DESIGNING A SEATING ELEMENT FOR A SACRED SPACE

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Abstract

The issue of sacred space falls into the category of the use of furniture in the public interior. In contemporary religious buildings, due to wear and tear or pest infestation, both individual parts of the interior and entire church interiors are being restored. It is desirable that new furniture already meets the criteria of modern church pews with regard to typology and ergonomics, safety requirements, construction and material design. However, these criteria must be closely related to the overall existing and planned space, aesthetics and liturgy of worship and ceremonies. The design and construction of the church pew was done through sketching, 3D modelling and also by creating several cardboard models. Subsequently, the production of a 1 : 1 model in the chosen materials was proceeded. The design of the church pew is situated in the so-called winter chapel, which is part of the Church of the Virgin Mary in Křtiny. This chapel is used mainly in the winter months or during services for smaller numbers of people. The chapel is currently undergoing renovation and therefore completely new furniture is planned.

Keywords: design, church pews, wooden furniture, sacral interior, public interior

INTRODUCTION

The furniture, created for public spaces, was constructed in accordance with modern design methods [1]. The sustainability aspect of the product is important due to the quality of workmanship. Thus, in conjunction with meeting the requirements for furniture in public spaces [2]. The current social climate in the church [3] and the condition of historic interiors are leading to the restoration and repair of sacred interiors [4] that are more in line with current church rules and needs. A significant part of the historic sacral buildings dates back to the Baroque period [5]. During this style, ergonomic principles were not yet known [6] the use of furniture, nor the principles of the use of public spaces [7]. Much of the current historic furnishings in churches are now often infested with pests or in a poor state of repair that does not lend itself to safe use.

Ergonomic dimensions, the right material and construction determine the overall impact on the use of the church pew. This is also linked to the social climate of the users in the place where the furniture is located and the interaction with other furniture and other people [8]. Thus, the composition of the church pew design was done with all historical, ecclesiastical, [9] ergonomic and structural and material contexts. Furthermore, the research and creation of cardboard models, see Fig. 1.

MATERIALS AND METHODS

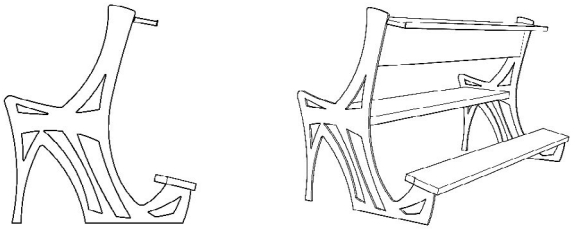
Materials

Research into the historical sources of church pews and research into modern church pews was the initial design phase. The design part included.

It is important to determine the parameters of the planned design of the entire product, including a survey of the ergonomics of seating and resting furniture. As this is not some furniture for long-term sitting, it was possible to choose parameters that were closer to resting furniture [10]. It was also necessary to consider the length of time the bench is used. An unusual and special part of the furniture - the kneeler - was subjected to research on its function and the dimensions usual for this part of this atypical furniture. In sacred settings, the kneeler is used not only for kneeling purposes, but also as a footrest.

1: *Cardboard models*

2: *Model of a church pew, front view*



3: *Sketch of concept No. 3*

Standards to be considered when designing furniture for non-residential premises:

- CSN 91 0100 (910100) Furniture - Safety requirements,
- EN 12775 (490004) Planks made of growing wood - Classification and terminology,
- EN 16139 (910650) Furniture - Strength, durability and safety - Requirements for non-domestic seating furniture,
- EN 204 (668503) Classification of thermoplastic wood adhesives for non-structural applications,
- EN 13353 (492810) Solid wood panels (SWP) - Requirements,
- EN 16139 (910650) Furniture - Strength, durability and safety - Requirements for non-domestic seating furniture,
- EN 1728 (910235) Furniture - Seating furniture - Test methods for determining strength and durability.

Methodology

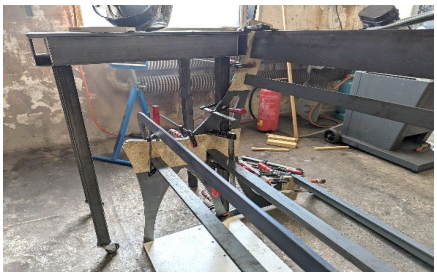
The design process was implemented in several steps:

1. survey of historical benches;
2. researching the current market for similar products and measuring the average values of other church pews against subjective feelings;
3. analysis of the obtained data and application to new design and material solutions;
4. analysis of the current layout of sacred space in selected churches and furniture in them, analysis of the behaviour of church pew users;
5. layout of the structural design using basic sketches with subsequent elaboration into variant solutions of the church pew - possibilities in relation to functionality and strength properties, the emergence of 3 variants - A. variant of the all-wooden pew, B. variant with a hinged kneeler, C. variant with a fixed kneeler - the resulting variant, see Fig. 3;

