CONCRETE IN THE MANUFACTURE OF HOUSING

The serious demand for low cost housing has led to major efforts in developing a system of construction which can be performed in plants. The advantages of plant production are obvious. The saving in housing construction can be similar to that experienced in the automobile, aircraft and mobile home industries. It is apparent mass factory production of housing is the only way in which future housing needs of low income persons can be provided.

Many designs have been developed which lend themselves to factory manufacture. Extensive work has been done by the mobile home industry and several low income housing demonstrations to utilize mobile home technology and manufacturing capabilities for the production of permanent, multi-family housing. It utilizes wood frame construction carried on a light gauge metal frame but lacks many of the characteristics which are necessary to permanent, multi-family structures. Permanent structures require fire resistance of unit separations, sound control, structural adequacy and durability of materials.

Most of these characteristics are provided by the natural properties of concrete, which is indigenous to all areas of the world.

Fire Resistance: The fire resistance of concrete is recognized by all building codes. Design in concrete provides freedom in design of required fire restrictions.

Sound Control: The density of concrete makes it a natural material for resisting sound transmission. The general sound loss is fifteen decibals for each inch of concrete. However, it is not a good material when considering tapping transmissions of sound which can occur from women walking in high heels directly on a concrete slab. This can be remedied with a floor covering such as carpet or resilient tile.

Structural Strength: The same structural element which is designed to prevent transmission of fire and sound has the structural strength to support many additional floors. An efficient use of concrete is in the wall load bearing type of construction. The use of concrete walls as deep beams and

the addition of reinforcing provides the designer with the opportunity of cantilevering one unit beyond another.

Economics: The cost of materials used for concrete structures is minimum. The major costs are the labor and material required in forming and finishing. Vast savings can be realized in concrete construction through the mass production of a standardized unit. The machinery required for minimizing labor cost can be amortized over a large number of units.

Durability: The indestructibility of concrete for floors and walls of dwelling units is a major consideration. The use of steel forms for concrete surfaces makes it feasible to simply paint the concrete for a finished surface. In order to reduce the initial cost and maintenance, the exposed or exterior concrete may be left untreated. The durability of concrete to exposure is well known.

Several attempts have been made to utilize prefabricated concrete units for housing. They were aimed at obtaining all the desiralbe qualities of concrete at minimum cost through factory or assembly line techniques.

Extensive work has been done in Puerto Rico on precasting panels at the site to form a shell. This leaves the remaining construction to be performed at the site by conventional methods. Generally, the major cost of construction is in the electrical, plumbing and finishing trades, and no significant cost savings can be realized unless these items are also factory produced. Another problem with the panels is the joinery. No matter how sophisticated the design, the matching and finishing of numerous joints is time consuming and often leads to an unsatisfactory end product.

A distinguished improvement over the precast panel concept was executed in Montreal, Canada at Habitat. This system is composed of three dimensional boxes which were precast off site. The boxes were stacked at the site to form a multistoried, prefabricated building. The fabrication of the units as a box resulted in a minimum of joinery. Attempts to completely install all interior finishing and mechanical were not successful because of limited time and plant facilities. Difficulties were also experienced in the cost of mechanical facilities caused by a lack of discipline in the floor plans which do not employ alignment of plumbing. The complicated arrangement of the boxes produced a difficult structural design. Very thick concrete walls and complex reinforcing cages resulted in an expensive element. The units weighed approximately 90 tons and required special handling equipment for transportation to the site and erection. The initial structure was unreasonably expensive due to its prototype nature and the distribution of costly equipment into so few units.

BINISHELLS

Thin shells made out of concrete are among the most efficient structures developed today as shown by some of the largest enclosed spaces designed so far and covered by thin shells.

The structural advantages presented by such shells would make them applicable to roofs of all kinds, were it not for the problems presented by the necessity of curved forms. All over the world construction engineers have tried to simplify or to avoid the form problem in order to reduce the cost and simplify the construction of such efficient roofs.

