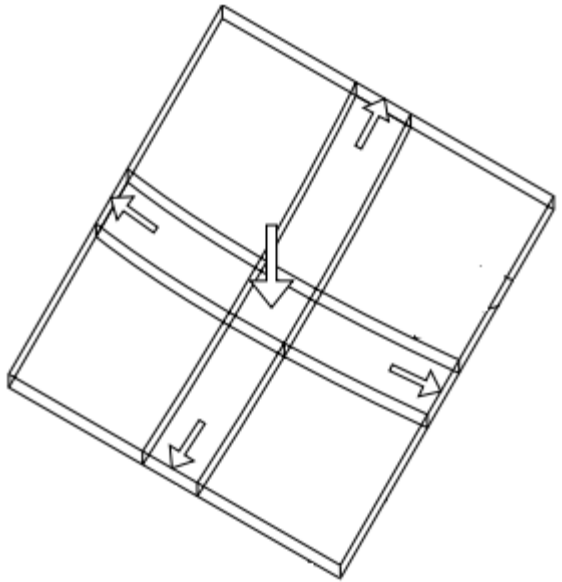
I.7.5.Plate Structures:

I.7.5.1. Definition

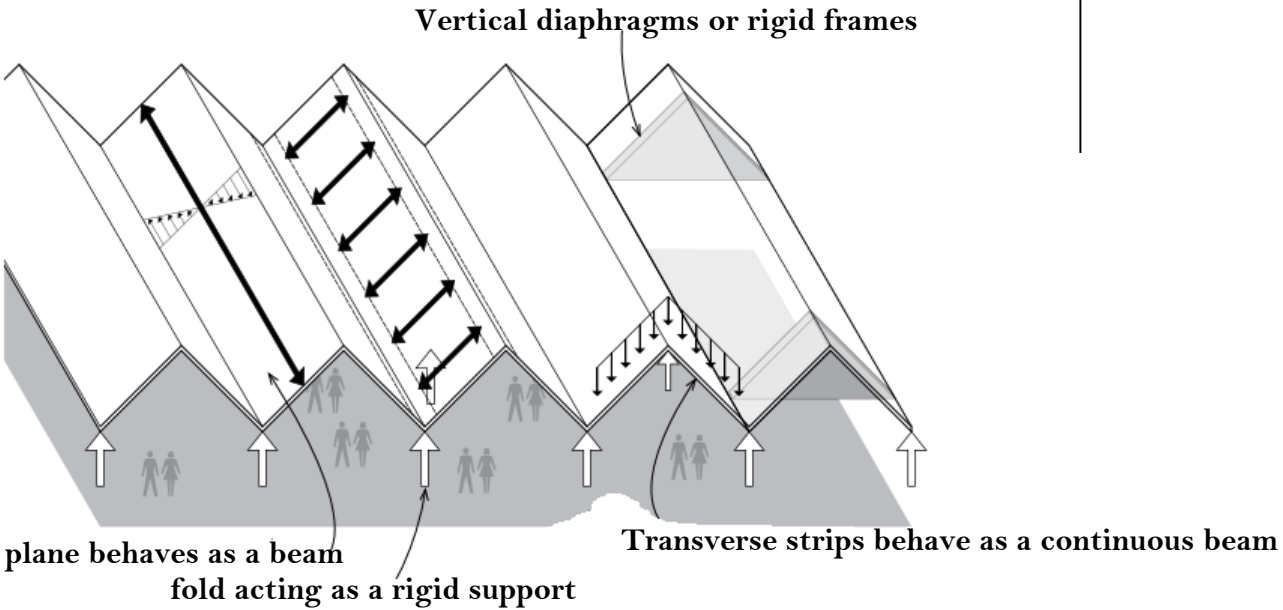
Plate structures are typically rigid, planar, usually monolithic structures . The applied loads are distributed in a multidirectional manner, with the loads generally following the shortest and stiffest routes to the supports. A slab of two-way reinforced concrete is a typical example of a plate construction.



