

INNOVATION OF THE BENT PROFILE PRODUCTION SYSTEM AT ADAMIETZ LTD. IN STRZELCE OPOLSKIE BY INTEGRATING THE PRODUCTION LINE OF REINFORCEMENT ELEMENTS OF MODULAR HALL STRUCTURES FOR THE USE OF MODERN CONSTRUCTION MATERIALS

¹Monika HYRCZA-MICHALSKA, ²Jarosław ŁOŚ, ³Arkadiusz OLSZEWSKI

¹Silesian University of Technology, Faculty of Materials Engineering, Department of Materials Technology, Katowice, Poland, EU, monika.hyrcza-michalska@polsl.pl

²Adamietz Ltd., Strzelce Opolskie, Poland, EU, jaroslaw.los@adamietz.pl, arkadiusz.olszewski@profilar.pl

<https://doi.org/10.37904/metal.2024.4933>

Abstract

Due to the need to increase the efficiency and quality of production, expand the range of products manufactured and optimize the use of personnel, a project entitled: "Development of an integrated production system for the production of elements of reinforcement of modular structures of halls using modern construction materials at Adamietz Ltd. in Strzelce Opolskie" was undertaken. This project was supported under the WO ROP 2014-2020. The production system innovations at Adamietz Ltd. were implemented and the project delivered: modernization, automation of the existing line for the production of modular hall elements and integration of the manufacturing operations of the newly built production line. This work presents the functionality of the new production line and the possibilities of processing modern construction materials to achieve product innovation in the form of expanding the range of geometries of bent sections - elements of reinforcement of modular hall structures. The integration of the production line of bent increased the efficiency of manufacturing, and thus expanded the manufacturing capabilities and the products offered range. This was made possible not only by the process innovation applied to profiling sheet metal production line and manufacturing functional panels for the construction industry, but also by determining the technological ductility of the high-strength sheet metal batches used in studies conducted at the Silesian University of Technology. Determining the range of possibilities for shaping complex bent products, enabled product innovation. Special sections and fasteners were added to the standard range of products and expected product innovation became possible

Keywords: Roll-forming line, bending integrated production system, bent sections, profiling sheet metal, high-strength sheet metal batches

1. INTRODUCTION

Adamietz Ltd. in Strzelce Opolskie in Poland (**Figure 1**) core business specialty is general construction contracting for the development of general, industrial and specialized buildings and design and production of cold-formed sections and sandwich panels. Innovation and new technologies have been the driving force behind the company's development since the beginning. It develops investment projects ranging from warehousing and logistic buildings, through public facilities, to complete and complex industrial plants in the 'Design & Build' formula. The company's customers expect shorter and shorter lead times. In addition, the structures must be lightweight, durable and take into account environmental safety and energy-saving considerations - in line with the idea of sustainable development. Hence the demand for advanced shaped bent components and complex high-strength yet lightweight modular halls, which the company manufactures. This became the motivation for undertaking the project "Development of an integrated

production system for reinforcing elements of modular hall structures using modern construction materials at Adamietz Ltd. in Strzelce Opolskie.”



Figure 1 Adamietz Ltd. factory in Strzelce Opolskie in Poland [1]

The realization of the project required the recognition of the possibility of using modern steels with higher strength than those previously used in the production of bent profile elements, bent sections and various structures of modular halls. Tests of mechanical properties, structure and technological plasticity reserve for selected steel sheets, expanding the range offered by Adamietz Ltd. were carried out in the research laboratories of the Department of Materials Technology of the Silesian University of Technology (SUT) in Gliwice. It was determined that steels in grades from DX51D to S450 and thicknesses from 0,5 mm to 4,0 mm can be safely deformed under bending conditions on both existing technology stations (examples of hitherto used stations are shown in **Figure 2**) and on a newly designed integrated line for bending modular hall components.

a)



b)



Figure 2 Examples of existing technology stations in Adamietz Ltd., a) straightening and roll-forming station, b) cutting station

2. RESEARCH ON MATERIALS

Tests of mechanical properties, structure and technological plasticity reserve for selected steel sheets, expanding the range offered by Adamietz Ltd. were carried out in the research laboratories of the Silesian University of Technology in Gliwice. The research laboratories used in this study are located at the SUT, Faculty of Materials Engineering, Department of Materials Technology in Katowice. It was determined that steels in grades from DX51D to S450 and thicknesses from 0,5 mm to 4,0 mm can be safely deformed under bending conditions on both existing technology stations (examples of stations are shown in **Figure 2**) and on a newly designed integrated line for bending modular hall components.

