CHAPTER I
INTRODUCTION

1.1 Background of the Study

The cable-stayed bridge is one of the most captivating bridge. This bridge has various arrangement of the cables; fan, harp and semi-fan (V. R. Panchal, D. P. Soni, & ka.patel, 2017). The cable-stayed bridges are classified as efficient, economical, and this cables is proven most decrease the cost in the short to long-span bridge construction (Cheung, Kim, Choi, Park, & I Gong). The bridge concatenated the elegance and the efficiency of structural system that are available to extend the span which are ineligible in the past with the great efficiency, and the typology of this bridge can be used in the large span, start from 200 m to 1000 m, and seems like develop in the short time. (Wu & Zhang, Dead Load Analysis of Cable-Stayed Bridge, 2011).

The bridge has the important role as the connectivity infrastructure for the economic and social activity, the bridge designed in the earthquake areas must consider the earth to ensure its safety. Especially, due to its long-span the length of the bridge will cause the complicated level of the design (J.-P. Ragaru, Nagano, Matsunaga, & Arnaud, 2008). The cable-stayed bridge have passably principle in resisting of the seismic motion. First the bridge is flexible and induce a long period motion to reduce the spectral acceleration level. Second, able to decrease the reaction of the support and the vulnerability of the structure towards the seismic load and the significant displacement in the deck (Camara, 2017)

The existing of the earthquake design code of the bridge in Indonesia is SNI 2833:2016. The code is references design in the earthquake zones. However, there are many bridge designs in the country do not implement the codes. Therefore in the post earthquake there are many bridges experiencing damaged and caused loss life (Silitonga & Imran, 2019). Thus, it is important to determine the behaviour of the structures due to the seismic motion.

To classify bridge according it vulnerability due to the earthquake motion using the fragility curve, it is reliable and applicable to manage the hazard (Nouri, Ghayamghamian, & Shirazian, 2011). Fragility curve is a value of exceedance probability and earthquake intensity of the structures (Silitonga & Imran, 2019). The curve can be developed using empirical or analytical analysis. For developing the curve using the analytical method, data of the respons of the structures are needed (Nouri, Ghayamghamian, & Shirazian, 2011).

Fragility curves using the analytical method are widely applied because of ease and convenient to use on bridge and geographic area where the bridge damage data are difficult to obtain (Remki, Mehani, Bechtoul, Kehila, & Kibbou, 2014). Because it can predict the extent of probable damages of the bridge structures, in addition fragility curves are regarded to be a useful tool. Meanwhile the vulnerability assessment of the bridges is useful for seismic retrofitting decisions, disaster response planning, estimation of direct monetary loss, and evaluation of loss of functionality of highway transportation systems (Remki, Mehani, Bechtoul, Kehila, & Kibbou, 2014).

In the development the fragility function, guidelines was estabilished by Hazard United States (HAZUS) and used in this study. To reduce the seismic hazard in United States, the National Institute of Building Science (NIBS) develop the HAZUS methodology for FEMA. The HAZUS provide the procedure to generate the fragility curves for different types of structures (Remki, Mehani, Bechtoul, Kehila, & Kibbou, 2014).

Based on the prior explanation background then is conducted the analytical study to develop the fragility curves on the pylon of the cable-stayed bridge using the seismic response in MIDAS CIVIL 2019 software. Using the existing record the earthquakes were subjected to the structure, then the damage states data are classified based on HAZUS standard obtained using the dynamic analysis Nonlinear Time History (NTHA) and then derrived to acquire fragility curve of the cable-stayed bridge.

1.2 Objective of The Study

The general purpose of this study is to develop the fragility curve of cable-stayed bridge using the analytical method nonlinear time history. The spesific purposes of this study are in the following :

1. To investigate the damage of the cable-stayed structure due to the ground motion of the earthquake.
2. To study the nonlinear behaviour of the cable-stayed structure and develop into the fragility curves.
3. To classify the damage level of the cable-stayed bridge due to the ground motion based on the HAZUS standard.

1.3 Benefit of The Study

The benefit of the study is to apply the fragility curve as the tool to estimate the prediction of exceedance probability of the damage states level of cable-stayed bridge due to the ground motion of the earthquake, and to make this study as the references to develop the fragility curve of the other bridge structures.

1.4 Scope of The Study

Because of widely research of this study about the fragility curve in the bridges, thus it need to define the scope to achieve the purpose of the study. The scope of the study as the following :

1. The cable-stayed bridge is an existing bridge and simplified by the researcher.
2. The nonlinear analysis conducted in this study are nonlinear geometric and nonlinear material.
3. The model of this cable-stayed bridge are consist of two span bridge with the total length of 642 meters.
4. The ground motion used are the existing record of Padang, El-Centro, Tohoku, and Northridge Time History.
5. The loads applied in the structure are pretension load, self weight, super imposed dead load, and earthquake load.

6. The output of this study is a lognormal distribution curve that showing the relation of exceedance of damage structure and the earthquake intensity (PGA).
7. The modelling of the cable-stayed bridge is conducted in general structural analysis program MIDAS CIVIL 2019.

1.5 Writing systematics

To achieve sytematically and dense the purposes of the study, so this thesis will be arranged with the following discussions :

CHAPTER I INTRODUCTION

Discuss about the background of the study, the purposes, benefit of the study, scopes of the study and schematic of this study writing.

CHAPTER II LITERATURE REVIEW

As the basic references and theories of cable-stayed bridge, nonlinear time history method, and fragility curve structure.

CHAPTER III RESEARCH METHODOLOGY

Discuss about the steps conducted in analyzing the cable-stayed structure using the nonlinear method and developing the response of the strcuture to be a fragility curve.

CHAPTER IV RESULT AND DISCUSSION

Discuss about the response spectrum, seismic intensity, identification result of damage states and performance level, the parameters of the capacity and deformation of the structure, and the probability of damage states level due to the earthquake intensity following the lognormal distribution.

CHAPTER V CONCLUSION

Discuss about the suggestion and conclution of the study.