A NEIGHBORHOOD OF HORIZONTAL MULTIPLE HOUSING

Submitted in partial fulfillment of the requirements for the degree of Bachelor in Architecture at The Massachusetts Institute of Technology April 17, 1962

Leonard Bidwell Stolba

Lawrence B. Anderson
Head of the Department
Department of Architecture
Massachusetts Institute of Technology

DISCLAIMER

Page has been ommitted due to a pagination error by the author.

(Page 17)

ABSTRACT

Three separate but interactive thoughts have been developing during the past thirty years.

I. Prefabrication is the direction which an industrialized society must take to obtain the universally accepted goal of more adequate housing for less money.

II. After the family, the neighborhood is the basic social unit for which we must plan in order to assure ordered, but invigorating communities.

III. Population increases, land development costs and rising individual standards coalesce to argue for greater unit density while still providing those amenities which are sought in the flight to the suburbs.

In spite of study and research in each of these areas, there are surprisingly few specific examples of the type of environment that the merging of these thoughts should enable us to create.

This thesis will briefly review these thoughts and ultimately propose such an environment.

April 17, 1962

198 Bay State Road
Boston, Massachusetts

Lawrence B. Anderson
Head, Department of Architecture
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

Dear Professor Anderson:

In partial fulfillment of the requirements for the degree of Bachelor in Architecture, I herewith submit this thesis entitled " A Neighborhood of Horizontal Multiple Housing".

Respectfully submitted,

Leonard B. Stolba

TO DAME FORTITUDE

AND

HER BOUNTIFUL BESTOWAL

UPON MY CRITICS,

WIFE AND SELF

TABLE OF CONTENTS

Background: Prefabrication

A BRIEF HISTORY

Prefabrication in its most basic sense means fabricating at some time prior to erection. In its broadest sense it is the application of any and all industrial principles to the building construction field.

Prior to 1900 prefabrication consisted in lumber yards shipping members cut to size; panelized chicken coops, playhouses, and other small structures. The largest structures were garages and cottages.

In the early 1900's very little progress was recorded. Thomas Edison proposed in 1908 a three story concrete house, cast in place, with either wooden or iron forms. The project proved impractical at that time.

Grosvenor Atterbury proposed and built with hollow core precast concrete panels low cost housing in Forest Hills, Long Island between 1913 and 1918. The heavy panels proved difficult to transport. This coupled with the capital required in both plant and equipment limited this system to very large developments.

Little was accomplished in the early 1920's. Renewed interest was generated by four events: (1) the stimulus of new ideas; (2) the development of sheet materials; (3) research and experimentation carried on by private and governmental agencies; (4) the Depression.

<u>New Ideas</u>

1927 Buckminister Fuller's Dymaxion I; an eight sided structure suspended from enlarged central utility core.

Richard Neutra Diatom I plus II; a rectangular structure with a series of masts placed on the center line of the building much like an old five master. Walls, floor and ceilings were suspended therefrom.

1932 George Fred Keck's House of Tomorrow had a central steel core topped by a truss system from which hung a twelve sided structure. Paul Nelson proposed a rectangular cage-like structure within which the rooms were suspended.

1937 Shape Engineering. Another new approach to structure was Monocoque Construction. Essentially this is the principle of the eggshell. Corwin Wilson proposed a trailer which consisted of a shell of plywood strips which he proposed to wrap around a mandrel. Although never tried, this thinking eventually led to the process of forming curved aircraft parts.

1939 Martin Wagner proposed a sectional steel igloo for earthquake devastated Turkey.

1941 Buckminster Fuller's Dymaxion II, derived from an article which he wrote in 1932 describing an instinctive use of monocoque construction in the domed huts of the Mongolian Yurts. These huts were woven together with staves and felt. This principle we see today in the geodesic dome. A somewhat similar house, consisting of concrete poured over an inflated rubber form, was later developed for war housing by Wallace Neff.

None of these ideas resulted in any massive changes in the building art; however, the principle of stressing the skin of the structure appears again and again, while the idea of a single mast continues to look attractive when we consider our most archaic foundation systems.

One other idea which appeared during this time was the Fuller core concept. Essentially it was felt that significant economies would be attained by segregating and repeating utility units. In 1932 Raymond Hood suggested the use of a separate stack in a high rise structure for elevators, bathrooms and kitchens. This internal stack took its next major step forward in the external viscera of the Kahn medical center.

Sheet Materials

The development of 4'x8' sheets of innumerable materials which could be attached to structural members by various glues and fastening systems freed the factories from the slow and laborious conditions associated with traditional sheathing, siding, and lath. This led to many new systems of prefabrication best catigorized as the panel house.

Research and Experimentation

A new type of political thinking coupled with a new sense of responsibility in both governmental and private agencies made it possible to explore many approaches which had not previously been examined. The Price Foundation attacked the utility core concept. The Purdue Residential Housing Foundation and the Farm Security Administration fostered the beginnings in the low cost housing field. The Bemis Foundation completely studied the housing field. The Forest Products Laboratory, Bureau of Standards and the T. V. A. all explored facets of the industry.

The Depression

Fortunately and unfortunately prefabrication was looked upon as a solution to the economic ills of the country. Raw materials producers saw prefabrication as a potential market to bolster sales. American Rolling Mills, U.S. Steel, and Republic Steel established subsidiaries to manufacture steel houses. Equipment manufacturers sought to use their machinery to produce components. The new materials producers attempted to show how their Celotex and Homosote could be utilized. Scores of new concerns arose to attempt to tap this new source. Unfortunately the low prices for prefab houses were based on mass production and volume sales. The volume proved small and as a result costs high. Most of these new industries failed.

Until World War II the remaining concerns redesigned, re-engineered and perfected erection procedures. The war, with the government housing which it engendered, was the shot in the arm that the industry required. By 1950 there were many organizations and systems operating effectively.

SYSTEMS OF PREFABRICATION

1. Classified by Materials

   Wood, lumber and plywood
   Steel
   Aluminum
   Concrete
   Plastics
   Paper and paper products

2. Classified by Structural System

   Frame assembly - precut members - wood, steel, aluminum

   Frame panels - structural members preassembled with all or some insulation, finish, doors, and windows - wood

   Stressed skin panels - surfacing elements contribute in a major way to structural performance - wood, steel, aluminum, plaster, paper

   Solid panels - panel fabricated as a solid entity, all parts assuming major structural roles

   Panels in situ - monolithic structures including lift slab, tilt up wall, LeTourneau house

3. Classified by degree of pre-assembly

   Precut members

   Panelized construction

   Sectional assembly

   Degree of preassembly of mechanical and plumbing

   Complete preassembly - the trailer - larger sizes limited by existing transportation methods - flying helicopter crane may in time eliminate this barrier

ADVANTAGES AND DISADVANTAGES

1. Advantages

Less expensive
- eliminate the middlemans profit
- eliminate waste of labor and materials
- mass buying of raw materials

Better construction
- workmanship
- strength
- new materials

Better plan and design
- more careful attention afforded when house is to be produced in quantity
- possibility of quality site planning on a large scale

Speed in construction
- extend building season

Flexibility

2. Disadvantages

Opposition of the building industry
- ignorance
- depression prejudice
- vested interests

Antiquated Building Codes

Standardization as the natural road to economy is opposed by potential owners' desire for individuality

Enormous merchandizing investment in methods of sales and distribution
- houses are largest commodity requiring mass distribution
- direct to customer, building crews from factory mail order, salesmen, factory showroom

- real estate developments - entrepreneurial responsibility for land acquisition, land development, house erection, and house and land sale.

- department store agencies - more often by display, but often by assistance in site selection, erection and financing

- local representatives - local builder, lumber dealer at present, but eventual goal is full time agencies which provide services of architect, real estate adviser, builder, landscape consultant and decorating experts.

TRENDS

Ten years after the publishing of Burnham Kelly's "The Prefabrication of Houses" we find that the art has not really advanced as might have been predicted at that time.

Wood prefabricated single family houses have taken a larger part of the market. These same components have been used in some minor multiple housing projects.

Very little work has been done with prefabricated row houses, high rise apartments, or the types of small offices, clinics, and industrial buildings. Other countries have begun to attack these problems, but at this stage they are not far advanced.

Although many refinements have been incorporated, the basic limitations still exist: Building code non-acceptance; conventional transportation size limitations; foundation systems which are not reflective of the needs of most prefabricated systems; failure by most prefabricated developers to plan the site as a complete environment.

Without these developments there can be no great cost reduction, mass public acceptance, entry of big investment capital and eventual volume production.

By analogy it seems as though the industry has the Stanley Steamer, the Maxwell, and even the Bugatti, but very much needs a Ford to start the upswing that has been anticipated since 1951.

Consideration of the preceding facts, necessitates my designing within the context of prefabrication as it exists today, without stating that the resulting structure will be prefabricated, site fabricated or entirely site built.

*Research for this section was prepared intially for the Department of Building Engineering and Construction in collaboration with Mr. R.H. McCrae. It is included in this report because of the relevance of its conclusions.

Background: Neighborhood Planning

Who of us does not recall the neighborhood of our youth, the subtle but ever present demarcation between what we felt belonged to our social sphere and what belonged to another. Perhaps it related to a street, a major space, or a river; perhaps it was merely an innate understanding of the immediate limits of our belonging. As we grew the range of travel extended; to another neighborhood, elementary school, library, high school, and ultimately to work, college or another town. Gradually we feel at ease in ever larger areas of movement; yet self-examination confirms that this feeling of belonging, whatever our age, is always strongest within a certain sphere. The so called neighborhood. Strongest evidence of these subtle, often undefined feelings, is best verified by a return to these areas. The emotion is one of nostalgic belonging. This is however only one of the elements of what might be loosely defined as a "good" neighborhood.

A second look at most neighborhoods will reveal many unpleasant, unsightly and even dangerous elements. They exist and are accepted by the inhabitants but one cannot help but think how much better they could be if these elements had been properly handled.

The problem thus becomes one of determining design criteria which will enable us to create safe, attractive, and invigorating neighborhoods.

There are no strict rules for the design of neighborhoods. Proponents differ by degrees yet agree in overall principle.

> "The absence of a sense of neighborhood or community in modern life poses a serious problem for the preservation of our American democracy"
>
> Dahir, Neighborhood Unit Plan, pg. 7

"From the standpoint of social life the neighborhood unit should possess the best qualities of the small town without sacrificing the broad opportunities inherent within the large citie"

Dahir, Neighborhood Unit Plan, pg. 38

"The subject is as deep and involved as group tension, antagonism and conflict"...Laws cannot create neighborliness between culturally differentiated and alienated groups"

Dahir, Communities for Better Living, pg.230

"The elements of neighborhood are developed in homogeneous areas by people who have positive feelings for each other" yet "change comes from diversity of interest and democratization."

Dahir, Communities for Better Living, pg. 226

"This sense of neighborhood should develope without imposing inhibitions on the residents or limiting social mobility"

Dahir, Communities for Better Living, pg. 223

The problem seems especially difficult in America today. The fact that we are a nation composed of many races, creeds and colors also implies that we are a conglomeration of remnant cultures, traditions, associations and tastes. The difficulty of designing for such diverse potential is enormous. To develope minor neighborhood segments of culturally similar people or to force together those of diverse backgrounds does not seem consistent with our democratic heritage. To subtly create a situation which will allow for the cooperative efforts of such variegated inhabitants must be the goal of any neighborhood.

It has been said that "The intellectual climate of Europe appears to be better suited to nourish cooperative efforts for social betterment than the aggressive individualism of our own country".[1]

---

[1]James Dahir, Neighborhood Unit Plan, pg. 70

Whereas the sense of community in most European countries seems to be reinforced by similar race, religion and tradition, any square mile of suburban land in this country will most probably contain a representative of 20 states and a dozen foreign countries.

Several concepts of neighborhood planning have been proposed. They vary from recommendations of total size to detailed proposals for physical makeup.[1]

Mr. C. B. Fawcett, an English specialist calls his neighborhood unit a "Vill". One quarter mile in radius, this unit contains approximately 2300 persons and was arrived at in an effort to personalize the group.

A Rotterdam group focussed their unit on the nursery school and envisioned concentric circles of town growth.

1. The family
2. The neighborhood: nursery school and shops. 3000 - 5000 persons.
3. Community: Elementary school, churches, shopping, 15,000 - 30,000 persons.
4. Urban district: Secondary education; first work experience, 100,000 persons.

The Royal Institute of British Architects proposed a more rigid breakdown.

1. Five groups of 200 persons disposed about a center for daily needs and day care center for preschool children.
2. Five of these units constitutes a neighborhood of 5000 and contains a school, community center, offices and shops.
3. Eight neighborhood centers equals a borough of 40,000 persons.

One concept proposes the elementary school of 1000 children, generated by

---

[1] James Dahir, Communities for Better Living, pg. 217

500 families located within a half mile walk, as a unit. This places 5000-6000 persons on 160 acres (10 families per acre).

The most detailed proposal, put forward by James Dahir, was called the Neighborhood Unit Plan.

1. Elementary school size - 3000 - 10,000 persons
2. Area bounded by through streets
3. Localize and segregate shopping around the intersection of through streets at the corners of neighborhoods
4. Minimum standards of open space
5. Open spaces leading to the common
6. Institutions on the common

Critics of these proposals argue that they tend to oversimplify the problem. That associations and interests, the prime components of neighborliness, overlap and cannot be ringed. They conclude that these proposals will build in tendencies for segregation.

It is evident that there are no definitive criteria for neighborhood design. The consensus would seem to be that neighborhood planning is an attempt to "organize a considerable area in an interrelated manner"[1] and to generate a "sense of neighborhood without imposing inhibition on the residents or limiting social mobility."[2]

"It follows.....that the neighborhood unit of the planner must be flexible, must take advantage of natural neighborhoods, should not work for self-contained small units except to provide for the most essential daily services

---

[1] Dahir, Neighborhood Unit Plan, Pg. 17

[2] " Communities for Better Living, Pg. 223

and should not try to strictly demarcate but rather to link neighborhoods.[1] That the size of the unit can be based on an educational system and group large enough to allow ample choice of friends and variety of housing types to attract many different income and intellectual groups."[2]

There have been some encouraging examples from the past. Surprisingly their success seemed to depend upon the quality of the site plan rather than the architecture:[3]

The Country Club District in Kansas City was the first to incorporate self-perpetuating private restrictions to assure continued community quality.

Sunnyside, Long Island successfully employed the principal of the superblock.

Radburn, New Jersey employed the superblock with cul de sac auto circulation and an internal park space.

Baldwin Hills Village, Los Angeles combined the Radburn superblock with the Sunnyside row house.

Chatham Village, Pittsburgh is the superblock plan on a hillside site.

Williamsburg, Virginia; Washington, D.C.; Kingsport, Tennessee; Fairview, Camden; Greenbelt, Maryland and Greenbelt Wisconsin each offers some basis for future considerations.

