URBANISM OF DISASSEMBLY
Strategies for Alang's shipbreaking Industry

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Waste is an integral part of our contemporary civilization based on consumption and material culture. From an empty soda can to the spent nuclear fuel rod, we define waste as the matter without immediate use: rotten, broken, unwanted. The notion of waste is also spatial—waste is simply matter in the wrong place and consequently of no value. One defining feature of globalization is the flow of waste to the places that extract value out of this otherwise worthless matter. Situated on the western shore of the Gulf of Cambay in India, Alang is one such place.

Alang owes its existence to the rise of modern maritime industry. Here obsolete end of life ships are broken, by manual labor, to transform them into a reusable commodity—steel. With an average lifespan of 25 to 30 years, most of these ships, often full of hazardous waste at the end of their working life, end up on the beach of Alang to be dismantled for their steel. Taking advantage of its unique geographical conditions, cheap migrant labor, and lax environmental regulations, Alang recycles half of the world’s scrapped ships. It is the epicenter of a scavenger economy that turns obsolete vessels into reusable commodities for a rapidly developing economy.

With the example of Alang, this thesis asserts that, due to their intricate connectivity to the global networks, places of resource extraction acquire an extra-territorial urban character. Only by acknowledging the urban nature of such places, can we start to design for these flows of waste, migration and resources. This thesis aims to explore the potential for urbanism to intervene into an industry like Alang to develop a regional strategy of urban metamorphosis.
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A Ship at Alang with its Bow sections cut off, a symbolic reminder that it will never sail again.
This thesis emerged from the fascination towards urban processes that are obscure but continues to shape the world we live in; specifically the processes that deal with waste. It is an acknowledgement to waste as a spatial construct and the tail-end of the urbanization cycle. Waste; the product of urbanization itself, shapes these urban processes. We constantly produce waste with every choice we make. We see waste as something that has no value and needs to be discarded. By the action of discarding it, we are assigning spatiality to the waste. Thus the concept of value is as spatial, as it is subjective in notion. This concept of value acquisition through spatiality manifests itself vividly in today’s globalized world, creating economies around what might be considered as ‘waste’ in some other place. The notion of waste as ‘out of place matter’ makes it disruptive in everyday setting thus forcing it to also be ‘out of sight’. This thesis aims to bring this ‘out of sight’ phenomenon under inspection, through the lens of urbanism.

Export of waste to the location that extracts value out of it is a reality today. These flows of waste are as important in shaping our urban future as the flow of resources and manufactured goods. Interconnected and globalized economy has expanded our ability to seamlessly connect two different places that associate two different values to the same matter. Today, recyclable waste ranks as the top export of the United States to China. It is the global shipping that transforms this trash into resource with the ‘Midas touch’ of shipping.

The ships are commodities themselves and they too will become obsolete at some point in their life. When a ship becomes obsolete it is destined to be broken down in order to transform it into valuable ‘matter’. A scavenger undertaking, the act of extracting the value out of this otherwise worthless matter is truly an act comparable to mining. The thesis is a study of one such location that breaks down obsolete ships that are a liability, to turn them into a resource that is sorely needed. Thus the thesis explores the possibility of locating the urbanization around this flow of obsolete ships and transformation.

Alang, a site of shipbreaking in India presents a unique opportunity...
as the testing ground for these strategies. By acknowledging the fact that Alang owes its existence to larger global notions of waste and value, we can begin to understand the intricate network that makes Alang what it is today, an urban condition linked with global flows. Alang may not fit within the definition of conventional urbanism i.e. a city as a nucleus, but it is a stark reminder of pervasive nature of the contemporary urbanism.

In order to frame the future of Alang with respect to waste and industry, the thesis probes three different concepts. These are then woven in the strand of industrial urbanization of waste economies. The three broader ideas are:

- The notions of waste and urbanization
- Concepts of industrial ecology and industrial symbiosis
- Urbanization as a function of industry, specifically a company town

Initial chapters serve as an entry point into spatiality of shipbreaking. Starting with the past and present of global shipbreaking to understand the geographies and processes involved at the global scale. It brings forth the link between economic development of any maritime country and shipbreaking activity. The rise of Indian subcontinent is a clear example of this link: a nexus of growing resource hungry economy, availability of cheap migrant labor and an inexpensive technique. These beaches came in on the radar for their ecological externalities, which has been the constant focus in any discussion on shipbreaking. This thesis, while acknowledging the fact of environmental externality seeks to address the other side of the coin: immense industrial potential and indirect environmental benefits that this industry represents. This is discussed further in subsequent chapters that look at Alang through different lenses. By bringing forth the stakeholders and conflicts within, it seeks a strategy to rid Alang of the stigma of waste landscape to transform it into a landscape of production based on a unique scavenger economy.

Chapter four is the search for defining what is waste. The questions
the concept of waste guided the research into the field of philosophy, specifically work of William James, who classified “dirt as a matter out of place” in 1929; and the work of Mary Douglas in “Purity and Danger”.

Our understanding of waste as the matter out of place is particularly interesting when seen in conjunction with the moments of crisis, when there is an urgent need for the much-needed ‘matter’. It is then that we acknowledge the waste as a matter that can be transformed into something useful. In the same light, we could see emergence of texts like “The recovery and use of industrial and other wastes,” in 1928 by John B. C Kershaw, a chemical engineer by profession, in the post war period of second industrial revolution. Understanding of waste as a resource by profession of chemical engineering is instructive one as it solely focuses on alchemist mission of changing one substance into another, meanwhile altering its value. This can also be seen as a move towards forming a ecology of waste and resources. The seminal text on industrial symbiosis titled “Strategies for Manufacturing” by Robert Frosch and Nicholas E. Gallopoulos, published in Scientific American, gave a call to various industries to locate themselves with specific spatial and manufacturing linkages, giving rise to an industrial ecology which intern gave rise to agglomeration economies.

Chapter six explores the urban implications of industrial agglomeration specifically in the case of company towns. It traces the company towns of Communist economy in Russia, Welfare capitalist economy in America and Colonial capitalist economy in India. The fate of these cities and towns varies drastically but the common feature is the urban diagram that is the direct result of flow of resources. With this example the thesis argues that there is a need to view industrial symbiosis on global scale, a project of industrial urbanization of waste with the agency of design.

Provocations


PROLOGUE

Rise of a Scavenger Industry

“why would not our industrial system behave like an ecosystem, where the wastes of a species may be resource to another species? Why would not the outputs of an industry be the inputs of another, thus reducing use of raw materials, pollution, and saving on waste treatment?”

Frosch, R.A, and N.E Gallopoulos. 1989. “Strategies for manufacturing.”
1. SS Independence on its maiden voyage in New York 1956

SS independence was an impressive, shimmering 682-foot steamship. She could cruise to Mediterranean from New York at 23 knots, carrying 1000 passengers. Constructed at Quincy shipyard by Bethlehem steel, she ferried President Harry Truman, Alfred Hitchcock, and Walt Disney on their trans Atlantic voyages. She was the venue for 1967 Governors conference en route to Virgin Islands and back, a 3000-mile journey carrying governors of all fifty US states, high level presidential representatives, CEO’s of fortune 500 companies. A voyage dubbed as ship of fools at that time seems far from the reality in today’s context. Advertisements boasted her Henry Dreyfuss designed cabins, as marvel of American design and craft. She had branches of fifth avenue shops onboard. She was the last US built ocean liner to sail under US Flag. With the advent of jet era, her cruise ship days were over. Her need for transatlantic voyages now long over, she was becoming a liability. In 2003 she was sold to Norwegian Cruise Lines to run the Hawaii cruises. In 2006 it again changed hands and was sold to another American company after being renamed as SS Oceanic. In 2008, renamed as SS Oceanic, she was towed out from San Francisco to Dubai.

In 2009 she was again renamed as SS Platinum II and was tugged to the beach of Alang situated in the Gulf of Cambay, India. The tug lost power some 25 km from Alang setting both the ships adrift. Another tug was then sent to assist the ship. Soon the ship SS Platinum II/ Oceanic/ Independence was turned away when it was found out that it was supplied with falsified papers. After much controversy the ship was found abandoned near the shore and its hull was cracked, soon the ministry of Environment and Forest gave its consent to beach the ship at Alang. The tug that carried it from Dubai was long scrapped at Alang.
Shipbreaking shores of Alang, Ultimate Fate of obsolete ships.
ALANG: INDUSTRY OF RESOURCES EXTRACTION

Alang, located in the Gulf of Cambay, is the last berthing place for not only passenger ships but for all kinds of vessels. Almost over 700 ships are scrapped worldwide; Alang alone processes half of them. The economic or structural life of these large vessels is 25 to 30 years, after which they become a financial and ecological liability. The steel in these ships though is of value and scrapping them for recycle is the only way to capitalize on these otherwise unusable vessels. It is a huge ecological challenge to dispose these colossal objects. Often over 10,000 tones in dead weight, they contain oil residue, lead paint, asbestos, PCB's (Polychlorinated biphenyl) and other hazardous and toxic material onboard. Stringent environmental laws makes ship-scrapping an elaborate process of decontamination, driving the scrapping coasts upwards. This led to the rise of shipbreaking activities on the beaches of Indian subcontinent. Their low operational expenses benefitted from the unique geography, cheap labor and lack of environmental control. These yards purchase obsolete ships, for the quantity of steel in them.

Though a number of different methods exist for disposing of a ship, shipbreaking is most prevalent as it is the only source for recycled material. Until early 70’s breaking was carried out in the dry docks of Western Europe and America. Then the industry moved to the east following the emerging economies of Korea, Japan, China and Taiwan. In 1980’s three shipyards in Indian subcontinent Chittagong (Bangladesh), Alang (India) and Gadani (Pakistan) formed a strong magnet for this industry. Today these locations carry out 95% of entire ship recycling, utilizing their very big tidal ranges and expansive mudflats. The method employed here is known as ‘beaching’. These locations have worlds highest tidal ranges, which means that at spring tides, ships can be driven as far up the beach as possible, over the mudflats and onto the beach. This makes elaborate dry-docks completely unnecessary.

The steel that is extracted from these ships is a valuable commodity
and has a high demand in these emerging economies. For countries with very little mining activity, like Bangladesh, ship scrapping is major source of the steel. This has led to skewed flow of commodities and waste. As in the case of SS independence, often these ships transfer owners, flags of registrations to circumvent legal structure in western world that prevents the sale of this toxic ships to developing world. With emergence of global regime like Basel convention, against transboundary movement of toxic waste, and Hong Kong convention shipbreaking has been brought under scrutiny of international law. In India, by recognizing shipbreaking as industry, the state has given clear indication that it recognizes the economic importance of the shipbreaking.

