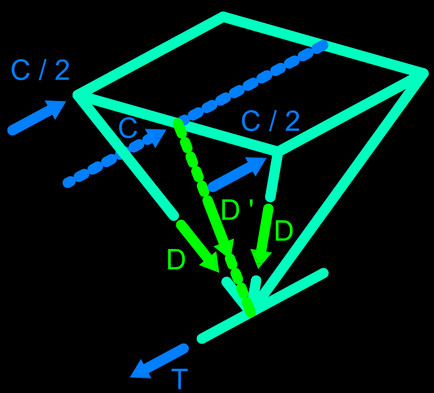
Cordón superior

$$2\ T\ \text{ó}\ C = \frac{Mf_{max}}{h}$$



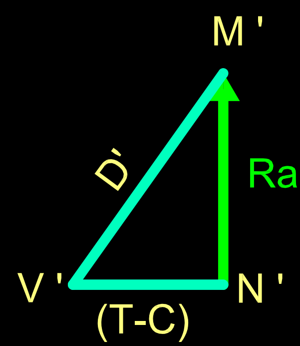
$\alpha \leq 60°$

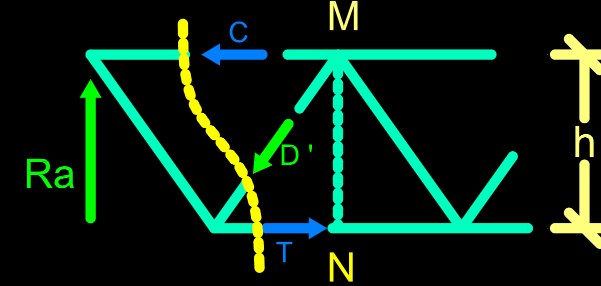
$h \geq 0{,}7\ \ \text{ó}\ \ l \leq 1{,}41$

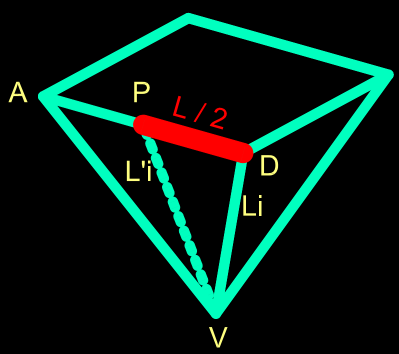


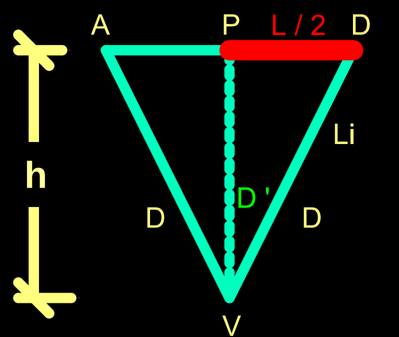
Cordón inferior

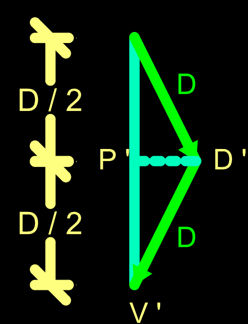
$$T\ \text{ó}\ C = \frac{Mf_{max}}{h}$$









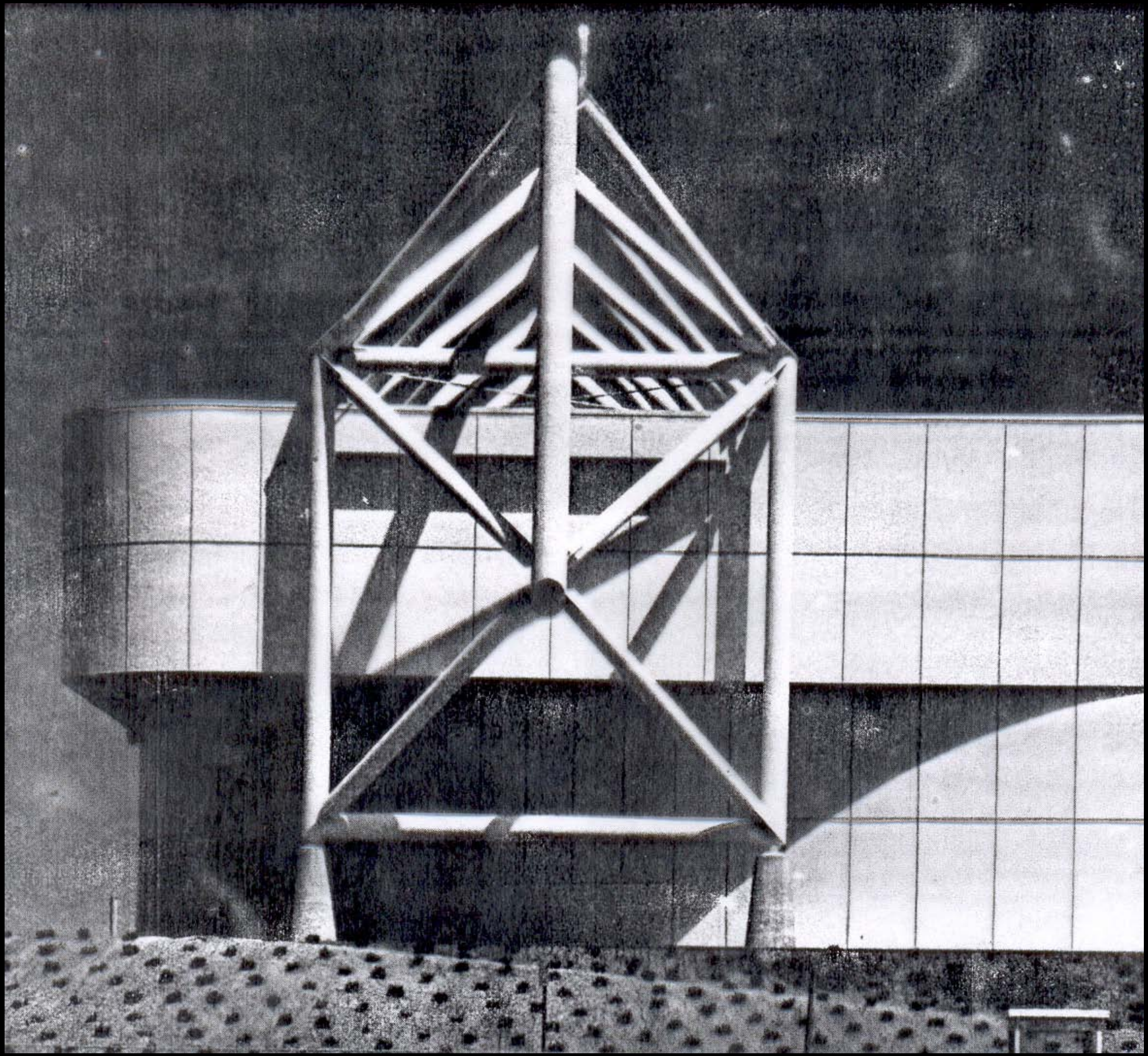


$$D = \frac{Ra}{2} \cdot \frac{L\,i}{h}$$

$$D = \frac{Q}{n^{o}} \cdot \frac{L\,i}{h}$$

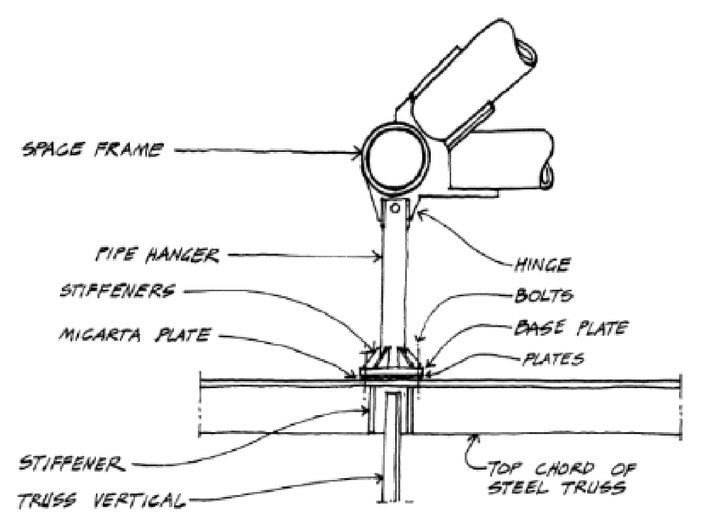
Los Reticulados Espaciales tienen una configuración tridimensional, y en general, la sección transversal triangular es la más utilizada.

ESTADIO KEMPER EN KANSAS CITY

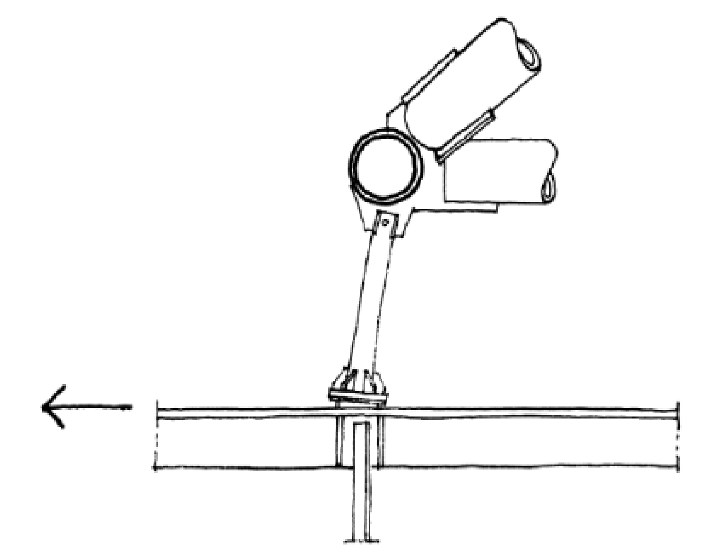


Kansas, USA, 1974 – Murphy & Asoc.

