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Canal ways for coastal cities

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Abstract

In the world of transportation engineering there are five ways of transportation, for goods and for man. This paper is focused on introducing a sixth way of transportation that is different from Roadways, Rail Ways Airways, Waterways and tube ways. It is slightly related to the waterways of transportation and is named as canal ways. By utilizing the enormous availability of sea water in coastal cities, a more reliable and economical mode of transportation can be introduced. Concept behind the canal ways consist of providing canal carrying flowing seawaters from oceans and making a network of water highways on which the so designed floating carts can be drive. For making it more controllable provision of rails alongside the canal is considered. The buoyancy provided by the canal water will provide an uplift thrust and slope in the canal will provide a forward thrust. Resultant of these two forces facilitated by water to the cart will reduce the normal force between the rails and the cart and hence indirectly reducing the frictional forces involved. The cart is designed as a non-mechanically drive, the cost of operation is purely dependent on the head of water flowing in the canal. A steady flow in the canal will be provided by Tidal Dams near the shore that will be capable in driving the whole system without supply of any mechanical or electrical energy.

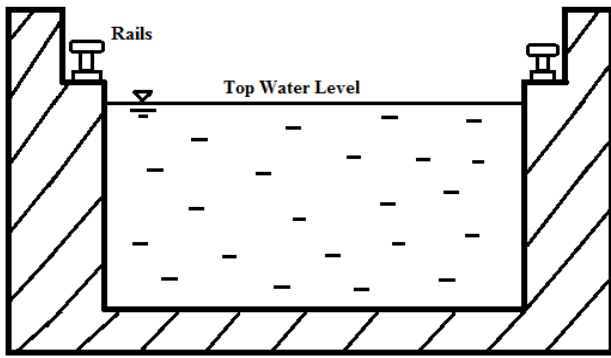
Keywords: Canal Ways, Tidal Dams, Ocean Power, Self-cleaning velocity, Rectangular Canal Section, transportation.

1. Introduction

Introducing a new way of transportation comes up with various challenges and requirements. These include feasibility over existing methods, design limitations and construction challenges. Talking about feasibility over existing methods, this method has a potential of providing a very smooth transportation in coastal cities with extremely low operating cost. Operation methods adopted in railways is to drive trains over the rails by providing electrical energy or burning fossil fuels. In this era of energy crisis feeding these transportation demand is became more challenging than ever. In Canal Ways the transportation is planned to be operated by flowing sea water that is maintained at a self-cleaning velocity by a series of tidal dams. If properly designed then this method has potential to drive the transportation of coastal cities with immense sea energy by this self-sustaining method at a very low cost of operation. Design of canals is well known to engineering for most efficient section and a self-cleaning velocity slope. By utilizing these previously known concepts, a highly efficient transportation system can be designed. The use of canals as waterways is not new, but using at a grand level to power transport of a whole city needs some serious designing and introduction to new methodology for construction. This method is slightly related to railways and waterways combined. Introduction of rails alongside the canals give more smooth and controlled ride on floating carts. The buoyancy provided by the water will reduce the friction between the rails and the cart to a significant amount. Application is not limited to intercity man transportation but also flexible to the continuous transportation of goods within the city without and obstacle.

2. Sectional design of canal

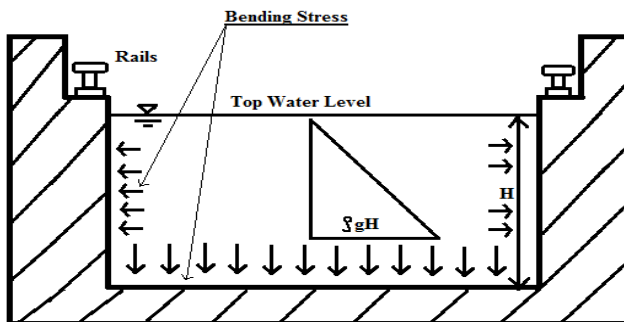
Sectional design showing the rectangular section of canal ways with rails provided alongside. The top water level lies below the rails bottom level. Cart to be run on rails will be partially submerged, taking advantage of upward thrust provided by buoyancy.



