Construction Materials For Food Science and Engineering

Construction Material: Sand

Prof. Dr. S M Iqbal Hossain
Dept. of Food Science and Engineering

Sand and its Classification

Sand: Sands are the weathered and worn out particles of rocks. In concrete work it is termed as **fine aggregate**.

Sand grains: The sand grains may be of – **sharp**, **angular** or **round**.

Classification of Sand: Classified on the basis of (a) Source and (b) Size

A. According to Source: : 3 groups

1. **Pit Sand:** This type of sand is obtained from pits. This is **sharp, angular, porous** and **free from salts**. It might contain clay and other impurities which should be screened and washed before use. It is **light brown** or **yellowish colour**. It is most suitable for **mortar work**.
2. **River Sand:**. This sand is obtained from river beds. This type of sand is **fine, round and polished.** It generally contains earthy impurities like gravels, pebbles etc. It is **whiter in colour**, globular and smaller in size than pit sand and hence most suitable for **plastering works**.
3. **Sea Sand:** This type of sand is also **fine, round and polished**. But it is the worst of the three varieties because it contains **sea salts** which absorb moisture from the atmosphere (hygroscopic) causing permanent dampness and efflorescence and thereby the work gradually disintegrates. It also contains **shells and organic matter** which decompose in the body of mortar. Plaster and concrete also reduce their life and strength.

Classification of Sand

Classification of Sand:

B. According to Size: 3 groups

1. **Fine Sand:** All the sand particles should pass through No. 16 (ASTM) sieve (Size 1/16 inch). This is usually **used in plastering works**
2. **Moderately Coarse Sand:** All the sand particles should pass through No. 8 (ASTM) sieve (size 2/16 inch = 1/8 inch). This type of sand is generally **used for mortar in masonry works.**
3. **Coarse Sand:** All the sand particles should pass through No. 4 (ASTM) sieve (size 3/16 inch). This type of sand is very **suitable for concrete works**.

Bulking and Fineness Modulus of Sand

Bulking of Sand: This is the increase in volume of a given weight of sand due to the presence of moisture. For up to about **5 to 8%** of moisture by weight of sand there is a steady increase in volume to about **20 to 30%.** The bulking of sand for small moisture content is due to the **formation of thin film of water around the sand grains** and **interlocking the air in between** the sand grains and the film of water.

Fineness Modulus: Fineness Modulus is an empirical value obtained by taking the sum of the cumulative percentages of sand retain on the following standard sieves 3", 1.1/2", ¾", 3/8", No. 4, No. 8, No.16, No. 30, No.50 and No. 100 and dividing the sum by 100. It is denoted by "F". The fineness modulus of sand should be between 2 to 3.

A smaller value of Fineness Modulus indicates the presence of larger proportions of finer particles and vice-versa.

1. Thus, $F = (m_1 + m_2 + m_3 \ldots\ldots\ldots\ldots)/100$
2. If two or more different variety of sand are mixed together the combined fineness modulus of the mixed sample can be determined as follows:

$F_{com} = (m_1F_1 + m_2F_2 + \ldots\ldots\ldots\ldots m_nF_n) / (m_1 + m_2 + \ldots\ldots + m_n)$

Where, F_{com} = Combined fineness modulus;

F_1 and F_2 = Fineness modulus of sample 1 and 2 respectively;

m_1 and m_2 = Amount of samples 1 and 2 respectively;

Fineness Modulus of Sand

3. If R is the ratio of one variety of sand to be mixed with 1 unit of the other variety, then

$$R = (F1 - Fcom) / (Fcom - F2)$$

This can also be written as

$$R = (F1 - Fcom) / (R1 - F2)$$

Where, R1 is the ratio of one variety in the combined mixture.

Example 1**.** 100 gms of Sunamganj sand was sieved through standard sieves and the following results were obtained:

Sieves	Cumulative percentage retained
3”	0.00
1.1/2”	0.00
¾”	0.00
3/8”	0.00
No. 4	0.00
No. 8	0.00
No. 16	10.00
No. 30	30.00
No. 50	100.00
No. 100	100.00

Calculate the fineness modulus of the sample of sand.

Solution: F = (10.00 + 30.00 + 100.00 + 100.00) / 100 = 240/100 = 2.40

Fineness Modulus of Sand

Example 2. If three samples of sand having weight 5 gm, 8 gm and 10 gm and fineness modulus 2.4, 2.5 and 2.7 respectively, are mixed together, find the combine fineness modulus of the samples.

Solution:

Fcom = (5X2.4 + 8X 2.5 + 10X2.7) / (5+8+10)

= 59/23

= 2.57

Example 3. If two samples of sand having fineness modulus of 2.2 and 2.6 are mixed together to obtain a combine fineness modulus of 2.5, what will be the ratio of the two samples.

Solution:

R = (F1-Fcom)/(Fcom-F2)

= (2.2-2.5)/(2.5-2.6)

= 3

Therefore 1 unit of sample with F=2.2 to be mixed with 3 unit of sample with F=2.6

Quality and Test of Sand

- **Quality of Sand:** Sand should be of pure silica (SiO_2). It should be free from clay, silt, organic matter, shells and salts. It is preferable that sand should be washed before use in all engineering construction.
- **Test Of Sand:** Sand is usually tested for silt, clay and organic matter (OM).

1. **Test of sand for silt and clay:** The presence of silt and clay in sand is determined by the percentage loss in weight of a sample of sand after washing it with clean water
2. **Test of sand for organic matter:** The presence of OM is determined by stirring a sample of sand with 3% solution of sodium hydroxide or caustic soda in a closed bottle. The sample is left for 24 hours when the color of the solution turns brown if any OM is present. The amount of OM is determined from the intensity of darkness of the solution.

Availability of Sand In Bangladesh

Availability of Sand in Bangladesh: Sand is abundantly available all over Bangladesh.

1. River sand of very good quality is available in Dhaka, Mymensingh, Jamalpur, Sylhet, Savar, Kaliakur
2. Sea sand is available in Khulna, Noakhali and Chittagong
3. Course sand of good quality is available in Cox's Bazar, Sylhet, Sunamgonj
4. Sand of poor quality is available in the northern districts,

Thanks