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Stress Analysis of Steel Frame Chair and a Comparative study for Various Loading Conditions

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Abstract

Bangladesh is one of the third world developing countries that largely depends on import for several products. Yet it has several sectors those are not only making it self-sufficient but also earning foreign currencies. Among these sectors some are well established like RMG and Lather. There are also some sectors which are currently contributing a little but has the potential of making a blasting impact in the near future. Furniture industry is one of those promising sectors. In the modern dynamic market, customers' requirements change frequently and constantly. In order to meeting those requirements, manufacturers are bound to introduce new designs of furniture as well as bringing modification to their existing products. During this process designers and manufacturers face different barriers, that limits their progress. Among these barriers, "STRESS" is the most significant and sensitive one.

This study is conducted with a view to investigate the impact of load on stress for furniture. The study is limited to chair of a certain design and shape which would be suitable for regular use in normal conditions. But other types of furniture used for sitting can be analyzed in this approach and a comparative study can be carried out. Model of chair is chosen as, it is the most commonly and frequently used furniture for sitting worldwide. A particular model with a specific design and material have been studied. Two varieties of the same model, one with circular cross-section and the other with square cross section have been analyzed. Two 3D CAD models of the same model of chair with different cross-sections (one cylindrical and other square) are designed using Autocad-2014. The calculation of stress is carried out using COMSOL Multiphysics-5.0 software under solid mechanics module with finite element analysis method. Two types of boundary condition are used; in first one, four legs of the chair is kept fixed and the next one with, two back-legs fixed and other two (front legs) with rollers. The data on stress and horizontal displacement of the top point of the chair back post, is calculated for the most common types of loading for chairs. The data obtained is analyzed through Microsoft Excel-2013 worksheet.

The results shows that amount of maximum stress and horizontal displacement of chair top, increases linearly with the amount of load. That means, it follows Hooke's law of elasticity. But the stress increases more rapidly with the increment of backload, keeping the seat load fixed rather than the increment of seat load, keeping backload fixed. This indicates that stress for chairs, is more sensitive to the backload rather than seat load. The point of maximum stress remains unchanged with the variation of load. The results and the methods of this study can be used in new product design and development as well as for the analysis and improvement of existing products.

Keywords
Finite element, COMPSOLE, stress analysis, chair frame