

METAL DECKING

FIELD OF THE INVENTION

The present invention relates generally to metal
5 decking and relates particularly, though not exclusively,
to a metal decking member for concrete clad roofing or
flooring.

SUMMARY OF THE INVENTION

10 According to one aspect of the present invention
there is provided a metal decking member for use in a
composite structure, the member being elongate and of C-
section profile including a web and a pair of flanges
extending from opposite longitudinal edges of the web,
15 each flange including a first part upstanding from the
web, and a second part extending from an upper margin of
the first part, the second part being inclined to the
first part and each of the first parts incorporating a
longitudinal extending rib, the member being adapted to be
20 interconnected to another said member to form metal
decking and the ribs of the member being shaped so that
the rib of one flange interlocks with the rib of the other
flange of another said member to resist separation of the
interconnected decking members.

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According to another aspect of the present invention
there is provided a metal decking member being elongate
and of C-section profile including a web and a pair of
flanges extending from opposite longitudinal edges of the
30 web, each flange including a first part upstanding from
the web, and a second part extending from an upper margin
of the first part, the second part extending inwardly from
the first part so as to be disposed over said web, and

each of the first parts incorporating a longitudinal
extending rib, the member being arranged to be
interconnected to another said member to form metal
decking and the ribs of the member being shaped so that
5 the rib of one flange interlocks with the rib of the other
flange of another said member to resist separation of the
interconnected decking members.

In a preferred form each rib includes a nose portion
10 and a recess, with the rib of one flange having its nose
portion extending downwardly towards the web and the
opening of its recess facing upwardly, and the other rib
has its nose portion extending upwardly and its recess
opening facing downwardly. With this arrangement, in use,
15 on interlocking the rib of one flange with the rib of the
other flange of another member, the nose portion of each
rib locates within the recess of the rib to which it is
interlocked so as to resist lateral separation of the
interlocked decking members.

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Preferably, each rib further includes a bearing
portion located intermediate the nose portion and the web
of that rib. The bearing portion of each rib has a
bearing surface which faces generally in an opposite
25 direction to the nose portion of that rib, so that in use,
on interlocking of the rib of one flange with the rib of
the other flange, the bearing surface of the interlocking
ribs engage so that the interlocking ribs resist vertical
separation of the interconnected decking members.

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According to another aspect of the present invention
there is provided a metal decking member being elongate
and of C-section profile including a web and a pair of

opposing flanges, each of the flanges incorporating a longitudinal extending rib, wherein the member is arranged to be interconnected to another said member to form metal decking and the ribs of the member being shaped so that
5 the rib of one flange interlocks with the rib of the other flange of another said member, and wherein, one of the pair of opposing flanges has a lower stiffness than the other flange, so that in use, on loading the decking, the one flange is arranged to deflect more than the other
10 flange so as to force the interlocked ribs into tighter engagement.

Generally the lower stiffness of said one of the flanges is provided by a reduction in the surface area of
15 said one flange relative to the other flange.

Preferably the metal decking member is of the C-section profile wherein the opposing flanges each having inwardly directed portions. More preferably a free edge
20 portion of each of the inwardly directed portions includes a lip return disposed parallel to the corresponding flange.

Preferably the inwardly directed portions of each of
25 the flanges includes one or more openings. More preferably said one or more openings are defined by longitudinally extending slits formed in the inwardly directed portions which are deformed out of the plane of the corresponding flange. The openings assist in the venting of air which
30 would otherwise be "trapped" as air pockets within the flanges when pouring concrete across the decking member.

Generally the metal decking member is one of a plurality of metal decking members arranged alongside one another to together form metal decking.

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It has been found that securing or interlocking of adjacent flanges of adjacent metal decking members of a generally symmetrical configuration restricts or inhibits collapse or rotation of the flanges. In conventional metal decking where the decking members are symmetric and adjacent inwardly and outwardly turned edge portions of the respective adjacent flanges overlap one another, the decking members tend to fail by rotation of the overlapped flanges in the "direction" of overlap.

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Preferably the web is longitudinally precambered inwardly of the metal decking member. It has been found that longitudinal precambering of the web is effective in increasing the unsupported span of the metal decking member.

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Preferably the longitudinal precamber is up to about 2% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length of the web. More preferably the longitudinal precamber is between about 0.4% to 1%. In one embodiment this equates to a precamber of between about 20 to 50 mm for an unsupported span of 5 metres.

