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Soft cells: Rounded tile shapes echo those found in nature

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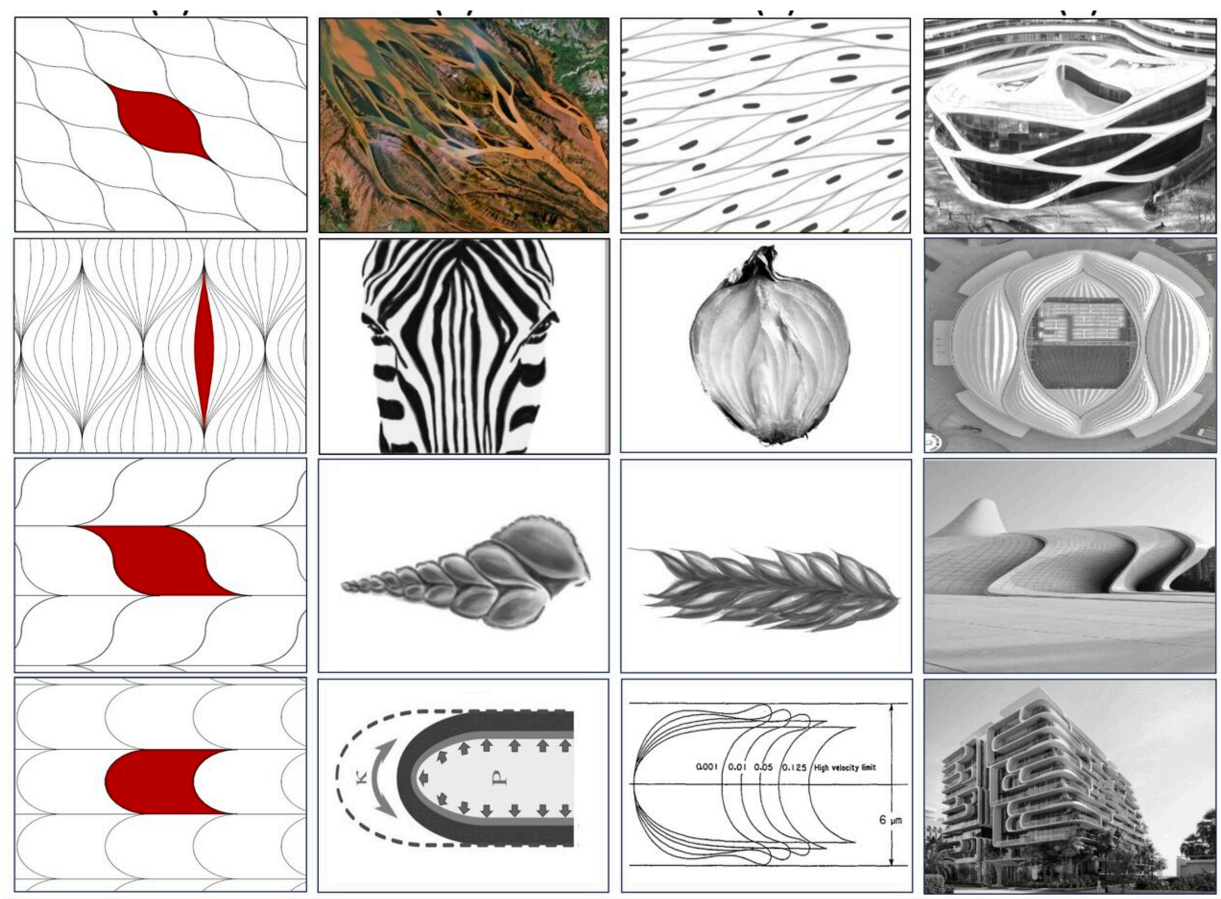


Examples of planar soft cells with two sharp corners in nature and in architecture. Left column: geometric soft cells. Middle columns: natural examples. Right column: examples from the architecture of Zaha Hadid. Credit: Wikimedia Commons, Google Earth, Krisztina Regős.

