UNIT 5 STORING, BATCHING AND MIXING OF INGREDIENTS OF CONCRETE

Structure

5.1 INTRODUCTION

Various properties of concrete ingredients, factors influencing these properties and the role of these ingredients in governing the property of concrete have been described in detail in the earlier units. The process of manufacturing concrete passes through various stages, i.e. storing, batching and dry mixing of concrete ingredients, mixing of concrete ingredients with water, transporting and placing of fresh concrete mix, compacting and finishing of concrete, etc. In order to produce good quality hardened concrete it is necessary to monitor these operations properly. In this unit, storing, batching and mixing of concrete ingredients and the related issues have been discussed.

At any construction project, proper arrangement for storing these ingredients in adequate quantity is the prime requirement. All these ingredients should be so stored as to preserve their quality for use in the work because the quality of concrete is mainly governed by the quality of its ingredients. *Batching* is the measurement of these ingredients in desired proportion in successive batches. In the design mix concrete it is necessary to take the exact quantity of each and every ingredient so as to maintain the designed proportion of these ingredients. There are two methods of batching namely, *weigh batching* and *volume batching*. Other important operation, in manufacturing of concrete, is *mixing* of these ingredients so as to ensure good workable concrete mix. The mixing method should be able to produce a uniform and homogeneous mass of fresh concrete so as to produce the good quality hardened concrete.

In this unit, storing, batching and mixing of concrete ingredients are discussed in detail. This includes various arrangements for storing cement and aggregates; batching of cement and water; weigh batching and volume batching of aggregates; hand mixing and machine mixing of concrete ingredients; various operations involved in the case of machine mixing; and finally the types of mixer commonly used for concrete mixing.

Objectives

After studying this unit, you should be able to

- appreciate the importance of storing, batching and mixing operations for manufacturing of concrete,
- list the necessary precautions to be observed during storing, batching and mixing operations,
- get acquainted with the various types of mixers commonly available now-a-days, and
- perform the duties of site engineer in a better way to produce good quality concrete.

5.2 STORING OF CEMENT

In the previous units, the role of cement and its quality has been discussed. As cement is chemically very active with water, it is necessary to protect it from moisture during its storage till it is used for manufacturing the concrete. In case of imperfect/long storage conditions, the strength of cement may reduce. For example, the 28 days strength of cement stored for 3, 6 and 12 months may reduce to 80, 70 and 60 percent, respectively.

The storing arrangement of cement should be such that cement delivered first can be used first and vice-versa. Generally, the cement is available in 50-kg bags, which are stored in *stacks*. At the large construction sites, the cement can also be stored in *silos*. These methods of storing cement and necessary precautions/requirements are explained in the subsequent sections.

5.2.1 Storing in Stacks

Cement is, generally, supplied in 50-kg bags, which are required to be stored in dry and damp free environment so as to prevent the air setting. At the work site, these bags can be stored in a building or shed which should be dry, leak-proof and moisture-proof to the best possible extent. It should have minimum numbers of windows and close-fitting doors, which should be kept closed as far as possible. The *Hand Book on Building Construction Practices* of Bureau of Indian Standards (SP 62 (S and T): 1997) recommends that for storing the cement bags in stacks following precautions must be observed :

(a) Do not stack the cement bags directly on the floors. They shall be placed on the dry wooden planks, which should be clear above the floor by 150 mm to 200 mm.

(b) Maintain a minimum alround space of 450 mm between the bags and the external walls. Also, maintain sufficient alround space between two adjacent stacks for proper movement.

(c) Place the cement bags in a stack close together so as to minimize the air circulation.

(d) Restrict the height of a stack to maximum 15 bags so as to prevent the possibility of lumping up under pressure.

(e) Restrict the width of a stack preferably to 4 bags or 3 or meter or whichever is less.

(f) For the height of a stack more than that of 8 bags, place the bags lengthwise and widthwise in alternate layer so as to minimise the danger of toppling over.

(g) Stack the cement bags in a manner so as to facilitate their removal in the order in which they are received.

(h) For storing the cement bags for longer period or during monsoon, cover each stack with waterproof sheathing.

(i) Store different types of cement in different stacks.

(j) Number of bags stored on site should be such so as to be consumed on the same day.

5.2.2 Storing in Silos

At the large construction sites where a large quantity of cement is required, the cement is preferred to be stored in silos. In silos, the cement can be stored in bulk (i.e. 12-50 tonnes) and that too under the ideal conditions. Silo is typically a welded steel cylindrical container. It is supported on four crossed braced legs and having a discharge outlet at the bottom. Moreover, it can also have some weighing arrangement at the bottom so as to get the required weight of cement in each batch. Cement is supplied in close tankers from the factory and pumped into these silos directly from these tankers. Storing of cement in silos has the following advantages as compared to storing in stacks :

(a) The cost of bulk cement per tonne is less than the bagged cement.