---

1 James Dahir, Neighborhood Unit Plan, pg. 38

2 James Dahir, Communities for Better Living, Pg. 227

3 James Dahir, Communities for Better Living, Pg. 172

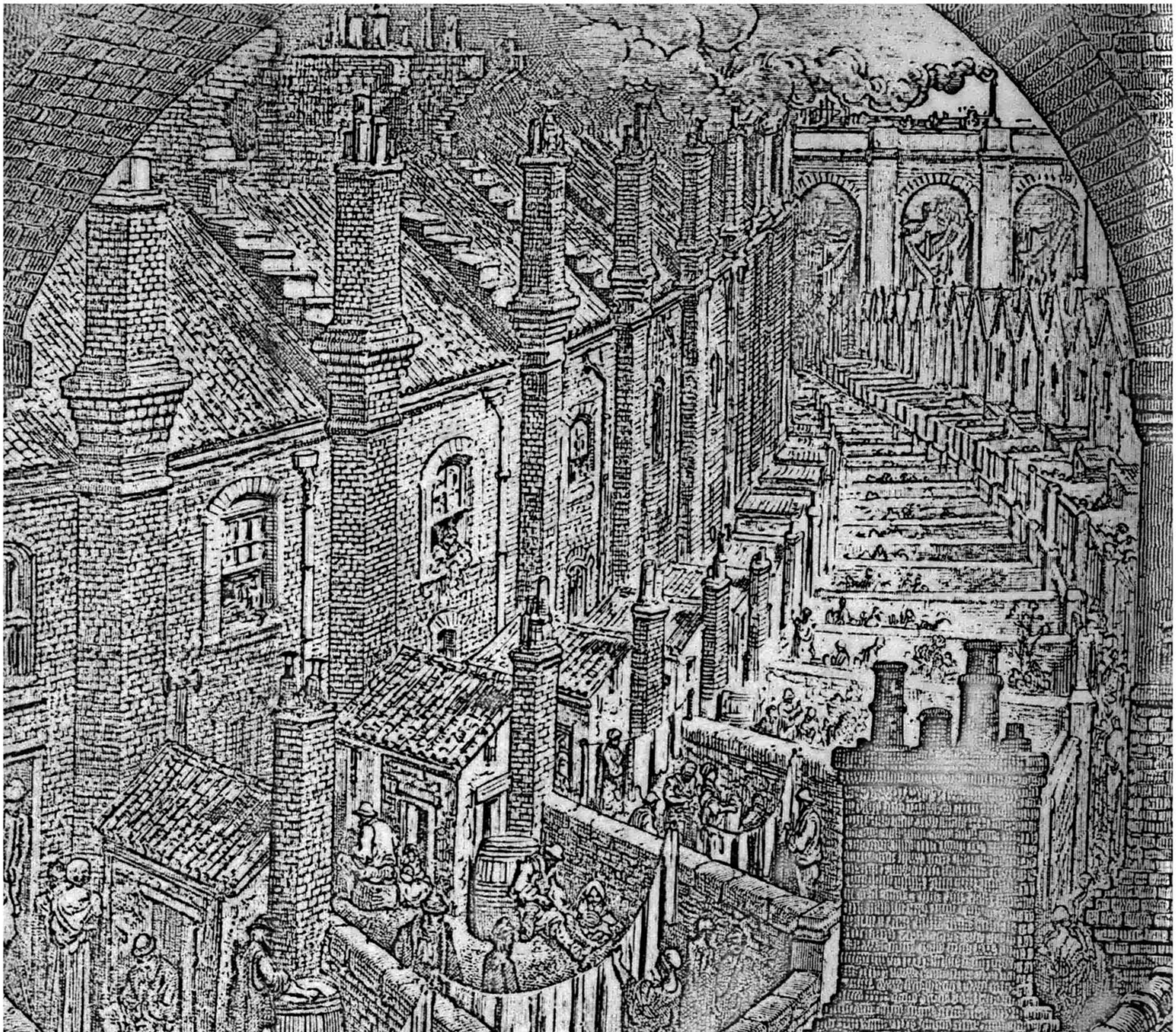
Although these examples seem like a miniscule output measured against the amount of building that has been done it is nevertheless encouraging to know that they exist and that the most successful, like Radburn, New Jersey have been successful in terms not only of community participation and morale, but also, financially, in regards to continued occupancy and sustained property value.

In spite of the differences that may be observed in the proposals and examples, there seems to be a very strong logic and consistancy running through both. The size of a neighborhood may vary from 2600 to 10,000; the elements of common interest may be nursery schools, elementary schools, semi-public gathering spaces, shops, or community areas; the spheres of interest, association and communication may overlap within and outside the neighborhood; however the essential facts remain.

Outside of his unit the individual and his family requires certain opportunities. These are to move about as a pedestrian within a group large enough to preclude unnecessary familiarity while small enough to retain a sense of individual identity within the group. To enjoy moving along safe pedestrian streets via successive, varied, spacial and visual experiences while encountering opportunities for both intended and chance encounters with similar and, occasionally, dissimilar persons. These circulation avenues must link the individual units, semi-public outdoor space and public outdoor space via varied paths in such a way as to produce in the individual a strong identity with and affinity for his neighborhood.

This is the neighborhood I shall propose.

Background: Housing



"For warmth, convenience and economy the historic tendency has been first to huddle houses closely and then join them together promiscuously as in Medieval London and eventually as after the Great Fire to rationalise this form of structure into the long terraces that culminated in Bloomsbury and Regent Park. This dignified form of living was eminently suited to our nature and our climate, and fitted the social way of life of the time.....Unfortunately this system of urban living was so rational and economic that it was used as the basis of industrial housing in the Victorian era. The slums contained all that was economic of the Georgian Terrace with none of the grace. It is no wonder that the Twentieth Century ushered in a hatred of this home so grossly unfair to the original. After six decades of the semi-detached house in suburbia and a multitudinous variety of slab and tall blocks of flats in the cities, the terrace form of structure is once more coming into its own. But there are differences from the past that are so great as to throw open wholly new lines of possibility." [1]

---

[1] G. A. Jellicoe, Motopia, Pg. 71

Houses have been huddled to retain heat in cold climates, to reduce heat absorption in warm climates, for mutual protection in fortified cities, for ease of access to central locations, because the social structure was intimate, and because the social structure demanded privacy. In all cases this huddling either effected or was a result of basic land economics.

Concurrently houses have been detached in an effort to attain abundant light, air, sunshine and breezes. They seemed more amenable to quiet, prestigious isolation and the expression of an individual environment. Amenity for amenity they are more expensive.

The problem of housing always seems to be one of providing for increased standards of sun, light, air and outdoor space along with the required interior space on ever more costly parcels of land.

This is not a new problem. William Penn faced it in Philadelphia.

"Penn's dream of a city of single houses and open gardens died at the hand of traditional building habits and increased land values both of which forced the break up of superblocks into smaller narrower lots more suitable to urban row house construction than to single buildings."[1]

The result was the Philadelphia row house.

---

[1] John Murtagh, "The Philadelphia Row House," Society of Architectural Historians, Dec. 57, Pg. 8

Row housing has been traditionally associated with the city or near city area. In the temperate zones it has usually been a two or three story structure on a narrow lot with very little private outdoor space. Entry is from the street and servicing is in the rear with the interior life usually segregated by floors. Numerous examples may be found in Boston, New York and Philadelphia.

In other countries various row house forms have evolved as a result of conditions particular to the climate, sociology and building technology.

The hot, dry countries evolved many one and two story atrium houses with vertical interior courts.

The hot, wet countries favored bi-nuclear one story houses that allowed the breeze to flow completely through and separated the kitchen and bath area from the main house.

In recent years there has been renewed interest in row houses, principally because of increased land cost, desirable proximity to the center of the city and a realization that the one family detached house on the type of lot most of us can afford has few amenities other than the psychic satisfaction that it's yours. There are at present several basic approaches to row housing which I itemize.

The Narrow Row House

One to three stories, four with grade differential; unlimited opportunities for site grouping
Narrowness overcome by spacious interiors
Exterior privacy difficult
Split level arrangements possible
Extra bedrooms yield extra floor and varied skyline
Offsetting varies street facade
Car difficult to handle except in group lots or underground
Possible density 20 units/acre including 100% parking

The Wide Row House

Similar to narrow row house
Better for exterior privacy
More spacious, much like detached house
Much lower density possible
Car in group lots or very expensively underground

The Stacked Row House

Two dwellings where one would occur
Best for hilly site where grade differential allows both access to ground
All the possibilities of narrow row house
with little loss of privacy if grade adjustment is possible
Noise problem between floors
Many sectional arrangements possible
Street variation by setback and omitting units on upper level
Difficult to obtain private entry
Density potential to 30 units/acre including 100% parking
Parking difficult as in narrow row house

The Raised Row House

Concept of porte cochere
Auto beneath unit,
Good auto/unit; Service/unit relationship
Auto still dominates one side of house
Direct access to garden
20 units/acre including 100% parking

The Back to Back Row House

Maximum density potential
Difficult privacy problems
Outdoor life and service on same side
No cross ventilation except by section
May incorporate interior gardens
30 units/acre including 100% parking

The Garden Court House

The natural result of high density housing with garden courts
Courts may be interior, private, shared, or abutting a common space
20 units/acre including 100% parking

The Double House

Efficient land use, and sharing of utilities while still retaining most of the feeling of a detached house

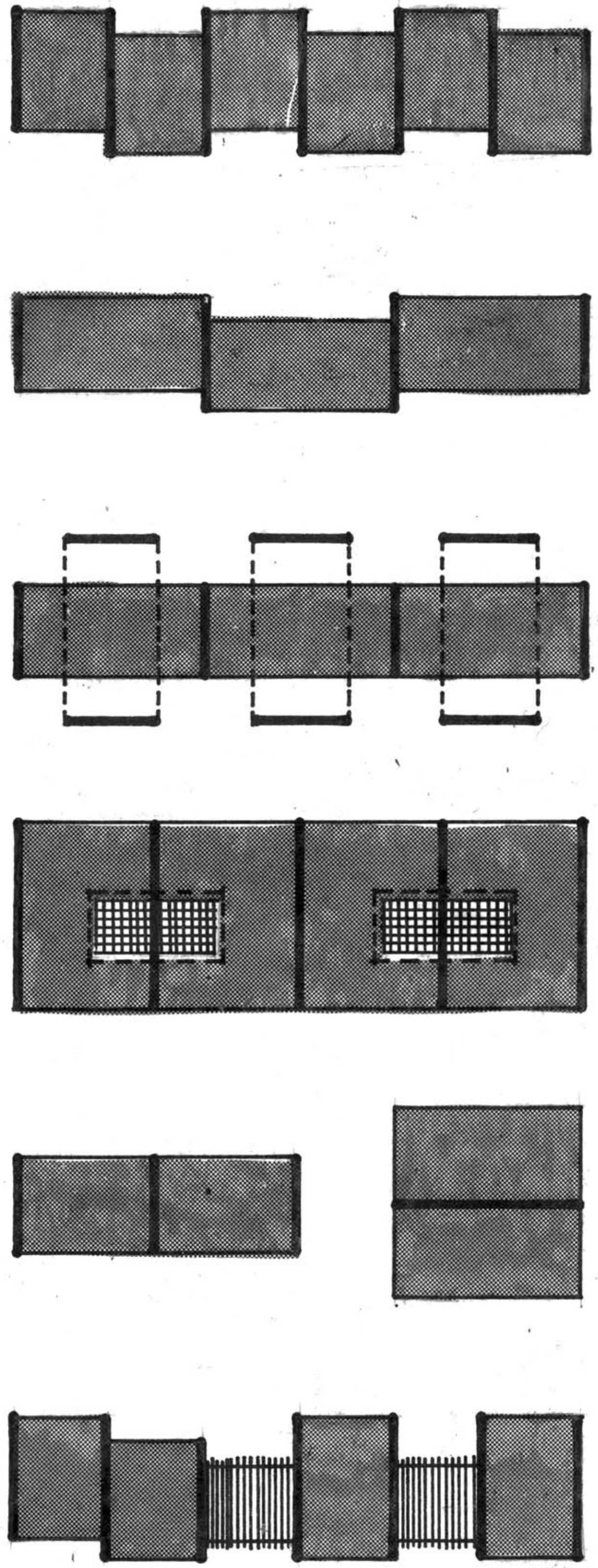
The Semi-Detached Double

Further land economy by joining double units on carport and service area of next unit.

The Semi-Detached House

Land economy by abutting carports and fences
Essentially a house within a fence

In considering historical precedent and its relevance to the present it is necessary to separate idea from specific form of the past. I shall attempt to accomplish this in my proposal.



Narrow Row

Wide Row

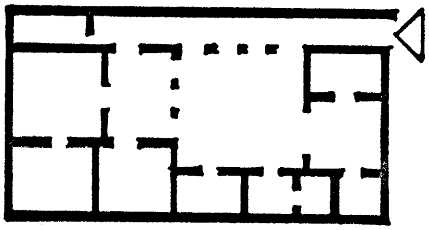
Stacked Row

Atrium

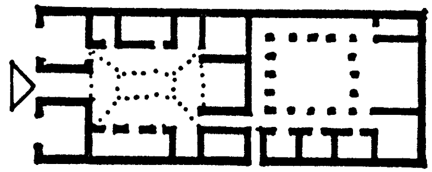
Double

Semi-Detached

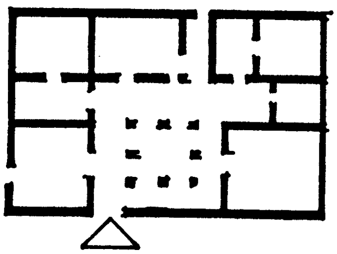
Approaches to Row Housing



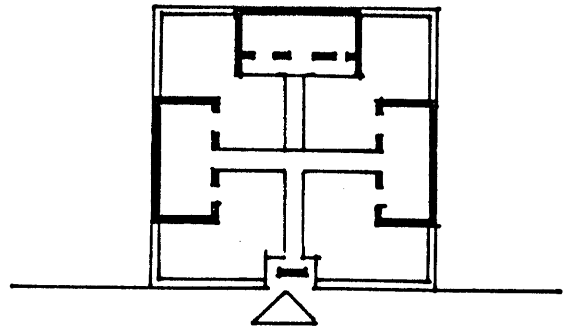
House in Priene 400 B.C.



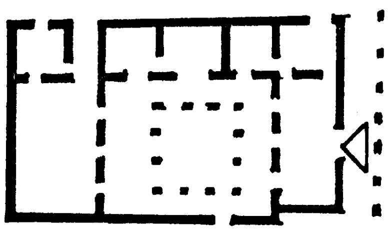
Pompei 100B.C.



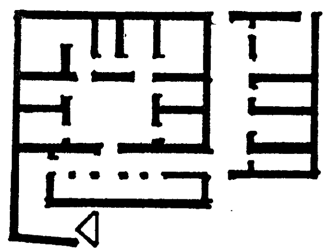
House in Salonika 200 B.C.



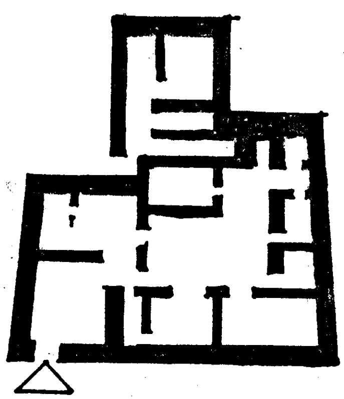
Chinese House
Middle Ages



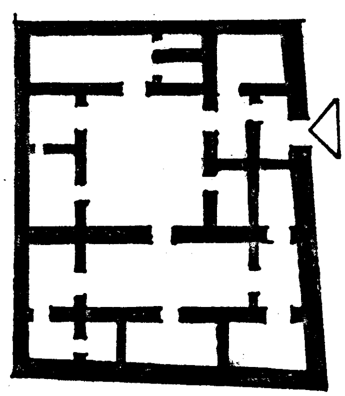
House Type in Delos 100 B.C.



Egyptian House 1500 B.C.

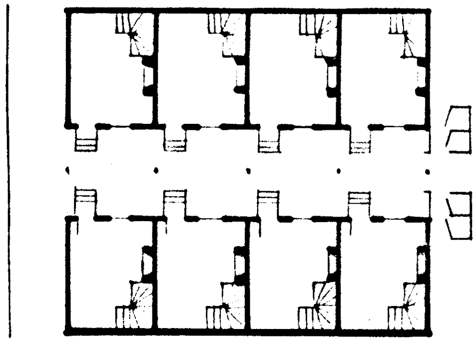


House on the Indus 3000 B.C.