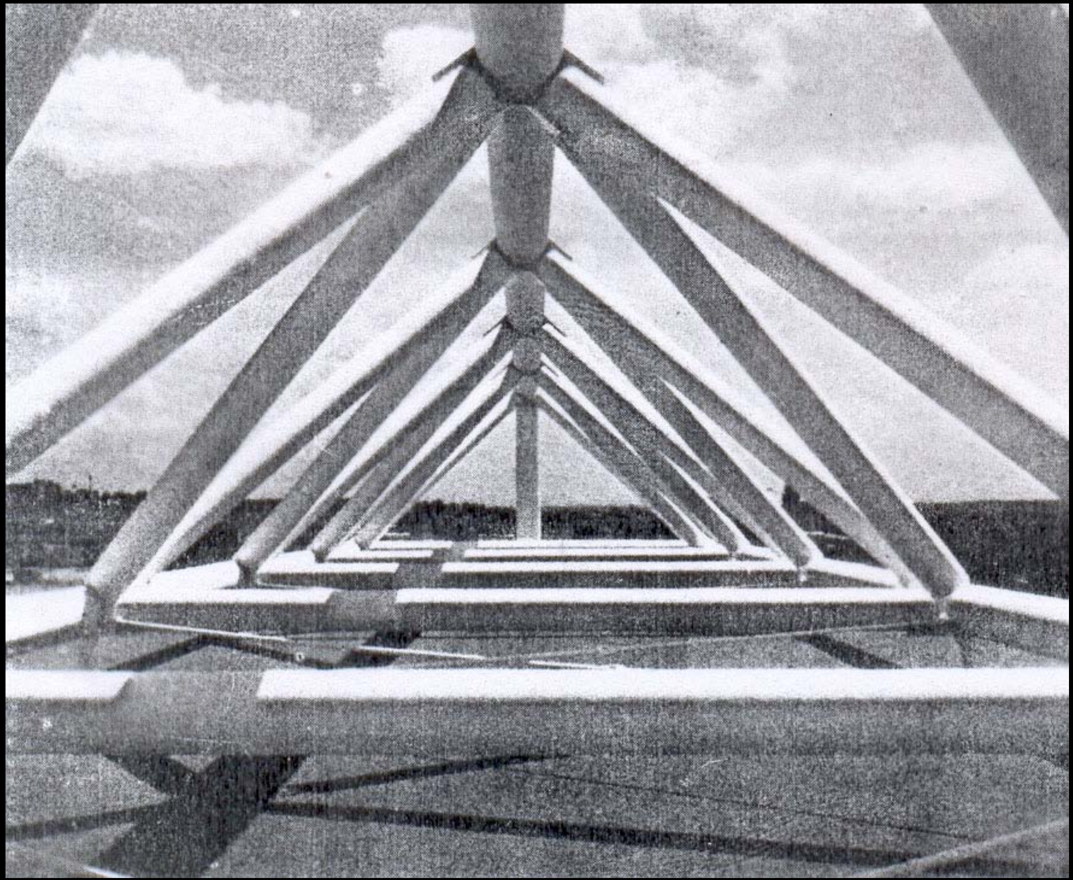
ESTADIO KEMPER EN KANSAS CITY



4.6 Components of the Hanger Assembly

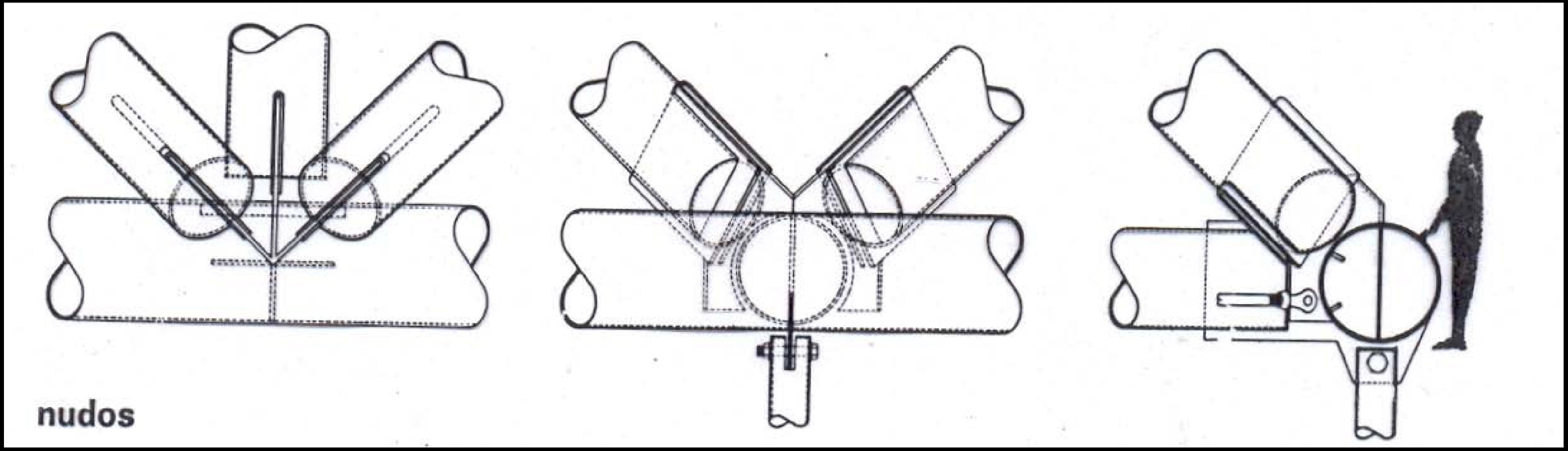


4.7 Hanger Assembly: bent by Lateral Force



Kansas, USA, 1974 – Murphy & Asoc.

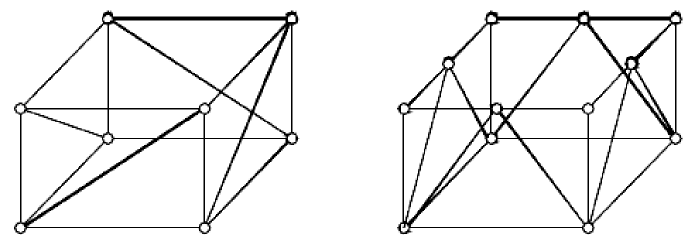
ESTADIO KEMPER EN KANSAS CITY



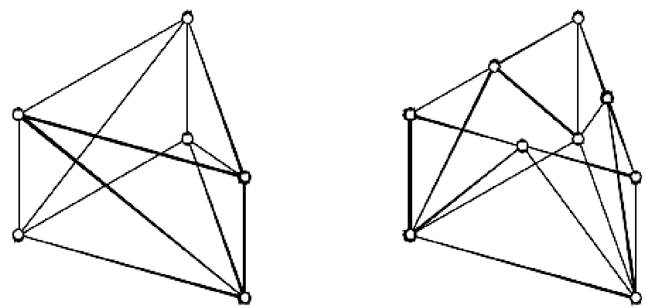
Tubos de acero

- **1200 x 35mm Cordón Superior**
- **900 x 25mm Cordones Inferiores**
- **760 x 16mm Diagonales**

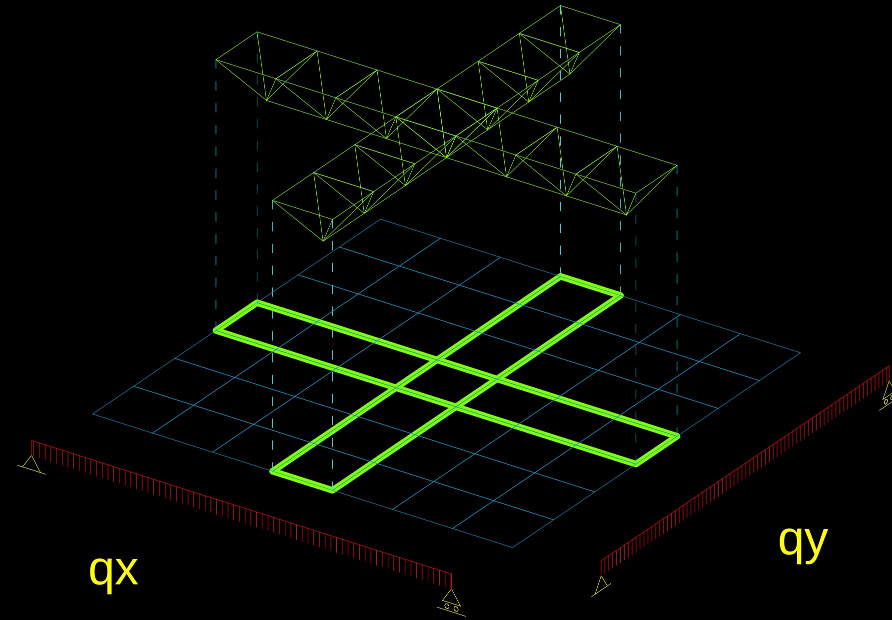
Kansas, USA, 1974 – Murphy & Asoc.

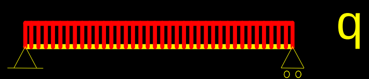


Módulos de prismas rectangulares

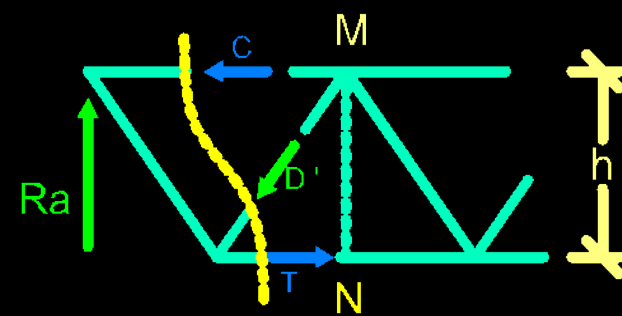


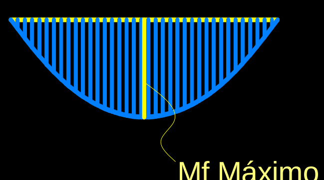
Módulos de prismas triangulares

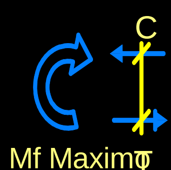


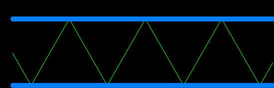


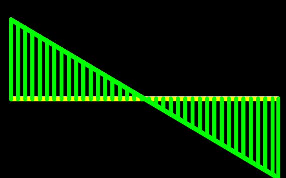
$$T \text{ ó } C = \frac{Mf_{max}}{h}$$

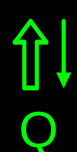


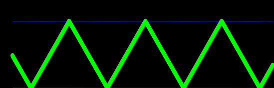




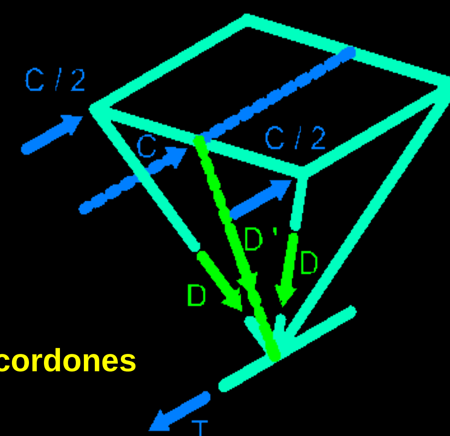






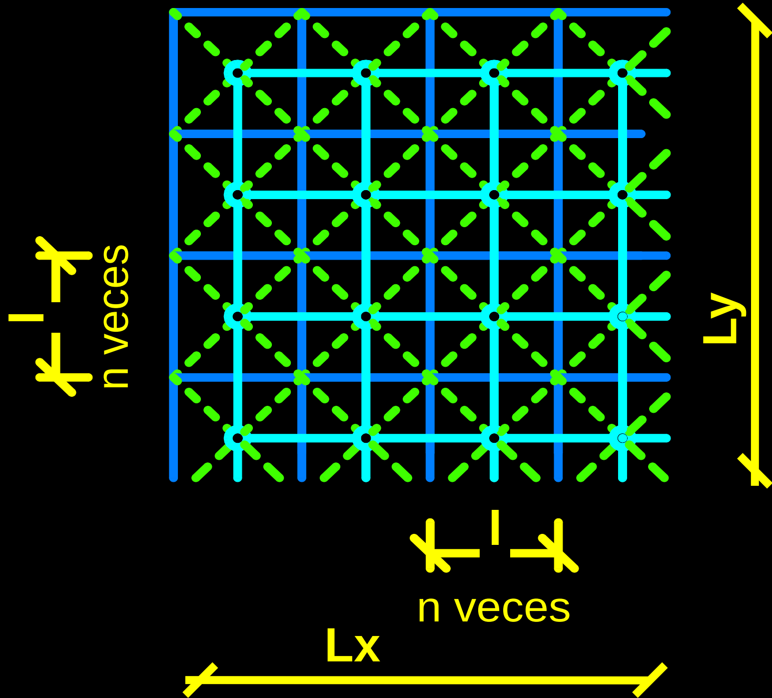


$$D = \frac{Q}{n^{o}} \cdot \frac{L\,i}{h}$$



Esfuerzo en cada uno de los cordones comprimidos es igual a C/2

MALLAS RETICULADAS

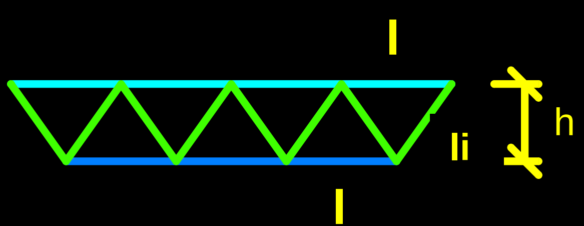


CRITERIOS PARA SU DISEÑO

- **Prefijar h —— 1/25 < h/Lx < 1/15**

Siendo Lx la menor

- **Elegir l**
  - **l ≤ 1.41h**
  - **l submúltiplo de Ly – Lx**



- **Inclinación de Diagonales**

  55° ≤ α ≤ 70°

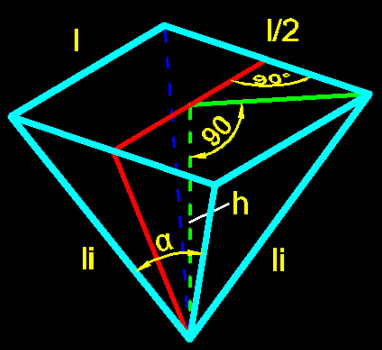
- **Cálculo de la carga q [kg/m2]**
- **Análisis de carga ε= Ly / Lx**

