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Studies on the Development of Inland Navigation Systems in Iraq.

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1. INTRODUCTION:

In the economic development of any country, transport plays a vital part. The essential elements in a modern transportation system are:

i) Inland and coastal waterways, including canals, improved or canalised rivers, lakes, bays and parts of the ocean used for coastwise navigation;
ii) A road system, in most cases originally constructed for the use of draft animals, but frequently re-constructed and enlarged for motor vehicles;
iii) A rail road system;
iv) Pipelines for the transportation of petroleum and its products;
v) Suburban and urban railways generally driven by electric power; and
vi) Air routes with proper landing places.

In the overall transportation development in any country, there must be a harmonious development of all types of transport taking into account local conditions and geography to produce the right mix for each region. Other factors, such as energy and water conservation as well as the more social ones of noise, pollution, vibration,and amenity values, should also be considered.

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The carriage of goods by inland waterway craft is known to be one of the most fuel - efficient methods of transport. The comparative fuel consumption for different modes of transport (1972, U.S.A.) are given in Table I. Ref.1) . On an examination of this table, it is apparent that, except for pipelines, waterways is the most fuel-efficient method of transport. The correlation between payload and fuel efficiency worked out by the British Waterways Board (BWB) in 1975 based on a questionnaire circulated to carriers requesting fuel consumption information and other details relevant to actual one-way loaded journeys, is given in Table II.. (Ref 1)·Of the 26 crafts involved, the average ton miles/gallon was 274.

Also, in the case of water transport, noise and vibration levels are insignificant when compared to the heavy lorry or the railway engine whilst, in contrast, canals are postive attaction to many people and have considerable amenity value such as cruising, angling, etc., and can become nature reserves in their own right. The provision of the initial cost to make the canals suitable for freight transport would seem a worthwhile expenditure when one gains an economic mode of transport, an attractive feature of landscape and a basis for many open air leisure activities.

The earliest medium of communication to be developed in a country is apt to be its waterways and this has been true in the case of Iraq also. The essential advantage of the waterway from the point of view of transport is that it offers less resistance to traction at moderate speeds than does the road. Natural waterways moreover, such as rivers, lakes and ocean routes adjacent to the land, are navigable to some extent without preliminary expenditure of capital and labour.

point. Average transit durations on the 340 km haul from Duisburg to Mannheim (W. Germany) are, by express freight train 15 hours, block freight train 8 hours, individual wagons by conventional rail freight movement 37 hours, road 7 hours and inland shipping 35-40 hours upstream and 20-25 hours downstream. On a fuel consumption basis, to move 1 tonne 100 km requires 5 litres of fuel by road, 1.5 litres by rail an d 1 litre by water.

TABLE III - THE CEMT CLASSIFICATION OF INLAND WATERWAYS

PARTICULARS OF BARGES

CLASS	Capacity tonnes	Length (m)	Breadth (m)	Draught (m)	Max. unladen Height (Airdraught) m
Class I	300	38.50	5.00	2.20	3.55
Class II	600	50.00	6.60	2.50	4.20
Class III	1000	67.00	8.20	2.50	3.95
Class IV	1350	80.00	9.50	2.50	4.40
Class V	2000	95.00	11.50	2.70	6.70

2. INLAND WATER TRANSPORTATION IN IRAQ .

According to a survey carried out in 1972 (2), the main volume of cargo transportation in Iraq is carried out by road, amounting to 80.2% of the total cargo transportation. The share of the railways and airways was 13.9% and 5.6%, respectively, and that of river transport was only 0.3%. The very low percentage of transpotation carried through the waterways is due to the fact that development of river transport has lagged behind that of motor and railway transport. For several years, improvement of navigation conditions on the rivers have not been carried out. The majority of navigation routes do not have beaconnage arrangement. Regular navigation is practised only during the flood season in the rivers.

In the coming years, river transport will have to play an important role in the transportation of export-import cargoes . The share of cargo turnover by river transport is expected to go up from 0.3% in 1970 to about 10% in 1995 . If the waterways have to carry out the projected increase in the volume of cargo transportation , then , large scale development works have to be carried out to improve the navigability of the water routes, to provide suitable port structures , and to increase the fleet pacity .

TABLE I-COMPARATIVE FUEL CONSUMPTION FOR DIFFERENT MODES OF TRANSPORT

MODE OF TRANSPORT	TON-MILE GAL.
Pipelines	300
Waterways	250
Railroads	200
Roads	58
Airways	3.7

TABLE II-CORRELATION BETWEEN PAYLOAD & FUEL EFFICIENCY (FOR WATERWAY TRANSPORT IN U. K.) (ACCORDING TO BWB)

TONS CARRIED	TON MILE GAL.
100	214
250	254
350	280
500	318
700	368

The disadvabtages of water transport are: (1)Lesser speed of conveyance compared to rail or road systems: (2)Freezing of water at higher latitudes in temperate zones in certain winter seasons; (3) The flow of streams varies, even when temperature is moderate, so that constant use of natural routes cannot be guaranteed individual wagons by conventional rail freight movement

by bars, falls or other obstacles. Normal depths may be sufficient for small craft but insufficient for the larger boats required for the economical handling of passengers and freight; and (5) Water routes may not connect the points between which people and goods must move or may connect them by long detours.

A system for classifying the waterways, according to their capacity, was established by the CEMT (a forum for the Ministers of Transport of 18 European countries) taking into account the predominant types of vessels in France, Belgium, the Netherlands and Federal Germany (1). According to this classification, the waterways are grouped under five classes. The details of each class are given in Table III. Ref 1) The CEMT established their Class IV as standard for all future waterways of international importance. The economic benefits of inland waterway transport are fully appreciated on the continent. The following figures (1) will help to underline this

3. EXISTING NAVIGATION CHARACTERISTICS OF IRAQI RIVERS :

3.1. General :

The total length of navigation routes in the country makes up about 2600 km. Of this, the most widely used routes are the reach of the Shatt-Al-Arab river from Qurna and the reach of the Tigris river from Qurna to Baghdad (vide Fig. 1). The reach of the Tigris river from Baghdad to Qurna and connected to Basrah through the Shatt-Al-Arab river, is a trunkline connecting the capital of Iraq with the Basrah port through which the economic ties of Iraq with other countries of the world are carried out . On the Satt-Al-Arab, there are two sea ports : Fao port, mainly used for export of oil and Basrah port located at a distance of68 km from the river mouth. The third sea port-Um Qasr port, until now has no internal connection with the rivers.

The major part of the Euphrates river is not suitable for through navigation in the present condition. Navigation is carried out for about 3 months during the flood season. During the low water season, navigation ceases ceases andonly local transport between separate settlements along the river is carried out.

The navigation characteristics of the Iraqi rivers are now discussed beginning from the Shatt-Al-Arab river.

3.2. *Navigation Characteristics:*

3.2.1. *Shatt - Al-Arab River :*

The length of the Shatt -Al-Arab river from its mouth to Qurna is 122 km. On this river reach are sitauted the ports of Basrah and Fao. This river serves as the main transport line for the passage of ships to the Iraqi ports. The canals for entrance and exit of the ships have been constructed in the delta bar. The canals are regularly dredged to maintain the necessary depth in them. The depth of the approach channel from the sea to Basrah harbour is sufficient for the passage of ships with a draught upto 10 m, length upto 180 m and load capacity upto 30 thousand tons.

