A SIX STORY APARTMENT HOUSE

By Norton Polivnick

Submitted in Partial Fulfillment
Of the Requirements for the
Degree of Bachelor in Architecture

Massachusetts Institute of Technology
School of Architecture
May 1941
<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter of Submittal</td>
<td></td>
</tr>
<tr>
<td>Acknowledgment</td>
<td></td>
</tr>
<tr>
<td>Letter from Pierce Foundation</td>
<td></td>
</tr>
<tr>
<td>Report</td>
<td>Pages 1 - 27</td>
</tr>
<tr>
<td>Financial Statement</td>
<td>Pages 28 - 29</td>
</tr>
<tr>
<td>Bibliography</td>
<td></td>
</tr>
</tbody>
</table>
May 12, 1941

Dean Walter R. MacCornack
Chairman of Thesis Committee
School of Architecture
Mass. Institute of Technology
Cambridge, Massachusetts

Dear Sir:

I hereby submit this thesis report entitled, "A Six Story Apartment House" in partial fulfillment of the requirements for the degree of Bachelor in Architecture.

Yours truly,

Signature redacted

Norton Polivnick
ACKNOWLEDGMENT

The author desires to take this means of thanking those professors who have been more than liberal with their time and aid during the course of this thesis. Of special assistance has been the advice of:

Mr. Walter R. MacCornack
School of Architecture

Mr. Albert G. Dietz
Department of Building Engineering and Construction

Lawrence B. Anderson
School of Architecture

Ernest N. Gelotte
School of Architecture

Robert L. Davison
The John B. Pierce Foundation

B. Leonard Krause
The Albert Farwell Bemis Foundation
April 15, 1941

Dear Mr. Polivnick:

I certainly agree with you that apartments could be built of radically new construction methods. You will find in the October 1929 issue of the Architectural Record in the article on new construction methods, a reference to the approach that I had to this problem at that time. Since this date I have considered making the wall panel act as a structural deep girder which would carry the floor load and we have run tests on this type of construction, but these data have never been printed. However, if you would care to visit us sometime we should be more than happy to show you what we did in this and other studies.

We have recently built a two-story six-family house at the Glenn Martin Airplane Plant which has some of the elements which would be used in a six-story apartment construction except that the core of the Cemestoboard as used in this house should be of more fire-resistant material if used in a six-story building. We are at the present time carrying on research on inorganic and fire-resistant material which in the course of time may lead to a solution of this problem for apartment house construction. The May issue of the Architectural Record will describe the single family house as built of Cemestoboard construction as built at the Glenn Martin Plant.

We are also carrying on studies of steel column and steel window sill and head with our type of panel construction with a view to such construction's being used in factory buildings. This construction method combined with inorganic core, when, as, and if this is developed by us or someone else, will probably give a satisfactory low cost wall for apartment construction.

Very Sincerely,

s/ R. L. Davison

Mr. Norton Polivnick
M. I. T. Senior House
Cambridge, Massachusetts
GENERAL DISCUSSION

Recently the trend towards suburban dwellings has made it possible for the realization of ideal plan solutions. The success which these projects have attained are the result of the removal of many limitations which have and will continue to have the greatest influence on the city apartment. Without them there is ample evidence of what can be accomplished - but with the limitations the results have been most disheartening. Present day apartment house design has become standardized to the point where little initiative remains on the part of the architect.

Until one studies the conditions that a city lot imposes it is hard to understand the results that adorn the streets today. To begin with the city lot is chosen because of its proximity to shopping, transportation, and residential areas - which means that the value of the land that fulfills these requirements is going to be that much greater. Valuable land necessitates its being split up into small areas so that a city block of 600 ft. x 200 ft. will usually yield 8 lots of 150 ft. x 100 ft. The result is a costly interior piece of land that is bounded on three sides by other buildings - free only on the street side. The problem confronting the architect now changes from that of presenting an ideal solution to one of conforming with the owner's wishes. Limited to six stories because of cost and fireproofing requirements the archi-
tect resorts to the usual H plan for maximum coverage. He might even realize that maximum coverage won't yield the best results, but the value of the land, plus the owner's desire for visual evidence of complete utilization of his property leaves little choice.