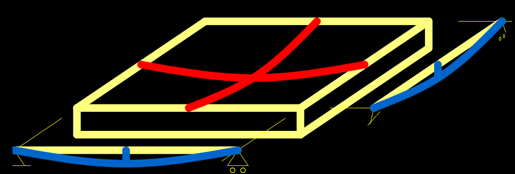
Coef α (de tablas de losas)

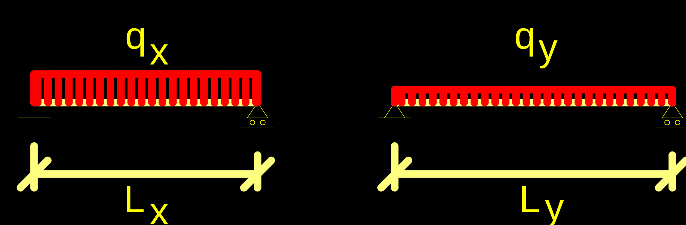
qx = α x q qy = q - qx

qx | para una faja de

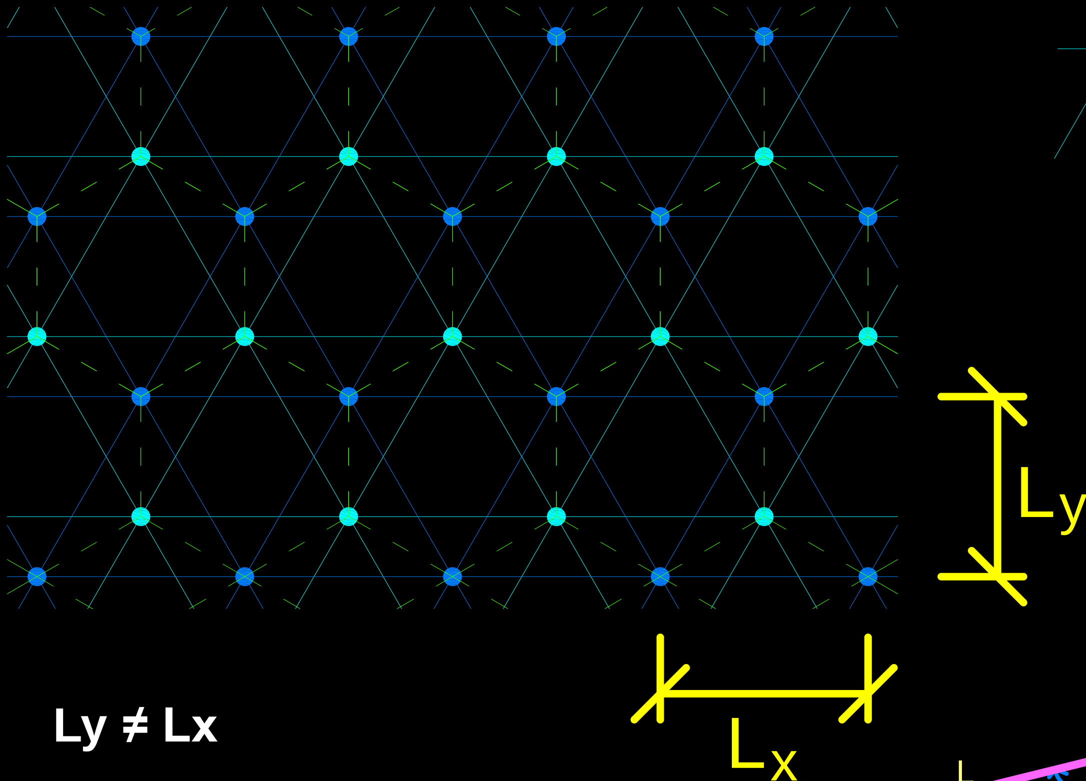
qy | ancho igual a l

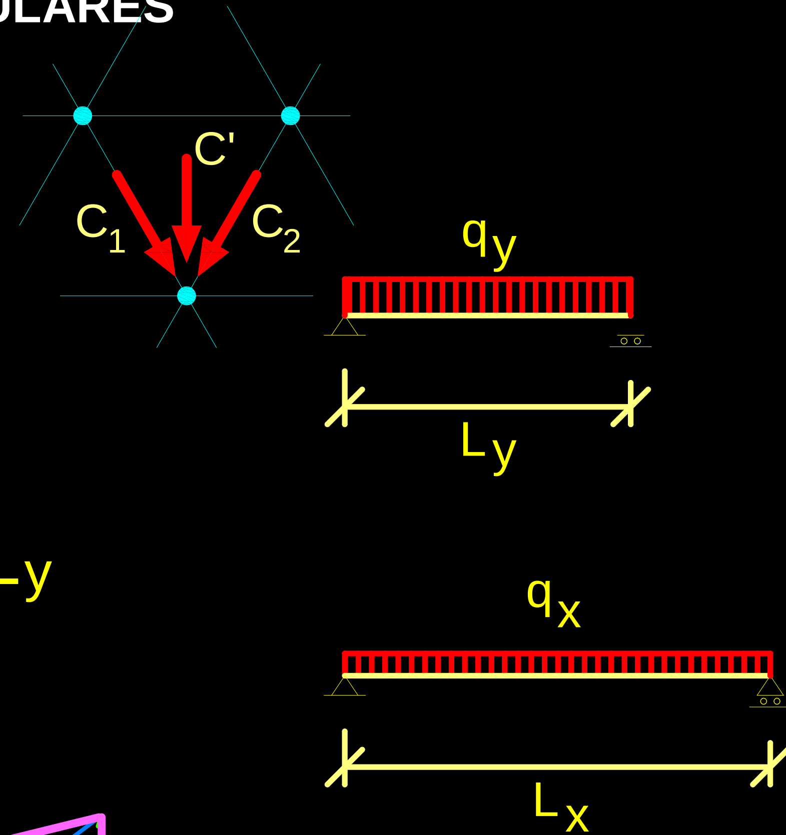






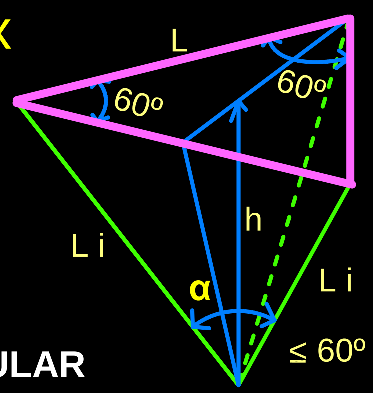
MALLAS TRIANGULARES





Ly ≠ Lx

Ly = Lx . cos 30°



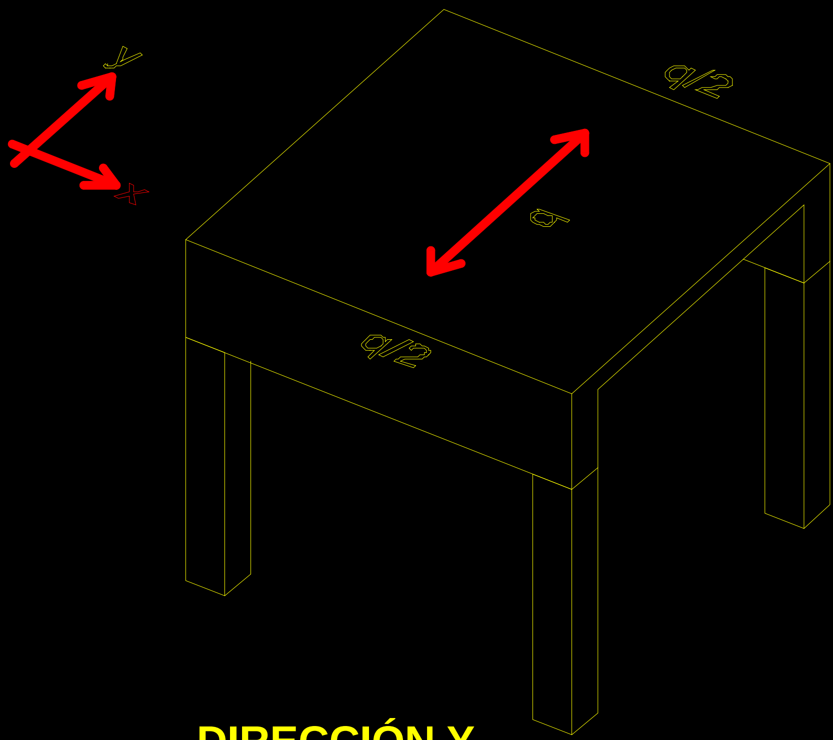
PIRÁMIDE BASE TRIANGULAR

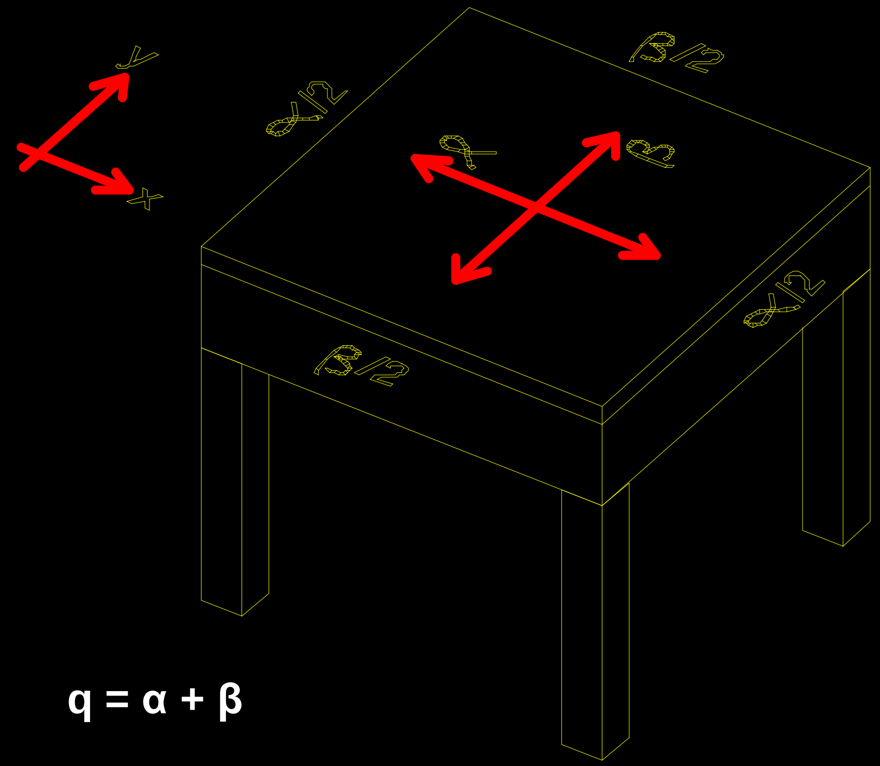
α ≤ 60°

l ≤ 0.821 L

h ≥ 1.22 l

MALLAS CONTINUAS





$q = \alpha + \beta$

DIRECCIÓN Y
losa q

DIRECCIÓN X
viga q/2 + viga q/2

Dirección x

losa: α

Vigas: $\frac{\beta}{2} + \frac{\beta}{2}$

$\alpha + \beta = q$

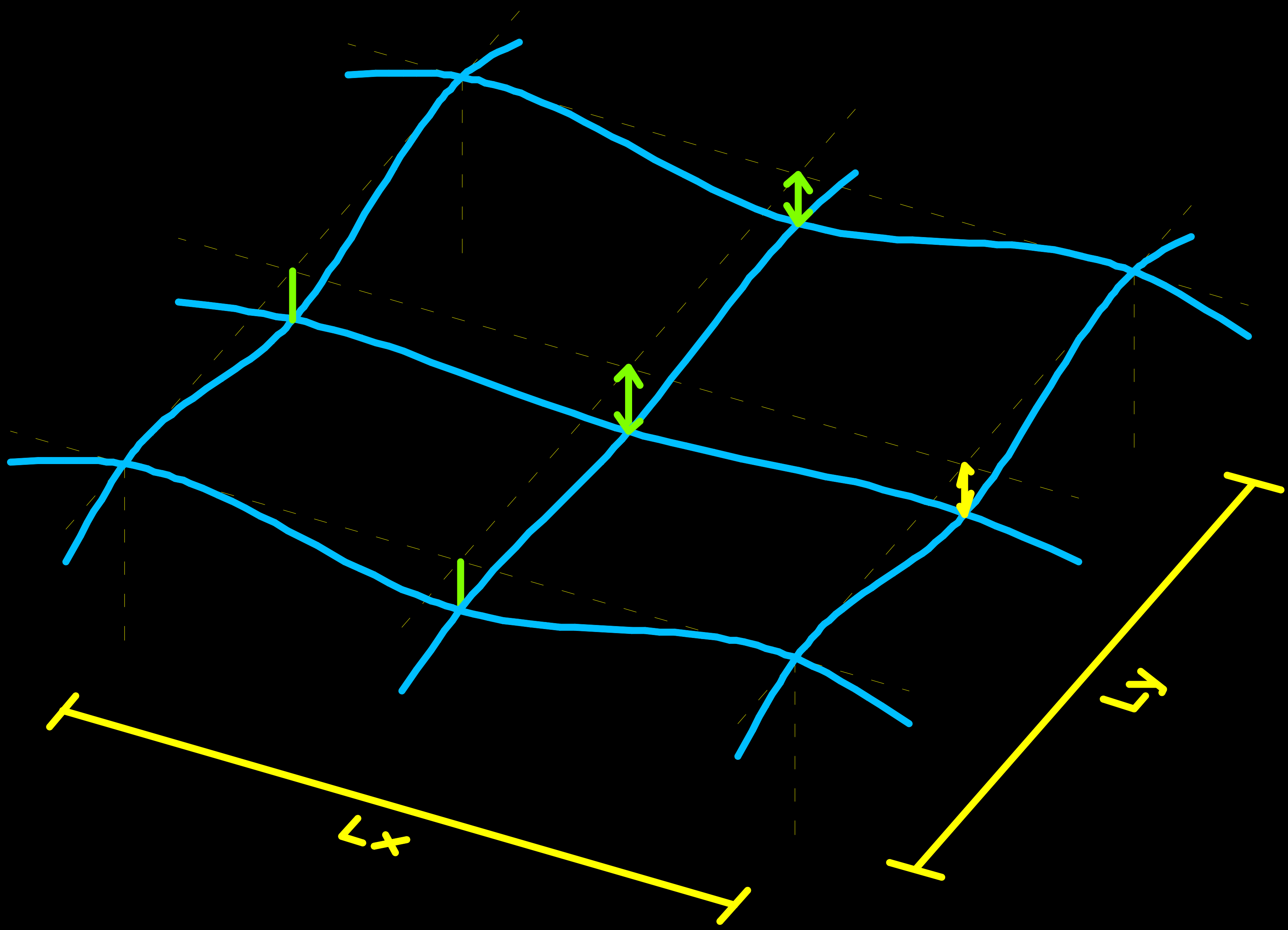
Dirección y

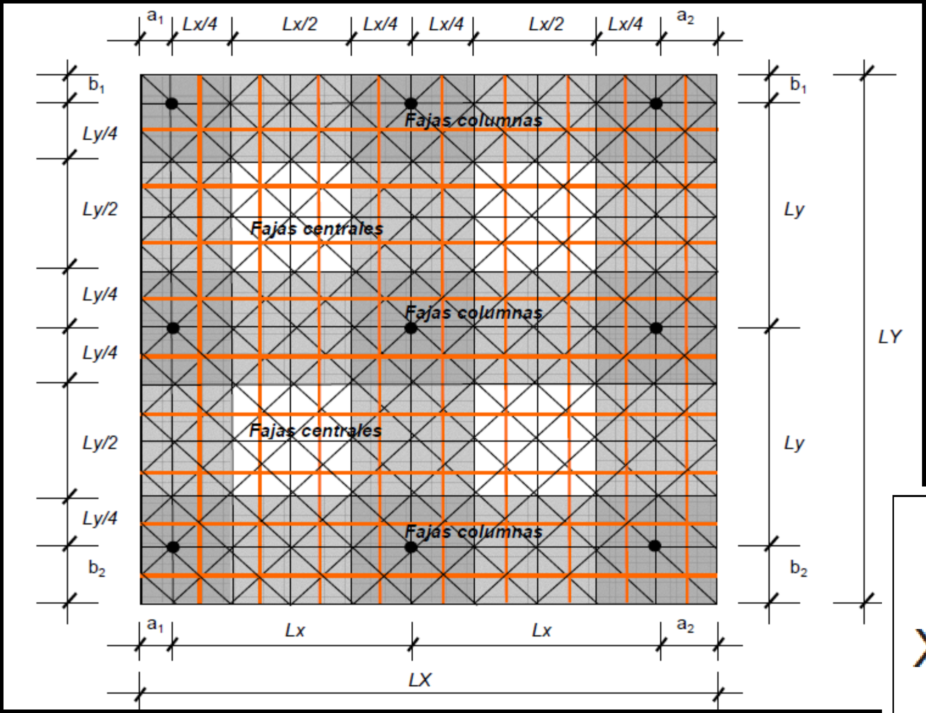
