FOLDABLE AND COMPACTABLE TRUSS AND STUD SUPPORT

FIG. 1.

FIG. 2.

FIG. 3.

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This invention relates to a building construction in which the framing for walls and roof consist of metal roof trusses and support studs that are assembled in a novel and inventive manner. The unique character of the combination being maintained from the time of factory fabrication through to final erection and installation.

Metal or steel building construction generally follows the course of factory fabrication and field erection. Planning and organizing the elements and subcombinations in the factory for simplified field assembly are the bases for low-cost construction.

Simplicity of attachment for the component elements of a roof truss and stud support forms the outline of the invention. Most metal elements can be joined with metal screws, bolts and nuts, welding, soldering, and numerous other devices and methods. In each case, the choice is governed by the efficiency of the construction. If the cost of time consumed in field assembly outweighs the savings in factory prefabrication, an adjustment must be made. If factory prefabrication costs, for material, labor or both, overbalance the cost of field erection to a degree that indicates inefficient sub-assembly units are responsible, then a revision of methods and assemblies is required to obtain maximum total efficiency.

One of the best methods of obtaining such efficiency is by the development of sub-assembly units for building construction that require only unit assembly components in the field. And this is further improved by having the components identical in size and shape or as much as possible. For instance, if the construction assembly is completed by means of a pin, it is more efficient to require only one or two sizes of pins than three or more sizes. This is the situation in the instant invention. The roof truss has been designed to require an absolute minimum of assembly parts in the field, and these parts are identical in character and shape with a minimum of size variation. The connection elements are the same for joining the truss and stud supports making a single sub-assembly framing unit.

Another distinct improvement of the inventive construction lies in its ability to be compacted and transported in a minimum of space. This element of the invention is referred to as the "cube" of the construction. The sub-assembly of the building construction invention of this application is arranged for shipment from the factory to a point of field erection its cubic space requirements have been reduced to a minimum. In addition, the weight of the entire inventive sub-assembly is such that it can be handled by a single workman for shipping arrangements, loading, unloading, and handling at the field site.

Therefore, it is an object of the invention to provide a factory prefabricated roof truss and stud support sub-assembly which is simple to fabricate and to erect on a field site. Another object is the provision of such a sub-assembly requiring a minimum of connection elements of identical character and shape, with a minimum of size variation. Further, it is an object to provide a prefabricated sub-assembly that is foldable and compactable into a minimum cubic space for handling and transportation. A further object is the ease and simplicity of compacting the sub-assembly, and of unfolding and arranging the sub-assembly for erection and installation at the field site. Still another object is the achievement of substantially lower costs in construction and field erection. These and other objects will appear in the description given below.

The description together with the appended drawings is a disclosure of some forms which the invention may take, and is not in any way intended to be a limitation of the forms or variations which persons skilled in the art may make. The terms used are for purposes of description, and not of limitation.

Referring now to the drawing annexed hereto and made an integral part of this specification,

Fig. 1 is a perspective view of a portion of a roof framing structure, showing two roof trusses supported on stubbing and held together by purlins.

Fig. 2 is a side elevation of a roof truss and stud supports shown in Fig. 1.

Fig. 3 is a plan view of one truss top chord section, showing connected purlins.

Fig. 4 is a partially diagrammatic side elevation of one side of the roof truss and stud support sub-assembly, indicating the first steps in compacting the same for transportation or handling.

Fig. 5 is a side elevation of the inventive sub-assembly and shows the truss and stud supports in the second stage of compacting.

Fig. 6 is a side elevation of the inventive sub-assembly showing the same in fully compacted form.

Fig. 7 is an end view of the compacted inventive sub-assembly taken from the left side of Fig. 6.

Fig. 8 is a sectional view on the line 8-8 of Fig. 6, showing the folded arrangement of tension and compression members with the chord elements.

The roof truss and stud support combination of this invention consists of top chords 12, bottom chords 14, stud supports 16, tension
members 18, compression members 20, and pur- lins 22.

