Internal Assessment Test 3 – Apr. 2018

Sub:	Alternative Building Materials					Sub Code:	15CV653	Branch:	CIVIL
Date:	23/ 05 / 18	Duration:	90 mins	Max Marks:	50	Sem/Sec:	VI-A/B		OBE

SOLUTIONS

1. a) Explain the characteristics for the selection of mortar.

8.6 SELECTION OF MORTAR

Selection of mortar for masonry construction depends upon several factors. Some of these factors are discussed below.

(*a*) Type of masonry and the strength of individual masonry unit

Type of masonry means whether it is brickwork, stone masonry, concrete block-work etc. It is preferable to have a lower modulus mortar—higher modulus masonry unit combination for satisfactory performance of masonry. Lower modulus mortars will be able to accommodate movements due to settlement, temperature and moisture changes. Stone has very high modulus and will absorb very little water from the fresh mortar bed, and hence for stone masonry used for superstructure slightly richer mortars are preferable to develop good bond strength.

(*b*) Use of masonry

Masonry is used for variety of applications like foundations, superstructure (walls), roofing panels, retaining structures, shell structures like domes, vaults etc. Generally for applications like foundations it is preferable to use leaner and lower modulus mortars which can accommodate movements due to settlements etc. Superstructure is subjected to both gravity loads and lateral loads due to wind etc. Some walls may have to be designed to resist tensile stresses. Similarly roof panels and masonry shells are subjected to tensile stresses. In such cases the mortar has to be carefully selected to give maximum tensile resistance for the masonry.

(c) Load carrying capacity of the masonry

Based on the masonry strength required to resist gravity loads masonry unit strength and mortar strength combination gives the basic compressive stress required. For example I.S. 1905 code gives a table to choose basic compressive strength of masonry based on a combination of mortar strength and brick strength.

(d) Moisture penetration, frost resistance, etc.

Impervious mortar is essential to keep away the rain water entry into inside of the buildings, prevent leakage of water retaining masonry structures etc. Composite mortars generally are more impervious than the pure cement mortars. Mortars with masonry cement and use of plasticizer additives have better resistant to frost attack during construction.

b) Write any 3 factors influencing the compressive strength of masonry.

The strength of masonry is influenced by a large number of factors. The brick, block or stone which is the basic unit of masonry will hereafter be referred to as the masonry unit. The following factors need to be considered in assessing the strength of masonry:

(*a*) Strength of masonry unit
(*b*) Height of masonry unit
(*c*) Solidity/hollowness of masonry unit
(*d*) Moisture absorption
(*e*) Strength of mortar
(*f*) Plasticity and flow characteristics of mortar
(*g*) Thickness of mortar
(*h*) Type of masonry loading
(*i*) The modular ratio of masonry unit and mortar
(*j*) Direction of loading

(a) Strength of masonry unit

In general increase in compressive strength of masonry unit will lead to an increase in the strength of masonry. However, the increase in the strength of masonry is not proportional to the increase in the strength of the masonry unit. Hendry (2) reports that the strength of masonry is proportional to the square root of the strength of masonry unit. Sahlin (3) provides a list of empirical formulas developed by various researchers. Since the masonry usually fails by the development of lateral tensile cracks, an increase in compressive strength of the unit will also increase its tensile strength and hence the improvement in the strength of masonry. However, a large increase in the strength of masonry unit may not be useful since the strength of masonry does not increase in the same proportion.

The strength of masonry is normally assessed by testing either masonry prisms or masonry wallettes. Testing of wallettes is more

reliable since the wallettes include the effect of perpend joints and the width of the wallette is two to three times the length of the brick. Since a larger number of bricks constitute the wallette, compared to the brick masonry prism, the wallette result could offset the variability in the strength of brick.

The height to thickness ratio of the prism/wallette is also important. If this is less than 3, the strength of the masonry is affected by the platen friction. It is hence desirable to use a height to thickness ratio of more than 3.

(b) Height of the masonry unit

Burnt bricks are normally laid in wall in such a way that the thickness of 7.5cm is also the height of one course of brick work. When other masonry units like stone or concrete blocks are used the height of the masonry course could be different. For instance, in size stone masonry the height of the unit is between 18 to 19cm. In the case of hollow-concrete blocks the height could be 20cm. Stabilized Mud Blocks often have courses of thickness ranging from 9 to 10cm.

