IMPORT CLEARING FACILITY

BOANKRA, KUMASI

By

Ishmael Ntori Asante (BSc. Architecture)

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DECLARATION

I hereby declare that this submission is my own work towards the PG-DIP and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Asante Ishmael Ntori	.....	18/09/09
Student Name and ID	Signature	Date

Certified by:

Mr. G. F. A. Olympio	.....	18-09-09
Supervisor(s) Name	Signature	Date

Certified by:

Prof. G. W. K. Intsiful	.....	.....
Head of Dept. Name	Signature	Date

DEDICATION

This design thesis is dedicated to God Almighty who gave me strength and wisdom to go through the six years architectural education and to my wonderful parents Mr. E.K. Asante and Mrs. Agnes Asante for their moral support throughout my studies in the university.

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ABSTRACT

Increasing congestion of the main seaports and the difficulty associated with transit trade to the hinterlands from these ports in Ghana is the main reason for an alternative. This paper focuses on the concept of dry ports which involves the movement of intermodal freight terminals further inland from seaports. In Ghana, the proposal of the establishment of the Boankra inland port has served a platform in dealing with the issues of congestion faced by the two main ports of Tema and Takoradi. The proposed inland port is expected to connect the seaports to the hinterlands and neighbouring landlocked countries of Ghana. For the purposes of developing Boankra port to achieving its objectives, this paper seeks to architecturally propose and develop parts of the inland container depot as an import clearing terminal to facilitate the operations of the port. The application involves an extensive collection of data and analysis through research leading to architectural design proposals as well as design conclusions and recommendations relative to the entire project.

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CHAPTER ONE

1.1 Background

"Freight movement along the main transit corridors is hindered by physical and non-physical bottlenecks, which increases transport costs, thus adversely affecting export competitiveness and posing formidable obstacles to the import of essential capital goods, food and fuel."(Shipping Review, volume10 no.3 July-Sept.2003). Importation of goods from countries through ports all over the world has been a principal contributor to the economic development and global integration of nations around the world. In Ghana, goods importation continues to be a major backbone of the country's economy especially in this dispensation of golden age of business. To ensure safety and security of all goods imported, clearing procedures must be carried out with the best practices and under very favorable facilities at the ports at arrival.

The establishment of well equipped facilities at the various ports of entry is a means of avoiding excess congestion as well as indiscipline around the ports. It is therefore imperative that government and all stakeholders of the import clearing process pay particular attention to the sector.

1.2 Problem Statement and Justification

Major ports in Ghana specifically the Tema and Takoradi ports, today are experiencing fast growth and are therefore forced with the challenges of:

- Congestion, this is as a result of increased import and export activities and volumes of goods.
- Mis-handling of imported goods
- Delays in accessing and clearing of cargo at the seaports of Tema and Takoradi by landlocked countries.
- Over stressing of major roads in Ghana due to the volumes of cargo trucks that have to travel southwards in order to convey cargo in and out of the ports.

It is in this vein that the government of Ghana has acquired a 400acre piece of land for the building of dry port at Boankra near Kumasi to facilitate the handling of the rapidly increasing volumes of trade with the hinterland countries. By this declaration, Boankra inland port is gradually coming into the lime-light of becoming one of the most important ports to

spear-head transit trade in the sub-region. It is therefore essential to establish an efficient clearing facility to enable the operations of the dry port avoiding all traces of congestion in its operations.

1.3 Objectives

The project seeks to:

- Enable decongestion of the seaports by providing faster cargo clearing process and shorter transit times.
- Give Ghana a competitive advantage that more cargo intended for the landlocked countries would pass through the dry port.
- Provide facilities that will improve cargo handling, methods especially those on transit to landlocked countries.
- Make available modern storage facilities including container devanning areas for the clearing process which could be ran by private companies.
- Provide administrative office spaces and proper working environment for CEPS officials, clearing agents and other import clearing officials.
- Contribute to the maintenance of economic and political stability.
- Promote increased foreign earnings through import clearing transit.
- Promote labour and employment.

1.4 Scope of Thesis

The project limits itself to the:

- Study in general, the activities and operations of import clearing agencies and port institutions in Ghana.
- Establishment of an import clearing facility at Boankra Inland port.
- Development of a design brief and propose a functional and aesthetically pleasing design of an import clearing facility at Boankra Inland port with operational offices and devanning terminals meant to enable the smooth running of the port.

1.5 Target Group

The target group for this scheme embraces import operators and cargo inspection officials and agents, this includes: import clearing agents, port administrators, ceps officials, terminal yard operators, etc.

1.6 Clients

- Ghana Ports and harbors Authority
- Ghana Shippers' Council

1.7 Client's Brief

The clients brief outlines the following:

- Container Devanning yard
- Container freight station
- Administration block
- Mechanical workshop
- Adequate parking for staff and costumers cars and trucks

1.8 Project Financiers

- The Government of Ghana
- Private investors who will finance the project on Build-Operate-Transfer (BOT) basis.

CHAPTER TWO

2.0 LITERATURE REVIEW

The purpose of this literature research is to review documentation on how ports over the years have metamorphosised into large economic and engineering enterprises as well as industrial cities. Specifically, this review is intended to discuss related developments as pertains to ports in Ghana. Statistics derived from these studies in Ghana hereby explains the need for an inland port establishment in the country.

2.1 Evolution of Commercial Ports

As implied, ports in their early stages of development are basically nodes of transportation interface. In their next level of evolvement, they become home to industries both light and heavy that have strong dependency on their services in terms of both exit and entry points for both raw materials and processed goods. Subsequently, transportation naturally becomes integrated; ports then evolve at this level into intermodal nodal points. This kind of evolvement was exhibited remarkably when containerization was peaking. Several ports had stuffing and de-stuffing processes done within their premises. However, as containerization gradually matured, less-than-container load activities were undertaken downstream before the loaded container arrived at the ports of entry and exits. By virtue of these developments, the port grew into a complex engineered intermodal point becoming a buffer zone for complex chain of activities where balancing and directional services are provided.

By the next phase of the development of the port, they tend to play a much more peripheral cargo-handling role since they become logistical platforms where value adding activities take place. Increased economic activities, cargo handling begins to assume a much wider dimension, therefore to manage these, the eventual step in the evolution of the ports becomes a globalised network which is driven by information technology.

Finally a booming port industry further mature to provide extensive residential (housing), educational, social as well as religious necessities for its users and operators based on population growth factors. Eventually, fully fledged ports evolve into towns and subsequently assume the status of cities often known as harbour cities especially if they are located around water bodies; seaports.

2.2 History of Ports in Ghana

The development of ports in Ghana began in 1900 with the establishment of small surf ports or landing points along the cost often closer to forts. These were instituted first by the Portuguese and later by the British, Dutch, Danish and other European trading companies, trading primarily in slaves and gold and to a smaller extent also in ivory.

This period 1900-1920, saw the big transport revolution when the first railway was built from Sekondi, first to the mines at Tarkwa and further to Obuasi. These transport line was meant to carry machinery, building materials, agricultural produce to the mines. Increasing amounts of cocoa were exported from areas round the town of Kumasi while many more agricultural produce were sent to the growing town of Kumasi. The eastern line of transport brought cocoa down to Accra for export.

In 1928 a modern habour in Takoradi was opened and this dramatically reduced the loading and turn -around times of ships. Much of the cocoa in the Central Province was not carried by the railways to Secondi/Takoradi or Accra, but shipped by the developed roads to the smaller ports in Cape Coast, Saltpond and Wenniba,

Freight traffic between 1940 and 1960 on the railways increased by 57% during the war this was due to increase in exports and the related boom in the internal economy and in imports. As a result, of increasing pressure on the transport system plans were developed around the construction of a new port in Tema to serve Accra and the eastern corridors of the country. In 1962 increased industrialization led to the opening of the Tema port.

During the Post-independence era, the two seaports Tema and Takoradi, controlled virtually all the seaborne trade of Ghana. In 1970, there was a temporary stagnation of the total throughput of these ports reaching a low point by 1983 and 84; however it assumed the same level of throughput as in the 70s only in the 1990s.

Variations in the size of both ports became eminent after the establishment of the Tema port. It grew rapidly outpacing the Takoradi port. By the early 1980s, it had grown about five times larger while the throughput of Takoradi port was emaciating. The Takoradi port although regaining its position, still trailed behind its rival the Tema port putting up a throughput of cargo about 2.2million tons relative to 5.4million tons of Tema port as at 1998.

Generally, imports are much larger than exports in terms of tonnage. In the 1970s, exports were slightly larger than imports nearing a balance. But eventually by the end of the 1990s, imports tonnage had climbed to three times more than the export tonnage. (Source: The Freight Transport and Logistical System of Ghana March 2001 by Poul Ove Pedersen)

2.2.1 Takoradi Port

The Port of Takoradi was built as the first commercial port of Ghana in 1928 to handle imports and exports to and from the country. It is located 228 km west of Accra and 300 km east of Abidjan, Cote d'Ivoire.

The mission of the port is to handle both domestic and transit cargoes quickly, provide excellent security and deliver service with a smile at very competitive cost. Over the past decade, the Takoradi Port on the average has been handling about 500 vessels, 32 of the total national throughput, 67 per cent of total national export and 20 per cent of total national imports annually.

The port enjoyed a major rehabilitation in 1986 after which it now has a full range of equipment and facilities to handle all types of cargo efficiently. Institutional changes made during the rehabilitation have produced highly skilled and productive staff and an excellent security network, especially with the recent installation of a Close Circuit Television (CCTV) to help monitor activities there.

It now turns vessels around at a productivity rate equal to those of most European ports. Apart from a brief period in 1994/95 when the port experienced a drop in its cargo throughput due to the Government's ban on the export of round logs, business at the port has been growing bigger and better.

The Takoradi port has pilotage and towage services to all vessel types that call there. It has adequate storage capacity and stores all types of cargo.

From 1928 to 1962, before the Tema Port was opened, Takoradi Port served as the main gateway to the country; handling imports, exports and passengers. It also served as a base for the country's naval operations for the country. It has over the years supported the revenue generating sector of the economy and had contributed immensely to the economy of Ghana (Source:www.GPHA.com 2006)

2.2.2 Tema Port

The Tema Port was built in 1962 and is the larger albeit younger of the two sea ports in Ghana. It handles 80% of the nation's import and export cargo. The Port of Tema is located 18miles east of Accra at 5°38'N and 0°01'E. The port has an enclosed water-area of 1.7 million square metres and a total land area of 3.9million square metres. apart from being a site for loading and unloading cargo, it serves as a traffic junction where goods are transshipped and transit cargo destined for the hinterland countries as Burkina Faso, Mali, Niger, etc are handled.

Tema port has a total area of 6,209,590sqm (620 hectares), of which 1,587,730sqm is total water area and 4,621,860sqm land area respectively. The port is Africa's largest man-made harbour. There are 3 miles (5 km) of breakwaters, 12 deepwater berths, an oil-tanker berth, and a dockyard, warehouses, and transit sheds. The port's container yard covers 77,200sqm of paved area capable of holding over 8,000 TEU's at any given time. There are 282 reefer container plug-in points available. The closed storage area about 25,049sqm consists of six sheds each with a storage capacity of 40,000 tonnes of cargo.

The port of Tema as part of its operation has inland clearance depots (ICDs) or off-dock terminals which are run by private companies, these includes: Tema Bonded Terminal, Maersk Container Terminal, Tema Container Terminal, Golden Jubilee Terminal, etc. (Source:www.GPHA.com2006)

Fig.1 Layout map for Tema Port.
Source: Ghana Ports and Harbours Authority.2006

2.3Types of freight

According to the CDR working paper 01.2 of March 2001, the Takoradi port has about 60% of its export goods consisting of dry bulk which is entirely made up of materials such as bauxite and manganese from the mines at the Western and Ashanti regions of the country. Others include; forest products such as logs of timber. The other share of export cargo is mainly cocoa beans. Previously, it was exported as bagged cargo; until recently cocoa is now exported by way of containers. Containerized export cargo, from 1990 to 1998 has gradually increased slightly up by 15%. (Source: The Freight Transport and Logistical System of Ghana March 2001 by Poul Ove Pedersen)

About 80% to 90% of imports to the Takoradi port consist of dry/liquid bulk. The liquid bulk is made up specifically of petrol products coming in from the Tema oil refinery. The dry bulk on the other hand consists mostly of clinker from Europe for the cement factory. Import trade has steadily increased from below 5% between 1997 and 1998 to 8%. (Source: The Freight Transport and Logistical System of Ghana March 2001 by Poul Ove Pedersen)

The Tema port has about 35% of its imports being liquid bulk made up of chemicals for Lever Brothers, crude oil and petrol products for the oil refinery. The dry bulk also makes about 35% of the import trade at the Tema port, basically comprising clinker and gypsum for the cement factory, alumina, coke and pitch for the aluminum factory. Wheat forms the third part of the dry bulk though small, has also increased a steadily.

Bagged cargo forms about 10% of the imported cargo; it is mostly rice and sugar. Trade of General cargo in this category has been stable while containerized cargo has increased. 30% of exports from Tema port is liquid bulk is entirely of oil products. Others include chemicals and palm oil from Lever Brothers. General cargo exported includes aluminum from Valco and sawn timber. Bagged cargo also containerized consists of cocoa beans which reduced to about 8% in the late 1990s from 15% due to rising containerization. (Source: The Freight Transport and Logistical System of Ghana March 2001 by Poul Ove Pedersen)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Imports	abs.%	abs.%	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %
Liquid bulk	9626.2	10523.1	9520.8	11622.5	9216.8	10114.4	11015.2	759.3	172.6	202.6	9411.2	787.3
Dry bulk	20956.9	30066.1	31369.4	35068.0	41375.2	54477.5	53674.2	60774.9	57387.2	63484.0	64676.6	80175.7
General cargo	3710.1	184.0	173.8	214.1	213.8	253.3	446.1	8811.0	223.3	537.0	313.7	555.2
Bagged cargo	61.5	102.2	92.0	51.0	30.5	101.4	50.7	70.9	111.7	101.3	30.4	444.2
Containerized cargo	184.9	214.6	173.8	234.5	213.8	243.4	263.6	324.0	345.2	374.9	698.2	807.6
Total Import	367100	454100	451100	515100	549100	702100	722100	810100	657100	755100	843100	1058100
Exports	abs.%	abs.%	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %
Liquid bulk	0	0	0	30.3	0	80.7	60.4	30.2	50.4	60.6	90.7	0
Dry bulk	48052.8	56758.2	65762.9	62359.7	64459.1	68362.1	67047.8	69746.2	69858.2	65062.3	87767.2	72362.3
Bagged cargo	9810.8	909.2	12512.0	969.2	1079.8	888.0	1148.1	744.9	594.9	858.1	745.7	1089.3
General cargo	414.5	202.1	80.8	70.7	70.6	151.4	282.0	80.5	10.1	30.3	90.7	50.8
Forest products	29031.9	29730.5	22221.3	25024.0	28626.2	26824.3	53538.2	63642.3	30325.3	14814.2	16012.3	14812.7
Containerized cargo	-	-	333.2	646.1	464.2	383.5	463.5	875.8	13411.2	15214.6	17613.5	17214.8
Total export	909100	974100	1044100	1043100	1090100	1100100	1401100	1504100	1200100	1044100	1305100	1161100

Table 1. Cargo throughput by packaging (1000 metric to nnes) Port of Takoradi 1987-98.
Source: CDR Working Paper 01.2 March 2001

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Imports	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %
Liquid bulk	1025442.6	1072463.3	1161423	1035361	1106361	899288	1023296	1291373	1276325	1387331	1439325	1564353
Dry bulk	713296	680237	873318	943329	1061346	1136364	1374389	1257363	1566398	1448346	1629368	1325281
General cargo	32313.4	14260	1917.0	1806.3	2026.6	2518.1	2547.2	1965.6	2476.3	2896.9	2886.5	2465.2
Bagged cargo	1827.6	2289.6	2629.5	31010.8	301.9.8	391125	432122	3139.0	3278.3	4411.05	3688.3	5801.23
Containers. cargo	1616.7	2491.05	2599.4	3961.38	3981.30	4421.42	4471.26	4061.17	5151.31	6251.49	7021.59	9001.91
Total imports	2405100	2370100	2746100	2864100	3067100	3118100	3529100	3461100	3930100	4180100	4427100	4715100
Exports	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %	abs. %
Liquid bulk	24140.6	31648.0	21237.6	16026.1	19834.3	34543.6	19031.6	18527.1	25537.4	18727.1	23731.9	22331.8
Dry bulk	0	0	0	0	0	0	0	0	0	0	0	0
General cargo	25743.5	23135.1	17731.4	24239.5	19233.2	23129.2	18931.4	17027.0	16023.5	16023.2	15520.9	9814.0
-of which aluminium	139	152	157	179	177	73	-	94	111	111	88	50
Bagged cargo	9616.2	11015.7	9717.2	9315.2	8414.5	6278	8514.1	8413.4	4566	7010.2	5878	5883
Containers. cargo	-	-	7813.8	11919.4	10418.0	15319.3	13722.8	18930.0	22132.4	27332.6	29339.5	32145.8
Total exports	593100	658100	564100	613100	578100	791100	601100	629100	682100	689100	742100	701100

Table 2. Cargo throughput by packaging (1000 metric to nnes) Port of Tema 1987-98.
Source: CDR Working Paper 01.2 March 2001

2.4 Import Agents

The continuous movement of freight between shippers and shipping companies are partly managed by shipping agents working on behalf of the shipping companies, while forwarding and customs clearing agents operate on behalf of the shipper. The shipping agents' role is to ensure the flow of freight to the shipping companies they work for.

Forwarding and custom clearing agents can roughly be divided in two types, namely large: Multinational companies with offices in many countries, which organize international door-to-door freight flows, and small local companies primarily concerned with custom clearing of goods imported into Ghana.

Delays in the ports are as a result of congestion; these congestions are also as a result of complex handling and custom procedures and the involvement of large number of private agents and public authorities as well as inadequate technical capacity. The procedures of clearing are cumbersome, taking up a lot of space and requiring the presence of lots of people which also contributes to the congestion of the ports.

2.5 Ghana Ports and Harbors Authority

Ghana Ports and Harbours Authority (GPHA) owns Ghana's two main ports, Takoradi and Tema built in 1928 and 1962 respectively. GPHA is a Statutory Corporation operating under Provisional National Council Law (PNDCL 160) of 1986. GPHA is a merger of the erstwhile Ghana Ports Authority, Ghana Cargo Handling Company Limited and Takoradi Lighterage Company Limited. It is charged with the responsibility of planning, building, managing, maintaining and operating the seaports of Ghana.

2.5.1 Mission

- To provide efficient port facilities and ensure quality services to customers.
- Present a pricing policy that seeks the mutual benefit of the Authority, operators and customers, as GPHA keeps them to keep GPHA in business.
- To recognize her workforce as the greatest asset and key to success in her pursuit to be the GATEWAY to the West African Sub-region
- To employ appropriate technologies and contribute towards a clean, healthy and safe marine environment.

2.5.2 Main Functions:

The Authority has the following statutory functions: Plan, build, manage, maintain, operate and control ports in Ghana and in particular shall:

- Provide in a port such port facilities as appear to be necessary for the efficient and proper operation of the port;
- Maintain the port facilities, extend and enlarge any such facilities as it shall deem fit;
- Regulate the use of any port and of the port facilities;
- Maintain and deepen as necessary the approaches to, and the navigable waters within and outside the limits of any port, and also maintain lighthouses and beacons and other navigational service and aids as appear to it to be necessary;
- Provide facilities for the transport, storage, warehousing, loading, unloading and sorting of goods passing through any port, and operate road haulage services for hire or reward;
- Carry on all the business of stevedoring, master porterage and lighterage services; and
- Generally discharge any other functions which are necessary or incidental to the foregoing:

Carry on such activities as it deems necessary for the discharge of its functions and it may in addition:

- Carry on the business of pilotage,
- Supervise stevedoring, lighterage and container services, where these are provided by persons other than the Authority;
- Operate tugs, dredgers and other craft for towerage, salvage, fire prevention and protection of life;
- Control the erection and use of wharves, stairs or stages in any port or its approaches;
- Enter into any agreement with any person:
    - For supply, construction, manufacture, maintenance or repair by that person of any property which the Authority may require for the efficient discharge of its functions under this Law; and

- For the operation or provision of any port facility which the Authority by this Law is empowered to operate or provide.

