A joist end cap is provided for fitting onto an end of an I-joint 1030. The I-joint comprises two flanges 1050, 1060 and a web 1120, and the end cap comprises two protrusions 1010, 1020 which extend from a front face of an end wall 1080 of the cap and define a space therebetween. The space is adapted to receive an end of the I-joint web 1120. The space has a depth in a direction parallel to a direction of extension of the protrusions and the front face extends, in use, between the flanges 1050, 1060 of the I-joint fitted with the end-cap. The protrusions 1010, 1020 may be resiliently biased to engage the web or the flanges of the I-joint.
"A Joist end-cap"

The present invention relates to a Joint end-cap intended to limit and/or prevent air or other gas leakage at I-joist ends.

Many situations exist where warm air can potentially leak out of a building such as at window openings, door openings of through electrical light sockets. In addition, the area around the perimeter of timber joists which have been built in to masonry walls is also a location where warm air leakage can occur. In this situation the mortar around the timber and the timber itself will sink as it dries and gaps will appear where each joist enters the wall, creating a path for air to leak to the outside.

The problem is particularly acute in the case of timber I-joists since although they do not shrink as much as solid timber joists (because they are drier to start with), there is a void between the masonry blocks situated at each side of the I-joist and the central web of the I-joist, which must be filled up with mortar. However, when the mortar is applied, it tends to slump downwards or shrink when it is drying to leave gaps for air to leak through.

Consequently, the recommended construction detail for supporting floor joists is therefore to support them in metal joist hangers. Hangers of this type have a thin steel flange which penetrates the masonry wall and the joist is supported by the hanger outside the wall. The joists therefore cannot penetrate the wall.

However the use of hangers has a number of problems associated with it:
1. Hangers are relatively expensive.
2. Their use increases the potential for site errors because the joist must be accurately cut to length to fit in between the wall and hangers.
3. Increased potential for squeaks.
4. Hangers have no ability to resist upward loads (these might occur where joists span over internal walls where they have two spans).
5. There is no longer any effective tying in between the masonry walls and the timber floors.
6. The hangers place eccentric loads on the masonry walls, which when the mortar is still young, sometimes means the walls can get pulled over if the joists are overloaded during construction.

In view of the above it is desirable to build joists into masonry walls but it is also desirable to ensure that the connection point in the masonry wall is air tight.

One possible solution to this problem is the use of silicone sealants around the perimeter of solid timber joists where they enter masonry walls. In cases where I-joists are used, plywood or a similar packing material can be used adjacent to the I-joists web to make the end a rectangular solid section once more and to combine this with the use of silicone sealant around the periphery.

However, experience with the plywood-in-sealant option has demonstrated that the plywood packers are laborious to fit on-site and if pre-fixed in the I-joist factory cause production issues and mean that fewer I-joists could be carried on in a single delivery container therefore increasing transport costs. In addition gaps were commonly found between the plywood packers and the I-joist webs because of the
difficulty in obtaining a tight fit between the two using nails or screws. The use of silicone sealant was technically difficult and often done as an additional operation after the mortar in the joist had been left to dry.

It is an object of the present invention to provide a Joist end-cap which seeks to overcome the aforementioned problems.

According to the present invention there is provided a joist end-cap for limiting gas leakage at an end of an I-joist, the device having a face from which two protrusions extend and define a space therebetween, said space being adapted to receive an end of an I-joist web, the face being sized to extend between flanges of the I-joist.

Preferably, the two protrusions are resiliently biased towards each other so as to provide a friction fit with the I-joist web.

Conveniently, each protrusion tapers from a point in the region of its end remote from the face to its root at the face.

Advantageously, the two protrusions are chamfered at ends of the protrusions remote from the face to provide an opening to the space between the protrusions.

Preferably, the end-cap is provided with flanges adapted to cover, in use, flanges of the I-joist.

Conveniently, the face is a face of an end-wall of the end-cap, the end-wall having a predetermined thickness in a direction parallel to a direction of extension of the two protrusions from the face, the extension of the two protrusions from the face defining a predetermined depth of the space in the direction parallel to the direction of extension of the two
protrusions from the face, the thickness of the end-wall and the depth of the space being predetermined such that, in use, when the end of the l-joist web is inserted fully into the space, the end-wall of the end-cap projects beyond an l-joist flange in a direction parallel to the direction of extension of the two protrusions from the face.

Advantageously, the joist end-cap is manufactured using a wood composite material.

Alternatively, the joist end-cap is manufactured using solid wood.

As a further alternative, the joist end-cap is manufactured using plastic.

In accordance with an aspect of the present invention there is provided apparatus for limiting gas leakage at l-joist ends, the apparatus comprising,
a body having a continuous first rear surface and a second surface containing a channel which extends towards the rear surface, said channel being adapted to receive an end of an l-joist web and wherein at least part of the continuous first surface is sized to extend between flanges of the l-joist.

Preferably, the channel is defined by walls that are resiliently biased to provide a frictional fit to the l-Joist web.

Preferably, the walls defining the channel taper outwards from a minimum width located towards the second surface to a maximum width located towards the first surface.

