A HOUSING SYSTEM:
A STUDY OF AN INDUSTRIALIZED HOUSING SYSTEM IN METAL

By:

BRUCE M. HAXTON
Bachelor of Architecture,
University of Minnesota (1969)

Submitted in Partial Fulfillment of the Requirements for the Degree of MASTER OF ARCHITECTURE, ADVANCED STUDIES

At the MASSACHUSETTS INSTITUTE OF TECHNOLOGY
May, 1973

Author..............................................................

Department of Architecture

Certified by......................................................

Thesis Advisor

Accepted by............

Chairman, Departmental Committee
on Graduate Students

Rotch
JUL 13 1973
May 11, 1973

Dean William Porter
School of Architecture and Planning
Massachusetts Institute of Technology

Dear Dean Porter:

In partial fulfillment of the requirements for the degree of Master of Architecture, Advanced Studies, I hereby submit this thesis entitled:

A HOUSING SYSTEM: A STUDY OF AN INDUSTRIALIZED HOUSING SYSTEM IN METAL.

Respectfully,

Bruce M. Haxton
ACKNOWLEDGEMENTS

The author wishes to gratefully acknowledge the following people, whose assistance and advice have contributed significantly to the development of this thesis.

Waclaw P. Zalewski
Professor of Architecture
Massachusetts Institute of Technology
Thesis Advisor

Eduardo Catalano
Professor of Architecture
Massachusetts Institute of Technology

Author D. Bernhardt
Professor of Architecture
Massachusetts Institute of Technology

Ezra Ehrenkrantz
Visiting Professor
Massachusetts Institute of Technology

James Bock
Executive Vice President
Bock Industries Incorporated
TABLE OF CONTENTS

Title Page
Letter of Submittal
Acknowledgements
Table of Contents
Abstract
Introduction
Design Analysis
  Design Constraints
  Methodology
  Design Considerations
Areas for Further Study
User Requirement Study
Market Study
Design Study
  Design Categories
  Design Components
  Delivery Components
Unit Plans
Unit Cluster Plans
Details
Unit Model
Bibliography
ABSTRACT

A HOUSING SYSTEM: A STUDY OF AN INDUSTRIALIZED HOUSING SYSTEM IN METAL

By BRUCE M. HAXTON

Submitted to the Department of Architecture on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Architecture, Advanced Studies.

The aim of this thesis is to study an industrialized housing system based on metal framed housing modules. These housing modules would be produced using assembly line techniques and delivered to the site for erection.

The thesis contains three primary elements: 1) The user requirement study, 2) The market study, and 3) The design study. The user requirement and market studies were used to establish parameters for the design study. The design study demonstrates how basic living elements can be used to generate building modules that are delivered to the site to form dwelling units.

Thesis Supervisor: Waclaw P. Zalewski
Title: Professor of Structures
INTRODUCTION

1.1 The Problem

A multitude of building systems are being marketed today to meet the numerous housing demands of the nation. Examples satisfy variations in family size and income level as well as providing a range of housing types. Mobile homes, for example, largely focus on rural, low-cost, single family housing. Conversely, modular housing is oriented toward larger extended families at a higher income level. Other systems have been developed for the urban apartment dweller using steel and concrete technology. Upon investigating a selected sample, the author has discovered inadequacies in the design of these systems. It has been observed that many of these systems are based on preconceived or poorly analyzed design parameters. Program inconsistencies exist which reflect a lack of a systematic investigation of three essential aspects; 1) Projected needs of the user; 2) An accurate assessment of market conditions; and 3) The effective and efficient application of utilizing existing factory production and distribution technology.
1.2 *Objective of the Study*

This thesis is intended to provide the designers and producers of industrialized housing systems with a methodology and design example for integrating assembly-line production techniques, effective marketing, and user requirements.

1.3 *Methodology*

Three primary elements form the thesis: 1) A user requirement study, 2) A market study, and 3) An illustrative design example. The user requirement study and market study were used to establish design categories which are used as parameters for the design study.

