MODELING THE DACIA DUSTER 4x4 REAR AXLE

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ABSTRACT

The success of the brand Dacia is explained by the fact that vehicles produced in Romania, from Mioveni, offer an unbeatable price-quality-benefit-reliability ratio. Over 93% of the vehicle production in Mioveni is exported in 34 countries on four continents. With a production capacity of 350,000 units per year, the Dacia Vehicle Plant ensures both the production range of vehicles made up of Logan sedan, Logan MCV, Logan Van, Dacia Sandero and Dacia Duster, one of the most popular car brands, and manufacture of spare parts. This paper aims to make the presentation of the steps to be followed in order to achieve the 3D model of a Dacia Duster's items of its rear axle and assembling the components using the software Autodesk Inventor 2015 in order to be able to do the calculations necessary to optimise the suspension.

KEYWORDS: Autodesk Inventor, Assemblage, Dacia Duster, Rear Axle.

1. INTRODUCTION

The rear axle of a vehicle is meant to take over all the forces and torques which occur in the center of the rear wheels of the vehicle and to pass them on to the elastic elements of the suspension and the frame or the bodywork of the vehicle [1], Figure 1.

Fig. 1. *Rigid rear axle [1]*

Depending on the steering mechanism, rear axles can be rigid, on weighbridges, or on semi-rigids [2]. Each of these categories has, in turn, several types of axles for vehicles, which are named according to the type of the suspension [3]. The rigid axle is the first axle the vehicles were equipped with. This formed an assembly together with the suspensions of the leaf spring, which can be found very rarely nowadays. Rigid axles are also used only at certain commercial and off-road vehicles, where the impeccable ride is compromised in favour of durability on rough terrain [4]. Within an axle on weighbridges, the wheels have independent suspension, and the arms no longer spin inside the shaft, but freely, if it is about a live rear axle.

In comparison with the rigid axle, which is basically a single large and voluminous assembly [6], the axle on weighbridges is made up of several items, much smaller in size, Figure 2, [7-8].
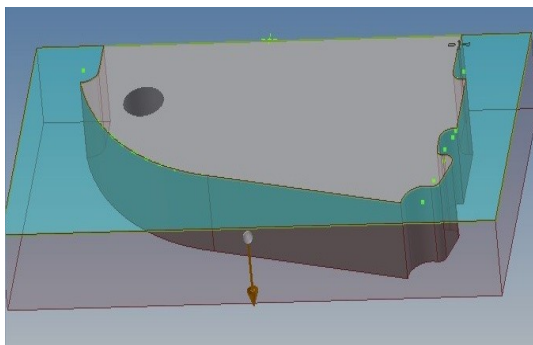

Fig. 2. *Independent rear axle [7]*

Semi-rigid axle is, in other words, a middle ground, because it is also composed of a single metal piece [9], exactly as the rigid axle, but has an increased mobility due to certain arms with big bushings that allow a vertical movement.

2. MODELLING THE ELEMENTS

For modelling the rear axle, component items were measured on the real model.

Fig. 3. *Implementation of the first floor*

Modelling the component items was done with Autodesk Inventor software in the Part module. For starters, we established the modelling of the front frame. To build up the front frame, we started with modelling the cylindrical shaft then moved on to modelling the floor which is welded at the front frame of the shaft. A plate was defined for this model, after which we designed the outlines of the floor, and by the control *Extrude*, the edge of the workpiece was cut, Figure 3. The two inner outlines were cut out, after which we used the *Thread* control in order to obtain a more realistic form.
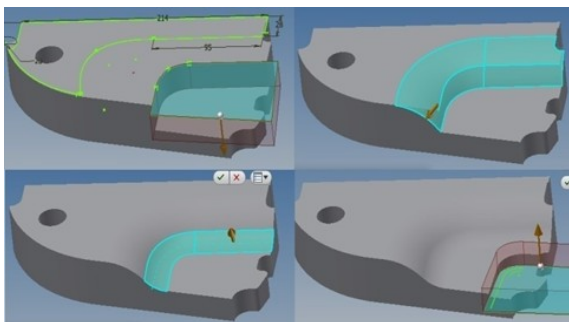