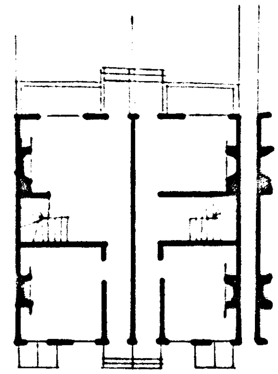


Babylonian House 2000B.C.

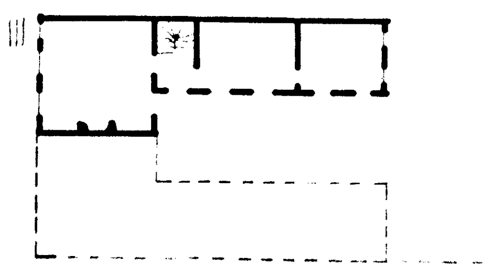
" How the Greeks built Cities"-- Wycherly



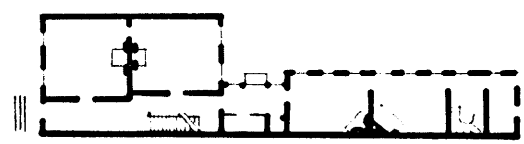
Bell Court
Band Box House



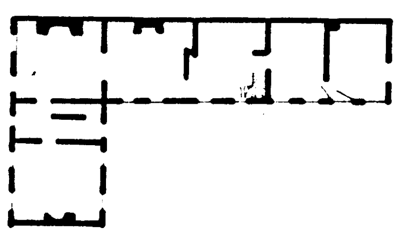
Marshalls Court
London House



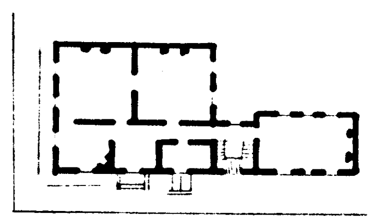
City House



Town House

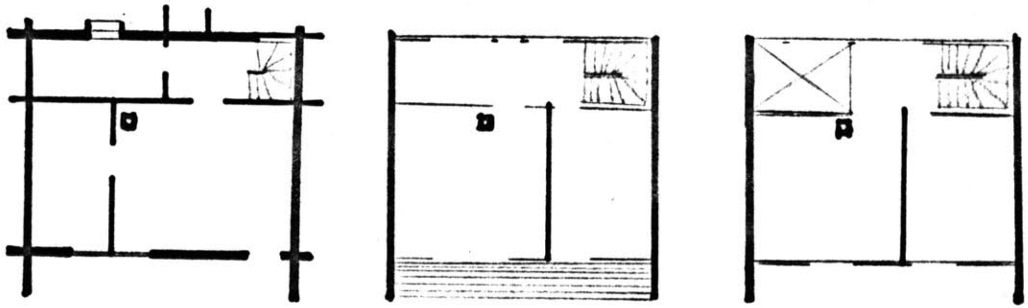


House on Double Lot
Reynolds-Morris House

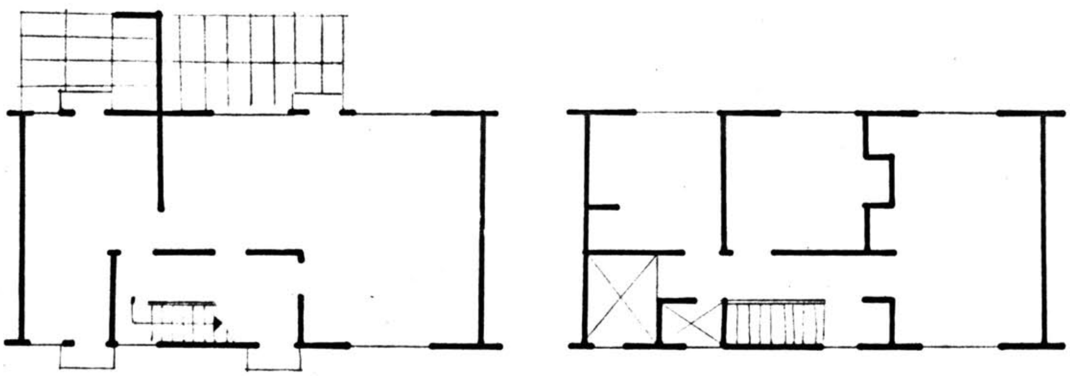


House on Corner Lot
Shippen- Wistar House

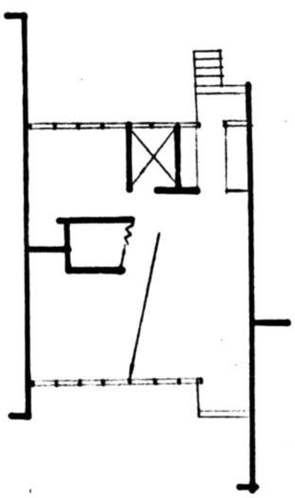
Society of Architectural Historians- December, 1957



Row Houses of the Bocksriet
Settlement Schaffhausen, Schweiz

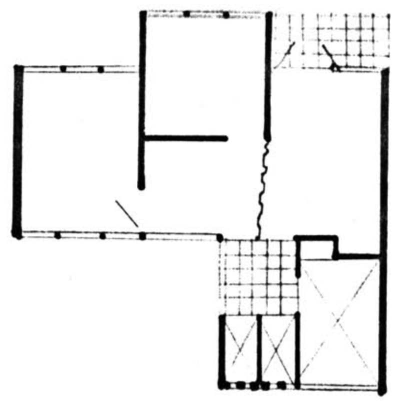


Braithwaite Row Houses
England

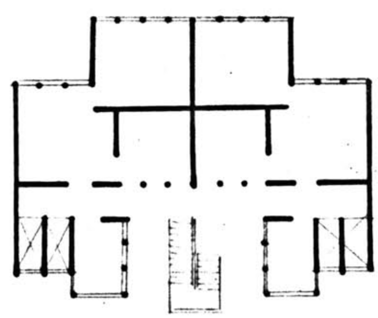


Valleyo Housing Project
California

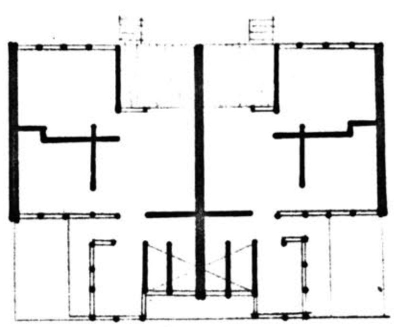
Keleti M. Arch. 1948



Working Class Flats in British Guiana

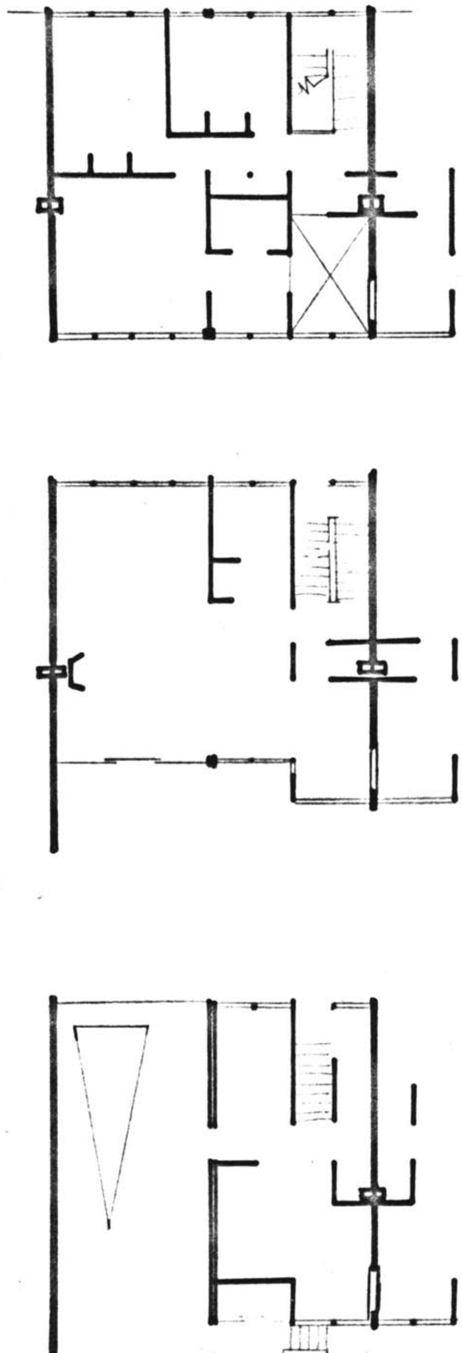


Terrace Housing in Barbados



Row Houses in British Hondurus

Keleti M. Arch. 1948



Neighborhood Project in Washington D.C.

Keleti M. Arch. 1948

General Conditions of The Problem

Housing design has been concentrated in two areas during the last 50 years: The detached house and the slab apartment. Representing the extremes of both suburban and urban living these forms leave untouched a great intermediate zone that might be called semi-urban. In this zone we presently find overly dense detached house communities, large old detached houses that have been divided into apartments, double houses, medium rise apartments, and recently what might be termed stripped down town houses. Except in rare cases these housing forms provide very minimum interior facilities and next to no exterior. In all cases their density is a response to the basic land economics which exist. Their form is indicative of a groping for some method of housing which provides those amenities sought in the suburbs while remaining within a reasonable distance from the opportunities offered only by the city. This form might be generalized under the heading of horizontal multiple housing. It cannot be specifically delineated by unit density because in most cases density is set by land value, potential market, and site considerations.

This area seems to be present in most cities. In Boston it is specifically that area within Route 128. Herein we still find reasonably large sites which are too costly to develope as single lots. An example of this is the fact that good 3/4 acre lots in Lexington are selling for between 7 and 10 thousand dollars. Examining this in light of the generally accepted rule that land is one fifth of the total cost of house and land; yields the frightening prospect that only 35 thousand to 50 thousand dollar homes can exist within this area. Taking this further, to the rule of thumb that your house cost should be no more than three times your annual salary, we must conclude that only those making 12 - 16 thousand annual salary should build within this zone. This is preposterous from any point of examination. What is happening in these areas is that the land cost is becoming a much larger portion of the total house and land package, house and land mortgages are becoming larger in relation to annual salary and most unpleasant of all lot size, house quality, and both interior and exterior amenities are, as a result, cut to the barest minimum.

It is my conclusion that this area of horizontal multiple housing is in need of restudy.

The question might well be asked. Just what is Horizontal Multiple Housing? Since it is so interrelated with neighboring houses it must be more than a house yet it is not a collection of housing units as an apartment building. The often used term "row house" seems to be a misnomer because we find ourselves moving away from both the row and the sharing of party walls as we attempt to coordinate the life of the family in the unit with the succession of private, semi-public and public outdoor spaces that consitute a neighborhood.

Most probably horizontal multiple housing must be considered as an attitutde toward land use which strives to shorten roads and utility runs, save natural landscape features, and concentrate remaining open land while still providing sun, light, air, privacy, a sense of ownership and individual expression.

The fact that horizontal multiple housing necessitates the successful combination of those amenities sought in the detached house and those economies inherent in the row house may suggest that what we need is a new form of housing.

There have been some current architectural writings which suggest one approach that might lead to this new form of housing. This is the approach of providing a basic shelter than can be modified to fit the needs and pocketbooks of the occupants:

> "Farewell to masters, goodbye to geniuses! Anonymous man, self-sufficient and free, will live in Earth-City, where houses will have undergone a radical transformation, built over the tops of factories, out into the water, or 'rising from steep rocks on giant skeletons.' In these skeletons the inhabitants will build their nests, as the birds do, without any need for an architect-decorator."
>
> Christopher Tunnard in his review of Leonardo Ricci's Anonymous 20th Century - New York Times Book Review, January 14, 1962.

> "The problem is how to establish a contrary movement; to restore family choice and freedom in the new architecture. Let us restrict the imposition of the architect to its minimum function, the provision of efficient shelter and services. We then provide for each family an empty shell without partitions and (for the rich) two stories high; completely serviced with light, conditioned air, water, and so forth through the columns of the building. Hitherto architectural practice has provided not only such a serviced shell, but also the imitation of a house, with plan and fundamental decoration complete. Partitions, balconies, etc. But these parts have no structural nor technical necessity and belong to private taste, need, or caprice; they need not be standard."
>
> Paul and Percival Goodman, Communitas, pg. 145

Naturally we do not have to look far to see the visual problems inherent within these proposals. The architecture must be strong enough to accept this individual variety as a rich addition which enhances but does not dominate. This basic structure must insure the definition, order and coherence of the community. Were this to be so, such a proposal might lead to a significant new housing form.

Specific Conditions of The Problem

I. <u>Success of Any Housing Scheme</u>

Although not always within the domain of the architect, it should be considered by him in his relationship with the owner/operator; especially in the early stages when the structure of the eventual ownership management pattern is set.

1. Occupants - Often the occupants will be set, by law if the project is under government aegis or by the existing market if a speculative project is being considered. In general the designer must know what occupant range he is designing for. Although it is generally considered that permanency of residence, education, income and nature of employment are the best indication of occupant quality, this is by no means conclusive. It would seem that the designer should know both the tradition and existing living patterns of the occupants he expects to shelter and shape the environment for these considerations.

2. Management - Although there are several physical forms of management each having their merits in given situations, the designer is primarily concerned with the fact that there will be some management and moreover what quality of project maintenance this management will be able to provide. This should be understood by the designer before he begins.

3. Site Planning - The major considerations in site planning are efficient utilization of land, economical layout of streets and services, exploitation of existing site assets, effective

relationship of buildings, and subtle but adequate parking areas. The total site plan should have both variety and unity especially as it would contribute to an occupant's sense of neighborhood.

4. Landscaping - The landscaping should serve to define the private, semi-public and public areas. It should provide areas for both active and passive recreation. Initiative, freedom and innovation should be encouraged in the occupants. Ideally these should be made up of hardy growth materials for minimum maintenance.

5. Buildings - The individual units should be planned to reflect the daily activities of the specific occupant group. Principal additional considerations are initial construction economy, low maintenance, variety within harmony, careful massing, choice of materials and good detailing.

II. <u>Type of Families</u>

> "As individuals and as families we are born, grow up, grow old and die; the correct physical structure of the community must accommodate this inevitable process."
>
> Murray and Fleiss, <u>New Forms of Family Housing</u>

1. Young married couples, bachelors and the so called bachelor couple.

   Provide for: Living, cooking, dining, entertaining, sleeping
   Day most often spent away from home
   Major recreation sought elsewhere
   Contact with ground desirable but not absolutely vital
   Flexible living and sleeping arrangements within the unit

2. Families with young children.

Provide For: Living, cooking, dining, entertaining, sleeping of adults and children
Kitchen and dining family area most important
Enclosed garden for children 1 - 3 years
Outdoor garden for children 1 - 8 years
Private garden for adults

3. Families with teenage children.

Provide for: Living, cooking, dining, sleeping, active recreation and privacy areas for adult and semi-adult elements.
Private garden more for adults as the children tend to be away from home
Direct contact with ground not absolutely necessary

4. Older couples.

Provide for: Living, cooking, dining, entertainment
Sleeping, active and passive recreation
Separation during sickness
Visitor sleeping
Puttering garden
Easy access to unit and from unit to nearby green areas, where they can feel a part of the vital young life

III. Auxiliary Services

1. Access to auto area, units, outdoor spaces

2. Delivery to unit via pedestrian
   or to unit via parking and service

3. Laundry to unit via pedestrian
   or to unit via parking and service
   from unit to neighborhood laundry provision

4. Garbage by incinerator with internal circulation
   or by storage and collection when service access is provided

5. Fire Trucks by access along both pedestrian and auto streets
   unless fireproof construction is used.

6. Parking separate the auto and the pedestrian
   via - open lot, shielded, recessed, removed
   least expensive but access to unit will usually suffer
   or via - storage in unit, desirable but presents garage door street elevation
   or via - underground access and storage, most desirable but expensive and requires some type of supervision.

