



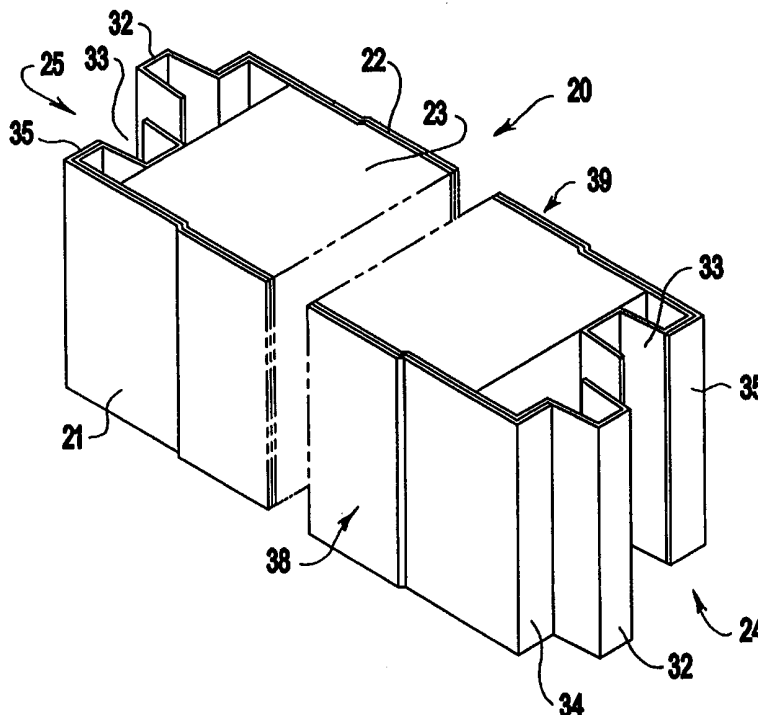
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/AU99/00264</p> <p>(22) International Filing Date: 9 April 1999 (09.04.99)</p> <p>(30) Priority Data: PP 2898 9 April 1998 (09.04.98) AU</p> <p>(71) Applicant (for all designated States except US): UNIPANEL PTY. LTD. [AU/AU]; 2/45 Powers Road, Seven Hills, NSW 2147 (AU).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): KROIE, Robert [AU/AU]; 34 Westbourne Road, Lindfield, NSW 2070 (AU).</p> <p>(74) Agent: PHILLIPS ORMONDE &amp; FITZPATRICK; Massie, Andrew, B., 367 Collins Street, Melbourne, VIC 3000 (AU).</p>	<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report.</i></p>	

(54) Title: A PAPER COATED METAL BUILDING PANEL AND COMPOSITE PANELS USING SAME

## (57) Abstract

A building panel (20) is disclosed which is of sandwich construction having metal sheet structures (21, 22) interconnected by a core (23). The panel (20) includes profiled edge regions (24, 25) enabling the panel to interlock with a like panel. In one form a paper covering (27) is bonded to the metal sheet structure so that panel has a surface characteristic similar to that of plasterboard. A reinforcing element (40) is also disclosed which is arranged to be connected at the joint between abutting panels to improve the load bearing capability of the panel (20).



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## A PAPER COATED METAL BUILDING PANEL AND COMPOSITE PANELS USING SAME

The present invention relates to a building panel. One aspect of the invention has been developed especially, but not exclusively for use in interior wall or ceiling panelling, and the invention is herein described in that context.

5 However it is to be appreciated that the invention has broader application and is not limited to these uses. In particular, another aspect of the invention is especially suited for use in flooring or the like .

In the building industry, panels are widely used in interior walls, partitions and ceilings. One of the most common type of paneling used is plasterboard, 10 which traditionally is formed from a core of gypsum or anhydrite plaster, faced with two sheets of heavy paper. Plasterboard has gained widespread acceptance because it is inexpensive, relatively light weight, can be easily cut and provides a good surface finish.

However, there are significant problems with plasterboard. Traditional 15 plasterboard panels are not self supporting and need to be fixed to a supporting frame such as a stud wall or the like. This substantially increases the cost of installation. Furthermore, plasterboard has relatively poor thermal and acoustic insulation properties as compared to block walls, and is relatively inflexible thereby making it difficult to form into complex shapes.

20 Various proposals have been made to address these problems. These include the development of hollow core reinforced plaster panels or prefabricated sandwich panels made from two sheets of plasterboard bonded to a paper honeycomb core. Whilst such designs are self supporting, they have limited applications and have not gained widespread acceptance.

25 An aim of a first aspect of the present invention is to provide a building panel which is similar to traditional plasterboard panels in both terms of its costs and surface characteristics, yet which is able to provide significant improvements in respect of its structural properties.

According to this aspect of the present invention, there is provided a 30 building panel which includes a metal sheet substrate and a paper covering bonded to the substrate.

The panel according to this aspect of the present invention provides significant advantages over plasterboard panels. The panel of the invention with its paper covering, has a surface characteristic which can match that of plasterboard, yet offers significant improvements in structural properties because of the metal substrate. For example, the panel may be load bearing, may be formed or otherwise shaped into complex configurations, and is able to exhibit improved thermal and acoustic insulation characteristics.

A particular advantage of the panel is that the surface of a wall formed from the panels can be finished to appear continuous using standard techniques used on plasterboard walls. Such techniques include plaster rendering and the use of plaster tape.

Throughout the specification the term "paper" includes sheet material formed from any fibrous material produced from either naturally occurring or synthetic fibres. The sheet material may be of unitary or composite construction. It also includes other types of sheet material which have characteristics, in particular surface texture, which are similar to paper.

In a particularly preferred form, the panel of the invention is formed in continuous lengths using a laminating process to adhere the paper covering to the metal substrate. The production of panels in this way provides significant cost benefit and also has the advantage of enabling panels of indefinite length to be produced.

Preferably the panel includes longitudinal edges which are profiled. These profiles may be incorporated to allow the panel to be interconnected with like panels, or associated componentry such as fixing rails, edge trim or the like. The profiled edges may also be designed to allow the panel to interconnect with a traditional plasterboard panel so that the panel of the invention can easily be used in conjunction with these traditional plasterboard panels. In addition the panel may be profiled to enhance its load bearing characteristics. These strengthening profiles may be included at the longitudinal edges, or could be incorporated mid span in the form of ribs or corrugations or similar structure. The profiles may be formed in the panel using any known technique such as roll forming, folding or the like. However in a

particularly preferred form, the panels are roll formed to the desired profile. In this way this forming step can be easily included as an extension to the laminating process.

Any appropriate sheet metal may be used as the substrate, such as steel, aluminium, tin or the like. In general construction, galvanised steel has wide application as the metal substrate as it is relatively inexpensive, has good structural properties and is corrosive resistant. The gauge of the metal substrate may be chosen depending on the required structural properties of the panel. However it is envisaged that the gauge will be between 0.3 to 1mm in most applications. Metal falling within this range of thicknesses can easily be cut thereby enabling services to be easily installed in the panel on site.

In a particularly preferred form, the panel is bonded directly to the metal surface. Preferably a reactive hot melt adhesive is used to bond the paper to the metal substrate. An advantage of using a reactive hot melt adhesive is that it provides high bond strength including high initial adhesive and cohesive strength which makes it ideal for laminating the paper directly onto the bare metal substrate. The ability to bond the paper directly onto a metal substrate again provides significant cost benefit in that it avoids the need for pretreatment of the metal such as the application of a primer coat to the metal surface. However, it is to be appreciated that intermediate layers such as paint or waterproof coatings may be included between the metal substrate and the paper covering if required.

In a preferred form, the adhesive is applied by a roller to the metal surface, as this gives good even coverage of the adhesive across the substrate surface which is important for providing an even surface finish on the panel.

The building panel of the invention has widespread application and can be used instead of, or in conjunction with, traditional paneling such as plasterboard. For example, the paneling of the invention may be used as a fascia, a ceiling panel or the like. In addition it may be used in conjunction with a traditional plasterboard partition or wall. For example, the panel may be included in a section of a plasterboard wall where a complex surface, such as a

curved wall, is required which could not be formed using conventional plasterboard.

The building panel may also incorporate additional layers to improve its structural properties. For example, the panel may include additional insulating or thermal layers bonded to the metal substrate on the opposite surface to the paper covering. Again these additional layers may be bonded using any known technique but are preferably applied using a laminating process so as to be easily incorporated in the overall forming process of the panel.

In a particularly preferred form, the building panel is incorporated as part of an integrated structural or composite panel. In this arrangement, the composite panel includes spaced sheet structures which are interconnected by a core and wherein at least one of the sheet structures includes a building panel as described above with the paper covering forming an outer surface of the composite panel.

A composite panel according to this arrangement has widespread application for use as interior walls or partitions. The composite panel is self supporting, is able to be configured to be load bearing and can incorporate profiled edge regions to enable the panel to be interlocked with adjacent panels.

