United States Patent [19]

Folley

[11] **3,820,295**

[45] **June 28, 1974**

[54] **BUILDING STRUCTURE FORMED OF FLAT CORRUGATED STEEL DECKING**

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[73] Assignee: **Inco Systems, Inc.**, Syracuse, N.Y.

[22] Filed: **Sept. 11, 1972**

[21] Appl. No.: **288,010**

[52] **U.S. Cl.** **52/270**, 52/90, 52/283, 52/293, 52/630

[51] **Int. Cl.** **E04c 2/32**, E04c 3/30

[58] **Field of Search** 52/90, 94, 169, 262, 274, 52/283, 293, 630; 61/39

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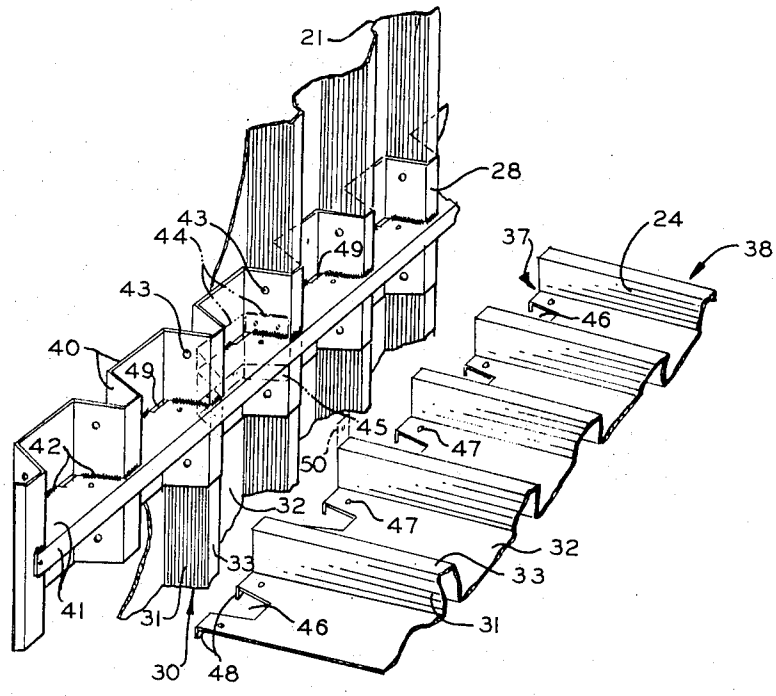
Primary Examiner—Henry C. Sutherland

Attorney, Agent, or Firm—Bruns & Jenney

[57] **ABSTRACT**

A building has sidewalls, roof and at least one floor formed of preformed panels of flat corrugated steel decking, the sidewall and roof panels providing, if desired, both outer skin and load bearing members. Where the roof panels meet the sidewalls at the eaves, and where the floor ends meet the end walls reinforcing strips are provided, each strip has a corrugated portion nesting with and secured to the wall and another portion secured to the floor or roof, the two portions being rigidly secured together, as by welding. The portion secured to the roof or floor is preferably formed to nest therewith. A ridge strip nesting with the roof panels is also preformed with two portions secured together at the desired ridge angle. Partitions are also formed of the same type of panels and footing panels of the same corrugated material nest with and are secured to the wall panels, the footing panels terminating in transversely extending corrugated pads adapted to be sunk in concrete or like material.

