ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Design & Fabrication of a Pocket Bike with Automatic Transmission


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Abstract:

The design process began by preparing a reference model of the chassis by keeping the constraints of the engine and auxiliary parts. The solid works platform is used to design the main chassis with the reference to the dimensions taken from the previous model. The 3D model of the chassis from the solid works was analysed using ANSYS Workbench software for weak areas. The different parameters analysed were Total Deformation, Directional deformation, Shear Stress, Equivalent Stress and Strain Energy. The material selected the structural steel, IS 1161 based on the analysis we made. This material has the yield strength of 350MPa. The chassis was fabricated with minimal welds possible, by replacing the need of the weld with bending the material to retain its strength. TIG welding was used to join different members of the chassis.

In the fabrication process we used all the concepts we learnt in the engineering production. The ultimate goal of this project is to build a pocket bike which is comfortable for any age group rider from 5 year old kid to a 6 feet tall guy in an economical price tag.

I. INTRODUCTION:

Like go-karts, the first minibikes were made by enthusiasts from spare parts found in their garages. They were first popularly used as "pit bikes", for drag racers to travel in the pits during races in the late 1950s. They were very useful for this purpose, as they could maneuver very well in the tight pit roads, fit in about the same space as a small bicycle in a trailer or pickup. As racers brought them home and used them around their neighborhoods, many children liked the idea of having a mini motorcycle and started building their own. These look like sport bikes and are used in pocket bike racing on kart racing tracks. The usual height is less than 50 cm (20 in), and up to 1 m (3 ft. 3 in) length. Power usually comes from a 39–50 cc (2.4–3.1 cu in) two-stroke engine with a maximum of 2.5–6 horsepower (2–4.5 Kw). Maximum speed varies between 30 to 64 km/h (19 to 40 mph). Pocket bikes are also made in both four-stroke gasolines. The four-stroke models are usually 110cc automatic or manual engines, and are referred to as Super Pocket Bikes.

II. ENGINES AND ITS TYPES USED IN POCKET BIKE

Two-stroke Engine

A two-stroke, or two-cycle, engine is a type of internal combustion engine which completes a power cycle with two strokes of the piston during only one crankshaft revolution. In a two-stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust (or scavenging) functions occurring at the same time. Two-stroke engines often have a high power-to-weight ratio, usually in a narrow range of rotational speeds called the "power band". Compared to four-stroke engines, two-stroke engines have a greatly reduced number of moving parts, and so can be more compact and significantly lighter.

In a two-stroke engine, the heat transfer from the engine to the cooling system is less than in a four-stroke, which means that two-stroke engines can be more efficient. However, crankcase-compression two-stroke engines, such as the common small gasoline-powered engines, create more exhaust emissions than four-stroke engines because their petrol lubrication mixture is also burned in the engine, due to the engine's total-loss oiling system.

Applications

The two-stroke petrol (gasoline) engine was very popular throughout the 20th century in motorcycles and small-engine devices. Part of their appeal was their simple design (and resulting low cost) and often high power-to-weight ratio. The lower cost to rebuild and maintain made the two stroke engine very popular. Simple two-stroke petrol engines continue to be commonly used in high-power, handheld applications such as string trimmers and chainsaws. The light weight, and light-weight spinning parts give important operational and safety advantages. For example, a four-stroke engine to power a chainsaw operating in any position would be much more expensive and complex than a two-stroke engine that uses a gasoline-oil mixture.

These engines are preferred for small, portable, or specialized machine applications such as outboard motors, high-performance, small-capacity motorcycles, mopeds, under bones, scooters, snowmobiles, karts, ultra-lights, model airplanes (and other model vehicles), lawnmowers, chain saws, weed-whackers and dirt bikes.

