

## Design and study of motor sports and racing car setups

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### Abstract

Expanding interests in vehicle of this age has expanded motor sports. Bringing about expanded number of dashing occasions held year long. In this paper an approach for designing, examining and assembling of air admission and fumes framework is talked about for model of a Formula style car with the locally accessible assets close by according to the tenets indicated by the two noteworthy understudy level occasions sorted out in India. It additionally gives a short prologue to the stream reenactment of the composed models in Solid Works for different rpm for tuning the motor and functional commotion testing of recently planned fumes framework for the model car fueled by 600 cc motor of Yamaha R6 YZF. These focused occasions require a restrictor on the section of air to the motor and furthermore require clamor emanations underneath 110dB with the fumes framework.

**Keyword:** racing cars, motor sports, design

### Introduction

In this generation, motor sports have turned out to be one of the real territory of enthusiasm of a huge number of individuals over the globe. This has lead way for various associations to accessible motor sports occasions everywhere throughout the world. It might be of various kind like-speed situated plain street vehicle or all train vehicle, monetary fuel arranged or in light of some other rule. It has tested designers to beat every one of the obstacles for accomplishing this. In India, there are such two noteworthy understudy level occasions (SUPRA and FDC) accessible for recipe style race car. The idea driving such an occasion is to get a plan group for advancement of a little Formula-style race car that will be made by an anecdotal assembling organization after palatably satisfaction of required objectives<sup>[1]</sup>. This model car will be judged for its quality and standard so it might be a superior market item. The conceivable showcasing bunch for this race car will be novice carcross racers or will be utilized to prepare equation one drivers of student stage. Members of these rivalries are montage understudies. Such cars are planned and fabricated by them just and tried on the occasion site whose object is to advancing better issue settling method. Numerous administer limitations of such occasions has characterized confined parameters on which configuration must be fit for sparing all of pull and bring out better execution and mileage of same motor. Air admission and fumes framework are a portion of those fields where there is heaps of extent of increasing additional power. A conceivable air admission and ventilation system for such a model (single seat race car) was proposed to configuration, investigate and fabricate with the locally accessible assets close by according to the standards indicated by the two noteworthy understudy level occasions sorted out in India. This race car was fueled by 600 cc motor of Yamaha R6 YZF. Additionally, investigation of different frameworks that are accessible and significant plan strategy received in this field was finished. This planning wouldn't have been be prevailing without persistent breaking down and reproducing the model of the outlined framework. This

investigation was finished by both explanatory and additionally trial techniques<sup>[2]</sup>.

### Inspiration

The FSAE group Team Roadrunner of NIT Rourkela chose YAMAHA R6 YZF motor for both Formula Student 2015 and SUPRASAE 2015. This motor was a 4 chamber, 600cc dislodging, 4 stroke motor from a cruiser. The decision to keep utilizing the R6 motor was made for a few reasons. Initially, the group has just a single motor and with a specific end goal to change to an alternate motor, the group would need to buy new motor and again we need to begin our tuning from fledgling's phase for new motor. And furthermore purchasing another motor and its frill at a critical cost was in any case not a smart thought. Also, the motor in an equation SAE car needs a few specially crafted subsystems with a specific end goal to be practical. These incorporate the oil framework, fuel framework, cooling framework, and additionally the greater part of the electrical segments. Keeping in mind the end goal to change to another motor, every one of these subsystems would should be painstakingly overhauled at a vast cost of the group's chance and assets. The FSAE group chose the most advantage would originate from expanding on the group's present learning of the R6 motor and endeavor to make a whole motor bundle that pushes this motor to its maximum capacity. Hence, for the chose motor an admission framework with restrictor and fumes framework must be composed with least cost and assets accessible locally keeping in mind the end goal to show signs of improvement execution out of same motor<sup>[3]</sup>.

### Literature Review

Air admission and fumes arrangement of a motor assumes critical part in motor execution in such rivalries where even a slight less execution builds odds of disappointment. In this way, outlining those necessities exceptional consideration and bunches of study. In showcase there are different producer like - Eurojet MK6 Exhaust System, SFX, Donaldson, and

Silex, which gives extensive variety of these framework as per execution prerequisites. Claywell *et al.* [1] examined distinctive kinds of general admission arrangement utilized as a part of such focused occasions. The Conical-Spline Intake framework was found to give less variety of volumetric effectiveness when contrasted with each barrel and motor execution out of all the three kinds of admission ideas that were assessed. Han-chi and Hong-wu [2] proposed diverse methods for improvement procedure utilized for air admission and fumes framework. Orthogonal Array Testing was executed which is basic nowadays to design air admission of such rivalries.

