

**PROBLEMS OF RESTORATION OF WINDOW FRAMES  
IN THE 19<sup>TH</sup> CENTURY INDUSTRIAL FACILITIES  
ON THE EXAMPLE OF ŁÓDŹ**

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The introduction to the historical window frames in industrial facilities presents the historical background. The issue will be discussed on the example of 19<sup>th</sup> century industrial facilities, as well as in the context of the solutions applied in other European countries. The characteristic of a standard factory window is presented on the basis of a typological analysis. The evaluation of the values of historical metal windows is the key point for the issue if and how original historical window frames should be protected. The importance of window frames for the recognition of a given historical monument as an industrial facility should be raised in the first instance. It is also important for the local identity. The degradation of the windows and their numerous drawbacks counteract their aesthetic and technical values. The paper discusses the main conservatory issues related to historical metal windows as well as the possibilities of treating them in light of adaptations of post-industrial buildings and the requirements of the current building standards. The methods of the repair and protection of architectural metal elements or their replacement into new ones will be discussed on the example of solutions applied in buildings adapted to new functions, in Lodz. The paper also presents windows with historical references available on the market.

Keywords: window frames, post-industrial objects, Lodz (Łódź), postindustrial heritage, window maintenance.

## **1. HISTORICAL BACKGROUND**

The origins of window frames in Europe date back to medieval metalsmith craft, when simple, unopenable window frames, filled with stained glass, were forged. Extremely expensive metal windows were applied only in temples or residences

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of distinguished people until the sixteenth century, when the window frames began to be used also in secular buildings.

In the eighteenth century, with the industrial revolution, iron processing moved from forges to factories, where iron began to be cast in identical forms and controlled conditions. It enabled manufacturers to cast stylised products in a variety of forms. They started to cast arched-shaped and slim frames with T-shaped sash bars which were then glazed. Glass sheets were then fitted and sealed with putty<sup>1</sup>. In this period, however, only the window wings were usually metal, the frames, into which the windows were embedded, still remained wooden.

In the second half of the eighteenth century, metal window frames with a universal appearance began to be used in many types of buildings, from residential, through industrial (factories and warehouses) to public utility buildings and representative buildings<sup>2</sup>. Iron was desirable for its fire resistance (important in factories and plants experiencing frequent fires), as well as its strength, providing security in places like factories, insane asylums or orphanages.

The use of window frames did not become common in the United Kingdom until the turn of the eighteenth and nineteenth centuries. It was possible thanks to the rolling technology derived from the metal industry, which in turn, enabled the mass production of windows and lowered their prices, which meant that they could compete with timber windows<sup>3</sup>.

The success of window frames was due to the cheap and fast production and standardization. In addition, they were easy to transport and the production process enabled performing a wide variety of light forms that resulted in brighter and better-ventilated interiors. Durable frames allow the use of large glazing, and combinations of multiple windows, which completely changed the style of buildings designed in the early twentieth century and later. Window frames of inconsiderable thickness were crucial for, inter alia, Art Nouveau and modernist architectural styles. The popularity of steel-framed windows did not

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<sup>1</sup> The development in technology allowed architects to experiment – in 1750 James Gibbs palced copper windows in the town hall of Warrington, and John Carr applied iron window frames in Wentworth Woodhouse in Yorkshire.

<sup>2</sup> The first fire resistant factory ( Williama Strutt's cotton factory in Derby, 1792) had iron window frams.

<sup>3</sup> The 19<sup>th</sup> century was rich in discoveries and improvements in iron processing. Yet in 1820, metal windows were applied in housing construction. In 1856 Sir Henry Bessemer elaborated the first industrial method of steel production. Great Britain was then the world leader steel producer. Steel started to be commonly applied in construction industry in all Europe.

decrease until the 70s of the twentieth century, when it was superseded by frames made of aluminium, which is cheaper and does not rust.

