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Offshore R+D Facility

Philip A. Marble

Offshore R+D Facility

Developing a new Offshore Research + Development facility

This Final Project is presented to the faculty of the School of Architecture

By
Phil Marble

In partial fulfillment of the requirements for the Degree
Bachelor of Architecture

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Request for Approval of Project Book

Philip Adam Marble

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Thesis Summary

Design a Research + Development facility that merges with a functional Oil Rig. This center will houses both a Marine Research Center and Oil rig Research + Development center. Both of these facilities will be in a separate structure than the Oil Rig but will have connections back to the Living Quarter.

Student Signature _____ Date_____

Approved by:

Thesis Advisor: Professor Peter Pittman _____ Date_____

Thesis Advisor: Professor Ameen Farooq _____ Date_____

Thesis Coordinator: Professor Liz Martin _____ Date_____

Department Chair: Dr. Tony Rizzuto _____ Date_____

Dedication

I would like to thank my wife, Cindi for being with me and supporting me over the past five years. I know it has not always been easy, I am grateful for your patience and being my rock. It is because of my family and friends, that I have been able to reach this milestone with my feet on the ground and a level head on my shoulders. This journey has taught me that there are no limits to my potential and showed me the amount of confidence that my family has instilled in me. It is because of this I would like to dedicate this book to my wife and son, Jackson.

Acknowledgements

Throughout the development of this thesis, several people have helped me reach this goal. I want to thank all of my past professors and classmates for sharing their knowledge with me and guiding me through this process. I want to thank Dr. Farooq and Professor Pittman who served as my thesis advisors and helped me through the development of my thesis.

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1.0

Theorem

Design a Research + Development facility that merges with a functional Oil Rig. This center will house both a Marine Research Center and Oil rig Research + Development center. Both of these facilities will be in a separate structure than the Oil Rig but will have a connection back to the Living Quarter.

Miles off of the shore, with only the horizon in sight, sit massive structures composed of thousands of tons of steel. To most of us, we will never see these structures in our lifetime nor may their function or use ever cross our minds. But this structure that I speak of, is home to hundreds of people for several weeks at a time.

Working on an oil rig is not your typical 9 to 5 job, and it certainly isn't for the faint of heart. This job requires its workers to uproot their lives and live away from their family for extended periods of time. If you have a fear of heights, or enclosed spaces, one may want to re think this career path. It takes a special person to do this job, and even those who have thought they had what it takes, have left this field to pursue safer, less extreme working conditions. There are many hazards associated with working on an oil rig. One of the obvious risks is falling overboard from an extreme height to the water below. Machines are running constantly moving heavy, 30 foot sections of steel pipe, that are hoisted up by a crane dangling over their head. Mother Nature brings even more hazardous conditions. Hurricanes, lightning, and heavy rainstorms all affecting the outdoor duties that comes with this line of work.

People who work on an offshore oil rig, not only work there but live there as well. Since most of these rigs are miles offshore the only way of transportation to the rig is a journey accomplished by helicopter or boat. Once onboard the crew works 2 week long shifts, without the ability to see husbands or wives, children or friends. The crew works 12 hour shifts every day for those 2 weeks. This leaves minimal time for rest, relaxation and mental recharging that we as human beings all require and also can take for granted every day.

The living quarters on an oil rig are similar to those of military barracks or even a jail cell. Rooms on average are small and cramped, approximately 150 square feet, and typically have 2 sets of bunkbeds on each side. Noise level is high due to machinery running nearby. Quiet areas and privacy are not available. There are no windows or any comforts included with these rooms because they were designed last and placed where there was room leftover on the rig. For most of the workers the only enjoyable part is the food. The kitchen staff is an, outsourced catering company, which is connately preparing excellent food for the workers.

This project seeks to study the offshore living typology and its relationship with the functional requirements of an offshore oil rig. It will explore the different elements and spatial connections of the rig in order to achieve a more balanced level of comfort and functionality.

The marine research center will be a center where scientists can study, research and predict the development of an eco-system around the structure of a rig. The center will consist of an underwater laboratory, aquatic garden, salt water pool, offices, conference rooms, and an auditorium where lectures can be held. There will be private and public areas throughout the center.

The Oil Rig R+D center will be a center where programs are organized to identify game-changing technologies aboard the rig with real time development. Gaining knowledge through state of the art equipment onboard, the Laboratories will be able to test mud, oil, gas and metal samples.

The Living Quarters (LQ) will be the common ground between the Oil rig and Research center. These different cultures will be merged under one roof in the LQ sharing spaces. When it is time for work the employee's will separate to their job location, Oil Drilling or the Research Center.

http://www.archdaily.com/786550/casa-brutale-is-getting-built-and-heres-why-hint-the-internet

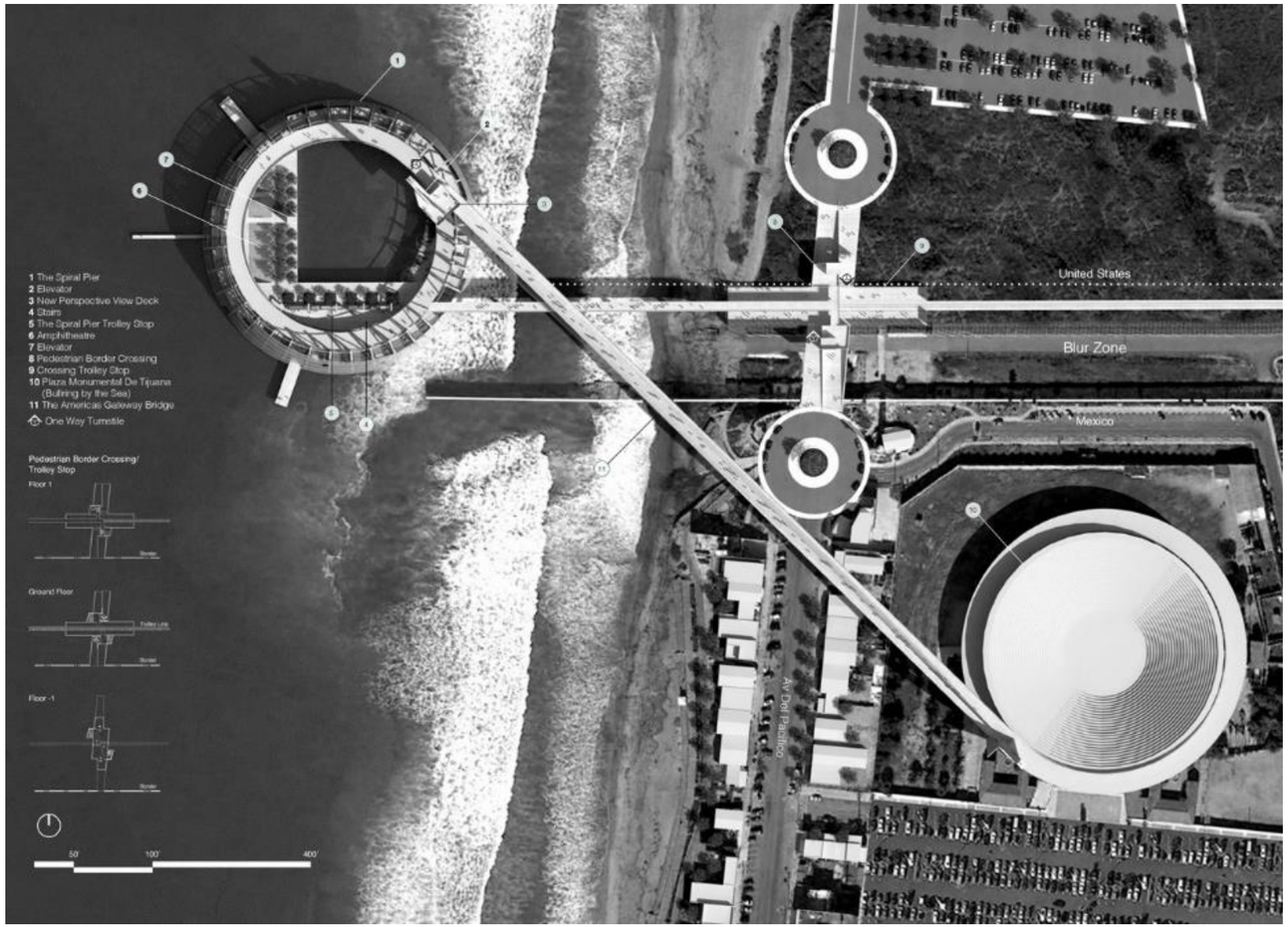
Casa Brutale

This project was designed by OPA. OPA's concept for this design was "seeks for an investor or an ambitious owner to finance the construction". It is located on the edge of a cliff with spectacular views towards the water.

They placed a pool on top of their project to help with the cooling of the area below. This rectangular building focus on the water only. In the renderings you can see how the pool acts also as a sunlight feature allowing light in from above.

This creates an interesting effect on the interior of the spaces. The skylight is the second form of light beside the large picture window facing the large body of water.

OPA uses a minimal approach while designing this project, the home is cooled because its sinks into the ground and has the pool on top and the concrete slabs keep it naturally cool on the inside. This project creates an interesting space that connects back with the water and the cliff surrounding it.



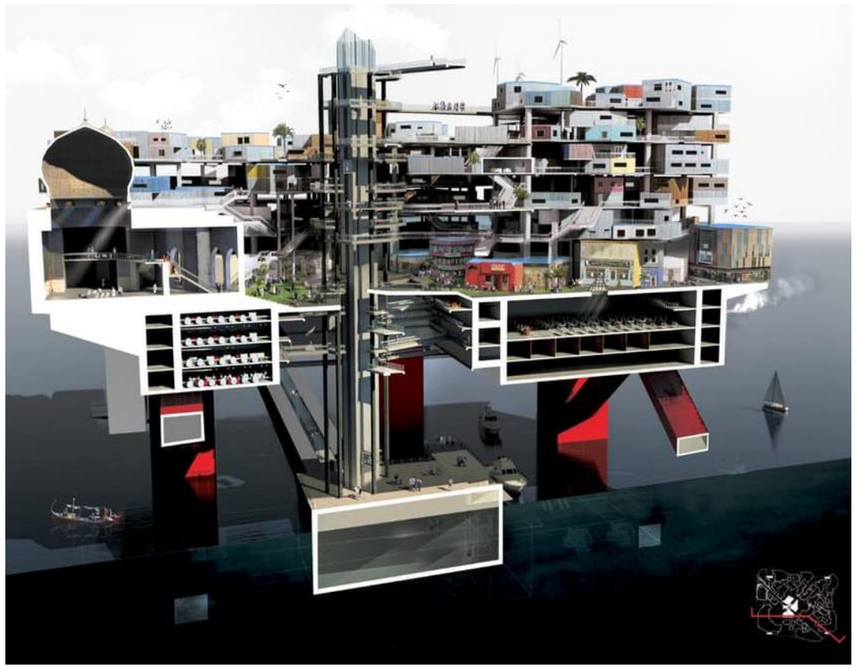
http://www.archdaily.com/772337/la-linea-borrosa-proposes-a-shared-space-at-the-us-mexico-border

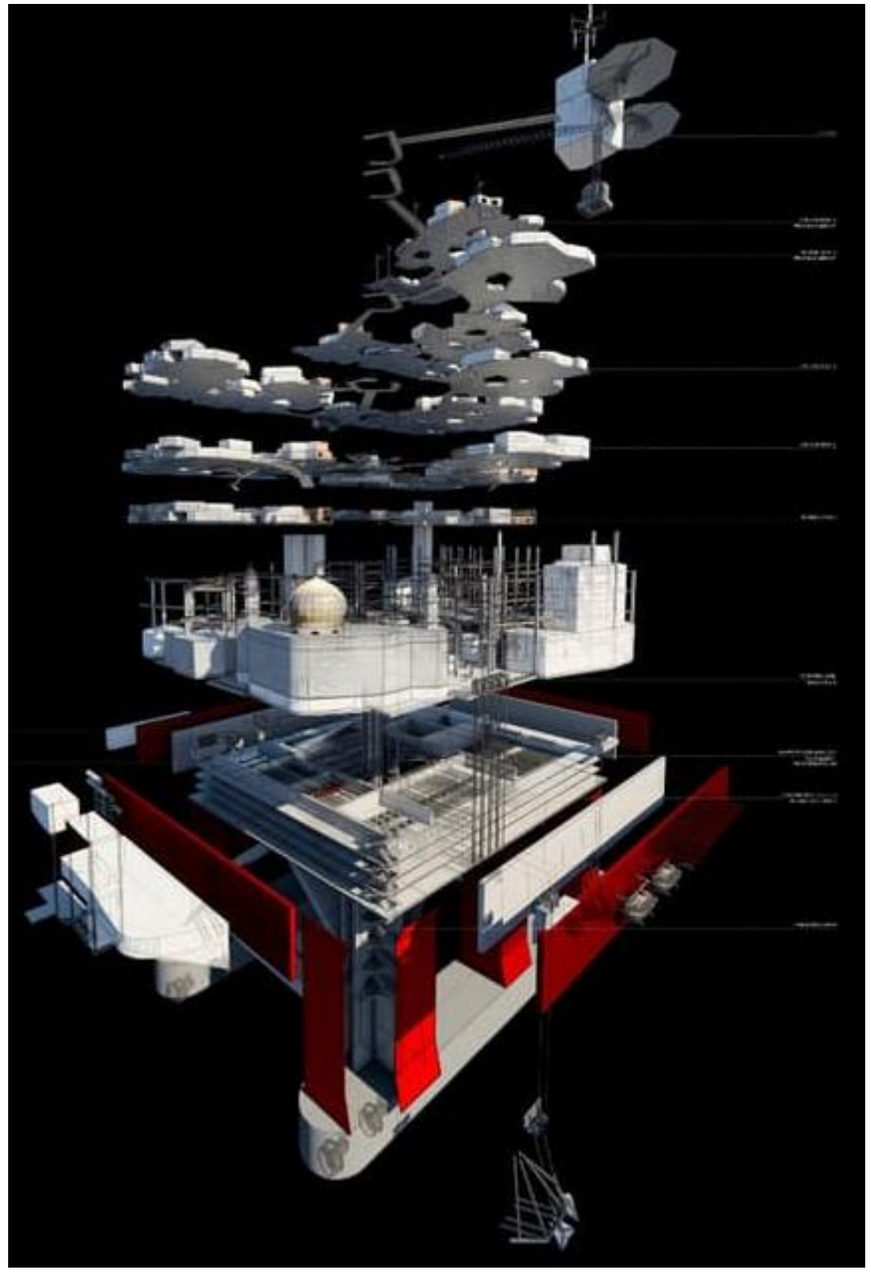
La Linea Borrosa

This project was designed by Patrick Cordelle, a student at California Polytechnic University San Luis Obispo. He called this project "The Blurred Line" because this project is located at the US-Mexico border on the western coast, between San Diego and Tijuana.

The offshore spiral pier was designed as a communal space for families from both sides of the border to meet and spend time together. The spiral pier offers areas that people can sit and talk together and escape the fact that they live in two different countries. Afterwards the families return to their prospective countries.

This project has an interesting concept about the journey to a space that is located offshore. The spiral pier offers an escape, and since it is inward facing the project forces you to see other families that are in the same situation. The exterior skin is created as a filter allowing you to only see a small part of the world around you.





http://newatlas.com/mayank-thammalla-maldives-oil-rigs/37656/

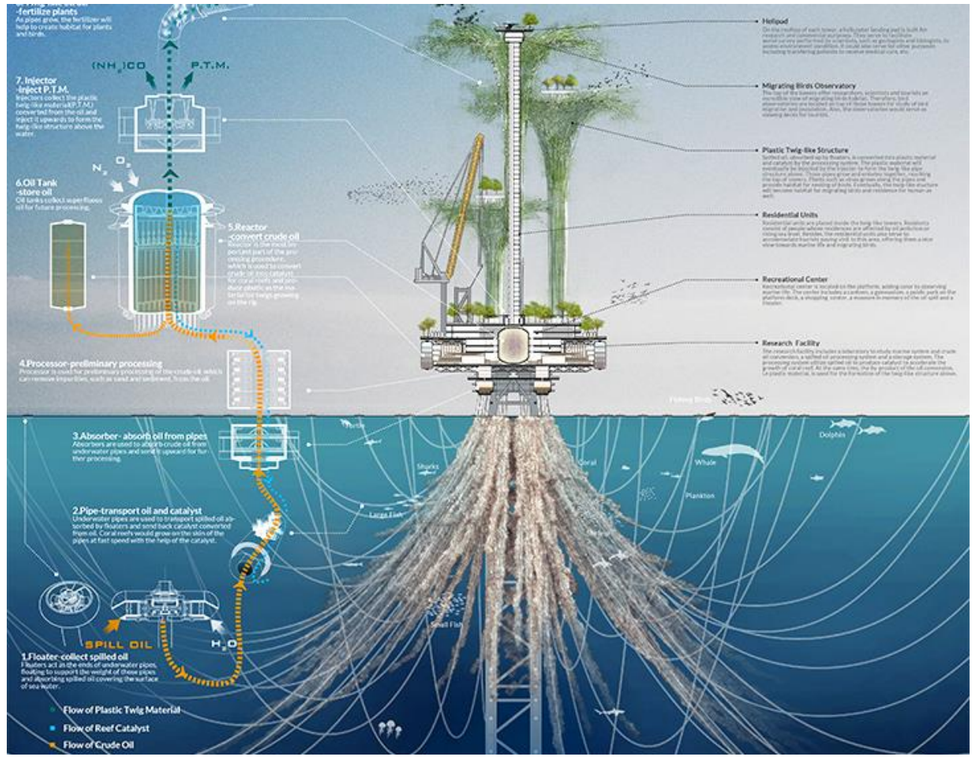
Relocation of the Maldives

This project was designed by Mayank Thammalla who is in his final year, Masters of Architecture thesis. He was looking into the future and how the sea levels could rise flooding any low-laying countries, thus the Maldives. Using existing oil rigs he redesigned them to fit the culture of the Maldives.

Mayank Thammalla was imagining these huge oil rigs as islands like the people of Maldives are already accustom to.

These "islands" would include markets, retail spaces, cinemas, mosques, and housing for 400,000 people.

In the central core of the oil rig, where the drilling and pumping takes place, the core was redesigned to make vertical transportation throughout the population possible. With this intelligent re-use of the core shaft, it allows people to descend to the ocean level and get onto a boat for some island hopping.



http://www.designboom.com/architecture/the-noah-oasis-vertical-bio-habitats-evolo-competition-03-31-2015/

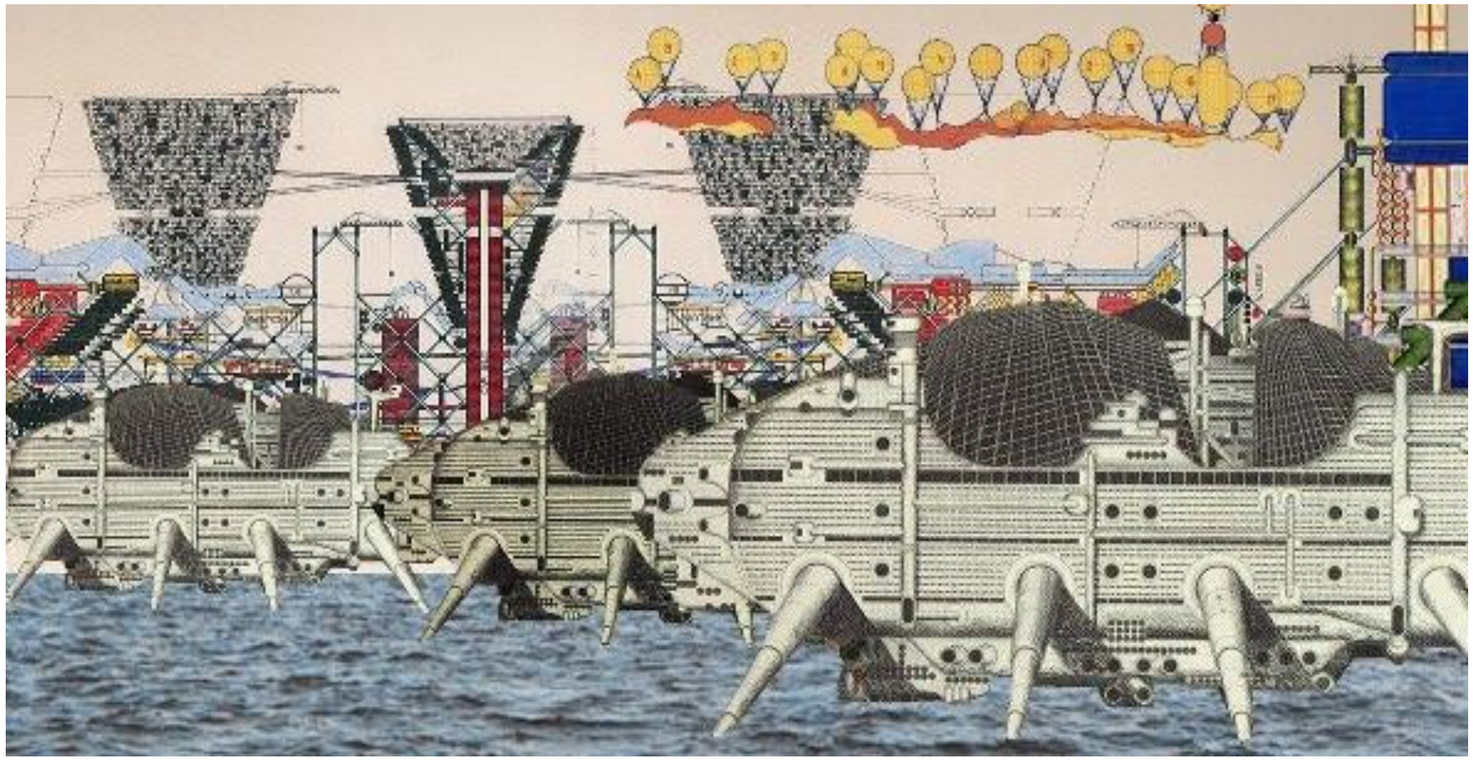
Noah Oasis

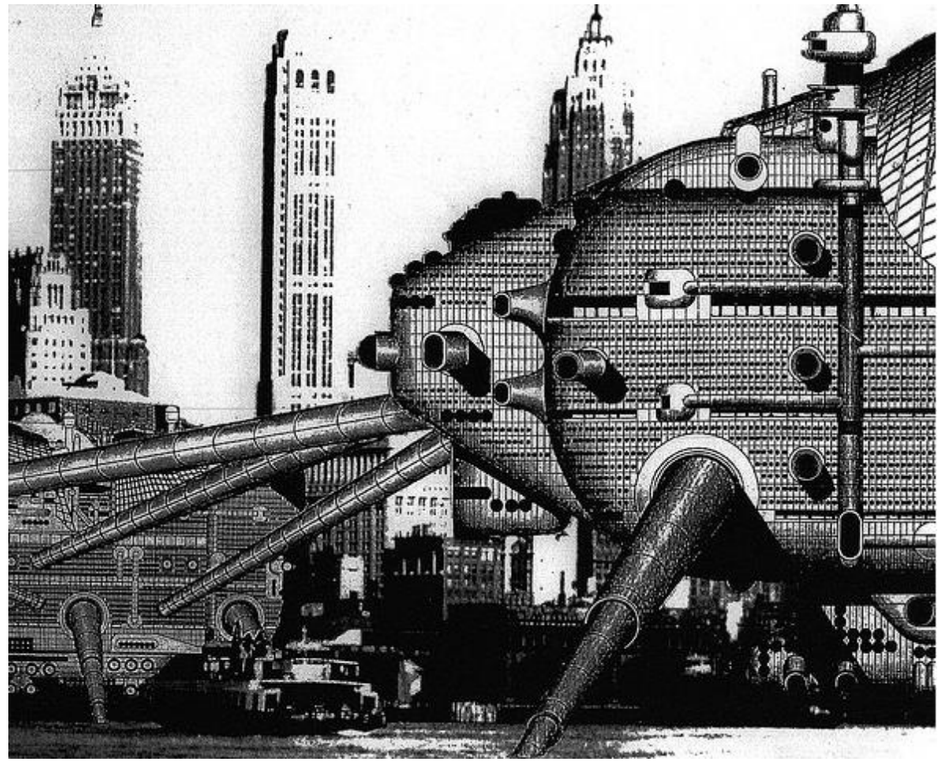
This project was designed by Ma Yidong, Zhu Zhonghui, Qin Zhengyu, and Jiang Zhe. This study was designed for oil rigs around the world to provide a fast response to offshore drilling oil spills. They designed these "floating absorbers" that "are attached to root-like pipes that draw spilt oil back to the rig". From there it goes through a filtering process that retracts the oil from the water so it can be sold.

In addition, they looked at the typology of the rig itself and re-designed it to have a research facility built within the functioning oil rig. This research facility is to study the marine system including the growth of coral reef and the animals nearby.

Noah's Oasis also offers a recreational center for the workers that includes a shopping center, a public park, gymnasium, and a theater. This area included a memorial museum featuring past oil spills and the devastation that it brought with it.

The residential units are placed up high in the tower to provide a view and to help connect them with the marine life and with the birds. These units were also designed for people to come visit and have a place to stay. This provides an escape for the workers who are stationed on the rig for long periods at a time.





http://walkingthecityupolis.blogspot.com/2011/03/guest-post-archigrams-walking-city.html

Walking Cities

This project was designed by a British architect, Ron Herron, Archigram, in 1964. The walking cities were robotic structures that offered portability and could house a large population of people. These massive structures had their own intelligence and made the cities mobile. This gave them the freedom to connect with other cities creating 'walking metropolises' or to be an individual city.

Design Analysis

2.0

Design Analysis

2.1

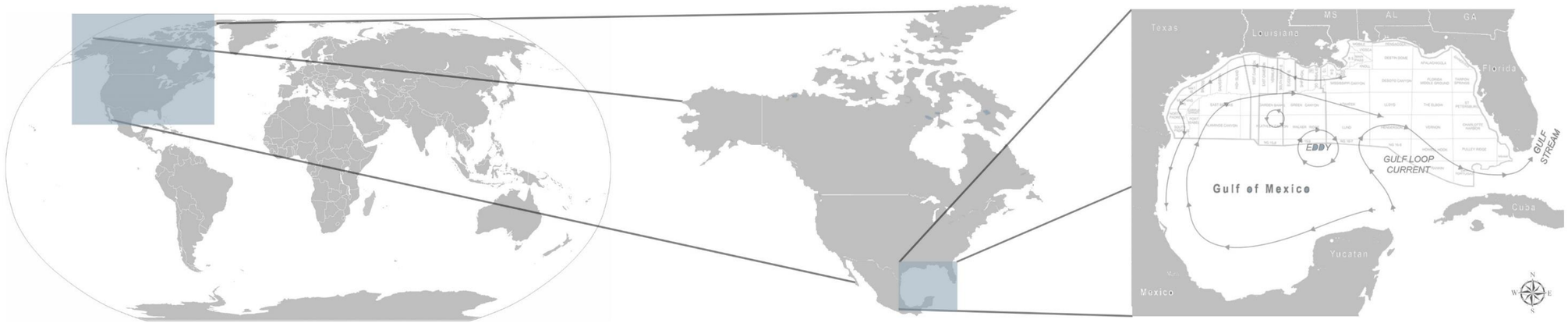
Site Context

Site: Gulf of Mexico

The Gulf of Mexico (GOM) is located at the southeastern part of North America. The Gulf is bordered by the United States to the North, and Mexico, to the southwest. As of December 2, 2016 there are currently 104 rigs on contract in the GOM, and 830 world wide.

The GOM has a variation of currents that help to move the warm water. Most of the warmer water enters in through the Yucatan Channel and is pushed through the Gulf loop current which as shown in the map.

