A PROJECT REPORT ENTITLED

V6 ENGINE

MODELLING IN CATIA V5

Submitted to CADD CENTRE in partial fulfilment of the requirement for the award of the course on CATIA Essential

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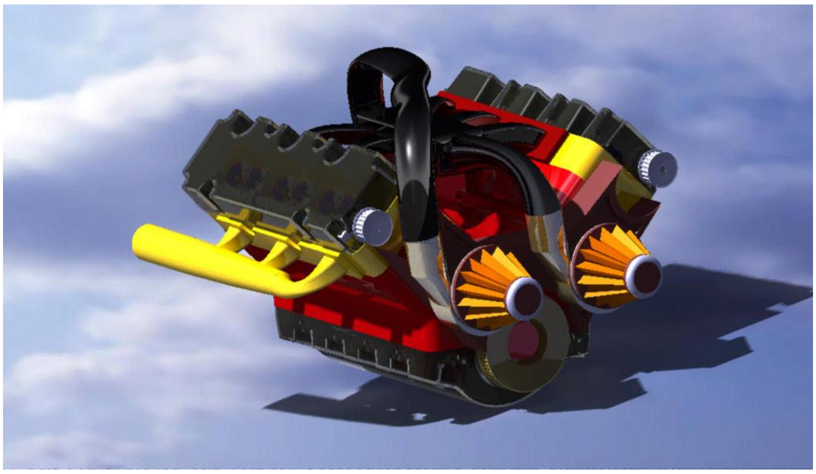

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November 2022

CERTIFICATE

This is to certify that the project report entitled ‘V6 ENGINE’ is a complete record of the work done by SHERRY DANIEL SAJAN [ES220675567] to the CADD Centre during the year 2022 in partial fulfilment of the requirements for the award of the Course on CATIA.

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INTRODUCTION TO CATIA

CATIA stands for Computer Aided Three-Dimensional Interactive Application. It's much more than a CAD (Computer Aided Design) software package. It's a full software suite which incorporates CAD, CAE (Computer-Aided Engineering) and CAM (Computer-Aided Manufacture).

CATIA started as an in-house development in 1977 by French aircraft manufacturer Avions Marcel Dassault to provide 3D surface modelling and NC functions for the CADAM software they used at that time to develop the Mirage fighter jet. Initially named CATI (conception assisted tri-dimensionality interactive – French for interactive aided three-dimensional design), it was renamed CATIA in 1981 when Dassault created the subsidiary Dassault Systemes to develop and sell the software, under the management of its first CEO, Francis Bernard. Dassault Systemes signed a non-exclusive distribution agreement with IBM that was also selling CADAM for Lockheed since 1978. Version 1 was released in 1982 as an add-on for CADAM.

During the eighties CATIA saw wider adoption in the aviation and military industries with users such as Boeing and General Dynamics Electric Boat Corp.

Dassault Systemes purchased CADAM from IBM in 1992, and the next year CATIA CADAM was released. During the nineties CATIA was ported first in 1996 from one to four UNIX operating systems, and was entirely rewritten for version 5 in 1998 to support Windows NT. In the years prior to 2000, this caused problems of incompatibility between versions that led to $6.1B in additional costs due to delays in production of the Airbus A380.

With the launch of Dassault Systemes 3DEXPERIENCE Platform in 2014, CATIA became available as a cloud version.

VERSIONS OF CATIA

Name/Version	Version History Value	Release Date
Catia V1		1981
Catia V2		1984
Catia V3		1988
Catia V4		1993
Catia V5		1998
Catia V5	R7	26/06/2001
Catia V5	R17	05/09/2006
Catia V5	R18	10/02/2007
Catia V5	R19	23/08/2008
Catia V6	R2010	23/06/2009
Catia V5	R20	16/02/2010
Catia V5	R21	05/07/2011
Catia V6	R	2011
Catia V5-6	R2012(R22)	18/04/2012
Catia V6	R20	20/05/2013
Catia V5-6	R2013 (R23)	2013
Catia V5-3DX (3D)	R2014 (R24)	2014
Catia V5-3DX (3D)	R2015 (R25)	2015
Catia V5-3DX (3D)	R2016 (R26)	2016
Catia V5-3DX (3D)	R2017 (R27)	2017
Catia V5-3DX (3D)	R2018 (R28)	2018
Catia V5-3DX (3D)	R2019 (R29)	2019
Catia V5-3DX (3D)	R2020 (R30)	2020
Catia V5-3DX (3D)	R2021 (R31)	2021

CATIA CAPABALITIES

The majority of users do not require all functionalities available in CATIA, which has significant cost impacts on the user or organisation. Licenses are therefore broken down to include required functionality and are pre-defined. Depending on the licence, additional workbenches become available and/or additional tools within workbenches become available. Workbenches in CATIA work a bit like different software held within CATIA. They allow the user to perform different tasks, from:

Part Modelling

Part Design workbench

The Part Design workbench enables users to design precise 3D mechanical parts. From assembly sketching to detailed design, the Part Design application accommodates the vast majority of design requirements.

Assembly Modelling

Assembly Design workbench

The Assembly Design workbench enables users to design cooperate with Part Design and Generative Drafting apps on scalable design projects. Various visual tools allow for 3D navigation through large assemblies.

Surface Modelling

Generative Surface Design workbench

The Generative Surface Design workbench enables users to create wireframe construction elements and enrich existing mechanical part design with wireframe and surface features.

Finite Element Analysis

Generative Structural Analysis

The Generative Structural Analysis enables users to perform first order mechanical analysis for 3D systems.

This workbench includes:

Generative Part Structural Analysis (GPS) for obtaining mechanical behaviour information.

ELFINI Structural Analysis (EST) for mechanical analysis developments.

Generative Assembly Structural Analysis (GAS) for analysis of the mechanical behaviour of a whole assembly.

Generative Dynamic Analysis (GDY) for working in a dynamic response context.

Sheet Metal Part Design

Generative Sheet metal Design

Generative Sheet metal Design enables users to perform associative feature-based modelling, making it possible to design sheet metal parts in concurrent engineering between the unfolded or folded part representations.

Rendering

Real Time Rendering workbench

The Real Time Rendering workbench enables users to define material specifications that will be shared across the whole product development process, while mapping materials onto parts and products to produce realistic renderings.

Engineering Drawing Creation

Generative Drafting workbench

The Generative Drafting workbench enables users to generate drawings from 3D parts and assembly definitions.

V6 ENGINE & ITS HISTORY

A V6 engine, also called as V6, is an internal combustion engine with six cylinders. The engine has three cylinders on each side which are called banks. The two banks form a "V" shaped angle. In most engines, the two banks are at a right angle (90°) or less to each other. All the six pistons turn a common crankshaft. It is one of the most common engine designs in modern cars after the inline four. It can be powered by different fuels such as gasoline, diesel, and natural gas.

The V6 is a very compact engine design. It is shorter than the straight-4. Many V6 engines are narrower than the V8 engine. They work well and are well suited to the popular transverse engine front-wheel drive cars. It has immensely replaced the inline-6, which is too long to fit in many modern cars. It is more complicated and not as smooth as the inline-6. The V6 is more compact, and rigid, but also it is more prone to vibrations. It is also becoming a high-performance engine. It has high torque and power output like the classic V8, but has good fuel economy.

Some of the first V6-cars were built in 1905 by the Marmon Motor Car Company.

Design-engineer Amadee Varlet of Delahaye's came up with a twin-cam V6, that went into series production as the Type 44, in 1911. It was not successful though to remain in production after 1914, when the first World war halted French automobile manufacturing.

Lancia V6

The first series production of V6 was introduced by Lancia in 1950. Other builders soon started using V6 engines. General Motors built a heavy-duty 305 in3 (5 L) 60° V6 for use in their pickup trucks and Chevrolet Suburban in 1959. The engine was later then enlarged to 478 in3 (7.8 L) for heavy bus and truck use.

In 1962, the Buick Special offered a 90° V6 with uneven firing intervals. As a result, consumers did not like this engine because of the vibration.

The Lancia Aurelia B10’s engine resulted from wartime research done by the engineer Francesco De Virgilio going through alternative V-angles for a low-vibration, well-balanced V6 engine. The Aurelia's V6 had a 60° angle which was cast in aluminum with iron cylinder liners. Its crankshaft rested on four main bearings, and its six crankpins were spaced at 60° intervals for an even firing sequence. The aluminum cylinder heads' two valves per cylinder were actuated via rockers by a single camshaft located in the engine block which was driven by a double chain equipped with a hydraulic tensioner.

Due to low fuel quality available at the time, the 1754cc B10 engine had a decidedly mild tune, with a low 6,8:1 compression ratio and a single Solex carburetor. But that would be only the start of a continuous evolution lasting for almost two decades.

2.0 Liters Aurelias

The new-for-1951 Coupé B20 GT was equipped with a 1991cc version of the V6, which gave 75 HP credits to larger valves, higher (8,4:1) compression, and two single-choke Weber carburetors. Simultaneously, the saloon B21 and the limousine B15 were offered. Each had its own mild version of the 2 liters V6 engine, with lowered compression and the same carburetor setup of the smaller B10 saloon, which remained on sale till 1953.

The second series of the B20 GT coupés which were built from May 1952, and the B22 saloon introduced a month later were then the last two liters Aurelias.

The B20 offered 80HP, credits to a yet higher compression ratio and a new cylinder-head with valves repositioned. Curiously, the B22 saloon had the pair's hottest setup, with 90HP thanks to a new cam profile and a larger double-choke Weber carburetor.

2.5 liters Aurelias

The B20 Series three, introduced in July 1953, was the first recipient of the larger 2.5 liters V6 that would carry the model until the end of production. The capacity was the result of mating the B12 saloon's crank (with an 85,5mm stroke) with larger (78mm vs. 75) cylinder bores. Valve diameter was further increased compared to the previous Aurelia engines and remained the same for all the 2.5 liters Aurelias. The Aurelia B20 GT and B24 Spider were all furnished with a double-choke Weber carburetor, whose model varied over the years, as did each model's camshaft profiles.

2.5 Liters Flaminias

These were launched in March of 1957 at the Geneva Motor Show and they replaced the Aurelia as Lancia's flagship. Heavier and larger than its predecessor, the Flaminia used a comprehensively revised V6, with "square" 80 x 81,5mm bore and stroke measurements. The performance was on the weaker side, though, given that the 100HP engine had to move a significantly larger and heavier body than previous models.

This was partly corrected with the Flaminia series two models, introduced in 1961 and rated at 110 HP due to a higher compression ratio. From 1962, the Touring and Zagato models were furnished with three single-choke Weber 35mm carburetors for a peak horsepower of 140HP that, helped by the shorter, lighter bodies, provided great performance for the standards of the era.

2.8 Liters Flaminias

The first V6 of automobile history received its last "stretch" around a year later, in 1963. Cylinder bore size grew by 5 mm, which resulted a 2.8 liters engine that produced 129HP in single-carburetor form and 140 with the three carburetors setup. With a top speed of ranging 210 Km/h, the fastest Flaminia was the SuperSport Zagato, which was provided with larger 40mm Weber carburetors and rated at 152HP. However, this model, together with the Touring and Pininfarina coupés, left the catalog in 1967 without replacement. The Flaminia 2.8 remained in production as late as 1970 when the last 8 examples left the Borgo San Paolo works in Turin.

Lancia designed the first V6 engine ever, but it would also prove to be his last one. Following Fiat's capture of the brand in 1969, quite a few Lancia models would be equipped with V6 engines, but all were supplied by other manufacturers. The examples include the legendary Stratos, furnished with the Ferrari Dino V6, then the Thema with the French PRV engine first, and the Alfa Romeo V6 from 1992 onwards.

DESIGN OF V6 ENGINE

V6 engines are often used as the larger engine option for vehicles which are otherwise produced with inline-four engines, especially in transverse engine vehicles due to their short length. A disadvantage for luxury cars is that V6 engines produce more vibrations than straight-six engines. Some sports cars use flat-six engines instead of V6 engines, due to their lower centre of gravity which could improve the handling.

The modern V6 engines has a displacement of typically between 2.5 to 4.0 L (153 to 244 cu in), though smaller and larger examples have been produced, such as the 1.8 L (110 cu in) Mazda V6 used in the 1991–1998 Mazda MX-3, or the 1.6 L (98 cu in) Mitsubishi V6 engine used in the 1992–1998 Mirage/Lancer, while the largest V6 built was the 7.8 L (476 cu in) GMC V6 used in the 1962 GMC C/K series 6500.

Balance and smoothness

All V6 engines—regardless of the V-angle between the cylinder banks—are exposed to a primary imbalance caused by each bank consisting of an inline-three engine, due to the odd number of cylinders in each bank. Straight-six engines and flat-six engines do not experience this imbalance. To reduce the vibrations due to this imbalance, most V6 engines use a harmonic damper on the crankshaft and/or a counter-rotating balance shaft.

Six-cylinder designs have less pulsation in the power delivery than four-cylinder engines, due to the overlap in the power strokes of the six-cylinder engine. In a four-cylinder engine, only one piston is on a power stroke at any given time. Each piston comes to a complete stop and reverses direction before the next one starts its power stroke, which results in a gap between power strokes, especially at lower engine speeds (RPM). In a six-cylinder engine with an even firing interval, the next piston starts its power stroke 60° before the previous one finishes, which results in smoother delivery of power to the flywheel.