Four-Stroke Engine

A four-stroke cycle engine is an internal combustion engine that utilizes four distinct piston strokes (intake, compression, power, and exhaust) to complete one operating cycle. The piston makes two complete passes in the cylinder to complete one operating cycle. An operating cycle requires two revolutions (720°) of the crankshaft. The four-stroke cycle engine is the most common type of small engine. A four-stroke cycle engine completes four Strokes in one operating cycle, including intake, compression, power, and exhaust Strokes.

Step 1: Intake Stroke

Air and fuel enter the small engine through the carburetor. It’s the job of the carburetor to supply a mixture of air and fuel that will allow for proper combustion. During the intake stroke, the intake valve between the carburetor and combustion chamber opens. This allows atmospheric pressure to force the air-fuel mixture into the cylinder bore as the piston moves downward.

Step 2: Compression Stroke

Just after the piston moves to the bottom of its travel (bottom dead center), the cylinder bore contains the maximum air-fuel mixture possible. The intake valve closes and the piston returns back up the cylinder bore. This is called the compression stroke of the 4-cycle engine process. The air-fuel mixture is compressed between the piston and cylinder head.

Step 3: Power Stroke

When the piston reaches the top of its travel (top dead center), it will be at its optimum point to ignite the fuel to get maximizing power to your outdoor power

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
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equipment, a very high voltage is created in the ignition coil. The spark plug enables this high voltage to be discharged into the combustion chamber. The heat created by the spark ignites the gases, creating rapidly expanding, super-heated gases that force the piston back down the cylinder bore. This is called the power stroke.

Step 4: Exhaust Stroke

When the piston reaches bottom dead center again, the exhaust valve opens. As the piston travels back up the cylinder bore, it forces the spent combustion gases through the exhaust valve and out of the exhaust systems. As the piston returns to top dead center, the exhaust valve closes and the intake valve opens and the 4-cycle engine process repeat.Ever repetition of the cycle requires two full rotations of the crankshaft, while the engine only creates power during one of the four strokes. To keep the machine running, it needs the small engine flywheel. The power stroke creates momentum that pushes the flywheel's inertia keeps it and the crankshaft turning during the exhaust, intake and compression strokes.

III. ENGINEERINGDESIGNAND ANALYSYS PROCESS

The general engineering design processes are used commonly incomplex engineering projects. An understanding of these processes was important in order to promote efficient and effective design practices. The application of these processes are utilised to design the chassis of the pocket bike and evaluate it in the analysing software.

Designing Using Solid Works:

Solid Works is a solid modular, and utilizes a parametric feature-based approach to create models and assemblies. The software is written on parasolid-kernel. Building a model in Solid Works usually starts with a 2D sketch (although 3D sketches are available for power users). The sketch consists of geometry such as points, lines, arcs, conics (except the hyperbola), and splines. Dimensions are added to the sketch to define the size and location of the geometry. Relations are used to define attributes such as tangency, parallelism, perpendicularity, and concentricity. The parametric nature of SolidWorks means that the dimensions and relations drive the geometry, not the other way around. The dimensions in the sketch can be controlled independently, or by relationships to other parameters inside or outside of the sketch.

