MORTAR

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Introduction

- The term *mortar* is used to indicate a paste prepared by adding required quantity of water to a mixture of binding material like cement or lime and fine aggregate like sand.
- The two components of mortar, the binding material and fine aggregate are sometimes referred to as the ***matrix*** and ***adulterant*** respectively.
- The matrix binds the particles of the adulterant and as such, the durability, quality and strength of mortar will mainly depend on the quantity and quality of the matrix.
- The combined effect of the two components of mortar is that the mass is able to bind the bricks or stones firmly.

Classification of Mortars

- The mortars are classified on the basis of the following:

1) Bulk density
2) Kind of binding material
3) Nature of application
4) Special mortars

1) Bulk density : According to the bulk density of mortar in dry state, there are two types of mortars

(i) Heavy Mortars

(ii) Lightweight Mortars

Heavy Mortars : The mortars having bulk density of 15 kN/m3 or more are known as the heavy mortars and they are prepared from heavy quartz or other sands.

Lightweight Mortars : The mortars having bulk density less than 15 kN/m3 are known as the lightweight mortars and they are prepared from light porous sands from pumice and other fine aggregates.

2) Kind of binding Material : The kind of binding material for a mortar is selected by keeping in mind several factors such as expected working conditions, hardening temperature, moisture conditions, etc., According to the kind of binding material, the mortars are classified into the following five categories :

(i) Lime mortar (ii) Surkhi mortar (iii) Cement mortar (iv) Gauged mortar (v) Gypsum mortar

(ii) Lime mortar : In this type of mortar, the lime is used as binding material. The lime may be fat lime or hydraulic lime.

- The fat lime shrinks to a great extent and hence it required about 2 to 3 times its volume of sand. The lime should be slaked before use. This mortar is unsuitable for water – logged areas or in damp situations.

- For hydraulic lime, the proportion of lime to sand by volume is about 1:2 or so. This mortar should be consumed within one hour after mixing. It possesses more strength and can be used in damp situations.
- The lime mortar has a high plasticity and it can be placed easily.
- It possesses good cohesiveness with other surfaces and shrinks very little.
- It is sufficiently durable, but it hardens slowly.

(ii) Surkhi Mortar: This type of mortar is prepared by using fully surkhi instead of sand or by replacing half of sand in case of fat lime mortar. The powder of surkhi should be fine enough to pass BIS No.9 Sieve(1 mm) and the residue should not be more than 10% by weight.

- The surkhi mortar is used for ordinary masonry work of all kinds in foundation and superstructure. But it cannot be used for plastering or pointing since surkhi is likely to disintegrate after some time.

(iii) Cement Mortar : In this type of mortar, the cement is used as binding material. Depending upon the strength required and importance of work the proportion of cement to sand by volume varied from 1:2 to 1:6 or more.

The sand only can be used to form cement mortar.

- The proportion of cement with respect to sand should be determined with due regard to the specified durability and working conditions.
- The cement mortar is used where a mortar of high strength and water resisting properties is required such as underground constructions, water saturated soils, etc.,

(iv) Gauged mortar : To improve the quality of lime mortar and to achieve early strength, the cement is sometimes added to it.

- This process is known as the gauging. It makes lime mortar economical. strong and dense.
- The usual proportion of cement to lime by volume is about 1:6 to 1:8.
- It is also known as the composite mortar or lime – cement mortar and it can also be formed by the combination of cement and clay.
- This mortar may be used for bedding and for thick brick walls.

(v) Gypsum Mortar : These mortars are prepared from gypsum binding materials such as building gypsum and anhydrite binding materials.

3) Nature of application : According to the nature of application, the mortars are classified into two categories :

(i) Bricklaying Mortars (ii) Finishing Mortars

(i) **Brick laying Mortar :** The mortars for bricklaying are intended to be used for brickwork and walls. Depending upon the working conditions and type of construction, the composition of masonry mortars with respect to the kind of binding material is decided.