Tiles that fill two- and three-dimensional spaces with no gaps—including triangles, squares, hexagons, cubes, and other polyhedra—are typically designed with sharp corners and flat faces (straight edges).

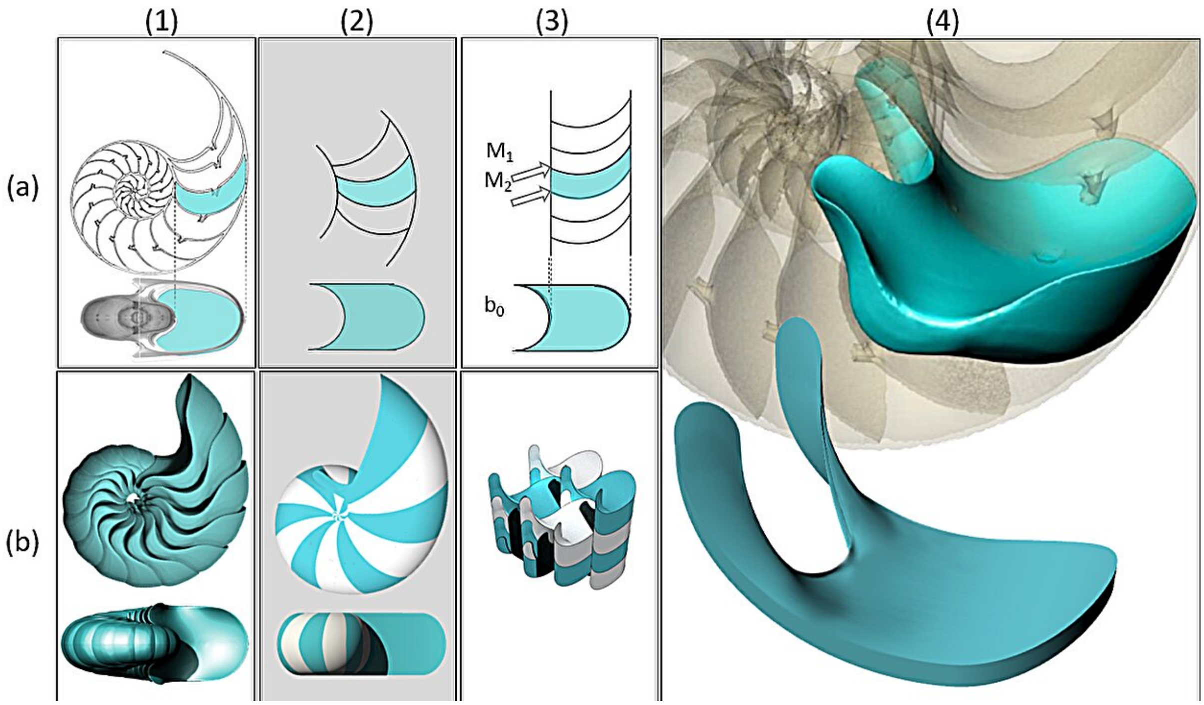
Gábor Domokos and colleagues explore soft and curved two- and three-dimensional tiles that completely fill space with a minimal number of sharp corners, which they term "soft cells."

The authors demonstrate how to soften polyhedral tiles by systematically deforming edges. The resulting shapes echo those found in nature, including river estuaries, zebra stripes, muscle tissue, and the chambers of seashells, including the Nautilus. Biological structures that evolved to fill space are likely to display these forms.