I.7.5.2. Types

A- Folded Plate Structures

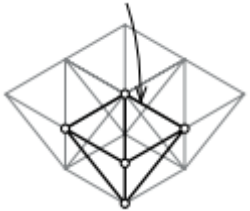
Folded plate structures are made of tightly connected thin, deep pieces that produce acute angles along their borders to buffer one another against lateral buckling. Folded plates are made from precast reinforced concrete or steel plates.

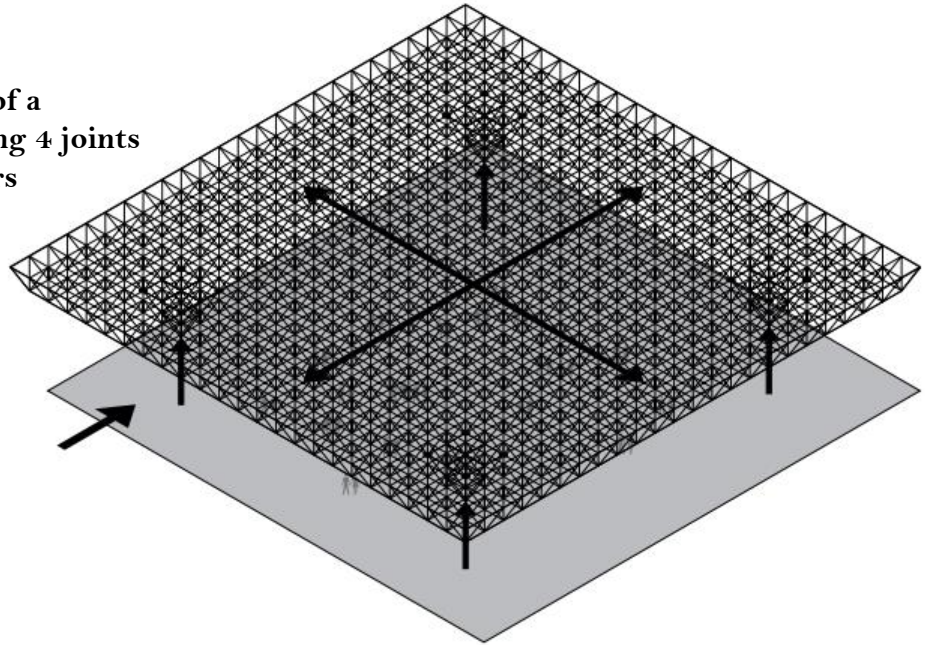


B- Space Frame

A space frame is long-spanning 3D plate structure based on the rigidity of the triangle and compoded of linear elements subject only to axial tension or compresion. As with plate structures, the supporting bay for a space frame should be square or nearly square to ensure that it acts as a two-way structure.

The simplest spatial units of a space frame is a tetrahedron having 4 joints and 6 structural members

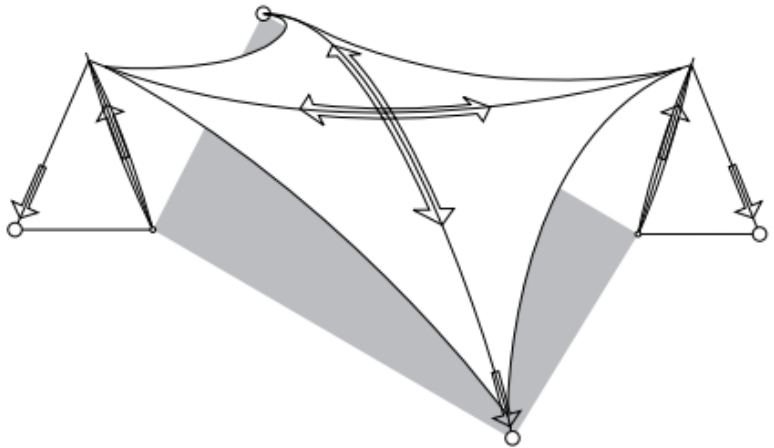




I.7.6.Membrane Structures:

