A SYMPOSIUM OF FIRE RESISTANT HOMES

THESIS FOR THE DEGREE OF B. S.

C. M. Hoedeman

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by

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Candidate for the Degree of

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Clarence M. Hoedeman

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INTRODUCTION

There is a type of home which is coming into demand more and more with the passing of time due to lower building costs and the revolutionization of house architecture. This new type is the Fire Resisting Home.

The fire resisting home is one which is built from materials which in themselves are fire resisting so that each integral part of the structure is fire proof. It is a home which will withstand exposure to either an internal or external fire and the hazards of neighboring fires. There are many materials which are fire resisting but when used with other materials which are fire hazards amy give a construction which is fire resisting externally only. This paper is intended to offer suggestions to the prospective builder on details of construction which will make a house fire resisting.

The reasons for building a fire resisting home are multifold. The main reason is for the preservation of the structure and its occupants in case of fire. In the suburbs and the rural districts where fire protection is small or non at all the insurance rates are exceedingly high in fact much too high for the average person at times. With the introduction of the fire resisting home the rates on such structures have come down. The factor of household and personal safety is greater with additional features added to the building simultaneously without additional cost.

A question as to the high initial cost of a fire proof structure has always arisen heretofore. With the changing

of construction methods and architecture the initial cost of a fire resisting home has been reduced to a reasonable limit of the average laymans budget. A comparison of prices of the fire resisting and the non fire resisting homes appears in the latter part of this paper.

Some pictures of the home planning division at the Century of Progress Worlds Fair are used to show what is being done in the line of fire resisting homes and new architecture.

The subject is discussed by taking the main parts of the structure individually such as the foundation, floor systems, wall systems and the other parts of the structure. Each part divided into its types, the types being steel, concrete and other construction materials. This method was chosen to facilitate the explanation of the subject.

FOUNDATIONS

The foundations are usually constructed from fire resisting materials but a discussion of the foundation will be made giving the various types of materials used in the construction of good foundations. The types of materials used are concrete products, brick, tile and composition building blocks.

Concrete foundations when constructed in the correct manner and after the specifications of a good engineer are permanent structures. Since it is fire proof and can be waterproofed it has proven to be an economical material to use in the construction of foundations.

Brick is another good material for use in footings and walls when the local conditions allow the use of brick. Brick for the footings is allowable only when the soil characteristics are such that bearing power of the soil is favorable. The footings, exterior and interior walls can be constructed of brick. The openings in the walls consisting of brick arches or steel lintels offering either a rectangular or a curved opening.

The use of tile for the foundation is made permissable by the use of the regular tile building block. The footings are usually constructed of concrete. The walls made from the building block tile can be either plastered or left unfinished giving an attractive wall in either case. The Natco concern offer a basement floor system made essentially of tile. The ground is packed down hard and cinders applied to a depth of

four or six inches according to the soil characteristics. The tile is layed on top of the cinders and a coating of concrete applied over the tile for bond and a wearing surface.

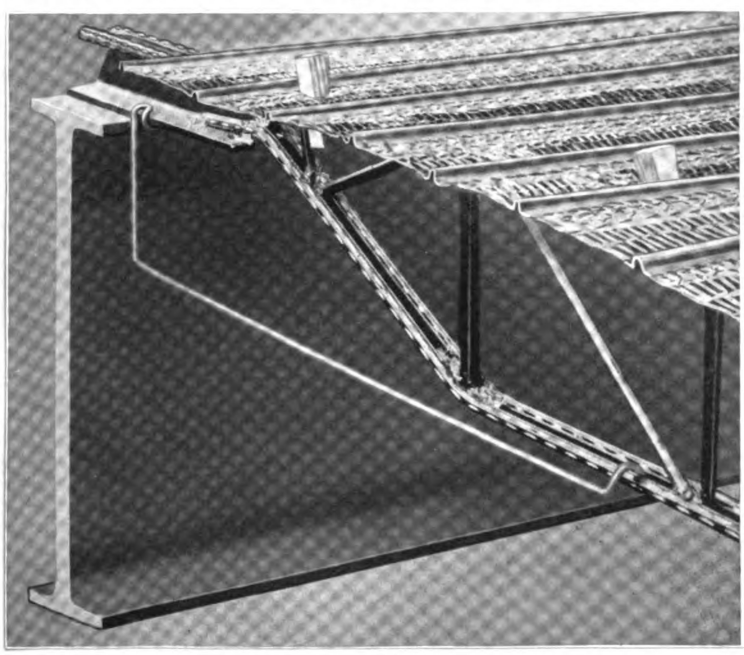
The other materials used in the construction of foundations are used in the same manner as either the tile, brick or building block. These materials may consist of the various patented composition blocks or brick as the Haydite materials, Dunbrik products and other products of composite materials.

FLOOR SYSTEMS

The divisions that may be made to the floor systems to facilitate their explanation are as follows; The steel joist, Concrete construction, Brick construction, Tile construction, and Frameless steel construction.

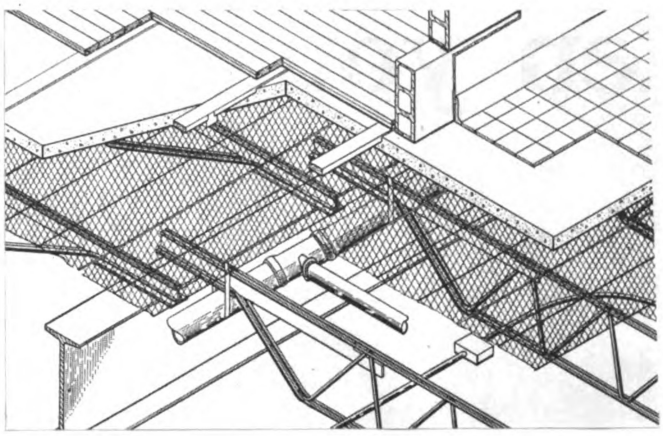
The steel joist floor system has its types according to the type of joist used and the kind of floor put on the joist. There are essentially two kinds of steel joists namely the open truss joist and the closed joist. The open truss joists are the various joists made in the form of a truss. The closed joist may be either a channel section or an 'I' beam section.

The subfloor with either type of joist may consist of a metal rib lath layed on top of the joist and concrete poured over that. The picture below illustrates the use of the



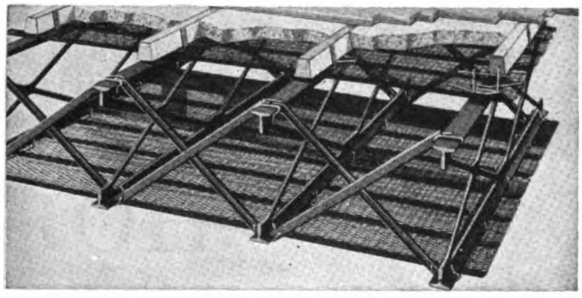
metal lath and the open truss joist using the steel 'I' beam for a girder. This is the Milcor method of steel joist floor system. Note the wire bar extending from the girder to the bottom of the joist, it is an accessory used in connection with

the ceiling construction. A light reinforced concrete subfloor with a linoleum finish floor makes a good fire resistant floor system. This picture illustrates the use of the whole floor system and a portion of the wall. Note the use of linoleum in the one room and a wood floor on sleepers in the other room. The picture also illustrates the method of hanging the plumbing and electrical units in conjunction with the use of the open truss joist.



Precast concrete slabs may be used as the subfloor with either type of joist. The floors may be finished with linoleum, tile, rubberoid products, or a monolithic concrete.

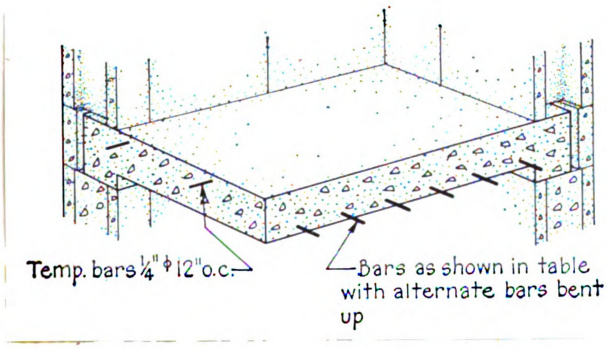
A plaster ceiling is used to protect the bottom portion of the steel joists from the heat hazard. This is illustrated in this view of the Kalman steel joist floor system. This system embodies the use of beveled sleepers with a concrete subfloor between the joists. A metal rib lath with plaster coating comprises the ceiling.



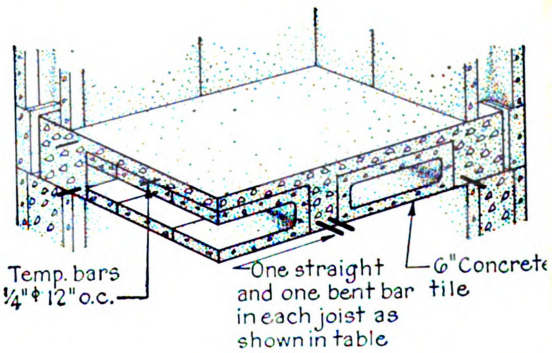
Steel I beams are generally used for the girder in any of the steel joist floor systems. The girder is usually supported by a cylindrical steel column or a small H section.