SITE CONDITIONS

The site is situated in a well to do residential area in Brooklyn, New York. One East 21st between Caton and Woodruff Avenues the 100 ft. x 165 ft. plot is surrounded on three sides by adjoining lots. At present only the rear side has been built upon but the possibility of future building limits the architect.

CONVENIENT TRANSPORTATION

The B. M. T. Subway express station at Church Avenue is two short blocks away. Another B. M. T. is around the corner at Parkside Avenue. The Flatbush and Church Avenue trolley lines are within one block of the lot.

SHOPPING

Is on Flatbush or Church Avenue, one block in either direction.

SCHOOLS

Many schools are in the immediate neighborhood such as Public School 92, Erasmus Hall High School, and many
Parochial Schools.

CHURCHES

Churches of several denominations are within walking distance.

RECREATION

Theatres are located nearby on Flatbush Avenue.

TYPE OF OCCUPANT

The neighborhood in which the house is situated is both well established and well to do. The tenants of this district consist of either unmarried school teachers or small families, but in either case they are capable of paying for a well priced apartment. This variation of occupants means that there will be a demand for all apartment sizes - mostly the twos and threes, with a sprinkling of ones and fours.

The financial position of the tenants indicates that many of them will be car owners. In New York the majority of the apartment occupants rely upon the subways and buses for transportation and as a result few possess cars. In this case though it is expected that about one-third of the tenants would require garage facilities.

SOLUTION

This problem was chosen with the full realization of present conditions, and with the express purpose in mind of being able to arrive at a more economic and fruitful means of handling a difficult situation. At any rate it was important to determine if present day methods are the
best possible.

I was not out to achieve maximum coverage, as is ordinarily done, but to arrive at the "most economical efficient arrangement of desirable rental space at the rentals desired". A superior solution would warrant the loss of a few rooms, for the higher rentals, and the elimination of vacancies would compensate for the change. The change, however, can be justified only, if, in addition to superior elements, the economic requirements are met. It must be remembered that most houses are in a definite rental zone, and although a few more dollars per room can be secured for better apartments, there is a limit above which no tenant will go in that particular neighborhood - no matter how good the house.

The common plan for this type of lot consists of a perpendicular H which will provide the maximum number of 30 rooms per floor. The hallway is served by one elevator and one stairway - fire escapes provide the other exit. The plan is irregular and cut in trying to give corner ventilation in the interior courts.

The one barrier to a satisfactory plan is the lot lines on both sides which make it necessary to have in-

1 Architectural Record, Oct. '29, P. 238.
terior courts. The rear lot line can be avoided with a wide court but there isn't enough frontage to allow for that with the side courts. In order to free the building from the restrictions of the lot line the building was placed at an angle to the street. The corner rooms become more valuable and the side courts are eliminated but only 22 rooms per floor are acquired.

Using the diagonal of the lot seemed good and a Z shaped plan was tried. Cross ventilation was achieved through uni-lateral corridors which became unmanageable and wasteful - only 19 rooms per floor.
Instead of using the corridor for cross ventilation an attempt was made to break out the apartments in groups so that each had cross ventilation. However this led to the same wasteful corridors and its irregularity would make it more expensive to build - only 22 rooms per floor.

It became apparent that economically satisfactory results could not be achieved with diagonals, for the lot wasn't large enough to secure the desired results. The idea of group cross ventilation was tried with the corridor parallel to the street. The result provided wasteful interiors and poor plans. Having the rooms face down the street though, rather than directly across is good - 20 rooms per floor.
Turning the Z shaped plan around so that it faced the street allowed an increase in the number of rooms but didn't correct any of the corridor faults, - 21 rooms per floor.

Separate buildings provided neither good cross ventilation or an unified service element. The buildings aren't large enough for separate elevators yet a small service link would cause a deep court, and a wide link would be too wasteful. Thus the plan tends to encircle the lot without having the space to secure the proper results.
The full utilization of the width without any courts or cross ventilation as in the Rockefeller apartments yields 27 rooms per floor. Their value in a neighborhood which is accustomed to cross ventilation is doubtful. Variations for this scheme with splayed rooms or bays to increase the view and the ventilation proved equally unsatisfactory.

