

MOMENT AND SPECIAL FRAMES

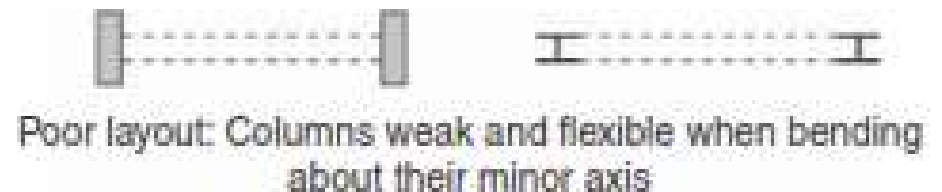
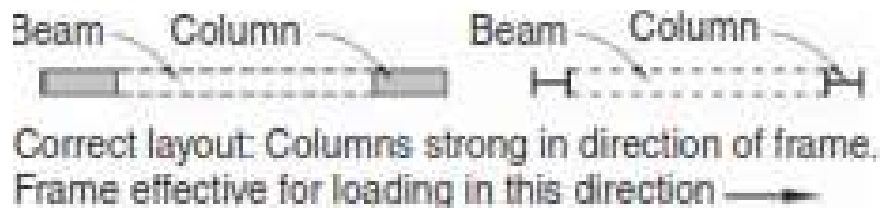
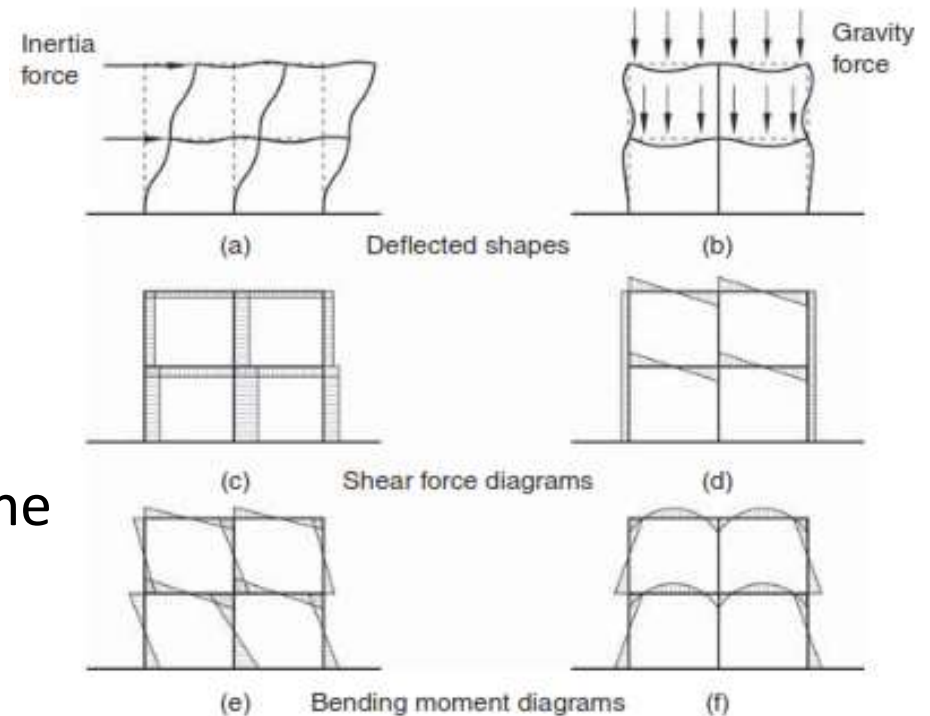
Section 5.3

Moment-Resisting Frame

Moment-resisting frame or "moment frame" transfers force primarily through bending.

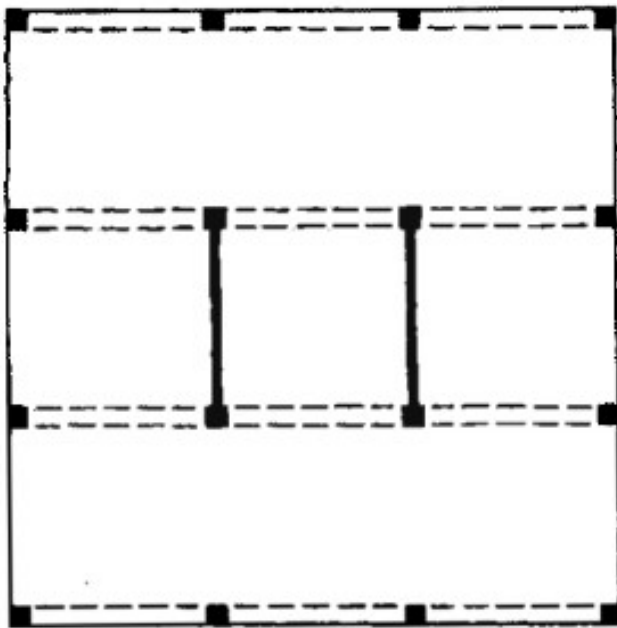
Frame Characteristics

- Large columns and beams dimension shall be expected. The beams and columns may have similar depths.
- The column's long dimension shall be laid parallel to the frame.

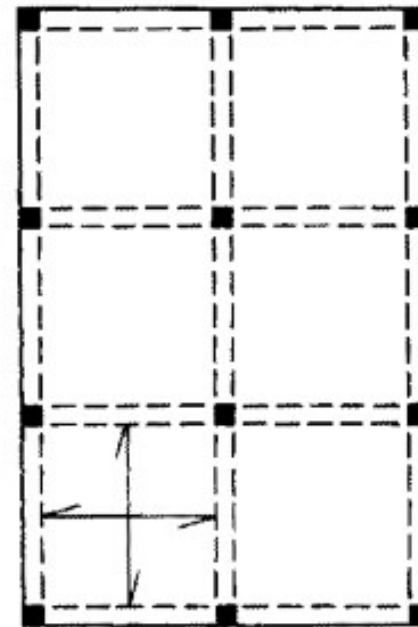


Concrete Frames

- There are two basic types of reinforced concrete frame, the distinguishing feature being whether the floor is a one-way-spanning or a two-way spanning system.



(a)



(b)

Plan arrangements for reinforced concrete beam-column frames.

(a) One-way-span slab spanning between parallel beams.

