ZESZYTY NAUKOWE POLITECHNIKI POZNAŃSKIEJ
Nr 25 Architektura, Urbanistyka, Architektura Wnętrz 2025
DOI: 10.21008/j.2658-2619.2025.25.6

Bartosz SZOSTAK[1], Aleksander KŁEMBOKOWSKI[2],
Maciej TROCHONOWICZ[3]

TECHNICAL AND CONSERVATION CHALLENGES AT THE DESIGN STAGE OF THE RENOVATION OF THE TIMBER TOWER AND NARTHEX OF THE CHURCH IN WERESZCZYN

The paper presents the course of works related to the comprehensive renovation of the historic timber tower and narthex of the Church of St. Stanislaus, Bishop and Martyr, in Wereszczyn – one of the most valuable examples of wooden sacral architecture in the region. The structure, erected using traditional post-and-beam timber framing, suffered severe damage due to long-term moisture exposure and advanced biological degradation. Based on detailed architectural surveys and mycological investigations, it was determined that the majority of the load-bearing timber elements had lost their mechanical properties and were unsuitable for preservation.

The article describes the process of digital reconstruction of the structure and the execution of structural analyses, which made it possible to better understand the load-bearing behaviour of the entire system. The results confirmed numerous exceedances of permissible deflections and stresses, justifying the necessity of reconstructing the tower and narthex using new materials and elements. The reconstruction design was based on the principle of maximum compliance with the historic spatial layout, supplemented by carefully selected reinforcements and modern timber connectors in order to combine structural safety with respect for the authenticity of the original form.

The paper also addresses the broader conservation context, demonstrating how design decisions take into account both technical requirements and the heritage value of the building. Comparisons with similar projects carried out in Poland and across Europe are presented, highlighting the importance of an interdisciplinary approach to the protection of wooden architectural heritage.

Keywords: timber tower renovation, narthex, post-and-beam timber frame structure, historic buildings, timber conservation, sacral architecture

[1] Lublin University of Technology, Faculty of Civil Engineering and Architecture. ORCID: 0000-0002-2325-7103.
[2] University of Technology and Arts in Applied Sciences in Warsaw, Faculty of Architecture.
[3] Lublin University of Technology, Faculty of Civil Engineering and Architecture. ORCID: 0000-0001-7742-7916.

1. INTRODUCIOTN

Cultural heritage constitutes a key element of social and historical identity; therefore, its protection and preservation for future generations is a priority for many countries [Mendoza 2023]. Contemporary research emphasizes that effective and sustainable conservation of historic buildings requires a multidisciplinary approach combining traditional methods with modern technologies [Pachta 2023]. The dynamic development of digital techniques in recent years has fundamentally transformed heritage conservation practice. Advanced tools such as 3D laser scanning and photogrammetry enable highly accurate and rapid documentation of historic structures [Szostak 2024].

The resulting 3D models can be integrated with BIM systems, forming so-called H-BIM (Historic Building Information Modeling). This approach allows the centralization of diverse information related to a monument – ranging from point clouds and historical records to current sensor measurements – within a coherent digital model of the building [Escudero 2023]. Based on such digital models, advanced structural analyses can be carried out using computer-based calculation methods. Moreover, three-dimensional models may also be utilized for additive manufacturing purposes in the future [Kantaros 2023].

Artificial intelligence and machine learning represent another breakthrough in the field of heritage conservation. Automated analysis of images of historic buildings – using, for example, deep neural networks – enables rapid detection of cracks, material losses, and other forms of degradation on the surfaces of historic structures [Giannuzzi 2024].

Wooden churches constitute a valuable component of Europe's cultural heritage and require modern technologies and specialized conservation measures to prevent their degradation and potential structural failures [Truong-Hong et al. 2021].

One such structure is the parish church of St. Stanislaus, Bishop and Martyr, in Wereszczyn (Urszulin municipality, Włodawa County, Lublin Voivodeship), whose tower requires urgent renovation. The church was erected in 1634 on the eastern edge of the village of Wereszczyn. It is currently located within a conservation protection zone and is listed in the register of monuments of the Lublin Voivodeship under entry No. A/144. The timber tower above the narthex, which forms the dominant feature of the building's massing, has suffered progressive deterioration due to many years without repairs and now poses a serious risk of structural failure.

