LECTURE 13

13-FEB-2016

CONTROL VOLUME APPROACH
or
(INTEGRAL APPROACH)

In the last lecture, we were discussing on metacenter and metacentric height.

→ For a symmetric body about an arbitrary axis, the metacentric height was ~~evaluated~~ formulated as:

$$\overline{MG} = \frac{I_0}{V_{submerged}} - \overline{GB}$$

→ One example problem is also done.

Today, we will start a new chapter on "Control Volume Approach".

→ Till now, we were dealing with statics of fluids. As an engineer you should also understand the dynamics of fluids.

→ We can describe the flow at each and every point in the mathematical space ~~and~~ (x, y, z).

That will be differential approach.

→ We can also work within a finite volume and balance the flow of fluids. This will be the control volume approach.

→ The fundamental laws of mechanics can be written for a System.

Q: What is a system?

A system from our point of view can be defined as an arbitrary quantity of fluid mass of fixed identity.

A system is ~~sepa~~ separated from its surroundings by its boundaries.

→ The fundamental laws of mechanics then describe what happens when there are interactions between system and its surroundings.

→ The system has a fixed quantity of mass, m.

Mass of the system is conserved.

$$m_{system} = \text{constant}$$

$$\therefore \frac{dm}{dt} = 0.$$

→ In solid mechanics, this is straight forward.

For example, we can take a beam as a system. Then we can follow its deflections, etc. The system mass is not changing.

Similarly in solid mechanics, you can directly apply

i) Conservation of linear momentum
ii) Conservation of angular momentum
iii) Conservation of energy, etc.

to the system in concern.

⇒ But a fluid system is difficult to analyse. That is, as described earlier we are not too interested to track the motion of each and independent fluid particles.

We are more interested in regions in space that form the required environment and then apply the mechanics principles. These regions are called Control Volumes.

It is the user, who will decide about the control volume.

→ To analyse control volume, we need to convert the mechanics principles that were applicable to systems. That is, when we decide a control volume, a fluid system might have occupied this region at an instant. After a few moments, some other fluid system occupies it

→ System passes on and other systems come along.

→ We need to reformulate the conservation laws with respect to this control volume.