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# Inventory Constrained Funicular Modelling

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## Abstract

This paper investigates the development of a digital form finding model that combines the generation of **funicular geometry** with a material **inventory constraint**. The model provides a flexible design tool that facilitates exploration of structural form whilst simultaneously satisfying two rationalizing criteria. It maintains an equilibrated structure derived from funicular geometry; and optimally assigns an inventory of parts with natural dimensional variation to this funicular geometry. The combined goal for the design outcome is to achieve material efficiency through both structurally rational form, and minimization of material waste.

The material chosen for the inventory is below-grade sawn timber[1], being lightweight but with high levels of naturally occurring structural variability. Sawn timber boards that are rejected for structural application due to their frequent structural defects (knots, checks, splits etc.) can readily yield usable short length structural members, once the defects are removed. In doing so, this provides a unique inventory of random short members. These short members are well suited to articulated structures, which, by employing an inverted funicular geometry, only incur axial stresses and can employ simple non-moment timber connections.

This research has been undertaken for the design of the pavilion for the "Working Group 21 – Advanced Manufacturing and Materials" exhibition at the IASS Symposium 2019.

**Keywords**: inventory-constrained design, form finding, funicular modelling, timber structures

[1] Timber sourced is Australian plantation grown softwood, *below-grade* refers specifically to timber members that do not meet structural grading standard requirements due to the presence of frequent structural defects.