3.2.2. *Tigris River:*

On the Tigris river, the navigation route can be divided into two major reaches-one connecting Basrah and Baghdad and the other Baghdad and Mosul . In the first reach between Basrah and Baghdad, the route can be subdivided as follows (Fig . 1)

Basrah - Qurna (74 km)
Qurna - Kassarah (60 km)
Kassarah - Amarah (84 km)
Amarah - Ali Garbi (132 km)
Ali Garbi - Kut (124 km)
Kut - Baghdad (308 km)

Between Basrah to Qurna, there are no difficulties to navigation during all the year round . In the rest of the route, navigation is possible only during the flood season (March - June). Even during this period, in the reach between Amarah-Kassarah, due to sharp bends in the river, navigation becomes difficult . During low water season (August - October), navigation in this reach becomes difficult due to inadequate depth of water (vide Fig . 2) .

In the reach between Qurna to Baghdad, there is only one barrage viz., the Kut barrage which is equipped with a navigation lock . This lock has a length of 70 m and the width of the sluicing chamber is 16.5 m. The time taken for a barge to be cleared in this lock is 1 hour 55 minutes with sluicing in one direction and it will be 3 hours 30 minutes with sluicing in two directions.

The details of the navigation characteristics in this reach of the river are given in Table IV [Ref 2]

The length of the second reach on the Tigirs river from Baghdad to Mosul is 524 km. This route can be subdivided as follows (Fig 1).

Baghdad - Balad (159 km)
Balad - Samarrah (50 km)
Samarrah - Fatha (121 km)
Fatha - Sharkat (73 km)
Sharkat - G. Zab mouth (66 km)
G. Zab mouth - Mosul (55 km)

Since there is no navigation lock at the Samarrah barrage, through navigation on this reach of the river between Baghdad and Mosul is not carried out . Moreover, there are 29 bars on this reach of the river . Minimum depth of flow at the bars is in the range of 1 m near Baghada and 0.5 m near Mosul . The velocity of flow varies from 2.5 m/sec. during the flood season to 1.3 m/sec. during the low water season. The details regarding the navigation characteristics in this reach of the Tigris river are given in Table V. [Ref 2] .

TABLE IV
NAVIGATION CHARACTERISTICS OF THE TIGRIS RIVER REACH BETWEEN BAGHDAD TO QURNA

River section	Length of reach (km)	Width of low water bed (m)	Maximum radius of curvature (m)	Flow Velocity (m/sec) during floods	during low water season	Mean gradient
Baghdad – Kut	308	200 – 500	400	2.5	0.24	5 – 8
Kut – Ali Gharbi	124	200 – 600	250	1.1	0.4	3
Ali Gharbi – Amarah	132	100 – 400	250	–	–	3
Amarah – Kassarah	84	40 – 80	150	0.64	0.43	4
Kassarah – Qurna	60	80 – 200	–	–	–	–
TOTAL :	708	–	–	–	–	–

TABLE V
NAVIGATION CHARACTERISTICS OF THE TIGRIS RIVER REACH BETWEEN BAGHDAD AND MOSUL

River Section	Length of Section (km)	No.of bars	Width of bed (m)	Minimum depth at bars (m)
Mosul G. Zab mouth	55	43	200	0.5
G.Zab mouth–Sharkat	66	36	200	0.5
Sharkat Fatha	73	26	280	0.5
Fatha Samarrah	121	56	800	0.6
Samarrah – Balad	50	34	320	1.0
Balad Baghdad	159	54	380	1.0
TOTAL :	524	249		

3.2.3. Euphrates River :

Navigation in the Euphrates river is affected by very low water levels during the summer months. During the low water season , only local transportation between separate towns and settlements is practised . According to conditions of navigation, the Euphrates river reach can be subdivided as follows (vide Fig . 1) :

River Entry Point - Hit (900 km)
Hit - Ramadhi barrage (63 km)
Ramadhi barrage - Hindiyah barrage (207 km)
Hindiyah barrage - Kifl village (45 km)
Kifl village - Samawah (138 km)
Samawah - Hammar village (150 km)
Hammar village - Qurna (60 km)

The navigation characteristics of the Euphrates river reach from its mouth to Qurna are outlined in Table VI [Ref 2]

4. IMPROVEMENT WORKS REGARDING NAVIGATION IN THE RIVERS :

As pointed out earlier, the share of the cargo transportation by river transport is expected to go up from 0.3 % in 1970 to about 5% in 1995 . To handle this volume of traffic, improvement works are necessary along the two rivers reaches. The details of improvement works are now discussed .

TABLE VI
NAVIGATION CHARACTERISTICS ALONG THE EUPHRATES RIVER

S. No.	SECTION OF RIVER	DISTANCE (km)	NAVIGATION CHARACTERISTICS
1.	River Entry Point - Hit .	900	Can be used for through navigation only during the flood season.
2.	Hit - Ramadhi barrage	63	During low water season only barges having a draught of 0.9 m can ply. Difficulties caused by many ponds constructed for irrigation. Ramadhi barrage is equipped with a navigation lock of size 46 mx 6m. 100 tons capacity barges can be passed through this lock .
3.	Ramadhi barrage – Hindiyah barrage	207	The river flows into flat territory. Bed of the river is unstable with many sharp bends. Only local navigation by small boats possible due to withdrawal of water for irrigation, thereby decreasing the water level.
4.	Hindiyah barrage – Kifl village	45	There is a navigation lock at Hindiyah barrage. Difficulties are caused by very low sill level of the lock. During low water season, only small barges can ply .

5.	Kifl Village – Samawah	138	Downstream of the Kifl village, the river divides into two branches, viz., Kufah and Shamiyah. During low water season, navigation is possible only on the Kufah branch up to the Lower Mishkab barrage. On the Kufah branch, there are two barrages- Upper Mishkab and Lower Mlshkab equipped with navigation locks (50^{m} X 8m and 86. 4 m × 6 m, respectively). The Lower Mishkhab barrage can pass barges only with a load capacity dn to 100 Tons. Downstream of the Lower Mishkhab barrage, the river again joins into one, but the navigation characteristics do not improve. Again, near the Gharab village, the river braids into two branches. During the low water season, through navigation is possible only in one of these branches, viz. , the Shatt Abu-Ripush branch up to Samawah .
6.	Samawah – Hammar village	150	Navigation from Samawah through Akaika and Haffar regulators on the Safah and Bini - said branches of the river. Depth of water available during low water season is 1m. Barges upto 100 tons capacity can ply. Difficulties to navigation are caused by sill levels of Akaika and Haffar regulators. During the flood season, navigation takes place in two directions : i) through navigation lock of Akaika regulator to Lesser Hammar Lake to Hammar village. ii) through Haffar navigation lock, then by canal and Lesser Hammar Lake to Hammar village.
7.	Hammar village-	60	Stable bed of the Euphrates river begins. No difficulty to navigation all the year round.

4.1. Improvement Work Along the Tigris River :

4.1.1. Shatt - Al - Arab River :

Major part of the foreign trade will have to be handled through the ports of Basrah and Um Qasr. Periodical dredging has to be done in the navigation channel of the Shatt - Al - Arab river to maintain a draught of 10 m for the ships. Moreover, due to the extensive silting of the sea - way canal and of the Qurun bar on the Shatt -Al-Arab river, it is necessary to carry out at these places annual routine dredging operations to maintain the required dimensions of navigation route. The annual volume of dredging will be of the order of 45 thousand m^3.