The balloon form was first used by the American architect, Wallace Neff, as early as 1942 in connection with sprayed concrete. The Neff process was used in a number of instances by Noyes and Salvadori in 1954, but the economy achieved by the repeated usage of the balloon form was not decisive in making thin shells popular, mainly because of the necessity of a scaffold from which to spray the concrete and because of the expense of guniting the shell.

The process invented, perfected and patented all over the world by the Italian Architect, Dante Bini, possessed all the advantages of the Neff process and none of its disadvantages. The Bini process has solved the problem of economically building domes varying in diameter from a few meters up to 100 and more meters.

The essential components of the Bini system consist of a balloon, a particular type of flexible or stretchable steel reinforcing mesh and a concrete mixture designed to be particularly plastic at first and to set rapidly later. Two small fans activated by a portable generator or by available electrical current, together with two simple air valves and a small air pressure control device constitute the mechanical equipment needed to erect a shell.

The sequence of operations in the construction of a Binishell follows:

1. A boundary foundation is built around the perimeter of the area to be covered, and a slab on grade is poured over the area. The pneumatic form is then connected to the boundary foundation by two inflatable tubes and securely tied to the foundation. A steel mesh of spring-like elements is laid over the balloon and tied to the boundary foundation so as to produce a hinged or fixed connection.

2. Regular two to three thousand pound concrete is then poured directly from the trucks onto the balloon form and smoothed out. The concrete contains additives that make it particularly fluid so as to permit an easy spreading over the balloon form on the ground.

3. A thin membrane of plastic material with high stretchability is laid over the concrete and tied around the boundary by wooden slats on which the membrane is wrapped and which are then forced between poured concrete and a number of vertical steel bars which stick out of the foundation.

   A practiced crew can perform these preliminary operations in approximately one hour.

4. The two, five to ten horsepower fans inflate the balloon and in about ten minutes lift the concrete with its fixed steel mesh to its final shape. The outer plastic membrane helps keep the concrete in place while allowing the weatherproofing of the dome if left in place.

5. The final construction operation consists of vibrating the entire dome for a period of between three and five minutes either by a vibrating plate lowered from a boom to the top of the shell, a number of small vibrators moved around the shell, or a sonic vibrator set inside the shell.

6. The pneumatic form can be deinflated after twelve to forty-eight hours, usually after twenty-four hours. Openings in the shell are obtained as soon as the form has been lowered by means of a rotary saw. The form is pulled out of the dome through one of the openings and is ready for usage again as many as three to five hundred times.

Experience obtained by Binishells, Inc. shows the concrete has a practically constant thickness over the entire dome with a small increase in thickness at its bottom. Results obtained by mathematical analyses and by actual load tests on Binishells indicate these shells behave elastically as assumed in the theoretical analyses and are capable of supporting high loads before indicating a beginning of failure. Such loads are about ten times the load expected to be carried under the worst conditions.

While both analyses and tests indicate the very minor amount of membrane stresses are developed under the largest portion of the dome, it has also been shown that the bending stresses around the dome boundary and around large openings introduced in the shell are also of a minor importance as expected in any property designed shell.

The simplifying of the construction procedure, the lack of heavy equipment in the building of the shell, the limited amount of labor needed for its erection, the variety of shapes obtained by the usage of a balloon made out of an elastic or a plastic material, the freedom of plan to be covered by the dome, the extreme rapidity with which a shell can be erected and the reduced amount of materials typical of shell construction make the Binishell process one of the most efficient procedures devised for the construction of either large or small shells.

Recognizing that machine controlled methods are essential to the advancement of construction technology, the Econo-co System has integrated a method of design with matching production equipment. The equipment produces structures in conformation with the design method and is flexible, permitting the selection of any floor plan or any style of exterior. The system is practical to the fourth story.