Most advocates forget that this is a major means of arrival in the suburbs.

IV. Livibility at High Density

1. Retention of the scale of the individual person

2. Expression of the identity of each family unit

3. Provision of space and variation

> "It is quite evident that the total experience of an environment involves passing from exterior spaces called streets, greens, squares, piazza into interior spaces called rooms."
>
> Irving Grossman, "Urbanizing the Town House", *Progressive Architecture*, March, 1962.

Livibility at high density necessitates the full exploitation of these spacial variations. In our current planning we have lost the art of defined exterior space. We must make use of the abrupt transition from town to country, the possibilities of dense spacial compression, the serenity of a quiet area set apart and the visual delight of strong housing shapes.

We must provide the following spaces.

Private Outdoor - Screened from neighbors, partly paved and partly shaded, need not be more than 1000 square feet, may be adjacent to unit on the ground, or in its more limited form a roof garden or balcony.Ideally it would provide a glimpse of uninterrupted spaces, trees, grass and flowers.

Planting Areas - Safe from intruders, but visually enjoyed by neighbors.

Semi-public Gathering - Childrens play, gossip, laundry, for a limited number of units. Three to five thousand square feet.

Community Open Space - Playing fields, school ground, open park space, both active participation and passive spectator potential, the sense of freedom of a big space, at least one acre.

This might be called the efficient planning of the back yard. The backbone is a contiguous pedestrian space rather than the current auto street.

Acoustic Isolation - Through walls and between spaces.

V. Variety and Diversity

Occupants

Units

Spaces

Circulation Patterns

Masses, Forms

Materials, Textures, Patterns

Detailing

Contrast of widening and narrowing streets. Variety of elevations with one and two story elements. Details that are part of peoples experience - porch rails, double hung windows, pitched roofs, flower boxes.

Vernon Deamrs "is convinced that any Row House solution that does not concern itself with the need for a recognizable, individual expression is simply dodging the real issue."

"Row Housing", House and Home, July 1955.

"Looking at our older communities...we find...an eloquent vocabulary of form. This dealt with proportion, detail and ornament and was carried through the interior as well as the exterior. When copy books were used, these contained the results of years of refinements by able architects and were embellished with contributions of skilled artisans and craftsmen. The builder had infinite solutions to his problems and generally, even with his own improvizations could not go far wrong. The results were rich in detail. Although facades were basically the same, there was infinite manipulation of entrances, windows, porches, details.... This is very desirable when large numbers of people are involved."

The Problem And The Program

To design a neighborhood of horizontal multiple housing for a site within the radius of Route 128. This site does not specifically exist but is assumed to be essentially flat, dense suburban, without any unusual edge conditions, views, or tradition. It is further assumed that this site is bounded by a major traffic artery and has pedestrian access to public transit, shopping, churches and those facilities normally associated with a community of which this neighborhood is a part.

This neighborhood will include a variety of housing units and a hierachy of outdoor spaces. No specific national, religious, racial, economic, occupational, or educational group will be designed for. It is assumed that if the basic amenities are provided and the neighborhood as a whole is successful its occupants will evolve their own patterns of sociability predicated upon their interest and desires at any given time.

The units will be rented with option to purchase or sold. In order to encourage individual ownership, rental rates will exceed the total of monthly 20 year mortgage payments and apportioned maintenance.

All occupants will automatically become members of a neighborhood association whose purpose, in conjunction with the owner-manager, shall be to assure proper maintenance of those portions of building and site that by their location or function can be said to effect the image of the neighborhood.

The Neighborhood

600 family units

6 to 12 units per acre including:

1. Dwelling unit
2. Entry space
3. Attached parking, on site visitor parking, road system
4. A service access for garbage, laundry and fire trucks
5. Private outdoor space
6. Semi-public (gathering space)
7. Public space including school at nursery level
8. Shopping for necessities
9. Places to meet
10. Public transit stations

Family Unit Breakdown

1.	25% single couples and bachelors	1 bedroom
2.	25% parents and one child	2 bedrooms
3.	25% parents and two children	3 bedrooms
4.	15% parents and three children	3 bedrooms
5.	5% parents and four children	4 bedrooms
6.	5% parents and five children	4 bedrooms

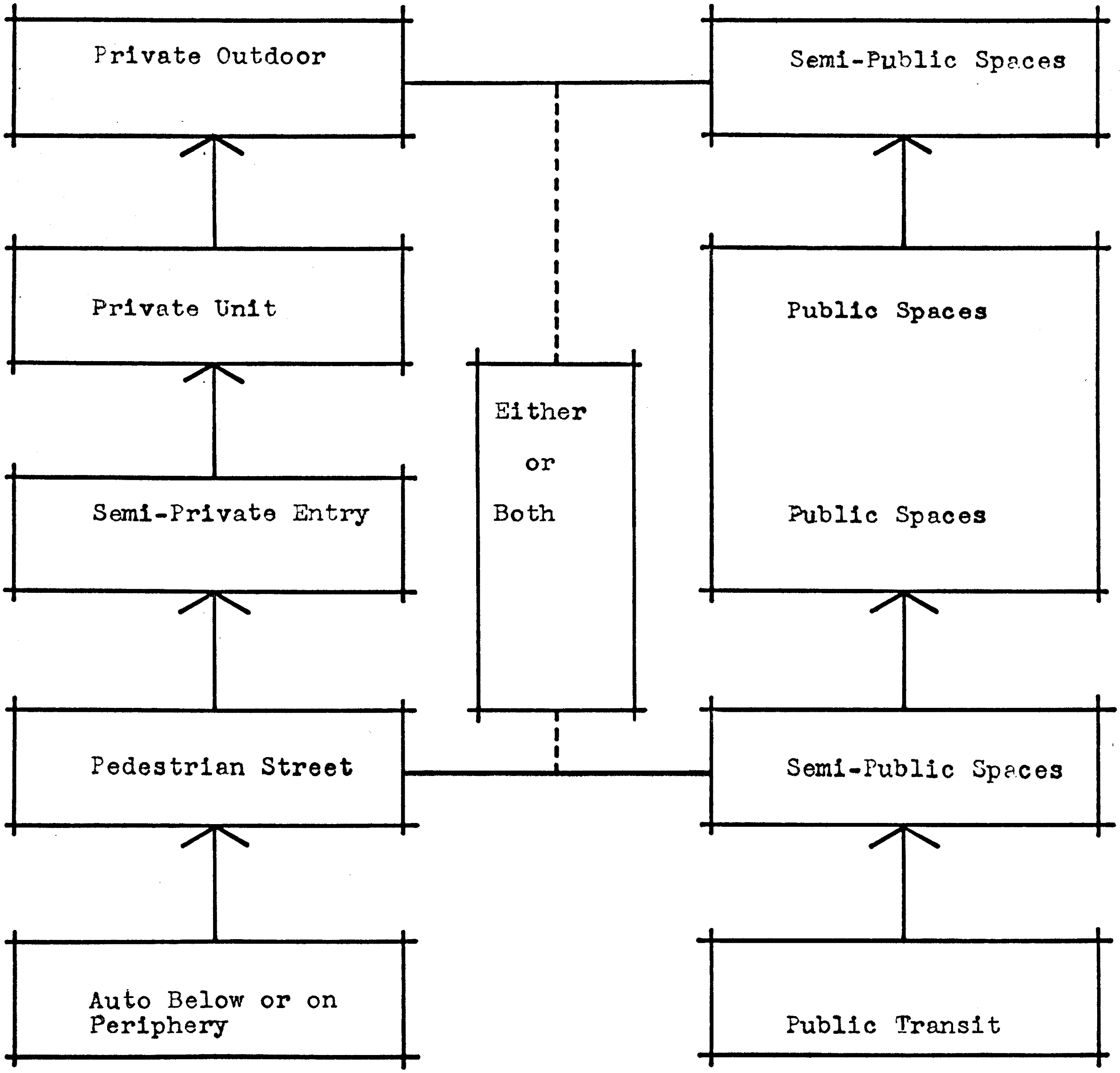
This breakdown yields 75 persons per 20 units or approximately 2250 in a neighborhood of 600 units

Room sizes established as minimum for any unit to be increased proportionately with size of family.

Entry	40	square feet
Dining	80	" "
Living	200	" "
Kitchen	100	" "
Laundry	30	" "
Lavatory	30	" "
Master Bedroom	150	" "
Extra Bedroom	125	" "
Car Shelter	320	" "
Entry Court	100	" "
Patio	400	" "

Detailed Development

Provided I can secure reasonable cost figures from a developer who is currently developing a neighborhood of similar size; I should like to submit my design to a realistic cost comparison.



Sequence Study   Row House Neighborhood   Thesis 1962

LIST OF ILLUSTRATIONS

BIBLIOGRAPHY Housing & Neighborhood Planning

Dahir, James, Communities for Better Living. New York: Harper & Bros. , 1950.

__________. Neighborhood Unit Plan. Russell Sage Foundation, 1950.

Goodman, Paul & Percival, Communitas.

Hahb, Home Builders Manual.

________. Home Builders Manual for Land Development.

Jellicoe, G.A. Motopia. New York: Frederick A. Praeger.

Keleti. From the Detached House to the Row House, A Study in Housing. M. Arch. Thesis, 1948.

Kennedy, Robert Woods. The House and The Art of its Design.

Murray, J. A. and Fliess, H. New Forms of Family Housing. Canadian Housing Design Council, 1961.

Perry, Clarance A., Housing for the Machine Age. Russell Sage Foundation, 1939.

Periodicals

Architectural Forum. October 1943. "Planned Neighborhoods for 194X".

Architecture & Building. September 1958. "The Living Suburb".

Ball & Werk. May 1959. "Row Houses - Good Elevations".

Castabella. December 1961. "A Town in the Country".

House and Home. September 1954. "Good Design for Production".

House and Home. October 1957. "Two Story Row Houses".

House and Home. April 1958. "Garden Apartments".

L'Architecture D'aujourd' Hui. May 1954. "Jacobson Elevations".

Progressive Architecture. January 1962. "Row Houses by Hisaki".

Society of Architectural Historians, December, 57. "The Philadelphia Row House".

Progressive Architecture. March 1962. "Urbanizing the Town House".

Werk, November, 1958. "Row Housing Using Roof for Semi-public Space".

Reports

Harvard University, Comparative Housing Study. May 1950.

PREFABRICATION

READING BIBLIOGRAPHY

Bemis, Housing Mass Produced.

Bruce, A History of Prefabrication.

Carr, A Practical Guide of Prefabricated Houses.

Cherner, Fabricating Houses from Component Parts.

Kelly, The Prefabrication of Houses.

Kelly, 1952 Housing Conference M.I.T..

M.I.T., Industrialized House Forum.

Walter Meyer-Bohe, Wohnhauser.

PREFABRICATION

REFERENCE BIBLIOGRAPHY

Collins, F., Design for Tilt-Up Construction.

Fertighaus - A prefabricated single family community including pricing

House and Home, Dec. '55, Is there a prefab in your future? pg. 128.

House and Home, Dec. '55, You can sum up prefab. like this. pg. 137.

Interbuild 1960, June, Universal design, pg. 21.
Lift slab, pg. 38
Plastic plumbing, pg. 29.

Interbuild 1960, Dec. Neolith roof and floor system, pg. 37.

Kistenmacher, Fertighauser.

Manufactured Homes, '60 May, Techniques of panel fabrication, pg. 34
Prefabricated closet, pg. 36
Tractor-trailer-crane, pg. 44
Precast Conc. foundation, pg. 89

'61 May
Review of foundation design, pg. 34
General Homes one day house, pg. 39
Automation in prefabrication, pg. 43.

'61 Aug.
Use of curtain wall panels in experimental house, pg. 30
Alcoa House, pg. 36

Prefabrication, '54 Sept.
Industrialized building in France
Asbestos board
Metal frame, Dexion Ltd.

'54 Oct.
Prefabricated elements in reinforced concrete, pg. 7.
Lift slabs, pg. 20
Light alloy panels, pg. 26
Impact of prefabrication on building techniques, pg. 28

'54 Nov.
Site handling of concrete components, pg. 7
Steel prefabs, pg. 11
Light weight prefabricated conc. roof - Tass system, pg. 23

Prefabrication, '54 Nov.

Unimer Buildings, pg. 30
Aluminum tiles, Welded Aluminum structures, pg. 33, 35.

'58 Jan.

Prefab building system - timber and panels pg. 103
Monolithor, pg. 108
Low cost timber housing in Malaya, pg. 112
Concrete facing elements, pg. 124

'58 Feb.

Precast concrete one story industrial building, pg. 161
Low cost housing in Sweden, Pg. 167

Progressive Architecture, Nov. '57

Floors for radiant heating and cooling by air, pg. 7
Modular Assembly, pg. 117
- modular measure
- prefabrication
- structure/use modules
- proportional modules
- curtain walls
- modular components
- modular assembly

Relocatable Defence Housing

Acorn
Gresham
HBC
Mobile home
Nicoll Lumber
pressed steel car
Transa Housing

Report on Material and Methods for Rapid Construction of Emergency Type Shelter - U.S. Army

