KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI.

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COLLEGE OF ARCHITECTURE AND PLANNING
FACULTY OF ARCHITECTURE AND BUILDING TECHNOLOGY
DEPARTMENT OF ARCHITECTURE

TITLE: FISHING PORT DESIGN, ELMINA

THIS THESIS REPORT IS PRESENTED TO THE DEPARTMENT OF ARCHITECTURE AS PARTIAL FULFILMENT OF THE REQUIREMENT OF POST-GRADUATE DIPLOMA DEGREE IN ARCHITECTURE

ENNINFUL JOSEPHINE, PEACE
AUGUST 2009

DECLARATION

We/I declare that we/I have wholly undertaken the study reported herein under supervision of Arch. D. Amoateng-Mensah and that except portions where references have been duly cited, this report is the outcome of my /our research.

15th September 2009 ..... Enninful .....

Date (Signature)

ENNINFUL JOSEPHINE, PEACE

15/09/2009 ....

Date (Signature)

ARCH. D. AMOATENG MENSAH

DEDICATION

This design thesis is dedicated to the Almighty God who gave me strength and wisdom to go through school and to my mother, Miss Regina Victoria Longdon for her support.

ACKNOWLEDGEMENT

I am very grateful to the Almighty God for His love, grace wisdom and protection throughout my six-year stay on KNUST campus and for knowledge and strength He gave me to finish this project successfully.

I am also grateful to my supervisor, MR. D. AMOATENG MENSAH, for his contributions, guidance and patience.

My heart felt appreciation also goes to Mr. S. O. Afram, my studio master and Mr. Olympio for their immense contribution during the interim juries.
My appreciation also goes to my family especially Mr. and Mrs. Bansah for their words of encouragement and support.

Finally, to all my colleagues who helped in one way or the other to make this project a success, I am very grateful.

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ABSTRACT

Since the creation of man, the quest for survival has led him to explore many ways of finding food. He hunted for animals if he found himself in the forest and fished if he was at a riverside lake or lagoon side or at the coast, by the sea.

Fishing became a very important means of finding food. In ancient times, some of the tools used for fishing included fishing hooks tied to the stems of the vine plant. In the second (2^{nd}) and third (3^{rd}) centuries (AD), the Roman rhetorician, Claudius Aelian wrote about Macedonian trout anglers who used artificial flies to catch fish.

Over the years, civilization has enabled man to find many improved ways of fishing from the use of fishing hooks and rods to seine nets, canoes, boats, trawlers and ships. The growing population of the human race has made it expedient for fishing to be commercialized so as to satisfy the growing numbers.

The commercialization of fishing has called for facilities on land where the catch will be loaded off and sorted out before it could be sold off quickly since fish tend to go bad easily especially in hot humid environments.

In Africa, most commercial fishing is done on the coast because it has been found to be a cheaper and easier way of fishing as compared to inland fish farming. Consequently, most fishing ports in Ghana, for instance, are found on the coast.

From this study, one could deduce that the fishing ports in Ghana have to be put in a proper shape in order to meet the growing demand for seafood. It has therefore become imperative to make recommendations for the upgrading of one existing fish market. The Elmina, (Edina) fishing port has therefore been selected to help solve the problem of inadequate seafood for the people.

CHAPTER 1

1.0 Introduction

The Elmina fishing area, also known as 'Atekyem' (muddy place) was established in January 1986 by a youth group in Elmina called the Zion Mobisquad. It was built to facilitate the fishing industry in the Edina community to create a good working environment for the people since fishing is their main economic activity.

When the market was expanded fisher folks came from other parts of the country (Greater Accra, Western Ashanti and the rest), to transact business there .The Zion Mobisquad did not have enough funds to put the place in a proper state so with the help of some organizations like the Construction Pioneers, Edinaman Rural Bank (now Kakum Rural Bank) and some other governmental organizations major rehabilitation was done.

As time went on, the bank started claiming ownership of the property since it helped to put it up. The case was litigated on for well over fifteen (15) years until recently in September 2007, when it was restored to the people.

Over the years, it has been observed that the fisher folks do not have enough space to market their harvest besides; the fishing industry in Ghana was on the brink of collapse. This was what prompted the ministry of fisheries to initiate a programme to save the fishing industry which was falling apart both in Elmina and other parts of Ghana. One of such moves was the inauguration of a fish processing factory dubbed 'CG Elmina' at Elmina in March 21, 2007.

This project was also to open up employment opportunities for the people, address the problem of post harvest losses and to help curb the ravaging poverty in the area. But the fishing port has however been neglected. Situated very close to an attractive storage facility, the port has become an eyesore and therefore needs serious attention.

1.2 Background Studies

According to the Ghana Poverty Reduction Strategy II (GPRS II) which was prepared in 2005, agriculture is the largest contributor to the GDP of Ghana, with a growth rate of 6.1 in 2003 and 7.5 in 2004. This shows the potential that agriculture has in turning the economic woes of Ghana around. In the same document, it states that in order to use agriculture as a pivot to increase Ghana's GDP, the decline in fisheries, which still provides the bulk of Ghana's protein intake has to be reversed by increased investments in aquaculture among other technological improvements.

Fishing is predominantly carried out along the coastal areas of the country. About 70% of the total fish supply in the country is from the sea. About 15 percent of the total annual fish production of 350,000 tonnes is fully or partially fermented into either dried or salted dried products for the local market. The product is used for food and as condiment in local dishes, particularly in the rural communities where there are no cold storage facilities. Fermented fishery products are a delicacy among the Akans of southern Ghana. Salted and fermented dried fishery products are also imported from the Gambia, Norway and Senegal to meet shortfalls in local supply. All the communities along the coast, no matter its size engage in fishing activities.

1.3 Problem Statement

Taking a cursory look around the coast reveals the unavailability of fishing ports which are attached with processing factories or facilities. The two (2) main fishing ports in Tema and Sekondi-Takoradi are clearly not enough to serve the whole country. More fishing ports are therefore needed to be built at strategic places along the coastlines like Elmina, to serve the other communities and regions close by as well as serve as a guarantee to increase in fish production.

It is also a known fact that the poverty levels that raid most fishing communities is very disturbing not to mention the grave social vices that come along with it. These problems come about as a result of the low income levels due to post harvest losses among other operating problems that affect their work.

1.4 Justification

Ghana by its location is flanked by three land-locked countries of Cote d'Ivoire, Burkina Faso and Togo. If the fishing port is well developed, many of its products can be exported to these countries and beyond, thereby generate income for the nation.

In 2000, cabinet signed a bill to re-vitalize the capital city and other traditional towns especially along the coast. As part of this proposal the ministry of fisheries inaugurated the 'CG Elmina' fish processing factory in March 21, 2007. The fish market was earmarked for rehabilitation and expansion but for the past year, not much activity has been seen there. It is only logical that when market is expanded, it will attract more traders and the fishing business will grow to serve the factory and the community.

Besides, Elmina has a rich cultural significance because of its cultural heritage; there are landmarks like castles and forts, for which reason tourist often visit there; so the fishing industry which happens to form part of the oldest tradition of the place will have to be revived in order increase the cultural significance of the area and boost tourism

The choice of the site has become necessary because of the rich fishing tradition in this place coupled with the cultural significance of the area; the availability of market will be a great advantage to the location of the facility and will facilitate making the area a vibrant fishing area. If this proposal is carried out to its logical conclusion it will help to curb the unemployment problem in the area by creating many job opportunities for the people. The rippling effect of job creation will be on other sectors like transportation and fuel sectors affecting vocations like weaving of sacks, basketry and so on. The port will awaken employment opportunities in Elmina and also help curb some of the social vices.

1.5 Objectives

- To upgrade the existing fishing facility in Elmina in order to improve the economic life of the township.

- To extensively use non-corrosive materials like wood, glass and concrete for the structures at the port to ensure its long life.

- To incorporate the visual arts of the people like (colors, designs on canoes, stonework) into the design of the facility to make them identify it as their own.

- To design a fishing port that will not only serve as a commercial facility but also as tourist facility.

1.6 Scope Of Study

The study will cover the design of a fishing port complete with other facilities like a water treatment plant, ice making plant, cold stores and so on. Auxiliary facilities will also be provided which will help to boost the fishing industry in Elmina. All this will be located at the main fishing hub of the town to facilitate the functional use of the port.

Canoe/ Boats Basin

- Docking Area
- Repair facility
- Storage for Gear
- Slipway/ Boatyard
- Sanitary (Toilets and bath houses)
- Net mending area
- Changing rooms

Commercial Area

- Security station/ Entrance
- Fish Market
- Fish handling shed
- Ice Plant
- Cold Store
- Bunker
- Electricity plant/Generator

Inner Port

- Administration
- Seafood restaurant
- Accommodation
- Shops
- Crèche
- Training room
- Exhibition facility
- Bank
- Clinic

PROJECT LOCATION

Elmina in the Central Region.

CLIENT

CEDECOM (Central Regional Development Commission)

FINANCIERS

Ghana government with funding from the World Bank.

RESEARCH METHODOLOGY

The data for the design of this facility would be collected through

- Interviews
- Case studies
- Internet research
- Photographs
- Visual survey
- Physical study of site and its environs
- Library and journals
- Media
- Government agencies.

CHAPTER 2

2.0 Literature Review

2.1 History Of Fishing In Elmina

2.1.1 Project Setting

Elmina is located at the gulf of Guinea in the central region of Ghana; 13 km west of Cape Coast and 150 km west of Accra. Major ports in Ghana are located in Tema 170 km east of Elmina and Sekondi Takoradi 180 km to the west. The existing port in Elmina is located in the Benya lagoon seaward access from the port to the bay at Elmina is through the lagoon outlet, partly sheltered behind the Elmina port where the scenic Elmina castle is located.

2.2 Historic Context

The Portuguese initiated the development of Elmina as a regional commercial centre and a node in an international trading network when they commenced with the building of St. George Castle in Elmina in 1482. When the Dutch succeeded the Portuguese in 1637, they made it their headquarters on the Gold Coast for the following three centuries.

Originally, the European commercial interest in gold alongside products like pepper and ivory changed to the trade in slaves for the New World. Elmina became an important distribution point for the slaves, to be shipped to the Americas.

All through the 15th to 19th centuries, the town became a bustling commercial centre, where fish and agricultural products were traded alongside a flourishing service industry providing transport, security, storage, as well as artisan activities like pottery and carpentry. The population of the town grew from several hundred people at the arrival of the Portuguese in the 15th century to roughly 20,000 in the mid-19th century.

After the abolition of the slave trade by the Dutch government in 1814, the Dutch lost interest in the Gold Coast and Elmina, and minimised their presence. During the 19th century, they tried to enhance their income from Elmina by developing a gold mine and a cotton plantation, which failed. More successful was the recruitment exercise set up in the 1830s, to enlist African soldiers for service in the Netherlands East Indies (Indonesia). Many returned after the Second World War and settled in Elmina, on what is

now known as Java Hill. They brought back the techniques to make batiks, which are still very popular in modern Ghana.

In 1872 the Dutch transferred all its possessions at the Gold Coast to the British. In Elmina, this gave rise to public protest and guerrilla activities against the British, in which the Ashantis were also involved.

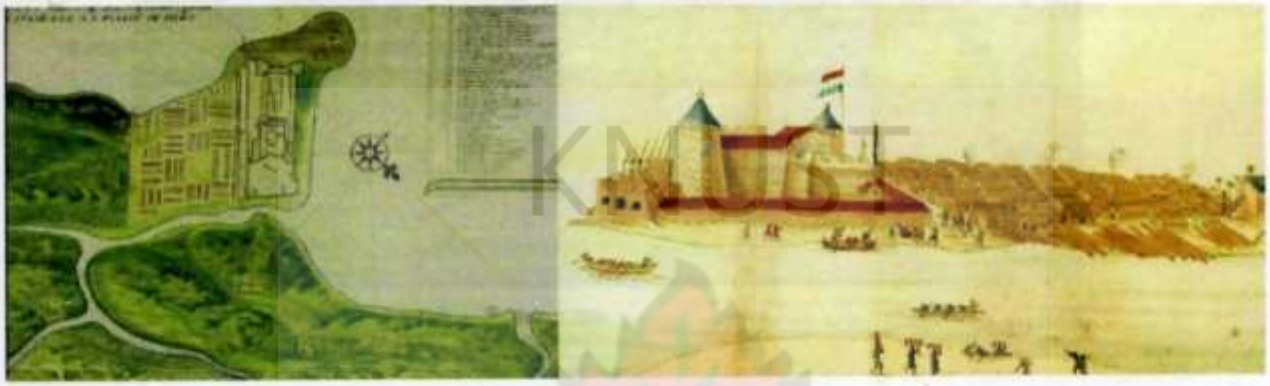

Figure 1: Elmina in 1660 with Castle and the adjacent Old Town, lands north of the Benya Lagoon were still largely undeveloped
(Source: Vingboons Atlas)

Eventually the British exiled the king of Elmina to Sierra Leone while locking up the Ashanti king in St George Castle. In June 1873 they bombarded the old town of Elmina, burning it to the ground completely. For almost a decade Elmina was a ghost town. The site of the old town was transformed into a parade ground and never rebuilt. In the 1920s money from gold and cocoa flowed into the town, and expectations of a new economic dawn returned. The typical 1920s-style colonial merchants' houses built in this period are still dominant in several parts of the Elmina townscape. Private initiatives to develop Elmina into an economic hub (undertaken between 1880 and 1920), including a railway connection to the mining and timber areas of the Western Region and the development of a modern harbour for intercontinental shipping, did not materialize.

When Ghana gained independence from the British in 1957, Elmina was little more than a fishing town. Since then it has grown significantly in terms of population but a growth unmatched by employment. What once was the heart of the West African Gold Trade has become one of Ghana's poorest towns.

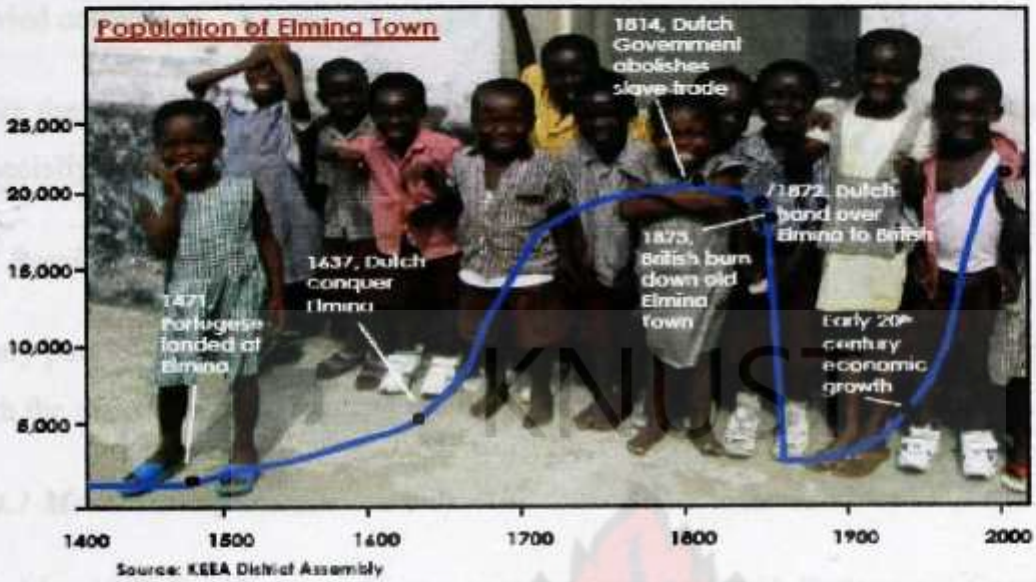

Figure 2: Population of Elmina during the centuries

2.3 The Elmina fishing port

Originally the Elmina port was developed as a second base for powered craft to, provide similar facilities to those at Takoradi.

Improvement included dredging the inner harbor, administrative buildings, maintenance workshop, training school fish market and fuelling point.

Between 1958/59 the main break water at the estuary on the southern-eastern bank extended retaining and quay walls were also added around the same period. However the area for fish handling was never paved and the port saw little development ever since it was until the early 1980s that ZION Mobisquad (a youth organization) saw the need to improve the situation through voluntary effort. Work started in 1984 with the rehabilitation of the quay walls at the canoe berthing grounds .By 1987 the fish market shed had been completed with funding from Edinaman Rural bank (now Kakum Rural bank) who hitherto became a stake holder.

- **The Danida Missions proposed solution;** this consists in principle of an extended break water supplemented with a lee break water running perpendicular to the coast line towards the tip of the main break water . This solution will cause large sedimentation in the entrance area due to vortex generation because this is sheltered for waves.

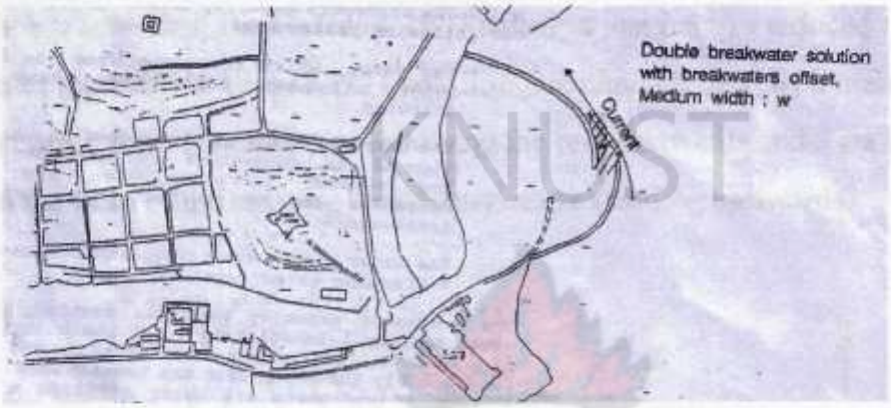

Figure 4: The Danida Missions proposed solution, schematic plan.

- **Portconsult's solution** ;this consist of an extended main break water to approximately the same location as the two former solutions, supplemented with a not directed lee break water which give shelter for a new harbour basin. The tidal channel and the harbour entrance have been separated by an internal guiding wall in order to minimize sedimentation in the basin due to exchange with the tidal current generated by the lagoon.

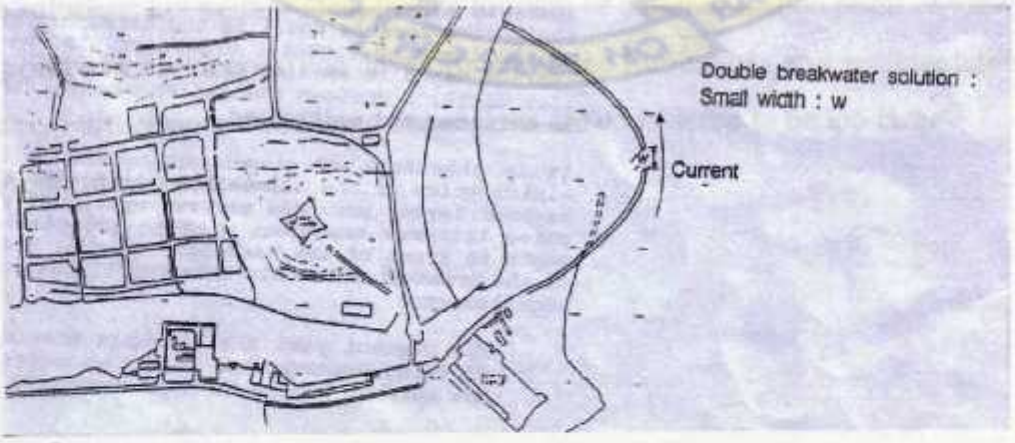

Figure 5: Portconsult's solution, schematic plan.

2.4.2 Large Expansions

Two large expansions have previously been proposed, namely the F.C. de wager 1971 and the Halcrow 1987 solutions.

- Both of these solutions, **the Halcrow 1987 solution** just being a reduced modification of the **F.C. de Wager 1971 solution**, are characterized by a main breakwater starting from Elmina point following the reef eastwards and a lee breakwater starting from the head of the existing breakwater and extending eastwards.

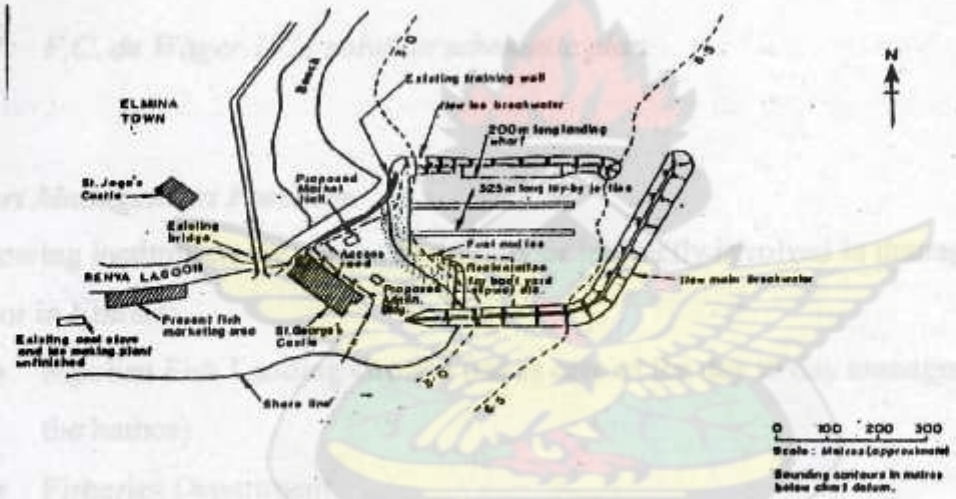

Figure 6: The Halcrow 1987 solution, schematic plan.

- These solutions are neither ideal from a tourism or communication point of view, nor from the point of view of coastline development in the Elmina bay and sedimentation in the entrance. Furthermore these large expansions are considered to be too large considering the catch potential.

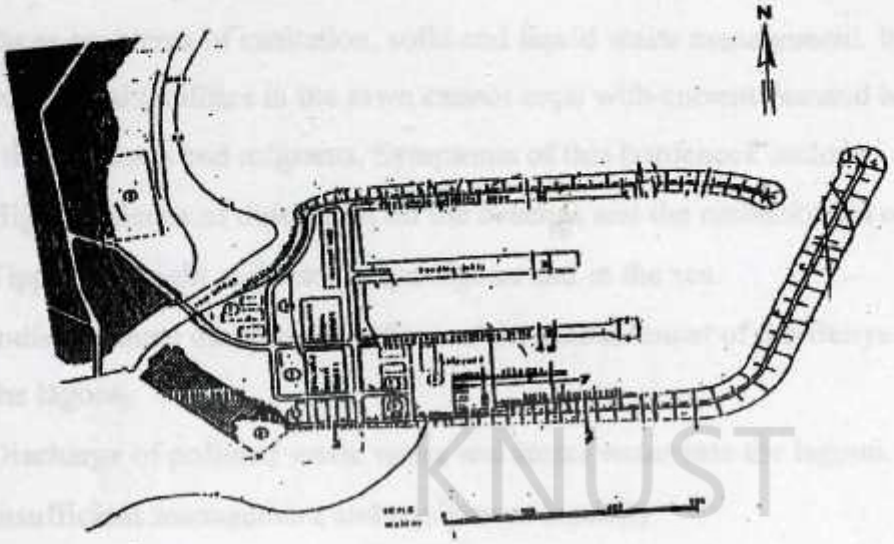

Figure 7: F.C. de Wager 1971 solution schematic plan.

2.5.0 Port Management Practices

The following institutions are presently directly or indirectly involved in management of the harbor in Elmina:

- Mpoben Fish Landing Ground (takes care of the day to day management of the harbor)
- Fisheries Department
- District Administration (KEEA)
- Edina Traditional Council
- The canoe owners association canoe fishermen refer to the Canoe Owners
- The fishmongers association (refer to traditional council /paramount chief)
- The inshore vessel owners association (the inshore vessel fishermen refer to the Fisheries Department)

The institutions listed above are each taking care of their own specific responsibilities.

2.6.0 Environmental facilities

Elmina faces problems of sanitation, solid and liquid waste management. It appears that the environmental facilities in the town cannot cope with current demand being made on them by the residents and migrants. Symptoms of this bottleneck include:

- High incidence of defecation on the beaches and the embankment of the port.
- Tipping of night soil into Benya lagoon and in the sea.
- Indiscriminate dumping of refuse on the embankment of the Benya lagoon and in the lagoon.
- Discharge of polluted waste water and storm water into the lagoon.
- Insufficient management and equipment capacity.

The lagoon is used both as the general unauthorized dump site for the waste from the central parts of Elmina. This both threatens the function as a harbour as well as the ecological conditions

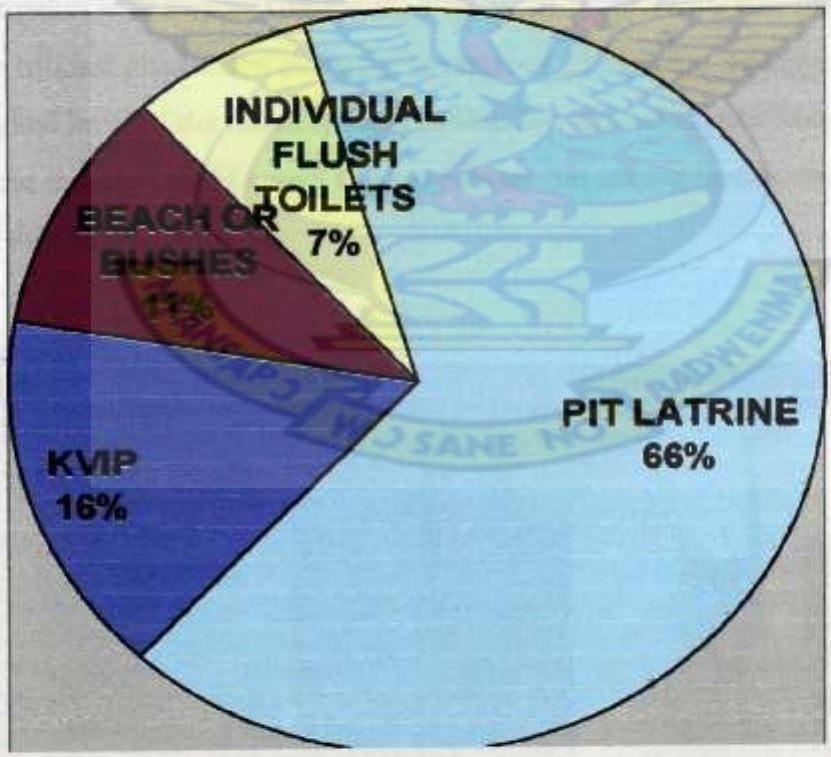

Figure 8: Toilet facilities in Elmina

Figure 9: Waste blocking water flow in drain

2.7.0 Boat building, ice production and cold storage activities

Elmina's shipbuilding industry has a good reputation and caters for a national and even international market with buyers coming from as far as Ivory Coast and Togo. The shipyard has a modest production output of average of 25-30 boats per annum. Yet, the low technological level of the industry leaves room for general improvement and greater efficiency in the industry. Cold stores exist in Elmina but are not operational or too expensive for the fishmongers.

Figure 10: A private cold storage enterprise

2.8.0 Tourism Potential

Presently one hundred and ten thousand tourists visit the Elmina castle yearly. With the rehabilitation of the lagoon port, the area surrounding Elmina Port and the Castle will even be more attractive and the originality of the Castle enhanced, if the quay walls are repaired with sandstone similar to the original structure.

The new quay facing the Castle is envisaged to be paved with micro-concrete tiles and would be ideal for the planning of recreational outdoor facilities attracting tourists as well as locals.

