

MARINE RESOURCE HUB

“ REVITALIZING HARNAI'S COASTAL INFRASTRUCTURE FOR
ECONOMIC GROWTH AND ENVIRONMENTAL SUSTAINABILITY ”

BY

AAMAAN KARBHARI

A REPORT

Submitted in partial fulfillment of the requirements for the degree of
Bachelor of Architecture.



University of Mumbai

2023 - 2024

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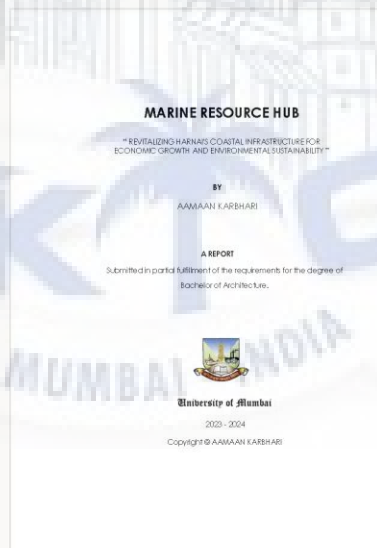


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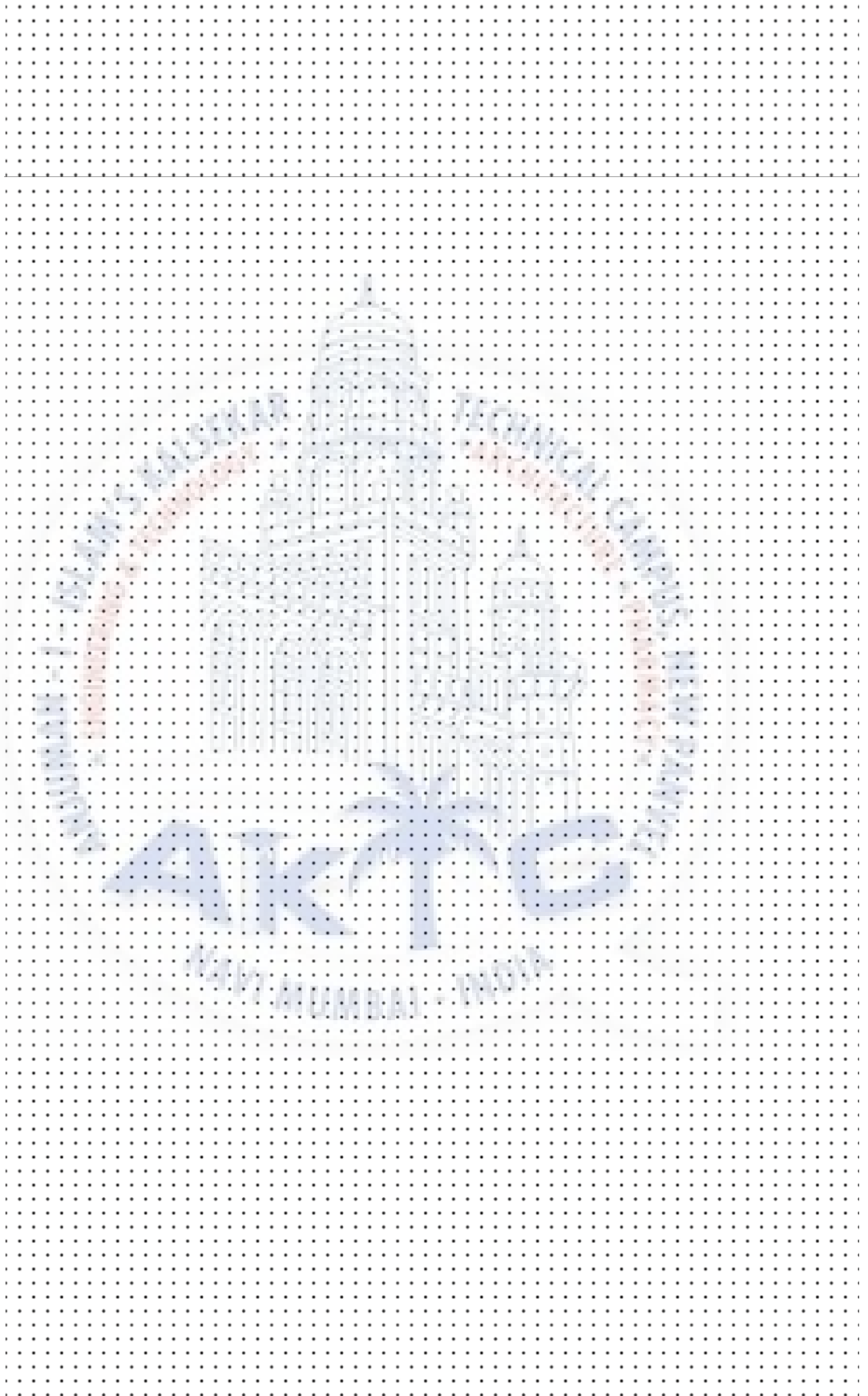
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1.0 : ABSTRACT

Title: "**MARINE RESOURCE HUB**, Revitalizing harnai's costal infrastructure for economic growth and environmental sustainability "

This thesis focuses on the vital role of Harnai's fishing harbor in the context of India's growing seafood consumption and the expanding seafood export industry. With a rising demand for Indian seafood products both domestically and internationally, it's essential to thoroughly assess the harbor's infrastructure, operations, and sustainability.

The research involves a detailed analysis of the harbor's structures, how it operates, its economic aspects, and its impact on the environment. The aim is to identify the challenges and opportunities that come with the booming seafood industry and provide practical recommendations to make the harbor work better, improve seafood processing, and meet the needs of local and international markets.

This research is valuable for government officials, seafood industry professionals, and the people in Harnai, Dapoli, Ratnagiri, as it aims to support sustainable growth, economic development, and environmental responsibility to meet the changing demands of the seafood market. We start by looking at how fish is produced in the Konkan region, emphasizing the importance of expanding, preserving, and developing strategies, given India's position as the world's third-largest exporter of marine food.

Keywords : Fisheries, Fishing Harbour, Seafood demand ,Economic development, Employment, Export market, Harnai, Dapoli, Ratnagiri,



2.0 : INTRODUCTION

Fishing harbors are pivotal for coastal communities and national economies. They serve as vital centers for the fishing industry, supporting livelihoods, ensuring food security, and driving economic development. These harbors offer secure bases for fishing vessels, enabling efficient catches and a consistent seafood supply essential for community development. They generate employment, benefiting not just fishermen but also related sectors, fostering local and national economic growth. Moreover, fishing harbors play a crucial role in seafood processing and export, contributing to foreign earnings. Beyond economics, they hold cultural significance, connecting communities to their maritime heritage. Recognizing and investing in fishing harbors is essential for coastal well-being and national prosperity. Japan and Russia lead in global fish production, followed by China, the United States, and Peru. India ranks 8th, producing 3.83 million tonnes, with unexploited fishing potential due to traditional methods and vast unexplored areas.

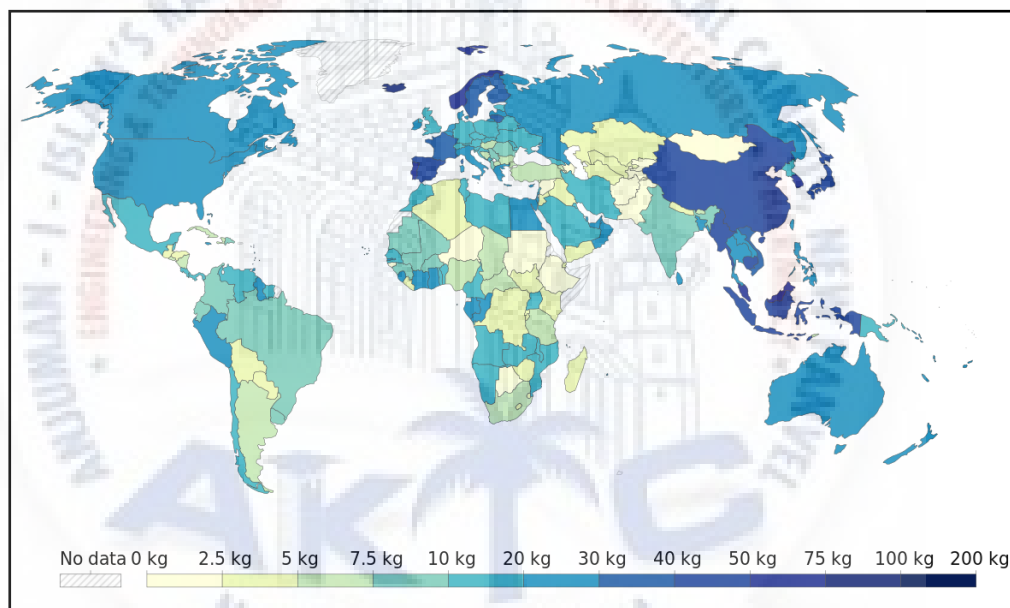
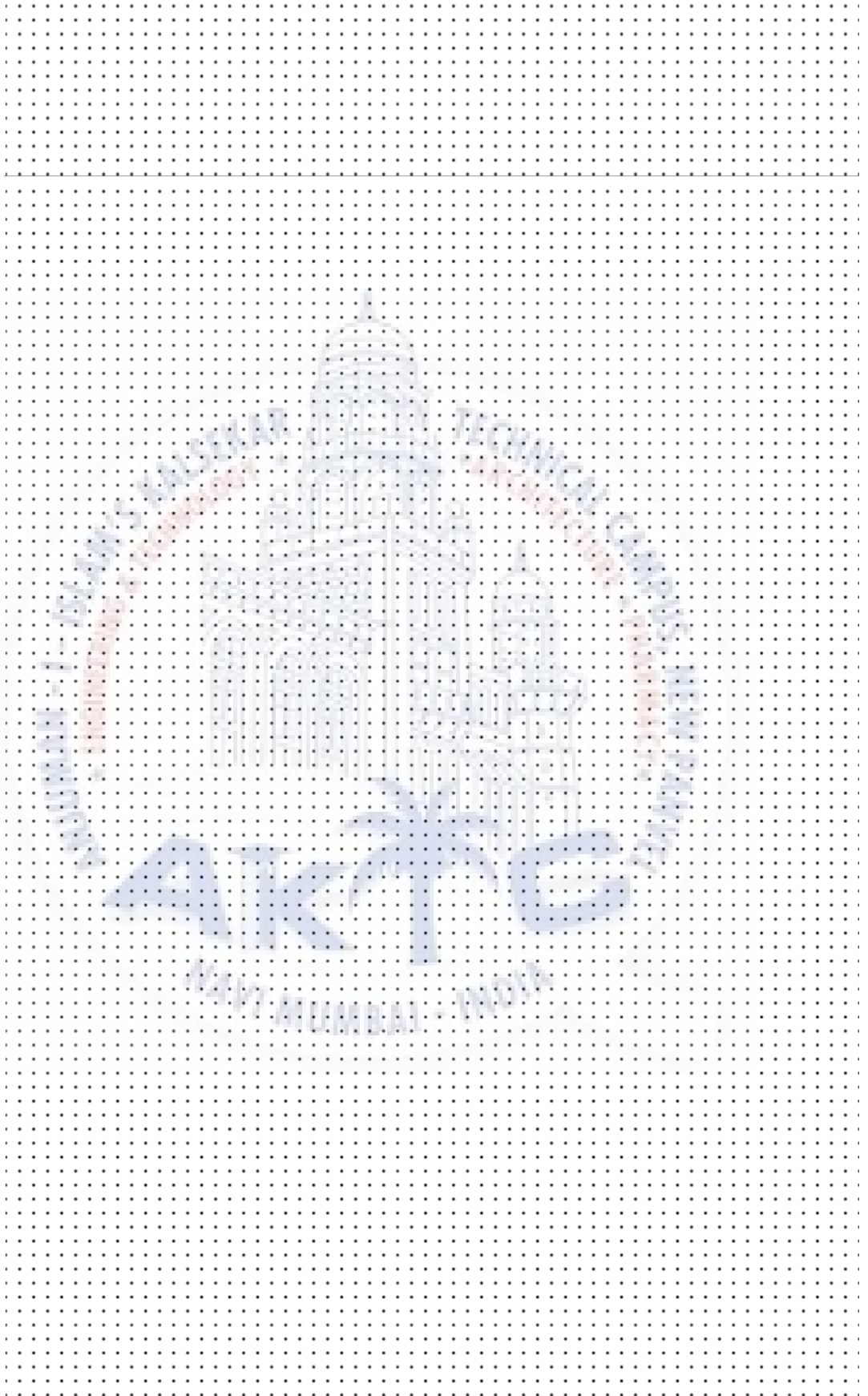


Figure 1 . World fish consumption per year and per capita
Source. State of the world's fisheries and aquaculture

Africa consumed the least in 2018 (7.6 million tonnes, or 8.3 kg per person), whereas Asia accounted for two-thirds of global consumption, with 33.6 million tonnes being used in China alone (26.1 kg per person) and 36.9 million tonnes being consumed outside of China (13.9 kg per person). Europe, Central America and the Caribbean, Oceania, North America, and South America all had consumption rates of 24.5 kg, 24.1 kg, 20.8 kg, 9.5 kg, and 8.4 kg per person, respectively. (Global condition of fisheries and aquaculture)



3.1 : BACKGROUND OF FISHERIES SECTOR

What Exactly Is Fishing Harbour ?

A port on the sea, a body of water, or a river designated for boats and fishing vessels is called a fishing harbour. They can unload easily and safely thanks to the area's infrastructure.

A fishing harbor is a piece of infrastructure that connects the production and consumption of fish. Small boats might bring in very little fish, which needs to be processed and stored. If the boats are beachable, then minimal infrastructure may be required. However, when fishing boats develop, greater and increased landed quantity, improved vessel maintenance and repair capabilities, and To hasten the delivery of the catch, better distribution infrastructure and equipment are needed. All operations including fishing and fish sales must be managed by the fishing harbor. These phases involve receiving fishing boats at the dockside, processing fish, and packaging fish in a variety of ways. A range of formats, sales and promotion, and finally the delivery of the finished item to its destination. The location of the port is determined by which of the tasks is most crucial. The vicinity of the sites where people fish or eat. Given this situation, particular consideration The network of lands and commercial links must be considered. The current inclination is toward landing prior to rerouting the fish, perhaps in fishing ports closer to the fishing grounds, containers to ports near the consumption sites, which primarily become transformed and advertising channels.

The majority of fishing ports are quite small because they frequently the most plentiful. Depending on the vessels they service, their dimensions alter; larger vessels, such as Considering that high-sea trawlers require plenty of dock space when they return to unload their cargo, Day-trippers and other smaller vessels must be able to rapidly discharge their catch for the auction. The requirements are low in comparison to a commercial port: wharves or pontoons, a gas station and a nearby market where the unprocessed sherry product can be sold board .

What is the need of Fishing Harbour ?

The fishing business has played an important role in improving fishermen's socioeconomic position. Fishing, along with agriculture, plays an important role and is recognized as a major source of income and employment. Employment in the fishing sector and other associated fields is increasing. It was invented, and it is becoming more popular. Furthermore, customer demand for quality is continuously increasing. importing nations In order to meet their high quality criteria for seafood, they require clean and sanitary landing places. With the hope of raising everyone's awareness of the fact that the fishing harbour complex is dangerous, an important element of social and civic capital that must be conserved. As a result, A well-equipped fishing harbor is critical to the industry's long-term success.

3.2 : GLOBAL MARINE FISHING INDUSTRY

The fisheries and aquaculture industry has gained recognition for its crucial role in global food security and nutrition. In 2020, global fisheries and aquaculture production reached 178 million tons, with captured fisheries contributing 51% and aquaculture contributing 49%. 89% of this production was used for human consumption, while there has been a steady increase in non-food uses, particularly in the production of high-value fishmeal and fish oil for livestock food and other applications like cosmetics

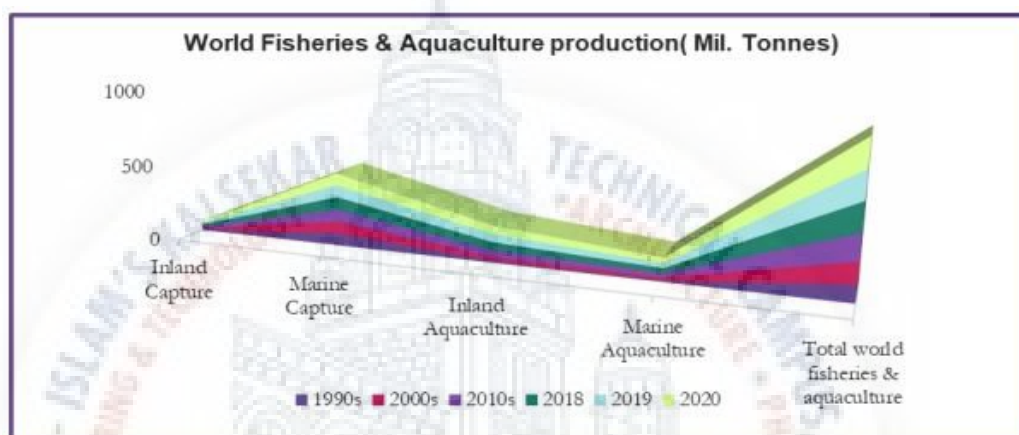


Figure 2 . World fisheries production trend

Source . State of the world's fisheries and aquaculture

The fisheries sector has undergone significant transformations, offering a wide range of products with diverse characteristics and flavors based on species, preservation methods, and product forms. Advancements in processing, refrigeration, freezing, and transportation have extended the shelf-life of fish products, enabling long-distance distribution and a growing variety of offerings. Approximately 20 million tons of fisheries production globally were used for nonfood purposes, with 81% converted into fishmeal and fish oil, and the remainder utilized for purposes such as ornamental fish, aquaculture, bait, pharmaceuticals, pet food, and livestock and fur animal feed.

The global fisheries industry has witnessed a significant increase in export opportunities, with the export production quantity reaching 59.8 million tons in 2020, a 33.7% increase over the previous year. Being the world topper in inland production and the third largest fish producing countries, India has a huge percentage in becoming a bigger superpower in fisheries and value addition activities. The export sector has experienced significant growth, with the annual growth rate increasing from -6.30% in 2020-21 to 31.71% in 2021-22. Frozen shrimp is the largest exported marine product, comprising over 53% of the total quantity and about 75.11% of the total export value in US dollars. Other exports include frozen fish, cuttlefish, squids, dried items, live fish, and chilled items.

3.3 : INDIAN MARINE FISHING INDUSTRY

India is the third largest fish producing country and the second largest aquaculture fish producer in the world. India contributes about 7% to the global fish production. The country is also home to more than 10% of the global fish biodiversity and is one of the 17-mega biodiversity rich countries. Around 14 million people are engaged in fisheries and its allied activities.

Andhra Pradesh is the largest fish producer in the country followed by West Bengal and Gujarat. The total fish production during 2017-18 is estimated to be 12.60 million metric tonnes, of which nearly 70% is from inland sector and about 50% of the total production is from culture fisheries. More than 50 different types of fish and shellfish products are being exported to 75 countries around the world. Fish and fish products have presently emerged as the largest group in agricultural exports from India, with 13.77 lakh tonnes in terms of quantity and Rs. 45,106.89 crore in value. This accounts for around 10% of the total exports and nearly 20% of the agricultural exports, and contribute to about 0.91% of the GDP and 5.23% to the Agricultural GVA of the country. (Department of Fisheries, 2020)



Fig. 3. Inland and marine fish resources
Source. Department of Fisheries, 2020

The top five states for fisheries production in India are Andhra Pradesh, West Bengal, Gujarat, Kerala and Tamil Nadu with a combined share of around 60% of the total fish production.

– **Inland Fish Production (6 Million MT):** The top five states are Andhra Pradesh, West Bengal, Uttar Pradesh, Bihar and Odisha contributing close to 68% to freshwater aquaculture.

– **Marine Fish Production (3.5 Million MT):** The top five states are Gujarat, Kerala, Maharashtra, Andhra Pradesh and Tamil Nadu, contributing close to 74% to the total production.

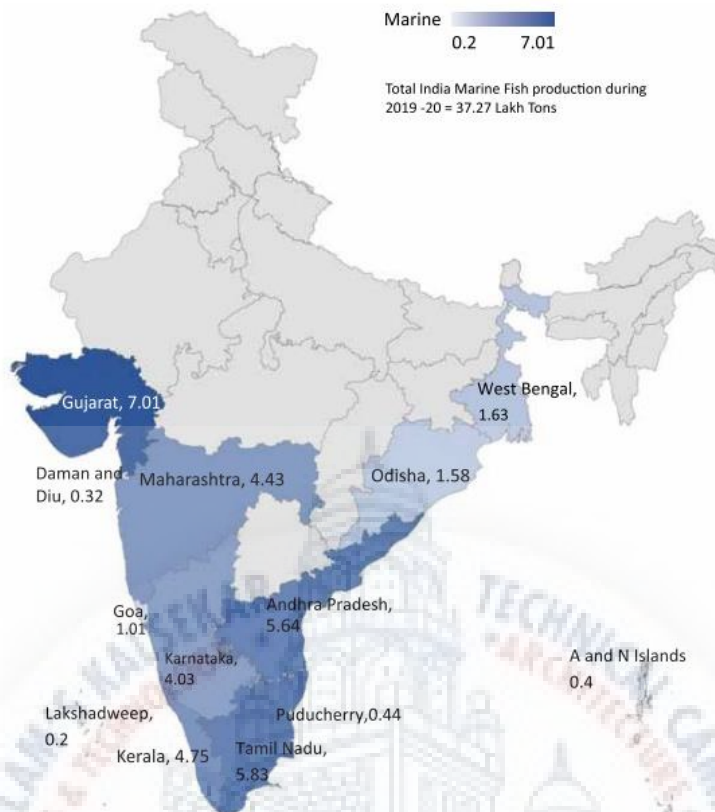


Fig. 4. Marine fish production : 2019-20 (In lakh tonnes)
Source. Department of Fisheries, 2020

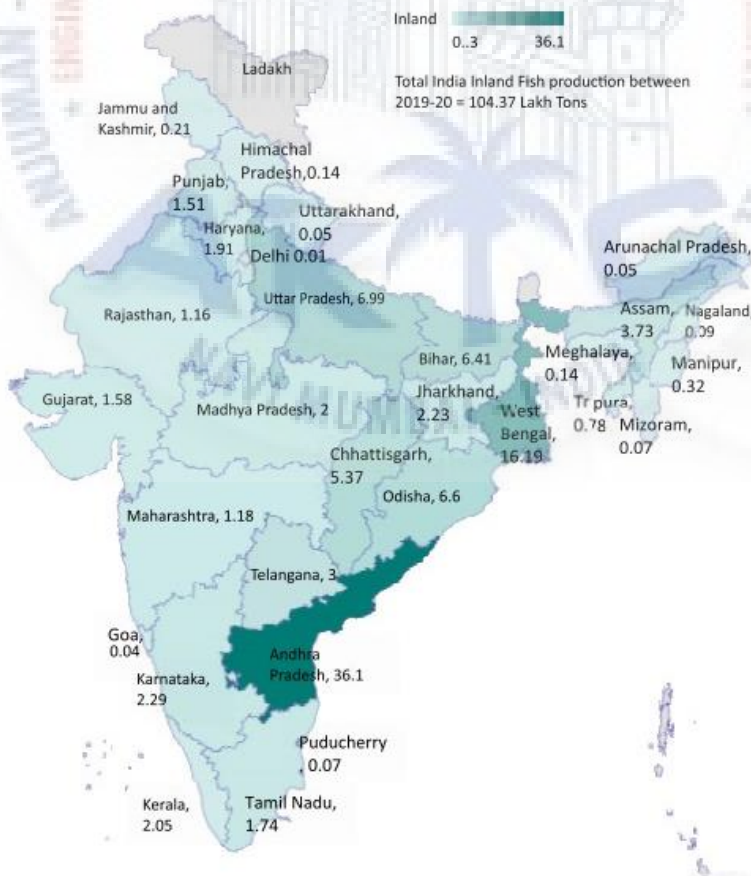


Fig. 5. Inland fish production : 2019-20 (In lakh tonnes)
Source. Department of Fisheries, 2020

Largest fish producing states in India

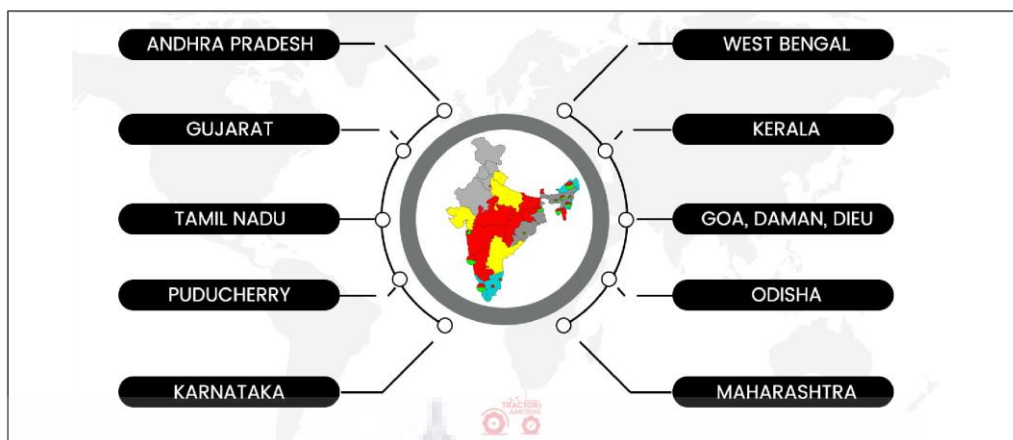


Figure 6. Largest fish producing states in india

Source: <https://www.tractorjunction.com/blog/top-10-fish-farming-states-in-india/>

The sector has been recognised as a key source of income and employment, and Indian fisheries make up a sizeable portion of global fisheries. This industry makes up **1.4 percent of the GDP** and considerably boosts revenue from foreign exchange. Fishing is the primary source of income for more than **6 million fishermen in the nation.** (Indian Reservoir Fisheries, Sugunan, v. v. 1995)

With an Exclusive Economic Zone (EEZ) covering 2.02 million square kilometers, the nation is the **7th** largest producer of marine fish in the world. On the other hand, inland fishery resources are just as abundant and varied, with rivers and canals covering 17,3287 kilometers, floodplain lakes covering 20,2213 hectares, estuaries covering 28,5000 kilometers, mangroves covering 35,6500 kilometers, estuarine impoundments covering 12,35000 kilometers, lagoons covering 19,0500 kilometers, upland lakes covering 72,000 kilometers, reservoirs covering 31.53366 kilometers, and ponds covering 22,54000 kilometers. (Sugunan, v. v. 1995, Indian Reservoir Fisheries)

CONTRIBUTION OF INDIAN FISH CULTURE	
Area of contribution in World	Contribution
Fish production	3 rd Rank
Aquaculture	2 nd Rank
Fisheries GDP	1.4 %
Agricultural GDP	5.15 %
Per Capita Availability of fish	9.0 kg
Annual export Earnings	Rs. 33,441.61 Cr
Sector Employment	14 million
Seafood export Approx	12,89,651 MT
Global Fish Diversity	10 %

Table 1. Contribution of Indian fish culture

Source: https://www.researchgate.net/publication/363476271_Current_status_of_fisheries_resource_of_India_Present_status_and_future_prospective

3.4 : MARINE FISHERIES RESOURCES OF INDIA

India has a 8,118 km long coastline stretching along 9 Maritime States and 4 Union Territories. The nine Maritime States are Gujarat, Tamil Nadu, Kerala, West Bengal, Maharashtra, Odisha, Andhra Pradesh, Karnataka and Goa. The 4 Maritime Union Territories are Daman & Diu, Puducherry, Lakshadweep Islands and the Andaman & Nicobar Islands. The country has also a 0.53 million sq.km continental shelf and 2.02 million sq.km of Exclusive Economic Zone (EEZ). The annual potential yield from the EEZ is estimated as 3.93 million tonnes of fish. The Marine Fisheries has been playing a pivotal role in the Indian Fisheries Sector. The major marine catches comes from the coast of Gujarat, Tamil Nadu, Kerala, West Bengal and Maharashtra. (Department of Fisheries, 2020)

Length of Coastline (KM)	8118
Exclusive economic zone (EEZ) (sq.km)	2,020,000
Continental shelf (sq.km)	530,000
Territorial Sea (upto 12 nautical miles)sq.km	193,834
Number of fish landing centres	1,537
Number of fishing villages	3,432
Number of fishermen families	874,749
Fisher-folk population	4,056,213

Table 2. Indian fishing resources

Source . Department of Fisheries ,Ministry of Fisheries, Animal Husbandry & Dairying Government of India

The important Marine Fisheries can be grouped into the following categories:

1. Surface-water Fish (Pelagic): Sardines, Anchovies, Ribbonfish, Mackerel, Seerfish, Tuna, etc.
2. Mid-water Fish (Pelagic): Bombay Duck, Cobia, Silver Bellies, Horse Mackerel, etc.
3. Bottom-water Fish (Demersal): Perches, Catfish, Pomfrets, Flatfish, Eels, etc.

MARINE EXPORT OF INDIA

Rank	Country	Export (USD bln)	% share
1	China	25	15.53
2	Norway	12.10	7.51
3	Vietnam	7.70	4.78
4	India	7.0	4.35
5	Chile	6.80	4.22
6	EU	6.50	4.04
7	USA	6.10	3.79
8	Thailand	6.00	3.73
9	Canada	5.40	3.35
10	Ecuador	5.00	3.11
	Others	73.40	45.59
	Total	161.00	100

Table 3. Country wise export share

Source . Indian council of agricultural research (Ministry of agricultural research and farmers welfare, Govt of India)

Facilities	Number /Capacity
Registered exporters	1476
Manufacturer Exporters	655
Total seafood processing plants	617
EU approved units	341
Non-EU units	276
Total installed capacity (MT/day)	34368 MT
Frozen Storages (MT)	388257.38 (cold storage) Nos. 650

Table 4. Export processing infrastructure in india

Source . Indian council of agricultural research (Ministry of agricultural research and farmers welfare, Govt of India)

Item	Species group
Shrimp	Vannamei shrimp, Black Tiger shrimp, white shrimp, Flower shrimp, Brown & pink shrimps, Scampi
Fish	Ribbon fish, Croakers, Threadfin breams, Mackerel, Tuna, Pomfret, Grouper, Marlins etc.
Cephalopods	Squid, Cuttlefish, Octopus
Other species	Clams, lobsters, crabs, Whelks etc.