The top chords 12, bottom chords 14, and pur- lins 22 are C-section structural members made of metal and preferably of easily formable 5 sheet metal gauge. The C-section structural comprises a web 26, parallel sides 28 at right angles to said web, and flanged flanges 30 parallel to web 26. The tension and compression members, 18 and 20 respectively, comprise channels 10 of preferably formable sheet metal in which a flat channel web 32 is formed between a pair of unidirectional parallel sides 34.

Each roof truss consists of a pair of bottom chords 14, of the same shape and size, arranged in line, their webs 26 lying co-planar, and joined together with hinges 36. The hinges 36 are standard leaf type hinges, and consist of a pair of leaves 38 having intermeshing knuckles 40 held together by a pin 42, which may be headed or straight. A pair of hinges 35 are attached to the bottom chord 14 at the center of the truss span, by affixing one hinge leaf 38 to the web 26 of one of the chords 14 and the other hinge leaf 38 to the web 26 of the other chord 14 so that the hinge knuckles 40 intermesh and are held together by pin 42. Oppositely at the center of the bottom chord span, a leaf hinge 35 is attached by affixing the hinge leaves 38 to the intermeshed flanges 30 of each bottom chord 14 so that the hinge knuckles intermesh and are held by pin 42.

The two top chords 12 are similarly joined by leaf hinges 36 at the center of the truss span, one hinge being affixed to the web sides of the chords 12 at the mitred peak, another to the intermeshed flanges 30 of the chords, at the line where the two chords abut and directly opposite the first described hinge. The hinges 36 on each side of the top and bottom chords, when the truss is in load supporting position, should have their pins 42 in parallel alignment, for the purposes to be described below.

At each end of the truss span, a stop 44 is affixed to the end of the bottom chords 14 on the upper chord side 28. The stop 44 consists of a flat piece of substantially thick metal, preferably rectangular in shape and of a size to come within the width of the chord side 28, so that there is no overhang. The stop 44 is spot welded to the chord side 28, and acts to restrain linear movement or drift of the top chords 12 off the bottom chords 14. The ends of top chords 12 abut and rest against the restraining stops 44 at each end of the truss span.

Tension members 18 are attached to and between the top chords 12 and bottom chords 14, by affixing a leaf hinge 36 to the lower side 28 of the top chord, near the truss peak, and to the channel web 32 at the upper end of the tension member 18, and a second leaf hinge 36 to the upper side 28 of the bottom chord and to the channel web 32 at the lower end of the tension member. The pins 42 of the hinges so affixed lie parallel horizontally at each end of the tension member. Similarly connected are the compression members 20, with leaf hinges 36 affixed at each end thereof and to the lower side 28 of the top chords 12 and the upper side 28 of the bottom chords 14. The hinge leaves 38 affixed to compression members 20 and tension members 18 are attached to the inside surface of the channel web 32. This construction makes for better compacting of the elements.

Purlins 22 formed of C-section structural elements are used to connect the roof trusses together in load bearing relation. To provide a means of connection which is simple and inexpensive, leaf hinges 36 are affixed to both web and intermeshed flanges of the top chords 12 and to abutting purlin webs 26. These particular hinges 36 are arranged with loose pins 42 so that purlin assembly to and disassembly from the truss top chords is achieved with a minimum of effort and time. The pins 42 are inserted within the loops of hinge knuckles 40 to join purlins 22 to top chords 12, and removed for disassembly.

Stud supports 16 formed of C-section structural elements are joined to the roof truss at each end of the bottom chords. A leaf hinge 36 is affixed to the lower side 28 of bottom chord 14 near the span end, and to the inner parallel side 28 of the stud 16. A second hinge 36 is affixed to the inside surface of the lower side 28 of the bottom chord, at its very extremity, and to the outer parallel side 28 of the stud 16. This latter hinge, with its pin 42 lying horizontally, protrudes beyond the end of the truss in order that the connection be properly made between bottom chord 14 and stud support 16, whose supporting end lies directly against and underneath the lower side 28 of the bottom chord, for maximum load bearing effect. The hinge pin 42 lies just beyond the extremity of the bottom chord 14 to permit the depending hinge leaves 38 to be affixed to the stud support 16.

