TRUNK WITH FOLDING CROSSBARS, PATENT OSIM – RO NR. 130559/2019 PROPOSED FOR INSTALLATION ON THE DACIA – DUSTER CAR

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Rezumat. Lucrarea prezintă o manieră de implementare a unui brevet românesc existent (Brevetul OSIM - Ro nr. 130559/2019), care se referă la un portbagaj auto cu bare transversale rabatabile, pentru adaptarea lui la autoturismul Dacia-DUSTER, ca portbagaj SMART. Elementul de noutate constă în faptul că portbagajul este astfel conceput încât el se poate plia/ascunde în interiorul barelor longitudinale existente atunci când nu este utilizat (conducând la economii de combustibil) și respectiv, se poate extinde prin rabatere pentru a fi pus în poziție de lucru, atunci când el devine activ. În plus, portbagajul are posibilități de reglaj functie de tipurile / dimensiunile bagajelor transportate si este integrat mai armonios formei caroseriei autoturismului, comparativ cu portbagajele universale existente.

Abstract. The work presents a manner of implementation of an existing Romanian patent (OSIM - Ro Patent no. 130559/2019 which refers to a car trunk with folding crossbars), for its adaptation to the Dacia-DUSTER car, as a SMART trunk. The novelty element is that the trunk is designed in such a way that it can fold / hide inside the longitudinal bars when it is not used (leading to fuel savings), and respectively, it can be extended by folding to be put in a working position, when it becomes active. In addition, the trunk has possibilities of adjustment depending on the types / dimensions of the luggage transported and is integrated more harmoniously with the shape of the car's body, compared to the existing universal

Keywords: smart trunks, folding crossbars.

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1. Introduction

The article presents an extract – adapted – from a Romanian patent of some of the authors of the article, a patent that refers to a new model of trunk – a SMART trunk

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– in a variant that the authors propose in order to be adapted / implemented on the Dacia-Duster car.
Car trunks with crossbars to which the crossbars are fixed are known. There are also known car trunks with removable crossbars where the crossbars are attached to the longitudinal bars is made by screws and other classic fastening elements, as well as other variants / combinations between them.
The disadvantage of the classic car trunks with crossbars, in the known version, lies in the fact that most of the time the crossbars are not necessary and, in order to reduce the fuel consumption and the noise given by the air flow at speed, they are disassembled and worn in the vehicle, or stored waiting for the moment when they will be needed (situation when they are mounted on the car).

Regarding the current situation: Stapleton et al [1] provides an article carrier assembly wich includes a pair of longitudinally laterally spaced siderails, each attachable to a vehicle roof panel, including a track and outboard corner portion ; a pair of stanchions are attached to the tracks for slidable movement through a plurality of positions.
Kmita et al [2] provides a vehicle article carrier having a pair of cross bars that can be positioned in a stowed position resting on or adjacent to a corresponding pair of side rails, or moved into an operative position with the cross bars extending perpendicularly between the side rails.
Polewarczyk et al [3] are proposing a roof rack assembly that includes first and second roof rails spaced from one another, each roof rail having a respective deployable roof rack bow and a respective drive mechanism operatively connected to the roof rack bow that causes the roof rack bow to extend in length by a predetermined amount when pivoted from a stowed position to a deployed position and viceversa.
Stahl et al [4] provides a solution concerning a roof rack assembly assembly with a first and second elongated roof rail substantially parallel and spaced from one another. An elongated cross member is secured to the first roof rail and configured to be selectively securable to the second roof rail. The cross member is pivotable between a stowed position and a use position (deployed position).
This article presents a new version of the trunk – SMART – with a structural optimization of the devices in question, optimization that was recognized as a new, original and patentable solution, and which was finalized by granting a Patent (OSIM Patent - Ro no. 130559/2019, authors L Rece and R Turcanu). The patent was published (in summary) in the Official Bulletin of Industrial Property of Romania (BOPI), no.3/2019 in the Patents section (figure 1) - https://osim.ro/wp-content/uploads/Publicatii-OSIM/BOPI-DM/2019/dm_3_19.pdf

