Harbor Engineering Graduation Project 2022

Nile Higher Institute
For Engineering and Technology

Department of Civil Engineering.

Planning and design of Dabaa port on the north coast

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ABSTRACT

The Dabaa power plant is a part of the government's strategy to secure and diversify the country's energy supply. El Dabaa Nuclear Power Plant is very important for Egypt economy. As Egypt is performing great development projects in various industrial, agriculture, new cities…etc., so these projects demand more energy for their sustainable continuation. The nuclear power which will be generated from El Dabaa Nuclear Power Plant together with the other energy resources generated from oil, gas, coal power will be helpful energy. The nuclear power plant produces a sustainable, clean, and safe type of energy and does not produce any harmful gases effect on the environment.

Therefore, the establishment of seaport in the Dabaa area to receive nuclear reactor equipment, nuclear fuel containers, and fuel storage canisters later exhausted is more important from the practical and economic point of view to transport reactor equipment instead of relying on other Egyptian ports. Also, Egyptian government has focused on developing the Mediterranean Sea coastal region between Marsa Matrouh and Alexandria to attract building new communities. The developing program include new port at site of El-Dabaa to serve fishing activities, commercial and tourism along north coast.

This project will cover the site selection of port, the design of port layout, including port master planning (port functions and organization, port planning methodology, planning process), and design of Wet Areas (ship maneuvering and hydrodynamic behavior, approach channels, maneuvering areas within the port, port basins and berth areas.

Also, an extensive overview of the design and construction of berthing structures (bulk cargo terminals…etc.) will be given. This part of project will cover the determination of design parameters and normal design sequence of berthing structures, typical lay-out and components of berthing structures.

Chapter 1

PROJECT DEFINITION

PROJECT DEFINITION

1.1 Introduction

The Egyptian authorities are currently studying the possibilities of developing and rehabilitating the north coast. The Egyptian government has focused on developing the Mediterranean Sea coastal region between Marsa Matrouh and Alexandria to attract building new communities.

El Dabaa nuclear power plant is being developed on the Mediterranean Coast in the Matrouh region of Egypt, approximately 6km away from the town of El Dabaa, approximately 130km northwest of Cairo, about 110 km from Marsa Matrouh at east and about 185 km from Alexandria at west as shown in Figure (1.1). The developing program include new port at site of El-Dabaa to receive nuclear reactor equipment, nuclear fuel containers, and fuel storage canisters later exhausted and to serve fishing activities, commercial and tourism along north coast.

The new El-Dabaa port will be an integral component of Egypt`s plan for economic and social progress and will benefit such endeavors as international trade, inland transportation, industrial development, urban renewal, and the creation of new communities.

The construction of the new port of El-Dabaa should be carefully investigated and planned to achieve this goal without affecting the environmental conditions and marine live.

Figure (1.1) Location of Dabaa on Egypt map

A harbor is described as a water area that is bounded by natural features or manmade structures or a combination of both. As such, it provides refuge and safe moorings and protection for vessels during storms or accommodations for such water to water or water to land activities as resupply, refueling, repairs, or transferring cargo and personnel. Harbors pilots and tugboats are often used to maneuver large ships in tight quarters as they approach and leave the docks, [1,2,3,6,7].

The intended goals in designing and constructing a harbor are twofold: to obtain a relatively large area of water, with adequate depth during all tidal stages that will provide shelter for ships and to provide a means by which transfer cargo and passengers between ships and shore locations and facilities.

Harbors can be classified according to purpose as harbor of refuge, commercial harbor, military harbor, and fishing harbor. Harbor of refuge is the harbor used for ships in storms or emergency condition to provide good anchorage, safe and easy access from the sea.

Commercial harbor provides facilities for loading and unloading of different kinds of cargo. The layout of this type of harbor requires large accommodation for the mercantile marine, sufficient quay space and facilities for transporting; loading and unloading cargo, storage sheds for cargo, and good and quick repair facilities to avoid delay, [1,2,3,4].

Military harbor is meant for accommodating naval crafts and serves as a supply deport. The layout of this type of harbor is greatly influenced by its location.

Traditionally, fishing harbors served the local port-based fishing fleet by provision of vessels orientated services such as mooring, unloading of fish, supplies of fuel, water and store provisions, and small vessels repairs, as well as simple fish handling and transportation ashore. In fishing ports with fish landings by international vessels, public services were added—customs, immigration, health services, and police.

The word terminal refers to a complete port facility for accommodating, loading/ discharge of ships and for the storage, stacking and handling of cargo on shore (e.g., bulk cargo terminal, oil terminal, livestock terminal, container terminal, ferry terminal, cruise terminal, LPG terminal, etc.).

The locations for constructing harbors range from open coastlines requiring artificial impoundments to natural bays, estuaries, and navigable rivers that need a minimum manmade structure for the necessary storm protection. Harbors may be built wherever suitable water depth exists or can be provided and maintained with dredging operations. The degree of artificial works necessary to construct a viable harbor varies with the site’s natural features. Harbors can be classified as natural harbors, semi-natural harbors, and artificial harbors, [3,4,5,6,7].

Required harbor area depends on the size and number of ships to be accommodated in the harbor at a time, the length and width needed for movement of ships to and from berths, and type of carried cargo.
The water depth in the entrance, approach channel and harbor basin should be sufficient even at the low water spring tide, to make the harbor useful for operating and dispatching ships. The location and alignment of elements such as entrance, approach channel, turning basin, break water, wharves, jetties, and docks etc. is very important to ensure easy maneuverability and additional navigation facilities, [1,2,3,4].

1.2 STUDY OBJECTIVES

- Collecting wind data at the proposed sites and draw wind rose to determine prevailing wind direction.
- Determine range of tide in the proposed sites.
- Collecting bathymetry data at the proposed sites.
- Construct and draw wave refraction diagram to determine harbor site.
- Calculate the minimum number of berths required for the harbor.
- Planning of harbor to determine the location and alignment of elements such as entrance, approach channel, turning basin, breakwaters, wharves, jetties, and docks etc. to ensure easy maneuverability and additional navigation facilities.
- Design approach channel, turning basin, breakwaters, and different kinds of berths.

1.3 DESIGN CONSTRAINTS

The primary constrains faced during our research work are classified into these categories:

1.3.1 Economic

The Egyptian code of water resources and irrigation works, volume seven, and the British standard code of practice for Maritime structures are applied in this project.

a) Availability of cheap land & construction material.
b) Traffic potentiality of harbor.
c) Calculate the minimum number of berths required for the harbor.
d) Determine the layout, the depth, and the width of approach channel.
e) Good and quick repair facilities to avoid delay.
f) Sufficient quay space and facilities for transporting; loading and unloading cargo.
g) Storage sheds for cargo.
h) Design breakwaters, and different kinds of berths.

1.3.2 Environmental

Prime Minister's decision No. 338 of 1995 Issuing the executive regulations of the Environmental Law Promulgated by Law No. 4 of 1994 and its modification.

a) Water wave motion and the bathymetry affect the selection of harbor site.
b) Terminals for coal, cement, clinker, fertilizers, iron ore, salt, and soda ash should be opposite to the direction of prevailing wind in harbor.
c) Terminals of oil, LPG, LNG should be close to the entrance of harbor.
d) Wastewater treatment station of harbor should be opposite to the direction of prevailing wind in harbor.

1.3.3 Sustainability

The natural metrological phenomenon should be studied at site with respect to frequency of storms, rainfall, range of tides, maximum and minimum temperatures, direction and intensity of winds, humidity, direction, and velocity of currents etc. It is common to use two or three environments including the 100-yr wave with associated wind and current, and the 100-yr wind with associated wave and current.

1.3.4 Ethical

The Egyptian Code of Ethics for the Practice of the Engineering Profession.

1.3.5 Health and Safety

Safety and health in the new Egyptian labor law, No.211 to No. 244.

1.3.6 Social and Political

Egyptian government has focused on developing the Mediterranean Sea coastal region between Marsa Matrouh and Alexandria to attract building new communities. The developing program include new port at site of El-Dabaa to serve El Dabaa Nuclear Power Plant, fishing activities, commercial and tourism along north coast.

Chapter 2

Project Data

2.1 PHYSICAL DATA:

2.1.1 Wind Data:

Table (1) gives the wind speed and number of hours of blowing wind during the year 2020.

TABLE (1): WIND DATA (2020);

Wind speed (knots)	No. of hrs of occurrences of wind blowing from directions indicated											
	345 014	015 044	045 074	075 104	105 134	135 164	165 194	195 224	225 254	255 284	285 314	315 344
1-10	1048	577	339	210	293	195	125	228	134	209	600	1339
11-27	423	167	52	51	20	20	51	229	294	239	743	962
28-47	0	0	0	0	0	0	7	23	8	0	0	0

*No. of hours of calm wind =141 hrs
* No. of hours of unrecorded wind=16 hrs
* No. of hours of variable wind =17 hrs

2.1.2 BATHYMETRY:

The Sea bed contours at the suggested site of North Beach at El-Dabaa with 70 km long are presented in the attached contour map Fig. (1).

2.1.3 WAVES:

The Wave characteristics at **El-Dabaa** coastal area are presented as follows:

- The most probable significant wave height H= 1.0 m, T= 5.0 sec From N.
- The Significant wave height during seasonal storms H= 2.5 m, T= 6.0 sec From N.N.W.
- The Significant wave height (once/ 10 years) H= 6.0 m, T= 10.0 sec.

2.1.4 WATER LEVEL VARIATION:

The tidal amplitude is small along the Egyptian Coast of the Mediterranean.
The tidal measurement variation values at site were deduced out of long period of tidal measurements and the relation between different water levels and the zero-survey datum can be estimated as shown in table (2).

TABLE (2): SEA LEVEL VARIABILTY AT NORTHERN COAST

Datum / Condition	L. L. W. L. cm	M. W. L.(cm) (survey department)
M. W. L.	**51.00**	**0.00**
M. H. W. L.	**64.00**	**13.00**
M. L. W. L.	**38.00**	**-13.00**
H. H. W. L.	**117.00**	**66.00**
L. L. W. L.	**0.00**	**-51.00**

Note: All the project levels refer to chart datum (L. L. W. L.).

2.1.5 LITTORAL DRIFT AND CURRENT:

The general littoral drift and littoral current due to wind waves are from West to East parallel to the shore. The littoral drift may carry suspended material which may be deposited at the entrance, but these deposits are insignificant in deep water. The speed of current is from 0.1 to 2.0 km./hour .

2.1.6 soil investigation & boring tests

Soil investigations from the geological map of ***El-Dabaa***
are shows that it is a coastal plain with very deep firm strata of calourous sand with shells and organic matters.

The soil is mostly silty with the following characteristics:

Weight of Course sand in air = 1.55 t/m^3

Weight of Course sand in water = 0.90 t/m^3

Weight of filling material in air = 1.60 t/m^3

Angle of repose of filling material in air Ø = 28 °

Angle of repose of filling material in water Ø = 22 °

Angle of repose of ruble mound = 45 °

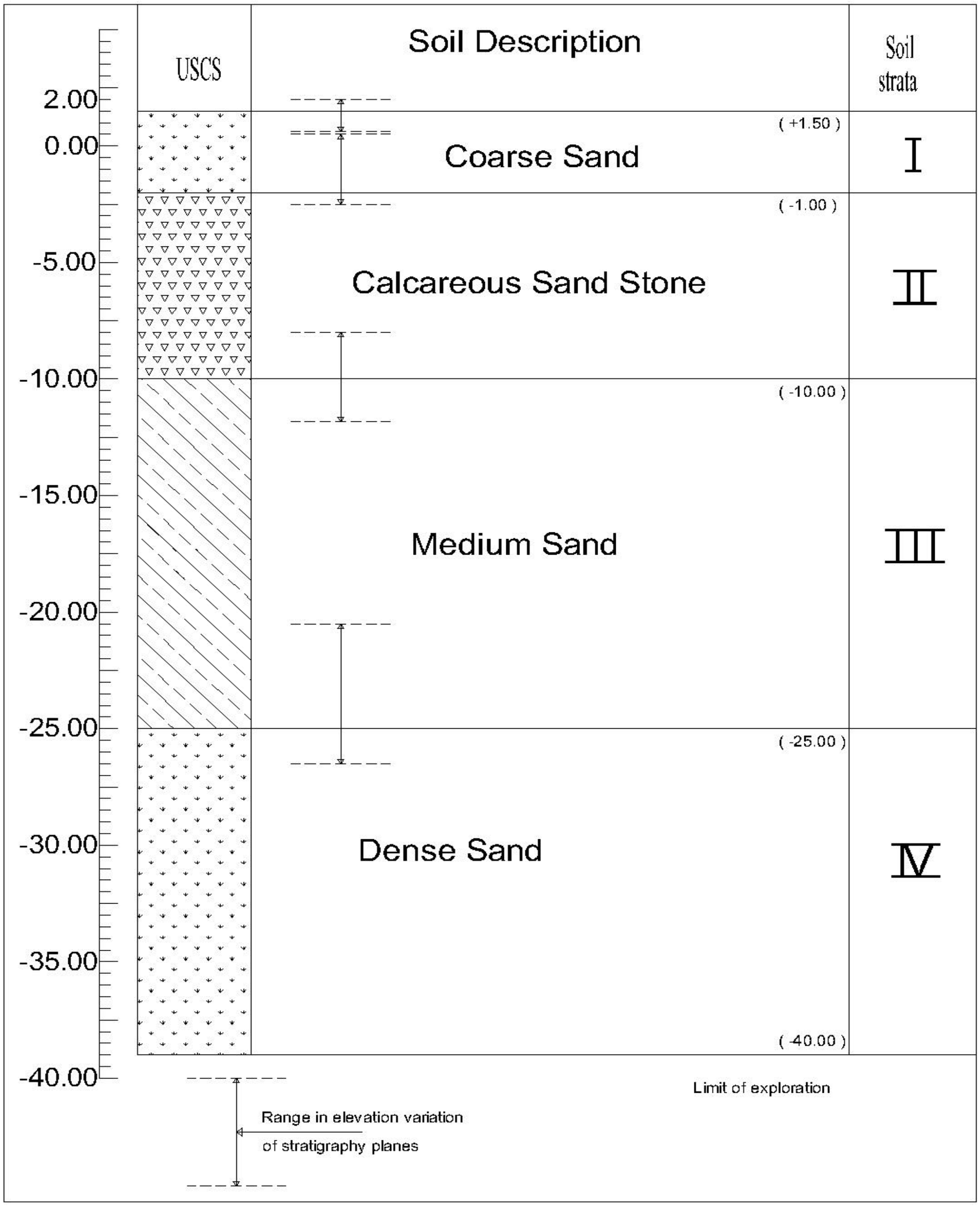
Angle of friction between the filling material & the concrete in water = 22.5 °

The intensity of cohesion "C" = 1.00 t/m^2 (below -8.00 m)

The attached Fig. (2) shows a typical bore hole near the estimated site.