Comparing engines on a dynamometer, a V6 engine shows instantaneous torque peaks of 154% above mean torque and valleys of 139% below mean torque, with a small amount of negative torque (engine torque reversals) between power strokes. In the case of a four-cylinder engine, the peaks are approximately 270% above mean torque and 210% below mean torque, with 100% negative torque being delivered between strokes. However, a V6 with uneven firing intervals of 90° and 150° shows large torque variations of 185% above and 172% below mean torque.

Cylinder bank angles

10 to 15 degrees

Since 1991, Volkswagen has produced narrow angle VR6 engines with V-angles of 10.5 and 15 degrees. These engines use a single cylinder head shared by both banks of cylinders, in a design similar to the 1922-1976 Lancia V4 engine. The VR6 engines were used in transverse engine front-wheel drive cars which were originally designed for inline-four engines. Due to the minimal extra length and width of the VR6 engine, it could be fitted to the engine compartments relatively easily, in order to provide a displacement increase of 50 percent.

Since there is no room in the V between the cylinder banks for an intake system, all the intakes are on one side of the engine, and all the exhausts are on the other side. It uses a firing order of 1-5-3-6-2-4 (which is the firing order used by most straight-six engines), rather than the common V6 firing order of 1-2-3-4-5-6 or 1-6-5-4-3-2.

60 degrees

A V-angle of 60 degrees is the optimal configuration for V6 engines regarding engine balance.[4] When individual crank pins are used for each cylinder (i.e.using a six-throw crankshaft), an even firing interval of 120 degrees can be used. This firing interval is a multiple of the 60 degrees V-angle, therefore the combustion forces can be balanced through use of the appropriate firing order.

The inline-three engine that forms each cylinder bank, however, produces unbalanced rotating and reciprocal forces. These forces remain unbalanced in all V6 engines, often leading to the use of a balance shaft to reduce the vibration.

The 1950 Lancia V6 engine was pioneering in its use of a six-throw crankshaft in order to reduce vibration. More recent designs often use a three-throw crankshaft with 'flying arms' between the crankpins to allow an even firing interval of 120 degrees to be achieved. A pair of counterweights on the crankshaft can then be used to almost perfectly cancel out the primary forces and reduce the secondary vibrations to acceptable levels. The engine mounts can be designed to absorb these remaining vibrations.

A 60 degrees V-angle results in a narrower engine overall than V6 engines with larger V-angles. This angle often results in the overall engine size being a cube shape [citation needed] making the engine easier to fit either longitudinally or transversely in the engine compartment.

90 degrees

Many manufacturers, particularly American ones, built V6 engines with a V-angle of 90 degrees based on their existing 90-degree V8 engines. Such configurations were easy to design by removing two cylinders and replacing the V8 engine's four-throw crankshaft with a three-throw crankshaft. This reduced design costs, allowed the new V6 to share components with the V8 engine, and sometimes allowed manufacturers to build the V6 and V8 engines on the same production line.

The downsides of a 90 degree design are a wider engine which is more vibration-prone than a 60 degree V6. The initial 90 degree V6 engines (such as the Buick Fireball V6 engine) had three shared crankpins arranged at 120 degrees from each other, due to their origins from the V8 engines. This resulted in an uneven firing order, with half of the cylinders using a firing interval of 90 degrees and other half using an interval of 150 degrees. The uneven firing intervals resulted in rough-running engines with "unpleasant" vibrations at low engine speeds.

Several modern 90 degree V6 engines reduce the vibrations using split crankpins offset by 30 degrees between piston pairs, which creates an even firing interval of 120 degrees for all cylinders.[4] For example, the 1977 Buick 231 "even-fire" V6 engine was an upgraded version of the Buick Fireball engine with a split-pin crankshaft to reduce vibration by achieving an even firing order.[5]: 16[7] Such a 'split' crankpin is weaker than a straight one, but modern metallurgical techniques can produce a crankshaft that is adequately strong.

A balance shaft and/or crankshaft counterweights can be used to reduce vibrations in 90 degree V6 engines.

120 degrees

At first glance, 120 degrees might seem to be the optimal V-angle for a V6 engine, since pairs of pistons in alternate banks can share crank pins in a three-throw crankshaft and the combustion forces are balanced by the firing interval being equal to the angle between the cylinder banks. A 120 degree configuration, unlike the 60 degree or 90 degree configurations, would not require crankshafts with flying arms, split crankpins, or seven main bearings to be even-firing. However, the primary imbalance caused by odd number of cylinders in each bank still remains in a 120 degree V6 engine. This differs from the perfect balance achieved by a 90 degree V8 engine with a commonly used crossplane crankshaft, because the inline-four engine in each bank of the V8 engine does not have this primary imbalance.

A 120 degree design also results in a large width for the engine, being only slightly narrower than a flat-six engine (which does not have the balance problems of the V6 engine). Therefore, the flat-six engine has been used in various automobiles, whereas use of the 120 degree V6 engine has been limited to a few truck and racing car engines, with the exception of McLaren Automotive's M630 V6 engine, which uses a 120 degree bank angle with a single balance shaft to eliminate all primary couples. The McLaren M630 engine also takes advantage of the wide angle by placing the turbochargers inside the vee, commonly referred to as a 'hot vee' configuration. The Ferrari 296 GTB is the first Ferrari road car to sport a V6 turbo with a vee angle of 120 degrees between the cylinder banks.

Other angles

Other angle V6 engines are possible but can suffer from severe vibration problems unless very carefully designed. Notable V-angles include:

45 degrees — EMD 567 and EMD 645 locomotive, marine and stationary Diesel engines. These engines were based on V8 and V16 engines which also used a V-angle of 45 degrees.

54 degrees — 1994-2004 General Motors 54-degree automotive engine. A slightly smaller than usual V-angle was used to reduce the width of the engine, allowing it to be used in small transverse-engine front-wheel drive cars.

65 degrees — 1956-1975 Ferrari Dino automobile engine. The V-angle was increased from the then-common 60 degree angle to allow larger carburetors to be used (for potentially higher power in race tuning). Crankpins with an offset of 55 degrees within every pair of cylinders were used to achieve the even firing interval of a 60 degree V6 engine. The 2009–present Nissan-Renault V9X automobile engine also used a 65 degree bank angle, to allow a turbocharger to fit between the cylinder banks.

72 degrees — Mercedes-Benz OM642 BlueTEC diesel engine. This engine uses crank pins offset by 48 degrees, to achieve an even firing interval.

75 degrees — 1992-2004 Isuzu V engine used in the Isuzu Rodeo and Isuzu Trooper. These engines were produced in both SOHC and DOHC versions. A 75 degree V6 engine is also used by the 2016–2022 Honda NSX.

80 degrees — 1988 Honda RA168-E engine used in the McLaren MP4/4 Formula One racing car.

COMPONENTS OF V6 ENGINE

1. Engine Block -

An engine block is the structure which contains the cylinders, and other parts, of an internal combustion engine. In an early automotive engine, the engine block consisted of just the cylinder block, to which a separate crank case was attached. Modern engine blocks typically have the crankcase integrated with the cylinder block as a single component. Engine blocks often also include elements such as coolant passages and oil galleries.

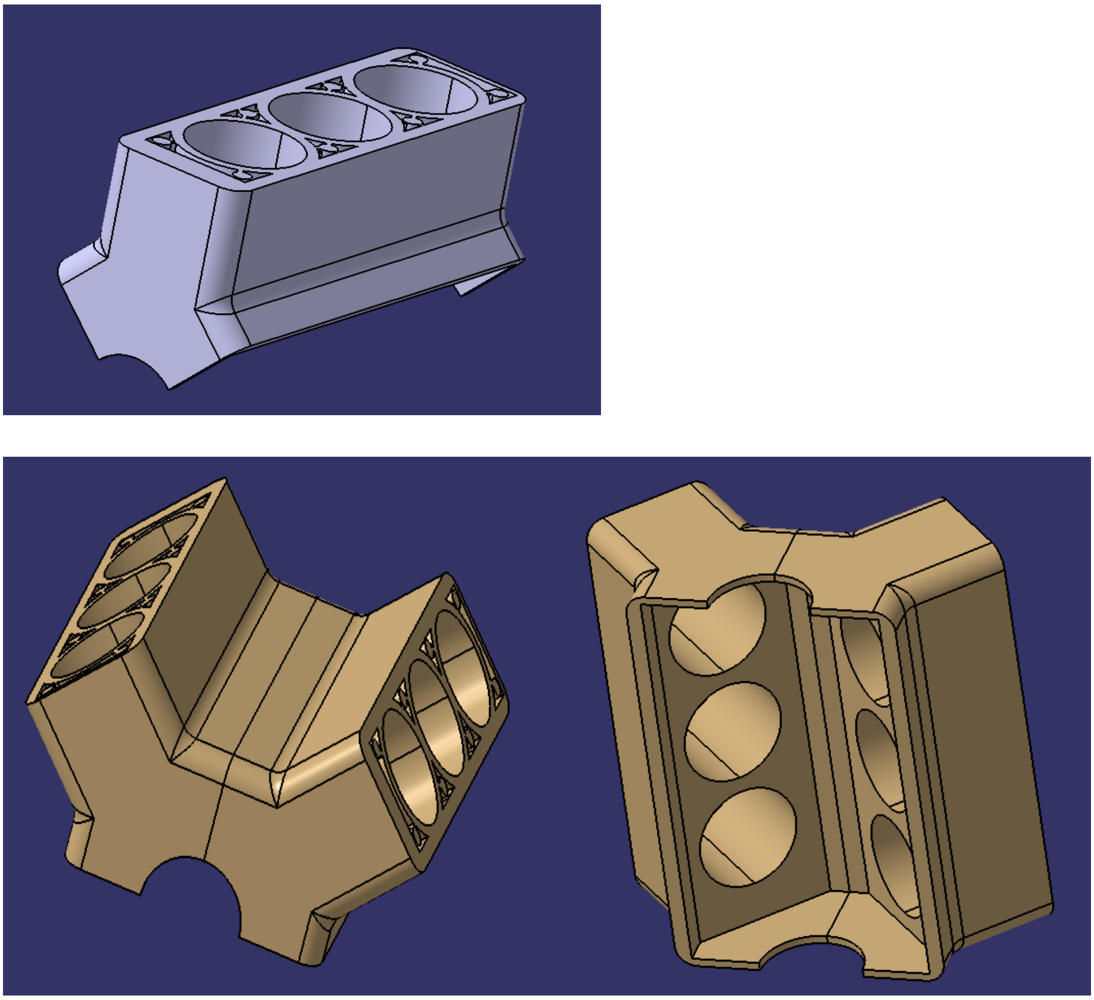
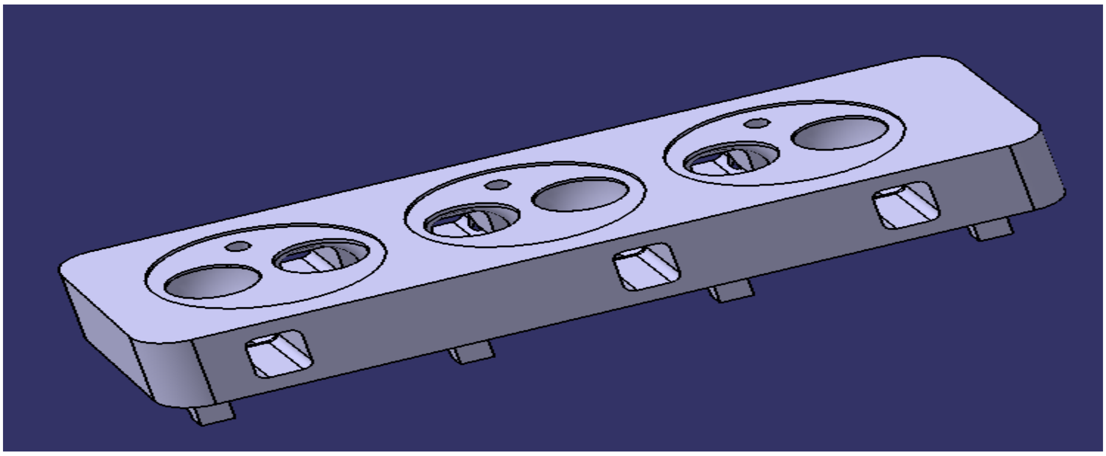


Fig 1- Engine Block

2. Cylinder Head

In an internal combustion engine, the cylinder head sits above the cylinders on top of the cylinder block. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a head gasket. In most engines, the head also provides space for the passages that feed air and fuel to the cylinder, and that allow the exhaust to escape. The head can also be a place to mount the valves, spark plugs, and fuel injectors.



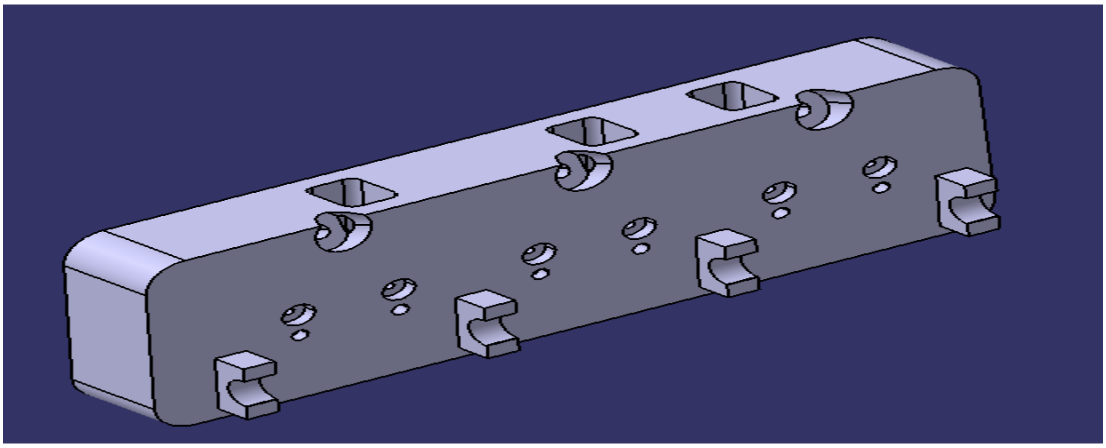


Fig 2– Cylinder Head

3. Crankshaft Bush

A pilot bearing or pilot bushing is one of the most important parts of your clutch. Typically pressed in the end of a crankshaft or flywheel, they center and support the input shaft.