- Appoint, license and regulate stevedores, master porters to operate in the container terminals;
- Establish pilotage districts, direct that pilotage shall be compulsory in any such district, determine the pilot (including Authority pilots) to operate in such districts, license pilots for work in such districts and establish pilotage boards and specify their duties including the duty of inquiring into the conduct of pilots;
- Within such limits as may be fixed by the Secretary prescribe rates, charges and dues for service provided by the Authority or specify the persons liable to pay such rates, charges and dues prescribed under section 75 of this law. (Source:www.GPHA.com 2006)

2.6 Ghana Shippers' Council

The Ghana shipper's Council was established in March 1974 by virtue of NRCD 254(1974) and has since worked closely with both private and public organizations in the maritime industry in galvanizing the interest of Ghanaian shippers while promoting the provision of relevant logistics for the growth and development of shipping in Ghana.

The Council currently has in its database over 17000 registered Ghanaian shippers whose interest it protects in various ways on a daily basis.

2.6.1Mission

To be a state-of the-art organization utilizing our available human resource to effectively and efficiently manage the demand side of shipping with a view to protecting and promoting the interests of Ghanaian shippers in relation to port, ship, inland transportation problems and the provision of ancillary shipping services.

To ensure for the Ghanaian Shipper, quick, safe and reliable delivery of import and export cargoes by all modes of transport at optimum cost. (Source: Ghanashipperscouncil.org 2005-2008)

2.7 Traffic Performance of Takoradi and Tema Ports

	Tema			Takoradi			Tema and Takoradi Total
	Imports	Exports	Total	Imports	Exports	Total	
1970	1940	725	2665	566	2250	2816	5481
71	2116	707	2823				
72	1667	855	2522				
73	1965	748	2713				
74	2137	816	2953				
75	2259	865	3124	572	1429	2001	5125
76	2445	789	2235				
77	3224	831	4055				
78	2902	897	3799				
79	2447	947	3394				
1980	2445	899	3344				
81	2742	898	3640				
82	2164	871	3035	210	417	627	3662
83	1433	473	1906	193	353	546	2452
84	1412	399	1811	196	437	633	2442
85	1975	390	2365	317	581	898	3263
86	2200	674	2875	191	496	687	3562
87	2406	593	2998	363	908	1271	4269
88	2369	657	3026	454	973	1427	4453
89	2747	564	3311	452	1045	1497	4808
1990	2864	613	3477	517	1044	1561	5038
91	3069	578	3647	549	1090	1639	5286
92	3118	791	3910	702	1100	1802	5712
93	3529	601	4130	722	1401	2123	6253
94	3461	629	4090	810	1504	2314	6404
95	3930	682	3612	657	1200	1857	5469
96	4191	689	4880	755	1044	1799	6679
97	4427	742	5171	843	1305	2148	7319
98	4716	701	5416	1058	1161	2219	7635
99				1154	1468	2623	

Table 3. Cargo throughput in ports of Tema and Takoradi (1000 metric tonnes) 1970-99.
Source: CDR Working Paper 01.2 March 2001

Table 1 SUMMARY OF THE MARITIME TRADE OF GHANA IN TONNES April- June 2008					
	IMPORTS	EXPORTS	TOTAL	Port % Share of Total	% Share of Total Traffic
TAKORADI	419,763	756,387	1,176,150	33	32
TEMA	2,082,564	339,097	2,421,661	67	64
TOTAL	2,502,327	1,095,484	3,597,811		
% Share of Trade	70	30			
TRANST	122,370	13,272	135,642		4
TOTAL TRAFFIC	2,624,767	1,108,786	3,733,453		
% Share of Total Traffic	70	30			

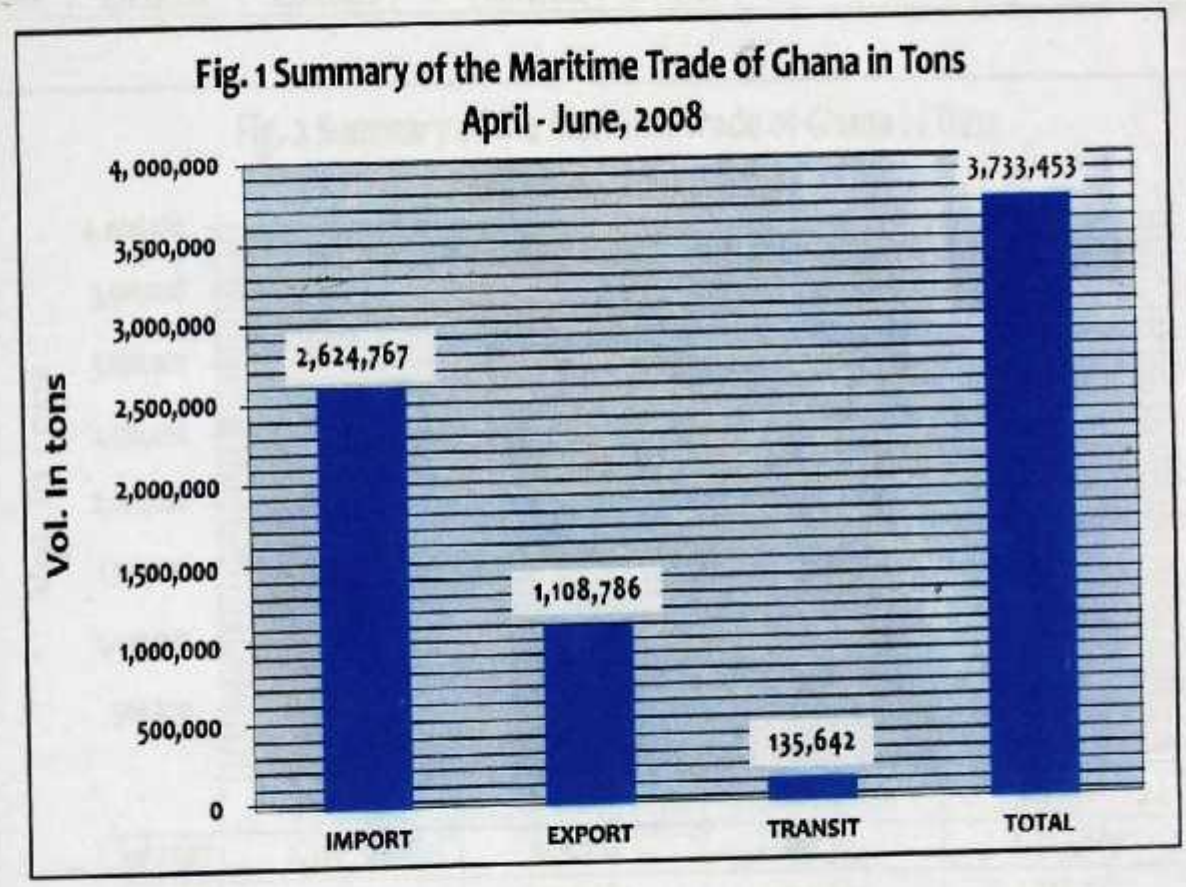


Fig.2 Maritime Trade Review Statistics
April-June 2008
Source: Shipping Review July-Sept, 2008

Table 2 Maritime Trade of Ghana - April - June, 2007 & 2008									
		TEMA		TAKORADI			TOTAL		
	2007	2008	% Diff	2007	2008	% Diff	2007	2008	% Diff
Imports	1,867,622	2,082,564	12	492,932	419,763	(15)	2,360,554	2,502,327	6
Exports	386,353	339,097	(12)	519,590	756,387	46	905,943	1,095,484	21
Total	2,253,975	2,421,661	7	1,012,522	1,176,150	16	3,266,497	3,597,811	10
Transit	201,349	134,665	(33)	43	977	2,172	201,392	135,642	(33)
Thru'put	2,455,324	2,556,326	4	1,012,565	1,177,127	16	3,467,889	3,733,453	8

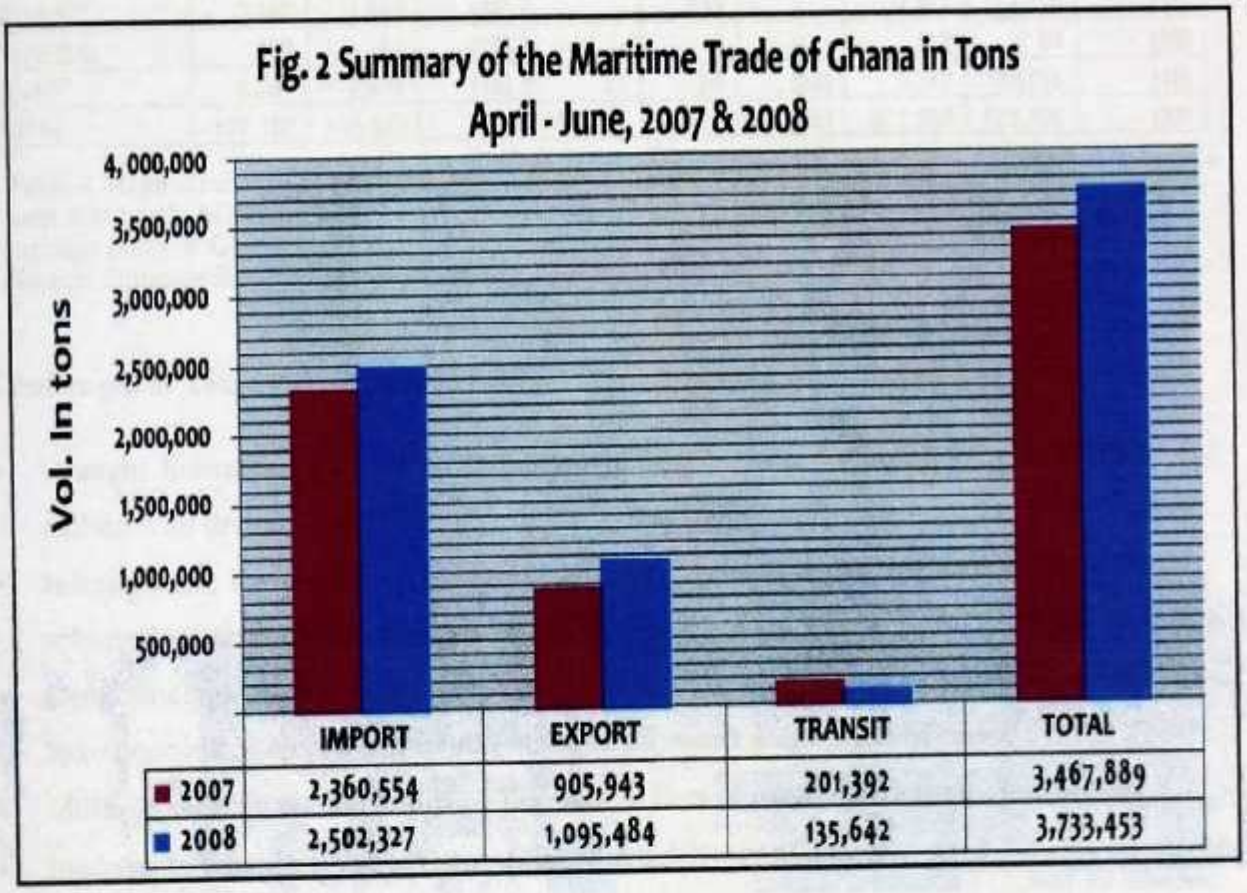


Fig.3 Maritime Trade Review Statistics between
April-June 2007 and 2008
Source: Shipping Review July-Sept, 2008

Transit Trade Through the Ports of Ghana - April - June 2008									
	IMPORT			EXPORT			TOTAL		
COUNTRY	2007	2008	% diff	2007	2008	% diff	2007	2008	% diff
ALGERIA	-	64	-	-	-	-	-	64	-
BENIN	1,315	778	(41)	1,821	2,387	31	3,136	3,165	1
BURKINA FASO	50,535	45,537	(10)	15,075	2,511	(83)	65,610	48,048	(27)
CAMEROON	1,235	-	(100)	16	24	50	1,251	24	(98)
COTE D'IVORE	532	111	(79)	5	199	3,880	537	310	(42)
CHAD	-	50	-	-	-	-	-	50	-
GABON	57	-	(100)	-	-	-	57	-	(100)
GAMBIA	12	-	(100)	-	-	-	12	-	(100)
MALI	83,230	32,423	(61)	1,268	-	(100)	84,498	32,423	(62)
NIGER	18,381	36,013	96	4,438	745	(83)	22,819	36,758	61
NGERIA	15,338	3,069	(80)	1,533	6,718	338	16,871	9,787	(42)
OTHERS	3,117	1,642	(47)	-	633	-	3,117	2,275	(27)
SENEGAL	112	84	(25)	-	-	-	112	84	(25)
TOGO	3,291	2,663	(19)	81	55	(32)	3,372	2,718	(19)
TOTAL	177,155	122,370	(31)	24,237	13,272	(45)	201,392	135,706	(33)

Table.4 Major Transit trade as made by west and north African countries through ports of Ghana
Source: Shipping Review July-Sept, 2008

2.8 Challenges of Tema and Takoradi Ports

- Draught limitation: inadequate deep draught lengths have led to queuing of vessels calling with draught.
- Infrastructure Development: the ports' design for general cargo still leaves a lot to be achieved in terms of infrastructural capacity development.
- Delay in cargo clearance from customs: Although electronic cargo clearance systems have been introduced, customs still insist on physical examination of cargo.
- Multiple security checks impeding the smooth flow of cargo clearance to destinations.
- Inadequate fixed installations preventing quick delivery of cargo.
- Limited space (both open and covered) for the storage of cargo.
- These and many other bottlenecks including annual increases in maritime trade that has prompted the government of Ghana and other promoters to acquire a large tract of land in the middle belt of the country (Boankra) for the establishment of an Inland Container Depot (dry port) to help ease the congestion at the country's seaports.

2.9 Proposed Boankra Dry port

Boankra is approximately 27km from Kumasi which is also about 280km from Accra/Tema. The project is facilitated by the Ghana Ports and Harbours Authority (GPHA) and the Ghana Shippers' Council (GSC).

The proposed facility is about 160hactres (400acres). It is located close to the existing main Accra-Kumasi highway as well as the Accra-Kumasi rail track.

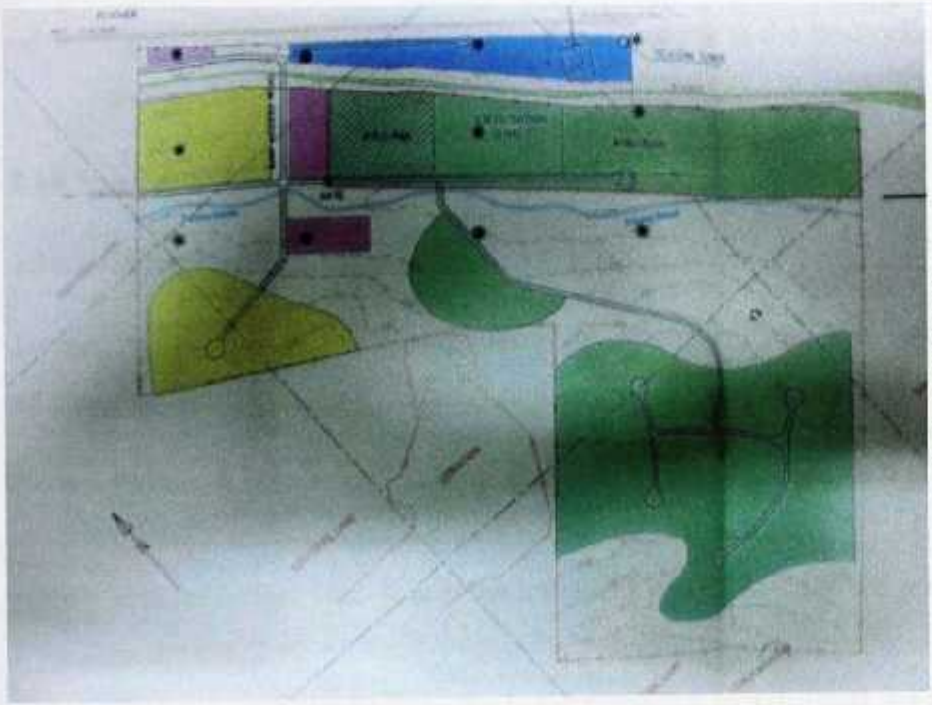


Fig.4 Proposed Boankra Inland Portsite zoning.
Source: Development study of an Inland port at Boankra, Kumasi - Ghana 2003 December(final report on strategy plan)

Fig.5 Perspective view of proposed Boankra Inland Port.
Source: The Ghana gateway programme" A model for accessing new markets by Ben Owusu-Mensah"

The development of the Boankra Dry port project seeks to:

- Bring import and export services closer to the doors of shippers in the middle half of Ghana, as well as in the landlocked neighbouring countries of Burkina Faso, Mali and Niger, etc.
- Enhance the operational efficiency of both the Tema and Takoradi Ports, through decongestion.
- Promote the competitive positioning of importing and exporting through Ghana and
- Facilitate greater levels of international trade with the landlocked countries mentioned above.

2.10 Special and Case Studies

2.10.1 Objectives

Studies into the operation and activities of dry ports have been undertaken in this thesis report to:

- Provide a theoretical basis for recommendations into the design of a proposed dry port terminal to be sited at Boankra near Kumasi.
- Initiate further studies into the topic and its relevance to the growth of maritime trade in the country.
- Bring to bear standards to guide the operation of a dry port in Ghana.
- Provide answers in the avoidance of bottlenecks within the operation of the dry port in order to make Boankra Inland Port achieve its desired objectives whilst being efficient.

2.11 Definitions

2.11.1 Dry ports can be described as ports located in the hinterlands serving an industrial or commercial region with connection to one or several ports by rail or road transport and offering specialized services between the dry port and the associated transmarine destinations.

2.11.2 An inland container depot is a common user facility with public status having fixed installations to provide services for the handling and temporary storage of import/export stuffed and empty containers.

2.11.3 Inland clearance facility is a common-user inland facility aside a seaport or airport having a public status authority, fixed installations and equipment offering services for the handling and temporary storage of several kinds of goods by way of rail or road transport. It operates under customs control to clear goods or cargo for home use, warehousing and temporary storage for onward transit.

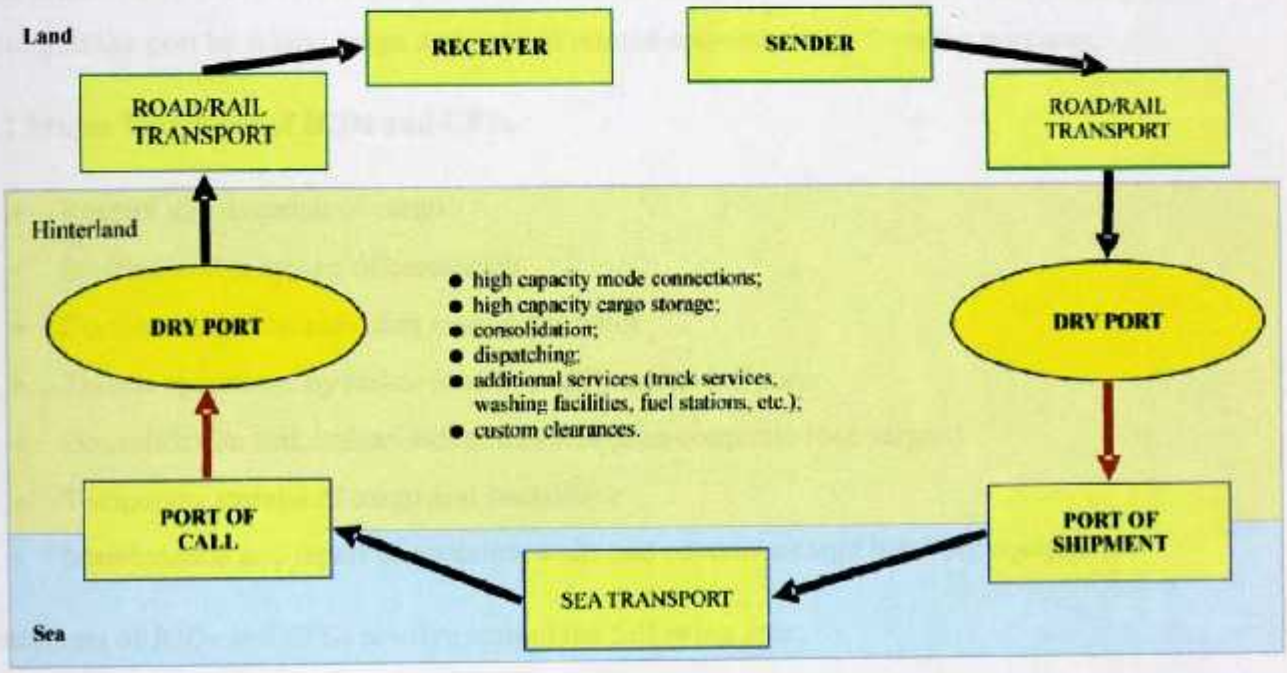


Fig.6 Dryport in the transportation chain.
Source: Research on dryport concept as intermodal node.
Andrius Jarûemskis1, Aidas Vasilis Vasiliauskas2

According to the "Research on Dry port concept as intermodal node" to ensure the effectiveness of a dry port, there are two general objectives that are to be met:

- The consolidation of maritime cargo in intermodal short and long distance transport flows
- Collection and distribution of local, regional and international transports

These are achieved by the dry port terminal by carrying out; hinterland warehousing, management of container flows, expansion of rail and road transport, offering of special and extra services, the reduction of transport cost, provision of an integrated flow of information on maritime related data, use of both advanced and existing technology and remove all bottlenecks in its operation.

