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Undergraduate Thesis
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CONTENTS

Introduction
Ships | Architecture
Construction | Destruction
Useless
Artifacts
Collective Form
From Object to Field
Capacity and Scale
Deconstruction
Wreck
Bibliography
Photograph Credits
Introduction

Ships (specifically interested in cruise ships, cargo ships, tankers and carriers) are constantly being built around the world but at the same time, thousands of ships are recycled, transformed, destroyed, or abandoned. Annually, around 1,000 large end-of-life ships are dismantled on tidal beaches causing environmental issues. These vessels simply become objects or artifacts left without purpose or function. Just this year there has been an increase of 9.5% of cargo ships being built and ordered. The Cruise ships have shown even greater growth due to the cruising industry, 167 new ships have been built since 2000. The National Defence Reserve Fleet in Suisan Bay, California, has around 230 decommissioned ships as of 2007. The incline in shipbuilding has been driven by larger capacity, more efficient and advanced ships. With all these ships to come, one has to question, what will happen to the older ships? Will there be an excesses amount of ships in the world? Where do they accumulate? How are they dealt with or recycled? How can these ships be understood through another lens? What are their characteristics? How can these vessels be understood as objects and be reutilized as a new typology?
Abstract

The object of interest is abandoned or at end-of-life ships. The once functional vessels that transports goods, resources and people around the world are left on beach sides or bays to be slowly dismantled. The uselessness of these ships provide an opportunity to examine and take apart structural components that could inform further understanding of space, form and formations.

This thesis explores and experiments with the ‘ship’ as an ‘object in field’ in the discourse of architecture. The ship is tested and understood in a variety of ways, such as its construction and deconstruction process, spatial relationships, the ship as a collective form and compared to urban structures.
A ship is basically a floating city or structure. It can be represented as a building on water. It shares very similar physical qualities such as structure, spatial dimensions, and functions to that of buildings. With this abstracted idea of ‘ships as urban structures’, different methodologies can be applied to the understanding of the process of deconstructing a structure. How can its characteristics and its form create an alternative experience? How can the ship be strategically deconstructed, cut and reconfigured for a new experience or purposeful space to these lifeless vessels. The ship must be treated as an abstract object.

Having the ship as a floating city or megastructure in mind, Fumihiko Maki, describes megastructure as, “a large frame in which all the functions of a city or part of a city are housed.” A cruise ship is a megastructure. It satisfies the idea of a large frame work and has diverse functions that are concentrated within a system. As the ship is deconstructed into parts different forms and formations can be created. How can these parts or objects become a field condition? The ship and ship formation becomes an analogy of Stan Allen’s ‘From Object to Field’. The condition in which the parts of the ship that are taken apart, become the object and by reconstructing and organizing these object into a larger system or field.
Ships | Architecture

From the literal understanding of structure to the ideas it embodies, the ship has always been prevalent in the field of architecture. Numerous of designs, ideas and symbolic meaning have used the ship as inspiration.

Spatial making

Bartolomeo Bon built the Chiesa di Santo Stefano in Venice in 1325. This church was known for its ship-shape nave structure made out of wood. In this particular church the nave could also be called a ship keel, which holds a symbolic meaning of Noah’s Ark. In order for Santo Stefano’s nave to function like one and not just be an implement of the ships keel it needs the clerestory, where light is able to fill the church. It is the design of mass, light and shadows that let us experience a space. Le Corbusiers, Toward an Architecture, reminds architects that mass and surface are elements which architecture can manifest itself. The mass and surface are determined by the plan, as the plan is the generator. (Le Corbusier 1946)
Using the formal simplicity born out of engineering necessities he saw in the gargantuan ocean liners of the day, Le Corbusier argued that modern people, practical men of action, had grown tired of the old aesthetics of luxury, and were concerned with new, powerful forms of beauty. The new beauty merely had to be developed from honest construction, repeating his admonition from “Aesthetic of the Engineer, Architecture.” In this case, the honesty can be achieved by building according to purpose and employing an architecture that celebrates the accomplishments of technology.” (Le Corbusier 1946) Around the nineteenth century, Modernism emerged as a result of growth in industrialization. Corbusier uses this industrial design as a new esthetic for architecture, a reductive machine esthetic.