This paper presents the results of an assessment of the technical condition of this historic tower and outlines the scope of the planned renovation works. The structure of the article includes the historical and architectural context of the building, the applied methodology of pre-design investigations, a description of the scope and course of the renovation works, and a discussion of the results in relation to European experience in the renovation of historic wooden church towers. The paper concludes with final remarks derived from the conducted analyses.

Fig. 1. View of the church tower and narthex [photo by A. Kłembokowski]

The church in Wereszczyn is an oriented wooden structure with a simple plan, consisting of a narthex (vestibule), nave, presbytery, and two symmetrical sacristies. Above the narthex, a choir gallery is located, with dimensions of approximately 6.0 × 12.0 m, corresponding to the plan of the narthex below.

A three-storey tower with a square plan is attached to the front (north-eastern) façade of the narthex and aligned with the front wall of the church. The two lower storeys of the tower have base dimensions of approximately 3.76 × 3.74 m and a total height of about 7.3 m, while the third storey (2.82 × 2.82 m, height approx. 3.95 m) is slightly narrower and set back relative to the footprint of the lower storeys [Kłembokowski, technical design, 2024].

The tower is crowned with a four-sided pyramidal roof with a pitch of approximately 70°, incorporating so-called *przypustnice* (stepped transitional roof slopes) inclined at about 45° [Kłembokowski, technical design, 2024]. This architectural form is characteristic of seventeenth-century wooden churches of the Lesser Poland and Lublin regions, combining a simple plan with a prominent front tower serving as both a belfry and a flèche.

Historical records indicate that the church underwent several renovations during the twentieth century. Restoration works were carried out in 1941 and 1964, and in 1975 the original wooden shingle roof covering was replaced with steel sheet roofing. In the 1970s and 1980s, the external cladding (façade boarding) was also replaced, interior walls were finished with wooden panelling, and parts of the floors and ceilings were renewed. However, these interventions were largely limited to the replacement of finishing materials and external sheathing, without comprehensive repair of the tower's load-bearing structure.

The lack of regular conservation maintenance in subsequent decades led to a gradual deterioration of the technical condition of the timber tower structure. At present, the state of preservation of this part of the building is assessed as requiring immediate renovation. Long-term use without ongoing repairs has resulted in advanced degradation of the timber structural elements, particularly in areas most exposed to moisture and biological pest activity.

2. METHODOLOGY – PRE-DESIGN ANALYSES

Prior to commencing the design of the renovation works, comprehensive analyses of the technical condition of the tower and the narthex were carried out. In the first stage, available archival materials were reviewed, including the architectural and conservation inventory of the building. Subsequently, in May 2024, a detailed on-site inspection and visual survey of the structure were conducted, accompanied by photographic documentation and geodetic and construction measurements (including the use of a laser distance meter and a level).

Exploratory openings were made in selected parts of the tower and narthex structure in order to assess the layout and condition of joints concealed beneath cladding layers. A macroscopic assessment of the quality and degree of technical wear of the timber was performed in the exposed areas. In parallel with the visual inspection, mycological and entomological investigations were carried out to evaluate the extent of biological corrosion of the timber caused by fungi, as well as the presence of technical insect pests within the structural elements [Kłembokowski, technical expertise, 2024].

It was found that, as a result of long-term moisture exposure caused by roof leakages, timber elements not protected by preservative treatment had been severely attacked by wood-boring insects. The dominant pest species was identified as the house longhorn beetle (*Hylotrupes bajulus*), with local occurrences of infestation by the common furniture beetle (*Anobium punctatum*). The intensity of fungal attack was lower; no active, extensive fungal infection was observed, although the presence of fungi (e.g. *Serpula lacrymans*) was locally identified at damp interfaces between structural elements.

Fig. 2. Photographs illustrating damage caused by infestation by the house longhorn beetle and the common furniture beetle [photo by M. Trochonowicz]

The most severe technical deterioration was observed in the floor beams above the narthex (choir), many of which had suffered significant cross-section losses – reaching up to approximately 50% – as a result of decay caused by technical insect pests. The corner posts and diagonal braces of the narthex walls were also heavily affected by biological corrosion and exhibited permanent deformations (out-of-plumb displacements), indicating a substantial loss of structural stiffness.

