COMPARITIVE STUDY BETWEEN EMPIRICAL EQUATIONS OF CRITICAL WIND SPEED FOR CABLE-STAYED BRIDGES

By

Nouran Mamdouh Tmam Nagdy

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Structural Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

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Key Words:

Cable stayed; Wind Loads; Vortex-Shedding; Flutter analysis; Aerodynamic.

Summary:

The long span cable-stayed bridges are considered as a modern form of the bridges which are both economical and aesthetic. In the past of few decades construction of long-span bridges was used widely in crossing wide water. The study of wind effect is considered main items to design the type of bridges. Therefore, the importance of the wind tunnel test measured the flutter critical wind speed. Some of the researchers concluded from this test some of empirical equations to calculate the flutter wind speed. The main objective of this research is comparing some of equations with each other. These empirical equations applied to the three dimensional finite element analysis of cable-stayed bridges. The conclusion results of the research are compared to the empirical equations with each other by using the frequencies of three bridges model shapes, that was modeled on the SAP program.

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LIST OF SYMBOLS

α	Angle of attack [deg]
β	Pitch angle [deg]
ζ	Damping ratio [-]
θ	Torsional angle [deg]
κ	The reduced frequency stiffness [-]
λ	Eigenvalue ρ Air density [kg/m3]
ρ	Density of the blade [kg/m3]
φ	Azimuth angle [deg]
Ω	Rotational speed [rad/s]
ω	Modal frequency [Hz]
A	Area [m2]
E	Young modulus of elasticity [Pa]
F	The cable force
$F_{\eta o}$,F_B	The heaving (Vertical of Flexural) natural characteristic frequency
$F_{\emptyset o}$, F_T	The torsional natural characteristic frequency
G	Shear modulus [Pa]
h	Flapwise deflection [m]
I	Moment of inertia [m4]
J	Polar moment of inertia [m4]
K	Stiffness matrix k Reduced frequency [-]
ki	Stiffness coefficient [N/m]
L	Aerodynamic lift [N]
L	Lagrangian operator
M	Mass matrix
M	aerodynamic moment [Nm]

m	Mass [kg]
q	Applied load per unit length [N/m]
t	Time [s]
u	Node deformation vector
W	Relative wind speed [m/s]