losa: β

Vigas: $\frac{\alpha}{2} + \frac{\alpha}{2}$

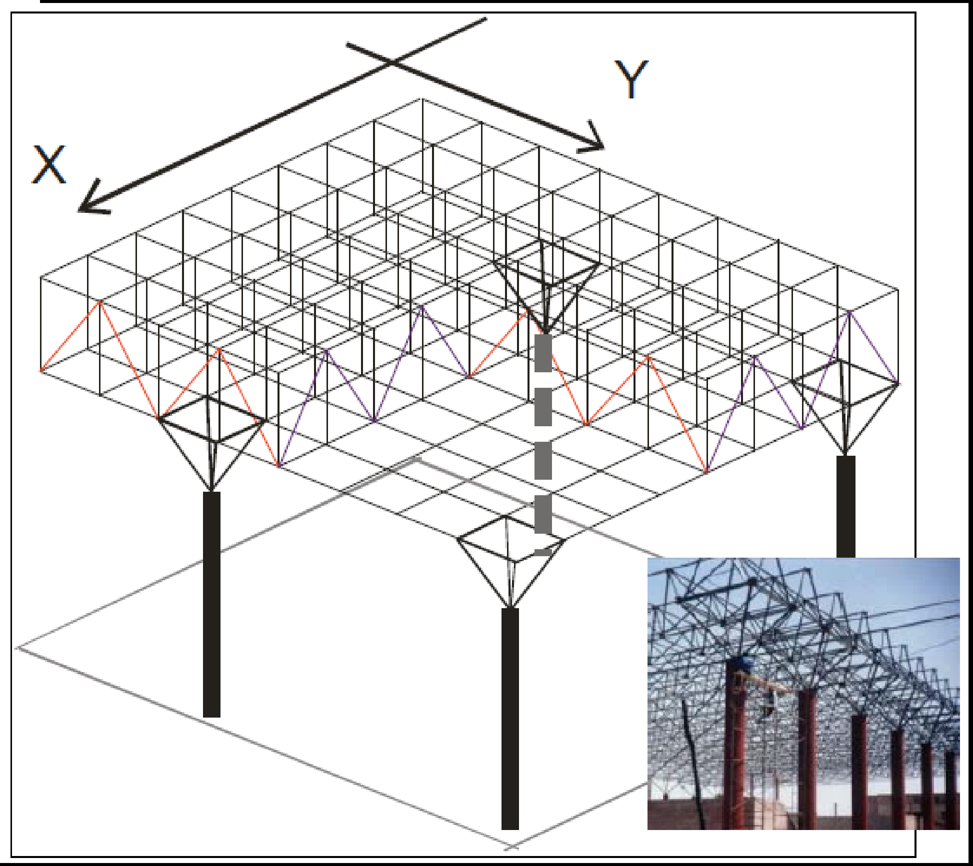
$\beta + \alpha = q$

MALLAS CONTINUAS

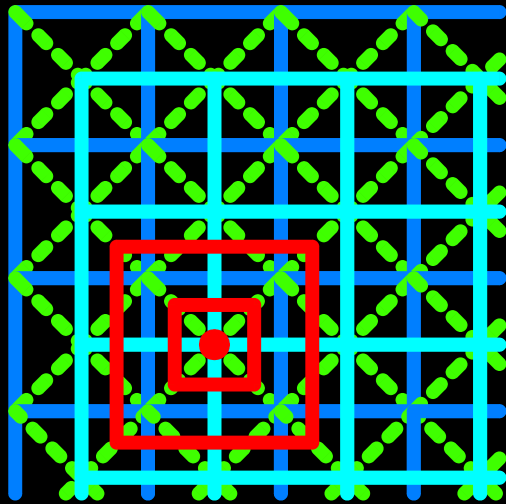


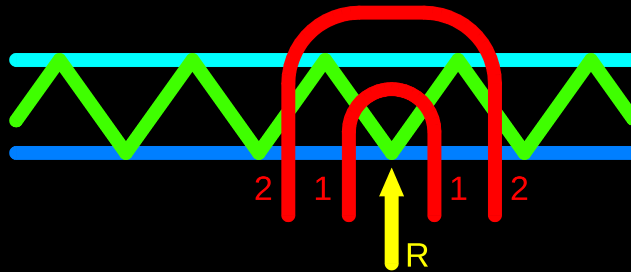


FAJAS DE MAYORES SOLICITACIONES

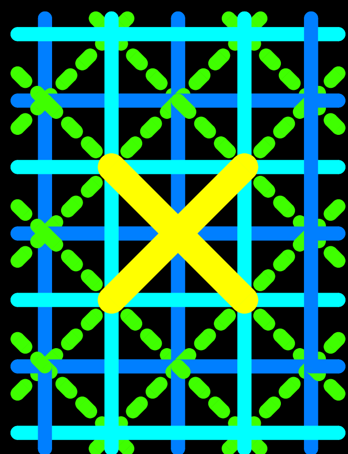


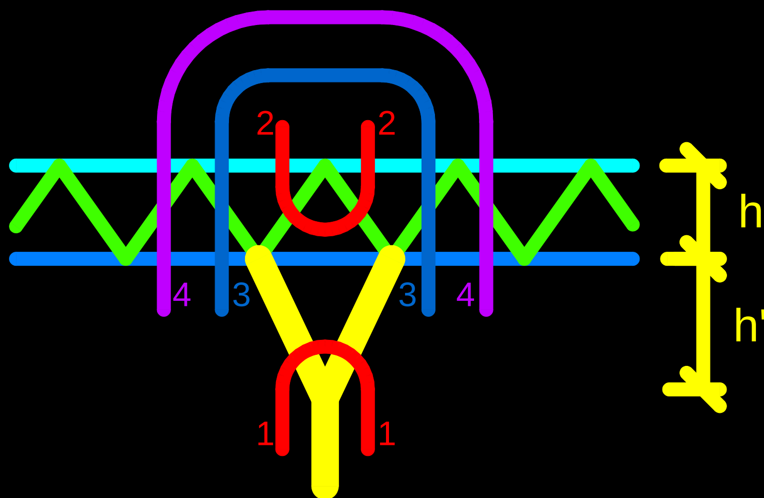
CAPITELES EN APOYOS PUNTUALES





CORTE 1 - 1 = 4 BARRAS
CORTE 2 - 2 = 12 BARRAS

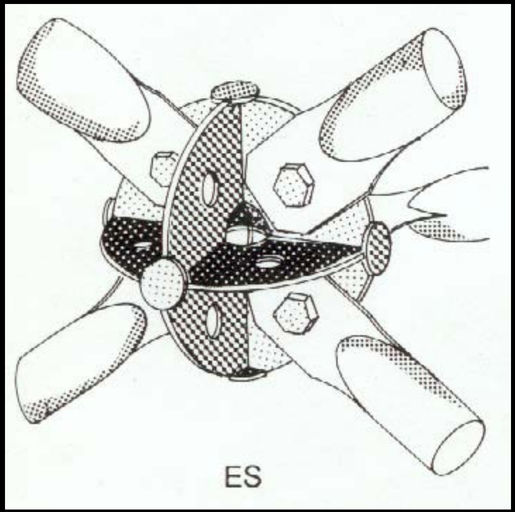


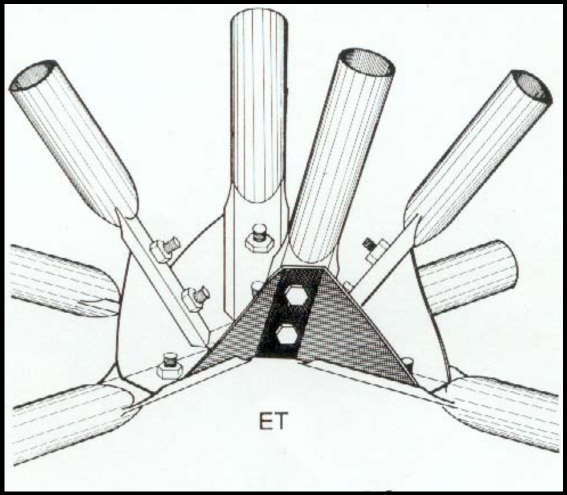


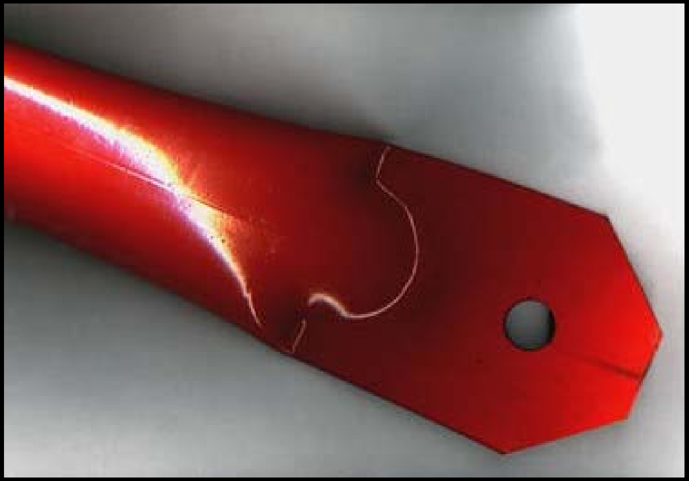
CORTE 1 - 1 = 4 BARRAS
CORTE 2 - 2 = 4 BARRAS
CORTE 3 - 3 = 12 BARRAS
CORTE 4 - 4 = 20 BARRAS

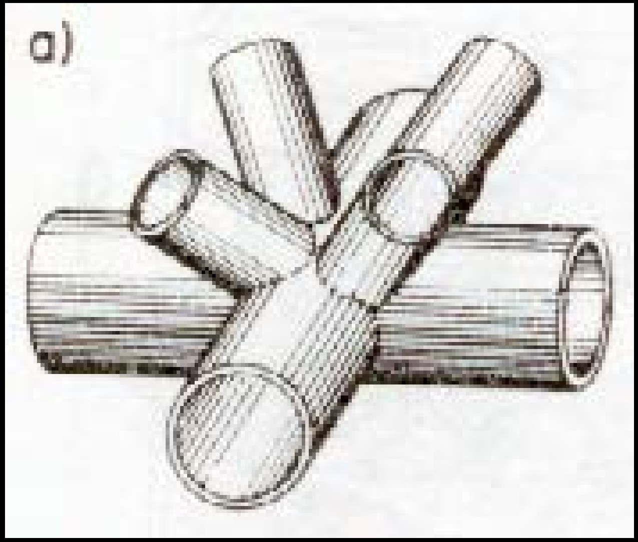
Para lograr una mejor distribución de las solicitaciones se aconseja el uso de capiteles en lo apoyos.