I.7.6.1. Definition

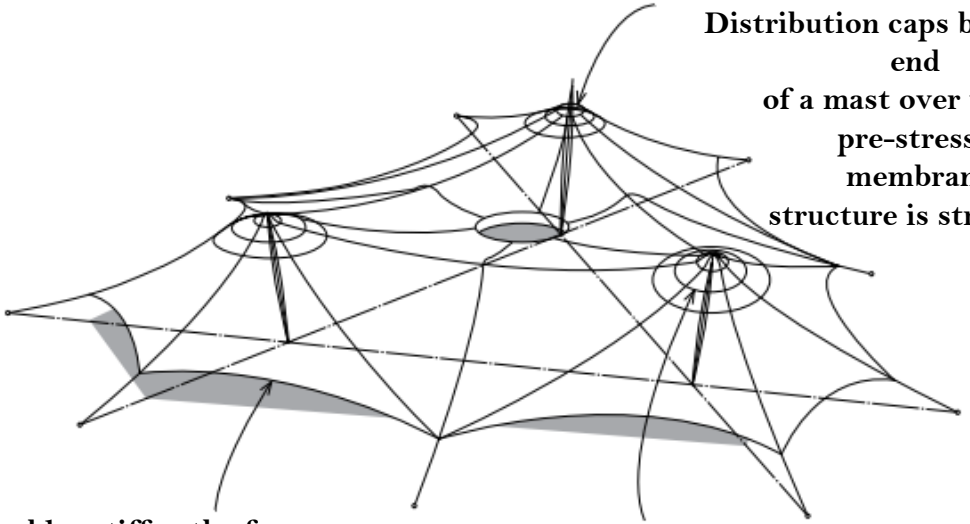
Membranes are surfaces covering large spaces with very little material. Their stability is achieved by tensioning their surface, by means of peripheral structures on which they are supported (usually steel or aluminium), creating self-standing parabolic shapes, or by arranging them to form inflatable volumes. They are light, very flexible, and expand easily in the presence of heat.



I.7.6.2. Types

A- Tent Structures

Tent structures are membrane structures pre-stressed by externally imposed pressures that hold them totally tight under all expected load conditions. A membrane construction should have reasonably steep curvatures in opposing directions to prevent exceptionally high tensile tensions.



Distribution caps broaden the end of a mast over which a pre-stressed membrane structure is stretched

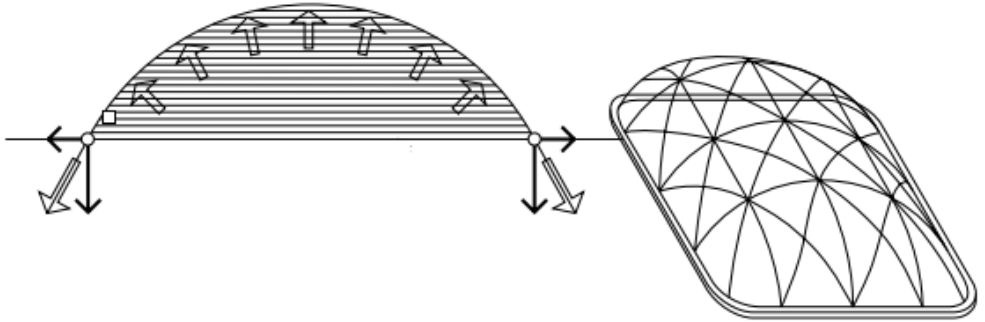
Reinforcing edge cables stiffen the free edges of a pre-stressed membrane structure

Cable loops are reinforcing edge cables tied to the mast support of a membrane structure