4.1.2. Reach of the Tigris River Between Qurna and Baghda d.

The proposed improvement works along the reach of this river can be done in two stages. In the first stage, the minimum depth of navigation can be kept at 2 m and in the second stage at 2. 5 m .

1st Stage : In this reach of the river, the most difficult conditions for navigation prevail in two sections : the first one between Kut and Ali Garbi and the second from Amarah to Kassarah. On the other sections of the river from Qurna to Kassarah and from Kut to Baghdad, free navigation with barges of load capacity upto 500 tons can be carried out with minimum expenditure on navigation beaconnage .

In the Kassarah - Amarah section, the minimum navigation depth of 2.0 m can be ensured by maintaining discharges in the range of 70 m^3/sec in the river. Howe ver, it is not possible to maintain this discharge when the irrigation requirements are also to be satisfied. Hence to satisfy both navigation and irrigation require-ments, it was necessary to construct two barrages - the first one 4 km upstream of Qalat Salih and another one near the Kassarah village. Work on these two barrages are more or less completed . Navigation locks of 90 m length and 16. 5 m width will have to be provided on these barrages. The normal water level elevations to be maintained in these barrages to satisfy both naviga tion and irrigation requirements will be as follows : for Kassarah barrage 4.0 m and for Qalat Salih - 5.75-6.0 m. In addition to construction of these two barrages, dredging works for deepening the section from Kassarah to Amarah and earth works due to levee construction for strengthening the river banks will have to be carried out. A method for protecting the river banks is given in the Appendix. This protection measure will be suitable especially at places near the inland waterway ports .

On the Ali Gharbi - Kut section, it will be necessary to execute dredging works on several bars in this reach in addition to routine annual dredging to maintain the required depth of navigation .

The total volume of bed material to be removed to provide a navigable depth of 2 m in the first stage will be about 1.3 million m^3. (3) .

2nd Stage :

In the second stage of development, it is proposed to keep the minimum depth in the reach at 2.5m which will ensure movement of barges with a load capacity of 1000 tons. This will involve the removal of 2.6 million m^3 of bed material (3) . Also, it will be necessary to reconstruct the navigation lock at the Kut barrage for providing a minimum depth of 2.5m at the lock sill .

4.1.3. Tigris River Reach from Baghdad to Mosul :

Navigation in this reach is possible only if a navigation lock is constructed at the Samarrah barrage and also river channel dredging and alignment work should be carried out .
Furthermore, obstacles to navigation on the river bed, such as remnants of broken structures and stones, have to be cleared .

The most optimum navigation depth in this reach will be 1.6 m for maintaining lowest capital investment in river fleet and minimum operating cost. The width to be provided on the Baghdad - Samarrah section will be 55 m and on the Samarrah - Mosul section, 26 m. The minimum radius of curvature on the first section has to be 200 m and on the second, 350 m. To provide these dimensions to these sections, it will be necessary to carry out initial dredging works to a volume of 3700x 10^3 m^3 and river channel alignment works amounting to 200 x 10^3 m^3. The routine annual maintenance works for dredging will be about 2800 x 10^3 m^3 and for river channel alignment, 20 x 10^3 m^3. The volume of work for clearing abstacles to navigation from the river bed will be 20 x 10^3 m^3 (initial) and 2 x 10^3 m^3 (maintenance) .In addition to these works, a navigation lock at the Samarrah barrage has to be constructed with dimensions of 90 m length, 16.5 m width and with a minimum depth of 2m. The entire navigation route from Baghdad to Mousl has to be provided with beaconnage .

4. 2. Improvement Works along the Euphrates River :

4. 2. 1. The River Reach from Basrah to Nassiriyah .

The navigation route followed in this reach will be as follows :
Basrah – Qurna
Qurna – Chibaish
Chibaish - Nassiriyah
In the section Basrah - Qurna and Qurna - Chibaish, the existing river conditions provide for through navigat ion . From Chibaish to Nassiriyah, several routes are possible. Among the several alternative routes, the following one connecting Chibaish with Nassiriyah is well suited for development :
Chibaish Village – Hammar village
Hammar village - Haffar canal regulator (through Lesser Hammar Lake)
Haffar canal regulator - Bini Said branch of the river.
Bini Said - Nassiriah
To provide this navigation route, a barrage with lock has to be constructed at Wana . The lock at the Haffar barrage has to be reconstructed. Levee construction along the Haffar canal and Bini Said branch as well as widening and deepening of the Haffar canal have to be taken up. Also, dredging works in this route have to be carried out .

4.2.2. Nassiriyah to Samawah :

To provide navigable conditions in this reach of the river, it will be necessary to carry out channel dredging and widening works to a volume of about 2323×10^3 m^3. Levee construction will amount to 608×10^3 m^3. Annual maintenance will make up to 159×10^3 m^3.

4.2.3. Samawah to Hindiyah :

In this reach, to provide navigable depths in the river, the barrages at Upper Mishkhab and Lower Mishkhab have to be reconstructed. Also, barrages at Kuffah on the Kuffah branch of the river and at Gharrab on the Shatt-Abu-Ryfush branch have to be constructed. The volume of dredging in this reach will be of the order of 585×10^3 m^3.

4.2.4. Hindiyah to Hit :

The length of this section of the river is 288 km. It will be most suitable to provide a depth of 1.6 m for navigation in this section. The width will be 55 m and the minimum redius of curvature has to be 350 m. With these dimensions, it will be possible to use 300 tons capacity barges with tug boats of 250 h.p. The volume of dredging and realignment works along this section will come to about 1112×10^3 m^3 and 35×10^3 m^3, respectively. The annual maintenance dredging will be about 670×10^3 m^3. To ply 300 tons capacity barges, the navigation lock at Ramadhi barrage has to be reconstructed.

To secure through navigation from Basrah to Hit, it will be necessary to provide beaconnage arrangements along the entire route.

5. TRANSPORT FLEET:

The existing fleet capacity has to be augmented to handle the expected volume of river cargo transportation. On the Tigris river, the most suitable types of ships to be used are barges with load capacity upto 500 tons and tugboats with capacity of 270 h.p., for the Euphrates river, barges with 300 tons capacity and tug boats of 250 h.p. will be suitable. Initially, a load train will consist of one barge and a tug boat, but later on, the size of the convoys can be increased as much as possible, lashing two to four barges propelled by one push tug. Of the two river systems, the development works along the Tigris river from Basrah to Baghdad have to be given first priority.

6. CARGO HANDLING AND STORAGE FACILITIES:

The major part of import and export of goods for the country will have to be processed through the Basrah and UM Qasr ports. Besides these two existing seaports, it will be necessary to construct a number of mechanized ports and berths in important towns located along the banks of the two rivers to handle the transport of cargo. (**) For the navigation route along the two rivers, it will be necessary to construct mechanized ports and berths as follows :

Tigris River : i) Basrah - Baghdad :

Mechanized ports at bAmarah, Kut and Baghdad .

ii) Baghdad - Mousl :

At Samarrah, Hammam - Ul - Alil and at Mosul.