Fig.1 – Patent 130559/2019

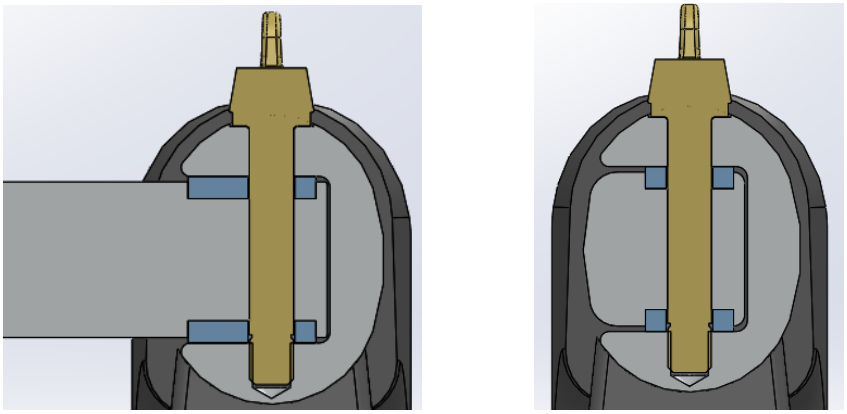
2. Constructive solutions proposed

2.1 Folding crossbars

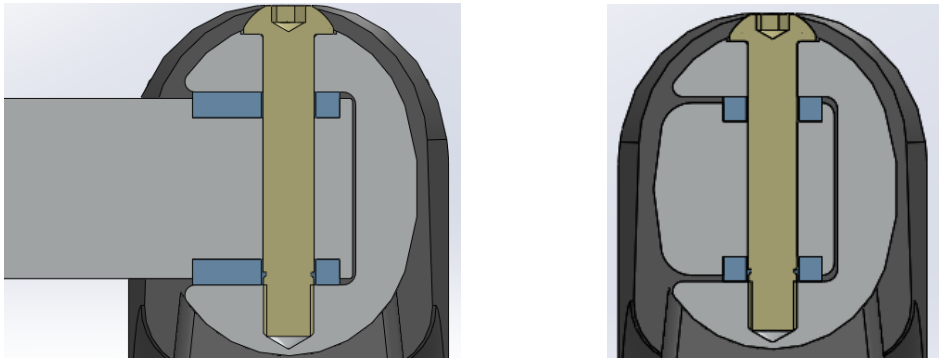
The car luggage compartment with folding crossbars according to the invention [5] removes the disadvantages mentioned above, in that it is made of two longitudinal bars fitted with a trench /recess (or resulting from the plastic deformation in question) in which the crossbars are located, articulated to the longitudinal bars by means of a spindle, at the upper end of which there is an ornament, and in the area of fixing the crossbars, they are provided with a hole in which a screw can enter that is threaded into a thread in the longitudinal bar, under the head of the screw a gasket is arranged (figure 2) .

The distance between the axes of the inlets at the crossbars coincides with the distance between the longitudinal bars if the positioning of the channels is symmetrical to the transverse plane of the respective trunk between the axis on one longitudinal bar and the axis of the hole on the other longitudinal bar. But the same distance between the crossbars, you can choose higher or smaller, if the joints in section A-A are positioned asymmetrically. For ease of mounting, the hole has at the top a conical centering evasion of the screw. The distance between the crossbars can

be chosen by the manufacturer by their asymmetrical positioning, as it results from the figures of the different constructive variants.



a. L1 bar. Sections in one of the three attachment points of the free end of the T1 bar with butterfly head screw for mounting/ folding positions



b. L1 bar. Sections in one of the three attachment points of the free end of the T1 bar with screw with semirotund head and hehagonal locas for mounting / folding positions

Fig. 2. Sections in one of the three attachment points of the free end of the T1 bar

2.2 Working subvariants

The expression/description (fluency) of the components/variants analyzed or proposed, respects the style of the descriptions (fluent) agreed by OSIM.
The above mentioned is a first variant analyzed. In another constructive realization, the distance between the crossbars can be increased, in which case another hole and a thread are made in the longitudinal bars, different from the one used when the crossbars are folded inside the longitudinal bars.

The crossbars press through elastic elements arranged in the trench/recess, on the longitudinal bars, avoiding games. This elastic element also helps to remove the crossbars from the respective ditch/recess. The shape of the longitudinal bars in lateral view can be straight or curved, in which case the crossbars have the same shape. In the latter case the ends of the crossbars will be made with play.