(b) Unloading of cement through pumping arrangement directly into the silos is quite convenient and cheaper.

(c) Fewer precautions are to be observed.

(d) Less site space is required for any given quantity of cement.

(e) As cement is delivered into the silos from top and extracted from bottom, the cement, which is received first, is always used first.

(f) The same silo can be reused for the other construction sites.

SAQ 1

(a) Describe the various methods of storing cement.

(b) Give the precautions need to be observed during storing of cement in stacks.

(c) Give the relative merits of storing cement in silos as compared to stack storing.

5.3 STORING OF AGGREGATES

As discussed earlier, the properties of aggregates particularly the uniformity of grading, moisture content and presence of foreign materials play an important role in governing the quality of concrete. In view of this, it is necessary to store the aggregates in such a way so as to avoid any variation in these properties during storage. The guidelines for storing coarse aggregates and fine aggregates are slightly different.

5.3.1 Suggested Guidelines for Storing of Aggregates on Sites

Following guidelines are recommended for storing of aggregates on sites :

(a) Aggregates should be stored at site on a hard, dry and levelled patch of ground. In case such patch of ground is not available near the construction site then following arrangements may be made.

(b) Provide a platform of planks or of corrugated iron sheets.

(c) Prepare a floor of dry bricks or of a thin layer of lean concrete.

(d) Stacks of fine and coarse aggregates should be kept separate so as to avoid the intermixing of fine and coarse aggregates particularly at the edges.

(e) On the large construction site, it is recommended to provide divide walls between the different types of aggregates. This arrangement is shown in Figure 5.1 where the aggregates of different fractions are separate out by suitable partitioning.

(f) Proper care must be taken in storing the fine aggregates to prevent the loss of finer particles due to wind.

(g) It is recommended to unload the aggregates on the large area surface so as to avoid the pyramid shape of the stack pile in which the coarser aggregates may roll down the sides of the piles thereby disturbing the uniformity of grading from top to bottom.

(h) It is recommended to avoid the dumping of aggregates from greater height or dropping the successive consignments at the same place.

(i) The stacks belonging to all types of coarse and fine aggregates and that of cement should be placed as close as possible so as to facilitate the batching and mixing operations.

(j) *Hand Book on Building Construction Practices* of Bureau of Indian Standards (SP 62 (S and T) : 1997) suggests the size of stacks for various types of aggregates as below :

Material	**Size of Stack (in m) (i.e. Length × Breadth × Height)**
Soling Stone	5.0 × 2.0 × 0.50 or 5.0 × 1.0 × 0.50
Coarse Aggregates	2.0 × 2.0 × 0.50 or 5.0 × 5.0 × 1.0
Fine Aggregates	2.0 × 2.0 × 0.50 or 5.0 × 5.0 × 1.0 or 5.0 × 1.0 × 0.50

It is convenient to measure the total volume of aggregates received on site if stacked in standard shape and sizes.

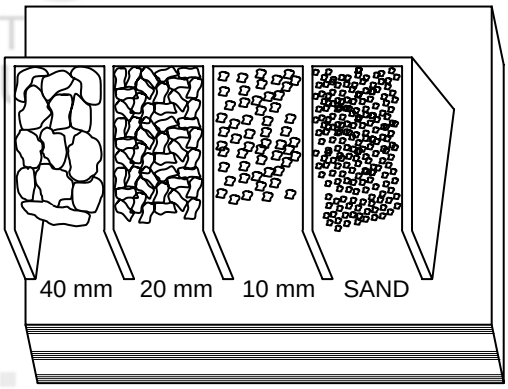


Figure 5.1 : Separation of Stacks of Different Aggregates

SAQ 2

Describe the suggested guidelines for storing the aggregates.

5.4 BATCHING OF INGREDIENTS OF CONCRETE

The measurement of different ingredients of concrete (i.e. cement, coarse aggregate, fine aggregate and water) for making concrete is known as batching. It is necessary to take accurate quantities of these ingredients so as to maintain the exact proportion of these ingredients as per mix design. The desired quantity of these ingredients can be measured by volume or by weight, which are respectively known as *volume batching* and *weigh batching*.

In case of volume batching of fine aggregates (i.e. sand), proper care must be taken for the bulking. Cement is always measured by weight in kg. Generally, the weight of one bag of cement is taken as 50 kg and volume as 35 litres. Water may be measured by volume (in litres) or by weight (in kg) as convenient.

