

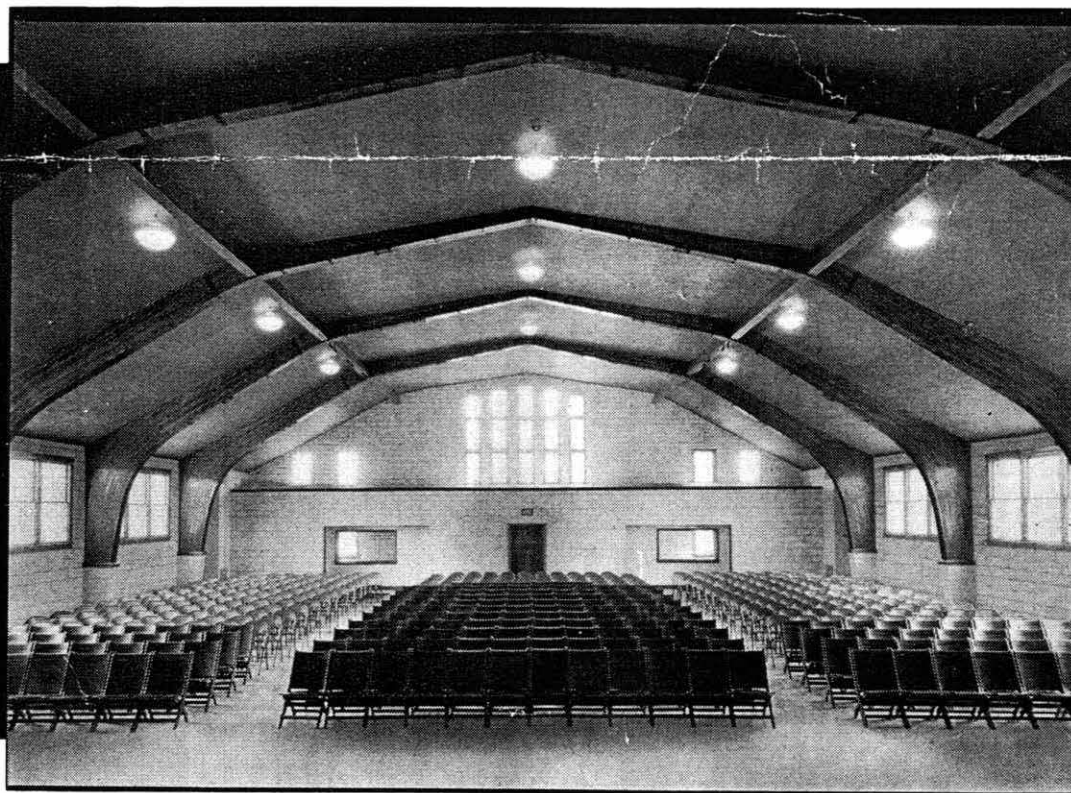
R.C. Wilson

Nov 15

A N O U T S T A N D I N G

Structural **ACHIEVEMENT**

A. I. A. File No. 19-B



by



MANUFACTURERS OF MODERN WOOD ROOF CONSTRUCTIONS

"UNIT" STRUCTURES and HOW THEY ARE MADE

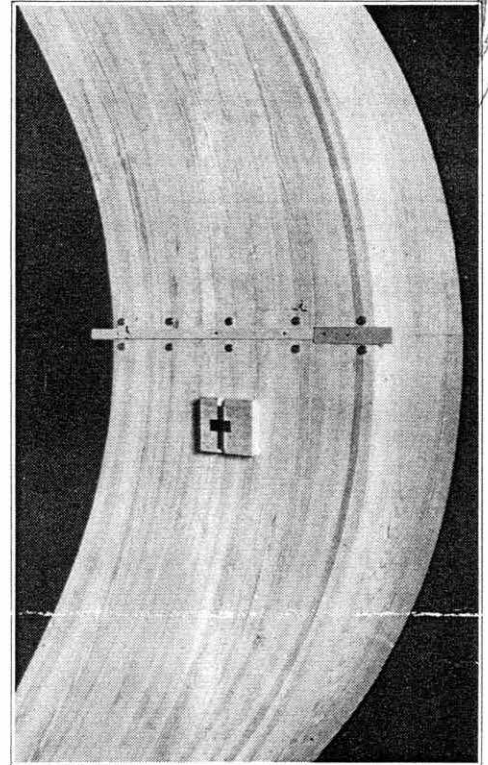
LAMINATED GLUED WOOD STRUCTURES have been in use since 1906 in other parts of the world. Engineers of "Unit" Structures, Inc., gained their knowledge of this method of construction through their association with the originators, and have combined this knowledge with the improvements developed by the Forest Products Laboratory.*

MANUFACTURE†

"Unit Structures" are manufactured by glueing together thin wood laminae under high uniform unit pressure. The surfaces of the laminae are properly prepared, then even coatings of glue are applied and finally they are placed into presses especially designed by engineers of Unit Structures, Inc. Applied pressure forcibly curves the members into desired shapes, producing uniform joints throughout. The final product is, and has the appearance of one solid piece of wood; with the cross section distributed in such a way as is most desired from the standpoint of loads and stresses.

