International Journal of Modern Manufacturing Technologies
ISSN 2067–3604, Vol. XIV, No. 2 / 2022
https://doi.org/ 10.54684/ijmmt.2022.14.2.159

CLAW FOR ROUND BALES

Gina Diana Muscă (Anghelache), Gigel Florin Căpățână, Maria Aurora Potîrniche

[1]"Dunarea de Jos" University of Galati, Engineering and Agronomy Faculty in Braila, Research Center for Mechanics of Machines and Technological Equipments, Calea Calarasilor 29, 810017, Braila, Romania

Corresponding autho: Gina Diana Muscă (Anghelache), danchelache@ugal.ro

Abstrac: The claw for round bales is an attachment to the base machine of a front loader. This is used in agriculture for handling of big sized straw bales. Arms opening respectively, closing, are performed with different speeds to allow claws removal from bales stack without damaging the nearby bales. The strong construction ensures handling of big sized bales. The needed force during transport is provided by two hydraulic cylinders and hydraulic safety valve. For making the transport systems used in agriculture, it is useful to make computer aided simulations, to obtain some virtual models for such equipment. This paperwork presents how the claw for round bales handling can be designed, starting from needed parameters (bale size, bale weight, lifting capacity, etc.) and farmer's requirements. We went through the stages of computer aided engineering taking into account various requirements of the farmers. The claw for bales handling is attached to a front loader or a tractor based upon the equipment fleet the farmers own. The parametric modeling of the claw type attachment for round bales was done by using NX 7.5 specialized software. This software uses powerful tools for modeling, allowing the use of the most efficient techniques for advanced modeling – from explicit modeling of solids and surfaces to parametric and direct modelling.
Key words: claw, modelling, bales handling.

1. INTRODUCTION

The claw can be installed as work equipment on a basis machinery such as: tractor front loader, telescopic loader, mini-loader. The claw for round bales, irrespective if they are foil wrapped or not, are helpful for transport of straw hay, silo bales, [1].
This equipment is made of hig quality steel. Stiffening elements ensure high reliability and high lifting capacity. The arms are fitted in a floating manner, namely, opening and closing processes for arms are performed at different speeds, to allow claws removal from bales stack without damaging the nearby bales. An important element of the claw is the hydraulic safety valve, this one having the role to ensure safe transport of the load. The strong and well manufactured construction of the claws ensure safe transport for foil wrapped bales. The durable lacquer shell is applied by spraying, [2].
All claws for bales are equipped with an equalizer to provide arms synchronous movement. These elements have possibility to be greased to provide a long-lasting period of use and avoid the need for bars replacement in case of wear.

2. PARAMETRIC MODELING OF CLAWS FOR ROUND BALES

The paperwork shows how the transport sstem for agricultural products can be designed by help of NX program, version 7.5, parametric modeling of claws for round bales being performed by running distinct stages such as: start with Nx 7.5 soft opening, and from the File-New toolbar we access the MODEL (figure 1) utilitary.
By means of this utilitary we will create the 3D reference points of the bales handling device. After creating these reference points, all will be brought in the ASSEMBLY utilitary, and assembled afterwards. To start, we modeled thhe lifting arm for the equipment used for bales handling. We choose the SETCH control from MODEL utilitary, as shown in figure 2, 3.
With controls from this utilitary we made a closed contour representing the profile of modeled part.
The most used controls from the SKETCH menu are drawing controls: LINE, ARC, CIRCLE, RECTANGLE, SPLINE, POINT, and modification and erase controls OFFSET, MIRROR, TRIM, FILLET, CHAMFER, EXTEND and so on. After maing the closed contour we used the solids maing controls, namely, EXTRUDE for solids that are to be extrudated (got higher or in other words pushed out) and REVOLVE for solids which look like revolving. In figure 2 we used EXTRUDE control to realize the model of lifting arm. In the end the 3D model for arm is shown in figure 3. To multiply the part of extruded element we used INSTANCE GEOMETRY control from ASSOCIATYVE COPY toolbar (figure 4). The second part which was modeled is the "movable plate" wherein the upper cylinders of the arm are fixed 4.