4: *Samples of surface treatment of solder and steel*

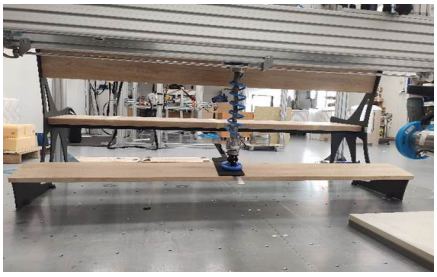
5: *All parts machined by milling*

6. 3D software modelling and visualisation in the planned space, see Fig. 2;
7. creation of models of sidewall shaping using cardboard and laser - scale 1 : 1 - see Fig. 1;
8. creation of samples of materials and their surface treatments - see Fig. 4;
9. creation of a 1:1 functional model from real materials - see Fig. 9, 10 and 11;
10. physical stress test using 3 persons - see Fig. 7;
11. testing of the 1:1 functional model in a certified furniture testing room for static loads - see Fig. 8.



6: *Creation of the structure before removing the templates*

7: *Assembly test and ergonomic seating test*



8: *Rear view of bench testing*

9: *Detail of the church pew-view from above*
Source: photo Pavel Jelínek

10: *General view of the church pew from the front*
Source: photo Pavel Jelínek

11: *Photo of the sidewall of the church pew*
Source: photo Pavel Jelínek

RESULTS

Production

The bench model consists of several parts. The basis of the whole construction is a metal frame, which is formed by two 8 mm thick steel side walls. These sidewalls are laser cut and connected by welding with 5 mm thick steel profiles. To this structure are attached the individual parts made of oak sprue, see Fig. 5. In total there are three parts: the seat, the backrest with book holder (consisting of two parts) and the kneeler. The pieces are attached to the metal frame with two types of screws. The backrest is made up of two parts and is attached on both sides by gluing so that the joints are not visible. All the wooden parts are milled on the inside of the non-visible side according to the shape of the steel ribs so that they fit together exactly, and the metal ribs are as little visible as possible.

The visible edges of the metal parts are milled to 2.5 mm, the wooden parts are milled with R10, R5 and R3. The metal sides of the bench are fitted with six 8 mm thick plates on the inside near the ground to accommodate the 3D printed rubber glides [11].

Samples of both materials and a sample of the edge of the seat were made before the surface treatment. This was to verify the correctness of the considerations for the new product, so that the final design would match the ideas of the overall product design.

The surface treatment of the metal parts is made by blasting and then powder coating in anthracite shade. The surface of the wooden parts is scratched, stained and treated with waterborne paints. Before the surface treatment, samples of both materials and a sample of the edge of the seat were made to verify the correctness of the product considerations and to ensure that the final design corresponds to the proposed idea of the overall design of the product.

Steel Construction

The steel structure consists of several parts - laser cut side surfaces (sidewalls) and steel T and L profiles that connect, strengthen and ventilate the entire structure.

A template had to be created for the exact welding of the connecting profiles. This was made using a CNC machine from MDF according to the data from the 3D model of the bench and glued to the laser cut sidewalls see Fig. 6. After welding all the parts together, the wooden templates were removed. Next, the platforms for the placement of the rubber gliders were welded to the fabricated structure.

Production of Wooden Parts

Oak wood was chosen for the production of the jointing board because of the attractive wood grain and the properties of this wood species. Oak planks, beech slats and PVAC glue were used. The selected parts for the production of the joints were glued together using D3 glue - a high strength waterproof PVAC glue, according to ČSN EN 204, designed for stressed interiors. Cut-outs were made using a milling head for fitting the wooden parts to the steel structure. In the next step, the edge of the seat was bevelled using a formatting saw, and all other edges were also modified to ensure safe use of the product.

Product Assembly

After the production and surface treatment of all the components of the product, i.e. the steel structure and the wooden parts, it was possible to proceed with the assembly.

A metal bar was glued into the milled hole in the bookshelf as a stop for the books to keep them from sliding down. After drying, this part was screwed to the underside of the L profile of the steel structure. It was also coated with PVAC adhesive and attached to both upper metal profiles. The back of the backrest was knocked down with the other part and also glued with PVAC glue. The seat and kneeler were then bolted to the steel structure.

Since it was not possible to find adequate gliders on the market that would meet the parameters for the bench, the possibility of 3D printing using rubber TPU filament was used.

