Acknowledgments

The researcher wishes to express his deepest gratitude and appreciation to Prof. Amir Alani, Ex-Head of the Mechanical & Design Engineering Department, University of Portsmouth, UK, Head of the Department of Civil Engineering at the University of Greenwich at present, who has guided and advised me from the very beginning of this research. The researcher thanks him for his kind supervision, immense contribution, continuous support and helpful suggestions during all stages of this work.

I wish to express my deep gratitude and my thanks to Dr. Naser Al-Shayea, Civil Engineering department, King Fahd University of Petroleum & Minerals, Saudi Arabia, for his kind supervision, his knowledge and for useful discussion during all phases of this research work.

Special thanks to Mr. Araslan Awan, for his help editing the text. Thanks also to Engineer Ahamed Hamidi for his assistance and help. Many thanks presented to the company GEOTEC-Software for providing the ELPLA program.

Finally, the researcher dedicates this thesis to his family for their continuous encouragement and sacrifices. Great thanks to them, especially for my son Eng. Abdul-Rahman Al-Mousa.
Declaration

Re: award of doctor of philosophy

Whilst registered as a candidate for the above degree, I have not been registered for any other research award, the results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

The candidate

Eng. Ahmed Al-Mmousa