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ECONOMIC, SOCIAL AND ERGONOMIC CONDITIONS OF WOODEN PEWS FUNCTIONALITY

Abstract: The presence of sacral furniture in social life in Poland is a universal phenomenon, exerting influence on the development of material and spiritual culture. The paper attempts at identifying the most important ergonomic and socio-economic factors determining the functionality of wooden pews used in Poznań, the capital of the oldest Polish diocese of the Roman Catholic Church. Hence, statistical relations were sought between the structural features of pews and their age, and then, using comparative and descriptive analysis, factors describing their functionality were selected. The research was carried out in an interdisciplinary, international research team, combining the experience of forestry sciences in the field of wood sciences, as well as medical and economic sciences. In conclusion, economic and technological recommendations were formulated that could indicate the optimal directions for the development of a specific market for sacral furniture in Poland, whose dominant part is the production of pews.

Key words: church furniture, pews, functionality, ergonomics, wood market, Poland.

INTRODUCTION

The form and style, but at the same time the comfort and usability of sacral furniture have a direct impact on the quality of human participation in social, cultural and religious life. This reason belongs to one of many that justify undertaking research on functionality conditions of wooden pews, which are an important part of religious buildings equipment in Poland. In view of Poland's belonging to the spiritual and cultural heritage of Christian Europe, it is understandable that science is interested in various aspects of sacral architecture and art.

Much less attention was devoted to research work on the issues of sacral buildings equipment, including in particular the study of sacral furniture. Although pews are usually the third part of the religious buildings surface, their selection is usually left to the individual vision of the designer. In countries where Christian Protestant churches dominate, the problems of the pews functionality were raised relatively more frequently (Harsimowicz 1983; Wojdak 2011; Jodkowski 2014). Developing the current scientific discussion in this area (Jabłoński 2008, Wypych 2009, Kusiak Jabłoński and Wypych 2009, 2011, Kusiak et al. 2017), based on the experience of the Roman Catholic Church, seems justified and needed. On the grounds of the available literature on the subject (Brown 1987, Choodoung and Smutkupt, 2012, pp., 540-544, Czyżewski 2008, Gyurkovich 2009, Martellotta and Cirillo 2009, Kuljian 2013, Kaputa et al. 2016) and authors' own studies (Kusiak et al. 2017, Paluš et al. 2017), factors were selected based on which research on the pews functionality was carried out.

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These factors include at least four main areas: design (sacral architecture), technology (construction), economic (funding) and social (religious culture). In the social aspect, the question is sought as to the extent to which the use of sacral furniture affects building social relations. This question refers to both material culture (architecture and church art), and also spiritual culture (the quality of religious life).

In the economic dimension, an answer is generally sought to the question about financial costs (regarding the design, construction, and maintenance of pews). At the same time, however, questions are asked about efficiency: functional (ergonomics, functionality, comfort of use) and economic (potential benefits, measured by the number of religious practices participants and the amount of their donations to the church community /in Poland, there is no so-called church tax/). In the social dimension questions are asked about development, and sometimes even about preservation of religious traditions and culture, which is closely related to social culture and economic culture, exerting influence not only on the quality of life, but also indirectly on economic activity, entrepreneurship, i.e. indirectly on economic growth and development (Kaczocha and Sikora 2016, Sikora et al. 2015, Wanat 2009, 2016, Wanat and Lis 2009). In this context, the need to continue research on the most popular sacral furniture - pews, and in particular their constructional and functional features, was observed.

THE IDEA OF RESEARCH, MATERIAL AND METHOD

The inspiration for the concept of research was a variety of the pews design, used in Roman Catholic churches in Poland, depending on the age of pews, that is the date of their manufacture. In the face of the identified differences, the research question about the potential relationship between the period of production and constructional features of pews cannot be considered a matter of no importance or neutral. Obtained answers can be a hint for designers and manufacturers of pews (most often made of wood), and also for users of these pews, active but also incidental participants of religious life.