Fishing activities and permanent berthing of fishing vessels shall be avoided and future development of boat services for tourist may utilize these attractive quays.

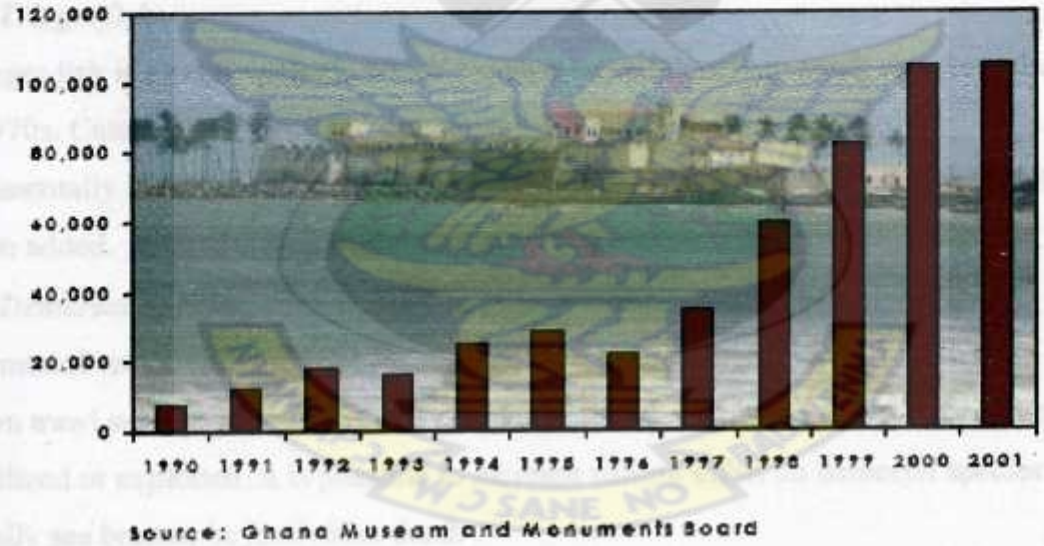

Figure 11: Annual number of tourists visiting the castle

2.9.0 The fish resource

Ghana is located in the Central Gulf of Guinea. The length of the coast line is 536 km. The continental shelf varies in width from a minimum of 10 km off cape St. Paul to a maximum of 80 km near Elmina.

From July to September major upwelling of cool, high salinity water occurs on the continental shelf. A second minor upwelling takes place in December –January. The upwelling drives important pelagic species into the upper layers of the water column, thereby increasing catch ability by the various gear types used.

The surveys on the demersal species show that distribution is rather variable, but most species are abundant in the waters west of Accra. The greatest standing crop occurs in the 4-50m zone.

The tuna resource will not be described, as this resource is fished mainly outside the continental shelf, and therefore cannot be utilized by canoes and inshore fishing vessels.

2.9.1 The fish species

- ***Pelagic species***

The most important pelagic species are round and flat sardine, anchovy and jack mackerel.

- ***Triggerfish***

The trigger fish is a semi –pelagic which increase tremendously in stock size from the early 1970s. Catches have declined dramatically, but this is almost certainly environmentally induced as the collapse was evident before any significant fishing effort had been added.

- ***Demersal Species***

The demersal species are the sea breams, croakers, groupers, sharper and cuttlefish. Based on trawl surveys made it may be concluded that the demersal fish stock are not yet fully utilized or exploited .It is possible to increase fishing effort on demersal species ,especially sea breams beyond 60m depth .

2.9.2 Important fishing grounds for national fishing fleet

In figure 12, the important fishing grounds in are indicated for the different fishing fleet in Ghana.

The figure illustrates that the majority of the fishing fleet of the fishing grounds are located off the central region and Elmina, as the continental shelf outside this region is wide.

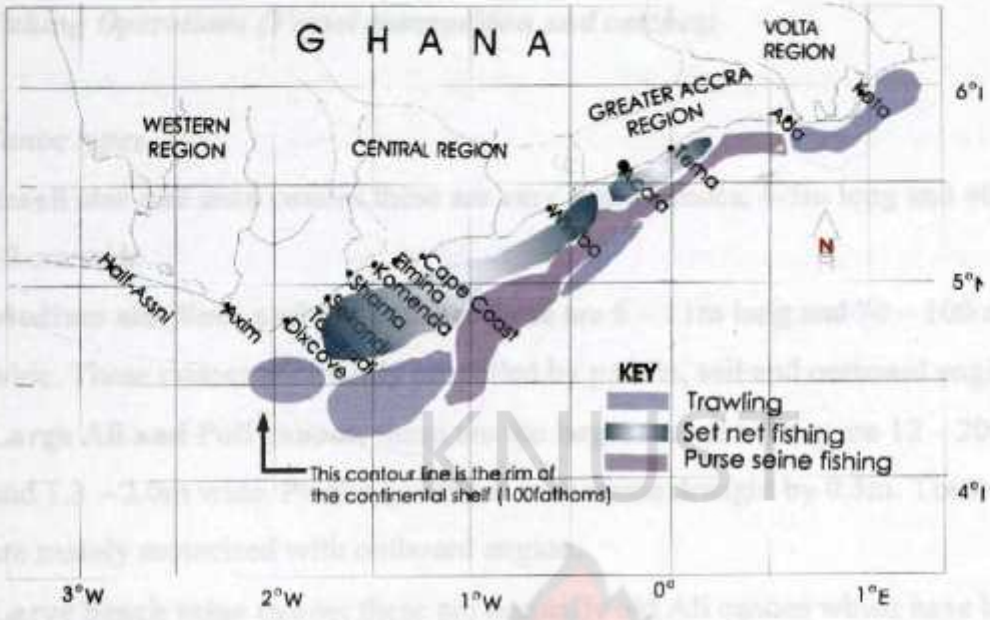

Figure 12: Important fishing grounds in Ghana EEZ

2.9.3 Important fishing grounds for Elmina fishing fleet

The above figure indicates important fishing grounds for canoes and inshore fishing vessels fishing from Elmina harbor. A comparison between figure 12 and 13 reveals that due to an attractive location of the harbor the vessels from Elmina are able to utilize most of the fishing grounds in Ghana's EE Z.

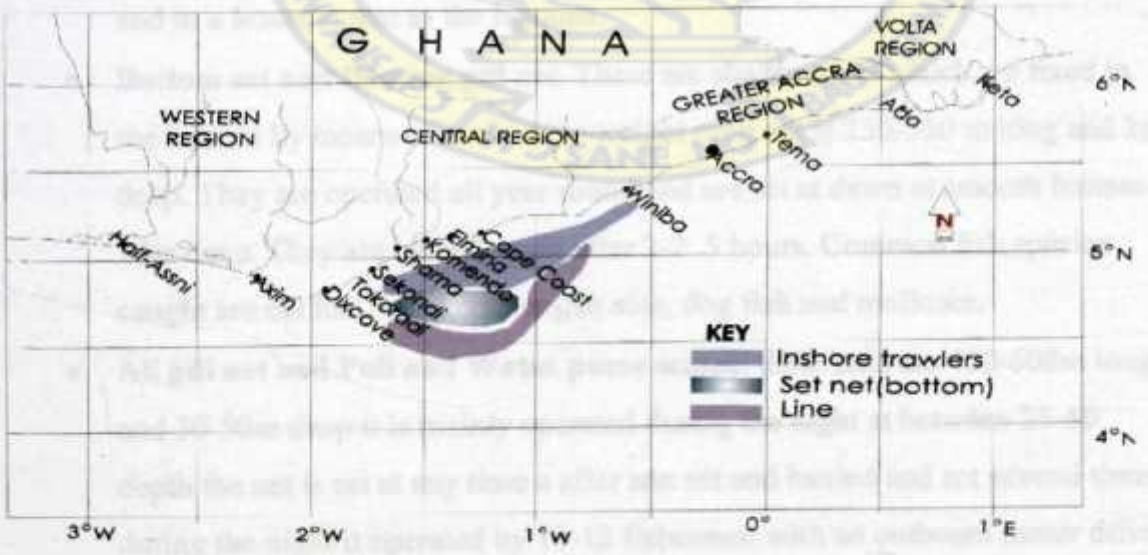

Figure 13: Important fishing grounds for Elmina fishing fleet.

2.10.0 Fishing Operations (Vessel composition and catches)

2.10.1 Canoe types

- **Small size one man *canoe*:** these are very small canoes, 4-5m long and 40 cm – 50 cm wide.
- **Medium size lines and net canoes:** these are 6 – 11m long and 70 – 100 cm wide. These canoes are mainly propelled by paddle, sail and outboard engine.
- **Large Ali and Poli canoes:** these are the largest canoes. They are 12 – 20m long and 1.3 – 2.0m wide. Planks are added to increase draught by 0.5m. These canoes are mainly motorized with outboard engine.
- **Large beach seine canoe:** these are normally old Ali canoes which have been converted for beach seining operations. The bow is raised to avoid taking water; they are mainly propelled by paddle and outboard engine.

2.10.2 Catch techniques

The fishing gear used by the different types of canoes can be described as follows:

- **Bottom set long line and hand lines in the inshore waters.** A set long line is 380-550m long with approximately 500-600 hooks. The long line anchored, baited and set on or near the bottom. It is operated in water of 10-30m depth and to a lesser extent to the lagoons.
- **Bottom set and floating gill net.** These are shallow nets which are fixed to the bottom by means of anchors or weight each net is 230-350 m long and 2m deep. They are operated all year round and are set at dawn at smooth bottom-20m deep. They are hauled again after 2-2 .5 hours. Common fish species caught are cat fish, croakers, tongue sole, dog fish and molluscs.
- **Ali gill net and Poli and Watsa purse seines:** these nets are 450-600m long and 30-50m deep it is mainly operated during the night at between 25-50 depth the net is set at any time a after sun set and hauled and set several times during the night it operated by 10-12 fishermen with an outboard motor driven canoe .The purse seine are characterized by the use of a purse line at the

bottom of the net which enables the net to be closed like a purse and thus retain most of the fish surrounded.

- **Beach seine:** this gear varies in size from 150m long and 6m deep -1800m long and 18-22m deep. Each net has a pair drag robes of about 100m length .Beach seines are only used during day time .A crew of 80 men is required for the operation of large beach seines. Paddle and outboard motor driven canoes are used for setting the nets. The setting and hauling of a large net can take 10-12 hours. The beach seines are mainly used for catching small species like grunts; tread fin, anchovy and sardine.

2.10.3 Inshore Vessels

The fleet of inshore vessel is divided into two categories according to length of the vessels, i.e.: smaller or larger than 12m. The two categories of inshore vessel use the same pattern of fishing operation. They used purse seine during the sardine season. Outside this season inshore vessel use trawl mainly for fishing demersal species.
The major difference between the small and the large inshore vessel is that the former are used from the beach and latter larger than 12m are used mainly from Tema Harbour, As this is the only harbour providing suitable facilities for operating these vessels.

2.10.4 Industrial Vessels

The industrial fishing fleet consist large steel trawlers of 100-800 G R T. These vessels are operated on a joint venture bases involving mainly Korean capital. Originally these vessels operated outside Ghana , but they were forced back to Ghanaian waters after introduction of the national E E Z' s these trawlers are mainly fishing for high value species like sea breams and cuttlefish.
The vessels operate in water depth of 15-50 m which is the main depth range for the target species there is an overlap fishing ground with the inshore vessel.

2.10.5 Catches

The development in total catches of the fishing industry in Ghana is presented in the table below

Source	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Marine	319000	278000	336000	378000	396000	376000	333000	380000	366000	290000
Inland	52000	54000	65500	74000	72000	76000	89000	88000	88000	88000
Total	**371000**	**341000**	**410500**	**452000**	**468000**	**452000**	**422000**	**468000**	**454000**	**37800**

Table 1: Annual fish production by source (MT)

Source: Fisheries Directorate, MoFA.

Table 1: shows that

- The marine source contributes ----- of the total catch, and is experiencing fluctuation .this is as result of under developed catch techniques, the exception of the industrial vessels.
- The sea is still the most important source of the fish resource in Ghana

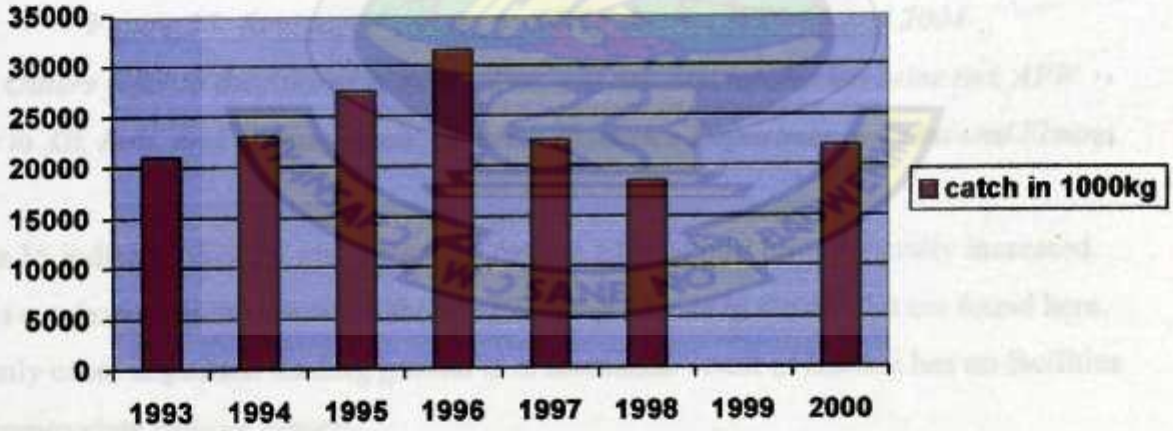

Figure 14: Annual fish landings at Elmina 1993-2000

Note; figures for 1999 were not available.

Source: Fisheries Department

Figure 16 shows that the fishing operations of Elmina have declined in recent times. This is however not due to inadequate fish resource but reasons stated in the first chapter and competition of vessels with industrial vessel.

2.10.6 Development of Vessel Composition in KEEA District

- **Canoes**

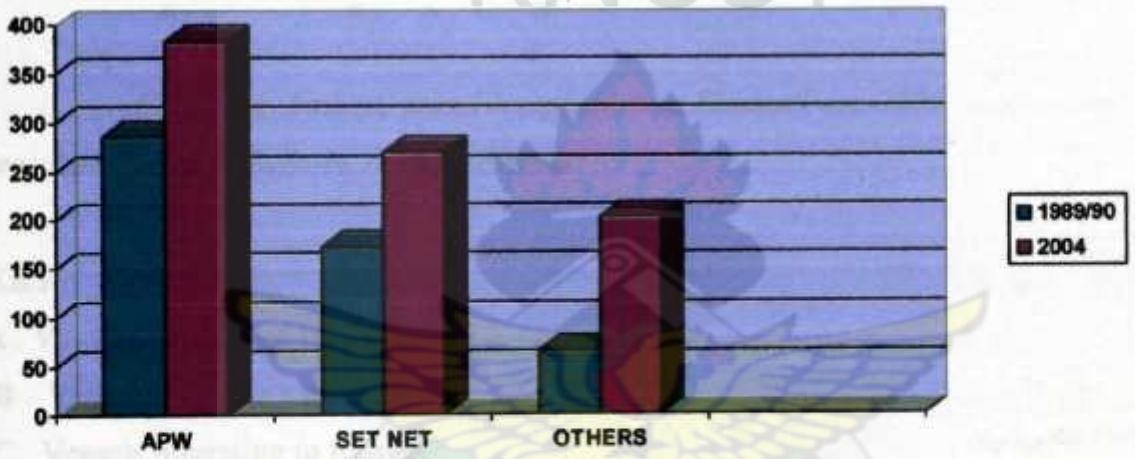

Figure 15: Registered canoes in KEEA district 1989/90 and 2004

Note: Others refer to the following gears, line, gill net, and lobster net seine net, APW refers to Ali, Poli, and Watsa vessels Source: Fisheries Departments, Tema and Elmina.

Figure 15 indicates that the vessels which use the Elmina port have generally increased. This is a safe assumption because about 70% of the canoes in the district are found here. The only other important landing ground is at Komenda –west of Elmina has no facilities to accommodate inshore vessels.

An estimated 1500 canoes (of various sizes and gear type) were found at the port presently. Comparing this figure to 854 vessels registered by KEEA indicates that the port at Elmina is utilized by vessels from other fishing centres along the coast of Ghana.

- **Inshore vessels**

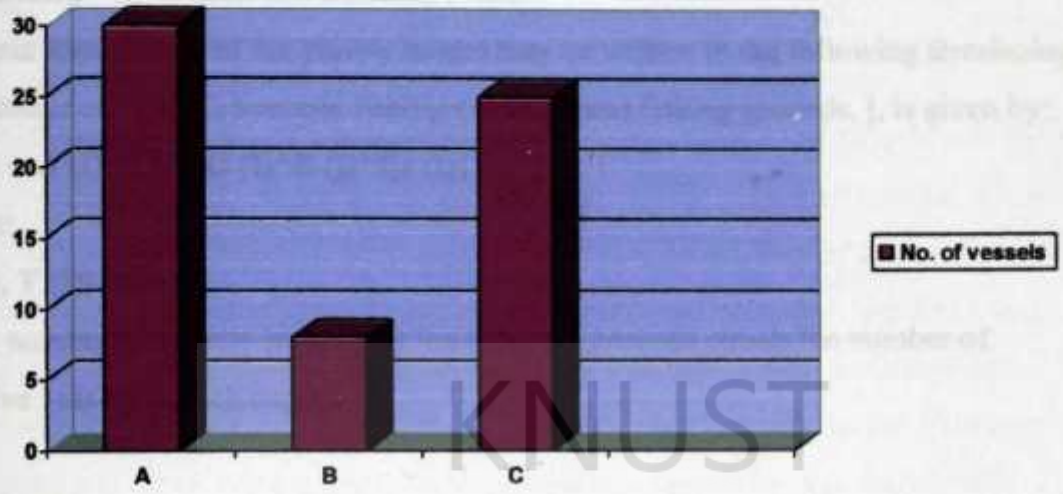

Figure 16: Inshore vessel composition at Elmina Port, 2005

Source: Association of Inshore Vessels, Elmina

KEY

A Vessels Registered Elmina

B Vessels migrating from Elmina

C Vessels migrating to Elmina

Figure 18 indicates that the Elmina port is used by migrating vessels and constitutes 50% of the vessels here. Only a small percentage of the vessels in Elmina migrate due availability of the attractive fishing grounds here. Migration usually takes place during the fishing lean season when the fishermen move from centre to centre based on where the fish is at a particular time.

2.11.0 Assessment of increased landings (Estimated relocation of fishing vessel)

2.11.1 The relocation model.

The model used to analyze relocation of fishing fleet in Ghana is the "Gravitation Model", which is widely used in the analyses of Economic Geography and Planning. The

model used in this study is presented in "Mathematical Methods in Human Geography and Planning" by Wilson and Bennett, 1985.

The basic formulation of the gravity model may be written in the following terminology:

The number of trips, **T**, between fishing centre, **I**, and fishing grounds, **j**, is given by:

T (I, j) = A (I)*B (j)*O (I)*D (j)*f{c (I)}

Where:

Sum {j, T (I)} =O (I)

I.e. the number of vessels leaving for the different grounds equals the number of operative vessels in each centre.

Sum {I, T (I)

I.e. the number of vessel leaving from different harbour to a given fishing grounds =the number of vessels at the fishing grounds.

A (I) and B (j)

Are scalars used in the description of attraction of fishing centres, I and fishing grounds.

F(c (I)

is a function that describe the efficiency of vessel from centre I using the fishing ground j

.

The first step is to study the distribution of vessel on fishing grounds, **D (j)**.

The distribution of the vessel on the fishing centres, **O (I)**, is known. For estimation to be made it is necessary to define an attractiveness factor, **W (j)** of the fishing grounds to represent the differences in catch potentials outside the individual fishing centres. In this analyses the width of the continental shelve is used to describe the attractiveness of the fishing grounds.

In the second step the relative attraction, A of Elmina Harbour is changed to include a future upgrading of harbour facilities.

The estimated distribution of vessels on fishing grounds, **D (j)**, is then used as a base for relocating the vessels on fishing centres, i.e. solving the equation for **O** (I).

This is a conservative estimate of the relocation of fishing vessels as the upgrading of Elmina may lead to increased use of the attractive fishing grounds outside Elmina.

2.12.0 Recent Developments In The Fishing Industry In Elmina

2.12.1 Problem identification and Prioritization

Fishing and its related activities constitute the main and major economic activity in Elmina and directly determine the financial status of the people of Elmina. About 75% of the people living in Elmina derive their livelihood directly from fishing or other activities that depend on it such as processing and trading of fish and canoe building. Although Elmina is still the biggest traditional harbour in Ghana its importance is slowly decreasing. Fishing in Elmina largely follows the traditional patterns and little increase in productivity has been realised in the past decade. Meanwhile the presence of foreign trawlers has increased competition in the industry and as a result Elmina's fishermen have seen their income declining.

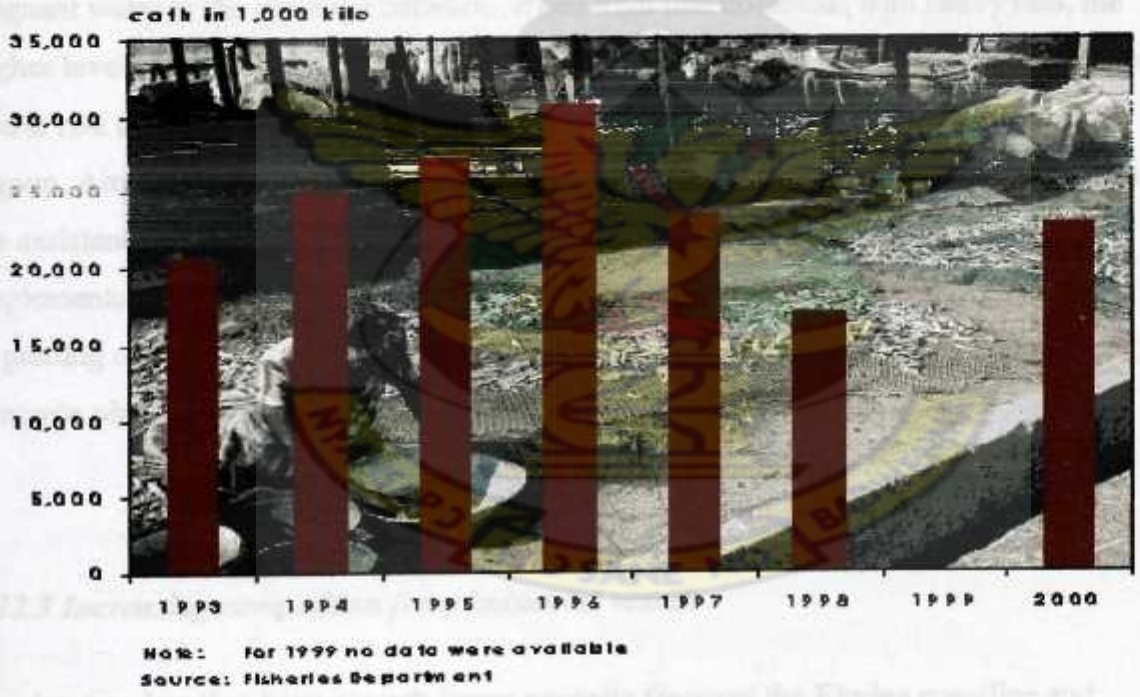

Figure 17: Fish landed at Elmina 1993-2000

The basic infrastructure for the fishing industry in Elmina is limited and therefore preventing an increase productivity and efficiency. The main problems identified by the working group on fishing and fishing harbor are (refer to overview map fishing & fishing harbour for more details):

2.12.2 Siltation of Benya Lagoon

The single most urgent problem for the fishing industry is the siltation of the harbour. It is estimated that silt has accumulated to a depth of three metres in the lagoon (harbour) therefore impeding the free movement of vessels. The present situation in the Elmina harbour is alarming. The silted lagoon seriously hinders fish landing in Elmina since boats can only enter the harbor during high tide. If no action is taken the economic activity in the harbor of Elmina will slowly decline and ultimately die. The siltation of the harbour therefore poses a serious threat to the town's main economic activity. The lagoon has also become polluted over the years, which poses a threat to the health situation of the fisherman and fishmongers.

Further, as mentioned in the section on waste management & drainage the silted lagoon also prevents the wastewater from discharging into the lagoon and hereby causing stagnant water in the drainage network. When high tide coincides with heavy rain, the higher level of the lagoon results in occasional flooding in the town posing an immediate health risk to the people of Elmina. These problems could be solved by dredging the lagoon. Already in the early 1990's plans were made by the Government of Ghana with the assistance of DANIDA to dredge the harbor; these plans were however never implemented. Discussions about the construction of a modern fishing harbour or the upgrading of the current harbour are also regularly held, but have not yet resulted in any concrete planning and implementation.

2.12.3 Increasing competition from industrial vessels

Foreign trawlers that have a much larger capacity frequent the Elmina coastline and compete with the local fisherman for harvest. According to legislation the industrial vessels referred to locally as 'Seiko' are not allowed to fish in shallow waters near the coast. Their minimum depth is 30 meters, theoretically allowing the local fisherman to retain their catchments area near the coastline. Yet as legislation is rarely enforced they are directly competing. The increasing competition induced some fisherman to adopt

illegitimate methods in order to boost their income. For example, both local fisherman and large trawlers use nets that do not filter out the young fish, which can lead to quick depletion of fish stock. Also dynamite or DDT is used to catch fish, posing a threat to fisherman and fishing grounds alike. The use of dynamite not only kills the fish indiscriminately depleting fish resources; it pollutes the sea and kills animals and plants.

Figure18: Fishing harbor is polluted and congested

2.12.4 Limited fishing capacity because of traditional equipment

Fishing boats that sail from Elmina typically stay out at sea for one day. It is recognised by the fishermen that an extension of the period spent at sea could result in greater productivity and enable the fisherman to compete better with the large foreign trawlers. Yet, because most traditional canoes only allow for a limited crew and cannot carry ice onboard to keep the fish fresh over a longer period of time, this rarely happens.

Further as the fishing industry in Elmina thrives on years of experience and tradition, innovative technological assistance to facilitate for increase in capacity has not been explored. While elsewhere along the Ghanaian coast experiments take place with devices to locate large schools of fish and alternative methods of fishing to compensate for the

decreasing saltwater harvest such as fish farming, these possibilities remain largely uncultivated in Elmina.

2.12.5 Limited processing facilities

Fish is sold raw, smoked or fermented with salt, smoking of fish is the most common fish processing method. Very little fish is fried or used to make street foods for sale. Sale of wet fish is also limited because although cold store facilities exist in Elmina but they are unaffordable for the large majority of fishermen.

Most of the fish landed in Elmina is taken outside the town after processing. Evidence suggests regular oversupply in the market for fish, forcing prices down especially at the peak of the fishing season, there are bumper catches, which lower prices and therefore not improve the financial situation of the fishermen. Cold stores exist in Elmina but are not operational or too expensive for the fishmongers.

Similar to fishing methods, also methods for fish processing are largely traditional. For fish smoking the usual method is to use clay ovens. As mentioned in the section on waste management and drainage clay winning for such ovens is not environmentally friendly. Neither is the use of wood fuel for smoking a question that must be answered by tree planting for constant fuel wood supply. For environmental reasons the use of clay ovens has to be reduced drastically. Yet to ensure local employment, alternatives could be explored in the form of large metal smoking ovens that would allow for standardized smoking of fish increasing both quality and capacity. Further the need for alternative solutions to make fish marketable, such as tinning or fish waste processing is urgent.