*Formal Materiality Esthetic*
The ideas of the ship were also experimented by Ron Herron with the Archigram group. Ron Herron proposed the Walking City, as building massive mobile structures that would be capable to move freely around the world. It would move to wherever their resources or manufacturing abilities were needed. The idea became a network and nomadic experience for people. Various types of ships can resemble what Ron Herron imagined in terms of its function and scope.
The ways ships have influenced architecture is seemingly significant and prevalent in the world today. Whether it is inspired by the form, spatial arrangements, esthetic or structure, it offers something quite different to design.
Construction

Ships are built in dry docks. A dry dock is a narrow basin or vessel that can be flooded to allow a load to be floated in, then drained to allow that load to come to rest on a dry platform. Dry docks are used for the construction, maintenance and repair of ships, boats and other watercrafts.

Modern shipbuilding techniques are done through prefabricated sections. These huge sections are built somewhere around the yard then lifted into place. This technique is known as block construction. Equipments such as pipes, electrical cables, and other components are pre installed within the section. The ships mega sections are then welded together. The hull of the ship is constructed first, then block structures are placed above and welded together. (Tupper 1996)
There are several ways that useless ships are dealt with. Most commonly the ship is destructed in a way that can be recycled. This process is called shipbreaking. These huge vessels lifespan are only a few decades, 30 – 40 years before they wear or become uneconomical to fix or renovate. The ship is torn apart for recycling useable material, mostly steel. Ninety-seven percent of the ship is recycled, including the equipment such as toilets, pipes, furniture, etc.

A more unconventional method would be for tourist attraction based. For example, the USS Oriskany CV-34 carrier was built shortly after WWII in 1945. It is the largest vessel ever sunk to make an artificial reef. The vessel was cleaned from its toxic substance and strategically sunk so that it would settle upright at a depth for recreational divers.

Another example would be the USS Intrepid aircraft carrier that became a museum. It is now known as The Intrepid Sea, Air and Space Museum. The ship has been revitalized with tourists but also serve as hub or event spot.

In many cases ships are simply left abandoned. They become ship graveyards and harm the environment because of deterioration or chemical material.
There are currently about 87,483 large ships around the world according to the World Fleet Monitor. Approximately 4,350 oil tankers, 50,000 cargo ships, 1000 luxury cruise ships and the US navy itself, has around 430 that are active and in use. Countries such as China are building 3,999 ships that are over 100 gross tonnages as of 2008. These enormous vessels consume a huge amount of resources. An average cruise ship it has about 70,000 ton of steel, the Eiffel Tower only uses about 7,000 ton of steel. Ships are constantly being built but at the same time thousands and thousands of ships are recycled, transformed, destroyed, or abandoned. These vessels simply become objects or artifacts left without purpose or function. (William 2013)
There has been a huge incline of ships being ordered and built over the past decade; growth strategies have been driven by larger capacity, more efficient and advanced ships. This causes places to construct more local ports, more destinations and new on-board/on-shore activities that match the demands of consumers. The cruising industry alone has an annual increase of 7% of new passengers starting from 1990 to 2014. It is projected that from the year 2014 – 2015 the cruising industry will generate 3.2 billion in annual revenue. Ships will start to accumulate and become ship graveyards. One example would be the Suisun Bay in San Francisco. There an entire National Defense Reserve fleet, dating all the way back to 1950s, was left on reserve. At one point, 2,000 ships were left sitting above water causing environmental issues and releasing anti-fouling agents in paint, heavy metal rust and hazardous materials. It takes millions of dollars to scrap a single ship and currently there are 55 vessels left in the bay. (European 2013)

Some of the world’s largest ship breaking yards in order are: Gadani, Pakistan, Chittagong, Bangladesh, Aliaga, Turkey, Changjiang China, and Brownsville, Texas in the United States.
Artifacts