Fig. 4. *Design stages of the first floor*

When we reached the approximate form of the workpiece, we used the *control Shell*, in order to design the inner form and to keep the same thickness throughout the floor, resulting in the form shown in Figure 5.
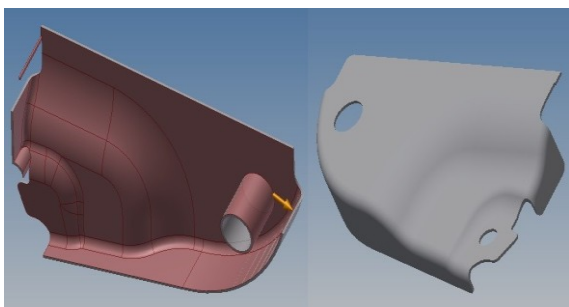
Fig. 5. *Using the control Shell*

For the second floor we used the similar method like we did in the case of the first floor, as shown in Figure 6.
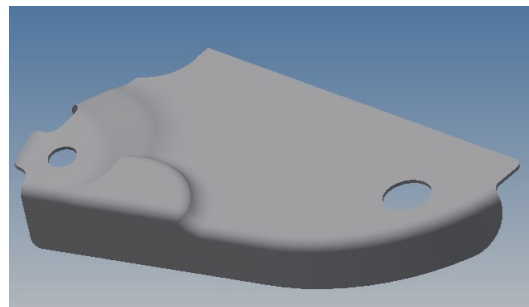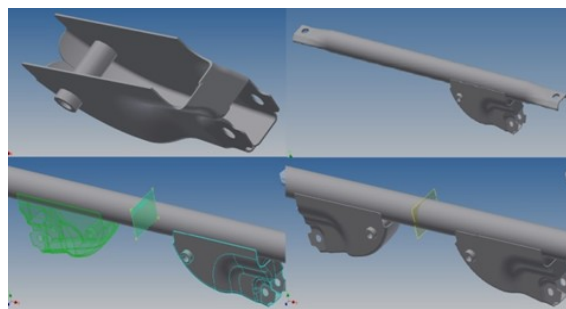

Fig. 6. *Designing the second floor*

Designing the first assembly

In order to design the first assembly, the two floors have been imported into the Assembly module; they were adjusted to the required size, after which we used the control *Like*, in order to add the upper shaft.
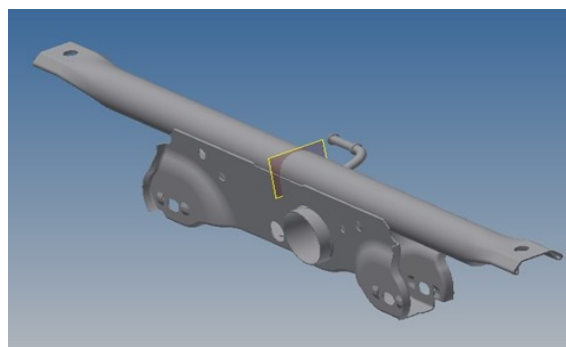
We used the control *Mirror*, in order to generate symmetrical floors.

Fig. 7. *Designing the floors with upper shaft*

Designing the second assembly

We modelled the rear floor as in the previous model, and then were assembled with the upper shaft.

**Fig. 8.** *Designing the rear floor assemblies with upper shaft*

Designing joint profiles between floors

For the joint profile we made a rectangular frame. From this we extracted a piece, in order to become a *U*-profile, then to make a sketch; we used the control *Loft* to design the end piece of the shaft. We used the same method for the other end piece,

designing another sketch, because the two end pieces are not symmetrical.

Using the control *Thread* we adjusted the workpiece to a more realistic form.

