

Steel bridge girders, cost optimization

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Steel Bridge Girders, Cost Optimization

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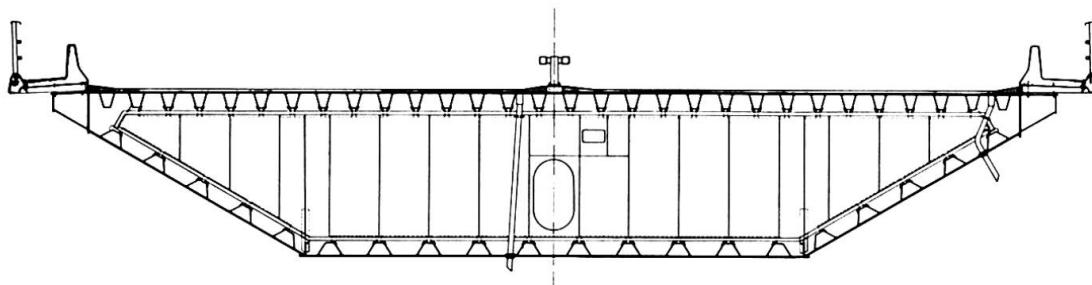
The steel box girder for the 3.3 km long bridge at Farø, Denmark has been made competitive by use of unusual design and construction methods.

A considerable saving has been possible by omission of painting of internal surfaces of the box girder, which amounts to more than 80% of the total steel surface. The corrosion protection of these surfaces is accomplished by ventilation by means of dehumidified air. The six dehumidification units represent low initial investment and are very economical in operation, each covering 5-600 m of bridge girder length. The external surface of the box girder to be painted has been reduced to a minimum by choice of a special cross section shape (refer to Farø bridge cross section below) with smooth exterior permitting an inexpensive initial painting cost and low maintenance.

The girder is composed of uniform steel panels welded by automatic welding, and a special assembly detail between exterior panels and diaphragms each 4 m has been detailed so as to require minimum of tight tolerance control during fabrication.

The box girder has been fabricated in a ship yard, all welded in full span sections each 80 m, and erected by simple lowering directly onto the pier tops. The girder continuity over full bridge length (1.6 km and 1.7 km) is subsequently established by field welding of box girders over the piers.

The bridge connection at Farø, which is part of European main highway E4, is presently under construction and is scheduled for completion Summer 1985.



Farø Bridge Cross Section

STEEL BRIDGE GIRDERS, COST OPTIMIZATION

Fabrication and maintenance costs for steel box girders may be optimized by:

1. Using identical or few types of similar panels.
2. Using simple panel connections for assembly of box cross sections.
3. Minimising the exterior surface area.
4. Corrosion protection of the box interior by dehumidification.

The steel box girders for the Faro Bridges were developed to satisfy the above criteria, and proved to be economically competitive in comparison with post-tensioned concrete box girders.

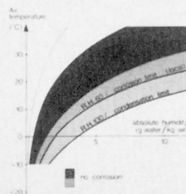
The internal corrosion protection scheme by circulation of dry air offers significant cost savings.

The dehumidification unit is based on the absorption principle and consist of readily available standard components. The steel surface is completely corrosion protected by relative humidities below 60%.

Dehumidification systems have been used in the Lille Bælt suspension bridge box girder since 1970, and the operating costs have been extremely low (approx. 1.5 US Cent per sq.m. per year). A similar installation will be used in the Faro Bridges, presently under construction in Denmark and scheduled for completion in 1985.

Owner: The Road Directorate, Denmark
Design and Supervision: Cowiconsult, Denmark
Fabrication and Erection: Monberg & Thorsen A/S, Denmark

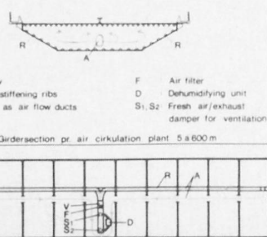
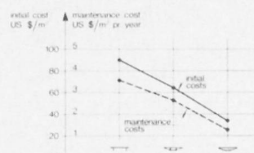
Relative humidity in box girder



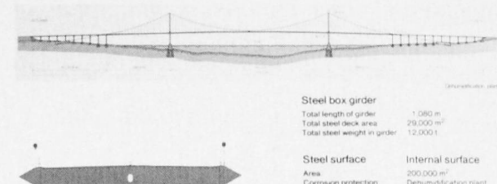
Corrosion protection of external and internal steel surfaces

SURFACE AREAS	Girder types		
	20 m/m	20 m/m	20 m/m
A ₁ deck area	20 m ² /m	20 m ² /m	20 m ² /m
A ₂ external painted area	72 m ² /m	50 m ² /m	24 m ² /m
A ₃ / A ₂	3.6	2.5	1.2
Protection:	painted	painted	painted
external area			
internal area		dehumidified	dehumidified

COSTS FOR CORROSION PROTECTION PER m² DECK AREA



Lille Bælt Bridge 1970



Steel box girder

Total length of girder 1 080 m
Total steel deck area 29 000 m²
Total steel weight in girder 12 000 t

Steel surface

Area 200 000 m²
Corrosion protection Paint

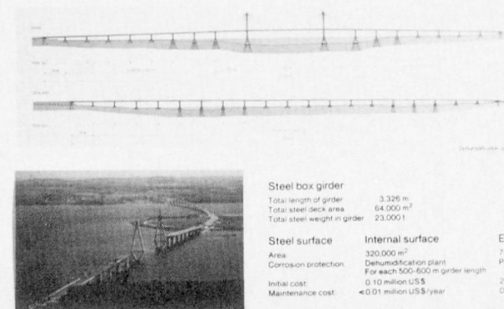
Internal surface

Dehumidification plant

External surface

Paint

Faro Bridges 1985



Steel box girder

Total length of girder 3 326 m
Total steel deck area 64 000 m²
Total steel weight in girder 23 000 t

Steel surface

Area 320 000 m²
Corrosion protection Dehumidification plant

For each 500-600 m girder length

Initial cost 0.10 million US\$

Maintenance cost <0.01 million US\$/year

Internal surface

Dehumidification plant

For each 500-600 m girder length

Initial cost 2.20 million US\$

Maintenance cost 0.08 million US\$/year

External steel surface

Paint

For each 500-600 m girder length

Initial cost 0.10 million US\$

Maintenance cost 0.08 million US\$/year