The T shaped plan with an unilateral corridor on the back side to provide cross ventilation is not very successful. The excessive corridor and the rear apartments are undesirable - 24 rooms per floor.
A return to a simplified perpendicular H plan with larger rooms and the elimination of unnecessary breaks provides 28 rooms to a floor with the usual cross ventilation. The value of the side courts is still in doubt since little light or air would penetrate them - especially if the adjacent lot was built upon.

By re-arranging this plan on the lot it was possible to get 24 rooms on a floor. The rooms are better than ordinary with no side courts to worry about. However the erection of buildings on the adjacent lots would create 2 courts in front where none exist now.
By changing the previous plan so that one court exists instead of a possible two, and by placing the small apartments in the rear it is possible to have 26 rooms on a floor. The limitation imposed by the small lot and the adjoining buildings has necessitated a variation of the existing scheme. By centering the baths around the interior of the building and removing the lightless and airless side courts, the plan is improved considerably. The majority of the apartments now have good cross ventilation - and at the same time the number of apartments facing each other is kept at a minimum.
The reasoning behind the choice of a plan is mainly of a practical nature. As already mentioned, although many other plans were theoretically better their failure to fulfill the economic part of the picture made their use unsound. The fact that the final plan is a variant of most plans in use today bears out the contention that years and years of apartment house planning has developed, mostly by trial and error, a solution that has the greatest possibilities under present conditions.

Another reason for believing that the solution is justified is by examining it in relation to maintenance. About $30 per room per year or half of the maintenance allowance is for repairs, redecoration, and vacancies. Large well designed apartments which are more in demand would necessarily have a smaller yearly turnover. A reduction in turnover in rentals saves on wear and tear, redecorating apartments, credit losses, bookkeeping, advertising and general administration.

PLANNING

Present planning of multi-family houses are completely lacking in any definite approach or system of layout. It appears as if an arbitrary corner is assumed as a starting point and from there the plan just grows - no particular care being taken to line up either the partitions or the framing members and a general hodge podge results.

In planning this problem particular care was taken to try to simplify construction and plan results by arriving at a framing plan that would carry through the whole
building. That in itself had to be broken at times, but the module upon which the framing was laid out was adhered to strictly. By enforcing some form of module, in this case 4 ft., it seemed as if many of the irregularities of present plans could be eliminated. It is true that in some cases the module might require larger or smaller than usual dimensions, but these instances were sacrificed for a simplified and direct plan. The more simplified the solution the cheaper and quicker the construction element becomes.

INDIVIDUAL APARTMENT SUITE

The basic 3 room suite consists of a bedroom, living room and kitchen and dinette. The bedroom receives the benefit of cross ventilation and the kitchen and living rooms are inner rooms. The dinette is done away with since it has long outlived its usefulness. As a part of the living room, the dining part serves the same purpose in a more pleasing way. Greater window area makes the whole apartment airier and more satisfying. The kitchen is placed adjacent to the bedroom in order to form a secondary family corridor and to serve as a buffer between the living and the bedrooms.
There is a lot to be said in favor of having the bedroom and kitchen separated by the living room and thus permit the kitchen stacks to be combined. However, the bedroom loses most of its privacy and a small circulation problem arises with the crossing of the foyer to reach the other rooms in the apartment. What was previously a service corridor now becomes nothing more than a part of the main foyer. The interior baths remove the problem of providing valuable wall space for an unnecessary element.

The other apartments consist of the following:

One and one-half rooms
Living Room, Foyer, and small Kitchenette.

Two Rooms
Living Room, Kitchenette, Foyer and Bedroom.

Four Rooms
Living Room, two Bedrooms, Kitchen, Foyer, and two Baths.

UTILIZATION OF BASEMENT AND ROOF

Basement

Besides the general storage for carriages and bicycles, lockers for individual apartments, meter rooms, boiler room, and mechanical services, the basement is to contain a garage for about one-third of the occupants. The garage will not only add to the income of the build-
ing but will help indirectly in renting the apartments. Rental is made per car rather than by square feet of occupancy. It is felt that whatever increased expenditures must be made for the fireproofing and approaches of the garage will be more than repaid by the income received.