It was accepted that the air in the framework because of its latency is sloshing forward and backward and bobbing in the full holes subsequently development and pressure waves are going through the pipeline, which gets reflected because of impact with open and shut finishes and furthermore because of variety in cross sectional territory of the pipeline, Hartmen and Jeff [3]. The motor execution of a JIALING JH600 bike was streamlined by applying vitality adjust condition for the entire framework and mass adjust in various area of the motor. Likewise, it was discovered that the answer for reenactment of 1-D stream in the approximated bearing thinking about normal of stream, requires the preservation of mass, force and vitality conditions, Delaney and Michael.

Murray *et al.* [5] have outlined a tri-Y fumes framework for a motor controlled by Honda CBR 600 RR. In this outline essential header leaving first valve is joining with the header of the last one in the arrangement. Also, the two center request essential headers join comparatively. After that both two optional headers join to make a solitary header through which a suppressor/silencer will be associated. Because of less number of sharp edges noticeable all around admission configuration keeping away from and because of its smooth outline there was less turbulent stream of air to every valve of the barrel. Subsequently, this new air admission diminishes the starvation of outside air to every one of the chambers. A flush ringer mouth outline on the passage to the sprinters was utilized which enormously upgrades the mass stream rate into the plenum and lessens the odds of formation of vacuum pockets. In any case, this sort of air consumption assembling will be finished by either strengthening a fast prototyping/3D printing or by throwing which will be unrealistic all over the place.

John Wall, [7], gave a concise understanding of the elements of fumes arrangement of an inner burning motor which makes it essential field for enhancing execution of the motor by both hypothetically and for all intents and purposes. Dynamic examination of fumes framework, hypothetical demonstrating and reenactment, exploratory examination item advancement and virtual models were contemplated. What's more, an unmistakable fumes design was demonstrated, recreated and tentatively explored for understanding the reality and to evaluate displaying thoughts. In this examination prime consideration was to watch the impact of the cries compose adaptable joint. Kennedy *et al.* [8], have outlined fumes and admission framework for a car which has 600cc Suzuki GXR motor. This was intended to meet the model to fulfill the control of 20mm restrictor on the admission stream of air to the motor. Another motor mapping was improved the situation better execution of the motor.

It additionally thought about the wind current reenactment utilizing CFD examinations and took a gander at different interchange air admission design. It examined utilization of quick model procedure for making a model. Also, exhibited outlining and assembling of another throttle body. The entire procedure for motor ECU tuning and dyno test comes about were additionally presented. This displayed an approach for the outlining and investigating of different fumes setup and estimating sound level. A straightforward method for planning an air admission for a motor which will be tuned by necessities is to thinking about various arrangements of air consumption with various plenum volumes and after that pick a specific. It is a fundamental prerequisite to have a tuned plenum volume and sprinter length for new mapping of ECU. As needs be models can be rejected with no plenum and distinctive sprinter lengths likewise the one which gives alternative to tuning plenum volume as it were. Last choice would be with the end goal that it gives tuning of the sprinter lengths and permits a slight alteration for changing the plenum volume [8].

### Design Methodology

The colligation of plenum and sprinters noticeable all around admission framework makes a Helmholtz Resonator [9]. A run of the mill design of air admission having plenum (pit) of volume V, sprinter of length L having an opening (in the hole) of cross sectional zone A, shapes a Helmholtz resonator. An essential Helmholtz resonator can be comprehended as a pen top which is when blown it produces sound of a particular recurrence. This sound is impact of back and forth development of air molecule through the entry of the pen top. Also, if the pneumatic force wave timing synchronizes with the admission valve opening in the admission header, the air will be drawn into the burning chamber itself rather than suction made by the cylinder development which makes an augmentation of the power yield from the motor. The unmistakable recurrence of a Helmholtz resonator is given in condition.

### Design Consideration

Fumes assumes a significant part in the execution of any interior burning motor. It's nonsensical impediment of stream can bring about additional fuel utilization, expanded fumes temperature and smoke. It likewise brings about decrement of fumes valve life. It is compulsory to keep up a particular point of confinement of back weight in deplete framework else it will expand discharges. Fumes framework ought to be composed remembering the admissible back weight will be half of the greatest reasonable. Confinement of backpressure is by and large because of pipe size, silencer, and framework design. A complex plan like a Tri-Y (or 4-2-1 Configuration) could be picked however assembling would not be conceivable all over the place. In this way, a crate compose course of action was picked which was anything but difficult to make, efficient and furthermore cost effective. Here, debilitate leaving ignition chamber enters a case going through discrete compartment in it. It was expected that high speed smoke molecule on entering in the container chamber gets reflected in a few bearing to such an extent that it will meddle with particles leaving each pipe. Geometry of box was composed to such an extent that division of molecule of

each pipe middle with the other one, bringing about additional sound diminishment. The second model was composed to such an extent that the smoke leaving each pipe gets reflected toward exit of the chamber. The composed two models are appeared in figure 1 and 2 [10].