It has been identified that the pews tested have four basic functions. They are used for sitting, kneeling, maintaining a comfortable standing position and comfortable movement in the inner space of pews. Considering such diverse and specific functions of pews, it is difficult to find strict recommendations regarding their construction (standards, literature, design recommendations). In Poland, manufacturers are guided first of all by their own experiences (individual approach), sometimes but not always referring to recommendations of the Polish Standard: Furniture for Sitting (normative approach), more often following the recommendations of users (investor's approach), sometimes formulated by the church administration (e.g. Curia of the Archdiocese of Lodz, see: Dąbrowski, 2013).

The research covered 76 types of pews located in 70 Roman Catholic churches in Poznań (www.archpoznan.pl, accessed 13/12/2017). In addition, a similar number of pews in selected Roman Catholic basilicas of other cities were selected for comparative analysis, including: Łódź, Opole, Nysa (Poland) and Bardejov (Slovakia). In this research group statistical relations were searched for. The inventoried pews were divided into three groups, taking into account the age criterion (date of manufacture) and type (construction). A group of historical desks (the first group), consisting of 31 types of the oldest pews, was designated. New pews were included in the second group. The group consisted of 33 types of pews distinguished by a modern and simple finish. The third group included 12 types of pews of mixed, board construction. Their characteristic feature is a simple structure, consisting in mounting seat boards, backrest and a kneeler on metal frames. All pews were inventoried: measured, described and photographed.

The research material was collected on the basis of measurements carried out in Roman Catholic churches from the administrative area of Poznań, subordinate to the Curia of the Archdiocese of Poznań from the deaneries: Poznań-Rataje, Poznań-Nowe Miasto, Poznań-

Piątkowo, Poznań-Starołęka, Poznań-Winogrady (www.archpoznan.pl, accessed 13/12/2017). For comparative analysis, similar groups and numbers of pews from cathedral basilicas and new churches were chosen for selected cities in Poland (Łódź, Opole, Nysa), (archidiecezja.lodz.pl and www.diecezja.opole.pl, accessed 13/12/2017) and in Slovakia (Bardejov), (<http://www.ke-arcidieceza.sk>, accessed 13/12/2017), in the archdiocese of Koszyce, and the deanery directly adjacent to the diocese of Tarnów in Poland.

Table 1. Types of pews according to the criterion of age (date of manufacture) and construction

Types/groups	Type name	Description	Quantity
Type (group) 1	old benches (antiques)	The oldest designs of church pews, produced up to the conventional caesura, which is marked by the ending of the Second Vatican Council (end of 1965);	31
Type (group) 2	new benches	Pews, which by the form and style refer to simple structures, typical of modern times, corresponding to the architecture of new, modern churches;	33
Type (group) 3	board (mixed) benches	New pews a mixed metal and wooden structure, consisting of a seat board, a backboard and a kneeling board, metal frame mounted on a skeleton.	12

Source: Authors' own elaboration based on (Kusiak et al. 2017, p. 256-258)

The measurements included a set of pews features characterizing the following wooden structural elements: the seat board, the kneeling board and the book-rest board. 18 parameters were chosen: pew height (1), pew length (2), seat length (3), seat height (4), seat depth (5), backrest height (6), chair inclination angle (7), backrest reclining angle (8), the distance between the pews in the row (9), the width of the passage inside the pew (10), the length of the kneeler (11), the width of the kneeler (12), the angle of the kneeler (13), the height of the kneeler (14), the height of the desk (15), width of the book-rest (16), length of the book-rest (17), angle of the book-rest (18). The measurement was made on the basis of data for one, purposefully selected pew located in the middle part of the row. The measurements of the length, width and height of the pew were made using a 3-meter-long steel measure (with an accuracy of 1 mm). A tubular vial was used to measure the angle of inclination, and then calculations were made using mathematical formulas on the basis of the given sections of the sides. It should be noted that making a synthetic division of the examined pews into three groups was preceded by agglomeration analysis, carried out for the whole set. Then, eight features were selected and considered for a detailed examination of the pews functionality, i.e. the height of the pew (1), the seat height (4), seat depth (5), width (12) and the angle of the kneeling (13), height (15), width (16) and desk inclination angle (18).