Functionally, there is no distinction between an inland container depot (ICD) and a container freight station (CFS), they both serve as transit facilities providing services for containerization of cargo by both stuffing and stripping. They could be served by rail and or road transport.

The ICDs are generally located in the interiors (outside port towns) or away from the serving ports while CFSs serve as off-dock facilities located close to the serving port and helping to decongest the port by taking cargo and custom related activities away from the port area.

2.12 Major Functions of ICDs and CFSs

- Receipt and dispatch of cargo
- Stuffing and stripping of containers
- Custom clearance and other related activities
- Transit operations by rail or road to and from serving ports
- Consolidation and deconsolidation of less-than-container load cargoes
- Temporary storage of cargo and containers
- Maintenance and repair of container units and container/cargo handling equipment.

Operations of ICDs and CFSs revolve around the following area:

- ***Rail siding (if available)***: the area where container trains are received and dispatched. Similarly, the containers are loaded on and unloaded off rail wagons using container lifting equipment and overhead cranes.
- ***Container storage yard***: this forms the largest area in the facility. Stacking of containers both loaded and empty, takes place here. Other parts of this area are designated for keeping special containers such as overweight and over-length, refrigerated, hazardous containers, etc.
- ***Warehouse***: a covered and usually enclosed space where cargo is received temporarily stored and delivered to clients. Containers are stuffed and stripped as well as physical examination of cargo by customs happens in the warehouse.
- ***Gate Complex***: the gate complex regulates and conducts checks on entry and exits of road vehicles or trucks carrying cargo and containers through the terminal. Final Documentation container inspection procedures by custom officials takes place in this area.

2.13 Technical Studies

Intermodal cargo terminals require the use of specialized heavy duty mobile equipment for the movement and transportation of containerized cargo from points of arrival, consolidation and deconsolidation the purpose of this study is to provide an understanding of the spatial requirements, environmental effects and variations that apply to these equipments, they include:

2.13.1 Reach Stackers: These machines are used for loading and unloading of containers onto railcars/ wagons and road container trucks. It is also for Transportation and stacking of containers in the storage yard.

Estimated productivity for container handling:

- loading and unloading railcars 20-30 moves per hour based on travel distances
- stack work: 15 moves per hour
- Loading and unloading trucks: 10 moves per hour.
- Storage capacity is approximately 500TEU per hectare based on 3-high stacking. However they can stack containers as high as 5stack.
- Optimum solution for small to medium size operations, with 1-4 parallel rail and when high flexibility is required.
- For yard operations aisle width of 15-18metres is required between container stacks.
- Dimensions depending on wheel base can be 8408mmX4180/3400, turning radius-8605mm

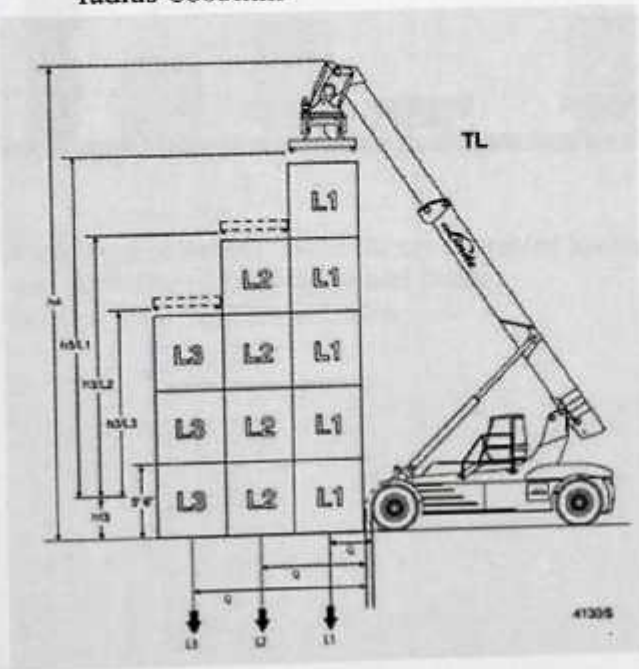


Fig.7 Container stacking hieght for reach stackers
Source:www. Linde-forklifts.com

2.13.2 Yard Cranes: These heavy duty stacking equipment are used for loading and unloading container rail cars as well as stacking in container storage yards.

- Estimated productivity for container handling: loading and unloading of railcars- 30 moves per hour
- Stack work- 20 moves per hour
- Loading and unloading of road trucks
- Storage capacity is approximately1000TEU per hectare based on 4-stack high.
- Optimum solution for large operations, with 4-8 parallel rails and when high storage capacity is required.
- Length of span is dependent on the number of rail lines expected to be served by the crane.

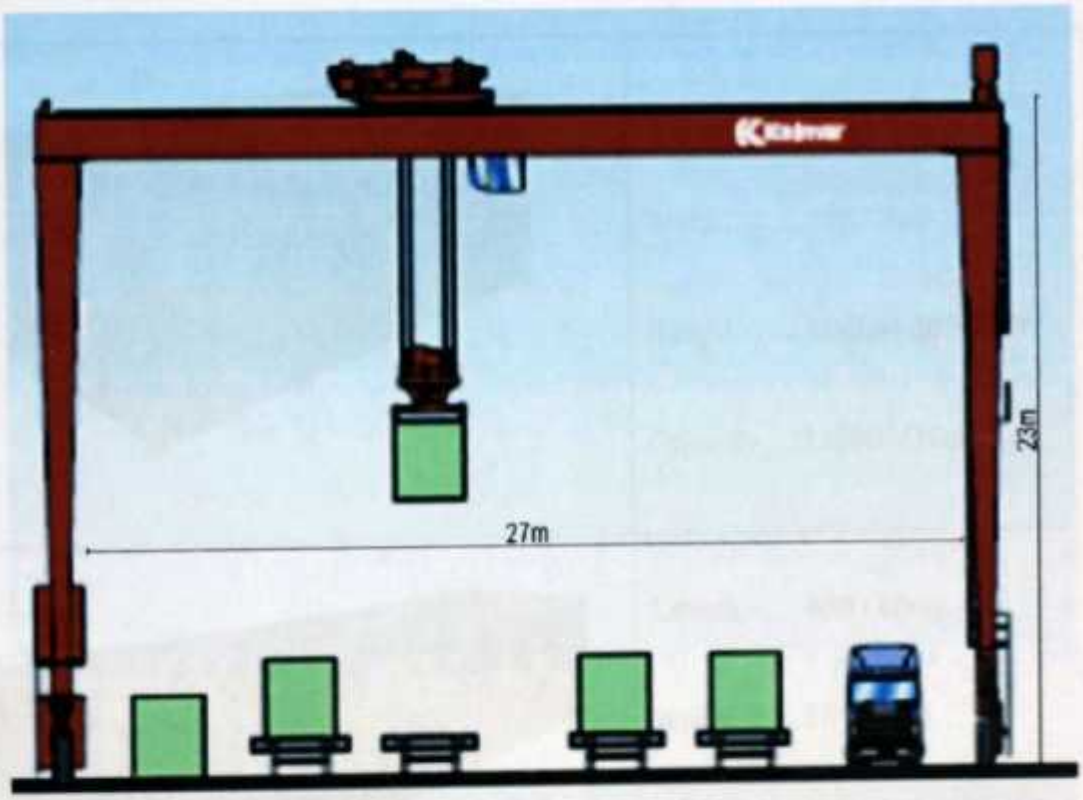


Fig.8 Typical Rubber Tyred Gantry Crane for loading and unlaoding of rail wagons and trucks.
Source:www. kalmarind..com

2.13.3 Container Sizes and Types

The container is a type of packaging for sending cargo and goods through sea and rail which is safe and easy. They are constructed of mild steel and owned by shipping companies and shipping lines. Precise details concerning freight container dimensions and types can be found in the standardization of international shipping association and the Australian and New Zealand Standard AS/NZS 3711.1–9 *Freight containers*. In Ghana, predominant sizes of freight containers are 20feet (6meters) and 40feet (12meters). The choice of type and size of freight containers is based on the kind and volume of cargo to be loaded for transportation which should be directly related to the transportation system to be employed by the transportation agent, that is, Full Container Load (FCL) or Less-than Container Load (LCL).

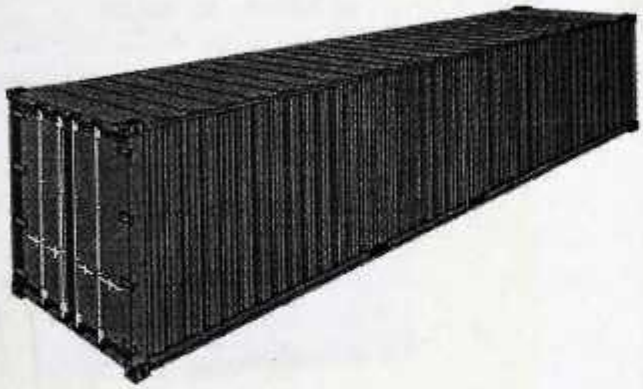
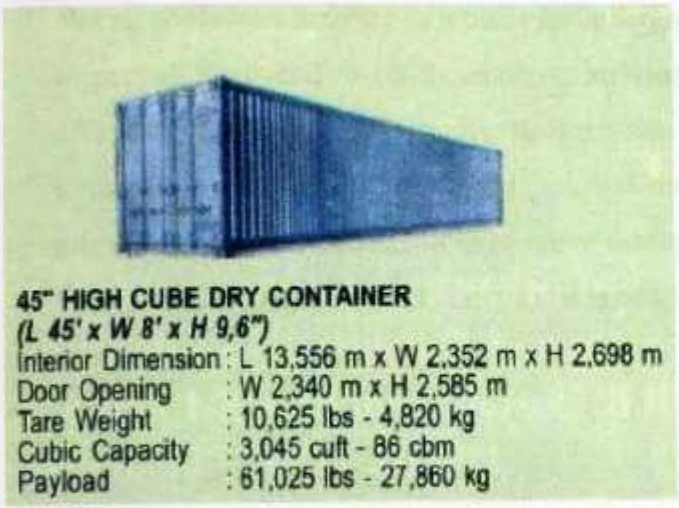
	Length……20ft (6m) Width……..8ft(2.4m) Height…….8ft(2.4)-10ft(3m) Capacity….1280ft^3 (36m^3)
	Length……40ft (12m) Width…….8ft (2.4m) Height……8ft(2.7)-10ft(3m) Capacity…2560ft^3(77.8m^3)

Table 5 Container sizes used at ports od Tema and Takoradi SourcAuthor

The sizes of these containers and the volume of cargo to be stored determine the area requirement for the container yard and devanning area of a container depot or terminal.

Below are lists of the types of freight containers usually used in the transportation of cargo:



45" HIGH CUBE DRY CONTAINER
(L 45' x W 8' x H 9,6")

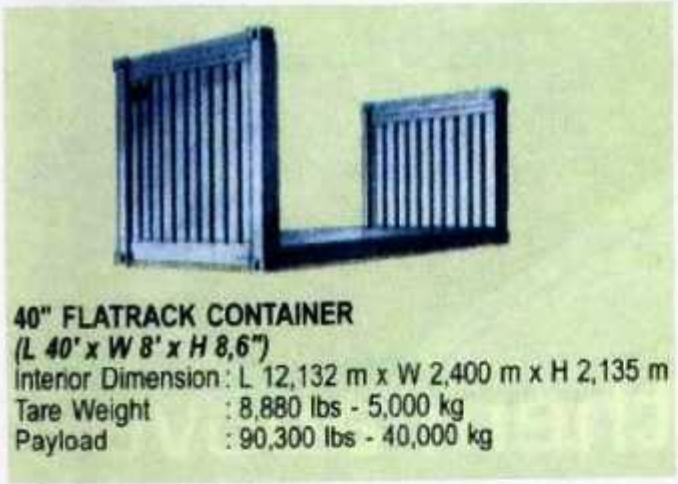
Interior Dimension	: L 13,556 m x W 2,352 m x H 2,698 m
Door Opening	: W 2,340 m x H 2,585 m
Tare Weight	: 10,625 lbs - 4,820 kg
Cubic Capacity	: 3,045 cuft - 86 cbm
Payload	: 61,025 lbs - 27,860 kg

Fig.9 High Cube Dry Container
Source:www.portaport.blogspot.com

40" REEFER CONTAINER
(L 40' x W 8' x H 8,6")

Interior Dimension	: L 11,561 m x W 2,280 m x H 2,249 m
Door Opening	: W 2,280 m x H 2,205 m
Tare Weight	: 10,580 lbs - 4,800 kg
Cubic Capacity	: 2,075 cuft - 59,3 cbm
Payload	: 61,070 lbs - 27,700 kg

Fig.10 Reefer Container
Source:www.portaport.blogspot.com



40" FLATRACK CONTAINER
(L 40' x W 8' x H 8,6")

Interior Dimension	: L 12,132 m x W 2,400 m x H 2,135 m
Tare Weight	: 8,880 lbs - 5,000 kg
Payload	: 90,300 lbs - 40,000 kg

Fig.11 Flatrack Container
Source:www.portaport.blogspot.com

20" VENTILATED CONTAINER
(L 20' x W 8' x H 8,6")

Interior Dimension	: L 5,898 m x W 2,352 m x H 2,392 m
Door Opening	: W 2,340 m x H 2,280 m
Tare Weight	: 5,070 lbs - 2,300 kg
Cubic Capacity	: 1,172 cuft - 33,2 cbm
Payload	: 62,130 lbs - 28,180 kg

Fig. 12 Ventilated Container
Source:www.portaport.blogspot.com

20" PORTHOLE CONTAINER
(L 20' x W 8' x H 8,6")

Interior Dimension	: L 5,444 m x W 2,300 m x H 2,250 m
Door Opening	: W 2,300 m x H 2,215 m
Tare Weight	: 6,130 lbs - 2,780 kg
Cubic Capacity	: 1,052 cuft - 29,8 cbm
Payload	: 61,070 lbs - 24,220 kg

Fig.13 Porthole Container
Source:www.portaport.blogspot.com

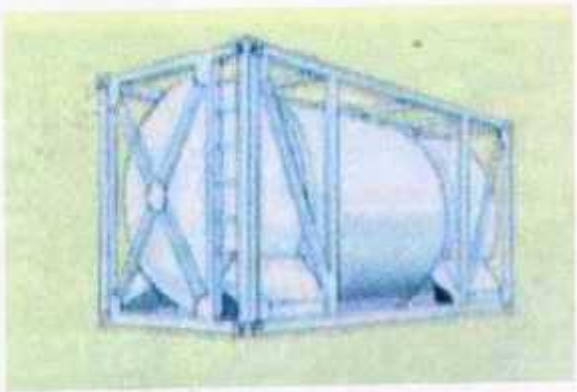


Fig. 14 Tank container
Source:www.portaport.blogspot.com

2.13.4 Cargo Container X-Ray Inspection Systems

Not all containers arriving in a port can undergo physical examination, it is just impossible to inspect all the over 500-1000 containers arriving in an inland port. In order to effectively and efficiently conduct these inspections, large-size X-Ray Digital Radiographic systems are used to inspect containers loaded aboard their trailers. These large scanning facilities operate by allowing container loaded trucks to move through them by way of conveyors while X-Ray beams scan through the containers for inspection to take place with computer generated images.

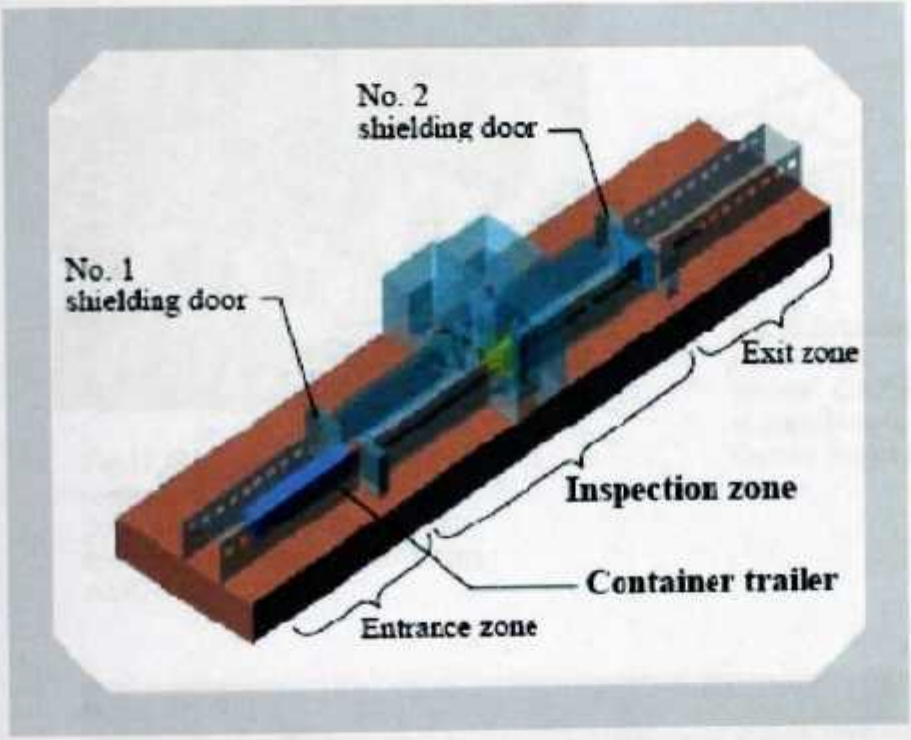


Fig.15 Schematic impression of X-Ray container inspection unit Source: Cargo Container X-Ray Inspection Systems- Hitachi Review vol:53 (2004) No.2

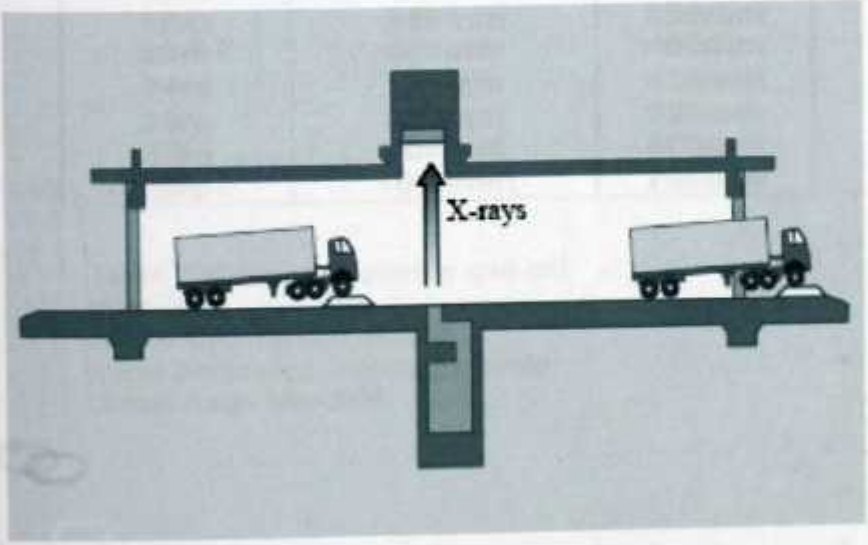


Fig.16 Schematic section of latest container inspection equipment. Source: Cargo Container X-Ray Inspection Systems- Hitachi Review vol:53(2004) No.2

2.13.5 Cellular or Castellated Beams

"Cellular beams have good structural efficiency"(GAF Piolotin training school Sumbrungu, Bolgatanga- Evans Osman Asigri May 2008). Its usage began to improve efficiency during steel shortages in the Europe and USA.