The height of the unit has influences on (*i*) the strength of the unit and (*ii*) masonry efficiency. Firstly, as the height of the masonry unit increases the apparent strength of the unit decreases due to the reduction of platen effects of the testing machine. However, the 'masonry efficiency' which may be defined as the ratio of the strength of masonry to the strength of masonry unit, is in general higher as the height of the unit increases. This increase in masonry efficiency may be misleading since the strength of the unit is reduced as its height is increased. In practice, the masonry efficiency may vary over a range of values from 0.2 to 0.9.

(c) Solidity/Hollowness of masonry unit

In general, a masonry unit can offer a solid horizontal surface against vertical loading or it may have a surface which is hollowed out with holes. Usually, a masonry unit with such hollows or perforations will have a lower strength, when the strength is measured on the basis of the gross area. The hollowness of a unit contributes to a reduction in the unit weight of masonry and can sometimes be advantageous, if the strength requirements are modest.

In Table 2.3, some typical strengths of hollow clay blocks are listed. These blocks show strength upto 11.0 MPa, when tested with loading parallel to the holes. Wirecut bricks (solid) of similar material often give strength of 20.0 MPa are more. It is thus clear, a strength reduction of about 50% (with reference to the gross area) can be expected when hollow masonry units are used. In another example (4) a solid concrete block had a compressive strength of 23.7 MPa while a hollow-concrete block of the same size and material composition had

strength of 7.75 MPa when the net solid area was 52.2%. In this case, the strength reduction is nearly 70%, when the area of cross section is reduced by 50%.

(d) Moisture absorption

The moisture absorption by a brick/masonry unit is important especially when cement mortars or cement based mortars are used. If the masonry unit is dry, it will tend to absorb moisture from the mortar. If the loss of moisture from the mortar is significant, the mortar is unlikely to achieve its full strength when it is cement based. This can have an unfavourable effect on the strength of masonry. In this connection, two properties of brick/masonry unit need to be considered. Firstly, one needs to know the moisture absorption by the masonry unit when it is saturated. It is desirable to keep this value below 20%. A good masonry unit often has moisture absorption values between 10.0 to 15.0%.

Even when the moisture absorption is within limits, there is a need to understand the rate at which moisture is absorbed by the masonry unit. This rate is specified through a parameter known as the Initial Rate of Absorption (IRA). This is determined by dipping the dry masonry unit in a 3mm layer of water for one minute (ASTM C67). The IRA is then specified in terms of $kg/m^2/min$. Typical values for Indian bricks are reported by Sarangapani (5) and Gumaste (6) and Gumaste et al. (7). The studies by Gumaste showed that the IRA of Indian Bricks varied over a wide range from 1.17 $kg/m^2/min$ to 9.33 $kg/m^2/min$. However, most of the bricks showed on IRA value below 3.5 $kg/m^2/min$. There was no correlation between strength, moisture absorption and IRA.

There is also a need to understand the rate at which moisture is absorbed by the brick after the initial absorption. This is necessary since the brick must have a certain moisture content below the saturation value for satisfactory bonding with mortar. Just as a dry brick is unsatisfactory for development of mortar strength, even full saturation of the brick is not desirable at the time of masonry construction. When the brick is fully saturated, brick-mortar bond is affected as pointed out by Sinha (8) and Hendry (2). This was also verified by tests made by Venumadhava Rao using Indian bricks (9). In general, it is useful to achieve 75% saturation in the brick at the time of constructing masonry. The duration of soaking in water depends on the brick type. The experiments by Gumaste (6) showed that this duration varies between 7 minutes to 20 minutes when the IRA is below 2.0, for table moulded bricks. Wire cut bricks, however, need between 45 minutes to 60 minutes soaking.

2. a) Explain about MIVAN construction technique.

MIVAN: - A Versatile Formwork

The system of aluminum forms (MIVAN) has been used widely in the construction of residential units and mass housing projects. It is fast, simple, adaptable and cost – effective. It produces total quality work which requires minimum maintenance and when durability is the prime consideration. This system is most suitable for Indian condition as a tailor–made aluminum formwork for cast–in–situ fully concrete structure.