In turn, the identification of the most important economic and social conditions was made on the basis of authors' own research, carried out using a questionnaire survey, participant observation, intelligence techniques and in-depth interviews. Questions were asked, among other things, about the quality and comfort of using pews for all selected groups and types of pews, as well as the number of religious participants in sacral buildings using old, new and mixed board pews.

DISCUSSION AND ANALYSIS OF RESULTS

On the basis of the conducted research, it was shown that dimensions of the majority of analyzed pews did not meet the recommendations of the standard describing the construction of sitting furniture. This applies in particular to the height and depth of the pew seat and the ergonomic backrest angle. In turn, in surveys (at the same time referring them to the standardization requirements), it was identified that the factors determining the comfort of use were primarily the structure and shape of the pew (over 87.6% of answers). Moreover, in the kneeling position,



dimensions of the kneeling board (78.6%) and the angle of its inclination (86.3%) play an important role, while the comfort of standing and moving in the inner space of the pew (passing) is crucial for the width of the walkway (92.8%). It can be assumed that pews of dimensions significantly differing from the standardization requirements are considered uncomfortable.

As already mentioned, there are no special recommendations or standards for the construction of church pews. The freedom of their design means that contractors and investors are sometimes guided primarily by dimensions (surface area) and financial limitations (investment budget). Therefore, the comfort and other functional aspects of pews and their decorative form (sacral art) become of secondary importance. It also results from the fact that in Poland the Roman Catholic Church lives primarily off the voluntary donations of the faithful.

Based on research (including anthropological and physiological studies), the conditions to be fulfilled to ensure the proper sitting position are determined. It was pointed out (Peacock, Northam and Diels 2008; Wykowska 2009; Muszyński 2016; Kusiak et al. 2017) that the “sitting position should be characterized by: high torso stability” (associated with the limitations of the apparent movements and allowing the body to maintain a given position); the “best possible coordination of limbs; relief of lower limbs and relief of the circulatory system”. A sitting position “can be harmful if you have: hanging feet due to the lack of footrest and behind the high seat; too shallow a seat and buttock pressure (resulting from a soft or poorly formed finish)”, (Kusiak et al. 2017, p. 255).

It was identified that functionally the most beneficial was a full backrest of the pew, and not only the one made in the form of a backboard (in accordance with the normalization requirements, the backrest of the pew should form an obtuse angle from 100° to 110°). It is worth emphasizing that the function of the pews footrest fulfills the kneeling board, which makes the sitting position more comfortable. In addition, the comfort of kneeling is influenced by the inclination (81.3%) of the kneeling plank (up to 34,5%). The pew has a knee-board position in relation to the front edge of the seat (this dimension was measured in a vertical view). This dimension also affects the comfort of kneeling and sitting (78.4%).

Too small passage width may cause difficulties when standing up and moving in the inner space of the pew and going outside. Seeking the optimal dimensions of the pews and comparing the analysis of the available literature with the results of authors' own research, the difficulty in the pews design was pointed out. It should include the combination of two important functions of pews, i.e. kneeling and moving. The book-rest should be placed at an angle to allow comfortable use of the prayer books in each position: standing, sitting and kneeling. Very often, the book-rest acts as a backrest, the width of which determines the space between the user of a given pew (in a kneeling position) and the preceding person (in a sitting position), deciding on the comfort or discomfort of use.

A separate group of pews are still numerous, historical, carved pews. These are sometimes works of art which through their ornaments and dignity give a sacral atmosphere to sacral interiors. This state has been identified to make users (even subconsciously) treat them as more comfortable (86.8%), regardless of the actual functional features.

Jabłoński (2008), Wypych (2008), and then Kusiak et al. already tried to ergonomically assess pews in the churches of Poznań (2009, 2011), showing no significant statistical relationships in these studies. In this manuscript, a detailed statistical verification of the results was performed by analyzing the confidence intervals (0.95) for all the pews features considered. It was shown (variability analysis) that in the types of examined pews there were significant differences for 6 examined traits (regarding directions of changes and their size). The following parameters were clearly differentiating types of pews: the height of the pew (1), the height of the seat (4), the angle of the knee (13), the height (15), the width (16) and the angle of the desk (18), (Kusiak et al. 2017, p. 259-263). Selected results are illustrated graphically (Fig. 1 and Fig. 2).

