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#### 4. Standard Motorway Bridges, Zealand, Denmark

*Owner: Ministry of Public Works / Roskilde Country Council*

*Engineer: Cowiconsult, Consulting Engineers and Planners AS*

*Contractor: Carl Nielsen A/S*

*Dimensions:*

*span length: from 17 to 21 m*

*(main side): from 12 to 12 m*

*bridge width: from 7 to 11 m*

*angle between axes highway/overcrossing: 60° to 90°*

*maximum grade: 3,5 o/o*

*Quantities of materials used pro m<sup>2</sup> of bridge:*

*0.55 - 0.65 m<sup>3</sup> concrete for superstructure*

*(span 17.3 - 21.3 m)*

*0.15 - 0.20 m<sup>3</sup> concrete for substructure (usual foundation conditions)*

*46 - 50 kg steel*

*19 - 24 kg steel for prestressing*

*Work's duration: 24 months (max. 8 months per bridge)*

*Service date: 1970*

During the initial period of motorway construction in Denmark, i.e. in the late forties and fifties, efforts were made to incorporate as far as possible uniform bridge types, and standard elements partly to benefit economically from the repetition of construction procedure, and partly in order to achieve an aesthetical uniformity within the individual motorway section.

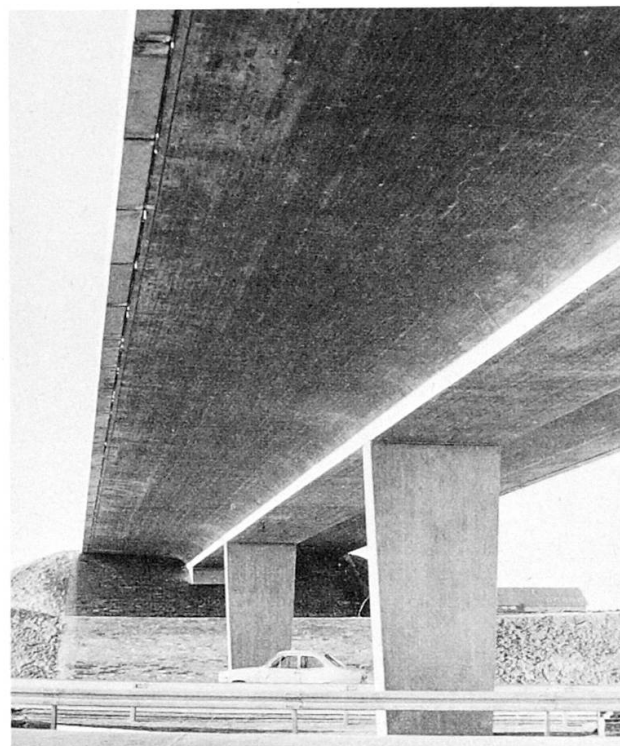
In connection with the design of motorways for Roskilde Country Council commenced in 1963, approximately 35 overpasses across four or six-lane motorways were to be provided. With this number, the question of standardisation had to be further evaluated.

Prior to this assignment the Consulting Engineers had, in an internal research project, concluded that a structure in pre-stressed concrete with supports in the median, and at verges and with open side spans — i.e. a four-span bridge — would be optimal.

As a start the geometrical data of the road crossings were evaluated — e.g. angle of intersection, horizontal and vertical profiles. Given these details it was decided that the highest degree of standardisation could be achieved by employing a structure resting on single pier supports, and with the abutments placed at a high level in the road embankments.

The selected superstructure was of a monobeam type with cantilever wings, post-tensioned longitudinally, and in the case of extreme widths of the overpass also post-tensioned transversally. For widths up to 11 m only normal reinforcement was provided transversally.

On this basis the total project was divided into 11 overpasses which could be constructed according to a standard design, and 24 overpasses which had to be designed individually, but incorporating as far as possible the same elements as those used in the standard design.



The drawing shows elevation and typical cross section of a standard bridge for an 11 m wide crossing road.

Pier and abutment forms are equal in both designs. Furthermore, the geometry of the bridge soffit is made from standard elements.

For the 11 standard bridges detailed design and tender documents were prepared, and tenders were called for both pre-fabricated and cast in situ superstructures. In the pre-fabricated solution, the superstructure was made up from segments as shown on the drawings. The segments were assumed supported on a standard scaffolding until post-tensioning was carried out. At the tender stage the cast in situ solution turned out to be approximately 10 o/o cheaper than the pre-fabricated solution and was, therefore, chosen for construction.

The only pre-fabricated concrete element which remained was the standard edge beam which has since been used on most of the various types of bridges designed by the Consulting Engineers. The main reason for employing this detail has been to provide an element manufactured under optimal conditions in a factory, and to enable easier renewal of the beams if required by the accelerated deterioration caused by air pollution, and use of de-icing salts.

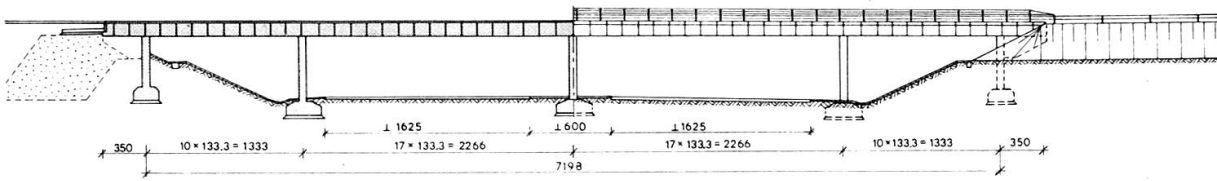
Since the construction of these bridges the type has been further developed into two-span bridges with spans up to approximately 35 m, and a superstructure with the beam made as a hollow box girder. Until 1976 a total of approximately 100 motorway bridges had been made according to the described typical design.

(Cowiconsult)

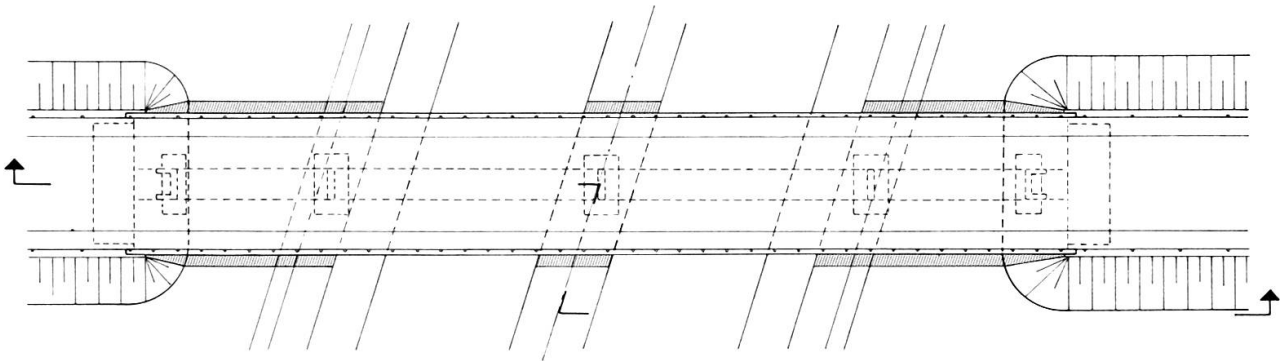


LONG SECTION

ELEVATION



PLAN



CROSS SECTION