1.4 *Scope*

The design proposal is based on factory produced metal framed housing modules. These housing modules would be transported to the building site to form dwelling units of the following types: 1) Single family detached, 2) Single-family attached, and 3) Multi-family low-rise up to three stories in height.
DESIGN ANALYSIS

2.1 Design Constraints

Unit Constraints
One to four bedroom configurations
Units limited to one floor only
Units must accommodate variations in floor area and utilities
Housing types will encompass single-family detached, single family attached, and multi-family low-rise up to three stories in height

Site Planning Constraints
Units must form cluster arrangements
The system must be suitable for single site application as well as multiple unit sites

Manufacturing Constraints
The system must be adaptable to assembly line production techniques
The system should use existing manufacturing technology and products
Transportation Constraints

The maximum shipping width 14'-0"
The maximum shipping length 70'-0"
The maximum shipping height 13'-6"
The maximum shipping weight 30 tons
2.2 Methodology

The procedure was to establish the ranges of various housing elements such as, living/dining square-footage, that could then be broken down into categories and used as design parameters. Minimum user requirements and housing examples were used to establish these ranges.

User Requirement Study

The User Requirement Study is divided into the following categories: 1) Living room requirements, 2) Dining room requirements, 3) Bedroom requirements, 4) Kitchen requirements, and 5) Bathroom requirements.

The primary source used for the study was the *Guide Criteria for the Design and Evaluation of Operation Breakthrough: Volumell. Multi-family Low-rise*, performed by the Building Research Division Team in 1970 and adopted by the U.S. Department of Housing and Urban Development as the criteria for Operation Breakthrough. The study was used to generate and check room sizes and shapes.
Market Study
The market study was accomplished by taking a selected sample. Dwelling unit groups of similar bedroom counts formed subdivisions in the following categories: 1) Dwelling unit size, 2) Living and dining areas, 3) Kitchen counter length, and 4) Utilities.

Design Study
The user requirement and market studies were used to form the range of various housing elements to be used in the design study. The user requirements formed minimums while the market study identified the upper limits for each housing element. The ranges for each housing element were then broken down into categories within each bedroom count. Each category could be used as a set of design parameters for a particular unit design.
2.3 Design Considerations

Building Form
The cluster arrangement was used because it promotes social interaction and was conducive to providing a hierarchy of spaces in planning arrangements. The social basis for this type of housing is covered in Architectural Environment and Our Mental Health, by Clifford B. Moller.

Manufacturing Considerations
The use of existing materials would reduce the "tooling up" aspect of production which could otherwise be an inhibiting factor. Box construction permits the highest degree of industrialization possible and labor costs are minimized. The ample supply of metal insures that material costs will not seriously escalate in the future. Metal construction allows close tolerance levels and rapid assembly.

Transportation Considerations
The use of the floor members as the chassis element for transportation allows a cost reduction. The wheel and hitch assembly are returned to the
factory thus saving the cost of these items over existing mobile home practices.

Marketing Considerations
The market network that has been established by the mobile home industry could be used to market this system. Since the system encompasses both single family and multi-family structures a greater aggregation of the market is achieved.

Construction Considerations
The rigid frame structure promotes structural continuity during the erection process. The connections between units establishes a structural continuity thus establishes resistance to horizontal forces. The use of steel promotes tolerance control. The use of the metal frame allows easy erection lifting with the metal column connections.
AREAS FOR FUTHER STUDY

Futher study is needed in the following areas:

Building Forms
Double loaded corridor configurations and two story units should be investigated. Criteria and options should be established for integrating more non-system elements into the unit designs.

Structural and Code Requirements
Additional structural calculations and testing should be made. Fire testing and building code acceptance should be accomplished.