It has been observed that the height of the pew seat is a feature with a variable tendency (increase after the initial decrease), the scale of changes is different (disjoint confidence intervals for types 1 and 2, and separately, a smaller variation between type 3 and types 1 and 2 - common parts of intervals confidence). This trend is illustrated in Figure 1.

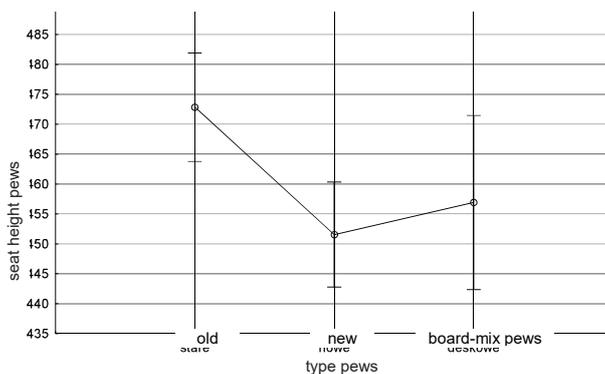


Figure 1. Analysis of confidence intervals for pews seat height

Source: Authors' own elaboration based on Kusiak et al. (2017, p. 259-263)

In the case of pews, the value of this parameter was not reduced, not only between type 1 and type 2 pews, but also between type 2 and the type 3 pews (the largest drop in height occurred between type 1 and 2 - separate confidence intervals). The width of the kneeler as well as its angle of inclination were also reduced (there was a change resulting from the construction of an almost flat knurled plank, which allowed a direct passage on this board). The height of desk mounting in pews also decreased, and a similar tendency was observed in relation to the desk inclination angle and the width of the book-rest.

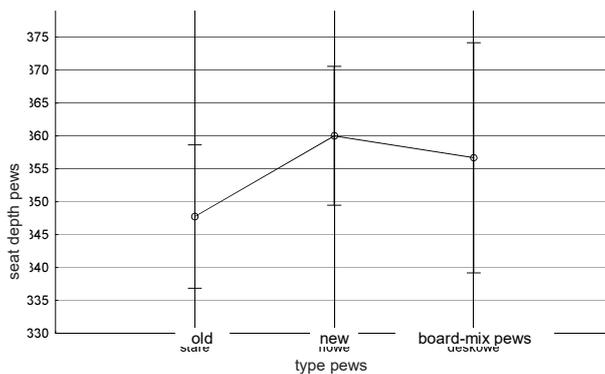


Figure 2. Analysis of confidence intervals for the depth of the seat

Source: Authors' own elaboration based on Kusiak et al. (2017, pp. 259-263)

Analyzing the depth of the pew seat, which is one of the key parameters when it comes to the convenience of use, a changeable tendency was noticed (type 1 pews were clearly “shallower” than type 2). This increase seems to be related to the tendency to improve sitting comfort



(standardization indications, in relation to the seat depth from 360 mm to 450 mm, were met by 48.9% of the pews tested (Figure 2).

Based on the comparative analysis of data concerning the examined pews from the administrative area of Poznań, for which a similar sample was selected from cathedral basilicas and new churches in Łódź, Opole and Nysa (Poland) and in Bardejov (Slovakia), similar results were obtained by analyzing confidence intervals (0.95) for the identical features of pews considered, the differences of which did not exceed the statistical error (error 9.7%). On this basis, it was assumed that the trend identified in Poznań and in the capitals of the Roman Catholic dioceses in Łódź and Opole, as well as in the deanery capitals having their own historical basilicas, i.e. in Nysa and Bardejov (Slovakia), was similar, which entitled the authors to analogous inference. No statistically significant differences were identified in this respect.