**Roof**

The elimination of the balcony makes it imperative that either a court or roof deck be provided to take its place. In this case the roof deck is the most suitable. The acceptance of outdoor living space as a natural element in today's habits mean that the roof is no longer a water drain and should be designed for heavy duty wear. An inexpensive system of paving a flat roof which permits walking on it was developed by Le Corbusier. Many years use has proved it to be most satisfactory, both as to weather resistance and as to insulation against the expansion and contraction of the roof. A 1 inch layer of gravel is laid over the roofing membrane; over this large 1-1/2 inch thick precast cement slabs are put in place with wide joints. Rain water runs over the slabs, and also seeps through the gravel, into a special type drain which runs through the center of the house. The establishment of gardens on the roof successfully combat the expansion and contraction of concrete and metal construction.

**CONSTRUCTION**

For the past centuries architectural tradition has been based on the building technique of the wall acting
as the main support of the structure. Structural walls were designed to express massiveness by a contrast between solid and void, and infrequent piercing and deep reveals were used to this end. Now this is all changed and the wall can be used as a thin sheathing of no more structural importance than the window. The wall becomes nothing more than a thin skin hung on a framework with no more strength than is required to support its own weight.

"New materials and construction methods at our disposal have created an entirely new and different concept of the structural relationship within the building bulk".¹ Yet despite this, present day apartment buildings clothe the steel structure in mass brick without the faintest appreciation of the fact that in any framed structure the pillars do all the work and the wall is merely a protection from the cold, heat, moisture, vibration and noise.

Apartment house construction which consists mainly of the brick bearing wall type is the most wasteful and inefficient known. Basically the idea of building a 6 story house out of 4" x 8" brick units seems wrong - especially when it is now possible to erect 4' x 8' wall panels with all the qualities of a 12" wall yet only 4" thick. The savings that would be accomplished would manifest itself in many ways - foremost being the slashing of the all important construction time. Only a mere fraction of the former time would be required, yet so much more

¹Rehousing Urban America, H. Wright, P. 120.
could be done.

In freeing the building from the bearing wall there must be something equally economical to take its place. The use of a skeleton frame will present two important economies. The frame itself can be made up of a few relatively inexpensive but highly efficient shapes that require little handling and small space. The bearing wall is replaced by thin light weight, stiff, and inexpensive curtain walls quickly assembled from large factory made sections. The result is a standardization of parts which, when combined with the story heights, beam spans and beam spacings that are fixed to certain dimensions, the wall partitions, floor sections and equipment units will all produce a more elastic and satisfactory solution.

The requirements for a satisfactory framing scheme are many and varied. The most important, however, of those listed by the Architectural Record are as follows:

- Materials for wall that effectually exclude heat, cold, dampness and sound.
- Weathertight joints throughout, not subject to deterioration.
- Exterior surface of wall hard and durable, requiring little or no maintenance.
- Wall units of uniform size to permit interchange of parts.
- Structure resistant to corrosion and attack by insects and fungi.
- Dry construction.
- Light weight.
- Erection and installation of units by unskilled labor.
- Fireproof.
- Economy of space due to thinness of walls.
- Wall structure capable of housing heating, wiring and lighting pipes and ducts.
- Windows of uniform and standard sizes, permitting maximum daylight and control of fresh air and sunlight.
- Roof drainage through center of house for economy in material and to prevent freezing.
- Soundproof partitions.
- Interior partitions flexible and capable of varied arrangements.
- Minimum cost of construction and upkeep.

**Cantilever Construction**

The cantilever system with thin insulated exterior walls was seriously considered as a basis of construction because of its many advantages and economy. However unless a flat slab reinforced floor is used there is no real saving. In this case where the building isn't fireproof the additional cost of concrete construction would be economically unsound. Placing the points of support in the wall provides greater flexibility and allows for an entire re-arrangement of the floor space. The thin exterior surface with no definite limitations outside of the column spacing has many possibilities.
Conditions that might require a change from a fairly high rental range to alteration for occupancy of a lower income group could be handled easily.

