

DESIGN AND DEVELOPMENT OF SCRAMJET COMBUSTOR USING CONCEPTUAL APPROACH

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in Aeronautical Engineering

By

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APRIL 2021

DEPARTMENT OF AERONAUTICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **BASHETTY PAVAN (37260030)** and **M. MOHAN RAO (37260022)** who carried out the project entitled **“DESIGN AND DEVELOPMENT OF SCRAMJET COMBUSTOR USING CONCEPTUAL APPROCH”** under our supervision from September 2020 to March 2021.

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DECLARATION

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ABSTRACT

The scramjet engine takes large amount of air to run the engine. In this the flow of air is turbulent in combustor part that the velocity of air will be in that area due to high velocity of air the pressure will be increased in combustor. That leads to the destruction of combustor. To maintain the steady and non-turbulent flow that we introduced semi-aerofoil structures near the inlet point by doing this semi-aerofoil structures which will provide less friction inlet and it compresses the air that flows through high velocity to the later section of the system is in rectangular shape by doing this it will maintains steady flow of air that reaches the specimen area. In this specimen area we have attached a specimen called as tob-shaped object which is placed at quator distance before the exit that which divides the flow by splitting it. By the semi-aerofoil and tob helps to maintain steady flow in the combustor and to avoid swirls that which will develop the pressure towards maintain structure of combustor. By placing the objects there is steady flow in the combustor.

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CHAPTER-1

INTRODUCTION

1.1 SCRAMJET ENGINE

Scramjets Engines are mainly design to work within beyond the reach of turbojet motors. The hyper-flight regime fills the gap between high-performance turbojets as well as high-speed rocket engines, together with ramjets. Turbomachinery-based motors are becoming increasingly inefficient. It is highly efficient at subsonic velocity because of the fact that the compressor rotors in turbojet motors require subsonic speeds. Although it is often caused by the transonic to the low supersonic rate. This leads to unbelievable temperature growth and loss at super-sonic velocity under the overall flow pressure.

The air intake, fuel injectors, a combustion chamber and divergent pin nozzle are all compressed in all Scramjet engines. Usually, motors have a quarter that functions as a keeper of a fire, but the high stagnating temperatures. This allows to use of a neighbourhood with focused waves, not of a discreet motor component as seen in turbine engines. To avoid flameouts, other engines utilise pyrophoric additives, such as silane. A combustion chamber is normally fitted with an insulator. To improve flow homogeneity within the combustion engine and to increase the engine's operating range.

In this type of combustor, a series of being physical and chemical changes like it should be completed by combustion and mixing in the limited space. There will be less time and sophisticated flow state, by doing this they will get performance loss. It should even be reduced the maximum amount as possible. This is often a really difficult task, and it is also the main problem to be solved with in the design of scramjet engine.

The Russian Federal Central Space Agency introduced the efficient use of cavity flame stabilisers to improve ignition and flame stability. Cavity has exceptional flame stability. The fuel and its combustion products are frequently contained inside

the cavity and close to the combustion chamber wall due to injection directly into the combustor wall. This is not only detrimental to the mixing of fuel and air, but it also prevents full utilisation of the combustor space, raising the heat resistance requirements of the combustor material.

TURBOPROP ENGINE:

Fuel-efficient turboprop aircraft engines spin at a mid-range speed of 250 to 400 knots. The turboprop engines are effective at the mid-altitudes, due to the turboprop engine weight, their gearing system can fail quickly. The turboprop engine has a combustion chamber that houses pressurised air and steam. The turbine and compressor that operate together to fuel the turbine.

TURBOJET ENGINE:

This type of engine takes the air in the engine's rear side so the pressure remains within the mechanical device. The fuel needs to value added to the combustion chamber and then burned to lift the fluid mixture at 1000 C temperature. The new air that created then pushed the air through a rotary engine to rotates the mechanical device. The pressure at the discharge of the rotary engine though to be double the pressure within the atmosphere. This is, however, dependent on the engine's power level. The high pressure then travels to the nozzle, where it produces the gas streams. That is responsible for launching a thrust. To ignite the mixture, the air mass is combined in the chamber. The combustion process continues because fuel continues to flow through the engine, compressor, and turbine. Because the engine requires an additional flow of air to stay cool, turbojet engines run lean.

TURBOSHAFT ENGINE:

It is a gas-powered rotary engine that functions as a turboprop engine. However, it is not a turboprop engine because turbo shaft engines do not have a propeller. Instead, it is used in helicopters to provide power to the rotor. Turbo shaft engines are

built in such a way that the speed of a heavier-than-aircraft rotor is multiplied by the speed of the gas generator.

This allows the speed of a heavier-than-aircraft rotor to remain constant even as the speed of the gas generator decreases. It also modifies the ability of a heavier-than-aircraft. These engines are commonly found in helicopters.

1.2 SCRAMJET COMBUSTOR

Scramjet Combustor should maintain stable combustion without being affected by very high air flow rates. The purpose of the Combustors is to mix and ignite the air with the fuel before adding more air to complete the combustion process. Many engine operating characteristics, such as fuel efficiency, emissions levels, and transient response, are determined by the combustion engine.

1.2.1 TYPES OF CONFIGURATIONS IN COMBUSTOR

1.2.1.1 CAN TYPE COMBUSTOR

Can combustors measure self-contained cylindrical combustion chambers squarely. Each "can" be equipped with its own fuel appliance, igniter, liner, and casing. The mechanical device's first air is guided into each individual will, where it is decelerated, mixed with fuel, and then ignited. The secondary air is supplied by the mechanical device as well, wherever it is fed outside of the liner. Secondary air is then introduced into the combustion zone, typically through slits in the liner, to cool the liner via skinny film cooling.

