

FIELD OF THE INVENTION

The invention relates to a sheet metal stud, to be partially embedded in a thin panel of concrete, for reinforcement and to a panel of concrete with reinforcing studs and to a method of forming a panel. Also disclosed is a stud
5 for general construction.

BACKGROUND OF THE INVENTION

Concrete panels are usually of thick material. Thin wall panels are made of concrete reinforced by a framework of metal studs. Edges or flanges of the metal studs are embedded in the concrete. The studs extend out from the
0 panels and provide great strength to the panels. The studs also permit the erection and attachment of interior wall panels. It is known that the metal studs conduct heat from the building interior to the outside.

Studs have been formed with generally triangular openings. Diagonal metal struts extended across the studs. Heat losses across the stud were thus
5 reduced. However the builder must run pipes or wires through the studs, within the wall. Where the openings are of unusual shapes the pipes or wires must fit the openings. Also, all openings in the studs in a wall should line up to pass the pipes or wires .

Also the openings had edge flanges around them. The edge flanges had to
0 be formed into a right angle bend for increased strength.

Such edges can make the sheet metal to crack. Consequently the corners had to be rounded out.

For construction use, the studs must be cut off to a specific length. If cutting
5 was not at an exact multiple of the spacing of the openings , the result was that waste end portions of studs must be trimmed off.

It is now found that the use of the special stud openings, is not always necessary. A reduction of heat transfer across the stud is possible using circular openings in the studs. In other cases the openings can be made
10 which are not completely circular, but have rounded corners and some more or less straight sides. In this case the corners could be rounded out over a much greater radius than was formerly used. One of the corners may even be semi-circular. It has been found that by the use of small additional

openings, the heat transfer path can be reduced, so as to improve on the heat transfer reduction.

Circular openings , or openings with rounded corners, avoid the problems caused by the corners of earlier openings and results in a much stronger stud. The use of circular or rounded openings leads to high speed manufacture

The blanks of sheet metal removed in this process provide secondary products of a more convenient shape. This leads to economies since the blanks can be remade into more products which can be sold .

Also the circular or semi-circular openings assists the builder to pass services through the studs.

Also cutting to length of a stud with identical circular openings may result in much less wastage of material.

A stud with all these improvements can be in general use, apart from the reinforcement of a concrete panel. Such a general purpose stud will have minor modifications and simplifications.

BRIEF SUMMARY OF THE INVENTION

The invention provides a composite construction panel having a thin panel of concrete material, a reinforcing grid of sheet metal studs and top and bottom members, characterized in that the studs have embedment portions which are actually embedded into the concrete panel, and wherein each of said studs comprises, a web defining a free edge, right angular flange formed on said free edge, an angular edge strip formed along the free edge of said right angular flange, an embedment flange portion formed along the opposite edge of said web, a retention edge strip formed on said embedment flange portion at an angle thereto, and, a plurality of spaced apart embedment flange openings formed in said angled flange .

The invention also that the embedment flange openings are formed by a series of semi-arcuate openings located spaced apart lengthwise along said embedment flange.

The invention also provides that the studs have web main openings of generally circular shape formed through said web between said embedment

flanges and said free edge flanges, and edges of said circular openings being formed out of the plane of said web to define an annular ring.

The invention also provides a reinforcing stud for use in forming a concrete thin wall panel and a reinforcing grid of sheet metal studs in which the studs have embedment portions which are embedded into the panel, and in which each of said studs comprises, a web defining a free edge, right angular flange formed on said free edge, an angular edge strip formed along the free edge of said right angular flange, an embedment flange portion formed along the opposite edge of said web, a retention edge strip formed on said flange portion at an angle thereto and, a plurality of embedment openings formed longitudinally spaced apart along said embedment flange portion.

The invention also provides a reinforcing stud in which the embedment openings are formed by a series of semi-arcuate openings

The invention also a stud formed with small circular indentations or depressions with openings in the indentations, and in which each opening in each such small indentation is formed as an elongated slot, leaving arcuate portions of sheet metal within the small indentations or depressions, on either side of the slotted opening.