WOOD:

We select the lumber best suited for the desired structure, both from the standpoint of appearance and strength. Since good glue joints can be obtained with most varieties of lumber found in this country, other considerations determine the proper selection of wood. The wood must be easy to bend since the thickness of laminae is a function of the curvature. But when we say that for a radius of only 39 inches, we used boards 9/16" thick it is obvious that lumber can be economically used and still be flexible enough to be bent to any curvature required in building construction. In addition, the wood must be sufficiently free of knots, checks, and other defects, and must have a low percentage of moisture.



Section of Laminated Structure



Corner posts and end of an Egyptian Mummy-case now in the Berlin Museum — 2700 years old*

*From pp. 56-7 of "The Story of Furniture" (Geschichte des Mobels) by A. Koeppen and C. Breuer.

GLUE:

The glue we use is a water-resistant casein glue. Such glue has been used in the United States since about 1870. However, the use of casein glue is traced back to the Ancient Egyptians, who have used milk curd and alkali in joining pieces of wood. The example of such workmanship is shown by the illustration.§ Pieces of furniture salvaged out of Roman ruins were found to be glued, and are practically intact today. The World War brought casein glue back into use when airplanes began to be built in large numbers, requiring structural members which were laminated and glued up. Tests which have been made by the Forest Products Laboratory have shown repeatedly that glue joints holding together a number of layers of wood are equal to or greater in strength than the wood.‡

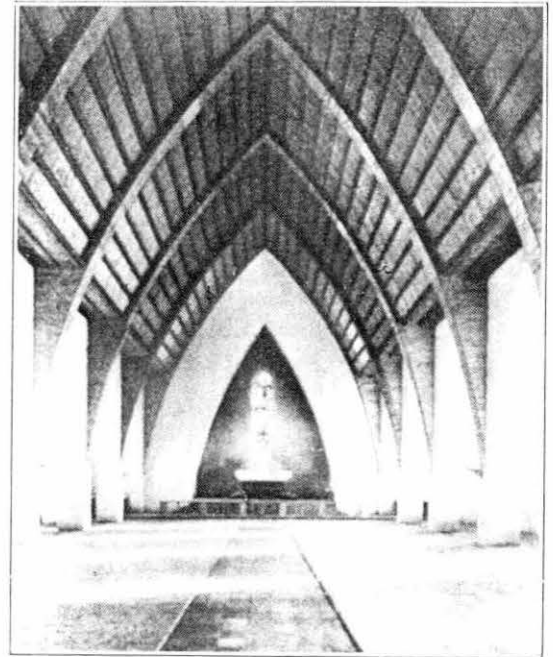
*"Modern Wood Construction" by L. V. Teesdale—Eng. News Record, April 11, 1935.
†Manufacturing Process—Patent Pending.

§"Glue of the Ancients: Gone Modern." By courtesy of Monite.
‡United States Department of Agriculture—Bulletin No. 1500.

DISTINCTION — BEAUTY — ADAPTABILITY



Interior of Peshtigo, Wis., Gymnasium and Community Building. Span 64 feet, showing Type "W" Unit Arch Frames.

