

Design and Fabrication of Wind Tunnel

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forces generated by air flow.

Abstract:

The use computational fluid dynamics to determine theoretical value for flow of the wind tunnel which is statically compared to actual values of fluids flow. An overall analysis of efficiency and effectiveness were also performed. Subsequent use of wind tunnel as the science of aerodynamic in the disciplines of aeronautical mechanical engineering fields. The Wind tunnels describe the designing testing and validation of an open circuit, the medium sized wind tunnel used for teaching and demonstration. A Wind tunnel is a tool used in aerodynamic research to study the effects of air movement over the solid objects. A wind tunnel consists of a tubular passage with the object mounted in the middle for testing. A powerful fan system allows the air through the wind tunnel over the object. The fan must have straitening vanes to smooth the air flow. Through the wind tunnel the power developed by the wind flows. The most effective way to simulative external turbulent flow is through the use of boundary layer wind.

INTRODUCTION:

A wind tunnel is a tool used in aerodynamic research to study the effects of air moving past solid objects .a wind tunnel consists of a closed tubular passage with the object under test mounted in the middle. A power full fan system moves air past the object, is instrument with a sensitive balance to measure the

The tunnel is ADIABATIC in the sense that there is no active cooling. At temperature above some mechanical elements many bind. Thus testing in the summer is stopped when the outside air temperature are low enough to provided cooling air. The pitch setting of certain diameters fan controls object for air flow speed. Wind-tunnel testing of full/model-scale components is a widely employed technique that guides detailed design decisions in thermal-fluid systems and allows for fundamental research of fluid phenomena. A wind tunnel capable of generating the three kinds of flow regimes, namely subsonic, transonic and supersonic flow regimes can perform well if the flow is continuous and accelerates to higher velocities. This particular capability will provide a lot of data on how flow interacts with the aircraft as it moves to higher velocities. mentioned above.

Wind tunnels are extensively used in research institutes, universities, industry, and governmental agencies for a wide variety of applications and can be classified in many ways from a fundamental viewpoint; one can look at the dimensionless form of the governing equations of fluid motion, which contain various dimensionless parameters Strouhal number St , Reynolds number Re , Euler number Eu , and Froude number Fr . When the energy equation is considered, additional dimensionless parameters

appear, such as the Eckert number E_c , Mach number M , and Prandtl number Pr . Additional dimensionless parameters also appear due to boundary conditions, etc. Wind tunnels can also be classified based on operational. Wind tunnels can also be classified based on their operational flow regime and corresponding relevant dimensionless parameters. It is common to characterize an incompressible gaseous flow, such as air, primarily its Reynolds number. Compressible gaseous flow is primarily characterized by its Reynolds numbers. Liquid flows are characterized primarily by the Reynolds and Froude numbers. These parameters are critical, as one of the key, though often unrealizable, goals of wind-tunnel testing is dynamic similarity, where all relevant dimensionless parameters match between model and full scale.

WIND TUNNEL DESIGN:

Power requirement; The power required to maintain to steady flow through the wind tunnel is equal to the total losses occurring in the flow through the tunnel. These losses are due to kinetic energy being dissipated by vortices and turbulence. The losses in kinetic energy, which appears as a decrease in total pressure must be compensated by a pressure rise usually provided by a fan Diffuser; The wind tunnel as additional pressure loss results from the discharge of the flow kinetic energy at tunnel exit. The loss is just to the dynamic are at the diffuser.

Corners:

Losses that occur at corners where the flow turns can be computed by methods for described in references 2 and 3 which give values of pressure drop coefficients for various types of turning valves. In open circuit tunnel corners are not advisable unless the available space is limited.

Damping Screens:

Wire screens, which are used for the reduction of turbulence, produce losses in pressure which are dependent on the screen mesh size and diameter of wire used pressure drop coefficients for commercially

available wire screen, are measured as the ratio of the pressure loss through the screen to local dynamic pressure loss coefficient in the flow.

DESIGN OF THE TEST SPECIMENS



Airfoil specimen:

Design of air foil specimen as per given dimensions.

LENGTH: 24cm

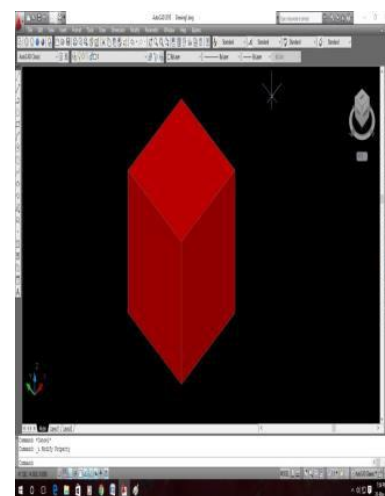
Diameter: 10cm

Radius: 5

Cubetest specimen:

Design of cube specimen as per given dimensions.

