

THE GRAPHICAL REPRESENTATION IN CATIA V5 OF AN AUTOMOTIVE TRANSMISSION

Abstract: In the present paper is defined and presented the method of representation of an automotive transmission using CATIA V5 software, having as reference the Dacia Duster automobile. This paper contains the steps required for 3D modeling of transmission for a better understanding of functionality and the role fulfilled in the vehicle. Creating the virtual model for the car transmission allows us to emphasize the compatibility between elements and the subassemblies of the front and rear axle's structure.

Key words: transmission, CAD, Catia V5 software, Dacia Duster automobile, front axle, rear axle.

1. INTRODUCTION

In the present article is defined and illustrated, with the help of graphics, the method of representation of an automotive transmission using CATIA V5 software, having as reference the Dacia Duster automobile.

This paper contains the required steps for 3D modeling of an automotive transmission, for a better understanding of functionality and the role deserved in a car.

First of all the car is a vehicle with a well defined purpose, of carrying people and improving mobility.

Depending on the type and the role to be performed, the vehicle can be with 2x2 traction or 4x4 wheel drive, like the one presented in this paper.

2. THE PURPOSE OF THE PAPER

The paper presents how to make 3D model of car axles, building on existing measurements on a real vehicle, as shown in figure 1.

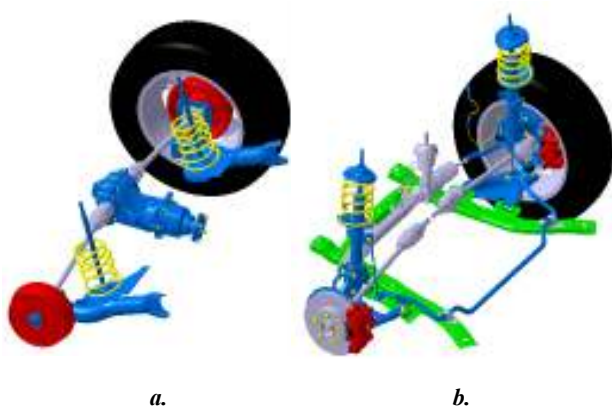


Fig. 1 Front axle(a); Rear axle (b)

3. THE MODELLING OF DACIA DUSTER AXLES

For the 3D representation in CATIA V5 of the front axle for vehicle Dacia Duster, measurements were performed on the car and were made a 3D model (wireframe) to facilitate the construction of the parts necessary for the later assembly in the Assembly module. After measurements it results the wireframe shown in

figure 2 that was made in Sketcher, Mechanical Design module. After making the sketch was followed by a 3D representation of the parts to be assembled and superimposed on the wireframe that we obtained previously.

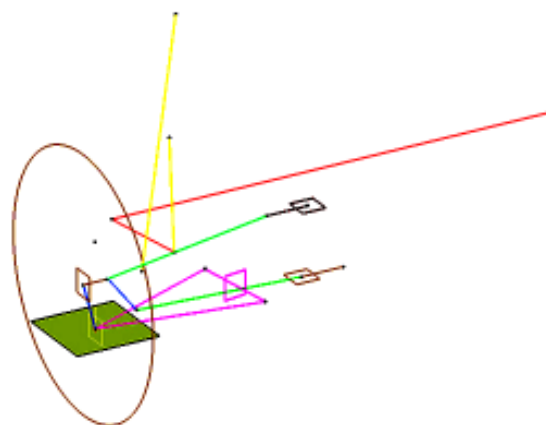


Fig. 2 Front axle sketch derived from measurements

The tire was represented in Sketch module, and after that we used Part Design specific operations for smoothing the model. By using command Shaft, with 360 degree rotation-profile sketch around the grid, it was obtained the 3D model of the tire, as shown in fig. 3. In the same way was proceeded to do the rims, bolts, spindle and other parts with geometric symmetry.

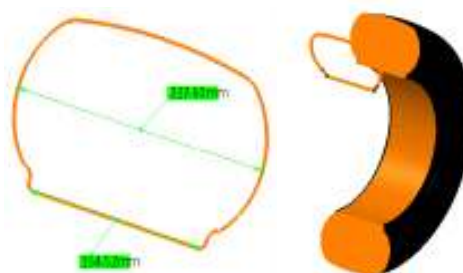


Fig. 3 Tire sketch and the final 3D model

From a technical standpoint, the front axle is presented in the vehicles with dependent suspension. Rigid front axle, also known as the front axle, consists of

a beam, the ends of which are mounted articulated by means of pivots, and the steering knuckles.