The Econoco System allows for the selection of any existing material such as stone, brick, plaster, wood siding, shake, etc., and it will reproduce the appearance of the selected material with exact fidelity in the building.

Construction is extremely rapid, making it feasible to custom plan, construct and occupy a complete new home in less than two weeks.

Delay due to the conventional succession of crafts at the jobsite has been totally eliminated. There are virtually no carpenters, stone or brick masons, plasterers, roofers, sheetrock hangers, tapers or texturers, sheetmetal men, countertop setters, cabinet makers, tile setters or appli-ance men at the jobsite. The work of those crafts retained has been greatly simplified. Assembly is rapid, utilizing the lift and weld method and can be completed in a single day.

The house so produced is completely conventional in appear-ance, is practically maintenance free, never needs reroofing and is fireproof, slump-proof, heavily insulated and costs from 35% to 50% less than comparable homes. The designs are classified as Fine Custom, Competitive Tract and Durable Low Cost. Even the durable low cost, which can be completed at close to five dollars per square foot of living area, represents a well finished, liveable, fine quality home.

The "Uniment" concept, developed by Conrad Engineers, is a total construction system which has been designed to take advantage of the characteristics of concrete in housing through the use of mass production technology. The disadvantages of difficult joint problems and site fabrication are surmounted by a form which can cast a three dimensional box in one piece. This permits installation of the complete interior at the plant. The interior partitions are cast monolithically with roof and exterior wall, thereby adding stability to the unit, providing highly durable interior walls and minimizing use of combustible materials. Floor layouts are designed to take advantage of the cost saving of vertical plumbing risers without sacrificing good design. The alignment of units results in simple concrete casting which can be mass produced.

Each unit weighs twenty tons, is eleven feet wide and can be transported on the highways with conventional equipment. A central manufacturing facility can therefore be established which has a marketing area limited only by trucking distance. This could be in excess of one hundred miles before the freight cost becomes unreasonable. The potentially great number of units which can be produced to amortize the installation cost is consequently restricted by transportation cost.

A wall thickness of two inches effects the reduction in weight, and the use of "Chem Stress" cement achieves structural integrity. This cement has the unusual property of expanding as it cures instead of shrinking. The expanding reaction, first noted seventy years ago as the expansive effect of the hydrated salt of calcium sulfoaluminate, had always been a disruptive, self-destructive force. It has since been recognized that if this force could be controlled, it could be put to use to counteract the shrinkage inherent in Portland cement. Enough calcium sulfoaluminate clinker was produced to conduct extensive experiments on concrete containing various amounts of the material, ground and mixed with Portland cement and hardening under varying amounts and types of restraint. These experiments led to the formulation of Chem Stress. The expansion is of such magnitude that it stretches the reinforcing, causing it to stress the concrete. The "post-stretching" of the units is in all three directions and through the corners, making the box easy to handle and crack-free. Casting of a two inch wall is accomplished with specially designed forms and heavy vibration.

Both mechanical and structural aspects of the casting technique have been fully tested through the construction of a full scale mock-up of a typical unit. Other testing was performed on isolated corners and cubicles.

Complete plans and specifications for a six story, twenty-four unit apartment building have been approved by F.H.A. Construction of the first building is expected to be completed by late 1967. Designs of greater height and size will be executed from the experience gained from the initial unit.

The Uniment system can be useful if construction of the precast building envelope can be economically placed on an assembly line for trimming out and later transported to the site.

Boise Cascade

Reston has met with Boise Cascade Corporation who is producing a three story condominium apartment at Sun Valley, Idaho. This unit is presently being manufactured at Boise and the unit stacking operation is scheduled to start this fall. This is an example for us in what is being done in stacking sectionalized house units to three stories and can be used as a cost criterion. It is also a construction process immediately available in development of a low cost area. Boise Cascade, through its wholly-owned subsidiary of Kingsberry Homes, will present the design and cost figures of the three story condominiums being constructed at Sun Valley for Janis Corporation. These cost figures will be adjusted for variations in construction necessary because of the BOCA Code and the Reston area labor market. They will not design out the Swiss Chalet look, however, anticipate no problem in so doing if we elect to develop their proposition more fully. This will give us an excellent cost base for a current three story stacking operation.

