Adaptive modularized constructions made in a flux

Priority program 2187 – Adaptive Concrete Diamond Construction (ACDC)

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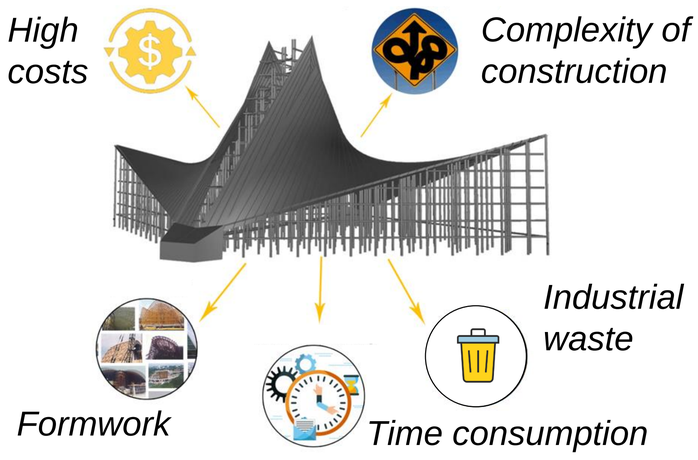
SPP 2187

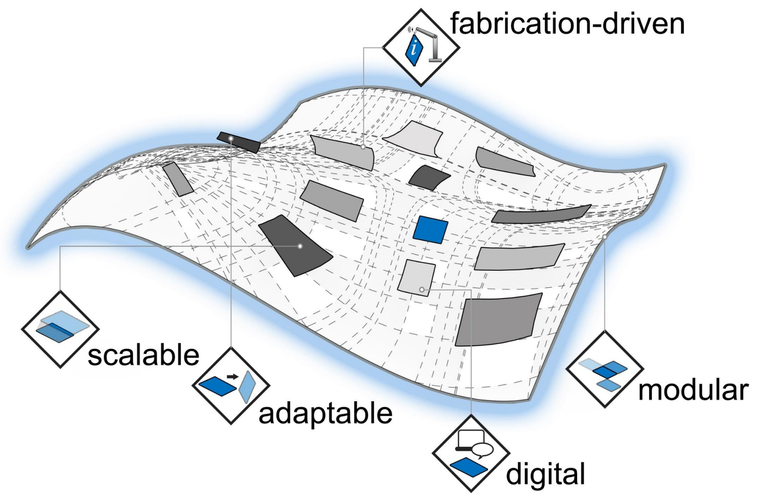
Motivation

Conventional construction of concrete shells with formwork



Proposed solution

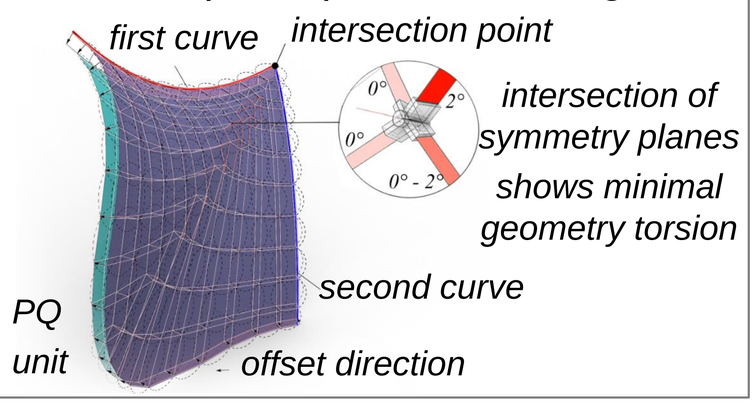
- Assembly of concrete shells from prefabricated modules
- Fully automated production of the modules by adopting:
  - 3D concrete printing
  - concrete pumping
  - automated reinforcing textile laying