The concrete construction has varied ways of producing a good fire resisting and economical floor system. Concrete floor systems may be classified as solid reinforced slab, tile joist floor, ribbed floor construction, an arch construction and the precast concrete joist construction. In each of these types steel reinforcing rods are used.

The solid reinforced slab construction, as shown in the illustration, consists simply of a solid slab reinforced with steel, the top of the slab as the floor and the bottom as a ceiling. This design is one of the floor designs set forth by the Portland Cement Association in their book Concrete Floors for Residences. This may be either the subfloor or the finished floor too.

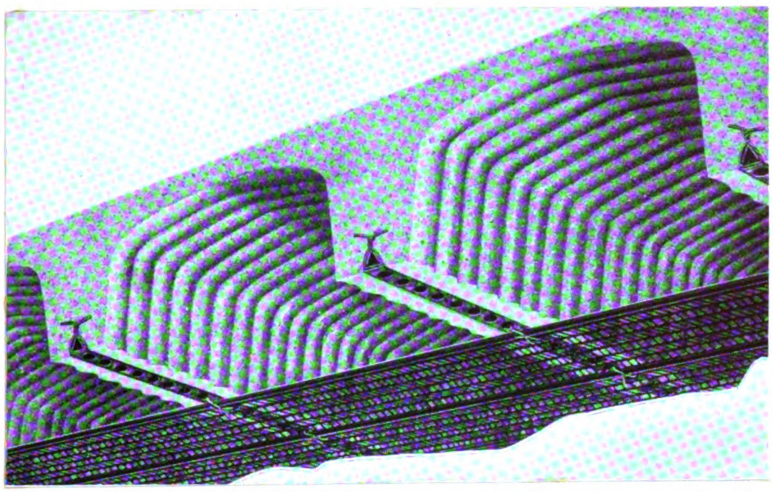


The tile and joist form of construction consists of tile filling in the space between a beam and slab construction. Another of the Portland Cement Association designs illustrates the tile and joist method of floor construction.



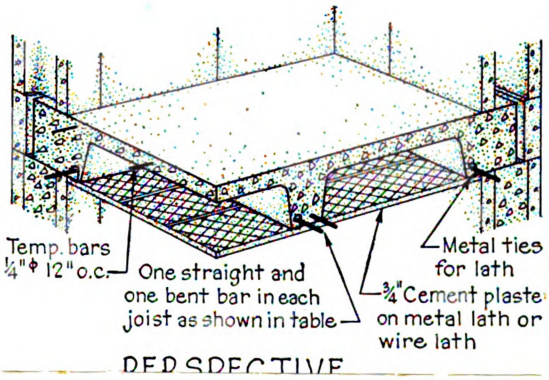
The ribbed method of constructing a fire resistant concrete floor system is done by pouring concrete over the ribbed forms layed on wood form work. After the concrete has

set the forms are removed giving the under side of the system



the appearance of a series of ribs or tees. Here are two illustrations of the ribbed concrete floor construction. One is the Milcor method while the other is a design of the Portland Cement Association. With both methods the metal lath ceiling is illustrated.

Among the latest in the designs of concrete floor systems is the method using the pre-cast concrete joist. These joists are made of concrete in standard lengths easily handled by one or two men on the job. The joists are designed for house construct-

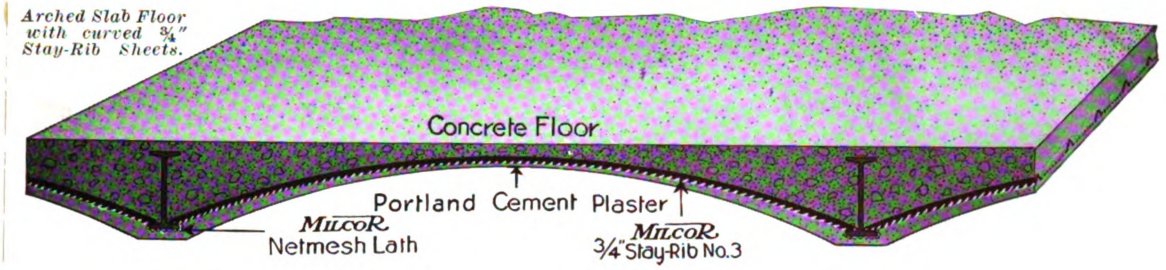


PERSPECTIVE

ion since the allowable load is sixty pounds per square foot of floor surface.

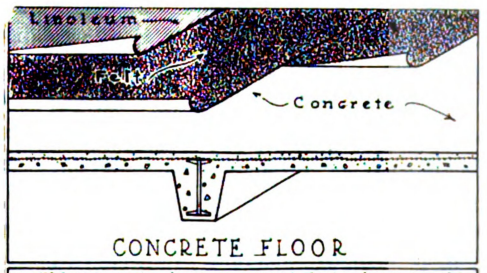
The method of construction is to set the joists on the foundation walls spaced with thirty inch centers and wood spreaders set between them. A form work of inch sheathing is put between the joists one half to three quarters of an inch below the top of the joists. A two and one half inch concrete slab constitutes the floor with the joists protruding into the bottom of the slab.

The Milcor concrete arch floor design is presented in the picture below. The design embodies the use of a heavy



metal lath and steel I beams for reinforcement. The lath called Stay-Rib comes in sheets ready for use. The design as presented in the illustration is a very good fire resisting floor system.

The floor systems can be finished off in a number of ways such as terrazzo, colored concrete cement, tile, linoleum or wood which ever is desired. Here is a skecth showing how linoleum should be layed on a concrete floor to give the best results. Other products similar in nature to linoleum would be layed after the same manner to produce the best results unless specified different by the makers.



·METHOD·OF·LAYING·LINOLEUM·AND·FELT·OVER·VARIOUS·TYPES·OF·FLOOR·CONSTRUCTION

The concrete floor systems are highly fire resistant and permanent in nature. The monolithic concrete finish adds to the fire resistance of the floor in preferance to other forms of finished flooring that may be used in the system.

Brick floor constructions consist mainly of the arch type of construction with either a concrete floor or a precast brick slab floor. The precast brick floor is used in connection with the I beam construction. It is a little heavy for the average house construction.

The load of the floor in the arch method is carried by a segmental brick arch. The spandrels are filled with a light concrete with the finished floor resting on the fill. The skew back of the arch is made of a special tile or brick which is made to fit around the steel I beam. To protect the steel beam from the hazard of intense heat that it might be exposed to the beam may be insulated by means of a special flange that fits around the bottom of the beam.

The tile floor construction constitutes mainly a series of flat or curved tile segmental arches. The flat arch is made up of tile with their sides shaped on an angle in such a way as to make up a complete arch with a flat intrados and extrados. The tile units have either a cross section made up of anbox or rib construction. The arches are suspended between steel I beams that carry the main load. The steel beams are covered by tile flange units that fit over the bottom of the beams in the same manner as in the brick arch construction. The main tile units in the arch are the keystone tile, the skewbacks and the intermediate tile. The floor may be finished off in a concrete subfloor and other composition or wood finished flooring or the concrete alone.

The framless steel floor is one of the more modern designs in fire resisting floor systems. This floor system is one of the results that came from research and experimention on the Armco steel prefabricated house. The floor system with the rest of the house was invented, or designed, by the architect Robert Smith Jr. in conjunction with the American Rolling Mill Company.

The illustration shows clearly the elements of the design and the method of prefabrication. Note the "Z" shaped sections and the box like construction. The design resembles a series of "I" beams brought together side by side in a rigid construction.

The sections are 18 gage hot rolled Armco steel sheets, 28 inches wide, formed into elongated "Z" or step shapes, the two parallel legs, or treads, being 11 inches long, and the vertical web, or riser, 6 inches high. Each section is lapped 1 inch longitudinally over the adjoining "Z", and welded, forming a series of boxes 6"x 10" which while structurally flexible and light in weight, posses great strength. An "L" shaped piece is inserted on either side of the floor area to complete the box like construction.

This floor system can be put together on the job or done in the shop.

The finished floor may be linoleum, composition flooring or a laminated hardwood floor using some adhesive such as the product called Stickum. The adhesive is spread over the steel floor and the finished flooring laid on the coating.

Another floor of an all steel nature or construction is made up of corrugated steel sheets welded together and a steel plate or some other subfloor placed over the top of these sheets. This floor system is called the pressed steel slab floor. The pressed steel sheets formed into reversed channels or a zig zag sheet construction interlocking with the adjoining sheet are 24 inches wide and made into standard lengths. The finished floor consists of a mastic and laminated wood flooring.

A steel panel floor system is another fire resisting prefabricated floor system. This floor consists of wide pressed steel channels with an "I" beam in the center of the channel to strengthen the floor each channel bolted or welded to the adjoining channel section. The finished floor may be the same as those described in the other floor systems.