In Aldo Rossi's 'The Architecture of the City' he states that architecture of a city is not based on program but rather that the characteristics of the city are based on form and experience of the architecture. The characteristics becomes the physical qualities of material and dimensions of the space. Rossi's mentions that “By architecture of the city we mean two different things: first, the city seen as a gigantic man-made object, a work of engineering and architecture that is large and complex and growing over time. Second, certain more limited but still crucial aspects of the city namely urban artifacts, which like the city itself, are characterized by their own history and thus by their own form.“ The abandoned ships becomes the artifacts and its form gives it its characteristics. The ship no longer serves its original program but it could still offer an experience because of its physical qualities, material and scale. "One is struck by the multiplicity of functions that a building of this type can contain over time and how these functions are entirely independent of the form. At the same time, it is precisely the form that impresses us; we live it and experience it, and in turn it structures the city." (Rossi 1991)
Form

Simplified graphical expression of hull

Angles of curvature
container ship

oil tanker

Abstraction of parts

Abstraction of parts
Different types of ship bow construction
Hold structure

Hold structure
“What is needed is not just observation and critical comment, but utilization of the observation to develop strategic tools in making our physical environment.” Maki illustrates and describes the way we should design through his three paradigms.

The first is compositional form, which is “the elements which comprise a collective form are preconceived and predetermined separately.” It is basically individually tailored buildings; different types of ships in a fleet can be seen as a compositional form.

The second form is megastructure; “which is a large frame in which all the functions of a city or part of a city are housed.” A ship is a megastructure; its functions are beneficially to be concentrated in one place.

Lastly, group form, “which evolves from a system of generative elements in space.” Maki points out the necessity of linkage. Whether through material, expression, theme, composition, etc. “Forms in group-form have their own built in link, whether expressed or latent, so that they may grow in a system.” The ship and the dismantled parts become the elements of the group form, suggesting a linkage between them. (Maki 1965)

The Diagram to the left illustrates how the ship can be translated into Maki’s three forms.
"Field conditions move from one toward the many: from individuals to collectives, from object to field." A similar approach to Maki’s ‘group form’ is translated in Allen’s ‘field condition’. The field condition could also be described as a formal or spatial matrix capable of unifying diverse elements while respecting the identity of each. In the case of the ships different parts will have its own identity and suggested spaces. Both Maki and Allen are suggesting a methodology for modelling program and space. Allen states “to go beyond conventional opposition of construction and form-making. By looking for a precise and repeatable link between the operations of construction and the overall form produced by the aggregation of those parts. It becomes possible to begin to bridge the gap between building and form making.” (Allen)

Below are diagrams examining and experimenting with different field conditions with ships

Fig. 22
1) Single column
A formation of ships travel in single file (lined up one behind the other), with the lead ship normally acting as the guide.

2) Column Open Order
Here the lead ship again acts as guide, the second ship is typically 4 degrees off the port quarter of the guide at the standard distance (or the default, 2000 yd), the third ship is 2 degrees off the starboard quarter of the guide at twice the standard distance, and the remainder alternate from port to starboard. (Harp 2013)

3) Line Abreast
In line abreast formation, ships are formed up abreast of the guide. The relative bearing of one ship to another is either 90 or 270 degrees, or in other words, the ships are side by side.

4) Echelon Left/Right or Line of Bearing
An echelon formation is one which the ships of the formation are arranged diagonally, each stationed behind and to the starboard (echelon right), or behind and to port (echelon left), of the ship ahead. (Harp 2013)
5) Diamond
The diamond is a line formation that maximizes distance between individual ships without lengthening the formation. It is often used as the formation for the main body of the larger, a "formation within a formation" if you will. In the diamond formation the most forward ship is often the guide, while the second ship takes station on its port quarter at twice the standard distance (at a 45 degree angle off the port quarter). The third ship takes station on the guide's starboard quarter (again at a 45 degree angle) at twice the standard distance, and the fourth ship takes station astern of the guide at three times the standard distance. (Harp 2013)

6) Vee
In a Vee (or V) formation, the guide is always in the lead, and the other ships of the formation form lines of bearing on the guide. The angle between the two lines of bearing is typically less than 90 degrees, so that the formation is always aligned along its intended course (in other words, the centerline of the formation and the course are the same). (Harp 2013)
"Artificial conception and accelerated birth of theories, interpretations, mental constructions, proposals and their infliction on the World, it facilitates and provokes speculative activities."