The invention also provides a stud with non-circular main openings, having at least one first radius corner formed as an arc of a circle having a first radius, and with two further lesser radius corners formed as arcs of circles having radii less than said first radius.

The various features of novelty which characterize the invention are pointed out with more particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

IN THE DRAWINGS

Figure 1 is a perspective general illustration of a typical thin wall panel of cast material such as concrete , of the type to which the invention relates illustrating the reinforcing frame of sheet metal studs partially embedded therein;

Figure 2 is a partial perspective of an embodiment of sheet metal reinforcing stud for use with a panel such as the panel of Fig 1;

Figure 3 is a side elevation of the stud of Fig 2;

Figure 4 is a section along line 4-4 of Fig 3;

Figure 5 is a side elevation of a further embodiment of sheet metal reinforcing stud for use where greater loading bearing is required;

Figure 6 is a section along line 6-6 of Fig 5;

Figure 7 is a schematic perspective of a further embodiment of cast panel, in this case there being two such panels poured on opposite sides of the reinforcing frame, to provide a two panel wall construction;

Figure 8 is a section of a further alternate embodiment of stud shown used in the assembly of a two-panel structure, similar to Fig 7;

Figure 9 is a side elevation of another embodiment of stud showing a modified edge flange;

Figure 10 is a section of the embodiment of Fig 9;

Figure 11 is a side elevation of one embodiment of a general purpose stud;

Figure 12 is a section of the embodiment of Fig 11;

Figure 13 is a side elevation of another embodiment of general purpose stud, suitable for heavier duty applications;

Figure 14 is a section of the embodiment of Fig 13;

Figure 15 is a side elevation of a further embodiment of stud in which the small circular indentations are formed with slotted openings;

Figure 16 is a side elevation of a further embodiment of stud in which the main openings are formed in a non-circular shape;

Figure 17 is a section along line 17 -17 of Figs 15, and 16, showing the small indentation and the slotted opening and a slot flanges therealong;

Figure 18 is a section of an embedment flange suitable for any of the foregoing studs;

Figure 19 is a section of an alternate form of embedment flange suitable for use on any of the foregoing studs; and,

Figure 20 is a section of a stud with a right angular flange having a folded strip forming a double thickness of sheet metal, suitable for use with the foregoing studs.

DESCRIPTION OF A SPECIFIC EMBODIMENT

Referring first of all to Fig 1 it will be understood that the invention relates generally to a composite wall panel (10) typically looking somewhat like the illustration of Fig 1. Such a composite panel (10) has a thin panel (12) of cast material, and a reinforcing frame or grid indicated generally as (14), formed of sheet metal studs indicated generally as (16). Typically the cast material is concrete, but various special forms of concrete are available, which would be suitable for the purpose. However the invention is not limited to concrete materials as such, but includes other panel materials which are capable of being cast into a thin panel and allowed to cure. As will be explained below such studs have embedment portions which are embedded into the concrete (12).

Typically the studs (16) may be arranged on twenty-four inch centers, and may have top and bottom transverse studs (18) joining the top and bottom ends of the studs (16). The top and bottom studs will usually be plain C-section studs, for the sake of simplicity in assembly.

In accordance with one embodiment of the invention, as shown in Figs 2,3 and 4, one preferred form of stud (20) is shown by way of illustrating the invention.

The stud (20) has a web (22), of whatever width is desired for the particular application. Along one edge of the web, the "free" edge, ie the edge that will be remote from the concrete panel, there is formed a right angular flange (24). Typically a further angular edge strip (26) is formed along the edge of flange (24), for added stiffness.

Along the opposite edge , the “embedment” edge, of web (22) there is formed, in this case, an embedment flange portion (28) formed at obtuse angle, in this particular embodiment , and having a retention edge strip (30) at an angle to flange portion (28). Preferably strip (30) makes an acute angle relative to flange portion (28), so as to form a type of partial “hook” formation, for secure retention in the panel.