(ii) **Finishing mortars :** These mortars include common plastering work and mortars for developing architectural or ornamental effects. The cement or lime is generally used as binding material for ordinary plastering mortar. For decorative finishing, the mortars are composed of suitable materials with due consideration of mobility, water retention, resistance to atmospheric actions, etc.,

4) Special Mortars : Following are the various types of special mortars which are used for certain conditions:

(i) Fire – resistance mortar

(ii) Light weight mortar

(iii) Packing Mortar

(iv) Sound – absorbing Mortar

(v) X – ray Shielding Mortar

Properties of Good mortar mix and Mortar

- The important properties of a good mortar mix are mobility, placeability and water retention.
- The term *mobility* is used to indicate the consistency of mortar mix which may range from stiff to fluid. The mobility of mortar mix depends on the composition of mortar and the mortar mixed to be used for masonry work, finishing work, etc., are made sufficiently mobile.
- The term *placeability* or the ease with which the mortar mix can be placed with minimum cost in a thin and uniform layer over the surface depends on the mobility of the mortar. The placeability of mortar mix should be such that a strong bond is developed with the surface of the bed.
- A good mortar mix should possess the ability of retaining adequate humidity during transportation and laying over the porous bed. If water retention power of mortar mix is low, it separated into layers during transportation and when it comes into contact with porous bed such as bricks, wood, etc., it gives away its water to that surface Thus the mortar becomes poor in amount of water and the remaining water proves to be insufficient for its hardening, Hence the required strength of mortar will not be achieved with such a mortar mix.

Following are the properties of a good mortar :

i. It should be capable of developing good adhesion with the building units such as bricks, stones, etc.,
ii. It should be capable of developing the designed stresses.
iii. It should be capable of resisting penetration of rain water.
iv. It should be cheap.
v. It should be durable.
vi. It should be easily workable.
vii. It should not affect the durability of materials with which it comes into contact.
viii. It should set quickly so that speed in construction may be achieved.
ix. The joints formed by mortar should not develop cracks and they should be able to maintain their appearance for a sufficiently long period.

Uses Of Mortar

- To bind the building units such as bricks, stones, etc., into a solid mass.
- To carry out pointing and plaster work on exposed surfaces of masonry
- To form an even and soft bedding layer for building units
- To form joints of pipes
- To improve the general appearance of structure
- To prepare moulds for coping, corbels, cornice, etc.,
- To serve as a matrix or cavity to hold coarse aggregated, etc.,
- To distribute uniformly the super incumbent weigh from upper layer to lower layer of bricks or stones
- To hide the open joints of brickwork and stonework
- To fill up the cracks detected in the structure during maintenance process, etc.,

Preparation of Mortar

- For preparing mortar, the water is added to an intimate mixture of binding material and sand.
- The water to be used for this purpose should be free from clay, earth and other impurities.
- The water which is fit for drinking should only be used for preparing mortar.
- The different mortars are prepared in the following ways :

1) **Lime mortar :** The lime mortar is prepared either by pounding or grinding.

- The pounding is adopted for preparing small quantities of mortar.
- The grinding is adopted for preparing large quantities of mortar and to ensure a steady and continuous supply of mortar.
- Two objects of pounding or grinding lime mortar are : (i) To crush the particles of unslaked lime, if any, so as to ensure slaking; and (ii) To make an intimate mixture of the whole mass so that no two grains of sand are without an intervening film of the binding materials.

- ***Pounding :*** In this method, the pts are formed in hard ground and they are provided with lining of bricks or stones at their sides and bottom. The pits are about 1.8 m long, 400 mm wide at bottom, 500 mm wide at top and 500 mm deep.
- The lime and sand are mixed in dry state and the mixture is then placed in pits.
- A small quantity of water is added and four to five persons with heavy wooden pounders or beaters work on mortar.
- They turn mortar up and down frequently.
- The required quantity of water is added at intervals.
- When desired consistency is achieved, the mortar from pits is taken out. This method of preparing lime mortar is not efficient.
- ***Grinding :*** In this method, the grinding mills are used to prepare mortar.
- These mills are of the following two types :

(i) Bullock driven grinding mill

(ii) Power – driven grinding mill

(i) **Bullock – driven grinding mill :** This is also known as the ghani.

