

**QUATIC  
HABITAT**

OCEANOGRAPHY  
RESEARCH  
LABORATORY

**JAY**

**R.**

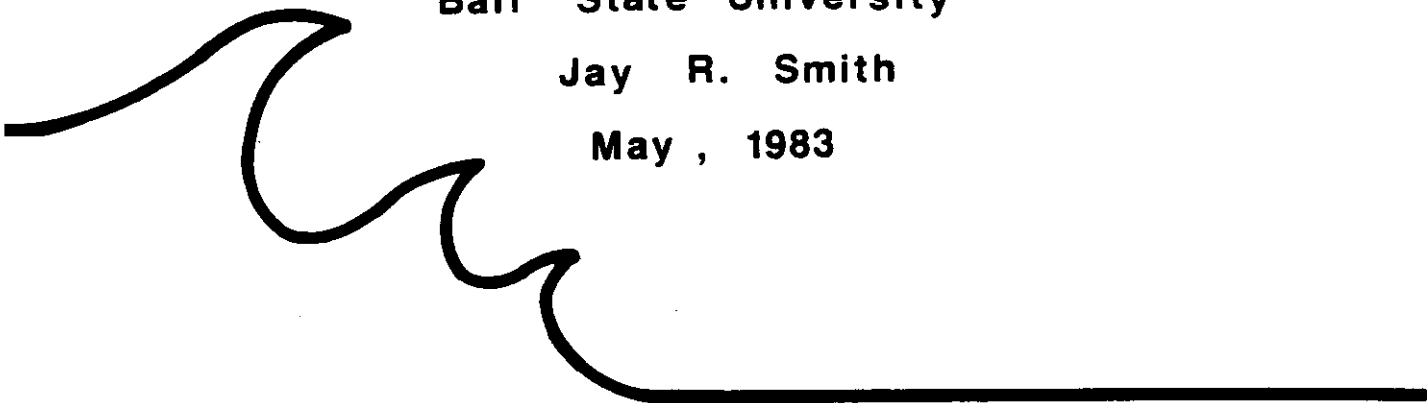
**SMITH**

**AQUATIC HABITAT**  
**OCEANOGRAPHY RESEARCH LABORATORY**  
**JACKSONVILLE, FLORIDA**

**College of Architecture & Planning**  
**Ball State University**

**Jay R. Smith**

**May , 1983**



# PREFACE

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This brochure is meant to give an overview of the Thesis Project. It is inclusive of project description, considerations, influences and final design solution over a thirty week period involving research, design, and presentation work.

# DEDICATION

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I would like to dedicate this book to:  
my Parents for all their love and support  
and to Jamie for all her love and understanding.

# PROJECT BRIEF

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My thesis project is to design a facility that will enable oceanography students to study the ocean in context. It is a two phase project which will have the capability of housing twenty oceanography students and their professors below the ocean surface. It will also house an additional thirty-two students and two professors above the surface along with six housing units for facility staff. The facility will have the capability and equipment of sustaining the personnel and conducting experiments for indefinite periods of time, without disrupting the normal ocean environment. The project is meant to stimulate further interest in the development of the aquatic environment as well as to induce some basic ideas from which future designs can emanate. The final design solution deals with the above surface phase along with considerations and influences for the underwater facility.

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# INTRODUCTION

# FOREWARD

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Recently there has been an ever increasing movement to explore new frontiers as man strives to increase his realm of habitation, and his knowledge about the world in which we live. Space exploration has received all the notariety as the way of the future, but the sea, to an even greater extent, becomes the most promising area of habitation. The world's oceans cover 70% of the earth's surface and for many years have shown the capability of becoming a major food source for an ever increasing world population, as well as a solution to an overcrowding of the earth's surface. Land reclamation has ocured for many years in numerous countries, but the economical feasibility of such an operation is limited to just a very small portion of the ocean. This is why new techniques of inhabiting the ocean's environment must be explored.

The purpose of this thesis Project is to be a prototype for ocean development by the proposed facility serving as an oceanography research laboratory. The inhabitants of the facility can be analyzed as well as the aquatic environment in which they live. This new environment by which scientists and oceanography students can study the ocean in context, will enable the gathering of new information and provide a better understanding of the vast amounts of data already collected. The design is meant to stimulate and provide solutions to some basic question about aquatic habiation.



# FACILITY OPERATIONS

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This facility is to function as a base facility by which oceanography research may be conducted and taught. The major users of the aquatic habitat will be that of oceanography schools; although visiting scientists may occasionally use the facility for data collection or testing of new equipment and materials. Students will be sent to the research laboratory where facilities are provided to enable a more informed hands on education with the ocean environment and its many sciences. Duration of the use may range from two or three days to two or three months; thus, the need for housing and necessary support facilities to ensure a comfortable learning experience.

Two types of facilities are provided: an underwater facility and an above surface facility to give a broader scope of research possibilities. The underwater facility is meant to be a self-sustaining environment seventy feet under the ocean's surface. It will have the capability of saturation diving to enable long periods at great depths without decompression. The facility will also be equipped with housing units and support facilities. To take full advantage of this new diving technique, as well as depend solely upon the ocean as its source of food, fresh water, and oxygen. Access to the underwater facility is by two methods.

One from the above surface facility through a pressurized elevator system and the other by small submarines or submersibles. However, this thesis project deals mainly with the above surface facility. It will serve as a base station by which surface operations may be conducted. Classrooms, laboratories, and library facilities are provided so that academic courses may be conducted along with the hands on exposure of the ocean's environment. This method allows in field measurements to be quickly analyzed in a controlled environment and to insure quality and accurate conclusions and provide the student with an exposure to an infield study program. Again housing accommodations along with support facilities will be provided for a comfortable environment during lengthy periods of use. Housing accommodations will also be provided for six full time staff members along with their families to enable proper administration and maintenance of the aquatic habitat. Access to the facility may be obtained by surface craft for large volumes of people and supplies or by helicopter for more emergency oriented access. This system will all be tied to a shore base by a network of communication methods. The surface facility will also become the overall support facility for the underwater research habitat.



# GOALS & OBJECTIVES

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To open new frontiers for architectural design (alternative housing).

To promote the use of the ocean environment to its potential.

To provide a facility for oceanography students to study the ocean context (experiment).

To provide a support facility for experimental underwater housing.

To provide supporting functions for indefinite use of the facility (self supporting environment).

To provide a sense of security to a facility which is surrounded by water.

To provide reasonable accessibility to the facility and the ocean floor.

To maintain this facility without disrupting the existing ocean environment.

# BUILDING CRITERIA

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A facility of this type addresses a variety of functional and philosophical questions. To design for a difference of spaces from housing to laboratory areas as well as their differences in environmental conditions requires strong organizing elements.

The building must functionally address the problem in relation to the concept. It must solve the questions of relationship of spaces and their uses while providing an exciting environment. Circulation must be concise and direct yet still allowing for the possibility of spontaneous activities. Complexity of spaces must respond to their flexibility so that their efficiency can be maximized. Cores must be designed to ensure optimum space efficiency as well as service to all portions of the building. The systems operations must consider the purpose of the project to study an ocean environment in context so no disruption of that environment should occur. Security of the building is a two fold concept. The first of which is to protect the building from the exterior elements by providing a shell around the facility and the second phase is to emphasize an open concept approach on the interior having only necessary spaces secured. These elements must be addressed individually then brought together to develop a uniform design.

# SPACE SUMMARY

## Support Facilities

Systems	8000	sf
Storage	1800	sf
Laundry	500	sf
Food Preparation	1700	sf
Serving Line	100	sf
Dining Area	2600	sf
Exterior Dining	600	sf
<b>Total</b>	<b>15,300</b>	<b>sf</b>

## Exterior Facilities

Boat Dock	1500	sf
Heliport	5200	sf
Escape Deck	1600	sf
Observation Deck	1000	sf
Exterior Plaza	3000	sf
<b>Total</b>	<b>12,300</b>	<b>sf</b>

## Housing Facilities

Single Unit Housing	600	sf
Double Unit Housing	6000	sf
Two Bedroom Staff Housing	700	sf
Three Bedroom Staff Housing	4200	sf
Interior Recreation	4500	sf
Lounge	3000	sf
<b>Total</b>	<b>25,900</b>	<b>sf</b>

## Instructional Facilities

Laboratory Facilities	6500	sf
Laboratory Classroom	1700	sf
Work Shop	500	sf
Pressure Chamber	300	sf
Medical Area	1800	sf
Lobby Area	1300	sf
Classroom	1500	sf
Projection	125	sf
Library	5000	sf
Meeting Room	550	sf
Vending Area	750	sf
Director's Office	400	sf
Communication Office	550	sf
Office	1000	sf

**Total** 22,475 sf

## Unassigned Spaces

Circulation	10200	sf
Mechanical	3200	sf
Restrooms	1000	sf
Janitors Closets	125	sf
Unassigned Storage	200	sf
Walls, Partitions, Structure	4500	sf

**Total** 19,225 sf

**Total** 95,200 sf

# SITE CRITERIA

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The major site considerations which pertain to the project of this magnitude are numerous. First location is to be sympathetic with the needs and purpose of the facility. It should be centered in an area of abundant marine activity with the ocean depth not exceeding a comfortable scuba diving limit. Water temperature and climatic conditions are to be of a moderate level as to obtain year-round use of the facility. The accessibility to a shore facility should allow easy access of prospective oceanography schools and scientists from across the country.

Transportation to the facility by way of boats require the need for docking facilities. A means of protection for people and supplies during the boat/facility interface is also needed upon the possibility of inclement weather. Appropriate considerations must also be given to helicopter transportation for quick access to and from the facility.

Exterior lighting, plantings, and circulation must all adhere to the variety of climatic conditions which may prevail in the area as well as give an image to the facility's exterior. Lighting will play an important role in the facilities image from afar. Plantings and circulation areas will give the exterior a character at a closer examination. In all these site considerations will have an influential role in the buildings location and appearance in the ocean's environment.

