Comparative Analysis of the Seismic Performance of Unreinforced Masonry Buildings using Globigerina Limestone and Hollow Concrete Blockwork.

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This dissertation is dedicated to my family for their unwavering support.

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I take full responsibility for any shortcomings in this dissertation.

Abstract

This dissertation investigates the seismic performance of unreinforced masonry (URM) buildings with soft-storey basements, comparing structures constructed using Globigerina limestone and Hollow Concrete Blockwork (HCB). The research problem addresses the disparity in seismic resilience between these two construction materials. The methodology involves numerical modelling and comparative analysis using non-linear static pushover analysis with 3D Macro. Virtual models of masonry structures built with HCB bonded with M5 mortar and Globigerina limestone bound with M2 mortar were developed to simulate seismic forces and assess structural performance.

Key findings reveal that HCB structures consistently outperform Globigerina limestone structures in terms of resilience and safety factors across various seismic conditions and ground types. Comparative analysis of pushover curves indicates that, for the same horizontal sway displacement at the top storey, Globigerina limestone structures experience higher horizontal base shear forces compared to HCB structures. Despite this, safety factors suggest that HCB aggregates enable structures to achieve greater building heights than Globigerina limestone aggregates. This seemingly counterintuitive result is due to HCB aggregates attracting less horizontal base shear force, which reduces seismic force demand on the structure. Consequently, structures with HCB aggregates undergo lower stress and strain, allowing for increased height without compromising safety. Additionally, HCB structures exhibit better ductility and energy dissipation, maintaining steadier performance post-peak. The critical impact of structural configuration on seismic performance was also highlighted, emphasizing the importance of symmetrical design in enhancing structural resilience

Keywords: Seismic Performance, Unreinforced Masonry, Globigerina Limestone, Hollow Concrete Blockwork, Numerical Modelling, Comparative Analysis.

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Symbols

A_b	Area of one single Masonry Block
A_m	Area of the Mortar
$c\dot{x}$	Damping force
E	Young's Modulus of Elasticity
E_b	Young's Modulus of Elasticity of Masonry Block
E_{bm}	Young's Modulus of the Smeared Properties of Masonry Unit and Mortar
E_m	Young's Modulus of Elasticity of Mortar
F	Peak seismic force
f_{block}	Compressive Strength of Block
f_{kbm}	Compressive Strength of the Smeared Properties of Masonry Unit and Mortar
f_k	Characteristic Strength of Masonry
f_m	Characteristic Strength of Mortar
f_{mx}	Compressive Strength
f_{tbm}	Tensile Strength of the Smeared Properties of Masonry Unit and Mortar
g	Acceleration due to Gravity
G_b	Shear Modulus of Elasticity of Block
G_{bm}	Shear Modulus of the Smeared Properties of Masonry Unit and Mortar
G_m	Shear Modulus of Elasticity of Mortar
h/l_w	Aspect Ratio
kx	Stiffness force
M_{max}	Overturning moment capacity
$M_{min(\theta Mu)}$	Overturning moment at the lowest ultimate rotation
m	Lumped mass of the structure
$m\ddot{x}$	Inertia force
q_k	Live Loading
S_e	Spectral acceleration given by response spectrum
T_b	Tensile Strength of Masonry Blocks
T_m	Tensile Strength of Mortar
X_b	Material Property of the Masonry Blocks
X_m	Material Property of the Mortar

X_t	Smeared material Property
X_u	Total elastoplastic deformation
X_y	Elastic deformation at yield
α	Safety Factor for the considered Limit State
ν	Poisson's Ratio
δ_u	Ultimate drift of the wall
δ_y	Yield drift of the wall
μ	Ductility
μ_{WE}	Displacement Ductility of Wall Element
σ_n	Applied Normal Stress
τ_{bm}	Shear Strength of the Smeared Properties of Masonry Unit and Mortar

Glossary

3D	3-Dimensional
AG	Aggregate System
DSHA	Deterministic Seismic Hazard Analysis
GL	Globigerina Limestone
HCB	Hollow Concrete Blockwork
JMA	Japanese Meteorological Agency
MDOF	Multi-Degree of Freedom
MSK	Medvedev-Spoonheuer-Karnik
NCR	No Collapse Requirement
NTC 2008	Ministerial Decree of 14 January 2008 Technical Standards for Construction
NTC 2018	Ministerial Decree of 17 January 2018 Technical Standards for Construction
PHA	Peak Horizontal Acceleration
PHD	Peak horizontal displacements
PHV	Peak Horizontal Velocity
PSHA	Probabilistic Seismic Hazard Analysis
SD	Significant Damage
SDOF	Single Degree of Freedom
SHA	Seismic Hazard Analysis
SLC	Collapse Prevention Limit State
SLD	Damage Limit State
SLO	Operational Limit State
SLS	Service Limit State
SLV	Life Protection Limit State
SU	Single Unit / Structural Unit
ULS	Ultimate Limit State
URM	Unreinforced Masonry

Chapter 1: Introduction

1.1 Background

While some regions might not experience frequent or strong earthquakes, like the Maltese islands, it is essential to assess the seismic risk and vulnerability of structures in these areas. The geological and tectonic characteristics of the region can provide valuable insights into the potential for future seismic events. Understanding the seismic hazard is crucial for developing appropriate design guidelines and construction practices that can mitigate the impact of earthquakes on structures.

The earthquake of 1693 had a devastating impact on buildings in Sicily and Malta. However, in Malta, many stone-built structures survived the earthquake due to superior construction practices, such as using large, well-laid limestone blocks. Buildings like the Norman Tower in Birgu, Castle Sant Angelo, churches, palaces, and towers endured various earthquakes over the centuries. These structures, including a building in Lija dated 1640, have withstood seismic events, proving the durability of well-built Maltese buildings. In contrast, poorly constructed buildings in Sicily, made from rubble and small bricks, were more susceptible to destruction. The surviving high bastions and the limestone block construction also withstood earthquakes and World War 2 bombardments. The use of prestressed planks in modern construction is concerning, as they may collapse even in moderate earthquakes. Thankfully, such methods were not prevalent during the 1972 earthquake, but it has become a lucrative practice today.

Seismic waves are the energy waves that travel through the Earth's crust during an earthquake. They can cause significant stress and damage to buildings and other infrastructure. Understanding how seismic waves propagate through different soil types and geologic formations in the region is vital for predicting the potential impact on structures, including unreinforced masonry (URM) buildings.

URM buildings are particularly vulnerable to seismic activity. These structures are made of materials like brick, stone, or concrete blocks that lack proper reinforcement. During an earthquake, URM buildings can suffer extensive damage or even collapse due to their inadequate resistance to lateral forces. Understanding the behaviour of URM buildings under seismic loads is critical for devising effective retrofitting measures and improving their seismic resilience. In unreinforced masonry, the mortar serves as the primary binding material. Buildings constructed with better mortar have a higher likelihood of surviving earthquakes with minimal damage. Unfortunately, the quality of mortar used in Malta is subpar, characterized by uneven application and lack of mortar on vertical surfaces. This leads to instability in untied masonry buildings when subjected to horizontal raking forces, causing them to collapse rapidly. The problem worsens if soft structures, like parking lots or commercial spaces, are present at the ground or basement level.

Developing structures that are resilient to seismic events is essential for safeguarding human lives and reducing economic losses. By implementing appropriate design and construction measures, the potential impact of earthquakes on URM buildings can be minimized. This not only protects the occupants but also preserves cultural heritage and reduces the need for costly post-disaster repairs and reconstruction.

1.2 Goals and Objectives

The primary objectives of this dissertation are to enhance the existing knowledge and understanding of the seismic performance of unreinforced masonry (URM) buildings featuring soft-storey basements. Specifically, this research aims to conduct a comprehensive comparative analysis between structures constructed using Globigerina Limestone and Hollow Concrete Blockwork (HCB). Additionally, the study delves into the influence of mortar strength and subsoil conditions on the seismic behaviour of these structures.

The prevalent use of class M2 mortar in the construction of URM structures in the Maltese islands has garnered prior research attention, particularly in the studies conducted by David Borg (2021) and Timothy Sammut (2023). However, EN1998-1-1 (9.2.3) mandates a minimum mortar strength of M5 for unreinforced masonry. Therefore, a central focus of this study is to explore whether the combination of HCB and the higher strength M5 mortar can attain seismic strengths comparable to the sturdier solid Globigerina Limestone.

In pursuit of these objectives, several specific aims guide this research. First, the investigation aims to assess the seismic performance of URM buildings featuring soft-storey basements constructed with HCB, a construction method increasingly prominent in modern practices. Subsequently, the study seeks to evaluate and compare the seismic behaviour of URM buildings with soft-storey basements, differentiating between those constructed using HCB and those utilizing Globigerina Limestone.

Furthermore, the impact of adopting M5 mortar, in accordance with EN1998-1-1 (9.2.3), on the seismic strength of URM buildings with HCB construction will be analysed. This assessment becomes particularly relevant given the relatively lower compressive strength of HCB when compared to solid Globigerina Limestone.

The research expands its scope to encompass variations in the seismic performance of URM building aggregates featuring soft-storey basements across distinct geological conditions. These conditions include Ground Types A (rock), B (very stiff clay), and C (weak clay), adding a critical layer of depth to the seismic assessment.

Ultimately, this dissertation endeavours to offer valuable insights into the seismic behaviour of URM buildings with soft-storey basements, taking into account subsoil conditions. Through a thorough exploration of these goals and objectives, the research aims to contribute to the body of knowledge in earthquake engineering and improve the understanding of URM structures' resilience in seismic events.

1.3 Dissertation Outline

Chapter 1: Introduction

The introduction of this research provides a concise overview of the research subject, highlighting the factors that drive the investigation. It outlines the primary aim of the dissertation and elucidates the chosen research methodology.

Chapter 2: Basic Principles of Seismology

In this chapter, the primary objective is to present the fundamental principles associated with the behaviour of earthquakes. These foundational principles encompass the origins of seismic events and the methods employed for their measurement and quantification. Subsequently, the chapter delves into the examination of seismic vulnerability, particularly within the context of the Maltese Archipelago. The discussion extends to elucidate the key concepts of seismic vulnerability, hazard, and risk. Finally, the chapter culminates by introducing the subject matters of response spectra and seismic design.

Chapter 3: Seismic Impact on Unreinforced Masonry Structures

This chapter delves into the seismic challenges faced by Unreinforced Masonry (URM) buildings, highlighting the inherent brittleness of masonry and the behaviour of URM structures. It emphasises the importance of load path efficiency and explores various failure modes. The chapter also examines the impact of stress types on masonry walls and the influence of various factors on stress distribution. It discusses the role of ductility in masonry walls and presents experimental studies on the impact of openings on damage patterns. The chapter concludes by exploring the concept of ductility in experimental testing, emphasizing its importance in seismic resistance.

Chapter 4: Research Methodology

This section provides a comprehensive overview of the seismic resilience assessment methodology for unreinforced masonry (URM) buildings using hollow concrete blockwork (HCB). It begins with a discussion of the background research, highlighting prior investigations and advancements in nonlinear analysis techniques. The chapter then delves into the non-linear static pushover analysis approach, detailing its significance, methodology, and application through the 3DMacro software. Subsequently, it explores the properties and modelling techniques used in the analysis, including the mechanical properties of masonry blocks and mortar, as well as the computational methods for deriving smeared material properties. Finally, the chapter outlines the seismic analysis and vulnerability assessment methodology, covering key aspects such as structural configurations, load considerations, and limitations encountered during modelling.

Chapter 5: Seismic Analysis Result & Discussion

This chapter presents the results of seismic assessments for various unreinforced masonry (URM) building configurations. Using tables and pushover curves, it compares the minimum safety factors for buildings made of Globigerina limestone and hollow concrete blockwork (HCB) through bar graphs. These graphs illustrate the structural responses and α-values of each building under seismic conditions. The analysis reveals that Globigerina limestone buildings typically exhibit higher initial stiffness but lower overall safety factors compared to HCB structures. The comparative study across different ground types highlights significant differences in seismic performance, emphasizing the resilience of HCB over Globigerina limestone in supporting more floors under earthquake loading.

Chapter 6: Conclusions and Recommendations for Future Research Work

The dissertation is concluded by identifying the key findings of this research, emphasizing the comparison between hollow concrete blockwork (HCB) structures and Globigerina limestone in seismic resilience and safety factors. It highlights the impact of ground type on structural integrity and suggests areas for future research to further advance the understanding of seismic performance in unreinforced masonry buildings.

Chapter 2: Basic Principles of Seismology

2.1 Earthquake Origins

Earthquakes have historically instilled fear due to their sudden and devastating impact on the environment. In ancient times, the inexplicable and uncontrollable nature of the earth's violent shaking led to death and destruction, evoking a sense of mystery.

Today, our understanding of earthquake origins reveals them as natural processes inherent to the Earth's evolution. Despite their unpredictable nature, earthquakes are recognized as periodic adjustments that the planet undergoes. Their abrupt occurrence has the potential to induce levels of devastation comparable to the most powerful weapons of warfare. The unsettling feeling of the ground moving beneath us, coupled with the unpredictability, contributes to the deep-rooted fear associated with earthquakes.

Earthquakes arise from seismic vibrations and disturbances within the Earth's crust, originating from a diverse range of factors, encompassing both natural and human-induced elements. Natural triggers include faulting associated with tectonic shifts, volcanic eruptions, and substantial movements of soil and rock. In contrast, human-induced causes often involve explosive events and the construction of reservoirs or dams. Broadly speaking, the most impactful earthquakes, which have far-reaching consequences and inflict significant damage, can be attributed primarily to tectonic activities (Chen & Scawthorn, 2003; Villaverde, 2009).

The Earth's crust, its outermost layer, is segmented into tectonic plates that drift and move atop the semi-molten mantle below. Due to the dynamic nature of the mantle, driven by convection currents, these plates undergo various forms and magnitudes of movement in diverse directions. As shown in Figure 1, plates may separate, at divergent boundaries (Figure 1a), allowing molten magma to rise to the Earth's surface, thus leading to the formation of new crust. Conversely, when plates converge (convergent boundaries), the thinner one tends to decline, resulting in subduction zones (Figure 1d), where portions of the crust are consumed. Regions affected by subduction often experience volcanic eruptions and heightened seismic activity. In cases where both plates carry continental crust, subduction is less likely, resulting instead in plate deformation and the formation of mountain ranges (Figure 1c). Additionally, transform boundaries (Figure 1b), two plates can experience lateral displacement which transforms into faults, leading to seismic activity and shallow-depth earthquakes (Villaverde, 2009).

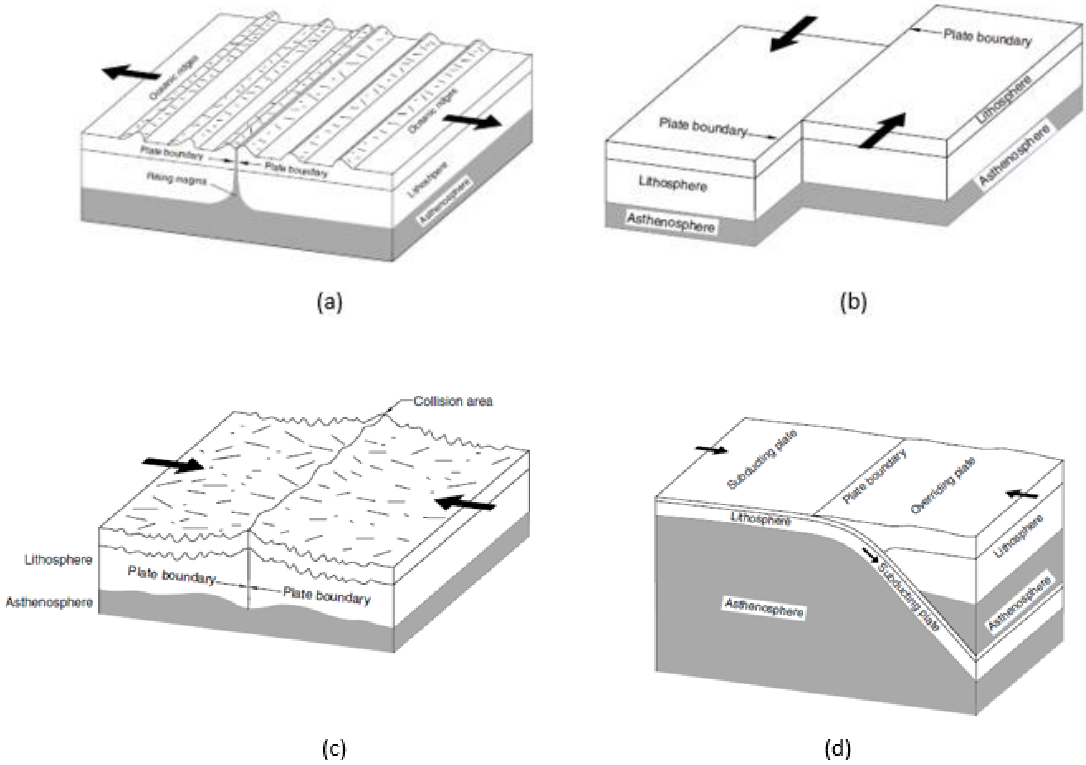


Figure 1: (a) Divergent Plate Boundary, (b) Transform Plate Boundary, (c) Convergent Plate Boundary, (d) Convergent Plate Boundary (Subduction)

The boundaries where tectonic plates meet is known as "faults." These fault zones are the result of the fractured nature of the plates and their relative movements, leading to a network of fractures and fissures that can extend over extensive distances, frequently reaching great depths beneath the Earth's surface. The motion along these faults can be gradual or sporadic, often culminating in seismic events. The magnitude of an earthquake is closely associated with the dimensions of the fault and the speed of its movement (Chen & Scawthorn, 2003; Villaverde, 2009).

Seismic data and geometric observations are essential for characterizing the orientation of fault planes and the direction of slip along them (Stein & Wysession, 2011). As illustrated in Figure 2, the strike of a fault measures the angle between the true north and the horizontal line at the intersection of the fault plane with the Earth's surface. Conversely, the dip indicates the angle between the fault plane and the Earth's surface. These definitions help classify faults according to their movement patterns. A fault is identified as a strike-slip fault when the slip occurs parallel to its strike, as shown in the left lateral (Figure 2a) and right lateral (Figure 2b) illustrations. On the other hand, if the movement is along the dip angle, causing the sides of the fault to either separate or collide, it is classified as a dip-slip fault (Villaverde, 2009). This includes normal dip-slip faults (Figure 2c) where the hanging wall moves down relative to the footwall, and reverse or thrust dip-slip faults (Figure 2d) where the hanging wall moves up relative to the footwall.

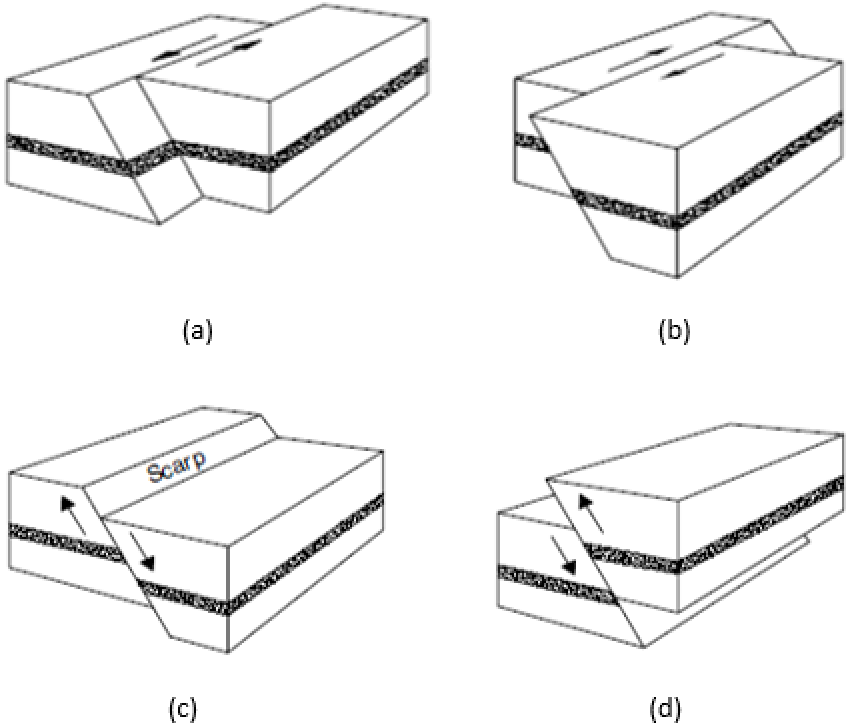


Figure 2: (a) Left lateral strike-slip fault, (b) Right lateral strike-slip fault, (c) Normal dip-slip fault, (d) Reverse or thrust dip-slip fault.

Earthquakes do not solely result from the movement of tectonic plates. The relative motion between these plates encounters resistance from frictional forces, generating stress along the fault boundary. As ground motion continues over time, strain energy builds up on both sides of the fault. When this accumulated energy exceeds the fault's frictional resistance, it is suddenly released as seismic waves. This process, known as the elastic rebound theory, was initially proposed by Reid (1910). Geodetic observations provide support for this theory, along with the observed permanent horizontal displacements that follow an earthquake event (Chen & Scawthorn, 2003; Villaverde, 2009)

2.2 Seismic Vulnerability in the Context of the Maltese Archipelago

In the realm of geophysics, the study of seismic waves and their interactions with geological structures provides invaluable insights into the Earth's subsurface. This exploration is not only crucial for understanding the planet's internal composition but also holds significant implications for assessing seismic risks in various regions. One such region is the Maltese archipelago, a seemingly serene cluster of islands nestled in the Mediterranean Sea. Despite its proximity to seismically active zones, the perception of seismic risk among its inhabitants remains surprisingly low.

The Maltese archipelago, consisting of the main islands Malta, Gozo, and Comino, covers a total land area of 316 km2 and is currently inhabited by around 520,000 people. While the significant Euro-African plate collision margin is situated roughly 200 km north, spanning from Sicily to the Hellenic Arc in the east, the seismically active Hyblean-Malta Escarpment is positioned about 100 km eastward. Figure 3 illustrates the bathymetry of the Sicily Channel and the main tectonic feature of the Sicily Channel Rift Zone, including normal faults and strike-slip lineaments. It also shows the Calabrian Arc subduction zone and the epicentre of the 11/01/1693 earthquake, with an inset highlighting the Maltese islands. Bathymetry and tectonic features of the Sicily Channel Rift Zone, including normal faults, strike-slip lineaments, and the Calabrian Arc subduction zone.

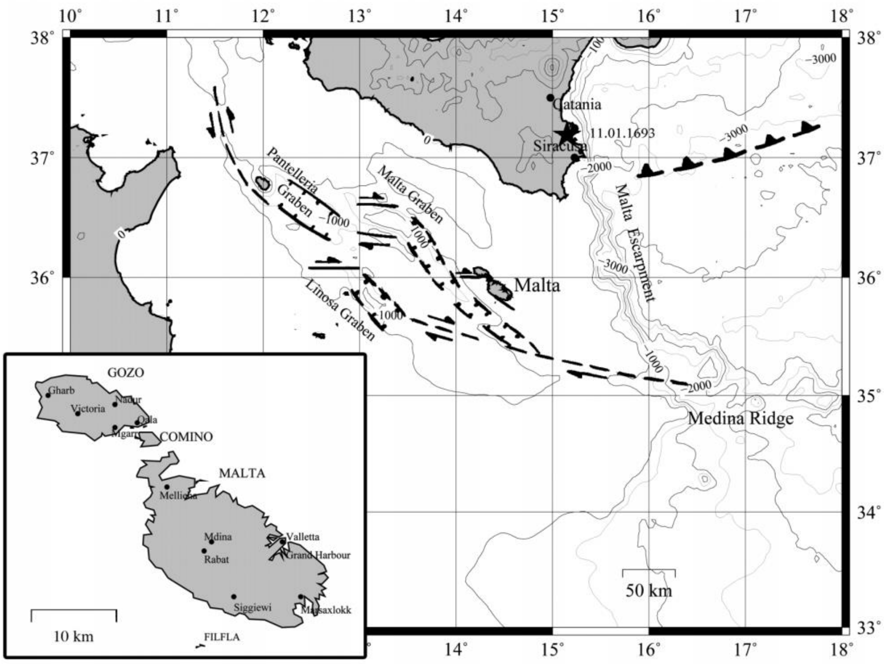


Figure 3: Bathymetry and tectonic features of the Sicily Channel Rift Zone, including normal faults, strike-slip lineaments, and the Calabrian Arc subduction zone. (Galea, 2007)

Despite these geological dynamics, there exists a dearth of seismic risk consciousness within the region. The common perception among the public is that the islands are relatively secure, and occurrences of earthquakes are both mild and rare. This outlook likely arises from the absence of documented fatalities directly linked to earthquake events and the fact that notable structural damage to buildings was last observed almost a century ago. Consequently, a comprehensive analysis of past seismic events has been neglected, preventing the creation of a historical record of earthquakes. This initial phase is crucial for a scientific evaluation of seismic hazards in the area. (Galea, 2007)

The historical records of the Maltese islands, systematically organized, trace back to around the arrival of the Order of St. John in 1530. Before this period, there are limited records from the Spanish rule over the islands during the 14th century. However, discussions with local historians suggest the absence of significant references to major earthquake impacts in these documents. These historical documents are stored in the National Library in Valletta. (Galea, 2007)

An impactful earthquake on January 11, 1693, is a notable event in the local seismic history. This earthquake resulted in the loss of more than 60,000 lives in Eastern Sicily and led to the complete destruction of numerous towns and villages in the region. This event stands as the most destructive earthquake to have affected the Maltese islands since 1500. The incident is extensively detailed in the Archives. The earthquake's effects were deeply felt across the entire archipelago, inducing widespread panic among the population. Many residents spent multiple nights outdoors, either in tents or underground shelters. Despite the intensity of the earthquake, no direct fatalities are officially documented. It is worth noting that the earthquake was preceded by a foreshock measuring magnitude 5.9 on January 9, which was felt in Malta but did not cause any damage. (Galea, 2007)

2.3 Seismic Waves

Seismic waves are the fundamental manifestations of energy released during an earthquake event. These waves are categorized into two primary groups: body waves and surface waves. Figure 4 illustrates the ground point displacement during the travel of different seismic waves. Body waves propagate through solid rock and encompass two distinct types: Primary waves (P-waves) and Shear waves (S-waves). P-waves, known for their exceptional speed, traverse both solid rocks and liquids, creating a longitudinal motion where particle movement parallels the wave's direction. This motion entails alternating compression and dilation of the medium, resembling the behaviour of sound waves in air. Interestingly, P-waves also contribute to the phenomenon of "earthquake sound," propagating into the atmosphere as sound upon reaching the Earth's surface. Conversely, S-waves induce shear deformation of rock perpendicular to their travel direction, making them unable to efficiently propagate through liquid materials. Moreover, S-wave amplitudes significantly diminish when passing through liquefied soil, causing motion in both vertical and horizontal directions upon reaching the Earth's surface. Figure 4 shows the effect of these waves on ground displacement. Surface waves, the other category, consist of Love waves and Rayleigh waves. Love waves, akin to S-waves in motion, are unique for their absence of vertical displacement and exclusive horizontal propagation parallel to the Earth's surface. Furthermore, Love waves do not traverse through liquid media and are typically responsible for inflicting damage to foundations. Rayleigh waves, on the other hand, arise from the coupling of P and S waves as they travel near the Earth's surface, generating elliptical particle motion primarily within the vertical plane, manifesting in both horizontal and vertical directions. Notably, the amplitude of Rayleigh waves exponentially diminishes with increasing depth below the Earth's surface (Bolt, 2001; Naeim, 2012; Kayal, 2008).

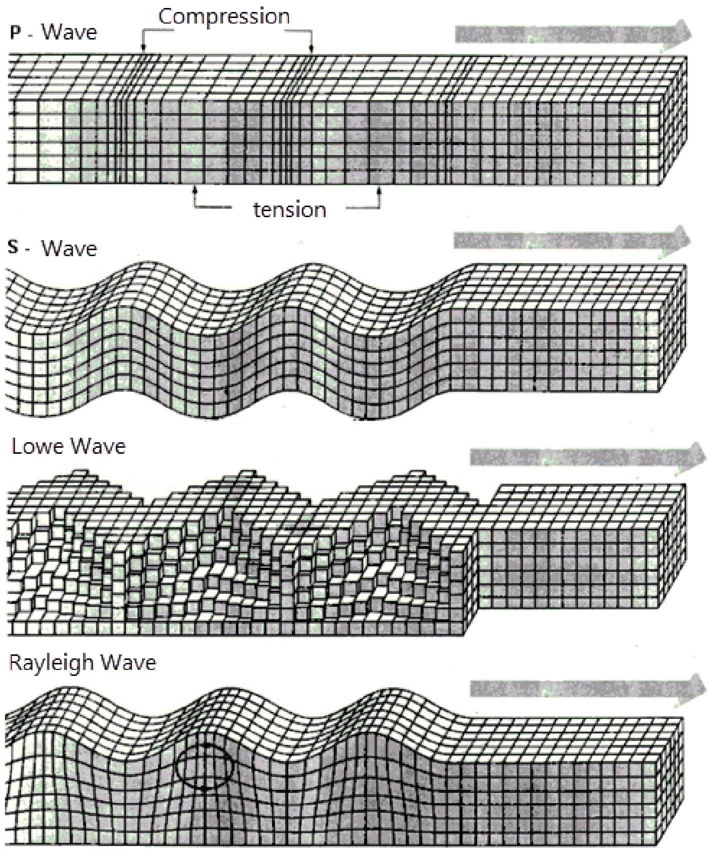


Figure 4: Ground Point Displacement During the Travel of Longitudinal P-Waves, S-Waves, Love Waves, and Rayleigh Waves.

2.4 Assessing Seismic Event Intensity

The evolution of earthquake intensity quantification and measurement methods has been largely influenced by technological advancements. Prior to the broad acceptance of instruments, the intensity of an earthquake was described using qualitative scales. The invention of seismometers and seismographs facilitated a more objective assessment of an earthquake, in terms of both its magnitude and origin. The refinement of seismic instruments enabled more precise recording of ground motion parameters, which are used to characterize individual earthquake events. These parameters can be analysed to determine how a building responds structurally to an earthquake (Kramer, 1996; Villaverde, 2009). Intensity scales, which rely on human observations and reports of earthquake impacts, collect accounts from various locations affected by the earthquake. These reports describe the damage to buildings and people's reactions and are typically documented. Analysing historical earthquake records helps determine the intensity, location, and recurrence rate of past events, which is crucial for assessing seismic hazards in a particular region. Various intensity scales are used globally, including the Medvedev-Spoonheuer-Karnik (MSK) scale and the Japanese Meteorological Agency (JMA) scale. The most commonly used scale is the Modified Mercalli Intensity (MMI) scale, which uses a 12-grade system to classify earthquakes from barely perceptible to those causing catastrophic destruction (Kramer, 1996; Villaverde, 2009).

Intensity scales, influenced by factors such as population density and building practices, are not effective for global earthquake comparisons. The measurement of the strain energy released during an earthquake, known as its magnitude, has been made possible by the development of contemporary devices like seismographs. In 1935, Richter introduced the concept of local magnitude (ML). He defined it as the measurement obtained by taking the base-ten logarithm of the peak wave amplitude, which is recorded in micrometres by a Wood-Anderson seismograph positioned 100 kilometres from the earthquake's epicentre (Villaverde, 2009, p. 146). This relationship is captured mathematically in Equation 1, which represents the Richter scale magnitude. This scale is appropriate for representing shallow earthquakes with epicentres located within 600 km of the recording device.

$$M_L = log \frac{A}{A_0} \qquad \text{Eqn. (1)}$$

Equation 1: Richter Scale Magnitude equation

Where: A represents the peak amplitude

A_0 denotes the peak amplitude of a zero-magnitude earthquake

The Richter scale has certain limitations, including its ineffectiveness for earthquakes with significant epicentral distances and those that occur at great depths. To address these issues, two other scales were introduced: the Body Wave magnitude scale (Mb) and the Surface Wave magnitude scale (Ms). The Ms scale evaluates the maximum amplitude of surface waves with a 20-second period, while the Mb scale is more appropriate for deep-focus earthquakes, as it measures the amplitude of the initial P-waves (Bolt, 2001; Naeim, 2012; Kramer, 1996).

For major earthquakes, scales based on ground-shaking measurements become less effective as the correlation between seismic energy release and ground-shaking weakens. As a result, traditional magnitude scales reach a saturation point at higher magnitudes. To address this issue, Kanamori developed the Moment Magnitude scale (Mw), which does not suffer from saturation and is suitable for large-magnitude earthquakes by utilizing seismic moment factors (Bolt, 2001; Kanamori, 1978; Kramer, 1996).

Seismographs provide valuable data for characterizing an earthquake's magnitude and epicentre location, but their application to engineering is not straightforward. Seismographs tend to amplify ground motion recordings at high-intensity locations, provide limited information on the impact of site ground conditions, and focus more on wave timing than amplitude. As a result, accelerographs, which offer a more precise recording of ground acceleration over time, have replaced seismographs (Villaverde, 2009). The data obtained is plotted on a time history, displaying motion parameters such as acceleration, velocity, and displacement over time.

Peak Horizontal Acceleration (PHA) is defined as the maximum value of acceleration recorded in an acceleration time history for each horizontal component. The maximum resultant PHA is obtained by combining the values of each orthogonal component vectorially. PHA is widely cited as a ground motion parameter because it correlates strongly with the significant dynamic forces affecting structures and reflects earthquake intensity. The vertical component of peak acceleration is typically considered less critical and is often assumed to be two-thirds of the PHA (Newmark & Hall, 1982). Estimating structural damage based solely on the PHA value is challenging. Although larger PHA values are usually more concerning, when they occur with brief durations and high frequencies, the actual damage might be less severe than the PHA value implies (Kramer, 1996). In contrast to Peak Horizontal Acceleration (PHA), the influence of higher frequencies on Peak Horizontal Velocity (PHV) is relatively minor. Consequently, at moderate frequencies, PHV offers a more precise depiction of ground motion amplitude. Thus, PHV is favoured for evaluating the impact on structures that are sensitive to these intermediate frequencies when assessing potential damage (Kramer, 1996).

On the other hand, Peak Horizontal Displacements (PHD) are associated with low-frequency ground motions and are challenging to quantify. As a result, PHA and PHV are generally chosen as the primary ground motion parameters (Kramer, 1996).

2.5 Distinguishing Seismic Hazard from Seismic Risk

Despite having comprehensive records of the location, magnitude, and frequency of past earthquake events, there remains a significant level of uncertainty in predicting seismic activity. Insufficient preparedness and awareness regarding the potential severity of seismic activity pose substantial risks to both human lives and infrastructure integrity, potentially resulting in significant destruction to buildings and essential services. It is imperative, therefore, to comprehensively identify, understand, and effectively mitigate the various dangers and uncertainties associated with seismic events, with the ultimate goal of minimizing asset losses. Moreover, a thorough grasp of these implications' aids in the formulation and implementation of essential regulations and protocols, guiding the allocation of resources toward earthquake mitigation infrastructure, communication strategies, response planning optimization, and further research endeavours (Baker et al., 2021; Chen & Scawthorn, 2003).

Furthermore, while seismic hazard and seismic risk are often used interchangeably, they represent distinct and multifaceted concepts within the realm of earthquake studies. Seismic hazard pertains specifically to the potential of earthquake-related phenomena, such as ground shaking or structural damage, to inflict damage and cause loss (Reiter, 1991; McGuire, 2004). Conversely, seismic risk encompasses the broader assessment of the likelihood of damage and loss to various assets, including human lives, buildings, and critical services, arising from seismic hazards (Wang, 2009). This relationship is quantitatively expressed by Equation 2, which defines seismic risk as a product of seismic hazard and vulnerability:

$$\text{Seismic Risk} = \text{Seismic Hazard} \times \text{Vulnerability} \qquad \text{Eqn. (2)}$$

Equation 2: Seismic Risk equation (Wang, 2009)

This distinction underscores the importance of recognizing that seismic risk is not solely contingent upon seismic hazard; it also encompasses the degree of vulnerability within a given context. Thus, even in the presence of a high seismic hazard, the resulting seismic risk may vary depending on the level of vulnerability present (Wang, 2009). Vulnerability, as elucidated by Barbat et al. (2010, p. 2), encompasses multifaceted aspects such as physical, economic, political, and social susceptibility to earthquake-induced harm or adverse impacts. Therefore, the quantification of seismic risk involves considering both seismic hazard and vulnerability, as expressed by Equation 2.

Performing a risk assessment necessitates both an analysis of potential hazards and a comprehension of the subject's exposure and vulnerability (Baker et al., 2021). This analysis can be conducted either deterministically or probabilistically. Deterministic seismic hazard analysis (DSHA) calculates the maximum ground motion parameters resulting from a specific earthquake or set of earthquakes based on typical earthquake characteristics derived from simple statistics (Wang, 2010). In contrast, probabilistic seismic hazard analysis (PSHA) estimates a variety of ground-shaking levels for various earthquake intensities at a particular location, defining seismic hazard as the likelihood of surpassing these values annually for any earthquake (Baker et al., 2021).

The unpredictable and variable characteristics of earthquakes pose challenges to both deterministic seismic hazard analysis (DSHA) and probabilistic seismic hazard analysis (PSHA) methods. According to Baker et al. (2021), DSHA is limited in its ability to consider the possibility of a future event exceeding the predicted “worst-case” ground motion. Reiter (1990) shares this view, adding that DSHA does not adequately address uncertainties in hazard analysis. On the other hand, Wang (2010) contends that by incorporating the maximum credible earthquake, these uncertainties are explicitly and suitably addressed. Despite their differing views, both Reiter (1990) and Wang (2010) concur that DSHA overlooks the temporal aspects of ground motion. To address these shortcomings, Wang (2010) proposes an alternative seismic hazard analysis (SHA) method that more effectively leverages available earthquake statistics, such as frequency, and ground motion prediction equations. While PSHA is often seen as the most adaptable and intuitive method (Baker et al., 2021), Abrahamson (2006) points out that some PSHA applications do not adequately consider ground motion variability. Wang (2010) further criticizes PSHA for its lack of a solid physical or mathematical foundation. Both authors warn that improper use of PSHA can result in underestimated seismic hazards, leading to potentially unsafe designs.

2.6 Earthquake Response and Structural Engineering

The majority of structures can be simplified into a system with three primary characteristics: a concentrated mass (m), rigidity (k), and a certain level of damping (c). This system, when subjected to force, demonstrates oscillatory behaviour, causing the mass to vibrate around its equilibrium position due to a combination of driving and restoring forces. Damping, a characteristic inherent to actual structures, inhibits indefinite vibration of the mass and is typically assumed to be 5% according to Eurocode 8. Although real structures can be displaced in countless ways, the simplified model only takes into account the horizontal displacement of the concentrated mass (Elghazouli, 2018).

A Single Degree of Freedom (SDOF) system experiences displacement (x) when exposed to a force that varies with time. The external force generates inertia, damping, and stiffness forces within the system as the mass vibrates. Dynamic equilibrium is achieved when these internal forces equal the external force: inertia force + damping force + stiffness force = external force. This equation can also be represented in terms of x and its time derivative:

$$m\ddot{x} + c\dot{x} + kx = F(t) \qquad \text{Eqn. (3)}$$

Equation 3: Equation of Motion

Where: $m\ddot{x}$ represents the inertia force

$c\dot{x}$ denotes the damping force

kx signifies the stiffness force

When an SDOF system undergoes ground motion over time, its elastic structural response can be assessed temporally. Only the highest amplitude of a structure's response is considered significant in many engineering scenarios. Thus, for a particular damping ratio and a certain earthquake, a response spectrum can be built to show the maximum response of SDOF structures with different natural vibration periods (Chen & Scawthorn, 2003).

Response spectra, which are generally derived from historical earthquake time histories, often fall short in accurately predicting a structure’s peak response to future seismic events. However, analogous structural reaction spectra are produced by earthquakes with comparable frequency components, according to an analysis of earthquake ground motion in the frequency domain. Using this idea, a design spectrum is created, in which the dynamic properties of several seismic accelerograms are represented by a single curve. This design spectrum is generated by calculating, enveloping, and smoothing several response spectra from different earthquakes (Elghazouli, 2018).

EN1998-1-1 (3.2.2) provides guidelines for two types of elastic response spectra based on the seismicity of a region: Type 1 for areas with moderate to high seismic activity, and Type 2 for areas with low to moderate seismic activity. These spectra are further differentiated based on the ground conditions at the site. As illustrated in Figure 5, the vertical axis shows the spectral acceleration (Se) of the structure, normalized by the design peak ground acceleration for each type of ground (Elghazouli, 2018).

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1,0	0,05	0,25	1,2
B	1,35	0,05	0,25	1,2
C	1,5	0,10	0,25	1,2
D	1,8	0,10	0,30	1,2
E	1,6	0,05	0,25	1,2

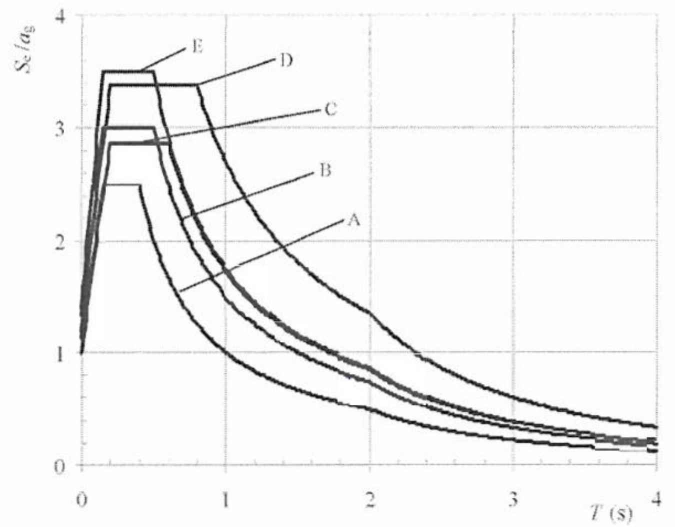


Figure 5: Characteristic Elastic Response Spectra for Various Ground Types and Damping Level

The maximum force applied to the structure and the corresponding displacement are the main factors of relevance in the context of seismic activity. This situation can be explained by Newton's Second Law of Motion, which states that an object's force, assuming a fixed mass, is directly proportional to its acceleration. Consequently, the greatest seismic force on the structure coincides with the mass's peak acceleration, obtainable from a response spectrum. The mass's position at spectral acceleration aligns with its maximum displacement. At this juncture, the mass's velocity is zero, indicating an absence of damping force. Thus, the peak force corresponds to the inertia force of the mass, expressed in Equation 4 is:

$$F = mS_e \qquad \text{Eqn. (4)}$$

Equation 4: Peak Seismic Force Equation

Where: F represents the peak seismic force

m denotes the lumped mass of the structure

S_e stands for the spectral acceleration given by the response spectrum

Dynamic equilibrium necessitates that this force equals the stiffness force produced within the structure, leading to the equation:

$$kS_D = mS_e \qquad \text{Eqn. (5)}$$

Equation 5: Equation of Dynamic Equilibrium in Seismic Analysis

which can be utilized to calculate the mass's maximum displacement, SD. This analytical approach is predicated on an idealized elastic structural response. Actual structures display some plasticity, which diminishes the forces acting upon them. EN1998-1-1(3.2.2) accommodates this by offering modified response spectra or design spectra, adjusted via a ductility (behaviour) factor (Elghazouli, 2018).

Structures that experience seismic forces in multiple directions and exhibit various vibration modes are referred to as Multi-Degree of Freedom (MDOF) systems. The mass and stiffness of the structure are represented in these systems by matrices, whose sizes correspond to the number of degrees of freedom. By combining the effects of these modes, a MDOF system may be analysed due to the orthogonality of the various vibration modes. This is achieved by treating each mode as a separate Single-Degree of Freedom (SDOF) system through a process known as modal superposition (Elghazouli, 2018).

2.7 Summary

- Earthquakes historically evoke fear due to their sudden and devastating impact.
- They are understood as natural processes inherent to the Earth's evolution.
- Earthquakes can be triggered by tectonic shifts, volcanic eruptions, and human-induced causes.
- The Earth's outer layer is divided into tectonic plates that move due to convection currents in the mantle.
- Faults, the boundaries where plates meet, play a key role in earthquake occurrence.
- Seismic waves, including body waves (P-waves and S-waves) and surface waves (Love waves and Rayleigh waves), are fundamental manifestations of energy release during an earthquake.
- Earthquake intensity can be quantified using intensity scales (e.g., Modified Mercalli Intensity scale) and magnitude scales (e.g., Richter scale, Moment magnitude scale).
- Seismic risk and hazard are distinct concepts: seismic hazard refers to the potential for earthquake-related actions to cause damage, while seismic risk is the likelihood of damage due to seismic hazards, considering vulnerability.
- Vulnerability is the susceptibility to damage or loss due to an earthquake event.
- Seismic risk can be expressed as Seismic Risk = Seismic Hazard × Vulnerability.
- Hazard analysis methods include deterministic and probabilistic approaches, each with its limitations.
- Response spectra are used to predict structural responses to earthquakes, considering factors like peak seismic force and displacement.
- The simplified model for structural analysis consists of a concentrated mass, rigidity, and damping.
- Multi-Degree of Freedom (MDOF) systems are used to analyse structures with multiple degrees of freedom in seismic action directions.

Chapter 3: Seismic Resistance on Unreinforced Masonry Structures

3.1 Understanding Seismic Challenges in Unreinforced Masonry Buildings

Unreinforced Masonry (URM) buildings, with their unique elements and structural characteristics, are the focus of this section. The discussion primarily revolves around how these structures react to forces induced by earthquakes. These forces, predominantly lateral, pose a significant challenge to structures primarily designed to resist gravity and compression, often leading to structural damage or even failure.

The inherent brittleness of masonry, a consequence of both the limited flexural and tensile strength of the individual blocks and the weakness of the mortar, is a significant factor in this. When the masonry is viewed as a structural component, the quality of the mortar becomes even more critical. Inferior mortar can lead to the masonry disintegrating at the joint, causing the floors above to lose support and potentially leading to a collapse (Tomazevic, 1999).

Evaluating the suitability of existing URM buildings, especially in the context of minor to moderate earthquakes, is a challenging task (Boussabah & Bruneau, 1992). Therefore, it is crucial to understand the primary failure modes of URM structures. This understanding can guide the development of more resilient masonry structures in the future.

3.2 Seismic Dynamics in URM Structures

Unreinforced masonry (URM) buildings, when exposed to seismic forces, exhibit behaviour that is governed by their constituent components. El Sabbagh (2014) identified three primary components that influence the behaviour of Unreinforced Masonry (URM) buildings under seismic forces: Walls, Diaphragms, and Non-structural Components.

The first of these are the walls, which can be either solid or have openings. Solid walls are homogeneous structures, constructed uniformly with a consistent quality of masonry and without any openings. Walls with openings, however, consist of vertical elements, known as piers, located between the openings, and horizontal elements, referred to as spandrels, that extend from one pier to another. The presence of these openings makes these walls less sturdy compared to solid walls, with their performance being influenced by the aspect ratio of the piers and the level of connectivity provided by the spandrels.

The second component is the diaphragms, which are horizontal elements serving as floors. They play a pivotal role in the structure's lateral sway-resisting system. During seismic events, these diaphragms accumulate the inertial loads produced by the structure's mass and distribute them to the vertical components of the structure. The distribution of these lateral forces is dependent on the type of diaphragm, which can be rigid, semi-rigid, or flexible.

The rigidity of a diaphragm plays a crucial role in how seismic forces are transferred to the walls and influences the building's overall response to seismic activity. A rigid diaphragm functions similarly to a stiff plate, distributing lateral forces evenly across all walls, with stiffer walls receiving a larger share of the forces. This even distribution enhances the building's overall performance by efficiently sharing the loads across the structural system.

In contrast, a flexible diaphragm primarily transfers seismic forces to the walls closest to the point of force application, leading to an uneven distribution. This can result in overloading the walls near the force concentration while other walls receive little force, increasing the risk of localized failures during an earthquake. Flexible diaphragms are often found in structures with timber or lightweight roofs.

A semi-rigid diaphragm represents a middle ground between the two. While it can distribute forces to some extent, it does not do so as uniformly as a rigid diaphragm. The level of flexibility affects how forces are distributed among the walls and how the building responds to seismic forces. For instance, semi-rigid diaphragms may cause a moderate concentration of forces on certain walls, although not as severe as with flexible diaphragms. This difference in force distribution can influence the building's ability to withstand seismic activity, depending on how the diaphragm interacts with the walls.

Lastly, there are the non-structural components. While these may seem insignificant at first glance, their failure can lead to more fatalities than the structural failure itself. For example, parapet walls, which are not attached to the building in any way, pose a significant risk. Structurally, they can be considered vertical cantilevers on rocker supports, rendering them highly unstable and susceptible to collapse.

3.3 Seismic Load Paths and Structural Efficiency in URM Buildings

The fundamental role of load paths in structural systems is to facilitate the transfer of loads from the structure to its foundations. The directness of these load routes is frequently used to measure a structure's efficiency. The load routes for gravity loads are typically visible since they come from within the structure itself because of live-loading and element self-weight, taking the shortest path to the foundations.

Seismic loading, however, presents a different scenario. The structure is subjected to ground acceleration, which impacts the structure. The behaviour of out-of-plane walls in particular affects how complexly URM walls respond to seismic loading. (Priestley, 1985).

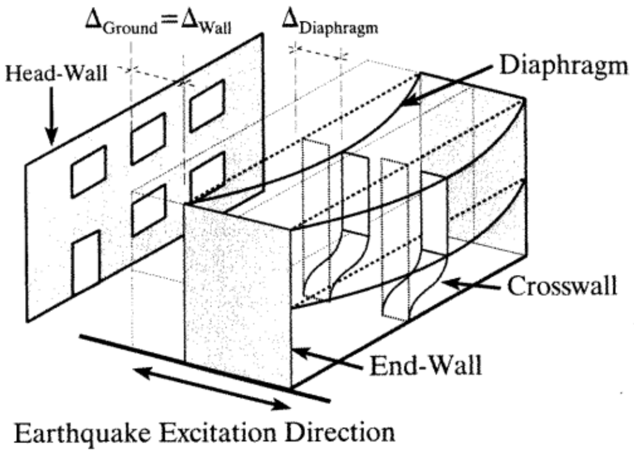


Figure 6: Path of loading and deflections in a URM (Unreinforced Masonry) building, referencing the Canadian Guidelines for Seismic Evaluation of Existing Buildings (CGSEEB) (n.d.)

An innovative methodology to characterise the seismic behaviour of a URM building was proposed by the Canadian Guidelines for Seismic Evaluation of Existing Buildings (CGSEEB). This methodology is predicated on the idea that the energy input from the ground motion is directly transferred to the floor diaphragms through the in-plane end walls and the end attachment points, as shown in Figure 6. This presumption of infinite stiffness in the end walls guarantees that the floor diaphragms receive seismic forces in an unchanged manner.

Out-of-plane displacements are caused by the diaphragms' displacement exerting forces on the headwalls (the walls that are perpendicular to the seismic action). The magnitude of these out-of-plane displacements is determined by the diaphragms' stiffness and dynamic behaviour. This procedure is relevant to seismic loading, which is an energy input. But these forces have to reverse and return to the ground along the same path (the structure's resistance to the loads).

According to Bruneau (1994), the CGSEEB's suggested methodology calls for limiting the spans of diaphragms to regulate "diaphragm-amplified seismic excitation" and establishing slenderness ratio restrictions for the headwalls to stop out-of-plane failure. This method greatly departs from the conventional understanding of how earthquakes affect buildings.

Adopting a more conventional approach, the floor diaphragm's in-plane stiffness is regarded as extremely high (completely rigid) because of the element's significant depth in the direction of the applied lateral load. Unlike the methodology proposed by Bruneau (1994), which assumed infinitely stiff in-plane walls, the passage of seismic forces through the walls is not unaltered. When contrasted to the ground's acceleration response, this causes the in-plane shear walls to exhibit a unique acceleration response.

Different input accelerations for the floor diaphragms at different heights are produced by the variable wall responses, which are brought about by differences in wall stiffness and loads (Priestley, 1985). There are extremely little out-of-plane deformations as a result of the rigid diaphragms. As previously mentioned, the load direction is the opposite of the energy input, which effectively transfers lateral pressures to the in-plane walls and increases resistance. Due to significant out-of-plane deformations, wall overturning may result from insufficient stiffness and an inadequate floor diaphragm-to-in-plane wall connection (Piazza, Baldessari, & Tomasi, 2008). The masonry's resistance to lateral loading will thus depend on the failure of the weakest component in the system, which is comparable to the weakest link in a chain.

3.4 Understanding the Modes of Failure in Masonry Walls

Boussabah & Bruneau (1992) have identified several ways in which masonry walls can fail. One of the primary causes is a lack of anchorage, which results in walls behaving like cantilevers rising from the ground. This can lead to increased flexural stresses at the base of the wall and potential wall failure. The absence of a connection can also result in a loss of bearing between the wall and slab during seismic activity.

Another failure mode is an anchoring failure. If anchors are present, they can fail, particularly at connection points. Failure modes include shearing off and anchor slippage. In-plane failures are also common. Despite their stiffness in their plane, walls can fail. Bending and shear failures are not uncommon, especially in walls with many openings (like windows and doors) as seen in facade walls. These configurations result in short piers that are vulnerable to shear. Slender piers are susceptible to flexural failure.

An additional kind of failure mode is out-of-plane failures. Wall anchors are required, and they must be present in sufficient numbers to lower the walls' effective height. Given that masonry walls have a very low known out-of-plane bending resistance, proper connection details are essential. Such collapse types are notably common in free-standing walls, particularly in parapet walls.

Failure may also result from a combination of in-plane and out-of-plane factors. Because damage from this kind of failure mode is linked to factors out-of-plane, it is frequently challenging to locate and understand. In actuality, during a seismic event, walls are susceptible to dynamic loads in both directions and buildings are subject to bi-directional forces.

Diaphragm-related failures are another type of failure mode. Diaphragms undergo dynamic actions in their plane; the flexibility of the diaphragm determines the reaction that is conveyed to the URM walls. Diaphragms rarely sustain damage since they are extremely stiff in-plane, but they frequently harm the top of the wall, particularly at corners.

The in-plane and out-of-plane wall failures are the failure types that are directly related to the masonry walls because of the direct application of lateral force. These failure types are not the same as building damage brought on by connections to other components, like floor slabs. In addition to providing clarification on these two mechanisms of failure, Lang (2002) explains what is occurring on a microlevel, (i.e., masonry module and mortar level). Walls are affected differently by different failure mechanisms, and it is important to observe these impacts in order to identify the mode of collapse, particularly in the aftermath of earthquakes.

3.5 Analysis of Failure Modes and Non-linear Behaviour in Masonry Walls under Different Stress Conditions

Tensile stress, which acts perpendicular to the bed joints, can lead to horizontal cracking along these joints, a failure mode often observed at the wall's heel (Region A in Figure 7). This is particularly likely when the axial load on the wall is relatively low compared to the applied horizontal load (Lang, 2002, p. 37).

Flexural failure often results in crushing at the wall's toe (Region B in Figure 7), with tensile stresses leading to cracks at the wall's heel (Region A). Ultimately, the wall may fail completely due to overturning and compression-induced crushing at the wall's toe. This type of failure is influenced by the wall's aspect ratio, with larger height-to-length ratios leading to near-vertical cracks due to a small resultant angle of inclination. Walls with these proportions also tend to exhibit larger overturning moments, leading to rigid body rocking motion. However, these moments decrease as the vertical load increases (Lang, 2002, p. 37).

Shear failure, characterized by diagonal cracks, occurs in Region C of the wall. Usually, the bed joints and butt joints are where these cracks spread because they are mortar joints. Particularly in low-strength masonry, the cracks are typically diagonal rather than stepped when there are significant vertical loads present (Lang, 2002, p. 38).

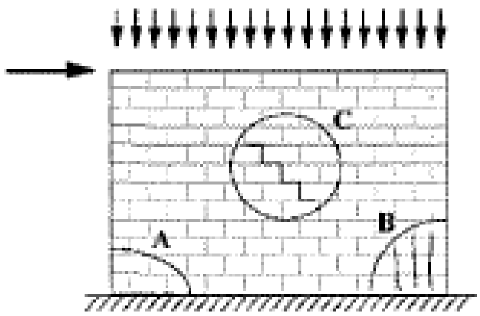
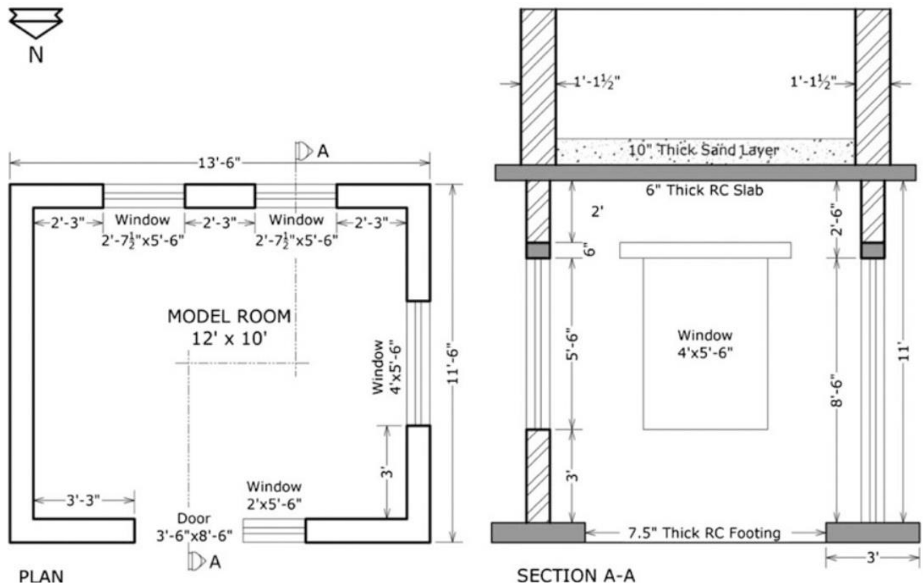


Figure 7: Various in-plane failure modes are observable in a masonry wall, as per Lang (2002).

Lang (2002) identifies four factors that influence the complex stress distribution in masonry walls: the type of masonry, wall geometry, applied forces, and support conditions. While different local failure modes can occur at the wall's centre or base, it is rare for any single failure mode to cause the wall's complete failure. Instead, the wall continues to sustain damage until a combination of failure modes leads to its failure.

In addition to introducing an important variable—openings—Shahzada et al. (2012) conducted full-scale investigations that illustrated several of the aforementioned failure types. Figure 8 shows an illustration of the tested sample building used in Shahzada et al.'s study, which highlights the structural weaknesses associated with openings. The configuration employed for the experiment is shown in Figure 9, detailing how the tested structure was set up to simulate the seismic effects. Because URM construction contains discontinuities in the wall, the presence of doors and windows modifies the damage pattern. According to the experimental model used in Shahzada et al. (2012), the spandrels receive very little damage compared to the piers, which have the maximum damage (Figure 11). This is because, although the spandrels transport horizontal forces, the piers are ultimately responsible for carrying all vertical and horizontal forces to the foundations, according to Lang (2002). Thus, the building's seismic resistance is largely dependent on the piers' capability.



(a) (b)

Figure 8: Illustration depicting a tested sample building as part of the study by Shahzada, et al. (2012).

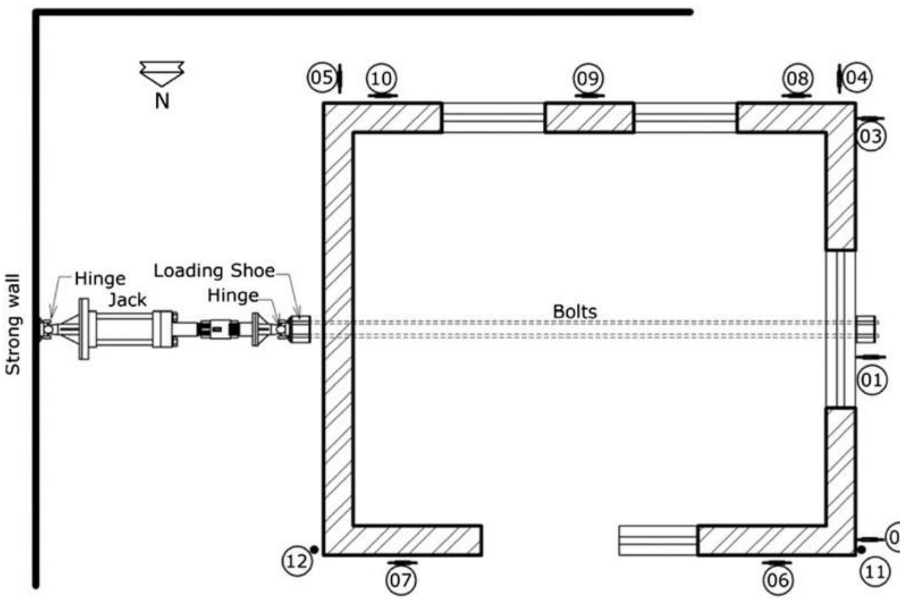


Figure 9 The configuration employed for the experiment as part of the study by Shahzada, et al. (2012).

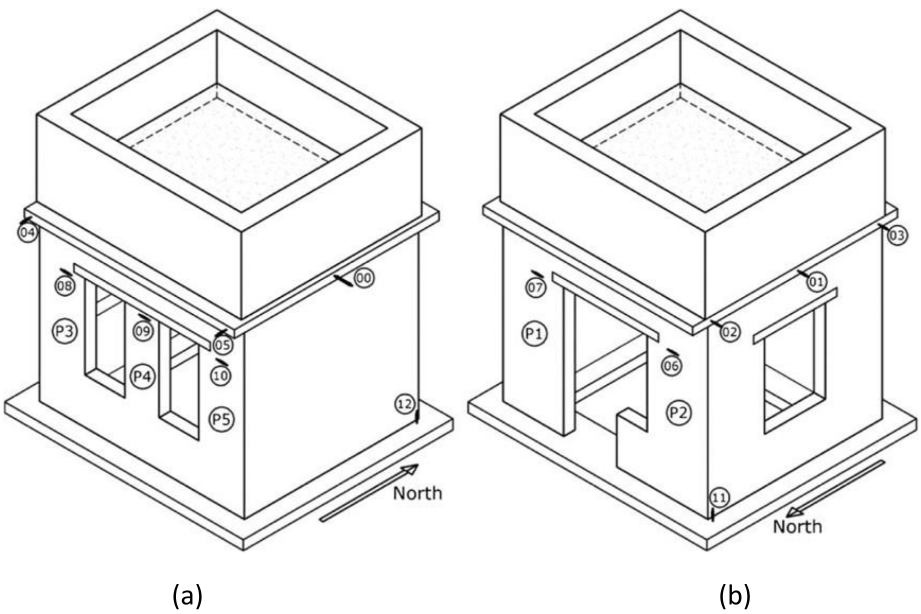


Figure 10: Instrumentation applied to the testing structure as part of the study by Shahzada, et al. (2012).