Preferably, the walls defining the channel are chamfered near to the second surface to provide a widened opening to the channel.
Preferably, the continuous first rear surface is provided with flanges adapted to extend across the l-joist flanges.

Preferably, the extent of the channel towards the first surface is predetermined such that when the end of the l-joist web abuts against the end face of the channel near the first surface, the first surface projects outwards with respect to the l-joist flanges.

Preferably, the apparatus of the present invention is made of a wood composite material.

Preferably, the apparatus of the present invention is made of solid wood.

Optionally, the apparatus of the present invention is made of plastic.

In order that the present invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows the end of an l-joist which has been located inside a wall;

Figure 2 is a perspective view of the first embodiment of the present invention;

Figure 3 is a side view of a wall;

Figure 4A is a side view of a wall containing an l-joist beam and the apparatus of the first embodiment of the present invention and Figure 4b is a plan view along the line a-a of the same;
Figure 5 is a perspective view of a second embodiment of the present invention;

Figure 6 is a side view of the second embodiment of the present invention in use with an I-joist;

Figure 7 is a plan view of the third embodiment of the present invention;

Figure 8 is a plan view of the third embodiment of the present invention in use;

Figure 9 is a perspective view of the third embodiment of the present invention;

Figure 10 is a perspective view of the fourth embodiment of the present invention.

Figure 11 is a perspective view of another embodiment of the disclosed joist end cap.

Figure 12 is a perspective view of the joist end cap depicted in Figure 11 in engagement with an I-joist and inserted into a support such as a wall.

Figure 13 is a sectional view of the embodiment of the end joist cap depicted in Figure 12.

Figure 14 is a perspective view of another embodiment of the disclosed joist end cap.
Figure 15 is a plan view of the joist end cap depicted in Figure 14 in engagement with an I-joist and inserted into a support such as a wall.

Figure 16 is a perspective view of another embodiment of the disclosed joist end cap.

Figure 17 is a perspective view another embodiment of the disclosed joist end cap.

Figure 18 is a side view of the embodiment of the joist end cap depicted in Figure 17.

Figure 19 is a side view of a modified embodiment of the joist end cap depicted in Figure 17.

Figure 20 is a perspective view of another embodiment of the disclosed joist end cap comprising two separate inserts.

Figure 21 is a perspective view of the joist end cap depicted in Figure 20 in engagement with an I-joist and inserted into a support, such as a wall.

Figure 22 is a sectional view of the joist end cap depicted in Figure 21 in engagement with an I-joist and inserted into a support, such as a wall.

Figure 1 shows an I-joist 1 positioned in the side an I-joist cavity 3 in a wall 5. The I-joist is of known construction having end flanges 23 and a web 25 which connects these end flanges 23. It can be seen from Figure 1 that the cavity surrounding the I-joist will extend the length of the I-joist and provide a location from where air can leak from the building.
Figure 2 shows a first embodiment of the present invention which has a front surface containing a channel which extends towards the back surface. In this example flanges and 17 are provided at a top and bottom of the apparatus. The flanges provide an additional means for preventing the escape of air from the area around the l-joist because the flanges are designed to fit over the l-joist flange and in particular to remove any gaps which could arise between the bottom of the l-joist flange and the top and bottom surfaces of the apparatus.

As can be seen in Figures 4a and 4b, the apparatus fits on to the end of the l-joist, such that the end of web 25 is contained within the channel. This fit is achieved by having a degree of resilience within the walls of the apparatus which define the channel such that the walls of the channel are biased to come together around the web. As a result, an air-tight fit is achieved once the channel has been attached to the web. It should also be noted that Figure 4a shows the bottom surface abutting against the top surface of the l-joist flange in order to prevent air leakage at this point.

Figure 4b shows that mortar 28 has been added to the gaps at the sides of the l-joist. It should also be noted that the mortar extends to the positions around the web itself adjacent to the apparatus.

Figure 5 shows an apparatus in accordance with the second aspect of the present invention having a front surface, a rear surface, and a channel. In contrast to the first embodiment of the present invention this embodiment does not contain top and bottom flanges. The apparatus in this embodiment and the first and third embodiments of the invention is manufactured from the same material as the l-joists.
In these embodiments, closely tolerated versa-lam LVL material is used.

In this example of the present invention the apparatus 107 was cut to precise lengths to fit between the flanges of the I-joist with sufficient space (approximately 2-4mm) to avoid load transfer into the block. This resulted in a small gap between the top or bottom of the apparatus and the I-joist flange, which allowed a small degree of air leakage to occur.

The performance of the apparatus of the second embodiment of the present invention was compared with the performance of alternative timber joists/masonry wall junctions. A series of air leakage tests were undertaken where the performance of these blocks was measured against the performance of a plain wall. The following were used:

1. Masonry hangers built into the wall;

2. I-joists build into the wall and mortared-up (ie no web-fillers);

3. I-joists built into the wall with plywood web fillers fitted and a mastic sealant applied between the ply filler/masonry junction.

4. I-joists built into the wall with plywood web fillers fitted with a mastic sealant applied between both the ply web filler/masonry and the web/ply filler junctions.

5. I-joists built into the wall in accordance with the second embodiment of the present invention (shown in Figure 5) fitted to the end of the I-Joist (no mastic sealants applied).