Weight of limestone used on both of walls, rubble mound base & rubble mound breakwater = 2.2 t/m^3

Figure (2)
Generalized Soil Stra



2.2 ECONOMIC DATA:

The forecasted trade volume via the new habor is presented in table (3).

A the daily cost ratio of a ship waiting to occupy a berth to the daily cost of a vacant berth waiting to serve a ship is **[4 : 1]**.

B It is found that the volume of trade passing through this port will be as follow, till the year 2030.

TABLE (3):

Kind Of Cargo	Annual Amount tons millions	Dimensions Of Vessel	DWT	Rate of Handling tons/hr	No. of working Days/year
General cargo	**3.0**	$\frac{180*20}{9}$	**18000**	**600**	**300**
Special Cargo	**2.00**	$\frac{160 \times 20}{8}$	**16000**	**800**	**200**
Clinker &Cement	**2.00**	$\frac{160 \times 20}{8}$	**16000**	**1500 ts (conveyer)**	**200**
Container	**1.50**	$\frac{270 \times 32}{13}$	**40000**	**35 TEU**	**300**
Passengers	**2 berths**	$\frac{240 \times 30}{12}$	**65000**	**----------**	**300**

b) The fishing fleet consists of :-

10 units	40 x 7 x 3.7	m.
25 units	20 x 4 x 2.5	m.
100 units	10 x 2.5 x 1.5	m.

c) **-**The range of boats and yachts (in meters) may be used at the marina are as follow:

Class 1	L<5	D<1.0	B<2.8
Class 2	5<L<8	1.0<D<1.5	2.8<B<3
Class 3	8<L<15	1.5<D<2	3<B<3.8
Class 4	15<L<18	2<D<2.5	3.8<B<4.5
Class 5	18<L<25	2.5<D<3	4.5<B<5.5

d) Port will accommodate 20 service units (20 * 6 * 3.5 ms).

Also, two 300 –ton slipways are required.

2.3 REQUIREMENTS:

1. Determine the prevailing wind direction by using bar and contour method.

2. Suggest the suitable site of the port.

3. Give a detailed layout of the port, with navigation channels and turning basins.

4. Draw a detailed Master plan of the port.

5. Make a Detailed design of navigation channel and draw 3 different sections.

6. Make a Complete design and detailed working drawings of the suggested breakwaters (If needed).

7. Complete design and detailed working drawing of suitable type for Special Cargo berth.

8. Complete design and detailed working drawing of suitable type for Container berth.

9. Complete dimension of all berthing facilities.

10. It is required to design and draw a master plan for Fishing Harbor or Marina with a total capacity of 500 berths

11. Complete design and detailed working drawing of slipways.

Chapter 3
Wind Rose

3.1 Introduction

The wind data gathered over a year can be graphically plotted to give a quick picture of the relative wind velocity and prevailing direction during the year.

The rose is a circular plot (polar) where the 16 main compass directions are identified. The percentage time that the wind blows in a particular direction is plotted as a wedge. Each wedge is divided into color-coded segments. The width of the segments corresponds to the percentage time over the year that the wind has a velocity in the range defined by the color used for the wedge segment, [1,2,3,6].

3.2 Required calculation for drawing of wind rose

*Total No. hours of year = 365×24=8760 hrs

*No. hours of recorded wind = 8586 hrs

* No. hours of unrecorded wind = 16 hrs

*No. hours of calm wind = 141 hrs

*No. hours of variable wind = 17 hrs

*Error = (8760-8586) ×100/8760 = 1.99 ≈ 2.0 %

DABAA WIND DATA (2020)												
Surface Wind												
wind speed (knots)	Percentage Frequency of Wind Blowing from the Following Direction											
	345 14	15 44	45 74	75 104	105 134	135 164	165 194	195 224	225 254	255 284	285 314	315 344
1.0-10.0	12.21%	6.72%	3.95%	2.45%	3.41%	2.27%	1.46%	2.66%	1.56%	2.43%	6.99%	15.60%
11.0- 27.0	4.93%	1.95%	0.61%	0.59%	0.23%	0.23%	0.59%	2.67%	3.42%	2.78%	8.65%	11.20%
28.0- 47.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.27%	0.09%	0.00%	0.00%	0.00%
∑sum	17.13%	8.67%	4.55%	3.04%	3.65%	2.50%	2.13%	5.59%	5.08%	5.22%	15.64%	26.80%

Chapter 4

Wave Refraction

4.1 Introduction

Waves usually approach the shore at an angle. Different parts of the wave is at different depths, so the wave must bend, or refract as parts of the wave reaches shallower water and slows. The slowing and bending of waves in shallow water is called wave refraction; the waves refract in a line nearly parallel to the shore, [3,4,5,6,7].

4.2 Refraction diagram construction

1. Determine the wave parameter in deep zone.
2. Draw a contour line midway between each two contours beginning with contour line at depth Lo/2 and the next contour, figure (4.1).
3. Draw line AB in the direction of wave progress and intersect the midway contour line in point B.
4. From point B, draw line BC about 5 cm orthogonal to line AB.
5. From point C, draw line CD equal to BC× (C1/C2) which cut midway contour at point D.
6. Draw line BE orthogonal to line CD. This line represents the new wave direction which will intersect the next midway contour line. Then continue with the same procedure.

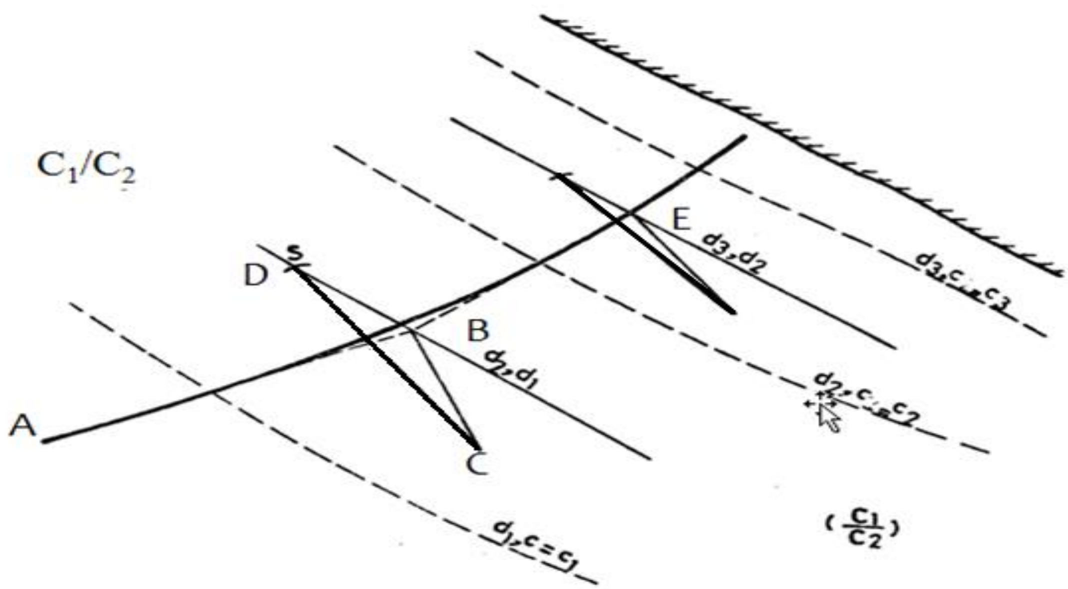


Figure (4.1): Construction of refraction diagram.

4.3 Computation for construction of refraction diagram

***For N.N.W direction :**

H_o = 2.50m **T = 6.00sec**

L_o= 1.56* T^2=1.56*6^2=56.16 m

d = L_o / 2 = 56.16/2 = 28.08 m

The beginning of transition zone = (-28.08)

d = L_o / 25 = 56.16/25 = 2.25m

The beginning of shallow zone = (-2.25)

d	d/Lo	Tanh(2πd/L)	R
28.08	0.50	0.9964	-
17.50	0.32	0.969	3.1
12.50	0.22	0.91	3.2
7.00	0.125	0.77	3.6
2.25	0.04	0.48	4.81

***For North wind (N) :**

H_o = 1.00m ***T = 5.00sec***

L_o= 1.56* T^2=1.56*5^2=39 m

d = L_o / 2 = 39/2 = 19.50m

The beginning of transition zone = (-19.50)

d = L_o / 25 = 39/25 = 1.56m

The beginning of shallow zone = (-1.56)

d	d/Lo	Tanh(2πd/L)	R
19.50	**0.50**	**0.9964**	
12.5	**0.32**	**0.97**	**3.1**
7.00	**0.18**	**0.86**	**3.4**
1.56	**0.04**	**0.48**	**5.4**

Chapter 5
Berths and break waters

5.1 Calculation of Berths Number

5.1.1 Berths number for container vessels

Approximate Method:

$$N = \frac{A_n}{R * D * H}$$

Where:

An = Annual Amount of Cargo t/year

R = The Handling rate t/hr

D = The number of Working Days day/year

H = The number of Working Hours hr/day

- Assume the total no. Of working hours during the day is 16 hrs
  Given: D=300day/year, R=30 TEU, $A=1.5*10^6$

The total no of berths= (1.5*1000000)/ (300*16*35*20)=0.74

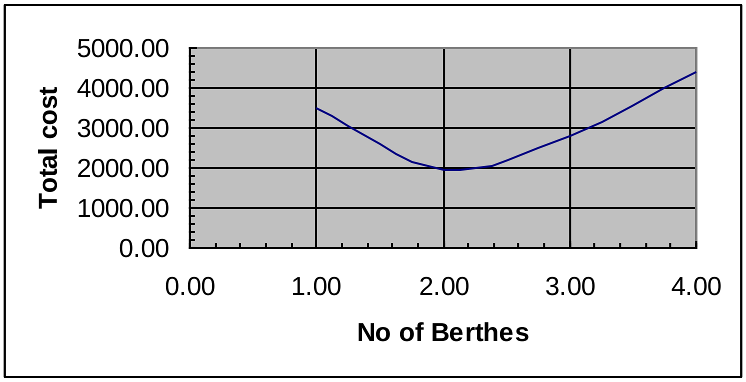
So, we need only **one berth** for container

Exact method

n = 2 × N + 2 = 2 × 1+2 = **4 trials**

$$P_n = N^n \times e^{-N} / n!$$

n	n!	p_n	1 berth		2 berths		3 berths		4 berths	
			v	w	v	w	v	w	v	w
1	1	0.37	0	0.00	0.37	0.00	0.74	0.00	1.10	0.00
2	2	0.18	0	0.18	0.00	0.00	0.18	0.00	0.37	0.00
3	6	0.06	0	0.12	0.00	0.06	0.00	0.00	0.06	0.00
4	24	0.02	0	0.05	0.00	0.03	0.00	0.02	0.00	0.00
		sum	0	0.35	0.37	0.09	0.92	0.02	1.53	0.00
		cost	138		73		98		153	



……… use (2) berths………

5.1.2 Berths number for special cargo vessels:

- **The Approximate Method: -**
- Assume the total no. Of working hours during the day is 16 hrs
  Given: D=200day/year, R=800, A=1*10^6

The total no of berths= (1*1000000)/(800*16*200) = 0.39

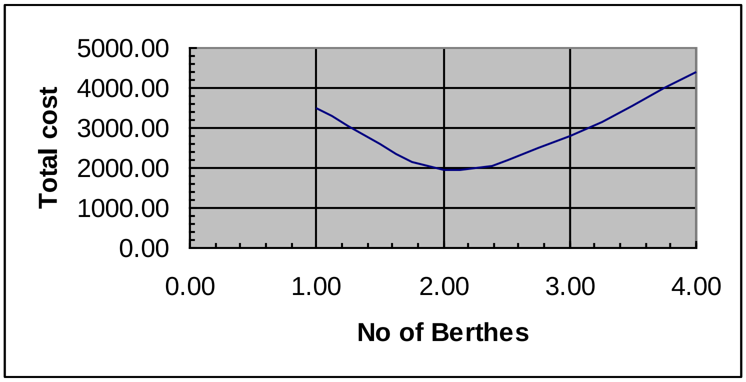
So, we need only **one berth**

Exact method

$\mathbf{n} = 2 \times N + 2 = 2 \times 1 + 2 =$ **4 trials**

$P_n = N^n \times e^{-N} / n!$

n	n!	p_n	1 berth		2 berths		3 berths		4 berths	
			v	w	v	w	v	w	v	w
1	1	0.37	0	0.00	0.37	0.00	0.74	0.00	1.10	0.00
2	2	0.18	0	0.18	0.00	0.00	0.18	0.00	0.37	0.00
3	6	0.06	0	0.12	0.00	0.06	0.00	0.00	0.06	0.00
4	24	0.02	0	0.05	0.00	0.03	0.00	0.02	0.00	0.00
		sum	0	0.35	0.37	0.09	0.92	0.02	1.53	0.00
		cost	140.6		73		98.4		154	



……… use (2) berths………

5.1.3 Berths number for Cement Cargo Vessels

- **The Approximate Method: -**
- Assume the total no. Of working hours during the day is 16 hrs
  Given: D=200day/year, R=1500, A=2*10^6

The total no of berths= (2*1000000)/(200*16*1500) = 0.416

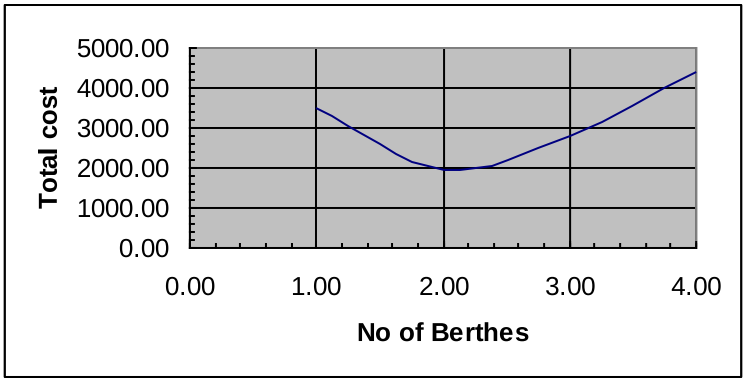
So, we need only **one berth**

Exact method

n = 2×N + 2 = 2×1+2 = **4 trials**

$P_n = N^n \times e^{-N} / n!$

n	n!	p_n	1 berth		2 berth		3 berth		4 berth	
			v	w	v	w	v	w	v	w
1	1	0.37	0	0.00	0.37	0.00	0.74	0.00	1.10	0.00
2	2	0.18	0	0.18	0.00	0.00	0.18	0.00	0.37	0.00
3	6	0.06	0	0.12	0.00	0.06	0.00	0.00	0.06	0.00
4	24	0.02	0	0.05	0.00	0.03	0.00	0.02	0.00	0.00
		sum	0	0.35	0.37	0.09	0.92	0.02	1.53	0.00
		cost	141		73.6		98		153	



……… use (2) berths………

5.1.4 Berths number for general cargo vessels:

- **The Approximate Method: -**
- Assume the total no. Of working hours during the day is 16 hrs
  Given: D=300day/year, R=600, $A=3*10^6$

