

CLADDING ELEMENT

BACKGROUND OF INVENTION

This invention relates to cladding elements and particularly the jointing of cladding elements side to side.

While the invention is described in relation to interlocking sheets, which are connected together at their longitudinal edges to provide roof/ceiling cladding and more particularly to roof/ceiling cladding formed of sheet metal material, the present invention is not limited thereto and is equally applicable to walling, decking and other cladding and may be formed of sheets of plastics or other material.

Traditionally, sheet metal roof cladding comprises a plurality of corrugated sheet metal elements laid side to side with overlapping edge margins. The elements are generally fastened to transversely extending spaced apart battens, purlins or other support members by nails, screws or other fasteners piercing the sheets and engaging the battens.

In more recent times, "flat" or "ribbed" cladding elements have been developed. These elements generally comprise an essentially flat web, often referred to as a "pan", having upright flanges along each longitudinal edge. Often the web includes one or more longitudinally extending upwardly directed stiffening ribs.

In roof structures these elements are laid side to side with the flange of one element overlapping that of an adjacent element. Each element is generally provided with one edge flange in the form of a male rib formation and the other edge flange in the form of a female rib formation. In assembly, the male rib formation is adapted to fit snugly within the female rib formation in interlocking engagement to resist separation of the elements in directions both normal to and along the longitudinal direction of said formations. These elements are generally fastened to battens by means of traditional fasteners or by concealed clips. Concealed

clips are generally affixed to the battens, and overlaid by the elements. The clips present an upwardly directed projection adapted to fit and snap engage with the underside of the element ribs.

5 While concealed clips provide a roof structure with a uniform appearance devoid of unsightly fastener heads, the underside presents an unsightly face similar to that presented by traditional fasteners. In the construction of verandahs, sheds, warehouses, patios, carports and
10 other building structures it is desirable for the one cladding element assembly to function as both roof and ceiling. In these circumstances battens, purlins and other supporting structural members are considered by some to be visually obtrusive. For this reason and for
15 economic reasons, it is desirable to place battens as far apart as possible consistent with the required strength of the structure as a whole. However, this means that in the centre regions between adjacent battens, substantial length of cladding element is unsupported and therefore,
20 prone to sagging. Sagging occurs as a result of inappropriate, excessive span lengths between adjacent battens. Additionally, to reduce cost, it is customary to make cladding elements from the thinnest steel sheet consistent with the necessary structural strength.
25 However, it sometimes happens that thin elements are walked on and that flexing of elements as a whole between the supporting battens forms a permanent deformation. To minimise the risks of this occurring span lengths are kept short. Short span lengths also minimise the risk of
30 sagging. Deformation and sagging is visually obtrusive and unacceptable in most building applications. It has, therefore, become desirable to construct roof/ceiling cladding assemblies having span lengths considerably longer than that which are used with tradition roof
35 cladding elements.

Even though the deflection of elements over a span is restrained, inter alia, by the interengagement of the longitudinally extending rib formations between

neighbouring elements it has been found that prior art assemblies have failed to provide adequate rigidity to limit deflection over a span to acceptable levels when the elements are used to span considerable distances, for example, distances in excess of 3 metres.

The object of the present invention is to provide an improved cladding element and cladding element joint which will substantially overcome or alleviate one or more of the above mentioned disadvantages.

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SUMMARY OF THE INVENTION

According to the invention there is provided a cladding element for use in a cladding element assembly, said element having a web and longitudinally extending side edges, one side edge being provided with an upwardly extending female rib formation and the other side edge being provided with an upwardly extending male rib formation able to enter the female rib formation of another element and when so entered lockably engage the elements side to side characterised in that when so assembled the interengaging rib formations form a closed loop in cross-section.

Preferably the closed loop is in the form of an inverted triangle. More preferably the triangle is substantially an equilateral triangle or an isosceles triangle.

Preferably the loop is closed by retention means. The retention means braces against lateral movement of the elements in at least one direction.

Preferably further the retention means is in the form of a tongue and groove formation.

The male or the female rib formation may be provided with a longitudinally extending groove and the other rib formation is provided with a longitudinally extending tongue adapted in assembly to extend into and be received by the groove of the neighbouring element in contiguous relationship. In assembly, the tongue and groove may close the loop formed by the interengaged male and female rib formation and brace the joint against lateral



movement of the elements at least in a direction normal to the plane of the elements.

Preferably, said groove extends continuously along the length of the element.