## 2. TYPOLOGY OF WINDOW FRAMES ON AN EXAMPLE/BASIS OF THE NINETEENTH-CENTURY INDUSTRIAL BUILDINGS IN ŁÓDŹ

The present work examines steel windows in industrial buildings in Łódź, produced between the mid-nineteenth century until 1945, in terms of their typology. Factories built in Łódź in this period were similar to industrial facilities built in other European countries in terms of technological, functional and structural conditions. For the analogy in the window production, the discussed solutions may be regarded as universal.

The appliances and machines used in spinning mills generated large amounts of heat, so the problem of thermal insulation of windows was not considered. The overall temperature in the factory and was high enough, not mentioning the fact that the working conditions were neither regulated by any norms nor supervised. On the other hand, the fact that the windows were not hermetic even provided natural ventilation of rooms.

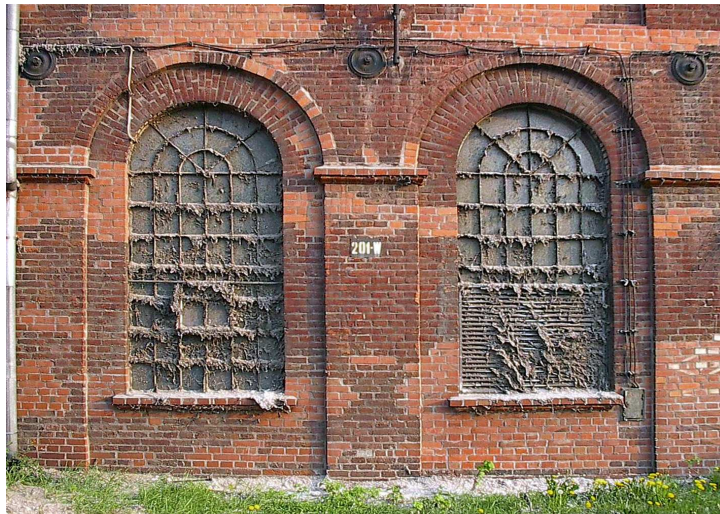


Fig. 1. Original windows in Scheibler's plant with the remains of accumulated cotton threads. Photo by W. Wiśniewska

The characteristics of typical window frames in factories in Łódź:

1. round-top windows (regular arches) on the ground floor,
2. segmented round-top windows (segmented arches), upper floors,
3. frames with small divisions and proportions of a vertical rectangle

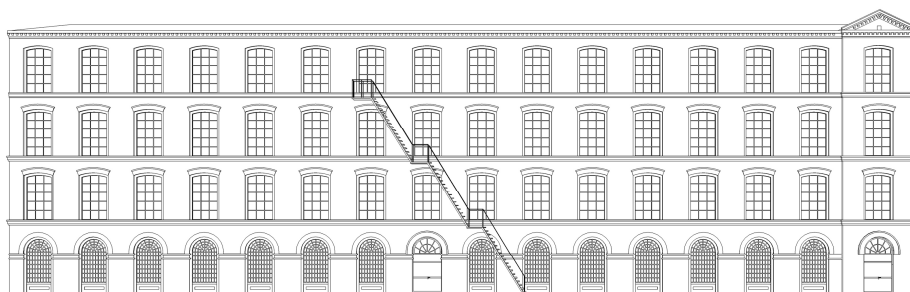


Fig. 2. An example of a typical façade of a textile factory in Lodz. Author: A. Kurzac.

Characteristic features of the factory windows from the late nineteenth and early twentieth centuries were determined by the manufacturers' main requirements, i.e.: minimum costs and fast pace of construction.