The total no of berths=(3*1000000)/(300*16*600)=1.04

So we need only **two berth**

Exact method

n = 2 × N + 2 = 2 × 2+2 = **6 trials**

$P_n = N^n \times e^{-N} / n!$

n	n!	$(N)^n$	p_n	1berth		2berth		3berth		4berth		5berth		6berth	
				v	**W**	**v**	**w**	**v**	**w**	**v**	**w**	**v**	**w**	**v**	**w**
1	1	2	0.27068	0	0	0.27066	0	0.54132	0	0.81198	0	1.0826 4	0	1.3533	0
2	2	4	0.27068	0	0.2706	0	0	0.27068	0	0.54136	0	0.8120 4	0	1.08272	0
3	6	8	0.18045	0	0.3609	0	0.18045	0	0	0.18045	0	0.5414	0	0.54135	0
4	24	16	0.09022	0	0.27066	0	0.18044	0	0.09022	0	0	0.0902 2	0	0.18044	0
5	120	32	0.03609	0	0.14436	0	0.10800	0	0.07218	0	0.03609	0	0	0.03609	0
6	720	64	0.01203	0	0.06015	0	0.04812	0	0.03609	0	0.02406	0	0.0120 3	0	0
			$\sum$	**0**	**1.1047**	**0.27066**	**0.516**	**0.8122**	**0.19849**	**1.5335**	**0.06015**	**2.5263**	0.0120 3	3.1923	0
			cost	**441.88**		**233.47**		**160.42**		**177.35**		**257.43**		319.23	

5.2 Layout of Harbor

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Types of berths	Number of berths	Length of berth	Depth of water
Container	2	475	13
Special cargo	2	375	10
Clinker cement	2	375	9
General cargo	3	610	10
passanger	2	535	13

5.3 PORT Planning

5.3.1 Design of container yard

The area for one berth is 24 fed for a ship 210*27/12
Lmax=210+27*2 = 264 m
Bmax=24*4200/264= 381.8m take it 385 m

5.3.2Design of transit shed for the special cargo (For Miscellaneous):

D.W.T. = 16000 ton
At.s=(2.25*D.W.T.*Sf)/h
Assume its mechanical storage, h=4m
At.s=9000 m²
L = L_{ship} = 160 m
B = 56.25 m take it = 60 m

For liquids and cement we need silos

5.3.3 Design of transit shed for the general cargo :

D.W.T. = 18000 ton
At.s=(2.25*D.W.T.*Sf)/h

Assume its mechanical storage, h=4m
At.s=12656.25 m²
L = L_{ship} = 180 m
B = 70.31 m take it = 75 m

5.4 Navigation Channel

1-The channel depth ;

M.W.L =(0.00)

The maximum ship dimension is:(270*32/12)
D=d+tr/2+H/2+ SQ+P.L+SL.+ clearance

Lmax.=270m, Bmax=32 m
Max. draft=12.0 m
D=12.0+2.5/2+1+2+1.25+1=18.5 m take it = 19.00 m

2-The Side slope Of the Channel:

According to the soil type at depth (-12.00) m which assumed as, browen sand stone and clay, so the side slopes=5:1

3-The Width Of the Channel:

Wmax.=(4.8 to 8.1)bship max.
The maximum ship dimension is:(270*32/12)
(Two Way)
W=8.1*32=260m
W=250m

4-The turning basin :

The maximum ship dimension is:
D=d+tr/2 + SQ+P.L+SL.+ clearance

Lmax.=270m, Bmax=32 m
Max. draft=12.0 m

D=12.0+1+1.5+1.25+1=17.25 m **<u>take it = 18.00 m</u>**

D=(2-3)Lmax

= 2* LMax = 2*270=540 m

5-Gap width :-

B=wmax+50 m

=270+50=320 m more than Lmax

Take it = 320 m

5.5 Design of Main Break water

Head section (A-A)at contour depth=4.50 m :-

d=6.5m H_o =6.0m   T=7sec

b_o =3.0 cm   b=3.1cm

L_o =1.56T²=156m.

d/L_o =0.04

d/L = 0.08329, K_S = 1.064

$\therefore k_r = \sqrt{b/b_\circ}$

$\therefore$ H = H_0 x k_r x K_S =6 x 1.064x 0.8165=5.213 m

1.25H= 6.5165

… d>1.25H

∴ (non-breaking wave)

∴ Kd=1.9

Armor unit weight:

Assume use natural quary stone (smooth rounded)

n=2.0 & cotα=2.0 & K_D=1.9

$$W_A = \frac{\gamma_r H^3}{K_D (S_G - 1)^3 COT\theta} = \frac{2.2x5.213^3}{2.8(2.2/1.025-1)^3 x2} \approx 36.98 \text{ t}$$

W_A =36.98t >10 t

use dolos

$$W_A = \frac{\gamma_r H^3}{K_D (S_G - 1)^3 COT\theta} = \frac{2.4x\,5.213^3}{16.5(2.4/1.025-1)^3 x\,2} = 6.5 \text{ t}$$

Filter unit weight:

Use natural quary stone (smooth rounded)

$W_f = W_A$ / (4: 10) = 2.5 / (4:10) =2 : 5 t

Core unit weight:

Use natural quary stone (smooth rounded)

$W_C = W_A$ / (400: 1000) = 2.5 / (400:1000) =20: 50 kg

Thickness of Layers:-

1) for Armor layer

For Quarry stone (rough), n =2 , k_{Δ} =1.03

∴ $t_A = n\, k_{\Delta} \sqrt[3]{V}$ =2*1.03*³√ (6.5/2.2) =3m

2)for filter layer

For Quarry stone (rough), n =2 , k_{Δ} =1.03

∴ $t_f = n\, k_{\Delta} \sqrt[3]{V}$ **=2*1.03****³√ (.6.5/2.2) **=2m**

Layers levels:

Core width and level

Where construction from sea

∴ Core width=16 m,

Core level = L.L.w.L + (1.5 – 2) m = 0 + 2 = + (2 .00)

Filter level

Filter level = core level + t_f =2 + 2 = + (4.00)

Armor level

Armor level = filter level + t_A = 3.5 +3= + (6.10)

Crest level

Crest level = L.L.w.l + H /2 + T.R + Run up

∴ R = 1.25 H = 1.25 x 2.2

∴ Crest level = 0.0 +2.2/2 +.6+ (1.25*2.2)= +(7.30)

Trunk Section (B-B) at contour depth=3.0 m :-

d=2.0 m H_0 =6.0m T=10 sec

Lo=1.56*T^2 =156 m

d/L_0 = 2/156=0.0128

from table get:

K_S = 1.435

b_o =3.0m b=3

=0.358548 $\sqrt{b/b\circ}$ **∴ k_r=**

H=H_0 *K_S *K_r =3m

… d<1.25H

∴ (breaking wave)

∴ Kd=2.1

Armor unit weight

use natural quary stone (ROUGH angular)

n=2.0 & cotα=4.0& K_D=2.1

$$W_A = \frac{\gamma_r H^3}{K_D (S_G - 1)^3 COT\theta} = 5.2t$$

W_A =5.20t <10 t

Filter unit weight:

Use natural quarry stone (rough rounded)

W_f = W_A / (4: 10) =5.2/ (4:10) =1.26 : .506594 t

Core unit weight:

Use natural quary stone (rough rounded)

W_C = W_A / (400: 1000) = 5.2 / (400:1000) =(12.66: 5.06)*10^{-3}ton

Thickness of Layers:-

1)for Armor layer

For Quarry stone (rough), n =2 , k_Δ =1.02

$\therefore$ $t_A = n\, k_\Delta \sqrt[3]{V}$ =2*1.02*$\sqrt[3]{(5.2/2.2)}$ =2.7m

2)for filter layer

For Quarry stone (rough), n =2 , k_Δ =1.02

$\therefore$ $t_f = n\, k_\Delta \sqrt[3]{V}$ **=2*1.02***$\sqrt[3]{(.883/2.2)}$ **=1.5m**

Layers levels:-

Core width and level

Where construction from land

$\therefore$ Core width=8 m,

Core level = L.L.w.L + (1.5 – 2) m = 0 + 2 = + (2 .00)

Filter level

Filter level = core level + t_f =2 + 1.5 = + (3 .50)

Armor level

Armor level = filter level + t_A = 3.5 + 2.7 = + (6.20)

Crest level

Crest level = L.L.w.l + H /2 + T.R + Run up

$\therefore$ R = 1.25 H = 1.25 x 3

$\therefore$ Crest level = 0.0 +3/2 +.6+ (1.25*3)= +(5.85)

Head Section at contour depth=2 m :

d=4.0 m H_0 =6.0m T=10 sec

Lo=1.56*T^2 =156 m

d/L_0 = 4/156=0.025

from table get :

b_o =3.0m b=3.20

K_S = 1.125

∴ **k_r=** $\sqrt{b/b_\circ}$

H=H_0 *K_S *K_r =2.5m

… d>1.25H

∴ (non-breaking wave)

∴ Kd=1.9

Armor unit weight:

assume use natural quary stone (rough angular special)

n=2.0 & cotα = 4. 0 &K_D=1.9

$$W_A = \frac{\gamma_r H^3}{K_D (S_G - 1)^3 COT\theta} = 3t$$

W_A =3 t <10 t

filter unit weight:

Use natural quary stone (rough rounded)

$W_f = W_A$ / (4: 10) =3/ (4:10) =.75: .3 t

Core unit weight:

Use natural quary stone (rough rounded)

$W_C = W_A$ / (400: 1000) = 3 / (400:1000) = (7.5: .3)*10^{-3}ton

Thickness of Layers:-

1)for Armor layer

For Quarry stone (rough), n =2 , k_Δ =1.02

∴ $t_A = n\, k_\Delta \sqrt[3]{V}$ =2*1.02*$\sqrt[3]{(3/2.2)}$ =2.5m

2)for filter layer

For Quarry stone (rough), n =2 , k_Δ =1.02

∴ $t_f = n\, k_\Delta \sqrt[3]{V}$ **=2*1.02*$\sqrt[3]{(.525/2.2)}$ =1.5m**

Layers levels:-

Core width and level

Where construction from land

∴ Core width=16 m,

Core level = L.L.w.L + (1.5 – 2) m = 0 + 2 = + (2 .00)

Filter level

Filter level = core level + t_f =2 + 1.5 = + (3 .50)

Armor level

Armor level = filter level + t_A = 3.5 + 2.5= + (4.78)

Crest level

Crest level = L.L.w.l + H /2 + T.R + Run up

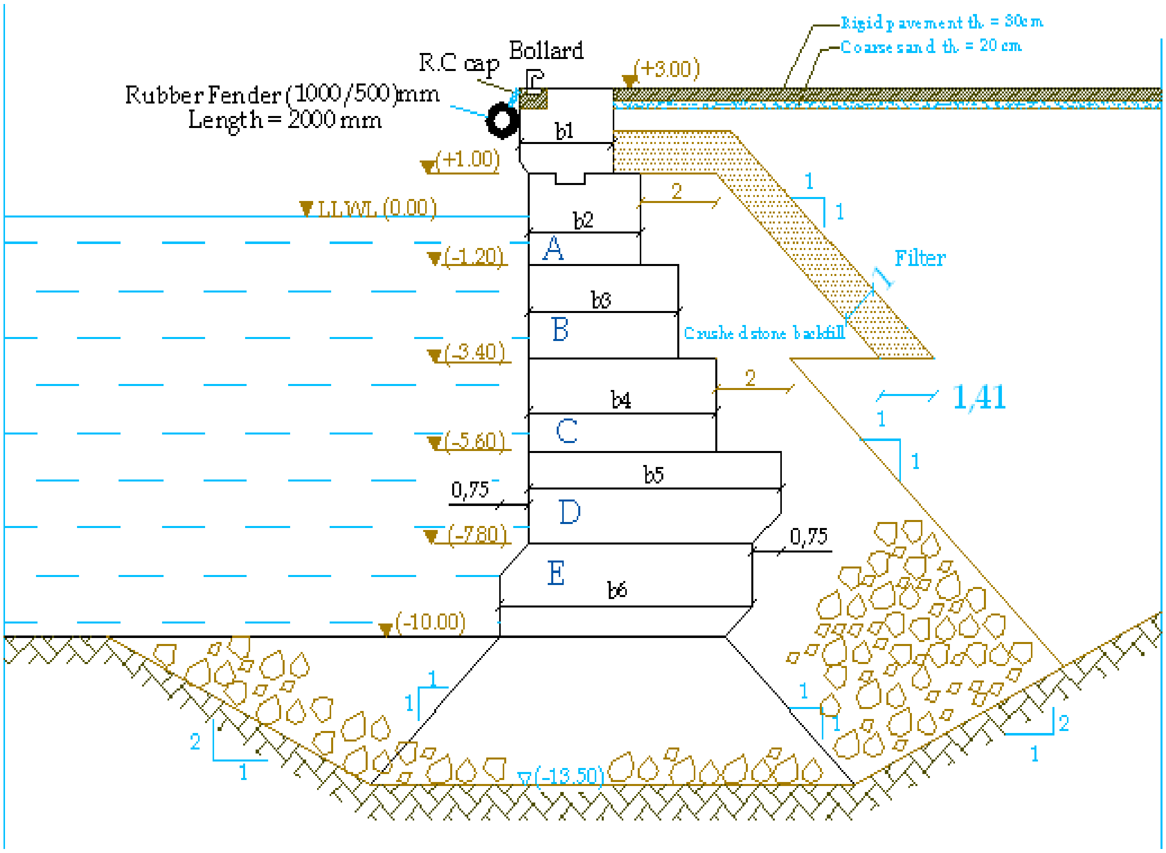
∴ R = 1.25 H = 1.25 x 2.5

∴ Crest level = 0.0 +2.5/2 +.6+ (1.25*2.5)= +(3.90)

Chapter 6

Design of Block Type Berths

6.1 Block type berth data for general cargo



* Surcharge Loads = **3 t/m**
* Tention On Bollard (Pw) = 180*9*9 .0065*90*90) = 85.3 ton
Let using 4 bolord
T = 85.3 /4 N= 21.5 ton .
T /m` =21.5 /20 = 1 T /m`
* Depth Of Water = 9+ 1.0 = **10.0 m**
* Tidal Range (T.R.) = **1.17 m**
* ▼ Crest =**3.00m** .∴

Total Depth Of Berth = 10.0 + 3 = **13.00 m** ∴

* for active earth pressure at Φ =40

.. K_a = (1 – Sin 40˚) / (1 + Sin 40˚) = **0.22**

e = γ * h * K_a .∴

e_1 = 1.8*2*2.2= **0.80** t/m²
e_2 = 1.8* 3*.22 = **1.2** t/m²
e_3 = 1.5+ 1.1*1.2*.22 =**1.5** t/m²
e_4 = 1.5+1.1*1.2*.22 =**2.01** t/m²
e_5 = 2.01 +1.1*1.2*.22 =**2.54** t/m²
e_6 = 2.54 + 1.1*1.2*.22 = **3.07**t/m²
e_7 = 3.07+1.1*1.2*.22= **3.6** t/m²
e_u = 3.00 *0.22 = **.66** t/m\