Scotcon Construction

The Techbuilt Manual

The Techbuilt Idea

Kelly, P., Prefabricated Housing Bibliography

APPENDIX II

Illustration of Components

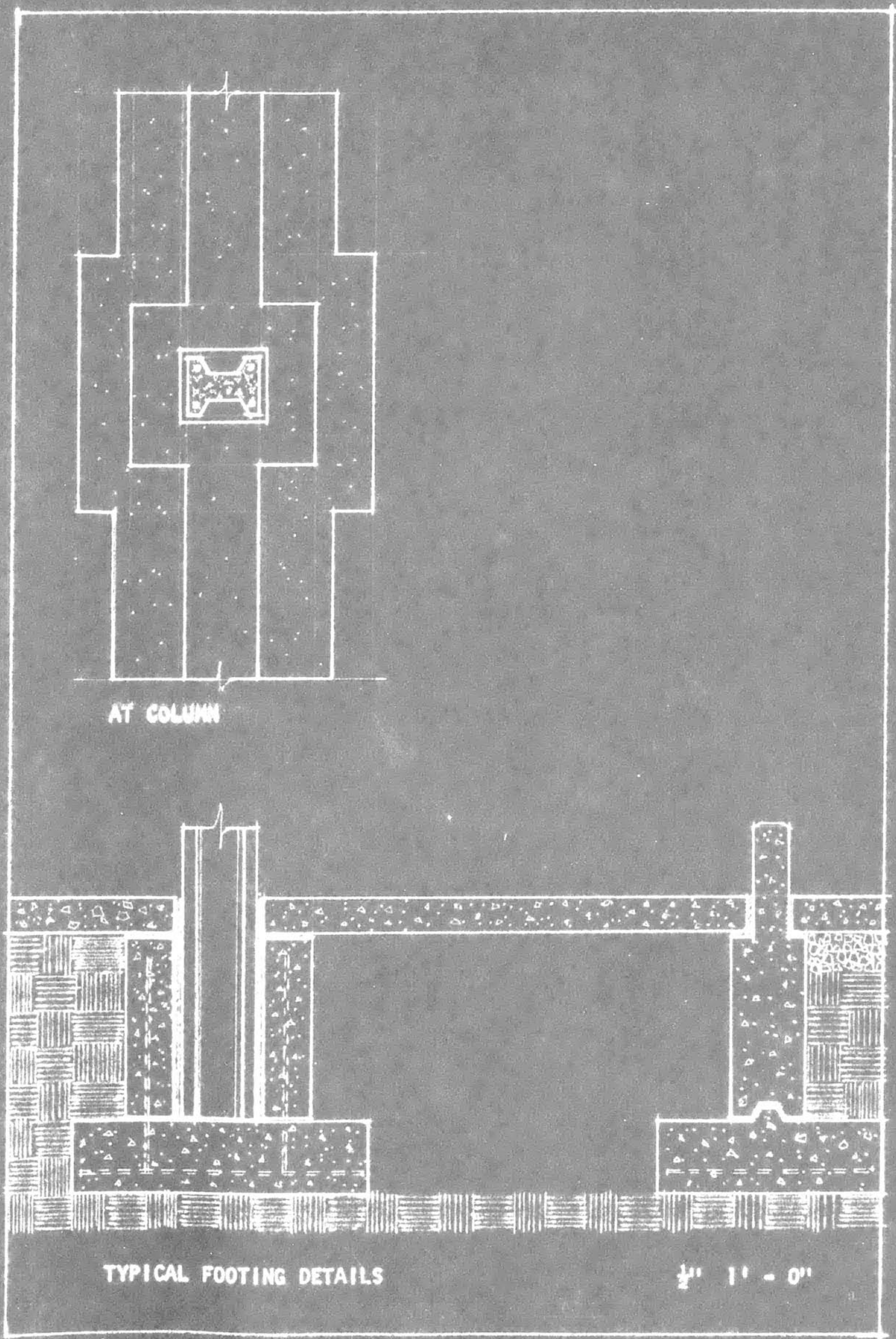


ILLUSTRATION #18

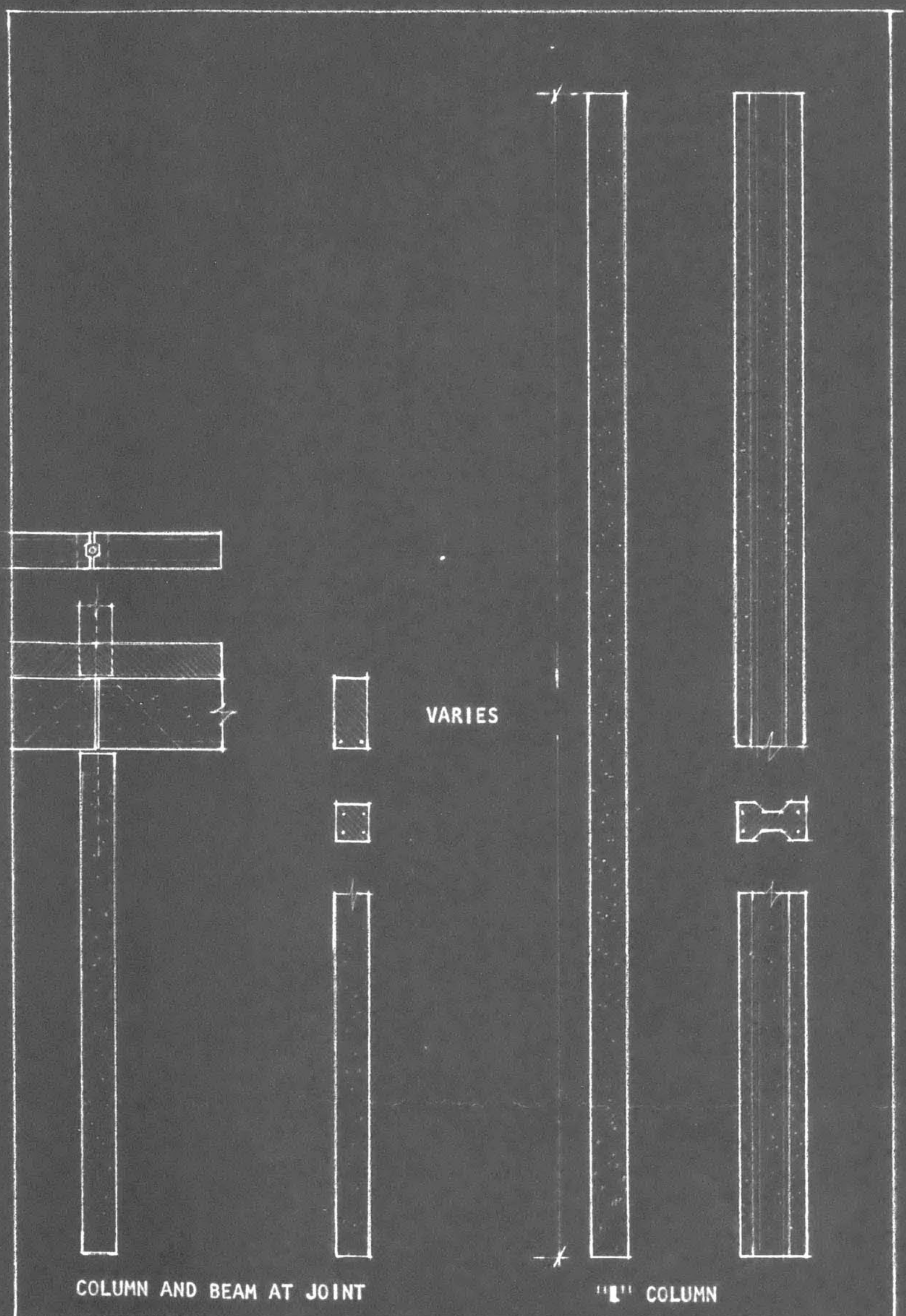


ILLUSTRATION #19

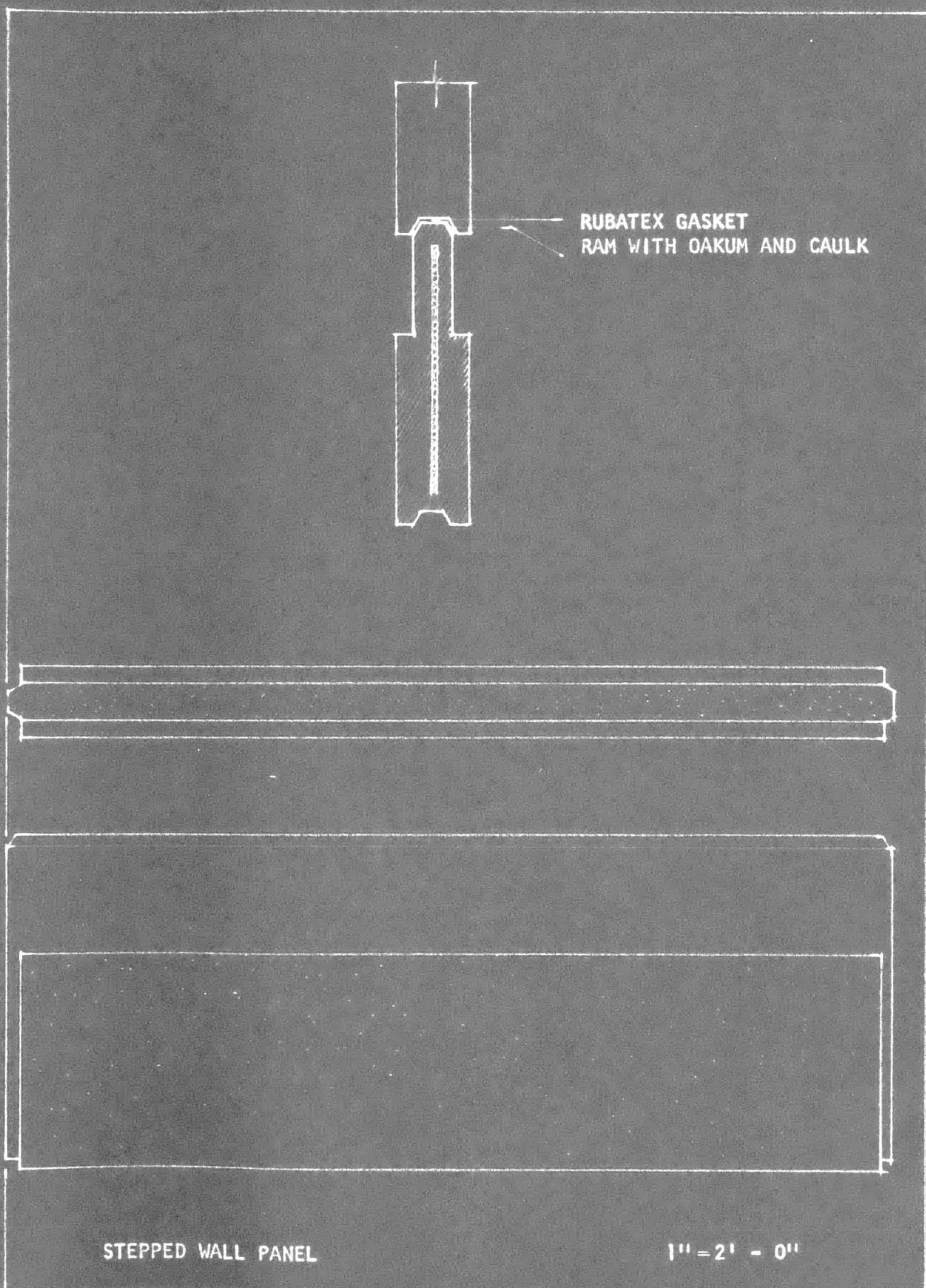


ILLUSTRATION #20

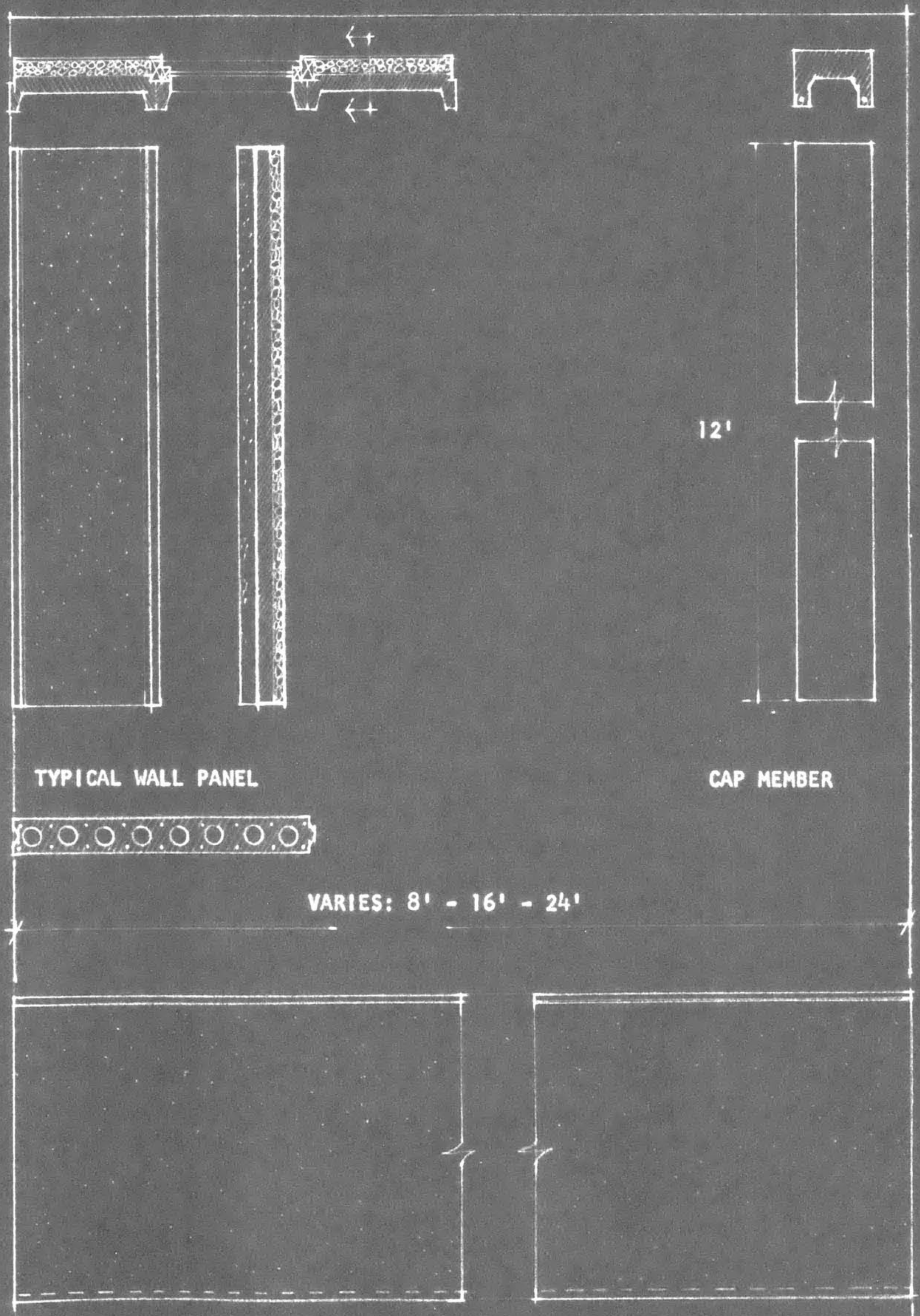


ILLUSTRATION #21

APPENDIX II

Prefabricated Bearing Wall System

Description of Components

Reinforced Concrete "I" Column

1. Primary lateral stiffness in party wall
2. Intended to receive the stepped wall panels
3. Exceedingly bulky footing required
4. Provision for expansion and contraction
5. Provision for weathertightness

Stepped Wall Panel

1. Provide ledge for floor and roof members
2. Adequate width for insulation and necessary acoustical insulation
3. Tack welding plates to meet "I" column
4. Reinforcing adequate for placing by crane
5. Horizontal weather proofing
6. Suitable surface to leave exposed
7. Resistance to unequal loading

Floor and Roof Panels (Spancrete, Flexicore or similar commercial product)

1. Widths of 16'
2. Lengths of 8' - 16' - 24'
3. Common depth or blocking to maintain common floor level in spite of different spans

Edge Beams

1. Required to support elevation panels
2. Lengths of 8' - 16' - 24'
3. Complex joint at side wall
4. Possible torsion problems may be counterbalanced by location of elevation panels

Double Tee Wall Panels

1. Attractive, durable elevation surface
2. Insulated interior ready to receive plaster, sheetrock, et al
3. Closure at top and bottom, weather and acoustical seal
4. MO - SAI, broom and rag finish possible

Wall Caps

1. Support only own weight
2. Acts as cap member especially when roof is in place and and flashing can extend up under
3. Primary purpose is to tie frame wall together visually

Roof Edge Members

1. To act as Gravel stop
2. Thicken roof line
3. Designed as precast but could very well be handled by flashing over a piece of wood per convention

Columns and Beams

1. To receive floor and roof members at interior support points
2. Problem of joining can be solved by welding or inserting rods and pressure grouting