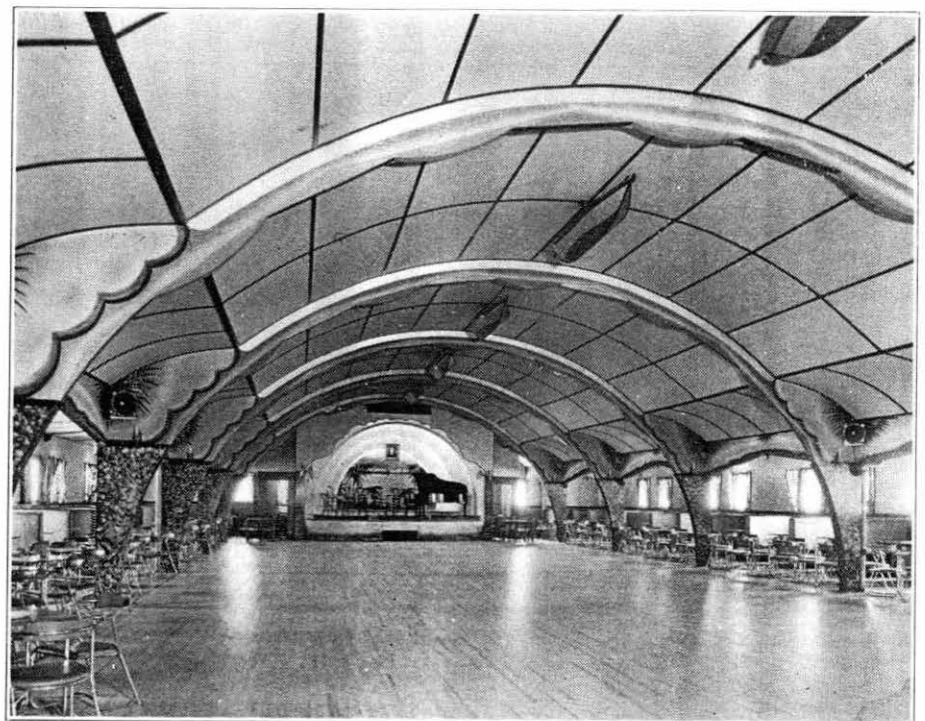


Wood Arches for Modern Church—Type "G". Unit Arch-Frame.

Graceful arch units replace unsightly truss frame work. New interior designs are created which harmonize with our modern architecture. Unit structures offer the advantage of great flexibility in design. Therefore, the builder will readily understand that we can furnish laminated "units" in all shapes and adhere strictly to specified dimensions.

The natural beauty of wood makes additional decorations unnecessary. Yet the finished frame surfaces lend themselves to additional architectural treatment if desired.

Interior of Terrace Gardens, night club, Escanaba, Mich. Span 50 feet, showing Type "U" Unit Arch-Frames.



STRUCTURAL ADVANTAGES OF "UNIT STRUCTURES"

"UNIT STRUCTURES" are timbers made up through a correct arrangement of laminae united under high, uniform unit pressure. The laminae are forcibly curved and glued into a solid timber of required shape; with the decided advantage over full sized timbers that the grain follows one principal stress plane, the same as nature provides in the branches of a tree.



"UNIT STRUCTURES" eliminate the dangers existing in made-up roof supports where collapse of the entire structure will result through the failure of one of many structural elements.



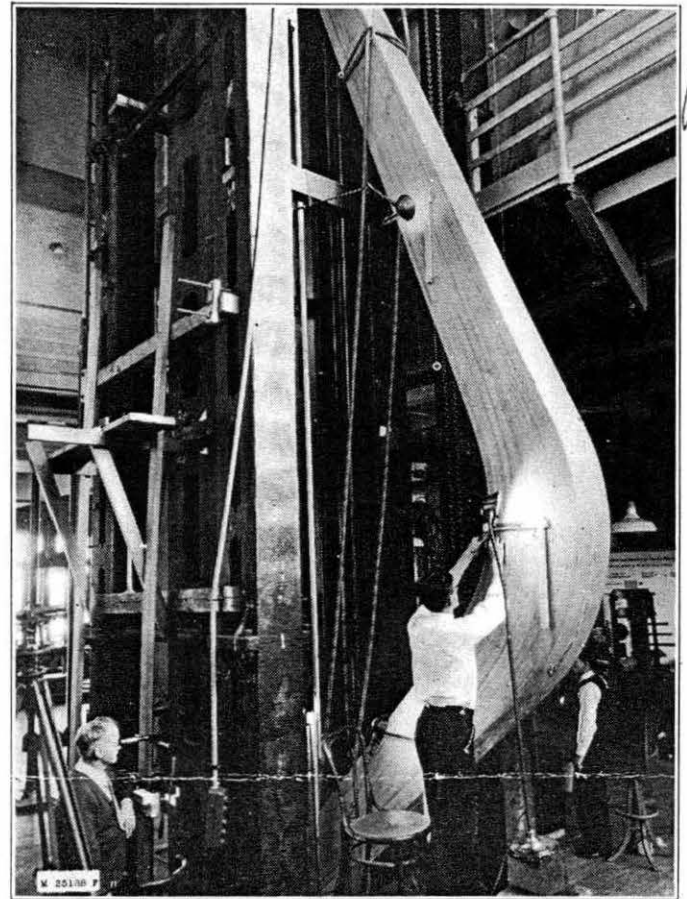
"UNIT STRUCTURES" are designed for unsymmetrical, as well as symmetrical loading conditions, whereby the weakness existing in other types of structures whose safety depends on the reliability of each individual member and part is eliminated.