The ends of the beam, which is articulated by the steering knuckles are shaped in a rounded design. Fixing the spring suspension beam is realized in two points in the superior bracket, as shown in figure 4.

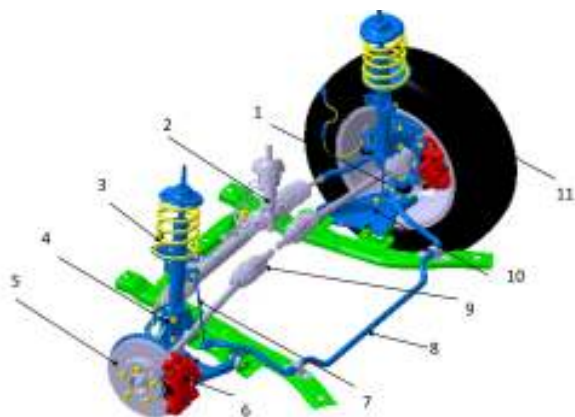


Fig. 4 Structural elements of the front axle:
1-pivot; 2-steering box; 3-spring suspension; 4-port knuckle;
5-brake disc; 6-skid; 7-directional power link;
8-torsion bar; 9-planetary; 10-arms; 11-tire

To achieve damping spring was made a sketch in Sketcher, it was defined a line which represented the maximum height of the spring, and also was drawn one point for defining spring's maximum diameter.

After the sketch was performed, Generative Shape Design was used in Shape module using Helix command, in the Insert window was created a wireframe model of the spring as shown in the figure 5.

To perform the 3D model was drawn a sketch containing a circle with a diameter of the spring. By using the Sweep command was resulted the final model of the 3D damping spring.

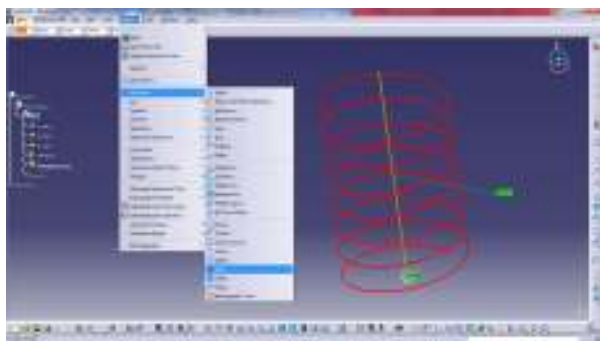


Fig. 5 Damping spring

For representing the other 3D parts of the front axle were constructed various sketches in Part Design and Assembly Design, in compliance with the measurements realised on a Dacia Duster vehicle.

It shows how the brake disc was performed, and other elements of the car deck. In the module Mechanical Design - Sketcher was created the contour of disk, then using the command Shaft was obtained the brake disc profile by rotation of 360 degrees around the axis of revolution, as shown in figure 6.

