OPTIMAL TECHNOLOGIES OF ROAD AND BRIDGE CONSTRUCTION FOR DEVELOPING RURAL ROAD NETWORK OF THE MEKONG DELTA

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abstract: MeKong Delta is a vast area with high economic potential. In order to promote this potential, Vietnam government has developed a plan for road network in this area called "Rural transport of Mekong Delta program". This paper deals with some optimal solutions for road and bridge constructions for developing rural road network of the MeKong Delta.

1. BACKGROUND

In order to implement the economic development strategy of Vietnam up to the year 2010, Vietnamese government has compiled a master plan for Mekong Delta development including rural transport development projects, of which transport infrastructure construction and improvement projects are given first priorities.

Mekong Delta is a vast area of 39,000 square kilometers, with population of 15 million inhabitants, most of them are directly or indirectly concerning with agricultural production. Sown area of paddy is about 2.3 million hectares occupied more than 40% of the whole country, the gross output of paddy occupies nearly 50%. The annual volume of surplus paddy is 4 Millions tons, which are sold with low price causing many suffering of losses for farmers. One of main reasons is high transport cost due to undeveloped transport infrastructure.

Well-known characteristics of road constructions in this area are:

- Lack of construction materials such as rock, hill soil for foundation and the loading-bearing layers of road surface structure and high density of wide canals, which require to have high under clearance for waterway traffic.
- The rural roads are usually built along the rivers and canals (to dig the canals in conjunction with embanking roads) so that roads base on soft soil layers.

- The roads network and rural network in particular are affected by the annual flood and daily tide. The underground water level is so high that the road embankments are always in wet condition.

Therefore it is most important to select a suitable structural and technological solution for road construction.

2. CLIMATE, GEOTECHNIC AND HYDROLOGICAL CONDITION

In Mekong Delta area there are two seasons in a year (dry and rainy season). In this area there are about 23,500 Km^2 of land affected by alum. The difference in water levels and river currents between dry and rainy seasons affects greatly on environment and the living conditions of animal, plant and residents. Every year, there are up to 10,000 Km^2 of land overflooded by Mekong river. Lower areas are always flooded due to under developed drainage system and without the existence of dike system along the rivers. In dry season the river water level is lowest and about 17,000 Km^2 of land are affected by brackish water. The embankments are often based on the soft soil layers (silt clays) with the thickness varies from 15 to 30 m.

3. SOLUTION FOR ROAD SURFACE STRUCTURE

To achieve the following objectives:
- To make the most of local material resource.
- To distribute gradually, to decrease the loading stress on the soft soil foundation.
- To stable the embankment in unfavorable wet condition.

The soft soil layer strengthened by slaked lime or cement becomes the stressed resistant layer in rural road structure.

The necessary technical parameters for rural road structures have been determined:

- Specific gravity of grain $\gamma_{k.max} = 1.68$ g/cm^3
- Optimal moisture content $W_o = 18 - 22\%$

Soil strengthening technology has showed:

- Ensuring the fine soil grinding and well-mixing soil with strengthening materials,
- Meeting the environmental demand,
- Working out the construction technological line by special equipment.

4. SOLUTION FOR BRIDGES

4.1. General solution

A well-known characteristic of the Mekong Delta is that it is separated by a dense network of rivers and canals. There is no access for almost communes, particularly the remote areas. Transport and communication is very difficult and mainly by waterway using small boats. Mekong Delta has the densest waterway network of the country with the length of 5000 Km creating the main waterway transport network, which three times longer in comparison with road network. Volume of freight traffic carried by inland waterway occupied about 70% from 10 million tons of the this area. Road transport occupies only 30 percent of the total due to undeveloped road network including bridges crossing canals and rivers linking living areas. The rural roads are usually been along the river and canals (digging the canals in conjunction with embanking roads) so that roads are based soft soil layer With a such the high density of rivers and canals network, the bridge stock of 20,107 bridges and 273,743 m long can not meet the traffic requirement.

To solve such a great demand of bridge, it is necessary to research for finding out a solution of structure which ensures the technical aspect, can be manufactured by local with lower price than when imported.

The kinds of bridge for rural transport in Vietnam need to be diversified: reinforce concrete, prestressed or poststressed concrete, steel composite, steel truss bridges. The selection depends on geographical condition, climate, local material resource of each area. It is suggested that suspension bridges should be used for mountainous area and steel truss bridges for areas far away from the sea.

There are many advantages in using steel beams such as it can be manufactured industrially, installed easily and crossed the river with long spans. However, its cost is higher than both reinforce concrete and steel composite concrete bridges in cases of small one.