P_1 = ½ * .8* 2.00 = 0.8t/m\ ∴

P_2 = 0.8 *1 = 0.8 t/m\

P_3 = ½ * 1 * (1.2 -.8) = 02 t/m

P_4 = 2.2 *1.20 = 2.64 t/m\

P_5 = ½ * 2.2 *(1.5-1.2) = 0.33 t/m\

P_6 = 2.2 * 1.5 = 3.4t/m\

P_7 = ½ * 0.22 *(2.01-1.5) = 0.56t/m\

P_8 = 2.0 * 2.01 = 4.42 t/m\

P_9 = ½ * 2.2 * (2.54 -2.01) =0.58t/m\

P_{10} = 2.20 *2.54 = 5.6t/m\

P_{11} = ½ * 2.2 * (3.07-2.4) =.583 t/m\

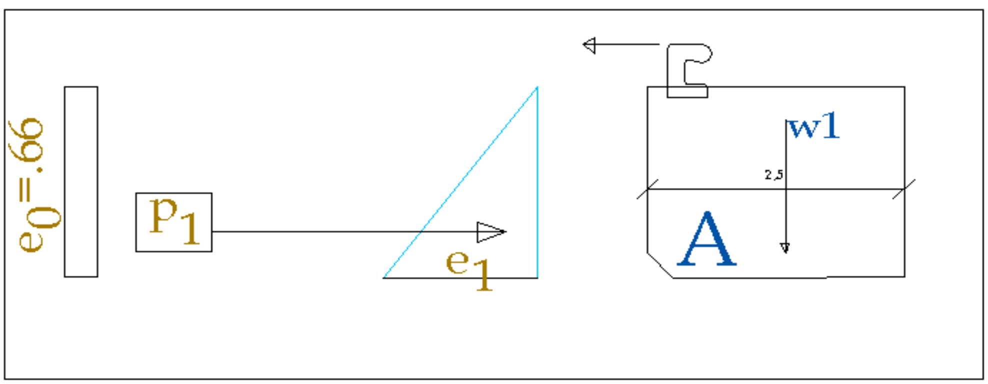
P_{12} = 2.2 * 3.07 =6.14 t/m\

P_{13} = ½ * 2.2 * (3.6 -3.07) =.583 t/m

P_u = 3 *.22 =.66 t/m\

6.1.1 Design of Block type berth for general cargo

Design Of 1st Block



*** Determination of block wdth :-**

M_o = .8 *(2/3) +.66*2*1 +1*(.4+2) = 6.65 t.m

M_S= (b1 *2.2*2) *(.5 b1 -.25) = 2.2 b1^2 -1.1b1

M_S / M_o =1.50. (so,,,,,,, b1 =2.50 m)

* **Check Of Sliding** :-

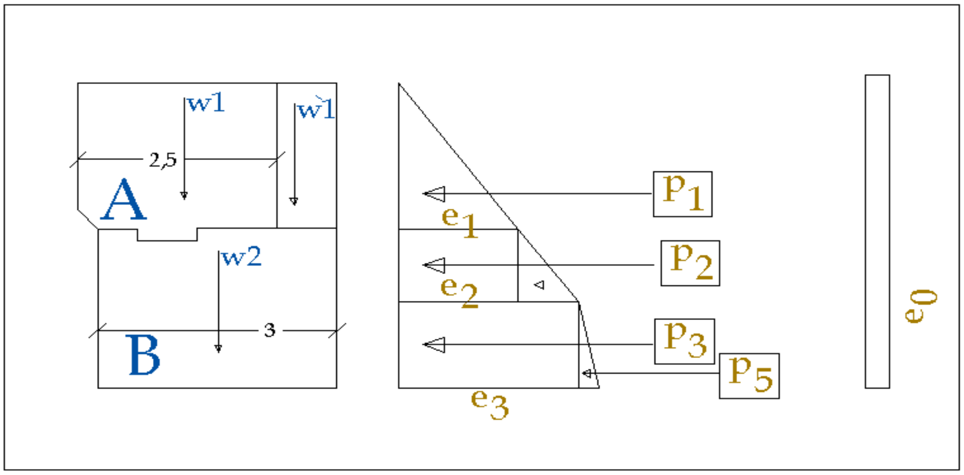
* Stability Force (w) 2.2*2.5 *2= 11t

* Sliding Force = P_1 + P_2 + P_3 + P_4 + P_5 + P_{u1} + P_{u2} + T = 4.3 t

∴ F.O.S. = Stability Force / Sliding Force =11/4.3 =1.76>1.5 (O.K. Safe)

To increase factor of safety against sliding use key

Design Of 2nd Block



* Sliding :-

* Stability Force (W2=2.5*2.2*2 +1*(b282.2) +1.2*b2*1.2 2*1.8 *(b2-2.25) =2.9+7.24b 2
* Sliding Force(H) = .5*1.2*3+.66*3 +1+.5*1.2(1.2+1.5)
  = 6.4ton

∴ F.O.S. = Stability Force / Sliding Force =.5*W2/6.4
.5*(2.9+7.2b2) /6.4 =1.5

∴(b2 =3 m)

* Check Of Overturning :-

* M_o =1.8*2.2+1.4*.6+.9*(1.2/3) +1*(.4+4.2) =.66*4.4(4.2/2) = 15.61 t.m.

* M_s = (6.6+4.322) *1.5 +11*1+.5*1.8*2 =29.18 t.m m.t.

∴ F.O.S. = M_s / M_s. = 29.18/15.61 = 1.87 > 1.50

∴ O.K. Safe.

* Check Of Stresses :-

X = [(Stability Moment – Overturning Moment) / ∑W]
= [(29.18 – 15.61) / 24.6]
= .55 m

e = b/2 - X
= 3/ 2 - .55 = .95 m

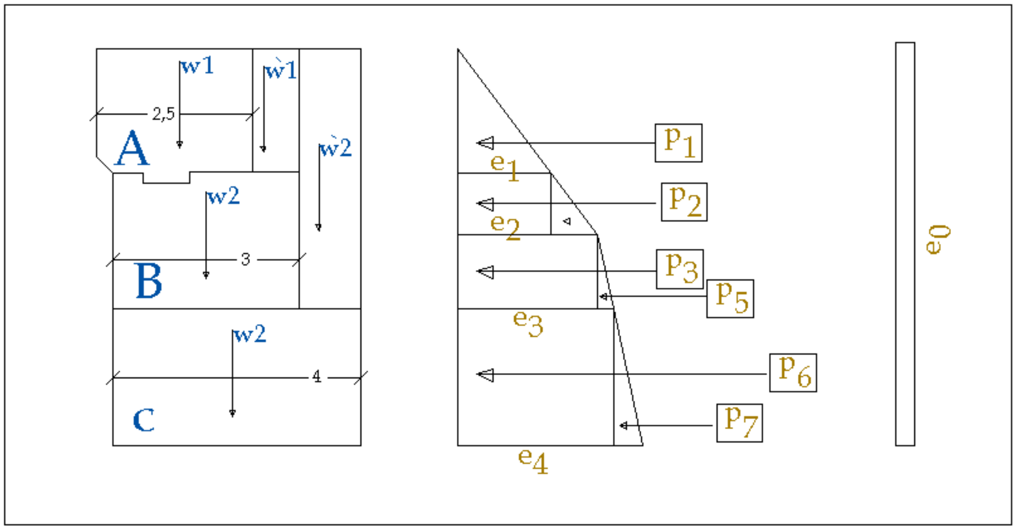
$f^1{}_2$ = - N/A [1 ± 6e / b]

f_1 = - 24.6/ (3.0*1.0) [1 + 6 * 0.95 / 3.0] = -23.8 (comp)t/m^2

f_2 = - 24.6/ (3.0*1.0) [1 - 6 * 0.95 / 3.0] =+ 7.3 t/m^2 (tens) <10 t/m^2

∴ O.K. Safe.

Design Of 3rd Block :



* Sliding :-

* Stability Force (W3) =11+6.6+4.32++1.8+(b-(3))*(1.2*1.1+3*1.8)+b3*1.2*2.2=(3.56+9.36b2).
* Sliding Force(H) = 1.8+1+5.44+4.224 =12.46 t
  = 12.64ton

∴ F.O.S. = Stability Force / Sliding Force =.5*W2/12.64

∴(b3=4 m)

* Check Of Overturning

* M_o =1.8*4.4 +1*6.8 +4.22*.5*6.4 +4.08*.5*3.4 +1.36*3.4 /3 =36.7 t.m
* M_s = 11*1+(6.6+4.32)*1.5 +4*2.2*1.2*2 +6.6*3.5 +1.8*2.5 =76.1 t.m

∴ F.O.S. = M_s / M_s. = 76.1/36.7 = 2.07> 1.50

∴ O.k .safe

* Check Of stresses :-

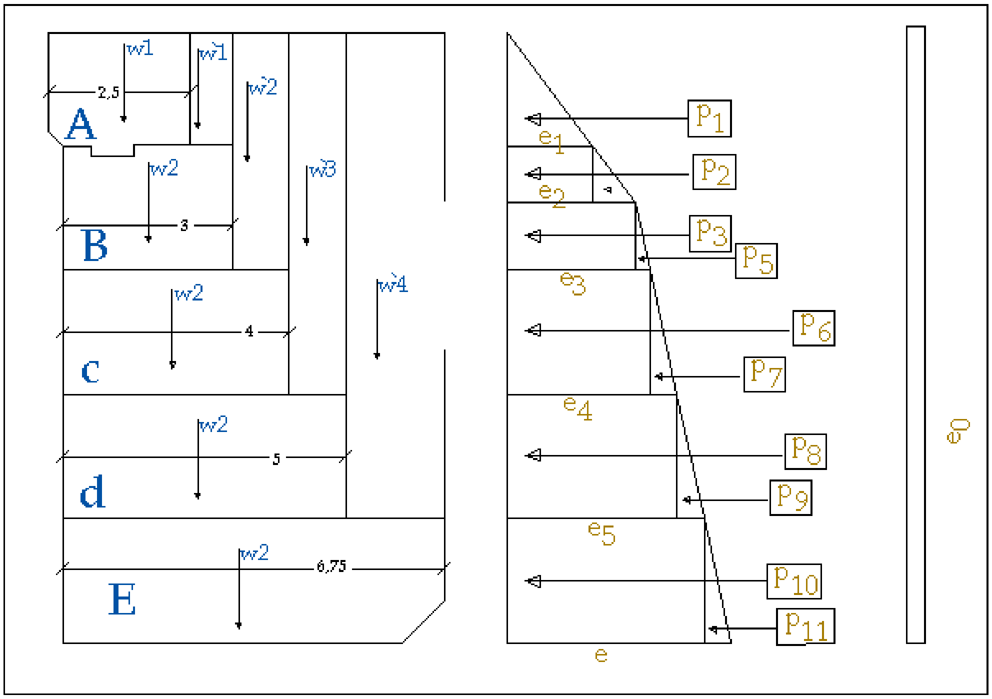
W =41 t

E =2-.96 =1.04 m

f_1 = -23.8 (comp)t/m^2 f_2 =+ 5.7t/m^2 (tens) <10 t

∴ O.K. Safe

Design Of 4th Block :



*

Sliding :-

* Stability Force (W3) = 11+6.6+4.32+10.56+1.8+6.6+b4*2.2*1.2+(b4-4)*(3.4*1.1+1.8*3) =4.32+11.789b4

* Sliding Force(H) = 1.8+1+10.47+.66*8.6

= 18.95ton

∴ F.O.S. = Stability Force / Sliding Force =.5*W2/18.95

∴(b4=4.5m)

* Check Of Overturning :-

* M_o = 1.8*6.6+1*8.6+5.67*4.3

= 44.86 m.t.

* M_s = 76.1+6.6*3.5+4.57*4.25

= 122.25 m.t.

∴ F.O.S. =. M_s / M_o. = 122.25/ 44.86 = 2.73 > 1.50

∴ O.K. Safe.

* <u>Check Of stresses</u> :-

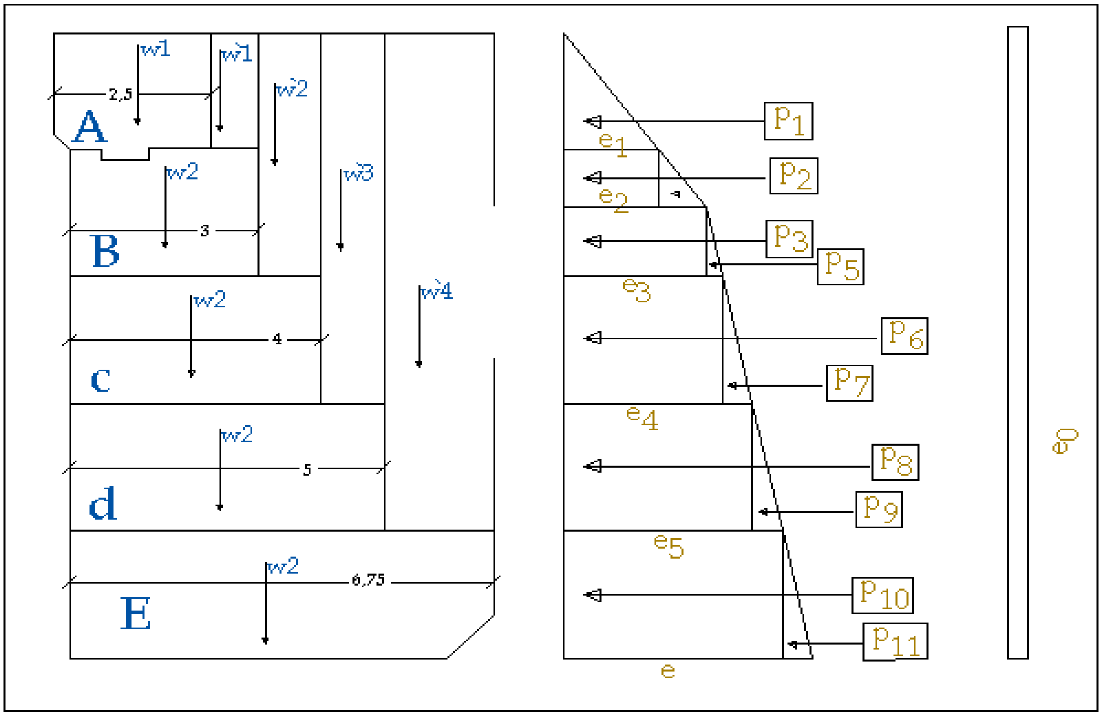
W =41 t

e=2-.96 =1.04 m

f_1 = -28.1(comp)t/m^2 **f_2 =+ 2.54t/m^2 < 10 t/m^2**

O.K. Safe

Design Of 5th Block :



* <u>Sliding</u> :-

*** Stability Force (W3) = 5.31+ 14.2b5**

*** Sliding Force(H) = 1.8+.66*10.8+16.38**

= 26.31ton

∴ F.O.S. = Stability Force / Sliding Force =.5*W2/26.31 **∴(b5=5m)**

*

<u>Check Of Overturning</u> :-

*** M_o = 120.28m.t.**

*** M_s= 219.98m.t.**

∴ F.O.S. =. M_s / M_o. =219.98/120.28 = 1.82 > 1.50

∴ O.K. Safe.

