

IMPACT ABSORBING CANOPY

FIELD OF THE INVENTION

The present invention relates generally to a deformable
5 mount and relates particularly, though not exclusively, to
an impact absorbing canopy structure.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is
10 provided a deformable mount being adapted to fix to a
support member to which canopy cladding is secured, the
deformable mount being capable of deforming when the
cladding is impacted by a falling object whereby said
deformable mount at least partly absorbs the kinetic
15 energy of the falling object.

According to another aspect of the present invention there
is provided an impact absorbing canopy structure
comprising:

20 one or more structural members being spaced from one
another;

a deformable mount connected to each of said
structural members;

a plurality of support members being spaced apart and
25 each fixed to at least a pair of the deformable mounts;
and

cladding secured to the support members whereby the
deformable mounts serve to at least partially absorb the
kinetic energy of a falling object impacting the cladding.

30 Preferably the deformable mount is in the form of a
bracket constructed of a flexible material, such as steel,
the bracket being designed to deform when the cladding is
impacted by the falling object. More preferably the
35 bracket includes a pair of mounting flanges interposed by
a web designed to deform when the cladding is impacted by
the falling object, the mounting flanges being adapted to

fix to a structural member and a support member, respectively. Even more preferably the web is elongate and includes transversely extending corrugations designed to promote deformation of the web.

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Preferably the support members are arranged generally parallel to one another and spaced a distance adequate to provide increased flexibility to the cladding which spans adjacent support members. More preferably the support

10 members are spaced at least 1500mm apart.

Preferably said one or more structural members include either support posts or rafters of the canopy structure.

15 Preferably the plurality of support members include canopy purlins to which the cladding is secured.

Preferably the cladding includes a plurality of elongate sheets of cladding each having a series of longitudinally
20 extending and spaced apart strengthening ribs. More preferably adjacent cladding sheets are lapped at their respective adjacent longitudinal edge margins. Even more preferably at least two of the strengthening ribs of
25 respective of the adjacent cladding sheets at the adjacent longitudinal edge margins are lapped. This lapping of the adjacent sheets of cladding increases the shear capacity of the lapped cladding.

Preferably the cladding is secured to the support members
30 via a plurality of screw fasteners such as TEKS screws. More preferably elongate cladding sheets are oriented with their strengthening ribs transverse to the underlying support members and the screw fasteners secure the
35 cladding to the support members at at least every second of the strengthening ribs.

Generally the cladding sheets are metal cladding sheets

and corrugated such as that commercially available as SPANDEK HI-TEN, 0.42mm BMT G550.

BRIEF DESCRIPTION OF THE DRAWINGS

- 5 In order to achieve a better understanding of the nature of the present invention a preferred embodiment of a deformable mount and an impact absorbing canopy structure will now be described, by way of example only, with reference to the accompanying illustrations in which:
- 10 Figure 1 is a perspective view of a deformable mount of an impact absorbing canopy;
- Figure 2 depicts schematic drawings of an impact absorbing canopy structure having been impacted by a simulated falling object; and
- 15 Figure 3 depicts schematic drawings of the impact absorbing structure having been impacted by a simulated falling object.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

- 20 The present invention relates generally to a deformable mount such as that designated as 10 and shown in Figure 1. The deformable mount 10 of this embodiment is designed to be included in an impact absorbing canopy (shown in phantom detail) being constructed from cladding secured to
- 25 underlying support members in the form of spaced apart purlins. The purlins are fixed to one or more of the deformable mounts such as 10 which are each connected to a structural member such as a rafter or support post.
- 30 The deformable mount 10 of this particular embodiment is in the form of a bracket including a pair of mounting flanges 12 and 14, respectively, interposed by a web 16. The web 16 is elongate with the mounting flanges 12 and 14 disposed orthogonal to the web 16 and directed in opposite
- 35 directions. The web 16 includes transversely extending corrugations such as 18 designed to promote deformation of the web 16 when loaded through the mounting flanges 12 and

14. In this example the corrugations such as 18 are in cross section shaped generally sinusoidal and the web 16 includes three(3)adjacent troughs and crests such as 20 and 22, respectively. The deformable mount 10 is thus
5 designed to buckle when loaded via the mounting flanges 12 and 14.

The lower mounting flange 14 of the deformable mount 10 is fixed to the rafter or structural post whereas the upper
10 mounting flange is connecting to the purlin. Appropriate fasteners such as those commercially available as TEKS screws fasten the deformable mount 10 to the rafter or post and the purlin. Each of the upper and lower mounting flanges 12 and 14, respectively, include a pair of
15 apertures such as 24 and 26 for receiving these mounting fasteners. The deformable mount 10 is in this embodiment roll formed from steel of the specification 2.0 BMT G300 Z275 ZINCFORM.

20 The deformable mount 10 is designed to at least partly absorb the kinetic energy of a falling object impacting with the canopy cladding which is fixed to the purlins of this embodiment. In some countries, such as Singapore, there is a requirement to construct canopy structures
25 which are capable of absorbing the impact of a falling object without the cladding being penetrated and thus to provide protection to persons present underneath the canopy. For example, in Singapore the canopy structure must resist the impact of an object up to 6kg in mass
30 falling from a height of 45 metres. Accordingly, the applicant designed and constructed a testing rig which simulated these conditions and wherein a computer controlled compressed air cannon fired a 950mm wooden log weighing 6kg at around 106km per hour through a 100mm
35 pipe. The speed of 106km per hour is the speed attained by a free falling object from a height of 45 metres.

