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More Precise Design Calculation of Bridge Deck Beams

Calculs plus précis d'entretoises de ponts

Genauere Berechnung von Brückenträgern

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Precise design calculations of bridge deck beams develope in three general directions, depending on the subject taken into account: there could be, firstly, spatial work of bridge deck, secondly, the influence of span elements on the work of bridge deck elements and thirdly, the peculiarities of the real work of joint elements and, certainly, conditions of load transmission.

Recently the most important direction in calculations is considered to be the third of abovementioned, because the majority of defects in bridge deck appear exactly in places where different elements joint. Only the least defects appear in other places and it is connected with the work of corresponded elements under local load.

But the questions of the local distribution of bridge deck stresses (third direction) could not be touched with out the other aspects of design calculation because all this more precise definitions bring in corresponding changes in distribution of the bridge deck efforts.

All the mentioned problems of design calculation in each direction could be solved by different methods and with different elabovation of details of the structure design scheme. And so, it is difficult to use the same design method for working out all the problems that meets all demands in equal measure.

All these questions could be solved with finite element method. But, in practic, it is not expedientiy and not disirable. Firstly, the quantity of equation grows considerably justified, secondly,the unification of finite element doesn"t allow to consider all peculiarity of the design scheme; and, thirdly, it is appears to be the complicated problem to determine the coditions of joint transmission of load.

General design scheme of the structure is irregular. So it is incorrect to use the finite element method. For this scheme the superelement method would be more appropriate. But in this case it is necessary to determine stiffness matrix of superelement.

For the solution of the general problem the next ways had been planed. For the problems of the first direction variation methods were used. Bridge deck is considered to be the beam-system. This problem was solved by L.V.Semenets" method. With definite assumptions the received function of surface is the function of two variables and is expressed by trigonometric series. Fitnees of the function is well enough. Thus the three members of series is quite enough for acceptable solution.

This function of the surface may be used to determine the bridge deck stiffness matrix, as the matrix of a superelement. It is necessary to take as much members of series as is needed for the indepedent coefficients quantity to be equal to the quantity of superelament degrees levels of freedom.

The role of such approach is important, especially for wide bridge deck, because taking into account of flexures in traversal section allows to determine the real bending stiffness EI of bridge deck in vertcal plane.

Problems of second directon, where the influence of girder elements on load distribution are taken into account, are solved by means of expanding design schemes which was proposed by author of this paper. The very idea of expanding design schemes is to sequentially join the inloaded elements to the loaded part of construction. The influence of the part of construction that was not taken into account on each iteration is interpretated as resilient connections.

Influence of girder elements is substituted by equivalent resilient connections. The method for determination of resilient coefficients of connections was proposed both theoretically and practically. In practice all statistic characteristics are determine during the determination of resilient coefficients.

The method of estimation of the influence of statistic characteristics of resilient connections on the determined efforts valuex was proposed.

Each superelement which interprets the resilient characteristics may be present in the form of finite undeformable element with resilient connections. For such elements stiffness matrix can be determined.

Problems of the third direction could be solved by means of finite elemement or superelement method.

For the solution of a problem as a whole the superelement method with stiffness matrix which was determined beforehand is used.

The approach described allows to quite precisely solve the proposed global problem, which the design scheme peculiarities of each component problem"s part maximally preserved.