- ✓ In this, A circular trench of diameter about 6 m to 9 m and depth of about 400 mm is prepared.
- ✓ The width of the trench is about 300 mm or so to accommodate stone wheel with side margins of about 50 mm.
- ✓ A horizontal wooden shaft passes through stone wheel.
- ✓ One end of shaft is attached to the pivot and at the either end, the bullock is attached to cause the rotation of stone wheel.
- ✓ The lime and sand in required proportion are placed in the trench by shovels.
- ✓ The required quantity of water is added to bring proper consistency of the mortar and the bullock is allowed to take turns round the mill.
- ✓ As bullock rotates, the lime and sand are intimately mixed by the grinding action of stone wheel.
- ✓ In addition, they are also frequently turned with the help of spade.
- ✓ To record the number of turns made by the bullock, an arrangement known as the beale's tell – tale is provided at the pivot.
- ✓ It is in the form of a spindle with groove. A turn is indicated by the rise or fall of groove.
- ✓ A normal ghani can prepare about 1.7 m3 of mortar at a time and it will require a period of about 6 hours to complete one cycle of operation.

(ii) Power – driven grinding mill : In this type of mill, the power is used to mix intimately lime and sand.

- ✓ It consists of a revolving pan of diameter about 1.8 m to 2.4 m.
- ✓ In this pan, two rollers are provided.
- ✓ The rollers are fixed.
- ✓ The pan is revolved either with the help of an oil engine or steam engine or electric power.
- ✓ In another variety, the pan is kept stationary and the rollers are moving.
- ✓ The lime and sand in required proportions are placed in pan.
- ✓ The required quantity of water is added and the pan is then revolved.
- ✓ This method of grinding lime mortar is quite efficient and it produces mortar of better quality.
- ✓ It also ensures steady and continuous supply of mortar.

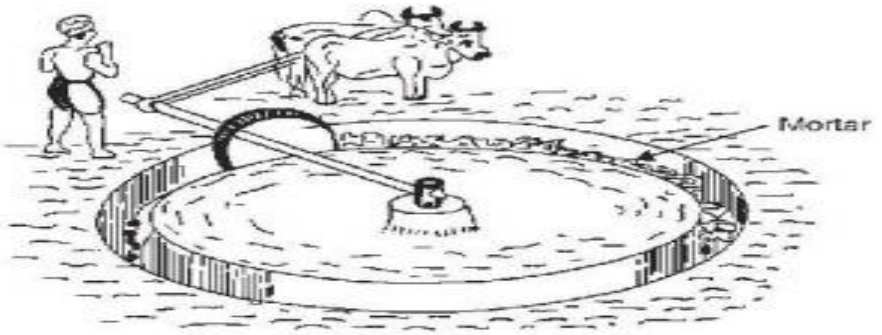

Fig. 19 Bullock Driven Mortar Mill (Ghanni)

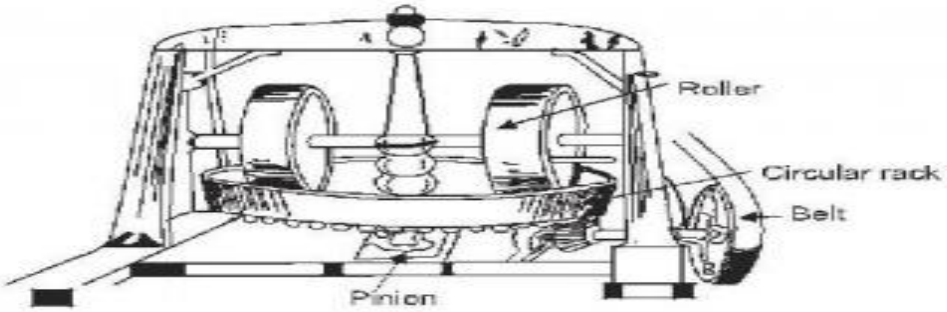

Fig. 20 Power Driven Mortor Mill (Pan Mill)

