

# Creative rational design of free form buildings and their constructions roofed with transformed corrugated steel sheeting

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## Abstract

The paper presents a creative use of an authors' method for shaping of free form buildings and their constructions roofed with nominally flat sheets folded in one direction and connected along their longitudinal edges into complete sheeting transformed into various unconventional shell forms [1]. General building forms designed with the help of the method are primarily conditioned by innovative forms of straight roofs taking different forms of regular warped surfaces that are a specific subgroup of ruled surfaces. Each transformed shell roof form is related to the geometrical and material properties of the sheets. These properties are a quite significant limitation of the roof forms possible to built.

In order to maximize the diversity of considered roof forms, the so-called effective transformations are employed by the method. These transformations allow the folds to adapt their shape to their appropriate supporting conditions in the roof shell in a relatively wide range [2]. In addition, the initial effort of the deformed flanges and webs of each shell fold designed by the method is relatively small in relation to its total capacity. The supporting conditions of each shell fold are defined by the shape and mutual position of roof directrices and the stiffening of the longitudinal edges of each complete fold by two its adjacent folds in the shell.

The method's algorithm uses the authors' parametric description of the building forms roofed with transformed sheeting and structural systems dedicated to these forms. The designed forms are sensitive internally to the shape integration of their individual elements and externally to the built environments. It is supported by computer programs of one of the authors written in the Rhino-Grasshopper program and the AutoLISP programming language of the AutoCAD program. Consistency of the overall form of each building results from the fact that the inclinations of the rulings and eaves of the roof shell are integrated with the inclination of the building elevation walls to the vertical and elevation patterns [1].

The method also takes account of shaping original structures composed of several aforementioned complete forms [3, 4]. The authors intend to perform further experimental tests and analyses on searching for rational corrugated steel shell forms and structural systems dedicated to these forms as well as their static and strength work.

## References

- [1] J. Abramczyk, *Shell free forms of buildings roofed with transformed corrugated sheeting*, Monograph, Rzeszow University of Technology, 2017.
- [2] J. Abramczyk, "Shape transformations of folded sheets providing shell free forms for roofing", in *Proceedings of the 11th Conference on Shell Structures Theory and Applications*, Gdańsk, Poland, October 11-13, 2017, Wojciech Pietraszkiewicz, Wojciech Witkowski, 2017. pp. 409-412.
- [3] J. Abramczyk, "Building Structures Roofed with Multi-Segment Corrugated Hyperbolic Paraboloid Steel Shells", *Journal of the International Association for Shell and Spatial Structures*, vol. 2, pp. 121-132, 2016, DOI: <http://dx.doi.org/10.20898/j.iass.2016.188.717>.
- [4] A. Reichhart, *Geometrical and structural shaping building shells made up of transformed flat folded sheets*, Monograph, Rzeszow University of Technology, 2002.(In Polish)