The story of SS Independence is far from being unique in the industry of shipbreaking; an industry, that operates on the edges of legality and economics. There are only a handful of such places like Alang, Gadani in Pakistan and Chittagong in Bangladesh. These sites are the nodes on global flow of waste. These sites convert, what is otherwise considered as junk, discarded and unwanted, into something that has value, and is sometimes needed even at the original place where it was considered scrap. Waste thus is merely a matter of place or to paraphrase philosopher William James it is matter out of place.
**Waste: One Man’s Trash is Another Man’s Treasure**

We are entering into a new phase of urbanization, as western economies go into post industrial phase, the developing nations in Africa, Asia and South America are transforming themselves as manufacturing economies. Both the spheres of production and consumption are predominantly urban. We are living in the urban world with most of the world’s population projected to be living in the cities by 2030 according to United Nations. One of the consequences of this rapid urbanization is generation of waste. Industrialized nations are the largest contributors, in particular the United States and Canada, with 2 and 1.7 kg per person per day respectively*, approximately double of what the rapidly growing urban population in Latin America or Asia generates.

Rapid urban growth also is the cause of global environmental change, driven by increased production, consumption, and the generation of waste. Over the past 10 to 15 years, per capita solid waste generation has increased in almost every city around the world. The changing pattern of consumption gives rise to changing pattern of production and the values that are acquired by the trash.

WASTE AS A SPATIAL PRODUCT.

Trash or waste is just matter without any immediate value. It is matter at the wrong location. Waste is always seen as a liability, it needs to be treated, incinerated, buried or needs to be collected and transported for recycle. Recycling is extracting the value out of this otherwise worthless matter. Everything that has been ever manufactured needs to go through this value cycle. Yet this is an economic activity that supports millions across the globe. From urban trash pickers to migrant workers at Alang this vast economy of resource extraction actually reduces our overall environmental impact. Often these industries are peripheral to formal manufacturing due to the stigma that is attached with the notion of trash. These scavenger industries present extensive economical and ecological benefits to overall system that is driven by constant urge to produce and consume more and pressing need for the resources needed for that.

INDUSTRIAL URBANIZATION AND WASTE

It is no wonder that it was during early industrial revolution that waste started to figure into larger discussions of ethics. The notion of waste and its reuse, acquired center stage during, what we now term as second industrial revolution. The interwar years: a period of great technological advancement in manufacturing, that coincided with colonial race for resources and periods marked by scarcity induced by wars. It was then; the geographic notions of waste were reexamined.
It resulted into the reconsideration of waste as a feed for further industrial processes. The chemical engineer John B C Kershaw wrote in his 1928 book, The Recovery and Use of Industrial and Other Wastes:

“Dirt, from the philosopher's standpoint, is simply matter in the wrong place, and industrial waste may be regarded similarly as useful material produced or dumped in places where it is not required. When transported to the right spot an industrial waste will often form the raw material for some secondary industry or manufacture”.  
(Kershaw 1928)

This might be considered as a start of industrial ecology as we know it today. At the time of Kershaw, the flow of waste was local in nature. After the second world war as globalization and international trade grew, this flow became international, often from global north to global south. This export of waste often spawned new economies around where it landed. These ‘recycling’ industries were often stigmatized; nonetheless they provided valuable resources to the industry. This industry was in turn the cause of rapid urbanization to the surrounding areas. To understand this feedback cycle better we must examine the process of shipbreaking and resultant urbanization at alang.

“Wasting is a necessary part of living, yet if processes are not well managed, life itself is threatened”

1. *The Fighting Temeraire on her way to be broken up* 1839, J M W Turner

2. *English: Scuttling of the German Fleet at Scapa Flow: Salvage work in progress on the German battleship BADEN at Scapa Flow. The cruiser FRANKFURT is also in view.*

3. *Susan bay mothball fleet*
This chapter begins with the overview and brief history of global shipbreaking. The focus is to explain the muddy business that shipbreaking has come to symbolize today. It will then touch upon the global regulatory regimes that govern the shipbreaking and migrations of the industry as a result. In order to untangle the process it will study the prevalent methods of shipbreaking and what makes the beaches of subcontinent the favored site to recycle obsolete ships.

Breaking ships for their material is not a new thing. Ships have always been recycled for the material value they represent when they are recycled. The ship, be it wooden or steel have always had a considerable value. Shipping industry is way ahead in terms of recycling than any other comparable logistical industry, such as automotive or aviation because almost 95 to 98% of ship by weight can be reused. In the times when timber was the main material of choice, timber used in ships represented material of great quality.

Seasoned and waterproof hard timber was used in construction. A famous example is of the departmental store liberty of London; which was constructed in 1857, from the timber of two former ships HMS Impregnable and HMS Hindustan (Liberty, 2013). During those times, ships used to be lined with copper at the bottom so as to make them watertight. This cooper also fetched significant price in the scrap market. According to lloyds records the ship Temeraire, made famous by painter J.M.W Turner, was sold for £5,500 in 1838. Her copper was sold for £3000 to admiralty (Lloyd’s Register, 2011). With advances in technology, metal replaced timber as the main product of shipbreaking. It was more profitable to recycle the metal than wood and also represented less material losses. Shipbreaking represented major source of steel in the years of The Great War during 1914-
1919. After the war, German naval fleet was scuttled at Scapa Flow, a group of islands north of British Isles. The value represented by this steel was so high that a salvage operation was mounted in 1922 and it took almost 20 years.

World War II locked up vast amount of steel in redundant battleships and cargo fleets. Some of the ships built at that time are now known as the mothballed fleets. This fleet known as The United States National Defense Reserve Fleet (NDRF), consists of about fifty World War II ships that have been moored in Suisun Bay near San Francisco since the 1950s or ’60s. The world war era ships were source of steel in the immediate post war years. After the war, ship scrapping continued in places such as La Spezia, Italy, and Japan. However, as the ship building industry shifted eastwards in the 1970s, so did the scrapping industry.

**MIGRATION OF THE INDUSTRY**

The industry of shipbreaking is a migratory phenomenon, much more so than any other industry. There is a clear link between economic development, and shipbreaking activity in any maritime economy (TERAO, 2011). During the after war booming years, it was USA and UK that were the primary shipbreaking nations. Soon as eastern manufacturing economies became more resource hungry; shipbreaking was a quick way to obtain much needed steel. Taiwan had overtaken Japan in the mid-1960s to become the world’s largest shipbreaking country, remaining so until, on August 11, 1986, after which an explosion and fire on board of the tanker Canari killed 14 people and injured 47 more. Due to a huge public outcry, what had been an unregulated industry in Taiwan suddenly became a subject of major crackdown. As is typical within the waste sector, the ship scrapping industry moved to Indian subcontinent, almost overnight.

**RISE OF THE SUBCONTINENT.**

Some ascribe the rise of shipbreaking industry in Indian subcontinent to an accident on coast of Bangladesh, when a Greek ship “M.D.Alpine” was driven ashore by tidal storm in 1960 and could not be refloated (Hossain et al., 2006). The ship remained stranded near Sitakunda until
MIGRATIONS OF SHIPBREAKING INDUSTRY

The UK, The Netherlands and the USA were the main shipbreaking countries until after the Second World War. In the 1950s,

In the 1960s, Taiwan took the shipbreaking lead with its yards clustered around Kaohsiung.

India, Pakistan and Bangladesh then became the major players in ship dismantling,

Le Clemenceau Supreme Court of India temporarily punished the French aircraft carrier Clemenceau from entering the port.

The Blue Lady Indian Supreme Court intervened but later cleared the ship's entry, due to 1000 tonnes of asbestos on board.

Kronos Nereus a ULCC superanker and the longest ship ever built. She possessed the greatest deadweight tonnage ever recorded.

Bosco Valdes Korean oil tanker, was beached at Abing on 2 August 2012.

1999

2002

2006

2008

2010

2012

2015

2017

2018

Europe

United States

Far East

Sub-Continent

Africa

Asia

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

The Long Depression

The Early 1990s

The Early 80s

The Great Depression

The Great Depression

The Long Depression

1800

1850

1900

1950

2000

2010
in 1964 Chittagong ship house bought the vessel to scrap it. This was the rise of shipbreaking in Indian subcontinent.

Alang, a small coastal town in the state of Gujarat became the epicenter of ship scrapping when “MV Kota Tenjung” was scrapped there in 1983. By 1989 the number of employees at Alang had already reached 40,000. Soon Gadani in Pakistan followed. There development went unnoticed or was deliberately ignored due to high returns it provided. As often the economies of waste remain out of sight. As the new scrapping method of beaching was perfected these three centers of ship recycling became industries in themselves often producing the considerable portion of national steel output. These locations attracted migrant workers from the impoverished parts of the country. The work was arduous and often the ships contained hazardous material. Living conditions on these beaches were often derelict. These industries evolved in extremely feudalistic manner resenting any attempts of control and regulation by the government.

It was in 1995, when journalist Will Englund, from American newspaper, The Baltimore Sun, became aware of complexities of shipbreaking while covering American shipbreaking yards. He then dug deeper along with investigative reporter Gary Cohn and ran a series of articles that exposed the brutalities of shipbreaking around the world. These Pulitzer Prize winning articles and diminished domestic ship scrapping operations resulted into a moratorium by the US government on export of federally owned ships to the shipbreaking yards of South Asia. This was also a policy shift in response to humanitarian and environmental concerns associated with shipbreaking.

After 1990’s series of conventions attempted to regulate the shipbreaking industry; notable amongst these are the first industry “Code on Safer Ship Recycling” in 2001, a term that was coined in late 90’s. “Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships” brought the sale of ships for scrapping under The Basal convention in 2003. International Maritime Organization sought to establish the Hong
Kong International Convention for the Safe and Environmentally Sound Recycling of Ships; this was adopted in May 2009, and will come in practice by 2014. All these conventions pertain to safe and ethical practices in recycling ships, yet it should be borne in mind that the ships that are being recycled are from 1970’s. In those days, our concepts on hazardous materials were extremely underdeveloped and primitive than those of today. Thus this is a long term process that starts with building better ships that are easy to recycle.

**METHOD OF SHIPBREAKING**

There are four main methods to recycle a ship. They differ according to the location. Shipbreaking in western world is mostly undertaken in dry-docks which is the most expensive of all the methods. In China it is done alongside of a wharf. Another method is to use a modified slipway, to drag the ship off to the sea onto a dry beach. This method is mainly employed at yards in Turkey. The most commonly used method though is beaching where natural tidal difference is used to drive a ship on to the flat beach. This method is predominantly used in sub continental yards of India, Bangladesh and Pakistan.