# SITE DATA

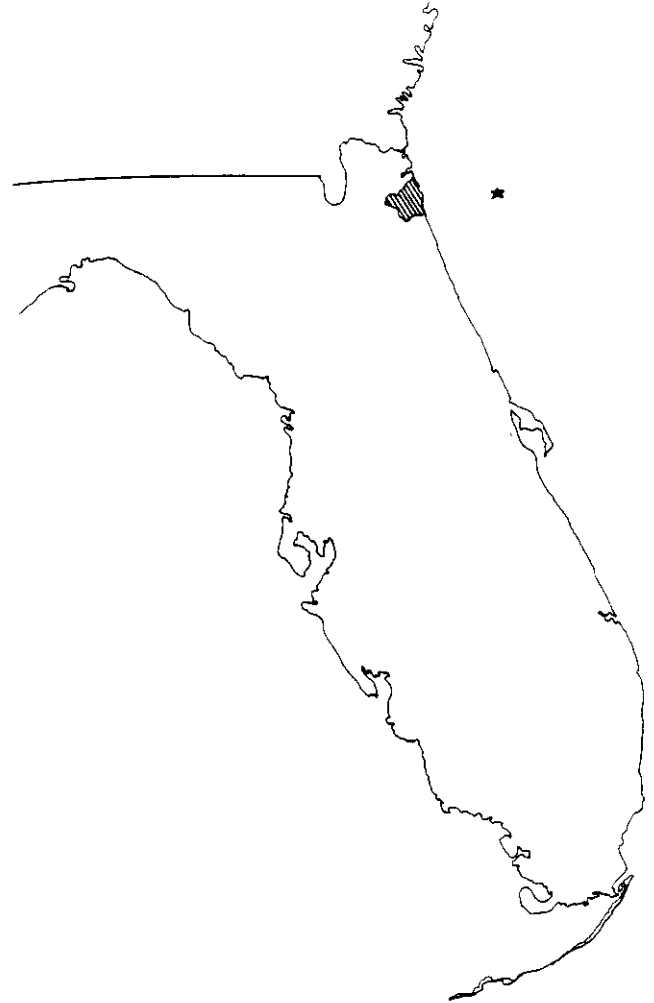
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Location: 81° 10' W Longitude  
30° 18' N Latitude  
10 nautical miles off the  
coast of Jacksonville Florida

Water depth 72 ft

High tide plus 4 ft

Low tide minus 6 ft



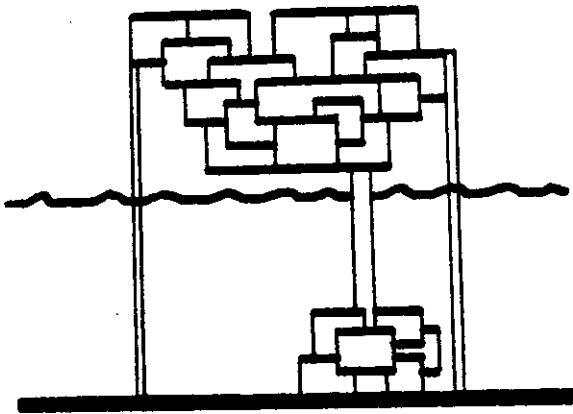
**DESIGN**



# CONCEPTS

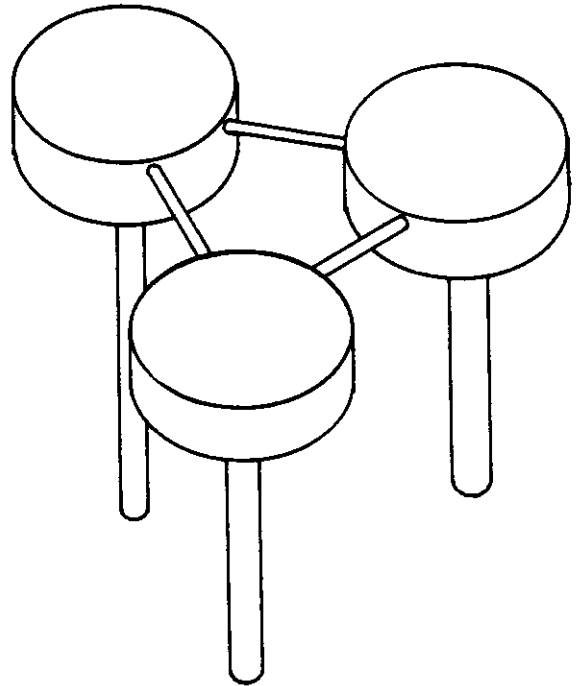
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The facility was first conceived as a two phase project: that of an underwater facility and a surface facility with concentration on the latter.



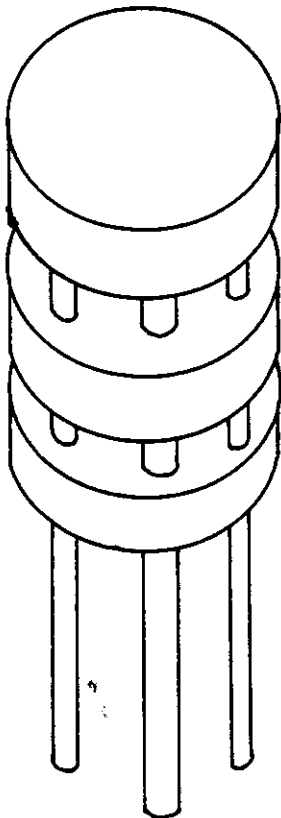
The underwater facility was to give the "in context" experience with the ocean environment while the above-surface facility serves as a base facility for surface operations and as a support area for the underwater environment zoning and grouping of the spaces by their functional processes yielded refinement to the design concept.

The building functions were divided into three main categories. Housing for the students and staff personnel were the first. Another was the schooling or instructional area. The third grouping was the support areas. Two concepts prevailed from these initial considerations. The first idea was to totally separate these areas by their functions with connecting circulation establishing each area's own identity.

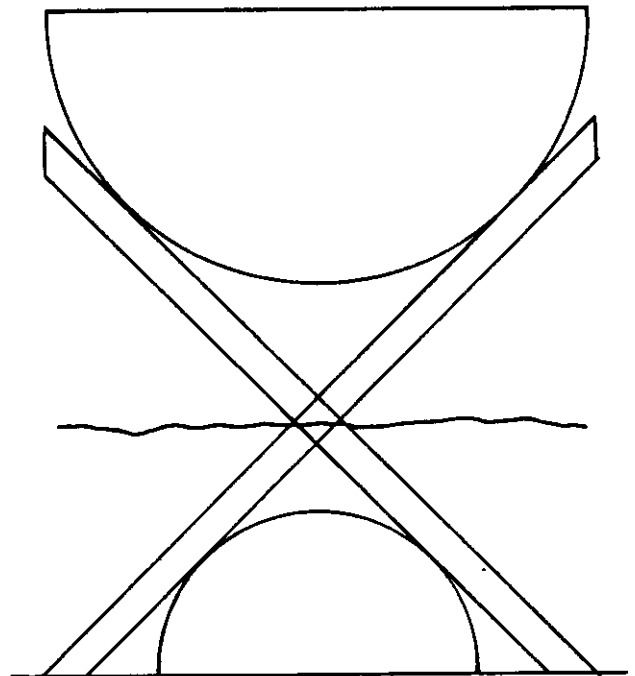


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In contrast to that notion the spaces were grouped together and formed a vertical heirarchy to provide a singular appearance and give the facility a better sense of unity and security from the environment.



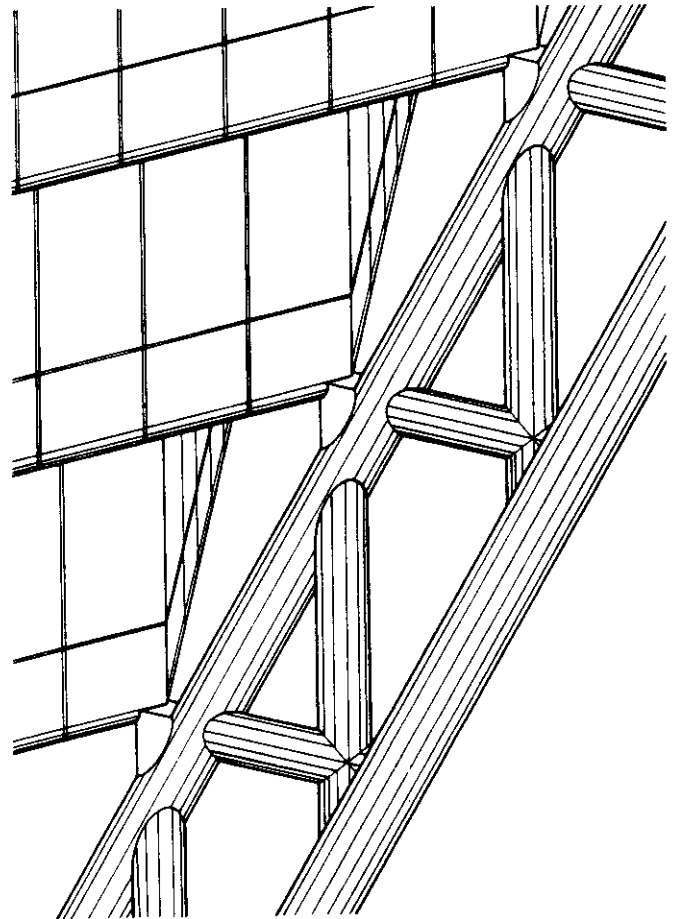
The later concept was further developed to minimize the water surface interface. Connection was held to a minimal surface area to eliminate undue stress from rough seas. The overall image was then given the appearance of continuity as the structural system was introduced.



# STRUCTURE

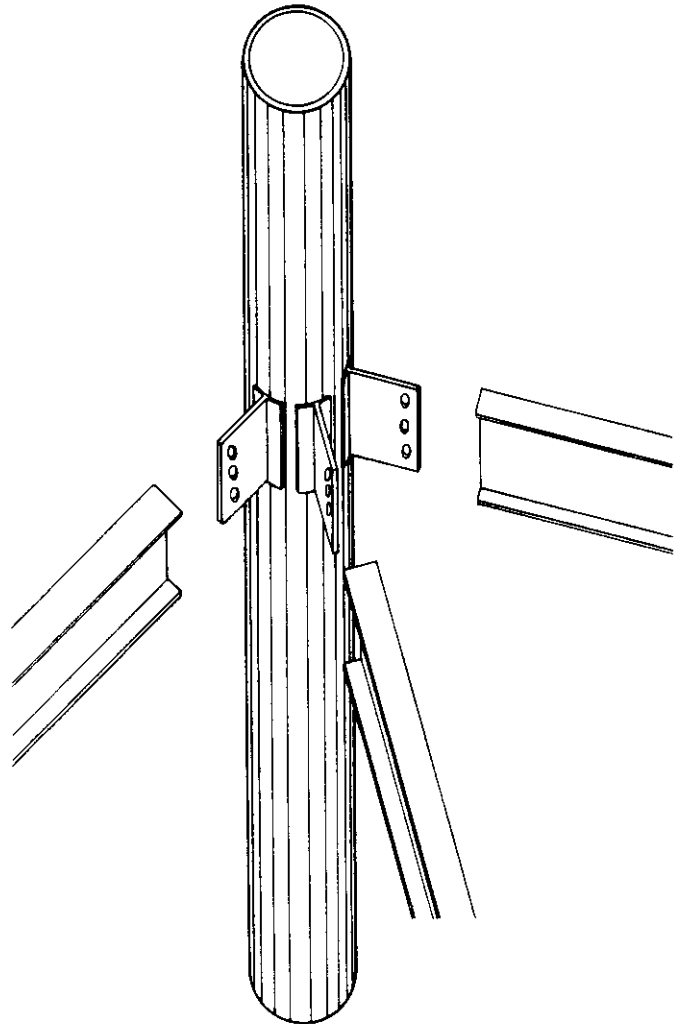
The introduction of the structural system developed the facility's image and plan organization. In the plan the forces of the system were to originally rest on three main support pods which in geometry determines a plane. However, superimposed over the original three member system was another three member system combining to give a six member support system. This was done to ensure a stable support systems without undue stress on a single member from lateral forces.