The apex of the embedment flange portion (28) and retention strip (30) will usually be about 3/4 of an inch from the edge of the web for reasons to be described below. However these measurements are merely an indication of what might be typical and are without limitation.

Along the length of embedment flange portion (28) there are formed a plurality of spaced apart openings (32) . Openings (32) are formed as struck out portions of sheet metal. In this case the struck out portions will leave openings (32) which will have one straight edge and one generally arcuate edge . Thus they will form openings (32) of a semi-oval shape. They are relatively long and wide so as to permit material , such as concrete and aggregate to flow readily through such openings during assembly as described below. The straight edge portion of the openings (32) may in fact extend partially into the web (22) itself.

Between the flanges (24) and flange portions (28), there is defined the central portion of the stud known as the web (22). The sheet metal of which the whole stud is formed has a relatively high rate of heat conduction, much greater than that of a conventional wooden stud, for example.

As already explained earlier forms of stud were formed with openings through the web of a complex geometrical shape , leaving diagonal strut portions extending across the web between the flanges. It was thought that by forming these struts along diagonal lines, that the heat conduction path would thus become elongated, and therefore lead to a slower rate of heat conduction across the web. These shapes were to some extent disadvantageous since they required careful engineering of the diagonal struts, particularly at their opposite ends in order to withstand shear forces across the stud. Because the openings were generally triangular in shape

they formed relatively sharp corners. The edge lips on the cross members had to be substantially reduced at these corners, to eliminate splitting of the metal during forming.

It has now been surprisingly found that the rate of heat conduction can be slowed down to the same, or to a greater degree, without forming diagonal struts and complex shaped openings in the web.

In accordance with the invention the web is now provided with a series of identical circular openings (34) spaced apart along the web (22) at regular equal intervals. These openings are formed simply by punching out circular shaped blanks of metal from the web. The circular blanks clearly provide an opportunity for secondary manufacture of unrelated products, thus avoiding wastage of sheet metal.

Around each of the circular openings the edges of the sheet metal are formed over into generally annular flanges (36), which define rings more or less at right angles to the plane of web (22). These have the effect of enlarging the diameter of each opening, and also adding stiffness to the stud. Because there are no sharp angles, and the openings are circular, the bent over edge flanges or rings (36) define a smooth continuous curve.

It is thus possible to provide deeper edge flanges than was possible with the diagonal strut stud, with triangular openings. This provides greater stiffness. Between each opening (34) there is defined a transverse web portion (38) which is of generally hourglass shape. The narrowest part of the web portion (38) is clearly at its mid point (38A). This narrow area will define one area of heat transfer reduction, since clearly the actual mass of sheet metal is least at this point, and heat flow at any given temperature gradient is a function of the mass of the conductor.

In order to increase still further the stiffness of the stud, generally annular depressions (40) are formed in the web, at each end of each of the transverse web portions (38). In order to further slow down the rate of heat transfer, semi-circular openings (42) are formed in depressions (40). The base or straight edge of each of these semi-circular openings forms a diameter of the depression. Each semi-circular opening (42) is formed so

that its curved edge extends towards the mid-point (38A) of each web portion (38)

In this way by removing these small semi-circular portions in the depressions (40) to leave openings (42) located at each of the ends of the web portions (38), the heat transfer path is narrowed once again towards each end of the web portions (38), on either side of the openings (42). This also results in creating generally sinusoidal heat transfer paths, which are thus longer than a direct line from end to end of the web portion (38). These factors still further slow down the rate of heat transfer.

The end result is a metal stud which has heat transfer characteristics close to that of a wooden stud.

Studs made in this way have numerous advantages. They can be manufactured more readily than more complex shaped studs.

The needed engineering characteristics of the studs can be more readily achieved.

