

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

By:

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Bachelor of Architecture,
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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



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.

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Thesis Advisor

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Professor of Architecture
Massachusetts Institute of Technology

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Visiting Professor
Massachusetts Institute of Technology

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Executive Vice President
Bock Industries Incorporated

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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 de-
livered to the site to form dwelling units.

Thesis Supervisor: Wacław 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 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 the upper limits for each housing element. The ranges for each housing element were then broken down into 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 FUTURE STUDY

Further 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.

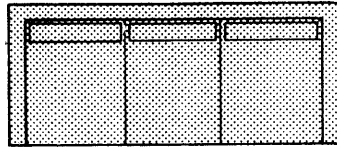
Market Studies

A more comprehensive market study should be made taking a wider sampling.

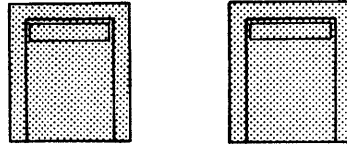
A market analysis should be made of the specific market area.

USER REQUIREMENT STUDY

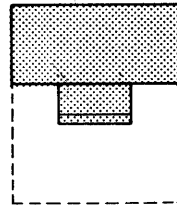
COUCH
3'-0" X 6'-10"



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



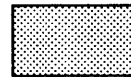
DESK
1'-8" X 3'-6"



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

30"

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



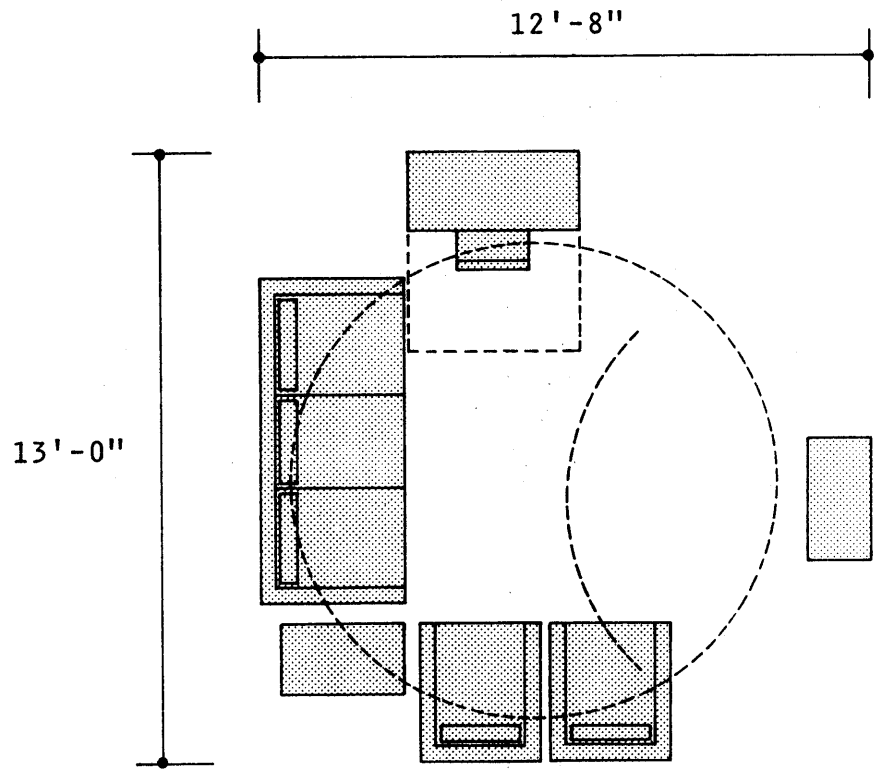
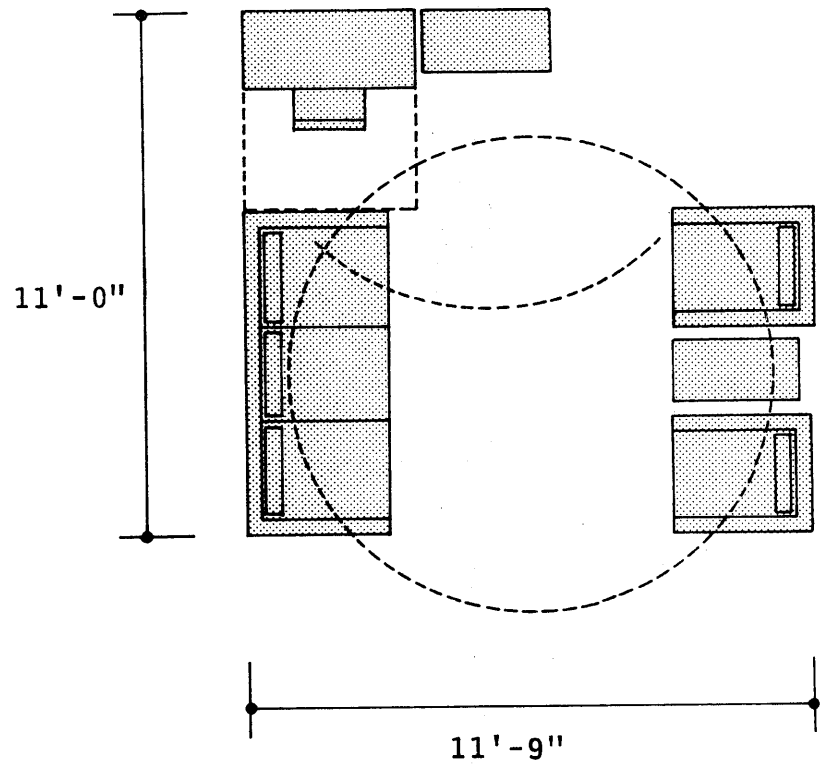
TELEVISION
1'-4" X 2'-8"



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"

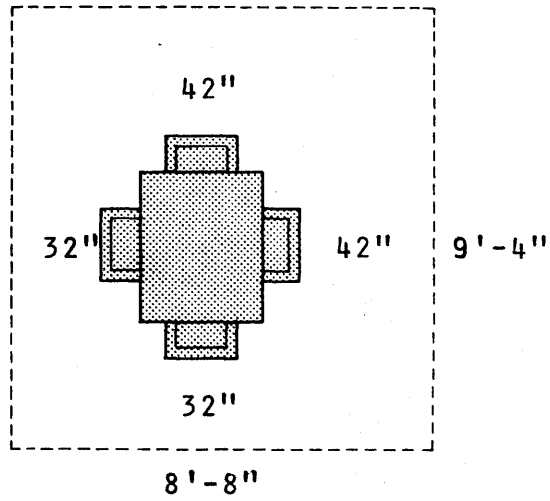


TABLE FOR SIX
3'-4" X 4'-0"

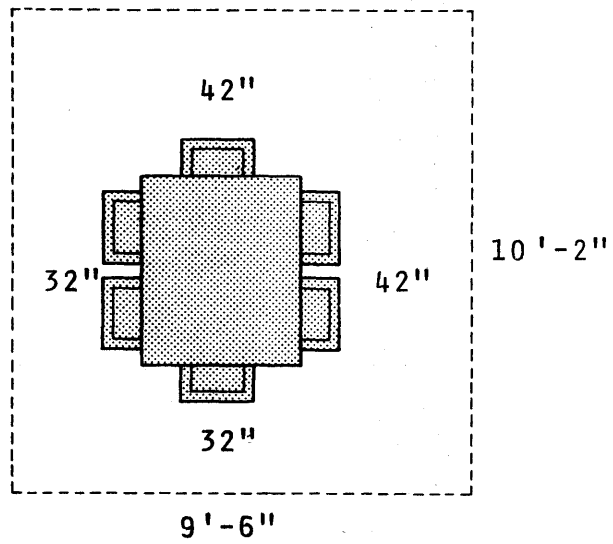
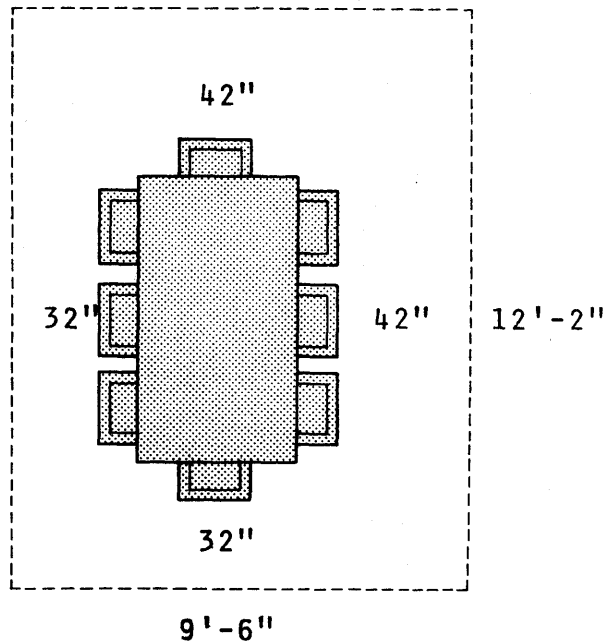


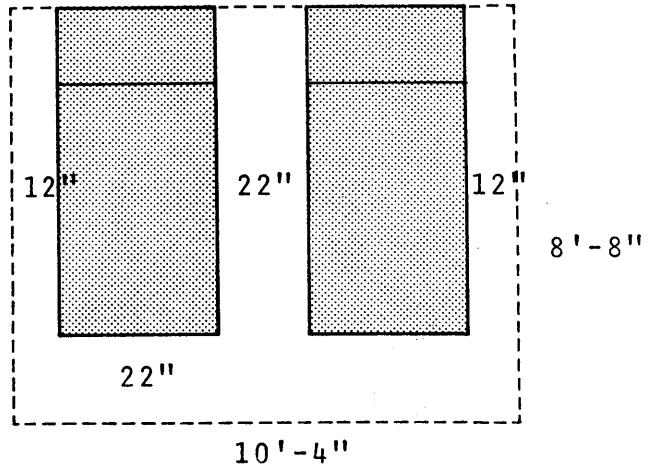
TABLE FOR EIGHT
3'-4" X 6'-0"



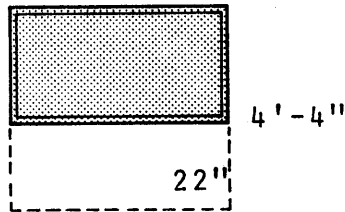
32" access for seating
42" for serving
48" from table to base
cabinets

DINING ROOM REQUIREMENTS

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



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



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

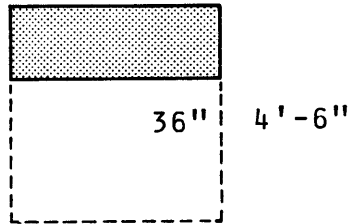
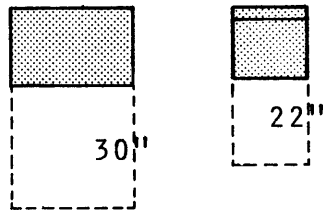


TABLE
2'-6" X 1'-8"

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

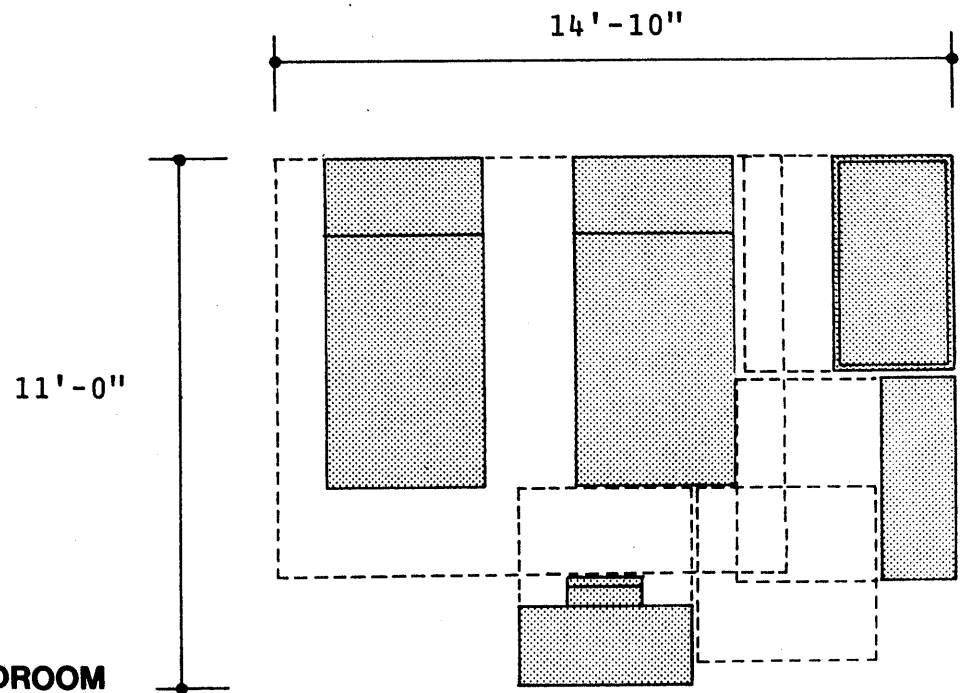
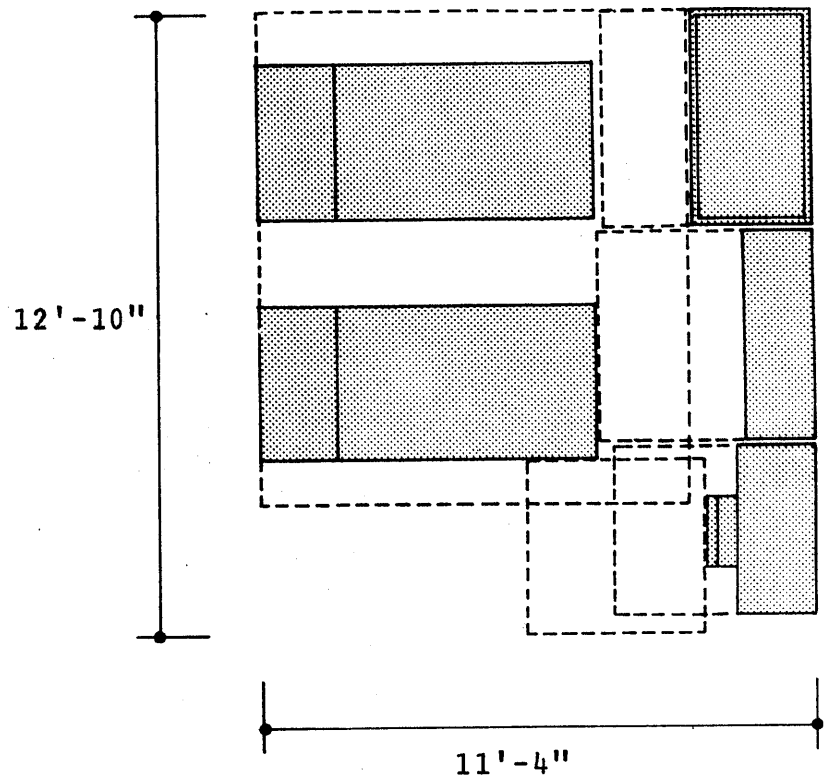


DRESSING AREA
3'-6" X 3'-6"



PRIMARY BEDROOM

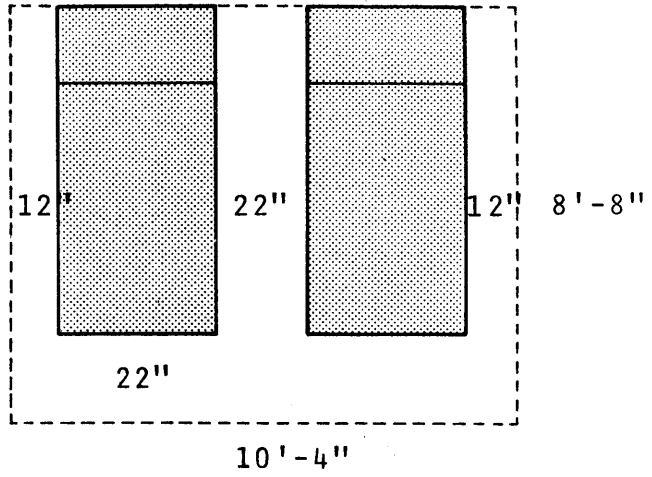
BEDROOM REQUIREMENTS



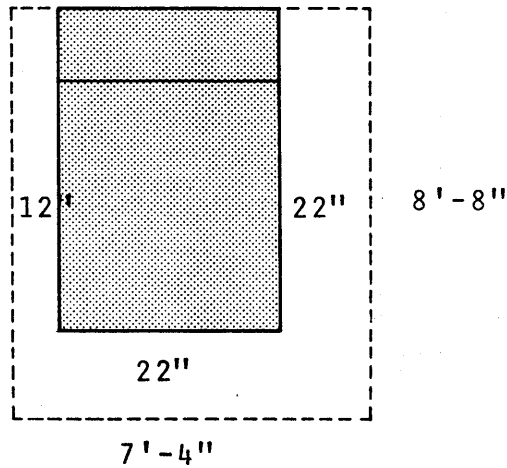
PRIMARY BEDROOM

BEDROOM ARRANGEMENT

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



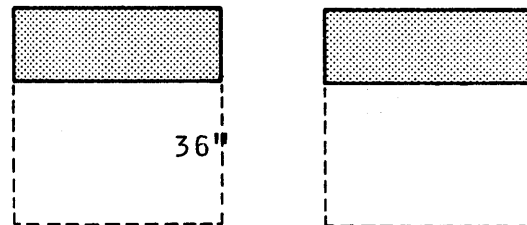
ONE DOUBLE BED
 (ALTERNATE)
 4'-6" X 6'-10"



TWO DRESSERS
 1'-6" X 4'-4" each

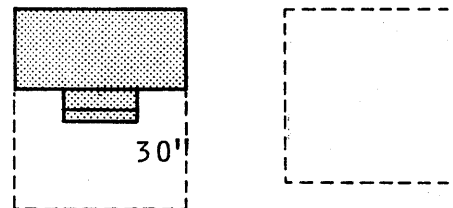
36" to use

Second dresser is desirable but not required.



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

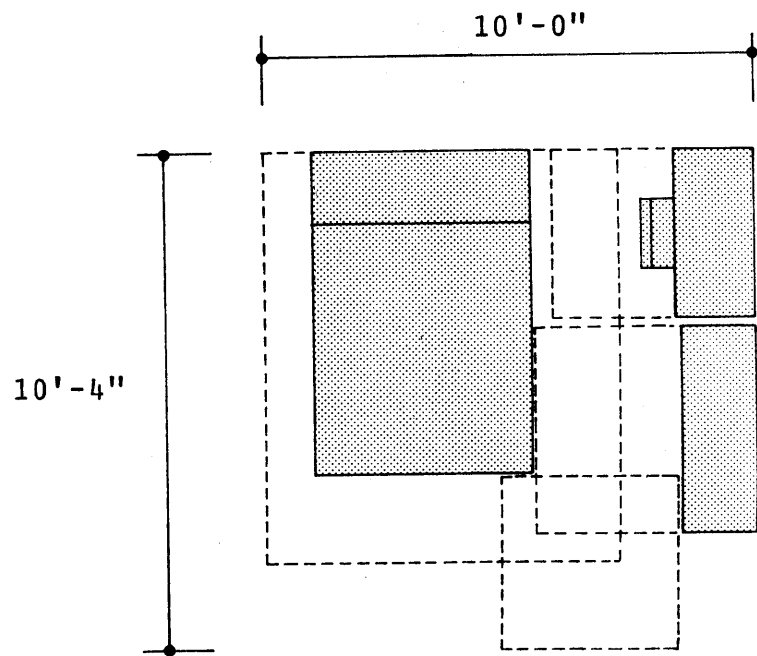
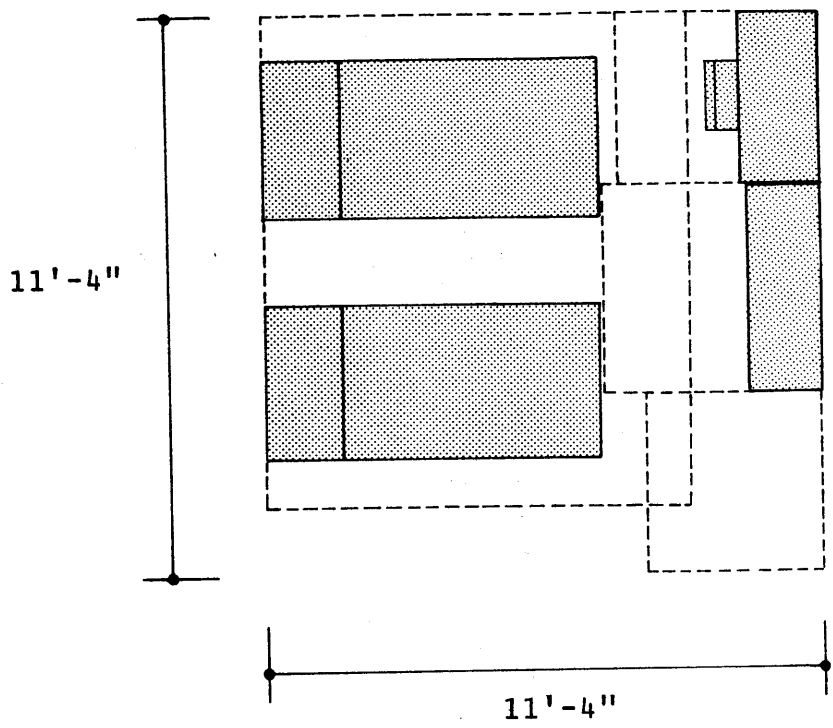
30" to use



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

**SECONDARY DOUBLE
 OCCUPANCY BEDROOM**

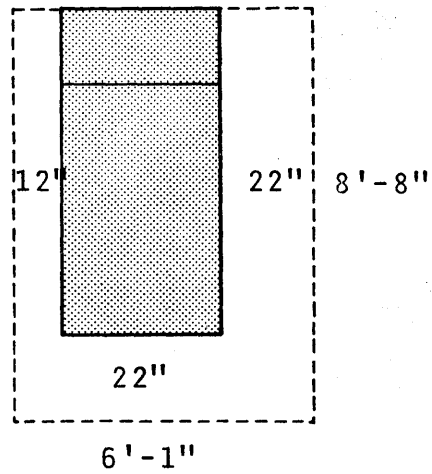
BEDROOM REQUIREMENTS



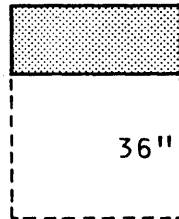
**SECONDARY DOUBLE
OCCUPANCY BEDROOM**

BEDROOM ARRANGEMENT

ONE TWIN BED
3'-3" X 6'-10"



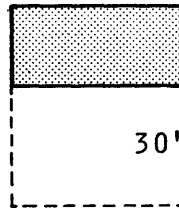
DRESSER
1'-6" X 3'-6"



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



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



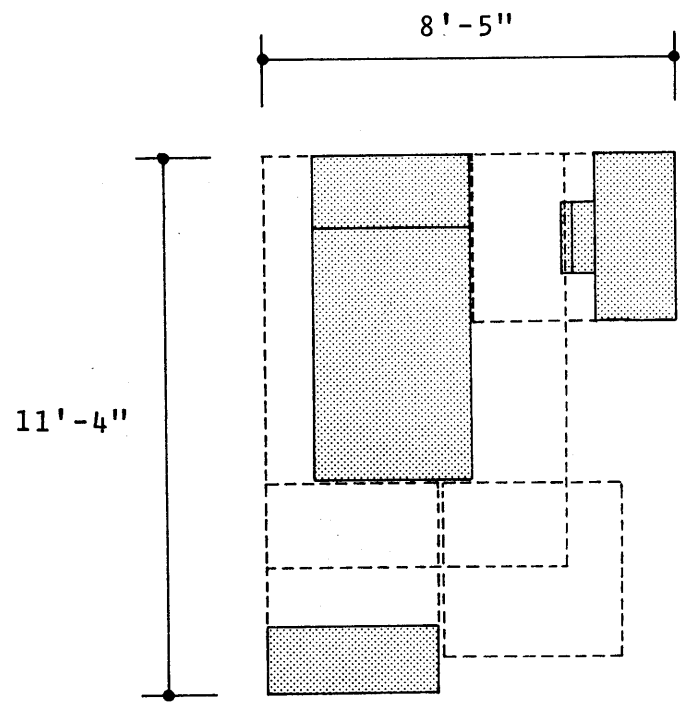
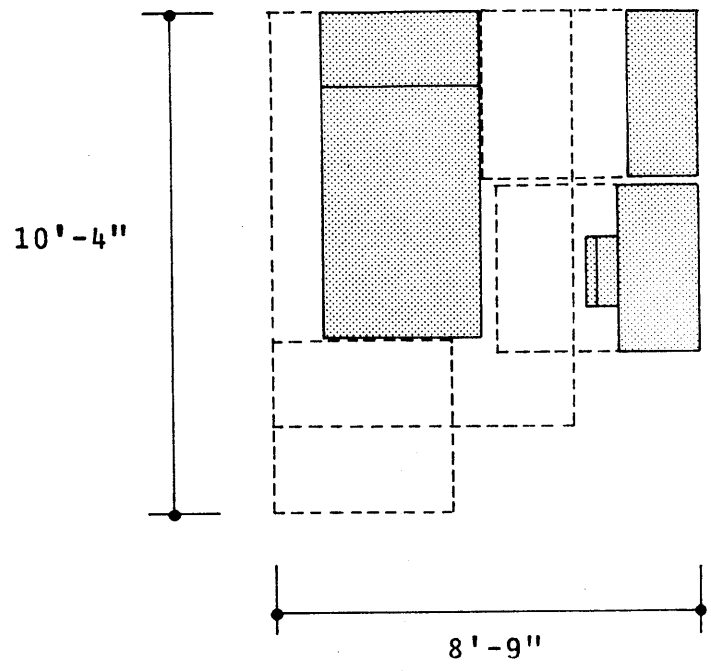
The desk and chair
are desirable but
not required.

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



**SECONDARY SINGLE
OCCUPANCY BEDROOM**

BEDROOM REQUIREMENTS

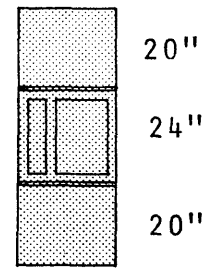
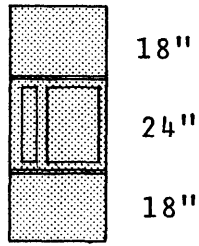


**SECONDARY SINGLE
OCCUPANCY BEDROOM**

BEDROOM ARRANGEMENT

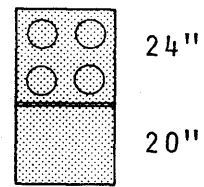
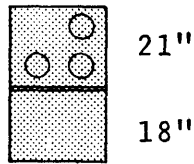
SINK

Counter and base cabinets at each side



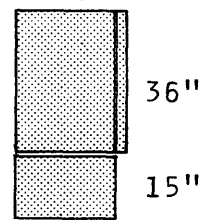
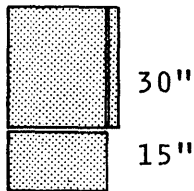
RANGE

Counter and base cabinet at one side



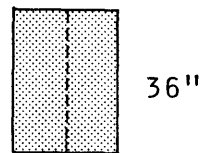
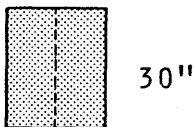
REFRIGERATOR

Counter at latch side



MIXING AREA

Base and wall cabinet

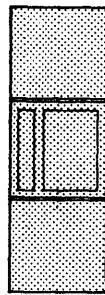


ONE BEDROOM / TWO BEDROOM

KITCHEN REQUIREMENTS

SINK

Counter and base cabinets at each side



24"

24"

21"



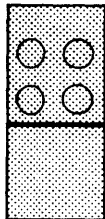
30"

36"

30"

RANGE

Counter and base cabinet at one side



30"

24"

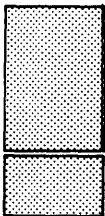


30"

30"

REFRIGERATOR

Counter at latch side



30"

15"

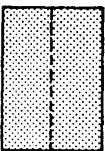


36"

15"

MIXING AREA

Base and wall cabinet



36"



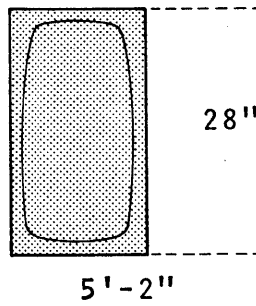
42"

THREE BEDROOM / FOUR BEDROOM

KITCHEN REQUIREMENTS

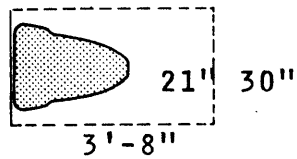
BATH TUB
2'-10" X 5'-0"

28" for drying



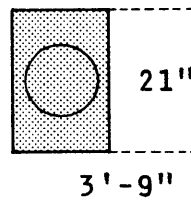
WATER CLOSET
2'-5" deep

21" to use



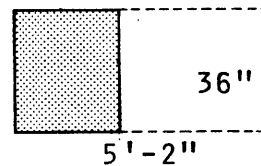
LAVATORY
2'-0" X 3'-0"

21" to use



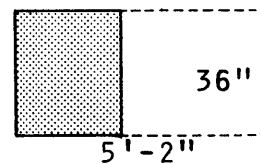
WASHER
2'-2" X 2'-7"

36" to use



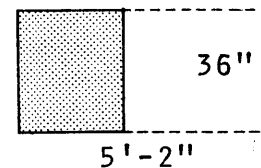
DRYER
2'-2" X 2'-7"

36" to use



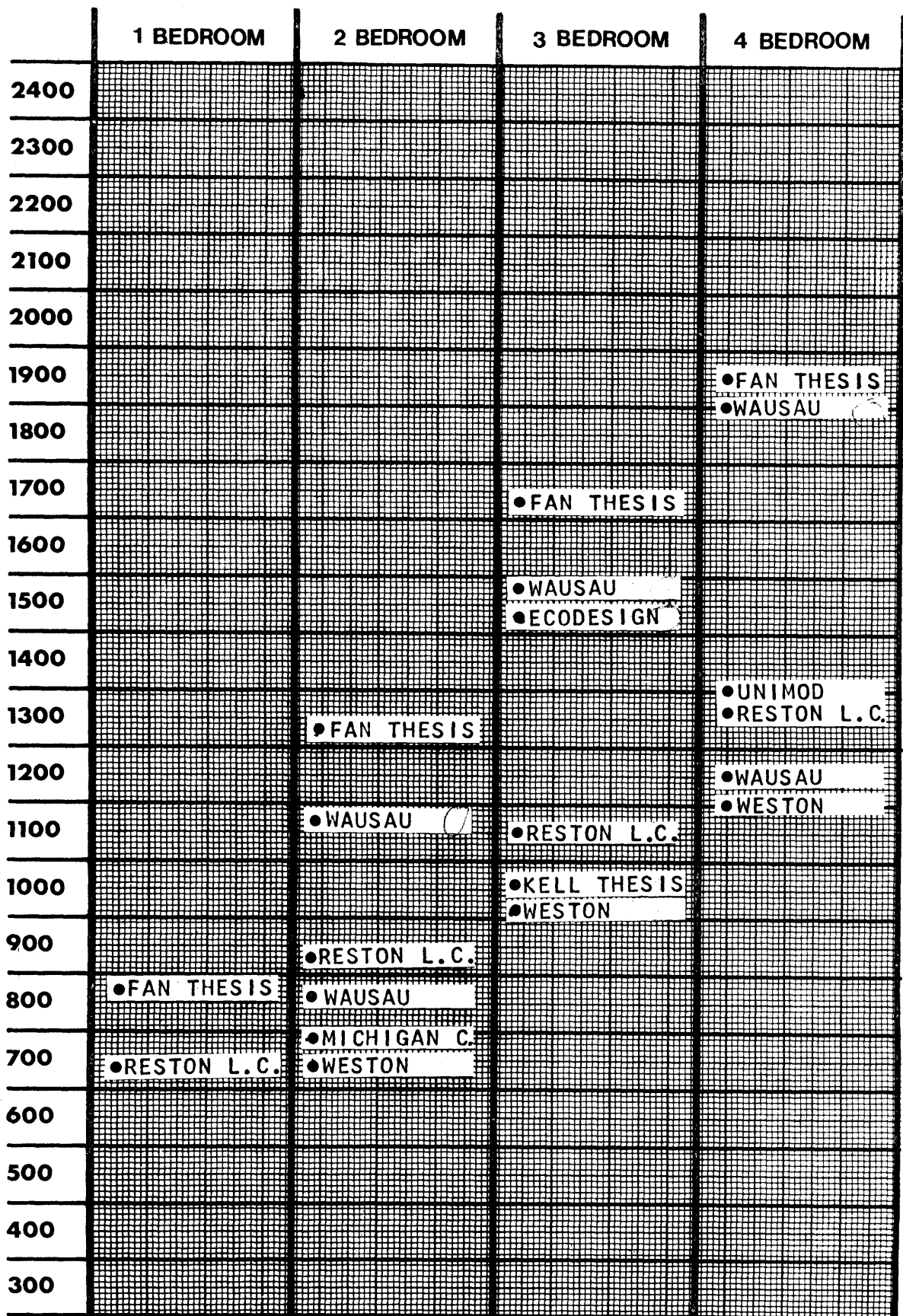
WASHER/DRYER
2'-2" X 2'-7"

36" to use



BATHROOM REQUIREMENTS

MARKET STUDY



LIVING UNIT SQUARE FOOTAGE STUDY

	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
625				
600				
575				
550				
525				
500				
475				
450				
425			●ECODESIGN	
400			●FAN THESIS	●FAN THESIS
375		●FAN THESIS		●WAUSAU
350				●RESTON L.C.
325	●FAN THESIS		●WAUSAU	●WESTON
300			●RESTON L.C.	
275	●RESTON L.C.	●RESTON L.C.		
250			●WESTON	
225		●WESTON		
200				
175				
150				
125				
100				

LIVING/DINING ROOM SQUARE FOOTAGE STUDY

	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
14-6				•WAUSAU
14-0		•FAN THESIS		
13-6			•FAN THESIS	•FAN THESIS
13-0				•WESTON
12-6				
12-0				
11-6				
11-0			•ECODESIGN •FAN THESIS	•FAN THESIS
10-6				
10-0				
9-6				
9-0				
8-6	•RESTON L.C.	•RESTON L.C.	•RESTON L.C.	•RESTON L.C.
8-0				•BREAKTHROUGH
7-6			•UNIMOD	
7-0		•BREAKTHROUGH	•BREAKTHROUGH	
6-6	•BREAKTHROUGH			
6-0				
5-6				
5-0		•MICHIGAN C		
4-6	•FAN THESIS			
4-0		•WESTON		

KITCHEN COUNTER STUDY

	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
2 1/2 B W D			•FAN THESIS	•FAN THESIS
2 B L W D				
2B W D			•WAUSAU	•RESTON L.C. •WAUSAU
1 1/2 B W D		•WAUSAU •FAN THESIS	•WAUSAU •FAN THESIS	•FAN THESIS
1B L W D				
1B W D			•WAUSAU •UNIMOD •RESTON L.C.	
1B W		•FAN THESIS		
1B	•FAN THESIS •RESTON L.C.	•WAUSAU •RESTON L.C.	•ECODESIGN	
1SB W D			•WESTON	•WESTON
1SB W		•WESTON		
1SB		•MICHIGAN C.		

