The invention relates to building construction and refers more specifically to folded plate roof structure fabricated of separate metal structural members including end frames, ridge and valley fold-line members and light gauge metal panels extending between adjacent ridge and valley fold-line members.

Traditional long span roof structures have been a series of spaced beams or trusses covered by an independent deck system spanning between the spaced beams and trusses. Such structure requires particularly heavy roof construction, or objectionable intermediate vertical supports to prevent over-stressing roof constructions of lesser depth.

In contrast to this traditional structure, folded plate roof structures, which are in essence deep structural beams tipped so that the flanges of adjacent beams are in contact at ridge and valley lines, have been known for some time. With folded plate roof structure efficiency of material usage is increased since the sloping plates of the deep structural beams not only carry primary web shear but also serve as structural roof deck and often as finished interior ceilings. Folded plate roof structures in this have been practical only in concrete and plywood construction.

Concrete folded plate roof structure however has the disadvantage of requiring complicated design procedures. Also, a much heavier dead load is present with concrete folded plate roof structure than is desired due to the weight of the concrete and complicated construction procedures which are suitable only under certain weather conditions are required with concrete folded plate roof structure. In addition concrete in such structures is not well suited to the application of insulation and building upoff, the concrete does not itself provide adequate acoustical characteristics for many installations.

It is therefore one of the objects of the present invention to provide improved folded plate roof structure.

Another object is to provide folded plate roof structure comprising a plurality of separate metal members rigidly secured together.

Another object is to provide improved folded plate roof structure comprising a plurality of vertical supports, parallel spaced apart end frames having aligned valleys and ridges supported by the support members, elongated fold-line members extending between the aligned valleys and ridges and light gauge metal panels covering the area defined by the fold-line members and the frame.

Another object is to provide folded plate roof structure as set forth above wherein the folded-line members are elongated V-shaped metal plates.

Another object is to provide folded plate roof structure as set forth above wherein the metal panels are elongated and extend longitudinally between adjacent ridge and valley fold-line members.

Another object is to provide folded plate roof structure as set forth above wherein the top surface of the fold-line members and adjacent surfaces of the end frames are coplanar.

Another object is to provide metal folded plate roof structure which is simple in construction, economical to erect and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a partly broken away diagrammatic representation of a building including folded plate roof structure constructed in accordance with the invention.

FIGURE 2 is an enlarged section view of a ridge of the roof construction illustrated in FIGURE 1 taken substantially on the line 2-2 in FIGURE 1.

FIGURE 3 is an enlarged section view of a valley of the roof construction illustrated in FIGURE 1 taken substantially on the line 3-3 in FIGURE 1.

FIGURE 4 is an enlarged perspective view of a valley detail of the folded plate roof structure illustrated in FIGURES 1-3 with the insulation and roofing material removed and illustrating a fold-line member in phantom.

FIGURE 5 is an enlarged perspective view of a modified eave detail of the folded plate roof structure illustrated in FIGURES 1-3 with the insulation and roofing material removed and illustrating a fold-line member in phantom.

FIGURE 6 is an enlarged section view of an end detail of the roof construction illustrated in FIGURE 1 taken substantially on the line 6-6 in FIGURE 1.

COLLUMS 7 and 8 are diagrammatic illustrations of possible modifications of the profile of the folded plate roof construction illustrated in FIGURE 1.

With particular reference to the figures of the drawing, one embodiment of the present invention will now be considered in detail.

As shown diagrammatically in FIGURE 1, the building construction 10 includes a folded plate roof structure 12 constructed of separate metal members rigidly secured together. The folded plate roof structure illustrated includes the vertical support members 14, end frame 16, fold-line members 18 and metal panels 20. Flashing 22, insulation 24 and roofing material 26 complete the folded plate roof structure 12.

More specifically the vertical supporting members 14 may be, for example, H-columns, as shown in FIGURES 2-5. The supporting members 14, as illustrated in FIGURE 1, are provided extending vertically from the ridges 28 and valleys 30 defined by spaced apart parallel end frames 16 to a support therefor, such as the foundation 32 of the building construction 10. As shown best in FIGURE 2, the tops 34 of the columns 14 at the ridges are provided with an inverted V configuration while the tops 34 of the columns 14 at the valleys are provided with a V configuration.