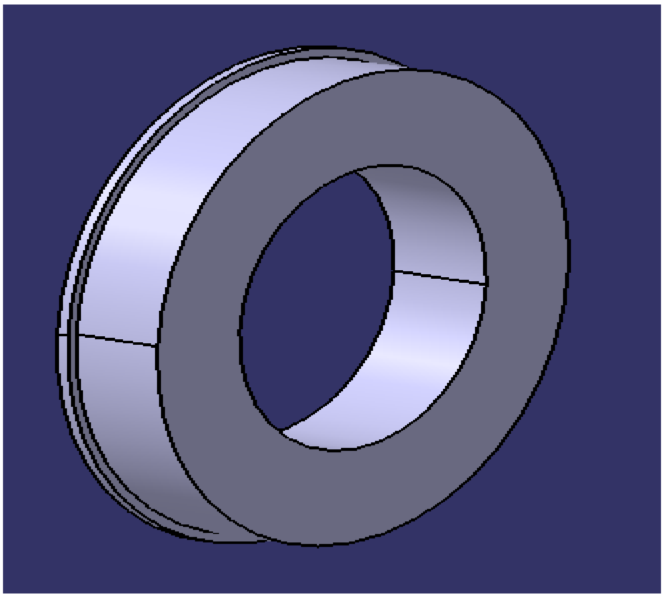


Fig 3-Crankshaft Bush

4. Crankshaft

A crankshaft is a rotating shaft which (in conjunction with the connecting rods) converts reciprocating motion of the pistons into rotational motion. Crankshafts are commonly used in internal combustion engines and consist of a series of cranks and crankpins to which the connecting rods are attached.

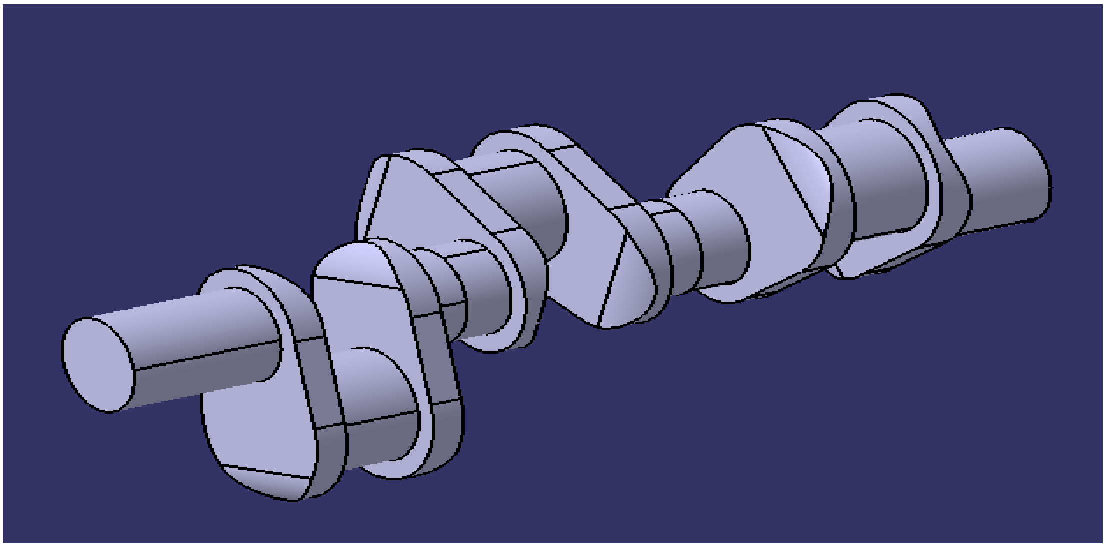


Fig 4- Crankshaft

5. Camshaft Retainer

It is used to hold the camshaft secure and avoid vibrations.

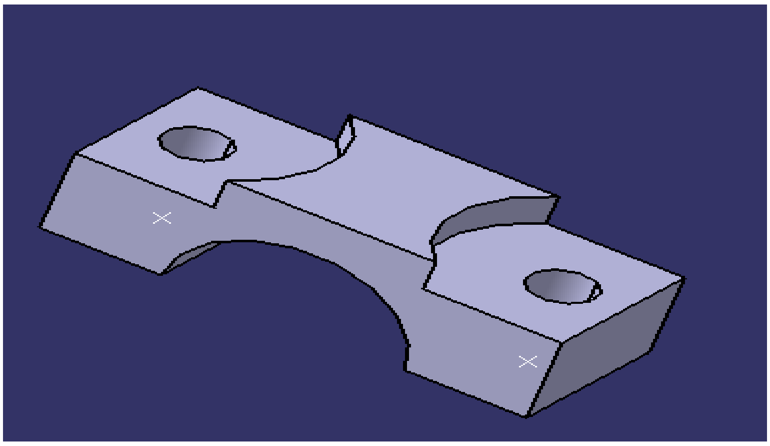


Fig 5-Camshaft Retainer

6. Camshaft

The camshaft is a mechanical component of an internal combustion engine. It opens and closes the inlet and exhaust valves of the engine at the right time, with the exact stroke and in a precisely defined sequence. The camshaft is driven by the crankshaft by way of gearwheels, a toothed belt or a timing chain.

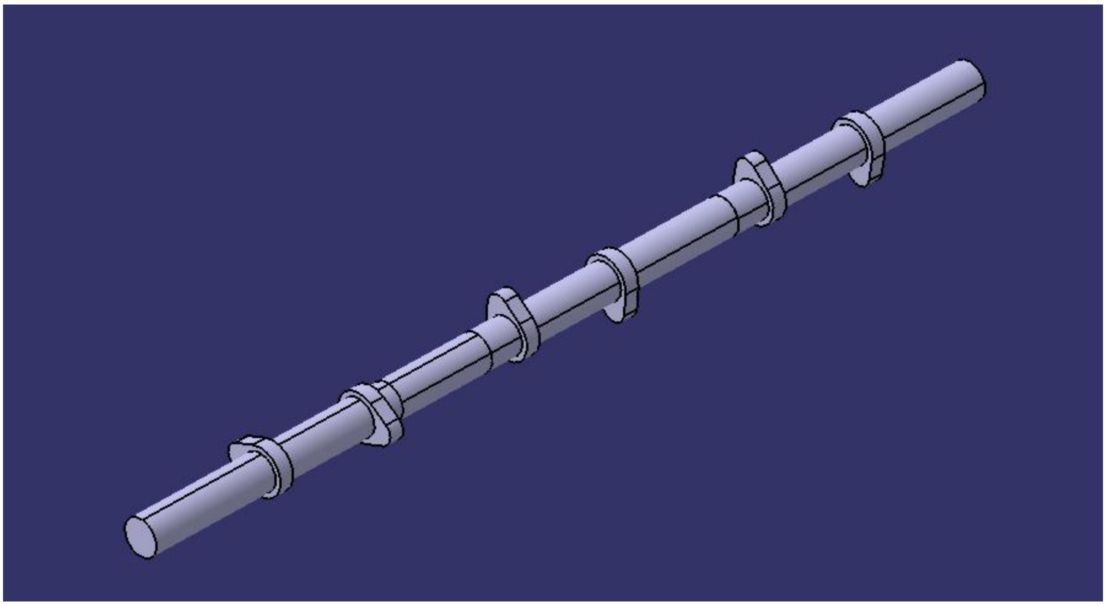
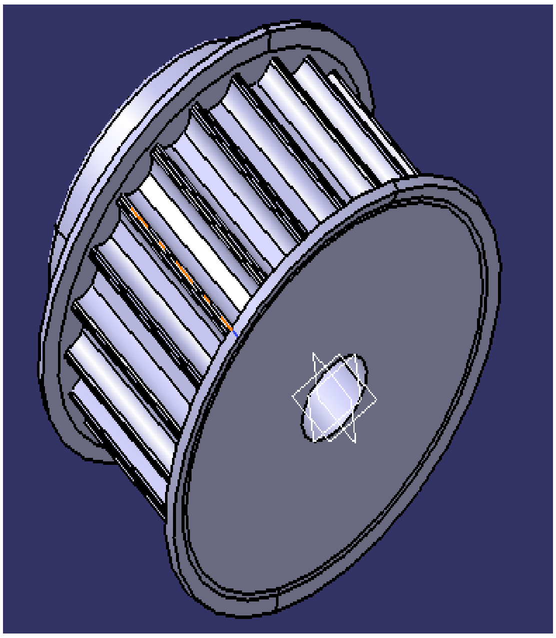


Fig 6-Camshaft

7. Engine Pulleys

These pulleys are mounted to the engine of an automobile and drives all belts. There are 2 types used in V6 Engine.



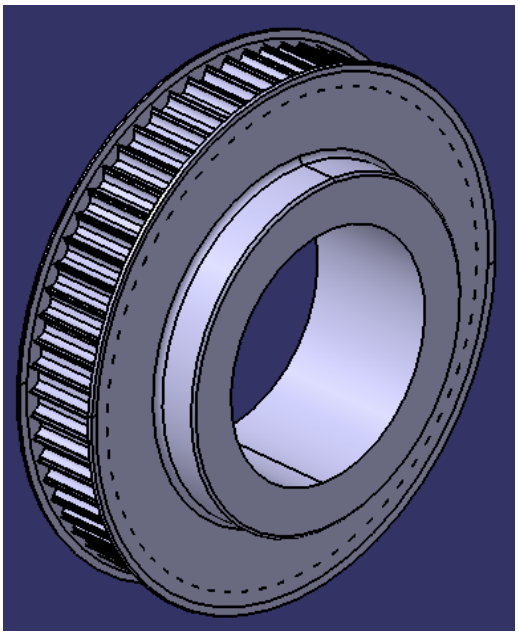


Fig 7- Engine Pulleys

8. Turbocharger

TurboCharger is a turbine driven forced induction device that increases the efficiency of internal combustion engine and power output by forcing extra compressed air into combustion chamber.

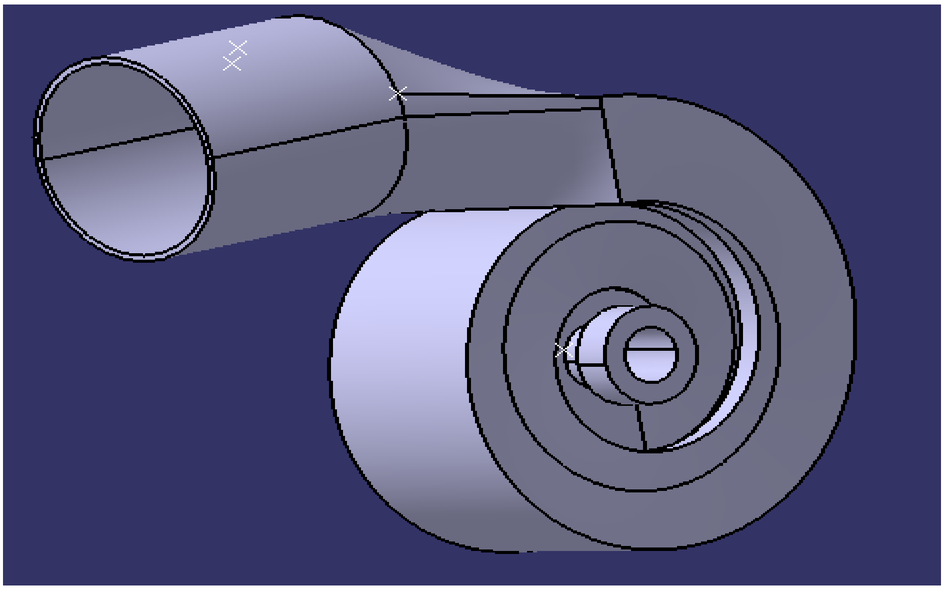


Fig 8-Turbocharger

9. Air Intake Filter

This filter helps in sucking of fresh cold air into the engine for combustion. It improves engine filtration and gas mileage giving more power usually up to 20% as the cold air pulls more oxygen into the combustion chamber.