Castellation of makes beams (steel beams) about 50% stronger the original beam without weight gain. It can be fabricated into several forms including portal frames. Castellated beams are capable of spanning over 36m depending on the depth of the beam and strength of the steel used.

Fig.17 Mechanical services through cellular beam
Source:PPT- Welcome to Long span steel solutions (Smart Beam, AISC)

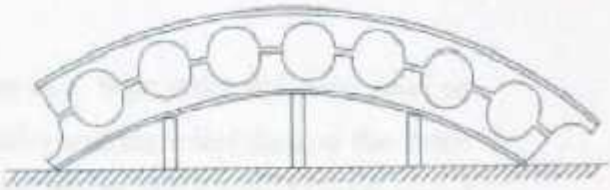


Fig.18 Schematic view of curved ce llular beam.
Source: GAF Piolotin training scho ol Sumbrungu, Bolgatanga- Evans Osman Asigri May 2008

SPAN	CELLULAR BEAM DEPTH	CELL DIAMETER	CELL SPACING
12m	400mm	300mm	400mm
16m	550mm	350mm	425mm
20m	600mm	400mm	500mm
24m	700mm	450mm	550mm
28m	800mm	550mm	650mm
32m	900mm	600mm	750mm
36m	1000mm	700mm	1050mm

Table6 Cellular beam possible span and beam depth
Source GAF Piolotin training school Sumbrungu, Bolgatanga- Evans Osman Asigri May 2008

CHAPTER THREE

3.0 Methodology

3.1. Objective

The objective of this research procedure focuses on how data and information will be acquired for the purposes of putting together a relevant thesis proposal with respect to import clearing facilities or terminals and how they can be operational in ports.

3.2 Summary of Structure of Report

Chapter one of the report, provides an introduction to the topic. It explains the objectives, problems and justification associated with the project.

Literature review and comments are discussed in chapter two. It provides documentation on the history and evolution of ports globally. Detailed history and statistical data on the Tema and Takoradi ports are also recorded in this chapter. Again, the Boankra inland port proposal and other special studies are discussed.

Data collection procedures and methods are stated and explained in chapter three which also outlines the structure of the entire repot. Case studies conducted are documented with observations. Related technical studies are also studied and their relevance to the subject has been discussed. Gathered data for the thesis have been recorded and analysed in this chapter alongside all projections and hypothetical conclusions.

Site selection and justification follows in the fourth chapter with all documented characteristics of the chosen site.

The next chapter which is five contains all explanations on the design brief, the entire conceptual site planning and process relative to the design proposal, it also documents the general services requirements and the provision made to that effect in the facility. It discusses the finishes to be used for the facility and the cost involved in the project.

Finally this chapter enumerates conclusions and recommendations as to how the project is to be handled and carried out in terms of phasing.

3.3 Data Collection Methods

Data collection procedures vary in terms of the quality, cost, depth of information they provide as well as the level of response they are likely to get. Consideration of data collection methods begins with the kind of information needed; here, there are two basic approaches: quantitative and qualitative.

- Quantitative method pays attention to the number of certain responses to a particular question, that is, mono-syllabic answers (yes/no) to a question as given by a number of people. They are useful when the range of answers expected to each question is already known. It involves ticking of boxes or filling in numbers. It is also useful for measuring numerical change as the same questions again can be asked at a later date and results compared. It is very relevant and reliable when the data is based on a large number of responses.
- Qualitative method focuses less on numbers, offering an opportunity to explore issues and to gain in-depth knowledge on the subject. Very often, the range of possible answers is not known beforehand. They are however demanding relative to the level of analysis required to extract the necessary information. On the whole, it is possible to bring on board both approaches as stated above in a single data collection exercise.

In this exercise, the use of qualitative method of data collection was employed. Most numerical data was obtained from issued data as indicated in annual and periodicals published by organizational bodies whose activities are directly or indirectly related to the topic under discussion.

3.3.1 Interviews

Interviews with selected bodies served as a major source of data acquisition for this project. A visit to the Tema port provided a platform for interaction with the supervising engineer of the Ghana Ports and Harbours Authority who explained issues concerning the current state of the port and some of the proposals issued out to resolve problems faced by the port. Further interviews with the Ghana Shippers' Council also brought to light the subject of Boankra inland port proposal.

To gain considerable knowledge as to the cargo clearing process in a port, the newly established Golden Jubilee Terminal at Tema port was visited. An interview with the main engineer provided information concerning how cargo is cleared in the facility and the available facilities that enabled the clearing process both administratively and architecturally.

Final interview was held with the consultant in charge of the Boankra Inland port proposal to ascertain issues regarding the project.

3.3.2 Internet

Documentation for the project report was sourced mainly from the World Wide Web; this was to allow a broader and wider scope for the study. The study covered researches on dry ports and how they function in relation to other ports. Most of the study documents downloaded from the internet was in formats of PDFs and Microsoft PowerPoint files.

3.3.3 Periodicals and Magazines

Data research and analysis for this project were documented from periodicals and magazines published by organizations like the Ghana Ports and Harbours Authority, the Ghana Shippers' Council and the December2003 final report on Strategy plan for development study of an inland port at Boankra.

3.4 Limitations

At the Golden Jubilee Terminal, several attempts to interview the operations manager of the facility proved futile making it difficult to obtain first-hand information and data concerning clearing operations within the terminal jurisdiction.

Inadequate documentation as regarding the topic became an obstacle for further literature study.

Another problem was stakeholders' inability to clearly understand the topic under discussion, since the topic was a little out of context. That is, "Import Clearing Facility" should read "Import Clearing Terminal".

3.5 Case Studies

3.5.1 Virginia Inland Port

The concept of the inland port refers to an inland facility that specializes in the transfer of intermodal (containerized) sea-borne freight. It is designed mainly to remove container and associated traffic congestion around a given seaport bringing closer transportation and distribution of infrastructure to the mainstream inland commerce region. This idea has been successfully implemented by the Port Authority of Virginia at the Virginia Inland port.

Fig.19 Map of Virginia inland port

Source: "Feasibility study on the network operation of hinterland hubs (dry port concept) to improve and modernize port connections to the hinterland and to improve networking".

The entire facility covers an area of 161acres and is located 70miles west of Washington DC in Front Royal, USA. The facility effectively connects the marine terminals of Norfolk, Newport News, and Hampton Roads 220miles inland.

Operating as an intermodal container transfer facility, the Virginia Inland Port creates a seamless interface between truck and rail for the transport of ocean-borne containers to and from the port of Virginia (Hampton Roads). The facility has adequate land for container storage and ancillary service companies.

Fig.20 Ariel view of Virginia Inland Port
Source: Meeting the transportation challenges of the 21st century: intermodal opportunities in the Appalachian region intermodal case studies.

The Inland Port terminal has a three-door cross-dock warehouse facility for transferring cargo, and a maintenance building for vehicle repairs. It has five parallel rail tracks totaling 17820feet (5431.5metres) which prevents congestion in the container handling and transfer process.

Fig.21 Site layout of Virginia Inland Port.
Source: Meeting the transportation challenges of the 21st century: intermodal opportunities in the Appalachian region intermodal case studies.

3.5.1.1 Infrastructure

- Cargo Division- Responsible for loading and unloading of trucks and railcars of break-bulk cargo and the stuffing and stripping of containers at the Container Freight Station.
- Rail Division-Responsible for the loading and unloading of intermodal containers at the on dock rail facility.
- Container Division-Responsible for the documentation on containers entering and exiting the terminal via ship, truck or rail.

3.5.2 Ludhiana Container Freight Station

Located in Ludhiana, India, this clearing facility covers a total gross area of 25acres (10ha) from its initial 5acres (2ha). By March 1999, it had been opened to import freight container traffic which increased from 10,000 containers to 50,000 containers per annum.

3.5.2.1 Infrastructure

- Warehouses.....5415sqm
- Open metalled area.....92632sqm
- Administration block.....978sqm
- Office accommodation. for customs.....227.1sqm
- Office accommodation. for custodian.....328.4sqm

Fig22. View of security gate entry to facility showing tarred access road.
Source: PPT- Salient Features,
Ludhiana Container Freight Station, 2008

Fig23. View of freight container yard and mobile container handling equipments the entire area is tarred.
Source: PPT- Salient Features,
Ludhiana Container Freight Station, 2008

Fig24. View of double volumed warehouse for storage of uncleared cargo. A portal framed structure with a sandcrete block walls, it has few windows and a number of steelroller shutter doors.
Source: PPT- Salient Features,
Ludhiana Container Freight Station, 2008

Fig25. View of maintenance and repair area. it is a simple shed roof supported about 6m above paved ground by steel trusses and girders.
Source: PPT- Salient Features,
Ludhiana Container Freight Station, 2008

3.5.3 Golden Jubilee Terminal (Tema Port)

The Golden Jubilee Terminal was commissioned on 29th march 2007. The construction of GJT is to facilitate the stuffing and unstuffing of cargo from containers and storage of cargoes and containers. It has a total storage area of 79164sqm and a total container holding capacity of between 3500 and 4000teus, a 1396sqm car park designated for the parking of vehicles unstuffed from containers. When fully operational, cargo throughput is expected to reach 2000TEUs per week.

3.5.3.1 Layout

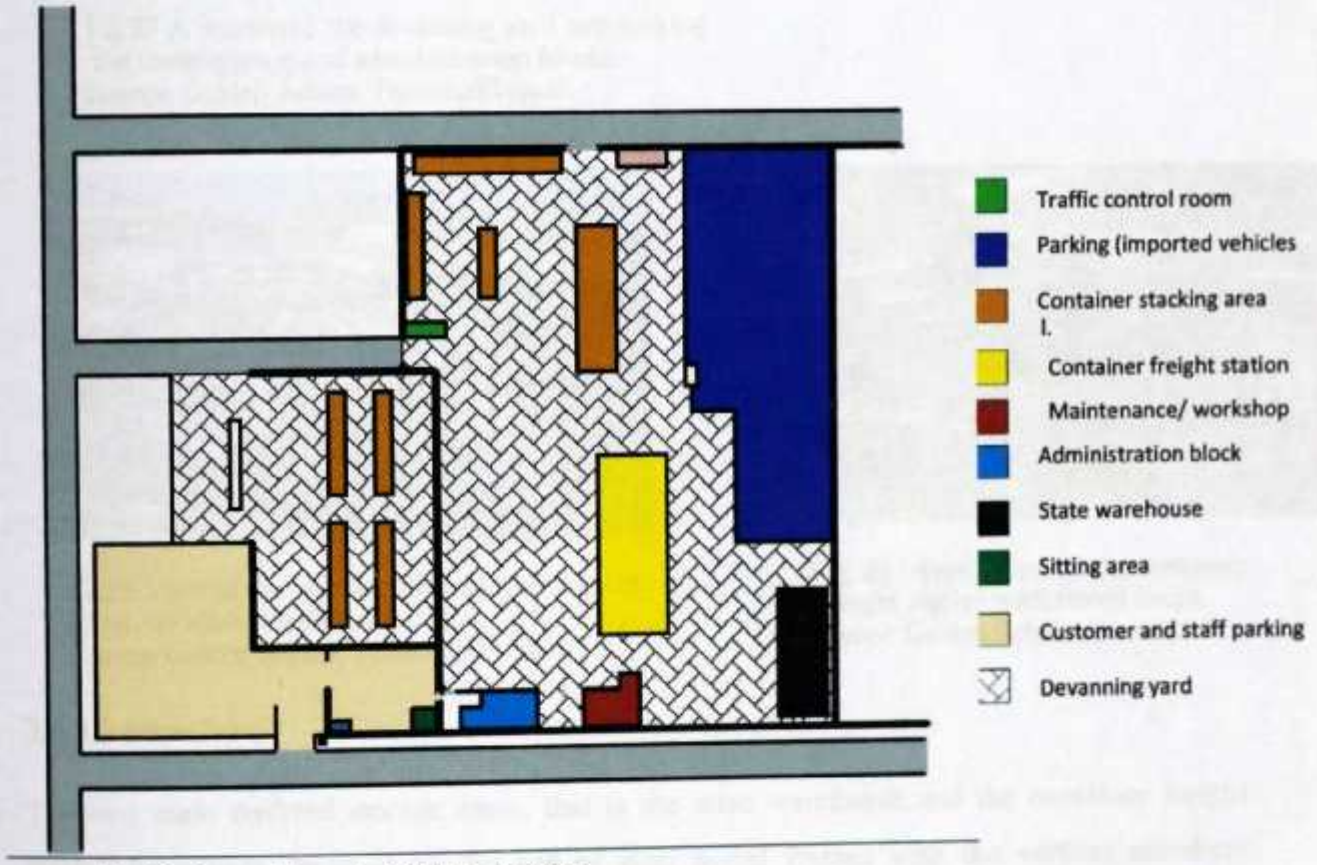


Fig.26 General layout of Golden Jubilee terminal.
Source: Golsen Jubilee Termonal (Tema)

It made provision for spaces such as:

- Duty payment hall
- Offices for CEPS officials
- Offices for Ghana standards board
- Office spaces for Narcotic control board

- Offices for managers
- Equipment maintenance yard
- Security surveillance room

Fig.27 A section of the devanning yard overlooking the maintenance and administration blocks.
Source: Golden Jubilee Terminal(Tema)

Fig28 View of the imported vehicle parking are a and the state warehouse facility.
Source: Golden Jubilee Terminal (Tema)

Fig. 29 Interior view of the container freight station with stored cargo.
Source: Golden Jubilee Terminal (Tema)

3.5.3.2 Structure

The two main covered storage areas, that is the state warehouse and the container freight station have been spanned by the use of steel portal frames with the vertical members anchored to reinforced concrete columns placed at 5000mm interval with a height of about 3000mm. At this height block work has been made while the rest of the structure is cladded in galvanized aluminum sheets to the roof level. Translucent materials at specific centres in the roof allow some amount of daylight into the storage space while floor is finished in granolithic screed.

3.5.3.3 Merits of the Facility

- Storage facilities are available.
- Facilities within are well formed and segregated.
- The use of steel to span wide unobstructed storage spaces
- Security is assured from the administration.
- Extensive paving within the facility.
- Both entry and exit points are segregated, enhancing traffic movement.

3.5.3.4 Demerits

- There are no green areas within the facility
- Devanning area is open to the weather especially rainfall
- Absence of eating area
- Facility has no designated truck waiting area
- Absence of sanitary facilities for customers in the container devanning area.

3.6 Conclusions

Import clearing facilities can be explained from the studies to be operational facilities established within or out of cargo ports whose main objective is to provide both fixed and mobile installations that aid the clearing of imported cargo into the port. In their operation, they require:

- Wide span storage spaces or warehouses for the storage of uncleared cargo.
- Large open spaces for vehicular circulation, storage of freight containers as well as stuffing and de-stuffing of loaded containers.
- Where necessary provision of freight container scanners can be installed to make cargo examination faster and secure.
- Administration and other ancillary facilities such as eating, sitting and extensive green areas to make the terminal user friendly.

3.7 Background Data

3.7.1 Volume of Marine Trade

The chart below gives a comparison as to the volume of cargo throughput in marine trade that took place in the ports of Tema and Takoradi between the periods of April-June 2007 and 2008.

Import trades of 2360554tons in 2007 and 2502327tons in 2008 expresses an increase of about 6%. Export trade between the same period revealed 905943tons of cargo in 2007 and 1095484tons in 2008 which also indicated an increase of about 17% in the trade. However transit trade recorded 201392tons in 2007 and 135642tons in2008 which represents a drop of about 32.7% in the trade.

Fig30 Cargo throughput at Tema and Takoradi ports between April-June 2007 and 2008
Source: shipping Review vol.10 July-Sept.2008

An assessment of the chart below of transit trade undertaken by landlocked countries such as Mali, Burkina Faso, Niger and Chad shows a decrease in the transit trade by the countries with higher trade in the previous year while the others recorded increases.

Decreases were 26.8% for Burkina Faso, 61.6% for Mali, while increases of 37.9% for Niger and an initial 50tons of trade by Chad were recorded in the same period.

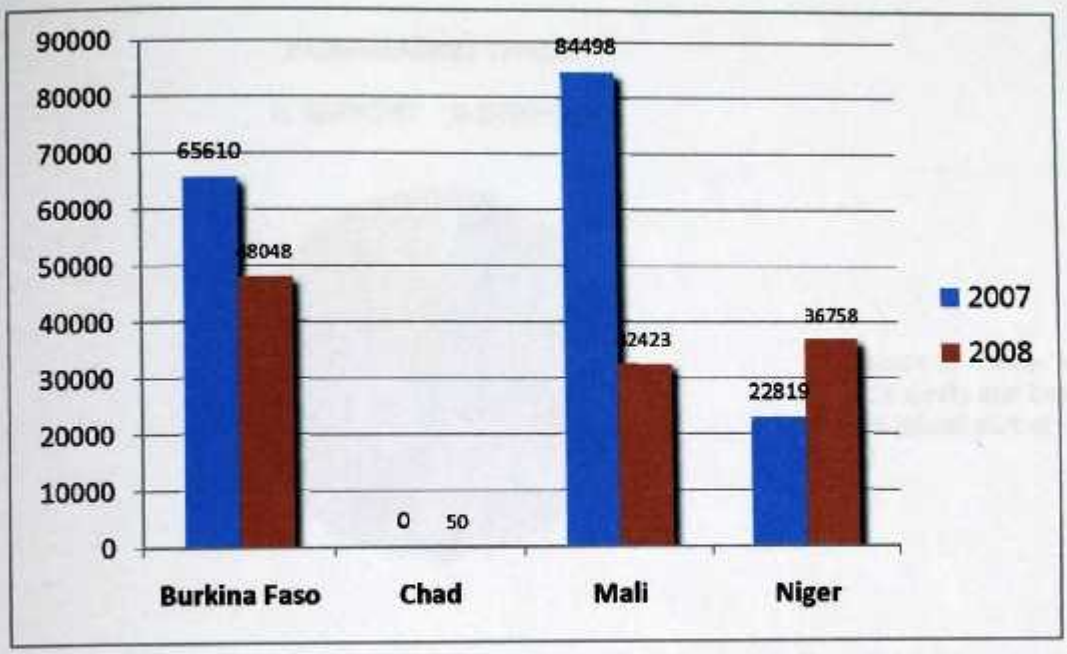


Fig31 Transit trade by Sahelian countries through Tema and Takoradi ports between April-June 2007 and 2008
Source: shipping Review vol.10 July-Sept.2008

3.7.2 Data Projections for Boankra Dry Port

Relative to the above stated volumes of trade, projections as pertaining to the proposed Boankra dry port project have been made in the December 2003 final report on strategy plan for the project by consultants (Royal Haskoning and ABP consult) expressing expected quantum and volumes of trade to be made at the dry port.

The charts below indicates market share to be expected at the dry port from the seaports of Tema and Takoradi in-terms of Home Market trade and Transit trade respectively.

The container volumes shown here are interpreted as a higher scenario of trade:

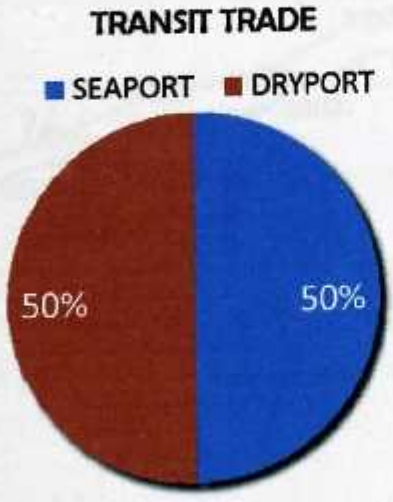
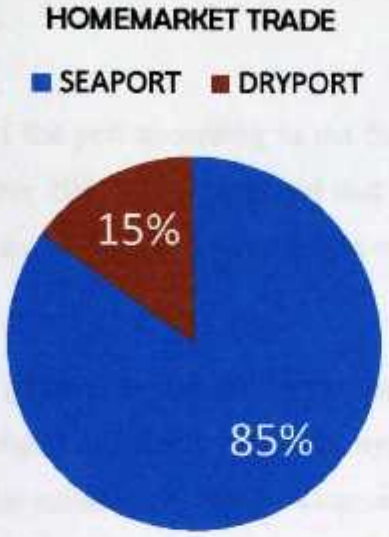


Fig 32. Projected share of transit trade between the Seaports and Dryport
Source: Study of an inland port at BoankraDec. 2003



1 share of Home Market
e Seaports and Dryport
an inland port at
03

Projected container volumes to be accommodated at the Boankra dry port have been calculated based on the market share trade from Tema and Takoradi ports.