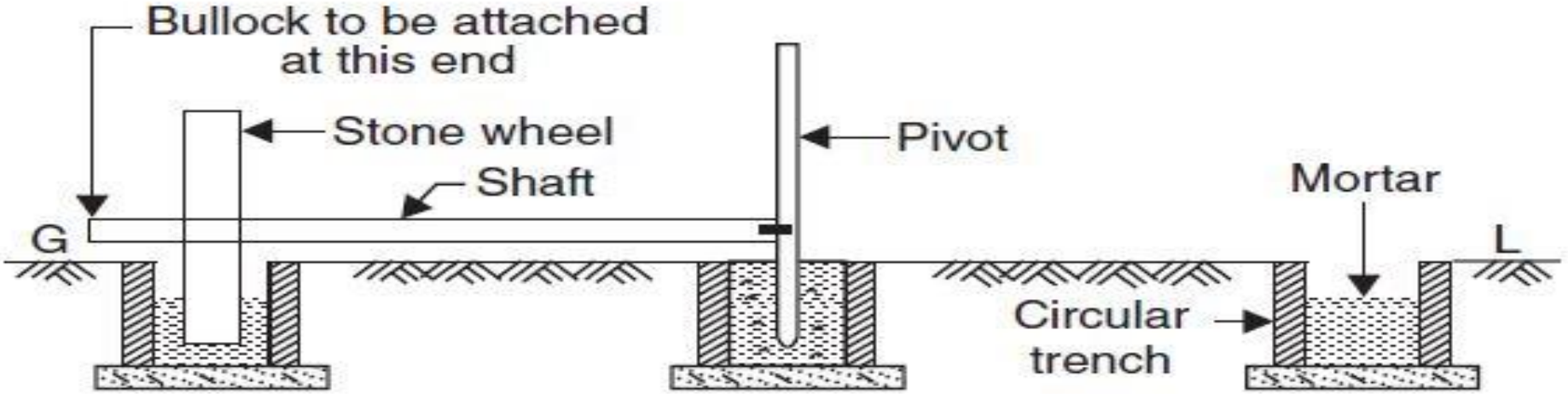

Fig. 2.1. Bullock driven grinding mill

(2) Surkhi Mortar : The mix of fat lime and surkhi, surkhi and sand is decided and it is converted into a good paste by grinding in a mortar mill or by pounding.

(3) Cement mortar : This mortar does not require pounding or grinding. The cement and sand are mixed in required proportions in dry state on a watertight platform or steel trough. The mixing in dry state is done twice or thrice. The water is then added and the ingredients are again thoroughly mixed.

(4) Gauged mortar : The lime mortar is prepared as shown above. The required quantity of cement is then added and the ingredients are thoroughly turned up and down to cause intimate mixing.

Tests For Mortars

- Following are the usual tests for mortar :

1) Adhesiveness to building units :

i. The two bricks are placed at right angles to each other.

ii. The mortar is placed to join them so as to form a horizontal joint. If size of bricks is 190 mm X 90 mm X 90 mm, a horizontal joint of 90 mm X 90 mm = 810 m2 will be formed.

iii. The upper brick is suspended from an overhead support and the weights are attached to the lower brick.

iv. The weights are gradually increased till separation of bricks occurs.

v. The ultimate adhesive strength of mortar per mm2 area is obtained by dividing maximum load with 810.

