DESIGN AT THE EDGE – BRIDGE PARAPETS

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Summary
BEaM and MOE engineers were appointed by Copenhagen municipality to design a new “Copenhagen Standard” parapet to be used on road and footbridges. The reason for Copenhagen municipality to embark on his undertaking was an increase in renovation of road bridges in the periphery of the city. One of the first bridges in this program was the Mørkhøjvej Bridge across the moat of the Vestvold, an extensive fortification system dating from the beginning of the 20th century. Due to the location of the Mørkhøjvej bridge in an area known for it’s recreational value, the municipality wanted a design that would combine the robustness of a road parapet with the transparency and haptic quality of a footbridge parapet. Also, the municipality wanted the city arms to be incorporated into the design, thus marking the bridges as place markers, defining the realm of the city.

Keywords: aesthetics; design analysis; informed design development; bridge parapets; integrated design process; maintenance; visual identity

1. Introduction
When in Venice, make sure to pass by the Ponte Chiodo over the Rio San Felice, commonly known as the bridge without parapet. Ponte Chiodo is a small bridge, leading from one embankment directly to the entrance of a private home, and a peculiar sight. The walk up to the few steps to the top of the arch makes for a unique spatial experience, solely due to the lack of a bridge parapet.

The parapet defines the envelope of the civic space, footbridges provide. At the parapet, the human scale is introduced to the structure – a tangible design statement is made. Along with this haptic experience comes the perception of quality.

Copenhagen municipality for many years, has enjoyed a transformation to a green transport hub and there has been an increasing effort from the municipality to link the cities green areas by cycling routes, thereby increasing the attractiveness of cycling and promoting it to a widely used, alternative mode of transportation [1].

2. Laying the foundation for the design process
In January 2016, BEaM together with MOE engineers, were commissioned by Copenhagen municipality to design a new parapet for so-called “standard” bridges within the municipality. This project was borne out of the context of older bridges being renovated, one of these being located on the Mørkhøjvej Road, crossing the “Fæstningsgravnen”, i.e. the moat of the Vestfolden.

The design process was conducted as an integrated design process, based on close cooperation between architect, consulting engineer and client.

2.1 Merging two products into one
The main challenge was in the technical requirement that the parapet had to be fit for use on road and pedestrian bridges. Or, explained differently: make a transparent footbridge parapet impact resistant to
Hence, BEaM carried out a survey of bridge parapets in central Copenhagen. This research was conducted by one of our architects in the course of four days. It would lead us to a better understanding of present road bridge and footbridge parapet designs. Our task would be to “innovate” by merging these two types into one product, which would be structurally and aesthetically fit to satisfy the needs otherwise taken care of by two products.

2.2 Survey template and catalogue

The survey template was to ensure equal comparison between documented parapet designs. As a first step in making up the survey template, together with the client we defined keywords for the future design.

![Fig. 1. Copenhagen Parapet survey a) existing parapet locations b) new “CPH standard”](image)

3. Design solution

The design solution was yielded in a traditional, intense and concurrent client dialogue. Architect and engineer developed 3 different viable design options over the course of six weeks. A common denominator for all design proposals was easy in maintainability and constructability, driven by the use of larger, pre-fabricated segments bolted to vertical posts.

The post design varied substantially in the different proposals. Due to the fact that the posts would have to bear the main force of impact, the basis for the design showed considerable dimensions, at the post footplate in particular. However, by looking at the system holistically and considering the different impact loads vertical to the system, we managed to shape the post in a more dynamic, aggressive way with an increase in mass towards the footplate, a vertical taper and introduction of a lateral stiffener, which as it turned out was an interpretation of a “flying buttress” style stiffener used on some bridges in the early 20th century.

Further to the above structural/ geometric considerations came the aspect of constructability. The design team strived for an economic use of material, e.g. it was anticipated that 2 or more posts could be cut from the same plate with minimal excess waste material.

Thanks to the geometry of the vertical poles and guardrails, the transparency of the parapet system is convincingly continuous. We had predicted this in 3D models during the design phase, however, bot client and consultants were very pleased to find out that this prediction rang true.

Client and consultants were pleased with the result, it remains to be seen in how far the robustness of the parapet answers to challenges like vandalism and tear.