Table 5. Major Species group contributing to exports

Source . Indian council of agricultural research (Ministry of agricultural research and farmers welfare, Govt of India)

Being the world topper in inland production and the third largest fish producing countries, India has a huge percentage in becoming a bigger superpower in fisheries and value addition activities. India is a leading fish-producing nation and ranks among the top 5 fish exporting countries globally. The quantity and value of fish and fish products exported from India have seen exponential growth, reaching 1.37 million tons worth 7760 million USD in 2021-22. Fish and fish products account for approximately 17% of India's agricultural exports. The export sector has experienced significant growth, with the annual growth rate increasing from -6.30% in 2020-21 to 31.71% in 2021-22. Frozen shrimp is the largest exported marine product, comprising over 53% of the total quantity and about 75.11% of the total export value in US dollars. Other exports include frozen fish, cuttlefish, squids, dried items, live fish, and chilled items (Department of Animal Husbandry, Dairying and Fisheries)

• Exports (2019-20): 12.9 lakh MT ; Rs. 46663 Cr. (US \$ 6. 68 Billion)



Fig. 7. Seafood export trend
Source. Indian Institute of Food Processing Technology

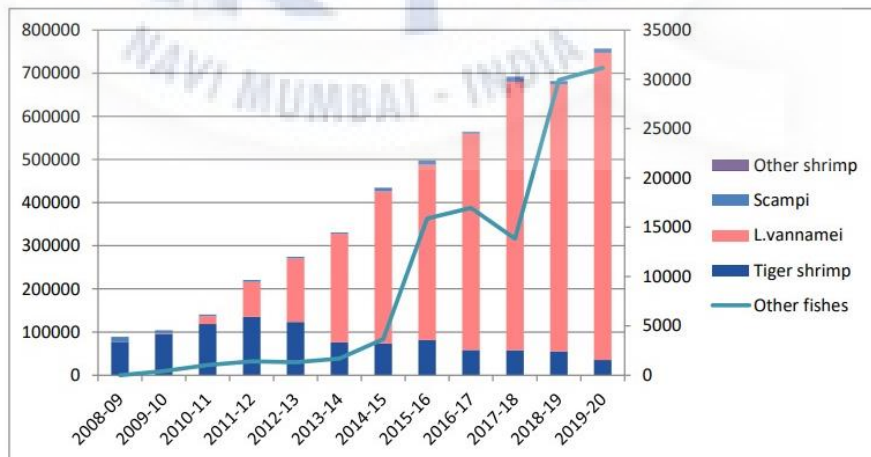


Fig. 8. Export oriented aquaculture production
Source. Indian Institute of Food Processing Technology

State/UT's	2015-16		2016-17		2017-18		2018-19		2019-20	
	Inland	Marine	Inland	Marine	Inland	Marine	Inland	Marine	Inland	Marine
Andhra Pradesh	18.32	5.2	21.86	5.8	28.45	6.05	33.91	6	36.1	5.64
Arunachal Pradesh	0.04	0	0.04	0	0.04	0	0.05	0	0.05	0
Assam	2.94	0	3.07	0	3.27	0	3.31	0	3.73	0
Bihar	5.07	0	5.09	0	5.88	0	6.02	0	6.41	0
Chhattisgarh	3.42	0	3.77	0	4.57	0	4.89	0	5.72	0
Goa	0.05	1.07	0.04	1.14	0.06	1.18	0.05	1.15	0.04	1.01
Gujarat	1.12	6.97	1.17	6.99	1.38	7.01	1.42	6.99	1.58	7.01
Haryana	1.21	0	1.44	0	1.9	0	1.8	0	1.91	0
Himachal Pradesh	0.12	0	0.13	0	0.13	0	0.13	0	0.14	0
Jharkhand	1.16	0	1.45	0	1.9	0	2.08	0	2.23	0
Karnataka	1.69	4.12	1.59	3.99	1.88	4.14	1.98	3.9	2.29	4.03
Kerala	2.11	5.17	1.61	4.31	1.89	4.84	1.92	6.09	2.05	4.75
Madhya Pradesh	1.15	0	1.39	0	1.43	0	1.73	0	2	0
Maharashtra	1.46	4.34	2	4.63	1.31	4.75	1	4.68	1.18	4.43
Manipur	0.32	0	0.32	0	0.33	0	0.32	0	0.32	0
Meghalaya	0.11	0	0.12	0	0.12	0	0.13	0	0.14	0
Mizoram	0.07	0	0.08	0	0.08	0	0.07	0	0.07	0
Nagaland	0.08	0	0.09	0	0.09	0	0.09	0	0.09	0
Odisha	3.77	1.45	4.55	1.53	5.34	1.51	6	1.59	6.6	1.58
Punjab	1.2	0	1.33	0	1.37	0	1.35	0	1.51	0
Rajasthan	0.42	0	0.5	0	0.54	0	0.55	0	1.16	0
Sikkim	0	0	0	0	0	0	0	0	0	0
Tamil Nadu	2.43	4.67	1.97	4.72	1.85	4.97	1.7	5.2	1.74	5.83
Telangana	2.37	0	1.99	0	2.7	0	2.84	0	3	0
Tripura	0.69	0	0.72	0	0.77	0	0.7	0	0.78	0
Uttar Pradesh	5.05	0	6.18	0	6.29	0	6.62	0	6.99	0
Uttarakhand	0.04	0	0.04	0	0.05	0	0.05	0	0.05	0
West Bengal	14.93	1.78	15.25	1.77	15.57	1.85	16.19	1.63	16.19	1.63
A and N Islands	0	0.37	0	0.39	0	0.39	0	0.4	0	0.4
Chandigarh	0	0	0	0	0	0	0.01	0	0.01	0
D & Nagar Haveli and Daman and Diu	0	0.23	0.01	0.23	0	0.24	0	0.28	0	0.32
Delhi	0.01	0	0.01	0	0.01	0	0	0	0.01	0
Jammu & Kashmir	0.2	0	0.2	0	0.21	0	0.21	0	0.21	0
Ladakh	-	-	-	-	-	-	-	-	0	0
Lakshadweep	0	0.16	0	0.3	0	0.21	0	0.22	0	0.2
Puducherry	0.07	0.47	0.04	0.46	0.07	0.42	0.07	0.4	0.07	0.44
India	71.62	36	78.06	36.25	89.48	37.56	97.2	38.53	104.37	37.27

Source: Department of Fisheries, States Government / UTs Administration

Table 6. State wise fish production, India (in lakh tonnes)
Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
Government of India, New Delhi November, 2020

		(In Tonne)				
Sr.No.	Variety	2016 – 17	2017 – 18	2018 – 19	2019 – 20	2020 – 21
1	2	3	4	5	6	7
1	Elasmobranchs	5593	11381	8028	8122	5001
2	Eels	2868	2644	1826	2038	5293
3	Catfishes	14288	10397	10412	8846	10673
4	Chirocentrus SPP.	4819	5431	4048	4037	2771
5	Sardine	22001	18899	7926	10851	10860
6	Hilsa Ilisha	1908	1459	3938	3038	2157
7	Anchovies	19032	19354	22169	27087	31196
8	Thrissocles	8152	8942	7348	5289	4738
9	Other Clupieds	3426	641	233	398	777
10	Harpadon Nehereus	39086	36228	34984	32507	26769
11	Perches	248	518	3042	520	239
12	Redsnapper	212	526	287	200	596
13	Polynemidae	988	866	1241	3112	1726
14	Sciaenids	2771	3471	2915	5279	3830
15	Otolithoides species	22324	23017	25402	41038	33137
16	Trichiuridae (Ribbonfishes)	16525	27209	22674	27079	27294
17	Caranx	4873	6312	12524	11030	11780
18	Pomfrets	10945	18826	15013	18041	14032
19	Black Pomfret	3405	2091	1053	2302	3198
20	Mackerels	42068	50379	31980	21739	27764
21	Seerfishes	12169	12521	10825	10516	11201
22	Tunnies	8269	9562	8293	13744	10414
23	Bregmaceros Mcclellandi	401	280	78	123	120
24	Soles	7943	6406	8171	8581	6506
25	Sphyracna Spp. (Barracuda)	1902	2981	3852	4943	1755
26	Leiognathus	764	1284	1597	3224	1909
27	Upeneus Spp.	20449	24353	23845	11460	4486
28	Penacid Prawns	55525	46214	46740	43266	45302
29	Non-Penacids Prawns	62682	59275	63972	48983	33867
30	Natantion Decapods (Lobsters)	1488	835	789	1143	327
31	Lactarius	6338	3308	3423	3566	2475
32	Loligo duvauceli(Cephalopoda)	26643	22128	27334	31896	25333
33	Miscellaneous	32642	37257	51270	29595	30985
TOTAL		462747	474992	467232	443593	398511

Table 7. Variety wise marine fish production of Maharashtra state
 Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
 Government of India, New Delhi November, 2020

		(In Tonne)				
Sr. No.	Variety	2016-17	2017-18	2018-19	2019-20	2020-21
1	2	3	4	5	6	7
1	Elasmobranchs	301	224	287	362	129
2	Eels	90	55	93	70	0
3	Catfishes	1597	550	245	164	851
4	Chirocentrus SPP.	1604	237	327	763	217
5	Sardine	7181	9069	943	2510	3111
6	Hilsa Ilisha	170	161	297	241	20
7	Anchovies	1307	705	820	1434	725
8	Thrissocles	421	38	2	567	696
9	Other Clupieds	3110	234	0	261	407
10	Harpadon Nehereus	805	177	79	364	92
11	Perches	6	0	2988	65	43
12	Redsnapper	18	100	47	12	27
13	Polynemidae	42	17	25	48	33
14	Sciaenids	20	0	2	0	1
15	Otolithoides species	5005	1902	1846	2821	1924
16	Trichiuridae (Ribbonfishes)	2799	7630	2492	4925	4314
17	Caranx	59	6	2674	235	7
18	Pomfrets	1463	653	619	1602	1032
19	Black Pomfret	966	242	220	574	420
20	Mackerels	25215	22863	16752	6127	11126
21	Seerfishes	1672	1548	1591	1313	1501
22	Tunnies	1097	3563	3473	7836	4228
23	Bregmaceros McClellandi	235	45	6	50	0
24	Soles	3854	3508	4916	3697	1777
25	Sphyraena Spp. (Barracuda)	18	17	238	644	264
26	Leiognathus	590	724	189	921	508
27	Upeneus Spp.	2260	1735	1778	1002	717
28	Penaeid Prawns	15203	2993	5823	6465	8873
29	Non-Penaeids Prawns	198	865	569	70	1706
30	Natantion Decapods (Lobsters)	164	81	24	21	5
31	Lactarius	3965	1336	1304	1590	537
32	Loligo duvauceli(Cephalopoda)	3150	4219	8068	8496	10171
33	Miscellaneous	13858	14843	15001	10923	9912
TOTAL		98443	80340	73738	66173	65374

Table 8. Variety wise marine fish production of Ratnagiri District
 Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
 Government of India, New Delhi November, 2020

		(In Tonne)				
Sr.No.	Variety	2016 – 17	2017 – 18	2018 – 19	2019 – 20	2020 – 21
1	2	3	4	5	6	7
1	Elasmobranchs	117	14	5	28	0
2	Eels	41	5	0	0	0
3	Catfishes	1000	2	6	5	727
4	Chirocentrus SPP.	1348	1	15	46	180
5	Sardine	6498	7646	715	2417	2601
6	Hilsa Ilisha	61	0	1	0	0
7	Anchovies	650	0	22	15	84
8	Thrissoles	366	0	0	0	27
9	Other Clupieds	2588	15	0	30	313
10	Harpadon Nehereus	716	76	54	9	44
11	Perches	3	0	2988	0	43
12	Redsnapper	3	0	3	0	0
13	Polynemidae	0	4	2	2	0
14	Sciaenids	0	0	0	0	0
15	Otolithoides species	2536	440	179	263	564
16	Trichiuridae (Ribbonfishes)	784	4278	1066	2326	1859
17	Caranx	0	0	2554	155	7
18	Pomfrets	583	191	33	86	305
19	Black Pomfret	346	33	72	55	144
20	Mackerels	23402	20771	14532	4814	9851
21	Seerfishes	583	414	505	617	1115
22	Tunnies	803	2525	2814	7562	3957
23	Bregmaceros Mcelellandi	191	21	0	0	0
24	Soles	1459	1870	2379	1593	527
25	Sphyræna Spp. (Barracuda)	0	0	80	436	242
26	Leiognathus	387	484	28	653	467
27	Upeneus Spp.	527	196	243	23	152
28	Penaeid Prawns	9093	777	1865	1506	2417
29	Non-Penaeids Prawns	24	1	8	0	0
30	Natantion Decapods (Lobsters)	34	21	0	4	0
31	Lactarius	2614	179	88	84	217
32	Loligo duvauceli(Cephalopoda)	796	1836	5093	6174	2141
33	Miscellaneous	8275	5210	9166	3938	2845
TOTAL		65828	47010	44516	32841	30829

Table 9. Variety wise marine fish production of Mirkarwada zone
 Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
 Government of India, New Delhi November, 2020

		(In Tonnes)				
Sr.No.	Variety	2016-17	2017-18	2018-19	2019-20	2020-21
1	2	3	4	5	6	7
1	Elasmobranchs	142	185	256	249	103
2	Eels	39	42	84	69	0
3	Catfishes	261	312	140	109	57
4	Chirocentrus SPP.	184	200	274	649	29
5	Sardine	345	119	20	81	182
6	Hilsa Ilisha	82	71	235	55	1
7	Anchovies	385	535	426	1135	484
8	Thrissoles	48	0	2	460	517
9	Other Clupieds	221	54	0	230	0
10	Harpadon Nehereus	33	0	12	280	43
11	Perches	3	0	0	5	0
12	Redsnapper	2	67	30	4	9
13	Polynemidae	20	13	23	35	16
14	Sciaenids	20	0	0	0	0
15	Otolithoides species	946	951	894	1733	508
16	Trichiuridae (Ribbonfishes)	1450	1738	1116	2363	2169
17	Caranx	56	6	97	80	0
18	Pomfrets	441	175	262	908	327
19	Black Pomfret	416	173	148	332	69
20	Mackerels	865	1225	1169	813	510
21	Seerfishes	777	1026	730	564	225
22	Tunnies	262	779	425	235	75
23	Bregmaceros Mcclellandi	39	24	0	50	0
24	Soles	780	495	980	1354	678
25	Sphyræna Spp. (Barracuda)	8	2	73	110	5
26	Leiognathus	114	75	156	230	28
27	Upeneus Spp.	916	703	1428	857	277
28	Penaeid Prawns	2845	891	1606	2423	3457
29	Non-Penaeids Prawns	88	52	131	42	0
30	Natantion Decapods (Lobsters)	111	32	17	15	0
31	Lactarius	635	867	909	714	177
32	Loligo duvauceli(Cephalopoda)	1424	1398	1805	1776	4998
33	Miscellaneous	2269	3386	2218	3255	4720
TOTAL		16227	15596	15666	21215	19664

Table 10. Variety wise marine fish production of Dabhol zone
 Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
 Government of India, New Delhi November, 2020

		(In Tonne)				
Sr.No	Variety	Q.I	Q.II	Q.III	Q.IV	Total
1	2	3	4	5	6	7
1	Elasmobranchs	1	764	2259	1977	5001
2	Eels	0	303	4602	388	5293
3	Catfishes	15	998	6400	3260	10673
4	Chirocentrus SPP.	3	434	1449	885	2771
5	Sardine	62	1326	5134	4338	10860
6	Hilsa Ilisha	3	171	1101	882	2157
7	Anchovies	243	6634	14673	9646	31196
8	Thrissoles	0	796	1758	2184	4738
9	Other Clupieds	0	86	687	4	777
10	Harpadon Nehereus	0	9411	14025	3333	26769
11	Perches	0	116	66	57	239
12	Redsnapper	4	51	458	83	596
13	Polynemidae	0	184	1060	482	1726
14	Sciaenids	0	348	2212	1270	3830
15	Otolithoides species	119	5046	15534	12438	33137
16	Trichiuridae (Ribbonfishes)	12	5765	13538	7979	27294
17	Caranx	0	164	7063	4553	11780
18	Pomfrets	147	7184	4263	2438	14032
19	Black Pomfret	4	439	2190	565	3198
20	Mackerels	61	1089	12589	14025	27764
21	Seerfishes	7	1957	5985	3252	11201
22	Tunnies	0	1231	4908	4275	10414
23	Bregmaceros McClellandi	0	0	120	0	120
24	Soles	637	1539	2977	1353	6506
25	Sphyræna Spp. (Barracuda)	1	260	1026	468	1755
26	Leiognathus	2	554	912	441	1909
27	Upeneus Spp.	0	797	1767	1922	4486
28	Penacid Prawns	603	11383	19859	13457	45302
29	Non-Penacids Prawns	1706	4097	15410	12654	33867
30	Natantion Decapods (Lobsters)	0	70	204	53	327
31	Lactarius	1	501	929	1044	2475
32	Loligo duvauceli(Cephalopoda)	111	1200	10304	13718	25333
33	Miscellaneous	504	3539	11474	15468	30985
TOTAL		4246	68437	186936	138892	398511

Table 11. Variety and quarter-wise marine fish production of Maharashtra state
Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
Government of India, New Delhi November, 2020

(In Tonne)						
Sr.No	Variety	Q. I	Q. II	Q. III	Q. IV	Total
1	2	3	4	5	6	7
1	Elasmobranchs	0	7	14	108	129
2	Eels	0	0	0	0	0
3	Catfishes	7	41	144	659	851
4	Chirocentrus SPP.	2	0	66	149	217
5	Sardine	0	2	417	2692	3111
6	Hilsa Ilisha	3	7	3	7	20
7	Anchovies	243	149	218	115	725
8	Thrissoles	0	79	175	442	696
9	Other Clupieds	0	86	321	0	407
10	Harpadon Nehereus	0	44	48	0	92
11	Perches	0	39	0	4	43
12	Redsnapper	3	2	0	22	27
13	Polynemidae	0	17	1	15	33
14	Sciaenids	0	0	0	1	1
15	Otolithoides species	79	439	857	549	1924
16	Trichiuridae (Ribbonfishes)	10	848	430	3026	4314
17	Caranx	0	0	0	7	7
18	Pomfrets	143	525	117	247	1032
19	Black Pomfret	4	97	199	120	420
20	Mackerels	42	77	3347	7660	11126
21	Seerfishes	6	313	214	968	1501
22	Tunnies	0	647	1484	2097	4228
23	Bregmaceros Mcclellandi	0	0	0	0	0
24	Soles	627	483	335	332	1777
25	Sphyracna Spp. (Barracuda)	0	2	182	80	264
26	Leiognathus	0	438	44	26	508
27	Upeneus Spp.	0	164	198	355	717
28	Penaeid Prawns	589	2814	2648	2822	8873
29	Non-Penaeids Prawns	1706	0	0	0	1706
30	Natantion Decapods (Lobsters)	0	0	0	5	5
31	Lactarius	1	105	123	308	537
32	Loligo duvauceli(Cephalopoda)	109	172	3154	6736	10171
33	Miscellaneous	472	738	1471	7231	9912
TOTAL		4046	8335	16210	36783	65374

Table 12. Variety and quarter-wise marine fish production of Ratnagiri district
Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
Government of India, New Delhi November, 2020

		(InTonne)				
Sr.No	Variety	Q. I	Q. II	Q. III	Q. IV	Total
1	2	3	4	5	6	7
1	Elasmobranchs	0	0	0	0	0
2	Eels	0	0	0	0	0
3	Catfishes	0	1	104	622	727
4	Chirocentrus SPP.	2	0	58	120	180
5	Sardine	0	0	304	2297	2601
6	Hilsa Ilisha	0	0	0	0	0
7	Anchovies	0	84	0	0	84
8	Thrissocles	0	0	27	0	27
9	Other Clupieds	0	0	313	0	313
10	Harpadon Nehereus	0	44	0	0	44
11	Perches	0	39	0	4	43
12	Redsnapper	0	0	0	0	0
13	Polynemidae	0	0	0	0	0
14	Sciaenids	0	0	0	0	0
15	Otolithoides species	5	248	118	193	564
16	Trichiuridae (Ribbonfishes)	10	683	173	993	1859
17	Caranx	0	0	0	7	7
18	Pomfrets	0	80	72	153	305
19	Black Pomfret	0	44	81	19	144
20	Mackerels	0	0	2774	7077	9851
21	Seerfishes	0	295	148	672	1115
22	Tunnies	0	613	1329	2015	3957
23	Bregmaceros McClellandi	0	0	0	0	0
24	Soles	4	252	73	198	527
25	Sphyræna Spp. (Barracuda)	0	0	182	60	242
26	Leiognathus	0	438	29	0	467
27	Upeneus Spp.	0	32	118	2	152
28	Penaeid Prawns	9	1015	682	711	2417
29	Non-Penaeids Prawns	0	0	0	0	0
30	Natantion Decapods (Lobsters)	0	0	0	0	0
31	Lactarius	1	32	47	137	217
32	Loligo duvauceli (Cephalopoda)	0	0	864	1277	2141
33	Miscellaneous	4	259	583	1999	2845
TOTAL		35	4159	8079	18556	30829

Table 13. Variety and quarter-wise marine fish production of Mirkarwada zone
Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
Government of India, New Delhi November, 2020

Sr.No	Variety					(InTonne)
		Q. I	Q. II	Q. III	Q. IV	Total
1	2	3	4	5	6	7
1	Elasmobranchs	0	5	2	96	103
2	Eels	0	0	0	0	0
3	Catfishes	1	0	33	23	57
4	Chirocentrus SPP.	0	0	2	27	29
5	Sardine	0	2	2	178	182
6	Hilsa Ilisha	0	1	0	0	1
7	Anchovies	243	13	113	115	484
8	Thrissocles	0	74	78	365	517
9	Other Clupieds	0	0	0	0	0
10	Harpadon Nehereus	0	0	43	0	43
11	Perches	0	0	0	0	0
12	Redsnapper	0	1	0	8	9
13	Polynemidae	0	0	1	15	16
14	Sciaenids	0	0	0	0	0
15	Otolithoides species	74	17	155	262	508
16	Trichiuridae (Ribbonfishes)	0	27	203	1939	2169
17	Caranx	0	0	0	0	0
18	Pomfrets	127	112	10	78	327
19	Black Pomfret	4	2	4	59	69
20	Mackerels	18	2	91	399	510
21	Seerfishes	6	8	17	194	225
22	Tunnies	0	3	0	72	75
23	Bregmaceros Meclellandi	0	0	0	0	0
24	Soles	623	1	24	30	678
25	Sphyraena Spp. (Barracuda)	0	0	0	5	5
26	Leiognathus	0	0	15	13	28
27	Upeneus Spp.	0	0	18	259	277
28	Penaeid Prawns	473	219	931	1834	3457
29	Non-Penaeids Prawns	0	0	0	0	0
30	Natantion Decapods (Lobsters)	0	0	0	0	0
31	Lactarius	0	25	52	100	177
32	Loligo duvauceli (Cephalopoda)	109	84	459	4346	4998
33	Miscellaneous	0	359	399	3962	4720
TOTAL		1678	955	2652	14379	19664

Table 14. Variety and quarter-wise marine fish production of Dabhol zone
 Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying
 Government of India, New Delhi November, 2020

3.5 : WHY INDIA FOR MARINE RELATED INFRASTRUCTURE

- India, with a production of 9.6 million MT is the second largest fish producer in the world.
- Processing levels of marine food in India are currently at 23%.
- India is endowed with abundant geographical resources suited for both marine and inland fisheries, such as long coastline (8118 km), abundant rivers and canals, reservoirs, ponds and tanks, and brackish water.
- The export market is currently valued at USD 5.5 Bn/ 1 Mn MT.
- Most exports currently are in the frozen form and there is immense potential for exporting value added products.

India's fishing industry boasts diverse resources, from the Himalayan waters to the Indian Ocean. The country's rich biodiversity offers a variety of widely consumed fish species. With a growing population and increased demand for fish protein, sustainable resource management is crucial. The sector employs around 16 million locally and double that in the value chain, addressing hunger and malnutrition with affordable, high-protein fish. India's fishing potential is vast, with marine and inland estimates at 5.31 and 17 million metric tonnes, respectively. Recent years have seen a 7% annual increase in fish production.

Fish Production In India

About 41% of all the seafood in the country comes from Andhra Pradesh (27.4%) and West Bengal (13.8%). The West Coast generates 59% of all marine fish, whereas the East Coast produces 41%. Gujarat, which produces 19% of all marine fish, is the top marine fish-producing state, followed by Andhra Pradesh (16.4%) and Tamil Nadu (13.5%). (Fisheries and fish of India)

Sr. No	States	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Andhra Pradesh	4.33	4.14	4.38	4.75	5.2	5.8	6.06
2	Goa	0.86	0.74	1.1	1.15	1.07	1.14	1.18
3	Gujrat	6.92	6.94	6.96	6.98	6.97	6.99	7.01
4	Karnataka	3.47	3.57	3.57	4	4.12	3.99	4.14
5	Kerala	5.53	5.31	5.22	5.24	5.17	4.31	4.14
6	Maharashtra	4.34	4.49	4.67	4.64	4.34	4.63	4.75
7	Odisha	1.14	1.18	1.2	1.33	1.45	1.53	1.51
8	Tamil Nadu	4.27	4.28	4.32	4.57	4.67	4.72	4.97
9	West Bengal	1.82	1.52	1.88	1.79	1.78	1.77	1.85
10	A and N Islands	0.35	0.36	0.37	0.37	0.37	0.39	0.39
11	Daman and Diu	0.17	0.19	0.19	0.32	0.23	0.23	0.24
12	Lakshadweep	0.12	0.12	0.19	0.13	0.16	0.3	0.21
13	Pondicherry	0.38	0.36	0.38	0.42	0.47	0.46	0.42
	India	33.72	33.21	34.43	35.69	36	36.25	36.88

Table 15 . State wise Fish production in India.

Source . Director of fisheries state Gov./UTs administration



4.0 : STUDY AREA

The focus area is only on the state of Maharashtra as it is easy to access and more reliable. As the border changes so does the culture, traditions and government policies accordingly the method of functioning might change as well. Also understanding the influence and strategies of government to uplift the fishing community

4.1.1 : FISHERIES IN MAHARASHTRA

The Arabian Sea coastline of Maharashtra is 720 kilometres long and is split into five coastal districts: Thane, Mumbai City, Raigad, Ratnagiri, and Sindhudurg. There are 25 fishing zones and 184 fish landing points within each of the seven districts. In 2018-2019, the state's total marine fish output was 4.6 metric tonnes. (Department of Forests, Government of Maharashtra). The state offers considerable potential for the long-term use of marine bioresources for fisheries, mariculture, coastal aquaculture, post-harvest growth, and exports. Maharashtra is situated on the North-West coast and is responsible for 32.8% of the catch in 2019-20. The greatest contribution comes from pelagic resources (39%), followed by crustaceans (31%), demersal (22%), and mollusks (7%). Non-penaeid shrimp (21%) and penaeid shrimp (9%), Bombay duck and croakers (8.2%), Indian mackerel (6.9%), threadfin breams (5.9%), squids (5.1%), ribbon fishes (4.1%), golden anchovy (4%), horse mackerel (3.5%), cuttle fish (2.1%), and silver pomfret (2.0%) make up the majority of the catch. 55% of the overall catch came from trawling, 23% from set bagnets (SBN/Dolnet), 15% from purse seines, and 7% from gillnets (CMFRI Annual Report 2019).

4.1.2 : FISH PRODUCTION IN MAHARASHTRA

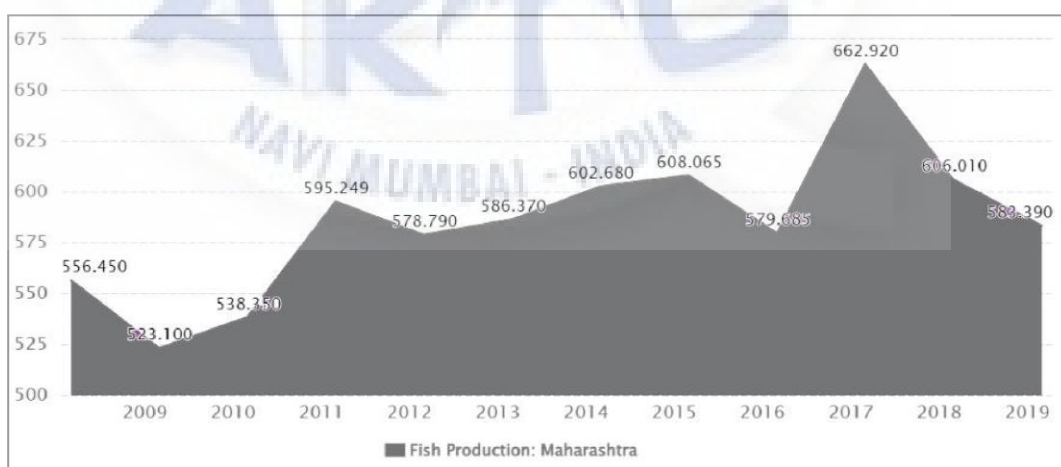


Figure 9. Fish production in Maharashtra

Source . <https://www.ceicdata.com/en/india/fish-production/fish-production-maharashtra>

Fish Production : In 2019, Maharashtra data was recorded at 583.390 metric tonnes. This is a reduction from the previous year's total of 606.010 tonnes. Maharashtra data is updated annually, with 21 observations averaging 578.790 tonnes from March 1999 to 2019. The statistics set a record high of 662.920 Ton th in 2017 and a low of 514.100 Ton th in 2003.

4.1.3 : PROFILE OF KONKAN COAST

The Konkan is a coastal strip of territory surrounded on the east by the Sahyadri highlands and on the west by the Arabian Sea. The stall accounts for 15–25% of the country's entire yearly fish output. The total marine fish landed in six marine areas was 5 lakh tonnes. There are a total of 184 fish landing centres in the Konkan area. Historically, the Konkan was made up of the coastal areas of Maharashtra, Goa, and Karnataka. In Maharashtra, it includes Mumbai and its suburbs, as well as Raigad, Thane, Ratnagiri, and Sindhudurg, which are all on the coast.

- 30.746 square kilometers.
- Population (census 2016): 24.807,351
- Mumbai's districts Mumbai Raigad, Ratnagiri, Sindhudurg, and Thane are all suburbs.
- Literacy rate: 81.36%
- Irrigation area: 4.384, 54 km².

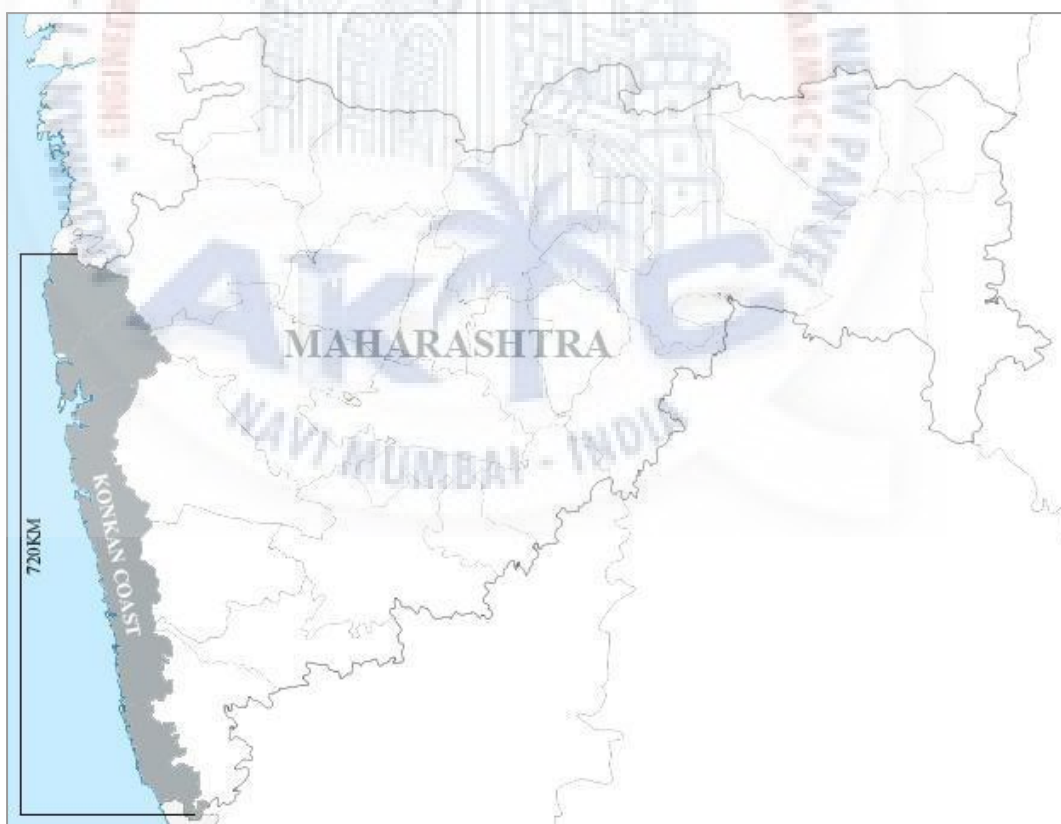


Figure 10. Location of Konkan Division in Maharashtra

Source. Maharashtra locator map.svg

4.1.4 : PROFILE OF KONKAN WITH RESPECT TO ITS FISH LANDING CENTRES

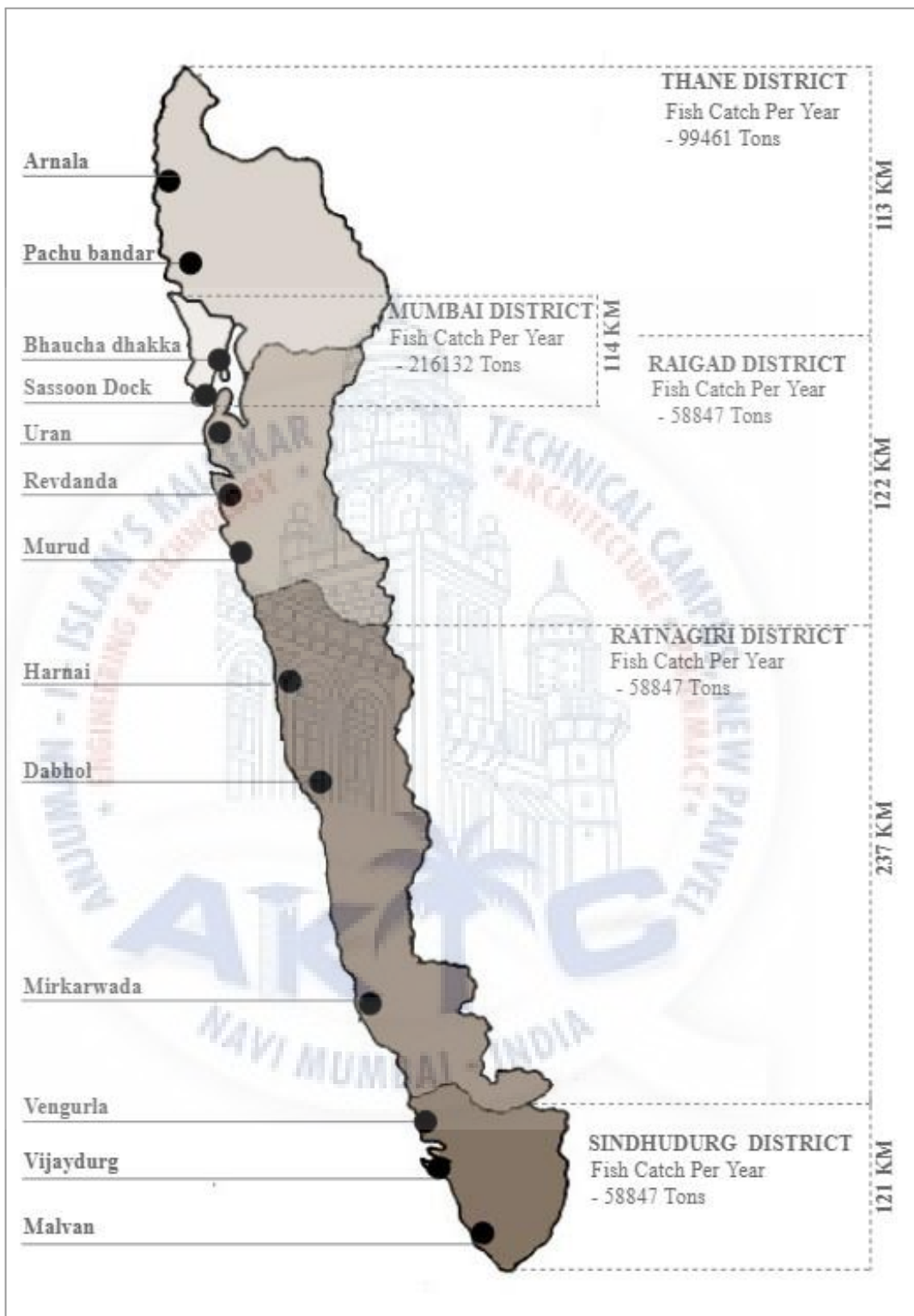


Figure 11 . Konkan coast

Source . Konkan fishing villages

4.1.5 : STATISTICS OF KONKAN DISTRICT

Total Marine fish landings of Ratnagiri district was (65374t) 16.40% to total Marine fish production. Out of these Burondi Zone was produced (8959t) 2.25% to total Marine fish production & high producing centres were Veshvi-Bankot (1604t), Veldur/Navanagar/Dhopave (2561t), Dabhol Zone was contributed (19664t) 4.93% to total Marine fish production & high Fish catch/landings centres were Harna port (18130t), Dabhol (1533t). Mirkarwada Zone was registered (30829t) 7.74% to total Marine fish landings & high producing centres were Mirkarwada (26082t), Sakhari-nate QD 989-3 10 (4276t). Fish Catch of Ratnagiri Zone was (5922t) 1.49% to total Marine fish production & high fish landings centres were Jaigad (4803t), Jakimiryabhatimiryab (385t) during the year in the state.