The six member truss system was then tied together at the support pod connection by a tension ring. Forces were transformed to the pods by the six trusses from the neck of the structural system. The neck minimized the surface cross-sectional area through the use of compression rings. The bulk of the structural forces are transferred from an extension of the six trusses which now form the structural envelope of the surface facility. These extensions were then tied together at their termination point by another tension ring. The bulkiness and exposure of the structural system gives the appearance of security as the spaces are layed inside this system of trusses. The tubular members compliment the esthetic effect created by the structures intersection with the water. The webbing of the trusses also establishes an esthetic appearance of continuing horizontal and vertical lines of the interior spaces as they connect to the truss system.



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The interior structural system utilizes Verendale trusses on alternating floors to establish open spaces. They are on a 24 feet center triangular bay system which again stays with the overriding structural organization. Construction of the structural system is largely prefab. The initial underwater structure and facility are assembled, floated to the site, sunk, and anchored to the ocean floor. The upper portion of the main structural system is also prefabricated, floated to the site, and attached at the neck. Once the main structure is assembled the Verendale truss system can then be erected inside. This process minimizes expensive underwater and surface construction.



# ZONING

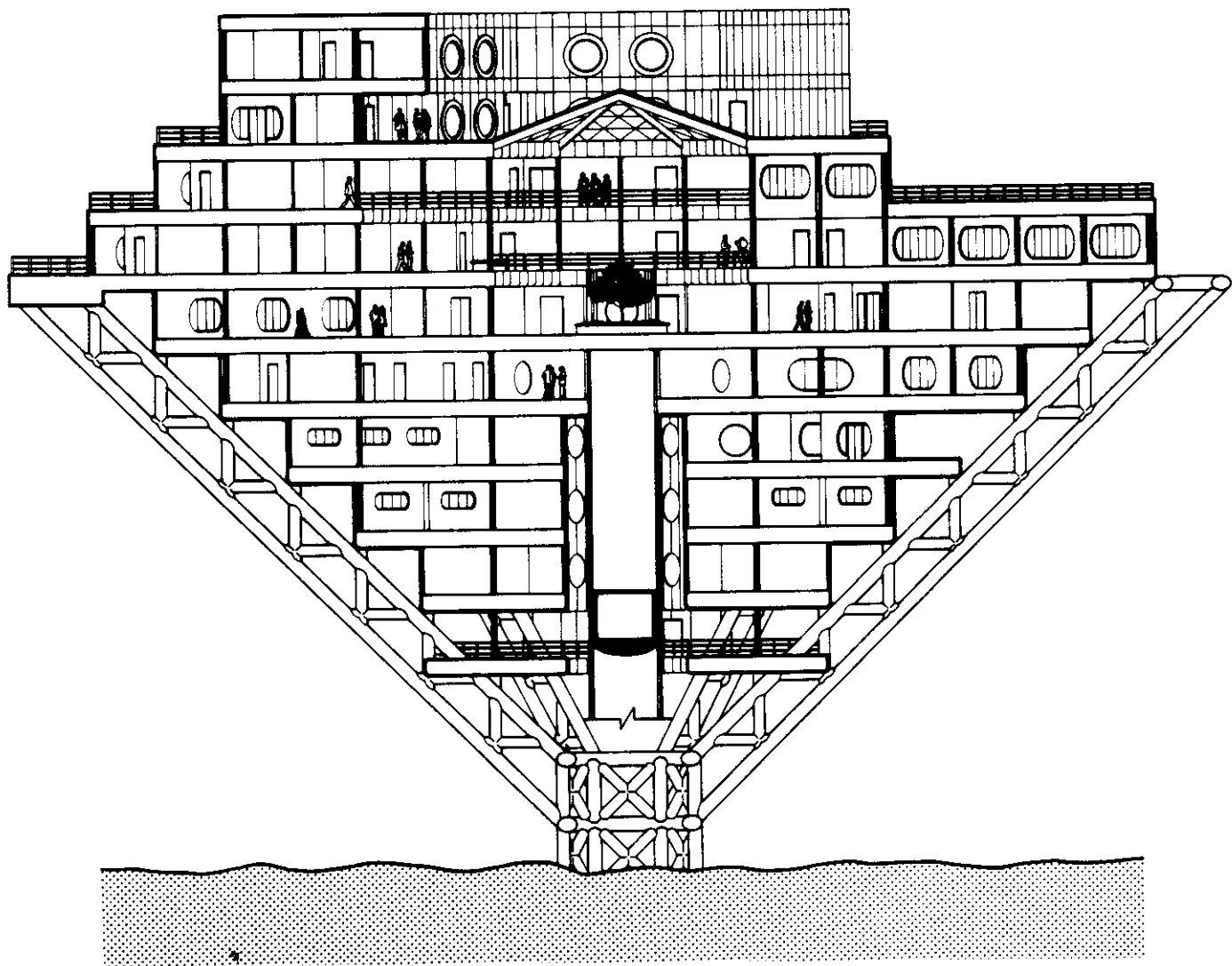
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Internal vertical zoning of the spaces was organized into three major categories: housing, instructional, and support.

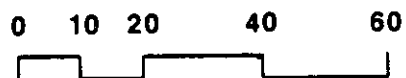
Support facilities were kept at the lowest level for access purposes to the ocean environment. The minimal square footage requirements also lended themselves best to these areas. The need for access to these areas as well as the necessity to be above the ocean surface were of a minimal concern; thus, justifying its separation from the other heavier used zones.

The instructional zone is the point of main entry into the building from the water surface and the underwater facility. It is the zone from which most daily activities will emanate. It is also the most important zone in terms of the buildings function; therefore, it receives the central position. Its close relationship to the student housing is expressed by the atrium space connecting the two zones. This enables a visual connection to what normally is a functional separation.

The housing zone is separated into two types of accomidations, those for visiting personnel and those for full time staff members. The visiting personnel housing is contained into two levels. These areas are separated from the staff housing due to their less private social structure. The staff housing, however, needs a sense of space and territory to ensure privacy from the normal functions of the facility. Therefore, their accomidations are pulled out of the normal facilities daily environment.

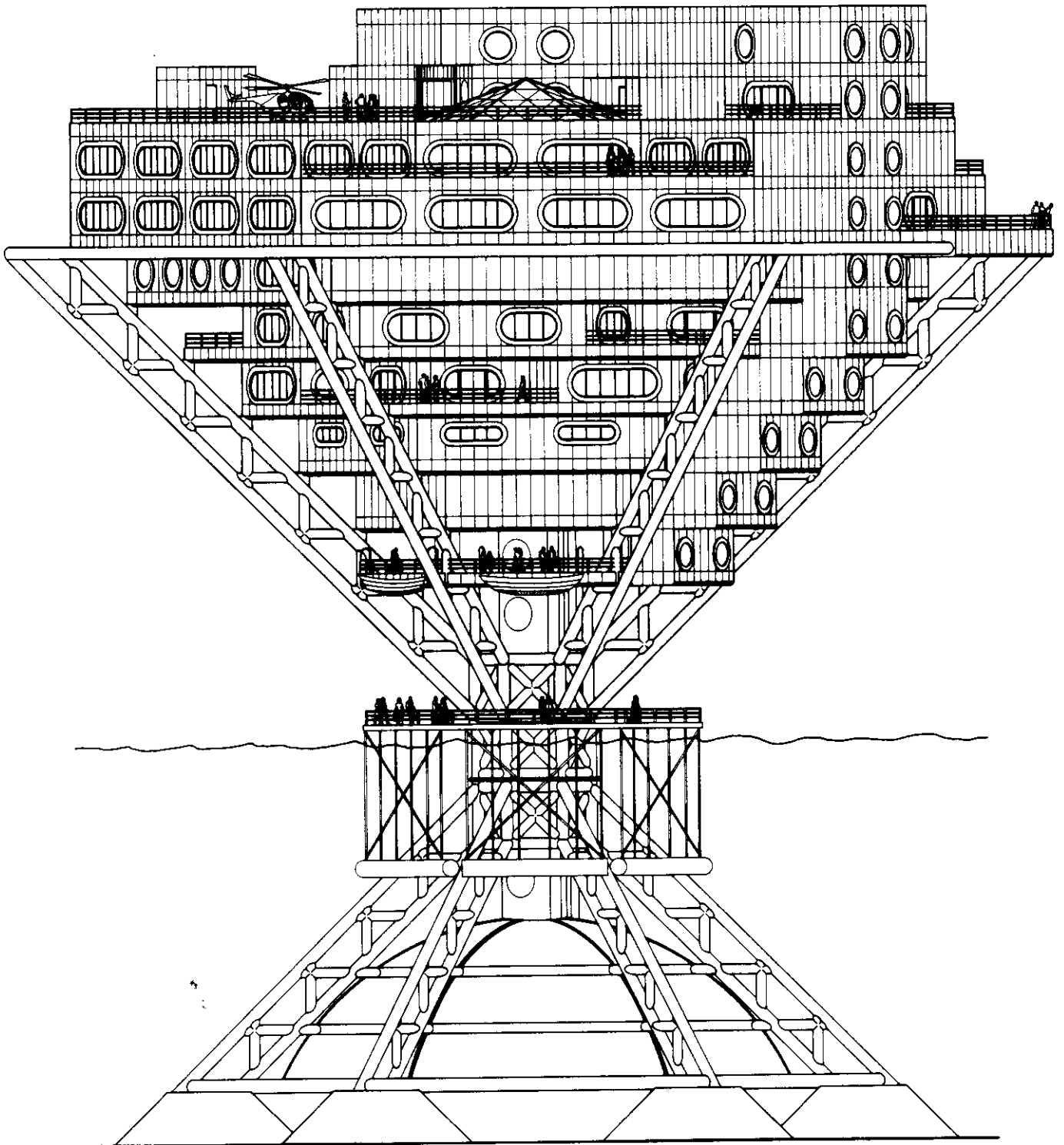


SECTION VIEWING EAST



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Zoning is expressed externally in two ways by the structural system. The support zone and instructional zone are grouped together within the main structural system. This area is separated from the housing areas by the structural tension ring. This is done to establish a sense of outwardly use of the facility in terms of work environment to recreational environment.