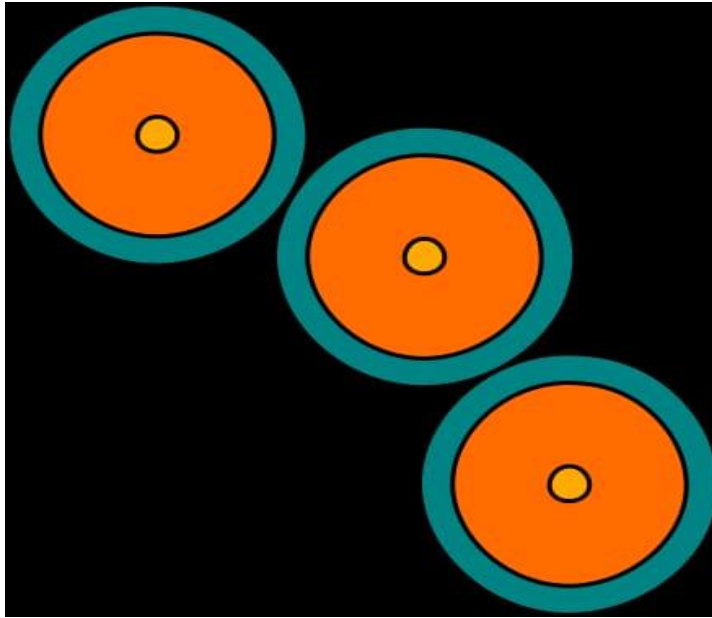


Fig: 1.1: CAN TYPE COMBUSTER

1.2.1.2 CANNULAR TYPE COMBUSTER

Cannular combustors have separate combustion zones contained within separate liners, each with its own set of fuel injectors. Unlike the will combustor, all of the combustion zones share a common ring (annulus) casing. A pressure vessel should not be used in any combustion zone. The combustion zones may also "talk" to one another through Liner holes or connecting tubes that allow some air to circulate circumferentially.

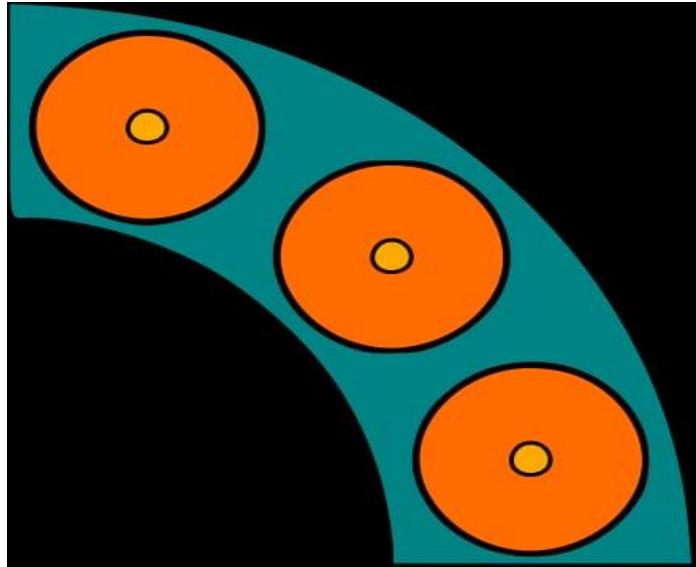


Fig: 1.2: CANNULAR TYPE COMBUSTOR

1.2.1.3 ANNULAR TYPE COMBUSTOR

Annular combustors are the most common type of combustor. That is a completely cancelled combustor. Annulated combustors eliminate separate combustion zones, and each ring can easily accommodate an infinite liner and casing (the annulus). There are several annulated combustors available, as well as more uniform combustion, shorter size (thus lighter), and fewer expanse. The exit temperatures of annulated combustors are extremely uniform. They also have the least amount of pressure drop out of the three designs (on the order of 5 percent).

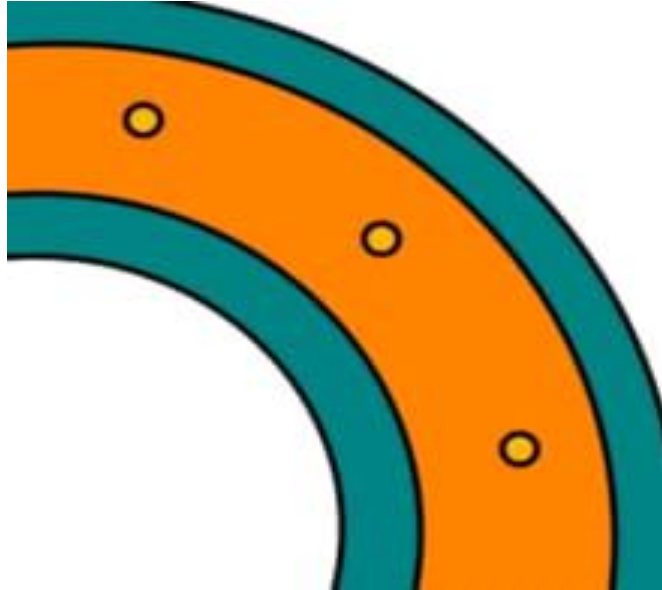


Fig: 1.3: ANNULAR TYPE COMBUSTOR

1.3 APPLICATIONS OF SCRAMJET COMBUSTOR

Scramjets are intended to control within the hypersonic flight rule, beyond the reach of turbojet engines, and to bridge the gap between the high efficiency of turbojets and the high speed of rocket engines. A scramjet (supersonic-combustion ramjet) is a jet engine in which the flow rate remains supersonic, or faster than the speed of sound. Vehicles with scramjet engines are available pictured to control at accelerates to a minimum of physicist fifteen. The key blessings of a scramjet over a jet engine are that the scramjet gets the chemical agent to combust its fuel from the air it's flying through, whereas a jet engine has to carry oxygen to burn its liquid hydrogen fuel. It is mainly used in missile and jet aircraft.

1.3.1 AVIATION INDUSTRY AND ROCKET PRODUCTION

In this the flow of air is turbulent in combustor part that the velocity of air will be in that area due to high velocity of air the pressure will be increased in combustor. Scramjet engine vehicles are intended to operate at least high speeds Mach 15.

1.4 FABRICATION OF SCRAMJET COMBUSTOR

1.4.1 CLASSIFICATION OF FABRICATION PROCESS

1.4.1.1 ALUMINIUM MATERIAL

The most common application for an aluminium 1100. Cold metal working refers to any metal forming process that occurs at or near room temperature. Chemical appliances, railroad tank cars, fin stock, dials, name plates, cooking utensils, rivets, reflectors, and sheet metal are all examples of manufactured items of the many products made from aluminium 1100. Aluminium 1100 is used in the plumbing and lighting industries as well. This is one of the most pliable aluminium alloys. It is not suitable for applications requiring high strength or pressure. Pure aluminium can also be hot worked in the same way that it can be shaped by spinning, stamping, and drawing. Aluminium shapes such as foil, plates, round bars or rods, sheets, strips, and wire are produced without the use of high heat in these processes. It is also possible to weld aluminium 1100, but with 1100, it is difficult to weld resistance. Aluminium 1100 is one of several common soft, low-force and containing aluminium alloys of 99 per cent min. It is also known as pure aluminium in commercial terms. Copper, iron, magnesium, manganese, silicone, titanium, vanadium and zinc are all other elements. The heat treatment is very smooth and cannot be hardened.