Beaching constitutes of almost 95% of the ships that are scrapped. These are beached on the shores of Alang, Chittagong and Gadani. These locations are of strategic importance due to their high tidal range and expansive flat muddy beaches. This means that at the spring high tide, once a month, the ship can be driven ashore as far as possible over these mudflats onto the beach. If they are stranded in the mud they are pulled higher with chains or heavy steel wires during the next suitable tide. These chains are attached to winches on the beach.

Before cutting the ship apart it is made lighter by removing all the furniture, machinery caballing and salvageable material, which then recirculates into secondhand market, reengineering firms and repairing shops. As these items are removed from the ship, it is progressively taken apart in sections by oxygen cutting. Winches drag
the large pieces further ashore. Their large pieces, plates and girders are then sent to cutting yards in the vicinity usually owned by the same company so as to cut them into regular size steel plates. A major issue with dismantling ships on tidal mudflats is that any spills of oil or cargo remaining on board are likely to be swept out to the sea in the next tide.

Alongside shipbreaking technique is mostly used in Chinese shipyards. Purposely built wharf or quay-side is used in this method. This is a top down process where vessel remains floating till the end. Superstructure and interior pieces are removed first and then the work continues along the ship into the engine room until only the double bottom is left. This is called the ‘canoe’. Through a process of ballasting, and lifting, in turn, the aft and forward ends clear, this canoe is further and further reduced until it is either lifted out in one piece, or sent to dry dock for final cutting. The local impact of any pollution is likely to be increased during alongside recycling since there is no tidal dispersal effect. However, this means that concentration can be properly monitored, contained and cleaned if necessary.

Dry-docking is the safest and most controlled method of shipbreaking. This is generally employed in the western countries that employ old dry-docks that were used for shipbuilding. Leavesley International in Liverpool, UK is one of the main dry-dock recycling facilities. The method is relatively self-explanatory. The ship enters the dry dock to be taken apart piece by piece. What makes this process safer at least environmentally is the level of control that is achieved by dry-docking. All the spillover effects are contained and can be remediated in a controlled manner. The biggest drawback however is the cost involved in constructing this infrastructure. Considering the volume of shipbreaking achieved by locations in subcontinent where almost 100 plus ships are broken simultaneously, dry-docking falls short of being a pragmatic option.

Modified Slipway is a method that is employed mainly in the shipbreaking yards of Turkey. A slipway is a ramp or rail on using which ship can be dragged onto the shore. The yards in Turkey are
situated on the Mediterranean Sea, where low tidal variance and predictable water levels which makes beaching impractical. The ship still goes hard against the shore or a concrete slipway extending to the sea. In both the cases lack of tide provides a degree of control over the course of ship. A semi permanent jetty or a quay can supplement slipway.

SHIPBREAKING AND NATIONAL ECONOMY
The main product of shipbreaking, the steel plate is extremely valuable resource in a growing economy. The plates are not very large in size however are of very high quality. They don’t need blast Furnace or electric arc furnaces for recycling. The preferred method is to simply shear them to adequate size and reheating them through a coal fired Furness to reroll them into bars. This material, known in the industry, as ‘ship plate’, is far cheaper and far more energy efficient than to produce same amount of steel from iron ore. They key aspect of this industry is to lower the cost. The beaching method lowers the cost of demolition sharply, using labor-intensive dismantling and low investment in equipment. It certainly has problems with labor safety and environmental pollution, yet it can be easily emulated anywhere with favorable condition either geographic or economical. It also needs a strong demand for scrap metal in the domestic market. It is projected that the output of Alang is equal to about 17% of national steel output. In case of Pakistan it is even higher about 50% and Bangladesh entirely depends upon shipbreaking for its steel. Thus any fluctuation in this scrap metal industry will have wide repercussions on national metal markets.

KEY LOCATION OF SHIPBREAKING
America
Shipbreaking facilities in the states are amongst the most controlled ones, consequently they are the most expensive ones too. They are tightly regulated by EPA as well as MARAD( the US Maritime Administration). The major U.S. shipbreaking activity is located at Texas and Maryland. These yards generally scrap about 20 to 25 ships a year. The mothballed fleet is always used as a feeder when the industry is in crisis.
Bangladesh

The shipbreaking industry in Bangladesh can be said as the start of beaching in the subcontinent. Beaching of “M D Alpine” by a cyclone and salvage of a Pakistani ship “Al Abbas” that was damaged in the 1971 war, led to formation of shipbreaking as an industry in Bangladesh. At present there are 24 yards that undertake the shipbreaking of almost 60 to 65 ships per year. As the country is dependent on the steel that is generated by the industry, government initially was lax on providing loans. As a result the industry got involved into many scams. However it now appears that it is under government regulations and is being taxed. (Hossain et al., 2006)

China

China is amongst one of the major shipbreaking countries; the industry here is highly regulated and works with ‘alongside’ recycling technique. Located mainly along the Yangtze River they have benefited from high standard of infrastructure. Entire process is controlled and inspected for environmental regulations.

Turkey

Aliaga is the main center of shipbreaking in Turkey, situated on the western coast; there are about twenty recycling yards that employ modified slipway technique. As the tidal range in Mediterranean is limited they are able to control the runoff from intertidal zone. The yards are concreted and are better suited to prevent any spillover pollution leaking in the soil.

India

Shipbreaking in India started in Mumbai, which still has the shipbreaking industry but Alang, located in gulf of Cambay by nexus of highest tidal range in the country. Migratory labor and low government oversight became a global hotspot in matter of two decades. Alang used same techniques as used by other yards in the subcontinent – beaching. Subsequent chapters will explore Alang in more depth focusing on the dynamics of industry and factors that surround it making it one of the most controversial industries in and around the world.
4. Existing and emerging landscapes of ship breaking
“If one used nothing then we would waste nothing [...] But look at it from another angle. if we use nothing at all is it not then the waste of total?”

Henry Ford. 1926.
“Today and Tomorrow”, p 89.
This chapter will discuss the origin and localities of shipbreaking in India and specifically in Alang. Shipbreaking activity is not new in India; it has been going on since 1912. Started first by British in Mumbai and Kolkata, these two still remain the centers of shipbreaking, but the scale of operations at Alang eclipses anything that Mumbai and Kolkata can ever manage in their docks.

It was in 1984, during the economic recession of early 1980’s, attributed to a general adoption of neoliberal economic policies throughout the world, that Alang first rose to prominence. Meanwhile due to recession and government regulations the prices of scrapping ships in the eastern shipbreaking yards sky rocketed. The yards in Indian subcontinent offered a less expensive alternative due to availability of cheap labor. In 1983 a shipbreaking yard was set up at Alang due it its favorable geographical conditions. The state and federal government saw this as a way to generate money by taxation and import duties. Alang, which is not a port in its physical and formal structure, continues to be listed in the admiralty charts of west coast of India. More than 90% of the total shipbreaking of India is done at Alang with its maximum capacity of 180 plots. As per recent reports, year 2012 recorded the highest number of ships; 527 to have been processed in a single year*. The start of this growth can be attributed to the liberalization of Indian economy during 1990’s thus loosening the restrictions on imports. Liberalization also brought about many controversial ships that were a center of negative publicity. Next chapter will briefly discuss how and why these ships were controversial and how they brought about change in the way Alang operates today.

RISE OF ALANG: LE CLEMENU, BLUE LADEY AND EXXON VALDEZ

The rise of Alang is closely linked with the recycling movement in 1970’s and development of environmental consciousness in the

* Shipbreaking Yards in India Demolish a Total of 527 Vessels in 2012, Breaking All Previous Records.” Accessed May 6, 2013.
west. As often is the case with waste, which is hidden away in the unseen places; Alang, relatively underdeveloped till then, an unknown beach in the interior of the gulf, became the ideal spot to send the obsolete ships. After the establishment of Basal convention for the movement of hazardous waste, its loopholes quickly became apparent, as operations at Alang went unnoticed, at times even attracting more ships than before. This prompted the environmental activist NGO’s such as Basal Action Network, shipbreaking platform and Greenpeace to protest and publicize bring the issues of hazardous waste and unethical working practices on the international scale. This activism though was a result of specific few ships being sent to Alang. These ships some well known and some infamous carried with them the international focus we will see some such cases. It is illustrative of the complex linkages that the industry works on.

Le Clemenceau (2006): Le Clemenceau episode put Alang on the world map as a center of shipbreaking partially due to relentless activism of Greenpeace. Le Clemenceau was a French aircraft carrier built in 1955 and was decommissioned in 1997. It was decided that she should be scrapped and the scrapping should be outsourced to Alang. Greenpeace, an international environmentalist NGO, was in protest even before she set sail to India as she was laden with asbestos, PCB’s lead and mercury and other toxic chemicals. Greenpeace argued this sale was a violation of Basal convention. Regardless she was sent to India but met with protest by Indian media as well. It was projected as the case of environmental dumping by the environmental lobby where as supporters of shipbreaking argued about the advantages of employment generation and benefits to the local economy. So intense was the debate over this ship’s entry into India that Supreme Court of India had to issue a five-day ban on public debates and protests over this issue (Thomas, 2007). It was eventually ordered back by French president Jacques Chirac before he embarked on the state visit to India.

SS Blue Lady (2009): This is another example of a convoluted case of a famous ship coming to Alang. SS Blue Lady originally named
GLOBAL FLOWS OF SHIPBREAKING

Based on data from NGO Shipbreaking Platform


*No data for Japan and Non-EU/ECD countries
SS France was a prestigious ship. She was one of the most famous ocean liners of the day. Due to a boiler explosion in 2003 and already dwindling sales of cruise lines it was declared that she would never sail again. After this she was towed to Bremerhaven, Germany. She then changed owners multiple times and arrived at Bangladesh where she was rejected entry. She later popped up at Alang and was renamed SS Blue Lady. It was presumed that she had almost 1000 tons of asbestos onboard as she was built in the days when asbestos was in widespread use. Another fact was the presence of radioactive material in the form of ionizing smoke detectors. Eventually Supreme Court of India intervened and ruled in favor of scrapping the ship.

SS Independence: The case of SS Independence is discussed in great detail amongst the available literature and also in the introduction of this thesis. What makes this unique is the fact that a complaint was filed against the owners of SS independence in United States for illegal export of hazardous waste specifically a ship that contained PCB’s. This is an example that government bodies can play instrumental role in regulating the ship-owners.

Alang thus remains in a status where it is legal in India, with Supreme Court of India setting up guidelines for proper operations. But the loopholes in international law will continue to plague the safety and environmental situation at Alang for some time to come. The ability
to operate on the fringes of legality makes Alang successful scavenger industry. This ability is also endowed by the geographic location of Alang.

