1.1 Preamble

In the present chapter, the study area's history is covered. This is followed by the justification for selecting the current research question and the thesis' organizational structure.

1.2 General Overview

Designing a stiff and robust structure that can withstand expected lateral stresses and can withstand earthquakes using conventional "brute force" methods. This approach might not be the most economical one. This method has the drawback that all lateral forces generated by the seismic ground motion must be absorbed by the building. The aforementioned issue can be prevented using the base isolation system.

The base isolation technique seemed to be created in an effort to lessen earthquakes' influence on structures when seismic strikes, also, it's been demonstrably among the most successful techniques in recent years. Installing the support devices that isolate the building from ground tremors brought caused by earthquakes constitutes base isolation. The input forcing feature is enabled by base isolation to be filtered and the structure to be protected against acceleration-induced seismic forces. Ground movement occurs during earthquakes while the structure barely moves if it is separated from the ground. Whereas this technique had first been developed in the 1900s, it wasn't until the 1970s that it became a useful method for seismic design.

The Base isolation's main goal is to significantly diminish the structure's ability to absorb the pressures and energy caused by an earthquake. To do this, a framework is placed on a lateral stiffness-low support mechanism, which causes only mild motion in the structure itself when an earthquake occurs and causes considerable motion in the ground. Movement of the framework as the support bearings' flexibility increases, challenges with how they relate to the ground when subjected to wind loads may arise.

According to research by Skinner and McVerry (1975), a base isolator with hysteric force-displacement qualities can withstand wind-induced horizontal stresses while still providing the essential high dumping, force limitation, and flexibility under earthquake stresses (Skinner & McVerry, 1975).

A basis for using a two-degree-of-freedom linear dynamic system was introduced by Connor in 2002 to analyze the reaction of the base isolation Mechanism. By shifting the system's actual fundamental frequency out of the region at which a quake would produce the most powerful inertia forces, base isolation reduces seismic reactivity. Increased support bearing flexibility (or a decrease in their stiffness) lengthens the system's corresponding natural period. Period is raised over the range of the surface trembling brought by earthquakes, preventing resonance & lowering seismographic acceleration response (Connor, 2002).

The performance of a base isolation system in a framework is based on specifications of bearing mechanisms that isolate the framework from surface vibrations. The lateral inertia forces brought on by earthquakes on a structure are reduced by a building's prolonged effective period and the base isolated structure's isolation from the support mechanisms' low rigidity. Understanding how the parameters of the framework's support systems affect the seismic performance of isolated structures is therefore critical. A number of base isolation devices, such as friction devices (PTFE sliding bearings), yielding steel devices, laminated elastometric rubber bearings, lead rubber bearings, and lead extrusion devices, have been developed to achieve this goal.

In contrast to unisolated structures, base isolation systems, according to Andriono [1990], greatly lower the superstructure's lateral stiffness and ductility requirements. Due to the reduction of materials used for lateral systems and the simplicity of structural detailing, cost savings are made possible. Additionally, base isolation gives the designer access to a larger selection of architect.ura1 forms and structural materials (Andriono, 1990).

In addition to the technical feasibility, the early stages of design should focus on the economic feasibility. Construction expenses, earthquake insurance premiums, earthquake damage costs, maintenance costs, market share loss, and potential responsibility are the primary considerations (Charng, 1998).

According to Skinner and McVerry [1975], the cost of creating buildings with the required level of seismic resistance may frequently be greatly diminished as a result of the current base isolation procedures (Skinner & McVerry, 1975).

Base isolation is a seismic safety technology that has gained popularity over the last few decades for both buildings and the stuff inside of them. Base isolation is a method for seismic retrofitting old buildings, designing buildings with moving parts, high-risk structure, and structure with special significance after quakes, among other things.

Base isolation has advantages over traditional methods in the aforementioned situations because it offers far higher protection from extreme seismic events. It is thought that base isolations systems can solve a variety of design problems.

1.3 Motion Caused by Earthquakes

It is vital to determine the applied forces in order to comprehend how buildings move. This section will go over the main, underlying problems with earthquakes.

1.3.1 Features of Earthquakes

The following are the primary aspects of earthquake ground motion that an engineer must comprehend:

- period
- amplitude of displacement
- amplitude of velocity
- increase in acceleration
- range of ground motion frequency

Additionally, structures possess a set of inherent frequencies respond to that which determine them. Its fundamental recurrence is the lowest. The basic recurrence resonance arises as the produced earthquake recurrence gets closer to it. A designer must make sure that the frequency response of the building is higher than the seismic frequency range. An approximation of the relationship between a building's n floors and the basic period T is provided by a general theory that is very helpful in the early design.

$$T = \frac{n}{10} \quad (1.1)$$

With six floors and a story elevation of 15 feet, a building that is 90 feet tall would have a period of roughly 0.6 sec.