2.12.6 Inadequate facilities at fish landing site

The Mpoben fish-landing site in Elmina is a multipurpose site: It is used for mending the nets, building of boats, fuelling the motor vessels as well as trading and smoking of fish. The combination of activities leads to unhygienic situations and makes the site congested. While the area would make an entertaining visit for tourists at present the littered waste and putrid smells make it unattractive for tourist to wander around.

Figure 19: Traditional fish smoking ovens at the fishing ground and St. Java hill causing environmental problems

2.13.0 Sector analysis

Strengths

- Availability of indigenous skills and experience.
- Available market for fish and fish products.
- Different resources for utilisation (lagoon and sea).
- Political will to improve industry.

- Presence of Community Based Fisheries Management Committee (CBFMC) and Non-Governmental Organisations (NGO's)like Central and Western Fishmongers Association, Christian Rural Aid Network (CEWEFIA, CRAN, Rudnet and NASOL)
- Elmina's natural strategic location/focal point for fishing within Central Region
- Ministry of Food and Agriculture (MOFA) for technical support (in theory: training in new technology, extension services, location of fish)
- Presence of fisheries Dept.

Opportunities

- New fisheries law/fisheries commissions Act
- Political commitment.
- Subsidization of premix fuel.
- Potential of industry becoming tourist attraction.
- Potential for revenue generation.
- Potential to attract related industries and create employment.
- Possibility to attract funding.

Weaknesses

- Poor fish handling (canoes are not equipped to carry ice to sea) and processing (limited cold storage facilities and absence of alternatives to drying and smoking fish)
- Practice of daily fishing.
- Illiteracy and ignorance about the fisheries law.
- Resistance to change among fisher folks. Lack of introduction to new fishing technologies/methods.

- Indiscipline: usage of undersized mesh nets, dynamite, DDT and lights for fishing.
- Law allows industrial vessels to fish at depth of 30m. Regulations are not being enforced
- Poor saving culture among fisher folks inability to repay loan.
- High interest rate on loans and difficult collateral requirement.
- No formal training for fisher folks (fishing school).
- Absence of storage facilities for large catch. Marketing of wet fish in high season.
- In practice role of fisheries department is limited.

Threats

- Quick depletion of fish stock caused by activities of foreign trawlers damaging the ecological habitat.
- Siltation of the harbour and lagoon
- Break down of the break water system
- Unhygienic environmental sanitation practices.
- Lack of processing facilities and logistics resulting in wastage during bumper harvest.
- Smuggling of inputs/resources needed for fishing

2.14.0 Strategy

The working group envisages that fishing will remain the most important economic activity in town for the next 5-10 years. For Elmina to maintain its status as important fishing town it is however necessary to take both immediate and long-term action to address these problems and improve the industry, boost the local economy, create more employment and improve the environment.

First and foremost dredging of the harbour is a necessity for the fishing industry to survive in the first place. Without dredging in a few years from now the fishermen will no longer be able to enter the lagoon. As already explained in the previous section dredging the harbour also is essential for the functioning of the drainage network making the dredging project one of great urgency and importance.

The working group believes strongly that the fishing industry should anticipate the further reduction of revenue out of the traditional fishing industry. There is not only a need for innovation in fishing and fish processing practices but also for diversification of the fishing methods and products.

To improve capacity in the industry it is important to adapt to new technologies to complement traditional methods such as new boat designs and fishing in fishponds. The fisherman and fishmonger should come to realise that their present fishing and smoking practices are often environmentally unfriendly and therefore need to adapt to larger and technically more advanced boats and smoking ovens that are less polluting and more efficient.

Further it is essential to adapt alternative methods of fish processing such as tinning and milling, providing an opportunity to expand the line of products from exclusive fresh fish to animal feed,

Related to fishing is Elmina's boat building industry, which has an excellent reputation but could play a more significant role than it does currently. It could also play a leading role in development of a new canoe design allowing fisherman to store fish on board and extend time spent at sea.

2.14.1 Short-term objectives (time horizon 2005)

To improve local fishing capacity

- To dredge the Benya lagoon to lower bed level
- To improve boat design to allow for extended periods of time spent at sea.

To improve local fish processing capacity

- To reduce the use of traditional fish smoking ovens and to relocate fish smoking activity away from fish landing site.
- To introduce more environmentally friendly fish smoking technology that can increase quality and capacity of smoked fish production.

To revitalize and expand the boat building industry

- To allow for an expansion of the boat building workshop in the space vacated by the smoking ovens.
- To regularly clean the boat building area from fish waste in order to make it more attractive for tourists.
- To train boat builders in new medium size canoe design that allows to carry ice on board.

To facilitate basic infrastructure improvements in the fishing industry

- To establish a daily waste collection system for the fish landing site
- To establish a clinic at the fish landing site

Long-term objective (time horizon 2015)

To improve local fishing capacity

- To restore the lagoon to its ecological balance.
- To develop alternative methods of fishing such as fish farming to complement traditional methods.

- To improve the skills of the indigenous fishermen in Elmina by introducing them to new fishing technologies, while actively discouraging the use of undersized nets. Dynamite DDT etc for fishing.

To improve local fish processing capacity

- To develop alternative fish processing methods such as canning to complement traditional methods.
- To diversify fish products. Explore the establishment of a small scale processing plant (feed mill) to process fish waste into animal feed.
- To expand the cold storage facilities in the vicinity of the Mpoben fishing ground.

To promote the fishing profession while raising awareness about alternative (related) income sources

- To educate school leavers about the honourable trade of fishing with an emphasis on the hygienic and technological aspects.
- To train fisherman as tour guides for the harbour area explaining about history, symbols, processing methods etc.

2.14.2 Institutional objective

- Institutional strengthening of fisheries department of Ministry of Agriculture and Fisheries to provide technical support.

- NGO's in fishing industry, Community Based Fisheries Management Committee CEWEFIA, CRAN, Rudnet and NASOL to assist in: adapting new methods of fishing and fish processing and negotiate with banks for seasonal credit lines.

2.15.0 World History of Fishing

Fishing itself is an ancient practice that dates back at least to the Paleolithic period which began about 40,000 years ago. Archaeological features such as discarded fish bones and cave paintings show that sea foods were important for survival and consumed in significant quantities. During this period, most people lived a hunter-gather lifestyle and were, of necessity, constantly on the move. However, where there are early examples of permanent settlements (though not necessarily permanently occupied) such as those at Lepenski Vir, they are almost always associated with fishing as a major source of food. The Neolithic culture and technology spread worldwide between 4,000 and 8,000 years ago. With the new technologies of farming and pottery came basic forms of all the main fishing methods that are still used today.

The ancient river Nile was full of fish; fresh and dried fish were a staple food for much of the population. The Egyptians invented various implements and methods for fishing and these are clearly illustrated in tomb scenes, drawings, and papyrus documents. Some representations hint at fishing being pursued as a pastime. In India, the Pandyas, a classical Dravidian Tamil kingdom, were known for the pearl fishery as early as the 1st century BC. Their seaport Tuticorin was known for deep sea pearl fishing. The paravas, a Tamil caste centred in Tuticorin, developed a rich community because of their pearl trade, navigation knowledge and fisheries. Fishing scenes are rarely represented in ancient Greek culture, a reflection of the low social status of fishing. However, Oppian of Corycus, a Greek author wrote a major treatise on sea fishing, the *Halieulica* or *Halieutika*, composed between 177 and 180. This is the earliest such work to have survived intact to the modern day. Pictorial evidence of Roman fishing comes from mosaics. The Greco-Roman sea god Neptune is depicted as wielding a fishing trident. The Moche people of ancient Peru also depicted fisherman in their ceramics.

Figure 20: Egyptians bringing in fish, and splitting for salting.

In traditional Chinese history, history begins with three semi-mystical and legendary individuals who taught the Chinese the arts of civilization around 2800–2600 BC: of these Fu Hsi was reputed to be the inventor of writing, hunting, trapping, and fishing.

One of the world's longest lasting trade histories is the trade of dry cod from the Lofoten area to the southern parts of Europe, Italy, Spain and Portugal. The trade in cod started during the Viking period or before, has been going on for more than 1000 years and is still important.

The fishing industry

Figure 21: A trawler leaving the port of Ullapool, north-west Scotland.

The fishing industry is the commercial activity aimed at the delivery of fish and other seafood products for human consumption or as input factors in other industrial processes.

The fishing industry includes any industry or activity concerned with taking, culturing, processing, preserving, storing, transporting, marketing or selling fish or fish products.

There are three principal industry sectors:

- The commercial sector comprises enterprises and individuals associated with wild-catch or aquaculture resources and the various transformations of those resources into products for sale. It is also referred to as the "seafood industry", although non-food items such as pearls are included among its products.
- The recreational sector comprises enterprises and individuals associated for the purpose of recreation, sport or sustenance with fisheries resources from which products are derived that are not for sale.
- The traditional sector comprises enterprises and individuals associated with fisheries resources from which aboriginal people derive products in accordance with their traditions.

The commercial sector of the fishing industry comprises the following chain:

1. Commercial fishing and fish farming which produce the fish
2. Fish processing which produce the fish products
3. Marketing of the fish products – Wikipedia,free encyclopedia

2.15.1 Fish production

Figure 22: Salmon for sale at a fish market.

Fish are harvested by commercial fishing and aquaculture. According to the Food and Agriculture Organization (FAO), the world harvest in 2005 consisted of 93.2 million tonnes captured by commercial fishing in wild fisheries, plus 48.1 million tonnes produced by fish farms. In addition, 1.3 million tons of aquatic plants (seaweed etc) were captured in wild fisheries and 14.8 million tons were produced by aquaculture.

2.15.2 Commercial fishing

The top producing countries were, in order, the People's Republic of China (excluding Hong Kong and Taiwan), Peru, Japan, the United States, Chile, Indonesia, Russia, India, Thailand, Norway and Iceland. Those countries accounted for more than half of the world's production; China alone accounted for a third of the world's production.

In the 1990's and 2000's it became increasingly evident that industrial fishing had severely depleted stocks of certain types of ocean fish, such as cod.
Commercial fishing provides a large quantity of food to many countries around the world, but those who practice it as an industry must often pursue fish far into the ocean under adverse conditions. Commercial fishermen harvest almost all aquatic species, from

tuna, cod and salmon to shrimp, krill, lobster, clams, squid and crab, in various fisheries for these species. Commercial fishing methods have become very efficient using large nets and sea-going processing factories. Many new restrictions are often integrated with varieties of fishing allocation schemes (such as individual fishing quotas), and international treaties that have sought to limit the fishing effort and sometimes, capture efficiency.

Fishing methods vary according to the region, the species being fished for, and the technology available to the fishermen. A commercial fishing enterprise may vary from one man with a small boat with hand-casting nets or a few pot traps, to a huge fleet of trawlers processing tons of fish every day.

Figure 23: Commercial fishermen in Alaska, early 20th century

Commercial fishing gears today are surrounding nets (e.g. purse seine), seine nets (e.g. beach seine), trawls (e.g. bottom trawl), dredges, hooks and lines (e.g. long line and handline), lift nets, gillnets, entangling nets and traps.

According to the Food and Agriculture Organization of the United Nations, total world capture fisheries production in 2000 was 86 million tons (FAO 2002). The top producing countries were, in order, the People's Republic of China (excluding Hong Kong and

Taiwan), Peru, Japan, the United States, Chile, Indonesia, Russia, India, Thailand, Norway and Iceland. Those countries accounted for more than half of the world's production; China alone accounted for a third of the world's production. Of that production, over 90% was marine and less than 10% was inland.

There are large and important fisheries worldwide for various species of fish, mollusks and crustaceans. However, a very small number of species support the majority of the world's fisheries. Some of these species are herring, cod, anchovy, tuna, flounder, mullet, squid, shrimp, salmon, crab, lobster, oyster and scallops. All except these last four provided a worldwide catch of well over a million tonnes in 1999, with herring and sardines together providing a catch of over 22 million metric tons in 1999. Many other species as well are fished in smaller numbers.

Figure 24: Korean style raw fish

Today, fisheries are estimated to provide 16% of the world population's protein, and that figure is considerably elevated in some developing nations and in regions that depend heavily on the sea. The flesh of many fish are primarily valued as a source of food; there are many edible species of fish. Other marine life taken as food includes shellfish, crustaceans, sea cucumber, and jellyfish. Roe are also harvested.

Fish may also be collected live for research observation or for the aquarium tradeFish and other marine life may also be used for a variety of other uses. Pearls and mother-of-pearl are valued for their lustre. Traditional methods of pearl hunting are now virtually extinct. Sharkskin and rayskin which are covered with, in effect, tiny teeth (dermal denticles) were used for the purposes that sandpaper currently is. These skins are also used to make leather. Sharkskin leather is used in the manufacture of hilts of traditional Japanese swords. Sea horse, star fish, sea urchin and sea cucumber are used in traditional Chinese medicine. Tyrian purple is a pigment made from marine snails *Murex brandaris* and *Murex trunculus*. Sepia is a pigment made from the inky secretions of cuttlefish. Fish glue is made by boiling the skin, bones and swim bladders of fish. Fish glue has long been valued for its use in all manner of products from illuminated manuscripts to the Mongolian war bow. Isinglass is a substance obtained from the swim bladders of fish (especially sturgeon), it is used for the clarification of wine and beer. Fish emulsion is a fertilizer emulsion that is produced from the fluid remains of fish processed for fish oil and fish meal industrially.

Sustainability

Figure 25: Fisheries scientists sorting a catch of small fish and langoustine.

There are many environmental issues surrounding fishing. These can be classed into issues that involve the availability of fish to be caught, such as overfishing, sustainable

fisheries, and fisheries management; and issues surrounding the impact of fishing on the environment, such as by-catch. Several prominent scientific studies in recent years have questioned the sustainability of current fishing practices. Fisheries management, which draws on fisheries science, aims to provide for sustainable exploitation of fisheries.

Cultural impact

Figure 26: Statue of fishermen in Petrozavadsk, Russia.

For communities, fisheries provide not only a source of food and work but also a community and cultural identity.- www.google.com

2.15.3 Fish farming

Aquaculture is the cultivation of aquatic organisms. Unlike fishing, aquaculture, also known as aquafarming, is the cultivation of aquatic populations under controlled conditions.[3] Mariculture refers to aquaculture practiced in marine environments. Particular kinds of aquaculture include algaculture (the production of kelp/seaweed and other algae); fish farming; shrimp farming, shellfish farming, and the growing of cultured pearls.

Fish farming involves raising fish commercially in tanks or enclosures, usually for food. Fish species raised by fish farms include salmon, catfish, tilapia, cod, carp, trout and others. Increasing demands on wild fisheries by **commercial fishing** operations have caused widespread overfishing. Fish farming offers an alternative solution to the increasing market demand for fish and fish protein.

2.15.4. Fish processing

Fish processing is the processing of fish delivered by commercial fisheries and fish farms. The larger fish processing companies have their own fishing fleets and independent fisheries. The products of the industry are usually sold wholesale to grocery chains or to intermediaries.

Fish processing can be subdivided into two categories: fish handling (te initial processing of raw fish) and fish products manufacturing. Aspects of fish processing occur on fishing vessels, fish processing vessels, and at fish processing plants.

Another natural subdivision is into primary processing involved in the filleting and freezing of fresh fish for onward distribution to fresh fish retail and catering outlets, and the secondary processing that produces chilled, frozen and canned products for the retail and catering trades.

2.15.5 Fish products

Fisheries are estimated to currently provide 16% of the world population's protein. The flesh fish is primarily valued as a source of food; there are many edible species of fish. Other marine life taken as food includes shellfish, crustaceans, sea cucumber, jellyfish and roe.

Fish and other marine life are also be used for many other uses: pearls and mother-of-pearl, sharkskin and rayskin. Sea horses, star fish, sea urchins and sea cucumber are used in traditional Chinese medicine. Tyrian purple is a pigment made from marine snails, sepia is a pigment made from the inky secretions of cuttlefish. Fish glue has long been

valued for its use in all manner of products. Isinglass is is used for the clarification of wine and beer. Fish emulsion is a fertilizer emulsion that is produced from the fluid remains of fish processed for fish oil and fish meal.

In the industry the term *seafood products* is often used instead of *fish products*.

2.15.6 Fish marketing

Fish markets are marketplace used for the trade in and sale of fish and other seafood. They can be dedicated to wholesale trade between fishermen and fish merchants, or to the sale of seafood to individual consumers, or to both. Retail fish markets, a type of wet market, often sell street food as well.

Most shrimps are sold frozen and are marketed in different categories.[5] The live food fish trade is a global system that links fishing communities with markets.

2.16 .0 The recreational industry

The recreational fishing industry consists of enterprises such as the manufacture and retailing of fishing tackle, the design and building of recreational fishing boats, and the provision of fishing boats for charter and guided fishing adventures.

2.17.0The traditional industry

The traditional fishing industry, or artisan fishing, are terms used to describe small scale commercial or subsistence fishing practises, particularly using traditional techniques such as rod and tackle, arrows and harpoons, throw nets and drag nets, etc. It does not usually cover the concept of fishing for sport, and might be used when talking about the pressures between large scale modern commercial fishing practises and traditional methods, or when aid programs are targeted specifically at fishing at or near subsistence levels.

2.18.0 Fishing In Africa

Fish is not a major staple food in the savanna and highland zones of Africa, where there is a relative abundance of livestock as a source of protein. However, in the tropical forest margins of the West African coast, fish is a crucial source of protein and, in dried form, a common condiment. Principal grounds for marine fish such as tuna, sardines, and hake are found off the West African coast from Morocco to Senegal, and from Angola and Namibia. The Nile, Niger, Congo, and Sénégal rivers and Lakes Victoria, Tanganyika, Malawi, and Chad are major sources of freshwater fish. The most common freshwater catch is the Nile perch.

In 1999 African fishers caught a total of 6.3 million metric tons of fish, of which 3.8 million metric tons were marine fish. Morocco, Egypt, South Africa, Ghana, and Nigeria were the top African countries in total fish catch; and Morocco, Namibia, South Africa, Senegal, and Libya exported the most fish. Morocco is also the leader in fish-processing industries, producing more canned fish, fish oil, and fish meal than any other African country.

Freshwater fish are available in the rivers and Lake Volta, but the Atlantic Ocean provides the bulk of the nation's fish supply.

Nigeria's 2001 fish catch was 476,500 metric tons live. Slightly less than half the catch was from inland waters, mainly Lake Chad, the Niger Delta, and Kainji Lake. Various species of catfishes, tilapias, and Nile perch, among others, are harvested using small-scale and traditional methods. Sardinellas, bonga shad, and shrimp are harvested from the Atlantic Ocean. In 1975 the government established the Nigerian National Fish Company to enter into joint fishing ventures with foreign companies. Most of Nigeria's 339 vessels larger than 100 gross registered tons are concentrated inshore; deep-sea fishing is still dominated by foreign boats. A growing fishing industry exists along the coast of Tunisia. In 2001 the catch was 100,350 metric tons. The catch typically includes sardines, pilchards, prawns, cuttlefish, and mackerels.

Kenyans engage in lake and ocean fishing, the former contributing most of the fish caught. The main sources of fish are Lake Victoria, Lake Naivasha, Lake Turkana, and

Lake Baringo. Most fishing is done by self-employed fishermen, often as members of cooperative organizations. Most of the fish caught are consumed domestically. Fishing is conducted in Lake Chad and the Niger River, and the catch is consumed locally.Fish are plentiful in Mediterranean waters off Libya's coast, especially tuna and sardines. However, Italians, Greeks, and other Europeans do most of the fishing in these waters. Libya's government has sought to expand the fishing industry and opened a fishing port with refrigeration facilities at Zliten. In 2001 the catch of marine fish totaled 33,339 metric tons. Sponges are also collected near the shore.

Mauritania has a large saltwater fishing potential, and the government has taken measures to protect its offshore fishing areas. In 2001 the country's catch was 83,596 metric tons.Nile perch and tilapia are the most important fish caught in Ugandan lakes. The total catch was 223,100 metric tons in 2001. A growing export industry based on fish processing plants developed in the 1990s.
Most of the fish caught in Cameroon come from the country's rivers and lakes and are consumed locally. However, deep-sea fishing activity is increasing, especially from the port of Douala. Some 111,081 metric tons of fish are caught annually. **-Microsoft ® Encarta ® 2007. © 1993-2006 Microsoft Corporation. All rights reserved.**

2.18.1 Recent Developments

The world's fishing industry is edging towards crisis, and most at risk are Africa's millions of fishermen and women, among the continent's poorest communities. This is the view of a joint Nigeria-World Bank study and the trigger for a global intervention - known as Profish - to meet the looming disaster.

Launched at the recent New Partnership for Africa's Development (Nepad) Fish for All summit in Abuja, Nigeria, Profish aims to promote effective fisheries strategies and policies at the country, regional and global levels by establishing a new worldwide programme for sustainable fishing. The most practical solution, the summit was told, is fish farming. According to a new report, turning the Tide, issued by the World Bank at the conference, over-fishing means far more than ecological loss. It also leads to fewer

jobs, rises in the price of fish, reduces an important source of revenue for developing countries, and is a real threat to the health of poor families in coastal and inland communities. The importance of fish in developing countries is shown by the numbers. The fish production sector employs some 150m people in developing countries and growth in jobs in the fisheries sector has been mainly in small scale fisheries in the developing world.

Studies released over the last year show that the marine fisheries are already heavily overexploited. Coral reefs are damaged globally and unless something is done about the ecological dilemma, sustained fisheries for either the poor or rich countries will disappear. The crisis stems from the simple fact that fish is being taken out of the sea much faster than existing stocks can replenish themselves. Fish is the most heavily traded food commodity and the fastest growing agricultural commodity on international markets. A worrying upshot of over-fishing is that even though yields are about the same every year, increasingly smaller fish species are being captured, disrupting the food chain. So while the same quantity offish is caught, the quality is declining. There are 38m full-time fishermen and 90% of the world's fishermen are from Africa and Asia - where poverty among coastal communities is often There is a clear need for an approach like Profish, as existing mechanisms to protect fisheries are not working satisfactorily. Poor governance, lack of regulations and lack of enforcement present a barrier to effective fisheries management.

Nepad is one hundred percent (100%) behind the initiative and is calling for greater investment into responsible and resource-aware fishing, and into the aquaculture industry.

The African Union as a body is firmly behind the development of fisheries as an additional way in which impoverished African countries can meet their commitments to the United Nations Millennium Development Goals (MDGs) to halve poverty by 2014. Since the 1950s, the total number of people fishing and fish-farming worldwide has at least quadrupled (compared with a 35% increase in the economically active population in agriculture) and the average catch has increased an estimated 270% between 1965 and 1995. One outcome of this explosive growth is that 30m small-scale fishermen have seen

their income decline in many parts of the world. Such over-exploitation of marine protein resources threatens the nutritional status of major population groups, particularly of the 400m people from the poorest African and south Asian countries, for whom fish products provide at least 50% of their essential animal protein and mineral intake.

Excessive fishing has not been the only cause of the industry's failing health. The population living within 100km of the coast has expanded to 2.2bn people, nearly 40% of the global population, leading to pollution and degradation of major marine ecosystems. Clearly, limiting access to fishing is only part of the solution. Another major factor to be addressed is the level of subsidies. Currently subsidies are devastating for sustainable fisheries in the sense that fishing fleets are subsidized; this results in over fishing in critical ecosystems. While there is a worsening crisis that particularly affects fisheries in tropical waters, where sector governance is currently weakest, not all is lost.

What can be done to turn the tide:

* Strengthen the co-management and restructure governance between fishers and government through extension, education and awareness.

* Change patterns of exploitation to avoid catching immature fish through mesh size regulations, setting legal fish sizes, and temporary and seasonal area closures.

* Establish marine protected areas to rejuvenate depleted fish stocks.

* Aquaculture will go a long way in meeting the global demand for fish and reducing the pressure on capture fisheries.

* Certification and food safety programmes have the potential to promote sector sustainability and poverty reduction.

* Institute restocking and stock enhancement programmes by releasing reared juveniles into open waters, funded through bilateral donors. – www.bnet.com

2.19.0 Fishing In Ghana

Fishing has been more successful, although less than 10 percent of Ghana's fish consumption comes from Lake Volta. The Volta Lake Research Project, established in 1968, has conducted research on the resettlement experience and on ways to enhance the development potential of the region.

Figure 27: A fishing village in Ghana, a country in West Africa, employs mud ovens to dry its fish.

2.19.1 Fisheries

The fisheries sub-sector in Ghana accounts for 5% of the Gross Domestic Product (GDP). Fishermen, fish processors, traders, canoe and boat builders, mechanics and families who depend on this sub-sector for a livelihood constitute 10% of the total Ghanaian population. Fish makes up 60% of the Ghanaian animal protein intake. As such 75% of the total production of fish consumed domestically.

2.19.2 Fish Storage

Fresh fish is usually stored in cold facilities. There are only two cold storage facilities at Elmina but no ice making plants. The inadequacy of storage facilities has resulted in the pervasive fish smoking along the coastal zone of the district. Alternatively, some of the smoked fish is converted into fish powder, which is packaged for sale. This product can be preserved much longer than the smoked fish.

2.19.3 Types of Fishing

Two main types of fishing are practised. These are: Marine and Inland (fresh water) fishing.

I. Inland Fishing

This is done on a limited scale by fish farmers who usually combine it with their normal farming activities. From official records, only two (2) active fish farmers are known in the district although other unregistered fish farmers exist.

II. Marine Fishing

Two groups of fishing fleet engage in marine fishing. These two groups, which together have a total fleet of 760 canoes and fishing vessels, are:

(A) A fleet of 735 wooden dugout canoes, half of them motorized and operate from 9 fishing villages and towns. In 1993 with catch from only canoes, the district produced 20,729 metric tonnes of fish.

(B) The second fleet comprises vessels of particular type, which only operate from Elmina. This is a fleet of about 25 diesel engine inshore vessels using mainly light bottom trawl and purse seine nets.

Fishing operates for six days of the week targeting mainly sardines, some demersal species and crustacea. A variety of fishing gears are used in both marine and inland fishing. These are:

- Trawl for motor fishing vessels;
- Ali, Poli and Wasta nets (APW) for both motorized fishing vessels and canoes;
- Drag-net for large canoes; and
- Set net for small and medium sized canoes; and Beach seine manual used in both inland and marine fishing.

2.19.4 Fish Landing

Elmina is the only fishing town in the district with a fish landing which offers the only berthing and landing facilities for both inshore and canoe fleet. The rest of the fishing villages and towns lack this facility.

There has been continuous decline in fish landings since 1995 due to many factors. Notable among these are the high cost of fishing inputs, unprotected and deteriorated landing beaches, unfavorable weather and the indiscriminate use of carbide.

2.19.5 Fish Processing

Fish landed by the canoes and inshore fleet is sold directly to the fishmongers who smoke the bulk of it with the rest being sun-dried or salted. Some of the fish is also sold directly to consumers at the landing sites.

Fish processing is done mainly through smoking by using the traditional round mud ovens and the "Choker Smoker". The traditional method of smoking contributes greatly to air pollution along the coastal zone due to inefficient biomass combustion generating large volumes of smoke.

The latter method of processing has many advantages over the first and need to be adopted. However, the limiting factor is finance. CEDECOM has constructed one but it needs to be tested. It is located at the fishing village at Elmina.

2.19.6 Characteristics of fishing in the KEEA District

Figures available from the Fisheries Department suggest that there are 9,669 fishermen using 924 canoes and 60 in-shore vessel for fishing in the KEEA district. The amount of fish landed in the district from marine sources is presented.

