4.4 SEDIMENTATION

4.4.1 SEDIMENT MOVEMENT AND DEPOSITION

As the silt originates from the water shed, the characteristics of the catchment such its areal extent, soil types, land slopes, vegetal cover and climatic conditions like temperature, nature and intensity of rainfall, have a great significance in the sediment production in the form of sheet erosion, gully erosion and stream, channel erosion. In regions of moderate rain- fall, sheet erosion is the dominant source of total sediment load while in arid and semi-arid regions, gullying and stream-channel erosion furnish the greater part of the load.

Experiments have shown that the erosive power of water, flowing with a velocity V, varies as V2 while the transporting ability of water varies as V6. Sediment moves in the stream as suspended load (fine particles) in the flowing water, and as bed load (large parti- cles), which slides or rolls along the channel bottom. Sometimes, the particles (small particles of sand and gravel) move by bouncing along the bed, which is termed as 'saltation', which is a transitional stage between bed and suspended load. The material, which moves as bed load at one section may be in suspension at another section.

The suspended sediment load of streams is measured by sampling the water, filtering to remove the sediment, drying and weighing the filtered material. The samplers may be of 'depth-integrating type' or 'point samplers'. Point samplers are used only where it is not possible to use the depth integrating type because of great depth of high velocity, or for studies of sediment distribution in streams. The sample is usually collected in 'pint bottle' held in a sample of stream-lined body so as not to disturb the flow while collecting a representative sample.

The relation between the suspended-sediment transport Qs and stream flow Q is given

$$Q_s = KQ^n$$
$$\log Q_s = \log K + n \log Q$$

and is often represented by a logarithmic plot of Qs vs. Q (Fig. 11.1); Qs = K when Q = 1, and n is the slope of the straight-line plot and 2 to 3.

The sediment rating curve from a continuous record of stream flow provides a rough estimate of sediment inflow to reservoirs and the total sediment transport may be estimated by adding 10-20% to the suspended sediment transport to allow for the bed load contribution.

When the sediment-laden water reaches a reservoir, the velocity and turbulence are greatly reduced. The dense fluid-solid mixture along the bottom of the reservoir moves slowly in the form of a density current or stratified flows, i.e., a diffused colloidal suspension having a density slightly different from that of the main body of reservoir water, due to dissolved minerals and temperature, and hence does not mix readily with the reservoir water (Fig.).

Smaller particles may be deposited near the base of the dam. Some of the density currents and settled sediments near the base of the dam can possibly be flushed out by operating the sluice gates. The modern multipurpose reservoirs are operated at various water levels, which are significant in the deposition and movement of silt in the reservoir.

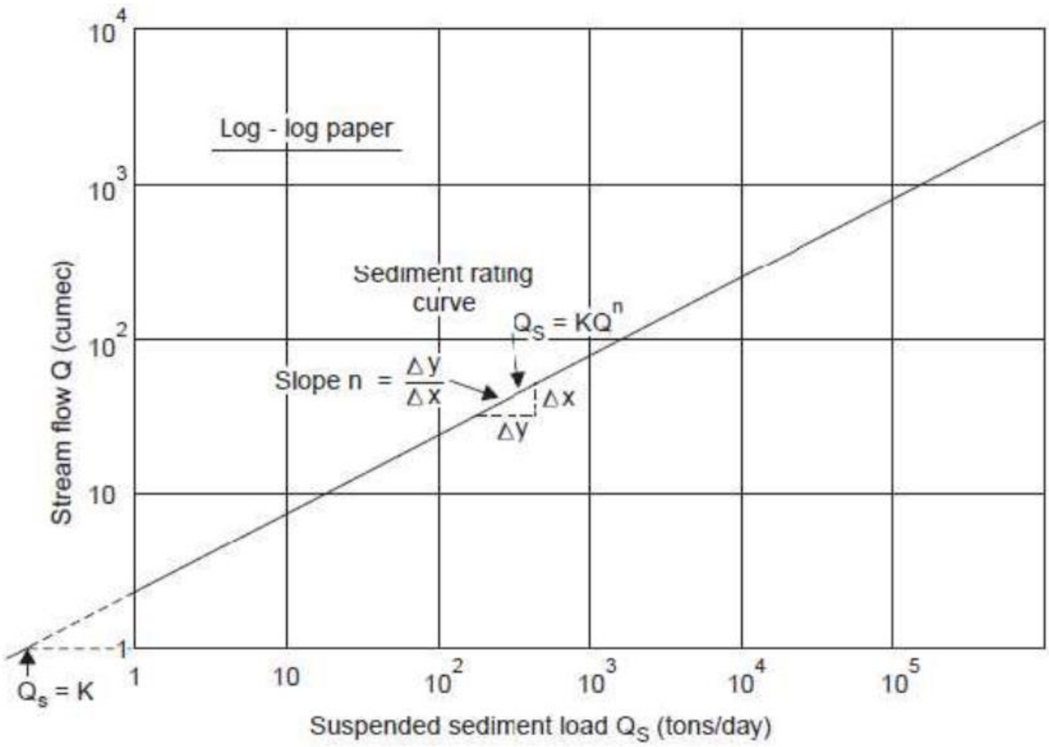

Fig. 11.1 Sediment rating curve

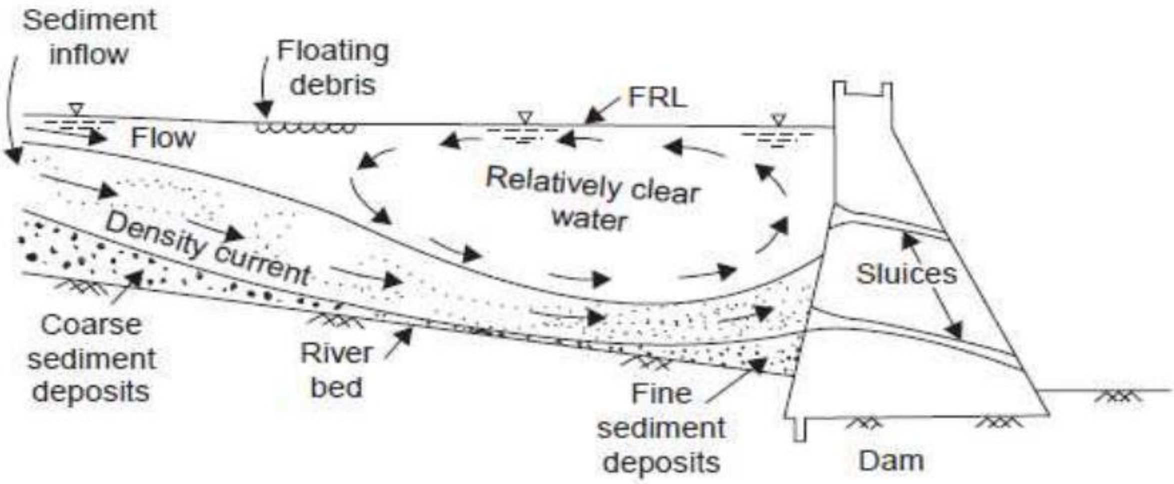

Fig. 11.2 Sediment accumulation in a reservoir

The total amount of sediment that passes any section of a stream is referred to as the sediment yield or sediment production. The mean annual sediment production rates generally range from 250-2000 tons/km2 or 2.5-18 ha-m/100 km2 and the Indian reservoirs are losing a storage capacity of 0.5-1% annually

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