5.4.1 Batching of Cement

Cement is always measured by weight in kilogram. Cement is commonly available in bags of 50 kg each. The volume of one bag of cement (i.e. 50 kg) is considered as 35 litres. For small or less important works, cement is generally not weighed and conveniently can be considered as 50 kg per bag. However, there is always a possibility of these bags being under weight as there are chances of loss of cement from these bags during their handling/transporting from place to place. Some times this loss of cement may be of the order of 2-5 kg or even more. Any variation in the quantity of cement will lead to variation in water cement ratio hence the strength of concrete. Therefore, it is always advisable that even for small or less important works the weight of cement bags should be checked randomly. For major and important works, where design concrete mix is used, the cement should be actually weighed for each batch.

During batching of cement, presence of any sort of lumps should be closely observed. If these lumps are so hard that they cannot be crushed by hand then various tests of cement should be performed in order to ensure its quality.

5.4.2 Batching of Water

The quantity of water must be measured accurately as the quantity of water plays an important role in governing the various properties of concrete particularly the workability of fresh concrete and the strength of hardened concrete. Water is generally measured by volume, as it is more convenient to take the desired quantity of water by volume as compared to weight. Moreover, the numerical value of a given quantity of water in terms of volume (in liters) and weight (in kilogram) is same, as the density of water is one kilogram per litre. For example, for the concrete mix of water cement ratio 0.6 the quantity of water for one bag cement (i.e. 50 kg) will be $0.6 \times 50 = 30$ kg or 30 litres.

The batching of water by volume can be done by using the graduated buckets (in terms of litres). Proper care must be taken to prevent the spillage of water during mixing. Some of the mixers are fitted with water tanks and the required quantity of water, to be mixed with mix, can be controlled manually or automatically. Sometimes, water is added to the mix through a water supply line fitted with the water-meters to measure the exact quantity of water.

It is necessary to make adjustment for the free moisture content of aggregates in determining the quantity of water to be mixed as mix design is carried out assuming the aggregates in saturated surface dry (SSD) condition. In case, the aggregates have free moisture content (i.e. water is in excess of that required for SSD condition) then accordingly the reduced quantity of water should be mixed. On the contrary, if the aggregates are in dry state then additional quantity of water, which is required to bring these aggregates in SSD condition, should be mixed in excess. The illustrative Example 5.1 explains the procedure for making necessary correction for free moisture content in the measured quantity of water.

Example 5.1

Determine the exact quantity of water to be mixed for one bag of cement to prepare a mix of 1 : 1.5 : 3 proportion by weight and water cement ratio as 0.5. The water content of fine aggregates is 2.5% and the coarse aggregates are in dry state (i.e. absorbed moisture is nil). Assume that water required to make the coarse and fine aggregates in SSD condition is 0.5% and 1.1% respectively.

Hint : *Fine Aggregates have free* (*surface*) *moisture = 2.5 – 1.1 = 1.4%. Coarse Aggregates require additional water to make them in SSD condition = 0.5%.*

Solution

Quantities required in SSD state for 1 : 1.5 : 3 proportion by weight :

i.e. 1 (Cement) : 1.5 (Fine Aggregate) : 3 (Coarse Aggregate)

Weight of one bag of cement = 50 kg

Weight of Fine Aggregate required in SSD condition = $1.5 \times 50 = 75$ kg

Weight of Coarse Aggregate required in SSD condition = $3 \times 50 = 150$ kg

For 0.5 W/C ratio the quantity of water required = $50 \times 0.5 = 25$ litres

Adjustment in quantity of water for fine aggregate being in wet condition :

Because sand is in wet condition and having free moisture = 2.5 – 1.1 = 1.4%.

Quantity of water to be deducted = 75 × 0.014 = 1.05 litres.

Adjustment in quantity of water for coarse aggregate being in dry condition :

Coarse aggregates, being in dry state, will require additional water to achieve SSD condition = 0.5%.

Quantity of water to be added = 150 × 0.005 = 0.75 litres

Actual quantity of water required to be added = 25 – 1.05 + 0.75 = 24.7 litres.

Actual quantity of water required to be added = **24.7 litres**.

5.4.3 Volume-Batching of Aggregates

In volume batching, materials are measured by volume (in liters or cubic meters). For measuring the ingredients of concrete by volume a typical gauge box is used as shown in Figure 5.2. These gauge boxes are available in different sizes particularly of 35 litres (i.e. volume of one bag cement) or in multiple of the same.

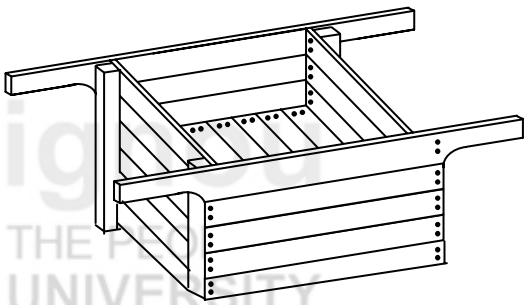


Figure 5.2 : Gauge Box for Measuring Volume of Concrete Ingredients

The aggregates in the gauge box should be filled loosely (i.e. without any compaction) and struck off. Table 5.1 shows the recommended sizes of gauge box for volume batching of aggregates.