Market Studies
A more comprehensive market study should be made taking a wider sampling. A market analysis should be made of the specific market area.
USER REQUIREMENT STUDY
COUCH  
3'-0" X 6'-10"

TWO EASY CHAIRS  
2'-6" X 3'-0" each

DESK  
1'-8" X 3'-6"

CHAIR  
1'-6" X 1'-6"  
30"

TABLE  
1'-6" X 2'-6"

TELEVISION  
1'-4" X 2'-8"  
5'-0" to view

60" between facing seating  
24" circulation between furniture  
36" main circulation  
10' diameter of conversation area

LIVING ROOM REQUIREMENTS
LIVING ROOM ARRANGEMENT
TABLE FOR FOUR
3'-2" X 2'-6"

TABLE FOR SIX
3'-4" X 4'-0"

TABLE FOR EIGHT
3'-4" X 6'-0"

32" access for seating
42" for serving
48" from table to base cabinets

DINING ROOM REQUIREMENTS
TWO TWIN BEDS
3'-3" X 6'-10"

CRIB
2'-6" X 4'-6"

DRESSER
1'-6" X 4'-4"

TABLE
2'-6" X 1'-8"

CHAIR
1'-6" X 1'-6"

DRESSING AREA
3'-6" X 3'-6"

PRIMARY BEDROOM

BEDROOM REQUIREMENTS
## Bedroom Requirements

**TWO TWIN BEDS**  
3'-3" X 6'-10" each

![Diagram of Twin Beds]

**ONE DOUBLE BED (ALTERNATE)**  
4'-6" X 6'-10"

![Diagram of Double Bed]

**TWO DRESSERS**  
1'-6" X 4'-4" each  
36" to use  
Second dresser is desirable but not required.

![Diagram of Dressers]

**DESK AND CHAIR**  
1'-8" X 3'-6"  
30" to use

![Diagram of Desk and Chair]

**DRESSING AREA**  
3'-6" X 3'-6"

**SECONDARY DOUBLE OCCUPANCY BEDROOM**
ONE TWIN BED
3'-3" X 6'-10"

3'-6" X 3'-6"

DRESSER
1'-6" X 3'-6"

DESK
1'-8" X 3'-6"

CHAIR
1'-6" X 1'-6"

The desk and chair are desirable but not required.

DRESSING AREA
3'-6" X 3'-6"

SECONDARY SINGLE OCCUPANCY BEDROOM

BEDROOM REQUIREMENTS
SINK
Counter and base cabinets at each side

RANGE
Counter and base cabinet at one side

REFRIGERATOR
Counter at latch side

MIXING AREA
Base and wall cabinet

ONE BEDROOM / TWO BEDROOM

KITCHEN REQUIREMENTS
SINK
Counter and base cabinets at each side

RANGE
Counter and base cabinet at one side

REFRIGERATOR
Counter at latch side

MIXING AREA
Base and wall cabinet

THREE BEDROOM / FOUR BEDROOM
KITCHEN REQUIREMENTS
BATH TUB
2'-10" X 5'-0"
28" for drying

WATER CLOSET
2'-5" deep
21" to use

LAVATORY
2'-0" X 3'-0"
21" to use

WASHER
2'-2" X 2'-7"
36" to use

DRYER
2'-2" X 2'-7"
36" to use

WASHER/DRYER
2'-2" X 2'-7"
36" to use

BATHROOM REQUIREMENTS
<table>
<thead>
<tr>
<th></th>
<th>1 BEDROOM</th>
<th>2 BEDROOM</th>
<th>3 BEDROOM</th>
<th>4 BEDROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LIVING UNIT SQUARE FOOTAGE STUDY**
<table>
<thead>
<tr>
<th>1 Bedroom</th>
<th>2 Bedroom</th>
<th>3 Bedroom</th>
<th>4 Bedroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-6</td>
<td>RESTON L.C.</td>
<td>RESTON L.C.</td>
<td>RESTON L.C.</td>
</tr>
<tr>
<td>8-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-0</td>
<td></td>
<td></td>
<td>WESTON</td>
</tr>
</tbody>
</table>