- The shape of window frames. The windows were usually round-topped with a full arch (on the ground floor) or segmented arch (on upper floors). The windows constituted 30% of the surface of the elevation. Later, they took a rectangular shape and their surface became greater.
- Fitting a frame into a wall. A frame was fitted into the wall at the stage when the wall was being erected which resulted in the fact that it is now very difficult to dismantle it without damaging either the wall or a part of the frame.
- Technology and materials. Prefabricated steel profiles replaced the woodwork and cast iron frames due to low production costs, lightness and durability while maintaining small cross-sectional profiles.
- The typical thicknesses of the elements. The external frame of the thickness of about 4 cm, is often completely hidden in the wall. The sash bars, both lateral and vertical are made of app. 2-cm-thick T-shaped profiles.
- The sizes of glass. Window frames were divided into smaller fields which were then glazed with small-size glass sheets. The cost of even a large number of small glass-sheets was not high in relation to large glass sheets. Moreover, if the window was broken, its exchange was neither difficult nor costs consuming<sup>4</sup>.
- Ways of opening the windows. The elaboration of a window with a system for window opening had always been difficult. Therefore, only a single partition of a window was openable. Typically, an additional smaller frame

<sup>4</sup> Most typical sizes of glazing in Lodz factories range from 17x21 and 18x23 (Tabacco Company Tytoniowy), through 19x25 (OFF Piotrkowska), to 20x35 cm (Art Center). Galzings larger than 50x55/ 60 prove that the frames were replaced in the post-war period.

or joints were installed in a large window frame, which served as a system for window opening. Sometimes, the window was supplied with a hinged wooden frame.

The advantages of industrial metal windows included primarily those that conditioned their common and universal use in the nineteenth and twentieth centuries. Frames were cheap and easily fabricated in bulk quantities. In addition, they could be produced in a wide variety of forms. Frames were light and thus easy to transport. Frames with small multiplied divisions enabled production of very large windows which resulted in bright, well-ventilated interiors.

Among the most serious drawbacks of the historic metal windows include their noncompliance with modern standards of thermal insulation. Old frames are not moisture-resistant, so in winter they were covered with ice since the interiors were not heated<sup>5</sup>. When neglected, the windows may be subject to various types of damage, including::

- corrosion,
- mechanical and structural damages: warps, distortions,
- defects or cracks, destroyed joining elements,
- glazing and putty cavities,
- excessive multiple painting, peeling and loss of coating (paint),
- defects in the window joinery (broken hinges, handles),
- destabilization of window fittings in the wall.



Fig. 3. Various types of hinged frames used in industrial windows. From left: Scheibler's factory, Kretschmer's spinning factory, Geyer's weaving factory. Photo by A. Kurzac

<sup>5</sup> In the case of cast iron, the cast may be faulty due to the imperfections of the production process. The excessive fragility of the elements may result from the excessive amounts of phosphor in the iron or excessive cooling of the cast elements.

### 3. THE MAIN PROBLEMS OF HISTORIC METAL WINDOWS PRESERVATION

The protection of the elements of historic buildings is an obvious and basic assumption of conservation etc. Windows carry the data on historical technologies, craftsmanship, materials, etc. In a protected property, in which the appearance of windows indicates its character, window frames determine the style of the building and shape the climate of both the façade of the building and of its interiors. Thus, the windows themselves may be considered to be of historic value. The change of old windows has an undeniable impact on the change of the image of the building.

The windows are elements which are particularly vulnerable to destruction and ill-treatment. They are easy to be removed and commonly believed to be impossible to be properly repaired. Thus, this view results in the historic windows end up massively in landfills. When a building is adapted to the new functions, it is usually expected to meet the new standards of thermal and acoustic insulation - the fate of existing windows almost in advance is doomed.