B BATHROOM W WASHER
 SB SMALL BATHROOM D DRYER
 L LAMATORY

UTILITIES STUDY

DESIGN STUDY

	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
LEVEL 1	688	770	1000	1200
LEVEL 2	752	971	1253	1450
LEVEL 3	816	1172	1506	1700
LEVEL 4	880	1375	1760	1950

**LIVING UNIT
SQUARE FOOTAGE**

	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
LEVEL 1	235	235	280	337
LEVEL 2	272	286	324	374
LEVEL 3	310	337	368	411
LEVEL 4	350	390	412	450

**LIVING / DINING
SQUARE FOOTAGE**

DESIGN CATEGORIES

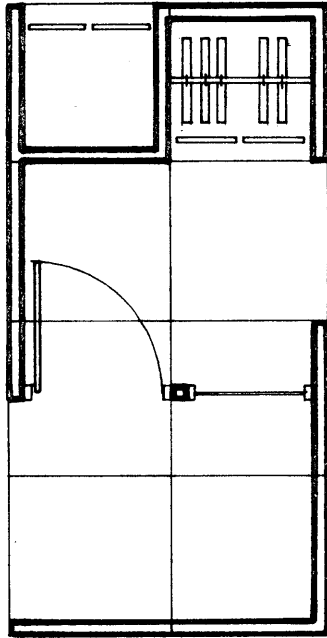
	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
LEVEL 1	6'	8'	8'	9'
LEVEL 2	8'	9'	10'	11'
LEVEL 3	10'	11'	12'	13'
LEVEL 4	11'	12'	14'	15'

KITCHEN COUNTER

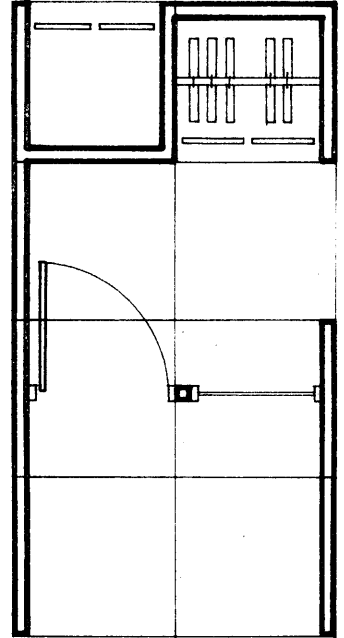
	1 BEDROOM	2 BEDROOM	3 BEDROOM	4 BEDROOM
LEVEL 1	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER DRYER
LEVEL 2	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER DRYER	1 1/2 BATHROOM WASHER DRYER
LEVEL 3	REGULAR BATHROOM WASHER	REGULAR BATHROOM WASHER DRYER	1 1/2 BATHROOM WASHER DRYER	2 BATHROOMS WASHER DRYER
LEVEL 4	REGULAR BATHROOM WASHER DRYER	REGULAR BATHROOM WASHER DRYER	2 BATHROOMS WASHER DRYER	2 1/2 BATHROOMS WASHER DRYER

UTILITIES

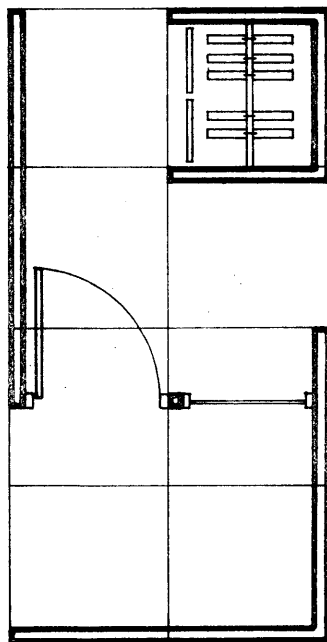
DESIGN CATEGORIES



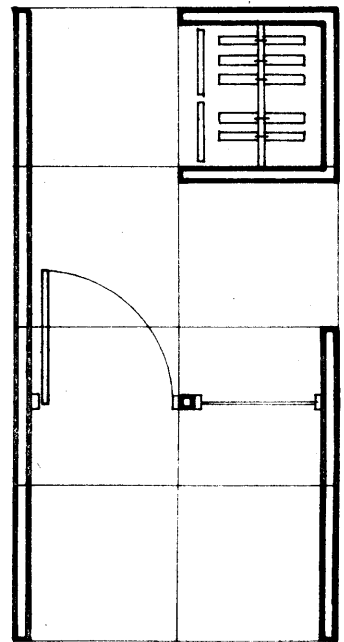
E1



E2

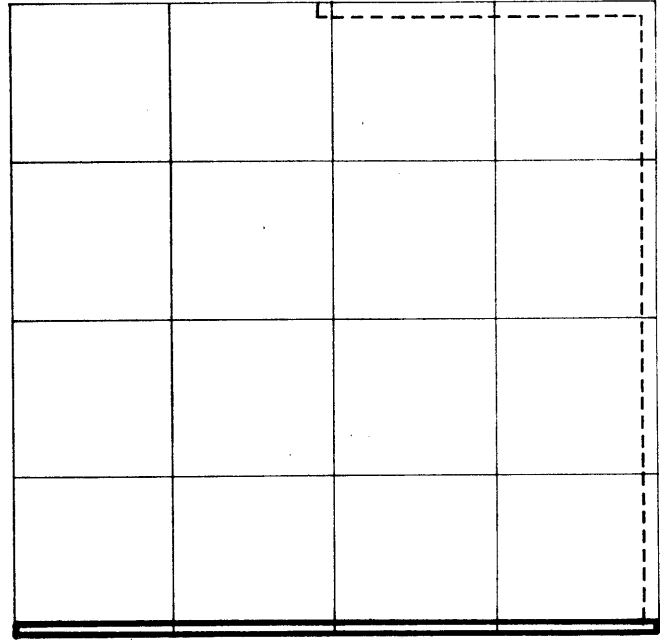


E3

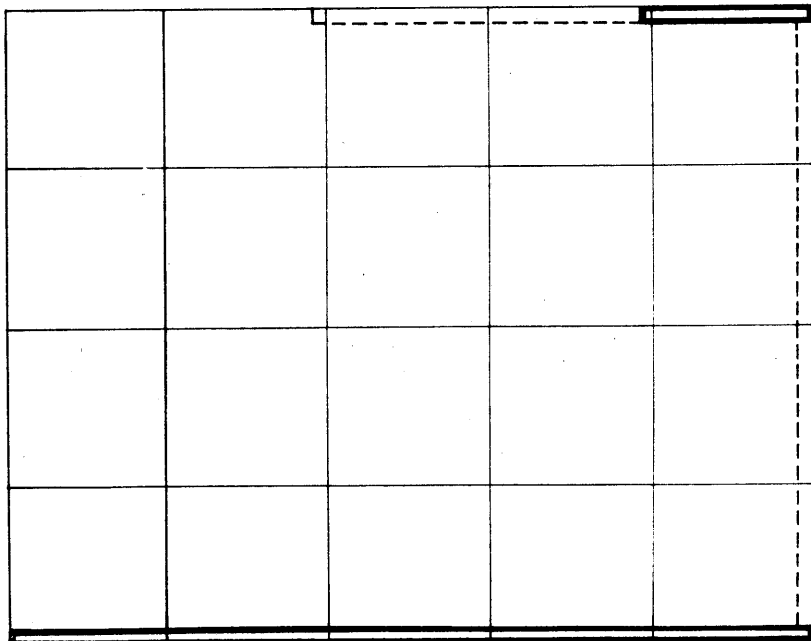


E4

ENTRY CONFIGURATIONS

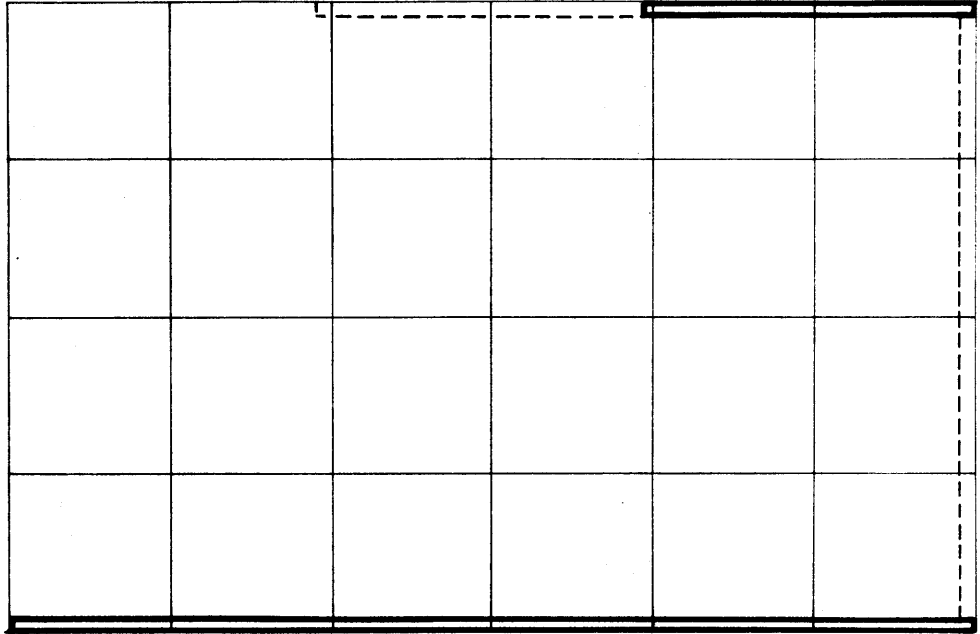


L1



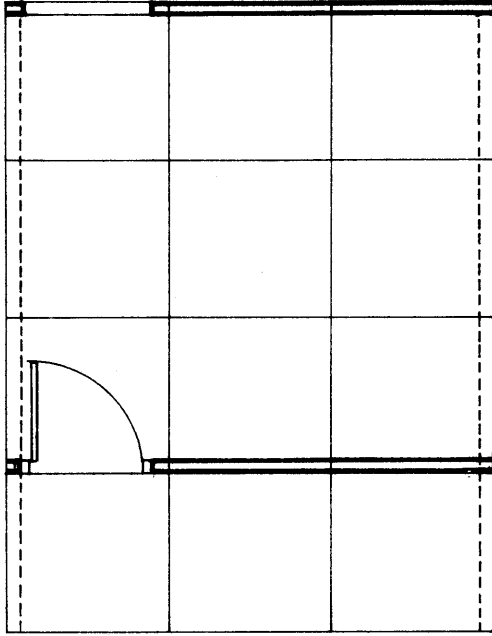
L2

LIVING ROOM CONFIGURATIONS

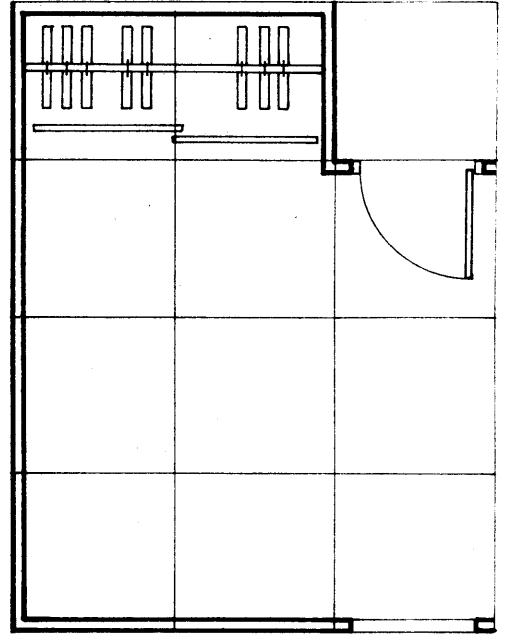


L3

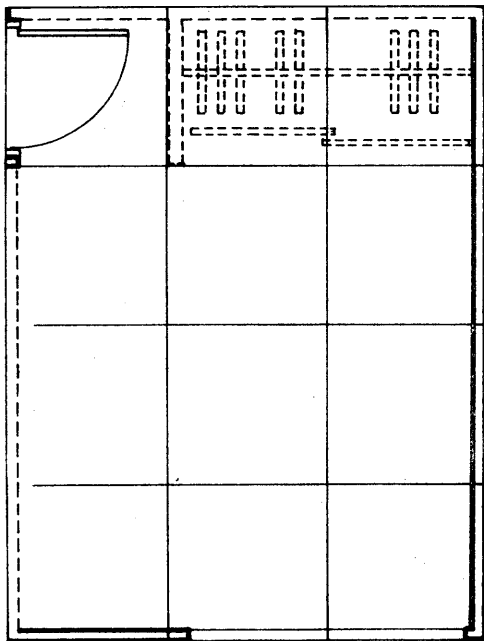
LIVING ROOM CONFIGURATIONS



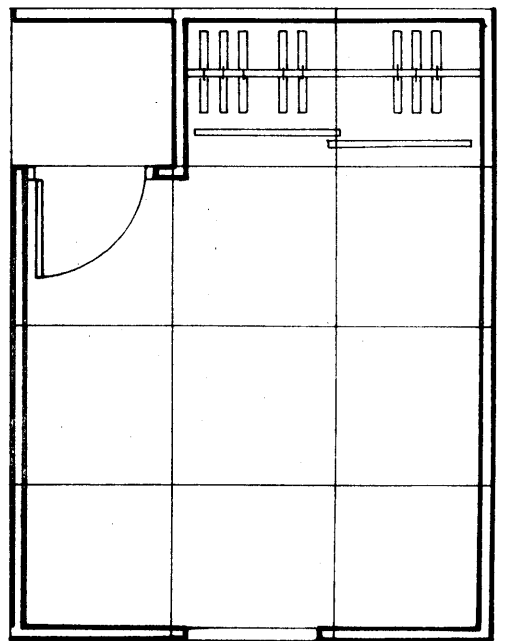
B1



B2

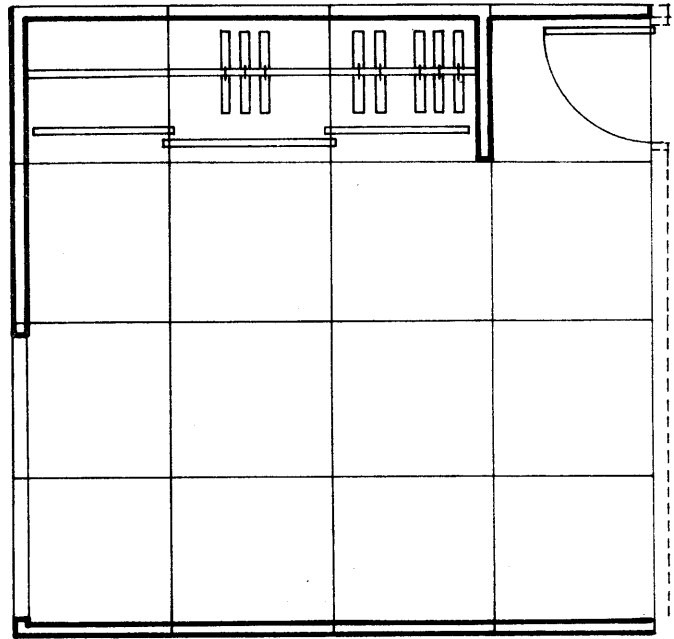


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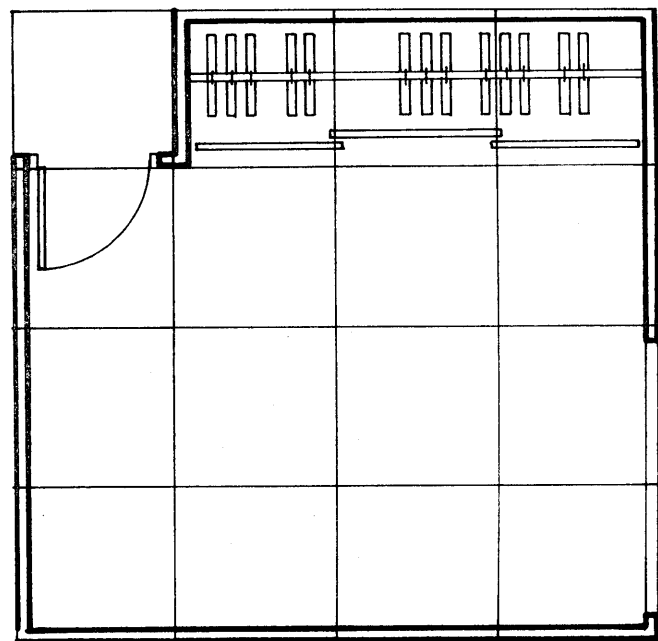


B4

BEDROOM CONFIGURATIONS

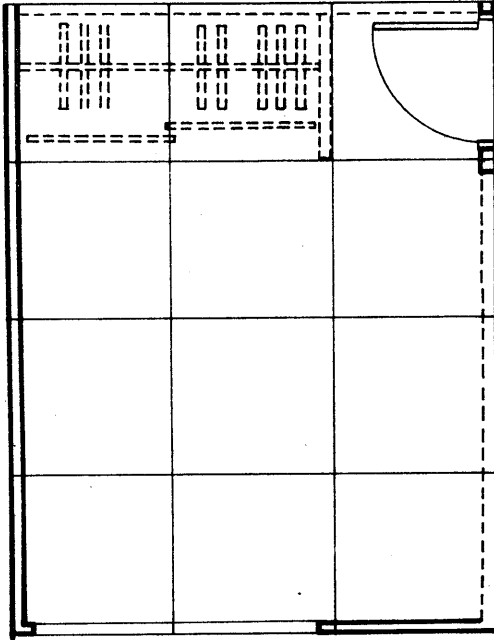


B5

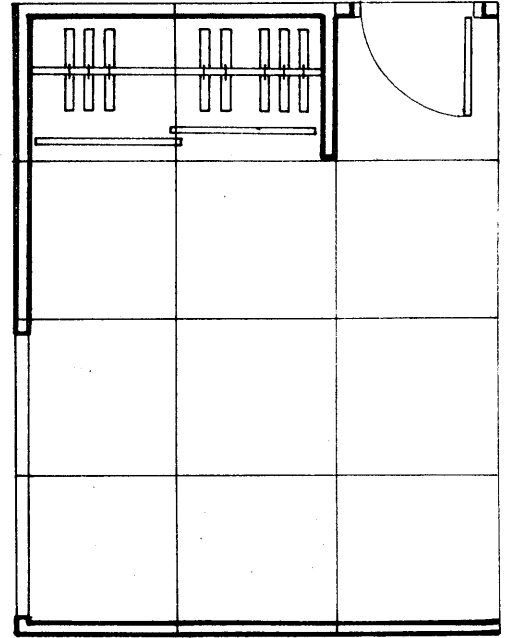


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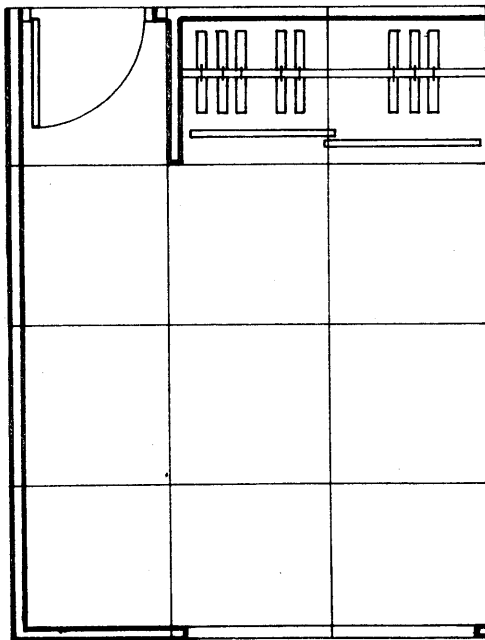
BEDROOM CONFIGURATIONS



B7

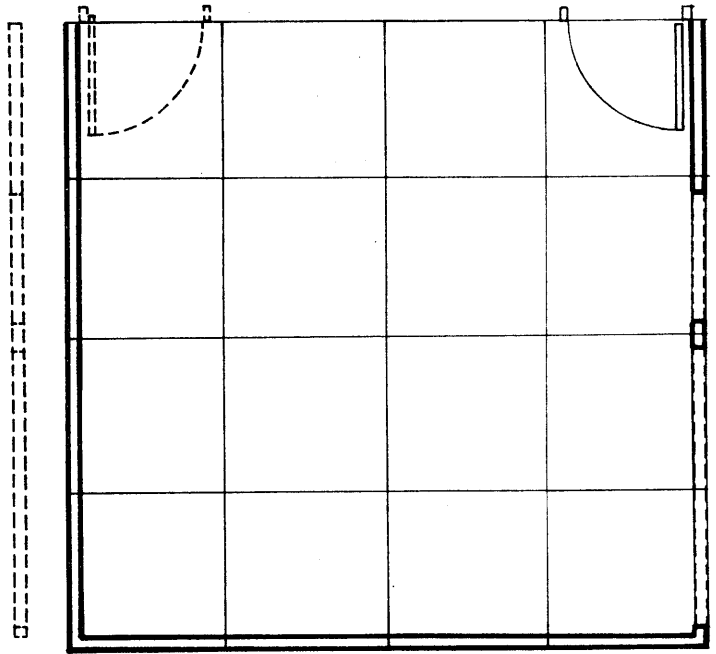


B8

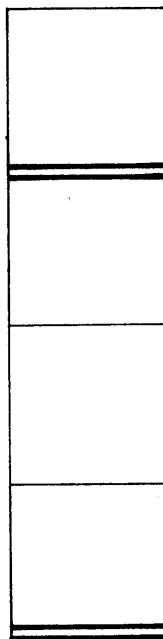


B9

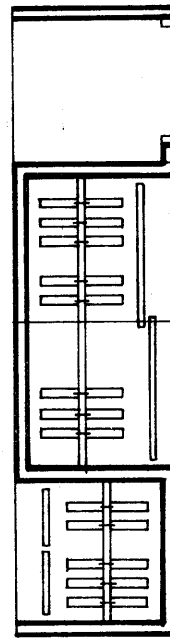
BEDROOM CONFIGURATIONS



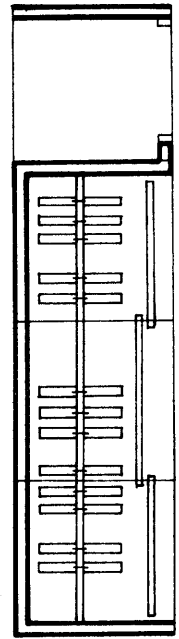
B10



B11

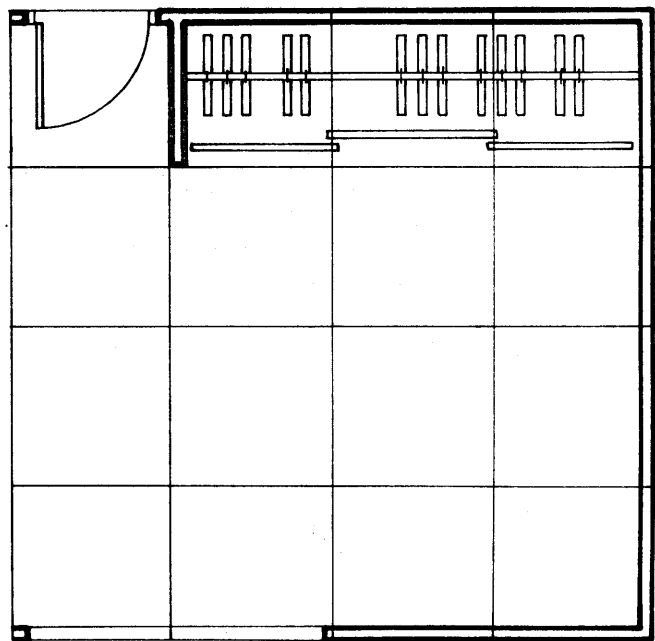


B12



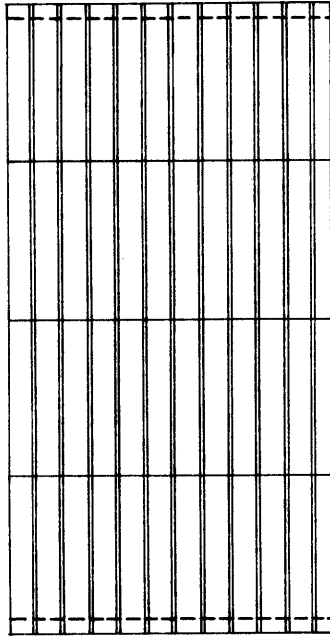
B13

BEDROOM CONFIGURATIONS

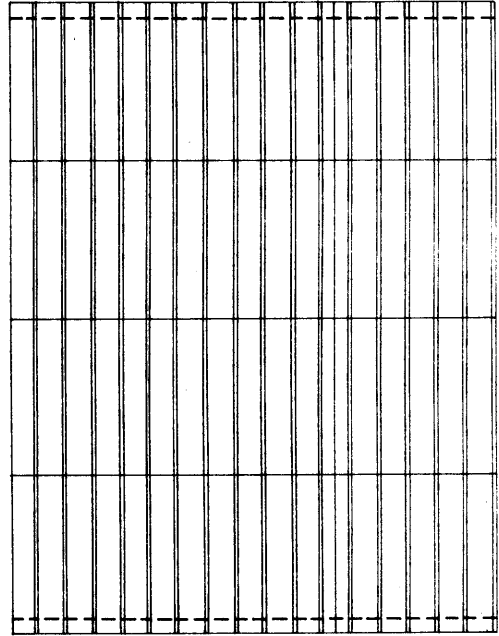


B14

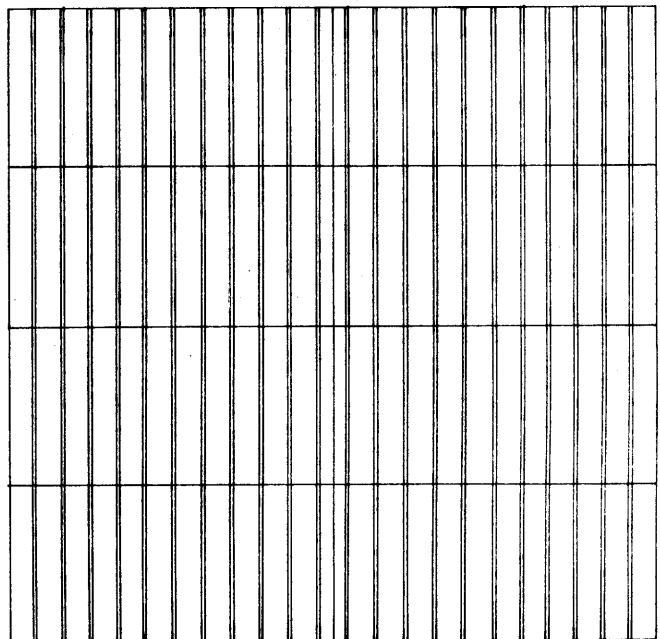
BEDROOM CONFIGURATIONS



D1

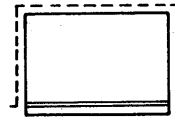
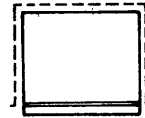
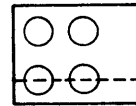
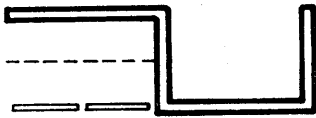
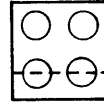
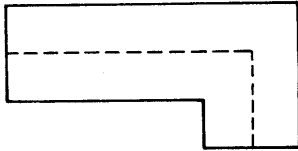
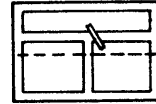
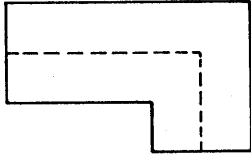
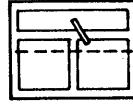
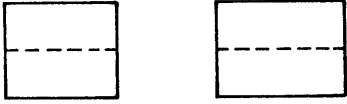
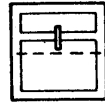
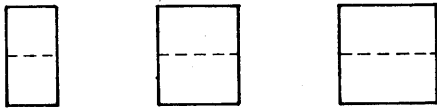


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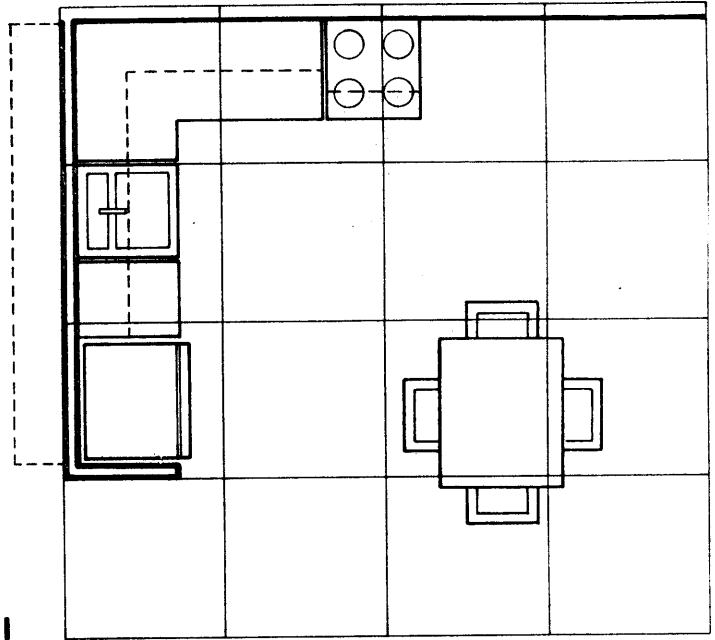


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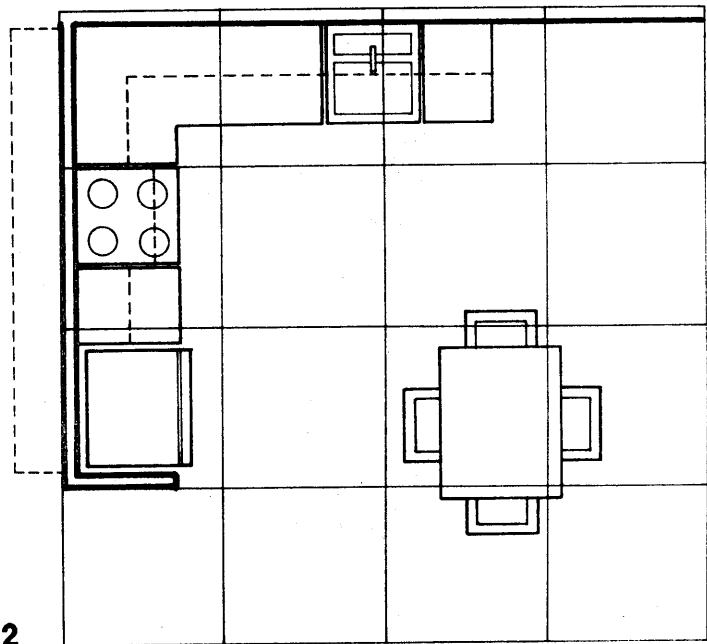
DECK CONFIGURATIONS



