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Design of a Manually Operated Detachable and Retractable Roof for Two-Wheeler Activa

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***Abstract* - Today rider needs more comfort while driving the vehicle because of the increase in the living standards. In the rainy season when someone needs to be at some other place and that too in the heavy traffic, it becomes hard to deal with such situation. In order to cope up with this situation the concept of a retractable roof for the two-wheeler is proposed.**

A retractable roof is basically provided to mount on a 2 wheeler Activa. The roof is made up of a flexible waterproof canopy which is supported by a tubular metal frame structure secured to the Activa.

Before actual manufacturing of the structure, CFD analysis needs to be done to decide the inclination of links and to analyses the structure of roof under drag.

The retractable roof is made up of links. Each link is made up of three pieces. The ends to be pivoted were pressed up to 15 cm, as all the five links should be pivoted together otherwise the ends would have created problems while folding and unfolding of the structure. Every link consists of three pieces was joined at two points in required angle.

Keywords– Grid Independence, Co-efficient of drag, Co-efficient of lift, Contours, Domain, Roof.

I. INTRODUCTION

More than 60% of the Indian population drives two-wheeler. Considering the parking and traffic problems it is the best solution. Riding a two wheeler in an open air is the most pleasurable part where as the car will offer the constrained and enclosed environment. However, the two-wheeler causes discomfort during rainstorms as the amount of discomfort that the two-wheeler causes out weights the benefits of riding in open air. In rain, the person could wear a raincoat but some part of the rider's body will always be left exposed. This shows the need for an overhead protection which introduced the moped with the retractable roof.

The roof is basically a flexible waterproof canopy that is removable which is supported by tube-frame secured to the vehicle. The Structure comprises a Base portion and the overhead portion which is pivoted to the base portion. Material having properties like transparency and flexibility is used to form the cover of the canopy. The proposed design consists of number of links of various dimensions and size. This roof can be fully retractable when not in use and thus will not be an obstacle considering aerodynamic aspects. Aerodynamic aspect is thus considered even when the roof is not in use and in folded position.

II. DESIGN CONFIGURATIONS

The links are of different size and heights. Thus, they form an aerodynamically stable and suitable design. The structure in folded position is much lower in height which does not create any hindrance in the path of air flow. When the arrangement is in use, the structure is aerodynamically stable.

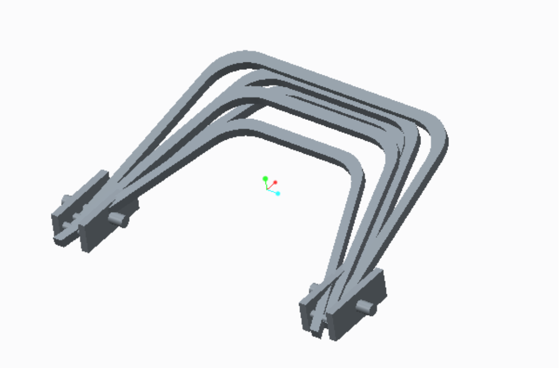

Figure 1: When the canopy frame is not in use.

The model is not prepared considering the actual dimensions and aerodynamics. It is only for getting the idea of how the design will look. Other aspects will be taken into account while actually designing the model and the necessary changes will be made in the design.

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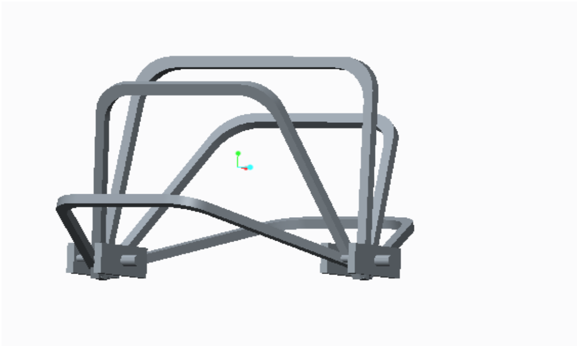

Figure 2: When the canopy frame is in use

III. CFD ANALYSIS

First, the geometry was imported and a domain was created, taking into considerations that the fluid parameters should not change the course of length. If the length of the roof structure is considered as ‘d’, then the distance of the domain from a structure on the outlet side is taken as 20 times d. The distance on all remaining seven sides is taken as 10 times d. This is done because it was identified from many experiments worldwide that the chances of variation in parameters on the side of outlet are greater

Boundary conditions:

