An insert for I-joist web holes provides support and separation for piping, tubing and/or cabling guided through the installed I-joist's web. At the same time, the insert protects the web hole against destructive forces commonly related to the installation process and/or gravitational loads of piping, tubing and/or cabling.
I-JOIST WEB HOLE INSERT

PRIORITY CLAIM

[0001] The present invention claims priority to U.S. Provisional Application of the same title and inventor, Application No. 60/552,326, filed Mar. 10, 2004, which is hereby incorporated by reference.

CROSS REFERENCES


FIELD OF INVENTION

[0003] The present invention relates to web inserts for I-joists. More particularly, the present invention relates to web inserts for supporting tubing, piping, cables and the like commonly installed across web holes of wooden I-joists in architectural constructions.

BACKGROUND OF INVENTION

[0004] I-joists referred in the following and in the context with the present invention are made from wood and wood like materials. I-joists become increasingly popular in architectural construction due to their high load carrying capability and their low weight, as well as their inexpensive fabrication and their good workability. I-joist’s high gravitational load carrying capability is provided by a large height to width ratio with a thinned central web portion connecting the top and bottom chord. Top and bottom chords are mainly exposed to tensile or compressive loads in grain direction of naturally grown wood, whereas the web has to withstand tensile, compressive and shear loads in varying combination. Because of the webs’ diverse load exposure and its relatively large height, webs are commonly fabricated from oriented strand board, oriented strand panel, oriented strand panel, floor joists, engineered wood floors, and other materials. The I-joist is a multi material structural element with two sets of materials of quite diverse composition and physical properties bonded together along the interfaces between top and bottom chords and their respective central webs.

[0005] Maintaining the structural integrity of the bonding interface between web and chords is crucial for the I-joist’s load carrying capability. I-joist manufacturers provide therefore standards for maximum web hole sizes and minimum remaining intact web structure height along the bonding interface. A practicable fabrication of web holes in accordance with such web hole standards is provided by a web hole cutting apparatus, the patent for which is incorporated by reference. Irrespective a proper cutting, the web hole may still suffer damage during the consecutive installation of pipes, tubes, and cabling at the construction site. Particularly sensitive is the bottom portion of the web hole due to its exposure to the gravitational loads of the through guided elements. Therefore, there exists a need for a structural element protecting the web hole against damage during installation and/or gravitational loads of piping, tubing, cabling and the like guided through that web hole. The present invention addresses this need.

SUMMARY

[0006] In an installed I-joist, web area is limited for cutting web holes. As a common result, a multitude of pipes, tubes and/or cables tend to be cramped through a single web hole. The resulting friction between the individual through guided elements may cause excessive lateral loads on the web, which in turn may increase the I-joist’s buckling risk at the already weakened web hole location. Therefore, there exists a need for a structural element that keeps individual through guided elements separated and spaced within a single web hole. The present invention addresses also this need.

[0007] An I-joist having a standardized hole cut in the vertical web portion between its top and bottom chord may be combined with an insert correspondingly shaped to the dimensional standards of the I-joist and the cut hole. The insert provides clustered cutout contours for positioning and holding various through guided elements such as tubing, piping, cables and the like commonly installed across I-joists in architectural constructions. The insert may be snapped on the I-joist, screwed on, nailed on, attached with a countersinking ring and/or in combination with an I-joist support. The insert may be preferably fabricated from plastic.

[0008] The insert is an easy to handle and easy installable element that in combination with standardized cut web holes provides guiding and support across I-joists in accordance with specialized needs of plumbers, electricians and the like.

BRIEF DESCRIPTION OF THE FIGURES

[0009] FIG. 1 shows a first perspective view onto the front of a first exemplary insert assembled on an I-joist portion.

[0010] FIG. 2 shows a second perspective view onto the back of an exemplary insert and I-joist portion of FIG. 1.

[0011] FIG. 3 shows the second perspective view onto the back of a second exemplary insert assembled on an I-joist portion.

[0012] FIG. 4 shows the second perspective view onto the back of a third exemplary insert assembled on an I-joist portion.