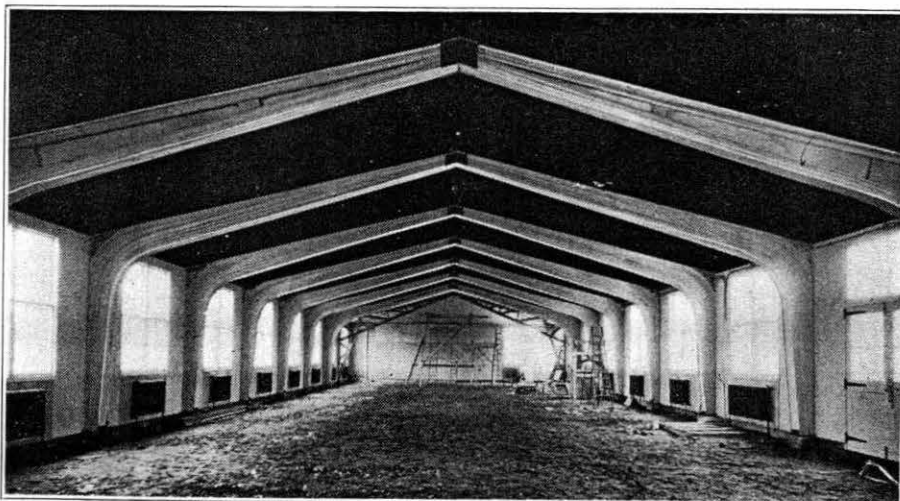
"UNIT FRAMES" possess the high rigidity of a two piece, three hinged arch and are therefore much more rigid than roof structures whose trusses and supporting columns are separate, artificially connected units. "UNIT FRAMES" have a high EARTHQUAKE SAFETY.



"UNIT STRUCTURES" retain their strength through subsequent volume changes and eliminate the weakening of structures which results from such changes in other types of construction.



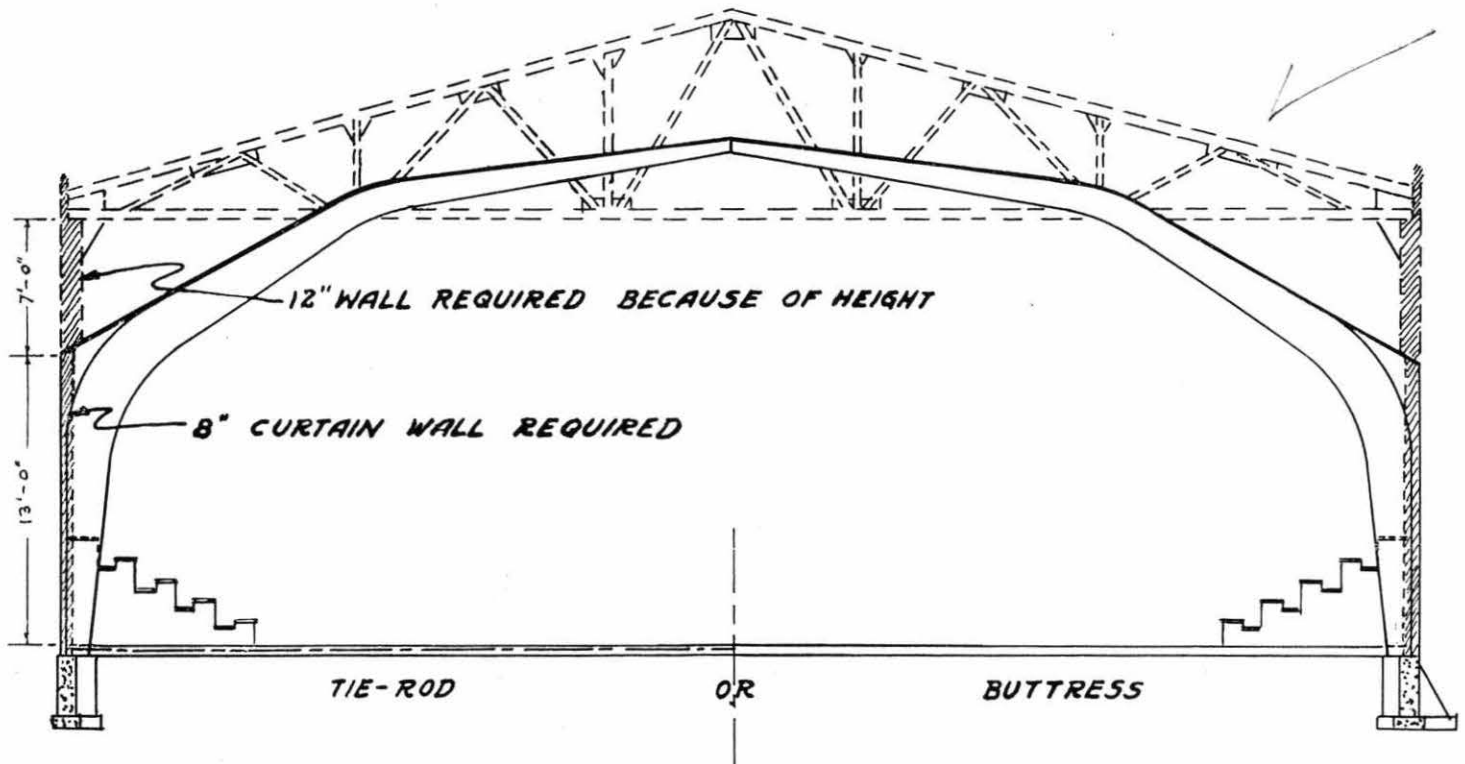
Our Arch Frame tested to failure at the Forest Products Laboratory with highly satisfactory results.



