ABOUT TESTING SEATS FOR DURABILITY AND STRENGTH

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Abstract
This paper presents the testing of chairs for durability and strength important operation that highlights its effectiveness, thus demonstrating the usefulness of the chairs which means not only the design, color or wood used but also strength, durability, comfort and relaxation.

Key words: Chair, Durability, Strength

INTRODUCTION

The chair is a piece of furniture subjected to very strong forces. It is not just about supporting the weight of people but also about resisting countless settlements and lifts, at different forces when the seat is left on its back or in front, remaining with only two feet on the ground. All these are tests that a prototype seat must pass in order to enter production.

That is why hard, resistant wood is used for the chairs. The most used wood is beech, being very good for the manufacture of curved elements (steam bending or with the help of high frequency currents).

However, chairs are also made of oak, ash, but also softwood. Several types of wood can be used to build a chair. However, care must be taken not to make the joints subjected to high forces between hardwood and softwood, and the legs should always be made of hardwood. Softwood can be used for arms or parts of the backrest that are less stressed. (https://revistadinlemn.ro/2018/11/06/detalii-tehnice-pentru-scaune-din-lemn-confortabile-si-sigure/)

MATERIAL AND METHODS

The seats under test are of the "BERTIL" type made at S.C. Plimob.

The structure of the seat is characterized by the existence of elements with different rigidities as well as with joint nodes that in exploatation are not always perfectly rigid. The different rigidity of the component elements is determined either by their different dimensions and materials, or by the type and nature of the joining elements (wood plugs fixed with adhesive, metal or plastic elements, etc). In the following, the nodes are considered perfectly rigid. A detailed treatment of the problem in case of considering the joints in the knots as elastic is presented in the specialized works. (Curtu, 1976, 1977)

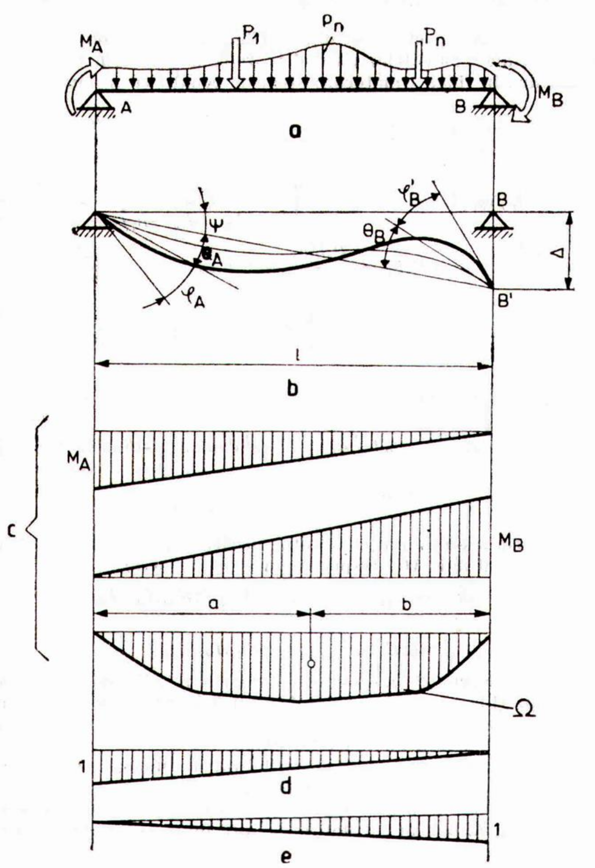

Fig. 1 General loading of a seat element (Curtu et al., 1981)