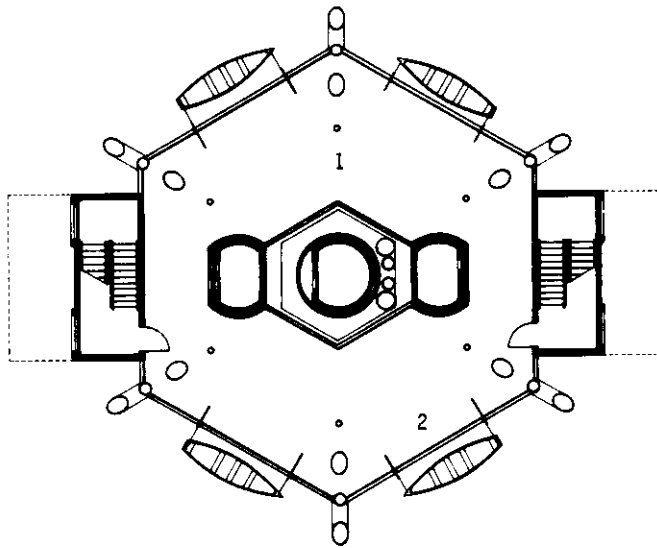


# SPACE PERFORMANCE

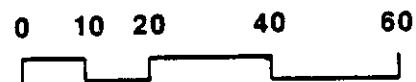
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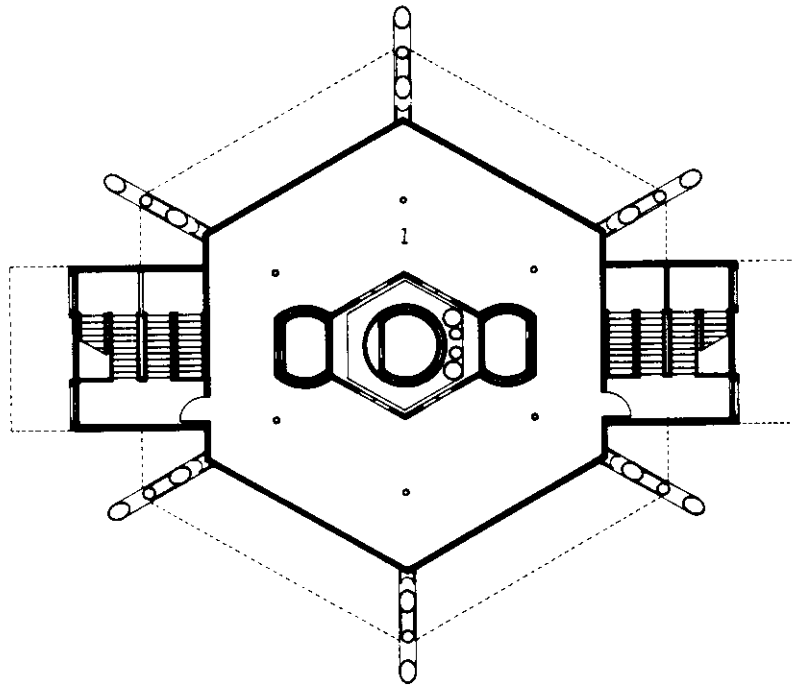
The two dimensional organization of spaces has somewhat been characterized by the structural system. An attempt was made to arrange the spaces within the six triangular zones dictated by that system to give each area its own identity.