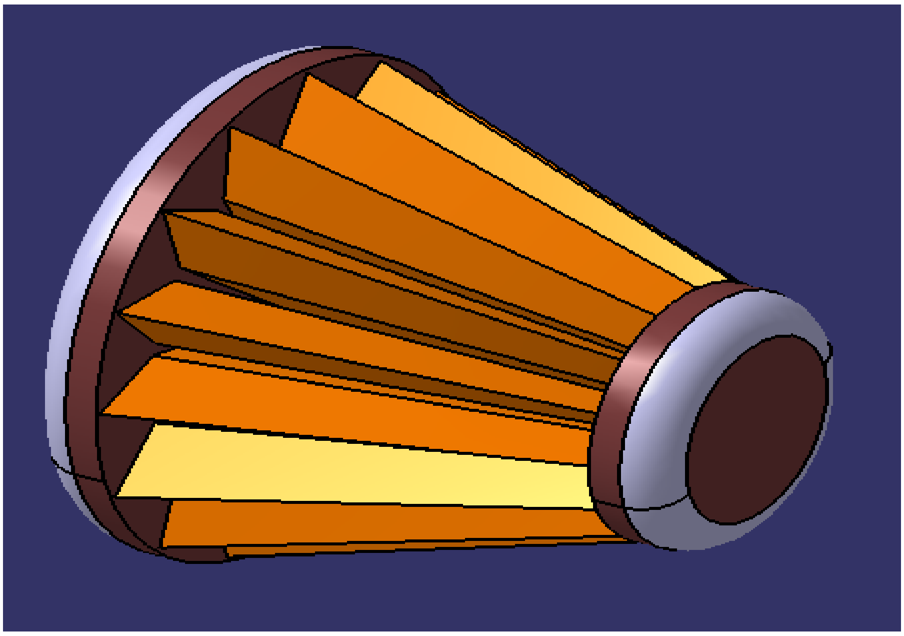


Fig 9- Air Intake Filter

10. Engine Valve

Engine valves are located in the cylinder head. The main function of the engine valves is to let air in and out of the cylinders. That air is used to help ignite the fuel which will drive the pistons up and down.

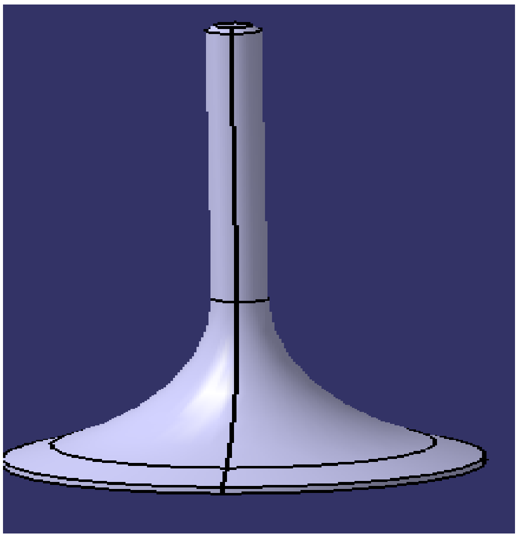


Fig 10- Engine Valve

11. Exhaust Manifold

Typically made of stainless steel, cast-iron or heavy-gauge steel, the exhaust manifold directs exhaust gases from multiple cylinders to a single exhaust. In doing so, the exhaust manifold also helps to minimize leakage of heat, air and gases.

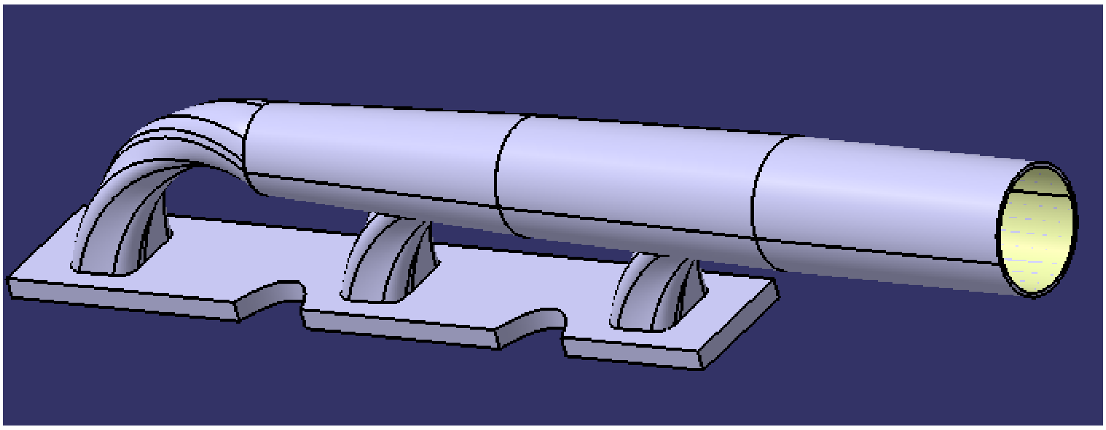


Fig 11- Exhaust Manifold

12. Front Cover

It is used as a bracket to hold the engine pulleys and the turbo chargers.

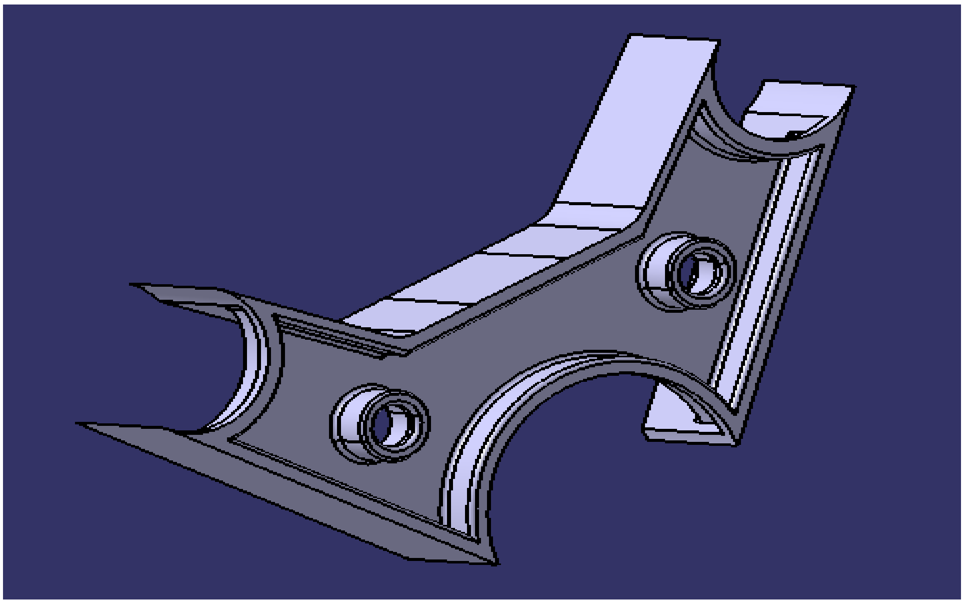


Fig 12- Front Cover

13. Intake Manifold

In automotive engineering, an inlet manifold or intake manifold is the part of an engine that supplies the fuel/air mixture to the cylinders.

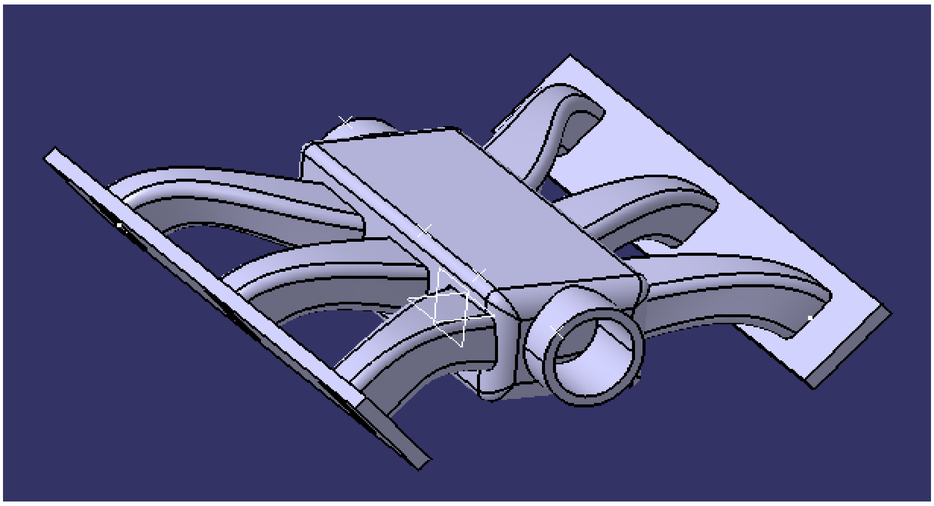


Fig 13- Intake Manifold

14. Oil Pan/ Crankshaft case

Oil pans are a major engine cooling system part. They are usually constructed of thin steel and shaped into a deeper section to fully perform its function. It is also where the oil pump is placed. When an engine is not running or at rest, oil pans collect the oil as it flows down from the sides of the crankcase. In other words, oil pans that are mounted at the bottom of the crankcase serves as an oil reservoir. Engine oil is used for the lubrication, cooling, and cleaning of internal combustion engines.

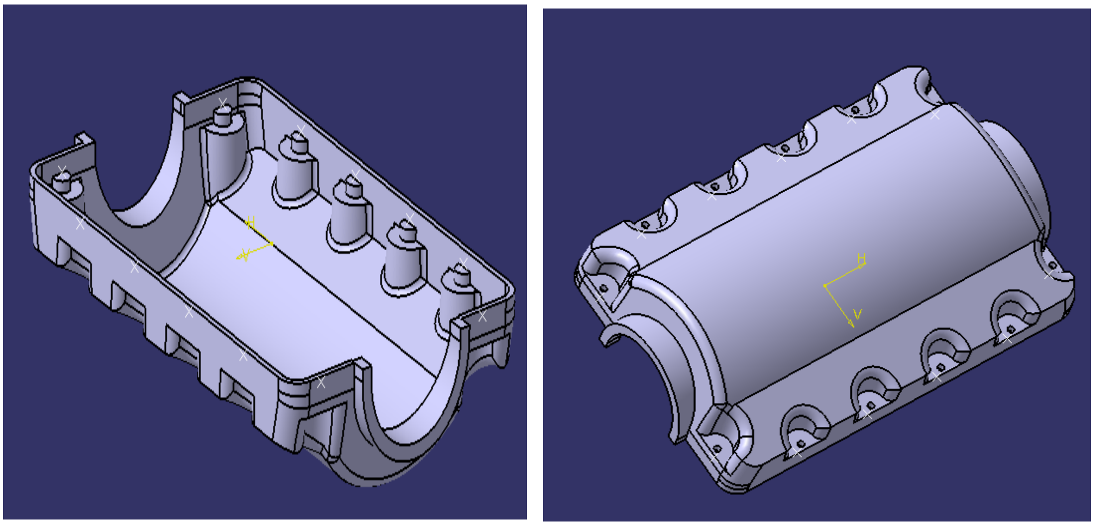


Fig 14- Crankshaft Case

15. Valve Cover

It is used to cover/protect the cam and valves systems of the engine.

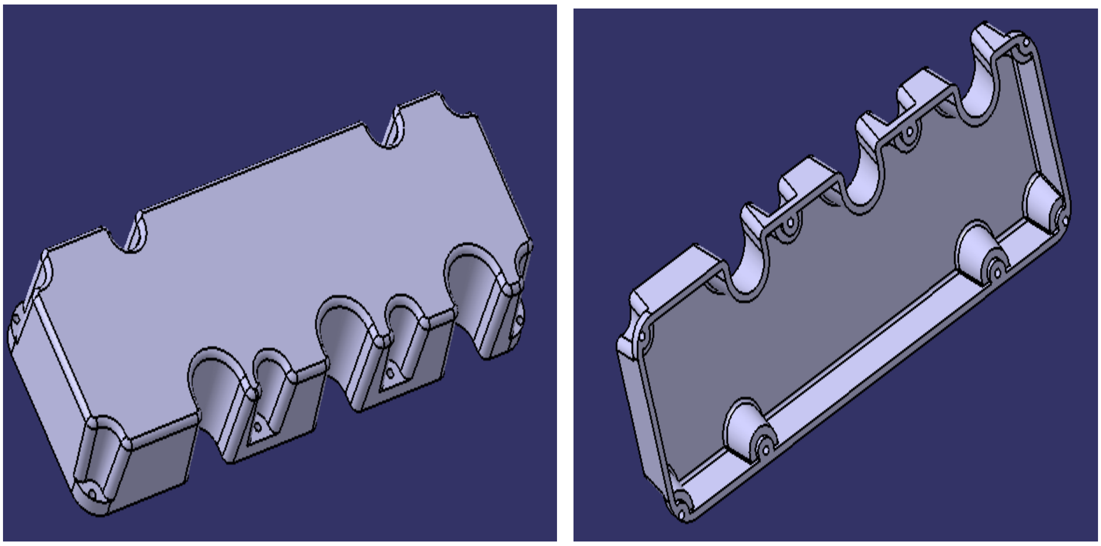


Fig 15- Valve Cover

16. Piston Parts and Assembly

a. Piston Head

The main purpose is to create a turbulence, for better combustion so that to avoid knocking. Due to the shape of a squish or quench area of piston, Incoming air is set into rotation by the inlet valve being positioned to one side of the cylinder head.

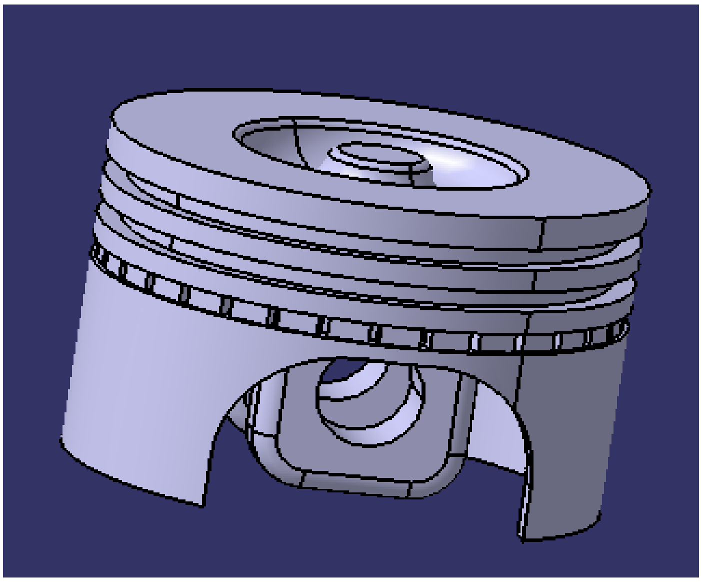


Fig 16- Piston Head

b. Piston Pin

Used for connecting the piston to the connecting rod.