The container volume to be accommodated at the dry port starting operations in 2002 with 55000TEUs per annum is projected to increase to about 278828TEUs per annum, as expressed in the chart below.

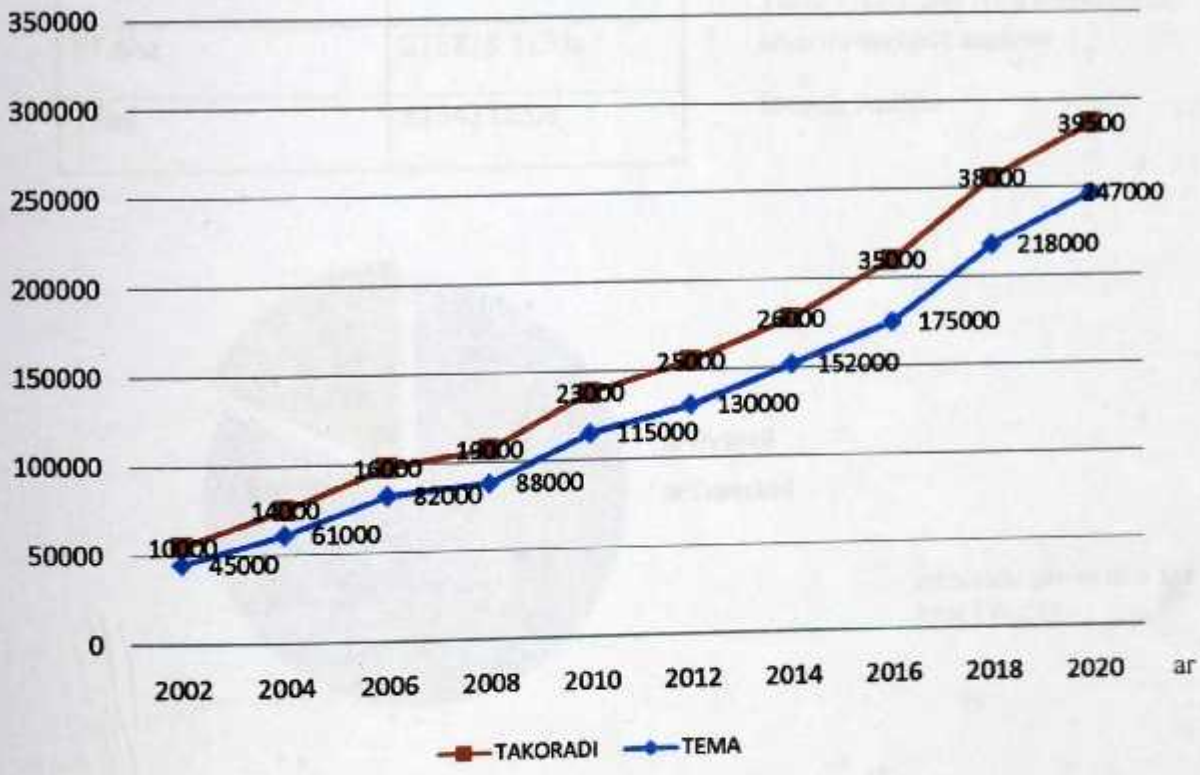


Fig 34. Projected container volume to be accommodated at dryport
Source: Study of an inland port at BoankraDec. 2003

3.7.3 Hypothesis

The establishment of the port according to the final report on strategy plan for the Boankra Inland port (December 2003), it is proposed that the facility will be developed in phases, of which 67.6ha of zoned Customs Bonded Estate will be developed at the final phase by the year 2020.

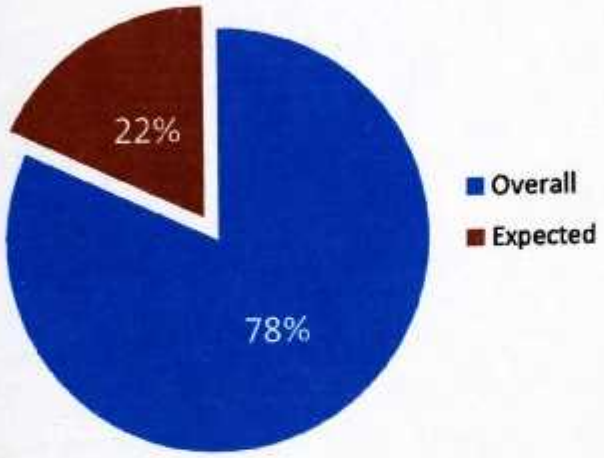
A look at the total gross area and the corresponding cargo throughput of the case studies conducted on both higher and lower scenarios, hypothetically, about 22% of the total customs bonded estate will be suitable for the development of an import clearing facility relative to the stipulated required area for the customs bonded estate.

Name of Facility	Area	Throughput
Golden Jubilee Terminal	10 ha	104000 TEUs per annum
Ludhiana CFS	10 ha	50000 TEUs per annum

Area	Throughput
67.6ha	278828 TEUs
15ha	61342TEUs

Table 7. Low and High scenerios of area/throughput analysis

Source: Author



othetical projection for
ring Facility

Projections for the year 2020 are based on the following considerations:

- Growth in the home market trade in Ghana with its related distribution as well as the expected growth in the transit trade.
- The demand for container related activities.

CHAPTER FOUR

4.1 Site Selection and Justification

As a result of increase in the volume of cargo through import and export trade both into the country and en-route to landlocked countries, Tema and Takoradi ports are gradually becoming congested. In-effect, increase in container traffic to and from the country resulting in congestion on the roads and pollution of the environment by heavy-duty trucks transporting cargo. The problem is also compounded by the long clearing procedures and the many security inspection of cargo at the ports. The establishment of an Inland Container Depot (ICD) at Boankra is expected to alleviate the plight of all stakeholders in the import clearing business especially those in the hinterlands.

To do this, the design of an Import Clearing Facility to operate within the ICD must be relevant in resolving the above mentioned issues by being "**an efficient intermodal point for cargo clearance**". Several architectural concepts will be considered and utilized to enable the achievement of this goal within the facility in question.

The selection of the site at Boankra is based on the proposal of the Government of Ghana to establish a dry port in the area with its attendant ancillary facilities. The port is expected to attract a large array of activities which includes:

- Inland Container Depot
- Container Freight Station
- Modern warehouses
- Commercial services
- Light industries

4.2 Location

The site is located in the Ejisu-Juaben district in the Ashanti region. It lies 25km south of the city of Kumasi and 220km north of Accra. The site is set-off about 100m from the main Kumasi-Accra highway. It is in a rural area and therefore the expectation that the facility will promote labour and employment.

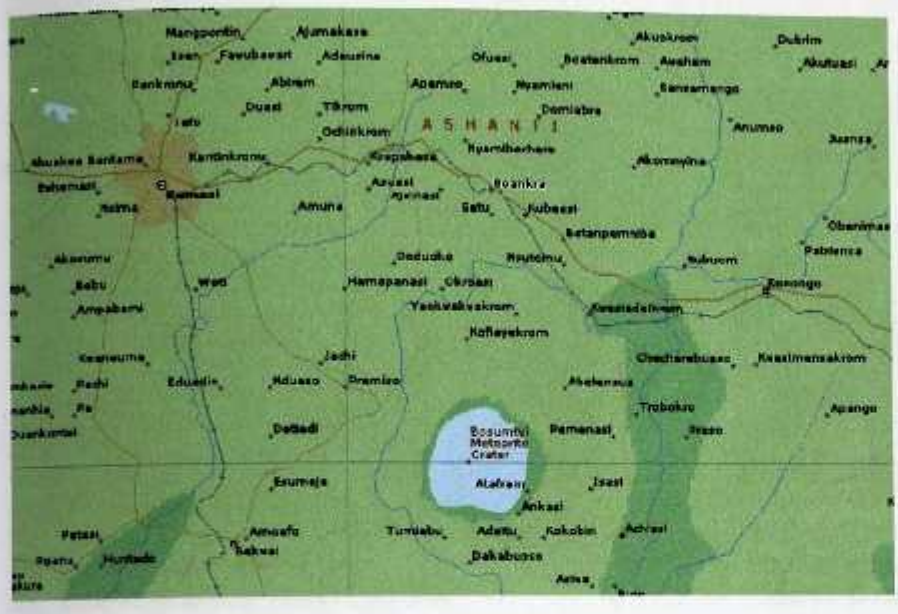


Fig.36 The rural community of Boankra located about 25km south of the city Kumasi.
Source: Encarta Encyclopaedia 2007

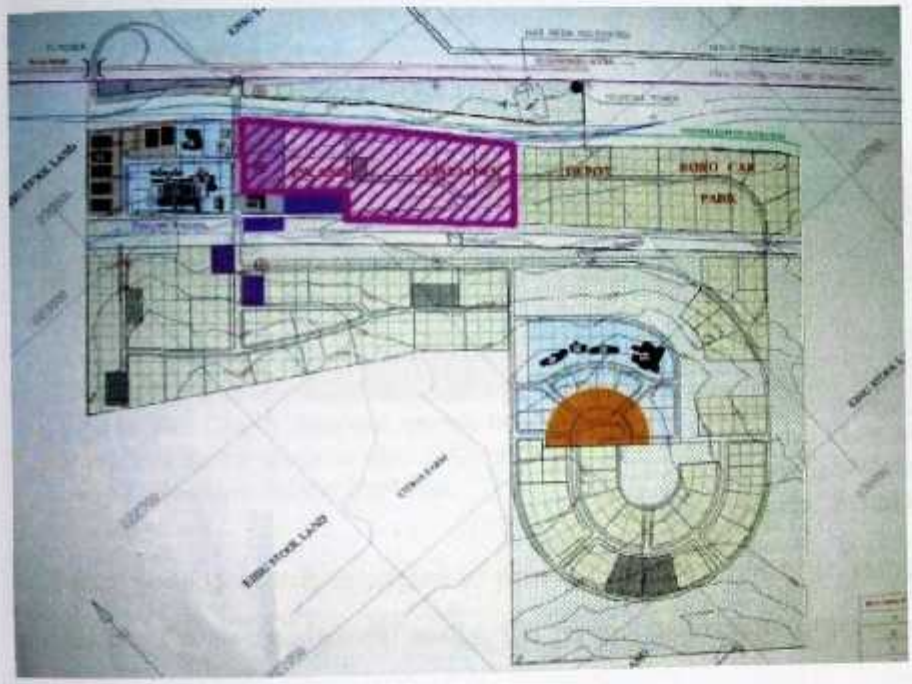


Fig.37 Map ofBoankra inland port. Site is located at the North-east ern side of th e proposed Inland port site.
Source: ABP Consult Limited (Consult ing Engineers)

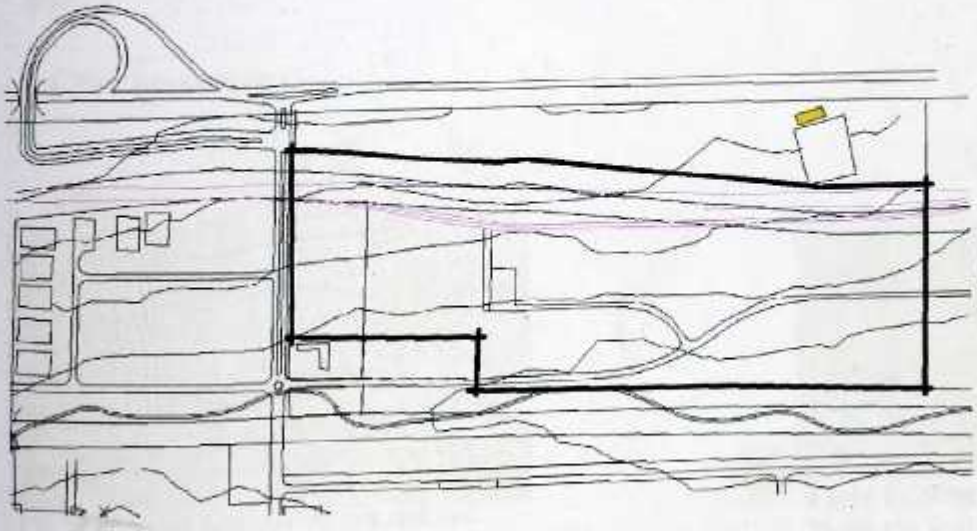


Fig.38 close-up view of site
Source: ABP Consult (Consulting Engineers)

4.3 Site Periphery

Fig.39 Filling station (Top Oil) located at north-eastern side of site.
Source: Boankra Inland Port Site

Fig. 40 Kumasi-Accra highway and restaurant located along north-eastern end of the site.
Source: Boankra Inland Port Site

Fig. 41 The Ghana shippers centre building located at south-western side of the site.
Source: Boankra Inland Port Site

Fig 42. View of weigh-bridge under construction at south-eastern boundary of the site.
Source: Boankra Inland Port Site

The filling station is expected to provide fuel to service the vehicles that will operate in the facility. By the peripheral study, the facility is expected to improve the urban setup of the area.

4.4 Site Inventory

Fig.43 Existing Kumasi-Accra rail line running through the site. It is currently not in use and is made of iron rail and timbersleepers.
Source: Boankra Inland Port Site

Fig44 Existing road access through the site; liking the south-western boundary of the site to the north-eastern end of the site.
Source: Boankra Inland Port Site

Fig.45 Swampy areas around the Penema streamin the lowest part of the site at south -western end of site.
Source: Boankra Inland Port Site

The site lies in an environment with about 90% of undeveloped land. However about 400acres of the area has been marked for the establishment of a dry port by the government of Ghana.

4.5 Site Analysis

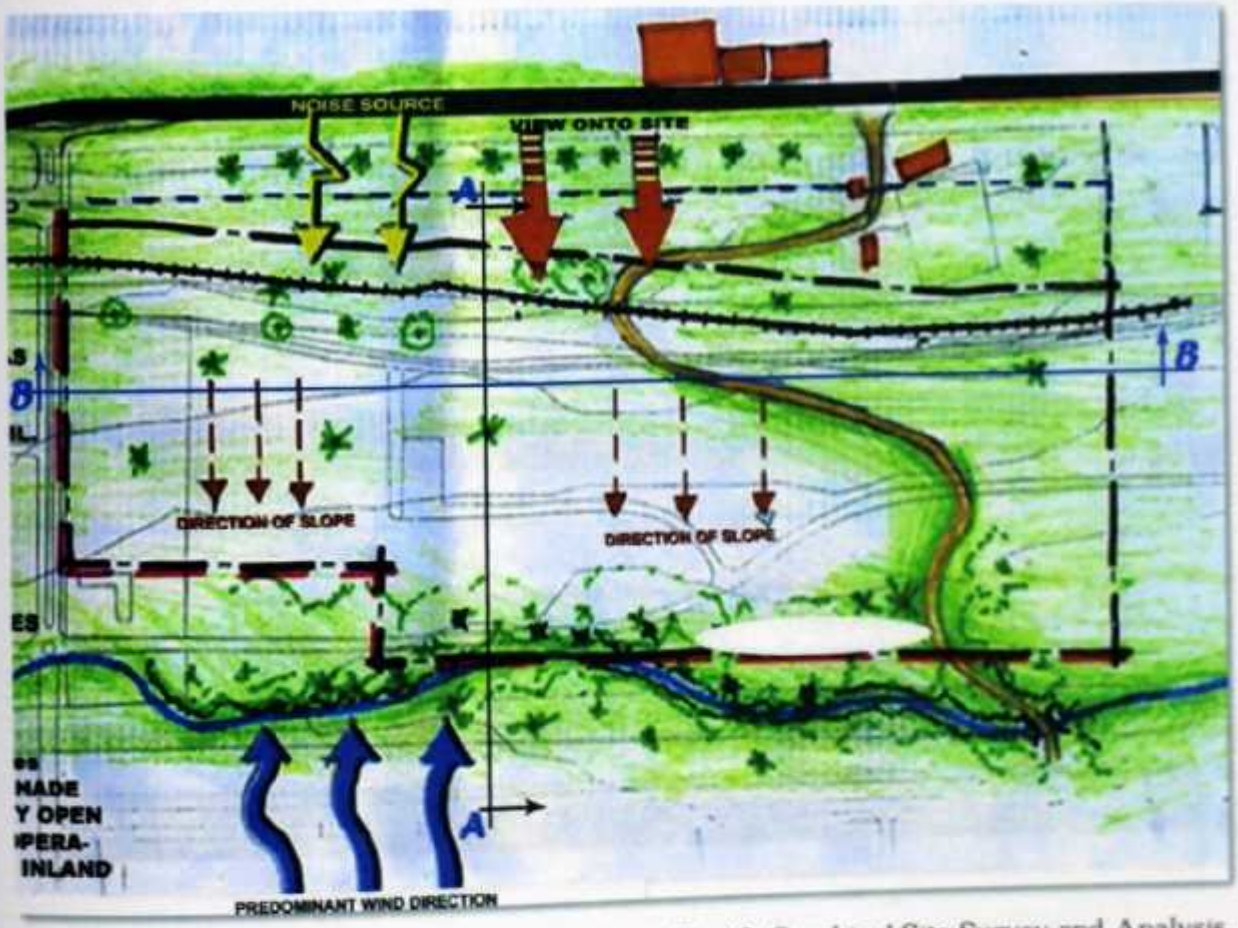


Fig.46 Graphical Site Survey and Analysis
Source: Boankra Inland Port Site

4.5.1 Potentials of the Site

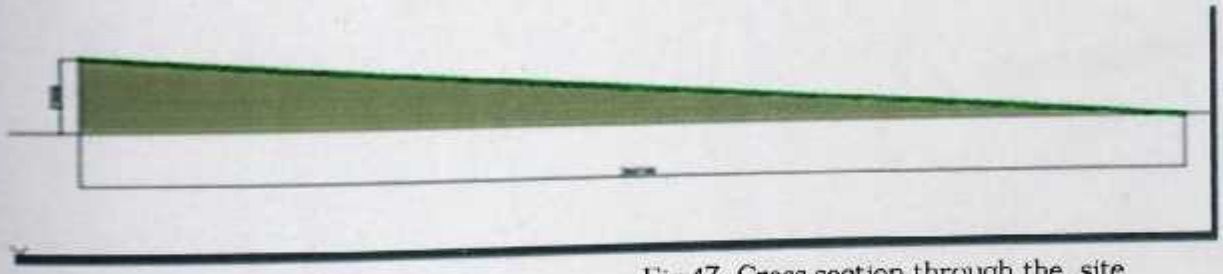
- The site is close to existing and proposed railway lines
- Site is accessible from the Kumasi-Accra highway
- Electricity is available on the site.
- The on-going construction of weigh-bridge at south-eastern boundary of site.
- Proposed removal of school block.
- Proposal of flyover to aid vehicular traffic to the site.
- Size of site with respect to intended land use.

4.5.2 Constraints of the Site

- The site lacks potable water.
- Existing railway line is in poor condition
- Site not oriented directly north-south.

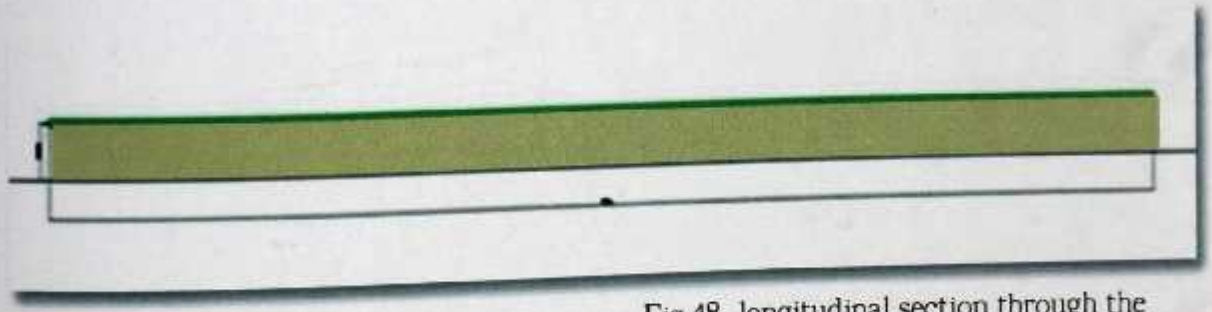
4.5.3 Observation

- There are scattered trees on the site, which will reduce cost of site development.
- There is need to cut and fill to site because of slope with respect to the operations of the intended facility.