* Check Of stresses :-

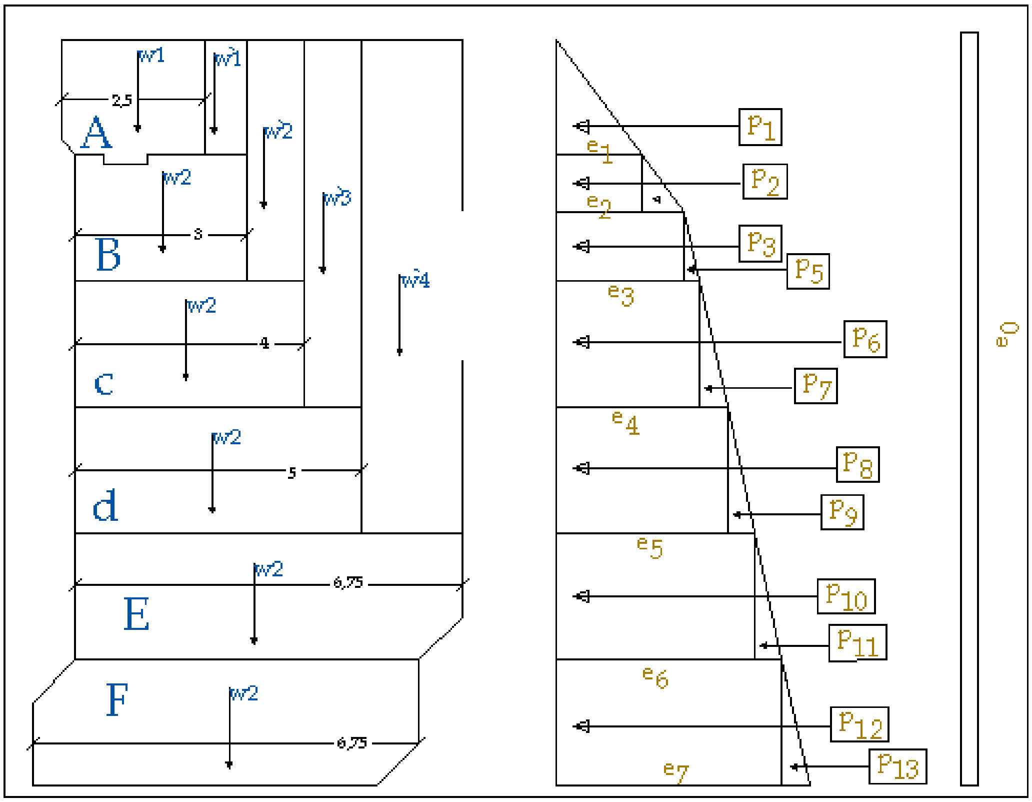
W =41 t

e =2-.96 =1.04

F1 =-28.1(comp)t/m² F2 =+ 2.54t/m²

O.K

Design Of 6th Block :



* Sliding :-

* Stability Force (W3) = 17.01+16.62b6
* Sliding Force(H) = 1.8+1+10.47+.66*8.6
= 18.95ton

∴ F.O.S. = Stability Force / Sliding Force =.5*W2/18.95

∴(b6=7.5m)

* Check Of Overturning :-

* M_o = 188.97 m.t.
* M_s = 538.53 m.t.

∴ F.O.S. =. M_s / M_o. = 538.53 / 188.97= 2.84 > 1.50 ∴ O.K. Safe.

* Check Of stresses :-

W =131.17 t

e =1.08 m

f_1 = -32.6(comp)t/m^2 f_2 =- 2.37 t/m^2

$\therefore$ f > q

$\therefore$ unSafe.

Where :

q = Safe bearing Capacity Of Soil

so we need to change dimension of blocks (5) & (6)as shown :

M= N*e= 124.6m.t e` =0 .75m

M_x` =124.6-131.17=26.23t.m

e1= 26.23/131.17 =.2

f_1 = -26(comp)t/m^2 f_2 =- 17 t/m^2

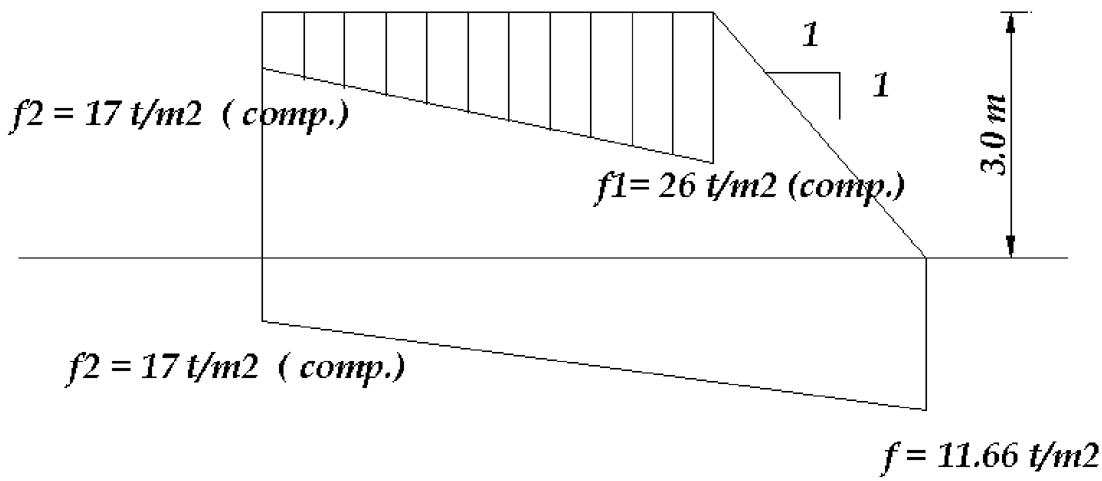
check shear at section (V-V):

w=12.9t

q=1.5*(12.9/2.2) =8.8t/m^2

Check stresses on soil:

bearing capacity = 15 t/m2



(16+17)*6/2=(f+17)*9/2 **f=11.66 t/m^2**

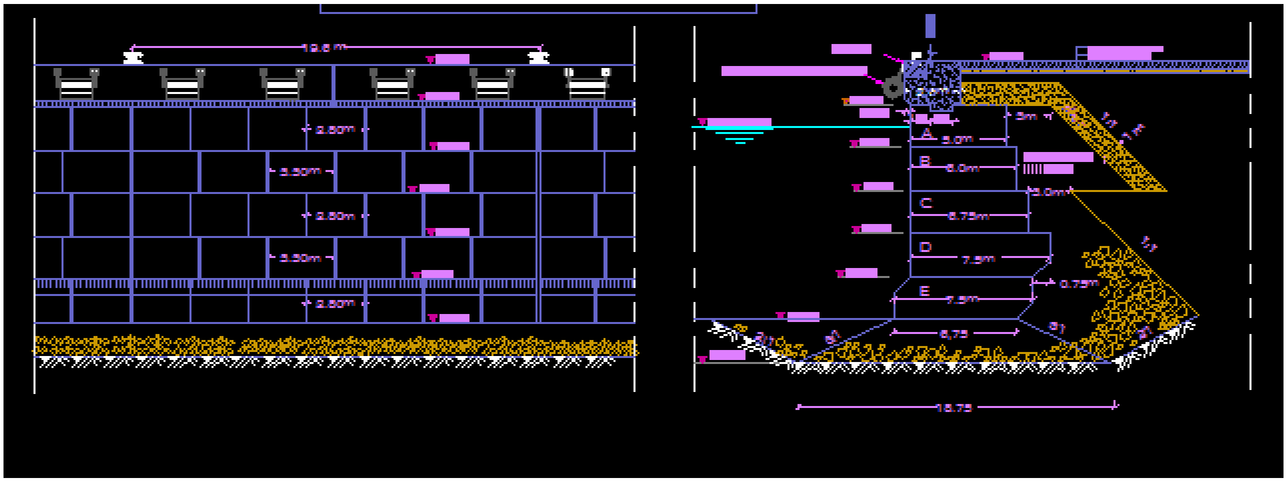
F_{max}=11.66+3*1.1=14.9 <15 safe

If using d =3.50m

* <u>determination of blocks length</u>:-

*** Width of largest block =6.75 m**
Height =2.2 m
Wench capacity =150t
150 =6.75 * 2.2*2.20*L
L_{max}=6.20 m
Total length of the quay =620 m
The quay consists of 31 cells (20m width each)
Details of Block type wall shown in the drawings.

6.2 Design of Block Type for Special Cargo



depth of quay= 12.5+t .r/2+.75+1.50=15.4 m

- **<u>Check stability for head of berth:</u>**

tension force in bollard =14.2 t

force / m = 14.2/7= 2 t/m

e1=4*.27=1.08 t/m^2

e2=4*.27+1.95*2.2*.27=2.24 t/m^2

f1=2.2*1.08=2.4 t/m

f2=.5*1.16*2.2=16.94t/m

w=3.5*2.2*1.0*2.2=16.94t/m

<u>CHECK OF SLIDING :</u>

ΣX=2.4+1.28+2=5.68 t

f_{all} in tension =7 kg/cm^2

f_{all} = $\Sigma X/$ A   7=5.68*1000/(100*x)

x =8.1 cm

take x=3.35/3 =1.0 m

<u>CHECK OF OVER TURNING:</u>

M_o=2*2.7+2.4*1.1+1.28*2.2/3=9 m. t

M_s=16.94*1.5=25.41 m. t

F . S= M_s/ M_o=25.41/9 =2.82 >2.0   O.K

<u>CHECK OF STRESS:</u>

F1,2 =N/A+,- MY/I

F1,2 =-16.94/(3.5*1.0) +,- 9*1.75*12/(1*3.5^3) =

F1 =-1kg/cm^2 ,   f 2=-0.11kg /cm^2 O.K

- **Check stability for BLOCK (A):**

tension force in bollard =14.2 t

force / m = 14.2/7= 2 t/m , Φ =45 , k_a =.172

e3=(4+2.2*1.95) *.172=1.43 t/m^2

e4 =(4+2.2*1.95+2.2*.85)*.172 =1.8 t/m^2

f1=2.4 t/m
f2=1.28 t/m
f3=3.15 t/m
f4=.41 t/m
f5=.28 t/m
f6=1.1 t/m

w1=2.2*3.5*1.0*2.2=16.94 t/m
w2=2.2*4.5*1.0*2.2=21.8 t/m
wa= (1.5*2.2*1.95+2.2*.85) *.172=1.8 t/m

CHECK OF SLIDING:

ΣX=2.4+1.28+3.15+.41+.28+1.1+2=10.6 t/m
Σw=16.94+21.8+6.44=45.16 t/m
F.S =0.5*45.16/10.62 =2.12>1.5

CHECK OF OVERTURNING

M_o=2*4.9+2.4*3.3+1.28*2.93+3.15*1.1+.41*2.2/3+.28*1.7+1.1*.483=26.24m. t
M_s=16.94*1.25+21.8*2.25+6.44*3.75=94.4 m. t
F. S= M_s/ M_o=94.4/26.24=3.6 >2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I
F1,2 =-45.18/(4.5*1.0)+,- 33.52*12*2.25/(4.5^3) =
F1 = -1.9kg/cm^2 , f 2=-0.11kg /cm^2 O.K

- **Check stability for BLOCK (B):**

f1=2.4 t/m
f2=1.28 t/m
f3=6.3 t/m
f4=1.56 t/m
f5=.28 t/m
f6=2.74 t/m

w1=16.94 t/m
w2=21.8 t/m

w3=24.2 t/m
wa=6.44 t/m
wb=3.8 t/m

CHECK OF SLIDING:

ΣX=16.56 t/m
Σw=74.2 t/m
F.S =0.5*74.2/16.56=2.24>1.5

CHECK OF OVERTURNING:

M_o=2.4*5.5+1.28*5.13+6.3*2.2+1.56*4.4/3+.28*4.15+2.74*1.83+2*7.1=60.9m. t
M_s=16.94*1.25+21.8*2.25+24.2*2.5+6.44*3.75+13.8*4.75=172.9 m. t
F . S= M_s/ M_o 172.9/60.9=2.83 >2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I
F1,2 =-70.3/(5*1.0)+,- 71*2.5*12/(5^3) =
F1 = - 3.1kg/cm^2 , f 2=+0.28kg /cm^2 O.K

- **Check stability for BLOCK (c):**

f1=2.4 t/m
f2=1.28 t/m
f3=9.44 t/m
f4=3.2 t/m
f5=.28 t/m
f6=4.59 t/m

w1=16.94 t/m
w2=21.8 t/m (25)
w3=24.2 t/m
w4=26.62 t/m
wa=6.44 t/m , wb=3.8t/m , wc=4t/m

CHECK OF SLIDING:

ΣX=21.19 t/m
Σw=100.68 t/m
F.S =0.5*100.68/21.19=2.37>1.5

CHECK OF OVERTURNING:

M_o=2.4*7.7+1.28*7.33+9.44*3.3+3.2*6.6/3+.28*6.1+4.59*2.93+2*9.3=99.81m. t
M_s=16.94*1.25+21.8*2.25+24.2*2.5+26.62*2.75+6.44*3.75+3.8*4.75+4*5.25= 251.72m. t
F . S= M_s/ M_o=251.72/99.81=2.52 >2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I
F1,2 =-100.63/95.5*1.0)-,+ 125*2.75*12/(5.5^3) =
F1 = - 4.3 kg/cm^2 , f 2=+0.65kg /cm^2 O.K

- **Check stability for BLOCK (D):**

f1=2.4 t/m
f2=1.28 t/m
f3=12.6 t/m
f4=5.64 t/m

f5=.28 t/m
f6=6.03 t/m

w1=16.94 t/m
w2=21.8 t/m
w3=24.2 t/m
w4=26.62t/m
w5=29.0 t/m
wa= 6.44 t/m , wb=3.8t/m , wc=4t/m , wd=4.95 t/m

CHECK OF SLIDING:

ΣX=24.2 t/m
Σw=133.4 t/m
F.S =0.5*133.4/24.2=2.75>1.5 O.K

CHECK OF OVERTURNING:

M_o=2.4*9.9+1.28*9.53+12.6*4.4+5.64*8.8/3+.28*8.3+6.03*4.025+2*11.5= 157.5m. t
M_s=16.94*1.25+21.8*2.25+24.2*2.5+26.6*2.75+29*3+6.44*3.75+3.8*4.75+4*5.25+4.95*5.75=360m. t
F . S= M_s/ M_o=360/157.5=2.28 >2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I