Table 5.1 : Size of Gauge Box v/s Volume

Capacity in Litres	Inside Dimensions in mm		
	Length	Width	Height
25	25	25	40
30	25	25	48
35	27	27	48
40	29	29	48
45	30	30	50
50	31	31	52

Volume batching is less precise as compared to *weigh batching*, hence preferred only for minor or less important works, where nominal mix of concrete is used rather than designed mix. In ordinary concrete, the proportions are generally mentioned by volume such as 1 : 2 : 4, 1 : 4 : 8 and so on. Volume of moist sand in a loose condition weighs much less than the same volume of dry sand because

of bulking. In case of volume batching of fine aggregates, necessary adjustment must be made for the bulking of fine aggregates. The illustrative Example 5.2 explains the procedure for making necessary correction for bulking in the measured quantity of sand.

Example 5.2

Determine the quantities of coarse aggregate and fine aggregate for one bag of cement to prepare a mix of 1 : 2 : 4 proportion by volume (in dry state). Consider the bulking of fine aggregate as 15%.

Solution

Quantities required in dry state for 1 : 2 : 4 proportion by volume :

i.e. 1 (Cement) : 2 (Fine Aggregate) : 4 (Coarse Aggregate)

Volume of one bag of cement = 35 litres

Volume of Fine Aggregate = $2 \times 35 = 70$ litres

Volume of Coarse Aggregate = $4 \times 35 = 140$ litres

Adjustment in quantity of fine aggregate for bulking :

Because sand is in bulked condition so if we are measuring 1 litre of sand its actual volume in dry condition will be = $1 \times (1 - 0.15) = 1 \times 0.85$ = 0.85 litre.

Hence, for having 1 litre of dry sand we have to take $1.15 \times 1 = 1.15$ litre of bulked sand.

In view of the above discussion the quantity of sand to be taken for the given mix = $1.15 \times 70 = 80.5$ litre.

Cement = 35 litre;

Sand (Fine aggregate) = 80.5 litre;

Coarse aggregate = 140 litre

The amount of coarse aggregate, if measured by volume, may vary from batch to batch depending upon the degree of compaction in filling the gauge box. It is recommended to fill the gauge box loosely, i.e. without applying any compaction effort. The volume of the aggregate can be obtained by multiplying the required weight of aggregate with its bulk density. The bulk density of fine aggregate and coarse aggregate is generally of the order of 1.5-1.6 kg/litre. It is advisable to determine the actual bulk density at site as the bulk density depends upon the size, grading and degree of compaction.

5.4.4 Weigh-Batching of Aggregates

In weigh batching materials are measured by weight in kilogram. It gives more accuracy in measuring the quantity of ingredients as compared to volume batching. Weigh batching does not have uncertainties with regard to bulking or non-uniform filling of gauge box. However, the appropriate adjustment in the quantity of water should be made according to the moisture content of aggregates. The weigh batching is recommended for major or important works. In mix design, we obtain the quantities of different ingredients by weight for one cubic meter of concrete and the same may be conveniently taken for weigh batching.

Using any conventional weighing system such as, spring balance, platform weighing machine or automatic weighing machines, one can perform weigh batching. Now-a-days electrically operated automatic batching plants are also available in which one can feed the desired information for the quantities of different ingredients required in one batch and the same are measured automatically. These types of plants are more suitable for production of ready mix concrete or at the factories of pre-cast concrete in bulk.

SAQ 3

(a) Differentiate the weigh batching and volume batching of aggregates.

(b) Why is it necessary to make the correction in determining the exact quantity of water to be mixed in manufacturing the design mix concrete?

(c) Determine the exact quantity of water to be mixed for one bag of cement to prepare a mix of 1 : 2 : 4 proportion by weight and water cement ratio as 0.48. The water content of fine aggregates is 3.0% and the coarse aggregates are in dry state (i.e. absorbed moisture is nil). Assume that water required to make the coarse and fine aggregates in SSD condition is 0.6% and 1.2%, respectively.

(d) Determine the quantities of coarse aggregate and fine aggregate for one bag of cement to prepare a mix of 1 : 1.5 : 3 proportion by volume (in dry state). Consider the bulking of fine aggregate as 18%.

5.5 MIXING OF INGREDIENTS OF CONCRETE

Mixing is the most critical operation amongst all handling operation of concrete mix. Most of the properties of the concrete, both in fresh and hardened stage, mainly depend upon the way the concrete ingredients are mixed. The mixing of the ingredients should be thorough in order to ensure that cement-water paste completely covers the surfaces of aggregates. Basically, the mixing method should be such so as to ensure a uniform and homogeneous mix of good consistency and that too without segregation and bleeding. Mixing of concrete ingredients can be performed by *hand mixing* and *machine mixing*. For small works or less important works the hand mixing is used and for large and important work machine mixing is preferred. As the machine mixers are commonly available now-a-days, hand mixing is generally avoided even for small works.