At Nassiriyah, Samawah, Hit, Ramadhi, Mussiyab, Hindiyah and Kufah .

Also, normal operation of river transport cannot be maintained without regular reinforcement and renewal of the fleet and repair facilities for the equipment used in ports and the ships. To satisfy this requirement, a ship building plant will have to be constructed at Basrah, which is conveniently located at the junctions of different types of transport, viz., road, rail and river. Also, it will be necessary to construct workshops for carrying out routine repair works to the fleet and the port equipment and these can be located at Baghdad, Mosul and Samawah .

Furthermore, since the main volume of cargo transportation will be between Baghdad and Basrah, it will be necessary to connect the river port in Baghdad with the railway yard at Baghdad railway station. This will provide an opportunity of combined cargo transportation between the industrial centres and agricultural areas by railways and river transport. Also, it will be of great use if the Tigris and Euphrates rivers are interlinked near Baghdad by a navigation canal. The interconnecting canal may be located along the Tigris river at Madain (Salman Pak) towards Euphrates river (near Iskandariah) . The length of such a canal is about 55 km .

** Works connected with some of these berths are already taken up.

7. UNIT COST OF DIFFERENT MODES OF TRANSPORT .

According to recent statistics available , the cost of transport of or 1 Ton/km for different modes of transportation in Iraq are as follows :

Road Transport : Major Roads - 6 1/2 fils
Minor Roads - 9 fils

Rail Transport
(Tariff No . 3) 3.3 fils

Water Transport : 5.8 fils

The present unit cost of water transport is slightly higher than rail transport due to inadequate development of the river systems and other shore facilities for handling the cargo . Ultimately , when the water transport is fully developed to handle the traffic , it will work out to be cheaper than the other modes of transport. Moreover water transport has the inherent advantages of strategic importance and as the best means for transporting bulk cargo .

8. NAVIGATION AIDS

The navigable portion of the river has to be indicated by a system of buoys and beacons to enable safe sailing at day or night time . The navigation aids will consist of shore beacons and buoys with radar reflectors. (Vide Fig.3) For the Tigris river, along the Basrah-Baghad route alone, the beaconnage system will consist of 750 buoys and 220 beacons (including spares) (3). However, the beaconnage system has to be executed in stages . The best way for implementation could be to service first those locations which are already critical for day-time navigation, e.g., in the reach from Baghdad to Kut. During periods of low water, continuous check surveys should be made to verify that the buoys and shore beacons are still in a proper position in view of the changing character of the river bed. After some initial experience has been gained with the operation of the system ; the opinions of all the parties involved in river transport, especially that of the river navigators, must be put together and reviewed to arrive at the best method for refining the system .

When the beacons are installed and the buoys laid out , they will need very frequent inspections . Firstly , with respect to their proper location , for which simple types of check soundings can be done by the river patrols and more extensive surveys can be done by a special hydrographic survey team . Secondly , the beacons and buoys will need frequent cleaning , checking of battery conditions , checking of damages , etc . Repairs on the spot or replacements should be executed very rapidly in view of the importance of continuous and safe transport .

9. ORGANISATION .

To meet the objective of providing a reasonably fast, continuous and economic water transport in the two rivers, an organisation similar to that shown in Fig. 4 will be required in the ultimate run (3). The various departments in this organisation must have good interrelationship among them , so that the common goal of providing a good and economic water transport can be reached in the shortest possible time . The major departments in this organisation are : Planning & Administration , River Engineering , Transport Organisation and Traffic & Waterway Control . During the initial stages of upgrading of the rivers for water transport , the following sections may have to be set up urgently :

i) Hydrographic and morphological surveys .
ii) River studies , design , planning & execution of dredging works .
iii) Pilotage and traffic control including instructions for navigators .
iv) Establishment of a river patrol and beaconnage service .
v) Selection , purchase and installation of buoys and shore marks .

The other departments as indicated in Fig . 4 could be started on a small scale or could be established later depending upon the need .

10 - CONCLUSIONS :

i) The development works necessary for upgrading the Tigris and Euphrates river systems for inland waterway transport are brought out .

ii) Of the two rivers , the development works necessary in the Tigris river has to be taken up first . Even in this case , top priority has to be given to the route between Baghdad and Basrah . The depth to be provided below low water level for navigation in the river systems during the first stage of development shall be as follows :

a) Tigris River :
Baghdad - Basrah Section : 2 m
Baghdad - Mosul Section : 1.6 m
b) Euphrates River : 1.6 m

iii) The existing fleet capacity has to be augmented to handle the expected volume of river cargo transportaion . On the Tigris river , the most suitable type of ships to be used are barges with a load capacity of 500 tons and tugboats with a capacity of 270 h.p., on the Euphrates river, barges with 300 tons capacity and tugboats of 250 h. p. can be used .

iv) Mechanised inland waterway ports will have to be set up at important towns along the two river systems. the following places are suggested for location of inland waterway ports :

a) Tigris River :

Baghdad to Basrah Section : Mechanised ports at Baghdad , Kut and Amarah .

Baghdad to Mosul Section:at Samarra , Hammam - Alil and at Mosul .

b) Euphrates River : at Nasiriyah , Samawah , Hit , Ramadhi , Musaiyab , Hindiyah and Kufah .

v) Normal operation of river transport cannot be maintained without regular reinforcement and renewal of the fleet and repair facilities for the equipment used in ports and the ships . To satisfy this requirement , building plant at Basrah will have to be constructed .

vi) The river port in Baghdad will have to be connected with the railway yard at Baghdad railway station, to provide a combined means of transportation.

vii) It will be highly useful if the Tigris and Euphrates rivers are interlinked by a navigation canal near Baghad. The interlinking canal may be located along the Tigris river at Madain (Salman PAK) towards Euphrates river (near Iskandariah). The length of such a canal is about 55 km .

viii) According to a recent statistics , the cost of transportation for I Ton/km for the different modes of transport are as follows:

Road Transport :
Major roads - 6 1/2 fils
Minor roads - 9 fils
Rail Transport : 3 fils
Water Transport : 4.55 fils

Even though , the present unit cost of inland waterway transport is slightly higher than the rail transport in the ultimate run , when the river systems are fully developed to handle the transport of cargo , water transport will work out to be cheaper . Moreover , water transport has the advantages of strategic importance and being eminently suited for transport of bulk cargo . The provision of the initial cost to make the rivers suitable for freight transport would seem a worth-while expenditure when one gains an economic mode of transport , an attractive feature of landscape and a basis for many open air leisure activties .

ix) Beaconnage system consisting of buoys and shore beacons has to be provided for day and night navigation.

x) A tentative organisation for development and maintetance of inland navigation has been indicated.

11 – REFERENCES :

1 – " Commercial Inland Waterways " - A Review of Development in the U.K. and on the continent. The Naval Architect , No. 4, July , 1979 .

2 General Scheme of Water Resources and Land Development in Iraq, Book 2 & 3, Vol. 1, Ministry of Irrigation , Directorate General of Dams & Reservoirs , Baghdad , Iraq , 1975 .

3 – Report on Survey , Beaconnage and Improvement for Navigation - Tigris River (Basrah - Baghdad) Iraqi State Organisation for Water Transport. Netherlands Engineering Consultants - September 1978 .

