Moto-3 Racing Prototype Design and Realization

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Introduction

This poster is about the design and the realization of a full racing prototype of Moto-3 category.
This prototype had to race against universities among all over the world in the circuit of Aragon Motorland.

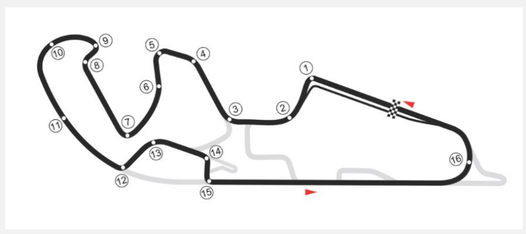

Figure 1 – *Aragon circuit track*

Every team had the same starting kit and the same constraints of the design process, listed below. The starting kit is composed as:

- engine KTM RC 250
- Dunlop front tyre 90/70 R17, rear tyre 115/70 R17
- Rimz OZ 17 ‘’
- Breaking system J. Juan

Technical regulation requirements	
Weight	*Minimum 95Kg*
Suspensions	*Only passive suspension can be used*
Handle bars	*The turning angle of the steering must be 15°.*
Tires	*Dimensions and producer are imposed.*
Rims	*Dimensions and producer are imposed.*
Braking system	*Dimensions and producer are imposed.*
Tilt angle	*Minimum 50°*
Engine	*The engine is established by the organization.*
- *Motors type*	*Monocylinder, 4t*
- *Bore*	*72 mm*
- *Stroke*	*61,1 mm*
- *Valves*	*4*
- *Cooling*	*Water cooled*
- *Power*	*23 kW at 9000 rpm*
- *Torque*	*24 Nm at 7500 rpm*
Fairing	
- *Distance from the ground*	*Minimum distance between road and motorbike: 100 mm*
- *Clearance*	*Minimum clearance of the tire tread to any part of the motorbike: 15mm*
- *Saddle*	*Max 450 mm for the minimum width of the saddle Maximum distance between saddle and tail: 150 mm*
- *Fairing width*	*Maximum width of the fairing: 600 mm*
- *Fairing edges*	*Minimum radius of the edges: 1 mm*
- *Others*	*No element beyond the front and rear tire*

Figure 2 – *Competition constraints*

There were 74 teams coming from 47 different countries from all over the world. 50 teams competing in combustion category and 24 in the electric one. The event lasted one week in which the prototypes were subjected to different kind of tests: from the security checks to the noise ones. The most important part of the event was the race, on Sunday, after a session of qualification. The possibility of acceding to the race was given to all the prototypes that passed the previous checks during the week. The final competition has been a wheel to wheel race among 33 teams that succeeded in passing all the steps.

Figure 3 – *Partecipants’ picture*

Objectives

The main goal was to design and build a full racing prototype from the scratch, following the imposed constraints. Every team had to design, test and realize every component in the most efficient way. Moreover in order to build the prototype each team had to find companies interested in sponsoring the project. The aim of the two years competition is to win the final race and to design the most innovative and performant prototype.

Methodology

In order to tackle the objectives, the team was divided in five different units, each unit with different functions: Engine, Chassis, Aerodynamics, Electronics and Operations. The four technical sections used CAD programs and Finite Element Analysis to study the behaviors of the components and to run simulations. Then some components has been realized by sponsors, others by the team itself. The Operations unit used excel, power-point, etc… to organize the work of the team and to make presentations in order to find funds for the project.