KITCHEN COUNTER STUDY
<table>
<thead>
<tr>
<th></th>
<th>1 BEDROOM</th>
<th>2 BEDROOM</th>
<th>3 BEDROOM</th>
<th>4 BEDROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 B W D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 SB W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 SB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **B** BATHROOM
- **W** WASHER
- **SB** SMALL BATHROOM
- **D** DRYER
- **L** LAVATORY

**UTILITIES STUDY**
<table>
<thead>
<tr>
<th></th>
<th>1 BEDROOM</th>
<th>2 BEDROOM</th>
<th>3 BEDROOM</th>
<th>4 BEDROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEVEL 1</strong></td>
<td>688</td>
<td>770</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td><strong>LEVEL 2</strong></td>
<td>752</td>
<td>971</td>
<td>1253</td>
<td>1450</td>
</tr>
<tr>
<td><strong>LEVEL 3</strong></td>
<td>816</td>
<td>1172</td>
<td>1506</td>
<td>1700</td>
</tr>
<tr>
<td><strong>LEVEL 4</strong></td>
<td>880</td>
<td>1375</td>
<td>1760</td>
<td>1950</td>
</tr>
</tbody>
</table>

**LIVING UNIT**
**SQUARE FOOTAGE**

<table>
<thead>
<tr>
<th></th>
<th>1 BEDROOM</th>
<th>2 BEDROOM</th>
<th>3 BEDROOM</th>
<th>4 BEDROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEVEL 1</strong></td>
<td>235</td>
<td>235</td>
<td>280</td>
<td>337</td>
</tr>
<tr>
<td><strong>LEVEL 2</strong></td>
<td>272</td>
<td>286</td>
<td>324</td>
<td>374</td>
</tr>
<tr>
<td><strong>LEVEL 3</strong></td>
<td>310</td>
<td>337</td>
<td>368</td>
<td>411</td>
</tr>
<tr>
<td><strong>LEVEL 4</strong></td>
<td>350</td>
<td>390</td>
<td>412</td>
<td>450</td>
</tr>
</tbody>
</table>

**LIVING / DINING**
**SQUARE FOOTAGE**

**DESIGN CATEGORIES**
<table>
<thead>
<tr>
<th>Level</th>
<th>1 Bedroom</th>
<th>2 Bedroom</th>
<th>3 Bedroom</th>
<th>4 Bedroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>6'</td>
<td>8'</td>
<td>8'</td>
<td>9'</td>
</tr>
<tr>
<td>Level 2</td>
<td>8'</td>
<td>9'</td>
<td>10'</td>
<td>11'</td>
</tr>
<tr>
<td>Level 3</td>
<td>10'</td>
<td>11'</td>
<td>12'</td>
<td>13'</td>
</tr>
<tr>
<td>Level 4</td>
<td>11'</td>
<td>12'</td>
<td>14'</td>
<td>15'</td>
</tr>
</tbody>
</table>

**KITCHEN COUNTER**

<table>
<thead>
<tr>
<th>Level</th>
<th>1 Bedroom</th>
<th>2 Bedroom</th>
<th>3 Bedroom</th>
<th>4 Bedroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>REGULAR BATHROOM WASHER</td>
<td>REGULAR BATHROOM WASHER</td>
<td>REGULAR BATHROOM WASHER</td>
<td>REGULAR BATHROOM WASHER DRYER</td>
</tr>
<tr>
<td>Level 2</td>
<td>REGULAR BATHROOM WASHER</td>
<td>REGULAR BATHROOM WASHER</td>
<td>1 1/2 BATHROOM WASHER DRYER</td>
<td>2 BATHROOMS WASHER DRYER</td>
</tr>
<tr>
<td>Level 3</td>
<td>REGULAR BATHROOM WASHER</td>
<td>REGULAR BATHROOM WASHER DRYER</td>
<td>2 BATHROOMS WASHER DRYER</td>
<td>2 1/2 BATHROOMS WASHER DRYER</td>
</tr>
<tr>
<td>Level 4</td>
<td>REGULAR BATHROOM WASHER DRYER</td>
<td>REGULAR BATHROOM WASHER DRYER</td>
<td>2 BATHROOMS WASHER DRYER</td>
<td>2 1/2 BATHROOMS WASHER DRYER</td>
</tr>
</tbody>
</table>