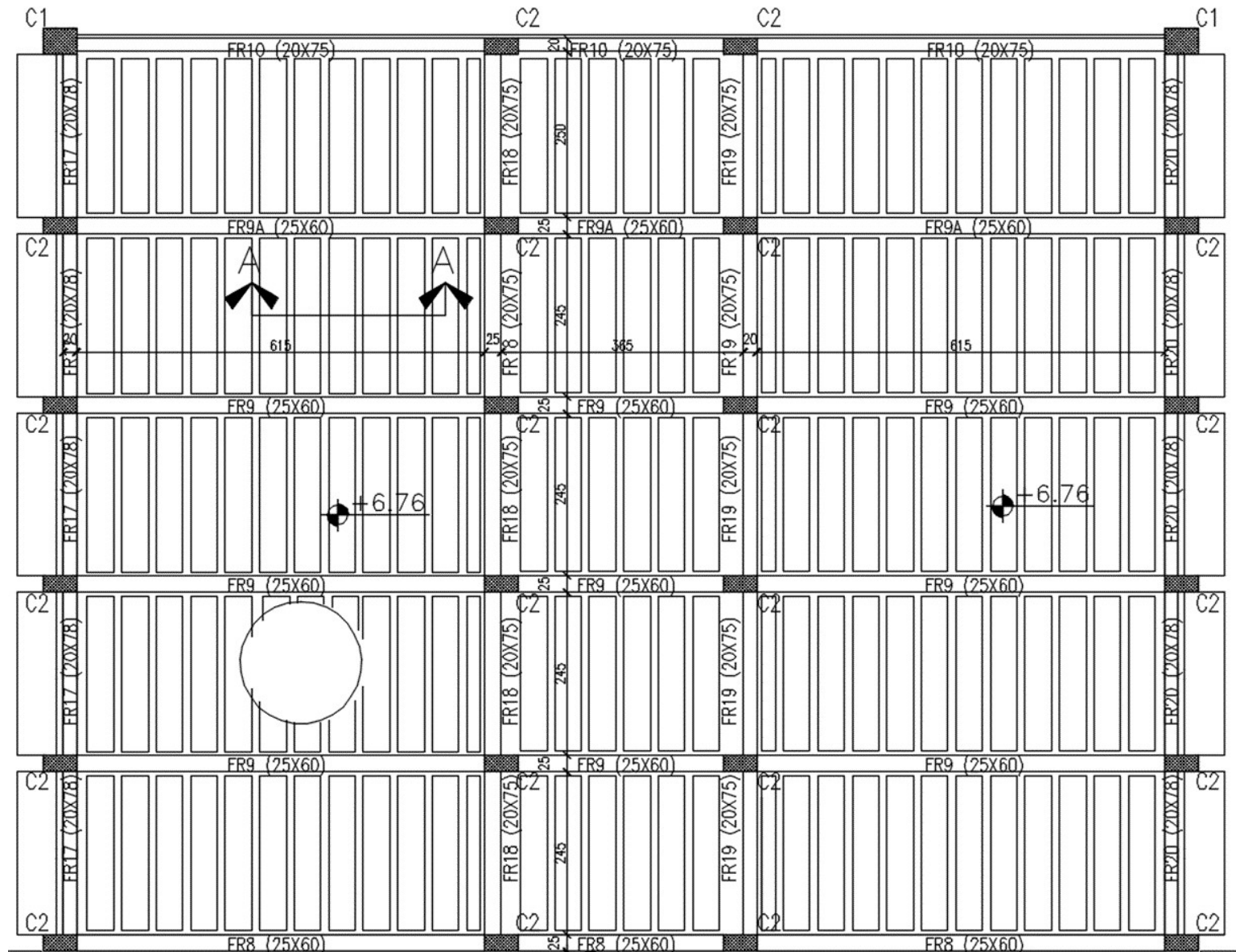
(b) Two-way-span slab on a grid of beams.

Concrete Frame Requirements

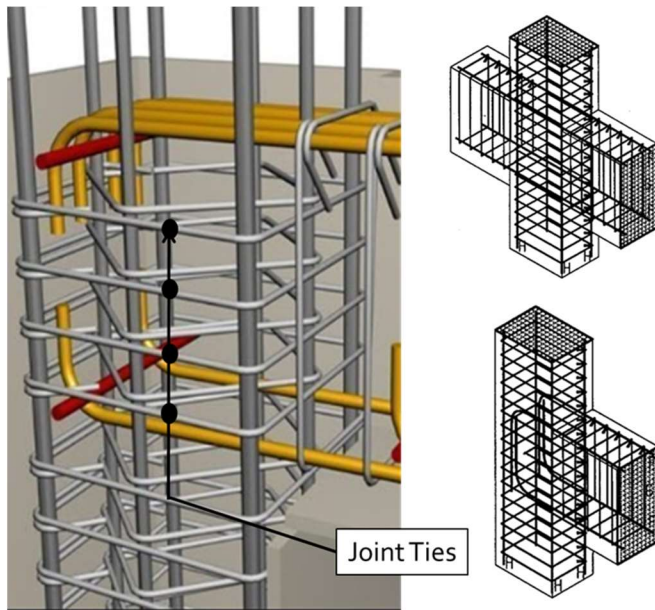
- Framing action shall be clear; columns and beams shall be arranged in straight lines with minimal offsets.
- Beam-column joint shall be rigid; carefully designed to have sufficient capacity to transfer the loads between the frame elements without being failed.
- Beams, columns, and joints need special detailing and shall be constructed under close supervision.