Area: $9 \times 9 \times 9$



CONSTRUCTION

Wind Tunnel Construction:

After basic research the early development of our wind tunnel seems to break down into five major components. These consist of the fan, convergent zone, throat section, divergent zone. Most sources indicate that the test section is the most important part of the wind tunnel and should be designed first, based on specific needs and Reynolds numbers, so that the rest of the wind tunnel can be construction accordingly to meet the specification determined by the test

1. Test Section

2. To accommodate the chosen air foil dimensions to test section dimensions are chosen as:

Cross section: $40 \times 30 \text{ cm}^2$

Length: 150 cm

2. Convergent Zone:

The convergent zone cone ratio can vary from a low speed wind tunnel thus. Accordingly to the length of the convergent zone ratio with respect to the test section the dimensions of the cone were chosen as :

Cross section: $30 \times 30 \text{ cm}^2$

(outer end) (inner end)

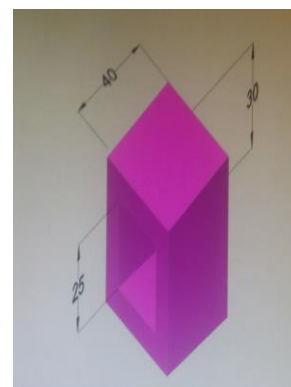
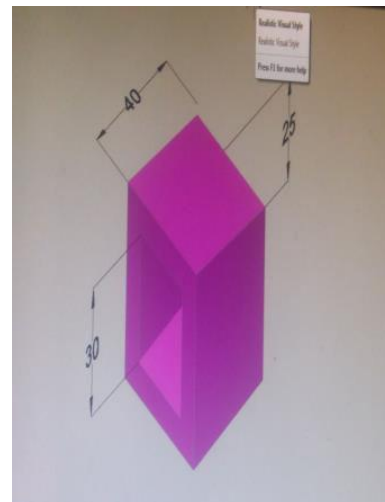
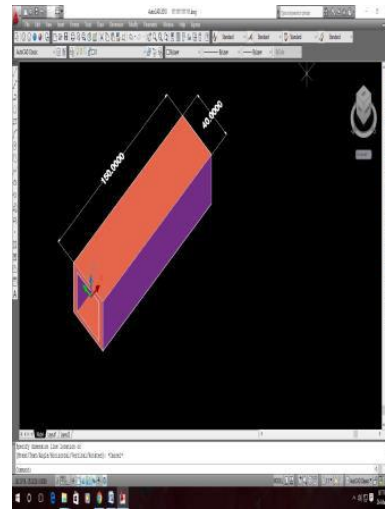
$40 \times 30 \text{ cm}^2$

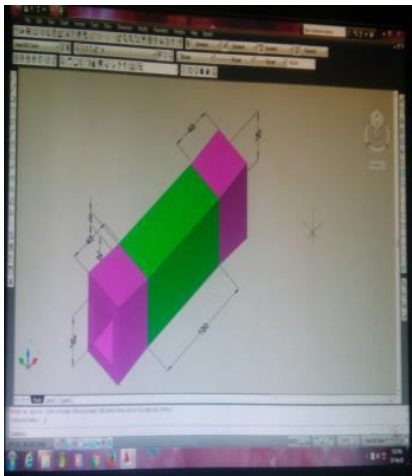
Divergent Zone:

Divergent zone cone ratio can vary from a low speed wind tunnel thus. Accordingly to the length of the convergent zone ratio with respect to the test section the dimensions of the cone were chosen as:

Cross section: $30 \times 30 \text{ cm}^2$ (outer

end) - $20 \times 30 \text{ cm}^2$ (inner end)





Working Principle:

The lathe is a machine tool which holds the work piece between two rigid and strong supports called centers or in a chuck or face plate which revolves. The cutting tool is rigidly held and supported in a tool post which is fed against the revolving work.

Wooden Circular Saw:

A circular saw is a tool for cutting many materials such as wood, masonry, plastic, or metal and may be hand-held or mounted to a machine. In woodworking the term "circular saw" refers specifically to the hand-held type and the table saw and chop saw are other common forms of circular saws. "Skilsaw" has become a generic trademark for conventional hand-held circular saw.

EQUIPMENT USED FOR FABRICATION

Hand Drilling Machine:

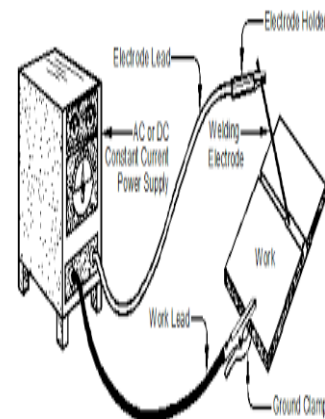
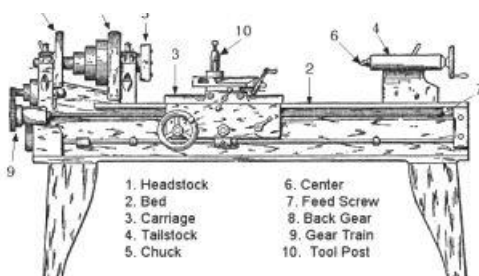


Working principal:

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit impressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (swarf) from the hole as it is drilled.