The figures suggest that there could be large fluctuations in the amount of catches. It seems worthwhile to undertake a study into the causes of fluctuation in fish catches, for a better understanding of the dynamics of this important economic activity in KEEA

(especially Elmina). The peak season for fishing lies between June and September. Most of the fish caught in the KEEA District is landed in Elmina.

Seventy-five percent of the inhabitants of Elmina perform jobs which are directly and indirectly associated with fishing. The importance of fishing in Elmina town has prompted programmes like a 'Fishing Continuation School' for first cycle school graduates and the establishment of the Paul Isert Centre to give update information on fishing technology.

In the late 1960's a fish-landing site (now called Mpoben) for diesel engine motorized boats was constructed in Elmina. Discussions about the construction of a modern fishing harbour or the upgrading of the current harbour are regularly held, but have not resulted in any concrete planning and implementation.

The type of nets and gear used for fishing determines the local organisation of canoe fishermen in Elmina. There are 215 Ali Poli Watsa net groups, 79 set net groups and 30 hook and line groups. Besides these, the town has ten beach seines. All the 60 in-shore motorised vessels of KEEA are stationed in Elmina town. The number of canoes and vessels increase between July-September, the peak of the fishing season.

Among the types of fish landed in Elmina is burrito, round and flat sardines, cassava fish, tuna, scad mackerel, sea breams, red fish, ribrin fish, barracuda, lobsters, prawns and crabs.

The figures once more bring forward the suggestion that factors which account for fluctuations in fish catch are worth assessing, in order to find ways of boosting or sustaining production in the future. An acknowledged problem for the local fishermen is for instance the presence of big production trawlers of mainly Korean origin, locally called Seiko, who use nets that catch both adult and young fish, and in general at times take away much of the harvest before the local fishermen.

These incomes represent what is obtained from fish sales alone. Apart from this there are incomes from supportive services like fuel supply, vessel engine repairs, fish gear sales, fish processing, and food and ware vending at the landing sites, as well as tolls.

Elmina has four fish landing sites, namely Mpoben, Zion, Liverpool Street and Post Office. These sites each have a chief fisherman referred to as Apofohene. The Apofohene elect from among each other an overall leader of all the fishermen in Elmina. There are advisors to help them in their duties.

The Apofohene and the advisors make regulations about fishing in Elmina, receive non-citizen (or guest) fishermen in Elmina and settle disputes. To support their duties, each vessel makes a financial contribution for the running of the governing body. The Apofohene is not only the spokesman for the fishermen, but also interacts with other agencies to make it easier for fishermen to acquire fishing assets and capital.

Similarly women, who buy the fish from the fishermen and either process or market it, have a 'queen mother' called Konkohenmaa. Together with her advisors, she sets the rules for fish trading and settles misunderstandings. Both the Apofohene and Konkohenmaa are channels through which communication, information, and education pass to the fishermen and fish traders.

What this local organisation does not do is the pricing of fish catches. That is left to be determined by market forces. By convention the local measure for a fish catch is not by tonnage but by basins or crates.

2.19.7 Financing of fishing assets and capital goods

In the fishing industry capital goods and assets are to a large extent privately owned. Fishermen are employed by owners of fishing equipment, and share the profits with the owner after deduction of amortization amounts for the vessel or canoe, the outboard motor, nets and fuel. The gear owner takes a greater proportion of the profit and the rest is shared among the fishermen.

Especially during the lean season, catches do sometimes not cover the cost of fuel used for each fishing trip. Debts accumulate and make the fishermen poor. When the major fishing season comes, there are often bumper catches, which lower prices and does not make the fishermen any better off.

New approaches are emerging to the financing of fishing. Fishmongers have been trying to come together to purchase the gear for the fishermen. In so doing the fishmongers reserve the right to first choice / first buy of the fish wholesale from such vessels before retailing it.

The Kakum Rural Bank in Elmina has been trying to help fishermen with financial investments, especially for outboard engines and nets, on the condition that the fishermen make their savings with the Bank. A micro credit scheme has just begun operating at the Mpoben landing site.

Besides this, the fishermen try to sustain themselves by a non-formal method of saving money, called 'Susu'. This involves paying a specified amount of money each day to a collector. The salary of the collector is made up of a day's deduction from the contributors to the Susu scheme. The scheme earns no interest, it merely encourages saving.

Fish is sold raw, smoked, or fermented with salt. Very little is fried or used to make street foods for sale. Of the named processing methods, smoking is the most common. The usual method is to use clay ovens. Clay winning for such ovens is not environmentally friendly.

Neither is the use of wood fuel for smoking a question that must be answered by tree planting for constant fuel wood supply. Fish smokers do not as yet know the components of smoke or the science that will make a standardised smoked fish. However, the known traditional method of smoking makes their products marketable.

Most of the fish landed in Elmina is taken outside the town after processing. The usual places of sale are Kumasi, Techiman and the forest regions. Information gathered from the fishing sector suggests regular oversupply in the market, forces prices down. For this reason cold stores and tinned fish factories are projects that could improve the living conditions in Elmina.

Fishing in Ghana exploits fish from stocks in the sea, rivers, lagoons, and lakes and in recent times also from artificially made fishponds. The marine resource of fish is the most important. An estimated 8,700 motorised and non-motorised wooden dugout canoes using purse seines, ring and set nets mostly. There are 300 in-board diesel engine powered vessels and 40 large distant water frozen trawlers in the country.

2.19.8 The future of fishing in Elmina

Fishing has got a future in Elmina, but then the idea of fishing, as a business for uneducated and illiterate people must be discarded. Fishing is an honourable trade, and school leavers who would like to take up fishing as a profession must be encouraged to do so. A higher percentage of educated fishermen will help the trade to achieve a higher professional status, and will ease the introduction of scientific methods of fishing.

Educated fish processors will know about handling fish hygienically and educated mongers ere able to take records of their ventures. Laws formulated to regulate fishing, vocational education, and technology transfer may be easier to enforce with educated fisher folk.

The fishing industry in Elmina will be helped with the construction of cold stores; a fish processing factory and the construction of improved harbour facilities or a new fishing harbour.

Fishing in Elmina has the potential as a tourist attraction. On a fishing day, the cluster of canoes and people on the landing sites, which can be viewed from the castle of St. George or from the waterfront, is a picturesque sight. The observer can choose what he

wants to see: types of canoes, colours of canoes, proverbs and slogans written on canoes, flag symbols of canoes, different apparel people put on at the landing sites, different languages spoken, barter and the procurement of fish, people's behavioural patterns and other social eccentricities.

On Tuesdays, the non-fishing day, it is also an attraction to observe how fishermen mend their nets, how they meet to settle disputes, and share their profits. The Elmina fishermen give a special touch to the local Bakatue Festival, when they hold canoe regattas. Their ways of contracting marriages, sustaining them, and conducting funerals are also points of interest.

Currently fishing and its connected activities have not been used or explored as a tourist attraction. This seams a missed opportunity. Apart from the ways tourists can enjoy the colourful aspects of fishing described above, tourists could for example also pay to enter the landing area and learn about the way fishing takes place in Elmina, get an explanation about proverbs and symbols, learn about the history, and listen to stories from the traditional fishermen. A tour guide from the fishing community itself, who receives a fee at the end of the tour, could guide the tourists.

2.19.9 The impact of fishing on the environment

A proper environmental impact study of fishing in Elmina has not been conducted so far. It is however, readily observable that there is lack of a scientific approach to fishing This may account for the notable fluctuating catches. It appears that migratory fishes are caught indiscriminately off season, and that there is no conscious stocking of the sea through non-fishing periods or otherwise to allow fishes to breed. There is the already noted problem of the factory trawlers who empty the sea with their nets.

Until quite recently some fishermen used dynamite or DDT to catch fish. Dynamite poses a danger to the fishermen themselves as well as the fishing grounds, and DDT pollutes the water. The hydrocarbons of the fuel used to power vessels are likely to have a negative cumulative effect on the flora and fauna of the sea. On land the fish processing

brings stench and smog into the town, the harvesting of clay to build ovens for smoking fish is environmentally degrading and a security hazard.

The use of dynamite by some fishermen does not only kill fishes indiscriminately, thereby depleting fish resources, but pollutes the sea and kills other animals and plants in the sea as well. It is also harmful to human beings. As stated earlier, Elmina has virtually no manufacturing concern or factory whose activities produce any hazardous affluent, which has a direct impact on the environment.

However, indiscriminate disposal of used oils and / or spillage of oils and other fuel from fishing vessels, especially into the Benya Lagoon and its environs, poses a danger to people and aquatic life as well as plants along the banks. The use of hard to decompose polythene bags for the carriage of goods and indiscriminate disposal of such materials poses an immediate environmental problem.

2.20.0 Case Studies-Tema Fishing Habor

2.20.1 Tema Fishing Harbor

The Tema Fishing Harbor was chosen as a case study in order to identify and investigate the standard elements which constitute an efficient modern fishing harbour and their functional relationship.

2.20.2 Layout and components

The Tema Fishing Harbour is broken into different activity based. The northern side, where the main entrance/exit is, has about seventy (70%) of the total land available. It is here that industrial activities such as food canary and cold storage of fish occurs amongst other interrelated activities. The elements which constitute the harbour include the following:

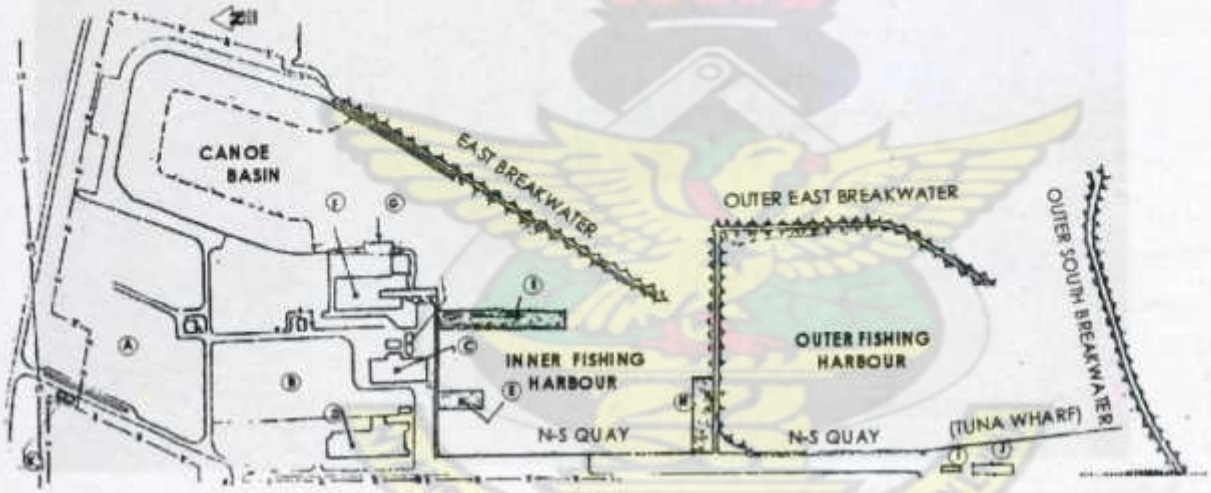

Figure 28: Layout plan, Tema fishing Port (not to scale)

Credit: Tema Fishing Harbour

- **A** , Pioneer food cannery
- **B**, Russian food factory
- **C**, Fish market
- **D** ,Cold store
- **E**, Finger jetties

F, Boat yard

G, Fitting shop

H, Lay by wharf

I, Fire fighting unit

J, Administration

Canoe Basin

The canoe basin caters for the artisnal fishermen as well as other fisher folks along the coast of Ghana. It has the capacity to accommodate 400 canoes and 500 in the peak season. It also has:

- Wooden jetty for motorboats
- Fish handling shed
- Protective water area of 5.2 hectares.
- A 120-room gear storage facility.
- Sanitary facilities
- Boat repairs yard

Figure 29: The fish handling shed where the fish are sorted out before they are carried to the fish market.

The dry dock can take two canoes at a time. It has a rail basin for the repairs of the canoes.

Figure 30: Boat repair yard provides a dry base for the repair faulty boats. Faulty boats area rolled from the sea with metal rollers on the dry sheltered dock.

Figure 31: The canoe basin has a protective water area of 5.2 hectares. It also has a depth of 3-4 meters but is heavily silted due to inflow of filth from the Chemu lagoon.

2.20.3. Main Activity Pattern of the Fishing Port

The main activity pattern of the port as shown below, helps to make the port function effectively. Due to the short life of fresh fish, this activity must be achieved within the shortest possible time to help make the best use of the fish harvested.

Figure 32: Main activity pattern of the Tema fishing port

Main elements considered in the design of the Fish market include:

- ***Lighting*** -Daylight factor
- ***Ventilation***
- ***Circulation***
-

- **Lighting**

Figure 33: The use of glass in the skylight helps to admit more light into the space. The skylight is effective because it creates an additional light source.

- Ventilation

Figure 34: The honeycomb wall allows enough air into the fish market to take away the smell of the fish. The volume of the space is also important to aid in the circulation of air.

Figure 35: Wide overhangs are used to cut off the sun's rays during the day in order to make the production floor conducive for business

Ventilation - This is basically achieved through the honeycomb walls and other openings. Aside the door openings, there is no other opening apart from the ones the honeycomb walls provide. This is to allow fresh air in the fish market. The transparent material used in the skylight helps to admit more solar radiance into the production floor.

There is a maximum use of day lighting in the fish market. This is achieved through the use of honeycomb walls.

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CONCLUSIONS

Merits

- The segregation of the vessels types has reduced the risk of accident and offers an effective planning option.
- The choice of the building materials has helped to fight the destructive nature of the sea breeze.
- The use of steel with antirust especially helps to prevent rust to a certain degree.
- Useful facilities are available to assist in the running of the port. A study of these facilities will give a fair knowledge of the facilities that need to be provided.
- Security checks are mounted at strategic points to ensure security measures.

- The breakwater constructed creates a very safe place for the vessels to dock.
- The provision of the service gallery for the supply of water and fuel is of great help.
- Repair facilities are provided to help the vessel owners to have their vessels repaired.
- The provision of cold storage facilities helps to preserve the fish caught especially to the local artisans, this is very important.

Demerits

- According to health requirements, it is not healthy to expose fish to the direct rays of the sun. This is not so at the port premises where fish is directly off-loaded in the sun.
- Despite the security checks, there are still very serious issues with security.
- The administration of the port is located too far from the main entrance.
- Filth generated at the canoe basin is thrown into the sea. This has reduced the depth of the canoe basin. It therefore needs serious dredging.

Considerations

- Construction of breakwater must be in respect to the wind direction and must rise at least 3 meters above sea level.
- The type of materials to be used must be considered. Much of concrete and steel is better. The various ways of handling corrosion must also be considered if corrosive materials are to be used.
- The facilities to be provided and the activity pattern for the spaces to be provided are very important.
- The type of construction system that best suits climatic considerations of the coastal areas is very vital.
- This case study was to establish the upper limit for consideration in my design. These parameters will also help to come up with considerations that will be relevant to the design.

2.20.4 Observation and Derivation from study

- The harbour entrance (into/from the sea) is well protected and sheltered.
- There is a satisfactory functional relationship facility. The port administration building is isolated, but it's a merit to the activities there, since they need quietness.
- Sanitation is good as sanitary facilities are located at vantage points all over the place.
- Major demerit is that most of the buildings are oriented in such a way that, it is exposed to greater heat loads. This has however been mitigated with sunshades.

2.21.0 Case Study- Bosomtwi Sam Fishing Harbour ,Sekondi-Takoradi

2.21.1 Focus of Study

The study of the Bosomtwi Sam Fishing Harbour-Sekondi was undertaken for similar analysis made at Tema. However this is a miniature model of Tema fishing habour

Figure 36 : Part of the administration and fish handling shed at the port

2.21.4 The Project

- **Project;** originally titled as Sekondi fishing port but later re-christened as Bosomtwi Sam Fishing Harbour, in memory and honor of the late District Chief Executive of the then ruling NDC government.
- **Consultants:** Tetra Consults
- **Clients:** Ghana Ports and Harbour Authority
- **Site:** A section or the old canoe landing bay behind the Ghana Armed Forces Naval Base installation
- **Programme**: to expand and modernize fishing activities in the Western region of Ghana
- **Funding**: Japanese Government(JICA)
- **Cost:** unknown

2.21.5 Layout and components

Unlike Tema, the Layout here is simple and straight forward, due to the scale of the project.

Office The open yard consists of the following facilities:

- Ice Making Plant
- Fish Handling Shed
- Lavatory
- Septic tank
- Reservoir tank
- Elevated water tank
- Fire fighting pump house
- Electric house

Figure 37: The Reservoir tank

Figure 38: The Electric house

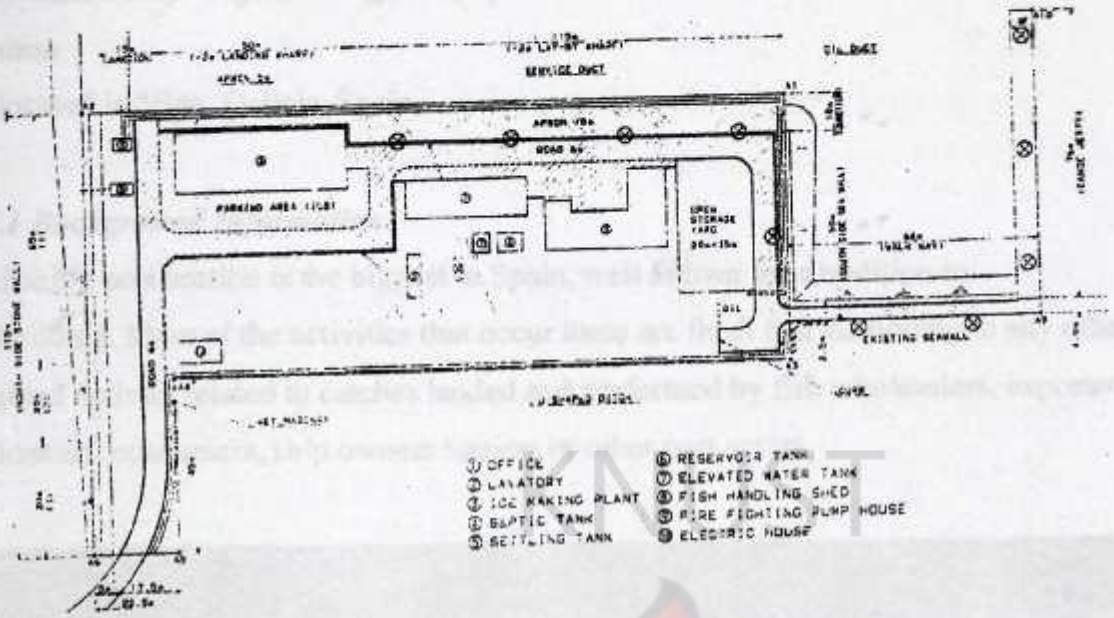


Figure 39: Layout plan, Bosomtwi Sam Fishing Habor (not to scale)

Credit: Bosomtwi Sam l Fishing Harbour

2.21.4 Observations and Derivations from study

- The breakwater is not closed enough, to shelter the port (vessels) from storm waves
- The functional relationship is straight forward
- The port is spacious and relieved of congestions, thus a clean environment.
- The facility is adequately serviced, thus providing an in-sight into the basic services requirement of a medium to large scale fishing harbour.
- The facilities here are well serviced, thus providing an insight into the basic services requirement for medium scale fishing harbour.

2.22.0 Case Study- Vigo Fishing Port, Spain

Location

It is located in Vigo, Galicia, Spain.

2.22.1 Background Information

The fishing port section is the biggest in Spain, well known for a tradition in shipbuilding. Most of the activities that occur there are fresh fish auctioning to any other imagined activity related to catches landed and performed by fish wholesalers, exporters, auctioneers, consumers, ship owners haulers or other port actors.

Figure 40: A live layout map of Vigo fishing port

Concept

To use information technology to develop services that reduce costs, maximize ports infrastructure use, achieve excellence in management and increase real time information available to take decisions.

Scope

The following facilities are available:

4 basins (unloading, supplying and mooring)

Fish Farming area

Cold Stores

All these facilities cover a total area of 236.953 square meters.

Security

An automatic security system which reads car plates before they are given access. Pedestrians are allowed in if they have the RFID card. Interphones have been installed on entrances in case of any inconveniences.

Figure 41: Main Entrance of the port where computerized security system is used

2.22.2 Activities

When the vessel arrives, it docks by the pier or quay and is moored with the help of ropes and bollards. The fish is usually packaged in wooden boxes or containers. They are then offloaded using cranes and trolleys.

Figure 42: Mooring a vessel on Vigo port

2.22.3 Observations and Derivations from study

- The security system used is very efficient but may not be suitable use in the traditional African setting.
- The facility is adequately serviced, thus providing an in-sight into the basic services requirement of a medium to large scale fishing harbour.
- The facilities here are well serviced, thus providing an insight into the basic services requirement for medium scale fishing harbour.

2.23.0 Special Studies and Technical Studies

2.23.1 Planning and Design Assumption (For new port layout)

The existing fleet of canoes and inshore vessels in Elmina has been described and analyzed and the following has been summarized as basic capacity criteria for the rehabilitation and improvement of lagoon port:

Existing Fishing Fleet	***Vessels*:***
Large canoes, (APW) registered In Elmina (2004)	210
Large canoes, (APW) migrating to Elmina in the peak season, up to 40% of above or approximately	84
Medium size canoes, including seasonal migration	298
Small canoes, including service vessels	403
Small inshore vessels (less than 12m), Operational	47
Small inshore vessels, non operational	10

Note: *estimates from KEEA values (2004)

2.23.2 Vessels Relocation

With the dredging of lagoon and the improvement of water depth and navigation conditions at the port entrance, it is estimated that the number of canoes attracted to the port will be increased by 55 vessels on conditions that they will find available berth.

2.23.3 Vessel Dimensions

Vessel dimensions to be used for the planning and design of the port rehabilitation can be summarized as

	Length (m)	width (m)	draught (m)
Small canoes	< 10	< 1.0	< 0.5
Medium size canoes	10-15	1.0 -1.5	< 1.0
Large canoes	15 -20	1.5 - 2.6	1.2 – 1.7
Small inshore vessels	10 – 12	3.5	< 1.5
Large inshore vessels	12 – 25	3.5 – 6.5	1.5 – 3.0

The listed draught values are for fully loaded vessels. Unloaded draught is estimated to be less than 0.6m for all vessels to be berthed in the lagoon.

2.23.4 Berthing Quay Requirements

There shall be basically three categories viz. quays for fish landing service quays and resting quays.

Quay for fish landing: the required number of fish landing berths for inshore vessels as well as fir canoes will depend on the frequency of trips; time required for landings and accepted berthing time.It has been assumed that, the vessels make one trip per day, unloading of the catch takes one hour and fish are landed day and night. It is anticipated that canoes berth perpendicular to the quay and inshore vessels berth alongside the quay in two or three layers.The above listed numbers and beam widths for the existing groups of vessels can be added up to the following requirements for berthing quays in the lagoon port:

Vessel	Quay length
APW—canoes registered in Elmina	460m
APW—canoes migrating to Elmina	182m
Medium size canoes (20% of registered Vessels)	92m
Small canoes	200 -300m
Small inshore vessels, operational	188- 280m
Small inshore vessels, non-operational	100- 140m

These requirements shall be increased by 100 metres of quay for relocated APW canoes when the lagoon entrance is improved.

Quay requirements for berthing of small canoes as these canoes berth in niches between the bigger vessels. Berthing of non operational vessels will not require quay area and can be arranged in the area at the area next to the boat repair area next to the old fish market hall.

- **Service quays:** the service quays where the vessels can bunker and take storage and ice or each trip will also be used day and night .it is assessed that the capacity of three berths will be sufficient.
- **Resting quays:** these shall basically occur on the northern quay walls and the areas west of the boatyard.

2.23.5 Design Water Levels

All levels in the present report will refer to National Level Datum (NLD=0.00).

The mean water level (MWL) found from the recordings carried out at the lagoon entrance's is approximately 35 centimeters above NLD. These water level recordings are reflecting the delay in water flowing in and out of the lagoon resulting in somewhat higher levels at low tide compared to the levels off-shore. It can be assumed that the rehabilitation with dredging and widening of the lagoon entrance will reduce the delay in the water flow and therefore bring the MWL to the datum level.

Water level variations in the re-habilitated port with improved entrance will therefore be close to the present variations off-shore, e.g. Ranging from 0.6m to +1.0 m

2.23.6 Design Dredging Levels

Dredging design levels at the entrance and in the lagoon harbour shall allow the existing fleet to navigate at all water levels with 0.3 m keel clearance. Water depth shall be increased where wave action will influence the vessel's movement.

The inner lagoon harbour where the vessels will berth unloaded shall be dredged to the following level:

Lowest tide level	-0.60m
Draught unloaded vessel	-0.60m
Keel clearance	*-0.30m*
Total inner lagoon dredge level	minimum-1.50m

Water depth given access to the fish landing quay shall be sufficient for the navigation of fully loaded vessels at low tide. The draught of the large canoes ranges from 1.2m to1.7m, when loaded. The average draught is assessed to 1.4m which gives the following dredging levels at the landing quay:

Lowest tide level	-0.60m
Draught unloaded vessel	-0.40m
Keel clearance	*-0.30m*
Total landing quay, dredge level	minimum -0.13m

This dredge level will allow the largest canoes to enter the landing quay t low tide. The keel clearance will however in these rare situations be less than the stipulated 0.3 m.

Quay Levels Existing quay levels in the lagoon port ranges between 1.5m and 3.1m. Highest springtide water level has been recorded to be approximately +1.0m.

Local wind generated waves will not exceed 0.3m whereas wind set-up and surf beat is estimated to add less than 0.2m.from the above ,new quay structures are shall be

constructed with a quay level not les than +1.5m and with levels meeting connecting existing structures. The freeboard on a large canoes will range from .5m or even less when loaded to 1.5m or more unloaded and rail level will therefore range approximately from -0.1m to +2.5m depending on tidal level and loading conditions, a quay level at +1.5m will correspond well to this range Rail levels for small inshore vessels will be within the same range.

2.23.7 Breakwater

The existing breakwater shall be demolished and reconstructed .this shall involve the construction of two new breakwaters with tidal length of 750 including breakwater heads.
The outer end of the breakwater and the entrance is located on 6m water depth.
The breakwater crest shall be +4m.
The angle between the breakwaters near entrance should be approximately 140°. The angle of the upstream eastern breakwater should be approximately equal to the current direction.

2.24.0 Port

A port is a facility for receiving ships and transferring cargo. They are usually situated at the edge of an ocean, sea, river, or lake. Ports often have cargo-handling equipment such as cranes (operated by longshoremen) and forklifts for use in loading/unloading of ships, which may be provided by private interests or public bodies. Often, canneries or other processing facilities will be located near by. Harbour pilots and tugboats are often used to maneuver large ships in tight quarters as they approach and leave the docks. Ports which handle international traffic have customs facilities.

The terms "port" and "seaport" are used for ports that handle ocean-going vessels, and "river port" is used for facilities that handle river traffic, such as barges and other shallow draft vessels. Some ports on a lake, river, or canal have access to a sea or ocean, and are sometimes called "inland ports". A "fishing port" is a type of port or harbor facility particularly suitable for landing and distributing fish. A "dry port" is a term sometimes used to describe a yard used to place containers or conventional bulk cargo, usually connected to a seaport by rail or road. A "warm water port" is a port where the water does not freeze in winter.

