A non-planar suspended panel system comprising a metal grid formed of curved main runners and straight cross runners extending between the main runners, a plurality of panels supported on the grid, the panels each having flat major faces with quadrilateral profiles, the edges of a panel being aligned with a pair of main runners and a pair of cross runners, each panel having flanges at its edges extending between its flat face and the runners in a manner that disposes the plane of its flat face generally parallel to chordal lines in the planes of the main runners between the intersections of the associated cross runners and main runners, whereby the panel system extends over a three dimensional surface and the surface is formed of a multitude of facets each formed by one of said panels.
FACETED METAL SUSPENDED CEILING

BACKGROUND OF THE INVENTION

[0001] The invention relates to ceiling and wall construction and, in particular, to a unique assembly of planar faced panels suspended on a curved supporting grid.

PRIOR ART

[0002] Architects, building owners, and developers strive to create unique structures that depart from traditional flat plane ceiling and wall structures. A designer looks to achieve a distinctive unconventional or dramatic appearance in an expansive wall or ceiling or combination of these static structures. These efforts are usually hampered by increased cost in material and/or its fabrication and its installation. Grid tees are commonly used for suspending tiles in ceilings. A known adaptation of such grid tee technology is to curve the main tee either concavely or concavely to produce a non-planar ceiling. Typically, in these ceiling constructions, the curved main tees are combined with non-planar panels or flexible sheets that conform to the radius of curvature of the main tees. As far as known, use of this type of construction has been limited to curvature in a single plane corresponding to parallel planes of the curved main tees.

SUMMARY OF THE INVENTION

[0003] The invention provides a construction for ceilings and walls as well as a combination of these structural elements to form vaults, domes, overhead valleys, non-planar walls and similar expanses that exhibit a unique and distinctive faceted distinctive look. The invention, moreover, is not constrained to single plane curvatures, nor to symmetrical expansions.

[0004] The invention utilizes curved main tees and straight cross tees to form an open network having a three dimensional shape corresponding to the expanse of the finished faceted ceiling, wall or combination structure. The faceted face of the expanse is made up of flat quadrilateral panels that bridge the individual spaces between the main and cross tees. Intertwined flanges along the edges of the panels serve to stiffen the panels and act as standoffs to space their respective panels from the grid or network in a stable manner. The flanges, optionally, can be shaped on their free edges to conform to the curvature of the main tees. The panels are releasably mounted on the tees by torsion springs so that a finished installation has the grid concealed and the face of the panels free of fasteners while ready access is available to the rear of the panels.

[0005] The invention provides a unique look for ceilings, walls and integrations of the same and is obtained with relative low manufacturing and installation costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a fragmentary perspective view of a convex ceiling area, as seen from below, constructed in accordance with the invention;
[0007] FIG. 2 is a fragmentary perspective view of the ceiling of FIG. 1 as seen from above;
[0008] FIG. 3 is a fragmentary plan view of the ceiling of FIG. 1;
[0009] FIG. 4 is an elevational view of a typical torsion spring associated with a panel;
[0010] FIG. 5 is a fragmentary perspective view of a concave ceiling area as seen from below;

[0011] FIG. 6 is a schematic rear view of a ceiling, wall, or combined ceiling and wall that is either concave or convex in two planes;
[0012] FIG. 7 is a fragmentary side view of a variant construction of a concave structure;
[0013] FIG. 8 is a fragmentary side elevational view of a variant of a convex structure; and
[0014] FIG. 9 is a fragmentary plan view of a cross tee having slots for receiving torsion springs associated with the flat panels of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Referring now to the drawings, FIG. 1 illustrates an application of the invention to a ceiling structure that is convex with reference to an observer standing below. The structure 10 includes main runners 11, cross runners 12 and panels 13. In this and other disclosed embodiments, the runners 11, 12 have the cross-sectional shape of an inverted T and, accordingly, are referred to as tees as is customary in the art. However, it will be understood that the runners can have other cross-sectional shapes such as a U, I, or C. In the various embodiments disclosed herein, the main runners or tees can be relatively long, for example, 10' in length, but can be of shorter length, such as 4' in length, or metric equivalent. The cross tees can be considerably shorter than the main tees, being for example, 2' or 4' in length. It will be understood, however, that the invention is not limited to these dimensions.