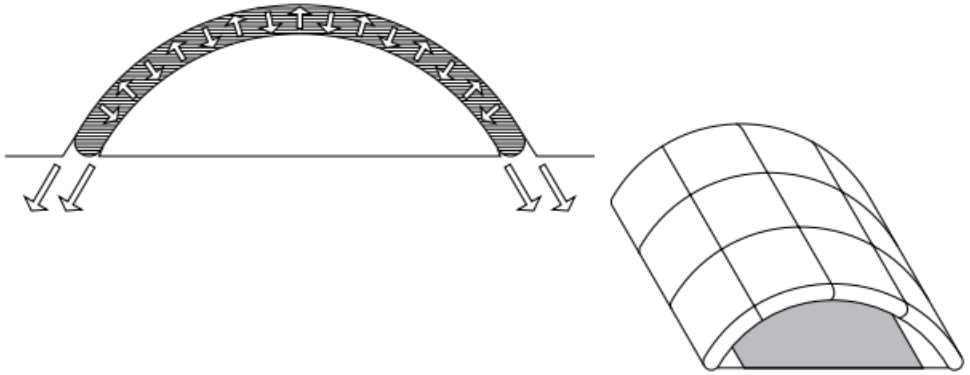
B- Pneumatic Structures

Membrane structures that are tensed and stabilized by compressed air are known as pneumatic structures.

Air-supported structures are consisting of a single membrane supported by an internal air pressure



Air-inflated structures are supported by pressurized air within inflated building elements



I.7.7.Shell Structures:

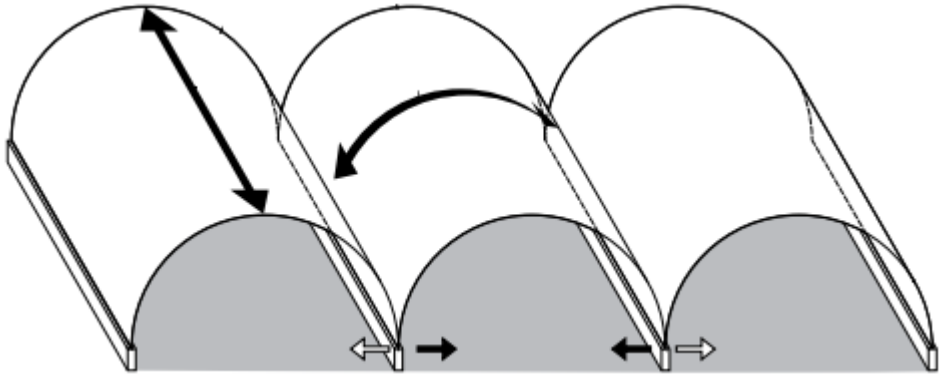
I.7.7.1. Definition

The structures that retains their size and support load, even without frame or solid mass material inside is called shell structures. They are shaped to transmit applied forces by membrane stresses—the compressive, tensile, and shear stresses acting in the plane of their surfaces. The shell structures have a smaller thickness than its other dimensions and they are lightweight constructions.