All joists used in the test programme were 45 x 241mm I-joists.
Under 50Pa positive pressure, the comparative air leakage performance of these various wall constructions, expressed as a percentage of the plan/control wall performance, is summarised below:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Detail</th>
<th>Leakage Performance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plain/control wall</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Joist hangers</td>
<td>123%</td>
</tr>
<tr>
<td>3</td>
<td>Present invention (second embodiment)</td>
<td>147%</td>
</tr>
<tr>
<td>4</td>
<td>Mortared-up end</td>
<td>165%</td>
</tr>
<tr>
<td>5</td>
<td>Ply filler + 2 mastic seals each side of the l-Joist</td>
<td>190%</td>
</tr>
<tr>
<td>6</td>
<td>Ply filler + 1 mastic seal each side of the l-Joist</td>
<td>400%</td>
</tr>
</tbody>
</table>

The results show that the second embodiment of the present invention exhibit slightly greater leakage than the joist hanger but performed considerably better than any of the other existing solutions tested. Test results for the first embodiment of the present invention are not available. However, in view of its more air tight construction it can be assumed to perform as well, if not better, than the apparatus of the second embodiment.

An arrangement similar to the arrangement provided during the test is shown in Figure 6. Figure 6 shows the apparatus of the second embodiment of the present invention fitted to the end of an l-joist and shows space above and below the apparatus 107 and also shows that it extends outwards slightly from the plain of the end of the l-joist beam 1.
Figure 7 is a plan view of the apparatus 207 of the third embodiment of the present invention. Taking this figure in conjunction with Figure 9, which is a perspective view of this embodiment, it can be seen that the apparatus 207 consists of a front surface 211, a rear surface 213 and a channel 209 extending through the front surface 211 towards the rear surface 213. The channel 209 in this embodiment is provided with a chamfered leading section which provides a widened entry into the channel 209, the chamfering extending inwards to the narrowest point of the channel 220. The channel extends towards the rear surface 213 and the width of the channel increases from the narrowest point 220. The channel is therefore widest at the rear most point of the channel 209 in this embodiment. The apparatus of the third embodiment is also provided with top and bottom flanges.

Figure 9 is a perspective view of the top portion of the apparatus of the third embodiment and shows the top flange 205 extending upwards from the rear surface 213.

Figure 8 shows the third embodiment of the present invention in use. As is shown, the web 25 of an I-joist (the flanges of which have been removed from the figure for clarity) is inserted into the channel 209 to the back to the channel and is held at the narrowest point 220. During insertion of the web the leading edge 26 of the web 25 is forced through the channel 209. This process is assisted by the presence of the chamfered section 221 which allows the web 25 to easily locate the channel 209.

In addition, the action of the leading edge 26 of the flange 25 on the narrowest point 220 and the tapering of 219 of the walls of the channel provides additional resilience and elasticity to the walls of the channel allowing them to bend outwards slightly to accommodate the web 25 of
the l-joist. Once the web has been fully inserted into the channel the elasticity and resilience of the channel closes around the web providing a tight fit.

Once the flange 25 has been inserted, mortar 28 is applied around the apparatus to seal the l-beam 1 and apparatus in place. As the apparatus does not extend across the full width between the wall members 5a and 5b the mortar encloses the apparatus and adheres to the chamfered surfaces 221. This has the effect of making the path that any escaping air would have to follow, more convoluted and makes it more difficult for the air to escape.

Figure 10 is a perspective view of the upper portion of a fourth embodiment of the apparatus of the present invention. This embodiment of the present invention has a channel 309 that is very similar in construction to the channel provided for the third embodiment of the present invention. However, the embodiment of the invention in Figure 10 does not contain upper or lower flanges.

The present invention has a number of advantages over the prior art:

1. It is simple and quick to fix to the end of an l-joist.
2. Once fitted it is extremely hard to inadvertently remove.
3. It provides an effective mortar lock for any joist width and removes the need for mastic or other similar seals.
4. Its air leakage performance is superior to most other air leakage solutions and it is cheaper and allows the l-Joist to be built into the wall, unlike joist hangers.
5. It can be made in the factory from the same wood materials as the l-joist itself, therefore shrinkage and differential movement are negligible.
6. Without significantly compromising the air leakage characteristics of the wall, it provides an extremely cost effective means of realising the significant benefits of building joists into walls, namely:

1. Simple floor construction without expensive propping.
2. Tolerance for inaccurate block work.
3. Simple cost effective lateral restraint (tying-in) to walls.
4. Concentric load application to walls.
5. Speedier built process with less construction health and safety risks.

Improvements and modifications may be incorporated herein without deviating from the scope of the invention.

The above-described embodiments of the present invention may be understood in an alternative manner, which now follows.

All four of the above-described embodiments of the present invention have a rectangular end wall which has a rear face and a front face 50; 150; 250; 350. Two protrusions extend from the front face 50; 150; 250; 350 in a substantially parallel fashion to each other and substantially perpendicular to the front face 50; 150; 250; 350 thus defining a space therebetween. The space has a predetermined depth in a direction parallel to a direction of extension of the protrusions from the front face 50; 150; 250; 350 which is dictated by the extension of the protrusions from the front face 50; 150; 250; 350 (i.e. the length of the protrusions).