End frames 16, as shown, are fabricated of I-beams secured to the spaced apart columns 14. As secured to the columns 14 the end frames 16 define transversely aligned ridges 28 and valleys 30.

The individual beams of the end frames 16 are provided with an upper flange 36 and a lower flange 40, as best illustrated in FIGURE 4. The individual beams of the end frames 16 make an angle with respect to the columns 14 similar to the angle formed by the V configuration of the ends 34 of the columns with respect to the longitudinal axes thereof. The beams of the end frames 16 are further provided with notches 42 in the upper flange thereof to receive the edge portions 44 of the fold-line members 18, as illustrated best in FIGURES 2-4.

The fold-line members 18 are elongated V-shaped plates which are inverted at the ridges 28 but not at the valleys 30. The fold-line members 18 are rigidly secured to the tops of the columns 14 by convenient means, such as welding and are provided with edge portions 44 fitting into the notches 42 in the upper flanges 36 of the beams forming the end frames 16.
The end frames 16 are so positioned vertically with respect to the fold-line members 18 that the upper surfaces of the fold-line members 18 and the end frames 16 are coplanar. End frames 16 and fold-line members 18 are rigidly secured together and to the columns 14 by convenient means, such as welding. The panels 20 are light gauge steel, high shear panels, similar to the elongated, low depth metal floor and ceiling panels well known in the construction industry. The panels 20 extend longitudinally between a fold-line member 18 at a valley 30 and a fold-line member 18 at an adjacent ridge 28. Panels 20 are rigidly secured to the fold-line members by welding.

Flashing members 22 are provided at the valleys extending between the panels 20, as shown best in FIGURE 3. The flashing members 22 extend downwardly and outwardly on both sides of the center of valleys 30, as illustrated best in FIGURE 1, to provide valley drainage in the folded plate roof structure 12.

The folded plate roof construction 12 is completed by securing rigid insulation 46 over the panels 20 and applying a built-up roof 48 over the insulation 46.

As shown best in FIGURE 2, the ridge portions 28 of the folded plate roof construction 12 include a V-shaped flashing 22 spanning between the panels 20 at the ridge 28 and a ridge member 50 cemented in the built-up roof construction 48.

The construction of the folded plate roof structure 12 at the ends 68 and 70 of the building construction 10 is shown in detail in FIGURE 6. In FIGURE 6 an end wall 52 of masonry is provided, a fold-line member 18 is secured to the masonry wall 52 by convenient means, such as grout 54 and anchor bolts 56. The panels 20 are then secured to the upwardly and inwardly extending portion of the V-shaped fold-line member 18 of FIGURE 4. Blocking 58 is provided to fill in the eaves trough 60 is secured. Insulation 46 and built-up roofing 48 are then provided over the panels 20, as illustrated.

The valley detail illustrated in FIGURES 3 and 4 is suitable for interior valley supports if needed or with the fold-line member 18 extended on both sides of the plane of the end frame, as shown in FIGURE 4, is suitable for overhanging eaves construction. With the fold-line member extending only on one side of the end frame 16, the detail of FIGURES 3 and 4 is suitable for substantially flush eaves.

Alternatively the structure illustrated in FIGURE 5 may replace the structure illustrated in FIGURE 4 at the eaves where flush eaves construction is desired. Thus in FIGURE 5 the I-beam end frame 16 is replaced by an end frame 62 including the exterior channel members 64 and the interior angle members 66. In such construction the valley fold-line member 18 is positioned to extend between the outwardly extending flanges of the angles 66, fold-line member 18 and channel members 64 are secured as by welding to the top of a supporting column 14 having a notched end 34 as before. A similar detail may of course be provided at the ridges where substantially flush eaves construction is desired excepting of course that the end frame 62, top of the column 14 and ridge fold-line member 18 would be in an inverted V form.