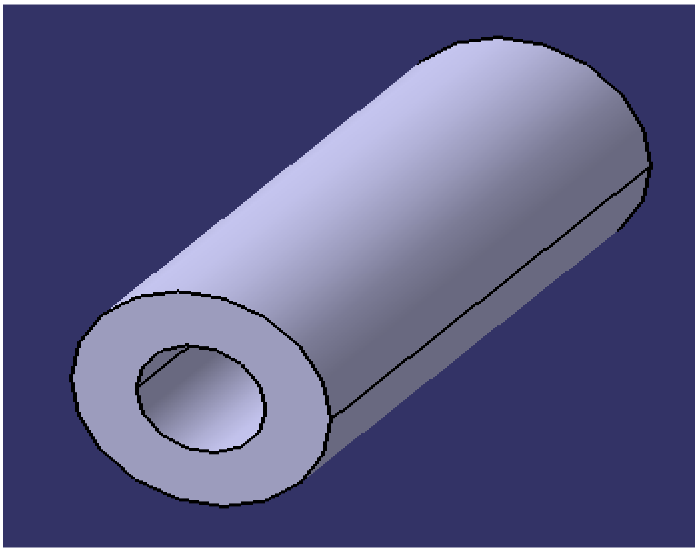


Fig 17- Piston Pin

c. Connecting rod

A connecting rod, also called a con rod, is the part of a piston engine which connects the piston to the crankshaft. Together with the crank, the connecting rod converts the reciprocating motion of the piston into the rotation of the crankshaft. The connecting rod is required to transmit the compressive and tensile forces from the piston, and rotate at both ends.

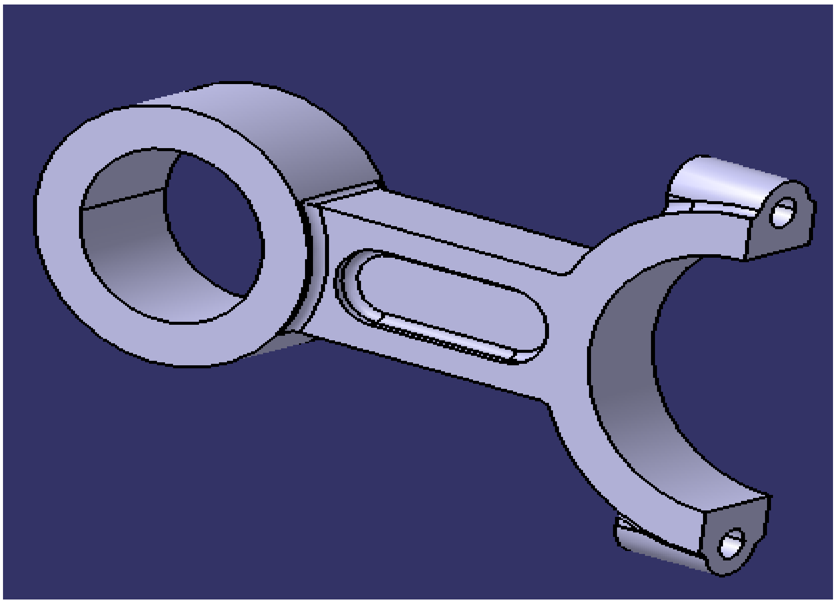


Fig 18- Connecting Rod

d. Piston Rod Cap

A rod cap is the removable section of a two-piece connecting rod that provides a bearing surface for the crankpin journal. The rod cap is attached to the connecting rod with two cap screws for installation and removal from the crankshaft.

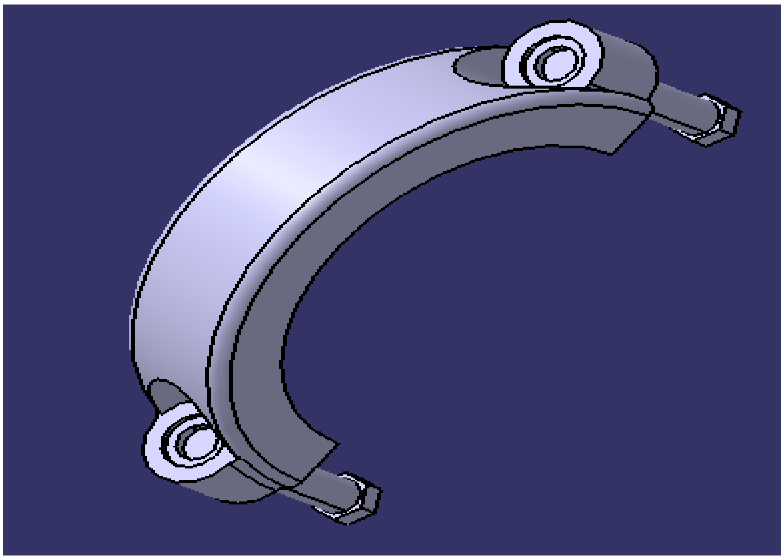


Fig 19-Piston Rod Cap

e. Piston Assembly

The parts used for this assembly are as below:

Piston Head, Piston Pin, Piston Rod/Connecting Rod and Piston Rod Cap.

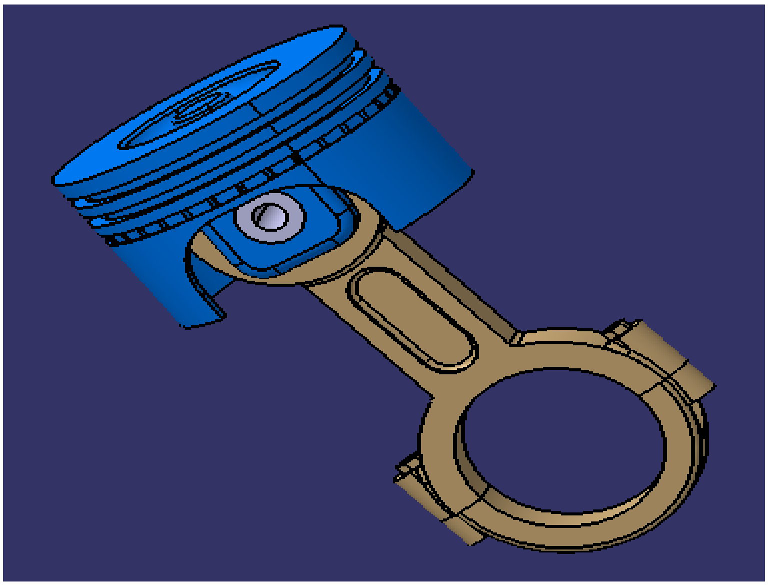


Fig 20- Piston Assembly

17. Rocker Arm Parts and Assembly

a. Rocker arm pin

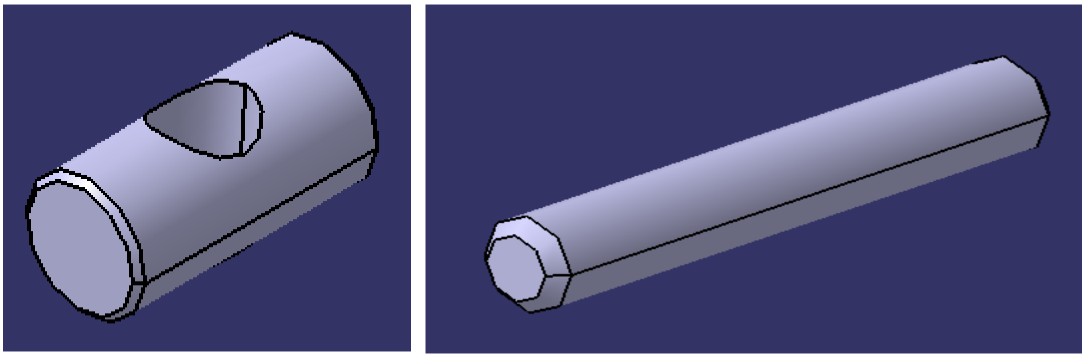


Fig 21- Rocker arm pin

b. Rocker Arm roller

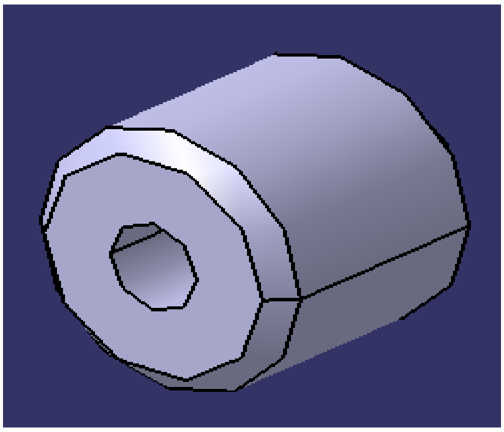


Fig 22- Rocker arm roller

c. Rocker arm Spring

This is used to actuate the valves due to motion of cams.

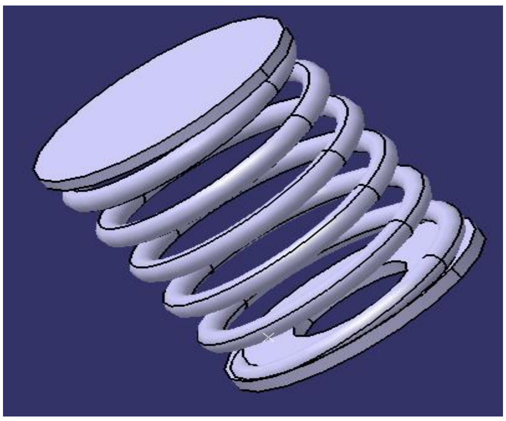


Fig 23- Rocker arm Spring

d. Rocker arm

A rocker arm (in the context of an internal combustion engine of automotive, marine, motorcycle and reciprocating aviation types) is an oscillating lever that conveys radial movement from the cam lobe into linear movement at the poppet valve to open it.

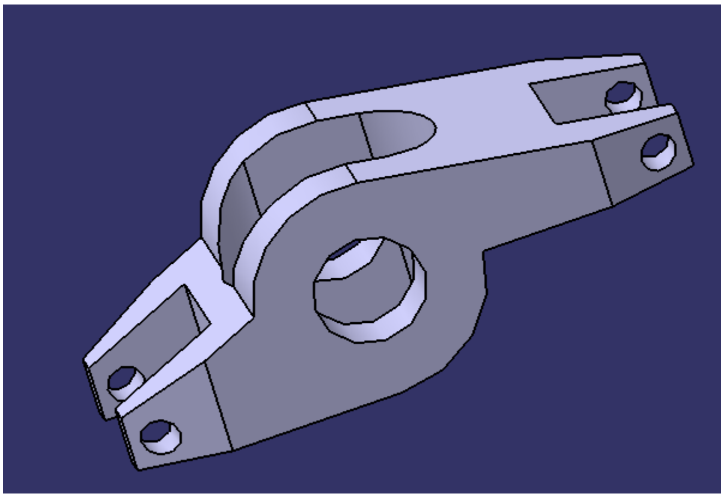


Fig 24- Rocker Arm

e. Rocker arm assembly

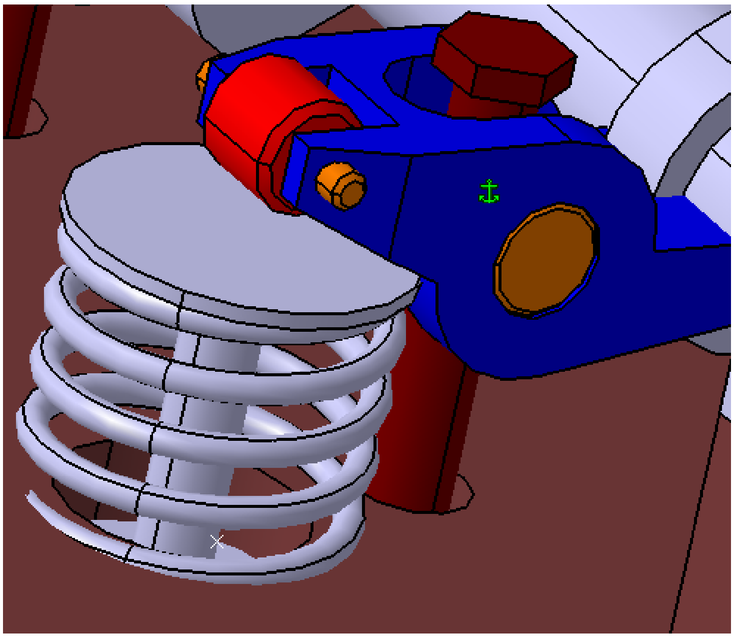


Fig 25- Rocker arm assembly

WORKING OF V6 ENGINE

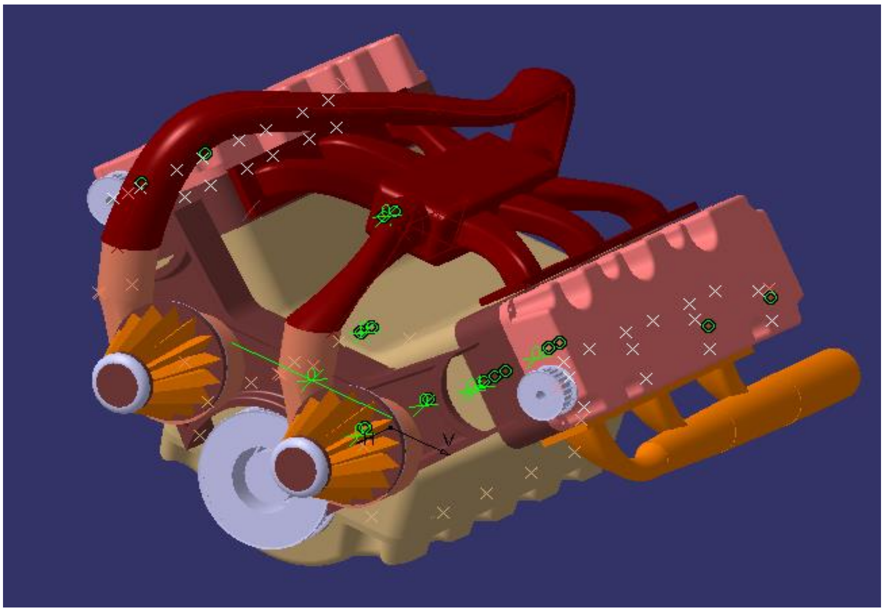


Fig 26- V6 Engine

A V6 engine, often just called a V6, is an internal combustion engine with a engine capacity of 2.5 to 4.0 L where the fuel is burned with the help of spark plug. SI engine working is based on the principle of the Otto cycle. It follows 4 stroke which means cycle of combustion operation is completed in four strokes. Each stroke consists of 180̊ rotation of the crankshaft and hence four strokes completed in 720̊ rotation of the crankshaft. The engine takes two revolutions of crankshaft. The engine takes two revolutions of crankshaft to complete the four strokes. The four strokes for spark ignition engines are-