In total Marine fish production the percentage share of Ferrywarff centre (74225t) & sasoon Dock (52966t) was contributed by 18.63%, 13.29% respectively and percentage contributed together 31.92% to the total Marine fish landings of the state during the year 2020-21.

In total Marine fish production, Maximum contribution centres were Ferrywarff (74225t) 18.63%, Sasoon Dock (52966t) 13.29%, Mirkarwada (26082t) 6.54%, Varsova (26583t) 6.67%, **Harna port (18130t) 4.55%**, Vasai (10142t) 2.54%, Uttan (15406t) 3.87%, Madh (14392t) 3.61%, Arnala (7302t) 1.83%, Yralgal bhati (7358t) 1.85%, Aandwadi (6077t) 1.52%, Jaigad (4803) 1.21%, Alibag (7579t) 1.90% & percentage contributed together 68.01% to the total Marine fish landings of the state during the year 2020-21. (Fish production report 2020-21, Govt of India)

District	Fsh Catching per year	fishermen Population	Major Harbour
Thane	99461 Tons	26,821	2
Mumbai	216132 Tons	20,304	2
Ratnagiri	58847 Tons	14,046	3
Raigad	73738 Tons	19,026	3
Sindhudurg	19054 Tons	7,277	3
Total	4,67,232	87,474	13

Table 16 . District profile
Source . Marine fisheries census 2016

OBSERVATIONS

- All districts were studied by looking at their fish catching per year, Mumbai and Ratnagiri district have large fish catch by the given data. So only these two districts were taken into consideration according to their potential
- The main junction of fish production is in Mumbai district from which all the other districts are connected. Ratnagiri district is much closer to the Mumbai district which becomes more accessible to import and export.
- There are two major harbours (Sasoon Dock and Bhaucha Dhakka) in Mumbai district and two (Mirkarwada and harnai in Ratnagiri)
- The main fish landing centres, Sasoon dock and bhaucha dhakka in Mumbai are the major fish producing harbours but the consumption ratio is also very high as compared to that of Harnai and Mirkarwada in Ratnagiri
- Since the urban problem faced by fishermen would be vastly different from the problem faced by fishermen in the villages, these landing centres were excluded from the study, but were helpful in understanding the basic requirements for development of landing centres. So, Ratnagiri district is the main focus of the study
- Mirkarwada has been evolved as a major harbour followed by many processing facilities and the dock infrastructure is also well built and thus there are no major issues faced by the fishermen in mirkarwada. As compared to that of harnai, it doesn't have a dedicated jetty for the fishermen where they can park boats and and carry out the fishing cycle, which also becomes hectic for them during any natural calamity

4.1.6 : PROFILE OF RATNAGIRI DISTRICT



Figure 12 . Profile of Ratnagiri district coast

Source: <https://www.mapsofindia.com/maps/maharashtra/districts/ratnagiri.htm>



Figure 13 . Fish landing centres on the coast of Ratnagiri district
Source. Department of fisheries, Government of Maharashtra

Ratnagiri is the capital of a maritime district of Maharashtra State, with the same name, situated on the Western Coast of India, having a coastline of about 167km. There are about 48 fish landing centers along Ratnagiri coast, one of which is in Mirkarwada. This is a major landing center. Mirkarwada village is a populated fish landing centre with nearly 3,000 people. The primary occupation of the people, most of whom are fishers, is fishing.

Fishermen population and fish production

Villages	Fishermen family	Fishermen population	Fish production per year	Coastline (km)
Mirkarwada	1231	8689	26082T	24
Harnai	751	2869	18130T	9

Table 17 . Fishermen population and fish production
Source . Marine fisheries census 2016

4.2.1 STUDY AREA FOR SITE

In Ratnagiri district, there are two major fish landing centres, like mirkarwada and harnai in dapoli . But Mirkarwada is a well-developed port with recently reconstructed facilities. Because the problem faced by fishermen in Mirkarwada is vastly different from the problem faced by fishermen in Harnai .Therefore Mirkarwada is excluded from the study.

4.2.2 HARNAI

Harnai, one of the city's fishing communities. It has faced issues such a lack of infrastructure, an unhygienic environment, and a lack of employment opportunities over the years. According to recent data, the fisheries market in this village has a significant amount of potential.

4.2.3 POPULATION OF HARNAI

In the 2011 Census of India, the village of Harnai in Dapoli, Maharashtra, was recorded to have a total population of 7,274 residents.

Perticulars	Total	Male	Female
Total population	7274	3623	3651
Literate population	4989	1951	2115
Illiterate population	2285	1672	1536

Table 18 . Population of Harnai village

Source . <https://www.census2011.co.in/data/village/564829-harnai-maharashtra.html>

- The total geographical area of the village is 591 hectares.
- Total licensed fishermen - 3568
- Total no. of houses - 1891

Population

At Harnai, marine fish output has been estimated to be 19930 tonnes per year on average over the past ten years. The marine fish production at harnai Fishery Center is shown in the table below. In addition to gill nets, bag nets, also known as "dole" locally, are another type of fishing gear. There are now 3,134 pieces of fishing equipment in use, including 2,719 bag nets, 100 gill nets, and 315 stake nets. There is no use of trawling, purse seining, or other fishing techniques. The prime months for bag net fishing are from August to December and again from March to May. Bagnetting is done from August to May. Gill netting, on the other hand, is done from August to May. Larger boats up to 19.8 m (4 or 6 cylinder engines) go on longer trips that last 4 or 5 days, while fishing boats up to 10 m (1 to 3 cylinder engines) only go on trips that last one day

Year	Marine fish production in tonnes	Year	Marine fish production in tonnes
2005-06	16302	2010-11	14484
2006-07	17812	2011-12	16484
2007-08	15376	2012-13	19372
2008-09	13672	2013-14	20313
2009-10	17359	2014-15	18130

Table 19 . Marine production from 2012 - 2022
 Source . <https://www.census2011.co.in/data/village/564829-harnai-maharashtra.html>

4.2.4 : EXISTING FISHING MODEL

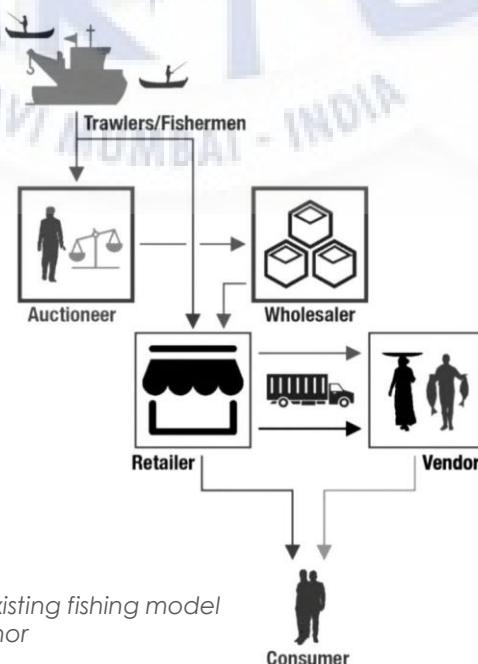


Figure 14 . Existing fishing model
 Source. Author

4.2.5 : A FLOW CHART OF MAIN FISHERS ACTIVITIES IN HARNAI VILLAGE

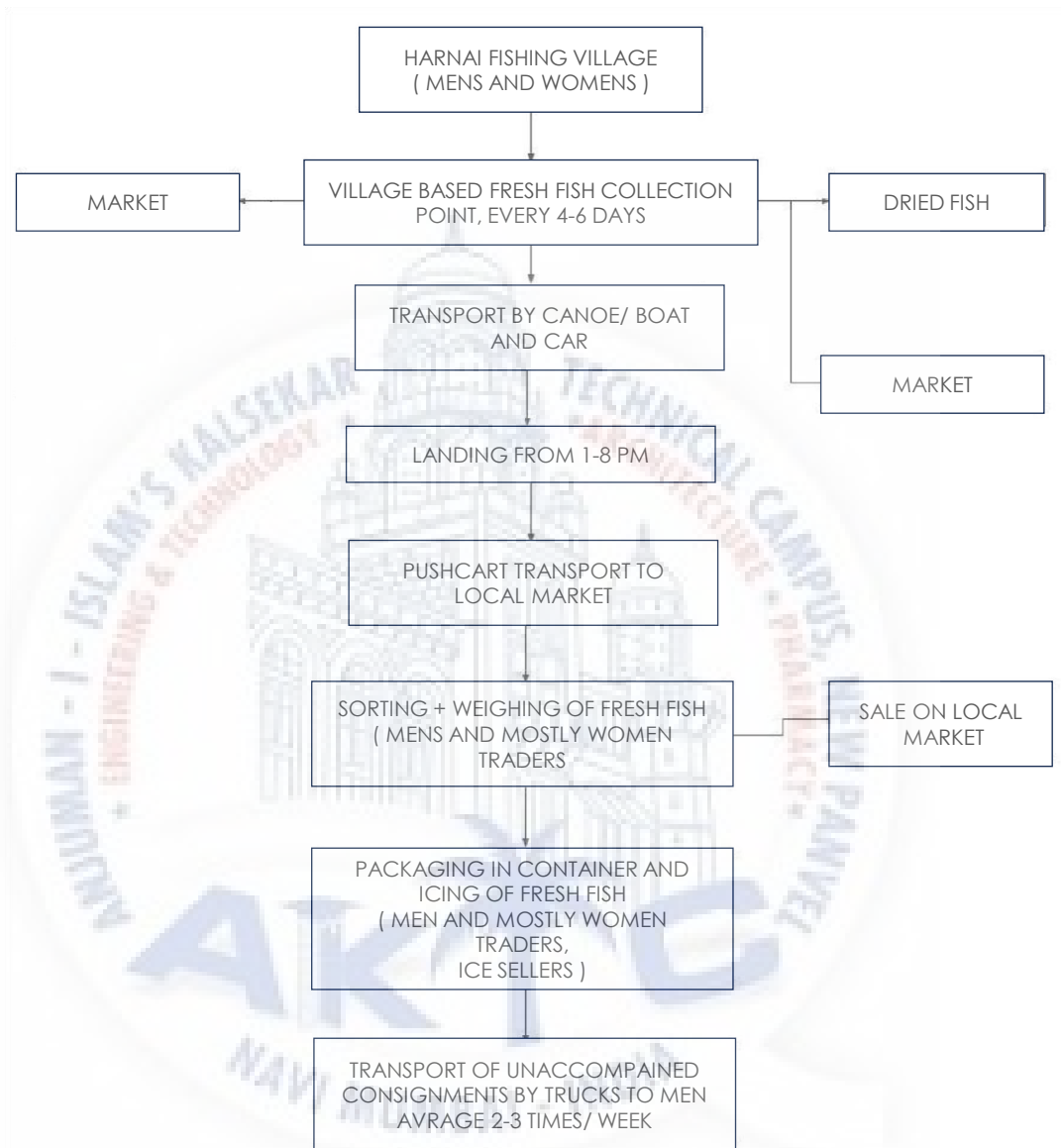


Figure 15 . Fishers activities in Harnai village
Source Author

Issues

- Harnai beach is polluted by the garbage, ranging from plastic, trash, and litter to sewage, etc.
- It also pollutes the air which affects the people living near the beach, leading to several diseases.
- There is no proper platform for loading/unloading of fishes and it is carried along the shore which makes it dirty.
- The fish waste derived after the cleaning is also left on the beach, leaving a permanent smell behind.
- Fish market is located far from the fish terminal.
- There is no proper space for circulation in the market.
- There is no hygiene in this area.
- Fish vendors selling on the road makes the road crowded.
- So , there is no sufficient space for the vehicles which ultimately turn into traffic.
- There is no proper space provided for net mending. So they do this at their house.



Image 1 . Harnai beach
Source Author



Image 2. Auction taking
place on beach
Source Author



Image 3. Fish sellers
Source Author

Need

- The fishing harbour is a major source of pollution for the surroundings as well as for the fisheries products it generates. So it needs to be designed properly.
- There is a lack of exposure and infrastructure for the fishermen of this village. So a proper infrastructure is needed.
- There is no dedicated space for the fish market so some fish vendors sell outside sitting near the road which leads to some issues like traffic, etc. Hence, this also becomes the need.

4.3.1 AIM, OBJECTIVES, SCOPE AND LIMITATIONS

INTRODUCTION

Marine ecosystems are priceless resources that greatly contribute to the economy, culture, and biodiversity of coastal regions. Harnai, a coastal town with a rich maritime tradition, has enormous potential for long-term growth if a well-integrated marine park is established. This plan details the design of a complete Marine ecosystem in Harnai, which will include an auction hall, fish market, food processing and export facilities, and a marine museum. The goal of proposing such infrastructure is to boost economic growth, protect local culture, encourage sustainable practices, and provide educational opportunities for both residents and visitors.

AIM

This research proposal seeks to create a fishing harbour which will boost the economy, enhancing cultural activity, and to promote learning. The park will support traditional and advanced fishing, food processing, cultural displays in terms of museum, and community involvement, benefiting locals and the area's progress.

OBJECTIVES

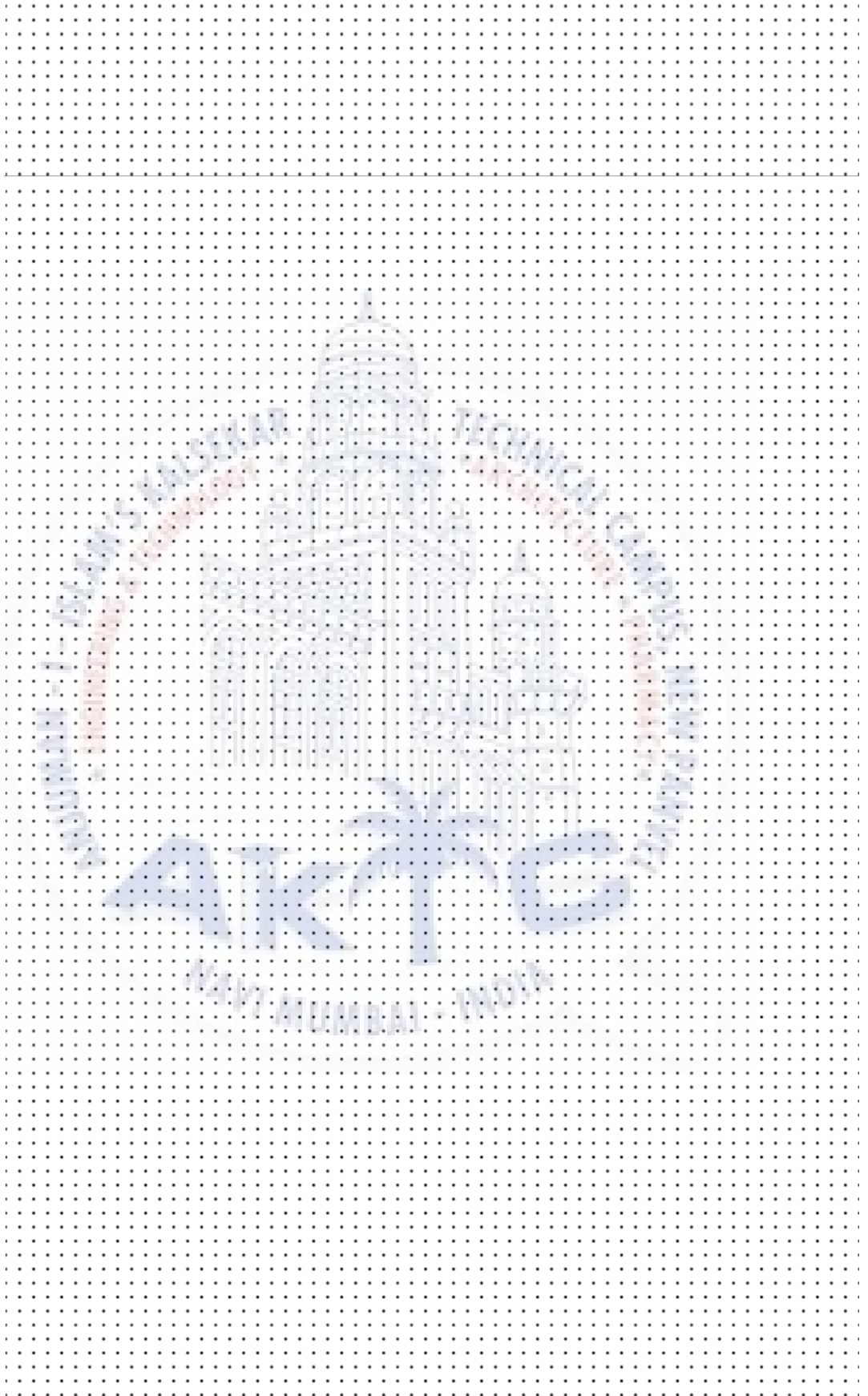
- To examine the laws and regulations for the coastal constructions, corporation rules, and discovering the possible interventions. To analyze the spaces which are necessary for the functionality of a fishing port.
- To enhance the beach's spatial and social character by adding recreational amenities they respond to input and are interactive.
- To provide the necessary infrastructure which required for a fishing harbour for its functioning.
- Employment generation for the people of harnai through the proposal of fishing harbour.
- Create a proposal that considers and addresses the needs of future generations , according to the cultural and climatic setting.

SCOPE

- The goal of this study is to offer a more affordable concept that concentrates more on local community development.
- In recent years, the global fisheries have evolved into a market-driven sector of the food business, and many coastal states have made significant investments in fishing harbours in an effort to seize this new opportunity.
- The the proposal for export fish processing is already given by MIDC in khem, Dapoli so all the raw fish will be acquired from harnai fishing port

LIMITATIONS

- The zone of study for this thesis is only limited for konkan region focusing Harnai.
- The proposal just consists of fish processing as a part of fishing harbour but the processing will be done on a local scale and more focus is on local market



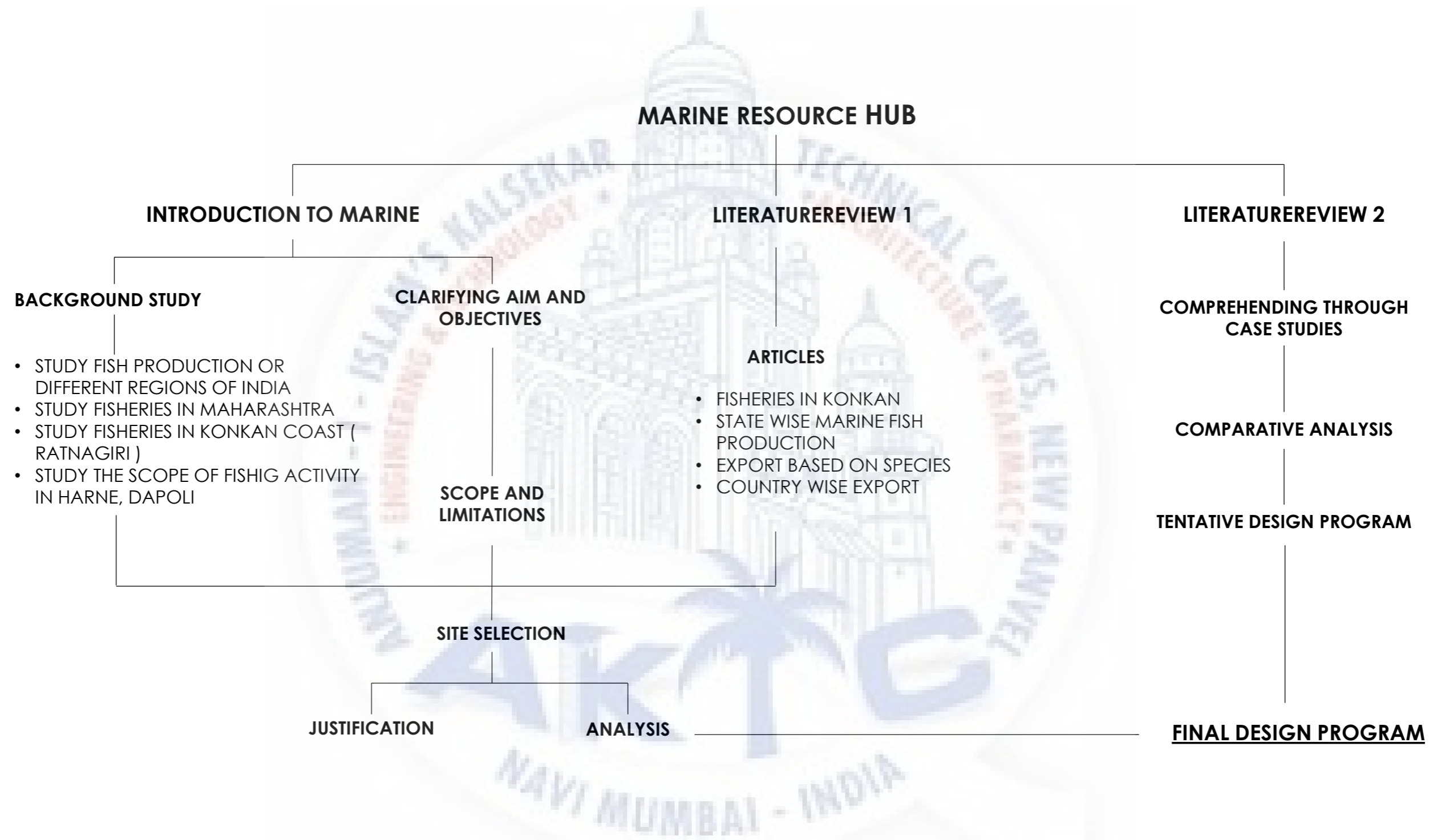


Figure 16 . Research methodology
Source . Author



6.0 : LITERATURE REVIEW - 1

Starting with the communities and borders of the Konkan, the literature study discusses how fishing became a significant industry. Additional reading about fishing people and fishing crafts, such as boats and net weaving techniques and how they affect fish capture, as well as when fishing is permitted depending on the kind of net. Despite the importance of hygiene and the necessity of handling fish, rules aren't always followed. The socioeconomic characteristics of fisherman from various social strata as well as their customs, gods, and rituals were investigated in order to comprehend why. Many studies look into the possibility of gathering, processing, and reusing fish waste as an alternative to damaging the coast.

6.1 : FISHERIES IN KONKAN

According to Saradesaya (2000), the Konkan region is traditionally defined as the narrow strip of land that runs from the Arabian Sea to the Western Ghats, with the Gangavali River serving as its southern boundary and the Maurya River as its northern boundary. Even now, there are differences in the geographical definition of Konkan, but it mostly includes the coastal regions of Maharashtra, the state of Goa, and the districts of Uttar Kannada, Udapi, and Dakshina Kannada in Karnataka. The Konkan Region of Maharashtra, which encompasses the coastal districts of Palghar, Thane, Mumbai, Raigad, Ratnagiri, and Sindhudurg, is the sole subject of this thesis.

(GUIDELINES: Central Sector Scheme on Blue Revolution Integrated Development and Management of Fisheries, June, 2016)

Prof. Prasad Pagdhare & Dr. J.A.Bhakay : Financial Understanding Of Fishermen In Mumbai And Palghar Area(March 2012)

The research paper by Prof. Prasad P. Pagdhare and Dr. J.A. Bhakay delves deeply into the different categories of fishermen according to the vessels they use for fishing. It also covers the different supply and management strategies that fishermen using trawlers, motorized crafts, and traditional craft employ. They also make clear the connection between the owner of a boat and the fisherman who owns a net.

6.2 : THE FISHER FOLK

Fish caught is landed in landing centers, which are found on beaches and in ports. Seventy-two of the 152 fish landing facilities are located in Raigad and Ratnagiri alone. There are 81,492 fishing families in the state at the moment, out of 3,86,259. 11,414 part-time fisherman and 62,614 full-time fishermen make up the fishing community; the remaining individuals fish seed collectors. Among these 81,492 families, 91% are traditional fisherman, and 15,506 households—of which 37% are in Sindhudurg—are impoverished. Thane held 16% and Raigad had 24%. (Marine fisheries census: Maharashtra, 2016)

Just 40% of active fisherman fish, with the remaining 40% working in related fields. About 1.11.276 fishermen work in related fields like marketing, labor, net construction and repair, curing and processing, and peeling. In the fields of peeling (93%), marketing (84%), and curing and processing (95%), women exceed men. Just 5% of fisherman work on maintaining and repairing nets; in Thane, 12%, and Sindhudurg, 13% and 65% of fishermen, respectively. (Marine fisheries census Maharashtra, 2016)

A cooperative society for fisheries is a group of fishermen who voluntarily combine their resources for the benefit of all members. (Anderson & Ben Yami, 1985), with such cooperative associations comprising 23% of fisherman. Most of them were found in the Greater Mumbai area. There are 17,362 fishing boats, of which 13,016 are mechanized, 15,63 are motorized, and the other boats are traditional. In the mechanized sector, trawlers, dolneters, and gillneters are the main boats. Cast-net, bag-net, gill-net, and trawler-net were the nets employed by fishermen; the sharing pattern of the latter three was more obvious. (Marine fisheries census: Maharashtra, 2016)

District	Actual Fishing		Fish Seed Collection				Total
	Full Time	Part Time	Full Time		Part Time		
			Male	Female	male	female	
Thane	13,350	3,021	258	103	346	481	17,559
Mumbai	4,112	550	24	5	0	7	4,698
Ratnagiri	13,573	2,285	1	0	0	4	15,863
Raigad	25,962	3,739	17	74	3	85	29,880
Sindhudurg	5,617	1,819	133	104	311	361	8,345
Total	62,614	11,414	1,819	286	660	938	76,345

Table 20 . Fisher Folk
Source . Marine fisheries census 2016

6.3 : THE FISHING CRAFT

The maritime fisheries of Maharashtra are based on multi-species fishing and are sustained by tropical species that have alternating small sizes, fast development rates, nearly continuous breeding cycles, and low volume characteristics with quick turnovers. With the exception of the Bombay duck, which is indigenous to the nation's northwest coast, marine fisheries are often distinguished by the gear employed rather than the primary species caught due to the multi-species nature of the catch. The two most widely employed traditional gears in the state are drift gill nets and bag-nets (also known as Dol nets; Tarti or Daldi). Additionally, shore seines (Rampan), long lines (Khanda), and bottom set gill nets (Budi) are employed. Other than this, a range of native inshore and nearshore gear is employed.

Since the start of the rapid mechanization process in 1960, trawling has become the predominant method of fishing. The government and various institutions supply the capital base for these gears. Commercial fish for the processing and export sectors are the main target of trawling. Cooperatives have organized the traditional dol and gill nets successfully, and they have undergone significant motorization and mechanization. Therefore, just 1% to 2% of significant fish landings come from traditional fisheries. Over the past ten years, the beach seine and long line fisheries have decreased in popularity while the purse seine fishing has grown in popularity. Bycatch from purse seine operations is significant (60–65%), consisting primarily of young, undersized fish and inedible biota that is dumped at sea. This greatly reduces the catch of non-mechanized fisheries, which has a negative effect on them. (Deshmukh, 2013)

District	Trawlers	Gillnetters	Dolhetter	Liners	Other	Total Mechanized	Motorized	Non Motorized	Total
Thane	16	206	1,613	0	0	1,835	773	247	2,855
Mumbai	2,849	551	1,236	5	26	4,895	0	830	5,725
Ratnagiri	2,015	620	31	0	3	2,811	49	796	3,656
Raigad	207	1,181	1,093	0	0	2,546	135	505	3,186
Sindhudurg	526	403	0	0	0	929	606	405	1,940
Total	5,613	2,961	3,973	5	29	13,016	1,563	2,783	17,362

Table 21 . Fishing Craft

Source . Marine fisheries census 2016

6.4 : FISH HANDLING AND HYGIENE

A crucial step in the creation of premium fish products is the post-harvest processing of the catch. In the sector, one of the most important factors is the freshness of the fish caught. How well fish is treated on board, as well as how well it is packaged, stored, and transported, all affect the quality of fish that is ultimately consumed. This affects the fish's pricing because fresher products command a greater premium. The quality of the fish that land is primarily the responsibility of the fisherman that are on board. (Singh, Santhakumar, Pandey, Bharti, & DebRoy, 2012)

Y. Jackie Singh, R. Santhakumar, D.K Pandey, H. Bharati⁴ and P. DebRoy: Adoption of Hygienic Fish Handling Practices by Fishermen(January 2012)

They looked at how much fishermen followed hygienic practices for handling fish, how socio-personal characteristics impact handling behavior, and what issues arise when landing, auctioning, and selling fish. This study was carried out in a number of Tamil Nadu's rural districts. They came to the conclusion that fishermen's ignorance prevented them from adhering to the strictest hygiene regulations. Along the coast, there are no cold storage facilities and no rules about how to handle seafood.

An addition to MPEDA, NETFISH (Network of Fish Quality Management and Sustainable Fishing) aims to enhance both fish quality and the sustainability of marine resources. It conducts community-based initiatives to inform fishermen and other industry participants about different approaches and regulations for preserving high-quality fish. In their yearly report, they outline the number of workshops that will be held in each state as well as their general goals. (Thomas. Afsal & Naveen. 2013-14).