In a preferred form, both the sheet structures of the panel are formed at least partially from a metal sheet. If only one side of the panel is to be exposed, then only the exposed face need include the covering; the other face may remain bare metal. If both sides are to be viewed then both faces can include the paper covering. Alternatively, if required, different surface finishes may be used. For example, one surface may include a plastic or similar water impermeable covering for use in a bathroom or the like while the other face may include the paper covering. If required, one face may include a decorative surface such as a timber veneer or the like.

A particular advantage of using metal sheet as part of the composite panel is that the longitudinal edges can be formed so as to enable the panel to interlock with adjacent panels thereby facilitating the construction of a wall using the structural panels. The profile of the longitudinal edges of the

composite panel may be such that no additional fasteners are required. Alternatively, the edge profiles may be designed solely to align the adjacent panels and mechanical fasteners such as rivets, screws or inserts are used to fasten the panels together.

5           In one form, the panels are installed using top and bottom rails. The rails may have a simple C-shaped cross section. In this arrangement, the depth of the rails, the distance they are spaced apart, and the height of the panel is related so that the panels may be easily installed by merely locating the upper  
10           end of the panel into the top rail and then swinging the bottom end of the panel into alignment with the bottom rail and then dropping the panel down into the bottom rail. The panel is then captured between the top and bottom rails and may be secured in place by fasteners, such as rivets or self tapping screws or the like. It is to be appreciated that other fastening arrangements may be used. For example the rails may be specially formed so that they interlock with the  
15           panels without the need for separate fasteners.

          The core of the composite panel may be of any suitable form depending on its application or requirements. In particular, the core may be of solid construction or may be of open form including interconnecting webs to thereby form cavities within the core. These cavities may be used to reduce the weight  
20           of the integrated panel or to provide passage for services such as wiring and the like.

          In one form, the edge profiles are shaped to form a slip joint at the interlock between the adjacent panels. In this arrangement, one edge profile forms the male component of the slip joint whereas the edge profile of the  
25           other panel forms a complimentary female component of the joint. In a particularly preferred form, the panels are arranged to interlock in a snap fit manner so as to facilitate proper engagement of the panels and to resist inadvertent separation.

          In another form, the edge profiles are specifically designed to form a load  
30           bearing member at the interlock between adjacent panels. In a preferred form, the interlock is still by virtue of a male/female coupling but the edge profiles are shaped to form a part box section. The section has inherent strength and also

is convenient for use in the passage of cabling or other services. Moreover, the male coupling may be arranged to be drawn into tight engagement with the female coupling so that the overlapping structure of the male and female connection acts in unison thereby increasing the load bearing capability of the panels.

In one form, the composite panel is designed to be able to receive a structural member between its sheet structures. The structural member improves the load bearing capability of the panel and preferably comprises a metal beam.

In a particularly preferred form, the edge profiles are designed to be able to receive the structural member so that the member is contained within the connection between the adjacent panels and is fully concealed. In this way, a wall formed from the panels may be continuous across the join which contains the reinforcing member.

In a further arrangement, the edge profiles are formed separate to the panel and are arranged to be located over, and secured to, the edge margins of the panels which are typically unformed. This arrangement enables use of a composite panel with straight edges. Alternatively, the separate edge profiles may be used as an accessory to the building system incorporating the composite panels with the profiled edges. For example, the edge profiles may be used when it is required to cut the composite panel or when the composite panel is required to interfit with conventional panels or other building members.

In a further aspect, the present invention relates to a building system which has enhanced load bearing capabilities.

According to this aspect, the present invention relates to a building system including a building panel and a reinforcing element, the building panel having spaced sheet structures interconnected by a core, said sheet structures defining opposite major surfaces of said panel and wherein the element is locatable between the planes of said major surfaces so as to form in use, a concealed reinforcing member which is operative to improve the load bearing characteristics of said panel.

Preferably the sheet structures are formed of metal and at least one of the sheet structures may be in accordance with an earlier aspect of the invention and incorporate a paper covering. Alternatively, the metal sheet structures may be fully exposed such as if a stainless steel surface is required, or other finishes or composite materials may be used.

The advantage of this aspect of the invention is that it provides a building panel with enhanced load bearing properties as compared to simple sandwich panels. Further, fully concealing the reinforcing member enables continuous smooth surfaces on both sides of the panels to be obtained.

A panel in accordance with this aspect of the invention is suitable for use both as wall panels or ceiling or floor paneling.

In a particularly preferred form, the sheet structure includes longitudinal edge regions which are profiled to enable the panels to be connected in abutting relationship with a like panel in edge to edge relationship and the reinforcing member is locatable within the join formed at the abutting panels.

In a particularly preferred form, the panel is arranged to interlock with a like panel at the longitudinal edge regions. Preferably the longitudinal edge regions interlock with the reinforcing element. This arrangement has the advantage that it further increases the load bearing capability of the panel as the reinforcing member and the profiled longitudinal edge regions can work together.

It is convenient to hereinafter describe embodiments of the present invention with reference to the accompanying drawings. It is to be appreciated however that the particularity of the drawings and the related description is to be understood as not limiting the preceding broad description of the invention.

In the drawings;

Figure 1 is a perspective view of a panel according to an embodiment of the invention;

Figure 1A is a detailed view to an enlarged scale illustrating the construction of the panel of Figure 1;

Figure 2 is a perspective view illustrating the panel of Figure 1 used as a ceiling panel when in position;

Figure 3 is a perspective view of a composite panel according to an embodiment of the invention;

Figure 3A is a detailed view to an enlarged scale illustrating the construction of the panel of Figure 3;

5 Figure 4 is an exploded perspective view illustrating the connection of the panel of Figure 3 with a like panel;

Figure 5 is a cross sectional view of the connection of the panel of Figure 3 with a like panel.

10 Figure 6 is a perspective view illustrating the connection of a variation of the panel of Figure 3 with a like panel and including an intermediate reinforcing member;

Figure 7 illustrates a variation of the panel of Figure 3 and its connection with a like panel;

15 Figure 8 is a partial perspective view illustrating the connection of an end trim component to the panel of Figure 7;

Figures 9A and 9B are schematic side views showing installation of the panel into top and bottom rails;

20 Figure 10 is a perspective view illustrating the connection of a variation of the panel of Figure 3 with a like panel and including an intermediate reinforcing member;

Figure 11 illustrates a variation of the panel of Figure 3 incorporate separately formed longitudinal edge profiles;

Figure 12 is a partial perspective view illustrating the panel of Figure 10 when used as a flooring system; and

25 Figure 13 is a line diagram of a laminating process for use in the production of a building panel.

Figure 1 illustrates a building panel 10 which is generally planar and includes opposite major surfaces 11 and 12 interconnected by edge regions 13 and 14.

30 The panel 10 is of composite material and formed from a laminating process which forms the panel in continuous lengths. The panel may be of any desired width, although if made from one sheet, the width will be limited by the

width of the feed stock. In one form, the panel is formed in standard widths of 1200mm, 900mm, 600mm and 300mm.

The panel includes a metal substrate 15 and a paper covering 16 which is bonded to the substrate 15 by a reactive hot melt adhesive 17. The covering 16 constitutes a heavy plasterboard paper so that the outer face 11 of the panel has the same general appearance and surface characteristics of a plasterboard panel. In the illustrated form, the substrate 15 is formed of galvanised steel thereby enabling the inner surface 12, which in use is concealed, to remain exposed due to its corrosive resistant properties.

The edge regions 13 and 14 of the panel are profiled so as to enable the panel 10 to be connected at these edge regions to a like panel. In the illustrated form, the profiles on the edge regions 13 and 14 are formed by roll forming the metal substrate 13. The edge regions 13 and 14 are formed with one edge region 13 forming a female coupling which is adapted to receive and contain the other edge region 14 which is formed as a male coupling. With this arrangement, the male edge region 14 locates in and is retained within a seat 18 formed within the female edge region 13 of a like panel so that the adjacent panels can be interconnected along their edge regions.

It is to be appreciated that the profiles formed in the edge regions 13 and 14 may take different embodiments as will be appreciated to those skilled in the art of roll forming techniques. Specifically, the profiles can be matched to suit the particular requirements of the panel and the mode of connection required between adjacent panels. For instance, the profiles may be designed such as those illustrated, to not require the addition of any mechanical fasteners to interconnect like panels together. Alternatively the edge regions could be formed so as to provide formations to receive specific mechanical fasteners such as rivets or screws or the like.

Figure 2 illustrates the panel 10 in place as part of a ceiling with the panel 10 aligned, and fixed to, the underside of parallel roof batons 60. In the illustrated form, the batons incorporate clips which are adapted to engage and hold the edge regions 13 and 14 of the panels. In this arrangement, the ceiling panels are installed progressively across the baton. A first panel 10<sup>i</sup> is installed

and fastened to the clips 61. A second panel 10<sup>ii</sup> is then installed by locating the male edge region 14<sup>ii</sup> within the female edge region 13<sup>i</sup> of the affixed panel 10<sup>i</sup> whilst the panel 10<sup>ii</sup> is inclined relative to the fixed panel 10<sup>i</sup>. Once located in place, the panel 10<sup>ii</sup> is then swung up into alignment with the panel 10<sup>i</sup> wherein its female edge region 13<sup>i</sup> engages with associated clips 61 attached to the batons. The process then continues until all the panels are in place.

