

Force Field Typological Design Strategies - A Data Centric Approach to Design

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Abstract

This paper aims to provide a tool that allows a designer to explore thousands of design solutions to optimize the design process. Brown and Mueller [1] have researched similar approaches. The collaboration of Architects and Engineers in a typical building design begins with a dialog of the project brief, the programmatic needs, the desired building typology, a study of building precedents, and ultimately to a design exploration by the Architect and Engineer to meet the needs of the brief. In most instances the outcome is predominantly structural solutions that have been successfully used on precedent projects and in some rare instances, the engineer is allowed to explore new innovative structural forms and/or materials. Given that the vast majority of an engineer's work is only to fine tune old designs, we are proposing a data centric approach to structural design where various structural typologies are pre-calculated and only applied/selected based on the structural "force field" generated from the resulting geometric and environmental parameters of the given project. The "force field" is the pattern of the moments, shears, and axial forces generated from the particular structural element.

As an example, the Force Field of a roof structure with supports on 2 of the 4 sides of the roof and an aspect ratio (L/W) greater than 2 would generate a one-way force field of uni-directional moments (k-ft/ft). That force field can then be applied to a more complex typology of a pre-calculated one way beam system, a one way truss system, a continuous arch, or any other structural system that is predominantly capable of supporting a one way system. With today's computational capabilities, we are proposing this solution to be a web and cloud based software application where a simplified structural analysis will yield thousands of solutions whereby a structural or architectural design has the option of choosing as many possible solutions without any calculations and will allow a launching point for detailed design yet allow the designer far more choices at the outset of a project. The Force Field is created by a simple FEA Shell analysis.

References

- [1] N. Brown, C. Mueller, *Designing with data: moving beyond the design space catalog*, Acadia 2017