Thus a metal folded plate roof structure is disclosed which is simple, economical and efficient. The folded plate roof structure disclosed has the particular advantage of simplifying design procedure as compared to concrete folded plate roof structures, provides a lighter dead load than concrete roof structures and simplifies erection procedures since no forms or the like are required and temperature and weather during erection is not an important factor. Also, panels 20 may be factory fitted with desired acoustical treatment to permit easy application of insulation and built-up roofing. Also, the metal folded plate roof construction is of course non-combustible and is particularly rigid to prevent deflection and considerably stronger than, for example, similar wood structures.

While one embodiment of the present invention has been considered in detail other embodiments and modifications are contemplated. For example, as shown in FIGURES 7 and 8, the ridges 28 and valleys 30 may be provided with a flat horizontal portion or may be singularly provided with a flat portion. It is the intention to include all such modifications as are defined within the scope of the appended claims within the scope of the invention.

What I claim as my invention is:

1. A folded plate roof structure comprising a plurality of spaced apart vertical supporting H-columns, parallel spaced apart roof end frames constructed of I-beams and having transversely aligned ridges and valleys which end frames are supported at the ridges and valleys on said H-columns, V-shaped plate fold-line members extending transversely between and secured to the end frames at both the ridges and valleys, the columns having V-shaped ends at the ridges and the fold-line members at the ridges having downwardly opening V-shaped cross sections complementary to the ends of the columns at the ridges, said beams being rigidly secured to the end of the columns at the ridges, the panels between the columns at the ridges and in the recesses at the beams to provide coplanar upper surfaces on the fold-line members and upper beam flanges at the ridges, light gage metal panels extending between and secured to adjacent fold-line members to cover the area between the end frames and fold-line members, rigid insulation positioned over the panels and roofing material applied over said rigid insulation.

2. A folded plate roof structure comprising a plurality of spaced apart vertical supporting H-columns, parallel spaced apart roof end frames constructed of I-beams and having transversely aligned ridges and valleys which end frames are supported at the ridges and valleys on said H-columns, V-shaped plate fold-line members extending transversely between and secured to the end frames at both the ridges and valleys, the columns having upwardly open V-shaped ends at the valleys, the fold-line members at the valleys being complementary in cross section to the end of the columns at the valleys, said beams being rigidly secured to the ends of the columns at the valleys, and including upper and lower flanges, recesses in the upper beam flanges at the valleys, the fold-line members being secured to the top of the columns at the valleys and in the recesses at the beams to provide coplanar upper surfaces on the fold-line member and upper beam flanges at the valleys, light gage metal panels extending between and secured to adjacent fold-line members to cover the area between the end frames and fold-line members, rigid insulation positioned over the panels and roofing material applied over said rigid insulation.

3. A folded plate roof structure comprising a plurality of spaced apart vertical supporting structural members, parallel spaced apart roof end frames having transversely aligned ridges and valleys which end frames are supported on said structural members, V-shaped plate fold-line members extending transversely between and secured to the end frames at both the ridges and valleys, the structural members having V-shaped ends at the ridges and the fold-line members at the ridges having downwardly opening V-shaped cross section complementary to the ends of the structural members at the ridges, said end frames being rigidly secured to the ends of the structural members at the ridges, the fold-line members being secured to the top of the structural members at the ridges and providing coplanar upper surfaces on the fold-line members and end frames at the ridges, light gage metal panels extending between and secured to the adjacent fold-line members to cover the area between the end frames and fold-line
members, rigid insulation positioned over the panels and roofing material applied over said rigid insulation.

4. Folded plate roof structure comprising a plurality of spaced apart vertical supporting structural members, parallel spaced apart roof end frames having transversely aligned ridges and valleys which end frames are supported at the ridges and valleys on said structural members, V-shaped plate fold-line members extending transversely between and secured to the end frames at both the ridges and valleys, the structural members having upwardly open V-shaped ends at the valleys, the fold-line members at the valleys being complementary in cross section of the end of the structural members at the valleys, said end frames being rigidly secured to the ends of the structural members at the valleys, the fold-line members being secured to the top of the structural members at the valleys to provide coplanar upper surfaces on the fold-line members and end frames at the valleys, light gage metal panels extending between and secured to adjacent fold-line members to cover the area between the end frames and fold-line members, rigid insulation positioned over the panels and roofing material applied over said rigid insulation.

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