The manufacturing process is simpler. The process produces less waste material, and by using the circular blanks for secondary products the waste is almost nil. Given suitable machines the secondary products could in fact be stamped out as part of the whole manufacturing process of the studs themselves.

The studs are easier to use since they can be more readily be cut to length than more complex studs, and with less wastage. The circular openings in the studs are much more suitable for construction techniques, since it becomes possible to pass relatively large services through these openings.

For some applications it may be desirable to provide a stud of greater strength.

In this case the stud of Figs 5 and 6 may be used.

In this case a stud (50) is shown having a web (52), and , along one side a generally triangular tubular edge formation (53) is formed, comprising, and first angled tube wall (54), a transverse tube wall (56), and a return tube wall (58). The three tube walls are formed integrally with the sheet metal of the web. The free edge (59) on return tube wall (58) is secured back to web (22)

by any suitable means, indicated generally as (60). This could be by spot welding, or by a technique known as "metal stitching". In this latter process a punch is forced into the two sheets of sheet metal. A female die opposite the punch receives the formed portions of sheet metal and allows them to expand outwardly, thus forming something like a rivet in the two pieces of sheet metal making a secure bond between the two portions of sheet metal. Another technique is simply to punch out tongue portions (not shown) from both the web and the return flange, and then simply fold the two tongue portions back over themselves, as at (61) (Fig 6), substantially as shown in US Patent No 5,592,848.

Along the opposite edge of the web (52) an embedment flange portion (62) is formed, in this case at an angle to the web (52). An acute angle retention edge strip (64) is formed on flange portion (62). Embedment openings (66) are formed in flange portion (62) as in the embodiment of Figs 2, 3 and 4.

In the use of either the embodiment of Figs 2, 3 and 4 or of Figs 5 and 6, the studs are assembled into a grid similar to that shown in Fig. 1 and the ends of the studs are secured in any suitable manner. Usually top and bottom studs are used to hold all the studs into a framework. The top and bottom studs can be simple C-sections, for convenience.

A thin layer of cast material, such as for example, concrete, is then poured into an open topped mold or form. The mold or form will define the size and shape of the finished panel. In one typical case the layer of cast material may be about 1 ½ inches thick, although this may vary significantly from one job to another. Concrete, or other such materials as thin as ½ inch total may be suitable in some cases. The usual reinforcing steel mesh will be attached to the embedment edges of the grid of studs. The grid of studs with the mesh attached is then brought over the open topped form, with the angled flanges (28) or (62) facing downwards. The grid, and mesh attached thereto, is then lowered down to the material in the form. The mesh and the angled flanges (28) or (62) are then pressed down through the surface of the material. This will also cause the mesh and the edge strips (30) or (64) to be completely submerged in the cast material, such as concrete.

This will allow the still semi-liquid cast material to flow through the embedment openings (32) or (66), in the angled flanges (28), or (62).

The cast material such as concrete is then allowed to cure and set.

The entire composite panel can then simply be lifted out of the form by
5 attaching lifting gear to the grid of studs.

The panel may then be transported to a work site. The panel can then be raised into position and secured to the building fabric, by securing the grid of studs to the existing building.

Once in place the panel covers the exterior of the building, and the grid of
0 studs provide the support for placing insulation batts (not shown) , and dry wall panels (not shown) for finishing the interior walls of the building.

Clearly, if desired, similar or modified panels can be made of lighter gauge materials. Materials other than conventional concrete can be used with advantage By using modified light weight concrete , or special high strength
5 concretes, the panel weight can be reduced. With some such materials it is possible to provide a panel without the use of reinforcing mesh at all. This will permit the use of such panels for finishing interior walls of the building. Special exterior finishes can be cured in place with the cast panel.

Simulated brick veneers can be placed in the form before the material is
0 poured.

They will then form the exterior finish of the building on which the panels are erected.

The system can also be used for making hollow structures, in which two thin wall panels are formed on opposite sides of a grid of studs.