F1,2 =-133.4/(6*1.0)-,+ 198*3*12/(6^3) =

F1 = - 5.52 kg/cm^2 , f 2=+1.08kg $/cm^2$ O.K

Check stability for BLOCK (E):

f1=2.4 t/m
f2=1.28 t/m
f3=15.73 t/m
f4=8.8 t/m
f5=.28 t/m
f6=7.7 t/m

w1=16.94 t/m
w2=21.8 t/m
w3=24.2 t/m
w4=26.62t/m
w5=29.0 t/m
w6=33.9 t/m
wa= 6.44t/m , wb=3.8t/m , wc=4t/m , wd=4.95 t/m , we=11.7 t/m

CHECK OF SLIDING:

ΣX=38.2 t/m
Σw=152.44 t/m
F.S =0.5*152.44/38.2=2>1.5 O.K

CHECK OF OVERTURNING:

M_o=2.4*12.1+1.28*11.73+15.73*5.5+8.8*11/3+.28*10.5+7.7*5.125+2*13.7= 232.63m. t

M_s=16.94*1.25+21.8*2.25+24.2*2.5+26.6*2.75+29*3+33.9*2.95+6.44*3.75+ 3.8*4.75+4*5.25+4.95*6.5=486.25m. t

F . S= M_s/ M_o=486.25/232.63=2.1 >2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I

F1,2 =-152/(5.9*1.0)-,+ 294.4*3.5*12/(5.9^3) =

F1 = - 4.3 kg/cm^2 , f 2=-.86 kg $/cm^2$ O.K

Check stability for BLOCK (F):

f1=2.4 t/m
f2=1.28 t/m
f3=18.9 t/m
f4=12.7 t/m
f5=.28 t/m
f6=9.34 t/m

w1=16.94 t/m
w2=21.8 t/m
w3=24.2 t/m
w4=26.62 t/m
w5=29.0 t/m
w6=33.9 t/m
w7=32.2 t/m
wa= 6.44 t/m , wb=3.8t/m , wc=4t/m , wd=4.95 t/m , we=11.7 t/m

CHECK OF SLIDING:

ΣX=44.9 t/m
Σw=215.6 t/m
F.S =0.5*215.6/44.9=2.4 >1.5 O.K

CHECK OF OVERTURNING:

M_o=2.4*14.3+1.28*13.93+18.9*6.6+12.7*4.4+.28*12.7+9.34*12.83+2*15.9= 388m. t
M_s=16.94*2.0+21.8*3+24.2*3.25+26.6*3.5+29*3.75+33.9*3.7+32.2*2.8+6.44*3. 5+3.8*5.5+4*6+4.95*6.5+11.77*7.25=780m. t
F . S= M_s/ M_o=780/388= 2 O.K

CHECK OF STRESS:

F1,2 =N/A+,- MY/I
F1,2 =-215.6/(5.55*1.0)+,- 231.2*2.8*12/(5.55^3) =
F1 = - 5.5 kg/cm^2 , f 2=+2.26 kg /cm^2 **> all. On crashed stone**

Changing dimension of block (E,F)

Block E b=7.7 m
Block F b=6.6 m
W6 =36t/m , w7= 29 t , we= 20 t/m
Σw=222.73 t/m , ΣM=198 m.t

CHECK OF STRESS:

F1,2 =N/A+,- MY/I
F1,2 =-222.73/(6.35*1.0)+,- 198*3.2*12/(6.35^3) =
F1 = - 6.45 kg/cm^2 , f 2=-0.6 kg /cm^2 use under this block another block b=10.35 m , then put crashed stone at depth =2.0 m

***STRESS on CRASHED STONE LAYER :**

N=268 t ,M= 273 m.t
F1=-4 kg/cm^2 F2=-1.1kg/cm^2 O.K

***STRESS on SOIL :**

N=270 t ,M= 348 m.t
F1=-2.9 kg/cm^2 F2=-0.86 kg/cm^2 O.K (ALL B.C OF SOIL=3 kg/cm^2)

Chapter 7

DESIGN OF COUNTER FORT RETAINING WALL FOR FISHING & SERVICES BERTHS

7.1 Design of Counter Fort Retaining Wall for Services Berths

DATA:

Size of units = 40*7*3.7

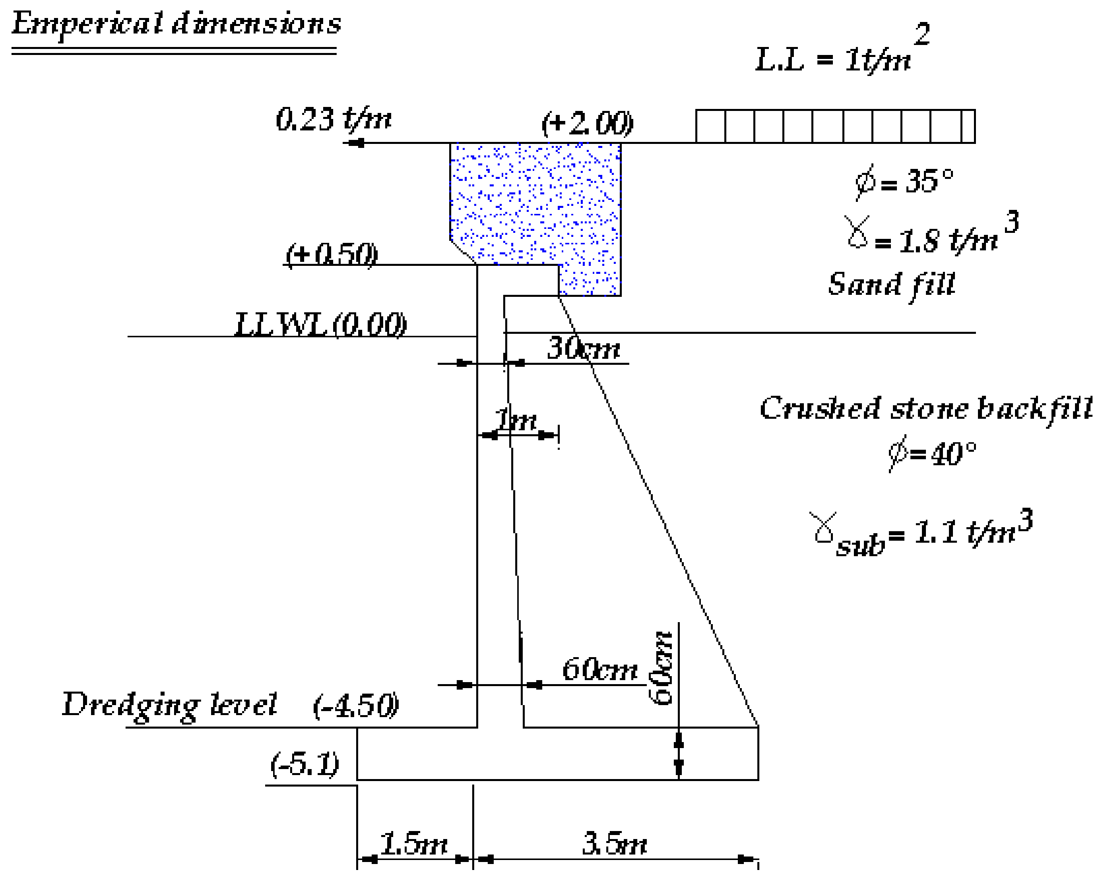
Pw = 1.5*A*.0065*v^2 A=3.7*40=148m^2

V=90km/hr

Pw= 10.7t   Pw=10.7/40=0.267t/m

H=0.267*cos30=0.23t/m

Uniform live load =1.0t/m



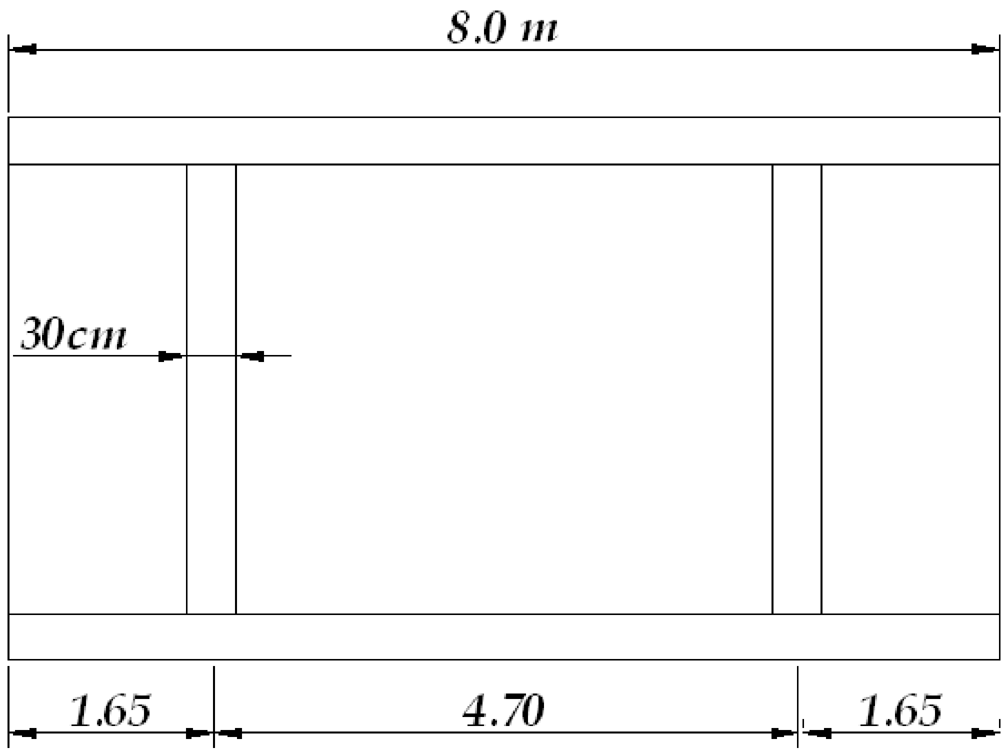
Determination of precast part dimension:

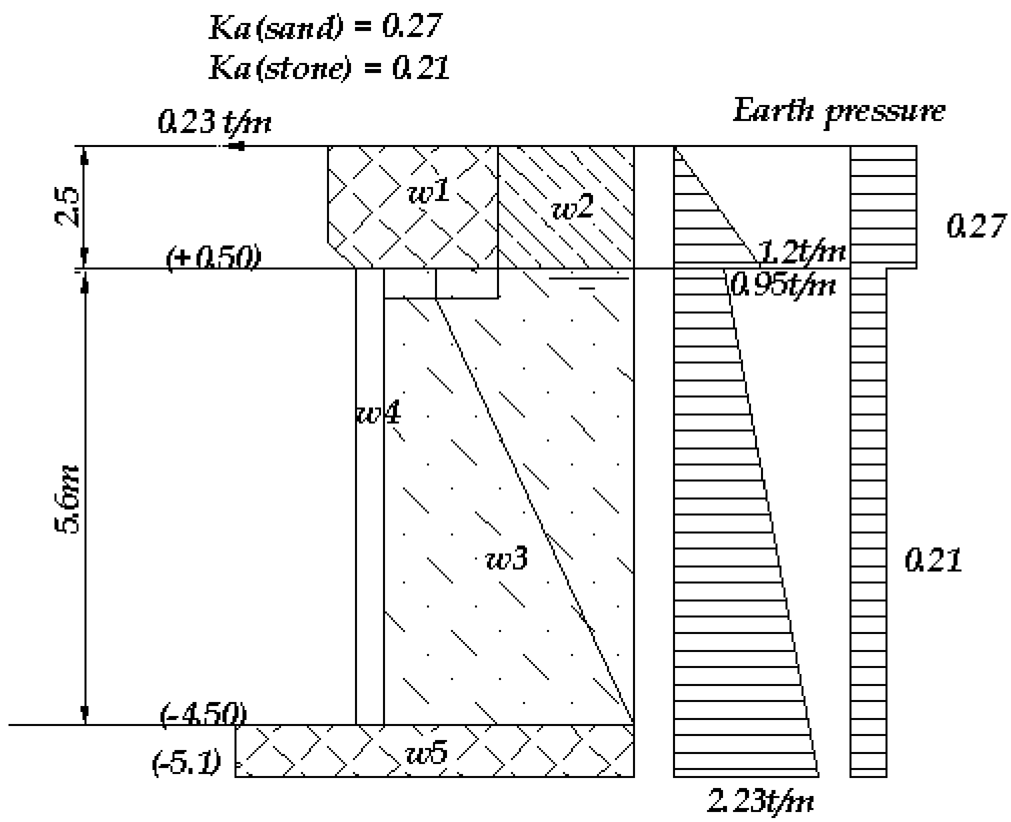
Wench capacity =100t

W/m= 2.5*(0.6*5+0.45*5+0.7*.3)+(n/L)*0.5*(.7+2.9)*0.3*2.5=10.84+1.35

W=10.84L+1.35*n   assume n=2

L=8.00m


8.0 m
30cm
1.65
4.70
1.65


Ka(sand) = 0.27
Ka(stone) = 0.21
0.23 t/m
Earth pressure
2.5
w1
w2
0.27
1.2t/m
(+0.50)
0.95t/m
w4
5.6m
w3
0.21
(-4.50)
(-5.1)
w5
2.23t/m

Width of cap :

Ms=(2.2*2.5*b)(0.5b-0.25)

Mo=0.23*2.5+(0.5*1.2*2.5*2.5/3)

$2.75b^2$-1.375b-4=0.0

b =1.5m

Check stability of the wall:

Force	ARM
W1=2.5*2.5*1.5=8.25T	2.25
W2=1.8*2*2.5=9T	3
W3=1.1*5.0*2.9=3.85T	3.85
W4=1.5*5.0*0.45=3.40T	1.7
W5=1.5*5.0*0.6=4.5T	2.5
∑W=41.10T	

Force	ARM
E1=0.5*1.2*2.5=1.5T	6.43
E2=0.27*2.5=0.675T	6.85
E3=0.21*5.6=1.18T	2.8
E4=0.95*5.6=5.32T	2.8
E5=1.28*0.5*5.6=3.58T	1.86
E6=0.23T	8.1
∑E=12.5T	

Check sliding :

F.S = 0.4*41.1/12.5 = 1.3>1.25(safe)

Check overturning :

F.S= MS/MO=124/41.27= 3.0>1.5 (safe)

Check stresses :

Mnet = 124-41.27=82.73m.t '

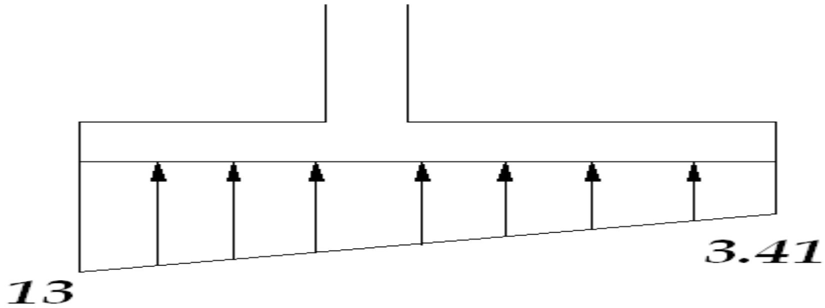
X=(82.73/41.1)=2.01m

E=2.2-2.01=0.487m<(b/6) safe

F=-41.1/5.0(1±(6*0.487/5))