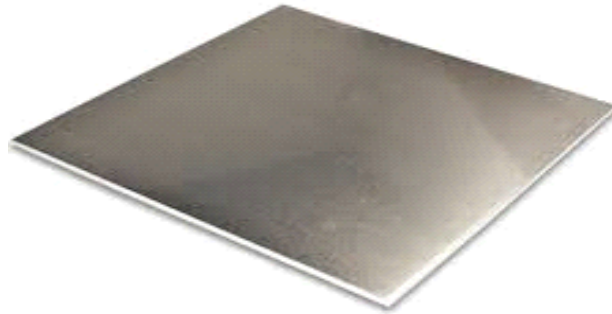


Fig: 1.4: Aluminium 1100 Grade

Table: 1.1: MECHANICAL PROPERTIES

Properties		Conditions	
		T (°C)	Treatment
Density (x1000 kg/m ²)	2.71	25	
Poisson's Ratio	0.33	25	
Elastic Modulus (GPa)	70 – 80	25	
Tensile Strength (Mpa)	110	25	H12
Yield Strength (Mpa)	105	25	H12
Elongation (%)	12	25	H12
Hardness (HB500)	28	25	H12
Shear Strength (Mpa)	69	25	H12
Fatigue Strength	41	25	H12

Table: 1.2: AA 1100

Tensile Properties		Conditions	
		T (°C)	Treatment
Tensile Strength (MPA)	110	25	H12
Yield Strength (Mpa)	105		
Elongation (%)	12		
Reduction in Area (%)			
Tensile Strength (MPA)	125	25	H14
Yield Strength (Mpa)	115		
Elongation (%)	9		
Reduction in Area (%)			
Tensile Strength (MPA)	145	25	H16
Yield Strength (Mpa)	140		
Elongation (%)	6		
Reduction in Area (%)			
Tensile Strength (MPA)	165	25	H18
Yield Strength (Mpa)	160		
Elongation (%)	5		
Reduction in Area (%)			
Tensile Strength (MPA)	90	25	0
Yield Strength (Mpa)	34		
Elongation (%)	35		
Reduction in Area (%)			

1.4.1.2 CUTTING MACHINE

Laser cutting to cut through sheet metal, a laser cutting system utilizes a high supercharged optical maser. Once the beam hits the floor, the energy in the beam melts. A gas stream blows any remaining liquid metal or vapour well away from the cut. The optical maser assumes the specified cutting path by normal course the location of the beam relative to the board. This method is used on optical maser cutting machines, which include a power supply, optical maser device, mirrors, focusing lens, nozzle, managed gas, and a work table.

The most common optical maser used for sheet cutting is a CO₂-based primarily optical maser with 1000-2000 watts of power. However, Nd and Nd-YAG lasers are commonly used for extremely high-power applications. A set of mirrors and the "cutting head," which includes a lens and nozzle, focus the beam on the cutting position. The beam diameter at the cutting surface is typically around zero.008 inch.

Laser cutting is often preformed on sheet metals that are each ferric and non-ferrous. Materials with a low reflectivity and a physical phenomenon enable the ray to be best-steel, aluminium, stainless-steel, and metal are commonest. Metals that mirror lightweight and conduct heat, like a metallic element and copper alloys will still be cut however need better power an optical maser. Optical maser cutting may also be used on the far side sheet applications to chop plastics, ceramics, a stone, wood.

1.4.1.3 BENDING MACHINE

Sheet Bending is usually performed in a machine such as press brake, which can be used as manually operation or a mechanically operation. The bending method is typically observed as press brake. The press brakes square measure on the market

in an exceedingly vary of sizes of the application. The press brake contains a higher tool referred to as the punch and a lower tool between that the sheet will be found. The sheet is rigidly positioned over the machine, and when the rear gauge commands punch lowers, the sheet is forced to bend. The punching in the automatic machine is forced into the sheet below the hydraulic pump's capability. The bend angle is determined by the depth of the punching forces applied to the sheet.

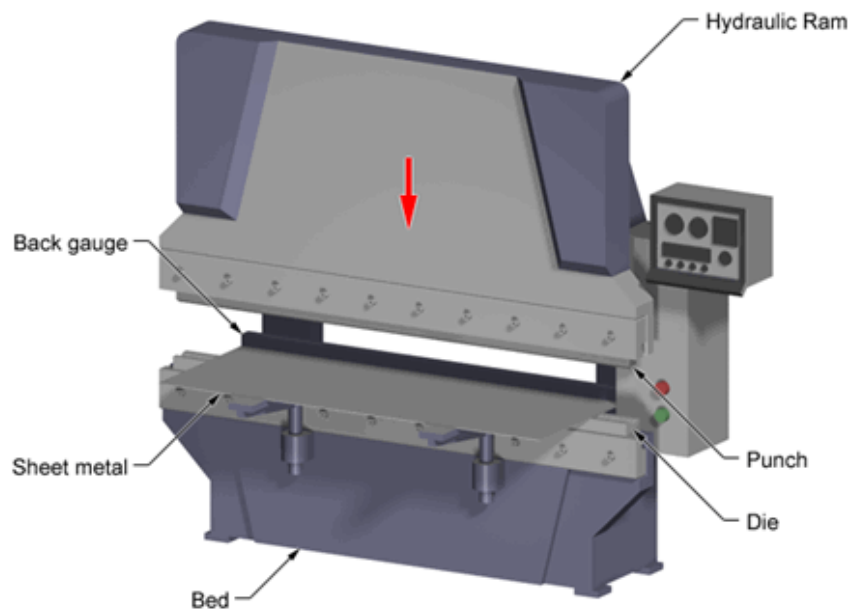


Fig: 1.5: BENDING MACHINE

In order to achieve the desired bend, the depth is precisely controlled. For punch and die, normal tooling is commonly used, resulting in a low initial cost and suitability for low volume production. Custom tooling may be used for specialised bending operations, but it can increase the value of the product.

