ОД ИНСПИРАЦИЈЕ
ДО ИНТЕРАКЦИЈЕ

SMARTART

art&
science
applied

КЊИГА АПСТРАКАТА
BOOK OF ABSTRACTS

ПРВА
МЕЂУНАРОДНА
КОНФЕРЕНЦИЈА
SMARTART
УМЕТНОСТ И НАУКА
У ПРИМЕНИ

FIRST
INTERNATIONAL
CONFERENCE
SMARTART
ART AND SCIENCE
APPLIED

FROM INSPIRATION
TO INTERACTION

Факултет примењених
уметности у Београду
28–30. 11. 2019.
Faculty of Applied
Arts in Belgrade
28–30 November, 2019

IV ПРИМЕЊЕНА ГЕОМЕТРИЈА У ВИЗУЕЛНИМ УМЕТНОСТИМА

IV APPLIED GEOMETRY IN VISUAL ARTS

3D LATTICE PANELS BASED ON THE CONCAVE POLYHEDRA OF THE SECOND SORT: IDEAS FOR ARCHITECTURAL ORNAMENTS

MARIJA OBRADOVIĆ
Faculty of Civil Engineering, University of Belgrade, Serbia
SLOBODAN MIŠIĆ
Faculty of Applied Arts, University of Arts in Belgrade, Serbia

Concave polyhedra of the second sort (abbreviated: C-II-n) constitute a group of polyhedra formed over regular n-sided base polygons and having a deltahedral lateral surfaces. This group includes: concave cupolae, concave pyramids and concave antiprisms of the second sort (CC-II-n, CP-II-n and CA-II-n, respectively). The common feature of these solids is that their lateral surfaces consist of a double row of equilateral triangles which can be assembled in two ways, making two different solids' heights: major (C-II-nM) and minor (C-II-nm). The geometrical regularities and a high level of symmetry that characterizes these polyhedra, makes them suitable for joining and combining, so they can be arrayed infinitely in space, in x, y and z direction forming 3D lattice structures. For some representatives of these solids, the congruity of their lateral deltahedral surfaces occurs, so 3D tessellations are formed.

In this paper, we focus on a single "layer" of such a structure, a panel-like 3D lattice. It is generated by multiplication of the chosen unit cell – the selected C-II-n representative – along the x-y directions. In the z direction the lateral surfaces form a deltahedral structure which makes the thickness of the panel. The method we used is based on the continuous connection of the edges of the two adjacent units, by joining relevant vertices. When we remove the base polygons, the unit cells become hollow, so they can create a honeycombed structure, more desirable for the purpose of application. Then, observed in 2D, by applying symmetry transformations, we form patterns similarly to the formation of wallpaper groups. In this way, we get visually interesting patterns in 2D, which transform into 3D lattice depending on the viewing angle.

The thickness of the panel can be halved in some cases, so we get a thinner structure with "face" and "back", having different tessellations of polygons appearing on them. As an artistic intervention, these panels can be modified by joining deltahedral surfaces of other C-II-n onto the compatible faces, whereby we add another layer of patterns to the resulting structure.

3D patterns and lattices are currently experiencing real boom in the design and industry, thanks to the 3D printing capabilities. As for architecture, they can be applied not only as an element of ornamentation, but also as a functional component of the project, especially concerning climate responsive facades.

Due to the simplicity of the geometry of C-II-n, such 3D structures are feasible and easy to perform in terms of production and assembly. They are achievable not only with 3D printing, but can also be manually assembled or folded like origami, which allows the use of a much wider range of materials. What makes an additional convenience in using the C-II-n is that their faces, regular polygons, allow and provoke various plays with symmetries. With a skillful composition of these patterns, an additional level of decorative design opens.

Surely, in order to materialize these structures, thickness must be added to the deltahedral surfaces. It is also possible to make such a 3D structure as a space truss composed of equal length rods. If we want to soften the sharp edges and introduce curved lines into

these forms, or do any other modification of the form, we can do this during modeling process, via tools of the software we use, and then produce the structure through 3D printing. By development of new building technologies, especially parametric design, geometric ornament returns to the design of buildings on a large scale. 3D patterns have already found a large application in architecture, so in this study we go a step further and suggest the application of these 3D structures as architectural elements: decorative panels, room dividers, brise-soleil, etc., which change their appearance depending on the viewing angle, and can also be performed in a quick and easy way, not only as 3D prints. In several examples, we propose models of such structures that can serve as a visually interesting ideas in design (or redesign) of the exterior and interior of the architectural objects. Not only the complete structure, but also its fragments can be used for this purpose.

One of the aims of the paper is to point out the possibilities offered by C-II-n geometry in artistic (visual and decorative) sense, linking the geometrical generation of 2D and 3D patterns with architectural design. This paper gives a few ideas that provide some new directions in creative thinking.

Keywords: polyhedron, concave, 3D pattern, 3D lattice, ornament, architecture

ACKNOWLEDGEMENT: This research was supported by the Serbian Ministry of Education and Science, Project No. III 44006, Развој нових информационо-комуникационих технологија, коришћењем напредних математичких метода са применама у медицини, енергетици, е-управи и заштити националне баштине (2010–2019).

BOOK OF ABSTRACTS:
INTERNATIONAL CONFERENCE SMARTART – ART AND SCIENCE APPLIED. “From Inspiration to Interaction”

Publisher
Faculty of Applied Arts,
University of Arts in Belgrade, Serbia

For the publisher
Dr. Irena Živković, Associate Professor – Acting Dean

Publishing council of the faculty of applied arts
Mag. Rastko Ćirić, Full Professor – President
Mag. Olivera Batajić Sretenović, Assistant Professor
Miloš Ilić, Associate Professor
D.A. Julijana Protić, Assistant Professor
Dr. Aleksandar Vuletić, Assistant Professor

Editors
Dr. Marijana Paunović,
Assistant Professor – Faculty of Applied Arts, University of Arts in Belgrade
Dr. Aleksandar Vuletić,
Assistant Professor – Faculty of Applied Arts, University of Arts in Belgrade

Publication Design
Olivera Batajić Sretenović

Proofreading (Serbian and English)
Aleksandar Vuletić

Conference SmartArt – Art and Science Applied “From Inspiration to Interaction” and realisation of the

МИНИСТАРСТВО ПРОСВЕТЕ,
НАУКЕ И ТЕХНОЛОШКОГ РАЗВОЈА

Book of Abstracts was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia

ISBN 978-86-80245-38-6

ФАКУЛТЕТ ПРИМЕЊЕНИХ УМЕТНОСТИ • БЕОГРАД •

THE FACULTY OF APPLIED ARTS • BELGRADE •