Design of Chassis

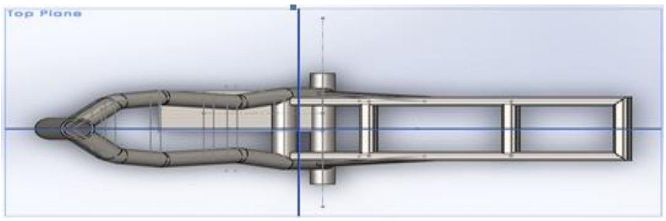

Fig 1: Top view of the chassis

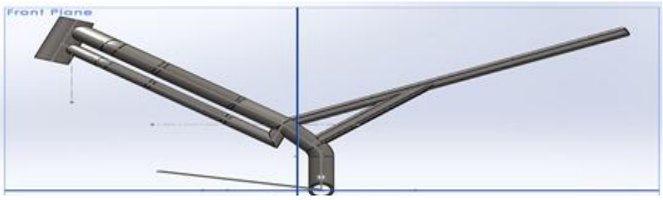

Fig 2: Front view of the chassis

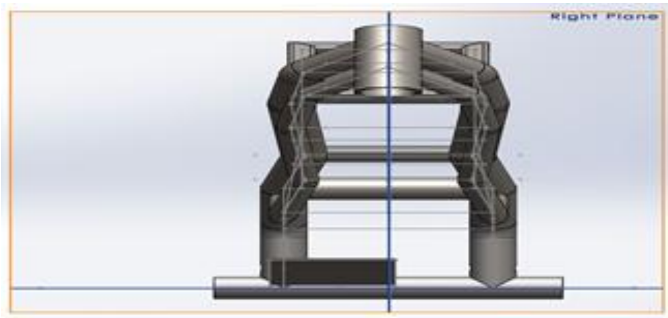

Fig 3: Side view of the chassis

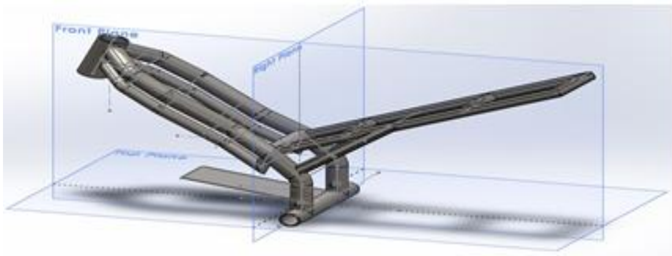

Fig 4: Isometric view of the chassis

Design of Swing Arm

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International Journal & Magazine of Engineering, Technology, Management and Research
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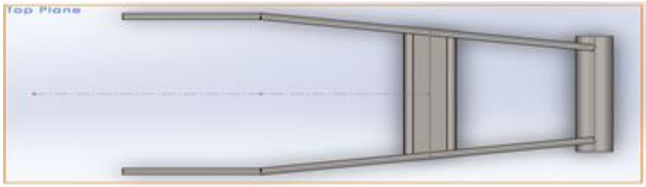


Fig 5: Top view of the swing arm

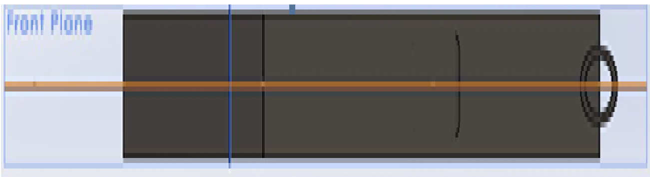


Fig 6: Front view of the swing arm

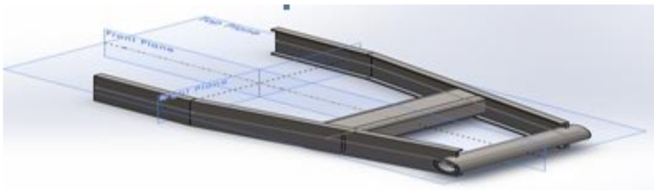
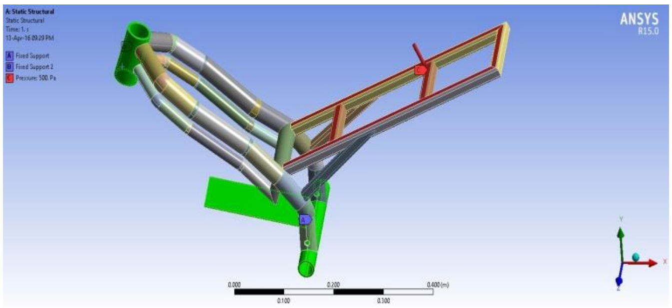


