UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

A MATHEMATICAL MODEL OF A SUSPENSION BRIDGE

NOOR ZULIHA BINTI ISMAIL 2014499176 D1CS2496D NUR ASILAH BINTI NORDIN 2014810088 D1CS2496D SYAFIQAH BINTI SUHAIMI 2014279704 D1CS2496D

Report submitted in partial fulfillment of the requirement for the degree of
Bachelor of Science (Hons.) Mathematics
Center of Mathematics Studies
Faculty of Computer and Mathematical Sciences

JULY 2017

ACKNOWLEDGEMENTS

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

First and foremost, we are very grateful to Allah S.W.T for giving us the strength to finish this project successfully.

We would like to express our sincere gratitude to our advisor, Madam Rahaidah Muhammad and our Final Year Project coordinator, Madam Wan Khairiyah Hulaini Wan Ramli for their continuous support, patience, inspiration, motivation, enthusiasm and immense knowledge in our study and research. Their guidance helped us in all the time of research and writing of this thesis.

This thesis also cannot be done without the cooperation from our group members, Noor Zuliha Binti Ismail, Nur Asilah Binti Nordin and Syafiqah Binti Suhaimi. Lastly, we would like to thank you to all lecturers, friends and families who always encouraged us in finishing this thesis.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS TABLE OF CONTENTS LIST OF FIGURES			ii v vii		
				LIST OF TABLES	
				AB	STRAC
1	INTR	CODUCTION		1	
	1.1	RESEARCH BACKGROUND	4		
	1.2	PROBLEM STATEMENT	4		
	1.3	RESEARCH OBJECTIVE	5		
	1.4	SIGNIFICANT OF PROJECT	5		
	1.5	SCOPE OF PROJECT	5		
2	LITE	TERATURE REVIEW			
3	METHODOLOGY		12		
	3.1	CROSS SECTION OF BRIDGE'S SPAN MODEL	12		
	3.2	"MATLAB" AND "SIMULINK"	14		
4	IMPLEMENTATION		16		
	4.1	DERIVATION OF THE VERTICAL AND TORSIONAL MOTION			
		EQUATION	16		
	4.2	DATA COLLECTION	23		
	4.3	DATA ANALYSIS	27		
5	RESU	RESULTS AND DISCUSSION			

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.

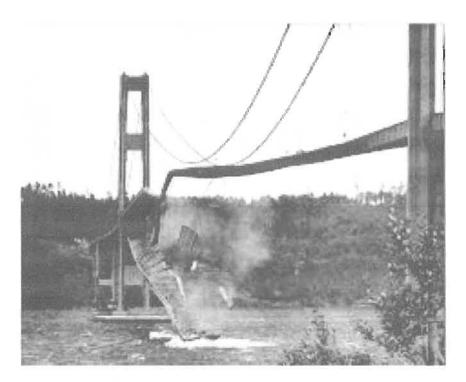


Figure 1.1: Old Tacoma Narrows Bridge