

CURTAIN WALL CLADDING SYSTEM

The present invention relates to a polygonal building panel and to a building assembly including such a panel.

There are many forms of building panel which essentially consist of first and second sheet metal pans each having a central portion defining a polygonal periphery and inturned marginal flanges, the flanges of one of the pans fitting within the flanges of the other pan, an insulating core being fitted within the pan which are secured to the core usually by adhesive or by having the core moulded directly therein. Profiles are engaged with the inturned flange portions and provide side edges to the panels enabling the panels to be secured to one another and to a support structure.

While known panels have been generally satisfactory for internal use, when they are used externally they are subjected to a far higher forces, especially forces attributable to the weather, in particular to the wind and known structures have not proved entirely satisfactory for this purpose.

It is now proposed, according to the present invention, to provide a polygonal building panel comprising a first sheet metal pan having a first central portion defining a polygonal periphery and first inturned marginal flanges on each side of the polygonal periphery; a second sheet metal pan having a second central portion similar in shape to that of the first pan, but covering a smaller surface area and second inturned marginal flanges on each side of the polygonal periphery and dimensioned to fit closely along side said first internal flanges of the first pan; a structural core substantially filling an interior defined by said first and second central portions and said second inturned flanges, some of the first or second inturned flanges having an edge portion projecting transversely of the associates flange, preferably generally



parallel to the central portion of that pan, the complementary second or first marginal flanges being substantially without such projecting edge portions; and peripheral intermediate profiles engaging and positioning  
5 said first and second inturned marginal flanges with respect to one another.

Desirably said intermediate profile includes a laterally projecting abutment engaging said edge portion on the side thereof to urge the associated pan against the  
10 core.

By providing the marginal flange with such an abutment which engages the edge portion, the edge portion can be prevented from being pulled outwardly by the wind. Preferably it is the edge portion of the flange associated  
15 with the exterior pan which is provided with such a transversely projecting edge portion.

The complementary inturned flange advantageously is engaged both internally and externally by a portion of the intermediate profile.

20 In a preferred construction, the intermediate profile has a portion engageable by a fastener which is used to fasten the panel against a support structure. Desirably this portion is disposed so as to urge the edge profile, when the fastener is tightened, in a direction to push the  
25 abutment against the transversely extending edge portion. In this way, the fastener can be used to hold the two pans tightly against the support structure thereby squeezing slightly the core sandwiched therebetween.

The fastener may, for example, be a screw fastener  
30 having associated therewith a washer-like rotatable member which preferably is formed with at least one groove to engage an out-turned bead formed on said portion of the profile.

The fastener will often be associated with the  
35 profiles of two adjacent panels, the profiles being positioned in mirror image with respect to one another. The rotatable member may be part circular with a portion of the



periphery omitted so that the rotatable member may be rotated to a position readily allowing a second panel to be positioned adjacent an already fixed panel whereafter the rotatable member is rotated, for example through 90°, so that the rotatable member engages the portion of the second panel.

In an alternative arrangement the fastener is in the form of a body having a profiled head engageable with said portion of the intermediate profile.

Indeed according to another aspect of the invention there is provided a panelling system comprising a support structure, a plurality of panels each comprising a first sheet metal pan having a central portion defining a polygonal periphery and first inturned marginal flanges on at least one side of the polygonal periphery; a second sheet metal panel having a second central portion similar in shape to that of the first panel, and second inturned marginal flanges on at least one side of the polygonal periphery; a structural core substantially filling an interior defined by said second inturned flanges, peripheral intermediate profiles engaging and positioning the first and second inturned marginal flanges with respect to one another, said intermediate profile including a channel shaped portion having inturned rims, and a plurality of fasteners each including a fastener body and a head portion engaged in said channel, said channel being slidable with respect to said head portion, the fastener body having means mounted on the support structure, and locking means to lock the fastener with respect to said channel.

With such fasteners, the head portion has a bore therein into which is engaged a threaded locking member which can be tightened to engage against the portion of the intermediate profile and lock the intermediate profile relative to the fastener.