With this arrangement, the fixed panels 10 have respective outer faces which incorporate the plasterboard paper covering and thereby have a general appearance of plasterboard. If required, edge trim (not shown) can be inserted between the adjacent panels. Typically the panels would include a bead or similar protrusion which locates within an associated groove (not shown) formed in the edge regions 13 and 14 of the respective panels. Alternatively, the join between the panels could be concealed so that the ceiling surface is continuous using standard finishing techniques such as plaster rendering or the like.

Figure 3 illustrates a building panel 20 according to a second embodiment of the invention. The panel 20 is of sandwich construction incorporating first and second spaced structures 21 and 22 respectively, which are interconnected by a core 23. The panel 20 further includes edge regions 24 and 25 which are profiled to enable the panel 20 to be interconnected to a like panel.

As best illustrated in Figure 3A, each of the sheet structures 21 and 22 incorporate a structure which is similar to the panel 10 illustrated above. Specifically the panels 21 and 22 incorporate a metal sheet substrate 26 which includes a covering 27 formed from heavy plasterboard paper which is bonded to an outer surface 28 of the metal substrate 26 by a reactive hot melt adhesive 29. Similarly, an inner face 30 of the metal substrate 26 is bonded to the core 23 by a similar adhesive 31. The longitudinal edge regions 24 and 25 are profiled by roll forming the respective edge regions of the metal substrates 26 of the respective sheet structures 22 and 21.

The core 23 of the panel is illustrated as a foam block. However it is to be appreciated that the core may be formed of any suitable structure depending on the application of the panel 20. For example, the core may be formed from a composite construction and/or may include cavities or channels if desired.

5 In a similar manner to the earlier described embodiment, the panel 20 is formed from a laminating process. Typically the sheet structures 21 and 22 are formed in a first laminating process. The sheet structures then form part of a second laminating process where they are bonded to the core. If desired, additional layers can be bonded to the panels to further improve the structural  
10 properties of the panel 20. For example additional layers may be incorporated to further increase the thermal or acoustic insulation properties of the panel. By virtue of the laminating process, the panels 20 are formed in continuous lengths and are typically formed in a range of standard widths such as 1200mm, 900mm, 600mm and 300mm.

15 The panel 20 has the general appearance and surface characteristics of plasterboard by virtue of the heavy paper covering 27. However because of its sandwich construction and sheet metal substrate, the panel 20 is lightweight, yet is self supporting and capable of acting as a load bearing member.

The edge region 24 of the panel 20 is roll formed to include a  
20 longitudinally extending projection 32 and recess 33 which are located intermediate the opposite faces 38, 39 of the panel 20. In the illustrated form, the projection 32 is formed from roll forming the edge of the structure 21 whereas the recess is formed from roll forming the edge region of the structure 22. An abutment face 34 is located between the face 38 and  
25 projection 32 and a similar abutment face 35 is formed between the recess 33 and the face 39.

Both the projection 32 and the recess 33 are shaped to be complementary such that the projection 32 is able to be received within the recess 33 of a like panel. To facilitate interconnection of adjacent panels, both  
30 the projections and the recesses include tapered surfaces to provide adequate lead in.

The other longitudinal edge region 25 of the panel 20 includes a similar edge profile and includes both a recess 32 and a projection 33, with the exception that the projection is formed from roll forming the edge of the sheet structure 22 whereas the recess 33 is formed from roll forming the edge region 21.

The panel 20 is arranged to be self supporting and typically arranged to be installed between top and bottom rails (62 63) which are formed as C-shaped channels or the like. Figures 9A and 9B illustrate the installation of the panel 20 between the rails 62 and 63. The panels are easily installed by merely locating the upper end 51 of the panel into the top rail 62 and then swinging the bottom end 52 into alignment with the bottom rail 63 and then dropping the bottom panel 20 into the bottom rail. The relationship of the distance between the panels to the height of the panel is such that the panel remains captured between the top and bottom rails as best illustrated in Figure 9B. Once in this position, the panels can then be interlocked with a like panel as will be described in more detail below. Once fully in position the panel are then secured in place to the rails merely by the use of fasteners, such as rivets or self tapping screws or the like.

Figures 4 and 5 illustrate the connection of the panel 20 with a like panel. For ease of identification, one panel is designated 20<sup>i</sup> whereas the other panel is designated 20<sup>ii</sup>. Other features of the panels are distinguished in a similar manner.

As best illustrated in Figure 5, the edge regions 24<sup>i</sup> and 25<sup>ii</sup> enable two panels 20<sup>i</sup> 20<sup>ii</sup> to be connected in edge to edge relationship with the respective projections and recesses of the edge region 24<sup>i</sup> engaging with the respective projections and recesses of the edge region 25<sup>ii</sup> of adjacent panel 20<sup>ii</sup>. Furthermore, the abutment surfaces 34<sup>i</sup> and 35<sup>ii</sup> engage so as to form a simple linear join 36 between the abutting panels 20<sup>i</sup> and 20<sup>ii</sup>.

In the illustrated form, both the longitudinal edge regions 24 and 25 of the panel is slightly waisted to form a recessed portion 37 in the outer surface of both the structures 21 and 22. This recess is designed to enable the join 36 between adjacent panels to be easily covered over by plaster tape or plaster

rendering which will be applied within this recess and create a flush surface across the join.

The profile of the edge regions 24 and 25 also enables the panel 20 to be easily used in conjunction with standard plasterboard panels. Specifically, the abutment surfaces 34 and 35 provide a space to enable a plasterboard panel to be located in abutting relationship with the panel 20. The abutment surfaces 34 and 35 are dimensioned to be slightly larger than a standard plasterboard panel which is typically 10mm or 13mm, so as to provide adequate clearance for the plasterboard panel to be located outside the projection 32 and the recess 33 so that the plasterboard surface can be flush with the respective faces 38 and 39 of the panel 20.

The coupling arrangement to join adjacent panels using the interfitting projections and recesses 32 and 33 provide an area of load bearing strength at the engaged edge regions. This has significant advantage as it improves the load bearing characteristics of the wall formed by the adjacent panels. In most applications, the interconnection of the panels gives the wall sufficient load bearing characteristics. If, however, additional load bearing strength is required in the constructed wall using the panels 20, a metal reinforcing member 40 may be incorporated at the connection. One such example is illustrated in Figure 6 where the beam is formed from roll formed metal sheet 41 and incorporates oppositely disposed channels 42 and 43 which are arranged to interfit between the engaging projections and recesses (32 and 34) of the adjacent panels 20<sup>i</sup> and 20<sup>ii</sup>. The member 40 substantially improves the load bearing characteristics of the wall as, by virtue of its configuration and its engagement with the adjacent panels, it is able to accommodate substantial compressive loading.

Figure 7 illustrates a variation of the coupling arrangement between adjacent panels 20<sup>i</sup> and 20<sup>ii</sup>. In this arrangement both the longitudinal edge regions 24 and 25 incorporate a pair of recesses 33. As illustrated in Figure 7 in connecting the panel 20<sup>i</sup> to like panel 20<sup>ii</sup>, the recesses 33<sup>i</sup>, 33<sup>ii</sup> of the respective panels are arranged to be aligned and inserts 44 are located within the cavity formed between the aligned recesses to couple the panels together.

The inserts may be of any suitable form and may include a continuous strip 45 which extends over the majority of the length of the connected panels, or may be in the form of smaller wedges 46 which extends over only a portion of the length of the panels.

5           Figure 8 illustrates a specially formed edge strip 50 which is arranged to be coupled to the longitudinal edge region 24 or 25 of the panel 20. The edge strip 50 may be solely as a decorative end strip or may have a functional purpose such as form part of a door frame assembly as in the illustrated embodiment where the strip 50 is configured to form a door jamb.

10           Figure 10 illustrates a further variation of the panel 20. This panel includes many similar features to the earlier embodiments and accordingly like reference numerals have been given to like features. In a similar arrangement to the previous embodiments, the panel 20 includes longitudinal edge regions 24, 25 which are profiled to enable the panel 20 to interlock with a like  
15 panel. A reinforcing member 40 is also arranged to interfit at the join between adjacent panels.

In the illustrated form, the longitudinal edge region 24 provides a pair of recesses or female couplings 33 whereas the edge regions 25 provide a pair of male couplings or projections 32. It is to be appreciated that if desired, each  
20 edge region could include both a male and female coupling similar to that illustrated in Figure 3.