THE GULF OF CAMBAY

Another factor that makes Alang successful is its location. It is located on the western coast of India, in the Gulf of Cambay. It is short distance away from major global maritime routes that runs from Suez Canal to Melaka strait. It is located on the western bank of the gulf, in a region that is primarily arid. Before the shipbreaking activity began Alang was a pristine beach and fishing was the main occupation. The gulf region though has been central to trade and commerce of northern India since medieval times. The Gulf of Cambay or Khambayat as it is known traditionally, is an inlet about 80 miles in length. Two major rivers of central India Narmada and Tapi empty into the gulf, bringing large quantities of sediments along with them. Gulf is a not very deep yet the tidal height variation, the difference between high and low tide, is amongst the highest in the world reaching 8 meters twice every month. This is the principal reason of shipbreaking industries location at Alang. The Eastern coast of the gulf is a bustling industrial belt, India’s largest industrial zone. It houses cities like Surat, Vadodara and industrial towns and harbors like Hazira, Dahej, Vapi, Ankleshwar. This region represents multi-billion dollar investment just in terms of the proposed projects that want to locate themselves in the region. There are two main ports on this coast, Hazira and Dahej. Hazira is India’s largest transshipment port and an important point in the petrochemical and gas industry of the country. Where as Dahej is all weather direct berthing multi cargo port situated on the southwest coast. This coast also has multiple power plants and even an atomic power generation station that feeds into countries energy hungry power grid.

In contrast the western coast is relatively underdeveloped with Bhavnagar in the northern part and Pipavav to its south, these being the only ports for considerable time. Now however there are many new developments underway or are at least in planning stage. In
SHIPBUILDING, SHIP DISPOSAL AND WORLD ECONOMY


5. Alang in March 2004, before Global Financial Crisis
this regional scenario Alang remains the only major extra-formal industry that feeds into regional small-scale industry. However Alang is intricately linked with Bhavnagar, Sihor area and Pipavav for the upstream industrial flows. This makes it a unique case of regional industrial ecology, which this thesis aims to expand upon as a generator of urbanity. We must need to understand the existing flow of materials, resources and labor at Alang region in order to shape them into more cyclic industrial process.

**INDUSTRY OF SHIPBREAKING**

Alang started in 1983, only 72 plots existed until 2004 but since then it has grown in an immense industry with 171 plots. To understand the dynamics of how Alang works we need to understand the main actors and their roles. Gujarat Maritime Board has the overall responsibility of Alang as it is listed as a port. It oversees all the administrative tasks and permissions that are needed to beach the ship. Apart from that many other certificates are needed in order to beach the ship.

Ship breakers need to submit Cargo Free Certificate, Decontamination Certificate, Atomic Radiation Free Certificate, Gas Free for Man Entry certificate, Gas Free for Hot Work certificate, Naked Light Certificate, Waste Disposal under Hazardous Materials and Waste Rules, Labor Insurance Certificate, Factory Inspector Certificate, and the Beaching Permission. Relevant authorities involved in the inspection of these certificates are customs department, GPCB (Gujarat pollution control Board), Department of Explosives, State factories and Labor commission, Atomic Energy and radiation Board, Department of inspection, GMB.* This complex bureaucratic process makes the process of beaching time consuming and ultimately unprofitable. For this reason ship breakers often work their way around these checks and balances thus encouraging the possibilities of corruption in the system.

After the liberalization measures in India in 1991 there was a acute demand for steel, shipbreaking offered an easy alternative. In 1994 GMB issued 10-year licenses for additional 100 plots, till then only 72 plots existed at Alang. As the capacity of shipbreaking increased

by almost twofold the availability of scrap grew rapidly, thus boosting the rerolling business. In order to maintain the breaking permit a ship breaker has to break larger ships, the ones that are above 25000 tons on the site with minimum of 120 meter waterfront. But the nature of industry is cynically speculative thus the calculated capacities are usually much higher than actual capacities. Besides the direct employment it generates, the ship breaking industry also provides spin-off to other industries, such as re-rolling mills and suppliers of oxygen and liquefied petroleum gas (LPG), and also to scrap processors and traders involved in selling second-hand products such as furniture and fittings from ships. The shops that sell salvaged goods, reengineering firms line the 10 km road that leads to Alang.

**BREAKING UP A SHIP**

The ships that come to Alang are often registered and flagged in the tax havens. these are often the countries that operate on the boundaries of international tax and maritime law; they are called as flag of convenience. Some of them are Liberia, Panama, Comoros islands, St. Kittsnevis. This makes the entry of ships easier as opposed to ships from EU states that need to undergo thorough inspections for hazardous waste. Once a decision to scrap a ship is purely market driven. During the financial crisis of 2004-2008 Alang saw overflowing of the discarded ships. During the times of recession a ship that is an asset immediately becomes an liability. If there is no perceived future use or the vessel is at the end of its working life (which is 20 to 25 years) then scrapping it is the easiest way to turn a liability into an asset.

The usual practice is to sell the ship to a cash buyer who then further sells it to the shipbreaking yard. This makes the entire process hard to track by circumventing the legal structure of specific countries where the operator of ship is located. A ship breaker purchases the ship for its shear quantity of steel, known as D.W.T.(dead weight tonnage). Considering about 90% of ships will be recycled, he is actually gambling on the cost of steel in the scrap market after the ship is broken. The details such as amount of steel on the ship, the condition
of the ship, place where it was built and condition of the equipment and possibility of reuse are crucial more so than the presence of toxic material on the ship (Puthucherril, 2010). The sale of ship involves considerable financial risk. Thus once a ship is purchased for breaking it is race against the clock to cash in maximum profit out of the steel that will come from it.

Once the deal is made, the ship is either towed or sails on its own power, often carrying the last load of cargo to the last port of call. It then sails straight to the scrapping yard of Alang. It is anchored in the international waters off Alang, about 12 km away from the coast. It is visited by multiple agencies mentioned above, these inspect the ship for hazardous material. Once all the certificates and clearances have been granted it is positioned off the coast on the course of appropriate plot, waiting for the highest tide of the month.

During the period of three of four days of high tide or spring tide, ships run with full steam aiming for the flag that indicates the location of the plot. It is often piloted in from the shore or a specialist beaching-captain takes over the helm for this last journey. Depending on the draught it is made lighter so as to make it run aground as far as possible. Once the ship runs aground depending upon its distance from the intertidal zone it is winched higher on subsequent high tides. After it is properly beached, it is emptied of all the electronics and furniture including doors and partitions. This is auctioned off and is called by the general buyers from the ship to be sold in the second hand shops that line the entry road. At this stage it is also emptied off, of its ballast and bilge water. At Alang this water is pumped out into takers to the treatment plant run by GEPIL (Gujarat environment protection and infrastructure Ltd.)

As it is being stripped off an agent from the shipbreaking firm draws up a scrapping plan. This is to ensure that to cut the ship while maintaining it perfectly vertical and structurally safe. This is often made complex by the possibility of limited ground contact of the ship during high tides. Thus they need to be broken symmetrically keeping
Pre-Demolition Certification

Cargo Free Certificate,
Decontamination Certificate,
Atomic Radiation Free Certificate,
Gas Free for Major Entry certificate,
Gas Free for Hot Work certificate,
Naked Light Certificate,
Waste Disposal under Hazardous Materials and Waste Rules,
Labor Insurance Certificate,
Factory Inspector Certificate, and the Beaching Permission.

Beaching

Furniture, Electronics and
Machinery
Bilge and Ballast Water
Preparation of scrapping plan

Breaking

Customs Department,
Gujarat Pollution Control Board
Department of Explosives
State factories and Labor commission
Atomic Energy and radiation Board
Department of inspection
Gujarat Maritime Board

Aditya Barve
the balance intact. Once the scrapping plan is finalized, series of small holes, six by ten feet in size are cut in the hull to vent the trapped gases in case of tankers and this helps to create openings for light. This task is often full of potential fire risk as the flame from oxygen cutting torch can possibly ignite the trapped gasses if there are any. Once it is cleared of all the residue and gases, ship is then systematically cut up in large pieces which are then trucked back in the cutting areas to be cut into small regular size steel plates. An average size cargo ship takes about three to four months to be broken up entirely. Then the plot is cleaned and prepared for next ship and the entire process repeats itself again. All the material taken from the ship; ferrous and non ferrous scrap is transported to rerolling mills for further processing. Dismantling of a single ship generates substantial material flow that spans over considerable distances for reprocessing. Alang thus forms a regional economy of substantial scale.

**Geographies of Martial Flows**

The regional economy of Alang as it exists today can also be seen as mining of resources from waste. Once we apply the analogy of mining to Alang we begin to understand more clearly the associated flow from Alang to the manufacturing areas. Alang’s shipbreaking produces ferrous, non-ferrous scrap, machinery, electronic, furniture and other various miscellaneous things. On the broader scale it can be divided into two streams – materials for direct reuse and those for the resale.

**Direct Reuse/ Resale**

Material that can be directly reused can be equipment on the ship or parts of the ship itself. Many parts of the ship are designed to perform in the worst conditions imaginable. They are always useful when are in working condition. Here at Alang these parts, which are in perfect working order, are categorized and taken apart. Once those are not working are repaired and repainted in order to make them look and perform as good as new. Generally these include compressors, pumps, engines and other such machinery. According to some reports a shipbuilding yard, which purchases some of these parts is opened about 20 miles from Alang. The access road to Alang from the main
Flows of waste, resources and labor
highway, a stretch of about 10 km is lined with shops that sell Tools, auxiliaries, lamps, TVs, fax machines, radios, tables, beds, fluorescent tubes, kitchen fittings, benches, ropes, safes, cables, ornamental plastic sheeting. Lifeboats are sold to coastal fishermen; local farmers use the diesel generator and pumps from the ships in their farms. All the sale of direct sale material happens within 10 km radius of Alang, whereas the material destined to be reprocessed travels 50 km north to Bhavnagar Sihor area.

Recycling / Reprocessing industries
Alang primarily exists because of the steel it provides. This steel comes in two types: Reroll-able scrap and Casting Scrap. Rerollable scrap amounts to almost 90% of all the steel that is extracted at Alang. This comes in the form of steel plates that originally form the skin and interior partitions of the ship. These plates are cut into manageable sizes and then sold to rerolling mills. All the rerolling mills are situated in the Bhavnagar area about 50Km from Alang. The main reason for this shift was that at the time when Alang started, Bhavnagar was the only city in the region that had a decent sized harbor needed for the import coal. Coal is needed to run the furnaces that make steel.
plates malleable and easy to form into bars. This logistical requirement made Bhavnagar and Sihor an area of choice and with the logic of agglomeration all the rerolling industry clustered around it. All non-ferrous metal and casting metal is sent to Rajkot or Ahmedabad where most of the heavy industry suited for casting is located.