SEC. A-A 0.8m: 30m

Fig.47 Cross section through the site.



SEC. B-B 1 m: 200m

Fig.48 longitudinal section through the site.

4.5.4 Geology

- Patchy clay soil at certain areas
- Top soil is generally loamy
- Patchy white sandy soil and swampy areas around the Penema stream.

4.5.5 Vegetation

- Bamboo trees
- Scattered palm trees along stream
- Vegetation is generally lower than 1000mm.

CHAPTER FIVE

5.1 Design Brief Development

The design brief as presented by the client encompasses the design of an import clearing terminal at the proposed inland container depot to be established in Boankra. The facility that will be provided will expedite import clearing process in the port of Boankra.

5.1.1 Design Requirements and User Function

The requirement and user requirements of this design revolve around:

- Both urban and suburban development brief as a result of its location and
- Operations within the proposed inland container depot.

The design of the facility is expected to specific performance of cargo clearance processes as well as the urban and suburban fabric.

5.1.2 Brief and Accommodation Schedule

Item	No. and Unit Area	Area
Staff parking	1(25cars - 12.5sqm)	312.5sqm
Customer parking	1(82cars- 12.5sqm)	1025sqm
Main Administrative offices		
Reception	1	25sqm
Shop		
Rail &Transportation Dept.	1	98.5sqm
General Manager	1	25sqm
Data & Info. Dept.	1	98.5sqm
General Manager	1	25sqm
CEPS Office	1	108sqm
Senior Ceps Officer	1	25sqm
Dept. of Operations	1	98.5sqm
General Manager	1	25sqm
Accounts Dept.	1	98.5sqm
General Manager	1	25sqm

Narcotics Control Board	1	70.6sqm
Exhibits Storage	1	28sqm
Chief Control Officer	1	25sqm
Library and Research	1	98.5sqm
Research Office	1	25sqm
Board room	1	50sqm
Chief Executive officer	1	32.5sqm
Secretary	1	14sqm
Sanitory	5 (16sqm per floor)	80sqm
Circulation	20%	
Total.....	2896sqm	
Restaurant		
Kitchen	1	89sqm
Staff eating area	1	150sqm
Customers eating area	1	225sqm
Store rooms	1	11sqm
Supervisor's Office	1	6sqm
Staff changing room	2 (12.5sqm)	25sqm
Circulation	20%	
Total.....	607sqm.	
Revenue collection unit		
Main hall	1	190.9sqm
Teller booths	5 (4.75sqm)	23.75sqm
Manager	1	10sqm
Circulation	20%	
Total.....	270sqm	

Maintenance unit		
Servicing area	1	480sqm
Tools & equipment room	1	25sqm
Staff changing room	2 (10sqm)	20sqm
Chief engineer□s office	1	25sqm
Staff room	1	10sqm
Security/CCTV control	1	22.5sqm
Circulation	20%	
Total.....		700sqm
Storage facility (warehouse)		
Import storage area	1	3400sqm
Export storage area	1	2100sqm
Manager□s office	1	12sqm
Staff room	1	30sqm
Receiving offices	3 (4.6sqm)	13.8sqm
Ceps offices	3 (13sqm)	39sqm
First-aid room	1	10sqm
Staff Changing room	2 (16sqm)	32sqm
Customer sanitory	2 (16sqm)	32sqm
Tools& equipment	1	24sqm
Devanning area	6 (144sqm)	864sqm
Platform	1	1250sqm
Circulation	20%	
Total.....		9368sqm
Container scanning unit		
X-ray scanning unit	1	385sqm
Data control	1	22sqm
Supervisor's office	1	6sqm
Enquiry	1	13sqm

Data unit	1	6sqm
Staff room	1	13sqm
Staff sanitory		13sqm
Customer sanitory	2 (20sqm)	40sqm
Circulation	20%	
Total		598sqm
Open storage yard		
Car Park(Imported vehicles)	1	1825sqm
Loaded container storage	1	3600sqm
Empty container storage	1	1800sqm
Circulation	40%	
Total		10115sqm

Ancilliary facilities		
Waste management	1	25sqm
Heavy equipment yard		635sqm
Entry and exit gateway	2 (25sqm)	50sqm
Truck waiting area	1(12 trucks)42sqm	495sqm
Total		1205sqm

Item	Area
Administration	2896sqm
Restaurant	607sqm
Revenue Collection Unit	270sqm
Maintenance Unit	700sqm
Covered Storage(warehouse)	9368sqm
Container Scanning unit	598sqm
Open Storage Yard	10115sqm
Ancilliary Facilities	1205sqm
Total	25759sqm

5.2 Planning And Design

An import clearing facility should have large open spaces to accommodate container storage and devanning yards, heavy duty truck and trailer circulations as well as the provision of enclosed spaces for managerial activities. Although serving a more functional purpose, the built up area must exhibit and portray an international architectural style and highly tropical for the capital intensive business environment.

5.3 Architectural design background

The Vitruvian three-part definition of architecture shall be the basis of this design scheme. "*Haec autem ita fiery debent, ut habeatur ratio firmitatis, utilitatis, venustatis.*" (Now these should be so carried out that account is taken of strength, utility, grace.) *Marcus Vitruvius, 'De architectura'*, c.25BC, 1.iii.ii ('Understanding Architecture '-Leland M. Roth pg.9)

This definition of architecture was later paraphrased by Sir Henry Wotten by the seventeenth century as commodity, firmness, and delight. Leland M. Roth in his book 'Understanding architecture' explained that by utility, Vitruvius meant the organization of spaces such that there are no hindrances to use and building is perfectly adaptable to its site. Firmness meant that the literal bones of the building as well as its foundations are solid and that materials used were carefully selected. Delight meant how the architecture is perceived by all of our senses; that its members are proportionate in adherence to the correct principles of symmetry.

Planning and designing of this sketch carefully accommodates this basic definition of architecture in order to achieve the client's goals.

5.4 Visibility and Orientation

Views play a major role in clearing facilities; for example, continuous monitoring of terminal operations from the administrative area can be achieved by way of views, Truck drivers and heavy equipment operators need clear sight lines to facilitate mobility. To facilitate these essential activities, there is the need for extensive glazing, higher building height for administrative area and provision of unobstructed clear circulation paths for yard operators. The facility is orientated to allow easy access to customers and staff while shading devices on the façade of the buildings shades the glazed areas to make the facility tropical and energy efficient.

5.5 Functional Relationship

When functional at full capacity, the facility operates in four areas. The design must therefore seek to creatively fulfill each of these aspects of functionality:

- Circulatory (i.e. Provision of access to cargo (containers) by heavy equipment and trucks as well as customers within a secured zone.)
- Operational (i.e. provision of services to conform to all cargo clearing standards in the confinement of the facility.)
- Catalyst (i.e. to serve as the beacon for the development of the inland container depot.)
- Commercial (i.e. attracting revenue from primary and secondary sources through quality of facilities and standard of services.)

A general functional flow diagram of an import clearing facility should operate like the diagram below:

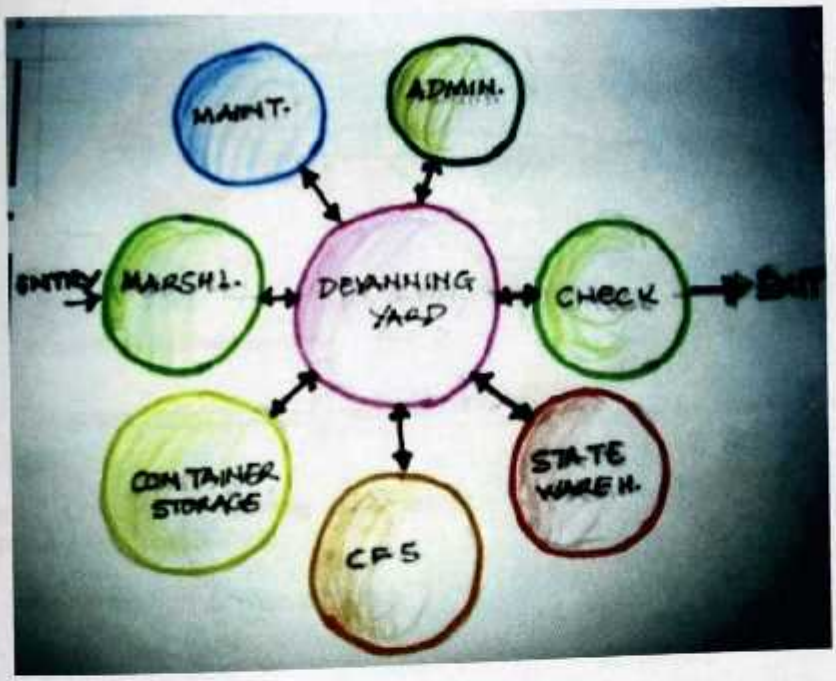


Fig.49 Functional relationship Diagram.
Source: Author

5.6 Conceptual Planning

As part of the functionality of an import clearing terminal the facility is required to employ:

- Long span structural grid for storage space
- Well defined vehicular and pedestrian access
- Sheltered devanning yard
- Unobstructed circulation for both cargo and personnel without compromising on security.

5.6.1 Conceptual Layout Planning

The series of sketches below provides an initial response to the design challenge. It fuses the concept, functional flow, site constraints and potentials and the inspiration to evolve an urban/ suburban streetscape.

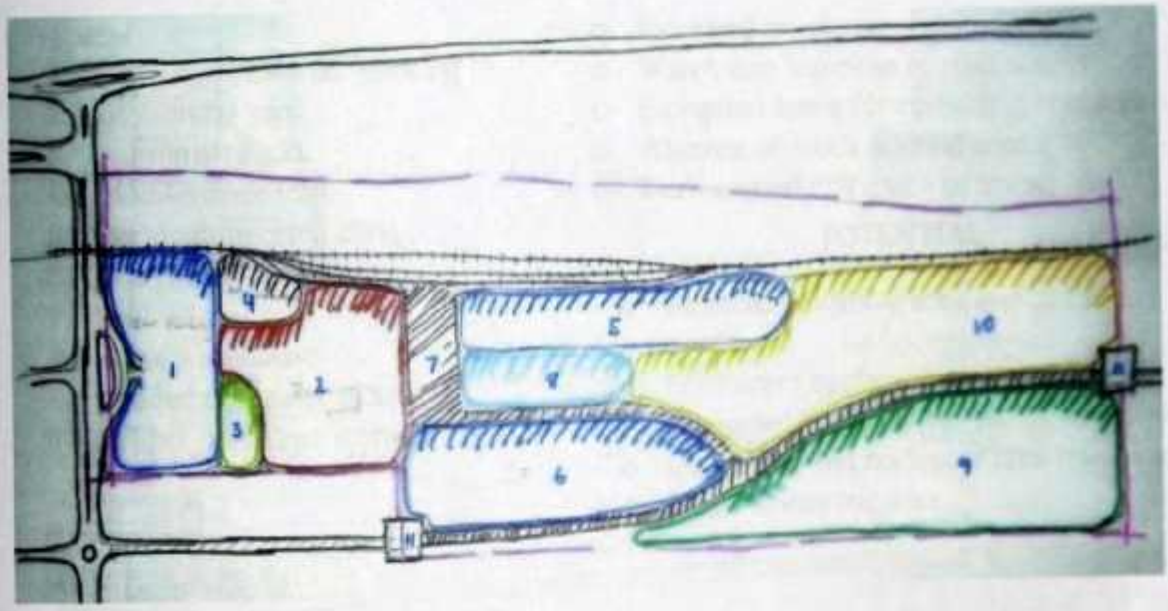


Fig.50 Conceptual planning of site layout Option 1. Source: Author

1. Staff and customer parking
2. Devanning yard
3. Administration
4. Maintenance unit
5. Parking(imported cars)
6. Warehouse
7. Rail siding
8. State warehouse
9. Loaded container storage
10. Empty container storage
11. Security check (gateway)

CONSTRAINTS

- Rail siding conflicts with devaning area activities.
- Reduction in size of devanning yard
- Difficulty in accessing containers on train
- Warehouse too close to road access
- Devanning area and container storage too far apart.
- Reduced rail siding operations.
- Absence of truck waiting area.

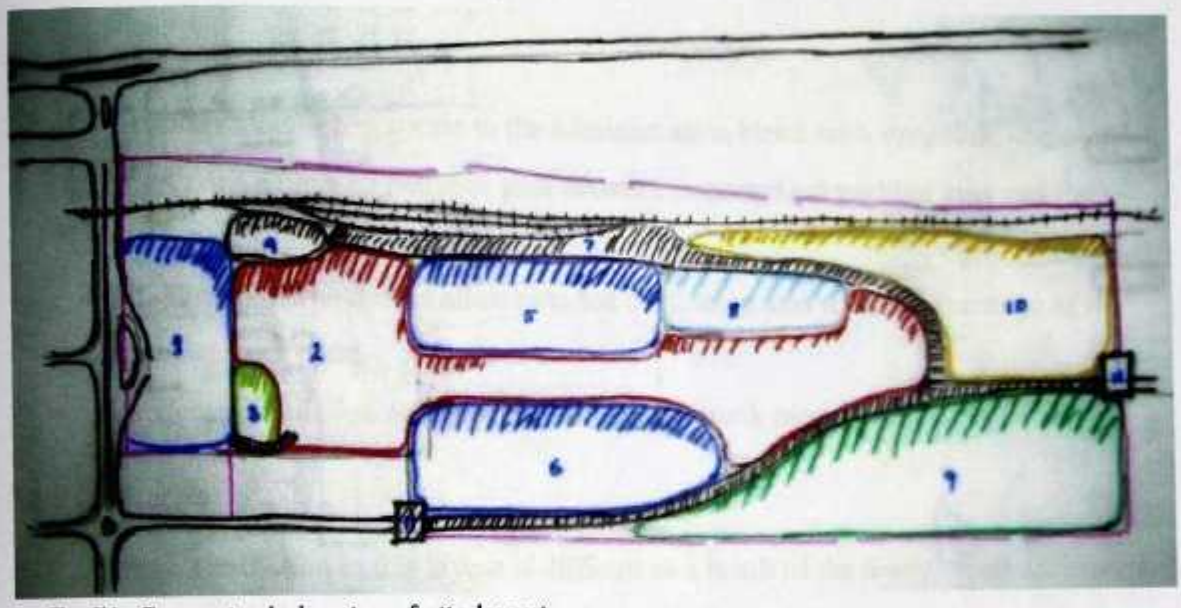


Fig.51 Conceptual planning of site layout Option 2. Source:Author

1. Staff and customer parking
2. Devanning yard
3. Administration
4. Maintenance unit
5. Parking(imported cars)
6. Warehouse
7. Rail siding
8. State warehouse
9. Loaded container storage
10. Empty container storage

CONSTRAINTS

- Increased truck travel distance
- Warehouse too close to road access
- Elongated space for rail siding operations.
- Absence of truck waiting area.
- Turn around difficulty to trucks

POTENTIAL

- Reduced devaninig area and rail siding activity conflict
- Containers easily accessible by trucks
- Elongated space for rail siding operations.
- Devanning and container area much closer.
- Large devanning area

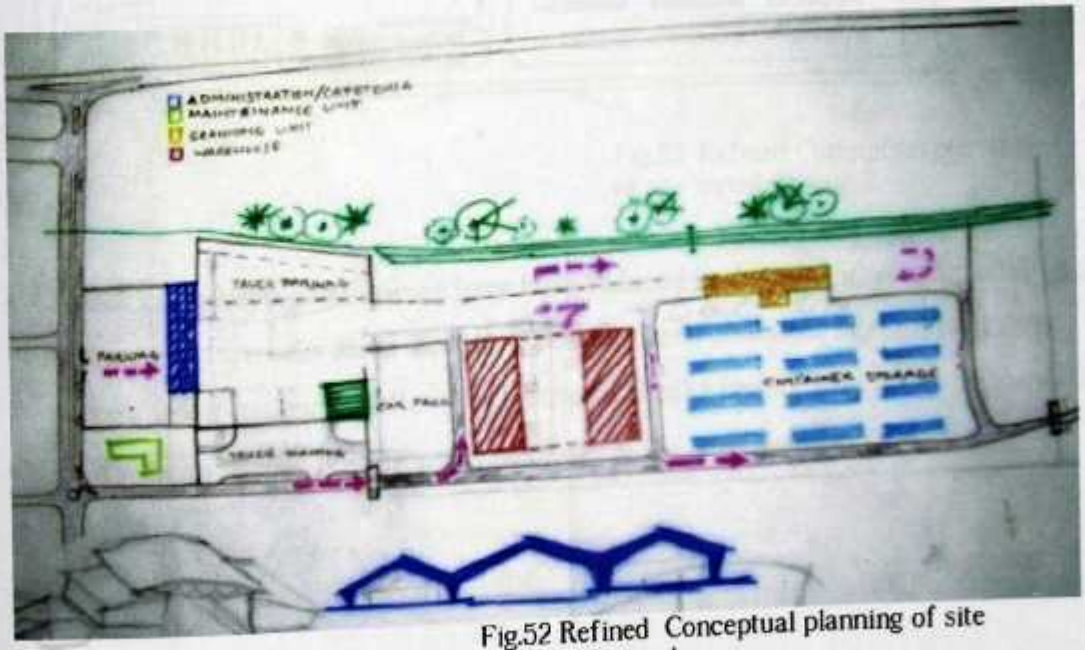


Fig.52 Refined Conceptual planning of site layout- Option 1.

5.6.2 Merits

- Customers have easy access to the administration block with very little obstruction.
- Trucks drive through entrance gate between imported car parking area and the warehouse to access rail siding.
- Orientation of warehouse allows shaded devanning area to take advantage of the south-western wind.
- Adequate circulation area along rail siding for truck movement.

5.6.3 Demerits

- Truck circulation in this layout is difficult as a result of the many road accesses and junctions in the facility especially at the container scanning area where trucks have to make 'u'-turns.
- Warehouse and devanning area not easily accessible to clients from the administration block.

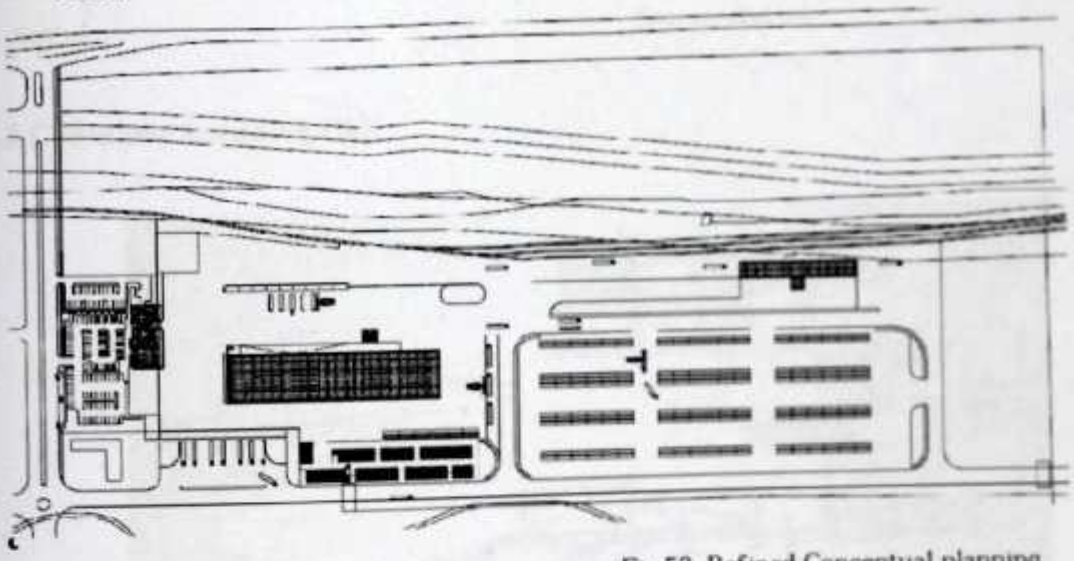


Fig.53 Refined Conceptual planning of site layout-Option 2.

- Truck circulation and turnings have been reduced in this layout. After checks at the entrance gate, trucks drive through access between container storage yard and warehouse to rail siding after which onward checks are done on the consignments.
- The warehouse has been re-oriented closer to the administration area.