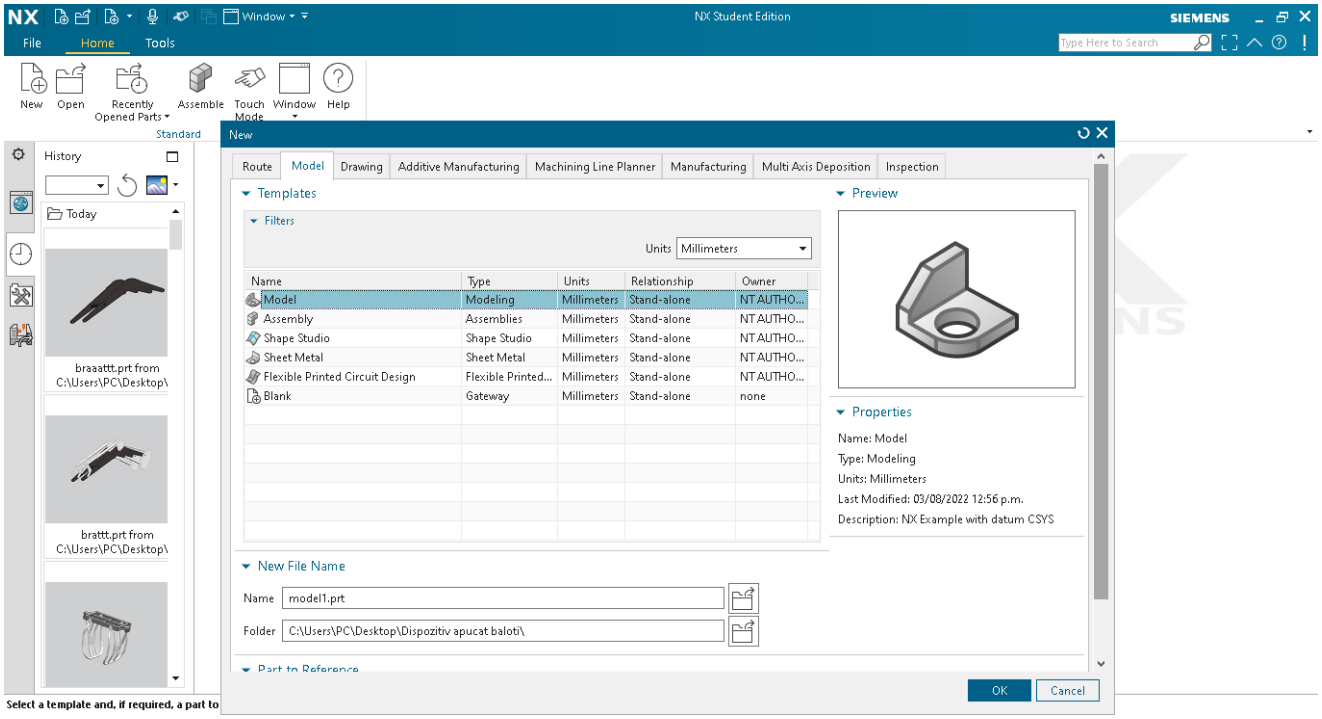

Fig. 1. Access the MODEL utilitary

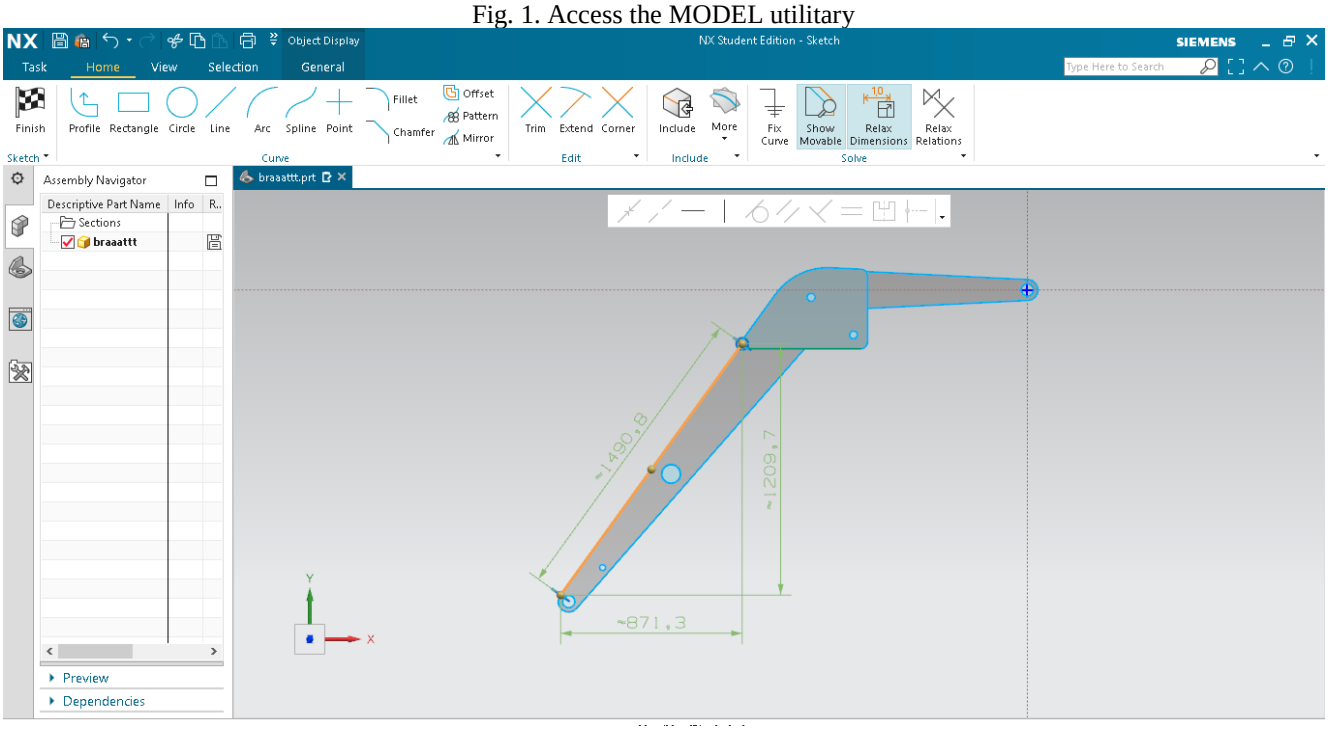

Fig. 2. Sketch used to perform the lifting arm of the bales grabbing device

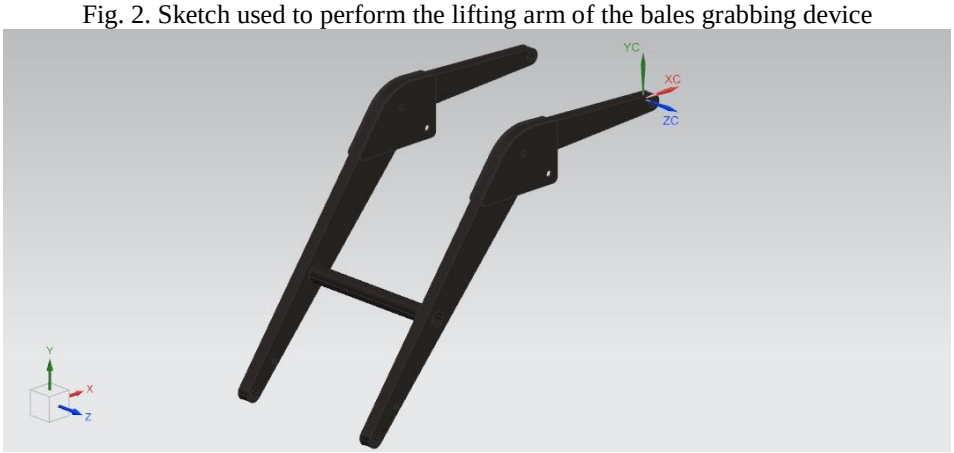

Fig. 3. Arm 3D model

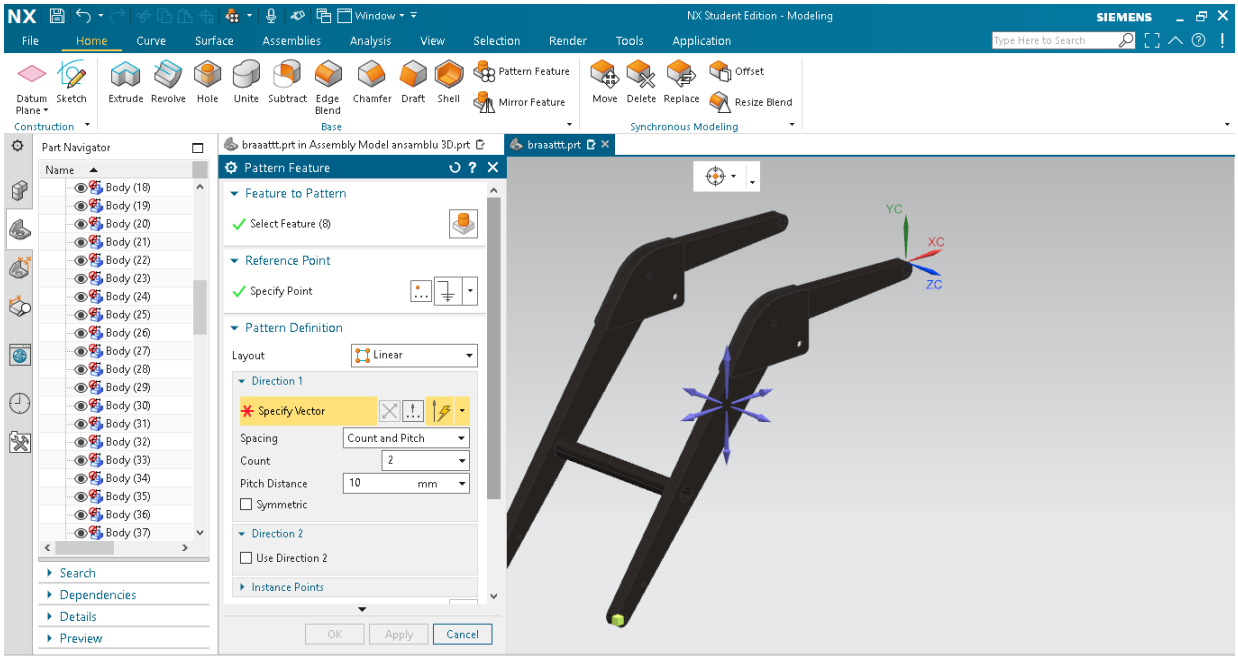

Fig. 4. Use of multiplication control INSTANCE GEOMETRY

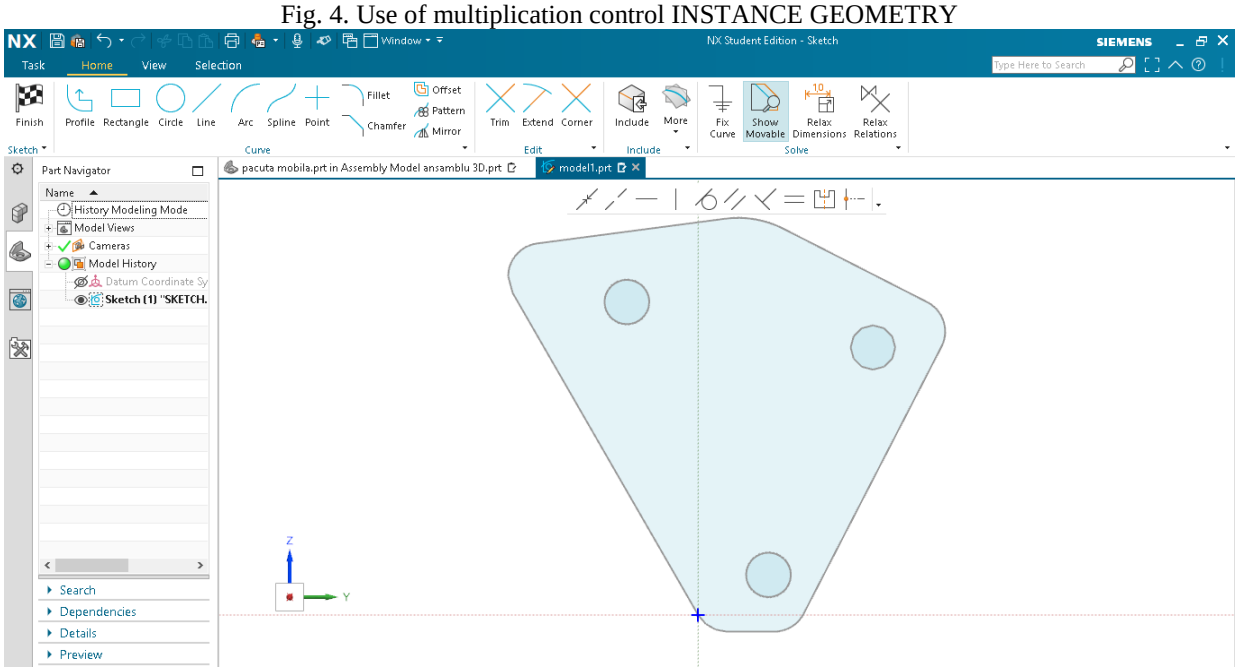

Fig. 5. Sketch of 3D model for movable plate

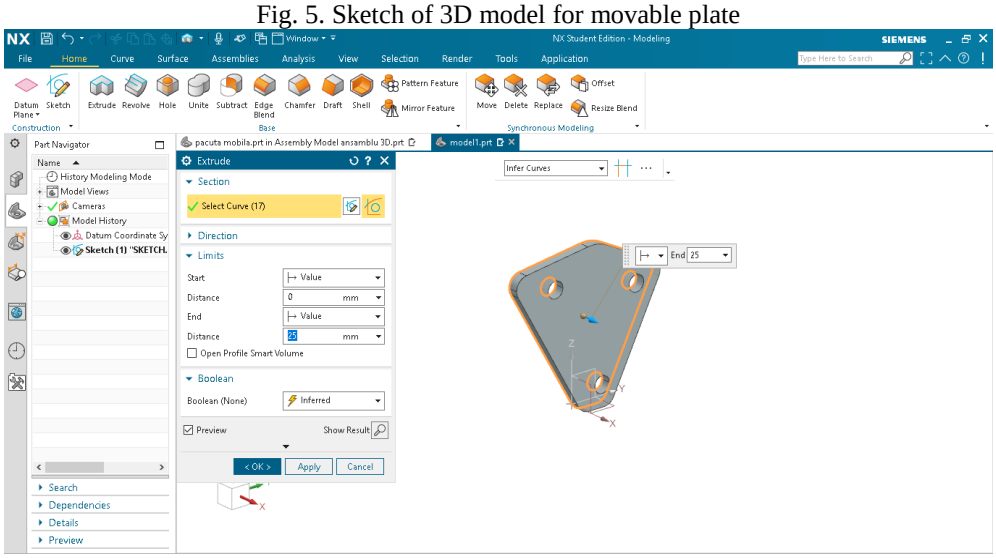

Fig. 6. Extrusion of “movable plate” sketch

The sketch of movable plate can be seen in figure 5.
This was extruded with a value of 15mm and a plate with 15mm thickness resulted. The extrusion stage can be seen in figure 6.
The next part is the stiff plate which is fixed to equipment. The sketch for realizing it, can be seen in figure 7.
In figure 8 the "stiff plate" extruded with 15mm thickness can be seen.
The next modeled item is the hydraulic drive cylinder. The cylinder is modeled in the first stage, then, its rod - separately.
The bales handling claws was realized with TUBE control from INSERT-SWEEP_TUBE toolbar. The control was applied after we have drawn the lines from the setches which, assembled, made the claws skeleton. The 3D model can be seen in figure 11.
After maing all the items, the ASSEMBLY utilitary is opened and all parts are brought with ADD COMPONENTS control. All items brought into the work window within ASSEMBLY utilitary can be seen in figure 12.
To obtain this item, the sketch is realized in the first stage with two circles. One circle has 100mm diameter and the other one 60mm. This can be seen in figure 9.
In the end, the hydraulic cylinder looks like in figure 10.