2 Claims, 15 Drawing Figures



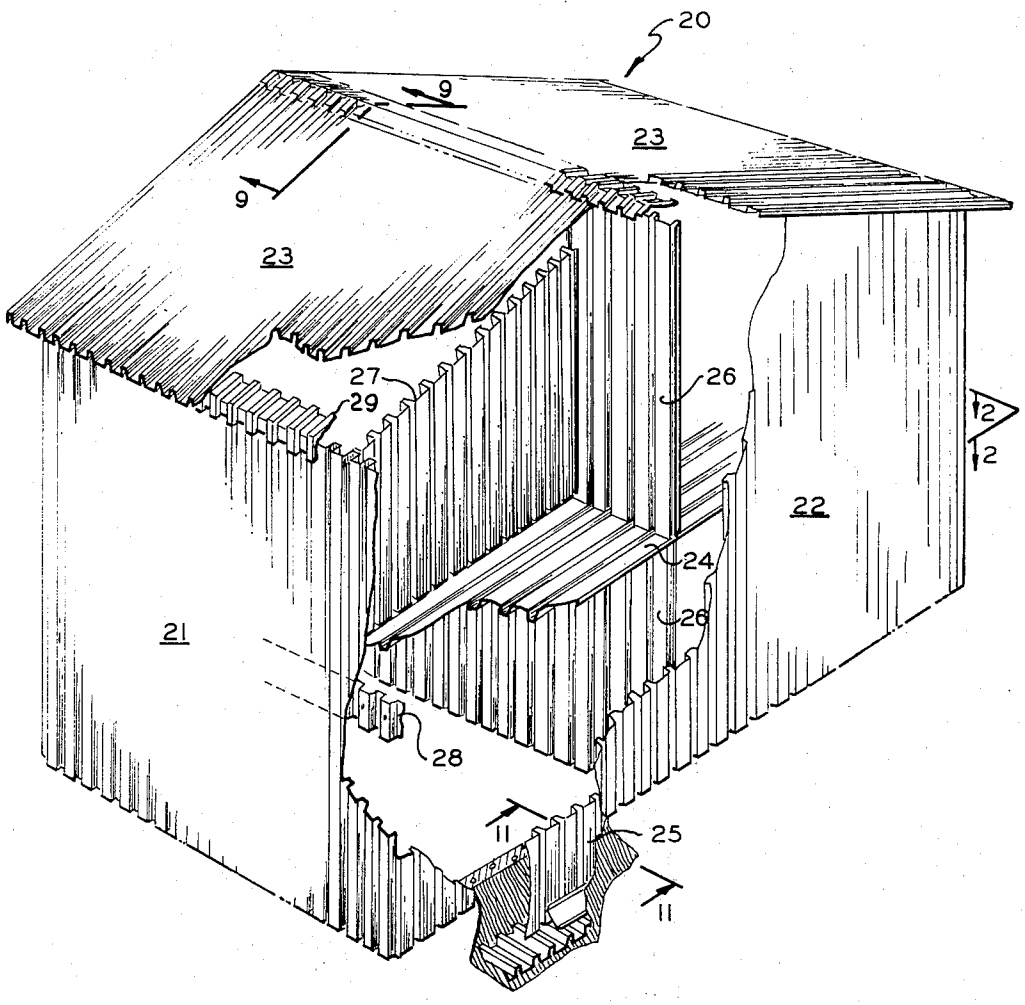


FIG. 1

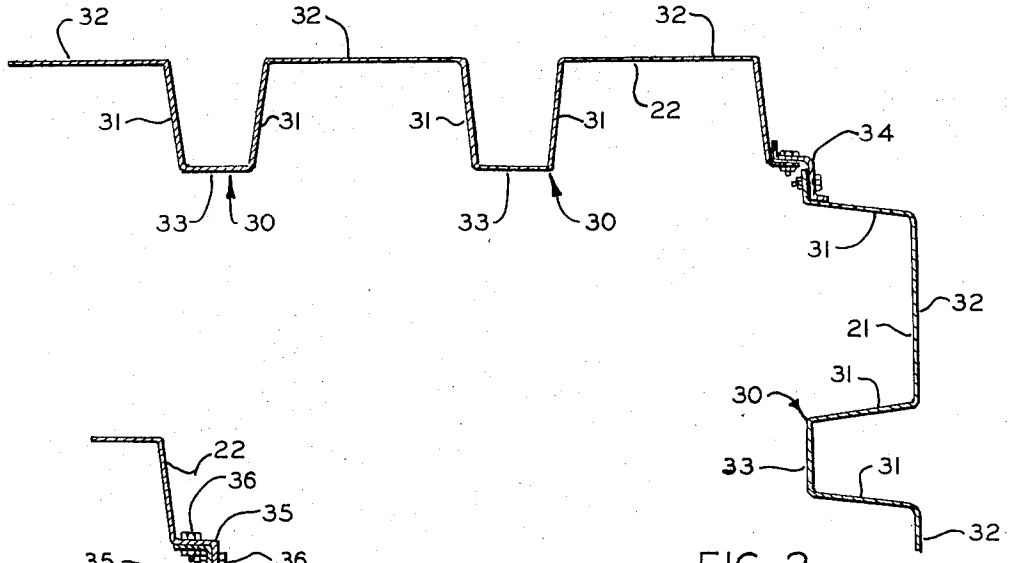


FIG. 2

FIG. 3

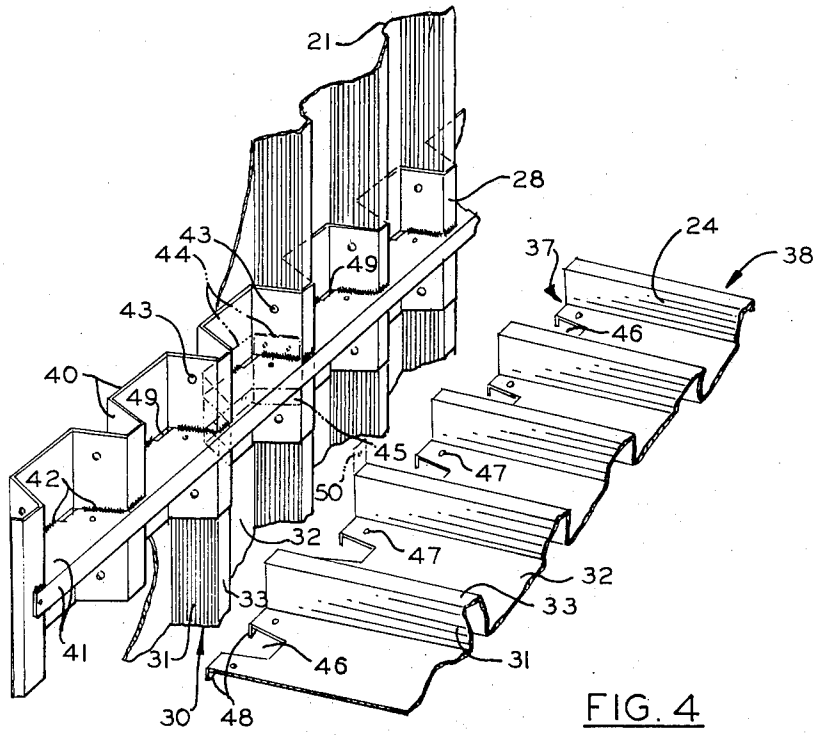


FIG. 4

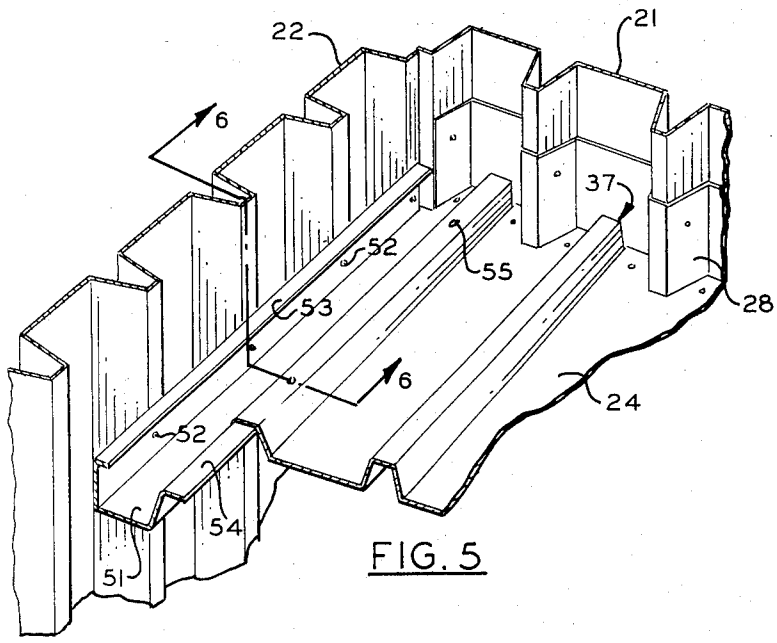


FIG. 5

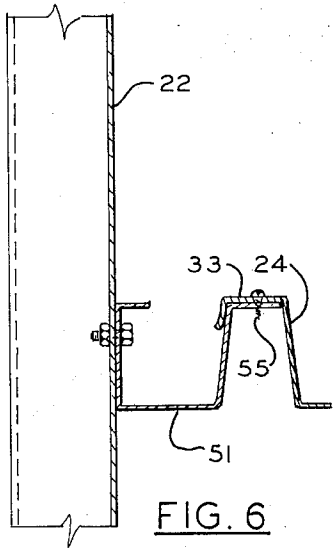


FIG. 6

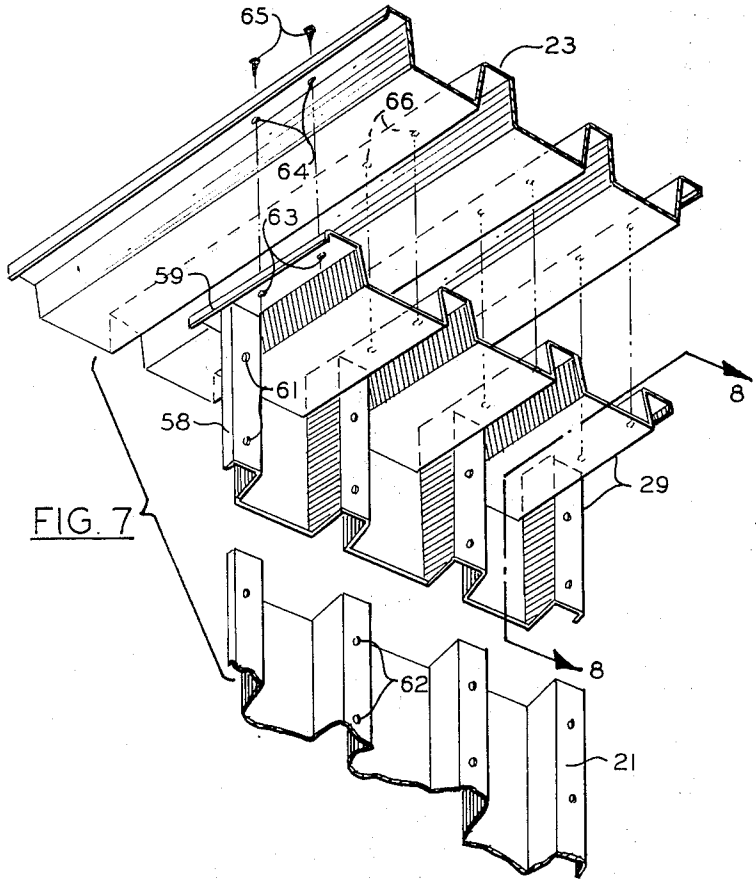


FIG. 7

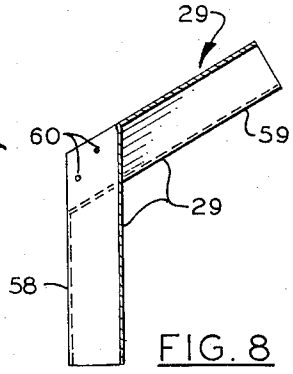


FIG. 8

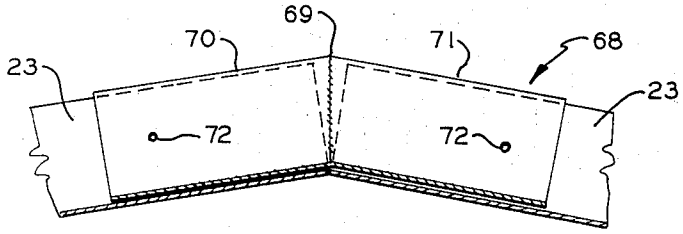


FIG. 9

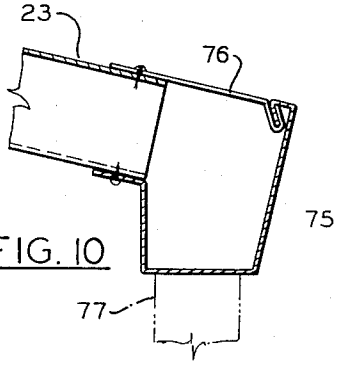


FIG. 10

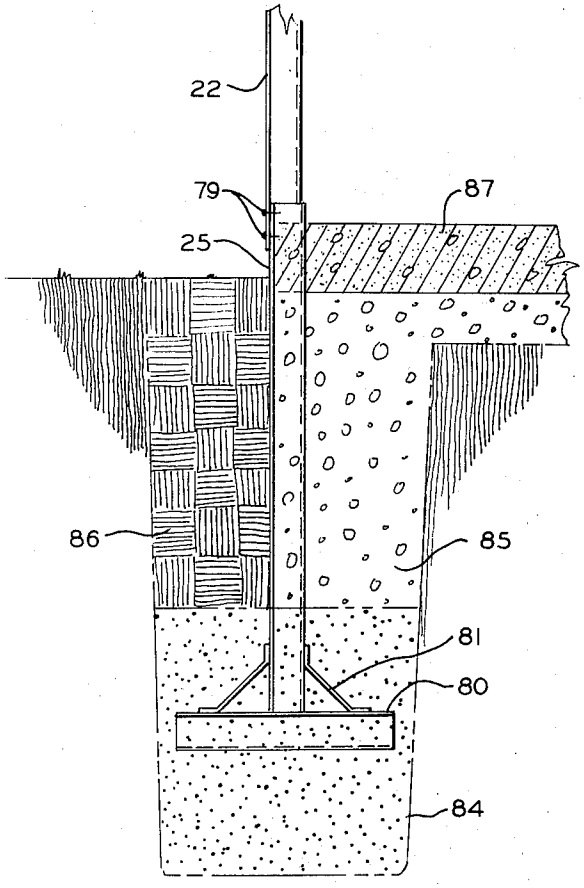