CONCLUSIONS

The paper attempts to identify the most important ergonomic and socio-economic factors determining the functionality of wooden pews used in Poznań, the capital of the oldest Polish diocese of the Roman Catholic Church. The results were verified by means of the comparative analysis with other selected Polish diocese capitals (Łódź and Opole) and deanery capitals, having their own basilicas in Poland (Nysa) and Slovakia (Bardejov). Statistical relationships were sought between the constructional features of pews and their age, and then the most important factors describing their functionality. In the course of the research, convergent results were obtained without significant statistical differences. Summing up, one should indicate both the limitations of the research method and the necessity of multi-aspect analysis of the pews functionality. Unfortunately, given the non-fulfillment of the assumption about homogeneity of variance, it was not possible to include a classical analysis of variance in the designed research scenario, performing a verification for confidence intervals, which were determined for selected structural features of the examined pews.

The pews in question were grouped and three leading types were identified: old, new and board (mixed), and these groups are distinguished by the period of production (age) and constructional features. It was shown that in addition to the increase in the dimension of the depth of the pews seat, the remaining construction dimensions decreased. This applies even to the width and height of the pews book-rest, its location and angle of inclination, which probably results from the change in functionality of individual structural elements. The inclination angle of the kneeling board also changed to an almost flat board, horizontally located (type 3). It can be assumed that the evolution of the pew construction began parallel to the changes that were introduced in the liturgy of the Roman Catholic Church based on the constitution and documents of the Second Vatican Council. In qualitative research, taking into account behavioral aspects, the relationship between the comfort of using pews and their historical construction was identified, with a clear preference for type 1, i.e. pre-conciliar (pews made before Vaticanum II). In addition to ergonomic preferences (comfort and quality of sitting and kneeling), dependencies of an economic nature were also identified (including the relation of income dependence of Polish parishes, living mainly off the donations of the faithful, from the functionality of furniture intended for religious worship), also indicating the preference for pews type 1 by religious life participants.

It should be assumed that identified tendencies will sooner or later be noticed by church institutions (as investors), and also by designers and manufacturers of pews, both for economic reasons (financing and maintenance) and social ones (religiousness), spiritual development (participation in religious culture events). The tendency to care for the quality of spiritual life, including the comfort of sacral space use, indicates a return to at least some traditional forms of pews, enriched with modern elements (such as heating) and innovation development.