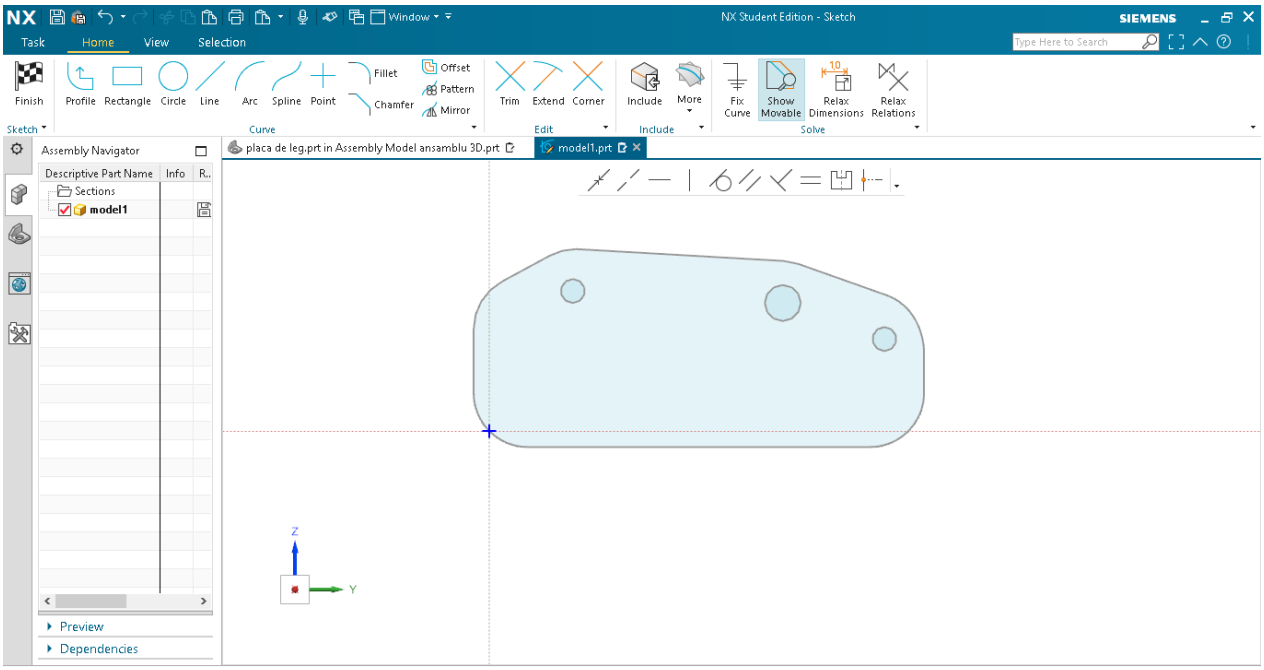

Fig. 7. Stiff plate sketch

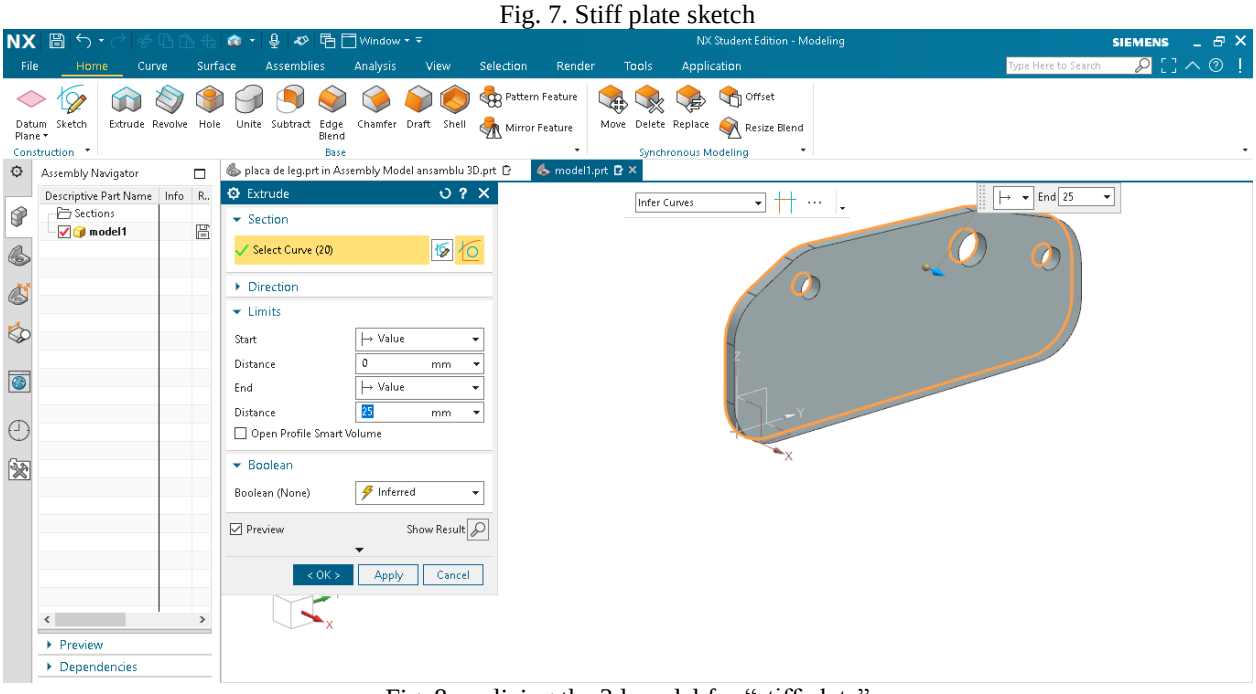

Fig. 8. realizing the 3d model for "stiff plate"