FIG. 11

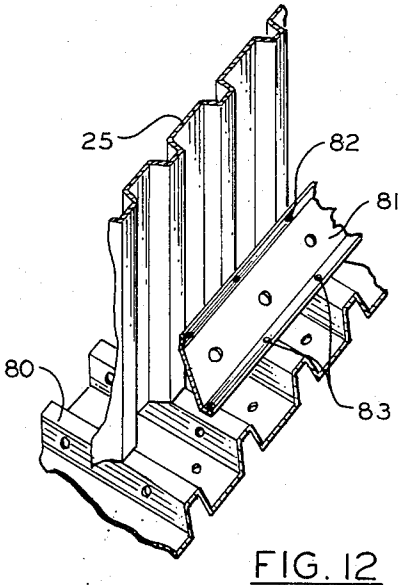


FIG. 12

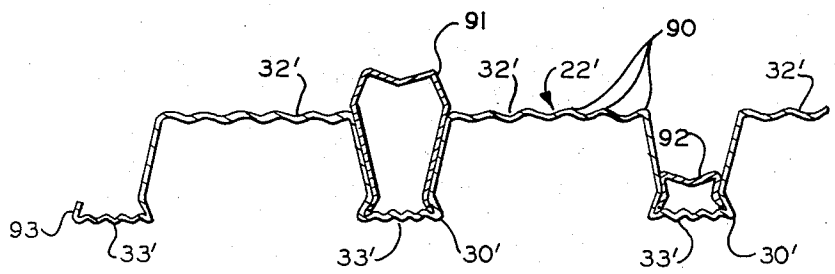


FIG. 13

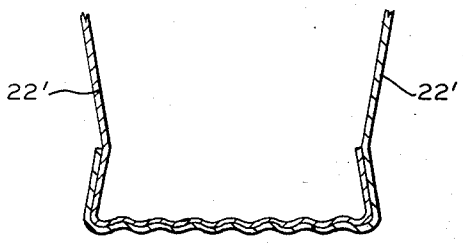


FIG. 14

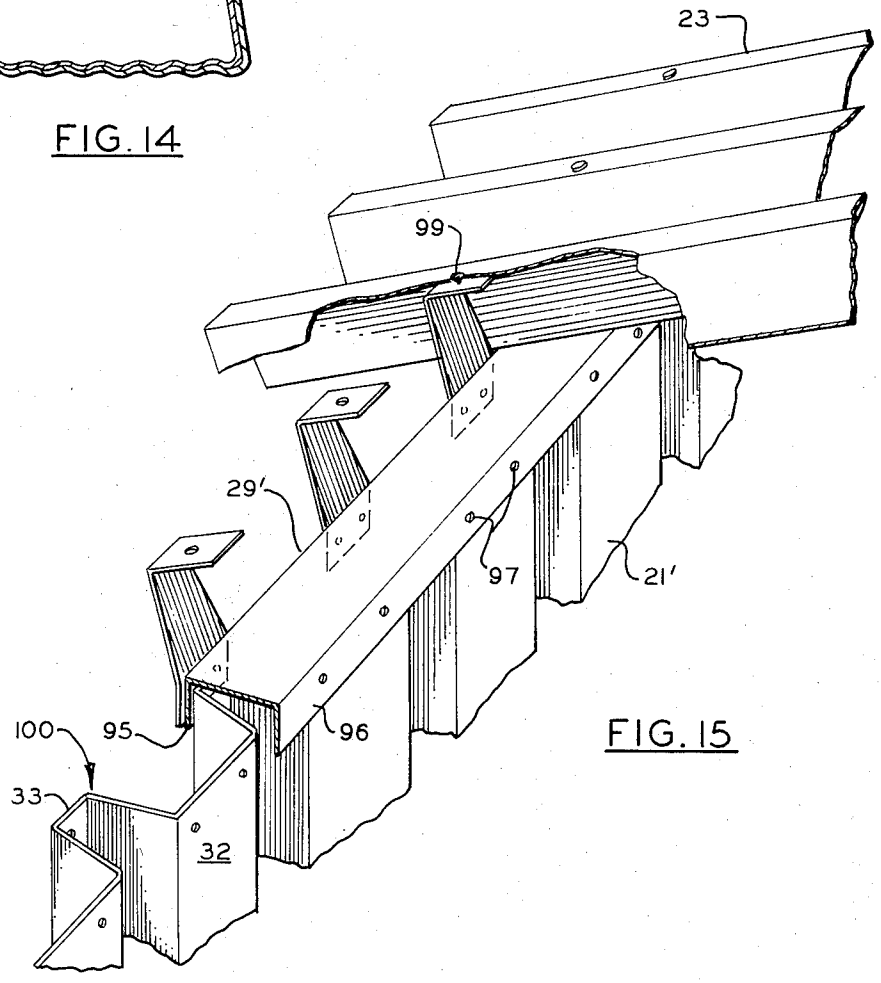


FIG. 15

BUILDING STRUCTURE FORMED OF FLAT CORRUGATED STEEL DECKING

BACKGROUND OF THE INVENTION

This invention relates to building structures made of flat corrugated steel decking so that external members serve both as supporting frame and external skin. An important element in reaching this result is the provision of reinforcing strips where the roof and floor are secured to the walls each strip has a portion extending away from the wall in a plane other than those of the corrugations of the wall.

Prior art corrugated metal walls employ sheetmetal which have arcuate corrugations. Flat corrugated steel decking has heretofore been employed as reinforcing members for concrete slabs used for the sidewalls of high-rise buildings but has not been used for panel members for the various parts of a building. Flat corrugated sheets have substantially rectangular corrugations so that portions of the corrugated sheet lie in two parallel planes while the sides of the corrugation lie in planes substantially at right angles to the parallel planes. When cast as reinforcement in a concrete slab, the concrete gives strength in a third plane at right angles to both the parallel planes and the planes of the sides of the corrugations. Flat corrugated steel decking has strength superior to arcuate corrugated steel sheets but of less strength than the decking forming part of a concrete slab.

