

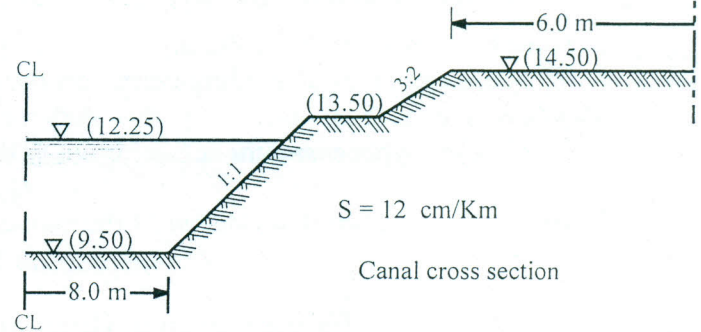
**Design of Irrigation Structures (I)**

- All sketches should be clear, neat and well proportioned
- Any missing data may be reasonably assumed.

Total marks = 100  
Two pages

**QUESTION (1) (17 marks)**

At the intersection of the roadway with a canal, a rolled steel joist bridge is to be constructed of 3 vents 4.5m each span. The canal cross section is shown in the figure. The following data are available:



- No heading up
- Roadway over bridge = 6.0 m
- Moving load = 60 tons lorry.
- Intensity of uniformly distributed L.L. = 400 kg/m<sup>2</sup>.

It is required to;

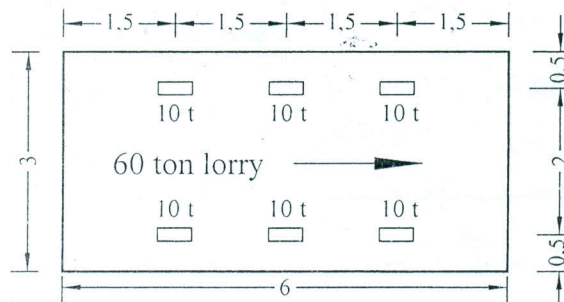
- 1- Design of main planks and cross girder. (7 marks)
- 2- Calculate the factor of safety for components of the screw pile, given P=20 t (from bridge), d = 30 cm, D = 100 cm, penetration depth = 5 m bearing capacity at ground level = 1.5 Kg/cm<sup>2</sup>,  $\gamma_s = 1.8 \text{ t/m}^3$ ,  $\phi = 25^\circ$ . F<sub>all</sub> for concrete = 60 kg/cm<sup>2</sup>. (4 marks)
- 3- Draw fully dimensioned sketches for P.H.E.R of the structure. (6 marks)

**QUESTION (2) (18 marks)**

- a) State with neat sketches types of escapes and their functions. (4 marks)
- b) At the end of canal, a Tail Escape (square well) is required to be constructed to escape the excess water from the canal to a branch drain provided that the water level in the canal does not exceed 20 cm. Following data are available.

	Canal	Drain
Bed width	3.0 m	4.0 m
Bed level	(9.50) m	(6.75) m
High water level	(11.00) m	(8.75) m
Berm level	(11.30) m	(10.80) m
Bank level	(12.30) m	(12.30) m
Bank width	6.0 m	8.0 m
Side slopes	1:1	3:2
Water surface slope	10 cm / Km	9 cm / Km

1. Give a complete design for the elements of the structure. (Length of last reach = 3.0 Km) (10 marks)
2. Draw fully dimensioned sketches for Sectional Elevation of the structure. (4 marks)

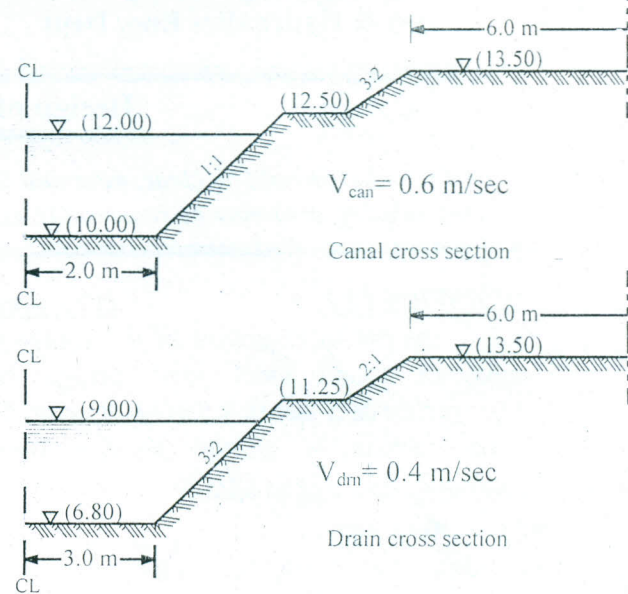


**QUESTION (3)**

**(28 marks)**

a) A straight two vent 2. x 2 m R.C syphon is to be constructed at the intersection between the given drain and canal, this syphon provided to **intermediate escape** (through the right berm only) to escape the excess water. If the escape discharge = 10% from draining discharge. It is required to;