- 
- 1 Escape Deck
  - 2 Life Boats



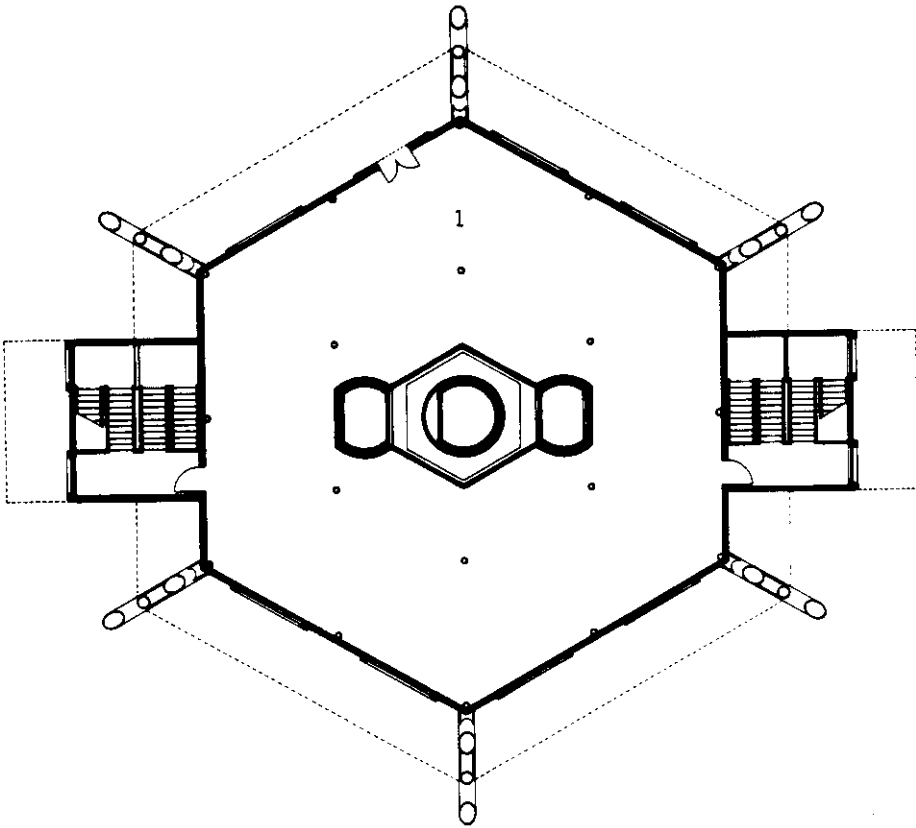
**LEVEL ONE**



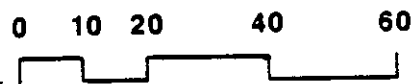


LEVEL TWO

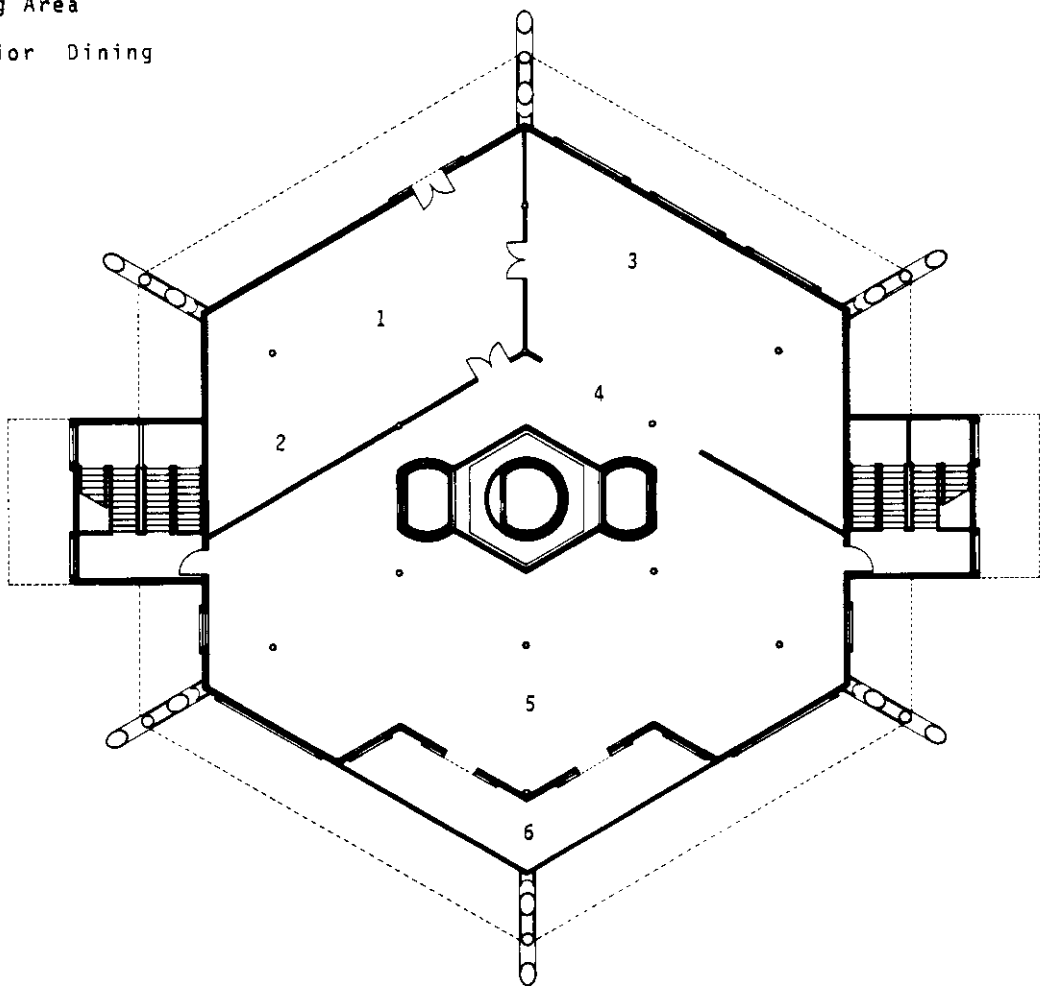




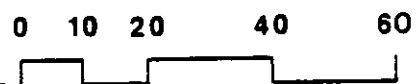
LEVEL THREE



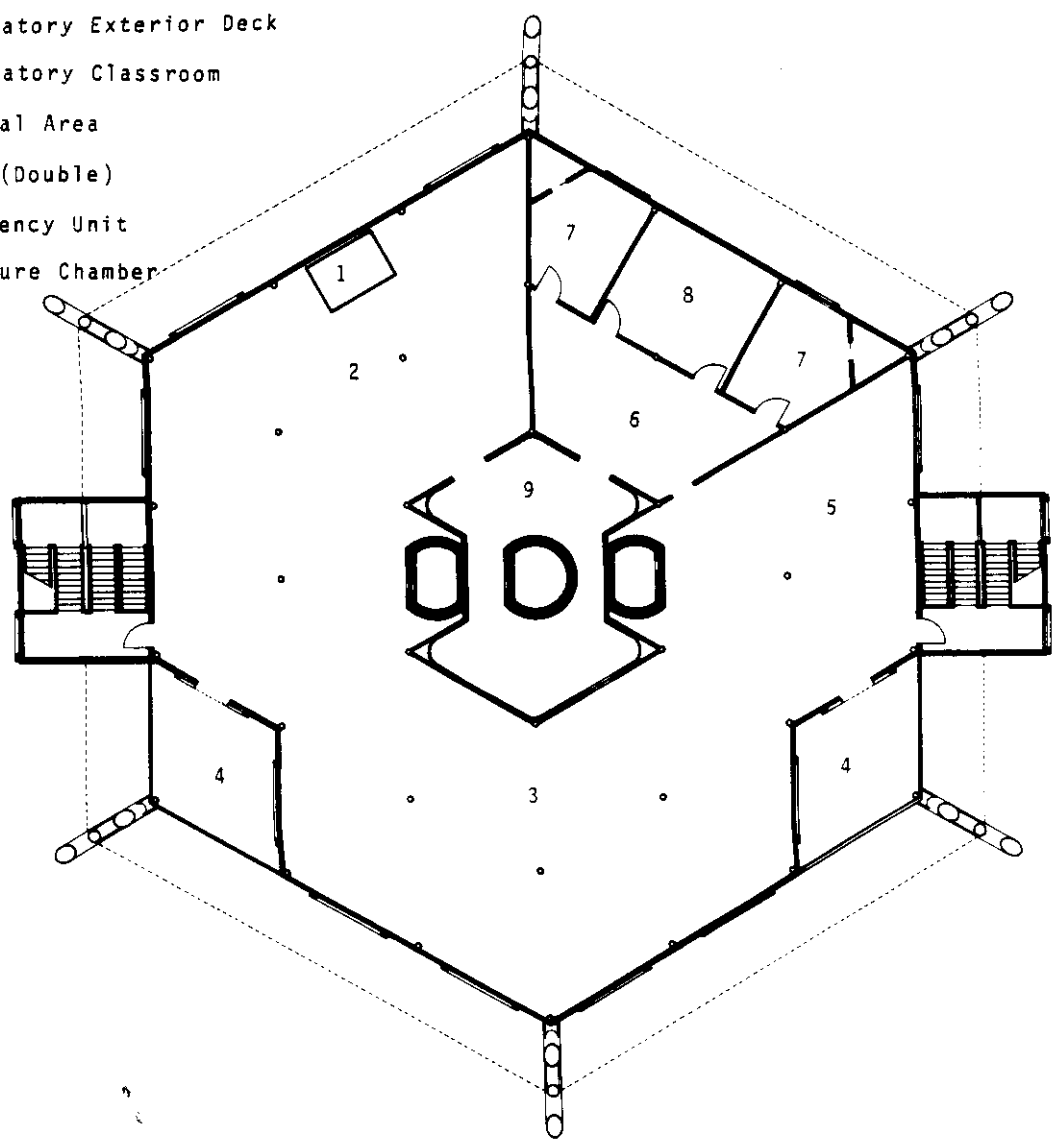
- 1 Storage
- 2 Laundry
- 3 Food Preparation
- 4 Serving Line
- 5 Dining Area
- 6 Exterior Dining



LEVEL FOUR



- 1 Crane/Winch
- 2 Workshop
- 3 Laboratory Area
- 4 Laboratory Exterior Deck
- 5 Laboratory Classroom
- 6 Medical Area
- 7 Room (Double)
- 8 Emergency Unit
- 9 Pressure Chamber

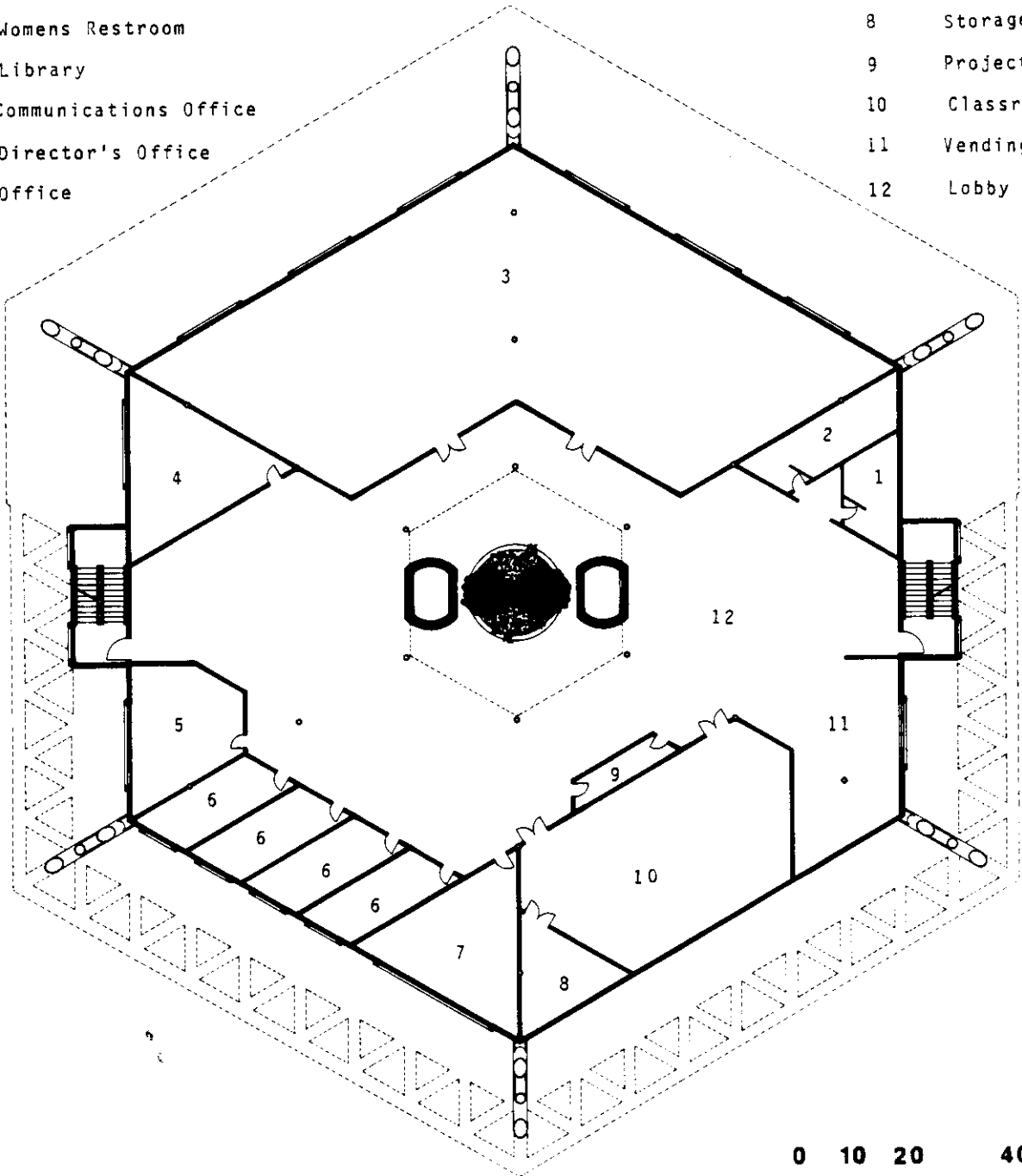


LEVEL FIVE



- 1 Mens Restroom
- 2 Womens Restroom
- 3 Library
- 4 Communications Office
- 5 Director's Office
- 6 Office

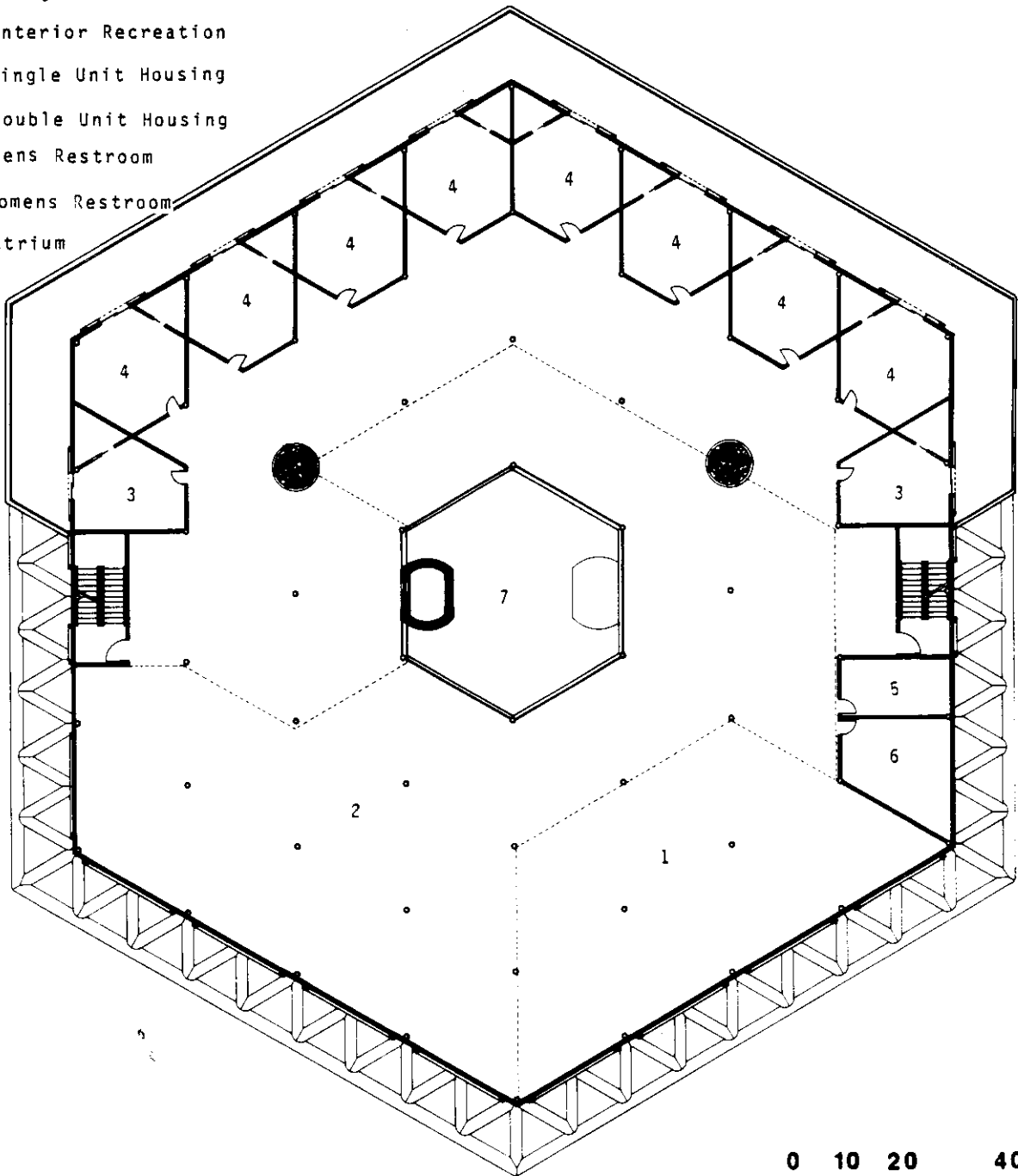
- 7 Meeting
- 8 Storage
- 9 Projection
- 10 Classroom
- 11 Vending Area
- 12 Lobby



