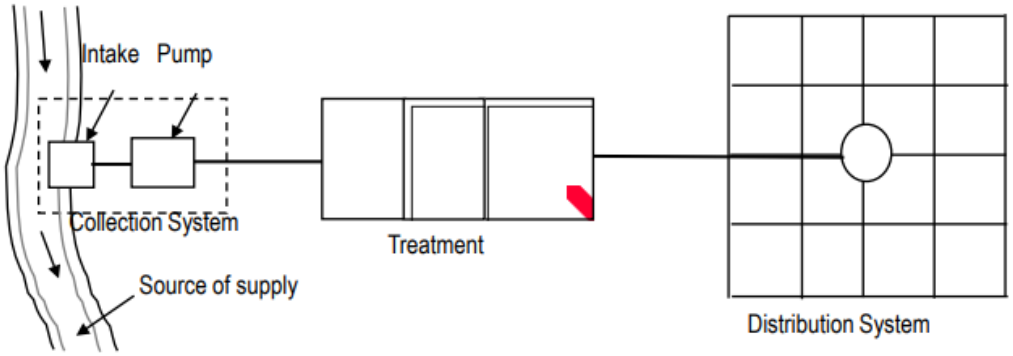
Health Engineering Department - 2020
Post: Assistant Engineer (Civil)

০১. ক) Water supply system এর উপাদান গুলো লিখুন এবং অংকন করুন

Solution:

1. Source of water
2. Collection system
3. Treatment system
4. Distribution system



খ) Bleaching powder এ 30% Chlorine আছে। 0.5 mg/L ডোজের 4 million litter পানিতে treat করতে কি পরিমান bleaching powder লাগবে ?

Solution:

Waste water to be treated $= 4$ Mld $= 4000000$ L/day

Amount of chlorine required $= \frac{4000000 \text{ x } 0.5}{1000 \text{ x } 1000} = 2$ kg

Amount of bleaching powder required $= \frac{2 \text{ x } 100}{30} = 6.67$ kg

০২. ক) একটি 5.1% grade রাস্তার SSD নির্নয় করুন যখন এর গতিবেগ 30 mph.

Solution:

Assume, Reaction time, $t = 2.5$ sec

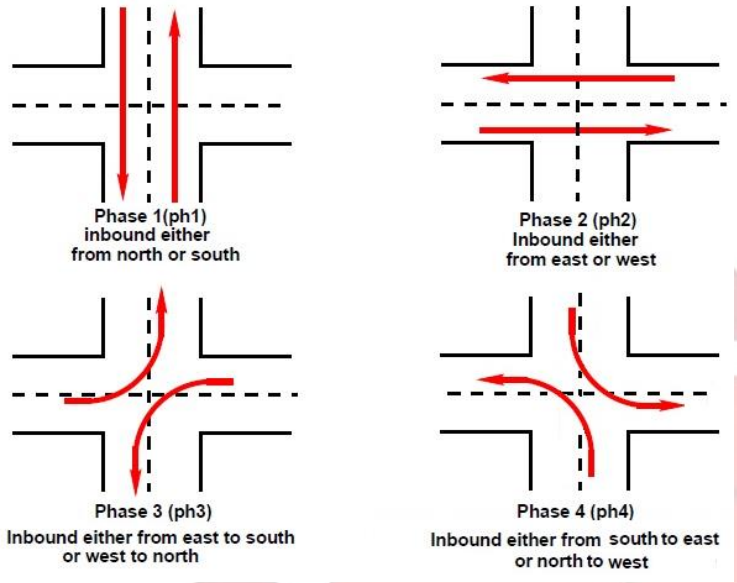
$$SSD = 1.47\ V\ t + \frac{V^2}{30\left(\frac{a}{g} \pm G\right)}$$

$$SSD = 1.47 \text{ x } 30 \text{ x } 2.5 + \frac{30^2}{30\ (0.35 + 0.051)} = 185.06 \text{ ft (If the gradient is positive)}$$

$$SSD = 1.47 \text{ x } 30 \text{ x } 2.5 + \frac{30^2}{30\ (0.35 - 0.051)} = 210.58 \text{ ft (If the gradient is negative)}$$

খ) 4 leg intersection এর 4 phase signal এর জন্য traffic movement অংকন করুন ।

Solution:



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০৩. ক) Quick sand এবং Sand drain বলতে কি বোঝায় ?