The merger of Boise Cascade and Divco-Wayne Industries, the nation's largest mobile home manufacturer, was recently announced. The considerable research and technological facilities of these two large corporations could be of inestimable value in Reston's program.

Acorn Homes

John Bemis, in association with Carl Koch, was a pioneer sectionalized house manufacturer and is currently continuing their Acorn Homes operation. It is evident this operation is not prospering, and Mr. Bemis is currently attempting to market a vacation house of which he has produced about ten. Acorn has been building the 4' panel system Techbuilt House, but Mr. Bemis indicates they are planning to do their own manufacturing, and he is considering changing his direction to the lines of the original Acorn House.

An interesting sidelight of the meeting with Mr. Bemis was his comment that the haulers currently used by the mobile home manufacturers are gypsy types, and this is the reason they are able to achieve the $0.50 per unit mile transportation cost. As soon as the business becomes important, one can expect Teamster Union intervention and probable doubling of the cost. For this and

other reasons, he is pessimistic about the future of the completely finished factory house and predicts the solution will be the manufacture of large components.

Mr. Bemis will study possibilities for construction of the various schemes and will make some recommendations.

Commonwealth Corporation

We had a meeting with Neal Wade, the president of Commonwealth Corporation. Commonwealth is a local prefabber whose present capability is 300 to 400 houses per year and is currently in production of 147 units for Richmond, Virginia, of a design similar to the original Smith Houses at Reston. He is also building a prefabricated apartment house at Manassas for shipment to Newark, Delaware. Mr. Wade has put together a cartel of about twenty-four large local materials men including Johnson and Wimsatt. He says he has exceptional vertical organization including architectural, engineering and production and is now trying to develop a large market with Commonwealth Corporation as manufacturer of the end housing product.

Use of such a facility as Commonwealth for production of our low cost house may become practical, especially when the very low transportation factor is considered, and the organization of the important local material outlets as financial partners in a house prefabrication operation will probably be copied.

Mr. Wade accepted the assignment of engineering the Forest Edge house for prefabricated construction and providing us with a firm cost proposal for the manufacturing and erection of the houses. This was considered a good method of determining the extent of Commonwealth's expertise, and it is possible he may come up with a workable solution and a competent proposal.

Steelcor

Inland Steel's steelcor method is expanded metal lath attached to both sides of a light guage metal stud or joist by rings. This allows the whole wall framing system to be folded flat and after shop cutting to size, the required building panel is compactly packed for shipment. The prelathed building frame is unfolded, erected, piped and wired and then sprayed with concrete on the site. It is necessary to hand finish the concrete surfaces, which may include the

roof, ceilings and all interior and exterior wall surfaces. This is the principal constraint to the use of the system in low cost housing. In addition, there is no reduction of ordinary on-site work with the exception of the extremely rapid framing of the building envelope unless the shells for the low cost house could be efficiently preconstructed and transferred to an assembly line for trimming out.

Reston is contracting with Inland Steel and their architects, Messrs. Pyskacek and Rosenwinkel, for actual construction of a prototype house in Reston using this method.

Neal Mitchell Associates, Inc.

Neal Mitchell Associates, Incorporated, has developed a prefabricated system of lightweight structural components that can be rapidly erected into the frame of a single or multi-story building. The system is based on four factory produced components: a column, a cantilever beam, a tie beam and a slab. All are made from precast, reinforced cellular concrete. The components can be erected at a building site by people who have no prior construction experience. No construction machinery is required since all components weigh less than 150 pounds and can thus be set in place by two men. The system is designed so that a one room building can be expanded incrementally into a multi-bay, four story structure. It is therefore possible to construct a wide range of building types -- from small homes to apartments, offices and stores.