0 10 20 40 60

LEVEL SIX

- 1 Lounge
- 2 Interior Recreation
- 3 Single Unit Housing
- 4 Double Unit Housing
- 5 Mens Restroom
- 6 Womens Restroom
- 7 Atrium

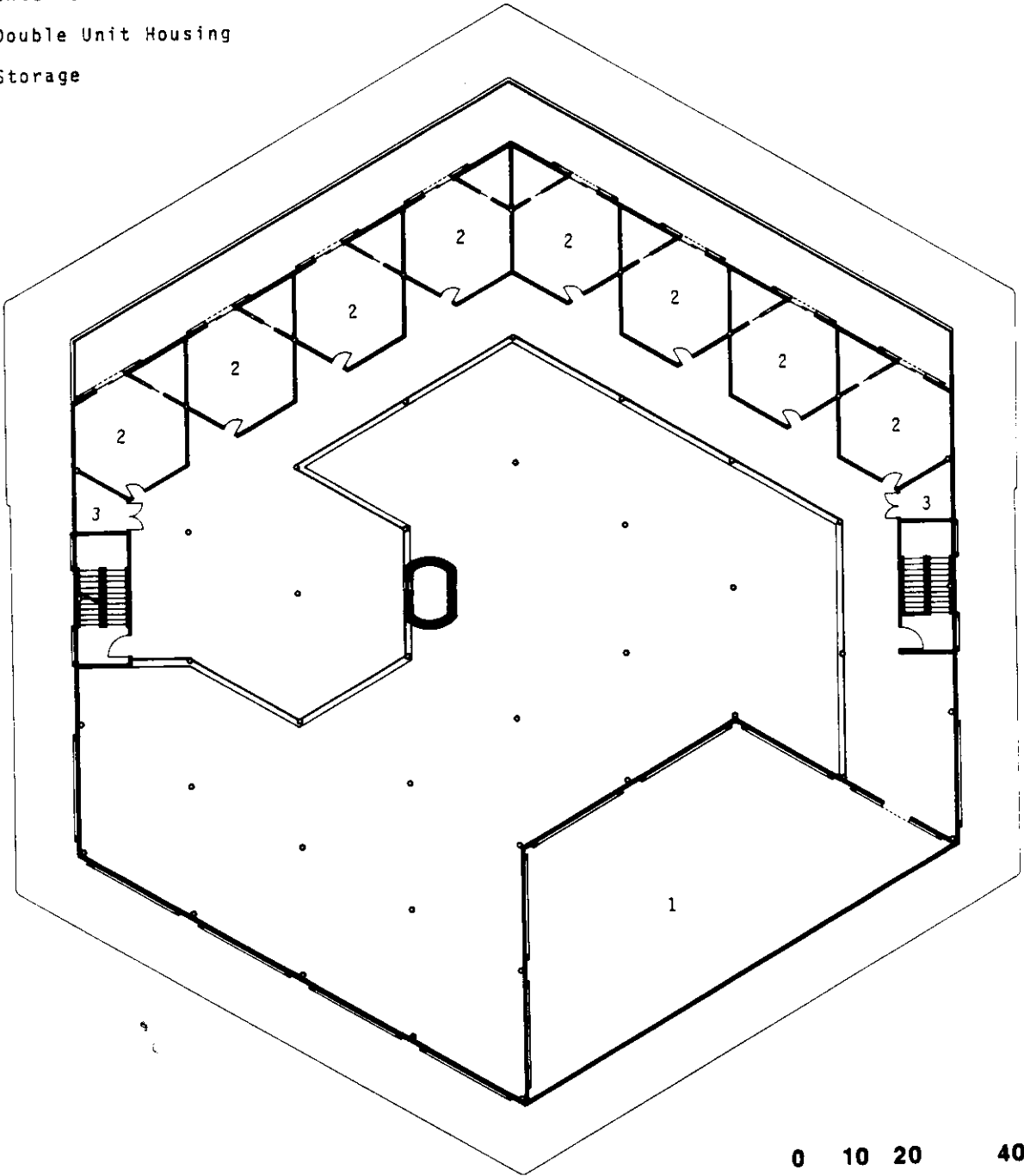


LEVEL SEVEN

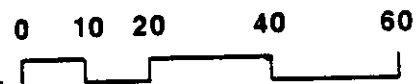
0 10 20 40 60



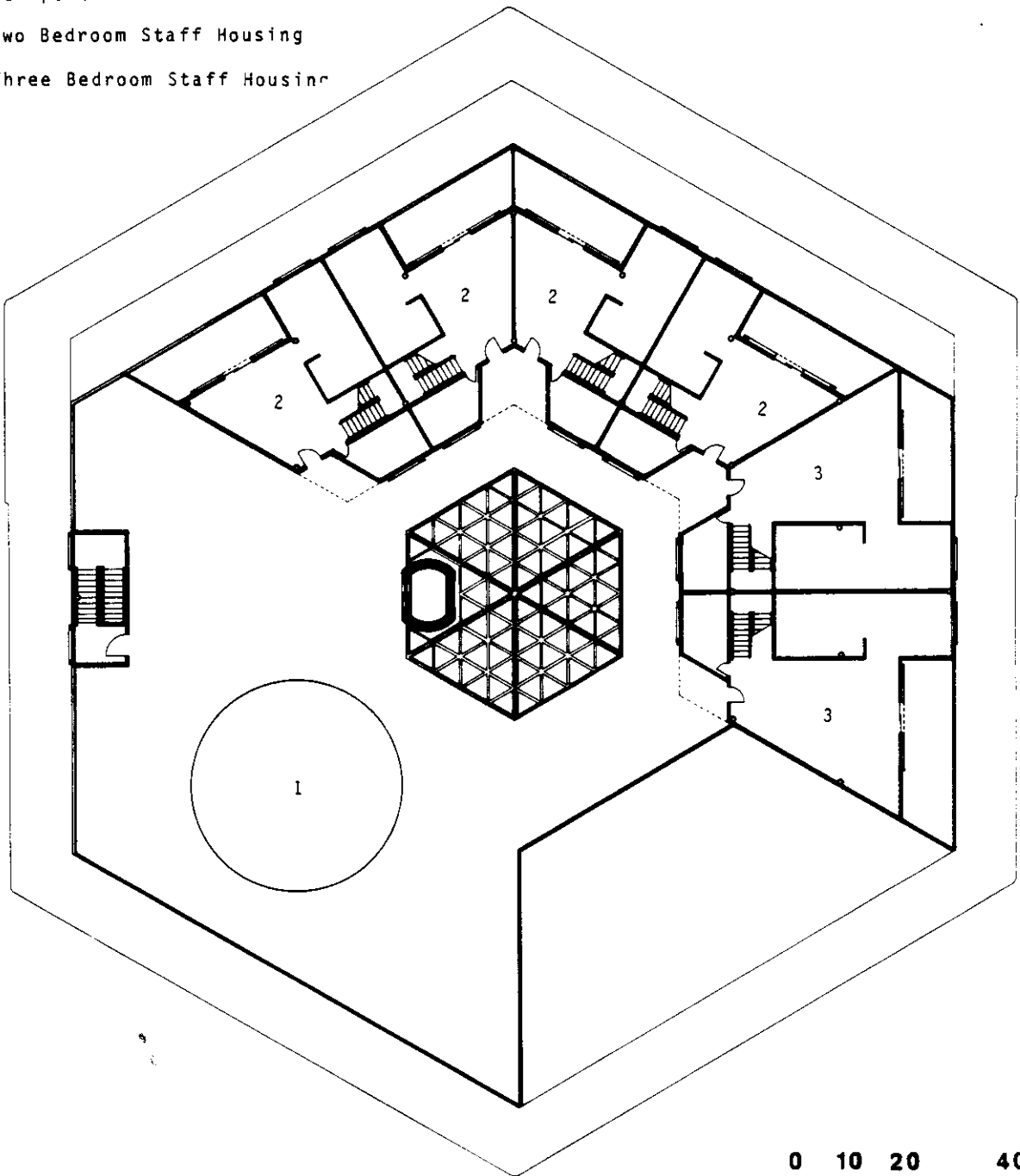
- 1 Exterior Plaza
- 2 Double Unit Housing
- 3 Storage