1. Inlet – Velocity 20 m/s
2. Outlet – Atmospheric Pressure i.e. Gauge pressure = 0 Pa
3. Wall and Wall1 – No slip condition

$$\partial u/\partial x = 0 \ and \ \partial u/\partial y = 0$$

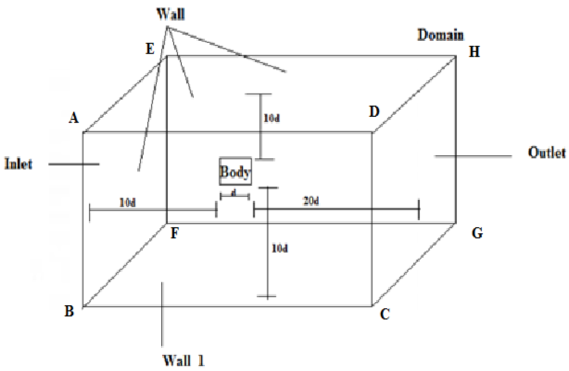

Figure 3: Representation of Domain

This condition is referred as a no-slip condition. Where the velocity at given point does not vary with respect to any direction. It is taken as constant thereafter.
Where,
ABCD, AEHD, EFGH –Walls, BCGF- Wall 1, ABFE- Inlet
DCGH- Outlet.
Grid Independence:

Grid independence is nothing but the study of finalization of mesh structure on the basis of results obtained by varying the mesh size.

For the grid independence study, also known as mesh independence, the graph between the varying mesh size is plotted against the parameters, specially identified for the study. These parameters are Co-efficient of drag (Cd), root mean square value of co-efficient of lift (C_{lrms}), Strouhal number (St).

We have plotted the graph of Cd versus mesh size. The mesh size was taken in terms of growth rate. As the growth rate increases, the mesh becomes coarser and coarser.
After giving all the inputs to the fluent module, the result was calculated computing 500 iterations. The solution was calculated for each growth rate varying from 1.1 to 2.0. It was observed that the results for Cd for various mesh sizes are as follows –

TABLE I: CO-EFFICIENT OF DRAG

Growth Rate	C_d
1.1	0.48
1.2	0.475
1.3	0.47
1.4	0.7
1.5	0.9
1.6	1.15
1.7	1.48
1.8	2.45
1.9	7.07
2.0	11

It was observed that the value of drag co-efficient didn’t vary much for growth rates 1.1, 1.2 and 1.3. Thus it was decided that 1.3 should be the mesh size for further calculations.

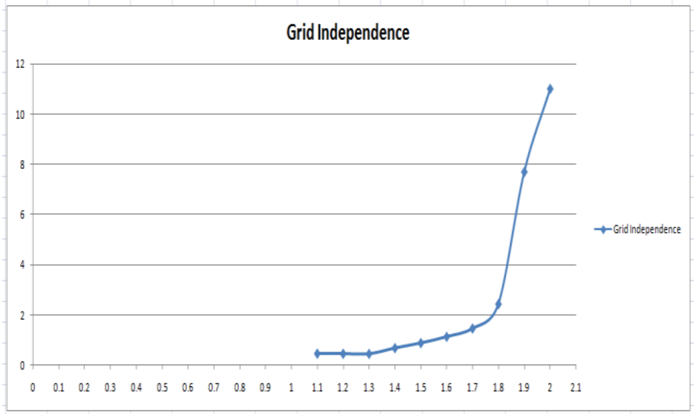

Figure 4: graph for grid independence

The major problem in deciding the front angle of a roof was solved using the contours obtained for different angles. The pressure contours were obtained for different angles varying from 43 to 48.
Considering the fact that the angle cannot be increased above 52 degrees because of the problem in vision, and from the contours obtained, it was decided that the front angle should be 46 degrees.

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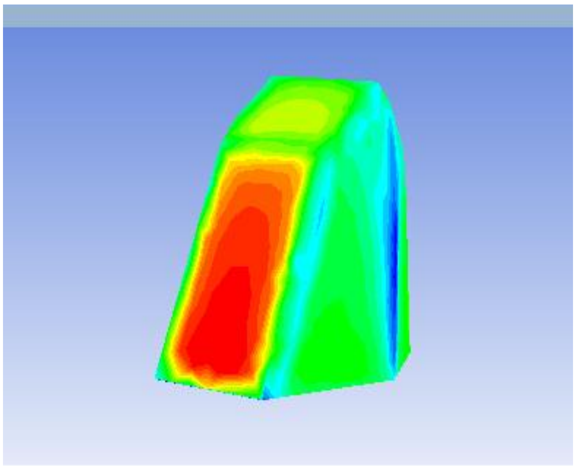

