# Seaford Rail Viaduct – Launching a Kilometre

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## Summary

The Seaford Rail Extension Project, recently completed to the south of Adelaide, South Australia, required a 1.125km long viaduct to cross the Onkaparinga Valley and River. The solution chosen was an incrementally launched, concrete box girder, supporting the up and down tracks of the suburban rail line as ballasted track. This paper will consider the design aspects of this structure.

The articulation of the structure is highly unusual. Rail/structure interaction on long ballasted deck bridges, as assessed by European guidelines and standards, can result in unacceptable risk of track buckling. An assessment of this complex phenomenon resulted in the partition of the structure into several different sections, each with its own longitudinal restraint system. A series of rail expansion switches and deck movement joints prevent build up of stresses in the rails.

**Keywords:** Incremental, launching, post-tensioning, ballasted, track/structure interaction.

In October 2010, Thiess McConnell Dowell Joint Venture (TMDJV) was contracted by the South Australian Government's Department for Transport Energy and Infrastructure (DTEI) to construct the Seaford Rail Extension. Under a traditional design and construct model, Aurecon Australia was engaged by TMDJV's head consultant Parsons Brinckerhoff (PB) to deliver the design of the most significant structural component of the project - the 1.125km Onkaparinga Valley Bridge (Viaduct). The project commenced in October 2010 and was completed in December 2012.

*Fig. 1: Artists perspective of the viaduct from the river (courtesy of HASSELL Architects)*

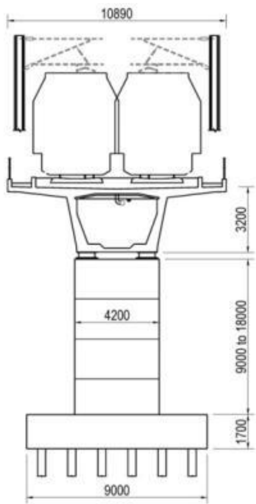


*Fig. 2: Typical cross section at piers*

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During the tender phase of the project, determination of the most appropriate form of bridge structure proved to be a balance between construction cost and the non-cost benefits associated with aesthetics, environmental impacts and the effects of structure behaviour on rail. A long span incrementally launched bridge was ultimately selected over alternative short, simple span solutions.

The design live loading for the bridge was specified as 230LA railway traffic loads (23 tonne axles) to the Australian Bridge Code - AS5100.

Historically in Australia, bridges having relatively short and simply supported spans, using superstructure forms such as Super Tee beams, prove overwhelmingly to be the cheapest option. Long/medium span alternative bridge forms, such as box girders, seldom compare favourably. This is particularly so when construction plant access to all elements of the structure is available as was the case for the Seaford Viaduct.

For the Seaford Rail Viaduct, the cost advantage of a short span super tee bridge superstructure compared with a longer span solution was diminished considerably by virtue of the difficult geotechnical conditions present. The presence of deep soft sand and clay alluvia meant that deep piled foundations would be costly. The reduction in the number of piers associated with a long span solution and hence cost contributed to the selection of the long span option.

More and more, Australian governments are recognising the importance of ensuring the provision of the most appropriate infrastructure solutions; the ‘right’ solution is not always represented by the lowest cost. In the case of the South Australian government’s request for tender for the Seaford Rail Extension, this recognition was represented by a series of non-cost evaluation criteria which allowed DTEI to assess and value the benefits that the long span bridge solution provided.

Environmental considerations were important non-cost criteria. The Onkaparinga Valley is a vast flood plain comprising several environmentally sensitive elements including the meandering river and native vegetation contributing to an important wetland ecosystem. The area is also the ancestral home of a community of local indigenous Australians. The selection of an incrementally launched bridge was heavily influenced by the need to minimize construction impacts on the environment. A launched solution meant fewer piers and confinement of construction activity away from the valley floor. Furthermore, a single, typical span was able to be used over the river itself.

From an early stage of the tender design, it became evident that the potential risks of track buckling required investigation. The length of the bridge and the number of continuous spans of the ballasted deck structure meant that deck movements from thermal effects, creep and shrinkage would be large and concentrated at only a few locations.

The presence of ballast between deck and tracks provides designers with some comfort that the two elements are isolated from each other and that differential effects between the two are immaterial. However, experience overseas has shown that high build-up of stress in rail track is possible due to relative movements between deck and tracks. If allowed to continue unchecked, derailment can occur.

Particular consideration was given to the articulation of the Viaduct in order to mitigate the risks associated with the effect of the deck movement behaviour on the supported railway. A bridge articulation arrangement was determined that limited deck and rail expansion lengths to 210m. Based on research, this length was considered to be appropriate to address track buckling risks, although the onus was placed on the designers to prove this point.

The bridge superstructure comprises a 1,125.3m long, single cell, prestressed concrete box-girder deck with 22 spans.

The incremental launching method was selected as the preferred methodology for the Viaduct, being a cost effective and environmentally friendly option.

The deck segments each side of each expansion gap were temporarily stressed together using a series of stressbars to allow incremental launching. The temporary connections were released upon completion of launching and the bridge segments jacked apart, using a combination of hydraulic jacks and the Eberspacher launching jacks, to create the expansion gaps. Control of each deck segment before, during and after splitting the deck was maintained by a coordinated sequence of permanent bearing lock off and temporary restraint frames at the bridge abutments.