Fig. 3. Example of a biologically deteriorated floor beam [photo by M. Trochonowicz]

The subsequent stage involved carrying out computational analyses to verify the load-bearing capacity of the primary structural elements of the tower and the choir. The works related to the structural analysis are described in one of the following sections of the paper.

3. STRUCTURAL ANALYSIS

The works commenced with a detailed survey of the existing structure of the tower and the narthex. Precise geometric measurements were carried out for the entire building volume, as well as for all linear structural elements (posts, beams, braces, etc.) and their traditional carpentry joints.

The previously prepared mycological assessment confirmed the initial concerns: the majority of the timber structural elements had been severely affected by fungal attack and had undergone advanced degradation. The technical condition of many components proved to be so poor that preservation of the original material was no longer feasible. Consequently, dismantling of the structure down to the level of the foundations and its reconstruction using new elements was recommended.

In addition, the measurements revealed that the tower was leaning out of plumb, indicating a loss of its original structural stability. This finding further influenced the decision to dismantle the entire structure and reconstruct it from scratch, restoring its correct geometry and ensuring safe use.

Fig. 4. View of the interior of the tower and narthex [photo by A. Kłembokowski]

Fig. 5. Photograph taken during measurements of structural element deviations [photo by A. Kłembokowski]

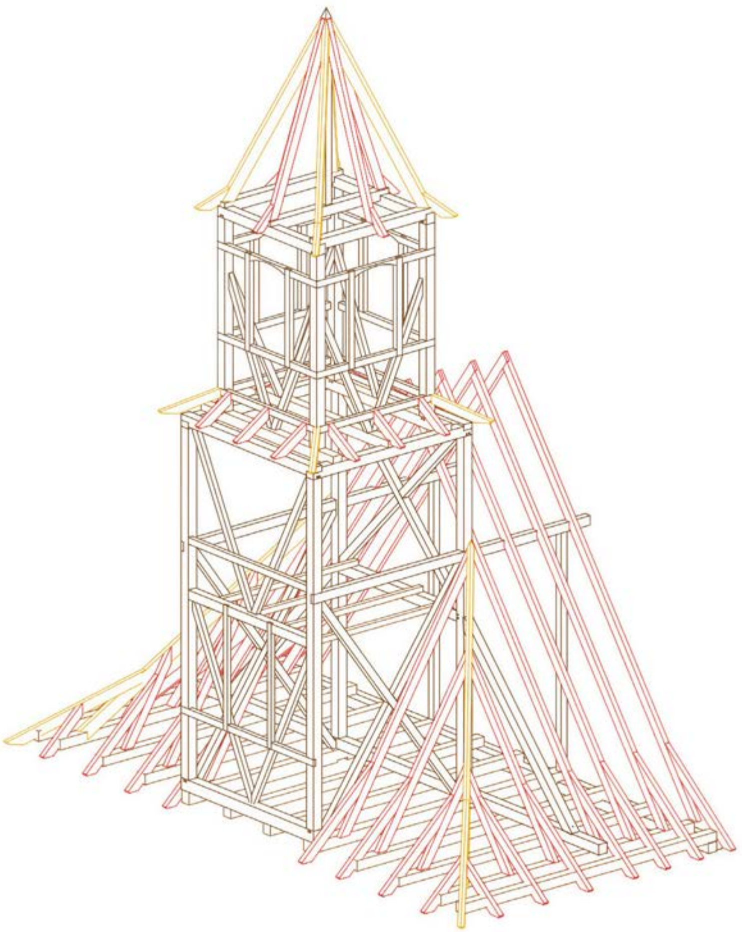

Fig. 6. View of the 3D structural model analysed in the Dietrich's software

A three-dimensional model of the tower and narthex structure was developed based on the survey data. All timber elements and carpentry joints were faithfully reproduced. Using the collected data, a comprehensive 3D model of the entire structure was created in the Dietrich's software environment. Dietrich's supports BIM technology, which means that the H-BIM model developed for analytical purposes may later be expanded and used for other applications beyond structural and strength analysis. This constitutes added value that is particularly important in the context of cultural heritage protection, as discussed in the Introduction.

The structure was divided into transverse and longitudinal systems (with individual walls modelled as frames) and subsequently subjected to spatial calculations in order to assess the global stiffness and load-bearing capacity of the combined tower–narthex structural system.