KITCHEN COMPONENTS



K1



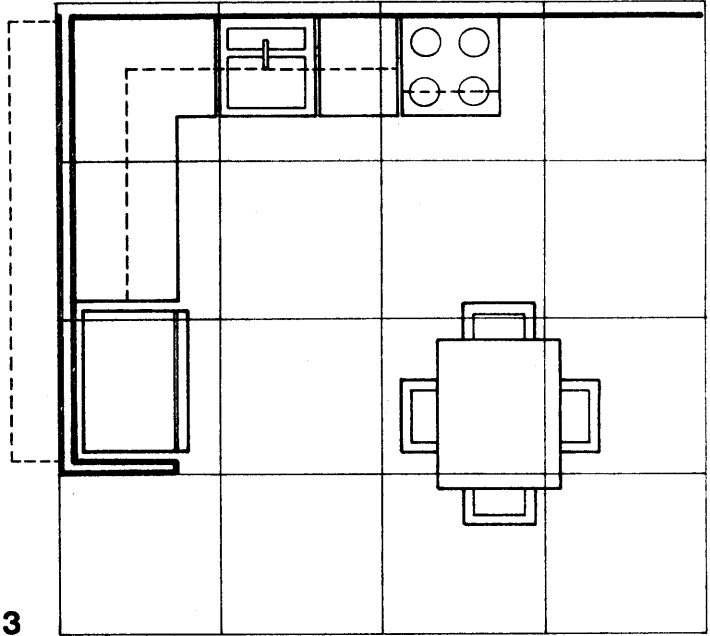
K2

**ONE
BEDROOM UNIT
BASIC PLANS**

KITCHEN CONFIGURATIONS

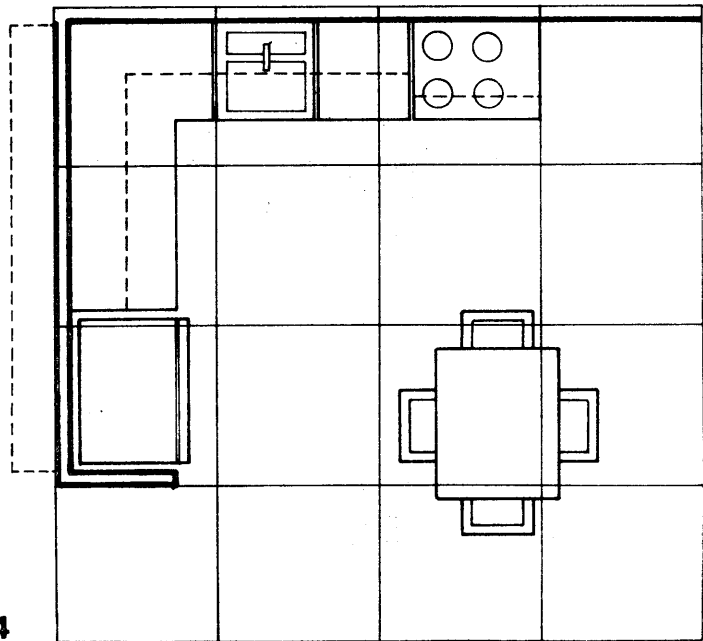
**TWO
BEDROOM UNIT
BASIC PLAN**

K3



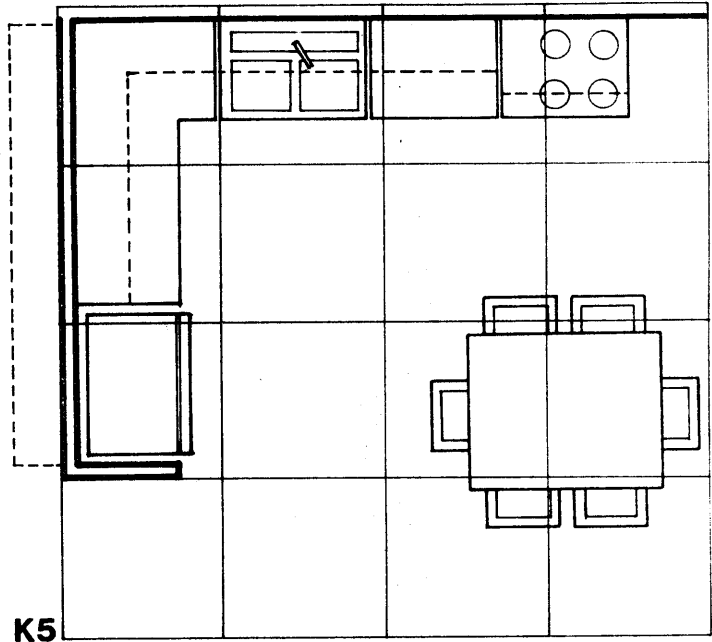
**THREE
BEDROOM UNIT
BASIC PLAN**

K4

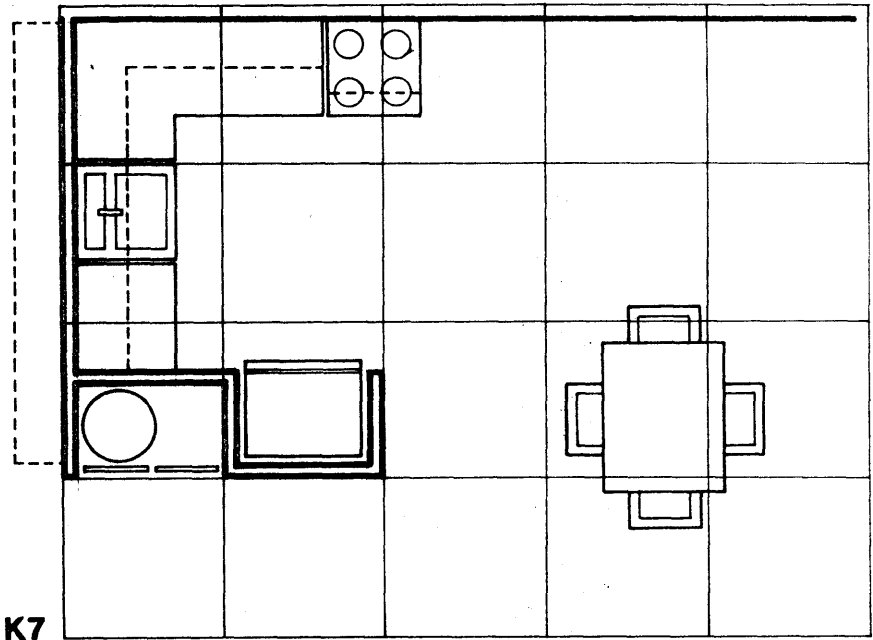


KITCHEN CONFIGURATIONS

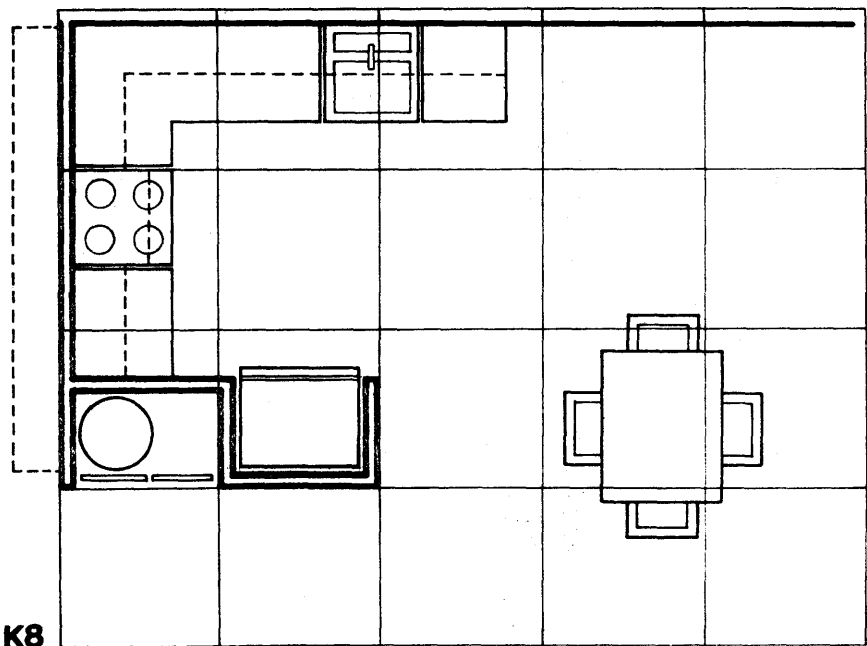
**FOUR
BEDROOM UNIT
BASIC PLAN**



KITHEN CONFIGURATIONS



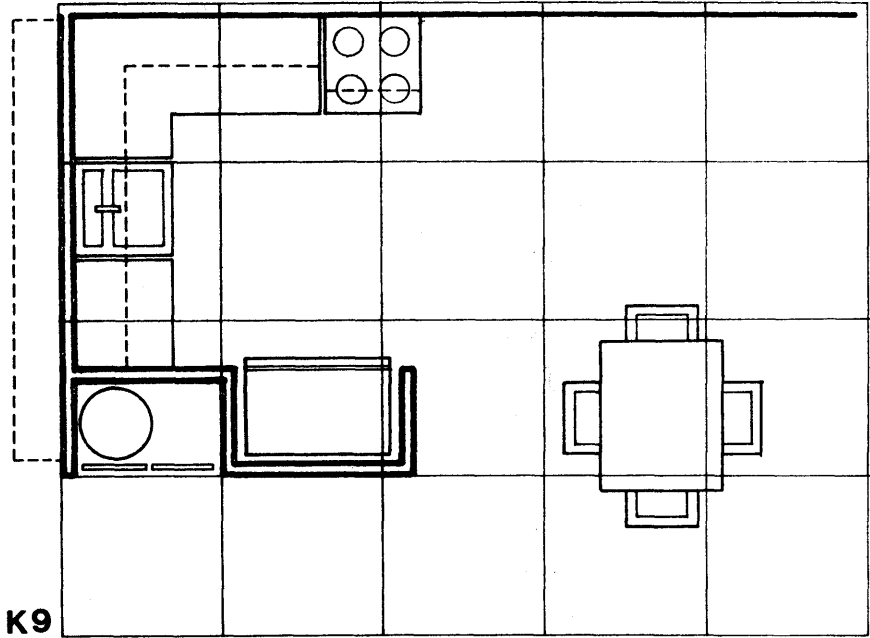
K7



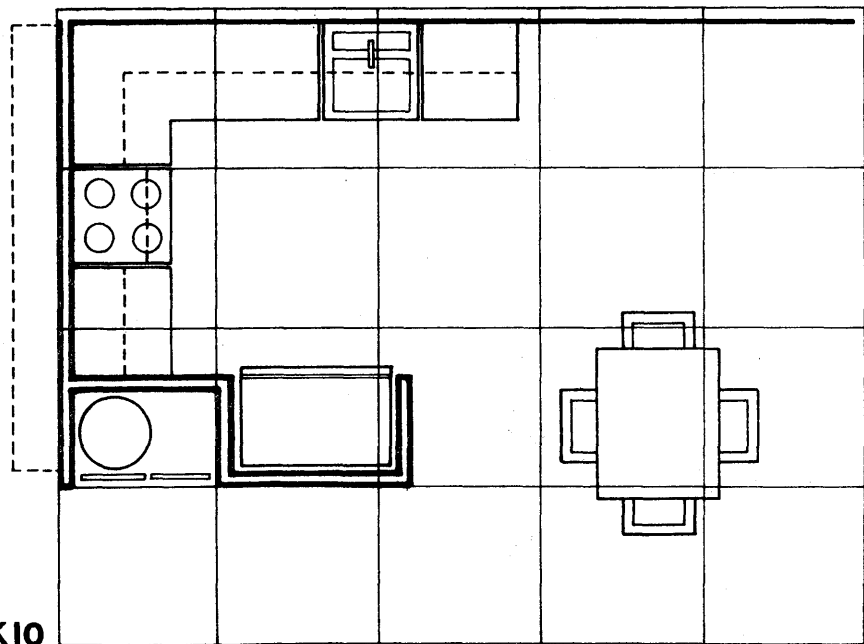
ONE
BEDROOM UNIT
BASIC PLANS

K8

KITCHEN CONFIGURATIONS

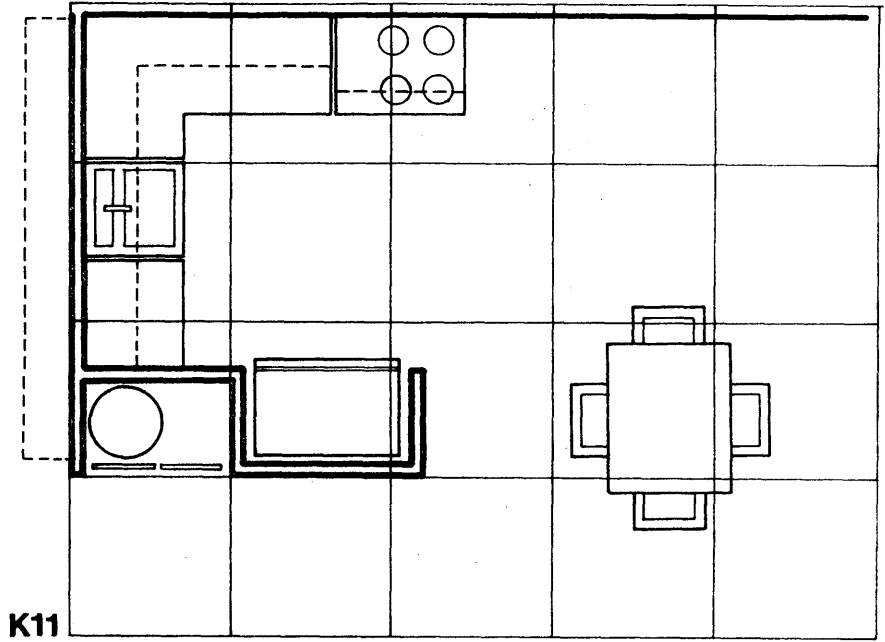


K9

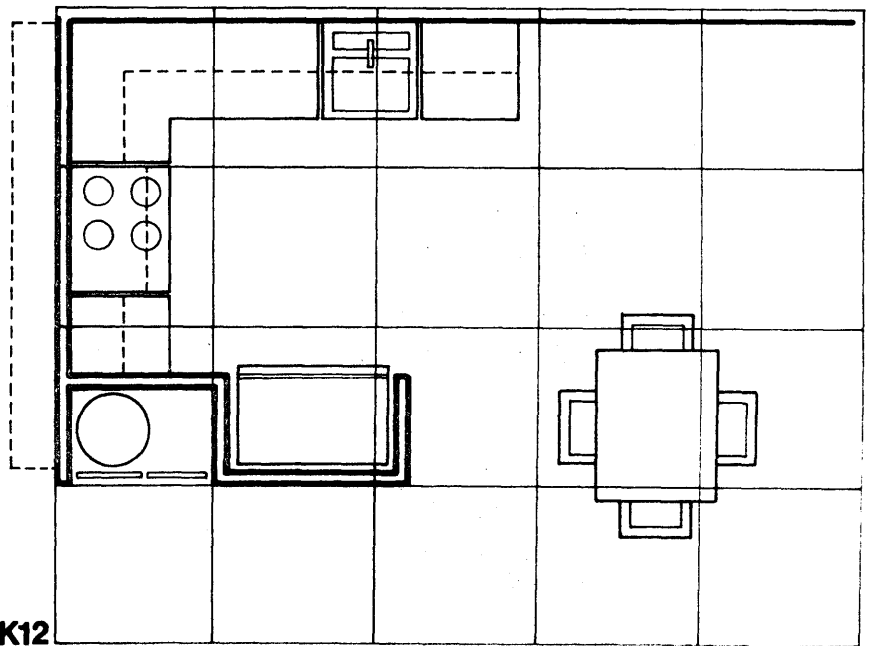


**TWO
BEDROOM UNIT
BASIC PLANS K10**

KITCHEN CONFIGURATIONS



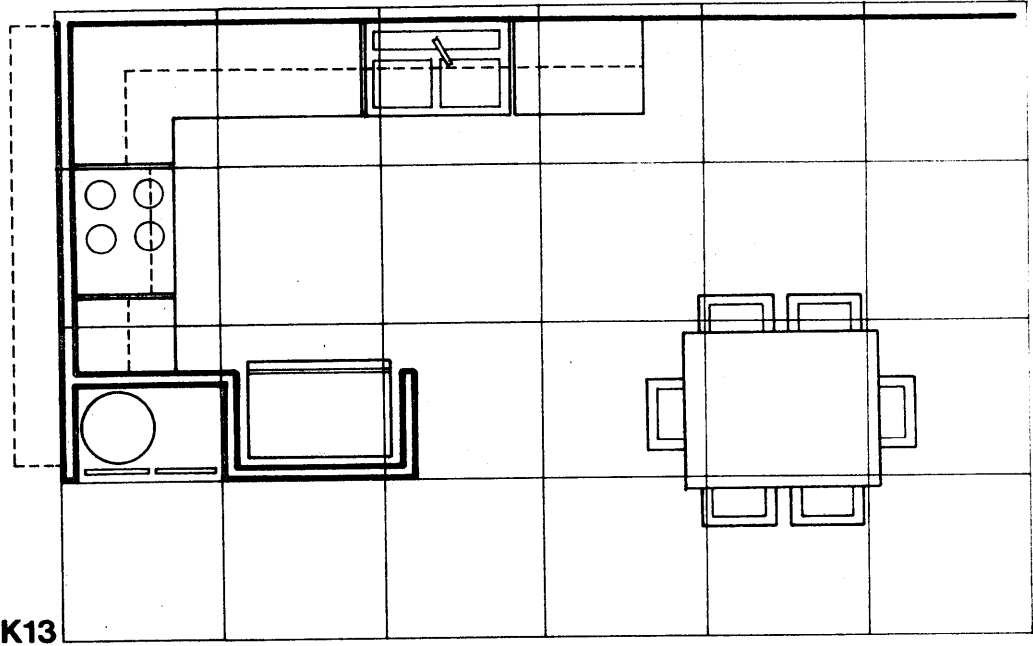
K11



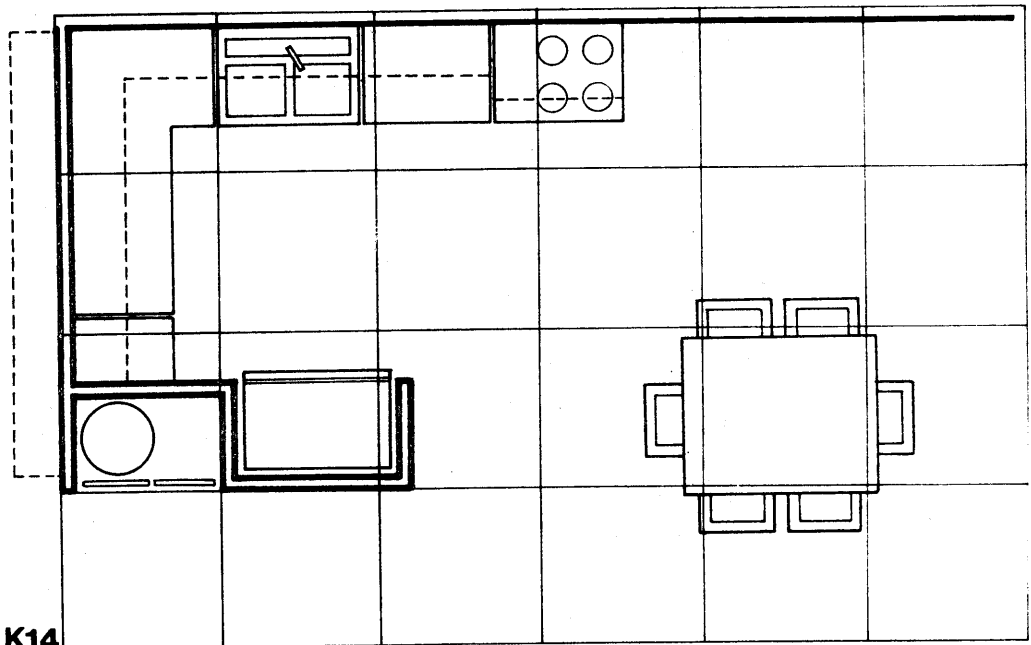
THREE
BEDROOM UNIT
BASIC PLANS

K12

KITCHEN CONFIGURATIONS



K13

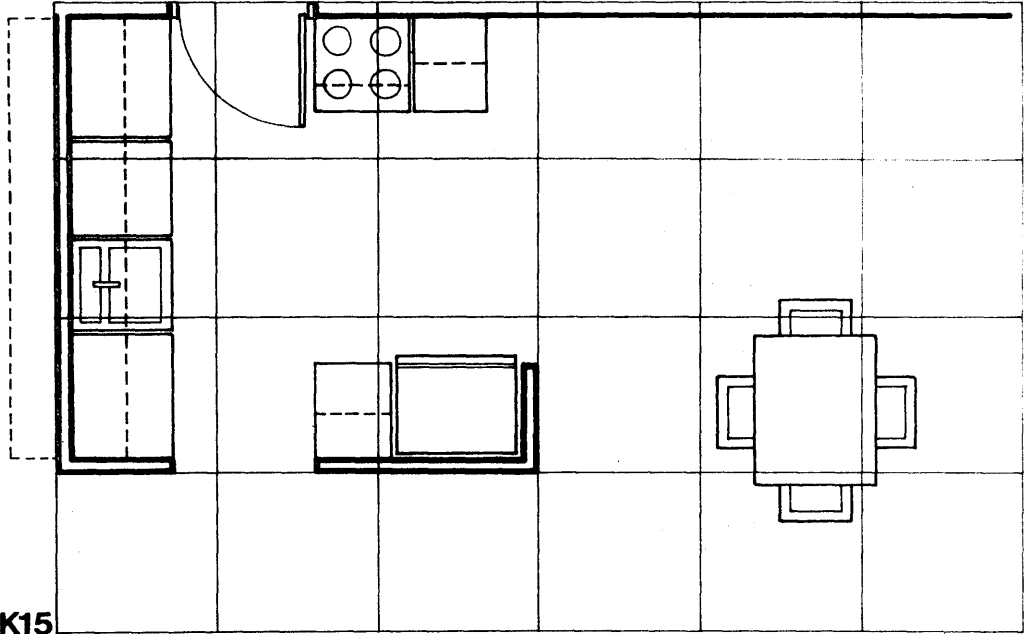


K14

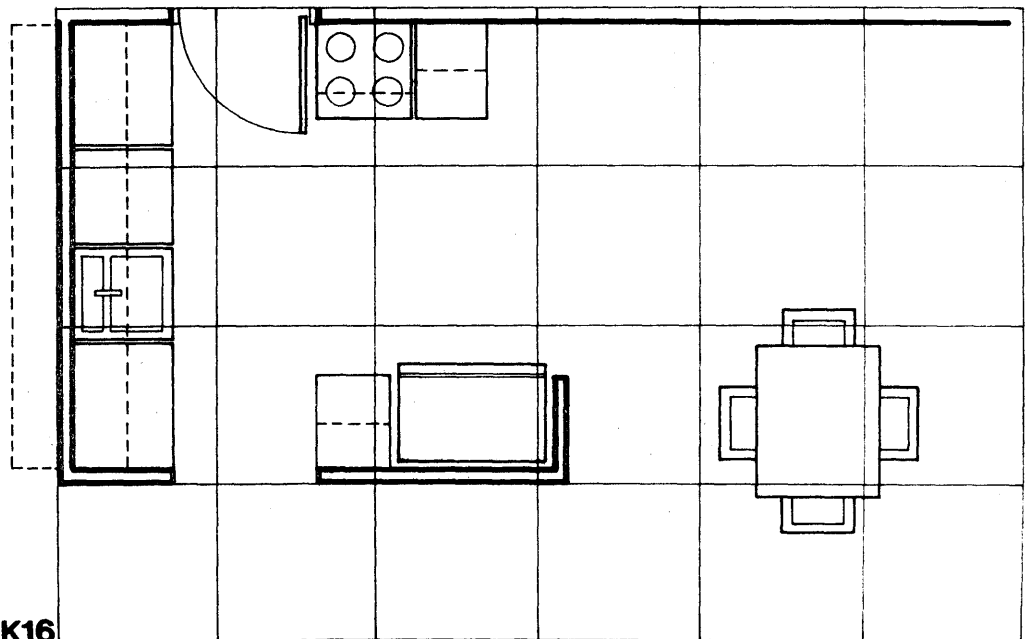
FOUR
BEDROOM UNIT
BASIC PLANS

KITCHEN CONFIGURATIONS

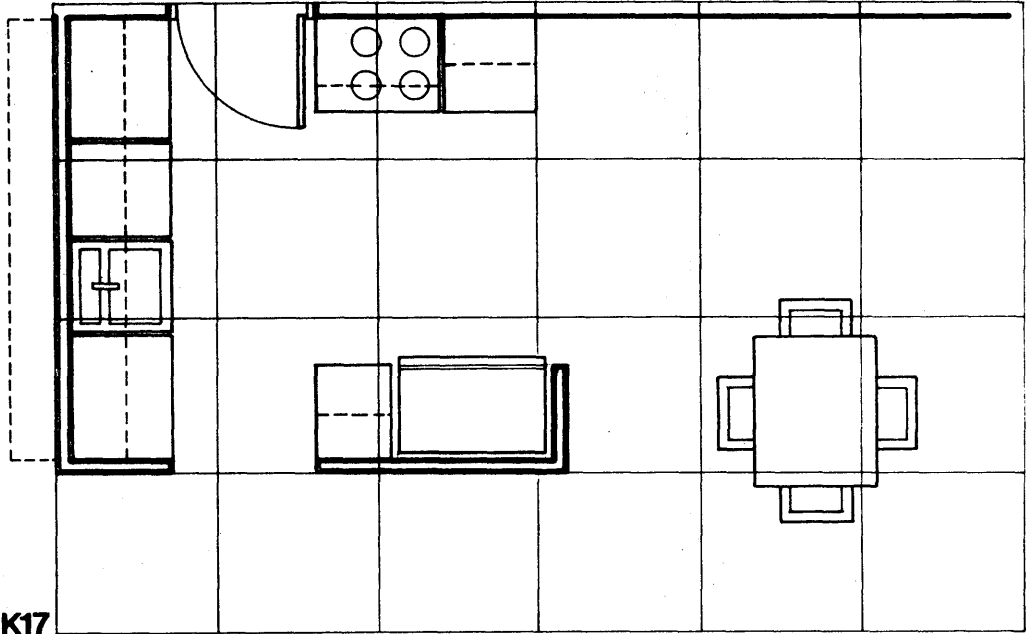
**ONE
BEDROOM UNIT
BASIC PLAN K15**



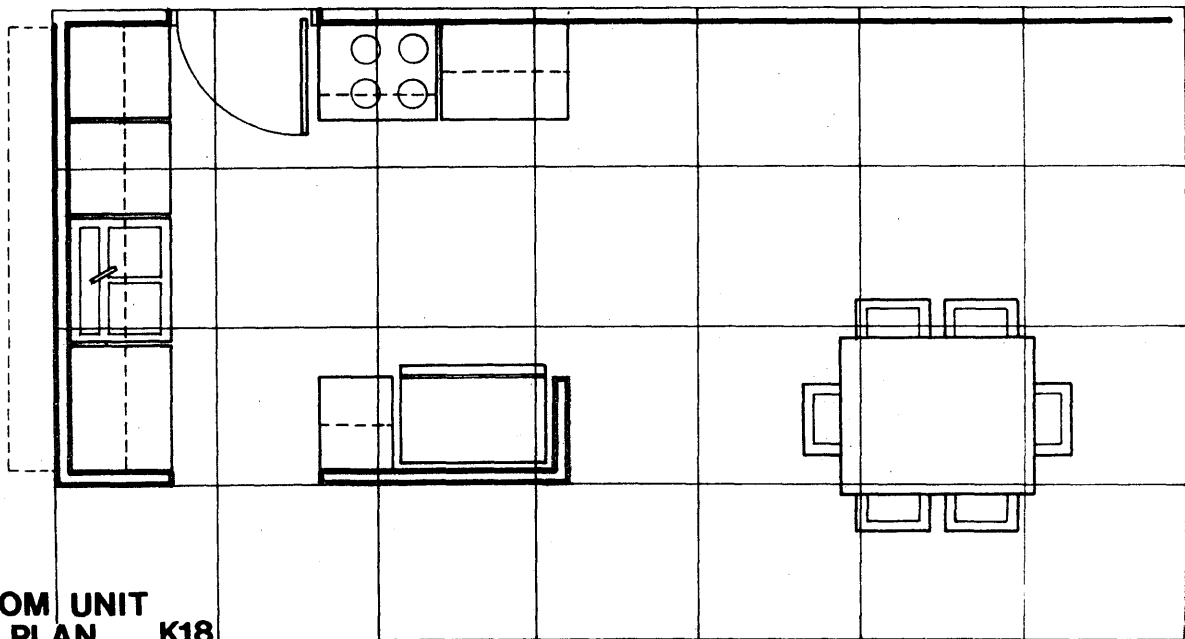
**TWO
BEDROOM UNIT
BASIC PLAN K16**



KITCHEN CONFIGURATIONS

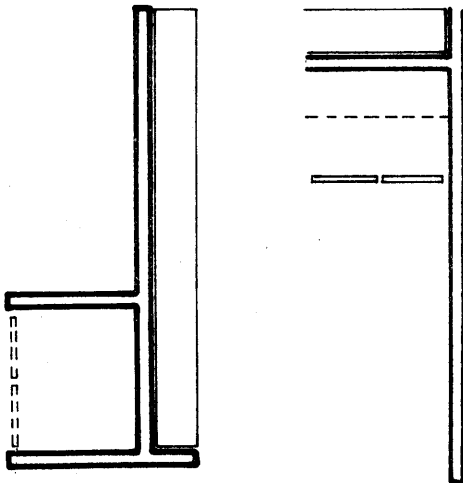
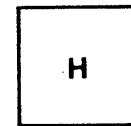
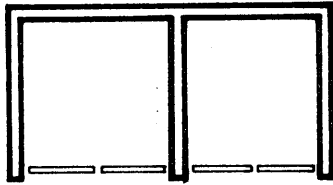
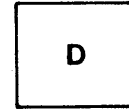
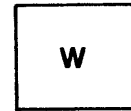
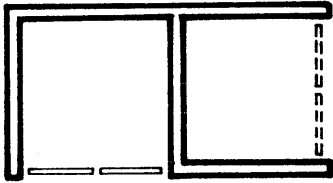
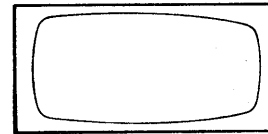
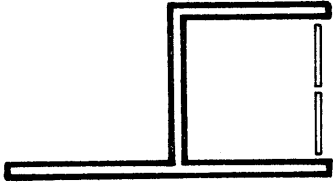
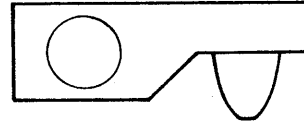
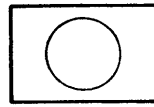


**THREE
BEDROOM UNIT
BASIC PLAN K17**

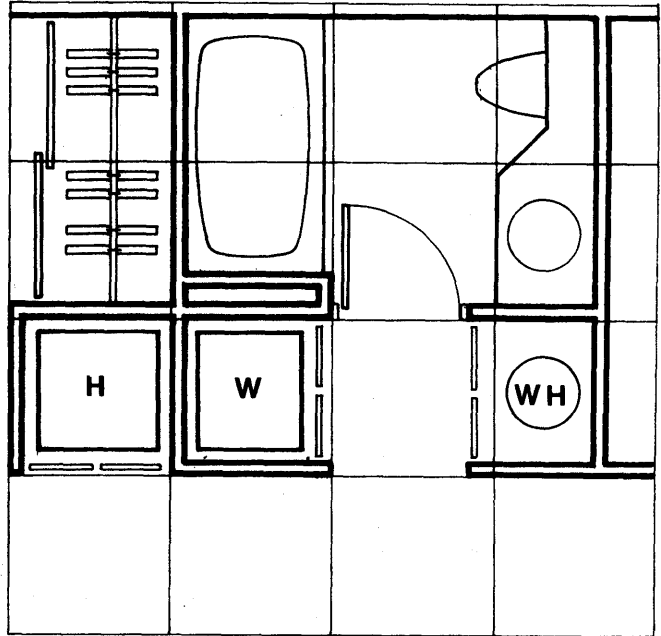


**FOUR
BEDROOM UNIT
BASIC PLAN K18**

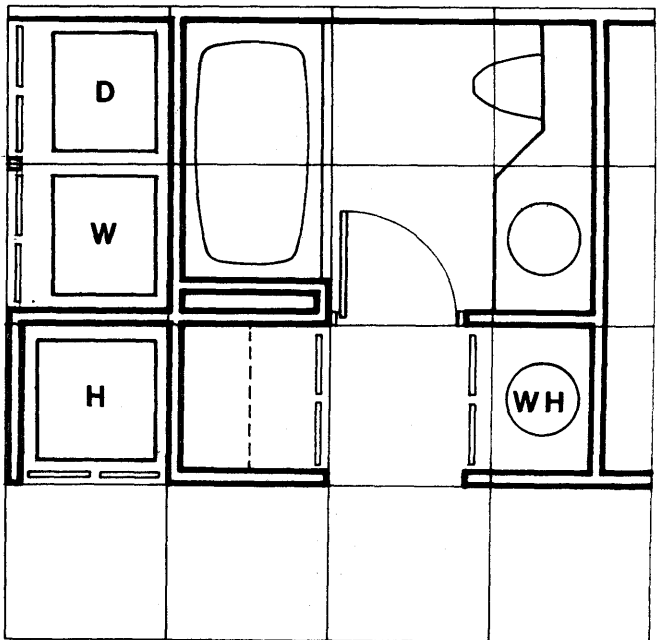
KITCHEN CONFIGURATIONS



BATHROOM COMPONENTS



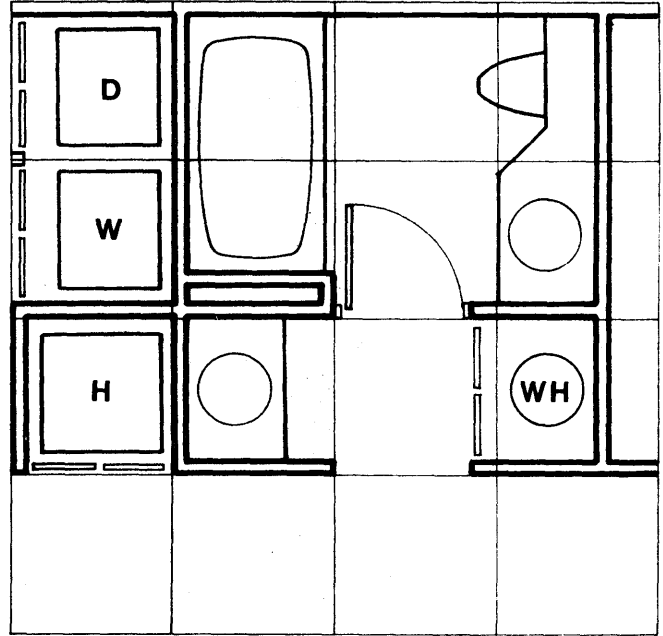
C1



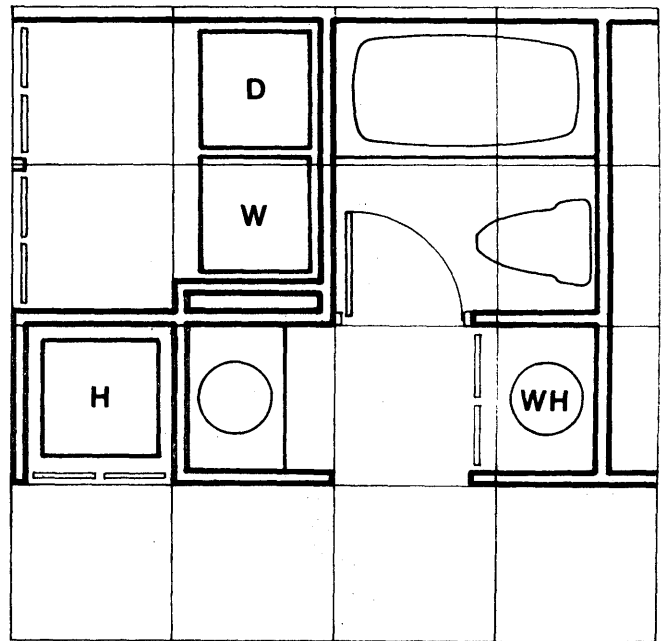
FORCED AIR HEATING

C2

BATHROOM CORE CONFIGURATIONS

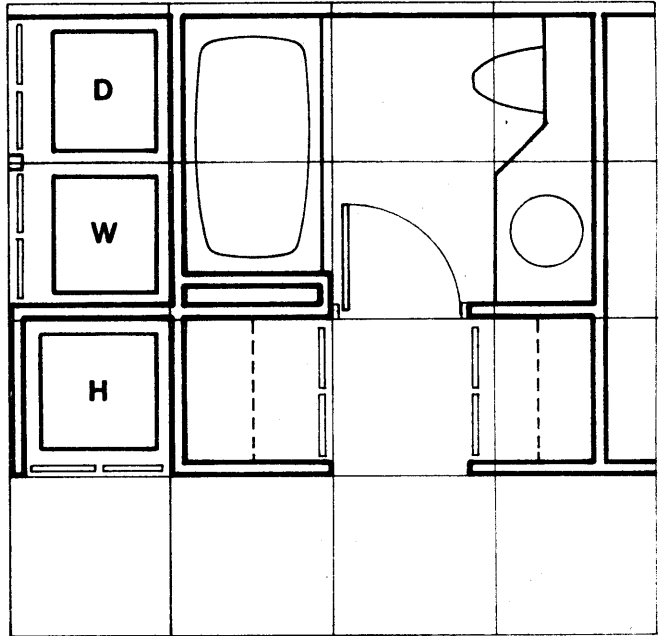


C3

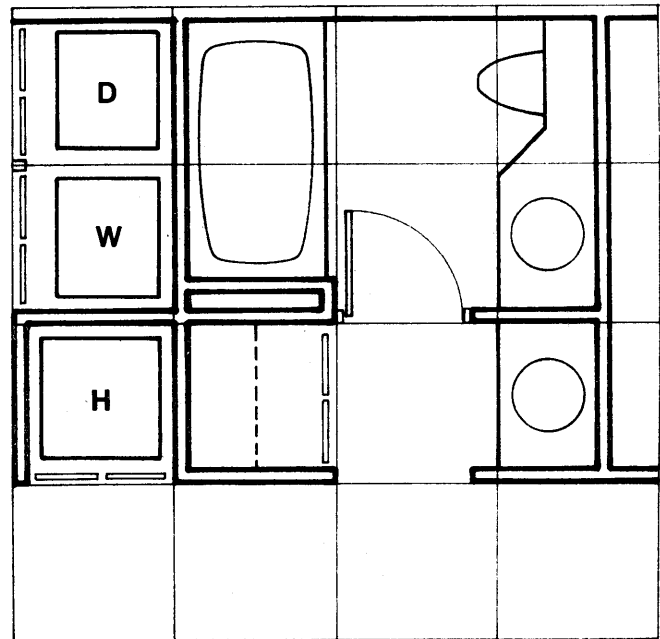


FORCED AIR HEATING C4

BATHROOM CORE CONFIGURATIONS



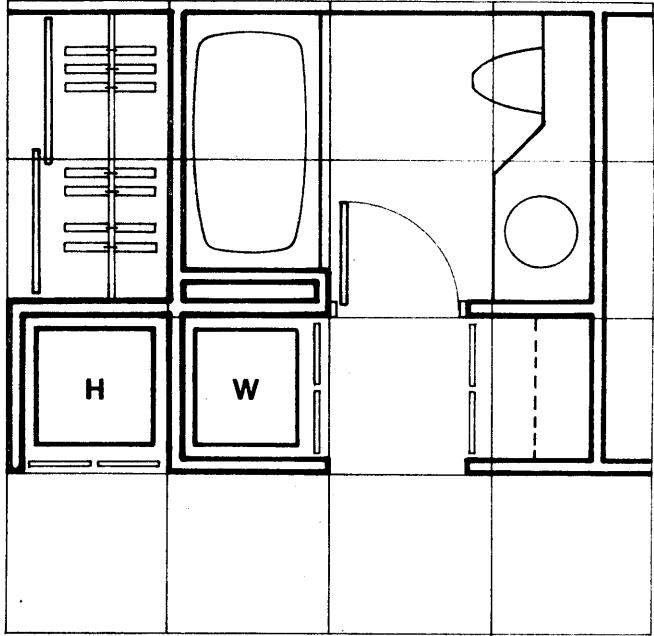
C5



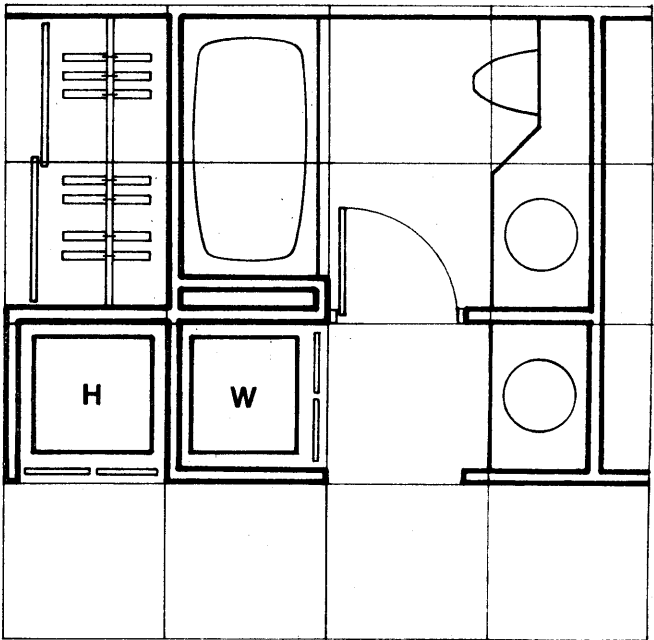
FORCED AIR HEATING -
WATER HEATER IN
KITCHEN MODULE

C6

BATHROOM CORE CONFIGURATIONS



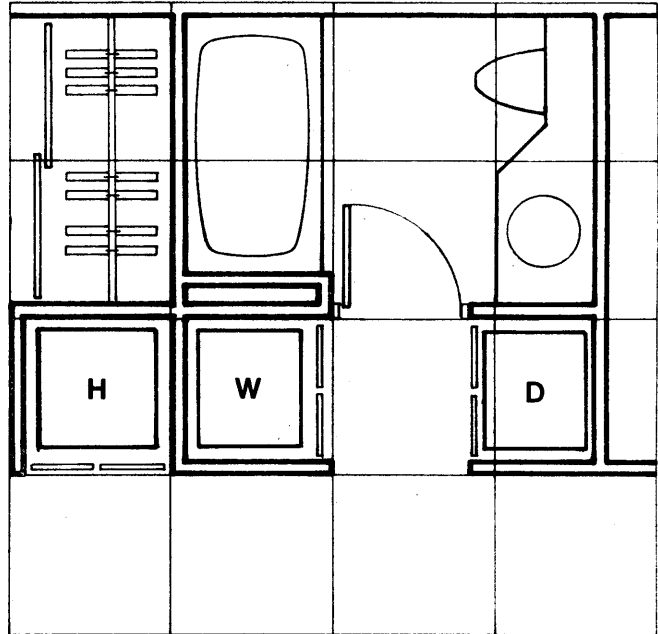
C7



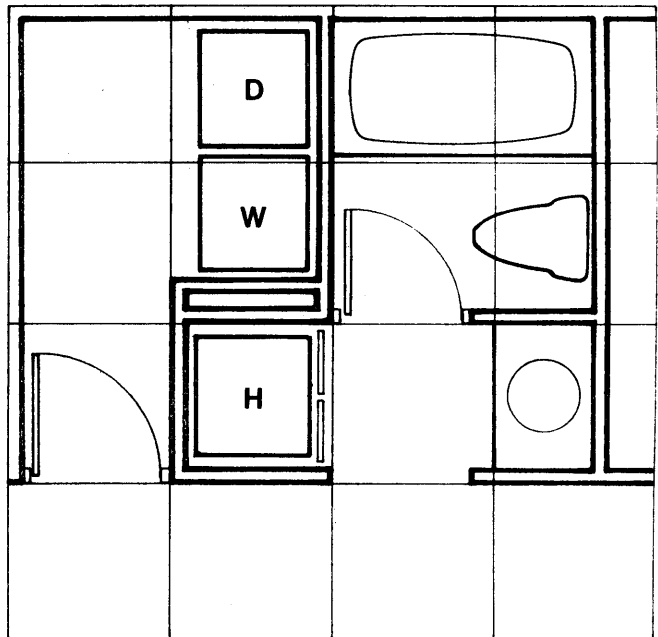
C8

**FORCED AIR HEATING
WATER HEATER IN
KITCHEN MODULE**

BATHROOM CORE CONFIGURATIONS



C9

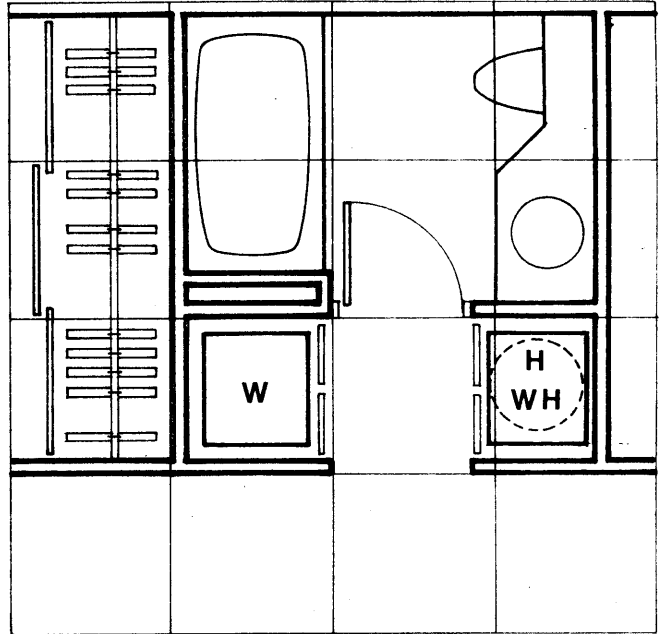


C10

**FORCED AIR HEATING -
WATER HEATER IN
KITCHEN MODULE**

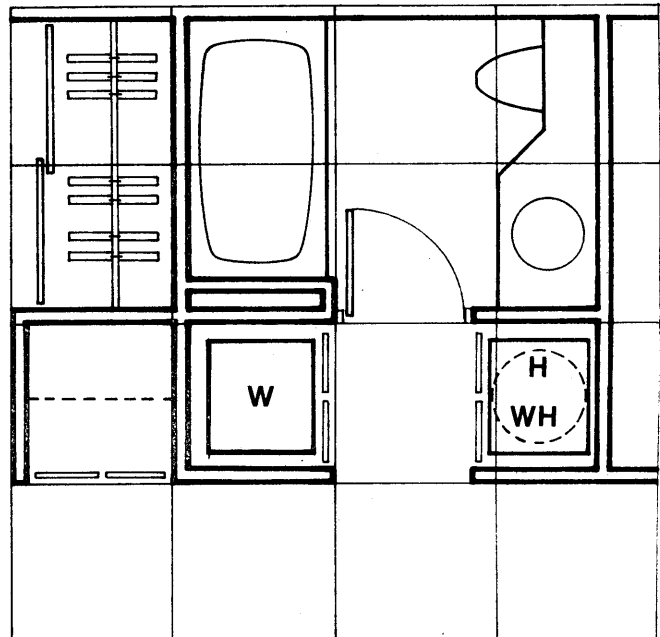
BATHROOM CORE CONFIGURATIONS

C11

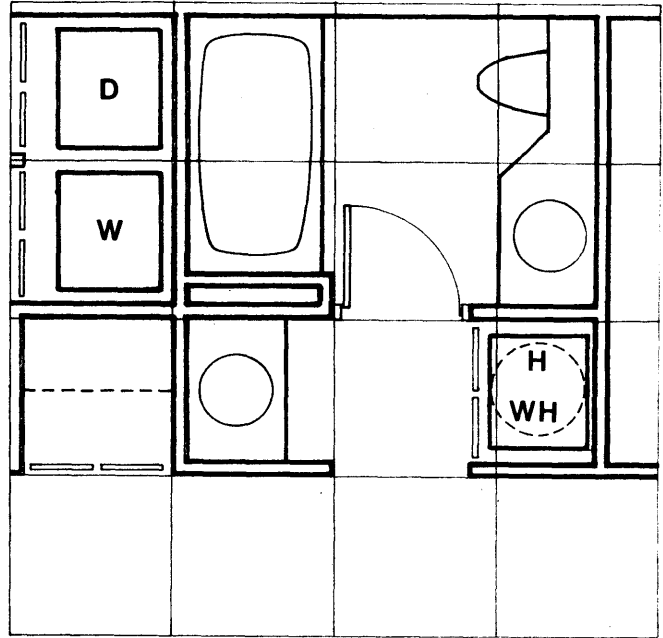


HEAT PUMP
AND WATER HEATER
IN A COMMON SPACE

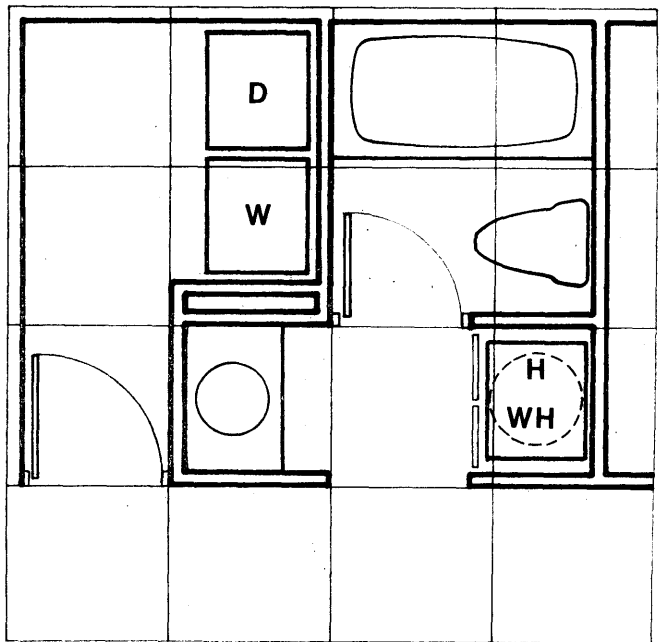
C12



BATHROOM CORE CONFIGURATIONS



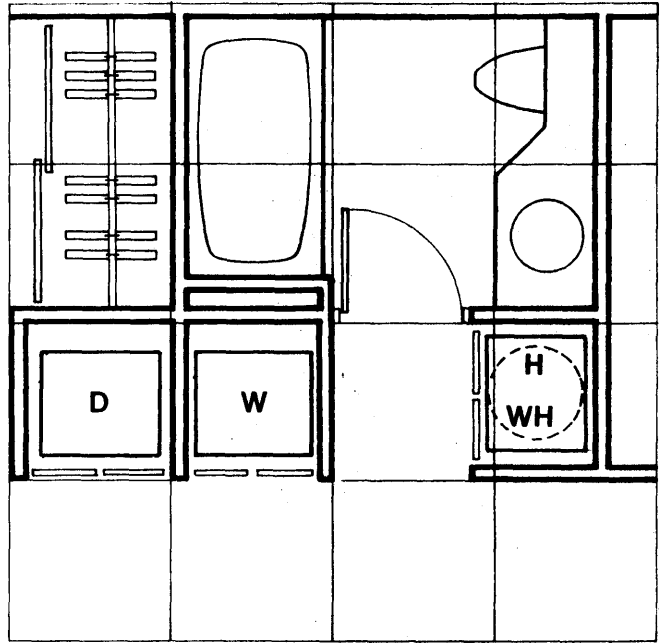
C13



C14

HEAT PUMP
AND WATER HEATER
IN A COMMON SPACE

BATHROOM CORE CONFIGURATIONS



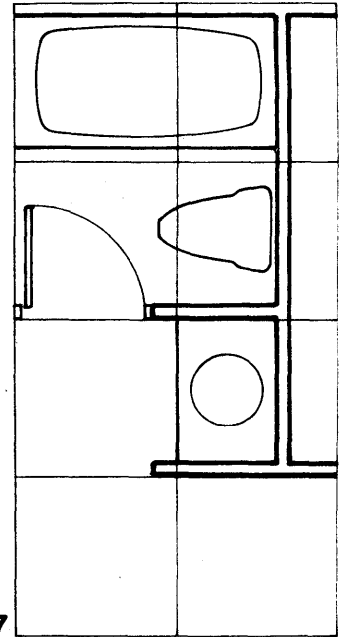
C15



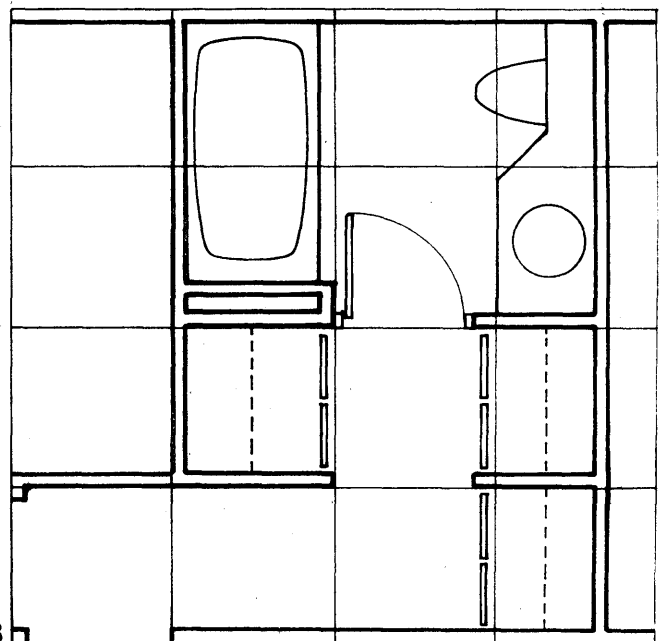
HEAT PUMP
AND WATER HEATER
IN A COMMON SPACE

C16

BATHROOM CORE CONFIGURATIONS



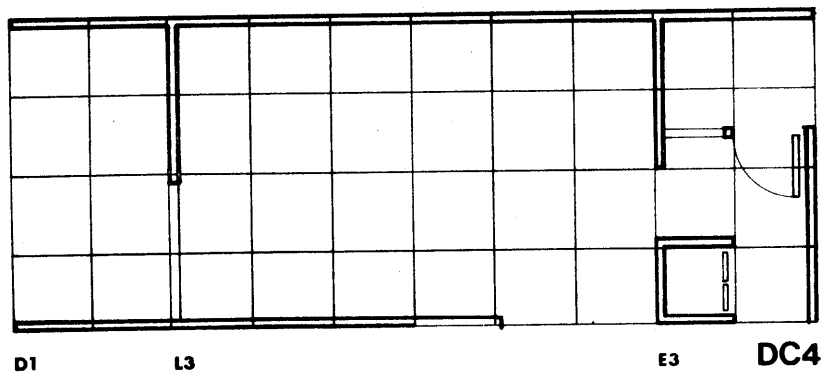
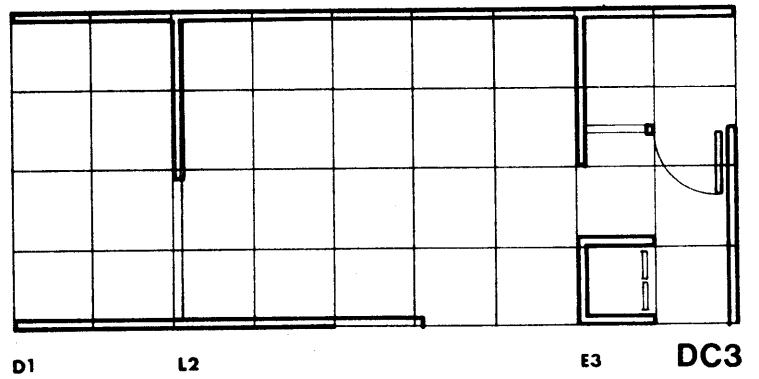
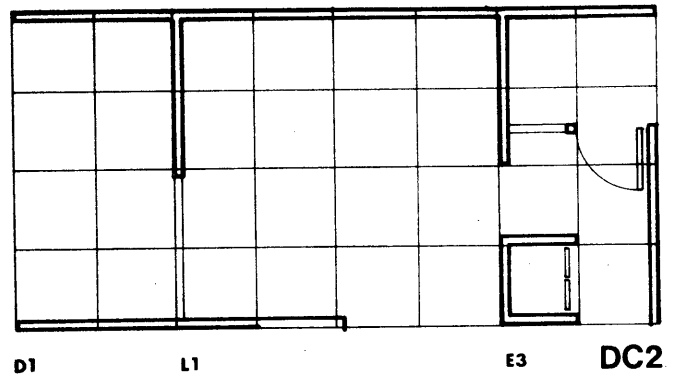
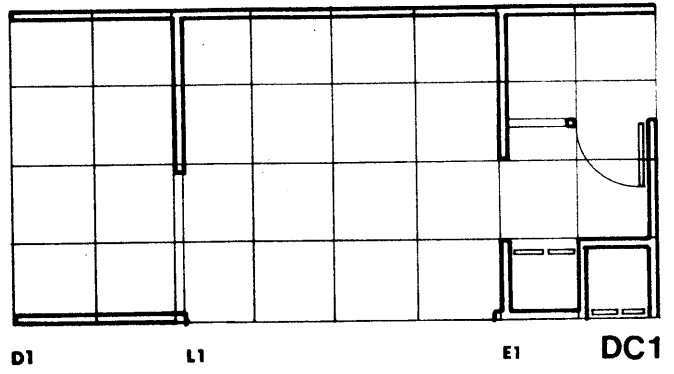
C17