Since the structural integrity of the system is consolidated in the frame, the architectural treatment of the exterior walls and interior partitions can be sensitively adapted to local climatic and environmental conditions, as well as to cost. This permits the use of a non-bearing wall material that functions merely as a climatic barrier, and provides the required privacy and security. Within the modular dimensions set by the framing system, the wall can also be mass produced under plant conditions, and then attached to the frame at the job site. The walls may be used as a skin that completely masks the frame or as infill, utilizing the precast concrete frame as a visual and architectural asset.

The Mitchell framing System reduces the cost of housing construction without sacrificing any of the attributes of conventional construction. This is possible because building components are mass produced from low cost raw materials, and the frame is easily erected at the site with a minimum

of labor and time and equipment. In addition, the frame allows designers and builders to choose any locally available and culturally appropriate material for low cost walls without regard to structural and load bearing properties.

Architectural plans and studies have confirmed that the system's modular structural frame can be used to build a $300 single cell dwelling in impoverished areas of developing countries, or four story luxury apartments in the United States.

Under study at present are prefabricated kitchen and bathroom packages and a study by Lennox Industries of a series of custom developed heating/air conditioning units. Also under development are a series of prefabricated modular wall panels utilizing a wide range of materials and finishes.

In summary, the project started as a systems-based analysis of the failure to provide adequate housing in the currently underdeveloped world. The strategy was to bring the latest in science and technology to bear in the controlled manufacturing of a structural system, yielding an inexpensive, durable and foolproof product that could be erected quickly and easily in the field by totally untrained people without any construction equipment. Interest centered on developing a lightweight fireproof system, so safe as to withstand heavy wind and seismic loads. The goal was a self-help "expandable" house that had provisions for future expansion and could grow with the needs and financial resources of the occupants.

While this and more has been achieved in the underdeveloped context, the system and component products developed have already demonstrated that they are strongly competitive in the domestic market, particularly where erection speed and low cost are essential.

A low income demonstration grant has been awarded to the Archdiocese of Detroit implementing this system in low income housing. The system has certain promise, however, it appears it has a long way to go in development, primarily because it is quite complicated and subject to potential errors in dimension and erection. Further, this system may have difficulty proving itself as low cost because it is a post, beam and concrete slab system, which, when incorporated in housing structures, seldom has proven economical because of the need for many walls, the materials of which are perfectly capable of supporting the loads of the floors above. Therefore, a system based on a structural beam and floor system which then has to be infilled is likely to be rather expensive.

RITZ-CRAFT

Ritz-Craft is producing several variations of a two piece sectionalized house using methods similar to the mobile home industry. The company is also heavily involved in the manufacture of mobile homes. However, when they entered this field, they determined that it would be impossible to build housing of the permanent type in a mobile home factory, and a separate manufacturing facility was built near Shamokin, Pennsylvania. This discourages the idea we have of a large, well distributed network of manufacturers ready, willing and waiting to produce permanent houses. However, Magnolia mixes the operations to some extent, and the degree of success remains to be seen.

Mr. Richardson, Vice President of Ritz-Craft, said his plant is producing approximately thirteen houses every other day or about thirty-two houses per week, and the plant is designed for double that capacity with only an increase in manpower. They use the heavily built, removable frame on which the house is moved through the production line, transported to the site and removed for return of the frame to the plant. Mr. Richardson submitted the price structure of his company's current product and offered to study our definitive drawings and make a preliminary cost survey. Ritz-Craft is certainly a prospect for the manufacture of the Reston houses if we end up with generally wood construction. One of their advantages is proximity to Reston and the company's agressive approach to the permanent housing field.

We were introduced to Mr. Ritzenthaler, President of Ritz-Craft. He was interested in participation but very dubious about using a precast concrete building envelope, finishing it out on an assembly line and transporting it by highway to the site. He said they had to design flexibility into sectionalized houses to avoid serious fractures from rough road conditions. Prestressed concrete in most sections has a high degree of flexibility. However, the concept of a precast building envelope, which in effect would be a large concrete box beam, is questionable.