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Preferably the web in transverse section is precambered inwardly of the metal decking member. More preferably the transverse pre-camber is up to about 5%

measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web. Still more preferably the transverse pre-camber is between about 1% to 4%.

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BRIEF DESCRIPTION OF THE DRAWINGS

In order to achieve a better understanding of the nature of the present invention a preferred embodiment of metal decking will now be described, by way of example
10 only, with reference to the accompanying drawings in which:

Figure 1 is a sectional view of one embodiment of a metal decking member according to the invention;

Figure 2 is a schematic sectional view of another
15 embodiment of metal decking according to the invention; and

Figure 3 is a perspective view of a further embodiment of metal decking according to the invention.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figures 1 and 2 there is a metal decking number 10 being elongate and of a C-section profile including a web 12 and a pair of opposing flanges 14 and 16, respectively. The metal decking member 10 is one of a
25 plurality of decking members such as 10 and 18 located alongside one another to together form metal decking 20 (see Figure 2). The metal decking 20 is designed to be embedded or clad in a concrete slab so as to form a roof or floor. In order to avoid repetition and for ease of
30 reference, similar components of the embodiments of the metal decking members 10 of Figures 1 and 2 have been designated with the same reference numerals.

The adjacent metal decking members such as 10 are of an identical cross-sectional shape being of the C-section profile wherein opposing flanges each include inwardly directed portions 22 and 24. Additionally, each of the
5 inwardly directed portions 22 and 24 include a respective lip return 26 and 28 which is either turned back toward or disposed generally parallel to the corresponding flange 14 or 16.

10 The flanges 14 and 16 include respective longitudinally extending ribs 30 and 32. The longitudinal ribs 30 and 32 are configured so that adjacent ribs of adjacent decking members interlock to prevent lateral and vertical separation of the metal decking members such as
15 10 and 18. This interlocking of the ribs 30 and 32 eliminates the need for fasteners to secure adjacent decking members such as 10 and 18 together. In these embodiments interlocking of the ribs such as 30 and 32 is provided by having the ribs 30 and 32 shaped complementary
20 to and substantially aligned with one another so that one of the ribs such as 30 resides within the other rib 32. The metal decking member 10 of Figure 1 includes a pair of generally C-shaped ribs 30 and 32 which protrude outwardly and inwardly, respectively, of the decking member 10. The
25 C-shaped ribs 30 and 32 are formed in an upright portion of the respective flange 14 and 16. The decking members such as 10 and 18 of Figure 2 include the longitudinal ribs 30 and 32 within the flange adjacent the juncture of the upright portion and the inwardly directed portion of
30 the flange 14 or 16. The ribs 14 and 16 are in this example generally U-shaped in transverse cross-section. The ribs 30 and 32 of both embodiments are roll formed in the respective flange 14 and 16.

Conventional metal decking members are generally of an asymmetric configuration wherein opposing flanges are turned inward and outward respectively. Thus, the conventional metal decking is formed by overlapping adjacent flanges. The tendency for conventional metal decking is to fail under load wherein the adjacent overlapping flanges collapse or rotate toward the web of one of the decking members. It is understood that the abutting or interlocking flanges of adjacent metal decking members of this embodiment of the invention are less vulnerable to failure in this manner.

According to another aspect of the present invention one of the pair of opposing flanges, such as flange 16 of Figure 2, is of a lower stiffness relative to the interlocking flange 14. This is achieved by reducing the surface area or in this example the width dimension of the inwardly directed portion 24 of the less stiff flange 16 relative to that of the other flange 14. Thus, the less stiff flange 16 has a tendency to deflect or rotate outwardly before the interlocking flange 14. The less stiff flange 16 may be designed to about 90% of the stiffness of flange 14. This reduction in stiffness is provided by reducing the surface area of the portion of the flange disposed above the rib for the less stiff flange relative to the corresponding portion of the other flange. In operation, the load of concrete within the metal decking member such as 18 forces interlocking engagement of the less stiff flange 16 with the flange 14 of the adjacent decking member 10. The adjacent metal decking members 10 and 18 are thus "tied" together without the need for a fastener which is onerous.

Although not illustrated, the inwardly directed portions 22 and 24 may include openings to allow air to vent from the flanges when concrete is poured across the metal decking. The air may otherwise be trapped as air pockets particularly within the area enclosed by the lip returns 26 and 28 of the inwardly directed portions 22 and 24, respectively. The openings are formed by a plurality of longitudinally extending slits in the inwardly directed portions 22 and 24 which are pressed upward out of the plane of the respective flange. In one embodiment the slits are formed as transversely spaced pairs each of a length of about 8 mm and the adjacent inwardly directed portion such as 22 is pressed about 3 mm out of the plane of the respective flange. The slits formed in the flanges also promote the engagement of concrete with the decking member.