- Suction/intake stroke
- Compression stroke
- Power Stroke
- Exhaust stroke

Suction stroke- In this stroke, the piston begins at top dead center (T.D.C.) and ends at bottom dead center (B.D.C.). In this stroke the intake valve must be in the open position while the piston pulls an air-fuel mixture into the cylinder by producing vacuum pressure into the cylinder through its downward motion. The exhaust valve remains closed at this stroke. The piston is moving down as air is being sucked in by the downward motion against the piston.

Compression Stroke- This stroke begins at B.D.C, or just at the end of the suction stroke, and ends at T.D.C. In this stroke the piston compresses the air-fuel mixture in preparation for ignition during the power stroke (below). Both the intake and exhaust valves are closed during this stage. At the end of this stroke, that is piston at TDC, the whole charge is compressed into clearance volume. The pressure increases with a decrease in volume. The compression ratio of SI engine is between 6 and 10.

Power Stroke- It is also known as combustion or ignition stroke. This is the start of the second revolution of the four stroke cycle. At this point the crankshaft has completed a full 360 degrees revolution. While the piston is at T.D.C. (the end of the compression stroke) the compressed air-fuel mixture is ignited by a spark plug in a gasoline engine forcefully returning the piston to B.D.C. This stroke produces mechanical work from the engine to turn the crankshaft. During this process, both intake and exhaust valves remain closed. In this process, temperature and pressure decrease while the volume of gas increases. At the end of the power stroke, the exhaust valve is open, the pressure drops to atmosphere pressure.

Exhaust Stroke- Also known as outlet. During the exhaust stroke, the piston, once again, returns from B.D.C. to T.D.C. while the exhaust valve is open. This action expels the spent air-fuel mixture through the exhaust valve. At the end of exhaust stroke, some residual gases get trapped in clearance volume. The residual gas gets mixed with fresh charge drawn into the cylinder during the following cycle.