Exterior wall surfaces available for use on a skeleton frame vary anywhere from aluminum to plastics. Each have special characteristics but it is mostly the combination of a few that produces the best results.

Aluminum
- Very light in weight, a good heat reflector and insulator. Excellent weatherability but too expensive at present.

Stainless Steel
- Of all the steels this is the only one that would withstand the weather without maintenance. Metal however transmits the cold quite readily and large areas are glaring. Expensive.

Enamel
- Although a good weathering material with no upkeep, problem, there is danger in chipping and corrosion. Factory finishing is required for best results. Also too expensive.

Plywood
- The large sizes in which this material can be secured are important. Its strength, comparative lightness, cheapness and ease in handling make
Plywood cont. - it an excellent surface material. Plywood, however, won't withstand the weather without some form of maintenance. Neither is it fireproof to too great a degree.

Treated Plywood - In order to correct the maintenance problem the plywood could be treated with a clear Phenolic Resin that would completely protect the wood. This method is still in the experimental stage but it is estimated that treatment would raise the price from 5¢ to 35¢ per sq.ft. It would still be comparatively cheap and in addition the treatment would make it fireproof.

Structural Glass - Although there would be no weathering problem, others would exist. Concrete, brick or terra cotta back up is necessary. Its weight and cost, $1.80 - $2.00 per sq. ft. are rather high.

Concrete - The main objection is based on its weathering ability. In this climate it is felt that some maintenance would be required.
Plastics - Although still in the experimental stage it is expected to eventually be used as an exterior surface. Large sheets would have to be backed up for rigidity with perhaps plywood. Somewhat like the phenolic resin plywood. Still expensive.

Formica - Consisting of a plywood base with a plastic facing it presents a good wearing surface. However it is not recommended for exterior use since the type of plastic used is effected by sunlight.

Cemestaboard - or Transite is made of asbestos fibres and portland cement united under hydraulic pressure. It is dense, un laminated monolithic sheets of great strength and rigidity and satisfies all the requirements for a good outside surface. It will not burn, rust, split or crack. Is easy to handle, can be drilled or sawed and is easily attached to the frame. The most important feature is the elimination of maintenance. Transite weighs about 4 lbs. per sq. ft. and costs only 19¢ per sq. ft. It has a
Cemestaboard cont. - clear light gray color which would be most pleasing in large areas.

Wall Construction

The exterior wall section which consists of corrugated transite backed with insulation board is prefabricated before arrival at the site. It is attached directly to the framework of light angle irons and sheet steel which acts as a light girder. The girder, which is in reality a spandrel thus carries the outside surface, the case ment windows, and part of the floor.

The girder is set flush with the ceiling so that full sill to ceiling window heights can be achieved.

Corrugated cement asbestos board presents a pleasing texture which is architecturally interesting. The corrugations permit a quick and effective watertight bond that requires no more than overlapping and bolting to the frame.

Plaster is used throughout because for some uncanny reason it is still the cheapest known method of finishing a wall. Although
dry construction is preferable, there is nothing that satisfactorily competes with plaster.

Floor Construction

The 6 story non fireproof apartment house is usually framed with wood joists. In this case however it is expected that maintaining a complete steel frame would speed erection and eliminate the complications produced with the introduction of another trade. The removal of shrinkage and the resultant cracks that take place is another point in its favor. Open web steel joists spaced 2 ft. on center are covered with rough planking or plywood, and then followed with the finished floor. All wiring and pipes can be carried through the open joists. The hung plaster ceiling which is partly insulated by the air space between it and the floor above can be further treated if thought necessary. At present, though, other insulation is too expensive to use.

Windows

The use of the skeleton frame makes possible the provision of windows of unlimited length. The isolated window which gave a harsh light and prevented an increase of daylighting beyond a very low maximum is replaced with a window area that extends from ceiling to sill and from partition to partition. The maximum result can be obtained and both the ceiling and partitions reflect the light to the farthest portions of the room, with shades
and curtains being used to control the intensity. The placing and size of windows are no longer governed by the requirements of symmetry for the glass becomes part of the wall surface.