Figure 3 illustrates a further embodiment of the invention where the web 16 of the metal decking member 12 is longitudinally pre-cambered inwardly of the metal decking member 12. For clarity the metal decking member is depicted without the longitudinally extending ribs. The metal decking member which ordinarily is embedded in a concrete slab (not shown) is thus capable of spanning an increased distance unsupported. The precamber of the web 16 is in this example about 0.6% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage relative to the length of the web 16. It is understood that the longitudinally precambered web 16 is at least partly deflected toward the flat plane under the significant weight of the concrete slab. Advantageously, this longitudinal precamber provides

minimal deflection of the metal decking member 12 which spans increased distances. In this embodiment the metal decking member 12 spans up to about 5 metres unsupported and includes a longitudinal precamber of about 30 mm which
5 corresponds to 0.6 percent. The unsupported span of 5 metres of this embodiment of the invention compares to a span of up to 3 metres for conventional decking without a longitudinal precamber.

10 Although not clearly illustrated the web 16 of the metal decking member 12 may also be pre-cambered in transverse sectional profile inwardly. The transverse pre-camber of the web 16 in this example is approximately 2% measured as the maximum offset of the web 16 from a
15 substantially flat plane and expressed as a percentage relative to the width of the web 16. In this example the metal decking member 12 has a width of approximately 300 mm and is roll formed from sheet metal of a thickness of about 1.2 mm.

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 The longitudinal precamber in the web 16 of the metal decking member 12 is formed by corrugating the web 16. The corrugations (not shown) are oriented transverse and extend partly across the width of the web 16. The
25 transverse corrugations are cold roll formed in the web 16 are sufficiently "light" to provide the preferred longitudinal precamber of up to about 2%. The corrugations may be formed either in the flat strip or in the web 16 once it is formed into the C-section profile. Otherwise,
30 corrugation of the web 16 is performed via corrugating rolls (not shown) in a conventional cold roll forming manner.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, the longitudinal ribs of the opposing flanges
5 may vary in configuration provided they permit interlocking of adjacent decking members. The less stiff flange may vary in constructions from that described provided it promotes interlocking of adjacent flanges of adjacent decking members. Preferably the web is
10 longitudinally and/or transversely precambered inwardly of the decking member whereby it can span increased distances unsupported. All such variations and modifications are to be considered within the ambit of the present invention the nature of which is to be determined from the foregoing
15 description.

In the preceding summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising"
20 is used in the sense of "including", that is the features specified may be associated with further features in various embodiments of the invention.

THE CLAIMS:

1. A metal decking member for use in a composite structure, the member being elongate and of C-section
5 profile including a web and a pair of flanges extending from opposite longitudinal edges of the web, each flange including a first part upstanding from the web, and a second part extending from an upper margin of the first part, the second part being inclined to the first part and
10 each of the first parts incorporating a longitudinal extending rib, the member being adapted to be interconnected to another said member to form metal decking and the ribs of the member being shaped so that the rib of one flange interlocks with the rib of the other
15 flange of another said member to resist separation of the interconnected decking members.

2. A metal decking member according to claim 1, wherein each rib includes a nose portion and a recess, with the
20 rib of one flange having its nose portion extending downwardly towards the web and the opening of its recess facing upwardly, and the other rib has its nose portion extending upwardly and its recess opening facing downwardly, wherein in use, on interlocking the rib of one
25 flange with the rib of the other flange of another said member, the nose portion of each rib locates within the recess of the rib to which it is interlocked so as to resist separation of the interconnected decking members.

30 3. A metal decking member according to claim 2, wherein each rib further includes a bearing portion located intermediate the nose portion and the web of that rib, wherein the bearing portion of each rib has a bearing

surface which faces generally in an opposite direction to the nose portion of that rib, and wherein in use, on interlocking of the rib of one flange with the rib of the other flange of another said member, the bearing surface
5 of the interlocking ribs engage so that said interlocking ribs resist vertical separation of the interconnected decking members.

4. A metal decking member according to any preceding
10 claim, wherein each of the first parts further include a generally linear bearing surface and wherein on interconnecting of the members, the bearing surface of the first part of one flange is in abutting relationship with the bearing surface of the first part of the other flange
15 of another said member, wherein, the rib of one flange extends inwardly relative to the bearing surface of that flange, whereas the rib of the other flange extends outwardly relative to bearing surface of that flange.

