CONCRETE HOUSES: THEIR POSSIBILITIES OF ECONOMY AND PICTURESQUENESS: BY HARVEY WHIPPLE

The importance of concrete as a modern building material is becoming every day more evident, and the success of its future more assured. There are many reasons for its steadily growing popularity. In the first place, concrete is especially welcome in this country on account of our decreasing timber supply. It is proof against fire, a barrier against summer's heat and winter's cold; it is solid, sanitary and economical, and is affected by time only in that the years add to its strength. Moreover, in addition to its practical qualities, concrete lends itself readily to interesting and varied architectural designs.

The term "concrete house" ordinarily conveys no definite idea of the nature of the construction, because the name "concrete" is often used loosely or misapplied. The reference may be to a monolithic or so-called "poured concrete" house, to a house built of concrete block, or to one having merely a covering of concrete stucco over almost any kind of wall.

Concrete houses are sometimes carelessly called cement houses. Probably this is because Portland cement, though proportionately small in quantity as compared with the other constituents, is nevertheless an essential part. Yet it is no more proper to call a concrete house a cement house than to designate a wooden house as a nail house, simply because nails are used to hold it together; or to call a wood mosaic table-top a glue table because the pieces of wood happen to be held by glue. Portland cement is mineral glue. When it is mixed with sand and stone and water, the water sets up an action in the cement which renders it jellylike and then crystalline in formation, so that all the parts of the mixture are knit firmly into a single piece of concrete.

Portland cement is a very fine powder, so fine (at least that which comes up to United States government specifications) that 92 per cent. of it will pass a sieve hav-
ing 10,000 meshes to the square inch, and 75 per cent. will pass a sieve having 40,000 meshes to the square inch. It is made by crushing and then burning in kilns at intense heat, certain definite mineral substances, containing lime and silica, and then grinding the resulting clinker to the powder mentioned. Its value as cementitious material lies in the fact that the addition of water in proper proportions forms the jelly and then the crystals in the action called "setting," which continues for several years, the mass constantly becoming harder.

Besides Portland cement, the other ingredients of concrete are sand, together with pebbles or crushed stone. All these materials should be thoroughly mixed and they should be so graded as to size and so proportioned in quantities that the resulting mass will be dense. The idea is that, by proper grading, the sand fills up all the spaces in and around the stones, and the cement in turn fills up all the spaces around the grains of sand, coating thoroughly every particle in the mixture. In the ideal condition all voids would thus be filled. Water should be used

A MONOLITHIC CONCRETE STRUCTURE, BUILT IN A SUBURB OF CHICAGO, WALTER BURLEY GRIFFIN, ARCHITECT.

in the mixture in sufficient quantity to develop thoroughly the cementitious quality of the cement.

MONOLITHIC CONSTRUCTION. — The use of concrete which is most radically different from all other types of construction, the use which has developed the most interesting problems and which is inspiring the architectural conceptions most apart from the beaten path, is monolithic concrete. The
ECONOMY AND BEAUTY IN CONCRETE

This house, 30 feet by 48 feet in plan, built of concrete and frame, is in a suburb of Pittsburgh. It was designed and built by W. H. Parrish for $4,600.

manner of its utilization may be likened to casting a huge mold of jelly. In building a house the mold may be set up for casting the concrete in layers or for almost if not quite the entire house. When the concrete is poured (if made wet) or dumped and tamped (if made with less water) in the forms which make walls, floors, beams, columns and so on, it will be held in the desired shape until it has "set." The forms are then taken down—stripped—or the mold taken apart, and behold there is a house, in one piece, as though chiseled from a gigantic block of stone. In molding this house a small quantity of steel has been used, usually in the form of rods, because while concrete has great compressive strength, its combination with steel is required to develop great tensile strength such as is required in beams and floors. This use of steel and concrete together makes reinforced concrete.

In monolithic concrete construction or mass construction it is a common sight to see buildings under way where forms either of steel plates or wooden planks are set up inside and outside of what is to be a wall, below what is to be a floor and around what is to be a column. If of wooden planks these forms are held by cleats and braces, built so secure as to resist the pressure of the concrete which they must sustain until it has set. If steel forms are used, and there are various systems of this kind, the unit plates are clamped, wired, bolted, clipped or otherwise held in place. Some of these plates are not unlike big shallow baking pans and the edges which make the sides of the pans are clamped together, the pans being set up edgeways.