**REFERENCES**

1. Brown, C. G. (1987). The costs of pew-renting: church management, church-going and social class in nineteenth-century Glasgow. *The Journal of Ecclesiastical History*, 38(3), 347-361.
2. Choodoung, S., Smutkupt, U. (2012). Factors of successful wooden furniture design process. *World Acad. Sci. Eng. Technol*, 70, 540-544.
3. Czyżewski, K. J. (2008). „Siądź mi po boku prawym”. O zasiadaniu w kościele słów kilka. In: Nowacki, D. (ed.), *Mecenat artystyczny a oblicze miasta* (p. 57-76). Materiały LVI Ogólnopolskiej Sesji Naukowej Stowarzyszenia Historyków Sztuki, Kraków 8-10 XI 2007. DOI: 10.11588/artdok.00001674.
4. Dąbrowski, A. (2013). Wytyczne dla inwestorów obiektów sakralnych i kościelnych Archidiecezji Łódzkiej, KO-22-688/13 z 23 kwietnia 2013 roku, Kuria Metropolitalna Łódzka, Łódź, <http://archidiecezja.lodz.pl/app/uploads/2016/08/Wytyczne-dla-Inwestorow.pdf>, accessed: 30.12.2017.
5. Gyurkovich, J. (2009). Architektura sakralna - współczesne tendencje w kościele zachodnim. *Przestrzeń i Forma*, 12, 173-186.
6. Harsimowicz, J. (1983). Protestantkie budownictwo kościelne wieku reformacji na Śląsku. *Kwartalnik Architektury i Urbanistyki: teoria i historia*, 28(4).
7. Jabłoński P. (2008). Antropometryczna ocena ławek w wybranych kościołach Poznania (p. 1-115). Unpublished diploma thesis.
8. Jodkowski, K. M. (2014). Budownictwo Kościoła ewangelickiego na obszarach historycznej Warmii w dobie sekularyzacji. *Studia nauk teologicznych*, 9, 1772-1840.
9. Kaczocha, W., Sikora, J. (2016). Ecological Ethics. Values and norms in local rural communities. *Journal of Agribusiness and Rural Development*, 1(39), 69-78. DOI: 10.17306/JARD.2016.8.
10. Kaputa, V., Paluš, H., Vlosky, R. (2016). Barriers for Wood Processing Companies to Enter Foreign Markets: a Case Study in Slovakia. *European Journal of Wood and Wood Products*, 74(1), 109-122.
11. Kuljian, C. (2013). *Sanctuary: How an inner-city church spilled onto a sidewalk*. Johannesburg: Jacana Media.
12. Kusiak, W., Jabłoński, P., Wypych, A. (2009). Próba ergonomicznej oceny ławek w kościołach Poznania. In: *Prewencja ergonomiczna schorzeń uwarunkowanych pracą* (p. 103-117). Monografia, W. M. Horst (ed.). Poznań: Wyd. Politechniki Poznańskiej.
13. Kusiak, W., Jabłoński, P., Wypych, A. (2011). Ergonomiczna charakterystyka ławek w kościołach Poznania. *Miesięcznik Kościelny Archidiecezji Poznańskiej*, 1, 31-42.
14. Kusiak, W., Mikołajczak, E., Molińska-Glura, M., Moliński, K., Biszof, A., Wanat, L. (2017). Innovative approach to traditional case studies: Economic, social and ergonomic aspects of wooden church pews functionality - the case of Poland. In: D. Jelačić (eds.) *Innovations in forestry, wood processing and furniture manufacturing*, (p.253-264). Zagreb: WoodEMA, i.a.
15. Martellotta, F., Cirillo, E. (2009). Experimental studies of sound absorption by church pews. *Applied Acoustics*, 70(3), 441-449.
16. Muszyński, Z. (2016). Rozwój ergonomii w Polsce i na świecie. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 1 (29), 87-100.
17. Paluš, H., Parobek, J., Vlosky, R. P., Motik, D., Oblak, L., Jošt, M., ... & Wanat, L. (2017). The status of chain-of-custody certification in the countries of Central and South Europe. *European Journal of Wood and Wood Products*, 1-12, 699-710.
18. Peacock, B., Northam, G., Diels, E. (2008). Ethics and Ergonomics: Customer Satisfaction. *Ergonomics in Design*, 16(3), 4-29.
19. Polska Norma PN-91/F-06027/03 Meble do siedzenia.



20. Sikora, J., Kaczocha, W., Wartecka-Ważyńska, A. (2015). Values and professional and ethical norms in rural tourism in Poland. *Agricultural Economics*, 61 (8), 377-392. DOI: 10.17221/14/2014-AGRICECON.
21. Wanat, L. (2009). Wood market science a new discipline of economic sciences supporting knowledge-based economy development. *Intercathedra*, 25, 149-151.
22. Wanat, L. (2016). Gospodarka leśna: zrównoważona czy integralna? Dylematy badawcze z perspektywy polskiego rynku drewna okrągłego. *Przegląd Leśniczy*, 9, 26-27.
23. Wanat, L., Lis, W. (2009). Promotion of best practices - project proposal for the wood industry in Poland. *Intercathedra*, 25, 151-155.
24. Wojdak, E. (2011). Postępowe idee protestanckiej architektury sakralnej w bydgoskim budownictwie kościelnym ostatniej ćwierci XIX w. *Materiały do Dziejów Kultury i Sztuki Bydgoszczy i Regionu*, 16, 16-37.
25. Wykowska, M. (2009). *Ergonomia: jako nauka stosowana*. Kraków: AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne.
26. Wypych, A. (2008). *Antropometryczna ocena ławek w wybranych kościołach Poznania* (p. 1-113). Unpublished diploma thesis.
27. www.archidiecezja.lodz.pl
28. www.archpoznan.pl
29. www.diecezja.opole.pl
30. www.ke-arcidieceza.sk