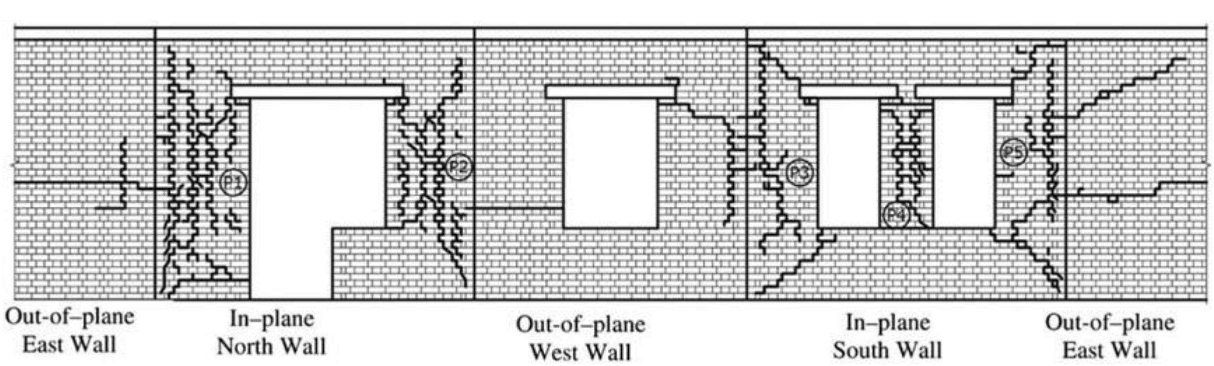
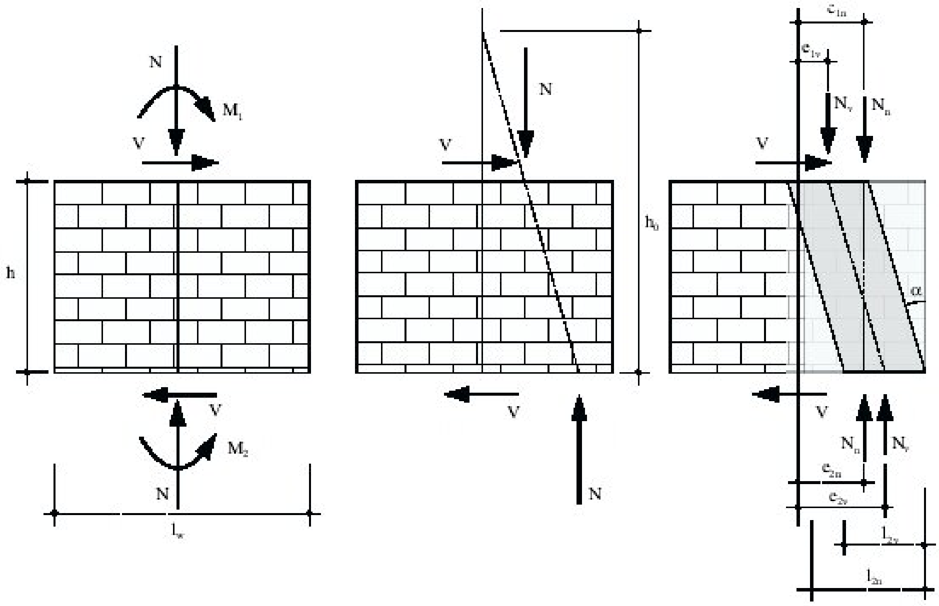


Figure 11: Ultimate pattern of damage observed in the tested structure as part of the study by Shahzada, et al. (2012).

Instrumentation applied to the testing structure, which measured forces and deflections during the experiment, is depicted in Figure 10. The experiment's final damage pattern is shown in Figure 11. The results of Shahzada et al. (2012) and Lang (2002) are compared and contrasted as follows:

In-Plane North Wall: Pier P1 (Figure 10(b))exhibited rocking flexural fractures and vertical compression. According to Lang (2002), the significant height-to-length ratio of the pier causes huge overturning moments and, as a result, vertical stresses in the pier, which is why there are numerous vertical flexure cracks (Figure 11). Using a lower bound theorem of plasticity, Lang (2002) suggests a model to determine a wall's maximum shear capacity. This figure assumes that there are two stress struts (one vertical and one inclined) connected with enough stiffness to transfer the forces into them (Figure 12).



$$N_v + N_n = N$$
$$N_n \cdot e_{1n} + N_v \cdot e_{1v} = M_1$$
$$N_n \cdot e_{2n} + N_v \cdot e_{2v} = M_2 = M_1 + V \cdot h$$
$$V = N_v \cdot \tan\alpha$$

Figure 12: Internal forces and the stress field corresponding to a wall element as part of the study by Lang. (2002).

The same causes that affected Pier P1 also caused shear, flexural, and vertical cracks to appear on Pier P2 (figure 10(b) and Figure 11). On the in-plane South wall (Figure 11), diagonal shear fractures were observed in Piers P3, P4, and P5. These fractures began at the window corners and extended to the corner of the wall, causing a separation between the pier and the spandrel. This suggests that the corners of openings are areas of stress concentration. In addition, vertical compression fractures were noted in these piers, likely due to significant overturning moments leading to a rocking motion.

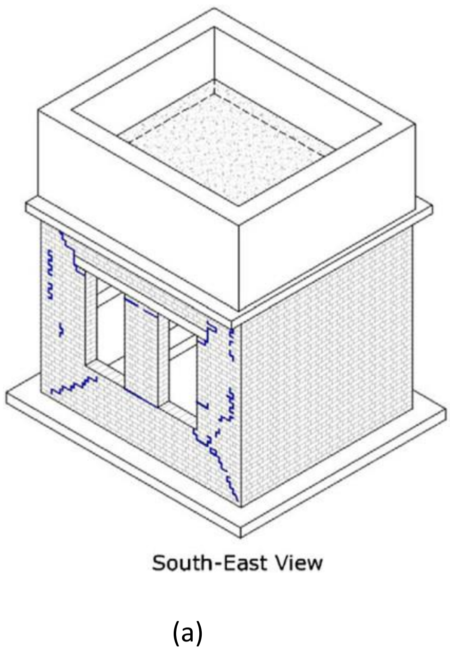


Figure 13: Crack development within the walls of a full-scale URM structure at a storey drift of 0.18% as part of the study by Shahzada, et al. (2012).

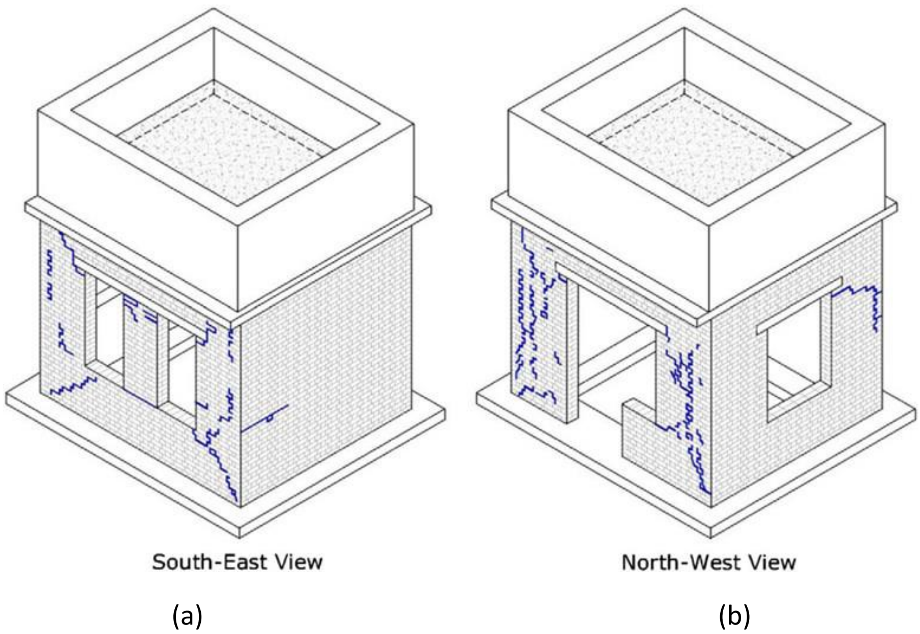
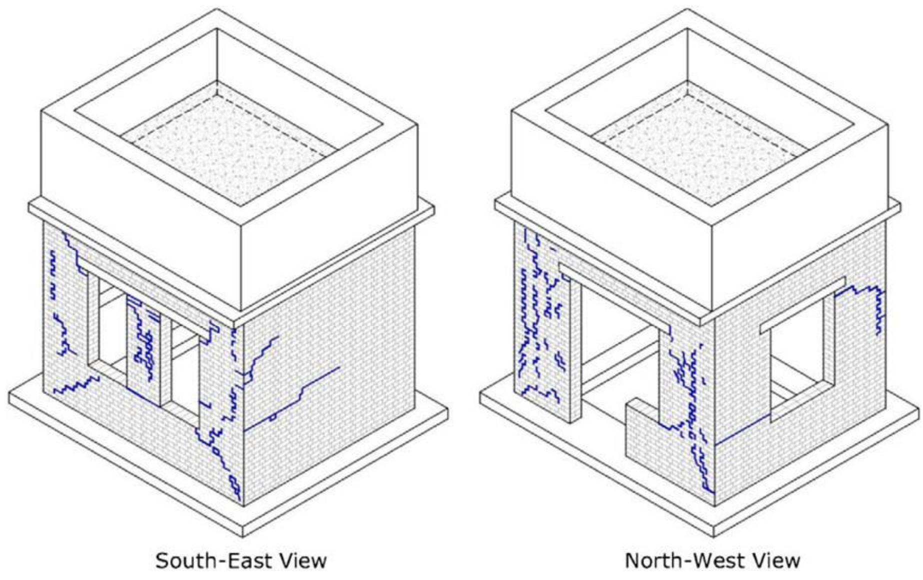


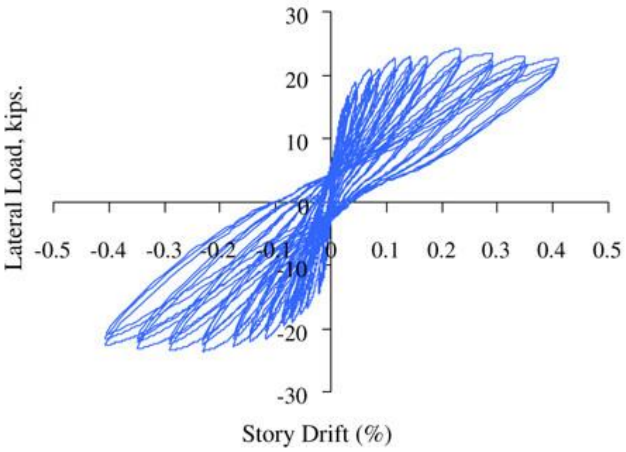
Figure 14: Crack development within the walls of a full-scale URM structure at a storey drift of 0.30% as part of the study by Shahzada, et al. (2012).



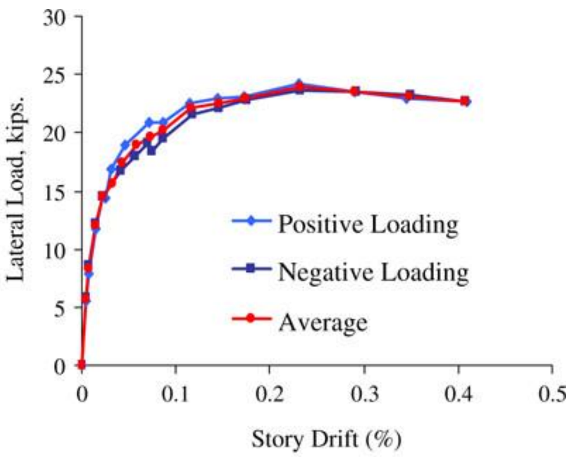
(a) (b)

Figure 15: Crack development within the walls of a full-scale URM structure at a storey drift of 0.36% as part of the study by Shahzada, et al. (2012).

Figures 10, 13, 14 and 15 show the evolution of crack patterns in relation to the percentage of storey drift, illustrating the initiation and progression of failure modes as displacement increases. The emergence of non-linear behaviour in masonry wall construction is signified by the onset of cracking, typically occurring at very low drift ratios (Shahzada et al., 2012). Force-deformation diagrams form hysteresis loops (Figure 16), signifying non-linear and non-elastic behaviour due to escalating levels of damage. Frequent loading and unloading of the structure cause the stiffness to drop and the displacement to increase; at a storey drift of 0.20%, the stiffness approaches zero. The non-linear shear behaviour was evident from the outset of the test based on the loops' shape. The structure began to lose strength at a storey drift of 0.23%, when the maximum resistance was detected, and at 0.41% storey drift, there was a 5% reduction in peak load. The process was stopped at a storey drift of 0.41% in Shahzada et al. (2012), thus not leading to failure.



(a)



(b)

Figure 16: Hysteresis response of a full-scale unreinforced brick masonry building in terms of force-deflection, including a) hysteresis loops and b) envelope curves. as part of the study by Shahzada, et al. (2012).

3.6 URM Wall Out-of-Plane Failure Analysis

Out-of-plane structural failures are often observed in scenarios where a structure has a flexible floor. While in-plane walls are typically designed to bear the brunt of lateral seismic forces, the collapse of out-of-plane walls can still occur. This can undermine the structure’s ability to carry vertical loads, given that all walls in most masonry structures serve as load-bearing elements.

The way that walls and floors, as well as orthogonal walls, are connected has a significant impact on the out-of-plane performance of masonry walls. The resistance to out-of-plane forces may be so minimal if these connections are not strong enough that out-of-plane failure occurs before the wall's in-plane behaviour can be engaged.

The bending failure of the out-of-plane wall may need a re-evaluation of the building's susceptibility. Because the boundary conditions would be regarded as constant and the stress resultants to which the wall is exposed would be greatly reduced, properly anchoring out-of-plane walls can reduce their susceptibility to early collapse (Lang, 2002).

To demonstrate common testing on masonry walls subjected to out-of-plane movements, two different experimental methodologies—one by Ferreira, Costa, Arede, Gomes, and Costa (2015) and the other by Shahzada et al. (2012)—will be utilised. The results for the out-of-plane walls of the identical test construction will be discussed using the previous methodology that was used to evaluate in-plane effects.

The latter approach involved testing isolated walls under two lateral loading scenarios on a concrete strip footing through an experimental procedure. Airbags were used in the first condition to provide the lateral force, and a horizontal actuator was used in the second condition to apply a force horizontally at the top of the wall. At the top of the wall, two different support conditions were applied in order to increase the relevance of the results. In order to replicate the behaviour of a simply supported wall panel, one condition needed pinning; the other condition left the wall unsupported to justify for the performance of cantilever walls.

This latter research was chosen to emphasise the significance of support conditions and the effect of pre-compression. A 25.4 mm thick layer of sand was utilised as a screed on the slab in the Shahzada, et al. (2012) technique to ensure consistent pre-compression. On the other hand, the pre-compression level was adjusted in the Ferreira et al. (2015) investigation using a loading cell and a vertical actuator.

According to Shahzada et al.'s (2012) research, vertical fractures at the intersection of the in-plane and out-of-plane walls and horizontal cracks along the mortar beds are the main characteristics of flexural cracks. This is a result of the two sets of walls' poor connections (see Figure 11 for actual crack patterns). In Ferreira, et al. (2015) study, the damage patterns have been replicated for comparison in Figure 17.

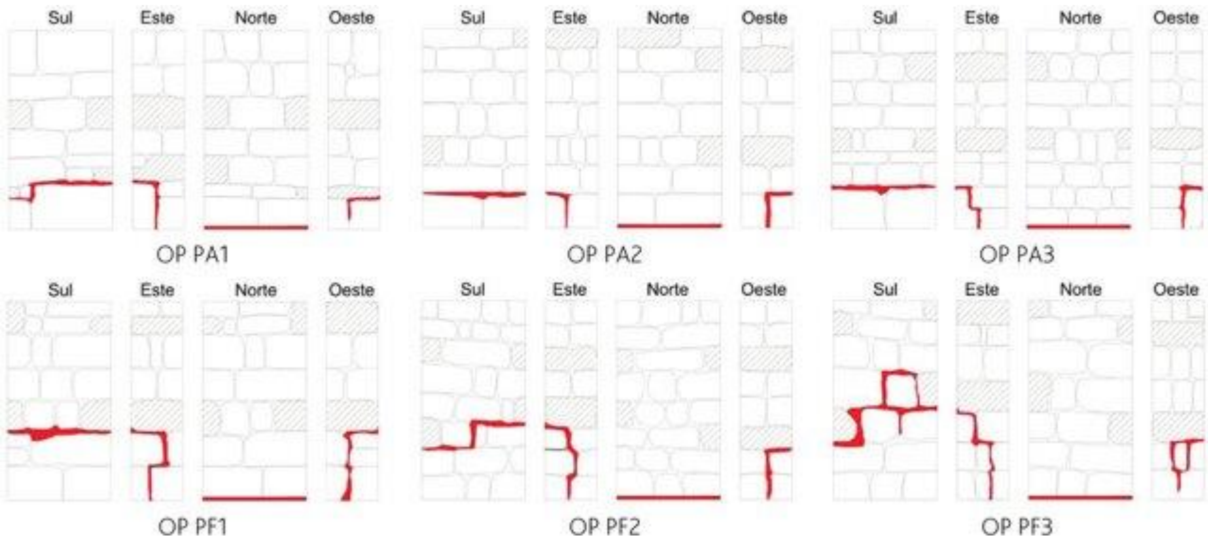


Figure 17: Patterns of cracks arising from out-of-plane testing of the wall as part of the study by Ferreira, et al. (2015).

An additional noteworthy point in the latter study is the use of bond stones to connect the two leaves of masonry that constitute the walls. Flexural cracks were generally seen, same like in the earlier investigation. It's interesting to see that the rocking caused vertical fissures in the wall's thickness, which spread into a horizontal crack on the wall's face. One of the leaves became partially detached from the wall's body as a result, and the detached leaf had a larger interleaf displacement.

As Ferreira, et al. (2015) anticipated, an increase in vertical pre-compression enhances the potential for horizontal displacement. This augmentation in pre-compression also escalates the overturning moment capacity, denoted as M_{max}, signifying that the peak experimental overturning moment saw a surge of 106%. Additionally, $M_{min(\theta Mu)}$, which represents the overturning moment at the lowest ultimate rotation, witnessed a rise of 73%. This escalation was a consequence of a stress increase of 60.8 kPa in the wall due to axial pre-compression.

Masonry walls possess the ability to expend energy via plastic deformation. The methodology employed demonstrated that a wall subjected to higher pre-compression can expend more energy at an equivalent level of rotation. As indicated in Table 1, cantilever walls exhibit a lower base frequency of vibration. Walls that were designed to function as simply supported panels, as anticipated, manifested a higher M_{max} and reduced rotations compared to cantilever walls, as illustrated in Table 2.

Specimen	Structural scheme	Fundamental frequency (Hz)	Elastic Modulus (GPa)
Wall 1	Cantilever	8.39	0.53
Wall 2		7.42	0.42
Wall 3		7.25	0.40
Wall 4	Pinned-pinned	21.34	0.44
Wall 5		24.59	0.58
Wall 6		24.66	0.59
		Mean value	0.49 GPa
		Coef. variation	17.1 %

Table 1: Table displaying the frequency of the fundamental mode and Elastic Modulus in the transverse direction as part of the study by Ferreira, et al. (2015).

Specimen	Test	K_{ini} (kN/m)	K_{eff} (kN/m)	Peak results			Post-peak results				
				M_{max} (kNm)	θ_{Mmax} (rad)	D_{Mmax} (mm)	$M_{min(\theta Mu)}$ (kNm)	M_u (kNm)	M_u/M_{max} (%)	θ_{Mu} (rad)	D_{Mu}/t (%)
Wall 1	OP PA1	3707	1986	14.57	0.0099	24.82	8.95	8.95	38.61	0.080	30.86
Wall 4	OP PF1	3575	1484	15.28	0.0051	12.72	9.17	9.17	39.94	0.068	26.30
Wall 2	OP PA2	4137	2469	28.30	0.0141	35.41	13.35	9.13	67.75	0.097	37.35
Wall 5	OP PF2	3893	1744	33.08	0.0043	10.75	18.02	16.07	51.41	0.079	30.51
Wall 3	OP PA3	4712	2689	47.33	0.0157	39.02	24.10	13.16	72.19	0.109	42.09
Wall 6	OP PF3	4769	2049	57.02	0.0113	28.28	33.33	28.47	50.62	0.080	30.82

Table 2: Table summarizing experimental findings as part of the study by Ferreira, et al. (2015).

The idea of ductility in masonry constructions is not the same as when it comes to steel structures, where it is a material characteristic, or when it comes to reinforced concrete structures, where it results from the plastic deformation of the steel reinforcement. The ductility of a masonry wall is a consequence of cracking that induces sliding, yet does not significantly diminish the wall's strength.

The ductility in masonry structures, represented by μ, is characterized by a linear elastic-perfectly-plastic behaviour as depicted in Equation 6 (Lang, 2002, p. 48):

$$\mu = \frac{Xu}{Xy} \qquad \text{Eqn. (6)}$$

Equation 6: Ductility

Where: X_u denotes the total elastoplastic deformation.

X_y signifies the elastic deformation at yield.

The ductility in question is influenced by four primary elements. These include the normal stress (σ_n), which is a result of the wall's self-weight and load, the aspect ratio represented by h/l_w, the compressive strength symbolised by f_{mx}, and the boundary conditions of the walls. These boundary conditions are associated with the connection specifics at the upper and lower sections of the wall, as illustrated in Equation 7 (Lang, 2002).

$$\mu = \mu\left(\sigma_n, \frac{h}{l_w}, f_{mx}, bc\right) \qquad \text{Eqn. (7)}$$

Equation 7: Influential Elements Impacting Ductility

Where: μ represents the ductility

σ_n denotes the acting normal stress

h/l_w signifies the geometry expressed by the aspect ratio

f_{mx} stands for the compression strength

bc implies boundary conditions

The association between ductility and normal stress was explored by Ganz (2002) at ETH Zurich through experimental testing, as referenced in Lang (2002). The experimental outcomes were linearly interpolated, as depicted in Figure 18, leading to Equations 8. These equations establish a relationship between the ultimate drift of the wall element, denoted by δ_u, and the normal stress, symbolised by σ_n. The ductility of a wall element, represented by μ_{WE}, is subsequently derived from Equation 9. The same study also observed that the ultimate drift, derived from Equation 9, holds true across a variety of wall aspect ratios.

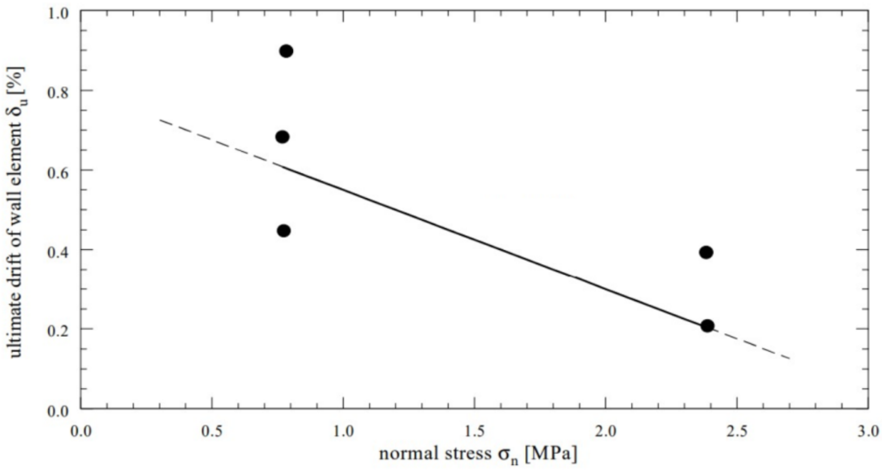


Figure 18:Correlation between ultimate drift and normal stresses observed in URM walls tested at ETH Zurich. Reference: Lang (2002).

$$\delta_u = \begin{cases} 0.8 \cdot (0.8 - 0.25\sigma_n) & \frac{h_p}{l_w} < 0.5 \\ 0.8 - 0.25\sigma_n & 0.5 < \frac{h_p}{l_w} < 1.5 \\ 1.2 \cdot (0.8 - 0.25\sigma_n) & \frac{h_p}{l_w} > 1.5 \end{cases} \qquad \text{Eqn. (8)}$$

Equation 8: Ultimate drift capacity of a pier

Where: δ_u represents the ultimate drift

σ_n denotes the normal stress

h_p stands for the height of the pier

l_w signifies the wall's length

$$\mu_{WE} = \frac{\delta_u}{\delta_y} \qquad \text{Eqn. (9)}$$

Equation 9: Ductility of the wall element in terms of drift

Where: μ_{WE} represents the displacement ductility of the wall element

δ_u denotes the ultimate drift

δ_y stands for the yield drift

The principle of ductility is grounded in the notion of energy dissipation, which has been demonstrated to be effectively applicable to the examination of Unreinforced Masonry (URM) structures. When considering the ductility of construction, the resistance of a URM wall to seismic forces can be proven to exceed the resistance produced solely by considerations of ultimate strength (Priestley, 1985).

3.7 Summary

- URM buildings face significant challenges due to lateral forces induced by earthquakes.
- Masonry's inherent brittleness, influenced by block and mortar characteristics, contributes to structural vulnerability.
- URM structures exhibit behaviour influenced by walls, diaphragms, and non-structural components.
- Solid and open-walled structures, diaphragm types, and the role of non-structural components impact stability.
- Load path efficiency is crucial for transferring seismic forces to foundations.
- Various failure modes include lack of anchorage, anchoring failure, in-plane and out-of-plane failures, and diaphragm-related issues.
- Post-earthquake evaluation should consider different failure mechanisms to qualify the mode of failure.
- Tensile stress, flexural failure, and shear failure impact masonry walls.
- Findings from studies highlight the influence of masonry type, wall geometry, applied forces, and support conditions on stress distribution.
- Out-of-plane structural failures are influenced by flexible floors and connections between walls and floors.
- Ductility in masonry walls, characterized by plastic deformation without significant strength loss, plays a crucial role.
- Factors influencing ductility include normal stress, aspect ratio, compressive strength, and wall boundary conditions.
- Experimental studies demonstrate the impact of openings on damage patterns in masonry walls.
- Findings from Shahzada et al. (2012) and Ferreira et al. (2015) underscore the importance of pre-compression and support conditions.
- Ductility in masonry structures is associated with energy dissipation.
- The concept of ductility, as explored in experimental testing, exceeds considerations of ultimate strength in seismic resistance.

Chapter 4: Research Methodology

4.1 Seismic Resilience Assessment of URM Buildings with HCB

This study expands on earlier research by Borg (2021) on the seismic performance of an existing residential unreinforced masonry (URM) building aggregate made of M2 mortar and Globigerina limestone. The aggregate consists of individual units with a plan aspect ratio of 1:4, following EN1998-1-1(9.7.2(2)b) guidelines. In this research, a peak ground acceleration of 0.10g was considered, corresponding to an earthquake with a 475-year return period, specifically attributed to the Maltese Islands. To provide a comparative analysis between structures constructed using Globigerina Limestone and Hollow Concrete Blockwork (HCB), the dissertation adheres to the design criteria used by Borg (2021). Additionally, Ground Types A (Rock subsoil), B (Stiff Clay), and C (Weak Clay) were included, following the methodology adopted by Borg (2021).

This study compares hollow concrete blocks (HCB) with soft-storey basements using M5 mortar, in accordance with Eurocode 8: Part 1 to the seismic assessment of URM building aggregates constructed with Globigerina limestone and M2 mortar. The objective is to evaluate the seismic resilience of URM structures made of HCB, considering that HCB has a lower compressive strength than solid Globigerina limestone. Several nonlinear static pushover analyses were conducted using 3DMacro software to identify, under seismic loading conditions, the safe height of individual URM units and other URM building aggregates.

Significant progress in nonlinear analysis methods for masonry structures has been made over the last decade, making nonlinear pushover analysis a practical tool. Nonlinear analysis was recognized as essential for the seismic design and evaluation of masonry buildings as early as the late 1970s in Italy and Slovenia. A technique based on the "storey-mechanism" concept was developed and refined in the following years, most notably by Tomaževic (1997 and 1999). This method involves conducting individual nonlinear inter-storey shear-displacement calculations for each storey. Each masonry pier is represented by an idealized nonlinear shear-displacement curve, which typically exhibits elastic-perfectly plastic behaviour with limited ductility (Magenes, 2006).

4.2 Non-Linear Static Pushover Analysis Approach

One effective method that meets the specified requirements is the application of non-linear static pushover analysis. While dynamic analysis provides a more accurate representation of seismic forces, non-linear static pushover analysis significantly reduces computational load. This approach accounts for mechanical non-linearities, offering a useful approximation of the seismic resilience and stress tolerance of URM structures.

During this phase of research, the Gruppo Sismica 3DMacro macro-element software, provided by the University of Malta, was utilized. This comprehensive tool visualizes the progressive deformation and failure patterns of URM structures under seismic loading conditions. Static inelastic analysis, applicable to both new and existing buildings, provides a thorough assessment of a structure's strength and ability to withstand seismic events. The resulting capacity pushover curve is highly valued for its accurate representation of structural behaviour during earthquakes (Shehu, 2021).

Understanding structural response involves critical factors such as inter-story drift, global drift, deformations of inelastic elements, and connection forces between elements (Alguhane et al., 2016; Krawinkler & Seneviratna, 1998). A key difference between Pushover Analysis and Conventional Seismic Analysis is how they handle lateral seismic loads. Both techniques use the basic period of the structure to determine lateral loads; however, Pushover Analysis continuously updates this load as the study progresses, whereas Conventional Seismic Analysis applies a constant lateral force throughout (Leslie, 2012). Additionally, Pushover Analysis employs a nonlinear model that accounts for nonlinearity at every hinge, providing a more accurate depiction of the structure’s behaviour as it approaches ultimate strength (Krawinkler & Seneviratna, 1998). Despite inherent uncertainties in seismic analysis, this approach—while not based on fail-safe theoretical models—offers insights into structural response and requires the inclusion of safety factors.

Pushover Analysis assumes that the response of a Multiple Degrees of Freedom (MDOF) system can be represented by an equivalent Single Degree of Freedom (SDOF) system, suggesting that a structure's response is governed by a single mode throughout the analysis (Krawinkler & Seneviratna, 1998, as cited in Seifi et al., 2008). This method, characterized by an incremental-iterative process, evaluates a structure's reaction to progressively applied lateral loads, considering mechanical and geometric nonlinearities for a more accurate portrayal of masonry structures (D'Altri et al., 2019). The pushover capacity curve's shape is influenced by seismic activity, which in turn impacts the seismic vulnerability assessment of the structure (Shehu, 2021). Notably, the 3D Macro software, developed by Gruppo Sismica, provides an efficient means for seismic vulnerability assessment, as evidenced in similar studies (Borg, 2021; Chetcuti, 2023).

As a result, leveraging sophisticated software tools to conduct non-linear static pushover analysis offers a valuable and insightful approach to evaluating the seismic resilience of URM structures. This method facilitates the identification of crucial failure mechanisms and informs the implementation of suitable strengthening measures (Pintucchi & Zani, 2014).

4.3 3D Macro Software

Formisano and Chieffo (2018) investigated the effectiveness of several tools in the field of seismic analysis software, including 3DMacro from Gruppo Sismica, which was essential to this investigation. This program simplifies complex masonry structures into quadrilaterals interconnected by springs, accurately representing crucial failure modes such as sliding and diagonal shear. Additionally, 3DMacro offers insights into structural behaviour by facilitating examination in multiple orientations.

For URM constructions, macro-element modelling provides a good alternative to conventional finite element models as it simplifies material definition and analysis procedures (D'Altri et al., 2019; Caliò et al., 2012). Using a spring-based methodology, 3DMacro models panels as rigid-edged quadrilaterals with diagonal springs, allowing for the discrete distribution of non-linear springs to facilitate interaction between panels. This technique accurately and efficiently models in-plane failure modes (D'Altri et al., 2019; Caliò et al., 2012).

Furthermore, 3DMacro's ability to integrate user-defined materials and handle large models enhances its suitability for seismic research, providing a comprehensive understanding of the response of masonry structures to seismic loading conditions (Caliò et al., 2012; Marques et al., 2011). According to Marques et al. (2011) and Caliò et al. (2012), upgrades incorporating out-of-plane reaction further enhance the software's capabilities, ensuring a thorough evaluation of structural resilience.

4.4 Seismic Analysis and Vulnerability Assessment Methodology

This dissertation investigates plan typologies similar to those examined by Borg (2021). The residential URM building under consideration is designed as a single-unit (SU) structure (see Figure 19) with an aspect ratio of 1:4, the maximum ratio allowed by EN1998-1-1(9.7.2(2)b) criteria. Each evaluated URM building includes a soft storey basement. The study also explores combinations of these single-unit structures, arranged to form a row of neighbouring SUs with the same plan arrangement as described in Appendix B.1, constituting the URM building aggregates.

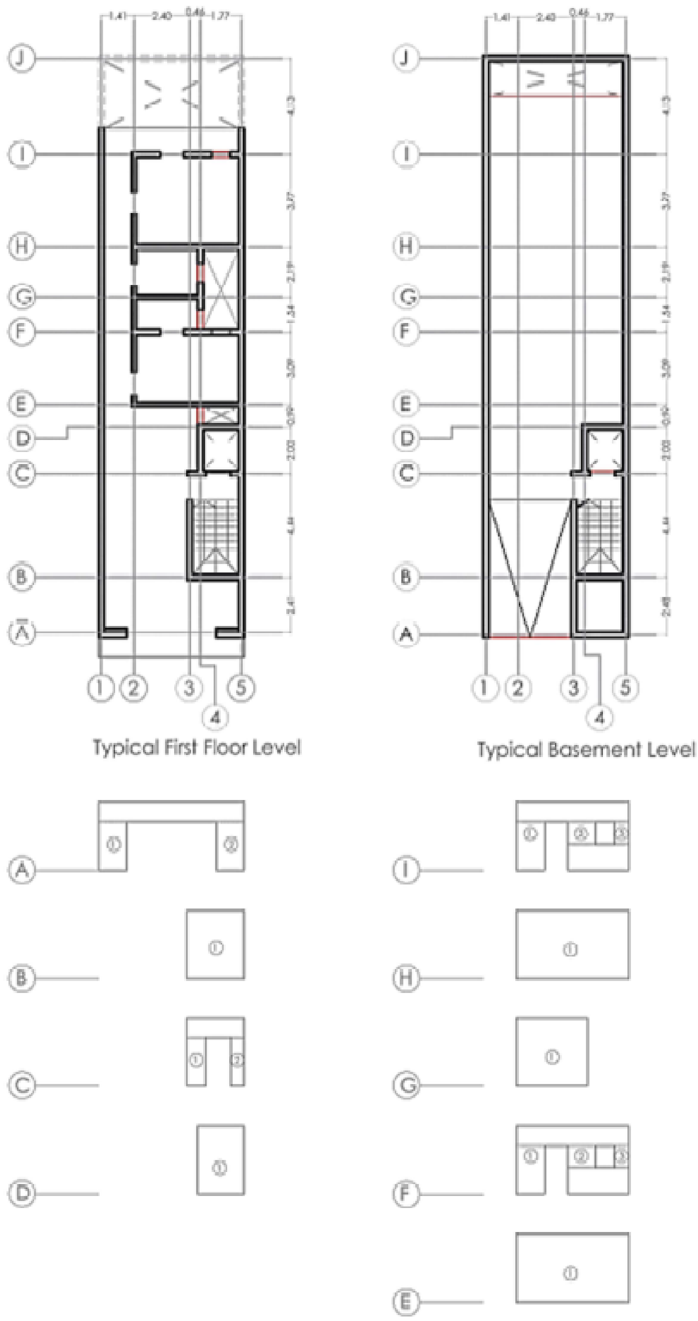


Figure 19: Standard layout for a residential building following a 1:4 plan ratio. Source: Borg (2021)

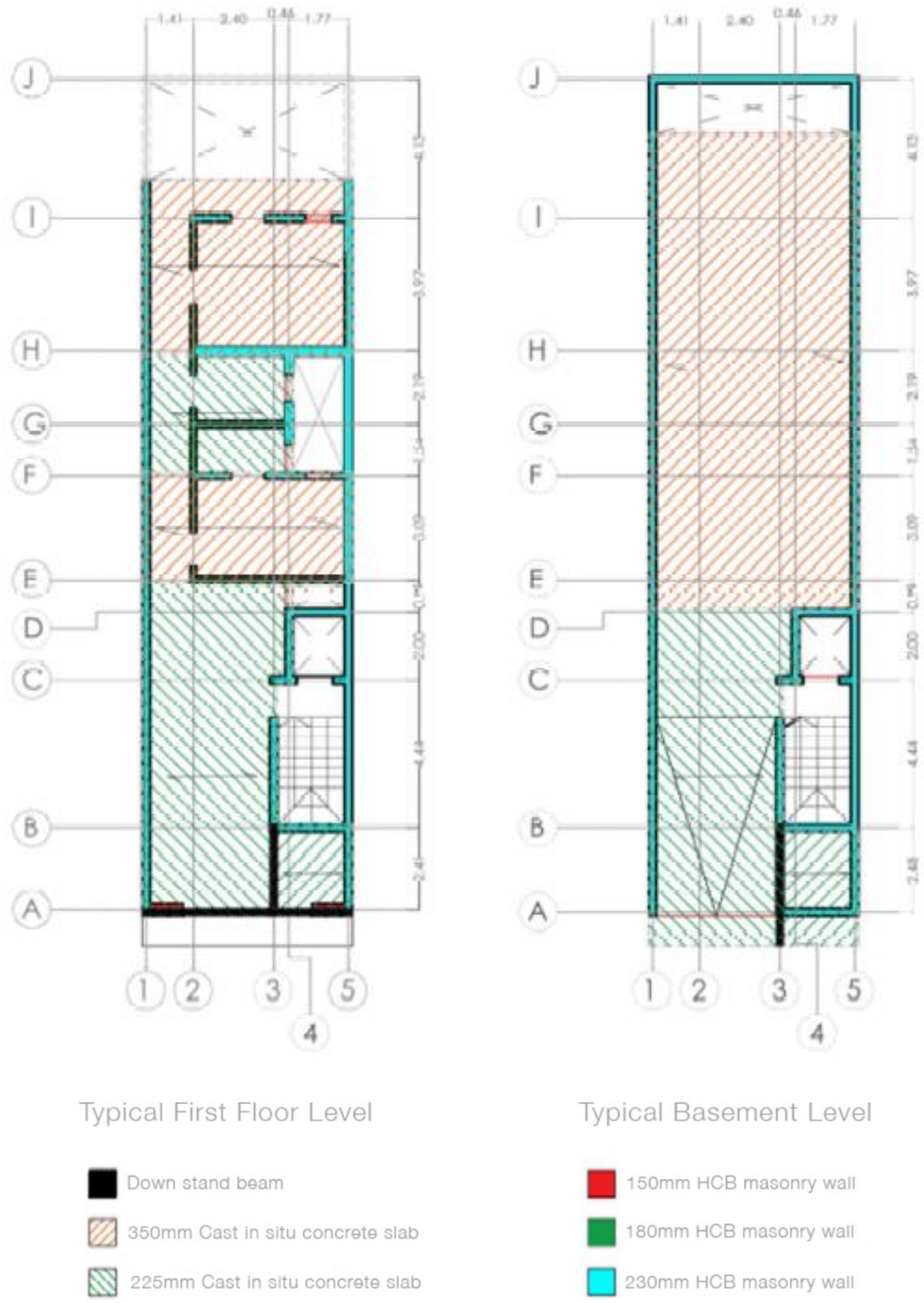


Figure 20: Assumed Structural Plans

The specific SU under study is an existing residential building with plot measurements of 6.03 meters in width and 24.83 meters in length. The masonry wall thicknesses are as follows: internal walls are 180 mm, external walls and third-party walls are 230 mm, and an additional wall leaf at the façade is 150 mm. The slab profile was carefully designed, using a ratio of 1:18 for heavily loaded slabs, such as those covering the basement roof, and a ratio of 1:20 for lightly loaded slabs, like those extending from the roof over the first floor. Additionally, a 0.90-meter offset was incorporated for balconies. The backyard depth varies between levels, starting at 1.50 meters in the basement and increasing to 2.90 meters on the first floor. The structural plans, including a legend showing the various wall thicknesses and slab configurations, are illustrated in Figure 20.

Tables 3 and 4, list the specific mechanical parameters used by the 3D macro modelling software. These parameters, derived from previous academic studies, provide the smeared characteristics of masonry elements, treating masonry components as a single-phase anisotropic continuum.

Mechanical Properties of Globigerina Limestone and M2 Mortar			
Symbol	**Description**	**Value (N/mm2)**	**Reference**
E_b	Young's Modulus of Elasticity of Globigerina Limestone	21000	Borg (2021)
E_m	Young's Modulus of Elasticity of M2 Mortar	8000	Borg (2021)
G_b	Shear Modulus of Elasticity of Block 0.4 * Eb	8400	Borg (2021)
G_m	Shear Modulus of Elasticity of Mortar Em / {2*(1+v)}	3076.9	Borg (2021)
f_{block}	Compressive Strength of Block	17.5	Borg (2021)
f_m	Compressive Strength of Mortar	2.134	Borg (2021)
T_b	Tensile Strength of Block	3	Borg (2021)
T_m	Tensile Strength of Mortar	0	Borg (2021)
f_k	Characteristic compressive strength of masonry	4.108	Borg (2021)

Table 3: Mechanical Properties of Globigerina Limestone and M2 Mortar Source: Borg (20121)

Mechanical Properties of Hollow Concrete Blockwork and M5 Mortar			
Symbol	**Description**	**Value (N/mm2)**	**Reference**
E_b	Young's Modulus of Elasticity of HCB	33000	Sapiano (2019)
E_m	Young's Modulus of Elasticity of Mortar	8000	Fassa Bortolo (2021)
G_b	Shear Modulus of Elasticity of Block 0.4 * Eb	13200	Sapiano (2019)
G_m	Shear Modulus of Elasticity of Mortar Em / {2*(1+v)}	3333.3	Author (2024)
f_{block}	Compressive Strength of Block	4.838	Sapiano (2019)
f_m	Compressive Strength of Mortar	5	Fassa Bortolo (2019)
T_b	Tensile Strength of Block	1.59	Sapiano (2019)
T_m	Tensile Strength of Mortar	0	
f_k	Characteristic compressive strength of masonry	2.038	Sapiano (2019)

Table 4: Mechanical Properties of HCB and M5 Mortar Source: Sapiano (2019), Fassa Bortolo (2019)

The smeared properties of the construction materials are calculated using Equation 10, which is based on the proportional areas of mortar and masonry blocks relative to the total area of a masonry wall. Tables 5 and 6 show the combined attributes necessary for the software to operate effectively.

$$X_t = \frac{[\, X_b \ x \ A_b \,] + [\, X_m \ \ x \ A_m \,]}{[\, A_b + A_m \,]} \qquad \text{Eqn. (10)}$$

Equation 10: Smeared Property equation Source: Borg (2021) adapted from Brincat (2020)

Where: X_t indicates the ultimate smeared material property value utilized in 3DMacro.

X_b represents the material property of the masonry block.

A_b denotes the area occupied by a single masonry block in elevation.

X_m stands for the material property of the mortar block.

A_m signifies the area filled with mortar in elevation.

Smeared Properties of Globigerina Limestone and M2 mortar		
Symbol	Description	Value (N/mm^2)
E_{bm}	Young's Modulus of Elasticity	20337.12
G_{bm}	Shear Modulus of Elasticity	8128.52
f_{kbm}	Compressive Strength	20.03
f_{tbm}	Tensile Strength	2.85
τ_{bm}	Shear Strength	0.603

Table 5: Smeared properties of Globigerina Limestone and M2 mortar used in 3D Macro Sources: Borg (2021), Author (2024)

Smeared Properties of Hollow Concrete Blockwork and M5 mortar		
Symbol	Description	Value (N/mm^2)
E_{bm}	Young's Modulus of Elasticity	32090.91
G_{bm}	Shear Modulus of Elasticity	12841.21
f_{kbm}	Compressive Strength	4.84
f_{tbm}	Tensile Strength	1.53
τ_{bm}	Shear Strength	0.28

Table 6: Smeared Properties of Hollow Concrete Blockwork and M5 mortar used in 3D Macro. Source: Author (2024)

All the walls under construction are made of HCB or Globigerina Limestone. The party walls and external façade have a thickness of 230 mm. At the first-floor level, a two-leaf wall system is used, with an outer leaf measuring 230 mm and an inner leaf measuring 150 mm to reduce internal heat gain. However, it is challenging to accurately model this system in 3D Macro, resulting in the simulation of a single leaf wall with an overall thickness of 380 mm. For interior walls, a thickness of 180 mm is used. Figure 20 graphically defines the various wall types incorporated into the building model under study.

In the 3D Macro program, slabs are set up as rigid elements, assuming all concrete components are made of C25 concrete grade. To simplify seismic analysis computations, tie beams with nominal reinforcement are included in the model. Stairs are omitted from the program as they do not contribute to lateral load transmission; ventilation shafts, lift shafts, and staircase shafts are represented as diaphragm openings.

The frame elements include tie beams, down-stand concrete beams, and strip foundations, all made of C25 concrete grade. Their sizing is calculated using the appropriate span-to-depth ratios. For the strip footing, it is estimated that the vertical load from the 230 mm-thick perimeter walls disperses into the strip footing at a 45-degree angle, resulting in a simulated strip foundation width of 690 mm.

In this study, the URM building structure is classified as Type 1 for site topography and Type A for ground profile, assuming it is situated on flat terrain having a strong rock profile. A range of simulations were conducted on Ground Type B and Ground Type C to evaluate the seismic performance of various URM building layouts across various geological subsoil formations.

According to EN1991-1-1 (6.3) standards, the residential buildings examined in this study are classified as Category A, meaning they meet the corresponding load criteria. The loads are:

Floor live loads: q_k = 2.0kN/m² (unfactored)

Balcony live loads: q_k = 2.5kN/m² (unfactored)

The following loads were considered for constructing a slab that included both the screed layer and tiles (referred to as non-structural dead loads):

150 mm layer of screed: 0.15 x 18 kN/m³ = 2.70 kN/m² (unfactored)

25 mm tile layer: 0.025 x 18 kN/m³ = 0.45 kN/m² (unfactored)

Before generating the 3D Macro numerical model, a set of design parameters were determined, including the site location of the structure, its lifespan, importance factor, soil type, structural damping, limit states, and ground acceleration response spectra. Detailed information about these design characteristics is provided in Appendix A.1.

The next step was to ascertain the number of seismic levels to include in the numerical model. Material properties for all steel, concrete, and masonry elements were then established to facilitate the design of section sizes for walls, beams, slabs, and foundations. After completing this step, the numerical model was built using the standard plan arrangement shown in Figure 19. The final step was specifying the load cases to be run for the pushover analysis.

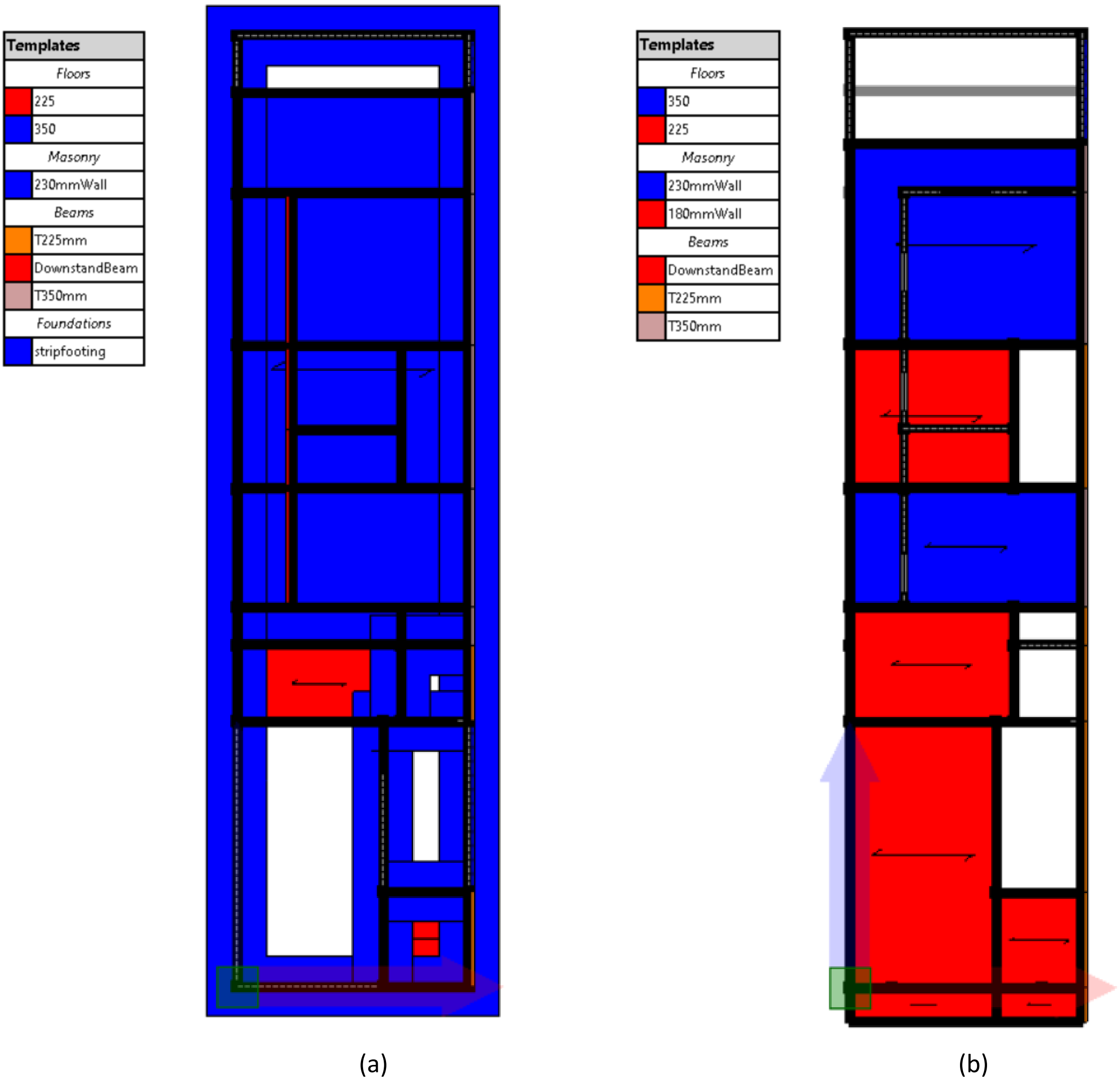


Figure 21: 3D Macro Shots; Typical layout plan (a) basement level (b) all upper floors. Source: (Author, 2024)

Different horizontal orientations, including eccentric directions, are taken into account while analysing seismic loads. The following load cases are included in the seismic analyses:

<u>Main Axis:</u>

Pushover with X Acc

Pushover with -X Acc

Pushover with Y Acc

Pushover with -Y Acc

Main Axis and Eccentricities:

Pushover with X Acc + e

Pushover with -X Acc + e

Pushover with Y Acc + e

Pushover with -Y Acc + e

Reduced Eccentricities:

Pushover with Ex + 0.3Ey

Pushover with 0.3Ex + Ey Acc

Pushover with -0.3Ex + Ey Acc

Pushover with -Ex + 0.3Ey Acc

Graphs were obtained and evaluated for each scenario of URM buildings for each load orientation. Structural damages resulting from different types of pushover analyses were recorded. In line with the Significant Damage (SD) Limit State in EN1998-1-3(2.2.3) and the No Collapse Requirement (NCR) in EN1998-1-1(2.1),, the seismic vulnerability assessment focused on the Damage Limit State (SLD), the Life Protection Limit State (SLV), and the Collapse Prevention Limit State (SLC) as defined by the Ministerial Decree of January 17, 2018, technical standards for construction (NTC 2018). The Italian government introduced the NTC 2018, an upgraded version of the NTC 2008, to impose tighter anti-seismic design requirements because of the high seismic vulnerability of Italian buildings. Anti-seismic limit states are divided into two categories by the NTC 2018: Service Limit State (SLS) and Ultimate Limit State (ULS).

There are two primary states in the Serviceability Limit State (SLS). The Damage Limit State (SLD) ensures that the building remains operational even if minor damage occurs to its components. In contrast, the Operational Limit State (SLO) guarantees that both structural and non-structural building components maintain functionality following an earthquake.

The Ultimate Limit State (ULS) comprises two states: the Collapse Prevention Limit State (SLC) and the Life Protection State (SLV). The SLC permits severe damage to structural components and the collapse of non-structural components post-earthquake, with only a minimal margin of safety against total collapse. The SLV allows for the collapse of non-structural components and significant damage to structural components post-earthquake, while preserving some resistance and stiffness for vertical actions and maintaining a margin of safety against horizontal seismic actions.

This study prioritized the most critical aggregate configuration, where seismic force applied perpendicular to longitudinal party walls results in the least lateral stiffness for the overall structure. To prevent independent actions of Structural Units (SUs), the modelling process considered the contribution from shared party walls between adjacent SUs. In symmetrical SUs with the same plan configuration, slipping failure can occur, whereas pounding failure can occur in unsymmetrical SUs with different plan configurations. Party walls that are not shared can mitigate these effects by providing sufficient seismic joints to permit sway motions.

4.5 Methodological Framework

This dissertation's assessment of the seismic vulnerability of URM building aggregates is based on several fundamental assumptions. Firstly, it assumes that structural units (SUs) at the basement level are uniform, disregarding variations such as stepped or sloped ground profiles. It also presupposes consistent building heights and floor slab levels across all SUs in the building aggregate.

The analysis assumes typical hollow concrete blocks (HCB) bonded with M5 mortar or regular soft stone blocks bound with M2 mortar, and that all concrete elements are made of C25 grade concrete, ensuring the appropriate span-to-depth ratios are met. The ground is assumed to be rock, eliminating the consideration of ground motion amplifications, and the foundations are presumed to be strong enough to bear seismic pressures without significant deformation or settlement. Additionally, all floor slabs, whether interior or at roof level, are considered to be inflexible, stiff diaphragms that prevent local deformations when lateral loads are transferred to in-plane loaded walls.

This research also suggests that SUs respond collectively to ground motion, enhancing their overall seismic performance and mitigating issues such as slippage, pounding, loss of force transfer, overturning force transfer, and local failures. By assuming consistent loading patterns across all levels, it eliminates additional eccentricities caused by irregular loading.

4.6 Limitations in Seismic Analysis and Building Modelling

The seismic analyses conducted in this research adhere to the NTC 2018 Italian Design Code for several reasons. Firstly, due to software constraints, seismic vulnerability assessment curves were unavailable when modelling the structure with EN1998-1-1. Additionally, material properties were predetermined since selecting EN1998-1-1 defaults to minimum material properties. Secondly, the focus on existing unreinforced masonry (URM) buildings in this study meant that the structural design did not adhere strictly to the seismic design requirements of EN1998-1-1, as URM buildings prioritize vertical gravity loading, which deviates from EN1998-1-1 seismic design norms.

Many constraints encountered during the numerical modelling and analysis stemmed from the inherent limitations of the 3D Macro software, as previously noted by Borg (2021). To support the slab above the basement level, downstand beams beneath the masonry walls were required due to 3D Macro's constraints, which prevent point or line loads on a floor slab without underlying walls or beams. Additional beams were necessary where the slab thickness changed and where slab edges met the structural unit's perimeter. As such, beam action rather than diaphragm action dominated lateral load transmission to the party walls, which is not representative of the actual situation (Borg, 2021).

It was also impossible to explicitly model the bending moments imposed by balconies on the façade in 3D Macro. The outcomes of the seismic vulnerability assessment may be unduly conservative because out-of-plane failures are not taken into account in the analysis. More kinematic failure analyses would be necessary for a more accurate depiction of the structural response. The modelling of masonry walls with more than one leaf was limited to modelling a single leaf wall whose total thickness was equal to the sum of the two leaves. Only apertures that extended the full height of the storey without a spandrel above them could be represented as facade openings in modelling software (Borg,2021)

4.7 Summary

- This dissertation extends Borg's (2021) research on seismic resilience in residential unreinforced masonry (URM) buildings, focusing on structures made of Hollow Concrete Blockwork (HCB) with M5 mortar.
- Peak ground acceleration of 0.10g, consistent with the designated earthquake for the Maltese Islands, was considered, along with ground types A, B, and C.
- Nonlinear static pushover analysis, facilitated by 3DMacro software, was employed to assess URM structures' seismic resilience.
- Pushover analysis, though less computationally intensive than dynamic analysis, provides practical insights into structural behaviour under seismic loading conditions.
- 3DMacro software simplifies complex masonry structures into quadrilaterals interconnected by springs, accurately capturing critical failure modes.
- The dissertation established a methodological framework, specifying design parameters, material properties, and seismic analysis approaches.
- Limitations in seismic analysis and building modelling were acknowledged, including software constraints and challenges in representing complex structural features.
- Adjustments were made to address site-specific parameters and ensure meaningful seismic vulnerability assessments.
- Challenges in modelling double-leaf cavity walls, staircases, and the toothing effect of shared party walls were encountered, highlighting areas for future refinement.
- Overall, the research provides valuable insights into the seismic resilience of URM buildings with HCB construction, informing future studies and practical applications in seismic design and assessment.

Chapter 5: Seismic Analysis Results & Discussion

5.1 Analysing Parametric Results

This chapter presents the results of the seismic assessments of various URM building aggregate configurations through a series of pushover curves and bar charts. The minimum safety factors for the various URM building aggregate configurations, consisting of different materials such as globigerina limestone and HCB, are extracted from the table results presented in Appendix D and compared using bar graphs. These different configurations' corresponding pushover curves for each type of analysis were integrated into one chart to examine the structural responses of the different combinations.

5.2 Summary of Seismic Vulnerability Assessment

Figures 22 to 25 provide a comparative illustration of the minimum α-values (safety factors) observed from seismic analyses of each unreinforced masonry (URM) building. The blue bars represent buildings constructed with Globigerina Limestone, while the orange bars represent those built with Hollow Concrete Blockwork. A minimum safety factor value below 1.00 indicates building failure, and this threshold is marked by a red line in the graphs. The minimum safety factor values were derived from the tables presented in Appendix D, where the critical α-values are highlighted with a thick border. In the bar graphs below, ground type A has been used for comparison purposes. This comparison highlights the differences in seismic performance between the two construction materials. The seismic vulnerability assessment revealed varying levels of performance for building aggregates constructed with Globigerina Limestone and Hollow Concrete Blocks (HCB). For the 1-unit building, the analysis showed that structures built with Globigerina Limestone could withstand up to 3 floors, while those constructed with HCB could support up to 5 floors. In the case of the 2-unit building aggregate, Globigerina Limestone structures were found to sustain up to 5 floors, and HCB structures could endure up to 7 floors. Similarly, for the 3-unit building aggregate, Globigerina Limestone structures were nearly capable of supporting 5 floors, whereas HCB structures could support up to 7 floors.

An interesting pattern emerged with the 4-unit building aggregate: Globigerina Limestone structures could support up to 5 floors, while HCB structures were able to withstand up to 6 floors. However, an anomaly was identified in the HCB results for this category. The HCB structure failed at 5 floors and 7 floors but unexpectedly survived at 6 floors. This inconsistency suggests that the 5-floor HCB structure should have survived the earthquake event with α-values greater than 1.

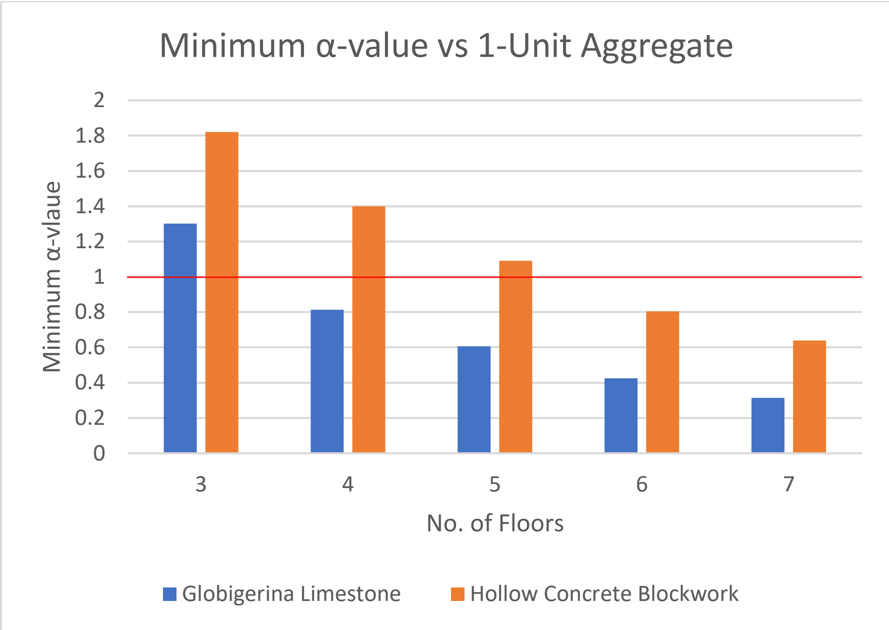


Figure 22: Bar graph comparing the minimum α-values of the 1-unit aggregate for globigerina limestone and hollow concrete blockwork.

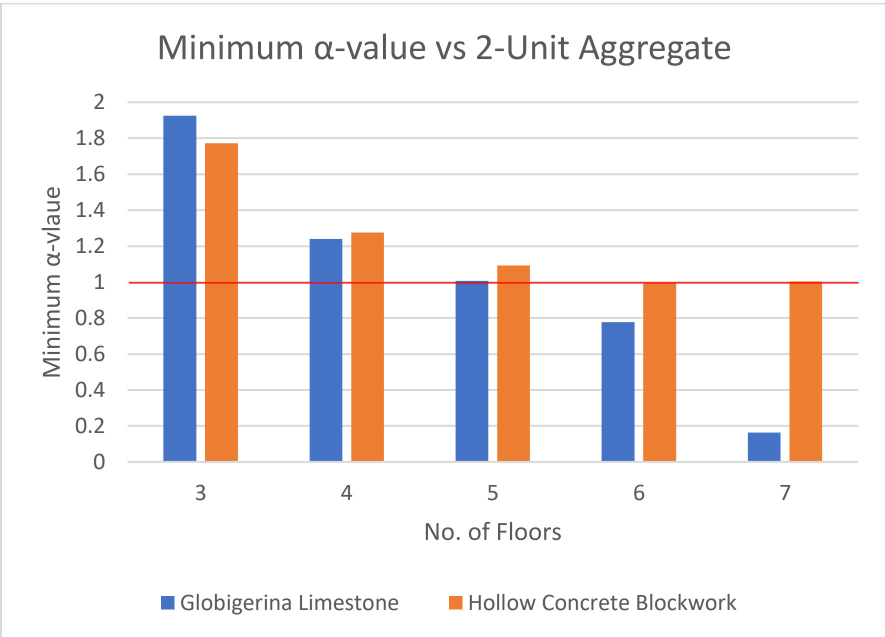


Figure 23: Bar graph comparing the minimum α-values of the 2-unit aggregate for globigerina limestone and hollow concrete blockwork.

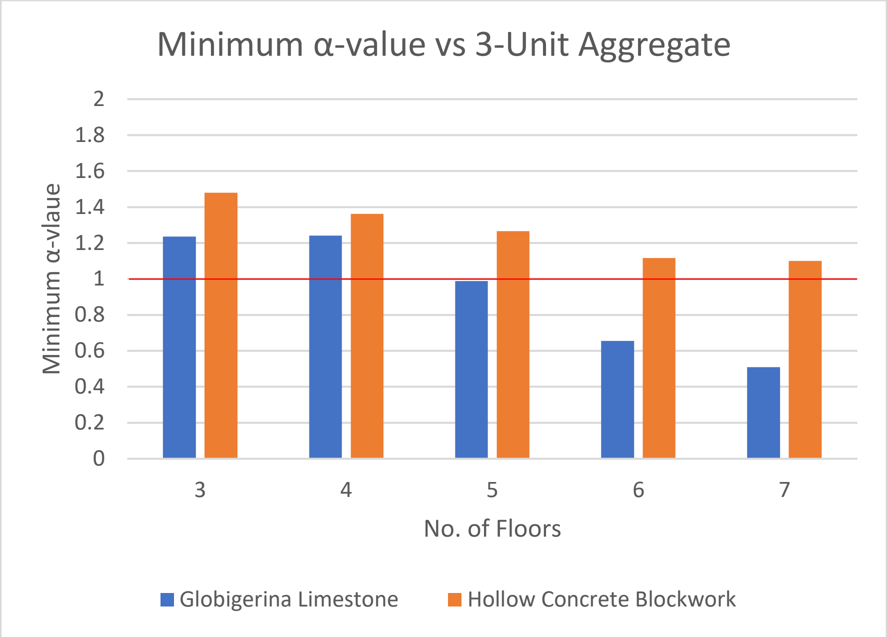


Figure 24: Bar graph comparing the minimum α-values of the 3-unit aggregate for globigerina limestone and hollow concrete blockwork.