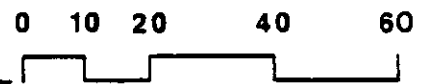
LEVEL EIGHT



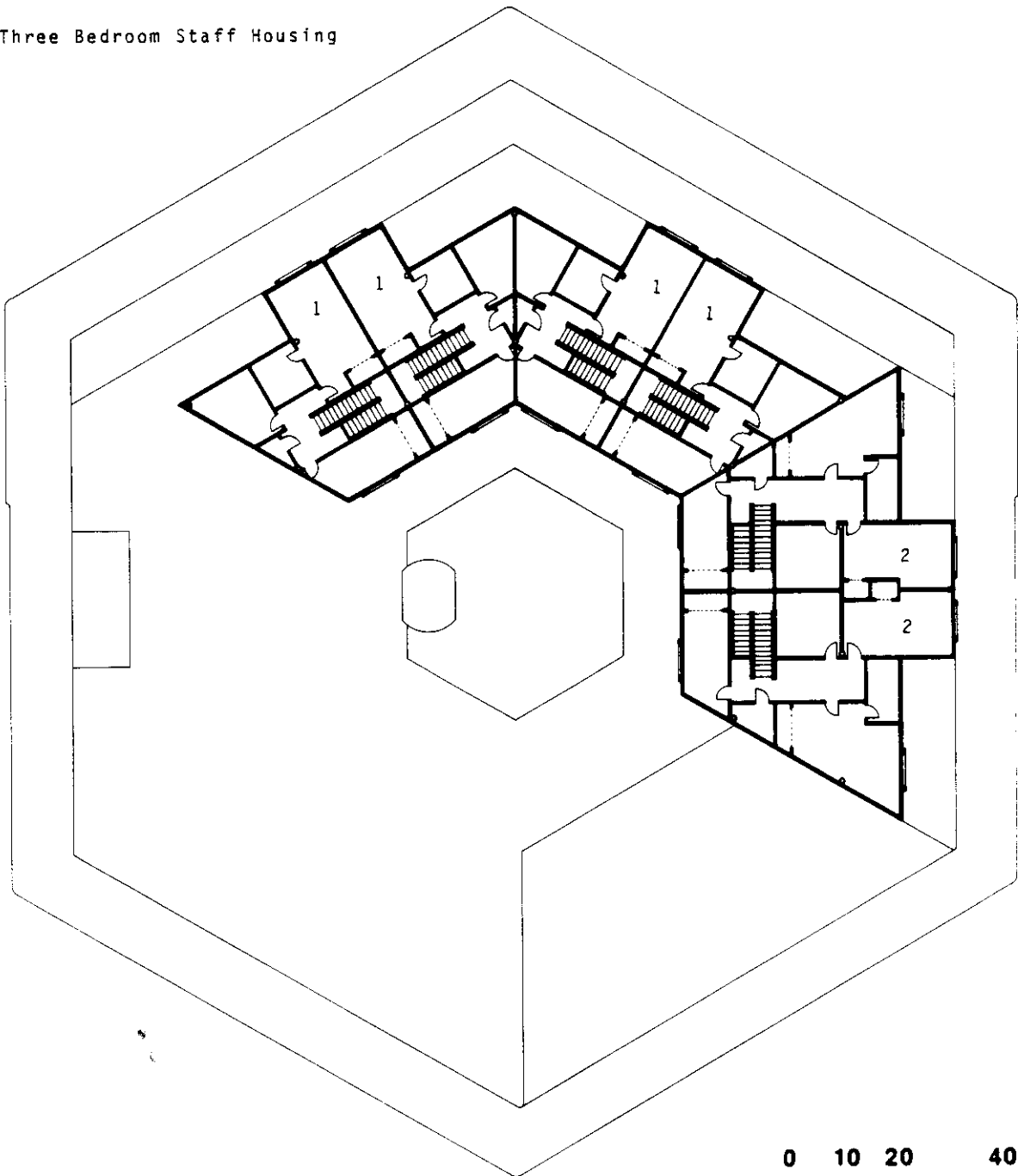
- 1 Heliport
- 2 Two Bedroom Staff Housing
- 3 Three Bedroom Staff Housing



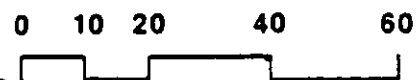
LEVEL NINE



- 1 Two Bedroom Staff Housing
- 2 Three Bedroom Staff Housing



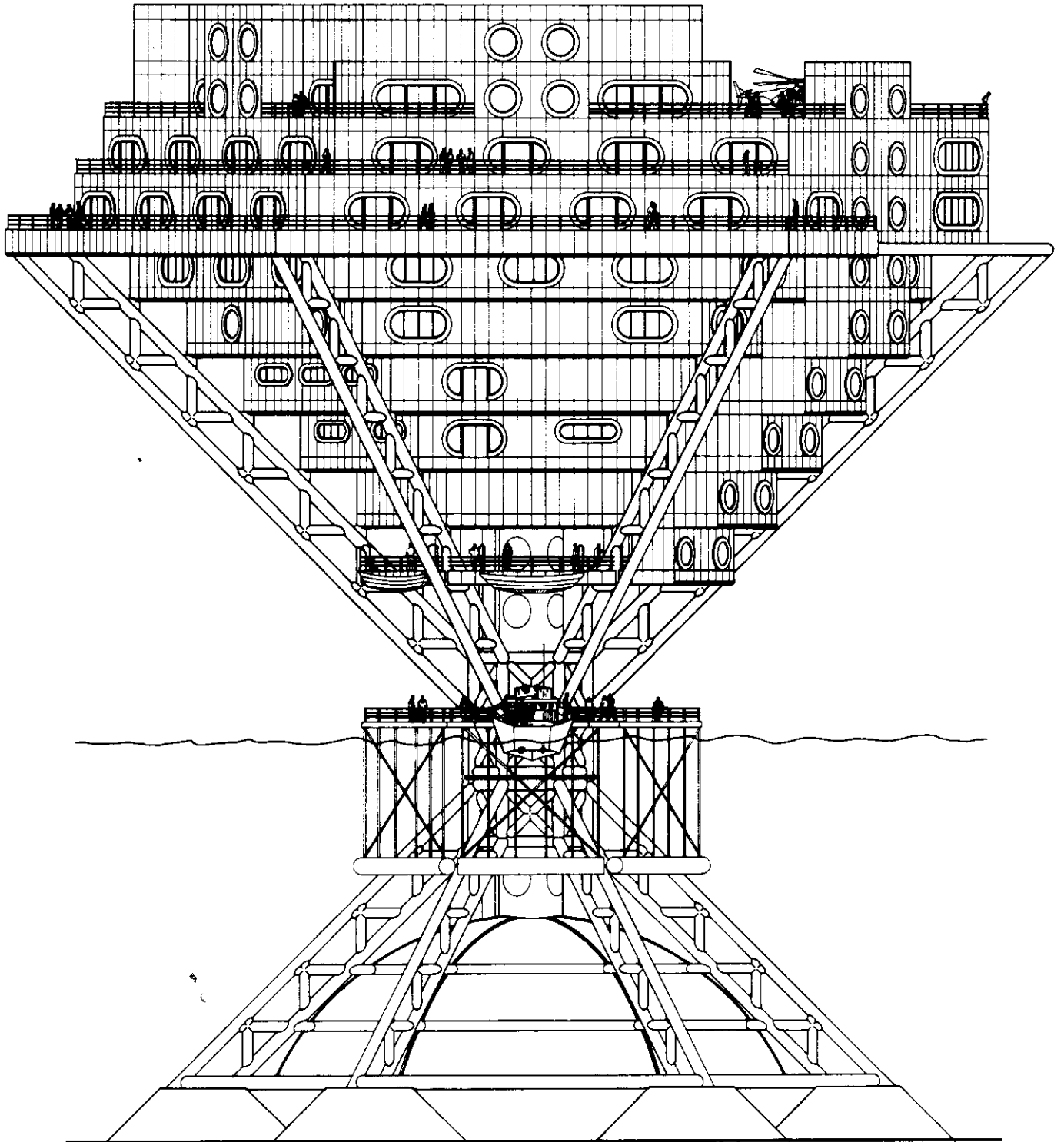
LEVEL TEN



# ACCESS

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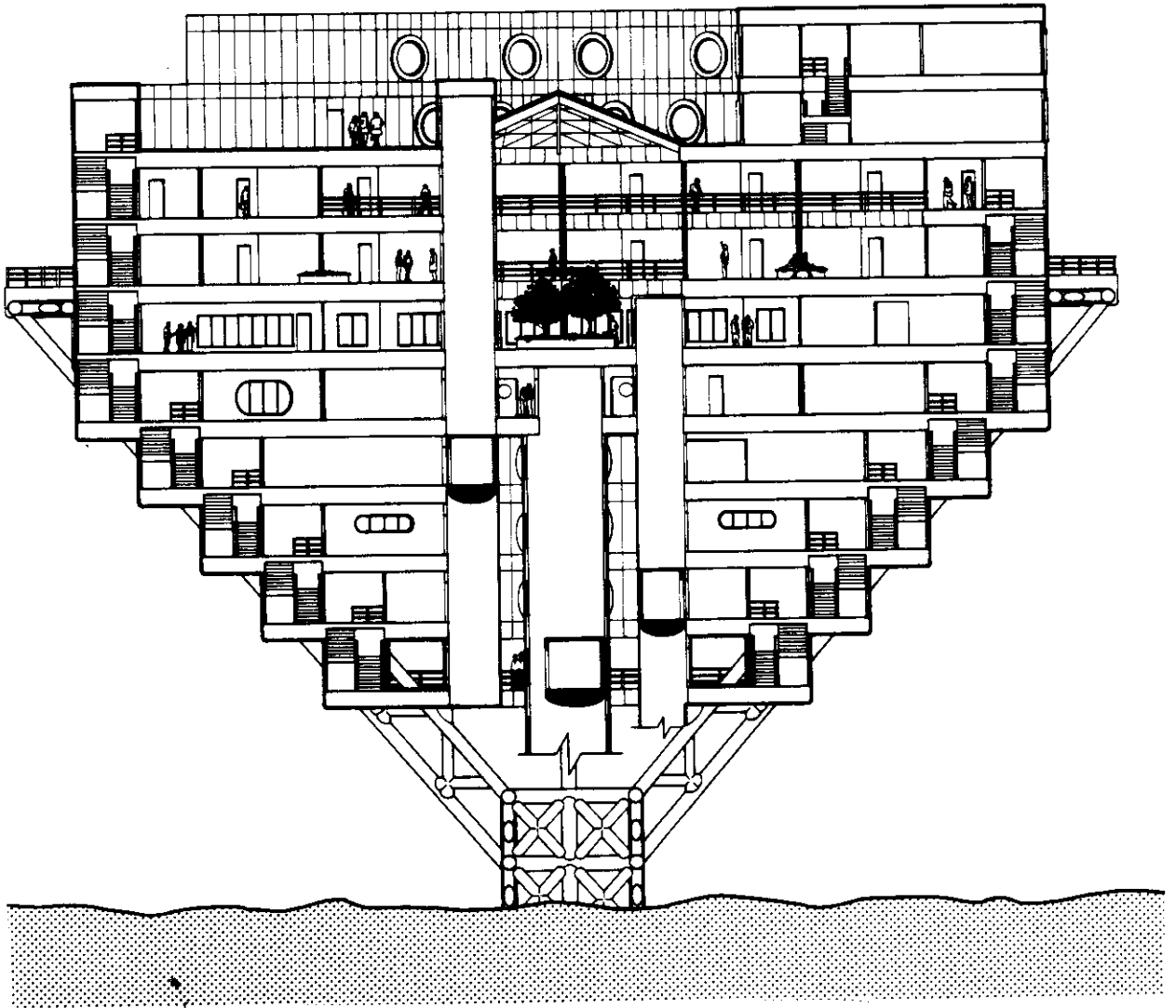
Main access to the facility will be by surface craft; therefore, demanding a need for a docking system. Quick and easy transportation of supplies and people into the protection of the facility is also desired in case of inclement weather. This is accomplished by an overhead crane system for the supplies and by a suspended elevator system on tracks for pedestrians. The dock itself is resting on a series of floats which are located twenty-five feet below the ocean's surface to subdue the intensity of wave motion by 50%. This system allows for a more comfortable docking and exchange area between boat and facility. A heliport is also included on the upper deck to allow for emergency access to and from the facility.



