AWARD
XSTRATA AERIAL WALKWAY, KEW

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CLIENT - ROYAL BOTANIC GARDENS, KEW

The Client wanted a walkway to enable visitors of all ages and physical abilities to experience the tree canopy in an arboretum originally laid out by Capability Brown. The walkway is an example of the complete integration of architectural idea with an elegant and efficient structure. The use of weathering steel was suggested as a material whose colour would blend well with nature, yet would look man-made and would need no future painting.

The walkway is approached via a Rhizotron and then visitors ascend to the tree canopy, via stairs or a lift. It was important that the walkway should not compete with the trees. By using the balustrades as trusses spanning between slender pylons, a simple yet elegant solution was found. The choice of weathering steel was crucial; all the elements are made from pieces of plate welded together.

Each pylon is a cantilever, supported by a group of four piles that resist the overturning moments. The triangular section is an efficient closed section, and looks smaller than an equivalent square. It splits into three tapering branches that support the circular node platform. A larger pylon supports the stair and lift. Halfway round, another larger pylon carries a “classroom” platform.

Reinforced concrete piles were acceptable for the foundation design, provided a survey was done to locate the main radial roots that provide stability, so these would not be damaged.

Pile caps were problematic since they would occupy the top metre of soil, where the fibrous roots occur. It was decided that the piles should be connected to each other and to the pylon base via a customised galvanized steel grillage, composed of stiffened, welded 356mm deep UC sections, installed above the roots close to existing ground level. A steel CHS plunged into the concrete pile and welded to the grillage acts as the principal pile reinforcement. The grillages are separated from the baseplates by neoprene isolators.

judges’ comment

This dramatic walkway provides an elevated view of the green canopy by a series of platform nodes and connecting decks on steel “trees”. The weathering steel plated structure is precisely located to avoid the trees and their roots, enabling close proximity without damage.

This brilliantly harmonises with its arboreal setting.

The spacing of the intersection of the diagonals with the top and bottom booms follows a Fibonacci sequence, with the closest spacing at the supports. The arrangement looks fairly irregular, has a maximum of three diagonals meeting at any point, and allows each truss half-span to be identical, but handed, to allow standardisation. Vertical "U" frames at each end, and at mid-span, reduce the effective buckling length of the handrail boom. The trusses also provide a safe balustrade, and support the walking surface. The steel mesh surface allows rain to fall through and is non-slip. The galvanized mesh is supported on secondary plates. Fixings are stainless steel, with neoprene strip isolators. The "ring beam" around the node is designed to carry the walkway loads applied at any point.

To reduce fabrication costs, most elements are single plates in standard thicknesses of 20mm, 25mm and 50mm. The node platform "ring beams" are T-sections composed of a 50mm thick flange and a 100mm thick web to take torsion. The pylons and their branches are equilateral sections that taper from 1300mm side at the base to 550mm at the branch point.

The stair and classroom platforms, carrying higher loads, are bigger at 1500mm tapering to 700mm and 890mm respectively.

The lift runs between the pair of guide pylons via rails and brackets welded to them. For emergency access or evacuation, the classroom platform incorporates a gate to allow escape via a cherry picker or similar.

The standard pylons complete with branches, the node platforms, and the walkways were fabricated off-site and brought to site as single components, to be connected on site via articulated pinned connections. For the stair and lift pylons and the two large platforms site welding was required. Welds between weathering steel elements used matching electrodes for capping passes.

Wind specialists were engaged to assess both the quasi-static wind loads for structural analysis and the dynamic effects. Dynamic studies focused on the accelerations at walkway level from wind effects, and their effects as perceived by visitors. This is a serviceability issue, with acceptability levels dependent on frequency of occurrence. As a result it was recommended that the walkway be closed to the public when wind speeds reach Beaufort force 5. Above force 6 the walkway is closed to all, including site staff. These speeds are expected to be exceeded on average 57 hours and 1.4 hours per year respectively.

It was anticipated from the outset that the structure would have some "liveliness". Natural frequency analyses gave a first frequency of approximately 1Hz. Synchronous lateral vibration does not occur on the walkway. Its non-symmetrical, closed-loop nature, and its use by visitors who generally walk only short distances before pausing, also mitigate against resonance effects. In practice, small vibrations of the structure as people walk around it and on the stairs can be felt at walkway level as tiny shivers, entirely consistent with the design intent.

The walkway was opened on 24 May 2008 to over 9,000 visitors and continues to be a great success.