As soon as the workpiece was finished, we continued with the assembly, after which, with the help of adjustments, the workpiece was placed in a functional working position. Using the control *Mirror* we generated the other symmetrical workpiece.
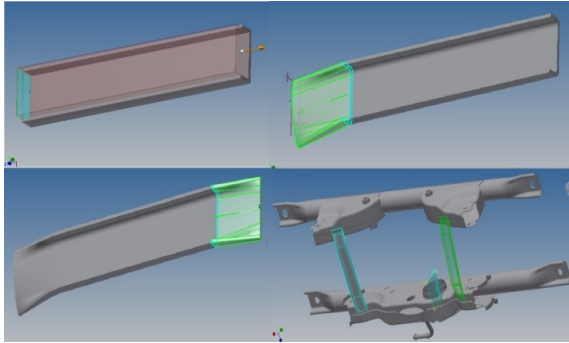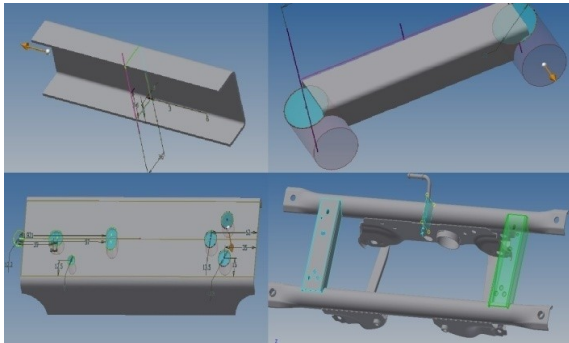

Fig. 9. *Designing joint profiles between floors*

Designing joint profiles between upper shafts

In order to design the profile we used the control *Extrude*: initially, we made the sketch of the profile and then we generated it.

The outlines of the upper pipes were modelled and we generated the fixing holes of the frame on the bodywork.

After designing the profile, we continued with the assembly, where this profile was placed, and by using the control *Mirror*, we generated the second symmetrical workpiece, as shown in Figure 10.


Fig. 10. *Designing joint profiles between upper shafts*
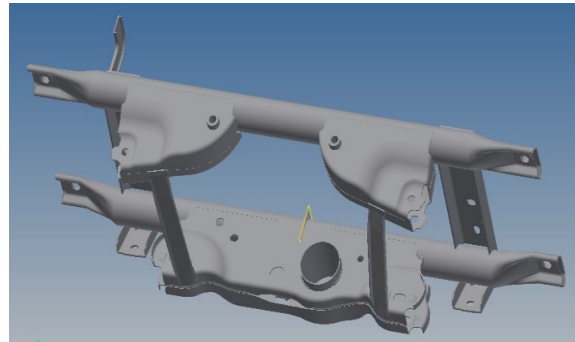
Designing the welding assembly

The whole assembly was turned into a welded assembly, and with the control *Chamfer* we generated an optimal model of the seam weld.

With the control *Welds* we generated seam welds between pieces, Figure 11.

We used the same method to generate the seam welds along the whole frame, Figure 12.
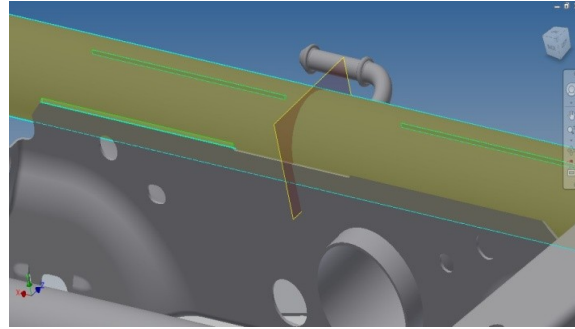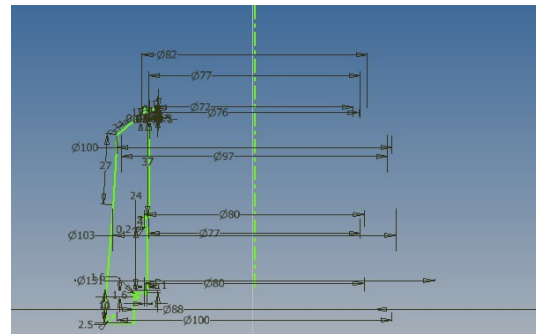