**UTILITIES**

**DESIGN CATEGORIES**
LIVING ROOM CONFIGURATIONS
LIVING ROOM CONFIGURATIONS
BEDROOM CONFIGURATIONS
BEDROOM CONFIGURATIONS
BEDROOM CONFIGURATIONS
BEDROOM CONFIGURATIONS
DECK CONFIGURATIONS
ONE
BEDROOM UNIT
BASIC PLANS

K1

K2

KITCHEN CONFIGURATIONS
TWO BEDROOM UNIT BASIC PLAN

THREE BEDROOM UNIT BASIC PLAN

KITCHEN CONFIGURATIONS
FOUR BEDROOM UNIT
BASIC PLAN

KITCHEN CONFIGURATIONS
TWO BEDROOM UNIT
BASIC PLANS K10

KITCHEN CONFIGURATIONS
THREE BEDROOM UNIT BASIC PLANS

KITCHEN CONFIGURATIONS
FOUR BEDROOM UNIT
BASIC PLANS

KITCHEN CONFIGURATIONS
ONE BEDROOM UNIT
BASIC PLAN K15

TWO BEDROOM UNIT
BASIC PLAN K16

KITCHEN CONFIGURATIONS
THREE BEDROOM UNIT BASIC PLAN K17

FOUR BEDROOM UNIT BASIC PLAN K18

KITCHEN CONFIGURATIONS
BATHROOM COMPONENTS
FORCED AIR HEATING C2

BATHROOM CORE CONFIGURATIONS
FORCED AIR HEATING

BATHROOM CORE CONFIGURATIONS
FORCED AIR HEATING - WATER HEATER IN KITCHEN MODULE

BATHROOM CORE CONFIGURATIONS
FORCED AIR HEATING
WATER HEATER IN
KITCHEN MODULE

BATHROOM CORE CONFIGURATIONS
FORCED AIR HEATING - WATER HEATER IN KITCHEN MODULE

BATHROOM CORE CONFIGURATIONS
HEAT PUMP AND WATER HEATER IN A COMMON SPACE

BATHROOM CORE CONFIGURATIONS
HEAT PUMP AND WATER HEATER IN A COMMON SPACE

BATHROOM CORE CONFIGURATIONS
HEAT PUMP AND WATER HEATER IN A COMMON SPACE

BATHROOM CORE CONFIGURATIONS
DELIVERY COMPONENTS
DELIVERY COMPONENTS
DELIVERY COMPONENTS
DELIVERY COMPONENTS
DELIVERY COMPONENTS
2 BEDROOM
LEVEL 1

937 SQ

UNIT 2.1

UNIT PLAN
2 BEDROOM
LEVEL 1

UNIT 2.2

UNIT PLAN
2 BEDROOM
LEVEL 1

UNIT 2.3

UNIT PLAN
2 BEDROOM
LEVEL 2

UNIT 2A

UNIT PLAN
2 BEDROOM
LEVEL 2

981 SQ

UNIT 2.5

UNIT PLAN
2 BEDROOM
LEVEL 2

UNIT 2.6

UNIT PLAN
2 BEDROOM
LEVEL 3

UNIT 2.9

UNIT PLAN
3 BEDROOM
LEVEL 2

1379 SQ

UNIT 3.3

UNIT PLAN
3 BEDROOM
LEVEL 2

UNIT 3.4

UNIT PLAN
4 BEDROOM
LEVEL 1

UNIT PLAN
GRID LINES 13'-4" O.C.

CHASE AREA

3"x10" E

OPEN WEB FLOOR JOIST 20" O.C.