5.7 Design Sketches

5.7.1 Administration Block

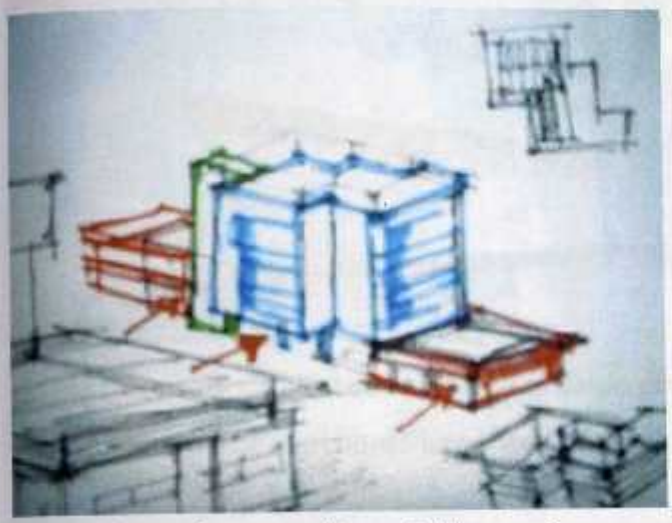


Fig.54 Three dimensional isometricimpression showing the various wings of the administration block
Source: Author

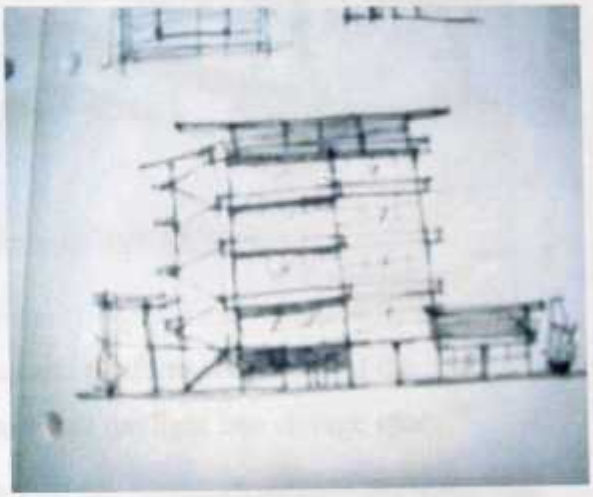


Fig.55 Two dimensional impression showing the access by escape stair of the administration block
Source: Author

5.7.2 Container Scanning Unit

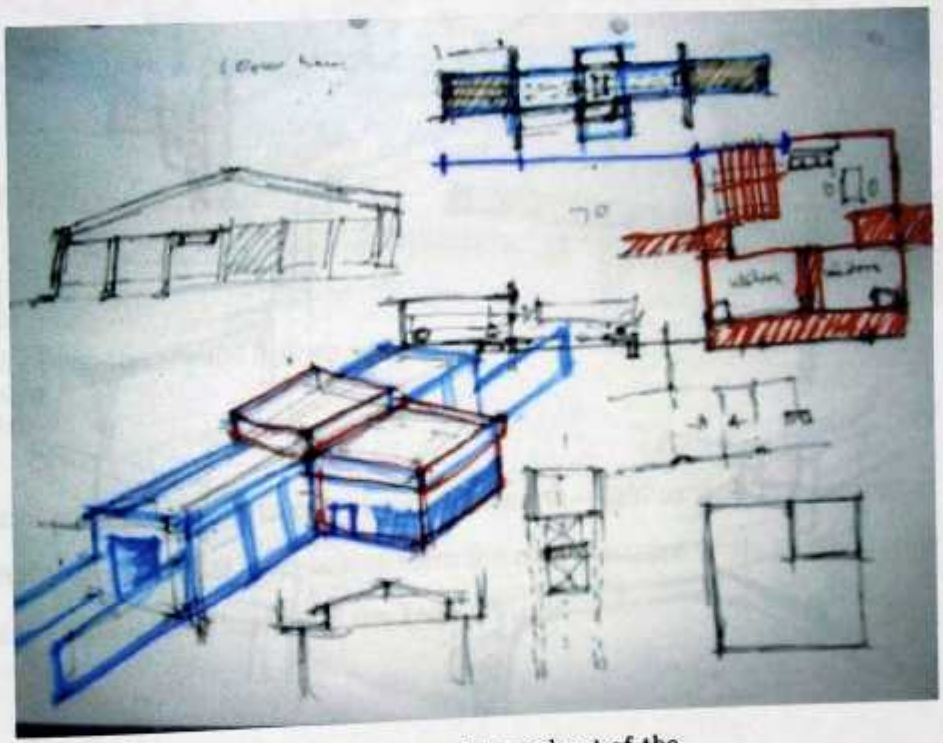
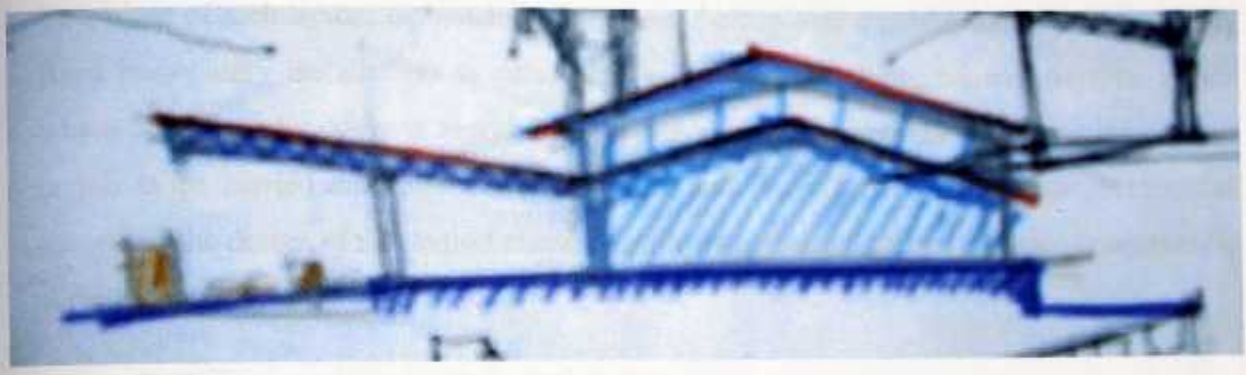


Fig.56 Truck access into and out of the container scanning unit and location of sanitory for container yard staff.
Source: Author

5.7.3 Warehouse and Devanning Area

Fig.57 Sketch of warehouse and Devanning area
Source: Author



A Lean-to-roof has been provided to shade devanning and platform area. Parts of the roof structure of the warehouse have been raised as well to admit daylight into storage space.

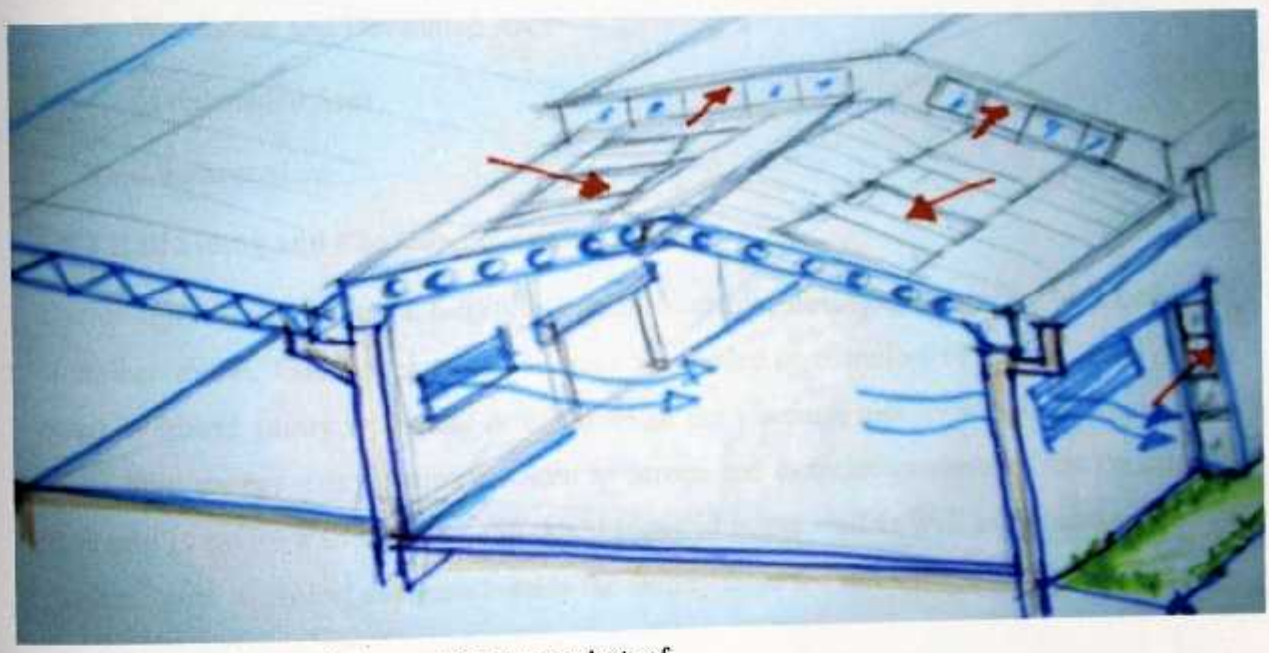


Fig.58 Sketch of ventilation and lighting analysis of warehouse area
Source: Author

Skylights have been employed to complement the north –light as well as openings at the sides of the external wall. Cellular steel beams form the roof structure while ventilation is achieved through jalousie windows in the external wall.

5.8 Description of Design Essentials

5.8.1 Detailed Facility

This piece of architecture is intended to be a user facility with a public status equipped with fixed heavy duty installations to offer services in cargo handling, containerization, cargo transit operations by rail/road to and from serving seaports, temporary storage of import and export laden carried out under customs control and clearance. To achieve these essential functions, the design of this import clearing facility is composed of five (5) main constituents, these include:

- Rail Siding and Container Scanning area
- Container Storage area
- Warehouse and Devanning Area
- Maintenance Area
- Administration

5.8.2 Rail Siding and Container Scanning Area

The design of this area in the facility is geared towards achieving unobstructed circulation for container trucks. Containers on rail wagons are loaded onto trailers of trucks using rubber tyred overhead gantry crane and driven through the scanning unit by means of a conveyor while high energy x-ray beams are used to screen and examine contents of the containers. This unit is cavity walled with x-ray shield installed in the wall as well as the entry and exit gates in order to protect elements outside the facility from the side-effects of the x-ray.

5.8.3 Container Storage Area

Scanned containers on trailers are driven to an off-loading bay on the south-eastern side of the facility adjacent to the container storage area. Loading and off-loading of containers in this area is done with reach stackers. This area is the largest of all the facilities; it is paved with concrete pavers and has markings to aid circulation of the stacking equipment around container stacks.

5.8.4 Warehouse and Devanning Area

Less container load (LCL) and suspicious containers are forwarded to the devanning for stripping and re-stuffing together with physical examination of content of containers by customs official and clearing agents. The area forms part of the platform area of the warehouse and it is shaded to allow clearing activities to take place even under harsh weather. The storage area in the warehouse is designed to temporarily store un-cleared general cargo until subsequent clearance. It has spaces for customs offices, receiving teller booths, changing rooms, etc. Sections of the roof has been broken and pushed up to allow daylight into storage space.

5.8.5 Maintenance Area

To ensure that cargo handling equipment are in constant operation, the mechanical maintenance unit with its adjoining yard is planned to facilitate the servicing all cargo handling and other mechanical equipment. It is located such that it is easily accessible to both staff and mobile equipment to be serviced. The much smaller equipment such as the forklifts is maintained within the covered area while the heavy duty ones such as the reach stackers and trailers are serviced in the maintenance yard. The unit has spaces for the office of the supervisory engineer, CCTV control room for the security of the entire facility. There are also changing rooms for staff and two "vehicular pits" to aid the maintenance process. The block also has wide openings at the north-eastern and south-eastern sides to allow maximum daylight and ventilation.

5.8.6 Administration Area

As part of providing unobstructed clearing processes for clients and agents, a covered walkway links the container devanning area and the administration block. The administration block; a six multi-storey architectural piece is designed to super-see and house the general management affairs of the facility. It is designed along three wings:

- The restaurant wing,
- The revenue payment wing, and
- The offices wing.

Although the tallest amongst the three, the offices section serves as a linkage block between the other two wings. It is graced with an elegant entrance leading to the main reception area where enquiries could be made. Vertical circulation system (stairs and lift) allows users to access offices on the top floors from the reception area. The revenue payment wing located on the south-western side has two levels this includes the main hall where there are teller booths to undertake general business, the first floor is a mezzanine level with offices for customs officials, this level is also linked to the first floor of the main office section in the administration block. A two level restaurant forms the north-eastern wing. It also has its segregated access for customers. On the ground level is the customer eating area while the first floor levels houses the staff eating area. The staff cafeteria is accessed via the escape stair between the restaurant wing and the office wing. The staff eating area is serviced by way of goods lift as well as a spiral stair located within kitchen.

NB: See appendices for detail drawings.

5.9 Services

5.9.1 Electricity

Electric power from the transformer on site steps down power and distributes it to the various facilities via underground cables to the respective distribution board among the individual facilities.

5.9.2 Lighting and Ventilation

As a result of the varied activities that take place in the facility, lighting requirements have been streamlined with respect to each space. For example office spaces in the administration block have very wide openings although shaded with horizontal concrete bands admit enough daylight into the spaces. However, the container scanning unit has fewer openings due to the nature of the x-ray activities and therefore daylight is supplemented with artificial lighting within some of the spaces.

Natural ventilation is achieved through the south-western orientation of facilities. Jalousie windows in the warehouse encourage continuous flow of fresh air across the storage space. Aside the use of top-hung windows in the curtain walls of the administration block to encourage natural ventilation, supplementary artificial ventilation is also used by way of the provision of a service floor in the design to contain condenser units of split air-conditioning systems to ventilate the building.

5.9.3 Information and Data systems

The entire facility operates on a unique data and information transmission systems, to facilitate this activity, reinforced concrete roof slabs have been provided at parts of the roof of the administration block for the installation of communication masts and other information transfer systems. All forms of data is received by the data department and processed for distribution to other agencies via wireless systems.

Other information dissemination media to customers are through installed computerized signage systems which are updated periodically by the data and information department.

Within the yard itself, road markings provide vehicle operators with direction and where to stop in order to control vehicular traffic.

5.9.4 Security Control

Safety of goods, clients and staff is major aspect of the design. The facility provides one pedestrian access to customers into the devaning area this ensures monitoring of pedestrian movement in and out of the facility. CCTV cameras are located at every entrance and are controlled from the maintenance block by specialist security services. The main truck accesses are manned and have traffic monitoring systems installed to check every vehicular entry and eventual exit from the facility. Circulation areas have been segregated to ensure that there is controlled pedestrian-vehicular conflicts. The design of the container x-ray scanning systems is also a creative means of checking and controlling the issues imported contraband goods into the facility. High luminous security lights have been located at vantage points to illuminate the facility at night to endure maximum security.

5.9.5 Fire Fighting

Two fire hydrants are located in the devanning area and another in the customer car park. They are serviced by 75mm diameter ring pipe from the 100mm mains. Fire prone spaces in the facility have fire extinguishers mounted at vantage points in the spaces. Other forms of fire fighting systems include smoke detectors and foam sprinklers especially in the warehouse where cargo safety is paramount. To protect human life on the highest structure, open fire escape stair has been provided as a means of evacuating people from the building.

5.9.6 Surface Drainage

Drainage is generally underground with the provision of grills at centers to drain surface water. The lawns have also been provided with subterranean drainage to keep moisture level requirement. All drains connect to a general culvert at the lowest point of the site and subsequently channeled to the Penema stream at the south-western side of the site.

Soil waste falling by gravity from administration block, warehouse and maintenance unit has been channeled to a central septic tank to be dislodged when full, while the container scanning unit has been provided with a septic tank that is closer to it, also to be dislodged when full.

5.10 Construction Technology

The general construction system to be used includes;

- Cellular steel portal frame anchored to reinforced columns at 5000mm centers for the warehouse and maintenance blocks.
- Reinforced concrete post and beam system for the administration and container scanning blocks respectively, of which columns are at 5000mm centers.

The choice of cellular steel portal frame is to provide light weight construction and to allow unobstructed wide span spaces for circulation and storage and also to quick run-offs of rainwater on the roof of the structure.

Concrete was also chosen as a construction material because:

- **mass**: giving a robust structure to absorb braking force of trains
- **stiffness**: naturally stiff therefore requiring fewer cladding joints
- **fire resistance**: easy achieve 2 hours standard
- **noise insulation**: its ability to absorb noise
- **fatigue resistance**: less sensitivity to live loads

The structural grid of 5000mm is used to be able to achieve office spaces of multiples of 5 which are very ideal for the design. It is also to ensure a sense of stability in the structure to users. The reinforced concrete columns and beams are cast in-situ some of which are designed to carry down pipes.

Expansion joints and construction joints have been provided in the design to cater for differential settlements and easy phasing of the project.

5.11 Finishes

5.11.1 Floors

Floors of office spaces are installed with fixed carpet and while public spaces except the reception hall are finished with durable polished porcelain floor tiles of bright but less glary colours.

Floor of warehouse, container scanning and maintenance units is finished in reinforced concrete float finish.

5.11.2 Walls

Wall rendering for administration block is acrylic paint while bright coloured emulsion paint is used for the interiors except for spaces where special characters are required. The interior and exterior spaces of the warehouse are finished acrylic paint with its accompanying wall markings to direct traffic.

5.11.3 Ceiling

The ceiling of the administration block and other office spaces in the other units is finished with bright coloured acoustic panels.

5.12 Landscape

5.12.1 Soft Landscape

The beauty of the facility shall be enhanced through the incorporation of existing trees and shrubs and the introduction of new ones. Solar radiation from hard surfaces shall be reduced by way of soft landscape in order to keep micro temperatures in the facility at reasonable levels. Excessive carbon emissions generated from continues circulation of vehicles shall be reduced by the provision of vegetation. The road network shall be lined with royal palm trees and lawns cultivated along pedestrian walkways. Additionally, open spaces and sitting areas shall be well landscaped with shade trees.

5.12.2 Hard landscape

The choice of hard landscape for this project shall be based on durability (resistance to abrasion), easy maintenance and aesthetic appeal. Driveways, parking lots and pedestrian walkways shall be finished with interlocking concrete paves. The paves, especially those of the pedestrian walkways shall blend with the rest of the rest of the landscape in both colour and texture. This is to achieve reduction in heat loads and glare while emphasizing the principles of repetition, rhythm and contrast to provide a humane environment.

5.13 Costing

This costing is an estimate to give the client an idea of the financial investment the project will need. Cost is estimated based on the cost per square area:

Administration Block- 500 GH¢ per sq area

2896 x 500.....GH¢1,448,000

Restaurant -300 GH¢ per sq area

607 x 300..... GH¢182,100

Revenue collection unit-300 GH¢ per sq area

270 x 300..... GH¢81000

Maintenance unit-300 GH¢ per sq area

700 x 300..... GH¢210,000

Warehouse -400 GH¢ per sq area

400 x 9368..... GH¢3,747,200

Container scanning unit-300 GH¢ per sq area

598 x 300..... GH¢179,400

Open storage yard-200 GH¢ per sq area

10115 x 200..... GH¢2,023,000

Ancillary facilities-300 GH¢ per sq area

1205 x 300..... GH¢361,500

Total..... GH¢8,187,200

5.14 Conclusion

Providing a modern and optimized approach to the clearing of cargo using basic architectural principles and elements with respect to cargo handling engineering systems is the main essence of this design proposal. Location of the design; Boankra, is to facilitate the decongestion of the two seaports in the country thereby increasing Ghana's trade prospects. The provision of this facility also seeks to promote transit trade in the sub-region putting Ghana on the map as the gateway to sub-Saharan Africa in terms of trade by way of giving the landlocked countries easy access to their imports and exports. Goods are expected to come into the facility mainly via rail transport, this will in-effect provide a means of revamping the rail transport industry in the country.

In pursuance of the aims and objectives of the design summarized above, it is hoped that the ***IMPORT CLEARING FACILITY*** (cargo terminal) to be located in Boankra Kumasi, will receive the utmost support of the Government of Ghana in conjunction with Ghana Ports and Harbours Authority, Ghana Shippers Council, World Trade Organization and the Economic Community of West African States to bring the proposal into light.

5.15 Recommendation

All the issues raised are best achievable by the collective participation of all stakeholders including the natives of the land on which the facility is to be sited.

