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**QUESTION ONE**

a) Define flexural strength

b) A group of four piles supports a 450 x 450 mm rectangular column which transmits an ultimate axial load of 4000 kN. If the pile diameter is 500 mm spaced at 1350 mm Centre - Centre, design the pile cap using fcu =30N/mm2, fy=410N/mm2.

**Answer**

1. The flexural strength of a material is defined as the maximum bending stress that can be applied to that material before it yields. The most common way of obtaining the flexural strength of a material is by employing a transverse bending test using a three-point flexural test technique. Flexural strength is also known as bending strength, modulus of rupture or transverse rupture strength.

**Shear check**

**QUESTION TWO**

a) A cantilever retaining wall has angle of friction 450 and supports a granular materials of saturated density of 1820kg/m3. Check the stability of the wall and determine the overturning and restrained moments. Assume 30-410N/mm3 grade of concrete.

b) Give reasons for the following; (a) Bored piles are enlarged at base (b) Precast piles must be reinforced and design to resist bending moment.

**Solution**

Bi) bored piles are enlarged at base so that they have large bearing capacity or greater resistance to uplift.

ii) precast piles must be designed to resist bending moment and stacking the head of the pile must be reinforced to withstand the impact of the driving hammer.

**QUESTION THREE**

**a)** Write a well detailed explanation of the construction procedure including materials used, tests on soil bearing capacity, pile length e.t.c during the construction of Fajuyi Park Bridge, Ado-Ekiti.

b) If a Bridge structure is to be located within Afe Babalola University, suggest a likely location and justify your assertion.

**Answer**

**Construction Procedure of a Bridge**

 **Placement / Location**

Whether the bridge to be built is for private use on an estate or for a busy municipal roadway, placement is the first consideration of the bridge building process. There is always a reason bridges need to be built, and that is to meet a need. It could be to allow access to an otherwise inaccessible location. It could be to drive traffic to a business district. Or it could be merely to enhance the architecture and aesthetics of an estate or company headquarters.

Construction of the [foundations](http://www.brighthubengineering.com/structural-engineering/59793-bridge-design-planning-and-construction/) is the first step toward building a bridge. This process involves detailed geotechnical investigations of the bridge site. The type of bridge foundation has to be selected, such as the well foundation, pile foundation, and the opened foundation. Each foundation is suitable for specific soil strata, and the desired bridge characteristics. The soil characteristics will determine the load bearing capacity, and other important parameters.

**Design**

For some, the design can be simple. If your farm co-op needs a bridge over a small creek to provide access to cattle, you probably will not opt for decorative lamps and painted arches. On the other hand, if your expanding business complex opens onto main street where potential clients have to pass to enter, decor enhances your brand.

**Cost Estimation**

Suppose one of you wants to build a tower. Won’t you first sit down and estimate the cost to see if you have enough money to complete it?

The obvious costs involved are the steel, concrete, rebar, labor, etc. But there are other costs that need to be factored in the equation. Our experienced experts know the costs involved, whether its material, legal, or human resource. We can give you a clear and accurate estimate before you make your decision to move forward.

* Bidding
* Negotiation
* Permits
* Fees

**Construction**

There are numerous options once you arrive at the actual construction stage for the bridge. If you followed the steps of the process, it is indeed “as simple as building blocks.” If you ever helped your child assemble a Legos kit, you get the point. This is why we call it a process. If everything is done correctly and in order, you will be rewarded with a bridge to be proud of.

* Break Ground
* Compaction of Soil
* Pour Abutments
* Girder Placement
* Decking Plan
* Railings Installed
* Paint and Decor
* Testing.

b) if a bridge should be built in Abuad it should located over the stream at the back of the staff quarters reason being that building a bridge there would make it easier for water to be taken for treatment as the water from the stream is used for different activities. Building a bridge in this location would open up the area as the land around the stream could be used other purposes such as beverage production instead of the space lying fallow. Location of water consuming factories close to the stream at this point reduces the cost of transporting water.

Secondly the soil around the stream is muddy and quite slippery, a small bridge in the area will enable hydrology practical’s to be conducted easily in the sense that a stair case can be constructed by the side of the bridge that way mobility around the stream would be easier.

**QUESTION FOUR**

a) Differentiate between HA and HB loading system.

b) Give a mathematical definition of active and passive pressure acting on a retaining wall.

c) A reinforced concrete portal bridge with group of vertical piles shown in Figure Q1 is subjected to pile load of 3000kN is acting vertically at point P. Determine the load distribution of the individual pile if, =5.5 m , . **[15 Marks]**



**Solution**

(I) HA (highest axle load) loads first appeared in 1945 and the concept of HB (highest body load) load was introduced in BS 153 in 1954. Type HA loads is the normal loading for United Kingdom and covers vehicles up to 44tons, it adequately covers the effects of all permitted normal vehicles other than those used for abnormal indivisible loads, HA loads are represented by a uniformly distributed load with a knife edge load. HA loads have covered the following situations:

(i) More than one vehicle occupying the width of a lane;

(ii) Overloading in normal vehicles;

(iii) Impact load induced when car wheel bounce when traveling crossing potholes.

**HB loading (**highest body load**)** requirements derive from the nature of exceptional industrial loads (e.g. electrical transformers, generators, pressure vessels, machine presses, etc.) likely to use the roads in the area. The vehicle load is represented by a four axle vehicle with four wheels equally spaced on each axle. The load on each axle is defined by a number of units which is dependent on the class of road. Motorways and trunk roads require 45 units, Principal roads require 37.5 units and other public roads require 30 units. One unit of HB is equal to 10kN per axle.

ii) Active Pressure

Passive Pressure