[0013] FIG. 5 shows the second perspective view onto the back of a fourth exemplary insert assembled in combination with a first exemplary thread flange on an I-joist portion.

[0014] FIG. 6 depicts the first perspective view of the first exemplary thread flange of FIG. 5.

[0015] FIG. 7 depicts the first perspective view of a second exemplary thread flange.

[0016] FIG. 8 depicts the second perspective view of the fourth exemplary insert of FIG. 5.

[0017] FIG. 9 depicts the second perspective view of a fifth exemplary insert.

[0018] FIG. 10 shows the second perspective view onto the back of a sixth exemplary insert assembled in combination with an exemplary I-joist support on an I-joist portion.
DETAILED DESCRIPTION

[0019] An I-joist 10, a portion of which is depicted in the Figures, may be combined with an insert 20A-20F in various configurations and eventual combination with other structures, such as attachment pins 30 as in FIG. 1, thread flange 40A, 40B as in FIGS. 5-7 and/or an I-joist support 50 as in FIG. 10. Attachment pins 30 may be nails, screws and the like well known in the field of architectural construction. The insert 20A-20F provides at least one cutout contour 25 for guiding at least one of a pipe, a tube, and a cable through the web hole 13 without direct contact between the web hole 13 and said at least one of a pipe, a tube and a cable, such that the web hole 13 edges are protected against inadvertent damaging.

[0020] According to FIG. 1, a first exemplary embodiment of an insert 20A may have a flange 21 for snugly contacting the web portion 13 of I-joist 10. The flange 21 may have a circumferential contour that at least partially complies with at least one of the bottom chord 11 and the top chord 12 in assembled position such that a distinct orientation of the insert 20A with respect to the I-joist 10 may be warranted. The flange 21 contour may also substantially comply with the web height WH and may have a primary chord rest 211 at least partially corresponding to an inside contour of at least one of the two chords 11, 12. The flange 21 may also feature attachment holes 22 positioned on the flange 21 in a radially outward distance to the fit ring 28 providing sufficient spacing to the edge of the web hole 14 to prevent splitting of the web due to an eventual wedging effect of attachment pins 30 driven into the solid web 13. The insert 20A may be attached at the web 13 via attachment pins 30 shown in FIG. 1 in assembly approach.

[0021] Inserts 20A-20F may feature cutout contours 25 in varying configurations and spacing as may best accommodate the particular needs for installing tubes, pipes, wiring and the like through guided elements commonly employed in architectural constructions. The cutout contours 25 are densely arranged to provide support and positioning for such through guided elements in tight clusters. At the same time, the cutout contours 25 provide spacing preferably in compliance with well known building codes and the like.

[0022] In the example of insert 20A, the cutout contours 25 are substantially square except peripheral cutout contours 25 limited by the surrounding fit ring 28 as shown in FIG. 2. Also, for the insert 20A, the cutout contours 25 extend all the way up to the ribs 26. The ribs 26 enforce the cutout contours 25 by providing structural support of and load transfer from the cutout contours 25 towards attachment features and interface features of the inserts 20A-20F such as the flange 21, fit ring 28 and load rest 27. The ribs 26 support against gravitational loads of the guided through elements as well as against eventual other loads commonly associated with imperfect assembly conditions of the through guided elements. The cutout contours 25 may be concentrically arranged with respect to the fit ring 28 as shown in FIGS. 3-5 and 8-10. Alternately, the cutout contours 25 may be linearly arranged as illustrated in FIGS. 1, 2.

[0023] The fit ring 28 is adjacent the flange 21 and may comply with its outside contour to the hole diameter HD of the standardized web hole 14 for positioning the insert 20A-20F within the web hole 14. Such web hole 14 may be cut into the web 13 via a specialized tool that cuts the hole with diameter HD and with a predetermined chord offset OF from at least one but preferably both of top chord 12 and bottom chord 11. Such specialized tool may one as described in the cross referenced patent titled "I-joist Hole Cutting Apparatus". Hole diameter HD and chord offset OF are preferably predetermined in accordance with well known static and other safety criteria well known for I-joists employed in architectural constructions.