The tooling material is chosen primarily based on the number of assemblies, the sheet material, and the degree of bending. To withstand larger quantities, more durable sheet, and multiple operations, a stronger tool is obviously required. Some common tooling materials, in terms of increasing strength, include hardwood, low

steel, tool steel, and inorganic compound steel. the bending of an aluminium sheet is one in every of the best processes, because of the well-known properties that characterize the aluminium: softness, plasticity and lightness permit to bend it while not risk of breaking or inflicting cracks.

1.4.1.4 TIG WELDING

TIG Welding is also known as Gas metallic element Arc fastening (GTAW), in this process they use joins metals sticks by heating them with associate degree of arc in between a metallic element conductor and also the work piece. This method is employed with an inert-gas and will even use while not the addition of different types of material metals. The first variables in TIG fastening area unit arc voltage or arc length, fastening current, travel speed and inert-gas composition. The quantity of energy that arc produces is proportional to the present and voltage. The quantity of energy is transferred per unit length of welding stick is comparable to the travel speed. Inert-gases area unit usually static to guard the conductor from the contamination. The employment of the shielding provides a lot of penetration than Ar.

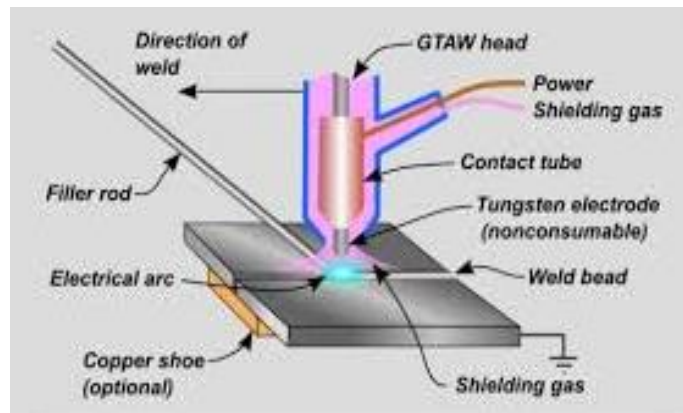


Fig: 1.6: TIG WELDING

The arc is established in between the tip of the conductor and also generates heat to soften the bottom metal. Once the arc and the welding pool area unit accepted, the torch is affected on the joint and the material arc increasingly melts the surfaces to be joined. If used, material stick is sometimes another to the vanguard of the weld fuse to fill the joint. The metallic element conductor may be alloyed with little amounts of active components to extend emissivity of the electrode; this provides faster arc beginning, larger arc stability, and longer conductor life. TIG attachment metal needs an inert-gas, a metal burnable conductor and a clean surface to get rid of any compound build up. The compound features a higher freezing point of the metal itself, that is why it must be removed before attachment. The attachment machine must either be designed for TIG attachment. A foot current management is crucial since heat builds up because the weld is started, requiring less heat from the conductor toward the top of the weld. For best results use AC at a high frequency. Electrical energy is employed as a restricted different however leads to higher heat levels on the conductor and poor compound cleansing. The torch nozzle conjointly should be designated to be used on metal. once the diameter of the conductor is modified, a wider vary of warmth input is used at totally different metal thicknesses. within the hands of a talented craftsman, TIG appearance higher and seals higher than MIG metal attachment. MIG metal attachment is most popular for thicker items of metal.

1.4.1.5 SPECIMEN HOLDER

We have taken an aluminium rod of thickness of 12mm, its length is 19.8cm and its breath is around 2.4cm. This aluminium rod should hold the specimen.



Fig: 1.7: Aluminium Rod

Aluminium 1100 material is smooth, non-heat treatable and it has low strength alloy that provides robust imperviable. It composed of ninety-nine metallic element and zero.12% copper, metallic element 1100 is purest grade of metallic element alloy obtainable commercially. An extremely asked for alloy, metallic element 1100 offers wonderful machinability still as maintaining strength in low temperatures and electrical physical phenomenon. There are variety of economic and industrial applications. rather than strength, 1100 is often used for chemical instrumentality, food handling instrumentality, utensils, rivets, ornamental trim, ornamental elements, dials and name plates, lighting instrumentality, heat exchangers, and sheet work.

CHAPTER-2

LITERATURE SURVEY

- S Jeyakumar, Antony Athithan et al. Performed on “The Combustion Characteristics of Double Ramps in a Strut-Based Scramjet Combustor”. They focused on the effect of ramp positions upstream of a strut-based combustor scramjet under numerically examined reaction flow conditions. In this case, the ramp combustor is seen to have a higher flame temperature. Since more shock interactions occur from the ramps, the overall pressure loss for ramp combustors in relation to the basic model is marginally increased, in February 2021.
- Jīn Gao et al. Carried out on Experimental research was conducted on a strut / wall combined injection plan for flush-wall scramjet combustion with liquid kerosene to increase combustion efficiency. The burning organisation with multi-stage fuel injection system in a scramjet combustor. "Research on combustion performance optimization in scramjet combustor with strut/wall combined fuel injection scheme", December, 2020.
- Varsha Rani, Ayush Passi et al. Performed on the major design considerations and fuel injection process that can lead to an effective design on “Scramjet Combustor Design – A Review”, October, 2020.
- Kumari Ambe Verma et al. Carried out on “Impact of parametric variation on combustion characteristics of hydrogen- fuelled strut-based scramjet combustor at supersonic speed”. They have got the optimum boundary condition in computation work is 833 K temperature with 115 299 Pa pressure, August, 2020.