[0016] The tees 11, 12 are fitted with respective end connectors, known in the art that can be snapped together with identical end connectors, to enable the tees to be joined end-to-end. U.S. Pat. Nos. 6,729,100 and 5,761,868 are examples of connectors that can be used for main tees and cross tees, respectively. Cross tee connectors 16 are typically joined together at slots 17 formed in the webs or vertical elements of the main tees 11 at the desired locations of the cross tees 12. While the various embodiments disclosed herein show the cross tees 12 in end-to-end alignment, it is contemplated that the invention is applicable to arrangements where the cross tees between adjacent pairs of main tees are staggered such that they are not in end-to-end alignment. Suitable slots 17 can be provided to receive the connectors 16 of such cross tees.

[0017] The main tees 11 in the embodiment of FIG. 1 are identical, being curved in a respective vertical plane and parallel to one another. The cross tees 12 are of equal length, are straight, and have their ends joined to adjacent aligned cross tees (i.e. where they are not staggered) with connectors coupled to one another through the slots 17 in the webs of the main tees 11. The main tee slots 17 are arranged so that the cross tees are parallel. Preferably, the main and cross tees 11, 12 each have a flange 18 extending on opposite sides of a central web 19. The flanges 18 are at an edge of the web 19 closest to the space for which the structure 10 forms a boundary or decorates. The flanges 18 of the main and cross tees 11, 12 typically can be substantially flush with each other where they intersect.

[0018] A panel 13 is preferably formed of sheet metal such as aluminum and is of a gauge suitable for the application; a typical gauge can be 0.032" or metric equivalent. The panel 13 has a flat or planar face 21 and peripheral flanges 22, 23 that extend along edges of the face. In the embodiment of FIG. 1, the face 21 is a quadrilateral in the form of a rectangle. An opposing pair of flanges 22 are aligned with the main tees
and have an arcuate edge 24 that substantially matches the arc of the main tee flange 18 such that this edge can abut the main tee flange along substantially the full length of the panel flange 22. The other opposing pair of flanges 23 are proportioned to rest against the cross tee flanges 18 when the arcuate edges 27 are seated in contact with the main tees.

[0019] The panels 13 are releasably retained on the grid, formed by the main and cross runners 11 and 12, by torsion springs 26. In the illustrated example, 4 torsion springs 26 are disposed on each panel. The torsion springs 26 are assembled in pairs, spaced from one another, on the flanges 23 associated with the cross tees 12. Each spring 26 is retained on a flange 23 by a metal bracket 27 fixed on the side of the flange facing inwardly of the panel periphery. The cross tee flanges 18, at a location corresponding to each torsion spring 26 are formed with a pair of elongated slots 28. The slots 28 are staggered or offset longitudinally and laterally of the cross tee to accommodate the geometry of divergent spring tings 29 that extend from turns of the coil of the torsion spring 26. In the free state of a torsion spring 26, the tangs 29 diverge at an angle greater than that permitted by the slots 28 when the panel is in place relative to its associated cross tee so that the springs hold the panel tightly in place against the cross tees.

[0020] The shape of the planar face 21 generally coincides with a projection of the geometry of the grid tees 11, 12, with which it is associated. The face 21 extends in one direction a distance approximating the distance between the webs of an adjacent pair of main tees and in the other direction a distance between the webs of adjacent cross tees. The brackets 27 and springs 26 provide a limited universal motion of the spring to permit the panel to be displaced and out of parallelism with its installed position while the springs remain in their respective slots. Each flange 23 associated with a cross tee 12 forms an acute angle with the plane of the face 21 so that it avoids interference with a flange 23 of an adjacent panel 13 on the same set of main tees. The flanges 22 associated with the main tees 11 are formed at substantially right angles although a slightly acute angle to the plane of the face is preferred to avoid interference with an adjacent panel 13.