Background

Mivan is basically an aluminium formwork system developed by one of the construction company from Europe. In 1990, the Mivan Company Ltd from Malaysia started the manufacturing of such formwork systems. Now a day more than 30,000 sq m of formwork used in the world are under their operation. In Mumbai, India there are number of buildings constructed with the help of the above system which has been proved to be very economical and satisfactory for Indian Construction Environment.

The technology has been used extensively in other countries such as Europe, Gulf Countries, Asia and all other parts of the world. MIVAN technology is suitable for constructing large number of houses within short time using room size forms to construct walls and slabs in one continuous pour on concrete. Early removal of forms can be achieved by hot air curing / curing compounds. This facilitates fast construction, say two flats per day. All the activities are planned in assembly line manner and hence result into more accurate, well – controlled and high quality production at optimum cost and in shortest possible time.

In this system of formwork construction, cast – in – situ concrete wall and floor slabs cast monolithic provides the structural system in one continuous pour. Large room sized forms for walls and floors slabs are erected at site. These forms are made strong and sturdy, fabricated with accuracy and easy to handle. They afford large number of repetitions (around 250). The concrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers.

The frames for windows and door as well as ducts for services are placed in the form before concreting. Staircase flights, façade panels, chejjas and jails etc. and other pre-fabricated items are also integrated into the structure. This proves to be a major advantage as compared to other modern construction techniques.

The method of construction adopted is no difference except for that the sub – structure is constructed using conventional techniques. The super–structure is constructed using MIVAN techniques. The integrated use the technology results in a durable structure.

b) Write about top- down construction in detail.

TOP – DOWN CONSTRUCTION TECHNIQUES

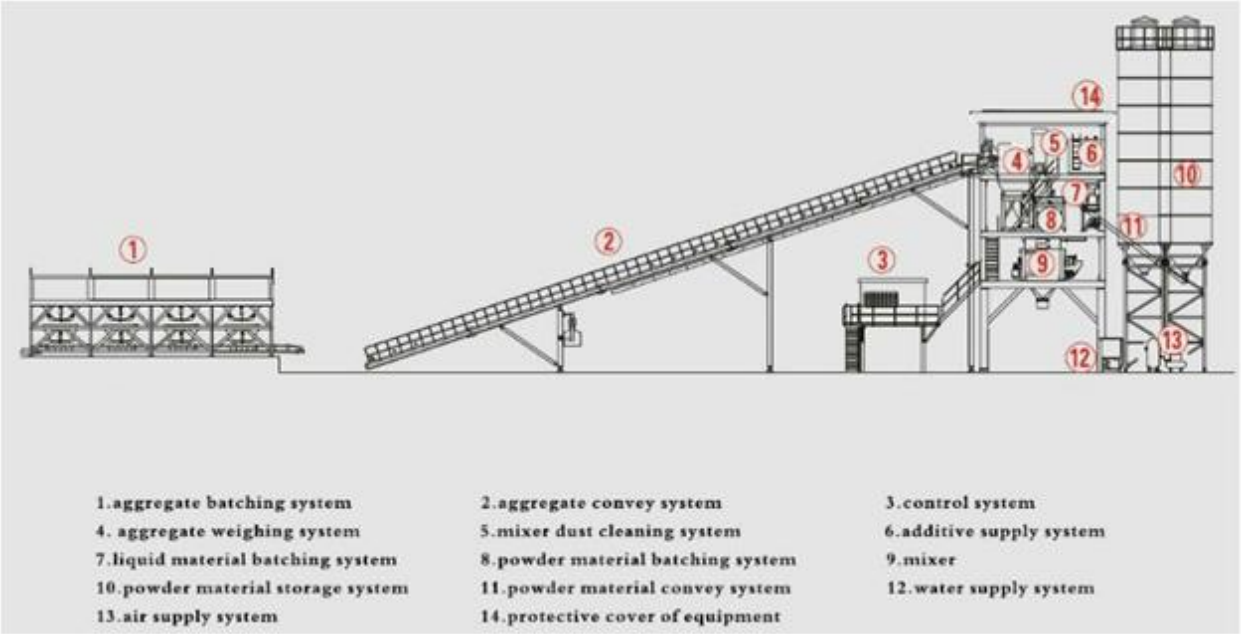
Introduction

Conventionally building having basements are usually built by bottom-up method. In simple words , stage of construction is from bottom of sub-structure to top of superstructure.Gigantic civil engineering projects usually have constraints of time and working space. So one has to follow the reverse of this conventional procedure. We call it “Top Down construction method” which means one goes from top to bottom.