**Insulation**

Although there is no difference in yearly rents before or after sound insulation it was found that it was easier to maintain tenants with it.

Sound is transmitted by molecular vibration and the structural vibration of the partition (or floor) which acts like a thick elastic plate or drum head. A normal speaking voice will deflect a 2" x 4" stud, lath and plaster partition 1/100 of an inch.

Part of the sound waves striking a surface are reflected and part are transmitted by molecular vibrations or diaphragm action to space beyond. A certain amount is absorbed by friction in the walls.

Air borne sounds are not as serious an annoyance to occupants of the room below as impact noises of walking, vibrations from piano or other sources of sound transmitted directly to the floor.

Cork, rubber or other resilient material will lessen impact noises. A hung ceiling, if constructed properly, will do the same.
Sound transmission through the walls may be retarded by mass, structural independence, breaks in density and use of absorptive material. Of these, the latter is the most important for partitions. All walls of adjoining apartments properly covered with 1/2" of celotex on both sides of studs will sufficiently take care of air borne noises.

New York Building Laws

At the very beginning of the problem it seemed as if it would be nigh near impossible to arrive at a solution without disregarding the building code. Codes are established with present methods of construction in mind and usually disregard any changes. The Revised New York Building Code, however, does provide leeway in the form of special approval for new methods that meet the requirements. There is ample reason for believing that skeleton frame construction with a fireproof exterior surface would receive approval since it is no more than an adaptation of the skyscraper principle.

The only other point in question so far as a non fireproof apartment house is concerned is the corridor. This must be built as a fire tower to comply with the regulations, a point that is easily accomplished.

SUMMARY

The present attitude towards apartment house design is perhaps best expressed by the Architectural Record when they said: "The decisive principle in the design of an
apartment house is the domination of the plan to the exclusion of all other factors. Once the plan......is finished, the building, properly speaking, is designed. There remains only the minor business of spacing the windows, and the addition of such proper architecture as may be applied in an effort to secure an acceptable facade - deplorable though this practice may be. But it is the plan which rents the apartment”. The last statement is the foundation for all that has been done under the name of apartment houses. Under its protection the builder has crowded the lot, defaced the exteriors, neglected construction improvements. The builder keeps up to date by keeping close to tradition, the architect does likewise, modernizing the house with venetian blinds and colored tile, but not daring anything more radical.

It is one of the great complaints of modern apartment house construction that the architect is sorely underpaid. For the working drawings of a typical 6 story house, similar to this problem, the usual fee in New York is no more than $1,000, if that much. The reason for this is obvious, for the architect has so standardized his own work that he has nothing new to offer the builder. As long as the architect resorts to his files and makes no attempt to present the builder with either new construction methods, means of saving money, or better plans, there is no reason why he is worthy/any more than he gets. Not until the Owner can be made to feel that the architect is trying
to create a new answer to a problem will there be any appreciation or remuneration.

The skeleton frame with a thin exterior surfacing is not radically new - yet it has scarcely been used in apartment house construction in this country. The arguments against its use are few - mainly that there will be no saving in initial cost. What is forgotten is the fact that the immediate cost is balanced by a saving in erection time, cleanliness, and elimination of confusion. The number of trades concerned with the building are cut down to a minimum and instead of the usual 3 months enclosure time it would be only a fraction. Further saving is gained with the thinner wall sections which add $\frac{2}{3}$ of a foot to the rental value of each room.

The traditionalist objects to the use of a new material because he can't foresee the change that is taking place. The use of a new technique that is without precedent appears strange to one whose preconceived ideas of architectural beauty have been formed in an environment of eclecticism. Accustomed as he is to traditional methods, this simplification of wall surface seems strange and stark. But a curtain wall made of large sections and new materials has a special character and beauty of its own and provided it is honestly and properly designed with the appropriate materials, habitual contact with a new type of wall, floor or window will induce an appreciation of its intrinsic beauty.
Times have changed and where the traditional house forms were the result of former dwelling standards and available materials, so the new forms should be the expression of the new dwelling standards with the new materials and construction methods.
FINANCIAL STATEMENT

Direct House Construction -
10575 x 66 = 697,250 cu.ft. @30¢ $209,385.