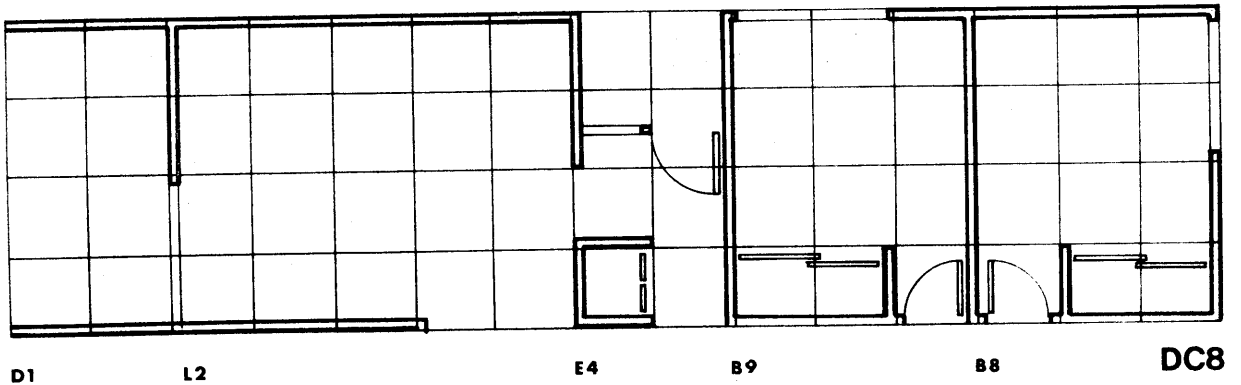
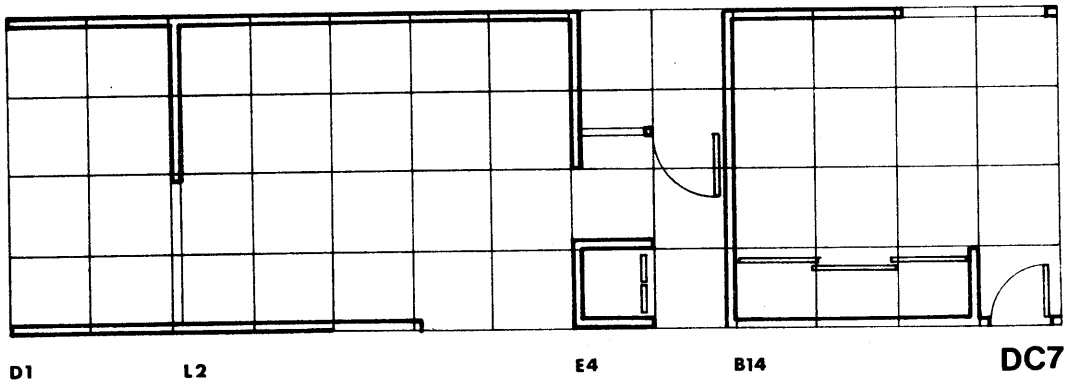
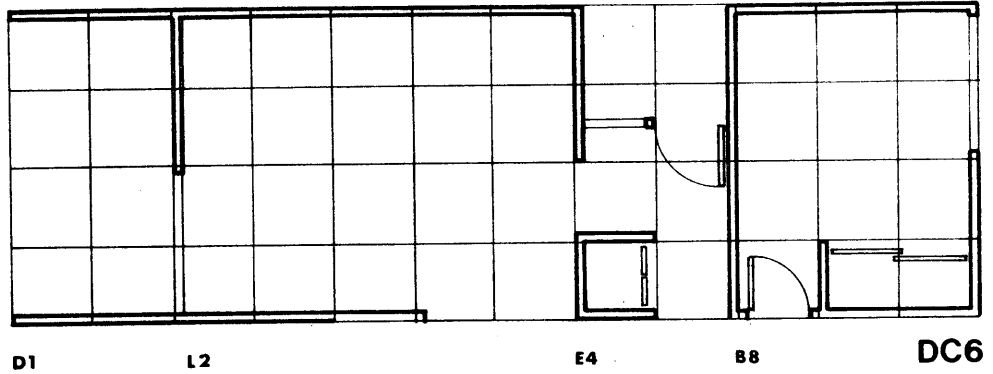
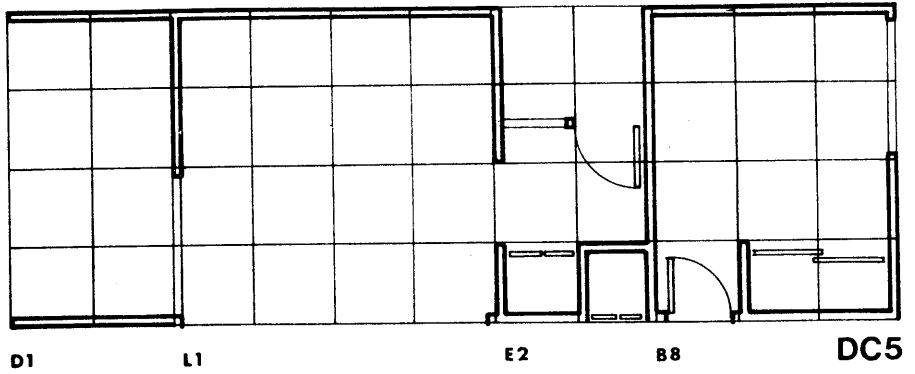
C18

**SECONDARY
BATHROOMS**

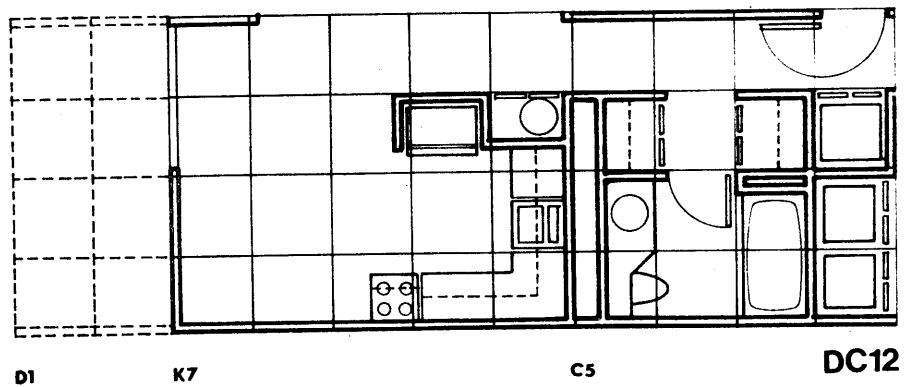
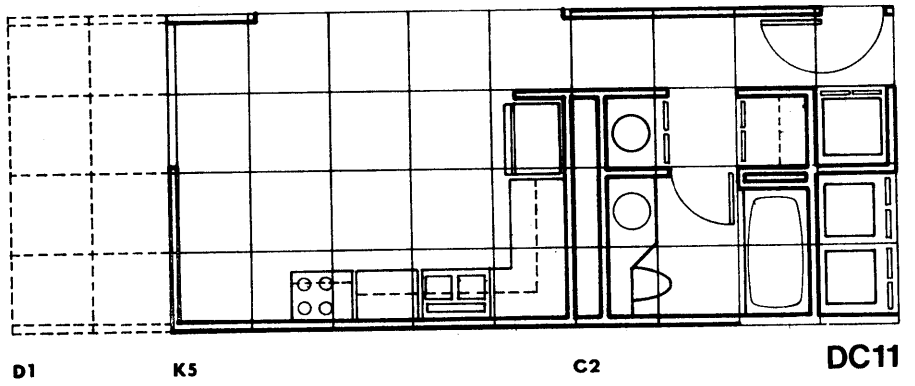
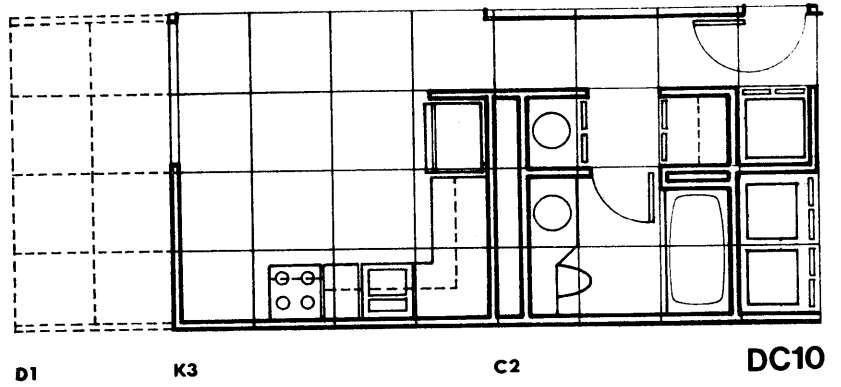
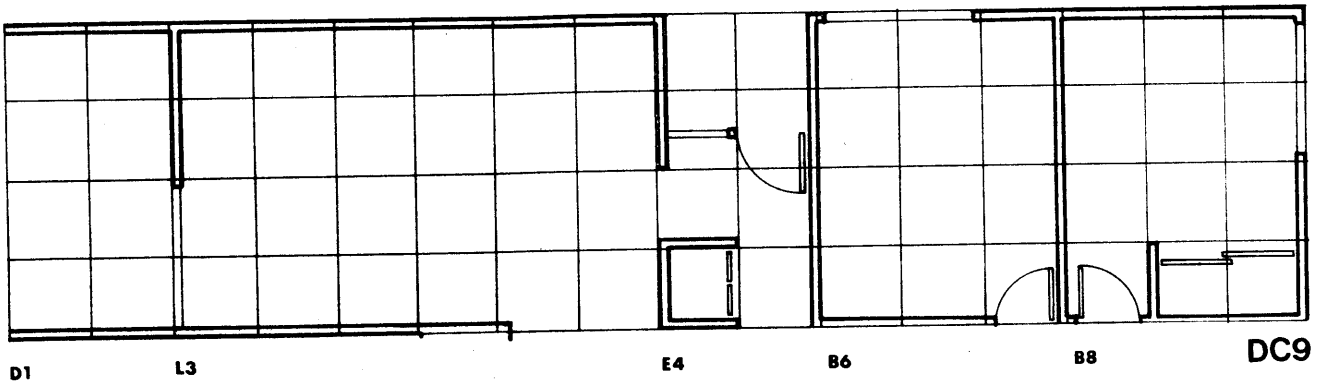
BATHROOM CORE CONFIGURATIONS



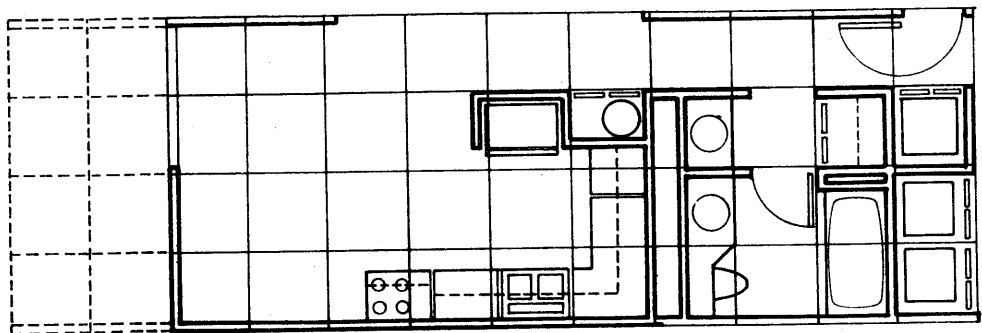
DELIVERY COMPONENTS



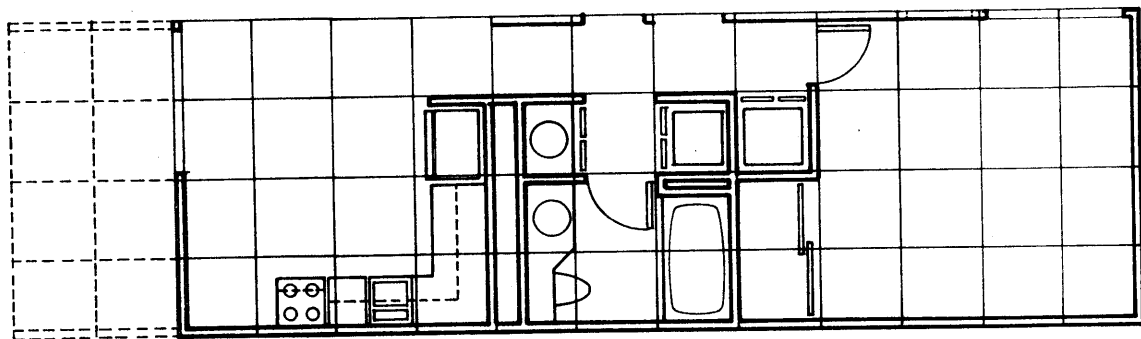
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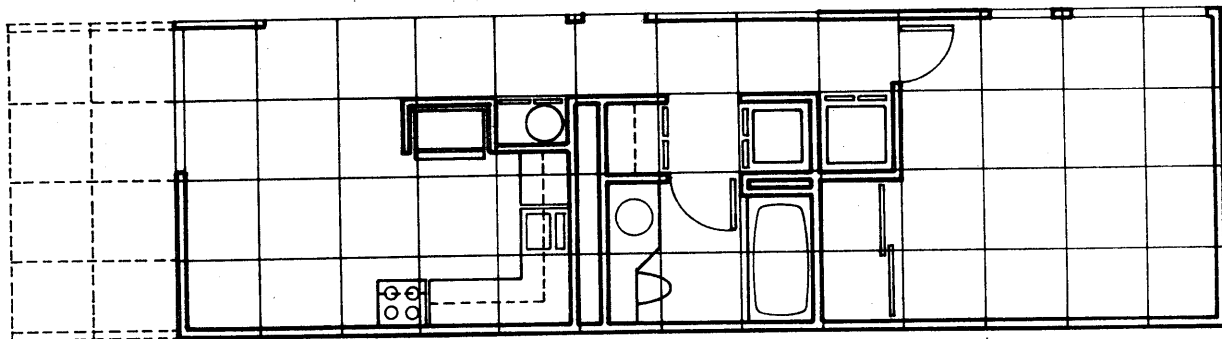
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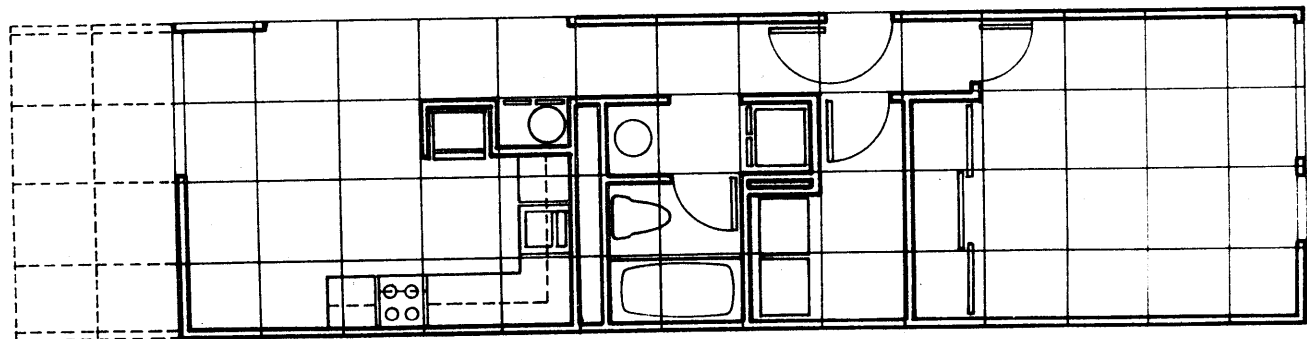
D1 K14 c6 DC13



D1 K3 C8 B10 DC14

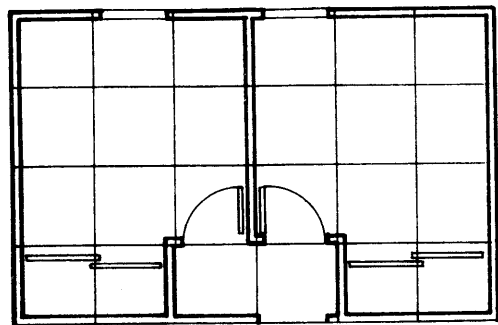


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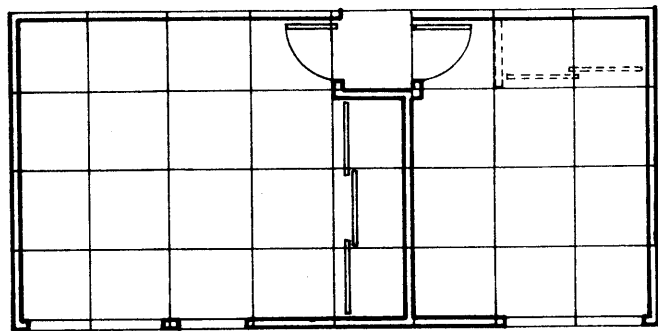


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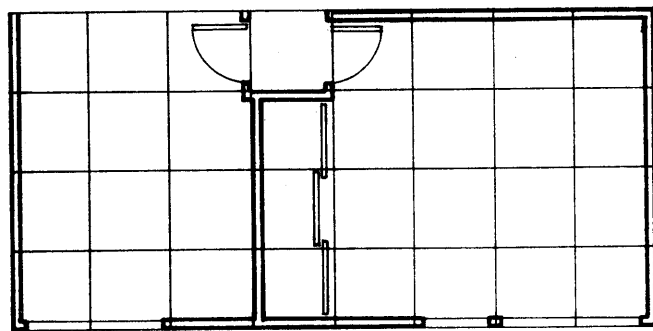
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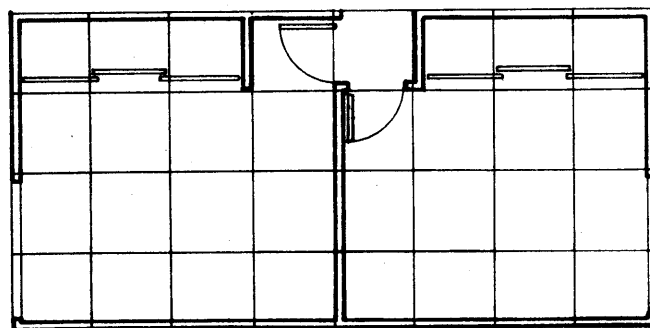
B4 B2 DC17



B10 B13 B3 DC18

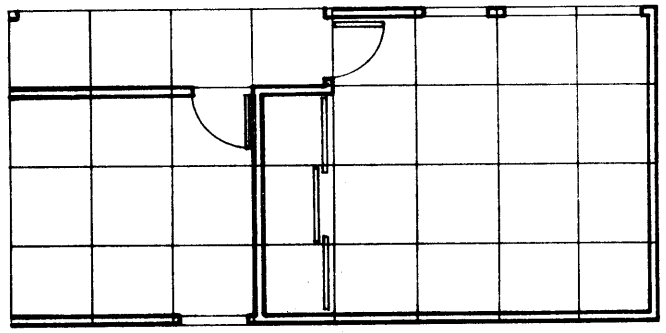


B7 B13 B10 DC19

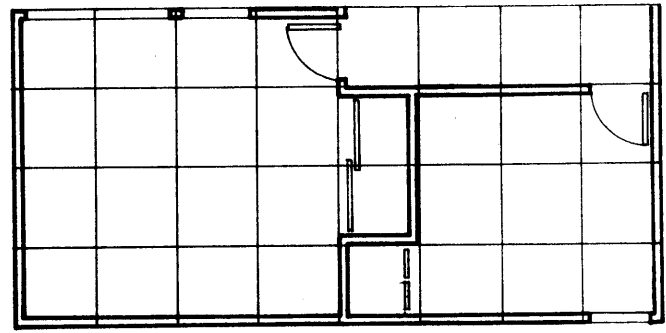


B5 B6 DC20

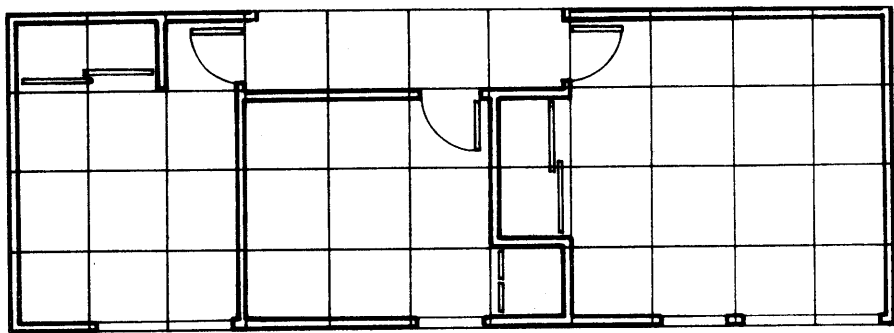
DELIVERY COMPONENTS



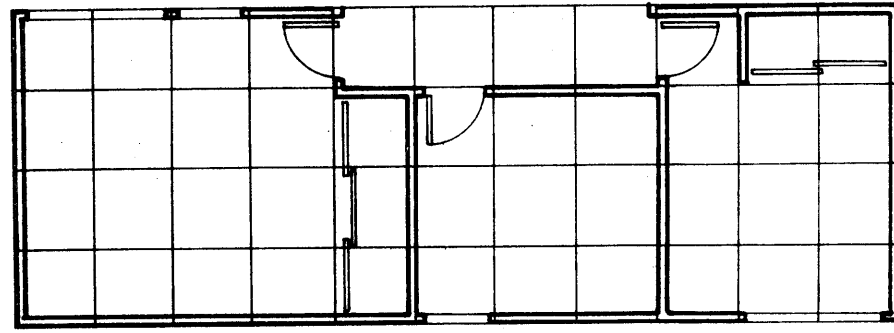
B1 B13 B10 DC21



B10 B12 B1 DC22

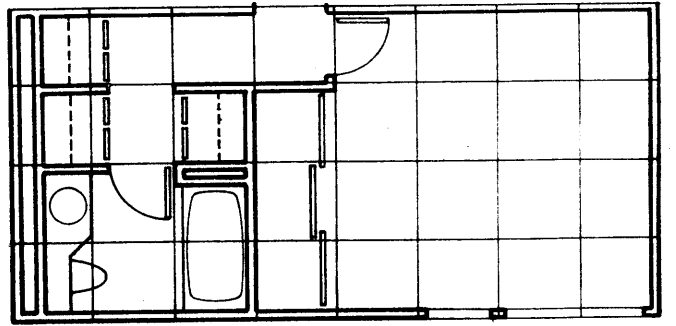


B7 B1 B12 B10 DC23



B10 B13 B1 B3 DC24

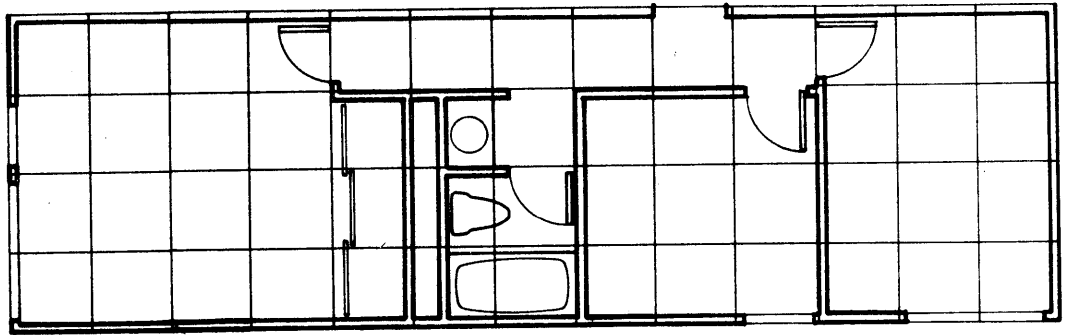
DELIVERY COMPONENTS



C18

B10

DC25



B10

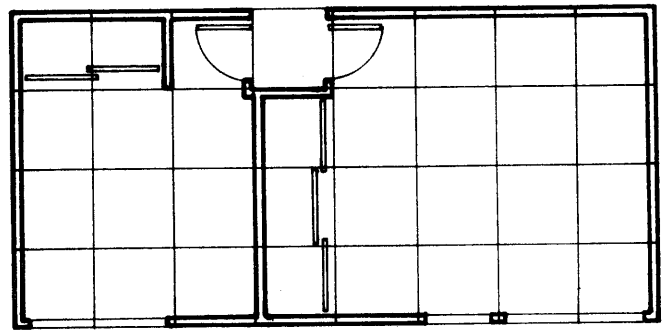
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C17

B1

B3

DC26



B7

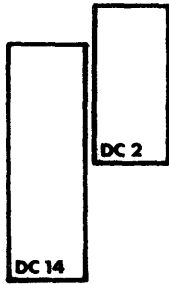
B13

B10

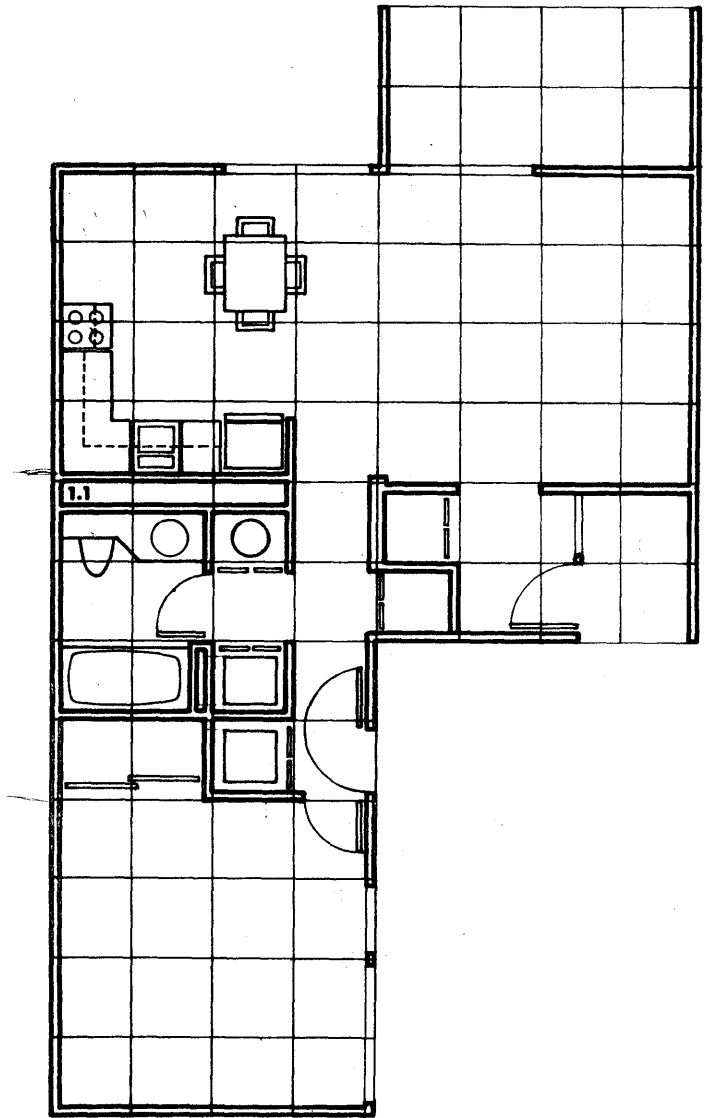
DC27

DELIVERY COMPONENTS

**1 BEDROOM
LEVEL 2**



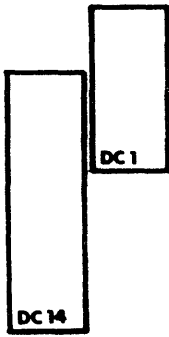
760 SQ



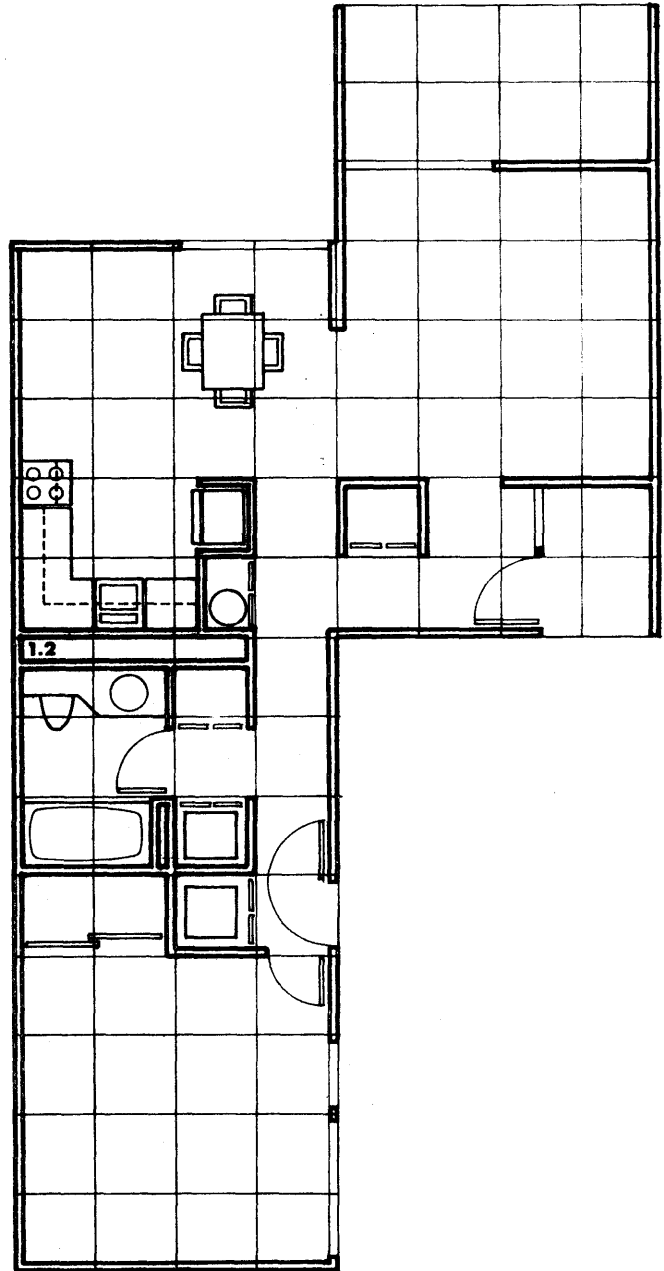
UNIT 1.1

UNIT PLAN

**1 BEDROOM
LEVEL 2**



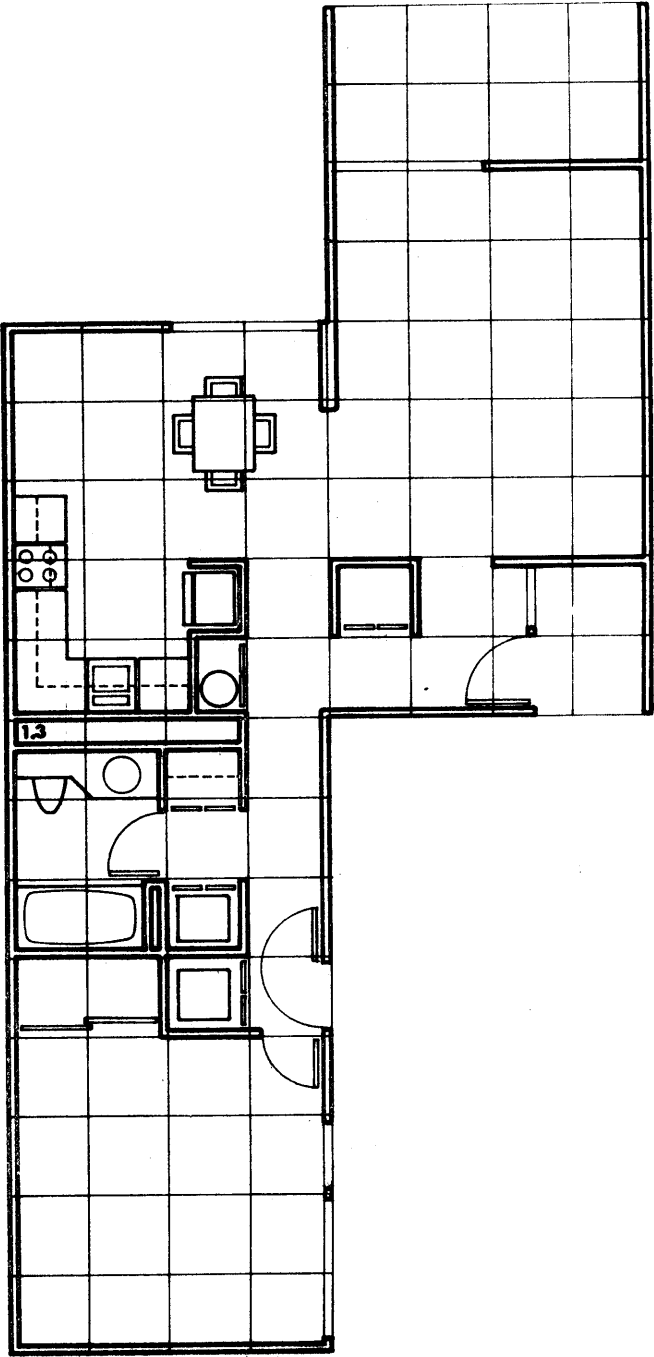
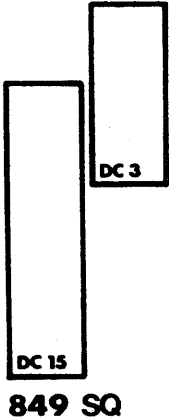
805 SQ