Results

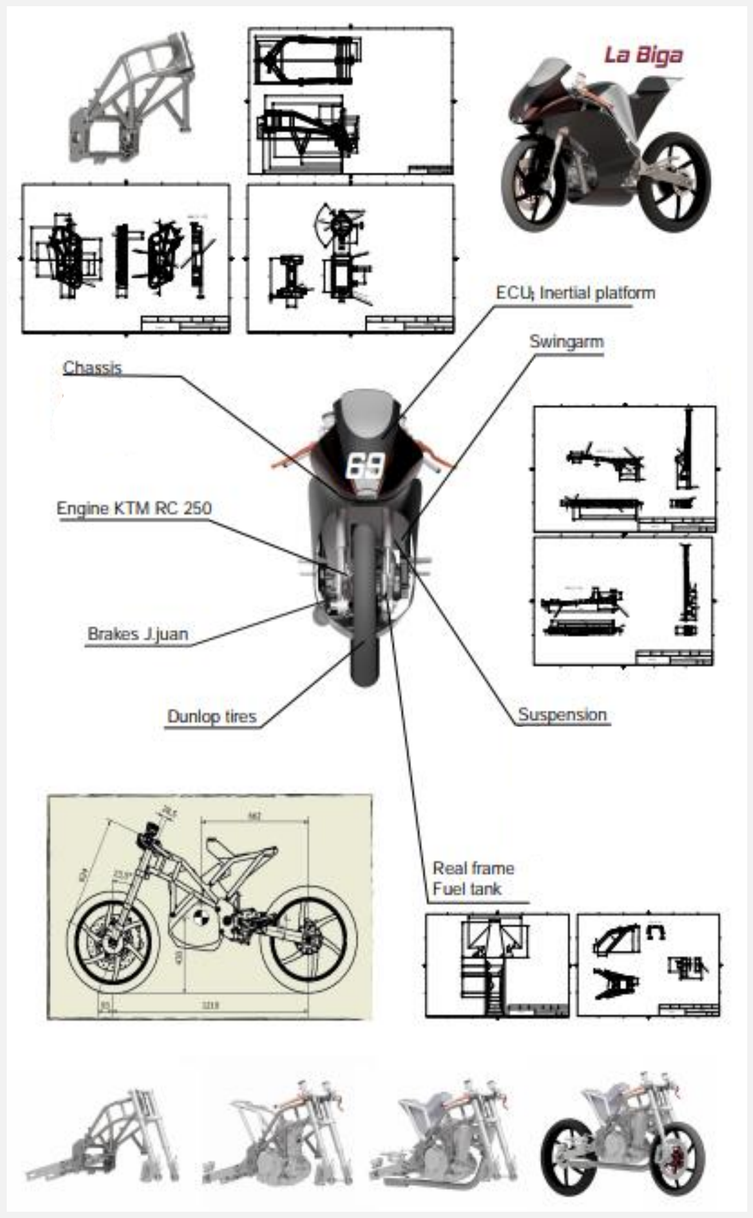

Figure 4 – *Chassis Characteristics*

The Chassis chosen is a tubular aluminium anticorodal series 6000. It has the peculiarity to be resistant and at the same time permitting small deformations in order has been to absorbe the torsion forces that are the strongest ones acting on the chassis. The tubolar configuration chosen in order to optimize the weight and the resistance. The tank has been placed right under the driver in order to well-balance all the weights of the prototype, and to strongly converge the fresh air into the inlet system.

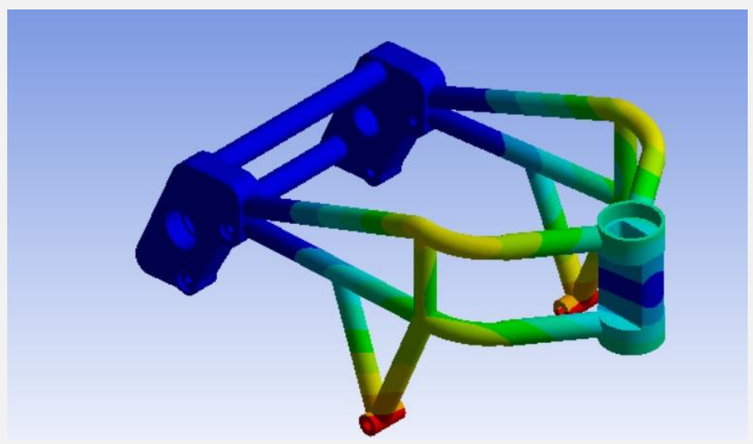

Figure 5 – *FEA on the chassis, torsional analysis*

Working together with the chassis unit to understand the size and create a well-suited hull for the prototype, the Aerodynamic unit ran several simulations with software like Ansys and OpenFoam. Trying different shapes and based on the size of the driver, they succeeded in obtaining the best shape to reduce the drag forces on the prototype. The central part (where the driver seats) is larger in order to obtain a better weights balance and to have enough space for the fuel tank.