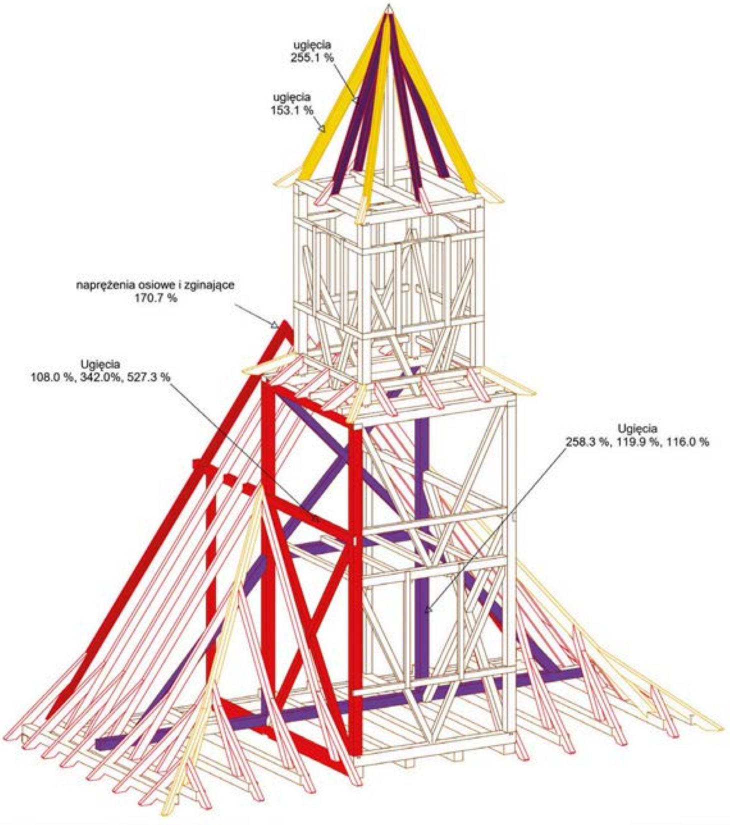

Fig. 7. View of the structural analysis and utilization of elements in the Dietrich's software. The diagram illustrates exceedances of allowable structural parameters, including deflections (ugięcia) and axial and bending stresses (naprężenia osiowe i zginające) in selected structural members

The conducted structural calculations revealed a number of deficiencies. It was found that, in its current condition, the structure did not meet the requirements of the serviceability limit states (SLS), as deflections of many elements significantly exceeded permissible values (in some locations, calculated deflections were several times higher than the normative limits). Failure to satisfy the ultimate limit states (ULS) was also identified, as stresses resulting from load combinations exceeded the allowable strength of the timber; the maximum calculated utilization reached approximately 170%.

The analysis of joints demonstrated that traditional carpentry connections (e.g. notched joints) were unable to transfer the acting forces in many nodes. In particular, tensile uplift forces occurred that could not be resisted by mortise-and-tenon or notched joints alone. These results confirmed that, without intervention, the structure would be unstable and unsafe according to contemporary design criteria. This is not surprising given the age of the building: the original builders did not have access to modern calculation methods, and decades of use combined with biological damage had further weakened the original structure.

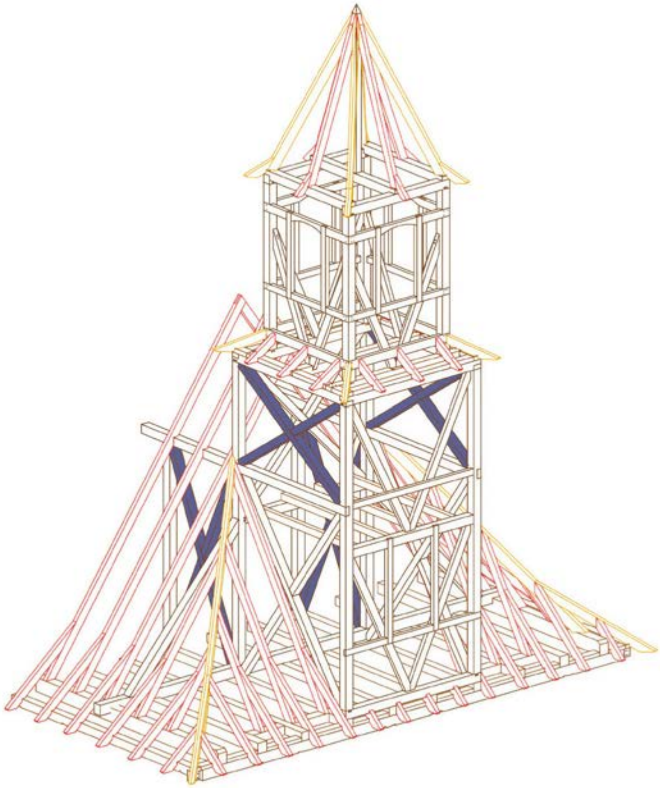

Fig. 8. View of the structure with newly introduced elements in the Dietrich's model