In another constructive realization, the transversal bars are provided at the ends with a clamping thread. The longitudinal bars may also have reinforcements inside a sliding body with a height lower than the inside of the longitudinal bars, so as to allow the passage of reinforcements.

This leads to a gap of the axes, the fixing of the sliding bodies being usually made with some screws, (at the sliding bodies being arranged a threaded axis having the end drowned, on the threaded axis being arranged a bushing to which a threaded spigot is attached).

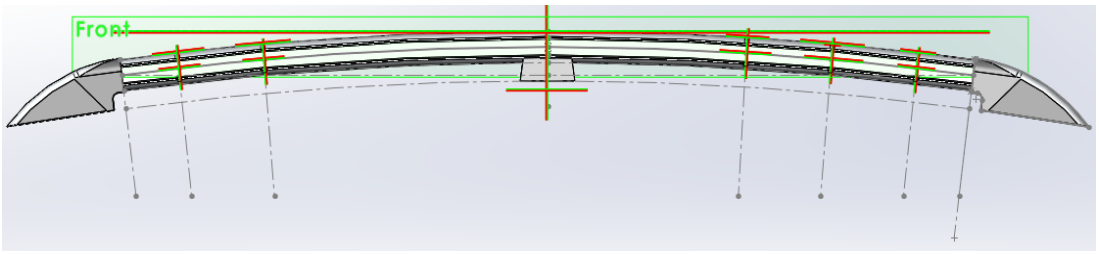
It can enter the threaded bush that is usually fixed to the crossbars. At the other end of the crossbars is a screw cylinder fitted with the safety nut, the screw cylinder threading into the threaded body, usually fixed to another symmetrical sliding body. For the centering of the screw cylinder in the threaded body, a bevel is provided (figure 3).

The crossbars are fixed along the longitudinal bars in the sliding fixtures provided with an elastic plate and elastic elements, which fix the crossbars, the fixing of the sliding fixtures to the longitudinal bars being usually done with a screw.

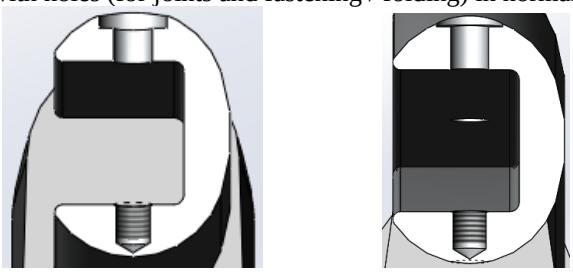
The shape of the longitudinal bars in the section can have different contours: circular, rectangular, elliptical or polygonal, etc.

The advantages of the invention consist in avoiding the separate transportation of independent trunks, or of disassembled crossbars and to be mounted only when needed by different processes, usually by screws, to the longitudinal bars.

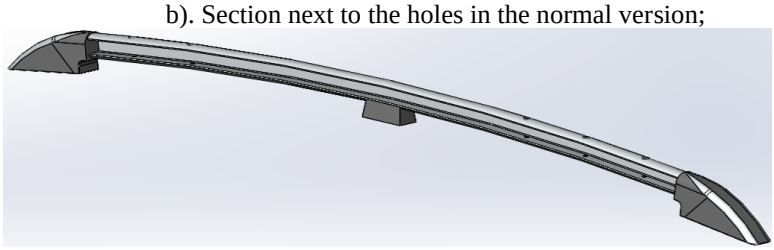
Within the patent, several constructive variants were covered so that the producing company can choose the optimal option and depending on the reaction from the public, its requirements and preferences. One of the variants even allows the adjustment (in steps or continuously) of the distance between the folding crossbars (figure 4)



a) Sketch of the longitudinal and flat bar used in the construction of the 3D model in the version with holes (for joints and fastening / folding) in normal position (radial);

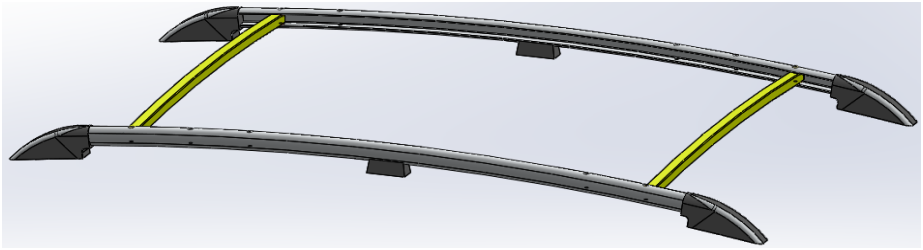


b). Section next to the holes in the normal version;