Such structures can be used for floors and ceilings and roofs, or for making
5 more substantial building walls if such are desired. If heavier gauge studs are used these structures can be used as load bearing walls in themselves. This will eliminate the need for pouring building columns and floors, at least in lower buildings.

If desired concrete or other such materials can be poured into the interior of
0 the hollow structure, at intervals, thus providing what are in effect cast columns (not shown), to give still further load bearing capacity.

Such an embodiment is shown in Fig 7.

In this case studs similar either to the Fig 2, 3 and 4 embodiment, or for greater strength, to the Fig 5 and 6 embodiment, are used, as before. Their embedment flange portions (28) or (62) are embedded in a thin-wall panel, such as concrete, indicated as (70), as already described.

On the free exposed flanges (24) or transverse tube walls (56) a layer of metal furring of expanded mesh (72) of a type well-known in the art, and having spaced apart attachment strips (74) formed integrally therewith, is secured by for example bolts (76), or any other suitable fastening system.

A second thin-wall layer of material, such as concrete, (78) is then poured directly onto the mesh (72). The material will flow into the openings in the mesh and will form an effective bond securing the cured material in position, attached to the grid of studs. The composite structure formed by combining a second panel spaced from the first panel (70) defines a hollow wall structure of great strength supported internally by the grid of studs.

For added security the flanges (24) (or transverse walls (56)) of the studs may be formed with locking loops (80). Loops (80) are formed simply by forming two parallel incisions in the flange and then forming the metal outwardly into loops as shown (Fig 7).

The loops will embed securely in the panel and make a secure bond.

It will be appreciated that the studs may be formed of lighter gauge sheet metal for some applications, and heavier gauge for other applications.

Similarly the specifications of the studs may vary from one application to another. For flooring, using the composite spaced panels of Fig 7, studs of up to say 14 inches in depth may be desired in some case, and made of say 12 gauge metal. This will provide great savings in material cost, and savings of costly down time on site, which are normally experienced while thick concrete slab floors are poured and then allowed to cure.

Such composite floors panels can be preassembled with all wiring and ventilation duct work, and plumbing pipes and fittings, in place, in a factory, under controlled conditions using mass production practices.

For walls however studs of say 2 ½ to 8 inches width may be used and formed of 12 to 24 gauge metal. For interior building partitions much lighter specifications may be used, and still produce building partitions superior to conventional building partitions made of two layers of dry wall in the conventional manner. Interior partitions made in this way will have the great advantage that they can be made in a secure factory location, and completely finished, and even dry walled and painted if desired, before they are brought to the actual building site.

Thus factory labor and mass production practices can replace costly on site labor conventionally used for covering in and plastering and painting walls. For adding still further strength to the studs of Figs 5 and 6 the angled walls (54), and the return walls (58) may be formed with indentations (82) at spaced intervals there along. These indentations may be in a zig zag diagonal pattern as shown or any other pattern suitable for the purpose.

A further embodiment of stud is shown in Fig 8. This stud will typically be used in fabricating a two-panel spaced structure similar to Fig 7. In most cases this stud would be used for somewhat lighter duty applications, although it could be made of heavier gauge metal for greater loads.

In this embodiment the stud (90) has a series of generally triangular shaped webs (92) all of which extend from a generally tubular edge formation (94). Between the webs (92) are defined generally inverted triangular spaces (96). The webs and the spaces are not truly triangular since the apex of each web (92) is flattened, and the apex of each space is elongated and linear. The word "triangular" is therefor used here as suggesting the general shape, without being in any way limiting to a specific triangular definition.

The tubular edge formation (94) is formed in the same way as the tubular edge (56) of stud (50) of Figs 5 and 6. The details are not illustrated since repetition is unnecessary.

Each of the webs (92) is formed with a larger circular opening (98), formed with an annular edge flange (not shown) as in the case of the previous embodiments.