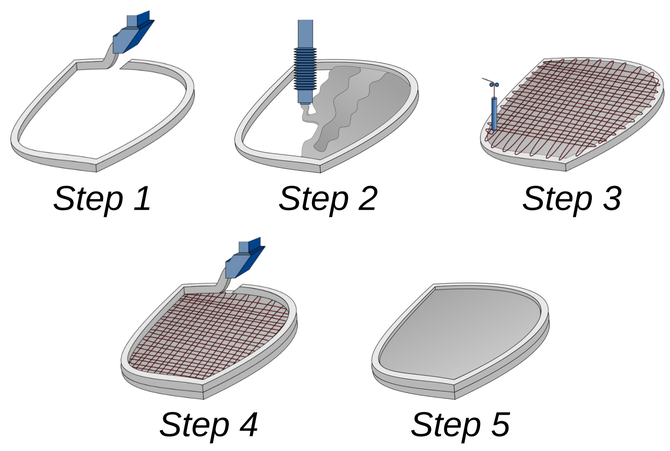
Methods

Design of segmented shells

- PQ mesh systems
- Bottom up computational design

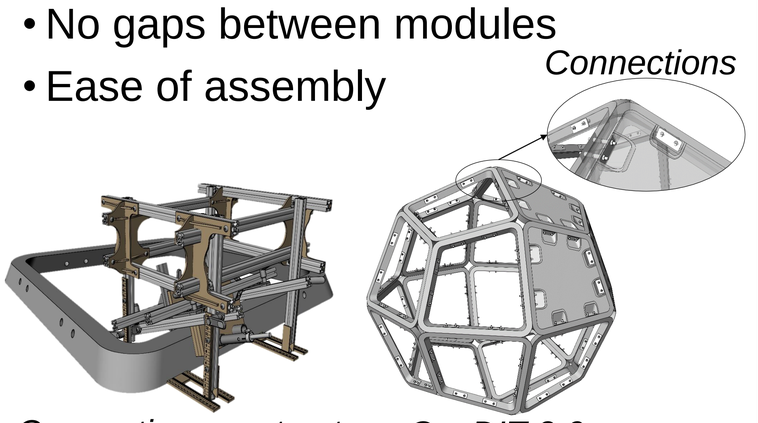


Automation of module production steps



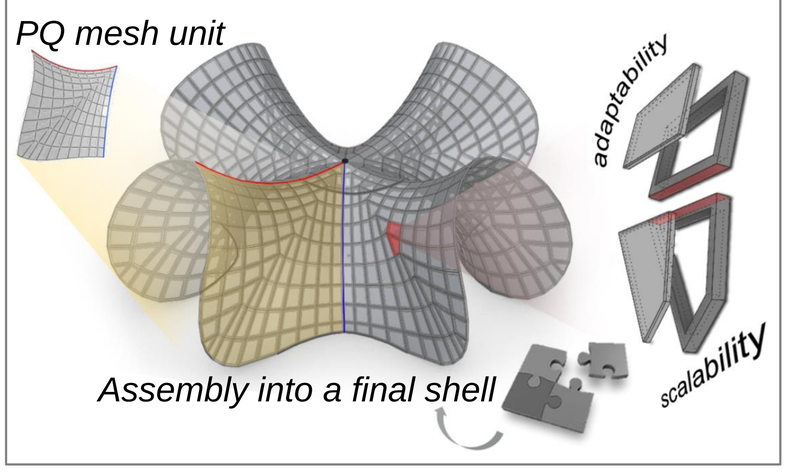
Development of connection systems between modules

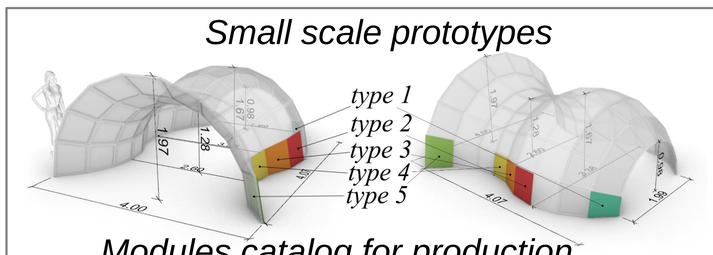
- No gaps between modules
- Ease of assembly