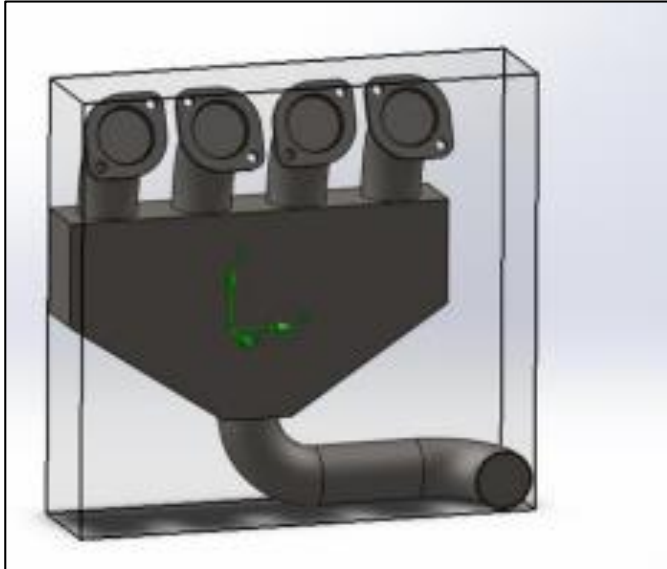


Fig 1: Exhaust manifold model 1

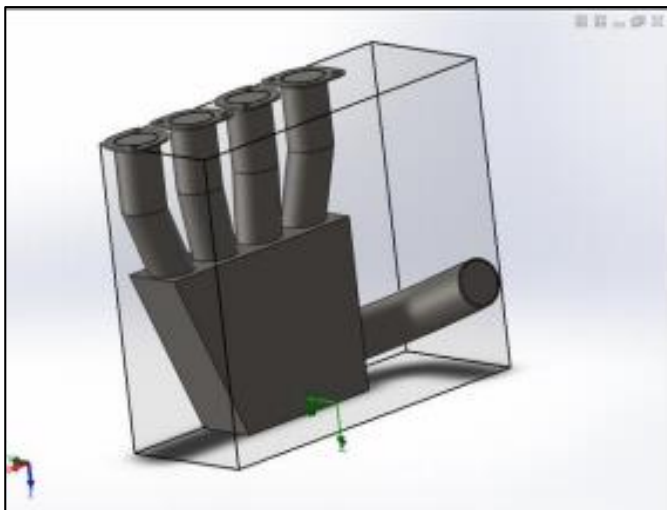


Fig 2: Exhaust manifold model 2

**Noise Test Setup**

The clamor trial of the motor will be done when car will be in rest position and furthermore obligatory that apparatus lever isn't locked in. Gadget used to quantify sound level will be a free-field receiver, which will be put around (0.5-1) m behind the fumes outlet with no hindrance in the middle of them. If there should arise an occurrence of numerous fumes, the past test method will be taken after for every outlet and the most extreme perusing will be considered. Motor insurgency which will give a normal cylinder dislodging of 914.4m/min will considered for the required clamor test general vehicles and 731.5m/min for the motors utilized for mechanical reason. The required test motor speed will be represented by the occasion advisory group, and most noteworthy passable sound level is 110dB. Commotion trial of the fumes

framework was done at the opposition site that requested clamor emanations ought to be beneath 110dB at approx. 11000rpm. The test outcomes gave a perusing of 103dB at approx. 11000rpm which was well inside the equation understudy prerequisites.



Fig 3: Noise test setup for model 1

**Conclusion**

The silencer is by and large the biggest single supporter of fumes back-Exhaust Systems Application and Installation Guide weight. Subsequently, required commotion diminishment and admissible backpressure must be considered while choosing a silencer. Application compose, maybe accessible space, cost and appearance likewise ought to be considered. To choose a silencer, utilize silencer provider information, amended for outlet temperature and speed, to decide the silencer size and sort that fulfills commotion lessening criteria with an adequate most extreme weight drop. In the wake of ascertaining weight misfortune, it might be important to check a moment silencer, or an alternate pipe measure, before an ideal mix is accomplished. Silencer configuration is a profoundly concentrated craftsmanship. Duty regarding the points of interest of plan and development ought to be relegated to the silencer producer.

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