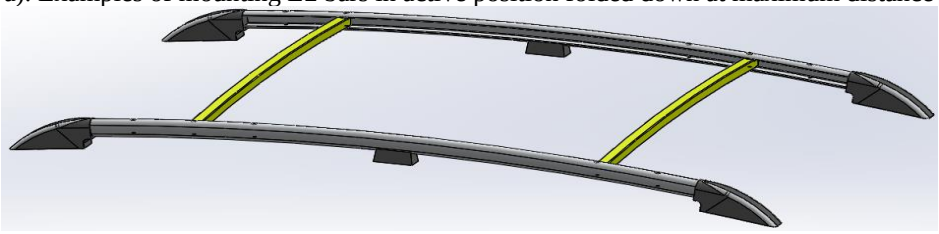


c). L2 curve bar

Fig.3 (a,b,c) L2 bar with different sections



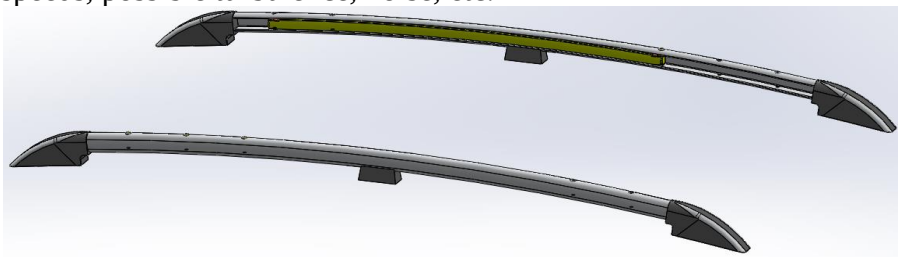
a). Examples of mounting L2 bars in active position folded down at maximum distance



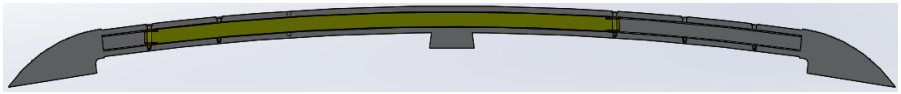
b). Examples of mounting L2 bars in active position folded down at minimum distance

Fig.4 (a,b) Trunk with longitudinal and transverse curved bars L2-T2, examples of mounting L2 bars in active position folded down to the maximum distance (a) / minimum (b)

Figure 5 represents the longitudinal bars (existing on almost all Dacia-Duster cars) in the position with the crossbars folded / hidden in the contour of the longitudinal bars. This variant is considered as the optimal option; We consider this in the hypothesis that the bars can be folded also by lateral joining (without inclusion in the contour), but this would lead to some deficiencies from an aesthetic point of view, of air flow at high speeds, possible turbulence, noise, etc.



a. Longitudinal and transverse bars curved L3-T3 in folded state when mounting extreme position



b. Section through the L3 bar in the mounting position in the folded state of the extreme poz

Fig.5. (a,b) Trunk with longitudinal and transverse curved bars L3-T3 in folded state at mounting

In the studies occasioned by the patenting activity, but also in the subsequent ones, several variants of fastening / articulation were analyzed to take into account the specific operating conditions, not to lead to air rollers at high speeds, not to vibrate, not to make noise, to allow a folding and respectively a light folding, etc. In figure 6 are presented some of the constructive solutions analyzed and proposed for implementation (depending also on the manufacturer's and customer's preferences).

