DOI: 10.24904/footbridge2017.01040

FOOTBRIDGES WITH PRESTRESSED CONCRETE DECKS

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Summary

Light and transparent pedestrian bridges with slender prestressed concrete decks are described in terms of their architectural and structural solutions. The function and principles of prestressing design are also discussed. The advantages of prestressed concrete decks are demonstrated on examples of arch, cable-stayed, suspension and stress ribbon structures.

Keywords: concrete; prestressing; force balancing; redistribution; creep; arch; cable-stayed; suspension; stress ribbon

1. Introduction

Although the first concrete structures were built two thousand years ago, concrete remains modern and structurally efficient material. The concrete decks of pedestrian bridges give structures a structural integrity and continuity, sufficient mass to damp dynamic effects, and represents a cost effective solution that requires minimum maintenance. By designing integral structural systems, we can avoid all weak structural members – bearings, expansion joints, etc.

The idea of prestressing put into the hands of the designer an ability to control structural behaviour. Prestressing allows us to balance the load, change boundary conditions and create supports within structures. Which is why prestressing is used in all our bridges.

2. Prestressed Concrete Deck

In design our stress ribbon structures, we have learnt that the prestressed slender deck (*the stress ribbon*) has tremendous bearing capacity and – if properly designed – also has large capacity to resist point load. Slender prestressed concrete decks are therefore used not only in stress ribbon footbridges but also in our arch, cable-stayed and suspension structures – see Fig. 1.

If the deck is suspended on its edges, it has a double tee cross section formed by edge girders, floor beams and a deck slab – see Fig. 2a. Alternatively, if the deck is suspended in the bridge axis, it is formed by a spine girder with two side overhangs supported by floor beam – see Fig. 2b. And finally, if the deck is suspended on one side, it has a non-symmetrical streamline box section – see Fig. 2c.