The City of the Captive Globe represents the narrative order of a city and how it can be changed by the addition of an architect’s story, developed from a reading of the city. This diagram changes the buildings into ships. How could ships inform the ideas and readings of a city?

**Capacity and Scale**

Before the ships are deconstructed, an abstracted understanding of the ships capacity and scale are tested. Through investigating a city that is most similar to that of a cruise ship, Manhattan seemingly became subject of comparison. The density, gridded blocks of the city, elongated form, resembled certain aspects of a cruise ship. The ship is compared in several scales, from Manhattan itself, to a superblock, to a city block, to apartments, and to single studios; it demonstrates the efficiency of space within a cruise ship. Through an abstract understanding of scale, dimensions and capacity, certain sized ship parts can be rationalized. Alan Colquhoun describes a superblock as “Take a New York City block 200 x 600 ft and pump ambition in it to lead a better life into it until it expands to 10 or 15 times its present area, say until it measures over a 1000 ft on one side and nearly 2000 on the other” (Colquhoun)
Manhattan, New York City
Length: 21.6 km (21600 m) (13.4 miles) (70,866 ft)
Width: 3.7 km (3700 m) (2.3 miles) (12,139 ft)
Area: 79.92 km2 (79920000 m2)(19724.8 acres)(30.82 miles2)(860242374 ft2)
Height: 142.6 meters
*Manhattans buildings have an average height of 142.6 meters with approximately 38 floors according to skyscrappercity.com
Volume: 11.4 km3 (1,139,659,200 m3)

Central Park
Length: 4115 m (13500 ft)
Width: 850 m (2788 ft)
Area: 3497750 m2 (37649467.66 ft2)
Central park is about 3.5 km2 that means Manhattan is about 22.8 central parks big
206 Oasis of the Sea can fit in central park
4697 cruise ships would fit in Manhattan
Superblock / Stuyvesant Town  317 Ave C

Length: 660 m (2165 ft)
Width: 630 m (2066 ft)
Height: 40 m (131.2 ft)
Area: 415800 m² (4475633.95 ft²)
Volume: 16,632,000 m³ (586,843,168 ft³)
The existing buildings have a cumulative of 3,362,627 m²
Assuming the super block as a solid mass
80% of the land is not used and 20% is built
25,000 residents
8,757 apartments in 56 residential buildings
Average 13 story height of building

Approximately 2 cruise ships equal the length of Stuyvesant town. It would only take 4.5 cruise ships to house 25,000 people

8 of these superblock like Stuyvesant town could fill up 1 central park
24 Oasis of the Sea could fill up the land area of this superblock If only calculating useable/built space 5 Oasis of the sea would substitute the buildings
Manhattan average city block
Length: 270 m (886 ft)
Width: 80 m (262.5 ft)
Area: 21600 m² (232575 ft²)
Height: 40 m (131.2 ft)
Volume: 864000 m³ (30513840 ft³)
A average block leaves about 20% of space not for buildings

about 19.25 blocks would make up 1 superblock. The total amount of residents in a superblock is around 25,000 and assuming there are 500 residents on one block. That means you would need 50 blocks to house the same amount.

1 cruise ship is almost equivalent to one city block
Cruise Ship Oasis of the Sea
Length: 360 m (1,181 ft)  Equivalent to three American football fields
Width: 47 m (154 ft)
Height: 72 m (236 ft) above water line
Area: 16920 m² (181874 ft²)
Volume: 1,218,240 m³ (42,922,264 ft³)

The Oasis of the Sea hold around 7500 passengers including crew members. It is 18 storys tall but only about 13 storys have cabins. Assuming 7500 passengers spread across 13 storys each would hold around 577 people, with a floor area of 16920 m², divided by 577 people each person takes up around 29.32 m².

Looking at the Oasis of the Sea’s plan, you notice the central part is empty. This is because it is a new design scheme to allow open air space/public space.

It is obvious that ships function differently and the use of space is alot more efficient than of a building or house. Many of the cabins do not need kitchen or much of a living room space. Is it because cruise ships are only temporary that people dont mind sharing spaces?
Imagine an average double corridor with 13 story apartment with 260 units each housing 1 person. You could fit 14 of these double corridor apartments in one block. This means it could house 3640 in 1 block.