Having gained insight into the actual structural behaviour, the design of the necessary reinforcements was undertaken (marked in dark blue). The guiding principle was to preserve the original structural layout – namely, the transverse frame system of the tower and the longitudinal system of the narthex – in a form as close as possible to the original.

Initially, an attempt was made to reproduce all original solutions without introducing additional elements; however, the calculations showed that the required load-bearing capacity and stiffness could not be achieved without intervention. Therefore, a minimal number of new stiffening elements was introduced. Several missing diagonal braces were added only where absolutely necessary to ensure the spatial stability of the tower and the narthex. After the introduction of these bracings, the structure achieved the required load-bearing parameters. Recalculation confirmed that both

ULS and SLS criteria were now satisfied within normative safety limits. The addition of these braces made it possible to retain the remaining structural layout in its historic character, using elements with dimensions identical to the original ones.

In the subsequent stage, attention was focused on strengthening the joints. The analysis indicated that certain nodes required modification in order to transfer forces that had not been anticipated in the historic carpentry solutions.

In the notched joints connecting posts and beams, uplift forces acting on the elements were identified. Traditional notched joints do not provide resistance to such actions; therefore, discreet fully threaded screws passing through the joints were designed. These steel connectors are concealed within the timber and significantly increase the withdrawal resistance of the joints without altering the appearance of the historic structure.

In designing all secondary elements (additional braces, ties, screws, etc.), materials and techniques compatible with the historic structure were adopted. New timber elements will be made of appropriate wood species and strength classes, while steel connectors were arranged to be as inconspicuous as possible and, where feasible, reversible, allowing for potential future dismantling.

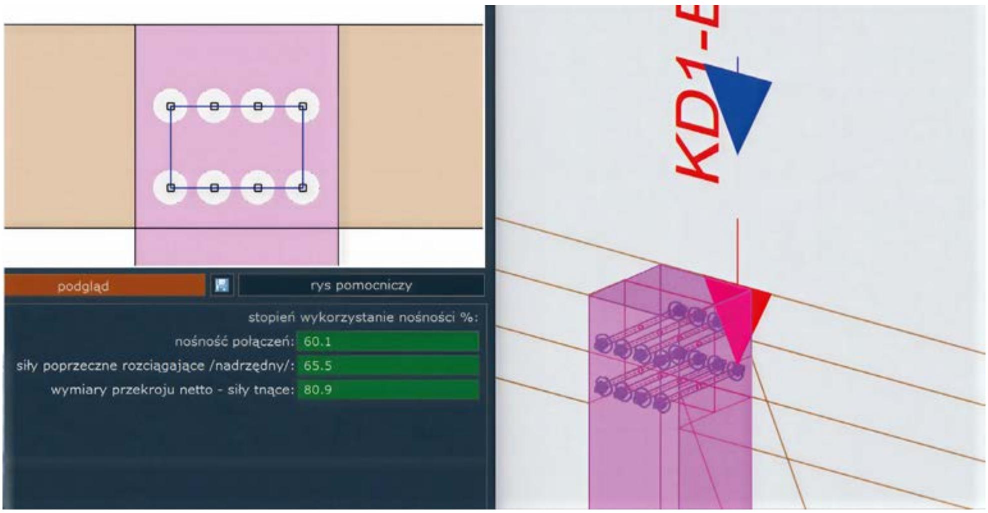

Fig. 9. Widok na analizę połączeń wykonaną w programie Dietrich's. The diagram presents the degree of utilization of connection capacity (stopień wykorzystania nośności połączeń), resultant shear forces (siły poprzeczne rozciągające / nadrzędne), and net cross-section utilization under tensile forces (wymiar przekroju netto – siły tnące)

Due to the extent of the damage, almost the entire structure of the tower and narthex will be reconstructed using new timber elements, while preserving the original dimensions and structural layout. A crucial issue, however, is the integration of the new structure with the remaining original elements of the building.