In conception that rural roads are the linking roads between districts, communes and villages, the bridge designed loading should be selected the codes of H8, H10 and H13, no need to take the code of X60 into consideration. The width of bridges should be from 3 to 4 meter, which is enough for single traffic lane. The service life of the bridge is not less than 20 years.

This proposal is based on the fact that the number of rural bridges in Mekong Delta is great so that the cost for one meter of bridge must be minimized in order to meet the demand of transport requirements with limited budget.

The bridges under the project "Steel Bridge Beams for Mekong Delta" will be selected and designed based on the priority assigned to the roads. Bridges would be built to accommodate current and future international loading standards for the existing category roads. In the flood-prone areas of Mekong delta, the project will emphasize the construction of the bridges and the protection of waterway embankments when they coincide with road embankments or when water erosion may endanger the structure of road embankment. When connections exist between road and waterway, making the two transport modes complementary, the project will include the provision or improvement of simple low-cost landings and piers for the interchange of traffic.

The criterion for optimization or selection of bridge constructions must be met the following requirements:

i/ Structures must be light, portable with the weight of each panel for installation is less than 500 kilograms.

ii/ Easy in installation and reinstallation and interchangeable to form single, double and combined trusses upon the length of spans and loading capacity without using special equipment but mainly manual method.

iii/ Using alloy-steel to reduce the dead weight and to slow down corrosion process. Reducing the routine maintenance works.

iv/ The manufacturing technology must be uncomplicated so that the production unit at provincial level can fabricate and install.

At present, the following kinds of beam for road bridges are used in the whole country:

Beam UIKM-60	With	Lp = 32 m	then	q = 1.1 T /m
Beam J-99 (Japan)		Lp = 36 m		q = 1.06 T/m
BeamPIGEAUD(France)		Lp = 37.5m		q = 1.41 T/m
Beam BAILEY (U.K)		Lp = 32 m		q = 1.2 T/m
Beam EIFFEL-100 (France)		Lp = 30 m		q = 1.34 T/m
Beam T.66 (China)		Lp = 32 m		q = 1.44 T/m
Beam Pony (USA)		Lp = 30 m		q = 2.8 T/m
Beam VN-64-71 (Vietnam)		Lp = 45 m		q = 1.75 T/m

4.2. Beam LAG-VN

Beam LAG-VN, which has been approved as result of research project 34-05, is installed from triangular-shape panels without truss posts. This kind of beams can be single, double and combined installed:

If Lp ≤ 21m then the beam is single installed with the weight of beam 21m = 22.010 T (or 1.036T/m)
If Lp varies from 24 to 30 m then the beam is double-storey installed with the weight of beam 30m = 37.152T (or 1.228T/m)

After analyzing, it is found that the research of using beam LAG-VN, as designed, should be continued because of following reasons:

i/ Beam LAG-VN is inherited the advantages of BAILEY beam, that is because of its abilities to be single, double and combined installed. The versatile design of the compact system allows a number of different constructions to be built to suite the span and loading, without increasing the number of difference components used . In fact, when being double installed its shape is similar to BAILEY beams without stringers with the height of 3.1 m (the double installed BAILEY beam is also 3.1m high).

ii/ Beam LAG-VN is manufactured into panels with Q ≤ 500 Kg so it can be installed easily and quickly.

iii/ High strength bolted connections with small coefficient of friction f = 0.30 - 0.35 means the processing of friction surface is very simple, even the cleaning surface of the steel provides suitable friction coefficient.

iv/ The most advantages of beam LAG-VN is that LAG-VN has smallest dead weight in comparison with others, therefore its cost for manufacturing and installing is lowest as well.

It is found that LAG-VN has met almost the above mentioned criterion.

Some suggestions

- Based on perfecting LAG-VN beam, series of compact bridge system should be modular designed with different spans : 15 m, 18 m, 21 m, 24 m, 27 m, 30 m with loading criteria of H-8, H-10, H-13 (without mention of caterpillars). Actually, chart of installation for every load takes after BAILEY beam. (see Appendices enclosed)

- Research and design a standard abutment for typical geotechnical profile of mekong Delta relevant to the above beams so that its shape and calculation can be referred by bridge design units of provinces with actual data.

- Pilot manufacturing one beam with the length of L = 30 m. To carry out the measurement and assessment of the whole beam and each panel. Approve and issue the manufacture technology and installation technology enclosed chart of installation (including specifications and hand-over requirements).

