



## Structure Analysis of Marine Pipes under the Effect of Water Explosion Force (Wave)

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### Abstract

Underwater explosion is a subject that has been paid attention to by many researchers. In this study the underwater explosion phenomena under shockwave loading is explored by numerical method. For this purpose, by modeling a marine pipe buried in the water by ABAQUS software, the effect of the shock wave and the damages were assessed. Then using the laboratorial results, the fluid-structure interaction and shock wave loading and its results were analysed. Finally, it was concluded from numerical modeling that the highest levels of strain on the pipe buried in the water under underwater explosion and shock wave loading occur in the ending parts of the pipe in both sides and away from explosion field.

*Keywords:* Underwater Explosion; Marine Pipes; Shock Wave; Interaction; ABAQUS.

## 1. Introduction

Underwater explosion which is abbreviated as UNDEX is a subject that has been continuously paid attention by researchers and is about 151 years old. The importance and the determining role of marine forces and marine battles in wars has been the main factor for studies about underwater explosions and even nowadays, the most equipped research facilities and the most prominent scholars are usually related to and under the support of military. On the other hand, how under sea structures are destructed under wave force of the explosion is among the concerns of sea engineers and researchers of offshore structures. Analysis of underwater explosion is one of the very important, new and complex issues and is among the main design considerations for sea structures such as platforms. The endurance and control of these structures against shock waves of explosion, accurate loading mechanism and obtaining a comprehensive method for the response of these structures against these types of loads is the current subject of many research centers in the world and hence the subject of this paper. Underwater explosion includes two main phenomena namely shock wave and air bubbles; and dynamic loading on the structure is the results of these. The methods for studying underwater explosion includes laboratory, analytical and numerical methods and in this study, the numerical method is mainly discussed. Therefore this paper aims to study the effect of shock wave on marine pipes and the damages on the pipes. Depending on the conditions including the type and the amount of the explosive material and its distance to structure and water surface, the initial pulse (shock wave) can result in a major part or a fraction of the structure response. Thus, the pipe and the surrounding fluid with non-reflective boundaries are subject to explosion of a certain amount of an explosive material and the analysis is done involving and taking into consideration the effects of structure and fluid interaction.

## 2. Review of the Literature

The initial studies include the works of Mind Lin and Haywood that studied low modes and the approximation of initial times [1, 2]. The first paper was published by Geers in 1969 and 1972 in which time history diagram related to

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