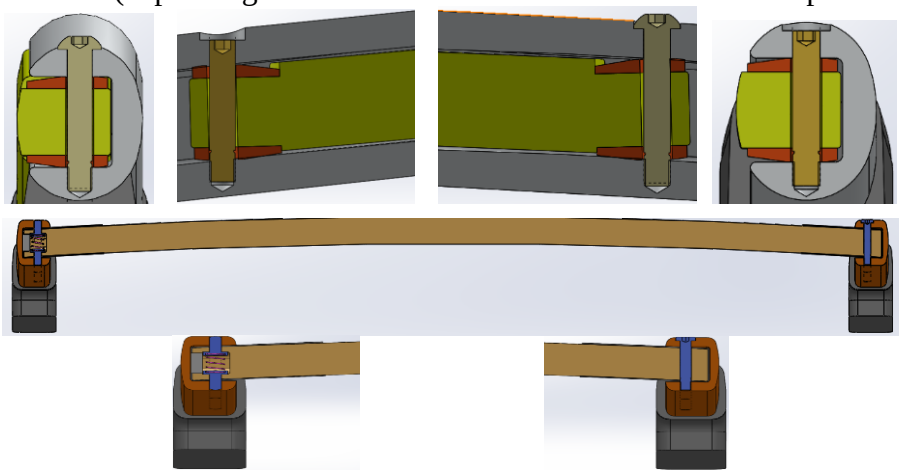


Fig.6 Details of longitudinal and transverse sections in the L3 bar in the rows with holes (for joints and fastening/folding) and various types of joints inclusive rapide joints

For the same reasons, figure 7 shows the geometrical places described by the folding crossbars, when moving them from the folded post to the extended position. It is true that they intersect, but the design and the fits are chosen so that the bars can "spend" on top of each other, so that they can be brought to the fastening position (whether it is the folded one or the folded one).

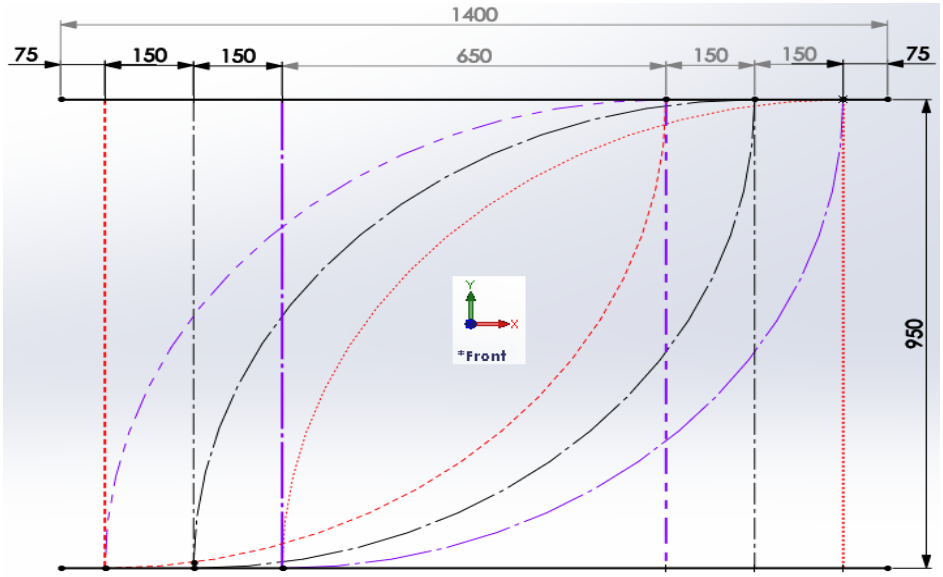
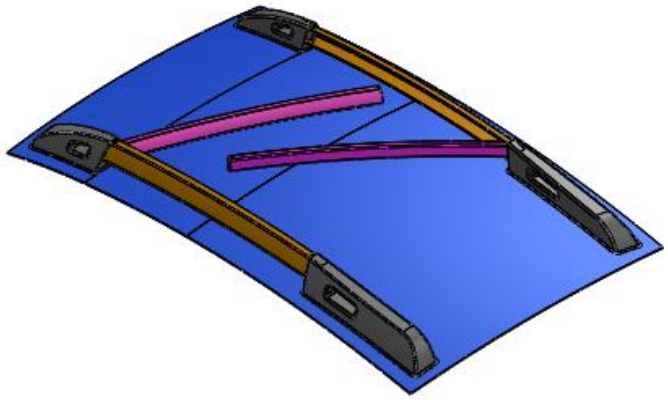