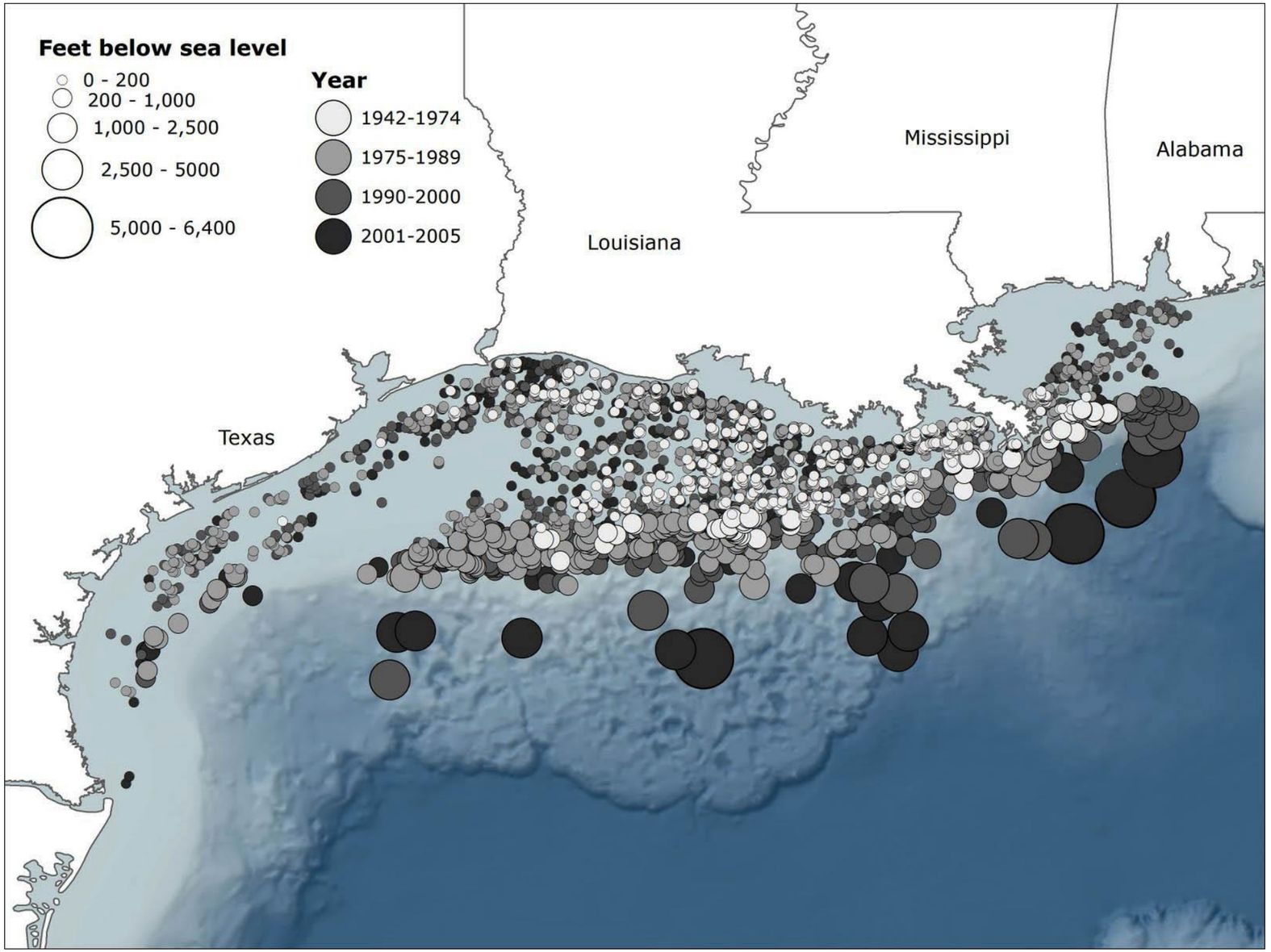
The Gulf Loop current exits around the southern tip of Florida. The Gulf Stream creates a vacuum like action taking it out to the open sea.



World

North America

Gulf of Mexico



http://www.deepseanews.com/2010/06/oil-platforms-in-the-gulf-how-many-and-who-owns-them/

Site: Gulf of Mexico

As of 2010, when this map was created, there are nearly 4,000 oil and gas platforms that populate the northern Gulf of Mexico. Each dot on the map represents a platform. As of Now, in 2017, there are many more Platforms filling up the Gulf of Mexico.

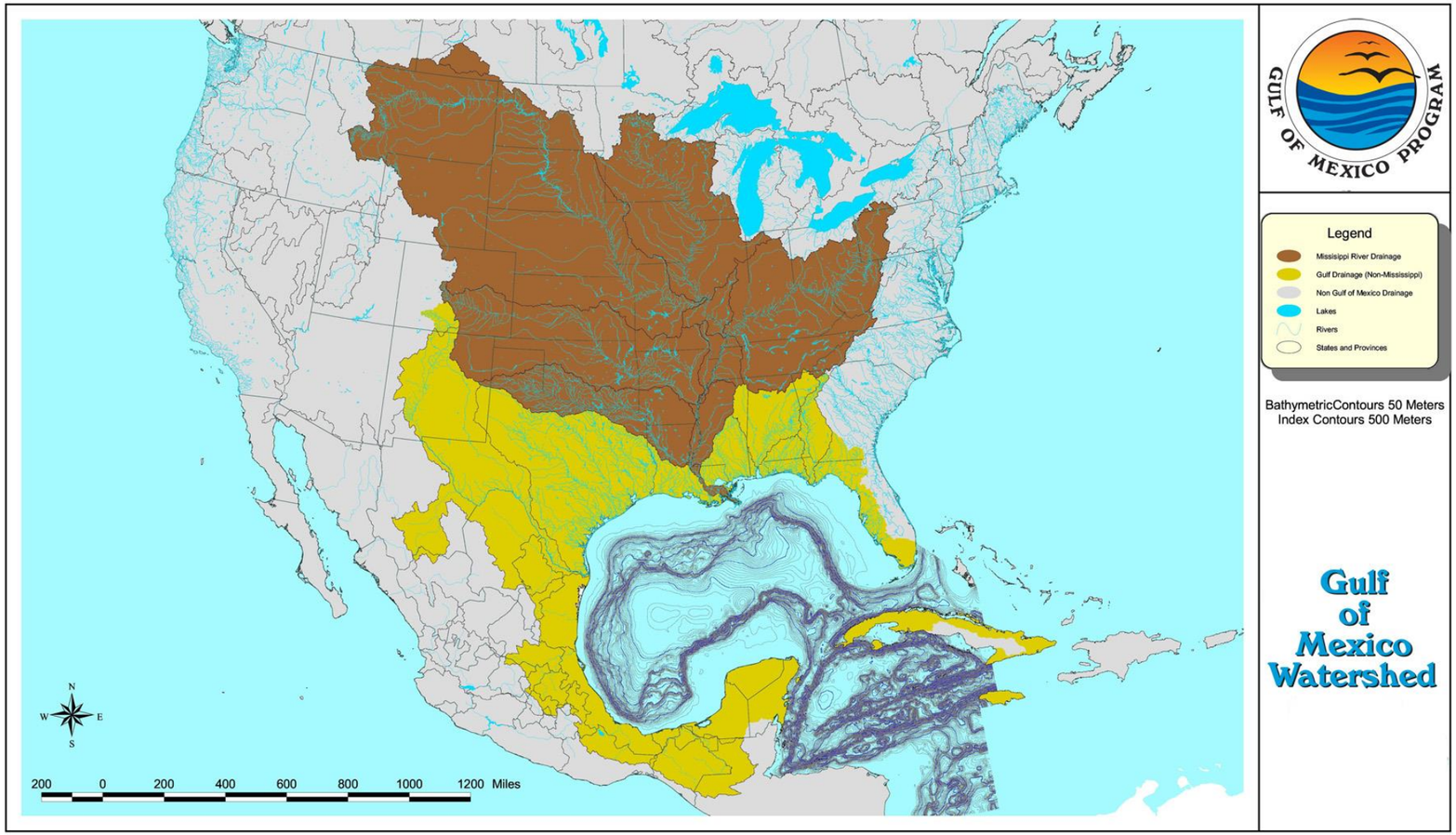
Site: Gulf of Mexico

Nearly two-thirds of rainfall in the United States drains into the Gulf of Mexico (GOM). One of the biggest river basins is the Mississippi river, which is the area in brown. All of this runoff is coming from cities, suburbs, and rural areas and has a chance to damage the GOM.

The Research + Development center would be able to study the effect of runoff that dumps into the GOM first hand. Normally, most of the rain soaks in and replenishes the ground.
With the cities and suburbs expanding rapidly, this creates excess runoff.

Most of the populated areas have heavily paved surfaces. Large roofs create a large amount of runoff that can cause flooding. With no place to go, it goes through man made channels that lead into the GOM.

As seen in the water currents, the GOM creates a whirlpool. All of the muddy water and waste get pushed into the GOM. This can create a problem for the marine life that lives there.



http://flowergarden.noaa.gov/image_library/maps/gulfcurrentsmap.jpg

Design Analysis

2.2

Brief Oil History

Brief offshore oil History

The first land drilled oil well was in 1859. 38 years later, offshore drilling began in 1897. Santa Barbara, California was the first city to drill for oil offshore. This well was designed at the end of a wooden pier. H.L. William was credited with this accomplishment. Within five years there were over 150 oil wells in the area. the first steel-pier island (60x90 ft. 25 ft. above sea level) was built in1932 about ½ mile offshore by a small oil company named Indian Petroleum corp.

During the late 1940's, in the swamps of Louisiana, the first barge (The Breton Rig 20 to the right) hit the waters. This submersible barge had two large pontoons that would be flooded to a set level to maintain necessary stability. This barge drilled close to the bays in shallow water, less than 20 ft.

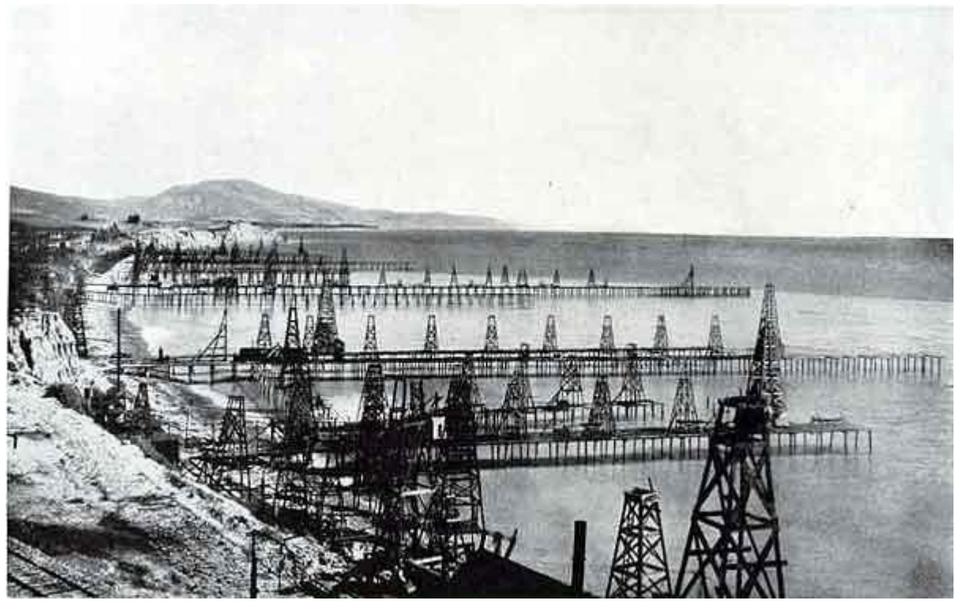


Fig. 1
http://aoghs.org/offshore-history/offshore-oil-history/

Fig. 1-America's first offshore petroleum drilling production platforms in the Pacific Ocean. This began in the late 19th century.

Fig. 2.
http://petrowiki.org/History_of_offshore_drilling_units

Fig. 2-Breton Rig 20, a swamp drilling barge converted to drill in the GOM off of Louisiana.

The first mobile offshore drilling unit (MODU) was built in 1954 and was named the "Mr. Charlie". It was designed by Ocean Drilling and Exploration Co. the overall dimensions are approximately 220x 80 ft. the living quarters are located on the bottom level about 136 ft. above sea level. this rig was built specifically to float so it could be moved to new locations in the GOM.

The "Mr. Charlie" was rated to drill wells to depths of 40 ft. which at the time was considered deep water.

On board, there is enough room to accommodate a crew of 58 people. The rig became an independent island that was nearly self-sufficient. It contained all of the food, drinking water, and supplies for the crew.

It created its own power and disposed of its own waste.

The "Mr. Charlie" retired in late 1986 and is now a museum and training rig in Morgan city, Louisiana.

This first MODU revolutionized the offshore oil industry and lead to technology that is used around the world. "the Mr. Charlie" launched an offshore industry that has propelled around the globe.

Fig. 3-Mr. Charlie first open-water MODU that was rated for 40 Ft. water depth.

Fig. 3

http://petrowiki.org/History_of_offshore_drilling_units

Fig. 4-Mr. Charlie now located in Morgan city, Louisiana is used as a training rig and museum.

Fig. 4

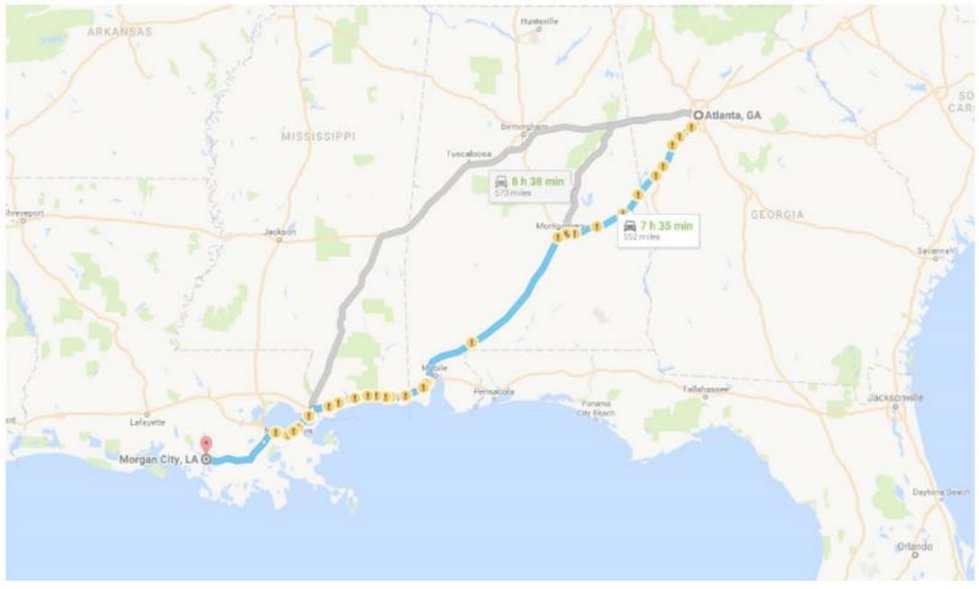


Fig. 2.2.3.1

Site Visit to "Mr. Charlie" Morgan City, Louisiana

Fig. 2.2.3.1

In October of 2016 we took a road trip to Morgan City, Louisiana to the Rig Museum. this is the only oil rig that I was able to board. The "Mr. Charlie" retired in 1986 and is now used as a training facility. Other petroleum companies rent out the "Mr. Charlie" for new employees to train on before sending them out to a rig.

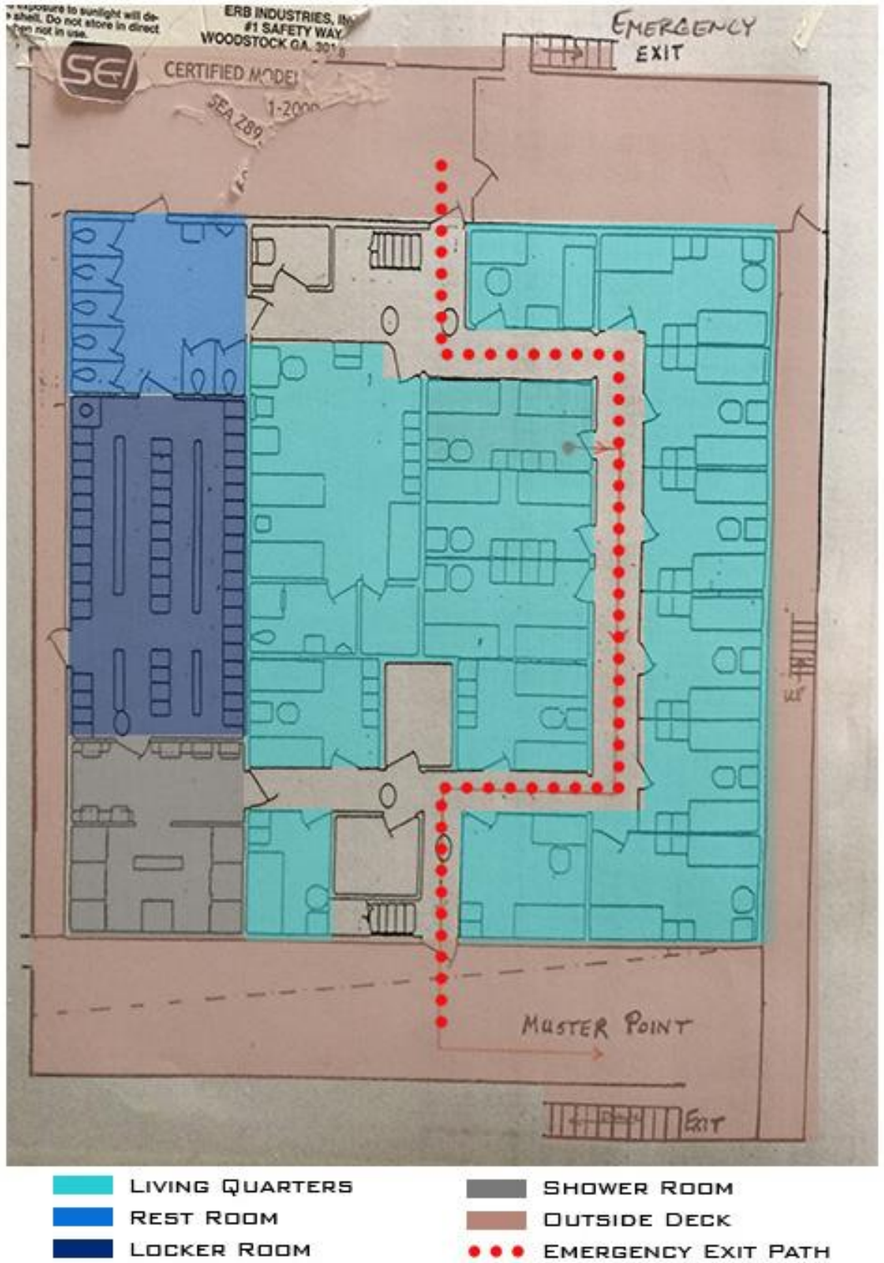


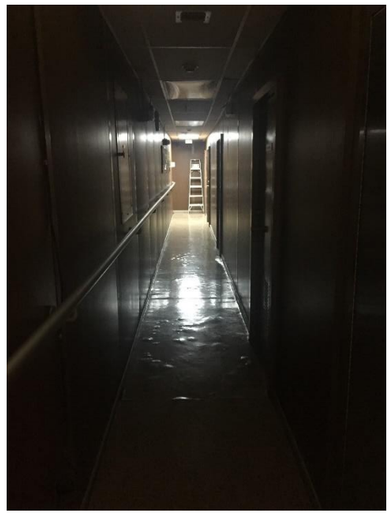
Fig. 2.2.3.2

Living Quarters Diagram
Fig. 2.2.3.2

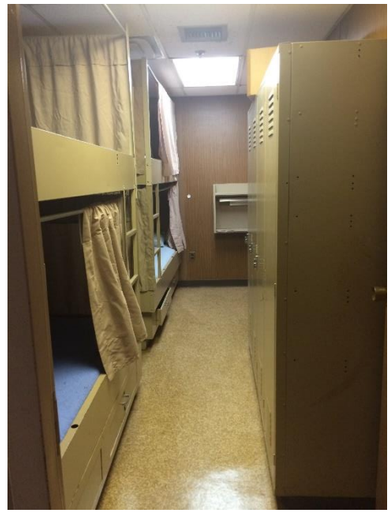
The plan to the left is of the living quarters onboard the "Mr. Charlie". The rig has a capacity of housing 58 crew people. The diagram shows the Living Quarters, Rest Rooms, Locker Rooms, Shower Rooms, Outside Deck, and Emergency Exit Path. Each room typically houses 4 persons. Above this floor is the mess hall and Recreation room. The rest of the rig is for drilling equipment and storage.

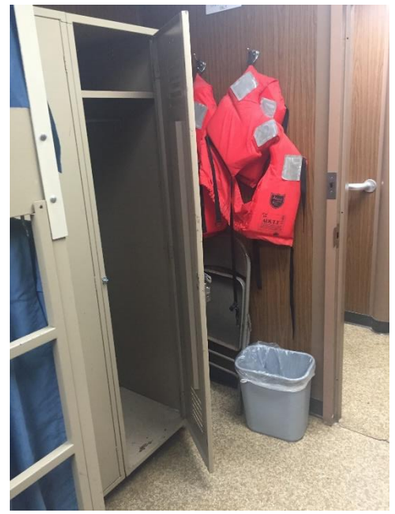
The "Mr. Charlie" is small compared to modern day rigs. This rig only has enough room for the necessary equipment to get the job done. There is not any room to safely test and sample materials. This would have to be done off site which means that it would have to be shipped back to Louisiana. To save time, money, and recourses, it would be beneficial to have a center nearby to do research and studies.

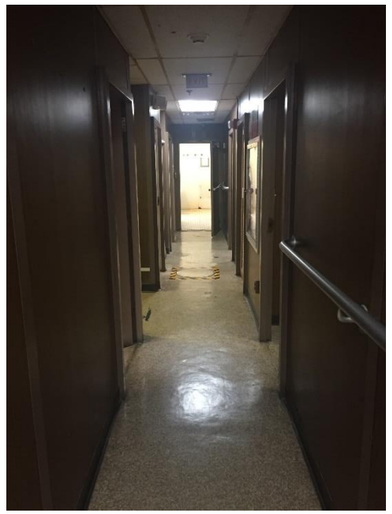
Photos of the Entrance to the Living Quarters



Photos From the Living Quarters





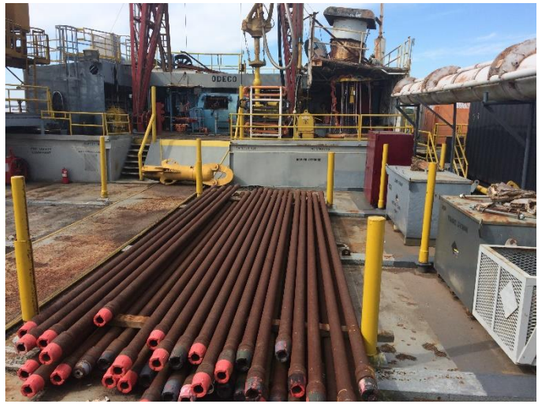


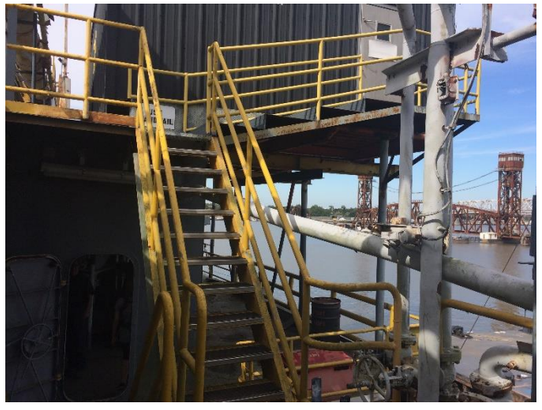
Photos From the mess hall

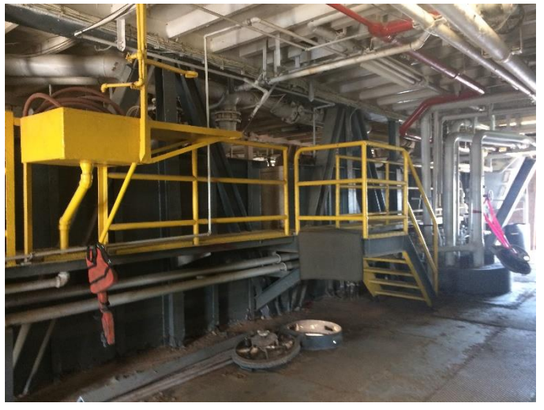
Photos From the Common Area

Photos From the restroom

Photos From the Deck

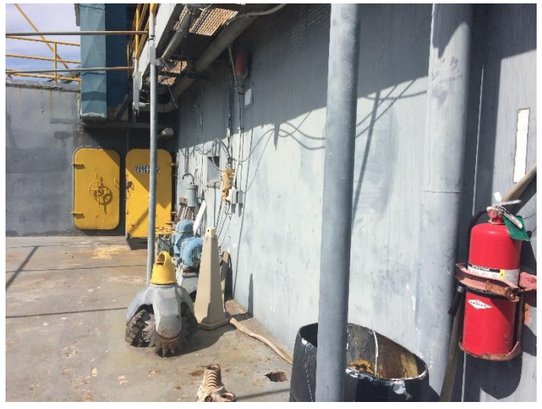




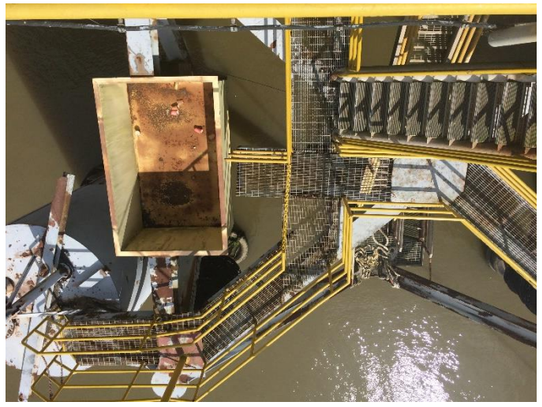


Photos From the Exterior







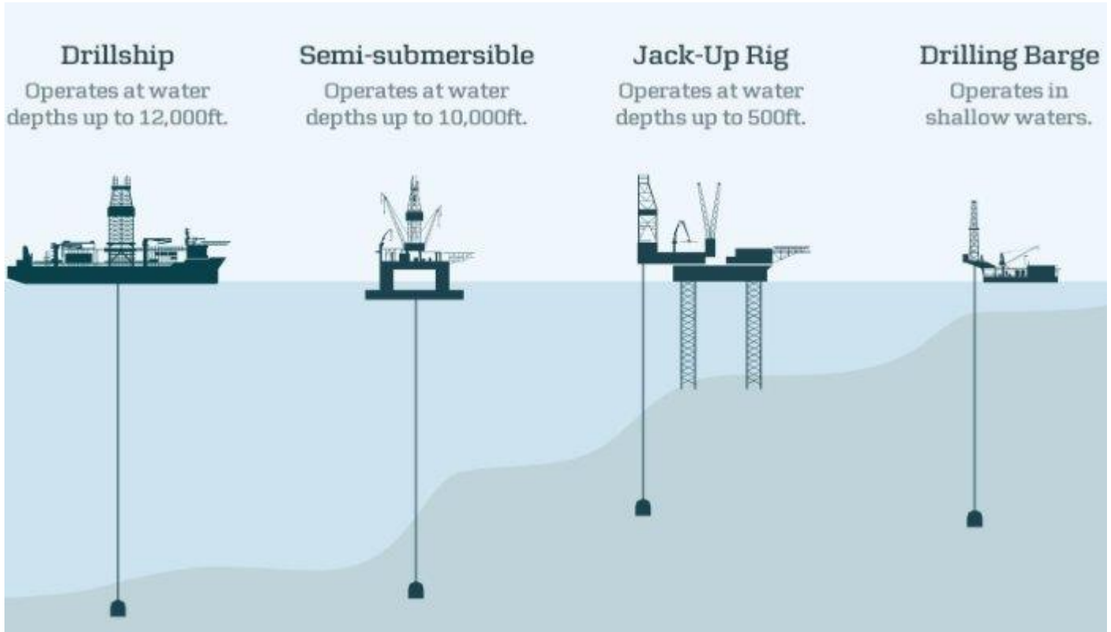


Fig. 2.2.4.1
http://designearthsynergy.com/?page_id=73/

The use of Different Rigs for Different Depths
Fig. 2.2.4.1

This chart shows the different types of rigs used at different depths of water. Each rig has a maximum depth that it can properly operate at. Jack-up and Semi-submersible are the most commonly used rigs in the Gulf of Mexico.