In the embodiment of Figure 10, the profiles have been specifically designed to give the panel enhanced load bearing characteristics at it join with an adjacent panel. The male and female couplings are shaped to provide  
25 generally a part box section which interlocks with a snap fit action. This arrangement has the advantage that the box section provides good load bearing characteristics and the snap fit action draws the interlocking members together. This inhibits inadvertent separation of the members and also enables the interlocking panels to act as a single unit thereby enhancing the panels  
30 overall load bearing capabilities at this connection.

The male coupling 32 includes opposite walls 53 and 54 which are interconnected by a base portion 55. To provide the snap fit, the

walls 53 and 54 are not linear but rather includes outwardly extending crests 56 intermediate the ends of the respective walls 53, 54. The female coupling 33 incorporates a complimentary shaped recess. Specifically, the female coupling 33 incorporates opposite walls 57, 58 which are interconnected by base portion 59 and which incorporate re-entrant portions 64 on their inner surface. In use, on interconnecting the panels together the male and female couplings are caused to flex through engagement of the male coupling walls 53, 54 with the female coupling walls 57, 58. The flexing continues until the crests 56 begin to align with the re-entrant surfaces 64 whereafter the couplings begin to return to their natural state as the crests move into alignment with the re-entrant surfaces 64. Once in alignment, the resilience of the couplings inhibits the release of the two interconnected members.

The positive or snap fit between the male and female couplings occurs whether or not the reinforcing member 40 is incorporated. The profile of the reinforcing member 40 has inner surfaces 65 which matches that of the female couplings 33 and an outer surface 66 which matches that of the male coupling 32. As a result, the reinforcing member 40 is able to snap fit into connection with the female couplings 33<sup>i</sup> of a first panel 20<sup>i</sup>. Once in place, the male couplings 32<sup>ii</sup> of the like panel 20<sup>ii</sup> is then able to locate into engagement with the inner surface 65 of the connected reinforcing member 40.

Figure 11 illustrates a similar view to that illustrated in Figure 10 except that the edge profiles 24,25 are formed separately to the panel 20. In this arrangement the edge profiles 67, 68 are similar to the edge strip 50 are formed from a folded metal sheet and are secured to the edge margins of the panels using any suitable fastening arrangements such as by screw, adhesive or the like. These edge profiles 67, 68 enable the system to be used with a panel 20 having a straight edge and may be used when it is required to cut the structural panel or when the structural panel is required to interfit with conventional panels or other building materials.

The composite panel 20 incorporating the profiled edges and the internal reinforcing member 40 may be advantageously used in many aspects of building constructions including in interior as well as exterior wall structures, or

in flooring or ceiling systems. Further, the choice of the surface materials used to form the outer faces 38, 39 of the panel will depend on the application of the panel. For example, if the panel is to be used as an internal partition wall, then the paper covering may be laminated to the metal substrate as described  
5 earlier so that the panel has a surface characteristic which is similar to that of plasterboard. Alternatively, the outer face of the panel may be exposed metal, such as stainless steel, which is suitable for use in operating theatres or the like. In this example, to reduce material cost, the stainless steel may be applied as a laminate to the metal substrate of the panel 20 or alternatively the  
10 substrate may be formed from solid stainless steel. It is to be appreciated that other surface configurations could be used as will be appreciated by those skilled in the art.

Figure 12 illustrates a further variation of the panel when used as part of a flooring system. In this arrangement the reinforcing member 40 acts as an  
15 internal bearer thereby providing the required loading characteristics for the flooring system. In this arrangement the upper face 38 incorporates a timber veneer so as to give the impression of a timber floor.

Figure 13 illustrates a line diagram of a laminating process used to bond  
20 the paper covering to the metal substrate for use in the building panel of the invention.

In this process, the metal feed stock 26 which is typically galvanised steel but may be any other sheet metal, is fed from an uncoiler 101 into the process line 100. The sheet metal is then correctly positioned by running through an edge guide 102 and then subsequently through a straightener 103.  
25 The sheet metal then passes through a cleaning and heating unit to remove any debris on the metal surface and to bring the temperature up to a predetermined level. The exact temperature range used is dependent on the characteristics of the adhesive being applied but is typically in the range of 20 to 50°C. The sheet metal then passes through to an adhesive coater 105 which  
30 incorporates a roller 106 which comes into contact with the upper surface 28 of metal substrate 26 so as to apply a thin film to the metal sheet. The adhesive is a reactive hot melt polyurethane and is typically applied at a temperature in the

range of typically 110 to 140°C with a coating being applied to the metal surface in the order of 10-20 microns in thickness.

After the adhesive has been applied, the metal sheet 26 then passes through a humidifier 107 which further conditions the adhesive coating on the metal surface 28. The sheet then passes to a laminator 108 where the paper 27 which is stored in a coil 109 is applied under tension to the surface 28 of the metal 26. The laminated product is then fed to a recoiler wherein it is stored in rolls ready for transporting (as illustrated) or to a further production station. The station further processes the metal panel and may include a roll forming station to form the edge profiles, a sheering station to form the panel into sheet form or to slit the metal panel so as to alter the panel width. To make the integrated composite building panel 20, the laminated metal sheet is fed to a separate laminating process to form the panel 20 with its sandwich construction.

An advantage of the panel of the present invention is that the paper laminated metal sheet is inexpensive to manufacture as it can be made using the laminating process without requiring any pretreatment, such as painting of the metal substrate. This has substantial practical benefit as it enables the building panel formed from the metal substrate to be extremely competitive in price with traditional plasterboard panels. Furthermore by making the building panel using the composite material of a metal sheet substrate and a paper covering, the panel of the invention can be used in conjunction with plasterboard panels, as it has a surface characteristic which can match that of plasterboard, yet has the additional advantages in that it can be load bearing, can be formed or otherwise shaped into complex configurations, including being able to have profiled edges to enable the panel to be interlocked with a like panel and can be designed to have improved thermal and acoustic insulation characteristics.

Finally it is to be understood that modifications and or additions may be made to the parts as previously described without departing from the spirit or ambit of the invention.

## CLAIMS:

1. A building panel including a metal sheet substrate and a paper covering bonded to said substrate.
2. A building panel according to claim 1, wherein the paper covering gives  
5 the panel a surface characteristic substantially the same as a plasterboard panel.
3. A building panel according to either claims 1 or 2, wherein said paper is bonded to said substrate using a reactive hot melt adhesive.
4. A building panel according to any preceding claim wherein said paper is  
10 bonded directly onto said metal substrate.
5. A building panel according to any preceding claim, wherein the panel is formed in continuous lengths using a laminating process to adhere the paper covering to said metal substrate.
6. A building panel according to any preceding claim, wherein the panel  
15 includes longitudinal edge regions which are profiled to facilitate interconnection of the panel with a like panel.
7. A building panel according to any preceding claim, wherein the panel is arranged to interconnect with a like panel in abutting relationship along the longitudinal edge regions and wherein a major surface of the panel including  
20 the paper covering incorporates a recess adjacent the longitudinal edge region to facilitate concealment of the join between abutting panels.
8. A composite panel including spaced sheet metal structures which are interconnected by a core, and wherein at least one of the sheet structures includes a building panel according to any preceding claim having the paper  
25 covering forming an outer surface of said composite panel.
9. A composite panel according to claim 8, wherein the panel includes longitudinal edge regions which are adapted to interconnect to a like panel in abutting relationship, and wherein said composite panel includes connecting elements to facilitate interconnection of said abutting panels.
- 30 10. A composite panel according to claim 9, wherein the connecting elements are integrally formed with the panel and are formed by profiling at least one of the edge regions of the metal sheet structures.

11. A composite panel according to claim 9, wherein the connecting elements are connected to the longitudinal edge regions of the panel.
12. A composite panel according to anyone of claims 9 to 11, wherein the connecting elements are in the form of interfitting recesses and projections.
- 5 13. A composite panel according to claim 12, wherein each recess is channel shaped and incorporates opposite walls interconnected by a substantially flat base portion, and wherein the or each projection is shaped to interfit with the channel shaped recess of a like panel and includes opposite walls interconnected by a substantially flat apical portion.
- 10 14. A composite panel according to either claim 12 or 13 wherein the recesses and projections are arranged to interfit in a snap fit arrangement.
- 15 15. A composite panel according to claim 14, when dependent on claim 13, wherein the opposite walls of the or each recess include a re-entrant inner surface, and wherein the opposite walls of the projections include a crest portion on their outer surface, and wherein the crest portions on the projection of one panel is arranged to engage with the re-entrant inner surface of the recess of a like panel to form said snap fit arrangement.
- 20 16. A composite panel according to any one of claims 9 to 15, wherein the panel includes opposite major surfaces and wherein the connecting elements are disposed inwardly of at least one major surface so as to form at least one abutment surface along each longitudinal edge region, said abutment surface being disposed between said one major surface and the connecting element located at that edge region.
- 25 17. A composite panel according to any one of claims 9 to 16, wherein a reinforcing member is operable to be received between said sheet structures to improve the load bearing capacity of said panel.
18. A composite panel according to claim 17, wherein the reinforcing member is operative to be contained within the connection of the panel to a like panel.
- 30 19. A building system including a building panel and reinforcing element, the building panel having spaced sheet structures interconnected by a core, said sheet structures defining opposite major surfaces of said panel and wherein the

element is locatable between the planes of said major surfaces so as to form in use, a concealed reinforcing member which is operative to improve the load bearing characteristics of said panel.