Erection Sequence - Isometric Illustrations

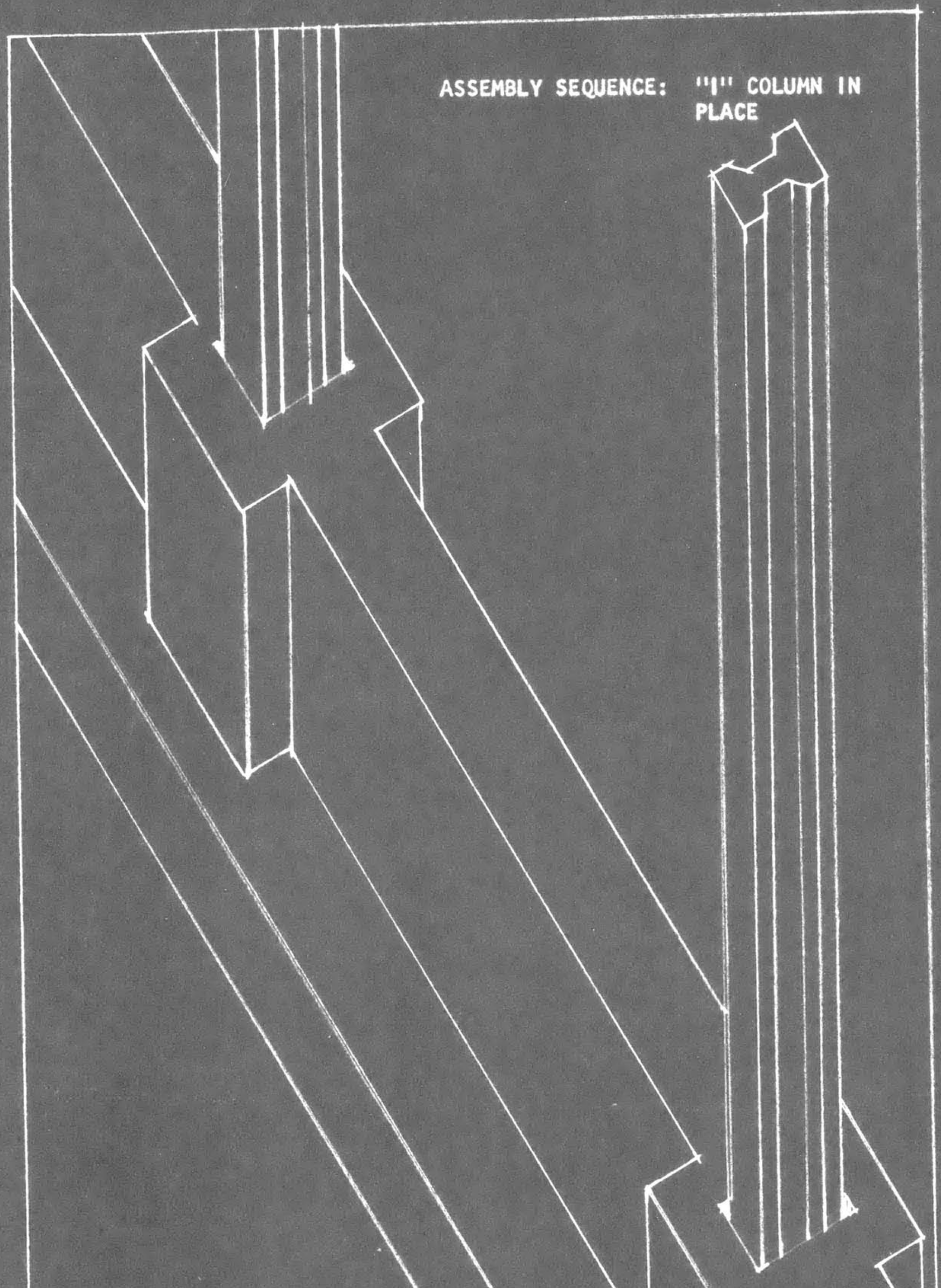


ILLUSTRATION #22

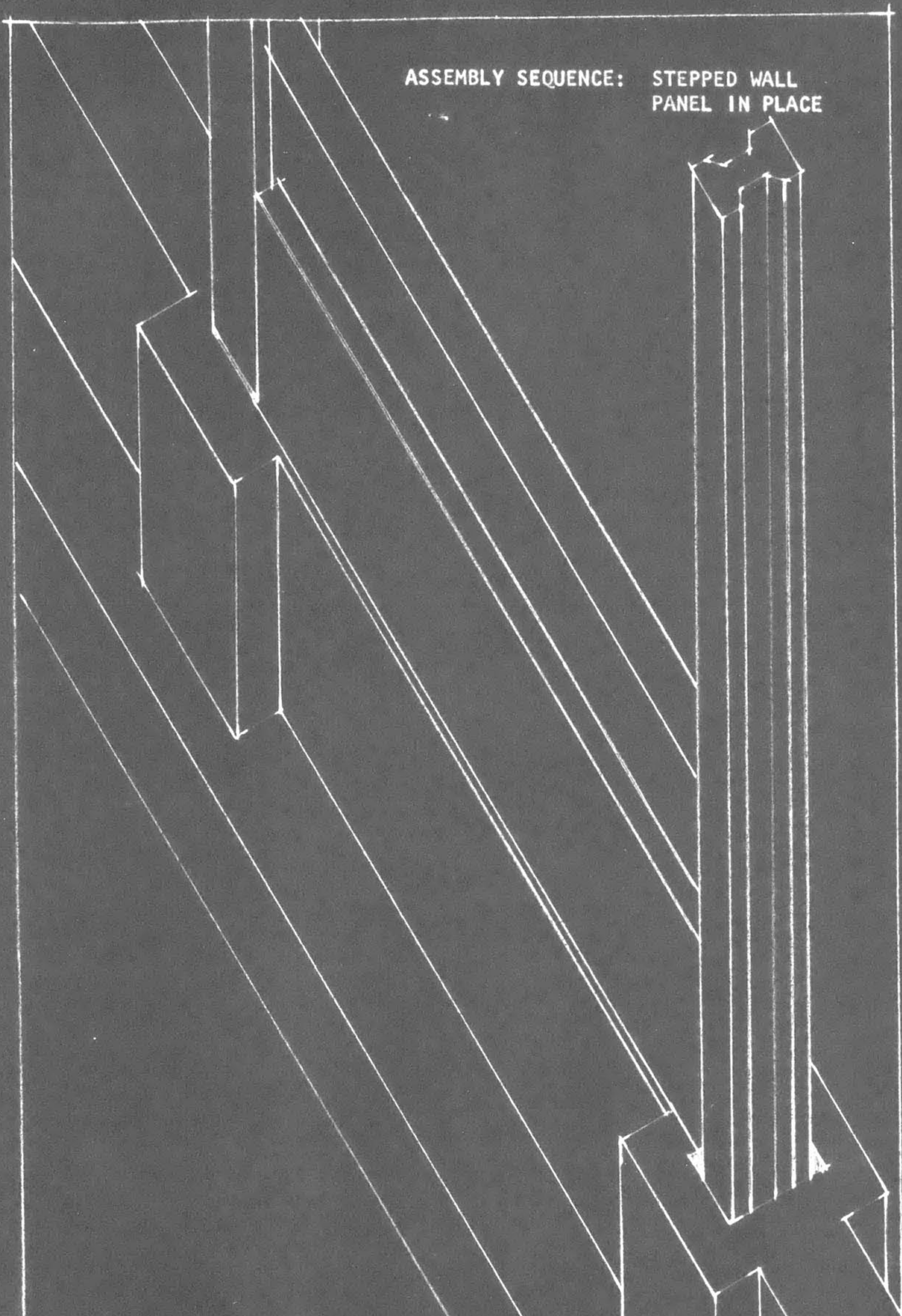


ILLUSTRATION #23

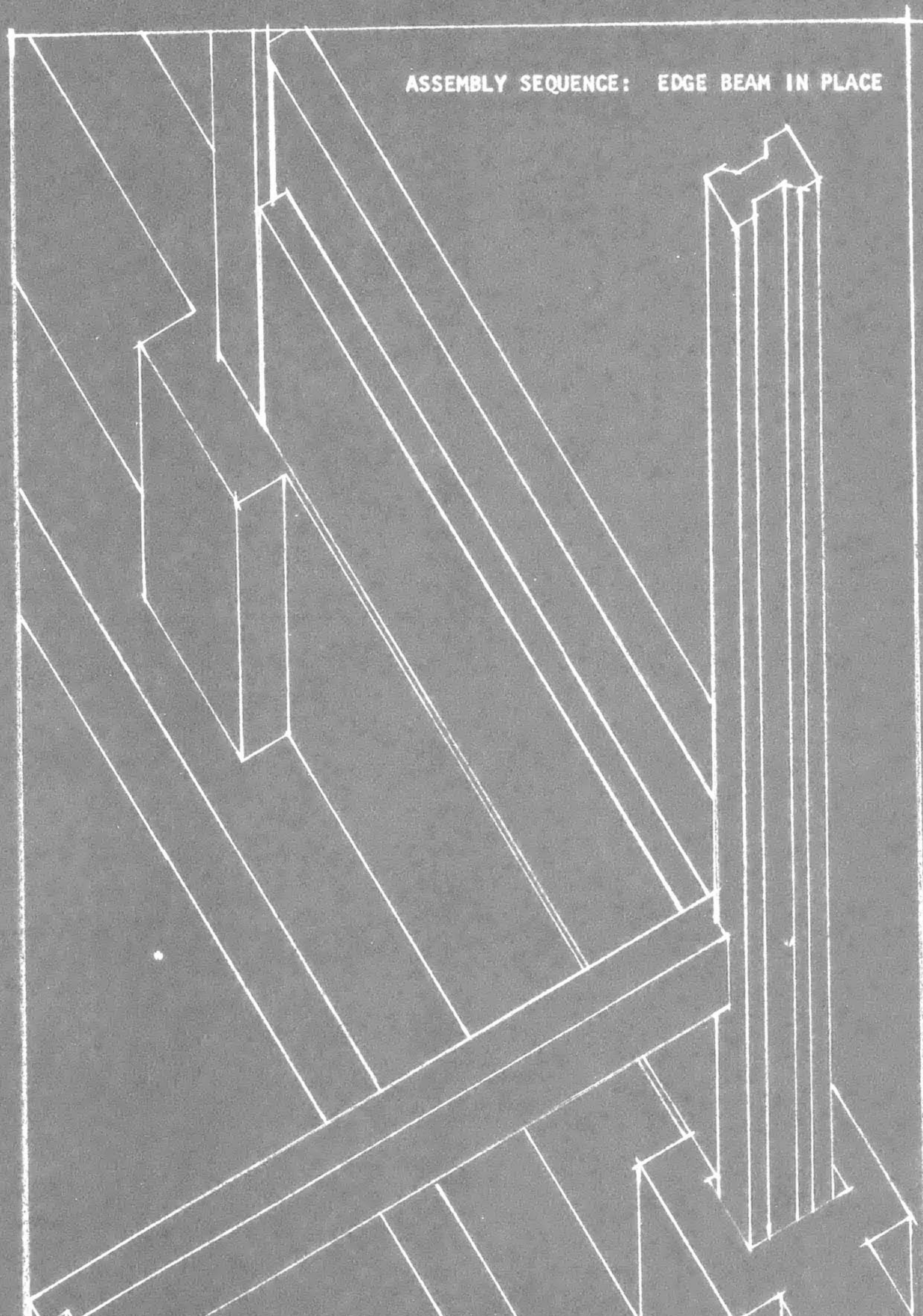


ILLUSTRATION #24

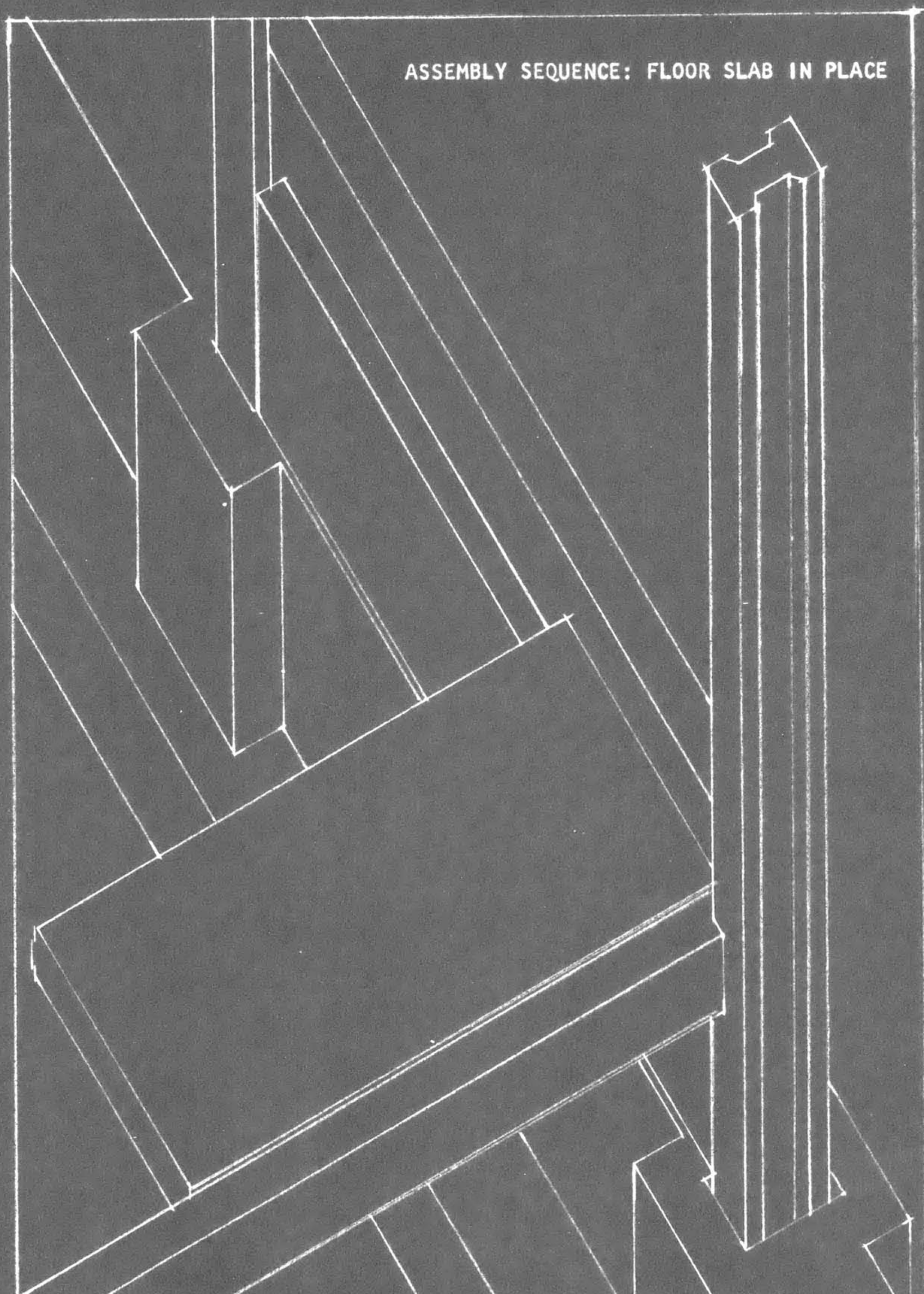


ILLUSTRATION #25

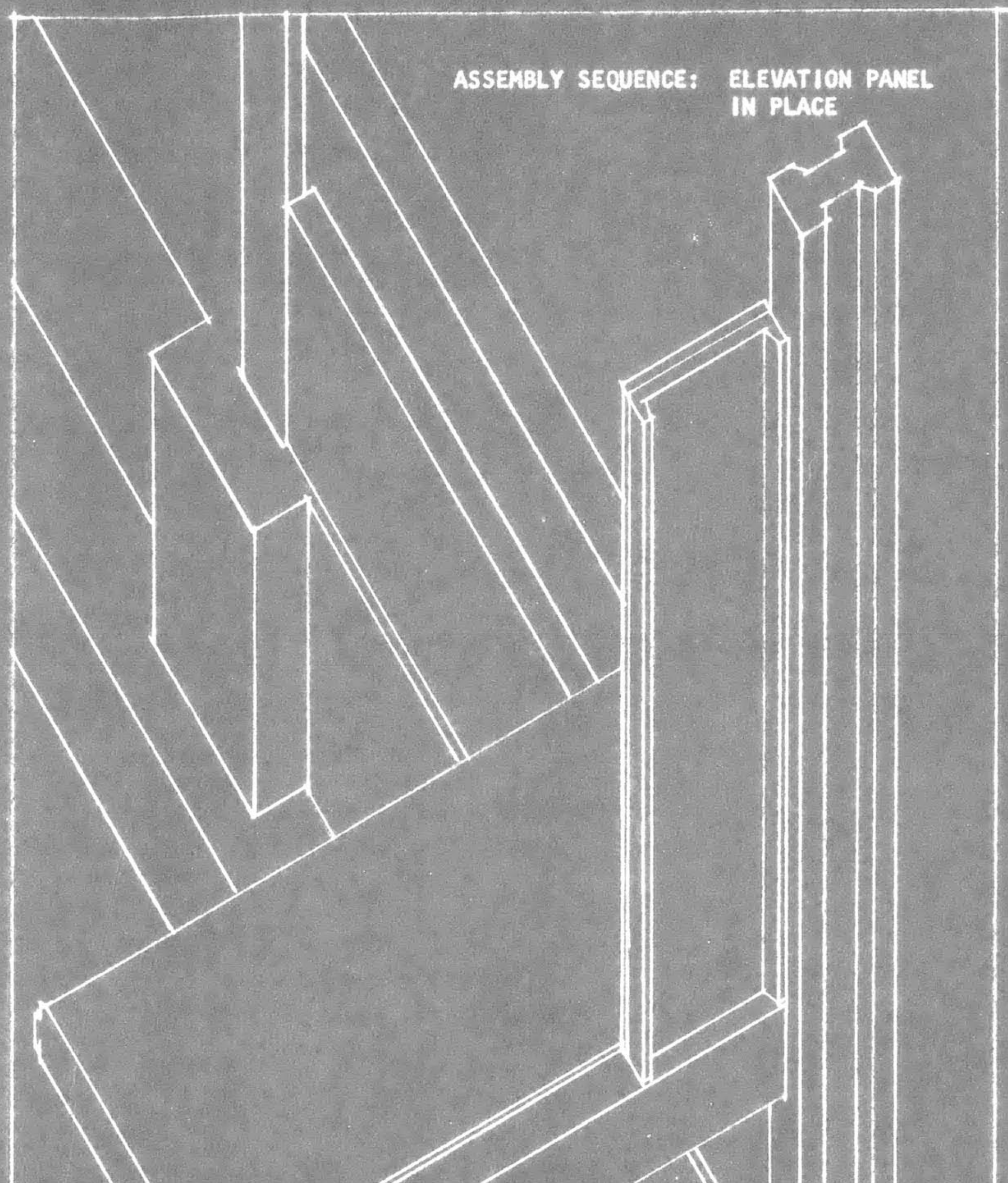


ILLUSTRATION #26

APPENDIX III

Economic Feasibility Calculations

The Site Plans

Illustration #9	Proposed Site Plan (Row Houses)
Illustration#10	Comparative Site Plan (Detached Houses)

Costs Used[1]

For detached house site plan, utilities in trenches below ground level

8" sewer	$3.50 per linear foot		(L)
6" sewer	3.25 " " "		(L)
6" water	2.25 " " "		(L)
1" water	1.50 " " "	(estim.)	(L)
main electrical	2.40 " " "		(L)
to house electrical	1.50 " " "	(estim.)	(L)
clearing	400.00 per acre		(L)
strip and remove topsoil	1.00 per cubic yard		(L)
excavation and backfill	.50 " " "		(L)
macadam road	.30 per square foot		(L)
finish grade and landscape	.05 " " "		(L)
	2150.00 per acre		(L)

All sub totals to nearest dollar
All totals to nearest ten dollars
All summaries to nearest hundred dollars

For proposed schemes with utility tunnel, subtract excavation and backfill cost from previous figure.

8" sewer	$3.50/l. ft.	-	0.50	=	$3.00/l.ft.
6" water	2.25 "	-	0.50	=	1.75 "
main electrical	.80/ft.	-	.50/ pole	=	.30/ "

all other figures as above

---

1. (L), Kevin Lynch, Technique of Site Planning
(M), R.S. Means,and Co., Building Construction Cost Data
(F), Sepp Firnkas, Consulting Engineer

Cost Calculations For Comparative Site Plan

Per unit costs for 24' x 36' Techbuilt House on partial basement including garage. Cost for site development including all costs outside of basic house based on 20 units at a time.

Clearing; @ $400.00/acre

15' around structure and 20' drive from street to house (average 40') plus portion of ring road (45' per unit).

around structure	66' x 54'	=	3550'
drive	15' x 20'	=	300'
portion of road	40' x 45'	=	1800'
			5650'

(5650'/43,000) x $400.00 = $52.00

Strip and replace topsoil; @ $1.00/cu.yd.

Same as clearing except topsoil would all be deposited around house. Assume 4" topsoil average.

(5650' x 1/3' x $1.00) / 27 = $70.00

Finish grade and landscape; @ $.05/sq.ft.

Same as clearing less road and drive.

5650' - ((24 x 45) + (12 x 38)) =
4110 x $.05 = $200.00

Excavation and backfill; @ $.50/cu.yd.

8' outside of building line to 6' below grade.

(40' x 50' x 6') / (27' x $.50) = $220.00

Road; @ $.30/sq.ft.

24' wide access road, 12' wide drive.

(24' x 45') + (12' x 38') = 1540 x $.30 = $460.00

Shared costs for the entire block:

To include landscaping of remaining land either by trimming out and leaving natural or by seeding and leaving as large field.

5650' (previously built upon,roads et al) x 20	=	2.6 acres
total site less above; 4.5 - 2.6	=	1.9 "
1.9acres @ $.05/sq.ft.	= $2150/ acre apportioned among 20 units	

(1.9 x 2150) / 20 = $215.00

Utilities to house:

45' of 8" sewer main	@$3.50	=	$158.00
50' Of 6" sewer lateral	3.25	=	162.00
45' of 6" water main	2.25	=	101.00
50' of 1" water lateral	1.50	=	75.00
45' of electric main	2.40	=	108.00
50' of elec. to house	1.50	=	68.00
			$672.00

Totals:

Total cost before overhead and profit	$1889.00
Plus 20% overhead and profit	370.00
TOTAL	$2270.00

Other developments costs in the form of permits, fees, bonds, taxes, sewerage fees etc. would be determinable only upon selection of a specific site. They have been omitted in this comparison along with the raw land cost because they would tend to be approximately the same for both site plans, and as a result cancel out.

Cost Calculations For Proposed Site Plan

Per unit costs of basic 24' wide frame with structurs 36' deep including standard 24' x 24' entry and garage. Cost for site development including all costs outside of basic house, based on 20 units at a time.

Clearing; @ $400.00/acre

24' x (4'+72'+24') = 2400' lot and land portion
32' x 150' / 20' = 240'
2640'

2640' / 43,000 x $400 = $25.00

Strip and replace topsoil; @ $1.00/cu.yd.

(2640 x 1/3' x $1.00) / 27 = $33.00

Excavation and backfill; @ $.50/cu.yd.

24' x (24+36) x 4' x $.50 / 27 = $106.00

Apportioned share of entry drive pitched from grade to -4'

(32' x 150' x 1/2 x 4' x $.50) / (20 + 27) = $10.00

Finish grade and landscape private court; @ $.05/sq.ft.

24' x 36' x $.05 = $43.00

Entry and interior road; @ $.03/sq.ft.

600' interior road
125' entry road
64' approximate at 4 corners
789' apportioned among 20 units

Width of road including mostly macadam but also including some entry stoops and small planting beds is 24'. Assuming planting beds about equal to concrete entry slabs, $.03/sq.ft. will apply for all.

789' x 24' x $.03 / 20 = $286.00

Shared costs for each square; @ $.05/sq.ft. or $2150/acre

To include landscaping of remaining land either by trimming out and leaving natural or by seeding and leaving as large field.

basic lots	72' x 600' =	43,000
hard surface	24' x 789' =	19,000
		62,000/43,000 = 1.45 acre

Total site less areas hard surfaced, built upon or landscaped. 4.5 - 1.45 = 3.05 acres

3.05 x$2150 / 20 = $330.00

Utility tunnel and retaining wall for 24' unit

Refer to Illustration #11
Total cost calculations which will be divided; and retaining wall, which is required in any case included as part of basic house costs.

Basic Costs	Applied to Utility	Applied to Shell
Footing 6/27 cu.yd/l.ft. @$38. (M) $8.50/l.ft. x 24' / 2 =	$100	$100
Retaining wall 11/27 cu.yd./l.ft. @$55. (M) $22.40/l.ft. x 24' =		$535
Block wall 8 sq.ft./l. ft. @$.66/sq.ft.=125		
3/4"gravel 1/8cu.yd./l.ft. @$4./cu.yd. $.50 x 24' =	$12	