The applicant constructed an impact absorbing canopy structure including the deformable mounts such as 10 described and impacted the canopy structure using the testing rig of the preceding paragraph. The canopy structure was clad in corrugated metal cladding commercially available as SPANDEK HI-TEN, 0.42mm BMT G550. Adjacent cladding sheets of the canopy structure were lapped at their respective adjacent longitudinal edge margins to increase the edge distance and hence the shear capacity of the cladding sheet at the point of impact. The adjacent cladding sheets were double-lapped wherein two longitudinally extending strengthening ribs at an edge margin of the respective cladding sheets mutually lapped one another. The purlins were spaced at a distance of around 1800mm and the cladding sheets fixed to the purlins with fastening screws in every second strengthening rib of the corrugated cladding.

20 The results of the impact test are shown in Figure 2. In this test there was a localised deflection of the cladding but without any tearing of the cladding. The maximum deflection of the cladding was about 200mm and the simulated falling object bounced back off the cladding.

25 The preceding test was repeated for an identical configuration of the impact absorbing canopy structure. The results of this impact test are shown in Figure 3. In this additional test the cladding deflected a reduced maximum distance of about 150mm. Furthermore, a gap which opened between the lapped cladding was well below the joint level to prevent passage of the falling object thus ensuring a high level of safety.

35 In order to obtain an indication of the effectiveness of the deformable mount such as 10, the applicant conducted a comparative test with a canopy structure excluding the

deformable mounts. The comparative test was run with the cladding of the previous embodiments of the invention's double-lapped and fixed directly to the purlins without the deformable mount located between the purlin and
5 rafter. In this comparative test impact of the simulated falling object caused a complete detachment of the impacted cladding sheet from the purlins as well as from its lapped sheet.

10 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 deformable mount may vary in its specific configuration from that described provided it serves to
15 absorb the kinetic energy of an impacted falling object. The deflectable mount may function in a similar manner to a spring and upon impact revert at least in part to its original shape.

20 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 description.

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CLAIMS:

1. A deformable mount being adapted to fix to a support
5 member to which canopy cladding is secured, the deformable
mount being capable of deformation when the cladding is
impacted by a falling object whereby said deformable mount
at least partly absorbs the kinetic energy of the falling
object.
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2. A deformable mount as defined in Claim 1 including a
bracket constructed of a flexible material, the bracket
being designed to deform when the cladding is impacted by
the falling object.
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3. A deformable mount as defined in Claim 2 wherein the
bracket includes a pair of mounting flanges interposed by
a web designed to deform when the cladding is impacted by
the falling object, the mounting flanges being adapted to
20 fix to a structural member and the support member,
respectively.
4. A deformable mount as defined in Claim 3 wherein the
web is elongate and includes transversely extending
25 corrugations designed to promote deformation of the web.
5. An impact absorbing canopy structure comprising:
one or more structural members being spaced
from one another;
30 a deformable mount connected to each of said
structural members;
a plurality of support members being spaced
apart and fixed to at least a pair of the deformable
mounts; and
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cladding secured to the support members whereby the deformable mounts serve to at least partially absorb the kinetic energy of a falling object impacting the cladding.

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6. An impact absorbing canopy structure as defined in Claim 5 wherein the deformable mount includes the a bracket constructed of a flexible material, the bracket being designed to deflect when the cladding is impacted by the falling object.

7. An impact absorbing canopy structure as defined in Claim 6 wherein the bracket includes a pair of mounting flanges interposed by a web designed to deform when the cladding is impacted by the falling object, the mounting flanges being adapted to fix a structural member and the support member, respectively.

8. An impact absorbing canopy structure as defined in Claim 7 wherein the web is elongate and includes transversely extending corrugations designed to promote deformation of the web.

9. An impact absorbing structure as defined by any one of Claims 5 to 8 wherein the support members are arranged generally parallel to one another and spaced a distance adequate to provide increased flexibility to the cladding which spans adjacent support members.

10. An impact absorbing structure as defined in any one of Claims 5 to 9 wherein said one or more structural members include either posts or rafters of the canopy structure.

11. An impact absorbing structure as defined by any one of claims 5 to 10 wherein the plurality of support members include purlins to which the cladding is secured.



12. An impact absorbing structure as defined in any one of claims 5 to 11 wherein the cladding includes a plurality of elongate sheets of cladding each having a series of longitudinally extending and spaced apart strengthening ribs.
13. An impact absorbing structure as defined in Claim 12 wherein adjacent of the cladding sheets are lapped at their respective adjacent longitudinal edge margins.
14. An impact absorbing structure as defined in Claim 13 wherein at least two of the strengthening ribs of respective adjacent cladding sheets at the adjacent longitudinal edge margins are lapped.
15. An impact absorbing structure as defined in any one of Claims 12 to 14 wherein the cladding is secured to the support members via a plurality of screw fasteners.
16. An impact absorbing structure as defined in Claim 15 wherein the elongate cladding sheets are oriented with their strengthening ribs transverse to the underlying support members and the screw fasteners secure the cladding to the support members at at least every second of the strengthening ribs.
17. An impact absorbing structure as defined in any one of Claims 5 to 16 wherein the cladding sheets are metal cladding sheets and corrugated.