Figure 6 – *Prototype hull*

Results

The engine has been developed in order to obtain the maximum torque and power in the desired rpm. The optimal rpm in which maximise these values depend on the type of track, so the engine of our prototype perfect suit the Aragon Motorland track and the maximum torque has been set to 7750 rpm and the power to 9500 rpm. In order to do this, due to the constraints on the engine, the Engine section worked only on the length and sections of the inlet and exhaust systems. Working on these dimensions, we succeeded in matching all the pressure waves in order to help the charge and discharge of the cylinder. Together with the Electronic units, the two sections managed in obtaining “one of the top five engine in the Motostudent 2018”. The two units worked together to match the lighting of the spark with the rotation of the cam-shaft.

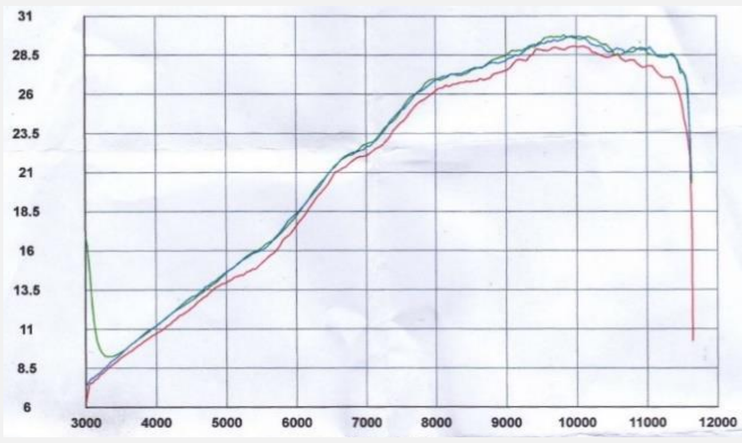

Figure 7 – *Power on wheel graph*
Rpm - Hp

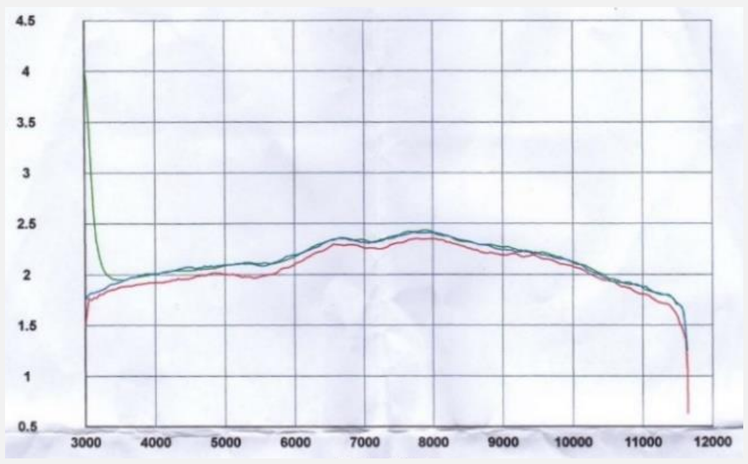

Figure 8 – *Torque on wheel graph*
Rpm - Nm

Conclusions

All the components were well designed and perfect fit together as the team achieved important results. The motorbike arrived in the 9th position overall and won the award as “World’s Best Rookie Team 2018”. As said In a newspaper interview one year before the race, the goal was to finish the race in the first 15 positions in the overall ranking and win the Rookie’s cup. As said before this objective has been reached thanks to the well done team working.

Figure 9 – *Racing prototype*

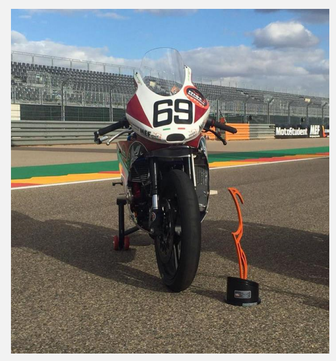

Figure 10 – *The victory*

Acknowledgements

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