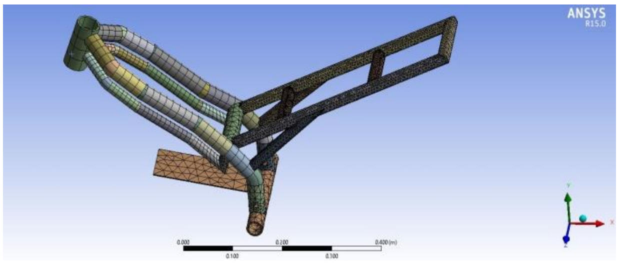
Fig 7: Isometric view of the swing arm

IV. ANALYSING USING ANSYS

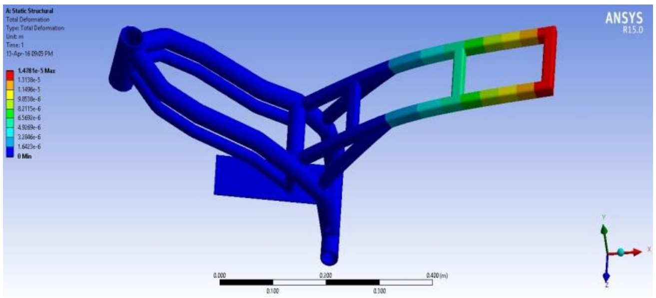
Boundary condition holds a node and prevents it from translating and/or rotating. It acts like a rigid support between the model and the ground. An edge or surface boundary condition applies nodal boundary conditions to each node on the edge or surface. When the model is being analyzed, an equation is generated for each degree of freedom of each node. If a boundary condition is applied to a node no equation is generated for that node because it experiences no translation or rotation



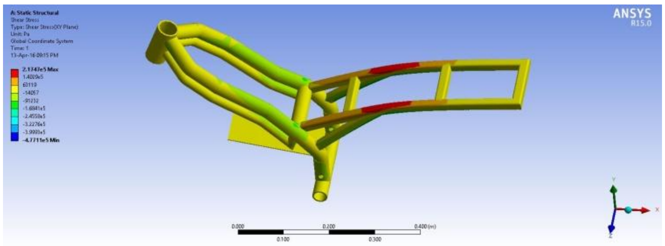
Mesh generation is the practice of generating a polygonal or polyhedral mesh that approximates a geometric domain. The term "grid generation" is often used interchangeably. Typical uses are for rendering to a computer screen or for physical simulation such asfinite element analysis or computational fluid dynamics.A mesh is otherwise a discretization of a domain existing in one, two or three dimensions.



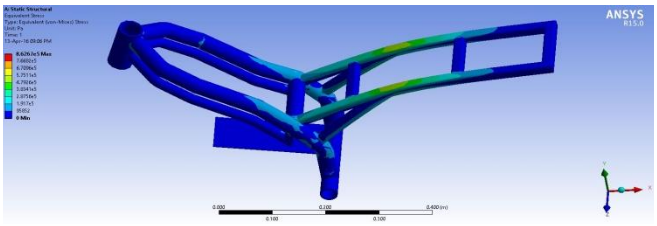
Total deformation is the transformation of a body from a reference configuration to a current configuration. A configuration is a set containing the positions of all particles of the body



Shear stress is a stress state where the stressis parallel to the surface of the material, as opposed to normal stress when the stress is vertical to the surface.



Equivalent stress or von Mises stress, which is used to predict yielding of materials under multiaxial loading conditions using results from simple uniaxial tensile tests.



Strain energy is released when the constituent atoms are allowed to rearrange themselves in a chemical reaction. The external work done on an elastic member in causing it to distort from its unstressed state is

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International Journal & Magazine of Engineering, Technology, Management and Research
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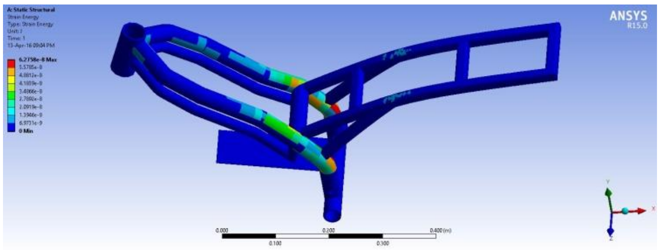
transformed into strain energy which is a form of potential energy.



