

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

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Kularb Narong
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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
A _m	steel area in model
A _p	steel area in prototype
	$A_m = \left(\frac{l}{\lambda} \right)^2 A_p$
A _s	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
f _y	yield stress of steel
F _{yL}	yield strength of one longitudinal bar
F _{yT}	yield force per unit length of beam
L _p	dimension of prototype
L _m	dimension of model
	$\lambda = \frac{L_p}{L_m}$
M _B (●)	positive bending strength of beam
\bar{M}_B	negative bending strength of beam
M _T (○)	torsional strength of beam
M _m	moment in model
M _p	moment in prototype (or plastic moment)
	$M_m = \left(\frac{l}{\lambda} \right)^3 M_p$
n	numbers of longitudinal bars

NOTATION (CONTINUED)

p	.....	pitch of stirrups
P _m	.....	concentrated load on model
P _p	.....	concentrated load on prototype
		$P_m = \left(\frac{1}{\lambda} \right)^2 P_p$
P _u	.....	ultimate point load
R _{min}	.....	$\frac{nF_y L}{C}$ or $\frac{F_y T}{p}$ whatever is lesser
W _E	.....	external workdone by the load
W _D	.....	work dissipated in the hinges
ε _m	.....	strain in model
ε _p	.....	strain in prototype
λ	.....	linear scale = $\frac{L_p}{L_m}$
δ	.....	deflection under load
θ	.....	rotation of beam or mechanism
α	.....	skew angle
φ	.....	diameter of bars