[0024] The inserts 20A-20F are preferably dimensioned in accordance with standardized hole diameter HD and chord offset OF for an I-joist 10 of a dimensional standard characterized also by web height WH. For example, at the time of the present invention was made, there exist dimensional standards in the United States for web heights WH of at least between 4.5" and 13.0" with corresponding hole diameters HD may be about 0.5" or 0.75" in diameter smaller than the web heights WH making the standardized offsets OF about 0.25" and 0.375".

[0025] Referring to FIG. 3, an exemplary insert 20B may have cutout contours 25 that recess from the ribs 26 and/or are shaped independently from the ribs 26. In the exemplary embodiment represented by insert 20B, the cutout contours 25 may be of substantially circular shape and concentrically arrayed within the boundaries of the fit ring 28. The ribs 26 may be arranged correspondingly in star like fashion with an optional central ring like rib portion around a central cutout.

[0026] Referring to FIG. 4, an exemplary insert 20C may have a number of well known snap fingers 29 resiliently attached or being a resilient portion of insert 20C. The snap fingers 29 may be dimensioned and positioned in a well known fashion such that a full insertion of the insert 20C in the standardized web hole 14 results in an interlocking engagement between the snap fingers’ 29 hook tips and the side of the web 13 that is opposite to the insertion side. The snap fingers 29 are preferably recessed into the fit ring 28 such that they fit together with the fit ring 28 within the web hole 14.

[0027] The present invention includes embodiments, in which the fit ring 28 is other than circular. Referring to FIG. 5 and in the preferred case of a circular fit ring 28 corresponding to a circular web hole 14 as described above, an exemplary insert 20D may be attached to the I-joist 10 at a web hole 14 via a thread flange 40A or 40B as shown in FIG. 7. In such embodiment and as is illustrated in FIG. 8, the insert 20D may feature a thread ring 23 extending next to the fit ring 28. The thread ring 23 has an outside thread corresponding to an internal thread of the thread flange 40A. In that way, the web 13 is sandwiched between the flanges 21 and the thread flange 40A, 40B once the insert 20D is assembled with the I-joist 10. The thread flange 40A may feature a secondary cord rest 41 that may at least partially conform to an inside contour of at least one of top chord 12 and bottom chord 11. The primary and secondary cord rests 211, 41 may alternately serve to oppose the rotational movement and torque between thread flange 40A, 40B and the insert 20D during tightening and to eventually transfer gravitational loads from through guided elements onto the bottom chord 11. A thread flange 40B may feature a groove features 42 that may puncture the web 14 during tightening of the insert 20D and prevent thereby inadvertent rotation of the thread ring 40B. Features of thread rings 40A, 40B may be combined as may be well appreciated by anyone skilled in the art.
Referring to FIG. 9, an exemplary insert 20E may feature a cut thread 24 on the circumference of the fit ring 28. The cut thread 24 may be configured in a well known fashion such that a rotational movement of the insert 20E at a cut web hole 14 causes the insert 20E to cut into the web hole 14 in a spiraling movement until the flange 21 is fully threaded into the web 13. Friction of the cut thread 24 within the web hole 14 may assure a reliable interconnection of the insert 20E with the I-joist 10.

Referring to FIG. 10, an exemplary insert 20F may be combined with an I-joist support 50 as described in the cross referenced application titled “Buckling Opposing Support for I-joist”. I-joist support 50 may be additionally employed in cases where either the web hole 14 is inadvertently fabricated with dimensions exceeding the corresponding safety standard and/or in cases where gravitational loads received by the insert 20F may require an intermediate load transfer and broader load distribution onto the I-joist 10 via the I-joist support 50.

The I-joist support 50 may feature attachment holes and a chord rest 54 for a rigid interconnection between I-joist support 50 and I-joist 10 such that load carrying capacity and/or buckling resistance of the I-joist 10 is improved.

Gravitational load transfer may be provided from a load rest 27 of the insert 20F onto a correspondingly shaped central contour 51 of the I-joist support 50. In case of a U-shaped support 50, the load rest 27 may correspond to a central arc of the central contour 51 as illustrated in FIG. 10. Gravitational load transfer may also be provided via attachment pins simultaneously engaging in attachment holes 22 and correspondingly positioned insert alignment holes 53. Regardless the exemplary illustration of FIG. 10 and as may be well appreciated by anyone skilled in the art, the insert 20F may feature any other elements described in the embodiments above for attachment to the web 13 and optionally in addition to the I-joist support 50.