6.5 : SOCIO ECONOMIC STATUS OF FISHERMEN

Education status

District	Primary		Higher Secondary		Above Higher Secondary		Unschooling	
	Male	Female	Male	Female	Male	Female	Male	Female
Thane	15,375	15,107	20,452	15,673	6,028	4,768	16,406	18,972
Mumbai	6,967	7,330	7,636	5,720	1,323	913	3,577	4,591
Ratnagiri	8,496	9,086	12,955	9,922	913	511	8,401	11,654
Raigad	15,418	16,519	20,621	14,774	3,130	2,125	18,577	20,637
Sindhudurg	4,750	5,349	7,059	5,446	841	491	3,079	3,584
Total	51,006	53,391	68,723	51,535	12,235	8,808	50,040	59,438

Table 22 . Education Status
Source . Marine fisheries census 2016

69% of fishermen in the Konkan region have finished their elementary schooling. There were those who had completed primary education (29%), secondary education (34%), above-secondary education (6%), and no education (31%). Raigad has more fisher folk without formal education than any other place, but it also has more with basic and secondary schools, with Thane and Ratnagiri coming in second and third, respectively. Conversely, the greatest percentage of fisherman in Thane have completed secondary education or above. (Marine fisheries census: Maharashtra, 2016)

Religion And Community

District	Religion					Community
	Hinduism	Islam	Christianity	Others	Total	SC/ST
Thane	22,714	71	4,031	5	26,821	799
Mumbai	8,039	261	781	223	9,304	637
Ratnagiri	8,141	5,911	0	12	14,064	926
Raigad	23,862	164	0	0	24,026	10,061
Sindhudurg	6,310	421	520	26	7,277	499
Total	69,066	6,828	5,332	266	81,492	12,922

Table 23 . Religion And Community
Source . Marine fisheries census 2016

85% of fishermen's families are Hindu, 8% are Muslim, and 7% are Christian. In every district, Hindu families make up the bulk of the fishing community. Ports like Mirkarwada in Ratnagiri are dominated by Muslim fishing families. Consequently, the Konkani Muslim community also celebrates a number of Hindu holidays. Approximately sixteen percent of the families that fished were SC/ST families. Raigad district is home to 78% of SC/ST fisherman. In Ratnagiri district, it was 7%. Hindu households are most concentrated in Raigad district, whereas Muslim fishermen are most concentrated in Ratnagiri. (Marine fisheries census: Maharashtra, 2016).

Population

District	Male			Female			Total	Average	Sex Ratio
	Adult	Childrens		Adult	Childrens			Family	
		Upto 5- y	Above 5- y		Upto 5- y	Above 5- y		Size	
Thane	40,635	4,621	17,626	40,141	4,476	14,379	1,21,869	4.54	938
Mumbai	15,343	1,445	4,160	14,875	1,451	3,679	40,953	4.4	955
Ratnagiri	23,256	2,411	7,509	24,461	2,336	6,712	66,685	4.74	1,010
Raigad	42,689	5,999	15,057	40,676	5,774	13,379	1,23,574	5.14	939
Sindhudurg	12,480	1,289	3,249	11,860	1,290	3,010	33,178	4.56	950
Total	1,34,403	15,756	47,601	1,32,013	15,327	41,159	3,86,259	4.56	4792

Table 24 . Population Source .
Marine fisheries census 2016

There are, on average, 179 families each village. Raigad has an average family size of 5.14, while Greater-Mumbai has a minimum of 4.4. Konkani has an average family size of 4.74. The population of maritime fishermen consists of 31% children, 35% adult females, and 34% adult males. The highest male to female ratio is found in Ratnagiri. Twenty percent of families who are fishers are impoverished. (Marine fisheries census: Maharashtra, 2016)

Gender Wise Work Distribution

District	Marketing Of Fish		Making Net		Curing / Processing		Peeling		Labourer		Others	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Thane	5,467	14,748	1,299	402	106	3,002	96	1,667	7,338	3,573	426	746
Mumbai	790	8,083	729	319	20	52	171	525	2,947	1,281	80	3
Ratnagiri	38	3,916	537	25	16	444	24	222	62	515	136	795
Raigad	633	8,858	3,257	6,097	159	4,242	150	3,540	6,166	4,884	783	2,649
Sindhudurg	375	3,063	1,240	572	126	1,387	25	73	890	1,217	203	87
Total	7,303	38,668	7,062	7,415	427	9,127	466	6,027	17,403	11,470	1,628	4,280

Table 25 . Gender wise work distribution
Source . Marine fisheries census 2016

60% of the fishermen engage in allied fishing activities, with 40% of them being active fisherman. Among the many related activities were marketing, labor, curing/processing, peeling, and creating and repairing nets. In coordinated fishing, women dominated the male population. Of the 17% of adult fisherman employed in marketing, Thane accounts for 44%, Raigad for 21%, and Greater Mumbai for 19%. About 5% of adult fisherman are employed in net construction or repair. Of them, the district of Raigad accounted for 65%, Sindhudurg for 13%, and Thane for 12%. Of adult fisherman, 11% are employed as laborers. Of them, the districts of Thane and Raigad account for 38%.

Y.N. Ulman, J.M. Talathi And V.G. Naik : Socio-Economic Status, Income And Expenditure Pattern Of Fishermen In Konkanregion Of Maharashtra

In this study, Y. Ulman examined the spending and income patterns of ten fisherman from different Konkan communities. The capital investments made by fisherman, as well as their main source of funding and yearly income, were also discussed. A number of other difficulties faced by fishermen were also cited, such as trading difficulties, fish catch uncertainty, high fishing costs, absence of drying platforms and transportation facilities, and price declines as a result of abundant harvests. Many fishermen also had other minor companies to augment their income, even though fishing was their principal source of revenue. Some studies, like "Physical and socioeconomic aspects of southern Konkan," look at the ways in which various landforms and already-existing natural resources, such rivers, influence the development of locations like Sindhudurg and Ratnagiri. They also examine patterns of land use, cropping, occupation structure, and population growth and density.

6.6 : TRADITIONS AND BELIEFS

A sample survey was conducted by "YN. Ulman, V.G. Naik, and J. M. Talathi in their research Traditional fishing practices and socio-cultural activities of Koli communities in Konkan region of India" from various villages from different tehsils in Ratnagiri and Sindhudurg in order to understand the aspirations, occupations, social life, and beliefs. They come to the conclusion that there were plenty of opportunities for future generations to follow interests outside fishing. The elders dissuade the younger generation from continuing the family tradition of fishing because of the decline in fish capture and the instability of daily revenue. The beliefs of Koli fishermen are changing because of education and urbanization. Some traditional beliefs, meanwhile, like bringing coconuts to calm the water after the monsoon, still hold true. It has been observed that festivals maintain social cohesion throughout communities even when people choose to pursue other careers. The study also features folk dances associated with many cultural celebrations that happen all year long, like holi and narali pomima. They also include the well-known gods worshipped in this area and the rituals connected to them.

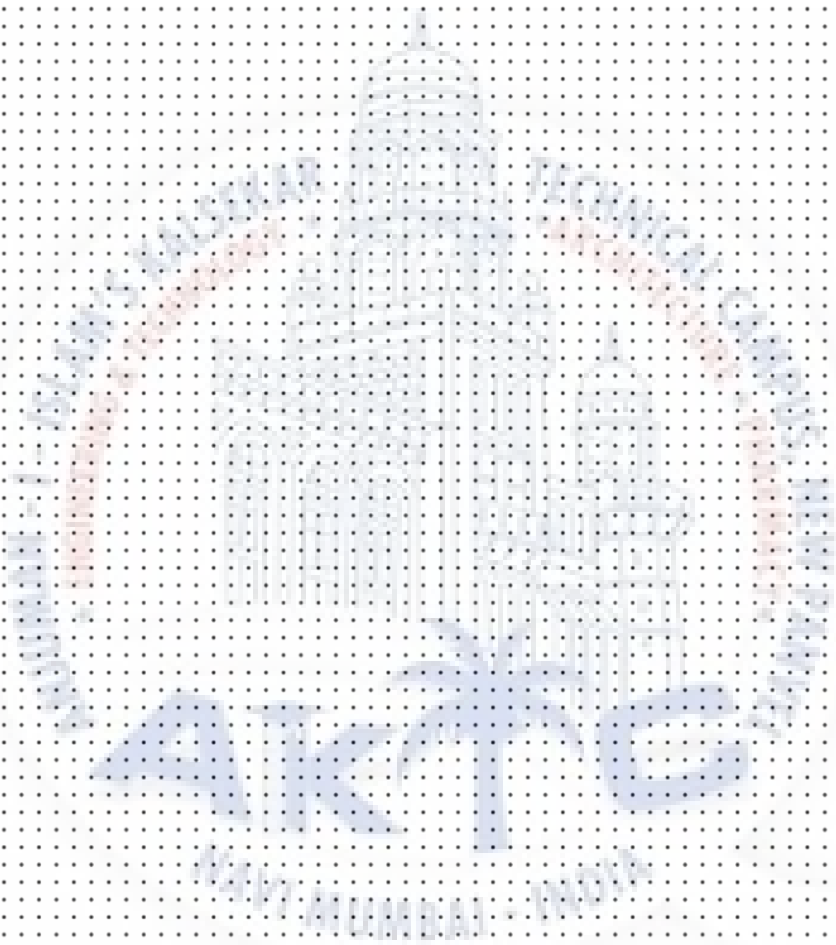
CONCLUSION

The overall study shows that a lack of facilities, such as cold storage and a sanitary fish auction hall, along with a lack of awareness among fishermen, prevent hygienic fish handling from occurring.

An organization called NETFISH organizes multiple camps and works to increase awareness. Such operations necessitate separate facilities. Even now, nets are still woven in public areas and often lie alongside the beaches; ultimately, amenities like a shed for repairing nets may be built, and they could function as gathering spots with proper hygiene.

It is necessary to analyze the primary survey results to see whether additional facilities like community space are needed. Fish auctions and other activities that are impacted by them need to be mapped together.

It is necessary to research further waste management strategies, case studies, and the requirements of factories and processing units.



7.1 : LIVE CASE STUDIES



7.1.1 : APOLLO BUNDER : SASSON DOCK (MUMBAI)

7.7.1 : APOLLO BUNDER (SASSON DOCK, MUMBAI)



Image 4. Apollo Bunder : Sassoon Dock
Source : Author

Reason for selection:

The reasoning behind choosing this case study was to understand the requirement of spaces and the circulation required for the functioning of fishing harbour.

Built by : David Sassoon Co.

Location : Azad Nagar, Colaba, Mumbai

Category : Fishing Terminal and market

Program : Auction Hall, Docks, Ice Plant, Drying Grounds, Fish Processing Unit, Net Making, Retail Market

First Off The oldest dock in Mumbai is Sassoon Dock. This is the western coast of India's first public wet dock. During colonial Mumbai, David Sassoon used it as a godown and trading port for the goods owned by his company. Later, commerce activity declined under the Bombay Port Trust. Kolis deliver their catch to a major fish market in Mumbai. On Sundays and Wednesdays, 200-240 Kolis return with catch. 150 vessels arrive every day on average. Local Kolis utilize the old dock for regular or daily fish supply, while smaller boats (Toni) use the newer dock.

Site plan



Figure 17. Sasson dock site plan

Source . . . <https://www.dnaindia.com/mumbai/report-dna-exclusive-state-expedites-sassoon-docks-revamp>

- A. Entrance Gate
- B. Loksatta godowns
- C. Non Fishing Industry Unit
- D. Fishing Industry Unit
- E. Peeling Shed
- F. Auction Shed local Market
- G. Ancillary spaces
- H. Water Tank
- I. Auction Shed Export

Design

- **Fish cleaning peeling and packaging godowns.** Koli fishermen who work full- or part-time are employed by small-scale companies that possess these. The fish is packaged for shipment after being peeled, its fins trimmed, and its guts removed.
- **Ice making factory** The majority of the ice used in the Mumbai marketplaces is supplied by a long-standing ice manufacturing plant. This machine produces blocks of ice from larger blocks that weigh up to 15 tons (15000 kgs) while it is operating for 17 hours a day.
- **Peeling sheds** These can be seen on the pier as well as along the godowns to the west, where fishmongers—mostly women—peel small fish and prawns in preparation for drying or sale. Additionally, the sheds serve as a common market area where seafood is kept cold for the retailers in thermocol containers.
- **Motor welding and turning shop, and a Garage** The trucks utilized in this area are serviced, customized, and repaired in this business, which caters to the dock's transport section.
- **Restaurants and eateries** There are little restaurants for both staff and guests. Seafood is slightly less expensive than it is outside and is guaranteed to be of high-quality fish.
- **Cold storage** Large godowns with cold storage are accessible. If an auction is held and a larger fish or batch of fish is needed to wait for an order, these places can be rented.
- **Auction Halls** These are covered halls that are open from all sides and found on every pier, but they are primarily utilized in the new jetty where auctions for big lots of fish intended for export are held. Here, packaging, sorting, and weighing are done.



Image 5. Storage shed
Source . Author



Image 6. Auction area
Source . Author

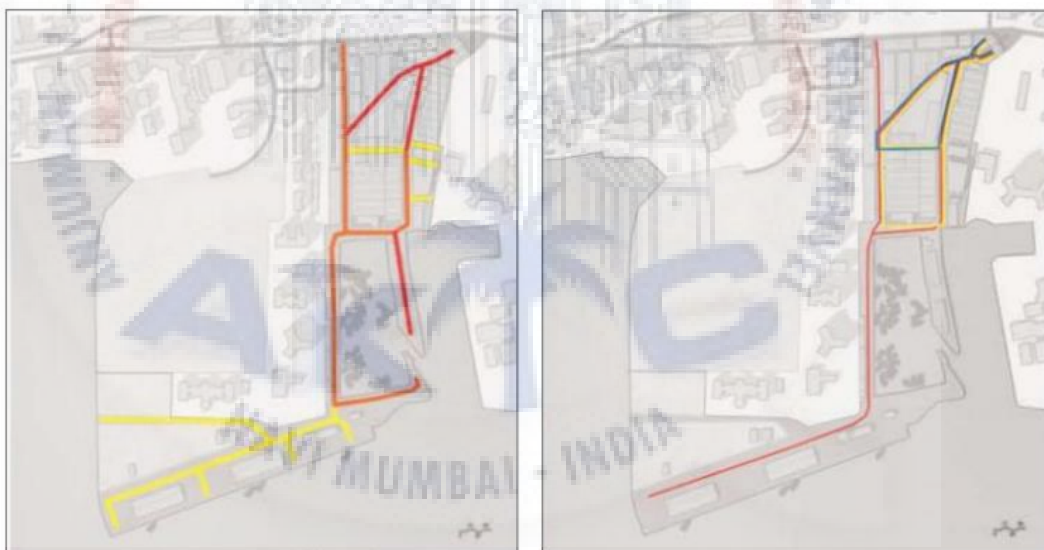


Image 7. Fish segregation area
Source . Author

Observations

- Dock godown circulation is superior to that of other ports because of its larger area and wide highways.
- There is parking on either side of the street. Trucks load and unload at factories and godowns. There, ice trucks unload and break up ice.
- Every day, between 12 to 15 garbage trucks service this dock.
- The boats fish for eight and a half days. Fish are gutted, cleaned, and kept during this period.
- Boats are refueled, cleaned, serviced, and restocked with food, ice, water, etc. when they dock, and intermediaries are responsible for supervising the batch for transportation and holding auctions. At city markets, wholesalers sell their catch.
- The main procedures include cleaning, peeling, gutting, and selling.
- Secondary procedures include exporting, drying, and refrigeration.
- Separate godowns are used for other extensive packing for regular export.

Circulations



PEDESTRIAN MOVEMENT

● High ● Medium ● Low

VEHICULAR MOVEMENT

● Trucks ● Fishing ● Non Fishing

Figure 18. Sassoon dock circulation plan

Source . . <https://www.dnaindia.com/mumbai/report-dna-exclusive-state-expedites-sassoon-docks-revamp>



PARKING

Every car is parked along the accessible boundaries, such as boundary wall and building frontages. There is no prescribed parking order based on the types of vehicles.

ACTIVE FRONTAGE

● High ● Medium ● Low

The majority of the building's construction has a frontage that is very busy. The vacant structures are not occupied.

Figure 19 . Sassoon dock parking plan

Source . . <https://www.dnaindia.com/mumbai/report-dna-exclusive-state-expedites-sassoon-docks-revamp>

Inferences:

- An abundance of biowaste that cannot be buried is produced by fish markets. When waste is burned, toxic gases are released. Thus, improved waste disposal is necessary for sustainable fishing.
- In this century, markets are becoming less and less important. India needs contemporary markets that can keep up with technological advancements and provide consumers with the same level of satisfaction as traditional markets.
- Fishing ports require godowns, ice factories, packing houses, utilities, and storage. Sassoon Dock includes all the amenities required by a manufacturing facility.



7.1.2. BHAUCHA DHAKKA, (MALLET BUNDER, MUMBAI)

7.1.2. BHAUCHA DHAKKA, (MALLET BUNDER, MUMBAI)



Image 8. Bhaucha dhakka, Ferry wharf
Source . Author

Reason for selection:

To understand the design techniques of typical wharf and the pier. Also, the working of services like loading and unloading.

Built by : Late Lakshman Hari Chander Ji Ajinkya

Location : Mumbai Port Trust, Dockyard Road, Mumbai

Category : Fishing Pier And Ferry Terminal

Program : Auction Hall, Docks, Ice Plant, Drying Grounds, Fish Processing Unit, Fish segregation space, Net Making, Ferry Terminal.

INTRODUCTION

Situated 1.7km from Dockyard Road Station, Bhaucha Dhakka is a modest quay next to Mumbai's largest port in terms of area and goods handled. Ferries to Mora (Uran, JNPT), Rewas (Patalganga), Mandwa (Raigad), Kandla (Gujarat), and Colombo (Sri Lanka) are launched from the ferry port.

Planning

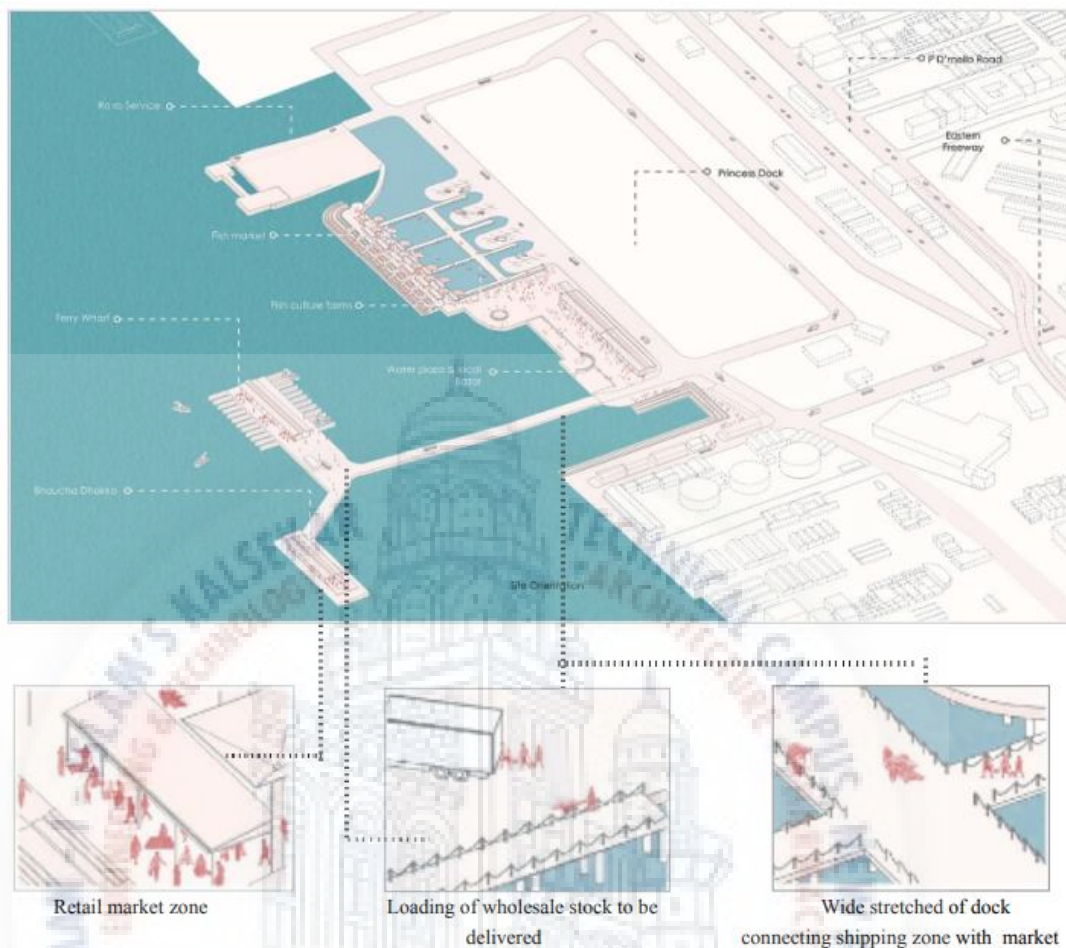


Figure 20. Master plan of Bhaucha Dhakka
Source . <https://portfolio.cept.ac.in/fp/every-any-all-some-ur3004-monsoon-2020>

DESIGN

- The focal point of this grand coastal parade is Bhaucha Dhakka. Dhakka is a Y-shaped pier that has a terminal and ferry port. The most basic layout divides dock operations into two categories: transportation and commercial. The MPT's domestic jetty and cruise terminal are located next to the customs office entrance.
- The roof of the ferry wharf slopes G+1. With MS box section columns and MS roofing sheets on the wings, it features an RCC spine. The slabs of the piers empty water straight into the ocean.
- Docking is at G+1. It has the superintendent's office and the newest fish jetty shed. There are facilities, a first-aid station, and a free help desk for fishermen on the dock.
- Stall/storage zones are displayed in columns. The trust doesn't rent out thermocol or timber storage.

- The first floor is accessed by a single private stairway. The two lengthier wings of the dock include an emergency ladder and staircases because the water level is low. dangerous stairwells. Crates and fish are hauled onto the wharf using ropes.
- Unlicensed vendors are common on the pier that connects the port to the main promenade. Next to the fish are novelty items, plastic bags, silverware, and gunny sacks. There are motorbikes and automobiles on the pier.
- junction, houses, and two damaged petrol stations. There is a lookout and a bus stop at this clearing.
- There are food vendors, restrooms, showers, and ticket offices at the ferry station. A waiting room occupies the remaining area. Fish and seafood are loaded and unloaded by the Dhaka. The market is too small for people to use.



Image 9. Fish segregation space
Source. Author



Image 10. Auction area
Source. Author



Image 11. Fuel station
Source. Author



Image 12. truck parking
Source. Author



Image 13. Ferry terminal
Source. Author



Image 14. Passenger waiting area
Source. Author

Observations:

- Sewage water builds up on the pier as a result of an inefficient drainage system.
- Absence of a way to dispose of garbage. Garbage and blood all over the place.
- Parking is scarce. due to a shortage of room.
- The drop-off location at the jetty is useless. There are no waiting areas or parking spaces available.
- Everywhere there is a room, there are trucks and trolleys loaded. Activities are happening in such a limited space, erratically.

- For this kind of little port, there are too many vendors and customers. To reduce this burden, the first level is not utilized.
- Only small and medium-sized motorized boats can dock at the wharf. A tugboat must halt 600–1000 meters away, depending on the tide.
- There are too many fishing boats and ferry boats at Dhakka for them to be addressed simultaneously. When not in use, the boats are berthed at the internal cove-like area between the piers and the coast.

Inferences:

- It is possible to study the usual wharf's design procedures. This includes the necessary subliminal design interventions for the pier to remain in place. The procedures used for loading and unloading cargo and the issues that arise when doing so play a crucial part in the terminal's operation. Limited access on the premises puts more strain on the infrastructure that is already in place. Because the dock serves both fishing and ferry operations, Bhaucha Dhakka was a crucial research to comprehend circulation and needs in this kind of area.
- Understanding the following developments made by the Mumbai Maritime Board and Mumbai Port Trust was made easier by studying these waterfront areas within the city of Mumbai.
- requirements and administration of municipal markets, both big and small.



7.1.3 : MARGAO WHOLESALE FISH MARKET, GOA

7.1.3 : MARGAO WHOLESALE FISH MARKET, GOA



Image 15. Margao wholesale fish market
Source. Author

Reason for selection:

To research how fish markets operate and comprehend the significance of light and ventilation in these environments

Architect : Ar. Ankit Prabhudesai

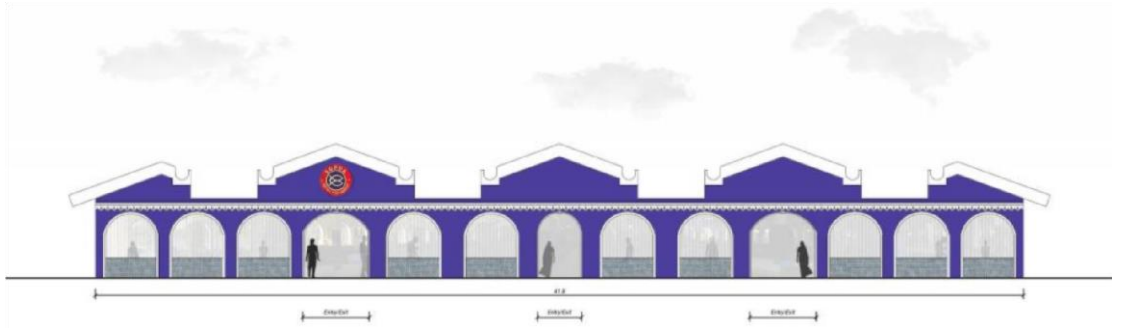
Location : Margao, Goa

Category : Market

Program : Vendors stalls, fish cutter stalls, dish cleaned area, storage area, cold storage area

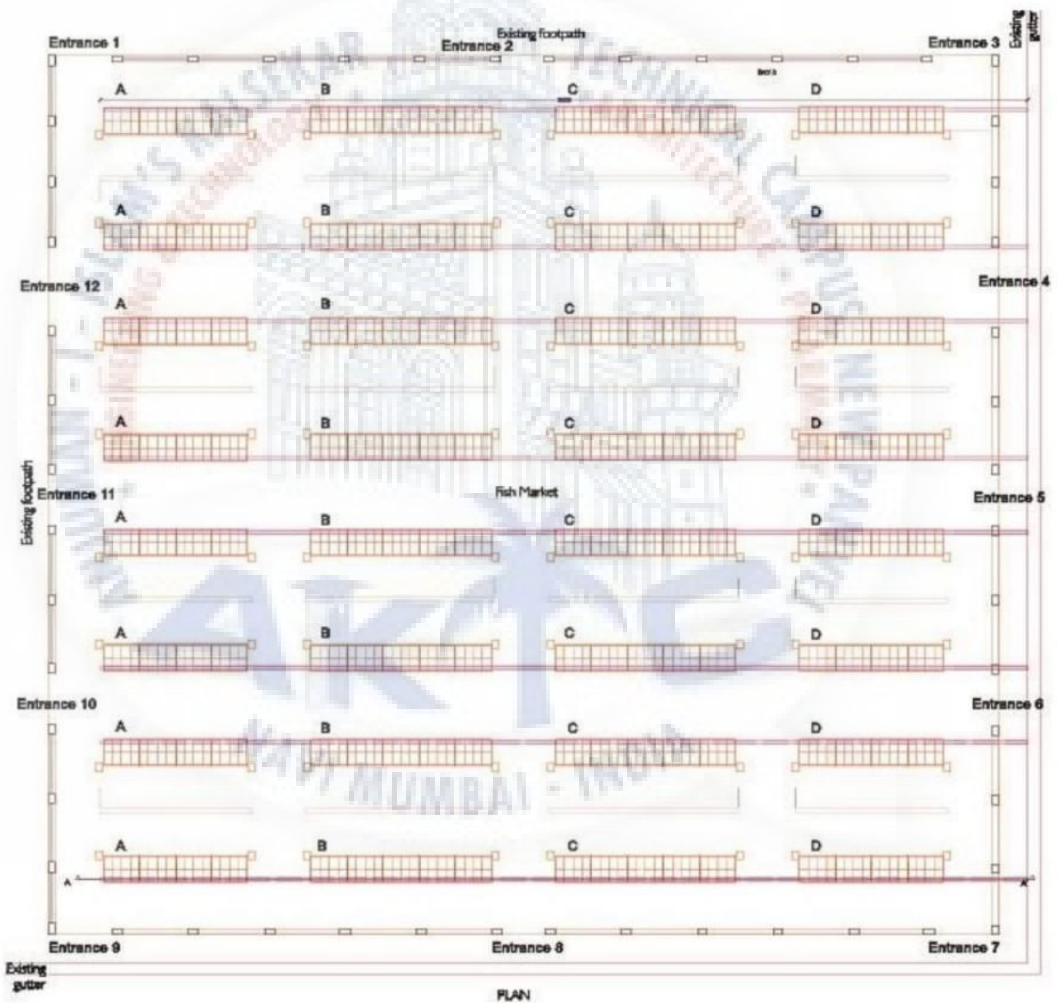
INTRODUCTION

Situated 1.7km from Dockyard Road Station, Bhaucha Dhakka is a modest quay next to Mumbai's largest port in terms of area and goods handled. Ferries to Mora (Uran, JNPT), Rewas (Patalganga), Mandwa (Raigad), Kandla (Gujarat), and Colombo (Sri Lanka) are launched from the ferry port.