UNIT 1.2

UNIT PLAN

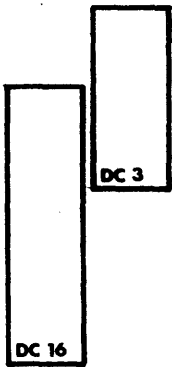
**1 BEDROOM
LEVEL 3**



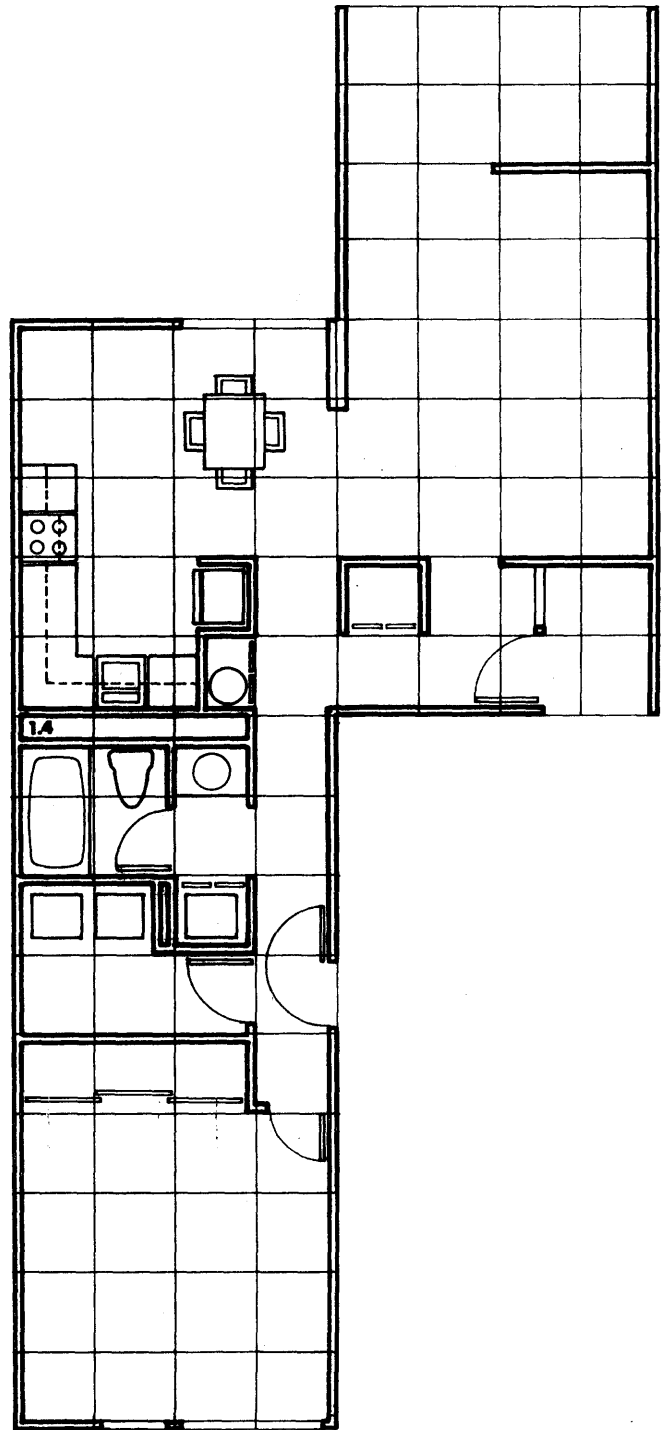
UNIT 1.3

UNIT PLAN

**1 BEDROOM
LEVEL 4**



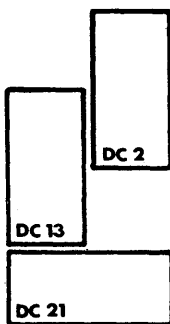
893 SQ



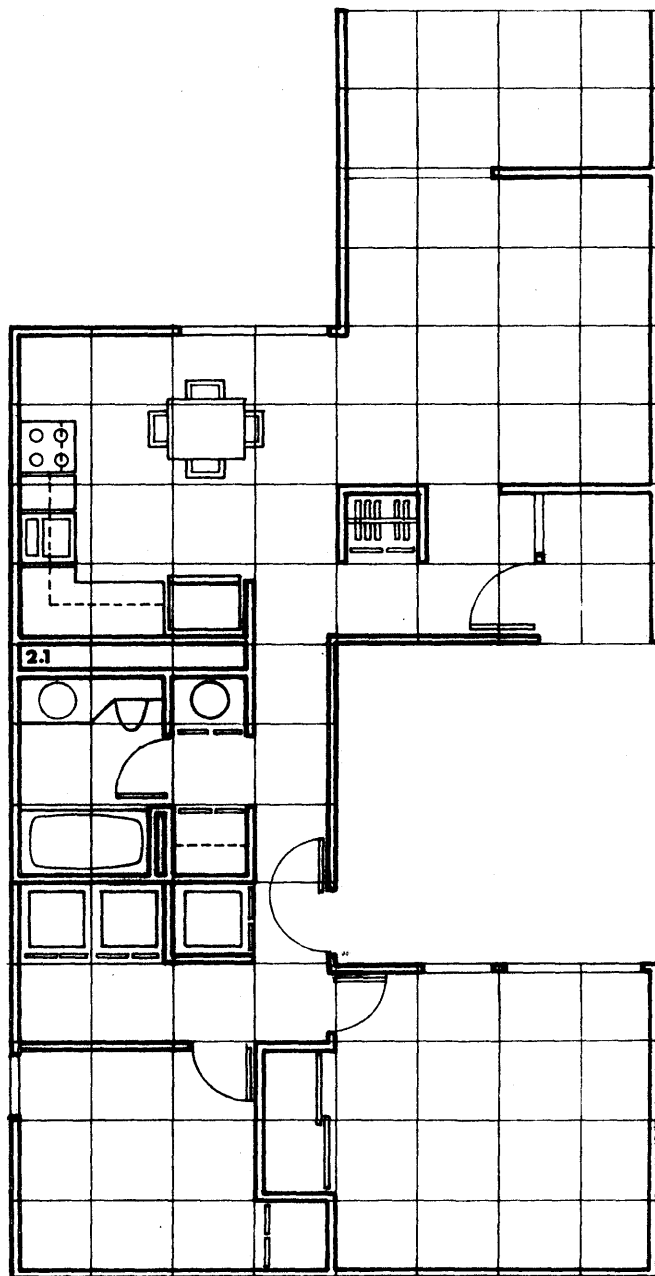
UNIT 1.4

UNIT PLAN

**2 BEDROOM
LEVEL 1**



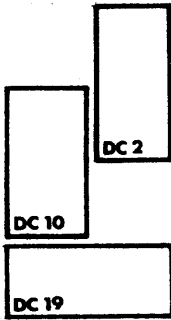
937 SQ



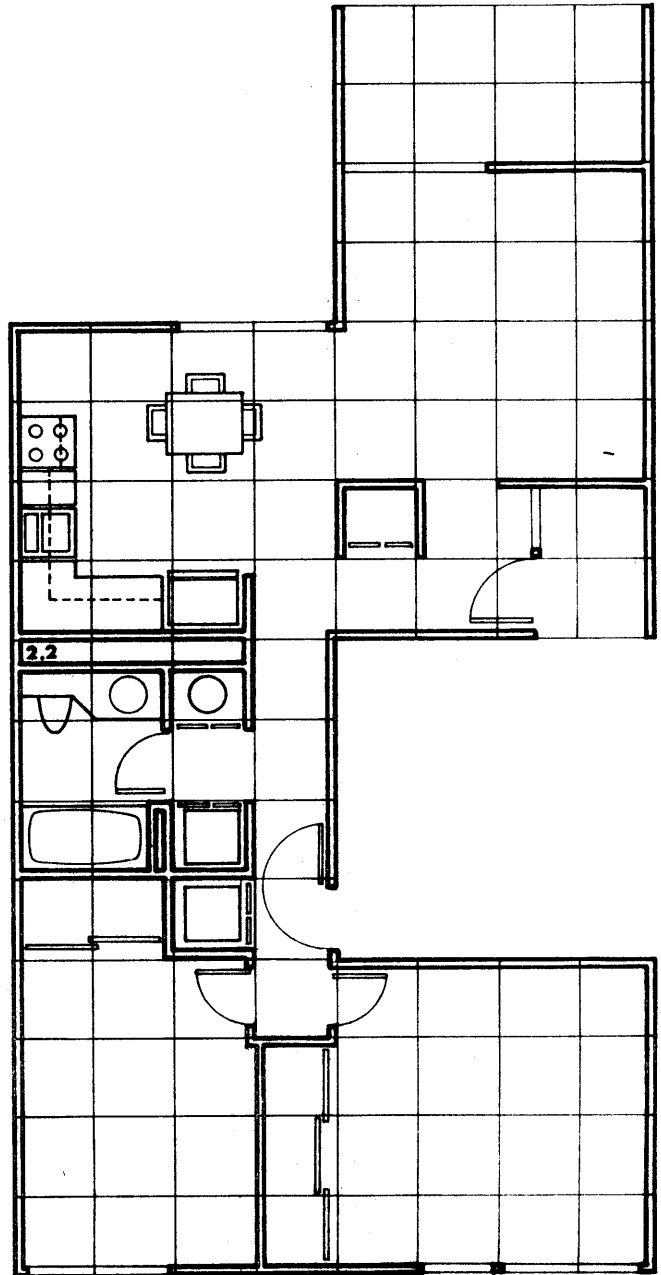
UNIT 2.1

UNIT PLAN

**2 BEDROOM
LEVEL 1**



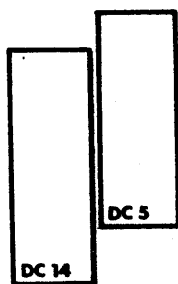
937 SQ



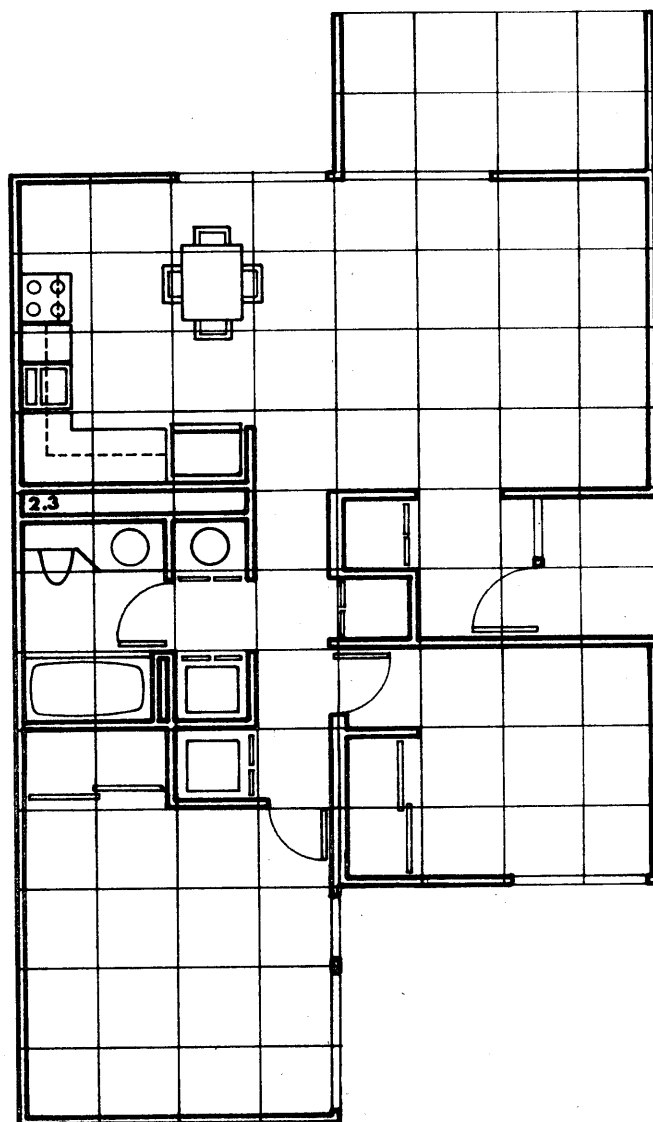
UNIT 2.2

UNIT PLAN

**2 BEDROOM
LEVEL 1**



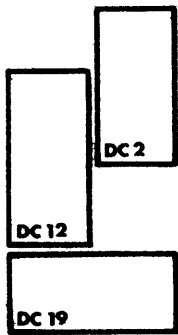
893 SQ



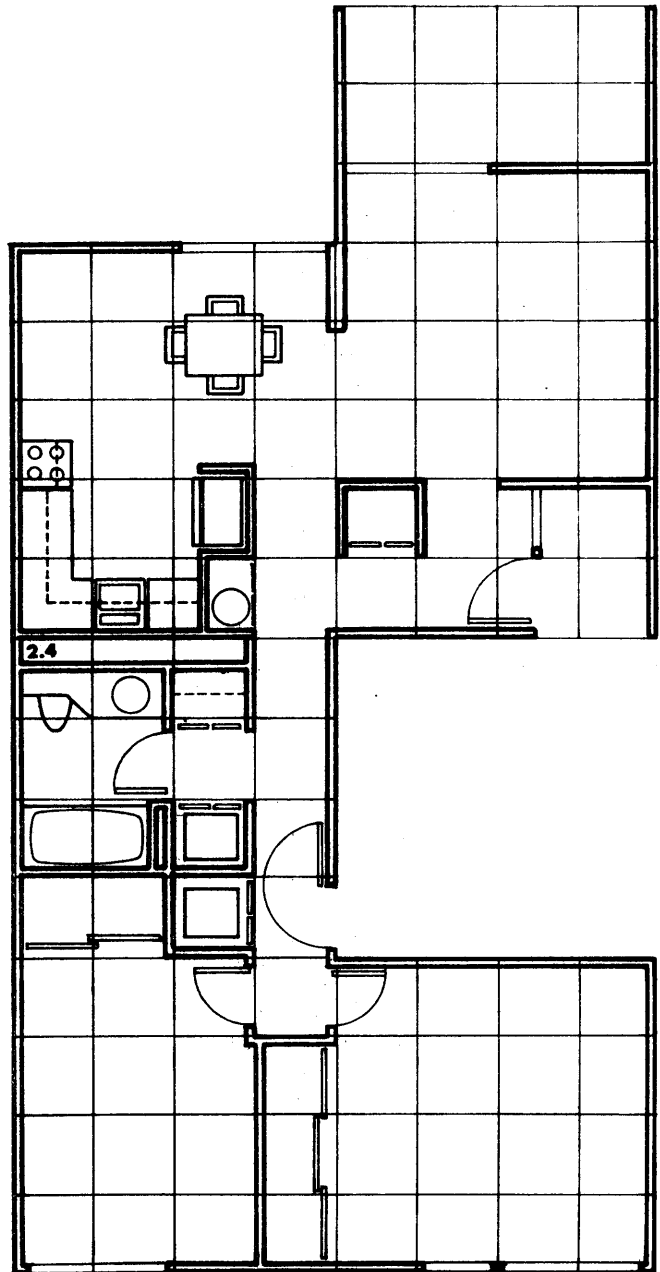
UNIT 2.3

UNIT PLAN

**2 BEDROOM
LEVEL 2**



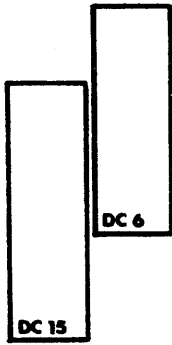
981 SQ



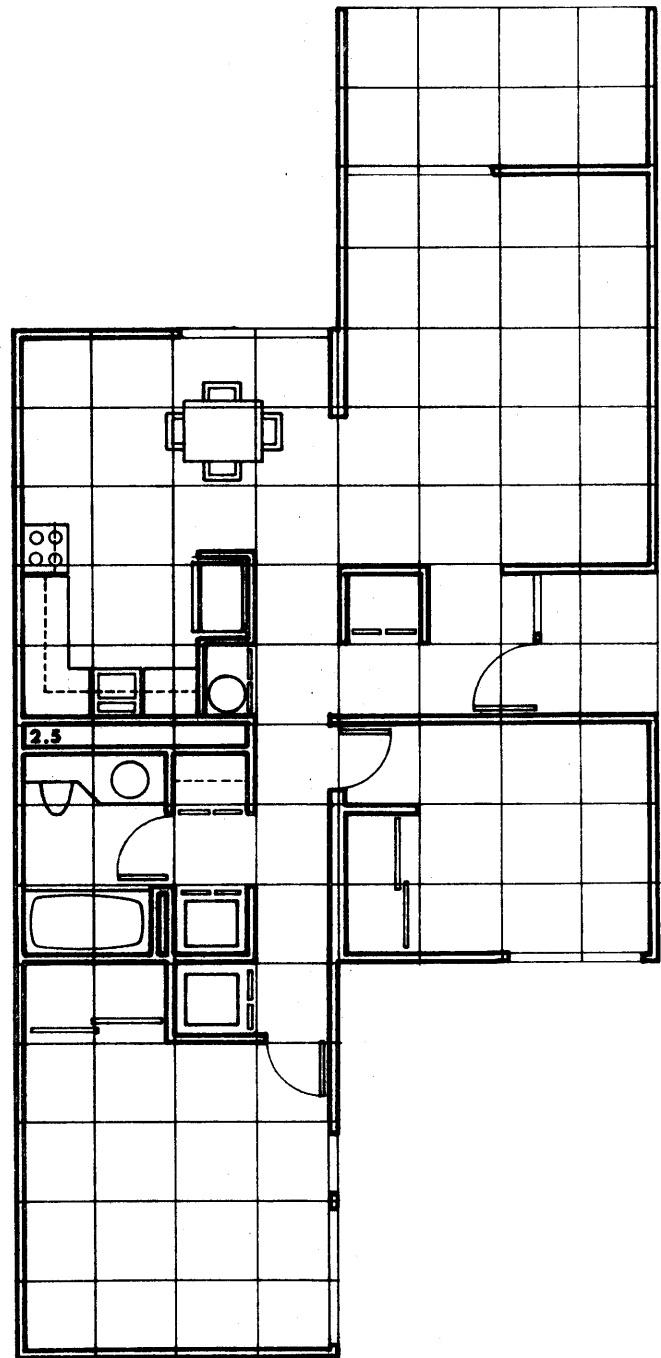
UNIT 2.4

UNIT PLAN

**2 BEDROOM
LEVEL 2**



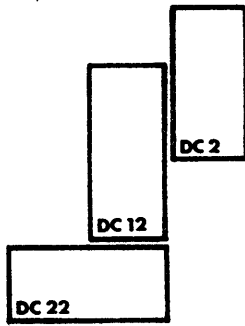
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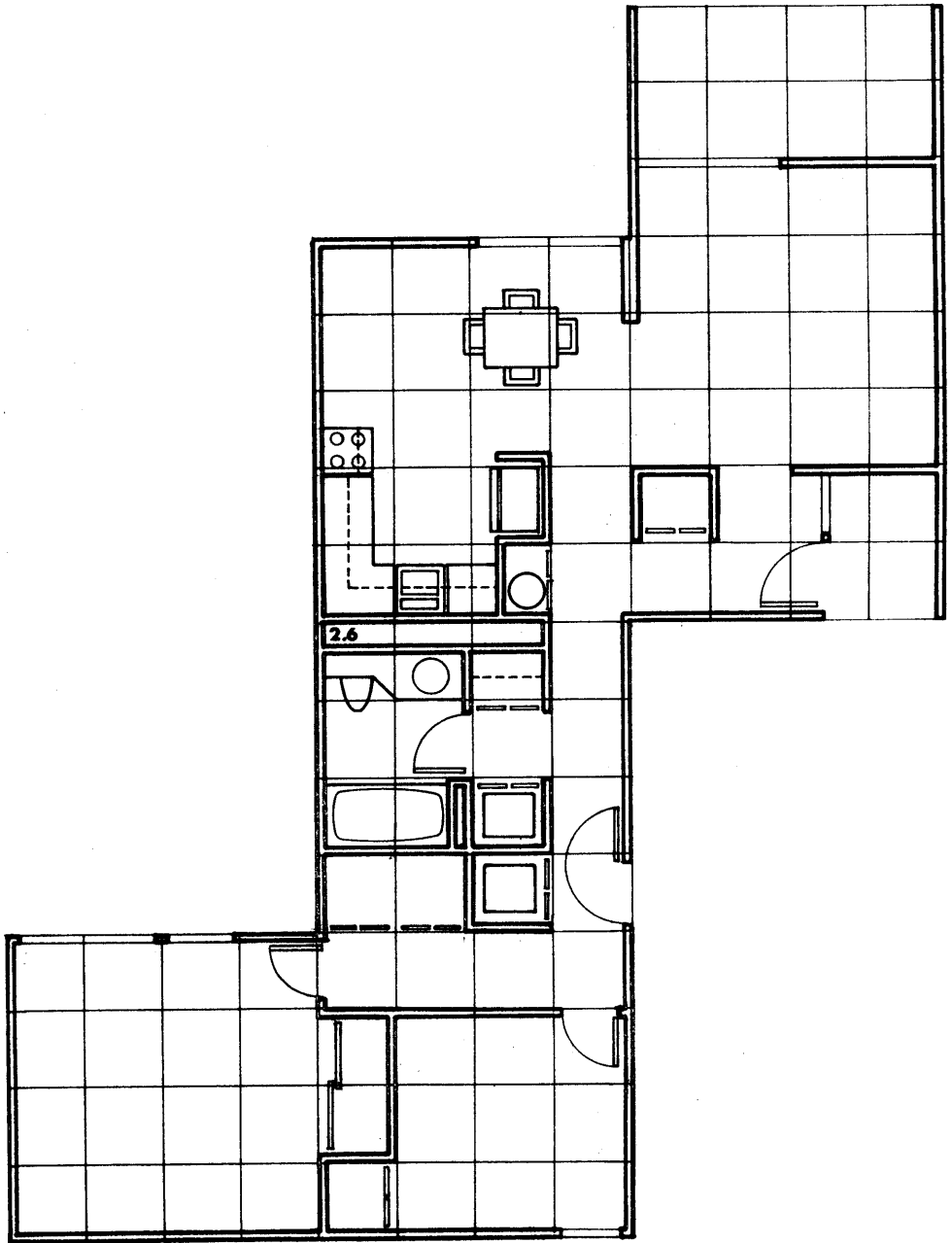
UNIT 2.5

UNIT PLAN

**2 BEDROOM
LEVEL 2**



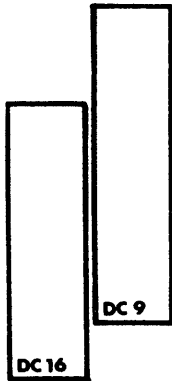
981 SQ



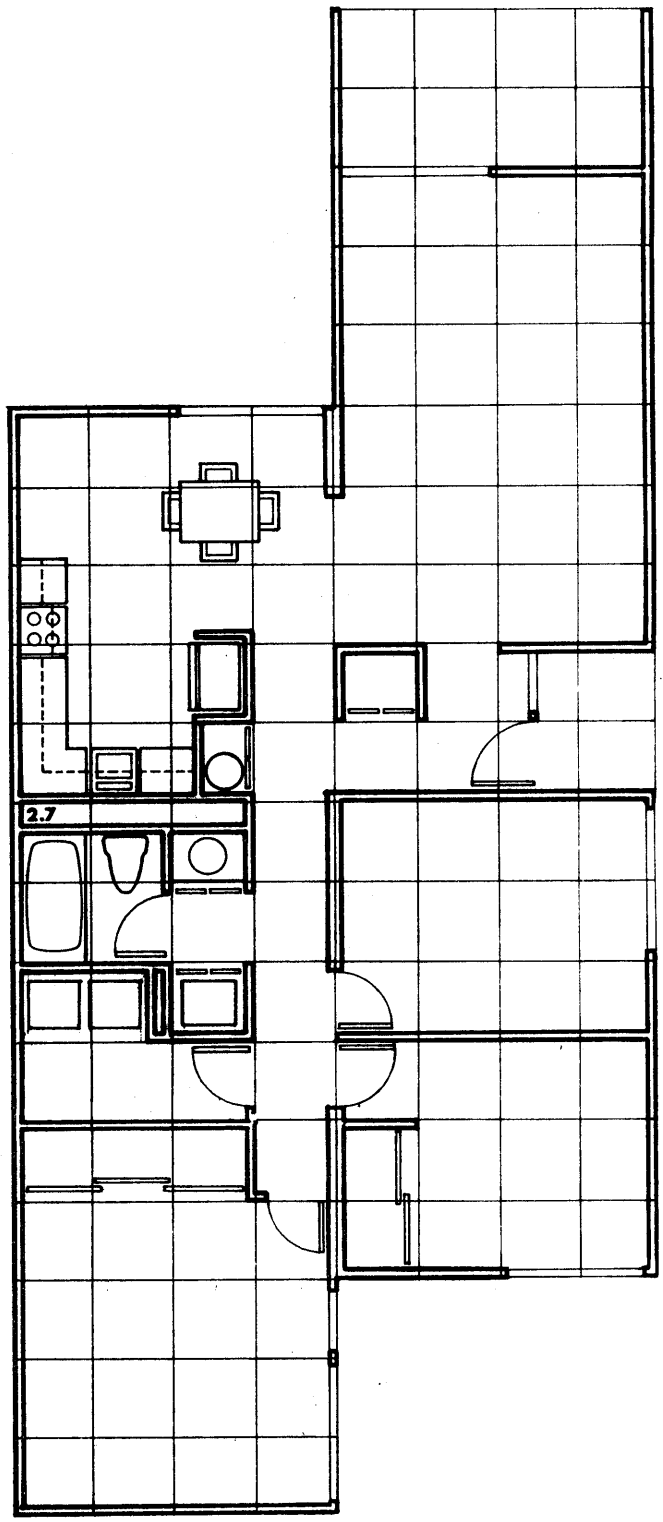
UNIT 2.6

UNIT PLAN

**2 BEDROOM
LEVEL 3**



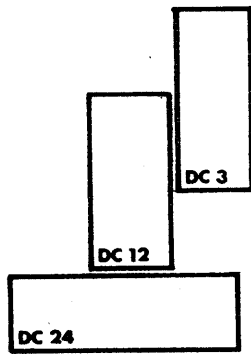
1203 SQ



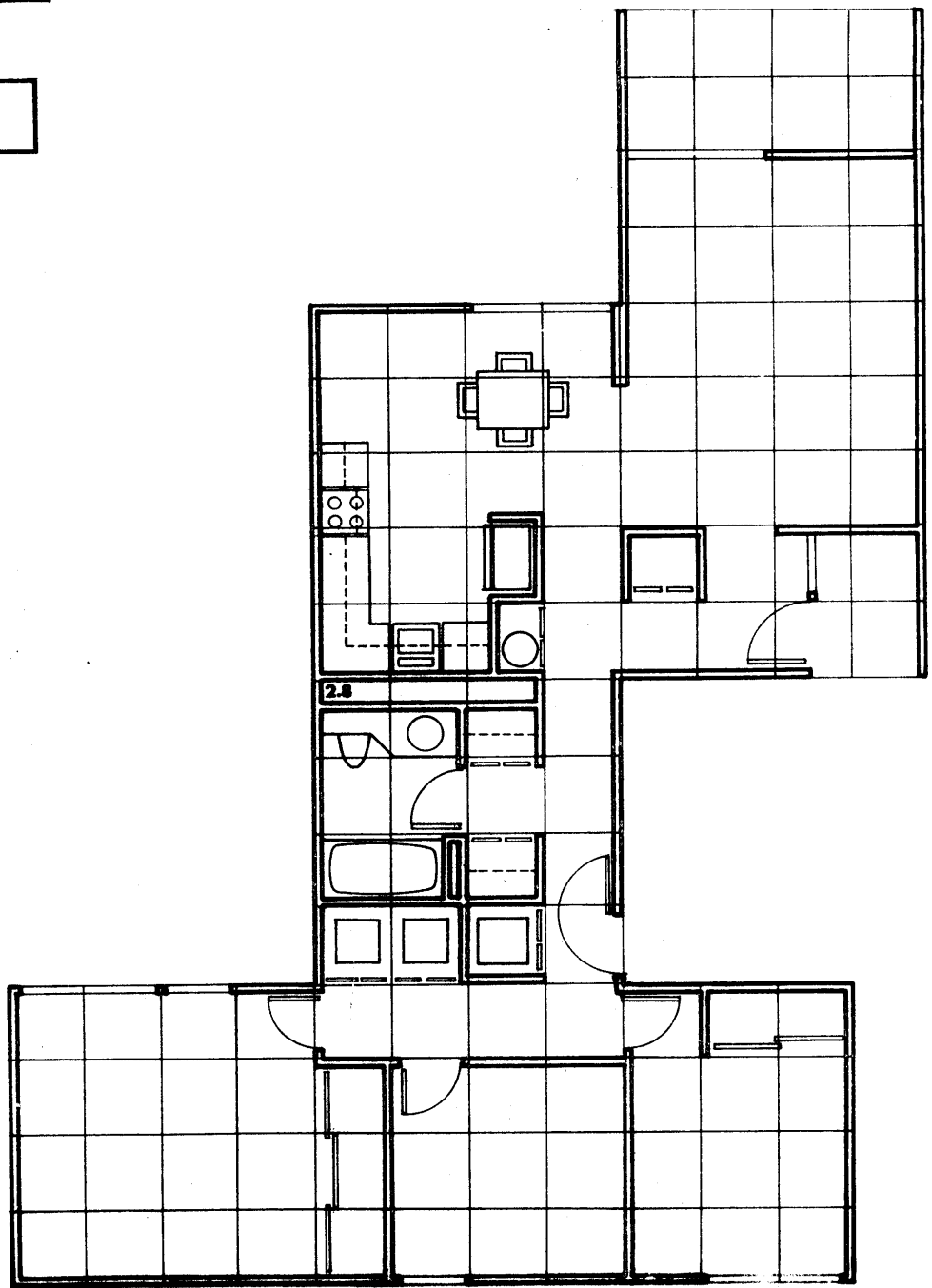
UNIT 2.7

UNIT PLAN

**2 BEDROOM
LEVEL 3**



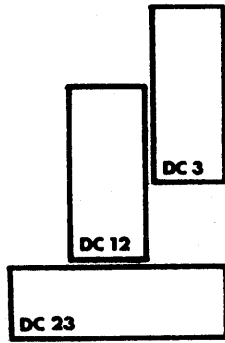
1158 SQ



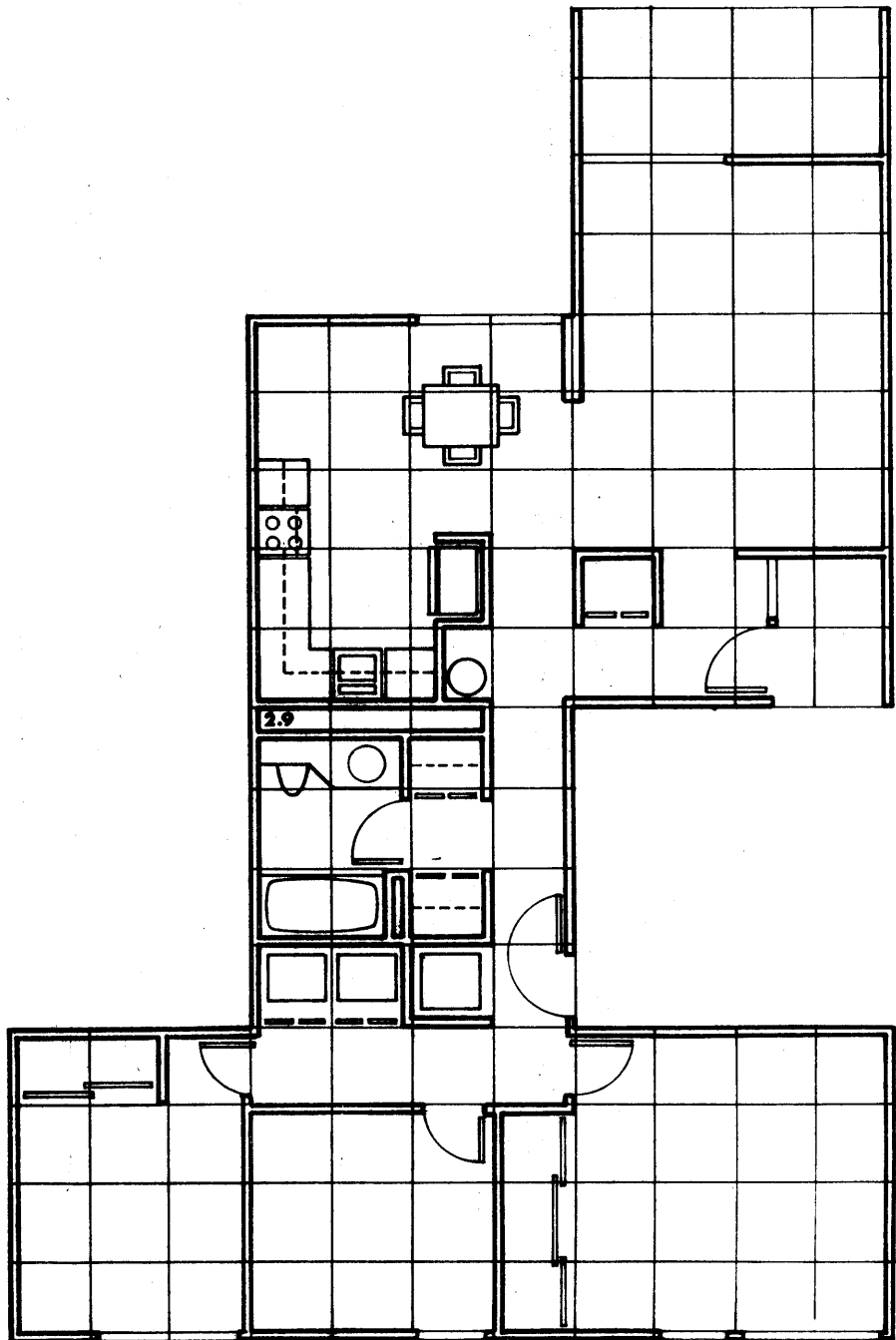
UNIT 2.8

UNIT PLAN

**2 BEDROOM
LEVEL 3**



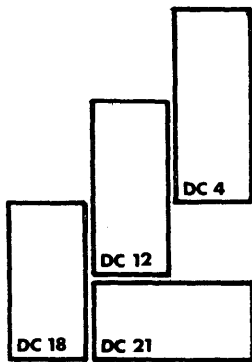
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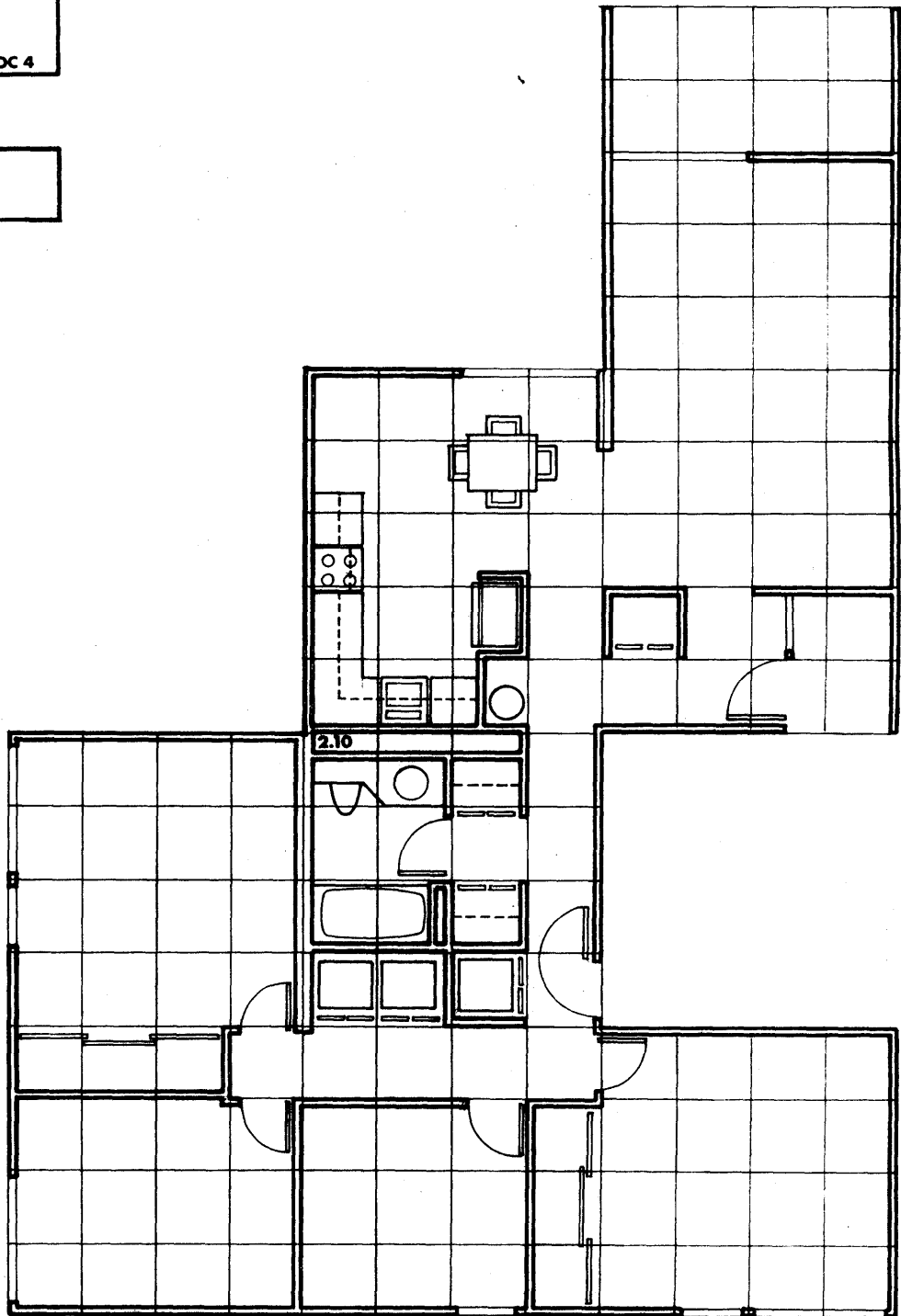
UNIT 2.9