The following tests were carried out:

- assessment of mechanical properties in a uniaxial tensile test,

- assessment of formability in the Erichsen test,
- bendability in a bidirectional 90-degree bending test,
- assessment of the springback angle of sheet metals,
- assessment of limit deformability in bending processes and forming limit curves for selected sheet metals,
- assessment of hardness
- and structure recognition.

The guidelines for the bending process of selected high-strength materials, developed on the basis of the research performed, are universal in nature, describe the tendency of design changes and the needs for the scope of adjustment of the integrated bending line, and thus constitute the boundary conditions for the design of the new line.

3. INNOVATION ON TECHNOLOGICAL PROCESS AND NEW LINE BUILDING

Based on previous experience in manufacturing bending profiles and complex panels new integrated line for advanced bended panels was designed and built in Adamietz Ltd. in Strzelce Opolskie. New line is shown on **Figure 3**. The new line integrates technological operations previously scattered over approximately 20 stations in one line, which reduces the time of inter-operational transport and waiting time for subsequent stations to be ready. Thus, the unit production time of long bent products – multi-layer panels and sections – was shortened. Manufacturing processes are carried out with greater accuracy due to the automation of material positioning and supervision of movement in the line. The integration of the line made it possible to reduce the costs of employing staff operating production stations.

The main element of innovation of the bent profile production system at Adamietz Ltd. is a new line shown in **Figure 3**. The line was created as part of the project and has increased the production capacity of Adamietz Ltd. Currently, the new line allowed:

- to manufacture products from 1 to 12 meters in length, to cut coils to a width of 150 mm to 1500 mm,
- to make perforations according to any shape design and their arrangement,
- to profile sheets of various steel grades (from DX51D to S450), types of anti-corrosion coating - mainly zinc (Z), zinc-magnesium, the so-called megnetholithic (ZM), aluminum-zinc (AZ) and other coatings according to EN 10346,
- to produce versatility of formats and openings of elements,
- to produce any order quantity, any production volume – short runs, medium or high volume production,
- to integrate unwinding and cutting operations, cross-cutting with slitting operations, punching operation – enabling the manufacture of semi-finished products in a single process sequence – a sheet from a wide range of batch materials (coils or sheet blanks) up to 4,0 mm thick and to 1500 mm wide.