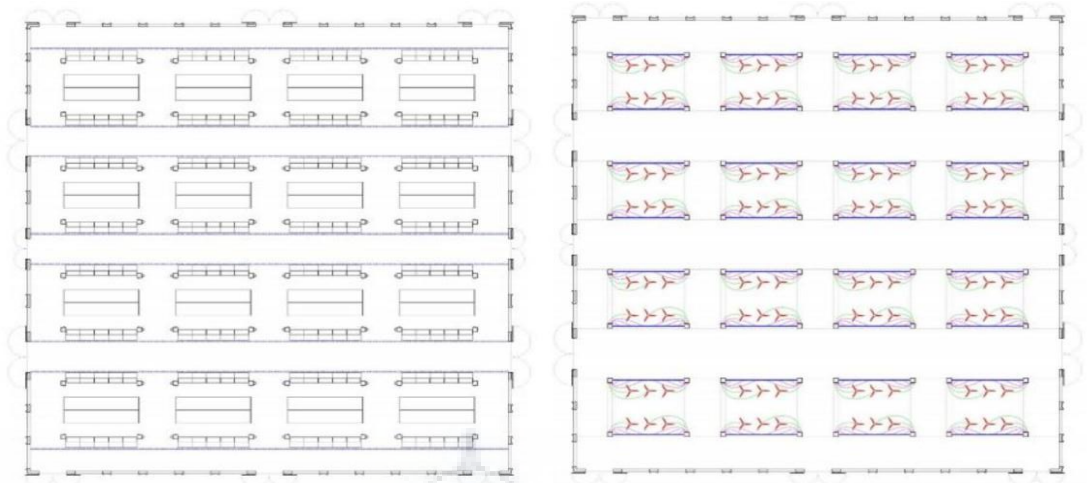
Front Elevation

Figure 23. Elevation of margao fish market
Source . <https://www.heraldgoa.in/Margao/New-wholesale-fish-market>



Plan

Figure 24. Plan of margao fish market
Source . <https://www.heraldgoa.in/Margao/New-wholesale-fish-market>



Drainage layout

Electrical layout

Figure 25. Drainage and electrical layout of margao fish market
Source . Author

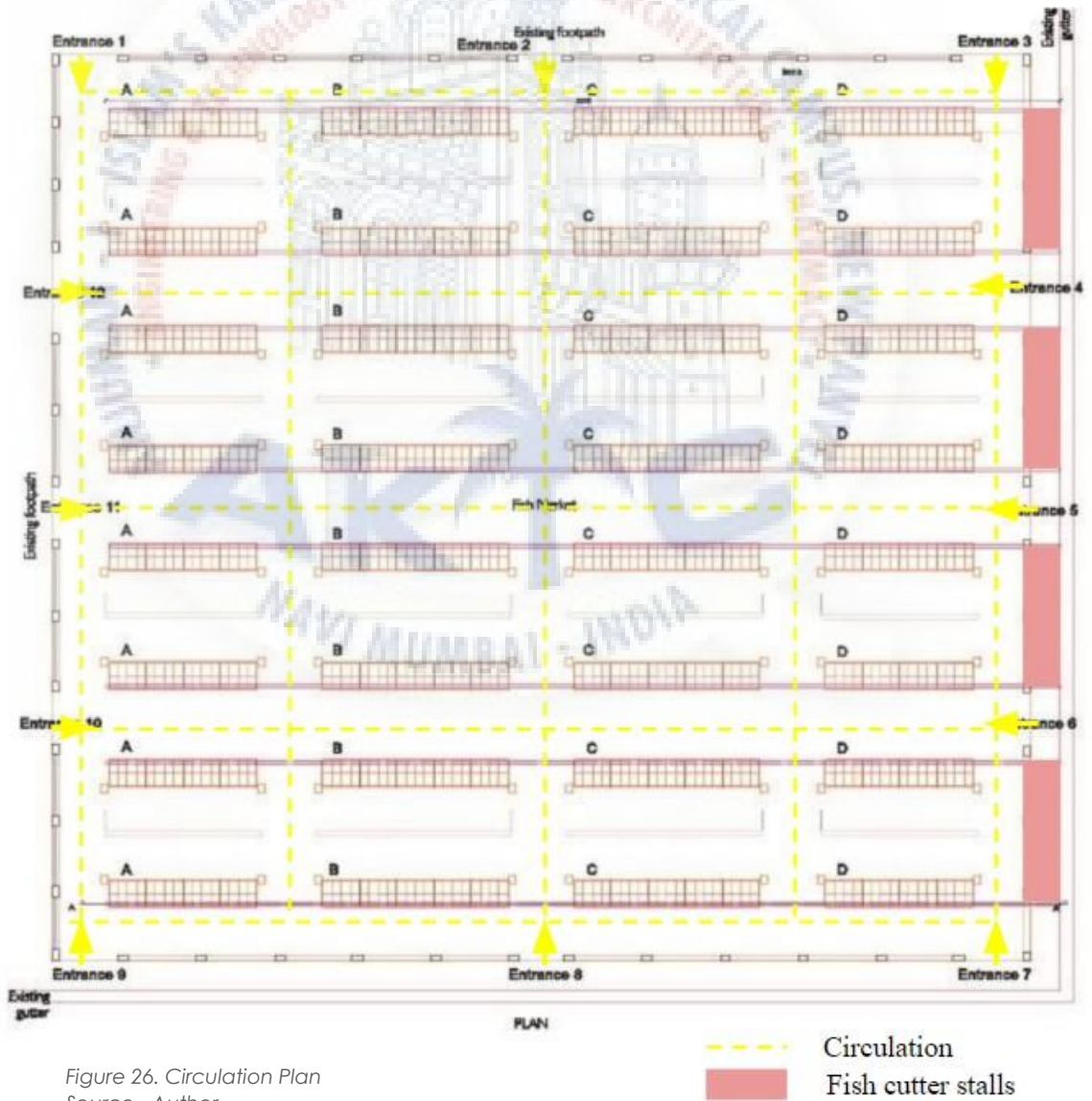


Figure 26. Circulation Plan
Source . Author



Image 16. Vendors stall
Source - author



Image 17. internal drainage facility
Source - author



Image 18. Fish cutter stall
Source - author

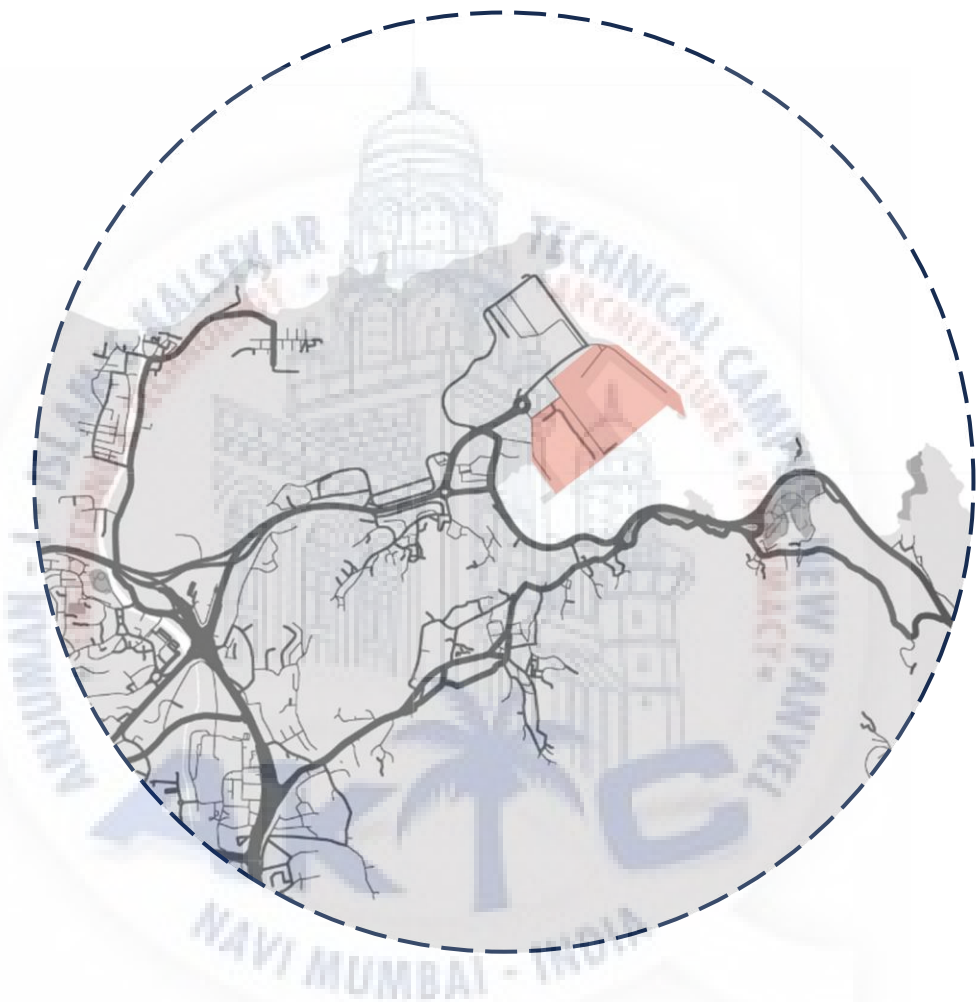
Observations

- There is practically any fish fragrance within the market because of the hygienic standards and the fact that fish is sliced outside.
- The interiors of the apartments are airy and spacious.
- Along with offices, parking, a theater, a catering service, and a huge market selling a variety of fast-food items, the structure is quite enormous.
- While the first parking is within wholesale and market buildings, the other parking is beside the roadway in front of companies.
- The fish are dumped off on the service road beyond.
- There are no bloodstains, smells, or dispersed scales.

Inferences:

- The market sets the standard for hygienic markets in India.
- Redesigning Mumbai's fish markets on these lines has been suggested.
- With its traditional market layout and abundance of amenities to keep it hygienic and functional, the Margao Market is designed like any other.
- Answers to particular problems with a market's outlook may be found by examining the practices, constraints, and other aspects of the market's functioning.
- It is devoid of the facilities necessary for a wholesale market, like ice manufacture and cold storage facilities.

7.2 : BOOK CASE STUDIES



7.2.1 : MUTTRAH FISHING PORT, OMAN

7.2.1 : MUTTRAH FISHING PORT, OMAN



Image 19. Muttrah fishing port

Source . <https://www.omanobserver.om/article/74121/Front%20Stories/muttrah-fish-market>

Reason for selection: To understand the structural system and its dynamic features. Also, the importance of material to be selected while designing the same.

Architect : Snohetta

Location : Oman, Muscat

Category : Fishing Port and Market

Program : Fish Shopping Area, Fish Cutting Area, Fish clean area, Fishermen's Boat Parking, Coffee Shop, Offices, Restaurants, Landscape, Parking

Introduction :

Constructed by Snohetta, the Muttrah Fish Market is intended to serve as both a focal point for the Muttrah neighborhood and a rising hub for Oman's fishing sector. The 4000 square meter port is an attempt to reconcile Muscat's expansion with the traditional fishing population and market. On Muscat's historic shoreline, the port serves as both a commercial and tourism destination. The fishing port connects the city, the shoreline, and the mountains, defining public space.

Concept

The architectural concept is inspired by the playful qualities of light and shadow through the shape of a double radial wall defining the spine of the new fishing port.

Ground Floor Plan

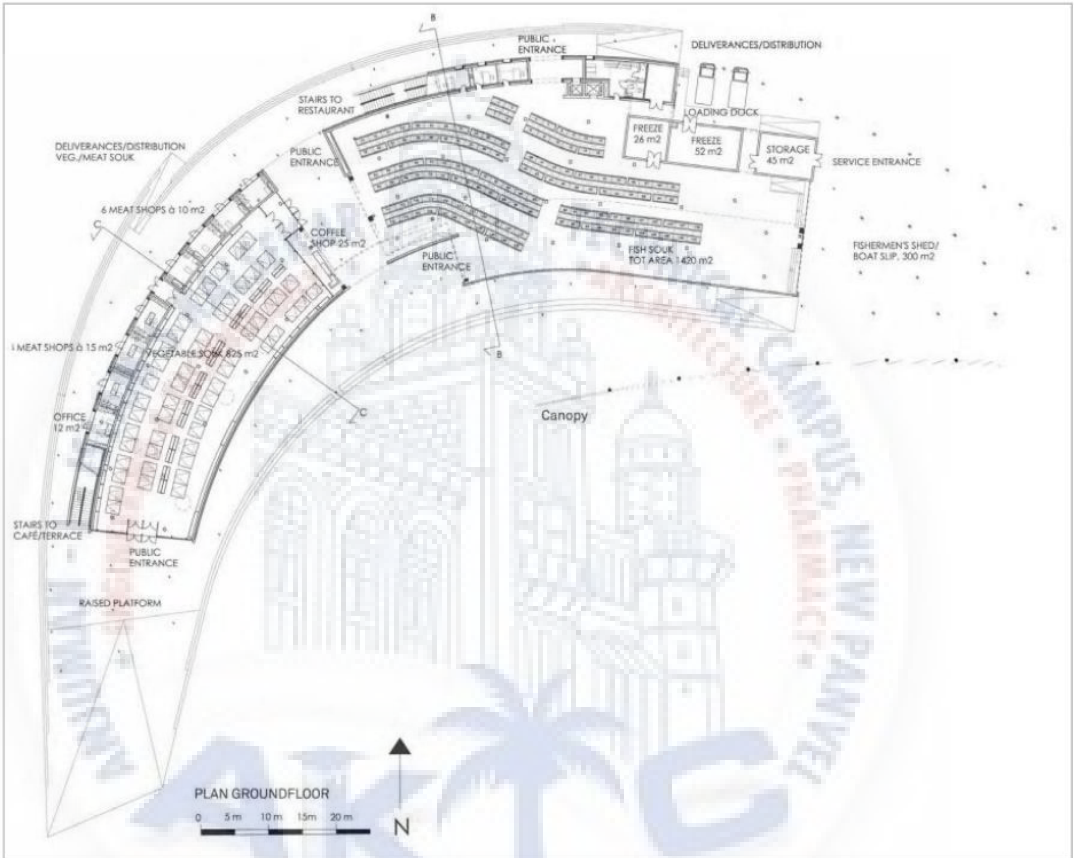
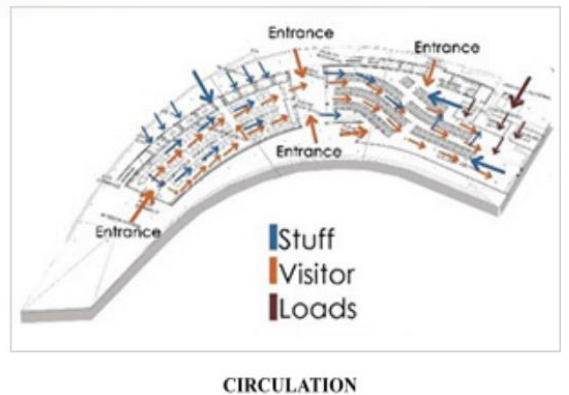
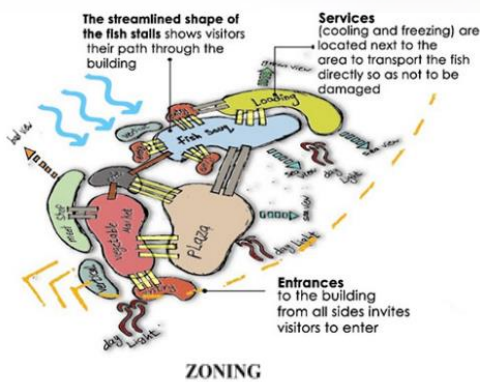


Figure 27. Ground floor plan of muttrah fish market

Source . <https://www.akdn.org/architecture/project/muttrah-fish-market>



First Floor Plan

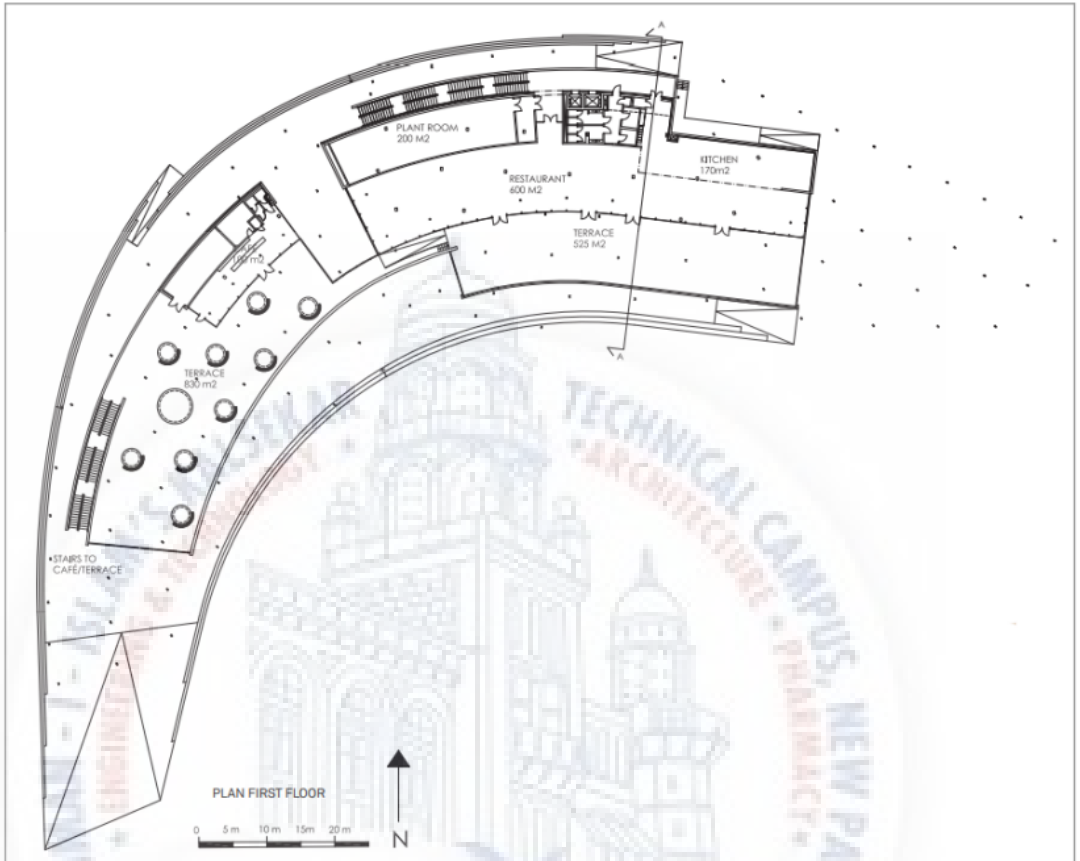
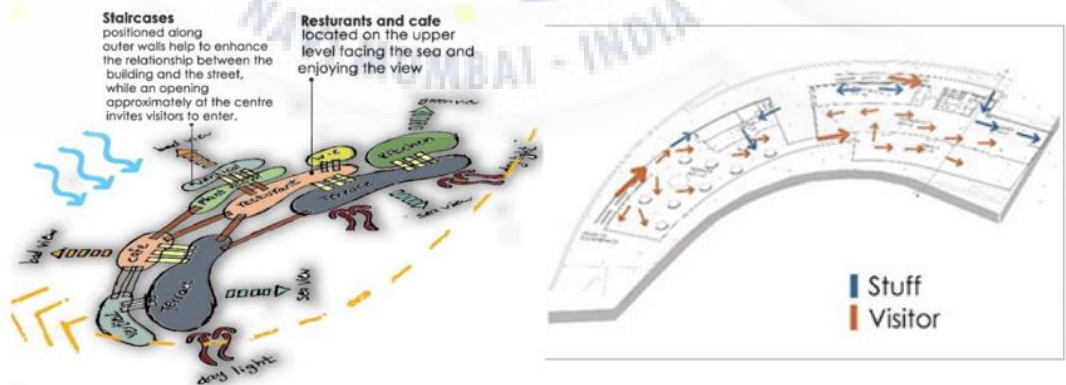


Figure 28. First floor plan of muttrah fish market

Source . <https://www.akdn.org/architecture/project/muttrah-fish-market>



ZONING

CIRCULATION

Design:

- Arabic calligraphy has an influence on the market. The canopy's dynamic surface is created by the spread-out metal fins, which are reminiscent of traditional Arabic calligraphy. The building's relationship with the street is enhanced by outer stairs, and guests are welcomed at the central entry.
- Together with refrigeration, packaging, and storage, the new facility features offices, coffee shops, and a rooftop restaurant.
- For the fair, they build 100 fish cutting and selling stands.
- The curved wall of the spine has light-filtering holes and matches the radial design of the comiche and bay area.
- The metal fin pergola provides natural ventilation, shade, and a transient appearance.
- In order to reduce stagnant dirty air and fish odor, the market places a strong emphasis on natural ventilation and airiness.
- For this, fish market walls have hexagonal apertures. The little gaps let cool air in before the wind enters and provide relief from the sun's heat.
- The dynamic qualities of light and shadow served as inspiration for the dual spiral wall that marks the spine of the new fish market.

Structural system

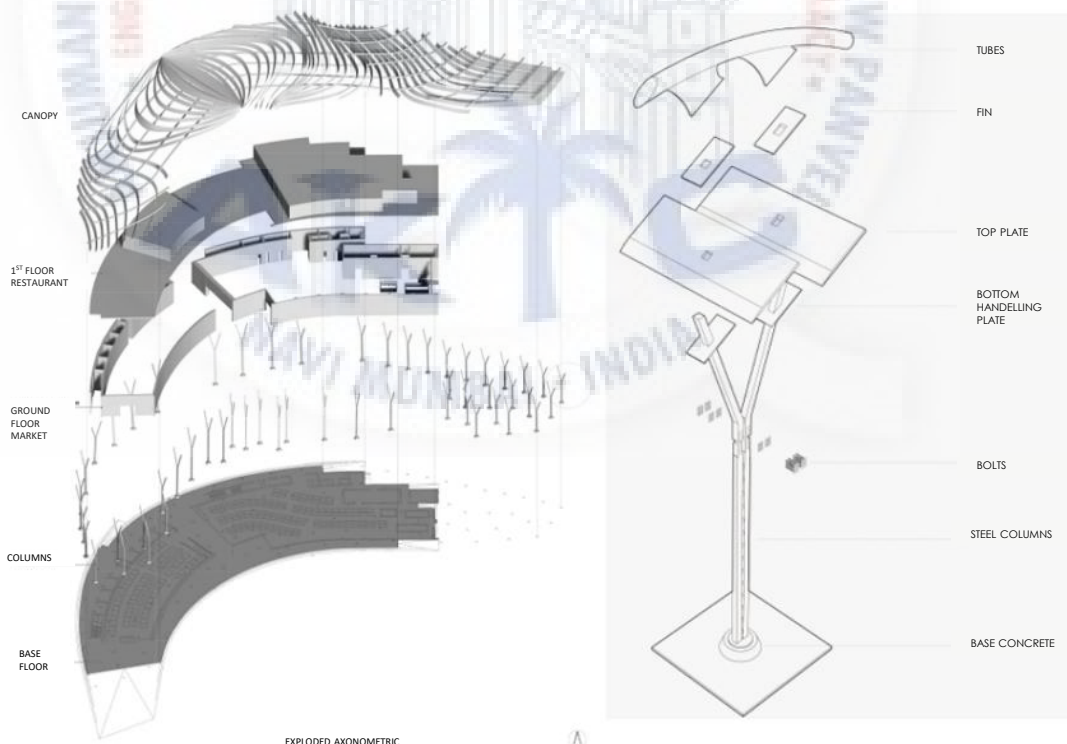


Figure 29. Structure System

Source: <https://www.akdn.org/architecture/project/muttrah-fish-market/>



Image 20. Outdoor mending yard
Source . Archdaily



Image 21. External deck for Fishermens
Source . Archdaily



Image 22. Vendor stalls
Source . Archdaily

Materials:

- Contents Reinforced concrete and structural steelwork are examples of structural members.
- Block infill walls and big aluminum screens/doors are examples of infill materials.
- Drawings and completions: Cement screed, tile, paint, and tempered glass.

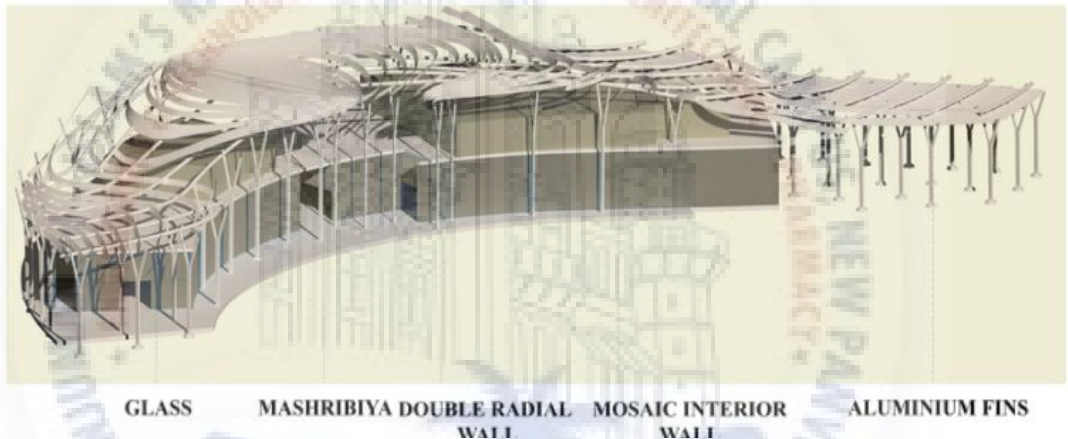
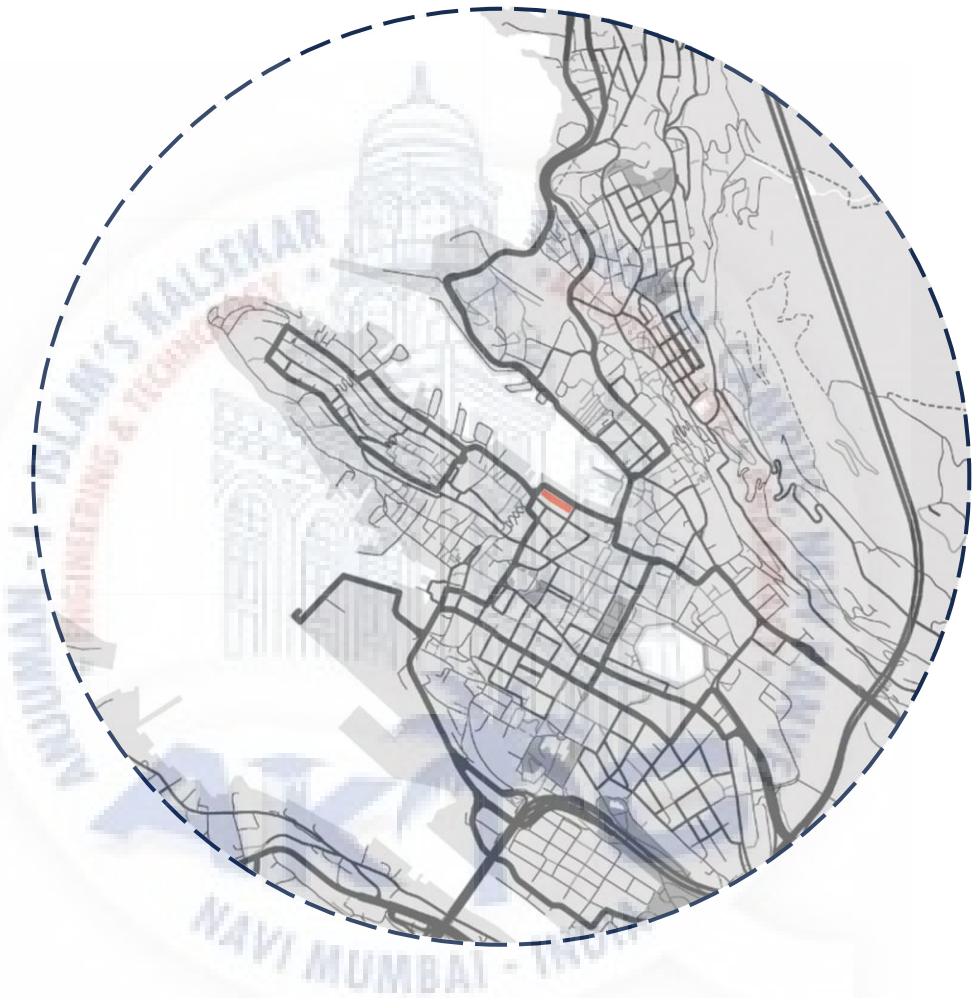


Figure 30. Materials used in muttrah fishing port
Source . <https://www.behance.net/gallery/98825419/Muttrah-Fish-Market-Oman>

Inferences:

- Rooftop cafes, eateries, and commercial spaces convert the market into an open-air area. Market and recreational activities are separated by a stairwell and level disparity.
- Light from the sun may enter the market since it is pierced and porous. A daylight market requires daylight. This encourages a healthy environment and reduces artificial lights.
- Outside, metal fins let light and airflow through while blocking direct sunlight. The market is a tourist destination because of its perforations and permeable walls.
- In the conventional market, modern amenities would increase output, visitors, and customers. The market's offices, packing, and refrigeration help with the city's seafood output.



7.2.2. BERGEN FISH MARKET, NORWAY

7.2.2. BERGEN FISH MARKET, NORWAY



Image 23. Bergen fish market

Source : <https://www.archdaily.com/422608/fish-market-in-bergen-eder-biesel-arkitekter>

Reason for selection : To comprehend the facade's design and the building's aesthetics while upholding the ventilation and light constraints.

Architect : Eder Biesel Arkitekter

Location : Bergen, Norway

Category : Market

Program : Fish Shopping Area, Fish Cutting Area, Fish clean area, Restaurants, Cooking Classroom, Tourism information centre, Landscape, Parking

Introduction :

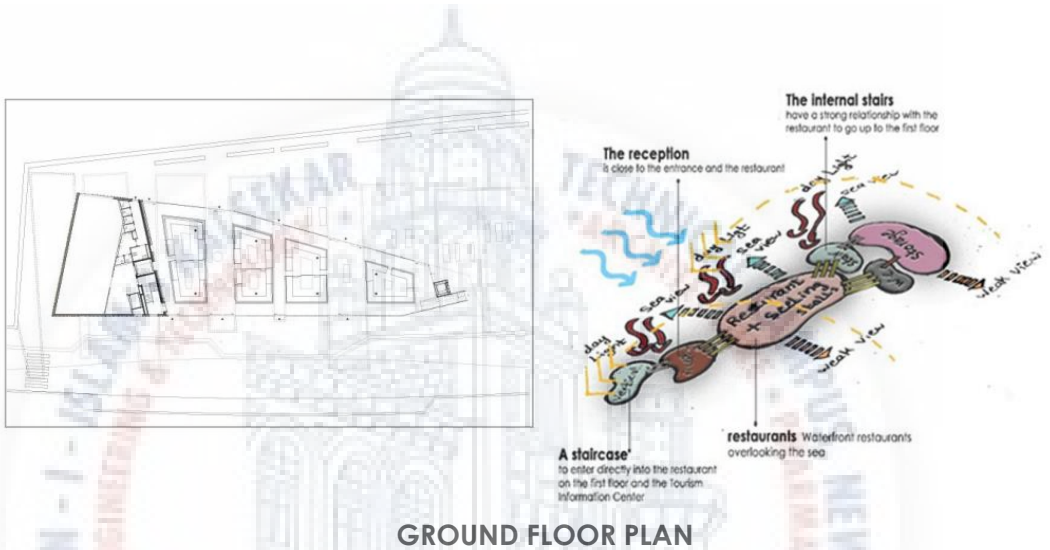
All year long, the fish market is open. For hygienic and convenient reasons, it required a permanent construction. It was suggested that the new fish market be built in the center of Bergen to address these issues. In addition to creating a modern market image and fitting into the historical setting, the building satisfies all urban requirements. From Almenning Road, the property offers views of the ocean and nearby landmarks. These were essential for understanding the ancient bay's surrounding urban context. There was simply a triangle site left for construction. The old facades behind it still restrict the bay, given the low height of the modern fish market hall.

CONCEPT

Their idea establishes boundaries between the market site and the market hall, protecting the area while avoiding the creation of inner space for the fish market. There is no division of space. The market's protected area is created by the floated volume, which acts as a roof. Additionally, they created shelters from the wind and weather using a flexible glass facade.

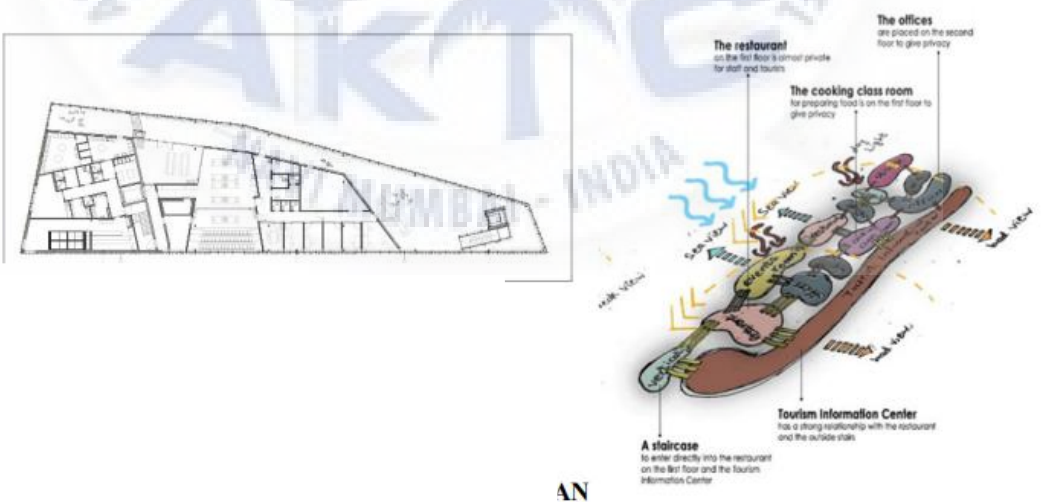
DESIGN

Direct sunlight is reflected by angling the wooden panels. The weather and wind are protected from by the pliable glass facade.