The method of displacements was used to deduce the size of the bending moments in each node. (Curtu et al., 1981). In this respect, considering the general load of a seat element as in figure 1, it results after performing the calculations, the values of the bending-reaction moments in the form

$$\left.\begin{aligned} M_A &= \frac{2EI}{l}\left(2\varphi_a + \varphi_b - 3\Psi\right) - \frac{2\Omega}{l^2}\left(3b - l\right) \\ M_B &= \frac{2EI}{l}\left(\varphi_a + 2\varphi_b - 3\Psi\right) + \frac{2\Omega}{l^2}\left(3a - l\right) \end{aligned}\right\} \qquad (1.1)$$

where l is the length (opening of the element), în cm: Ω – the surface of the diagram of bending moments produced by the forces on it, the element being considered as a simple beam resting on the ends; *a* şi *b* – distances from the ends to the center of gravity of the surface *Q*, in cm; φ_a şi φ_b –

rotations (angular displacements) of the average fiber in supports A and B, in rad. $\Psi = \Delta/l$ settling angle, Δ being the unevenness of point B with respect to A, in cm. From relation (1.2) follows the following expression for the rotations φ_a şφ_b:

$$\left.\begin{aligned} \varphi_a &= \frac{M_A I}{3EI} - \frac{M_B I}{6EI} + \Psi + \Omega \frac{b}{l} \\ \varphi_b &= \frac{M_B I}{3EI} - \frac{M_A I}{6EI} + \Psi - \Omega \frac{a}{l} \end{aligned}\right\} \qquad (1.2.)$$

For the general case of the seat structure, they were obtained with the displacement method, general expressions of bending moments. nts in each node, the following system of equations with the unknowns was finally obtained. φ_B, φ_C, φ_D,, φ_E şi Δ:

$$\left.\begin{aligned} & 2(k_{BD}+k_{BC})\varphi_B + k_{BC}\varphi_C + k_{BD}\varphi_D - 3\left[\frac{k_{BD}}{h_2} + \frac{k_{BC}}{l_{BC}}\left(\frac{h_3}{h_2+h_5} + \frac{h_6}{h_4+h_7}\right)\right]\Delta = P_3\frac{h_8 h_9^2}{l_{BC}^2} \\ & k_{BC}\varphi_B + 2(k_{BC}+k_{CE})\varphi_{CE} k_{CE}\varphi_E - 3\left[\frac{k_{BC}}{l_{BC}}\left(\frac{h_3}{h_2+h_5} + \frac{h_6}{h_4+h_7}\right) + \frac{k_{CE}}{h_4}\right]\Delta = P_1 h_1 - \frac{P_3 h_8^2 h_9}{l_{BC}^2} + P_7 h_{12} \\ & k_{DB}\varphi_B + 2(k_{DE}+k_{DB})\varphi_D + k_{DE}\varphi_E - 3\frac{\Delta}{h_2}k_{DB} = F_H h_5 + \frac{h_3 h_5}{h_2+h_5} + P_5\frac{h_{20}h_{11}^2}{l_{DE}^2} \\ & k_{EC}\varphi_C + k_{ED}\varphi_D + 2(k_{EC}+k_{ED})\varphi_E - 3\frac{k_{EC}}{h_4}\Delta = G_H h_7 - G_V\frac{h_6 h_7}{h_4+h_7} - P_5\frac{h_{10}^2 h_{11}}{l_{DE}^2} \\ & k_{BD}h_2 l_{CE}^2\varphi_B + k_{CE}h_4 l_{BD}^2\varphi_C + k_{BD}h_2 l_{CE}^2\varphi_D + k_{CE}h_4 l_{BD}^2\varphi_E - 2\left(k_{BD}l_{CE}^2 - k_{CE}l_{BD}^2\right) = \frac{1}{3}l_{BD}^2 l_{CE}^2\left(P_1+P_6\right) \end{aligned}\right\} \quad (1.3)$$

In these equations by k were noted the rigidities of each element of the seat structure relative to the rigidity of the AC element, respectively in the general case

$$k_{xy} = k_{yx} = \left(2E_{xy}\frac{I_{(xy)}}{l_{xy}}\right) \Big/ \left(2E_{AC}\frac{I_{AC}}{l_{AC}}\right) \qquad (1.4)$$

For Example

$$k_{BC} = \left(2E_{BC}\frac{I_{BC}}{l_{BC}}\right) \Big/ \left(2E_{AC}\frac{I_{AC}}{I_{AC}}\right)$$

Solving the system of equations (1.3) we obtain the values of the rotations φ_B , φ_C , φ_D, φ_E and the settlement Δ, which introduced in the expressions of the moments result their values. Knowing the maximum values of the bending moments determines the maximum tension $\sigma_{\max} = \frac{M_{iY\max}}{I} = \frac{M_i}{W}$ and compares with the admissible one.

