REHABILITATION OF STEEL BRIDGES THROUGH PRESTRESSING

A Thesis submitted for the partial fulfillment
Of the Degree of Master of Engineering in
Structural Engineering Design

Submitted by

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ABSTRACT

Throughout the world, bridges are being newly built, repaired, strengthened, replaced to provide essential infrastructure facilities for the Development. Sri Lanka is no exception. The cost of bridging has become a heavy burden to the National Economy in Sri Lanka, due to the continuing demand for access and mobility to under developed or developed areas respectively.

The bridge stock in Sri Lanka mainly comprises of small to medium span bridges, built using steel and/or concrete. Almost all the Medium Span Bridges are steel truss bridges.

The Steel Bridges are generally more than 50 years old and are in need of repair/strengthening or replacement.

Sri Lanka has successfully repaired/strengthened some of the Steel Bridges in the past, though now they are replaced due to their insufficient width, more often than not. This is primarily due to the fact that the steel truss bridges are not easily amenable to widening, economically.

In this research, it is shown that the steel truss bridges could be widened to meet the current traffic demand, even without strengthening, due to the large factor of safety, used in the original designs, and the new knowledge gained in the material and structural behavior of these bridges.

In bridges where such a large factor of safety is not in-built, it is shown that prestressing could strengthen the bridge after the widening, economically.

Further, it is shown that the life span of the widened bridge could be prolonged after the widening due to the application of the prestressing force, which reduces the probability of fatigue failure.

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Notations

Z_{req}	....	Is the required Section Modulus
l_e	....	Is the Effective length of compression chord
δ	....	Is the lateral deflection of the U frame at the level of the centroid of the chord due to a unit lateral force
d_1	....	Is the distance from the centroid of compressive chord to the nearer face of the cross member of the U frame
d_2	....	Is the distance from the centroid of compressive chord to the centroidal axis of the cross member of the U frame
E	....	Is the Young's Modulus of the material
I_1	....	Is the second moment of area of the web member forming an arm of the U frame
I_2	....	Is the second moment of area of the cross member
u	....	0.5 for outer beam and 0.33 for inner beam
s	....	Is the distance between U frames
f	....	Is the flexibility of the joint
k_3	....	Is taken as 1.0
I_c	....	Is the second moment of area of the compression chord
A	....	Is the cross sectional area
I	....	Is the second moment of area
λ_{LT}	....	Is the slenderness ratio
r	....	Is the radius of gyration
I_{xx}	....	Is the the second moment of area on major axis
I_{yy}	....	Is the the second moment of area on minor axis
r_{yy}	....	Is the radius of gyration on minor axis
σ_c	....	Is the allowable compressive stress
σ_y	....	Is the Yield stress of the material