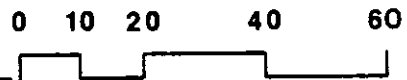
# CIRCULATION

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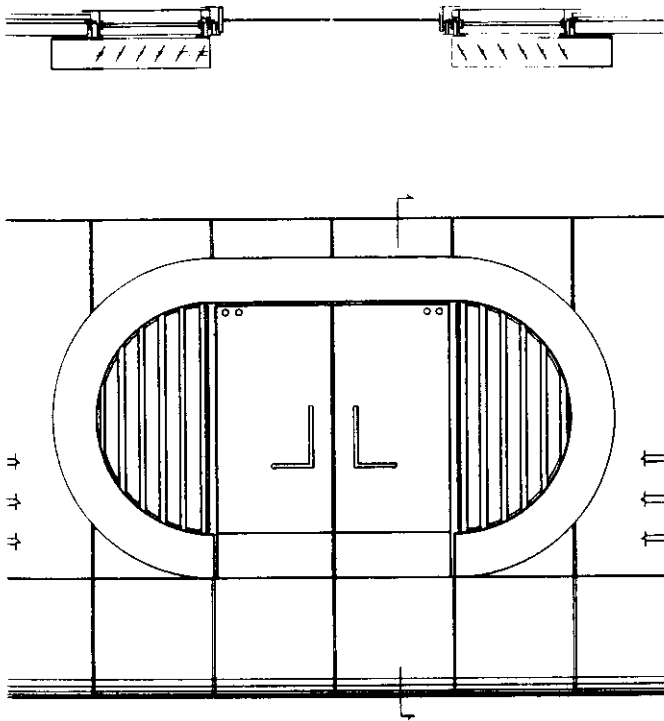
Circulation is induced into the plans through a central core with horizontal circulation extending along an axial path to exterior stairs. Three elevators in the core serve three different functions. The main elevator services the entire upper facility. Another is the direct access from the ocean surface to the lobby area. The third is the pressurized elevator which extends from the pressure chamber through the neck of the structure to the underwater facility. The stair circulation will also warrant major use when ascending or descending a few levels.



SECTION VIEWING NORTH

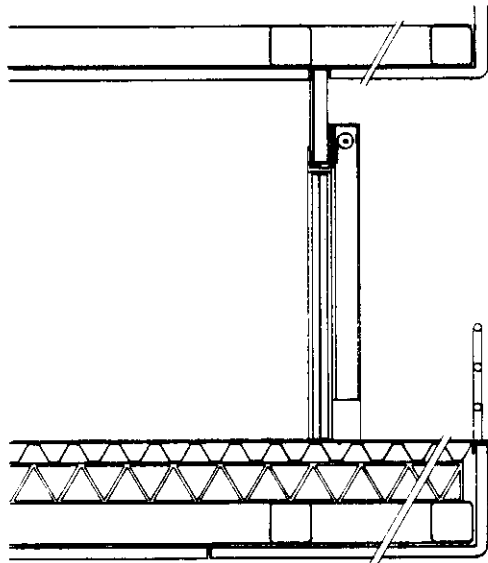


# MATERIALS



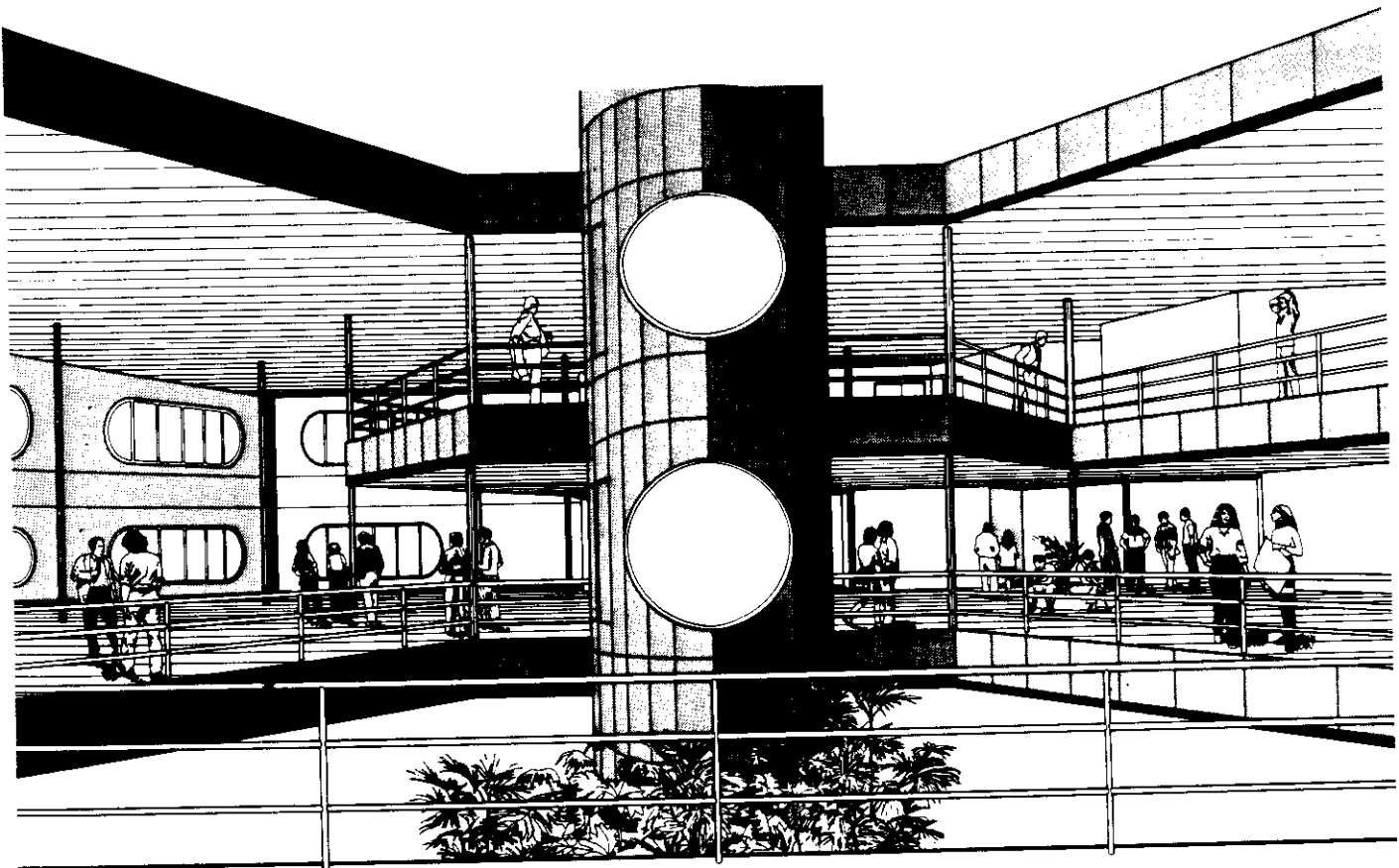
Due to the harsh conditions caused by the ocean environment special considerations must be given to material selection and design. The salinity content in the air demands materials with corrosive resistant qualities. A plastic panel system has been called out for the building skin. The fenestration mullion system is also of a plastic material to retard any deterioration which may be caused by the salty environment. A special louver system is also designed into the fenestration system to provide sun control and protect the glass from wind swept debris.





Metal joists, decking, and space frames provide the floor and ceiling structural systems.

Interior materials are of a clean line quality which reflects the exterior skin. metal rails, fenestration and other interior and exterior qualities all coordinate to generate a continuity in design



# SYSTEMS

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The systems of the project were developed in a manner to promote a self-sufficiency of the facility. Back up design alternatives have been incorporated to prevent a total shutdown of the operation in case of undesirable conditions. The lower floors of the surface facility have been allocated for the location of the systems area, in subsurface environments.

As variety of different system functions will be introduced to maintain self-sufficient and ecological goals of the habitat. The use of solar panels will be a major source for hot water generation. Bio-conversion of organic materials will produce methane gas to be burned along with inceneration of other waste materials for generation of electricity. This system will be supported by fossil fuel back up capabilities to insure consistent heating capabilities. Environmental process such as fresh water will be taken from the ocean through a desalintation process. Oxygen for the underwater facility will also be obtained from the ocean water. These systems are all designed to promote conservation of energy and promote ecological concerns.

**CONCLUSION**

# SUMMARY

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This thesis project enabled a thorough investigation of different aquatic design considerations as well as solutions to those considerations. However, under no circumstances is this brochure trying to document all of the knowledge and processes that were considered, but merely give an overview of the entire project. Many options were studied and explored. One option was chosen which best fits into the entire design.

This project was meant to spur further investigation into the use of the ocean's vast resources. Exploring new ways of existing within the ocean's environment may better understand the world in which he lives.

# ACKNOWLEDGEMENTS

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Paul Laseau .....Studio Critic  
Jeff Culp.....Mechanical/Structural Critic  
Jeff Hall.....Landscape Critic

A special thanks to:

Rod Underwood..... Outside Critic  
Mike & Debbie Meehan  
my Classmates