- Akshat Deshpande, Girish Barpande et al. Performed various test such as total pressure loss, combustion efficiency, top wall static pressure, and so forth. To comment on mixing and combustion efficiency further, mass fraction contour plots of species are obtained. And carried out the “Numerical Investigation of Effect of Fuel Jet Configuration on Scramjet Combustor Performance”, February, 2020.
- Kumari Ambe Verma et al. Carried out an “Computational investigation on Design of Scramjet Combustor – A review”, March, 2019.
- Tao Cui, Yang Ou et al. Performed on the efficacy of the development strategy, and the migrated model is demonstrated to be suitable for the new combustor in terms of higher accuracy with less time and calculation on the “Modelling of Scramjet Combustors Based on Model Migration and Process Similarity”, June, 2019.
- Sukanta Roga et al. Performed on Machine firmness is needed to achieve higher combustion efficiency in “CFD analysis of Scramjet engine combustion chamber with diamond-shaped strut injector at flight Mach 4.5”, 2019.
- Obula Reddy Kummitha, Rajat Gupta et al. Performed on “CFD analysis of a scramjet combustor with cavity-based flame holders”. They discovered that the mixing and combustion efficiency of a scramjet combustor with a phase cavity configuration is superior to other versions. January, 2018.
- Obula Reddy Kummitha et al. Performed on “Numerical analysis of passive techniques for optimizing the performance of scramjet combustor”. From They obtained numerical analysis results, and after discussion, it was determined that the highest mixing and combustion efficiency is associated with a uniform zigzag (wavy wall) surface combustor wall design. February, 2017.
- Wu Xianyu, Li Xiaoshan et al. Carried on “Experimental Study on Effects of Fuel Injection on Scramjet Combustor Performance”, December, 2007.

CHAPTER - 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM

To prove that this scramjet combustor would reveal the feature using semi aerofoil and a specimen called tob-shaped object to improvement in combustion efficiency.

3.2 SCOPE OF THE PROJECT

The present works deals to avoid the unnecessary pressure produced in certain areas of combustor due the turbulent flow that which helps the better performance of combustor and decrease the internal damage factor of combustor and it increase the steady flow and better lifetime with low maintenance cost. To avoid maximum amount of turbulent flow that which produce unnecessary pressure development in certain areas of combustor.

Scramjet Combustor are used in jet aircraft and missile. This project gives the experimental study of scramjet combustion. We have fabricated the scramjet combustor with aluminium metal sheet of grade 1100. We have changed some objects like aerofoil, specimen and specimen holder by changing the objects there will be a steady flow in combustor and to avoid swirls that which will develop the pressure towards maintain structure of combustor.

CHAPTER 4

MATERIALS AND EXPERIMENTAL METHOD

4.1 COMBUSTOR DESIGN PROCESS

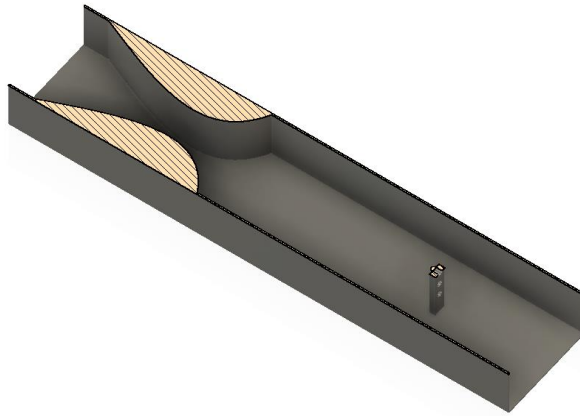


Fig: 4.1: TOP VIEW OF COMBUSTOR



Fig: 4.2: SIDE VIEW OF COMBUSTOR

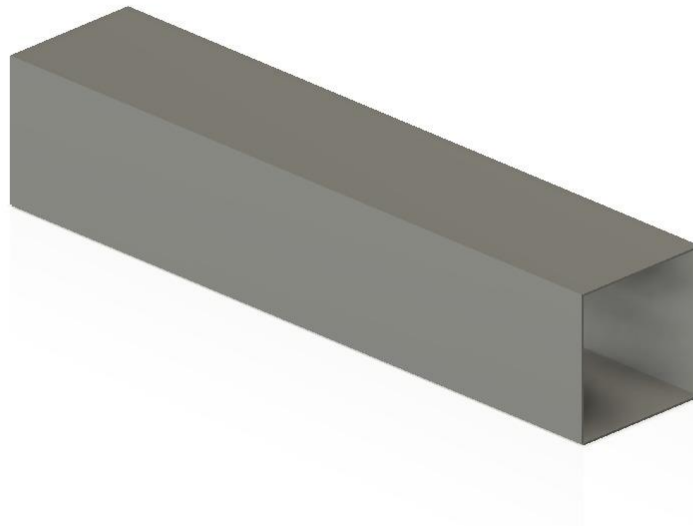


Fig: 4.3: 3D VIEW OF COMBUSTOR

4.2 MATERIAL

4.2.1 MATERIALS REQUIRED

- Aluminium sheet 1100 - Thickness 3mm
- Aluminium rod - Thickness 12mm
- Tob shaped specimen made of iron - Diameter 0.045m

4.2.2 TOOLS REQUIRED

- Cutting Machine
- Bending Machine
- Lathe Machine
- Treading Machine
- Grinding Machine
- Tig Welding
- Hammer

4.3 EXPERIMENTAL PROCEDURE

4.3.1 CUTTING PROCESS

The aluminium sheet is 1m*1.2m dimension with the thickness of 3mm. We had slashed an excess part of 40cm in breath. After cutting the excess part of 40cm then the sheet dimension will be 1m*0.8m. Then in 1m*0.8m dimension we had slashed another 20cm sheet. Now the sheet dimension will be 1m*0.6m. Cutting machine is shown in fig 1.8.