[0021] The torsion springs 26 releasably hold a panel 13 in position on the grid. The tangs 29 are long enough and the connection of the springs to the panel is universal enough to allow one edge of the panel to be initially attached to the grid by inserting the tangs of the spring at a first edge of the panel into the grid tee slots 28. The tangs 29 of each spring are manually squeezed together to fit them into the slots. With these first springs in their respective slots 28, whether or not the tangs are allowed to spread and draw the associated panel edge towards the grid, the springs on the opposite side of the panel are inserted in the slots of the corresponding cross tee 12. When the springs and/or panel is released, the springs tend to spread their tangs while they are confined to the slots with the result that the panel 13 is drawn up against the grid tees. In the installed position, the panel flanges abut and rest against the adjacent flanges of the grid tees 11 and 12. The springs 26 are distributed around and remote from the geometric center of the panel to assure that it is drawn and rests stably against the grid. In the embodiment of FIG. 1 and certain embodiments to be discussed, the panels are tangent to an imaginary surface that curves in a single plane. The effect of the flat panels 13 is a distinctive multi-faceted look quite different from a continuously smooth surface that would correspond to this imaginary surface.

[0022] FIG. 5 illustrates a second embodiment of the invention wherein flat faced panels 31 are arranged in a convex pattern when observed on a side of the panels opposite a side from which their flanges project. Similarly to the embodiment described above in connection with FIG. 1, the panels 31 are supported on a grid 33 of runners or tees. The grid 33 comprises a plurality of relatively long main tees 34 and a plurality of relatively short cross tees 12. The main tees 34 are identical, being curved in a single plane and concave with respect to a point of reference from which the face side of the panels 31 are to be observed. The cross tees 12 and their connectors can be identical to those described in connection with the embodiment of FIG. 1. The main tees 34 can be produced, in a known manner, by curving conventional suspended ceiling grid tees and stretching their reinforcing bulbs 37 relative to their flanges 38. As before described, the cross tees 12 are joined end-to-end by suitable connectors known in the art, that extend through strategically located longitudinally spaced slots in webs 40 of the main tees 34. The cross tees 12 serve to maintain the main tees 34 in parallel alignment.

[0023] The main tees 34 are joined end-to-end by conventional connectors, known in the art. Connection receiving slots in the main tees 34 are situated in predetermined locations corresponding to the geometry of the panels. The panels 31, as in the embodiment of FIG. 1, have flat or planar faces 41 with a quadrilateral or rectangular profile and peripheral flanges 42, 43 extending rearwardly from the plane of the face. A pair of the flanges 42 aligned with the main tees 34 have free edges 44 shaped to match and contact the arc of the concave main tee flanges 38. The other panel flanges 43 have straight edges of a width sufficient to sent against the flanges of the cross tees 12. The panels 31 are releasably held in place with torsion springs 26 received in the cross tee slots 28 as described above in connection with FIG. 1. The included angle between the plane of the panel flanges 43 and the plane of the panel face 41 can be slightly less than 90 degrees where the arc of the main tee is of a large radius or can be greater than 90 degrees to allow the torsion springs to align with the slots 28. The arrangement of the panels 31 depicted in FIG. 5 yields a distinctive faceted appearance in a structure, whether it be a ceiling, wall or combined ceiling and wall or segment thereof.

