FALMER HIGH LEVEL WALKWAY

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Summary
Structural properties such as stiffness and strength are generally considered desirable in bridge design. They can however have negative implications on a design. This paper explores a design where these had to be managed: a situation which triggered a train of events with unforeseen knock-on effects in construction.

Keywords: steel; complex geometry; accessibility; design evolution; snaking; logistical constraints; replacement

1. Introduction
Falmer High Level Walkway near Brighton UK, is a replacement structure linking an existing footbridge with a nearby bus stop and footpath. It replaces an old, stepped concrete ramp at 1 in 6 gradient, which was substandard to modern accessibility codes. The old ramp also exhibited signs of alkali silica reaction and was at the end of its serviceable life. The new replacement structure was designed to both improve accessibility and visually enhance the facilities provided.

Structurally, the 50m long walkway consists of six continuous spans on a constant gradient of 1 in 20 (see fig 1). The bridge curves both one way then another, creating a snaking effect as it descends to meet the ground (see fig 2). The structural system is a prefabricated steel box girder, chosen to mirror the adjoining main bridge, and it rests on five, slender circular steel columns (see fig 3). The deck is split into three sections of two spans each.

The project had a variety of logistical constraints to contend with, which made design and construction challenging. These included building the structure almost directly over a rail tunnel, within meters of busy
roads either side, contending with onerous ecological constraints, and the need to keep the connecting footbridge open to traffic throughout the works.

2. A ‘Story’

One aspect of using a light-weight continuous box girder with short spans was not appreciated until late in the design, and this had a notable effect on the final design, fabrication and erection. Modelling the new structure on 3D finite element structural software revealed that the thermal loads would result in significant uplift at the central supports (see fig 4). Self-weight was not nearly sufficient to counteract the vertical uplift generated by the temperature loads.

The preferred solution to the uplift was to add self-weight to the structure to counteract the uplift. Filling the void within the steel box girder with a low strength concrete would achieve the required effect, and would be a relatively simple, effective and cheap solution. However, the solution would also have negative consequences on the scheme, chief of which would be the added self-weight to be considered during installation and moving the sections around in the factory. Further ramifications were also to occur during fabrication and erection.

The concrete infill was carried out in the factory prior to delivery to site. It later transpired however that settlement of one of the two span deck sections had occurred in the factory whilst it was being concreted, resulting in the center of the section sagging an estimated 15 to 20mm. When the concrete cured, this deformed shape was permanently imposed on the deck unit.

When brought to site, levelling the first two span deck section on its columns proved very difficult, as the deck was not sitting comfortably on its columns, but rather ‘rocking’ on the central support. This was particularly critical given that the entire deck erection had to occur under a 10-hour closure of the adjacent trunk road. After much deliberation on site, the chosen solution was to remove packers underneath the central column baseplate, which allowed the center column to be lowered a sufficient amount. As a result of concreting the deck sections therefore, over-run of the night closure of the strategically important highway could easily have occurred, with the associated loss of reputation of both Client and Designer.

The title of the Footbridge 2017 conference is ‘Tell a Story’, with the aim of ‘cultivating debate’. This paper hopes to embrace, encourage and address this theme. Specifically, it is a matter for debate whether the uplift effects as described in the paper, with the associated knock-on implications during design, fabrication and erection, should have been foreseen at the early stages of concept development of the design.

Whether the answer to the above is yes or no, it is hopefully demonstrated that the problem was resolved with sensible, cost effective solutions. It could be argued that it is precisely the act of solving of such practical problems, under the difficult real world circumstances of cost and programme pressures, which are the essence of what design and engineering and design is all about.

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Fig. 3. High level walkway from underneath  
Fig. 4. Uplift effects generated by thermal loads