At the wider base edge of each web (92) two smaller depressions (100) and (102) are formed for added stiffness. A semi-circular opening (104) is formed in each depression (100) and (102) as in the earlier embodiments. The apex of each web (92) is formed with a flattened linear embedment formation (106), and semi-arcuate embedment openings 108 are formed through the webs (92) for passage of concrete and aggregate, for locking the apex formation (106) of each web (92) securely in a panel of concrete (110).

Locking loops (112) are formed along tubular edge formation (94) as in the case of the Figs 5 and 6 embodiment. These loops will extend into the second panel of concrete (114) for locking in place. Furring mesh (not shown) would usually be attached to tubular edge formation (94), much the same as shown in Fig 7.

It will be appreciated that in the foregoing description the embedment flange portions (28) or (62) and the retention edge strips (30) or (64), have been described and shown as bent at defined angles. This is simply to provide added stiffness.

In many cases these two features could be made as a simple continuous radius. Such a feature is shown in Figs 9 and 10.

The stud (120) has the same large openings (122) and indentations and small openings as the studs of Figs 2,3,4,5, and 6.

However the embedment flange portions and retention edge strips are formed by the smoothly curved radius bend portion (124), having openings (126) along its length.

The studs described are intended for use in reinforcement of concrete panels in the manner described above.

However it will be understood that with minor modifications studs of this type could be used for general purpose studs, for use in construction, whether such concrete panels are used on the building exterior or not.

Figs 11 and 12 illustrate one form of general purpose stud (130). This is similar to the stud of Figs 2,3, and 4 in many respects. The stud (130) has first and second right angular flanges (132-132), with first and second edge strips (134-134).

Between the flanges there is a web (136), formed with larger central circular openings (138), with annular flanges or rings (140), as before. Depressions (142) are formed adjacent the openings 138 and have semi-circular openings (144).

The stud (130) can be used for general construction, and can be made wider, or of heavier gauge metal, to suit many different applications.

Figs 13 and 14 show a general purpose stud or beam (150) similar in many respects to Figs 5 and 6. The stud or beam (150) has first and second triangular tube formations (152-152), formed as before, with first and second fastenings (154-154).

Between the tube formations (152) there is a web (156), formed with larger central circular openings (158), with annular flanges (160), as before. Depressions (162) are formed adjacent the openings (158) and have semi-circular openings (164).

The stud or beam (150) can be used for general construction, and can be made wider, or of heavier gauge metal, to suit many different applications. Various modifications may be made in certain circumstances, which may either facilitate manufacture of the studs, or may improve their strength, or may achieve both advantages in some cases.

Thus as shown in Fig 15 a stud (170) may be made which is generally similar to those described above, having a circular main opening (172) as described. However in this case the circular depressions (174) are formed with elongated slotted openings (176). Openings (176) are, in this case formed along a diameter of the depression (174). Side edges (178) (Fig 17) of the depression (176) are formed at an angle to the plane of the sheet metal in the depression, for added strength.

Such slotted openings provide a barrier to heat transfer through the stud, without materially reducing its strength.

In other cases (Fig 16) the stud (180) may be made with main openings (182) which are non-circular. Each opening (182) has one first corner (184) which is formed around an arc of a circle having a first radius, and has two further

corners (186-188) which are formed around arcs having a radius less than the first corner (184). The main openings (182) thus define a linear base edge (190) and two linear side edges (192). The side edges (192) are angled more or less diagonally to the transverse dimension of the stud. The edges (192) define diagonal struts (194).

The main openings are arranged with their first corners (184) alternating in direction from one opening to the next, thus locating the struts (194) in a generally zig-zag pattern along the stud.

In this embodiment the circular depressions (196) are formed with slotted openings (198) as described above, and formed as shown in Fig 17.

Any of the foregoing studs can be made with embedment flanges (200) (Fig 18).

Flanges (200) are formed on right angle bend portions (202). A further simplified embedment flange (204) is shown in Fig 19 which is also suitable.

