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TECHNICAL REPORT

A MATHEMATICAL MODEL OF A SUSPENSION BRIDGE

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

Since the fall of the Old Tacoma Narrows Bridge in 1940, mathematical modeling of suspension bridges has been studied by many researchers. A mathematical model of a suspension bridge by McKenna is applied to a bridge located at Ghana named Adomi Bridge as there is no studies to possible vertical and torsional oscillations have been published previously. In this research, only a cross section of the center of the bridge's span is considered for the derivation of the nonlinear differential equation system as in McKenna's mathematical model. MATLAB Simulink is used to perform the simulation of the bridge response under various initial conditions and parameters of the bridge to know its stability.

1 INTRODUCTION

Since the fall of the Old Tacoma Narrows Bridge (Figure 1.1) in 1940, mathematical modeling of suspension bridges has been studied by many researchers. For fifty years, it is believed that the cause of collapse was contributed by resonance until it was argued by mathematicians Lazer and McKenna. They used a system of uncoupled nonlinear ordinary differential equation (ODE) to provide an explanation for the fall of the bridge. Thus, with suitable engineering constants, their model will be used to determine the reaction of Adomi Bridge (Figure 1.2) under large induced initial oscillations. Suspension bridge is a dynamical system. The existence of the vertical supporting cable stay that constraint the movements of the centre span of the bridge in downward direction generates the nonlinearity and have no effect on its nature on the upward direction.

Figure 1.1: Old Tacoma Narrows Bridge