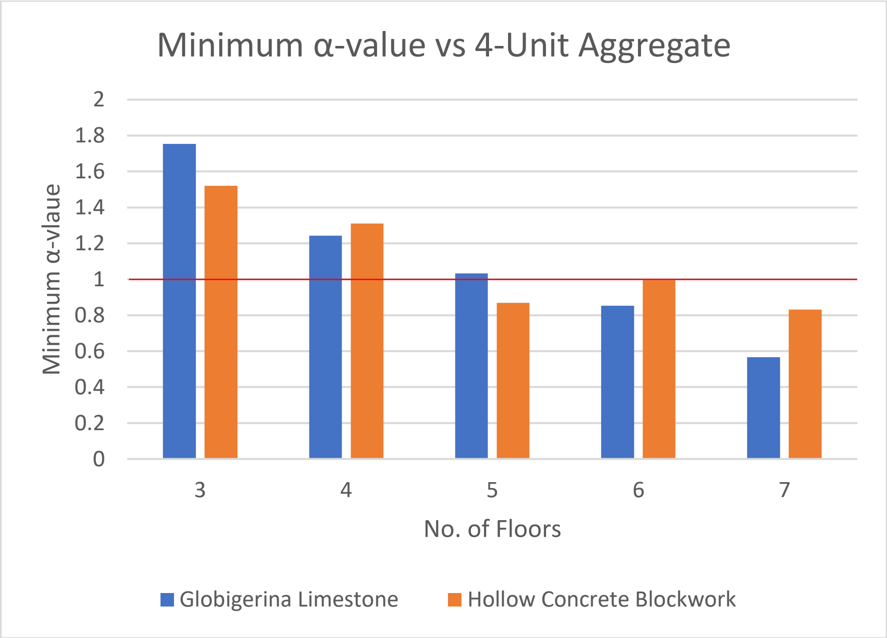


Figure 25: Bar graph comparing the minimum α-values of the 4-unit aggregate for globigerina limestone and hollow concrete blockwork.

Figure 26 below illustrates the minimum α-values for the two building materials across three different ground types: rock (A), stiff clay (B), and weak clay (C). Key observations include a consistent trend where the minimum α-value decreases as the subsoil weakens for both materials, transitioning from rock (A) to stiff clay (B) to weak clay (C). Specifically, for globigerina limestone, the minimum α-values are 0.31, 0.20, and 0.15 for ground types A, B, and C, respectively. For hollow concrete blockwork, the minimum α-values are higher, recorded at 0.63, 0.41, and 0.31 for ground types A, B, and C, respectively. Across all ground types, the minimum α-values for globigerina limestone are consistently lower than those for hollow concrete blockwork, indicating that the safety factors for globigerina limestone are lower compared to hollow concrete blockwork in all ground conditions examined. Additionally, none of the minimum α-values for either material meet the required threshold (1.0) for passing the safety criteria, as shown in the illustration.

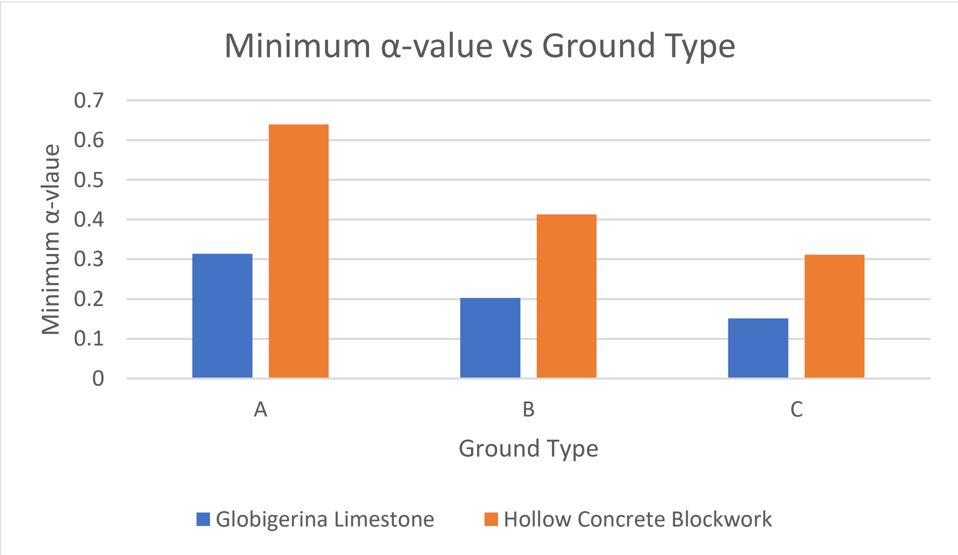


Figure 26: Bar graph comparing the minimum α-values for globigerina limestone and hollow concrete blockwork across different ground types.

5.3 Pushover Analysis Curves

The pushover analysis comparison between Globigerina Limestone and Hollow Concrete Blockwork (HCB) reveals notable differences in stiffness, maximum values, and plateau behaviours across various building configurations. HCB generally exhibits slightly higher initial stiffness compared to Globigerina Limestone, as evidenced by the steeper initial slopes of the pushover curves. This higher initial stiffness indicates that HCB structures resist larger lateral forces before undergoing significant displacement.

In terms of maximum values, Globigerina Limestone structures typically attain higher maximum base shear values compared to HCB structures of the same height. This suggests that Globigerina Limestone has a greater capacity to withstand lateral forces before failure. However, a critical evaluation of the plateau behaviour post-peak load reveals contrasting characteristics between the two materials. While both materials exhibit a similar plateau behaviour, Globigerina Limestone structures tend to have a larger drop in load-bearing capacity after reaching their peak values compared to HCB structures, though this drop is not drastic. This behaviour can be observed in Charts 1 to 48, which present the Pushover Analysis Curves for the 1-Unit to 4-Unit Aggregates. This decline highlights a relatively quicker loss of strength, which is less desirable in seismic applications where sustained performance under prolonged stress is crucial.

In contrast, HCB structures exhibit a more gradual decline post-peak, maintaining higher plateau values. This behaviour indicates a ductile failure mode, where the structure can sustain further deformation while retaining a significant portion of its load-bearing capacity. This gradual decline and ductile behaviour are evident in Charts 1 to 48The plateau values in HCB structures suggest better energy dissipation and resilience during seismic events. As the number of floors increases, both materials exhibit a convergence in behaviour. In 7-floor buildings, the disparities in initial stiffness and maximum base shear values between Globigerina Limestone and HCB are less significant than in 3-floor buildings. Although Globigerina Limestone structures still demonstrate slightly higher peak values, the gap narrows with added floors. The curves for taller Globigerina Limestone buildings tend to show a more substantial decline post-peak, leading to a less stable plateau phase. On the other hand, HCB buildings, while showing a gradual increase in shear capacity, maintain more consistent plateau values, indicating better ductility and post-peak performance.

Furthermore, the α-values (safety factors) indicate that HCB aggregates enable structures to achieve greater building heights than Globigerina Limestone aggregates. Despite the higher pushover curves for Globigerina Limestone, HCB aggregates attract less horizontal base shear force for the same horizontal sway displacement, reducing the seismic demand on the structure. This lower base shear force results in reduced stress and strain on HCB structures, allowing for increased height without compromising safety. The enhanced ductility and energy dissipation capabilities of HCB aggregates further contribute to their superior seismic performance. Consequently, the capacity of HCB aggregates to attract less base shear and dissipate energy more effectively permits the construction of taller and safer buildings, despite their lower peak pushover curves compared to Globigerina Limestone aggregates.