The Swing Arm Using ANSYS

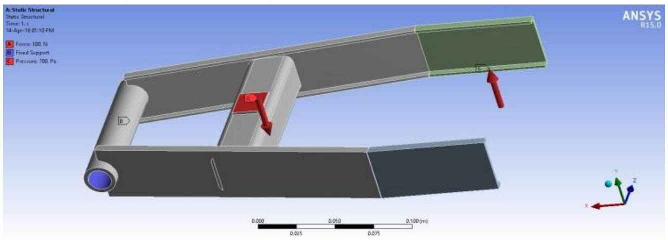


Fig 8: Boundary condition

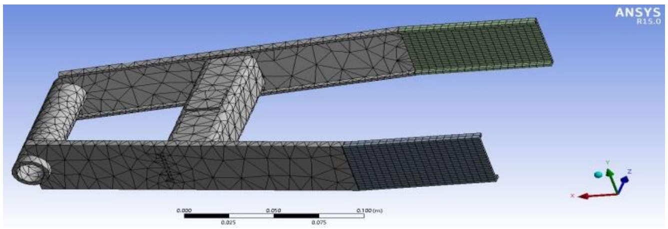


Fig 9: Mesh generation

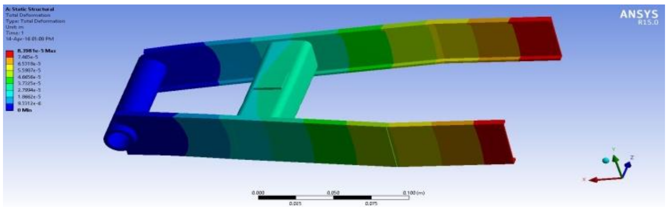


Fig 10: Total deformation

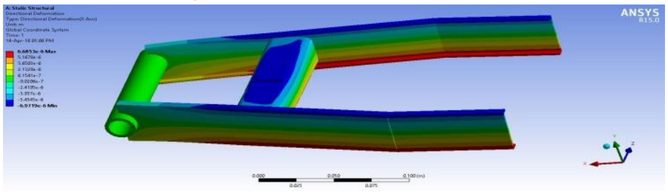


Fig 11: Directional deformation

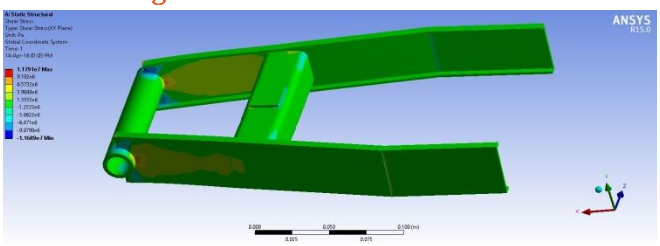


Fig 12: Shear stress

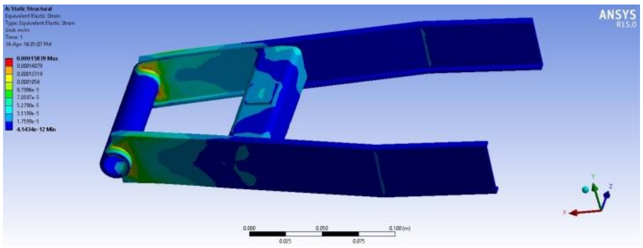


Fig 13: Equivalent stress or von Mises stress

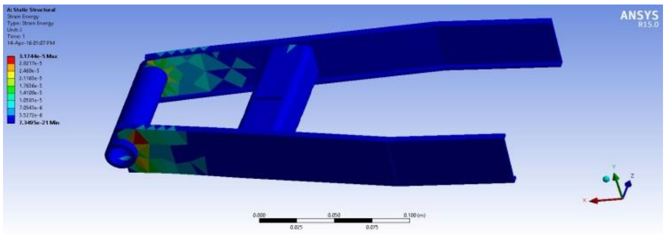


Fig 14: Strain energy

So, all the data availed from the design and analysis. Then changes were made to the design as per the load requirements and thenpreceded to the fabrication of each part of the chassis and swing arm.