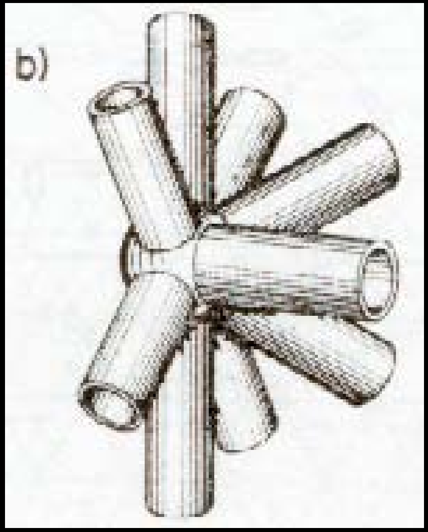
DETALLES DE NUDOS









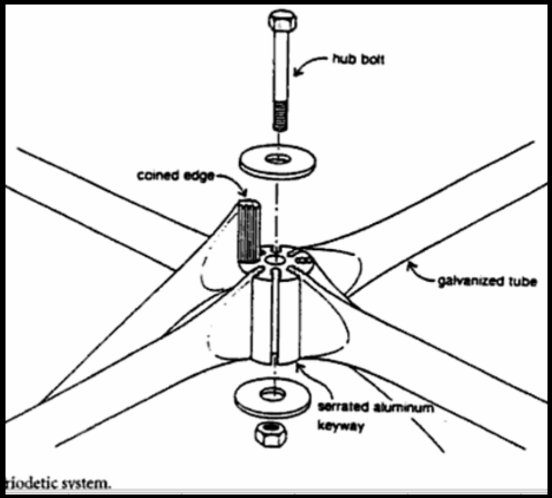


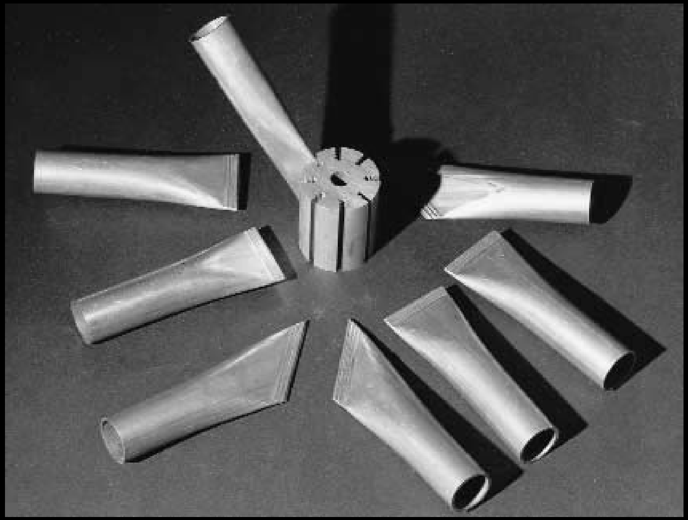
Procedimiento OKTAPLATTE

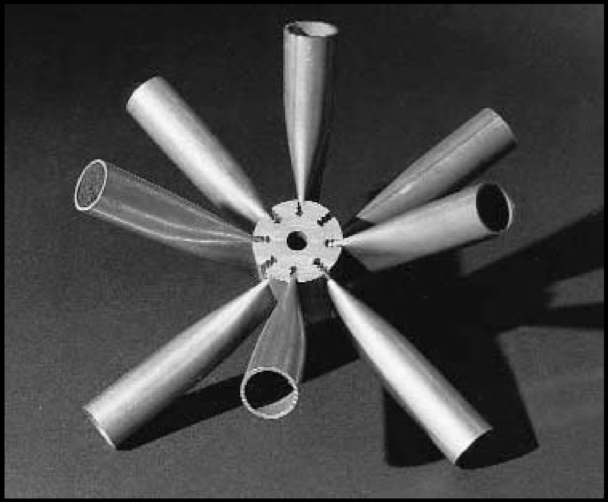
Axonométrica de unión con tubos

DETALLES DE NUDOS

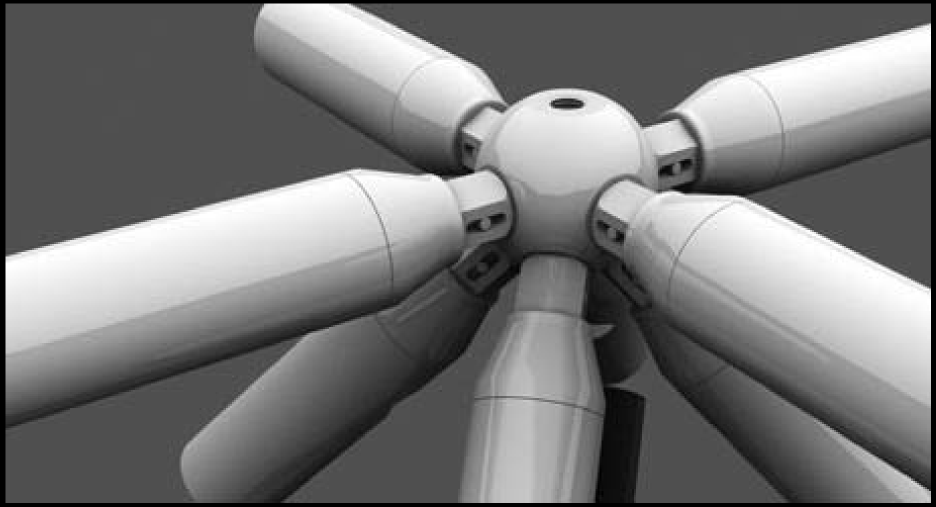
Procedimiento TRIODETIC



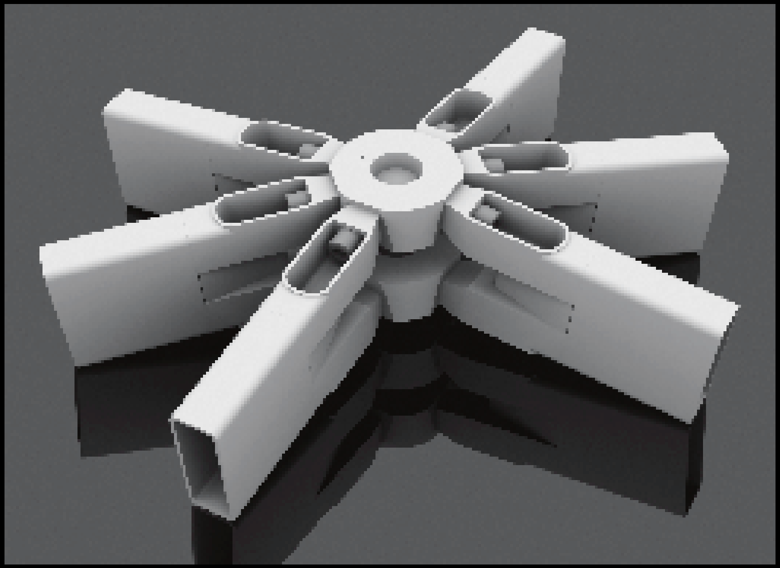




Sistema NOVUM

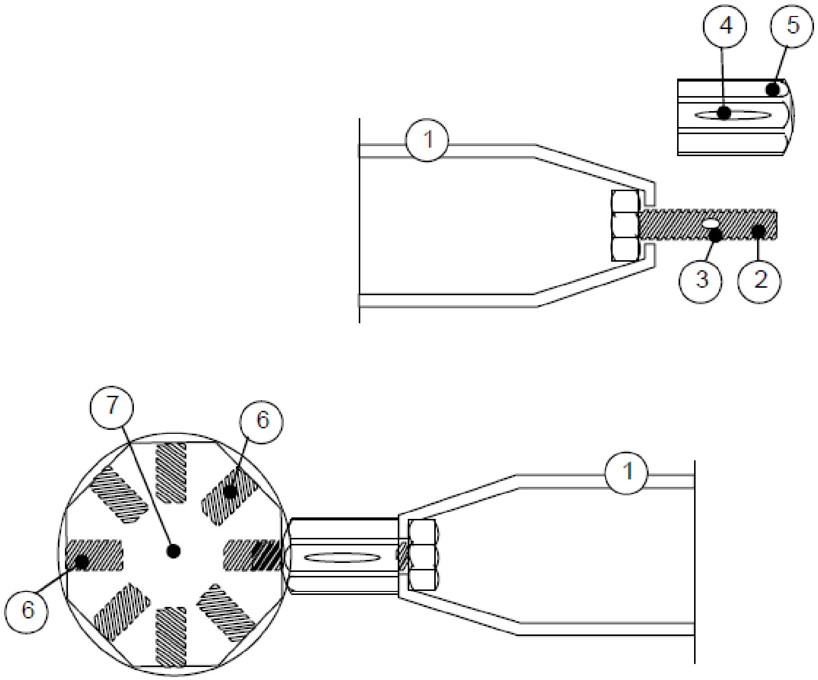


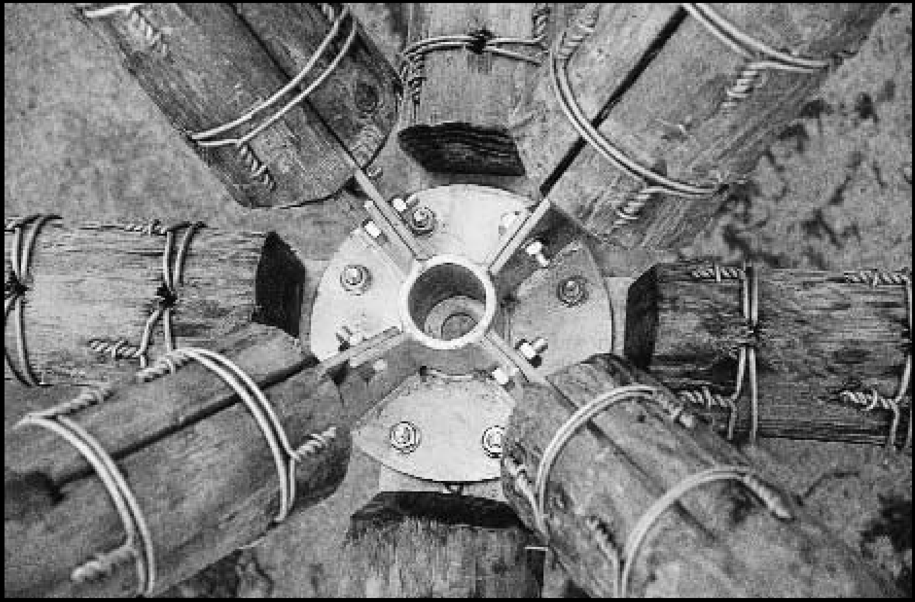
Kugel Knoten (Ball Node)
Conectores esféricos para grillas de doble napa



Free Form.
Conectores para mallas de una napa