Automatic Lathe Machine:



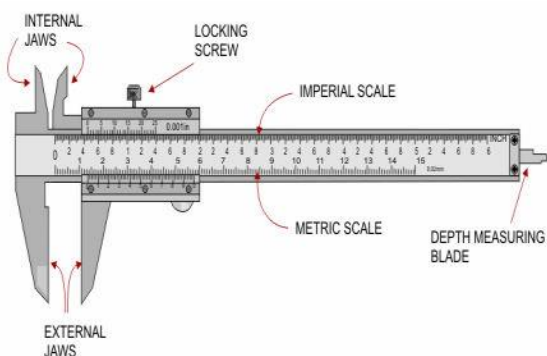
Welding machine:

Arc welding is a method of joining metals by applying sufficient electrical pressure to an electrode to maintain a current path (arc) between

the electrode and the work piece. In this process, electrical energy is changed into heat energy, bringing the metals to a molten state; whereby they are joined. The electrode (conductor) is either melted or added to the base metal or remains in its solid state. All arc welding utilizes the transfer of electrical energy to heat energy, and to understand this principle necessary.

Steel Rule:

A ruler, sometimes called a rule or line gauge, is an instrument used in geometry, technical drawing, printing, engineering and building to measure distances or to rule straight lines. The ruler is a straightedge which may also contain calibrated



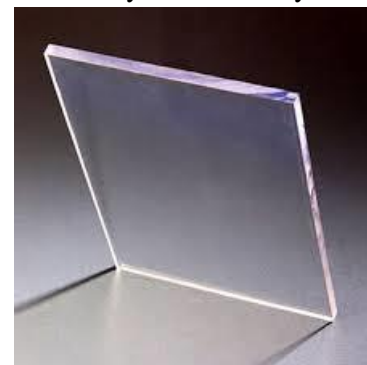
Vernier caliper:

A Vernier scale is a device that lets the user measure more precisely than could be done unaided when reading a uniformly divided straight or circular measurement scale. It is a scale that indicates where the measurement lies in between two of the marks on

the main scale. Vernier are common on sextants used in navigation, scientific instruments used to conduct experiments, machinists' measuring tools (all sorts, but especially calipers and micrometers) used to work materials to fine tolerances, and on theodolites used in surveying.

MATERIALS USED FOR MANUFACTURING OF WIND TUNNEL:

Transparent plastic sheet material: This plastic sheet is completely transparent, flexible, and exhibits great resistance to breakage. Acrylic is excellent material to use in place of glass for windows, skylights, doors, partitions, etc. It is lightweight, half the weight of glass, and it is virtually unaffected by na.



Epoxy Resin:



The applications For epoxy-based materials are extensive and include coatings, adhesives and composite materials such as those using carbon fiber and fiberglass reinforcements (although polyester, vinyl ester, and other thermosetting resins are also used for glass- reinforced plastic.

High Speed Fan:

A fan is a machine used to create flow within a fluid, typically a gas such as air.

The fan consists of a rotating arrangement of vanes or blades which act on the fluid. The rotating assembly of blades and hub is known as an impeller, a rotor, or a runner. Usually, it is contained within some form of housing or case this may direct the airflow or increase safety by preventing objects from contacting the fan blades. Most fans are powered by electric motors, but other sources of power may be used, including hydraulic motors and internal combustion engines..



on car doors. The term "door knob" or "doorknob" tends to refer to round operating mechanisms

Connecters:

A connector is used to get from the piping to the appliance that's all. The connectors should never be used as a substitute for piping section



Fabrication of wind tunnel



Knobs:

A door handle is an attached object or mechanism used to manually open or close a door .In the United States, a door handle generally can refer to any fixed or lever-operated door latch device, including



ADVANTAGES:

- Low construction cost.
- Compact size.
- Superior design for propulsion and smoke visualization. There is no accumulation of exhaust products in an open tunnel.

Applications

- Airfoil Designs
- Auto Mobile Design
- Construction Building Design

FUTURE SCOPE:

Describes current practices for the testing of buildings and other structures in flows simulating natural winds. Provides a basis for discussion on needed improvement to those practices improvement are required because, as was demonstrated by recent studies.

CONCLUSION:

The design of wind Tunnel is a purely related to advanced aerodynamic theory. While the overall goal is to Implement a complete , remote package to control the wind tunnel system a systematic approach will be most beneficial by working through each step.

REFERANCES

- Google
- Wikipedia
- Aviation.com
- Anderson, Fundamentals of Aerodynamics, 2nd Ed., pp. 1995- 2000 and pp. 228-236, McGraw Hill 1991
- Bails, D.D and Corliss, W.R Wind tunnels of NASA, NASA SP -440, National aeronautics and space administration, Washington D.C,1981



CALCULATIONS

- Calculation Of The Mass Of Airfoil Section,
- Velocity,
- Lift Force,
- Drag Force,
- Discharge, and Co-efficient Of Discharge