Tunnel at corner Illustrations #9, #11 200'/20 units = 10'/unit footing 6/27cu.ys/l/ft. @$38 $8.50 x 10 =	$85	

8" reinforced block wall
2 x 7' = 14sq.ft/l.ft
@$.76/sq.ft. = 14x .76x 10 $105

3/4"gravel
1/8cu.yd/ @$4.00/cu.yd.
7'+7'+6' = 20 x 1'/100sq.ft.
1/5 x $7. = $1.40/l.ft. $14

4" slab
4/12 x 5' = 1.65/27 x
$51./cu.yd. (M) $30

$476 $635

Utilities from street to trench

100' / 20 = 5'

5 x 8"sewer @$3.50
5 x 6"water @$2.25
5 x main elec. @$2.40 $ 40

Utilities in tunnel per unit
24' x 8"sewer @$3.00=72$
24' x 6"water @$1.75=42
24' main elec. @$.30= 8
10' corner share @$5=50 $172

Heat pipes, air conditioning pipes and piping as taps from mains are not in either set of figures because basic finishing costs in both cases would include utilities inside of unit.

Totals:

Utilities in trench/24' unit	$688.		$688.00
Retaining wall and footing		$635	
Total development costs for proposed plan before overhead and profit			$1521.00
Plus 20% overhead and profit			304.00
TOTAL			$1830.00

Comparison

Total development comparisons = $2270/$1830 = 25% higher

Control Unit Costs For Detached House On Control Site Plan

These costs are typical costs for the Techbuilt Houses and include all costs for a complete house except basic land and land development costs which have been previously covered.

From a standard flyer used by Techbuilt Incorporated.

"DEVON 361" 1728 sq.ft. April 1961

Concrete, forms and sills	$ 925
Techbuilt component package	7450
Erection	600
Interior stock	1000
Labor	750
Drywall	750
Wiring and fixtures	625
Masonry	850
Glass	325
Painting	700
Plumbing and heating	1845
Tile work	950
TOTAL +	$16,770
3.5% adjustment to mid 1962	$17,400
20% overhead and profit	$ 3,500
	$20,900

The basic assumption that I have used is that; assuming equal specifications, the basic shell price of one building can be seperated from the finishing costs, and that the finishing costs will apply to another building shell with only minor inequities.

Taking those costs that comprise the basic Techbuilt shell, erected and weathertight:

Shell package only	$ 5465
Excavation, forms and sills	925
Erection	600
Portion of masonry	350
Glass	325
Portion of painting	250
	$7,915
3.5% adjustment to mid 1962	$ 275
20% overhead and profit	$1,635
TOTAL BASIC SHELL	$ 9,825

\$9825/1728 = \$5.75/ sq.ft. for basic shell

Total cost less basic shell divided by total square footage (20,900 - \$9,825) / 1728 = \$6.75/ sq.ft. finishing costs

Add partial basement of same 24' x 24' = 576 sq.ft, as in our typical proposed unit, to make total space and type of space as similar as possible for the two units being compared. Basement space is less expensive than the basic shell space before finishing, but the minor finishing required in lights, rough partitions and heat will tend to equalize this inequality. I have thus used my basic shell price as a figure for total basement costs.

576 sq.ft. x \$5.75 = \$3,300

For future comparison I will divide this into:
576 x 2.75 = \$1580 garage shell
576 x 3.00 = \$1720 garage finishing

Summation Of Comparison, Detached House Unit

Basic shell including partial basement	\$9,825
	1,580
TOTAL	\$11,400
Finishing of shell including partial basement	\$11,075
	1,720
TOTAL	\$12,800

Proposed Prefabricated Bearing Wall System

24' x 36', two story unit with 24' x 24' garage and entry. Total space identical with control unit. Assumption that finishing cost of this shell will be identical with control unit and that major areas of quality and cost comparison must be between basic shells.

Cost factors used:	Material in place	Source
Footings	$38.00/cu.yd.	(M)
Foundation wall	55.00/ "	(M)
"I" column	6.00/ l.ft.	(F)
Stepped wall panel	100.00/cu.yd.	(F)
Floor and roof	1.30/sq.ft.	(F)
Interior columns, beams	120.00/cu.yd.	(F,M,)
Cap members	120.00/ "	(F)
Elevation panels		
Mo-Sai or equal	3.75/sq.ft.	(F,M)
Window wall	3.75/sq.ft.	(M)

Quantity Calculations, Basic Shell

From typical site plan assume average of 6 units in row. This requires 7 footing, foundation and party walls, hence the factor of 1/6 which appears in following calculations.

Footings; @$38.00

At wall 1/9 cu.yd./l.ft. x
24/27 (6+6/6) = 6.25 cu. yd.

At column, 25/27 cu.yd. x
(7 + 7/6) = 7.5 cu.yd.

At interior, for maximum flexibility, original assumption was to place all footings.
2' x 2' x 3' x 7 / 27 = 3.1 cu.yd.

total; 16.85 cu. yd.@$38.00/cu.yd = $640.00

Foundation wall;

At wall (2.5' x 1) + (1/2 x 11/2)/27=
.12 cu.yd/l.ft.
.12 x 9'/bay x (6 + 6/6) = 7.5 cu.yd.

At column, 16/27 x (7 = 7/6) = 5.5 cu. yd.

Total; 13.0 @ $55. /cu.yd = $715.00

Retaining wall from previous calculation
for utility tunnel $635.00

"I" columns;

3 @ 28' + 4 @ 20' =
84 + 80 = 164 + 164/6 = 195 x $6.00 = $1170.00

Stepped wall panels;

$100/cu.yd. including foam glass interior
1.3 cu.yd./panel x 16 panels x 5/3 x $100 = $3450.00

5/3 factor; scaling of shared and unshared party wall from typical square, which represents extreme in unit variation, yields information, that for every panel shared, two are unshared therefore some factor must be introduced which represents this occurance.

1/3 shared, 2/3 unshared
(2 x 2) + (1 x 1)/3 = 5/3

Floor and roof panels;

1728 x 3/2 x 1.30 = $3380.00

Interior columns and beams @ 120 cu.yd.

2/3' x 2/3' x 7' = .445 x 7 = 3.1/27 cu.yd.
column x 8 = .92
2/3 x 1 x 12 = 8.0/27 beam x 11 = 3.08

4 cu.yd. = $480,00

Cap members;

a 12' section in place contains .22 cu.yd.

6 + 6/6 = 7 x .22 x $120 = $185.00

Elevation panels

Both Mo-Sai panels including foam insulation and glazed panels with fixed and operable sash at 3.75 sq.ft.

24' x 7 1/2' x 5 = 900 sq.ft. x $3.75= $3370.00

Miscellaneous

Roofing (tar and gravel on 1" regid insulation) 24 x 36 x @$.37 = $320.