Steel panels, made in such units as to be interchangeable in building up forms, are more economical than wood, because they can be used over and over again on structures with entirely different plans. Wood forms are more economical for working out special features and intricate castings which are not frequently to be repeated on the same or another work.

Another method in monolithic construction is in the use of a mold box, open at top and bottom and at one end, which makes a small section of wall at one time. A drier mixture is used than in ordinary monolithic construction, so that after the mixture is well tamped in place, the box can be taken away or rather moved along and another section of wall cast. The apparatus is

Concrete vases cast in glue molds for ornaments at garden entrance.
constructed with a core in the center of the box so that two walls are built up at one time with an air space which is continuous up and down and all around. The section cast at each operation is less than a foot high, and when one circuit of the wall has been made the apparatus is raised one tier, set on top of the concrete cast at the starting place and another tier begun. The wall is left with a rough surface to which a finish of stucco is readily applied.

**Concrete Block.**—A growing use of concrete is in the form of pre-cast units—chief among which is the concrete block. While monolithic concrete construction gives us a new medium in building houses, factories, warehouses and other buildings, as well as sewers, silos, sidewalks, pavements, dams and bridges, concrete in its unit form is not new in any particular, so far as methods of construction are concerned. The development of mass construction is demanding a new architecture and new field methods, but concrete block may immediately be utilized with the skill that for a long time has been a part of stone masonry construction. Concrete block is nothing but manufactured building stone. While in this aspect it is nothing new, it does open up entirely new possibilities in unit construction.

Concrete units are made either in an established factory or in an improvised plant at the scene of the building operations. Construction with concrete units differs from that with natural stone in the important feature that the former can be reinforced with steel so that they have great tensile as well as compressive strength. Concrete blocks for ordinary wall construction are not reinforced, but besides blocks there are beams, slabs, sills, lintels and other structural members for spans which are not possible with natural stone except where arch forms are utilized.

The outer walls of this house at Albany, N. Y., consist of two 4-inch concrete walls with a 4-inch air space; it was designed by Charles R. Selkirk, architect, and built by C. R. Knapp.

The possibilities with concrete stone lie in the fact that it is not quarried, nor gathered from the fields like hardheads; it is not cut to fit but is cast to fit—man-made out of a very wide range of raw materials. This difference between cutting and molding stone has been at the bottom of much lively discussion of aesthetics, and the early products were so crude that many architects would have none of them.

A simple mold box of five boards, the bottom one for a pallet, will suffice to make good concrete block. But as such equipment does not make for rapid and economical operation, many different block machines have been devised and manufactured, some to work by hand and some power-operated. They vary not only in the means of operation but in the shapes and dimensions of the blocks produced. To save material, to lessen the weight and at the same time to introduce into walls the insulating value of air space, many mold boxes are designed with cores to produce hollow blocks—some of them with the air spaces so great and the webs so thin as to make them more like tiles than blocks. Some of the blocks have the hollows so provided as to produce only vertical ducts in the wall; other blocks come from the machine in two pieces, tied through the air space with metal strands; others are made in two entirely separate pieces so designed as to have projecting webs of concrete which tie an outer to an inner wall and thus by "staggering" in laying them in the wall provide a continuous
air space up and down and all around. In the rapid operation of a block machine, it is necessary of course that the mixture be made sufficiently dry so that after the concrete has been pressed, tamped and “struck off” at the top of the mold, the blocks can be removed at once on a pallet and put away to “cure.” Such blocks should be kept out of sun and wind and in a moist condition, either by sprinkling or in curing rooms where low-pressure, very moist steam is supplied. Blocks which are cured by sprinkling under ordinary atmospheric conditions require some time to become sufficiently hard to use, but with the moist air of a steam room and its temperature around 100 degrees, curing is very rapid and the blocks frequently are as hard in two or three days as in as many weeks under the other conditions.

Other apparatus which consists merely of multiple molds is used in making blocks with a very wet mixture, the molds not being removed until the concrete has taken its first set. Molds for special pieces of concrete also are made of sand, as in iron molding, or of plaster or even of glue. Glue molds are used when the piece to be cast has deep lines of relief with considerable undercut. The glue mold, being flexible, pulls out and away from these depressions when the concrete has become hard.