EXTERIOR WALL SYSTEMS

The wall systems are of two kinds that of the interior and exterior walls. The two classifications may vary in respect to the load bearing characteristics, the kind of materials used and the relative thicknesses of each. The exterior walls may be classified as concrete, brick, tile, building block, steel stud, and frameless steel walls. The interior walls may be classified in a similar manner with some additions and subtractions which will be dealt with later.

The many ways that concrete can be used to make a fire resisting wall as offered by the Portland Cement Association are: solid concrete with reinforcing rods, precast slabs, and precast units or concrete tile.

Reinforced solid concrete walls are constructed in the same manner as any other concrete work that is by pouring the concrete into a form work and allowing to set. The wall may be finished off with a coating of stucco or a colored cement facing.

The precast walls are made in the shop in standard or special lenghts and sections to be assembled on the job. All the necessary parts are cast in the concrete at the same time such as the frames and heating recesses or other recesses for plumbing or electrical work. The maximum size wall panel that is efficient to use is 10'x 30' since that is most conveniently handled on flat cars in shipment. This exterior wall may be left to give a paneled appearance or may be covered with a stucco or some other cement facing. The interior of the wall may be plastered directly

on to the precast unit or on some insulation board or metal lath.

There is another type of precast walls that is slightly different from the one just mentioned. This precast wall is molded flat of reinforced cinder concrete, raised and put on the foundation. This system also has the frames and necessary units set in with the first pouring of the concrete. The walls are made up from reinforcing rods layed in cement grout and stone slabs embedded in soft mortor. The construction of this nature is a natural insulation against weather, vermin and fire. Samuel P. Carrol designed or invented the method and hence it is called the Carrol method.

The precast units that may be used in the design of a fire resisting house are commonly called building blocks but can be explained here from the concrete view point. These units are cast in forms so as to have a hollow shape giving an added insulation value. The blocks may be use in the exterior and interior walls according to the individual desires. The blocks have good load bearing qualities and are made lighter and easier to handle than concrete. The walls may be plastered directly on both sides thus offering a full concrete wall of a high fire resistance.

The next wall system is the brick wall offered by the Common Brick Manufacturers Association of America. This wall is highly fire resistant and lasting when constructed correctly. The classification of these walls are hollow and solid brick walls.

The solid walls are made entirely of the brick bonded toghether by a good mortor under the specifications of the association. The walls vary in thickness according to the size of the load put upon them. The sizes vary from the 4" to the 12½" wall, that is from a one course of brick to a three course brick wall. The exterior portion of the wall is usually left in the form of the brick wall using a regular face brick but may be finished off in a stucco or other methods if structural brick is used. The interior facing of the wall may be finished off with a steel lath on furring and a plaster coating or an insulation paneling for an alternative.

The hollow walls called rolok are divided into three classes the ideal rolok-bak wall, the ideal all-rolok wall and the ideal all-rolok wall in Flemish bond. This classification is according to the method of construction. The brick walls may also be reinforced with steel reinforcing rods for an added strength and factor of safety. The hollow construction of the wall adds to the insulation and fire resistance of the system. These walls are finished in the same manner as the solid brick walls.

A very efficient wall that adds to the fire resistant property a proof against vermin, weather and heat is the steel frame or steel stud wall system. There are many different designs and combinations of materials that make up the summary. The steel companies offer one design, the insulation material companies offer another design, and various architects and designers offer their respective designs,

so one has a wide choice in the variety of the designs.

The United States Gypsum company designed a steel stud wall that is fire resistant and soundproof called their free floating design. The steel studding are light steel channels set in a base channel also a light structural steel member. The exterior of the wall consists of a wall board which is fire resistant and weather proof. The insulation board is attached to the studding by means of steel clips which actually allow the wall to hang from the studding. The interior of the wall is constructed in the same way except for the use of a thinner material for the insulation board. The walls are finished with a plaster or stucco coating according to the kind of wall.

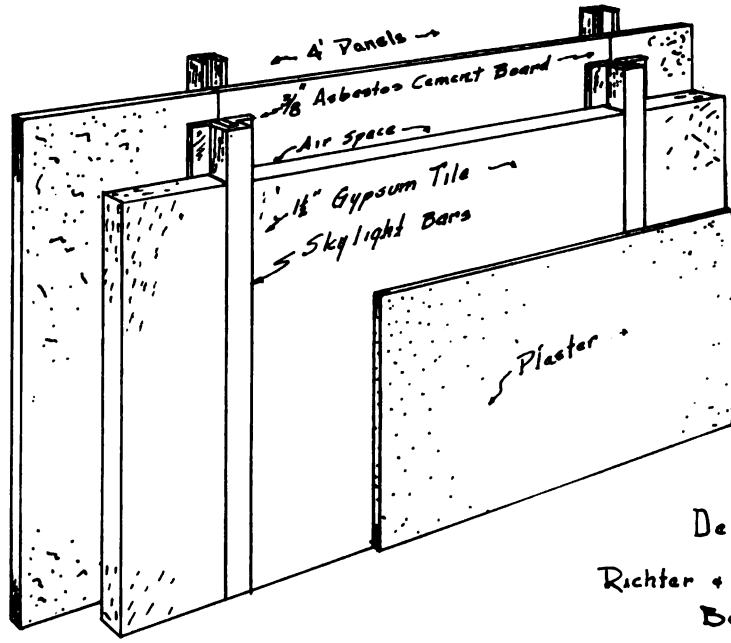
The house that employs the use of steel studding is essentially one with an all steel frame, the usual case. The steel studs may be light channels, "I" beams or angles according to the load bearing qualities of the wall. The frame work may be covered by the use of lath and plaster, inulation board, precast units of concrete or gypsum or some metal panel board. One method of covering the exterior of the house is by the use of ferro enameled shingles applied to an insulation board with mastic felt in between the shingle and the insulation.

One of the latest designs in wall systems is on the next page. It consists of a channel and tee shped stud with a metal clad insulation board wedged in between the studding. The channels and tees are bolted together in

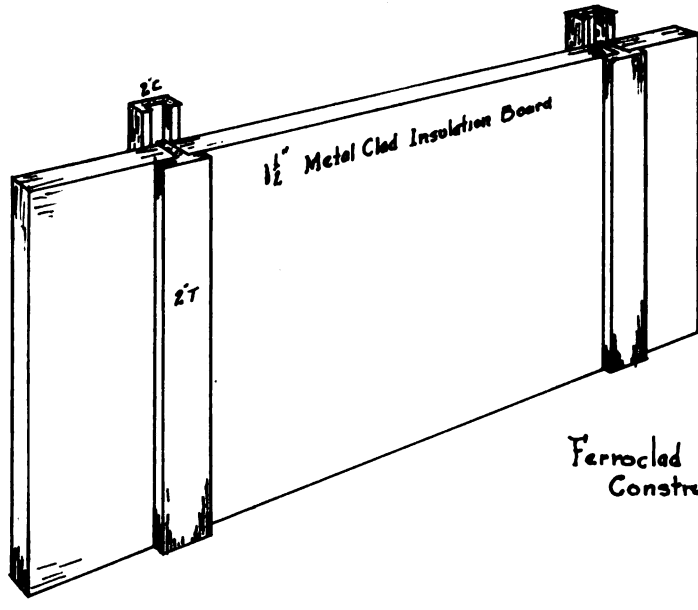
the field. The panels of 1" or 1½" thickness are prefabricated and cut to size so that they may slide into the space between the studding. These panels come up to 4 feet in width and 8, 10, and 12 feet long. For small houses the spacing of the mullions are at 3'-3" center to center permitting the use of units 3 feet in width(panels, windows and doors). Standard skylight bars may be substituted for the tees and channels. This is a design owned by the Ferroclad Insulation Company.

Along with [illegible] designs is that of Richter and Schadel of Berlin Germany. Their design [illegible] the use of skylight bars for the uprights and asbestos cement (Transite) boards take the place of the glass with tile of gypsum used for the base on which to plaster on the interior face of the wall. The panels are four feet wide and run up the height of the ceiling. A half inch air space providing added insulation results from the separation of the Transite from the tile by the flange or wing of the skylight bar. The tile is 1½ inches thich while the asbestos cement board is 3/8 of an inch thick. This design is shown in perspective on the next page.