The body portion preferably includes a notch engageable with a support member of a support structure.

Advantageously there is located between each pair



of adjacent panels a filler strip. This may be of channel shape sheet metal construction and may have associated therewith a gasket on each side of the flange of the channel shaped filler member so that when the filler member is pressed forcibly into the space between two adjacent panels, the gasket firstly provides a weather proof seal between the facing inturned flanges and secondly has an engagement portion engaging behind complementary rims formed on the two associated intermediate profiles.

While it would normally be the case that the edge portion of the first and second inturned flanges are bent outwardly away from the associated core, it is contemplated that this may be the situation, say, with the first inturned flanges, but the second inturned flanges may have inwardly directed transversely extending edge portions.

In a preferred structure, the edge portions are formed on alternate flanges and not on the intermediate flanges. For example, most commonly the panels will be rectangular and in those circumstances two opposite first flanges will have the edge portions and the other two edge flanges will not. If that be the case in one particular embodiment the complementary second flanges to said alternate flanges will not have any edge portions, but the other flanges will have inturned edge portions. It is also contemplated that the polygonal shape can have a different number of sides, for example, the polygonal building panel may be hexagonal and here again preferably alternate first flanges are provided with out-turned edge portions and the other three are not.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a schematic perspective view of one embodiment of building panel assembly according to the invention from the exterior;

Figure 2 is a similar view from the interior;



Figure 3 is a detail showing the rotatable element associated with a screw fastener more clearly;

Figure 4 is an enlarged cross-sectional view through two adjacent building panels according to the invention with a filler strip therebetween;

Figure 5a and 5b are similar views, but with the filler strip omitted, and showing the rotatable member associated with the fastener in two different positions;

Figure 5c is an enlarged view of the filler strip;

Figure 6 is a view similar to Figure 4 but showing the two other sides associated panels with the filler strip inserted;

Figure 7 is an exploded view of the panel of Figures 1 to 6;

Figure 8 is a view illustrating two intermediate profiles abutting at a corner;

Figure 9a and 9b are schematic perspective views showing portions of two of the intermediate profiles of the invention;

Figure 10 is an exploded view similar to Figure 7 showing a hexagonal panel;

Figure 11 is an exploded view showing a modified structure of rectangular panel;

Figure 12 is a view similar to Figure 4 of a further modified panel;

Figure 13 is an enlarged section taken on the line XIII-XIII of Figure 12;

Figure 14 is a perspective view of a further embodiment of building panel assembly according to the invention;

Figure 15 is a fragmentary top plan view of the panel of Figure 14;

Figure 16 is a perspective view of a pair of fastening members of the assembly of Figures 14 and 15; and

Figure 17 is a section taken along the line XVII-XVII of Figure 14.

Figures 1 and 2 show a front and back view of a



fragmentary portion of a curtain wall cladding system according to the invention. More in particular a portion is shown at the location of a junction between horizontal and vertical filler elements.

5           A load bearing building frame or structure 10 having a frontal flange or web 12 is used as an attachment for a plurality of individually removable and interchangeable panels 14. The load bearing frame can comprise any number of parallel spaced elongate profiles of  
10 L-shaped, U-shaped or H-shaped cross-section having one flange or web exposed in a frontal plane for mounting of the panels. Each panel 14 is mounted by a rotatable member 16 and a screw fastener 18 engaging upper and lower horizontal flanges 20 rigidifying profiles forming edges of the panels.

15           The panels themselves consist of a first outer sheet metal pan 22, a second inner sheet metal pan 24, a lightweight structural core member 26 and horizontal and vertical intermediate rigidifying profiles 28 and 30. The horizontal flanges 20 are integral with the horizontal  
20 profiles 28. Also integral with each of the profiles 28 and 30 are outwardly opening outer channels 32 into which filler element profiles generally indicated with a numeral 34 can engage. The filler element profiles 34 consist of a resilient gasket 36 and a rigid sheet metal channel shaped  
25 outer strip or body 38.