Not until the last few years have architects taken hold of concrete block with any great degree of enthusiasm. Many have proclaimed it the best and cheapest building unit. Yet while many saw future possibilities, not a few were at first unwilling to accept concrete block as they found it.

Nothing but a superior building unit could have survived the displeasure which the early manufacture and use of concrete blocks occasioned among the architects. The machinery with which to make them was cheap and was frequently exploited as a means of easy money. “Factories” where concrete blocks were made were frequently only sheds beside gravel banks. A skimping of Portland cement in the mixture was only one of the early errors of ignorance and greed. Unskilful persons found it easy to set themselves up in the manufacture of concrete block and the products could be sold so cheap that it was not difficult to find indiscriminating buyers. Many of these block makers had not only a very limited knowledge of the proper grading, proportioning and mixing of materials and curing of products, but they were equally ignorant of the possibilities of aesthetic quality in building units such as they tried to make. The result was that absurd forms and surface finishes were common.

Many of such absurdities were the result of the ease with which concrete could be molded. Putterers in the plastic material found it so obedient to their wishes that they cast it—turning at once to imitation—to look like every conceivable form of masonry construction; they tried to make it look like everything but what it was.

One of the most absurd and most generally adopted of these imitations was the rock-face block—cast to look like, or at least something like, pitched stone. And this was the rock on which the whole industry came near to splitting. The beauty of pitched stone, that is, natural pitched stone, is in the fact that no two pieces ever look alike. The cutter cannot make them alike. The grain of the stone gives the surface. When a wall of such stone is laid up it has variety. It affords a play of light in no two places just the same. Unless the block manufacturers had a different face plate for every piece going into a structure they could not get the same result no matter how perfect was every other feature of the operations. As a matter of fact they usually had only a few different plates.

Such early errors were really more the fault of the manufacturers of the equipment than of its users. Conditions have changed. Not only have methods been perfected but higher architectural ideals now prevail.

The concrete house may then be either of monolithic construction, unit construction or, according to popular usage, it may be of stucco. As a matter of fact a stucco house is not a concrete house, unless the concrete stucco has been applied over walls of monolithic concrete or concrete units, and in such cases the name of the structural part and not its mere covering should designate the type of the work. In most cases a stucco house is merely a frame house, built much the same as a house which is to have an outer covering of clapboards, except that metal lath is applied over the sheathing, usually being nailed or stapled to furring strips, placed vertically over the sheathing. Thus the stucco is not a structural material, being supported by the wall or frame to which it is attached. That stucco makes a frame
house nearly permanent and weatherproof, there can be no doubt.

Costs.—In estimating roughly the costs of concrete houses there are three entirely different types of construction to be considered.

Despite some isolated instances to the contrary, a house cannot be built under any ordinary conditions as cheaply as of wood. To cite the few exceptions as anything but exceptions to the rule is not only to deceive the public but is to urge concrete for the least of its advantages. The error has been in confounding economy with cheapness. Good concrete may not be cheap but it will invariably be economical. Too much stress upon the matter of making it cheap has sometimes left room for an interrogation after economy. People are glad to consider a material that lessens waste and repair and wards off many of the dangers that beset homes, a material that opens up the possibility of making homesteads out of houses and, by giving Nature the scope and time to make it a part of herself, creating atmosphere and harmony.

The use of stone, brick and wood in the construction of dwellings is something so ancient as to be accepted as a matter of fact, and steel, aside from the phenomena of skyscrapers has never appealed so strongly to the popular imagination. It has served admirably as a skeleton, when adequately protected, and as a skeleton has been covered with the flesh and skin of other building materials.

Popular interest in the use of concrete for dwelling-house construction was aroused by the announcement a few years ago that Thomas A. Edison was at work upon a set of metal molds in which a whole house might be very cheaply made. The idea somehow got abroad that a roomy, comfortable, fireproof, timeproof and storm-defying house might be built after the Edison idea for a thousand dollars. It was to be made in one piece, cast all at one operation, with walls, floors, roof, stairs and all, a solid monolith, and accomplished with amazing economy.

While all this may yet be true, the immediate effect of such a popular idea was disappointment. There is a great deal of difference in cost between individual houses—even though of modest size—and houses built at wholesale in one enterprise to solve some community housing problem. In a community which offered abundant and readily obtainable concrete materials, where every facility of equipment was available, it might be possible with a set of metal molds to build a row of similar houses at somewhere near the thousand dollar mark for each dwelling.