5.5.1 Hand Mixing

Hand mixing is performed on an impervious, leveled and rigid platform for which the measured quantity of coarse aggregate and sand is evenly spread in alternate layers and the measured quantity of cement is spread over it. This spread mass of concrete ingredients is then mixed uniformly in dry state. After mixing it uniformly, this dry mix is now evenly spread in about 200 mm thickness. The measured quantity of water is then applied with a sprinkler and simultaneously, mixing is carried out by turning the mix over and over. The mixing is done until the homogeneous concrete mix of uniform appearance with good consistency is

obtained. In case of hand mixing it is suggested to take about 10% extra quantity of cement. Hand mixing is used only for very small works, as concrete mixers are very common now-a-days.

5.5.2 Machine Mixing

Machine mixing ensures a better and uniform mixing of concrete. It produces concrete of better quality and at much faster rate as compared to that with hand mixing. Now-a-days concrete mixers are very common and are frequently used even for small works. The concrete mixers are available in various types and capacities such as drum type and pan type, tilting type and non-tilting type, batch mixers and continuous mixers, etc. The choice of mixer depends upon the size, nature and extent of work. The capacity of a mixer should be such that it can produce required amount of concrete per hour under normal working conditions of these mixers. Machine mixing proves to be economical and efficient particularly for large works.

Whatever may be the type of mixers the mixing of concrete in a concrete mixer is carried out in the following steps :

(a) Installing the mixer

(b) Charging/feeding the ingredients

(c) Mixing the ingredients

(d) Discharging the concrete mix

In order to perform the mixing operation efficiently and effectively following precautions are to be observed during each of the above step :

Installing the Mixer

Mixers are installed at site itself or suitably at central place, respectively called as site mixing and central mixing. The choice between the two depends upon several factors, such as accessibility, availability of working space, water supply, transportation routes, etc. As far as possible, mixer should be installed close to the concreting site and at firm and levelled ground. Before starting the mixing operation, cleanliness of mixer should be ensured.

Charging/Feeding the Ingredients

The order of feeding the ingredients into the mixer depends upon type of concrete mix and mixer. Certain mixers have the facility to feed the ingredients into the mixer through a *hopper* or *loading skip* arrangement, in the absence of which the ingredients can be directly fed into the mixer. Following sequence of feeding is suggested :

Direct Feeding of Mixer

Generally, a small amount of water is fed first followed by all the solid materials, preferably fed uniformly and simultaneously into the mixer. While feeding these materials simultaneously, the remaining quantity of water must be fed uniformly in part into the mixer.

Feeding of Mixer Through Hopper

Total quantity of coarse aggregates followed by the total quantity of sand and then cement is fed into the hopper. The mixer receives these ingredients from hopper in reverse order, i.e. coarse aggregates in last. This helps in pushing any part of cement or sand adhering to the mouth of the drum. This arrangement is shown in Figure 5.3.

Generally, a small amount of water is fed first followed by feeding operation through the hopper. The remaining quantity of water must be fed uniformly in part into the mixer during mixing operation but total quantity of water should be fed within one quarter of the mixing time.

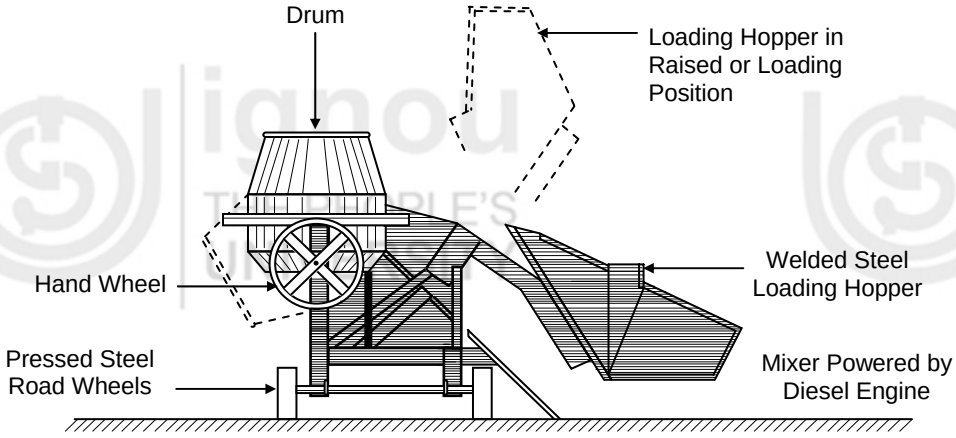


Figure 5.3 : Typical Hopper Fed Tilting Concrete Mixer

Buttering the Mixer

In machine mixing, a certain amount of cement mortar adheres to the inside of drum walls and remains adhered to after discharging the first batch of concrete mix. Therefore, it is recommended that before mixing the first batch of concrete ingredients, a certain amount of cement mortar (i.e. cement, sand and water) is fed into the mixer and mixer is rotated. The quantity of mortar should be just sufficient to adhere to the walls. This process of mixing cement mortar prior to the mixing of first batch of concrete is called as *buttering the mixer*. In successive batches buttering is not required.