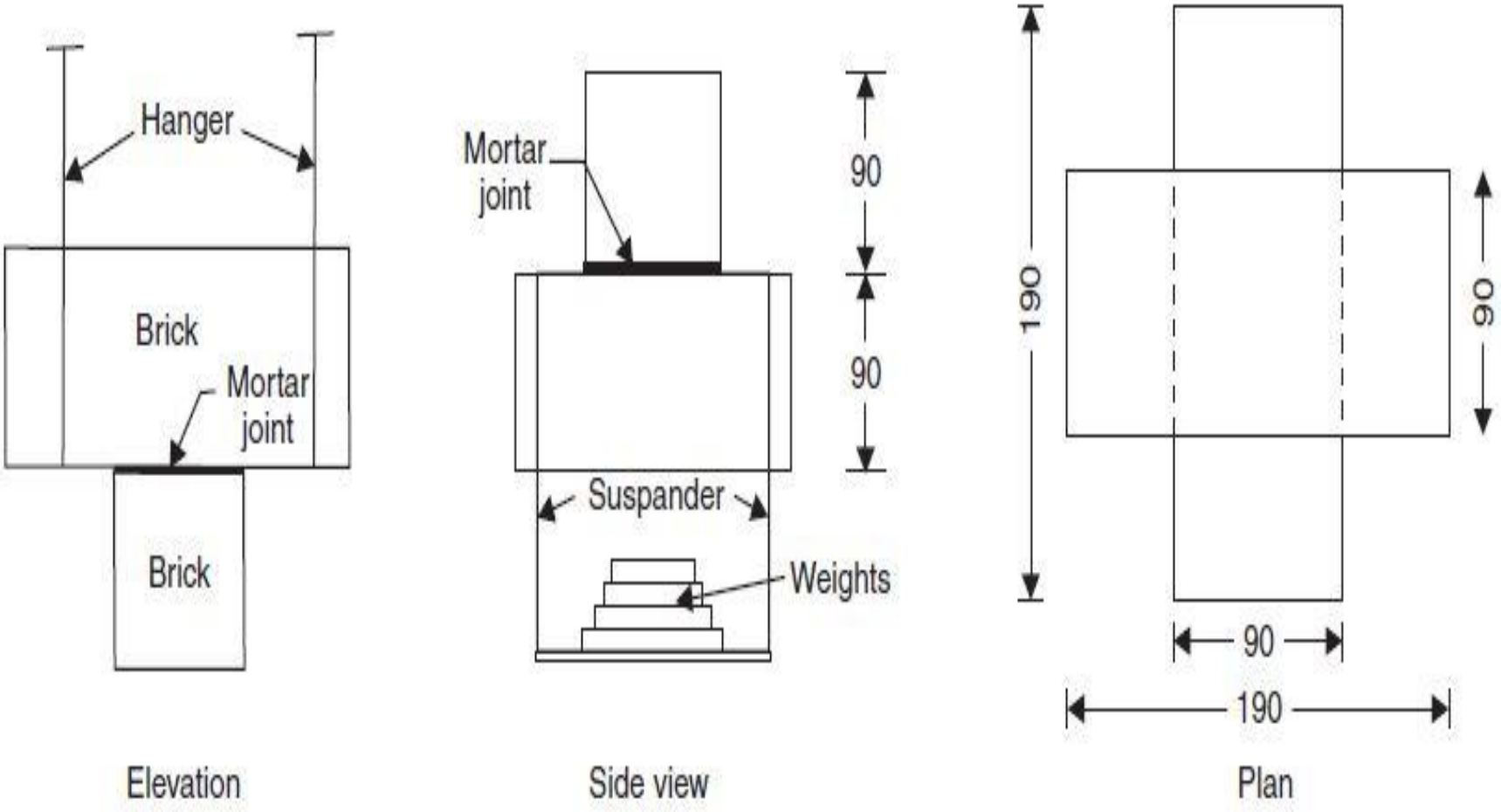

Fig. 2.4. Adhesiveness test arrangement

2) Crushing Strength : For this test, the brickwork is carried out with mortar to be tested. A sample of this brickwork is taken and it is gradually loaded in a compression testing machine till failure occurs due to crushing. The ultimate crushing strength is obtained by dividing maximum load with cross sectional area.

3) Tensile strength : For this test, the mortar to be tested is placed in the briquette moulds. The briquettes are then tested in a tension testing machine. The cross – sectional area of central portion is 38 mm X 38 mm or 1444 mm2. The ultimate tensile stress per mm2 is obtained by dividing falling load with 1444.

References

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Thank You