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Editorial Open Access

Computer Aided Design (CAD): A New Era in Design of Farm Machines

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Editorial

Computer-Aided Design (CAD) is becoming one of the most important software tools in the design industry. Quite simply, CAD programs allow the designer to draw the object on his or her computer screen, instead of using pencil and paper. It uses the computer systems to assist in the creation, modification, analysis and optimization of a design. In today's World, everything from small nut-bolt to large machines is being visualized and designed using Computer-Aided Design (CAD) software. By using CAD, engineers, manufacturers and drafters can imagine, invent and revise detailed drawings used to give physical form to their ideas. This field often appeals to individuals with a construction background who prefer designing projects over physically building them.

Numerical methods have been used to solve complicated problems in different engineering disciplines. In mechanical design process, one of the most used numerical methods is Finite Element Method (FEM). This method has been developed at the beginning of 1950's in order to computing stress distribution of complicated structure in aeronautic industry. Today, the method can be used nearly all kind of different engineering field together with developing technologies and computers. In addition, using these applications are so important in agricultural mechanization system design. The FEM is also being used to study soil cutting and tillage. The goal of modern farming system is to economize energy consumption and thereby reduce farming cost. Optimal design of agricultural machines proportionate to the present tractor power must be considered in order to achieve this goal. This leads to an increase in farm effective efficiency, timeliness in farm operations and maximizing the use of tractor power.

A number of different types of tillage equipment designs can be seen in agricultural fields, which are used for a number of varied applications. When working with the tillage equipment, its construction is subjected to reaction forces from the soil due to the deep tillage. According to these working conditions, if the construction does not compensate the soil reaction forces, elements of the tillage implement could be subjected to forces that cause deformation. This deformation could cause machinery failure during operation. Hence, the basic elements of an implement construction must be durable enough during tillage operations. Therefore, proper design of these machines is necessary in order to increase their working life time and reduce the farming costs. Although much research can be found about tillage effects or its soil interaction conditions, it can be concluded that there have been limited studies about the structural optimization of the construction and constituent elements using CAE applications. Finite Element (FE) is one of those methods which used for evaluation of a structure under static and dynamic loads before making the main model. Subsoiler and rotavator blade type equipment have high magnitude reaction forces from the soil during tillage operation. For these reaction forces affect construction elements of subsoiler and rotavator blade directly or indirectly. If the construction elements cannot compensate the reaction forces, they become useless due to plastic deformation or fracture.

Therefore, structure of these type of tillage equipment must have been designed as stable and durable enough to avoid undesired failure cases. Usually, machine manufacturers uses materials, which have high safety coefficient or high weight machine members to avoid unappreciated case and operating conditions. However, this is not an optimum way. Actually, stress distribution should be well known to generate design, optimum material shape and durability of elements according to defined operating conditions. In fact, not all of the factors (non-linear and dynamic) can be described exactly in real working condition on field. Therefore, some assumptions are generated to define these factors for developing approaches to reality like all engineering problems. Therefore, proper design of tillage equipment is necessary in order to increase their working life time and reduce the farming costs. So we analysed different tillage equipment like subsoiler, rotavator blade and M.B. plough in CAD software for static structural analysis.

Static structural analysis of subsoiler, rotavator blade and M.B. plough were carried out using Creo and ANSYS software. 3D models of these tillage implements were made using Creo software and static structural analysis and optimization were carried out using ANSYS software. The material and dimensions were taken from the local manufacturing database. A field experiment was conducted to determine maximum draft force of the subsoiler for the boundary condition. Results of simulation provide maximum deformation, maximum equivalent (von-mises) stresses and minimum factor of safety type different parameter as per the requirement. If factor of safety was found to be very low and do not satisfy the safety conditions then optimize design is required. So ANSYS designXplorer type different module was utilized for the optimization study.

Therefore, CAD application in agricultural field is very important because CAD application gives the value of deformation, stress, factor of safety type different parameters with their better solution and also increase their working life time, reduce the costs of tillage equipment in agro industries.

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