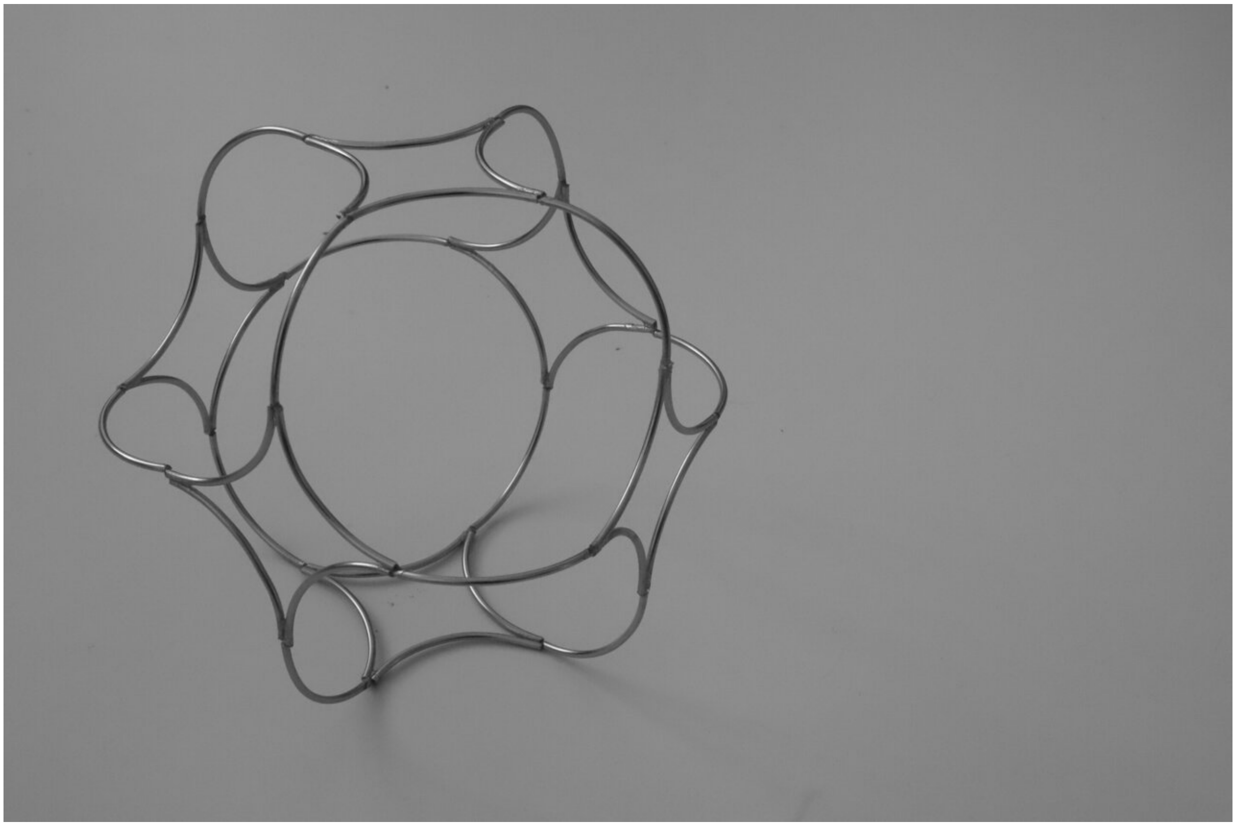
The authors prove a theorem demonstrating that soft tilings are combinatorically abundant. Soft cells are also found in art and architecture, especially in situations where architects wish to avoid corners.

According to the authors, some types of three-dimensional soft cells have not yet been found in nature—although they are not convinced they do not exist.

The study is published in *PNAS Nexus*.