5.3.1 Pushover Analysis Curves for the 1-Unit Aggregate

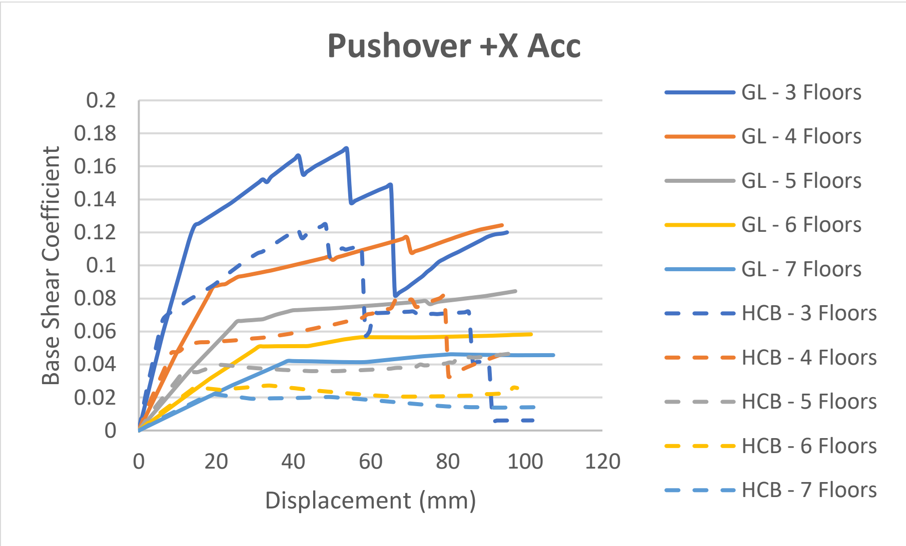


Chart 1: Pushover + X Acc Curves for a single-unit structure

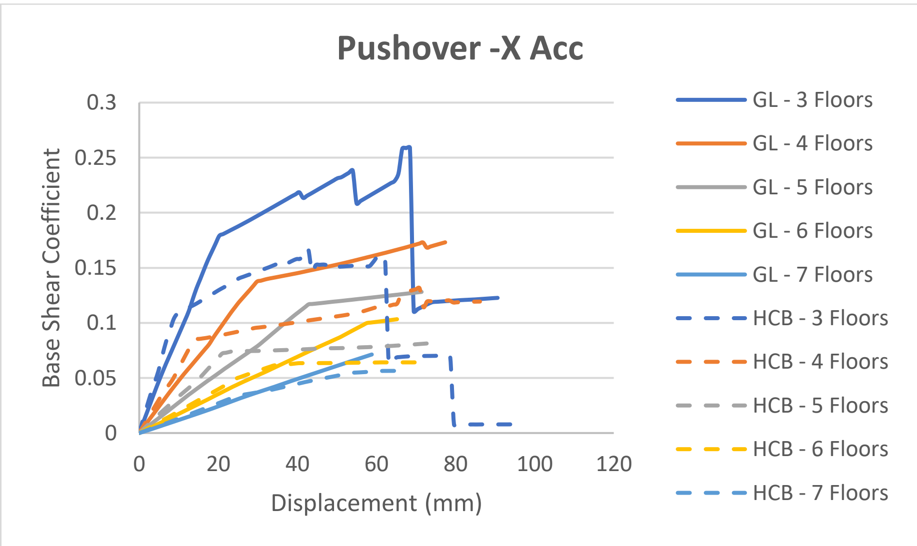


Chart 2: Pushover - X Acc Curves for a single-unit structure

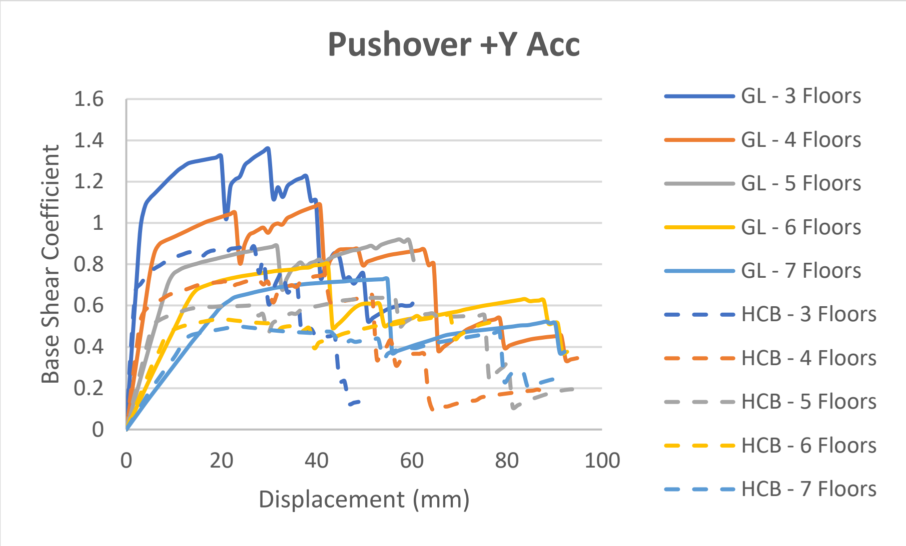


Chart 3: Pushover +Y Acc Curves for a single-unit structure

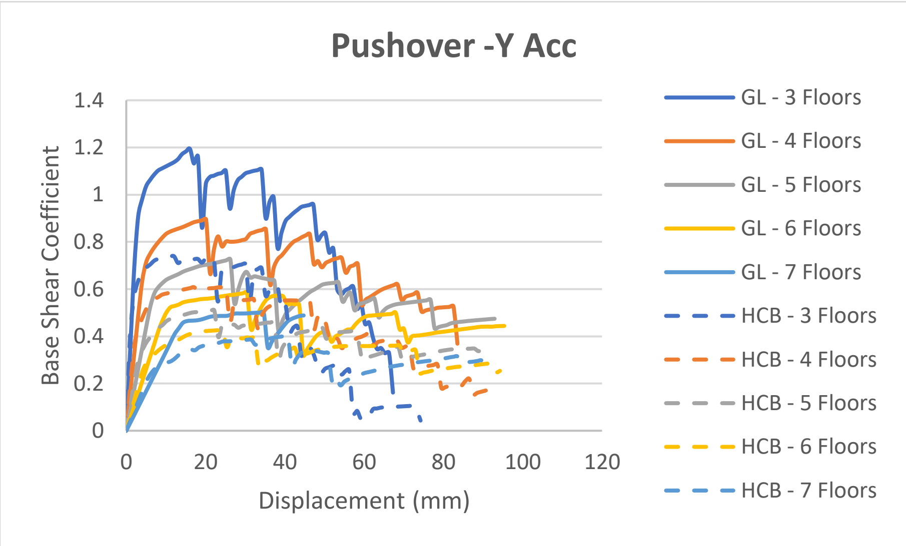


Chart 4: Pushover -Y Acc Curves for a single-unit structure

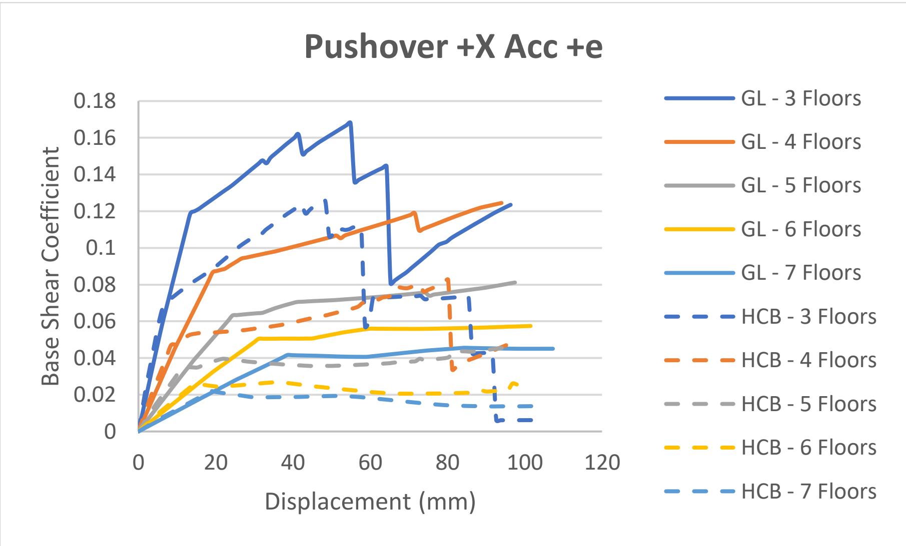


Chart 5: Pushover +X Acc +e Curves for a single-unit structure

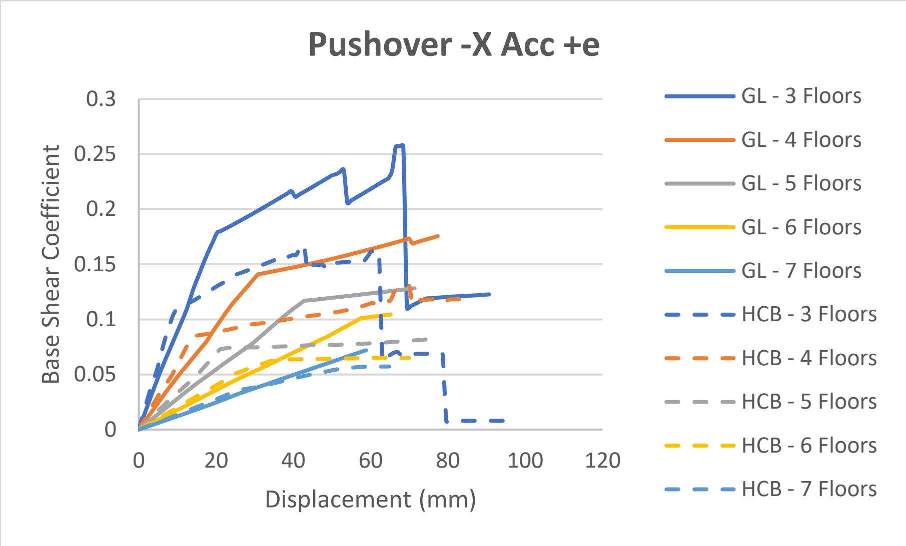


Chart 6: Pushover -X Acc +e Curves for a single-unit structure

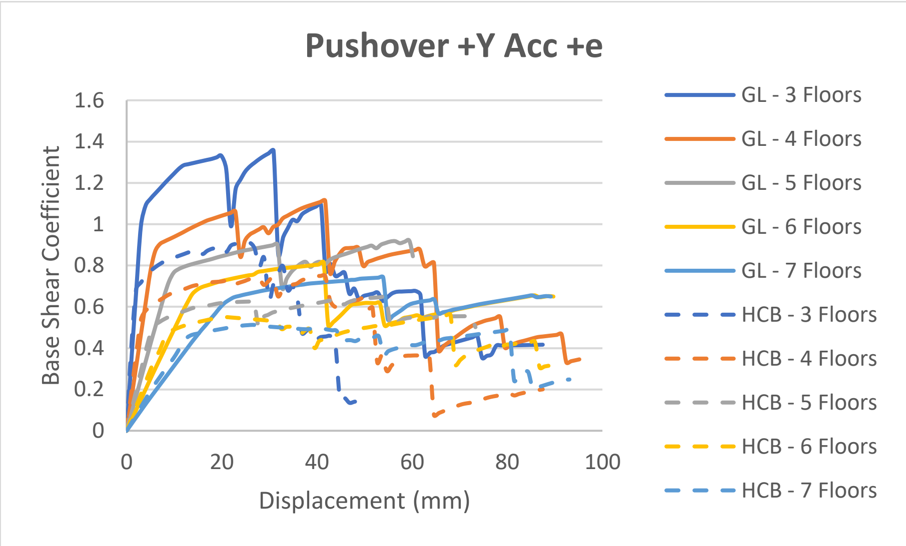


Chart 7: Pushover +Y Acc +e Curves for a single-unit structure

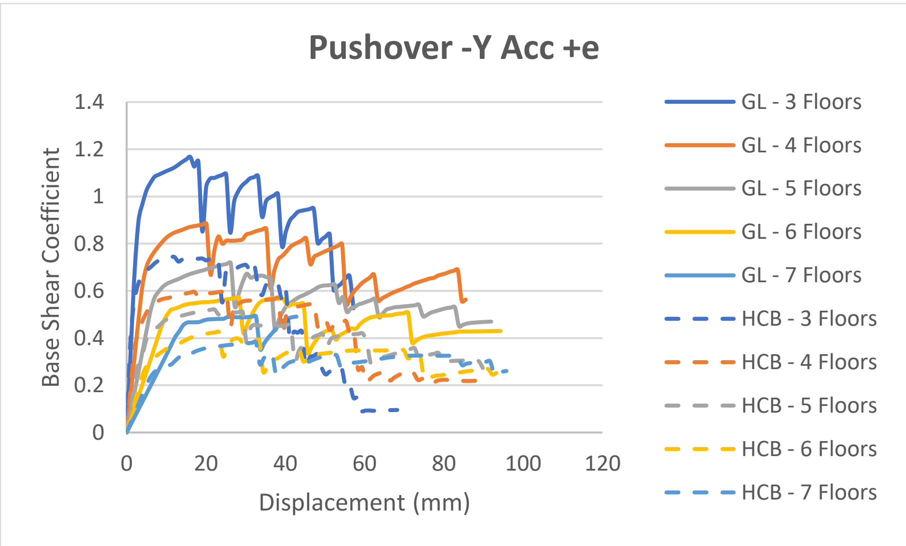


Chart 8: Pushover -Y Acc +e Curves for a single-unit structure

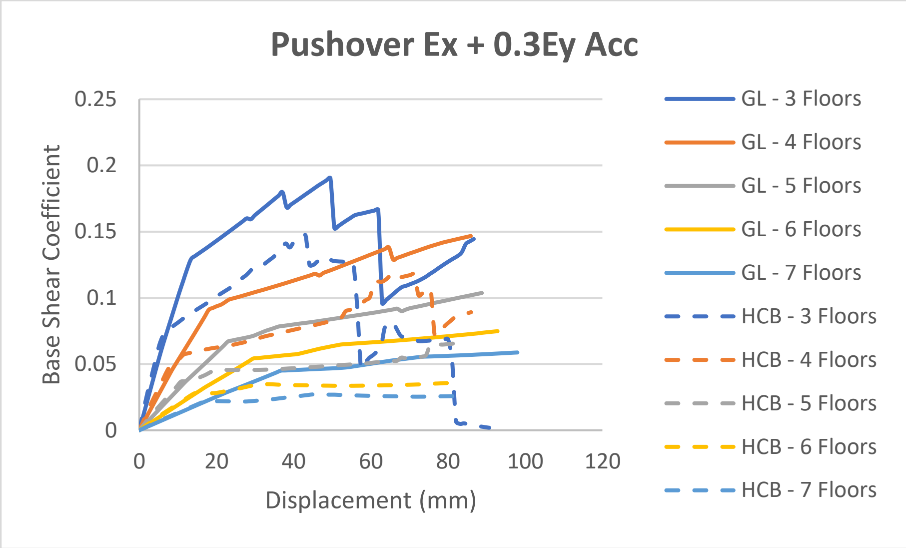


Chart 9: Pushover Ex + 0.3Ey Acc Curves for a single-unit structure

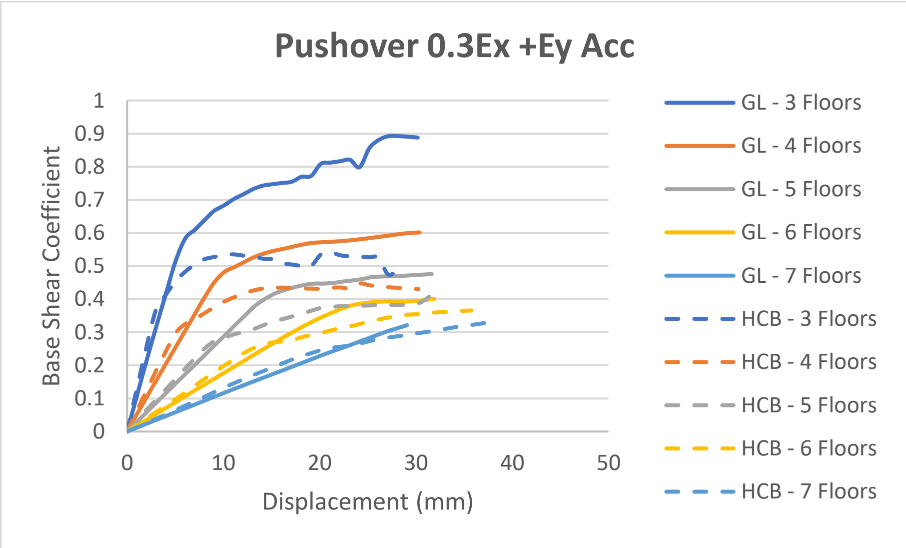


Chart 10: Pushover 0.3Ex + Ey Acc Curves for a single-unit structure

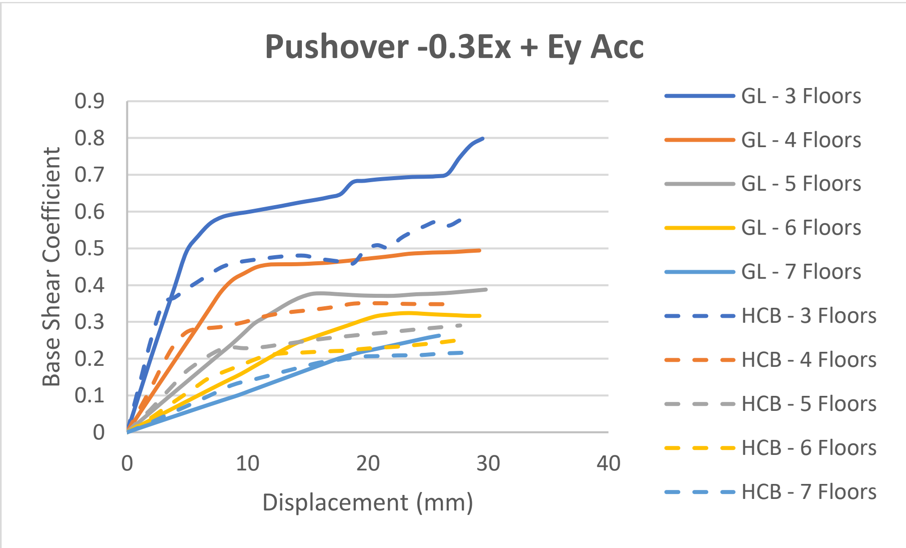


Chart 11: Pushover -0.3Ex + Ey Acc Curves for a single-unit structure

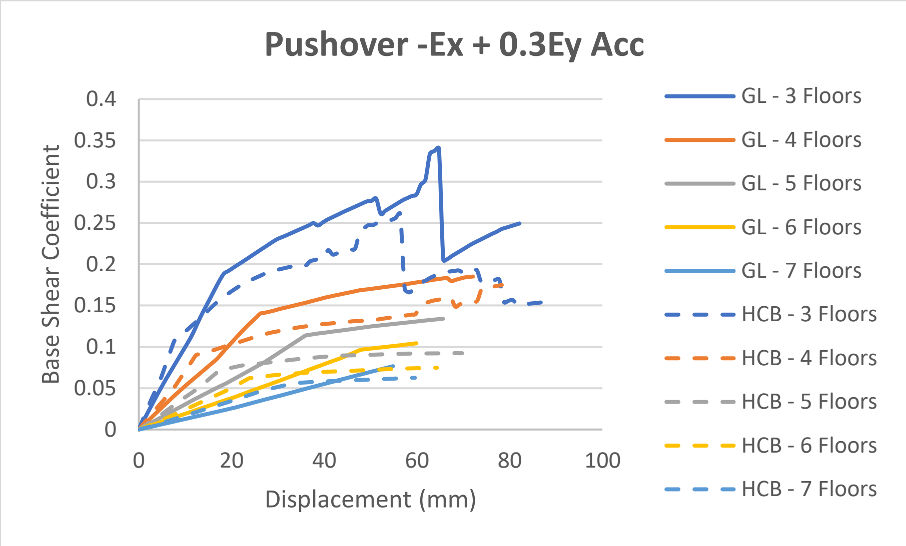


Chart 12: Pushover -Ex + 0.3Ey Acc Curves for a single-unit structure

5.3.2 Pushover Analysis Curves for the 2-Unit Aggregate

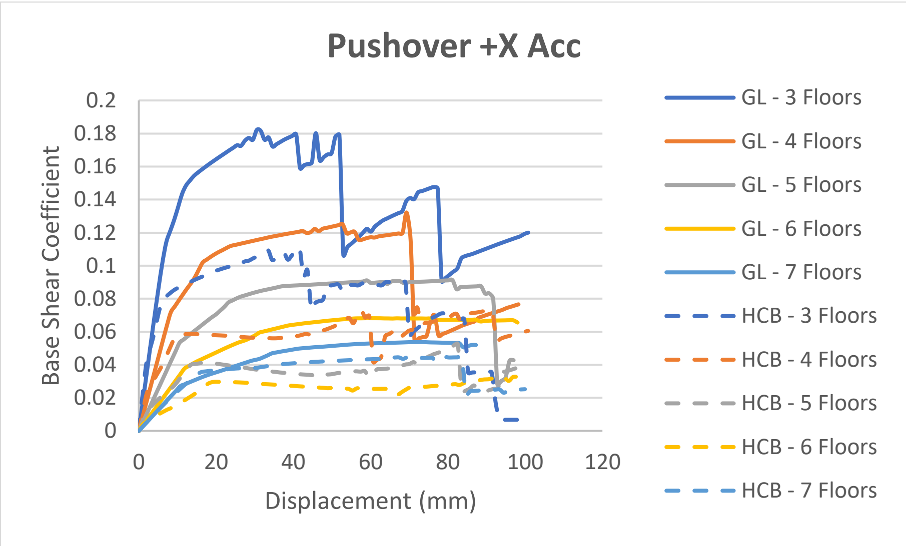


Chart 13: Pushover +X Acc Curves for a two-unit structure

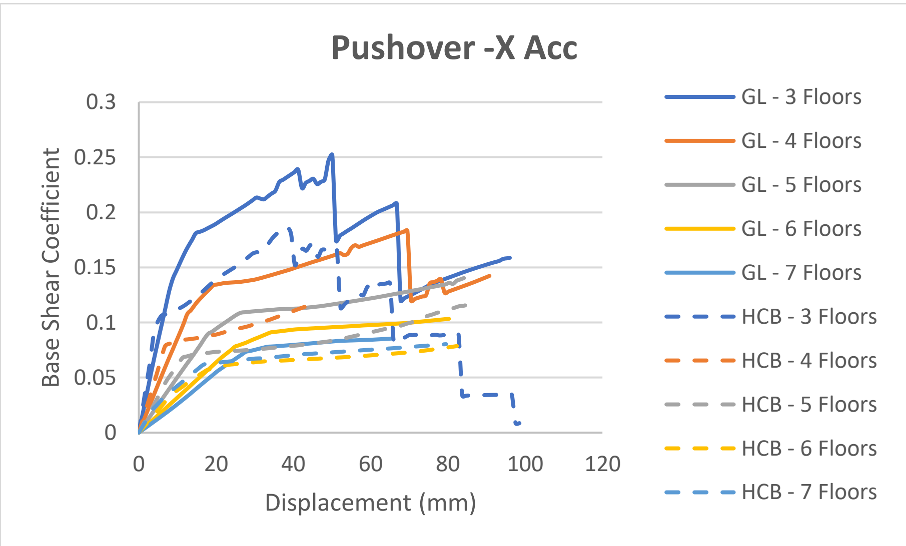


Chart 14: Pushover -X Acc Curves for a two-unit structure

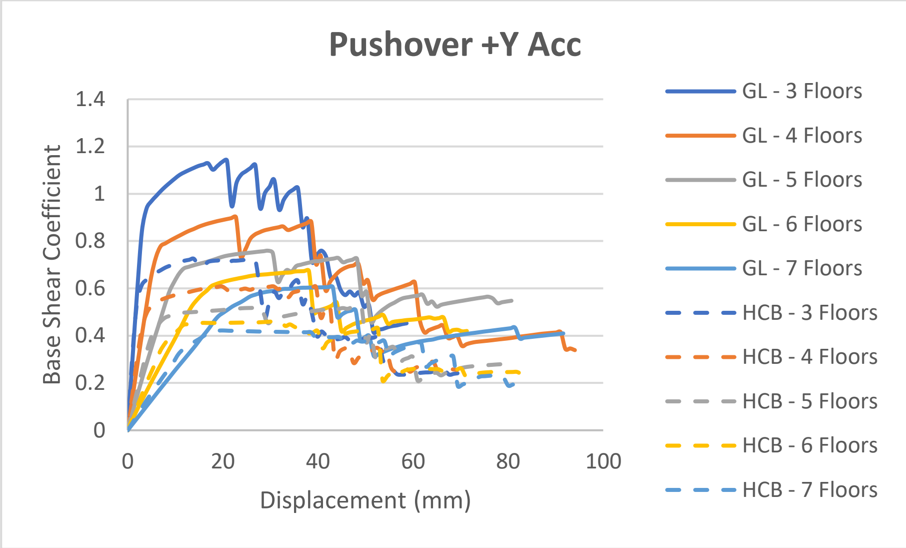


Chart 15: Pushover +Y Acc Curves for a two-unit structure

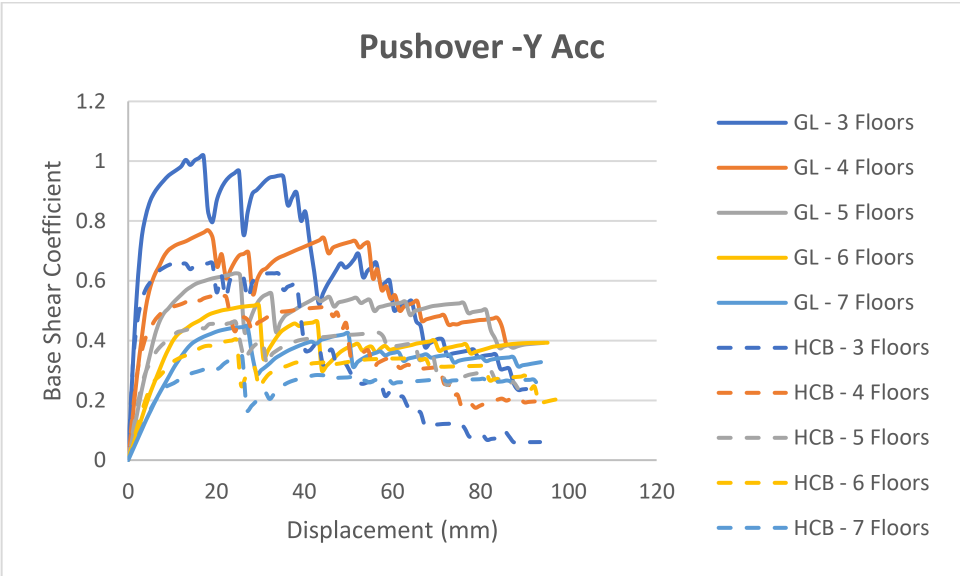


Chart 16: ChaPushover -Y Acc Curves for a two-unit structure

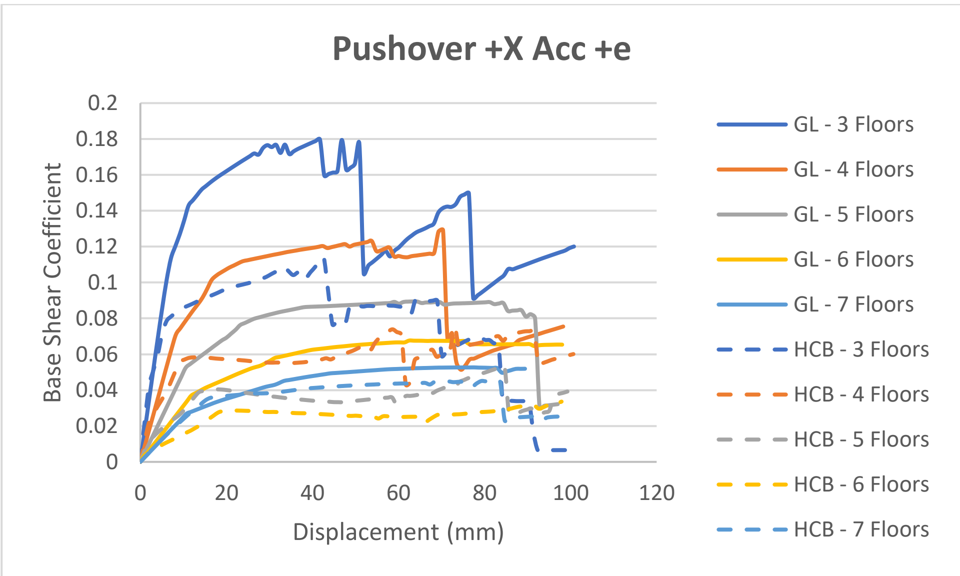


Chart 17: Pushover +X Acc +e Curves for a two-unit structure

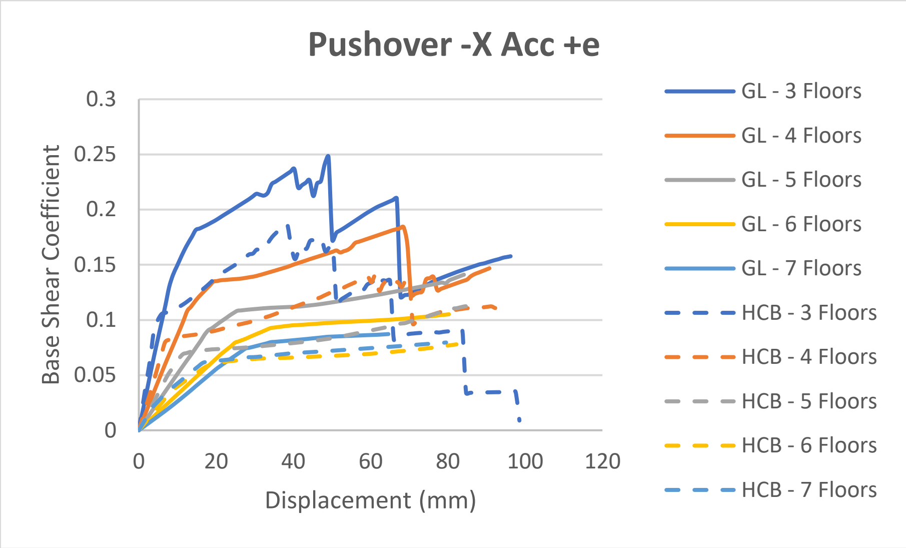


Chart 18: Pushover -X Acc +e Curves for a two-unit structure

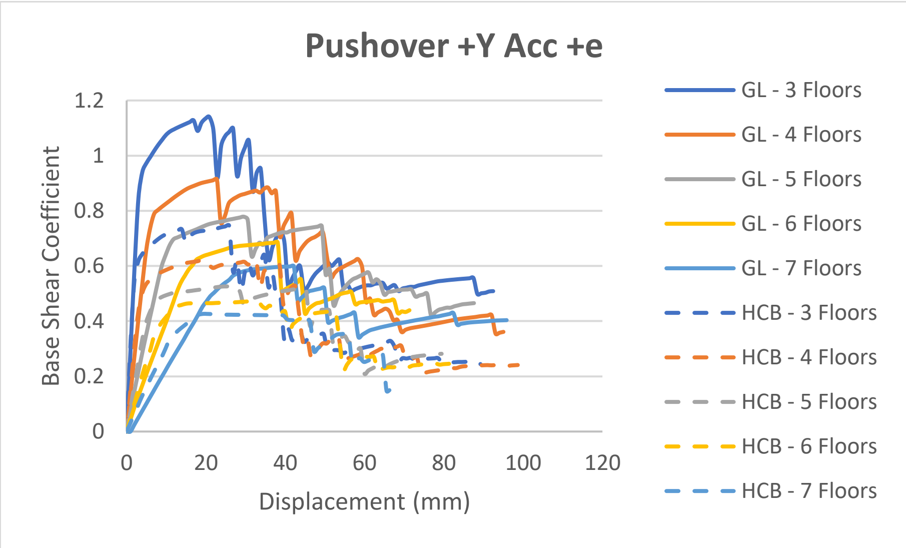


Chart 19: Pushover +Y Acc +e Curves for a two-unit structure

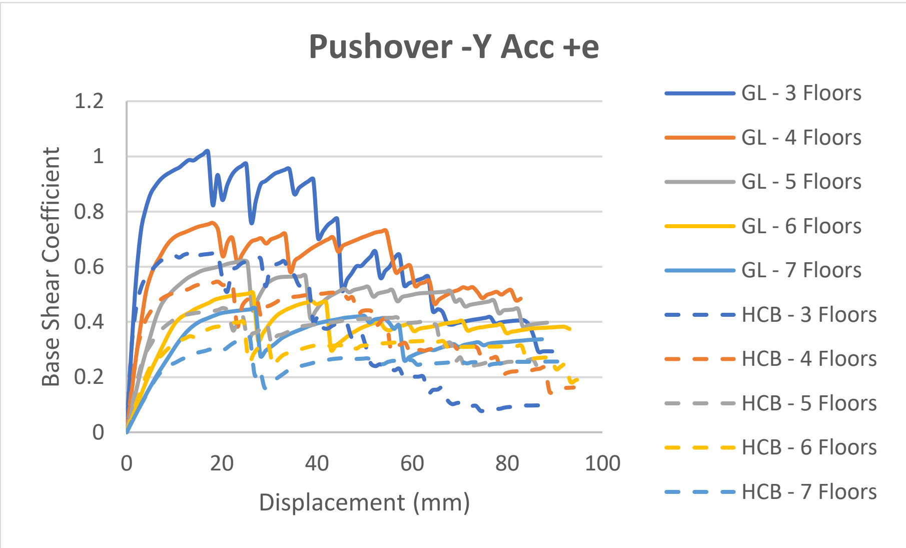


Chart 20: Pushover -Y Acc +e Curves for a two-unit structure

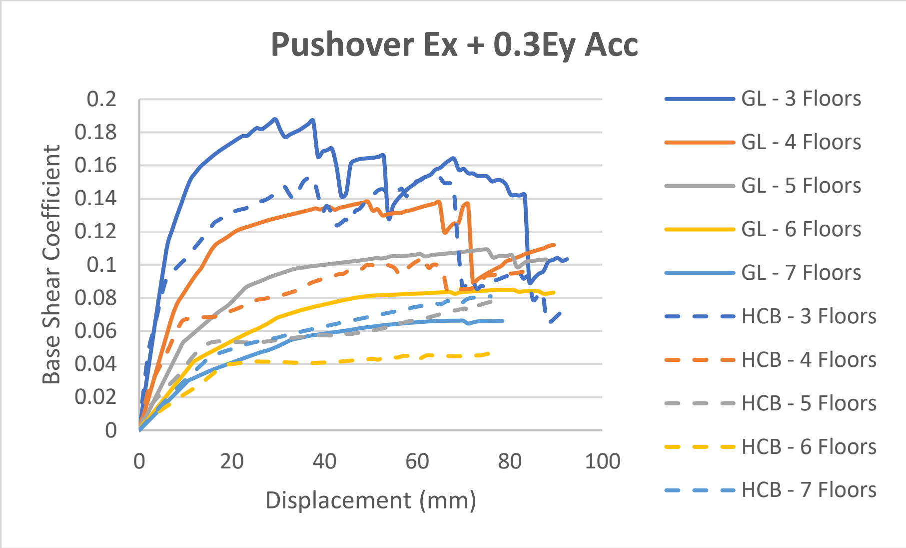


Chart 21: Pushover Ex +0.3Ey Acc Curves for a two-unit structure

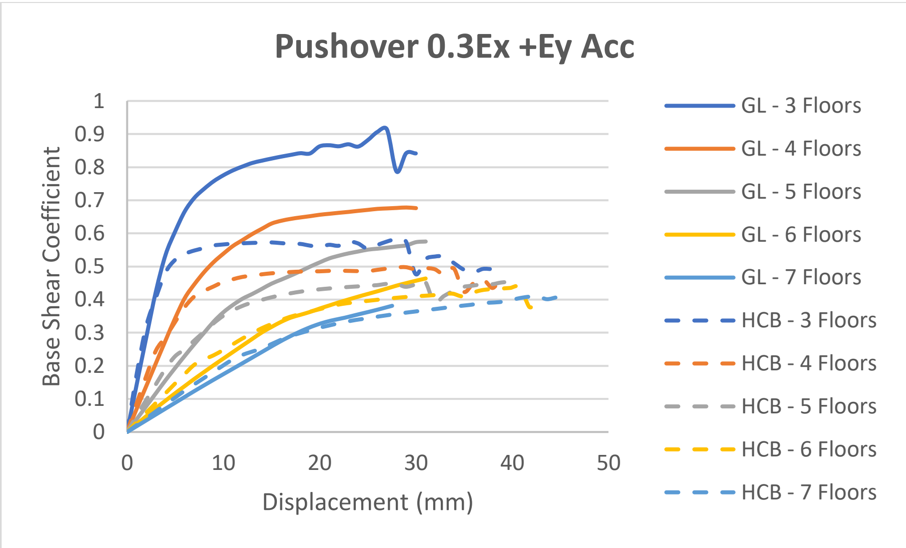


Chart 22: Pushover 0.3Ex +Ey Acc Curves for a two-unit structure

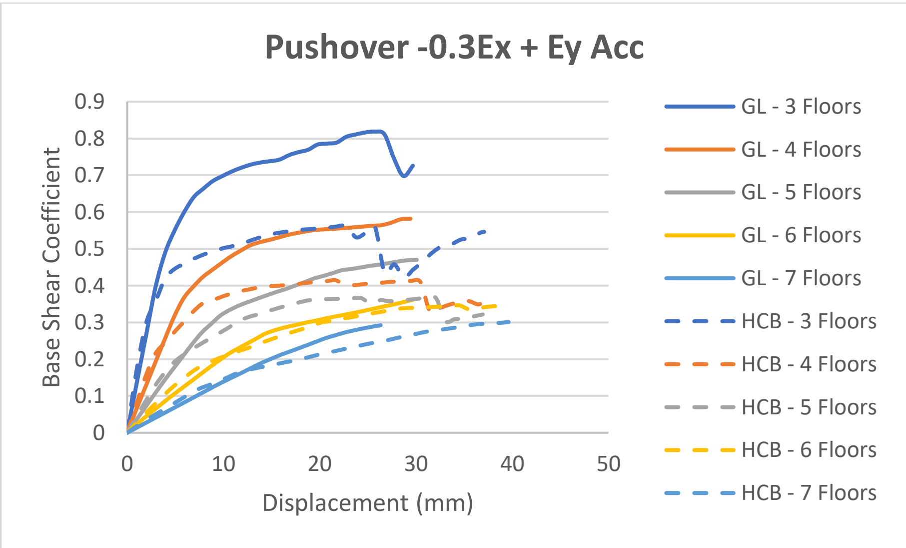


Chart 23: Pushover -0.3Ex +Ey Acc Curves for a two-unit structure

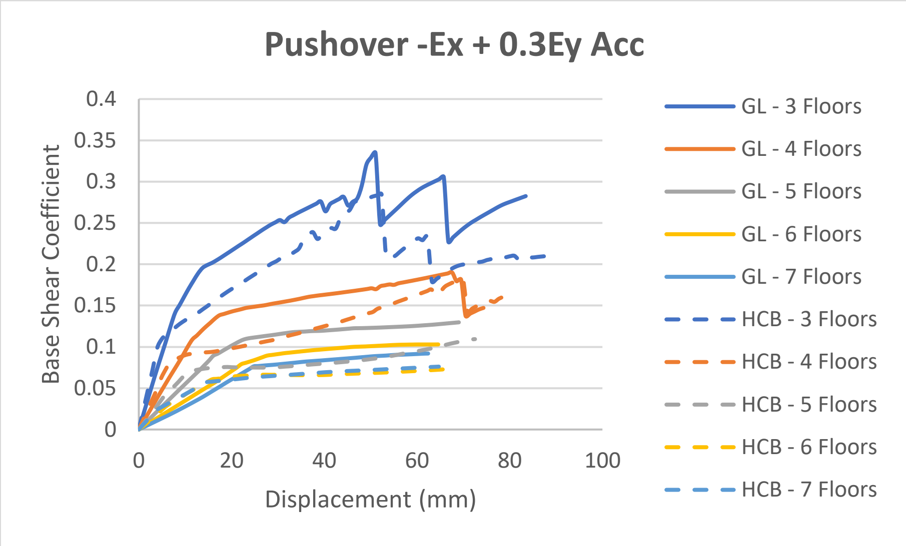


Chart 24: Pushover -Ex +0.3Ey Acc Curves for a two-unit structure

5.3.3 Pushover Analysis Curves for the 3-Unit Aggregate

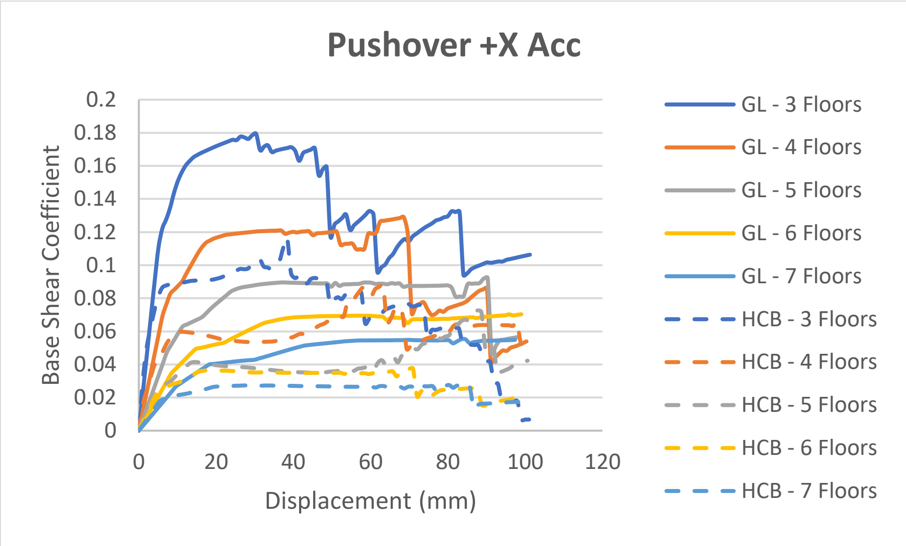


Chart 25: Pushover +X Acc Curves for a three-unit structure

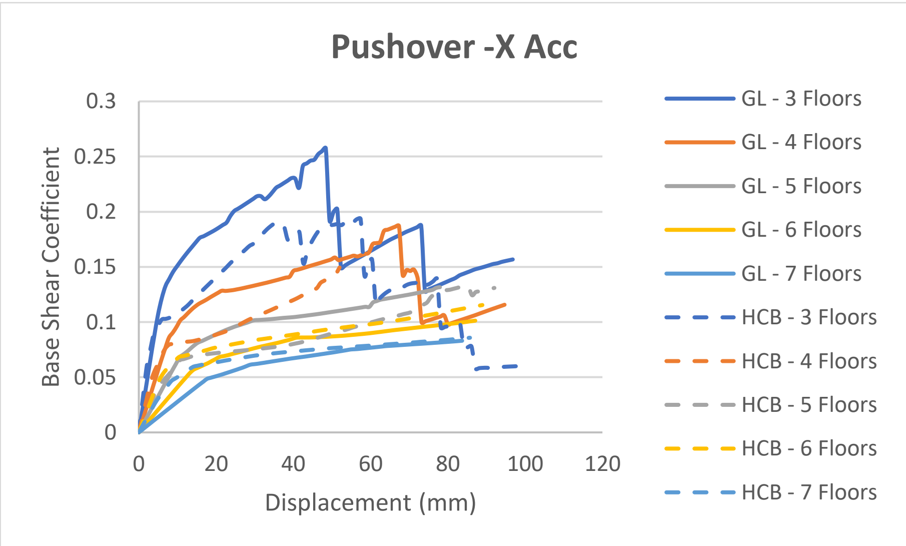


Chart 26: Pushover -X Acc Curves for a three-unit structure

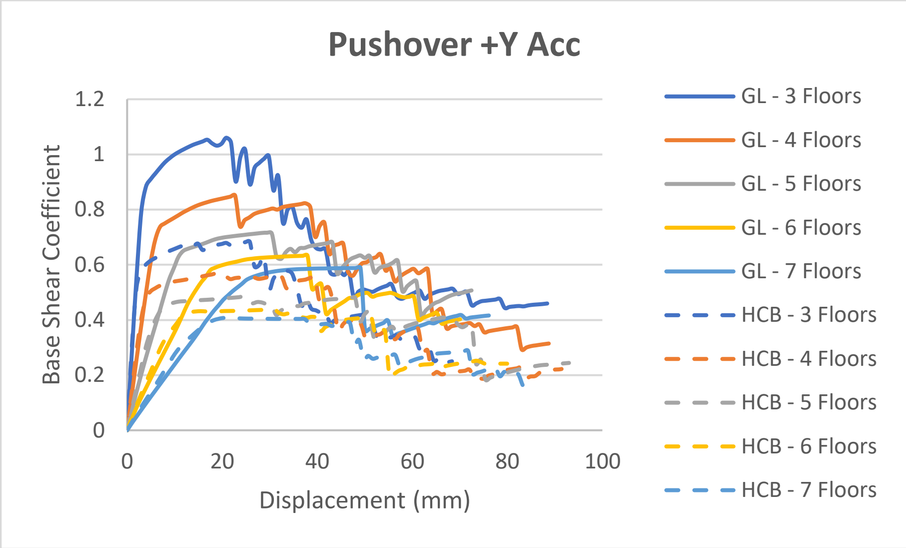


Chart 27: Pushover +Y Acc Curves for a three-unit structure

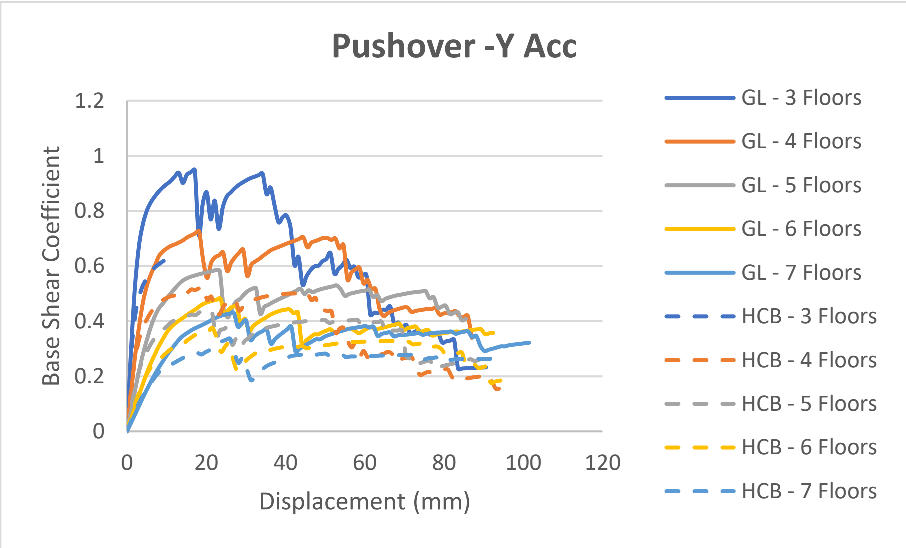


Chart 28: Pushover -Y Acc Curves for a three-unit structure

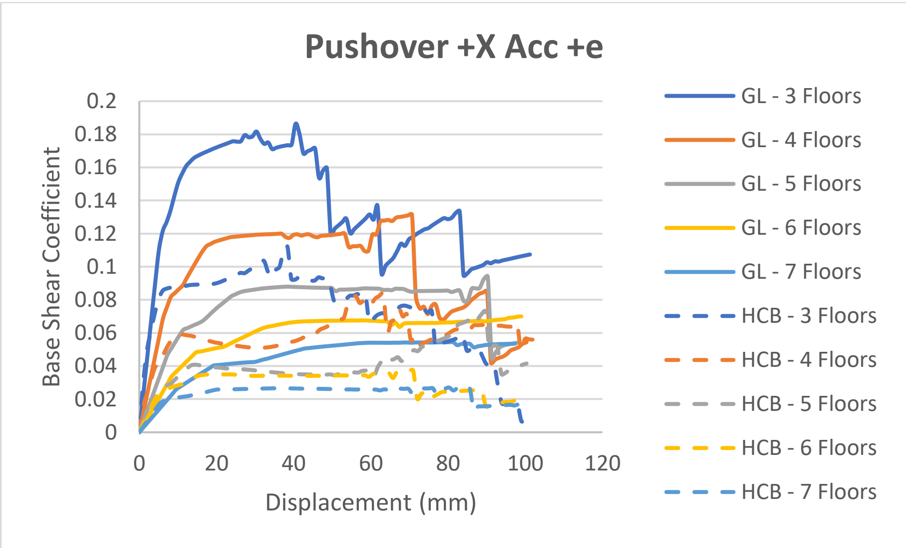


Chart 29: Pushover +X Acc +e Curves for a three-unit structure

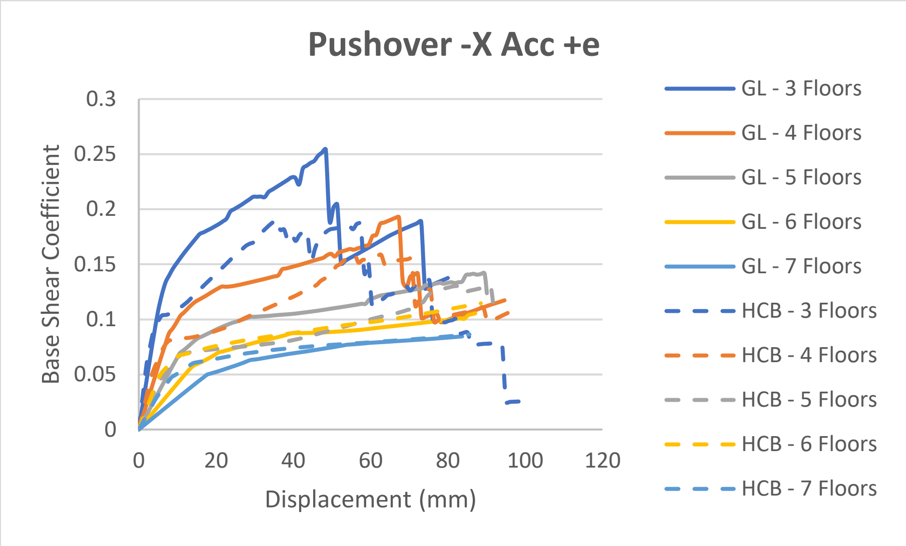


Chart 30: Pushover -X Acc +e Curves for a three-unit structure

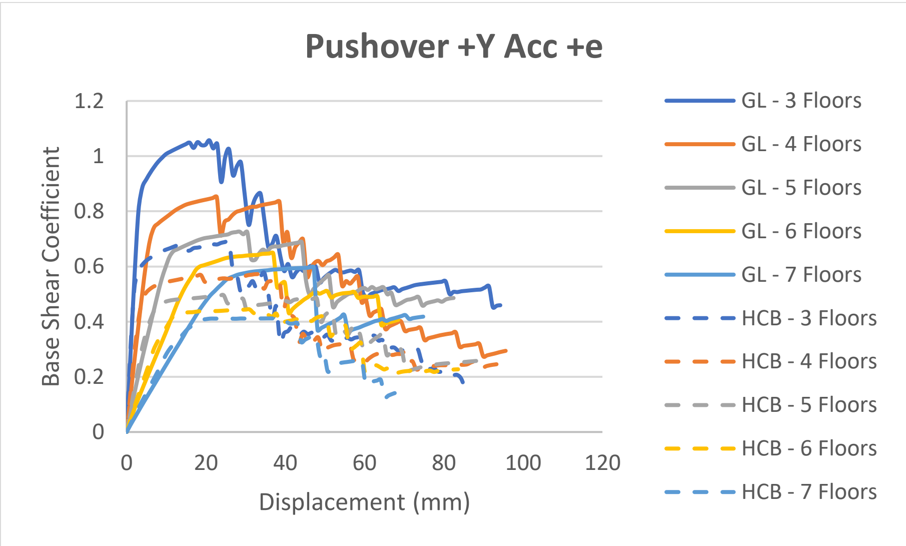


Chart 31: Pushover +Y Acc +e Curves for a three-unit structure

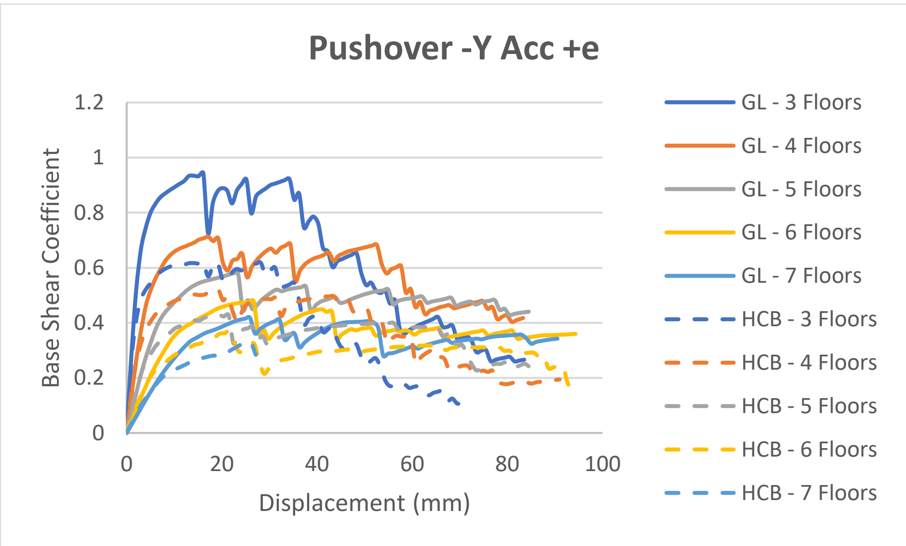


Chart 32: Pushover -Y Acc +e Curves for a three-unit structure

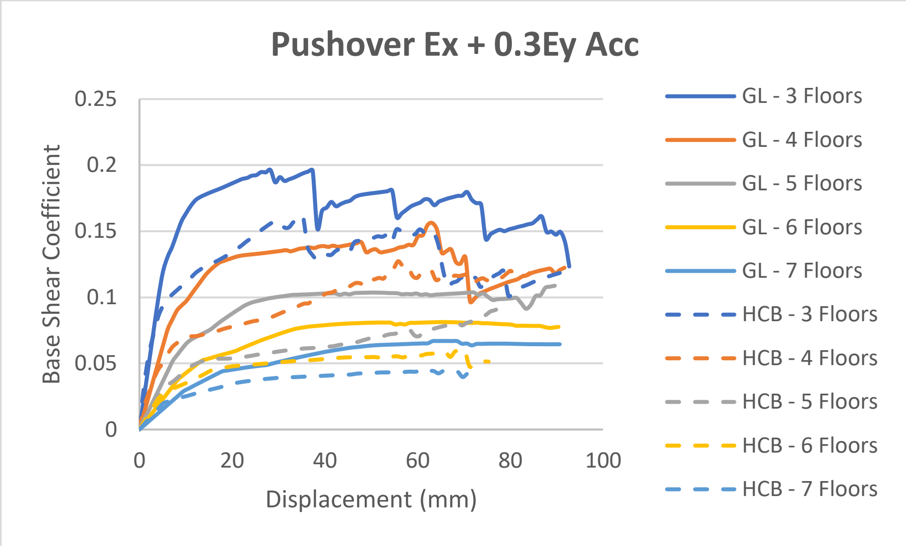


Chart 33: Pushover Ex + 0.3Ey Acc Curves for a three-unit structure

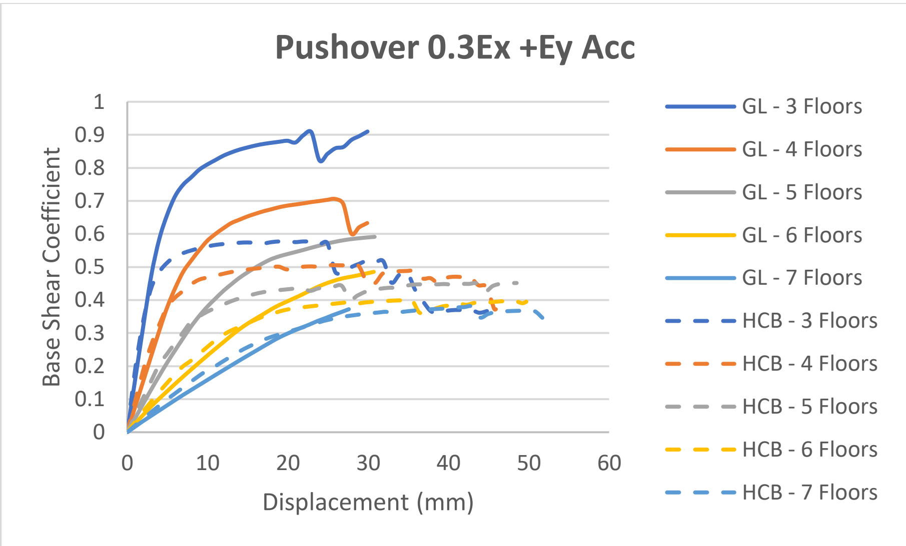


Chart 34: Pushover 0.3Ex + Ey Acc Curves for a three-unit structure

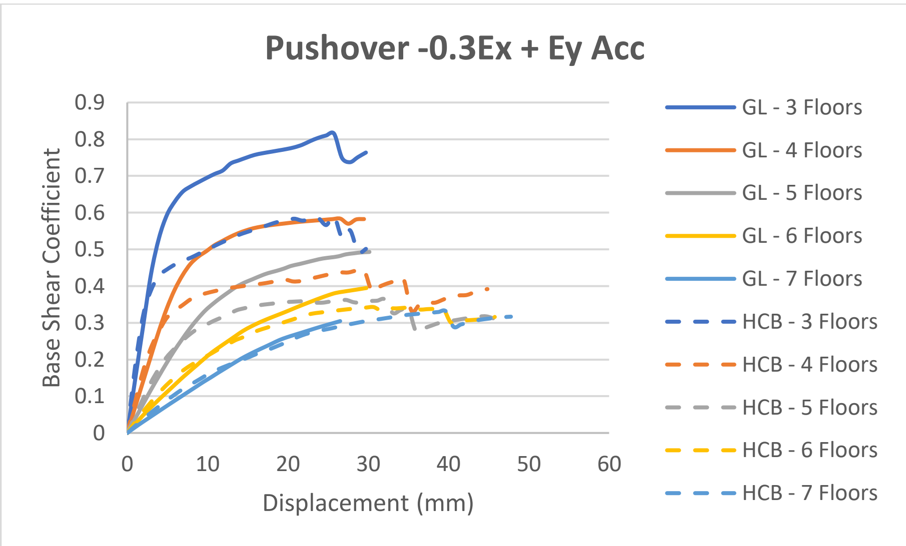


Chart 35: Pushover -0.3Ex + Ey Acc Curves for a three-unit structure

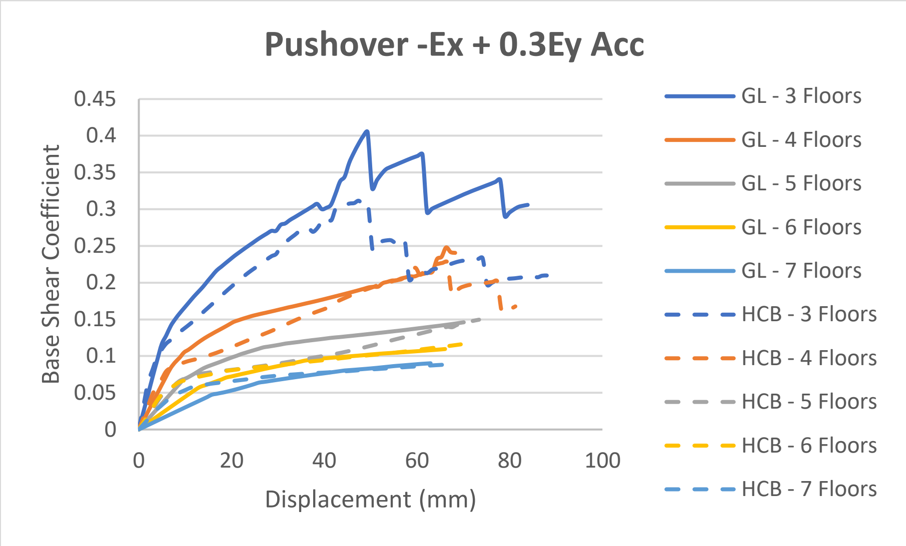


Chart 36: Pushover -Ex + 0.3Ey Acc Curves for a three-unit structure

5.3.4 Pushover Analysis Curves for the 4-Unit Aggregate

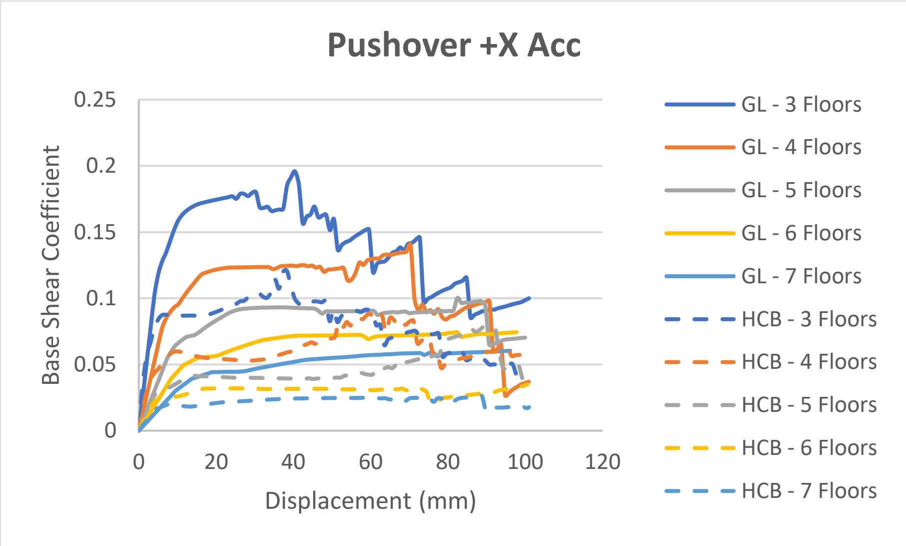


Chart 37: Pushover +X Acc Curves for a four-unit structure

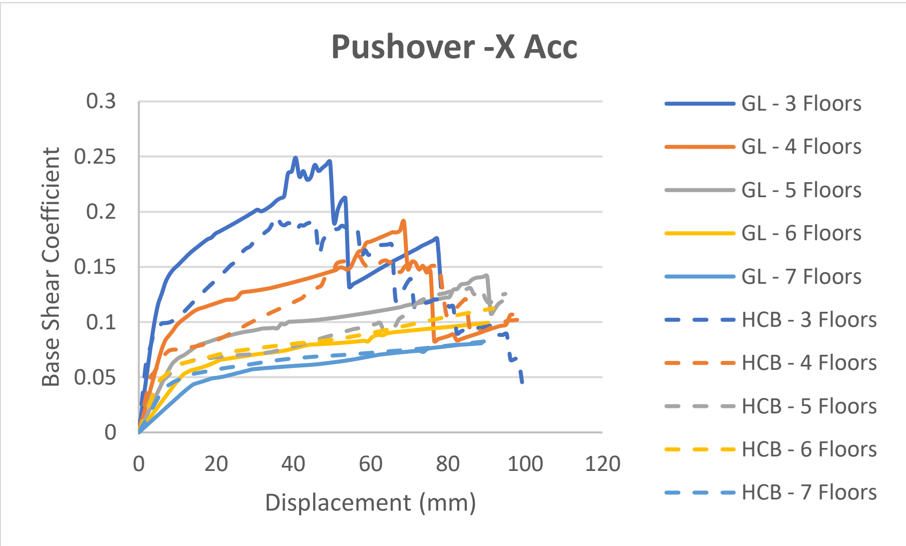


Chart 38: Pushover -X Acc Curves for a four-unit structure

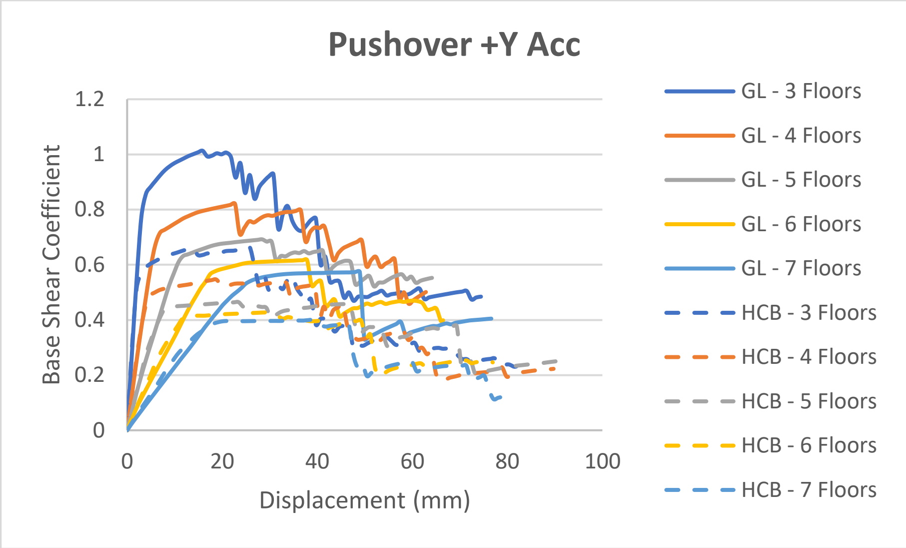


Chart 39: Pushover +Y Acc Curves for a four-unit structure

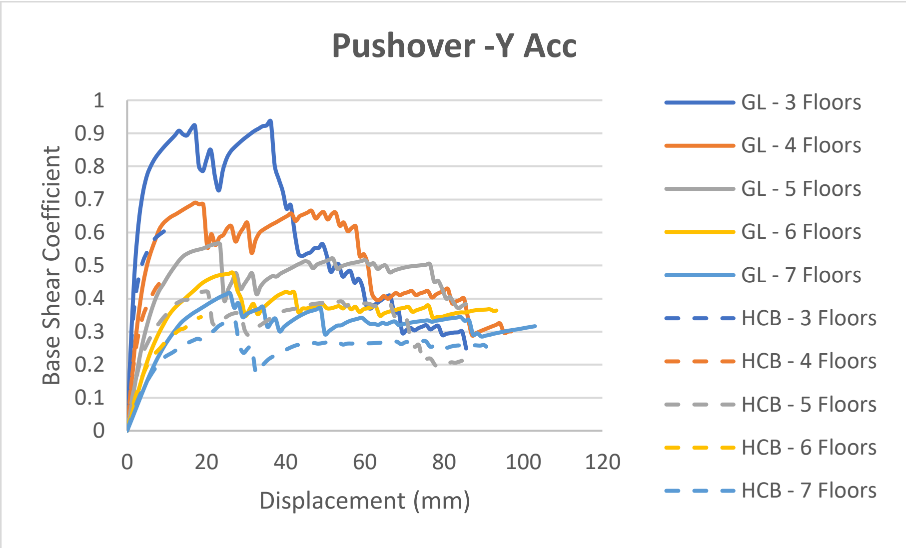


Chart 40: Pushover -Y Acc Curves for a four-unit structure

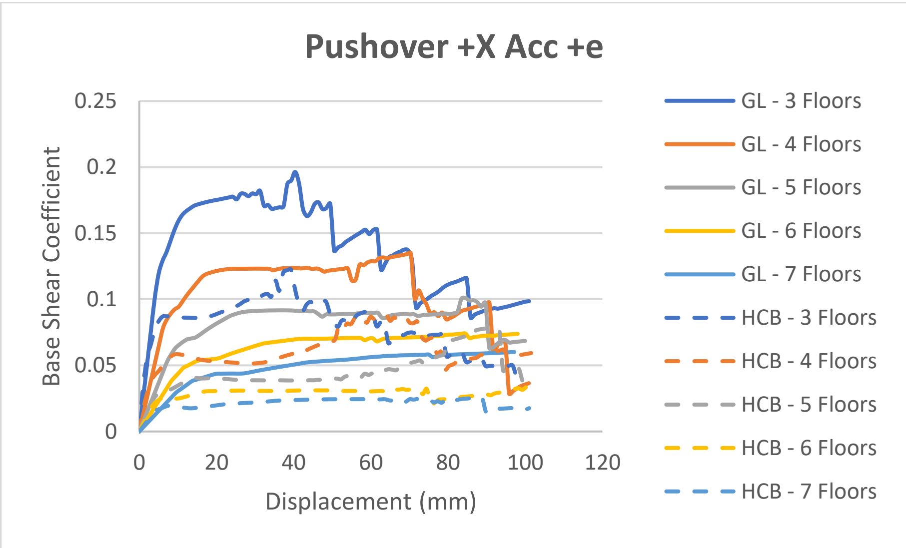


Chart 41: Pushover +X Acc +e Curves for a four-unit structure

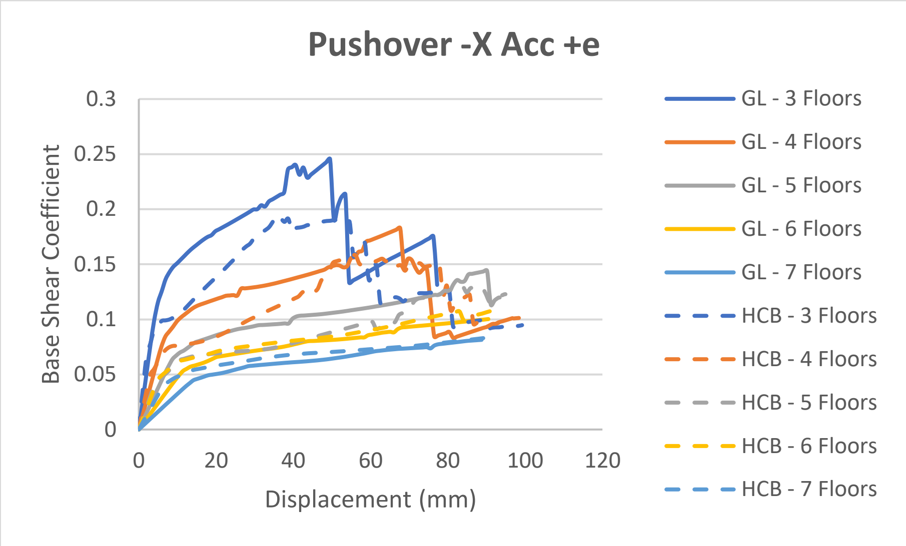


Chart 42: Pushover -X Acc +e Curves for a four-unit structure

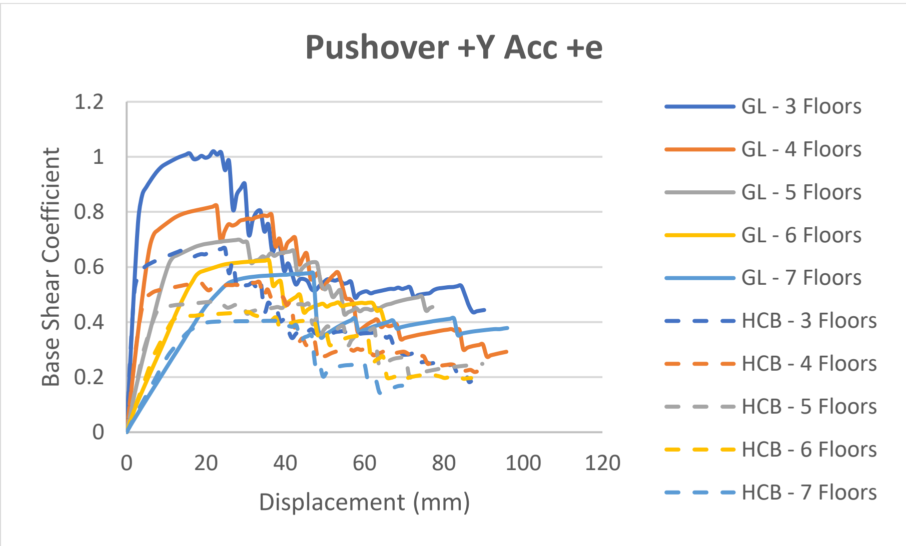


Chart 43: Pushover +Y Acc +e Curves for a four-unit structure

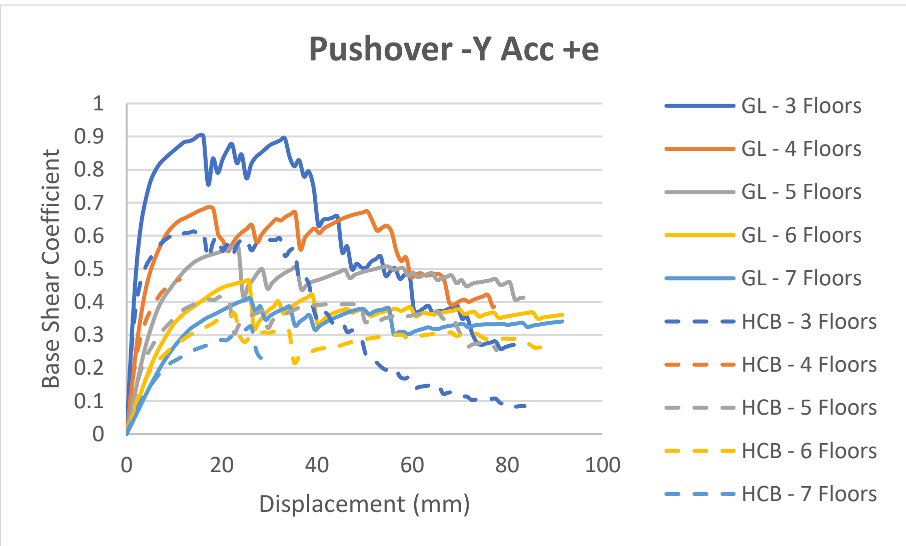


Chart 44: Pushover -Y Acc +e Curves for a four-unit structure

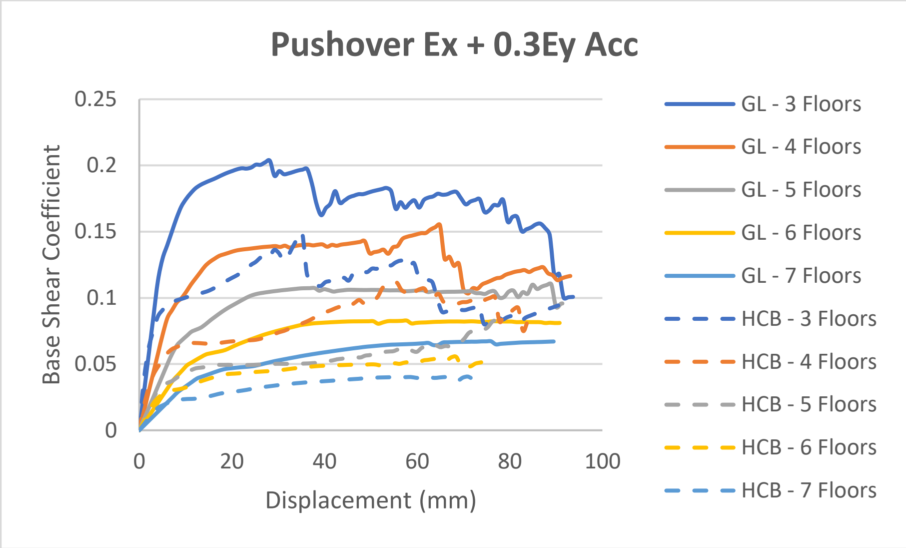


Chart 45: Pushover Ex + 0.3Ey Acc Curves for a four-unit structure

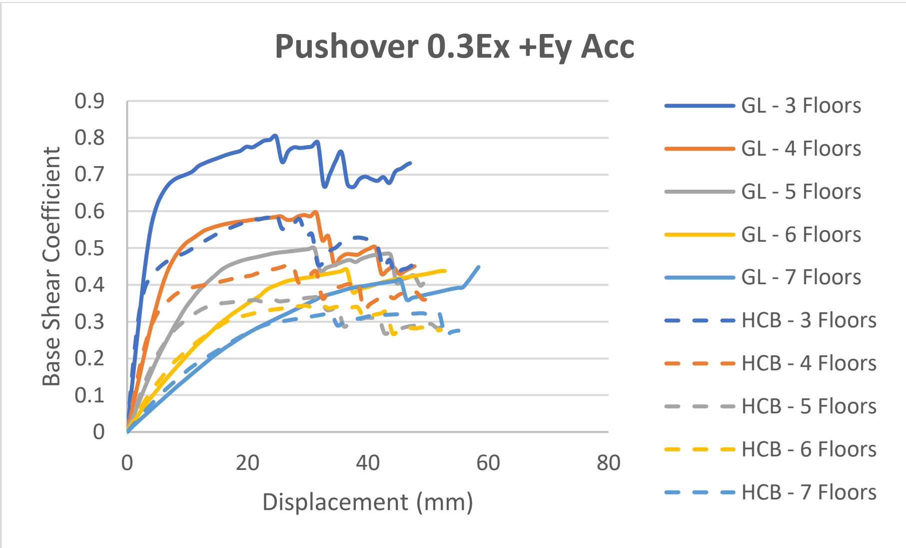


Chart 46: Pushover 0.3Ex + Ey Acc Curves for a four-unit structure

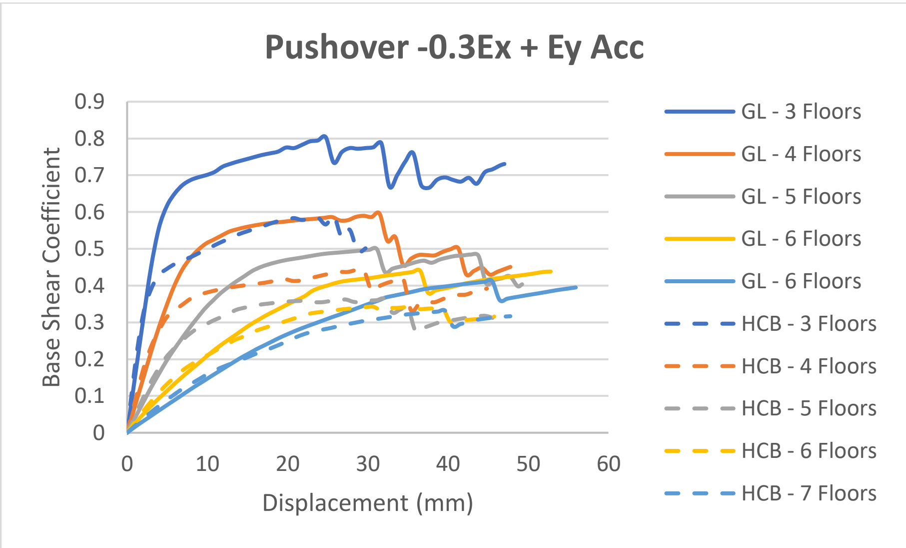


Chart 47: Pushover -0.3Ex + Ey Acc Curves for a four-unit structure

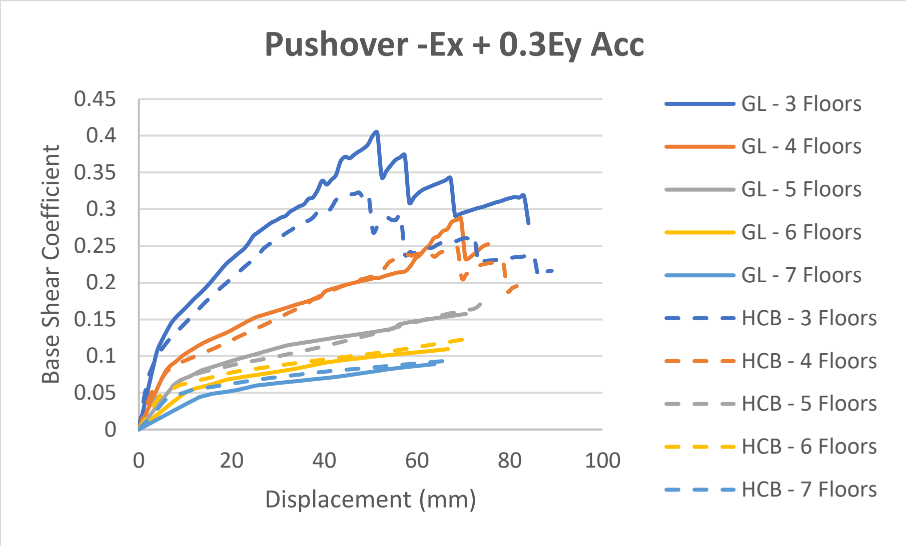


Chart 48: Pushover- Ex + 0.3Ey Acc Curves for a four-unit structure

5.4 Observations on the Seismic Analysis Results

In this research study, a comparative analysis of the seismic performance between Globigerina limestone and hollow concrete blockwork (HCB) was conducted through pushover analyses.

5.4.1 Single Unit – Detached URM

The comparative analysis of seismic performance between Globigerina limestone and hollow concrete blockwork (HCB) across different ground types (A: Rock, B: Stiff Clay, C: Weak Clay) and varying numbers of floors (3, 4, 5, 6, and 7) reveals significant differences in structural resilience.

In ground type A, the Globigerina limestone structure failed at 4 floors under the Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc conditions, while passing all other load cases. These failures were most pronounced due to the asymmetrical layout of the basement, where shafts oriented in the +ve X-direction induced compression during lateral earthquakes in that direction. In contrast, earthquakes in the –ve X-direction induced tension, leading to premature failure. The HCB structure, however, demonstrated better resilience, enduring up to 6 floors before failing under similar conditions. It's noteworthy that both Globigerina limestone and Hollow Concrete Blocks (HCB) exhibited their highest safety factors in the Pushover+Y Acc and Pushover-Y Acc load cases.

In ground type B, both materials exhibited decreased performance. The Globigerina limestone structure failed at 3 floors under Pushover-X Acc and Pushover-X Acc + e conditions, passing all others.

Conversely, the HCB structure failed at 4 floors under Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc conditions but succeeded in other load cases.

For ground type C, the weakest soil condition tested, the Globigerina limestone structure again failed at 3 floors under Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc conditions. The HCB structure exhibited failure at 3 floors only under the Pushover-Ex+0.3Ey Acc condition, passing all other load cases. These observations suggest that HCB offers superior seismic performance across all conditions.

5.4.2 Two Unit – URM building Aggregate

The analysis of seismic performance for a two-unit aggregate on different ground types reveals notable distinctions between structures made of Globigerina limestone and Hollow Concrete Blocks (HCB). On ground type A, both materials failed at 6 floors. The Globigerina limestone structure failed under the Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc load cases, while the HCB structure failed only under Pushover-X Acc, indicating a slightly better performance for HCB in these conditions. For ground type B, the Globigerina limestone structure failed at 4 floors under the same three load cases, whereas the HCB structure managed to sustain up to 5 floors before failing under Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc load cases, again showcasing HCB's superior resilience. Finally, on ground type C, the Globigerina limestone structure failed at 3 floors under Pushover-Ex+0.3Ey Acc, while the HCB structure failed at 3 floors under all three load cases (Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc), indicating that while both materials perform poorly on weak clay, Globigerina limestone exhibited marginally better resilience under these specific conditions.

5.4.3 Three Unit – URM building Aggregate

The seismic performance analysis for a three-unit aggregate indicates distinct differences in the resilience of structures made from Globigerina limestone and Hollow Concrete Blocks (HCB) across various ground types. On ground type A, the Globigerina limestone structure failed at 5 floors under the Pushover-Ex+0.3Ey Acc load case, while the HCB structure exhibited no failures up to 7 floors, demonstrating significantly better seismic performance. For ground type B, the Globigerina limestone structure failed at 4 floors under Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc load cases. In contrast, the HCB structure failed at 3 floors under the Pushover-X Acc load case, indicating a slightly lower resilience in this condition. On ground type C, both the Globigerina limestone and HCB structures failed at 3 floors in half of the load cases, specifically those in the x-direction, suggesting similar vulnerabilities under weak soil conditions. These observations highlight that while HCB generally offers superior seismic performance, particularly on rock, it exhibits comparable weaknesses to Globigerina limestone on weak clay.

5.4.4 Four Unit – URM building Aggregate

The seismic performance analysis for a four-unit aggregate highlights varying levels of resilience between structures made from Globigerina limestone and Hollow Concrete Blocks (HCB) across different ground types. On ground type A (rock), the Globigerina limestone structure failed at 6 floors under the Pushover-X Acc, Pushover-X Acc + e, and Pushover-Ex+0.3Ey Acc load cases. The HCB structure, however, failed at 5 floors under Pushover+X Acc and Pushover+X Acc + e load cases. Notably, there is an anomaly in the HCB results for the four-unit building aggregate, showing weaker safety factors for 5 floors than for 6 floors under the same load cases. Despite the three-unit aggregate not failing up to 7 floors, the four-unit aggregate fails at 5 floors. This suggests that the 5 floors should have theoretically survived the earthquake event with α-values greater than 1. Further investigation is necessary to examine this anomaly, likely due to the convergence criteria used in the 3D Macro analysis for this specific case.

In ground type B (stiff clay), the Globigerina limestone structure failed at 4 floors under Pushover-X Acc and Pushover-Ex+0.3Ey Acc load cases, while the HCB structure failed at 3 floors under Pushover-X Acc and Pushover-X Acc + e load cases. For ground type C, the Globigerina limestone structure failed at 3 floors under the Pushover-Ex+0.3Ey Acc load case. Similarly, the HCB structure failed at 3 floors in half of the load cases, specifically those in the x-direction. These observations indicate that while Globigerina limestone generally offers superior seismic performance on rock, it shares similar vulnerabilities with HCB under weak soil conditions.

Chapter 6: Conclusions and Recommendations for Future Research Work

6.1 Conclusions

Several important findings may be made from the testing of models constructed with hollow concrete blockwork (HCB) and Globigerina limestone applied to seismically loaded unreinforced masonry (URM) building types utilising non-linear static pushover analysis with 3D Macro:

- HCB structures outperform Globigerina limestone structures because they have higher resilience (can withstand more floors), better y factors (higher α-values), and ductility failure modes (slower decline after peak resistance, making them more reliable during earthquakes across a variety of seismic conditions and ground types.
- Structures made from Globigerina limestone exhibit lower safety factors, especially under challenging conditions like weak clay soil.
- Comparative analysis revealed that HCB structures can support more floors before failure compared to Globigerina limestone structures because they have higher ductility, attract less seismic force, and show a slower reduction in strength after rear load capacity, allowing for better performance in taller buildings under seismic conditions.
- Structures built on rock (Ground Type A) demonstrated the best performance, with higher safety factors across both materials. Performance decreased on stiffer clay (Ground Type B) and was lowest on weak clay (Ground Type C), highlighting the significant impact of ground type on structural integrity.
- Both materials achieved their highest safety factors in certain load cases (Pushover+Y Acc and Pushover-Y Acc), but HCB consistently showed better resilience across more challenging seismic load cases.
- Failures were most pronounced due to the asymmetrical layout of the basement, where shafts oriented in the positive X-direction induced compression during lateral earthquakes in that direction. Conversely, earthquakes in the negative X-direction induced tension, leading to premature failure. This highlights the critical impact of structural configuration on seismic performance, emphasizing the importance of symmetrical design in enhancing structural resilience.

- The analysis of pushover curves for structures utilizing Globigerina limestone bonded with M2 mortar aggregates and HCB bound with M5 mortar aggregates reveals significant differences in their seismic performance. The pushover curves for Globigerina Limestone aggregates consistently lie above those of HCB aggregates for equivalent building aggregate sizes. This indicates that, for the same horizontal sway displacement at the top storey, Globigerina Limestone structures experience higher horizontal base shear forces compared to HCB structures. This higher base shear reflects that Globigerina Limestone aggregates, resist larger forces before achieving the same level of displacement.
- Despite this, the safety factors, suggest that HCB aggregates enable structures to achieve greater building heights than Globigerina Limestone aggregates. This observation might initially seem counterintuitive given the higher pushover curves for Globigerina Limestone structures. However, the underlying reason for this trend is rooted in the differential behaviour of these materials under seismic loads. HCB aggregates attract less horizontal base shear force for the same horizontal sway displacement, which translates to a reduced seismic force demand on the structure. Consequently, structures with HCB aggregates undergo lower stress and strain, allowing for increased height without compromising safety.
- HCB aggregates may contribute to enhanced structural ductility and energy dissipation during seismic events due to their material composition and design features. These properties are critical in mitigating seismic damage and ensuring structural integrity. Therefore, the lower base shear forces associated with HCB aggregates, coupled with their potential for higher ductility, explain why these materials achieve greater safety margins, as reflected by the α-values.

6.2 Recommendations for Further Research Work

URM single building units with a plan aspect ratio of 1:4 in different building aggregate configurations sharing party walls were the subject of this study. To comprehend the elements impacting URM building aggregates' seismic vulnerability, more investigation is recommended. The subsequent research endeavours are suggested:

- This study used M2 type mortar for Globigerina limestone URM structures to reflect typical construction practices and M5 mortar for HCB URM structures following EN1998-1-1(9.2.3) (considering HCB's lower compressive strength compared to Globigerina Limestone). Since mortar strength significantly affects the seismic resistance of URM buildings, it is recommended to reanalyse the same building aggregate configurations with different mortar strengths. This will provide insights into how varying mortar strengths impact structural performance during seismic events.
- An anomaly was observed in the HCB results for the 4-unit building aggregate, which fails for 5 floors and 7 floors but shows better performance for 6 floors. Further investigation is necessary to understand this anomaly, which is likely due to the convergence criteria used in 3D Macro for this particular case.
- This research studied up to 4-unit aggregates. Future research should investigate larger aggregates to see how the patterns and trends continue and develop. This will help determine the scalability of the current findings.
- Specifically for larger aggregates, future studies should explore increasing the number of floors. Seismic performance tends to improve with larger unit aggregates, as seen in the 3-unit aggregate where no failures were recorded up to 7 floors. Examining higher floors will help in understanding the limits and potential of URM structures under seismic loads.
- Further research should examine the impact of structural symmetry on seismic performance in more detail. Since asymmetrical layouts have shown to significantly affect the seismic resilience, investigating various symmetrical and asymmetrical designs will provide valuable insights into enhancing structural resilience.

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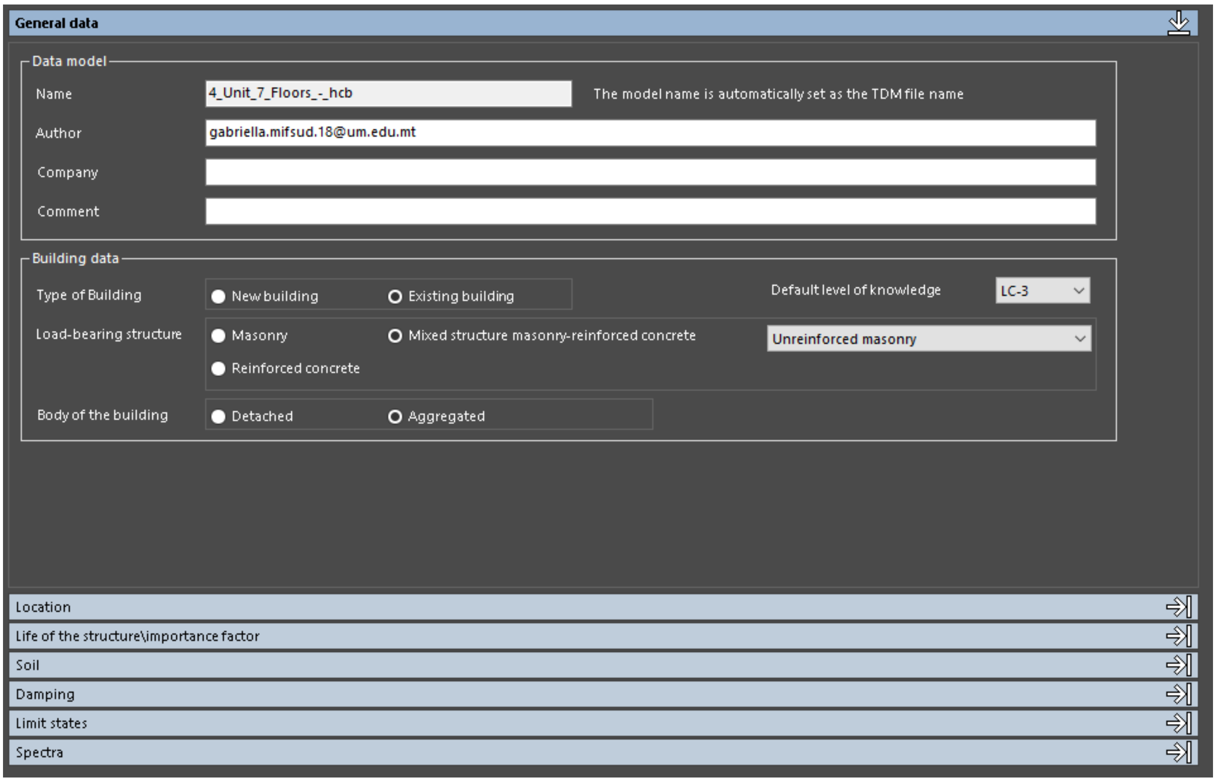
Appendices

Appendix A.1

3D Macro – General Settings



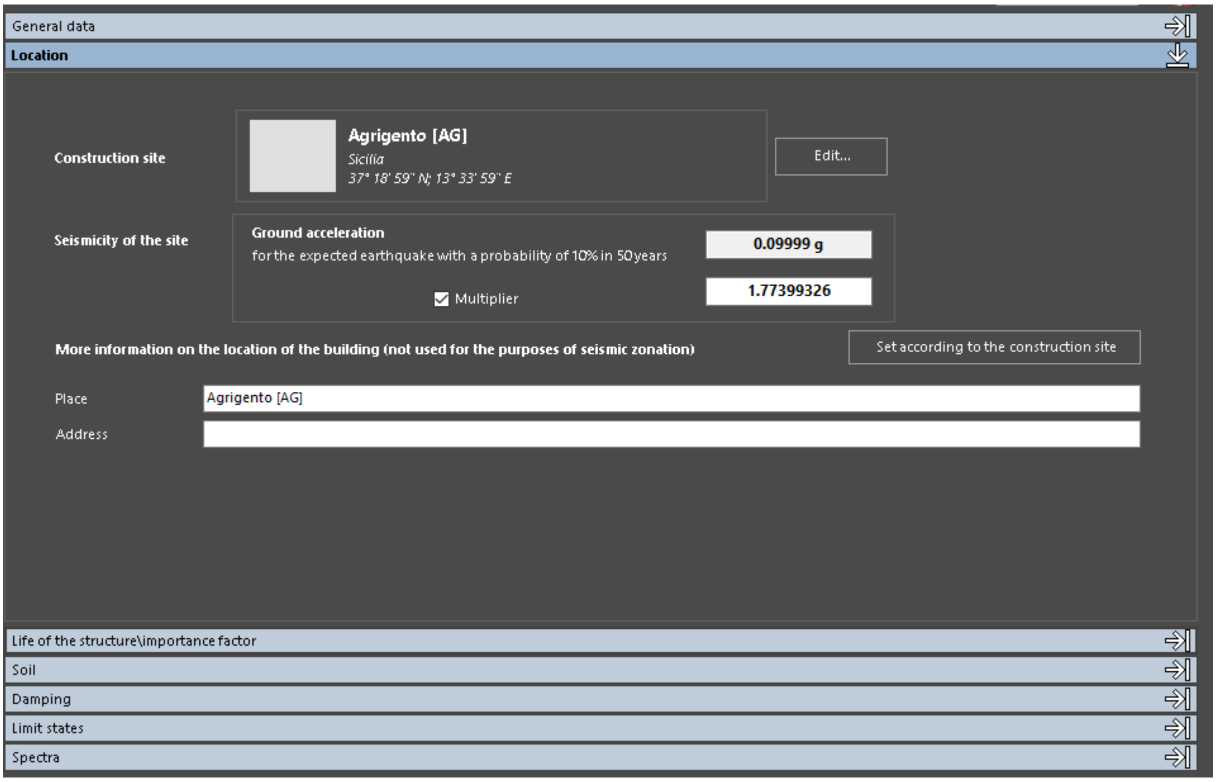
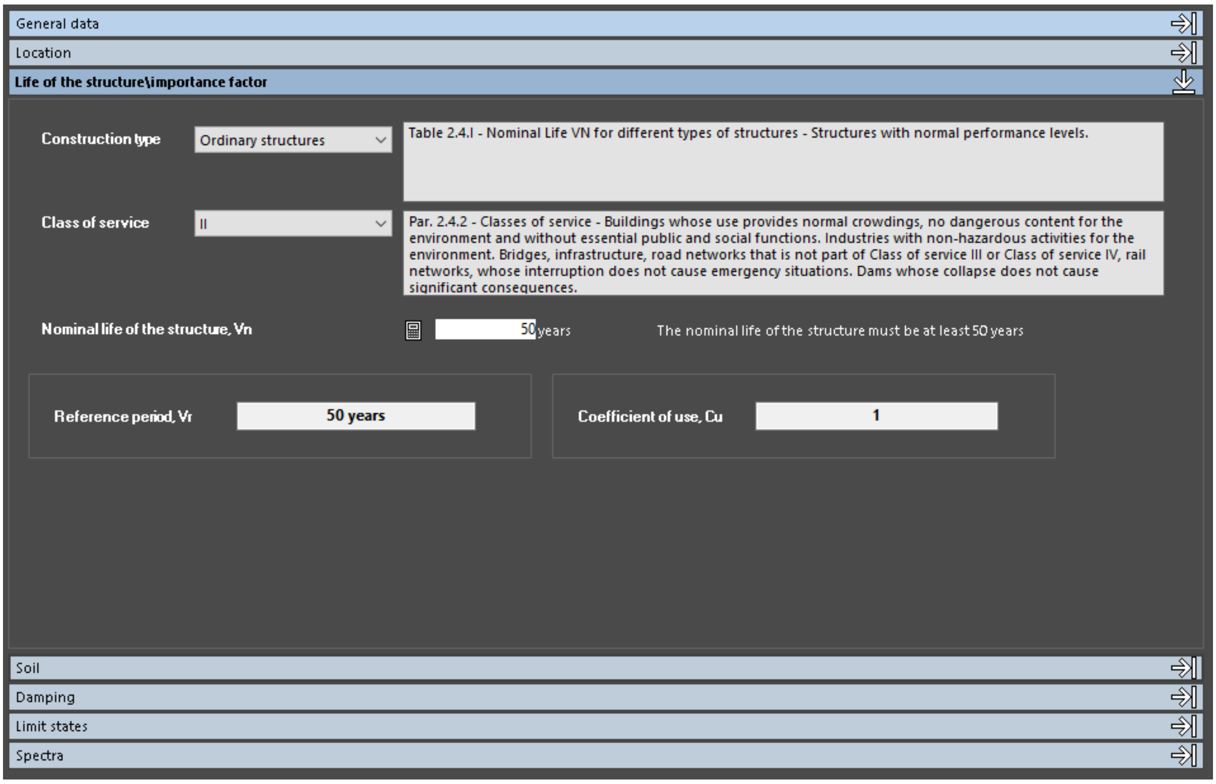


Figure 27: Captured images showcasing the complete set of general settings implemented for AGs pushover analysis during the entirety of this investigation.



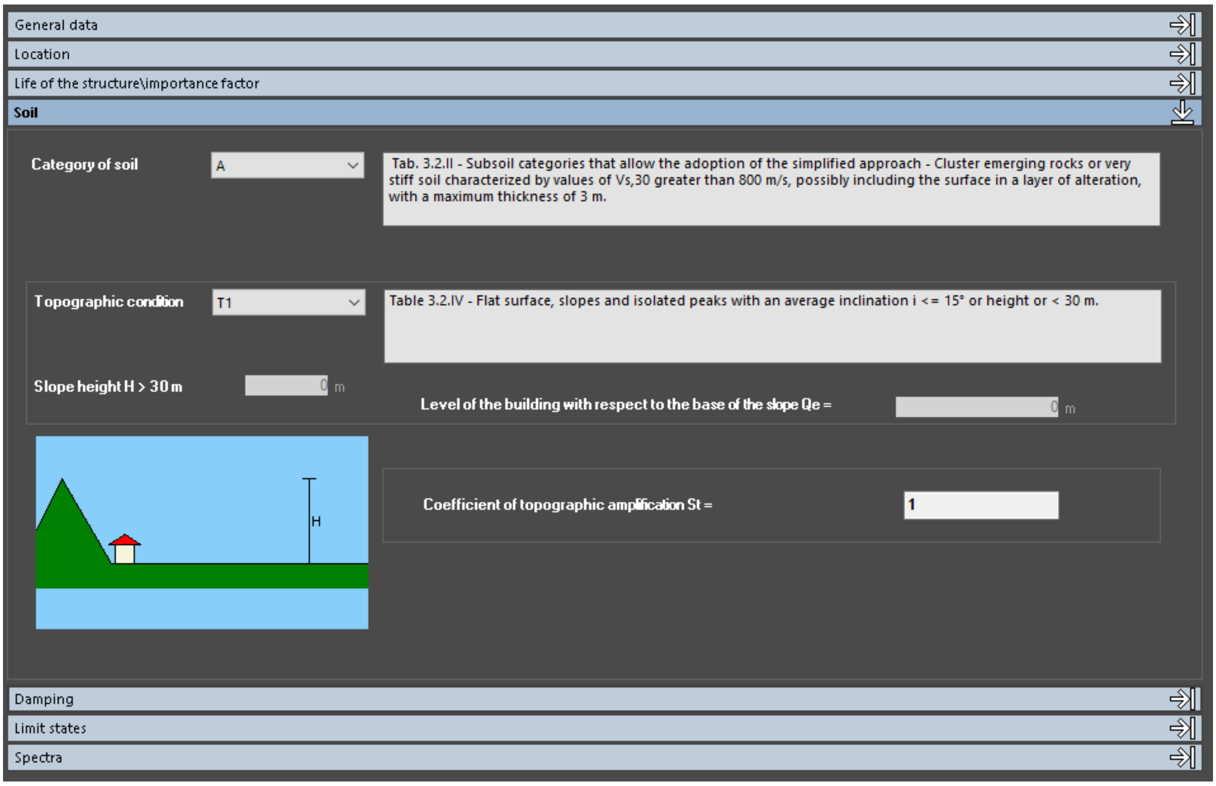
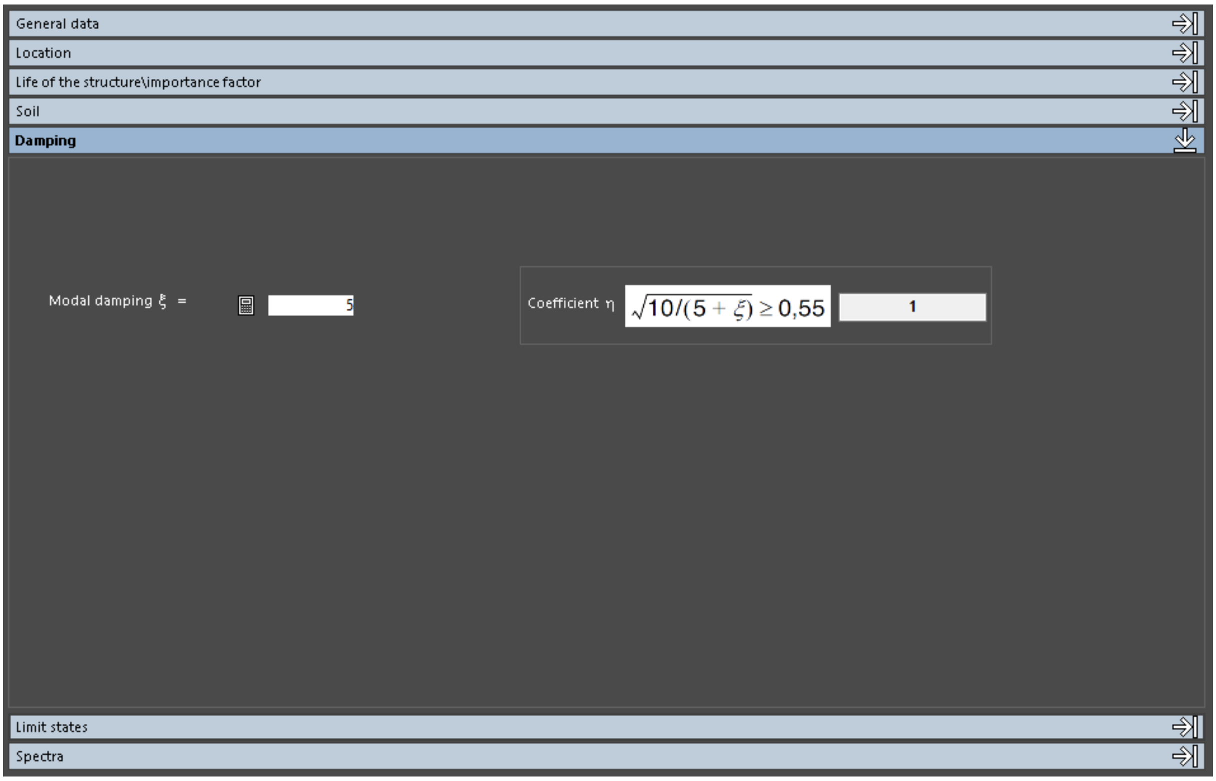


Figure 28: Captured images showcasing the complete set of general settings implemented for AGs pushover analysis during the entirety of this investigation.



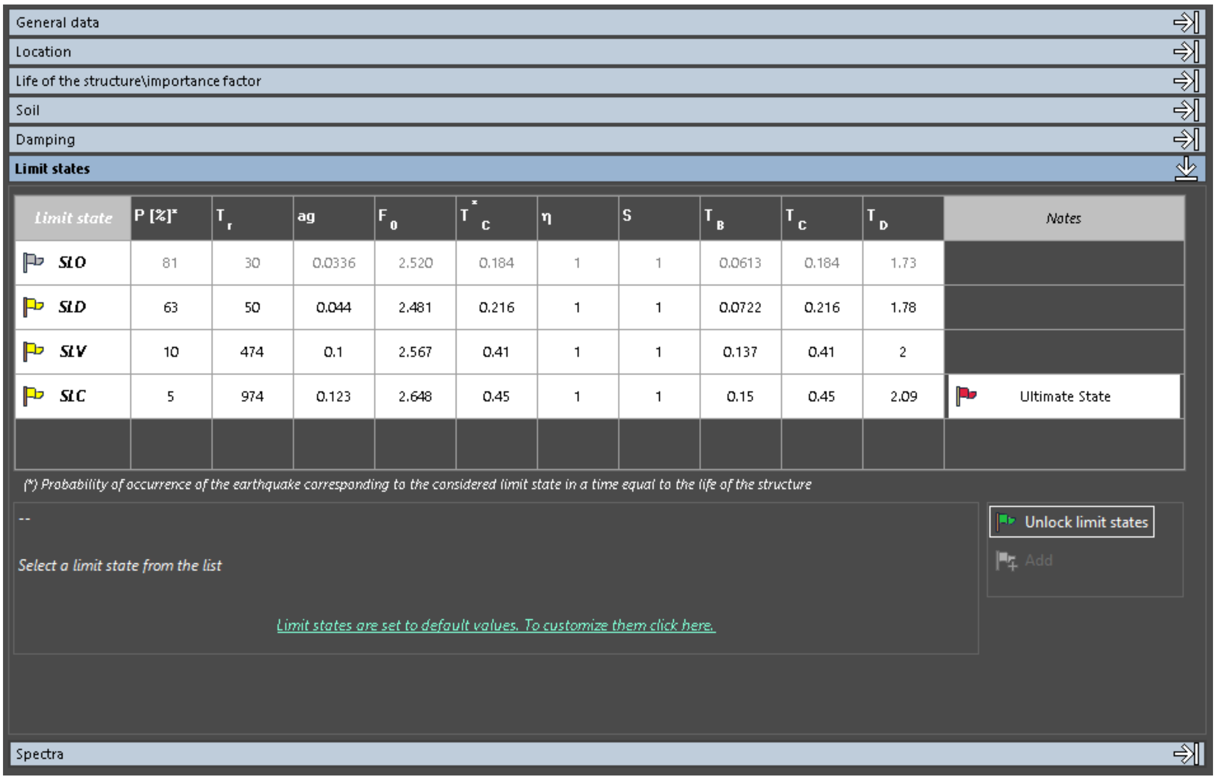


Figure 29: Captured images showcasing the complete set of general settings implemented for AGs pushover analysis during the entirety of this investigation.

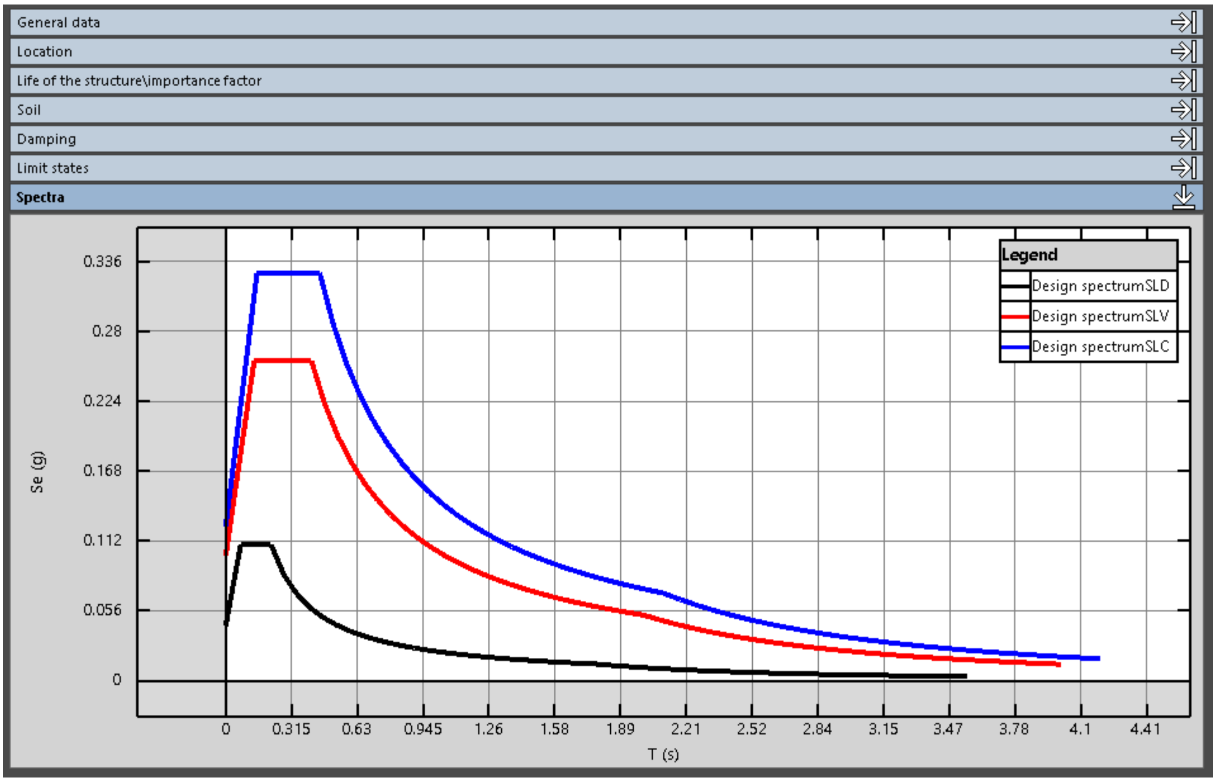


Figure 30: Captured images showcasing the complete set of general settings implemented for AGs pushover analysis during the entirety of this investigation.

