LATERAL BUCKLING OF A BOWED STRUT

By

SUPORN HOTIMAVORAKUL

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T. Nilanidhi
....
Dean of the Graduate School

Thesis Committee

P. Pattabongse .... Chairman

....

V. Chalitthan ....

....

Thesis Supervisor ....

Date .....24th Apr. 1969.................................

ABSTRACT

An experimental and theoretical investigation of the elastic lateral buckling behavior and the instability of mild steel, shallow bowed struts is presented herein. The dimensions of the struts are 48 in.long, 2 in.wide and ¼ in. thick. The bowed strut is loaded by a lateral concentrated load at midspan.

Two different types of ends of bowed struts are tested by varying the amounts of initial bow or geometry λ^* which correspond to the rise "h" of 0.500, 0.625, 0.750, 0.875, 1.000, 1.125, 1.250, 1.375 and 1.500 inches.

The mode shapes at various stages of lateral loading are studied.

The results show that the critical lateral load P is expressed as a function of geometry λ^*, and it depends on the types of ends of bowed strut.

The comparison with experiments shows that the critical lateral load based on the energy buckling criterion agrees quite well with the experimental results.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

n. 8-09

LIST OF SYMBOLS

A_m	=	Fourier co-efficients of initial curve.
A_1	=	Amplitude of initial sinusoidal curve.
B_m, B_n	=	Fourier co-efficients of deflected curve.
B_1, B_2	=	Amplitude of symmetrical and antisymmetrical deflection of bowed strut, respectively.
b_m	=	Non-dimensional Fourier co-efficients of deflection curve for classical buckling criterion.
b_1, b_2	=	Non-dimensional amplitude of symmetrical and anti-symmetrical deflection for classical buckling criterion, respectively.
b_1^*, b_2^*	=	Non-dimensional amplitude of symmetrical and anti-symmetrical deflection for energy buckling criterion, respectively.
C_i	=	Constants
E	=	Young 's modulus.
f	=	Width of bowed strut.
H	=	Axial thrust built in the bowed strut due to the application of a lateral central concentrated load.
H_o	=	Initial axial thrust in the bowed strut.
H^*	=	Non-dimensional axial thrust for energy buckling criterion.
h	=	Rise of bowed strut.
I	=	Moment of inertia of cross-section of bowed strut.
K	=	Change in curvature of bowed strut.
L	=	Span of bowed strut.
M_b	=	Bending moment due to lateral load.
P	=	Lateral concentrated load.
P^*	=	Non-dimensional lateral load for energy criterion.

P_T^*, P_U^* = Transitional and upper lateral buckling load for energy criterion in non-dimensional form, respectively.

R = Non-dimensional lateral load; also radius of curvature.

R_T, R_U = Transitional and upper lateral buckling load for classical criterion in non-dimensional form, respectively.

S = Non-dimensional axial thrust for classical criterion.

t = Thickness of bowed strut.

U_b = Strain energy due to bending in non-dimensional form.

U_d = Strain energy due to the axial deformation in non-dimensional form.

U_p = Work done by lateral load in non-dimensional form.

U_T = Total energy expressed in non-dimensional form.

W = Radial displacement of the center line of bowed strut.

W_1, W_2 = Symmetrical and anti-symmetrical displacement respectively.

Y, Y_o = Deflected and initial curve of center line of bowed strut respectively.

α = Angular co-ordinate for bowed strut.

β = Central angle subtended by bowed strut.

ϵ = Axial strain of bowed strut.

λ_1 = Geometry of sinusoidal bowed strut for classical criterion.

λ^* = Geometry of shallow bowed strut for energy criterion.

ξ = The ratio of α to β.