Flashing 24 + 24+36 + 36 = 120 @ 1.00/l.ft.= $120
Slab in basement 576 sq.ft. x 1/3/27 x $27= $193
Caulking and waterproofing estimated $400.
$1070.00

Totals:

Total cost before overhead and profit	$15095.00
Plus 20% overhead and profit	3000.00
TOTAL	$18100.00

This is higher than control structure by 58 %.

Typical Proposed Unit: Cast in Place (See illustration 15)

The first question that should be asked about any prefabricated system is how do its costs compare with the same system cast in place. Although this can only be exactly figured after recalculating the entire structural system, a reasonable approximation can be made more simply by totaling total cubic yardage of concrete required and using an average cubic yard figure for cast in place concrete. This figure according to Means is $69.40.

Casting this proposal in place would simplify the footing system. All units could be expected to be built at the same time and thus problems of lateral stability would be eliminated. Needless to say this compromises the original idea of purchasing a lot with a frame structure on it for building in stages as the owner desired. With this system of construction individual units would have to be decided on, assembled into squares and built at one time.

Quantity and Cost Calculation for Cast in Place

Cost Factors Used	Source
1. Footing @ $38 cu. yd.	(M)
2. Foundation @ $55 cu.yd.	(M)
3. Total structure @ $69.40 cu.yd.	(M)

Footings: Party Wall

Wall footings throughout, no beefed up structure as at previous column locations

1/9 cu.yd./l.ft. x 72' + 72/6 =
1/9 x 84/1 = 9.3 cu.yd.

Footings: Interior only as required

2' x 2' x 3' x 4/ 27 = 1.78

Total; 11.08 x $38/cu.yd. = $420.00

Foundations

Wall footings throughout, no special structure at previous column locations
.12 cu.yd./l.ft. x (72 + 72/6) = 10 cu.yd.
10 cu.yd. x $55 = $550.00

Retaining wall from previous section = $ 635.00

Party wall, Beams, Columns, Caps, Floor, Roof

Poured in place in stages by floors using multi-story building total cost ($69.40 cu.yd.) for all concrete above foundation. To include concrete frame to rear lot line as in prefabricated system.

Calculation of yardage:

1. Party wall solid 10" wide
   5/6 x (27' x 24 + 19 x 12)/ 27 = 26.5
   26.5 + 26.5/6 = 31.0

2. Frame columns 10" x 10"
   5/6 x 5/6 x 19 x (6 + 6/6)/27= 3.4cu.yd.
   caps for frame columns 3 + 3/6 = 3 1/2 x .22 cu.yd. = .8

3. Interior column and beam
   from previous = 4.0 cu.yd.

4. Floor and roof slab
   Span of 16' and 8' depth average 6"
   1/2 x 865 x 3/27 = 48.0 cu.yd.
   Total concrete 87.2 cu.yd. x $69.4/cu.yd.= $6050.00

Elevation as Previous $3370.00

Miscellaneous as Previous $1070.00

Totals: $12095.00

Total cost before overhead and profit

Plus 20% overhead and profit 2400.00
TOTAL $14,500.00

This exceeds the control system by 27%

Prefabricated Frame Wall System (See illustration 16 and 17)

Frame party wall infilling would be with 8" block and the elevation wall system modified as per Mr. Robert Leventhal's suggestion to utilize a double tee wall panel @ $1.75/sq.ft. in place and a window wall system @ $2.50/sq.ft. which Beacon Construction used on one of its buildings

Quantity Calculations

Footings from preceding	$420.00
Foundation from preceding	$550.00
Retaining wall from preceding	$635.00

Frame wall

Column 1/2 x 1 x 7 1/2 x (17 + 17/6)/27= 2.70cu.yd.

Beam 2/3 x 1 x (72' + 72' + 30)/27 =4.25
4.25 + 4.25/6 = 4.96
Total = 7.66 cu.yd.

Cost 7.66 x 120 = $920.00

Floor and Roof panels = $3380.00

Interior beams and columns as previous $480.00

Block infilling

Quantity 7' x 8 bays = 675 sq.ft.

The 1/6 factor has not been added here because this system allows windows for the end unit and for this advantage the owner should pay the premium.

8" block @ \$0.66 x 5/3 (share wall factor as previously defined) = \$1.10 sq.ft. average block wall cost when figuring only one side of typical unit.

675 sq.ft. x 1.10 =	\$740.00

Elevation Panels

\$1.75/sq.ft. solid and \$2.50 glazed. Assume slightly more solid than glazed in typical unit and average \$2.00/sq.ft.

900 sq.ft. x \$2.00 =	\$1800.00

Miscellaneous

Roofing as preceding = \$320.00

Flashing as preceding = \$120.00

Basement slab as preceding = \$193

Caulking and waterproofing as preceding = \$200.00

\$833.00

Totals:

Total cost before overhead and profit	\$9758.00
Plus 20% overhead and profit	1950.00
TOTAL	\$11700.00

REVISED BASIC SHELL

APPENDIX IV

Summary Of Meeting Notes

December 1962

Mr. Harry Behr
Flexicore Corporation:

1. Physically feasible
2. Good system for Flexicore usage
3. 6" Flexicore F.O.B. Pawtucket $1.00/ sq. ft.
4. Shipping to Boston .08/ sq. ft.
5. Installation costs .20/ sq. ft.

Mr. Robert Bierweiler
New England Concrete Corporation:

1. Few specific comments about proposal
2. Out of their line of work
3. Need for all architects and engineers to understand the limits of the material and tolerances possible
4. Listen to recommendations of suppliers when dealing with a new material

Mr. Sepp Firnkas, Consulting Engineer
69 Newbury Street, Boston

1. Feasible
2. Good
3. Footing detail requires revision
4. Weather proofing will be both difficult and expensive
5. Interior column to beam joint; rigidity through floor support and grouting

Mr. Harold Fox
San - Vel Corporation;

1. Feasible, no major problem
2. One of the simplest proposals he has seen
3. Prestress floor, "I", and edge members
4. All other members precast and reinforced for handling
5. Possible simplification by post tensioning wall panels, thus avoiding expensive "I" unit
6. Require 40 - 50 units to establish exact costs
7. Stresses need for standardization in the industry

Mr. Robert Leventhal
Beacon Construction Company;

1. Physically entirely feasible
2. Cost will be the problem
3. Party wall too expensive
4. Utility trench too expensive
5. Elevation wall panels too expensive, suggested examination of Allied Instrument Building in Bedford Mass., similar elevation system at $1.75/ sq.ft. solid, $2.50/ sq. ft. glazed

Dr. Leon Levitan
Nelson Concrete Products;

1. Fabricator of New Seabury House, Cape Cod, Mass.
2. Physically feasible but could be simplified by eliminating stepped wall panels and using frame system with light infill panels
3. Problems of the appearance of large areas of concrete, the water proofing and caulking problems of many joints virtually insoluble, shiplap or dovetail joints the only way
4. Economically feasible in 20 or more units, but only in those numbers

Mr. Francis Smith and Mr. Robert Van Epps
Portland Cement Association;

1. General conversation on the entire proposal, no specific comments other than that it seemed like a quite reasonable proposal

Mr. Frank Strong
Builder, Winchester, Mass.;

1. Roofing costs, tar and gravel on top of rigid insulation $0.38/ sq. ft.
2. Verification of finishing costs being approximately identical after shell is erected and closed in

Mr. Charles Todis
Todis Real Estate;

1. Cost of land depends on zoning (i.e. use) more than on any other factor
2. It would be a false premise to assume that you could buy land one cost and then change its density and use, this could only be done on a variance based on wisdom, Ford Foundation type of experiment, cluster zoning approval or careful selection of low cost land which is appreciated by development
3. Land costs vary with unit density; savings only in development and construction
4. This proposal would not appeal to the "first home" owner with concept of "ivy covered" cottage, but "second time" buyer should really go for it; this is for selective clientele

APPENDIX V

Pertinent Notes From THE COMMUNITY DEVELOPERS HANDBOOK

Planning a development is a team process. Many of the steps in this process are procedural and would vary with each site, architectural proposal, plan of organization and selling campaign. Since this study was not for any specific site, these steps have been omitted. Their pertinence however, for anyone considering a specific development and a specific site justify their inclusion as supplementary material.

Necessary Areas of Investigation

A. Market Analysis

- Analyze market
  - Who prospective buyers are
  - What their preferences are
  - What their incomes are
  - How many children they have
  - Then guage kind, size, scope and timing of project
- Sources of information
  - Local Planning agencies
    - Zoning boards
    - Building inspectors offices
    - Public utility companies
    - Title insurance companies
    - Savings banks
    - Mortage companies
    - Newspapers
  - Regional
    - F.W. Dodge services
    - Dun and Bradstreet
    - Housing Securities Incorporated
  - Nationwide
    - U.S. Department of Commerce
    - U.S. Department of Labor

Data Desirable for use in market analysis
- Population growth
- Regional changes
- Family formation and number of households
- Average family size
- Housing inventory
- Occupations
- Income
- Construction costs
- Tax rates and assessments
- Direction of urban growth

B. Required Technical Planning

- Land planning
- Site planning
- Landscape architecture
- Engineering
  - Surveying
    - Streets
    - lots
    - Building lines
  - Data
    - Gradea
    - Earthwork
    - Street improvements
    - Storm drainage
    - Sanitary sewers
    - Water supply mains
    - Public utilities

C. Considerations For Selection of The Site

- Access
- Transportation
- Location
- Approaches
- Size of proposed development
- Land costs
- Physical characteristics
  - Topography and shape
  - Drainage and subgrade
  - Tree growth
- Utility services
  - Water
  - Gas
  - Sanitary
  - Storm
  - Electric
  - Public transportation
- Site environment
  - Land use
  - Dampness
  - Smoke
  - Views

- City service and community facilities
  - Fire and police protection
  - Schools
  - Recreation
  - Waste disposal and street service
  - Auxiliary facilities
    - Churches
    - Hospitals
    - Movies
    - Banks
    - Laundries
    - Shopping
- Comprehensive or master planning
- Zoning
- Subdivision regulations
- Building codes
- Consultation with local officials

D. Planning The Development

- Required site data (usually on one map)
  - Property lines
  - Topography
  - Utilities
  - Site location
    - Principle approaches based on existing and proposed streets
    - Built up areas in vicinity
    - Location of shopping and employment centers
    - Location and type of transportation
    - Location of churches, schools and parks
    - Zoning covering adjacent land and approaches
    - Jurisdictional boundaries
    - Mile or half mile circles radiating from site
- General considerations
  - Landscape planting
    - Conserve existing growth
    - Plant street trees
    - Other trees
      - Groups at ends of buildings
      - Low branched at rear lot lines to reduce noise and give privacy
    - Shrubs
    - Protective planting
    - Hedges
    - Vines
  - Street and utility construction
    - Project grading plans
      - Fix building floor elevations and finish grades
      - Balance cut and fill
      - Earth banks not to exceed 3 to 1
      - Check drainage patterns

Hard surface areas, pavement types must depend on study of

- Subgrade
- Climatic conditions
- Comparative costs
- Wheel loads
- Character of project
- Cost limitations

Sewerage

- Public sewers
- Small central community systems
- Septic Systems

Septic systems are to be avoided even though initial cost may be less. In addition to their imperfectability, for this kind of a housing situation they are not feasible.

In planning the system the developer should investigate the following:

- Is existing system adequate for added load
- Is it separate or combined sanitary and storm sewer
- On what basis does city charge for installation of sewers
- Are they charged entirely to developer
- Is total or partial recovery of initial cost possible
- Can a special sewer improvement district be set up to cover developed area
- How are costs allocated when mains and trunk lines must be constructed through the development to serve property beyond
- Is a permit to discharge surface drainage into natural water courses required by local or state government
- In general the sewer lines should be located within street rights of way but not necessarily under roadway paving

House connection to sewer 6" to avoid clogging, laterals not less than 8"

Normal sanitary not in same trench with water supply however, where permitted by local authorities, combine in double shelf trench

Surface water and storm drainage connections to sanitary sewer to be avoided

Except in open estate development, underground storm sewers will be required

Street plan and storm drainage plan can dovetail if land planner will consider engineering aspects of storm water collection

Water distribution system

Mains in street, preferably in parking strip between walk and pavement

Hydrants accessible, protected from traffic hazards located so as not to disturb walks and parking

Hydrant"rule of thumb" one hydrant for 400 to 500 feet of street or one per 5 acres, where buildings are large, closely grouped or inflammable one hydrant for 300 to 400 feet

Central water supply desirable

Check capacity and pressure of existing mains for both domestic service and fire protection and check regulations for a new system with city council and state

Pole lines and gas service

Desirable to keep out of street, unsightly interfere with trees, rear lot easements a possibility

Power and phone, highly desirable for them to be underground

Underground wiring

Eliminates overhead storm damage and tree trimming
Reduces maintenance
Adaptable to curved streets
Easier to amortize
Helpful in promoting larger electrical loads

Gas and power lines do not mix, Gas must be buried by itself away from house

The future of the development, covenents and administration

Protective covenents are agreements between private parties expressing agreement covering use of land

The goal of the developer is to aid his program; the goal of the purchaser is to protect investment, strict enforcement gives the best assurance to all parties that no one will destroy values, lower character of neighborhood or create a nuisance

Many years experience have proved covenents to be essential instruments in maintaining stability, permanence, character and marketability in community development, properly prepared for legal soundness they contribute to establishing character and maintaining value levels through regulation of type, size and placement of structure, lot sizes and other land use

Customary and recommended covenants
- Control of land use, type and design of buildings
- Architectural control of all structures including fences and walls
- Sideyard and setback
- Control of minimum lot size
- Prohibition of nuisances and regulation of "for sale" signs
- Temporary dwellings and trailers
- Limitation of size of structure through minimum cost or area clause
- Reservation of utility easements
- Other clauses

Effective period, opinion favors covenant that runs with land subject to revision by stipulated percentage (not less than majority) at regular intervals, action should be required several years prior to scheduled termination

Enforcement, passed on from developer to homes association as soon as possible, in this case always retain architectural control (fences, walls, et al)

Where adequate public maintenance of park areas, streets and other facilities is not available it is advisable to establish a property owners maintenance association with appropriate powers to assess and administer assessments

The development company, as the initial original owner, sets up the association with company officers acting temporarily until succeeded by property owners, company officers should be resident owners

Selling the project, powers and duties
- Establish sales organization scaled to size of operation
- Well designed name plate
- Well delineated map of project
- Display of each house type built as a demonstration model complete with interior furnishings
- On site display room showing samples of materials
- Sales office equipped to perform services of buying a home including legal work, insurance, loans et al
- Build in less desirable lots first
- Identify non residential uses with signs
- Offer landscape plans or perhaps include the basics in the lot purchased
- Get staff employees living there
- Sales commission on sliding scale
- Build only what market can readily afford

BIBLIOGRAPHY FEASIBILITY STUDY

Armour Research Foundation, Phase Report 1957
Feasibility Studies of Air Cellular Featherweight Housings

Clough, Richard H., Construction Contracting
John Wiley and Sons, New York 1960

Dietz, Albert G.H., Dwelling House Construction
D. Van Nostrand Company, 1958

Horowitz, Harold, An Analysis of Utilities Supplies For Housing
Master—in Architecture Thesis, September 1951

Lynch, Kevin, Technique of Site Planning
Massachusetts Institute of Technology 1960

Means, R.S.Company, Building Construction Cost Data
Duxbury, Massachusetts

NAHB,Home Builders Manual For Land Development
National Association of Home Builders 1958

Turabian, Kate L., A Manual for Writers of Dissertations
University of Chicago Press 1949

Urban Land Institute, Community Builders Handbook
Washington, D.C.