An experiment in solving a housing problem for an English manufacturing corporation resulted in building a cottage 27 feet by 30 feet in plan, with solid concrete walls and flat reinforced concrete roof for less than $450 complete in every particular. Concrete cottages—a group of them—20 feet by 36 feet in plan, were built recently in Oklahoma for $2,000 each. These cottages had large open porches and stairways leading to concrete roofs with parapets. Cost data kept by a building corporation using its own metal forms and with expert supervision in erecting a group of houses in a suburb of an Eastern city, reports a cost for one-story concrete cottages of $5.40 per cubic yard—this with cement costing $1.50 per barrel, gravel at $1.50 per cubic yard and sand at $1.20 per yard. With a wall six inches thick this means a cost of 10 cents per square foot of wall. Another corporation using its own metal forms in the middle west reports a cost of 16 cents per square foot of 12-inch wall. Two-story concrete houses with six rooms and bath—concrete throughout walls, partitions and floors, with flat roofs and parapets—are reported to have cost less than $3,000 each when built as part of an extensive community enterprise conducted by a large corporation in Indiana. Twenty two-family houses, each half of each double dwelling having three rooms downstairs and three upstairs, and built entirely of cinder concrete (cement, sand and cinders) were erected in a Pennsylvania mining community at a reported cost of $2,500 for each building or $1,250 for each dwelling. These houses were built facing a hollow square, which was to serve as a park and playground, and the concreting outfit was mounted on cars which traveled on rails around this square. This all makes for economical operation.

One important thing must be considered in concrete construction. The scene of the operation is not merely a scene of assembling as with other materials; it is a scene also of manufacturing. The raw ingredients are brought to the site. Costs are thus less readily standardized. There may be a difference of two hundred per cent.
the cost of Portland cement between two localities. In one place the gravel may be had for the hauling. In another place it may cost $2.00 per cubic yard; in still another locality it might be the good fortune of the enterprise to excavate the gravel on the site of the work.

The cost of concrete, however, should not be compared with the cost of wood, which is inflammable. Neither should the all-concrete house, which is proof against fire inside and out, be compared as to cost with a house which has brick walls or tile walls or stone walls and wooden floors. Concrete houses are not the cheapest. They are the cheapest fireproof houses and they are oftentimes much cheaper than other types of construction which are fireproof only so far as their walls are concerned. Better even than that is the fact that concrete houses will be cheaper: First, when form systems are more fully perfected; when concreting equipment is devised for economical operation on small undertakings; and, second, when architects study the characteristics of concrete and design houses which lend themselves properly to that material.

The use of concrete is comparatively new. The first barrel of Portland cement was not made in this country until in the seventies, and only within comparatively few years has its use been entirely without suspicion. It will not be long before even small contractors can equip themselves to build concrete houses at very low cost, because many engineers are devoting themselves to the problem. Many beautiful and excellent concrete houses of individual types already have been built throughout the land, yet no standard of cost has been established and every work must be considered in the light of an exception unless the conditions of construction and supervision are identical.

The foregoing estimates of cost refer to monolithic concrete. Concrete block is without doubt the cheapest building unit, but it should be considered in comparison with brick and stone, not with wood upon one hand and monolithic concrete on the other. The cost of stucco houses using metal lath over frame construction probably may safely be said to lie somewhere between 5 per cent. and 20 per cent. more than all wood construction.

Architectural Treatments.—Without some remarkable development not now foreseen, probably the greatest architectural novelty in residence construction entailed by the exclusive use of concrete is the flat roof. This eliminates some attractive architectural treatments of which we are fond chiefly through association. Yet the flat roof brings its advantages; it makes the roof a usable feature of the dwelling. Although concrete has been successfully used in gables and steep slopes such as frame construction has given us (the concrete being reinforced and covered with whatever roofing units are desired) such construction is not economical, because forms for such work are not readily set up and because concrete is not adapted to the same kind of expression as wooden framework. There seems to be a growing opinion that the roof of the all-concrete house should be flat, and that this is the best architectural treatment because it employs a natural use of the concrete with no straining after effects which are not in keeping with the material.