Fig. 4. An example of a building where an uncontrolled replacement of window frames led to the complete loss of the original aesthetics. Photo A. Kurzac

#### **4.1. Selected renovation and adaptation procedures connected with original window frames on the examples of their usages in Łódź.**

1. Preserving the original frame. Repair, seal and proper exploitation.
  - Karol Scheibler's factory Łódź Art Center
  - Adolf Kebsz's factory of knitted materials, Old Sewing Club
  - Franciszek Ramisch's factory complex, OFF Piotrkowska
2. Preserving the window exterior, the installation of double glazing or mounting a composite window from the inside.
  - Ludwik Geyer's "Biała Fabryka", Museum of Textiles, wing B
3. Removing the original frames from walls and leaving them as a witness on the property area.
  - Ludwik Geyer's "Biała Fabryka", Museum of Textiles, wing D
  - Franciszek Schweikert's factory, Łódź University of Technology, building of WTiMS
4. The replacement of a whole window – restored with the use of modern technologies
  - I. K. Poznanski's Spinning, Andel's Hotel,
  - Eitingon's Factory, Office Center,
  - Muehle brothers' Spinning, offices and corporate headquarters,
  - Józef Balle's Factory, the seat of Gazeta Wyborcza.
5. The replacement of a whole window – forms of new windows are inspired by historical solutions:
  - Franciszek Schweikert's Factory, Łódź University of Technology, building of WTiMS
  - Edward Bormann's factory of silk and woollen gloves, Zenit
  - Adolf Dauby's factory, Synergia Business Centre
  - Karol Steinert's factory, Milionowa Residence

The most appropriate procedure is, of course, current, cyclical maintenance of the original frames. The authentic character and the integrity of a building are preserved and the owner of the historical building avoids expenses on window replacement. In the case of the adaptation of the building, it is unfortunately the least common procedure, usually understood as a temporary measure taken before the proper window replacement, due to the lack of funds. So, it is advisable to analyse the real possibilities of repair, strengthening and sealing the original frames.

#### **4.2. Methods of repair of metal window elements**

Metal windows may be renovated *in situ* – in a building site, or in a workshop after they have been removed from walls. Unfortunately, it is often too dangerous or even impossible due to their tight attachment to the wall.

In the considered case, in Lodz factories, the removal of frames involved partial demolition of walls (without damaging the frames),

The renewal of ungalvanized metal window frames (iron, iron cast or steel) involves the removal of old paint and rust, and then the appropriate protection of their elements. There are numerous techniques for removing rust and the top layer of paint. From the simplest and cheapest methods, such as hand scraping and chipping or brushing the surface to the more advanced and more precise methods of removing rust and paint, such as: rust removal by acid etching, blasting (sandblasting), cleaning with oxy-acetylene flame or propane-oxygen (in the case of wrought iron), to the exchange of a part of a frame. In the latter case, the rusted part is cut out and then the frame is complemented with elements made of the same material which are welded [7].

#### **4.3. Techniques for sealing windows**

One of the best and least invasive ways to achieve higher thermal efficiency of windows in old buildings is to install the seal. It is available in several forms, each of which has a different effect.

Some are simple joint fillers applied as mastic or foam. Other forms provide the isolation through convenient, ready-made constructions, which are so versatile that they can be adapted to any type of window. Cheap products “do it yourself” products survive ten years, while those of better quality at least twenty years. Good seal should not only insulate but also be durable and present some aesthetic values. Professionals may both renovate and simultaneously seal the window providing good value for money services. The investment will bring fast returns thanks to the energy savings, thermal comfort and the exclusion of noise and dust [10].

#### **4.4. Installation of an additional glass sheet or a composite window**

The original window may be left *in situ*, even if its technical condition forecloses its repair, through preserving an external window and the installation of an additional internal division. If the window survived to the present day in good condition, it is even better, because we receive a double protection from the weather.





Fig. 5. Example of the installation of an additional window. Ludwig Geyer's "Biała Fabryka" (now Central Museum of Textiles), Łódź. Photo by A. Kurzac.