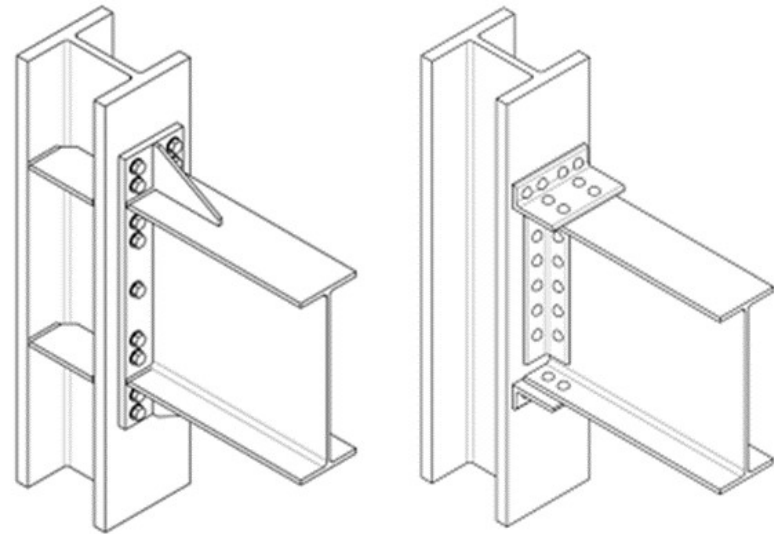
Moment Frame - local project



Joints of Moment Frames



Beam-column joint - Concrete



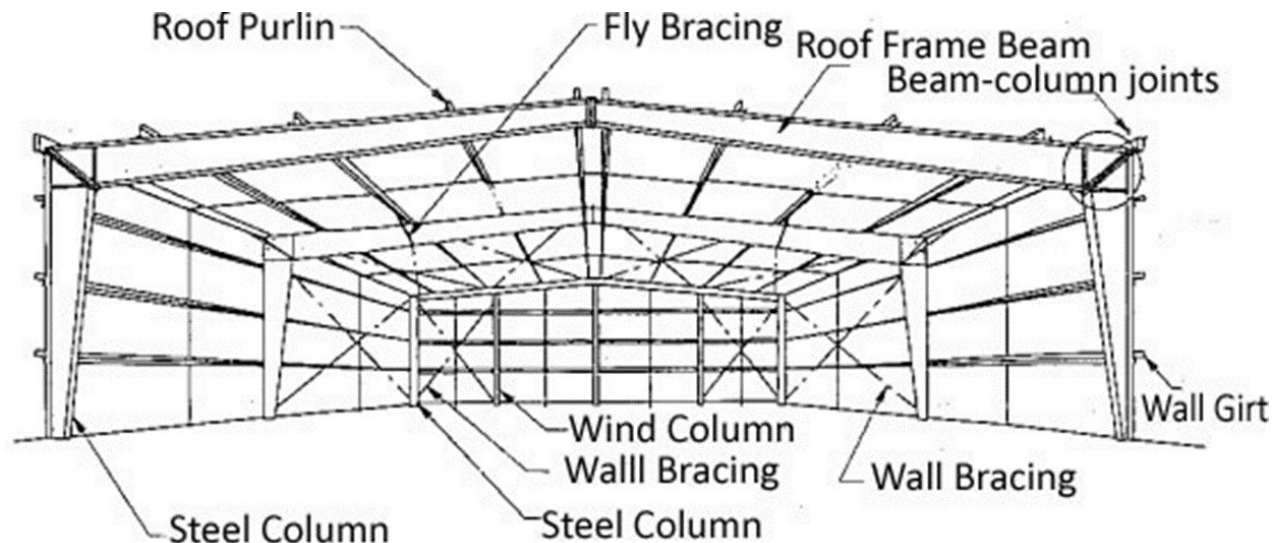
Beam-column joint - Steel

- In moment-resisting frames, beam-column joints must be rigid to effectively transfer axial forces, shear forces, and bending moments between the structural elements.
- These joints require special detailing, are challenging to construct, and necessitate careful supervision and inspection.

Steel Portal Frames

- Portal frames are generally low-rise structures, mostly one story, comprising columns and horizontal or pitched rafters, connected by moment-resisting connections. Resistance to lateral and vertical actions is provided by the rigidity of the connections and the bending stiffness of the members.
- They are very efficient for enclosing large volumes, therefore they are often used for industrial, storage, retail, and commercial applications as well as for agricultural purposes.

Typical Portal Frame Components



Steel Portal Frames

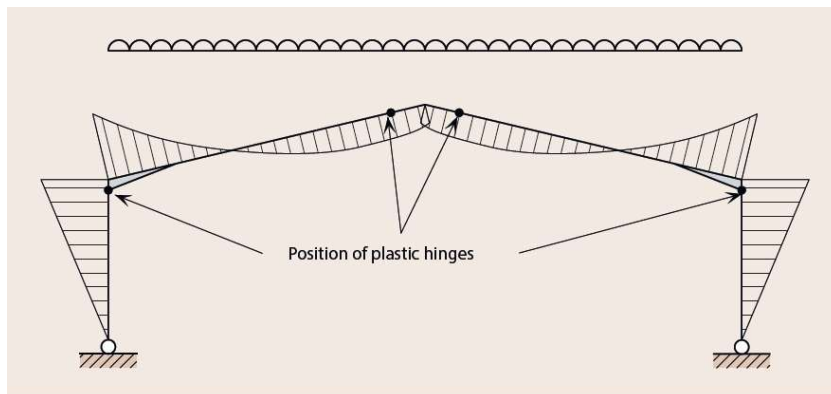
Table 1 Approximate span ranges and element dimensions for steel portal frameworks

Span, L (m)	Spacing, S (m)	Height, H (m)	Main Frame	
			Rafter depth (mm)	Depth at knee (mm)
10	3	6	300	600
15	4	7		
20	5	8	450	800
25	6	9		
30	7	10	550	1050
35	8	11		
40	9	12	600	1200
45	10	13		
50	10	14	700	1350
55	12	15		
60	12	16	750	1600

Steel Portal Frames

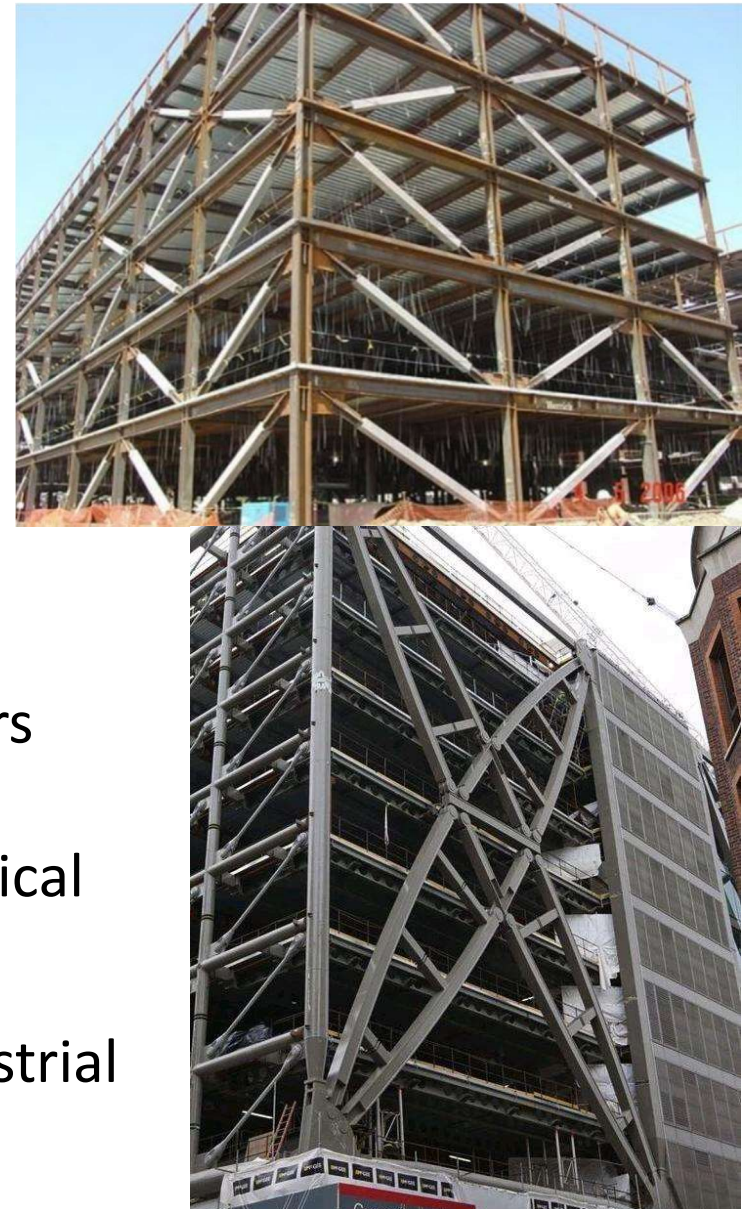
Efficiency of portal frames improved recently through

- The use of built up sections.
- Shaping of the columns and rafters (tapered sections)
- Utilizing form active forms and cellular beam concept.