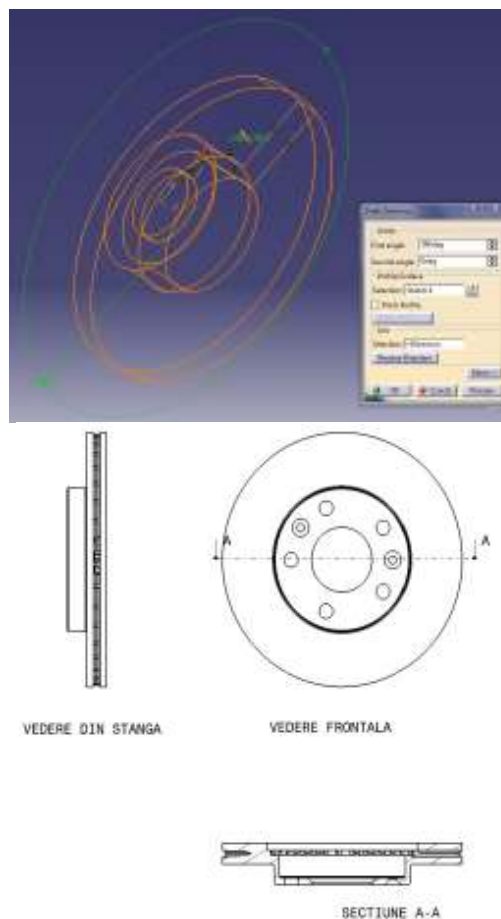


Fig. 6 Brake disc

To shape the sleeve, on which it will assemble the arm, having the functional role of damping vibration and shock, it opens a new Part Design to create a sketch in one of the planes of the system. In this plan was drawn the sleeve outline using the command Profiles, with establishment and sizing of piece, as shown in figure 7.

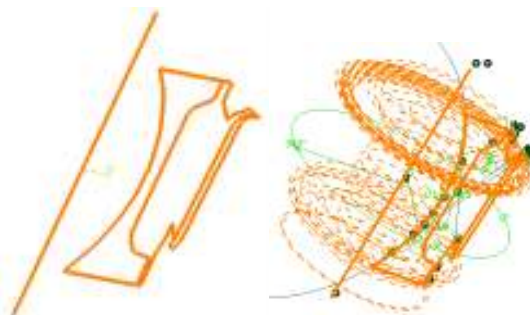


Fig. 7 Rubber sleeve - draft

Using the command Exit Workbench followed by the command Shaft, the angle of rotation must be stated and then selected contour that will be rotated. Finally, based on the initial drawing, after a rotation of 360 degrees, was obtained the 3D model of the final rubber sleeve as shown in figure 8.



Fig. 8 Rubber sleeve - 3D model

Another extremely important element in the structure of the steering system is the supporting frame, which is designed to support the swing arms and the pad at the bottom of the motor and the steering gear assembly.

The first step for achieving the landmark consists in drawing a sketch in Sketcher, and then drawing the profile of frame, which is extruded after initial sketch, as shown in figure 9. The end result is a beam 3D, on which will assemble necklaces to support the torsion bar. Using Pocket command was made holes to be fixed later on other parts. For finishing of frame, Fillet command was used to chamfer the edges.

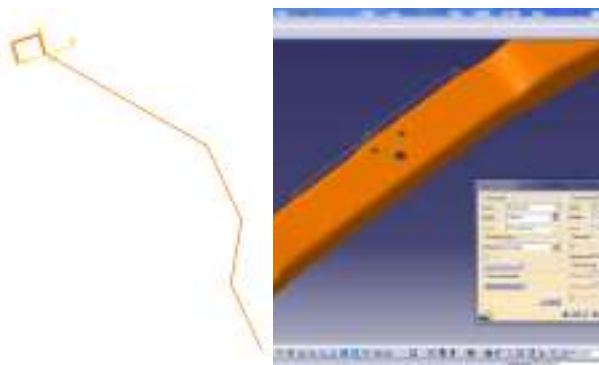


Fig. 9 Profile of supporting frame

After drawing the beam which is a fragment of supporting frame was passed to achieve clamping plate for fixing brackets arms. The support was developed based on a sketch that defines the contour. After creating the sketch was used for profile extrusion Pad command, as shown in figure 10.



Fig. 10 Clamping plate

In the same way were made other parts of frame and at the end of their execution was given the command to use Snap branch Cumulative DMU Navigator for easy assembly. In order to obtain a symmetrical pattern of frame, respecting dimensions of real piece of the car, it defines all component elements, so that the assembled frame is illustrated in figure 11.

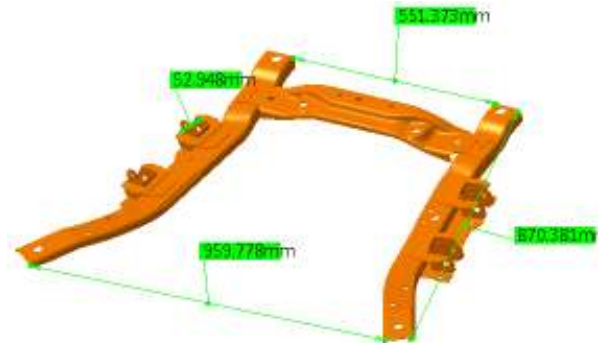


Fig. 11 Assembled frame

Torsion bar construction is based on a sketch made in Part Design, which is a wire profile. It was represented in the XZ plane with a circle that was extruded in the outline of the bar profile, by using the command Sweep, as shown in figure 12.