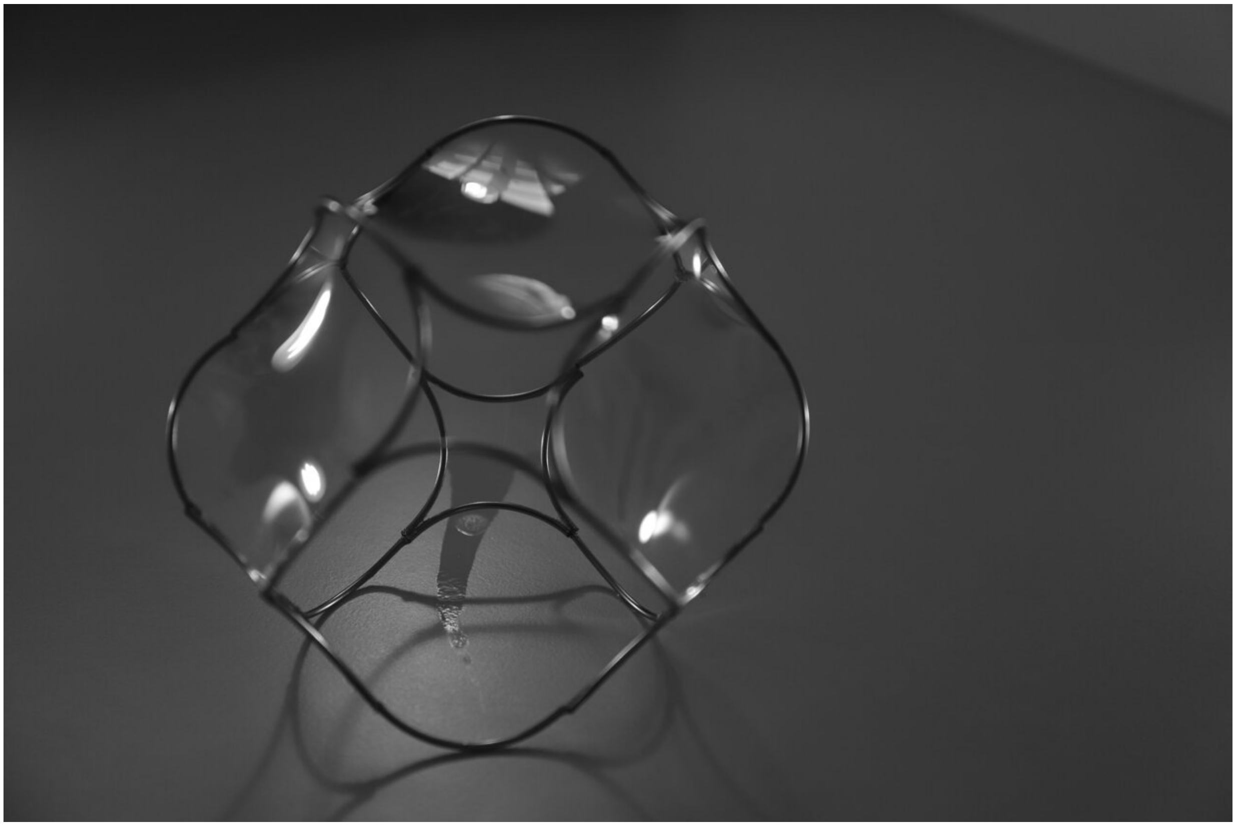


Soft cell as geometric model of the Nautilus chamber. In the right panel the geometric model is shown next to the actual chamber. Credit: Lajos Czeglédi and Krisztina Regős.



Edge skeleton of the soft version of the truncated octahedron, a space-filling polyhedron. This soft cell fills space without gaps but has no sharp corners. The faces (not shown) are minimal surfaces, which could be represented by soap films. Credit: Krisztina Regős and Gábor Domokos

Soft version of the truncated octahedron, a space-filling polyhedron. This soft cell fills space without gaps but has no sharp corners. The faces are minimal surfaces, represented by soap films. Credit: Krisztina Regős and Gábor Domokos



Soft version of the truncated octahedron, a space-filling polyhedron. This soft cell fills space without gaps but has no sharp corners. The faces are minimal surfaces, represented by soap films. Credit: Krisztina Regős and Gábor Domokos

More information: Gábor Domokos et al, Soft cells and the geometry of seashells, *PNAS Nexus* (2024). DOI: 10.1093/pnasnexus/pgae311. academic.oup.com/pnasnexus/art … /3/9/pgae311/7754698

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