A STUDY OF A REINFORCED CONCRETE SKEW GRILLAGE BRIDGE UNDER ULTIMATE LOAD

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Abstract

A laboratory test was made on a one-fourth scale simply-supported, reinforced concrete grillage bridge having a skew angle of 30 degrees. The model structure was chosen to accommodate a 2-lane capacity and was designed for H20 - S16 highway truck loading. The design was based on the elastic theory but the structure was analyzed for collapse strength by the yield hinge theory. In this particular test it was assumed that the critical condition prevailed; that is, four equal wheel loads applied at the same time to the four middle node points. The predicted ultimate wheel load was obtained by using the method of upper and lower bounds.

The purposes of the test were:

(i) To determine the ultimate capacity of the skew grillage bridge;

(ii) To observe conditions at the ultimate load - in particular, how the concrete cracked and was crushed and to measure the maximum deflection when the reinforcing first yielded.

The result of the test showed that the method of upper bound and lower bound for predicting the ultimate capacity is valid.

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NOTATION

A cage ...... cross section area enclosed by reinforcement

Am .... steel area in model

Ap .... steel area in prototype

$$Am = \left(\frac{1}{\lambda}\right)^2 Ap$$

As .... steel area

C .... circumference of cage

f_m .... stress in model

f_p .... stress in prototype

$$f_m = f_p$$

f'_c .... compressive strength of concrete

fy .... yield stress of steel

FyL .... yield strength of one longitudinal bar

FyT .... yield force per unit length of beam

Lp .... dimension of prototype

Lm .... dimension of model

$$\lambda = \frac{Lp}{Lm}$$

M_B(●) ..... positive bending strength of beam

$\bar{M}_B$ .... negative bending strength of beam

M_T (o) .... torsional strength of beam

Mm .... moment in model

Mp .... moment in prototype (or plastic moment)

$$Mm = \left(\frac{1}{\lambda}\right)^3 Mp$$

n .... numbers of longitudinal bars

NOTATION (CONTINUED)

p .... pitch of stirrups

Pm .... concentrated load on model

Pp .... concentrated load on prototype

$$Pm = \left(\frac{1}{\lambda}\right)^2 Pp$$

Pu .... ultimate point load

Rmin.......... $\frac{nFyL}{C}$ or $\frac{FyT}{p}$ whatever is lesser

W_E .... external workdone by the load

W_D .... work dissipated in the hinges

ϵm .... strain in model

ϵp .... strain in prototype

λ .... linear scale = $\frac{Lp}{Lm}$

δ .... deflection under load

θ .... rotation of beam or mechanism

α .... skew angle

ϕ .... diameter of bars