12: *Probable form of „bradellas“ according to the work of K. Boromejský, 3D modelling of perspective*

DISCUSSION

The aim of the work was to design and realise a church pew for the sacred space, which would be designed for three adults and fit into the planned interior of the “winter chapel” in Křtiny. This chapel is used by the parish of Krtina for various meetings. It is a public space where people with limited mobility can move around. Therefore, the whole interior should be adapted to this. The design of the bench should also meet the requirements for stability and safety, so that it changes its position as little as possible, which affects the ergonomics of use throughout the chapel. The bench is therefore also characterised by a higher weight than, for example, furniture for private spaces.

The research focused first on a literature search regarding the historical development of church pews. Due to the less available historical sources of this specific furniture, a more detailed analysis was carried out. While researching the history, an accurate description was found in the writings of Boromejsky [12] similar to the Renaissance church benches called “bradelas”, see Fig. 12, which had not been depicted anywhere before. In the historical part of the research obtained by mapping the typology of pews from the period, it is evident that the church pews of the Baroque period experienced the greatest boom in ornamentation and elaboration. However, the ergonomic requirements for this type of furniture did not begin to be applied until the modern history of the twentieth century.

The options and characteristics of the intended materials for the bench were set to steel and oak continuous joint. An important part was also the determination of the technological processes that were planned to be used in the production. This was followed by an analysis of the typology of church pews which was an important starting point in considering the design and dimensions that the future pew would have. In connection with the considerations of dimensions, measurements of several modern pews were taken. The average values from the measurements taken were considered in the design. In addition to the average, the subjective

feelings of the user when trying to use the measured benches were also decisive. It turned out that average values are not always related to the feeling of comfort, and it is necessary to work with the fact that there are more factors for pleasant use. Here one can also include the layout of the space itself, both in terms of ergonomic or standard parameters for public spaces and in terms of the artistic value of the space and the atmosphere of the sacred space. The furnishings designed for the sacred space must then be in harmony with the overall concept of the church or chapel. This knowledge was then used in the design itself. They are interrelated and one cannot be separated from the other.

It is evident that the above-mentioned surveys of all possible influencing factors were part of the design process. This was followed by first sketches, creation of paper models (5 variants in total) and 3D visualizations, up to the realization of the 1 : 1 model.

The main inspiration was the interior of the chapel itself and the unique architect Jan Blažej Santini-Aichel, the creator of the Church of the Virgin Mary in Křtiny. When dealing with the issue of ergonomics, extensive research into the dimensions and shapes of modern church pews and their fitting into the interiors was important.

By creating samples of both the shaping of the furniture parts and the samples for the surface treatment, it was possible to eliminate errors in the final model. The side metal parts were laser cut and the steel sections were welded together to form the base of the structure. This was followed by the surface treatment of the metal and wooden parts.

An important part of the successful creation of the model was the participation of the designers in the production process. Thanks to the immediate feedback, it was possible to change some details directly in production and react faster to the situation. In fact, some product parameters and their consequences may only become apparent during production. This was confirmed in the production of the kneeler, where the inclination was slightly reduced as the kneeling proved too steep in the physical test. The kneeler was therefore adjusted to a more moderate inclination, since steepness and slipperiness could be dangerous for use.

The functionality and basic stability of the physical model was first verified by a test with three volunteers directly on the workshop. The results of the testing were then confirmed with a small deviation by a physical test of the model at a certified furniture testing facility.

Testing of the real model showed that the kneeling part shows slightly more flexibility in the middle at higher loads. Also, the seating section showed a small amount of flexibility in the load area. This therefore means that if the bench were to be made longer than the current model, the design should be modified and stiffened at the stressed areas to eliminate this phenomenon.

CONCLUSION

The work describes the development of the church pew from extensive research to its production. The church pew is designed for a specific sacred space. Ideally, it should become part of the interior of the “winter chapel” in Křtiny, for which it was designed.

Initially, the work was concerned with analysing seating furniture in sacred space, with a focus on the church pew for the faithful people.

By visiting many sacred interiors and measuring ergonomics in several modern church interiors and extensive literature research, a better orientation in the design of furniture for these spaces was possible. The creation of cardboard models based on sketches and 3D models helped in the creation of the final shape of the side metal parts of the pew. The production of the 1 : 1 model confirmed the correctness of all ergonomic assumptions with a minor modification in the kneeling part. Subsequently, the surface treatment was carried out by scratching, pickling and painting.

The bench makes an interesting impression, its elegant, subtle appearance connects with the interior of the chapel. The seating is comfortable and pleasant, the seat does not slip, and the sides do not press in any way. The stiffness and stability of the structure stood up to the load of the seat and backrest by three adults, as well as to the static load test in the furniture testing room.

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