For example, a thread ring 40A may be shaped in correspondence to the central contour 51 and/or to the chord rest 54 such that gravitational load may be transmitted from the insert 20D via the thread ring 40A onto the I-joist support 50. In that case, merely the ring 40A may be provided in different configuration to provide combined and exclusive utilization of insert 20D and I-joist support 50.

Inserts 20A-20F are preferably monolithically fabricated from plastic. Thread flange 40A, 40B may be fabricated from plastic or sheet metal. I-joist support 50 may be fabricated preferably from sheet metal.

Accordingly, the invention described in the specification above is set forth by the following claims and their legal equivalent:

What is claimed is:

1. An I-joist web hole insert comprising:
   a. a fit ring adjacent said flange for positioning said insert within said I-joist web hole;
   b. a flange radially extending at one and of said ring for positioning said insert with respect to an insertion side of said web;
   c. a number of cutout contours arrayed within said fit ring; and
   d. an attachment feature for attaching said insert to said I-joist.
2. The insert of claim 1, wherein said attachment feature are attachment holes positioned on said flange in a radially outward distance to said fit ring;
3. The insert of claim 1, wherein said attachment feature is a snap finger recessed into said fit ring such that said snap finger fits together with said fit ring within said web hole and such that a hook tip of said snap finger snaps behind a web side opposite said insertion side.
4. The insert of claim 1, wherein said flange further comprises a primary chord rest at least partially corresponding to an inside contour of a chord of said I-joist.
5. The insert of claim 1, wherein said cutout contours are enforced via ribs.
6. The insert of claim 1, wherein said cutout contours are concentrically arrayed with respect to said ring.
7. The insert of claim 1, wherein said flange is circular.
8. The insert of claim 7, wherein said attachment feature is an outside thread placed on said ring.
9. The insert of claim 8, wherein said outside thread is a cut thread configured such that said insert may be said attached by threading said insert with said outside thread into said web hole.
10. The insert of claim 8, wherein said outside thread is provided by a thread ring extending next to said fit ring, said outside thread being configured in conjunction with an inside thread of a thread flange such that said insert is said attached by sandwiching said web between said flange and said thread flange via said thread flange screwed on said outside thread.
11. The insert of claim 10, wherein said thread flange features a secondary chord rest at least partially corresponding to an inside contour of a chord of said I-joist.
12. The insert of claim 1, wherein said insert further comprises a load rest at least partially corresponding to a central contour of a web stiffening support providing buckling reducing support of said web adjacent said web hole.
13. The insert of claim 1 made of plastic.
14. An I-joist web hole support system comprising:
   a. a web stiffening support having a central contour;
   b. an insert having:
      i. a fit ring adjacent said flange for positioning said insert within said I-joist web hole;
      ii. a flange radially extending at one and of said ring for positioning said insert with respect to an insertion face of said web;
      iii. a number of cutout contours arrayed within said fit ring;
      iv. an attachment feature for attaching said insert to said I-joist;
      v. a load rest at least partially corresponding to said central contour.
15. The web hole support system of claim 14, wherein said web stiffening support has a U-shape and wherein said load rest said corresponds to a central arc of said central contour.
16. The web hole support of claim 14, wherein said web stiffening support further comprises a load rest for resting on an inside contour of a chord of said I-joist.

17. The web hole support of claim 14, wherein said web stiffening support further comprises alignment holes corresponding to holes of said attachment features being positioned on said flange.

18. The web hole support system of claim 14, wherein said web stiffening support is made of sheet metal.

19. The web hole support system of claim 14, wherein said insert is made of plastic.

20. An I-joist comprising:
   a. a web hole; and
   b. an insert inserted in said web hole and attached to said I-joist;

wherein said insert has a cutout contour for guiding through at least one of a pipe, a tube and a cable through said web hole without direct contact between said web hole and said at least one of a pipe, a tube and a cable.