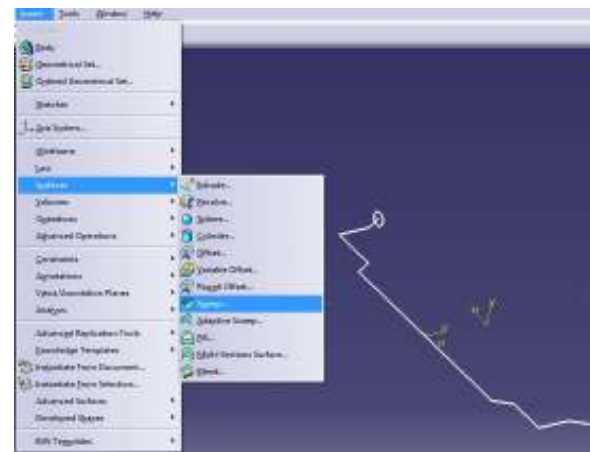


Fig. 12 Torsion bar – wire sketch

After obtaining profile of the bar, to insert a new body, were built two prisms used to trim the ends of the bar and achieve its mounting area of auxiliary connecting rod, as illustrated in figure 13.

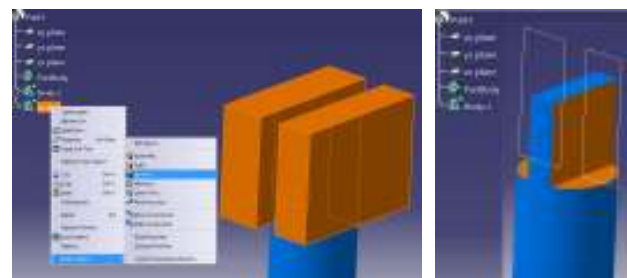


Fig. 13 The required steps for the realization of the 3D model of the torsion bar

To finish the piece, final operations have been applied for rounding ends of the bar and to achieve the mounting holes. Chamfer command is used for chamfering the inside of the bore, resulting in the torsion bar shown in figure 14.



Fig. 14 Torsion bar – finished 3D model

One of the most important components in the steering system is the pivot knuckle [1]. Steering knuckle pivot bearing is of critical importance to the friction of the steering, estimating that 50% of the losses are due to friction in this camp, 35% by friction in the steering and 15% by friction in the ball receways [2]. In operation, in the pivot-knuckle-wheel assembly occur increased friction caused by dirt from entering the bearings that cause bearing wear, wear of pivots and of pivot bushing.

The pivot is a component of the steering that makes the steering knuckle and the junction between the weighbridges and consists of four main parts: mounting bracket, pivot spindle, stiffeners, rubber bellows.

The modeling is based on the consideration that the pivot is constituted by several components, each of which is made individually, respecting the exact dimensions of real workpiece.

The construction was carried out in the pivot shaft Part Design, by drawing an outline of the shapes, so that after using the command Shaft is obtained a 3D model of it, figure 15.



Fig. 15 Knuckle rod

Rubber bellows serves to protect against the ingress of foreign bodies and corrosive agents inside pivot and it is used to retain grease inside the joint. From the functional point of view must be taken of the fact that non technical principles of a pivot assembly and dismantling, can lead to a number of disadvantages aimed, ultimately, even driving safety of the vehicle and the driver.

Bellows was modeled in Part Design by drawing a preliminary draft, which was then processed using Shaft command to obtain the 3D model, figure 16.



Fig. 16 Rubber sleeve - section view

Stiffeners of the pivot are made of hard plastic or brass and allow the pivot shaft a tight contact with the bracket and stiffening of joints by rubber bellows cupping.

These elements have been made in Part Design and consist of a sketch by drawing a circle in the XY plane, subsequently, by attaching a circular-shaped profile and the use of the control shaft ZX plane gives the 3D model of the stiffeners, illustrated in figure 17.



Fig. 17 O-rings sealant

Pivot body is the element that contain all component parts and is rigidly fixed on weighing lever.