SUMMARY OF THE INVENTION

This invention contemplates the use of reinforcing strip members which are prefabricated and have a portion for securing it to both the portions of corrugated wall lying in the general plane of the wall and to the wall portions lying in planes substantially perpendicular to the first plane. In addition, portions of the prefabricated strip lie in a separate plane at nearly right angles to both of the first two perpendicular planes. The reinforcing strips are placed where the roof panels are secured to wall panels at the roof eaves and where the wall panels are secured to the ends of a floor panel. Where the wall panels are subjected to heavy loads the portion of the strip lying in the separate plane is also made of flat corrugated steel decking for additional strength and the floor and roof panels are secured thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, diagrammatical, perspective view of a structure embodying the invention, parts being broken away to disclose interior portions;

FIG. 2 is an enlarged sectional view on the lines 2—2 of FIG. 1 and showing a corner of the structure;

FIG. 3 is a sectional view similar to FIG. 2 and showing a modified form of corner;

FIG. 4 is an exploded, fragmentary, perspective view of the structure where a floor end is secured to a wall;

FIG. 5 is a fragmentary, perspective view of the structure where a floor side is secured to a wall;

FIG. 6 is a fragmentary sectional view on the line 6—6 of FIG. 5;

FIG. 7 is an exploded, fragmentary, perspective view, as viewed from below the roof, of the structure where a roof panel is secured to a wall;

FIG. 8 is a fragmentary sectional view on the line 8—8 of FIG. 7;

FIG. 9 is a fragmentary sectional view on the line 9—9 of FIG. 1;

FIG. 10 is a fragmentary sectional view of a gutter construction;

FIG. 11 is a fragmentary, sectional view on the line 11—11 of FIG. 1;

FIG. 12 is a fragmentary, perspective view of the footing and pad members shown in FIG. 11;

FIG. 13 is an enlarged, fragmentary sectional view of a sidewall of a modified form of flat corrugated steel decking;

FIG. 14 is a further enlarged, fragmentary, cross-sectional view through a modified form of corrugated decking showing a joint construction for securing together adjacent panels; and

FIG. 15 is a fragmentary, perspective view of a modified form of structure where a roof panel is secured to a wall.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a building structure 20 is shown having end wall panels 21, sidewall panels 22, roof panels 23, floor panels 24, footing panels 25, bearing partition panels 26, other partition panels 27, floor bearing reinforcing strips 28, and eaves reinforcing strips 29. All these panels and strips are formed, at least in part, of flat corrugated steel decking of 16 to 22 gauge metal.

As best seen in FIG. 2, the decking has each corrugation 30 substantially rectangular with sharply bent corners, as shown, and the corrugations are adapted to extend vertically in the sidewall panels 21 and 22, and to extend from eaves to ridge in the roof panels 23 and from end to end in floor panels 24. The depth of each corrugation is at least 3 inches to give the wall panels a measure of transverse stability and the sides 31 of the corrugations extend from the outer surface portions 32 of corrugations and from the inner surface portions 33 of the corrugations at an angle which approaches a right angle. The angle by which this divergence of the corrugation sides 31 exceed right angles is less than 10°, the divergence being so that the panels may be nested.

The surface portions 32 and 33 are in planes parallel to the general plane of the panel. Portions 32 are shown longer than the portions 33 but it will be understood that each panel 21 and 22 may be reversed with the shorter portions 33 on the outside, if desired. As in all structures, joining the sidewalls at a corner adds transverse stability to the sidewalls.

The corner joint shown in FIG. 2, is made with an angle iron 34 bolted to shortened flanges 33 at the ends of each panel 21 and 22. As shown in FIG. 3 each shortened portion 33 at the side of each panel 21 and 22 may be formed as an angle 35 and the angles nested and joined together by rivets 36 or other securement means may be used for joining the wall panels together at the structure corners.

Referring to FIG. 4, the floor panels 24 are fabricated with their corrugations 30 extending from end 37 to end 37 of the panel. For this reason, panel 21 is termed an "end" wall while panels 22 are "side" walls adapted to be secured to the sides 38 of the floor panel. Since the corrugations extend from end to end of panel 24,

the greater portion of the weight of the floor is carried by end panels 21.

For securing the end 37 of floor panel 24 to wall panel 21 the reinforcing strip 28 is provided. Strip 28 has a portion 40 of like flat corrugated steel decking adapted to nest with panel 21, as shown. Portion 40 is reinforced along its centerline with a portion 41 which is U-shaped in cross section, notched for the corrugations 30 of the wall panel and welded, by metal-added welding at 42 to the portion 40, as shown.