Appendix A.2

3D Macro – Section Design

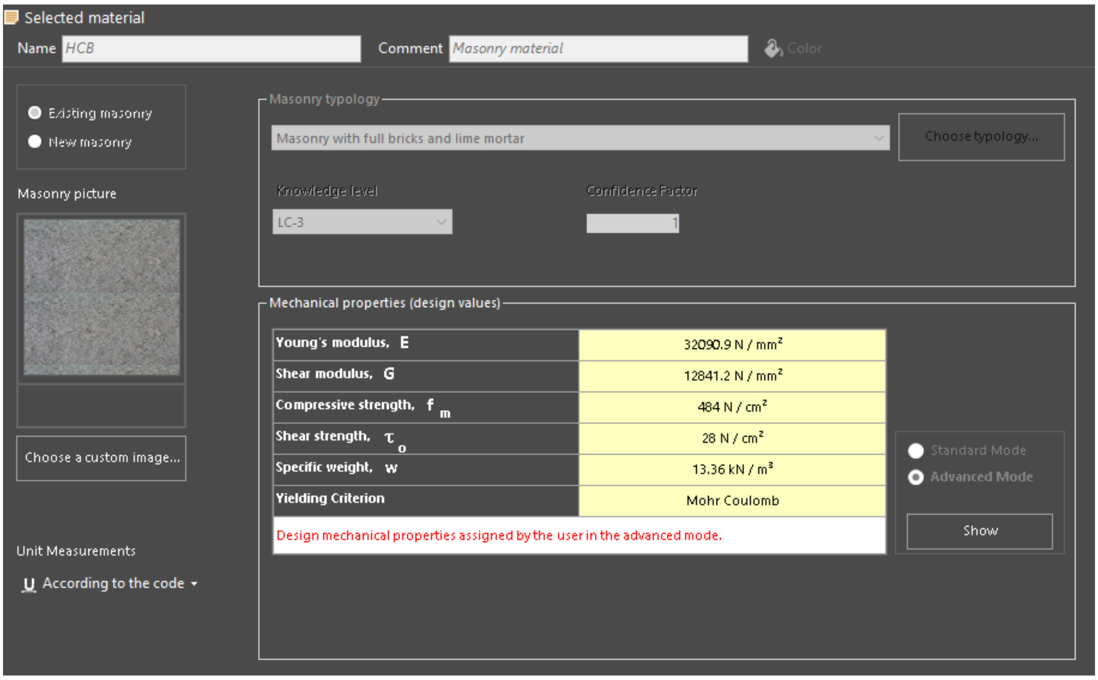
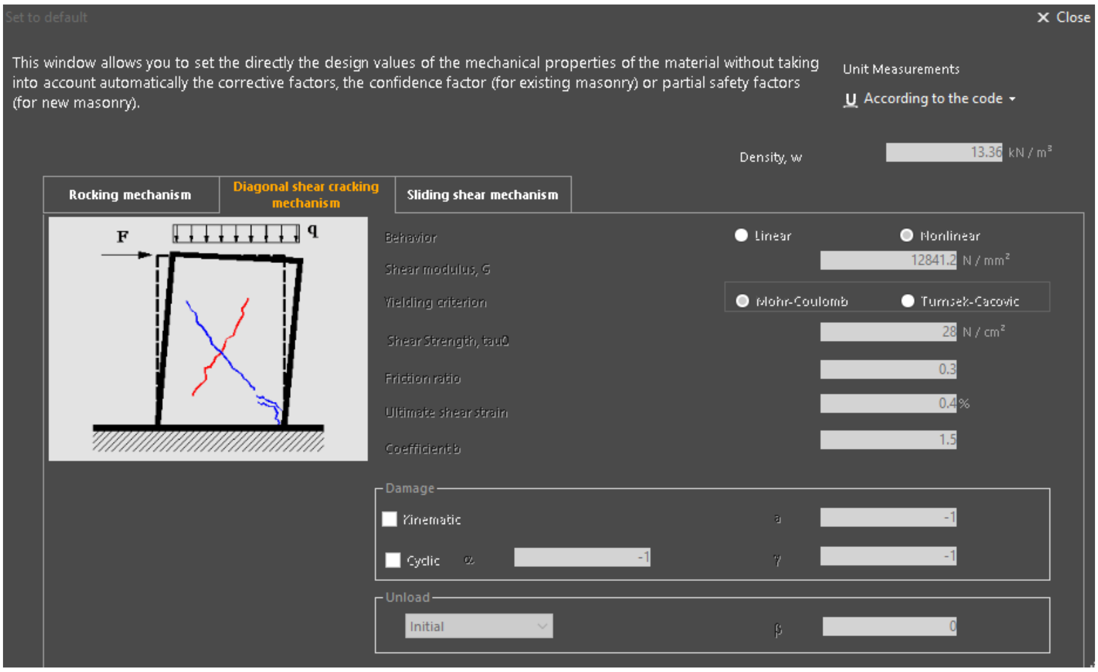


Figure 31: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



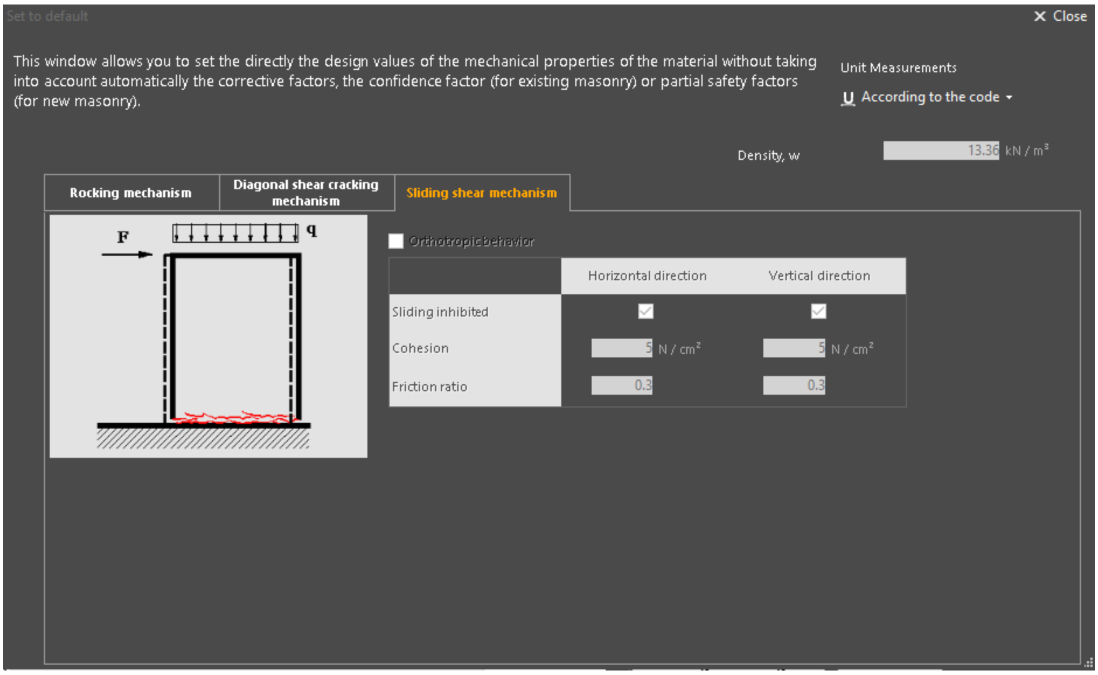
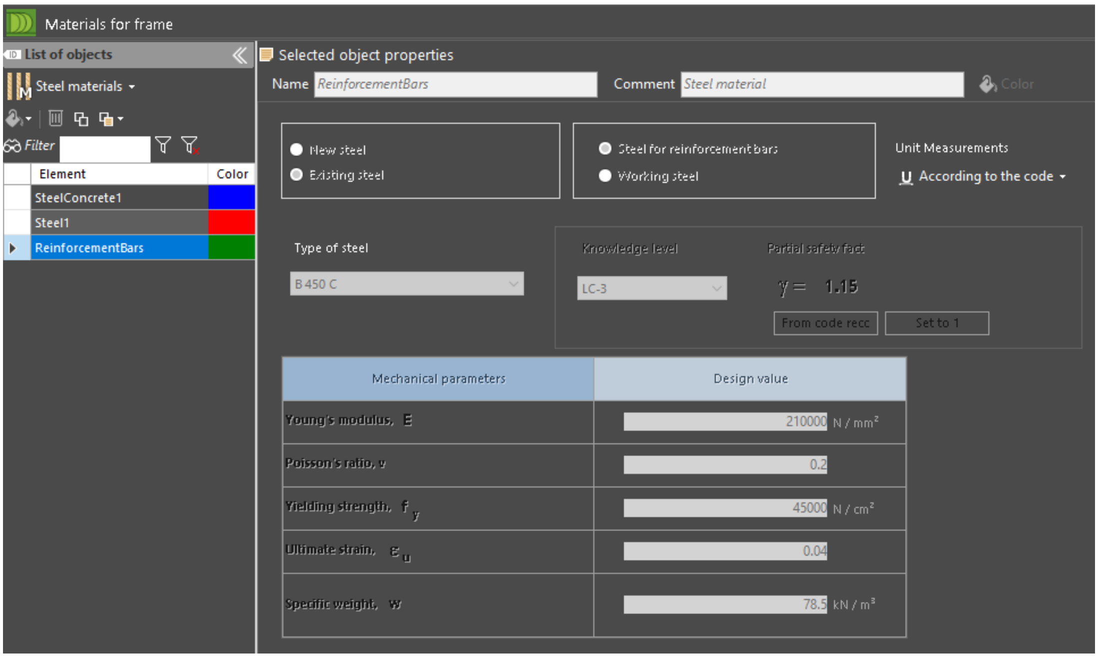


Figure 32: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



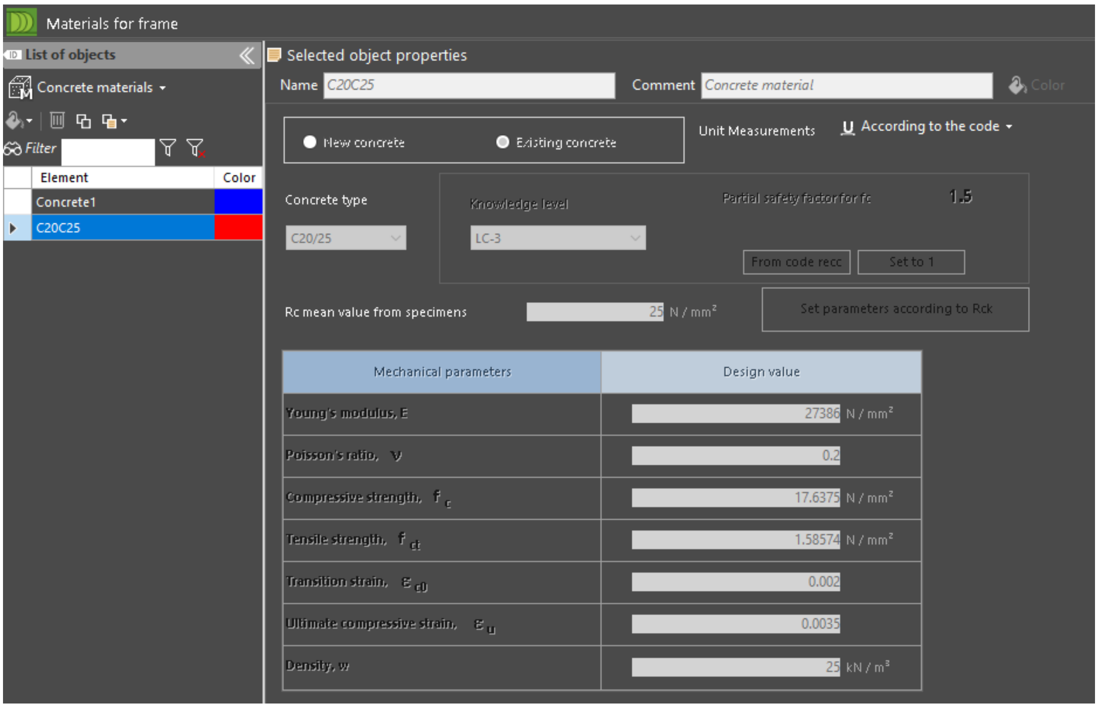
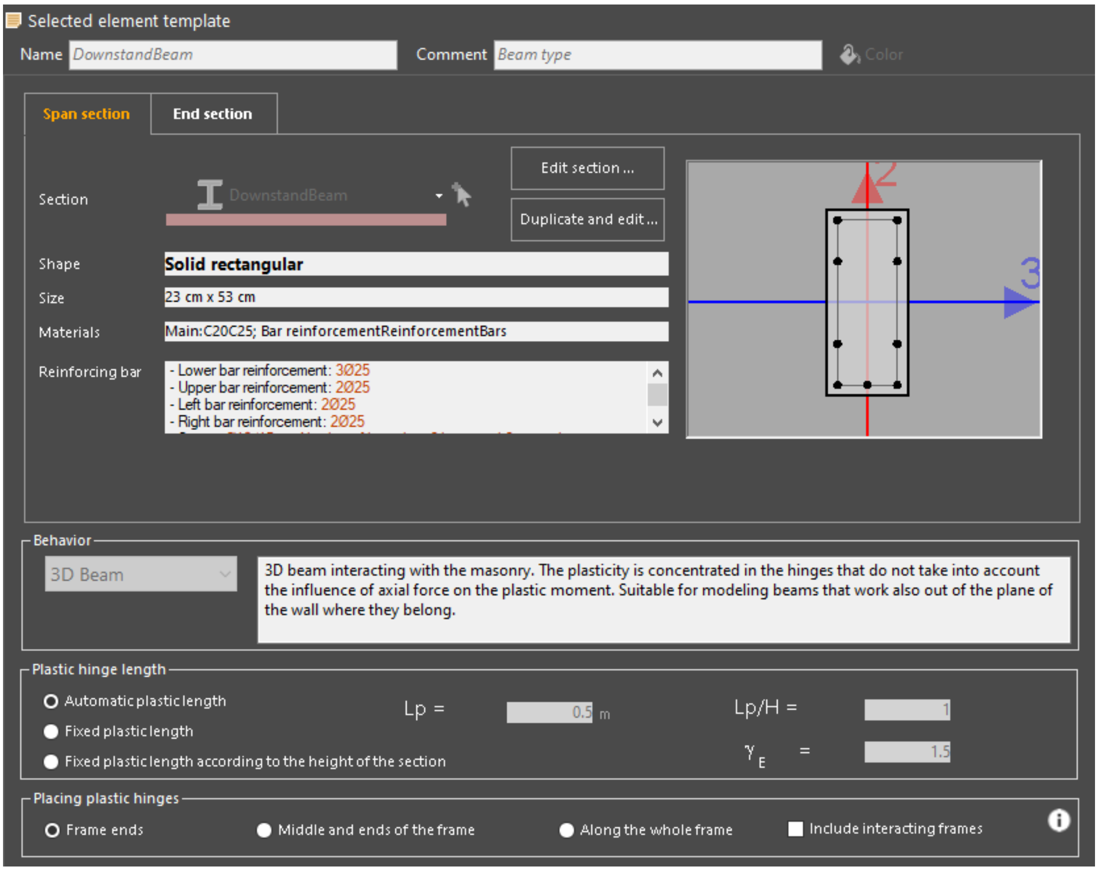


Figure 33: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



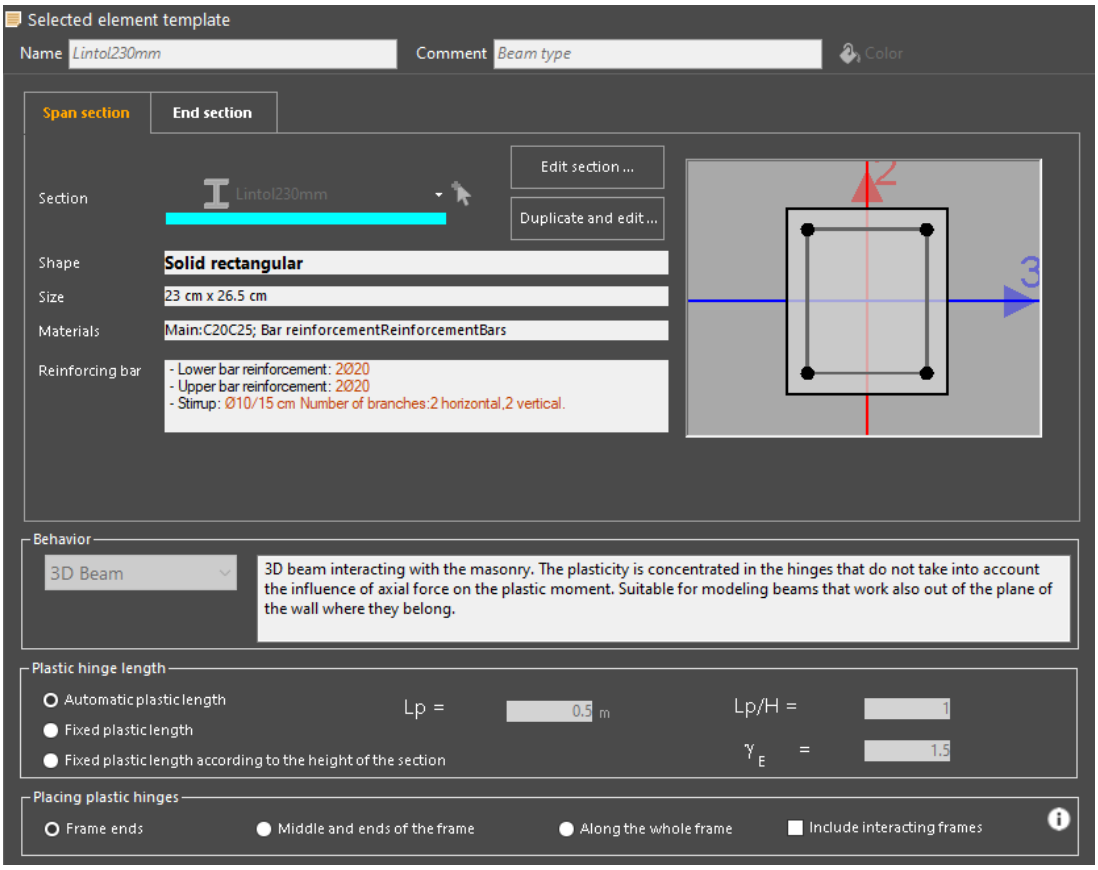
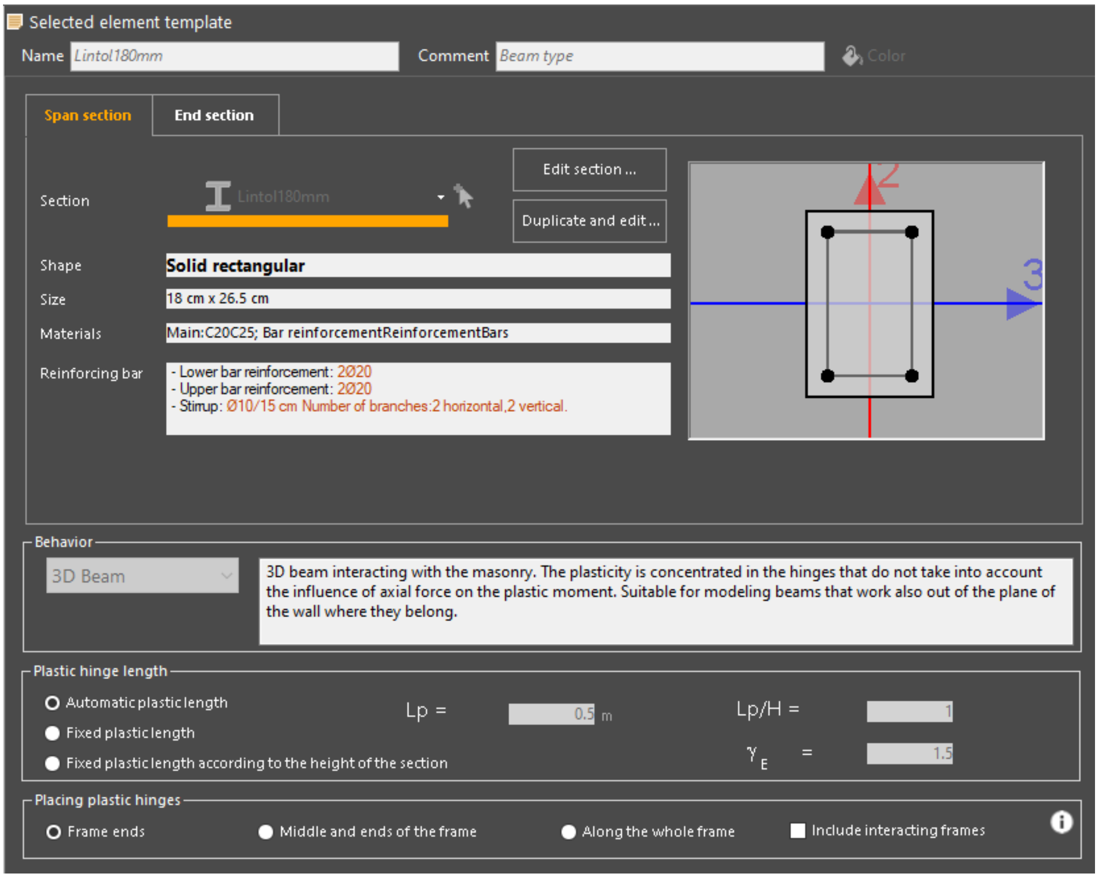


Figure 34: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



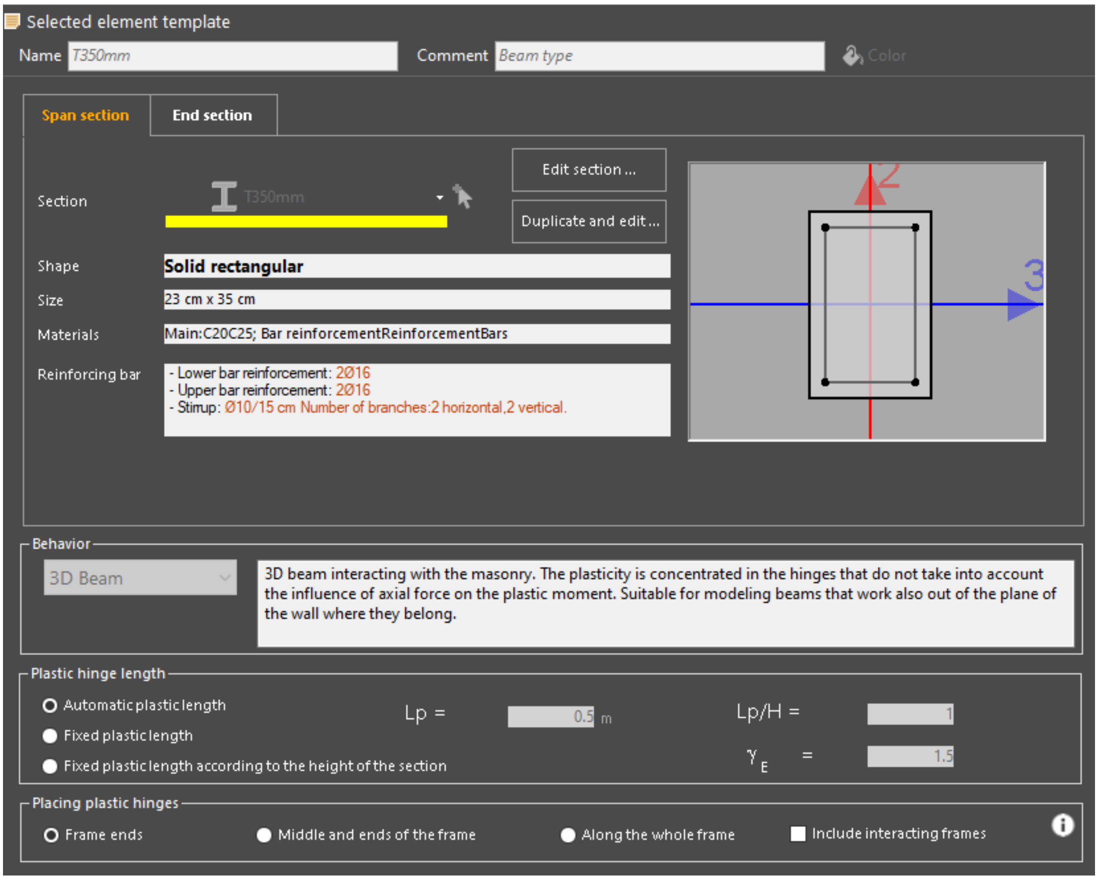
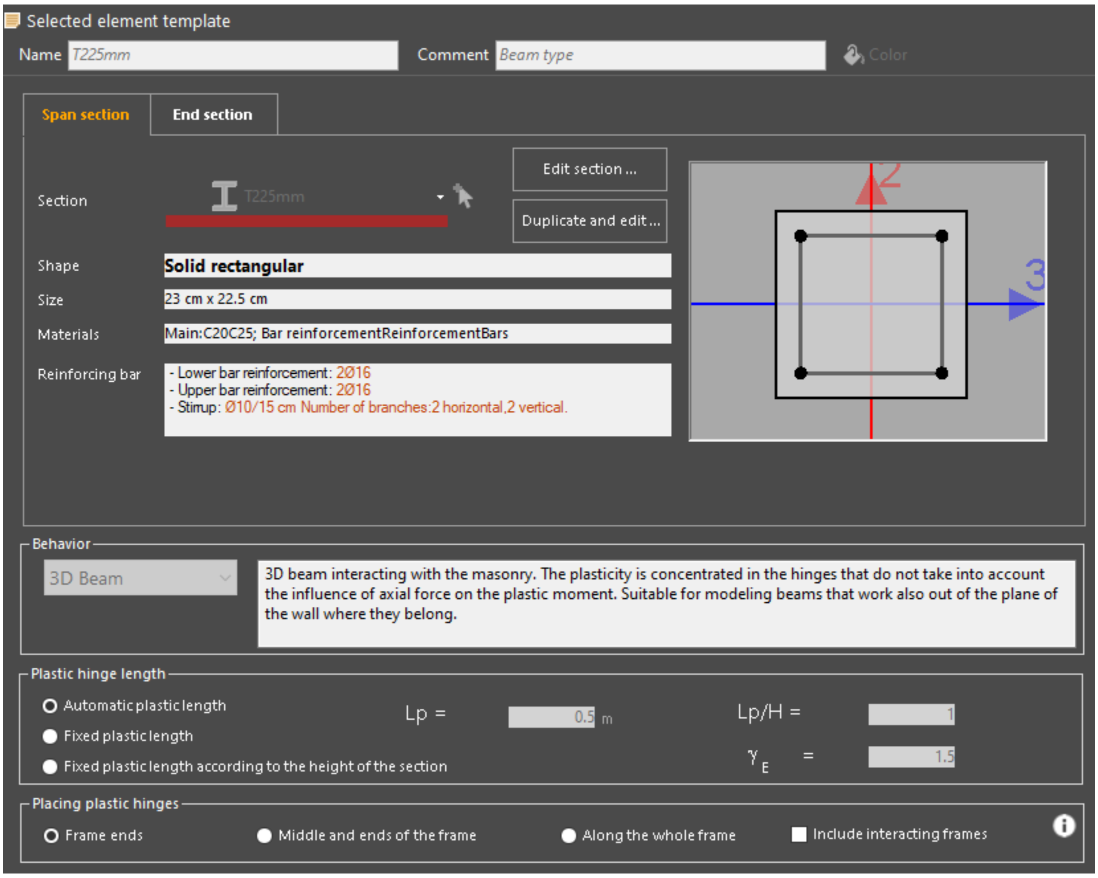


Figure 35: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



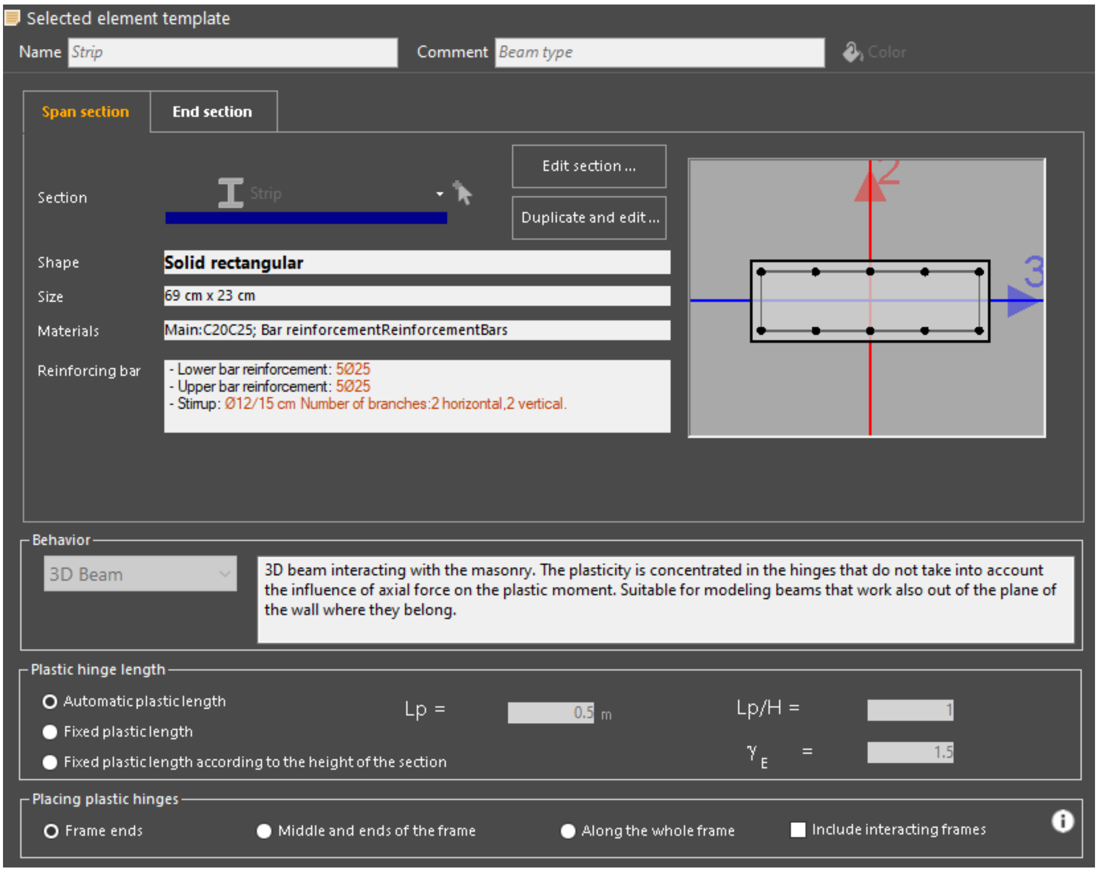
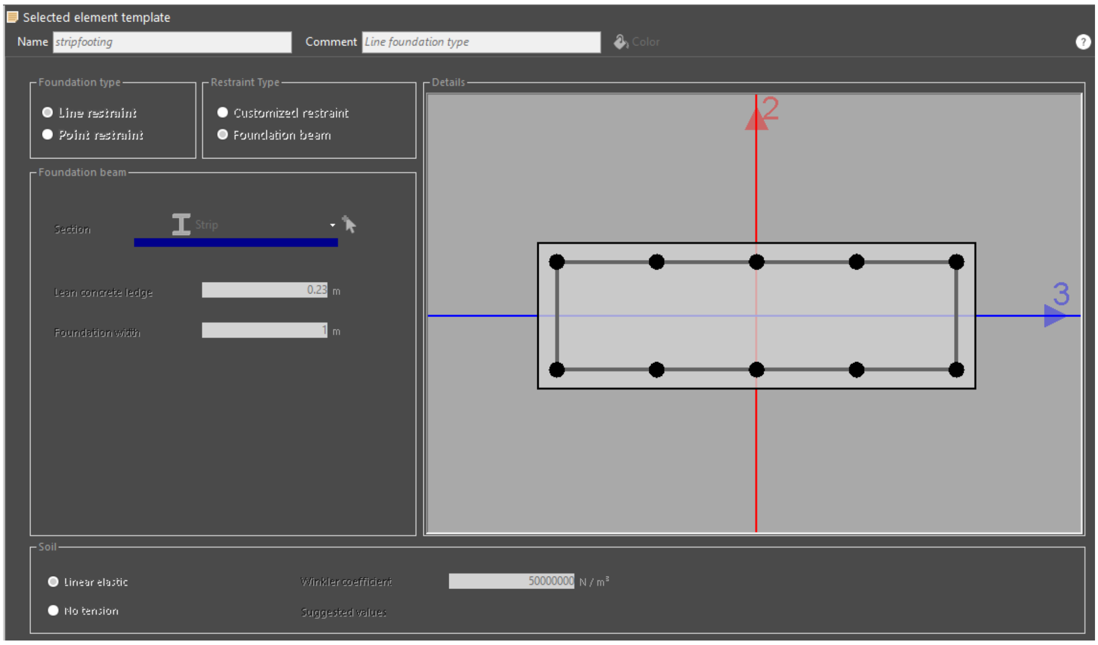


Figure 36: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.



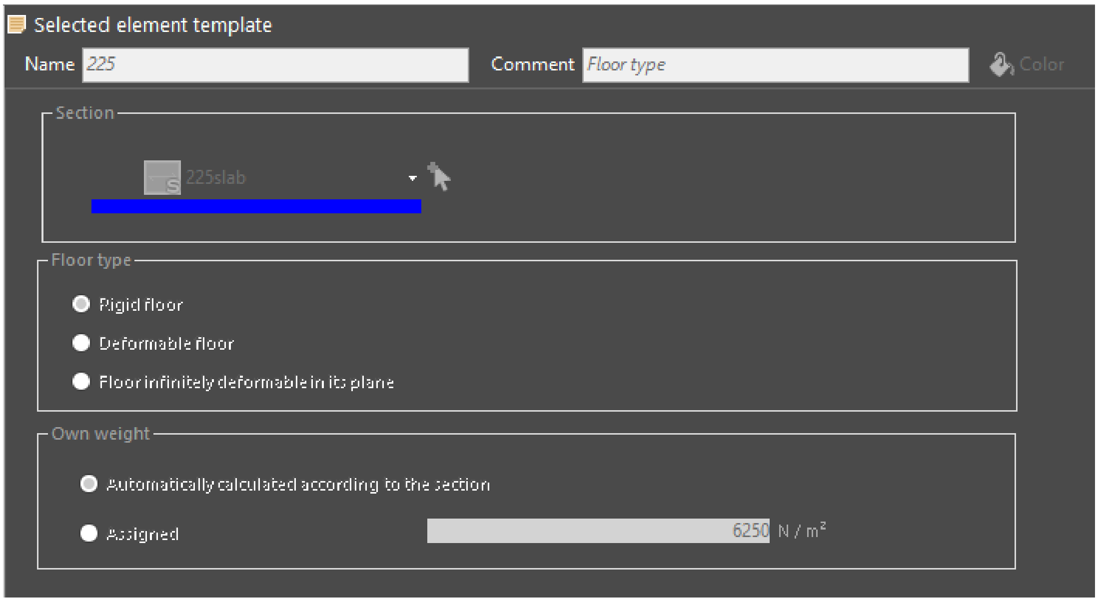
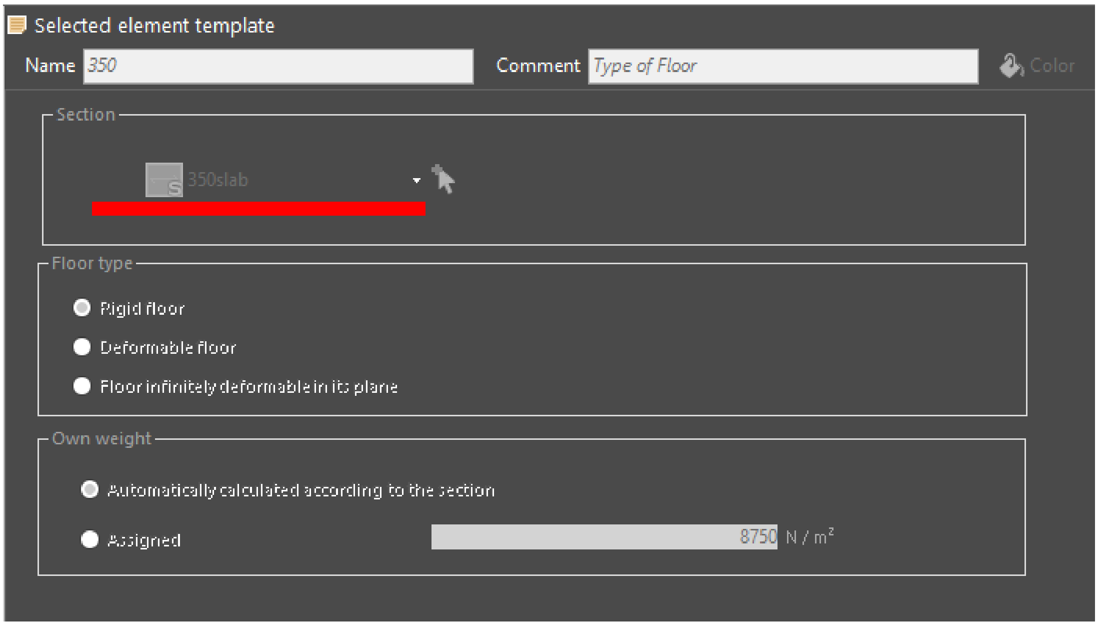
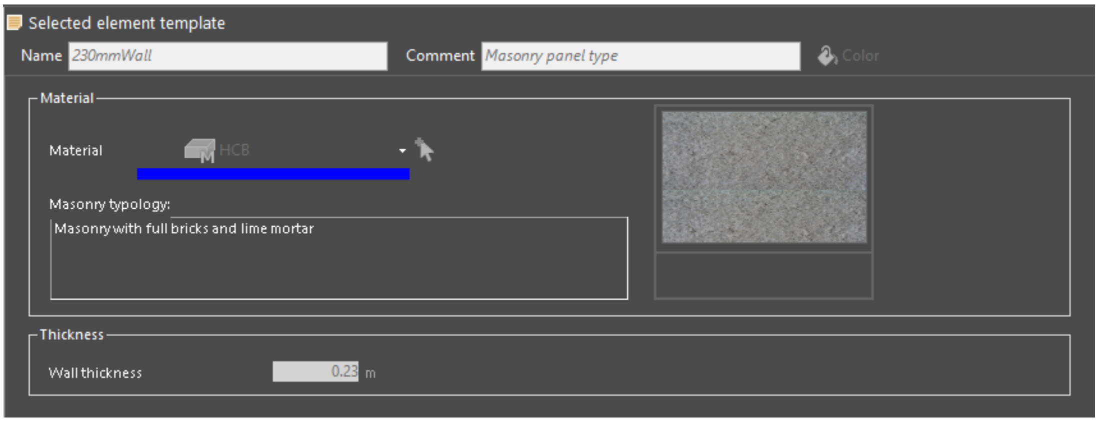


Figure 37: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.





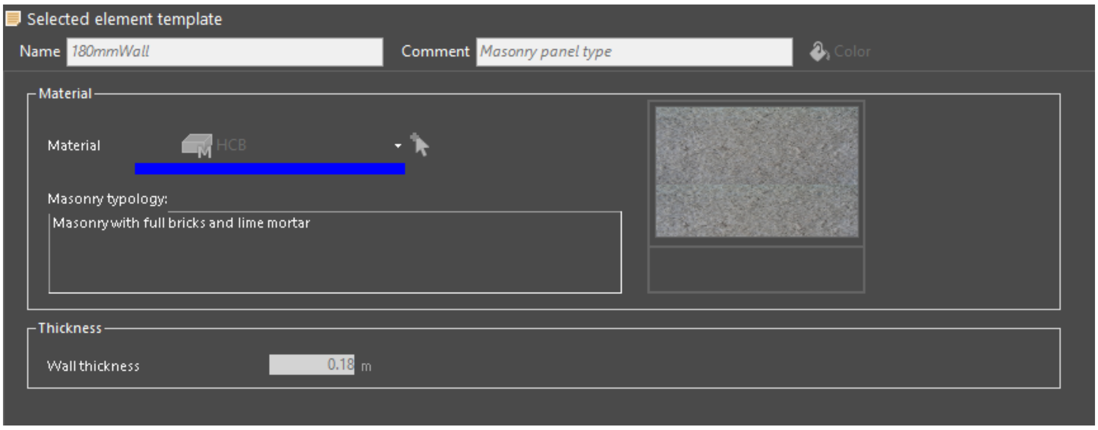


Figure 38: Images capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.

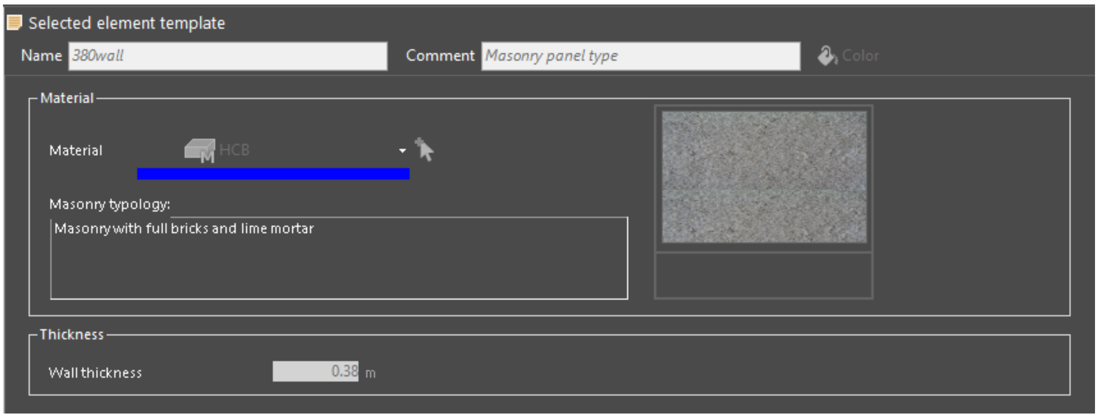
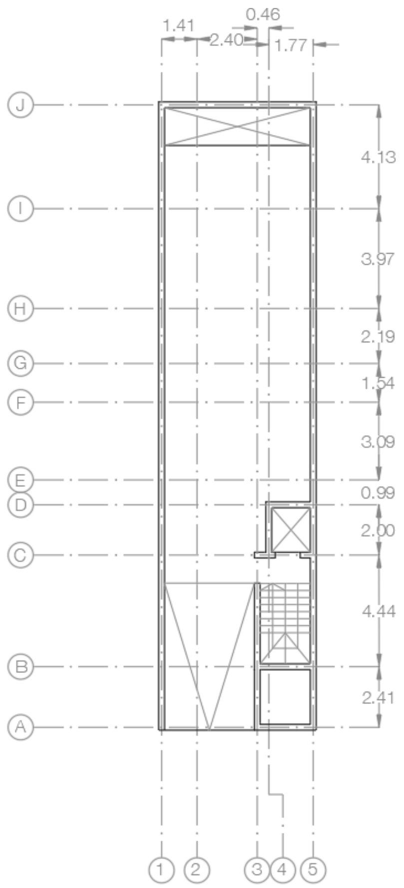


Figure 39: Image capturing the entirety of materials and section design properties employed in modelling all configurations of the AGs.

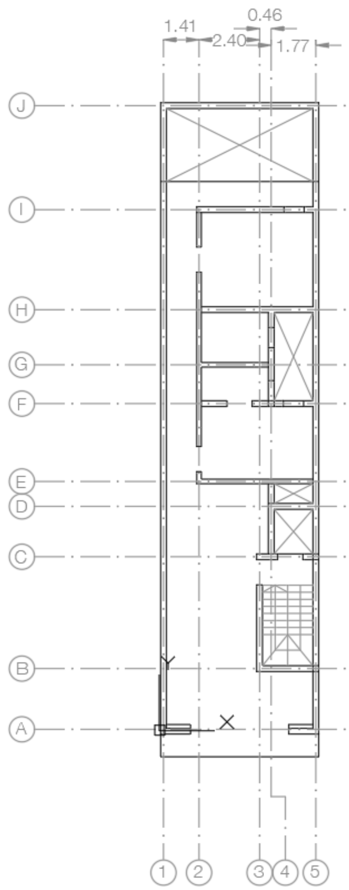
Appendix B.1

Plans and Drawings Evaluated in this Analysis

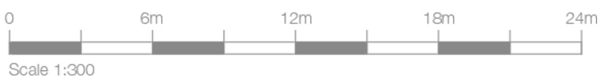
Standard Floor Layouts - Individual Dwelling



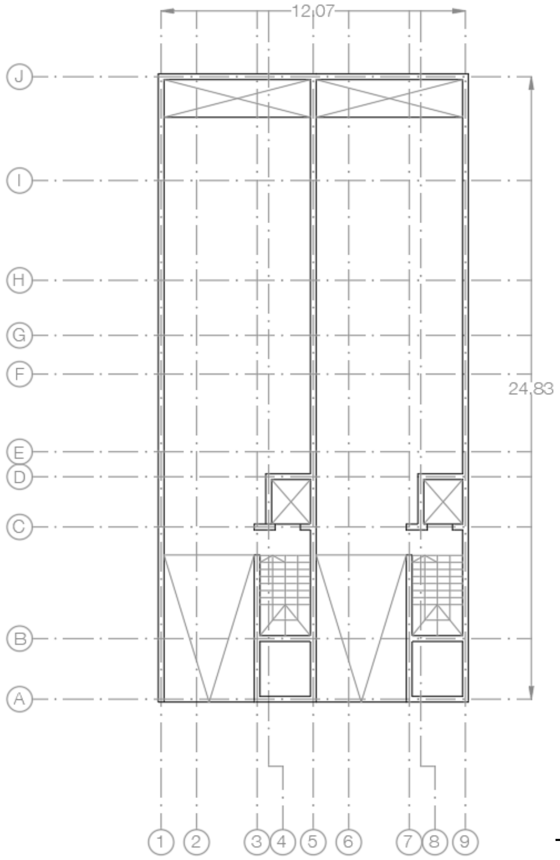
Typical Basement Floor



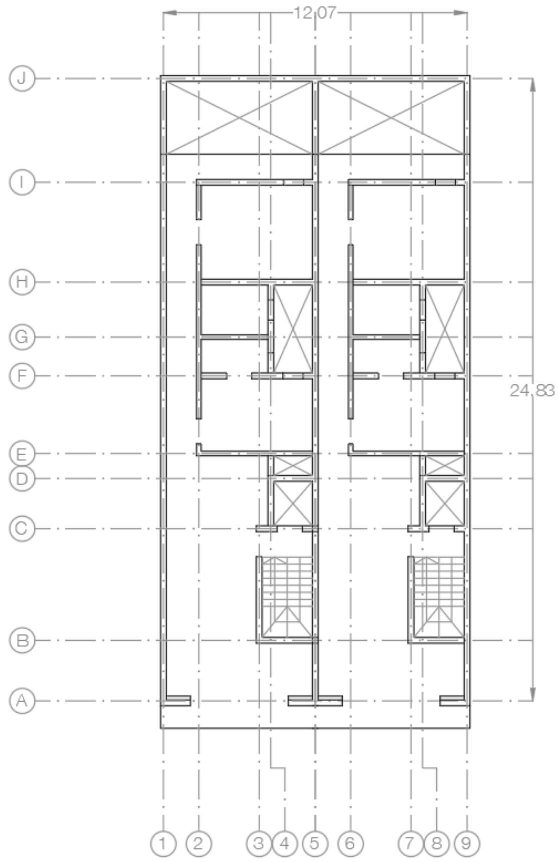
Typical Floor



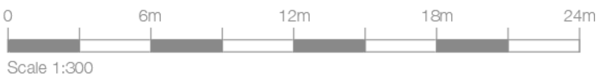
Aggregate Type 2 - Two Units



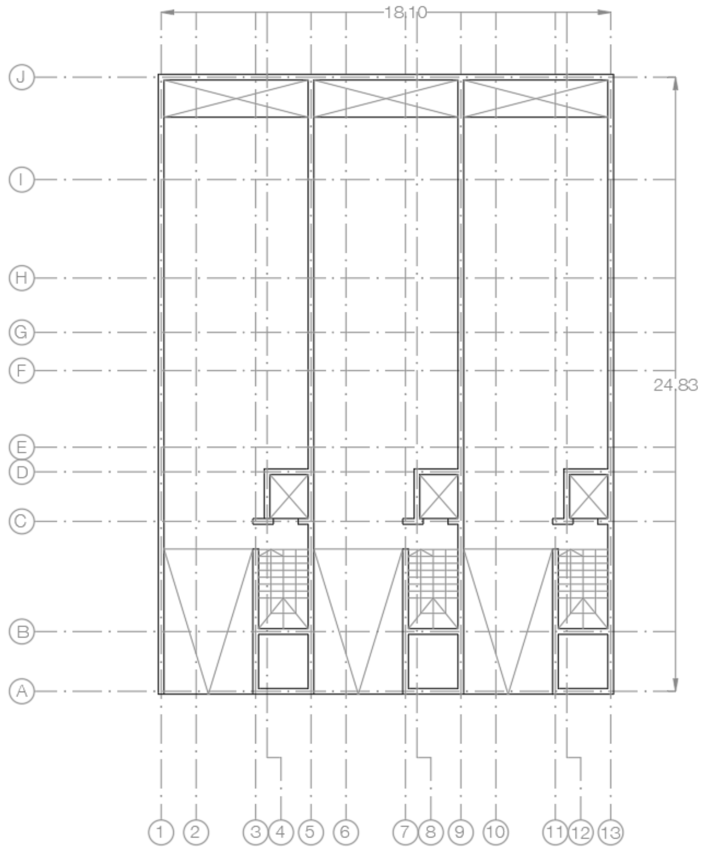
Typical Basement Floor



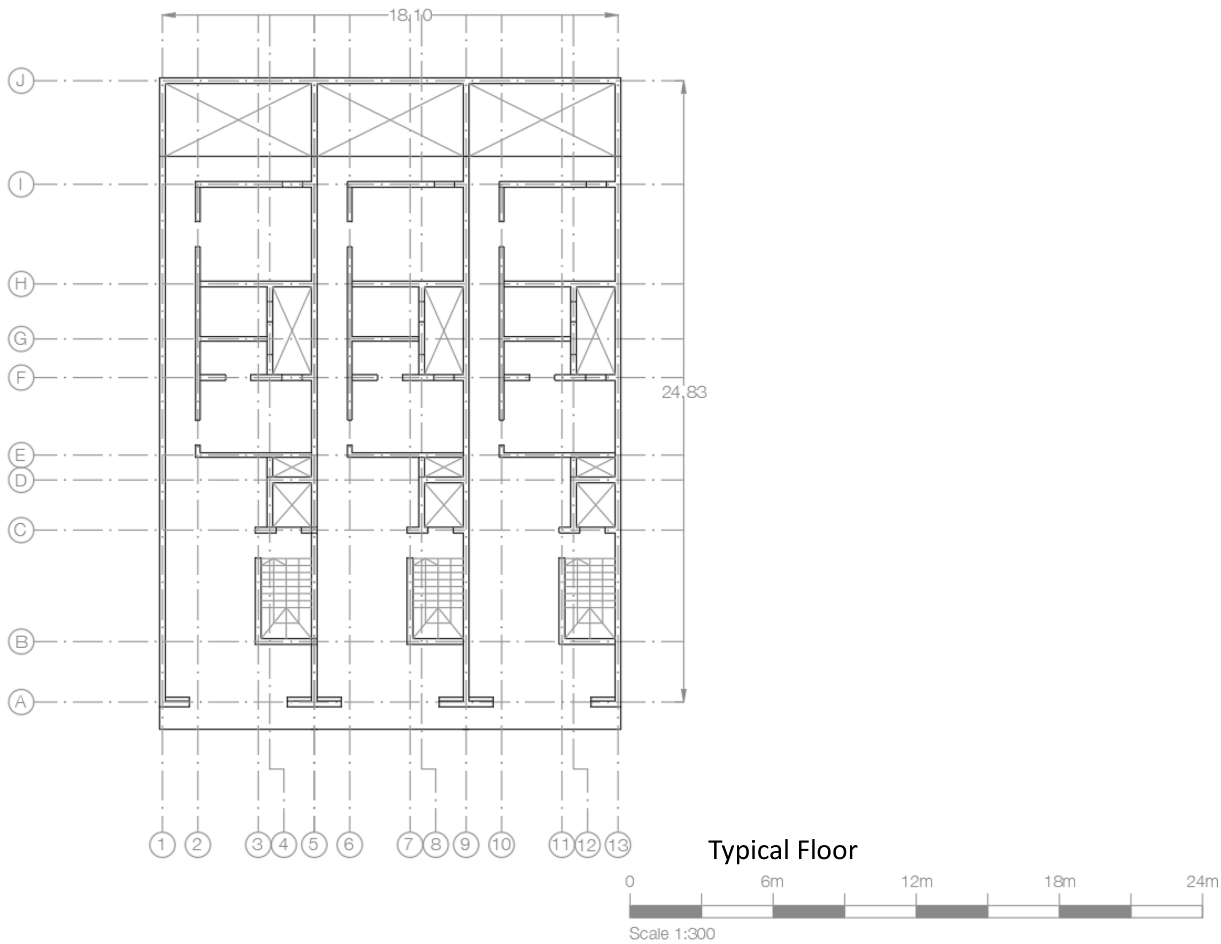
Typical Floor



Aggregate Type 3 - Three Units

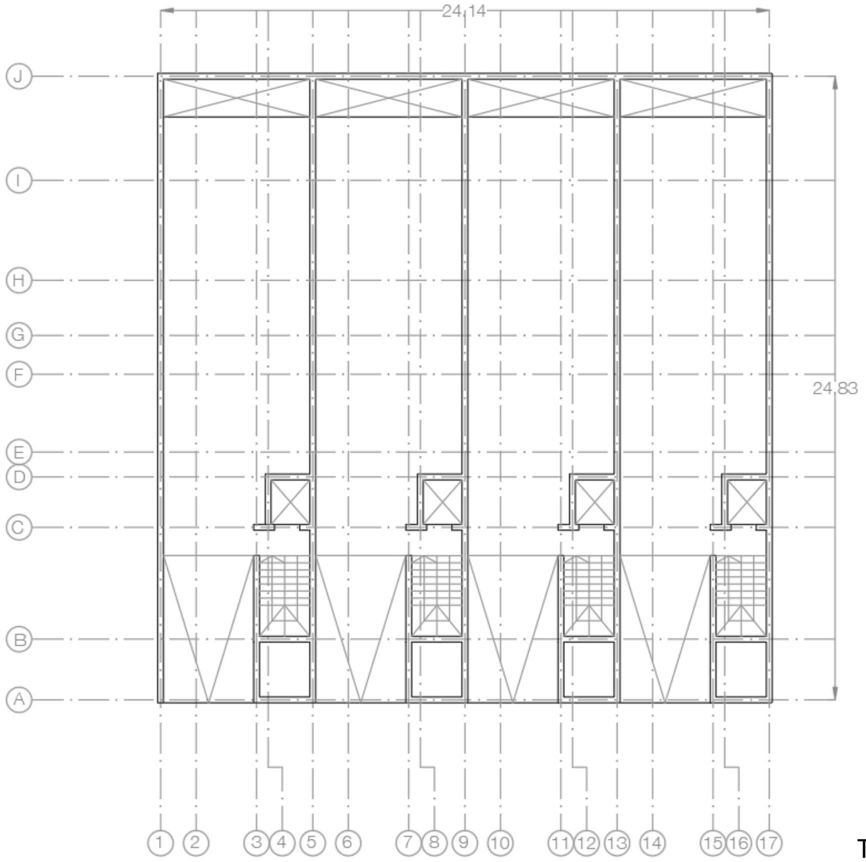


Typical Basement Floor

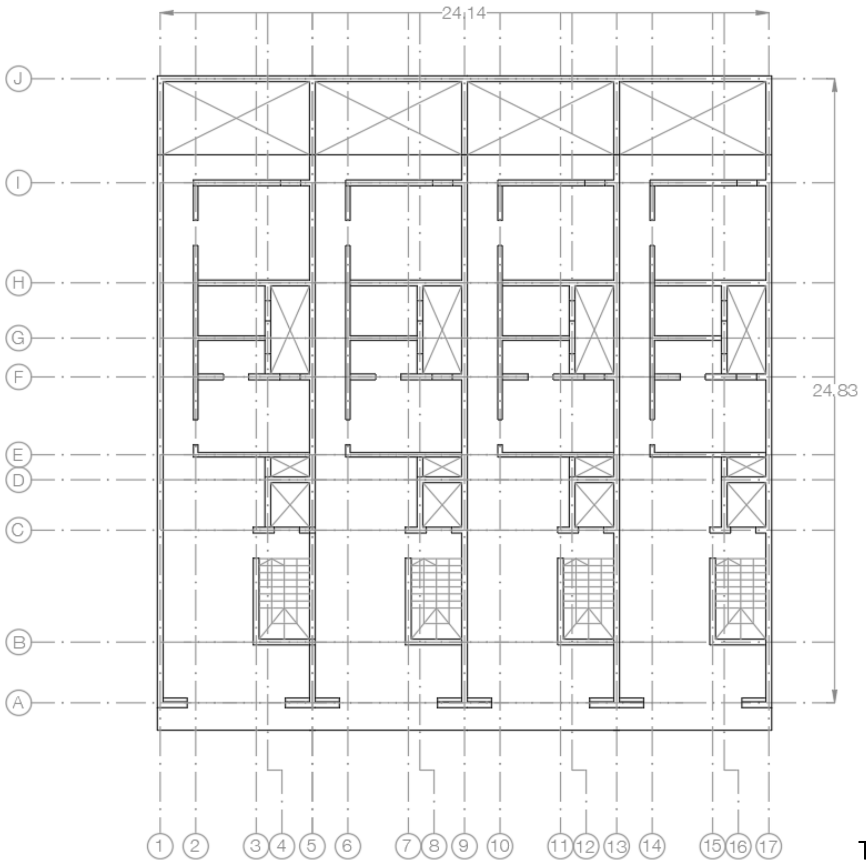


Typical Floor

Aggregate Type 4 - Four Units



Typical Basement Floor



Typical Floor

Appendix B.2

3D Macro representations for different types of URM building aggregates

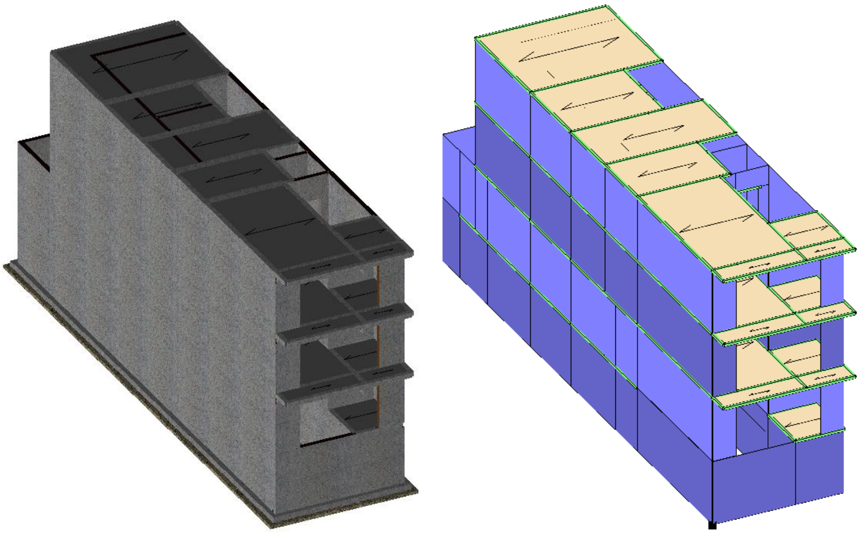


Figure 40: Left: Conceptualized model of a detached single unit, Right: Computational model of the same structure.

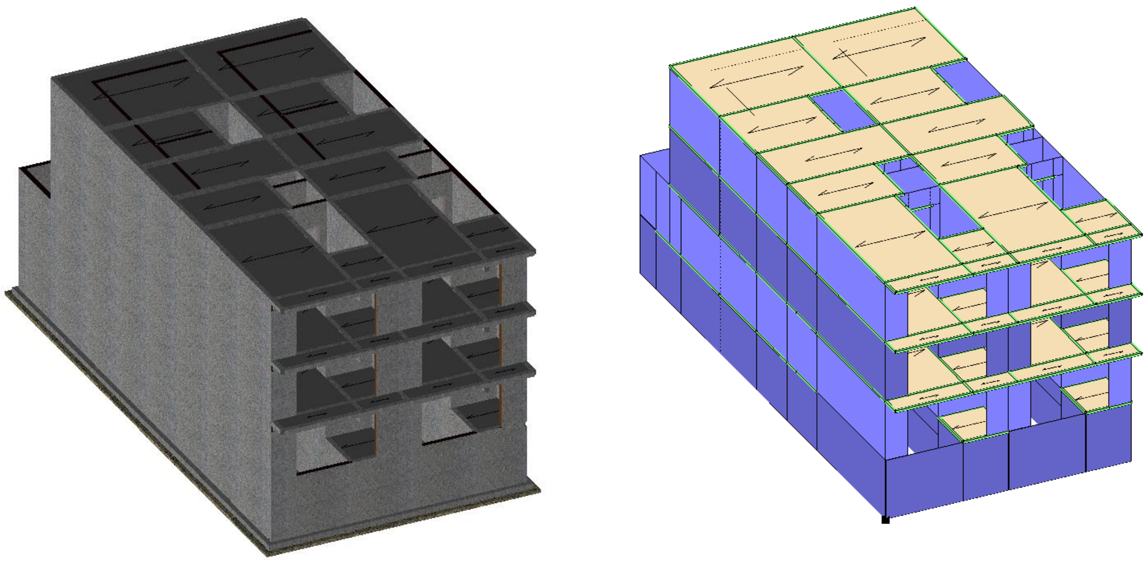


Figure 41: Left: Conceptualized model of a 2-unit aggregate, Right: Computational model of the same structure.

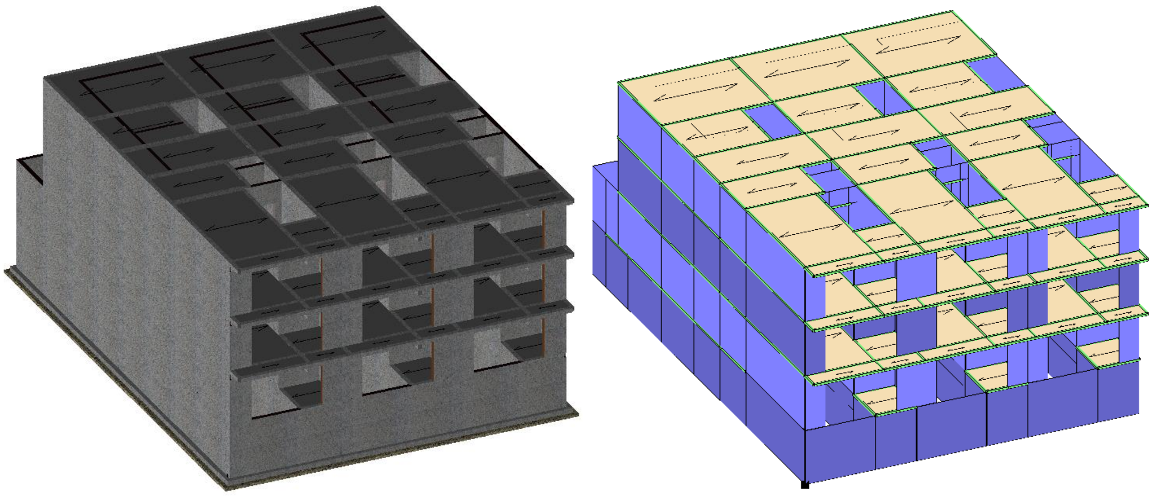


Figure 42: Left: Conceptualized model of a 3-unit aggregate, Right: Computational model of the same structure.

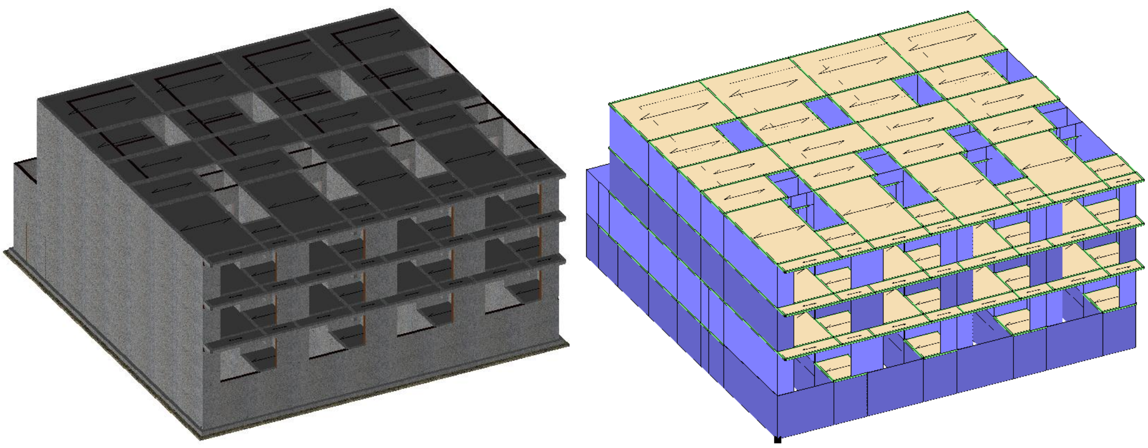
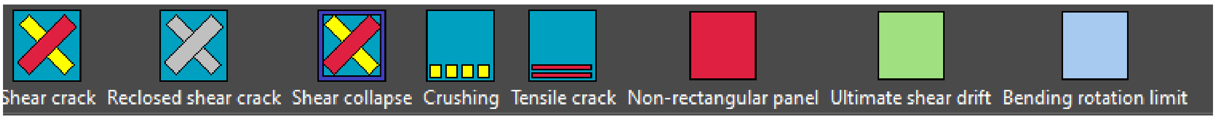


Figure 43: Left: Conceptualized model of a 4-unit aggregate, Right: Computational model of the same structure.