In this case the embedment flange (204) is simply an edgewise extension of the web of the stud.

In both cases locking portions (206) are bent over for embedment , and embedment openings (208) are formed at spaced intervals as described above.

Many of the studs described can also be formed , as shown in Fig 20, with a right angular flange having a folded strip. Stud (210) shown in Fig 20 has the features already described above. However its right angle flange (212), has a free edge strip (214) which is folded back on flange (212) as shown.

This will enhance the performance of the stud in many cases. It will also greatly facilitate the insertion of insulation between adjacent studs, in a wall.

Such insulation may be in the form of batts. Or in many other cases the insulation may be in the form of blocks of cellular foamed styrene plastic.

Such blocks are rigid and the use of studs having the folded strips (214) will be more suitable for insertion of such rigid blocks, than other forms of studs.

The foregoing is a description of a preferred embodiment of the invention which is given here by way of example only. The invention is not to be taken

as limited to any of the specific features as described, but comprehends all such variations thereof as come within the scope of the appended claims.

CLAIMS

1. A composite construction panel (10) and having a thin panel (12) of cast material, and a reinforcing grid of sheet metal studs (14) and top and bottom studs (18), in which the studs have embedment portions which are embedded into the cast panel, and characterized by;
- 5 each of said reinforcing studs (14) having a web (22) defining a free edge, which is not embedded in the panel;
- an angular flange (24) formed on said free edge;
- 10 an angular edge strip (26) formed along said angular flange
- an embedment flange portion (28) formed along the opposite edge of said web, opposite to said free edge;
- an embedment edge strip (30) formed on said embedment flange portion;
- and,
- 15 a plurality of spaced apart embedment flange openings (32) formed in said embedment flange portion .
2. A composite construction panel as claimed in claim 1 wherein said embedment flange openings (32) are formed by a series of semi-arcuate
- 20 openings (32) located spaced apart lengthwise along said embedment flange portion (28).
3. A composite construction panel as claimed in claim 2 and including web main openings (34) of generally circular shape formed through said web
- 25 between said embedment flange portions and said free edge angular flanges (24), and edges (36) of said circular openings being formed out of the plane of said web, to define an annular continuous ring.
4. A composite construction panel as claimed in claim 3 and including
- 30 generally circular depressions (40) formed in said web between said web main openings (34) and said angular flanges (24), and between said web

main openings (34) and said embedment flange portions (28), and openings (42) formed within said depressions (40).

5 5. A composite construction panel as claimed in claim 4 wherein said web between said web openings defines generally hour-glass shaped web portions (38), which are narrower at about the mid point of said web, and wherein said openings (42) are directed towards said narrower portions of said hour-glass shaped web portions.

10 6. A composite construction panel as claimed in claim 1 including a tube formation (53) formed on said free edge.

15 7. A reinforcement stud (20) for use in forming a composite construction panel (10) wherein the panel is formed with a thin panel (12) of cast material, and a reinforcing grid of sheet metal studs (14) wherein said reinforcement studs (20) have embedment flange portions (28) which are embedded in the cast panel, and characterized by; each of said reinforcement studs (20) having a web (22) defining a free edge, which is not embedded in the panel; an angular flange (24) formed on said free edge;
20 an angular edge strip (26) formed along the free edge of said angular flange
an embedment flange portion (28) formed along the opposite edge of said web, opposite to said free edge;
a retention edge strip (30) on said embedment flange portion (28) formed out of the plane of said embedment flange portion; and,
25 a plurality of spaced apart embedment flange openings (32) formed in said embedment flange portion .

30 8. A reinforcing stud for use in forming a composite construction panel as claimed in Claim 7 in which said embedment flange portion (28) is formed at an angle to said web (22) herein said embedment flange openings (32) are formed by a series of semi-arcuate openings (32) located spaced apart lengthwise along said embedment flange portion (28).

