Topics for internships in the lab for Geometry and Computational Design

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There is a wealth of topics around geometric design for architecture. A good overview of typical research in this area is provided in the following survey article:

H. Pottmann, M. Eigensatz, A. Vaxman, and J. Wallner, *Architectural geometry*, Computers and Graphics 47 (2015), 145-164.

1. Currently, one focus of our work is on ***structures in force equilibrium*** and connections to *differential geometry,* in particular *discrete differential geometry*.

Topics, which could be addressed in this context, include the following ones:

- 3D counterpart of the Airy stress potential and its geometric interpretation within isotropic geometry;
- design of discrete surfaces in force equilibrium, where special types of curves (e.g. geodesics) are used for discretization (motivated by fabrication);
- a mathematical study of the "nested catenaries" concept.

2. Another stream of work is related to ***computational fabrication***. Here the possible topics include

- *Strip-based surface design*. These strips could be generated, for example, by CNC machining, folding, wire cutting. This is not a single topic, but several, depending on the fabrication method and material properties. We are aiming at general principles which can then be specialized to various practical cases.
- *Nearly developable surfaces*. This is about surfaces and structures which can be almost isometrically mapped into the plane, the deviations from exact isometry being taken care by the material behavior or the fabrication method (e.g. formed by congruent elements such as bricks, with sufficiently small gaps in between them).

Necessary background for these topics: experience in programming, solid knowledge of analytical geometry, classical differential geometry, numerical optimization.

If students have a background in *classical sphere geometries*, but at least a very solid knowledge of *projective geometry*, there are also a number of topics on ***sphere geometric concepts in discrete differential geometry***.