Every day almost about hundreds of trucks ply the road between Alang and Bhavnagar, transporting over 10,000 ton of steel plates.
19. Rerolling the hot steel strips into reinforcement bars
The rate of the scrap is decided daily. At present thought all the coal needed for rerolling comes from Pipavav a port south of Alang and 80 km from Bhavnagar, as the port of Bhavnagar is not large enough to accommodate the demand and has problems of silting.

Alang not only ships its materials inland but it also exports the reengineered parts. The reconditioning firms that line the approach road export the equipment like generator, engines, and compressors once these are repaired and painted to make them look as good as new. The area of export is generally limited to China and Middle East, via Bhavnagar port.

Alang provides direct employment to almost 35000 strong labor force. Most of the workers that work at Alang come from states of Orissa, Bihar and Uttar Pradesh from some of India’s most impoverished regions. This predominantly single male migrant workforce also has altered the social balance in the region.

20. A lorry transporting engine block to casting mill.
“Dirt is the by-product of a systemic ordering and classification of matter{…} shoes are not dirty themselves, but it is dirty to leave them on the dining table.”

1. Eight mile long beach of Alang Sosiiya Ship breaking Yard. Officially designated as a notified industrial zone.
Alang, since it started in 1983 has changed the area beyond recognition. It has altered the environmental and socio-political dynamics as well. To situate any project of industrial urbanization; we need to understand the relevant stakeholders and the dynamics amongst them. The principal actors at Alang are Government: represented by Gujarat Maritime Board, Ship breakers and the association of ship breakers, workers and villages in the area.

**GMB : GUJARAT MARITIME BOARD.**

Gujarat Maritime Board is a coastal maritime authority that administers the entire coastline of Gujarat, the longest of any coastal states in India, GMB also oversees the development of ports in Gujarat. In 1998 GMB designated an area of 17 square km on Alang’s coast as a notified area by an agreement with GIDC (Gujarat Industrial Development Corporation). A notified area is an area designated for special business purposes, it needs to have the facilities set up in order to meet the needs of that business (Workshop on Wise Practices for Coastal Conflict Prevention and Resolution, 2002). GMB, as per the agreement is responsible to provide all the facilities until the area is

*Inside of a ship breaking plot, a hull of a broken tanker in the background.*
self-sustaining. At which point it will be handed back to the same Notified Area Authority. Both GIDC and GMB are bodies that belong to the Government of Gujarat.

GMB and ultimately the government is responsible for the safe working practices at ASSBY (Alang Sosiya Ship Breaking Yard). To regulate safety in the industrial setting, GMB needs to ensure a proper adherence to the Factories Act (1948 – Second amendment 1987). With current nature of industries it will not be self-sustaining unless there is a spatial planning in place. This would include physical infrastructure such as roads, housing, drainage, sewage disposal, water and electricity; and social infrastructure like schools, hospitals, centers for entertainment and social gatherings, places of worship, and community services. GMB have implemented various infrastructure and social schemes, including an ambitious waste management plan, but being a maritime administration it is not set up for such diverse task of area planning and is stuck as a sole government authority in charge of the problem for which it has no core expertise.
SHIP BREAKERS.

Ship breakers are the entrepreneurs who started this industry. The ship breaking companies manage the plots that are leased by GMB. These companies are responsible for the purchase of ship, its beaching and breaking till the steel plate is driven away from the plot. These companies are often family businesses. Most are based in Mumbai and some in Bhavnagar. They have been organized under Gujarat Ship breakers Association that lobbies for the interest of the industry. Most of the ship breakers are first or second generation entrepreneurs. The major concern for any ship breaker is the maximum return on the cost of ship that is being broken. The return of this investment only starts as soon as the steel plates start to roll out of a breaking yard. Government of Gujarat also charges, 15% customs duty and 16% excise duty.* These additional costs further factor the cumulative profit. Thus often environmental and health concerns of the workers become secondary concerns.

WORKERS

Due to the transient nature of workforce, the estimate of direct employed workers at Alang varies from 25,000 to 40,000. Alang provides upstream and downstream employment to estimated 150,000 (International Federation for Human Rights (FIDH, 2002)) in various industries. The industries include re-rolling mills, oxygen bottling plants, transportation companies, local scrap dealers and storage agents. Upstream activity includes the brokers, insurance and banking sector, communication industry.

The main workforce at Alang still is the one that works on the shipbreaking plots. These workers, mostly single male migrants, are from three Indian states of Orissa, Bihar and Uttar Pradesh. An estimated 70% come from agricultural background. They migrate to Alang on their own, taking a train ride of over 3 days. They send money to their families back home every month which constitutes on an average 50% of their total earnings. They return to their homes once a year during the monsoons (Gujarat Ecological Society et al., 1998). Often the migration dynamics comes into play with the cast system in India. Though officially banned it still remains present deep in the conscience. Most of the workers hail from lower rungs of the society where as the owners are from higher. This sometimes results into paternalistic approach towards the workers but often it ends up being discriminatory.

The presence of massive population of single men has also generated...
Basic equipment of cutting a ship. LPG gas cylinders that are generally used for household cooking are used for gas cutting operations.
social and health problems in the area. Socially this population is always kept at bay from the existing villages in the area. In the sphere of health, the concerns about spread of HIV-Aids are serious.

Workers are hired on daily or monthly basis; in order to be hired they need to obtain a pass from GMB’s training center that provides a three day course on basic safety. The work hours tend to be longer, 10 hours a day, six days a week, is common. There are eleven categories of workers based on their jobs. As per the information given by the owner of the plot they are paid in the ranges of 250Rs ($5) to 450Rs.
($9) per day. But most of the documented evidence puts these figures in the ranges of: low Rs. 2,100 per month (US$ 50 approx.) for a first-time helper, to Rs. 9,000 (US$ 200 approx.) for high-risk jobs.

Categories and their job responsibilities of the workers are
Battiwala: cutters who cut the ship with oxygen torches
Helpers: who primarily assist the battiwala and in all other duties as required
Jodiwala: workers who move the heavy iron plates from one place to another
Mukadam – contractors who function as leaders and place workers at appropriate stations Supervisors, Winch operators, Crane drivers, Fitters, Carpenters, Foremen and Common laborers

The working conditions are far from ideal, though there have been some improvements, the entire operation remains under total power of the employer. He has the power to hire and fire any worker at any time. Employers, not long ago, saw formation of labor unions completely unwelcome; A change that will end the industry. Likewise working hours, wages and benefits are controlled by employers without workers having much of a say in these matters. This situation prevails due to the abundance of unskilled workforce. The totalitarian control of operation by the owners, abundance of cheap labor and no job security generates a feeling of helplessness among the workers which was evident from the interviews conducted on site

Thus over supply of workers has led to almost a feudal approach on the part of owners. Government, represented by GMB, apart from issuing the attendance cards and training, has limited say in this regard. A possible way to tackle the problems of oversupply and helplessness of workers is to create a skilled workforce by enforcing the safe work practices and strict training cross subsidized by the taxes that are paid by the industry.
The ten villages in the vicinity of the shipbreaking yard have experienced a tremendous economic and social change since 1983. The economy of these villages before Alang’s shipbreaking was primarily agrarian, now they have found multiple new avenues of employment in trade, transportation and retail sectors. On the other hand though, arrival of the shipbreaking industry has raised serious concerns about the environmental and social changes of the existing fabric.

Dumping of waste and noise pollution has been a serious issue and a source of conflict between the industry and the villages. The reports of respiratory and skin problems are on the rise. The coastal area of Alang faces water scarcity due to overuse of ground water resources. Overpopulation and high density due to migration are the main reasons of the water scarcity. Environmentalist also report that the quantity and quality of crops has decreased. (Demaria, 2010)
LOCAL FISHING COMMUNITIES

With the advent of Alang, all the above actor, though loaded with problems, had something to gain. The local fisherman community was the only stakeholder without voice and any apparent benefit from the industry at Alang. This part of the coast of Gujarat has always been rich in costal fisheries. From the available data there is a definitive drop in the fish catch and even disappearance of some species altogether. Often the entry points to the yard are in conflict with the fishing zones. There have been instances of heavy metals entering into the food chain through the fish catch. Also the locations of fishing are very limited due to legal restriction on where they can fish. Increasingly this community is being marginalized by the activity of shipbreaking yard. Some of them have started to work as unskilled labor while others have migrated in search of better opportunities.
Re-configuring flows at Alang
FUTURE OF ALANG

The environmental lobby and NGO’s often cite the case of Alang as the site of international waste dumping which to some extent it is. The main argument present as a solution of Alang is to close it down completely and let nature take its course to restore itself. But given all the complexities and externalities created by Alang it is a major catalyst in the area. One must acknowledge that the changes that Alang has brought about are benefiting to large extent of population but as Federico Demaria puts it, It is an ecological distribution conflict. We simply cannot go back to the rural and pristine Alang now. The only option we have is to acknowledge this global change and shape the future of Alang in a way that it creates a new industrial and environmental ecology around it. It is only possible if we acknowledge that Alang is not a one off phenomenon, it is a node in the chain of global flows. We can leverage those forces that created Alang in the first place to make Alang a better place.
“Dirt, from the philosopher's standpoint, is simply matter in the wrong place, and industrial waste may be regarded similarly as useful material produced or dumped in places where it is not required. When transported to the right spot an industrial waste will often form the raw material for some secondary industry or manufacture”

Kershaw, John B. C. 1928. The recovery and use of industrial and other wastes. London: E. Benn Ltd.
Economies of Waste

Waste or dirt is a product of systemic ordering by the virtue of being a polar construct of the human mind. The ordering that assigns the value to any object. This ordering also manifests itself as a ritual in almost all religions. The law of food and food containers in Judaism, the ritual bath in Hinduism are some examples of this. The broader idea of pollution or dirt is thus rooted in our hearts and minds not by its scientific and ecological impact but more by the urge to stabilize the order of things itself. The conversationalist nature of this urge always manifests itself.

Thus urge become more acute at moments of crisis, the moments when the very nature of this stabilized system is under threat. We human being are engineered to seek safety in stability, order and clear structure. Death, decay and decomposition, shocks us. Similarly the ideas regarding waste and pollution become sharp in the face of this change. We need waste in order to understand what is pure. When we categorize what remains within and what goes out. It instantly acquires spatiality.