ISOMETRIC VIEW OF V6 ENGINE

Fig 27- Isometric View of V6 Engine

TOP VIEW OF V6 ENGINE

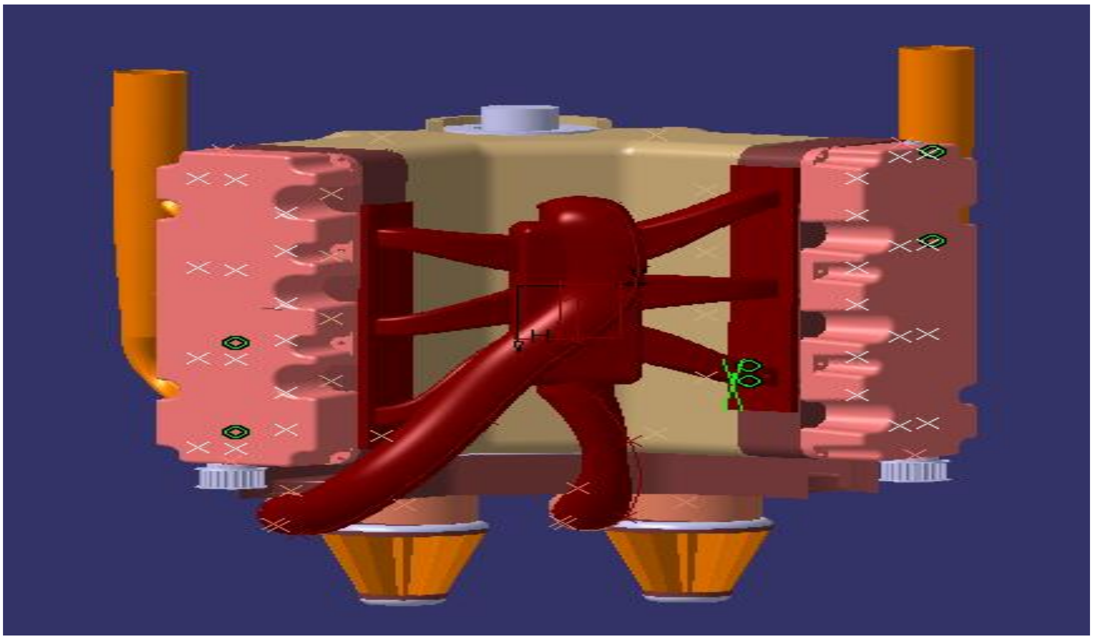


Fig 28- Top View of V6

BOTTOM VIEW OF V6 ENGINE

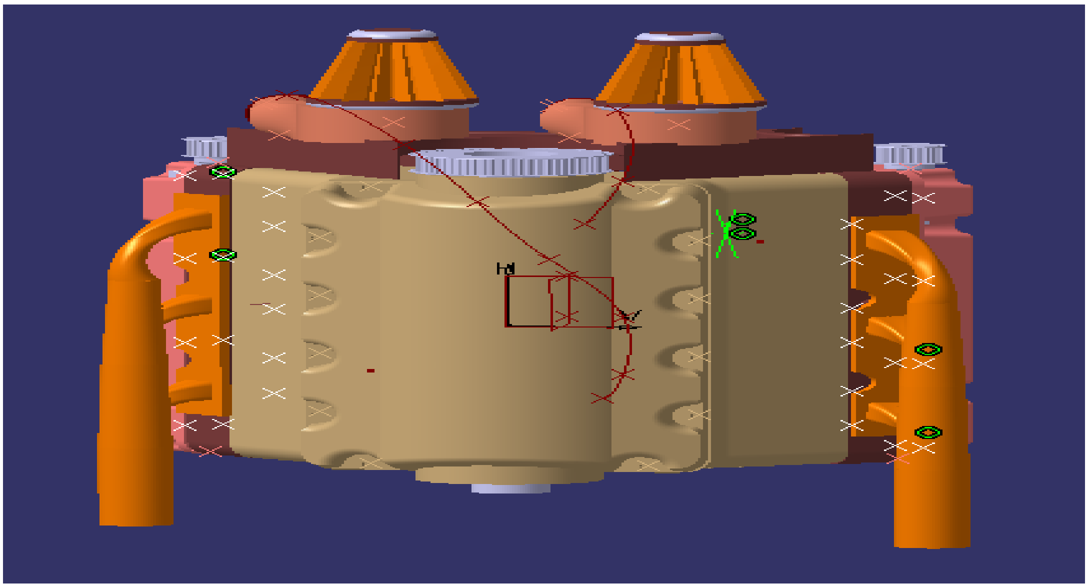


Fig 29- Bottom View of V6

RIGHT SIDE VIEW OF V6 ENGINE

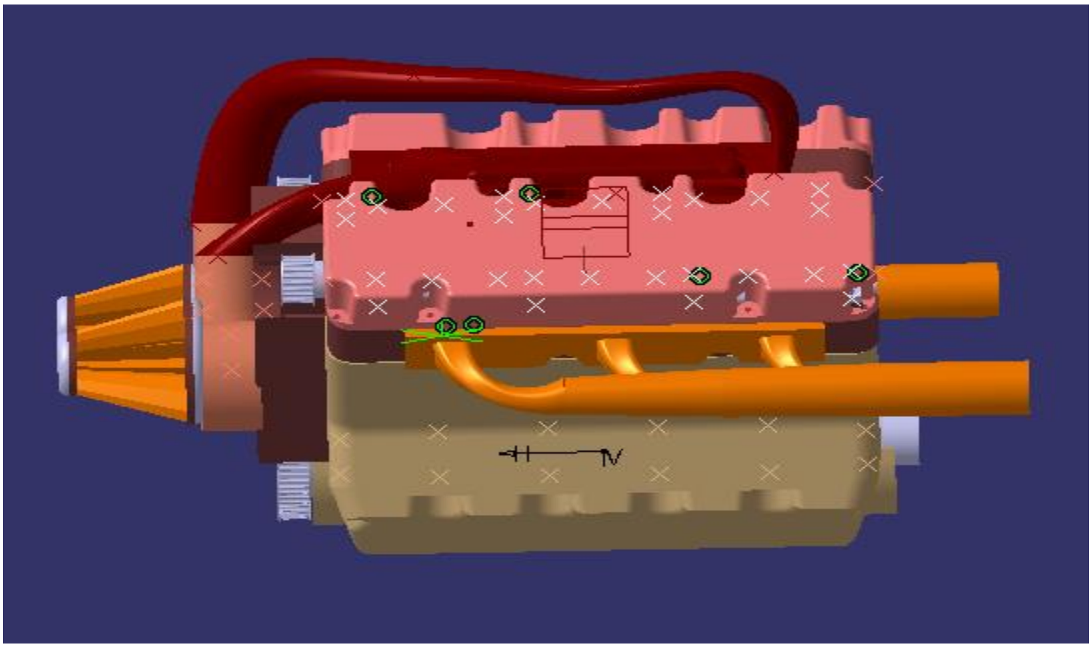


Fig 30- Right view of V6

LEFT SIDE VIEW OF V6 ENGINE

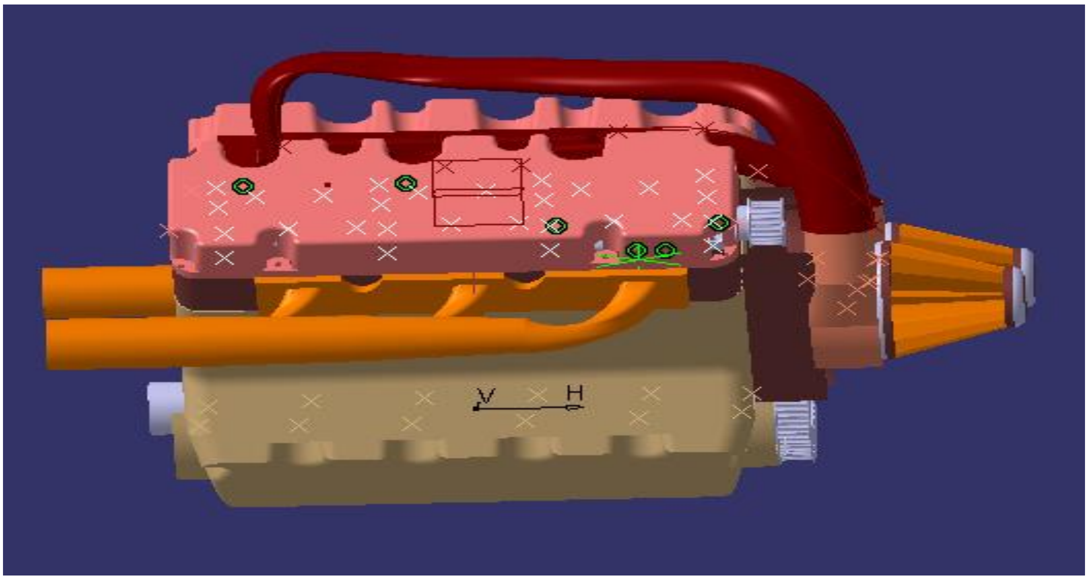


Fig 31- Left view of V6

FRONT VIEW OF V6 ENGINE

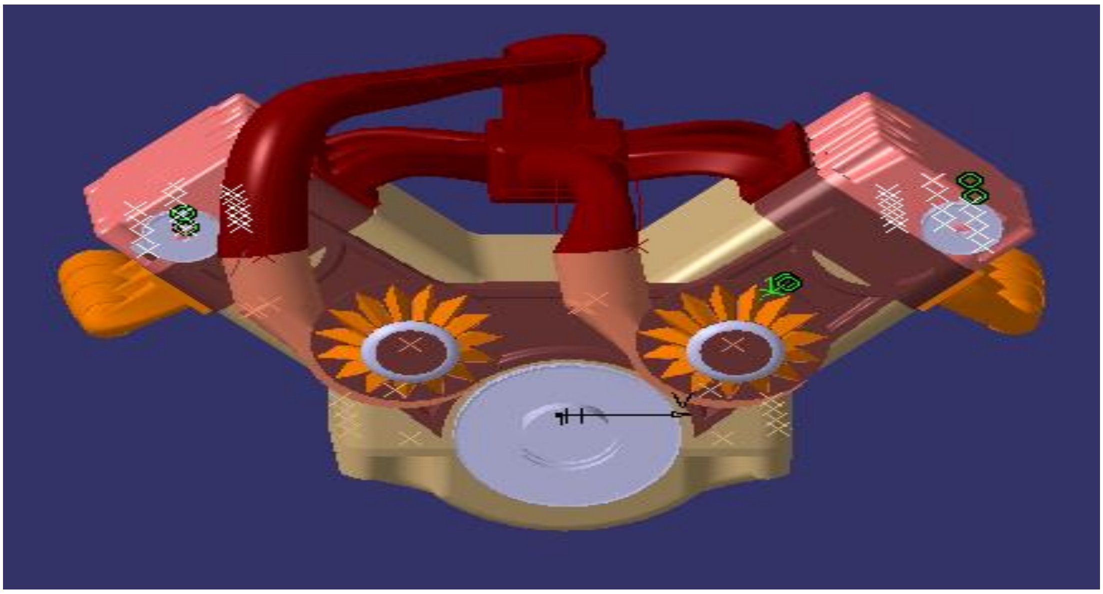


Fig 32- Front view of V6

BACK VIEW OF V6 ENGINE

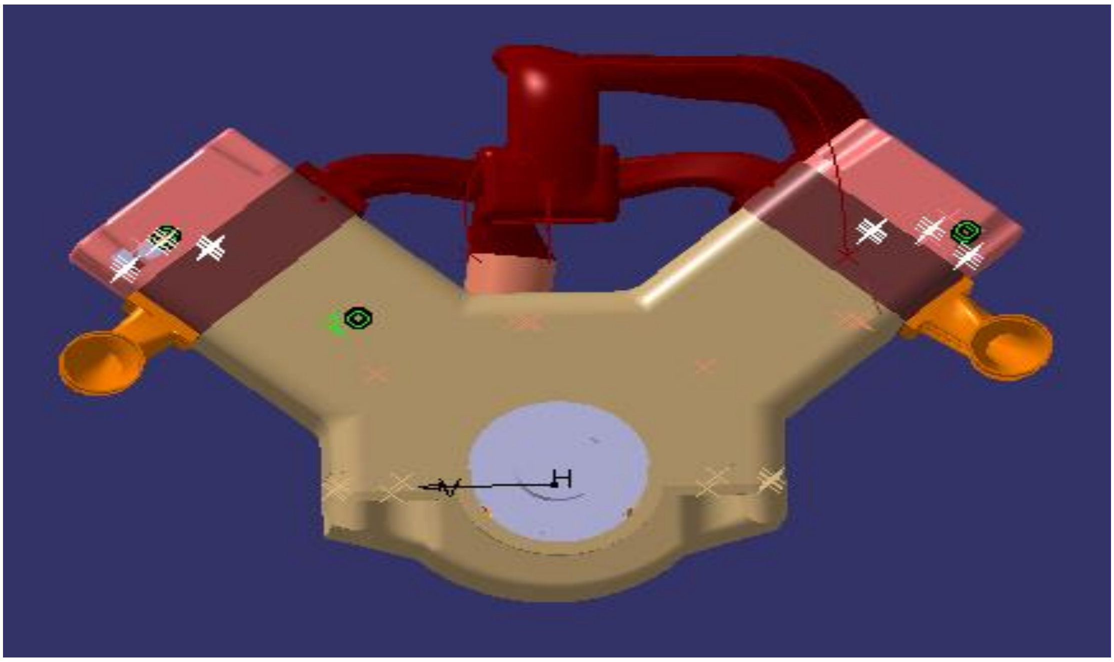


Fig 33- Back view of V6

SECTIONAL VIEW OF V6 ENGINE

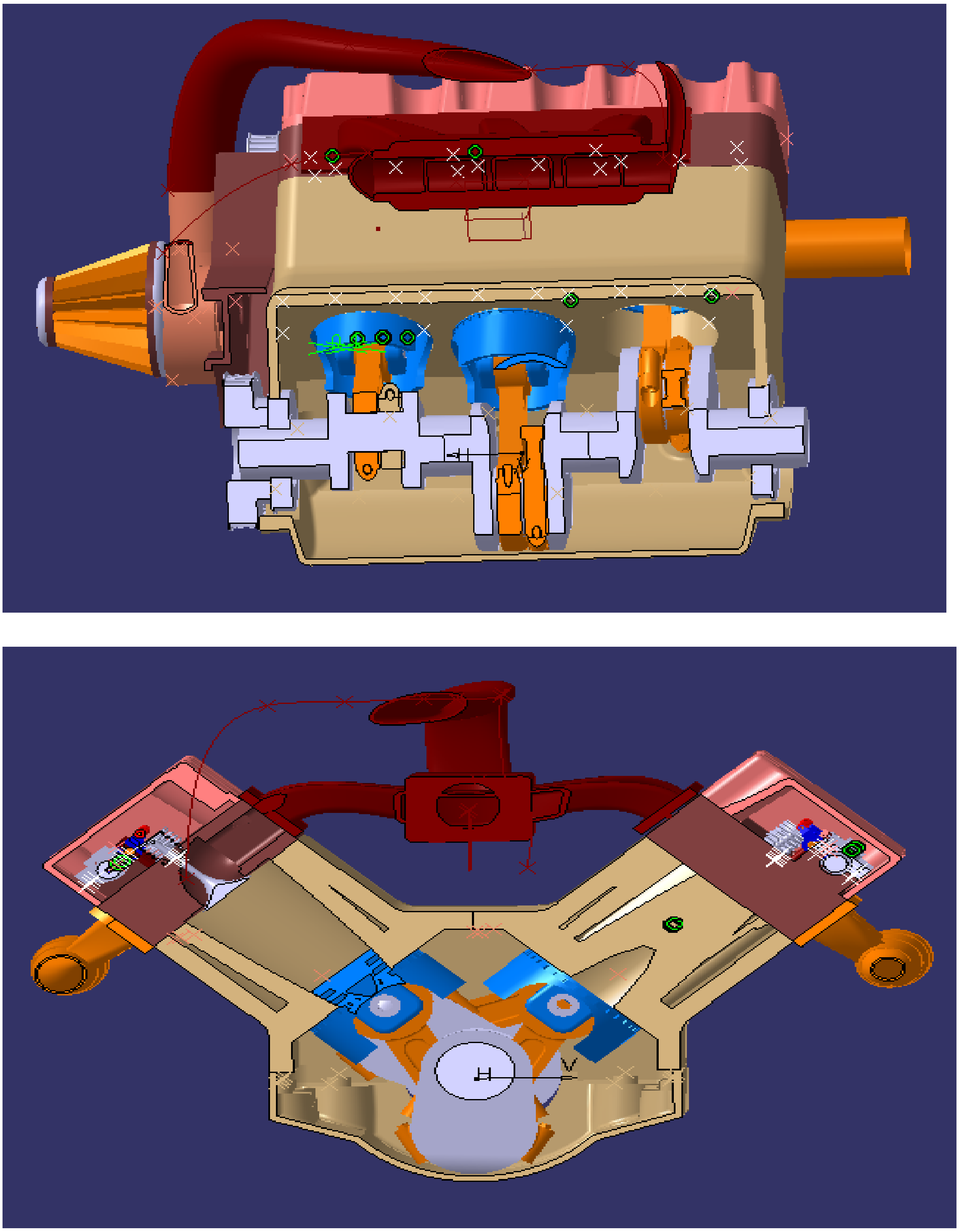


Fig 34- Sectional views of V6

EXPLODED VIEW OF V6 ENGINE

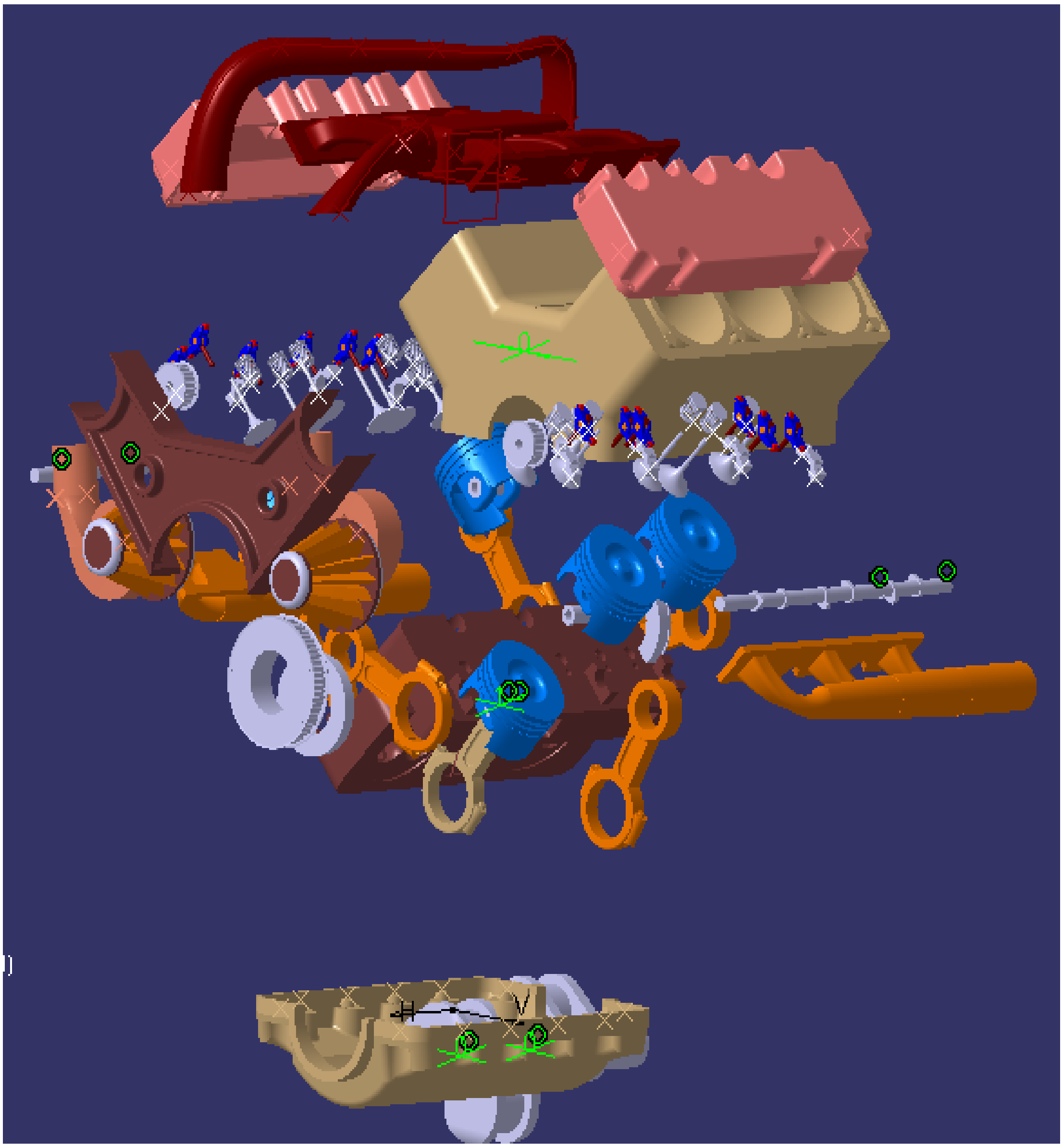
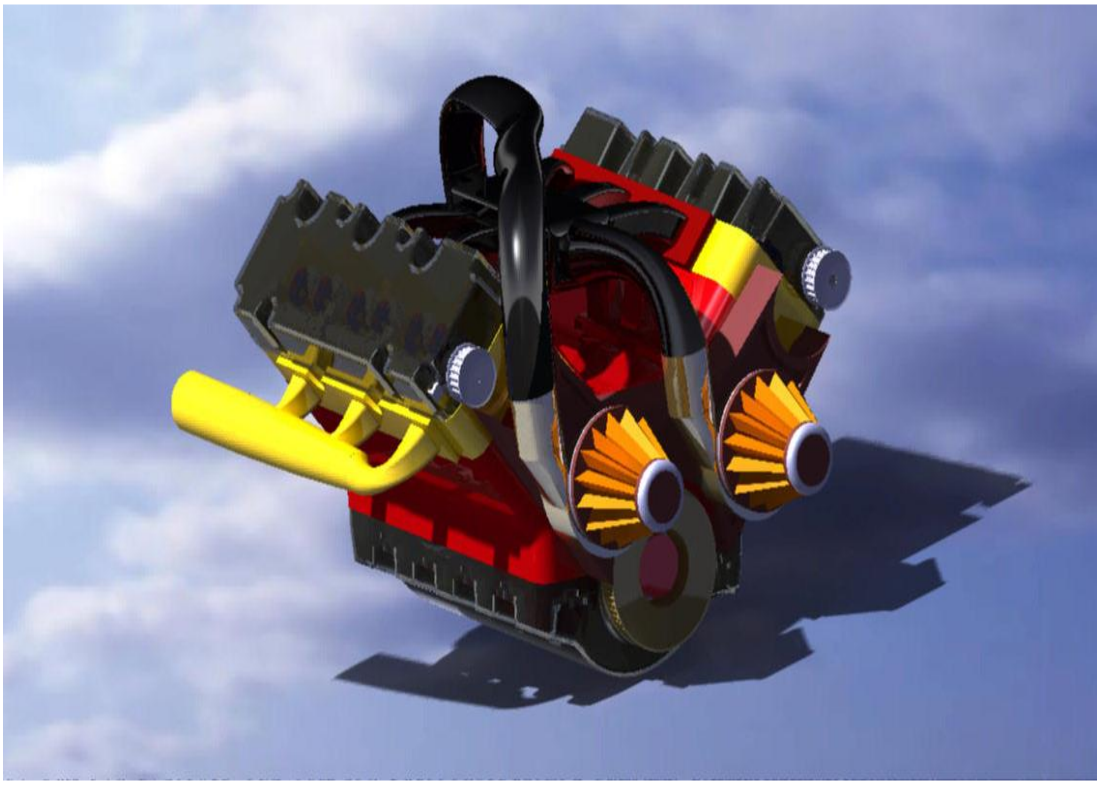
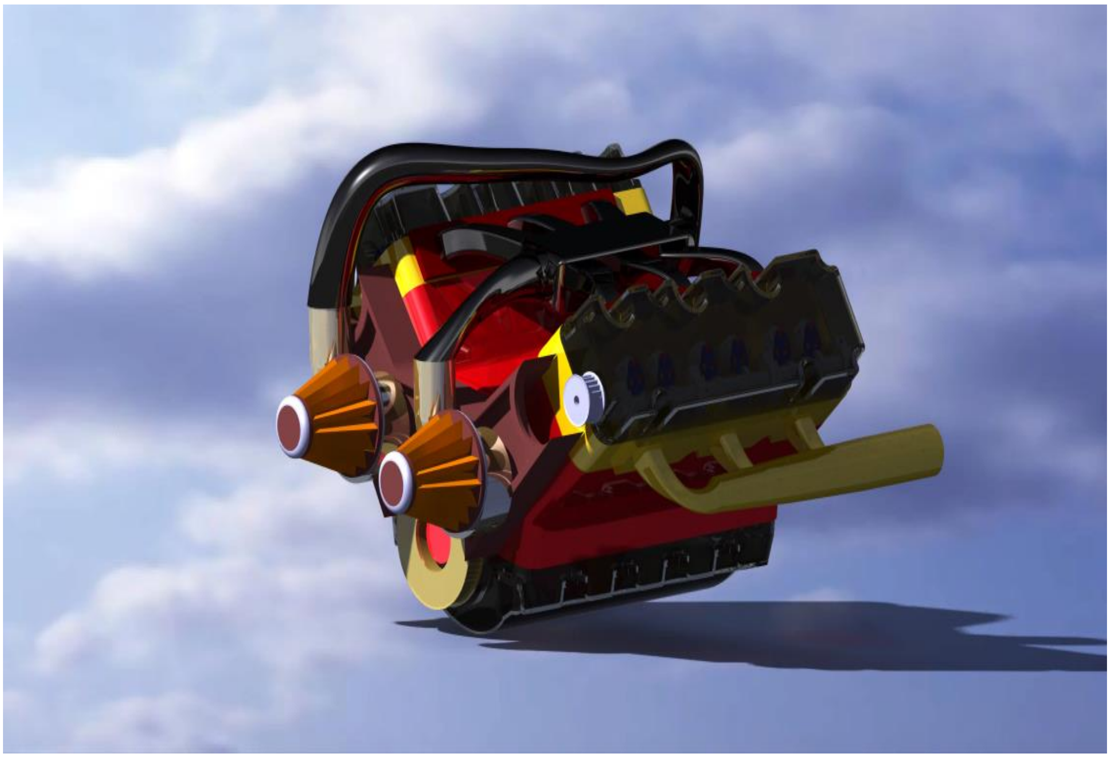