Another German design is that of Bohler Stahlbau, G. in B. H. Berlin. This design embodies the use of steel and masonry. Steel beams give stiffness to relatively thin masonry walls. Precast cinder concrete blocks bearing stucco on the exterior slide into a three inch steel "I" beam. Metal lath is used on the exterior surface for the plaster to cling to. A two inch light weight concrete wall is used



Design by
Richter + Shädel
Berlin Germany

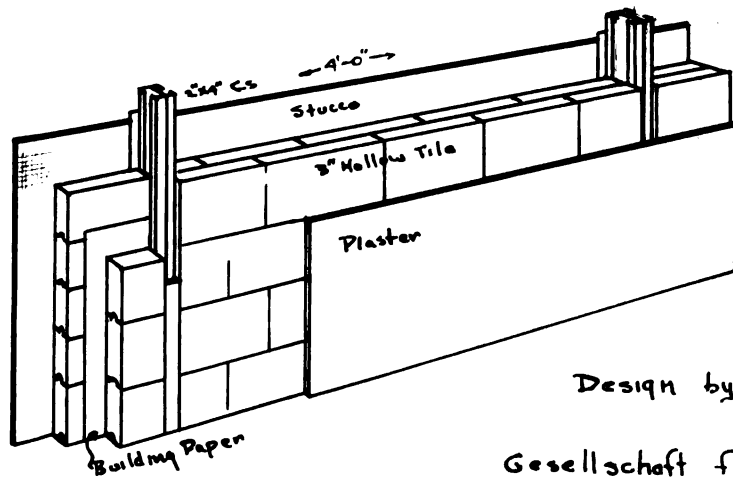


Ferroclad Insulation
Construction

on the interior for a base on which to plaster. Between the two walls a metal foil is used to prevent dampness from penetrating through the wall system. The foil also insures excellent heat insulation. The steel uprights are spaced four feet apart with four inch cinder blocks making a wall panel in between. The concrete wall on the inner side of the wall system is made up of two inch light weight concrete slabs. This system has the characteristics of a good fire resisting wall system..

A tile wall with a pressed steel frame is a design offered by Gesellschaft fur neue Bauweisen, Berlin Germany. This wall also has panels of a four foot width. The frame work is set up from 2"x4" pressed steel channels put back to back to make a "I" section. The uprights are space four feet on centers covered with an insulation board and a stucco finish. In between the uprights are two thicknesses of three inch tile blocks of gypsum separated by a sheet of building paper. A plaster coating is used to cover the interior portion of the hollow tile wall. Six materials are used in the construction of this wall and much hand labor is required. The insulation value of the wall is fair while the salvage value of the system is moderate. This is a patented wall system.

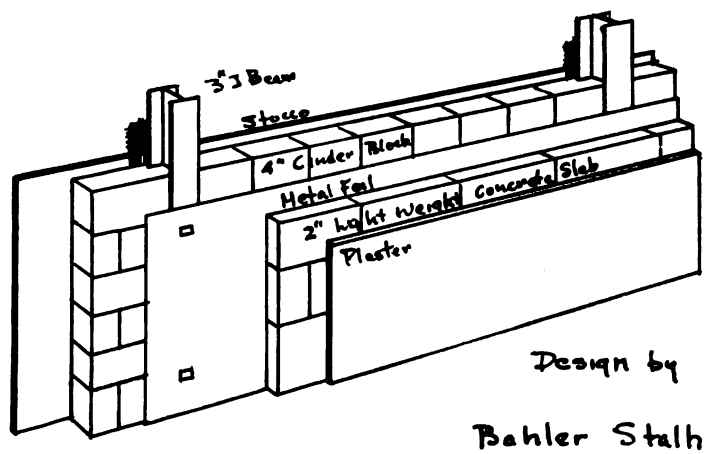
Deutsche Stahlhausbau Gesellschaft, m. B. H. Hindenburg Germany designed a concrete steel wall consisting of steel uprights, a light concrete slab, insulation fibre board, stucco and plaster. The uprights are steel channels



Design by

Gesellschaft für neue

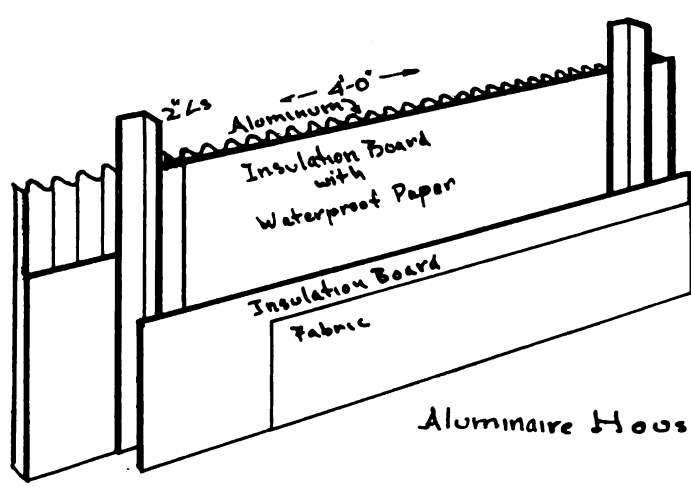
Banweisen Berlin Germany



Design by

Bahler Stalhbau G.

in Berlin Germany



Aluminaire House Design

of the standard 2x2½ inch size, bolted back to back to form an "H" or an "I" section. The uprights are spaced four feet center to center with a three inch light weight concrete slab inserted between the columns from the top of the wall. The exterior portion of the wall is formed by a stucco coating over the concrete slab with asphalt plates over the uprights between the stucco and the columns. Plastered fibre board on the interior of the wall adds to the heat, weather and fire protection. The light weight concrete slab is designed for a three inch thickness while the fibre board with a three quarter inch thickness.

G. Kunze Jr., another German designer presents the wall of sheet steel. Steel pressed to form the outer wall surface and columns as a single unit in a long channel section form the main load bearing part of the wall system. The units are designed to be 3'-4" wide and running ceiling height. These members are bolted together as channels are bolted together back to back. The interior portion of the wall consists of an insulation board glued to the inside of the channel sections, a two inch air space, and a wall of one quarter inch plywood screwed or nailed on to wood strips attached to the uprights or joints of the exterior panels. The total thickness of the wall is three and one half inches. With a fire resisting interior wall consisting of the plywood the wall system is a highly fire resistant wall.

Still another steel stud wall system employs the use of light concrete precast slabs for the exterior portion of the wall. These slabs being finished off with a metal enameled sufsce on the outside of the slab. The units are attached to the studding by the use of bolts with the nuts countersunk in the concrete. The same idea is used in connection with limestone or some other precast or cut units. This design may be inspected on one of the houses at the Century of Progress Worlds Fair at Chicago.

The Aluminaire House design has what is called a dry assembly wall. Steel angles with attached wood strips form frame work of the wall. Insulation board on the inside and the outside serves as a base for surfacing. Polished aluminum slightly corrugated, reflect the suns rays and is a water proof skin requiring minimum maintenance. Oil cloth in plain colors is desirable for a sanitary wall finish for most rooms. This construction is fire resisting and eliminates the use of water in the erection or construction of the wall.

Brick veneer in conjunction with the use of steel studding makes a very good fire resisting wall from the exterior portion of the wall. The brick veneer can be used very effectively when a wire mesh fabric is wired to the frame and a cement grout filling the space between the brick and the fabric. Another method is to use a wall board for a sheathing acting independently of the veneer.

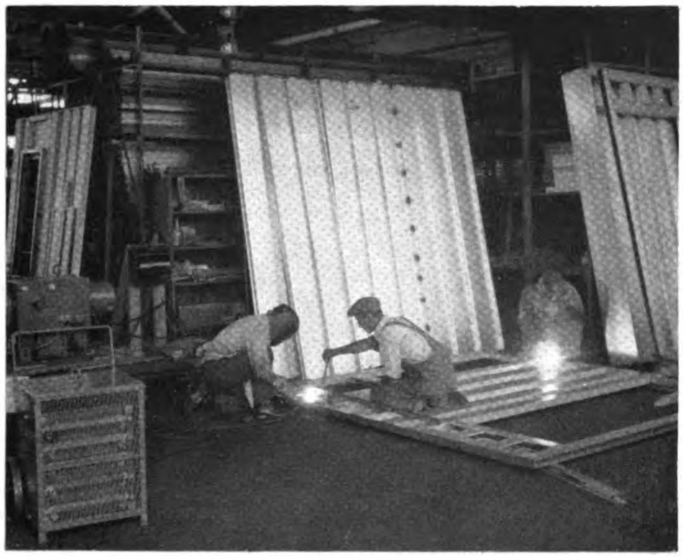
Tile for a fire resisting wall has its selling point in the fact that it is one of the lightest of the building materials yet having good load bearing qualities and high fire resistance. Tile can be made from various materials such as clay vitrified or plain tile, concrete, gypsum and other composition materials although it is generally thought as clay when tile is spoken of.

The Natco vitrolite structural tile, manufactured by the National Fireproofing Corporation, is one of the good examples of tile for a fire resisting wall. The tile units come either glased or unfinished so that a wall may be finished in most any desired manner.

The thickness of a tile wall varies with the size of theload put upon the wall. The walls are constructed from the tile units, with a good mortor for a bond at the joints, faced with a tile glazed, brick or stucco for the exterior. The interior portion of the wall may be left with a glazed tile finish or a plaster coating over the unglazed tile.

Some of the types of tile used in the construction of houses and homes are called as by their trade names: the unibacker tile, the interlocking tile, Dantile. A double shell tile used as a building unit gives a maximum number of air spaces vertical in the wall yet having high strength and greater insulation than the regular tile units. The other forms or kinds of tile are used in the same manner in construction of a fire resisting wall system.

