



Stay simple, stay nice at Ostellato

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Summary

The Ferrara waterway, connecting this historic town with *Comacchio* on the Adriatic Sea is being upgraded: section widening and straightening as well as higher clearance has called for the replacement of most of the existing bridges. On the outskirts of Ostellato the conditions were appropriate for a medium span stay cable road bridge having the peculiarity of a curved girder with a plan and crest radius of 1000 metres. The structure had to be cost efficient, because it was offered as an alternative design to an awkward but smaller tender solution within the same budget. Concrete towers had to be of the inverted Y shape to resist lateral forces given by the horizontal radius; steel frames have been cast into the upper concrete section of the tower to facilitate positioning and erection of the 48 stays. The 14m wide deck sports the classical composite design with plated girders running at both sides and transverse beams at 4 metres centre; with an height of 1.5m circa for the 130 metres span, the resulting slenderness is considerable and associated with the double curvature gift the structure with elasticity and lightness.

Keywords: Stay cable bridges, fibre reinforced concrete, stay anchorages, pylon design.

1. Introduction

Small to medium stay cable bridges have been the main target of the “*make it strange*” fashion that has contaminated structural engineering in the last 20 years. Contrary to suspension bridges where fanciness is not possible because of size but also because suspension cables are designed by the force of gravity and there is no way to arrange them in fancy configurations, stays can go from here to wherever you want provided that you have enough money to make it. Wannabe architects become structural engineers have proposed all sorts of stay configurations taking advantage of the fact that a steel girder can self support itself over 100 plus metres span and stays can then be added without any particular static function.

As a matter of fact, designing a nice looking stay cable bridge of small to medium size is not an easy task because stay anchorages are quite cumbersome and consequently towers and deck cannot be made as slender as global stability would allow. For larger spans the problem vanishes because anchorage size becomes negligible compared to tower and deck cross section dimensions. The only solution to reducing the impact of anchorages on the aesthetic of the bridge is to use ropes with cast sockets possibly pinned to gusset plates welded to steel decks and towers. This is the arrangement of choice for small architectural stayed structures that have sprung around our cities in the last decades. For these structures white paint finishing is generally “*de rigueur*”.

For the Ostellato bridge, fashionable solution and other fancy arrangements had to be ruled out because of severe budget constraints and therefore a different approach, one of structural and economic efficiency, had to be undertaken to obtain a nice looking stay cable bridge. The paper presents the main feature of the design and the construction stages up to stays erection undergoing at the time of going to print with the finished bridge due to open in fall 2015.

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The authors were asked to devise an alternative solution to the tender design, a small and awkward stay cable bridge with two H shaped pylons placed at 95 m distance inside the waterway main embankments. The stay solution had to be retained although spans and all other elements could be changed within the same budget.



Fig. 1: A render of the bridge with artist intervention

To start with, the road alignment has been modified so as to obtain a curve of constant radius that bypass the old bridge and smoothly rejoin the old alignment. This required the new stay cable bridge deck to be built with an horizontal radius of 1000m. Secondly, the towers were displaced out of the main embankments increasing the span to 130m circa. The shape of the tower had also to be modified so as to resist the horizontal (centripetal) pull caused by the deck radius of curvature.

2. Conclusions

Cable-stayed bridges for medium and short spans may not be able to compete with conventional girder systems from a cost point of view, but there might be many occasions where the benefits warrant the extra cost. For the Ostellato bridge, the following aspects had to be taken into account.

A limitations in deck thickness due to the required vertical clearance, an environmental concerns that suggested to move the piers out of the river embankments and the aesthetics requirement that called for a signature structure. Designing and building a signature stay cable bridge requires the following components to be carefully evaluated and optimized:

- Composite decks may be particularly efficient and easy to erect.
- Tower design and material need to be efficient otherwise these elements are simply a cost addition with respect to a girder scheme. Concrete is certainly economic and efficient.
- Anchorages need to be optimized because they are typically expensive and awkward to built.
- Stays cost need to be comparable to that of a post-tensioning system since the two are similar and have the same structural function.