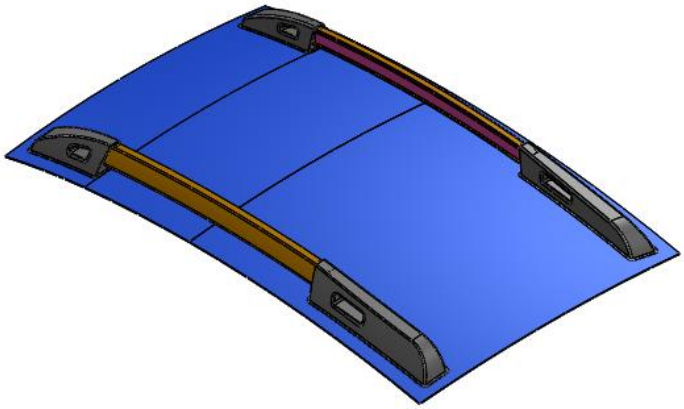
Fig. 7. The geometrical places described by the ends of the folding crossbars, when moving them from the folded poz to the extended position

As a case study (the object of this article) is analyzed the variant of mounting this SMART trunk on the Dacia Duster car.

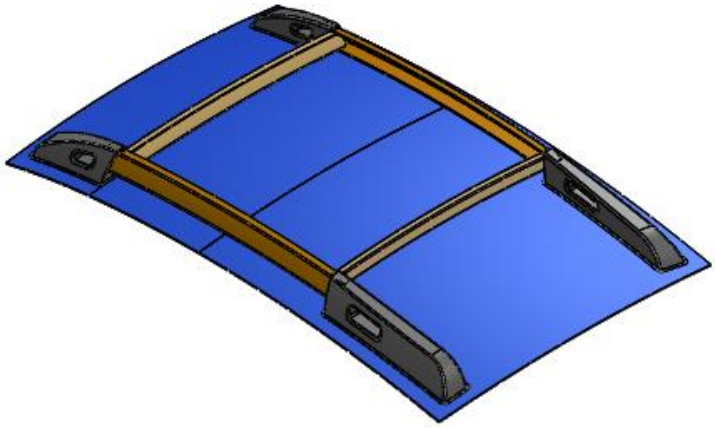
Respecting all the above considerations, and analyzing the shape, the profile of the bodywork and the longitudinal bars present on the bodywork, as well as the distances between them (which is an important factor in the implementation of this project), we consider that the patented trunk that was the object of this article could be successfully implemented on this type of car, with economic effects, of obvious design and functionality (figure 8)



a. Intermediate position



b. Folded position



c. Operating position - folded bars

Fig. 8. (a,b,c) Smart trunk Patent Ro nr. 130559/2019 – proposed on the ceiling Dacia Duster,

3. 3D modeling and simulation of behavior in the presence of a calculation scheme, by the Finite Element Method (MEF)

In order to study the behavior of the optimized structure, it was resorted to the elaboration of a 3D model of it, a model to which a calculation scheme was subsequently attached, in order to simulate the way of working. The material chosen for completing the calculation step is Aluminum 1060-H16, extruded profile, with constant cross section (fig. 9).

1060-H16

Property	Value	Units
Elastic Modulus	69000	N/mm^2
Poissons Ratio	0.33	N/A
Shear Modulus	26000	N/mm^2
Density	2705	kg/m^3
Tensile Strength	110	N/mm^2
Compressive Strength in X		N/mm^2
Yield Strength	105	N/mm^2
Thermal Expansion Coefficient	2.36e-005	/K
Thermal Conductivity	230	W/(m·K)

Fig. 9 Characteristics of the material used

The calculation diagram (the reclining diagram and the loading diagram), as well as the discretization network in finite elements for the L1 bar are visible in figure 10.

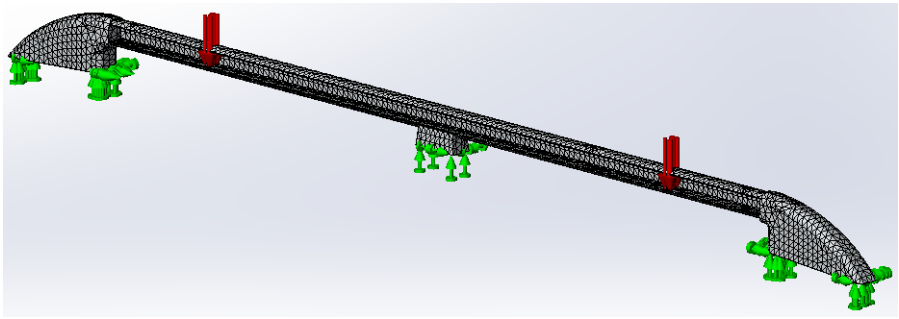


Fig. 10 Diagram of calculating the L1 bar, constant section and rectangular recess

As output sizes of the analysis via MEF, in figure 11 the distribution of vonMises equivalent normal voltages can be tracked, and in Figure 12, the field of the final deformations of the structure under the action of the imposed calculation diagram.