Solution:

Quick sand: Quick sand condition is the floatation of particles of cohesion less soil, like fine gravel and sand, due to vertical upward seepage flow. As sand boiling occurs, the bearing capacity and shear strength of the cohesion less soil decrease and the agitations of soil particles become apparent. Quick sand condition is not a type of soil but a flow condition that occurs in cohesion less soils. Practically, boiling condition may occur when excavations are made below the water table and water is pumped out from the excavation pit to keep the area free from water.

Sand drain: Sand Drain is based on principles of rapidly and centrally dewatering system. Sand

Drain is a process of radial consolidation which increases rate of drainage in the embankment by driving casing into the embankment and making vertical boreholes. The holes are backfilled with suitable grade of sand.

খ) প্রতি ৬ ইঞ্চি পর পর ধারাবাহিক penetration এর জন্য blow লাগে 4,6,8 টি তাহলে SPT এর মান কত ?

Solution:

SPT value $= 6 + 8 = 14$

০৪. ক) Concrete এর strength কি কি বিষয়ের উপর নির্ভর করে ?

Solution:

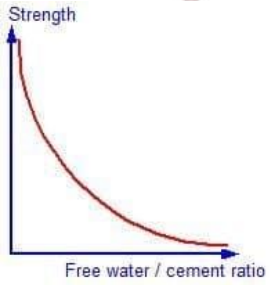
Factors Affecting Strength of Concrete: Concrete strength is affected by many factors, such as quality of raw materials, water/cement ratio, coarse/fine aggregate ratio, age of concrete, compaction of concrete, temperature, relative humidity and curing of concrete.

Cement: Cement affect strength of concrete directly, Appropriate & standard quality of cement should use for proper strength of concrete.

Aggregates: Quality of aggregates, its size, shape, texture, strength etc. determines the strength of concrete. The presence of salts, silt and clay also reduces the strength of concrete.

Water: Quality of the water should be fit for drinking.

Water/Cement Ratio: The higher the water/cement ratio, strength reduced. But w/c should not be less than 0.5, after that workability will reduce. The relation between water cement ratio and strength of concrete is shown in the plot as shown below.

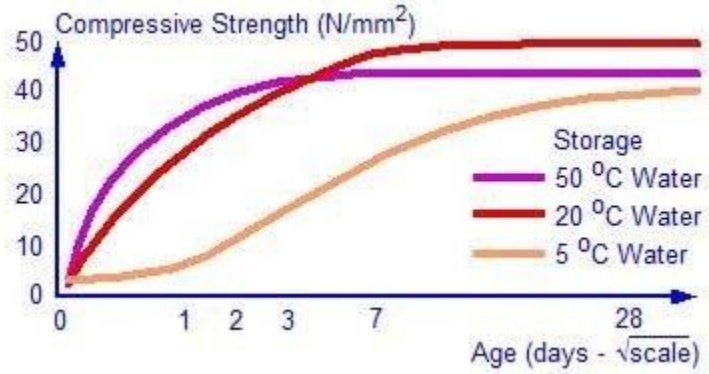


Age of concrete: The degree of hydration is synonymous with the age of concrete provided the concrete has not been allowed to dry out or the temperature is too low. It is generally accepted that the majority of the strength has been achieved by 28 days.

Compaction of concrete: Any entrapped air resulting from inadequate compaction will lead to a reduction in strength. If there was 10% trapped air in the concrete, the strength will fall down in the range of 30 to 40%.

Temperature: Rate of hydration reaction is temperature dependent. If the temperature increases the reaction also increases. This means that the concrete kept at higher temperature

will gain strength more quickly than a similar concrete kept at a lower temperature. But the final strength of the concrete kept at the higher temperature will be lower.