4 – R.G. Hennes and Martin Ekse ., Fundamentals of Transportations Engincering, McGraw-Hill Book Co., New York , 1969 .

5 Saeedy , H.S., "Some Protective Measures for Waterway Embenkments in Basrah ", The Arab Gulf Journal, University of Basrah , Iraq, Vol. 10, 19 – 24 , 1978 .

6 – Joseph E. Bowles , "Foundation Analysis and Design" , McGraw-Hill Book Co., New York , 1977 .

APPENDIX

The side protection of the river banks is vitally important when considering the developments of inland waterway navigations . The protection measures as suggested by Saeedy (5) were divided into two parts :

(a) Short distance protection : which takes place within the city limits including small ports by the use of precast reinforced concrete units particularly useful for levee construction along regions consisting of soft soil formations. where better soil conditions are prevailing , then a more monolithic retaining structure may be applied , using the following graphical solutions shown in figure (A2) and figure (A3). The figures are produced by computerizing the analytical solution of retaining walls. The graphical solutions suggest the use of different dimensional ratios as shown in fig . (Al) (vide Bowles (6)). After fixing the dimensions of the retaining structure and obtaining the soil formations , then the graphical solutions are adapted to estimate values of bending moments and shear forces .

(b) Long distane protection : In this part , much cheaper costing systems are suggested to provide adequate protection of river banks .