20. A building system according to claim 19, wherein said sheet structures  
5 are formed of metal.

21. A building system according to either claim 19 or 20, wherein the panel includes longitudinal edge regions which are adapted to interconnect to a like panel in abutting relationships, and wherein said panel includes connecting elements to facilitate interconnection of said abutting panels.

10 22. A building system according to claim 21, wherein the connecting elements are integrally formed with the panel and are formed by profiling at least one of the edge regions of said sheet structures.

23. A building system according to claim 21, wherein the connecting elements are connected to the longitudinal edge regions of the panel.

15 24. A building system according to any one of claim 21 to 23, wherein the reinforcing member is locatable within the join formed at the abutment of the panel with a like panel.

25. A building system according to any one of claims 21 to 24, wherein the connecting elements are in the form of interfitting recesses and projections, and  
20 wherein the reinforcing element incorporates opposite major surfaces, with one of said major surfaces incorporating at least one projection which is operative to locate within the recess of a connecting element of the panel, and said other major surface incorporating at least one recess which is operative to receive the projection of the connecting element of a like panel so that said reinforcing  
25 element is able to interfit with the recesses and projections of the connecting elements.

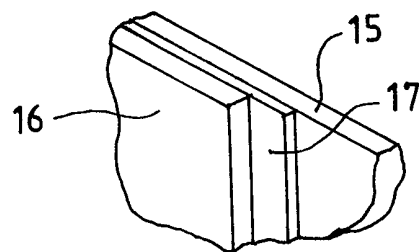
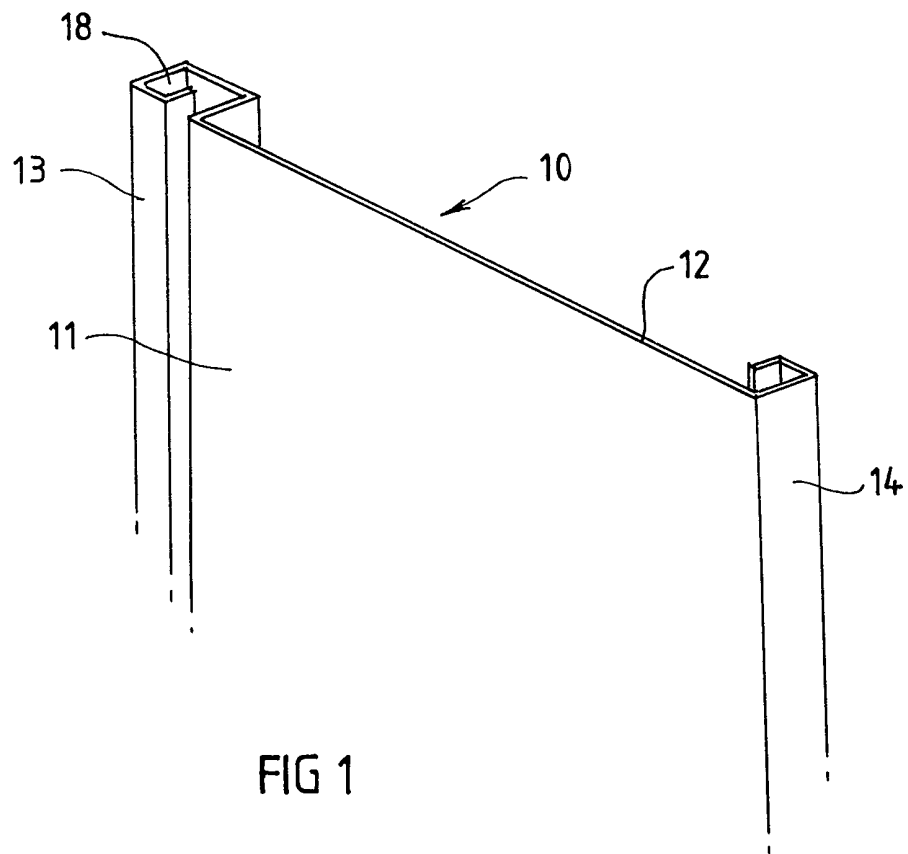
26. A building system according to claim 25, wherein the reinforcing element is operative to engage with the connecting elements of the panel in a snap fit arrangement.

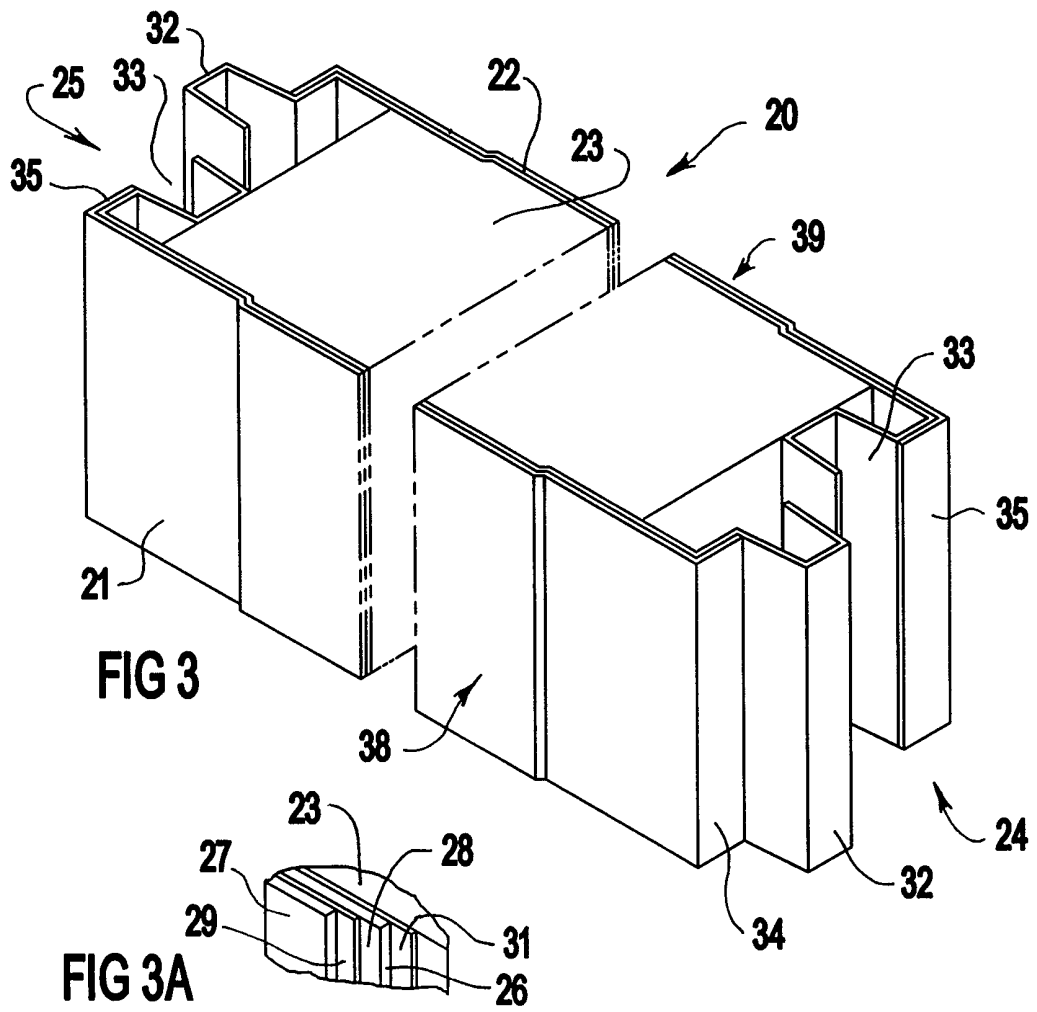
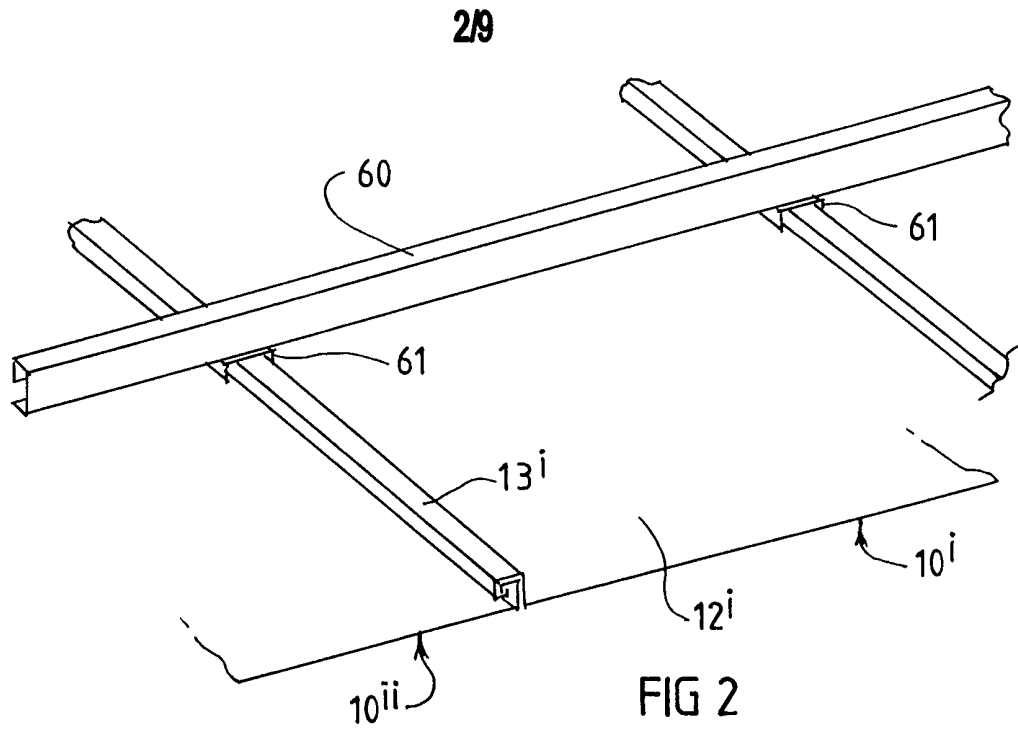
30 27. A building panel substantially as herein described with reference to the accompanying drawings.