Fig. 11. *Designing the welded assembly*


Fig. 12. *Welded assembly of the frame*

Designing the steering knuckle and positioning it into the assembly

For this workpiece we generated the sketch for the body, in which the bearing is fixed. After defining the sketch we used the control *Revolve* and the body of the steering knuckle was generated.
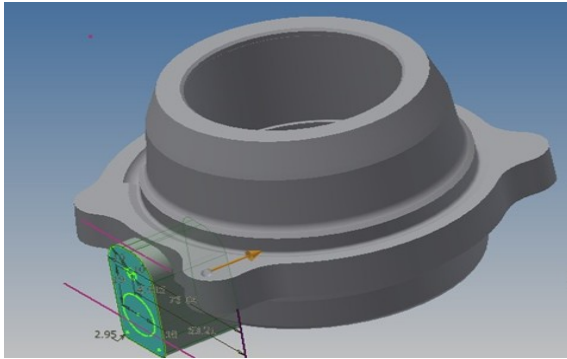

Fig. 13. *First sketch of the steering knuckle*

After generating the body, we modelled the frame in which the screws are inserted for the brake drum.
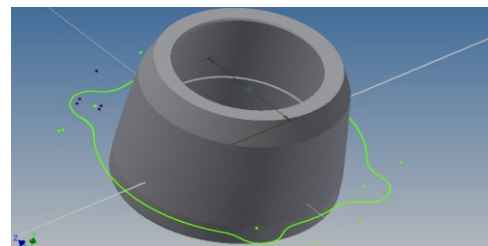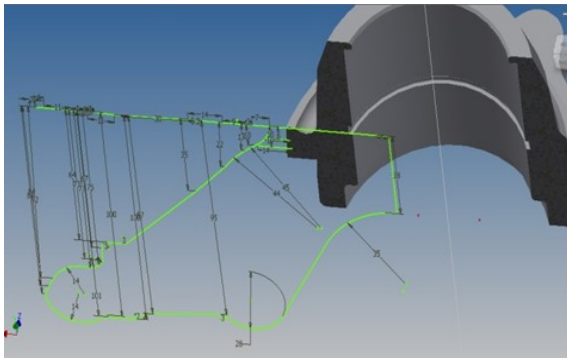

Fig. 14. *Sketch of the lower frame*

Using the control *Extrude* we generated the port in which the vehicle speed sensor (VSS) of the wheel was inserted.
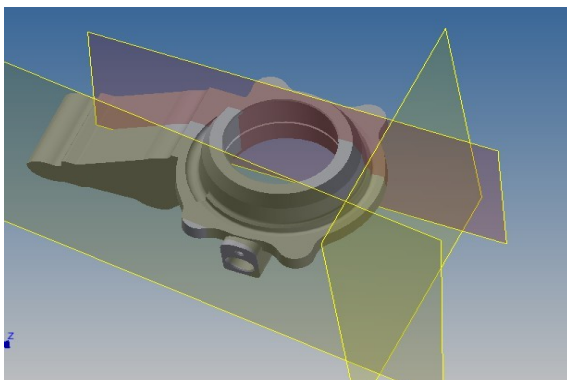

Fig. 15. *Port of the speed sensor*

Next we created the first plan of the arm, followed by the design of the sketch on this plan. We created the first plan of the arm, followed by the design of the sketch on this plan.
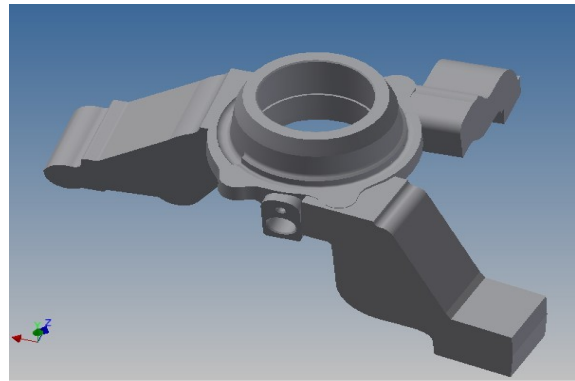

Fig. 16. *Sketch of the first shaft of the steering knuckle*

The sketch that we generated was extruded, and then the other two plans were created for the next arms.


