CHAPTER 1
INTRODUCTION

1.1. Background

With increasing material ages and damage caused by loading, weathering, and natural disaster, it become apparent that more advanced method to observing and analyzing structure strength is needed. Previously this is conducted using visual inspection and engineering judgement, but this method is limited to damage that can be detected visually and cannot accurately predict the strength of the structure accurately.

One of the first methods used to analized civil structure are Modal Testing or Experimental Modal Analysis (EMA). According to Erwins (2000), modal testing are the processes involved in testing components or structures with the objective of obtaining mathemathical description of their dynamic or vibration behavior. The parameters usually are natural frequncy, damping ratio, and mode shape. Experimental Modal Analysis (EMA) identifies those parameters from measurements of the applied force and the vibration response.

EMA has been applied in different fields, such as automotive engineering, aerospace engineering, industrial machinery, and civil engineering. The identification of the modal parameters by EMA becomes more challenging in the case of civil engineering structures because of their large size and low frequency range.The application of controlled and measurable excitation is often a complex task that requires expensive and heavy devices. For this reason most of civil engineers has more recently focused the attention on the opportunities provided by

Operational Modal Analysis (OMA). (Carlos and Giovanni, 2014)

OMA can be defined as the modal testing procedure that allows the estimation of the modal parameters of the structure only from measurements of the vibration response. The idea behind OMA is to take advantage of the excitation due to ambient forces and operational loads (wind, traffic, micro-tremors, etc.) to replace the artificial excitation. The main difference is in the formulation of the input, which already known in EMA while it is random and not measured in OMA. Thus, while EMA procedures are developed in a deterministic framework, OMA methods can be seen as their stochastic version (carlos and Giovanni, 2014)

There are two main method in OMA, one is to do the identification in the time domain and the others is frequency domain. One of the best method in frequency in frequency domain are Frequency Domain Decomposition. This technique was introduced by Brincker et al. (2000) as improvement of basic “peak-picking” method to better separation of closely spaced modes and offer method to more accurately estimate the damping ratio.

In analysis of *Operational Modal Analysis of Large Bridge* made by Schanke (2015), FDD give the best result in estimating natural frequency compared with other basic method and only better by more advanced method such as Cov-SSI while quite computationally efficient. While in analysis of *Damping Estimation of Large Wind-Sensitive Structures* made by Cheynet et al. (2016) conclude that damping estimation of FDD method have a larger bias compared to Cov-SSI method. Considering all of this FFD method is chosen for research in the this thesis because of it’s simplicity and efficient computational code.

This research using MatLab implementation of FDD code developed by Cheynet et al. (2016) to extract dynamic parameter of model structure and comparing it to the numerical simulation of the model. If the result of experiment is consistent with prediction then it can be concluded that FDD method is sufficient to measure the dynamic parameter of shear structures.

1.2. Problem formulation

In this thesis the main problems that are being asked are:

1. How to extract dynamic parameters from response of acceleration output of numerical analysis?
2. How to extract dynamic parameters from response of acceleration output of accelerometer history of model structure that tested with ambient excitation?
3. How is the comparison of dynamic parameter between prediction using numerical analysis and the result of the experimental model?

1.3. Problem limitation

To limit the scope of this thesis, the limitation are:

1. Structure details:
    a. The numerical simulation method model is structure of two stories portal with height every floor 0.4 m, with concentric mass on every stories 7 kg.
    b. The laboratory test model are two stories model made using small steel plate bolted into frame.

2. Calculation for dynamic structural analysis for both theoretical dan eksperimental used computer software R2016a.
3. Excitation of of the structure is an ambient loading made by hammering the model with random strength for an amount of time.
4. Structural analysis method being used are finite element, and then for extraction of dynamic parametric from experiment acceleration data is using FDD alogarithm.

1.4. Originality

Based from authors knowing the thesis title of "**PREDICTION OF DYNAMIC PARAMETERS OF STRUCTURES BASED ON OUTPUT-ONLY OPERATIONAL MODAL ANALYSIS USING FREQUENCY DOMAIN DECOMPOSITION METHOD IN SHEAR FRAME"** have not been done.

1.5. Significance of study

Benefit of or analysis that will be done in this study are:

1. As academic exercise to learn and understanding of structure identification system using Output-only Operational Modal Analysis using FFD method.
2. This research can be used as based for others research or reinforcement to the existing research.
3. For author, this thesis serve as the application of knowledge learn at Civil Engineer Magistrate Program at Universitas Atma Jaya Yogyakarta.

1.6. Objectives

The objective of this thesis are:

1. To get dynamic parameter from output of response of acceleration output from calculation of numerical analysis.
2. To get dynamic parameter from output of response of acceleration output from acceleration history of model structure tested using ambient excitation.
3. Compare the dynamic parameter between prediction using numerical analysis and the result of the experimental model.