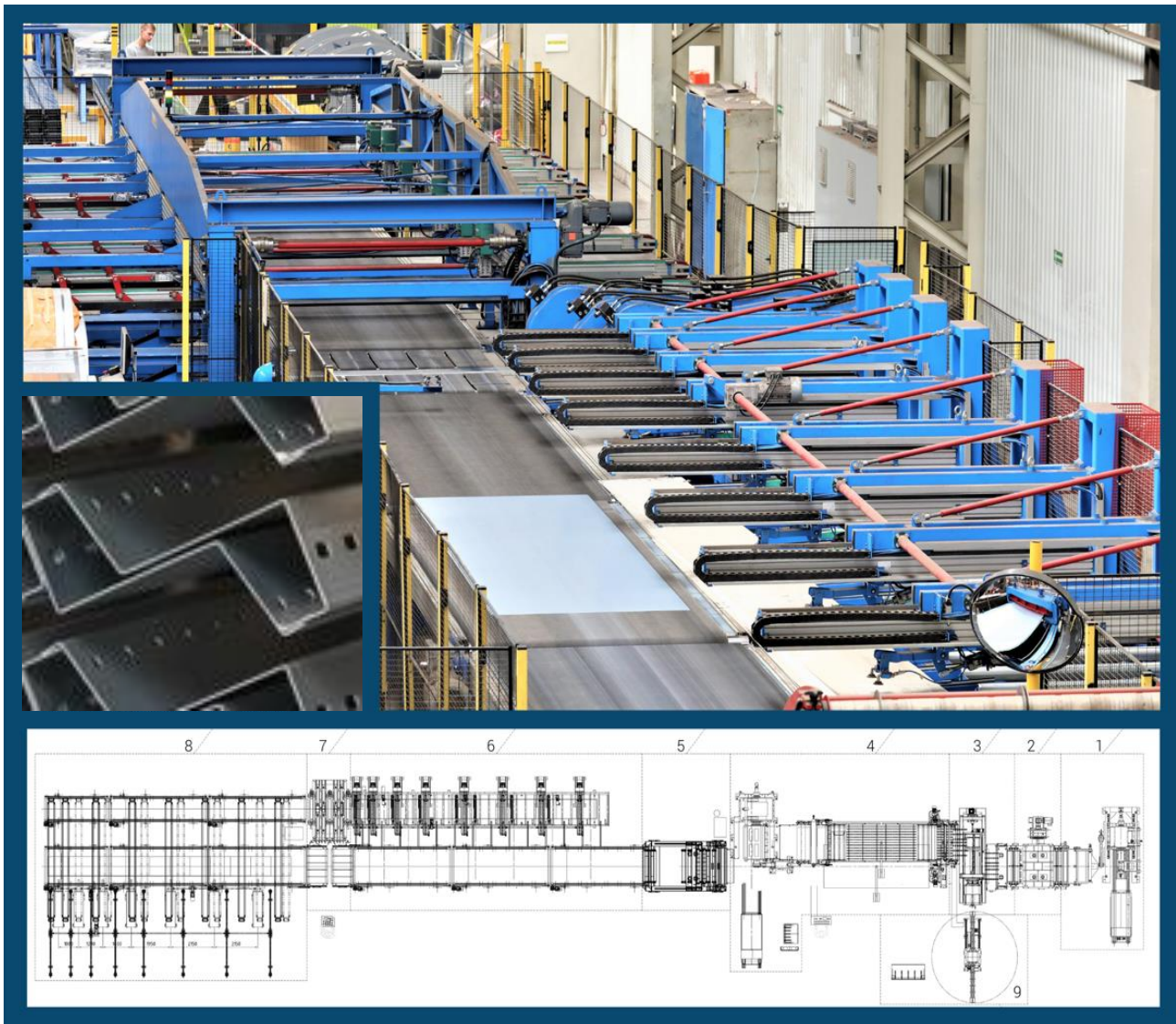


Figure 3 Newly designed integrated production line of reinforcement elements of modular hall structures where: 1- sheet metal uncoiling module, 2 – sheet metal straightening module, 3 – longitudinal and transverse cutting module, 4 – sheet metal coiling module, 5 – transverse cutting module, 6 – automatic stacking module, 7 – perforating module, 8 – perforated sheet automatic stacking module, 9 – cutting rollers and rings

4. INNOVATION ON PRODUCTS

By determining the reserves of technological plasticity for selected types of high-strength steel, i.e. by determining their bendability, it became possible to design and produce complex bent profiles according to customer needs, which have not been produced before. Examples of such profiles are shown in the **Figure 4**.