What is the reason for selecting Top Down Construction?

1. Distance between boundary wall of existing building and building to be constructed is too close and possibility of soil collapse is too high.
2. This method is preferred for buildings having two or more basements.
3. If water table is too high in area where building has to be constructed.
4. This method is usually preferred for tall buildings with deep basements , underground car parks , underpasses and metro railway projects.

3. **Draw a labeled diagram of an RMC plant and explain its parts.**



4. **a) Describe the use of laterite blocks and stabilized mud block**

Laterite Stone Blocks:

- Size:13x8x8/12x7x8 inches
- Laterite - Most commonly used stone in construction in Goa, it is soft when unearthed but hardens once exposed and is resistant to air and water.
- When moist, laterites can easily be cut with a spade into regular-sized blocks.
- Laterite is mined while it is below the water table, so it is wet and soft.
- Upon exposure to air it gradually hardens as the moisture between the flat clay particles evaporates and the larger iron salts lock into a rigid lattice structure and become resistant to atmospheric conditions.
- The art of quarrying laterite material into masonry is suspected to have been introduced from the Indian subcontinent.
- These stones are used for constructing buildings instead of bricks and other stones.
- When these stones are used, plastering and painting can be avoided and the stones are very strong.

- It can save the cost of painting and plastering and gives building an elegant look.
- The room temperature will be very low inside the building that AC can be used seldom.

SMB pls refer ppt.

5. b) Write the difference between sand and m-sand.

Parameters	M Sand	River Sand
Process	Manufactured in factory.	Naturally available on river banks.
Shape	Angular and has rougher texture. Angular aggregates demands more water. Water demand can be compensated with cement content.	Smoother texture with better shape. Demands less water.
Moisture Content	Moisture is available only in water washed M Sand.	Moisture is trapped in between the particles which is good for concrete purposes.
Concrete Strength	Higher concrete strength compared to river sand used for concreting.	Lesser concrete concrete compared to M Sand
Silt Content	Zero silt	Minimum permissible silt content is 3%. Anything more than 3% is harmful to the concrete durability. We can expect 5 - 20% slit content in medium quality river sand.
Over Sized Materials	0%. Since it is artificially manufactured.	1 - 6% of minimum over sized materials can be expected. Like pebble stones.
Marine Products	0%	1 - 2% like sea shells, tree barks etc
Eco Friendly	Though M Sand uses natural coarse aggregates to form, it causes less damage to environment as compared to river sand.	Harmful to environment. Eco imbalances, reduce ground water level and rivers water gets dried up.
Price	M Sand price ranges from Rs.35 - Rs.45 per cubic feet in Bangalore.	River sand price ranges from Rs 60 - 80 per cubic feet in Bangalore.
Adulteration	Probability of adulteration is less.	High probability of adulteration since filtered sand (a type of pre-washed sand which contains high silt contents) are mixed together. As a rule, supply shortage always brings adulterer products to the market.
Applications	Highly recommended for RCC purposes and brick/ block works.	Recommended for RCC, plastering and brick/ block work.
Quality	Better quality control since manufactured in a controlled environment.	No control over quality since it is naturally occurring. Same river bed sand can have differences in silt contents.
Particle passing 75 micron	Up to 15% (IS: 383 - 1970)	Up to 3% (IS:383 - 1970)

6. **List the parts of any one stabilized mud block compressing equipment, explain its capacity, mould size and other details of the equipment.**
7. ***Aurum Press 3000 Multi-Mould Manual Press***

   Main features are:
   - Block height adjustable in 1 to 5 mm increments
   - High and adjustable compression ratio
   - Double compression (folding back lid)
   - Easy interchange ability of moulds
8.

Technical specifications:

• Available force	: 150 KN (15 tons)
• Compression ratio	: 1.60 to 1.83
• Block height (mm)	: 25 and 50, then up to 100 in 1 to 5 mm increments
• Practical output	: 106 strokes per hour
• Daily output	: 1,000 plain blocks
• Manpower needed	: 3 men on machine, plus 4 more mixing and handling
• Net weight	: 365 kg to 415kg