Carrying charges during construction
Ordinarily 10%
Reduction in construction time would make it 5%
Architect's Fee - 5% 10,450.

TOTAL CONSTRUCTION COSTS $220,831.

Land.
Lot 165 x 100 = 16,500 sq.ft. @3.27 $54,000.

TOTAL LAND AND BUILDING COSTS $274,831.

Maintenance -
158 rooms @$60 per year $9,480.

Mortgage interest on $180 @4-1/2% 8,100.
Amortization $180,000 @2-1/2% 4,500.
Taxes 8,000.

$30,360.

Management @6% of what? 1,800.

$32,160.

5% allowance for vacancies (half of usual allowance) 2,620.

$34,780.
## RENTAL SCHEME

<table>
<thead>
<tr>
<th>No. of Apts.</th>
<th>Type</th>
<th>No. of Rooms</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>4 rm. apts.</td>
<td>24 @ $105. per apts.</td>
<td>$7,560.</td>
</tr>
<tr>
<td>30</td>
<td>3 &quot; &quot;</td>
<td>90 @ $80 &quot; &quot;</td>
<td>28,800.</td>
</tr>
<tr>
<td>16</td>
<td>2 &quot; &quot;</td>
<td>32 @ $55 &quot; &quot;</td>
<td>9,560.</td>
</tr>
<tr>
<td>12</td>
<td>1 &quot; &quot;</td>
<td>12 @ $45 &quot; &quot;</td>
<td>6,480.</td>
</tr>
<tr>
<td>64</td>
<td></td>
<td>158</td>
<td>$52,400.</td>
</tr>
</tbody>
</table>
ARCHITECTURAL FORUM, JAN. 1937.  
APARTMENT HOUSES.

THE MODERN HOUSE - F. R. S. YORKE  
THE ARCHITECTURAL PRESS - 1935.

ARCHITECTURAL RECORD, MARCH 1929.  
THE MODERN APARTMENT HOUSE, HENRY WRIGHT.

THE MODERN FLAT - F. R. S. YORKE.  
THE ARCHITECTURAL PRESS.

THE BUILDING COST CALCULATION - J. R. SMITH.  
J. R. SMITH AND SON, 1939.

REHOUSING URBAN AMERICA - HENRY WRIGHT.  
COLUMBIA PRESS, 1935.

YEAR BOOK, N. Y. SOCIETY OF ARCHITECTS.  
EDITED BY CHARLES M. CLARENDON, 1940.

ARCHITECTURAL FORUM - AUGUST, 1931.  
SMALL HOUSE CONSTRUCTION, NORMAN N. RICE.

PENCIL POINTS, MARCH 1939.  
PORCELAIN ENAMEL.  
D. H. GROOTENBOER AND DON GRAF.

ARCHITECTURAL FORUM - MARCH 1941.  
PLYWOOD - PRODUCTS AND PRACTICE.

ARCHITECTURAL FORUM - MAY 1937.  
APARTMENT HOUSES.

ARCHITECTURAL RECORD - OCTOBER 1939.  
CONCRETE AND BUILDING DESIGN.

ARCHITECTURAL RECORD - SEPTEMBER 1938.  
BUILDING TYPES - APARTMENTS.

ANALYTIC STUDY OF COST DIFFERENTIALS - PART I & II.  
HOUSING STUDY GUILD - 1934.

WOOD HANDBOOK.  
FOREST PRODUCTS LABORATORY - 1935.

ARCHITECTURAL FORUM - SEPTEMBER 1930.  
THE MODERN APARTMENT HOUSE - F. S. BANCROFT.

ARCHITECTURAL RECORD - OCTOBER 1929.  
NEW CONSTRUCTION METHODS - R. L. DAVISON.
Bibliography continued.

Architectural Forum - September 1937.
Processed Wood Products - Products & Practice.

Architectural Forum - June 1940.
Plastics in Building.

Architectural Record - July 1940.
Plastics and Architecture.

Other books, magazines and pamphlets in the library of the Massachusetts Institute of Technology.