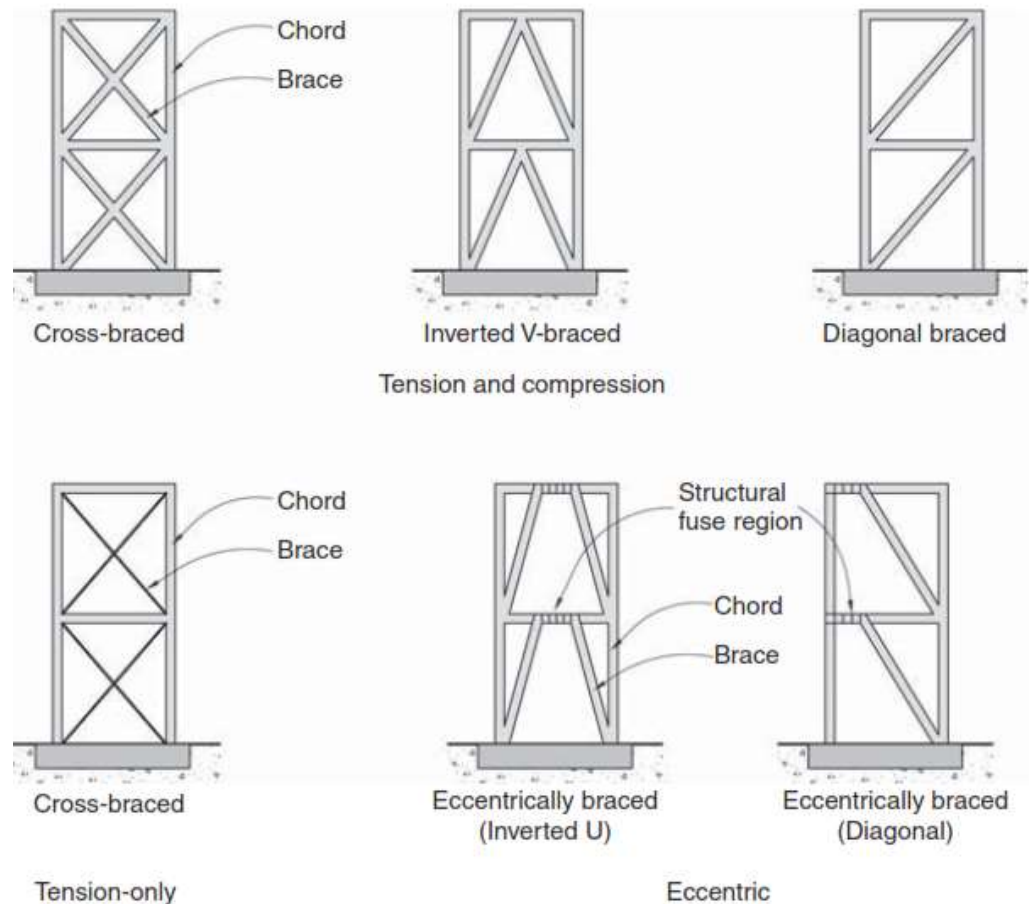
Braced Frames

- Braced frames are essentially pin-jointed structures (a pin connections are used to make beam-column joints & connection).
- Braced frames are effective structural solution for resisting lateral loads due to wind and earthquakes.
- Most of their horizontal load-carrying capability is achieved by their members working in either pure compression or tension. They can be visualized as vertical trusses.
- Usually made of steel; popular in industrial countries where steel is affordable.



Types of braced frames

- There are two general types of braced frames: conventional concentric and eccentric frames.
- In the concentric frame, the center lines of the bracing members meet the horizontal beam at a single point.
- In the eccentric-braced frame, the braces are deliberately designed to meet the beam some distance apart from one another.



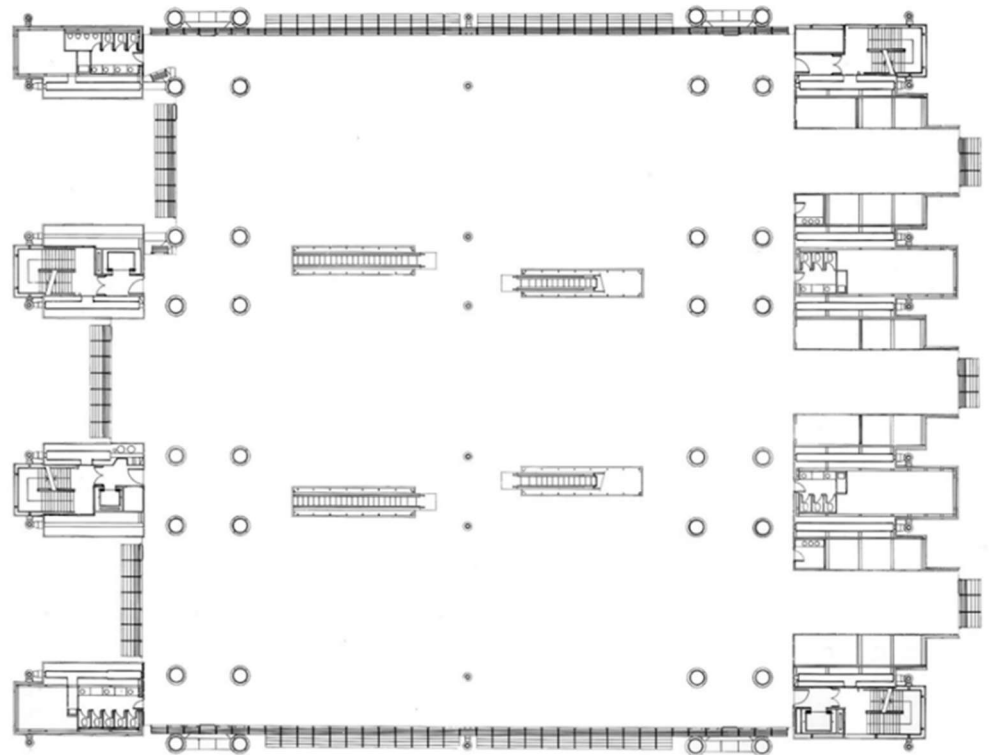
Suspended Frames

The need for a frame that has quite different characteristics does sometimes arise. An example of a special requirement is the situation in which the lowest story of a building must have a different plan geometry from the upper and if there is a requirement to reduce the number of columns in the lowest story. This can be achieved by

- Locating a number of very large girders at first floor level so as to transmit the loads from the columns in the upper stories to a smaller number of columns on the ground floor.
- Suspended frame (see next slides). This has the additional advantage that it reduces the size of the majority of the vertical elements because tension elements have a smaller cross-section than equivalent columns

Hong Kong Bank Headquarter

The floors here are suspended from massive trusses which are supported on a central core. The total volume of the vertical structure is theoretically lower than with the traditional column grid arrangement.