In more than one way, industrial revolution proved how deep our relationship with waste and pollution is. Before the industrial revolution the production of waste was rarely a problem as it is diluted or used up. With growth of cities and industries the refuse of all the processes became a growing concern as well as an opportunity for economic and social segregation. Certain professions evolved out of this singular need of the society to get rid of its impurities. In nineteenth century England we can find an elaborate systems of professions that dealt with the problem of waste: bone gruber, chimney sweep, the rubbish carter, the ragman.
Getting rid of the impurities also means to move them away and out of our/the consciousness. Thus it is natural that the initial exploration about our concept of waste was undertaken in the fields of psychology. It was William James, an American philosopher and psychologist based at Harvard; who wrote in his book ”Dirt is matter out of place”. In many ways the spatiality is thus the determining factor of the value. This is again highlighted in the writings of Mary Douglas, specifically in her analysis of purity and pollution. The spatial notion of waste that is highlighted in the psychological discourse was also reflected into the other fields that dealt with waste. The writing of British chemical engineer John B C Kerkshaw is illuminating in this regard. In his book “the recovery and use of industrial and other wastes” published in 1928 he writes

“Dirt from philosophers standpoint, is simply matter in the wrong place, and industrial waste may be regarded similarly as useful material produced or dumped in places where it is not required. When transported to the right spot an industrial waste will often form the raw material for some secondary industry or manufacture” (Kershaw 1928)

The relationship of spatiality and value of the matter is instrumental in understanding the waste processes. The writings of Kershaw are precursors of industrial ecology, as we know it today.

The mainstream concept of industrial ecology or industrial symbiosis is commonly attributed to the article written by Robert Frosch and Nicholas Gallopoulos, published in a 1989 special issue of Scientific American, titled Managing Planet Earth. The idea of industrial ecology borrows the concept of interrelated webs and symbiotic relationships from natural systems. The aim for industrial symbiosis is to change the nature of industrial processes from the linear mode of resources extraction, purification, production, consumption, to a more cyclic one, where refuse at every stage is tied back to the system. In natural setting the ecosystems evolve so as to form an equilibrium with the waste production of all the species, it operates through linkages in which organisms consume waste of other species with minimum
energy loss.

A classic example of industrial symbiosis found in almost all the literatures, is the small city of Kalundborg in Denmark. It is not a result of any designed inter plant linkages but is shaped over the span of four decades through various bilateral and multilateral agreements to share the byproducts of one industry with the other. The resource and energy linkages are shared between power plant, a refinery, a gypsum wall plant, a pharmaceutical plant, an aquaculture operation, and agriculture in the area. These inter linkages are the result of private sector firms searching for uses of its bi-products and another one for its cheaper inputs.

The thought of re linking the waste as an input has a long history going back to the book by John Kershaw. This concept also evolved due to evolution of economic geography. The term industrial symbiosis was first used in the writings of George T. Renner in which he refers to the industrial symbiosis as, “The General Principle of Industrial Location” as a “Law of Industrial Ecology” (Renner, G.T. 1947. Geography of Industrial Localization. Economic Geography 23, no. 3: 167–189). Renner’s idea of location based resource linkages is extremely important when seen in conjunction with the present ideas of industrial symbiosis or eco-industrial parks. What makes an industrial symbiosis work is not just the close proximity and linkages in its input and output but the geographical location itself. Thus the spatiality manifests itself again as ‘the Midas Touch’ in changing the value of a byproduct to a resource. The role of proximity is undoubtedly important in shaping the industrial symbiosis but more than that, because of the imbalance in waste production and demand, certain type of waste such as scrap steel, textile and hazardous materials are prone to long distance linkages. Low Labor costs or high demand are the main pull factors for these global recovery linkages. The globalized byproduct linkages are shaped by global logistical supply and demand chain that was the result of post liberal policies since the 1990’s. Another significant factor is the rise of the environmental movement with its fundamental beliefs, that we need to conserve the
1. Kalundborg, Denmark

Aerial image of Kalundborg, a city that runs on industrial symbiosis.
surroundings that have been idealized as natural and any interference with it will destroy the fragile ecosystem. In short, at some level it aimed at getting rid of ‘pollution, dirt and waste’ from our visible surroundings in order to make it ‘naturalistic and healthy’.

The present literature on industrial symbiosis is almost exclusively dominated by examples of inter-plant flows*. It almost always focuses on primary processes in the geographies of production and consumption. There seems to be a growing interest though in the geographies of waste. By using concepts on industrial symbiosis and drawing parallels from the ecosystem we can map out the processes that act as ‘scavengers’ and ‘decomposers’. These process deal with recovery, reuse and remanufacturing of the waste to recirculate it into the cycles of economy and urbanization. The economical and industrial flows dependent on shipbreaking exemplify these linkages.

SHIPBREAKING: INDUSTRIAL ECOLOGY OF THE GLOBAL SOUTH.

The major component of the debate that surrounds shipbreaking industry is the environmental justice and dumping of waste by global north to south. But this thesis aims to study the connection between global flows of waste (or by-products) and economic activity induced as a result of secondary processing, which shapes urbanization around these areas. Shipbreaking has long been an industry that has provided precious resources. The role of shipbreaking in the economies of India, Pakistan and Bangladesh is largely based on its impact on the metal industry. The quantity of steel extracted from shipbreaking at Alang in India is equivalent to 17% of India’s total steel production, this figure is even higher for Pakistan and Bangladesh.

Shipbreaking as an industrial symbiosis is not unique to Alang, it is present in almost all the locations that need steel scrap, from Lagos in Africa to Jakarta in Indonesia. One can see shipbreaking as an instance of industrial symbiosis, in congruence with the examples often cited in Europe. The core criteria proposed by Mariam Chertow of any industrial agglomeration being industrial symbiosis is: “At least three different entities must be involved in exchanging at

least two different resources to be counted as a basic type of industrial symbiosis” (Chertow 2007). In case of shipbreaking, it gives rise to industries upstream and downstream such as Rerolling mills located in Bhavnagar area and oxygen plants, furniture shops, repair and remanufacturing firms, transportation contractors, insurance and banks involved etc.

Places like Alang show that the industrial symbiosis is as much the result of geographical linkages as they are of inter-industrial linkages. Often agglomeration is an indication of industrial symbiosis. The core of this economic activity is the shipbreaking activity at Alang with its flows reaching inland. Shipbreaking is by far the most important industry in the Bhavnagar-Alang region. According to some literature there are almost 400 rerolling mills in the area that depend upon the steel from shipbreaking. The secondary employment generated by this shipbreaking activity is estimated as high as 200,000 jobs up and downstream.

Alang provides a vivid example of urbanization as a result of industrial agglomeration. A scavenger industry that no one planned for, yet that has spawned multiple other industrial operations in the area. As we see the notion of waste in different light we need to see Alang’s growth in a more coherent format that acknowledges the role of economy in design. Also the project of industrial urbanization needs to be revoked in order to provide a model for urbanism to operate within the scavenger economies that complete the material cycle.
Urbanism of Disassembly
“Be sure to lay wide streets planted with shady trees, every other of a quick-growing variety. Be sure that there is plenty of space for lawns and gardens. Reserve large areas for football, hockey and parks. Earmark areas for Hindu temples, Mohammedan mosques and Christian churches.”

Jamsetji Tata in a letter to son Dorab about his vision for the steel city of Jamshedpur, 1910
THE PROJECT OF INDUSTRIAL URBANIZATION-CITY, INDUSTRY & WASTE

This chapter probes into industry as a trigger to urbanization, specifically in the context of company towns. With the examples of cities with different political economic background we can trace the normative form diagrams of industrial city. This concept of industrial urbanization is inexorably linked to concept of industrial agglomeration and thus to industrial symbiosis, which considers the byproducts of one industry as feed for its products. This notion of waste as industrial product are helpful then to understand the possibility of projecting industrial urbanization of waste economies, linking back the city to the industry.

All big cities of today are truly the product of industrial society, either formal or informal. From earliest known time the city has provided opportunities to achieve scale and scope of economies through division and specialization of labor. Thus most urban areas arise due to economic advantages received by large-scale activity either industry or trade. The true push towards the industrial urbanization predictably started from the time of second industrial revolution, the period that Geddes refers to as the paliotechnic period.

Cities have always had a parasitic relationship with their hinterlands. Till the industrial revolution cities depended on the raw material and resources from the area. After the industrial revolution; the location became a function of manufacturing process. The resource-location logic was no longer valid for this new form of industrial city. The new processes were located in the areas that minimized the production and the transport costs. Only selected sites served this purpose, which gave rise to agglomeration industries. Industry clustered around such location so as to benefit from this locational advantage. Agglomeration
economies can be defined as the benefits that any industry can reap from being in close proximity to other cascading industries and even its competitors. One can thus infer that the robust logistical capacity, industries that are suited for agglomeration with sufficient cascading production, and access to skilled and unskilled labor are key commonalities in all industrial cities.

There was a new shift in political philosophy due to the changes in spheres of production. One can say that the main strands of contemporary political thought capitalism and socialism, Marxism are consequences of industrial revolution. In their turn they also influenced the design of cities. The cities of welfare capitalism like Lowell and Pullman and that of soviet idealism such as Zlatoust, Tolyatti share the similar urge towards the efficient organization and flow of input and output.

**CITIES OF WELFARE CAPITALISM: LOWELL, PULLMAN**

Welfare capitalism, a paternalistic form of employer labor relations, was promoted in multiple ways throughout the world. It stems from the idea that benefits provided by private sector employer will shield workers against the fluctuations in the economy. In return the employers would get a loyal workforce which is skilled, stable in production. This paternalism from the employer was often heavy handed where employers sought to build a utopian community with middle-class ideals. Welfare capitalism sought to align the business interests of the employers with the advancement of the social class. It was also seen as a moral responsibility towards worker, at times fueled by religious ideals of an employer. Prime examples of the welfare capitalism in action were the boarding houses for single female employees; built in Lowell, Massachusetts by textile manufacturers and Pullman, Illinois built for the workers of railway coach factory.

A fatal drawback of these early welfare capitalist urban utopias was they did not address the basic problem of the workers at the workplace. Long working hours, unsafe conditions and insecurity was amplified as the housing by employers was seen as a way to control the housing
and commercial future of the employees, by the owners. Pullman was a noted example of this strife, when a strike destroyed the town. Lowell was planned in 1820’s as planned manufacturing town owned by Boston Manufacturing Company. In 1814, the Boston Company built America’s first fully mechanized mill in Waltham, Massachusetts. Nine years later, the company built a complex of new mills at East Chelmsford, soon renamed Lowell in honor of the company’s founder, Francis Lowell. With the production process fully mechanized, the principal limitation on the firm’s output was the availability of labor. The company began to recruit young farm girls from the surrounding countryside. In order to attract them and to reassure their families the company developed a paternalistic system of well-run boarding houses. The workers were strictly supervised both at work and at the boarding houses but were also paid good wages. Soon it became an exemplary model of welfare capitalism, as we know it today.