Mixing the Ingredients

Mixing time is an important parameter as far as mixing operation is concerned. Mixing time depends upon the type of concrete, capacity of mixer, number of revolutions of the drum per minute, etc. Basically, these parameters, i.e. number of revolution per minute, capacity of mixer and time of mixing are inter-dependent parameters, which are generally specified by the manufacturer of the mixer. The mixing time reduces as the number of revolution per minute (rpm) of mixing drum increases. On the other hand, it increases with the capacity of drum. Also, harsh mix requires more mixing time as compared to wet mix. In normal circumstances, the mixing time of 1-2 min is sufficient. The time is measured from the moment when all the solid ingredients are fed into the mixers and further, it should be ensured that all water is added within one quarter of mixing time. Generally, the speed of a mixer drum varies between 16 rpm to 20 rpm.

IS 456 : 2000 recommends that concrete shall be continued to mix in a mechanical vibrator until there is a uniform distribution of the materials and the mass is uniform in color and consistency. If segregation is observed after unloading from the mixer, the concrete should be re-mixed.

Discharging the Mixed Concrete

Every type of mixer has got its own discharging arrangement. For example, in tilting type mixer the mixed concrete is discharged from the open top of the drum by tilting the drum downward and in pan mixers the mixed concrete is discharged through a central hole at the bottom of the pan. Whatever may be the discharging arrangement in mixer, certain precautions are necessary during the discharging operation. The full batch of mixed concrete should be discharged at the same time and not in parts. The discharged concrete should be collected in an enclosed container or hopper without spreading out. If segregation is observed after discharging from the mixer, the concrete should be re-mixed.

After completing the day work the mixers should be cleaned and washed properly. Cleaning may be done by charging the mixer with dry aggregates and water and then by rotating the drum for 1-2 minutes. The aggregates will induce abrasive action against the stick mortar, which will facilitate the cleaning action.

5.6 TYPES OF MIXER

Machine mixers are broadly classified in two categories, namely *batch mixers* and *continuous mixers*. Batch mixers are of two types, namely *drum type* and *pan type*. The drum type mixers can further be classified into *tilting, non-tilting* and *reversing type* batch mixers. This classification is shown in a block diagram.

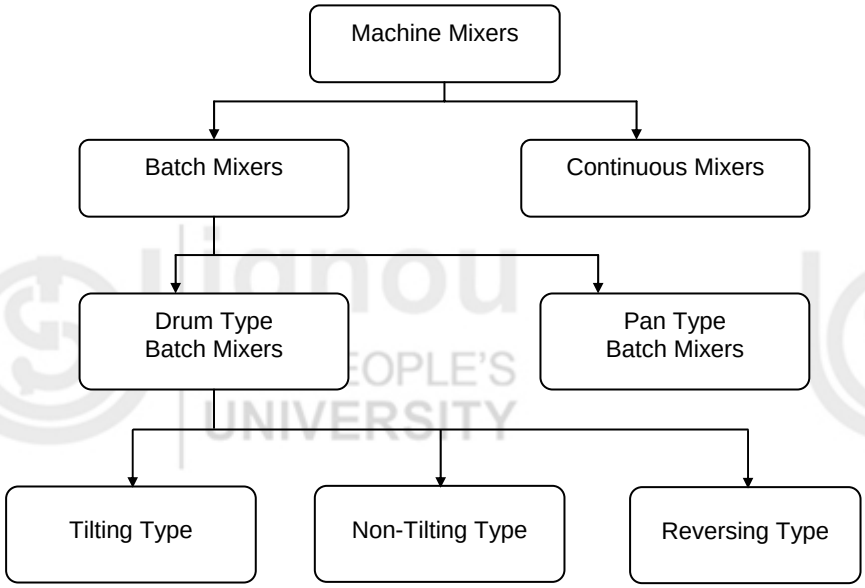
Batch Mixers are those in which concrete ingredients are mixed in batches with certain time interval. In this type of mixers though the concrete is produced in batches but continuous concreting can be ensured by properly coordinating the various handling operations, namely transporting, placing and compacting. These types of mixers are most common and are frequently used. Batch mixers are mainly available in two types, namely *drum type* and *pan type*. The drum type mixers are further classified as *tilting type* and *non-tilting* type mixers.