Figure 43: New York/Jersey Seaport seen from the bay.

Because they are available year-round, warm water ports can be of great geopolitical or economic interest, with the ports of Saint Petersburg and Valdez being notable examples.

Figure 44: Colón seaport city as seen from the ocean

A "port of call" is an intermediate stop, for example to collect supplies or fuel.

Cargo containers allow efficient transport and distribution by eliminating loading of smaller packages at each transportation point, and allowing the shipping unit to be sealed for its entire journey. Standard containers can easily be loaded on a ship, train, truck, or airplane, greatly simplifying intermodal transfers. Cargo often arrives by train and truck to be consolidated at a port and loaded onto a large container ship for international transport. At the destination port, it is distributed by ground transport.

Ports sometimes fall out of use. Rye, East Sussex, England, UK was an important port in the Middle Ages, but the coastline changed and it is now 2 miles (3.2 km) from the sea. Also in the UK, London on the River Thames, and Manchester, on the Manchester Ship Canal, were once important international ports, but changes in shipping methods, such as the use of containers and larger ships, put them at a disadvantage.

2.24.1 Concepts and Definitions

The Inventory covers all ports catering to water-borne commerce. A port is defined as a place where ships may anchor or tie up for the purpose of shelter, repair, loading or discharge of cargo, or for other such activities connected with water-borne commerce, and including all the land and water areas and the structures, equipment and facilities related to these functions. The Inventory is prepared by region, and by province. The ports in a particular province are enumerated alphabetically with the location, classification and status cited.

a. Location - the municipality where the port is situated. If the barangay location is known, the name of the barangay is cited and enclosed in parenthesis. However, there are cases when the name of the barangay cited is incomplete. For example, in the municipality of Isabela, province of Basilan, there are three barangays of almost similar names, namely Kaumpurnah 1, Kaumpurnah 2 and Kaumpurnah 3. Based on the validation conducted, only Kaumpurnah was mentioned, without specifying the exact location. In this case, the barangay name Kaumpurnah, although not the exact location, is still reflected and enclosed in parenthesis.

b. Classification - Prior to the inventory, the various agencies concerned adopted their own schemes of classification. For instance, the PPA classified its ports into: base ports, terminal ports, and other government ports. The PFDA, on the other hand, adopted the following categories: municipal fishing, commercial fishing, and multipurpose fishing.

For purposes of the inventory and for consistency in classification, ports were classified according to general purpose, regardless of the agency-in-charge. The following categories were adopted:

1. Commercial Private - ports which are owned and operated by private entities, constructed primarily to serve the needs of the owners.

2. Commercial Public - ports which are owned and operated by the government, constructed primarily to serve the needs of the general public, and which generally cater to vessels of more than 30 tonnage.

3. Fishing - ports which are owned and operated by the government or private entities, constructed primarily to serve the fishing industry, either within the area, or may be regional in scope, serving as the main collection and distribution center for fish.

4. Feeder - ports which are owned and operated by the government, constructed primarily to provide linkages among neighboring small islands and nearby urban centers. This port generally caters to small passenger and fishing boats.

It is possible that two ports may be located in the same area, even have similar names, but are classified differently. For instance, a port mainly used for fishing may exist side by side with a commercial public port administered by the PPA. In such case, the two ports are listed but classified differently in the inventory. On the other hand, a commercial public port which is also used for fishing purposes, is listed only once in the inventory as a commercial public port. A feeder port which is also used for fishing purposes is classified as a fishing port.

c. Status - ports are classified as to whether operational or non-operational. Operational ports are those which are still being used. Non-operational ports are ports which although existing are not utilized.

2.24.2 Commercial trawler

A commercial trawler is a commercial fishing vessel designed to operate fishing trawls.

Trawling

Figure 45: A modern Icelandic trawler.

Trawling is a method of fishing that involves actively pulling a trawl through the water behind one or more trawlers. Trawls are fishing nets that are dragged along the bottom of the sea or in midwater at a specified depth. A trawler may also operate one or more trawl nets simultaneously (double-rig and multi-rig).

There are many variants of trawling gear. They vary according to local traditions, bottom conditions, and how large and powerful the trawling boats are. A trawling boat can be a small open boat with only 30 hp or a large factory trawler with 10,000 hp. Trawl variants include beam trawls, large-opening midwater trawls, and large bottom trawls, such as "rock hoppers" that are rigged with heavy rubber wheels that let the net crawl over rocky bottom.

2.24.3. Trawler types

Figure 46: Amandine, the last Belgian trawler operating in Icelandic waters.

- Side trawlers: Until the 1950s trawlers in the Atlantic Ocean were designed to shoot and haul trawl gear from the side.

- Stern trawlers: From the 1950s, trawlers have been designed to operate gear from the stern. Technically, stern trawling is more feasible than side trawling and uses space more efficiently. It can be fully mechanized, enabling faster and safer operation of the gear, and better performance in heavy weather.

- Factory trawlers: A factory trawler is a large stern trawler which has additional facilities for processing and freezing fish installed on board. This allows the factory trawler to stay for long periods at sea. Factory trawlers can displace up to 3,000 tons.

- Wet trawlers: Wet trawlers are designed to make short fishing trips and land fresh fish kept in ice.

- Sailing trawlers: Traditional sailing trawlers were limited to trawling at depths of 55-75 metres, but modern trawlers often trawl to 900 metres, with experiments having gone even deeper. –Wikepedia, free encyclopedia

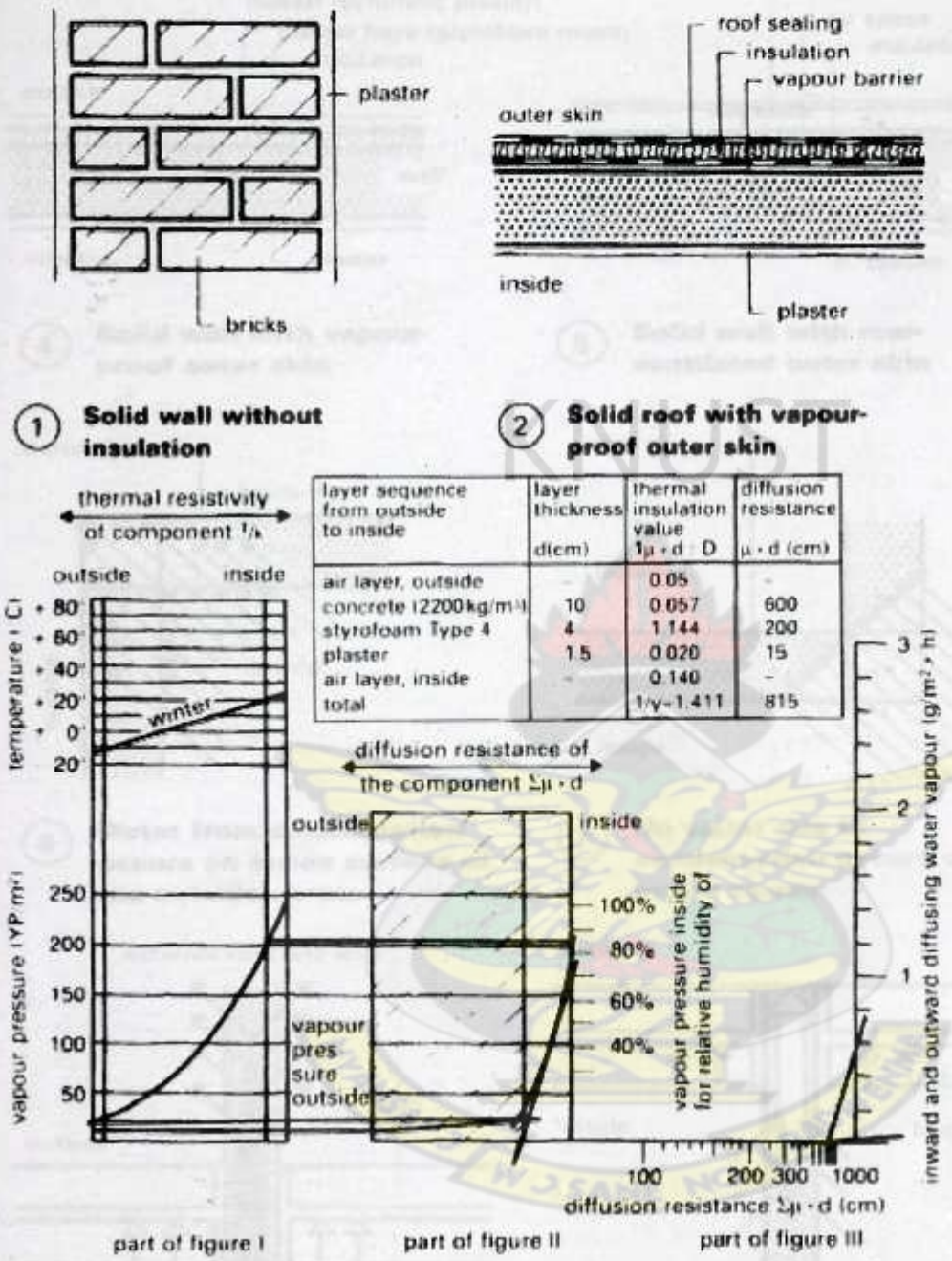
2.25.0 Thermal Insulation for walls roofs and Foundations of cold stores and ice making plant

2.25.1. Construction without vapour barrier

Conventional construction contains no vapour retarding layers. Layers should be provided so that no condensation occurs: for sufficient thermal insulation, the layer factor λ should fall from inside to outside. In the case of very damp rooms (e.g.) swimming pools), the vapour pressure variation should be checked either graphically or by calculation. Note that on the outside of thermal insulation layers with normal plastering, there is a danger of cracking due to the build up of heat and low shear strength of the base material; therefore, glass fiber reinforced finishing plaster should be applied (but not in case of swimming pools.

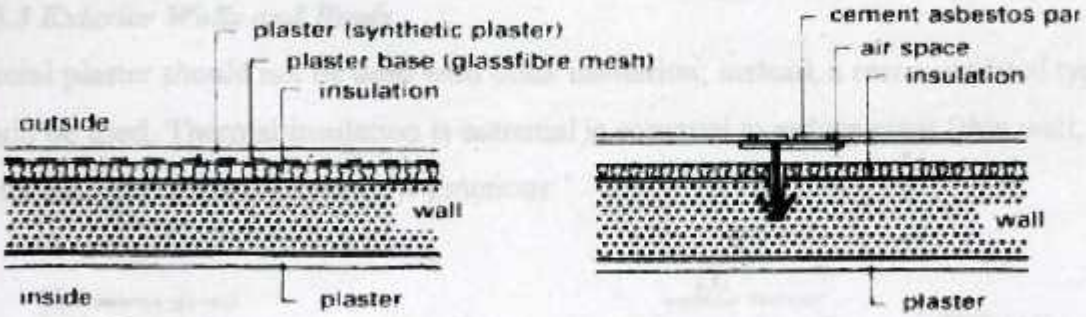
2.25.2 Construction with vapour barrier

In ore recent building construction ('warm roof', 'warm façade'), there is a vapour impermeable outside layer, resulting in the necessity for an internal vapour barrier. On vertical components, this is difficult to accomplish; a better form of construction is to provide a rear-ventilated outer skin (except for pre-fabricated walls). Note that the thermal insulation, including the air boundary layer on the layers up to the condensation barrier, must not exceed a specific level of contribution to the resistance to heat. In solid constructions, protection of the vapour barrier against mechanical damage can be achieved by means of a protective layer. Since no high pressure- in the sense of a steam boiler- occurs on the inside of the vapour barrier, only vapour pressure, the frequently recommended 'pressure compensation' provided by this layer, is not in fact required.



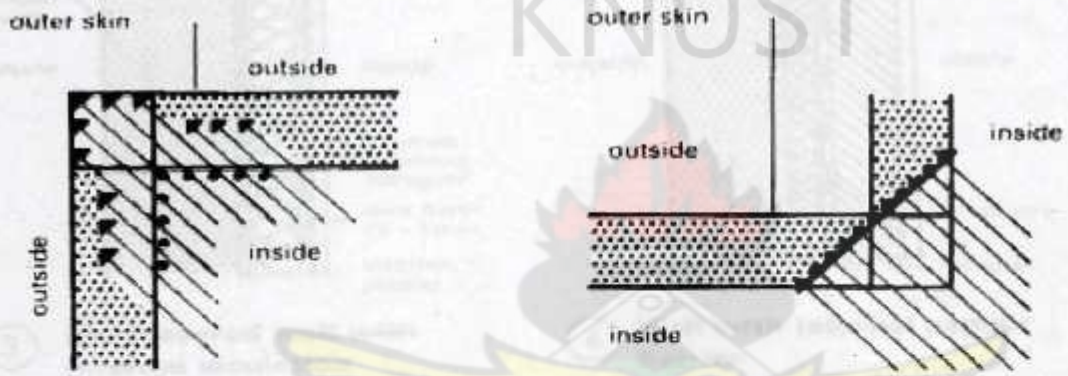
layer sequence from outside to inside	layer thickness d(cm)	thermal insulation value 1/μ · d : D	diffusion resistance μ · d (cm)
air layer, outside	-	0.05	-
concrete (2200 kg/m³)	10	0.057	600
styrofoam Type 4	4	1.144	200
plaster	1.5	0.020	15
air layer, inside	-	0.140	-
total		1/γ=1.411	815

Figure 47: Sections through walls showing construction with and without insulation and condensation of vapour in a roof



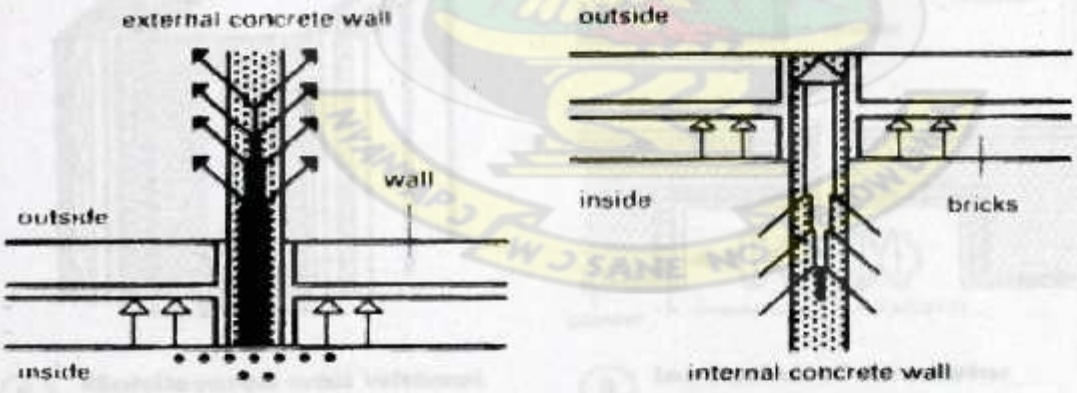
(4) **Solid wall with vapour-proof outer skin**

(5) **Solid wall with rear-ventilated outer skin**



(6) **Water from condensation occurs on inside surface of the outside corner**

(7) **No water due to condensation occurs on the inside corner**



(8) **Water from condensation occurs on large outer surface of the cold bridge (high heat extraction per unit area)**

(9) **The heat extraction per unit area is significantly less on the large inside surface of the cold bridge**

Figure 48: Sections through walls showing various ways of damp proofing

2.25.3 Exterior Walls and Roofs

Mineral plaster should not be used with outer insulation; instead, a rear-ventilated typr should be used. Thermal insulation is essential is essential to reduce costs (thin wall, higher temperature for the window junctions.

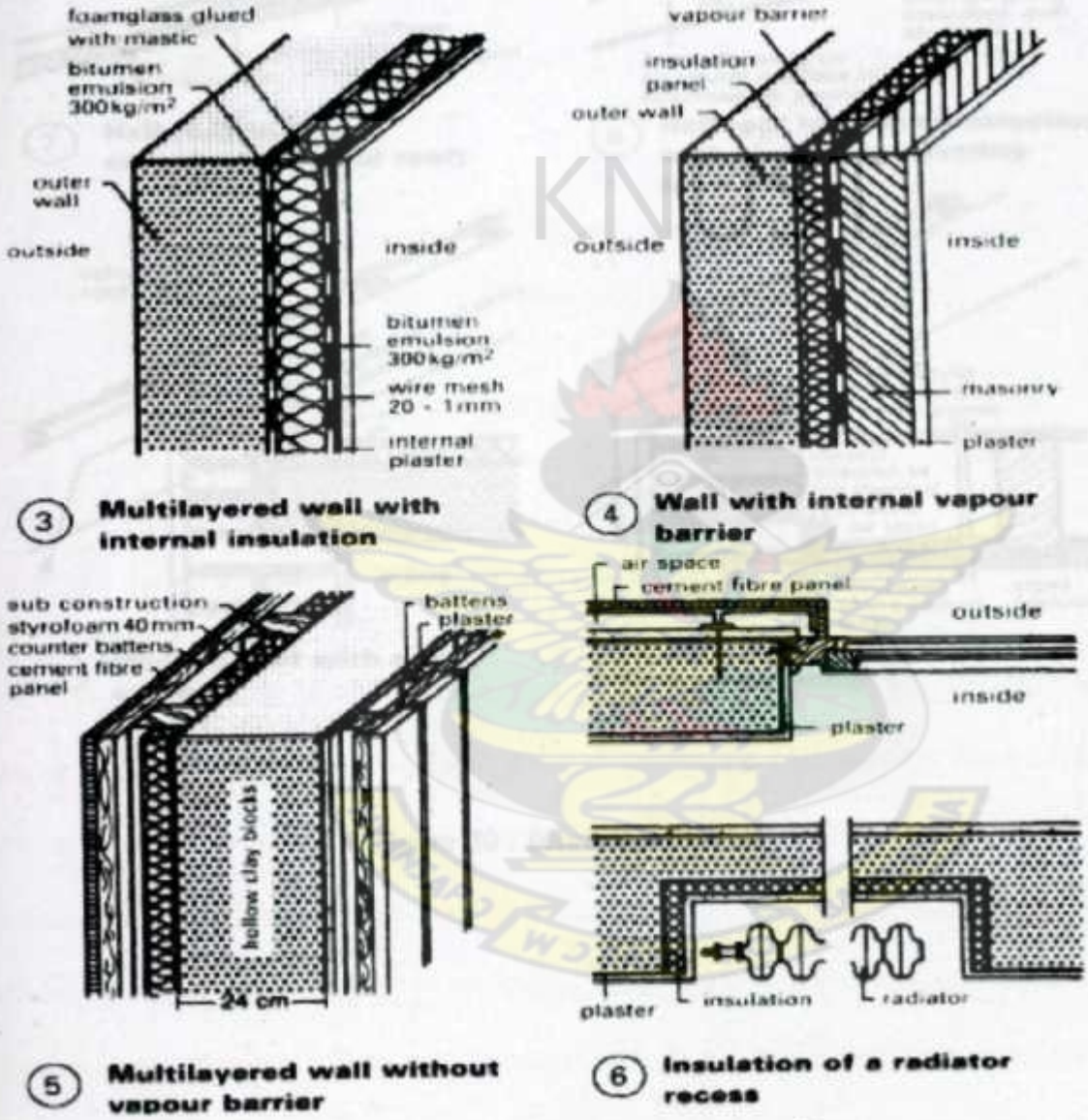


Figure 49: Insulation in exterior walls

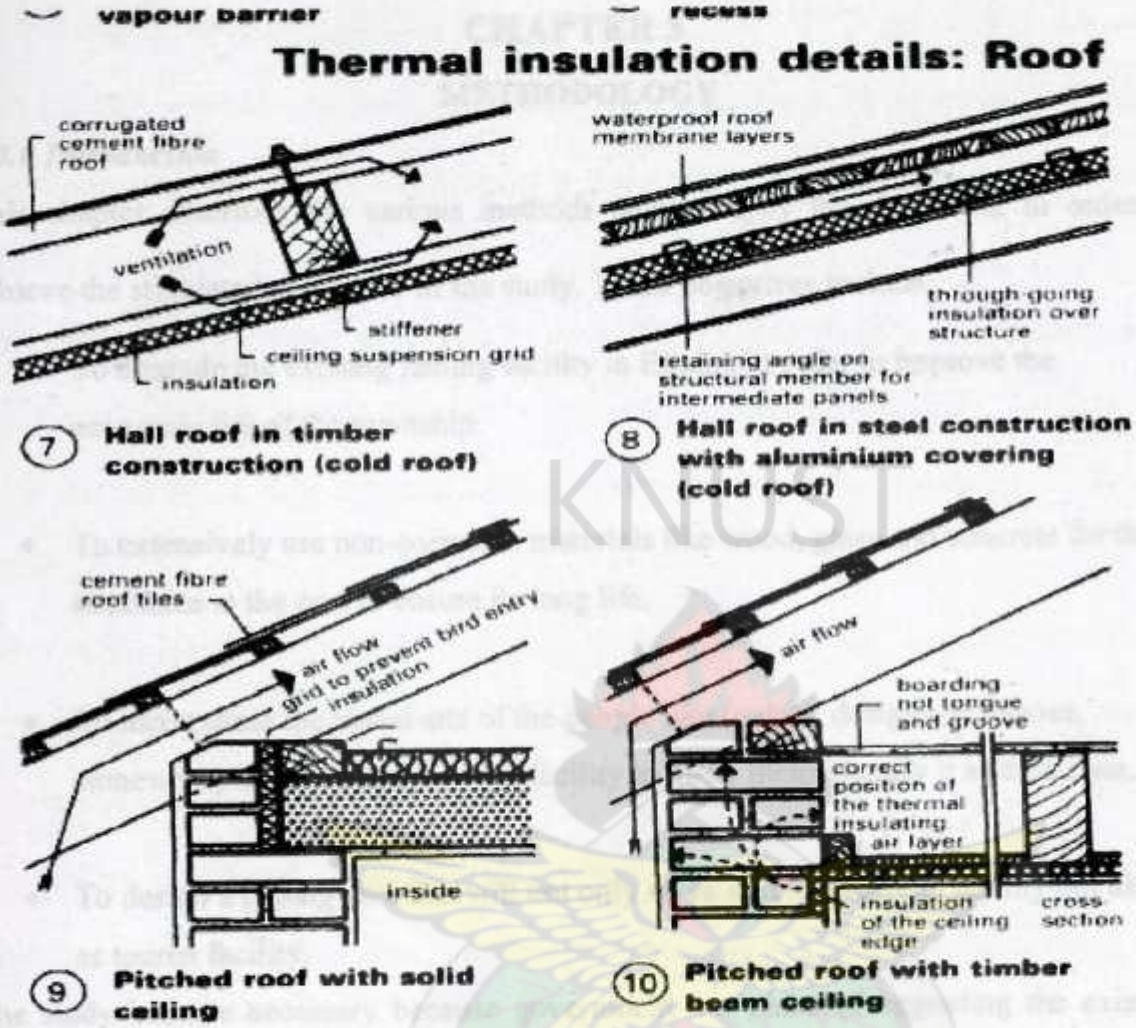


Figure 50 : Insulation in roofs

CHAPTER 3

METHODOLOGY

3.0.0 Introduction

This chapter describes the various methods employed by the researcher in order to achieve the stipulated objectives of the study. These objectives include;

- To upgrade the existing fishing facility in Elmina in order to improve the economic life of the township.
- To extensively use non-corrosive materials like wood, glass and concrete for the structures at the port to ensure its long life.
- To incorporate the visual arts of the people like (colors, designs on canoes, stonework) into the design of the facility to make them identify it as their own.
- To design a fishing port that will not only serve as a commercial facility but also as tourist facility.

The study became necessary because government has plans of upgrading the existing fishing ports in the country as well as embark on projects in communities like Elmina that will improve the socio-cultural and economic status of the people.

Nonetheless, there are different methodologies for carrying out a dissertation which requires a systematic approach of organizing data. Owing to the fact that this study is theoretical, the following methodological procedures were adopted to describe how the project was undertaken. These are research design, library research, population for the study, sampling design, the sample, primary and secondary data, and data collection instruments, validation of instruments, administration of instruments, data collection and data analysis plan.

3.1.0 Research Methodology

There are two research designs that were adopted for the study. These are qualitative and quantitative approaches. The characteristics of the variables or population being studied influence the research design to adopt.

Thus the quantitative research approach which focuses on measuring and counting facts and the relationships among variables was partly adopted for the study. As such, the researcher analyzed data obtained through questionnaires using numerical values and statistics.

Conversely, qualitative research is the search for qualities - the characteristics of our experience (Eisner, 1991, p. 33). We translate these qualities through our chosen representation form and conceptual outlook.

For this study, the qualitative approach is largely considered because, it encompasses several approaches to research that are, in some respects, quite different from one another.

The following research techniques were adopted,

- Case studies: an intensive study under existing condition at Elmina, Sekondi Takoradi, and Tema fishing harbours as well as the Vigo fishing port in Spain were undertaken and accessed.
- Data collection: data was collected from various sources to serve as basis for the proposal. The sources included fishery department of Elmina and Tema among several other sources.
- Interviews and questionnaire: interviews with agric extension boat builders and artisans fishermen association leaders private ice making plant operators were reviewed for further studies. The planning officer in charge of the KEEA district Assembly was also interviewed for his input on the best area to site the facility.

The fisheries department in Tema and Elmina were also visited for information as well as the Ghana museums and monuments board.

- Libraries: The search for sufficient information relevant to the study took the researcher to a number of libraries in Accra and Kumasi. These were both public and private libraries. The information gathered ranges from archival materials as well as written documents. The libraries visited include the Elmina Library, Cape Coast Library and the Ghana Institute of Journalism library, Accra and K.N.U.S.T. libraries, Kumasi.

At the above libraries mentioned, relevant literatures that related directly or indirectly to the research topic were chosen. Articles on fishing ports were studied from news papers and magazines. Latest books on fishing ports and beachfront design were also examined from these libraries.

- The internet: was also another source of information which provided the researcher with valuable current information on the study. The researcher was able to browse diverse beachfront design websites to access further information on the history of fishing and new techniques in fishing in other parts of the world. Other electronic media sources included the 2008 Microsoft Encarta, the 2008 Encyclopedia Britannica and other electronic dictionaries like the pocket Oxford dictionaries and PDF information on research. They were installed on the researcher's computer, which was useful in correcting spelling mistakes, checking the meaning of words and, rectifying grammatical errors.

Also the consultation of television stations such as Metro TV, GTV, TV3 provided vital information concerning the recent developments concerning fishing in Ghana government bills that have been passed.

The visit to these libraries and the study of literatures provided useful data that helped in organising the review of related literature. Theoretical as well as empirical reviews concerning the study were obtained.

- Physical Study of the Site and it's/Visual Survey : Observation is one of the oldest and most fundamental research method approaches. It involves collecting impressions of the world using all of one's senses, especially looking and listening, in a systematic and purposeful way to learn about a phenomenon of interest (Given, 2008, p. 573).

In this study, in order to evaluate the present conditions of the structures studied and indicate the best ways the new fishing port will be designed.

CHAPTER 4

4.0 Site

4.1.0 The Site

The project is located in the historic core of Elmina along the Benya lagoon. It spans 650m from the western portions [close to saltpans] to the estuary and the Elmina beach to the east.

Figure 51: The site

4.1.1 Parameter for site selection

The motive of urban renewal of the inner water front of Elmina and the improvement of fish landing, handling, sale and storage was of primary importance in section of the site for redevelopment.