F1=-13.0 t/m^2

F2=-3.41 t/m^2



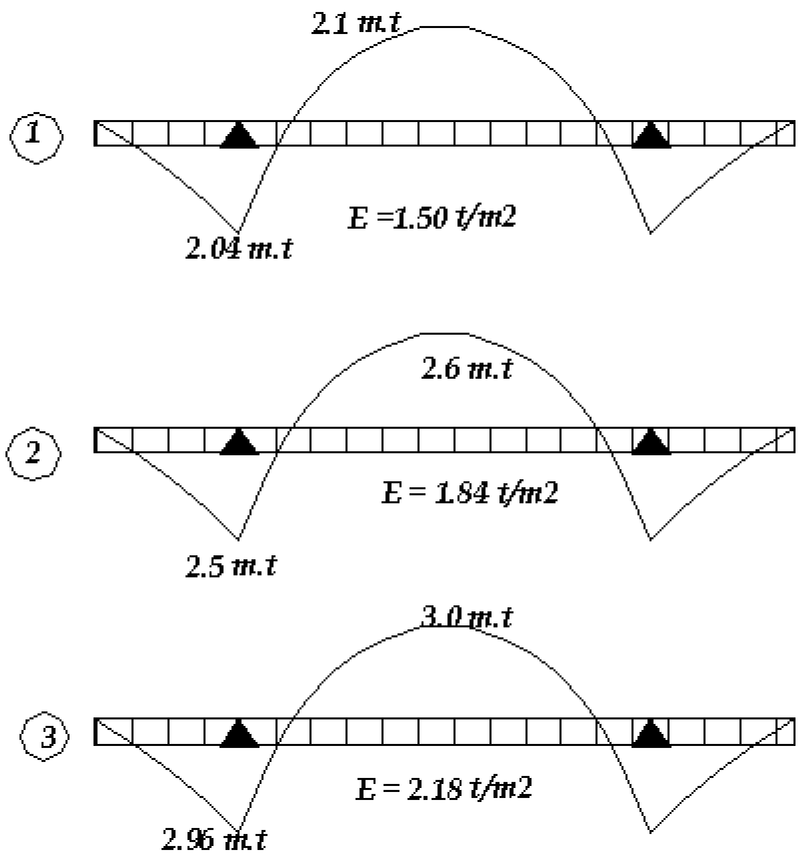
<u>**Design of structure members of wall**</u>

Stem section

$E@1.5m = 0.95+0.21+0.34 = 1.5 t/m^2$

$E@3.0m = 1.84\ t/m^2$

$E@6.0m = 2.18\ t/m^2$



<u>**Design of section**</u>:

Check crack :

for M=3.0m.t $t = 6M/bt^2 = 6*3*10^7/1000*600^2 = 0.5 < 1.93 N/mm^2$

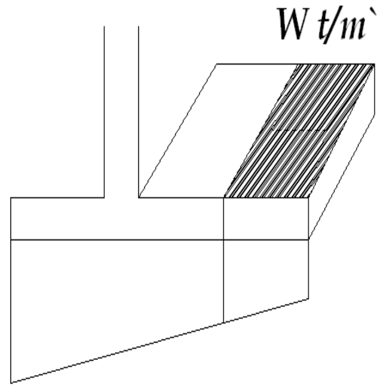
$As1 = M/K_2*d = 2.1*10^5/1100*30 = 6.36 cm^2$

$As1 = M/K_2*d = 2.5*10^5/1100*30 = 7.57 cm^2$

$As1 = M/K_2*d = 3.0*10^5/1100*30 = 8.96 cm^2$

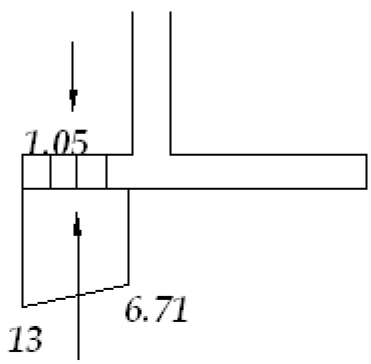
Use 5Ø16/m`

Design of heel section



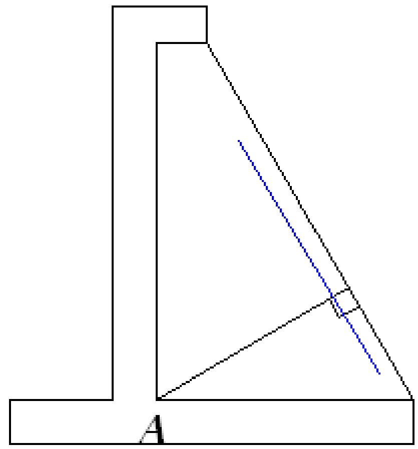
W=5*1.1+2.5*1.8+0.6*1.5+1.0=11.90t/m`
Pnet=11.90-3.41=8.51t/m`
M+ve=8.51*1.65^2/2=11.57m.t
M+ve=8.51*4.70^2/2=11.9m.t
D=$(11.9*10^5/300)^{0.5}$=62.98cm
65=k1$(11.9*10^5/100)^{0.5}$ k1=0.59 k2= 1100
As = 16.65cm^2 use 6 Ø 20 /m`

Design of toe:



W net = (0.5*19.71)-(1.05)=8.82t/m`
d=$(12*10^5/300)^{0.5}$=63.24
T=70cm
As= $(12*10^5)$/(65*1100)=16.78cm^2
Use 6Ø20/m`

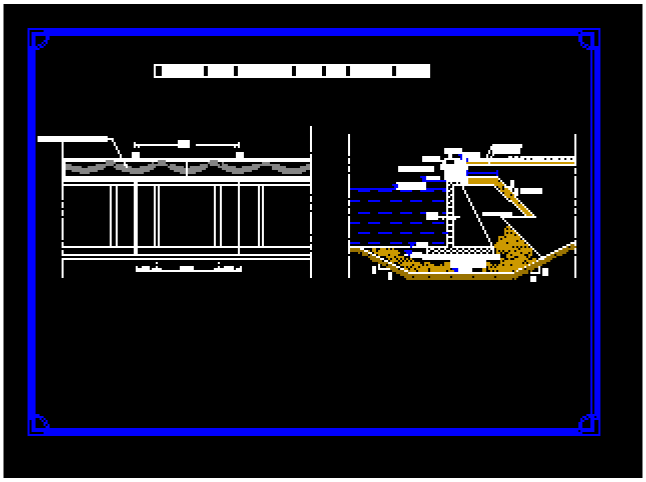
Design of counterfort:
Take moment @A



Ma=42.27m.t/m`
Ma=41.27*(4.7/2+1.65)=165.08m.t
r 1=2.7m
d1=15cm
Ta=165.08/(2.7-0.15)=64.7t
As=64.7/1.2=53.9cm^2 **used As = 8Ø25**
<u>Horizontal steel:</u>
Eh=2.18*4=8.72t
As=8.72/1.2=7.26cm^2
Used 6Ø12/m` each side

<u>Vertical steel:</u>
V=8.32*4=33.28t
As= (33.28/1.2) =27.7cm^2
Used 6Ø18/m` each side

7.2 Design of Counter Fort Retaining Wall for Fishing Berths



H= 6.5+2.75=10.25

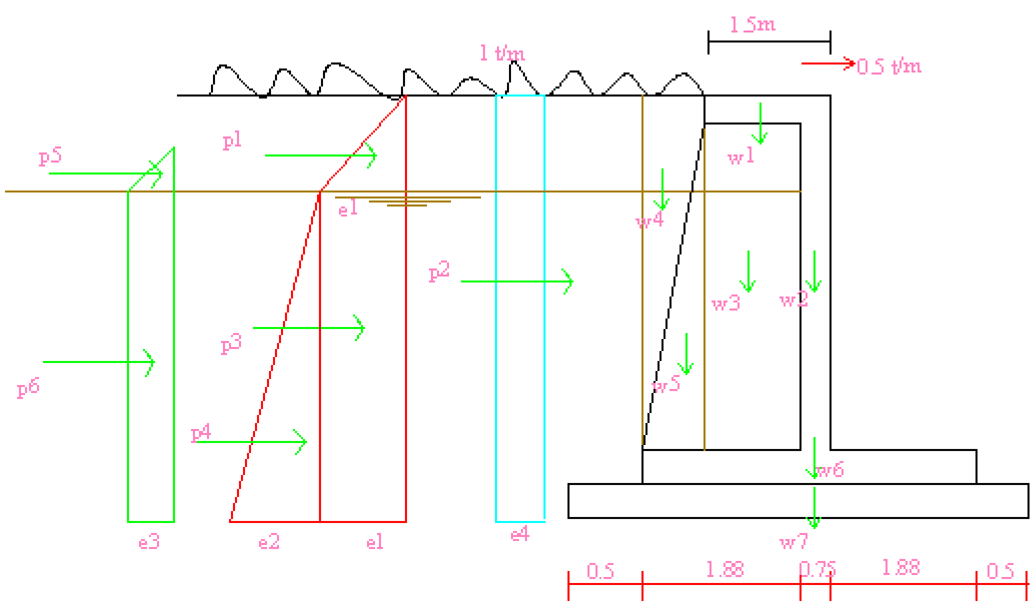
spacing between counterfort = s= (h/3-h/2)= 4m

base width (b) =(0.4-0.65)h= 4.5m

a = 0.3b = 1.35

c = 0.7b= 3.15

******stability calculation******



w1 =1.5 *0.5 * 2.5 = 1.875 t

w2 = 0.5* 2.75 * 1.8 + 0.6 * 6.5 * 1.1 = 6.765 t

w3 = 1 *8.5 * 1.1 =9.35 t

w4 = 0.5 *0.7 * 6.75 =2.4 t

w5 = 4.5 * 0.5 *1.8 = 1.7 t

w6 = 5.5 * 0.5 * 2.5 = 6.875 t

w7 = 0.5* 0.85 * 1.1 * 9.25 =4.32 t

***horizontal force per unit length ***

ka = 1-sin 35 /(1+sin 35) = 0.27

e1 = 1.8 * 2.15 * 0.27 = 1.05

e 2 = 1.1 * 7.4 * 0.27 =2.19

e 3 = 0.6

e 4 = 1 * 0.27 = 0.27

at o $_2$

check against overturning

M over turning = 0.5 *1.05 * 2015 *7.7 + 0.27 * 11.25 * 5.65 + 0.6* 7.4 * 3.6 + 0.5 * 7.4 *2.9 * 2.46 + 1.05 *7.4 * 3.6 + .5* 10.75 = 101.58 m.t

M stability = 0.9 * 0.25 * + 1.7 * 1.4 + 6.875 * 2.75 + 5.63 * 2.25 + 6.75* 2.65 + 5.9 * 2.7 + 9.35 * 2.85 + 2.4 * 4.13 + 4.32 * 4.25 = 162.5 t

f.o.s = 162.5 / 101.58 = 1.6 o. k

at o$_1$

M over turning = 0.5* 1.05 * 2.15 * 7.4 + 0.27 * 10.9 * 5.65+ 0.6 * 7.1 * 3.1 + 0.5 * 7.1 * 2.9 * 2.46 + 1.0 5 * 7 .1 *3.1 + 0.5 * 10.45 = 91.84

M stability = 1.7 * 1.4 + 5.63 *2.25 + 6.75 * 2.65 + 5.9 * 2.7 + 9.35 * 2.85 + 2.4 * 4.13 + 4.32 * 4.25 = 139.76

f.o.s = 139.76 / 91.84 = 1.54 o.k

check of stress

sec (I – I)

∑ N = 40.5 t

Net moment = 139.76 – 91.84 = 47.92 m.t

X = 47.92 / 40.5 = 1.184

E = 4.5/2 – 1.183 = 0.9

F12 = - 40.5/ 4.5 (1 ± 6 * 0.9 / 4.5) = - 1.98 kg / cm^2 & + 0.6 kg / cm^2

Sec (II – II)

∑ N = 50.46 t

Net moment = 162.5 – 101.58 = 60.92

X = 60.92 / 50.46 = 1.207

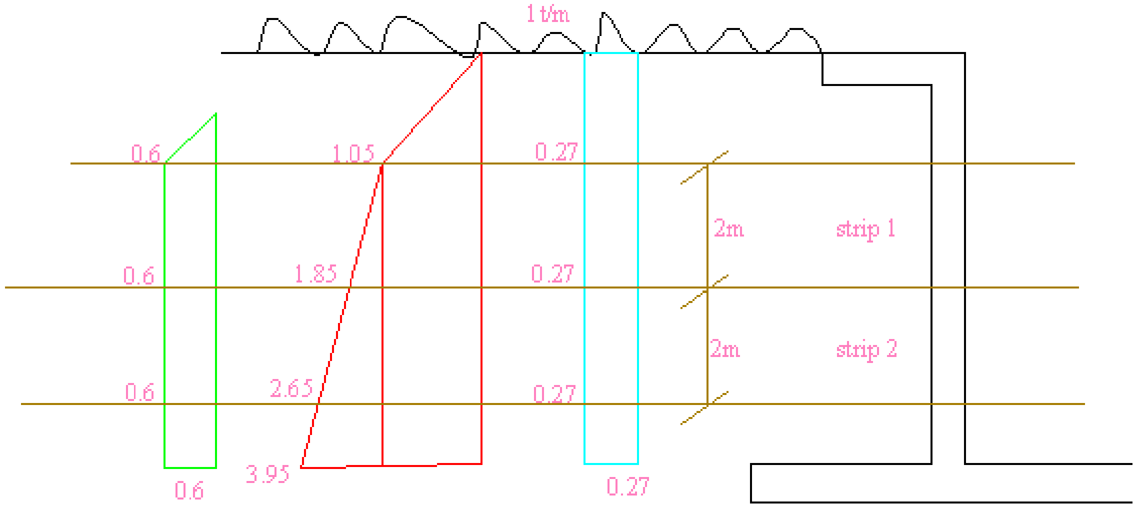
E = b/2 – x

E = 6.5/ 2 – 1.207 = 1.25 < b/6

f12 = - 50.46 / 6.5 (1 ± 6*1.25/6.5)= - 1 .195 kg/cm^2

= + 0.2 kg/cm^2

******Design of wall slab*** ***



*1 st strip *

Take strip each 2.0 m height with 1.0 long

Load = (1.05 + 1.8)/2 + 0.6 + 0. 27 = 2.328 t/ m,

M = 2.3 * 4.5 ^2 /12 = 10.9

d=k1 (M/b)^ 0.5 = 21.6 cm

put d = 70cm = 0.7 m

As = 10.9 * 10^5/(1070*70)=12.7 cm^2

Use (5Φ13) /m

2 nd strip

Load = (1.8+ 2.6)/2+0.6+0.27=3.07

M = 3.07*4.5^2/12=14.7

d=0.411(14.7*10^5/300)^0.5=27.7cm

put d= 70 cm

As= 14.71*10^5/(1070*70)=10.68cm

Use (5Φ13) /m

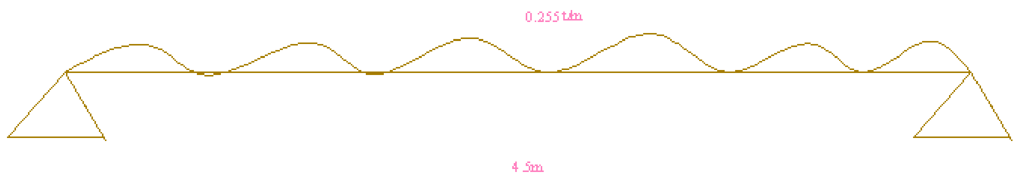
****Design of HL slab****

r=4.5/4=1.125

α= 0.825

β= 0.085

direction(I)