Continuous Mixers are those in which all the operations of mixers (i.e. feeding, mixing and discharging) are performed simultaneously and continuously so as to obtain the mixed concrete continuously. This type of mixers is used at large construction site where mass concreting is done, such as construction of dam, etc.

Pan Mixer is basically a typical cylindrical container mounted on its vertical axis. One or two stars of paddles mounted on separate vertical axis are also provided in the pan. On the basis of whether the pan is rotated or the paddles, pan mixers may be of two types. One, in which the pan is static whereas the axis of stars moves along the circular path about the axis of the pan and the other, in which the paddles remain stationary and the pan rotates about its vertical axis during mixing operation. In both the types, the relative motion of paddles and the ingredients of concrete induces a thorough mixing action in every part of the concrete. Another attractive feature of the pan mixer is the provision of scraper blades, which prevents sticking of mortar to the pan sides by continuous scrapping. That is why, this type of mixers is more suitable for stiff and cohesive mix and being non-mobile type, generally preferred on a large construction site or at pre-cast concrete factory. The mixed concrete is discharged through the central hole provided at the bottom of the pan.

Types of Machine Mixer

Tilting Type Mixer (T) consists of a bowled shape or double-conical-frustum shape drum, which rotates on an inclined axis. Figure 5.4 shows a typical sketch of tilting type concrete mixer. In these types of mixer the feeding and discharging operations are performed through its top opening. As the mixed concrete is discharged from the open top of the drum by tilting the drum



downward, it is popularly known as tilting type mixer. Inside the drum, the vanes are fixed in such a manner so as to direct the concrete to move into circulatory path when drum is rotated. Subsequently, during each rotation of drum these vanes lift the mixture to a certain height and then allow the mixture to drop towards bottom of the drum.

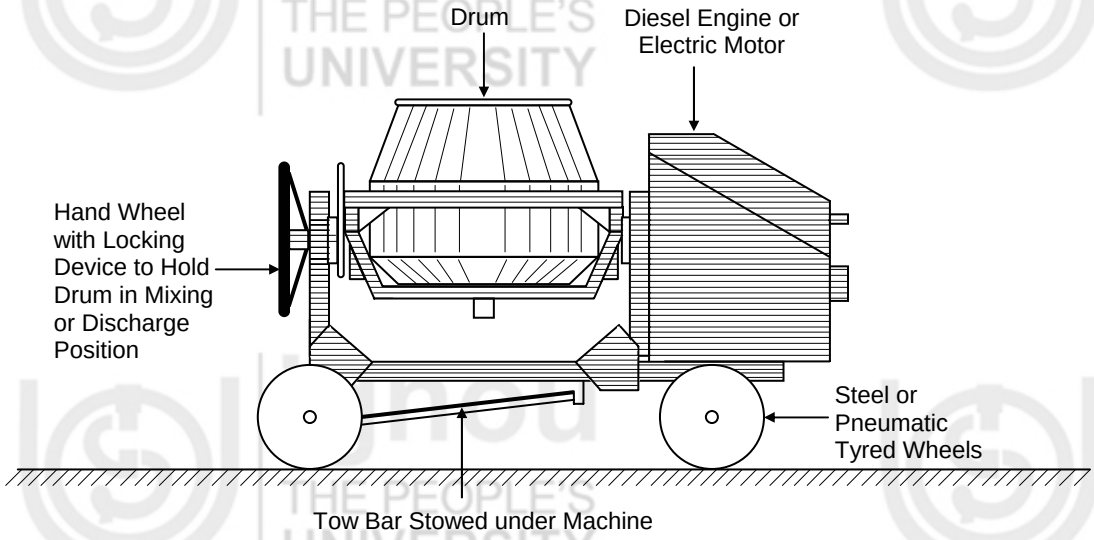


Figure 5.4 : Tilting Type Concrete Mixer

This type of mixer is generally preferred for the concrete mixes of low workability and for those with large size aggregates. These mixers being movable type can be conveniently used at most of the construction sites. As per IS : 1971 (1968), the size/capacity of a mixer is defined by the total volume of concrete that can be mixed in a batch. It is given in litres and designated as 85 T, 100 T, 140 T and 200 T, where 'T' represents the tilting type mixer and numeric data represents one batch capacity in litres.

Non-tilting Type Mixer (*NT*) consists of a cylindrical drum, which rotates about a horizontal axis and does not have the tilting facility. The vanes are fixed inside the drum surface. The drum is provided with two central openings at the opposite ends. Feeding of the ingredients is done through front opening and discharging of mixed concrete through rear opening. For discharging the mixed concrete, an inclined chute is introduced into the drum at rear opening end with the help of a lever. This type of concrete mixer is shown in Figure 5.5.