The church foundations, as well as the adjoining parts of the nave and roof, form the base to which the reconstructed tower and narthex must be connected. New anchorage systems were designed to attach the tower frame to the existing foundations, ensuring full stability and verticality of the structure while correcting the previous inclination.

The interfaces between the new structure and the historic part of the church (the connection between the narthex and the nave wall) were designed to minimize interference with the original fabric. These connections were conceived to transfer loads evenly to the historic material without causing local weakening; for example, bolted connectors were used, which can potentially be removed in the future without damaging the original elements.

As a result of these measures, the new structure cooperates harmoniously with the existing historic fabric, ensuring the required load-bearing capacity and stiffness while respecting the heritage value of the building. All interventions involving the introduction of new elements were carried out with due respect for the historic substance.

4. SUMMARY

The scope and method of renovation of the church tower in Wereszczyn result from the exceptionally poor technical condition of the structure; nevertheless, the adopted approach fits into the broader methodological framework of wooden heritage conservation. The preliminary investigations conducted – ranging from historical research, through detailed surveys using modern measurement techniques and material diagnostics, to structural calculations – are consistent with the recommendations presented in contemporary scientific studies on the protection of historic structures. As indicated by Nuzzo and Faella [2021], effective and sustainable conservation requires a multidisciplinary approach, encompassing in-depth historical studies, detailed measurements, and diagnostic investigations, followed by multi-variant structural analyses prior to design decision-making. This very scheme was applied in Wereszczyn, where decisions regarding the dismantling and reconstruction of the tower were based on reliable expert assessments that took into account both heritage values and current structural design standards.

One of the dilemmas typical of the renovation of historic timber structures is the choice between preserving as much original fabric as possible and ensuring adequate safety for use. The literature emphasizes the overarching principle of minimal intervention, recommending that historic elements be repaired and strengthened rather than replaced, provided this is technically feasible [Nuzzo, Faella 2021].

In the case of the tower in Wereszczyn, however, the condition of many elements was so critical that there was no realistic possibility of saving them through localized strengthening. The extent of biological corrosion and structural damage (including column buckling and loss of up to 50% of the cross-section of floor beams) necessitated an almost complete reconstruction of this part of the building in order to ensure safety. It should be noted that similar situations occur in other European countries, where the scale of deterioration requires far-reaching interventions. For example, Kubica et al. [1999] described a case of severe failure of the tower of the pilgrimage church in Piekary Śląskie, where the completely devastated upper part of the masonry tower was reconstructed from scratch, while avoiding the dismantling of the preserved 17 m high timber spire. This unusual solution – leaving the historic spire in place and rebuilding its supporting structure – made it possible to preserve a valuable original crowning element that constituted a symbolic feature of the church.

In Wereszczyn, unfortunately, such a solution was not possible: the entire tower, including its spire, was destroyed, making complete dismantling unavoidable. Nevertheless, the principle of preserving authenticity was reflected in the decision to reincorporate selected, best-preserved fragments of the historic timber structure as historical witnesses. Such an approach is consistent with conservation principles, which advocate preserving original materials wherever possible and avoiding the erasure of the "traces of time" on historic buildings [Nuzzo, Faella 2021]. As a result, even after comprehensive renovation, the tower will retain elements originating from earlier periods, although they will no longer perform a primary structural function.

In the context of the discussed renovation, it is also worth addressing the issue of preventive maintenance and monitoring of historic structures. The example of the Wereszczyn tower clearly demonstrates that long-term neglect of routine conservation leads to extreme degradation, necessitating costly and invasive interventions. Meanwhile, contemporary research highlights the importance of regular monitoring of historic buildings – particularly tall towers – in order to detect damage and deformations at an early stage.

Thanks to modern technologies such as terrestrial 3D laser scanning, it is possible to periodically monitor deformations and deviations from verticality of church towers with sub-millimetre accuracy. Truong-Hong et al. [2021] described the application of 3D scanning to analyse the geometry of a 500-year-old timber tower of St. Bavo's Church in Haarlem; the study revealed non-uniform wall deformations and allowed for an assessment of the level of structural risk. Such engineering monitoring provides valuable data for planning maintenance activities and can prevent unexpected failures through early intervention.