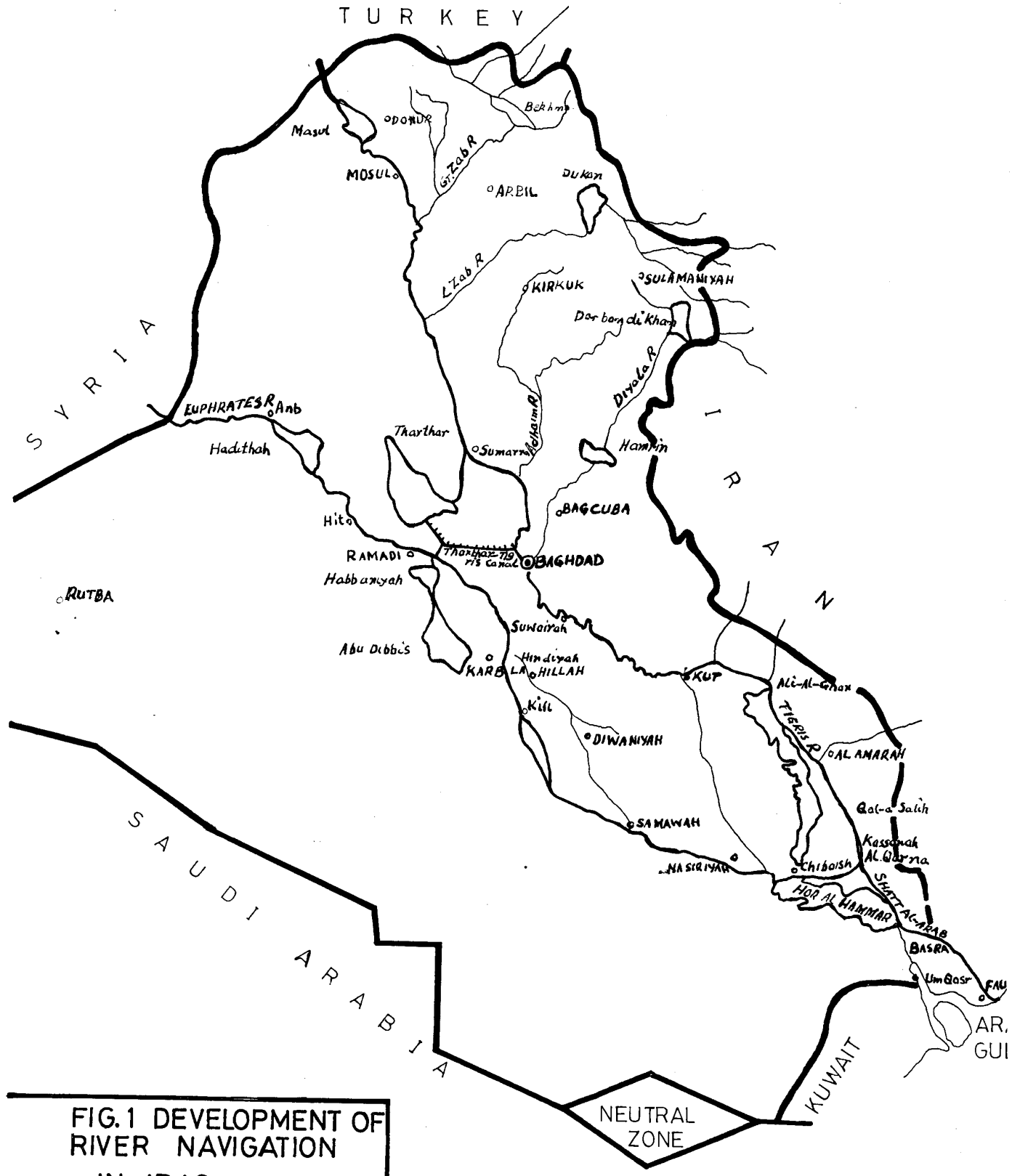


FIG. 1 DEVELOPMENT OF RIVER NAVIGATION IN IRAQ

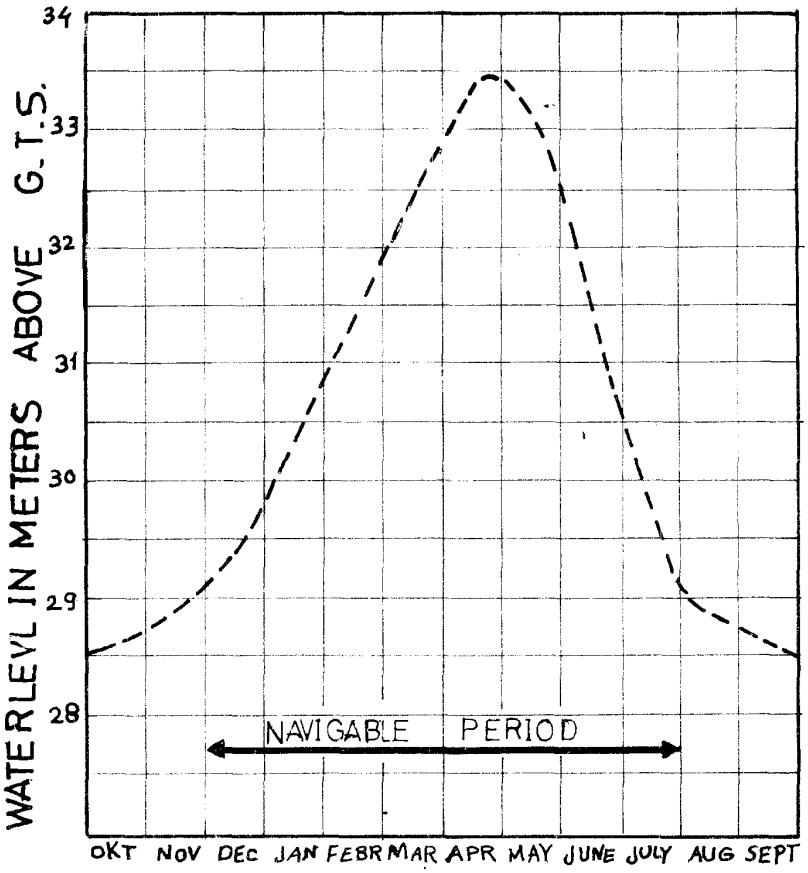
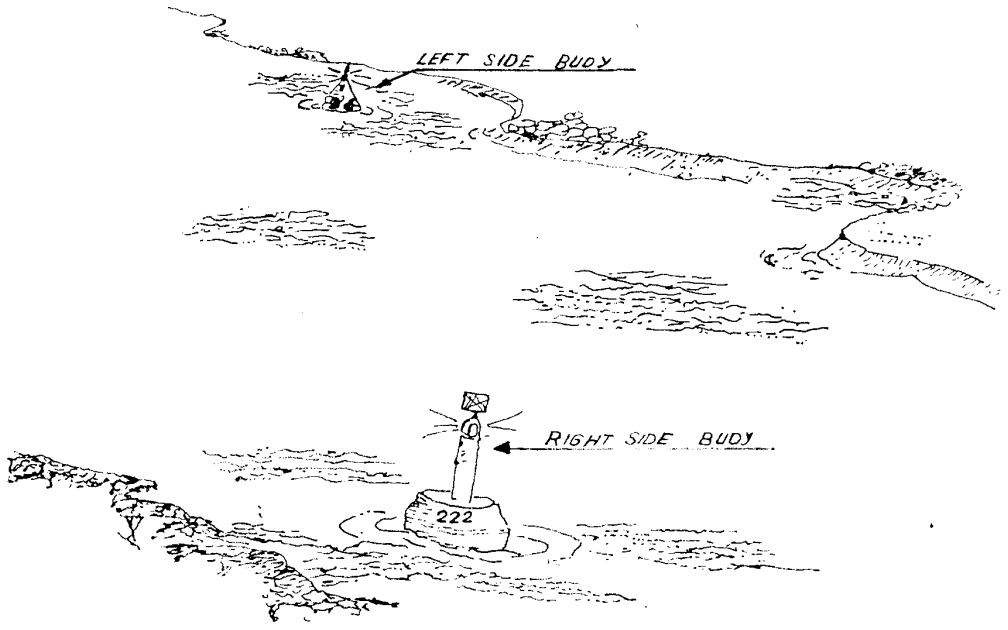
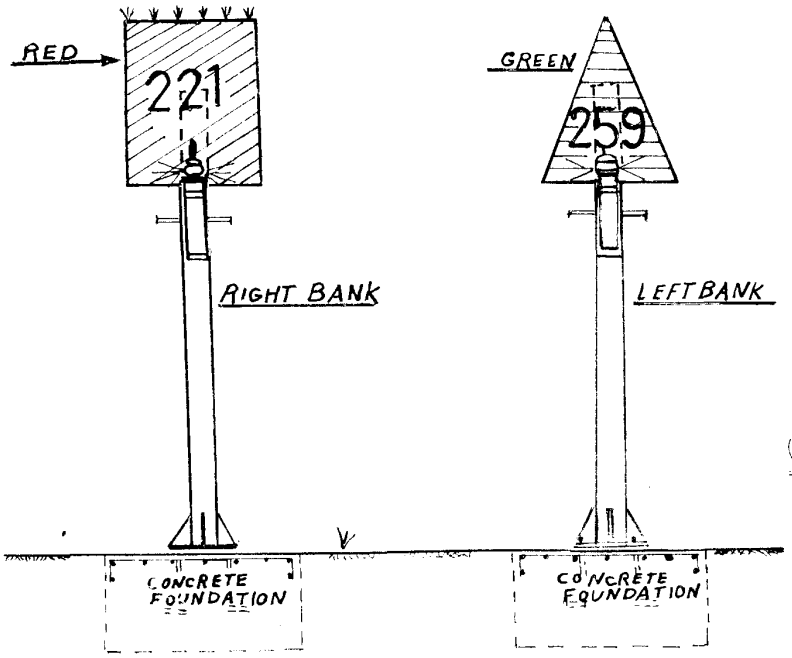
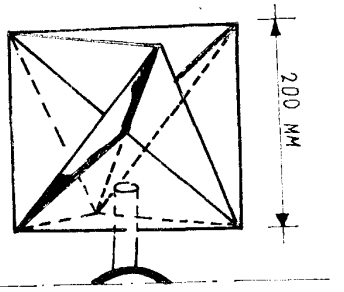