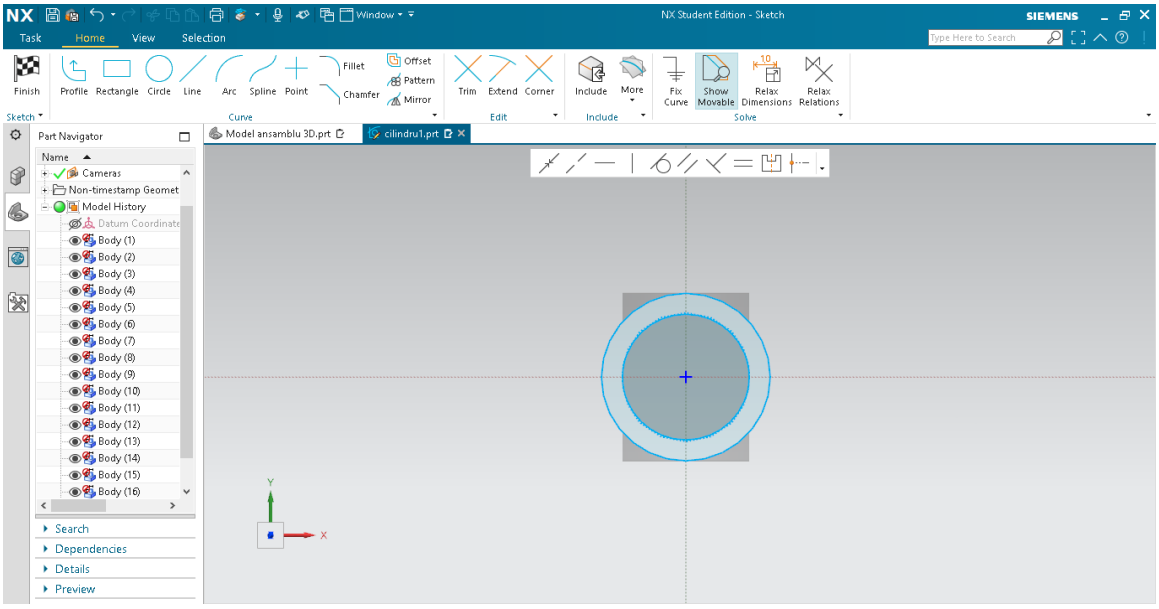

Fig. 9. Sketch for realizing the 3D model for cylinder

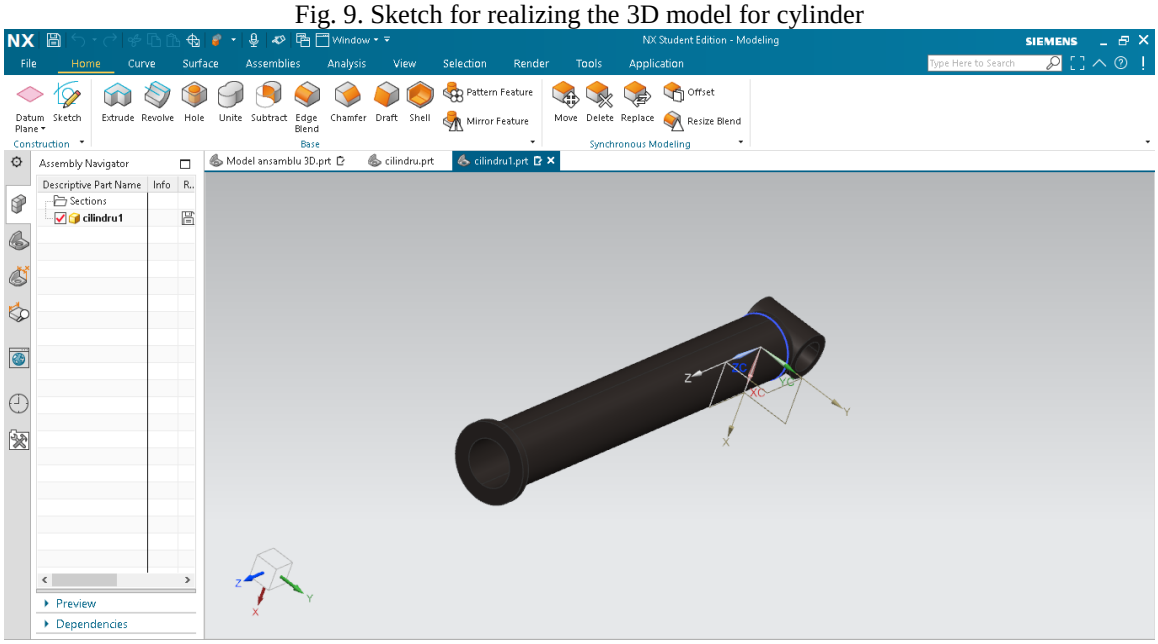

Fig. 10. The 3D model for hydraulic cylinder

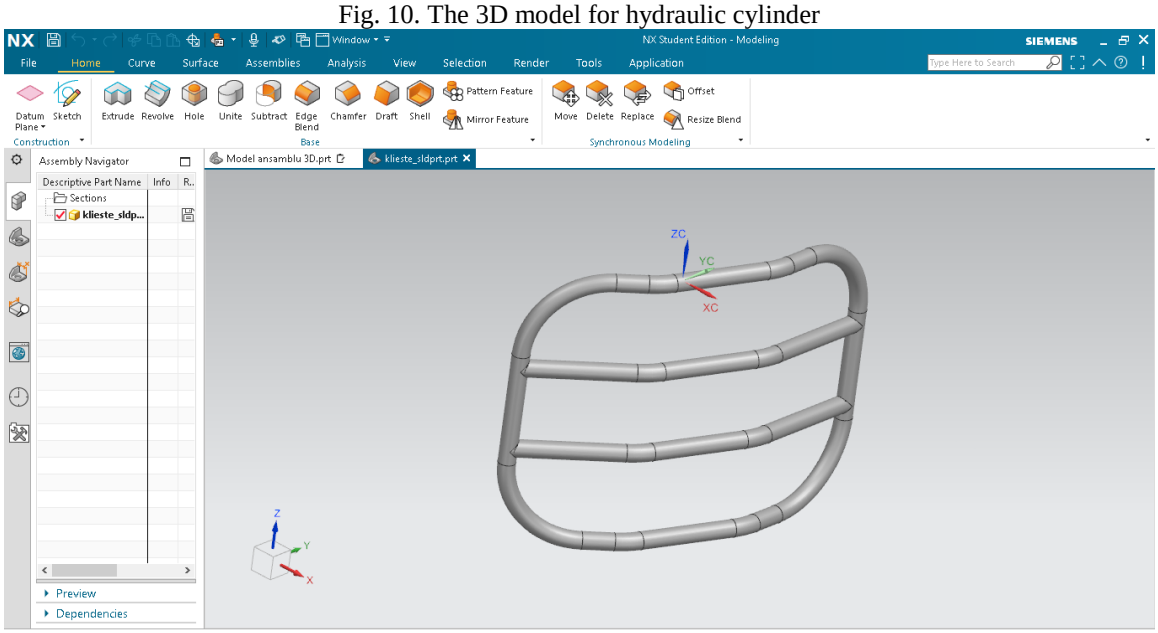

Fig. 11. The 3D model of the bale grab claws

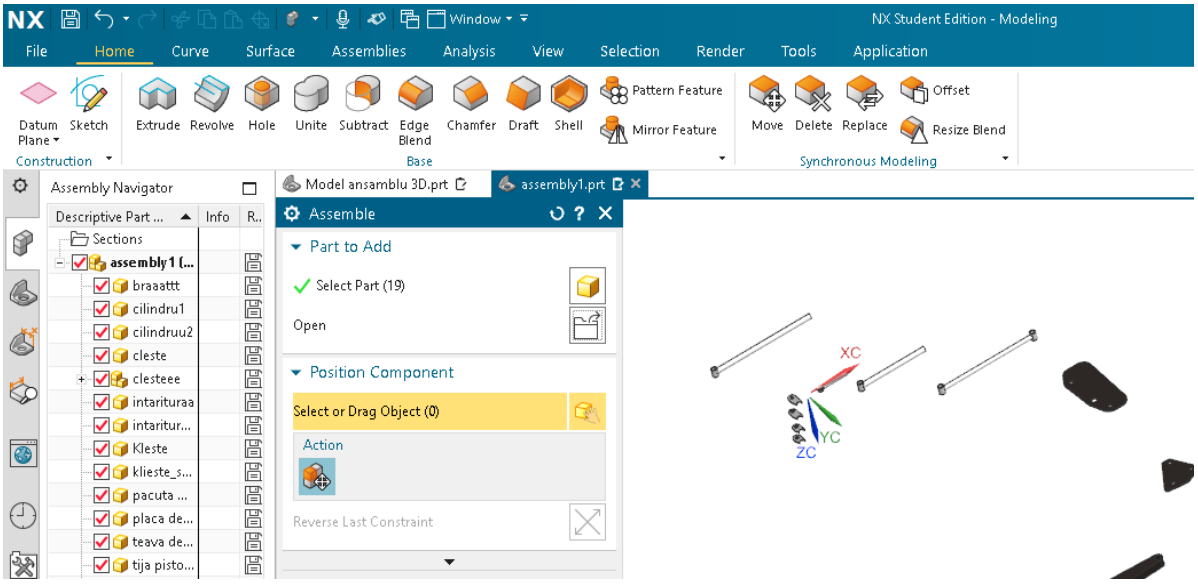

Fig. 12. Adding the component items of the bales handling device

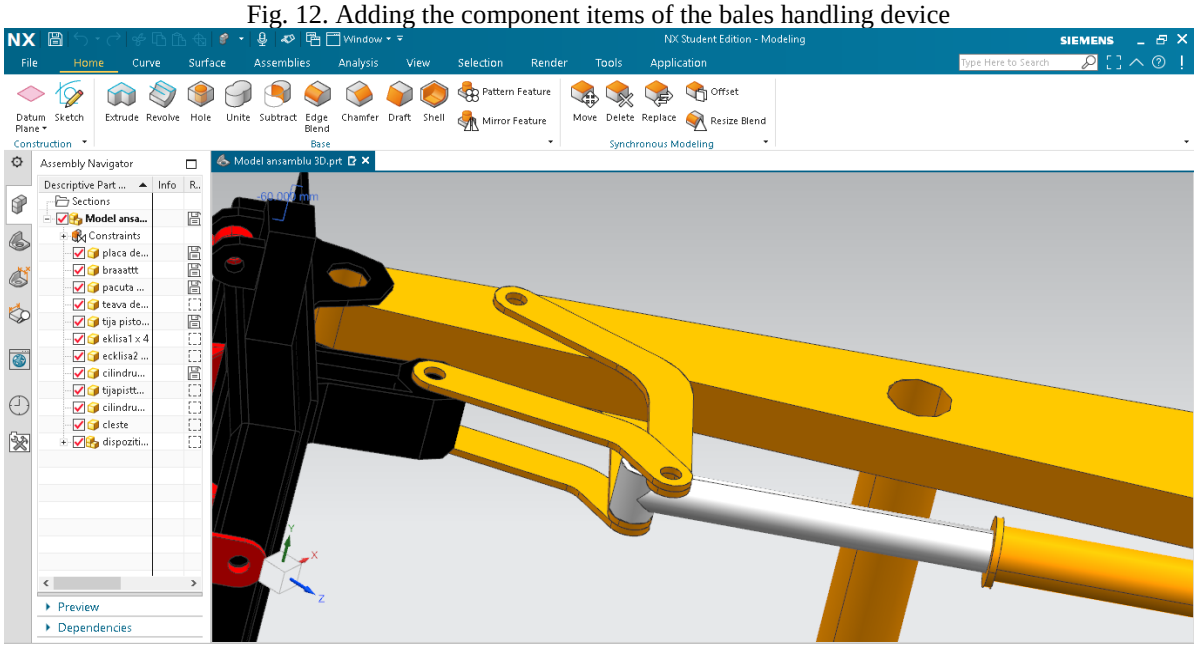

Fig. 13. Adding the component items of the bales handling device

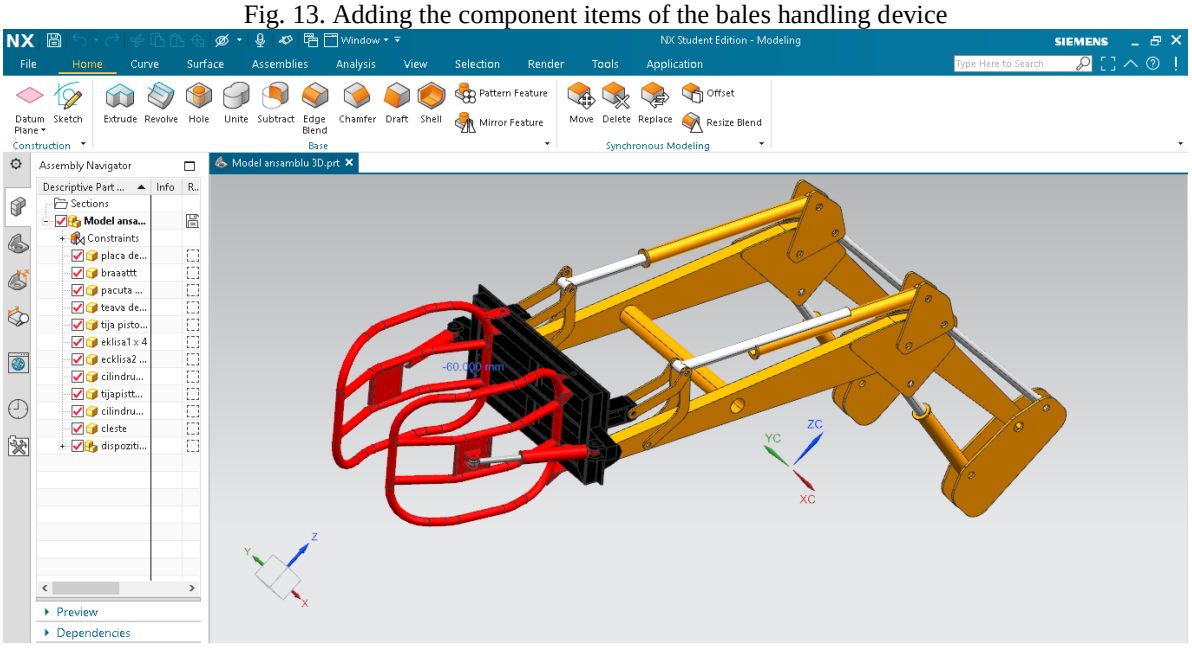

Fig. 14. The 3D model of the general assembly

With constraint controls, the bales handling device is assembled with accurate precision. The constraint controls are: CONCENTRIC, PARALEL, DISTANCE, TOUCH ALIGN, FIT, FIX, BOND and are found within ASSEMBLY CONSTRAINS control (figure 13).

Special attention is required when using the constraints. The first click is done on the part we want to move, then, on "mother" part. The MOVE COMPONENTS control is also used to move and rotate every piece or assembly. Sub-assemblies can also be added to an assembly. The basic condition is all modeled items to be in the same place, in one file.

