Prelude demonstrates the possibilities for engineered bamboo in structural applications. Our pavilion is a spiral pathway that cantilevers from its base. Embodying the function of the Muziekgebouw through a lightweight design, the pavilion mirrors a musical prelude in structure, concept and form. Inspired by Rafael Guastavino’s masonry vaults, the structure evokes the image of a spiral staircase originally constructed from thin tiles, transformed in a novel material with properties distinct from structural masonry.

With a growing need for the development of sustainable materials, engineered bamboo combines the benefits of a natural fibre composite with the advantages of a laminated material.

Highly renewable, large diameter bamboo used for structural applications is harvested every 3-5 years. Once harvested, the raw material can be processed into strips, which are then laminated into a board.

The processing reduces inherent geometric and mechanical variability of the natural material that currently limit the application of bamboo products. As an engineered composite, the material demonstrates higher strength in compression and tension than soft woods and glue laminated timber, with comparable bending properties. Currently promoted as a decorative material, the engineered bamboo in Prelude is an example of a potential use beyond aesthetic applications in architecture.

As an example of this potential, the pavilion includes a cantilevered spiral that acts as a stiffened shell supported by an edge board and a base from which the freestanding section springs upwards. While bamboo is often thought of as analogous to timber, it has greater strength and flexibility, suggesting an expanded role in structures made from natural materials.
Prelude is a pavilion composed of a helical pathway that cantilevers from the base and embodies the function of the Muziekgebouw through a lightweight design that mirrors a musical prelude in structure, concept and form. Inspired by Guastavino’s masonry vaults, the structure evokes the image of a spiral staircase originally constructed from thin tiles, transformed in a novel material with properties distinct from structural masonry. With a growing need for the development of sustainable materials, engineered bamboo combines the benefits of a natural fibre composite with the advantages of a laminated material.

Guastavino’s shells are constructed to act in compression. In contrast, the bamboo shell acts in bending and tension, utilising the inherent properties of the material to form the structure. To utilise the helix as the support for a stairway, the shell would need to act in compression through the addition of wall supports and a thrust connection at the upper end, improving its overall performance.

The spiral has a 2m radius, it is 1m wide and 3m high. It is composed of 20 pieces of 19mm in the edge and 20 of 5mm in the shell. The base and edge supports were connected using biscuit joints. For the shell, the individual panels were connected using bamboo dowels and attached to the edge support through a slotted connection. All parts were glued in place using a fast curing polyurethane glue. Additional bolted connections were added to the underside of the shell to facilitate construction, deconstruction, and for additional load transfer in tension between the panels. To aid with final construction the spiral was preassembled into six sections, although the structure was designed to fit the original size constraints of the Expo. These sections were dry joints, only connected through bolted connections.

Prelude demonstrates the possibilities for structural bamboo. With exceptional structural properties, there are applications that have yet to be explored. Through parametric design and structural analysis the cantilevered helix was prepared for the Expo at the Muziekgebouw. The process of construction and assembly enabled further understanding of the engineering and construction benefits, possibilities and limitations of building with structural bamboo. The structure serves as an illustration of structural bamboo in engineering applications.