FIG. _2_ WATER LEVELS BAGHDAD THROUGH THE YEAR



(a) LIGHTED BUOYS





(c) RADAR REFLECTOR

(b) SHORE BEACONS

FIG. 3. BEACONNAGE SYSTEM

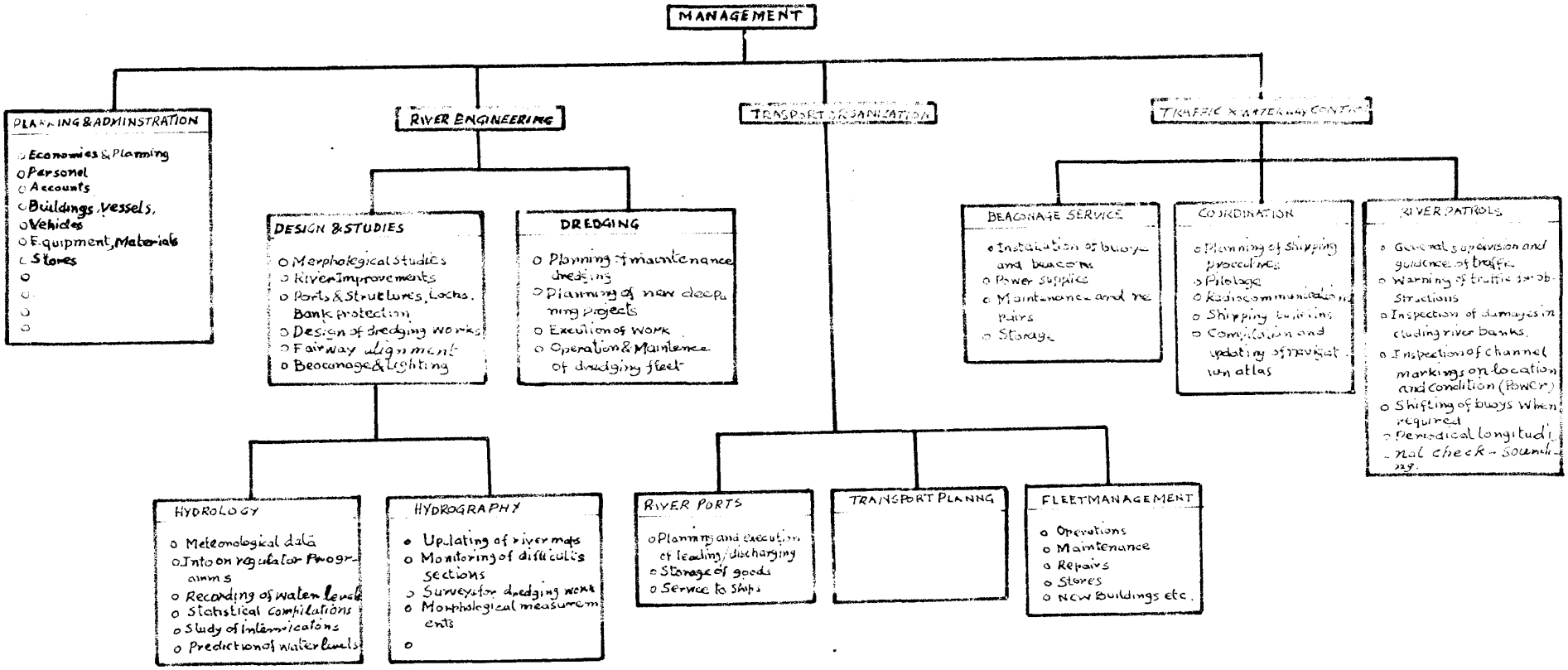


FIG (4) TENTATIVE SCHEME OF ORGANIZATION FOR RIVER TRANSPORT

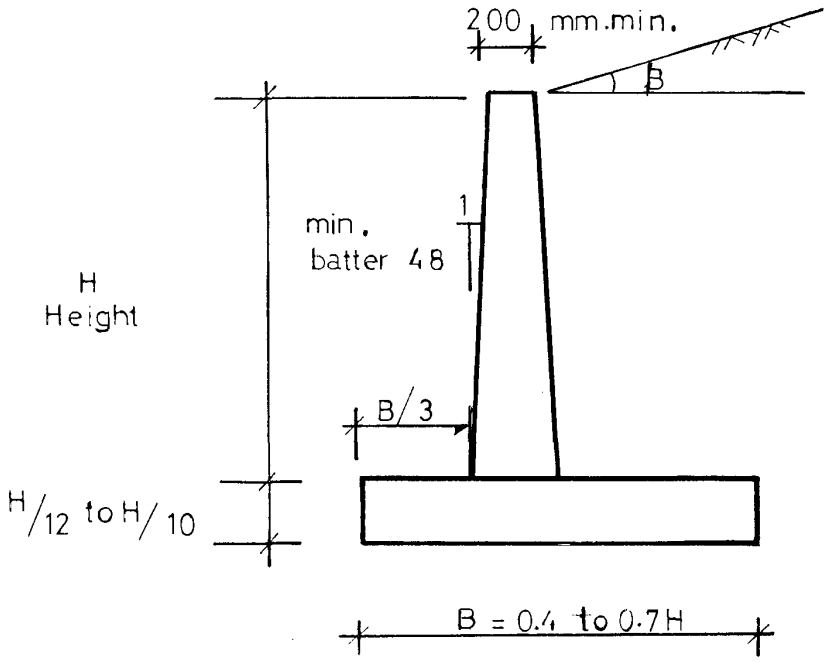


Figure (A1) Dimensional Ratios of Retaining wall

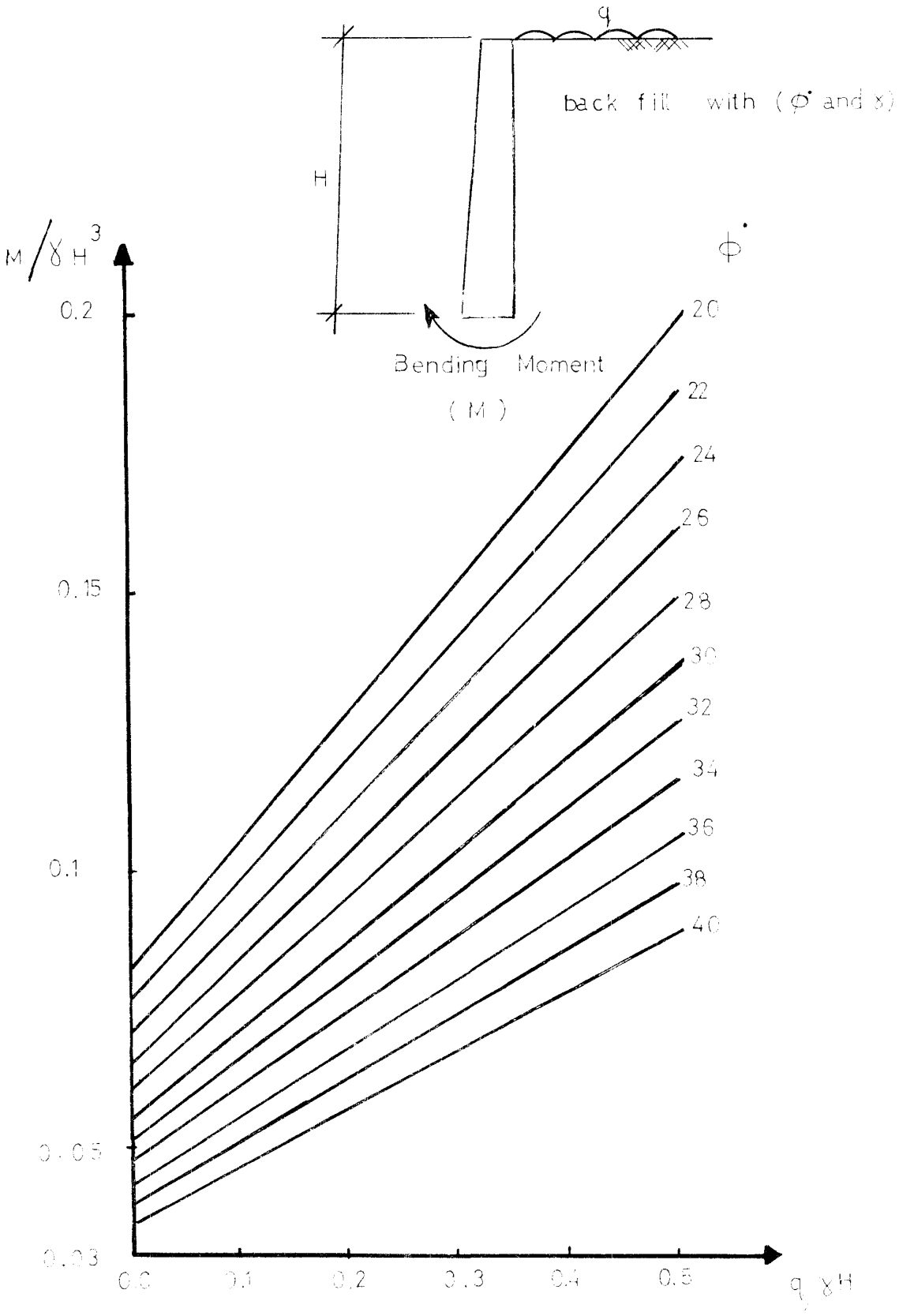


Figure (A2) Determination of Bending moment

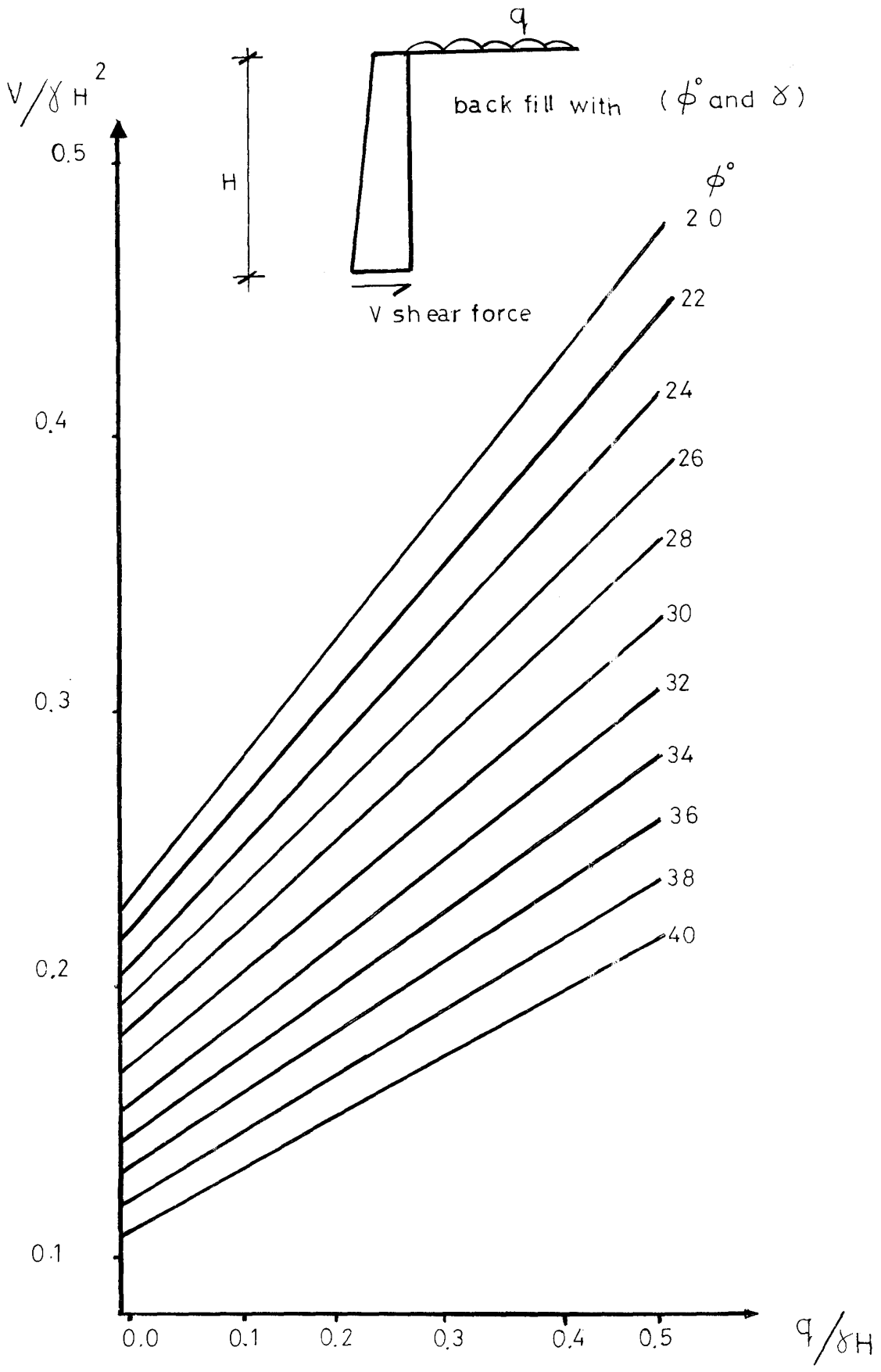


Figure (A3) Determination of Shear Force

دراسة حول تطوير الملاحة النهرية في العراق

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موجز البحث

من بين الاطوار العديدة في النقل . ان تحميل البضائع ونقلها عن طريق الملاحة النهرية هي وسيلة عرفت بكفائتها الاقتصادية في استهلاك الوقود السائل دون غيرها من سبل النقل .

ان الخواص الملاحية لنهري دجلة والفرات في الوقت الحاضر قد وضحت . اولاً باعتبارهما النهرين الممتدين من شمال شرقي وشمال غربي العراق حتى جنوبه . وتحدد الاعمال الضرورية في تطوير استعمال الملاحة كتعميق قاع النهر لتوفير الغاطس الملاحي اللازم . وانشاء الاهوسة والنواظم او محاولة اعادة استقامة النهر في المنحنيات الحادة وسبل حماية جوانب النهر باستعمال المواد الاولية المتوفرة محلياً قدر الامكان . ان الدراسة قد شملت جميع هذه النواحي الهامة والحساسة في مجال النقل النهري .

ان سعة اسطول النقل الحالي غير كافية ويجب توسيعه كي يتحمل حجم البضائع المتوقع نقلها بواسطة النهر . في نهر دجلة يكون اكثر انواع السفن ملائمة لنظامه الملاحي هو استعمال الجنائب بسعة حمولة خمسمائة طن لغاطس ملاحي يبلغ مترين وتسحب بزوارق قوتها الحصانية بحدود مائتين وسبعين حصاناً . اما