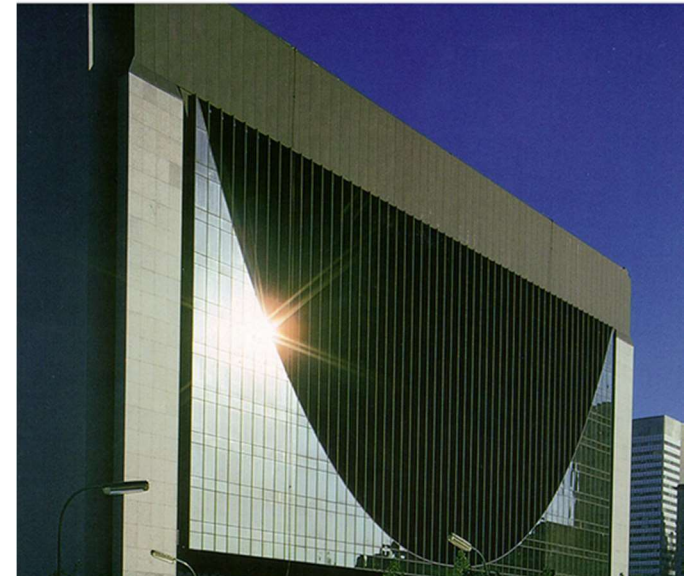


Hong Kong Bank Headquarter

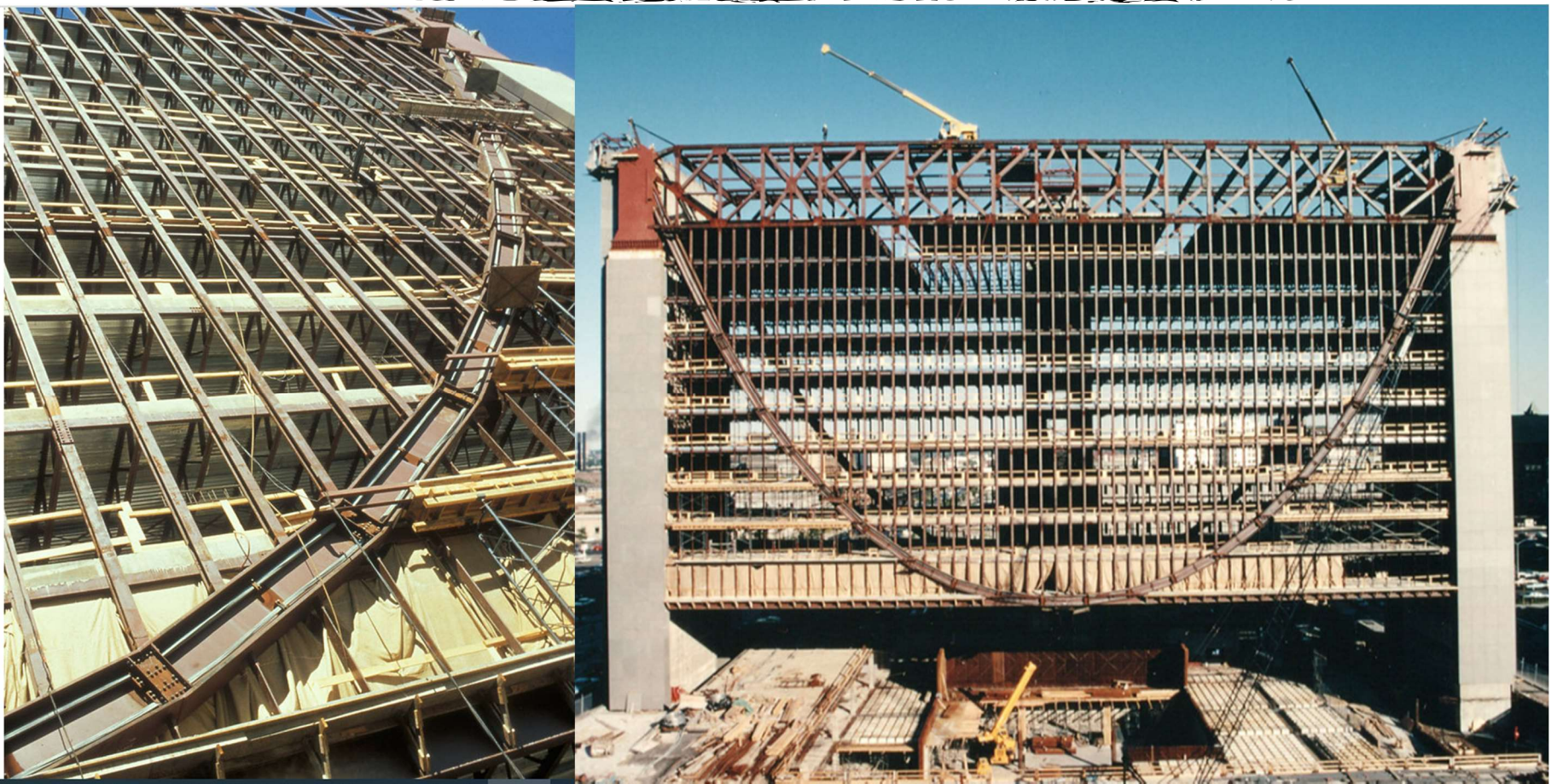


Federal Reserve Bank Minneapolis, MN

- The building features a structure similar to suspension bridges. The floors are suspended from parabolic “cables”. However, the “cables” are actually wide-flange steel sections of parabolic curvature of 37 inches (94 mm) spanning 328 feet (100m) between two concrete towers.
- Trusses on top of the towers resist the lateral thrust of the parabolic suspenders. The floors above the suspenders are supported by compression columns. Those below are suspended by tension hangers



Federal Reserve Bank Minneapolis, MN

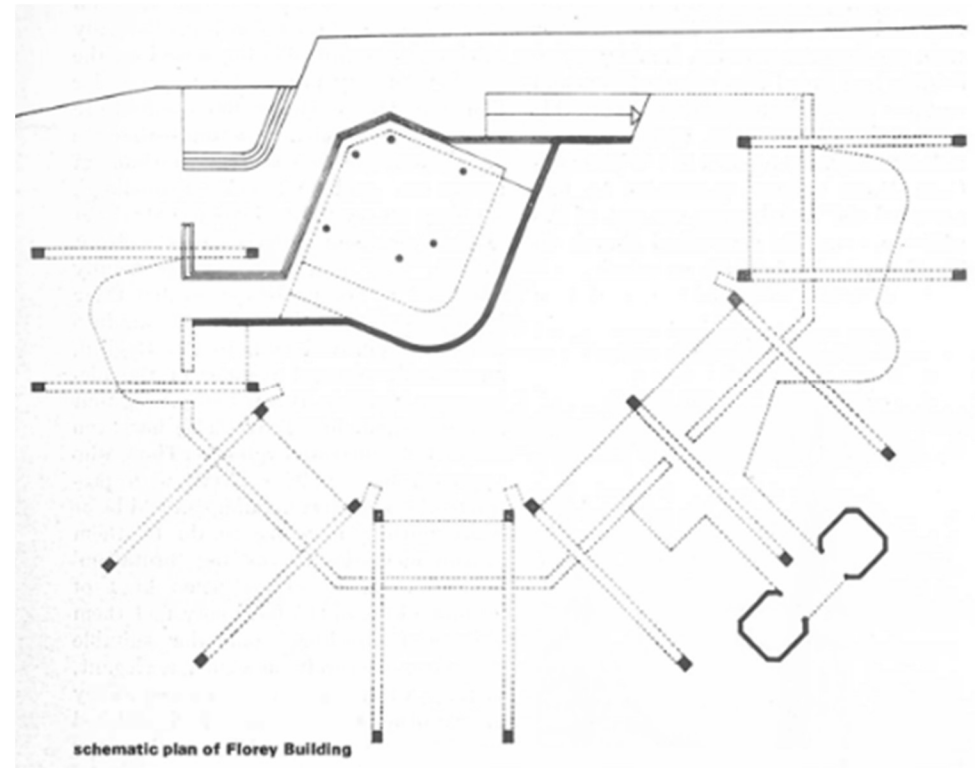


Floor construction of concrete slabs rests on steel trusses that span 60 feet (18m) in width without interior columns.