Fig. 2.2.4.2
http://www.offshoreenergytoday.com/tag/drillships/page/2/

Drillships
Fig. 2.2.4.2

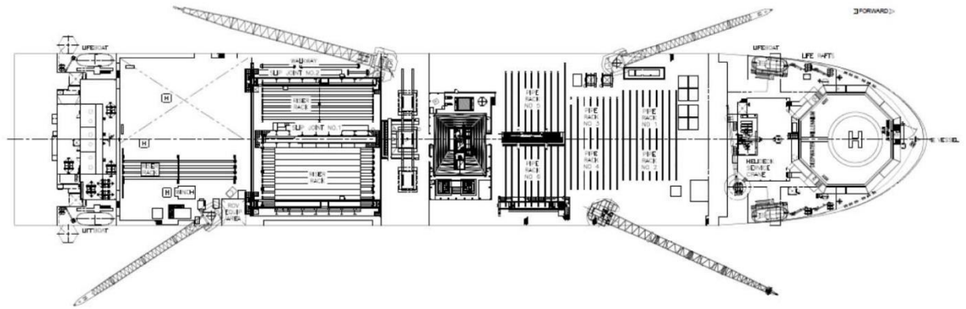
Designed for deep water drilling, these ship-shaped floating rigs move from location to location under their own power. they are capable of operating in more remote locations and require fewer trips from supply boats than semi-submersible rigs. they are maintained on location via dynamic positioning system, and most of the rigs currently under construction are drillships.

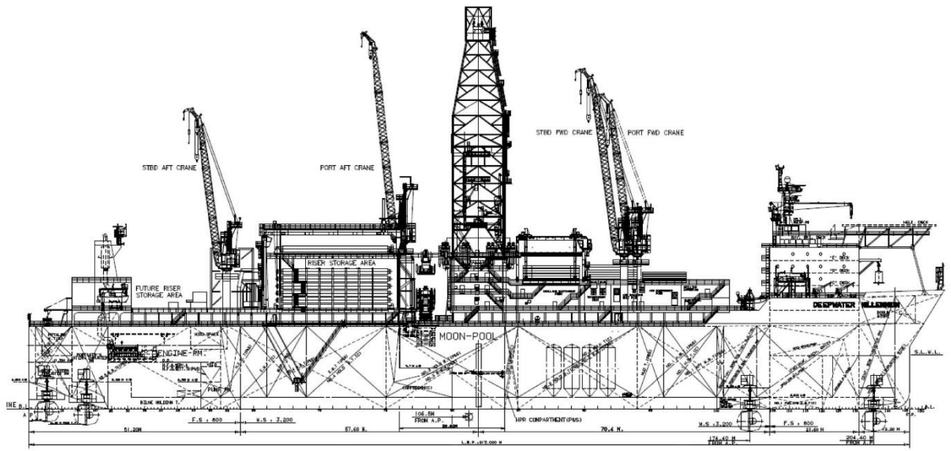
Fig. 2.2.4.3
http://www.noblecorp.com/rig-fleet/rigs-byclass/jackups

Jack-ups
Fig. 2.2.4.3

Used for shallow water drilling, there are two jack-up types. Independent-leg jack-ups make up the majority of the existing fleet. they have legs that penetrate into the sea floor and hull jack up and down the legs. Mat-supported jack-ups are presently used only in the u.s. gulf of Mexico. as the name implies, the mat rests on the seafloor during drilling operation. Cantilever jack-ups are able to skid out over the platform or well location, while slot units have a slot that fits around a platform when drilling development wells.

Deepwater Millennium





General Description

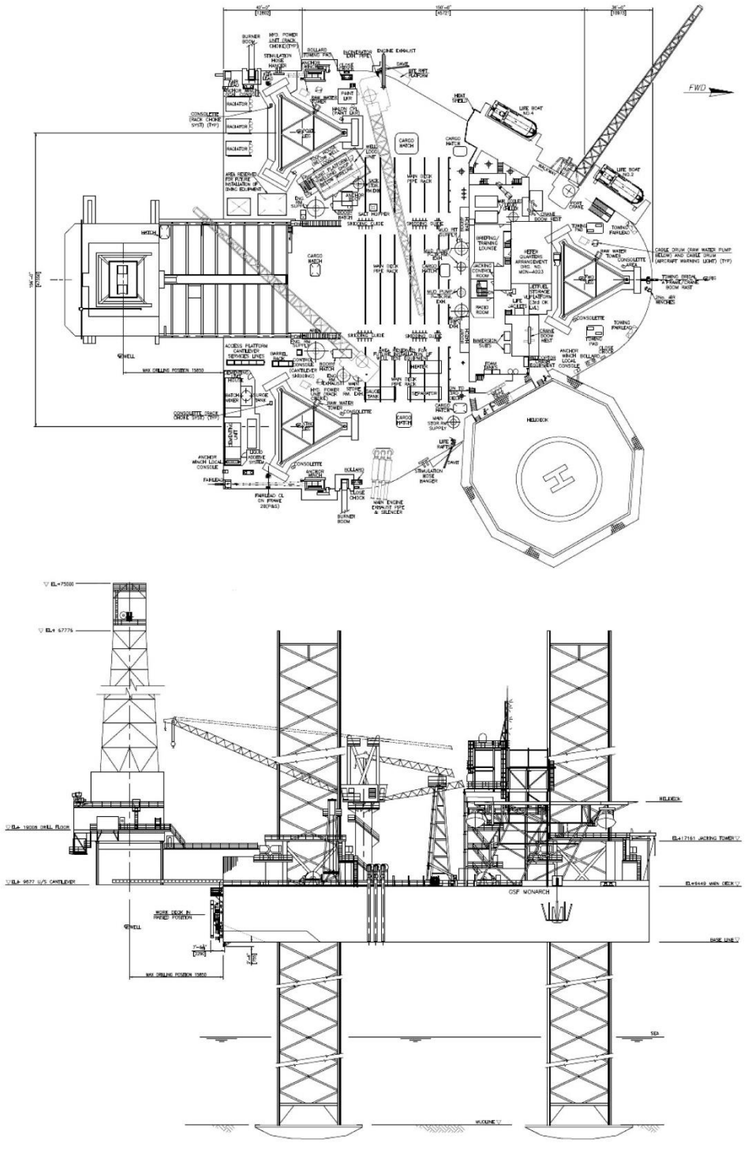
Fig. 2.2.4.4

Design/Generation:	Reading and Bates
Construction Shipyard:	Samsung Heavy Industries
Year Entered Service:	1999/2007/201
Dimensions:	726ft. Long x 138ft. Wide x 66ft. Deep
Accommodation:	180 persons
Transit Speed:	up to 8 knots
Maximum Water Depth:	10,000 ft.
Maximum Drilling Depth:	30,000 ft.

Revision Date: 29-August-2014

Fig. 2.2.4.4

GSF Monarch



Revision Date: 30 June 2014

Transocean

These specifications are intended for general reference purposes only, as actual equipment and specifications may vary based upon subsequent changes, the contract situation and customer needs. All equipment shall be operated and maintained at all times, in compliance with Transocean standard operating manuals, policies and procedures, and within its stated operational limits or continuous rated capacity, in order to assure maximum operational efficiency.

Fig. 2.2.4.5

General Description

Fig. 2.2.4.5

Design/Generation:	Friede & Goldman L-780 Mod V
Construction Shipyard:	Far East Levingston, Singapore
Year Entered Service:	1986
Dimensions:	228ft. Long x 222ft. Wide x 31ft. Deep
Accommodation:	111 persons
Transit Speed:	4 knots
Maximum Water Depth:	361 ft.
Maximum Drilling Depth:	30,000 ft.

Fig. 2.2.4.6
http://itaxynax.hostweb4u.info/offshore-oil-rig-locations.php?i=1

Platform Rigs
Fig. 2.2.4.6

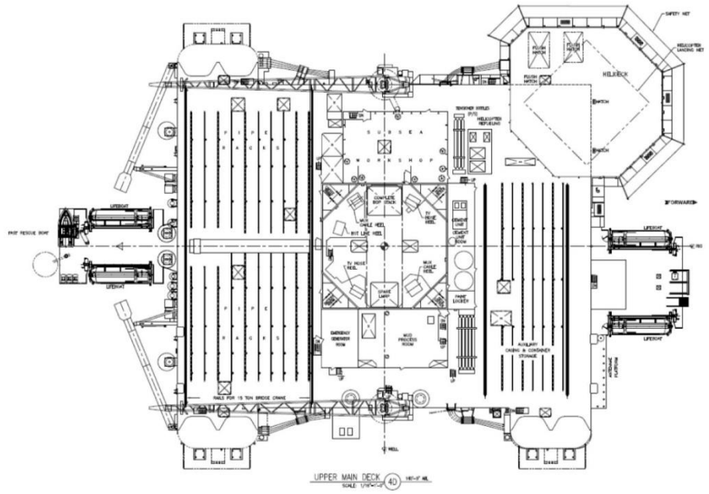
These are self-contained rigs that are placed on fixed platforms for field development drilling. some are called self-erecting and can be rigged up in as little as a few days. other larger units require a derrick barge to be installed and can take up to two weeks to be rigged up. once drilling is completed, the rig is removed from the platform.

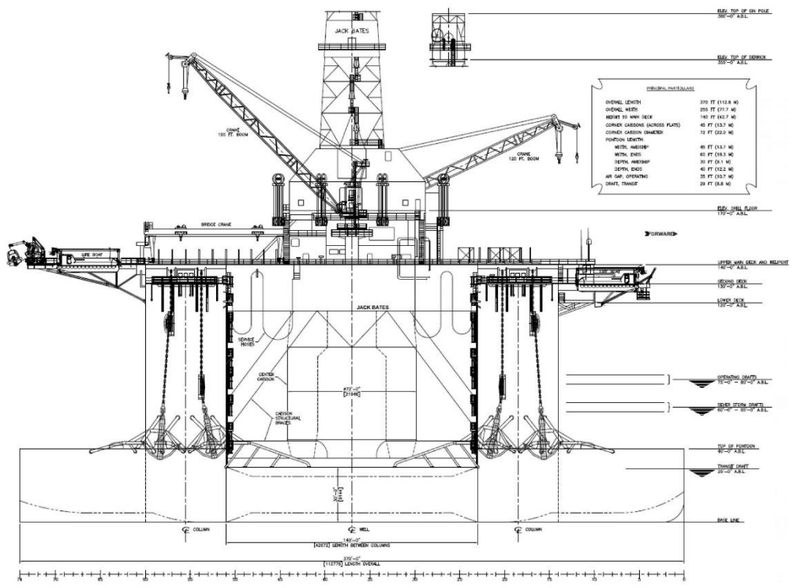
Fig. 2.2.4.7
https://plus.google.com/117074213209680994035

Semi-submersibles
Fig. 2.2.4.7

Used for deepwater drilling, these floating rigs, (sometimes referred to as “floaters”) have columns that are ballasted to remain on location either by mooring lines anchored to the seafloor or by dynamic positioning system. A Mooring Line is a steel cable that is used to secure buoys and prevent free movement. A dynamic positioning system is a computer added system that commutates to small propellers under the rig to keep it the correct location. they are used for both exploratory and development drilling.

Jack Bates





Revision Date: 24 June 2014

Fig. 2.2.4.8

General Description

Fig. 2.2.4.8

Design/Generation:	Friede & Goldman L-1020 Trendsetter
Construction Shipyard:	Ishikawajia-Harima Heavy Ind., Japan
Year Entered Service:	1986/1997
Dimensions:	370ft. Long x 255ft. Wide x 140ft. Deep
Accommodation:	136 persons
Transit Speed:	8 knots
Maximum Water Depth:	5,400 ft.
Maximum Drilling Depth:	30,000 ft.

Design Analysis

2.3

Site Analysis

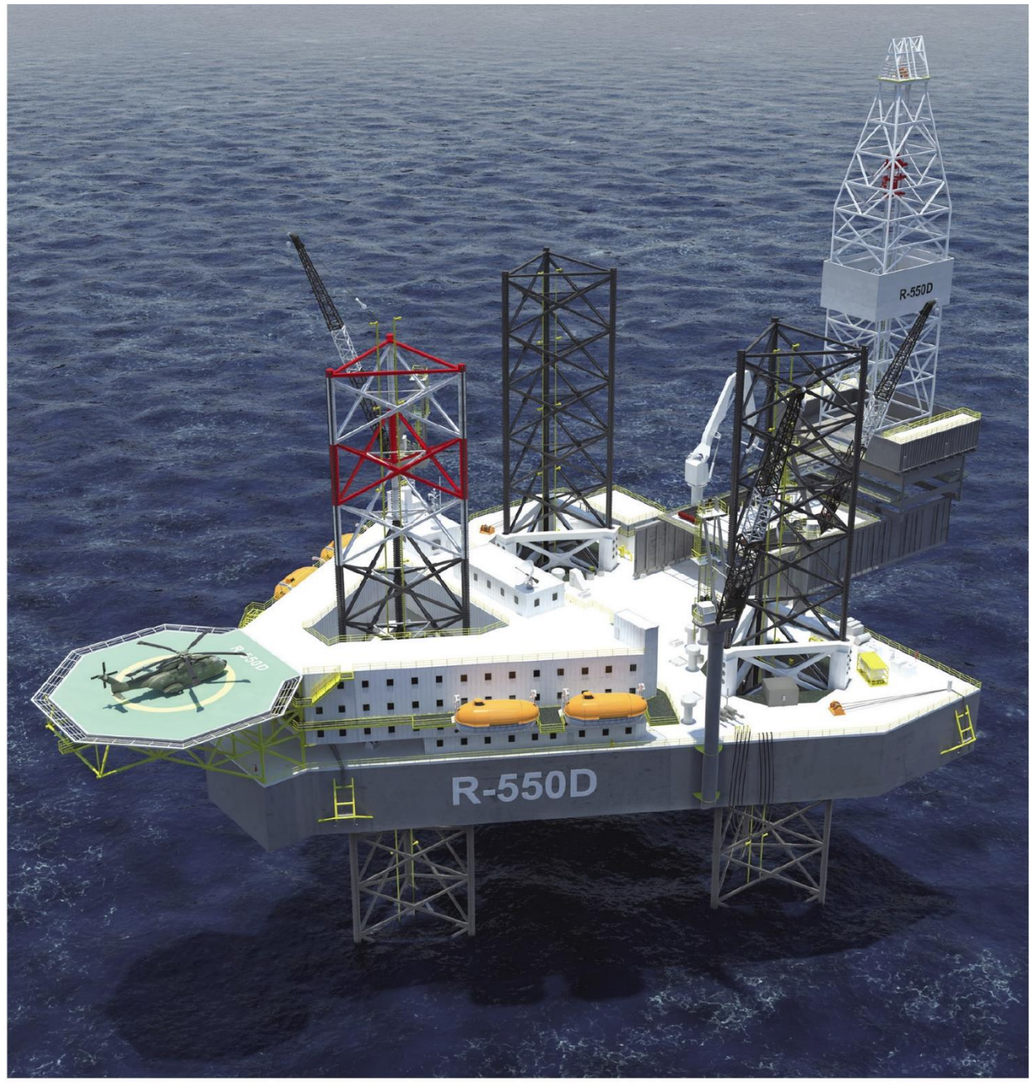


Fig. 2.3.1.1
http://zentech-usa.com/new-build-designs/jackup-rig-designs/r-550d/

Zentech
R-550D Jack-up Rig
Fig. 2.3.1.1

Jack-up rigs are one of the most commonly used oil rig in the GOM second to Semi-submersible rigs. This is also a modern day rig design that offers accommodations for 150 persons. There is one helideck for transportation of the crew persons back to the main land.
The Crew typically spends two weeks on board and two weeks off. While onboard for their two week shift they work everyday; typically 12 hour shifts. An oil rig is a machine that runs 24/7. This is because our economy relies heavily on the crude oil that the rig extracts from below the sea floor.

The jack up design has 3 or 4 main legs that hold up the structure and allow for the Hull to be raised or lowered depending on the required air gap. Attached to the bottom of the legs are spud cans which serve as anchors. The spud cans get burred deep into the sea floor, sometimes as deep as 100 Ft.

The derrick is a massive structure that is cantilevered over 80 Ft. off the backside of the rig. The derrick houses and moves the pipe so the roughnecks can attach it to the other pipe. These segments of pipe are joined together to extend, in this case, down to a maximum of 30,000 Ft.

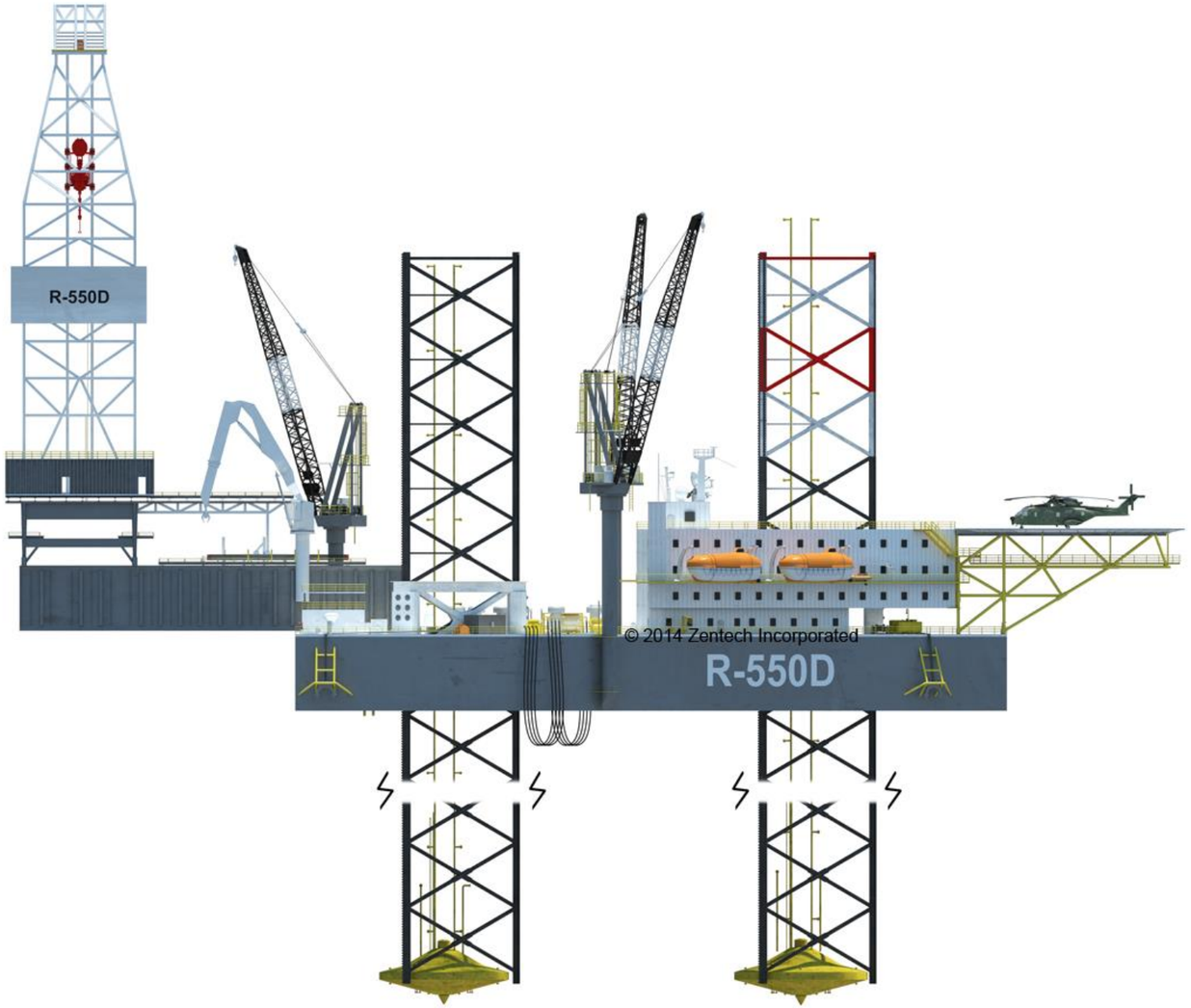


Fig. 2.3.1.2
http://zentech-usa.com/new-build-designs/jackup-rig-designs/r-550d/

Zentech
R-550D Jack-up Rig
Fig. 2.3.1.2

- Living Quarters holds 150 persons
- Utilities and drains configured for zero discharge
- Base design for closed loop or air cooling of all equipment
- Drilling depth 30,000 Ft.

Hull

Hull Length	260 Ft.
Hull Width	261 F.t
Hull Depth	27 Ft.
Transverse Leg Center	142 Ft.
Longitudinal Leg Center	129 Ft.

Legs

Triangular, open truss X-braced legs

3 Leg configuration	558.5 Ft.
Spud Can Dia.	54 Ft.

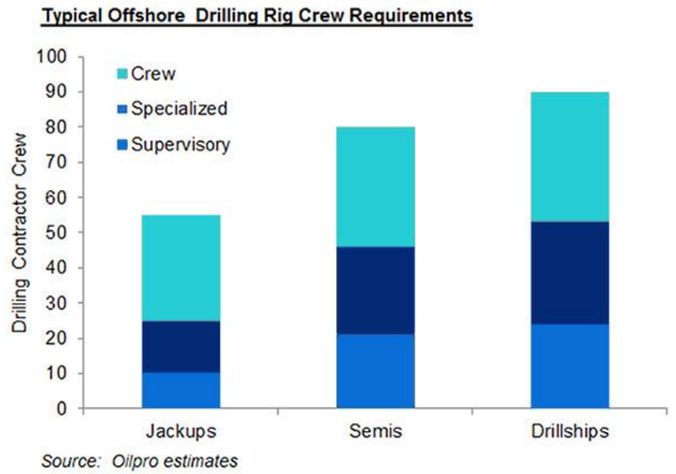


Fig. 2.3.1.3

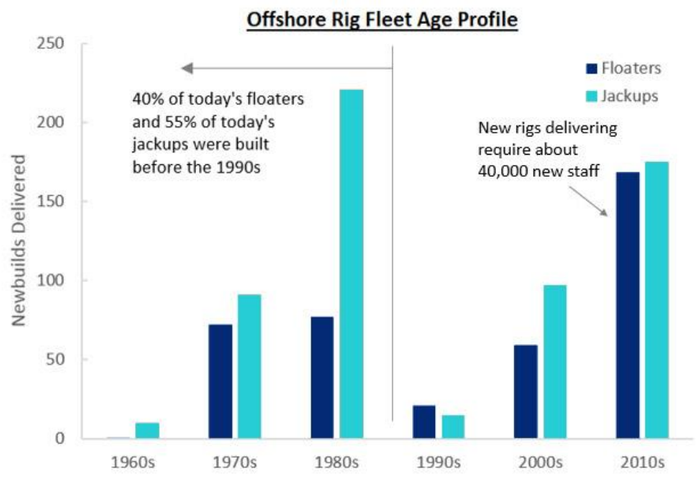


Fig. 2.3.1.4

Compared to other types of rigs, jack-ups have a larger group of crew members (roughnecks) Fig. 2.3.1.3 than other forms of management. Because of the complexity of a jack-up rig there a lot more moving parts. For example, on the R-550D there are three pedestal cranes that need to be running at all times to supply pipe to the derrick. The pipe is stored on the main deck when its not in use. The pipe is in twenty Foot segments and takes many links to reach the oil well below. the crew members on the deck are doing all of the manual labor.

These days there are almost as many semi-submersibles as there are jack-ups. according to Fig. 2.3.1.4. both types of rigs are usable for the same number of years before it is retired and sent to the bone yard. A rig will typically last about 20 years before it has to be retired because it is unsafe to operate and outdated by newer rigs and technologies. It is then sent off to a bone yard, broken down, and reused to meet current standards and regulations. Therefore, it is reborn and sent out to sea again.

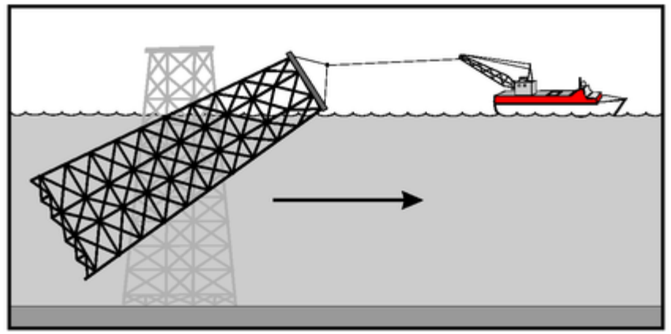


Fig. 2.3.1.5
http://www.rig2reefexploration.org/read-me/

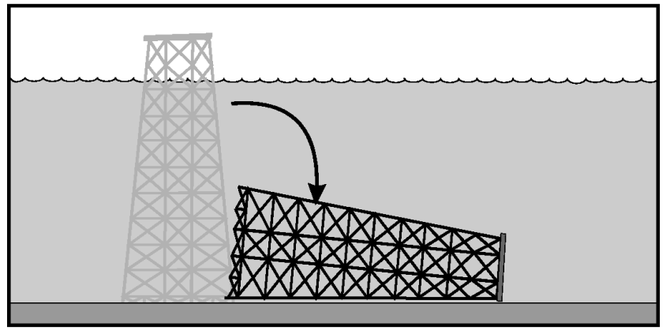


Fig. 2.3.1.6
http://www.rig2reefexploration.org/read-me/

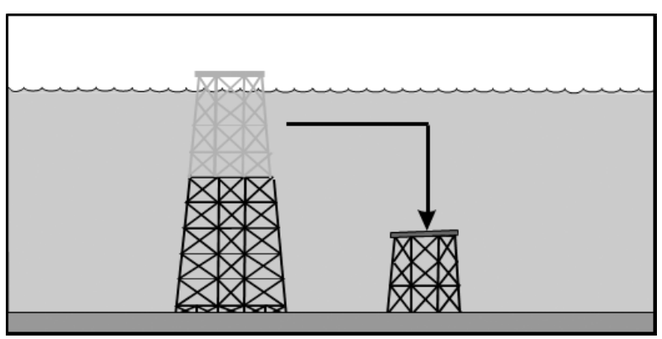


Fig. 2.3.1.7
http://www.rig2reefexploration.org/read-me/

Rigs-To-Reefs

"Rigs-To-Reefs provides an alternative to complete rig removal in which an oil company chooses to modify a platform so that it can continue to support marine life as an artificial reef. Through this decommissioning process, the oil well is capped and the upper 85 feet of the platform is either towed, fig. 2.3.1.5, toppled, in place fig. 2.3.1.6 or removed. fig. 2.3.1.7. Not all platforms are suitable as reefing candidates, and in order for any platform to be considered for reefing, it must undergo extensive ecological evaluations to assess any potential value it might add to the local ecosystem."