The advantage of the presented method consists in the possibility of studying a wide range of constructive variants of chairs and choosing the optimal one. [11]

RESULTS AND DISCUSSION

Testing furniture for strength and durability is used to provide an overview of testing methods

Static arm load ISO 7173 pct. 7.3 and 7.4

Fig 2 Static arm load

The seat is fixed to prevent the chair The seat is fixed to prevent the chair from moved. The specified force is applied horizontally, without impact, for a duration of 10 seconds against the inside of the armrest at the point where the risk of damage is highest.

The force is applied vertically, without impact, for a duration of 10 seconds against the top side of the armrest at the point where the risk of damage is highest.

The durability test for seat and backrest ISO 7173 pct. 7.5 and 7.6

The chair is placed with the legs against stop-pers to prevent it from sliding. The specified force 950 N and 330 N respectively simultaneously applied to seat and back for the specified number of cycles without impact.

The basic requirements are 25000 cycles without degradation: visible cracks, ruptures with deformations greater than the specified maximum values, weakening of rigid joints (which cannot be corrected by restricting the hardware). 50.000 cycles are required for high requirements.

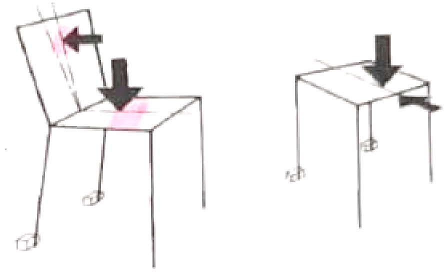

Fig. 3 The durability test for seat and backrest

The “BERTIL” type seat has been factory tested on a seat test bench

Fig. 4 Test bench

Fig. 5 Backrest test view

Fig. 6 Seat test view

 

Fig. 7 Simultaneous seat and backrest test view

Static load in the back and static load in the side ISO 7173 pct. 7.7 and 7.8

The legs opposite the applied force are placed against stoppers to prevent the furniture from sliding. The specified force is applied horizontally and without impact, for 10 seconds to the centre of the seat edge.

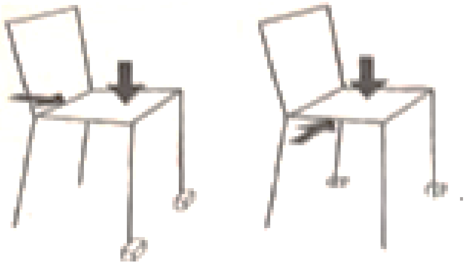

Fig. 8 Static load in the back and static load in the side

Impact test against the seat ISO 7173 pct. 7.10

The legs are placed against stoppers to prevent the furniture from sliding.

A weight is dropped from the specified height in the centre of the seat with c.a 180 mm in front of the backrest.

Fig. 9 Impact test against the seat

Bearing capacity of frame   SS 839622

The original position of the seat frame is measured. The load is applied to the seat.

After 15 minutes the position is measured and the load is removed and the position is measured once more and the deflection with and without load are calculated.

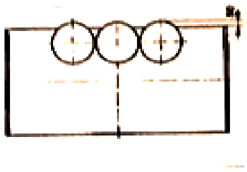

Fig. 10 Bearing capacity of frame

Measuring of resilience characteristics SS 839508 pct. 3.7

After 100 cycles a load is applied to the seat in the steps of 4 and 200N. For each load the measurement is noted. This measuring is repeated for each test level. The difference in F value between the first measurements (100 cycles) and the following is used in evaluating the result.

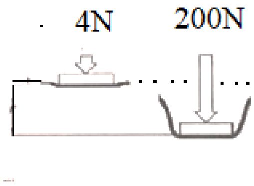

Fig. 11 Measuring of resilience characteristics

CONCLUSIONS

Testing the seats for durability and strength is particularly important because it shows a clear situation of the products made.

If they do not meet the requirements, they can be improved, retested and put back into the production cycle..

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