The end-wall has a predetermined thickness defined by the separation between its front and rear faces, i.e. in a direction parallel to a direction of extension of the two protrusions from the front face 50; 150; 250; 350.
The first and third above-described embodiments of the invention further feature flanges which extend away from the end-wall in the plane of the end-wall.

Each of the two protrusions of the third and fourth above-described embodiments of the invention tapers from a maximum width at a point in the region of its end remote from the front face 50; 150; 250; 350 to its root at the front face 50; 150; 250; 350. Each of the protrusions are chamfered at the ends thereof remote from the front face 50; 150; 250; 350 to provide an opening to the space between the protrusions.

All four of the above-described embodiments and invention may be manufactured using a wood composite material, solid woods or plastic, or any other material having suitable qualities for this application.

In use, the space is adapted to receive an end of an I-joist web. The two protrusions of each of the four embodiments are resiliently biased towards each other so as to provide a friction fit with the I-joist web. Furthermore, in each case, the front face 50; 150; 250; 350 is of a predetermined size such that it extends between the flanges of the I-joist.

In the cases of the first and third above-described embodiments of the present invention, the flanges are of a predetermined length such that, in use, they extend across the flanges of the I-joist at either end of the I-joist web.

In each of the above-described four embodiments of the present invention, the thickness of the end wall and the depth of the space are predetermined such that when the end of the I-joist web is inserted fully into the space of each joist end-cap the end-wall of the end-cap projects
outwards with respect to the I-joist flanges, i.e. the end-wall of the end-cap projects beyond at least one of the I-joist flanges in a direction parallel to the direction of extension of the two protrusions from the front face 50; 150; 250; 350.

In another embodiment of the disclosed joist end cap, and with reference to Figs. 11-13, protrusions 410 extending from the front face 420 of the end wall 430 of the end cap 400 may further include distal flanges 440 attached to their distal ends 450. As shown in Fig. 11, the distal ends 450 of the protrusions 410 are the ends opposite the end wall 430 of the end joist cap 400. The distal flanges 440 are adapted to engage a surface 460 of a support, such as a wall 470 into which the I-joist 480 is inserted, as shown in Figs. 12-13, which further reduces gas leakage at the end of the I-joist.

The distal flanges may be integral with the protrusions, for example in some embodiments the distal flanges are formed as one piece with the protrusion or the entire end cap. Alternatively, the distal flanges may be separate components attached to the protrusions with any suitable fastening means, such as a screw, nail, and/or adhesive.

In certain embodiments the distal flanges are pliable, formed at least in part of a pliable material such as rubber, or a plastic such as polyvinyl chloride, polyurethane, polyethylene. The use of pliable distal flanges allows for greater tolerances in manufacturing as the pliable material can engage a surface of the support, such as the wall 470, into which the I-joist is inserted through a greater range of protrusion dimensions and also through a range of depths into which the I-joist is inserted into the support. For example, in certain embodiments of methods of using the disclosed end cap the pliable distal flange 440 engages the front surface 460 of the support, such as the wall 470, as shown in Fig. 12. In
other embodiments, for example, where the same size end cap is used, but the l-joist is inserted farther into the wall, the pliable distal flange engages a surface of an interior portion of the wall.

In other embodiments the protrusions 410 of the end joist cap 400 are striated on a wall facing surface 490, as shown in Fig. 11. As shown in Fig. 11, the striations 500 are perpendicular to the front surface 420 of the end wall 430 of the joist end cap 400. In other embodiments the striations are parallel to the front surface of the end wall. In still other embodiments the striations extend in random directions, or form a cross hatch pattern on the wall facing surface of the protrusion. In use, the striations accept mortar or other such bonding material used in masonry, surfacing, and plastering when the l-joist and end cap are bonded into the wall, such that the striations key with the mortar to assist in further reducing gas leakage at the end of the l-joist.

The striations are formed in any suitable manner, such as with a router. In certain embodiments, for example, where the protrusions are part of a single plastic end cap piece, the striations are formed by the mold for the end cap.

In another embodiment, with reference to Figs. 14-15, the disclosed joist end cap 600 includes first 610 and second 620 protrusions extending from the front face 630 of the end wall 640 of the joist end cap each comprising at least one first curved and/or angled member 650, 655 which curves or angles towards the other protrusion. Each member 650, 655 has an inner surface 660 wherein the curve or angle forms an inner space 670 (as can be seen in Fig. 15) between at least two points on the inner surface. The first and second protrusions 610, 620 extend substantially parallel to each other and perpendicular relative to the front face 630 of the end wall 640 to define an l-joist receiving space 680.
therebetween adapted to receive the end of the l-joist 700, specifically, the web of the l-joist 690. The first and second protrusions 610, 620 may be biased towards each other to assist in achieving a friction fit with the web of the l-joist. In certain embodiments, the first and/or the second protrusion 610, 620 is divided into a plurality of separate members (not shown).

In the embodiment depicted in Fig. 14, the members 650, 655 of the first and second protrusions 610, 620 have a curved, J-shaped cross section and each member curves towards the other protrusion. As can be seen, the J-curve forms a space 670 between at least two points of the inner surface of each member. In other embodiments the members have a U-shaped cross section and in still other embodiments the members are angled, for example the members have an L-shaped or V-shaped cross section.