REFERENCES

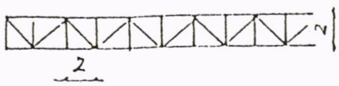
Research Institute for Transportation Science and Technology (1996) **Typical Designed 'Steel Bridge Trusses for Rural Transport'** - RITST, Hanoi.

Research Institute for Transportation Science and Technology (1996) **Project: Steel Bridge Beams for Mekong Delta** - RITST, Hanoi.

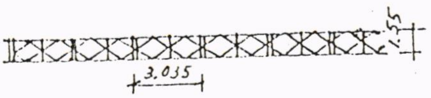
Ministry of Transport (1993) **Master Plan for Mekong Delta** - TESI, HoChiMinh City.

APPENDIX I

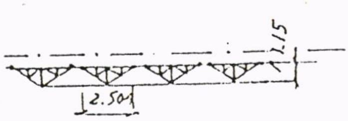
STRUCTURAL OPTIONS



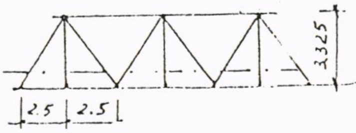
Beam Y KM 60 (Russia)
L = 32 m q = 1,1 T/m



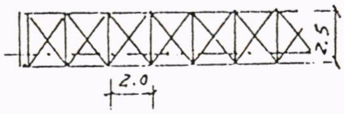
Beam BAILEY (UK)
L = 32 m q = 1,2 T/m



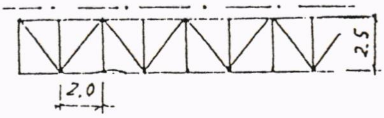
Beam J-99 (JAPAN)
L = 36 m q = 1,06 T/m



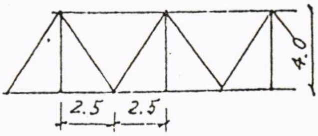
Beam EIFFEL-100 (FRANCE)
L = 30m q = 1,34 T/m



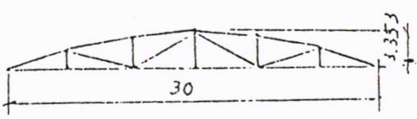
Beam PIGCAUD (FRANCE)
L = 37,5 m q = 1,41 m



Beam T-66 (CHINA)
L = 32 m q = 1.44 T/m



Beam VN64-71 (VIETNAM)
L = 45 m q = 1,75 T/m

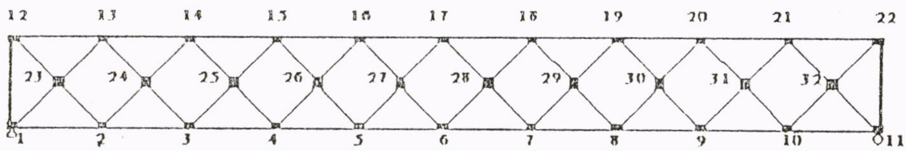


Beam PONY (USA)
L = 30m q = 2,8 T/m

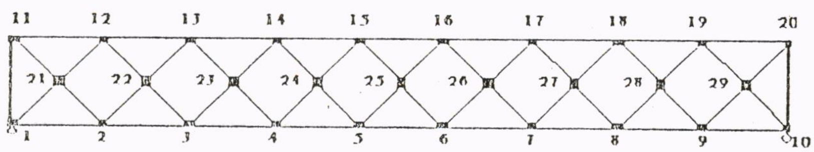
APPENDIX 2

LAG-VN SINGLE TRIANGULAR-SHAPE TRUSS - DOUBLE STOREY

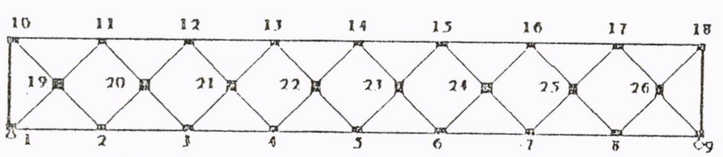
L = 30M



L = 27M

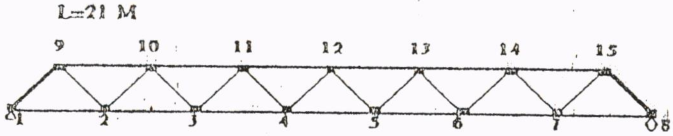


L = 24M

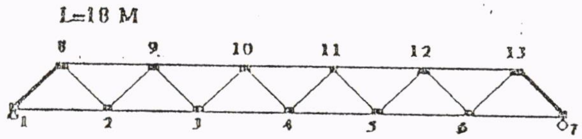


LAG-VN SINGLE TRIANGULAR-SHAPE TRUSS

L=21 M



L=18 M



L= 15 M