The leaf hinges 36 used to connect the various elements of the roof truss and stud support combination 10 as previously described consist of a pair of leaves 35, each leaf having intermeshing knuckles 40, and a joining pin 42 that is held within the knuckles 40. The hinge leaves 28 rotate about the pin 42, which serves as a pivot or fulcrum. The pins 42 can be headed loose or straight and fast. A loose pin is one that is easily removable from the knuckles, a fast pin being firmly anchored in the knuckles and not easily removable.

In the inventive construction above described, some of the hinge pins are loose and some are fast. The purpose of such arrangement is to provide a roof truss and stud support combination that is at once an integral unit and also a collapsible, foldable and compactable unit. The hinge connections of this unit permit simple and facile compacting and accurate alignment of the elements into a load bearing component.

These objects are accomplished as follows. Starting at the truss peak, the hinge 36 on the intermeshed flange side of top chords 12 is a loose pin hinge, the opposite hinge having a fast pin. Central of the truss span at the bottom chords 14, the hinge 36 on the intermeshed flange side has a loose pin, the hinge opposite on the web side having a fast pin. By removing the loose pins 42 from hinges 36 on the intermeshed flange side of the truss, top and bottom chords are rotatable about the hinges 36 affixed to the web sides 28 thereof at the center of the truss span until the truss ends meet.
The tension members 18 are held by loose pin hinges 35 to top chords 12, and by fast pin hinges to bottom chords 14. By removing the loose pins 42, and deflecting the top chords 12, the tension members 18 are rotatable about the fast pin hinges 35 on the bottom chords 14, until they rest upon the upper sides 29 of the bottom chords 14. Similarly, the hinges 35 by which the lower end of the compression members 20 are connected to the bottom chords 14, are loose pin hinges; those connecting the compression members 20 to the top chords 12 being fast pin hinges. Removing the hinge pins 35 at the lower ends of the compression members 20 permits them to be rotated upward to rest against the lower parallel side 28 of the top chords 12.

The hinges 35 lying at the truss ends between top and bottom chords, 12 and 14 respectively, are both fast pin hinges. The top chords 12, lying parallel to each other and with compression members 20 tucked up under and around (Fig. 5), can be lowered on the outer horizontally positioned hinges 35 to rest upon the tension members 18 and bottom chords 14. It should be noted that greater compactness is achieved if the channel web 32, of the tension and compression members, 18 and 20 respectively, is as wide or slightly wider than the chord sides 28. By being thus dimensioned, the members 18 and 20 will slip easily over and fast against the chords 12 and 14, in this way requiring a minimum of waste space between the folded chords. Only the hinge knuckles 40 will lie between the compacted elements of the truss.

The stud supports 16 at each end of the truss have fast pin hinges 35 affixed inwardly of the ends of the bottom chords 14. The hinges 35 at the very extremities of the truss being loose pin in character. By removing the loose pins 42 from the outermost hinges, the studs 16 can swing inwardly and upward toward and against the bottom chords 14.

In order further to achieve compactness and reduce cubic content of the folded combination 10, it should be noted that by using a three knuckle hinge leaf 38 on the web side of the top chord 12 for one half of the truss and a two knuckle hinge leaf 38 on the web side of the other top chord, and by spacing them equidistant from the knuckles of the other hinge leaves, the stud sections will intermesh as the top chords are folded back to back.

To achieve further standardization and interchangeability, the hinge leaves 38 on the intumescent flange sides of top chords 12 can be complementary to the hinge leaves directly opposite on the web side of the same chords. Thus, it does not matter whether the trusses all face the same way or not, the purlin connections are identical. Each purlin 22 has a three knuckle hinge leaf 38 attached to one end and a two knuckle hinge leaf 38 affixed to the other end. This arrangement simplifies the construction, assembly and cooperation of the roof trusses, in that skilled labor is not required and accuracy of assembly is practically positive.