The members 650, 655 of the first and second protrusions 610, 620 each have an inside portion 685 adapted to engage the web of an l-joist. For example, the inside portions 690 of the J-shaped members depicted in Fig. 14 are adapted to engage the web 690 of the l-joist 700 by a friction fit when the web 690 is inserted therebetween, as shown in Fig. 15. The inside portions 685 of the members 650, 655 in some embodiments are tapered towards each other so that the l-joist receiving space 680 narrows in the direction of the end wall 640 to assist in achieving a friction fit. In certain embodiments the inside portion of at least one member is resiliently biased towards the inside portion of the other member to further assist in creating the friction fit.

In still further embodiments the inside portions 685 include a friction increasing coating or surface. For example the inside portion in some embodiments is coated with a substance adapted to assist in achieving
a friction fit with the l-joist web. Such a substance may include, for example, an adhesive, tacky, or roughened substance, or any substance having a higher coefficient of friction that the l-joist web, such as rubber. In other embodiments the surface of the inside portion of the member that engages the web is rough, for example, serrated or crosshatched.

The members of the first and second protrusions comprise any suitable material that can be formed in the described curved and/or angled shape and achieve a friction fit with the web of an l-joist. For example, metals, such as steel or aluminum, or plastics, such as high density polyethylene are used in certain embodiments.

In some embodiments the members of the first and second protrusions are attached to the end wall of the joist end cap with any suitable fastening means, such as a screw, nail, and/or adhesive. In other examples the members are welded to the end wall, for example where the end wall and the members are metal. In still other embodiments the members are integral with the end wall, for example where the entire end cap comprises a single work piece, such as a molded plastic work piece. With reference to Fig. 14, the members 650, 655 are attached to the end wall 640 at the long end of the J. In other embodiments the members have a U-shaped cross section and are attached to the end wall at one or both ends of the U.

In certain embodiments the end wall 640 of the end cap 600 includes at least one end-wall flange 710 that extends beyond the protrusions 610, 620 and is adapted to engage a flange 720 of the l-joist. As shown in Fig. 14, the end-wall flange 710 may include at least one fastening point 730, for example, a pre-drilled screw or nail hole, located in a position such that the fastening point will be adjacent at least one l-joist flange
720 when the end-wall flange 710 engages the I-joist 700. Such a fastening point in certain embodiments includes a fastener integral with the end-wall flange, such as one or more sharp cones that can be forced into the I-joist flanges.

In another embodiment of the joist end cap, with reference to Fig. 16, the end cap 800 comprises first and second protrusions 810, 820 extending from the front face 830 of the end wall 840 of the end cap that are adapted to engage at least two outside edges 850 of the I-joist flanges 860. The first and second protrusions 810, 820 extend substantially perpendicularly relative to the front face 830 of the end wall 840 and substantially parallel relative to each other to form a space therebetween 870 adapted to receive an end of the I-joist 880. The width of the space 870 is about the distance between opposite outside edges 850 (opposite edges not shown) of the I-joist flanges 860 so that when the end cap 800 engages the I-joist 880, the first and second protrusions engage the at least two opposite outside edges of the I-joist to create a friction fit.

In some embodiments the first and second protrusions are biased towards each other to assist in creating the friction fit. In still further embodiments the end cap is fastened to the I-joist with any suitable fastening means, such as nails, screws, and/or adhesives. In certain embodiments where the end cap is fastened to the I-joist with fasteners at least one of the first and second protrusions 810, 820 includes at least one fastening point 890, for example, a pre-drilled screw or nail hole, located in a position such that the fastening point will be adjacent at least one I-joist flange 860 when the end cap 800 engages the I-joist 880. Such a fastening point in certain embodiments includes a fastener integral with the first and/or second protrusion, such as one or more sharp cones that can be forced into the I-joist flange.
In some embodiments, and as shown in Fig. 16, the one or more of the protrusions 810, 820 may include one or more keying holes 900. The keying holes 900 as depicted in Fig. 16 are circular, but in other embodiments the keying holes have any other shape, such as a square or a star. The keying holes are located on the protrusion in a manner to allow mortar to pass through the protrusion into a gap between the protrusion and the web of the I-joist when the I-joist and end cap are bonded into a support such as a wall, for example with mortar or other suitable bonding material. The bonding material in the gap assists in reducing gas leakage at the end of the I-joist.

The protrusions 810, 820 in certain embodiments are integral with the end wall 840, for example, where the entire end cap is formed in a single piece. In other embodiments the protrusions are separate components that are attached to the end wall, for example by a fastener such as a screw, nail, or adhesive. The protrusions comprise any suitable material that can be formed in the described shape and achieve a friction fit with the flanges of an I-joist. For example, in certain embodiments the protrusions comprise wood, metal, such as steel or aluminum, or plastics, such as high density polyethylene.

In another embodiment of the disclosed joist end cap, the end cap is adapted to engage inner and/or outer surfaces of the flanges of an I-joist, rather than the web, or in addition to the web. In this embodiment the end cap comprises a plurality of protrusions extending from the front face of the end wall of the joist end cap which are adapted to engage the flanges of the I-joist.