Appendix C

Structural Response Model in 3D Macro

LEGEND



Appendix C.1

Single Unit – Detached URM

Globigerina Limestone – Single Unit, 4 Floors – Ground type A

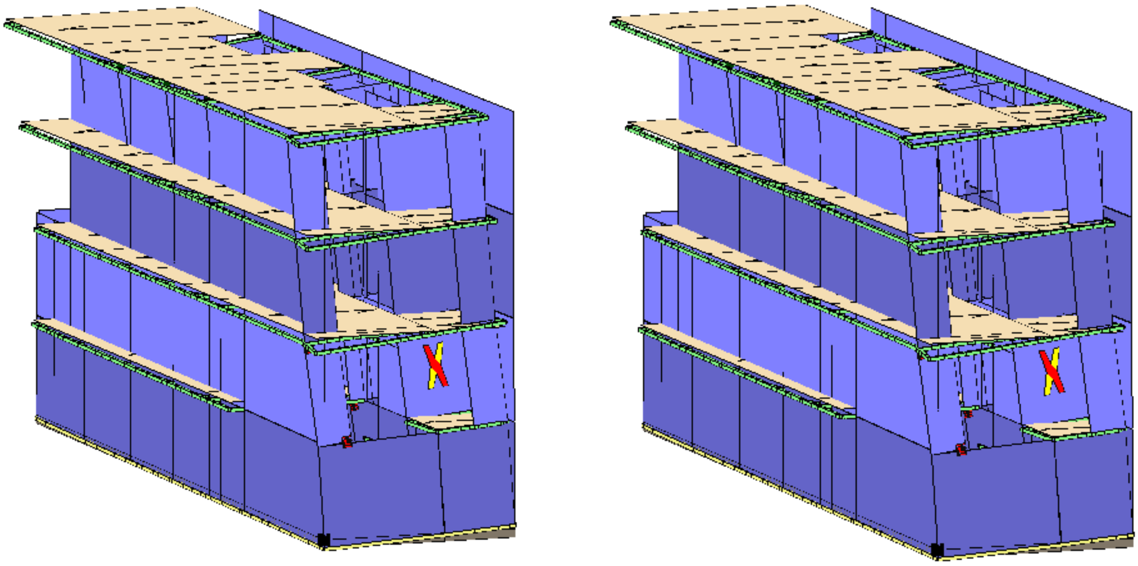


Figure 44: Load case- Pushover-X Acc (Left), Load case- Pushover-X Acc (Right)

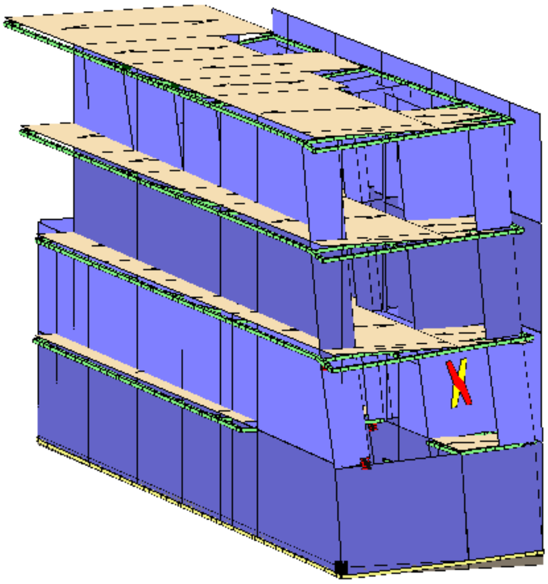


Figure 45: Load case- Pushover-Ex+0.3Ey Acc

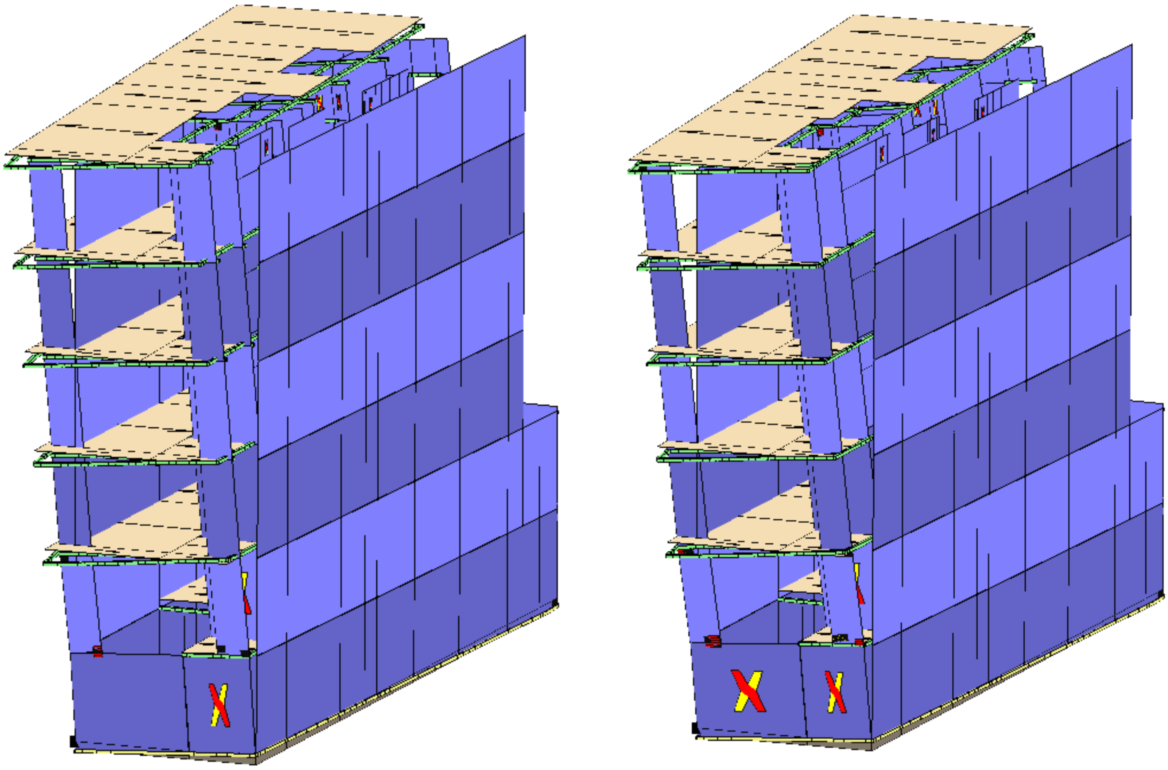


Figure 46: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

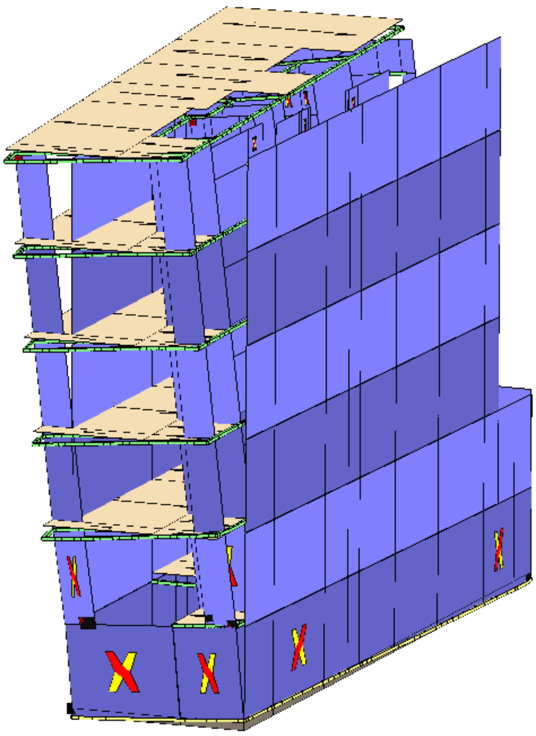


Figure 47: Load case- Pushover-Ex+0.3Ey Acc

Globigerina Limestone – Single Unit, 3 Floors – Ground type B

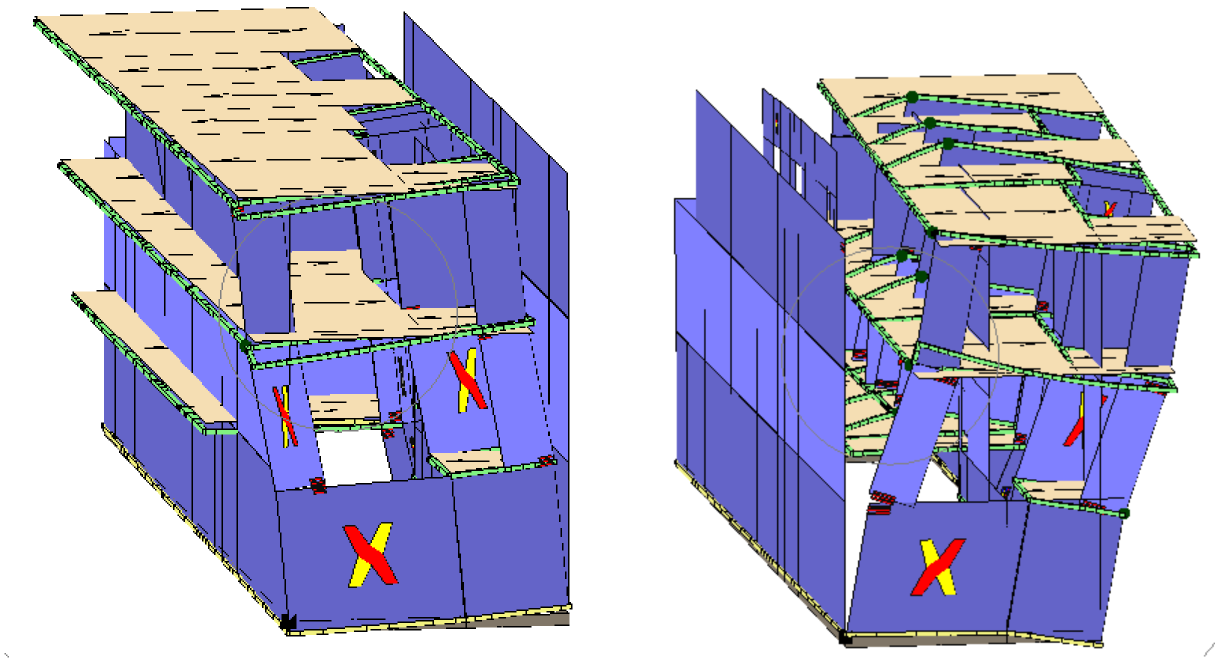


Figure 48: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

HCB – Single Unit, 4 Floors – Ground type B

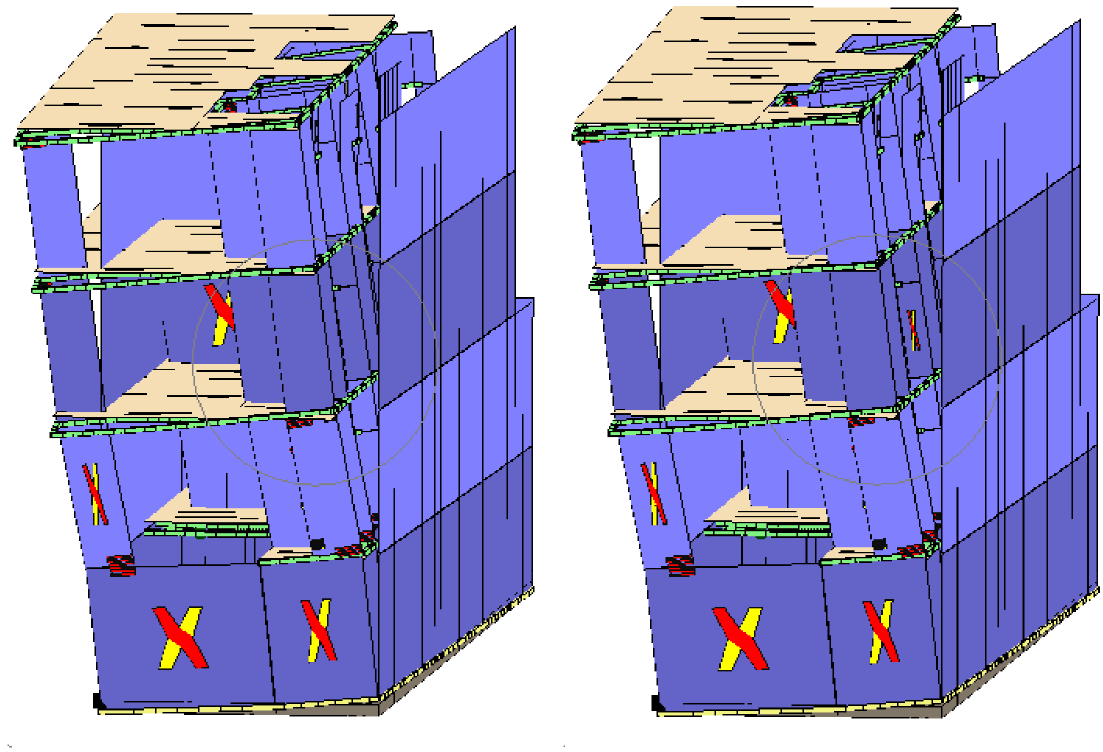


Figure 49: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

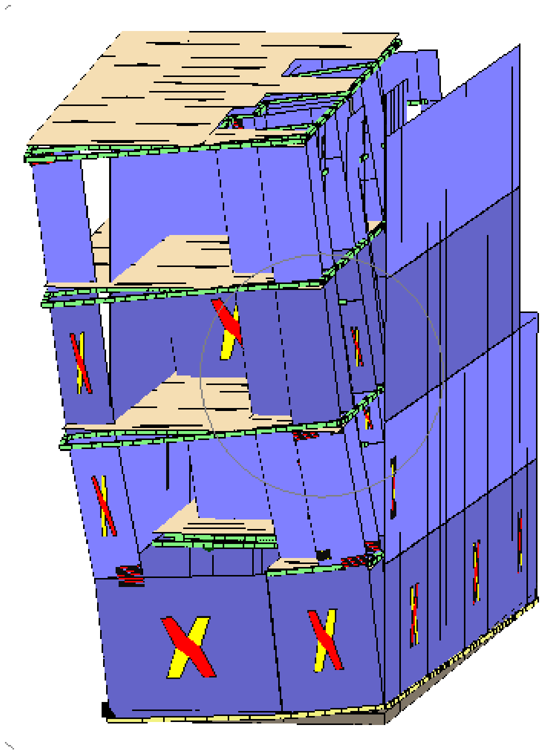


Figure 50: Load case- Pushover-Ex+0.3Ey Acc

Globigerina Limestone – Single Unit, 3 Floors – Ground type C

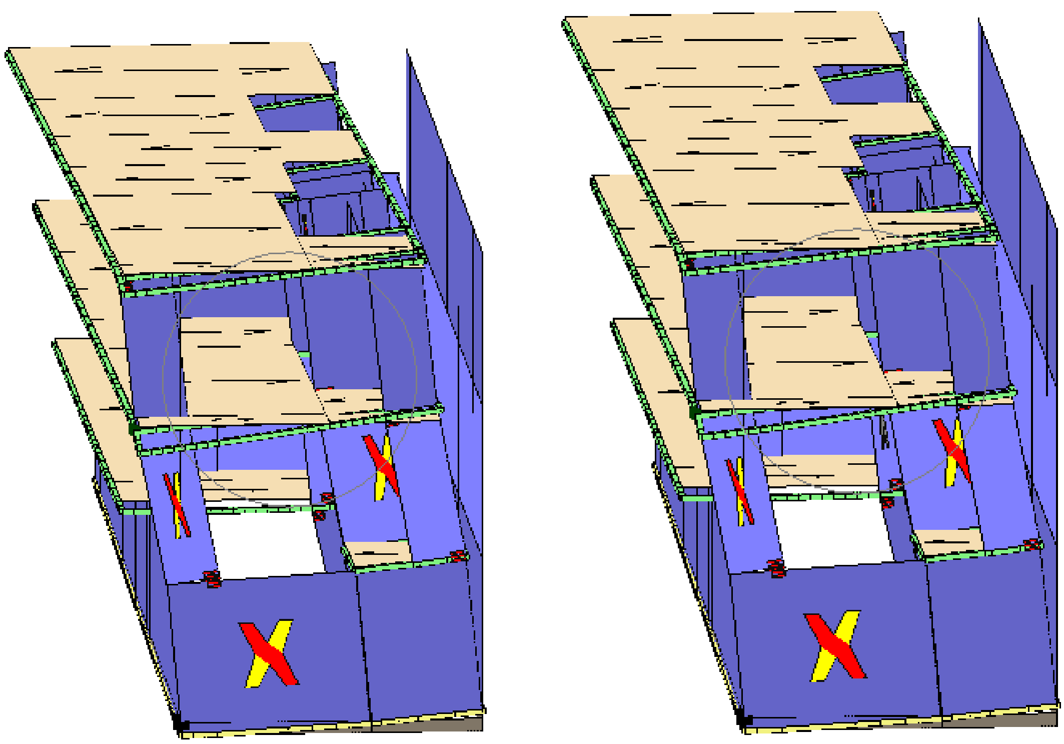


Figure 51: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

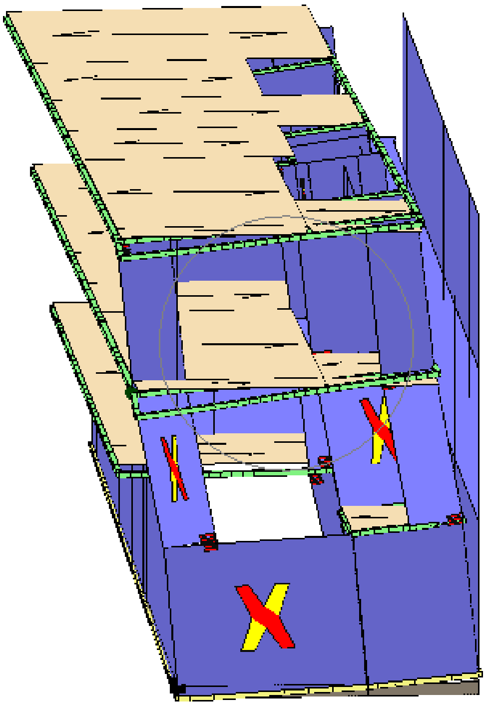


Figure 52: Load case- Pushover-Ex+0.3Ey Acc

HCB – Single Unit, 3 Floors – Ground type C

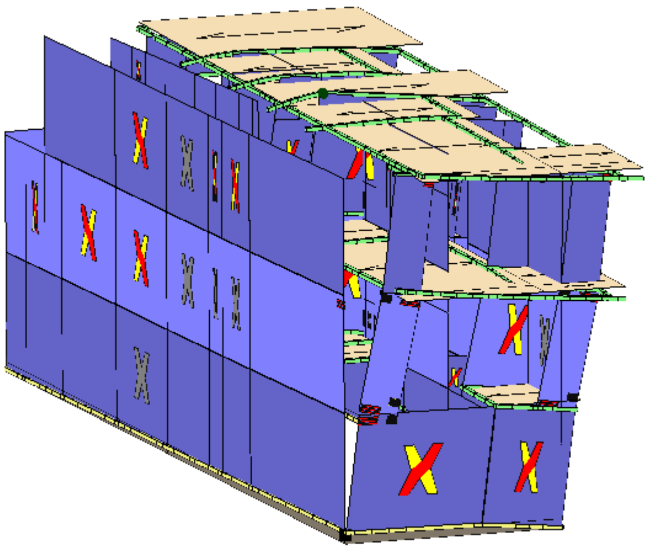
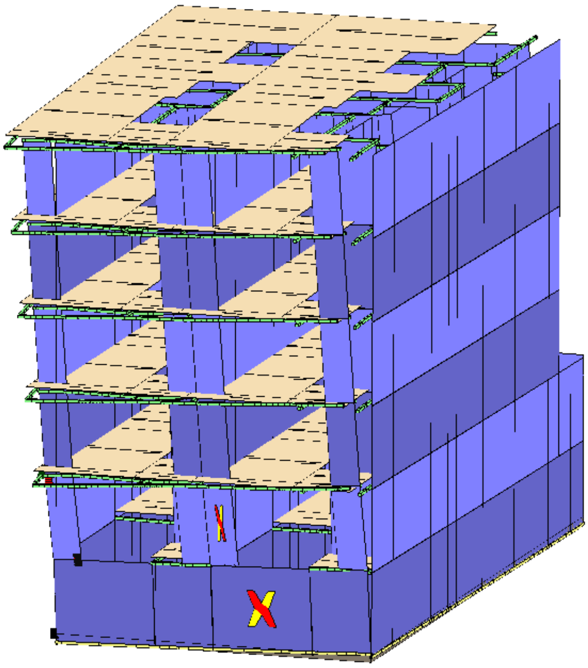


Figure 53: Load case- Pushover Ex+0.3Ey Acc

Appendix C.2

Two Unit – URM building Aggregate

Globigerina Limestone – Two Unit, 6 Floors – Ground type A



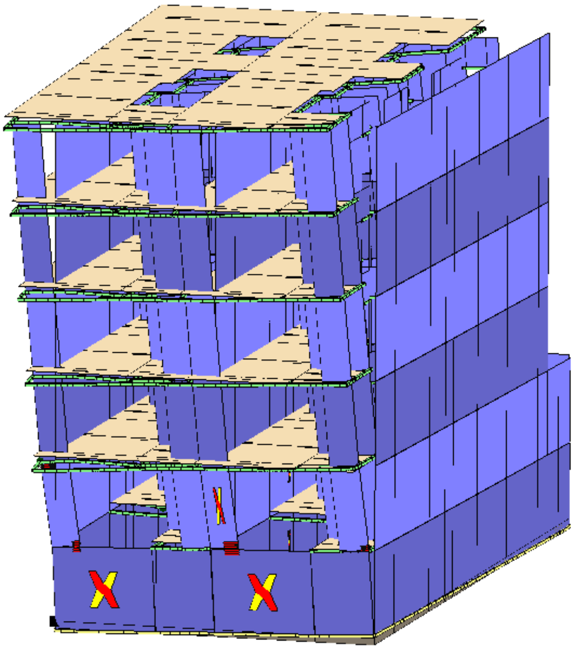


Figure 54: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

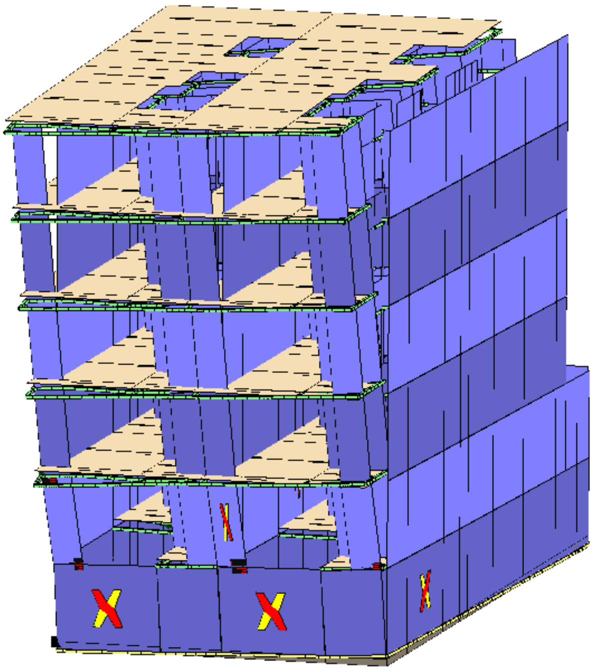


Figure 55: Load case- Pushover -Ex+0.3Ey Acc

HCB –Two Unit, 6 Floors – Ground type A

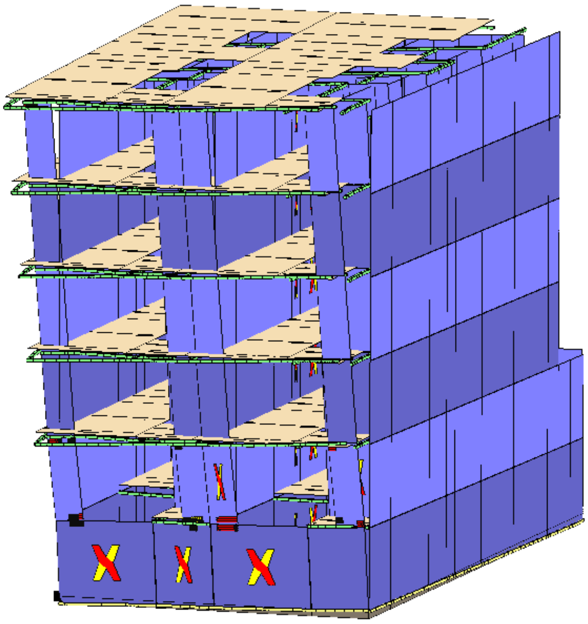


Figure 56: Load case- Pushover-X Acc

Globigerina Limestone – Two Unit, 4 Floors – Ground type **B**

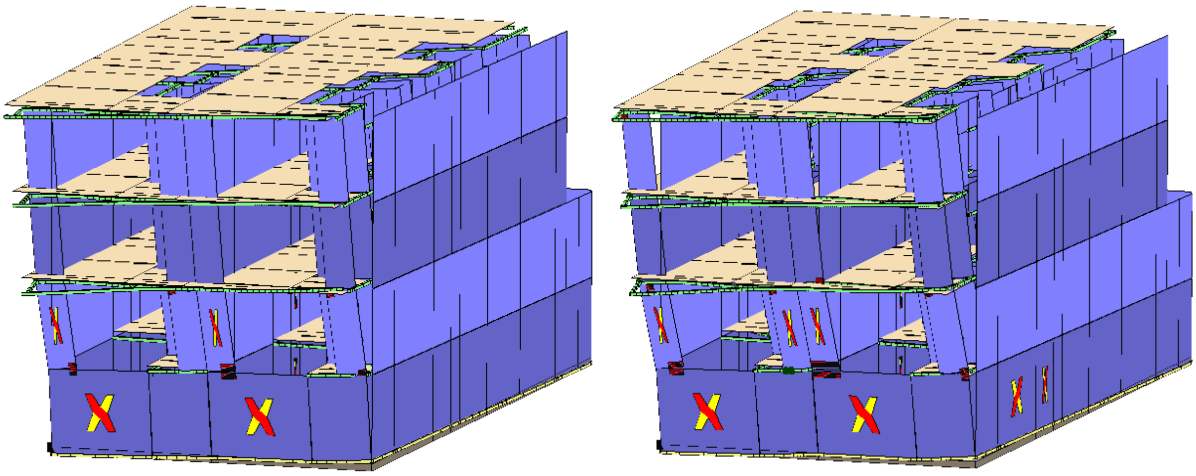


Figure 57: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

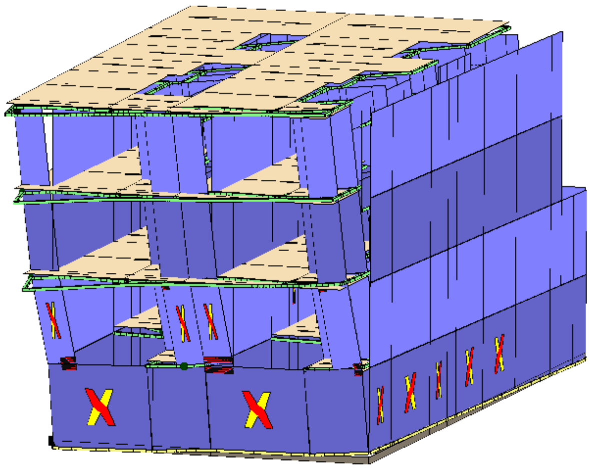


Figure 58: Load case- Pushover -Ex+0.3Ey Acc

HCB – Two Unit, 5 Floors – Ground type **B**

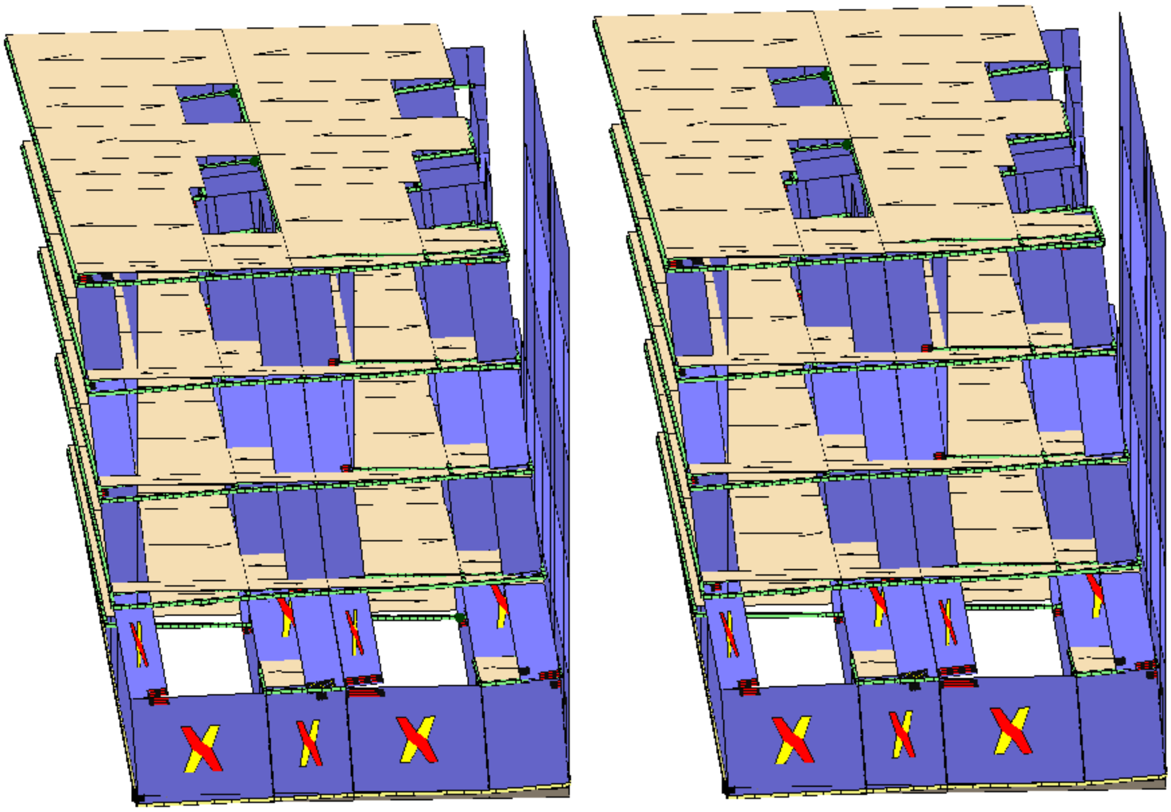


Figure 59: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

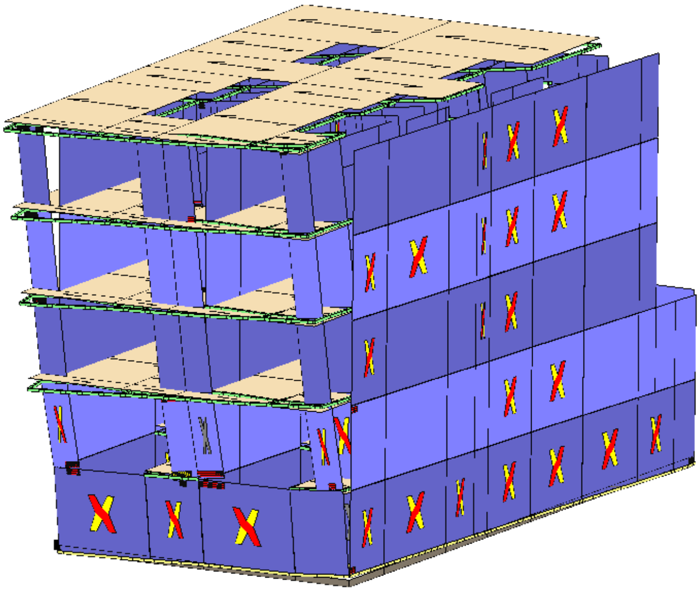


Figure 60: Load case- Pushover -Ex+0.3Ey Acc

Globigerina Limestone – Two Unit, 3 Floors – Ground type C

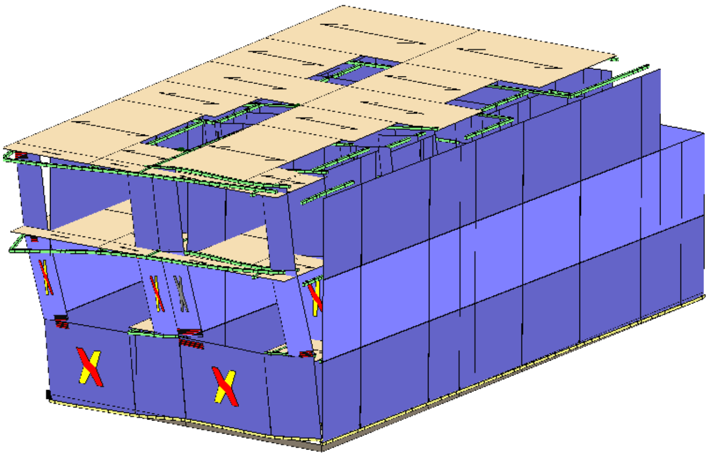


Figure 61: Load case- Pushover -Ex+0.3Ey Acc

HCB – Two Unit, 3 Floors – Ground type C

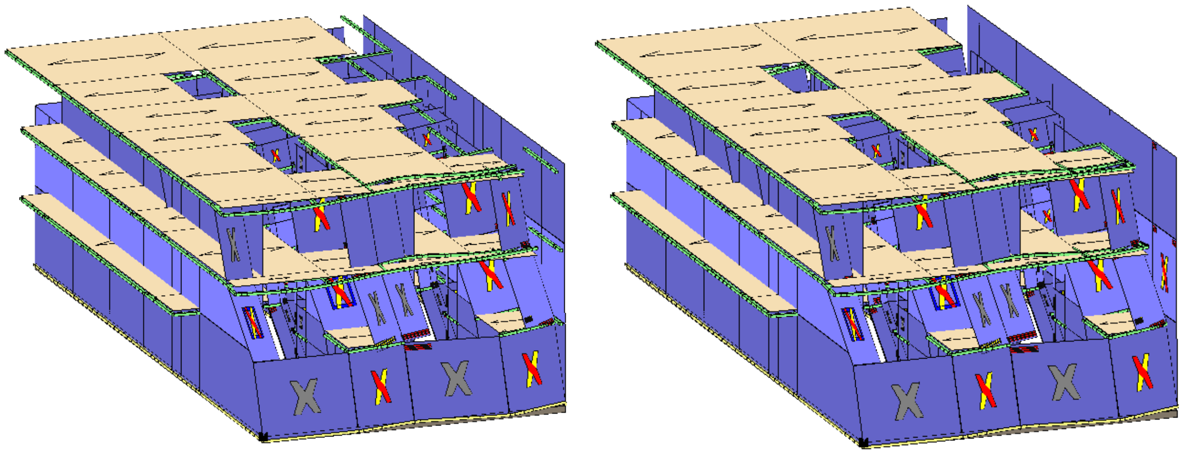


Figure 62: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

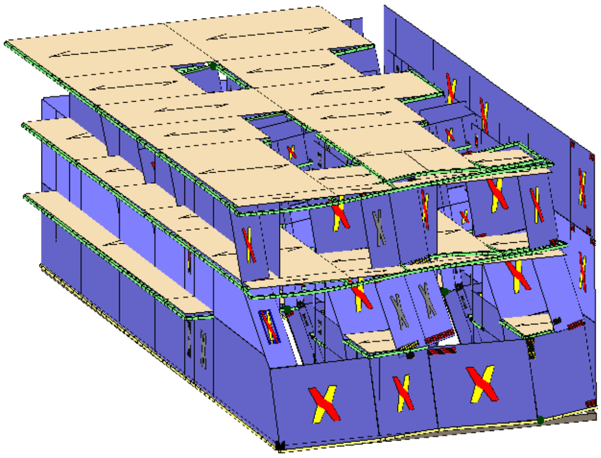


Figure 63: Load case- Pushover -Ex+0.3Ey Acc

Appendix C.3

Three Unit – URM building Aggregate

Globigerina Limestone – Three Unit, 5 Floors – Ground type A

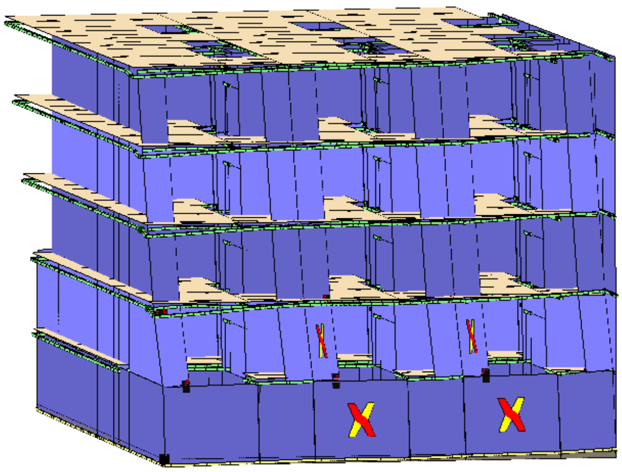


Figure 64: Load case- Pushover -Ex+0.3Ey Acc

Globigerina Limestone – Three Unit, 4 Floors – Ground type B

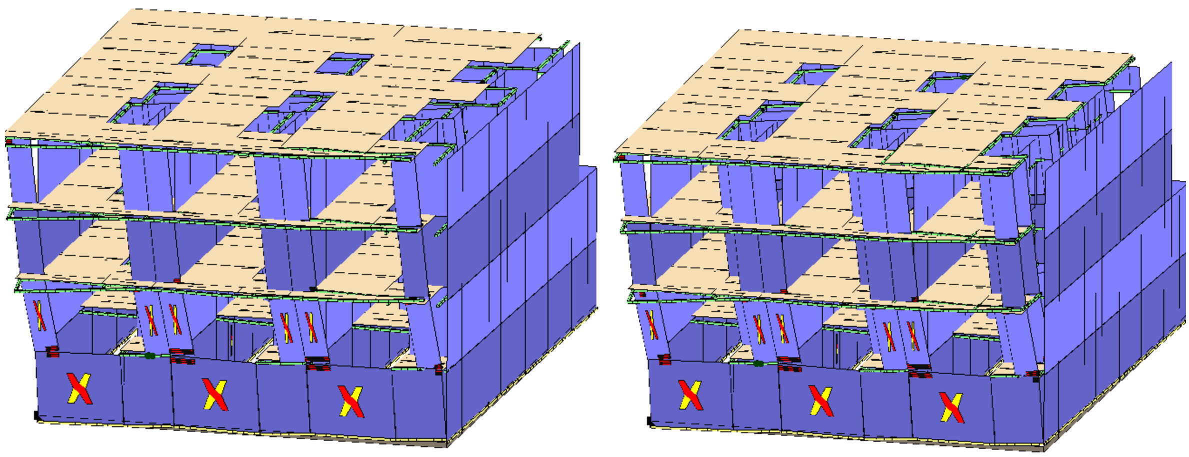


Figure 65: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

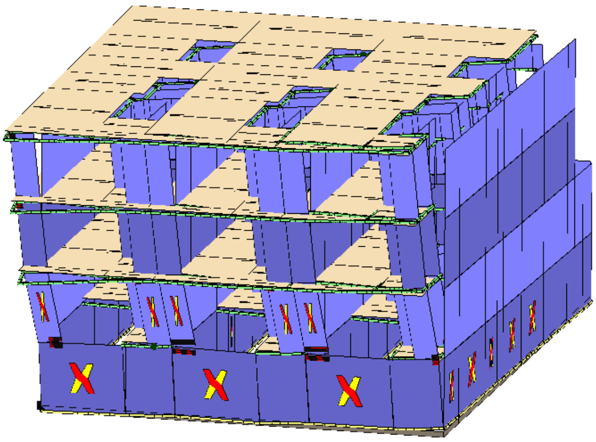


Figure 66: Load case- Pushover -Ex+0.3Ey Acc

HCB – Three Unit, 3 Floors – Ground type B

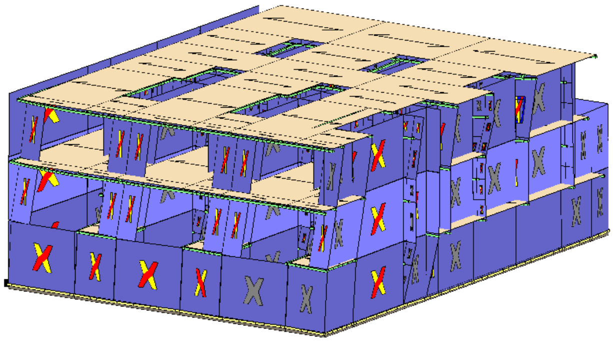


Figure 67: Load case- Pushover +X Acc

Globigerina Limestone – Three Unit, 3 Floors – Ground type C

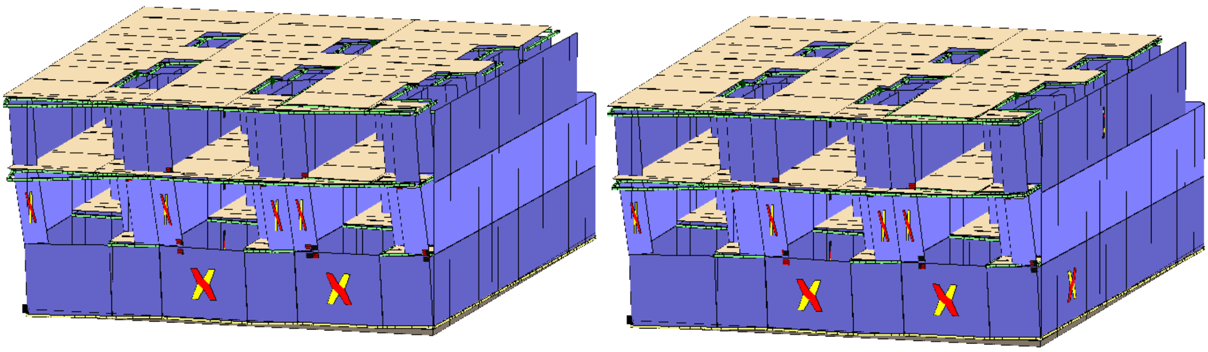


Figure 68: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc +e (Right)

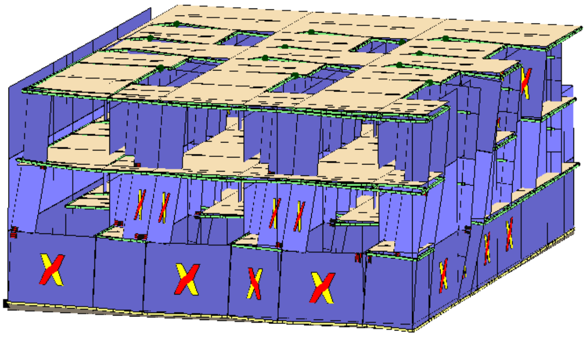


Figure 69: Load case- Pushover -Ex+0.3Ey Acc

HCB – Three Unit, 3 Floors – Ground type C

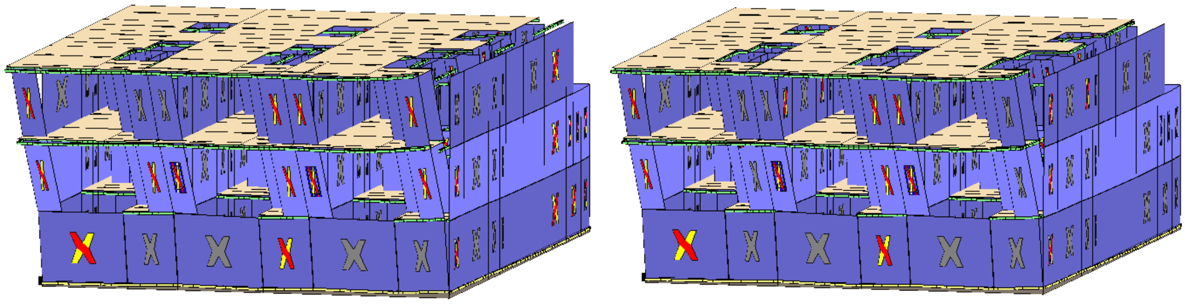


Figure 70: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

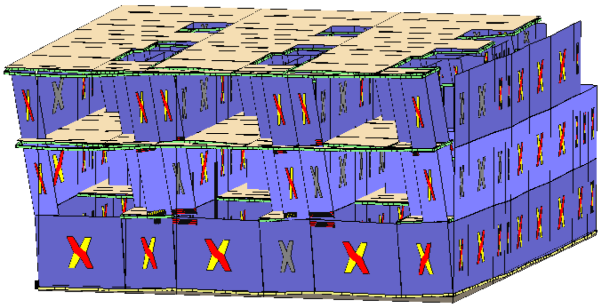


Figure 71: Load case- Pushover -Ex+0.3Ey Acc

Appendix C.4

Four Unit – URM building Aggregate

Globigerina Limestone – Four Unit, 6 Floors – Ground type A

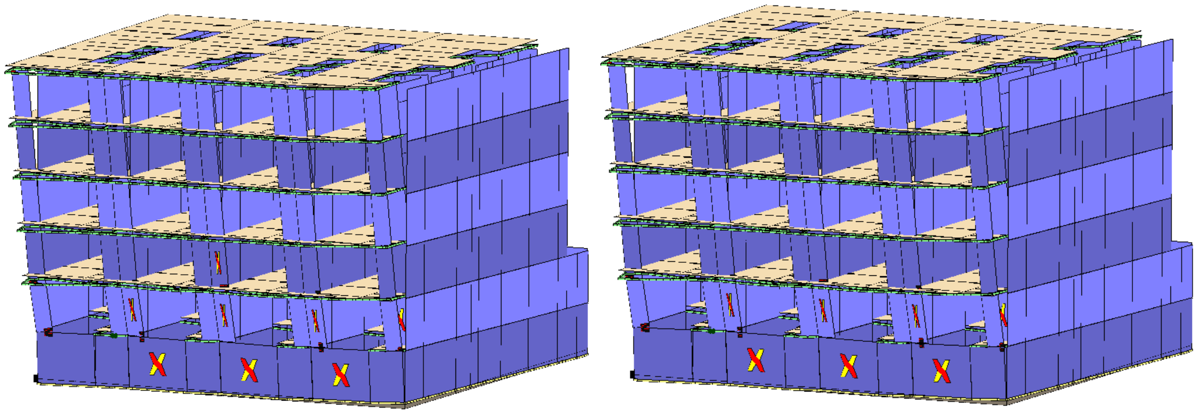


Figure 72: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

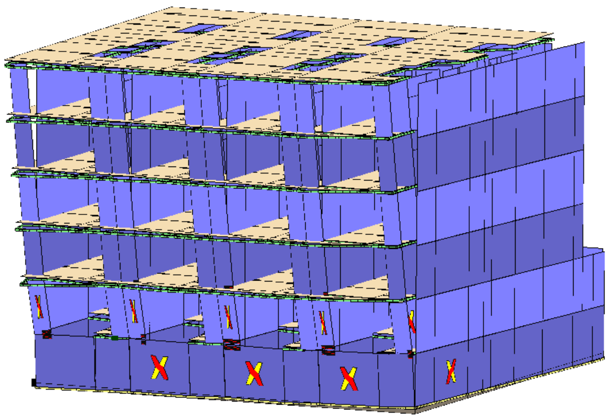


Figure 73: Load case- Pushover -Ex+0.3Ey Acc

HCB – Four Unit, 5 Floors – Ground type A

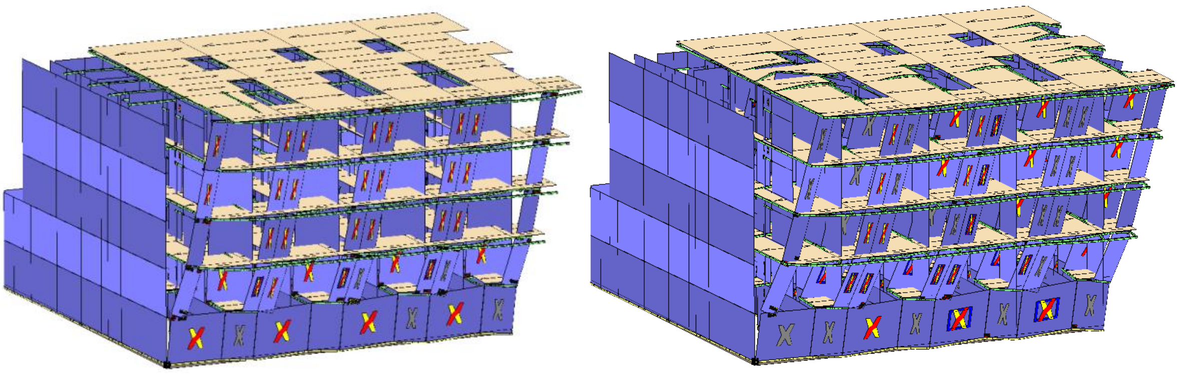


Figure 74: Load case- Pushover +X Acc (Left) Load case- Pushover +X Acc + e (Right)

Globigerina Limestone – Four Unit, 4 Floors – Ground type B

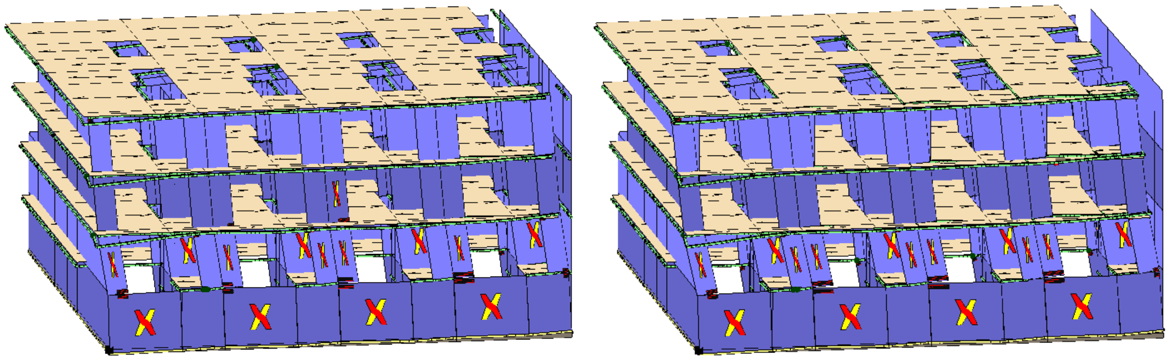


Figure 75: Load case- Pushover-X Acc (Left) Load case- Pushover -Ex+0.3Ey Acc (Right)

HCB – Four Unit, 3 Floors – Ground type B

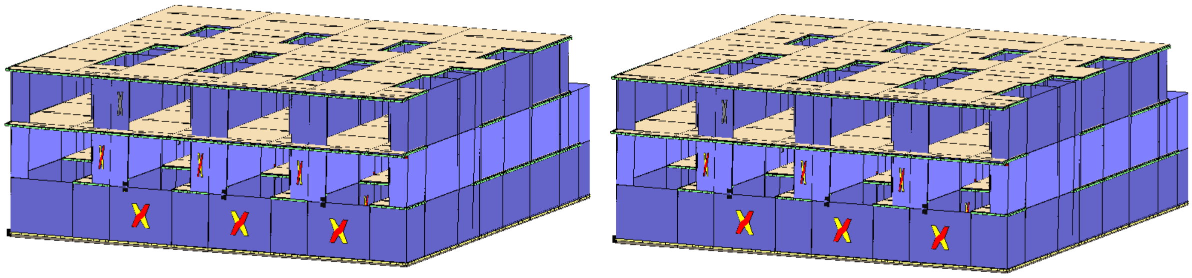


Figure 76: Load case- Pushover +X Acc (Left) Load case- Pushover +X Acc + e (Right)

Globigerina Limestone – Four Unit, 3 Floors – Ground type C

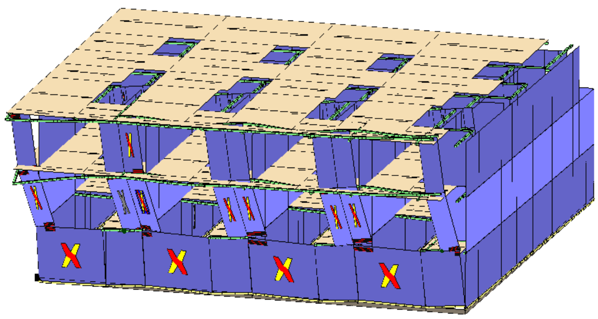


Figure 77: Load case- Pushover -Ex+0.3Ey Acc

HCB – Four Unit, 3 Floors – Ground type C

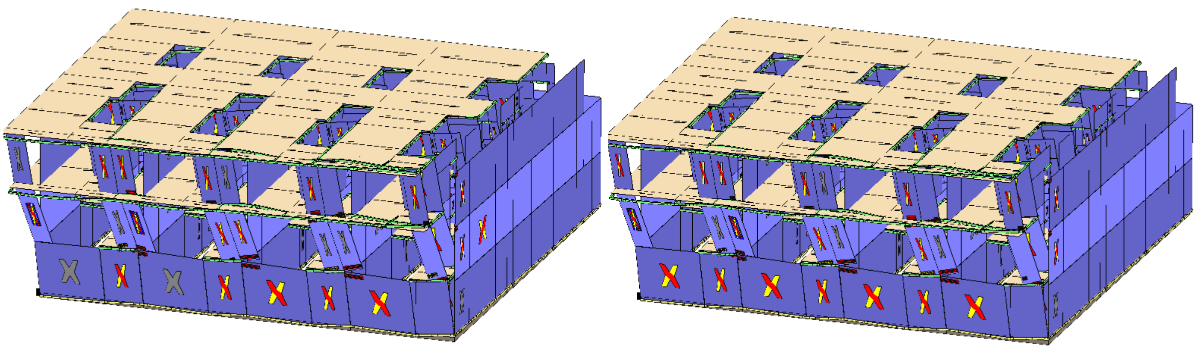


Figure 78: Load case- Pushover-X Acc (Left) Load case- Pushover-X Acc + e (Right)

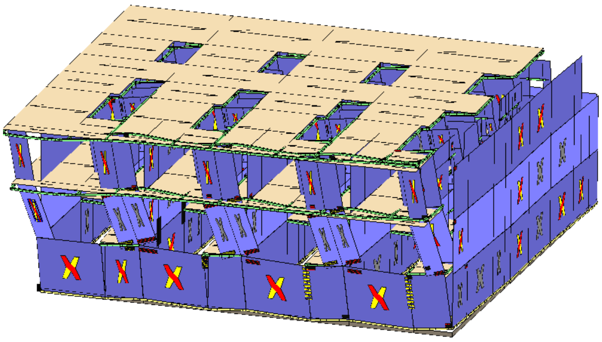


Figure 79: Load case- Pushover -Ex+0.3Ey Acc

Appendix D.1

Results for Structures on Ground Type A (Rock)

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	0.35	1.66	4.79	PASS
Pushover-X Acc	0.35	2.12	6.12	PASS
Pushover+Y Acc	0.02	0.30	14.48	PASS
Pushover-Y Acc	0.02	0.30	14.87	PASS
Pushover+X Acc + e	0.35	1.55	4.50	PASS
Pushover-X Acc + e	0.35	2.12	6.12	PASS
Pushover+Y Acc + e	0.02	0.30	14.69	PASS
Pushover-Y Acc + e	0.02	0.30	14.74	PASS
PushoverEx+0.3Ey Acc	0.33	1.65	5.02	PASS
Pushover0.3Ex+Ey Acc	0.07	0.70	10.60	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.49	7.27	PASS
Pushover-Ex+0.3Ey Acc	0.32	1.93	5.95	PASS

Table 7: The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	1.54	4.04	2.63	PASS
Pushover-X Acc	1.54	2.12	1.38	PASS
Pushover+Y Acc	0.04	0.70	19.44	PASS
Pushover-Y Acc	0.04	1.41	40.10	PASS
Pushover+X Acc + e	1.54	4.04	2.63	PASS
Pushover-X Acc + e	1.54	2.12	1.38	PASS
Pushover+Y Acc + e	0.04	0.70	19.79	PASS
Pushover-Y Acc + e	0.04	1.41	39.68	PASS
PushoverEx+0.3Ey Acc	1.46	3.71	2.54	PASS
Pushover0.3Ex+Ey Acc	0.16	1.71	10.96	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.79	4.95	PASS
Pushover-Ex+0.3Ey Acc	1.44	1.93	1.34	PASS

Table 8: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	2.15	5.39	2.50	PASS
Pushover-X Acc	2.15	2.89	1.34	PASS
Pushover+Y Acc	0.04	1.10	25.24	PASS
Pushover-Y Acc	0.04	1.91	44.96	PASS
Pushover+X Acc + e	2.15	5.49	2.56	PASS
Pushover-X Acc + e	2.16	2.89	1.34	PASS
Pushover+Y Acc + e	0.04	1.00	23.36	PASS
Pushover-Y Acc + e	0.04	1.91	44.50	PASS
PushoverEx+0.3Ey Acc	2.04	4.95	2.42	PASS
Pushover0.3Ex+Ey Acc	0.19	2.31	12.12	PASS
Pushover-0.3Ex+Ey Acc	0.20	1.09	5.52	PASS
Pushover-Ex+0.3Ey Acc	2.00	2.61	1.30	PASS

Table 9: The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.69	3.60	2.13	PASS
Pushover-X Acc	1.32	3.30	2.49	PASS
Pushover+Y Acc	0.03	2.19	69.66	PASS
Pushover-Y Acc	0.03	1.71	55.46	PASS
Pushover+X Acc + e	1.68	3.60	2.14	PASS
Pushover-X Acc + e	1.33	3.20	2.41	PASS
Pushover+Y Acc + e	0.03	2.19	70.67	PASS
Pushover-Y Acc + e	0.03	1.81	55.37	PASS
PushoverEx+0.3Ey Acc	1.77	3.39	1.91	PASS
Pushover0.3Ex+Ey Acc	0.12	1.31	10.69	PASS
Pushover-0.3Ex+Ey Acc	0.13	1.48	11.69	PASS
Pushover-Ex+0.3Ey Acc	1.41	3.11	2.21	PASS

Table 10: The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.38	1.44	3.79	PASS
Pushover-X Acc	0.30	1.16	3.91	PASS
Pushover+Y Acc	0.02	0.20	10.74	PASS
Pushover-Y Acc	0.02	0.10	5.51	PASS
Pushover+X Acc + e	0.38	1.44	3.82	PASS
Pushover-X Acc + e	0.30	1.16	3.89	PASS
Pushover+Y Acc + e	0.02	0.20	10.87	PASS
Pushover-Y Acc + e	0.02	0.20	10.51	PASS
PushoverEx+0.3Ey Acc	0.40	1.95	4.89	PASS
Pushover0.3Ex+Ey Acc	0.05	0.30	5.55	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.30	5.31	PASS
Pushover-Ex+0.3Ey Acc	0.32	1.75	5.53	PASS

Table 11: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.36	4.94	2.09	PASS
Pushover-X Acc	1.74	4.47	2.57	PASS
Pushover+Y Acc	0.04	2.99	78.46	PASS
Pushover-Y Acc	0.04	2.31	61.96	PASS
Pushover+X Acc + e	2.35	4.94	2.10	PASS
Pushover-X Acc + e	1.76	4.37	2.49	PASS
Pushover+Y Acc + e	0.04	2.99	79.59	PASS
Pushover-Y Acc + e	0.04	2.41	60.99	PASS
PushoverEx+0.3Ey Acc	2.48	4.51	1.82	PASS
Pushover0.3Ex+Ey Acc	0.15	1.81	12.29	PASS
Pushover-0.3Ex+Ey Acc	0.15	2.08	13.60	PASS
Pushover-Ex+0.3Ey Acc	1.91	4.18	2.19	PASS

Table 12: The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.51	2.24	4.42	PASS
Pushover-X Acc	0.51	1.96	3.86	PASS
Pushover+Y Acc	0.05	0.50	10.64	PASS
Pushover-Y Acc	0.04	0.50	11.33	PASS
Pushover+X Acc + e	0.51	2.24	4.41	PASS
Pushover-X Acc + e	0.51	1.96	3.86	PASS
Pushover+Y Acc + e	0.05	0.50	10.81	PASS
Pushover-Y Acc + e	0.05	0.50	11.17	PASS
PushoverEx+0.3Ey Acc	0.48	2.33	4.83	PASS
Pushover0.3Ex+Ey Acc	0.14	0.91	6.46	PASS
Pushover-0.3Ex+Ey Acc	0.15	0.68	4.70	PASS
Pushover-Ex+0.3Ey Acc	0.48	1.78	3.69	PASS

Table 13: The outcomes of the SLD pushover analysis for four-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.26	5.77	2.56	PASS
Pushover-X Acc	2.26	1.96	0.87	FAIL
Pushover+Y Acc	0.10	0.79	8.03	PASS
Pushover-Y Acc	0.09	1.51	16.26	PASS
Pushover+X Acc + e	2.26	5.77	2.55	PASS
Pushover-X Acc + e	2.25	1.96	0.87	FAIL
Pushover+Y Acc + e	0.10	0.79	8.20	PASS
Pushover-Y Acc + e	0.09	1.51	15.96	PASS
PushoverEx+0.3Ey Acc	2.15	5.41	2.52	PASS
Pushover0.3Ex+Ey Acc	0.33	2.13	6.42	PASS
Pushover-0.3Ex+Ey Acc	0.34	0.78	2.29	PASS
Pushover-Ex+0.3Ey Acc	2.14	1.78	0.83	FAIL

Table 14: The outcomes of the SLV pushover analysis for four-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.15	7.69	2.44	PASS
Pushover-X Acc	3.15	2.61	0.83	FAIL
Pushover+Y Acc	0.12	1.09	9.16	PASS
Pushover-Y Acc	0.11	2.11	18.89	PASS
Pushover+X Acc + e	3.16	7.69	2.43	PASS
Pushover-X Acc + e	3.15	2.61	0.83	FAIL
Pushover+Y Acc + e	0.12	1.09	9.35	PASS
Pushover-Y Acc + e	0.11	2.11	18.54	PASS
PushoverEx+0.3Ey Acc	3.00	7.21	2.40	PASS
Pushover0.3Ex+Ey Acc	0.42	2.84	6.72	PASS
Pushover-0.3Ex+Ey Acc	0.43	1.07	2.47	PASS
Pushover-Ex+0.3Ey Acc	2.99	2.43	0.81	FAIL

Table 15: The outcomes of the SLC pushover analysis for four-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.51	1.37	2.68	PASS
Pushover-X Acc	0.45	1.51	3.40	PASS
Pushover+Y Acc	0.04	0.30	7.53	PASS
Pushover-Y Acc	0.04	0.30	7.55	PASS
Pushover+X Acc + e	0.52	1.48	2.85	PASS
Pushover-X Acc + e	0.45	1.51	3.40	PASS
Pushover+Y Acc + e	0.04	0.30	7.68	PASS
Pushover-Y Acc + e	0.04	0.30	7.52	PASS
PushoverEx+0.3Ey Acc	0.73	4.51	6.16	PASS
Pushover0.3Ex+Ey Acc	0.12	0.61	5.11	PASS
Pushover-0.3Ex+Ey Acc	0.11	0.39	3.42	PASS
Pushover-Ex+0.3Ey Acc	0.41	1.52	3.74	PASS

Table 16: The outcomes of the SLD pushover analysis for a four-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.28	5.91	2.59	PASS
Pushover-X Acc	1.98	2.84	1.43	PASS
Pushover+Y Acc	0.08	3.88	48.36	PASS
Pushover-Y Acc	0.08	1.91	23.57	PASS
Pushover+X Acc + e	2.31	6.01	2.61	PASS
Pushover-X Acc + e	1.98	2.84	1.43	PASS
Pushover+Y Acc + e	0.08	3.78	48.30	PASS
Pushover-Y Acc + e	0.08	1.91	23.45	PASS
PushoverEx+0.3Ey Acc	3.25	5.45	1.68	PASS
Pushover0.3Ex+Ey Acc	0.28	2.22	7.97	PASS
Pushover-0.3Ex+Ey Acc	0.27	1.08	4.01	PASS
Pushover-Ex+0.3Ey Acc	1.80	2.65	1.47	PASS

Table 17: The outcomes of the SLV pushover analysis for a four-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.18	8.02	2.52	PASS
Pushover-X Acc	2.77	3.88	1.40	PASS
Pushover+Y Acc	0.10	5.27	54.49	PASS
Pushover-Y Acc	0.10	2.62	26.74	PASS
Pushover+X Acc + e	3.23	8.12	2.52	PASS
Pushover-X Acc + e	2.77	3.88	1.40	PASS
Pushover+Y Acc + e	0.09	5.07	53.74	PASS
Pushover-Y Acc + e	0.10	2.62	26.61	PASS
PushoverEx+0.3Ey Acc	4.55	7.34	1.61	PASS
Pushover0.3Ex+Ey Acc	0.35	3.03	8.53	PASS
Pushover-0.3Ex+Ey Acc	0.34	1.47	4.29	PASS
Pushover-Ex+0.3Ey Acc	2.52	3.60	1.43	PASS

Table 18: The outcomes of the SLC pushover analysis for a four-story, single-unit structure built with HCB on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.69	2.77	4.03	PASS
Pushover-X Acc	0.67	1.87	2.78	PASS
Pushover+Y Acc	0.09	0.89	10.01	PASS
Pushover-Y Acc	0.08	0.71	8.46	PASS
Pushover+X Acc + e	0.69	2.66	3.87	PASS
Pushover-X Acc + e	0.67	1.87	2.80	PASS
Pushover+Y Acc + e	0.09	0.89	10.18	PASS
Pushover-Y Acc + e	0.08	0.71	8.32	PASS
PushoverEx+0.3Ey Acc	0.65	2.85	4.36	PASS
Pushover0.3Ex+Ey Acc	0.21	1.33	6.35	PASS
Pushover-0.3Ex+Ey Acc	0.21	0.77	3.62	PASS
Pushover-Ex+0.3Ey Acc	0.64	1.80	2.79	PASS

Table 19: The outcomes of the SLD pushover analysis for five-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.05	6.64	2.18	PASS
Pushover-X Acc	3.00	1.87	0.63	FAIL
Pushover+Y Acc	0.21	1.19	5.68	PASS
Pushover-Y Acc	0.20	2.02	10.29	PASS
Pushover+X Acc + e	3.05	6.53	2.14	PASS
Pushover-X Acc + e	2.98	1.87	0.63	FAIL
Pushover+Y Acc + e	0.21	1.19	5.78	PASS
Pushover-Y Acc + e	0.20	2.02	10.12	PASS
PushoverEx+0.3Ey Acc	2.91	6.14	2.11	PASS
Pushover0.3Ex+Ey Acc	0.60	2.65	4.43	PASS
Pushover-0.3Ex+Ey Acc	0.62	0.77	1.24	PASS
Pushover-Ex+0.3Ey Acc	2.86	1.80	0.63	FAIL

Table 20: The outcomes of the SLV pushover analysis for five-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.27	8.86	2.08	PASS
Pushover-X Acc	4.19	2.59	0.62	FAIL
Pushover+Y Acc	0.27	1.58	5.95	PASS
Pushover-Y Acc	0.25	2.73	10.90	PASS
Pushover+X Acc + e	4.26	8.75	2.05	PASS
Pushover-X Acc + e	4.17	2.59	0.62	FAIL
Pushover+Y Acc + e	0.26	1.58	6.05	PASS
Pushover-Y Acc + e	0.25	2.73	10.73	PASS
PushoverEx+0.3Ey Acc	4.06	8.22	2.02	PASS
Pushover0.3Ex+Ey Acc	0.76	3.57	4.68	PASS
Pushover-0.3Ex+Ey Acc	0.79	1.06	1.34	PASS
Pushover-Ex+0.3Ey Acc	4.00	2.43	0.61	FAIL

Table 21: The outcomes of the SLC pushover analysis for five-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.63	1.20	1.90	PASS
Pushover-X Acc	0.62	1.73	2.80	PASS
Pushover+Y Acc	0.08	0.59	7.68	PASS
Pushover-Y Acc	0.08	0.40	5.35	PASS
Pushover+X Acc + e	0.63	1.20	1.89	PASS
Pushover-X Acc + e	0.62	1.73	2.81	PASS
Pushover+Y Acc + e	0.08	0.59	7.87	PASS
Pushover-Y Acc + e	0.08	0.50	6.22	PASS
PushoverEx+0.3Ey Acc	0.70	2.05	2.92	PASS
Pushover0.3Ex+Ey Acc	0.20	1.12	5.59	PASS
Pushover-0.3Ex+Ey Acc	0.19	0.68	3.53	PASS
Pushover-Ex+0.3Ey Acc	0.56	1.65	2.93	PASS

Table 22: The outcomes of the SLD pushover analysis for a five-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.80	7.17	2.56	PASS
Pushover-X Acc	2.75	3.10	1.13	PASS
Pushover+Y Acc	0.18	4.26	23.44	PASS
Pushover-Y Acc	0.18	1.72	9.69	PASS
Pushover+X Acc + e	2.81	7.17	2.55	PASS
Pushover-X Acc + e	2.75	3.10	1.13	PASS
Pushover+Y Acc + e	0.18	4.16	23.46	PASS
Pushover-Y Acc + e	0.19	2.22	11.66	PASS
PushoverEx+0.3Ey Acc	3.12	6.36	2.04	PASS
Pushover0.3Ex+Ey Acc	0.55	2.34	4.26	PASS
Pushover-0.3Ex+Ey Acc	0.51	1.26	2.48	PASS
Pushover-Ex+0.3Ey Acc	2.50	2.84	1.14	PASS

Table 23: The outcomes of the SLV pushover analysis for a five-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.92	9.57	2.44	PASS
Pushover-X Acc	3.85	4.20	1.09	PASS
Pushover+Y Acc	0.23	5.75	25.28	PASS
Pushover-Y Acc	0.22	2.32	10.56	PASS
Pushover+X Acc + e	3.93	9.57	2.43	PASS
Pushover-X Acc + e	3.84	4.20	1.09	PASS
Pushover+Y Acc + e	0.22	5.55	25.20	PASS
Pushover-Y Acc + e	0.24	3.03	12.54	PASS
PushoverEx+0.3Ey Acc	4.36	8.60	1.97	PASS
Pushover0.3Ex+Ey Acc	0.70	3.21	4.59	PASS
Pushover-0.3Ex+Ey Acc	0.65	1.74	2.70	PASS
Pushover-Ex+0.3Ey Acc	3.50	3.85	1.10	PASS

Table 24: The outcomes of the SLC pushover analysis for a five-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.93	3.23	3.47	PASS
Pushover-X Acc	0.91	1.78	1.95	PASS
Pushover+Y Acc	0.17	1.38	8.07	PASS
Pushover-Y Acc	0.16	1.01	6.38	PASS
Pushover+X Acc + e	0.93	3.23	3.46	PASS
Pushover-X Acc + e	0.91	1.78	1.96	PASS
Pushover+Y Acc + e	0.17	1.38	8.23	PASS
Pushover-Y Acc + e	0.16	1.01	6.27	PASS
PushoverEx+0.3Ey Acc	0.89	3.52	3.97	PASS
Pushover0.3Ex+Ey Acc	0.29	1.75	6.08	PASS
Pushover-0.3Ex+Ey Acc	0.29	0.76	2.58	PASS
Pushover-Ex+0.3Ey Acc	0.87	1.71	1.96	PASS

Table 25: The outcomes of the SLD pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.14	7.61	1.84	PASS
Pushover-X Acc	4.05	1.78	0.44	FAIL
Pushover+Y Acc	0.40	1.48	3.68	PASS
Pushover-Y Acc	0.37	2.23	5.98	PASS
Pushover+X Acc + e	4.15	7.61	1.83	PASS
Pushover-X Acc + e	4.03	1.78	0.44	FAIL
Pushover+Y Acc + e	0.39	1.48	3.75	PASS
Pushover-Y Acc + e	0.38	2.13	5.61	PASS
PushoverEx+0.3Ey Acc	3.95	6.93	1.76	PASS
Pushover0.3Ex+Ey Acc	1.11	2.88	2.61	PASS
Pushover-0.3Ex+Ey Acc	1.17	0.76	0.65	FAIL
Pushover-Ex+0.3Ey Acc	3.89	1.71	0.44	FAIL

Table 26: The outcomes of the SLV pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.78	10.15	1.76	PASS
Pushover-X Acc	5.66	2.46	0.43	FAIL
Pushover+Y Acc	0.51	2.07	4.05	PASS
Pushover-Y Acc	0.48	3.04	6.40	PASS
Pushover+X Acc + e	5.80	10.15	1.75	PASS
Pushover-X Acc + e	5.63	2.46	0.44	FAIL
Pushover+Y Acc + e	0.50	2.07	4.13	PASS
Pushover-Y Acc + e	0.48	2.84	5.87	PASS
PushoverEx+0.3Ey Acc	5.52	9.28	1.68	PASS
Pushover0.3Ex+Ey Acc	1.41	3.88	2.76	PASS
Pushover-0.3Ex+Ey Acc	1.58	1.04	0.66	FAIL
Pushover-Ex+0.3Ey Acc	5.44	2.31	0.42	FAIL

Table 27: The outcomes of the SLC pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.89	1.24	1.39	PASS
Pushover-X Acc	0.86	2.36	2.75	PASS
Pushover+Y Acc	0.15	0.79	5.43	PASS
Pushover-Y Acc	0.14	0.61	4.46	PASS
Pushover+X Acc + e	0.89	1.24	1.39	PASS
Pushover-X Acc + e	0.86	2.36	2.76	PASS
Pushover+Y Acc + e	0.14	0.79	5.53	PASS
Pushover-Y Acc + e	0.14	0.61	4.37	PASS
PushoverEx+0.3Ey Acc	0.87	1.67	1.93	PASS
Pushover0.3Ex+Ey Acc	0.27	1.64	6.00	PASS
Pushover-0.3Ex+Ey Acc	0.26	0.95	3.67	PASS
Pushover-Ex+0.3Ey Acc	0.77	2.11	2.75	PASS

Table 28: The outcomes of the SLD pushover analysis for a six-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.95	4.39	1.11	PASS
Pushover-X Acc	3.81	3.15	0.83	FAIL
Pushover+Y Acc	0.34	3.26	9.53	PASS
Pushover-Y Acc	0.32	2.43	7.60	PASS
Pushover+X Acc + e	3.97	4.50	1.14	PASS
Pushover-X Acc + e	3.80	3.15	0.83	FAIL
Pushover+Y Acc + e	0.34	3.16	9.42	PASS
Pushover-Y Acc + e	0.33	1.82	5.58	PASS
PushoverEx+0.3Ey Acc	3.85	6.67	1.73	PASS
Pushover0.3Ex+Ey Acc	0.99	2.66	2.68	PASS
Pushover-0.3Ex+Ey Acc	0.90	1.43	1.59	PASS
Pushover-Ex+0.3Ey Acc	3.41	2.91	0.85	FAIL

Table 29: The outcomes of the SLV pushover analysis for a six-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.52	5.85	1.06	PASS
Pushover-X Acc	5.33	4.28	0.80	FAIL
Pushover+Y Acc	0.43	4.34	9.98	PASS
Pushover-Y Acc	0.41	3.24	7.96	PASS
Pushover+X Acc + e	5.54	6.08	1.10	PASS
Pushover-X Acc + e	5.32	4.28	0.81	FAIL
Pushover+Y Acc + e	0.43	4.24	9.94	PASS
Pushover-Y Acc + e	0.42	2.43	5.84	PASS
PushoverEx+0.3Ey Acc	5.38	8.89	1.65	PASS
Pushover0.3Ex+Ey Acc	1.26	3.58	2.83	PASS
Pushover-0.3Ex+Ey Acc	1.22	1.91	1.56	PASS
Pushover-Ex+0.3Ey Acc	4.77	3.96	0.83	FAIL

Table 30: The outcomes of the SLC pushover analysis for a six-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.14	3.86	3.38	PASS
Pushover-X Acc	1.11	1.59	1.43	PASS
Pushover+Y Acc	0.22	2.06	9.42	PASS
Pushover-Y Acc	0.21	1.43	6.81	PASS
Pushover+X Acc + e	1.15	3.86	3.36	PASS
Pushover-X Acc + e	1.10	1.67	1.52	PASS
Pushover+Y Acc + e	0.22	1.96	9.06	PASS
Pushover-Y Acc + e	0.21	1.43	6.74	PASS
PushoverEx+0.3Ey Acc	1.09	4.14	3.81	PASS
Pushover0.3Ex+Ey Acc	0.36	2.39	6.66	PASS
Pushover-0.3Ex+Ey Acc	0.36	0.65	1.78	PASS
Pushover-Ex+0.3Ey Acc	1.07	1.53	1.43	PASS

Table 31: The outcomes of the SLD pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.07	7.95	1.57	PASS
Pushover-X Acc	4.94	1.59	0.32	FAIL
Pushover+Y Acc	0.63	2.06	3.26	PASS
Pushover-Y Acc	0.58	2.55	4.39	PASS
Pushover+X Acc + e	5.11	7.95	1.56	PASS
Pushover-X Acc + e	4.90	1.67	0.34	FAIL
Pushover+Y Acc + e	0.62	1.96	3.17	PASS
Pushover-Y Acc + e	0.59	2.45	4.14	PASS
PushoverEx+0.3Ey Acc	4.84	7.33	1.52	PASS
Pushover0.3Ex+Ey Acc	1.60	3.12	1.95	PASS
Pushover-0.3Ex+Ey Acc	1.62	0.65	0.40	FAIL
Pushover-Ex+0.3Ey Acc	4.77	1.53	0.32	FAIL

Table 32: The outcomes of the SLV pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.08	10.73	1.51	PASS
Pushover-X Acc	6.90	2.23	0.32	FAIL
Pushover+Y Acc	0.80	2.84	3.54	PASS
Pushover-Y Acc	0.74	3.47	4.69	PASS
Pushover+X Acc + e	7.14	10.73	1.50	PASS
Pushover-X Acc + e	6.84	2.30	0.34	FAIL
Pushover+Y Acc + e	0.79	2.75	3.49	PASS
Pushover-Y Acc + e	0.75	3.26	4.33	PASS
PushoverEx+0.3Ey Acc	6.76	9.80	1.45	PASS
Pushover0.3Ex+Ey Acc	2.16	4.26	1.97	PASS
Pushover-0.3Ex+Ey Acc	2.25	0.93	0.41	FAIL
Pushover-Ex+0.3Ey Acc	6.67	2.10	0.31	FAIL

Table 33: The outcomes of the SLC pushover analysis for six-story, single-unit structure built with Globigerina limestone on rock subsoil.