To place a folded roof truss and stud support combination in use, a preferred method is here described. Swing the top chords 12 upward and away from bottom chords 14, rotating them about the truss center axis until the hinge leaves on the intumescent flange sides of the top and bottom chords at the truss center axis intermesh. Insert pins 42 in the hinge knuckles at the peak and at the bottom chord span center. Rotate the tension members 18 about their hinges on the bottom chords, deflecting the top chords to allow them to pass and connect members 18 to the top chords by inserting pins 42 into the intermeshed hinge leaves. Rotate the compression members 20 downwardly until the affixed hinge leaves 38 at the end of the members 20 intermesh with the leaves 38 on the bottom chords and connect with pins 42. Swing stud supports 16 downward until in right angle relation to bottom chords 14, with extreme hinge leaves 38 intermeshing and connect with pins 42 at each end of the truss span.

By virtue of infolding tension and compression members against folding chords, studs and intermeshing hinge leaves, the compact, low-cube package of Fig. 7 is achieved. Transportation of compact building materials is an essential element today when high freight rates hold sway. Freight hauling vehicles have space limitations. If this space is not loaded with the weight limit allowed, the shipper pays the full load rate. Therefore, it is to his advantage to load as much as possible into the vehicle up to the maximum weight limit. Where freight rates are not important or involved, efficient loading is still highly desirable in order to get the most goods per trip to their destination.

The method of affixing the leaf hinges 38 is optional, a preferred method being to spot weld the leaves 38 to the parts as described. The usual practice is to disassemble the hinge 38 by removing the pin 42 from the knuckles 40, spot welding each leaf 38 to its appropriate site and reassembling the elements by intermeshing the knuckles and inserting the pin therewith. However, spot welding is not the only means of affixing the hinges 38. Tack welding, arc welding, nuts and bolts, metal self-tapping screws, rivets and numerous other fasteners and fastening means may be employed. Also, it should be clearly understood that when the attachment of a hinge 38 to two components of combination 10 is described, that a hinge leaf 38 is affixed to each of the components so that a swinging or rotating relation is established between the two components about the hinge pin 42 as a pivoting axis.

Having described our invention in its very simplest terms, it is to be understood that the details of the foregoing specification may be changed and varied in greater or lesser degree without departing from the essence of our invention.

We claim:

1. In combination, a foldable and compactable roof truss consisting of top chords hingedly connected at the truss peak, bottom chords hingedly connected at the center of the truss span, the truss ends of each of said top chords hingedly connected to the truss ends of each of said bottom chords, compression members hingedly connected to top and bottom chords, and tension members hingedly connected to top and bottom chords.

2. The roof truss of claim 1, and including supporting studs hingedly connected at each end of said roof truss so as to swing and move toward said bottom chord sections.

3. The roof truss of claim 1, and including supporting studs connected at the truss span extremities to the lower side of said bottom chord sections by hinges, one of said hinges being mounted inwardly of the extremity of the truss span and connecting said supporting stud to the lower side of said bottom chord section, the other
of said hinges being affixed to the extremity of said bottom chord section and to the outermost side of the said supporting stud.

4. A foldable and compactable roof truss including C-section structural members made of sheet metal and consisting of top chord and bottom chord sections hingedly connected, the top chord sections abutting each other at the truss peak being joined by hinges affixed across the top chords with hinge pins in a vertical position, the bottom chord sections abutting each other at the truss span center being joined by hinges affixed across the bottom chords with hinge pins in a vertical position, the connection between top and bottom chords at the truss span ends being achieved by hinges affixed to the top and bottom chord sections there contiguous with hinge pins in a horizontal position.