In the embodiment depicted in Fig. 17, the end cap 1000 comprises inner protrusions 1010 and outer protrusions 1020 defining spaces
therebetween adapted to receive the end of the l-joist 1030, specifically the flanges 1040 of the l-joist. The inner protrusions 1010 are adapted to engage an inner surface 1050 of the l-joist flanges 1040, while the outer protrusions 1020 are adapted to engage an outer surface 1060 of the l-joist flanges.

The inner protrusions 1010 comprise one or more inner members 1070 that extend from the front face 1080 of the end wall 1090. In the embodiment shown in Fig. 17 the inner members comprise a first set of inner members 1100 including at least one inner member that extends substantially perpendicularly to the front face 1080 and a second set of inner members 1110 including at least one inner member that extends substantially perpendicular relative to the front face 1080 of the end wall 1090 of the end cap 1000. The first and second sets of inner members 1100, 1110 may be substantially parallel to each other as well. In some embodiments, the first and second sets of inner members 1100, 1110 may be biased away from each other, as shown in Fig. 17. The inner members 1010 engage the inner surfaces 1050 of the l-joist flanges 1040 by a friction fit. In some embodiments at least one member in the first set of inner members 1100 is resiliently biased away from at least one member of the second set of inner members 1110, or visa versa, to assist in achieving a friction fit with the inner surfaces 1050 of the l-joist flanges. As depicted in Fig. 17, the first and second sets of inner members 1100, 1110 include members adapted to be located on either side of the web 1120 when the end cap 1000 is in engagement with an end of the l-joist 1030. However, in some embodiments the first set 1100 or the second set 1110 of inner members may include members located only on one side of the web 1120. For example, in certain embodiments the first set of inner members is adapted to be located on one side of the web and the second set of inner members is adapted to be located on the other side of the web when the end cap engages the l-
joist. Further, in some embodiments each inner member is divided into a plurality of separate inner members.

The outer protrusions 1020 comprise one or more outer members 1130 that extend from the front face 1080 of the end wall 1090 substantially perpendicular relative to the front face of the end wall of the end cap 1030. In certain embodiments, and as shown in Fig. 17, there are at least two outer protrusions 1020 biased towards each other each comprising one or more outer members 1130.

In the embodiment shown in Fig. 17, the outer members comprise a first set of outer members 1140 including at least one outer member that extends substantially perpendicular relative to the front face 1080 of the end wall 1090 of the end cap 1000 and a second set of outer members 1150 including at least one outer member that extends substantially perpendicular relative to the front face 1080. The outer members 1130 engage the outer surfaces 1060 of the I-joist flanges 1040 by a friction fit. In some embodiments at least one member of the first set of outer members is resiliently biased towards at least one member of the second set of outer members, or visa versa, to assist in achieving a friction fit with the outer surfaces of the I-joist flanges. In some embodiments, the first and second sets of outer members 1140, 1150 may each comprise a single member adapted to extend substantially across an entire width of the I-joist flange 1040. In other embodiments, and as depicted in Fig. 17, one or more of the first and second sets of outer members 1140, 1150 may comprise a plurality of separate outer members.

In some embodiments the end cap 1000 comprises either inner protrusions 1010 or outer protrusions 1020, but not both. For example, the embodiment depicted in Fig. 19 shows an end cap 1160 comprising
only inner protrusions 1170. With reference to Fig. 19, the inner protrusions 1170 comprise a first set of inner members 1180 and a second set of inner members 1190 extending substantially perpendicular relative to the front face 1210 of the end wall 1200 of the end cap 1160. The first and second sets of inner members 1180, 1190 are biased away from each other to assist in achieving a friction fit with the flanges 1220 of the l-joist. Alternatively, the end cap may comprise two inner protrusions and one outer protrusion, or two outer protrusions and one inner protrusion.

The inner and outer protrusions may comprise substantially straight members, for example, as in the inner protrusions 1170 shown in Fig. 19. In other embodiments the inner and outer protrusions comprise first and second sets of inner and outer members including distal ends wherein the distal ends of the first set of inner members are bent to assist in guiding the l-joist flanges between the members. As shown in Fig. 18, the distal ends 1230 of the first set of inner members 1100 are bent towards the second set of inner members 1110, and visa versa, and the distal ends 1240 of the first set of outer members 1140 are bent away from the second set of outer members 1150, and visa versa. The protrusions have any suitable geometric cross section, such as, for example, a square cross section, or an oval or circular cross section.

In others embodiments the surfaces of the protrusions that contact the l-joist flanges include a friction increasing coating or surface. For example the surfaces of the protrusions that contact the l-joist flanges in some embodiments are coated with a substance adapted to assist in achieving a friction fit with the l-joist flanges. Such a substance includes an adhesive, tacky, or roughened substance, or any substance having a higher coefficient of friction than the l-joist flanges, such as rubber. In
other embodiments the surfaces of the protrusion that contact the I-joist flanges are rough, for example, serrated or crosshatched.