UNIT PLAN

**2 BEDROOM
LEVEL 4**



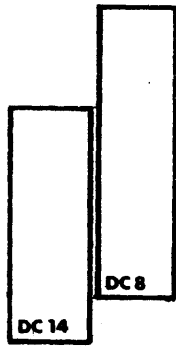
1424 SQ



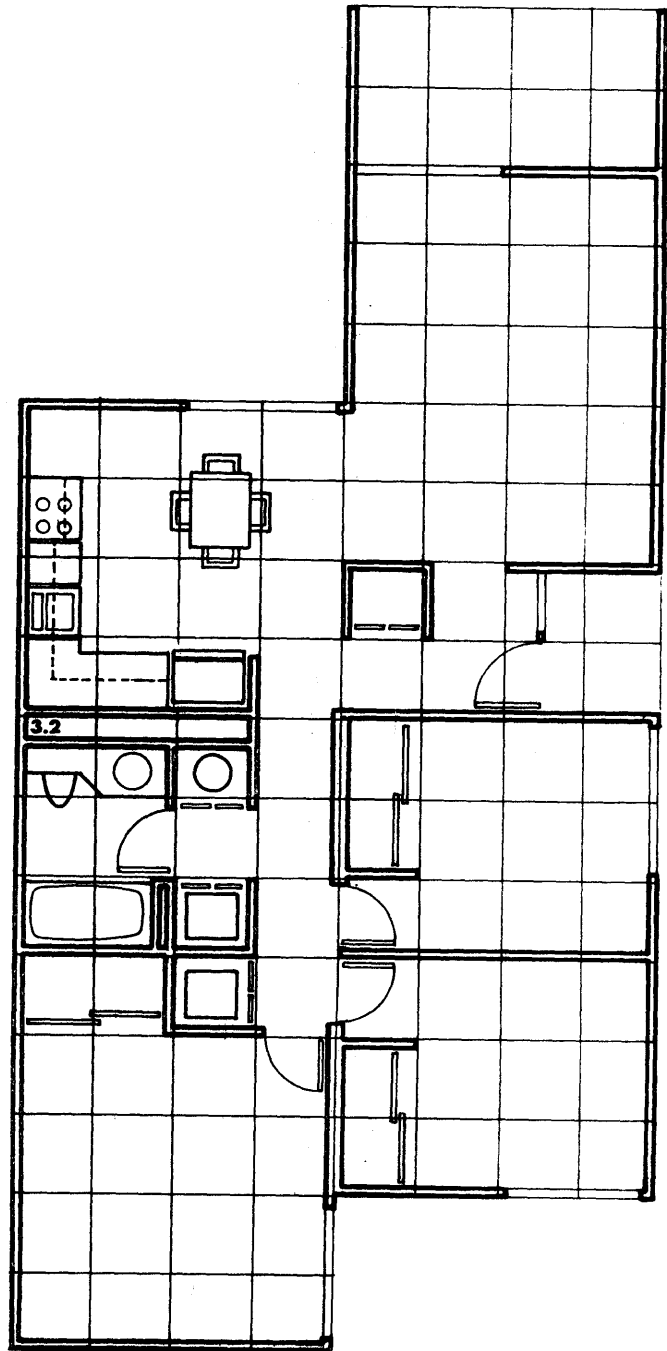
UNIT 2.10

UNIT PLAN

**3 BEDROOM
LEVEL 1**



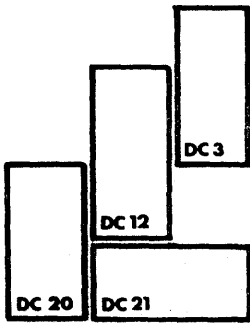
1070 SQ



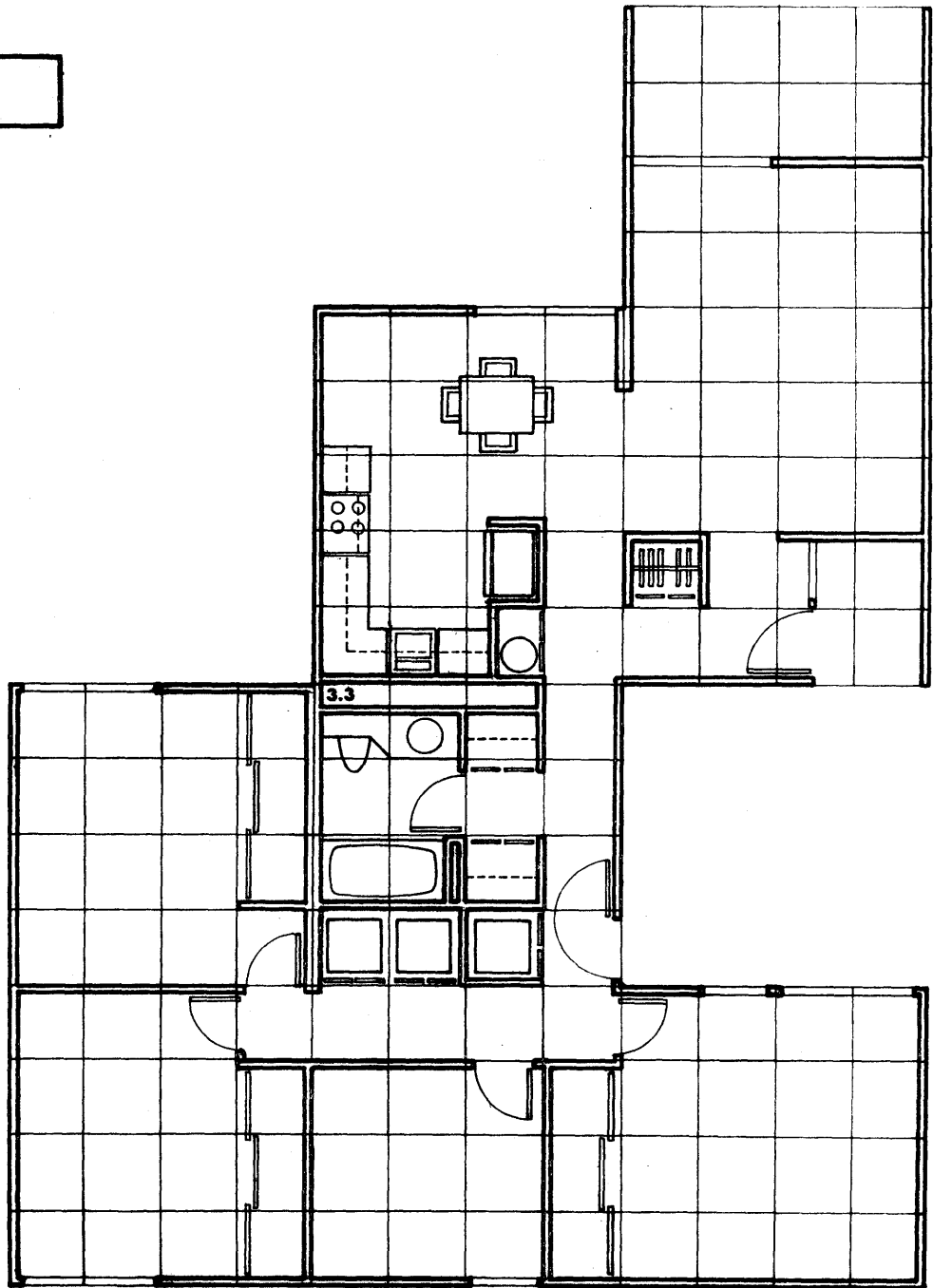
UNIT 3.2

UNIT PLAN

**3 BEDROOM
LEVEL 2**



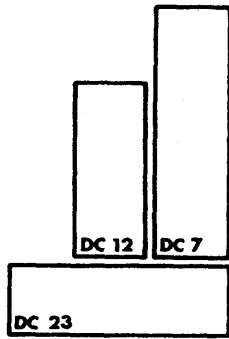
1379 SQ



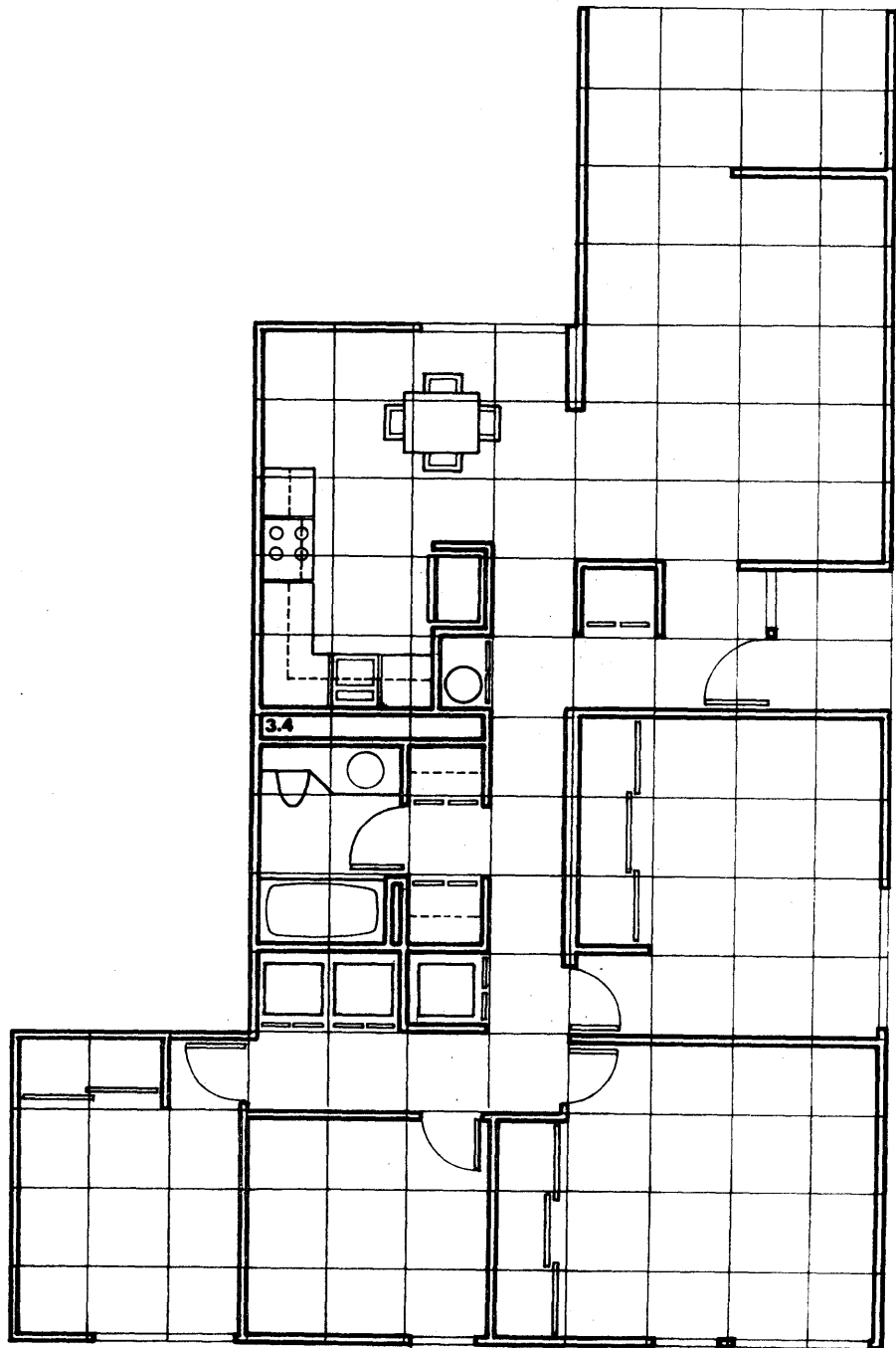
UNIT 3.3

UNIT PLAN

**3 BEDROOM
LEVEL 2**



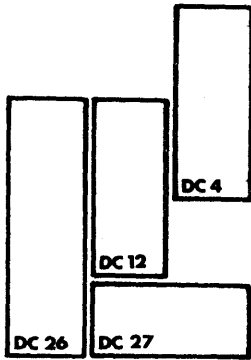
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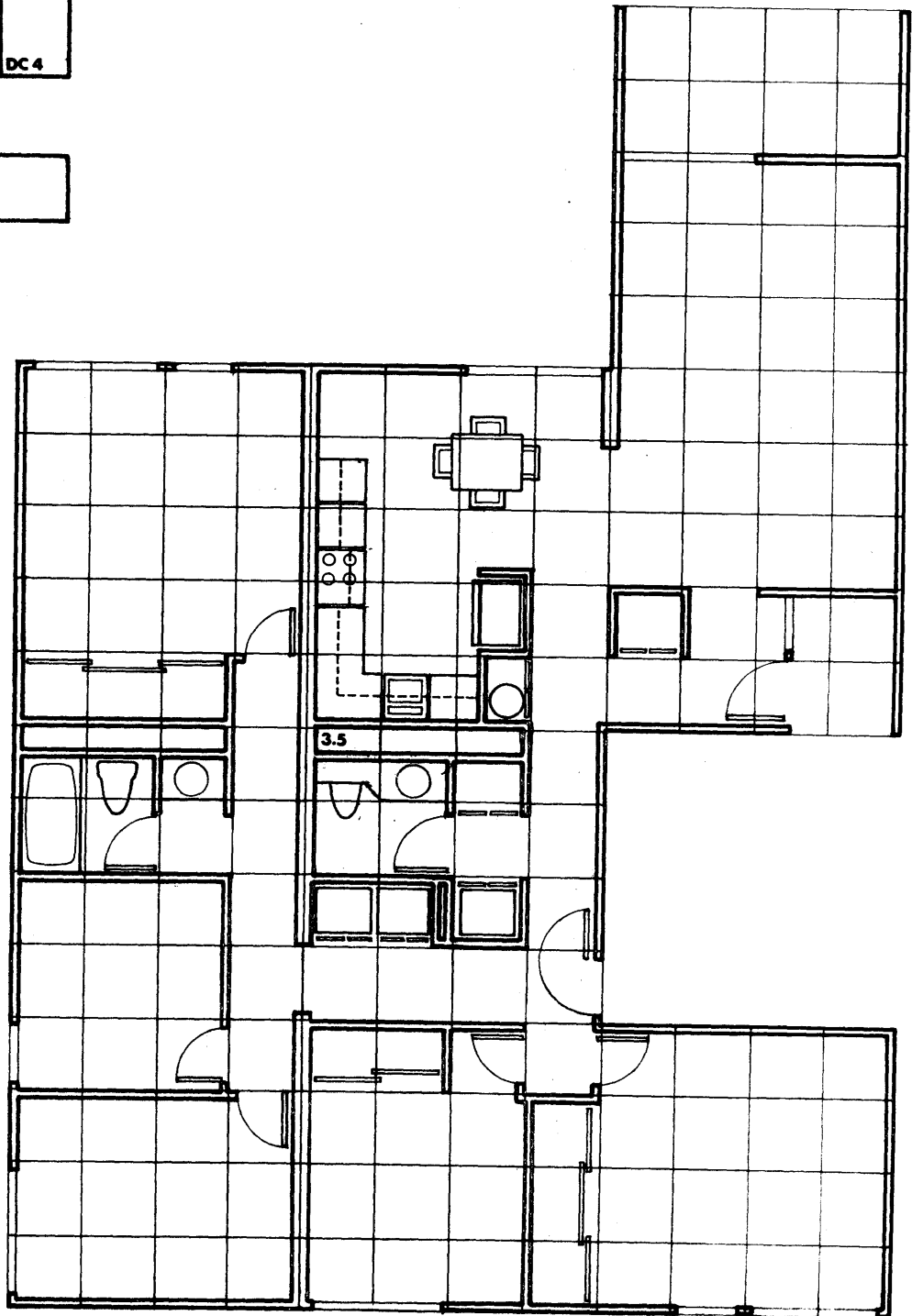
UNIT 3.4

UNIT PLAN

**3 BEDROOM
LEVEL 3**



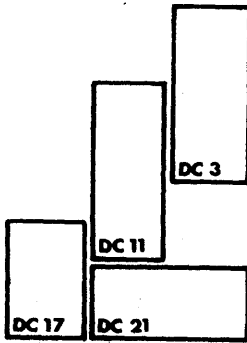
1680 SQ



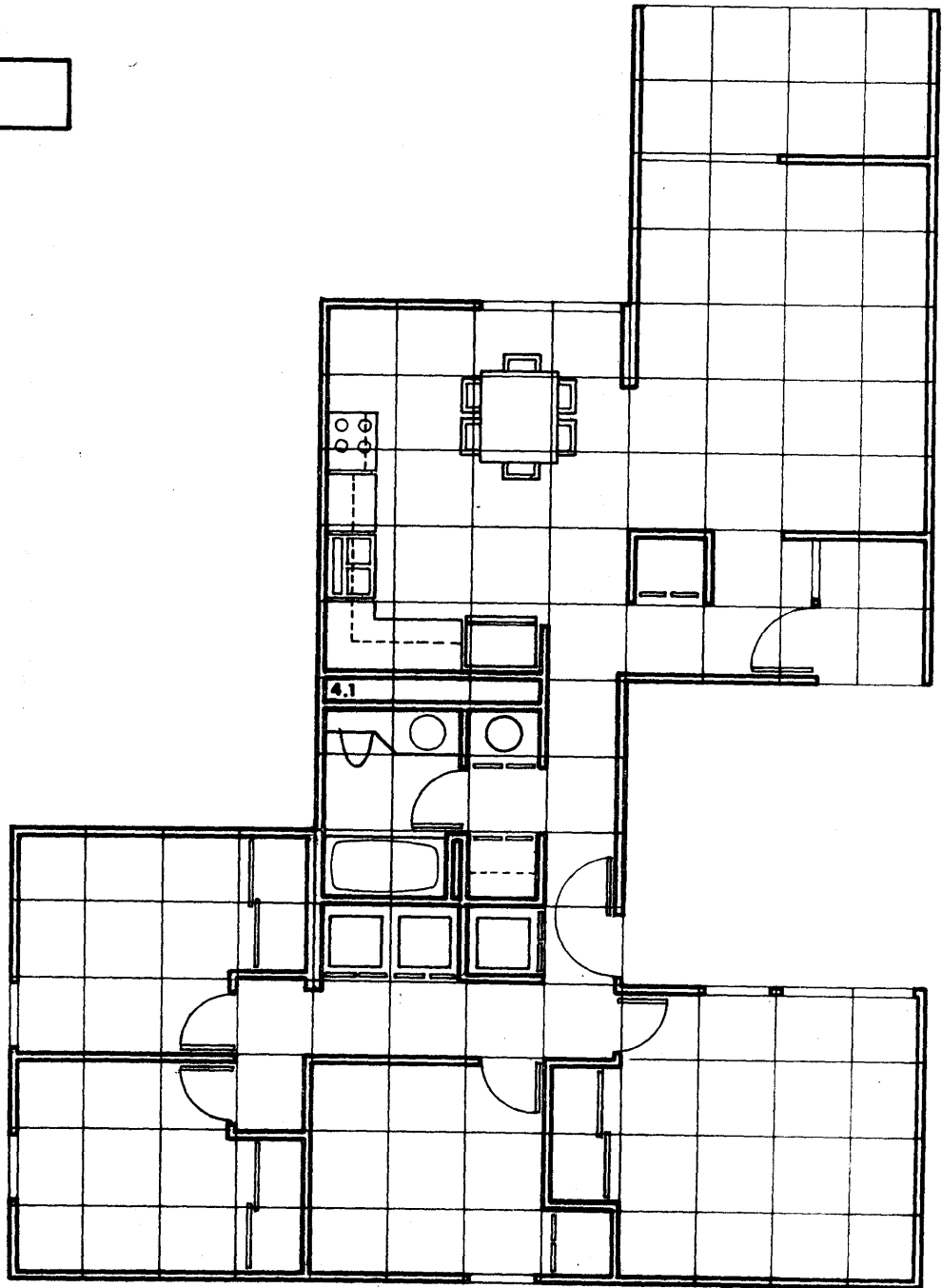
UNIT 3.5

UNIT PLAN

**4 BEDROOM
LEVEL 1**



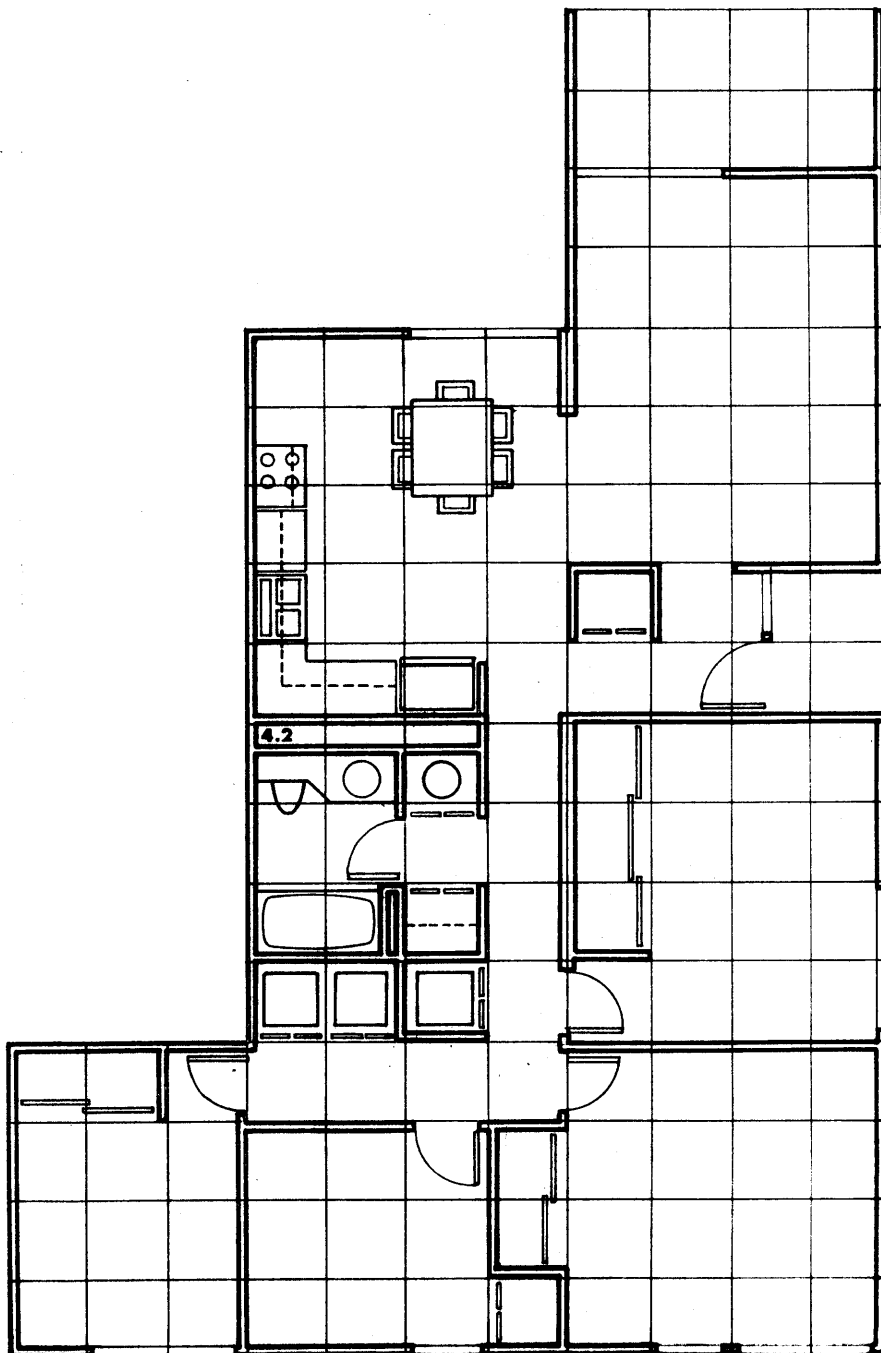
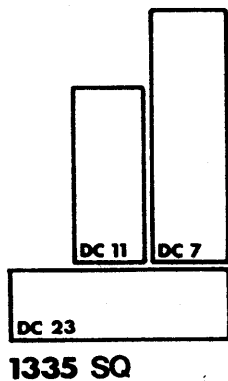
1291 SQ



UNIT 4.1

UNIT PLAN

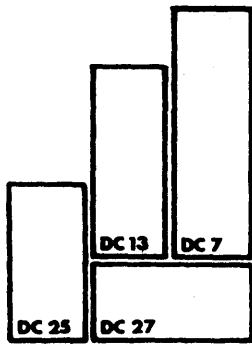
**4 BEDROOM
LEVEL 1**



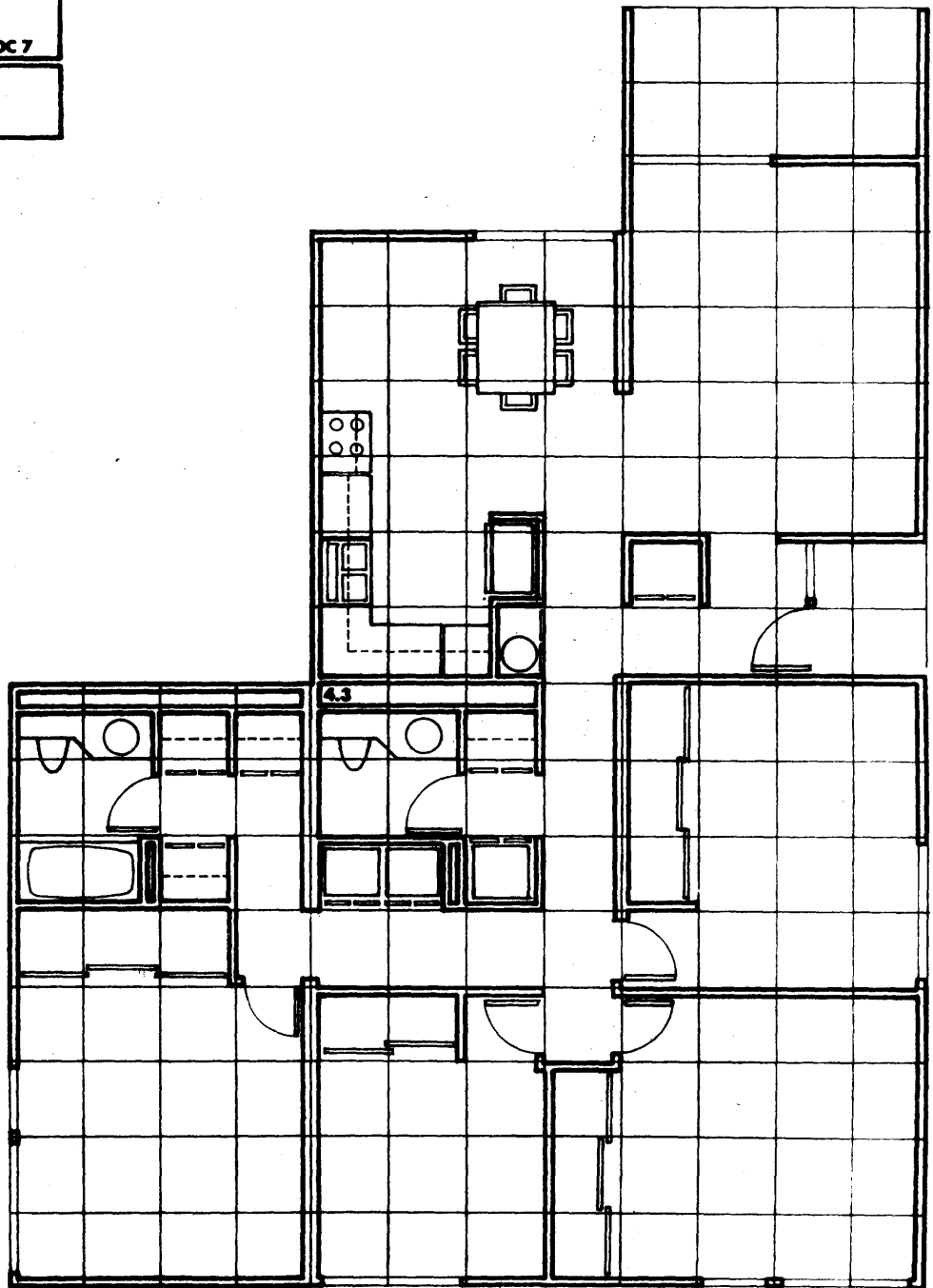
UNIT 4.2

UNIT PLAN

**4 BEDROOM
LEVEL 2**



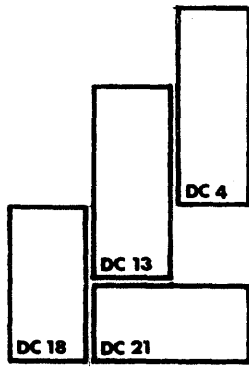
1601 SQ



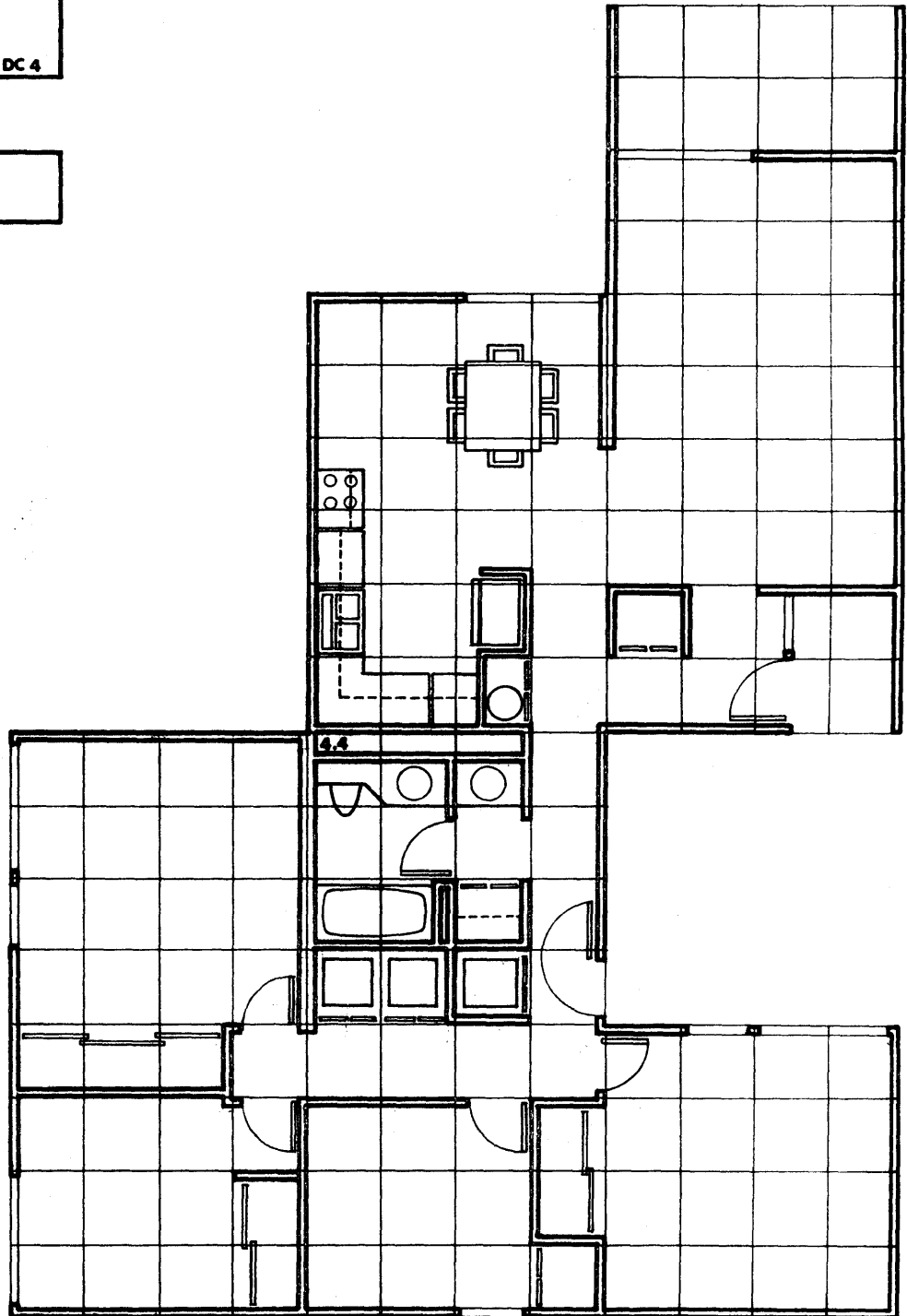
UNIT 4.3

UNIT PLAN

**4 BEDROOM
LEVEL 2**



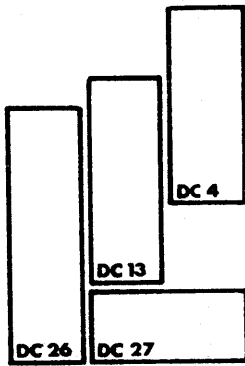
1468 SQ



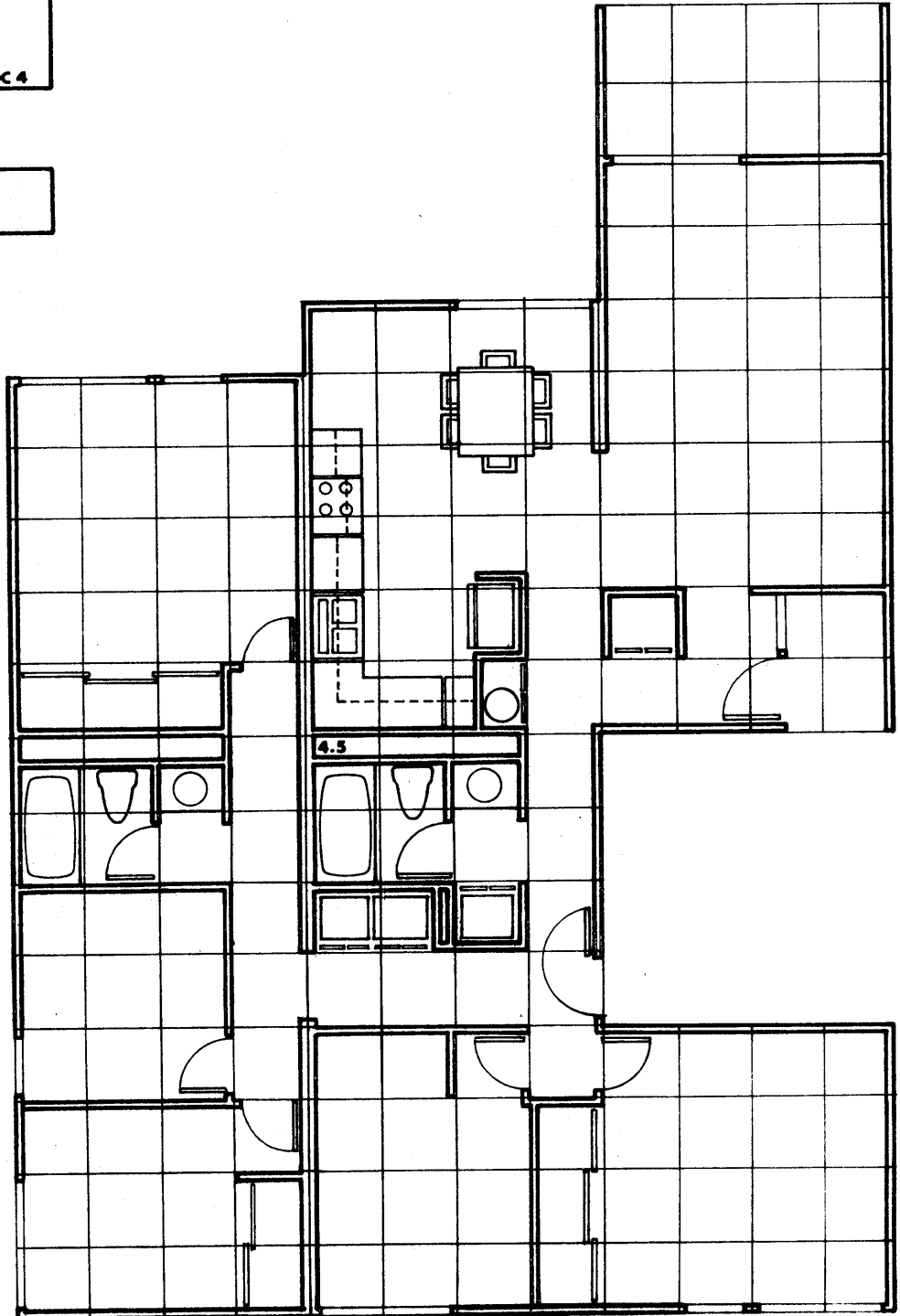
UNIT 4.4

UNIT PLAN

**4 BEDROOM
LEVEL 3**

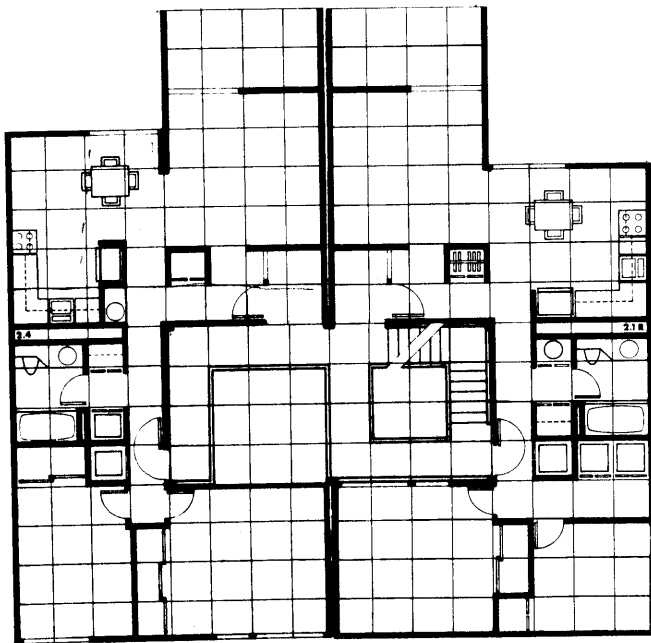
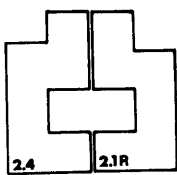
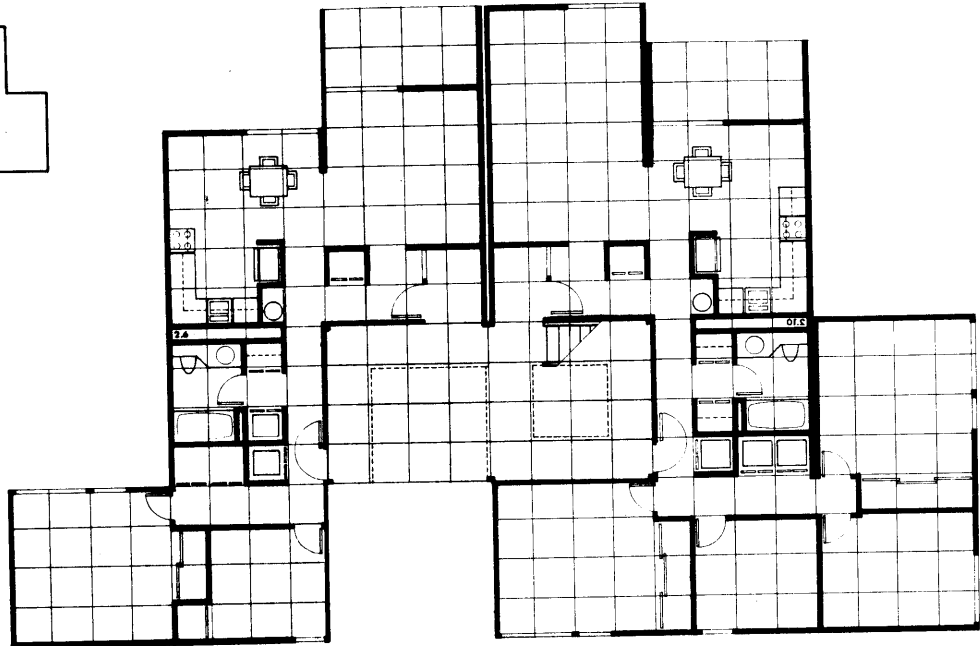
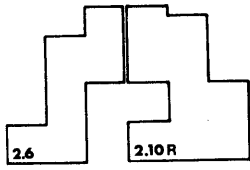


1680 SQ

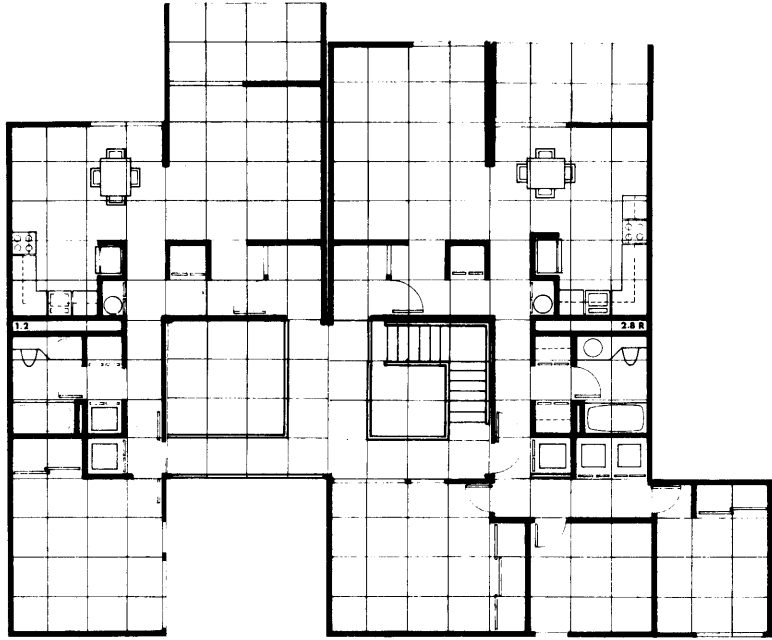
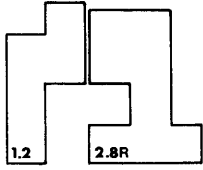