5. A foldable roof truss assembly in which the truss chord sections are composed of C-section structural members and consisting of top chord sections hingedly connected, the top chord sections abutting at the truss peak having hinges there affixed connecting the said top chord sections to provide movement relative to each other and rotation about a vertical pivot, the bottom chord sections having hinges affixed at the truss span center and connecting the said bottom chord sections to provide movement relative to each other and rotation about a vertical pivot, the ends of said top and bottom chords at the truss span extremities being connected in load bearing relation, the said pivots of top and bottom chord sections at the truss span center being arranged in alignment to provide folding of said truss in two segments into a folded unit.

6. A foldable and compactable roof truss in which the truss chord sections are composed of sheet metal structural members and consisting of top chord sections abutting at the truss peak being connected by a pair of hinges mounted on abutting top chord sections, the pair of hinges being affixed opposite each other, each of said hinges connecting the top chord sections, with the pins of said pair of hinges arranged in parallel vertical position, one of said pins being fast in its hinge while the other hinge pin is loose and easily removable, bottom chord sections abutting at the truss span center and being connected by a pair of hinges mounted on abutting bottom chord sections, these hinges being affixed opposite each other, with each of said hinges connecting the bottom chord sections and arranged with hinge pins in parallel vertical position, one of said latter pins being fast in its hinge while the other of said latter pins is loose and easily removable, the truss span ends of said top and bottom chord sections being connected in load bearing relation, the said roof truss being foldable about a vertical pivoting axis of the fast hinge pins at the truss peak and truss span center of the bottom chord after removal of the loose hinge pins from the same locations.

7. A foldable and compactable roof truss consisting of top chord sections abutting at the truss peak and being there connected by a pair of hinges oppositely affixed to two sides at the truss peak and connecting the abutting top chord sections, the pins of said hinges being arranged in parallel vertical position, bottom chord sections abutting at the center of the truss span and being there connected by a pair of hinges oppositely positioned and affixed to two sides of the bottom chord sections and connecting said bottom chord sections, the hinge pins on one side of said roof truss being fast in their hinges, the hinge pins on the opposed side of said roof truss being loose and removable in their hinges, the top and bottom chord sections at the truss span ends being connected by hinges affixed to the top and bottom chord sections and positioned with their hinge pins lying horizontally between the top and bottom chord sections.

8. A compactable and foldable roof truss consisting of top chord sections hingedly connected to bottom chord sections at the truss span extremities, the said top chord sections connected at the truss peak by hinges vertically arranged and oppositely affixed on each side of the truss peak, and said bottom chord sections connected at the truss span center by hinges vertically arranged and oppositely affixed on each side of the truss span center.

9. In combination, a foldable and compactable roof truss consisting of top chords hingedly connected at the truss peak, bottom chords hingedly connected at the center of the truss ends of each of said top chords hingedly connected to the truss ends of each of said bottom chords, compression members hingedly connected to top and bottom chords, and tension members hingedly connected to top and bottom chords, and supporting studs connected at the truss span extremities to the lower side of said bottom chord sections by hinges, one of said hinges being mounted inwardly of the extremity of the truss span and connecting said supporting stud to the lower side of said bottom chord sections, the other of said hinges being affixed to the extremity of said bottom chord section and to the outermost side of the said supporting stud, wherein the connecting hinges for each supporting stud at the truss span extremities consist of a fast pin hinge inwardly of the said extremity connecting the said bottom chord section to said supporting stud and a loose and removable pin hinge at the extremity of the truss span connecting the extremity of the said bottom chord section to the said supporting stud.

10. A foldable roof truss assembly in which the truss chord sections are composed of C-section structural members and consisting of top chord and bottom chord sections hingedly connected, the top chord sections abutting at the truss peak having hinges there affixed connecting the said top chord sections to provide movement relative to each other and rotation about a vertical pivot, the ends of said top and bottom chords at the truss span extremities being connected in load bearing relation, the said pivots of top and bottom chord sections at the truss span center being arranged in alignment to provide folding of said truss in two segments into a folded unit, and hinge leaves for connection to purlins affixed with complementary hinge leaves, said first hinge leaves being affixed to the sides of said top chord sections.

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