The portion 41 provides a shelf for the end 37 of the floor panel and both its legs extend perpendicular to the planes of surfaces 32 and 33 of the portion 40 and perpendicular to the planes in which the corrugation sides 31 lie, thus strengthening and rigidifying the wall panel 21 at the junction of floor panel 24 therewith.

The reinforcing strip 28 is thus a diaphragm, in the architectural sense, for the panel 21.

The nesting portion 40 of the reinforcing strip may be secured to wall panel 21 by spot welds at 43, or otherwise. The shelf portion 41 of the strip may, alternatively, be secured to portion 40 by turning up or down tabs indicated in broken lines at 44 and 45 in FIG. 4 and spot welding the tabs to portion 40.

The end 37 of the floor panel is notched at 46 for the corrugations 30 of strip 28 and the surface portions 32 of the floor panel may be spot welded at 47 to the shelf portion 41 of the strip. Additional means for securing the floor end 37 to the shelf portion 41 are provided by the down turned tabs 48, at the ends of portions 32 of the floor panels, which interlock with slots 49 formed in the shelf portion 41 of the strip, as shown. Alternate or additional means for securing the floor panel to the strip 28 are indicated at 50 in broken lines and comprise an upturned tab on the end of each portion 33 of the floor panel which may be spot welded to the reinforcing strip 28.

Means for securing the side 38 of floor panel 24 to sidewall panels 22 are shown in FIGS. 5 and 6. A channel-shaped reinforcing strip 51 is secured to panel 22 by spot welding or by bolts at 52 and horizontally turned flanges 53 and 54 increase the longitudinal strength of the channel portion to strengthen the reinforcing strip 51 laterally of panel 22. The shortened portion 33 along the side of panel 24 may have a turned down end and overlies the flange 54 of strip 51, as shown, being secured thereto by screws 55 or otherwise.

It will be understood that floor panels 24 may be inverted, if desired. Usually panel 24 and strip 51 are covered with a sound deadening board layer and a carpet or hardwood floor or other layer may be added. The downwardly opening corrugations of panel 24 may be filled with foamed insulation material or the undersurface may have some sort of ceiling board secured thereto.

In FIGS. 7 and 8 a reinforcing strip 29, at the eaves, is provided for securing roof panel 23 to an endwall panel 21. Strip 29 comprises welded together portions 58 and 59 of corrugated decking like panels 21 and 23, portion 59 being disposed as to portion 58 at an angle chosen for the pitch angle of the roof, as best seen in FIG. 8. The two portions may be spot welded together at 60, as shown, or may be secured together by metal-added welding.

Portion 58 is adapted to nest with wall panel 21, usually outwardly of the panel as shown in FIG. 1. Holes 61 are provided in portion 58, as shown, and cooperating holes 62 in panel 21 are adapted to register therewith so that metal screws may attach the one part to the other. Alternatively, the parts may be spot welded together.

Portion 59 of strip 29 is adapted to nest with roof panel 23 thereunder. Holes 63 are provided in the upwardly projecting corrugations of portion 59 and registering holes 64 are provided in panel 23 so that metal screws 65 may be used to secure panel 23 to strip 29. Since the downwardly projecting troughs of roof panel 23 act as gutters for the rain, holes are not provided therein. Should additional securement be desired, spot welding at points 66 or elsewhere may be used.

Since portion 58 projects at an angle less than 45° from portion 59, it will be apparent that the substantially horizontal portions of portion 59 are in a plane separate from any of the planes of portion 58 and provide lateral stiffening for wall panel 21.

A similar arrangement is shown in FIG. 9 for securing together the adjacent ends of roof panels 23 at the roof ridge. A strip 68 is formed by welding together, along the line 69, two portions 70 and 71 of corrugated decking like the decking of panels 23, the welded together edges of portions 70 and 71 having been beveled to form the desired ridge angle. Portions 70 and 71 may then be secured to respective roof panels by metal screws through holes at 72, or otherwise.

In FIG. 10, it will be seen that the ends of roof panels 23 are adapted for the attachment of gutters 75. Panel 23 is shown in longitudinal section and gutter 75 in cross section. At intervals along the roof edge hangers 76 are fastened by appropriate screws to the top surface of the roof panel. Hangers 76 terminate in a hook which engages with a hook formed on the outer edge of the gutter. The other edge of the gutter is fastened to the lower portions of the roof panel by metal screws. Downspouts 77 may be provided in the usual manner where needed.

Footing panels 25, of like flat corrugated steel decking, are shown in FIGS. 11 and 12. The footing panels may be surface treated against soil damage and are nested with and secured to wall panels 21 or 22 at their bottom ends, as by bolts 79, at a selected height above ground level.

A pad 80, preferably of the same decking material, is secured by welding to the bottom edge of footing panel 25 so as to project transversely on either side of the panel. Diagonal brace strips 81 have one edge welded at points 82 to panel 25 and the other edge welded at points 83 to pad 80. Pad 80 and brace strips are perforated as shown.