          Mounting of the panels 14 onto the load carrying structure 10 is effected by member 16 and fastener 18, whereby as more clearly shown in Figures 2 to 5b, the rotatable member 16 on its back face is provided with two  
30 parallel grooves 40 which are adapted to engage over ridges 42 on the flanges 20.

          The arrangement is such that the lateral cross sectional dimensions of the grooves 40 exceed the cross sectional width of the ridges 42 so as to allow for certain  
35 dimensional tolerances and differences in heat expansion and contraction. The generally circular rotatable members 16 have a flattened side 44 which can be rotated to be in

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register with one flange 20, to allow passage of the profile while retaining another profile during installation. This feature is particularly shown in Figures 5a and 5b in which the screw fastener and load bearing structure have been  
5 omitted for clarity.

Figure 4 shows a details cross section through a horizontal filler element, with the panels 14 and filler element profiles 34 properly installed. The screw fastener 18 as shown in the illustrated embodiment is of the type  
10 having a drilling end 46 and self-tapping screw thread 48 so as to perform several steps in a single operation. It should be clear that any kind of screw fastener can be employed provided that there is a sufficient length of screw thread 48 to allow loosening and rotation of the member 16 over the  
15 ridge 42 while retaining it on the load bearing structure.

Also shown in Figure 4 is how the filler element profile 34 engages in the outwardly exposed channels of the intermediate profiles 28. For a further explanation of this structure reference is made to Figure 6, which shows a cross  
20 section through a vertical filler element and Figure 5c which shows the filler element profile itself. A comparison of Figure 6 and Figure 4 makes it directly apparent that there is no attachment of the panels in the vertical filler elements.

25 The filler element profile 34 is pressed in from the outer side of the structure, and both the gasket 36 and the rigid body 38 are sufficiently resilient to accommodate slight building tolerances resulting in a somewhat variable distance between the channels 32 of adjacent panels. The  
30 gasket 36 as shown in Figure 5c having outwardly biased lateral wings 50 which provide a weather-tight seal against first inturned marginal flanges 52 of the outer pans. The gasket profile is also provided with inwardly directed lips 54 which grip behind ribs 56 on the outwardly opening  
35 channels 32, so as to retain the filler element profiles 34 in position.

Figure 5c shows the filler element profile in its



relaxed form. Figure 6 shows a cross section through a vertical filler element, whereas Figure 4 shows a cross section through a horizontal filler element. It can also be seen from Figures 4 and 6 that the horizontal and vertical panel edges are different from one another. It is seen that the sheet metal outer pans 22 at the horizontal panel edges as shown in Figure 4 have inturned marginal flanges 52 which have laterally projecting edge portions 58.

The horizontal intermediate profiles 28 are provided with an inwardly facing abutment in the form of a ridge 60 in the outwardly opening channels 32, which ridge can be engaged over and retain the laterally projecting edge portions 58 of the outer pans. This enables the curtain wall structure to withstand even excessive wind suction forces as the outer pans are positively retained by the load carrying structure. Thus the connection of the outer pans to the load carrying structure is not subject to chemical deterioration as would be the case if the outer sheet were merely adhesively kept in place.

The inturned marginal flanges 52 of the vertical panel edges as shown in Figure 6 are formed without any laterally projecting edges.

Figure 7 shows the panel in a somewhat simplified and in an exploded arrangement. The core member 26 which covers and adheringly interconnects substantially the entire interior main surfaces of the inner and outer pans is not shown in Figure 7 but will be part of the assembled structure.

The rigidity of the assembled panel as well as the flatness of the relatively thin walled outer surface, however, are in particular dependent on a homogeneous connection with and on the structural rigidity of the core. The purpose of Figure 7 is to explain the assembly of the inner and outer pans and the horizontal and vertical rigidifying intermediate profiles.