To obtain the fixing plate on weighing lever was drawing a sketch in *Part Design* module, then the obtained profile in the XY plane was extruded with *Pad* command, figure 18.

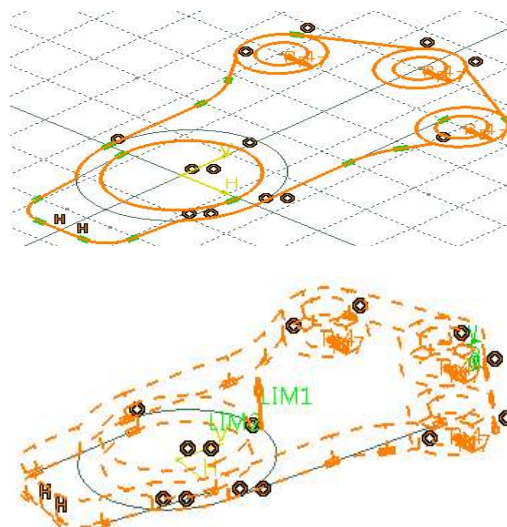


Fig. 18 Fixing plate pivot

The existing design also drew to another in order to create the ZX plane that will seat on shoulder of pivot spindle, following the analogous steps for the fixing plate, figure 19.

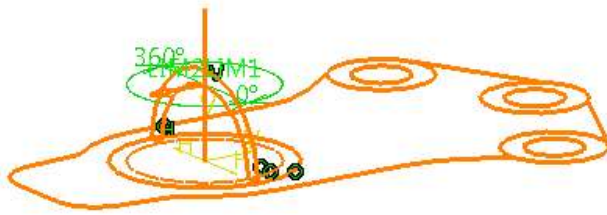


Fig. 19 Fixing plate with shoulder

For finishing, in figure 20 is presented the Generative Shape Design module where, using the Fill command, the surfaces were created to connect various elements of the pivot knuckle plate. The Snap Cumulative commands were used to assembly all the components of the knuckle pivot system.



Fig. 20 Pivot bearing

For modeling of the screws was used the Sketcher in Part Design module, for which a particular command (Shaft) was used to obtain the final 3D model.

For drawing of the hexagonal head shape, in the first step was inserted a new body in which was drawn a Sketch and extruded with the Pad command, in the final operations the initial body was removed from the main body resulting the finished 3D model as shown in the below image, figure 21.

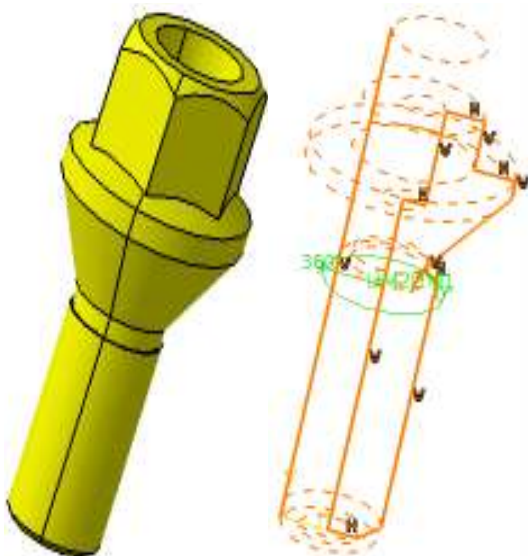


Fig. 21 The 3D model of a screw

To check the quality execution of the parameterized parts, the 3D models were assembled using the Cumulative Snap command from the Digital Mockup-DMU module and then superimposed the parts on the wireframe model, as shown in Figure 22.



Fig. 22 Assembling with Cumulative Snap function

The sketch that resulted from the precise measurements on the rear axle of the Dacia Duster vehicle is shown in the figure 23.