Rectangular Canal Section

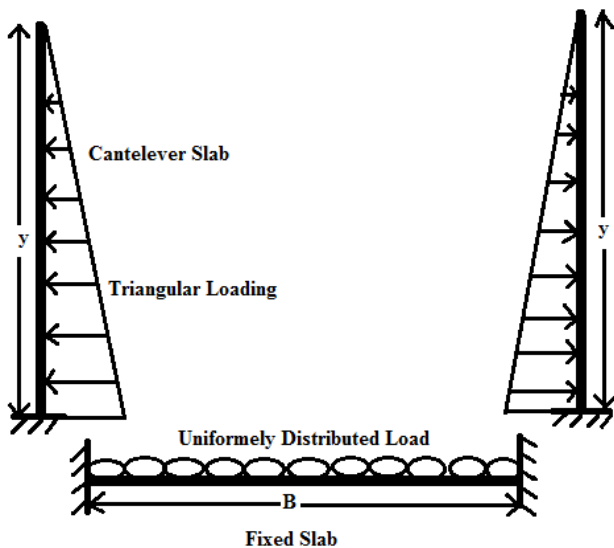
The forces acting on canal will be water pressure at the bottom slab, at the side walls and the excess pressure due to the buoyancy provided to the cart.

3. Stress analysis



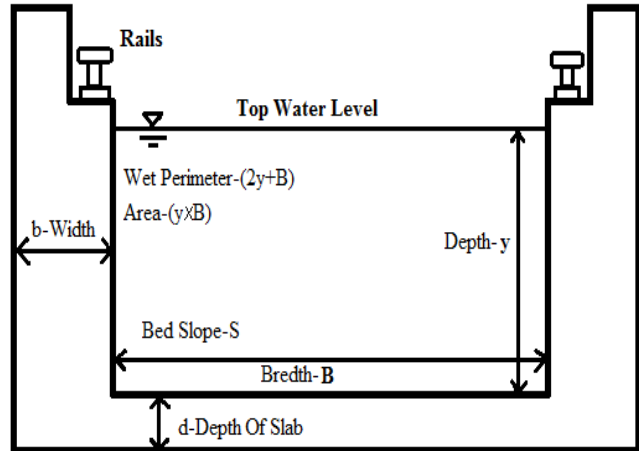
Stress Developed

Stress distribution is represented via vectors along the bottom slab, and side walls. The hydraulic pressure is acting at the bottom slab and producing a bending stress. Slab will act as a fixed slab with uniformly distributed loading on it. The sideways pressure is acting on the walls of canal, providing an outward UDL on the side walls. The hydraulic pressure head is represented by the triangular representation of force, with zero at the top and $\rho g H$ at the bottom. The overall pressure on the side walls is acting at $H/3$ from the bottom of the canal.



4. Design specifications

Canal is designed for a minimum of self-cleaning velocity to avoid silting at the bottom of the canal. Optimum bottom slope is provided to support this criterion. With choice of most efficient section the hydraulic mean depth is chosen and dimensions of canal is set.



y- Depth of Water

B- Breadth of Canal

s- Bed Slope

2y+B- Wetted Perimeter

y*B- Area of cross section

Hydraulic mean Depth $R = [(2y+B)/y*B]$

For most economical Section-

$$y = 2R$$

Conditions for self-cleaning velocity involves various method and conditions. Depending upon the sediments in the sea water, the constant used varies accordingly.

$$V = \sqrt{(8k/f)(es-e)/eg.ds}$$

V- Minimum Velocity of flow

k- Size of sediments in water

f- Darcy's coefficient of friction (0.03)

es- Specific gravity of sediments (1.2-2.65)

e- Specific gravity of sea water

g- Gravitational acceleration

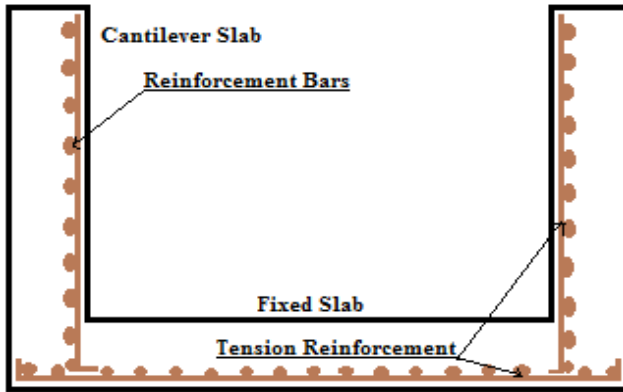
ds- Diameter of sediments in mm

5. Reinforcement specification

As per IS:456-2000 the provision for severe exposure condition the use of minimum M30 concrete is allowed. For coastal construction the M30 concrete is safe with proper provision of cover for exposure conditions.

Cantilever reinforcement: The side walls of the canal is loaded as triangular loading and is fixed only from one end. This makes it as a cantilever slab. The reinforcement provision for cantilever slab is on the tension side i.e. the inner side of the wall.

Fixed slab reinforcement: For the bottom slab which is fixed form both ends the tension reinforcement is provided at the bottom side which is at tension.



6. Acknowledgment

We wish to thank our mentors and college for supporting us in completing our work introducing the sixth way of transportation as Canal Ways. We also wish to thank our parents for providing us with assets that helped us completing research regarding this concept.

7. References

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