The all steel wall is the latest change in the modes of architecture. The walls of the all steel house are frameless consisting of panels of pressed steel units. The two illustrations below show how the walls are conctructed and

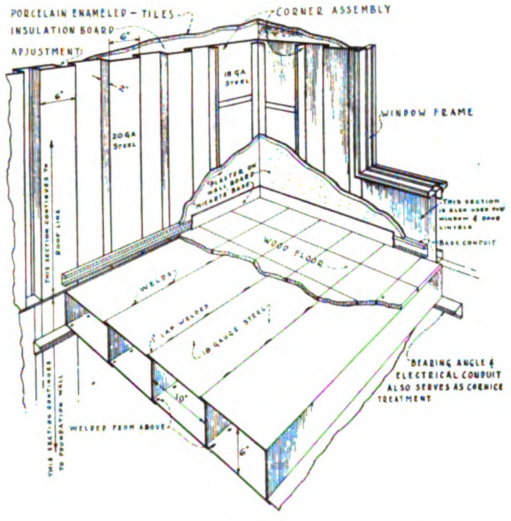


the method used for their erection. The illustrations are that of the construction of the Armco all steel prefabricated house built at Solon Ohio.

There are two types of units used in the construction of the wall of the all steel wall system. The types of the units are the "Z" shaped and the "U" shaped. In either type of unit they are welded together to form the entire wall section. The sections of the walls are constructed in the factory and brought to the place of erection on trucks like scenery for a theatre. The sections are set up temporarily by bolting then finished by welding the whole wall with a portable electric welding set.

The wall itself is made from 18 gage sheet steel crimped to form the shape of the unit. There are several widths in the various units all of which are two inches thick with

six inch channels ranging from seven inches, one foot one inch, two feet one inch to three feet one inch in width to give flexability in the construction of the rooms. The extra inch on the sections is used for the purpose of a lap in the welding process. The exterior of the wall consists of porcelain enameled tiles nailed to an insulation board. The interior of the wall is made up of plaster on a wall board with a micarta base. The micarta base is a composition base made of non-inflamable material manufactured by the Westinghouse Electric Company. The cutaway section show below illusrtates a good fire resistant construction. This is an illustration of the Armco Steel



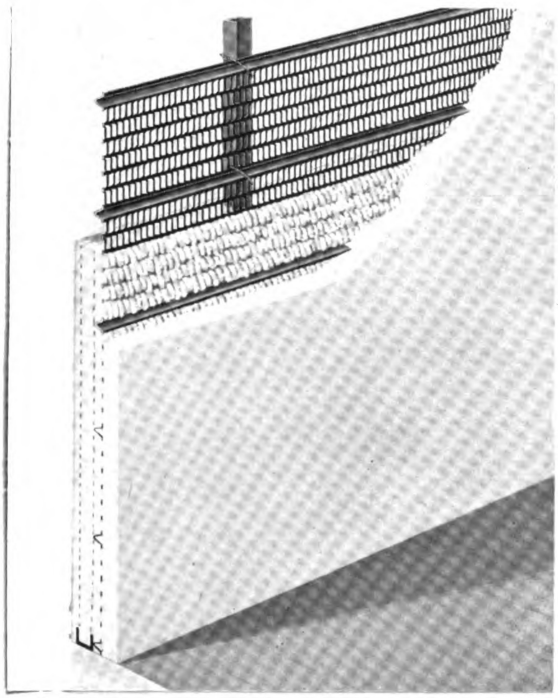
house. The wood floor is laid in a mastic as explained in the section on wood floors. Note the method of adjustment as shown in the upper left corner of the picture. The method of caring for the electrical conduits is by using the channel section behind the micarta base. The alternative for the interior finish of the wall is an asbestos wall board with an asbestos base and cap. This is the first of its kind in the line of all steel wall systems and is in the stage of development but shows a good possibility is a great change in architecture.

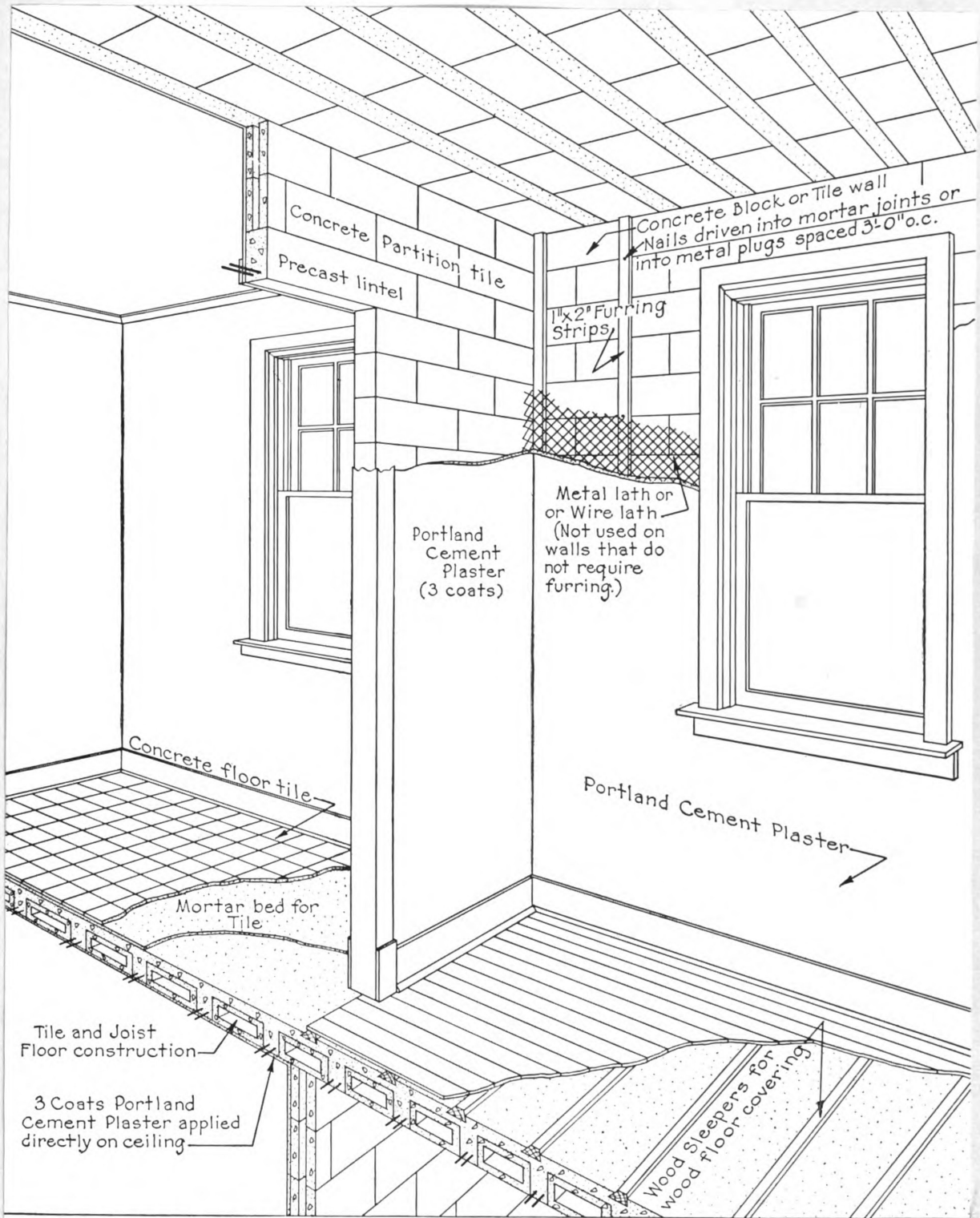
INTERIOR WALL SYSTEMS

The interior wall systems have a similar construction in many respects to the interior portion of the outside walls but are in some cases of a different nature due to the fact that all the interior walls are not load bearing. The interior walls may be classified as solid and hollow. Under the classification of the solid walls falls the brick, concrete, plaster and insulation board walls. The hollow walls or partitions are subdivided into the tile, concrete units, steel studding, and frameless steel units.

The brick walls are simple in their construction and similar to the exterior brick walls. The wall is made of a base of brick on which to plaster or nail lath for plastering on both sides.

The solid plaster wall may be constructed as shown in the accompaning picture. Light steel channels form the uprights with a metal rib lath for which the plaster clings to. The whole frame of steel is covered by the plaster coating. This is one of the Milcor methods of solid plaster partitioning. Two fireproof materials make this a highly fire resistant wall or partition system.