Frames of complex geometry

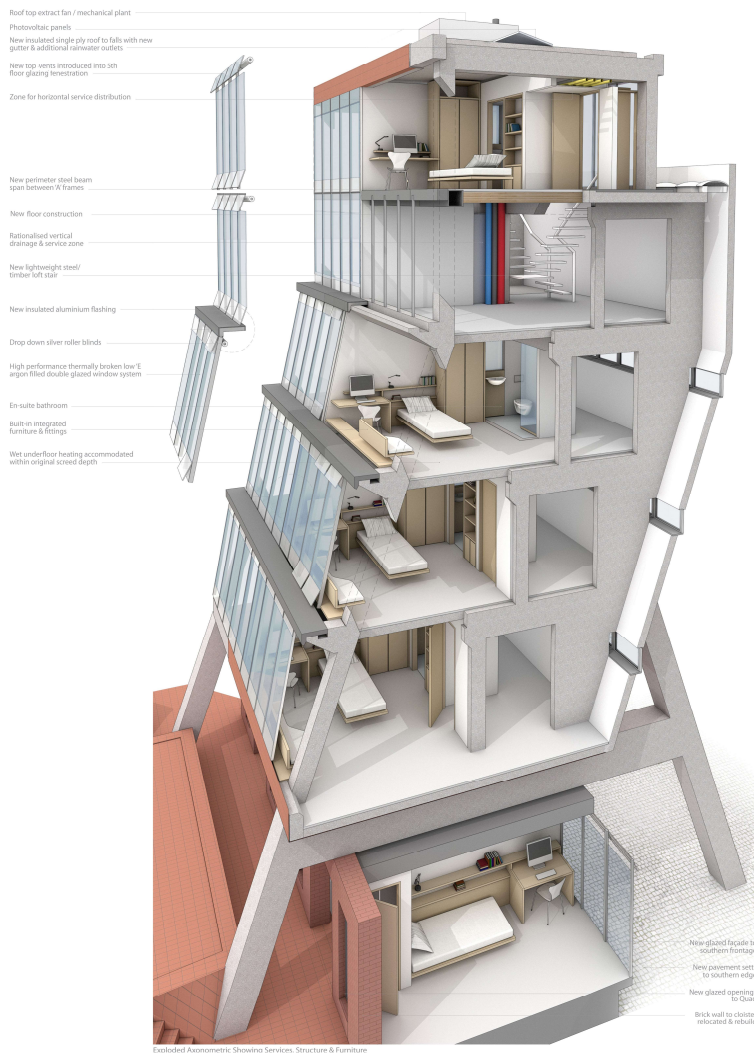
Florey Building - Exford

The structure consisted of 11 irregular A shaped frames placed about 7.25 m and linked by spine beams at each floor. The frames carry a one-way-spanning floor system. a complex form has been achieved by the straightforward adaptation of a basic structural arrangement .