The specific parameters are:

- The locality has been zoned for such a facility.
- The Benya lagoon is a natural harbour and the *raison d'etre* for the settlement of the early people of Elmina and therefore must be cleaned up to improve the image of the town.
- Fishermen/vessels in Elmina can utilize the greatest/largest fishing grounds in Ghana
- It's approximately to the scenic St George Castle and Fort Jago can attract tourist to its activities.

4.2 Site inventory and analysis

4.2. 1. Existing Site Conditions

The site is presently characterized by several activities which lack a harmonious functional relationship. Overcrowding here has brought about unsanitary conditions. Both authorized and unauthorized are in a state of disrepair. Most sections of quay walls are damaged and need repairs or reconstruction. A large portion to the west is illegally occupied by fish smokers.

4.2.3 Elements of site

- **Gradient of land [topography]: with a granite slope towards the north-west end.** The site is relatively flat; with the exception of the depression forming the lagoon, and sandbank at the estuary as a result of littoral activity here.
- **Geology:**
- **Vegetation;** the site is predominately developed and lacks vegetation, however the lagoon has some islands of mangrove and the beach on the southern shore[sea] boasts of coconut trees

- **Best views;** best views is found on the bridge where you can observe the site in accordance with the cardinal points.

Boundaries; the site is bounded at the south by the main access road[Bantuma road] ,the north by the street, the east by the Elmina beach and the Gulf of Guinea and the historic site at the south.

4.2.4 Climate Features and Bioclimatic design techniques

- **Rainfall;** the annual rainfall ranges from 720 to 885mm with most of the rainfall occurring in the two distinct seasons ;April to July(major season) and September to November (minor season)
- **Temperature;** the climate of the area falls within the warm-humid climates of the sub-region. Highest temperatures are observed in the months of November to May: maximum temperatures range from 32°C to 34°C, minimum temperatures range from 23°C to 24°C which are experienced by the months of May to September.
- **Relative humidity;** this is usually high in both the wet and dry (harmattan) seasons with figures ranging from 80% upwards. The air here has a very high moisture content which is ridden with salt from the sea breeze.

- **Sunshine and wind;** the sun shines an average of 9 hours daily in the vicinity, the absence of trees in the area allows the intense heat of the tropical sun to be felt on the site. Wind measurements show that wind speeds range from an average of 2.3 to 3.25kts.this is characterized by the effect of the phenomenon of land and sea breezes.

Bioclimatic design techniques can be set forth as a set of design opportunities:

• **Wind breaks:** the design technique serving the function of minimizing wind exposure is:

- The use of neighboring land forms, structures, or vegetation for wind protection.

• **Thermal envelope:** Isolating the interior space from the hot sun and cold harmattan climate, such as:

- Minimize the exposure outside wall and hard floor surfaces.
- The use of attic space as buffer zone between interior and outside climate.

- The use vestibule to screen the warm air.
- Select insulating materials for resistance to heat flow through building envelope.
- Select high-capacitance materials to dampen heat flow through the building envelope.
- Provide insulating controls at glazing.
- Detail window and door construction to prevent undesired air infiltration.
- Provide ventilation openings for air low to and from specific spaces and appliances.
- Use heat reflective (or radiant barriers) on (or below) surfaces oriented to sun.
- Use clerestory skylights for natural illumination.

• **Indoor/outdoor rooms:** Courtyards, covered patios, seasonal screened and glassed-in porches, greenhouses, atriums and sun spaces can be located in the building plan for cooling, as in these techniques:

- Provide outdoor semi-protected areas for year-round climate moderation.
- Plan rooms or functions to mismatch with solar orientation.

• **Thermally massive construction:** Particularly effective in hot arid zones or in more temperate zones with cold clear winters. Thermally massive construction provides a "thermal fly wheel."

- Use high mass construction with outside insulation and night time ventilation techniques.

• **Sun shading:** Because the sun angles are usually on the East and West facades, it is possible to shade windows from the sun with vertical shading devices, then horizontal shading devices for the south and north windows.

4.2.5 Detailed description/analysis of existing port element

4.2.5a Buildings and Sheds

- **Shed at fish market**

This shed is constructed of wood with open side. It is approximately 105 by 4 meters, and was constructed circa 1988/89. The shed appears to be satisfactory condition. It will however be broken down and the area dredged to make way for a better circulation for the vessels.

Figure 52 : Shed at fish market

- **Office** for Mpoben fish landing grounds. The building has walls of plywood and is used as offices. It approximately 10 x 4.5 meters. The building is an unacceptable condition and would be demolished.

- **Fishery School**

The building is constructed of masonry, and has a cement asbestos roof installation and is used for banking by Kakum Rural Bank.

- **Fisheries Department Office**

The building is constructed of concrete blocks and wood in two storeys, and measures approximately 22 x 8 meters. It is in a poor state, making it unattractive for its occupants.

Figure 53: Fisheries department offic

- **Net Repairing Shed**

The shed is constructed of concrete posted and beams with barrel roof installation. It is approximately 18 x 16 metres and is generally in a satisfactory condition save some mission roof cover elements. It is inadequate for its purpose.

Figure 54: Net Repairing Shed

- **Old Fish Market Hall**

The building was constructed, 30 x 16 meters approximately. It is constructed with concrete columns and blocks and opens towards the north and south facades.

The building appears to be in a poor state.

Figure 55: Old Fish Market Hall

- **Workshops [private]**

The building is constructed with concrete blocks. The building measures approximately 24 x 6 meters and appears to be in good condition.

Figure 56: Workshops [private]

- **Public Toilet Building**

The building is a public toilet, but it is not used. It appe[illegible] be in a satisfactory condition. It measures approximately 14 by 5 meters.

- **Ice marking Plant[private]**

This facility is an uncompleted make shift structure which produces ice for the temporary preservation of fish caught.

Figure 57: Ice making Plant [private]

- **Oil/Fuel Station**

The building is constructed of concrete blocks and measures 6 x 5 meters approximately. East of the building is a fuel tank 7 by 3 meters and at the sheet pile wall a pump has been installed. The building is in a satisfactory condition although it has been abandoned.

Figure 58: Oil/Fuel Station

- **Fisheries Department Workshop**

The building is constructed of concrete blocks at the slipway area it is approximately 28 by 8 meters. The building is in good condition.

Figure 59: Fisheries Department Workshop

- **Boat Building Area**

The area is located south of the workshop and is a non paved area used for construction of inshore vessels; it is approximately 500 square meters

- **Area For Repair Of Inshore Vessels**

The area is located northeast of the workshop and is partly a paved area which is for repair of inshore vessels .it is approximately 700 square meters

- **Net Repairing Area**

The area measures approximately 3300square meters. The area which has been used for this activity is located inside the old fish market including areas east and south of the building. Pavement in this area is a mixture of asphalts, concrete and gravel and generally the area seems too small for this activity.

- **Repair of Inshore Vessels and Canoes**

The area measures approximately 2000square meters and is a non paved area located west of the fishery department office along the shore of the lagoon.

- **Unloading and Handling of Fish**

The Mpoben Fish landing Ground is an area with concrete pavements along the south side of the area is a 4 meter wide shed has been constructed. The area is being used for land and handling of fish by the canoe fleet and is usually much crowded with a lot of activity going on.

These measures approximately 1900square meters. The pavement is in good condition with no major settlements, with exception of some minor cracks.

Figure 60: Unloading and Handling of Fish

- **Area as Steel Sheet Pile Wall**

This area is characterized by concrete slabs along steel sheet pile wall which serves as berthing area for the inshore vessels. It measures approximately 300square meters. The concrete slabs towards the lagoon have all severe settlement which has caused cracks in the slabs.

Figure 61: Area as Steel Sheet Pile Wall

- **Area at Shipway**

This area is characterized by con concrete slabs north and east of the workshop. It is approximately 450square meters .The slabs are generally in good condition. Towards the lagoon they are covered by sand and the exact extent of the slabs is not clearly defined.

Figure 62: Area at Shipway

- **Perimeter fence**

Perimeter Fence the Fence is located along the south side of the lagoon separating port structures and port activities. The Fence is constructed of wood and is in bad state due to age.

Figure63: Perimeter fence

Figure 64: The site showing points of major structural defects in red points.

Figures 65-69 show the points where these defects are found

Figure 65: Breakwater at entrance channel

Figure 66: Retaining wall

Figure 67: Retaining wall at entrance channel

Figure 68: Resting quay

Figure 69: quays at canoe landing bay

4.3.0 The Elmina Bridge

4.3.1Significance of the present location

The Liverpool street and the continuation over the bridge to the southern bank of the lagoon forms the spine, and the most lively section of the Elmina township.

A survey of vehicular traffic (excluding bicycles) into Elmina indicated volume of over 250 vehicles per hour enters Elmina with about 90% of the traffic using the bridge. This confirms the important economic role of the fishing industry at Elmina very large pedestrian traffic also uses the bridge.

Again the bridge at the present location has very important historic and therefore cultural significance as well. The bridge has been in existence here since the 18th century.

It was originally built as Draw Bridge to link the St. George's Castle to fort St .Jago which was built specifically to defend the castle from enemy attack. The present bridge was constructed in 1998. It was constructed with steel and hinged at the ends on concrete piers. It measures approximately 8 meters wide and spans 40meters connecting the north and south sides of the lagoon with a 1.2 m extensions at the east and west sides serving as pedestrian walkways. The bridge is in satisfactory condition however the extended pedestrian walkways are in poor state to the extent that the western walkway is out of use and needs repairs).

Figure 70: The Elmina Bridge

Figure 71: Damaged and disused pedestrian walkway of the bridge.

The bridge continues to symbolize the link between the fort and the castle, and from the tourism point of view, the visual link between them. It is therefore inconceivable to imagine Elmina without the bridge between these closely related monuments.

The third significance of the present location of the bridge over the lagoon is its restrictive influence on size of fishing vessels which can use the Elmina port facilities. The effective distance free head room of only 2.7m remains at MHWST. The available head room is only sufficient for the regular passage of only a 35 footer inshore vessel with the mast removed.

4.3.2 Alternative location

Relocation of the bridge crossing the lagoon from the present location to a new location west hereof will ease the access to the lagoon port for the smaller inshore vessels. In combination with improved water depth the relocation will also allow larger inshore vessels to use the lagoon port.

4.3.3Analysis of alternative location

With the alternative bridge location all traffic destined for the southern bank of the lagoon have to go through Elmina town.

A number of factors have been considered in the evaluation of the alternative routes. The factors included the need:

- To reduce to a minimum the number of permanent structures to be demolished,
- To reduce the extent of social dislocation and
- The level of commercial activity along the Liverpool Street.

4.3.4 Conclusion

Relocation of bridge can however not be recommended as part of this solution of the rehabilitation of the port for the following reasons:

Two of the objectives of this thesis proposal are to improve the conditions of the existing fleet of vessels in Elmina and to support tourism development plans.

The small inshore vessels operating from the lagoon today have short wooden masts. The mast has to be lowered each time a vessel passes under the bridge. This operation is a simple routine which alone does not justify a relocation of the bridge. The scope of these proposals does not for any development towards more inshore vessels than those in operation today and a change in this assumption will lead to expansions for berthing requirement outside the existing bridge. Furthermore the regional and town planning aims at strengthening the tourism activities around Elmina Castle and the and the present location of the bridge is important for the comfortable access to the scenic sites at the castle, at fort St. Jago and the port area.

4.4.0 Site Peripheral Studies and Existing Architecture

The development around the site is generally residential and commercial buildings of up to two storeys. The buildings are generally in poor condition with the exception of the heritage buildings. Along the street on the northern bank of the lagoon are residential

buildings are predominantly in colonial architecture. This area is also characterized by permanent and non-permanent buildings which function as fuel points. There are also some non-permanent sheds, public baths and toilets.

Figure 72: The northern portions of the site

Further north on the Jago hill is the Fort St Jago. A Dutch fort of Gothic military architectural piece built to protect the St George Castle from enemy onslaughts.The western portions of the site are characterized by salt pans, leading to Bantuma [a village under Elmina]

Liverpool Street which is the main commercial street is on the north-eastern portions. This street links the Elmina Bridge. Famous and old architectural edifices which had been bequeathed to indigenes of Dutch descents are found along the Liverpool Street. Notable among these are the Viala House which has been ear-marked for conservation by the Elmina Heritage programme 2005-2015 and Bridge House, which has been rebuilt and adapted to a guest house. The southern- eastern portion of the site is the St George Castle built originally by the Portuguese from 1481-1482. Its Architecture displays the archetypes of the various Europeans who controlled it over the course of time. They were; the Portuguese, the Dutch and finally the British.

Figure 73: Brick and stone finished fence wall

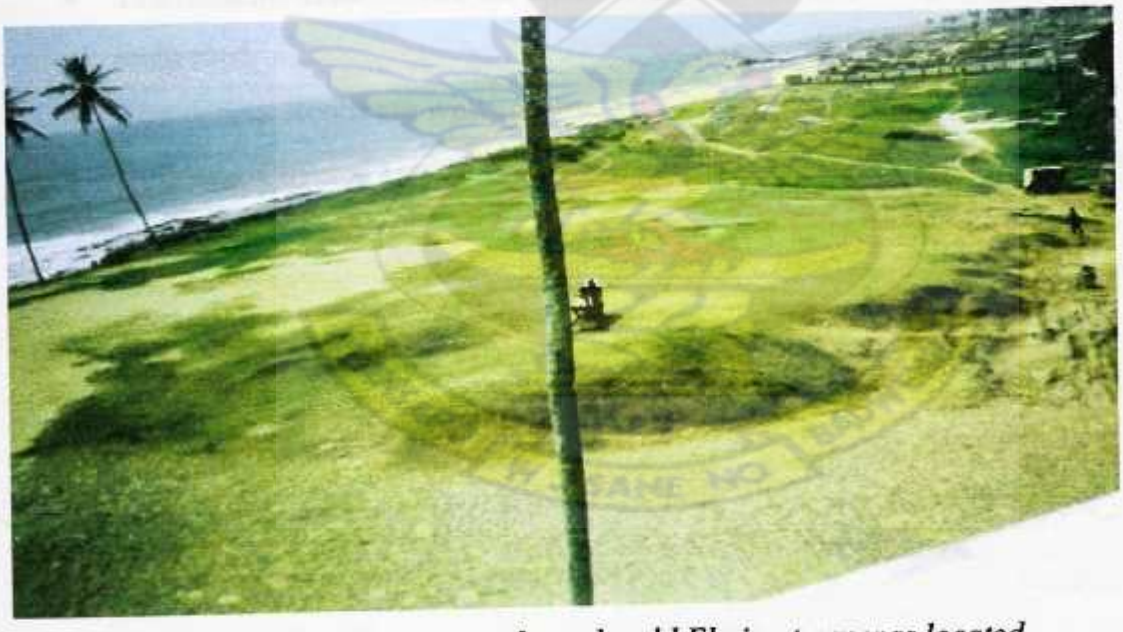


Figure 74: The historic site where the old Elmina town was located

The southern portions are the following features:

- Elmina old town; this area is now a historic site. It is demarcated by a brick and stone cladded fence wall. The site now functions as the durbar grounds for the annual Bakatue Festival of the people of Elmina.

- A lorry park
- Fish processing area
- Gulf of Guinea

4.5 .0 Available Services

- Water: A 150mm diameter supply pipe lines are along the Bantuma road.
- Electricity: power is available from overhead cables crossing the northern side to the south.
- Telecommunication: there are telecom lines from over head poles along the main road.
- Circulation: Roads are well constructed with asphalt and well drained.
- Drainage: Covered Drains have been constructed along the main road. This drains into the lagoon.

CHAPTER 5

DESIGN PHILOSOPHY AND CONCEPT

5.1.0 Design Philosophy

The area chosen for the fishing port is very vital to the people of Elmina. This is because it has been their traditional grounds for doing the fish business since time memorial. Also, this area is close to the Fort St. Jago St. George's Castle which is one of the heritage tourist sites in the world.

The fishing business is on the brink of collapse and its revival can be done with the use of technology which has been tried and tested. The blending of this traditional location among others as well as technology brought about the philosophy TRADITION MEETS TECHNOLOGY.

Tradition means a custom or belief: a long-established action or pattern of behavior in a community or group of people, often one that has been handed down from generation to generation or a body of customs: a body of long-established customs and beliefs viewed as a set of precedents. It can also mean handing down of customs: the handing down of patterns of behavior, practices, and beliefs that are valued by a culture.

Technology means application of tools and methods: the study, development, and application of devices, machines, and techniques for manufacturing and productive processes or a method of applying technical knowledge: a method or methodology that applies technical knowledge or tools machines and systems: machines, equipment, and systems considered as a unit

5.1.1. Design Concept

- Using the traditional fish market but introducing characteristics of a modern fish market into it.
- Incorporating the traditional visual arts of the people as well as a modern architectural character into the design of the facility.

- Creating a facility in which people from all classes can do business in comfort.
- Designing the facility in which traditional boats can operate as well as modern boats.

5.1.2 Conceptual Site Planning

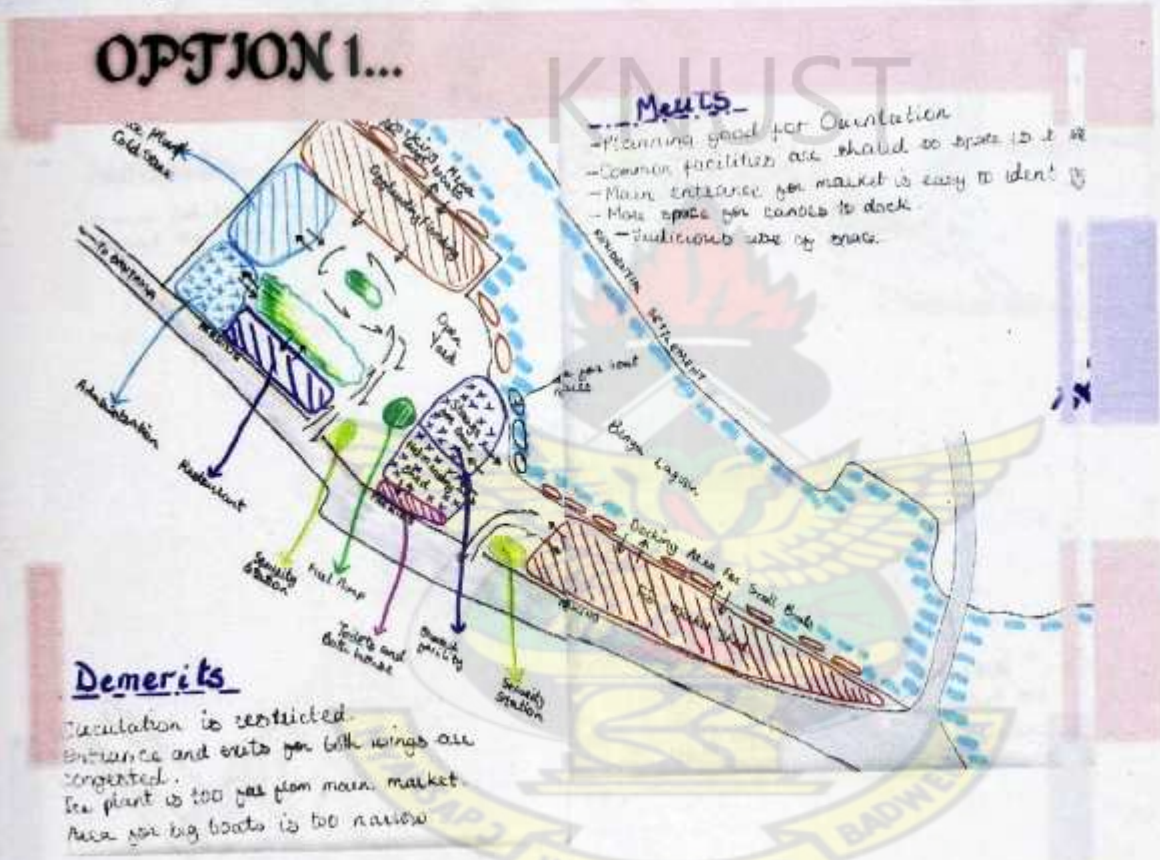


Figure 75: Option 1, Conceptual Site planning

OPTION 2...

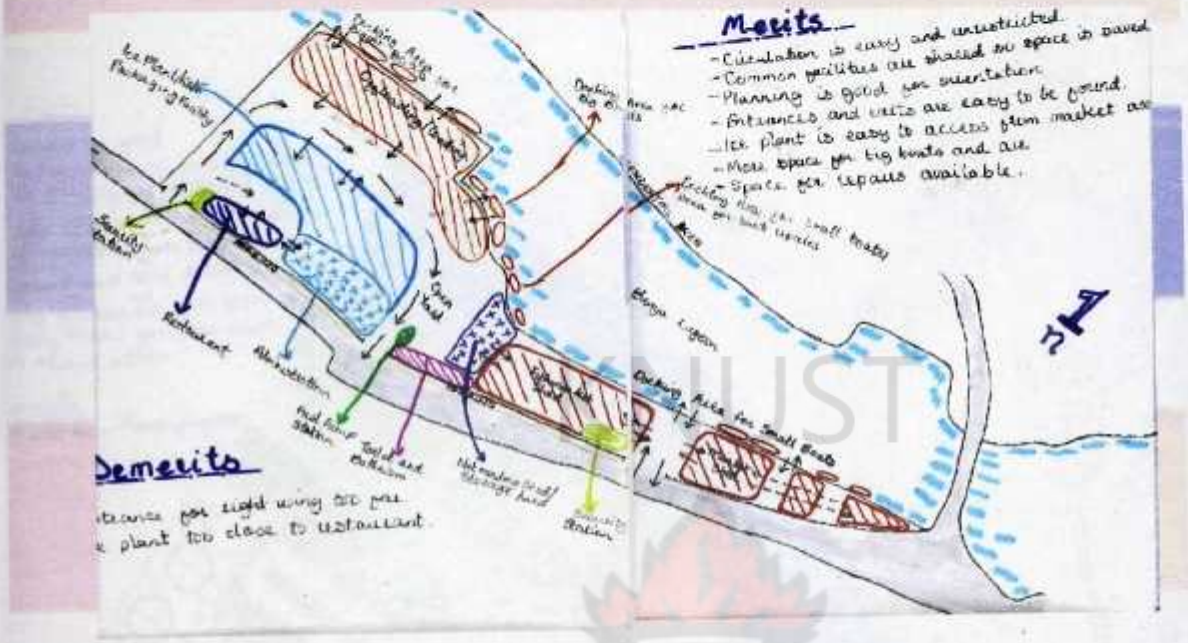


Figure 76: Conceptual Site Planning, Option 2

OPTION 3...

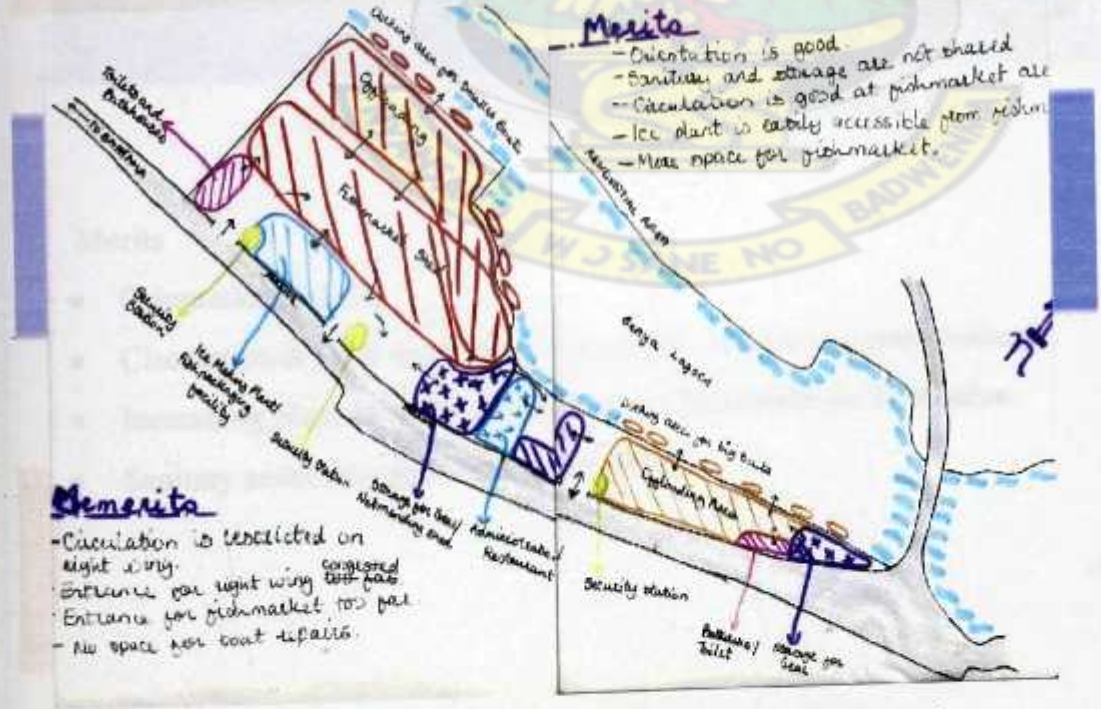


Figure 77: Conceptual Site Planning, Option 3

OPTION 4

Figure 78: Conceptual Site planning, Option 3

Merits

- Orientation is good.
- Circulation is good on both sides for both vehicles and pedestrians.
- Icemaking plant and cold store are easily accessible for both sides.
- Sanitary areas face east-west orientation

Demerits

- Street will be a thoroughfare.

Option 5 (chosen)

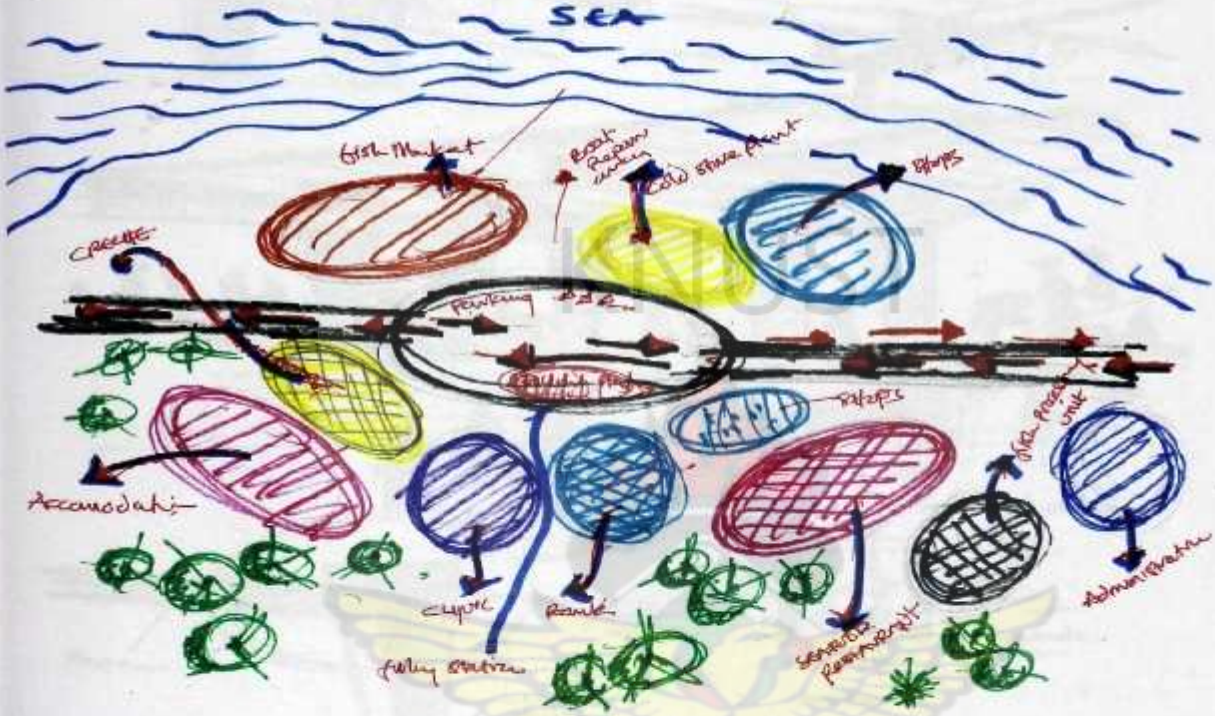


Figure 79: Conceptual Site planning, Option 5

Merits

- Orientation is good.
- Circulation is good on both sides for both vehicles and pedestrians.
- Ice making plant and cold store are easily accessible.
- Sanitary areas face east-west orientation
- Street will not be as busy as option 4
- Boat repair yard is easily accessible to large boats and smaller boats.