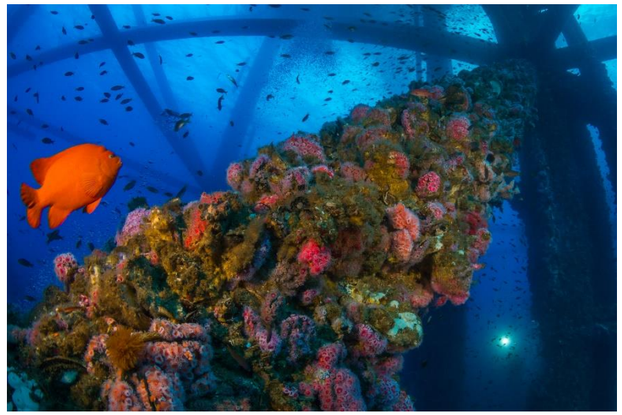


Fig. 2.3.1.9

http://www.rig2reefexploration.org/read-me/

Fig. 2.3.1.10

http://www.rig2reefexploration.org/read-me/

Fig. 2.3.1.11

http://www.rig2reefexploration.org/read-me/

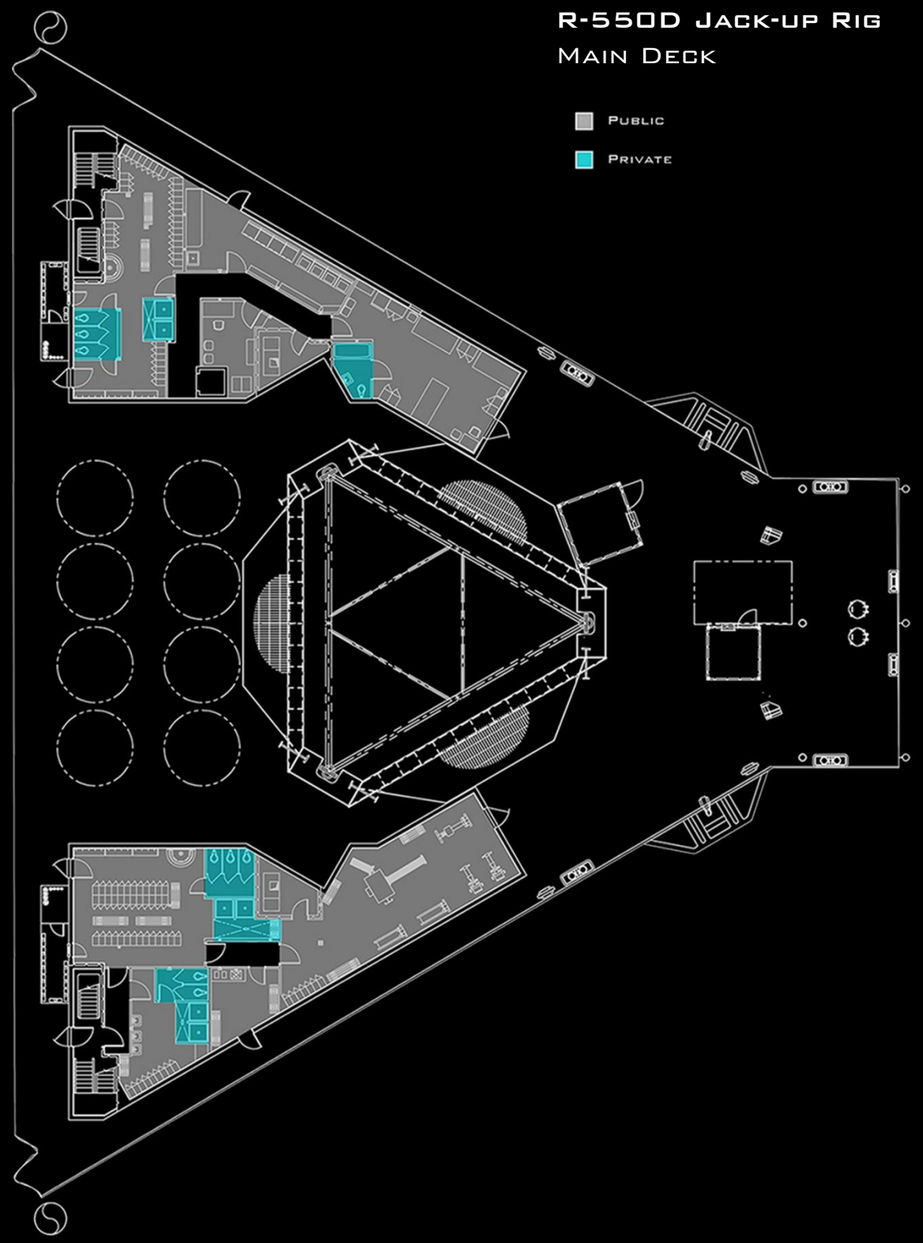
Rigs-To-Reefs

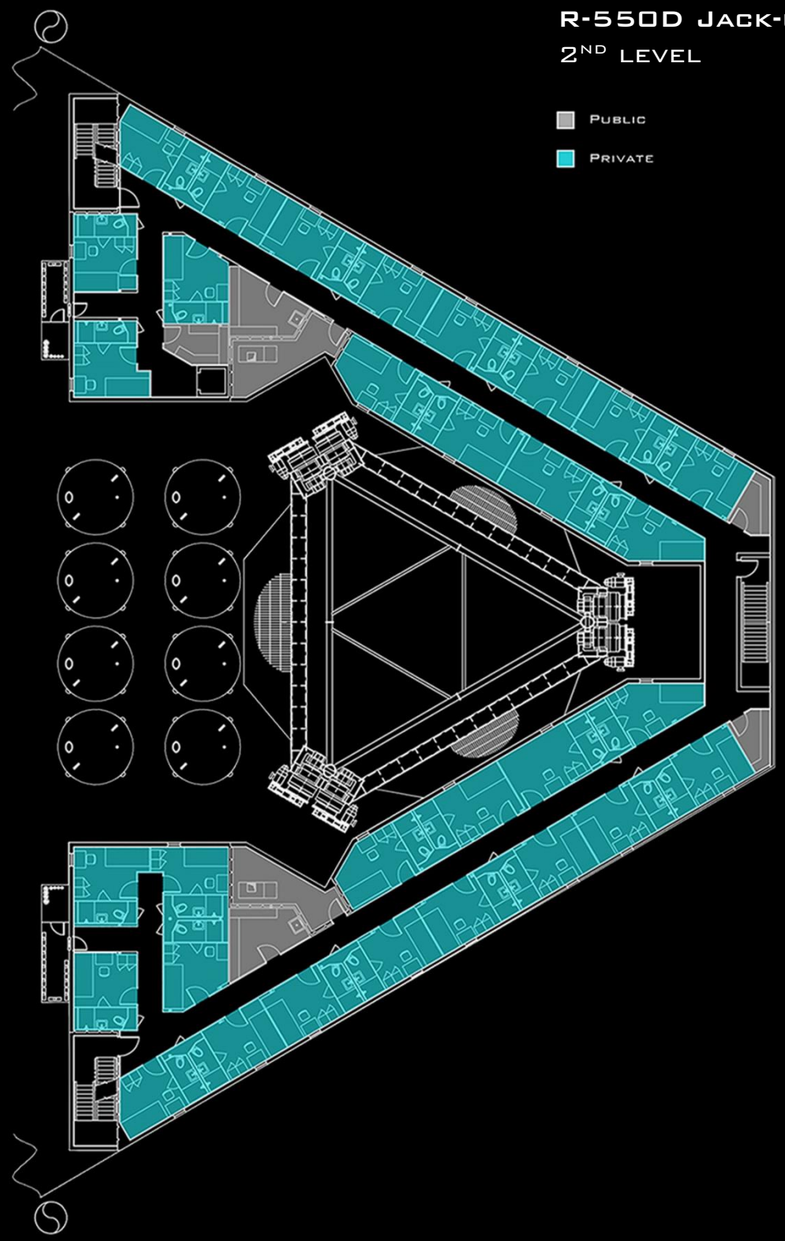
The legs on a Jack-up rig naturally create a marine eco-system. while the rig is busy extracting oil, there are thousands of fish and marine life swimming around the structure of the legs. because of the heavy structure, this creates safe areas for smaller fish to hide from predators. Also, unsurprisingly, coral starts to develop and grow on the structure which promotes the marine eco-system that is created. Many people take photos and like to fish around Jack-up rigs because of the large amount of marine activity.

It is for this reason that the marine R+D center be underwater. With the center surrounded by structure, there be ample windows to exhibit this. The R+D center would be able to study and record the growth of the eco-system in real time. After a few years of data collection, it could be possible to speed up the process of developing a marine ecosystem.

As seen in fig. 2.3.1.9,.10, and .11 the photos are breath taking. Imagine enjoying the beauty of the marine growth, and the same view as an experienced diver without ever getting into the water.

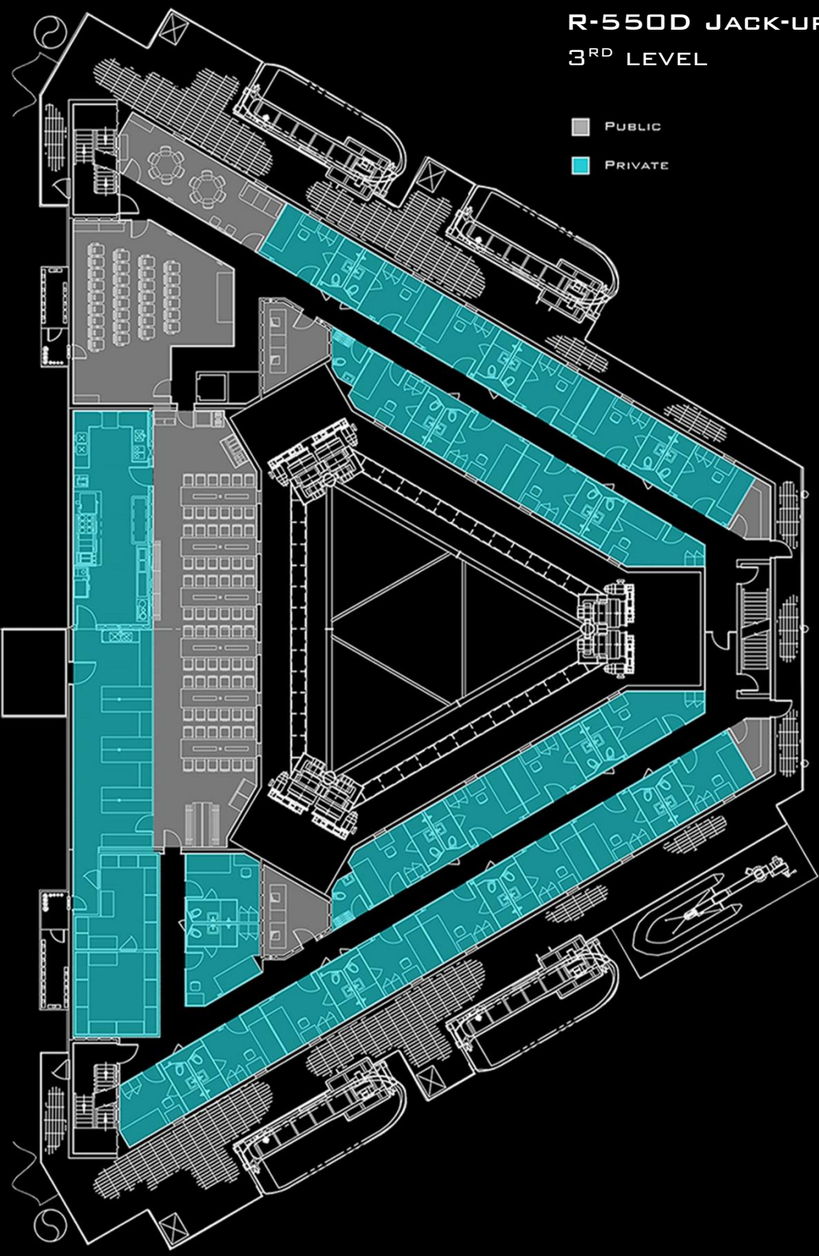
Zentech
R-550D Jack-up Rig
Main Deck





Zentech
R-550D Jack-up Rig
2nd level

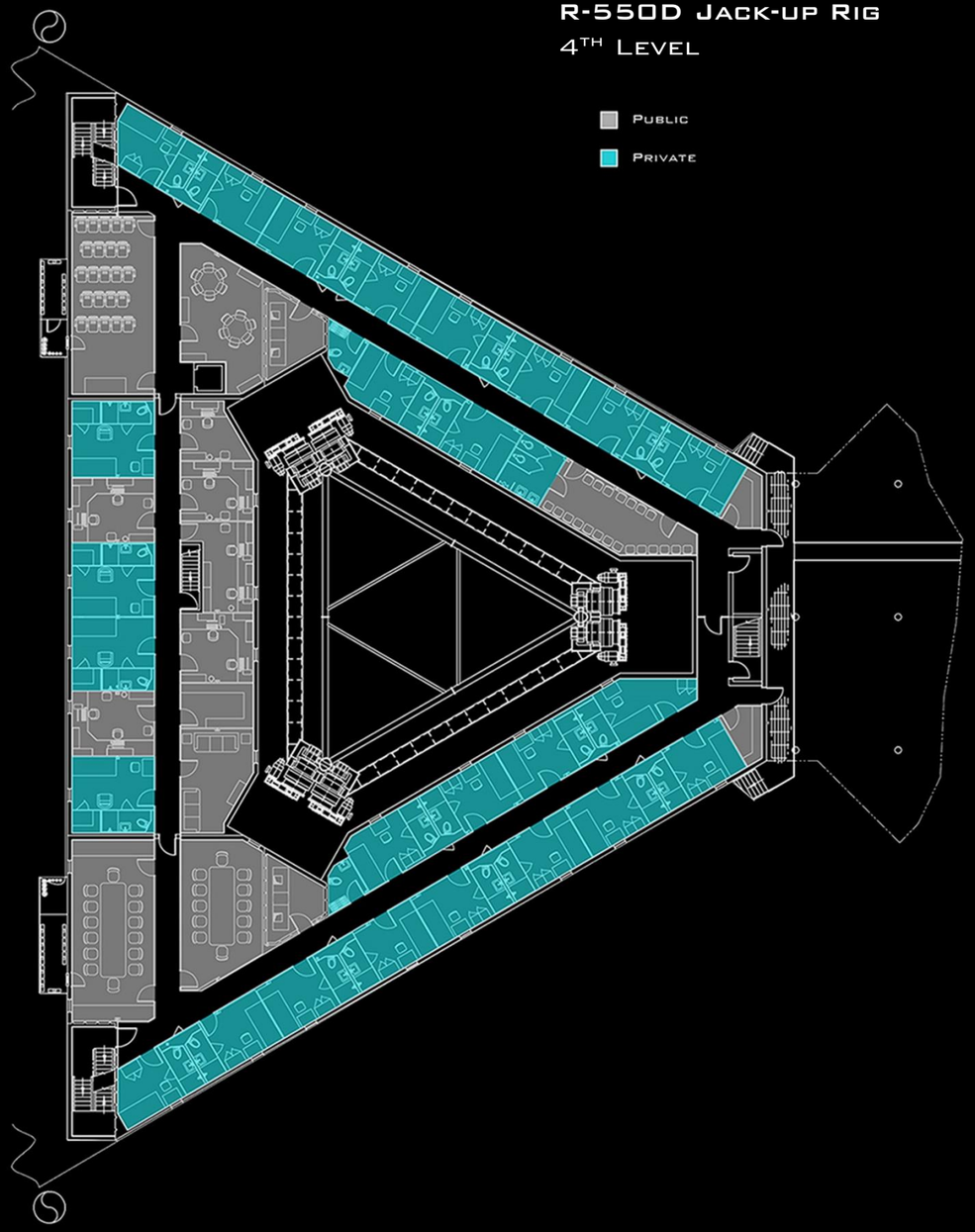
- Public
- Private



Zentech
R-550D Jack-up Rig
3rd level

- Public
- Private

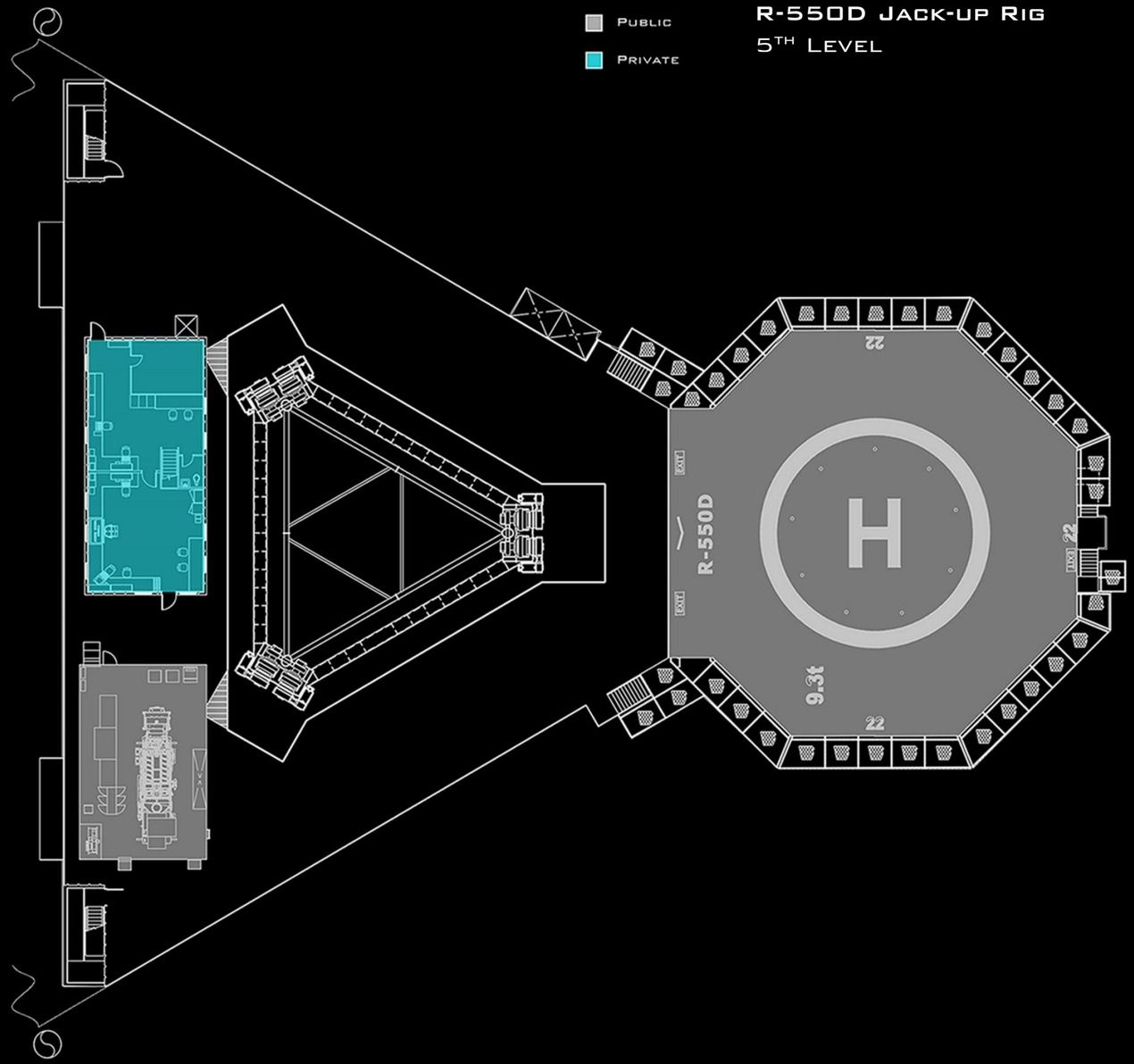
Zentech
R-550D Jack-up Rig
4TH Level



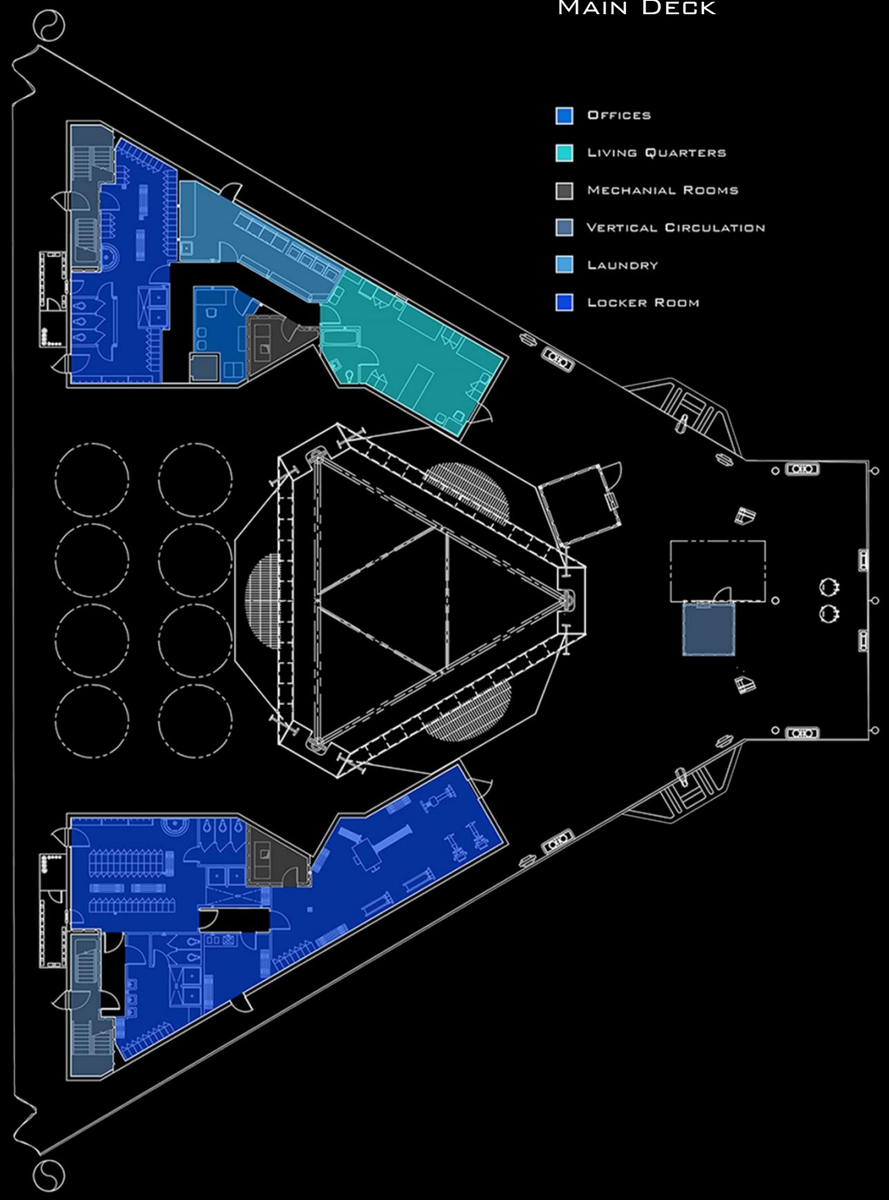
Public

Private

Zentech
R-550D Jack-up Rig
5TH Level



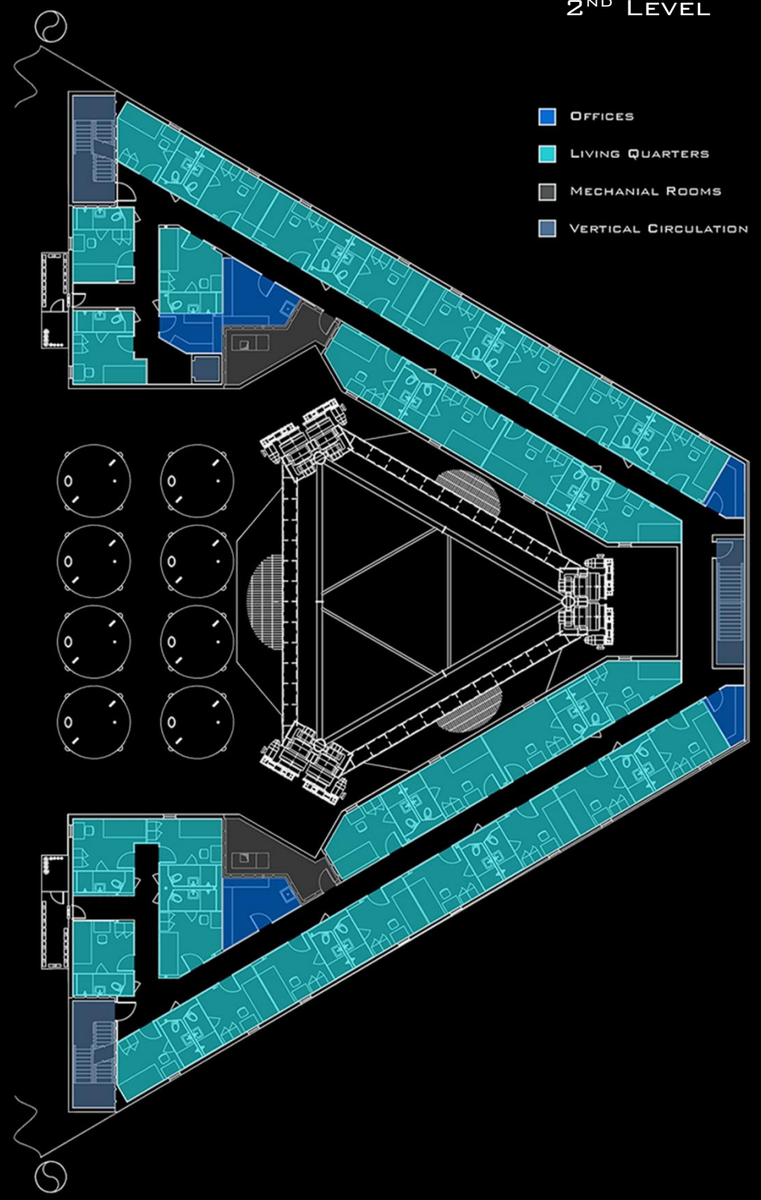
Zentech
R-550D Jack-up Rig
Main Deck



Area Distribution

Office:	144 s.f.
Living Quarters:	566 s.f.
Mechanical:	160 s.f.
Vertical Circ:	471 s.f.
Laundry room:	323 s.f.
Locker Room:	2498 s.f.

