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MAINTENANCE DREDGING: ALLOWABLE LIMIT FOR DREDGE VOLUME DIFFERENCES USING SBES AND MBES DATASETS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In order to ensure channel clearances based on final dredging level are valid, sounding works are required to be used. The dredge volume being excavated is computed using sounding datasets. Although multi-beam echo sounders (MBES) are widely used today because of high-density data, single-beam echo sounders (SBES) are still relevant to be used to calculate dredge volume up to this date. As different hardware generates different data trends and distributions, different software uses various algorithms to calculate dredge volume and also due to different gridding sizes, it can be expected that the results with varying amounts of dredge volume will be generated. However, there is no thorough study on the magnitude of differences in dredge volume that can be established as an allowable limit. Although there are standards that can be used as a guideline, the applicable allowable limit is rarely discussed. This study aims to establish the allowable limit between SBES and MBES in terms of dredge volume calculation. Dredge volume calculation by various methods using different software, which are surface to datum, surface to surface and cross sections generated from SBES and MBES raw dataset, were compared. Five spatial interpolation methods which are inverse distance weighted (IDW), global polynomial interpolation, local interpolation polynomial, radial basis function (RBF), and ordinary kriging were used to grid the area before performing dredge volume computations. The comparative study of dredge volume differences were analyzed to justify the numerical limits in terms of total volumes generated by variable grid sizes, data distributions, cross sections, software, and spatial interpolations based on statistical analysis. The standard deviation result shows that using the allowable level of different limits, the percentage of dredge volume generated in between ± 0.5 to ± 1%.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Sedimentation in navigation channel is a common problem faced by port authority (Fah, 1995). Sediment is fragmented material formed by physical and chemical weathering of rocks (Harris, 2003). The main effect of this process resulted in a shallow channel for ships. Therefore, it would be dangerous for the safety of ships accessing the port. To recover the water depth from sediment silted, then maintenance dredging need to be carried out in order to deepening and maintaining formation level of ship channel within port area. Based on Ahmed (2014), routine maintenance dredging refers to the removal of accumulated sediments from channel beds to maintain the channel design depths of existing public-use facilities.

IADC, which stands for International Association of Dredging Companies, is a global umbrella organization for contractors in private dredging industry. According to IADC, dredging is the removal of soil deposits and sediments for development and maintenance of waterways, dikes, transport infrastructure, land improvement, and reclamation.

Hydrographic survey is one of the important elements in excavation work other than civil engineering, oceanography, geology, and others. Hydrographic survey work is required to determine the amount of sediment excavation to be dredged. Volume calculation using cross section method is a most popular method used to determine the amount should be dredged.

In general the layers of sediment thicknesses that will be removed during maintenance dredging are small (Ahmed, 2014). Therefore, hydrographic surveys for dredging works usually require a high degree of accuracy to estimate the annual requirement of excavation, determine payment for dredging contractors, and certify the final acceptance and approval of project for authorized navigation depth (USACE, 2002). Otherwise, there will be a dispute on the amount of payment as excavation volume between client and contractor or with other survey parties involves hydrographic work, especially in determining the amount of dredge volume. To avoid