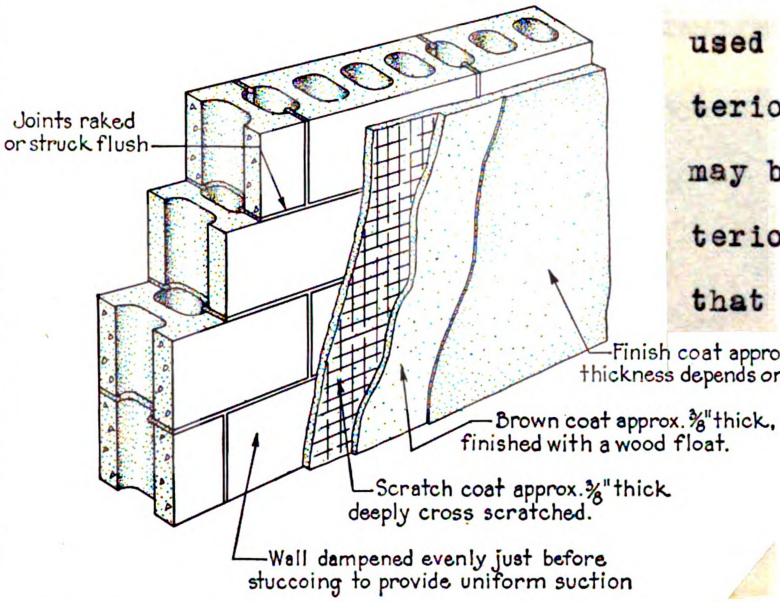




INTERIOR VIEW OF CONCRETE MASONRY BUILDING

The tile walls are made from tile units which are thinner than the units used in the exterior wall system. The method of construction is practically the same in both types. The illustration shows the method of construction for a

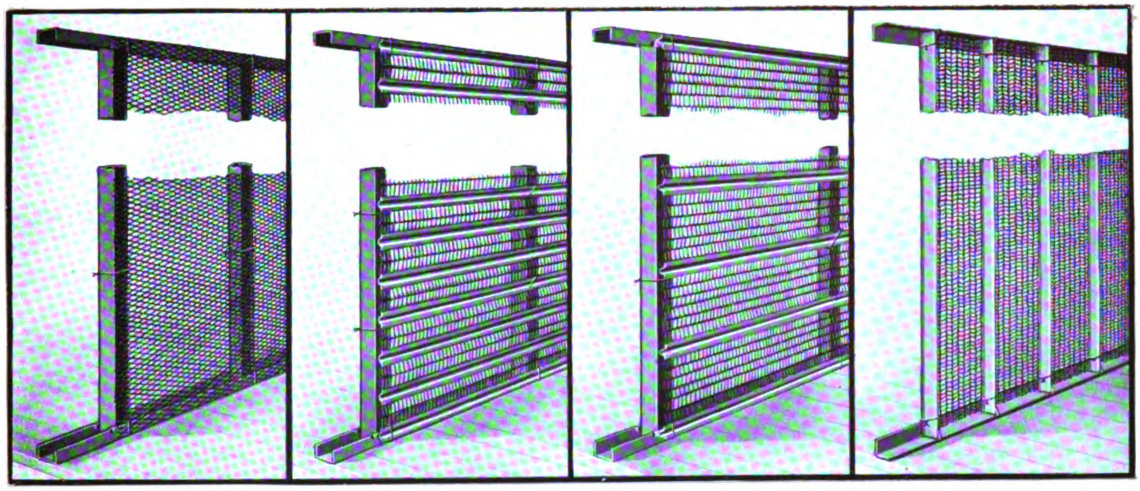
concrete masonry house. The illustration below shows in comparison another type of concrete wall used mainly for an exterior wall system but may be used in an interior wall for one that has a heavy load to bear. This type construction may be used in the foundation walls.



Steel studding partitions can be constructed in several ways due to the varied types of materials that can be used in the covering of the frame. Some of the types that were explained in the exterior wall systems can be used for an interior wall by simply using the interior portion of the design for both sides of the wall. The types that can be used in this manner are the: Ferroclad design, Richter and Schadel design, Aluminaire wall design, the other German designs except that of G. Kunze Jr. In some of these the wall would prove to be quite expensive for the moderate or average home.

Some of the more economical designs for interior partitions are those presented by the Milcor company. These are constructed with light weight steel channels, a metal

lath of which there is a variety in kind, and a plaster coating. Some of the Milcor partitions are shown in the



pictures above. These show the different types of mesh and rib lath in connection with angle and channel construction.

Insulation board may be use in the place of lath either as a base for plastering or as a panel unit with a finished face. Some of the insulation boards used for a base on which to plaster are: Gyprock, Insulite, and Celotex, in each case the fire resistant board of its kind is one that is meant. These may be nailed, screwed, or wired to the steel studding or to wood furring attached to the studding.

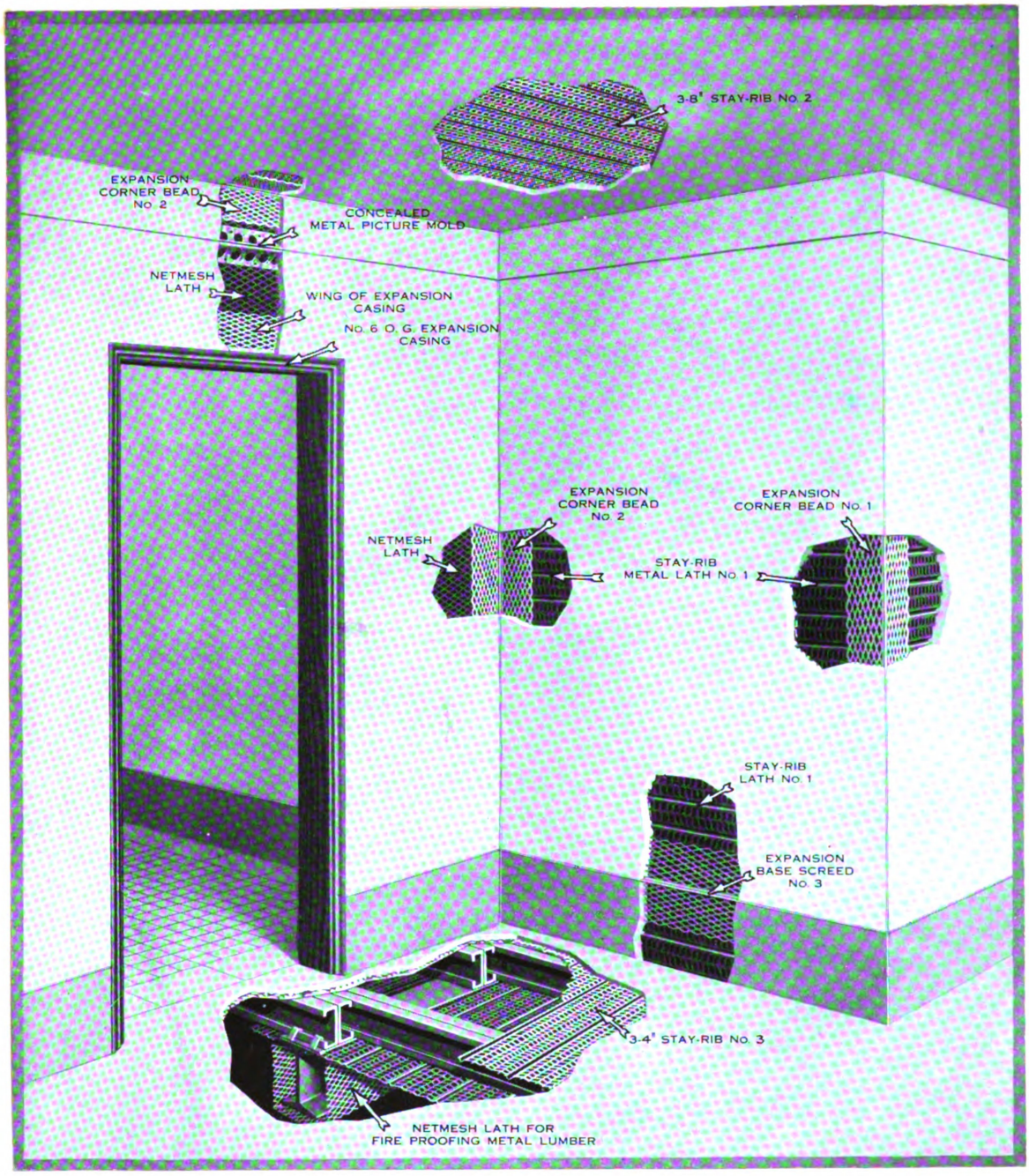
Some of the insulation panel boards use for a finished wall are: Formica, Micarta, and Ferro enameled sheets. Formica is a fire resisting coating applied to wood fibre or metal sheets used in paneling and many other parts of building construction. Micarta is a paneling used in the same manner as Formica and is made by the Westinghouse Electric

Company. Ferro enameled sheets are panels made from a steel sheet with an enameled facing. These sheets may be screwed or bolted to the studding.

The frameless steel partitions are made in the same way that the exterior wall systems of the same type. These may be finished with a plaster coating, panel board or with an oil cloth. The Armco house has a regular wall paper finish over the steel panels with a mastic to cover the panel joints flush.

The illustration below shows an example of a good wall system and good examples of trim which is to be discussed in the next part of the paper. This is the Milcor method of finishing a good fire resisting home. Notice the wall, floor and ceiling construction shown by the cutaway sections. The illustration will be found on the next page.

The Milcor method of construction of the floor, walls ceiling and trim in the fire resisting home.



INTERIOR TRIM

The trim and the finishing parts of the house may be constructed from wood or some othe combustable material provided the rest of the construction is a fire resistant construction. It is best to have the entire house constructed from fire resistant materials to make it a full fire proof home. But in case of fire with some of the parts of the house made from combasteble material they could easily be replaced without much work according to the degree of fire it was exposed to.

