UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

FINITE DIFFERENCE METHOD FOR SOLVING ONE DIMENSIONAL OF SHALLOW WATER EQUATION

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

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ABSTRACT

Shallow Water Equation (SWE) also known as Saint-Venant equations. One-dimensional Saint-Venant equations are developed in order to simplify the Shallow Water Equations to a much simpler equations. These equations are solved using finite difference method which is one of the famous method that have been used by many researchers.The Shallow Water Equations are solved using the Crank-Nicolson method and the First Upwind Difference method. The purpose of this project are to solve one-dimensional shallow water equation by using finite difference methods and determine the velocity and the amplitude from the one-dimensional shallow water equations.Validation of the results are made using the Crank-Nicolson method and the First Upwind Difference method with Upwind Interpolation method.

1 INTRODUCTION

Fluid flow is one of the natural phenomena that occur daily in our life. Ones always consider that fluid flow is just a simple nature's activity that involve of water flowing from one point to another point. But there is much more to this phenomenon that lead to bigger and more important things. For example, the subdiscipline of fluid flow is fluid dynamics that offers systematic structures for solving fluid flow problems such as calculation of flow velocity, pressure, temperature and many more. Fluid flow problems also include the propagation of tsunamis, water damping and river flow which can give either advantages or disadvantages in our life. However, these problems can be solved using mathematical modelling of shallow water equation.

Shallow water equations are a set of partial differential equations or to be more precise, a set of hyperbolic partial differential equations. As stated by Park (2007), the shallow water equations are the description of water wave propagation when the wavelength of the water wave is longer than the depth of the water. This behavior can be seen clearly when the waves from the middle of the sea which is in the deep area enter the shallow water area causing the velocity to become slower and decrease the wavelength just as in Figure 1.1.

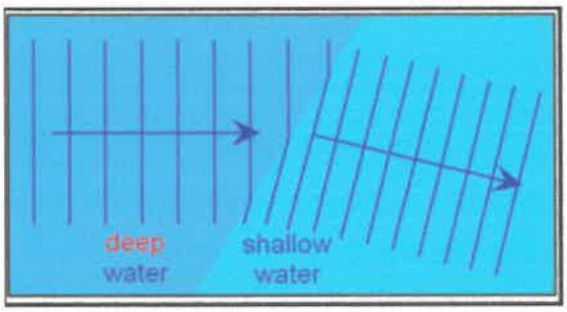

Figure 1.1: The wavelength of the water wave

However, contradict to velocity and the wavelength reaction, the amplitude of the water wave increase rapidly. In the next figure, the process of the shallow water phenomenon is shown,