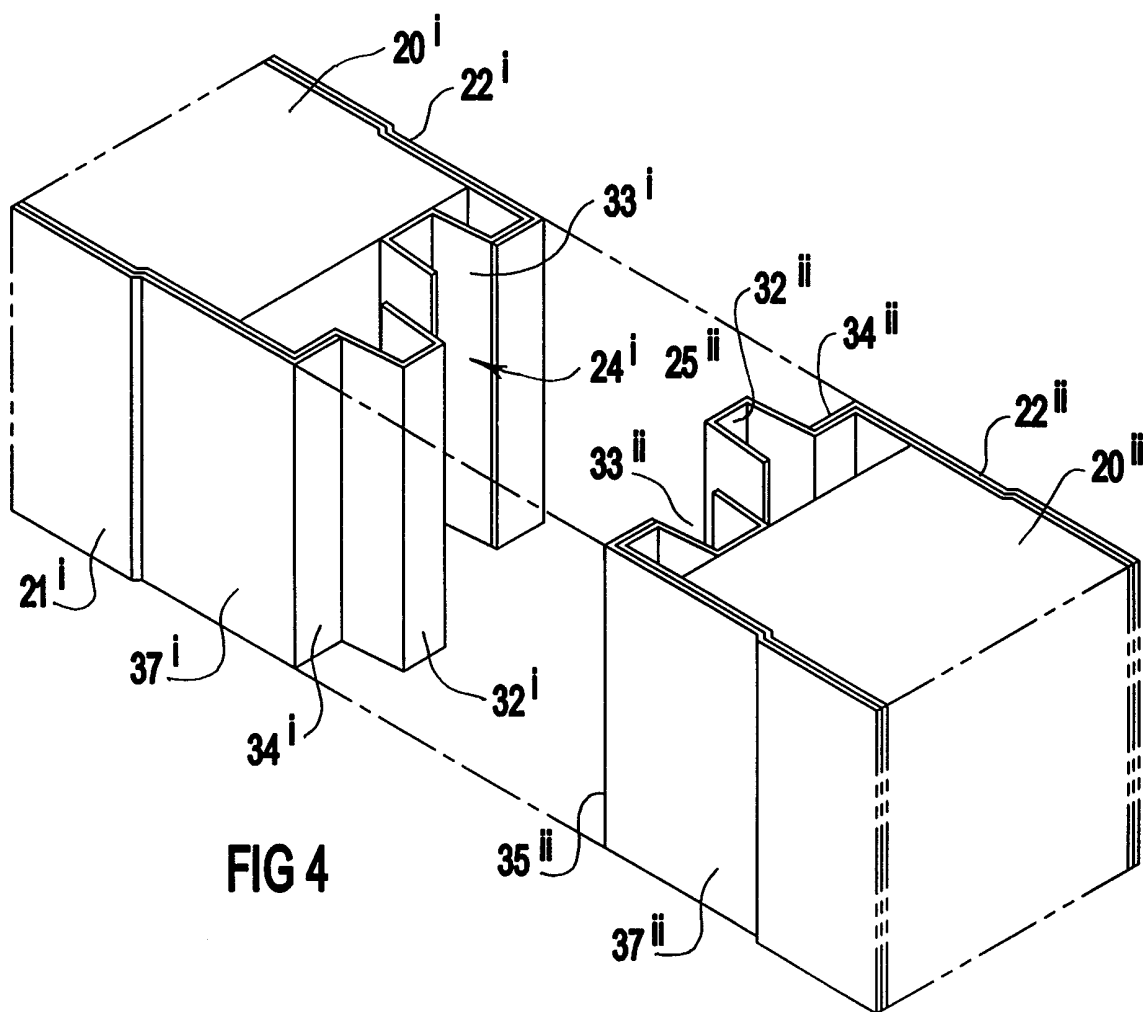
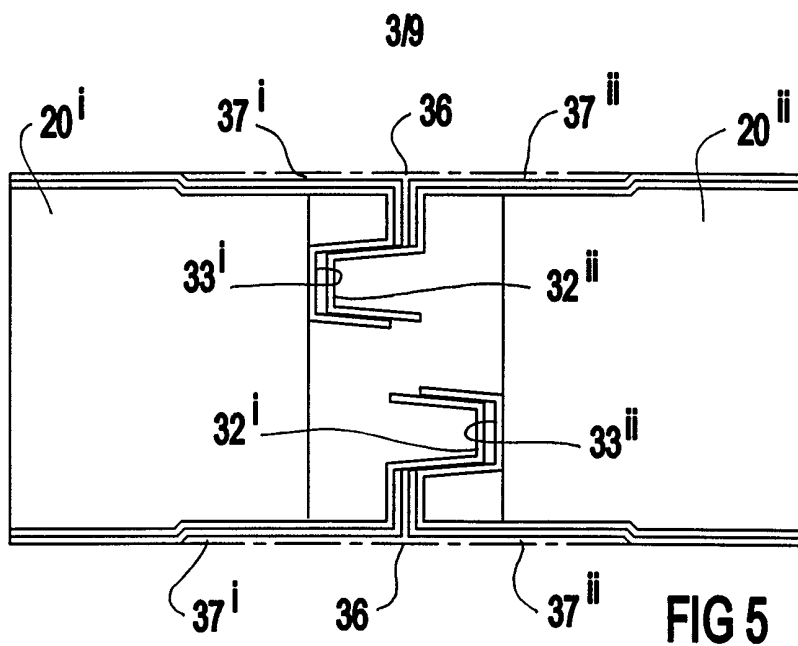
28. A composite panel substantially as herein described with reference to the accompanying drawings.