Heretofore wood has been used in the construction of the doors and door frames, windows and window frames, the base and moldings, cabinets and various other items that come under the heading of trim in the average house. Wood has been replaced by many kinds of materials such as tile, steel, aluminum and other metals and composition boards, that may be used in the construction of the items mentioned under the description of trim.

Steel can be used through out the whole house in the finishing parts if desired. In the construction of the windows one can get either the steel casement windows or the double hung steel windows with their frames and casings. One method in the construction or setting of the windows is to set them in the wall weather proofed by a mastic putty which closes the air space that may cause a draft of a rain leak. There are many companies that manufacture the steel window units some of which are: the Truscon Steel Company, the Kalman Steel Company and the Bates Steel Corporation.

The Kalman steel Company offers and attractive fire resisting door frame which is also patented for the idea that no mater how hard the door is slambed the plaster will not crack. This frame can be had for practically any type wall construction. There are other companies that make steel door frames but will not be mentioed here.

Boards may be made fire resisting by the use of steel panels or a composition fire resisting panel board. Steel doors have been used in offices but can be had for the home as well. One type of fire resisting door is the fire proof plywood door. Another good door is the Formica or Micarta fire resisting panel door. The Formica door is made with a hollow construction with the panels from the Formica insulation. The Micarta door has the same type of construction as the Formica door with the only difference in the panel board itself.

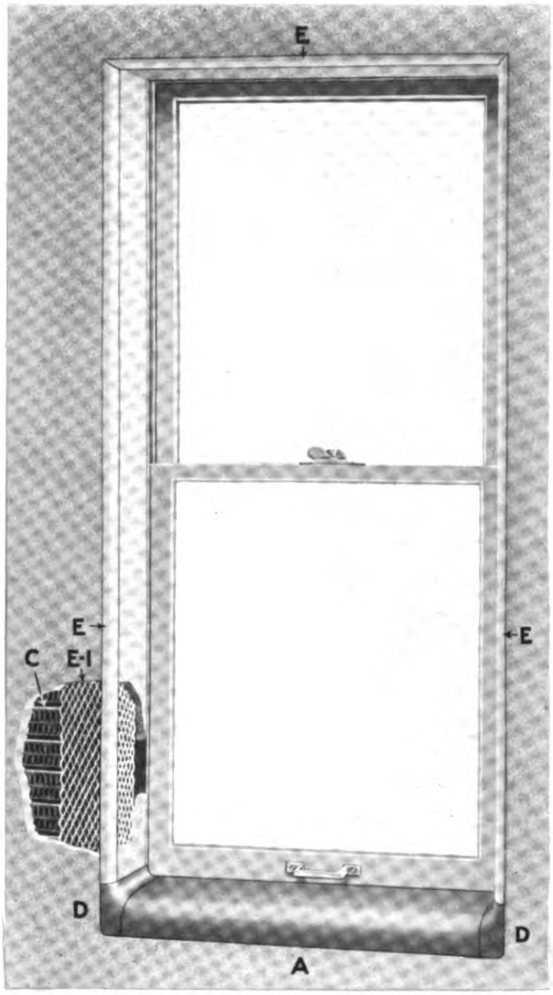
Formica can be used in the fire resisting home for several different things. The base and moldings with the wainscot, cabinets, work tables, and parts of the furniture may be made from Formica.

Tile may be used as a trim for the base, bathroom equipment, walls, floors and window trim.

Plaster has been used for a base and molding with a good metal lath for a backing and a bead protruding for a protection to the well of plaster.

The kitchen equipment made fire proof by the use of steel and other materials makes just an attractive room as that constructed in the old manner. The cabinets come

ready made also the breakfast nook furniture can be had ready made from the fire r:stant material.



Milcor Window Assembly

Formica Bath

Formica Door

ROOF CONSTRUCTION

The two types of roofs to be considered are the deck and the gable roofs. The trend in the prefabricated homes is the deck construction although the gable type is used in the other kinds of fire resisting homes. Steel rafters are used universally, in the gable roofs, with various kinds of coverings; while the deck roofs have different types of construction as in the floor systems.

The deck roofs may be classified as ribbed steel, steel joist and concrete.

The coverings of the gable roofs vary from an asphalt to a metal or asbestos shingle. Concrete slabs precast and bolted to the steel rafters any comprise one method of making a fire resitant base for the top covering of the roof. Another method is the gypsum plank subroof construction with either an asphalt, tile or metal shingle. The rafters are usually channels or light "I" standard sections.

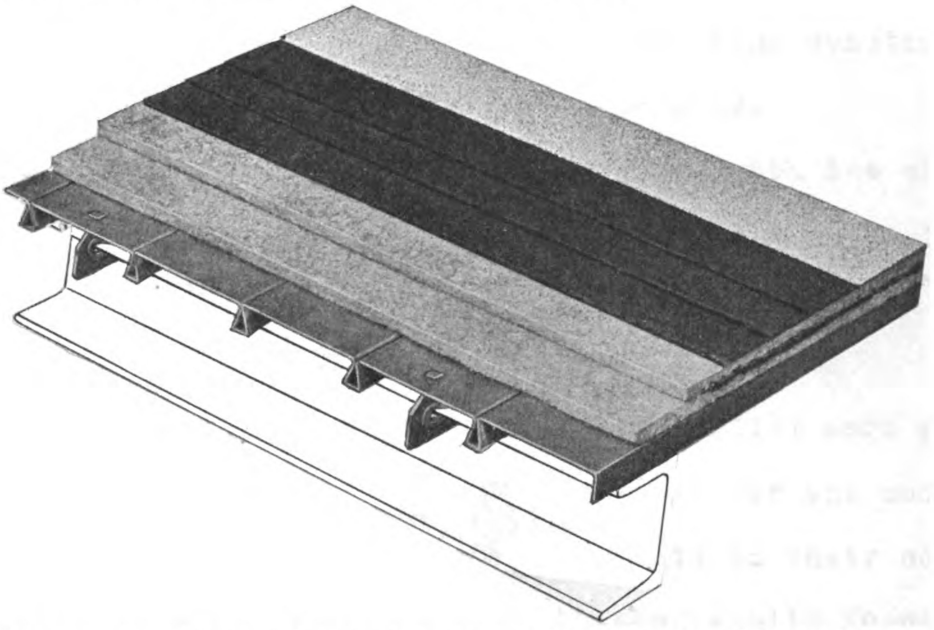
The deck roofs may be constructed in the same manner as the fire resistant floor systems lighter in weight and consisting of a weather proof covering. Among the ribbed deck roofs are the Holorib roof, the Truscon deck roof and the Kalman roof. The ribbed deck roofs consist of some steel joist with a metal plate crimped in the form of a series of ribs. The ribbed portion of the plate used to carry the load of the roof from one joist to the other. The decks are covered with the various constituents of a good weather proof and fire proof roof, consisting of layers of felt and asphalt and gravel or a mastic with some material of good wearing qualities such that can be

used for a sun deck. Slate or tile are used for sundeck construction. In connection with the ribbed type of construction there is a pressed steel slab roof consisting of a coorugated steel slab made in units of two feet wide above which is applied an insulation and roofing material.

The prefabricated steel roof consists of pressed steel panels with insulation board for the subroof and other roofing materials for a covering. The panels consist of a channel shaped section made from 24 gage pressed steel with an "I" beam in the center of each channel section to help it support the roof.

Another deck construction is made of light weight concrete slabs three inches thick placed over beams with an asphalt covering for the waterproofing. The concrete deck roofs may be constructed in the same manner as the concrete floor systems with the exception of the finishing part of the system. The methods of construction used in the deck roofs are the same as those used in the floor systems. The load bearing part of the deck can be made up from a series of concrete ribbed arches, a flat slab on tee beams, a flat slab reinforced with out the use of beams, tile and joist construction and precast concrete joist construction. The waterproofing and the fire resisting part of the roof may consist of a concrete slab with a mastic or asphalt layer and layers of felt or other roofing material. The exposed layer of the roof may consist of concrete or tile with good wearing qualities such that can stand walking on.

The illustation below shows one of the ribbed deck roof constructions that of the Holorib.



Note the steel plate in the rib shape clipped on to the steel channel used for the joist in this system.

Examples of fire [illegible] houses with their [illegible]

American houses corporation.

This corporation offers a prefabricated fire [illegible] with their allied attractions and the following construction points as stated in the following paragraphs.

The sizes and costs of the houses are with the choice of four types of houses with four rooms for $3500 to $7200.

The construction amounts to standard wall panels of asbestos composition with a steel frame.

The foundation is made from a cment called aero cement. The foundation does not include the cellar for the modern trend and designs do not include basements in their construction. The heating plant and other things usually found in the basements of homes are taken care of in the garage.

The walls both the exteriror and the interior may be of an asbestos nature a very good fire resisting material.

The exterior finish is painted wals while the interior is of an asbestos composition with a feature of being washable.

This house offers proof against fire, vermine, lightning, and earth-quake. The stock equipment for this house includes lighting, heating, plumbing, humidifier, and exterior wall finish. The house can be dismanteled and moved away at a small cost. It is economical to reshape and enlarge. A six room two story type with a bath and sun deck can be obtained for $3600.