The usual ditch 84 is dug, the depth depending on the frost line, and the pad end of footing panel 25 is sunk in aggregate treated for solidification such as poured concrete. When the aggregate has solidified the ditch 84 is filled on one side with prepared backfill 85 and with soil 86 on the other side.

In FIG. 11 the lower or ground floor 87 is a concrete slab but it will be understood that a panel floor, such as shown at 24 in FIG. 1, may be installed as the lower floor spaced above ground level.

The width of pads 80 and their thickness will depend on the soil capacity and their loading. It will also be understood that the thickness or metal gauge of all the panels herein described as well as the corrugation depth may be varied according to loading requirements

so long as the materials may be handled by modern metal working equipment at reasonable cost.

The wall structure hereinbefore described may be termed frameless since the same panels serve as surface skin and load bearing members. It will be understood, however, that the exterior corrugations may be filled and the outer surface painted or otherwise coated, if desired. When a structure **20** is intended for human habitation, the interior of the wall panels may be furred and suitable wallboard attached in the usual manner. The furring strips may be secured on **12** inch centers to panels **21** and **22** by rivets or other fasteners passing through prepared holes through the portions **33** of the panels. The interior corrugations may be filled with glass wool, foamed insulation, or other material, if desired.

In FIGS. **13** and **14** a decorative surface effect is accomplished by providing the exterior surface portions **32'** and the interior surface portions **33'** with fine conventional corrugations **90** as shown. Snap in colored strip members **91** projecting beyond the outer surface portions **32'** or recessed snap in strip members **92** may be provided for a decorative effect and for concealing furring rivets, if used.

At the side edge **93,** shown in FIG. **13,** a cup joint corrugation is provided for connection with a similar corrugation on the adjacent edge of another panel **22'**, as shown in FIG. **14.** A snap in strip **90** or **91** may be used or further locking may be obtained by rivets or other fasteners.

In FIG. **15** a modified reinforcing strip **29'** for use at the eaves is shown which can be used where the expected snow or other loading is small. Strip **29'** is channel shaped or substantially so and has depending flanges **95** and **96** which may be secured to the end of portions **32** and **33** of panel **21'** by sheet metal screws through the holes **97.** Alternatively, strip **29'** may be secured to panel **21'** by welding. Flashing tabs **98** are provided spot welded to flange **95** and adapted for securing to the roof panel **93** as shown at **99.** Preferably the upper end **100** of panel **21'** is cut at a bevel corresponding to the pitch of the roof so that panel **23** rests on a flat surface rather than an edge.

It will now be apparent that there has been provided a structural system wherein the superior load bearing properties of flat corrugated sheet steel has been utilized, the flat surfaces of the corrugations extending in two directions, the one at substantially a right angle to the other. Furthermore, the load bearing capabilities of the wall panels have been further strengthened where these panels are joined to substantially transversely extending roof and floor members by the provision of prefabricated reinforcing strips having an integral portion extending in a separate direction other than the two directions in which the wall portions extend. The basic concept for the structural system utilizes the diaphragmic action of the building components of walls, floors and roof to stabilize the structure through the connections to and reinforcement by the diaphragm planes.

I claim:

1. A building structure having sidewalls, roof, and at least one floor, the sidewalls comprising secured-together preformed panels of corrugated steel decking having substantially rectangular corrugations extending vertically of the structure, the corrugations having portions extending in planes spaced at least substantially **3** inches apart and the spaced planes being parallel to the general plane of the building site, the portions in spaced planes being joined by angled portions sharply bent at their junctions with the portions in spaced planes, the angled portions extending between the spaced plane portions and at an angle thereto larger than a right angle by not more than **10** degrees, the floor being horizontally disposed and comprising at least one panel of like flat corrugated steel decking, the floor corrugations extending from end to end of the floor, a reinforcing strip secured to the sidewalls adjacent to each of the two floor ends, the strip comprising a first part of like flat corrugated steel decking nesting with and secured at spaced intervals along its length to the wall panel at that end of the floor, the reinforcing strip having another part rigidly secured to the first part and comprising a U-shaped shelf portion having upper and lower shelf portions projecting outwardly into the inwardly opening corrugations of the first part of the reinforcing strip and secured thereto at the bottom of the wall corrugations and along both sides of the wall corrugations, and the ends of the corrugated floor panel being notched to interlock with the corrugated portions of the first part of the reinforcing strip and secured to the shelf portion of the reinforcing strip.

2. The structure defined in claim **1** wherein the upper shelf portion of the reinforcing strip is slotted and the projecting portions of the floor panel ends have downturned tabs for engagement in the slots for locking the floor panel to the reinforcing strip.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,820,295 Dated June 28, 1974

Inventor(s) Milo D. Folley

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 19, "site" should read -- side --.

Signed and sealed this 18th day of February 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

USCOMM-DC 60376-P69