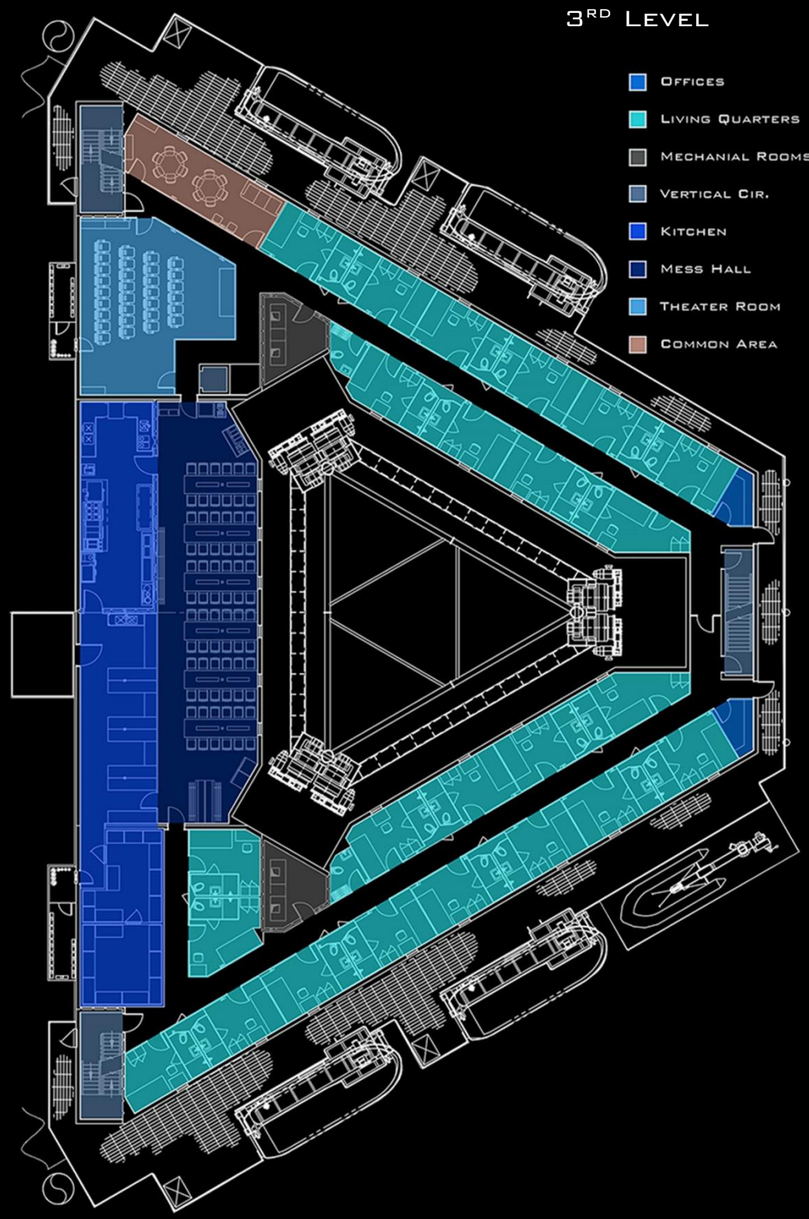
Zentech
R-550D Jack-up Rig
2nd Level



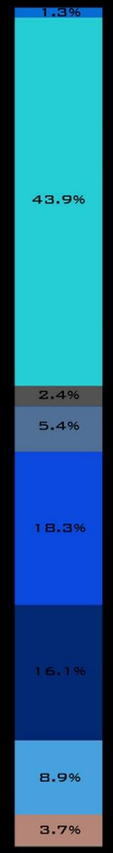
Area Distribution

Office:	376 s.f.
Living Quarters:	5307 s.f.
Mechanical:	298 s.f.
Vertical Circ:	471 s.f.

Zentech
R-550D Jack-up Rig
3rd Level

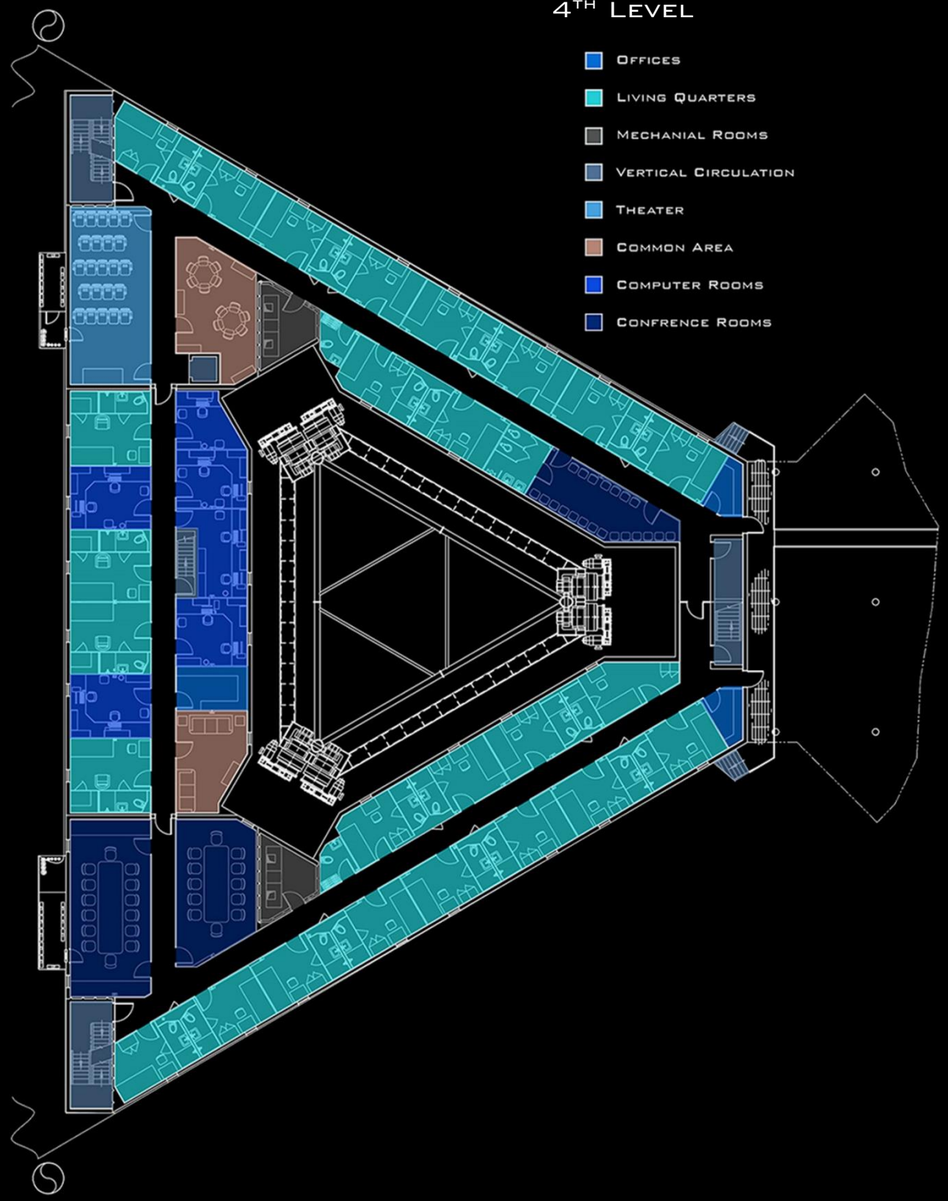


Area Distribution



Office:	114 s.f.
Living Quarters:	3854 s.f.
Mechanical:	208 s.f.
Vertical Circ:	471 s.f.
Kitchen:	1610 s.f.
Mess Hall:	1413 s.f.
Theater Room:	777 s.f.
Common Area:	328 s.f.

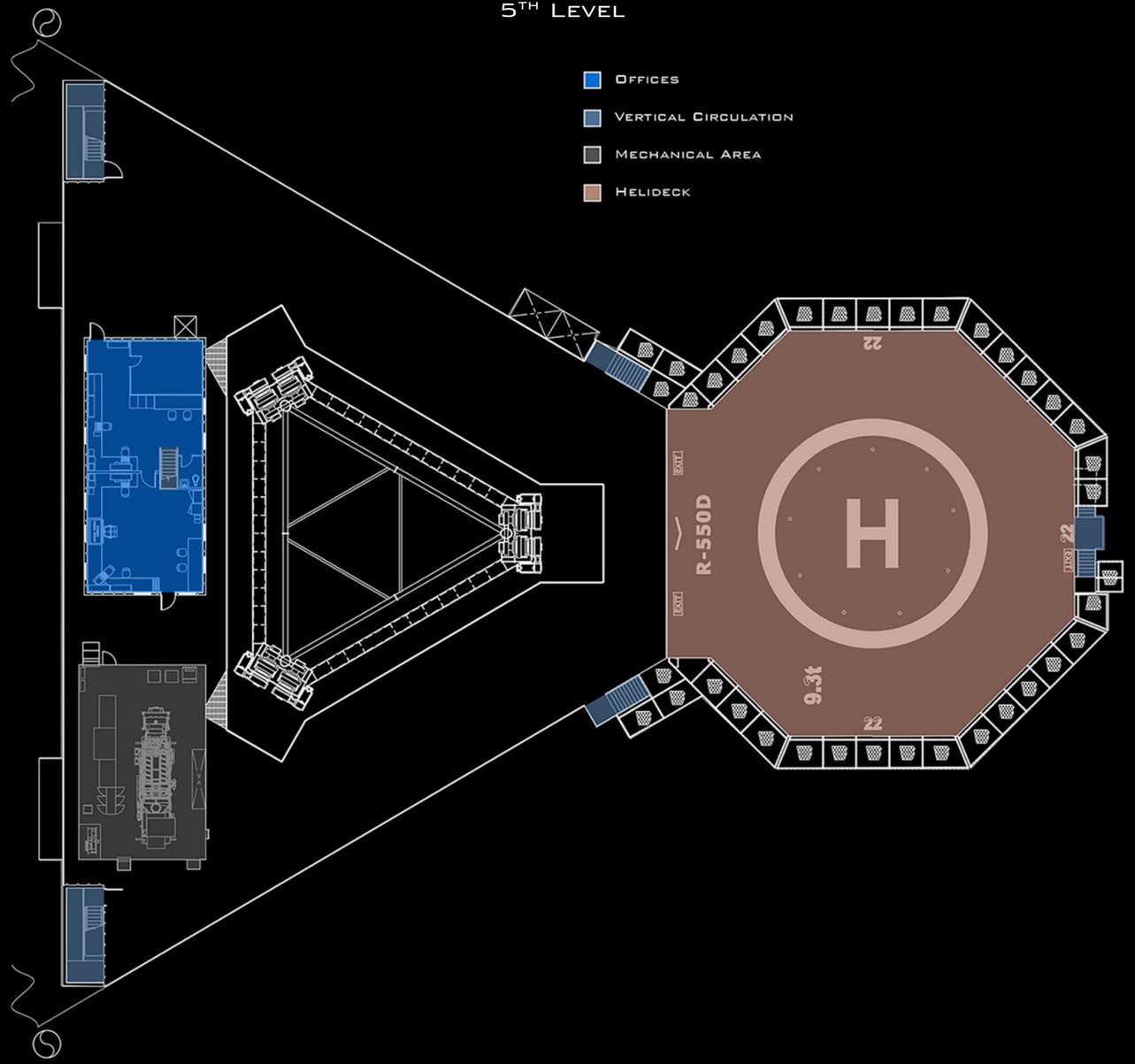
Zentech
R-550D Jack-up Rig
4th Level



Area Distribution

Office:	222 s.f.
Living Quarters:	4585 s.f.
Mechanical:	234 s.f.
Vertical Circ:	512 s.f.
Theater:	489 s.f.
Common Area:	539 s.f.
Computer Rooms:	950 s.f.
Confrence Rooms:	1123 s.f.

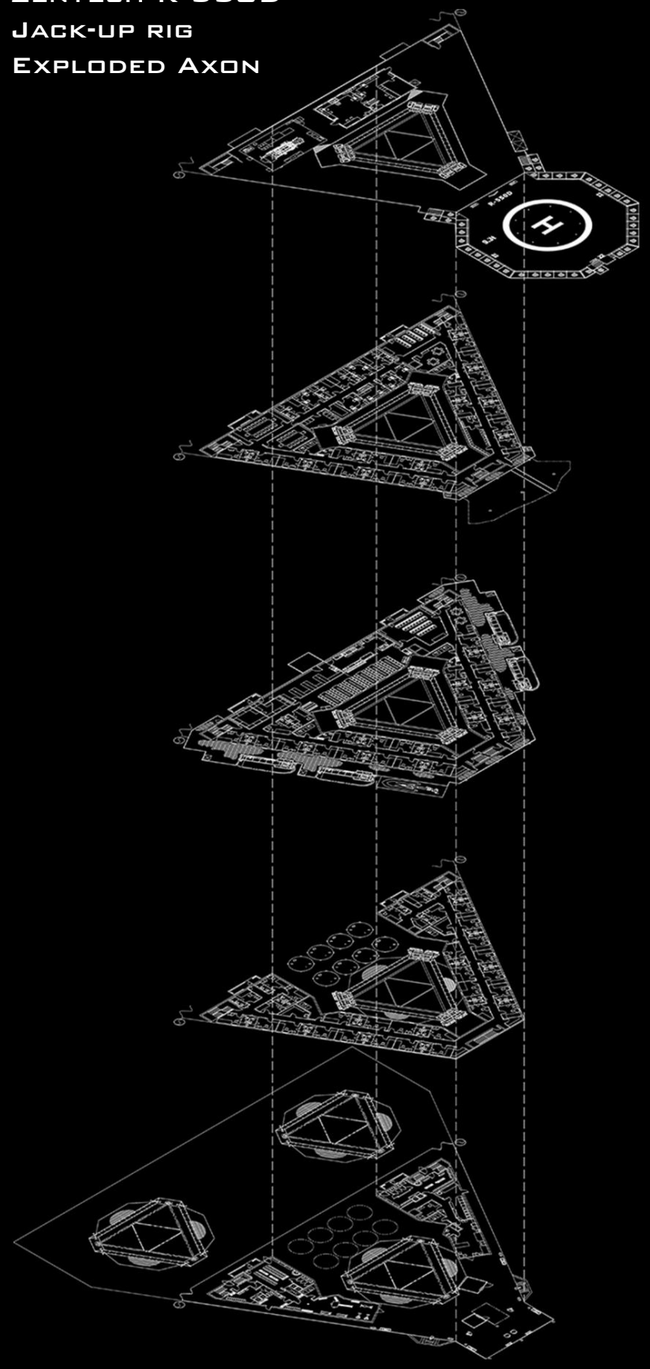
Zentech
R-550D Jack-up Rig
5th Level



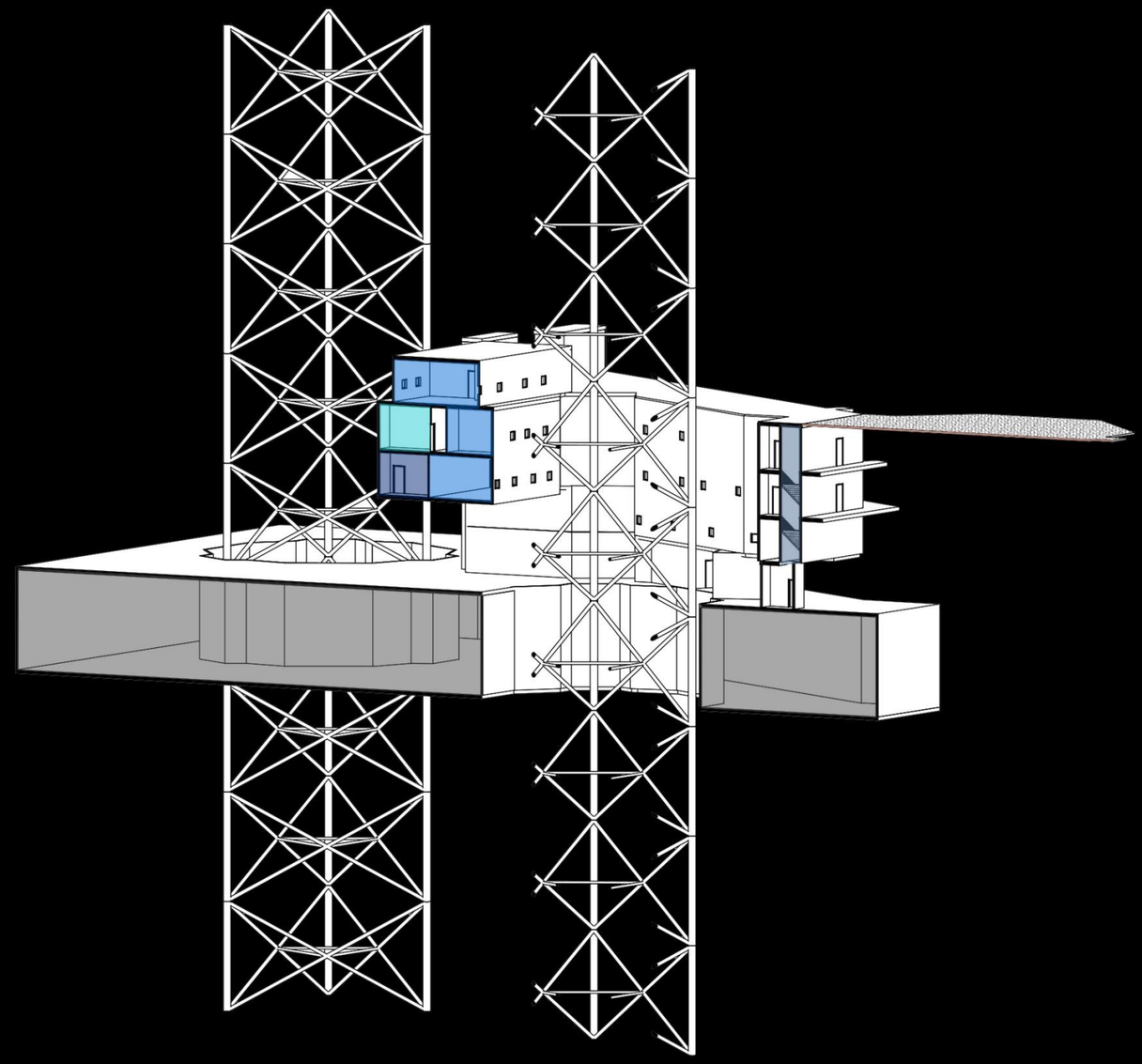
Area Distribution

Office:	970 s.f.
Vertical Circ:	533 s.f.
Mechanical:	885 s.f.
Helideck:	4895 s.f.

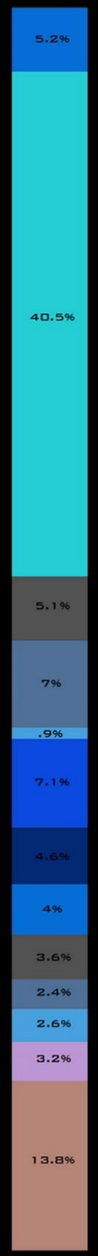
Zentech R-550D
Jack-up rig
Exploded Axon



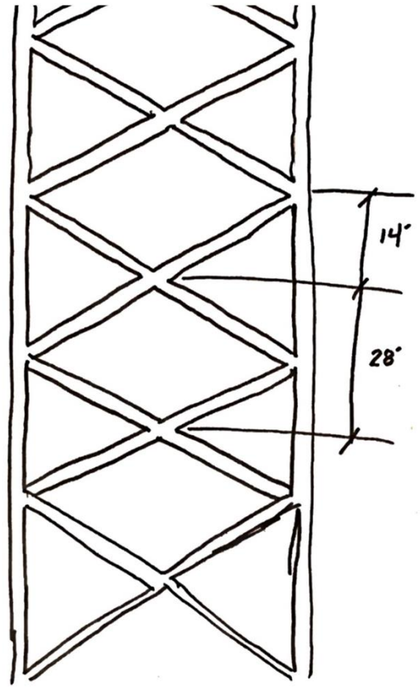
Zentech R-550D
Jack-up rig
Section

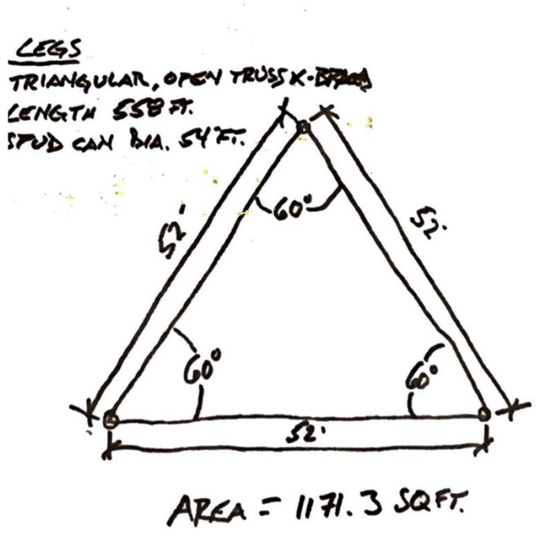


Total Area Distribution



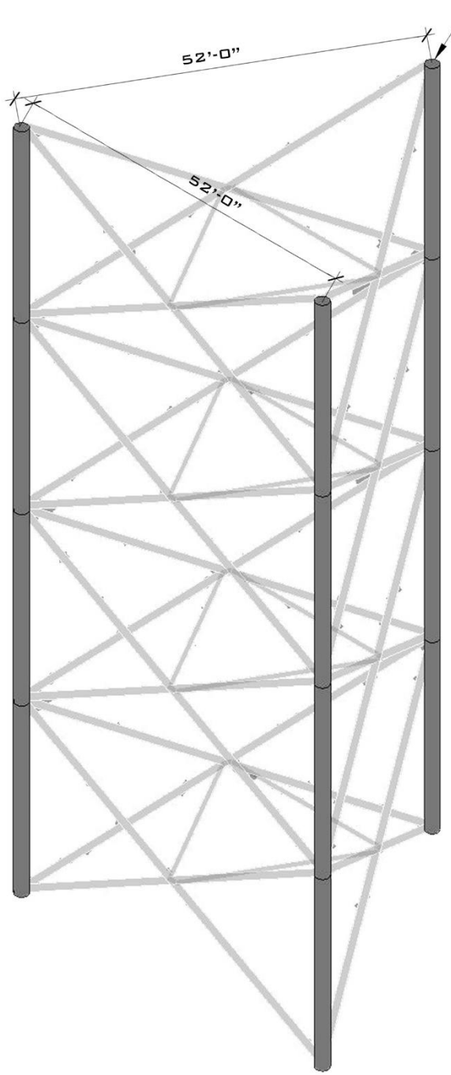
Office:	1826 s.f.
Living Quarters:	14312 s.f.
Mechanical:	1785 s.f.
Vertical Circ:	2458 s.f.
Laundry room:	323 s.f.
Locker Room:	2498 s.f.
Kitchen:	1610 s.f.
Mess Hall:	1413 s.f.
Theater:	1266 s.f.
Common Area:	867 s.f.
Computer Rooms:	950 s.f.
Confrence Rooms:	1123 s.f.
Helideck:	4895 s.f.
total:	46641 s.f.



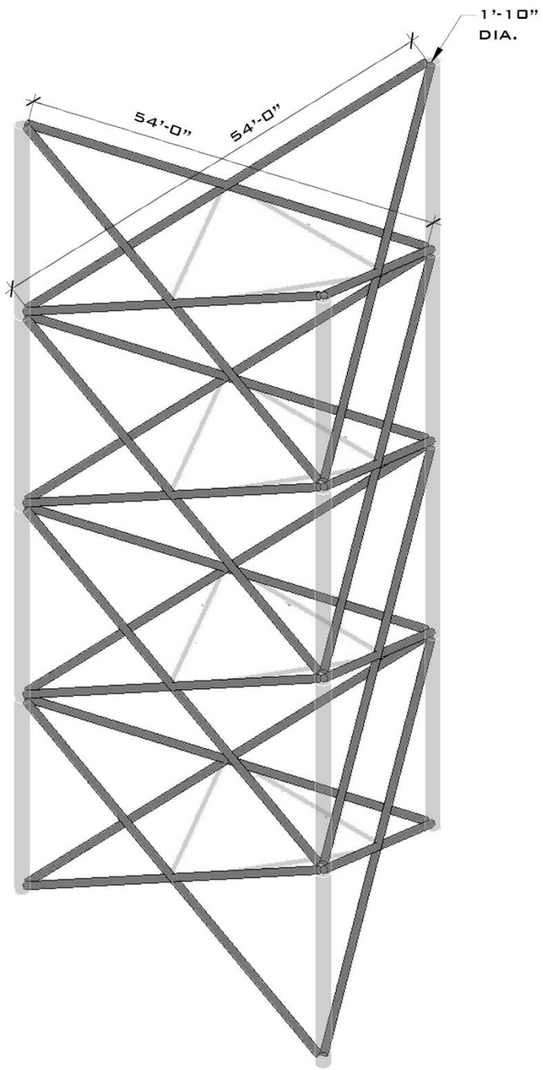


Zentech
R-550D Jack-up Rig

Elevation and plan sketches of Jack-up legs. Understanding how these complex leg structures work took many studies. This structure informed one of the designed that was generated. The whole R+D center was built around one of these jack-up legs. Since the Square footage is 1171 within it was enough for a lab area.

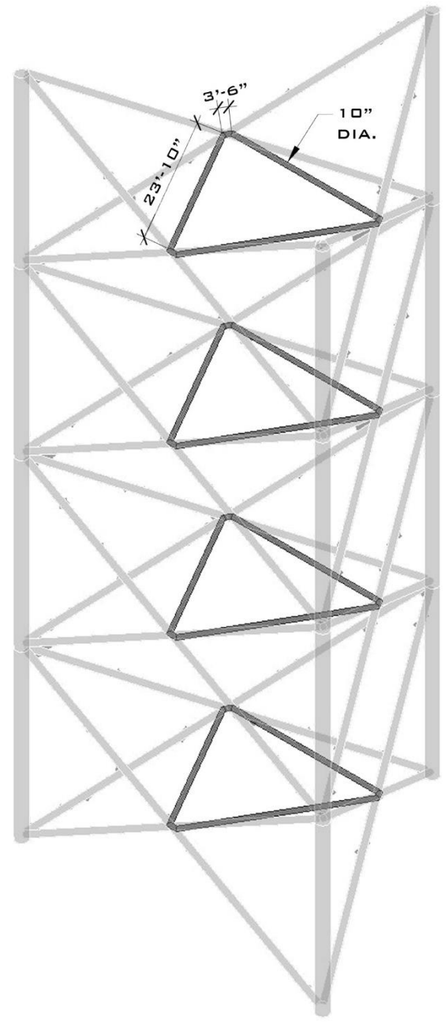


Primary System supports vertical loads. This load is carried down to the Spud cad and transferred to the sea floor.
Tubular Steel 3'-4" Dia.



Secondary System consist of the open X-Bracing. This system holds the primary together.

Tubular Steel 1'-10" Dia.



Tertiary system supports lateral loads from the primary and secondary system.

Tubular Steel 10" Dia.

Zentech
R-550D Jack-up Rig

Triangular, Open Truss X-Braced Legs
Constructed of Tubular Steel
3 Leg Configuration
558.5 Ft. in Length

Design Analysis

2.4

Program and Spatial exploration

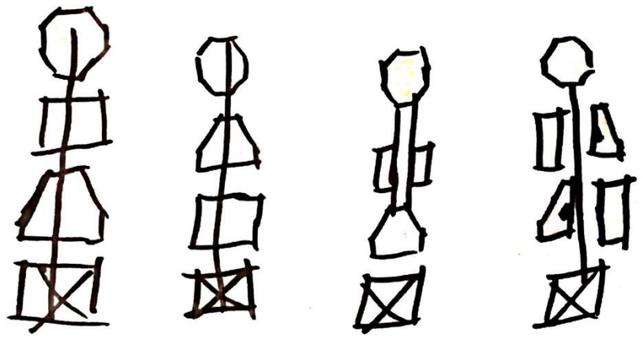
Program for the R+D Center

Oil Rig R+D Center:	
Offices	1120 s.f.
Conference Rooms	2500 s.f.
Lobby	250 s.f.
Restroom	350 s.f.
Locker Rooms	900 s.f.
Labs [5]	4500 s.f.
Training Center	350 s.f.
Total:	13620 s.f.

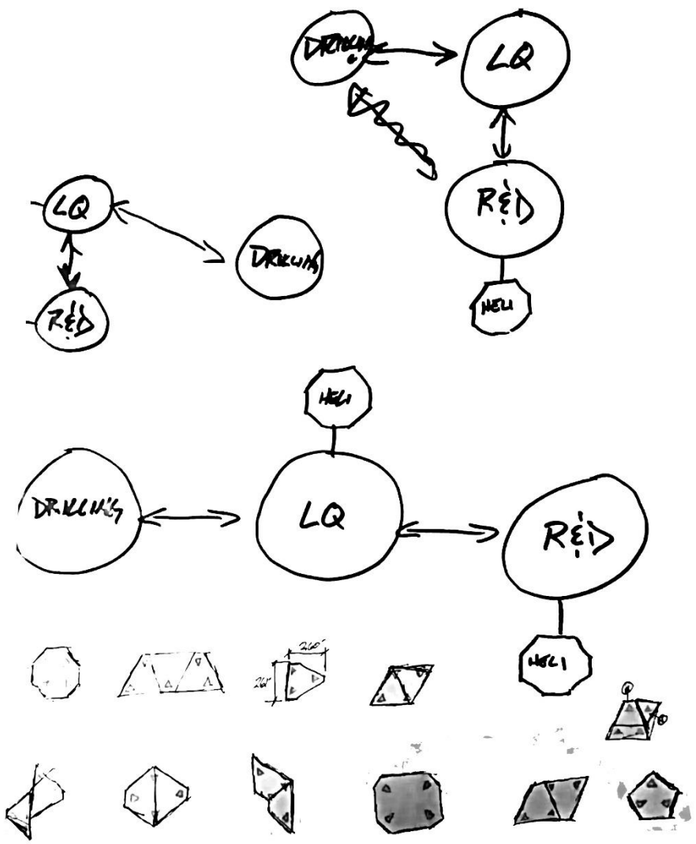
Marine Research Center:	
Auditorium w/ seating	1000 s.f.
Library	550 s.f.
Restroom	350 s.f.
Locker Rooms	900 s.f.
Labs [5]	4000 s.f.
Seawater pool	13500 s.f.
Aquatic Garden	10000 s.f.
Lobby	200 s.f.
Offices [6]	840 s.f.
Conference rooms	2000 s.f.
Gallery Spaces	300 s.f.
(for display or social gatherings)	
Underwater Equipment	2000 s.f.
Total:	35640 s.f.