The inner and outer protrusions may be integral with the end wall, for example where a complete joist end cap is molded in one piece. Alternatively, the inner and outer protrusions may comprise components attached to the end cap with any suitable fastener, such as, for example, screws, nails, and/or adhesive. The protrusions comprise any suitable material that can be formed in the described shapes and achieve a friction fit with the web of an I-joist. For example, wood, metals, such as steel or aluminum, or plastics, such as high density polyethylene are used in certain embodiments.

In another embodiment, with reference to Figs. 20-21, the joist end cap 1300 comprises two or more inserts 1310 adapted to fit between the flanges 1370 of the I-joist 1385 and against the web 1380. The inserts 1310 comprise an inner block portion 1320 and an outer flange portion 1330. The inner block portion 1320 has a height 1330, a depth 1340, and a width 1350. The height 1330 of the inner block portion 1320 is about the distance between opposing inner surfaces 1360 of I-joist flanges 1370, as shown in Fig. 21. The depth 1340 is about the distance from the web 1380 of the I-joist 1385 to the outer edge 1390 of the flange 1370 of the I-joist, as shown in Fig. 21. The width 1350 of the inner block portion is at least as wide as a width 1400 of the outer flange portion 1330, as can be seen in Fig. 20. With reference to Fig. 20, the outer flange portion 1330 has a height 1340 of at least the height 1330 of the inner block portion 1320. In certain embodiments and as shown in Fig. 20, the height 1340 of the outer flange portion 1330 is longer than the height 1330 of the inner block portion 1320 and is about the distance between opposite outer surfaces 1350 of the flanges 1370 of the I-joist, as shown in Fig. 21. With reference again to Fig. 20, the width 1400 of
the outer flange portion 1330 is equal to or less than the width 1350 of the inner block portion 1320. The outer flange portion 1330 also has a depth 1410 of any convenient distance, for example, about one or two times the depth 1340 of the inner block portion 1320, as shown in Fig. 20.

In a method of using the disclosed inserts 1310 to prevent and/or reduce gas leakage at an end of the l-joist 1385, the inner block portions 1320 of the inserts 1310 are inserted between the flanges 1370 of the l-joist 1385 to engage the inner surfaces 1360 of the l-joist flanges 1370 at an l-joist flange facing surface 1440 of the inner block portion and to create a friction fit therebetween and also to engage the web 1380 of the l-joist 1385, as shown in Fig. 21. As shown in Figs. 21 and 22 the outer flange portions 1330 of the inserts 1310 engage a surface 1420 of a support 1430, such as a wall, into which and end of the l-joist 1385 is placed to further prevent and/or reduce gas leakage. The fit between the inserts and the l-joist is augmented in some embodiments by fastening the insert to the l-joist and/or the surface of the support into which the l-joist is placed with any suitable fastening means such as screws, nails, and/or adhesives.

In other embodiments, at least one of the l-joist flange facing surfaces 1440 of the inner block portion 1320 of each insert 1310 includes a friction increasing coating or surface to assist in creating the friction fit with the l-joist flange. Such a coating includes an adhesive, tacky, or rough substance, or any substance having a higher coefficient of friction that the l-joist flanges, such as rubber. In other embodiments l-joist flange facing surface of the insert is rough, for example, serrated or crosshatched.
The inserts comprise any suitable material that can be formed in the described shapes and achieve a friction fit with the web of an I-joist. For example, in some embodiments the inserts are formed, at least in part, from wood, metals, such as steel or aluminum, or plastics, such as high density polyethylene and combinations thereof.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.
PREFERRED FEATURES

1. A joist end-cap for limiting gas leakage at an end of an I-joist, comprising at least two protrusions extending from a front face of an end wall of the joist end cap adapted to engage an end of the I-joist.

2. The joist end cap of clause 1, wherein the protrusions are adapted to engage a web of the I-joist.

3. The joist end cap of clause 2, wherein the protrusions are biased towards each other to provide a friction fit with the I-joist web.

4. The joist end cap of any of clauses 2-3, wherein each protrusion tapers from a point in the region remote from the front face to a root of the protrusion at the front face.

5. The joist end cap of any of clauses 2-4, wherein the protrusions are chamfered at ends of the protrusions remote from the face.

6. The joist end cap of any of clauses 1-5, wherein at least one protrusion further includes a distal flange.

7. The joist end cap of clause 2, wherein the protrusions comprise first and second protrusions each comprising at least one curved or angled member, wherein the curved or angled members curve or angle toward the other protrusion.

8. The joist end cap of clause 7, wherein each curved or angled member has an inner surface, wherein the curve or angle forms an inner space between at least two points on the inner surface.
9. The joist end cap of any of clauses 7-8 wherein the first and second protrusions have a J-shaped cross section.

10. The joist end cap of clause 1, wherein at least two protrusions are adapted to engage outside edges of the I-joist flanges.

11. The joist end cap of clause 10 wherein the at least two protrusions adapted to engage outside edges of the I-joist flanges are biased towards each other.

12. The joist end cap of any of clauses 10-11 wherein the at least two protrusions adapted to engage outside edges of the I-joist flanges include at least one fastening point.

13. The joist end cap of any of clauses 10-12 wherein the at least two protrusions adapted to engage outside edges of the I-joist flanges include keying holes.