MODULUX

Modulux, Inc. is a division of Dymo Industries located at Newark, California. They are engaged in factory construction of building units nearly identical to the kinds we have under study in this project. The major difference is the cost and use. The Modulux people have 400,000 square feet of plant space almost entirely devoted to factory produced living units and industrial units which are primarily for institutional use and the military.

In talking to Mr. Lowell Denney, President of Modulux, and Mr. Silverman, Vice President of Operations, scant enthusiasm was displayed for getting involved in low cost housing, primarily because the expected profit is too low in their opinion. They said they have stayed away from that field because they have adequate orders for their factory from the military and from institutionalized consumers such as dormitories for universities. In their words, there is no money in low cost housing.

They did indicate that given certain conditions and assuming we would pay for their engineering services they would be glad to consult with us on the details of fabricating such units. Whether or not they would be interested in producing them is another question. It appears that the technical ability of a firm such as theirs in helping us with the construction details of the units as well as the necessary techniques of joining, transporting and erecting them could be of great value.

DESIGNED FACILITIES LABORATORY

A firm similar to Modulux called Designed Facilities Laboratory is located in Monrovia, California. Only telephone contact has been made with this firm; Mr. Rice will investigate any interest they may have in joining us in the low cost housing study.

LOCKHEED

We contacted the Lockheed Division, discussed their system and looked at a couple of prototype houses at the Meyer Brothers Construction yard in Los Angeles. The Lockheed system does not appear to be practical for use in our study primarily because it depends on prefabricated panel units and, at this time at least, we are confining ourselves to wholly factory produced units. The Lockheed system is a highly engineered and fairly sophisticated one of putting precast, prefabricated panels together which are locked in by intricate keys and channels made primarily from aluminum. We have been told that in a series of houses being built in Puerto Rico a great deal of difficulty was encountered in assembling and erecting these panels because of the lack of skilled labor. The intricate locking and pinning system which was designed by the aircraft engineers was not actually used; a rather crude field applied lap joint arrangement was finally used.

The Lockheed System does not appear to offer any practical contribution to our project here at Reston.

SPEARS ENGINEERING CORPORATION

A prototype in Richmond, Virginia, was visited by a number of us several months ago. This prototype was built by Spears Engineering Corporation and designed by a Richmond architect by the name of Van Bakergem. It consists of a steel frame, concrete floor and metal roofing. Interior finishes are carpet flooring, vinyl covered wall paneling and acoustical celotex light ceiling. This particular prototype was arranged for use as a motel unit with bedroom sections at each end and the bathrooms in the interior backing up to each other.

An interesting aspect of the system is that they allowed a small space, something like 2' to 3' wide between the walls of the back-to-back bathrooms, thereby making it possible for a man to work inside and make the necessary connections and also making it possible for the plumbing inspector to inspect the plumbing systems on the site rather than having them entirely concealed. Even though there is a certain amount of wasted space here, this could be considered in our design of core units, particularly when it becomes necessary to stack three or four units, in order to facilitate the connections of the piping. Also, there is a possibility that an access door could be given to this space; it could be slightly enlarged and used for an excellent storeroom.

The Spears box appears heavy and expensive because of the combination of materials used. Looking at this design leads one to the thought that the most economical box must be a concrete structural system.

DREDMAN INDUSTRIES

Mr. Schultz intends to take a trip to Detroit to discuss the possible participation of Dredman Industries, which is a contact supplied by John St. Lawrence who is presently in charge of the General Electric research system. The Dredman people are heavily engaged in sectionalized and prefabricated housing, are well funded and appear to be a likely prospect to work with us on our project. The meeting with Dredman is scheduled for the 13th of July, and a report will be made on the result.