sistema Mero, nudo roscado



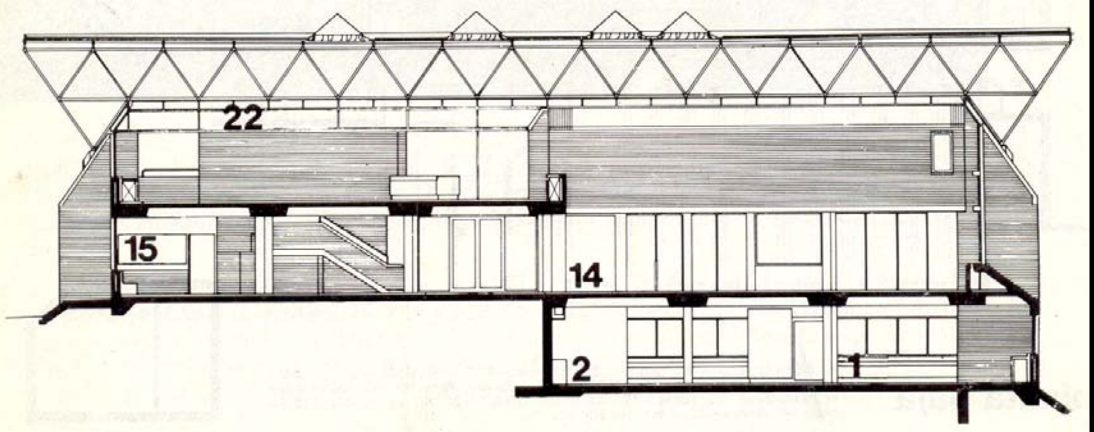


BIBLIOTECA DE MAIDENHEAD

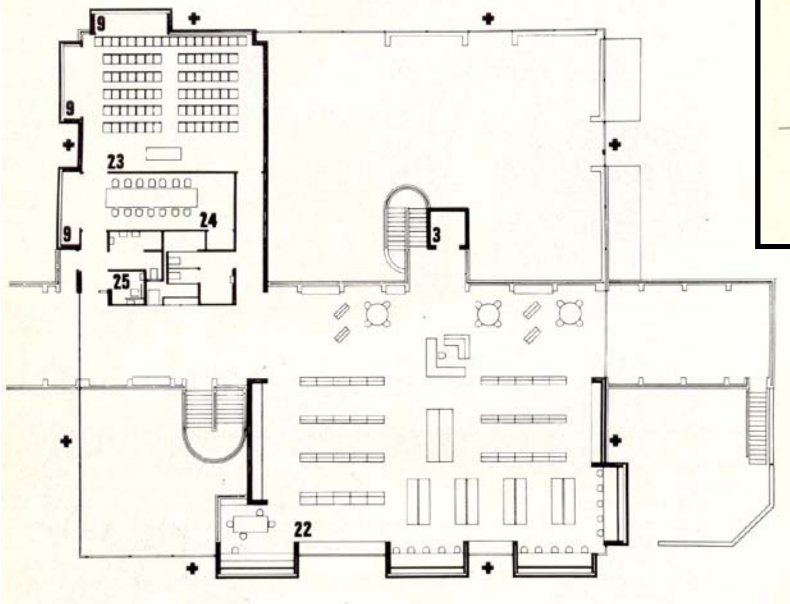
Gran Bretaña - Ahrends Burton & Koralek

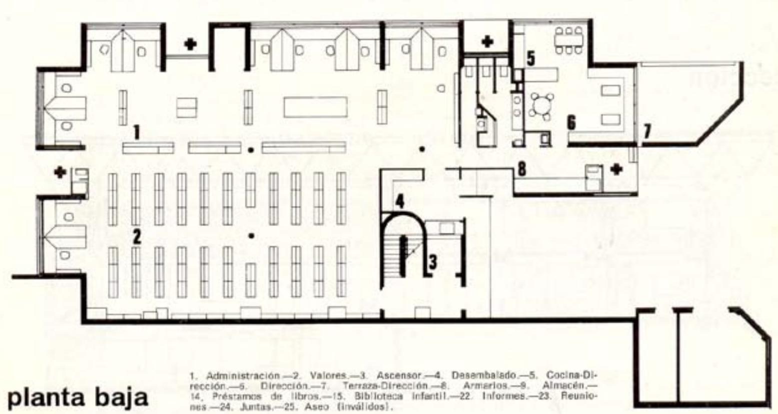
BIBLIOTECA DE MAIDENHEAD

sección



planta primera



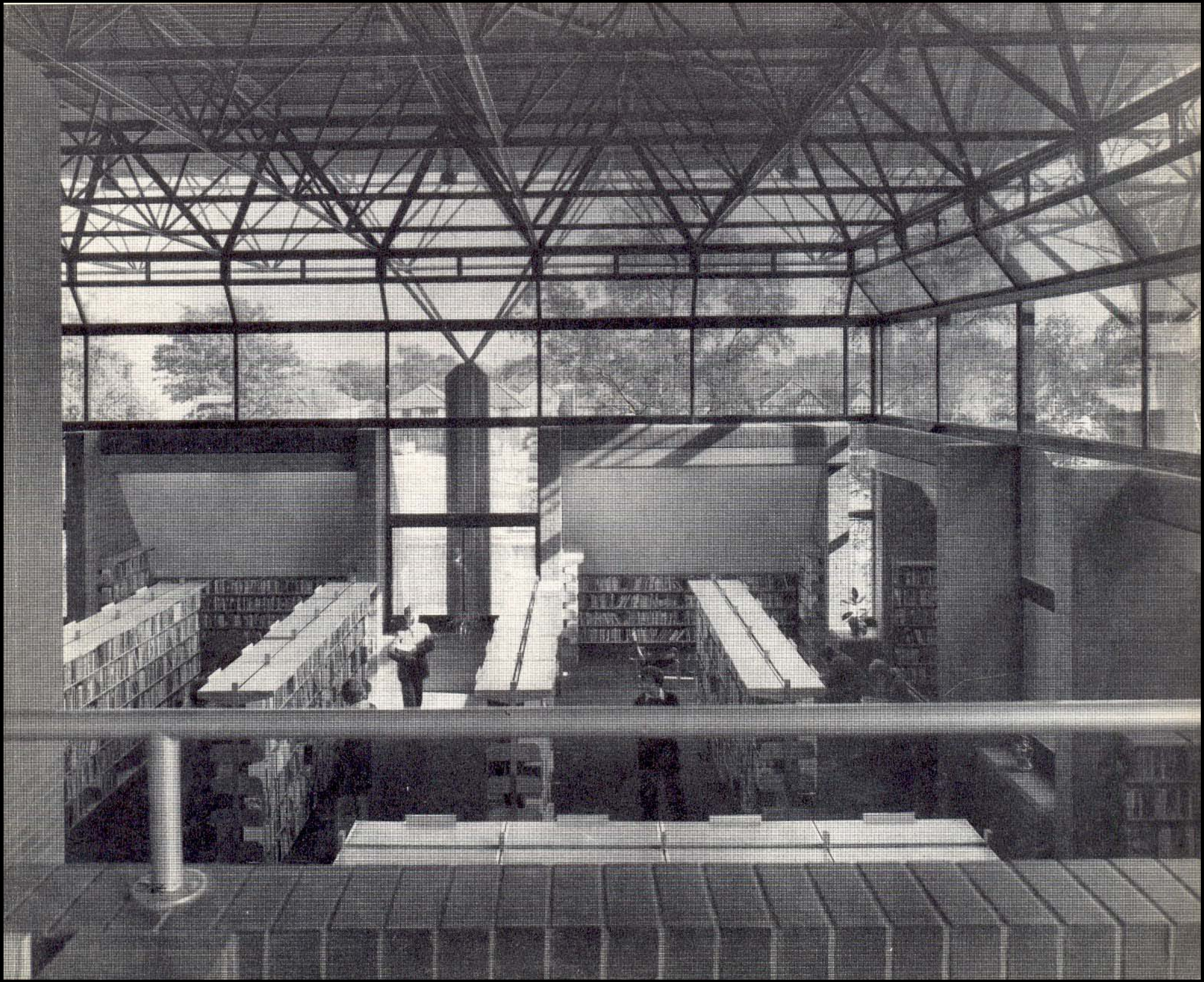


planta baja

1. Administración.—2. Valores.—3. Ascensor.—4. Desembalado.—5. Cocina-Dirección.—6. Dirección.—7. Terraza-Dirección.—8. Armarios.—9. Almacén.—14. Préstamos de libros.—15. Biblioteca infantil.—22. Informes.—23. Reuniones.—24. Juntas.—25. Aseo (inválidos).