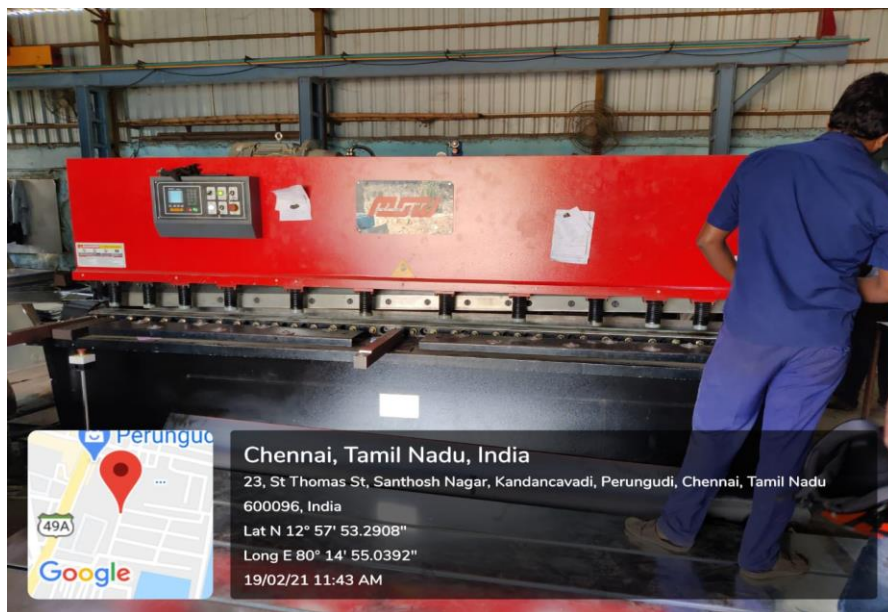


Fig: 4.4: CUTTING MACHINE

4.3.2 BENDING PROCESS

The aluminium sheet dimension is 1m*0.6m after cutting. In bending machine, the sheet will bend only 3 side so we have slashed the 4th part by welding we had attached. The 3 side are equally distributed by 20cm*20cm*20cm. Bending Machine is shown as fig 1.9.

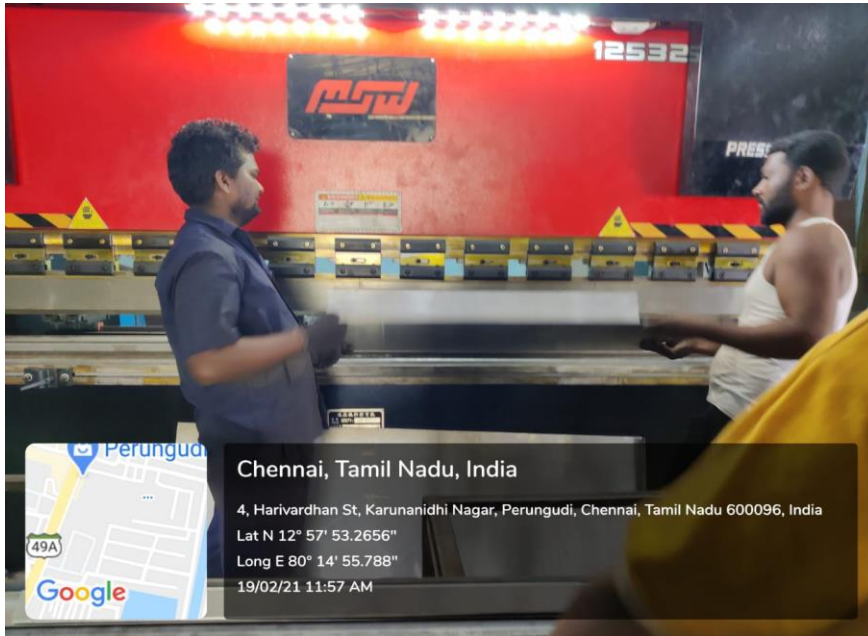


Fig: 4.5: BENDING MACHINE

4.3.3 SEMI-AEROFOIL STRUCTURE

The semi-aerofoil structure is made up of aluminium sheet of length is 35cm, breath is 9.8cm and thickness of 3mm. The aluminium sheet is place on two circular fixed rods on ground and given strokes by hammer in certain angle moving forward to backward direction that which the semi-aerofoil structure made. It is shown in fig: 2.0 and fig:2.1.

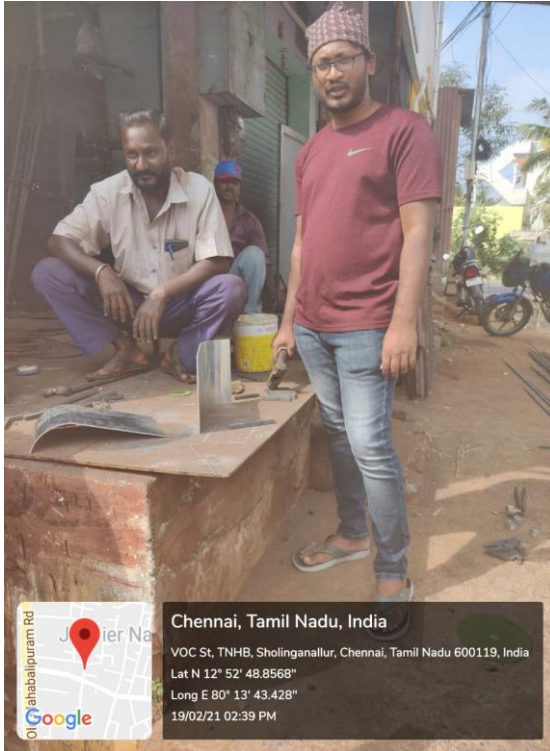


Fig: 4.6: MAKING OF
SEMI-AEROFOIL STRUCTURE.



Fig: 4.7: SEMI-AEROFOIL STRUCTURE

4.3.4 GRINDING PROCESS

The semi-aerofoil structure is made up of aluminium sheet of length is 35cm, breath is 9.8cm and thickness of 3mm. The grinding of the edges of semi-aerofoil by placing the grinding machine at 45° angle too and forward motion.