খ) Soil improvement কি ? বাংলাদেশে ব্যাবহার হয় এমন একটি soil improvement পদ্ধতির বর্ননা করুন

Solution:

Soil improvement: Soil improvement in its broadest sense is the alteration of any property of a soil to improve its engineering performance such as strength, reduced compressibility, reduced permeability, or improved ground water condition.

Soil improvement in Bangladesh: There are various techniques used in Bangladesh for the improvement of the soil based on the construction activity and type of soil. The soil improvement techniques are

Surface Compaction: Most common method of soil improvement is surface compaction. Construction of a new road, a runway, an embankment or any soft or loose site needs a compacted base for laying the structure. If the depth is less, the surface compaction alone can solve the problem. The usual surface compaction devices are rollers, tampers and rammers. All conventional rollers like smooth wheel, rubber-tyred, sheep foot, vibratory and grid rollers are be used.

Drainage Method: Ground water is one of the most difficult problems in excavation work. The presence of water increases the pore water pressure and decreases the shear strength. Heavy inflow of water during excavation collapses the side of open excavations. Drainage method used to control the ground water and ensure a safe and economical construction scheme.

Vibration Method: Vibration method can be effectively used for rapid densification of saturated non-cohesive soils. Some of the mostly adopted vibration methods are vibratory rollers, vibro-displacement Compaction Piles, Vibro-floatation, Heavy Tamping etc.

Pre-Compression and Consolidation: This method aims to consolidate the soil before construction. Various techniques adopted are Preloading and Surcharge Fills, Vertical Drains, Dynamic Consolidation etc.

Soil Reinforcement: Soil Reinforcement is in the form of a weak soil reinforced by high-strength thin horizontal membranes. A large variety of materials such as rubber, aluminum and thermoplastics have been used successfully.

Geotextiles and Geomembranes: Geotextiles are porous fabrics manufactured from synthetic materials, which are primarily petroleum products and others, such as polyester, polyethylene, polypropylene and polyvinyl chloride, nylon, fibre-glass and various mixtures of these. Geotextiles are used as separators, filters, Drains, reinforcement, geo-membranes etc.

০৫. ক) Waste water এ BOD5 ২০ ডিগ্রি সেলসিয়াস তাপমাত্রায় পাওয়া যায় 150 mg/L , K এর মান 0.23 / day হলে ১৫ ডিগ্রি সেলসিয়াস তাপমাত্রায় BOD8 এর মান কত হবে ?

Solution:

$$BOD_5 = BOD_u\,(1 - e^{-k\,t})$$

$$BOD_u = \frac{BOD_5}{(1 - e^{-k\,t})} = \frac{150}{(1 - e^{-0.23\ x\ 5})} = 219.50\ \text{mg/L}$$

$$K_{15} = K_{20}\ \theta^{(T-20)} = 0.23\ x\ 1.047^{(15\ -\ 20)} = 0.182/\text{day}$$

$$BOD_8 = BOD_u\,(1 - e^{-k\,t}) = 219.50\,(1 - e^{-0.182\ x\ 8}) = 168.31\ \text{mg/L}$$

খ) একটি কংক্রিট ব্লকের সাইজ যদি 5 ft x 2.5 ft x 5 inch হয় এবং কংক্রিট ডেনসিটি 2130 kg/m3 হলে 1:2:4 অনুপাতে কংক্রিট তৈরি করতে কত কেজি সিমেন্ট প্রয়োজন হবে ?

Solution:

Wet volume $= 5\ x\ 2.5\ x\ 5/12 = 5.21$ cft

Dry volume $= 1.54\ x\ 5.21 = 8.0234$ cft

$$\text{Weight of concrete block} = \frac{8.0234\ x\ 2130}{3.28\ x\ 3.28\ x\ 3.28} = 484.30\ \text{kg}$$

$$\text{Amount of cement} = \frac{1}{1+2+4}\ x\ 484.3 = 69.18\ \text{kg}$$

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