It has been observed that in this type of mixers the rate of discharge is slow and chances of segregation are more as compared to tilting type mixers. The capacity of these mixers is generally higher than that of the tilting type mixers. As per IS : 1971 - 1968, the size/capacity of non-tilting type mixers are available as 200 NT, 280 NT, 340 NT, 400 NT and 800 NT, where 'NT' represents the non-tilting type mixer and numeric data represents one batch capacity in litres.

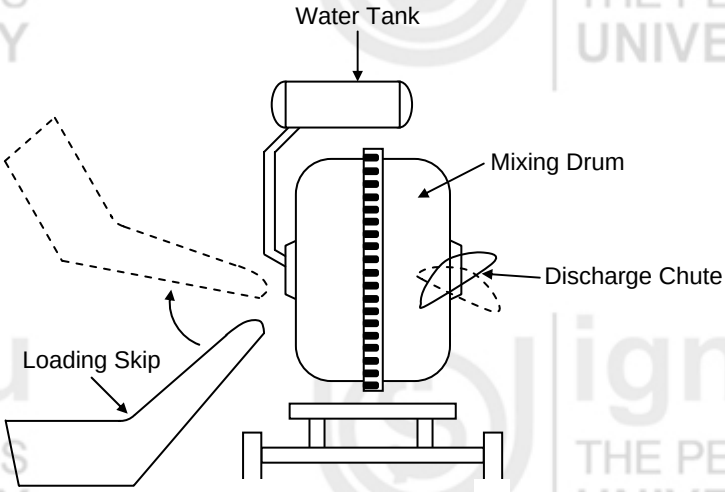


Figure 5.5 : Non-tilting Type Concrete Mixer

Reversing Drum Type Mixers (*R*) are similar to *Non-tilting Type Mixer* (*NT*), i.e. with a cylindrical drum, which rotates about a horizontal axis and does not have the tilting facility. The only difference is in the discharging mechanism. In reversing drum type, the mixed concrete is discharged from the rear end opening by rotating the drum in reverse direction. The capacities of these mixers available are 200 R, 280 R, 340 R and 400 R, where 'R' represents the reversing drum type mixer and numeric data represents one batch capacity in litres.

5.7 SUMMARY

In the process of manufacturing of concrete it is necessary to ensure the ready availability of all the ingredients with desired properties at construction site, for which there should be proper storing arrangement for these ingredients, i.e. cement, sand and coarse aggregates. Also, it is equally important to take/measure the required quantities of all these ingredients for preparing the concrete mix of specified quality, for which it is necessary to batch the ingredients in standard manner. Finally, the most important operation is mixing of concrete ingredients so as to produce homogeneous, consistent and cohesive concrete. All these operations involved in the process of manufacturing the concrete and the related aspects have been discussed in this unit.

5.8 ANSWERS TO SAQs

SAQ 3

(c) Quantities required in SSD state for 1 : 2: 4 proportion by weight :

i.e. 1 (Cement) : 2 (Fine Aggregate) : 4 (Coarse Aggregate)

Weight of one bag of cement = 50 kg

Weight of Fine Aggregate required in SSD condition
= 2 × 50 = 100 kg

Weight of Coarse Aggregate required in SSD condition
= 4 × 50 = 200 kg

For 0.48 W/C ratio the quantity of water required
= 50 × 0.48 = 24 litres

Adjustment in quantity of water for fine aggregate being in wet condition:

Because sand is in wet condition and having free moisture
= 3.0 – 1.2 = 1.8%

Quantity of water to be deducted = 100 × 0.018 = 1.8 litres

Adjustment in quantity of water for coarse aggregate being in dry condition :

Coarse aggregates, being in dry state, will require additional water to achieve SSD condition = 0.6%

Quantity of water to be added = 200 × 0.006 = 1.2 litres

Actual quantity of water required to be added = 24 – 1.8 + 1.2 = 23.4 litres

Actual quantity of water required to be added = 23.4 litres

(d) Quantities required in dry state for 1 : 1.5 : 3 proportion by volume :

i.e. 1 (Cement) : 1.5 (Fine Aggregate) : 3 (Coarse Aggregate)

Volume of one bag of cement = 35 litres

Volume of Fine Aggregate = 1.5 × 35 = 52.5 litres

Volume of Coarse Aggregate = 3 × 35 = 105 litres

Adjustment in quantity of fine aggregate for bulking :

Because sand is in bulked condition so if we are measuring 1 litre of sand its actual volume in dry condition will be
= 1 × (1 – 0.18) = 1 × 0.82 = 0.82 litre.

Hence, for having 1 litre of dry sand we have to take 1.18 × 1 = 1.18 litre of bulked sand.

In view of the above discussion the quantity of sand to be taken for the given mix = 1.18 × 52.5 = 61.95 litre.

Cement = 35 litre;

Sand (Fine aggregate) = 61.95 litre;

Coarse aggregate = 105 litre.