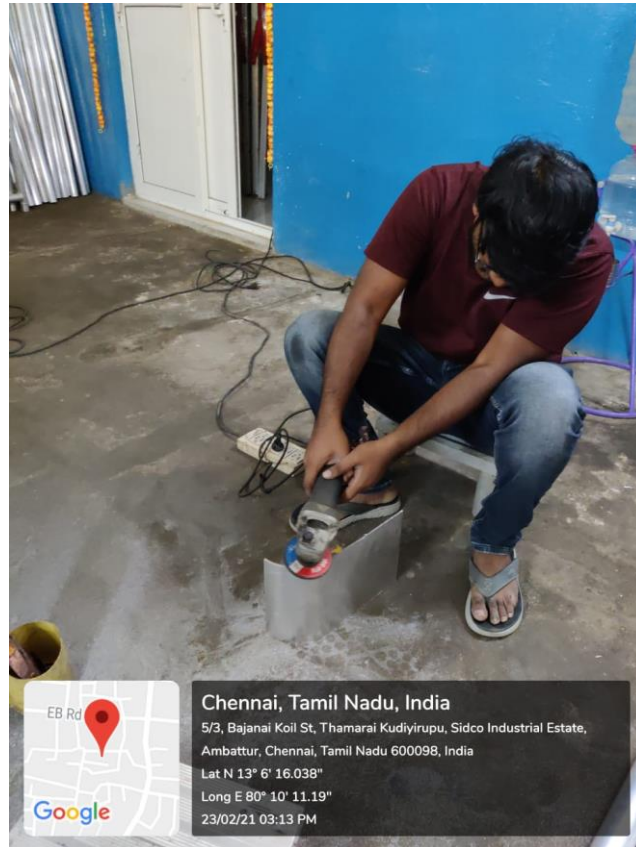


Fig: 4.8: GRIDING PROCESS

4.3.5 SPECIMEN HOLDER

We have taken an aluminium rod of thickness of 12mm, its length is 19.8cm and its breath is around 2.4cm. This aluminium rod should hold the specimen. For the specimen rod we have made 5 holes so the flow should be steady. The diameter of holes is 12mm and distance between two holes from end point start point of the holes is 2.2cm and this were made by lathe machine. It is shown in fig: 2.3



Fig: 4.9: SPECIMEN HOLDER

4.3.6 SPECIMEN

The Tob-shaped specimen was made of iron that which high in strength. The tob-shaped specimen divides the flow by splitting it. The dimension of specimen was diameter 0.045m, plane circular length 0.018m, cone length 0.043m. The specimen attached to the specimen holder by screw mechanism. The fig: 2.4 is given below.



Fig: 4.10: TOB-SHAPED SPECIMEN

4.3.7 TIG WELDING

This type of welding is also known as Gas metallic element Arc fastening (GTAW), in this process they use joins metals sticks by heating them with associate degree arc between a metallic element conductor (non-consumable) and also the work piece. One of the foremost styles fastening processes for a metallic element is gas metallic element arc fastening (GTAW), otherwise referred to as metallic element gas (TIG) fastening. GTAW could be nice method for metallic element as result of it doesn't need a mechanical wire feeding, which may produce supply with the material problems. Instead, the aluminium material is melted into the puddle by the journeyman together by his hand. Also, the GTAW method is spotless, that preventing metallic element from being contaminated by the atmosphere. The semi-aerofoil structures were welded by using aluminium tig welding by using aluminium sticks in this welding natural gas was used for smooth welding and to maintain temperature of welder gun the temperature was fixed to 159° C.

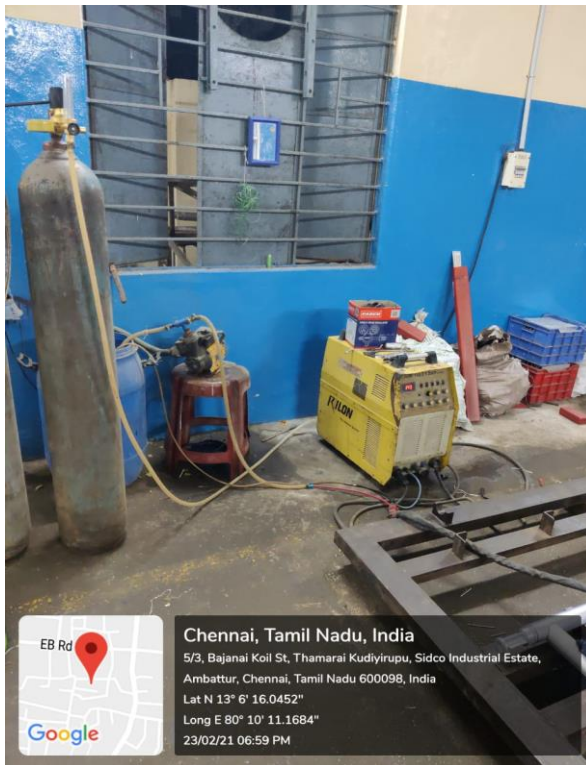


Fig: 4.11: TIG WELDING MACHINE



Fig: 4.12: SEMI-AEROFOIL TIG WELDING

The specimen holder was placed at distance of 0.7747m from starting making centre of two side walls 9.8cm. The specimen was welded by using aluminium tig welding by using natural as propellant and aluminium sticks as combining particle.



Fig: 4.13: SPECIMEN HOLDER TIG WELDING

CHAPTER 5

RESULTS AND DISCUSSION

Finally, when we compare the existing model and the introduced model, we have found huge difference by changing the parts of scramjet combustor with a semi-aerofoil structure, specimen holder, tob-shaped specimen. By placing the semi-aerofoil structure and tob-shaped specimen helps to maintain steady flow in the combustor and avoid swirls that which develop the pressure towards maintain structure of combustor.



Fig: 5.1: SUPERSONIC WINDTUNNEL

By modifying the combustor, the pressure values on semi-aerofoil structure and on tob-shape specimen will be

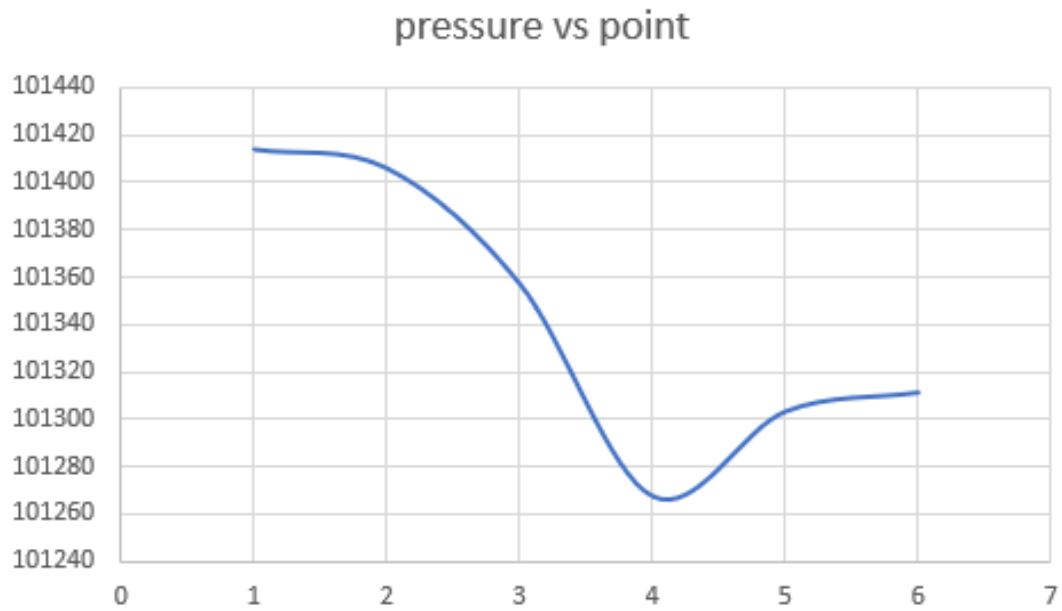


Fig: 5.2: PRESSURE TEST FOR COMBUSTOR

By modifying the combustor, the velocity values on semi-aerofoil structure and on tob-shape specimen will be