5 Preferably, the tongue extends continuously along the length of the element, however, in some embodiments the tongue may extend intermittently along the length of the element. That is to say, the tongue may, for example, comprise a number of short tongues regularly
10 spaced apart along the length of the element. In the latter embodiment, the groove may be in the form of a number of short grooves extending intermittently along the length of the element with each short groove being regularly spaced apart by substantially the same distance
15 as are the short tongues so that the short tongues and short grooves may in assembly be placed in register.

Preferably, the groove is formed in a lower portion of the male rib formation and the tongue is formed in a lower portion of the female rib formation, the groove
20 being spaced by substantially the same distance from the plane of the element as is the tongue.

The invention also provides a cladding element assembly comprising a plurality of cladding elements of the kind described above in accordance with the invention
25 in which the elements are laid side to side with male rib formation overlapped by and lockably engaged with the female rib formation of a neighbouring cladding element.

The invention further provides a joint, comprising a pair of cladding elements of the kind described above in accordance with the invention, laid side to side with the
30 male rib formation overlapped by and locking engaged with the female rib formation of neighbouring cladding element.

In some embodiments of the invention the tongue and
35 groove formations may be supplemented with a plurality of clinch fastenings, button punchings or other fasteners intermittently and regularly spaced apart along the length of the elements to assist to maintain the lower

portions of the respective ribs in fixed relationship.

BRIEF DESCRIPTION OF DRAWINGS

By way of an example, an embodiment of the above described invention is described in more detail
5 hereinafter with reference to the accompanying drawings.

Figure 1 is a cross-sectional view through a cladding element according to the invention;

Figure 2 is an enlarged view of a cross-section of the male rib formation according to the invention;

10 Figure 3 is an enlarged view of a cross-section of the female rib formation according to the invention;

Figure 4 is an enlarged view through a cross-section of two overlapping edge formations of two cladding elements according to the invention; and

15 Figure 5 is a perspective view of a cladding element according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The roof/ceiling element illustrated by figure 1 may be a coated steel sheet having a longitudinally extending female rib formation 3 bordering one longitudinal edge of the sheet and a longitudinally extending male rib formation 2 bordering the other longitudinal edge interconnected by a substantially flat web 1. The web 1 comprises a substantially flat land portion between said
20 longitudinal edges, which when used as a roof/ceiling element is the lowermost portion. Said flat portion is provided with a pair of upwardly formed longitudinally extending substantially parallel spaced apart minor stiffening ribs 4 to impart stiffness to an otherwise
25 flat land portion.
30

The cladding sheet is formed from a strip of 0.42 mm base metal thickness (BMT). The cladding sheet may be produced by roll forming. Other methods include stamp pressing and progressive stamp forming.

35 In the illustrated example, the upwardly extending shifting ribs 4 in the web 1 project marginally above the plane of the web by, for example, about 4mm, to maintain the substantially flat appearance of the web 1. The

female rib formation 3 extends about 45mm above said plane and the width of the female rib formation 3 is about 35mm with the width of the male rib formation 2 being about 33mm. The width of the web 1 is about 254mm.

5 The male rib formation 2 comprises an upwardly extending rib having an outwardly sloping portion 6 merging with a substantially upright portion 7 having a groove 8 therein, merging again with an inwardly extending portion 9 which is located over the web 1 and
10 terminating in an outwardly extending male flange 10 having a trailing edge 11 and a leading edge 12 in the form of a downwardly and inwardly extending return lip. Said male flange 10 protrudes beyond the web 1. The groove 8 extends continuously along the length of the
15 sheet.

 The female rib formation 3 comprises an upwardly extending rib having an outwardly sloping portion 13 merged with an inwardly sloping portion 14 which is located substantially over the web 1 and an outwardly
20 extending female flange 15 having a trailing end 16 and a leading end 17 in the form of a downwardly and inwardly extending return portion and an outwardly extending lip 18, said female flange 15 protruding beyond the web 1. The outwardly sloping portion 13 merged with the inwardly
25 sloping portion 14 forms an outwardly protruding tongue formation 19. The tongue 19 extends continuously along the length of the sheet, however, in some embodiments the tongue may extend intermittently therealong.