[0024] FIG. 6 schematically illustrates application of the invention to a surface expansive again, such as a wall, ceiling, or combination of these structures where the expanses is a compound curve, being curved in two perpendicular planes. FIG. 6 can be interpreted as a plan view of either a convex or concave grid 50 for supporting flat quadrilateral panels. The main runners or tees 51 are curved, either convexly or concavely in one or two planes but in either case are each situated in a plane different from the plane of an adjacent main runner. In one arrangement, suggested by FIG. 6, all or part of the main tees 51 can be supported on the surface of an imaginary sphere such that the main tees are located at selected longitudes and the cross tees are located at selected latitudes. In such arrangement, the cross tees of a given latitude would be equal in length, but different from the length of the cross tees of adjacent latitudes. Panels to be mounted on the grid 50 have a profile that generally corresponds to straight lines drawn between the intersections of the main and cross tees 51, 52. The panels used with the grid 50 are like earlier described panels having a flat planar face of quadrilateral profile with rearwardly extending flanges arranged to contact overlying main and cross tees.
Torsion springs can be used as described to releasably retain the panels to the grid as previously described.

It is important that a panel be seated in a stable manner against the grid tees at least at 3 distributed locations. This follows from the fact that three points determine a plane and, therefore, represent a minimum of contact between a panel and grid for stability.

FIGS. 7 and 8 illustrate arrangements where the panel edges associated with curved main tees have straight edges free of substantial contact with the flanges of the main tees. In these arrangements, the flanges associated with the cross tees are adequate to stably support their respective panel on the grid with the retention forces being applied by a plurality of torsion springs carried on these flanges and coupled with the cross tees. In the various described embodiments, the panels each have a flat major face with a quadrilateral profile. Peripheral flanges on each panel are preferably arranged to support the panel on associated cross and/or main runners so that it is parallel or substantially parallel to chordal lines drawn between the intersections of associated cross runners with associated main runners.

In certain applications, it may be desirable or necessary to retain the panels on a grid by attaching torsion springs on the panel flanges overlying the main tees and providing these main tees with slots to receive the spring tangs.

While the invention has been shown and described with respect to particular embodiments thereof, this is for the purpose of illustration rather than limitation, and other variations and modifications of the specific embodiments herein shown and described will be apparent to those skilled in the art all within the intended spirit and scope of the invention. Accordingly, the patent is not to be limited in scope and effect to the specific embodiments herein shown and described nor in any other way that is inconsistent with the extent to which the progress in the art has been advanced by the invention.

1. A non-planar suspended panel system comprising a metal grid formed of curved main runners and straight cross runners extending between the main runners, a plurality of panels supported on the grid, the panels each having flat major faces with quadrilateral profiles, the edges of a panel being aligned with a pair of main runners and a pair of cross runners, each panel having flanges at its edges extending between its flat face and the runners in a manner that disposed the plane of its flat face generally parallel to chordal lines in the planes of the main runners between the intersections of the associated cross runners and main runners, whereby the panel system extends over a three dimensional surface and the surface is formed of a multitude of facets each formed by one of said panels.

2. A suspended panel system as set forth in claim 1, wherein said panels each include a flange extending generally perpendicularly to the plane of the flat face.

3. A suspended panel system as set forth in claim 2, wherein said panels include flanges having edges, distal from the flat face, having a shape that conforms to the curvature of an associated main tee.

4. A suspended panel system as set forth in claim 1, wherein said panels are attached to said grid by resilient springs biasing said panels toward said grid.

5. A suspended panel system as set forth in claim 1, wherein said panels are formed of sheet metal.

6. A suspended panel system as set forth in claim 5, wherein said sheet metal is aluminum.

7. A suspended panel system as set forth in claim 4, wherein said springs engage said cross runners.

8. A suspended panel system as set forth in claim 7, wherein said springs are torsion units.

9. A suspended panel system as set forth in claim 7, wherein the torsion units include tangs that in a free state are divergent.

10. A suspended panel system as set forth in claim 9, wherein said cross runners have slots to receive said divergent tangs.

11. A suspended panel system as set forth in claim 10, wherein said tangs and slots are arranged so that said springs serve, to raise their respective panel towards an associated cross runner.

12. A suspended panel system as set forth in claim 1, wherein each of said panel edges has a flange that contacts an overlying runner.