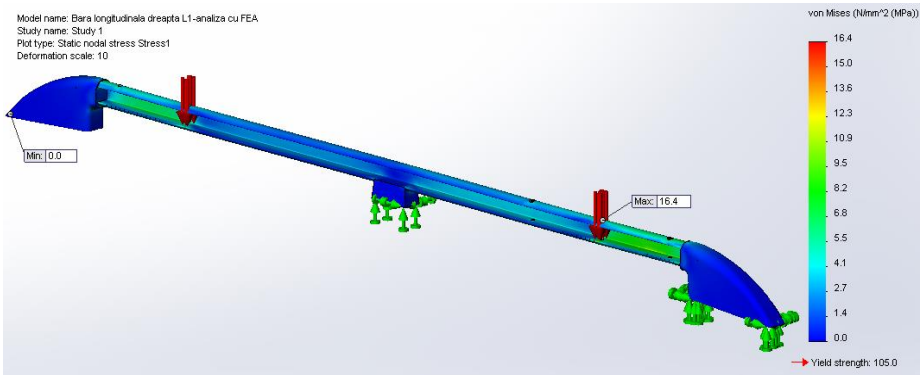


Fig. 11 The state of vonMises equivalent stress, [MPa]

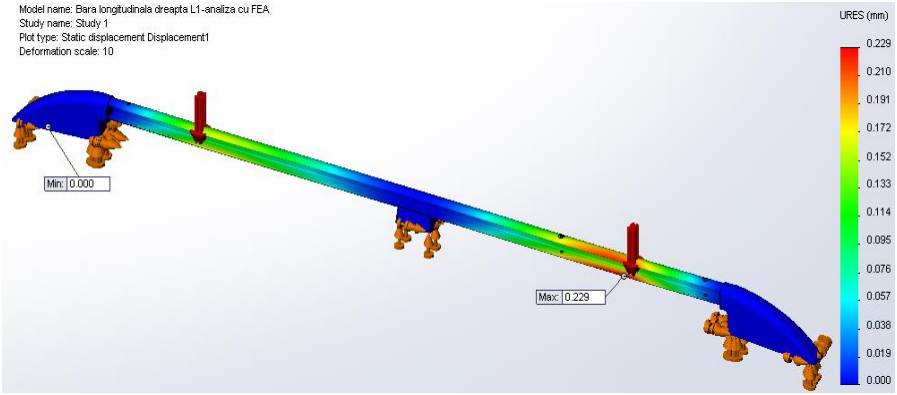


Fig. 12 Field of the resulting deformations [mm]

4. Conclusions

In the paper we approached a way of implementing an existing Romanian patent (OSIM Patent - Ro no. 130559/2019) which refers to a SMART car trunk, in a new construction that is not found in other variants of trunks, and which could be adapted for inclusion in the list of accessories / options for the Dacia-DUSTER car.

The novelty element consists in the fact that the trunk is designed in such a way that it can be folded / hidden inside the longitudinal bars existing on the hood of the mentioned car when it is not used (leading to fuel savings and mounting / disassembly times) and, respectively, it can be extended by folding to be put in a working position, when it is desired that he becomes active.

The way of conceiving this new type of trunk allows multiple advantages, starting from the increase of the ergonomics of the car, the reduction of the assembly /

disassembly times (there are also quick articulation solutions) the reduction of the weight of the car with this variant of the trunk compared to the existing variants, the reduction of the trunk cost (which no longer needs anti-theft insurance systems as the universal trunks have).

There are also possibilities of adjustment depending on the types / dimensions of the luggage transported and last but not least a better adaptation of the shape of the trunk to the overall appearance of the car, because it "follows" the 3D contour of the bodywork, being integrated more harmoniously to the shape of the car's body, compared to the existing universal trunks that do not take this into account.

R E F E R E N C E S

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