Fig. 17. *Sketches of the other two arms of the steering knuckle*

After creating and extruding the sketches, we obtained the arms presented in Figure 18.
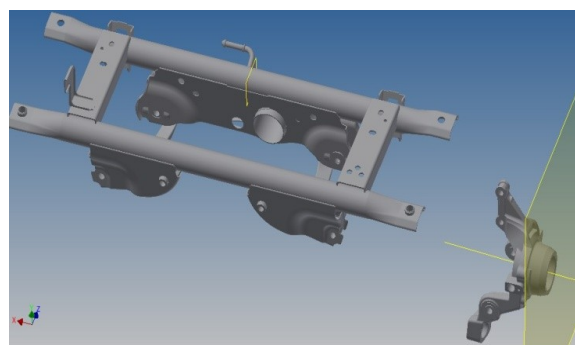

Fig. 18. *Arms of the steering knuckle*

By repeated controls we modelled each arm, individually, the controls being multiple. The most frequently used controls were: *Extrude*, *Chamfer*, *Fillet*, *Sweep* and *Delete face*, resulting from Figure 19.
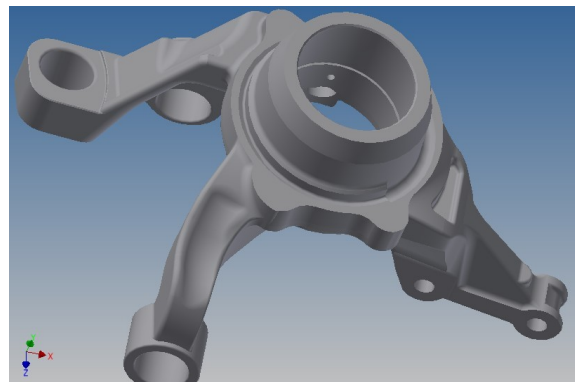
Fig. 19. *Final form of the steering knuckle*

The resulting workpiece was placed in the assembly, with the control *Axis*, an axis which was linearly and angularly positioned in relation to the front frame and the steering knuckle.


Fig. 20. *Positioning the steering knuckle*

After generating the axis and the plan, the steering knuckle was bound on the two items. Later, bushings were created inside the arms of the steering knuckle, using the control *Revolve*.

Creating lower arms that link the steering knuckle to the frame

Lower shaft is an element that connects the steering knuckle to the frame, and limits the movement of the steering knuckle only on a single axis. The end piece that connects to the steering knuckle was created. Initially, for this end piece, we created a sketch which was extruded, following that, on the resulted block, a sketch with the outline of the workpiece was designed, this being extruded by cutting. The margins were rounded using the control *Fillet*. The pocket inside the workpiece was created using the control *Shell*, the mounting holes will be made using the control *Extrude*.
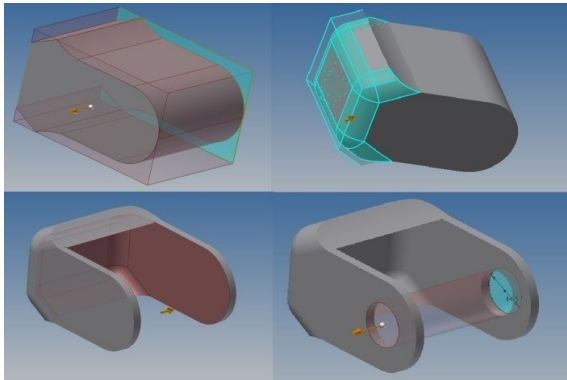

Fig. 21. *Junction end of the lower shaft*

The end that connects to the frame was created using the controls *Extrude* and *Chamfer*. The two items were placed in the assembly and positioned in those point.