Professor Colin Davidson has developed and marketed a component system in England and is currently working as a consultant for Divco-Wayne's United Kingdom efforts in sectionalized housing. He briefly showed his own system, the procedural construction drawings of which were of great interest.

His system consists of structural, precast concrete wall panels in three widths, timber floor panels, aluminum window sections, trussed rafters, interior lining panels, partitions and prehung doors, plumbing assemblies and a storage system.

Components are produced by a consortium of manufacturers which are selected both on the basis of ability and willingness to produce particular components and relative equality of size with the other members of the consortium. Mr. Davidson believes that there would be a shift of control of system development and change to a dominant manufacturer if a very large firm were to become a member of the consortium.

Mr. Davidson expressed some concern at the small scale of our project relative to the scale required to absorb tooling costs for industrialization. At the same time, he feels that industrialization has a greater chance for more immediate success in the United States because of the larger client markets.

He has made a thorough study of mobile home industry techniques and promised us a report. He is mainly impressed with the phenomonon of the mobile home in the United States. The industry leaves much to be desired in production and engineering, and there are wide areas of improvement possible in the end product. However, it is manufactured housing per se and can be used in the manufacture of permanent housing.

Messrs. Maurice Parkins, AIP, ASLA, and William Mackey represent RESCOM, Inc. and were in Washington soliciting a HUD grant for their project. The package they are selling consists of twenty-four trailer sections arranged on a 1½ acre lot in a radial pattern. The basic combination of elements consists of four, two bedroom trailer sections stacked in parallel pairs eight feet apart with the upper two sections being served by a common stair. An exposed steel frame carries the upper section. To this frame is attached a wood fascia piece, and to the roof of the upper sections is attached a synthetic mansard roof. Exterior cladding is plywood, and the claim is made that this combination of features de-trailerizes the trailers.

Each of these four unit sections is structurally independent of the others, which would allow for separation of the six radial wings to comply with code requirements for fire separation. No additional provisions for compliance with code fire regulations seem to have been included.

Approximate retail price was quoted at $9,000, including some appliances and draperies, but not furniture. This yields a unit price of about $12.50 per square foot for the basic two bedroom section.

Work is underway on the development of three bedroom units, but no definitive cost information is available at this time.

Mr. Parkins has negotiated an agreement with an unspecified trailer manufacturer to produce units which meet his and F.H.A. specifications. He believes that an initial rate of production of thirty units per month will compliment the twenty-one day curing time required for concrete footings on site to produce a continuous production-erection cycle.

This scheme appears to utilize the sectionalized or trailer concepts which have been popularized in recent issues of the architectural magazines, however, this effort does not appear to demonstrate any particularly new thoughts on the technology involved.

KINGSBERRY HOMES

Kingsberry Homes is a division of Boise Cascade Corporation which offers over one hundred architecturally designed homes, pre-built in sections at the factory for rapid assembly on site. Boise Cascade owns three Kingsberry Homes plants and has a combined annual capacity to produce 5,300 factory-built homes.

At a later meeting with the Boise Cascade/Kingsberry Homes representatives, the plans for the units being built in Sun Valley, Idaho were presented. It is obvious the system is too expensive and will require extensive re-work to modify it to reduce the cost and comply with the BOCA Code. These units are much larger than permitted to be hauled over the highways in the Eastern United States.

Mr. John Odegaard, Director of Research and Development, reviewed the costs on various systems being produced by Kingsberry which present a favorable picture. The general costs are $7.00 to $7.50 per square foot for apartments, $7.50 to $8.00 per square foot for townhouses and $8.00 to $8.50 per square foot for detached houses. He felt our cost goals could be reached if the least intricate Conklin and Rossant schemes were selected and reduced in size.

We discussed the participation of Boise Cascade through Kingsberry Homes and Divco-Wayne. Mr. Odegaard said he was personally delighted with the prospect and knows Jerry Nowak, Director of Kingsberry Homes and Divco-Wayne, is also enthusiastic.