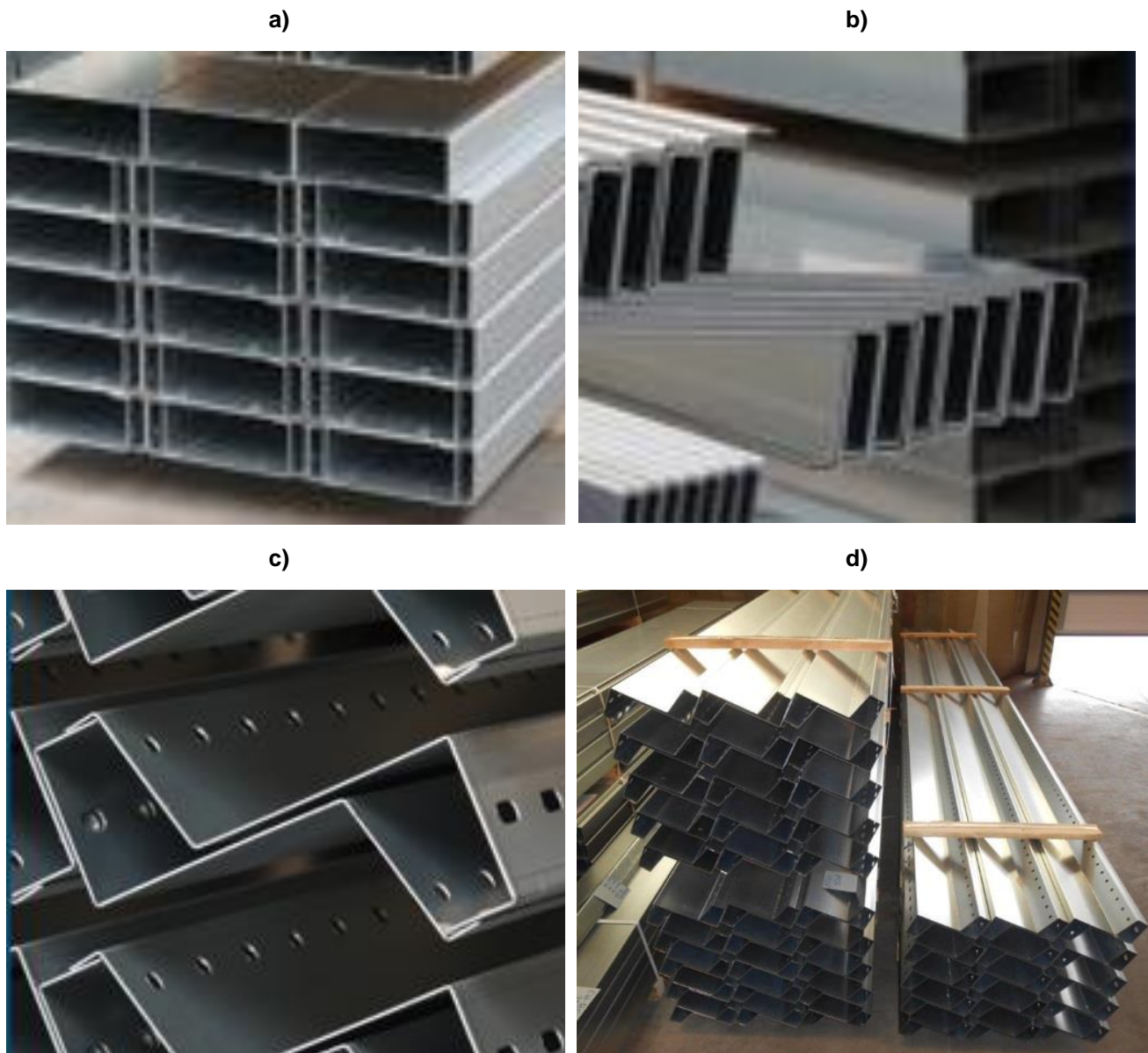


Figure 4 Examples of products and manufacturing capabilities: a) a closed profile of a rectangular cross-section, b) corners, c), d) a connector with a "z" cross-section with holes

5. CONCLUSION

Based on previous experience in manufacturing bending profiles and complex panels, new integrated line for advanced bended panels was designed and built in Adamietz Ltd. in Strzelce Opolskie, as the result of project of innovation of the bent profile production system in this company. And thanks to the cooperation between the Adamietz Ltd. production company and the Silesian University of Technology, it was possible to set deformation design assumptions for the range of high-strength sheet metal planned for production for the new integrated line for bending reinforcement elements of modular hall structures. Process and product innovation was achieved, thus increasing the economic efficiency of Adamietz Ltd. The project involved implementing the innovation of the production system and carrying out modernization, automation and the integration of the manufacturing operations of the new line. The project assessed also the possibilities of processing modern construction materials on the new line, so that the range of bent products that could be manufactured was expanded.

ACKNOWLEDGEMENTS

This work was supported under the financing of the project entitled: "Development of an integrated production system for the reinforcement elements of modular halls structures with the use of modern construction materials at Adamietz Ltd. in Strzelce Opolskie", which was supported under RPO WO 2014-2020, Priority Axis: I. Innovation in the economy, Measure: 1.1 Innovation in enterprises, Sub-measure: Thematic objective - Strengthening scientific research technological development and innovation.

REFERENCES

- [1] Adamietz Ltd. presentation. Available from: <https://adamietz.pl/>