The Theory of our design has been checked and approved by H. M. Westergaard, Professor of Theoretical and Applied Mechanics, University of Illinois.

Interior of Forest Products Exhibition Building, Madison, Wis. Span 46 feet. Showing type "V" UNIT Arch-Frames.

Since "Unit Frames" are designed for the purpose of providing better structures at lower costs, the cost of a complete building using our type of roof construction must be compared with the cost of the same building using any other type of roof construction to appreciate the great saving "Unit Frames" afford.

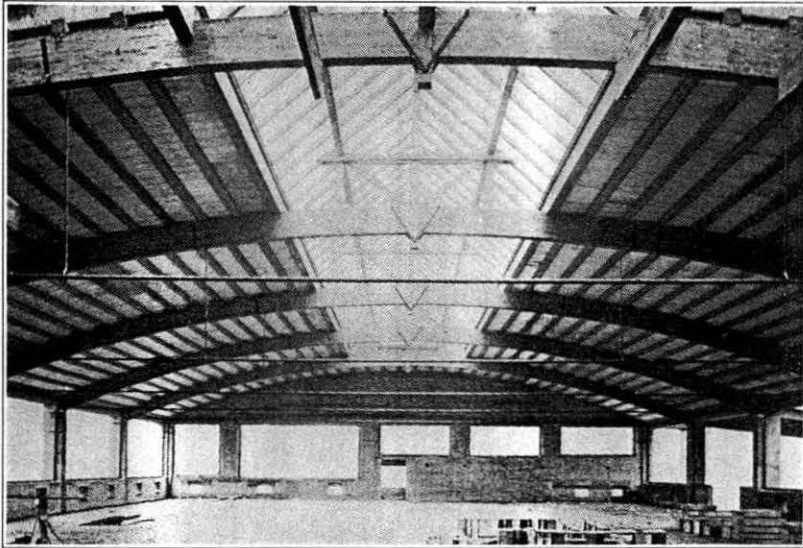


WHAT "UNIT" ARCH-FRAMES SAVE

1. By deducting cost of additional height of sidewalls, gablewalls, and columns or pilasters needed with other types of roof structures, "Unit" Arch-Frames save their own cost.
2. "Unit" arches and their columns are one frame, no additional expense for columns or load-bearing pilasters such as are needed with trusses or other types of roof construction.
3. "Unit" Arch-Frames provide large unobstructed floor space without additional cost to maintain the clear height of the interior.
4. By eliminating the waste overhead space necessary to accommodate the conventional truss, "Unit" Arch-Frames materially reduce the cubical contents of a building with a resultant saving in cost of heating and air conditioning.
5. After "Unit" Arch-Frames are purchased, there is no additional expense involved. "Arch-Frames" are completely finished before leaving the shop to give the desired interior effect.
6. "Unit" Arch-Frames are easy to erect. No expensive equipment or trained crew is required.

"UNIT" SEGMENT ARCHES—LOW COST

Span Your Roof With "Unit" Segments For Unobstructed Floor Space, Economy, and Clean-cut Appearance.