Concrete construction has developed new ideas in cornices and parapets and in features which lend a distinct and pleasing appearance, in view of the availability of the roof area for at least partial occupancy. This should prove popular in a day of growing belief in the efficacy of the out of doors. So, after all, new interest is added to the skyline and what may have seemed objectionable because of its novelty will come to be understood and appreciated. There can be no good architectural development which has not clearly and definitely followed the natural use suggested by the particular characteristics of a material.

The treatment of concrete surfaces is something only beginning to be generally evident. In a world that provides such variety of color and texture for the gratification of individual tastes, it is not to be wondered at that many people dislike what they have termed the cold, dull, gray of concrete. There are others who find nothing more beautiful as a background for the vines and shrubs and trees which are the furnishings and draperies of nature. Yet those who hold the former view need not forego concrete. Gray is, after all, the color of cement—not necessarily the color of concrete. Concrete is to be had in greater variety of color, tone and texture than is possible with any natural building unit, because in the making of concrete, materials are available which could not be
used in their natural condition. A concrete surface may be colored; there are special paints for the purpose. It may be given a coat of stucco, either in a smooth trowel finish or in a float finish containing either the common gray or the more expensive white Portland cement. It may be given a rough-cast stucco finish in almost any degree of roughness desired. Skilful workers can throw from a paddle a mixture of mortar containing pebbles, thereby producing a rough texture with delightful high lights and shades. Still another stucco treatment is with what is called a dry-dash. In this treatment pebbles or stone chips of specially selected colors may be thrown into a fresh mortar coat, and being only partially embedded, their natural beauty remains exposed.

Wonderful progress has been made in the manufacture of concrete stone. While at first the besetting idea in block factories was to produce an imitation of some stone unit, the inherent possibilities of concrete have long since become assertive, and the manufacturer now offers, not a make-believe stone but a real block of concrete, with beauties distinctively its own. All those possibilities in surface treatment which belong to monolithic construction are also possible with blocks and still other possibilities are added. The block maker has a world of mineral aggregates from which to choose, to produce a desired effect. You may have your concrete block made to order; have it cast according to the architect's detail and specification; have the color and texture controlled in the making as is not possible with natural stone and yet have it tooled after manufacture just as natural stone has been tooled. Natural stone is taken as Nature provides. Concrete stone is the consummation of man's art and skill in combining the raw mineral aggregates which Nature has put at his disposal. Much natural stone is injured in appearance by exposure to the weather because it is highly absorptive. While much poor, porous concrete stone has been made, methods are now so perfected that concrete stone can be made so dense as to absorb almost no disruptive and discoloring moisture.

Whether in the use of monolithic concrete or unit concrete, the architect has in this new material a medium for his skill and the owner a realization of permanence and comfort. The architect has an opportunity for the richest ornamentation or for the most effective of simple treatments—and all these at less cost than for any other enduring construction.

SELF HELP THROUGH GOVERNMENT

The money gathered by the Government through the postal savings banks belongs to the people, and should be loaned to them at one-half per cent. advance over the interest allowed on these deposits, instead of being loaned to the national banks at the small advance of one-fourth per cent., and reloaned to the people by the banks at five per cent. more than the banks pay for it.

The money so loaned by the Government should be made productive, by security on cultivated land, thus adding to the wealth of the nation and the independence of many of its citizens.

Fifty million dollars from the postal savings deposits would enable 200,000 heads of families to pay $250 for a five or ten-acre farm or garden, sufficient for the maintenance of a family.

Made available only to married men or to widows with children, this fund would benefit directly, and at once, 1,000,000 people, who, in returning the loan and becoming depositors, would, in conjunction with other depositors, create a fund sufficient to provide loans on five-acre homesteads for all families desiring to locate on the land.

This could be accomplished within ten years, providing a way for millions of wealth producers to find self employment in healthful, independent, outdoor occupations, reducing the danger from many loathsome diseases, such as tuberculosis, and at the same time reducing the need for and cost of charitable institutions, "homes," courts of justice and pens of punishment, through a saner and more natural mode of life and higher ideals of social relations, without costing the people or the Government one cent. In fact, the wealth and stability of both would be vastly increased.

We, the undersigned, petition our Congressmen to consider a bill at the present congress making provision for such use of the postal savings deposits.

To members of the League: Please use your influence in having this petition reprinted in local papers and send a marked copy to the secretary.

(Through the courtesy of the Landward League.)