1.3.2 Concept of Resonance

As previously indicated, Engineers are required to create structures that their response to ground motion occurs at frequencies that are distinct from those of earthquakes. Resonance happens when the response frequency of the building is similar to or nearly equal to the frequency of surface motion. The horizontal resonance pressures on a structure are amplified when resonance increases the building reaction, which can have catastrophic effects. A well-known illustration of this is the Tacoma Narrows Bridge, instance of a catastrophic failure brought on by resonance. Instead of ground motion, the Tacoma Narrows Bridge collapsed due to oscillating in response to wind vorticity, who's frequency matched one of the torsion modes of tremors within the structure about the orientation along the long axis of the deck. Although reverberations caused by wind is outside the study's parameters, a wonderful example of the disastrous collapse caused by resonance is the Tacoma Narrows Bridge.

Figure-1. Resonance-Induced Severe Deformation and Eventual Collapse of the Tacoma Narrows Bridge.

1.3.3 RS - Response Spectrum

The spectrum of response of the structure to ground movement for different frequencies are readily shown by a RS. A graph of RS structure, which displays the high response rates of velocity against the duration of excitation, is a standard way to see the spectrum (inverse of frequency). The fundamental mode frequency of a building is first determined by engineers, who then use the aforementioned graph to calculate the acceleration that an earthquake will have on a building. The inter-story drift of a structure determines the degree of structural damage it will sustain. Therefore, when examining the way a structure responds to tremors, it’s crucial for analyzing the structure to determine its reaction frequencies.

1.4 Structure Reaction

The primary factors influencing building reaction and earthquake damage will be briefly covered in the section that follows. A building may sustain a variety of damages, ranging from modest surface finish cracking to significant cracks inside the primary structural elements, which could lead to total structural damage. Structure-related destruction (damage to structural members brought on by deformations) and non-structural damage are the two categories into which damage is commonly divided. Damage to the structure could result in considerable property damage and death. Although non-structural damage has the potential to result in fatalities, it is largely associated with the injuries and probable infrastructure damage.

1.4.1 Consequences of Surface Acceleration

Understanding how a structure is harmed by ground acceleration requires applying the Second Law of Motion, that states that the force exerted against an object equals the the body's mass times its acceleration. As a result, the forces acting on a building rise together with acceleration. Therefore, an engineer must lessen the building's acceleration in order to lower forces on the structure. The inertia force is defined as the sum of mass and acceleration. The structure deforms as a result of the inertia force brought on by ground motion. Beams, columns, lateral braces, bearing mills, interconnections and additional internal structures are all affected.

1.4.2 Effects of Stiffness and Ductility

Height, materials, connections, lateral systems, and other factors all affect stiffness. The lateral forces that the structure experiences as a result of ground motion are significantly influenced by stiffness. Accelerations equal to those of the ground will be experienced by an endlessly stiff edifice. Therefore, the more rigid the framework, the greater the lateral inertia forces that result from ground motion on the framework. System for base isolation successfully lowers the system's similar rigidity, which lowers the inertia forces acting on the structure.

The most critical element determining a building's seismic performance in traditional seismic design is its ductility. A building's ductility must be sufficient to survive any earthquakes it may suffer over the course of its lifetime. The primary duty of an engineer building a quakes structure is to do this.

1.4.3 Damping's impacts

Damping is characterized as the gradual decrease in oscillation amplitude. Every structure has some natural damping. An oscillatory object wouldn't ever come to a halt without dampening. Internal friction in buildings causes damping, which loses input energy. The ability of a building to dissipate earthquake energy depends on its intrinsic damping, which increases with size.

1.5 Thesis Organization

Current Chapter (Introduction) provides a succinct summary of the topic of current research, the impetus for the current study, and an outline of the thesis's organizational structure.

Chapter 2 (Components of Base Isolation System) contains components of the numerous kinds of base isolation system.

Chapter 3 (Literature review of Base Isolation System) contains the review of literature in the field of numerous kinds of base isolation system.

Chapter 4 (Methodology of Research) the chapter contains the scope of present work, objectives defined based on the identification of the gap in existing research, the hypothesis of thesis and overall design methodology.

Chapter 5 (Base Isolation Bearing Design). In this chapter the Base Isolation System: LRB) & TFPB are design according to axial load, biaxial load and Tri-axial load (Cumulative load from fixed base modal).

Chapter 6 (Analysis & Results Summary). In this chapter the result obtained from all the model: Time period, Base Shear, Storey-Drift, Storey-Displacement, Steel reduction and overall cost economy is analyzed and a Results summary is made for comparison along with graph.

Chapter 7 (Conclusions & Recommendation). In this Chapter the entire work of this thesis is concluded & Recommendation based on the conclusion.
The resources consulted for this project have been cited at the respective places of use and listed in the Bibliography chapter.

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