GROUND FLOOR PLAN

Figure 31. Ground floor plan of Bergen fish market
Source . <https://www.area-arch.it/en/fish-market/>



FIRST FLOOR PLAN

Figure 32. First floor plan of Bergen fish market
Source . <https://www.area-arch.it/en/fish-market/>

SECTION

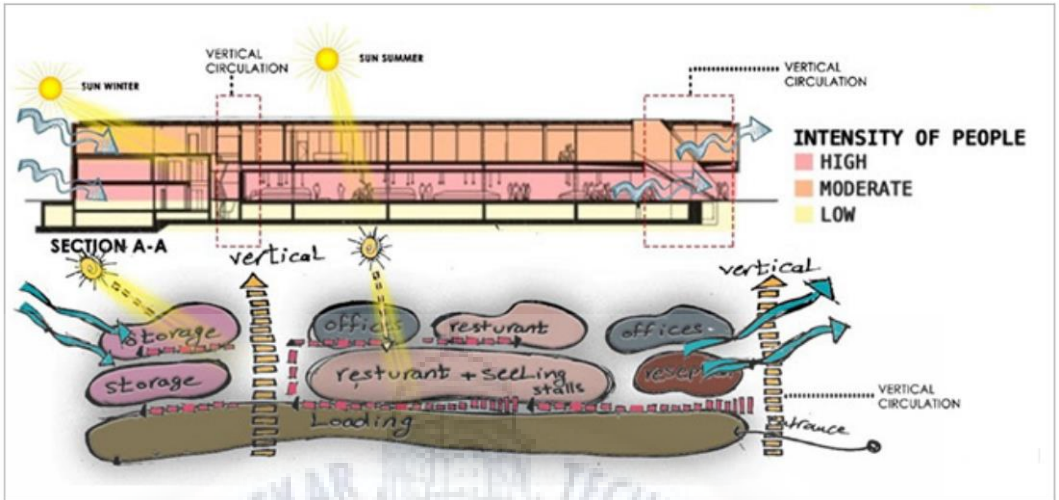
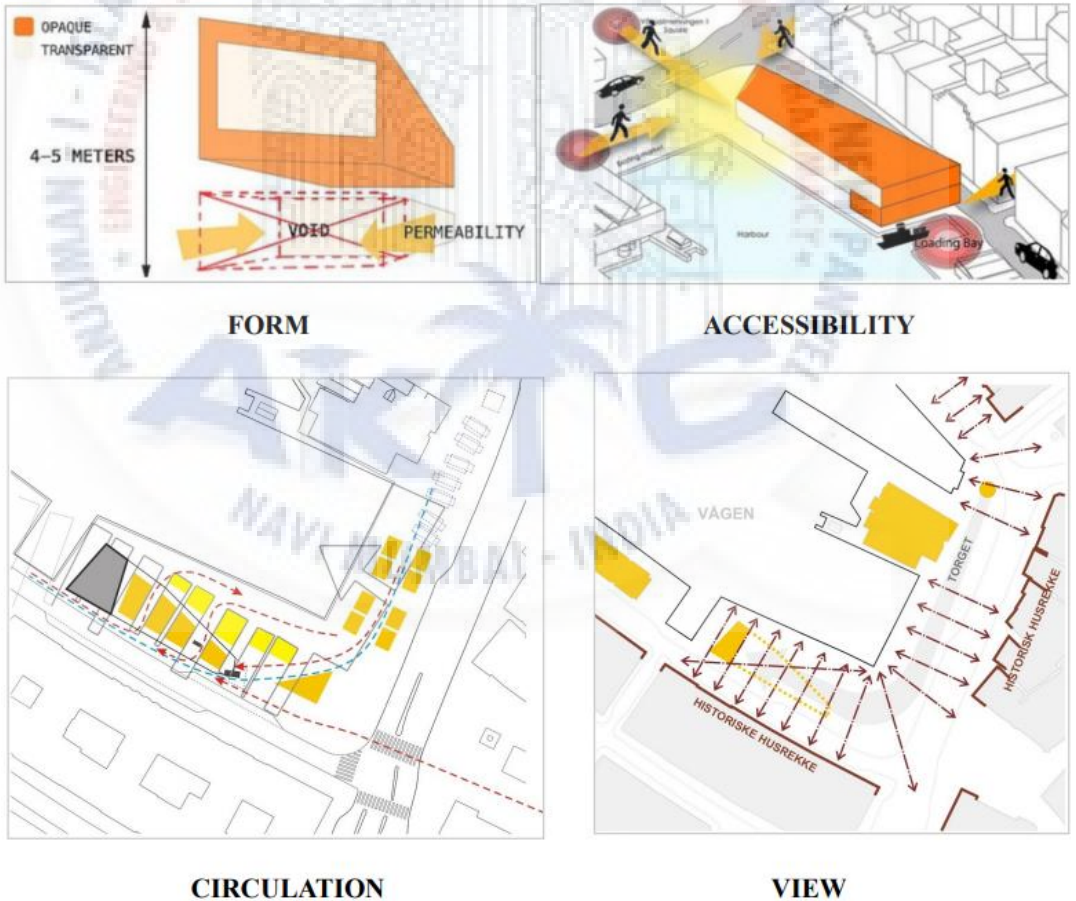


Figure 33. Section of Bergen fish market

Source . <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>



The circulation inside the market is made as the fish movement in the sea and it's destined to be open and continuous to provide the view.

INFERENCE

- The market served as a showcase for the harbor and city. Market places are a symbol of a city's language and progress as it expands through trade and business. People congregate here and then leave.
- This market views the neighborhood as a landmark and a popular tourist destination. Unobstructed walls provide tourists with vantage points to view the architecture of Bryggen.
- Clear planning, wholesome public dining options, and locally grown food provide unimpeded movement. It lends a friendlier feel to the encounter.
- Preserve sentimentality and municipal pride in everything from the choice of materials to the graphics telling the story of the pier.





7.2.3 : SYDNEY FISH MARKET, AUSTRALIA

7.2.3 : SYDNEY FISH MARKET, AUSTRALIA



Image 24. Sydney fish market

Source . <https://www.theplan.it/eng/award-2019-retail/sydney-fish-market>

Reason for selection :

To understand how the structure can be designed while using coastal and local material on the water.

Architect : 3XN

Location : Sydney, Australia

Category : Market

Program : Fish Retail market ,Fish wholesale market, Fish Cutting Area, Fish clean area,Restaurants.

Introduction

Three million domestic and foreign visitors visit Sydney Fish Market (SFM) annually, having grown from a small fish market to a full-fledged tourist destination. The project's goal is to develop a paradigm for fusing contemporary market space with public space that will stand out in Sydney's unique harbor-based urban environment. The architectural design for the new market will put people first, with a focus on placemaking to create a strong sense of community at Blackwattle Bay.

CONCEPT

Feature a unique timber and aluminium roofing inspired by fish scales floating over the building like canopy.

DESIGN

The Canopy

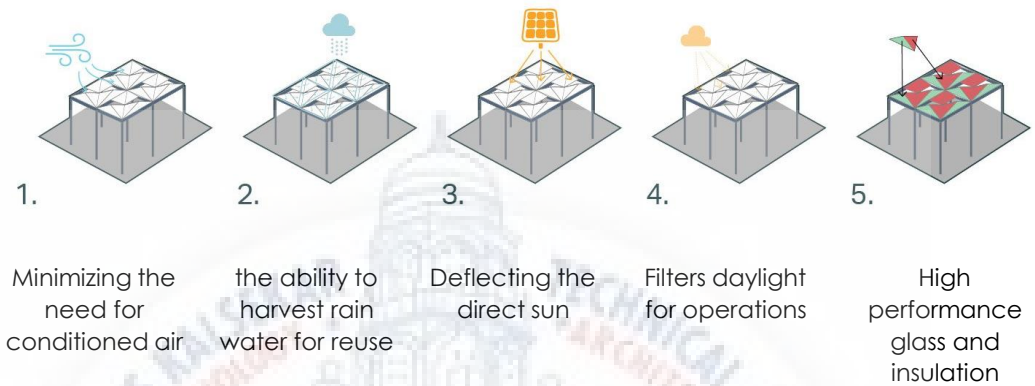


Figure 34. Canopy of sydney fish market Source .
Source. <https://www.theplan.it/eng/award-2019-retail/sydney-fish>

- Improved conditions for pedestrians on Bridge Road.
- Distribution of functions according to land use and user type.
- Outdoor activities are distributed based on accessibility.
- 'Entries' distribution is also influenced by accessibility.

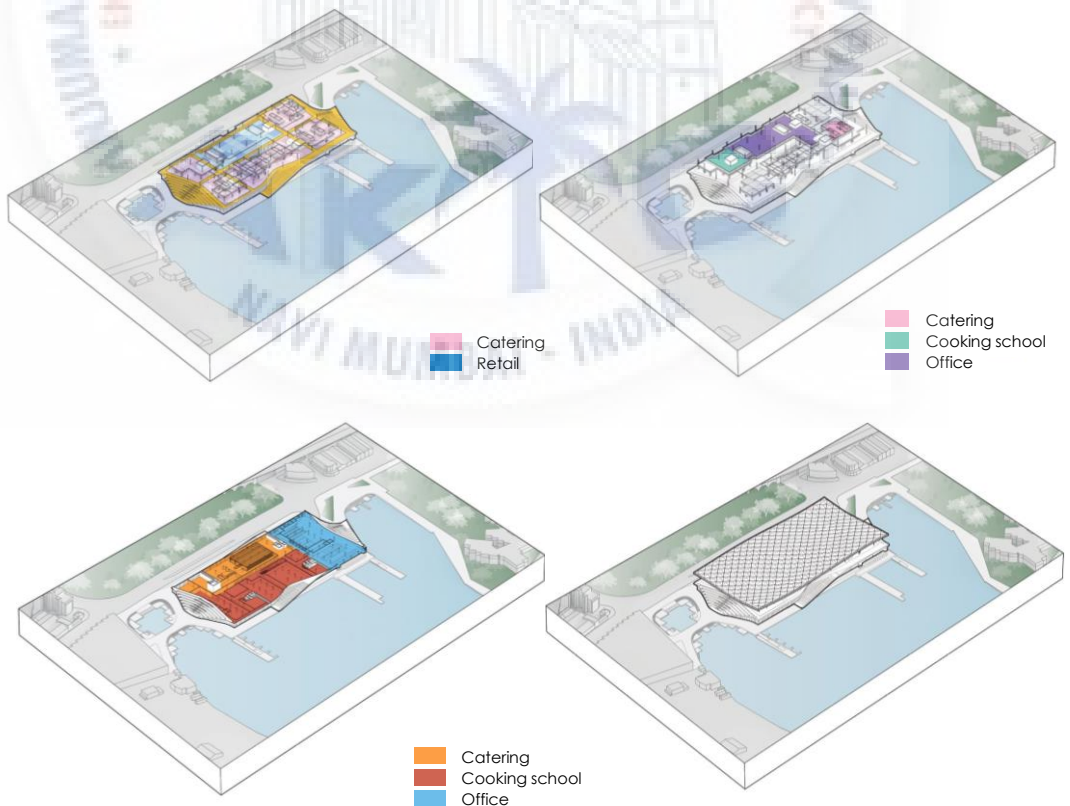


Figure 35. Isometric view showing function of space
Source. <https://www.theplan.it/eng/award-2019-retail/sydney-fish-market>

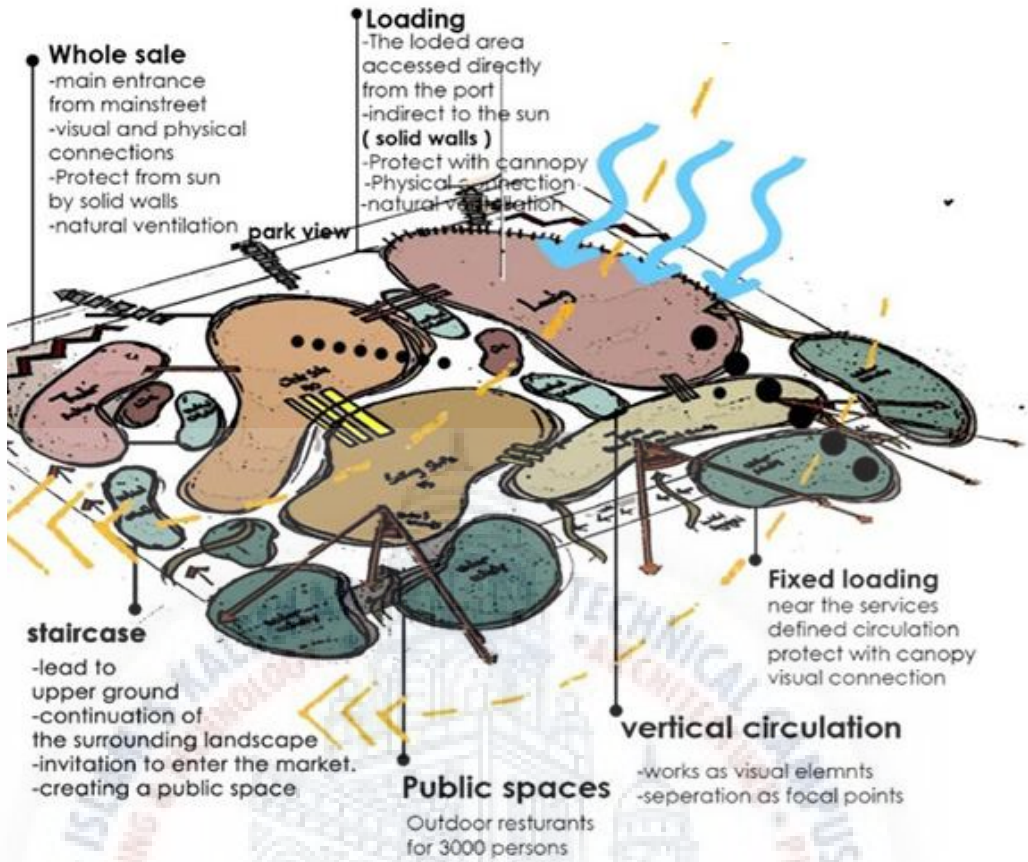


Figure 36. Ground floor zoning.

Source: <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

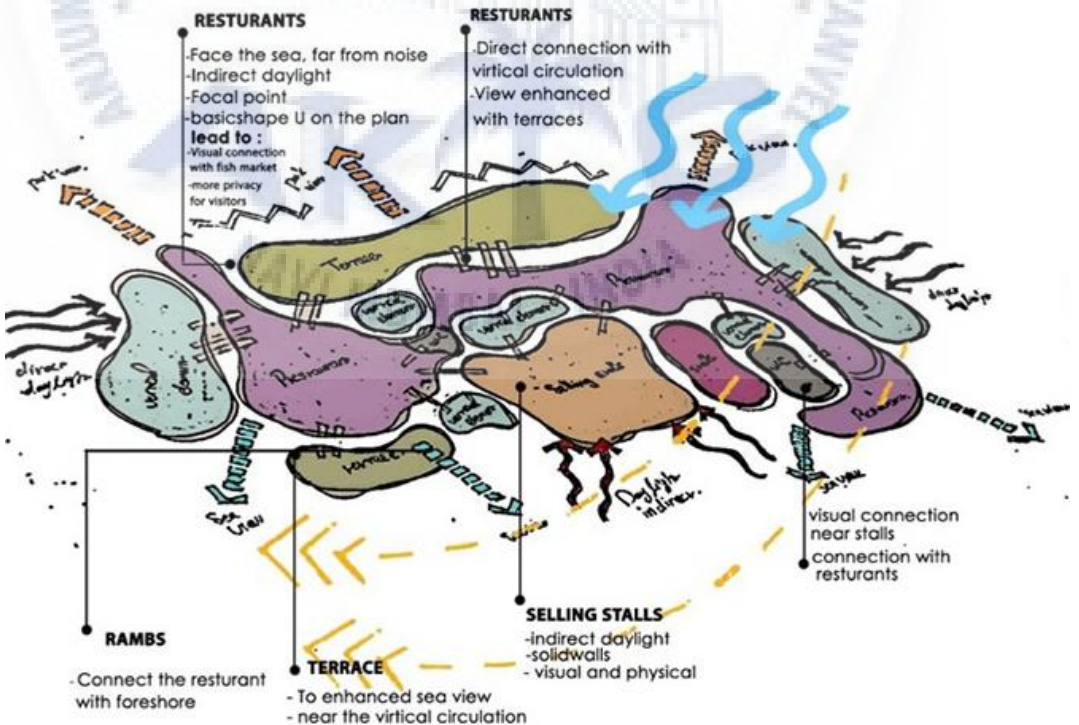


Figure 37. First floor zoning.

Source: <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

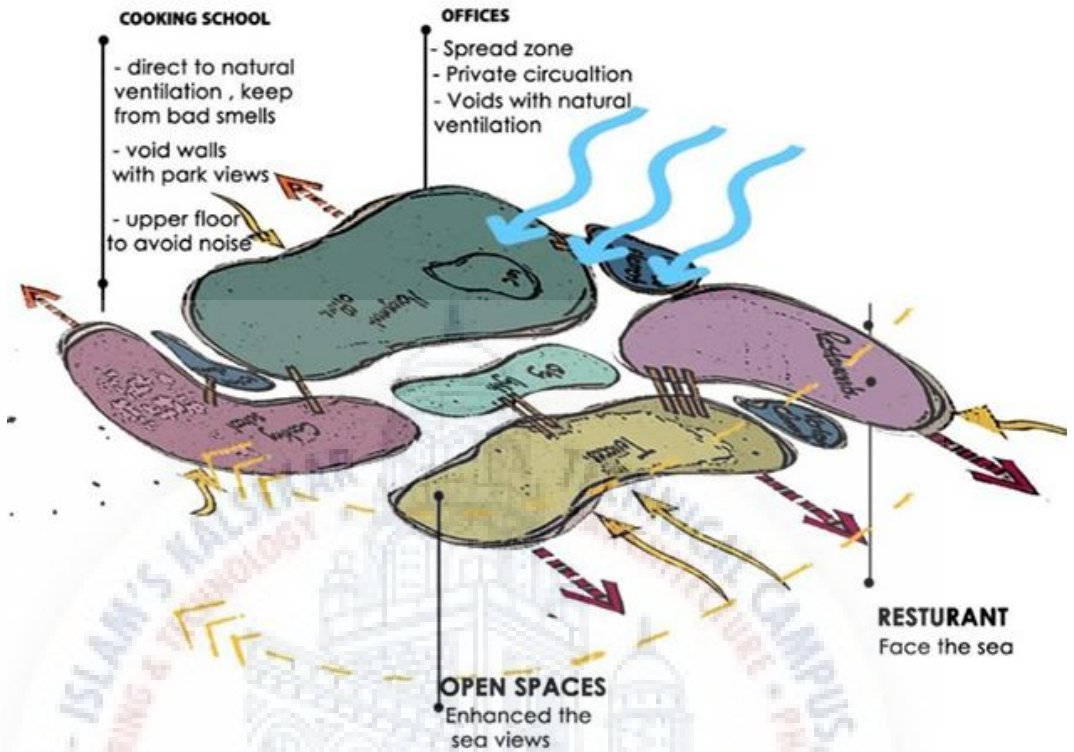


Figure 38. Terrace zoning.
 Source: <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

Inference

The ground floor consists of mainly fishing activities such as cold storage, fish cleaning, gutting and whole sale fish market, which involves a lot of public interactions

While the first floor consist of some part of overlooking restaurant and selling stalls and some semi-open over looking spaces

And the second floor comprises of open spaces and restaurants, cooking school and offices

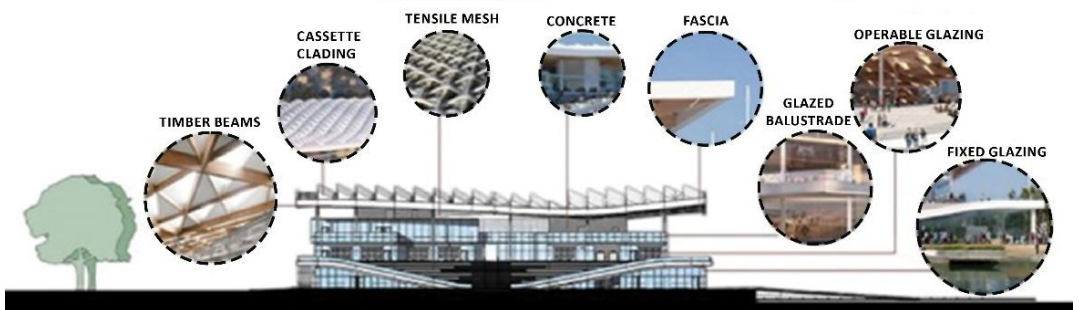


Figure 39. Material of sydney fish market
 Source: <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

COASTAL AND LOCAL CONSTRUCTION MATERIALS

Steel is durable and reasonably priced.

Reinforced concrete: if it's a suitable material, the building may need to have additional strength.

Timber: locally sourced material, with consideration for using hardwood and avoiding excessive use in water since it is prone to moisture damage.

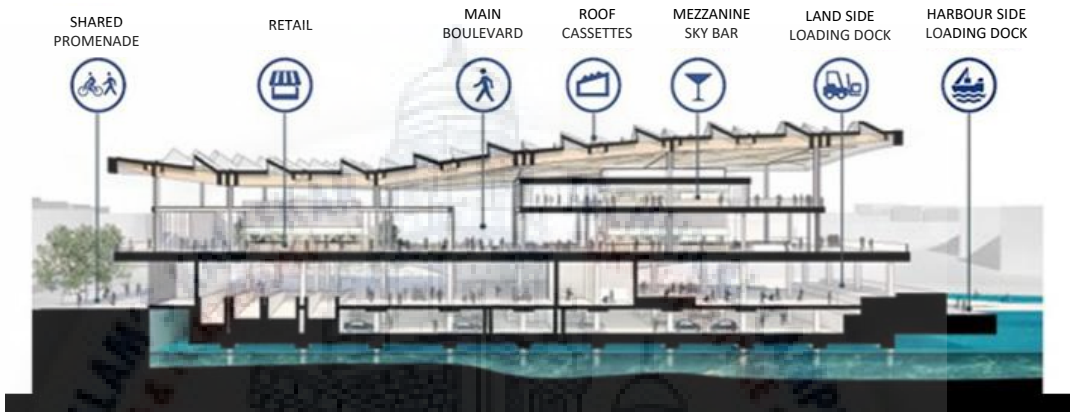


Figure 40. Functioning of spaces through section.

Source. <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

Impact-rated Glass: To resist storms, coastal winds, and weather conditions.

SECTIONS

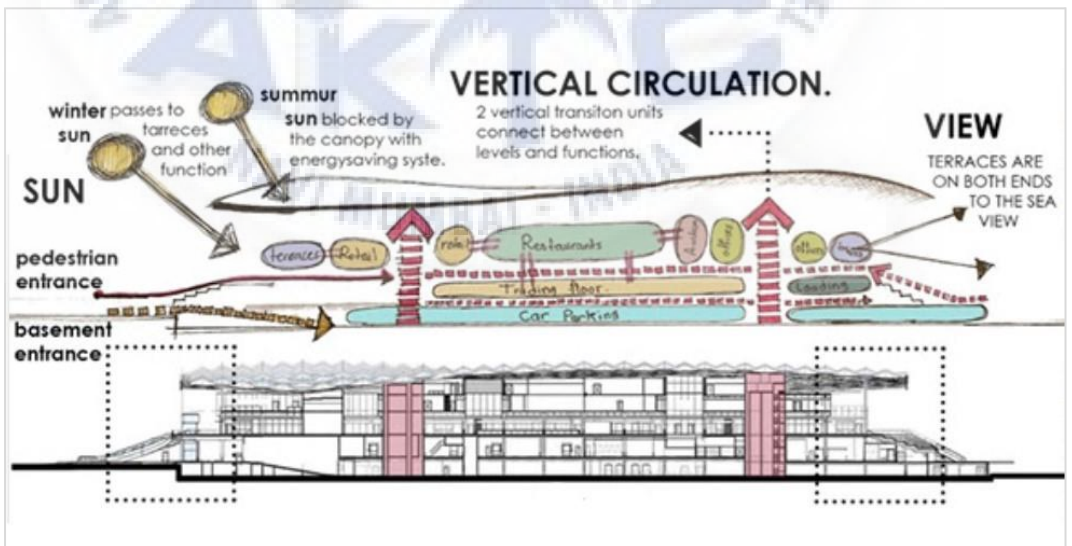


Figure 41. Section of Sydney fish market.

Source. <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

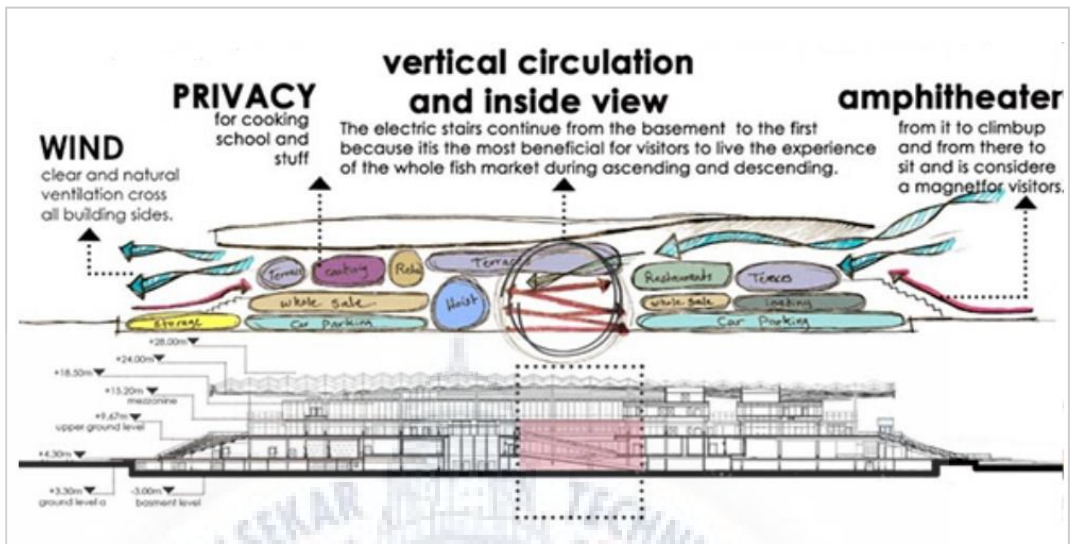


Figure 42. Section of sydney fish market

Source. <https://www.behance.net/gallery/110212383/graduation-thesis-fish-market-complex>

Inferences:

- This neighborhood's market transforms into a hub for nearby companies. The fish market needs to change to compete with tiny culture, capitalism, and atomization.
- Like other markets, the connection between this one and its neighbors and local residents is hidden. People feel most at ease in places they are familiar with. You don't always have to create something entirely new to make something that's already good even better. You can make improvements or enhancements to what you already have, and that can be just as effective..

No	Project name	Project image	Intent	Observations
1	Apollo bunder: (Sasson dock)		The reasoning behind choosing this case study was to understand the spaces and the circulation required for the functioning of fishing harbour.	There is a lot of biowaste produced by a fish market that cannot be buried. Thus, improved waste disposal is necessary for sustainable fishing. Storage, utilities, godowns, packaging centres, ice factories, and godowns are all present in Sassoon Dock, which provides everything an industrial company needs.
2	Bhaucha dhakka (Mallet Bunder)		To understand the design techniques of typical wharf and the pier. Also, the working of services like loading and unloading.	Design techniques for a typical wharf can be studied. This consists of subliminal design interventions that are required for the pier to stand. The lack of numerous access points on site increases the load on the only existing infrastructure. It was an essential study to understand the requirements and circulation in such a precinct.
3	Margao Retail fish market		To study the functioning of fish markets and to understand how the light and ventilation plays an important role in such spaces.	The Margao Market has been proposed to be a clean marketplace for fish markets in Mumbai, India. The marketplace establishes a benchmark for clean marketplaces in India. It lacks essential infrastructure for a wholesale market, such as cold storage facilities, ice manufacturing facilities, etc. and is not sanitary and hygienic.
4	Muttrah Fishing Port		To understand the structural system and its dynamic features. Also, the importance of material to be selected while designing the same.	Rooftop restaurants, cafés, and businesses transform the market into a permeable public place. The market's refrigeration, packaging, and offices assist city seafood production. Perforations and permeable walls make the market a tourist attraction.
5	Bergen Fish Market		To understand the design of the facade and aesthetics of the structure while maintaining the parameters of light and ventilation.	Unrestricted movement is provided by the open design, nutritious public cafes, and local cuisine. Tourists may view the architecture of Bryggen from vantage points provided by unobstructed walls.
6	Sydney Fishing Harbour		To understand how the structure can be designed while using coastal and local material on the water.	The link between this market and its neighbours and neighbourhood inhabitants is concealed, as is typical of most markets. The market in this neighbourhood develops become a gathering place for local businesses. In order to compete with atomization, capitalism, and mall culture, the fish market must evolve. Spaces that people are familiar with often make them feel comfortable.

Table 26 . Intent of selection

Source. Author


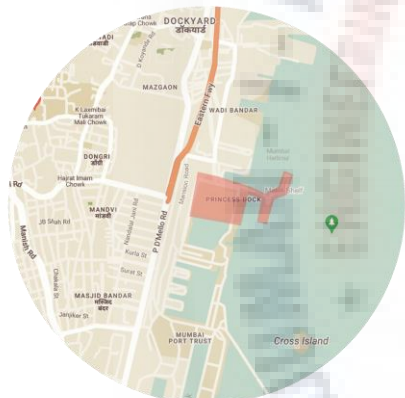


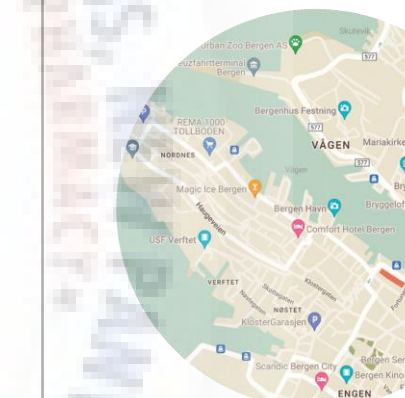
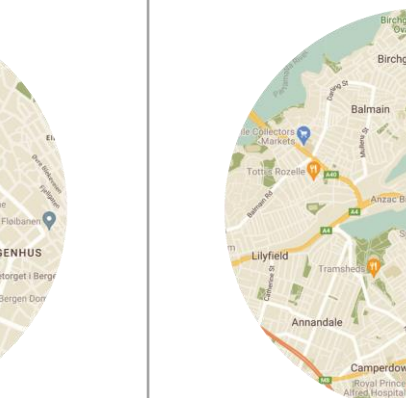


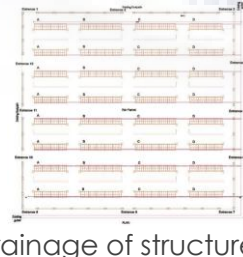
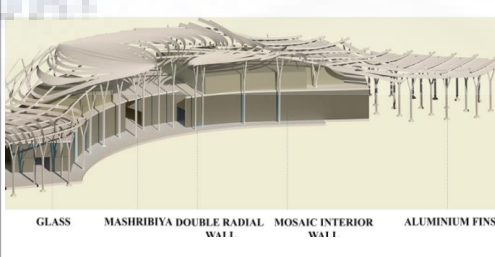

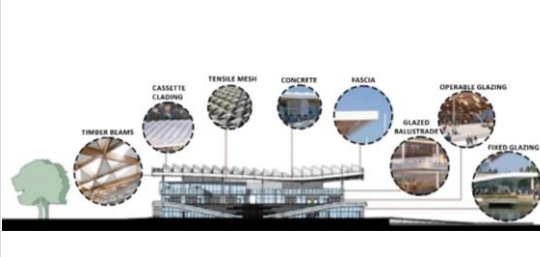
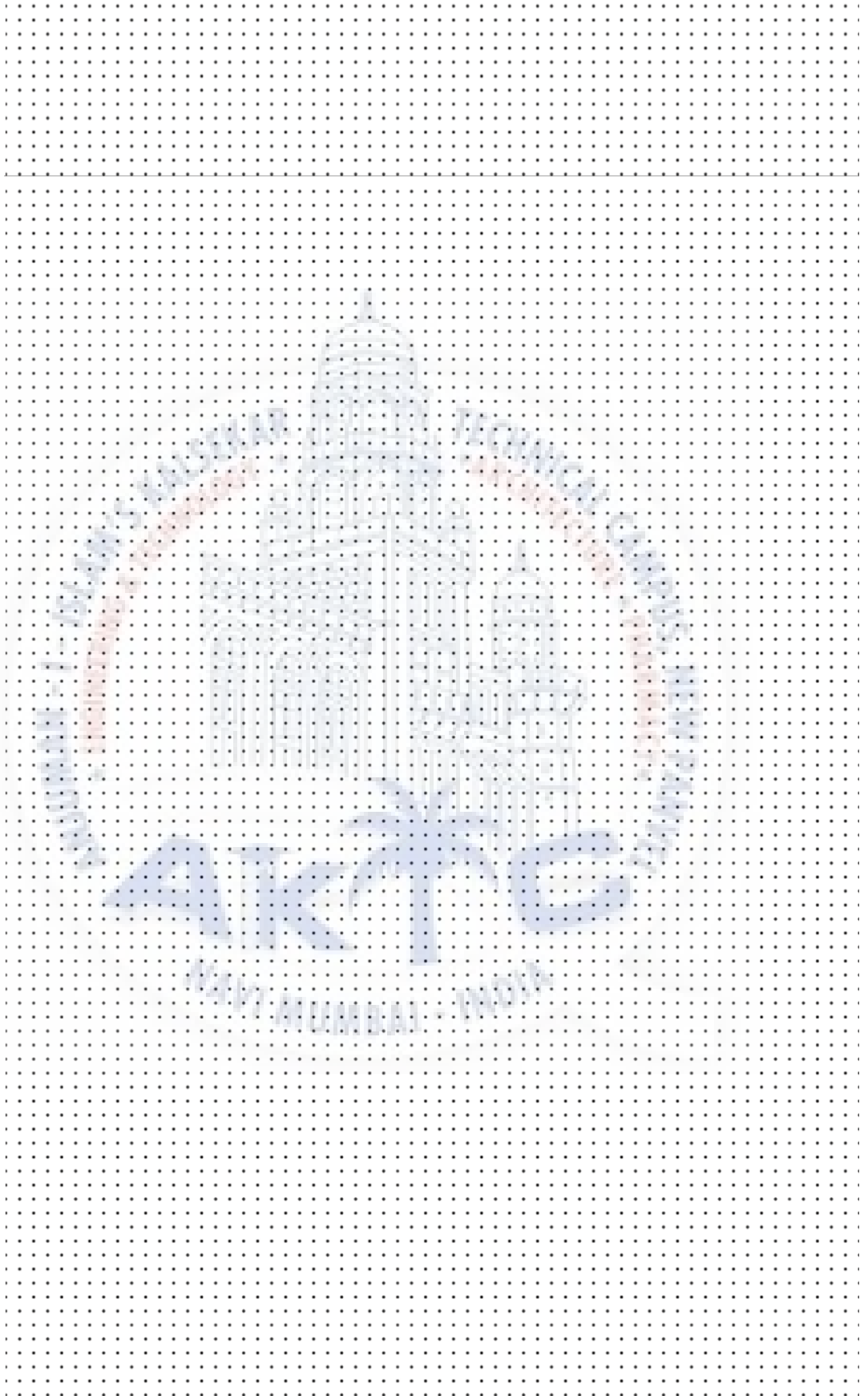
COMPARATIVE ANALYSIS	APOLLO BUNDER : SASSOON DOCK	BHAUCHA DHAKKA :MALLET BUNDER	MADGAON WHOLESALE FISH MARKET	MUTTRAH FISHING PORT	BERGEN FISH MARKET	SYDNEY FISH MARKET
LOCATION	Azad Nagar, Colaba, Mumbai	Mumbai Port Trust, Dockyard Road, Mumbai	Margao, Goa	Oman, Muscat	Bergen, Norway	Sydney, Australia
SITE AREA	56,416 sq.m	47617 sq.m	10,000 sqm.	22249 sqm	4260 sq.m	3.6-hectare
ARCHITECT	David Sassoon Co	Late Lakshman Hari Chander Ji Ajinkya	Ar. Ankit Prabhudesai	Snohetta	Eder Biesel Arkitekter	3XN
YEAR	1875	1841	2009	2017	2012	2022
PROGRAM	Auction Hall, Docks, Ice Plant,Drying Grounds, Fish Processing Unit, Net Making, Retail Market	Auction Hall, Docks,Ice Plant,Drying Grounds, Fish Processing Unit, Fish segregation space, Net Making, Ferry Terminal.	Vendors Stalls, fish cutter stalls, fish cleaned area ,storage area, cold storage area.	Fish Shopping Area, Fish Cutting Area, Fish clean area, Fishermen's Boat Parking, Coffee Shop,Offices, Restaurants, Landscape, Parking	Fish Shopping Area, Fish Cutting Area, Fish clean area,Restaurants,Cooking Classroom, Tourism information centre, Landscape, Parking	Fish Retail market ,Fish wholesale market, Fish Cutting Area, Fish clean area,Restaurants.
CONTEXT	 <p>The site is located in on the edge of Mumbai, surrounded by many port activities</p>	 <p>In very close proximity to masjid bandar railway station, also beside Mumbai port trust</p>	 <p>It is located in a dense residential zone, leading to better accessibility for people</p>	 <p>It is been surrounded by many museums, thus also attracts tourists</p>	 <p>The market is located very close to the fishing port thus ease in circulation</p>	 <p>The site selected for the harbour is surrounded by land, thus minimize threats due to natural calamity</p>
CATEGORY	Fishing Terminal and market	Fishing Pier And Ferry Terminal	Market	Fishing Port and Market	Market	Market
TOPOGRAPHY	Flat site	Flat Site	Flat Site	Flat Site	Flat Site	Flat Site
MATERIAL	RCC	RCC spine, MS box section columns, MS roofing sheets	RCC, Steel	Glass, Aluminium,	Wood, Glass, steel	Steel, concrete, timber, glass
SPECIAL FEATURE	 <p>Spaces and circulation</p>	 <p>Design technique</p>	 <p>drainage of structure, natural light & ventilation</p>	 <p>Structural system, materials</p>	 <p>Facade design</p>	 <p>Material and form of structure</p>

Table 27 . General comparison
Source. Author
ir.aiktclibrary.org

7.3.2 : SPACIAL COMPARATIVE ANALYSYS

	Sasson dock	Bhau cha dhakka	Margao fish market	Muttrah fishing port	Bergen fish market	Sydney fish market
Fishing dock						
Boat parking						
Auction hall						
Fish segregation						
Retail fish market						
Wholesale fish market						
Cutting area						
Cleaning						
Processing						
Ice plant						
Drying grounds						
Vendor stalls						
Restaurants						
Cooking and learning						
Net weaving						
Engine repair						
Landscape (recreational)						
Tourism information centre						
Parking						

Table 28 . Spacial comparative analysis.
Source. Author



8.0 : DESIGN RESEARCH

8.1 : STANDARDS AND DATA COLLECTION

To ensure profits, safety, environmental consideration, and ataraxy10 for those nearby, fishing demands advanced gear and procedures. The following guidelines protect the interests of architecture.