78 ft. Span Segment Arches Over Factory Building.

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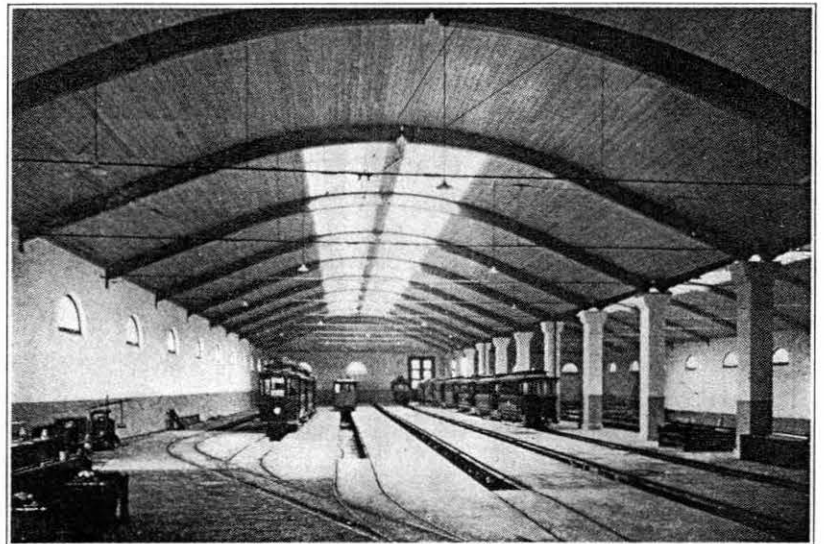
"Unit" Segments should be used for Garages, Warehouses, Factories, Airplane Hangars, Store Buildings; in fact, any place where a saving is desired with improved appearance.

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"Unit" Segments
Are Supported and
Fastened in the Same
Way As Trusses

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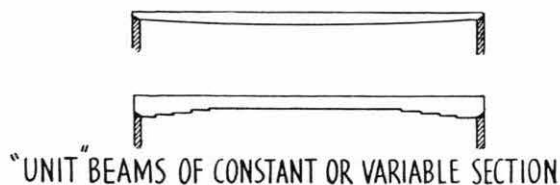
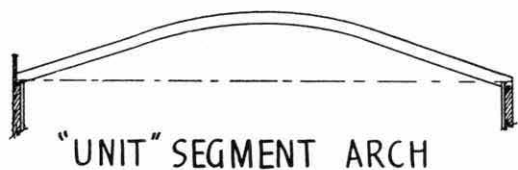
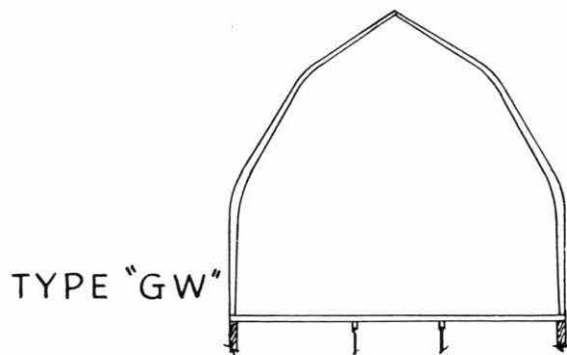
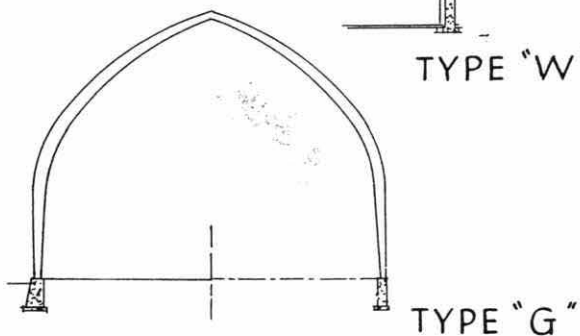
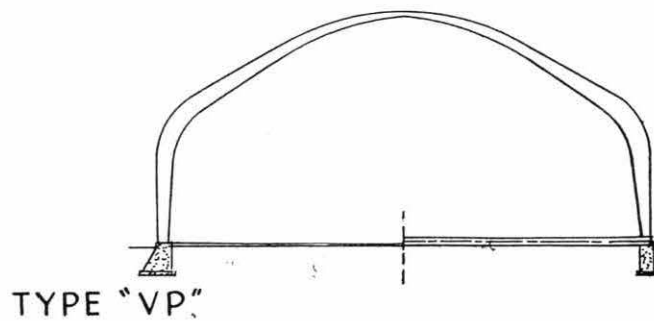
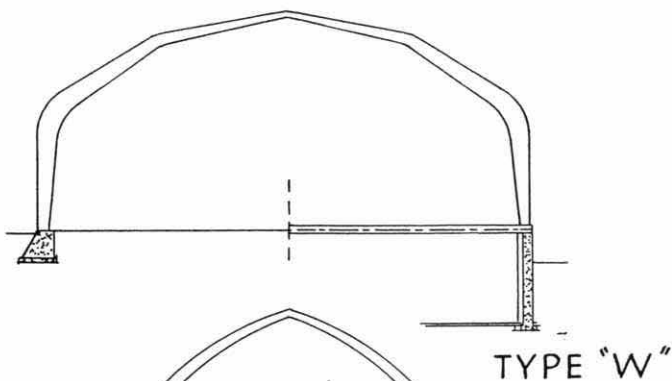
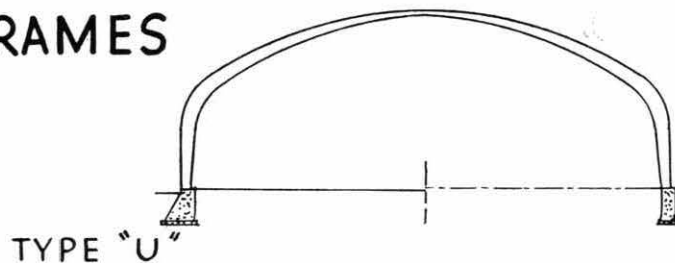
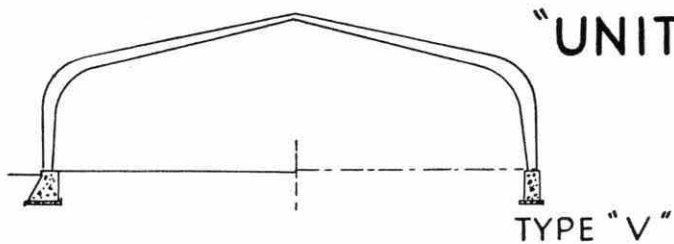