If a building such as the church in Wereszczyn had been subject to continuous observation and preventive conservation, the scale of degradation could have been significantly reduced – minor roof leakages or the first signs of pest activity could have been detected and addressed before extensive damage to the timber structure occurred. Therefore, the post-renovation programme of regular inspections and protective measures appears essential for extending the service life of the monument.

In conclusion, the renovation of the church tower in Wereszczyn constitutes an interesting case study that combines a classical conservation approach – aimed at preserving authenticity to the greatest possible extent – with the requirements of structural safety. The relevant literature emphasizes that conservation-oriented design should be based on a conscious, scientific approach to historic buildings, integrating historical knowledge, an understanding of traditional construction techniques, and the results of diagnostic investigations and engineering analyses. The Wereszczyn case fully aligns with this paradigm, as the design decisions were made on the basis of interdisciplinary findings developed by specialists from multiple fields.

5. CONCLUSIONS

The analyses carried out and the design measures adopted for the renovation of the historic church tower in Wereszczyn lead to the following conclusions:

- The technical condition of the timber tower prior to renovation was assessed as critical. Long-term lack of repairs, prolonged moisture exposure, and intensive biological corrosion (with a predominance of the house longhorn beetle) had brought the structure to the verge of failure, posing a real risk of structural collapse. This constitutes a clear warning that historic timber buildings require continuous supervision and preventive conservation; otherwise, they are subject to rapid degradation.
- The methodology applied to assess the condition of the structure proved appropriate and effective. A comprehensive investigative approach – including archival research, on-site inspections, exploratory openings, mycological and entomological studies, measurements, and structural calculations – enabled an accurate diagnosis and the development of an adequate repair design. Such interdisciplinary procedures are consistent with best practices in the field of architectural heritage protection.
- The scope of the renovation works had to be extensive due to safety requirements. A decision was made to completely dismantle and reconstruct the tower and the narthex, as partial repair of the existing elements would not have ensured sufficient stability and structural safety. Although this entailed significant intervention in the historic fabric, it was the only viable means of preventing structural failure. Owing to improved technical solutions (e.g. the introduction of additional bracing and strengthened connections), the reconstructed tower will be fully safe and durable.
- Respect for the heritage values of the building was ensured despite the dismantling works. The design предусматриwał the preservation and display of selected original structural fragments as historical witnesses. The reconstructed tower will retain the form and architectural details consistent with the seventeenth-century original, and the use of traditional materials (timber and wooden shingles) will restore its authentic character. In this way, two key objectives have been reconciled: structural safety and historical continuity of the monument.

Finally, it should be emphasized that the execution of the renovation will require continuous specialist supervision. Detailed technical solutions related to the tower structure (e.g. joint reinforcement systems, the species and strength class of the timber used, and assembly techniques) were developed in the detailed design by licensed engineers in cooperation with conservation authorities. This will ensure that the final outcome – beyond its aesthetic qualities – meets all requirements for safety and durability, allowing the historic church in Wereszczyn to serve future generations of worshippers and heritage researchers.

LITERATURE

DESIGN DOCUMENTATION AND TECHNICAL REPORTS

Kłembokowski A., 2024a, *Structural and construction design – Renovation of the tower above the narthex and the narthex of the Parish Church of St. Stanislaus, Bishop and Martyr, in Wereszczyn*. Building design documentation, OLSEN – Engineering Office, Lublin.

Kłembokowski A., 2024b, *Technical expertise of the tower of a historic building – Parish Church of St. Stanislaus, Bishop and Martyr in Wereszczyn, 22-234 Urszulin, Lublin. Voivodeship, Włodawa County*, 2024, technical report No. 05/2024, OLSEN – Engineering Office, Lublin.

SCIENTIFIC PUBLICATIONS

Escudero P.A., 2023, *Scan-to-HBIM: Automated transformation of point clouds into 3D BIM models for the digitization and preservation of historic buildings*, “VITRUVIO – International Journal of Architectural Technology and Sustainability”, 8 (2), pp. 52-63, https://doi.org/10.4995/vitruvio-ijats.2023.20413.

Giannuzzi V., Fatiguso F., 2024, *Historic built environment assessment and management by deep learning techniques: A scoping review*, “Applied Sciences”, 14 (16), 7116, https://doi.org/10.3390/app14167116.