I.7.7.2. Types

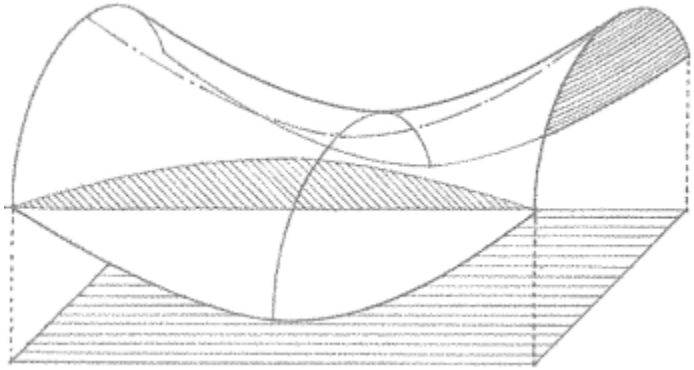
A- Barrel Shell

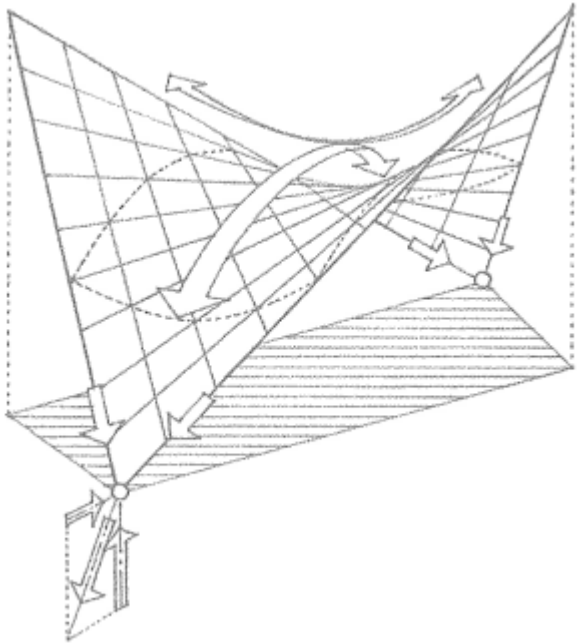
The barrel shell is a series of very thin arches that share their compressive strengths with one another. This relationship of compressive forces allow for the barrel shell to support very large amounts of weight as long as the weight is distributed proportionally. However barrel shells with a consistent thickness are very weak against concentrated loads.



B- Hyperbolic Paraboloid

The hyperbolic paraboloid takes the thinness of shell construction and applies it in a much more complex way. A hypar is essentially two parabolas that sit reflected and rotated along a common axis, or by a series of strait lines that are slid from one skew line to another.



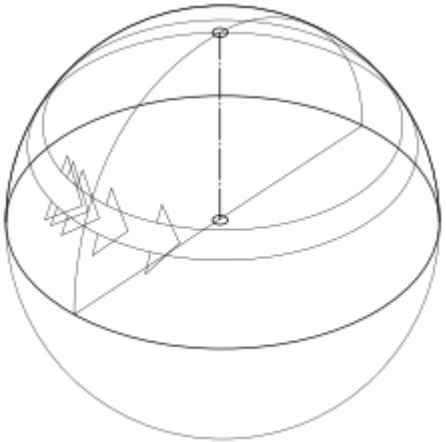


C- Gridshells

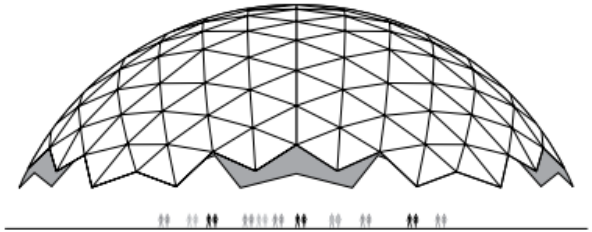
Structures with the stiffness and form of a double curvature shell are known as gridshells because they are made of a grid rather than a continuous surface. Gridshells are often free-form and due to the presence of some bending stresses, the wood or steel members are required to resist loading through their cross section.

D- Domes

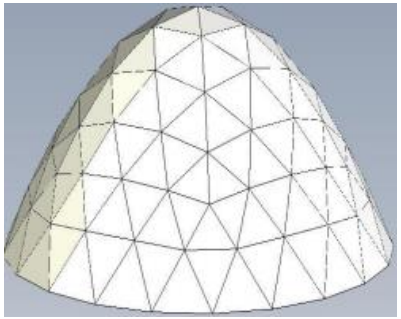
A dome is a structural component that has a semi-spherical shape and is hollow inside. However, there are many variations on this basic shape, and The Building Construction Handbook describes domes as: "Double curvature shells which can be rotationally formed by any curved geometrical plane figure rotating about a central vertical axis"



And there are many types of domes, we mention among them:

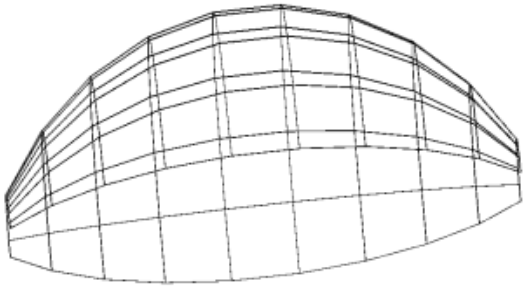


Geodesic dome



Parabolic dome

Onion dome



Oval dome

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