We created an axis that intersects the center of the end piece that is connected to the workframe, at the end piece that connects to the steering knuckle.

Then we created a sketch on the end piece which connects to the steering knuckle.

Next, we generate the shaft between the end pieces, and using the control *Sweep*, we selected the sketch that defines the thickness of the shaft.
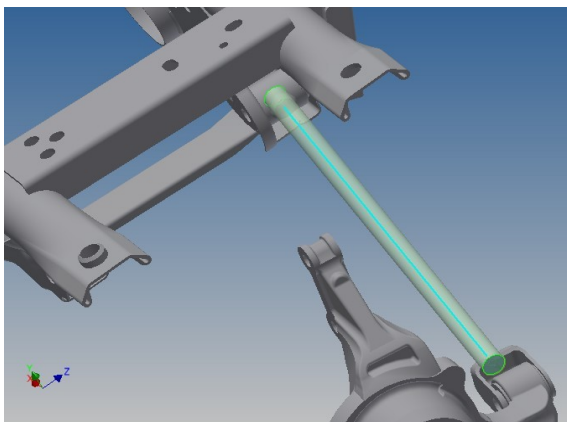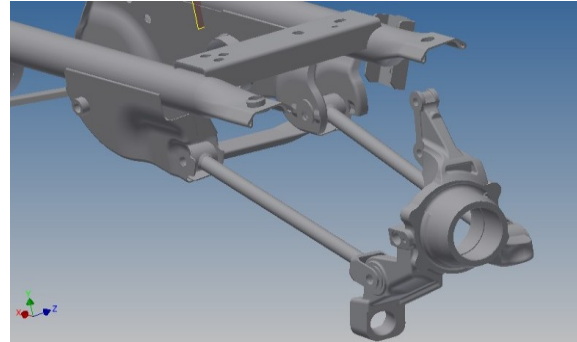

Fig. 22. *Lower shaft*

In order to create a common body, the three components thus created were imported into a new

assembly. After their assemblage, a welded assembly was created and the seam welds were generated.

For the other shaft, being unsymmetrical, placing the two elements in position was once again required. It was generated a new axis, by using the same method as with the first shaft, resulting in the assembly presented in Figure 23.

**Fig. 23.** *Assembly of the two lower shafts*

Creating the dumper spring

The damper spring is a device used for damping a shock, a noise or an oscillation phenomenon of a technical system. For this assembly, we starter by modelling the inner support using the control *Extrude*; profile and support for the wireframe of speed sensor was generated. Mounting holes for the supports of the steering knuckles and bevels were made using the same control.
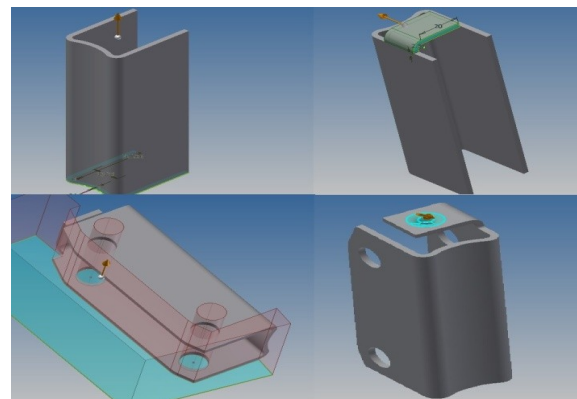