Kantaros A., Ganetsos T., Petrescu F.I.T., 2023, *Three-dimensional printing and 3D scanning: Emerging technologies exhibiting high potential in the field of cultural heritage*, “Applied Sciences”, 13 (8), 4777, https://doi.org/10.3390/app13084777.

Kubica J., Pająk Z., Starosolski W., Głąbik J., 1999, *Reconstruction of the Kalwaryjski Church tower without disassembling the 17.0 m high timber spire*, in: *Structural Studies, Repairs and Maintenance of Historical Buildings IV*, ed. C.A. Brebbia, WIT Press, Southampton–Boston, pp. 663-672.

Mendoza M.A.D., De La Hoz Franco E., Gómez J.E., 2023, *Technologies for the preservation of cultural heritage – A systematic review of the literature*, “Sustainability”, 15 (2), 1059, https://doi.org/10.3390/su15021059.

Nuzzo M., Faella G., 2021, *The Carmine Maggiore bell tower: An inclusive and sustainable restoration experience*, “Sustainability”, 13 (3), 1445, https://doi.org/10.3390/su13031445.

Pachta V., Malachtaris I., Terzi V., 2023, *Architectural, constructional and structural analysis of a historic school building in the Municipality of Agia, Greece*, "Heritage", 6 (1), pp. 374-396, https://doi.org/10.3390/heritage6010020.

Szostak B., Wac M., 2024, *The use of digital technologies in assessing the technical condition of historic structures*, "Budownictwo i Architektura", 23 (4), pp. 151-172, https://doi.org/10.35784/bud-arch.6669.

Truong-Hong L., Lindenbergh R., Woudenberg P., Gard W., van de Kuilen J.W.G., 2021, *Monitoring deformations of a wooden church tower by laser scanning*, in: *Proceedings of the 12th International Conference on Structural Analysis of Historical Constructions (SAHC 2021)*, eds. P. Roca, L. Pelà, C. Molins, CIMNE, Barcelona, pp. 709-721.

WYZWANIA TECHNICZNE I KONSERWATORSKIE NA ETAPIE PROJEKTOWYM REMONTU DREWNIANEJ WIEŻY I BABIŃCA KOŚCIOŁA W WERESZCZYNIE

Streszczenie

Publikacja prezentuje przebieg prac związanych z kompleksowym remontem zabytkowej wieży i babińca drewnianego Kościoła pw. św. Stanisława Biskupa Męczennika w Wereszczynie – jednego z najcenniejszych przykładów drewnianej architektury sakralnej regionu. Konstrukcja obiektu, wzniesiona w tradycyjnej technologii słupowo-ryglowej, uległa poważnym uszkodzeniom na skutek długotrwałego zawilgocenia i zaawansowanej degradacji biologicznej. Na podstawie szczegółowej inwentaryzacji oraz badań mykologicznych ustalono, że większość drewnianych elementów nośnych utraciła swoje właściwości mechaniczne i nie nadaje się do zachowania. W artykule opisano proces cyfrowego odwzorowania konstrukcji w środowisku projektowym Dietrich's oraz wykonania obliczeń statycznych, które pozwoliły lepiej zrozumieć sposób pracy całego układu. Wyniki analiz potwierdziły liczne przekroczenia dopuszczalnych ugięć i naprężeń, co uzasadniło konieczność całkowitej rekonstrukcji wieży i babińca z zastosowaniem nowych materiałów. Projekt odtworzeniowy oparto na zasadzie maksymalnej zgodności z historycznym układem przestrzennym, uzupełniając go o starannie dobrane wzmocnienia i nowoczesne łączniki ciesielskie, tak by połączyć bezpieczeństwo konstrukcji z poszanowaniem autentyzmu formy. Artykuł porusza również szerszy kontekst konserwatorski, pokazując, jak decyzje projektowe uwzględniają zarówno wymagania techniczne, jak i wartość zabytkową obiektu. Przedstawiono także porównania z podobnymi realizacjami w Polsce i Europie, wskazując na znaczenie podejścia interdyscyplinarnego w ochronie drewnianego dziedzictwa architektonicznego.

Słowa kluczowe: remont wieży drewnianej, babiniec, konstrukcja słupowo-ryglowa, obiekty zabytkowe, konserwacja drewna, architektura sakralna