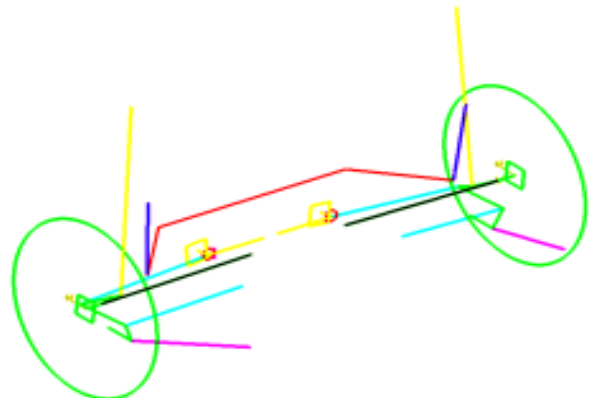


Fig. 23 Rear axle wireframe sketch after measurements

Having established that the components were executed correctly, proceed to achieve longitudinal transmission and rear axle of the car, using techniques analogous to those described above, figure 24.

Components of rear axle were made and positioned using Cumulative Snap command, the end result is a set of benchmarks to illustrate the operation of transmission and contributes to a better understanding of the operation of the braking and steering. Basically, must meet the following requirements: to be resilient wheels to provide good stability, ensuring correct cinematic direction at the vehicle oscillations, to have their own weight as low as possible to reduce the car's unsprung weight etc. [3].

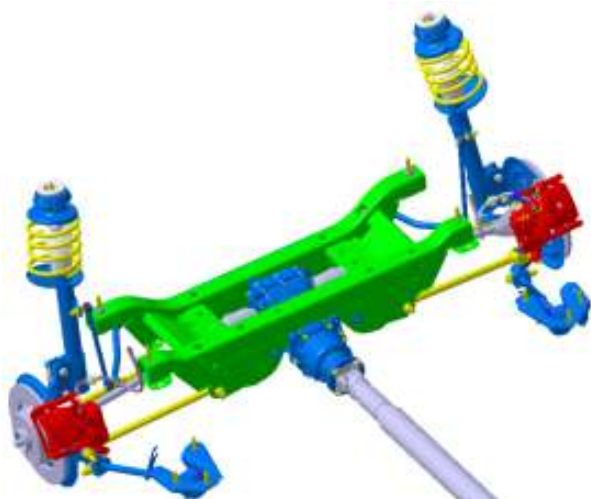


Fig. 24 Rear axle

After completing the drawing of the demanded parts shown in Figure 24, they were assembled using the commands in the Assembly Design module and to verify the quality of the parameterized parts they were superimposed on the wireframe of figure 23, resulting in the assembly shown in figure 25.

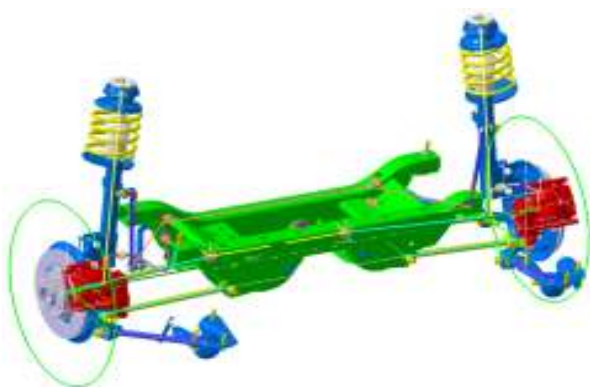


Fig. 25 The rear axle assembly superimposed on the main wireframe sketch

Due to the high complexity degree, the graphical representation of the front and rear axles, and the longitudinal transmission, it is summarized, and the final form of the assembly can be viewed in figure 26.



Fig. 26 Front and rear axles along with the longitudinal transmission

4. CONCLUSIONS

The technical condition of the steering system is of great importance for road safety. It contributes decisively to ensure the performance of the car's handling, maneuverability and the stability which it also influenced by the intensity of the tires wear [5].

About 17-18% of traffic accidents caused by technical problems, as a result of blocking the steering wheel, loosening joints steering levers, etc., it's required to check everytime the technical status of the steering system [4], [9].

Diagnostic parameters are: the free displacement of the steering wheel (angular spacing), the driving force of the steering wheel in existence gaming steering joints of the arms and bridges [6].

The correct modeling of this system implies a proper construction of all components, so that they can fulfill their duty: to stabilize rectilinear motion to reduce the effort required for maneuvering the steering wheel, not to transmit shocks due to irregularities in the way of running, to show no excessive wear which can lead to big games and, therefore, to decrease safety management, have a simple construction and prove durability over a long period of time etc.

5. REFERENCES

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