The construction procedure; from inception to completion, every underlaid procedure must be adhered and followed to the letter.

5.16 Phasing

It shall be recommended that the project be carried out in phases which will include:

Phase 1: Laying of proposed railway tracks and vehicular road accesses.

Phase 2: Administration block and Gateways

Phase 3: Container Scanning Unit and container storage Area.

Phase 4: Warehouse and Maintenance Unit

Phase 5: External works (landscaping)

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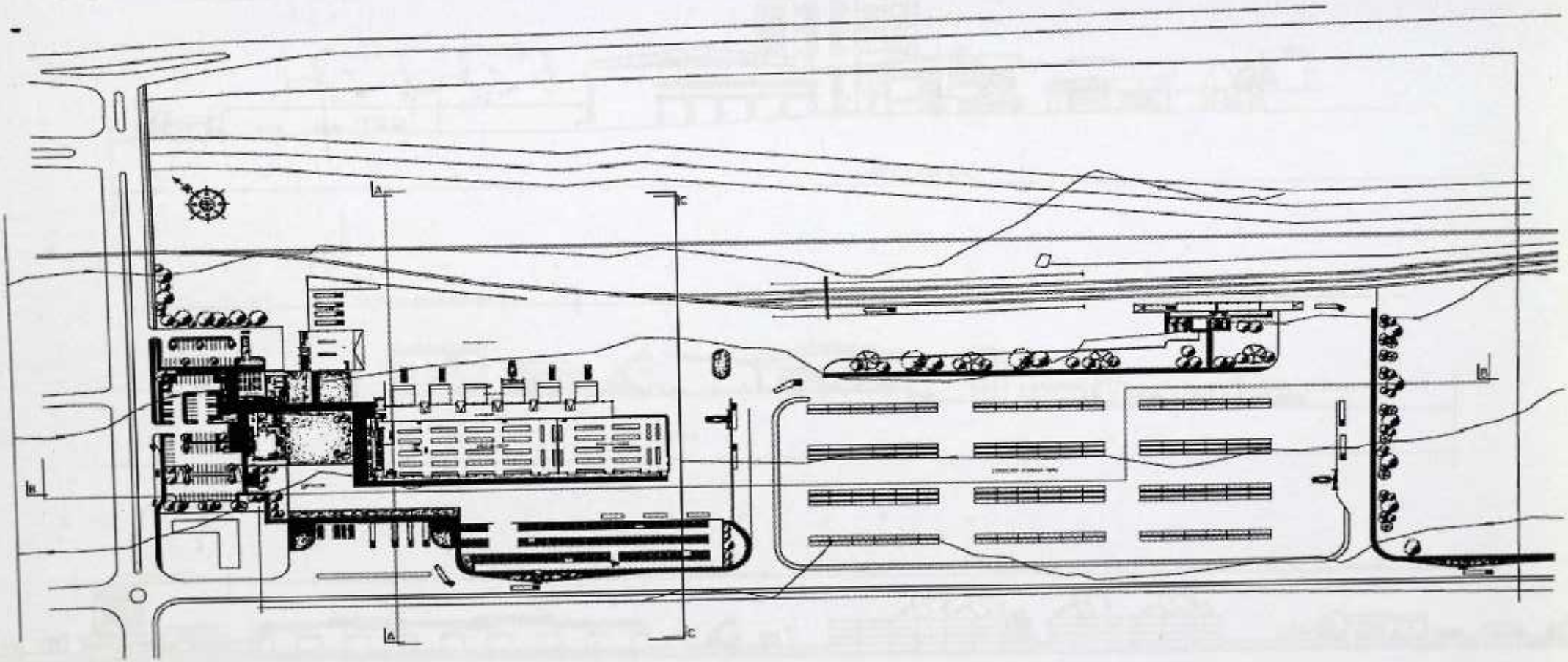
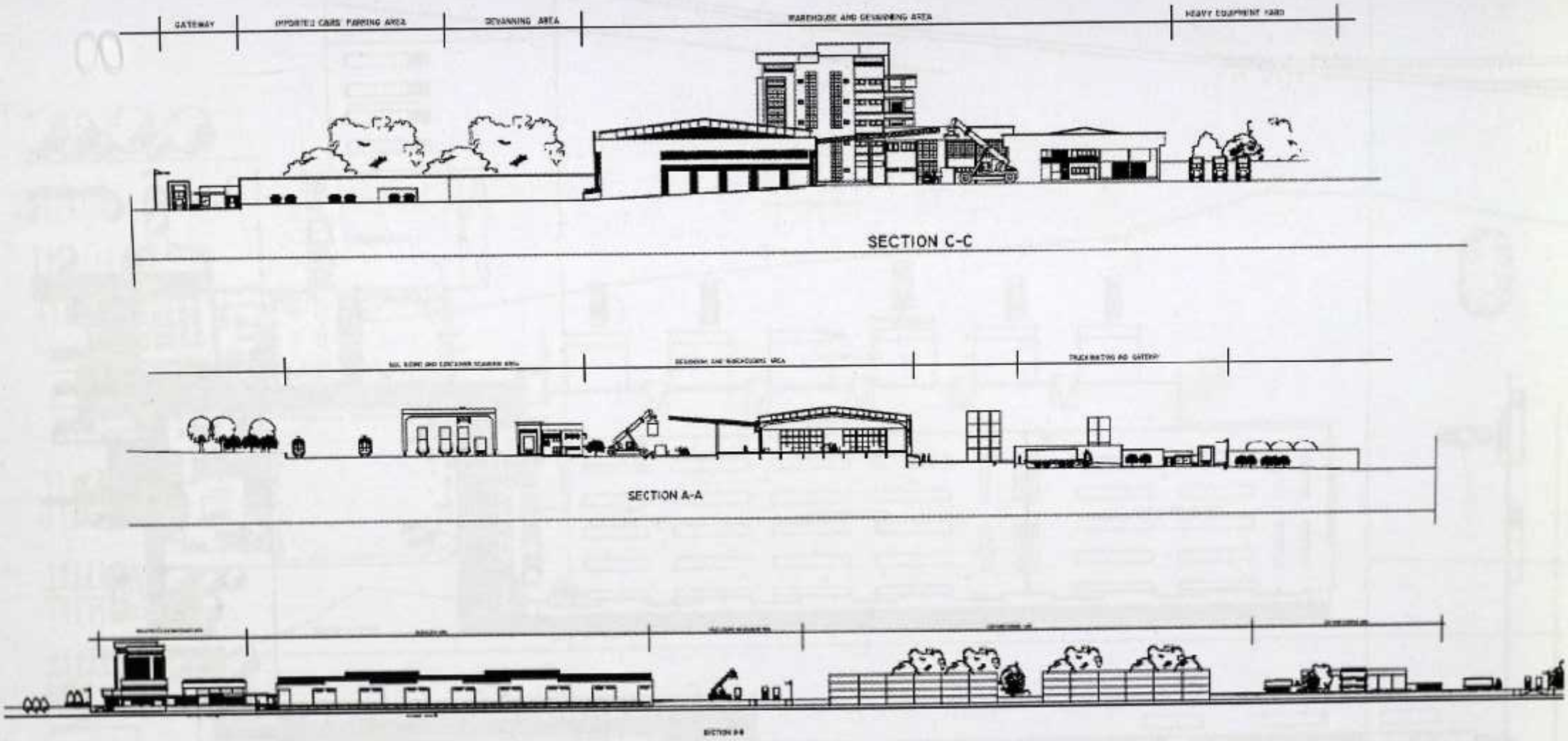
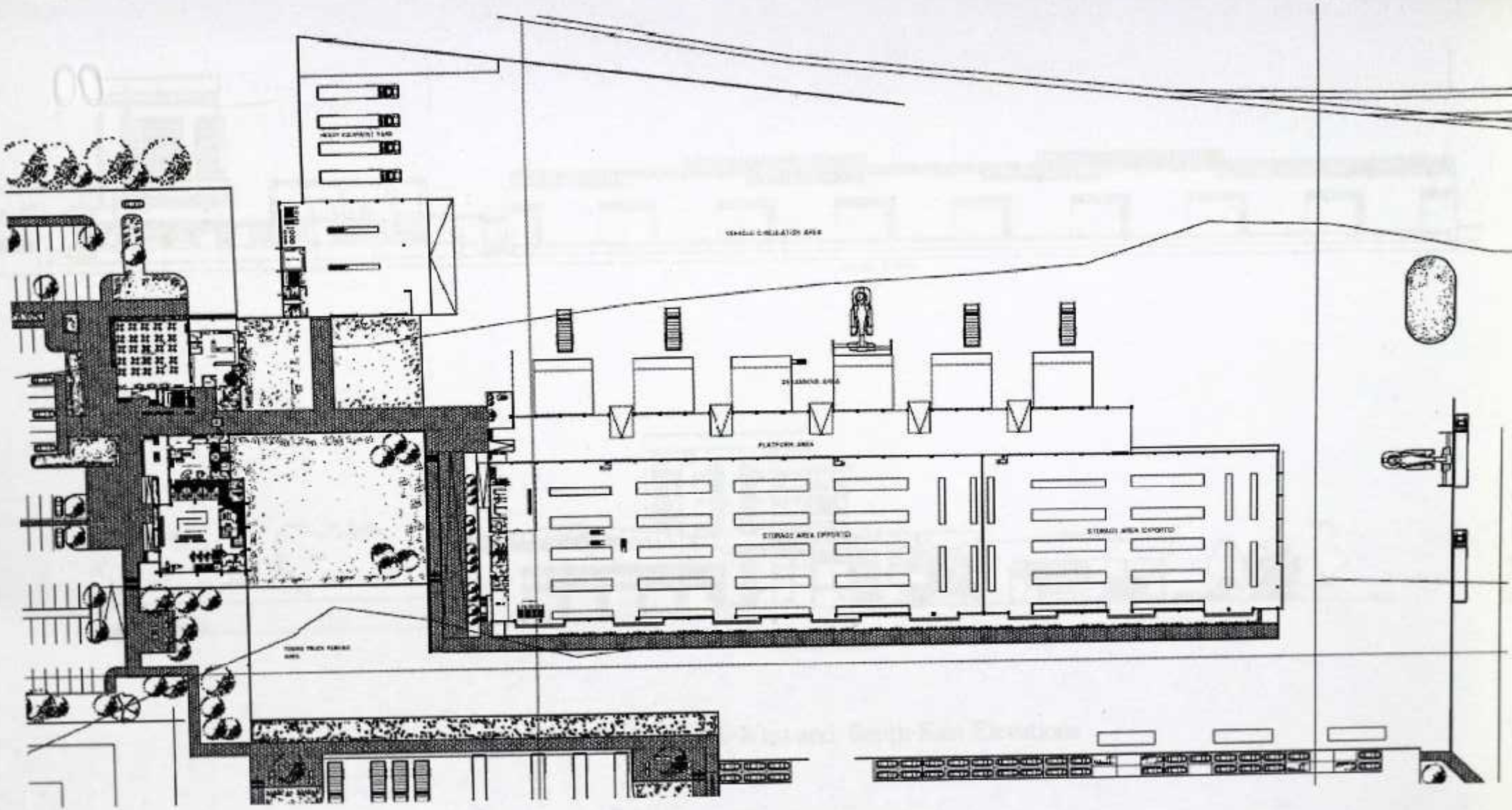
APPENDIX



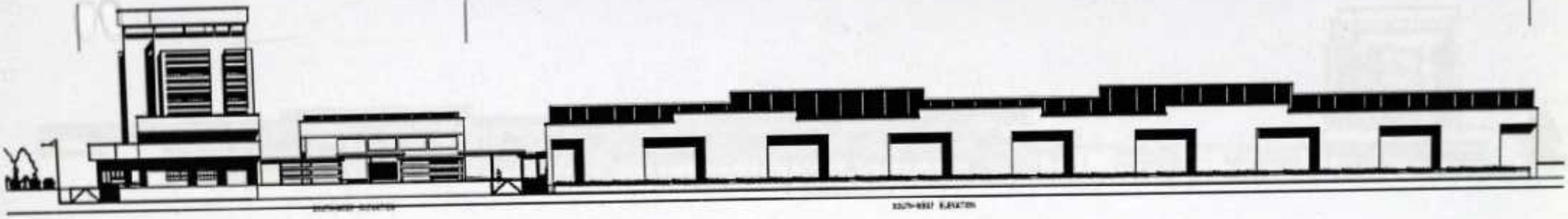
Appendix 1. General Site layot

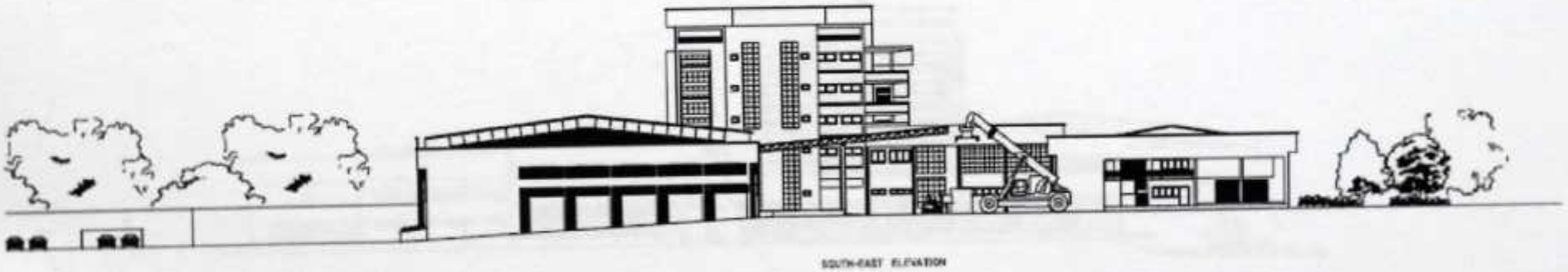


Appendix 2. Site Sections

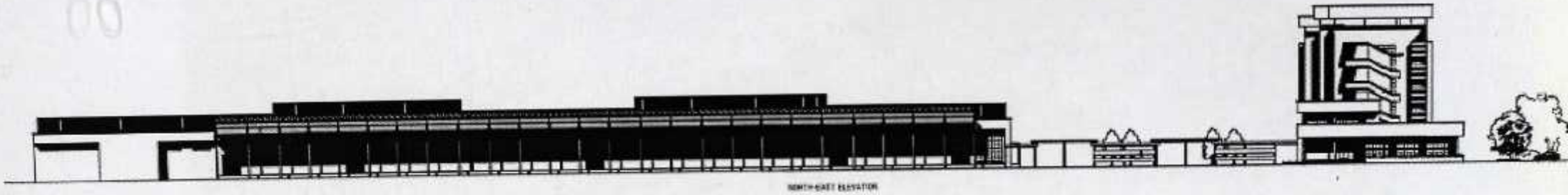


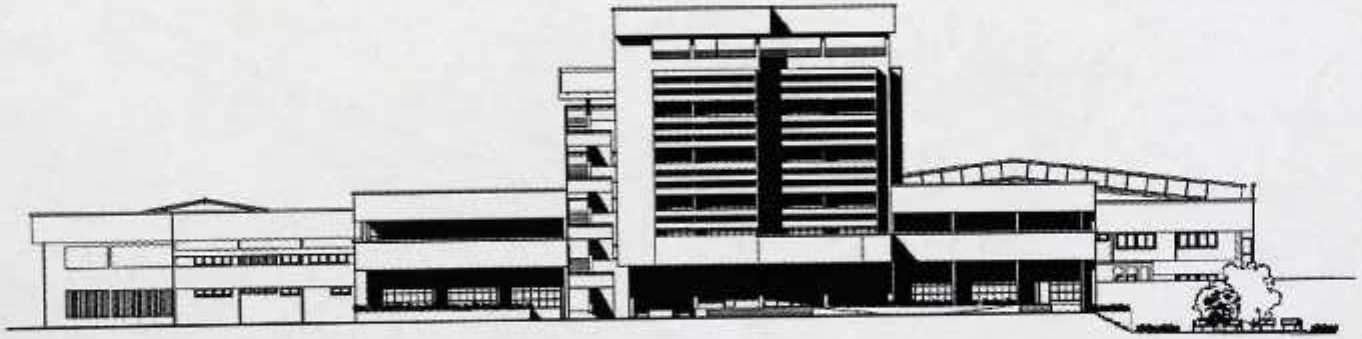
Appendix 3. Ground Plan of Administration, Maintenance and Warehouse



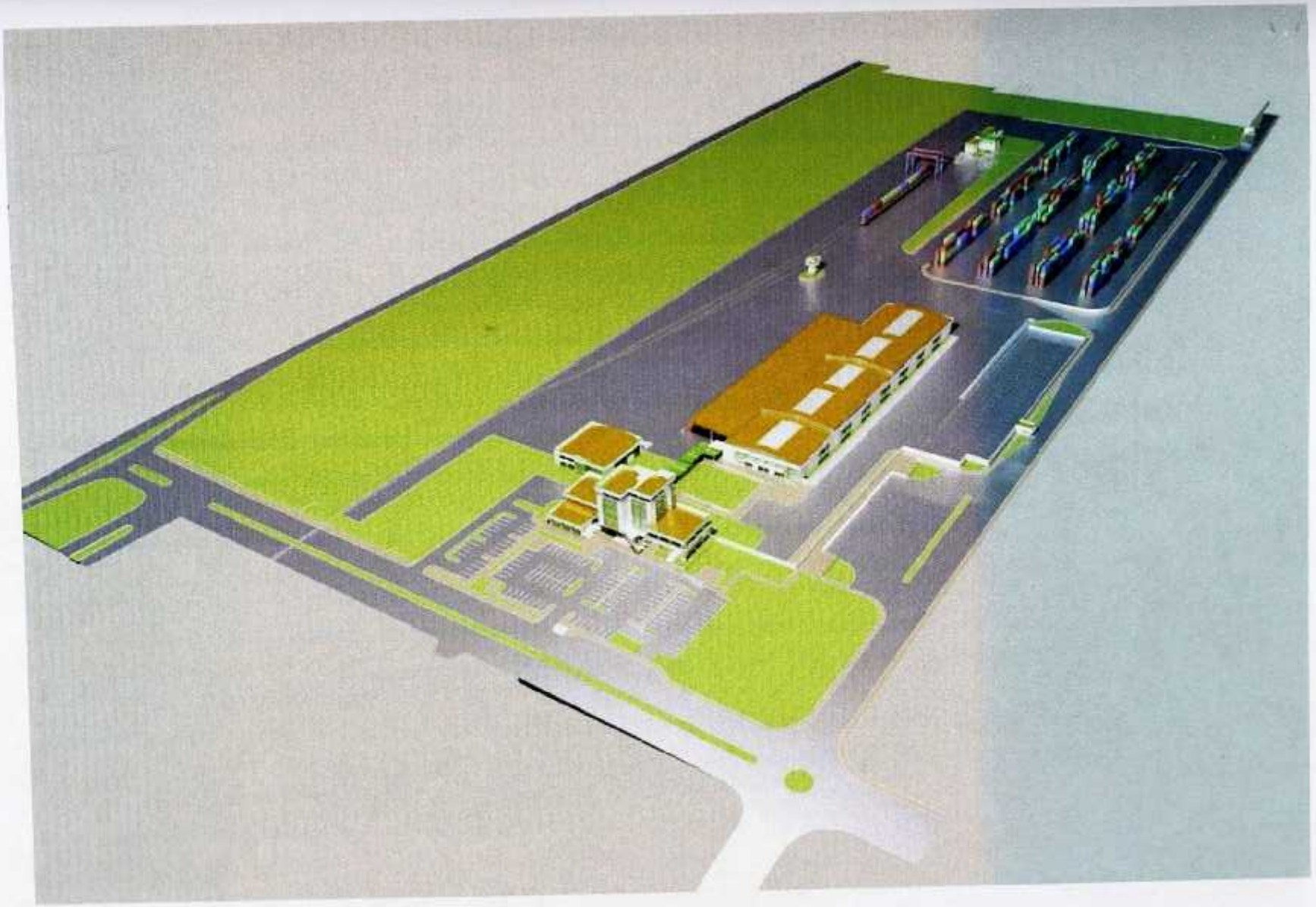


Appendix 4. South-West and South-East Elevations





Appendix 5. North-East and North West Elevations



Appendix 6. Ariel perspective View of Facility

Appendix 7. View of North-Western side of Administration and Maintenance Block

Appendix 8. View of Security Truck Entrance and Rail siding