UNIT 4.5

UNIT PLAN

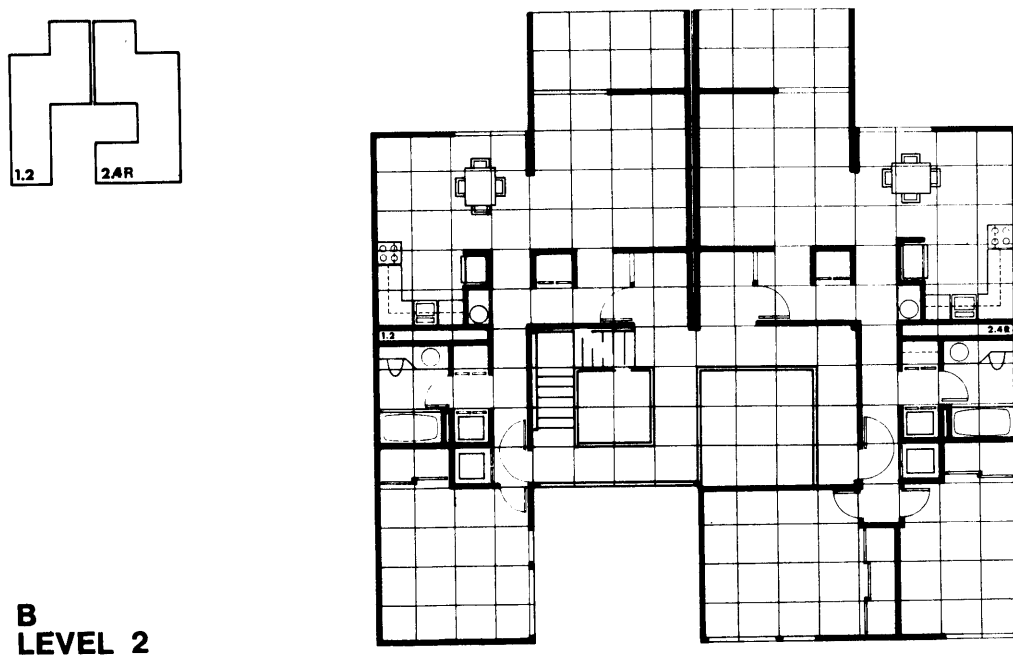
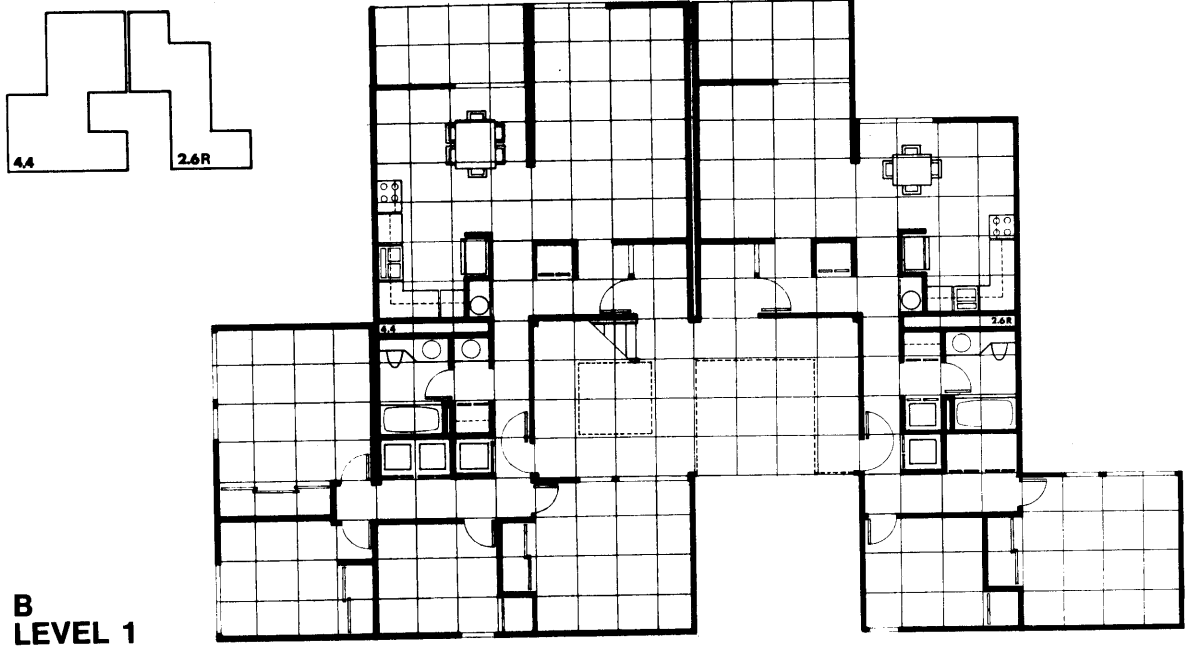


CLUSTER PLANS

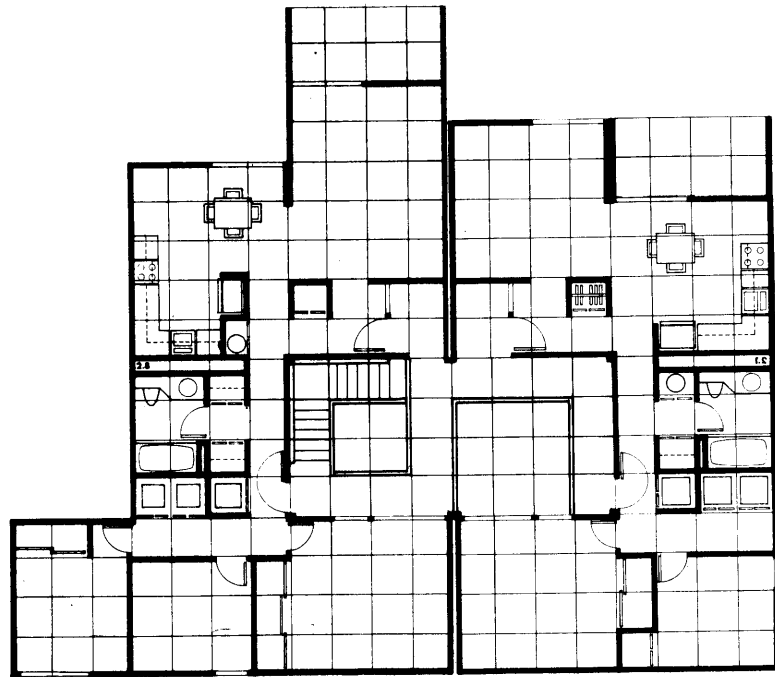
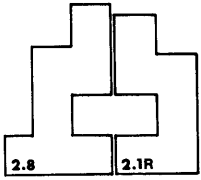


A
LEVEL 3

CLUSTER PLANS

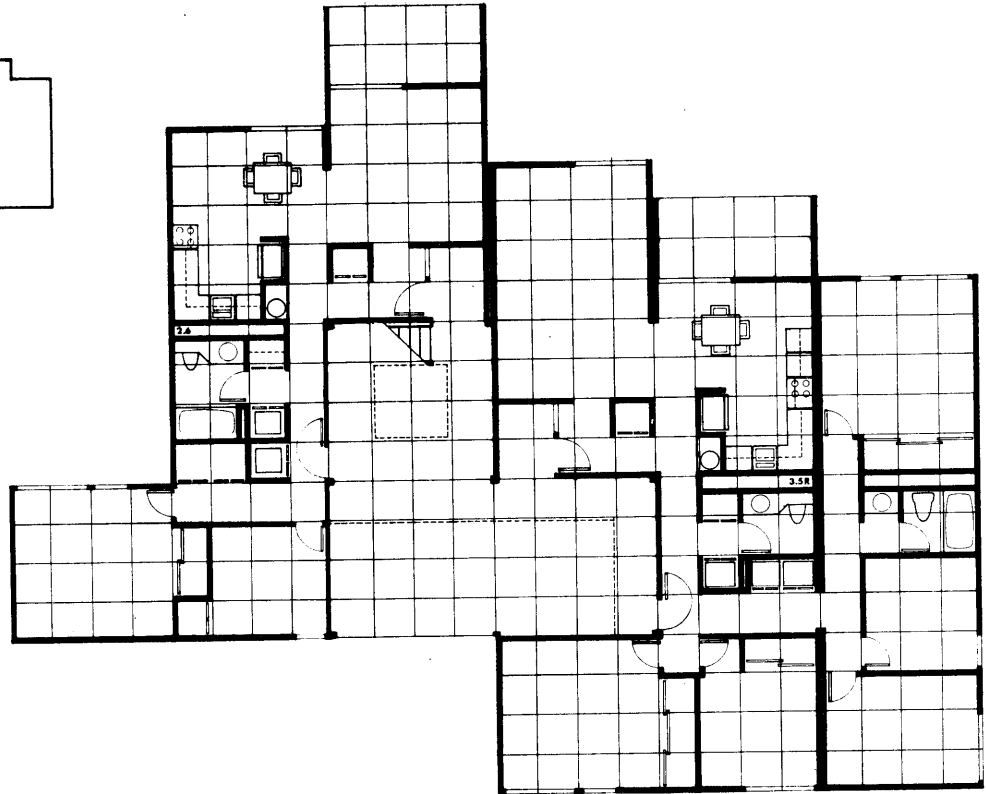
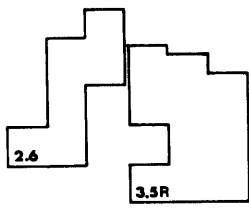


CLUSTER PLANS

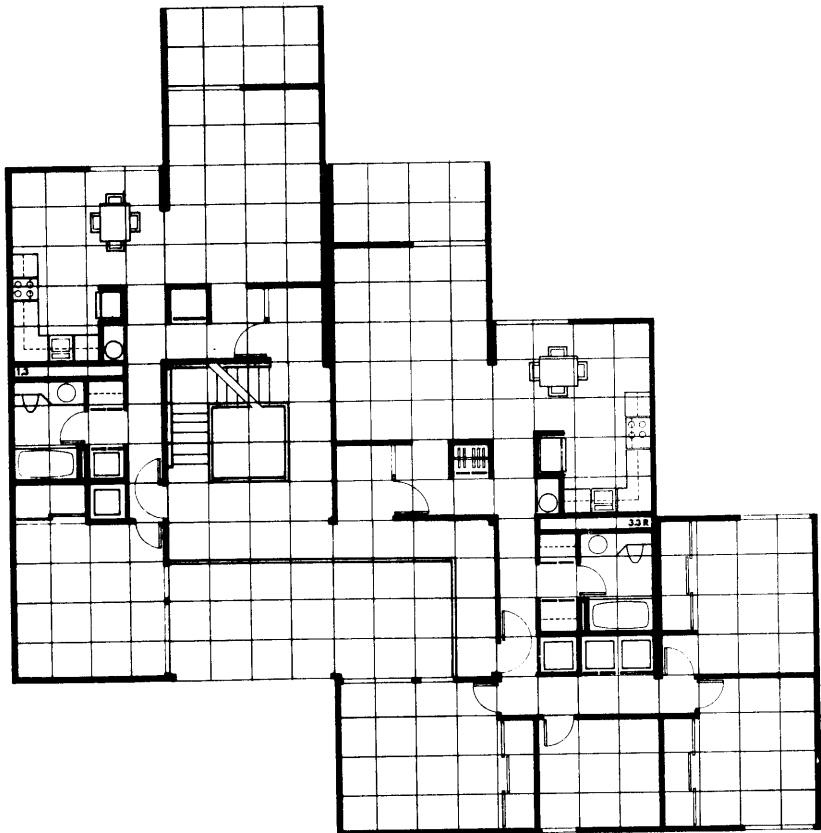
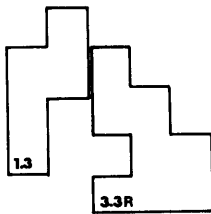


B
LEVEL 3

CLUSTER PLANS

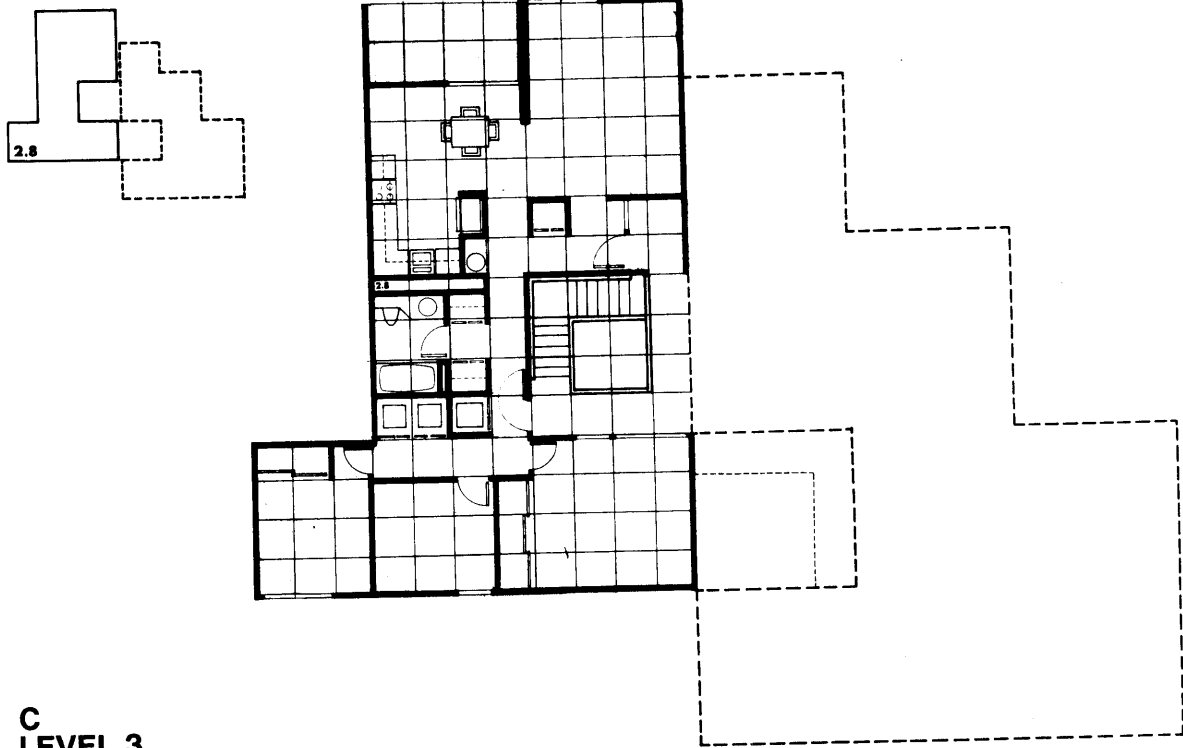


C
LEVEL 1



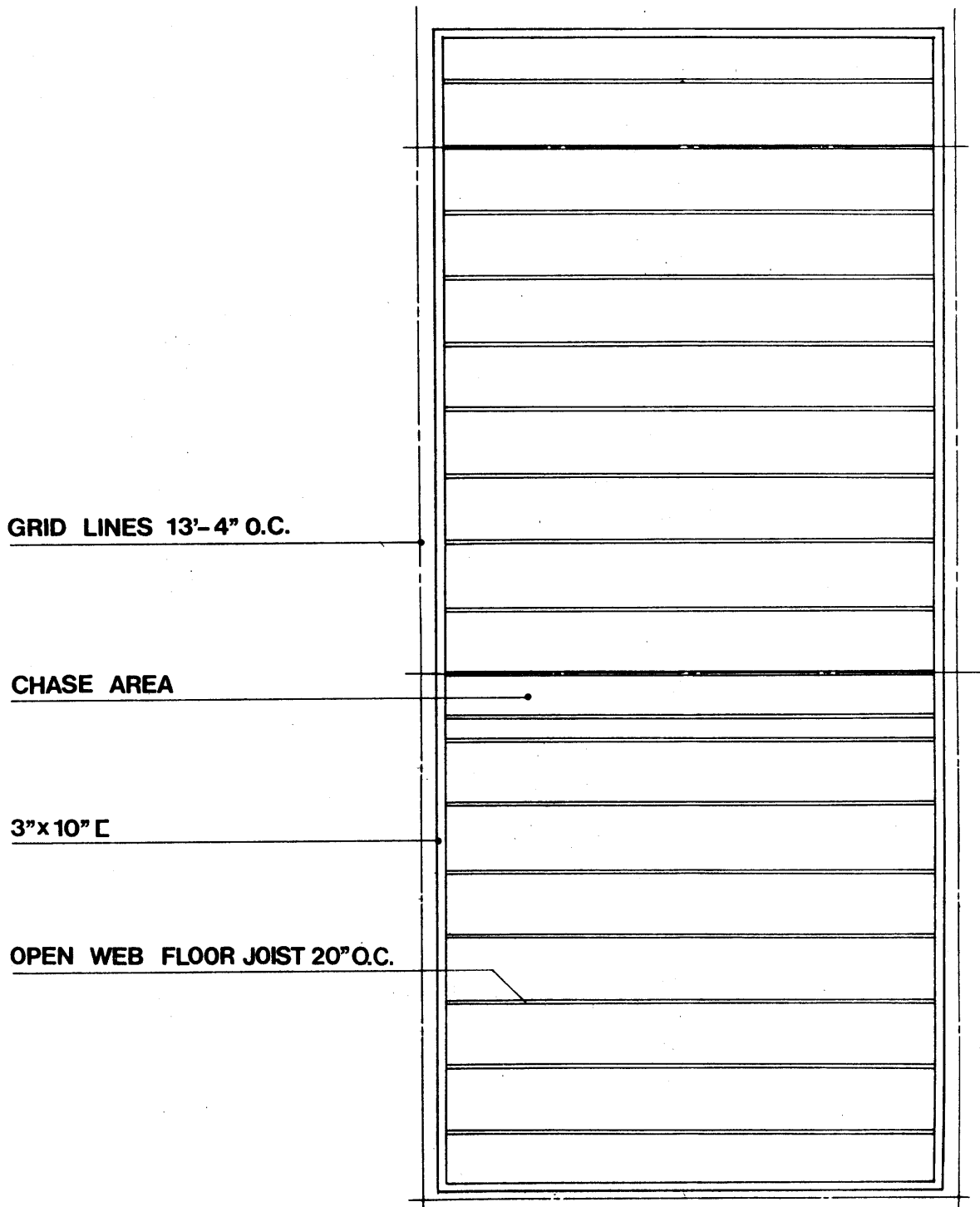
C
LEVEL 2

CLUSTER PLANS

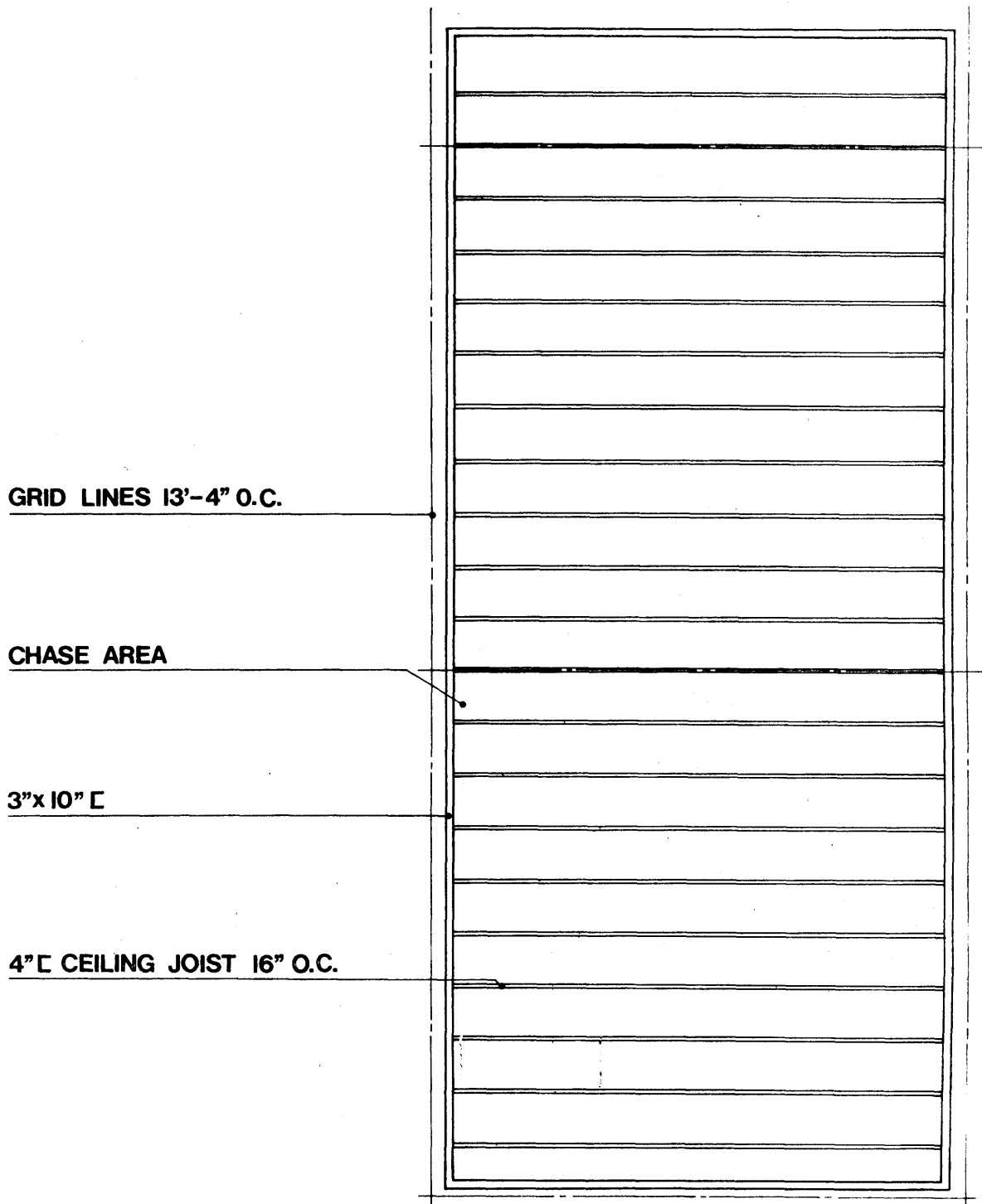


C
LEVEL 3

CLUSTER PLANS



FLOOR FRAMING PLAN

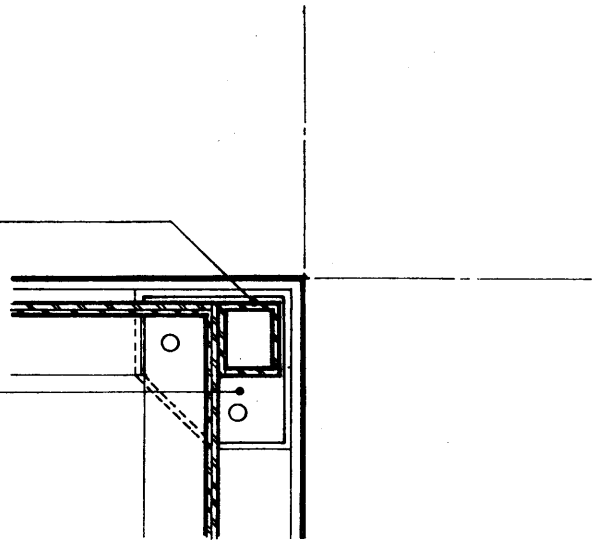


CEILING FRAMING PLAN

**STEEL TUBE
2 1/2"x 3" COLUMN**

COLUMN BASE PLATE

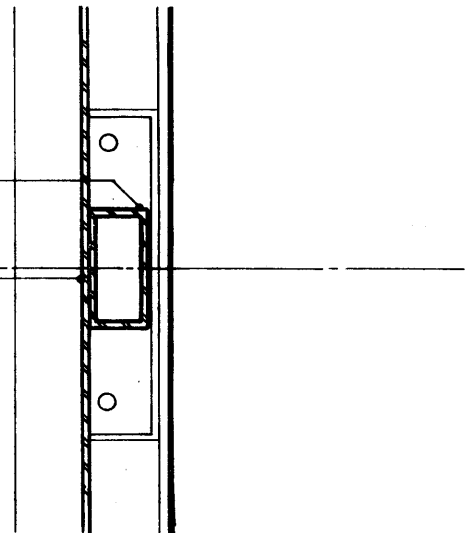
END COLUMN



**STEEL TUBE
2 1/2"x 5" COLUMN**

3"x 10" C

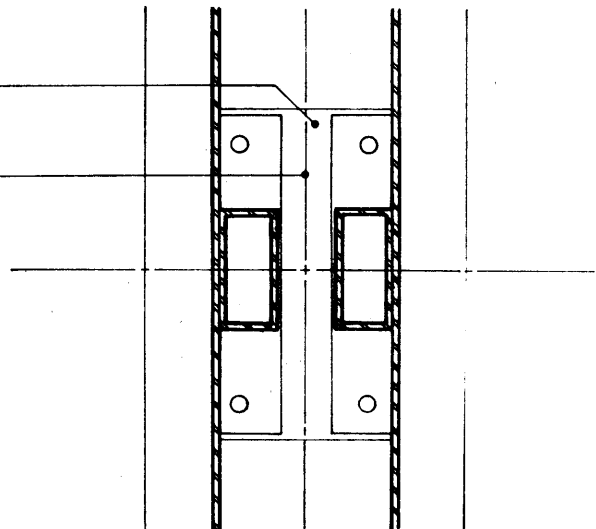
INTERIOR COLUMN



**METAL SHIM AND
CONNECTOR PLATE**

GRID LINES 13'-4" O.C.

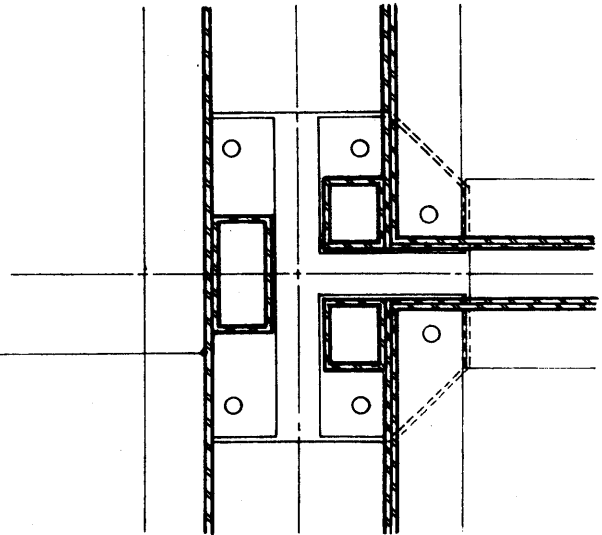
**TWO DELIVERY COMPONENT
CONNECTION**



COLUMN DETAILS

3"x10" C

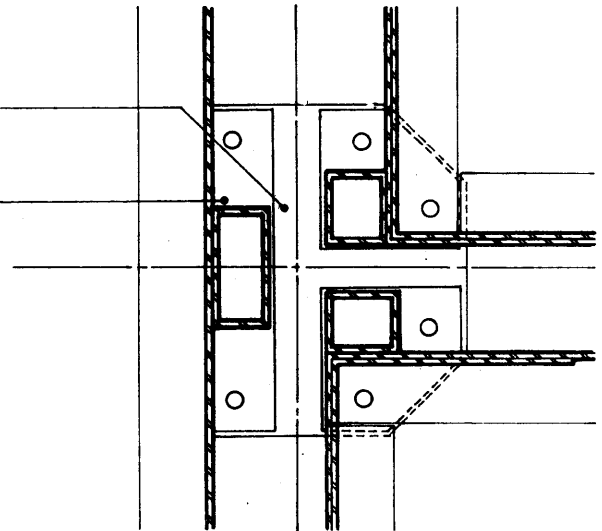
**THREE DELIVERY COMPONENT
CONNECTION**



**METAL SHIM AND
CONNECTOR PLATE**

COLUMN BASE PLATE

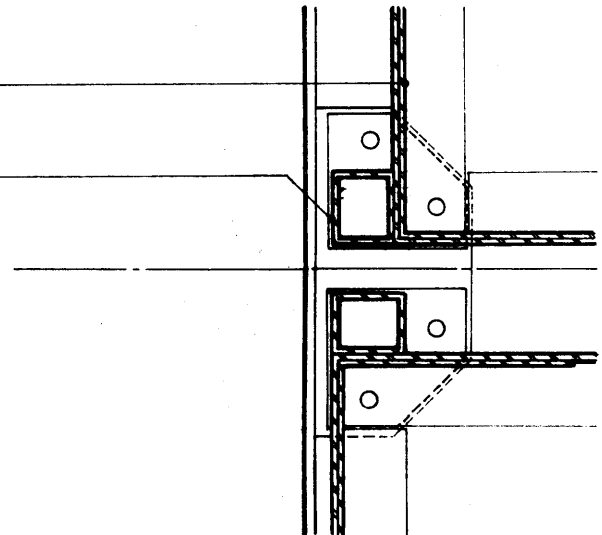
**THREE DELIVERY COMPONENT
CONNECTION**



CORNER BRACKET

END COLUMN

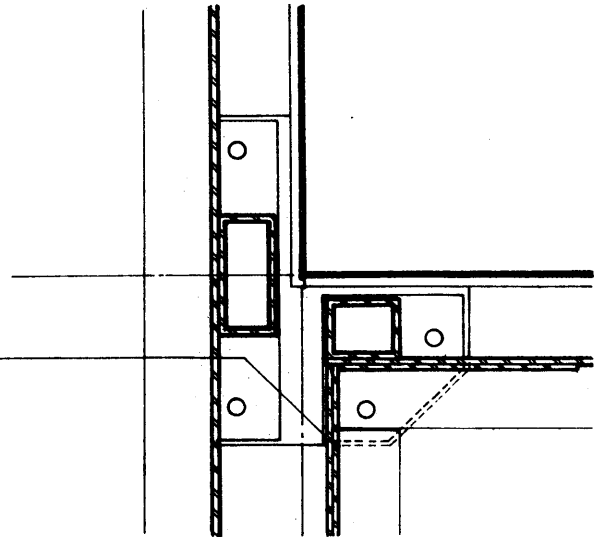
**THREE DELIVERY COMPONENT
CONNECTION**



COLUMN DETAILS

**CORNER BRACKET RIVET
CONNECTED TO 3"x10"E**

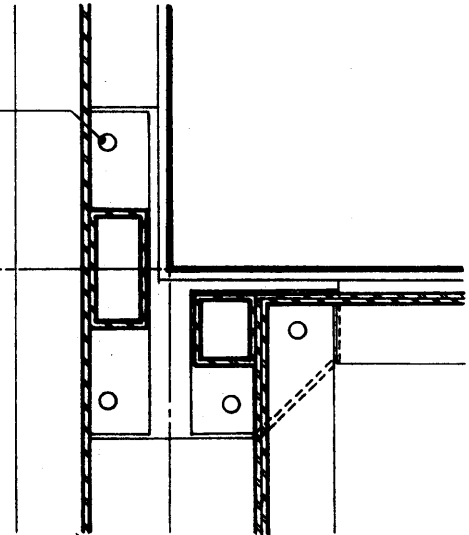
**TWO DELIVERY COMPONENT
CONNECTION**



POSITION FOR BOLTING

GRID LINES 13'-4" O.C.

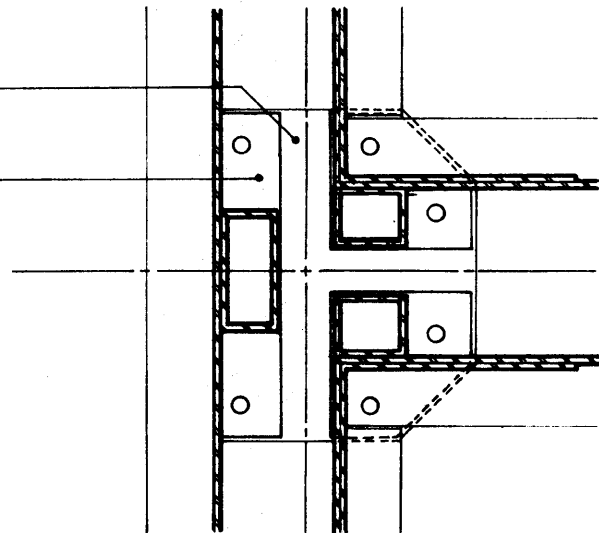
**TWO DELIVERY COMPONENT
CONNECTION**



CONNECTOR PLATE

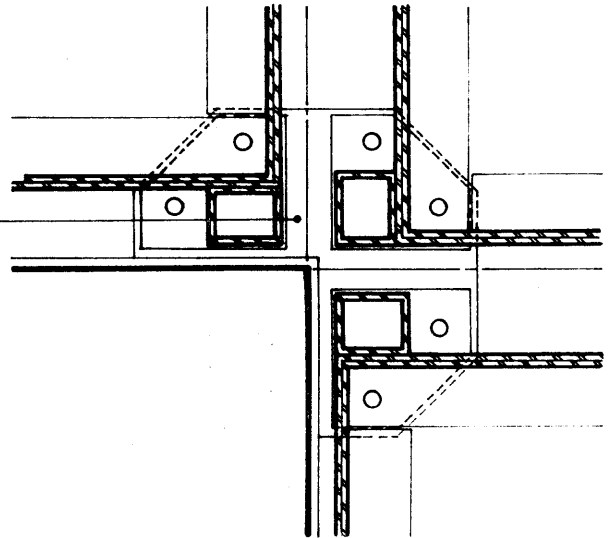
**METAL SHIM AND
COLUMN BASE PLATE**

**THREE DELIVERY COMPONENT
CONNECTION**



COLUMN DETAILS

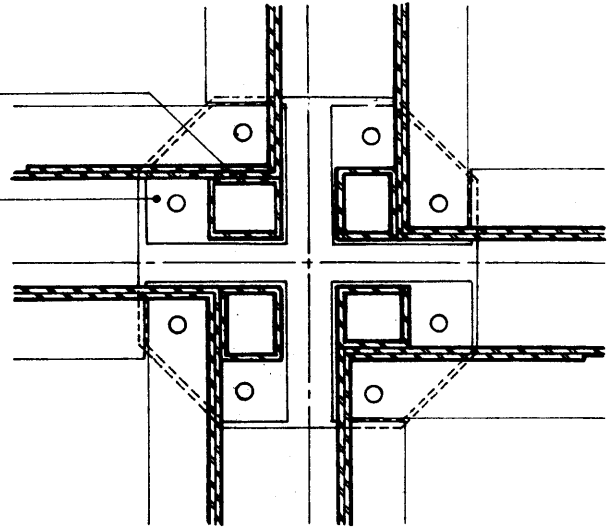
**METAL SHIM AND
CONNECTOR PLATE**



**THREE DELIVERY COMPONENT
CONNECTIO**

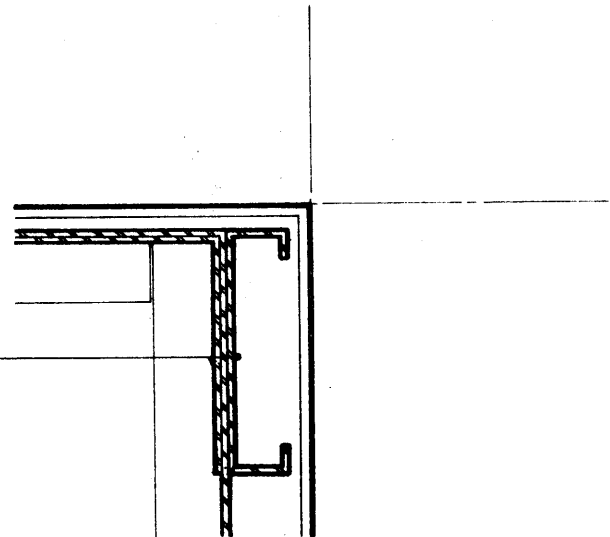
3"x10" C

COLUMN BASE PLATE



**FOUR DELIVERY COMPONENT
CONNECTION**

STEEL CORNER BRACE



CANTILEVER CONDITION

COLUMN DETAILS

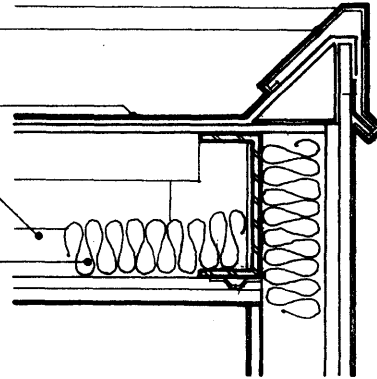
**CONTINUOUS METAL
FLASHING**

BUILT UP ROOF

OPEN WEB ROOF JOIST

3" INSULATION

**SECTION AT ROOF
EXTERIOR WALL**



PLYWOOD SUBFLOOR

FIRE RETARDANT PLYWOOD

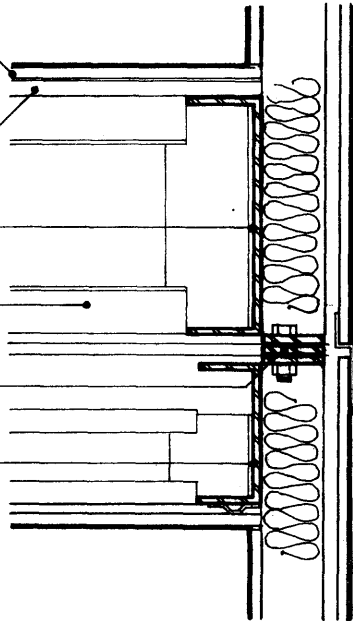
3 C 10 RIVET CONNECTED

**OPEN WEB
FLOOR JOIST**

**COLUMN BASE PLATES
BOLTED TO METAL CONNECTOR**

3 C 6 RIVET CONNECTION

**SECTION AT CEILING /
FLOOR CONNECTION
EXTERIOR WALL**



**GYPSUM SCREW
ATTACHED TO METAL STUDS**

INSULATION

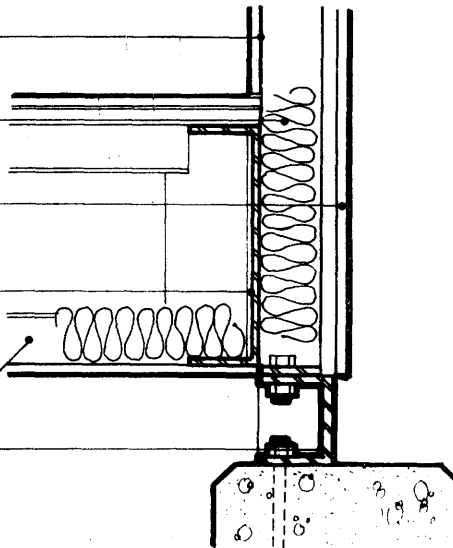
**WOODROCK SIDING
OVER SHEATHING**

3 C 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 C 6 METAL CHANNEL

**4" METAL CEILING JOIST
RIVET ATTACHED TO CHANNEL**

**SECTION AT CEILING/
FLOOR CONNECTION
INTERIOR WALL**

**METAL STUDS
ATTACHED TO 3 C 10**

**2 1/2" x 5"
METAL COLUMN**

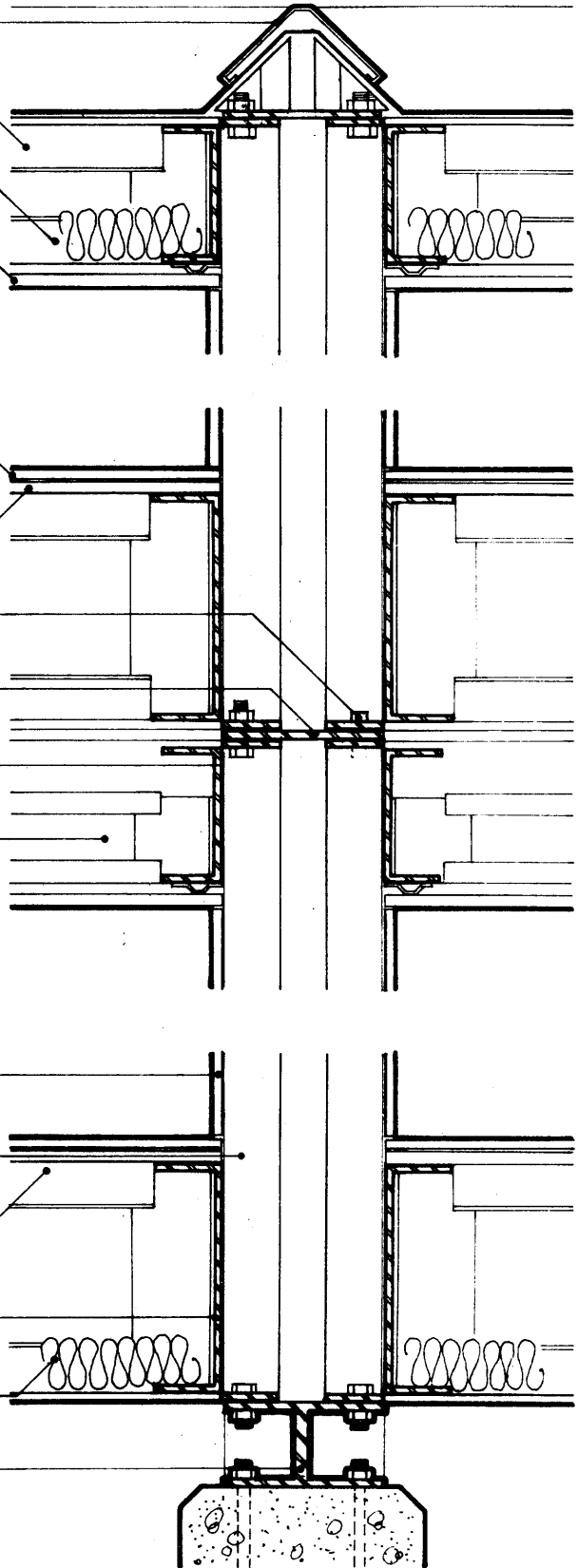
**OPEN WEB FLOOR
JOIST RIVET ATTACHED**

**3 C 10 RIVET
CONNECTED FRAME**

3" INSULATION

**STEEL CONNECTOR
BOLTED TO FOOTING**

**SECTION AT FLOOR
INTERIOR WALL**



WALL DETAILS

METAL CONNECTOR BOLTED
TO COLUMN BASE PLATES

BUILT UP ROOF

OPEN WEB ROOF JOIST

GYPSUM ATTACHED
TO RESILIENT PANELS

SECTION AT ROOF
FIRE WALL

PLYWOOD SUBFLOOR

FIRE RETARDANT
PLYWOOD OR GYPSUM

COLUMN BASE PLATE

METAL SHIM/CONNECTOR

MINERAL FIBER

4" METAL CEILING JOIST
RIVETED TO CHANNEL

SECTION AT CEILING /
FLOOR CONNECTION
FIRE WALL

GYPSUM SCREW ATTACHED
TO METAL STUDS

2 1/2"x5" STEEL TUBE COL.

