

A JOINT SYSTEM

The present invention relates to a joint system and in particular, but not exclusively, to a joint system for a space frame.

Space frames can be defined as a three dimensional assembly of elements resisting loads acting on the frames. Most space frames include a skeleton frame constructed from steel due to its strength and lightness properties. Space frames are extensively used to cover large and obstructive areas such as sports stadiums, assembly halls, gymnasiums, shopping arcades, swimming pools, exhibition pavillions, hangers, churches and industrial buildings. Double layer grids, barrel vaults and domes are all examples of space frames. Furthermore space frames may be non-load bearing and in which case are primarily for decorative purposes.

Commonly known space frames are of double-layer or single-layer types. A double-layer space frame consists of top and bottom chord members, which may be longitudinal or lateral, and oblique web members being interconnected by a joint system. A single-layer space

frame consists of chord members arranged in a hexagon and/or a pentagon being co-joined at a node or connector.

The most important component of a space frame is the joint system connecting the skeleton structural members to connectors. The structural strength and the cost of production of the joint system crucially affects the reliability and cost of the space frame.

An aim of the present invention is to provide a joint system for a multiple-layer or single-layer space frame which may be either load or non-load bearing. The joint system connects skeleton members which consist of circular tubes or other hollow sections to solid body connectors which have a plurality of threaded passages, thereby forming a space frame.

According to the present invention there is provided a joint system comprising a bolt having a bolt head and a shaft, an annulus, and a collar, each of the annulus and the collar having the shaft extending therethrough, the bolt head being arranged to bear against the annulus, said bolt being rotationally connected to and held captive in the collar by means of a transverse pin positioned between the collar and a flat portion extending along a part of the length of the shaft spaced from the tip of the shaft, such that the bolt and the collar turn together while permitting only limited axial

relative movement of the collar and the bolt shaft.

By way of example, an embodiment of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a joint system according to the embodiment of the present invention coupling a skeleton member to a connector;

Figure 2 shows a schematic cross section through the plane X-X shown in Figure 1;

Figure 3 is a schematic illustration of three perpendicular views of the bolt according to the embodiment of the present invention;

Figure 4 is a schematic illustration of two perpendicular views of an end cap; and

Figure 5 is a schematic illustration of side and end views and a cross section on plane ZZ, of the collar according to the embodiment.

Referring to Figures 1 and 2, the joint system comprises four major components: a bolt 2, an annulus in the form of an end cap 3, a collar 4 and a pin 7. The joint systems provides coupling between a skeleton member in

the form of a tube 1 to a connector 9. The end cap 3 is provided with a passage sufficient to allow free movement of the bolt 2 which is slotted into the end cap. The end cap 3 is secured to the tube 1 by welding, adhesives or other means suitable for the securement at position 5. The end cap 3 acts as a bearing against the bolt head 11 when the joint system is under a tensile force. The bolt head 11 may have a circular, hexagonal or other shape. The bolt tail 12 is threaded. The collar 4, like the end cap 3, has a passage sufficient to allow free movement of the bolt 2 and enables the collar 4 to be slotted over the bolt 2.

As shown in Figure 3, the bolt 2 is provided with a flat groove 8 along part of the bolt shaft spaced from the shaft tip. The depth of the groove 8 is minimised to maximise the strength of the bolt 2 under tension. Preferably the depth of the groove 8 is equal to the radius of the pin 7 and the shape at the two ends of the groove 8 is rounded to reduce stress concentration.

Figure 4 illustrates the end cap 3 having a coaxial passage 13 sufficient to allow free movement of the bolt 2. The end cap 3 has an outer and an inner diameter.

The outer and inner diameter are equal to the outer and inner diameter of the tube 1 respectively. The end cap

3 is plugged into the tube 1 and secured by welding, adhesives or any other means at position 5 depending on the material of the respective parts and the strength required.

Figure 5 illustrates the collar 4 with tapered sides but having an internal diameter sufficient to allow free movement of the bolt 2. The sides of the collar 4 are provided with a number of key holes 6 which enable a tool (not shown) to turn the collar 4. The number of key holes 6 is preferably six and the size and shape of the holes is consistent with the size and shape of the tools key. A passage 14 is provided on the side of the collar 4 which allows the pin 7 to be inserted. The length of the pin 7 should be less than the length of the passage 14. Where the passage 14 intersects the central bore of the collar, the passage forms a semi-cylindrical recess in the collar in register with the flat groove 8, so that the pin 7 is positioned between the flat groove and the semi-cylindrical recess in the collar.

When the collar 4 is slotted onto the bolt 2, the pin 7 is inserted in the passage 14 and slides along the flat groove 8 of the bolt 2 to prevent the collar 4 from slipping off the bolt 2. The pin 7 holds the collar 4 and the bolt 2 together and also guides the bolt 2 to turn while turning the collar 4. The bolt 2 is screwed

into the connector 9 which consists of a solid body having a plurality of right-hand threaded passages. The bolt 2 is screwed into the connector 9 by turning the collar 4 with the tool engaging the key holes 6. An opening 10 just above the end cap 3 on the side of the tube 1 is provided so as to allow another tool (not shown) to press the bolt head 11 so that the first thread of the bolt 2 can engage the threaded passage in the connector 9.

The joint system interconnects structural members to the connector at any angle to enable single or multiple layer grids, barrel vaults or domes to be constructed. The joint system may be constructed from steel, stainless steel, aluminium, plastic and any materials consistent with the materials of the frame members and connectors.

When the joint system is under a compression force, the tapered end of the collar 4 bears against the connector 9 resisting the compression force. The thickness of this tapered end is designed according to the magnitude of the compression force.

The aforesaid description has been given by way of

example only and it will be appreciated by persons skilled in the art that modifications may be made without departing from the scope of the present invention.

CLAIMS:

1. A joint system comprising a bolt having a bolt head and a shaft, an annulus, and a collar, each of the annulus and the collar having the shaft extending therethrough, the bolt head being arranged to bear against the annulus, said bolt being rotationally connected to and held captive in the collar by means of a transverse pin positioned between the collar and a flat portion extending along a part of the length of the shaft spaced from the tip of the shaft, such that the bolt and the collar turn together while permitting only limited axial relative movement of the collar and the bolt shaft.
2. A joint system as claimed in claim 1, in which said pin is positioned between the flat portion and a semicylindrical recess in the collar.
3. A joint system as claimed in claim 1 or claim 2, in which the joint system provides coupling between a skeleton frame member and a connector.
4. A joint system as claimed in claim 3, in which the annulus is fixed to the skeleton frame member and the shaft of the bolt is fixed to the connector.



5. A joint system as claimed in claim 4, in which the annulus is welded to the skeleton frame member and the shaft of the bolt and the connector are provided with the screwthreads thereby enabling the bolt to be screwed to the connector.

6. A joint system as claimed in claim 4 or claim 5, in which an opening is provided in the skeleton frame member to enable the bolt to be pressed towards the connector for fixing therewith.

7. A joint system as claimed in any of the preceding claims, in which the collar is provided with a number of key holes for engaging with a key thereby facilitating the turning of the collar and bolt.

8. A space frame comprising one or more skeleton frame members, one or more connectors and a joint system as claimed in any one of the preceding claims for coupling each frame member to at least one connector.

9. A joint system substantially as herein before described with reference to the accompanying drawings.