في نهر الفرات فتستعمل جنائب لها سعة حمولة تقدر بثلاثمائة طن لغاطس ملاحي متر وستة اعشار وتكون الزوارق الساحبة بقوة حصانية بحدود مائتين وخمسين حصاناً . اما في المدن الرئيسية فهناك ضرورة لانشاء موانيء وارصفة تحتوي على اجهزة نقل وتفريغ الجنائب الياً وتربط هذه الموانيء بطرق برية او سكك حديد تأميناً لايصال البضائع الى مكانها المطلوب .

لغرض زيادة الكفاءة الملاحية في النهرين يتوجب انشاء قناة ملاحية لربطها ببعض عند جنوبي مدينة بغداد حيث انها اقصر المسافات واكثرها ملائمة .

عند توسيع الاسطول الملاحي واحتمال استهلاك الجنائب العاملة وكذلك انشاء جنائب اخرى يكون من المفيد جداً ارساء نواة في الصناعة البحرية وتشمل هذه انشاء معمل بناء السفن في مدينة البصرة وفي موقع تقاطع طرق وسائط النقل المختلفة .

تقاس وحدة كلفة النقل بالطن الواحد لمسافة كيلومتر واحد . ومن جراء مقارنة وحدة كلفة النقل بين الوسائل المختلفة وحسب الاحصائيات الحديثة المتوفرة يلاحظ ان اقلها كلفة هو النقل بواسطة سكك الحديد وبعدها يأتي النقل النهري حالياً وسبب هذا الارتفاع هو وجود العديد من المعوقات الملاحية التي تؤدي الى تاخر السير في النهر مما تزيد في كلفة النقل عن طريق النهر في الوقت الحاضر .

اما على المدى البعيد وبعد تطوير تلك الانهر للاغراض الملاحية المتوقع ان تخفض تلك الكلفة الى حد بعيد . وبالرغم من ذلك فان للنقل النهري مزاياه الخاصة في نقل الحمولات الضخمة . وكذلك اهميته من الناحية الاستراتيجية مقارنة مع وسائل النقل الاخرى . اضافة الى ان تطوير انظمة الملاحة النهرية ستؤدي الى فوائد سياحية واجتماعية يستفاد منها في فعاليات الفراغ وهذه ناحية حضارية هامة .

لقد تناول البحث سبل تطوير انظمة العلاقات الملاحية وهيكل تنظيمي لادارة وتطوير العمليات الملاحية وصيانتها .