SHEAR DESIGN OF BRIDGE BEAMS BY STRUT-AND-TIE MODEL

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ABSTRACT

High Strength Concrete (HSC) is an aesthetic and durablematerial for bridge construction. One of HSC advantagesis that columnswill have smaller cross section hence their visual obstruction to their surrounding environment will be reduced. Horizontal Web Bar (HWB), figure 2, has a number of advantages such as improved shear capacity of RC beams. This paper discusses shear behaviour of HSC beams with HWB and recommends a Strut-and-tie model (STM) forthis structural system, figure 6.

A number of HSC and Normal Strength Concrete (NSC) beams were tested in order to compare their shear resistance. Furthermore an equal numbers of HSC and NSC beams with HWB weretested to failure, table 1.

The rules for estimating the contribution of HWB to the shear resistance wereinvestigatedby using the experimental measurement of strains in the steel as well as otheravailable tests results.

Finite Element analysis was performed on HSC beams with HWB. The acquired numerical results were compared with those of experimental strains obtained by strain gauges of stirrups, tension steel and HWB. The experimental and the numerical results were used to propose suitable assumptionsin order to develop an appropriate Strut-and-tie (STM) model for HSC beams with HWB and shear stirrups of span/depth ratio equals 3.

INTRODUCTION

High strength concrete is generally considered for a wide range of structural applications[i]. The existing recommendations in AASHTO LRFD[ii] code which has incorporated STM since 1994, ACI-318-08[iii] Appendix A, and EC2-04 [[iv]]for use of STM to design shear are derived from research conducted essentially on Normal Strength Concrete (NSC) with cube strengths up to 50 MPa, and it was felt that these might not be applicable to High Strength Concrete (HSC) when a Horizontal Web Bar (HWB) is present in the beam.

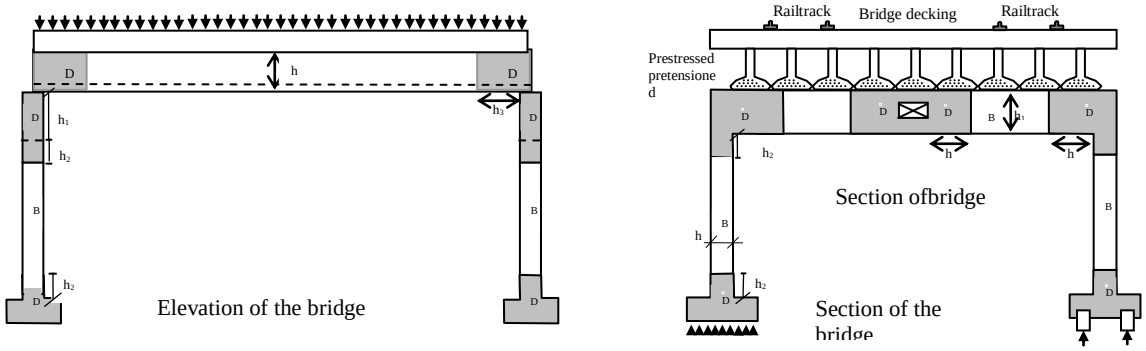

Figure 1: Structures are divided up into D-regions that extend the depth of the member each way from a reaction or discontinuity and B-regions, the parts of the structure between D-regions. Figure 4 shows Strut-and-tie models (STM)