Even though these dimensions are just an average of existing buildings it offers a understanding of scale and the number of people that could occupy the space.
Imagine an average single corridor with 13 story apartment with 130 units each housing 1 person. You could fit 26 of these double corridor apartments in one block. This means it could house 3380 in 1 block.
Average two bedroom
Length: 8.1 m (26 ft)
Width: 11.3 m (37 ft)
Height: 2.7 m (9 ft)
Area: 91.5 m$^2$ (962 ft$^2$)
Volume: 247.13 m$^3$ (8658 ft$^3$)

A average 2 bedroom is about 91.5 square meters. If this space is used for 2 people then each person would take up around 45 square meters of space.

Average one bedroom
Length: 8.1 m (26 ft)
Width: 11.3 m (37 ft)
Height: 2.7 m (9 ft)
Area: 91.5 m$^2$ (962 ft$^2$)
Volume: 247.13 m$^3$ (8658 ft$^3$)

A average 1 bedroom is about 69 square meters, compared to an average 2 bedroom the 2 bedroom is more efficient.
Ship cabins
Average 2 – 4 person cabin
Length: 8.7 m (28.5 ft)
Width: 3 m (9.8 ft)
Height: 2.7 m (8.8 ft)
Area: 26.1 m² (279.3 ft²)
Volume: 70.47 m³ (2457.8 ft³)

Average 1 - 2 person cabin
Length: 6.5 m (21.3 ft)
Width: 2.4 m (7.8 ft)
Height: 2.7 m (8.8 ft)
Area: 15.6 m² (166.2 ft²)
Volume: 42.12 m³ (1462 ft³)

A 2 - 4 Person cabin with an area of 26.1 m can house twice as many people than 2 person studio.

It is obvious that when comparing a cabin to a 1 person studio space it the cabin is more efficient. This is because there is no kitchen and living room space. But it helps to understand a basic size of 1 persons living space.
Scale Comparison

1 person

Average 1 bedroom  Average 2 bedroom

Average 1-2 person cabin  Average 2-4 person cabin

Single corridor  Average double corridor

Oasis of the Sea  Manhattan average city block

Superblock/ Stuyvesant Town 317 Ave C

Manhattan
Gordon Matta Clark

Abandoned ships are already prepared to be dismantled, why not deconstruct it in different ways to test the form and spatial qualities that it could offer? Gordon Matta Clark and his splitting of houses offers a different understanding of his incisions of abandoned houses. He was drawn to remaking and recreating. He mentions that it is important that “you are the measure” in his work; “He challenges traditional perceptions of artistic production; rather than creating objects, he pursues visual and conceptual experiences in the form of large-scale architectural interventions, installations and ideas.” His work informs the deconstruction methodology as way to understand and reveal structural principles. “An intuition about spatial relationships that complicated the perception of walls and floors in normative experience.” (Matta Clark 2006)

A response to cosmetic design completion through removal completion through collapse completion in emptiness
Richard Serra

“The difference between composed and decomposed objects are how objects carry meaning or purpose.” The ‘verb list’ created by Richard Serra offers a way or strategy to work with any object. His large panels of steel are actually bought from shipyards. Some words included in the verbs list are, to roll, to crease, to fold, to bend, to remove, to curve, to join, etc. Using these verbs to understand the materiality of steel, Serra’s strategy pushes the boundaries on how this material can be experimented with. He uses these verbs to understand the materiality of steel. In some ways similar to Clark, he states, “it is about a series of actions related to oneself, material, place and process.” It is the understanding of scale and experience through oneself. (Serra)
cutting, removing, opening, pealing, reconfiguring, puncturing, splitting, extorting, splicing, joining, decomposing, separating, isolating, breaking, dissecting, juxtaposing, penetrating, bending

reconfiguring, joining, scattering, assembling, grouping, merging, stacking, adding
Cargo Ship Split into three separate objects
Structural pieces
Hull skeleton
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Fig. 28 Ibid
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Fig. 30 Richard Serra
Fig. 31 Ibid
Fig. 32 Ibid
Fig. 33 Paula Montes
Fig. 34 Jan Moller Hansen
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Fig. 36 Ibid
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