Hazelton House.

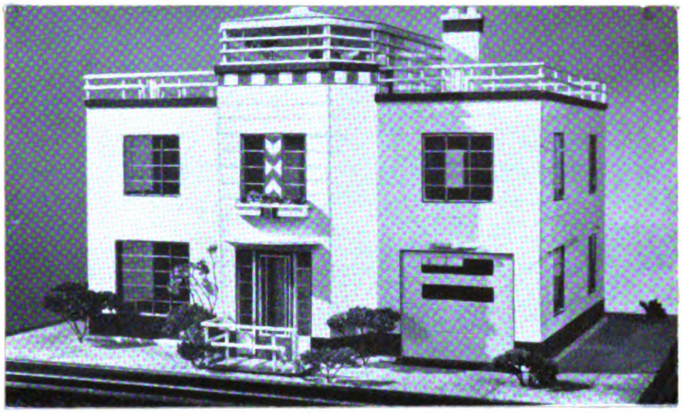
This house is another of the prefabricated houses which can be had in many variations due to its flexibile construction. The house is manufactured in the shop in such a way as shown by permutations that there can be 628,992 variations made from the same panels. These variations as stated are made in consideration of the wall decorations and furnishings with the same floor plan used throughout. An itemized list of the cost of construction of a house of this type is as sated below.

Excavation, footings, first floor slab, mastic and masonite flooring	$544.00
Frame, bolts and erection	451.80
Roof, ceiling insulation, roofing, and enameled coping	426.50
Walls, windows and exterior doors	865.30
Partitions, interior doors and trim, painting anddecorating	387.21
Jeddo Highland heating equipment, chimney and coal pocket	280.00
Porch	98.60
Bathroom fixtures, sink and laundry tray, copper piping and hot water supply	325.00
Kitchen cabinets	40.00
Electrical work and fixtures	81.59
Total	$3500.00

In general a house with four rooms and bath sells at the above price while a five room house with bath sells at $4000.

The Armco House.

The Armco house that is described here is the one that was built at Solon Ohio.. The picture of the house with is solarium appears below. The picture of the house



was taken from the model whereas the other illsustation is an actual photo-graph from the roof of the all steel home.

The size of the house is stated as a seven spacious room house with two baths, a garage and sun deck, It is estimated that in the future when production of the house gets on the large scale basis it will sell at $5000.00

The house is constructed with frameless steel walls and chassis. The walls are made of two ply electric welded steel sections. The interior of the walls is finished with plaster on rock lath. There is no cellar to the foundation which consists of a concrete wall. The heating

plant is in the garage and consists of an automatic furnace with oil as the fuel. The exterior finish of the house is made of ferro enameled shingles and celotex with an asphalt saturated felt backing.

The added features of the house besides being fire resistant and prefabricated are proof against weather, vermine, lightning and earth quake. There is no repainting necessary for the exterior of the house since it is enameled. The house is equiped with an air conditioning apparatus. It took 156 man hours to build the house at Solon Ohio.

Pierce Foundation.

This prefabricated fire resisting house is called the Pierce foundation since it is just in the experimental stage. Besides being in the experimental stage it is kept secrete to the public. The house is located on the roof of the American Radiator Company in New York City. There is no commercial model as yet so the size and cost of the house can not be determined by an outsider and nothing has been said about that part of the design by the experimenter. The construction consists of a heavy steel frame with steel lath trusss and standard wall panels of which three kinds are used these being the Transite, Xite, and Homanite. The panels are glued to the lath truss. The roof consists of sheet steel base with thermax and asbestos covering. The partitions are of the same construction as the walls.

The house is entirely fire resistant and proof against weather, vermin and lightning. Due to the fact that it was built by the American Radiator Company it has a remarkable bath unit which is being experimented with embodying new ideas in that line. The house might be sold for $3000 on

the basis of 10,000 homes.

National Steel House.

The National Steel Homes Corporation is offering a small house which is fire resistant, vermin, earth quake, lightning and weather proof. The price of this house is $495 for a one room with bath and $1.250 for a one room, kitchenette and bath.

The construction points on this house are interlocking steel wallpanels and tubular steel frame. The foundation is made of concrete and as with the other houses there is no basement. The walls are steel panels with a rock wool filling and insulation board. The exterior finish consists of painted insulation board. The roof is made up of steel panels with a weather proof covering. The partitions consist of insulation board with tacked shrunken muslin.

The added feature of the house under the heading of complete equipment is heating, lighting, plumbing, and air conditioning. Besides being fire resistant it is weather proof, lightning, vermin, and earthquake proof.

The Dymaxion.

There is a house being constructed at the fair grounds in Chicago that embodies a new thought on fire resisting frame work in fact an intirely new idea on framing a house. The new creation is known as the Dymaxion. The frame consists of a central tubular column from which cantilever beams radiate, cross connected by other steel beams, in the manner of a large wheel and axel. The snap shot on

this page illustrates the frame of the house on the fair grounds. The walls of the house and some of the furniture incorporated with the walls are made from a transparent casein composition. The rooms are triangular or parallelepiped to form a strong construction.

Portland Cement Association House.

Another example of a fire resisting house that is advertised much today is the house of the Portland Cement Association. The association has a series of houses which they offer to the public as a good fire resisting structure.

Among the designs that are offered by the Portland Cement Association is the design No. 5-3-42 which is a fair design to describe in comparison with the prefabricated homes. The design is that of a Spanish Mission with soft tones of the old ages rather than the hard lines of the new structures of steel. The house consists of four rooms and a bath all on the same floor.

Among the fire resisting points that the house is noted for are: walls of concrete masonry, exterior finish of Portland cement stucco, a roof of concrete tile and the floor of reinforced concrete.

On some of the other designs the walls of concrete masonry are left exposed in the ashlar manner or painted with a portland cement paint. The shingles may be of cment asbestos or tile to guard the home from adjoining property fires.

Worlds Fair Homes and Construction Points.

The Century of Progress Worlds Fair will act as an introductory medium for many new products and designs that are the result of recent research and experimentation. Due to the slump in the building of homes a great deal of research has been going on in the steel mills, the cement companies and other building material companies.

One of the latest developments resulting from the research work is the prefabricated home. The prefabricated house, a fire resisting structure, is the development from the conjunction of architects, engineers, steel companies and various other concerns all with the same idea in mind that of producing comfortable and profitable without much cost in any one item. The prefabricated houses to be shown at the Fair will be the Crane Steel house, the Armco house, General Houses Incorporated house and the Dymaxion.

The picture below shows one side of the Crane Steel house with its panneled walls of precast concrete and enameled metal finish.

The picture of the partially constructed house is that of the Rostone House which is entirely constructed now.

This is a steel frame house with precast or cut stone units bolted to the frame with countersank heads to the bolts thereby hidding the bolts from the exterior of the house. The picture below shows the construction on the second floor of the house. Note the asphalt covered deck and the exterior wall

units in the background of the left side of the picture. These units are rostone a different stone produced by the Rostone Company. The interior walls are finiched off with a panel board and plaster. The roof is a ribbed deck construction with a mastic and asphalt covering.

The Common Brick House has a different feature in its construction in that the whole house is constructed as one unit made up of brick cement and reinforcing rods. The

walls are solid so the heating and other fixtures are exposed and finished in a chrome plating. This is a very good fire resisting home.

The picture displayed below was explained before and is a showing of the Dymaxium frame. The house built like

a tree as the designer explained in his article in a recent publication.

A house built of glass blocks with no windows is another contribution of the Fair to the new designs in architecture. This house is fire resisting and has good insulation faculties since the blocks are hollow in construction. Some of the other features of the house are artificial ventilation, drapes and blinds that come up from the floor the full length of the wall, a garage and a hangar.

Construction details for the entire Fair may be summed in the following sentences. The foundations mostly rest on piles with concrete wall construction. The frame of nearly every building consists of steel girders, joists and trusses. The deck roof construction with a mastic floor covering and wood flooring clipped to the metal is another feature. Included in the flooring is that of the large panels of plywood flooring layed in lengths three to twelve feet long and three feet wide. The roofs many of asphalt composition over an insluation board. The exterior walls either metal ribbed siding or an asbestos cement board or some other insulation board.

Thus the Century of Progress World Fair is an aid to the introduction of new ideas in the field of architecture and engineering.

Conclusion

One may conclude from a review of the foregoing material that the future or even the present day prospective builder has a very wide variety in his choice of construction for a good fire resisting house. Each type of construction is good and its backers are confident that it is permanent in the basic principle of the design.

Upon looking over the material one may conclude that there is a renaissance in house architecture with a trend toward the fire resisting prefabricated house. The methods of other things have changed but the method of house construction has not changed with the rest of the transitions. Now there is the beginning of the transition period from wood structures for family quarters to the composite material structural fire resistant houses that are economical.

The fire resistant home should not be a vague thing in the minds of the public within the next few years for with anything that is new and economical it is a psychological fact that people will buy. Even such drastic changes such as are presented by the Glass House and the Dymaxium may come about in the commercial world.

The fire resitant home is still in the process of development and has a great future before it.

FINIS

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