29. A building system substantially as herein described with reference to the accompanying drawings.

1/9







49

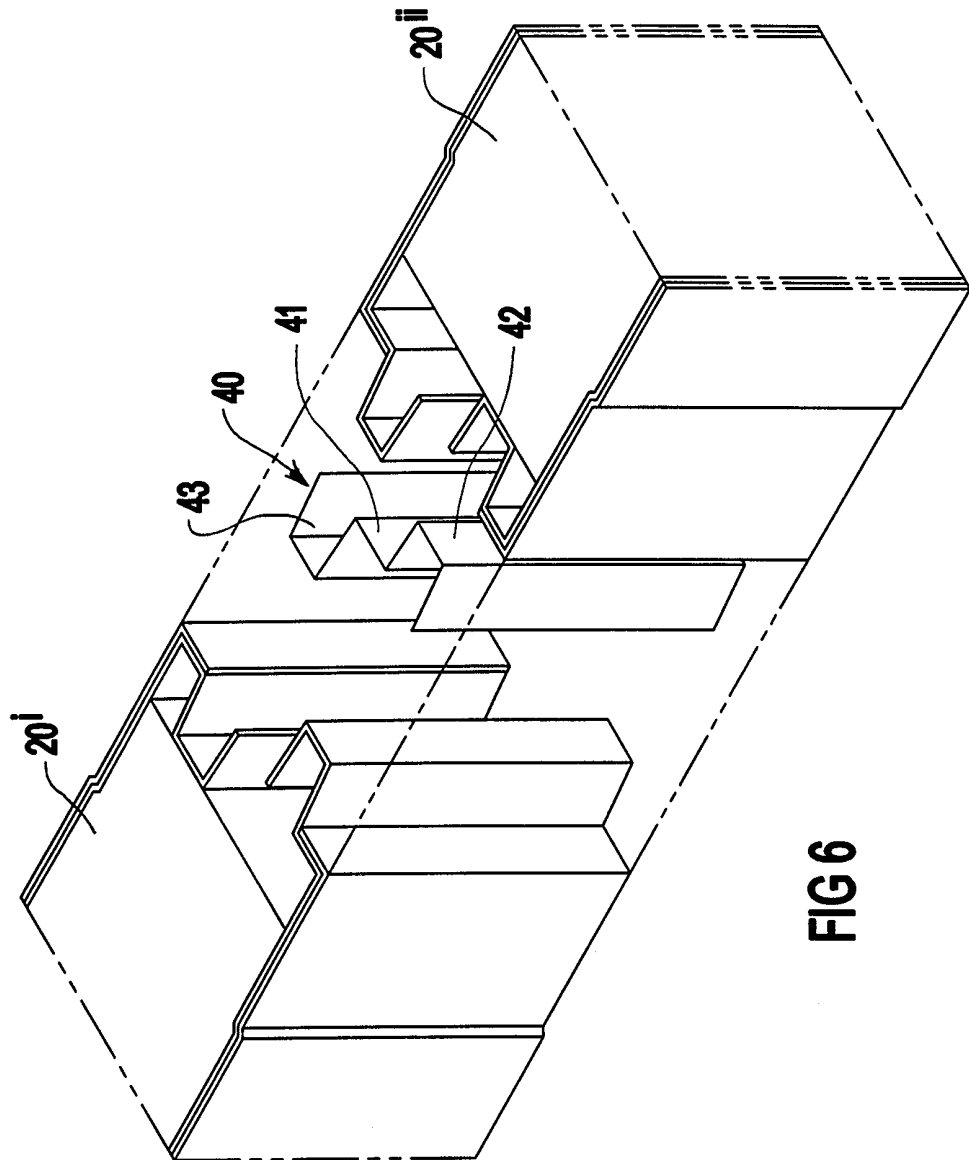


FIG 6

5/9

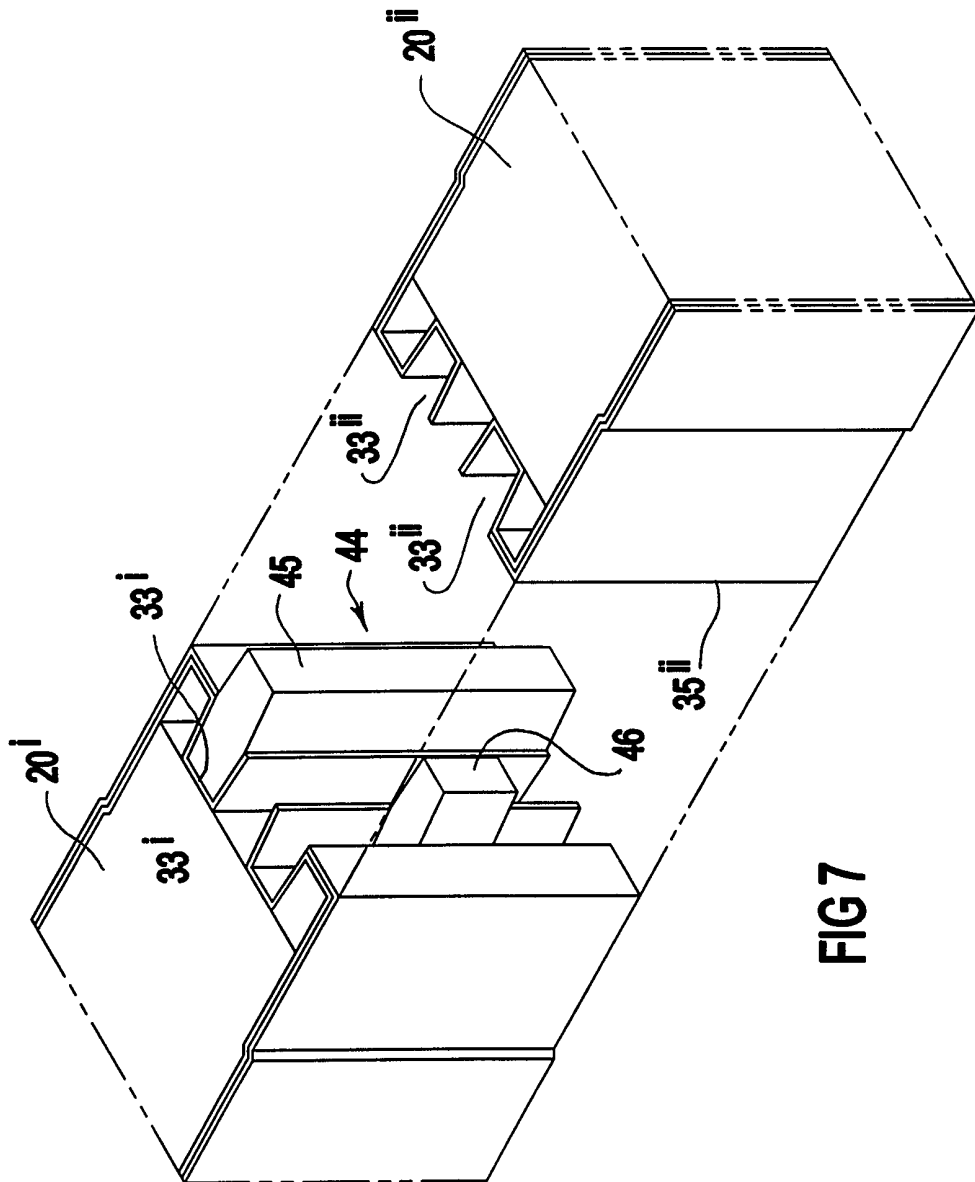
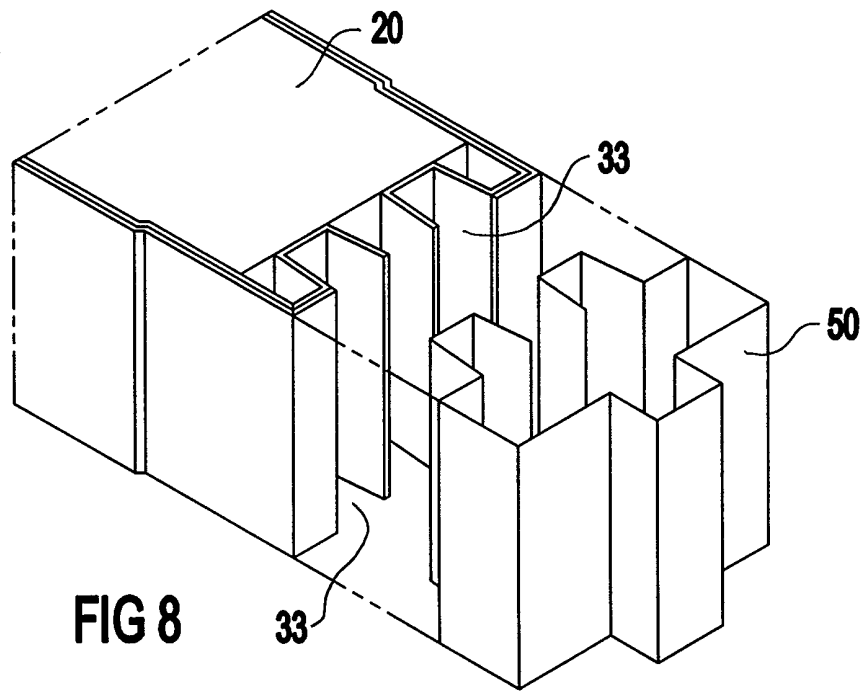