One Unit – Detached Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.10	1.52	1.38	PASS
Pushover-X Acc	1.04	2.90	2.78	PASS
Pushover+Y Acc	0.20	1.28	6.25	PASS
Pushover-Y Acc	0.19	0.82	4.21	PASS
Pushover+X Acc + e	1.11	1.52	1.37	PASS
Pushover-X Acc + e	1.04	3.07	2.96	PASS
Pushover+Y Acc + e	0.20	1.28	6.34	PASS
Pushover-Y Acc + e	0.19	0.82	4.20	PASS
PushoverEx+0.3Ey Acc	1.06	1.84	1.74	PASS
Pushover0.3Ex+Ey Acc	0.34	1.96	5.76	PASS
Pushover-0.3Ex+Ey Acc	0.32	1.12	3.55	PASS
Pushover-Ex+0.3Ey Acc	0.92	2.77	3.00	PASS

Table 34: The outcomes of the SLD pushover analysis for a seven-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.90	4.80	0.98	FAIL
Pushover-X Acc	4.64	3.07	0.66	FAIL
Pushover+Y Acc	0.55	3.92	7.15	PASS
Pushover-Y Acc	0.49	2.85	5.77	PASS
Pushover+X Acc + e	4.94	4.68	0.95	FAIL
Pushover-X Acc + e	4.61	3.15	0.68	FAIL
Pushover+Y Acc + e	0.53	3.92	7.34	PASS
Pushover-Y Acc + e	0.50	2.45	4.92	PASS
PushoverEx+0.3Ey Acc	4.72	7.02	1.49	PASS
Pushover0.3Ex+Ey Acc	1.51	2.78	1.84	PASS
Pushover-0.3Ex+Ey Acc	1.33	1.31	0.98	FAIL
Pushover-Ex+0.3Ey Acc	4.11	2.85	0.69	FAIL

Table 35: The outcomes of the SLV pushover analysis for a seven-story, single-unit structure built with HCB on rock subsoil

One Unit – Detached Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.85	6.44	0.94	FAIL
Pushover-X Acc	6.49	4.15	0.64	FAIL
Pushover+Y Acc	0.70	5.30	7.58	PASS
Pushover-Y Acc	0.63	3.87	6.15	PASS
Pushover+X Acc + e	6.90	6.32	0.92	FAIL
Pushover-X Acc + e	6.44	4.23	0.66	FAIL
Pushover+Y Acc + e	0.68	5.30	7.78	PASS
Pushover-Y Acc + e	0.63	3.36	5.31	PASS
PushoverEx+0.3Ey Acc	6.59	9.44	1.43	PASS
Pushover0.3Ex+Ey Acc	1.94	3.84	1.98	PASS
Pushover-0.3Ex+Ey Acc	1.77	1.78	1.01	FAIL
Pushover-Ex+0.3Ey Acc	5.74	3.86	0.67	FAIL

Table 36: The outcomes of the SLC pushover analysis for a seven-story, single-unit structure built with HCB on rock subsoil

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.29	1.02	3.49	PASS
Pushover-X Acc	0.29	0.79	2.69	PASS
Pushover+Y Acc	0.03	0.30	10.13	PASS
Pushover-Y Acc	0.03	0.30	9.54	PASS
Pushover+X Acc + e	0.29	0.92	3.14	PASS
Pushover-X Acc + e	0.29	0.79	2.69	PASS
Pushover+Y Acc + e	0.03	0.30	10.25	PASS
Pushover-Y Acc + e	0.03	0.30	9.41	PASS
PushoverEx+0.3Ey Acc	0.27	0.91	3.33	PASS
Pushover0.3Ex+Ey Acc	0.06	0.50	7.93	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.40	6.12	PASS
Pushover-Ex+0.3Ey Acc	0.29	0.69	2.41	PASS

Table 37: The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.24	3.36	2.71	PASS
Pushover-X Acc	1.23	2.65	2.15	PASS
Pushover+Y Acc	0.06	0.80	14.35	PASS
Pushover-Y Acc	0.06	1.31	21.58	PASS
Pushover+X Acc + e	1.24	3.46	2.79	PASS
Pushover-X Acc + e	1.23	2.65	2.15	PASS
Pushover+Y Acc + e	0.05	1.29	23.68	PASS
Pushover-Y Acc + e	0.06	1.41	22.83	PASS
PushoverEx+0.3Ey Acc	1.11	3.15	2.84	PASS
Pushover0.3Ex+Ey Acc	0.15	1.80	12.26	PASS
Pushover-0.3Ex+Ey Acc	0.15	0.69	4.56	PASS
Pushover-Ex+0.3Ey Acc	1.17	2.26	1.93	PASS

Table 38: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.65	4.58	2.78	PASS
Pushover-X Acc	1.63	3.54	2.17	PASS
Pushover+Y Acc	0.07	2.09	31.19	PASS
Pushover-Y Acc	0.07	1.81	24.75	PASS
Pushover+X Acc + e	1.65	4.68	2.83	PASS
Pushover-X Acc + e	1.62	3.54	2.18	PASS
Pushover+Y Acc + e	0.07	2.29	34.69	PASS
Pushover-Y Acc + e	0.07	1.91	25.66	PASS
PushoverEx+0.3Ey Acc	1.49	4.26	2.86	PASS
Pushover0.3Ex+Ey Acc	0.18	2.40	13.59	PASS
Pushover-0.3Ex+Ey Acc	0.18	0.99	5.41	PASS
Pushover-Ex+0.3Ey Acc	1.53	3.14	2.06	PASS

Table 39: The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.31	0.61	1.95	PASS
Pushover-X Acc	0.35	1.38	3.90	PASS
Pushover+Y Acc	0.03	0.20	6.77	PASS
Pushover-Y Acc	0.03	0.20	5.86	PASS
Pushover+X Acc + e	0.31	0.61	1.95	PASS
Pushover-X Acc + e	0.36	1.48	4.12	PASS
Pushover+Y Acc + e	0.03	0.20	6.83	PASS
Pushover-Y Acc + e	0.03	0.20	5.78	PASS
PushoverEx+0.3Ey Acc	0.30	0.81	2.70	PASS
Pushover0.3Ex+Ey Acc	0.06	0.30	5.34	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.30	4.59	PASS
Pushover-Ex+0.3Ey Acc	0.36	1.97	5.51	PASS

Table 40: The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.39	3.25	2.34	PASS
Pushover-X Acc	1.57	2.96	1.88	PASS
Pushover+Y Acc	0.06	2.09	37.80	PASS
Pushover-Y Acc	0.07	1.41	20.96	PASS
Pushover+X Acc + e	1.39	3.25	2.34	PASS
Pushover-X Acc + e	1.60	2.96	1.85	PASS
Pushover+Y Acc + e	0.05	1.99	36.44	PASS
Pushover-Y Acc + e	0.07	1.41	20.61	PASS
PushoverEx+0.3Ey Acc	1.31	3.04	2.33	PASS
Pushover0.3Ex+Ey Acc	0.13	1.80	14.27	PASS
Pushover-0.3Ex+Ey Acc	0.15	1.29	8.49	PASS
Pushover-Ex+0.3Ey Acc	1.59	2.95	1.86	PASS

Table 41: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.88	4.36	2.32	PASS
Pushover-X Acc	2.20	4.04	1.84	PASS
Pushover+Y Acc	0.07	2.88	43.22	PASS
Pushover-Y Acc	0.08	2.01	24.81	PASS
Pushover+X Acc + e	1.88	4.47	2.38	PASS
Pushover-X Acc + e	2.23	4.04	1.81	PASS
Pushover+Y Acc + e	0.07	2.68	40.72	PASS
Pushover-Y Acc + e	0.08	2.01	24.40	PASS
PushoverEx+0.3Ey Acc	1.75	4.05	2.32	PASS
Pushover0.3Ex+Ey Acc	0.15	2.40	15.80	PASS
Pushover-0.3Ex+Ey Acc	0.18	1.78	9.77	PASS
Pushover-Ex+0.3Ey Acc	2.22	3.94	1.77	PASS

Table 42: The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.43	1.45	3.34	PASS
Pushover-X Acc	0.41	0.77	1.89	PASS
Pushover+Y Acc	0.06	0.59	9.42	PASS
Pushover-Y Acc	0.07	0.51	7.77	PASS
Pushover+X Acc + e	0.43	1.45	3.35	PASS
Pushover-X Acc + e	0.41	0.77	1.90	PASS
Pushover+Y Acc + e	0.06	0.59	9.55	PASS
Pushover-Y Acc + e	0.07	0.51	7.64	PASS
PushoverEx+0.3Ey Acc	0.41	1.44	3.55	PASS
Pushover0.3Ex+Ey Acc	0.13	0.70	5.57	PASS
Pushover-0.3Ex+Ey Acc	0.13	0.39	3.01	PASS
Pushover-Ex+0.3Ey Acc	0.39	0.68	1.74	PASS

Table 43: The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.93	5.28	2.74	PASS
Pushover-X Acc	1.81	2.32	1.28	PASS
Pushover+Y Acc	0.15	0.89	6.14	PASS
Pushover-Y Acc	0.15	1.52	10.03	PASS
Pushover+X Acc + e	1.92	5.28	2.74	PASS
Pushover-X Acc + e	1.81	2.41	1.34	PASS
Pushover+Y Acc + e	0.14	1.09	7.64	PASS
Pushover-Y Acc + e	0.15	1.62	10.46	PASS
PushoverEx+0.3Ey Acc	1.81	5.04	2.79	PASS
Pushover0.3Ex+Ey Acc	0.30	2.40	8.13	PASS
Pushover-0.3Ex+Ey Acc	0.31	1.08	3.52	PASS
Pushover-Ex+0.3Ey Acc	1.73	2.22	1.29	PASS

Table 44: The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.69	7.14	2.65	PASS
Pushover-X Acc	2.54	3.19	1.26	PASS
Pushover+Y Acc	0.17	1.29	7.37	PASS
Pushover-Y Acc	0.18	2.12	11.67	PASS
Pushover+X Acc + e	2.69	7.14	2.66	PASS
Pushover-X Acc + e	2.53	3.28	1.30	PASS
Pushover+Y Acc + e	0.17	1.88	10.96	PASS
Pushover-Y Acc + e	0.19	2.22	11.96	PASS
PushoverEx+0.3Ey Acc	2.53	7.10	2.81	PASS
Pushover0.3Ex+Ey Acc	0.38	3.20	8.51	PASS
Pushover-0.3Ex+Ey Acc	0.39	1.47	3.77	PASS
Pushover-Ex+0.3Ey Acc	2.41	2.99	1.24	PASS

Table 45: The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.47	0.93	1.96	PASS
Pushover-X Acc	0.35	0.78	2.22	PASS
Pushover+Y Acc	0.06	0.30	5.24	PASS
Pushover-Y Acc	0.07	0.30	4.59	PASS
Pushover+X Acc + e	0.48	0.93	1.94	PASS
Pushover-X Acc + e	0.35	0.78	2.23	PASS
Pushover+Y Acc + e	0.06	0.30	5.34	PASS
Pushover-Y Acc + e	0.07	0.40	5.99	PASS
PushoverEx+0.3Ey Acc	0.44	1.13	2.54	PASS
Pushover0.3Ex+Ey Acc	0.12	0.50	4.17	PASS
Pushover-0.3Ex+Ey Acc	0.13	0.49	3.72	PASS
Pushover-Ex+0.3Ey Acc	0.34	0.68	2.03	PASS

Table 46: The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with HCB on rock subsoil

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.11	5.55	2.64	PASS
Pushover-X Acc	1.56	2.62	1.68	PASS
Pushover+Y Acc	0.13	2.97	23.52	PASS
Pushover-Y Acc	0.15	1.62	10.49	PASS
Pushover+X Acc + e	2.12	5.66	2.67	PASS
Pushover-X Acc + e	1.55	2.72	1.75	PASS
Pushover+Y Acc + e	0.12	2.87	23.26	PASS
Pushover-Y Acc + e	0.16	1.62	10.19	PASS
PushoverEx+0.3Ey Acc	1.97	4.91	2.49	PASS
Pushover0.3Ex+Ey Acc	0.28	2.80	9.94	PASS
Pushover-0.3Ex+Ey Acc	0.31	1.18	3.80	PASS
Pushover-Ex+0.3Ey Acc	1.49	2.33	1.56	PASS

Table 47: The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.94	7.40	2.52	PASS
Pushover-X Acc	2.18	3.60	1.65	PASS
Pushover+Y Acc	0.15	4.06	26.70	PASS
Pushover-Y Acc	0.19	2.22	11.98	PASS
Pushover+X Acc + e	2.96	7.61	2.57	PASS
Pushover-X Acc + e	2.16	3.69	1.71	PASS
Pushover+Y Acc + e	0.15	3.96	26.64	PASS
Pushover-Y Acc + e	0.19	2.22	11.65	PASS
PushoverEx+0.3Ey Acc	2.75	6.65	2.42	PASS
Pushover0.3Ex+Ey Acc	0.36	3.86	10.77	PASS
Pushover-0.3Ex+Ey Acc	0.39	1.57	3.98	PASS
Pushover-Ex+0.3Ey Acc	2.04	3.20	1.57	PASS

Table 48: The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.55	1.69	3.09	PASS
Pushover-X Acc	0.54	0.76	1.41	PASS
Pushover+Y Acc	0.12	0.79	6.49	PASS
Pushover-Y Acc	0.12	0.81	6.83	PASS
Pushover+X Acc + e	0.55	1.69	3.08	PASS
Pushover-X Acc + e	0.53	0.76	1.42	PASS
Pushover+Y Acc + e	0.12	0.79	6.62	PASS
Pushover-Y Acc + e	0.12	0.81	6.69	PASS
PushoverEx+0.3Ey Acc	0.56	1.67	2.97	PASS
Pushover0.3Ex+Ey Acc	0.20	0.90	4.57	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.39	1.93	PASS
Pushover-Ex+0.3Ey Acc	0.51	0.66	1.29	PASS

Table 49: The outcomes of the SLD pushover analysis for a five-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.43	5.27	2.17	PASS
Pushover-X Acc	2.39	2.55	1.07	PASS
Pushover+Y Acc	0.28	0.79	2.76	PASS
Pushover-Y Acc	0.28	1.83	6.54	PASS
Pushover+X Acc + e	2.44	5.17	2.12	PASS
Pushover-X Acc + e	2.38	2.55	1.07	PASS
Pushover+Y Acc + e	0.28	0.79	2.82	PASS
Pushover-Y Acc + e	0.29	1.83	6.41	PASS
PushoverEx+0.3Ey Acc	2.50	4.91	1.96	PASS
Pushover0.3Ex+Ey Acc	0.53	1.50	2.85	PASS
Pushover-0.3Ex+Ey Acc	0.55	1.07	1.94	PASS
Pushover-Ex+0.3Ey Acc	2.29	2.36	1.03	PASS

Table 50: The outcomes of the SLV pushover analysis for a five-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.40	7.07	2.08	PASS
Pushover-X Acc	3.35	3.50	1.05	PASS
Pushover+Y Acc	0.36	1.08	2.98	PASS
Pushover-Y Acc	0.36	2.54	7.14	PASS
Pushover+X Acc + e	3.41	6.96	2.04	PASS
Pushover-X Acc + e	3.32	3.50	1.05	PASS
Pushover+Y Acc + e	0.36	1.08	3.04	PASS
Pushover-Y Acc + e	0.36	2.54	6.99	PASS
PushoverEx+0.3Ey Acc	3.50	6.59	1.88	PASS
Pushover0.3Ex+Ey Acc	0.67	2.10	3.13	PASS
Pushover-0.3Ex+Ey Acc	0.70	1.55	2.22	PASS
Pushover-Ex+0.3Ey Acc	3.20	3.22	1.01	PASS

Table 51: The outcomes of the SLC pushover analysis for a five-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.70	1.25	1.80	PASS
Pushover-X Acc	0.47	1.05	2.23	PASS
Pushover+Y Acc	0.10	0.59	5.88	PASS
Pushover-Y Acc	0.11	0.51	4.63	PASS
Pushover+X Acc + e	0.71	1.36	1.91	PASS
Pushover-X Acc + e	0.47	1.05	2.26	PASS
Pushover+Y Acc + e	0.10	0.49	4.99	PASS
Pushover-Y Acc + e	0.11	0.51	4.50	PASS
PushoverEx+0.3Ey Acc	0.62	1.66	2.67	PASS
Pushover0.3Ex+Ey Acc	0.19	0.90	4.70	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.78	3.92	PASS
Pushover-Ex+0.3Ey Acc	0.45	1.05	2.31	PASS

Table 52: The outcomes of the SLD pushover analysis for a five-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.10	6.27	2.02	PASS
Pushover-X Acc	2.09	2.87	1.37	PASS
Pushover+Y Acc	0.24	2.65	11.26	PASS
Pushover-Y Acc	0.26	1.83	7.10	PASS
Pushover+X Acc + e	3.17	6.37	2.01	PASS
Pushover-X Acc + e	2.07	2.87	1.38	PASS
Pushover+Y Acc + e	0.23	3.24	14.04	PASS
Pushover-Y Acc + e	0.27	1.73	6.51	PASS
PushoverEx+0.3Ey Acc	2.77	6.12	2.21	PASS
Pushover0.3Ex+Ey Acc	0.49	2.99	6.05	PASS
Pushover-0.3Ex+Ey Acc	0.53	1.17	2.18	PASS
Pushover-Ex+0.3Ey Acc	2.02	2.58	1.27	PASS

Table 53: The outcomes of the SLV pushover analysis for a five-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.33	8.36	1.93	PASS
Pushover-X Acc	2.93	3.82	1.30	PASS
Pushover+Y Acc	0.30	3.64	12.12	PASS
Pushover-Y Acc	0.33	2.54	7.74	PASS
Pushover+X Acc + e	4.43	8.57	1.94	PASS
Pushover-X Acc + e	2.90	3.82	1.32	PASS
Pushover+Y Acc + e	0.29	4.33	14.70	PASS
Pushover-Y Acc + e	0.34	2.44	7.22	PASS
PushoverEx+0.3Ey Acc	3.87	8.19	2.12	PASS
Pushover0.3Ex+Ey Acc	0.63	4.06	6.44	PASS
Pushover-0.3Ex+Ey Acc	0.68	1.65	2.43	PASS
Pushover-Ex+0.3Ey Acc	2.82	3.53	1.25	PASS

Table 54: The outcomes of the SLC pushover analysis for a five-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.71	2.05	2.88	PASS
Pushover-X Acc	0.68	0.74	1.09	PASS
Pushover+Y Acc	0.19	0.78	4.10	PASS
Pushover-Y Acc	0.19	1.13	6.05	PASS
Pushover+X Acc + e	0.73	2.05	2.82	PASS
Pushover-X Acc + e	0.67	0.74	1.10	PASS
Pushover+Y Acc + e	0.19	0.78	4.14	PASS
Pushover-Y Acc + e	0.19	1.13	5.98	PASS
PushoverEx+0.3Ey Acc	0.72	1.92	2.67	PASS
Pushover0.3Ex+Ey Acc	0.26	1.10	4.27	PASS
Pushover-0.3Ex+Ey Acc	0.27	0.38	1.44	PASS
Pushover-Ex+0.3Ey Acc	0.65	0.65	0.99	FAIL

Table 55: The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.16	6.14	1.94	PASS
Pushover-X Acc	3.02	2.49	0.83	FAIL
Pushover+Y Acc	0.49	0.78	1.61	PASS
Pushover-Y Acc	0.46	2.15	4.64	PASS
Pushover+X Acc + e	3.23	6.14	1.90	PASS
Pushover-X Acc + e	2.99	2.49	0.83	FAIL
Pushover+Y Acc + e	0.48	0.78	1.64	PASS
Pushover-Y Acc + e	0.47	1.94	4.12	PASS
PushoverEx+0.3Ey Acc	3.19	5.64	1.77	PASS
Pushover0.3Ex+Ey Acc	0.89	1.50	1.69	PASS
Pushover-0.3Ex+Ey Acc	0.94	1.25	1.32	PASS
Pushover-Ex+0.3Ey Acc	2.89	2.31	0.80	FAIL

Table 56: The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.42	8.30	1.88	PASS
Pushover-X Acc	4.22	3.41	0.81	FAIL
Pushover+Y Acc	0.62	1.07	1.74	PASS
Pushover-Y Acc	0.59	2.97	5.04	PASS
Pushover+X Acc + e	4.51	8.19	1.81	PASS
Pushover-X Acc + e	4.18	3.41	0.82	FAIL
Pushover+Y Acc + e	0.61	1.07	1.77	PASS
Pushover-Y Acc + e	0.60	2.66	4.42	PASS
PushoverEx+0.3Ey Acc	4.46	7.56	1.69	PASS
Pushover0.3Ex+Ey Acc	1.13	2.10	1.86	PASS
Pushover-0.3Ex+Ey Acc	1.20	1.72	1.44	PASS
Pushover-Ex+0.3Ey Acc	4.04	3.14	0.78	FAIL

Table 57: The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.97	1.49	1.53	PASS
Pushover-X Acc	0.62	1.59	2.56	PASS
Pushover+Y Acc	0.17	0.88	5.14	PASS
Pushover-Y Acc	0.17	0.72	4.13	PASS
Pushover+X Acc + e	1.00	1.60	1.60	PASS
Pushover-X Acc + e	0.61	1.50	2.46	PASS
Pushover+Y Acc + e	0.17	0.88	5.23	PASS
Pushover-Y Acc + e	0.18	0.72	4.07	PASS
PushoverEx+0.3Ey Acc	0.83	1.58	1.90	PASS
Pushover0.3Ex+Ey Acc	0.25	1.49	6.06	PASS
Pushover-0.3Ex+Ey Acc	0.25	0.96	3.90	PASS
Pushover-Ex+0.3Ey Acc	0.59	1.40	2.39	PASS

Table 58: The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.32	7.34	1.70	PASS
Pushover-X Acc	2.76	2.81	1.02	PASS
Pushover+Y Acc	0.40	3.02	7.54	PASS
Pushover-Y Acc	0.41	1.85	4.52	PASS
Pushover+X Acc + e	4.44	7.34	1.65	PASS
Pushover-X Acc + e	2.71	2.90	1.07	PASS
Pushover+Y Acc + e	0.39	3.02	7.67	PASS
Pushover-Y Acc + e	0.41	1.85	4.45	PASS
PushoverEx+0.3Ey Acc	3.69	6.63	1.80	PASS
Pushover0.3Ex+Ey Acc	0.81	3.08	3.81	PASS
Pushover-0.3Ex+Ey Acc	0.81	1.34	1.66	PASS
Pushover-Ex+0.3Ey Acc	2.61	2.80	1.08	PASS

Table 59: The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.04	9.79	1.62	PASS
Pushover-X Acc	3.86	3.84	0.99	FAIL
Pushover+Y Acc	0.51	4.09	8.03	PASS
Pushover-Y Acc	0.52	2.46	4.73	PASS
Pushover+X Acc + e	6.21	9.79	1.58	PASS
Pushover-X Acc + e	3.78	3.93	1.04	PASS
Pushover+Y Acc + e	0.50	4.09	8.16	PASS
Pushover-Y Acc + e	0.53	2.46	4.66	PASS
PushoverEx+0.3Ey Acc	5.16	8.84	1.71	PASS
Pushover0.3Ex+Ey Acc	1.03	4.23	4.10	PASS
Pushover-0.3Ex+Ey Acc	1.04	1.82	1.76	PASS
Pushover-Ex+0.3Ey Acc	3.64	3.74	1.03	PASS

Table 60: The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.83	2.05	2.46	PASS
Pushover-X Acc	0.73	0.55	0.76	FAIL
Pushover+Y Acc	0.23	0.19	0.82	FAIL
Pushover-Y Acc	0.21	1.35	6.34	PASS
Pushover+X Acc + e	0.83	2.05	2.46	PASS
Pushover-X Acc + e	0.72	0.55	0.77	FAIL
Pushover+Y Acc + e	0.24	0.19	0.81	FAIL
Pushover-Y Acc + e	0.21	1.25	5.91	PASS
PushoverEx+0.3Ey Acc	0.81	1.80	2.23	PASS
Pushover0.3Ex+Ey Acc	0.28	0.20	0.70	FAIL
Pushover-0.3Ex+Ey Acc	0.32	0.28	0.89	FAIL
Pushover-Ex+0.3Ey Acc	0.70	0.55	0.79	FAIL

Table 61: The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.69	5.06	1.37	PASS
Pushover-X Acc	3.23	1.57	0.49	FAIL
Pushover+Y Acc	0.94	0.19	0.20	FAIL
Pushover-Y Acc	0.65	1.77	2.71	PASS
Pushover+X Acc + e	3.70	5.17	1.40	PASS
Pushover-X Acc + e	3.22	1.48	0.46	FAIL
Pushover+Y Acc + e	0.95	0.19	0.20	FAIL
Pushover-Y Acc + e	0.64	1.46	2.28	PASS
PushoverEx+0.3Ey Acc	3.60	4.56	1.27	PASS
Pushover0.3Ex+Ey Acc	1.20	0.20	0.16	FAIL
Pushover-0.3Ex+Ey Acc	1.41	0.28	0.20	FAIL
Pushover-Ex+0.3Ey Acc	3.12	1.47	0.47	FAIL

Table 62: The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.17	6.79	1.31	PASS
Pushover-X Acc	4.51	2.12	0.47	FAIL
Pushover+Y Acc	1.32	0.29	0.22	FAIL
Pushover-Y Acc	0.83	2.40	2.88	PASS
Pushover+X Acc + e	5.18	7.00	1.35	PASS
Pushover-X Acc + e	4.49	2.03	0.45	FAIL
Pushover+Y Acc + e	1.33	0.29	0.22	FAIL
Pushover-Y Acc + e	0.81	2.08	2.56	PASS
PushoverEx+0.3Ey Acc	5.03	6.14	1.22	PASS
Pushover0.3Ex+Ey Acc	1.66	0.39	0.24	FAIL
Pushover-0.3Ex+Ey Acc	1.93	0.47	0.24	FAIL
Pushover-Ex+0.3Ey Acc	4.36	2.02	0.46	FAIL

Table 63: The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on rock subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.79	1.74	2.19	PASS
Pushover-X Acc	0.59	1.10	1.87	PASS
Pushover+Y Acc	0.22	1.25	5.65	PASS
Pushover-Y Acc	0.22	0.93	4.31	PASS
Pushover+X Acc + e	0.79	1.74	2.19	PASS
Pushover-X Acc + e	0.59	1.10	1.87	PASS
Pushover+Y Acc + e	0.22	1.25	5.71	PASS
Pushover-Y Acc + e	0.22	0.93	4.26	PASS
PushoverEx+0.3Ey Acc	0.77	1.82	2.34	PASS
Pushover0.3Ex+Ey Acc	0.28	1.88	6.65	PASS
Pushover-0.3Ex+Ey Acc	0.31	0.66	2.15	PASS
Pushover-Ex+0.3Ey Acc	0.58	1.00	1.72	PASS

Table 64: The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with HCB on rock subsoil

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.52	6.30	1.79	PASS
Pushover-X Acc	2.61	2.74	1.05	PASS
Pushover+Y Acc	0.65	3.95	6.08	PASS
Pushover-Y Acc	0.62	1.86	3.02	PASS
Pushover+X Acc + e	3.53	6.30	1.79	PASS
Pushover-X Acc + e	2.61	2.74	1.05	PASS
Pushover+Y Acc + e	0.64	3.47	5.46	PASS
Pushover-Y Acc + e	0.63	1.86	2.95	PASS
PushoverEx+0.3Ey Acc	3.45	6.73	1.95	PASS
Pushover0.3Ex+Ey Acc	1.06	3.37	3.19	PASS
Pushover-0.3Ex+Ey Acc	1.25	1.42	1.13	PASS
Pushover-Ex+0.3Ey Acc	2.59	2.73	1.06	PASS

Table 65: The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with HCB on rock subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.93	8.47	1.72	PASS
Pushover-X Acc	3.65	3.66	1.00	FAIL
Pushover+Y Acc	0.83	5.40	6.52	PASS
Pushover-Y Acc	0.79	2.59	3.29	PASS
Pushover+X Acc + e	4.93	8.47	1.72	PASS
Pushover-X Acc + e	3.64	3.66	1.00	FAIL
Pushover+Y Acc + e	0.81	4.72	5.83	PASS
Pushover-Y Acc + e	0.80	2.59	3.22	PASS
PushoverEx+0.3Ey Acc	4.82	9.08	1.89	PASS
Pushover0.3Ex+Ey Acc	1.35	4.51	3.35	PASS
Pushover-0.3Ex+Ey Acc	1.67	1.89	1.13	PASS
Pushover-Ex+0.3Ey Acc	3.62	3.65	1.01	PASS

Table 66: The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.25	0.71	2.81	PASS
Pushover-X Acc	0.27	0.59	2.22	PASS
Pushover+Y Acc	0.03	0.30	9.60	PASS
Pushover-Y Acc	0.03	0.30	8.71	PASS
Pushover+X Acc + e	0.25	0.71	2.78	PASS
Pushover-X Acc + e	0.27	0.59	2.22	PASS
Pushover+Y Acc + e	0.03	0.30	9.74	PASS
Pushover-Y Acc + e	0.03	0.30	8.63	PASS
PushoverEx+0.3Ey Acc	0.24	0.71	2.92	PASS
Pushover0.3Ex+Ey Acc	0.06	0.50	8.80	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.30	5.11	PASS
Pushover-Ex+0.3Ey Acc	0.29	0.59	2.06	PASS

Table 67: The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.95	3.34	3.51	PASS
Pushover-X Acc	1.04	2.57	2.47	PASS
Pushover+Y Acc	0.06	1.39	23.50	PASS
Pushover-Y Acc	0.07	1.21	17.73	PASS
Pushover+X Acc + e	0.97	3.34	3.45	PASS
Pushover-X Acc + e	1.03	2.67	2.58	PASS
Pushover+Y Acc + e	0.06	1.39	23.92	PASS
Pushover-Y Acc + e	0.07	1.21	17.54	PASS
PushoverEx+0.3Ey Acc	0.87	2.83	3.26	PASS
Pushover0.3Ex+Ey Acc	0.13	1.99	15.60	PASS
Pushover-0.3Ex+Ey Acc	0.13	0.59	4.49	PASS
Pushover-Ex+0.3Ey Acc	1.20	2.27	1.89	PASS

Table 68: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.31	4.56	3.49	PASS
Pushover-X Acc	1.40	3.46	2.47	PASS
Pushover+Y Acc	0.07	2.28	31.97	PASS
Pushover-Y Acc	0.08	1.71	20.81	PASS
Pushover+X Acc + e	1.32	4.56	3.44	PASS
Pushover-X Acc + e	1.40	3.56	2.55	PASS
Pushover+Y Acc + e	0.07	2.38	33.96	PASS
Pushover-Y Acc + e	0.08	1.61	19.38	PASS
PushoverEx+0.3Ey Acc	1.20	3.84	3.20	PASS
Pushover0.3Ex+Ey Acc	0.15	2.79	18.14	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.89	5.60	PASS
Pushover-Ex+0.3Ey Acc	1.53	3.06	2.00	PASS

Table 69: The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.27	0.51	1.84	PASS
Pushover-X Acc	0.39	0.79	2.03	PASS
Pushover+Y Acc	0.03	0.20	6.42	PASS
Pushover-Y Acc	0.04	0.20	5.07	PASS
Pushover+X Acc + e	0.27	0.40	1.48	PASS
Pushover-X Acc + e	0.38	0.79	2.07	PASS
Pushover+Y Acc + e	0.03	0.20	6.50	PASS
Pushover-Y Acc + e	0.04	0.20	5.01	PASS
PushoverEx+0.3Ey Acc	0.29	0.81	2.81	PASS
Pushover0.3Ex+Ey Acc	0.05	0.20	3.88	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.30	5.00	PASS
Pushover-Ex+0.3Ey Acc	0.35	0.69	1.96	PASS

Table 70: The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.16	3.03	2.62	PASS
Pushover-X Acc	1.73	2.97	1.72	PASS
Pushover+Y Acc	0.06	2.18	37.04	PASS
Pushover-Y Acc	0.08	0.81	9.95	PASS
Pushover+X Acc + e	1.15	3.03	2.64	PASS
Pushover-X Acc + e	1.70	2.97	1.74	PASS
Pushover+Y Acc + e	0.06	2.09	35.95	PASS
Pushover-Y Acc + e	0.08	1.21	14.72	PASS
PushoverEx+0.3Ey Acc	1.21	2.72	2.24	PASS
Pushover0.3Ex+Ey Acc	0.11	2.09	18.59	PASS
Pushover-0.3Ex+Ey Acc	0.14	2.18	16.02	PASS
Pushover-Ex+0.3Ey Acc	1.57	2.77	1.76	PASS

Table 71: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.59	4.04	2.54	PASS
Pushover-X Acc	2.42	3.96	1.64	PASS
Pushover+Y Acc	0.07	2.98	41.82	PASS
Pushover-Y Acc	0.10	1.11	11.34	PASS
Pushover+X Acc + e	1.58	4.14	2.63	PASS
Pushover-X Acc + e	2.38	3.96	1.66	PASS
Pushover+Y Acc + e	0.07	2.88	41.11	PASS
Pushover-Y Acc + e	0.10	1.71	17.30	PASS
PushoverEx+0.3Ey Acc	1.63	3.73	2.28	PASS
Pushover0.3Ex+Ey Acc	0.14	2.79	20.58	PASS
Pushover-0.3Ex+Ey Acc	0.16	2.97	18.15	PASS
Pushover-Ex+0.3Ey Acc	2.19	3.76	1.71	PASS

Table 72: The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	0.37	1.02	2.79	PASS
Pushover-X Acc	0.36	0.59	1.63	PASS
Pushover+Y Acc	0.07	0.59	8.81	PASS
Pushover-Y Acc	0.07	0.51	7.11	PASS
Pushover+X Acc + e	0.37	1.13	3.02	PASS
Pushover-X Acc + e	0.36	0.59	1.64	PASS
Pushover+Y Acc + e	0.07	0.59	8.96	PASS
Pushover-Y Acc + e	0.07	0.51	7.02	PASS
PushoverEx+0.3Ey Acc	0.37	1.22	3.29	PASS
Pushover0.3Ex+Ey Acc	0.11	0.80	6.95	PASS
Pushover-0.3Ex+Ey Acc	0.12	0.29	2.41	PASS
Pushover-Ex+0.3Ey Acc	0.36	0.49	1.37	PASS

Table 73: The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	1.63	5.22	3.20	PASS
Pushover-X Acc	1.59	2.15	1.35	PASS
Pushover+Y Acc	0.16	1.19	7.51	PASS
Pushover-Y Acc	0.17	1.42	8.48	PASS
Pushover+X Acc + e	1.66	5.22	3.14	PASS
Pushover-X Acc + e	1.58	2.24	1.42	PASS
Pushover+Y Acc + e	0.15	1.19	7.67	PASS
Pushover-Y Acc + e	0.17	1.52	8.97	PASS
PushoverEx+0.3Ey Acc	1.65	4.79	2.90	PASS
Pushover0.3Ex+Ey Acc	0.27	1.99	7.40	PASS
Pushover-0.3Ex+Ey Acc	0.29	1.08	3.77	PASS
Pushover-Ex+0.3Ey Acc	1.58	2.05	1.30	PASS

Table 74: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	2.28	7.07	3.10	PASS
Pushover-X Acc	2.23	2.93	1.31	PASS
Pushover+Y Acc	0.19	1.78	9.36	PASS
Pushover-Y Acc	0.20	1.92	9.41	PASS
Pushover+X Acc + e	2.32	7.07	3.04	PASS
Pushover-X Acc + e	2.22	3.03	1.37	PASS
Pushover+Y Acc + e	0.19	1.88	10.09	PASS
Pushover-Y Acc + e	0.21	2.02	9.74	PASS
PushoverEx+0.3Ey Acc	2.31	6.42	2.78	PASS
Pushover0.3Ex+Ey Acc	0.34	2.69	7.84	PASS
Pushover-0.3Ex+Ey Acc	0.37	1.47	4.04	PASS
Pushover-Ex+0.3Ey Acc	2.21	2.73	1.24	PASS

Table 75: The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.44	0.82	1.84	PASS
Pushover-X Acc	0.36	0.69	1.90	PASS
Pushover+Y Acc	0.06	0.30	4.90	PASS
Pushover-Y Acc	0.08	0.41	5.38	PASS
Pushover+X Acc + e	0.45	0.82	1.83	PASS
Pushover-X Acc + e	0.36	0.69	1.91	PASS
Pushover+Y Acc + e	0.06	0.30	4.95	PASS
Pushover-Y Acc + e	0.08	0.41	5.27	PASS
PushoverEx+0.3Ey Acc	0.59	1.22	2.07	PASS
Pushover0.3Ex+Ey Acc	0.10	0.50	4.91	PASS
Pushover-0.3Ex+Ey Acc	0.11	0.39	3.46	PASS
Pushover-Ex+0.3Ey Acc	0.43	0.59	1.36	PASS

Table 76: The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.98	4.79	2.43	PASS
Pushover-X Acc	1.61	3.24	2.01	PASS
Pushover+Y Acc	0.14	3.26	23.72	PASS
Pushover-Y Acc	0.18	1.42	8.02	PASS
Pushover+X Acc + e	1.98	4.79	2.42	PASS
Pushover-X Acc + e	1.60	3.33	2.08	PASS
Pushover+Y Acc + e	0.14	2.96	21.87	PASS
Pushover-Y Acc + e	0.18	1.42	7.85	PASS
PushoverEx+0.3Ey Acc	2.62	4.46	1.71	PASS
Pushover0.3Ex+Ey Acc	0.24	3.38	14.21	PASS
Pushover-0.3Ex+Ey Acc	0.27	1.57	5.89	PASS
Pushover-Ex+0.3Ey Acc	1.92	2.84	1.48	PASS

Table 77: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.76	6.42	2.33	PASS
Pushover-X Acc	2.25	4.41	1.96	PASS
Pushover+Y Acc	0.17	4.44	26.87	PASS
Pushover-Y Acc	0.22	1.92	8.75	PASS
Pushover+X Acc + e	2.77	6.42	2.32	PASS
Pushover-X Acc + e	2.24	4.51	2.01	PASS
Pushover+Y Acc + e	0.16	3.95	24.23	PASS
Pushover-Y Acc + e	0.23	1.92	8.50	PASS
PushoverEx+0.3Ey Acc	3.66	6.09	1.66	PASS
Pushover0.3Ex+Ey Acc	0.30	4.57	15.10	PASS
Pushover-0.3Ex+Ey Acc	0.34	2.16	6.36	PASS
Pushover-Ex+0.3Ey Acc	2.68	3.82	1.42	PASS

Table 78: The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.49	1.35	2.76	PASS
Pushover-X Acc	0.47	0.48	1.02	PASS
Pushover+Y Acc	0.13	0.69	5.28	PASS
Pushover-Y Acc	0.13	0.81	6.28	PASS
Pushover+X Acc + e	0.49	1.35	2.73	PASS
Pushover-X Acc + e	0.47	0.48	1.02	PASS
Pushover+Y Acc + e	0.13	0.69	5.38	PASS
Pushover-Y Acc + e	0.13	0.81	6.16	PASS
PushoverEx+0.3Ey Acc	0.47	1.44	3.07	PASS
Pushover0.3Ex+Ey Acc	0.19	0.89	4.73	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.29	1.47	PASS
Pushover-Ex+0.3Ey Acc	0.45	0.48	1.06	PASS

Table 79: The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.18	5.09	2.34	PASS
Pushover-X Acc	2.11	2.31	1.10	PASS
Pushover+Y Acc	0.31	0.69	2.25	PASS
Pushover-Y Acc	0.30	1.73	5.68	PASS
Pushover+X Acc + e	2.20	4.98	2.27	PASS
Pushover-X Acc + e	2.09	2.31	1.11	PASS
Pushover+Y Acc + e	0.30	0.69	2.29	PASS
Pushover-Y Acc + e	0.31	1.73	5.57	PASS
PushoverEx+0.3Ey Acc	2.09	4.74	2.27	PASS
Pushover0.3Ex+Ey Acc	0.48	1.09	2.25	PASS
Pushover-0.3Ex+Ey Acc	0.53	1.36	2.56	PASS
Pushover-Ex+0.3Ey Acc	2.02	2.02	1.00	FAIL

Table 80: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.04	6.85	2.25	PASS
Pushover-X Acc	2.95	3.08	1.05	PASS
Pushover+Y Acc	0.39	0.98	2.52	PASS
Pushover-Y Acc	0.39	2.34	6.04	PASS
Pushover+X Acc + e	3.07	6.75	2.20	PASS
Pushover-X Acc + e	2.92	3.08	1.05	PASS
Pushover+Y Acc + e	0.38	0.98	2.57	PASS
Pushover-Y Acc + e	0.40	2.34	5.92	PASS
PushoverEx+0.3Ey Acc	2.92	6.38	2.19	PASS
Pushover0.3Ex+Ey Acc	0.62	1.59	2.57	PASS
Pushover-0.3Ex+Ey Acc	0.68	1.85	2.73	PASS
Pushover-Ex+0.3Ey Acc	2.82	2.78	0.99	FAIL

Table 81: The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.54	0.72	1.33	PASS
Pushover-X Acc	0.46	0.58	1.27	PASS
Pushover+Y Acc	0.11	0.59	5.36	PASS
Pushover-Y Acc	0.13	0.61	4.73	PASS
Pushover+X Acc + e	0.55	0.72	1.31	PASS
Pushover-X Acc + e	0.45	0.68	1.51	PASS
Pushover+Y Acc + e	0.11	0.59	5.46	PASS
Pushover-Y Acc + e	0.13	0.61	4.66	PASS
PushoverEx+0.3Ey Acc	0.57	1.23	2.15	PASS
Pushover0.3Ex+Ey Acc	0.18	0.79	4.41	PASS
Pushover-0.3Ex+Ey Acc	0.19	0.39	2.06	PASS
Pushover-Ex+0.3Ey Acc	0.43	0.58	1.35	PASS

Table 82: The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.42	4.54	1.87	PASS
Pushover-X Acc	2.04	3.39	1.66	PASS
Pushover+Y Acc	0.26	3.82	14.84	PASS
Pushover-Y Acc	0.30	1.53	5.04	PASS
Pushover+X Acc + e	2.46	4.54	1.85	PASS
Pushover-X Acc + e	2.00	3.39	1.70	PASS
Pushover+Y Acc + e	0.25	3.92	15.49	PASS
Pushover-Y Acc + e	0.31	1.53	4.97	PASS
PushoverEx+0.3Ey Acc	2.53	4.30	1.70	PASS
Pushover0.3Ex+Ey Acc	0.44	3.56	8.15	PASS
Pushover-0.3Ex+Ey Acc	0.49	1.75	3.61	PASS
Pushover-Ex+0.3Ey Acc	1.91	2.80	1.47	PASS

Table 83: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.38	6.08	1.80	PASS
Pushover-X Acc	2.85	4.55	1.60	PASS
Pushover+Y Acc	0.33	5.19	15.84	PASS
Pushover-Y Acc	0.39	2.14	5.54	PASS
Pushover+X Acc + e	3.43	6.08	1.77	PASS
Pushover-X Acc + e	2.79	4.55	1.63	PASS
Pushover+Y Acc + e	0.32	5.29	16.42	PASS
Pushover-Y Acc + e	0.39	2.14	5.46	PASS
PushoverEx+0.3Ey Acc	3.54	5.73	1.62	PASS
Pushover0.3Ex+Ey Acc	0.56	4.85	8.71	PASS
Pushover-0.3Ex+Ey Acc	0.62	2.33	3.78	PASS
Pushover-Ex+0.3Ey Acc	2.67	3.86	1.45	PASS

Table 84: The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.63	1.69	2.66	PASS
Pushover-X Acc	0.60	0.47	0.79	FAIL
Pushover+Y Acc	0.20	0.78	3.91	PASS
Pushover-Y Acc	0.19	1.03	5.31	PASS
Pushover+X Acc + e	0.64	1.69	2.64	PASS
Pushover-X Acc + e	0.59	0.47	0.80	FAIL
Pushover+Y Acc + e	0.20	0.78	3.95	PASS
Pushover-Y Acc + e	0.20	1.13	5.76	PASS
PushoverEx+0.3Ey Acc	0.61	1.56	2.58	PASS
Pushover0.3Ex+Ey Acc	0.25	0.99	3.97	PASS
Pushover-0.3Ex+Ey Acc	0.26	0.29	1.10	PASS
Pushover-Ex+0.3Ey Acc	0.58	0.38	0.66	FAIL

Table 85: The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.81	5.79	2.06	PASS
Pushover-X Acc	2.66	2.46	0.92	FAIL
Pushover+Y Acc	0.53	0.78	1.47	PASS
Pushover-Y Acc	0.50	1.75	3.49	PASS
Pushover+X Acc + e	2.84	5.69	2.00	PASS
Pushover-X Acc + e	2.64	2.46	0.93	FAIL
Pushover+Y Acc + e	0.52	0.78	1.50	PASS
Pushover-Y Acc + e	0.51	1.95	3.80	PASS
PushoverEx+0.3Ey Acc	2.70	5.52	2.05	PASS
Pushover0.3Ex+Ey Acc	0.83	1.19	1.43	PASS
Pushover-0.3Ex+Ey Acc	0.92	1.25	1.36	PASS
Pushover-Ex+0.3Ey Acc	2.56	2.26	0.89	FAIL

Table 86: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.93	7.79	1.98	PASS
Pushover-X Acc	3.73	3.31	0.89	FAIL
Pushover+Y Acc	0.67	1.07	1.59	PASS
Pushover-Y Acc	0.64	2.36	3.71	PASS
Pushover+X Acc + e	3.98	7.69	1.93	PASS
Pushover-X Acc + e	3.69	3.31	0.90	FAIL
Pushover+Y Acc + e	0.66	1.07	1.62	PASS
Pushover-Y Acc + e	0.65	2.67	4.08	PASS
PushoverEx+0.3Ey Acc	3.77	7.40	1.96	PASS
Pushover0.3Ex+Ey Acc	1.06	1.58	1.50	PASS
Pushover-0.3Ex+Ey Acc	1.17	1.73	1.47	PASS
Pushover-Ex+0.3Ey Acc	3.58	3.11	0.87	FAIL

Table 87: The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.56	0.63	1.13	PASS
Pushover-X Acc	0.42	0.67	1.58	PASS
Pushover+Y Acc	0.19	0.97	5.22	PASS
Pushover-Y Acc	0.19	0.82	4.25	PASS
Pushover+X Acc + e	0.56	0.63	1.12	PASS
Pushover-X Acc + e	0.43	0.67	1.56	PASS
Pushover+Y Acc + e	0.18	0.97	5.28	PASS
Pushover-Y Acc + e	0.20	0.82	4.20	PASS
PushoverEx+0.3Ey Acc	0.68	1.34	1.99	PASS
Pushover0.3Ex+Ey Acc	0.24	0.98	4.16	PASS
Pushover-0.3Ex+Ey Acc	0.26	0.38	1.48	PASS
Pushover-Ex+0.3Ey Acc	0.43	0.57	1.34	PASS

Table 88: The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.47	5.32	2.15	PASS
Pushover-X Acc	1.89	3.54	1.87	PASS
Pushover+Y Acc	0.46	3.88	8.42	PASS
Pushover-Y Acc	0.50	1.55	3.07	PASS
Pushover+X Acc + e	2.50	5.32	2.13	PASS
Pushover-X Acc + e	1.91	3.63	1.91	PASS
Pushover+Y Acc + e	0.45	3.10	6.89	PASS
Pushover-Y Acc + e	0.51	1.55	3.01	PASS
PushoverEx+0.3Ey Acc	3.00	6.71	2.23	PASS
Pushover0.3Ex+Ey Acc	0.75	3.64	4.87	PASS
Pushover-0.3Ex+Ey Acc	0.90	1.92	2.14	PASS
Pushover-Ex+0.3Ey Acc	1.89	3.04	1.61	PASS

Table 89: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.46	7.20	2.08	PASS
Pushover-X Acc	2.64	4.78	1.81	PASS
Pushover+Y Acc	0.59	5.23	8.93	PASS
Pushover-Y Acc	0.64	2.17	3.38	PASS
Pushover+X Acc + e	3.49	7.20	2.06	PASS
Pushover-X Acc + e	2.66	4.88	1.83	PASS
Pushover+Y Acc + e	0.57	4.26	7.44	PASS
Pushover-Y Acc + e	0.66	2.17	3.30	PASS
PushoverEx+0.3Ey Acc	4.20	9.08	2.16	PASS
Pushover0.3Ex+Ey Acc	0.95	4.97	5.23	PASS
Pushover-0.3Ex+Ey Acc	1.14	2.59	2.26	PASS
Pushover-Ex+0.3Ey Acc	2.64	4.09	1.55	PASS

Table 90: The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.78	1.93	2.46	PASS
Pushover-X Acc	0.73	0.37	0.51	FAIL
Pushover+Y Acc	0.25	0.77	3.11	PASS
Pushover-Y Acc	0.23	1.35	5.86	PASS
Pushover+X Acc + e	0.80	1.93	2.42	PASS
Pushover-X Acc + e	0.72	0.37	0.52	FAIL
Pushover+Y Acc + e	0.24	0.77	3.15	PASS
Pushover-Y Acc + e	0.23	1.35	5.83	PASS
PushoverEx+0.3Ey Acc	0.76	1.79	2.36	PASS
Pushover0.3Ex+Ey Acc	0.31	1.18	3.87	PASS
Pushover-0.3Ex+Ey Acc	0.32	0.19	0.60	FAIL
Pushover-Ex+0.3Ey Acc	0.70	0.37	0.53	FAIL

Table 91: The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.48	6.63	1.91	PASS
Pushover-X Acc	3.25	2.51	0.77	FAIL
Pushover+Y Acc	0.81	0.77	0.95	FAIL
Pushover-Y Acc	0.70	1.97	2.82	PASS
Pushover+X Acc + e	3.55	6.53	1.84	PASS
Pushover-X Acc + e	3.21	2.51	0.78	FAIL
Pushover+Y Acc + e	0.79	0.77	0.98	FAIL
Pushover-Y Acc + e	0.71	1.87	2.64	PASS
PushoverEx+0.3Ey Acc	3.38	6.01	1.78	PASS
Pushover0.3Ex+Ey Acc	1.23	1.18	0.96	FAIL
Pushover-0.3Ex+Ey Acc	1.33	1.14	0.85	FAIL
Pushover-Ex+0.3Ey Acc	3.13	2.41	0.77	FAIL

Table 92: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.87	8.88	1.83	PASS
Pushover-X Acc	4.55	3.44	0.76	FAIL
Pushover+Y Acc	1.03	1.06	1.03	PASS
Pushover-Y Acc	0.89	2.70	3.03	PASS
Pushover+X Acc + e	4.96	8.77	1.77	PASS
Pushover-X Acc + e	4.49	3.44	0.77	FAIL
Pushover+Y Acc + e	1.01	1.06	1.05	PASS
Pushover-Y Acc + e	0.90	2.59	2.88	PASS
PushoverEx+0.3Ey Acc	4.72	8.12	1.72	PASS
Pushover0.3Ex+Ey Acc	1.57	1.68	1.07	PASS
Pushover-0.3Ex+Ey Acc	1.74	1.61	0.93	FAIL
Pushover-Ex+0.3Ey Acc	4.37	3.24	0.74	FAIL

Table 93: The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on rock subsoil.

Three Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.67	0.74	1.11	PASS
Pushover-X Acc	0.52	0.66	1.28	PASS
Pushover+Y Acc	0.23	1.34	5.76	PASS
Pushover-Y Acc	0.23	1.04	4.49	PASS
Pushover+X Acc + e	0.67	0.74	1.10	PASS
Pushover-X Acc + e	0.51	0.66	1.28	PASS
Pushover+Y Acc + e	0.23	1.34	5.82	PASS
Pushover-Y Acc + e	0.23	1.04	4.46	PASS
PushoverEx+0.3Ey Acc	0.82	1.46	1.79	PASS
Pushover0.3Ex+Ey Acc	0.29	1.07	3.71	PASS
Pushover-0.3Ex+Ey Acc	0.32	0.47	1.49	PASS
Pushover-Ex+0.3Ey Acc	0.49	0.56	1.14	PASS

Table 94: The outcomes of the SLD pushover analysis for a seven-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.97	6.45	2.17	PASS
Pushover-X Acc	2.30	3.68	1.60	PASS
Pushover+Y Acc	0.71	3.54	4.96	PASS
Pushover-Y Acc	0.71	1.88	2.64	PASS
Pushover+X Acc + e	2.99	6.45	2.16	PASS
Pushover-X Acc + e	2.29	3.77	1.65	PASS
Pushover+Y Acc + e	0.70	3.25	4.66	PASS
Pushover-Y Acc + e	0.72	1.88	2.60	PASS
PushoverEx+0.3Ey Acc	3.62	6.24	1.72	PASS
Pushover0.3Ex+Ey Acc	1.10	3.81	3.45	PASS
Pushover-0.3Ex+Ey Acc	1.33	2.27	1.70	PASS
Pushover-Ex+0.3Ey Acc	2.19	3.28	1.49	PASS

Table 95: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with HCB on rock subsoil.