There is a possibility of supplying the window with additional glazing along the perimeter of the window wings or doubling the number of wings, or finally, the installation of the additional glazing of the whole window opening from the inside or also providing an additional contemporary window. In many cases, introducing an additional glass sheet is a cheap, workable, and much more appropriate alternative to the installation of closed double-glazed units. It may be removed, allowing the original window to operate normally. It also solves the problem of heat losses and air streams passing through the leakage at the edges of the glass. Unfortunately, an additional glass sheet is not a popular option in Poland. The installation of an additional glass is merely an auxiliary, which may not be sufficient when the original window is in poor condition, but if connected with the renovation and repair, the results may be surprisingly good.

#### **4.5. Replacement of windows**

Preservation and restoration of historic elements should always be considered in the first place as the best option of conduct. Unfortunately, in many cases, the metalwork is so destroyed that it is not possible to be repaired or maintained effectively. It also should not be assumed in advance that each window proves the rank and aesthetics of the object, and thus does not have to be protected at all costs.

When replacing the windows with new ones, there are numerous problems which need to be resolved: low stiffness of profiles, which, with a considerable height of the window, imposes the use of considerably thick elements, the limited ways of window openings, not to mention the inconsideration of such details as glazing, fixing or handles.

While deciding on the window replacement, best solutions need to be applied that combine modern design with historic looks. Manufacturers' offer is really wide, but only single products are close to historical aesthetics. It should be emphasized that windows made of super-slim profiles and with the frame splits referring to solutions used in the late nineteenth and early twentieth century (multiple columns and beams) are in scarce. Only a few manufacturers make the effort to elaborate individual solutions tailored to a specific historical object. And only one company has assembly lines designed purposefully for historic buildings. While, in most cases, the standard technologies are used for aluminium windows and their adjustment is limited to only, more or less successful, decorating the windows with profiles stuck on glass.

#### **4. CONCLUSIONS**

Typological features of Lodz factories (including a modest articulation of walls and a large share of windows in the façade surface) make the window frames play an important role for the image of the industrial heritage and identity of the town. Adapting buildings to new functions implies the necessity to adapt them to modern needs, which usually leads to the replacement of windows. Even when the divisions and style of old windows are maintained, the original historic substance is irretrievably lost, depriving them of the authenticity and the reduction of the educational value of the object. Therefore, any effort should be made to increase the awareness of the value of historic windows, as well as the ways of their protection and preservation. At the same time, the increasing number of manufacturers is producing windows which are very similar to their original forms.

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## PROBLEMATYKA KONSERWATORSKA ŚLUSARKI OKIENNEJ W XIX WIECZNYCH OBIEKTACH PRZEMYSŁOWYCH NA PRZYKŁADZIE ŁODZI

### Streszczenie

Wstępem do omówienia problematyki historycznej ślusarki okiennej w architekturze przemysłowej jest osadzenie w kontekście historycznym. Zagadnienie zostanie omówione na przykładzie łódzkich okien w XIX-wiecznych budynkach przemysłowych, jak również w kontekście rozwiązań występujących w innych krajach europejskich. Charakterystyka standardowego okna fabrycznego przestawiona jest w oparciu o analizę typologiczną. Ocena walorów metalowych okien historycznych jest punktem wyjścia dla zagadnienia czy i dlaczego należy chronić oryginalną ślusarkę okienną. W pierwszej kolejności podnieść należy kwestię wpływu ślusarki okiennej na identyfikację zabytku jako obiektu poprzemysłowego, jak również znaczenie dla tożsamości lokalnej. Zaletom

estetycznym i technicznym przeciwstawiają się usterki i degradacja okien. W artykule zostaną omówione główne problemy konserwatorskie dotyczące metalowych okien historycznych oraz możliwości postępowania z nimi w świetle adaptacji budynków postindustrialnych oraz konieczności spełniania współczesnych norm budowlanych. Sposoby ochrony i naprawy metalowych elementów architektonicznych bądź możliwości wymiany okien na nowe zostaną omówione w oparciu o przegląd łódzkich rozwiązań w budynkach adaptowanych na nowe funkcje oraz przedstawienie dostępnych obecnie na rynku ofert okien historyzujących.