 The male rib formation 2 and the female rib
30 formation 3 are formed as interengagable formations, in that, in assembly, the male rib formation 2 of one sheet is able to enter the female rib formation 3 of a neighbouring similar sheet and when so entered lockably engage the sheets. The leading edge 12 of the male
35 flange 10 enters the mouth of a cavity 20 formed by the female flange 15 and is directed towards the trailing end 16 of the female flange 15 and then the trailing edge 11 of the male flange 10 is fitted and snap engaged under

the leading end 17 of the female flange 15. To effect the snap engagement, the inwardly extending portion of the leading end 17 the female flange 15 is sprung away from the trailing end 16 of the female flange 15 as the trailing edge 11 of the male flange 10 is inserted into the mouth of said cavity 20. In assembly, the upperside of the male flange 10 contacts the underside of the female flange 15 and the contacting parts lie flatly against each other and are secured together by the snap fit formations of the female flange 15. This interengagement provides an interference fit between the male and female rib formations 2,3.

The outwardly extending lip 18 of the female flange 15 may assist in guiding the leading edge 12 of the male flange 10 into the mouth of the cavity 20 and may also assist in manually opening said mouth to facilitate insertion of the trailing edge 11 of the male flange 10 during assembly. Further, the provision of the lip 18 assists to enhance the locking engagement of the joint when the lip 18 is walked upon.

As illustrated, the groove 8 is formed in a lower portion of the male rib formation 2 and the tongue 19 is formed in a lower portion of the female rib formation 3, the groove 8 being spaced by substantially the same distance from the plane of the web 1 as is the tongue 19.

The groove 8 has a relatively gentle sloping lower side and a more steeply sloping upper side. The interengaging rib formations 2,3 are sized such that the sheets have to be sprung apart to enable the tongue 19 to enter the groove 8 of an adjacent sheet. Thereafter, the resilience of the steel which is roll formed ensures that the tongue 19 remains lodged below the steeper side of the groove 8.

Thus, with the engagement of the male 10 and female flanges 15, the tongue 19 of the female rib formation 3 is lodged against the side walls of the groove 8 of the male rib formation having been sprung into the recess formed by the groove 8, to provide a closed loop in

cross-section between the two rib formations 2,3.

The tongue 19 and groove 8 may thus serve as an additional snap fitting formation between the interengaging male and female rib formations 2,3 in a finished roof.

The shaping of the lower portions of the rib formations 2,3 in that manner enables the tongue and groove to function as retention means. This results in less deflection of the joint under load, by comparison with conventional arrangements wherein the lower portion the rib formations do not engage, in that the load is transferred directly to the sheet assembly as a whole instead of an independently yieldable rib formation. This in turn enables the sheet to be made from thinner material than would otherwise be the case. The retention means not only provides an additional locking mechanism to prevent the male and female rib formations disengaging but also braces the joint against lateral movement when loads are applied normal to the plane of the web.

Accordingly, the invention provides a cladding joint which displays greater rigidity than traditional cladding joints.

In this regard also, the present invention combines the traditional advantages of cold formed hollow sections with a basic shape which is relatively efficient in resisting bending movement.

As is evident from figure 4, the joint between neighbouring sheets is in the form of a structural member or universal beam having two parallel flanges and a single flat web, wherein the upper flange is in the form of an elongate closed loop hollow section of inverted triangular cross-section being the interengaged male and female rib formations 2,3, the lower flange being the web portions of the neighbouring cladding sheets of single sheet thickness and the beam web being the lower portions of the male and female rib formations of double sheet thickness. Structural members of this kind have high flexural rigidity and therefore provision of these

members at each joint of an assembly imparts high flexural rigidity to the cladding assembly as a whole.

The provision of a closed loop hollow section of inverted triangular cross-section has a markedly increased load capacity due to local buckling considerations relative to the provision of hollow sections of other shape.

Accordingly, the making of a closed hollow structural member at the joint between two neighbouring elements enhances the flexural rigidity of the assembly. The provision of retention means further enhances its flexural rigidity. The provision of retention means in the form of a tongue and groove formation enhances the ability of the elements to be easily and quickly assembled. The provision of a closed loop hollow section of inverted triangular cross-section further enhances the flexural rigidity of the assembly.

The present invention thus provides cladding elements and element joints that facilitate the use of such elements to span distances much longer than those possible with conventionally joint elements while limiting deflections to within acceptable tolerances and minimising deflection when loads are applied normal to the surface of the element assembly, and at the same time reducing the risk of the joint being unclipped by such loads.