Overall Total s.f.	49260 s.f.

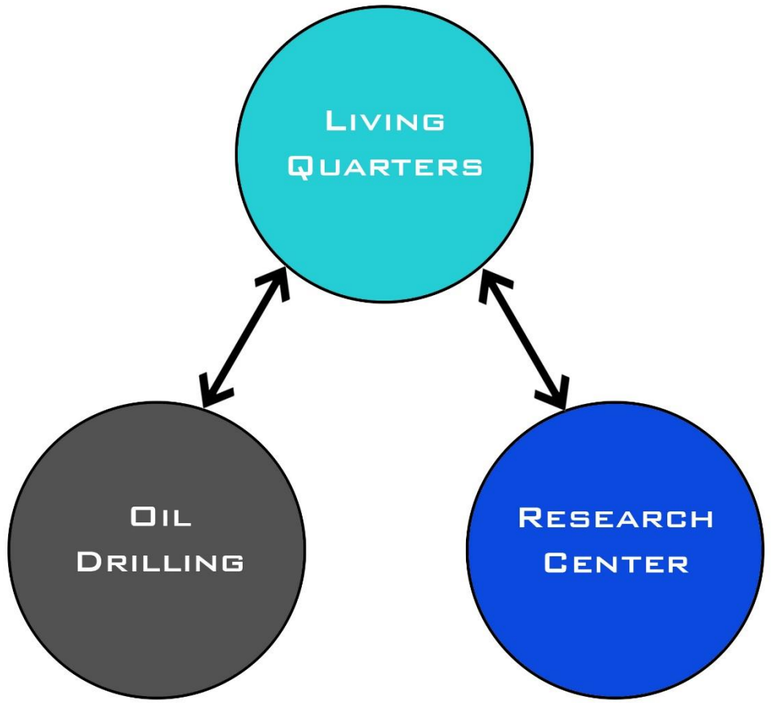
Zentech Oil Rig	45461 s.f.
R+D Center	49260 s.f.
s.f. difference	3799 s.f.



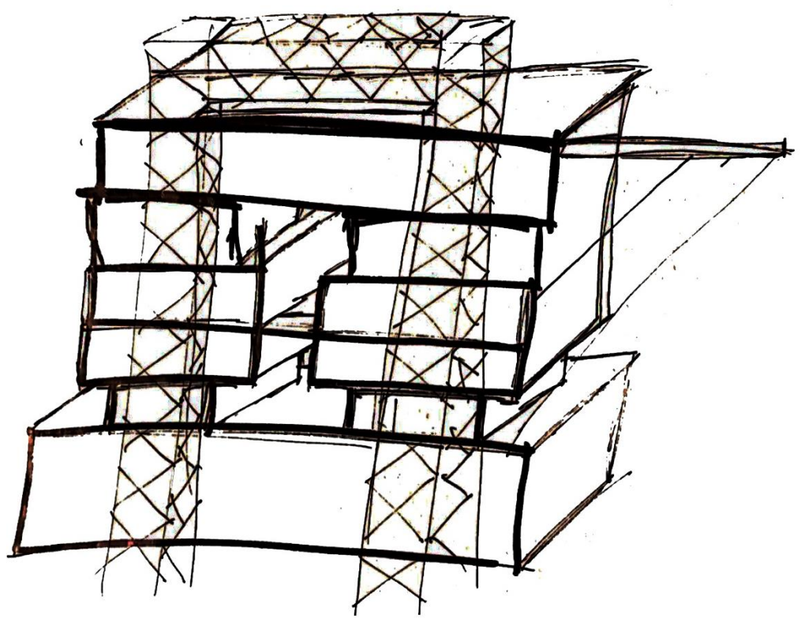
Parti Diagrams



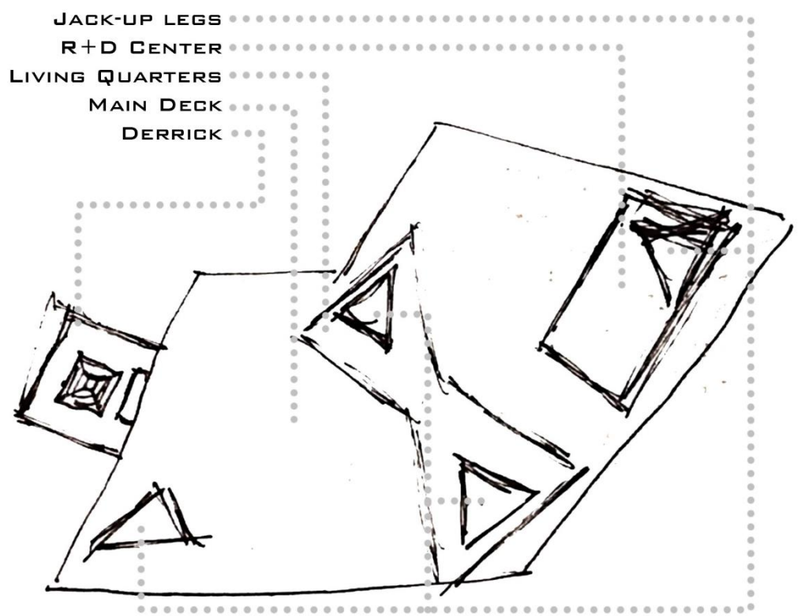
Program Connection diagrams
And Form Diagrams



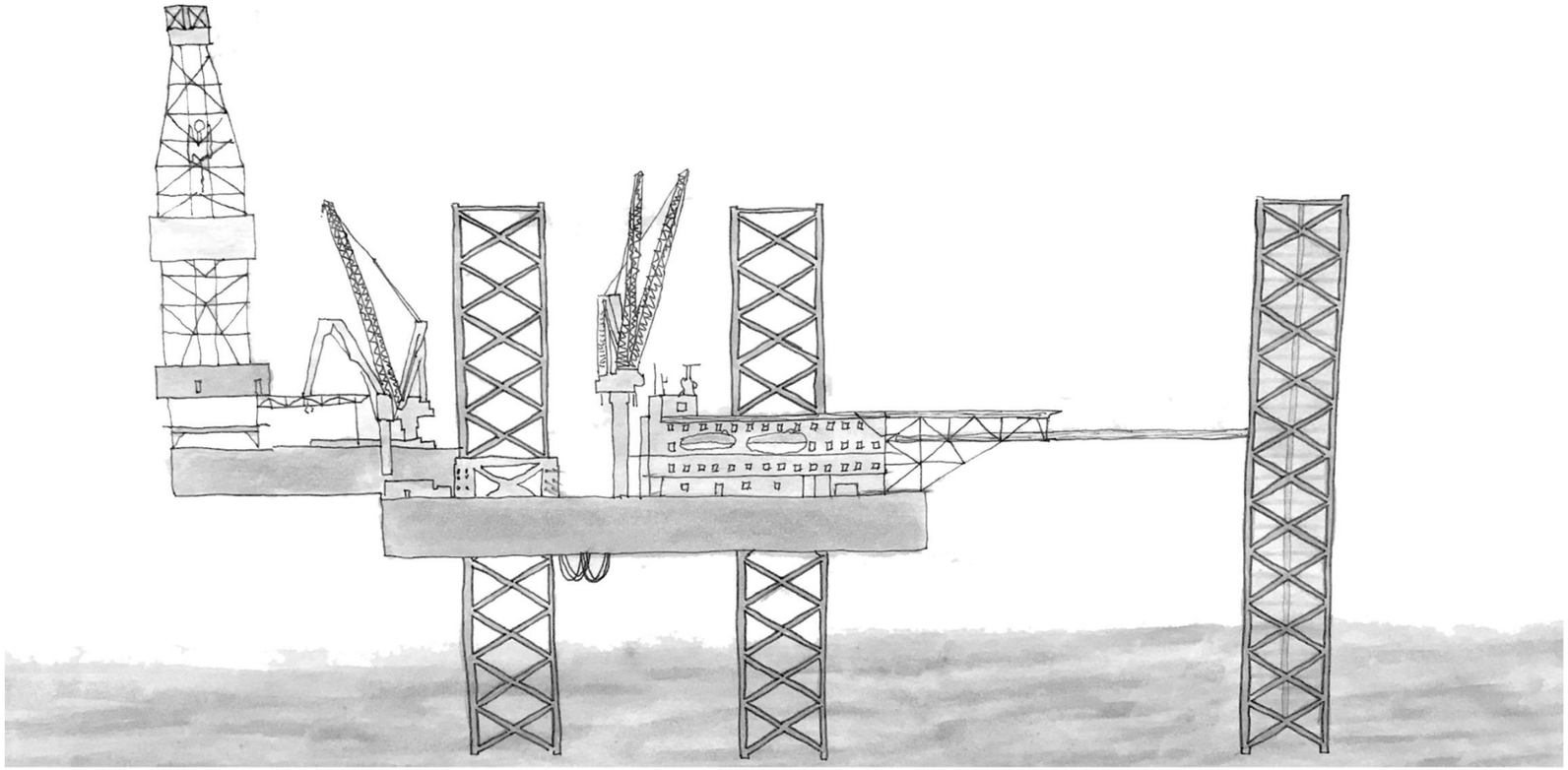
Spatial Connections Diagram



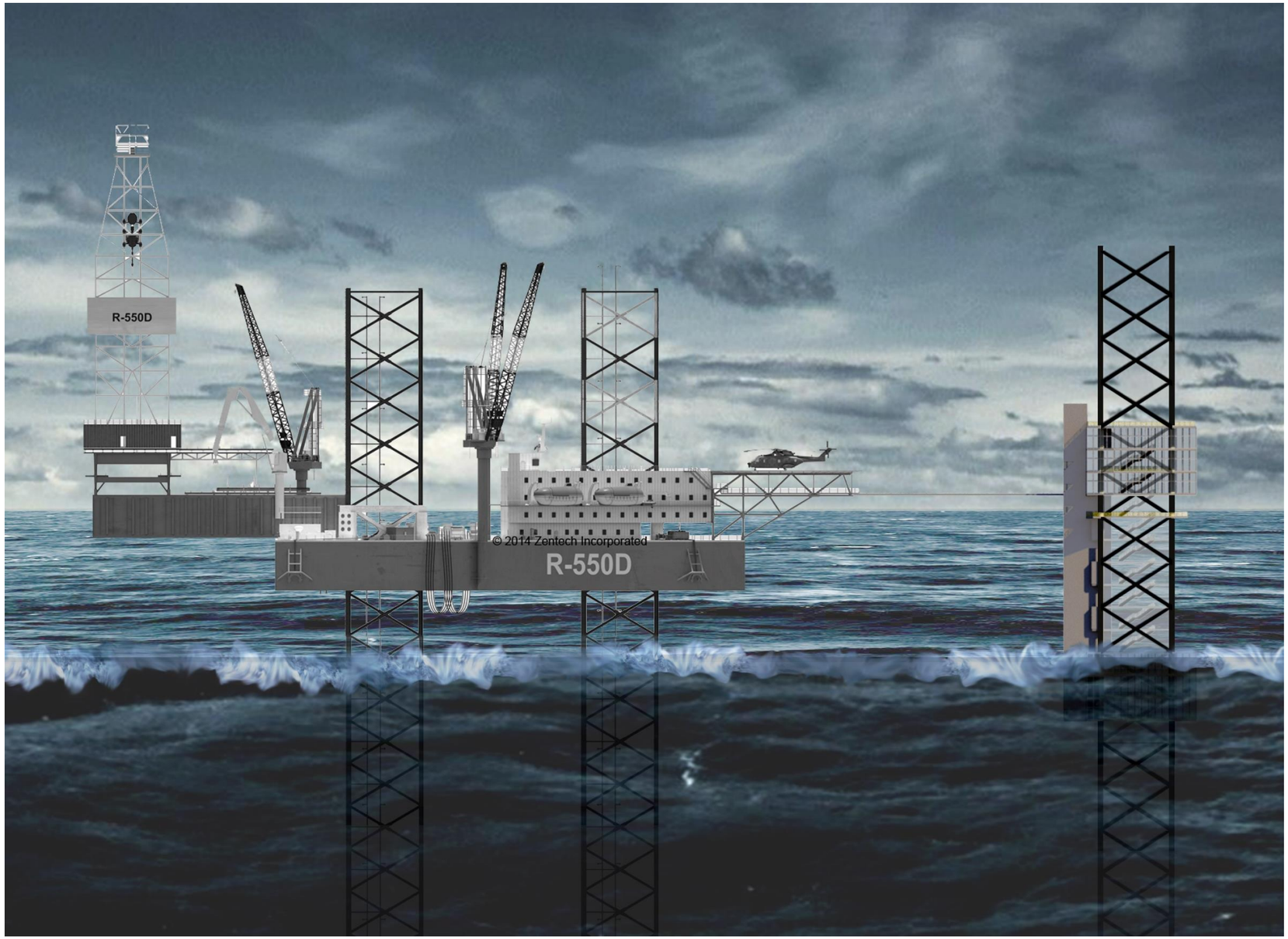
This Diagram was for a new Oil Rig design that had the living quarters above the hull with an open balcony in the middle. The top layer was the R+D Center.



This Diagram was for a new Oil Rig design that was created from previous geometry. the main deck more than doubled in size proving room for more pipe.



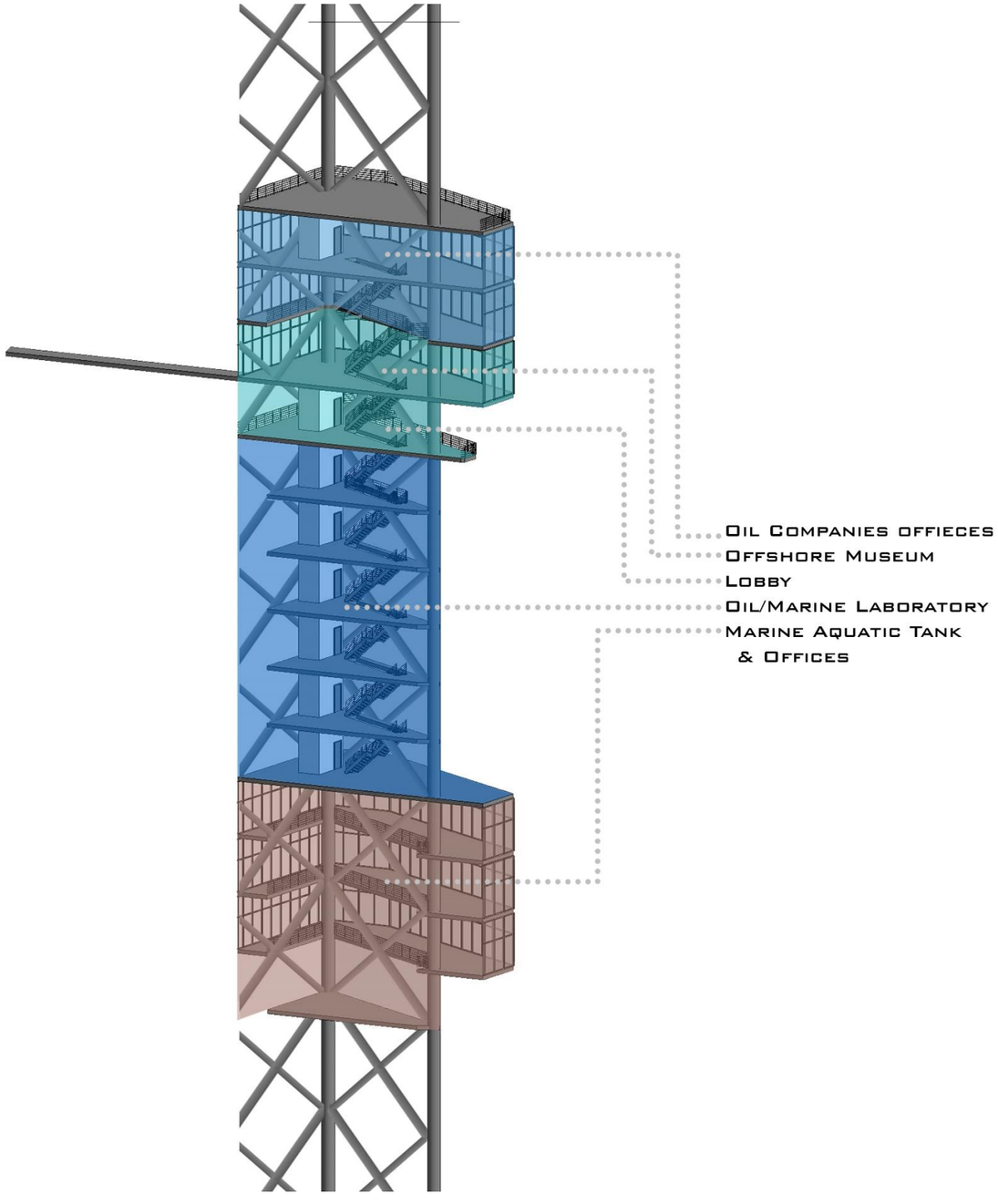
This concept was developed after studies on the jack-up legs. Within each leg there is 1171 s.f. I added a leg to the front of the Oil Rig. The Jack-up structure itself became the R+D Center. The R+D Center has a direct connection back to the living Quarters and the Helideck.



This concept was developed in programmatic approach. The R+D center breaks down into five separate programs, from top to bottom,

Oil Company Conference rooms
Offshore Museum
Lobby
Oil/Marine Laboratory
Under water Marine tank

The persons whom worked in the R+D center would take the journey across the bridge everyday from the Living Quarters to their work areas.



To the left is a sectional axonometric showing the breakdown of the different programs that make up the R+D Center. This study is based within one of the Jack-up rig legs.

Practicum

3.0

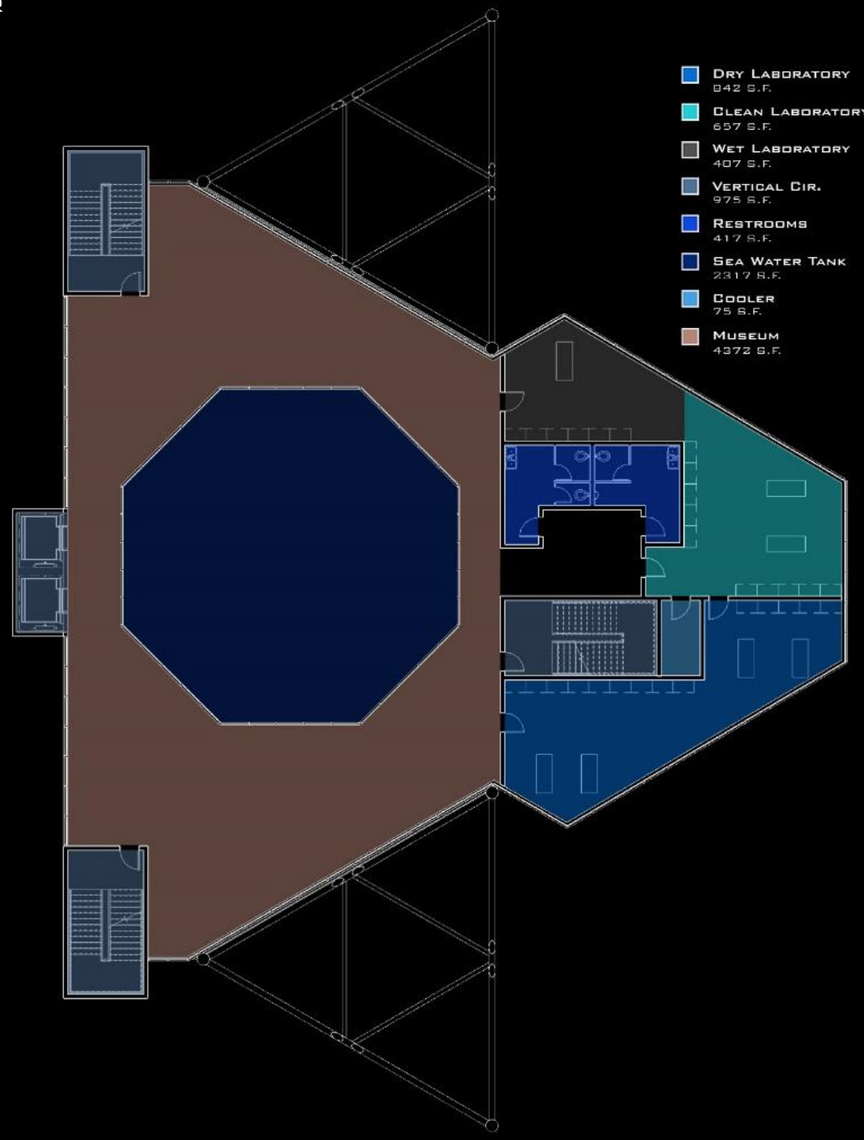
Practicum

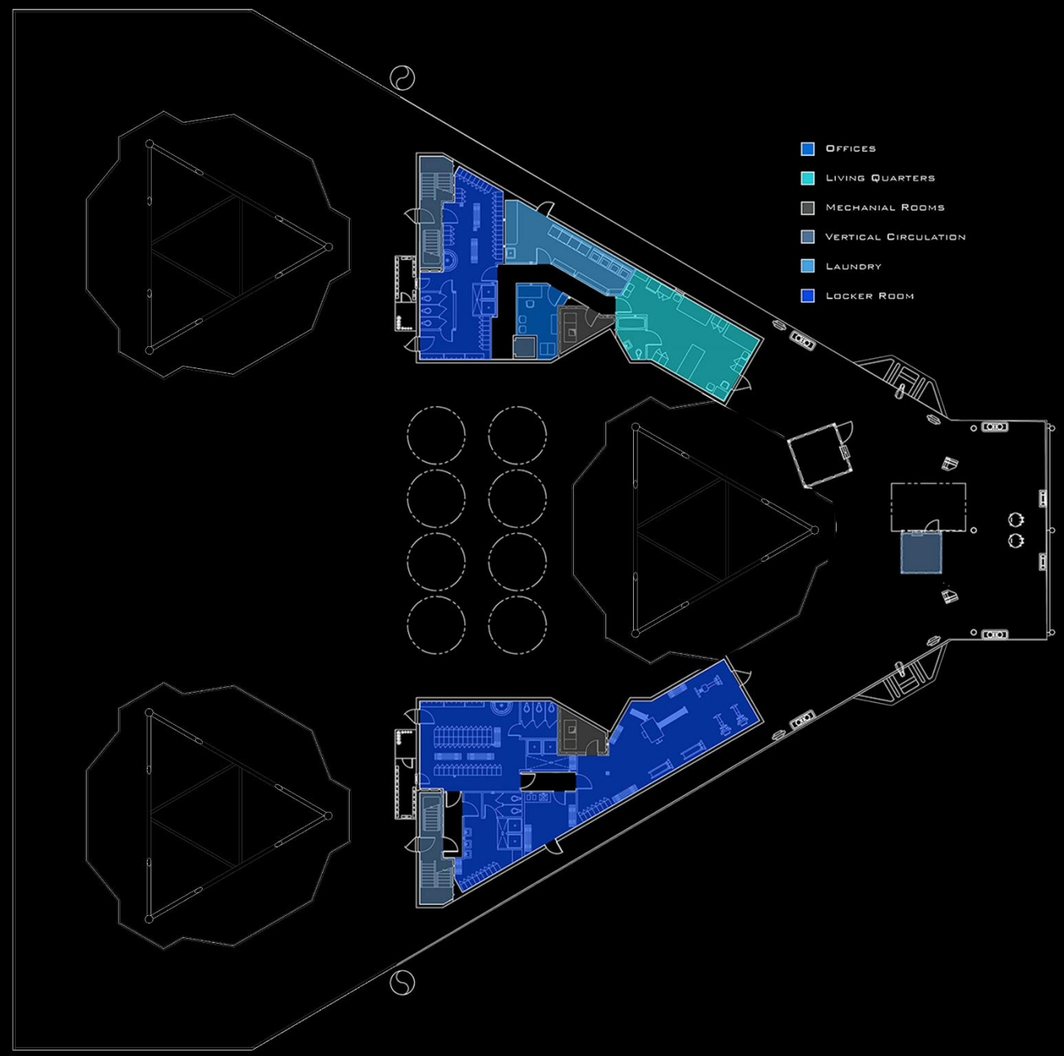
3.1

Program and Spatial exploration

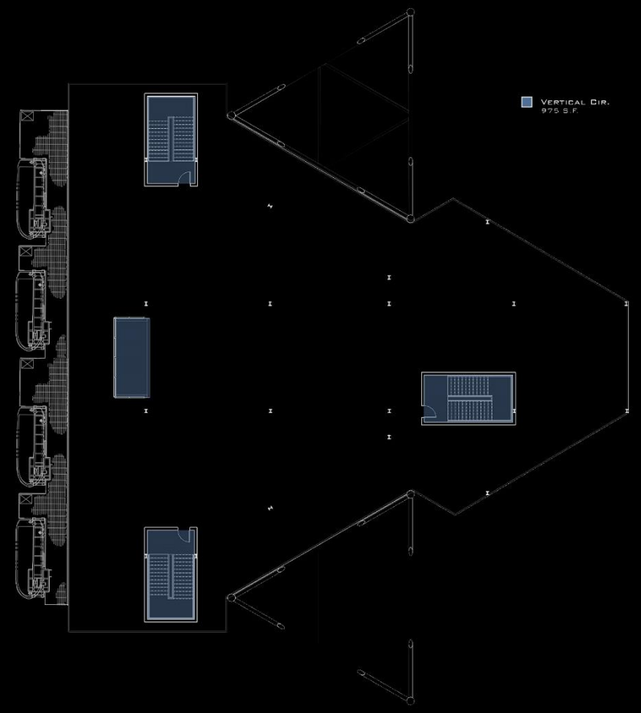
This diagram shows the typical plans for level 1-3 of the marine R+D center that is under water.

