

### 4.3. Space truss

Skeleton, three dimensional frame works consisting of pin connected bars are called space trusses. They are characterised by hinged joints with no moments or torsional resistance. All members carry only axial compression or tension.

#### 4.3.1 Space grids

A grid may be defined as two or more sets of parallel beams intersecting each other at any angle and loaded by an external loading normal to the plane. They are characterised as two way or three way depending upon whether the members intersecting at a node run in two or three directions.

#### 4.3.2. Double layer grid

A space truss can be formed by two or three layers of grids. A double layer grid consist of two plane grids forming the top and bottom layers, parallel to each other and interconnected by vertical and diagonal members. A space truss is a combination of prefabricated tetrahedral, octahedral or skeleton pyramids or inverted pyramids having triangular, square or hexagonal basis with top and bottom members normally not lying in the same vertical plane.

Double layer flat grid truss, having greater rigidity allow greater flexibility in layout and permit changes in the positioning of columns. Its high rigidity ensures that the deflections of the structures are within limits. They are usually built from simple prefabricated units of standard shape. Due to its high indeterminacy, buckling of any member under any concentrated load may not lead to the collapse of the entire structure.

Various types of double layer grids are shown in fig 4.1. They can be developed by varying the direction of top and bottom layers with respect to each other, by different positioning of the top layer nodal points and also by changing the size of the top layer grid with respect to bottom layer grid. Some examples of double layer flat grid truss constructed in India and abroad are given in Table 4.1.

**Table 4.1: Some examples of Double layer grids**

Sl.No	Name and location	Types of frame work	Year
1	Al Wahda sports hall at Abudhabi	Square over diagonal grid (set orthogonally) covering an area of 54 x 43.4m tuball spherical connectors	1989
2	Tennis court at Deira city center, UAE	Square on square offset set diagonally 50.4 x 58.8m Depth:2.1m plate connectors.	1995
3	Indian Oil Corporation Ltd., LPG Bottling Plant, Cuddapah India.	Diagonal (size 2.8m) over square topology, consists of several largest having a size of 47.6 x 39.6m Depth:2m for larger shed 1.4m smaller shed, schkul spherical node.	1998
4	Indian Oil Corporation Ltd., LPG Bottling Plant, Ennore, Chennai	Similar configuration (vide fig)	1999

### 4.3.3. Advantages of space truss

1. They are light, structurally efficient and use materials optimally. It can be designed in such a way that the total weight comes between 15 to 20kg/m<sup>2</sup>

2. It can be built up from simple, prefabricated units of standard size and shape. Hence they can be mass-produced in the factory, can be easily and rapidly assembled at site using semi-skilled labour.

3. The small size components simplify the handling, transportation and erection.

4. They are an elegant and economical means of covering large column free spaces.

5. They allow great flexibility in designing layout and positioning of end supports.

6. Services such as lighting, air conditioning etc., can be integrated with space structures.

7. The use of complicated and expensive temporary supports during erection are eliminated.

8. They possess great rigidity and stiffness for a given span/depth ratio and hence are able to resist large concentrated and unsymmetrical loading. Local overloading can be taken care by built-in reserve strength. They do not collapse locally.



#### 4.3.4. Advantages of steel pipes

The tubular sections having lot of advantages compared to the other sections. The advantages are:

1. The load carrying capacity increases because of increase in moment of inertia.
2. Circular section may have as much as 30 to 40% less surface area than that of an equivalent rolled shape and thus reduces the cost of maintenance, cost of painting.
3. There is no better section than the tubular one for torsional resistance.
4. Tubes are of special interest to architect from an aesthetics viewpoint.

5. The external surface of the tube does not permit the collection of moisture and dust thus reducing the possibility of corrosion.

6. Under dynamic loading the tube has a higher frequency of vibration than any other cross section including a solid round bar.

#### **4.3.5. Components of space truss**

1. Axial members which are preferably tubes.
2. Connectors which join the members together
3. Bolts connecting members with nodes.

Depending upon the connecting system space truss systems are classified as Nodular and Modular systems.

##### **Nodular systems**

They consist of members and nodes.

##### **Mero connector**

It is an abbreviation for Dr. Merigenhausen, a German, inventor of the connector. With his invention in 1942, he commercialized the space frames successfully due to factory mass production of standard components and easy field assembly. It can accept as many as 18 members (Fig 4.2 shows a K-K system mero).

## Tuball

It was developed by Dr. Eekhout, Neitherlands in 1984. It consists of 14 of hollow sphere as cap and 3/4 as cup. It is made of steroidal graphite. The ends of members are fitted with treated solid props by welding. It is lighter, less expensive. A typical cross section of the tuball system illustrated in Fig 4.3. Each end of a member has a cast end piece with a threaded boring to receive a bolt.

There are also other type connectors such as triodetic, nodus, schkul etc. The search for an ideal and simple connector is going on in India and abroad. The connectors explained above are all patented nodes and royalty to be paid to make use of them.

## Octatube

Developed Prof.Dr. Ir.Mick Eekhout of netherlands. It is a plate connector and developed in 1973. It can be fabricated at any well equipped workshop. The joint consist of three plates an octagonal base plate and two half octagonal plates. Each member end is pressed to form a flat shape. A member is connected to a joint by two bolts. The plates are welded together to form the shape as shown in Fig 4.4.

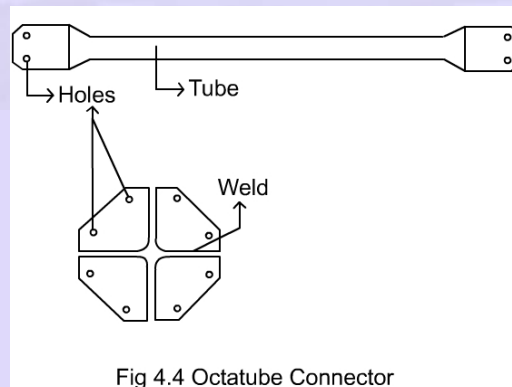


Fig 4.4 Octatube Connector

### Plate connector

A new type of connector is being developed in India by Dr. A.R. Santhakumar, Dean, Civil engineering, Anna university to suit Indian requirements and conditions (vide Fig 4.5). It is successfully used in Gymnasium in Shenoy Nagar, Chennai. It can be easily fabricated in any local workshop and it can take 13 members.

It consists of a 9" x 9" square M.S base plate. Two rectangular plates with chamfered top corners are welded to the base plate perpendicular to each other across the diagonal. A solid piece with a slit is welded to the pipe ends. Web members are connected to the vertical plates while chord members are connected to the base plates

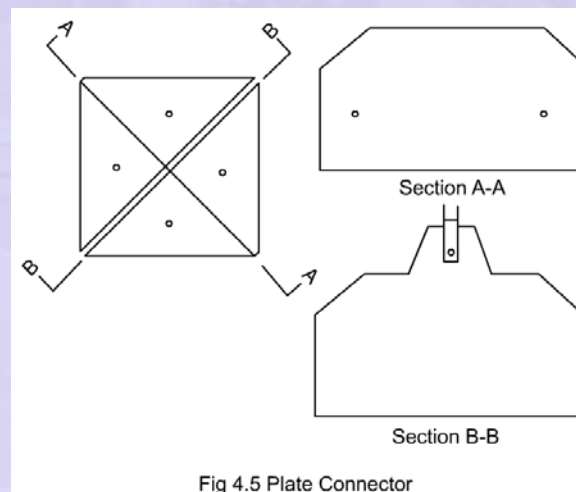


Fig 4.5 Plate Connector