1. **Design** the syphon hydraulically. **(7 marks)**
2. What are the cases of loading acting on the syphon, **show** the critical ones on the different cross sections of syphon and the affecting loads on it. **(8 marks)**
3. **Draw** the U.S section elevation of the syphon. **(5 marks)**

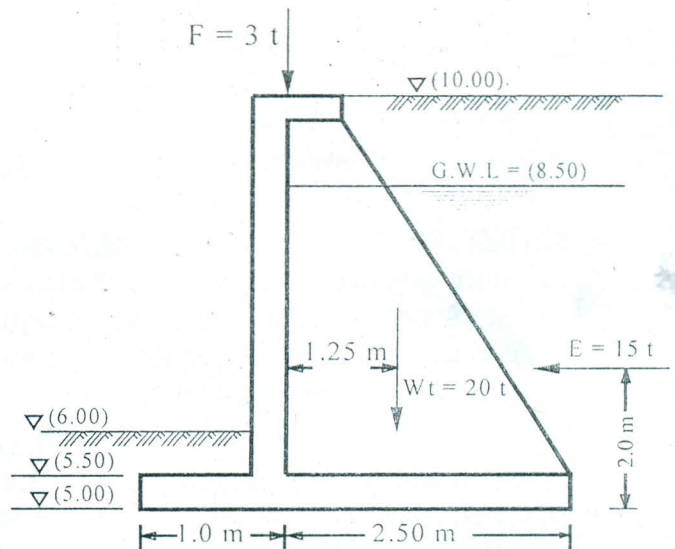


b) The alternative for the syphon in **Question (3-a)** is aqueduct without intermediate escape, two vent R.C box type. It is required to, **design** the vents (**open channel hydraulic system**) and determine location of supports for aqueduct part. **(8 marks)**

**QUESTION (4)**

**(20 marks)**

- a) Give the empirical dimensions of all elements of the Arch Bridge used net sketch. **(5 marks)**
- b) The given figure shows a R.C counterfort type retaining wall. The allowable bearing capacity of the soil is 1.5 Kg/cm<sup>2</sup> and sliding coefficient  $\mu = 0.5$ . It is required:
  - 1- **Check** the wall stability against sliding, overturning and stressing. **(10 marks)**
  - 2- **Show how** you can design the horizontal slab and in this wall, show it's of Reinforced details. **(5 marks)**

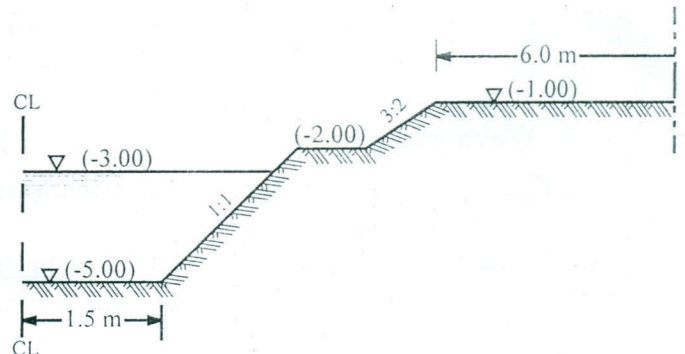


**QUESTION (5)**

**(17 mark)**

A R.C. bridge providing **zero heading-up**, was proposed to pass a road 9.0m wide across a canal whose discharge is 5.0 m<sup>3</sup>/sec and the canal cross section is shown in the figure. It is required:

- 1- **Choose span** of the bridge, **calculate** the **maximum bending moment** for **superstructure**. **(12 marks)**
- 2- **Draw sectional side view** for bridge. Live loads are 600 kg/m<sup>2</sup> and 60 ton lorry. **(5 marks)**



*With Best Wishes*

*Dr. Samy Khalaf*