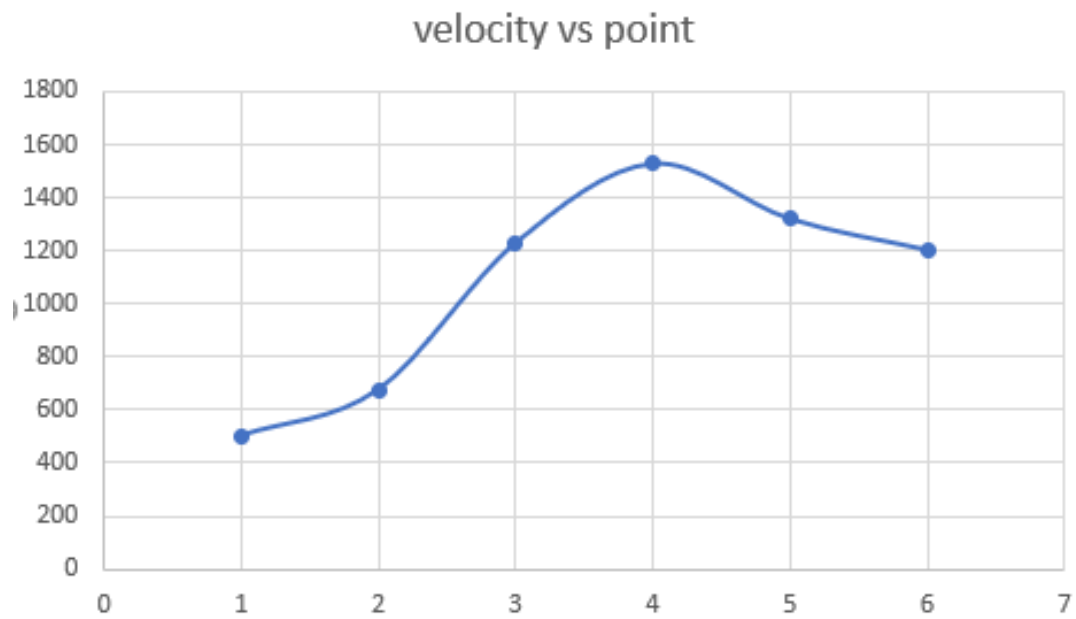


Fig: 5.3: VELOCITY TEST FOR COMBUSTOR

COMPUTATIONAL ANALYSIS

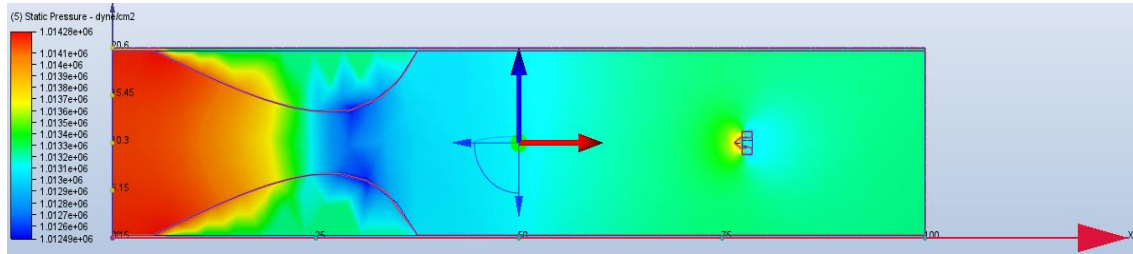


Fig: 5.4: STATIC PRESSURE IN COMBUSTOR

This figure: shows that the static pressure of combustor has the maximum pressure of 1.01428×10^6 dyne/cm².

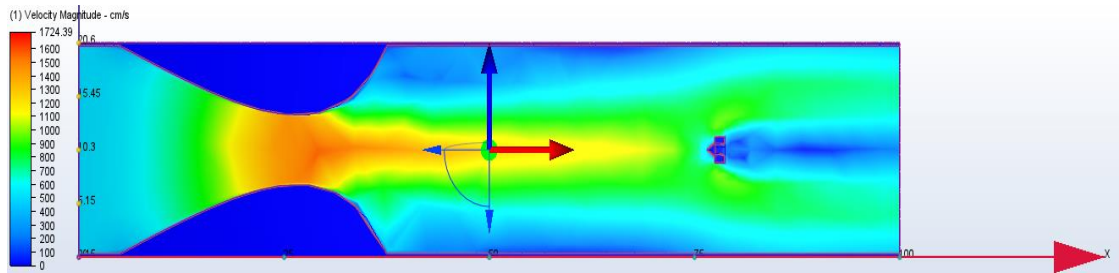


Fig: 5.5: VELOCITY MAGNITUDE IN COMBUSTOR

This figure: shows that the velocity magnitude of combustor has the maximum velocity of 1724.39 cm/s.

CHAPTER 6

CONCLUSION

Finally, the high velocity air which enters in the combustor is highly turbulent. That which comes in contact with the internal surface of the combustor. That which generates friction that which rises the temperature of combustor. The turbulent air also has swirls that which create shocks inside the combustor. That in adding up of shocks with high velocity generate pressure in certain areas of combustor. That the development of pressure in certain areas of combustor lead to the dimensional changes. The change in dimensions disturb the flow patterns that which generates high turbulence. That problems were solved up adding internal structure of combustor with semi-aerofoils and tob shaped specimen that which helps in reduce the turbulence in the air and decreasing the swirl formation and attesting steady smooth flow and restricts the dimensional changes and damages in the combustor.

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