8.1.1 : OFF SHORE

Off-shore construction and activities are things that are built or done in the sea, a creek, or a cove.

Docking

Level to make it easier to load and unload products

Depending on the tide, the water level in relation to the land level, the function, the activities, the types of boats the vessel serves, and other factors, docking a boat or ship can be done in a variety of ways.

Docks are frequently categorized by materials and purpose in addition to being wet or dry, temporary or permanent. In order to load and unload passengers and goods, ships and boats must berth at wet docks. Another name for these is harbor docks. Ship repairs are carried out on dry docks. These let ships to be pulled ashore for keel, bow, and hull repairs, cleaning, and restoration.

Floating dock (Wet dock):

These are often platforms that are constructed to stay afloat and allow the floating material to rise and fall in tandem with the tideline. They resemble balloons. For robustness, the dock platform's materials could be anything from metal to plastic or wood. It might be as simple as laying plain wooden planks over empty plastic tanks or barrels, or as complex as floating plastic docks connected to other docks. Because it is easily disassembled and can support light activities, it is primarily used for temporary docking or enjoyment. Because prefabricated docks are modular and may be connected in a chain, future extension and modification will be easier.

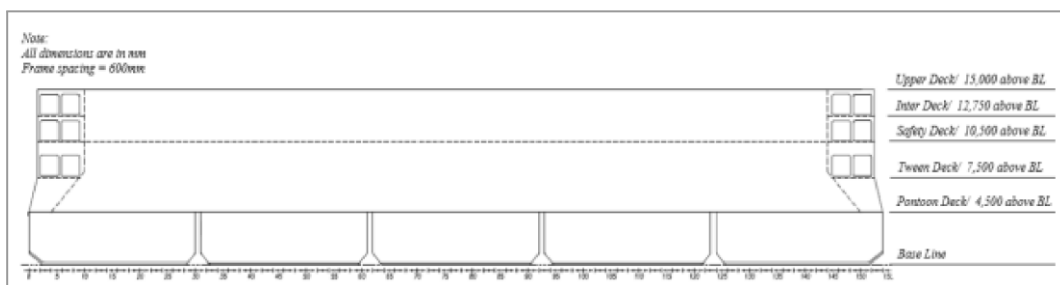


Figure 43 . Floating dock profile view

Source . <https://matheo.uliege.be/bitstream/2268.2/6069/1/Kodathoor>

Graving dock (Dry dock):

Graving docks are the most common kind of dry dock. With floor, semicircular end wall, and side walls, the chamber is long and dug. A gate at the open end of the chamber is the dock's entrance. The boat is supported by beams or a platform to provide access to the keel when the water is drained out. The ship can be freely inspected or maintained once the remaining water has been drained off. The ship is safely refloated when its maintenance is finished and water is reintroduced into the dry dock. Modern graving docks are box-shaped to fit newer, boxier ship designs, while conventional dry docks are often constructed to resemble the ships that will land there. Because it was easier to build, easier to side-support the ships, and required less water to be drained away, its design was helpful.

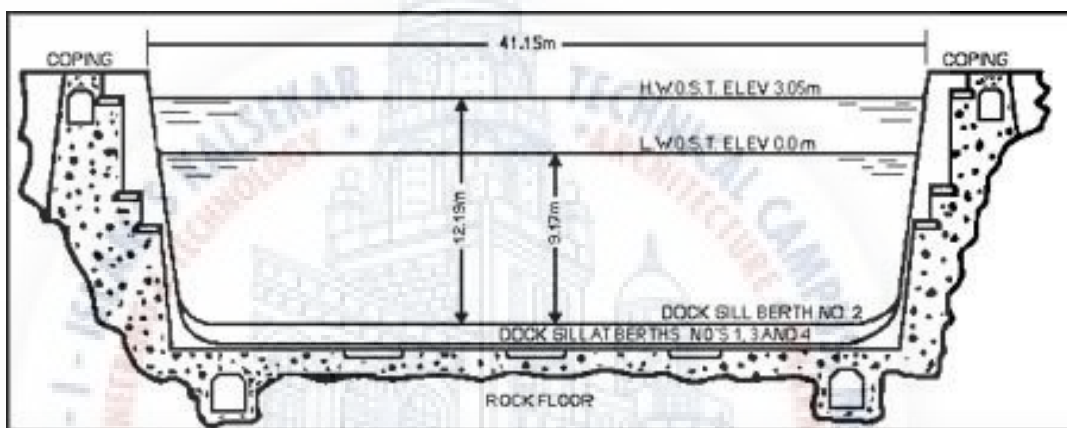


Figure 44 . Section of Graving Dock

Source . <https://www.tpsgc-pwgscc.gc.ca/biens-property/cse-egd>

8.1.2 : BOATS

Konkan fisherman fish using a variety of powered, non-motorized, and mechanized vessels. The kind of boat chosen will depend on its intended usage, cost, the infrastructure at hand, and the quantity of fisherman using it (i.e., available hands). In Konkan, Tandel is acknowledged as the ship's captain. He makes all of the ship's decisions and navigates it. Khapnar (workers) goes after him. While it is their responsibility to get fish from the sea, Tandel controls their route. The shipboat belongs to Malak, also known as "Nakha." The ruler is the Nakiwa. All of the fishing gear is kept in Khopar's storage whenever he's around.

Non - Motorized Boats:

Boats that are powered by natural forces like wind and currents or by rowing are known as non-motorized boats. This group of boats includes sailboats, catamarans, and other comparable craft. These are the most popular, most affordable, and least expensive fishing boats to maintain. These were the boats that almost every fishing family owned in the past. But when automation develops, non-motorized boats become antiquated and can no longer compete with automated and powered boats.

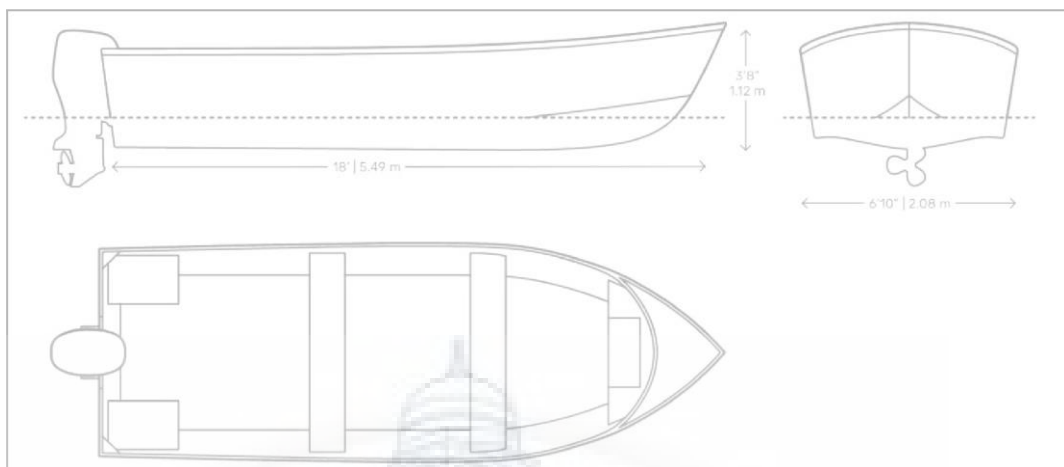


Figure 45. Non - Motorized Boat

Source . <https://www.dimensions.com/collection/fishing-boat>

Motorized Boats:

Boats with motors and propellers are referred to as motorized boats. Most of these boats have diesel engines, and some may include GPS, satellite tracking, and other on-board navigation systems. With almost no labor required, motorized boats offer faster and easier mobility. These boats require more maintenance because their engines consist of numerous, finer parts. These boats are either owned by groups of fishermen or are frequently seen in affluent Konkan areas.

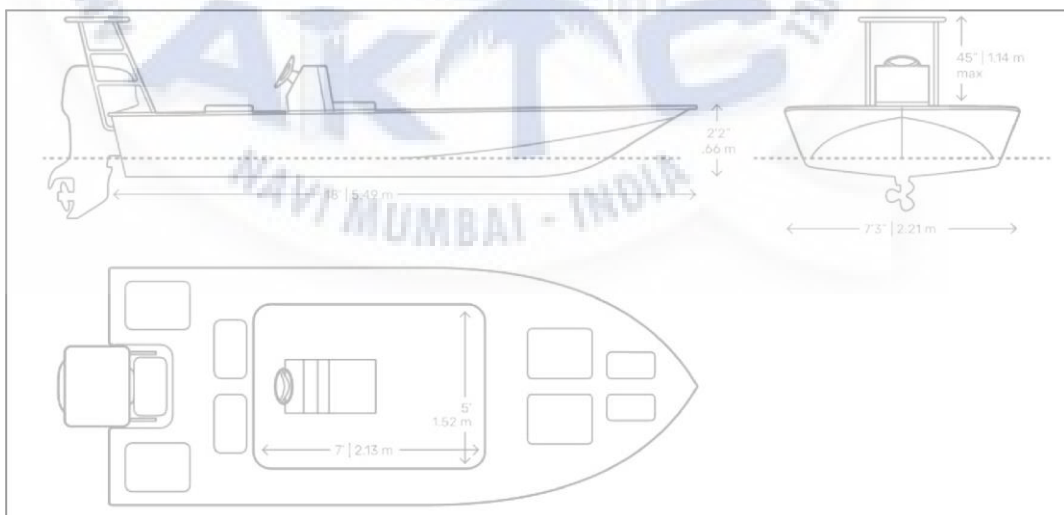


Figure 46 . Motorized Boat

Source . <https://www.dimensions.com/collection/fishing-boat>

Mechanical Boats:

Mechanized boats are powered vessels with additional mechanical gear to facilitate fishing. Crane boats and trawlers are two of these. These vessels are designed to be out on open waters for several months solely for fishing. A trawler is any boat that pulls a bag net or specially designed trawl net across the ocean. From open boats powered by outboard engines to enormous industrial ships that can fish in the most remote locations, trawlers come in a variety of sizes. The majority of trawlers are designed to fish in the demersal/bottom layer of the water. Trawlers are required to meet two conditions. The necessity for a winch or other mechanical pulling gear comes first, followed by the need for towing force. Wealthy fishermen who employ their own crews of fishermen or companies involved in large-scale fish exports frequently own trawlers.

Length between perpendicular	70m
Breath	9.6m
Depth	6.4m
Draught	4.48m

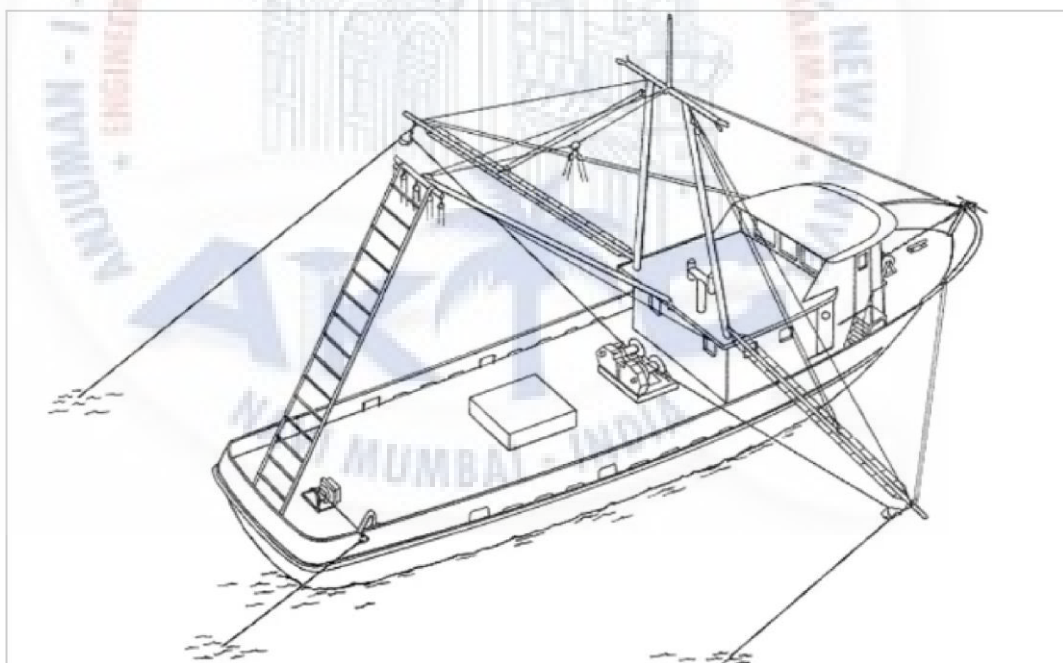


Figure 47 . Mechanical Boat

Source . <https://www.dimensions.com/collection/fishing-boat>

8.1.3 : CONSTRUCTION AND MATERIAL

When building new fish marketing facilities, a seamless flow of tasks from the fish's receipt to its loading and transportation should be achieved. Every task ought to be carried out off the ground, at a height that permits workers to carry out their duties while standing. For instance, a one-story building close to the landing area will enable efficient and minimal fish handling along the quay, marketing operations inside the market hall, and financial savings on structural civil works and drainage. Additionally, cars on the market will have easy access to this sort of architecture for loading.

Floors

Hardwearing, non-porous, washable, easy to drain, non-slip, and impervious to brine, weak ammonia, fish oils, and offal are all desirable qualities for floors. The selection of flooring materials will be influenced by the qualities and prices of the materials available in the area. Although clay tiles are the best, terrazzo, granolithic concrete, and clay tiles can all be utilized for this purpose. Generally speaking, softer tiles are more absorbent but more difficult to clean, while harder tiles are less absorbent but more slippery. Considerably rougher tiles work better because they are less brittle. It is recommended to use light-colored tiles since they show dirt and reflect light. The drainage outputs must be 2% sloped down from the highest point, and the drains must have a minimum diameter of 10 cm.

Walls

The materials used to build walls should have light-colored, smooth, washable, and impermeable interior surfaces. To facilitate easy cleaning, they should be rounded at the intersections with nearby walls. Additionally, to minimize dust accumulation, ceilings should be kept free of ledges, projections, and ornamentation. Finishing walls with internal surfaces that are not tiled requires plaster. Good partitions can be built using prefabricated concrete blocks and finished to a hard, smooth surface, with special attention to the lower portions that are constantly being worn down.

Doors

Doors should have a straightforward, practical design. When forklifts are used in medium-sized fish terminals, the main doors must be high enough and broad enough to allow for the safe circulation of internal transport vehicles. For example, a door that is 2.8 meters high and between 1.5 and 2.5 meters wide is necessary.

Sanitary Facilities

Employees and fishermen should have access to sufficient hygienic facilities in small-scale fish landing centers. Facilities for sanitation should be able to accommodate both manufacturing and staff demands. The water effluent disposal system and cultural factors specific to the area will dictate the design and selection of on-site latrines and toilets.

8.1.4 : CLEANING AND DISPLAY

There may be a need for filleting lines or gutting. Give out stainless steel or concrete tables. Crabs and other shellfish must be boiled, shucked, and chilled using small boiling pans. Water and space should be provided for these operations.

If fish were not already in boxes at sea, ships should dump them into market containers at landing places. After cleaning, weighing, species and size sorting, and refrigerating, the fish might be sold nearby or stored for later use.

To clean and arrange the catch, one can use straightforward tables made of concrete, stainless steel, aluminum, or galvanized iron. Fish are sorted and washed on tables to speed up the process of classifying them into their appropriate species, remove blood and debris, and lessen the amount of bacteria on their skin. The catch should be cleaned, sorted, and then prepared for the market by gutting, filleting, packing, or boxing the fish, keeping it in a cool location, and shipping it.

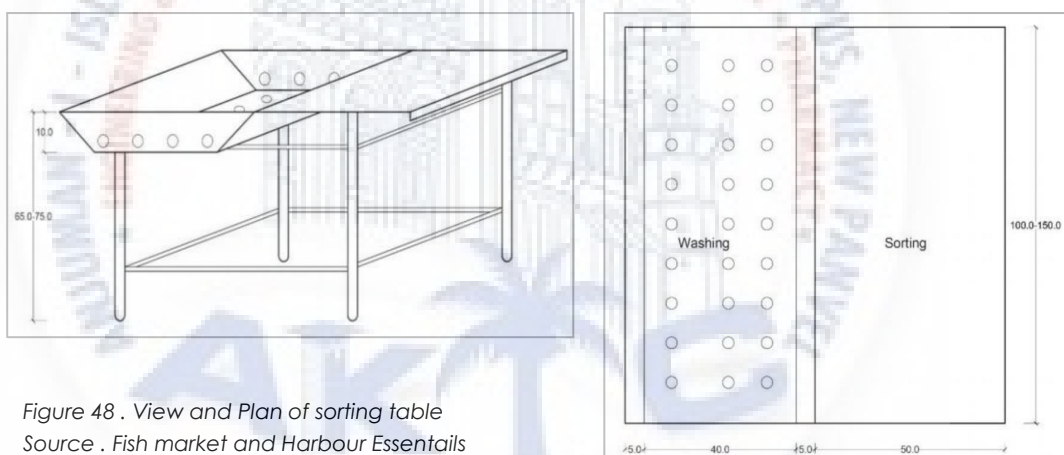


Figure 48 . View and Plan of sorting table
Source . Fish market and Harbour Essentials

Sorting and washing tables should be robust, free of exposed seams, easily cleaned, and constructed of non-corrosive metal or another impermeable material. Such tables should be made with the workers' bodies in mind.

Gutting and filleting tables that are simple to clean are necessary for small landing and marketing operations. A good water supply and drainage system, impermeable and corrosion-resistant surfaces, raw meat chutes or bins next to the workstations, and a proper working area are all necessary.

Tables can be made of stainless steel or smooth concrete. Wooden worktops are difficult to clean and are soaked in water.

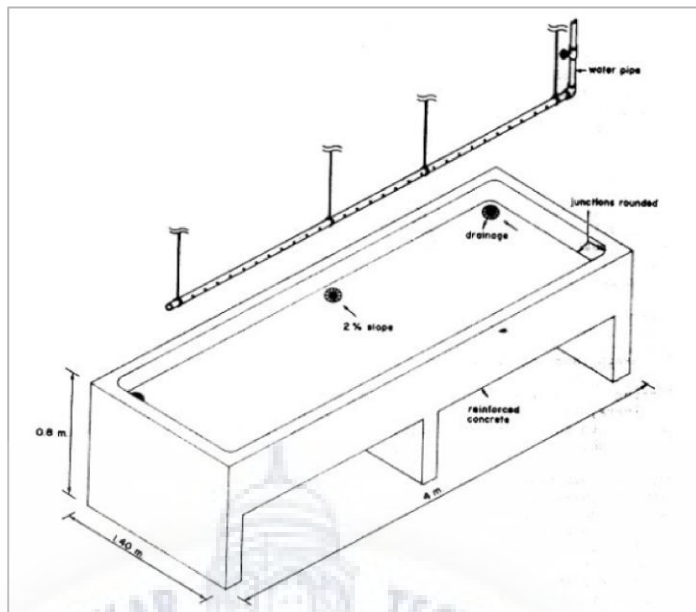


Figure 49 . Fish washing and Auctioning table

Source . Fish market and Harbour Essentials

A metal portable gutting and filleting table could have the following features

Dimensions:

3 meters in length, 1.2 meters in width, and 85 meters in height

Materials:

Plastic cutting boards made of 18/8 stainless steel are attached to each side of a central trough.

The size and reach of the users should be considered while designing tables. In addition to being the appropriate height for their size and reach, they should have a comfortable workspace.

8.1.4 : WHARF IN MARINE STRUCTURES

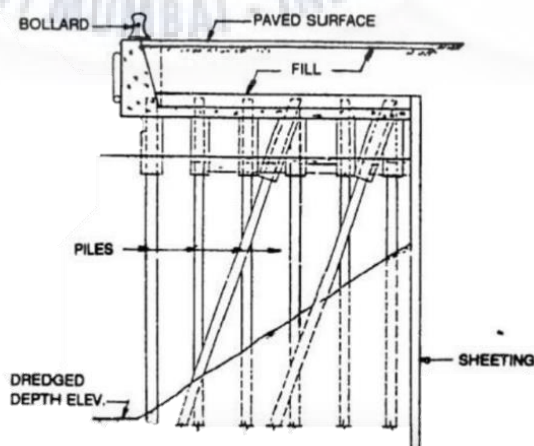


Figure 50. Design of wharf resting over piles

Source, https://issuu.com/priyankathakur58/docs/arnala_fishing_harbour_-part1_294fe983fba63c

These platforms are built nearly parallel to the land on the edge of sea and most wharves are not connected completely to the shore. Bulkhead or quay walls are used to support fill materials or stones behind the structure. Unlike pier, ships can be supported only at one side of the wharf.

Structural, geotechnical, and functional considerations are considered when the width of the wharf is specified and wharf length depend on the length of ships which may use the structure. Solid fill and open platforms are the major types of wharves.

Wharf structures supported by piles may be built at specific distance away from the land on the edge of sea if the water close to land is not adequately deep and ships with long draft cannot get close to the structure without damages.

8.1.5 : BREAK WATER

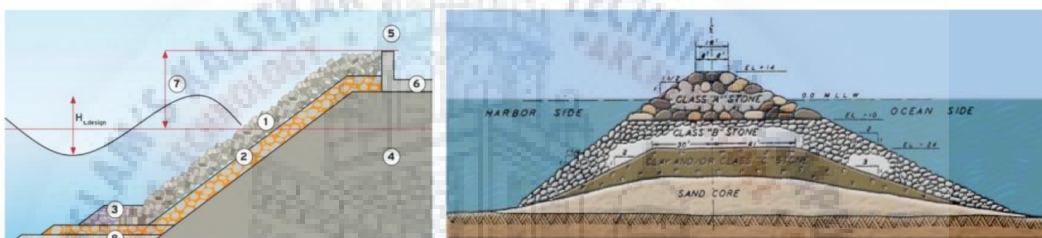


Figure 51. Breakwater construction

Source, https://issuu.com/priyankathakur58/docs/amala_fishing_harbour_-_part1_294fe983fba63c

Armour layer	(1)	Outer layer of structure
Core	(4)	Inner part of breakwater
Crest height	(5)	Top level of structure
Crown wall	(6)	Concrete structure placed on break water crest
Filter	(8)	Filter layer between sea and bed and breakwater toe
Freeboard	(7)	The crest height above design high water level
Relative freeboard		The freeboard divided by the design wave height
Under layer	(2)	Rock layer between core and armour layer
toe	(3)	Rock protection: foundation of armour layer

Breakwaters can be constructed with one end linked to the shore, otherwise they are positioned offshore from as little as 100 m up to 300-600 m from the original shoreline. There are two main types of offshore breakwater, single and multiple; single as the name suggests means the breakwater consists of one unbroken barrier, which multiple breakwaters (in numbers anywhere from 2-20) are positioned with gaps in between (50-300 m). Length of gap is largely governed by the interacting wavelengths. Breakwaters may be either fixed or floating, and impermeable or permeable to allow sediment transfer shoreward of the structures, the choice depending on tidal range and water depth. They usually consist of large pieces of rock (granite) weighing up to 16 tons each, or rubble-mound. Their design is influenced by the angle of wave approach and other environmental parameters. Breakwater construction can be either parallel or perpendicular to the coast, depending on the shoreline requirements.

8.1.6 : FISH STORES AND ICE PLANT

Fish landing ports need facilities to store fish during the seasonal highs in landings and maintain fish quality. There are a number of options, such as insulated rooms, chilled or refrigerated sea water reservoirs (or tanks), insulated containers, and simple fish boxes. Chilled rooms also have mechanical refrigeration to maintain 0°–1°C. Your desired level of marketing sophistication and local factors will play a major role in the decision.

Because plate and flake ice makers can be placed above an ice storage facility, less ground space is required for ice distribution via gravity. In any event, there ought to be a location for storing empty fish boxes, access to enough water for cleaning, and, if at all feasible, a location for hand washing the boxes.

The ice plant should be able to produce more ice than what is anticipated to be transported into the fish processing facility each day if there is a mechanism in place for harvesting fish as well.

The following is a possible way to estimate the daily need for ice:

- Tons of ice for unsold fish to be stored overnight before being sold, and tons of ice for cooling fish to be maintained and delivered for sale outside the region. (A tons)
- For a fish harvesting system, more ice is needed (B tons).
- Daily ice production capacity (in tons, A+B)

The ice storage facility's capacity ought to be sufficient to store enough ice for at least two days. The expected market turnover should determine how much space the chilled chamber has to store iced seafood. There should be enough storage room at the fish landing facility to retain enough fish for at least one day. Planned collecting systems will require additional storage space.

The quantity of ice storage required by an ice plant is determined by the type of ice being produced and the local demand for ice. It needs to be well-insulated, and it could be a rectangular bin or a silo. The frequency of fish delivery and the planned activities can be used to determine the capacity of the ice storage facility.

Cold rooms are heavily utilized by small and medium-sized fish distribution and marketing enterprises. A excellent option would be a walk-in, prefabricated chill room with independent refrigeration equipment, insulation for tropical temperatures, and, if feasible, a straightforward but dependable control system.

8.1.7 : DESIGN FACTORS FOR CALCULATING AREA AND CAPACITIES FOR FISH STORAGE FACILITIES

Type	Characteristics	
Refrigerated, chilled, rooms	<i>Storage capacity:</i>	3–4 m ³ /ton of iced fish in boxes
	<i>Area required:</i>	2.1 m ² /ton of iced fish stored in boxes
	Type: Manual operation, held overnight and sold next day	
Chilled seawater storage facility (fixed)	<i>Storage capacity:</i>	1.25 to 2 m ³ /ton of fish
	<i>Area required:</i>	1.5–2.7 m ² /ton of fish
Portable container with Chilled seawater system	<i>Storage capacity:</i>	1.57 m ³ /ton of fish
	<i>Area required:</i>	1.5 m ² /ton of fish
Ice plants (ice maker and refrigeration plant only):		
(a) Block ice	<i>Plant capacity:</i>	10 ton/24 hours
	<i>Area required:</i>	100 m ²
(b) Flake ice	<i>Plant capacity:</i>	10 ton/24 hours
	<i>Area required:</i>	20 m ²
(c) Tube ice	<i>Plant capacity:</i>	10 ton/24 hours
	<i>Area required:</i>	30 m ²
(d) Plate ice	<i>Plant capacity:</i>	10 ton/24 hours
	<i>Area required:</i>	9 m ²

Table 14 . Design factors for calculating area and capacities for fish storage facilities

Source . <https://fliphtml5.com/tyuo/axgm>

8.1.8 : ARCHITECTURAL PATTERN DOUMENTATION

The maala/ Attic is an wooden floor

Materials used:

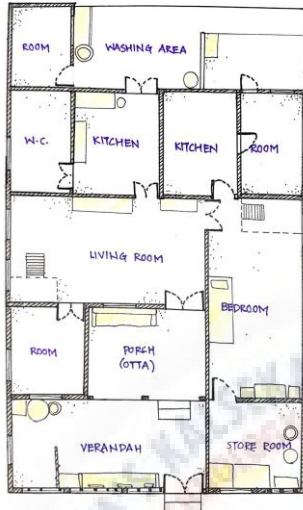


Figure 52. Ground floor plan
Source. Author

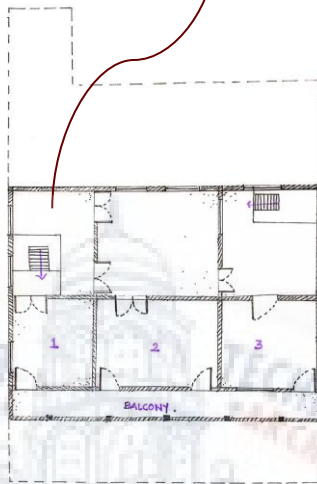


Figure 53. First floor plan
Source. Author



Laterite stone



Sagwan wood



Sessam wood



Stone



Clay mangalore tile

This is a load-bearing structure built in 1931. It's made with columns constructed from laterite, and the outside has a stone facade. Inside, there's also a mezzanine floor made of wood.

