GRIT CHAMBER:

Grit is the heavy inorganic fraction of the wastewater solids. It includes road grit, sand, eggshells, ashes, charcoal, glass and pieces of metal; it may also contain some heavy organic matter such as seeds and coffee grounds. Grit has an average relative density of ~2.5 and thus it has a much higher settling velocity than organic solid s(~30 mm/s, compared with ~3 mm/s). There are two basic types of grit removal plant: constant velocity grit channels and the various proprietary grit tanks or traps available commercially.

Principle of Working of Grit Chamber

Grit chambers are like sedimentation tanks, designed to separate the intended heavier inorganic materials (specific gravity about 2.65) and to pass forward the lighter organic materials. Hence the f low velocity should neither be too low as to cause the settling of lighter organic matter, nor should it be too high as no to cause the settlement of the silt and grit present in the sewage. This velocity is called "differential sedimentation and differential scouring velocity".

The scouring velocity determines the optimum flow through velocity. This may be explained by the fact that the critical velocity of flow ' vc' beyond which particles of a certain size and density once settled, may be again introduced in to the stream of flow it should always be less than the scouring velocity of grit particles. The critical velocity of scour is given by Schield's formula:

$$V = 3t \text{ o } 4.5(g(Ss - 1) d) 1/2$$

A horizontal velocity of flow of 15 t o 30 cm/sec is used at peak flows. This same velocity is to be maintained at all fluctuation of flow to ensure that only organic solids and not the grit is scoured from the bottom.

Horizontal Velocity in Flow Though Grit Chamber:

The settling of grit particles in the chamber is assumed as particles settling as individual entities and referred as Type – I settling. The grit chamber is divided in four compartments as inlet zone, outlet zone, settling zone and sludge zone.

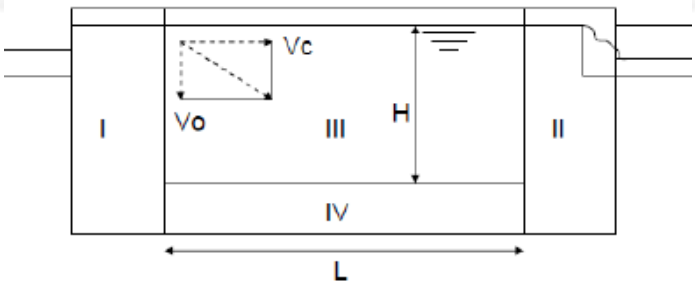

Figure: compartments of Grit chamber

Zone – I:
Inlet zone: This zone distributes the incoming wastewater uniformly to entire cross section of the grit chamber.
Zone – II:
Outlet zone: This zone collects the wastewater after grit removal.
Zone – III:
Settling zone: In this zone settling of grit material occurs.
Zone – IV:
Sludge zone: This is a zone where settled grit accumulates.

L – Length of the settling zone
H – Depth of the settling zone
v – Horizontal velocity of wastewater
Vo – Settling velocity of the smallest particle intended to be removed in grit chamber.

Now, if Vs is the settling velocity of any particle, then
For Vs greater than equal to Vo these particles will be totally removed,
For Vs than less Vo, these particles will be partially removed,

Disposal of Grit:
Considerable quantities of grit will be collected at the sewage treatment plant, about 0.004 to 0.2 m3/ML. Quantity of grit will be more particularly for combined system. Necessary arrangement should be made at the treatment plant for collection, storage and disposal of this grit matter.
The grit collected can be disposed in the following manner:
-In large treatment plant, grit is incinerated with sludge.
-In the past, grits along with screening was dumped into sea.
-Generally, grit should be washed before disposal to remove organic matter.
-Land disposal after washing is most common.

PROBLEM
Design a grit chamber for population 50000 with water consumption of 135 LPCD.
Solution:
Average quantity of sewage, considering sewage generation 80% of water supply, is
= 135 x 50000 x 0.8 = 5400 m3/day = 0.0625 m3/sec
Maximum flow = 2.5 x average flow
= 0.0625 x 2.5 = 0.156 m3/sec
Keeping the horizontal velocity as 0.2 m/sec (<0.228 m/sec) and detention time period as one minute.
Length of the grit chamber = velocity x detention time

= 0.2 x 60 = 12.0 m

Volume of the grit chamber = Discharge x detention time

= 0.156 x 60 = 9.36 m3

Cross section area of flow 'A' = Volume / Length = 9.36/12 = 0.777 m2

Provide width of the chamber = 1.0 m, hence depth = 0.777 m

Provide 25% additional length to accommodate inlet and outlet zones.

Hence, the length of the grit chamber = 12 x 1.25 = 15.0 m

Provide 0.3 m free board and 0.25 m grit accumulation zone depth,

hence total depth = 0.777 + 0.3 + 0.25 = 1.33 m and width = 1.0 m