The horizontal and vertical intermediate profiles 28 and 30 are substantially identical in cross section, but



differ in length and in the shape of their ends.

As shown in Figure 7, each of the intermediate profiles has an outer main surface 62 which upon assembly engages the inner surface of the inturned flanges 52 of the outer pan 22. The intermediate profiles are also provided with an inner main surface 64 which upon assembly engages an outer surface of a second, inturned marginal flange 66 of the inner pan 24. The inner sheet metal pan 24 has a central portion 25 which is similar in peripheral shape to the central portion 23 of the outer sheet metal pan 22, but covers a somewhat smaller surface area so that the inturned flanges 66 of the inner pan will fit inwardly of the inturned flanges 52 of the outer pan while allowing room for the intermediate profiles 28, 30.

The intermediate profiles 28,30 are each also provided with an inner channel 68 opening towards the inturned flanges 66 of the inner pan. While the free ends of the inturned flanges of both the inner and outer pans are each engaged in a channel such as 68 or 32, loads and forces exerted on the inner and outer pans can be transmitted onto the intermediate profiles and thereby onto the load bearing structure.

From a safety point of view, especially in structures that should be relatively maintenance free such as a curtain wall for a building, it is clear that one should preferably not rely solely on adhesive material for structural connections as such connection can be easily affected by chemical deterioration. The building panel according to the present invention in particular achieves a positive mechanical locking of all its components once it is attached to a load bearing structure in the manner described above.

Of particular importance in this respect is the sequential assembly of the panels, which is as follows:

Each of the horizontal intermediate profiles 28 is first assembled with the relevant horizontal flanges 52 of the outer pan 22. This is done by manoeuvring the lateral edge



portion 58 behind the ridge 60 of the channel 32, by rotating the horizontal profile 28 about its longitudinal axis.

As can be seen in Figure 7, the inner channels 68 on the horizontal profile 28 have been cut shorter than the remainder of the profile over a portion 70. The recessed portion 70 allows accommodation of the confronting end of the inner channel 68 of the adjacent vertical profile 30.

After inserting the vertical profiles 30 between opposed horizontal profiles 28, the latter can no longer be moved out of engagement with the edges 58. After the horizontal and vertical intermediate profiles 28,30 are positioned on the outer pan, preparations can be completed for mounting a structural core, which is preferably lightweight, into the interior of the outer pan 22 as defined by the intermediate members. This structural core while not illustrated in Figure 7 can be of any suitable form, such as a preformed block or slab of polystyrene foam, polyurethane foam, mineral wool or other suitable material as well as prefabricated cores of cellular configuration such as structural honeycombs or the like.

To complete the 'sandwich ', the inner pan is inserted with the free ends of its marginal flanges 66 facing the free ends of the marginal flanges 52 of the outer pan and into the inner channels 68 of the intermediate profiles. The central surface 25 of the inner pan is adhesively connected to the core and thereby to the main surface 23 of the outer pan and so holds the entire assembly together. Such a sandwich structure is very advantageous as it allows large surface area panels, without having to resort to heavy gauge metal plates.

Large surface area panels are usually critical with respect to flatness, which if defective would directly destroy the visual aspect of the wall cladding. The sandwiched panels of the present invention ensure flatness while being lightweight which enhances installation and reduces costs for the support structure.



A corner detail of the position taken by a vertical and a horizontal intermediate profile is additionally shown in Figure 8. The different ends of the horizontal intermediate profile 28 and the vertical intermediate profile 30 as they would appear on the particular (more elaborate) profiles of the preferred embodiment of Figures 1 to 6 are additionally illustrated in Figures 9a and 9b respectively.

Figure 10 shows a variation of the panel which is not rectangular and in this example is hexagonal. The assembly arrangement of the panel is similar to the embodiment of Figure 7, but here three profiles of the 'horizontal' type and three profiles of the 'vertical' type alternate along the six peripheral flanges of the panel.