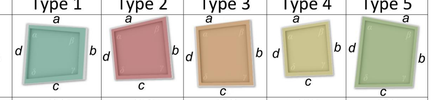
Results

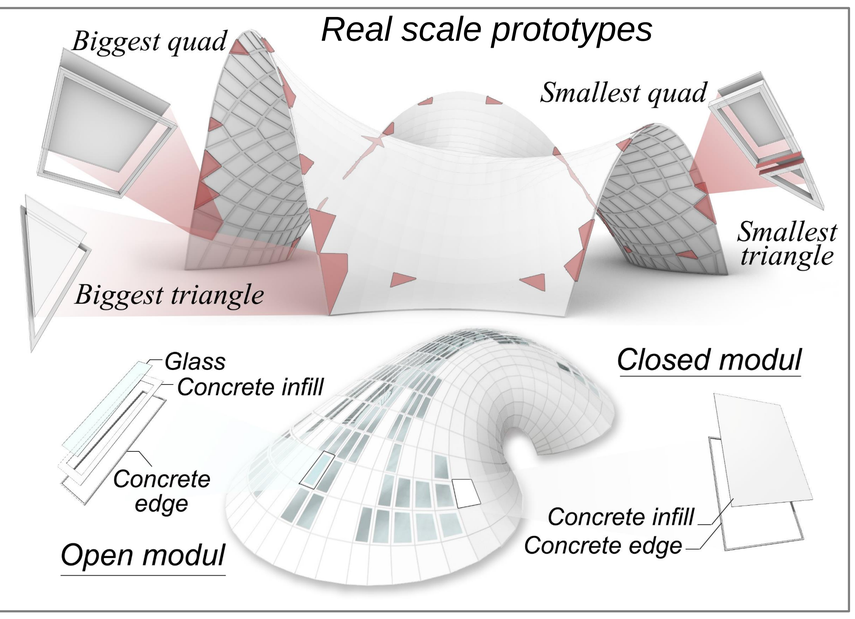
Formwork-free concrete shell construction from modules





Modules catalog for production

	Type 1	Type 2	Type 3	Type 4	Type 5
Modules					
Egde size	a = 0.52 m b = 0.34 m c = 0.52 m d = 0.47 m	a = 0.54 m b = 0.56 m c = 0.54 m d = 0.47 m	a = 0.52 m b = 0.59 m c = 0.525 m d = 0.56 m	a = 0.42 m b = 0.47 m c = 0.42 m d = 0.45 m	a = 0.55 m b = 0.56 m c = 0.55 m d = 0.70 m
Angle between edges	α = 83° β = 83° γ = 97° δ = 97°	α = 88.5° β = 88.5° γ = 91.5° δ = 91.5°	α = 85.5° β = 85.5° γ = 94.5° δ = 94.5°	α = 91.5° β = 91.5° γ = 88° δ = 88°	α = 83° β = 83° γ = 97° δ = 97°
Edge inclanation	a = -7° b = -10° c = -7° d = -8°	a = -10° b = -9° c = -10° d = -9°	a = -9° b = -10° c = -9° d = -8.5°	a = -13.5° b = +27° c = -13.5° d = +9°	a = -9° b = +27° c = -9° d = 0°
Number for production	N = 9	N = 27	N = 18	N = 18	N = 9	ΣN = 81



Publications

[1] Tošić Z., Eichenauer M. F., Lordick D., FREE FORM SEASHELL DESIGN FOR MODULAR PREFABRICATION, *Proceedings of the fib Symposium 2021 held online from Lisbon, Portugal, Concrete Structures: New Trends for Eco – Efficiency and Performance*, 14-16 June 2021, Lisbon, Portugal, pp. 1374 - 1385.

[2] Tošić Z., Eichenauer M. F., Ivaniuk E., Lordick D., Krasić S., Mechtchrine V., CONSTRUCTIVE DESIGN OF DOUBLE CURVED SHELLS FOR 3D CONCRETE PRINTING, *Proceedings of the IASS Annual Symposium 2020/21 and the 7th International Conference on Spatial Structures Inspiring the Next Generation,* 23 – 27 August 2021, Guilford, UK

[3] Ivaniuk E., Eichenauer M. F., Tošić Z., Müller S., Lordick. D., Mechtcherine V., 3D PRINTING AND ASSEMBLING OF FRAME MODULES USING PRINTABLE STRAIN-HARDENING CEMENT-BASED COMPOSITES (SHCC), September 2021. Manuscript submitted for publication.

[4] Tošić Z., Eichenauer M. F., Ivaniuk E., Lordick D., Krasić S., Mechtchrine V., DESIGN UND OPTIMIZATION OF FREE-FORM SURFACE FOR MODULAR CONCRETE 3D PRINTING, June 2021. Manuscript submitted for publication.

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