Fig 35- Exploded View of V6

RENDERED IMAGE OF V6 ENGINE





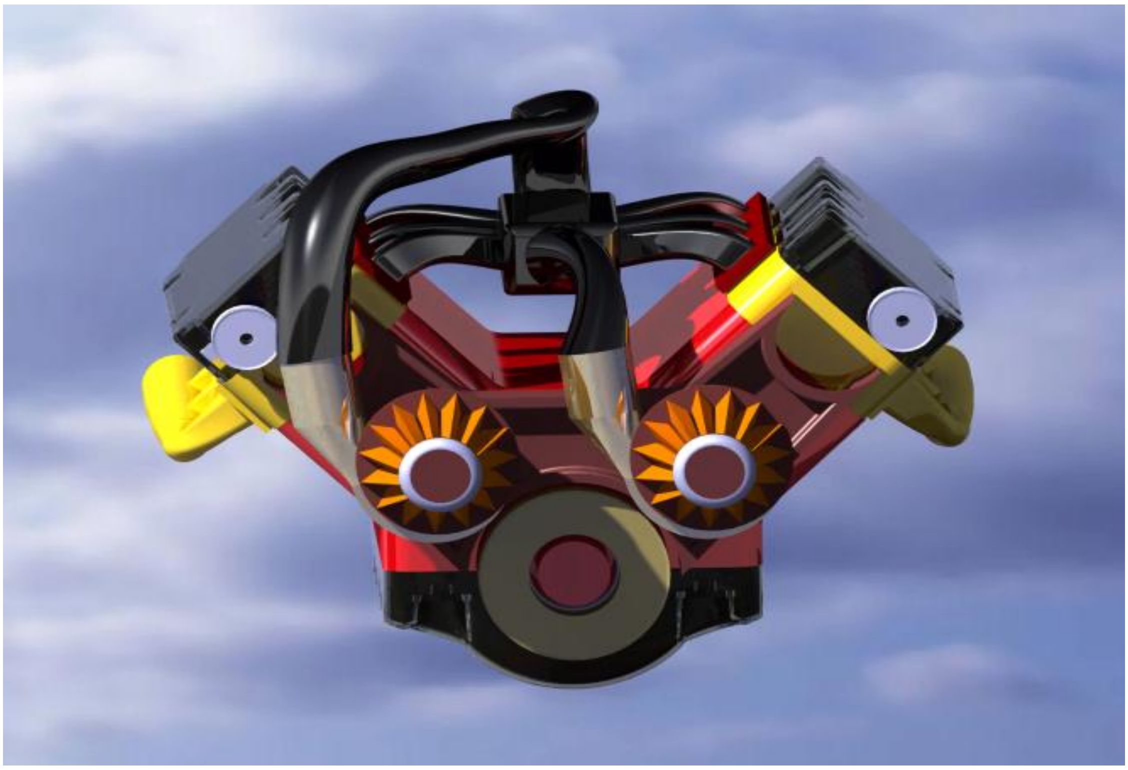
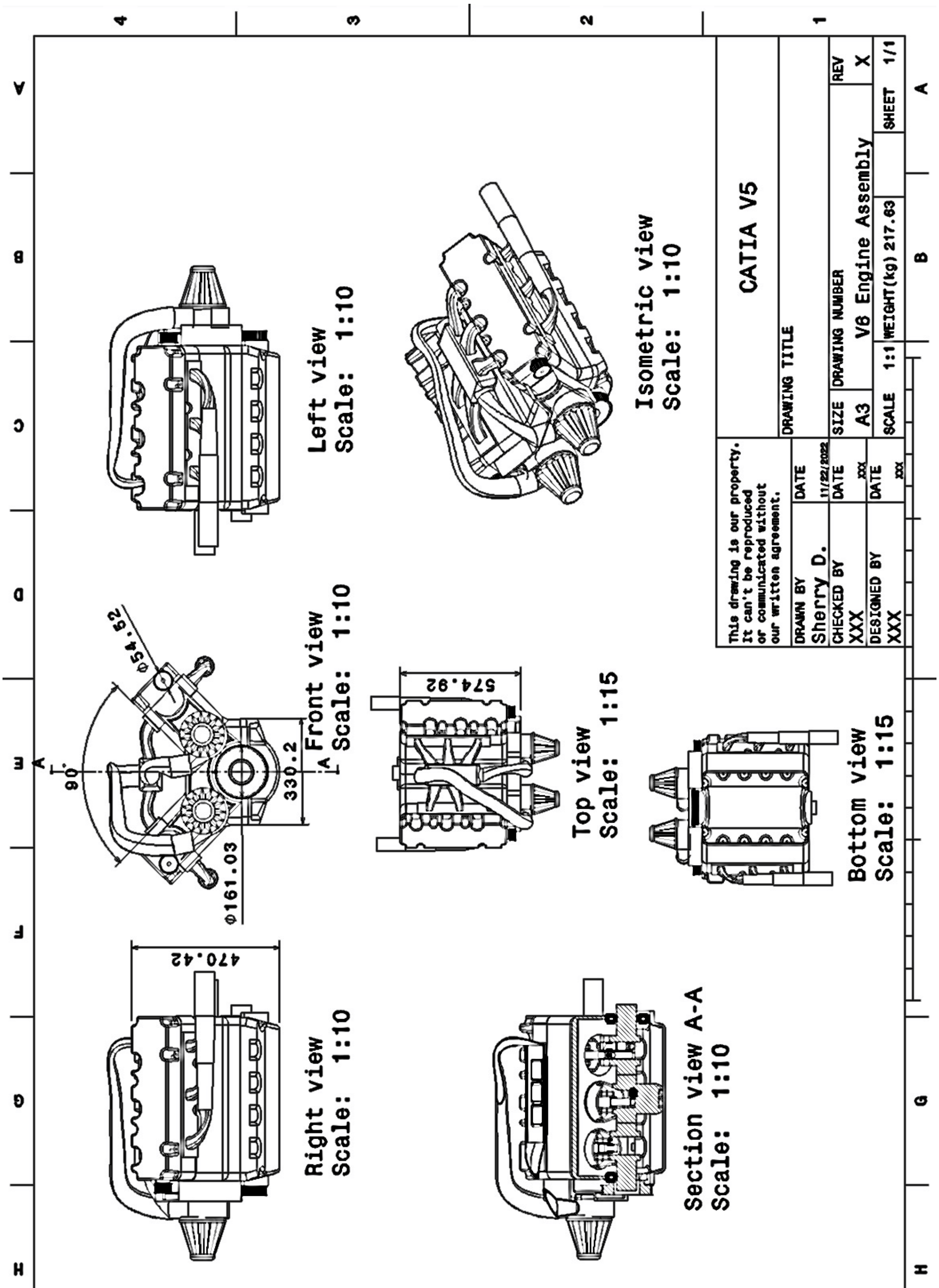


Fig 36- Rendered Image of V6

DRAFTING VIEW OF V6 ENGINE



DRAFTING BILL OF MATERIALS

Bill of Material: V6 Assembly

Number	Part Number	Quantity
	Engine Block	1
1	Bush	2
	Crank Shaft	1
	Piston rod assembly	1
	Connecting rod	5
2	Piston	2
3	Piston rod	2
	Piston assemble	3
4	Cylinder head	1
	Cam Shaft	2
	Rockerarm assem	12
5	Spring	12
6	Eng valve	12
7	Retainer	8
8	valve cover	2
9	Cylinder head.1	1
10	Eng Pulley	1
11	side cover	1
12	supercharge	2
13	Air filter	2
14	Exhaust manifold	2
15	Oil sump	1
16	Intake manifold	1
17	Eng Pulley.1	2

Bill of Material: Engine Block

Number	Part Number	Quantity
18	Cylinder Block	1
19	Cylinder Block.1	1

Bill of Material: Crank Shaft

Number	Part Number	Quantity
20	cam	1
21	cam.1	1
22	cam.1.2	1

Bill of Material: Connecting rod

Number	Part Number	Quantity
23	crank case	1
24	crank shaft	1

Bill of Material: Cam Shaft

Number	Part Number	Quantity
25	cam shaft	2
26	cam shaft.1	1

Bill of Material: Rockerarm assem

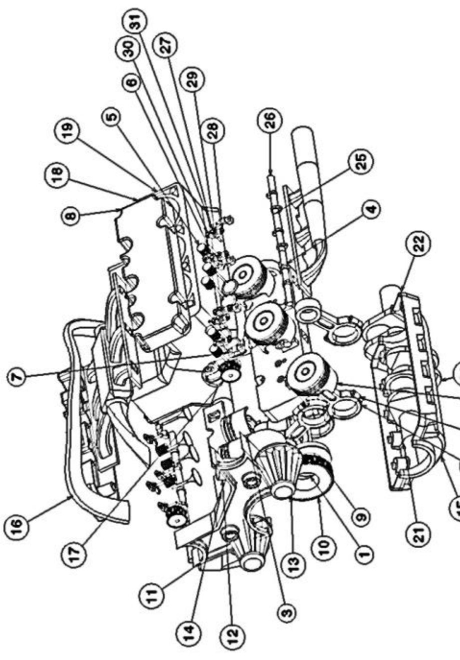
Number	Part Number	Quantity
27	Rocker arm	1
28	Roller	2
29	Pin	1
30	Pin2	2
31	Bolt	1

Bill of Material: Piston rod assembly

Number	Part Number	Quantity
2	Piston	1
	Connecting rod	1
3	Piston rod	1

Bill of Material: Piston assemble

Number	Part Number	Quantity
2	Piston	1
3	Piston rod	1



Isometric view
Scale: 1:8

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DRAWN BY Sherry D.	DATE 11/22/2022	DRAWING TITLE CATIA V5	
CHECKED BY XXX	DATE XXX	SIZE A2	DRAWING NUMBER V6 Engine Assembly	REV X
DESIGNED BY XXX	DATE XXX	SCALE 1:1	WEIGHT(kg) 217.63	SHEET 2/2