9. A reinforcing stud for use in forming a composite construction panel as claimed in Claim 7 and including web main openings (34) formed through said web between said embedment flange portions (28) and said angular flanges (24) , and edges (36) of said openings being formed out of the plane of said web into a continuous ring.

10. A reinforcing stud for use in forming a composite construction panel as claimed in as claimed in claim 9 and including generally circular depressions (40) formed in said web between said web main openings (34) and said angular flanges (24) , and between said web main openings (34) and said embedment flange portions (28), and openings (42) formed within said depressions.

11. A reinforcing stud for use in forming a composite construction panel as claimed in as claimed in claim 10 wherein said web between said web main openings (34) defines generally hour-glass shaped web portions (38) , which are narrower at about the mid point of said web.

12. A reinforcing stud for use in forming a composite construction panel as claimed in claim 7 and including a tube formation (53) formed on said free edge.

13. A reinforcing stud for use in forming a composite construction panel as claimed in claim 12 and including a series of generally V-shaped web portions (92) extending from said free edge;
an apex on each of said V-shaped web portions (92);
an embedment portion (108) formed on each said apex; and,
each said apex having an embedment opening (108) formed therein.

14. A reinforcing stud for use in forming a composite construction panel as claimed in claim 13 and including web main openings (98) formed through

said web in said V-shaped web portions. and edges of said openings being formed out of the plane of said web, into a continuous annular ring.

5 15. A reinforcing stud for use in forming a composite construction panel as claimed in claim 14 and including generally circular depressions (102) formed in said V-shaped web portions (92) between said web openings and said tube formation (53) and openings (104) formed within said depressions (102).

0 16. The method of making a composite construction panel (10) by assembling a plurality of reinforcing studs (20), each having webs with openings therethrough, in parallel spaced apart relation with said openings aligned with one another, and with cross members (18) arranged transversely at the ends of said parallel reinforcing studs (20) thereby forming
.5 a grid of studs, said parallel reinforcing studs (20) having embedment flange portions (28) thereon, and characterized by ;
pouring panel material into a form shaped to provide a planar cast panel (12);
placing reinforcing mesh in said panel material;
10 placing said grid (14) of studs over said panel material in said form and lowering the same until said embedment flange portions (28) of said reinforcing studs (20) are at least partially immersed in said panel material;
allowing said panel material to cure, and removing said formed composite panel (10) consisting of cured material with said grid of studs secured in and
25 extending from said panel.

30 17. The method of making a composite construction panel as claimed in claim 16 and wherein said reinforcing studs (20) have embedment openings (30) formed in said embedment flange portions (28), said panel material flowing through said embedment openings (30) and integrally bonding around said embedment flange portions (28).

18. The method of making a composite construction panel as claimed in claim 17 and including the step of pouring a second said panel (78) and attaching same to the edges of said studs (14) remote from said embedment flange portions (28).

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19. A steel stud (130) as claimed in claim 1 and including a second angular flange (132) on said stud remote from said first angular flange (132).

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20. A steel stud (150) as claimed in claim 1 and including a second tube formation (152) formed on the other said edge, of said stud.

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21. A steel stud (170) as claimed in claim 1 and including an elongated slot (176) formed in each said depression (174) defining arcuate portions of sheet metal within said depressions, on either side of said slot.

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22. A steel stud (180) as claimed in Claim 1 wherein said main web opening (182) is non-circular having at least one first radius corner formed as an arc of a circle having a first radius, and with two further lesser radius corners formed as arcs of circles having radii less than said first radius.

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23. A steel stud as claimed in Claim 21 and in which said circular depressions (196) are formed in said web alternately spaced further apart and closer together adjacent said first radius corner and said lesser radius corners respectively.

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24. A steel stud (170) as claimed in Claim 21 including edge flanges (178) formed in said depression (174) along either side of said slot (176).

25. A steel stud (210) as claimed in claim 1 including a folded strip (214) formed along said angular flange (212), forming a double thickness of sheet metal therealong.