14. The joist end cap of clause 1, wherein at least one protrusion is adapted to engage at least one inner surface of a flange of the I-joist.

15. The joist end cap of clause 14, comprising first and second protrusions adapted to engage inner surfaces of the flanges of the joist.

16. The joist end cap of clause 15, wherein the first and second protrusions adapted to engage inner surfaces of the flanges of the joist comprise a first set of inner members having at least one inner member and a second set of inner members having at least one inner member.
17. The joist end cap of clause 16, wherein at least one inner member of the first or second set of inner members is biased away from another member of the first or second set of inner members to provide a friction fit with the l-joist flange.

18. The joist end cap of clause 1, wherein at least one protrusion is adapted to engage at least one outer surface of a flange of the l-joist.

19. The joist end cap of clause 18, comprising at least protrusions adapted to engage outer surfaces of the flanges of the joist.

20. The joist end cap of clause 19, wherein the two outer protrusions adapted to engage outer surfaces of the flanges of the joist comprise a first set of outer members having at least one outer member and a second set of outer members having at least one outer member.

21. The joist end cap of clause 20, wherein at least one outer member of the first or second set of outer members is biased towards another member of the first or second set of outer members to provide a friction fit with the l-joist flange.

22. The joist end cap of clause 1, wherein at least one protrusion is adapted to engage at least one inner surface of a flange of the l-joist and at least one protrusion is adapted to engage at least one outer surface of a flange of the l-joist.

23. The joist end cap of any of clause 1-21, wherein the joist end cap is formed in part from wood.

24. The joist end cap of any of clause 1-21, wherein the joist end cap is formed in part from a wood composite material.
25. The joist end cap of any of clause 1-21, wherein the joist end cap is formed in part from plastic.

26. The joist end cap of any of clause 1-21, wherein the joist end cap is formed in part from metal.

27. A joist end cap for limiting gas leakage at an end of an l-joist, comprising at least two inserts adapted to fit between flanges of an l-joist, wherein the inserts have an inner block portion and an outer flange portion.

28. The joist end cap of clause 27, wherein the inner block portion of at least one insert has an l-joist flange facing surface comprising a friction increasing surface.

29. A method for limiting gas leakage at an end of an l-joist, comprising:

   providing two inserts adapted to fit between flanges of an l-joist, wherein the inserts have an inner block portion and an outer flange portion;

   inserting the inner block portions of the inserts between l-joist flanges on opposite sides of a web of the l-joist so that an l-joist flange facing surface of each insert engages the flange of the l-joist; and

   inserting the l-joist and inserts into a support so that the outer flange portions of the inserts engage a surface of the support.
CLAIMS

1. A joist end-cap for fitting onto an I-joist to limit gas leakage at an end of the I-joist,
   the I-joist comprising two flanges connected by a web,
   the end-cap comprising two protrusions extending from a front face of an end wall and defining a space therebetween,
   which space is adapted to receive an end of the I-joist web,
   the space having a predetermined depth in a direction parallel to a direction of extension of the protrusions from the front face,
   the front face being of a predetermined size such that the front face extends, in use, between the flanges of the I-joist fitted with the joist end-cap.

2. A joist end-cap according to Claim 1 wherein the two protrusions are resiliently biased towards each other.

3. A joist end-cap according to Claim 1 or 2, wherein each protrusion tapers from a point in the region of its end remote from the face to its root at the face.

4. A joist end-cap according to any preceding claim, wherein the two protrusions are chamfered at ends of the protrusions remote from the face to provide an opening to the space between the protrusions.

5. A joist end-cap according to any preceding claim, wherein at least one protrusion further includes a distal flange.

6. A joist end-cap according to Claim 1, wherein the protrusions comprise first and second protrusions each comprising at least one
curved or angled member, wherein the curved or angled members curve or angle toward the other protrusion.

7. A joist end-cap according to Claim 6, wherein each curved or angled member has an inner surface, wherein the curve or angle forms an inner space between at least two points on the inner surface.

8. A joist end-cap according to any of Claims 6 or 7 wherein the first and second protrusions have a j-shaped cross section.

9. A joist end-cap according to any preceding claim, wherein the end-cap is provided with flanges adapted to cover, in use, flanges of the l-joist.

10. A joist end-cap according to any preceding claim, wherein the end-wall has a predetermined thickness in a direction parallel to a direction of extension of the two protrusions from the face, the thickness of the end-wall and the depth of the space being predetermined such that, in use, when the end of the l-joist web is inserted fully into the space, the end-wall of the end-cap projects beyond an l-joist flange in a direction parallel to the direction of extension of the two protrusions from the face.

11. A joist end-cap according to any preceding claim, wherein the joist end-cap is manufactured using a wood composite material.

12. A joist end-cap according to any one of Claims 1 to 10, wherein the joist end-cap is manufactured using solid wood.

13. A joist end-cap according to any of Claims 1 to 10, wherein the joist end-cap is manufactured using plastic.
Application No: GB0706219.3
Claims searched: 1-13
Examiner: Eleanor Wade
Date of search: 3 May 2007

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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The following online and other databases have been used in the preparation of this search report

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Yours faithfully

Eleanor Wade
Examiner