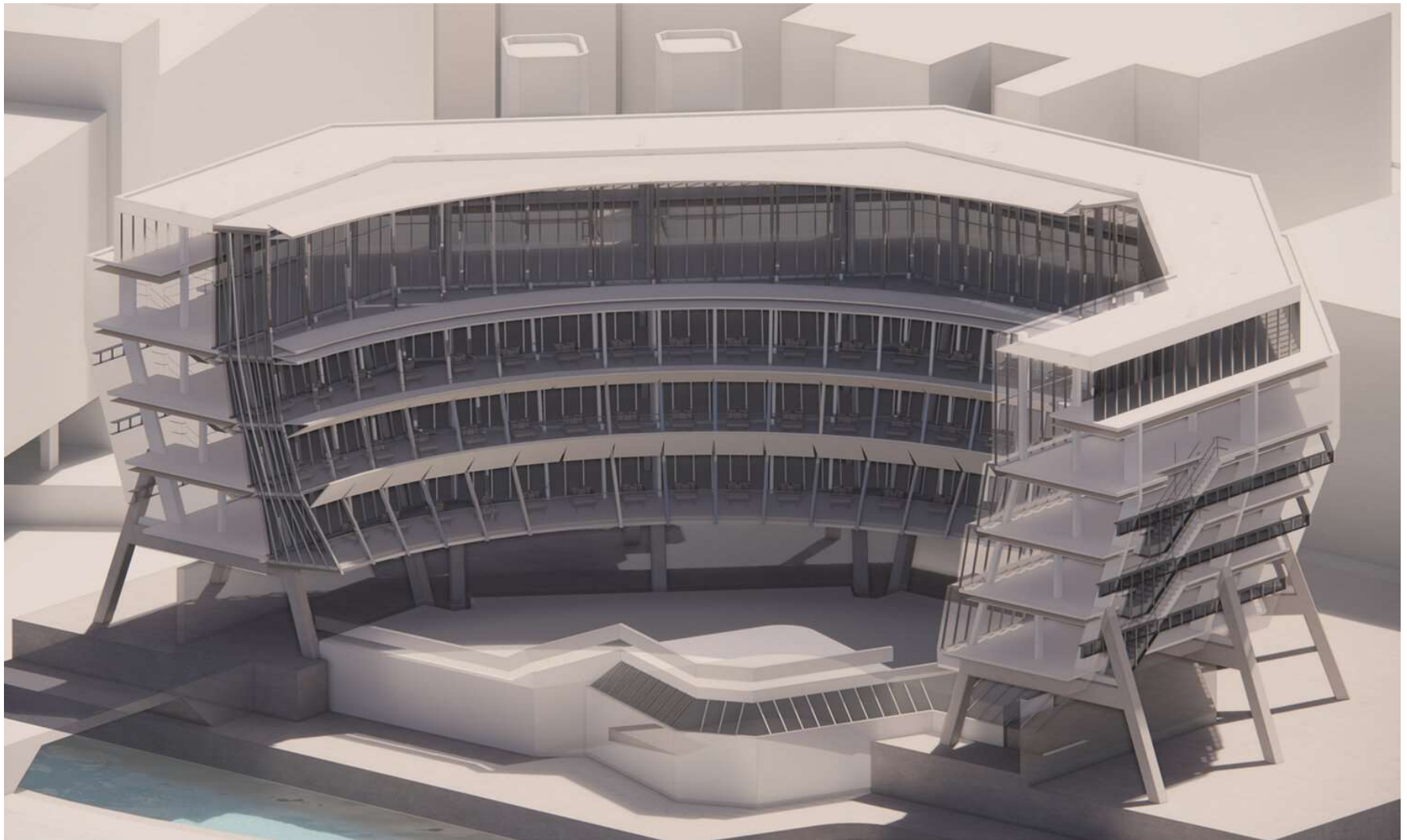
Frames of complex geometry

Florey Building - Exford



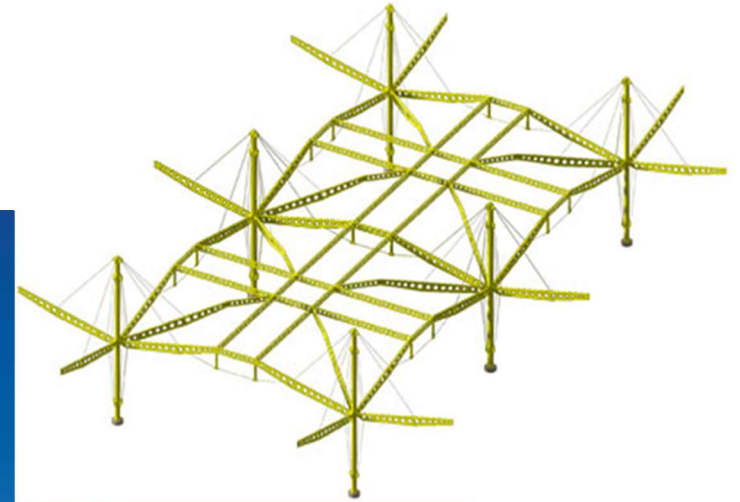
Frames of complex geometry

Florey Building - Exford

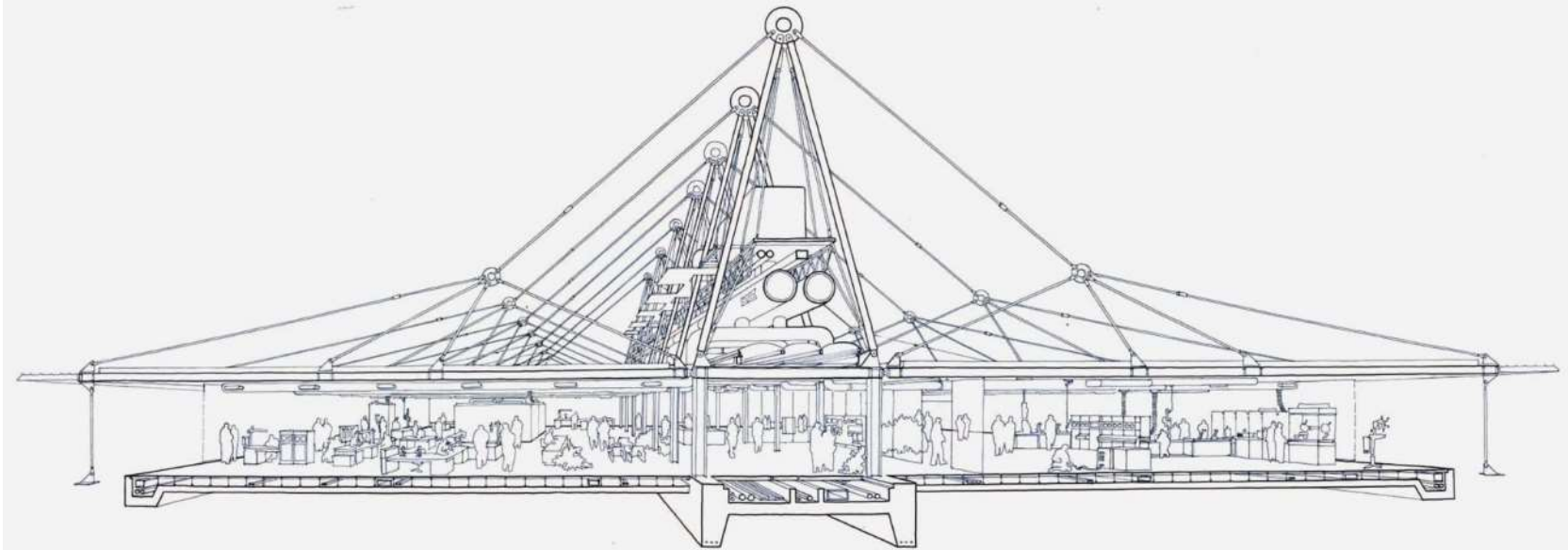


Frames with special geometries

Renault Distribution Center

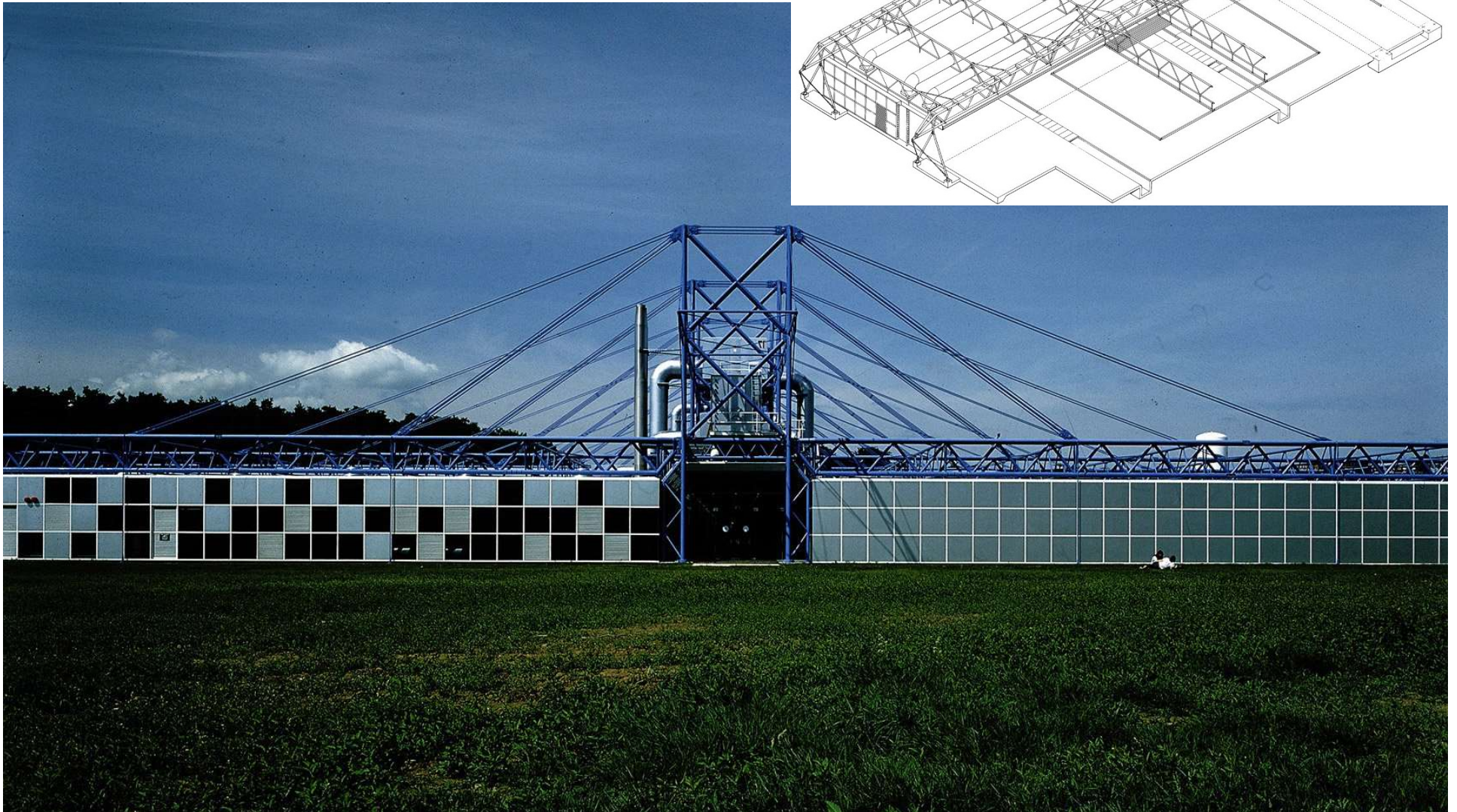