Another alternative arrangement is shown in Figure 11, which assembly differs from that of Figure 7 in that two opposed inturned marginal flanges 66 of the inner pan each have an inwardly directed edge portion 72 which can be preassembled with an inner channel 74 on the intermediate profile 30 somewhat similar in shape to the outer channel 32.

Obviously this latter modification requires a slight adjustment in the assembly procedure, in that the 'vertical' type of profile 30 will now be assembled together with the inner pan 24.

Figures 12 and 13 show a further embodiment in which the mounting structure differs from that of Figures 1 to 4. Figures 12 and 13 illustrate a horizontal and a vertical cross section through a vertical filler element. The arrangement of this further embodiment is such that the vertical load bearing structure 110 coincides with the vertical filler elements and the panels are attached at their vertical filler elements instead of the horizontal filler elements as in the first described embodiments.

Apart from having different intermediate profiles 120 the inner and outer pans of the panels have also been re-orientated through 90°, making the horizontal edges the



vertical edges and vice versa.

Figure 12 shows that the lateral edge portions 58 and the ridges 160 are now positioned in the vertical filler element.

5 Figure 13, which is a cross section according to the line XIII - XIII in Figure 12 shows that the panels 114 are lowered in attachment onto bolts 115. The bolts 115 are engaged by hook like members 117 which are connected to the panels 114 by enlarged head sections 119 fitting in undercut  
0 grooves 121 in the intermediate profiles 120.

The hook like members 117 can be retained in the undercut grooves 121 by a fastener 123 as shown in Figure 13.

To obtain a rattle-free and close fitting  
5 connection the bolt 115 can be additionally provided with a resilient member 125, which may have additional means 127 to snap-fit over the bolt 115 and additionally also engage behind a detent 129 on the hook like member 117.

20 Preferably the structural support 110 is of top-hat configuration and has lateral surfaces 112 to support the back face of the panels.

Resilient padding in the form of strips 113 may be provided between the surfaces 112 and the inner panel faces.

25 The embodiment of Figures 12 and 13 would be generally preferred for installations where rectangular panels are positioned with their length in a vertical orientation, whereas the embodiment of Figures 1 through 4 would be preferred for rectangular panels in a horizontal  
30 orientation.

Figures 14-17 illustrate a further embodiment of the invention which shows intermediate profiles generally similar to those of Figures 1-4 and a mounting arrangement generally similar to those of Figures 12 and 13, but with  
35 modifications.

In detail the support structure 210 is very similar to that of Figure 12 and includes a cross-bolt 215.



Two panels 214 having a first pan 222, a second pan 224, and a core 226 are shown mounted adjacent one another (Figure 15) and are retained thereagainst by fasteners 216 each including a body portion 217, an elongate head portion 218 and a downwardly extending notch 219 (Figure 16), this being engageable over the bolt 215.

It will be seen from Figure 15 that the head portion 218 is engaged in a recessed portion 227 of the associated intermediate profile 228, this recess portion including inturned rims 229 to engage under the head 218.

The head portion 218 is provided with at least one threaded bore 250 into which is threaded a locking member 252 so that when the locking member 252 is screwed inwardly, it will engage the intermediate profile 228 to lock against relative movement between the intermediate profile and the fastener 216. As can be seen from Figure 16, the threaded bores 250 of the two fasteners are offset longitudinally of the head portion with respect to one another. This facilitates the operation of a spanner on the locking member. In this way the actual height and location of each panel 214 can be adjusted to suit a particular requirement. Other aspects of the design are similar to that shown in Figure 4 and it will be seen that the assembly is again provided with a filler element profile 234 and a gasket 236. These can be removed to enable the locking element 252 to be tightened up and loosened by means of a suitable spanner.

It will be appreciated that this form of fastening can be employed not only in the type of structure illustrated herein, but is equally adaptable to other panels provided they have some form of edge profile into which the head of the fastener can be engaged and locked.