Figure 5: Roof A

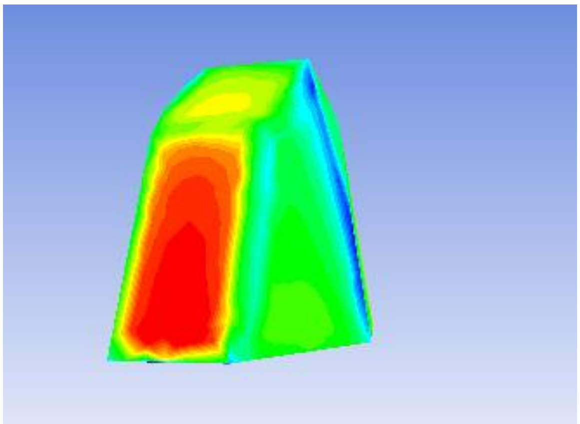

Figure 6: Roof B

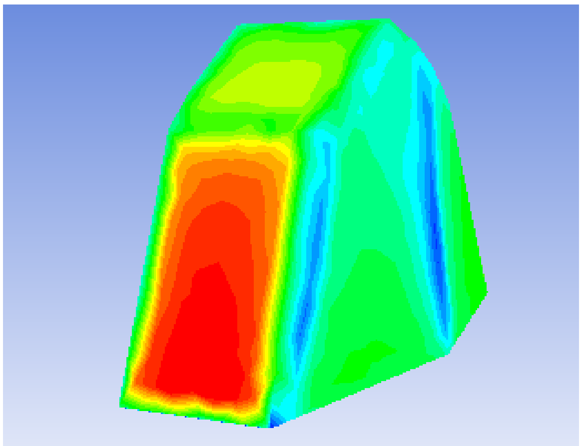

Figure 7: Roof C

IV. DESIGN OF THE CANOPY

From all the iterations Roof C is selected as it offers minimum air resistance and qualifies all the prerequisites for the mountings.

Actual dimensions of Activa:

Length	1814mm
Width	704mm
Height	1151mm
Wheelbase	1260mm
Ground clearance	155mm
Seat height	765mm

Considering the layout of the actual Activa the linkages are designed and assembled in the Creo 2.0

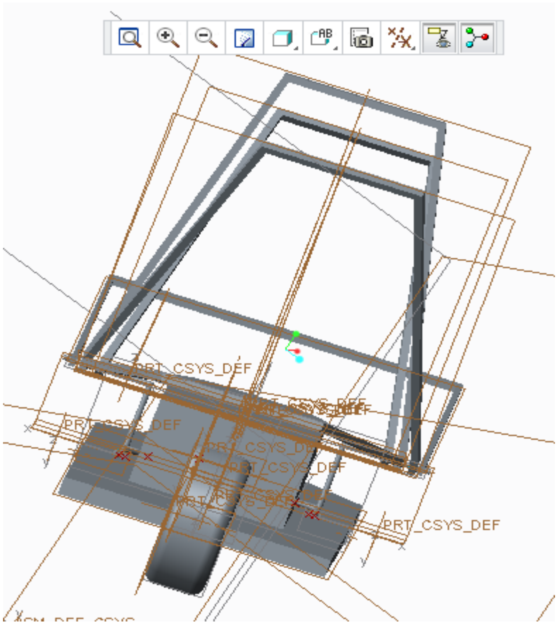

Figure 8: Front view of assembly

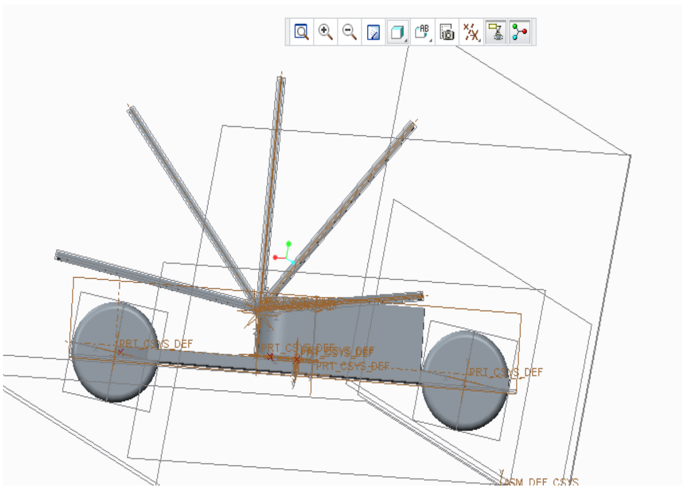

Figure 9: Side view of assembly

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V. CONCLUSION

After observing the fluent analysis results we got value for the meshing is 1.3 as the drag co-efficient gets stabilized. Also as the growth rate increase the mesh size becomes coarser and coarser. The linkages for the assembly can be made using the actual dimensions of an Activa considering all the aerodynamic and aesthetic aspects.

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