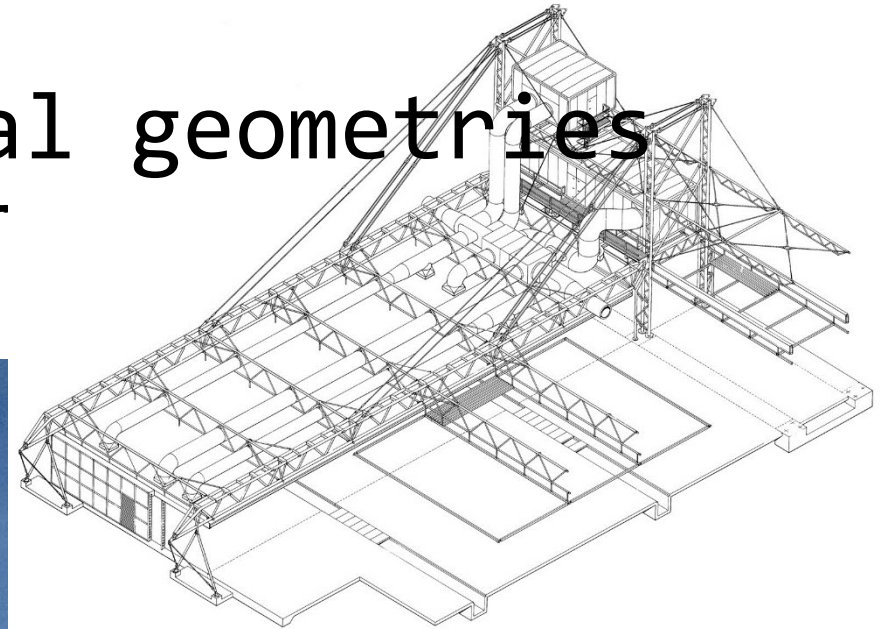


Frames with special geometries



Frames with special geometries

INMOS Factory Building

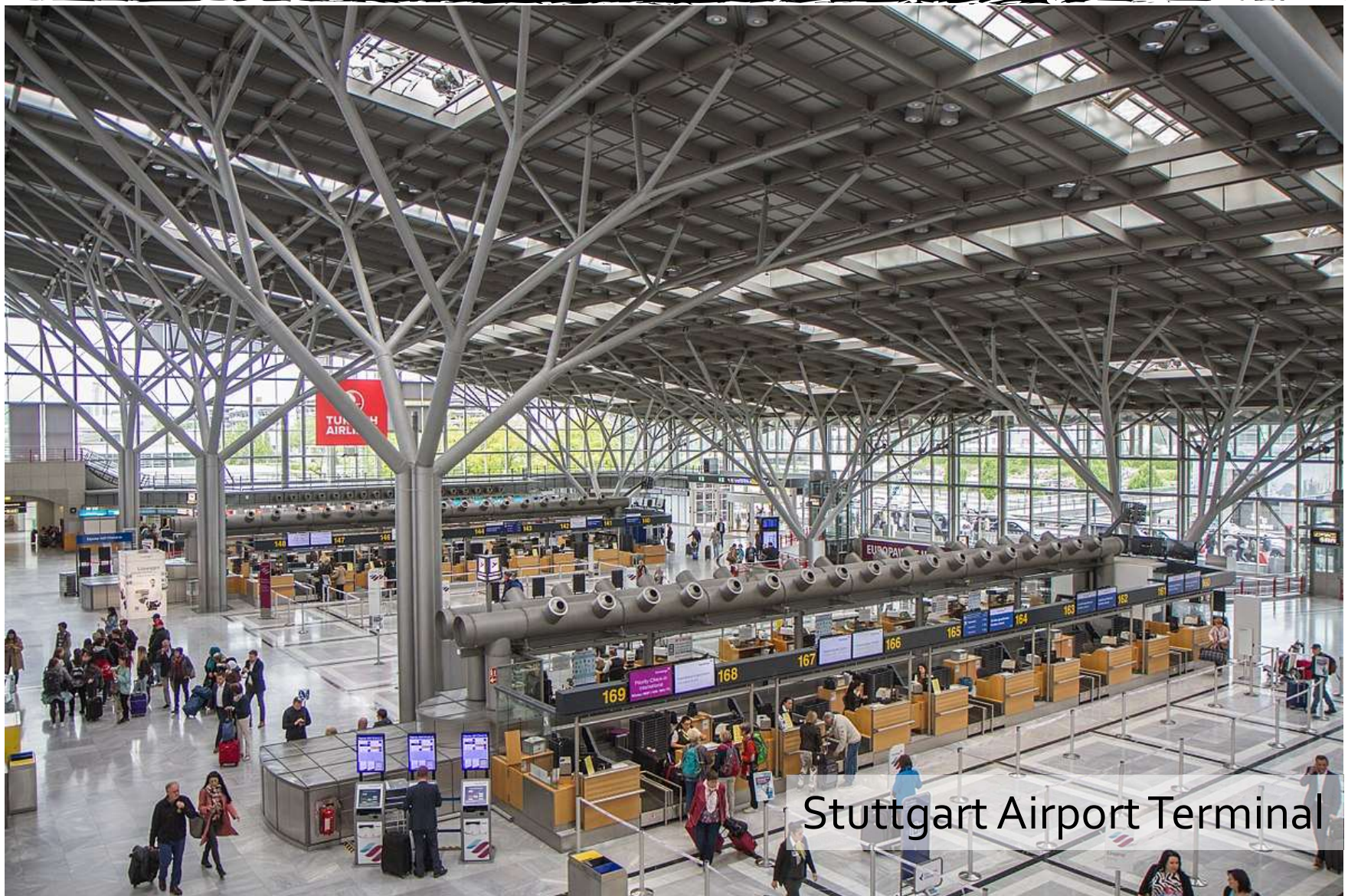


Frames with special geometries

Fleetguard Manufacturing Plant



Frames with special geometries



Stuttgart Airport Terminal