

Why Hyperboloid Reefs ?

History

The hyperboloid is part of a group of structures that have ruled or warped surfaces. These surfaces have double curvature and yet can be constructed from straight structural members.

The simplicity of their construction has led to their employment in numerous engineering and architectural applications.²

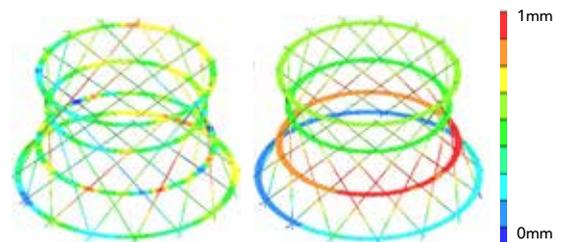
Hyperboloid designs offer architectural flexibility which is advantageous for vital infrastructure, such as oil rigs or cooling towers, enabling them to meet heavy environmental load demands.

The use of intersecting metal rods, where each rod shares a nearly equal load, was a groundbreaking advancement. In case of failure of individual elements, these structures show the greatest potential for continued safe operation and survivability of the entire system.³

The geometric characteristics of the hyperboloid have been investigated in-depth within existing literature.⁴ CCell has contributed to this research by modelling the forces and displacements experienced by hyperboloid reef structures.



Hyperboloids in commercial architecture and marine operations.



Displacement in a hyperboloid reef due to vertical (left) and horizontal (right) forces.

'Boiler' and microatoll reefs

CCell's extended research explores the use of hyperboloid structures in breakwater reefs, drawing inspiration from nearshore boiler reefs or microatolls.

These natural 'boiler' formations, most notably observed in Bermuda's holocene algal cup reefs, exhibit hyperbolic shapes with 1-2 meter diameters and a partially exposed surface during low tides.⁵

Similar to CCell reefs, these microatolls are fortified through the settlement of biogenic materials, and are typically home to vermetids and coralline algae.



Boiler reefs in Bermuda. Photo by: Roy Burch

² Clifford, D. T. (1999). *The Hyperbolic Lattice: morphology, kinematics, and potential applications*. Boston, Massachusetts; Department of Architecture, Massachusetts Institute of Technology (MIT).

³ Samokhvalov, I., & Erofeev, V. (2020). Research on survivability of mesh hyperboloid structures. *IOP Conference Series: Materials Science and Engineering*, 896(1), 012012. <https://doi.org/10.1088/1757-899x/896/1/012012>

⁴ Giordano, A. (1999). *Domes, vaults and other surfaces: the genesis and the form*. Utet.

⁵ Rodrigues, L. J. (2000). *Shelter use by Calcinus verrilli, Bermuda's endemic hermit crab* (Doctoral dissertation).