Fig. 24. *Inner connecting support with steering knuckle*

The next item to be modelled was the inner support; also, using the control *Extrude*, we designed the profile, the lower and the upper margin, after which the control *Fillet* was used in order to obtain a more realistic form. The other modelled components are presented in Figure 25 and Figure 26, in which controls such as *Extrude*, *Chamfer* and *Fillet* were used.
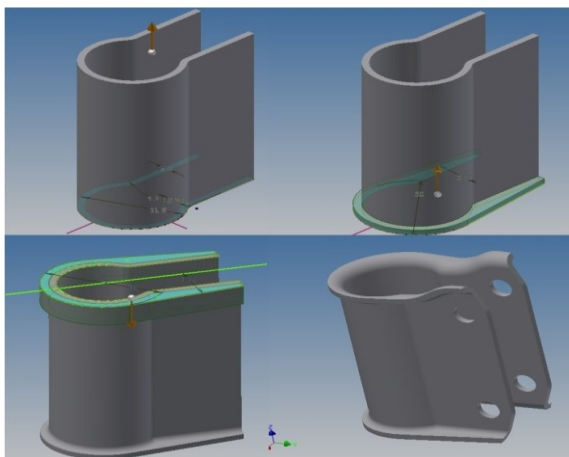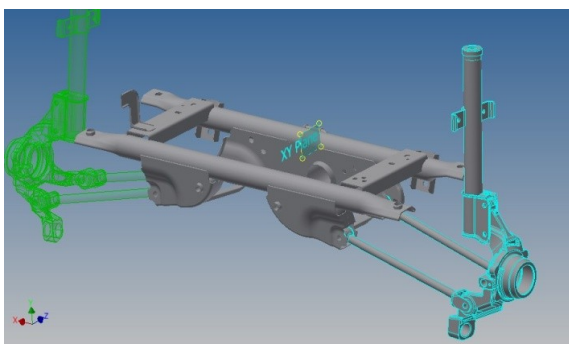
**Fig. 25.** *Outer mounting support for the steering knuckles*
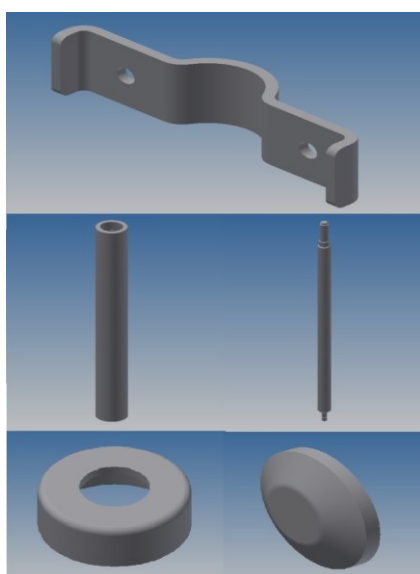
Fig. 26. *Components necessary to assembly the damper*

After designing the damper, it was assembled on the steering knuckle and using the control *Mirror*, symmetrical workpieces were generated, resulting in the assembly presented in Figure 27 and Figure 28.

Fig. 27. *Symmetrical form of the damper and the steering knuckle*
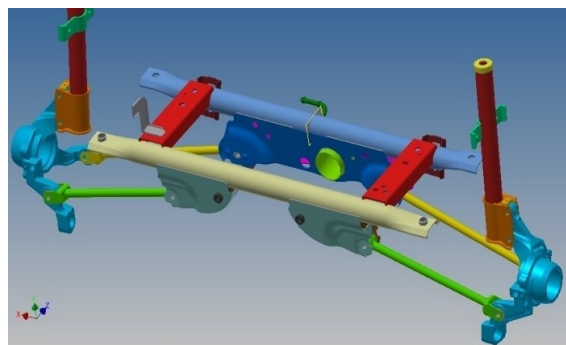
Fig. 28. *Final form or the rear axle of Duster 4x4*

3. CONCLUSIONS

The suspension system technical condition is very important for driver and passengers comfort, as so as for the reliability and maintainability of the others parts and subsystems included and dependent from suspension system.

This modelling was made in order to carry out tests on the 3D model and optimize the manufacturing process. For reasons of trade secrets, as a set of techniques, procedures and know-how elements based on which the car body components were designed, data containing numerical and dimensional values of the previously submitted landmarks could not be presented.

ACKNOWLEDGEMENTS

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