FLOOR FRAMING PLAN
GRID LINES 13'-4" O.C.

CHASE AREA

3"x10" E

4" E CEILING JOIST 16" O.C.

CEILING FRAMING PLAN
STEEL TUBE
2 1/2"x3" COLUMN

COLUMN BASE PLATE

END COLUMN

STEEL TUBE
2 1/2"x5" COLUMN

3"x10" E

INTERIOR COLUMN

METAL SHIM AND
CONNECTOR PLATE

GRID LINES 13'-4" O.C.

TWO DELIVERY COMPONENT
CONNECTION

COLUMN DETAILS
CORNER BRACKET RIVET CONNECTED TO 3"x10"C

TWO DELIVERY COMPONENT CONNECTION

POSITION FOR BOLTING

GRID LINES 13'-4"O.C.

TWO DELIVERY COMPONENT CONNECTION

CONNECTOR PLATE

METAL SHIM AND COLUMN BASE PLATE

THREE DELIVERY COMPONENT CONNECTION

COLUMN DETAILS
METAL SHIM AND CONNECTOR PLATE

THREE DELIVERY COMPONENT CONNECTION

3"x10" C

COLUMN BASE PLATE

FOUR DELIVERY COMPONENT CONNECTION

STEEL CORNER BRACE

CANTILEVER CONDITION

COLUMN DETAILS
CONTINUOUS METAL FLASHING

BUILT UP ROOF

OPEN WEB ROOF JOIST

3" INSULATION

SECTION AT ROOF EXTERIOR WALL

PLYWOOD SUBFLOOR

FIRE RETARDANT PLYWOOD

3 E 10 RIVET CONNECTED

OPEN WEB FLOOR JOIST

COLUMN BASE PLATES BOLTED TO METAL CONNECTOR

3 E 6 RIVET CONNECTION

SECTION AT CEILING / FLOOR CONNECTION EXTERIOR WALL

GYPSUM SCREW ATTACHED TO METAL STUDS

INSULATION

WOODROCK SIDING OVER SHEATHING

3 E 10

OPEN WEB FLOOR JOIST

STEEL CONNECTOR BOLTED TO FOOTING

SECTION AT FLOOR EXTERIOR WALL

WALL DETAILS
CONTINUOUS METAL FLASHING

OPEN WEB ROOF JOIST

3" INSULATION

GYPSUM ATTACHED TO RESILIENT CHANNELS

SECTION AT ROOF INTERIOR WALL

PLYWOOD SUBFLOOR

FIRE RETARDANT PLYWOOD

SLIP ON PIN CONNECTION

METAL SHIM AND CONNECTOR PLATE

3 E 6 METAL CHANNEL

4" METAL CEILING JOIST RIVET ATTACHED TO CHANNEL

SECTION AT CEILING/FLOOR CONNECTION INTERIOR WALL

METAL STUDS ATTACHED TO 3 E 10

2 1/2" x 5" METAL COLUMN

OPEN WEB FLOOR JOIST RIVET ATTACHED

3 E 10 RIVET CONNECTED FRAME

3" INSULATION

STEEL CONNECTOR BOLTED TO FOOTING

SECTION AT FLOOR INTERIOR WALL

WALL DETAILS
EXTERIOR WALL OPTIONS
EXTERIOR WALL OPTIONS
EXTERIOR WALL OPTIONS
EXTERIOR WALL OPTIONS
EXTERIOR WALL OPTIONS
BIBLIOGRAPHY

Books and Reports


9. Horayangkura, Vimolsiddhi; Intha, Chalermpol; and Surintraboon, Chumpon, An Industrialized Housing System," Massachusetts Institute of Technology, June, 1970


Manufacturers Printed Material

1. Bock Industries Incorporated
   Elkhart, Indiana

2. Wausau Homes Incorporated
   Wausau, Wisconsin

3. Weston Homes Incorporated
   Rothschild, Wisconsin

4. Westinghouse Home Systems Division
   Pittsburg, Pennsylvania