FIG 7

6/9





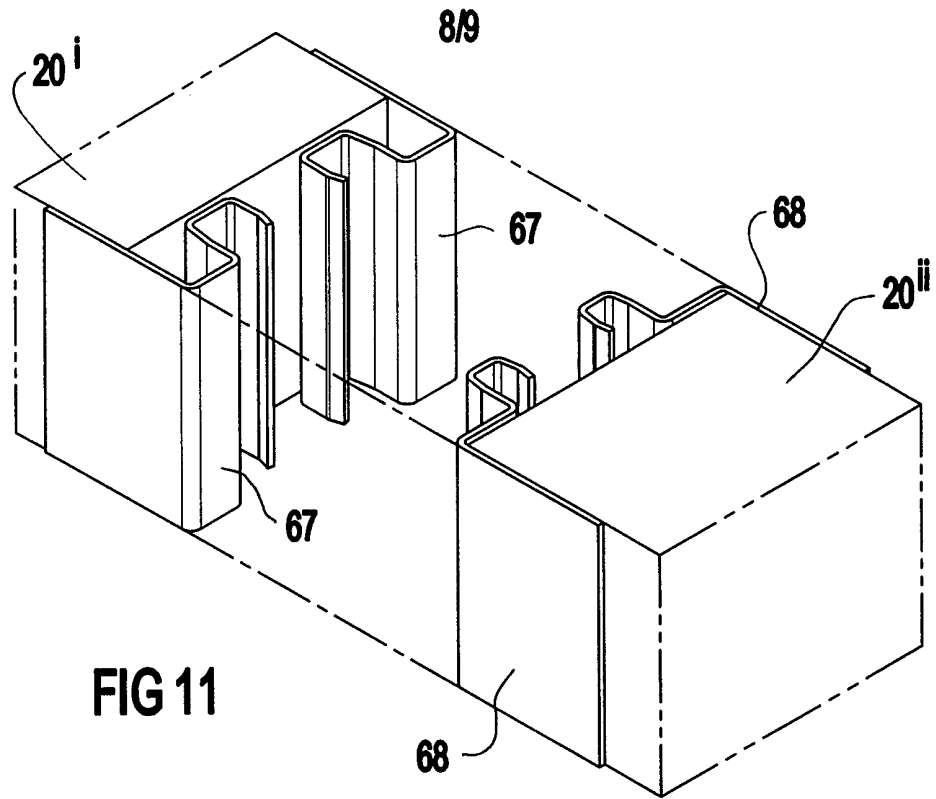


FIG 11

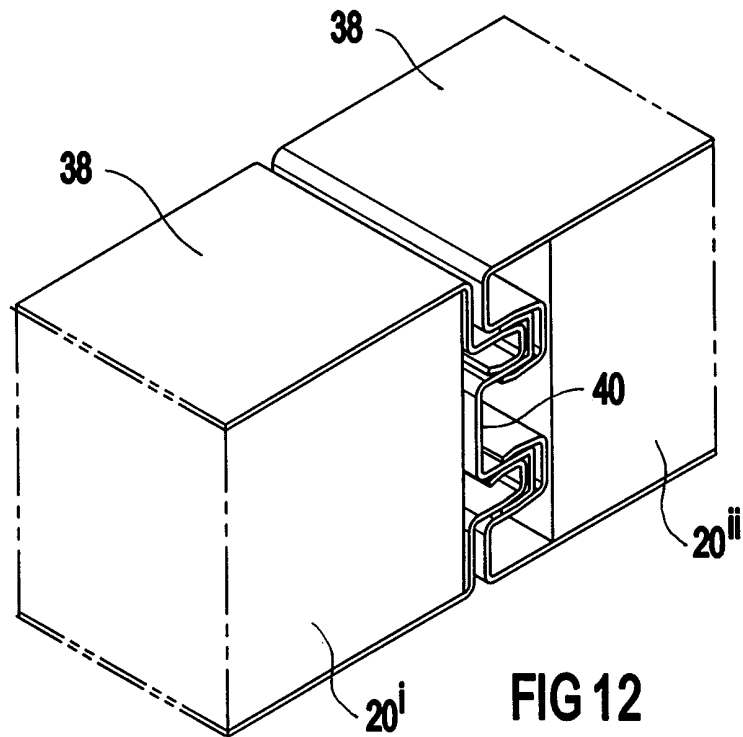


FIG 12

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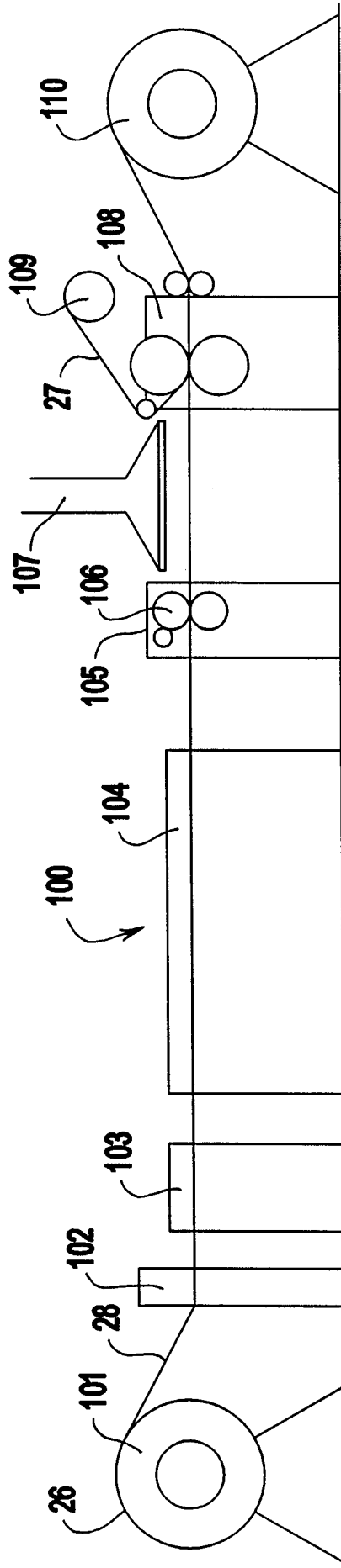
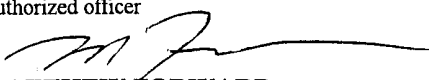


FIG 13

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU 99/00264

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>																						
Int Cl <sup>6</sup> : E04C 2/08 E04F 13/02 B32B 15/12, E04B 2/72																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
<b>B. FIELDS SEARCHED</b>																						
Minimum documentation searched (classification system followed by classification symbols) E04C 2/08, 2/26, 2/34, 2/38 E04B 2/72, 9/28 E04F 13/02, 13/12, 13/18 E04D 3/18, 3/34, 3/361 3/362 B32B 15/12 F16S 1/02, 1/10																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU IPC AS ABOVE																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT and JAPIO : metal steel aluminium paper cellulose fibre fiber coat cover back layer render skin panel sheet board partition laminate connect link attach																						
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X Y Y	GB 391936 B (H H ROBERTSON CO.) 1 June 1933 Page 1 lines 37 to 59, page 2 lines 101 to 109	1 to 4 6,7 8 to 16																				
X Y Y	US 2850999 A (KAPLAN et al) 9 September 1958 Column 3 line 65 to column 4 line 19, column 6 line 71 to column 8 line 3, figure 1	1 to 5 6,7 8 to 16																				
X	Derwent Abstract Accession No. 11966W/07, Class A32,M13,P73, JP 75001912 B (DAIDO STEEL SHEET MFG CO.) 22 January 1975 Abstract	1 to 5																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 7 July 1999		Date of mailing of the international search report 15 JUL 1999																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer  <b>MATTHEW FORWARD</b> Telephone No.: (02) 6283 2606																				

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00264

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y Y	GB 1482111 B (SUMITOMO METAL INDUSTRIES LIMITED and IGETA STEEL SHEET CO. LTD) 3 August 1977 Page 1 lines 53 to 66	1 to 5 6,7 8 to 16
X	Derwent Abstract Accession No. 90-221720/29, Class P73, JP 02151440 A (FUJI KOBUNSHI KK) 11 June 1990. Abstract	1 to 5
Y	FR 1133582 A (MAZZOLI) 28 March 1957 Figures	6,7
Y	AU 41506/78 A (RUCKZIEGEL) 15 May 1980 Figures	6,7
Y	US 3667180 A (TISCHUK) 6 June 1972 Entire document	8 to 16 22, 23, 25, 26
Y	DE 2449917 A (ACIEROID ITALIANA S.p.A) 29 April 1976 figures	8 to 16 22, 23, 25, 26
Y	US 4316351 A (TING) 23 February 1982 Entire document	8 to 16 22, 23, 25, 26
X	DE 647272 B (MAUSER KOMM-GES) 1 July 1937 Figure	19-26
X	DE 2611893 A (ELDA AG, GLARUS) 29 September 1977 Figure	19-20
X Y	EP 250258 A (SEVEN S STRUCTURES INC.) 23 December 1987 Figures 3, 9-10	19-21, 23-24 22, 25, 26
X Y	WO 93/12303 A (JAMES HARDIE & COY PTY LIMITED) 24 June 1993 Entire document	19-21,23-24 22, 25, 26
X Y	FR 2694774 A (VIGNOLLES) 18 February 1994 Figure 1	19-21, 23-24 22, 25, 26

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00264

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 27 to 29  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

They do not comply with Rule 6.2(a) of the PCT, which requires that claims should not rely on references to the description or drawings.

3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1 to 18 define a building panel of a metal substrate with a paper covering bonded thereto, and a composite panel of spaced covered metal substrates and a core between the substrates and interconnecting same.

Claims 19 to 26 recite a building system with spaced sheets, a core between said sheets and a reinforcing element between the spaced sheets and within the core.

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/AU 99/00264**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	1482111	DE	2433453	JP	50040639		
US	3667180	CA	952679				
EP	250258	AU	74461/87	CA	1287964	FI	872585
		NO	872544	NZ	220698	US	4765105
WO	93/12303	AU	31525/93				

END OF ANNEX