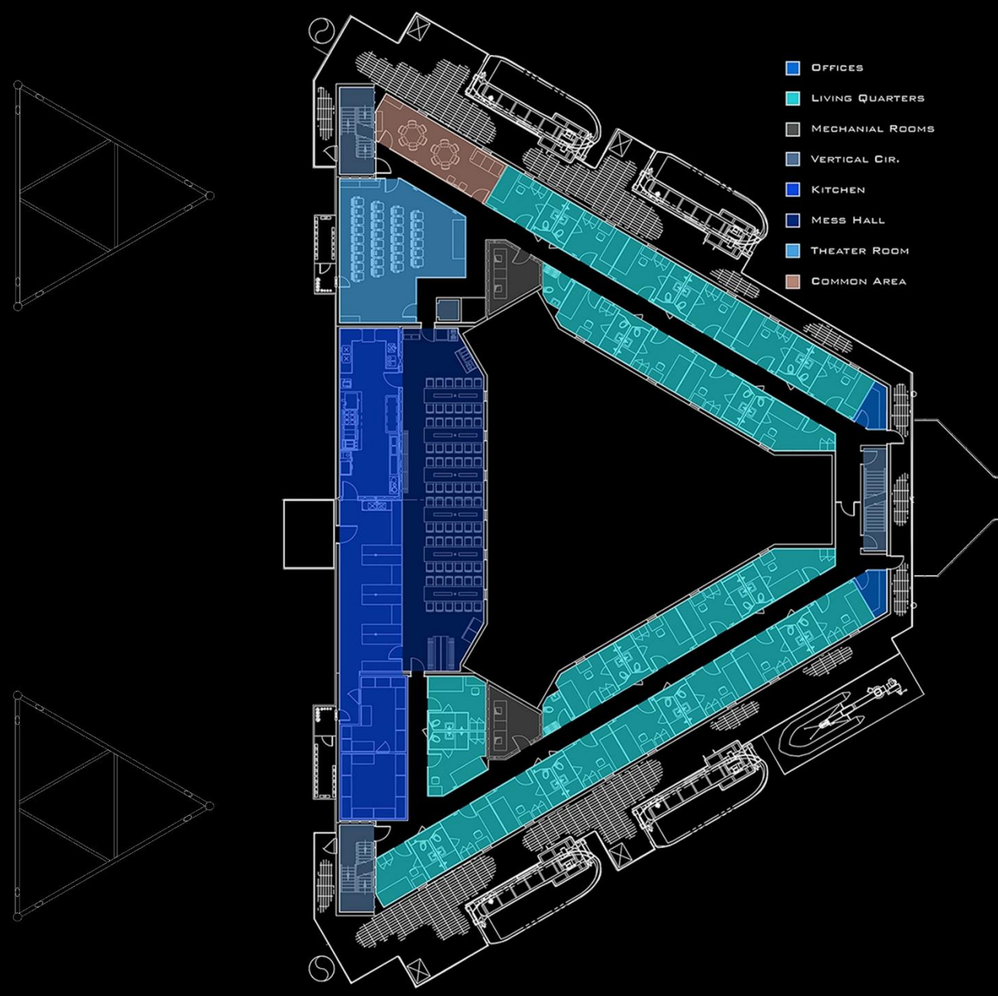
R+D Center
Level 1-3
Scale: N.T.S.



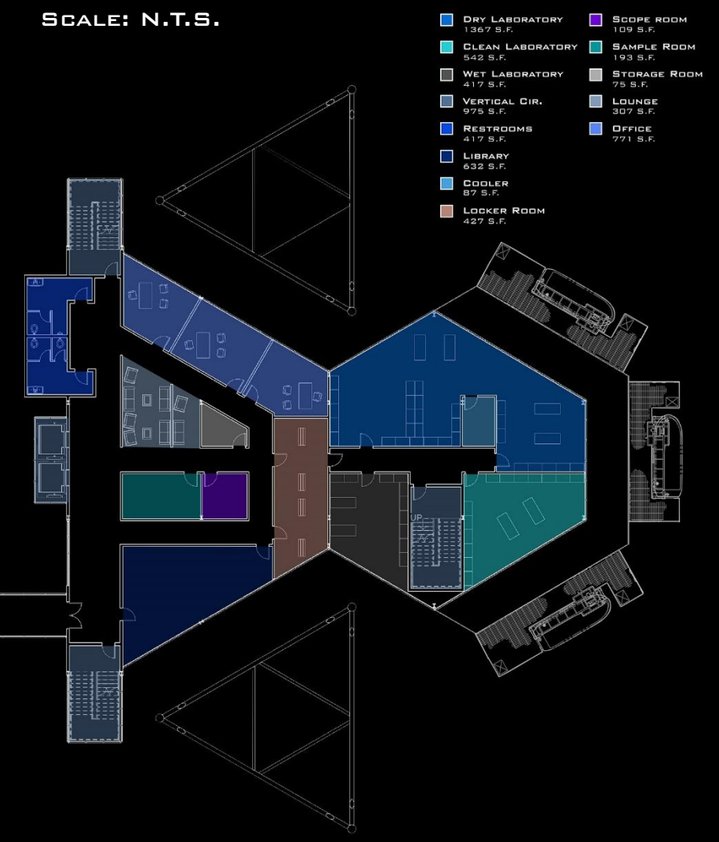


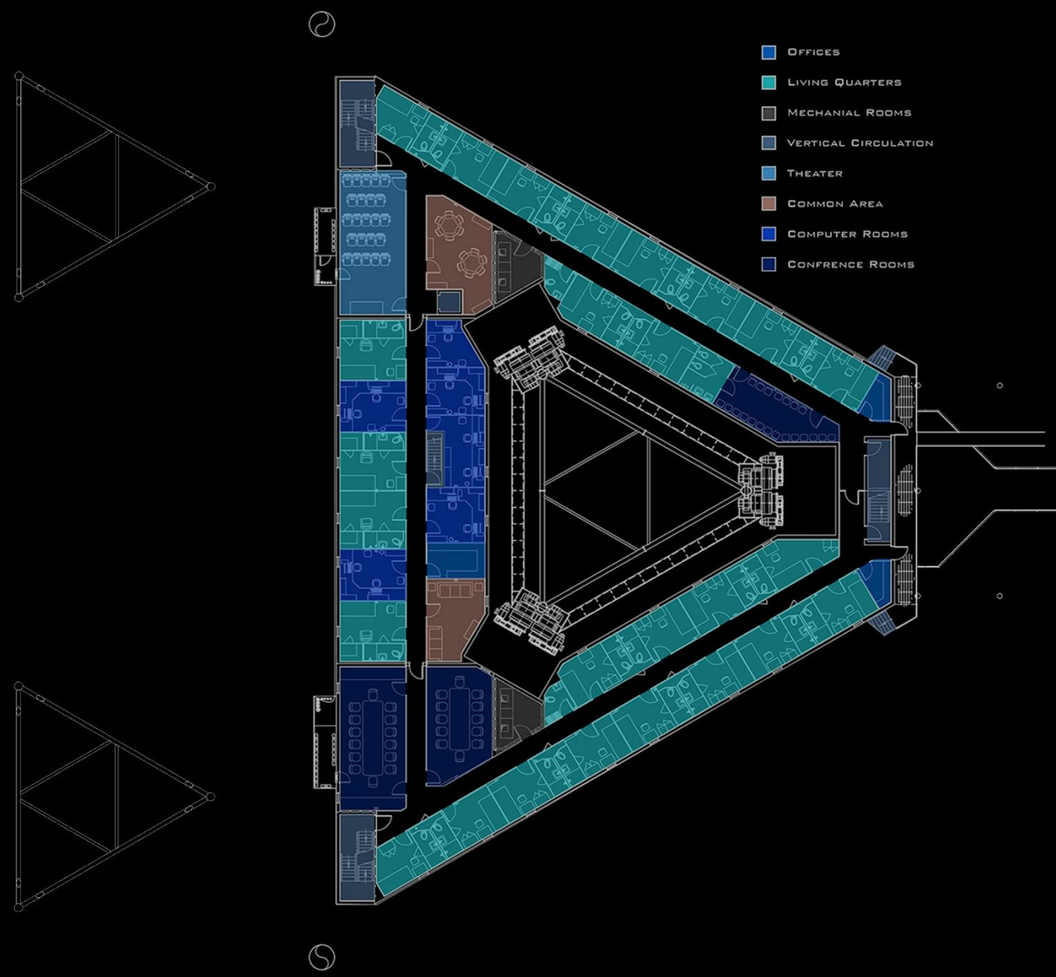
R+D Center
Level 5
Scale: N.T.S.



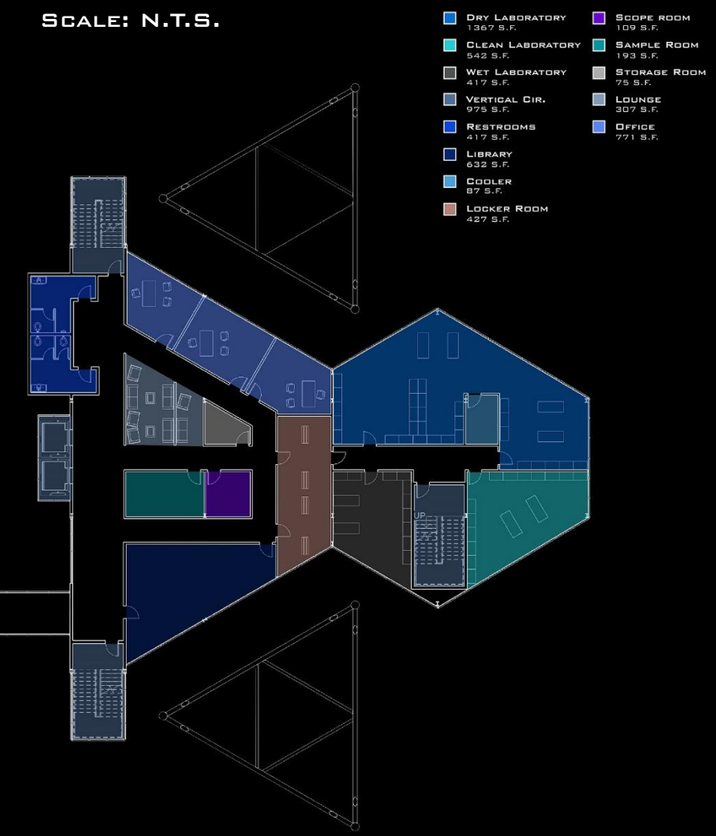


R+D Center
Level 6
Scale: N.T.S.





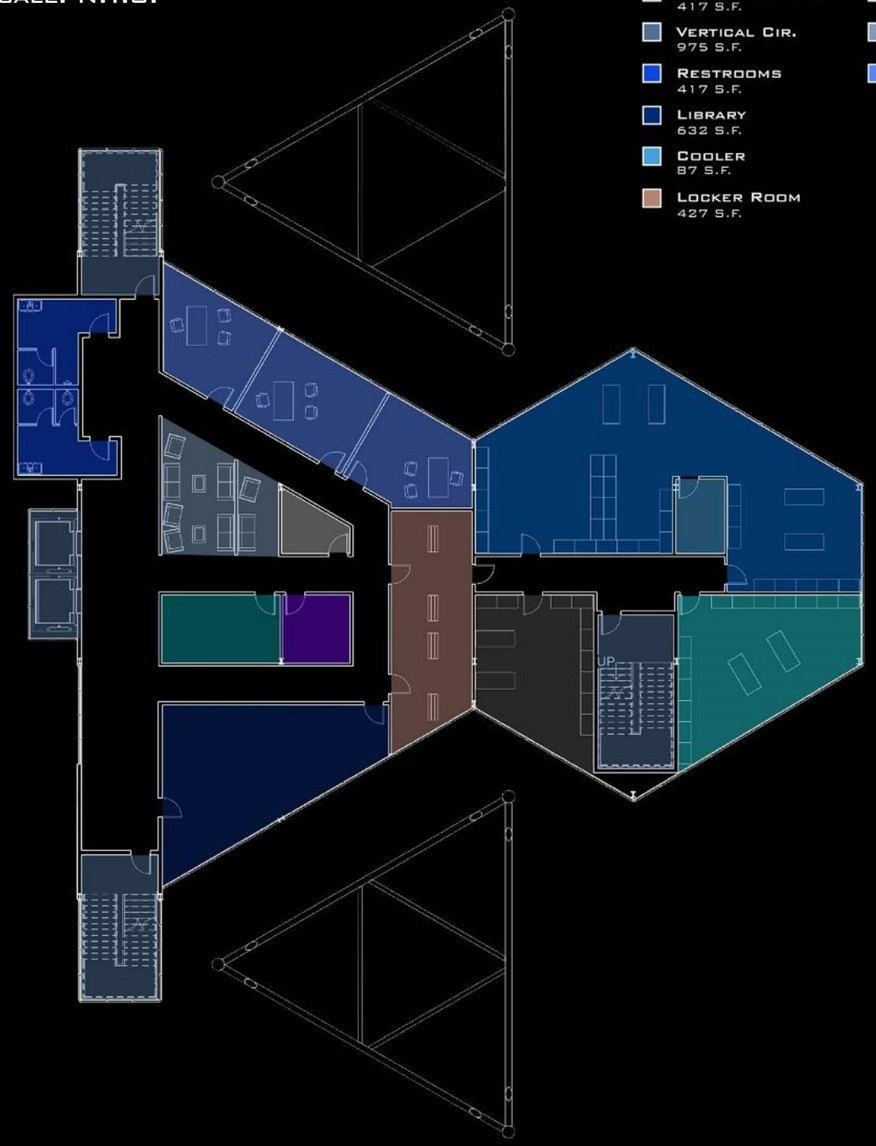
R+D Center
Level 7
Scale: N.T.S.



This diagram shows the typical plans for level 8-9. This is the oil R+D center.

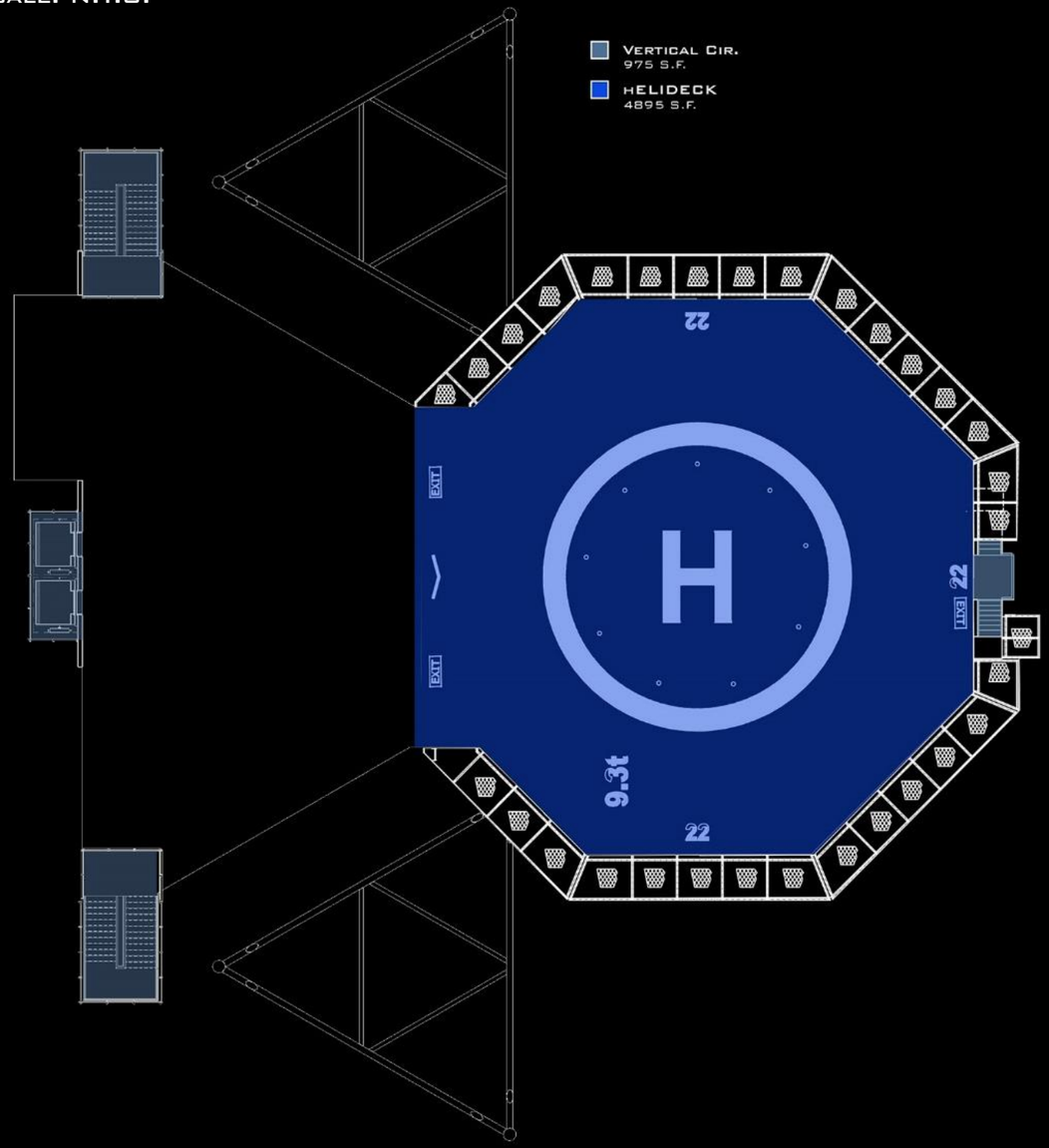
R+D Center
Level 10
Scale: N.T.S.

- Dry Laboratory 1367 S.F.
- Clean Laboratory 542 S.F.
- Wet Laboratory 417 S.F.
- Vertical Cir. 975 S.F.
- Restrooms 417 S.F.
- Library 632 S.F.
- Cooler 87 S.F.
- Locker Room 427 S.F.
- Scope room 109 S.F.
- Sample Room 193 S.F.
- Storage Room 75 S.F.
- Lounge 307 S.F.
- Office 771 S.F.



this diagram shows the plans for level 10 this is the top level of the oil rig which has the Helideck on it. Since this is the primary form of transportation to and from the rig it is necessary to have a helideck.

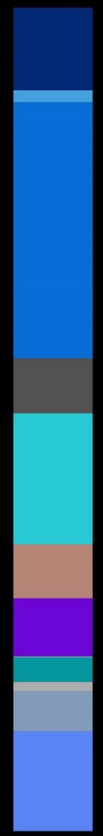
R+D Center
Level 10
Scale: N.T.S.



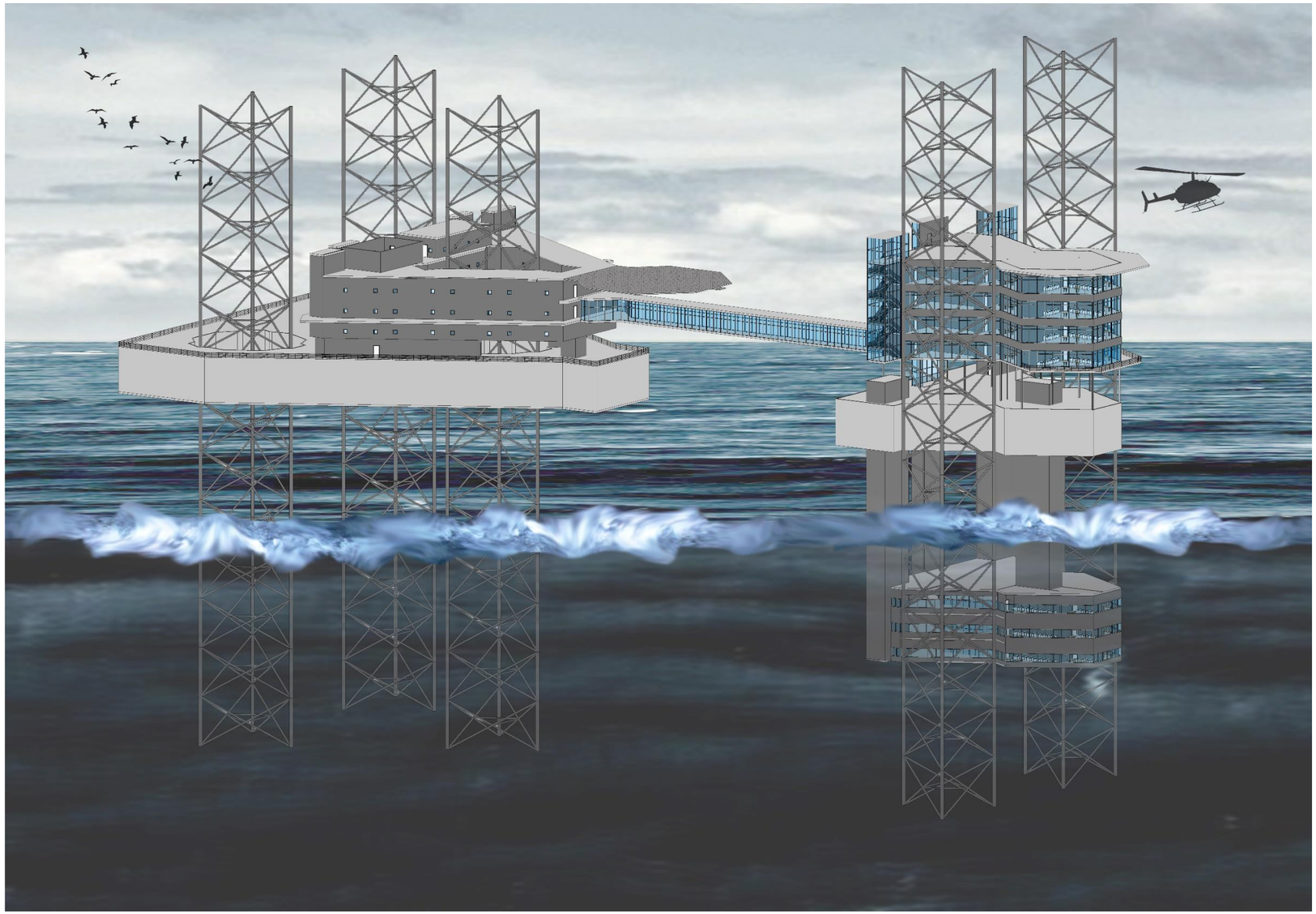
Area Distribution
Levels 1-3

Museum:	4372 s.f.
Cooler:	75 s.f.
Sea Water Tank:	2317 s.f.
Vertical Circ:	975 s.f.
Rest Rooms:	417 s.f.
Dry Laboratory:	842 s.f.
Clean Laboratory:	657 s.f.
Wet Laboratory:	407 s.f.

Area Distribution
Levels 6-9



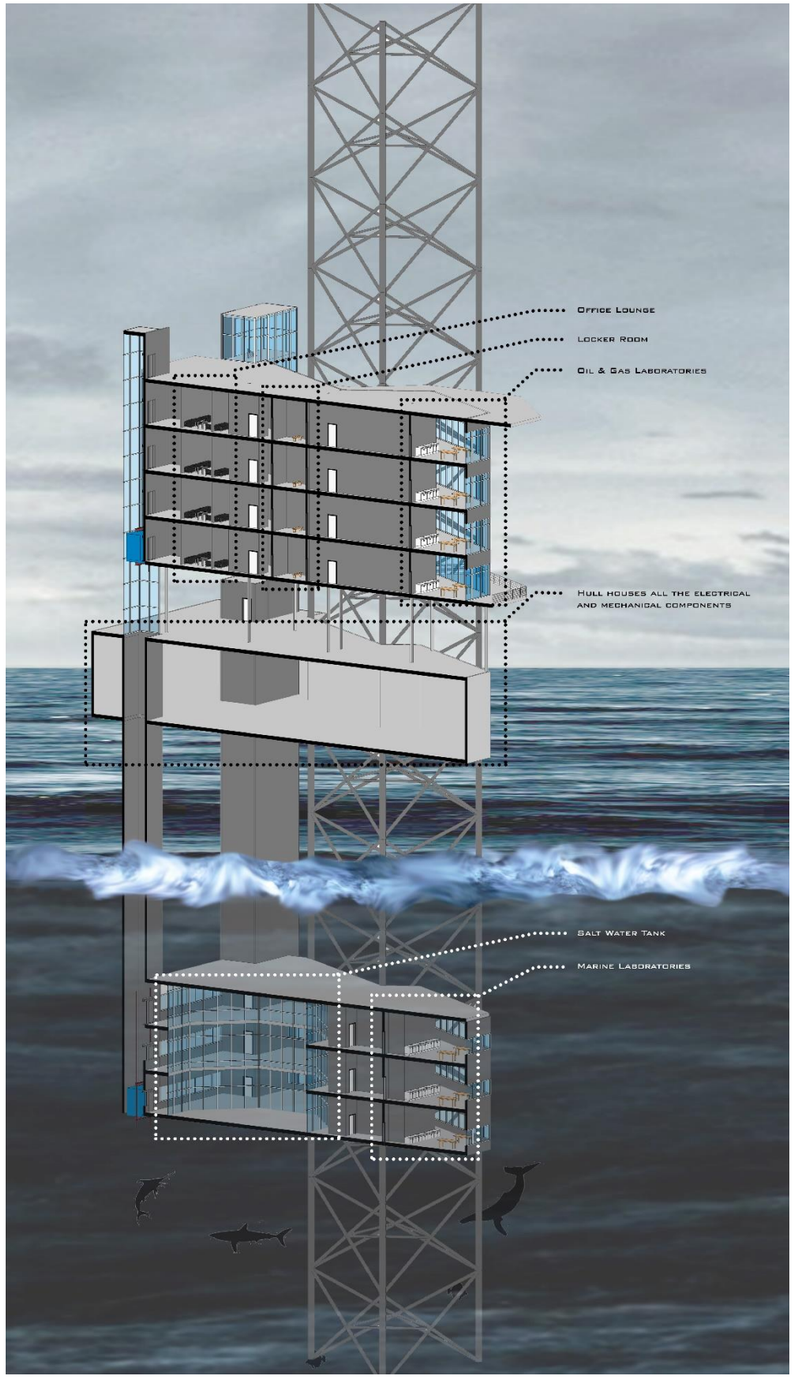
Library:	632 s.f.
Cooler:	87 s.f.
Dry Laboratory:	1367 s.f.
Wet Laboratory:	417 s.f.
Clean Laboratory:	542 s.f.
Locker Room:	427 s.f.
Scope Room:	109 s.f.
Sample Room:	193 s.f.
Storage Room:	75 s.f.
Lounge:	307 s.f.
Office:	771 s.f.

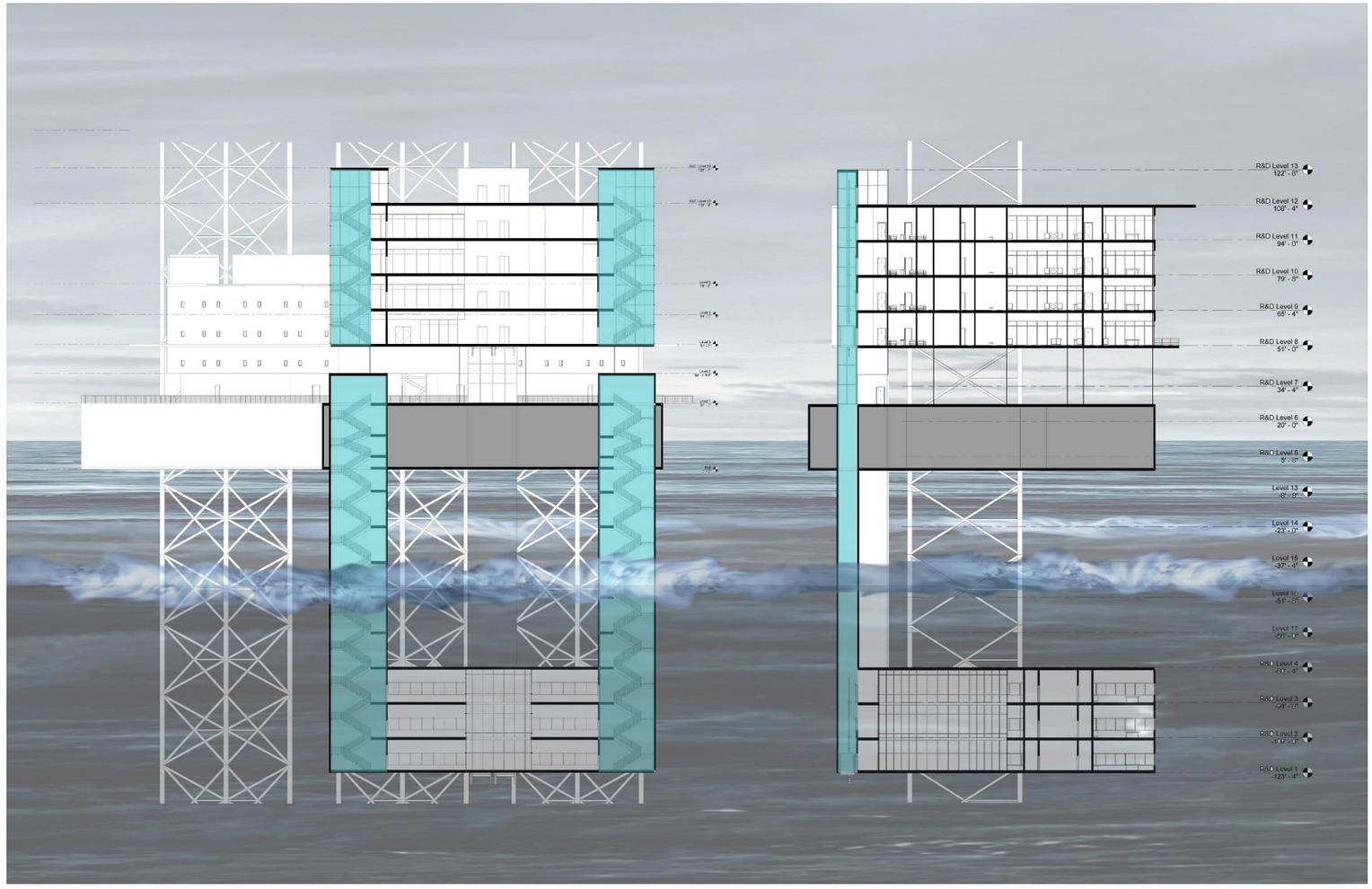


The R+D Facility is designed to have a direct connection with the oil rig. It is meant to be seen as having the same kind of typology as the rig but noticeably be a different program. Having an onsite R+D facility, as opposed to an onshore laboratory, will speed up the response time when it comes to testing samples. It will also help with monitoring of the oil wells and wellheads.