Indeed, the hollow structural member at the joint can be said to function as a tubular truss integral with the elements. The formation of joints according to the invention provides a cladding assembly comparable in flexural rigidity with sheets integral with and supported by elongate hollow structural members thereby alleviating the need to provide battens building structures having roof/ceiling assemblies of overall length of 3 to 4 metres. That is to say, the strength of the assembly as a whole is considerably enhanced by the formation of these hollow structural members at the joints sufficient to enable the use of a minimum number of battens, purlins or like supporting members and, in particular, for span

lengths of, for example, 3-4 metres, no intermediate purlins or battens are required. The cladding assembly need be supported only at its ends. Preferably, the ends are ensconced into the troughs of a pair of C-section channels supported by studs or other frame members of the building structure.

Accordingly, the invention provides for the formation of jointed cladding elements which are extremely rigid both longitudinally and laterally while allowing very quick jointing between the elements.

Another advantage of an element assembly according to the preferred embodiment of the invention includes the aesthetic appearance of the underside of the elements, which is particularly desirable when the elements are used as roof/ceiling assemblies.

The foregoing detailed description is indicative of one embodiment of the invention. Various modifications and improvements obvious to those skilled in the art may be made without departing from the spirit and scope of the invention. For example, the closed loop formed at the joint may be in the form in cross-section of a right angle triangle with the hypotenuse extending substantially wholly over the web of one of the neighbouring elements.

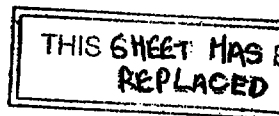
Additionally, the web may include one or more major stiffening ribs, particularly where wide elements are required. The major stiffening ribs may, for example, be of a size and general shape comparable in cross-section with the substantially upright formation at the joint. Additionally, further, the tongue and groove may be formed such that the tongue merely abuts against the groove so that the female rib is braced against movement in one direction only.

In another variation the tongue and groove formations could be replaced by a plurality of fastening means intermittently and regularly spaced apart along the length of the element. The fastening means may be in the form of clinch fastenings, button punchings or other

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fasteners able to maintain the lower portions of the respective male and female ribs in fixed relationship. That is to say, any suitable fastening means that substantially prevents displacement of the rib formations of the joint along the length of the element in response to the application of loads normal to the plane of the element.

Preferably, the fastening means do not pierce the elements and do not damage the integrity of the protective coating thereby minimising problems of leakage and corrosion.



This Sheet Has Been Replaced



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CLAIMS:

1. A cladding element for use in a cladding element assembly, said element having a web and longitudinally extending side edges, one side edge being provided with an upwardly extending female rib formation and the other side edge being provided with an upwardly extending male rib formation able to enter the female rib formation of another element and when so entered lockably engage the elements side to side characterised in that when so assembled the interengaging rib formations form a closed loop in cross-section.
2. A cladding element according to claim 1 wherein the closed loop is in the form of an inverted triangle.
3. A cladding element according to claim 2 wherein the triangle is substantially an equilateral triangle or an isosceles triangle.
4. A cladding element according to any one of the preceding claims wherein the loop is closed by retention means.
5. A cladding element according to claim 4 wherein the retention means braces against lateral movement of the elements in at least one direction.
6. A cladding element according to any one of claims 4 or 5 wherein the retention means is in the form of a tongue and groove formation.
7. A cladding element according to any one of the preceding claims wherein one of the male or the female rib formations is provided with a longitudinally extending groove and the other rib formation is provided with a longitudinally



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extending tongue adapted in assembly to extend into and be received by the groove of the neighbouring element in contiguous relationship.

5 8. A cladding element according to any one of claims 6 or 7 wherein, in assembly, the tongue and groove close the loop formed by the interengaged male and female rib formation and brace the joint against lateral movement of the elements at least in a direction normal to the plane of the elements.

10 9. A cladding element according to any one of claims 6 to 8 wherein said groove extends continuously along the length of the element.

15 10. A cladding element according to any one of claims 6 to 9 wherein said the tongue extends continuously along the length of the element.

11. A cladding element according to any one of claims 6 to 9 wherein said tongue comprises a number of short tongues regularly spaced apart along the length of the element.

20 12. A cladding element according to any one of claims 6 to 11 wherein said groove is formed in a lower portion of the male rib formation and the tongue is formed in a lower portion of the female rib formation, the groove being spaced by
25 substantially the same distance from the plane of the element as is the tongue.