To keep in mind, when we want to change the name of an item we have to add it as a new element because NX reads the items with the names they were inserted. After using the constraint, movement and rotation controls we will obtain the assembly in figure 14. To obtain more realistic illustrations, right click on mouse then TRUE SHADING control.

3. CONCLUSIONS

Once the production increase, it becomes more and more necessary to increase transport capacity for agricultural products and, meanwhile, is necessary to increase the possibility for designing and dimensioning of needed equipment per categories related to farm size. An oversized equipment is a too high investment and its return is much too slow, meanwhile, an undersized equipment means a too high energy expense. From the need of equipment dimensioning based upon demand, starts the need to design equipment in an easier and faster manner, using computer aided graphics. Technological development has led to emergence of some new information systems and programs for 3D graphic representation in a virtual space containing applications dedicated to designing of mechanisms for lifting and transport, in a short time and with very high precision. The NX software - is a CAD / CAM / CAE leader system based upon the best technologies to create products of any complexity. The main goal of the system is to reduce costs, improve quality of designed equipment and reduce the manufacturing time. It can be used in various industries (aerospace, buildings architecture, automotive engines designing, engineering, etc.), giving top solutions in MCAD.

4. REFERENCES

1. Available from: https://plasmacut.ro/cupa-incarcator-telescopic/cleste-baloti-2-cilindri/, Accessed: 03.03.2022

2. Available from: https://www.agnet.ro/u2-Cleste-pentru-baloti-cilindrici, Accessed: 03.03.2022

3. Goanţă A. M., (2015). *Digital development of products with NX9 for academical areas,* IOP Conf. Ser.: Mater. Sci. Eng. 95 012152, doi 10.1088/1757-899X/95/1/012152

4. Goanţă A. M., (2009). *Modern Instruments of Transfer of Geometrical Patterns in Designing Building Machines and Equipment's,* Proceedings of the 13th International Conference Iaşi&Chişinău – ModTech, pp. 271-274.

Received: August 2, 2022 / Accepted: December 15, 2022 / Paper available online: December 20, 2022