The marine facility is underwater because of its program. It will allow for a first hand experience of seeing coral growing and watching fish inhabit the space. Within the marine R+D Facility there is a salt water holding tank, this allows the marine scientists to hold fish that are being studied.

This rendering shows the connection of the Oil Rig and the R+D Facility.





Longitudinal and Transverse Section showing vertical circulation and highlighting the 27 F.t. deep hull

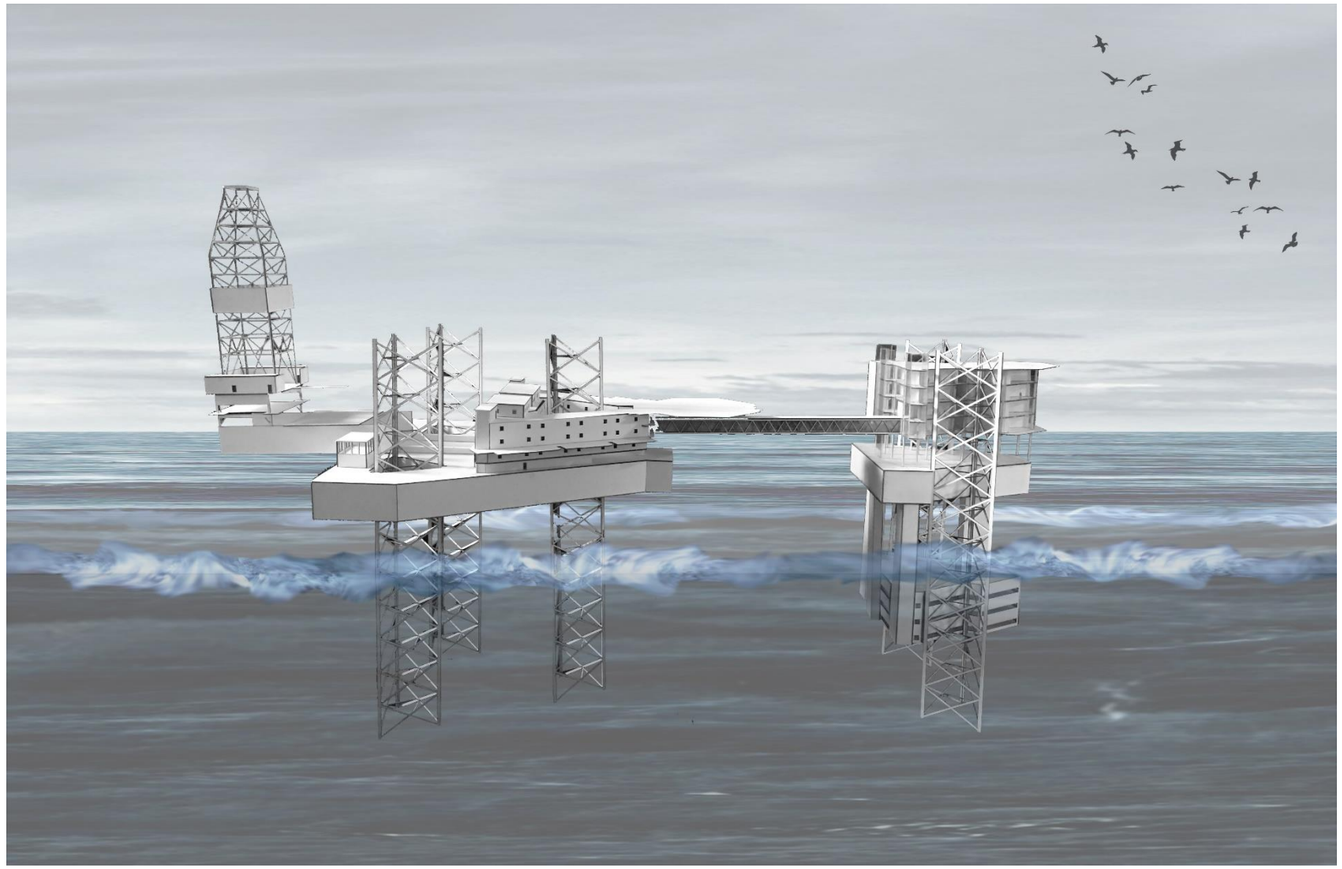
Design Synthesis

4.0

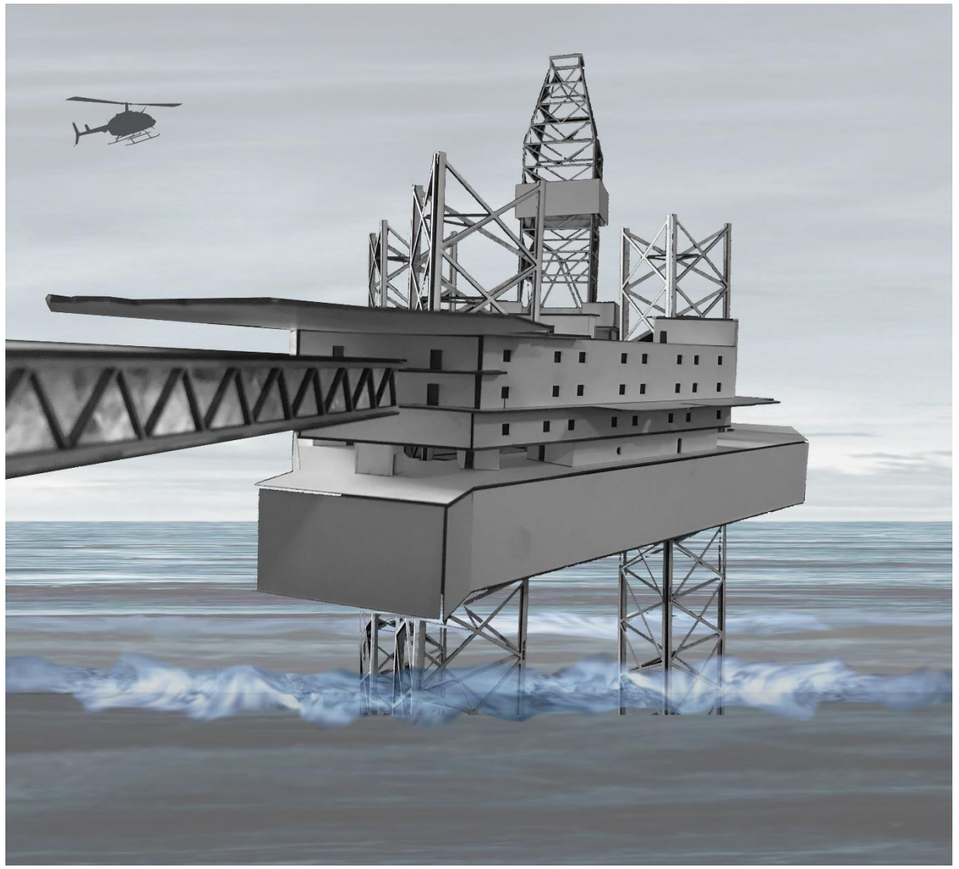
Design Synthesis

4.1

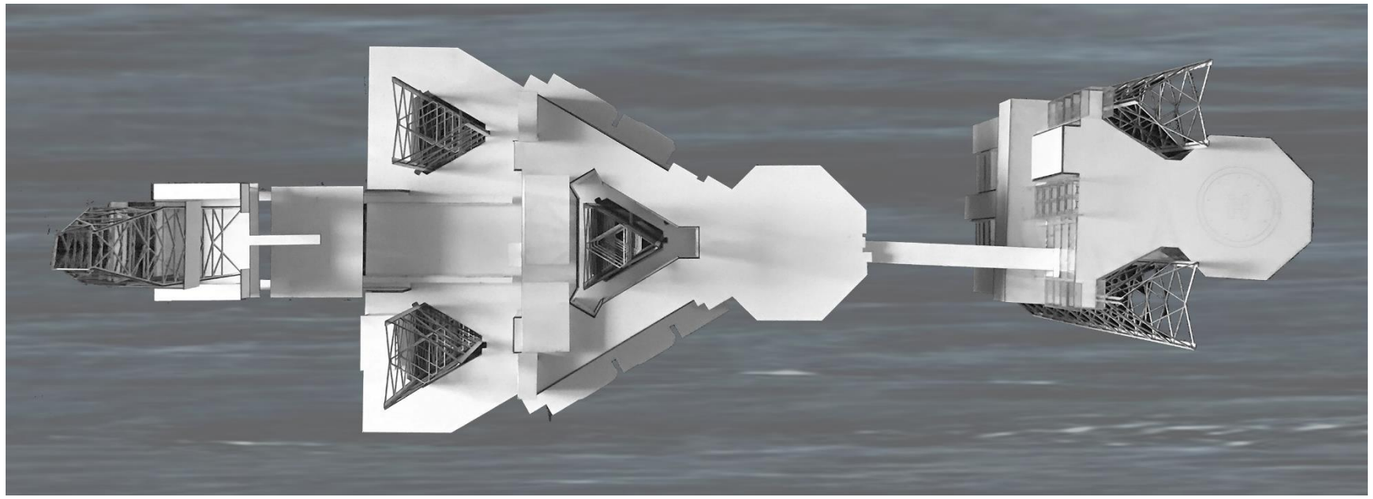
Design Documentation



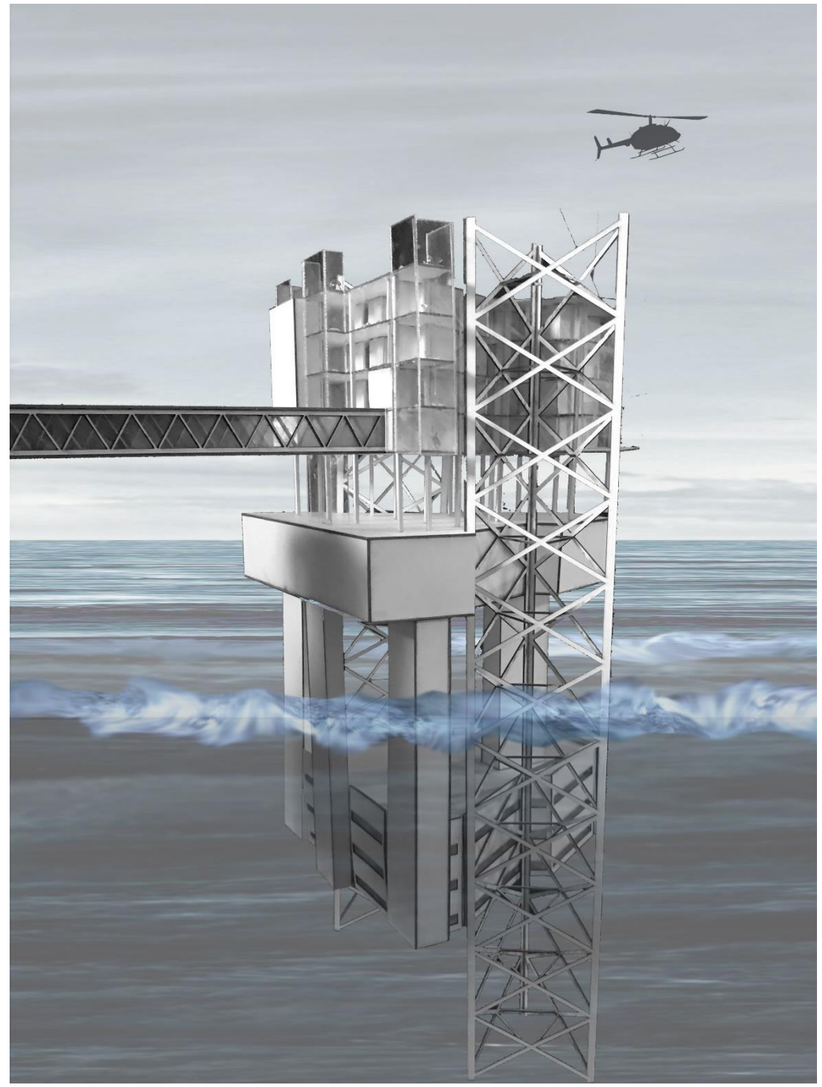
Elevation of the model



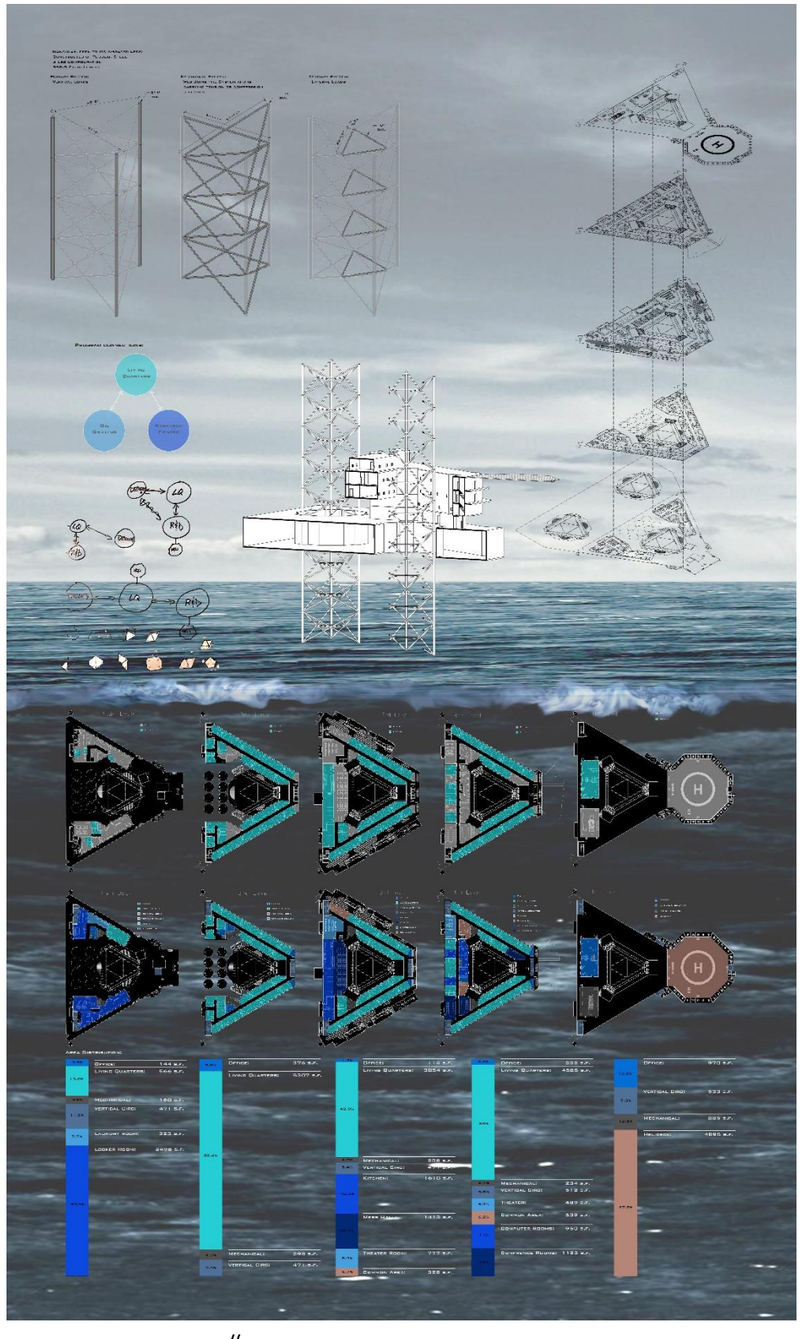
From the R+D Facility looking
back at the oil rig



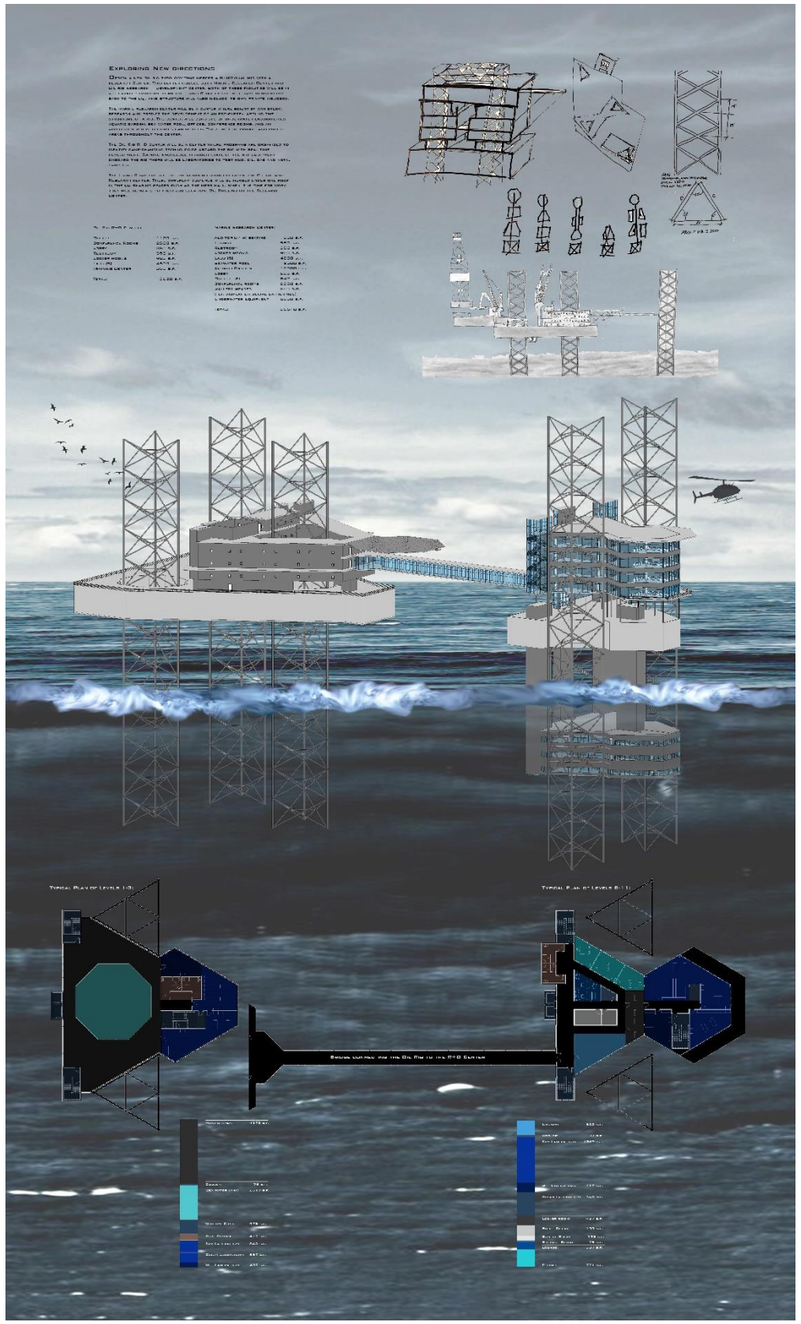
This mode shows the connections between the Derrick, Living Quarters, and the R+D Facility. You can also see the amount of structure that is used.



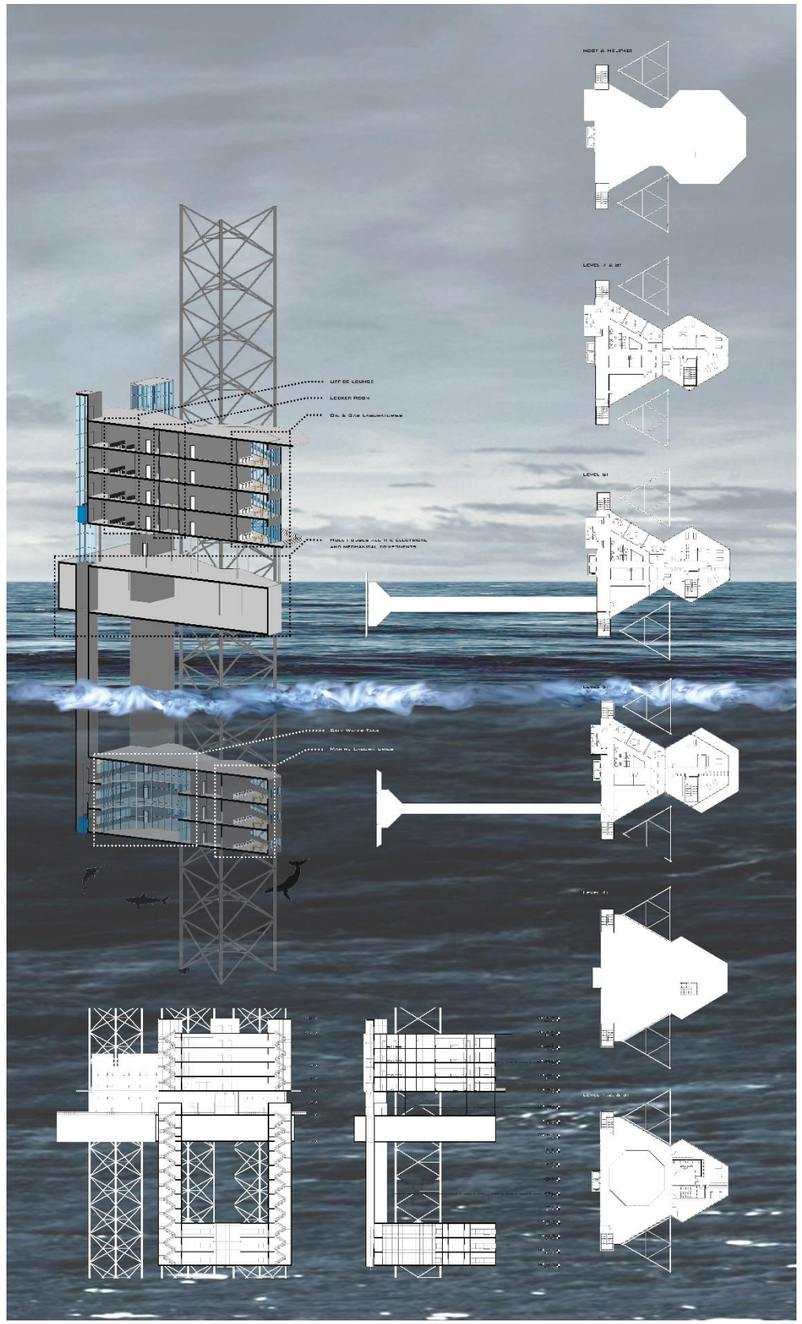
Final board #1



Final board #2



Final board #3



Final board #4

Conclusion

Throughout this investigation, the thesis focus started to shift unexpectedly from the redesign of a rig, to the comprehensive design addition to a rig. Many surprising findings were made during this process. These findings were recorded in this thesis document and had a major impact on the R+D facility.

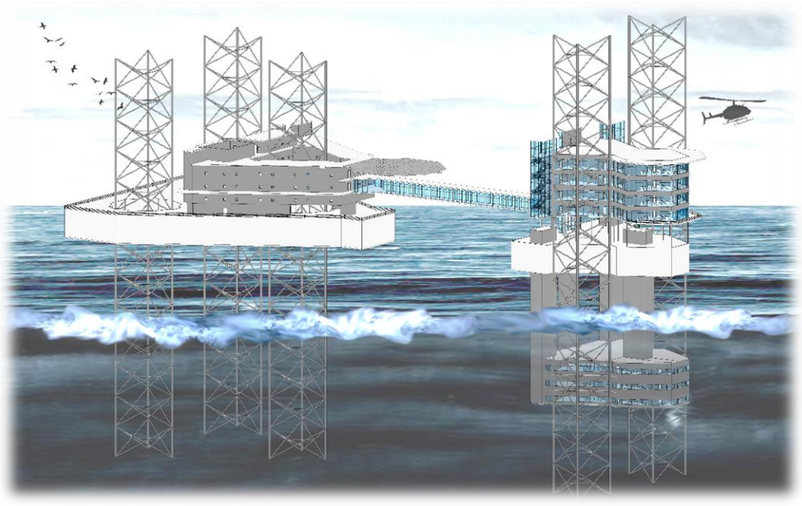
When analyzing the R-550D Oil rig, it was unveiled to me that design in the living quarters has already begun. They are taking the workers' health and wellbeing into consideration now. This was unforeseen, especially after witnessing the living quarters during my visit to the "Mr. Charlie Oil Rig Museum".

The heavy structure is one of the first topics brought up when discussing oil rigs. Understanding and analyzing the leg structure was important for this thesis. It took different models to fully understand how strong the leg structure is and can be.

When designing the R+D center it is important to note that it was designed and modeled directly from the Oil Rig. The reason for this is because the rig itself, works and does what it needs to do, I didn't want to disturb that. I designed a separate rig. Since it has a direct connection with both programs, the name Oil and Marine R+D seemed fitting.

During this thesis investigation, I have learned a lot about offshore structures and differences that impact the design.

It is important to note that this proposal would only be possible if the oil companies saw the benefits. These structures are extremely expensive to construct. Oil Companies would have to work together to make this a possibility.



Glossary of Terms

Barge- a large boat with a flat bottom capable of carrying large loads of freight or equipment

Bone Yard- a metal junk yard for old oil rigs to be broken down and re used if possible

Derrick- a large frame work that is used to lift components primarily used on oil rigs

Drillship- a offshore vessel designed to search for new oil and gas wells

Gulf of Mexico- a large ocean basin mostly surrounded by United States of America and Mexico

Hull- a watertight floating barge. it is also, used to house mechanical and electrical equipment

Jack-up rig- maneuverable floating barges that have log supporting legs that can be raised or lowered. The legs are lowered when on site to drill or pump oil out below the sea bed

Living Quarters- an area that is designated for people to live in

Mooring Line- a heavy weight steel line that is used in the water to secure a barge from moving

Platform Rig- a large offshore structure that is temporary and has equipment to drill or pump oil out from below the sea floor

Oil Rig- an offshore large structure that can be one of four types, Drillship, Jack-up Rig, Platform Rig, Semi-submersible Rig. The rig is composed of cranes, derrick, hull, and a living Quarters.

Semi-Submersible Rig- an offshore platform that is fixed typically on two large pontoons for easy maneuverability

Spudcan- is an inverted cone that placed on the end of a offshore Jack-up rig legs. This is pounded deep into the sea bed to provide stability for the rig.

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