72 ft. Span Over Car Barn

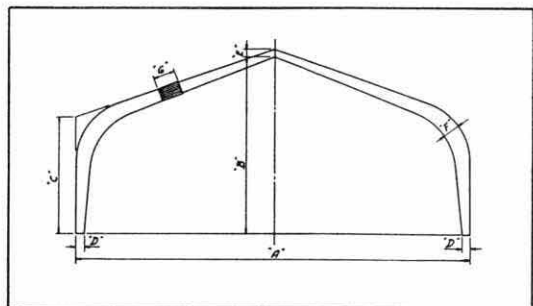
One Segment replaces the network truss. "Unit" Segment arches are furnished for any span and are easily and quickly erected.

Some Suggested Shapes of "UNIT STRUCTURES"

"UNIT" FRAMES



DIMENSIONS OF SOME "UNIT FRAMES"

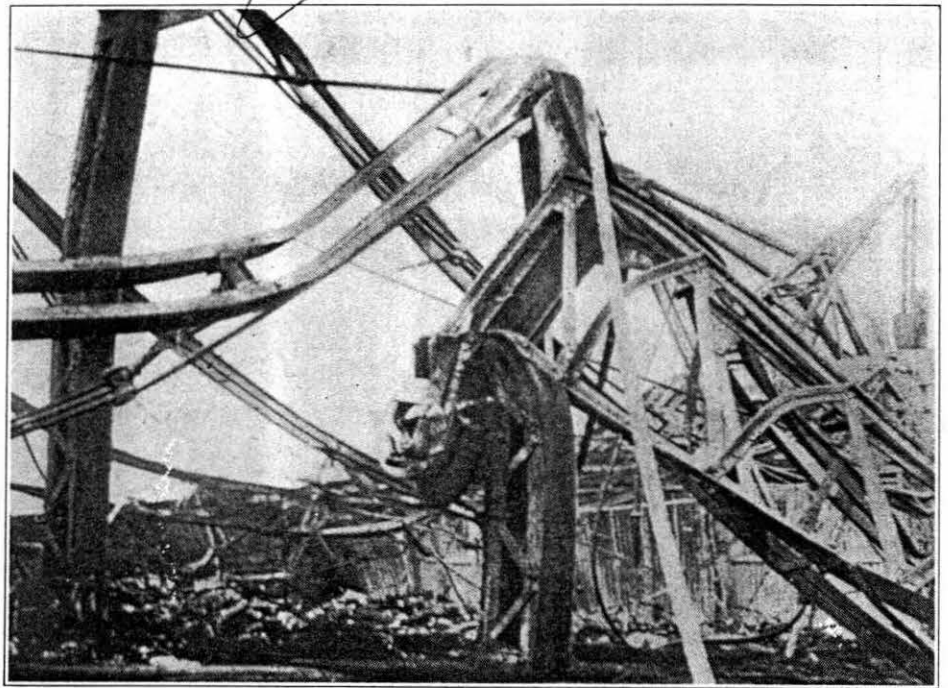
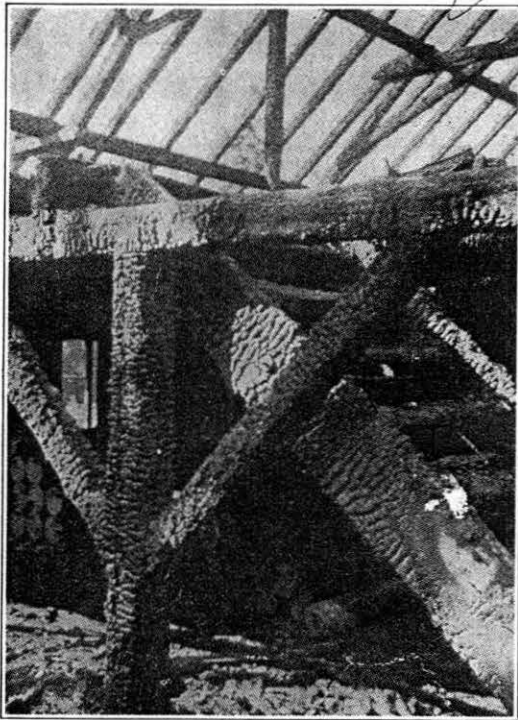


Any Shape Arch That Is Structurally Sound
Can Be Made by the "Unit" Process.

Dimensions (D), (E), and (F) Will Vary
With Changes of (G)

Type of Arch	Span (A)	Height (B)	Wall Height (C)	(D)	(E)	(F)	Width of Arch (G) in.	Spacing of Arch	Roof Load (lb./sq. ft.)
"V"	40'	16'	10'	13"	8"	22"	7½	16'	40
	40'	20'	10'	10"	8"	19"	7½	16'	40
	50'	17'	10'	18"	10"	23"	9½	20'	40
	50'	23'	10'	13"	10"	21"	7½	16'	40
	60'	25'	20'	12"	8"	28"	11½	16'	46
	70'	21'	12'	22"	11"	30"	9½	16'	40
	80'	23'	12'	29"	13"	34"	9½	18'	40
	80'	26'	18'	24"	12"	37"	11½	20'	40
"W"	40'	17'	10'	12"	8"	20"	7½	16'	40
	50'	19'	10'	16"	8"	22"	7½	16'	40
	70'	20'	10'	24"	11"	28"	11½	21'	40

GRAPHICAL PROOF OF A WELL KNOWN FACT



A Comparison of the Behavior of WOOD and STEEL Under Fire

WOOD does not lose in strength when exposed to heat.

WOOD weakens only when in direct contact with a continuous, hot, open flame, through a gradual reduction of its cross sectional area.

WOOD eliminates the hazards due to expansion since its thermal conductivity is $1/200$ that of steel and its coefficient of expansion only $1/10$ that of steel.

WOOD as fires have repeatedly shown, was still in a position to act as a support after its section was reduced to $1/3$ of its original size. The possibility of sudden collapse is eliminated.

STEEL weakens under heat, losing its strength at 700° F. Since ordinary fires reach temperatures of 2000° F., steel structures collapse at early stages of the fire.

STEEL is a good conductor of heat, therefore will readily distribute high temperatures, which in combination with its high coefficient of expansion will cause a considerable increase in its length. In case of steel trusses, sidewalls often are bulged out, causing complete destruction of the building and great damage to its contents.

STEEL collapses quickly. Flash fires have caused total failure of such structures. Extra expense in clearing away the tangled mass of wreckage adds to the already sustained loss.

"UNIT" STRUCTURES also afford better fire protection than other wood roof construction, since they replace the large number of scattered members by one solid timber.

The fire insurance rates for buildings where "Unit Structures" are used are equal to those of exposed steel.

"UNIT" STRUCTURES INC.,

PESHTIGO, WIS.