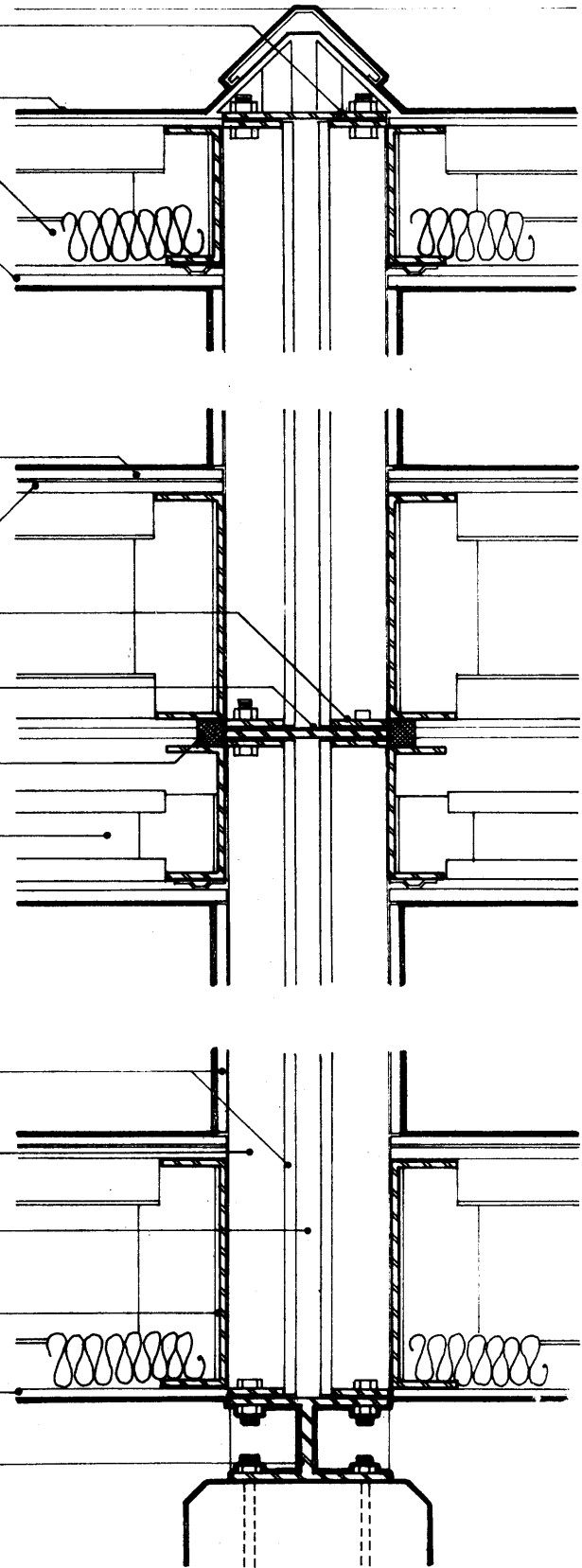
1" CONSTRUCTION CLEARANCE

3 C 10

OPEN WEB
FLOOR JOIST

STEEL CONNECTOR
BOLTED TO FOOTING

SECTION AT FLOOR
FIRE WALL



WALL DETAILS

STEEL CONNECTOR BOLTED
TO COLUMN BASE PLATE

OPEN WEB
ROOF JOIST

INSULATION

GYPSUM ATTACHED
TO RESILIENT CHANNELS

SECTION AT ROOF
INTERIOR WALL

PLYWOOD SUBFLOOR

FIRE RETARDANT PLYWOOD

SLIP ON PIN CONNECTION

METAL CONNECTOR BOLTED
TO COLUMN BASE PLATES

3 C 6

4" METAL CEILING JOIST
RIVET ATTACHED TO CHANNEL

SECTION AT CEILING /
FLOOR CONNECTION
INTERIOR WALL /
EXTERIOR COLUMN

GYPSUM SCREW
ATTACHED TO METAL STUDS

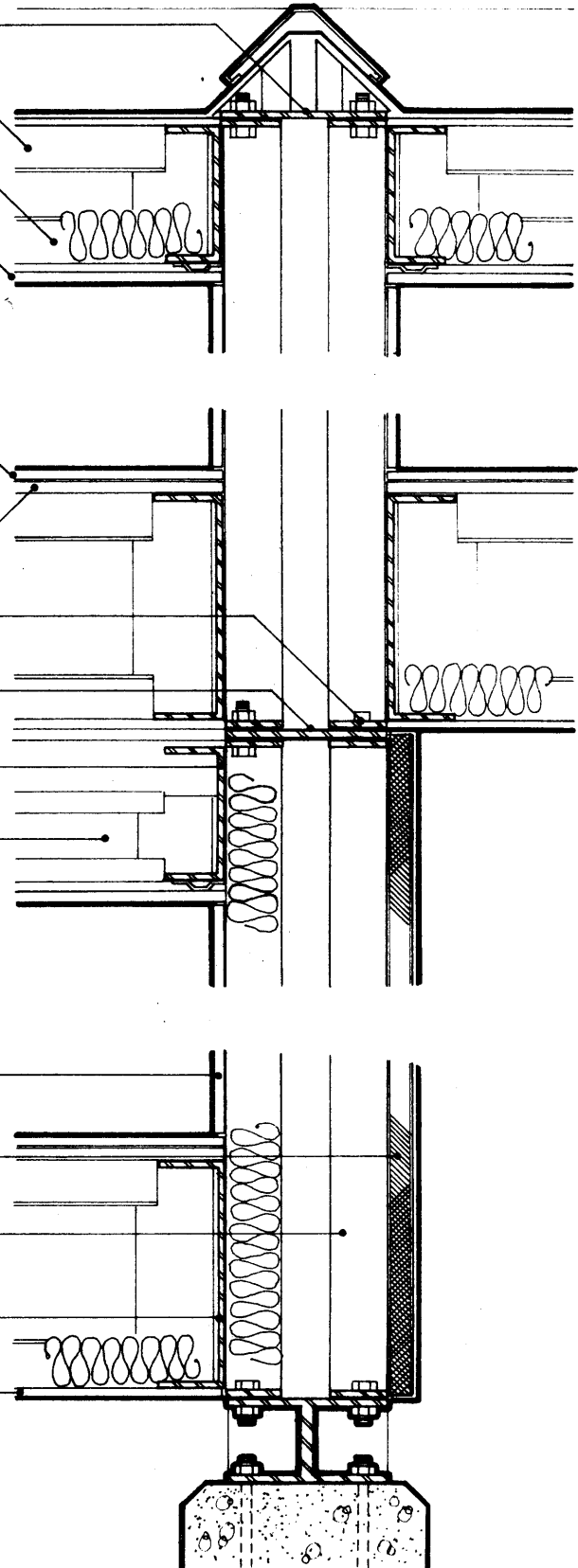
MINERAL FIBER BOARD
W/ METAL COVER

2 1/2" x 5"
METAL COLUMN

3 C 10

EXTERIOR PLYWOOD

SECTION AT FLOOR
EXTERIOR WALL /
EXTERIOR COLUMN



WALL DETAILS

LATERAL SUPPLY
AND RETURN

VERTICAL SUPPLY
AND RETURN

WASTE LINE

COLD WATER SUPPLY
HOT WATER SUPPLY

KITCHEN EXHAUST

BATH AND DRYER EXHAUST

UNIT EXHAUST

HEATING DUCT

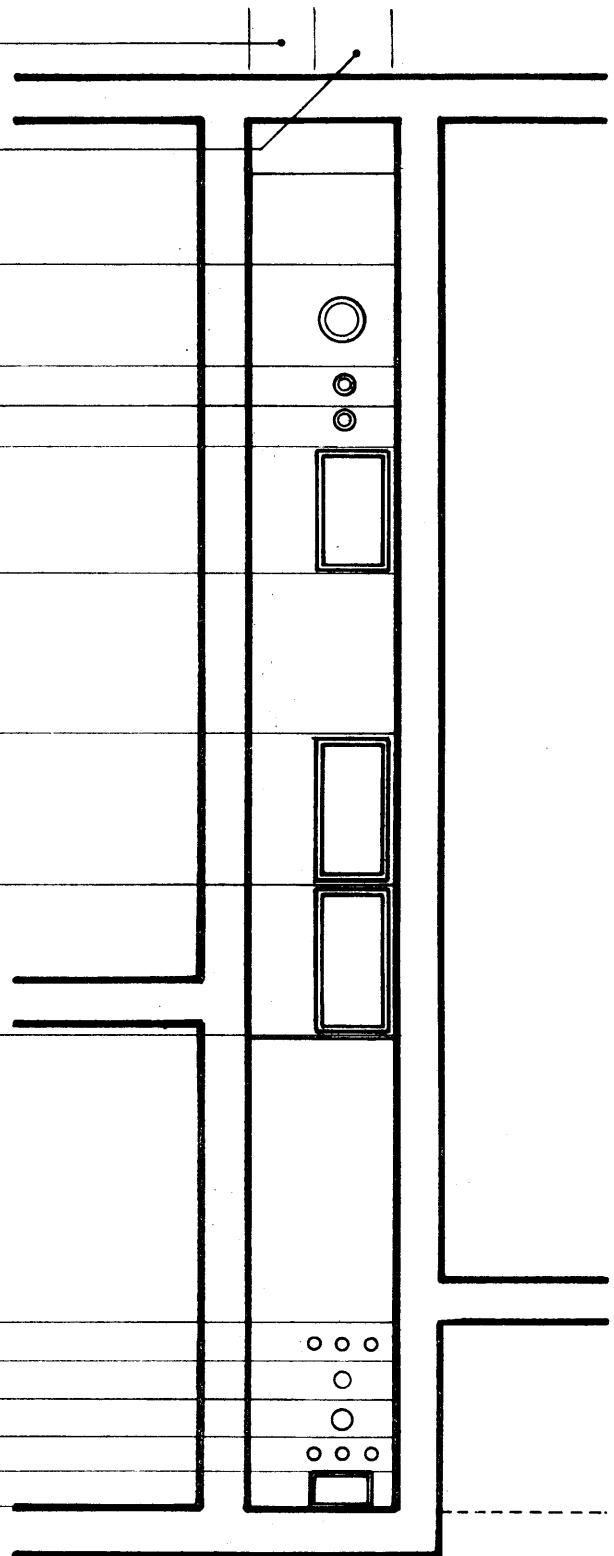
ELECTRICAL AND COMMUNICATION

WATER ALTERNATE

GAS SUPPLY

FAN COIL SUPPLY

FAN COIL VENTILATION



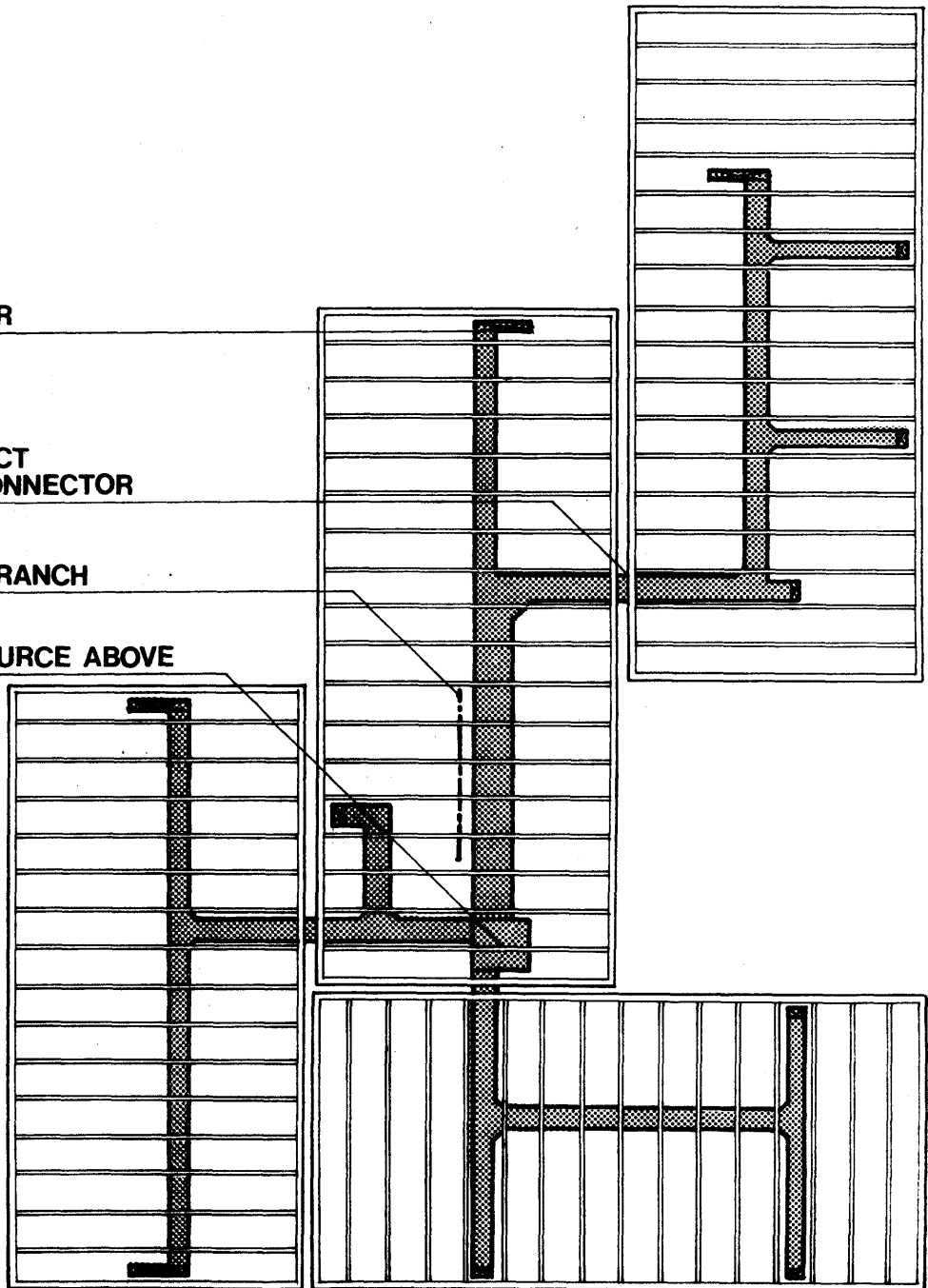
CHASE DETAILS

AIR DIFFUSER

**HEATING DUCT
FLEXIBLE CONNECTOR**

PLUMBING BRANCH

HEATING SOURCE ABOVE



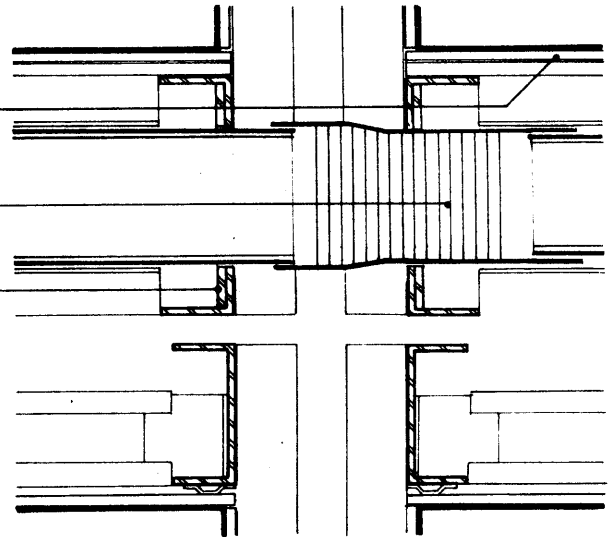
MECHANICAL PLAN

ACCESS PANEL

**HEATING DUCT
FLEXIBLE CONNECTOR**

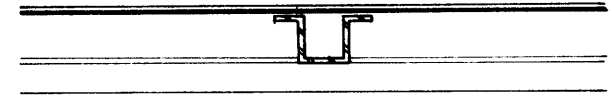
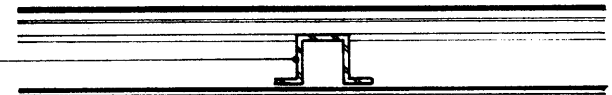
METAL REINFORCING PLATE

**TRANSVERSE SECTION /
HEAT DUCT CONNECTION**

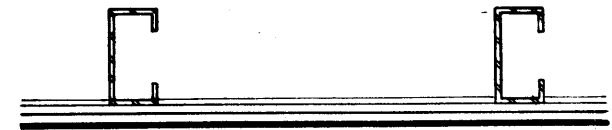


OPEN WEB FLOOR JOIST

HEATING DUCT



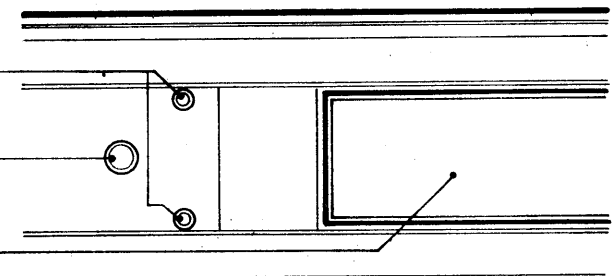
**LONGITUDINAL SECTION /
HEAT DUCT AND FLOOR JOISTS**



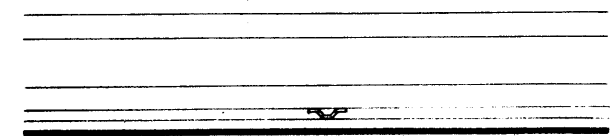
HOT AND COLD WATER SUPPLY

WASTE LINE

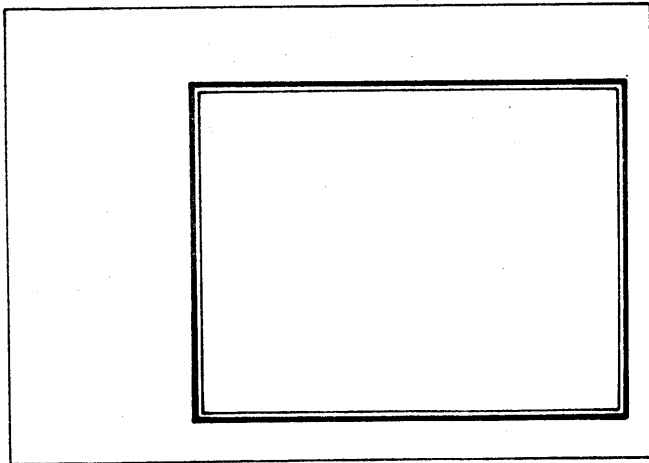
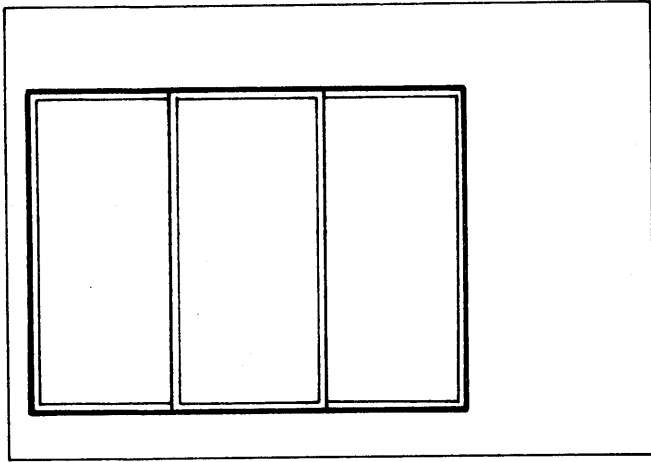
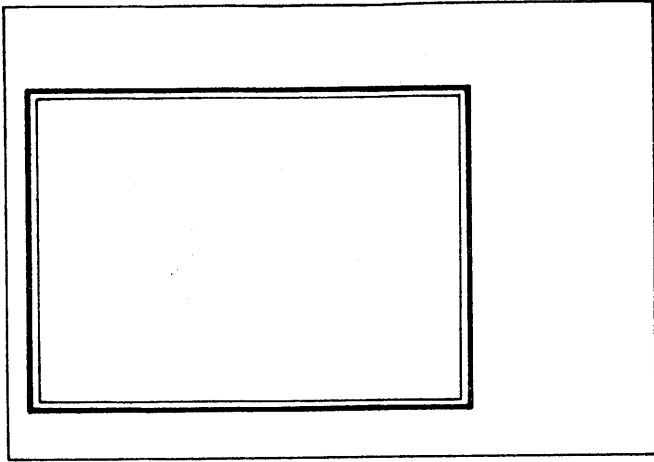
HEATING DUCT



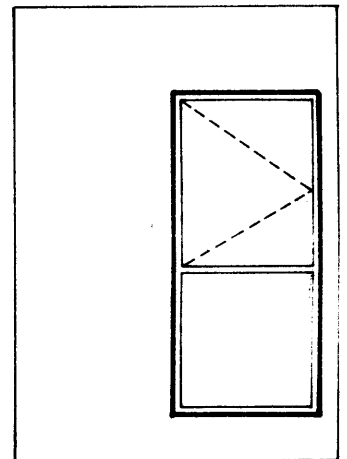
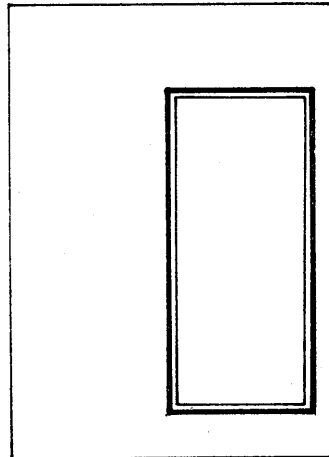
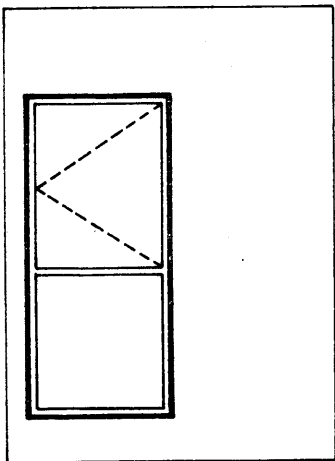
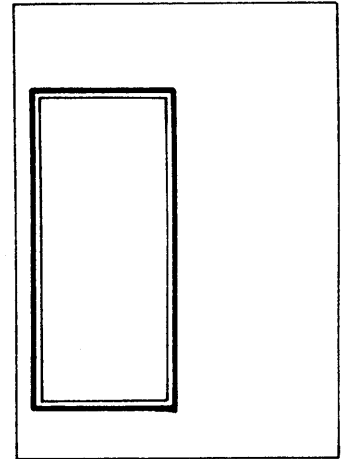
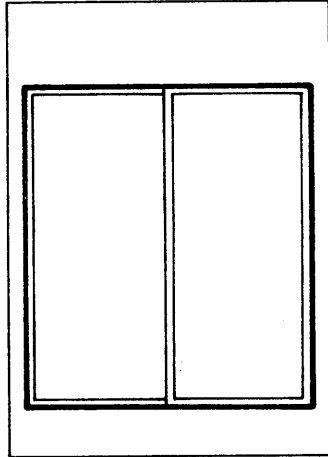
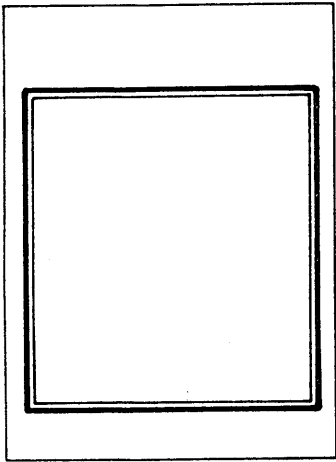
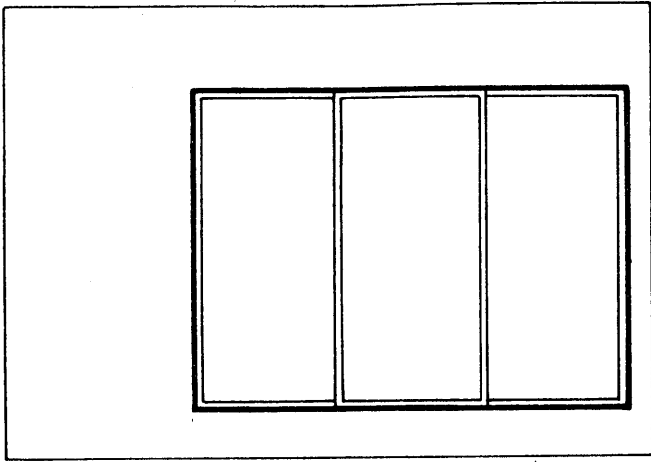
**TRANSVERSE SECTION /
MID SPAN**



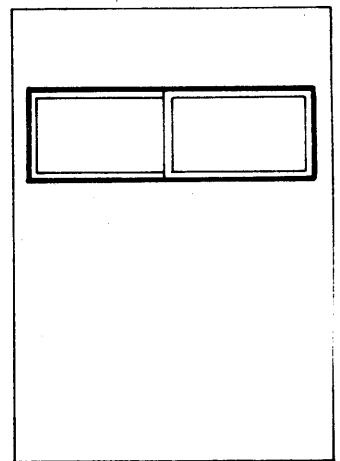
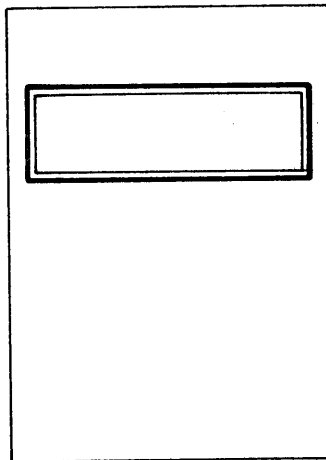
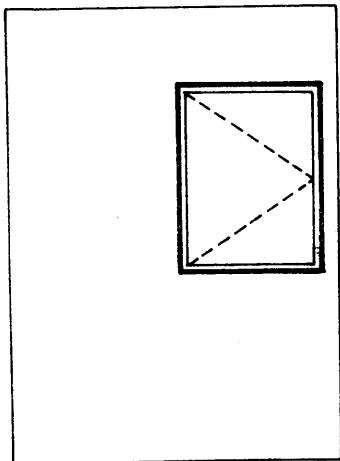
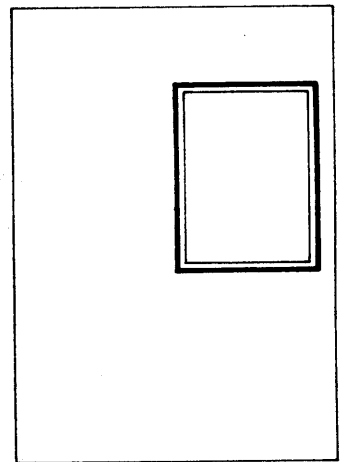
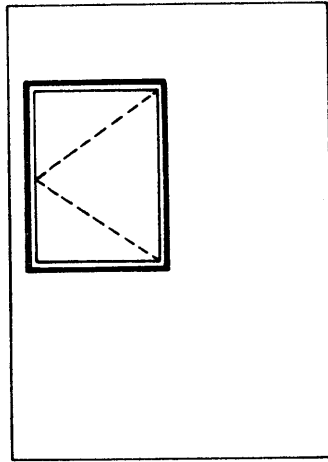
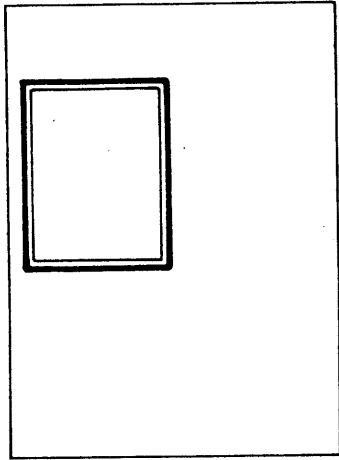
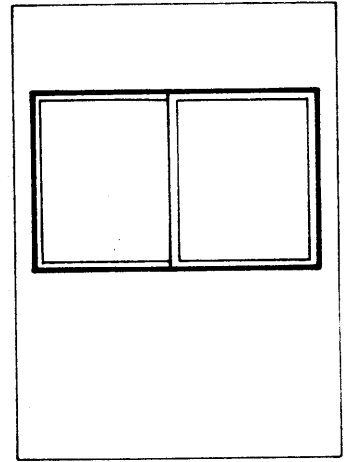
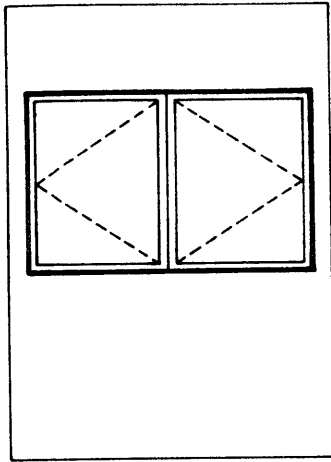
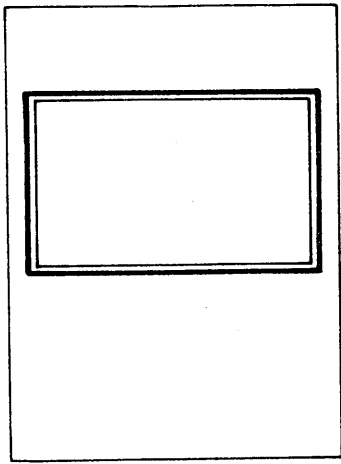
MECHANICAL DETAILS



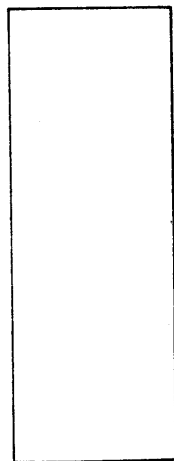
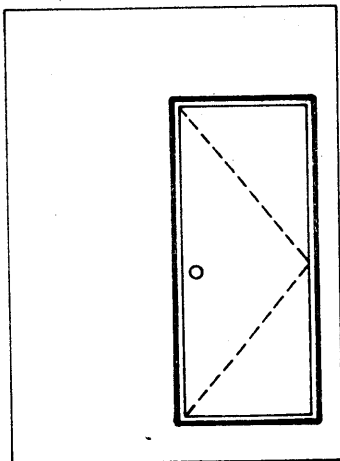
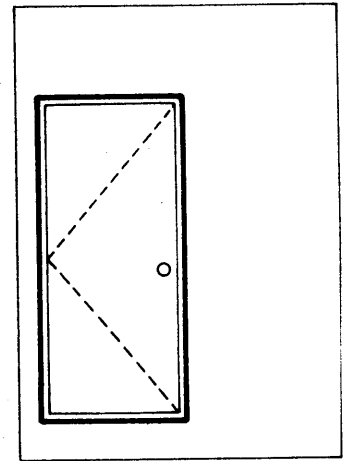
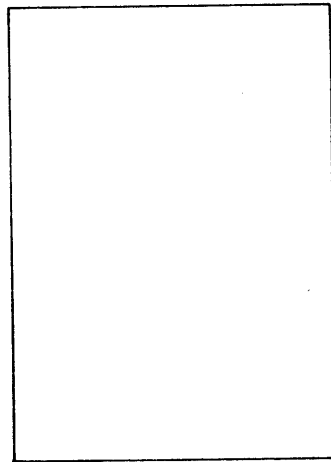
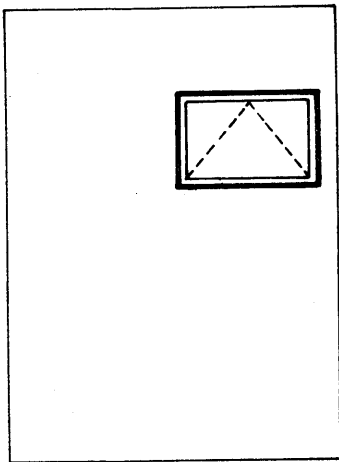
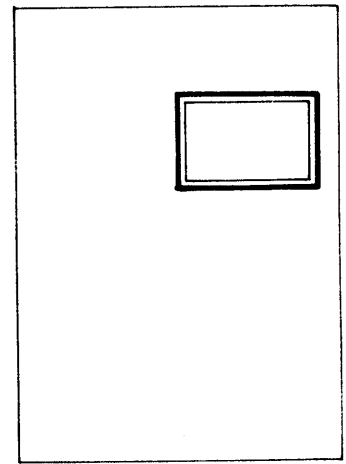
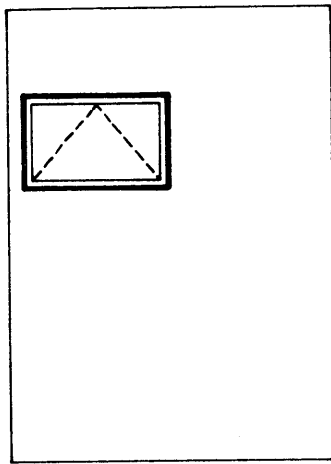
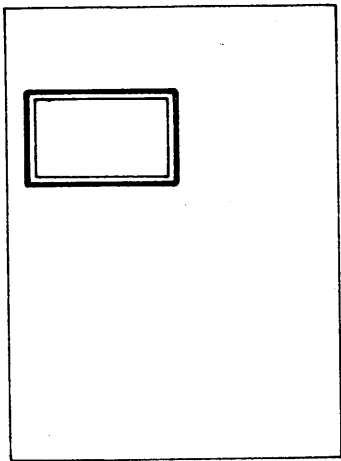
EXTERIOR WALL OPTIONS



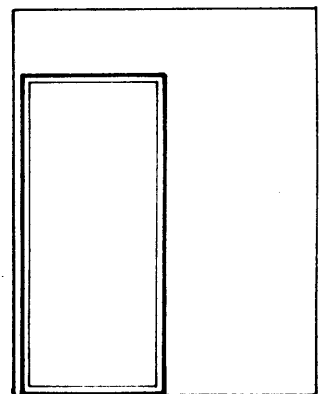
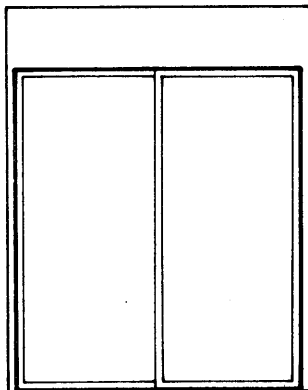
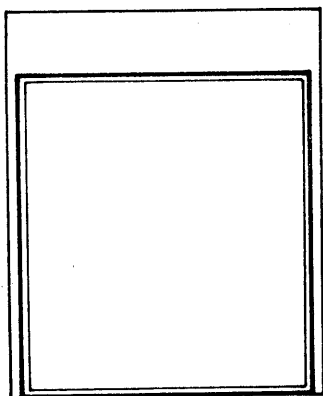
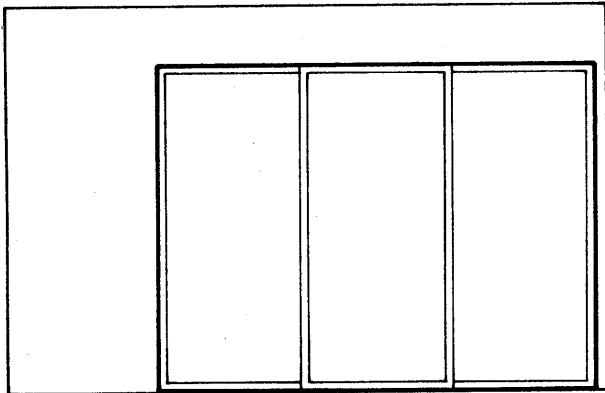
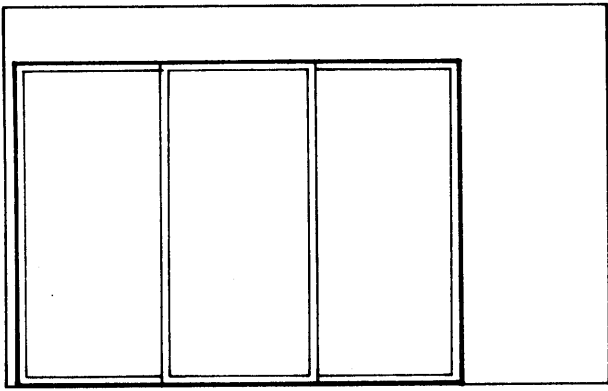
EXTERIOR WALL OPTIONS



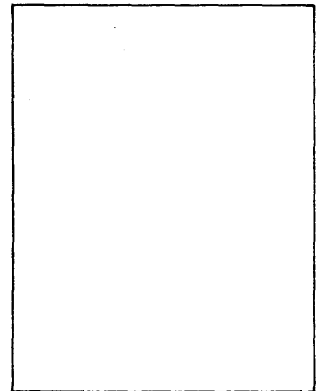
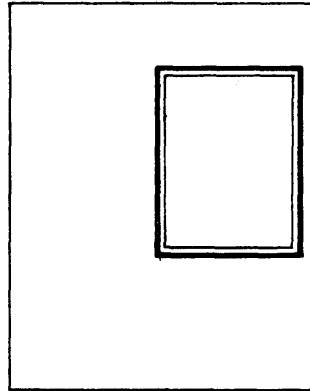
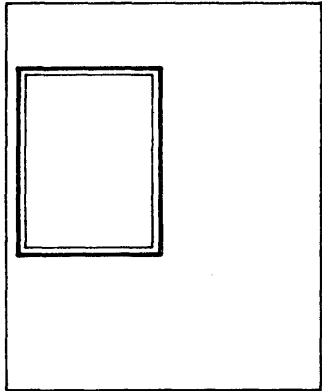
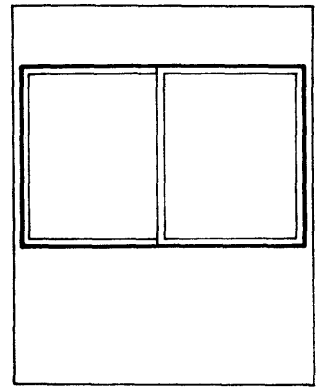
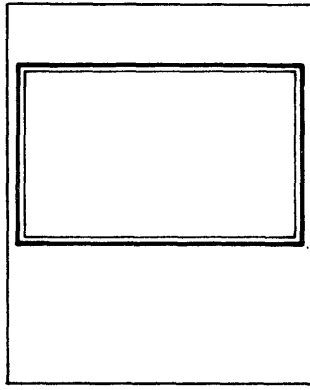
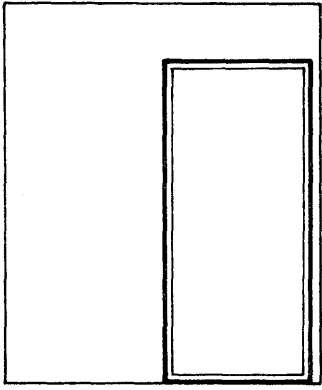
EXTERIOR WALL OPTIONS



EXTERIOR WALL OPTIONS



EXTERIOR WALL OPTIONS



EXTERIOR WALL OPTIONS

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Pittsburg, Pennsylvania