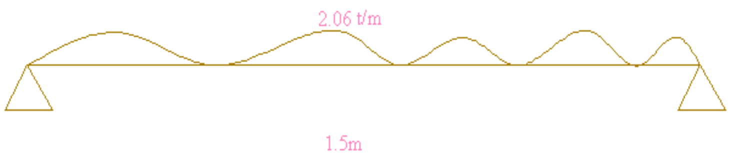
w = 1.0 * 2.5 * 0.0 85 = 0.255

M = 0.255*4.5^2/10 = 1.134 m.t

d=50 cm

As= 1.134*10^5/(1070*50) = use (5Φ13)/m

Direction (II)



W = 0.825* 1 2.5 =2.0625 t

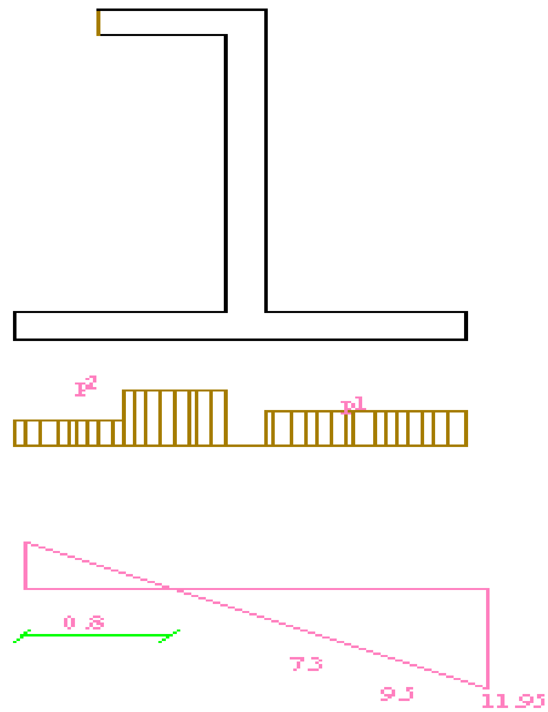
M =2.06*10^5/10=1.854 m.t

d=50cm

As = 1.854*10^5/(1070*50) = 6.27 cm^2

Use (5Φ16) /m

****Design of base slab****



W7 = 4.5 * 0.5*2.5=5.63t/m

P1 = w8/3+w7= 6.875/3+5.63=5.86t/m

P2 =(37.1875+3.125)/2.5+1.5 =18.6 t/m

P3 = 6.7*2/2.5+2.5 =7.8 t/m

(1) Toe

M at o

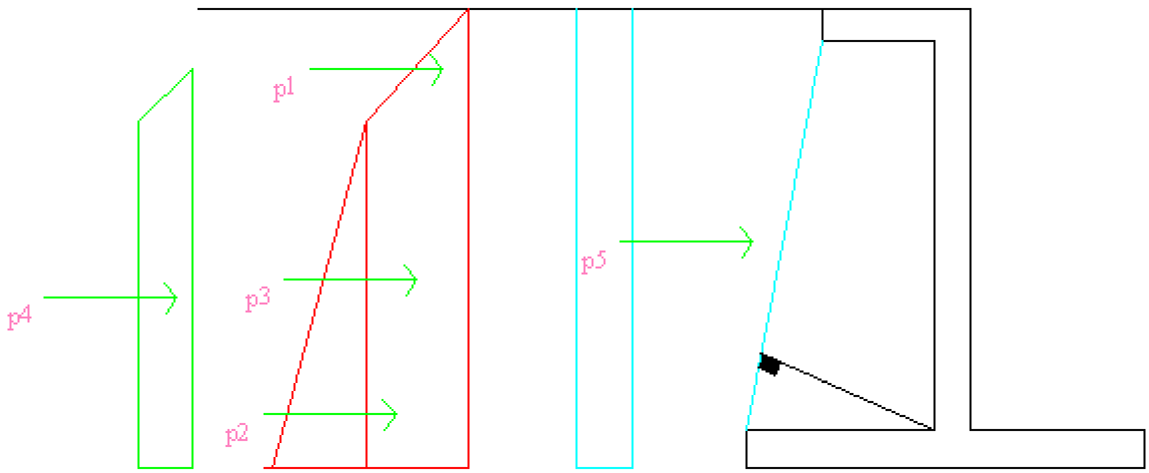
14.662*2.1^2/2 + 0.5*2.1*2*10.098-3.5*2.1^2/2= 36.8 m.t

d= 0.411(56.843*10^5/100)^0.5 = 100 cm

As= 56.843*10^5 /(1070*100) = 46.92

Use (5Φ16) /m

***Design of counter fort web ***



P1 = 0.5*1.05*2.75=1.425
P2 = 0.5(2.19-1.05)*6=3.42
P3 = 1.05*6 = 6.3
P4= 0.6*6= 3.6
P5 =0.27*8.75=2.36

Take m at n

1.425*7.75+6.3*3+3.42*2+3.6*2+2.36*4.36 =3.5T

T=36.7 t

As= 36.7/1.4= 26.21 cm^2

Use (8Φ25)

Put stirrup (6Φ10) /m

Chapter 8

Slipway Design

8.1 Design of slipway for fishing unit

8.1.1 Data

Ship dimension: 40*7.0*3.7

Width =2Bship +2*5=24m

Length =L1+L2+L3

L1=Lship+5.0=45.0m

L2=d*slope

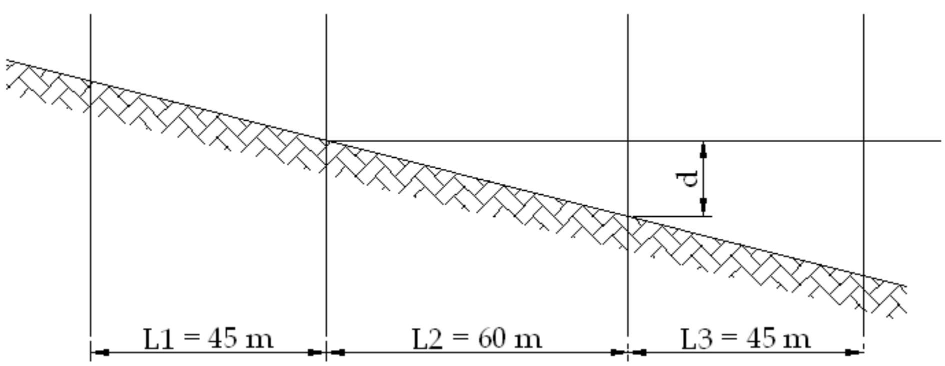
d =draft+tidal range +cradle height(0.75-1.0m)

d=3.70+1.17*1.0=6.0m

L2=6*10=60.0m (slope1:10)

L3=L1=45.0m

Total length=45+60+45=150m



8.1.2 Loads

W=L*B*d*C*1.025
W=40*7*3.5*0.65*1.025=690.0T
C=bulk coefficient

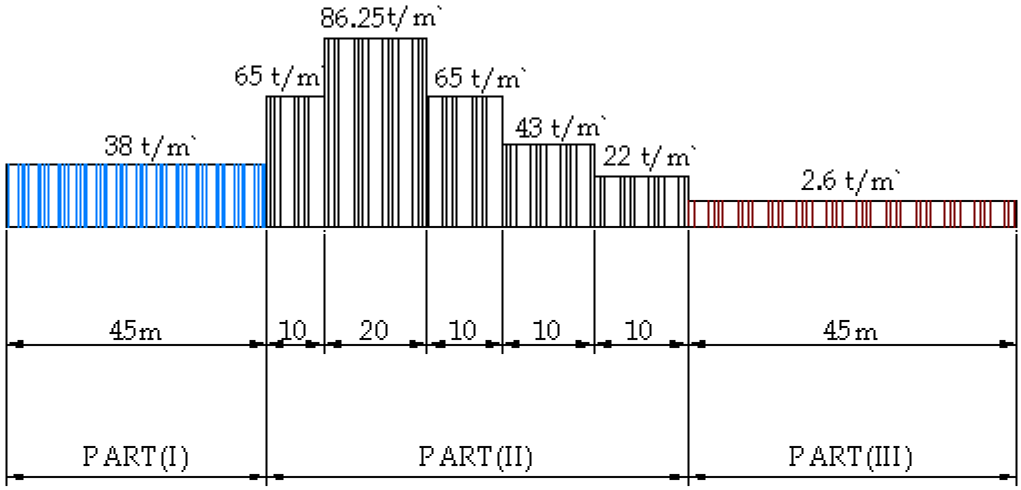
W>500T take W=W/8=86.25t

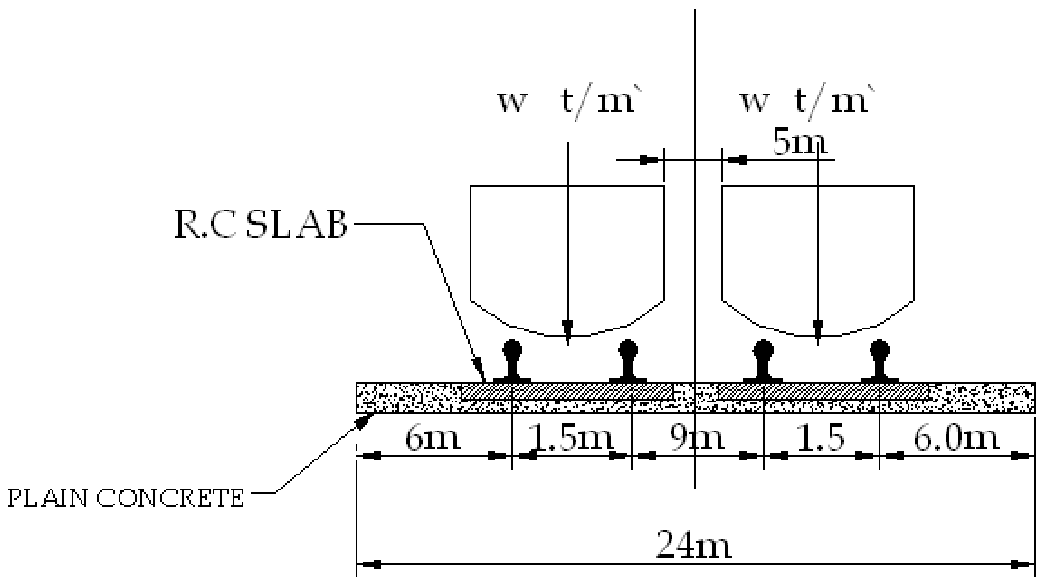
W`=(weight of cradle/length of cradle)=(0.1Wship/(2/3)Lship

=0.1*690/((2/3)*40)=2.6t/m`

W``=(Wt of ship +cradle/cradle length)*1.33=38t/m`

Load distribution :





8.1.3 Design of R.C slab:

Part (2)

1-for 86.25t/m`

W=86.25/4.5=19.2t/m`<qall (crushed stone)

M-ve =21.6m.t

Design according to crack control:

Fcu=250kg/cm2

Fs=1400 kg/cm2

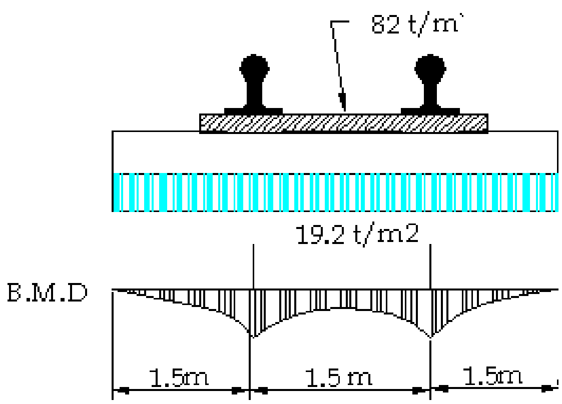
$$t = \sqrt{\frac{M}{300}} = 85 \text{ cm}$$

$$\boxed{d = 80 \text{ cm}}$$

$$d = k1\sqrt{\frac{M}{100}}$$

k1 = 0.55
k2 = 1100
As = 23.82 cm2 / m`
Check As min = 0.4% Ac
= 0.4 % (85 x100) = 34 cm2/ m`

$$\boxed{\text{Use } 10\ \phi 22 \text{ t/m`}}$$



(2) w = 65 t/m`

w` = 14.5 t/m2

M-ve =16.3 m.t   t = 75 cm

d = 65 cm

As = 30 cm2/m`        8 $\phi$ 22 /m`

(3) w = 43 tm`

w` = 43/4.5 m = 9.56 t/m2

M-ve = 10.76 t.m   t = 60 cm

d= 55 cm   As = 7 ϕ 22 /m`

(4) w = 22 t/m`

W` = 22/4.5 = 4.89 t/m2

M-ve = 5.5 m.t   t = 45 cm

d = 40 cm

As = 12.5cm2/m`        As = 5 $\phi$ 20 /m`

PART (I):

w = 38 t/m`

W` = 38 /4.5 = 8.5 t/m2

M = 9.6 m.t   t = 60 cm

As = 16 .0 cm2/m`        As= 6 $\phi$ 20 /m`

PART (III)

w = 2.6 t/m`

W`= 0.55 t/m2   t = 20 cm

M = 0.62 t.m   As = 8 ϕ 12 /m`

CONCLUSIONS

The new El-Dabaa port will be an integral component of Egypt`s plan for economic and social progress and will benefit such endeavors as international trade, inland transportation, industrial development, urban renewal, and the creation of new communities.The construction of the new port of El-Dabaa should be carefully investigated and planned to achieve this goal without affecting the environmental conditions and marine live.

At the end we reach the following

- Taking the effect of wind in our design by determine the prevailing wind direction.
- Study the range of tide and bathymetry data in the proposed sites.
- Determine the best harbor site Construct by drawing wave refraction diagram.
- Calculate the minimum number of berths required for the harbor by economic way.
- Planning of harbor to determine the location and alignment of elements such as entrance, approach channel, turning basin, breakwaters, wharves, jetties, and docks etc. to ensure easy maneuverability and additional navigation facilities.
- Design approach channel, turning basin, breakwaters, and different kinds of berths.
- The construction of the new port of El-Dabaa is carefully investigated and planned to achieve this goal without affecting the environmental conditions and marine live.

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STANDARDS

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