The town of Lowell itself is planned according to the needs and flows of the cotton mills. Canals were used to divert the water from Merrimack and concord rivers to run the mills. Boarding houses were

1. Lowell, MA, United States- 1845
Map showing canals that fed the resources and energy to the mills
2. Lowell, MA, United States- 1845
Wood carving showing the sequence of urbanization - canals, factory and housing.

3. Farms girls from surrounding area provided ideal labour force for this growing industry. They were provided with boarding houses.
located in a subsequent tire of developments. A rail line was used to carry raw cotton bales from south.

PULLMAN

Pullman is one of the most famous cases of rise and fall of a company town in America. The oldest part of Pullman is notable for its role in American labor history and the effects of urban planning. The town was built by George M Pullman as a part of a rail car factory complex. The main aim was to attract the skilled and loyal workforce. With the background of 1877 railroad strike, Pullman wanted to avoid the workers to be what he believed as morally corrupted by social dislocation and urban poverty. Thus, Pullman workers town was also a social engineering experiment complete with wide boulevards and parks, in stark contrast to other working class areas in the city. First workers were settled in Pullman in 1881. Not only did Pullman workers live in brick houses, they and their families had access to schools, parks, a library, a theater, educational programs, and many other activities provided by the town. When state labor commissioners visited in 1884, they proclaimed it a successful venture, especially for the women and children, who seemed protected from the worst aspects of industrial America. Pullman was so driven by his idealism that he is often accused of creating a paternalistic system that took away men’s rights as citizens, including the right to control their own
5. Planned workers town of Pullman

6. Workers strike at Pullman, in response to reduction in wages. Despite low wages rents of the housing remained same.
domestic environment. With the strike in 1894 and subsequent legal battles, the factory was forced to divest itself from the residential property.

CITIES OF SOCIALISM: ZLATOUST, TOLYATTI

Products of Stalinist industrialization, Russian company towns were built around a single plant or factory, hence the official designation, the “monotowns”, The Soviet planned economy created hundreds of monotowns based on specific rational thought about transport of resources and goods, distribution and reach. As these industries faced no market competition, they were located in geographically inhospitable areas. Most of them were located in the north and east of central Russia. The goal was to maximize regional specialization.

In a socialist system where everything is centrally distributed without a free market, a monotown was seen as strategy to efficiently organize resources but when Russia opened up to global market economy the situation in many of Russia’s monotowns became highly problematic due to their inflexibility. What also compounds to the problem is the way monotown differ from western one-company towns. They were, and many still are, municipal service providers that offer social services, including subsidized housing, canteens, shops, hospitals and recreation facilities. They are expected in participating in building infrastructure thus making the industry a cornerstone of the region. Contemporary discussions about monotowns almost always center around them either being a liability to the economy in terms of a ticking socio-economic time bomb or in the framework of shrinking city dialogue of the western world. One must not forget however that the planning focus of these cities on efficient resource flow is not unlike to their western counterparts.

ZLATOUST

Zlatoust is a monotown that is developed around the Zlatoust Metallurgical Works. It is one of the largest steel production establishments in Russia. Situated about 1000 miles southeast of Moscow, situated in a narrow valley, the morphology of Zlatoust is
7. Zlatoust, one of the most powerful industrial centres in Ural. It is home to steel-mills, machine-building factories, metal structure’s plant.

Railway is the main resource line for bringing the ore to mills, with Zlatoust Metallurgical Works ZMZ in the background.

guided by the river and railroad link next to it. Railroad links the ore supply to the steel plants that occupy most of the flat land. Typical Soviet slab housing occupies the land between steep slopes and the steel mill. They need this linear configuration in order to situate linear rolling mills. Presently this town currently supports 1,88,000 residents, almost 50% drop from its 1989 census population. Main reason for this decline was the drop in production and reduced demand due to increased logistical cost. Since 2008 the town has been in steep...
economical decline due to severe drop in the production, as steel alloy output has been diminished by 80% and workweek has been cut in half.

TOLYATTI

Tolyatti or Togliatti is a city in Samara region of Russia, about 600 miles southeast of Moscow. It is situated on the river Volga and is extremely well connected with the rail network. It is one of the regions of Russia, which are witnessing industrial growth arguably due to the connectivity they offer. The main industry in the city is AvtoVAZ’s Lada car plant, employing almost 110,000 people. It was started in 1970’s in cooperation with FIAT motors and is currently collaborating with GM since 2001. Other industries have moved into Tolyatti because it is close to abundant supplies of electricity and water. Petrochemicals are well represented in the city. Among the significant enterprises based there are “TogliattiAzot” (Russia’s biggest ammonia manufacturer headed by Sergei Makhlai) and “KuibyshevAzot” (a nitrogen fertilizer manufacturer and Russia’s biggest caprolactam and polyamide producer). Other industries include building materials production, ship repair and electrical equipment and electronics.

In 2011 the Togliatti Special Economic Zone was first introduced to further develop the region and diversify the economy of the city. Several auto-component producers have since been registered, as well as large industrial manufacturers. By November 2012 the project amounted to 10 billion Rubles and represented creation of 3000 jobs.
10. Rail infrastructure feeding into various industrial plants

11. Soviet era planned workers settlement
Togliatti represents ideal example of agglomeration economies migrating to the location that offer common benefits, most prominently the transportation benefits.

**INDIAN COLONIAL AND POSTCOLONIAL INDUSTRIAL CITIES**

The concept of company towns or welfare capitalism is not new in India. Many cities founded by British East India Company like present day Mumbai started its journey as Company Town. In case of Mumbai, in 1668, the Royal Charter led to the transfer of Mumbai islands (then known as Bombay) from Charles II to the British East India Company for an annual rent of £10. East India Company then established the mint and printing press in Bombay and developed the islands into a center of commerce by offering business incentives to various communities.

Since early 20th century, armed with colonial or native capital, industrialists like Tata, Birla and Kirloskar amongst the other's have known to pioneer the project of social engineering. Kirloskarwadi (1910), Jamshedpur (1912), Batanagar (1934) are amongst the oldest industrial urbanization projects. Since independence there has been a consistent attempt to incentivize the industrial city project. Large scale engineering projects and housing around them was also seen as a way to tackle the refugee problem that arose due to partition.

**JAMSHEDPUR**

Jamshedpur, known as the steel city, was founded in 1908. It is considered as a remarkable success story in the era when company towns all over the world were in decline and the era when predominant thinking was that the private sector should not get involved into managing cities. Jamshedpur predates many modern urban experiments from the subcontinent, like Luyten's New Delhi, Corb's Chandigarh and Doxiadis’s Islamabad. In 1911 it employed new ideals in urbanism, employed modern town planning principals and used industry to herald new energy into predominantly agrarian economy.
INDUSTRIAL URBANIZATION IN INDIA
The main ideological shift in the design of Jamshedpur from that of New Delhi and Chandigarh is the incremental nature of its conceptions. Both, Chandigarh and New Delhi were conceived in totality where as Jamshedpur evolved over 34 years with various plans directing the growth pattern. The first plan in 1911 visualized it as a small company town. It was in 1944-45 that well renowned planner Otto Koenigsberger designed a garden city plan that incorporated neighborhood units as a base module. The Pittsburgh firm, Julian Kennedy and Axel Sahlin; designed and built the original colony for housing managers and skilled workers.

When compared with the failures of restrictive policies of Pullman, Jamshedpur stands out as a remarkable example of how sound management practices and a flexible regulatory framework can create a successful industrial town. Yet it is not free from problems. Since housing is provided only to permanent employees of the...
company, daily laborers and workers in other support industries live in impoverished settlements, thus representing constant state of flux of any Indian city.

**BATANAGAR**

Batanagar was established to start the first shoe factory in India. Czech industrialist, Thomas Bata began to expand the company in 1930’s. First to escape the Nazis and then the communists he arrived in India and travelled from Karachi to Kolkata. With the background of Taylorism – a theory of management that analyzed and synthesized workflow Bata was also an industrialist who sought to align his business interests with that of his workers. He saw colonial India as a promising market without major competition. Bata Shoe Company had three factories in India and created company towns that now are known as Batanagar (W. Bengal, India), Bataganj (Bihar, India) and Batapur (Pakistan). Batanagar today is a suburb of Kolkata but a remarkable feature is that it has evolved into a town with cottage industry. Some of the most renowned brands in India have outsourced major portion of their manufacturing to Batanagar. Every other house in Batanagar has a small unit to manufacture shoes. This was born out of necessity, as families were solely dependent on the Bata factory for their livelihood. With fluctuation and changing nature of shoe industry meant Bata Company no longer enjoyed the same market monopoly and had to fight for the market share. She making from the home, a cottage industry parallel to the factory has given many an alternative source of income. This points to agglomeration tendencies described in many other examples that evolve out of tight control on their own.
Industrial agglomeration or economies of agglomeration refer to the tendency of industries to cluster together to share the same benefits or to use byproducts from other industry as resources. In economical sense it points to the fact that as more firms in the related field cluster together, cost of production drops. This clustering can be helpful for urban growth as well as it attracts supplier industries, greater specialization and more skilled labor. City itself is an example of agglomeration effects. It is concentration of various services, opportunities that clustered around specific advantages; these advantages can be natural, administrative or logistical. Agglomeration tendencies have helped city to be the main economic driver of the region. Jane Jacobs puts this eloquently “Cities, not countries are the constituent elements of the developing economy and have been so far from the dawn of the civilization” (Jacobs, 1969). Agglomeration economies also gave rise to what we now call as Industrial ecology or industrial symbiosis, advocated by Frosch and Gallopoulos in the article “strategies for manufacturing”, that was published in scientific American in 1989. But the term “Industrial Ecology” has been used since 1940’s alongside “Industrial Symbiosis”. Economic geography was perhaps one of the first fields to use these terms. For example, in an article published in 1947, geographer, George T. Renner refers to “The General Principle of Industrial Location” as a “Law of Industrial Ecology”.