CLAIMS

1. A polygonal building panel comprising a first sheet metal pan (22) having a first central portion (23) defining a polygonal periphery and first inturned marginal flanges (52) on each side of the polygonal periphery; a second sheet metal pan (24) having a second central portion (25) similar in shape to that of the first pan, but covering a smaller surface area and second inturned marginal flanges (66) on each side of the polygonal periphery and dimensioned to fit closely alongside said first inturned flanges (52) of the first pan; a structural core (26) substantially filling an interior defined by said first and second central portions (23,25) and said second inturned flanges (66), some of the first or second inturned flanges having an edge portion (58) projecting transversely of the associated flange, preferably generally parallel to the central portion of that pan, the complementary second or first marginal flanges being substantially without such projecting edge portions; and peripheral intermediate profiles (28,30) engaging and positioning said first and second inturned marginal flanges (52,66) with respect to one another.

2. A panel according to claim 1, wherein said intermediate profiles include a laterally projecting abutment (60) engaging said edge portion (50) on the side thereof to hold the associated pan and intermediate profile in position with respect to each other.

3. A panel according to claim 1 or 2, wherein the complementary inturned flange (66,52) is engaged both internally and externally by a portion of the intermediate profile (28,30).

4. A panel according to any preceding claim, wherein the intermediate profile (28,30) has a portion (42) engageable by a fastener (18) which is used to fasten the



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panel against a support structure (10).

5. A panel according to claim 4, wherein the said portion (42) is disposed so as to urge the edge portion (58), when the fastener is tightened, in a direction to push the abutment (60) against the transversely extending edge portion (58).

6. A panel according to claim 5, and further comprising a fastener in the form of a screw fastener (18) having associated therewith a washer-like rotatable member (16).

7. A panel according to claim 6, wherein the washer-like rotatable member is formed with at least one groove (40) to engage an out-turned bead (42) formed on said portion of the profile and wherein the rotatable member is part-circular with a portion (44) of the periphery omitted so that the rotatable member may be rotated to a position readily allowing a second panel to be positioned adjacent an already fixed panel whereafter the rotatable member is rotated, for example through 90°, so that the rotatable member engages the portion of the second panel.

8. A panel according to claim 5, and further comprising a fastener (216) in the form of a body (217) having a profiled head (218) engageable with a portion (227) of the intermediate profile wherein said head portion has a bore therein into which is engaged a threaded locking member (252) which can be tightened to engage against the portion (227) of the intermediate profile and lock the intermediate profile relative to the fastener.

9. A panel according to any preceding claim, and further comprising a filler strip (34) adapted to be located between each pair of adjacent panels and wherein the filler strip is of channel shape sheet metal construction having

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associated therewith a gasket (36) on each side of the flange of the channel shaped filler member, so that, when the filler member is pressed forcibly into the space between two adjacent panels, the gasket firstly provides a weather proof seal between the facing inturned flanges and secondly has an engagement portion engaging between complementary rims (56) formed on the two associated intermediate profiles.

10. A panel according to any preceding claim, wherein the edge portion (58) of the first and second inturned flanges are formed on alternate flanges of the panel.

11. A panelling system comprising a support structure (10,110,210), a plurality of panels (14,114,214) each comprising a first sheet metal pan (22) having a central portion (23) defining a polygonal periphery and first inturned marginal flanges (52) on at least one side of the polygonal periphery; a second sheet metal panel (24) having a second central portion (25) similar in shape to that of the first panel, and second inturned marginal flanges (66) on at least one side of the polygonal periphery; a structural core (26) substantially filling an interior defined by said second inturned flanges, peripheral intermediate profiles (28,30,120,228) engaging and positioning the first and second inturned marginal flanges (52) with respect to one another, said intermediate profile (28,30) including a channel (40,121,227) having inturned rims (42), and a plurality of fasteners (16,117,216) each including a fastener body and a head portion (44,119,218) engaged in said channel, said channel being slidable with respect to said head portion, the fastener body having means (18,118,215) mounted on the support structure (10,110,210), and locking means (18,123,252) to lock the fastener with respect to said channel.



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