Rigidized inflatable structures

A production method for optimized structures using rigidized inflatables

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A reduction of material use in construction is deemed essential for achieving a resource efficient Europe[1,2]. One of the most promising solutions, made possible by the emergence of generative design, is the use of structural optimization, which can lead to a weight reduction of 40% while maintaining stiffness properties. However, current production methods and processes are not adequately equipped for producing elements whose shape is derived from a structural optimization analysis[3]. Due to its nature to conform to funicular shapes, a production method based on inflatable moulds which are subsequently rigidized, is believed to be a promising solution. The purpose of this paper is to identify the morphological features of structurally optimized elements and which typology of inflatable structures best reflects them. In addition, rigidizable materials are explored to counteract the weaknesses of inflatable structures. This empirical scientific research is design oriented, and consists of a literature review and experimental research. In addition, to gain feedback on results, expert meetings were conducted. It is an explorative study into the coherence and relations between the characteristics of structural optimization, inflatable structures and rigidizable materials. The morphological features of section active structure systems[4] were exposed using Solidthinking Inspire 9.0. Subsequently, for validation purposes, the ParaGen method developed by Dr.-Ing Peter von Buelow at the University of Michigan was used. Simultaneously, in depth literature reviews revealed the requirements, typologies and materials of inflatable structures and rigidizable materials. Ultimately, by comparing and ranking the variables from an optimization and production viewpoint, a tool that aids in developing a production method for structurally optimized elements based on rigidized inflatable structures is proposed.

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