Specifications

Engine Capicity	: 49 Cc Single Cylinders
Engine Type	: 2 Strokes
Ignition Type	: Spark Ignition
Drive Type	:Chain Driven
Cooling Type	: Air-Cooled
Start Way	: Self Start & Recoil Start
Top Speed	: 52 Kmph
Max Power	: 2.5 Kw/700rpm
Gross Weight	:4.5kgs
Bhp	: 3.6 Bhp
Wheel Base	: 84cm
Maximum Height	: 78cm
Seating Height	:50cm
Total Weight	: 20 Kgs
Brake	: Front and Rear (Dry Disk Brake)
Tire	: Front &Rear – 2/2.50-10
Battery	:12volts
Holding Capacity	:120kgs
Ground Clearance	:26 Cm

ISSN No: 2348-4845
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Advantages

- Compact and portable in size.
- Light weight.
- Easy to ride.
- More economy for low costs.
- Cheaper price for manufacturing.
- Easy to handle at dangerous scenarios.
- Cheap maintenance.
- High weight to power ratio.
- Dry type Brakes
- Comfort riding posture for any age group.

Outstanding Features

Though our pocket bike stands out in many ways,
The major ones are as follows

- It is comfortable for any rider to ride with ease, no matter if the rider is 5 years old kid or 6 feet tall man.
- The fuel efficiency of our bike is 49kmpl with the rider who weighs 62kgs.
- The top speed of our pocket bike is 54kmph on a straight road.

Fig 15: Fabricated Bike

Maintenance

The following steps are important and must be followed before starting the engine each time it is used.

Thoroughly Checking Your Bike Takes Only A Few Minutes And May Save Your Life

- Check the fuel level in the fuel tank – Ensure that it is fully fuelled with the correct fuel/oil mixing ratio.
- Check the brake operation – Tightly squeeze the brake lever and firmly push the bike backwards and forwards. If the bike moves with the brakes applied then the brakes need replacement or adjustment. Do not drive with worn or defective brakes.
- Check the tire surface – Look for uneven surfaces, bumps that could cause tire failure or blowouts. Do not drive if the tire surface is uneven or if objects such as nails or stones are embedded in the tire.
- Check the tire pressure – Tires must be inflated to 32 psi. Driving with too low air pressure in the tire may cause accidents. Never inflate over 32 psi.
- Check the throttle for smooth operation – Rotate the throttle and release a couple of times. Ensure that it smoothly returns to the original position without manual assistance.
- Check the steering – Turn the steering from side to side several times. Ensure that it can fully turn without sticking.
- Check the front wheels – Lift up the front end of the bike and spin the front wheel. Ensure that it turns smoothly.
- Check the fuel tank cap – Make sure that it is tightly closed.
- Check the front steering column – Double-check that the handlebar assembly and telescopic extension is firmly tightened.
- Check the drive chain – Check to ensure that both engine and wheel drive chain is in good condition (not torn or frayed) and not too slack.

Check all nuts, bolts and fasteners AGAIN – Ensure that all wheel nuts, seat and handlebar assembly etc. are securely fastened.

CONCLUSION:

A mini bike also known as a mini motor or pocket bike, is a mini motor cycle which is built by using two stoke engine to turn there a wheel via a chain. This paper gave us a chance to work on various machines

ISSN No: 2348-4845
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while fabricating it, such as lathe, welding, grinding, milling, drilling, etc.

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