5.1.3 Conceptuals

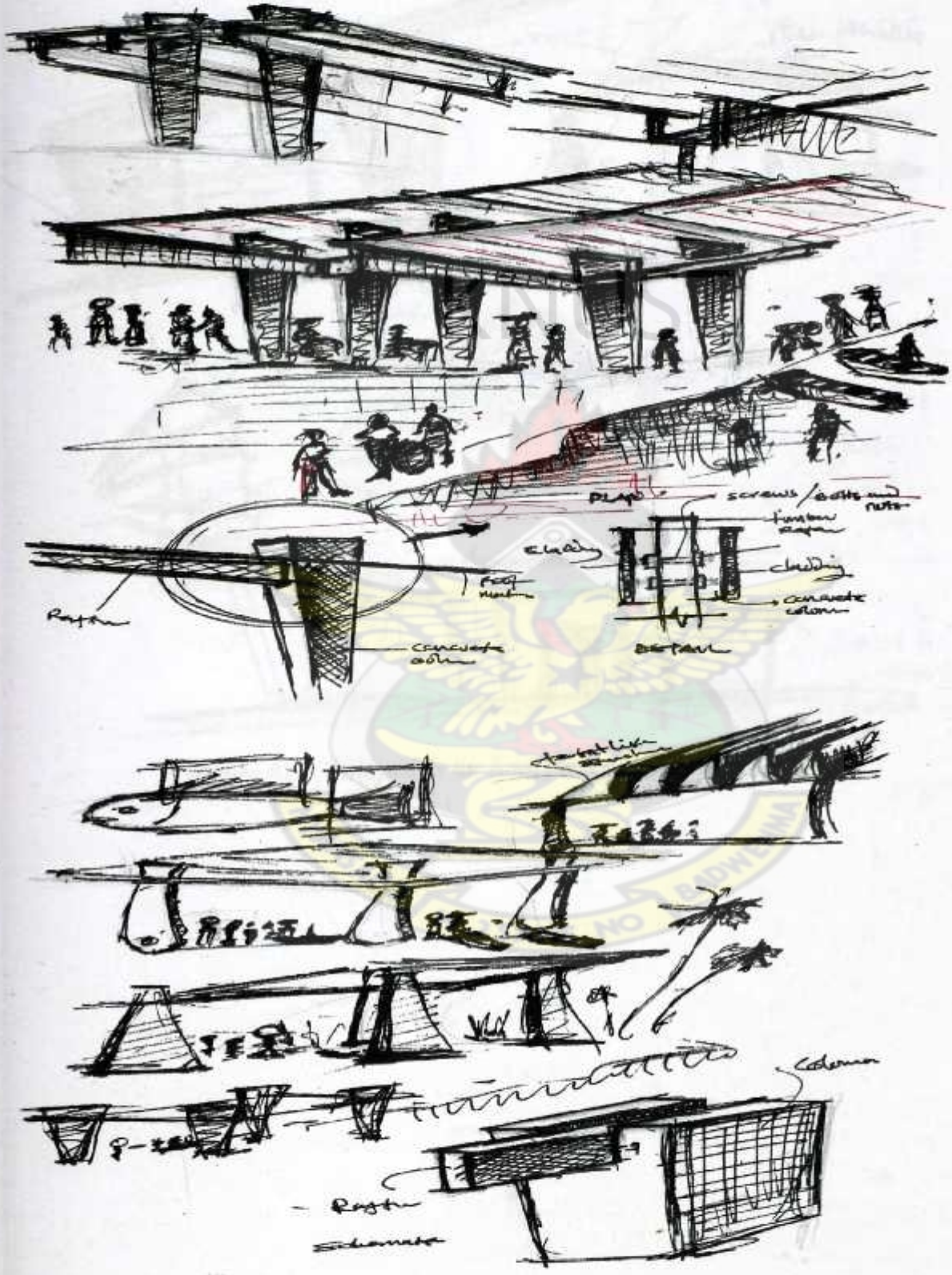


Figure 80: Conceptuals for Roof at Market shed

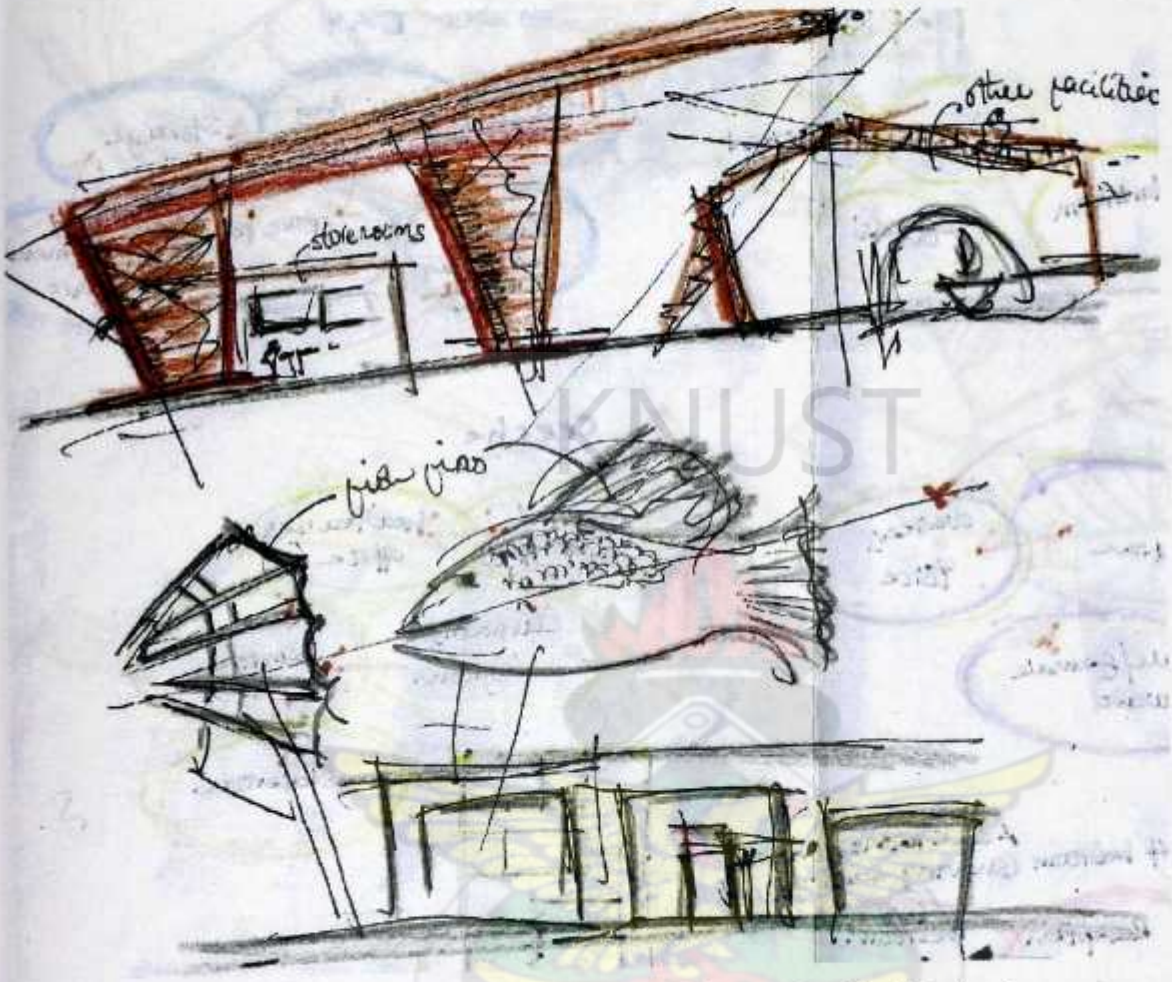


Figure 81: Conceptuals for Roof form at for Market shed

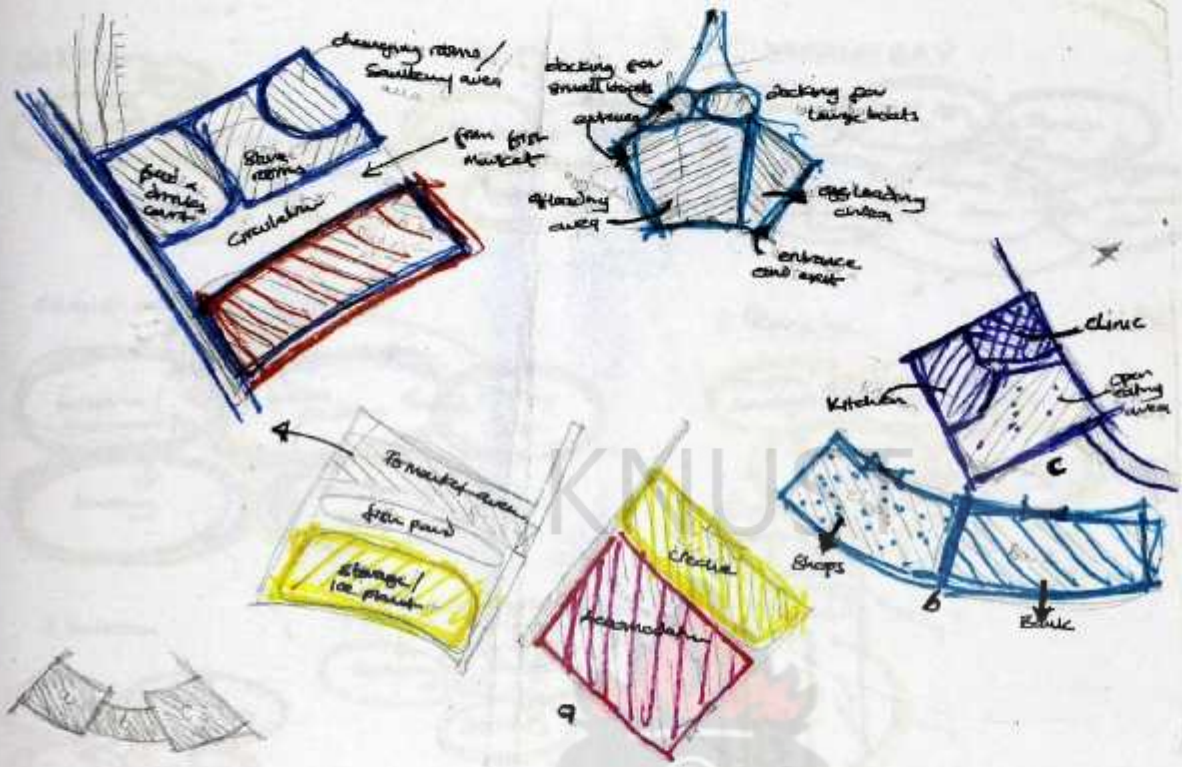


Figure 82: Conceptuals for fishing port facilities

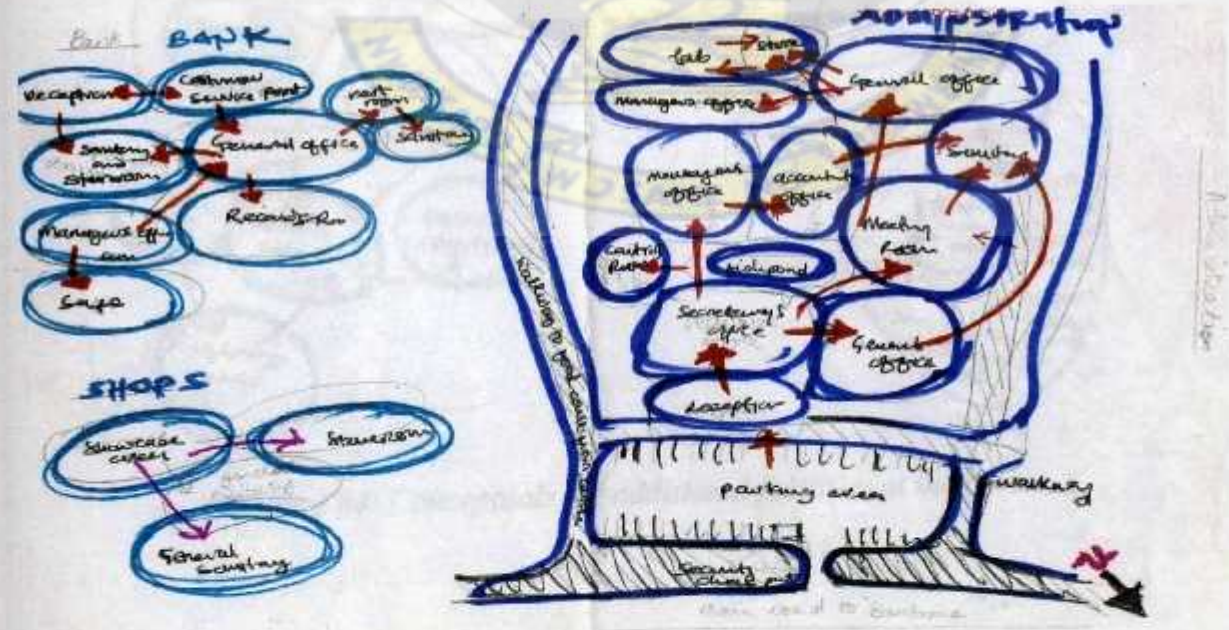


Figure 83: Conceptuals for administration and bank

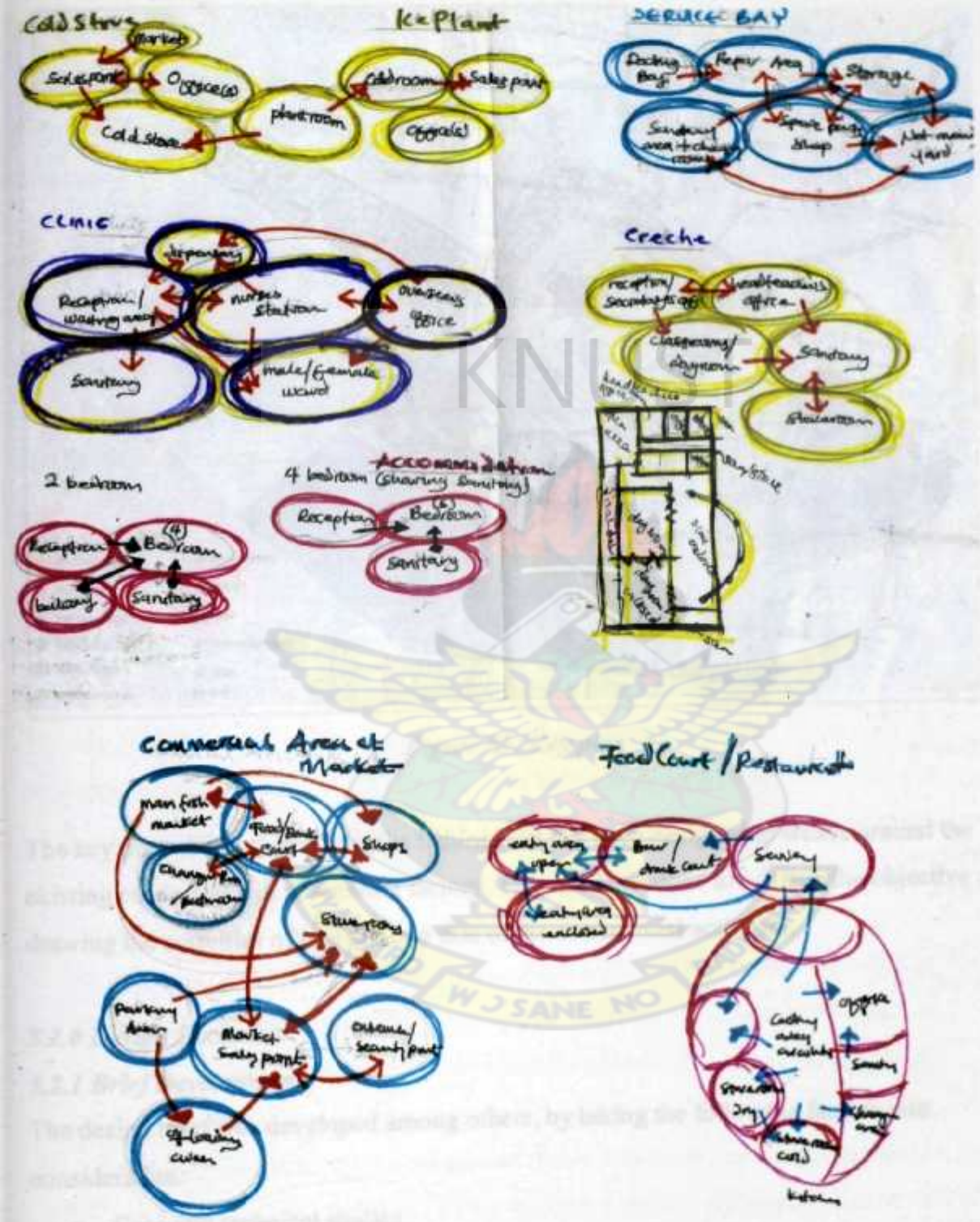


Figure 84: Conceptuals for additional facilities at the port

5.2.0 The Design

Figure 85: Key plan

The key plan above shows how the fishing port has been designed to weave around the existing castle and fish processing factory. This has been done to achieve the objective of drawing the activities of tourism into that of the commercial activities.

5.2.0 Design Evolution

5.2.1 Brief Development

The design brief was developed among others, by taking the following factors into consideration:

- Case and technical studies
- The pans of the GPRS II
- The design philosophy and concepts
- Client's brief
- The social, economic, environmental and cultural state of the people

- The analysis of the outstanding problem and a workable solution

5.2.2 Design Requirements

The standard requirements for fishing ports have been discussed above. They include breakwater, quays and inshore vessel sizes. They were discussed in Chapter 3. The analysis done below focuses on the additional facilities provided as well as how the site was molded to create the favorable environment for the port to function properly.

5.3.0 Conceptual Site Planning

The site measures approximately 41792 square meters. It is cupped by the Benya Lagoon and the Gulf of Guinea. A bridge exists between the town and the land where the site is located. This side also where the Elmina Castle is located. The bridge links the town to the proposed site and the area on which the Castle is located. The topography of the land creates a natural harbor for vessels to dock and offload.

The site is accessed by two major roads in the town: the Bantuma road from the west and the Liverpool Street from the north which goes over the Elmina Bridge.

The site, which lies very close to the town, has been designed mainly to cater for the economic needs of the people. It has therefore been divided into 3 main wings:

- The northern wing which is made up of the main docking area, fish markets, cold stores and other complementing facilities. These facilities will be further discussed in the ensuing paragraphs.
- The eastern wing is comprised of the main administration and an exhibition facility. The administration caters for the activities of the port whilst the exhibition facility designed to showcase to tourists, the culture of the people.
- The southern wing provides facilities for accommodation for fishermen, light shopping, and relaxation banking and so on. It is linked to the administration and exhibition facility since most of the tourists will want to use a restaurant on that wing often. Between the southern and eastern wing is an existing fish processing factory. The existence of the fish processing factory is one of the important factors that influenced the location of the port.

5.3.1 Security and Circulation

In terms of the security, 6 posts have been located on the premises of the main fishing port area. This is very important since it will help the users to do business comfortably due to traffic control and to enable tolls to be collected if the need arises.

One security post has been located at the edge of the bridge to ensure that only registered vessels are allowed into the docking area. Others are located at each of the entry and exit points of the main docking area and fish markets. Three are located at the main entries for the markets. These entries can sometimes be used as exits, especially on busy market days.

The posts are not located close to the main Bantuma-Liverpool street since it is a road that leads to other parts of the town and the activities of the port need not disrupt circulation of people and goods throughout the town.

A pedestrian walkway has been placed along the main roads to facilitate the movement of pedestrians throughout the facility or to the other sides of the facility. It will also enable tourists to enjoy the scenery of the port as they walk to and from the restaurant which is located on the southern wing.

Figure 86: Block plan, Port

5.4.0 Conceptual Evolution of Design

The ensuing discussion focuses on the port facilities. The core facilities of the port will be discussed first. These are the facilities on the northern wing. The other facilities on the southern wing will follow.

- The docking area, Repair Yard, Ice and fish cold stores

These are located closest to a culturally significant area of the lagoon. It is where the original docking bay and fish market of the people of the Elmina town was located. This was also where most of the celebrants stand to observe the annual Bakatue festival which is climaxed by a boat race. Most of that area shall be dredged as discussed in the earlier discussion to make circulation easy for the vessels. Most of the structures are located under a huge shed which is structured to allow enough lighting and ventilation to pass through the facility. Due to the nature of fresh fish and its short lifespan, especially when

exposed to the hot weather, an environment with good ventilation will help to carry away the bad stench and also kill bacteria on the ground. The quay has small ducts that will carry away liquid waste.

Located next to the repair yard is the main docking area where the boats dock to offload the harvest. The harvest is either sold off to buyers or to fishmongers or stored in the cold store. Big trucks that are buying in large scale have a parking area close to the docking area where the fish will be loaded into the trucks. The fish will be loaded and taken to the cold stores with the use of forklifts or carts.

Prospective buyers can buy ice from the ice plant located adjacent to the cold store.

Figure 87: The docking area, repair yard, ice and fish cold stores

- The fish markets and storerooms

The storerooms separate the repair yard area from the market. These storerooms have been provided to serve as storage for the fishing gear. It was realized that the fishermen usually left their nets to the vagaries of the weather after drying them because they had no storage space for them. It was therefore necessary to provide them with the storerooms. The market is divided into 3 main parts: the main fish market, hawkers' market and smoked fish market. The smoked fish market is located close to a bridge that links to an area in the town where fish is smoked or processed.

This market is designed with 2 sanitary facilities, 1 for general use and the other for the fishermen who may want to freshen up after a trip. It is built with bathrooms and changing rooms.

Figure 88: The fish market and storerooms

Figure 89: Circulation Pattern for the port area

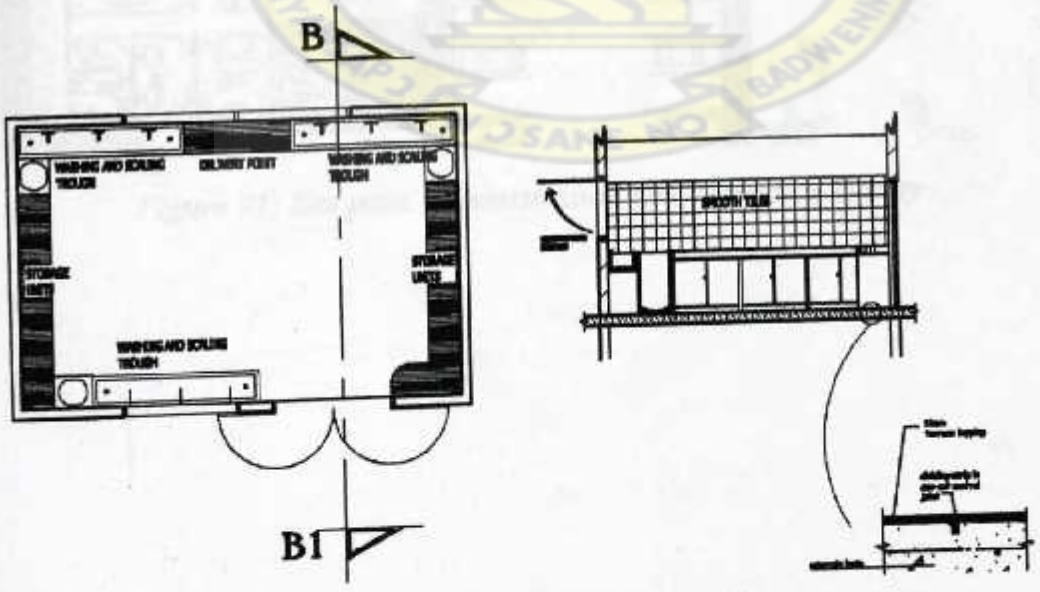


Figure 90:Plan and Section of Fish scaling room

- The main administration and exhibition facility

The main administration caters for administrative activities of the port like monitoring of vessels and handling of tolls or revenue generated from the port. It also has offices for the fisheries department. There is a fishermen's meeting room where the fishermen will meet to discuss issues pertaining to their work and how they can improve their methods of fishing for increased profit.

The exhibition facility is designed to showcase to tourists, the culture of the people as well as the importance of the fishing port to the culture and economic well being of the people. It has shops where they can purchase artifacts made by the people. They can also take pictures of some of the exhibits for educational and promotional purposes.

Figure 91: Site plan, administration and exhibition facility

- The restaurant and shops

These facilities are placed close together since most of the people who visit the restaurant may want to do some light shopping for fish products. The restaurant has the capacity of about 64 people. It is designed with a swimming pool, a bar and an open sightseeing area. The pool is there since the shoreline on that side is rocky and not safe for swimming. The open sight seeing area has been provided for those who may want to enjoy views like the ocean and the castle. The restaurant is linked to the main exhibition facility to encourage the tourists to visit.