Gran Bretaña - Ahrends Burton & Koralek

BIBLIOTECA DE MAIDENHEAD

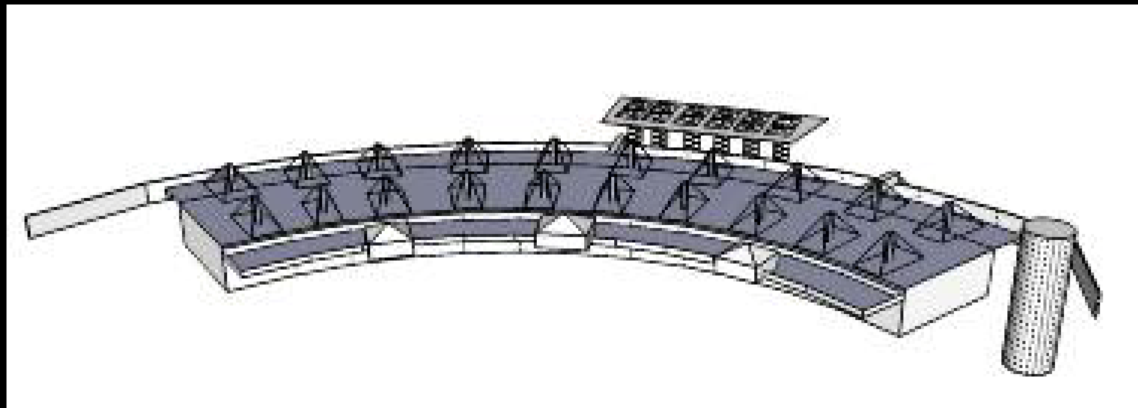


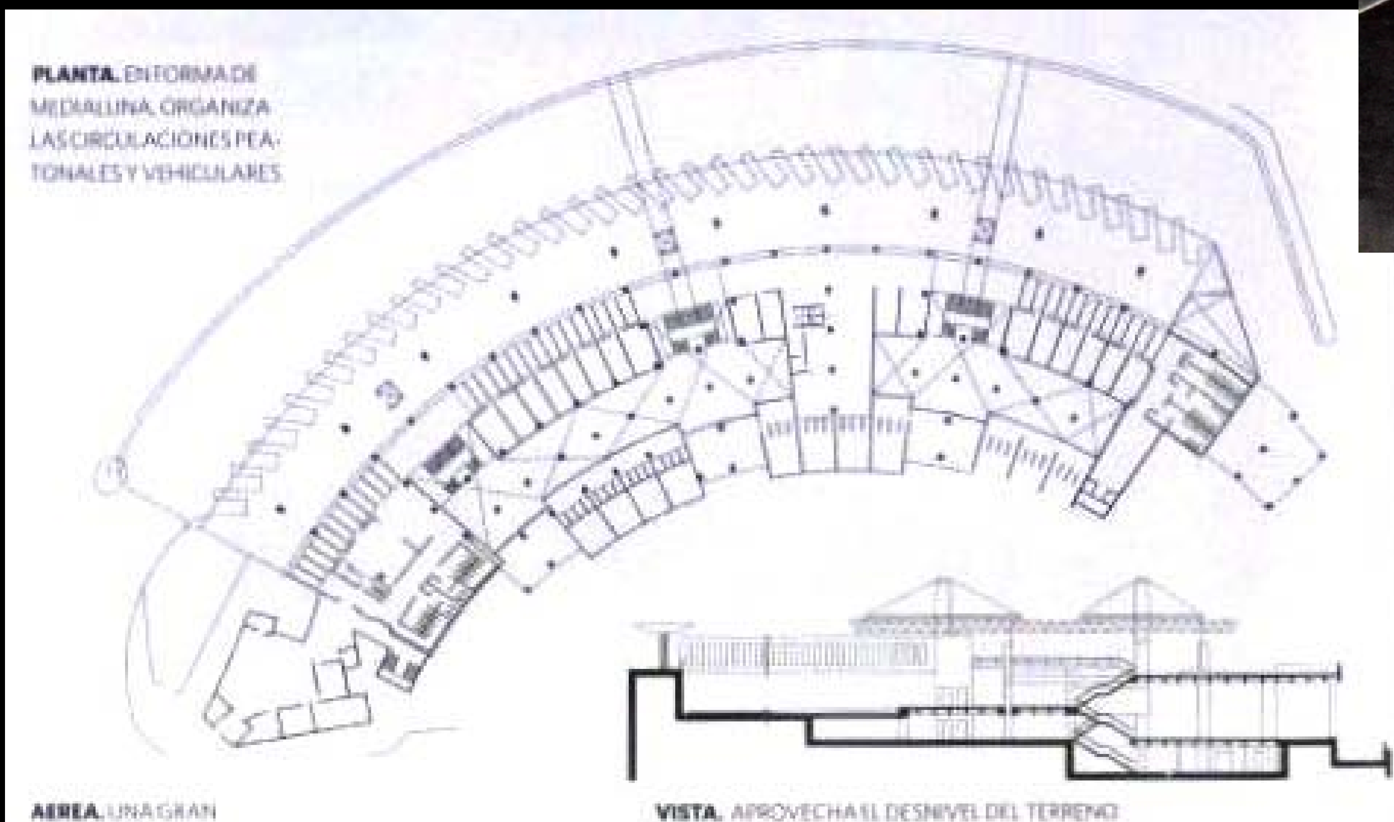
Gran Bretaña - Ahrends Burton & Koralek

ESTACION TERMINAL DE OMNIBUS

Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga

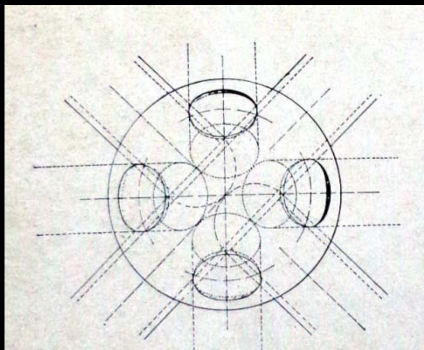
ESTACION TERMINAL DE OMNIBUS

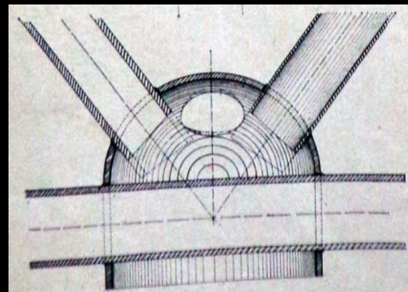




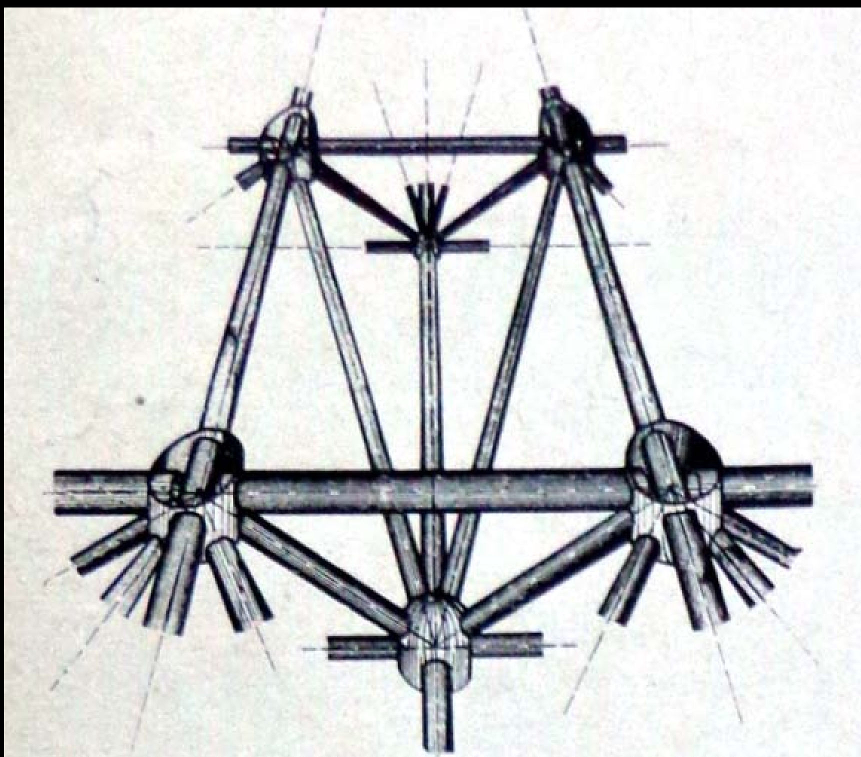
Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga

ESTACION TERMINAL DE OMNIBUS





Planta y corte de un casquete de uniones.



Perspectiva de una pirámide.

Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga

ESTACION TERMINAL DE OMNIBUS

Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga

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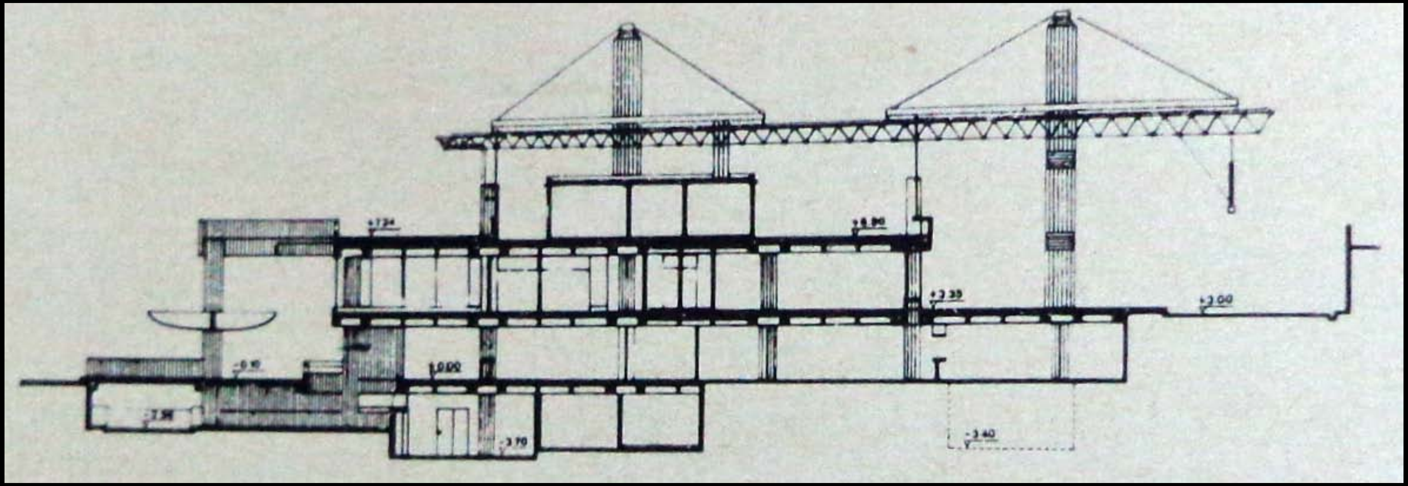
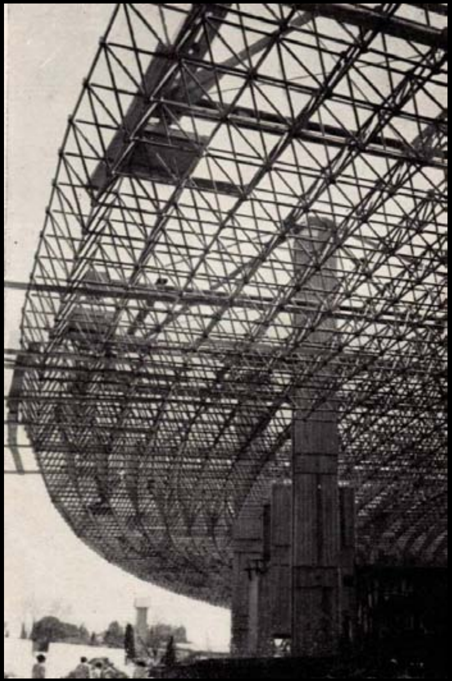
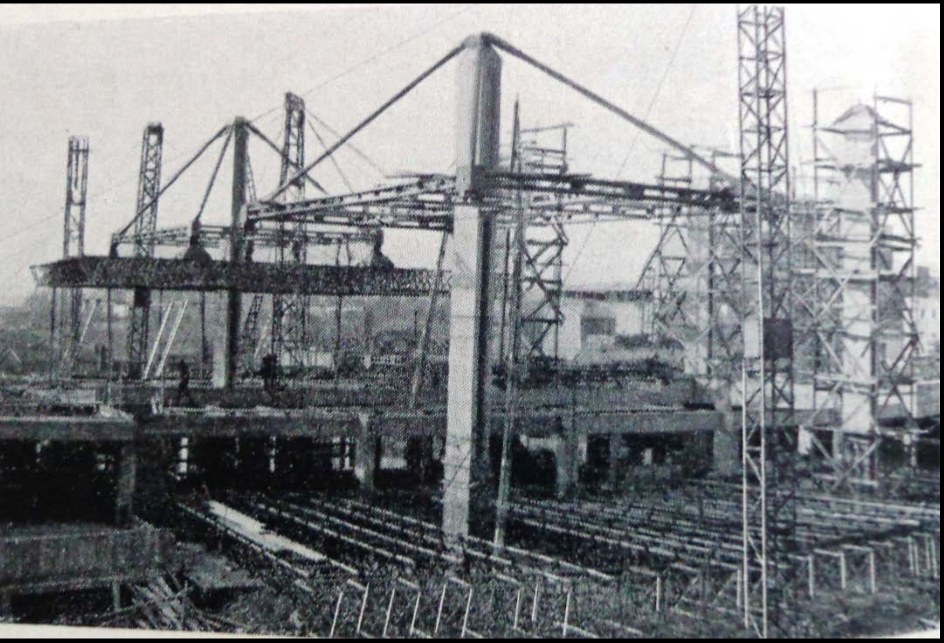
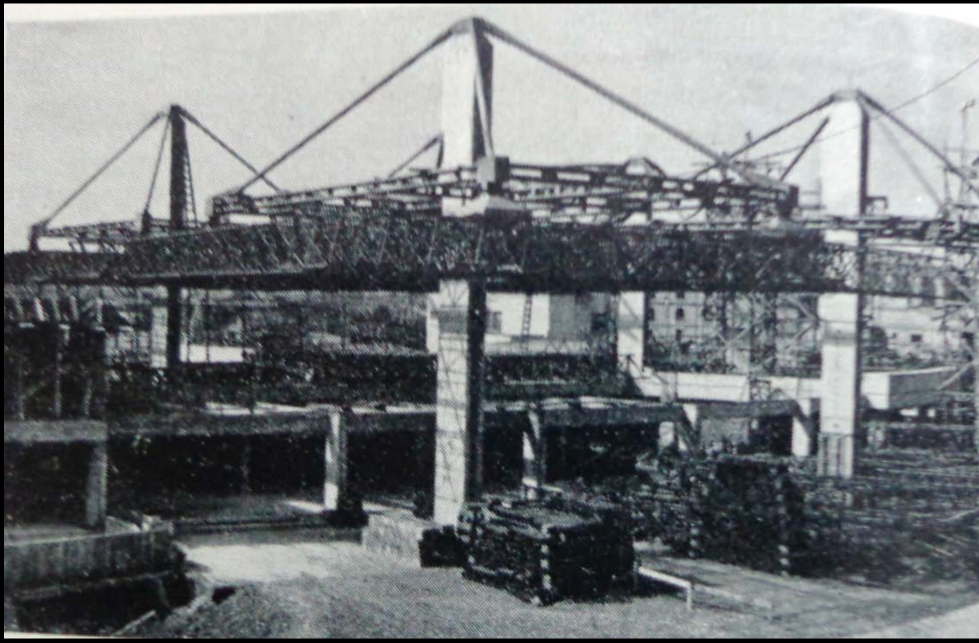




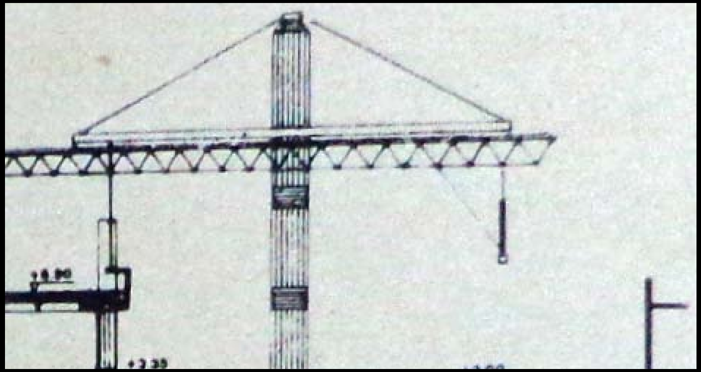


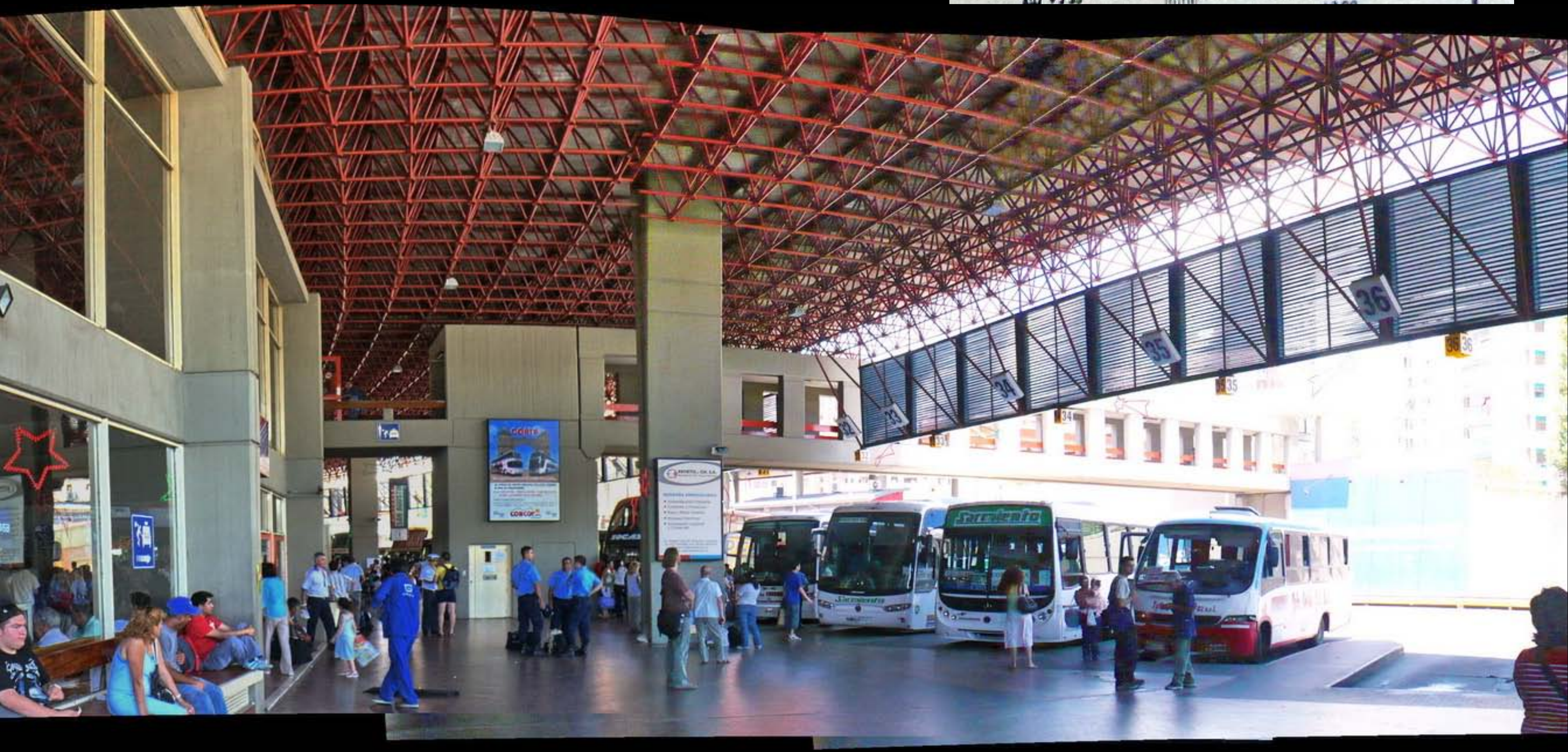


Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga

ESTACION TERMINAL DE OMNIBUS

Estación Terminal de Ómnibus
Autores: J.C. Fontán, L. E. Fandiño, H. R. Egea, G.R. Meriles y T. J. Valle Luque.
Año: 1971
Archivo Fontán & Asociados.





Córdoba, Argentina, 1971 – Fandiño, Fontan, Moyano, Zarazaga





•Se reemplaza el trabajo a flexión por esfuerzos axiales de tracción y compresión en las barras. Una mayor altura en la estructura reticulada aumenta su capacidad resistente a flexión, con economía de material.

•Viga Vierendeel: se suprimen las diagonales y se incrementan las secciones de las montantes para generar nudos indeformables.

•Diferentes posibilidades formales a partir de la geometría de la estructura, la ubicación de los apoyos y disposición de los elementos de cubierta.

•Los Sistemas Reticulados son aplicables a diferentes Tipos Estructurales: Vigas, Pórticos, Arcos, Estructuras Laminares, etc.

•**Reticulados Espaciales:** configuración tridimensional, la sección transversal triangular es la más utilizada.

•Las mallas reticuladas espaciales son una extensión de los reticulados planos en dos direcciones. Están conformadas por módulos repetibles iguales, en general pirámides de base triangular y de base cuadrada.

•Requieren de un diseño especial de elementos de unión, que se complejiza cuando los módulos son diferentes. Existen en el mercado sistemas patentados.

•**Uniones:** chapas nodales, conectores metálicos, nudos especiales , soldaduras, etc… (según el sistema constructivo adoptado)