20 5. A metal decking member according to any preceding claim, wherein the second part of each flange extends inwardly from the first part so as to be disposed over said web, so that when the decking member is interconnected with another said member, the second parts
25 of the interconnected flanges extend in opposite directions.

6. A metal decking member being elongate and of C-section profile including a web and a pair of flanges
30 extending from opposite longitudinal edges of the web, each flange including a first part upstanding from the web, and a second part extending from an upper margin of the first part, the second part extending inwardly from

the first part so as to be disposed over said web, and each of the first parts incorporating a longitudinal extending rib, the member being arranged to be interconnected to another said member to form metal decking and the ribs of the member being shaped so that the rib of one flange interlocks with the rib of the other flange of another said member to resist separation of the interconnected decking members.

7. A metal decking member according to either claim 5 or 6, wherein each of the second parts extends generally parallel to the web.

8. A metal decking member according to any one of claims 5 to 7, wherein the second part of the flanges lie substantially in a common plane.

9. A metal decking member according to any one of claims 5 to 8, wherein each of the second parts includes a lip at its distal end which is turned out of the plane of the second part to which it is associated.

10. A metal decking member according to claim 9, wherein the lip of one flange is turned through approximately 90° whereas the lip of the other flange is turned through an angle of approximately 180° .

11. A metal decking member according to any one of claims 5 to 10, wherein the second parts of each of the flanges include one or more openings.

12. A metal decking member according claim 11, wherein the one or more openings are defined by longitudinal extending slits formed in the second parts.

5 13. A metal decking member according to any preceding claim, wherein the first part of the flanges are generally parallel.

10 14. A metal decking member according to claim 13, wherein the first parts of the web extend generally perpendicularly from the web.

15 15. A metal decking member according to any preceding claim, wherein one of the pair of opposing flanges has a lower stiffness than the other flange, and wherein the ribs of the member are configured so that in use, on loading the decking, the one flange is arranged to deflect more than the other flange so as to force the interlocked ribs into tighter engagement.

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16. A metal decking member according to claim 15, when dependent on claim 5, wherein the lower stiffness of one of the flanges is provided by reducing the surface area of the second part of that flange relative to the second part
25 of the other flange.

17. A metal decking member being elongate and of C-section profile including a web and a pair of opposing flanges, each of the flanges incorporating a longitudinal
30 extending rib, wherein the member is arranged to be interconnected to another said member to form metal decking and the ribs of the member being shaped so that the rib of one flange interlocks with the rib of the other

flange of another said member, and wherein, one of the pair of opposing flanges has a lower stiffness than the other flange, so that in use, on loading the decking, the one flange is arranged to deflect more than the other
5 flange so as to force the interlocked ribs into tighter engagement.

18. A metal decking member according to claim 17, wherein the flanges incorporate a first part upstanding from the web, and a second part extending from an upper margin of
10 the first part, the second part being inclined to the first part, and wherein the lower stiffness of one of the flanges is provided by reducing the surface area of the second part of that flange relative to the second part of
15 the other flange.

19. A metal decking member according to any preceding claim, wherein the web is longitudinally precambered inwardly of the metal decking member.

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20. A metal decking member according to claim 19 wherein the longitudinal precamber is up to about 2% measured as the maximum longitudinal offset of the web from a substantially flat plane and expressed as a percentage
25 relative to the length of the web.

21. A metal decking member according to claim 19 or 20, wherein the web includes transversely oriented corrugations which are effective in the longitudinal
30 precambering of the metal decking member.

22. A metal decking member according to any preceding claim, wherein the web in transverse section is precambered inwardly of the metal decking member.

5 23. A metal decking member according to claim 22, wherein the longitudinal precamber is up to about 2% measured as the maximum offset of the web from a substantially flat plane and expressed as a percentage relative to the width of the web.

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24. A metal decking member according to any preceding claims, wherein the longitudinal ribs are in transverse cross-section shaped complementary to and are substantially aligned with one another.

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25. Metal decking including a plurality of metal decking members as defined in any one of the preceding claims, wherein said decking members are arranged alongside one another so that flanges of adjacent decking members abut, 20 said decking members being connected together by interconnecting of each of said abutting flanges with the ribs of one flange interlocking with the ribs of the other flange.

25 26. A composite structure including a concrete slab and metal decking as defined in claim 25, which is clad or embedded in said slab.