

# Pressure ratio

By

Sangram Samal

# Designing of Blow down tunnel

(Input Mach No at test section)

- Following points need to ensure correct flow condition at the test section
  - Achieving desired velocity in test section
  - Enough mass to meet the tunnel size and run time requirement
  - Dry to avoid the condensation
  - Hot to avoid liquefaction
- Blow down tunnel consists of following
  - Compressor
  - Air storage Tank
  - Pressure control
  - Test section
  - Exhaust

# Determine the allowable operating pressure

- After knowing the test section mach no, isotropic relation/table/graph can be used to find out the pressure ratio
- As blow down the exhaust is to atmosphere so exist pressure is known and the operating pressure can be easily find out from above relation

## Determining the size of tunnel

- The complete W/T size depend on the size of the test section
- With reasonable cost , largest test section possible to make
- Larger model can be kept in side large test section
- It is easier to work on large model than small model
- Reynolds no is directly proportional to model size
- For a given air supply and given run time the largest Reynolds is possible using smallest test section.

## **Specifying Run Times**

- Tunnel run time is normally determined from the type and amount of data required during test
- More time is required to measure the pressure
- The effect on stabilization time increase rapidly with pressure below 1 psi
- For this type of measurement minimum 15 to 20sec is required
- In force test the model is attached with the strain gage balance to measuring the load
- Time required on this type of system depend on the drive mechanism and the alpha range
- This type of test minimum 15 sec is required
- Also time is depend on the recorded device
- Blow down W/T is usually designed for 20 to 40 sec run time

## **Calculating the Air Flow rate**

- The rate of mas flow is one of the primary consideration is sizing the tunnel

## Calculating run time

- There are two way in which blow down W/T is operated
  - With Constant  $q$
  - With constant mass flow rate
- For Constant  $q$  operation the pressure regulator is only necessary control
- For Constant mass flow the temperature also need to be controlled by the heater
- The run time can be calculated by assuming following
  - Polytrophic expansion in storage tank
  - Heater that keep constant temperature
  - Pressure regulator that keep pressure constant
  - No heat loss in duct
  - Isentropic expansion in settling chamber