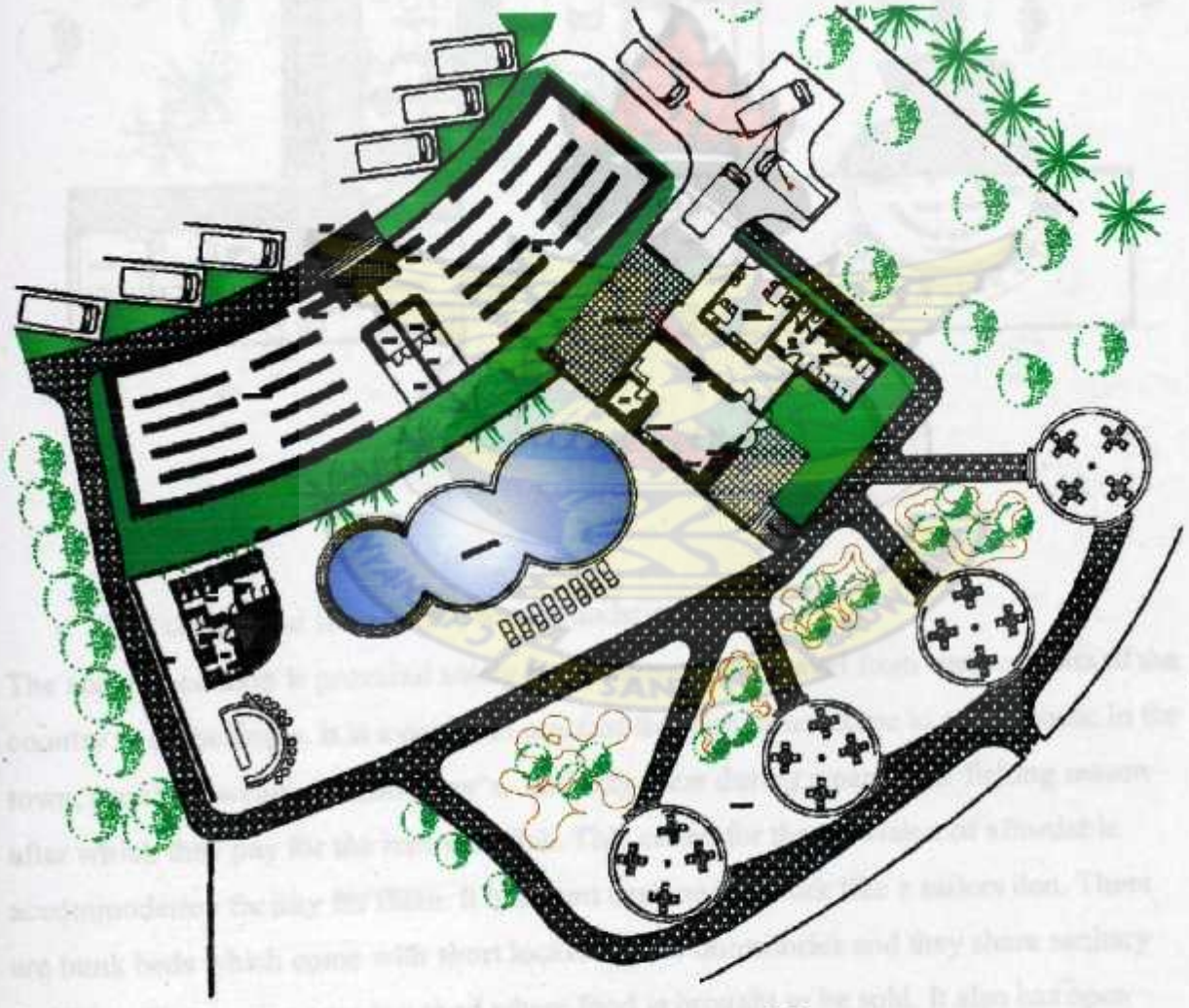


Figure 92: Restaurant Area and Shops

- The clinic and bank

The bank operates like a mini bank (credit union). It has an ATM point, a bullion van park, and a strong room. The clinic has been provided to handle minor accidents that may occur at the port and surrounding area. It also comes with male and female wards, and a dispensary.

Figure 93: Clinic and Bank

- The crèche and fishermen's accommodation

The accommodation is provided solely for fishermen who travel from various parts of the country to do business. It is a common practice that fishermen come to rent a house in the town, usually a wealthy fishmonger's, and stay there during a particular fishing season after which they pay for the rent with fish. This called for the provision of affordable accommodation facility for them. It has been designed to work like a sailors den. There are bunk beds which come with short lockers in the dormitories and they share sanitary facilities. They eating area is a shed where food is brought to be sold. It also has open enclaves between the dens where the fishermen can sit and socialize or play music as they like to do this most mornings to revive themselves before they go on their fishing

expedition. These spaces have also been provided to facilitate ventilation and lighting in the buildings.

The crèche has been provided to enable busy fishmongers to take their kids who are not yet ready for school for safe keeping whilst they are at work. It is located close to the fish market to enable the mothers to have easy access to it. It comes with a cafeteria, sanitary area, classrooms, and a play area among others.

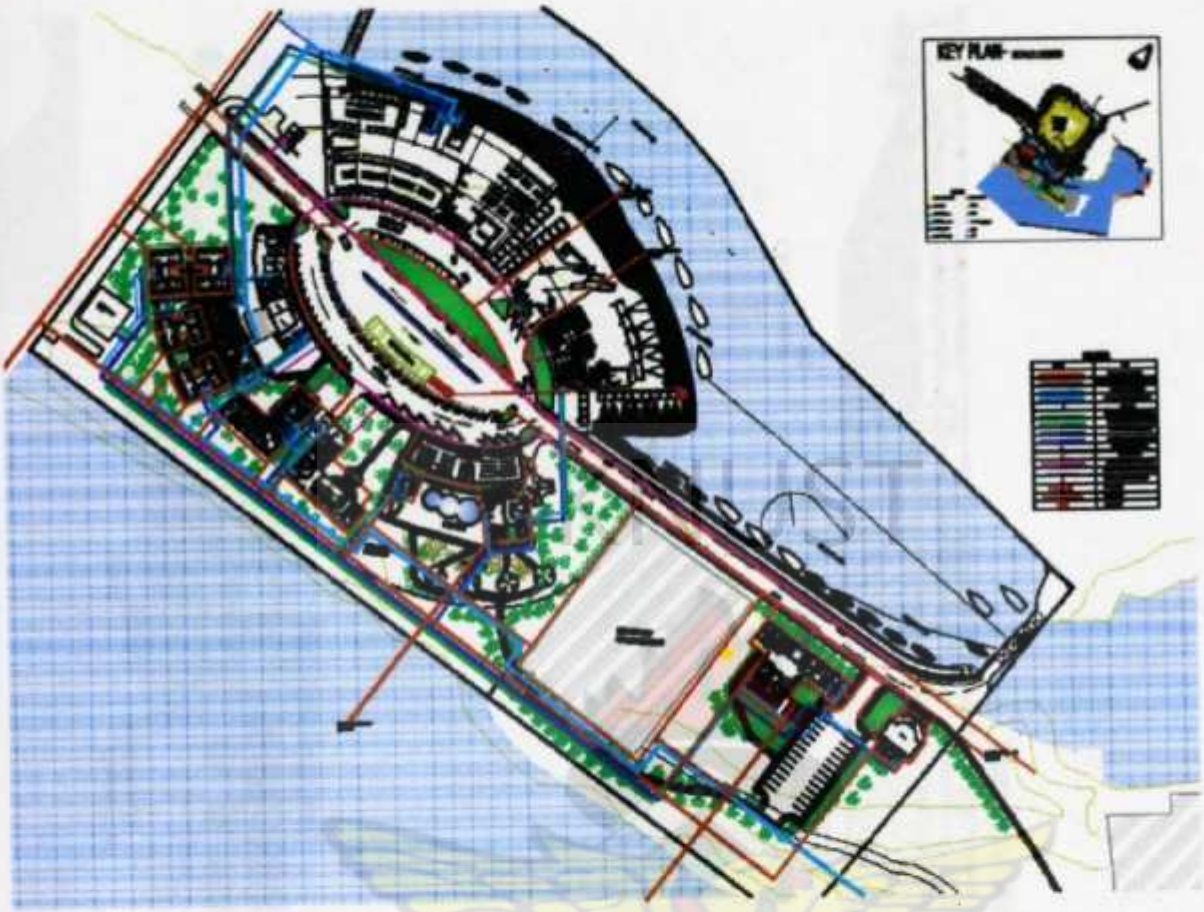
Ramps have been provided to assist the handicapped to access all the facilities at the port.

Figure 94: Crèche and Accommodation

Miscellaneous facilities that have been provided to support the functions of the port are:

- Security checkpoints
- Powerhouse
- Central Sewage System
- Fire Station
- A fuel station
- A bunker/ Service gallery

Figure 95: Site plan of the port



LEGEND

SYMBOL	NAME
	300 MM Ø SURFACE WATER GUTTER
	100 MM Ø POROUS CONCRETE PIPE (FOUNDATION DRAINAGE)
	12 MM Ø COLD WATER SUPPLY PIPE
	120 MM Ø WATER SUPPLY PIPE FROM RESERVOIR
	WATER VALVE
	100 MM Ø PVC PIPE FROM TOILET TO MANHOLE 150 MM Ø PVC PIPPE FROM MANHOLE TO MAIN PIPE
	300 MM Ø SOIL WASTE PIPE TO CENTRAL SEWAGE
	38 MM Ø FOUL WATER PIPE FROM BUILDING
	150 MM Ø FOUL WATER PIPE TO CENTRAL SEWAGE
	200 X 400 MM INSPECTION CHAMBER
	600 X 900 MM MANHOLE
	ELECTRICITY DISTRIBUTION OVER HEAD CABLES
	230 VOLTS, SINGLE PHASE SERVICE ELECTRICITY CABLE
	NEW TIMBER ELECTRICITY POLES 15M CENTERS
	BUNKER (BURSTED)
	BUNKERING PIPES
	SERVICE GALLERY

Figure 96: Services layout

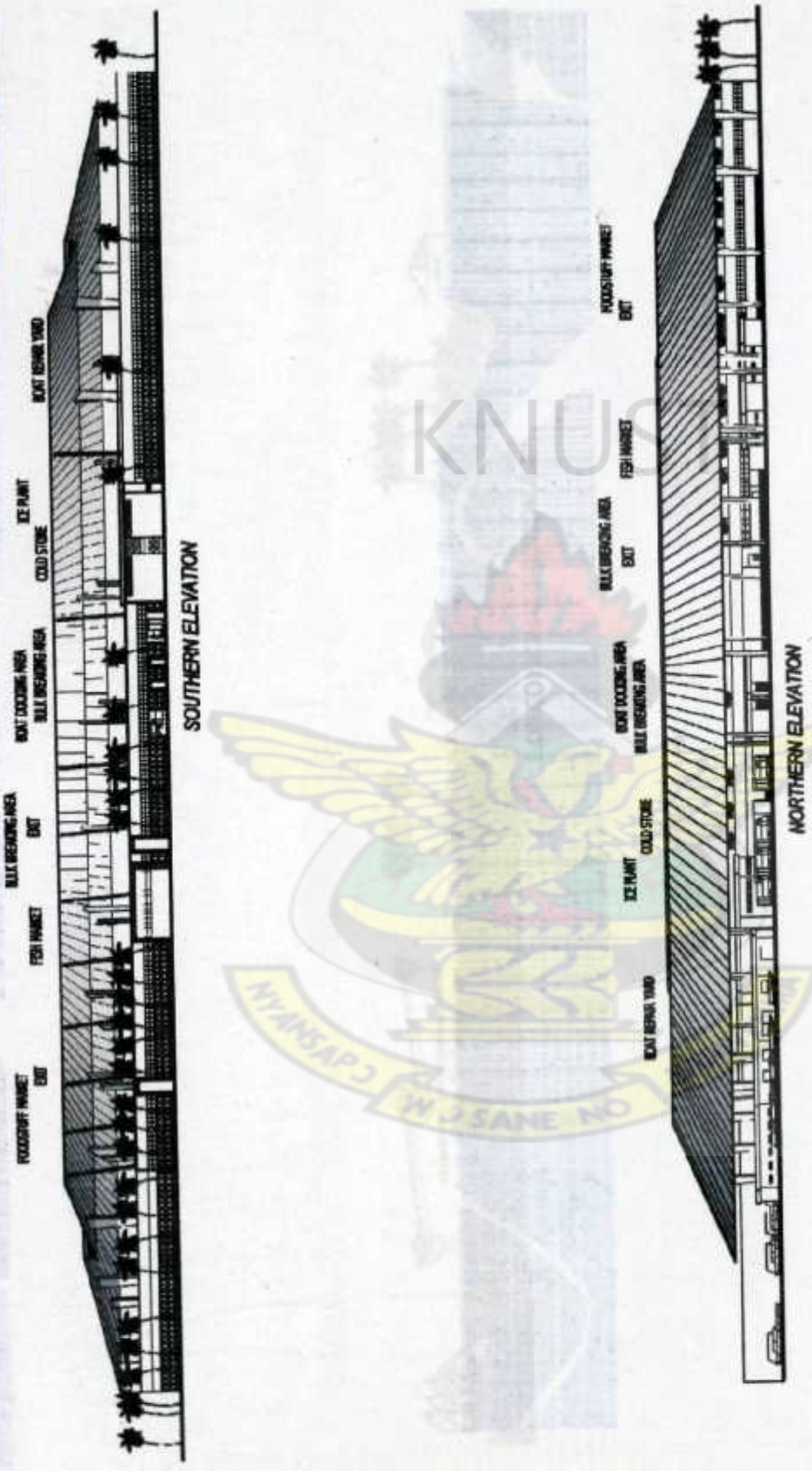


Figure 97: Elevations, Fishing port area

Figure 98: Long elevation, Port to Bank area

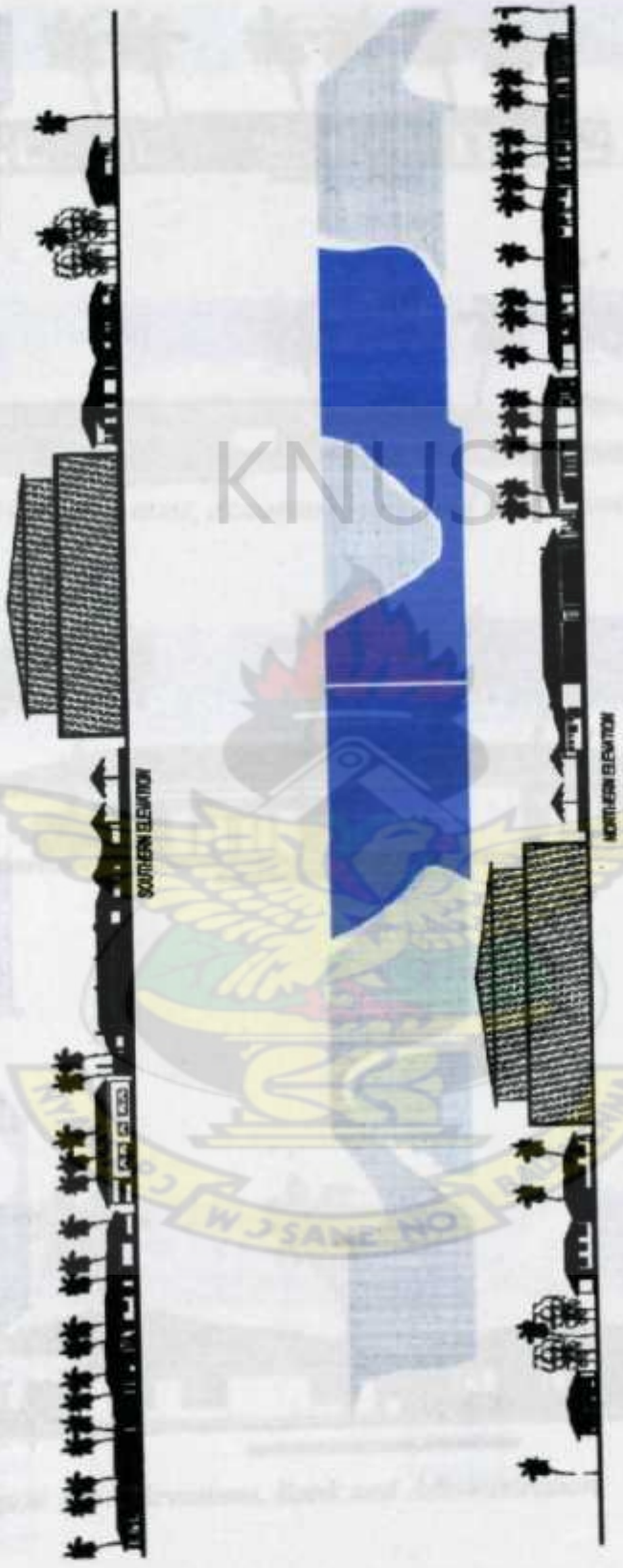


Figure 99: Long Elevations, Southern Area

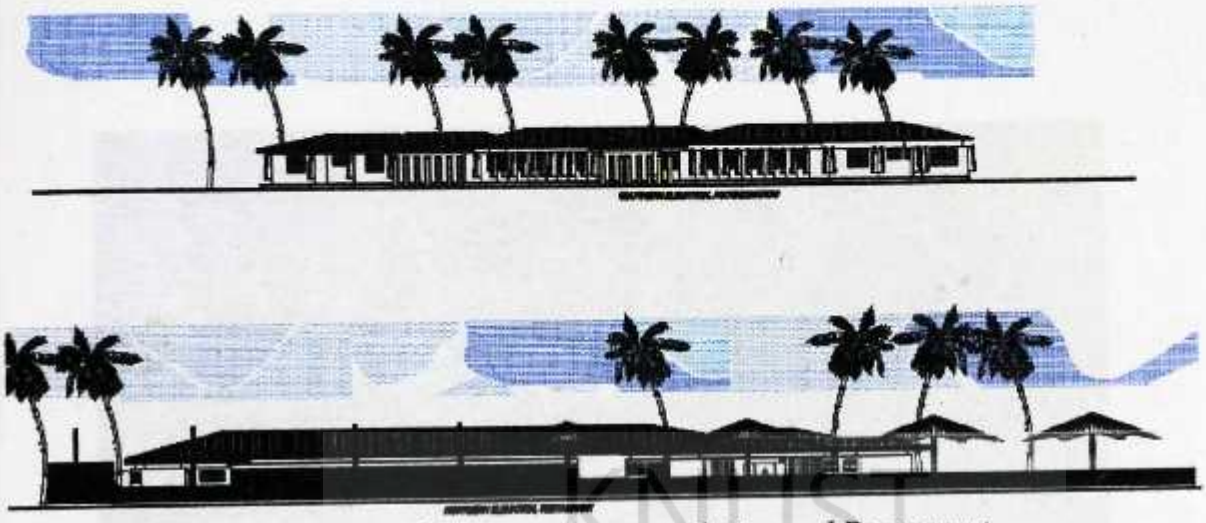


Figure 100: Elevations, Accommodation and Restaurant

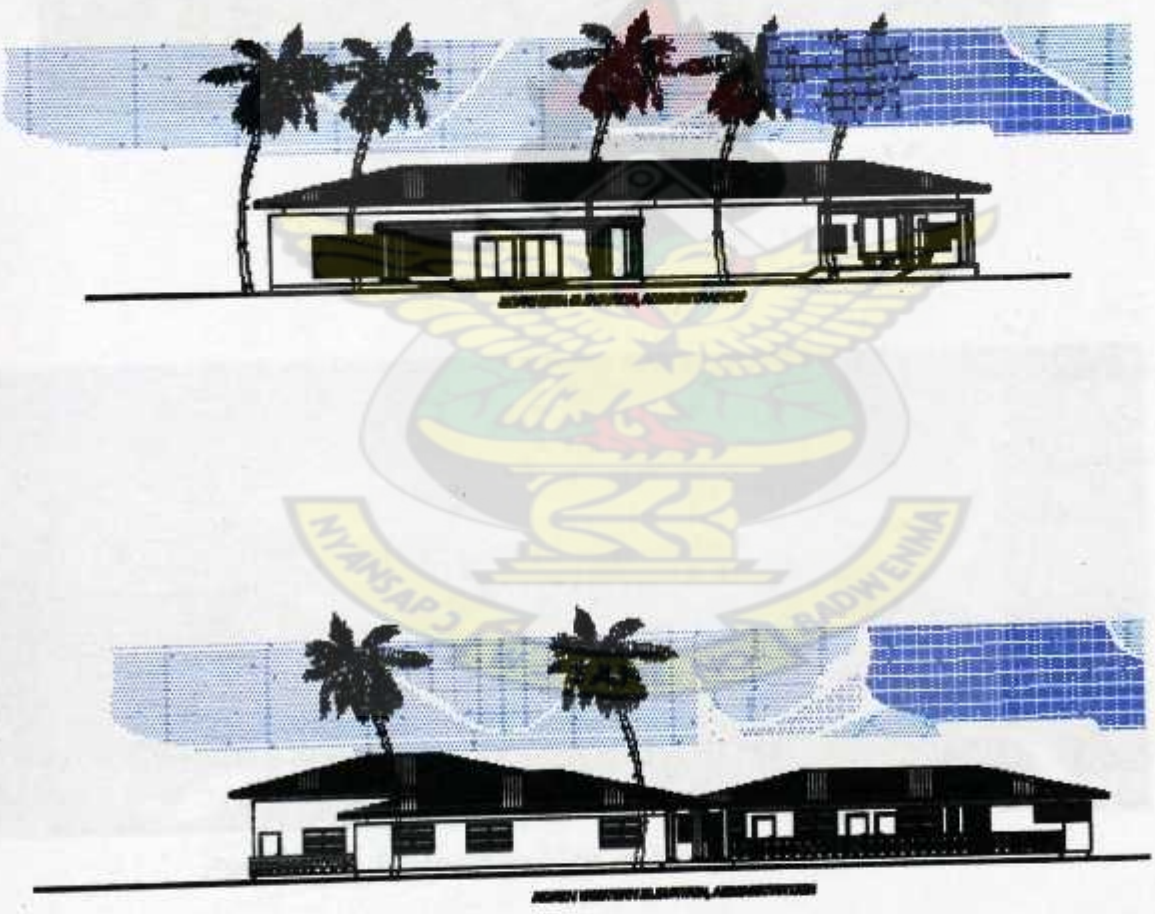


Figure 101: Elevations, Bank and Administration

Figure 102: Ariel view of Port

Figure 103: Perspective View of Port form the Castle

Figure 104 : Perspective View of Restaurant

Figure 105: Perspective View of Accommodation Facility

Figure 106: Perspective View of Shop from Fish market

Figure 107: Perspective View of Main Fishing Port

Figure 108: Perspective View of Administration

5.6.0 Services

5.6.1 Electricity

Power to the site is made available from 11kV ECG feeder to the area. This is stepped down with a transformer to 240V required appliances.

A 315 kW transformer has been provided on site to cater for the machines and refrigerator at the ice making plant and the cold store at the fish market hall. The remaining energy will be used to power the rest of the electrical installations. A stand by generator with automatic switch –over mechanism has been recommended.

5.6.2 Water Supply

Water has been tapped from the 150mm diameter (along the Bantuma Road), through 100mm diameter pipes to each unit block. This is sent down into subterranean cisterns and up into overhead over head cisterns through a 50mm diameter rising mains .the aquarium at the fishermen's hall is fed with water from the sea and has separate connection.

5.6.3 Fire Prevention, Protection and Fighting

In the event of fire, a fire safety/ fighting unit has been installed to deal with the situation. There are fire extinguishers installed at vantage points. There are also smoke detectors and sprinkler systems to cater for the offices, auditorium at banking hall, clinic, ice plant, cold store and most of the other facilities.

Reduction of fire load in the choice and treatment of materials has also been a major consideration.

5.6.4 Ventilation

Air exchange between the facilities and the environment is basically obtained from their orientation to the prevailing wind direction. To take advantage of natural cross ventilation, wide unconstructive windows have been provided on the north –east facades. The length to breadth ratio of the plans is controlled, in order to avoid deep rooms and make cross ventilation effective.

Artificial ventilation is basically provided by ceiling fans. However in the special situations where the use of air conditioners is more appropriate, 1.5- 2HP split system air conditioners are recommended.

5.6.5 Communication System

The use of Ghana telecom lines for external communication is envisaged and the network communication outlets have been provided. This has been done with flexibility and possible re-organization of spatial disposition of certain functions.

5.6.6 Lighting

Solar radiation is the primary source of daytime light requirement in the facilities.
Artificial lighting is by means of energy saving fluorescent lamps.
Lighting effects obtained from row of lamps installed externally to give dramatic night scenery.

5.6.7 Means of escape

The concept for safety through the means of escape is to bring users into open spaces where they can be easily evacuated. Several openings have been provided to enable occupants to evacuate easily in the fire out break especially at the fish market which is envisaged to accommodate hundreds of people.

5.6.8 Waste disposal

Sanitary accommodation has been considered in or near and on every floor in the fish market, administration and commercial complex.

Waste in the form of litter is collected at vantage points in plastic containers are carted away to the district's main disposal site. The floors of the fish market shall be washed the end of each day, this will be channelled into floor channels and finally into main drain. Taps has been fixed to the columns here for this purpose.

Surface drains have been sloped towards covered which leads to main storm drain along the Bantuma road.

There is also the need to design a drainage system to prevent waste from or into the drains which empty into the Benya lagoon.

At high tide there is a back flow of water from the lagoon into the drains and this is accompanied by trash which found its way into the lagoon. The project seeks to establish a filtration system at the interface of the drainage exit points such that the backflow from the lagoon induced by the high tide withholds the solid waste from the lagoon at the point where the drain discharges into the lagoon. Only one of such mechanisms will be needed for the current drainage system in place at Elmina. The backflow arising from the tidal effect of the Benya Lagoon will be solved by constructing a one - way sluice valve at the point of entry of the drain into the lagoon. In addition a concrete sump of size 3m x 4m x 2.5m deep will be constructed to serve as a waste catchments tank. At the same time, the tank will serve as a holding tank when the sluice gate is shut during high tides.

5.6.9 Sewage

Sewage from individual points take their outlets at inspection chamber s provided at a maximum centres of 9metres and at every change in direction and/or gradient of soil/waste pipe lines lead to septic tanks at the western end of the site .

5.6.10 Landscape

The landscape has been designed to offer variety, rhythm and balance. Hard and soft landscape has been integrated to mitigate dullness. Hard landscaping elements, with the soft landscape elements punctuating the predominant hard areas have been utilized. The introduction of soft landscape has both aesthetic and functional values.

Carefully chosen plant species have been employed. A major parameter which guided the choice of plant materials is the rate at which leaves are shed by the plants. This is significant in order not to litter the site with debris as a result of withered foliage.

Some of the plants species used are

- Coconut
- Royal palm
- Cactus
- Hedging plants and
- love grass

Hard landscape elements include;

- Marble stones
- Concrete slabs and Granite chipping

5.6.11 Conclusions

The purpose of the design is to promote the economic and socio-cultural lives of the people of Elmina by upgrading the fishing port they have there. The fishing business, which has been part of the people for centuries, is the main activity that they involve themselves in since most of them are not in the financial position to educate themselves or to start a business.

Apart from boosting their economic status, it will attract more tourists to the area since the facility is located close to the Elmina Castle, which is the main edifice which attracts tourists to the town.

This will be achieved by the design of the exhibition facility and the seafood restaurant that has been incorporated in the design of the fishing port.

For most people who visit the town for the first time, a tour through the castle will be incomplete without going through the fishing port.

For the inhabitants and fishermen or fishmongers, their means of doing business will now be much smoother and they can probably get more profit since most of the conditions for them to do business will be much better than before.

REFERENCES

1. Neufert. E.N. (1999). Architect's Data, Third Edition. Oxford Brooks University.

2.Guzowski, Mary. (1999) Daylighting for Sustainable Design. Massachusstes, London

3.Sloman, Lynn. (2000) Living Streets, a Guide to Cutting Traffic and Reclaiming Street Space

4. Dudek, Mark (1998) Kindergaten Architecture: Space for the Imagination. London

5. Weingarden, Lauren S. (1987) The banks. Massachusetts.

6. Davis, Douglas. (1990) The Museum Transformed. New York

7. White, Ken (1982) Bookstore. Planning and Design. New York

8.Fitch, Rodney and Knobel, Lance (1990): Fitch on Retail Design. Oxford Phaidon Press

9. Ackerman, Kurt(1991): Building for Industry UK, Watermark Publications

10. Falconer, Peter and Drury, Joylon (1987): Building and Planning for Industrial Storage and Distribution. London.

11. Wilkinson, Chris, Supersheds (1995). The Architecture of Long Span, large Volume Buildings, 2nd edition. London

12. Abercrombie, Stanley (1999): Hospitality and Restaurant Design. NewYork

INTERNET SOURCES

Microsoft ® Encarta ® 2007. © 1993-2006 Microsoft- History of fishing

www.wikepedia.com- Fishing and fishing methods

www.bnet.com- Fishing port and types of fishing vessels

www.beachfront designs.com- Beachfront design

www.google.com- Industrial Design

answers.com- Fishing port design, Case Study, Vigo Fishing port, Spain

askme.com- Fishing Vessels, Terminologies in Marine Technology

dogpile.com- Bunkering