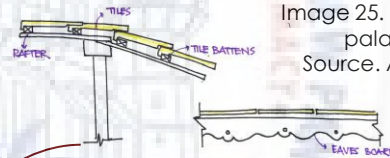


Image 25. Material palate
Source. Author

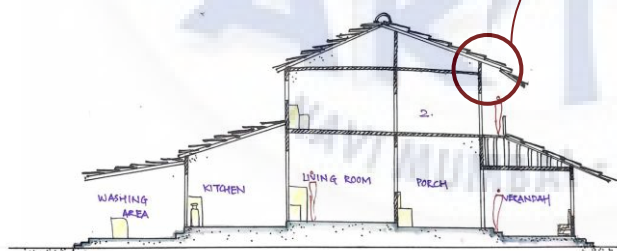


Figure 54. Section
Source. Author



Image 26. Niche in wall for storage
Source. Author



Image 27. Wooden jaali
Source. Author

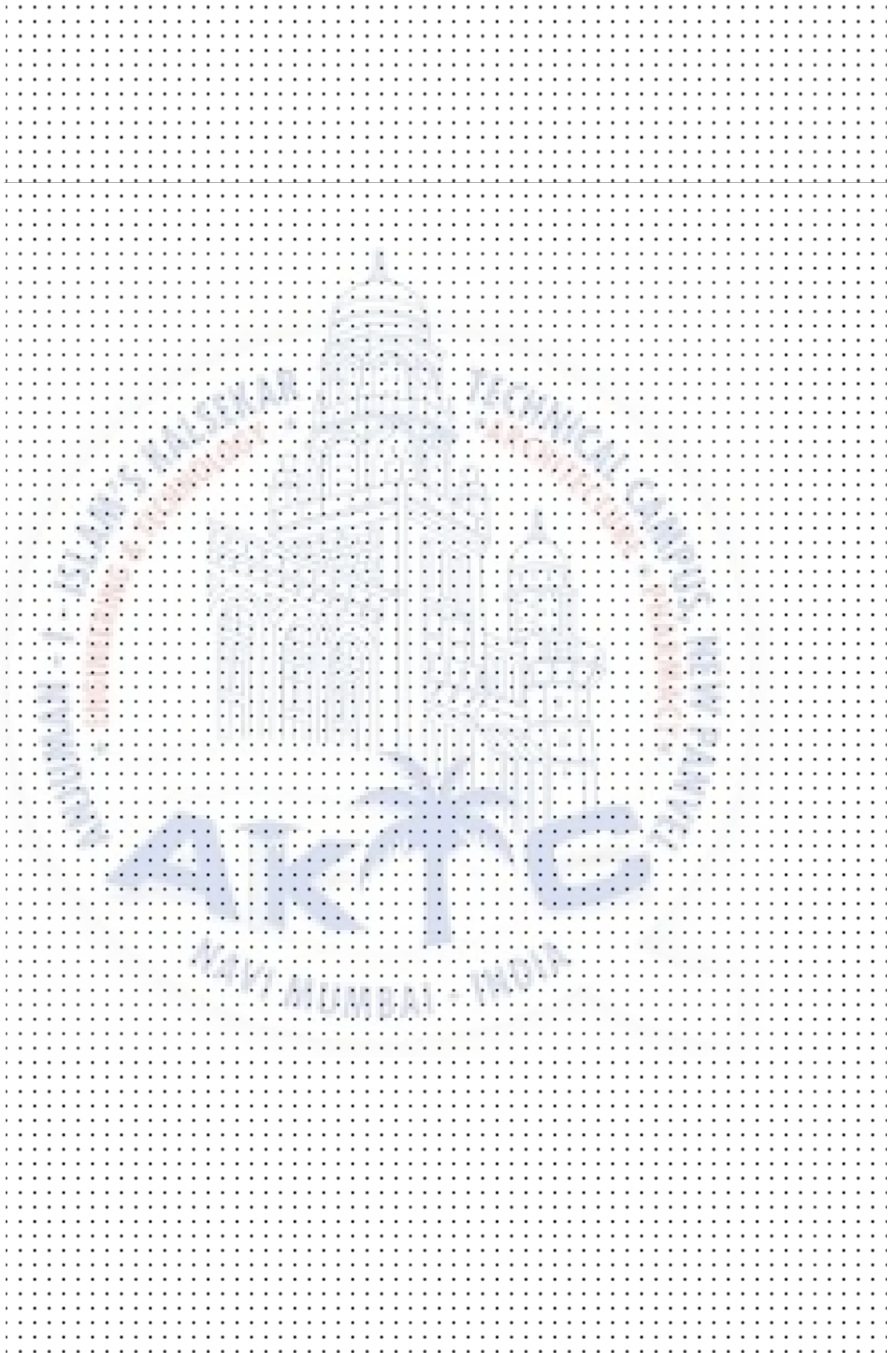


Image 28. Wooden grills
Source. Author

PLANNING ELEMENTS :

- Aangan – Public space
- Verandah / Padvi- public space
- Majghar / living room – semi private space
- Kirchen – private space
- Mala/ attic – private space

Aangan ood Padvi is generally used in summers



**CHAPTER 9.0 : TENTATIVE ARCHITECTURAL
SPACE PROGRAM AND SITE STUDY**

9.0 : TENTATIVE ARCHITECTURAL SPACE PROGRAM

Program	Main space	Detail space	Pax	Area per person	Total area (sq.m)
Fishing	Fish landing	Wharf / quay wall	Length according to the number of boats in peak hours		
		Bunkering			
		Boat parking	Accoring to number of boats		
	Fish handling	Fish collecting area	40	5 sq.m per ton of fish	200 sq.m
		Fish segregation area	30	12 sq.m per ton of fish	360 sq.m
		Fish distribution area	30	15 sq.m per ton of fish	450 sq.m
		Peeling area	20	10 sq.m per ton of fish	200 sq.m
		Fish drying area	20		20
		Toilet (male)	10	2 sq.m	20
		Toilet (female)	10	2 sq.m	20
	Hall	Auction hall	100	12 sq.m per ton of fish	1200
	Workshop area	Boat repairing area	10		225
		Engine repairing area	10		40
		Machine and fish equipment area	10		30
		Storage	6		30
	Net weaving and allied activities	Net weaving and repairing shed	10	4 sq.m	40
		Store room	6		30
Rest room		4	2 sq.m	8	
Administration	Reception	Reception	5	10 sq.m	150
		Lounge	5	5 sq.m	15
	Management office	Meeting room	20	2 sq.m	40
		Working room	20	2.5 sq.m	50
	Workers facility	Pantry	4	2 sq.m	8
		Storage	5		10
		Toilet (male)	4	2 sq.m	8
Toilet (female)		4	2 sq.m	8	
Other spaces	Security room			40	
	Crate washing and stacking area		120	120	
	Dormitory	15-20	5 sq.m	100	
Total = 3422 sq.m					

Table 15. Tentative architectural space program

9.0 SITE SELECTION AND JUSTIFICATION

9.1 SITE LOCATION

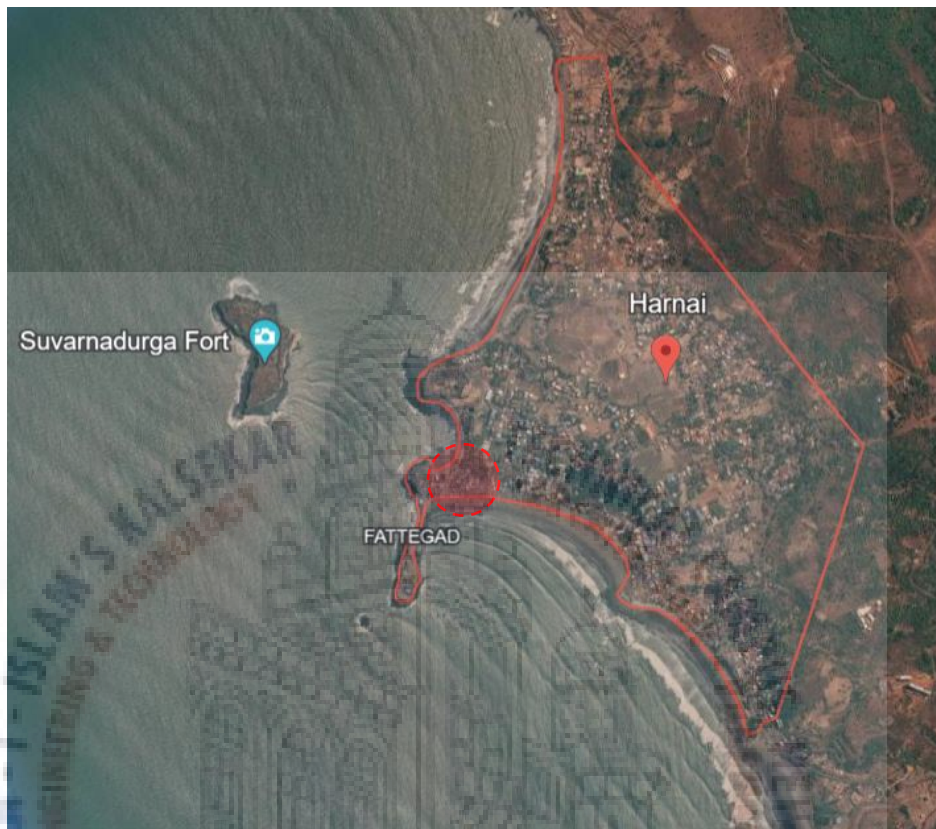


Image 29. Map of Harnai
Source . Earth google

- The Fishing Harbour property is located at Harnai and spans around 6 acres.
- One of the fishing villages in the Ratnagiri district is Harnai.
- The site is situated in the Indian state of Maharashtra's Dapoli taluka in the Ratnagiri District.
- It is a part of the Division Konkan.
- The distance from the Khed railway station is 51.2 km.

9.2 SITE JUSTIFICATION

Why this site?

- About half of the people who live in Harnai work in the fishing industry.
- The infrastructure and exposure for the fisherman in this village are lacking. in order to make it better.
- In order to make it better the area surrounding the site requires management.
- During this fishing season, exporters arrive from various places.
- The rich historical legacy of Harnai can be largely credited for its rise to prominence.
- The location of the site allows for near proximity for the fishermen who are already engaged in fishing operations on the beachfront ahead of the site.

Site features

- Harnai is the 5th largest fish producing/ catching port in Maharashtra and its contibutues to 4.55 % to the overall production of Maharashtra.
- Has a larger mass of land facing to the sea, which thus engcourages more fishing and thus the population of harnai engaged in it .
- No contours, gradually sloped.
- Excellent view of with mangrove cover adjacent to the beach.
- A lot of tourist activity is been seen in the village, which can eventually help the boosting the fishing community's income.

9.3 : PROPOSED LAND USE

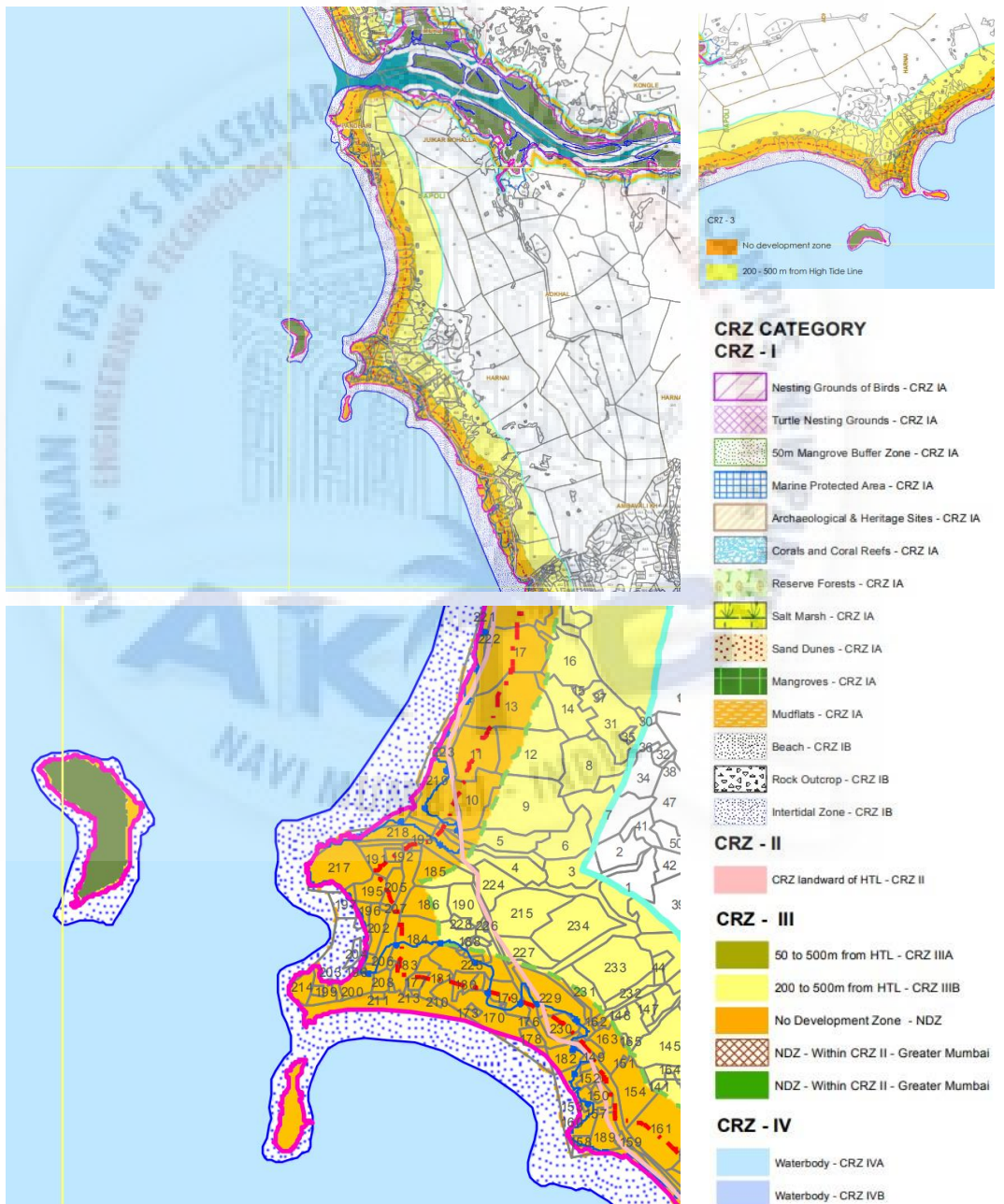


Figure 55 . Proposed land use

Source . Final-CZMP-Raigad-&-Ratnagiri-(50-Sheets-)-Unsigned-21-30.pdf

9.4 : CRZ RULES AND REGULATIONS

CRZ-I B - The intertidal areas:

Activities shall be regulated or permissible in the CRZ-I B areas as under:-

- (i) Land reclamation, bunding, etc. shall be permitted only for activities such as,- foreshore facilities like ports, harbours, Jetties, wharves, quays, slipway, bridges, hover ports for coast guard, sea links, etc;
- (ii) Activities related to waterfront or directly needing foreshore facilities such as ports and harbours, jetties, quays, wharves, erosion control measures, breakwaters, pipelines, lighthouses, navigational safety facilities, coastal police stations, Indian coast guard stations and the like.
- (iii) Storage of non-hazardous cargo i.e. edible oil, fertilizers and food grains in notified Ports.
- (iv) Hatchery and natural fish drying.
- (v) Existing fish processing units may utilise 25% additional plinth area for modernisation purposes (only for additional equipment and pollution control measures) subject to the following:-
 - a) Floor Space Index of such reconstruction not exceeding the permissible Floor Space Index as per prevalent town and country planning regulations;
 - b) additional plinth area is constructed only to the landward side.
 - c) approval of the concerned State Pollution Control Board or Pollution Control Committee

CRZ-II

Activities as permitted in CRZ-I B, shall also be permissible in CRZ-II, in so far as applicable.

The areas that have already been developed up-to or close to the shore-line. For this purpose, developed are municipal limits or in other legally designated urban areas which are already substantially built up and which approach roads and other infrastructural facilities, such as, water supply and sewerage mains

Building shall be permitted only on the landward side of the existing road, or on the landward side of the existing authorized structures;

Buildings permitted on the landward side of the existing authorized structures shall be subject to the existing local town and country planning regulations including the existing norms of Floor Area ratio, Provided that no permission for construction of building shall be given on landward of any new roads which are constructed on the seaward side of an existing road:

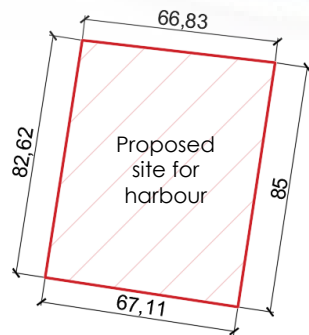
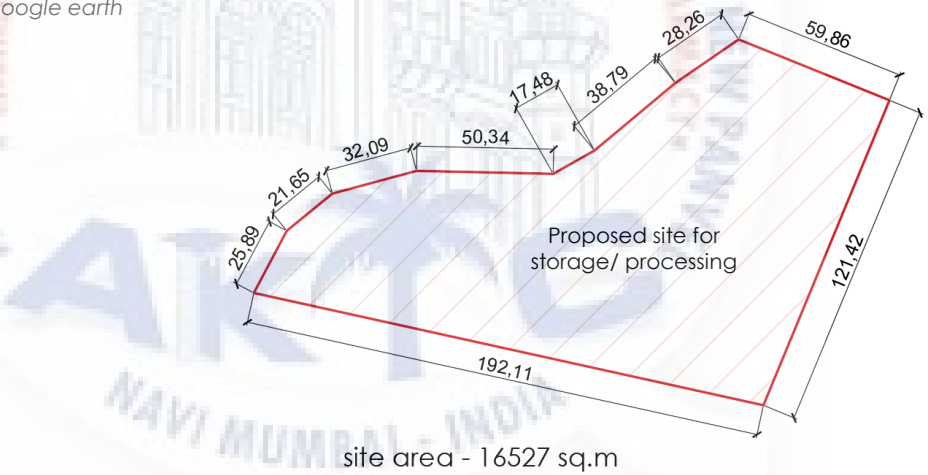
Reconstruction of authorized buildings to be permitted subject with the existing Floor Area Ratio Norms and without change in present

9.5 : SITE DIMENSIONS



Image 30 . Map of site location

Source . Google earth



site area - 5610 sq.m

All dimensions are in m

Figure 56 . Site dimensions

Source . Author

9.6 : CLIMATE

Harnai's climate is influenced by alternating north-east and south-west monsoons, however the north-east monsoon is light. Morning winds are from the northeast, and afternoon breezes are from the west-northwest from December to March. During the monsoon, which lasts from June to September, winds over the sea blow west and southwest. There are mostly land and sea breezes throughout October and November. At times throughout this period, tropical cyclones can be seen in the Arabian Sea. An overview of the temperature, relative humidity, wind, and rainfall

Wind

West and north-west winds blow 7 to 10 knots from June to September. The southwest monsoon in the coastal regions is consistent, year-round, and without major fluctuations. The winds are north, north-east, and east throughout the remainder of the year. Except for the south-west monsoon, land and sea winds are predominant for the majority of the year. From November to February, the northeast monsoon brings with it strong land winds. In April, afternoon land winds give way to maritime breezes. After the temperature cools off in September, thunderstorms signal the beginning of the northeast monsoon in late September or early October.

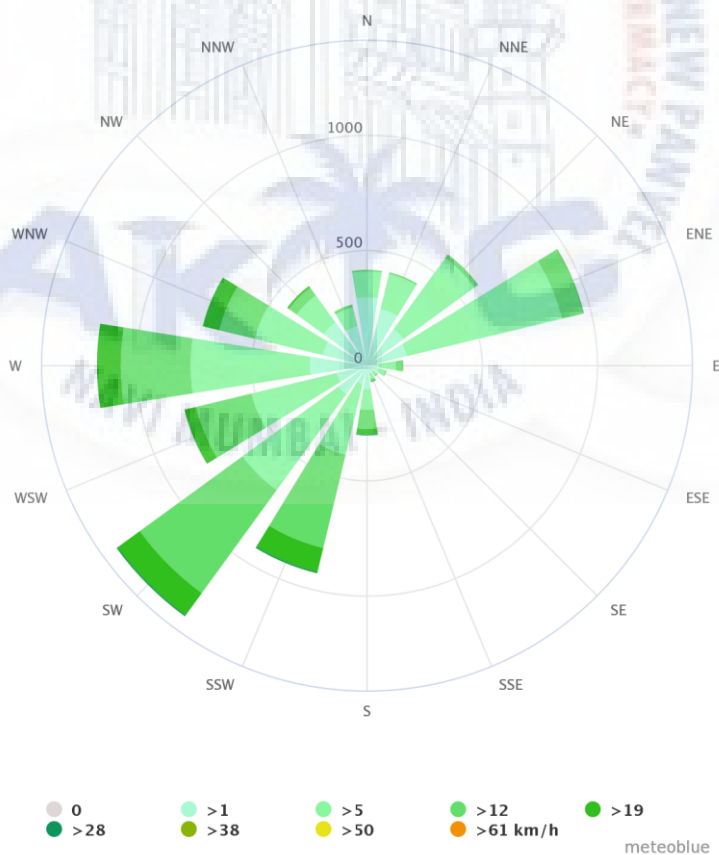


Figure 57 .Wind rose diagram of Harnai

Source. https://www.meteoblue.com/en/weather/archive/windrose/harnai_1177098

Temperature

All year long, the average air temperature is between 31C and 3MC, with the exception of December, January, and February, when it falls to 200C. The range of average daily lowest and maximum air temperatures is 240°C to 310°C. Prior to the south-west monsoon, summertime temperatures range from 300C to 32C or below. The greatest and lowest temperatures are 40T and 12T..

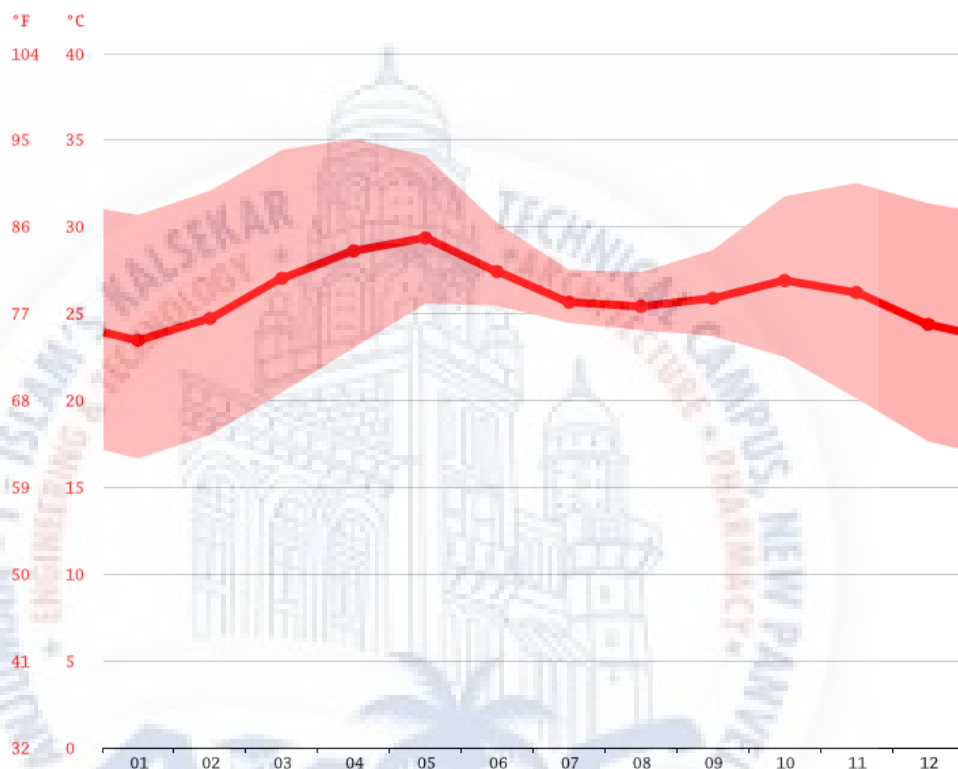


Figure 58. Temperature of Harnai
 Source . <https://en.climate-data.org/asia/india/maharashtra/harnai-172854/>

Rainfall

The southwest monsoon brings rain to the state of Maharashtra. The annual rainfall in the Western Ghats is typically in the range of 2000 mm to 9000 mm. Harnai and other coastal parts receive a lot of rain (about 2000 mm), very little in the middle due to the Western Ghats' rain shadow zones (around 500 mm), and moderate rains in the eastern region (roughly 1000 mm). In harnai, the south-west monsoon lasts from June to September. The pre monsoon rains arrive in May. There may be rain from the northeast monsoon between October and November. It rains the most in July. The months of June, July, August, and September see the most rainfall in Hanai, based on meteorological data collected from 1937 to 1966 in Mumbai. Ninety-four percent of the annual rainfall falls in this period. There is 2,079 mm of rainfall on average per year, with 2.5 mm or more falling on 71 days. July has the highest average monthly rainfall (709 mm), while September has the lowest (297 mm).

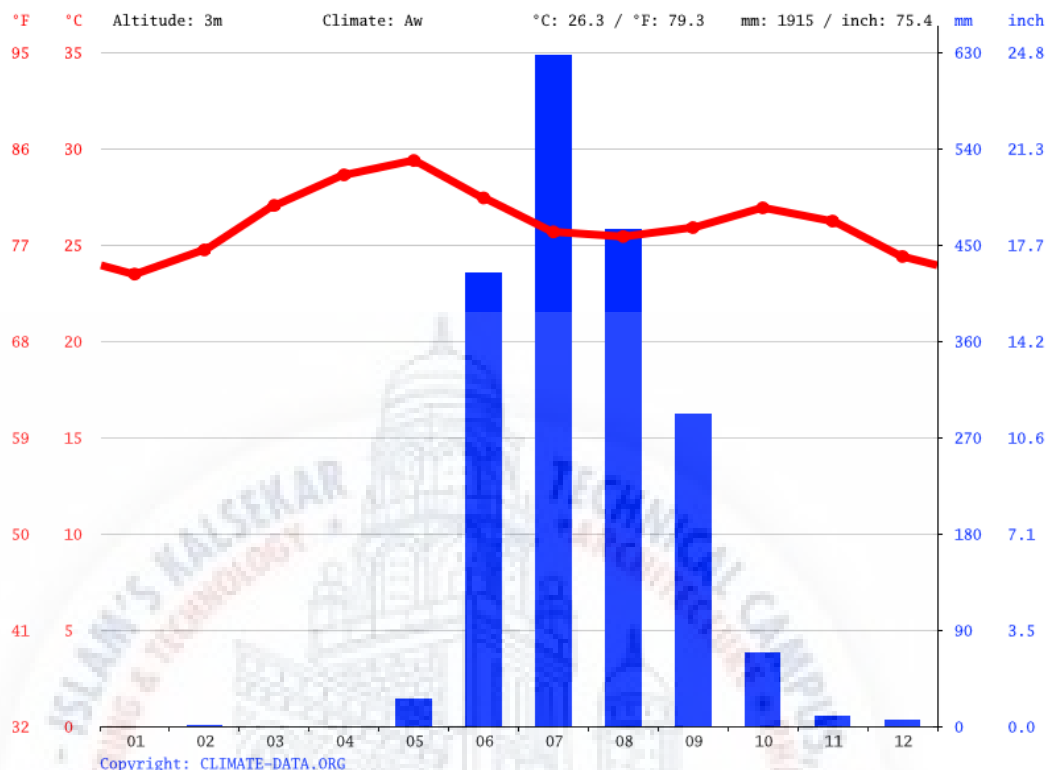


Figure 59 .Rainfall of Harnai
 Source . <https://en.climate-data.org/asia/india/maharashtra/harnai-172854/>

Water Temperature

The Arabian Sea's annual temperature in Harnai is 27.70°C, or 81.86°F. It reaches 30.30°C (86.54°F) in June. The average water temperature in January is 24.40°C (75.92°F). The water temperature hits 30.30°C/86.54°F around June 2. It will be coolest in the ocean around January 28. 75.92°F | 24.40°C

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	25.1 °C (77.1) °F	25.6 °C (78.1) °F	26.9 °C (80.4) °F	28.2 °C (82.8) °F	28.8 °C (83.8) °F	26.5 °C (79.8) °F	25.3 °C (77.5) °F	25.1 °C (77.1) °F	25.6 °C (78.1) °F	26.8 °C (80.3) °F	26.9 °C (80.5) °F	25.9 °C (78.5) °F
Min. Temperature °C (°F)	20.2 °C (68.4) °F	20.7 °C (69.3) °F	22.5 °C (72.4) °F	24.6 °C (76.2) °F	26.1 °C (79) °F	25 °C (77.1) °F	24.2 °C (75.6) °F	23.9 °C (75.1) °F	23.9 °C (75) °F	23.8 °C (74.9) °F	22.7 °C (72.9) °F	21.2 °C (70.2) °F
Max. Temperature °C (°F)	30.3 °C (86.5) °F	31 °C (87.7) °F	32 °C (89.6) °F	32.6 °C (90.7) °F	32.3 °C (90.2) °F	28.7 °C (83.7) °F	26.8 °C (80.3) °F	26.8 °C (80.2) °F	27.9 °C (82.2) °F	30.3 °C (86.6) °F	31.5 °C (88.8) °F	30.9 °C (87.6) °F
Precipitation / Rainfall mm (in)	0 (0)	0 (0)	2 (0)	2 (0)	49 (1)	647 (25)	827 (32)	601 (23)	330 (12)	119 (4)	18 (0)	4 (0)
Humidity(%)	58%	60%	64%	69%	72%	86%	91%	91%	88%	79%	64%	58%
Rainy days (d)	0	0	0	0	4	19	22	22	19	10	3	0
avg. Sun hours (hours)	10.0	10.3	10.4	10.2	9.1	6.8	6.3	6.6	7.1	8.9	9.9	9.9

Figure 60 .Water temperature of Harnai
 Source . <https://en.climate-data.org/asia/india/maharashtra/ratnagiri-24258/>

NOTICE

Inviting Expression of Interest for lease of plots for setting up sea food processing units at Marine/ Aquaculture Park, Harne, Dist. Ratnagiri, Maharashtra on 95 years of registered lease deed

Name of Project: Integrated Marine/ Aquaculture Park, Harne, Dist, Ratnagiri, Maharashtra

Location: Survey no. 235, Harne Industrial area, Tal. Dapoli, Dist. Ratnagiri

Area: 217 acres (Status - Planned)

Last date of receipt of EOI: 30.09.2023

MIDC - Integrated Marine/Aquaculture Park, located in Harne, Ratnagiri District, Maharashtra, is inviting expressions of interest for leasing plots to establish seafood processing units within the park. The lease period offered is 95 years, documented through a registered lease deed. Interested parties can submit their proposals to Circle and Division under Chief Engineer- Mumbai Zone Supertending Engineer, Konkan Circle, Panvel, Plot No. 57, Sector-17, Khanda Colony, New Panvel (W), 410206.

For further inquiries, please contact at Office of Executive Engineer, MIDC, Ratnagiri, Phone No.: 02352 228630/9689216669

or via email at eeratnagiri@midcindia.org.

Application can be downloaded from website: www.midcindia.org

Applicants needs to pay the EOI document Fee of Rs.10000 by Demand Draft in favour Executive Engineer, MIDC, Ratnagiri and payable at Ratnagiri from any of the scheduled nationalized / commercial bank

Figure 61 . Proposal for in hamai undertaken by MIDC
Source . Final EOI, MIDC HARNAI

9.7 : DESIGN BRIEF

In today's world, it's crucial to plan and operate fishing activities in coastal areas while being mindful of the environment. Fishing ports and fish landing areas are complex places where a lot happens – environmentally, biologically, economically, and socially. To ensure we manage these areas sustainably, we need to involve different sectors and work together right from the planning stage.

My plan is to organize these scattered regions and create a fishing port in Harnai, Ratnagiri.

This port will have various facilities like a market, ice plant, cold storage, and more. These are essential for processing and distributing fish and seafood products efficiently. By providing better services and facilities to local fishermen, we can help them earn more money. This not only improves their quality of life but also attracts more visitors who spend money in the area, increasing the port's revenue, especially during the fish breeding season.

The main goal of this project is to build a fishing port in Harnai, Ratnagiri, which includes recreational areas. We'll consider the needs and comfort of the workers and the local community. This will be a modern port with all the latest features and services to serve the workers, customs officials, and visitors.

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(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying Government of India, New Delhi November, 2020)

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(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying Government of India, New Delhi November, 2020)

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(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi November, 2020)

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(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying ,Government of India, New Delhi November, 2020)

Table 12. Variety and quarter-wise marine fish production of Ratnagiri district

(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi November, 2020)

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(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi November, 2020)

Table 14. Variety and quarter-wise marine fish production of Dabhol zone

(Source . Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi November, 2020)

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(Source . Director of fisheries state Gov./UTs administration)

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