30 13. A cladding element assembly comprising a plurality of cladding elements according to any one of the preceding claims wherein the elements are laid side to side with male rib formation overlapped by and lockably engaged with the female rib formation of a neighbouring cladding element.



- 5 14. A joint comprising a pair of cladding elements according to any one of the preceding claims laid side to side with the male rib formation overlapped by and locking engaged with the female rib formation of neighbouring cladding element.



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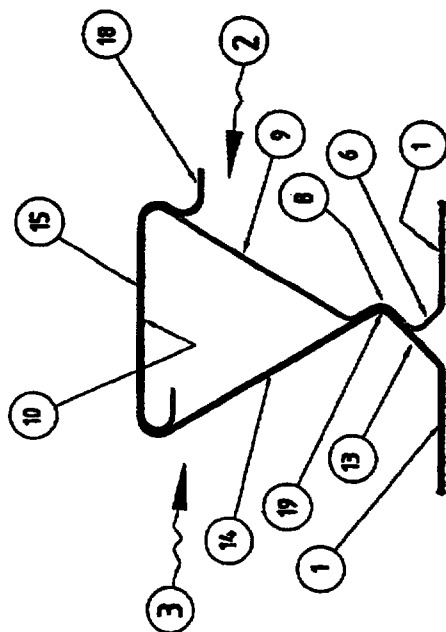


FIGURE 4

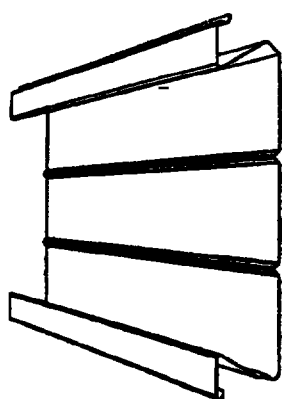


FIGURE 5 - PERSPECTIVE VIEW

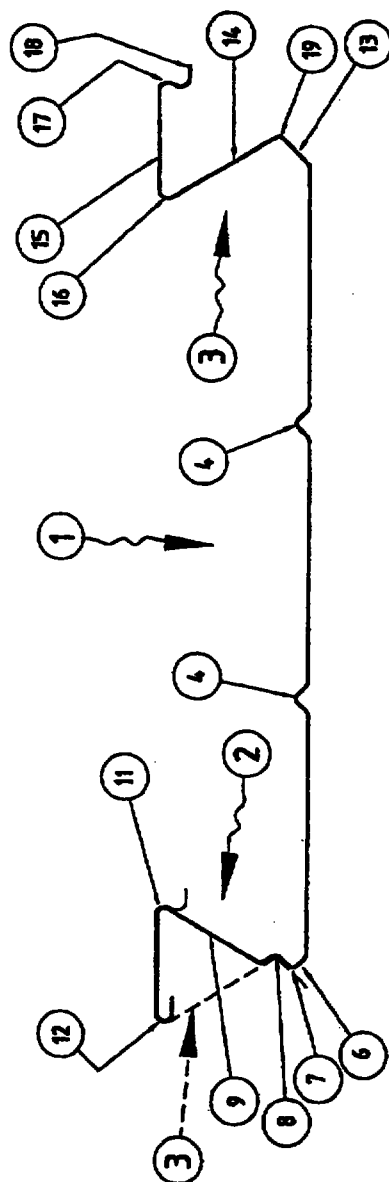


FIGURE 1

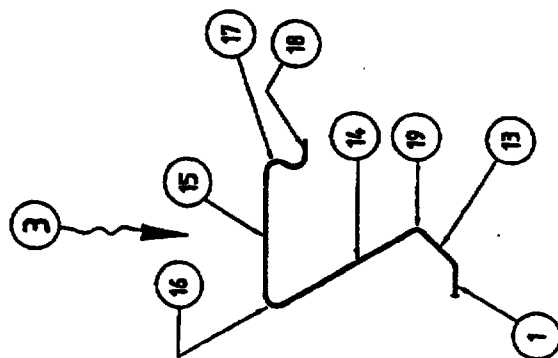


FIGURE 3

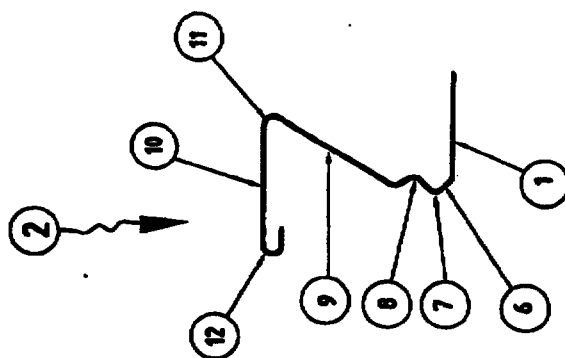


FIGURE 2

neighbouring elements it has been found that prior art assemblies have failed to provide adequate rigidity to limit deflection over a span to acceptable levels when the elements are used to span considerable distances, for example, distances in excess of 3 metres.