Yet industrial ecology or industrial symbiosis today is primary concerned with the formal industry. The literature on industrial ecology is focused more on the flows of waste and resources at the level of industrial plants (Gregson et al., 2012). But the need to consider industrial symbiosis, its agglomeration effects and resultant urbanization is urgent. The global trade of waste and its use as a feed for secondary industry points towards this fact. It is creating local agglomeration of industries that are interconnected in the effort to extract value from what is otherwise perceived as waste. Alang presents a clear case of this secondary industrial symbiosis and resultant urban
This thesis thus argues that with our current knowledge of industrial urbanization and feedback loops of industry we can be and need to be projective about new typologies of urbanism that are global nodes of remanufacturing. Waste today constitutes single largest export of United States to its biggest trading partner, China. By acknowledging the fact that there will always be directional flows of waste from spaces of consumption to spaces of production we can start designing for these flows.
“I believe that ten billion or so healthy people cannot prosper on Earth without a manufacturing industry and large, complex materials flows. A simple agrarian society will not be efficient or effective enough to support likely future human numbers. Yet, vast reductions in waste seem possible if we begin to reconceive the ways we understand and operate industrial ecosystems.”

Frosch, Robert A, 1996
Economies of waste: Interconnections of the industrial cycle
The aim of this thesis is to seek strategies for industrial urbanization of Alang. The lessons that industrial cities provide us with the understanding, that if the city is planned around a mono-cultural economic process, it leads to the decline of the city, once the industry moves out. The ideal scenario at Alang thus is to design a process that can shift Alang's economical focus as per the changes in the larger economic environment.

The proposal is structured as set of triggers that will bring in new economical dependencies and linkages. The initial triggers are set up to diffuse conflicts amongst the main stakeholders. This proposal aims to change current status of Alang as just a centre of breaking ships to a centre that will process all the subsequent products and will churn out the finished goods. The aim is to build interlined industrial flows of resources and wastes (Fig 1) that can act as a cornerstone of the regional urbanization. The first step in this endeavour is to change the current sequence of shipbreaking.
Current growth of Alang is linear along the main coastal road and its connection with the state highway. Workers live in informal settlements, in-between cutting yards and shipbreaking plots. They don’t have access to clean drinking water or basic sanitation services.

The location of informal settlement is a direct function of land. This is useless for any economical activity due to current sequence of breaking and cutting yards. These settlements are in the area of considerable coastal flood risk induced by tropical cyclones and sea level rise. This map shows zone of vulnerability for two meter rise (based on SRTM topo data).
Urbanism of Disassembly
Learning from the precedents and site analysis, the thesis projects a full scale industrial development, one that is developed on the bi-products of other industries. The main argument here is to make Alang a place that not only extracts the value out of waste but also adds value to it. The main concern with shipbreaking in the continent is the lack of control and its environmental repercussions.

The design process was conceived as set of levers that will control various growth flows, as opposed to conventional planning approach of phasing. The operative strategy of regional growth in terms of flows of resources, waste, energy and labour asks for a more systemic design approach where the ultimate urban form is secondary to the interconnections of various processes and systems, in short the flows.

The first lever is to develop a robust local economy of inland fishing and aquaculture. This will help diffuse the conflict between the migrant labour, the industry and the local population particularly fisherman community who has lost its livelihood due to the environmental impact of the industry.

By developing the strategy of controlled beaching, the design aims to arrest the floating pollutants and oil runoff within the region so that it can be properly treated. Floating pollutants will be arrested by oil booms installed on specifically designed seabed sections. These sections will also encourage the effect of riptides there by depositing the sediments on coast. This natural capping process can be furthered by redistribution of dredged deposits from the gulf. This mode of controlled beaching will eventually expand the entire market of shipbreaking dispelling the concerns about its implications.

The thesis argues the need of bringing re-rolling industry; presently situated in Bhavnagar, to Alang. The introduction of rerolling at Alang will transform Alang into a regional hub of metal production and cascading industries. This will also bring in the upstream industrial process that support rerolling such as coal distribution and imports.
The initial growth trigger is to introduce the re-rolling industry at Alang. This will lower the transport costs currently incurred by the rerolling industry. This will also encourage a strong linkage between shipbreaking to rerolling by fixed spatial agreements. Introduction of aquaculture is specifically aimed at establishing more local economy and diffusing existing conflict. This phase is the start of restructuring the housing conditions of workers.

**Introduction of Harbour, Manufacturing spine, Site and Services Spine,**

By providing the harbour that imports coal for rerolling one can begin to establish another layer of industrial linkages. This harbour can further be used for ship repairing and for small scale shipbuilding. This will also establish a second order manufacturing industry that will feed on imported recyclable waste. like rubber, glass, paper, plastic and textile.

**Growth of Waste based manufacturing, Connecting to national rail network**

The harbour will be connected to larger regional growth by a rail network. This connection of harbour and rail will trigger a manufacturing spine around the rail corridor. This spine will act as link in-between parallel layers of road network in the region.

**Controlled Beaching.**

By introducing the subsurface structures that will encourage a riptide effect the proposal aims to transform beaching into more controlled activity. These coves if beaching will be supported by oil booms that will catch the floating pollutants and oil runoff. The aim here is not to eliminate pollution in totality but to limit it to a manageable level, which can then be diluted even further by tidal effects.
CONTROLLED BEACHING.

The core argument against shipbreaking at Alang is the process of beaching. Due to its use of intertidal zone it leaves scope for hazardous waste, oil to get mixed with seawater. There are some alternative methods, for instance in Turkey, a modified slipway is used. The method proposed here is a mix of modified slipway and soft strategies to control the pollution runoff. The pollution in the intertidal zone of Alang can be controlled by using oil-booms, supported on subsurface structures. Subsurface structures will be constructed using the dredge gathered upstream.
INDUSTRIAL MUTATIONS.

Any project of industrial urbanization needs to consider the future agglomerations due to growth as well as possible collapse of a core industry. Only by acknowledging these shifts we can establish parallel economic processes that will sustain the critical mass of any industrial city. In case of Alang the proposal develops four branching off points that can guide the development. It also acknowledges the post urban conditions as a possible future and shapes economical activities like tourism around this condition.
Industrial symbiosis of waste

Shipbreaking
will act as a main source for steel for the city, eventually will be replaced with other imports.

Ship repairing / Shipbuilding
with Savannah's shipyard and repaired parts along will become a hub for ship repairing and even shipbuilding due to certain specific expertise.

Energy
Secondary industry will need coal to produce the needed steel, along can also be an ideal site for power gas and oil in the region.

Waste
Some recyclable waste can be imported and converted into other commodities, products, and even resources.

Seawater greenhouse
is a greenhouse structure that enables the growth of crops in hot regions using seawater and solar energy.

Reprocessing
Steel obtained from ships will be turned into bars and profiles.

Drinking Water

Inland Fishing

Remanufacturing
Along is already a hub of remanufacturing firms and shops. Formal structure will encourage remanufacturing firms and will bring in added small industries.

Resale
Directly dependent on the shipbreaking, this industry sells salvaged goods from the ships.
The growth strategy carefully integrates the existing transport infrastructure, villages, flood patterns to the new infrastructure. The cost of infrastructural development is offsetted by the industrial linkages that it will offer and the value that it will add to the raw materials i.e. Waste imports.
Most of the workers at Alang live in shantytowns next to the shipbreaking yard. Five to six workers share a single hut, with average floor space of 22 sq.ft per person. The hut is used only for sleeping purpose, which is facilitated by working shifts. These huts, often constructed from the salvaged shipbreaking materials, lack any wind or rain protection. Workers also lack access to water or sewage connection. The housing scenario at Alang is one of the reasons that workers choose not to bring families at Alang. Due to migratory nature of workforce, there is less inclination amongst workers on spending on housing needs.

To structure any growth at Alang, a careful understanding of migrations and social dynamics is necessary. the proposal aims to approach this problem by structuring the housing around designed corridors that will provide basic services and amenities around which housing can grow. This approach draws on the writings of Habraken and John.
Urbanism of Disassembly
Turner*. The core of this strategy is in the fact that government or development agencies need to identify the very specific gaps they need to fill, design and construction of housing stock is not one of them.

By acknowledging the incremental nature of housing this proposal strategically limits the investment into the corridors of services and amenities. This will be the area where agency of design is leveraged. Initially these spines will provide basic services like public toilets, water points and sewer connections to the single male migrant community. As the demographic nature of surrounding community changes the spine itself will reciprocate this change. it will house schools, health clinics and markets as the surround community transitions from single male migrants to families. Being a common social space the spine can also act as a lever for social change or policy implementation.

**BIPOLAR CITY MODEL**

A lesson that is apparent from industrial cities around the globe is the migration within the region. As certain affluence level is reached the population migrates within the city area so as to get away from
the industry. Proposal for Alang anticipates this migrations and is structured as a bipolar city, a coastal shipbreaking settlement and a more stable interior one. These two nodes will form the ends of a dynamic city process. This model also allows to develop the two areas differently in the industrial and postindustrial phases of the city. By acknowledging the intra-city migrations this proposal provides an opportunity to diffuse the conflict within migrant workforce and local population.
Schools, Health Care Centre, Civic Centres, Water, Sewer Infrastructure

Structural support for future civic buildings like markets, neighborhood centres
The idea of a spine as a designed public infrastructural space is central to the urbanization strategy. It provides a degree of autonomy to residents so that they can build as per the availability of resources and demographics of the neighborhood.
LANDSCAPES OF INDUSTRIAL SYMBIOSIS

The term cradle to cradle manufacturing will become a reality at Alang. Ships will be built and repaired alongside the yards that will break them.
A lesson from industrial centres around the world is that industry is a transitory phenomenon. Once Alang no longer remains viable for shipbreaking due to various market forces, the unique nature of industry at Alang can be tapped to launch Alang into the industry of tourism.
Mapping the future import and export flows of the gulf.

**Bhavnagar**

**Dahej**
Coal, cement, clinker, fertilisers, steel, iron ore, soda ash, LNG, crude oil

**ALANG**
Coal and Coke, Iron Scrap, recyclable waste,
Steel Bars, Recycled Paper, Plastics, Salt, Reengineered Ship Parts, small marine vessels

**Hajira**
Coal, cement, clinker, fertilisers, steel, iron ore, soda ash, LNG, crude oil

**Surat**
Container Fuel Oil Steel Pipe Grain
Alang, will be connected to the ports in the region that will further expand the reach of inputs into the waste economies of Alang. In contrast to the eastern coast of the gulf that is highly driven by manufacturing industries, western coast can be developed as a region of resource recovery thus fulfilling the regional industrial ecology.

In conclusion this thesis sets up the framework for Alang to be a regional node of industrial ecology. That will turn the matter that is otherwise worthless and it will not only extract the value from it but add more value to the waste.
Chapter 1


Chapter 2

3. “San Fransisco Bay” 38°04'15.61"N 122°05'35.31"W Google Earth, Accessed May 3, 2013

Chapter 3


Chapter 5


Chapter 6


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