The object of the present invention is to provide an improved cladding element and cladding element joint which will substantially overcome or alleviate one or more of the above mentioned disadvantages.

10 SUMMARY OF THE INVENTION

According to the invention there is provided a cladding element for use in a cladding element assembly, said element having a web and longitudinally extending side edges, one side edge being provided with an upstanding female rib formation having a proximal portion and a distal end portion and the other side edge being provided with an upstanding male rib formation having a proximal portion and a distal end portion able to enter the distal end portion of the female rib formation of another element and when so entered lockably engage the elements side to side characterised in that when so assembled the respective proximal portions make contact with one another so that the interengaging rib formations form in cross-section a closed loop extending from one contacting proximal portion to the other.

Preferably the closed loop is in the form of an inverted triangle. More preferably the triangle is substantially an equilateral triangle or an isosceles triangle.

30 Preferably the loop is closed by retention means. The retention means braces against lateral movement of the elements in at least one direction.

Preferably further the retention means is in the form of a tongue and groove formation.

35 The male or the female rib formation may be provided with a longitudinally extending groove and the other rib formation is provided with a longitudinally extending tongue adapted in assembly to extend into and be received by the groove of the neighbouring element in contiguous relationship. In assembly, the tongue and groove may close the loop formed by the interengaged male and female rib formation and brace the joint against lateral

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CLAIMS:

1. A cladding element for use in a cladding element assembly, said element having a web and longitudinally extending side edges, one side edge being provided with an upstanding female rib formation having a proximal portion and a distal end portion and the other side edge being provided with an upstanding male rib formation having a proximal portion and a distal end portion able to enter the distal end portion of the female rib formation of another element and when so entered lockably engage the elements side to side characterised in that when so assembled the respective proximal portions make contact with one another so that the interengaging rib formations form in cross-section a closed loop extending from one contacting proximal portion to the other.
2. A cladding element according to claim 1 wherein the closed loop is in the form of an inverted triangle.
3. A cladding element according to claim 2 wherein the triangle is substantially an equilateral triangle or an isosceles triangle.
4. A cladding element according to any one of the preceding claims wherein the loop is closed by retention means.
5. A cladding element according to claim 4 wherein the retention means braces against lateral movement of the elements in at least one direction.
6. A cladding element according to any one of claims 4 or 5 wherein the retention means is in the form of a tongue and groove formation.
7. A cladding element according to any one of the preceding claims wherein one of the male or the female rib formations is provided with a longitudinally extending groove and the other rib formation is provided with a longitudinally



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(21) International Application Number: PCT/AU97/00244 (22) International Filing Date: 21 April 1997 (21.04.97) (30) Priority Data: PN 9409 22 April 1996 (22.04.96) AU (71) Applicant (for all designated States except US): BHP STEEL (JLA) PTY. LTD. [AU/AU]; 600 Bourke Street, Melbourne, VIC 3000 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): CAMPBELL, John, Secombe [AU/AU]; 141 Pentecost Avenue, Turramurra, NSW 2074 (AU). (74) Agent: GRIFFITH HACK; G.P.O. Box 4164, Sydney, NSW 2001 (AU).		(81) Designated States: AU, CN, NZ, SG, US, VN. Published <i>With international search report.</i>

(54) Title: CLADDING ELEMENT**(57) Abstract**

Cladding elements having adequate rigidity to limit sagging over a span to acceptable levels when the elements are used to span considerable distances for use in a cladding element assembly, generally comprising a web (1) and longitudinally extending side edges (2, 3), one side edge being provided with an upwardly extending female rib formation (3) and the other side edge being provided with an upwardly extending male rib formation (2) able to enter the female rib formation (3) of another element and when so entered lockably engage the elements side to side characterised in that when so assembled the interengaging rib formations form a closed loop in cross section which can be in the form of an inverted triangle. The loop is closed by retention means to brace against lateral movement of the elements, the retention means is in the form of a tongue (19) and groove (8) formation.