Three Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.16	8.67	2.09	PASS
Pushover-X Acc	3.22	5.00	1.55	PASS
Pushover+Y Acc	0.91	4.78	5.26	PASS
Pushover-Y Acc	0.91	2.61	2.87	PASS
Pushover+X Acc + e	4.18	8.67	2.07	PASS
Pushover-X Acc + e	3.20	5.09	1.59	PASS
Pushover+Y Acc + e	0.89	4.40	4.95	PASS
Pushover-Y Acc + e	0.92	2.61	2.83	PASS
PushoverEx+0.3Ey Acc	5.07	8.32	1.64	PASS
Pushover0.3Ex+Ey Acc	1.41	5.17	3.67	PASS
Pushover-0.3Ex+Ey Acc	1.70	3.02	1.78	PASS
Pushover-Ex+0.3Ey Acc	3.06	4.40	1.44	PASS

Table 96: The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.24	0.71	2.91	PASS
Pushover-X Acc	0.25	0.59	2.34	PASS
Pushover+Y Acc	0.03	0.30	9.37	PASS
Pushover-Y Acc	0.04	0.30	8.27	PASS
Pushover+X Acc + e	0.24	0.71	2.93	PASS
Pushover-X Acc + e	0.26	0.59	2.32	PASS
Pushover+Y Acc + e	0.03	0.30	9.47	PASS
Pushover-Y Acc + e	0.04	0.30	8.23	PASS
PushoverEx+0.3Ey Acc	0.23	0.70	3.09	PASS
Pushover0.3Ex+Ey Acc	0.05	0.40	7.55	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.40	7.04	PASS
Pushover-Ex+0.3Ey Acc	0.30	0.59	1.98	PASS

Table 97: The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with Globigerina limestone rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.88	3.33	3.77	PASS
Pushover-X Acc	0.95	2.57	2.71	PASS
Pushover+Y Acc	0.06	1.59	26.03	PASS
Pushover-Y Acc	0.07	1.21	16.60	PASS
Pushover+X Acc + e	0.87	3.33	3.82	PASS
Pushover-X Acc + e	0.96	2.57	2.67	PASS
Pushover+Y Acc + e	0.06	1.59	26.39	PASS
Pushover-Y Acc + e	0.07	1.21	16.50	PASS
PushoverEx+0.3Ey Acc	0.77	2.92	3.81	PASS
Pushover0.3Ex+Ey Acc	0.12	1.99	17.08	PASS
Pushover-0.3Ex+Ey Acc	0.13	0.59	4.69	PASS
Pushover-Ex+0.3Ey Acc	1.30	2.27	1.75	PASS

Table 98: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with Globigerina limestone rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.22	4.54	3.71	PASS
Pushover-X Acc	1.30	3.47	2.66	PASS
Pushover+Y Acc	0.07	2.28	30.99	PASS
Pushover-Y Acc	0.09	1.71	19.49	PASS
Pushover+X Acc + e	1.21	4.54	3.76	PASS
Pushover-X Acc + e	1.31	3.47	2.64	PASS
Pushover+Y Acc + e	0.07	2.48	34.15	PASS
Pushover-Y Acc + e	0.09	1.61	18.23	PASS
PushoverEx+0.3Ey Acc	1.08	3.93	3.65	PASS
Pushover0.3Ex+Ey Acc	0.14	2.79	19.85	PASS
Pushover-0.3Ex+Ey Acc	0.15	0.89	5.84	PASS
Pushover-Ex+0.3Ey Acc	1.65	3.07	1.86	PASS

Table 99: The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with Globigerina limestone rock subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.26	0.40	1.54	PASS
Pushover-X Acc	0.41	0.79	1.95	PASS
Pushover+Y Acc	0.03	0.20	6.29	PASS
Pushover-Y Acc	0.04	0.20	4.81	PASS
Pushover+X Acc + e	0.27	0.40	1.52	PASS
Pushover-X Acc + e	0.41	0.79	1.95	PASS
Pushover+Y Acc + e	0.03	0.20	6.34	PASS
Pushover-Y Acc + e	0.04	0.20	4.70	PASS
PushoverEx+0.3Ey Acc	0.27	0.60	2.22	PASS
Pushover0.3Ex+Ey Acc	0.05	0.20	4.14	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.30	4.98	PASS
Pushover-Ex+0.3Ey Acc	0.34	0.69	2.02	PASS

Table 100: The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with HCB rock subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.08	3.02	2.80	PASS
Pushover-X Acc	1.81	2.98	1.64	PASS
Pushover+Y Acc	0.06	2.08	34.49	PASS
Pushover-Y Acc	0.09	0.81	9.30	PASS
Pushover+X Acc + e	1.10	3.02	2.75	PASS
Pushover-X Acc + e	1.81	2.98	1.64	PASS
Pushover+Y Acc + e	0.06	2.08	34.84	PASS
Pushover-Y Acc + e	0.09	1.21	13.56	PASS
PushoverEx+0.3Ey Acc	1.12	2.71	2.41	PASS
Pushover0.3Ex+Ey Acc	0.10	1.99	19.26	PASS
Pushover-0.3Ex+Ey Acc	0.14	2.28	16.67	PASS
Pushover-Ex+0.3Ey Acc	1.53	2.87	1.88	PASS

Table 101: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with HCB rock subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.49	4.13	2.77	PASS
Pushover-X Acc	2.53	4.07	1.61	PASS
Pushover+Y Acc	0.07	2.78	38.08	PASS
Pushover-Y Acc	0.10	1.11	10.61	PASS
Pushover+X Acc + e	1.51	4.13	2.73	PASS
Pushover-X Acc + e	2.53	4.07	1.61	PASS
Pushover+Y Acc + e	0.07	2.78	38.47	PASS
Pushover-Y Acc + e	0.11	1.71	15.94	PASS
PushoverEx+0.3Ey Acc	1.53	3.62	2.36	PASS
Pushover0.3Ex+Ey Acc	0.12	2.69	21.58	PASS
Pushover-0.3Ex+Ey Acc	0.16	3.07	18.67	PASS
Pushover-Ex+0.3Ey Acc	2.14	3.86	1.81	PASS

Table 102: The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with HCB rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.34	0.92	2.67	PASS
Pushover-X Acc	0.34	0.59	1.74	PASS
Pushover+Y Acc	0.07	0.59	8.55	PASS
Pushover-Y Acc	0.07	0.51	6.80	PASS
Pushover+X Acc + e	0.34	0.92	2.70	PASS
Pushover-X Acc + e	0.34	0.59	1.75	PASS
Pushover+Y Acc + e	0.07	0.59	8.68	PASS
Pushover-Y Acc + e	0.08	0.51	6.70	PASS
PushoverEx+0.3Ey Acc	0.34	1.01	3.01	PASS
Pushover0.3Ex+Ey Acc	0.11	0.70	6.40	PASS
Pushover-0.3Ex+Ey Acc	0.12	0.39	3.29	PASS
Pushover-Ex+0.3Ey Acc	0.35	0.59	1.66	PASS

Table 103:The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with Globigerina limestone on rock subsoil

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.53	5.20	3.40	PASS
Pushover-X Acc	1.50	2.26	1.50	PASS
Pushover+Y Acc	0.16	1.28	7.89	PASS
Pushover-Y Acc	0.18	1.42	8.10	PASS
Pushover+X Acc + e	1.51	5.20	3.44	PASS
Pushover-X Acc + e	1.49	2.26	1.51	PASS
Pushover+Y Acc + e	0.16	1.38	8.62	PASS
Pushover-Y Acc + e	0.18	1.42	7.99	PASS
PushoverEx+0.3Ey Acc	1.50	4.77	3.18	PASS
Pushover0.3Ex+Ey Acc	0.26	1.69	6.62	PASS
Pushover-0.3Ex+Ey Acc	0.28	0.98	3.50	PASS
Pushover-Ex+0.3Ey Acc	1.58	2.06	1.30	PASS

Table 104: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.12	7.03	3.32	PASS
Pushover-X Acc	2.06	3.04	1.48	PASS
Pushover+Y Acc	0.20	1.78	9.01	PASS
Pushover-Y Acc	0.22	1.92	8.86	PASS
Pushover+X Acc + e	2.08	7.03	3.38	PASS
Pushover-X Acc + e	2.04	3.04	1.49	PASS
Pushover+Y Acc + e	0.19	1.88	9.69	PASS
Pushover-Y Acc + e	0.22	1.92	8.71	PASS
PushoverEx+0.3Ey Acc	2.05	6.39	3.12	PASS
Pushover0.3Ex+Ey Acc	0.33	2.29	7.03	PASS
Pushover-0.3Ex+Ey Acc	0.36	1.38	3.85	PASS
Pushover-Ex+0.3Ey Acc	2.21	2.74	1.24	PASS

Table 105: The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.42	0.81	1.93	PASS
Pushover-X Acc	0.50	0.69	1.38	PASS
Pushover+Y Acc	0.07	0.39	5.92	PASS
Pushover-Y Acc	0.08	0.41	4.92	PASS
Pushover+X Acc + e	0.43	0.81	1.88	PASS
Pushover-X Acc + e	0.47	0.69	1.46	PASS
Pushover+Y Acc + e	0.07	0.39	5.98	PASS
Pushover-Y Acc + e	0.08	0.41	4.82	PASS
PushoverEx+0.3Ey Acc	0.65	1.11	1.71	PASS
Pushover0.3Ex+Ey Acc	0.10	0.40	3.93	PASS
Pushover-0.3Ex+Ey Acc	0.11	0.49	4.33	PASS
Pushover-Ex+0.3Ey Acc	0.45	0.59	1.31	PASS

Table 106: The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.87	5.18	2.77	PASS
Pushover-X Acc	2.22	3.35	1.51	PASS
Pushover+Y Acc	0.16	2.96	18.95	PASS
Pushover-Y Acc	0.19	0.81	4.19	PASS
Pushover+X Acc + e	1.92	5.18	2.70	PASS
Pushover-X Acc + e	2.10	3.35	1.59	PASS
Pushover+Y Acc + e	0.15	3.16	20.49	PASS
Pushover-Y Acc + e	0.20	0.81	4.10	PASS
PushoverEx+0.3Ey Acc	2.89	4.45	1.54	PASS
Pushover0.3Ex+Ey Acc	0.24	2.97	12.55	PASS
Pushover-0.3Ex+Ey Acc	0.27	1.77	6.64	PASS
Pushover-Ex+0.3Ey Acc	2.00	2.85	1.42	PASS

Table 107: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.62	6.91	2.64	PASS
Pushover-X Acc	3.10	4.53	1.46	PASS
Pushover+Y Acc	0.19	4.04	21.53	PASS
Pushover-Y Acc	0.25	1.12	4.52	PASS
Pushover+X Acc + e	2.68	7.01	2.61	PASS
Pushover-X Acc + e	2.94	4.53	1.54	PASS
Pushover+Y Acc + e	0.19	4.24	22.89	PASS
Pushover-Y Acc + e	0.25	1.12	4.43	PASS
PushoverEx+0.3Ey Acc	4.03	5.96	1.48	PASS
Pushover0.3Ex+Ey Acc	0.30	4.07	13.47	PASS
Pushover-0.3Ex+Ey Acc	0.34	2.36	6.95	PASS
Pushover-Ex+0.3Ey Acc	2.80	3.83	1.37	PASS

Table 108: The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.45	1.13	2.55	PASS
Pushover-X Acc	0.44	0.58	1.31	PASS
Pushover+Y Acc	0.14	0.69	5.06	PASS
Pushover-Y Acc	0.14	0.82	5.97	PASS
Pushover+X Acc + e	0.45	1.13	2.53	PASS
Pushover-X Acc + e	0.44	0.58	1.32	PASS
Pushover+Y Acc + e	0.13	0.69	5.15	PASS
Pushover-Y Acc + e	0.14	0.82	5.91	PASS
PushoverEx+0.3Ey Acc	0.43	1.23	2.85	PASS
Pushover0.3Ex+Ey Acc	0.19	0.89	4.80	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.39	1.96	PASS
Pushover-Ex+0.3Ey Acc	0.44	0.48	1.11	PASS

Table 109: The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.98	4.95	2.50	PASS
Pushover-X Acc	1.98	2.33	1.18	PASS
Pushover+Y Acc	0.32	0.69	2.15	PASS
Pushover-Y Acc	0.32	1.73	5.40	PASS
Pushover+X Acc + e	2.00	4.95	2.48	PASS
Pushover-X Acc + e	1.96	2.33	1.19	PASS
Pushover+Y Acc + e	0.31	0.69	2.19	PASS
Pushover-Y Acc + e	0.32	1.73	5.35	PASS
PushoverEx+0.3Ey Acc	1.91	4.60	2.41	PASS
Pushover0.3Ex+Ey Acc	0.47	0.99	2.12	PASS
Pushover-0.3Ex+Ey Acc	0.53	1.27	2.37	PASS
Pushover-Ex+0.3Ey Acc	1.94	2.03	1.05	PASS

Table 110: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.77	6.60	2.38	PASS
Pushover-X Acc	2.76	3.10	1.12	PASS
Pushover+Y Acc	0.41	0.98	2.42	PASS
Pushover-Y Acc	0.41	2.35	5.74	PASS
Pushover+X Acc + e	2.79	6.60	2.36	PASS
Pushover-X Acc + e	2.74	3.10	1.13	PASS
Pushover+Y Acc + e	0.40	0.98	2.46	PASS
Pushover-Y Acc + e	0.41	2.35	5.68	PASS
PushoverEx+0.3Ey Acc	2.67	6.24	2.33	PASS
Pushover0.3Ex+Ey Acc	0.60	1.39	2.33	PASS
Pushover-0.3Ex+Ey Acc	0.68	1.75	2.58	PASS
Pushover-Ex+0.3Ey Acc	2.71	2.80	1.03	PASS

Table 111: The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.41	1.23	0.87	FAIL
Pushover-X Acc	0.45	0.68	1.52	PASS
Pushover+Y Acc	0.12	0.59	4.77	PASS
Pushover-Y Acc	0.16	0.61	3.95	PASS
Pushover+X Acc + e	1.42	1.23	0.87	FAIL
Pushover-X Acc + e	0.44	0.68	1.56	PASS
Pushover+Y Acc + e	0.12	0.59	4.84	PASS
Pushover-Y Acc + e	0.16	0.61	3.89	PASS
PushoverEx+0.3Ey Acc	1.07	1.12	1.04	PASS
Pushover0.3Ex+Ey Acc	0.18	0.69	3.81	PASS
Pushover-0.3Ex+Ey Acc	0.19	0.49	2.58	PASS
Pushover-Ex+0.3Ey Acc	0.44	0.58	1.32	PASS

Table 112:The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with HCB on rock subsoil

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.25	6.97	1.11	PASS
Pushover-X Acc	2.00	3.22	1.61	PASS
Pushover+Y Acc	0.29	3.61	12.53	PASS
Pushover-Y Acc	0.36	1.53	4.21	PASS
Pushover+X Acc + e	6.30	7.07	1.12	PASS
Pushover-X Acc + e	1.95	3.22	1.65	PASS
Pushover+Y Acc + e	0.28	3.61	12.70	PASS
Pushover-Y Acc + e	0.37	1.53	4.14	PASS
PushoverEx+0.3Ey Acc	4.78	6.10	1.28	PASS
Pushover0.3Ex+Ey Acc	0.44	4.04	9.09	PASS
Pushover-0.3Ex+Ey Acc	0.48	1.94	4.03	PASS
Pushover-Ex+0.3Ey Acc	1.97	2.91	1.48	PASS

Table 113: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with HCB on rock subsoil

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.74	9.32	1.07	PASS
Pushover-X Acc	2.79	4.29	1.54	PASS
Pushover+Y Acc	0.37	4.89	13.30	PASS
Pushover-Y Acc	0.46	2.05	4.40	PASS
Pushover+X Acc + e	8.80	9.43	1.07	PASS
Pushover-X Acc + e	2.72	4.29	1.58	PASS
Pushover+Y Acc + e	0.36	4.89	13.47	PASS
Pushover-Y Acc + e	0.47	2.15	4.55	PASS
PushoverEx+0.3Ey Acc	6.68	8.23	1.23	PASS
Pushover0.3Ex+Ey Acc	0.57	5.50	9.71	PASS
Pushover-0.3Ex+Ey Acc	0.62	2.62	4.27	PASS
Pushover-Ex+0.3Ey Acc	2.75	3.88	1.41	PASS

Table 114: The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with HCB on rock subsoil

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.57	1.46	2.55	PASS
Pushover-X Acc	0.56	0.48	0.85	FAIL
Pushover+Y Acc	0.20	0.68	3.35	PASS
Pushover-Y Acc	0.20	1.13	5.70	PASS
Pushover+X Acc + e	0.58	1.46	2.52	PASS
Pushover-X Acc + e	0.56	0.48	0.86	FAIL
Pushover+Y Acc + e	0.20	0.78	3.85	PASS
Pushover-Y Acc + e	0.20	1.13	5.66	PASS
PushoverEx+0.3Ey Acc	0.56	1.44	2.58	PASS
Pushover0.3Ex+Ey Acc	0.25	1.08	4.40	PASS
Pushover-0.3Ex+Ey Acc	0.26	0.38	1.46	PASS
Pushover-Ex+0.3Ey Acc	0.54	0.48	0.88	FAIL

Table 115: The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.55	5.63	2.21	PASS
Pushover-X Acc	2.49	2.49	1.00	FAIL
Pushover+Y Acc	0.55	0.68	1.24	PASS
Pushover-Y Acc	0.53	1.96	3.71	PASS
Pushover+X Acc + e	2.58	5.63	2.18	PASS
Pushover-X Acc + e	2.47	2.49	1.01	PASS
Pushover+Y Acc + e	0.54	0.78	1.43	PASS
Pushover-Y Acc + e	0.53	1.85	3.47	PASS
PushoverEx+0.3Ey Acc	2.49	5.26	2.11	PASS
Pushover0.3Ex+Ey Acc	0.81	1.08	1.34	PASS
Pushover-0.3Ex+Ey Acc	0.92	1.15	1.25	PASS
Pushover-Ex+0.3Ey Acc	2.41	2.29	0.95	FAIL

Table 116: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.56	7.61	2.14	PASS
Pushover-X Acc	3.49	3.35	0.96	FAIL
Pushover+Y Acc	0.70	0.97	1.39	PASS
Pushover-Y Acc	0.67	2.68	3.99	PASS
Pushover+X Acc + e	3.60	7.61	2.11	PASS
Pushover-X Acc + e	3.45	3.35	0.97	FAIL
Pushover+Y Acc + e	0.69	1.07	1.54	PASS
Pushover-Y Acc + e	0.68	2.57	3.78	PASS
PushoverEx+0.3Ey Acc	3.48	7.12	2.04	PASS
Pushover0.3Ex+Ey Acc	1.03	1.48	1.43	PASS
Pushover-0.3Ex+Ey Acc	1.17	1.63	1.39	PASS
Pushover-Ex+0.3Ey Acc	3.36	3.05	0.91	FAIL

Table 117: The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with Globigerina limestone on rock subsoil

Four Unit – Aggregate Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	0.52	0.52	1.00	FAIL
Pushover-X Acc	0.42	0.68	1.60	PASS
Pushover+Y Acc	0.19	0.97	5.05	PASS
Pushover-Y Acc	0.20	0.72	3.66	PASS
Pushover+X Acc + e	0.52	0.52	0.99	FAIL
Pushover-X Acc + e	0.42	0.68	1.59	PASS
Pushover+Y Acc + e	0.19	0.97	5.09	PASS
Pushover-Y Acc + e	0.21	0.83	4.02	PASS
PushoverEx+0.3Ey Acc	0.74	1.23	1.66	PASS
Pushover0.3Ex+Ey Acc	0.23	1.08	4.63	PASS
Pushover-0.3Ex+Ey Acc	0.25	0.48	1.90	PASS
Pushover-Ex+0.3Ey Acc	0.45	0.58	1.28	PASS

Table 118: The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	2.30	7.45	3.24	PASS
Pushover-X Acc	1.88	3.28	1.75	PASS
Pushover+Y Acc	0.49	3.67	7.52	PASS
Pushover-Y Acc	0.52	1.34	2.58	PASS
Pushover+X Acc + e	2.31	7.45	3.22	PASS
Pushover-X Acc + e	1.89	3.28	1.74	PASS
Pushover+Y Acc + e	0.48	3.57	7.44	PASS
Pushover-Y Acc + e	0.57	1.65	2.93	PASS
PushoverEx+0.3Ey Acc	3.28	6.85	2.09	PASS
Pushover0.3Ex+Ey Acc	0.72	4.21	5.83	PASS
Pushover-0.3Ex+Ey Acc	0.85	2.21	2.60	PASS
Pushover-Ex+0.3Ey Acc	2.00	2.97	1.49	PASS

Table 119: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure - HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor α	Check
	Demand	Capacity		
Pushover+X Acc	3.21	10.06	3.13	PASS
Pushover-X Acc	2.63	4.44	1.69	PASS
Pushover+Y Acc	0.62	5.02	8.09	PASS
Pushover-Y Acc	0.66	1.86	2.80	PASS
Pushover+X Acc + e	3.23	10.06	3.11	PASS
Pushover-X Acc + e	2.64	4.44	1.68	PASS
Pushover+Y Acc + e	0.61	4.83	7.89	PASS
Pushover-Y Acc + e	0.72	2.28	3.16	PASS
PushoverEx+0.3Ey Acc	4.59	9.15	2.00	PASS
Pushover0.3Ex+Ey Acc	0.92	5.62	6.12	PASS
Pushover-0.3Ex+Ey Acc	1.08	2.97	2.75	PASS
Pushover-Ex+0.3Ey Acc	2.79	4.03	1.44	PASS

Table 120: The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.71	1.69	2.39	PASS
Pushover-X Acc	0.69	0.47	0.69	FAIL
Pushover+Y Acc	0.25	0.67	2.66	PASS
Pushover-Y Acc	0.23	1.35	5.83	PASS
Pushover+X Acc + e	0.72	1.69	2.35	PASS
Pushover-X Acc + e	0.68	0.47	0.70	FAIL
Pushover+Y Acc + e	0.25	0.67	2.69	PASS
Pushover-Y Acc + e	0.23	1.35	5.78	PASS
PushoverEx+0.3Ey Acc	0.70	1.66	2.37	PASS
Pushover0.3Ex+Ey Acc	0.30	0.98	3.25	PASS
Pushover-0.3Ex+Ey Acc	0.32	0.28	0.90	FAIL
Pushover-Ex+0.3Ey Acc	0.66	0.38	0.57	FAIL

Table 121: The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.15	6.55	2.08	PASS
Pushover-X Acc	3.05	2.55	0.84	FAIL
Pushover+Y Acc	0.84	0.67	0.80	FAIL
Pushover-Y Acc	0.71	1.87	2.63	PASS
Pushover+X Acc + e	3.20	6.55	2.05	PASS
Pushover-X Acc + e	3.01	2.55	0.85	FAIL
Pushover+Y Acc + e	0.83	0.67	0.81	FAIL
Pushover-Y Acc + e	0.72	1.87	2.59	PASS
PushoverEx+0.3Ey Acc	3.12	5.93	1.90	PASS
Pushover0.3Ex+Ey Acc	1.20	0.98	0.82	FAIL
Pushover-0.3Ex+Ey Acc	1.32	1.14	0.86	FAIL
Pushover-Ex+0.3Ey Acc	2.94	2.44	0.83	FAIL

Table 122: The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.40	8.77	1.99	PASS
Pushover-X Acc	4.26	3.49	0.82	FAIL
Pushover+Y Acc	1.13	0.96	0.85	FAIL
Pushover-Y Acc	0.91	2.60	2.87	PASS
Pushover+X Acc + e	4.47	8.77	1.96	PASS
Pushover-X Acc + e	4.21	3.49	0.83	FAIL
Pushover+Y Acc + e	1.10	0.96	0.88	FAIL
Pushover-Y Acc + e	0.92	2.60	2.83	PASS
PushoverEx+0.3Ey Acc	4.36	8.01	1.84	PASS
Pushover0.3Ex+Ey Acc	1.58	1.37	0.87	FAIL
Pushover-0.3Ex+Ey Acc	1.73	1.52	0.88	FAIL
Pushover-Ex+0.3Ey Acc	4.11	3.28	0.80	FAIL

Table 123: The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on rock subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.63	0.52	0.84	FAIL
Pushover-X Acc	0.50	0.67	1.33	PASS
Pushover+Y Acc	0.24	1.43	6.01	PASS
Pushover-Y Acc	0.24	1.05	4.35	PASS
Pushover+X Acc + e	0.63	0.52	0.83	FAIL
Pushover-X Acc + e	0.50	0.67	1.34	PASS
Pushover+Y Acc + e	0.23	1.43	6.08	PASS
Pushover-Y Acc + e	0.24	1.05	4.32	PASS
PushoverEx+0.3Ey Acc	0.92	1.34	1.45	PASS
Pushover0.3Ex+Ey Acc	0.28	1.16	4.08	PASS
Pushover-0.3Ex+Ey Acc	0.31	0.47	1.54	PASS
Pushover-Ex+0.3Ey Acc	0.52	0.57	1.09	PASS

Table 124: The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.78	6.69	2.40	PASS
Pushover-X Acc	2.23	3.44	1.54	PASS
Pushover+Y Acc	0.74	3.52	4.73	PASS
Pushover-Y Acc	0.77	1.99	2.60	PASS
Pushover+X Acc + e	2.80	6.69	2.39	PASS
Pushover-X Acc + e	2.22	3.44	1.55	PASS
Pushover+Y Acc + e	0.73	3.52	4.83	PASS
Pushover-Y Acc + e	0.78	1.89	2.43	PASS
PushoverEx+0.3Ey Acc	4.10	6.89	1.68	PASS
Pushover0.3Ex+Ey Acc	1.07	4.26	3.98	PASS
Pushover-0.3Ex+Ey Acc	1.24	2.45	1.98	PASS
Pushover-Ex+0.3Ey Acc	2.32	3.12	1.35	PASS

Table 125: The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with HCB on rock subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.89	8.99	2.31	PASS
Pushover-X Acc	3.12	4.68	1.50	PASS
Pushover+Y Acc	0.95	4.76	5.02	PASS
Pushover-Y Acc	0.98	2.73	2.79	PASS
Pushover+X Acc + e	3.91	8.99	2.30	PASS
Pushover-X Acc + e	3.10	4.68	1.51	PASS
Pushover+Y Acc + e	0.93	4.76	5.13	PASS
Pushover-Y Acc + e	0.99	2.62	2.65	PASS
PushoverEx+0.3Ey Acc	5.73	9.25	1.61	PASS
Pushover0.3Ex+Ey Acc	1.36	5.71	4.19	PASS
Pushover-0.3Ex+Ey Acc	1.58	3.30	2.09	PASS
Pushover-Ex+0.3Ey Acc	3.24	4.25	1.31	PASS

Table 126: The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with HCB on rock subsoil

Appendix D.2

Results for Structures on Ground Type A (Stiff Clay)

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.62	1.66	2.67	PASS
Pushover-X Acc	0.62	2.12	3.42	PASS
Pushover+Y Acc	0.02	0.30	14.41	PASS
Pushover-Y Acc	0.02	0.30	14.87	PASS
Pushover+X Acc + e	0.62	1.55	2.51	PASS
Pushover-X Acc + e	0.62	2.12	3.41	PASS
Pushover+Y Acc + e	0.02	0.30	14.67	PASS
Pushover-Y Acc + e	0.02	0.30	14.71	PASS
PushoverEx+0.3Ey Acc	0.59	1.65	2.80	PASS
Pushover0.3Ex+Ey Acc	0.08	0.70	8.84	PASS
Pushover-0.3Ex+Ey Acc	0.08	0.49	6.06	PASS
Pushover-Ex+0.3Ey Acc	0.58	1.93	3.32	PASS

Table 127: The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with Globigerina limestone on stiff clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.20	4.04	1.83	PASS
Pushover-X Acc	2.15	2.12	0.99	FAIL
Pushover+Y Acc	0.04	0.70	18.27	PASS
Pushover-Y Acc	0.04	1.41	37.66	PASS
Pushover+X Acc + e	2.21	4.04	1.83	PASS
Pushover-X Acc + e	2.16	2.12	0.98	FAIL
Pushover+Y Acc + e	0.04	0.70	18.59	PASS
Pushover-Y Acc + e	0.04	1.41	37.28	PASS
PushoverEx+0.3Ey Acc	1.99	3.71	1.87	PASS
Pushover0.3Ex+Ey Acc	0.16	1.71	10.53	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.79	4.73	PASS
Pushover-Ex+0.3Ey Acc	1.89	1.93	1.02	PASS

Table 128: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with Globigerina limestone on stiff clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.96	5.39	1.82	PASS
Pushover-X Acc	2.87	2.89	1.01	PASS
Pushover+Y Acc	0.05	1.10	23.48	PASS
Pushover-Y Acc	0.05	1.91	41.80	PASS
Pushover+X Acc + e	2.96	5.49	1.85	PASS
Pushover-X Acc + e	2.88	2.89	1.01	PASS
Pushover+Y Acc + e	0.05	1.00	21.72	PASS
Pushover-Y Acc + e	0.05	1.91	41.39	PASS
PushoverEx+0.3Ey Acc	2.70	4.95	1.84	PASS
Pushover0.3Ex+Ey Acc	0.20	2.31	11.69	PASS
Pushover-0.3Ex+Ey Acc	0.20	1.09	5.34	PASS
Pushover-Ex+0.3Ey Acc	2.51	2.61	1.04	PASS

Table 129: The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with Globigerina limestone on stiff clay subsoil.

One Unit – Detached Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.68	1.44	2.11	PASS
Pushover-X Acc	0.53	1.16	2.18	PASS
Pushover+Y Acc	0.02	0.20	10.98	PASS
Pushover-Y Acc	0.02	0.10	5.66	PASS
Pushover+X Acc + e	0.68	1.44	2.13	PASS
Pushover-X Acc + e	0.54	1.16	2.17	PASS
Pushover+Y Acc + e	0.02	0.20	11.14	PASS
Pushover-Y Acc + e	0.02	0.20	10.66	PASS
PushoverEx+0.3Ey Acc	0.71	1.95	2.73	PASS
Pushover0.3Ex+Ey Acc	0.07	0.30	4.63	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.30	4.42	PASS
Pushover-Ex+0.3Ey Acc	0.57	1.75	3.09	PASS

Table 130: The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with HCB on stiff clay subsoil.

One Unit – Detached Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.63	3.60	1.37	PASS
Pushover-X Acc	1.72	3.30	1.92	PASS
Pushover+Y Acc	0.03	2.19	65.25	PASS
Pushover-Y Acc	0.03	1.71	51.91	PASS
Pushover+X Acc + e	2.60	3.60	1.39	PASS
Pushover-X Acc + e	1.74	3.20	1.84	PASS
Pushover+Y Acc + e	0.03	2.19	66.17	PASS
Pushover-Y Acc + e	0.03	1.81	51.91	PASS
PushoverEx+0.3Ey Acc	2.80	3.39	1.21	PASS
Pushover0.3Ex+Ey Acc	0.13	1.31	10.38	PASS
Pushover-0.3Ex+Ey Acc	0.13	1.48	11.37	PASS
Pushover-Ex+0.3Ey Acc	1.80	3.11	1.73	PASS

Table 131: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with HCB on stiff clay subsoil.

One Unit – Detached Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.50	4.94	1.41	PASS
Pushover-X Acc	2.38	4.47	1.88	PASS
Pushover+Y Acc	0.04	2.99	72.75	PASS
Pushover-Y Acc	0.04	2.31	57.42	PASS
Pushover+X Acc + e	3.47	4.94	1.42	PASS
Pushover-X Acc + e	2.40	4.37	1.82	PASS
Pushover+Y Acc + e	0.04	2.99	73.77	PASS
Pushover-Y Acc + e	0.04	2.41	56.60	PASS
PushoverEx+0.3Ey Acc	3.73	4.51	1.21	PASS
Pushover0.3Ex+Ey Acc	0.15	1.81	11.79	PASS
Pushover-0.3Ex+Ey Acc	0.16	2.08	13.06	PASS
Pushover-Ex+0.3Ey Acc	2.44	4.18	1.71	PASS

Table 132: The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with HCB on stiff clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.91	2.24	2.47	PASS
Pushover-X Acc	0.91	1.86	2.05	PASS
Pushover+Y Acc	0.06	0.50	8.87	PASS
Pushover-Y Acc	0.05	0.50	9.44	PASS
Pushover+X Acc + e	0.91	2.24	2.46	PASS
Pushover-X Acc + e	0.91	1.86	2.05	PASS
Pushover+Y Acc + e	0.06	0.50	9.01	PASS
Pushover-Y Acc + e	0.05	0.50	9.30	PASS
PushoverEx+0.3Ey Acc	0.87	2.33	2.70	PASS
Pushover0.3Ex+Ey Acc	0.17	0.91	5.39	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.68	3.92	PASS
Pushover-Ex+0.3Ey Acc	0.86	1.78	2.06	PASS

Table 133: The outcomes of the SLD pushover analysis for a four-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.56	5.77	1.62	PASS
Pushover-X Acc	3.56	1.86	0.52	FAIL
Pushover+Y Acc	0.10	0.79	7.75	PASS
Pushover-Y Acc	0.10	1.51	15.66	PASS
Pushover+X Acc + e	3.57	5.77	1.62	PASS
Pushover-X Acc + e	3.56	1.86	0.52	FAIL
Pushover+Y Acc + e	0.10	0.79	7.90	PASS
Pushover-Y Acc + e	0.10	1.51	15.38	PASS
PushoverEx+0.3Ey Acc	3.39	5.41	1.60	PASS
Pushover0.3Ex+Ey Acc	0.40	2.13	5.35	PASS
Pushover-0.3Ex+Ey Acc	0.41	0.78	1.91	PASS
Pushover-Ex+0.3Ey Acc	3.38	1.78	0.53	FAIL

Table 134: The outcomes of the SLV pushover analysis for a four-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.88	7.69	1.57	PASS
Pushover-X Acc	4.88	2.61	0.53	FAIL
Pushover+Y Acc	0.13	1.09	8.73	PASS
Pushover-Y Acc	0.12	2.11	17.97	PASS
Pushover+X Acc + e	4.90	7.69	1.57	PASS
Pushover-X Acc + e	4.88	2.61	0.53	FAIL
Pushover+Y Acc + e	0.12	1.09	8.91	PASS
Pushover-Y Acc + e	0.12	2.11	17.65	PASS
PushoverEx+0.3Ey Acc	4.65	7.21	1.55	PASS
Pushover0.3Ex+Ey Acc	0.51	2.84	5.60	PASS
Pushover-0.3Ex+Ey Acc	0.52	1.07	2.06	PASS
Pushover-Ex+0.3Ey Acc	4.64	2.43	0.52	FAIL

Table 135: The outcomes of the SLC pushover analysis for a four-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.92	1.37	1.49	PASS
Pushover-X Acc	0.80	1.51	1.90	PASS
Pushover+Y Acc	0.05	0.30	6.35	PASS
Pushover-Y Acc	0.05	0.30	6.35	PASS
Pushover+X Acc + e	0.93	1.48	1.59	PASS
Pushover-X Acc + e	0.80	1.51	1.90	PASS
Pushover+Y Acc + e	0.05	0.30	6.51	PASS
Pushover-Y Acc + e	0.05	0.30	6.32	PASS
PushoverEx+0.3Ey Acc	1.31	4.51	3.44	PASS
Pushover0.3Ex+Ey Acc	0.14	0.61	4.25	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.39	2.85	PASS
Pushover-Ex+0.3Ey Acc	0.73	1.52	2.09	PASS

Table 136: The outcomes of the SLD pushover analysis for a four-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.59	5.91	1.64	PASS
Pushover-X Acc	3.12	2.84	0.91	FAIL
Pushover+Y Acc	0.08	3.88	46.39	PASS
Pushover-Y Acc	0.08	1.91	22.61	PASS
Pushover+X Acc + e	3.64	6.01	1.65	PASS
Pushover-X Acc + e	3.12	2.84	0.91	FAIL
Pushover+Y Acc + e	0.08	3.78	46.30	PASS
Pushover-Y Acc + e	0.08	1.91	22.51	PASS
PushoverEx+0.3Ey Acc	5.13	5.45	1.06	PASS
Pushover0.3Ex+Ey Acc	0.33	2.22	6.64	PASS
Pushover-0.3Ex+Ey Acc	0.32	1.08	3.34	PASS
Pushover-Ex+0.3Ey Acc	2.82	2.65	0.94	FAIL

Table 137: The outcomes of the SLV pushover analysis for a four-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.93	8.02	1.63	PASS
Pushover-X Acc	4.29	3.88	0.90	FAIL
Pushover+Y Acc	0.10	5.27	51.65	PASS
Pushover-Y Acc	0.10	2.62	25.36	PASS
Pushover+X Acc + e	5.00	8.12	1.63	PASS
Pushover-X Acc + e	4.29	3.88	0.90	FAIL
Pushover+Y Acc + e	0.10	5.07	50.91	PASS
Pushover-Y Acc + e	0.10	2.62	25.24	PASS
PushoverEx+0.3Ey Acc	7.04	7.34	1.04	PASS
Pushover0.3Ex+Ey Acc	0.41	3.03	7.36	PASS
Pushover-0.3Ex+Ey Acc	0.39	1.47	3.74	PASS
Pushover-Ex+0.3Ey Acc	3.76	3.60	0.96	FAIL

Table 138: The outcomes of the SLC pushover analysis for a four-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.23	2.77	2.25	PASS
Pushover-X Acc	1.21	1.87	1.55	PASS
Pushover+Y Acc	0.11	0.89	8.34	PASS
Pushover-Y Acc	0.10	0.71	7.05	PASS
Pushover+X Acc + e	1.23	2.66	2.16	PASS
Pushover-X Acc + e	1.20	1.87	1.56	PASS
Pushover+Y Acc + e	0.11	0.89	8.49	PASS
Pushover-Y Acc + e	0.10	0.71	6.93	PASS
PushoverEx+0.3Ey Acc	1.17	2.85	2.43	PASS
Pushover0.3Ex+Ey Acc	0.31	1.33	4.34	PASS
Pushover-0.3Ex+Ey Acc	0.32	0.77	2.43	PASS
Pushover-Ex+0.3Ey Acc	1.15	1.80	1.56	PASS

Table 139:The outcomes of the SLD pushover analysis for a five-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.82	6.64	1.38	PASS
Pushover-X Acc	4.73	1.87	0.40	FAIL
Pushover+Y Acc	0.23	1.19	5.14	PASS
Pushover-Y Acc	0.21	2.02	9.49	PASS
Pushover+X Acc + e	4.81	6.53	1.36	PASS
Pushover-X Acc + e	4.71	1.87	0.40	FAIL
Pushover+Y Acc + e	0.23	1.19	5.26	PASS
Pushover-Y Acc + e	0.22	2.02	9.29	PASS
PushoverEx+0.3Ey Acc	4.58	6.14	1.34	PASS
Pushover0.3Ex+Ey Acc	0.72	2.65	3.69	PASS
Pushover-0.3Ex+Ey Acc	0.74	0.77	1.03	PASS
Pushover-Ex+0.3Ey Acc	4.52	1.80	0.40	FAIL

Table 140: The outcomes of the SLV pushover analysis for a five-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.61	8.86	1.34	PASS
Pushover-X Acc	6.48	2.59	0.40	FAIL
Pushover+Y Acc	0.28	1.58	5.63	PASS
Pushover-Y Acc	0.26	2.73	10.52	PASS
Pushover+X Acc + e	6.60	8.75	1.32	PASS
Pushover-X Acc + e	6.46	2.59	0.40	FAIL
Pushover+Y Acc + e	0.27	1.58	5.76	PASS
Pushover-Y Acc + e	0.26	2.73	10.30	PASS
PushoverEx+0.3Ey Acc	6.29	8.22	1.31	PASS
Pushover0.3Ex+Ey Acc	0.92	3.57	3.90	PASS
Pushover-0.3Ex+Ey Acc	0.95	1.06	1.12	PASS
Pushover-Ex+0.3Ey Acc	6.20	2.43	0.39	FAIL

Table 141: The outcomes of the SLC pushover analysis for a five-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.13	1.20	1.06	PASS
Pushover-X Acc	1.11	1.73	1.56	PASS
Pushover+Y Acc	0.09	0.59	6.40	PASS
Pushover-Y Acc	0.09	0.40	4.46	PASS
Pushover+X Acc + e	1.13	1.20	1.06	PASS
Pushover-X Acc + e	1.11	1.73	1.57	PASS
Pushover+Y Acc + e	0.09	0.59	6.56	PASS
Pushover-Y Acc + e	0.10	0.50	5.19	PASS
PushoverEx+0.3Ey Acc	1.26	2.05	1.63	PASS
Pushover0.3Ex+Ey Acc	0.28	1.12	3.99	PASS
Pushover-0.3Ex+Ey Acc	0.26	0.68	2.62	PASS
Pushover-Ex+0.3Ey Acc	1.01	1.65	1.64	PASS

Table 142: The outcomes of the SLD pushover analysis for a five-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.43	7.17	1.62	PASS
Pushover-X Acc	4.34	3.10	0.71	FAIL
Pushover+Y Acc	0.19	4.26	22.08	PASS
Pushover-Y Acc	0.19	1.72	9.19	PASS
Pushover+X Acc + e	4.44	7.17	1.62	PASS
Pushover-X Acc + e	4.33	3.10	0.72	FAIL
Pushover+Y Acc + e	0.19	4.16	22.26	PASS
Pushover-Y Acc + e	0.20	2.22	10.85	PASS
PushoverEx+0.3Ey Acc	4.92	6.36	1.29	PASS
Pushover0.3Ex+Ey Acc	0.66	2.34	3.55	PASS
Pushover-0.3Ex+Ey Acc	0.61	1.26	2.07	PASS
Pushover-Ex+0.3Ey Acc	3.95	2.84	0.72	FAIL

Table 143: The outcomes of the SLV pushover analysis for a five-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.07	9.57	1.58	PASS
Pushover-X Acc	5.96	4.20	0.70	FAIL
Pushover+Y Acc	0.23	5.75	24.45	PASS
Pushover-Y Acc	0.23	2.32	10.21	PASS
Pushover+X Acc + e	6.09	9.57	1.57	PASS
Pushover-X Acc + e	5.95	4.20	0.71	FAIL
Pushover+Y Acc + e	0.23	5.55	24.36	PASS
Pushover-Y Acc + e	0.25	3.03	12.14	PASS
PushoverEx+0.3Ey Acc	6.75	8.60	1.27	PASS
Pushover0.3Ex+Ey Acc	0.84	3.21	3.83	PASS
Pushover-0.3Ex+Ey Acc	0.88	1.74	1.98	PASS
Pushover-Ex+0.3Ey Acc	5.42	3.85	0.71	FAIL

Table 144: The outcomes of the SLC pushover analysis for a five-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.67	3.23	1.94	PASS
Pushover-X Acc	1.63	1.78	1.09	PASS
Pushover+Y Acc	0.21	1.38	6.73	PASS
Pushover-Y Acc	0.19	1.01	5.32	PASS
Pushover+X Acc + e	1.67	3.23	1.93	PASS
Pushover-X Acc + e	1.62	1.78	1.10	PASS
Pushover+Y Acc + e	0.20	1.38	6.86	PASS
Pushover-Y Acc + e	0.19	1.01	5.23	PASS
PushoverEx+0.3Ey Acc	1.59	3.52	2.21	PASS
Pushover0.3Ex+Ey Acc	0.52	1.75	3.39	PASS
Pushover-0.3Ex+Ey Acc	0.53	0.76	1.44	PASS
Pushover-Ex+0.3Ey Acc	1.57	1.71	1.09	PASS

Table 145: The outcomes of the SLD pushover analysis for a six-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.52	7.61	1.17	PASS
Pushover-X Acc	6.39	1.78	0.28	FAIL
Pushover+Y Acc	0.48	1.48	3.07	PASS
Pushover-Y Acc	0.45	2.23	4.98	PASS
Pushover+X Acc + e	6.55	7.61	1.16	PASS
Pushover-X Acc + e	6.35	1.78	0.28	FAIL
Pushover+Y Acc + e	0.47	1.48	3.13	PASS
Pushover-Y Acc + e	0.46	2.13	4.67	PASS
PushoverEx+0.3Ey Acc	6.23	6.93	1.11	PASS
Pushover0.3Ex+Ey Acc	1.33	2.88	2.17	PASS
Pushover-0.3Ex+Ey Acc	1.57	0.76	0.48	FAIL
Pushover-Ex+0.3Ey Acc	6.14	1.71	0.28	FAIL

Table 146: The outcomes of the SLV pushover analysis for a six-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.95	10.15	1.13	PASS
Pushover-X Acc	8.77	2.46	0.28	FAIL
Pushover+Y Acc	0.61	2.07	3.37	PASS
Pushover-Y Acc	0.57	3.04	5.34	PASS
Pushover+X Acc + e	8.98	10.15	1.13	PASS
Pushover-X Acc + e	8.71	2.46	0.28	FAIL
Pushover+Y Acc + e	0.60	2.07	3.44	PASS
Pushover-Y Acc + e	0.58	2.84	4.89	PASS
PushoverEx+0.3Ey Acc	8.55	9.28	1.09	PASS
Pushover0.3Ex+Ey Acc	1.69	3.88	2.30	PASS
Pushover-0.3Ex+Ey Acc	2.22	1.04	0.47	FAIL
Pushover-Ex+0.3Ey Acc	8.42	2.31	0.27	FAIL

Table 147: The outcomes of the SLC pushover analysis for six-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.59	1.24	0.78	FAIL
Pushover-X Acc	1.54	2.36	1.54	PASS
Pushover+Y Acc	0.17	0.79	4.52	PASS
Pushover-Y Acc	0.16	0.61	3.72	PASS
Pushover+X Acc + e	1.60	1.24	0.77	FAIL
Pushover-X Acc + e	1.53	2.36	1.54	PASS
Pushover+Y Acc + e	0.17	0.79	4.61	PASS
Pushover-Y Acc + e	0.17	0.61	3.64	PASS
PushoverEx+0.3Ey Acc	1.55	1.67	1.08	PASS
Pushover0.3Ex+Ey Acc	0.49	1.64	3.35	PASS
Pushover-0.3Ex+Ey Acc	0.46	0.95	2.07	PASS
Pushover-Ex+0.3Ey Acc	1.38	2.11	1.54	PASS

Table 148: The outcomes of the SLD pushover analysis for a six-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.59	1.24	0.78	FAIL
Pushover-X Acc	1.54	2.36	1.54	PASS
Pushover+Y Acc	0.17	0.79	4.52	PASS
Pushover-Y Acc	0.16	0.61	3.72	PASS
Pushover+X Acc + e	1.60	1.24	0.77	FAIL
Pushover-X Acc + e	1.53	2.36	1.54	PASS
Pushover+Y Acc + e	0.17	0.79	4.61	PASS
Pushover-Y Acc + e	0.17	0.61	3.64	PASS
PushoverEx+0.3Ey Acc	1.55	1.67	1.08	PASS
Pushover0.3Ex+Ey Acc	0.49	1.64	3.35	PASS
Pushover-0.3Ex+Ey Acc	0.46	0.95	2.07	PASS
Pushover-Ex+0.3Ey Acc	1.38	2.11	1.54	PASS

Table 149: The outcomes of the SLV pushover analysis for a six-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.55	5.85	0.68	FAIL
Pushover-X Acc	8.26	4.28	0.52	FAIL
Pushover+Y Acc	0.52	4.34	8.32	PASS
Pushover-Y Acc	0.48	3.24	6.70	PASS
Pushover+X Acc + e	8.58	6.08	0.71	FAIL
Pushover-X Acc + e	8.23	4.28	0.52	FAIL
Pushover+Y Acc + e	0.51	4.24	8.28	PASS
Pushover-Y Acc + e	0.50	2.43	4.88	PASS
PushoverEx+0.3Ey Acc	8.33	8.89	1.07	PASS
Pushover0.3Ex+Ey Acc	1.52	3.58	2.36	PASS
Pushover-0.3Ex+Ey Acc	1.71	1.91	1.11	PASS
Pushover-Ex+0.3Ey Acc	7.39	3.96	0.54	FAIL

Table 150: The outcomes of the SLC pushover analysis for a six-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.04	3.86	1.89	PASS
Pushover-X Acc	1.99	1.59	0.80	FAIL
Pushover+Y Acc	0.32	2.06	6.39	PASS
Pushover-Y Acc	0.30	1.43	4.82	PASS
Pushover+X Acc + e	2.06	3.86	1.87	PASS
Pushover-X Acc + e	1.97	1.67	0.85	FAIL
Pushover+Y Acc + e	0.32	1.96	6.21	PASS
Pushover-Y Acc + e	0.30	1.43	4.73	PASS
PushoverEx+0.3Ey Acc	1.95	4.14	2.12	PASS
Pushover0.3Ex+Ey Acc	0.64	2.39	3.71	PASS
Pushover-0.3Ex+Ey Acc	0.65	0.65	0.99	FAIL
Pushover-Ex+0.3Ey Acc	1.92	1.53	0.80	FAIL

Table 151: The outcomes of the SLD pushover analysis for seven-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.00	7.95	0.99	FAIL
Pushover-X Acc	7.79	1.59	0.20	FAIL
Pushover+Y Acc	0.76	2.06	2.72	PASS
Pushover-Y Acc	0.70	2.55	3.66	PASS
Pushover+X Acc + e	8.06	7.95	0.99	FAIL
Pushover-X Acc + e	7.73	1.67	0.22	FAIL
Pushover+Y Acc + e	0.74	1.96	2.64	PASS
Pushover-Y Acc + e	0.71	2.45	3.45	PASS
PushoverEx+0.3Ey Acc	7.63	7.33	0.96	FAIL
Pushover0.3Ex+Ey Acc	2.04	3.12	1.53	PASS
Pushover-0.3Ex+Ey Acc	2.37	0.65	0.27	FAIL
Pushover-Ex+0.3Ey Acc	7.53	1.53	0.20	FAIL

Table 152: The outcomes of the SLV pushover analysis for seven-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.97	10.73	0.98	FAIL
Pushover-X Acc	10.69	2.23	0.21	FAIL
Pushover+Y Acc	0.96	2.84	2.95	PASS
Pushover-Y Acc	0.89	3.47	3.91	PASS
Pushover+X Acc + e	11.06	10.73	0.97	FAIL
Pushover-X Acc + e	10.60	2.30	0.22	FAIL
Pushover+Y Acc + e	0.94	2.75	2.91	PASS
Pushover-Y Acc + e	0.90	3.26	3.61	PASS
PushoverEx+0.3Ey Acc	10.47	9.80	0.94	FAIL
Pushover0.3Ex+Ey Acc	2.60	4.26	1.64	PASS
Pushover-0.3Ex+Ey Acc	3.24	0.93	0.29	FAIL
Pushover-Ex+0.3Ey Acc	10.34	2.10	0.20	FAIL

Table 153: The outcomes of the SLC pushover analysis for seven-story, single-unit structure built with Globigerina limestone on stiff clay subsoil

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.97	1.52	0.77	FAIL
Pushover-X Acc	1.87	2.90	1.55	PASS
Pushover+Y Acc	0.28	1.28	4.55	PASS
Pushover-Y Acc	0.25	0.82	3.23	PASS
Pushover+X Acc + e	1.99	1.52	0.76	FAIL
Pushover-X Acc + e	1.86	3.07	1.65	PASS
Pushover+Y Acc + e	0.27	1.28	4.67	PASS
Pushover-Y Acc + e	0.25	0.82	3.21	PASS
PushoverEx+0.3Ey Acc	1.90	1.84	0.97	FAIL
Pushover0.3Ex+Ey Acc	0.61	1.96	3.21	PASS
Pushover-0.3Ex+Ey Acc	0.57	1.12	1.98	PASS
Pushover-Ex+0.3Ey Acc	1.66	2.77	1.67	PASS

Table 154: The outcomes of the SLD pushover analysis for seven-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.73	4.80	0.62	FAIL
Pushover-X Acc	7.32	3.07	0.42	FAIL
Pushover+Y Acc	0.66	3.92	5.96	PASS
Pushover-Y Acc	0.59	2.85	4.81	PASS
Pushover+X Acc + e	7.79	4.68	0.60	FAIL
Pushover-X Acc + e	7.27	3.15	0.43	FAIL
Pushover+Y Acc + e	0.64	3.92	6.12	PASS
Pushover-Y Acc + e	0.60	2.45	4.10	PASS
PushoverEx+0.3Ey Acc	7.44	7.02	0.94	FAIL
Pushover0.3Ex+Ey Acc	1.83	2.78	1.52	PASS
Pushover-0.3Ex+Ey Acc	1.75	1.31	0.75	FAIL
Pushover-Ex+0.3Ey Acc	6.48	2.85	0.44	FAIL

Table 155: The outcomes of the SLV pushover analysis for seven-story, single-unit structure built with HCB on stiff clay subsoil

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.60	6.44	0.61	FAIL
Pushover-X Acc	10.05	4.15	0.41	FAIL
Pushover+Y Acc	0.84	5.30	6.31	PASS
Pushover-Y Acc	0.76	3.87	5.12	PASS
Pushover+X Acc + e	10.69	6.32	0.59	FAIL
Pushover-X Acc + e	9.97	4.23	0.42	FAIL
Pushover+Y Acc + e	0.82	5.30	6.48	PASS
Pushover-Y Acc + e	0.76	3.36	4.43	PASS
PushoverEx+0.3Ey Acc	10.21	9.44	0.92	FAIL
Pushover0.3Ex+Ey Acc	2.33	3.84	1.65	PASS
Pushover-0.3Ex+Ey Acc	2.45	1.78	0.73	FAIL
Pushover-Ex+0.3Ey Acc	8.89	3.86	0.43	FAIL

Table 156: The outcomes of the SLC pushover analysis for seven-story, single-unit structure built with HCB on stiff clay subsoil

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.52	1.02	1.95	PASS
Pushover-X Acc	0.52	0.79	1.50	PASS
Pushover+Y Acc	0.03	0.30	9.24	PASS
Pushover-Y Acc	0.04	0.30	8.54	PASS
Pushover+X Acc + e	0.52	0.92	1.75	PASS
Pushover-X Acc + e	0.52	0.79	1.50	PASS
Pushover+Y Acc + e	0.03	0.30	9.39	PASS
Pushover-Y Acc + e	0.04	0.30	8.38	PASS
PushoverEx+0.3Ey Acc	0.49	0.91	1.86	PASS
Pushover0.3Ex+Ey Acc	0.08	0.50	6.61	PASS
Pushover-0.3Ex+Ey Acc	0.08	0.40	5.10	PASS
Pushover-Ex+0.3Ey Acc	0.51	0.69	1.34	PASS

Table 157: The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.65	3.36	2.04	PASS
Pushover-X Acc	1.58	2.65	1.67	PASS
Pushover+Y Acc	0.06	0.80	13.64	PASS
Pushover-Y Acc	0.06	1.31	20.56	PASS
Pushover+X Acc + e	1.65	3.46	2.09	PASS
Pushover-X Acc + e	1.58	2.65	1.68	PASS
Pushover+Y Acc + e	0.06	1.29	22.50	PASS
Pushover-Y Acc + e	0.06	1.41	21.76	PASS
PushoverEx+0.3Ey Acc	1.48	3.15	2.12	PASS
Pushover0.3Ex+Ey Acc	0.15	1.80	11.95	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.69	4.45	PASS
Pushover-Ex+0.3Ey Acc	1.45	2.26	1.56	PASS

Table 158: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.30	4.58	1.99	PASS
Pushover-X Acc	2.22	3.54	1.59	PASS
Pushover+Y Acc	0.07	2.09	29.31	PASS
Pushover-Y Acc	0.08	1.81	23.31	PASS
Pushover+X Acc + e	2.31	4.68	2.03	PASS
Pushover-X Acc + e	2.21	3.54	1.60	PASS
Pushover+Y Acc + e	0.07	2.29	32.58	PASS
Pushover-Y Acc + e	0.08	1.91	24.18	PASS
PushoverEx+0.3Ey Acc	2.09	4.26	2.04	PASS
Pushover0.3Ex+Ey Acc	0.18	2.40	13.08	PASS
Pushover-0.3Ex+Ey Acc	0.19	0.99	5.22	PASS
Pushover-Ex+0.3Ey Acc	2.04	3.14	1.54	PASS

Table 159: The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.56	0.61	1.09	PASS
Pushover-X Acc	0.63	1.38	2.17	PASS
Pushover+Y Acc	0.03	0.20	6.18	PASS
Pushover-Y Acc	0.04	0.20	5.12	PASS
Pushover+X Acc + e	0.56	0.61	1.09	PASS
Pushover-X Acc + e	0.64	1.48	2.30	PASS
Pushover+Y Acc + e	0.03	0.20	6.26	PASS
Pushover-Y Acc + e	0.04	0.20	5.04	PASS
PushoverEx+0.3Ey Acc	0.54	0.81	1.51	PASS
Pushover0.3Ex+Ey Acc	0.07	0.30	4.45	PASS
Pushover-0.3Ex+Ey Acc	0.08	0.30	3.83	PASS
Pushover-Ex+0.3Ey Acc	0.64	1.97	3.07	PASS

Table 160: The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.98	3.25	1.64	PASS
Pushover-X Acc	2.27	2.96	1.30	PASS
Pushover+Y Acc	0.06	2.09	35.92	PASS
Pushover-Y Acc	0.07	1.41	20.02	PASS
Pushover+X Acc + e	1.98	3.25	1.64	PASS
Pushover-X Acc + e	2.32	2.96	1.27	PASS
Pushover+Y Acc + e	0.06	1.99	34.61	PASS
Pushover-Y Acc + e	0.07	1.41	19.70	PASS
PushoverEx+0.3Ey Acc	1.80	3.04	1.69	PASS
Pushover0.3Ex+Ey Acc	0.13	1.80	13.86	PASS
Pushover-0.3Ex+Ey Acc	0.16	1.29	8.28	PASS
Pushover-Ex+0.3Ey Acc	2.24	2.95	1.32	PASS

Table 161: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.73	4.36	1.60	PASS
Pushover-X Acc	3.06	4.04	1.32	PASS
Pushover+Y Acc	0.07	2.88	40.61	PASS
Pushover-Y Acc	0.09	2.01	23.43	PASS
Pushover+X Acc + e	2.72	4.47	1.64	PASS
Pushover-X Acc + e	3.13	4.04	1.29	PASS
Pushover+Y Acc + e	0.07	2.68	38.25	PASS
Pushover-Y Acc + e	0.09	2.01	23.05	PASS
PushoverEx+0.3Ey Acc	2.49	4.05	1.63	PASS
Pushover0.3Ex+Ey Acc	0.16	2.40	15.16	PASS
Pushover-0.3Ex+Ey Acc	0.19	1.78	9.41	PASS
Pushover-Ex+0.3Ey Acc	2.99	3.94	1.32	PASS

Table 162: The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.78	1.45	1.86	PASS
Pushover-X Acc	0.73	0.77	1.06	PASS
Pushover+Y Acc	0.08	0.59	7.85	PASS
Pushover-Y Acc	0.08	0.51	6.47	PASS
Pushover+X Acc + e	0.78	1.45	1.87	PASS
Pushover-X Acc + e	0.73	0.77	1.06	PASS
Pushover+Y Acc + e	0.07	0.59	7.96	PASS
Pushover-Y Acc + e	0.08	0.51	6.36	PASS
PushoverEx+0.3Ey Acc	0.73	1.44	1.98	PASS
Pushover0.3Ex+Ey Acc	0.15	0.70	4.64	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.39	2.51	PASS
Pushover-Ex+0.3Ey Acc	0.70	0.68	0.97	FAIL

Table 163: The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.04	5.28	1.74	PASS
Pushover-X Acc	2.81	2.32	0.82	FAIL
Pushover+Y Acc	0.15	0.89	5.98	PASS
Pushover-Y Acc	0.16	1.52	9.77	PASS
Pushover+X Acc + e	3.03	5.28	1.74	PASS
Pushover-X Acc + e	2.80	2.41	0.86	FAIL
Pushover+Y Acc + e	0.15	1.09	7.43	PASS
Pushover-Y Acc + e	0.16	1.62	10.20	PASS
PushoverEx+0.3Ey Acc	2.80	5.04	1.80	PASS
Pushover0.3Ex+Ey Acc	0.35	2.40	6.77	PASS
Pushover-0.3Ex+Ey Acc	0.37	1.08	2.94	PASS
Pushover-Ex+0.3Ey Acc	2.59	2.22	0.86	FAIL

Table 164: The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.10	7.14	1.74	PASS
Pushover-X Acc	3.75	3.19	0.85	FAIL
Pushover+Y Acc	0.18	1.29	7.08	PASS
Pushover-Y Acc	0.19	2.12	11.23	PASS
Pushover+X Acc + e	4.09	7.14	1.75	PASS
Pushover-X Acc + e	3.73	3.28	0.88	FAIL
Pushover+Y Acc + e	0.18	1.88	10.54	PASS
Pushover-Y Acc + e	0.19	2.22	11.51	PASS
PushoverEx+0.3Ey Acc	3.74	7.10	1.90	PASS
Pushover0.3Ex+Ey Acc	0.44	3.20	7.25	PASS
Pushover-0.3Ex+Ey Acc	0.46	1.47	3.18	PASS
Pushover-Ex+0.3Ey Acc	3.48	2.99	0.86	FAIL

Table 165: The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.85	0.93	1.09	PASS
Pushover-X Acc	0.63	0.78	1.24	PASS
Pushover+Y Acc	0.07	0.30	4.37	PASS
Pushover-Y Acc	0.08	0.30	3.82	PASS
Pushover+X Acc + e	0.85	0.93	1.08	PASS
Pushover-X Acc + e	0.62	0.78	1.24	PASS
Pushover+Y Acc + e	0.07	0.30	4.45	PASS
Pushover-Y Acc + e	0.08	0.40	4.99	PASS
PushoverEx+0.3Ey Acc	0.79	1.13	1.42	PASS
Pushover0.3Ex+Ey Acc	0.14	0.50	3.47	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.49	3.10	PASS
Pushover-Ex+0.3Ey Acc	0.60	0.68	1.13	PASS

Table 166: The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.32	5.55	1.67	PASS
Pushover-X Acc	2.30	2.62	1.14	PASS
Pushover+Y Acc	0.13	2.97	22.82	PASS
Pushover-Y Acc	0.16	1.62	10.23	PASS
Pushover+X Acc + e	3.34	5.66	1.69	PASS
Pushover-X Acc + e	2.28	2.72	1.19	PASS
Pushover+Y Acc + e	0.13	2.87	22.55	PASS
Pushover-Y Acc + e	0.16	1.62	9.94	PASS
PushoverEx+0.3Ey Acc	3.11	4.91	1.58	PASS
Pushover0.3Ex+Ey Acc	0.34	2.80	8.28	PASS
Pushover-0.3Ex+Ey Acc	0.37	1.18	3.17	PASS
Pushover-Ex+0.3Ey Acc	2.15	2.33	1.08	PASS

Table 167:The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.56	7.40	1.62	PASS
Pushover-X Acc	3.14	3.60	1.14	PASS
Pushover+Y Acc	0.16	4.06	25.58	PASS
Pushover-Y Acc	0.19	2.22	11.54	PASS
Pushover+X Acc + e	4.59	7.61	1.66	PASS
Pushover-X Acc + e	3.12	3.69	1.18	PASS
Pushover+Y Acc + e	0.16	3.96	25.51	PASS
Pushover-Y Acc + e	0.20	2.22	11.22	PASS
PushoverEx+0.3Ey Acc	4.23	6.65	1.57	PASS
Pushover0.3Ex+Ey Acc	0.41	3.86	9.32	PASS
Pushover-0.3Ex+Ey Acc	0.47	1.57	3.34	PASS
Pushover-Ex+0.3Ey Acc	2.95	3.20	1.09	PASS

Table 168: The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.98	1.69	1.72	PASS
Pushover-X Acc	0.96	0.76	0.78	FAIL
Pushover+Y Acc	0.15	0.79	5.41	PASS
Pushover-Y Acc	0.14	0.81	5.69	PASS
Pushover+X Acc + e	0.98	1.69	1.72	PASS
Pushover-X Acc + e	0.96	0.76	0.79	FAIL
Pushover+Y Acc + e	0.14	0.79	5.52	PASS
Pushover-Y Acc + e	0.15	0.81	5.57	PASS
PushoverEx+0.3Ey Acc	1.01	1.67	1.66	PASS
Pushover0.3Ex+Ey Acc	0.27	0.90	3.34	PASS
Pushover-0.3Ex+Ey Acc	0.28	0.39	1.38	PASS
Pushover-Ex+0.3Ey Acc	0.92	0.66	0.72	FAIL

Table 169: The outcomes of the SLD pushover analysis for a five-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.83	5.27	1.38	PASS
Pushover-X Acc	3.78	2.55	0.68	FAIL
Pushover+Y Acc	0.34	0.79	2.30	PASS
Pushover-Y Acc	0.34	1.83	5.46	PASS
Pushover+X Acc + e	3.85	5.17	1.34	PASS
Pushover-X Acc + e	3.75	2.55	0.68	FAIL
Pushover+Y Acc + e	0.34	0.79	2.35	PASS
Pushover-Y Acc + e	0.34	1.83	5.34	PASS
PushoverEx+0.3Ey Acc	3.95	4.91	1.25	PASS
Pushover0.3Ex+Ey Acc	0.63	1.50	2.37	PASS
Pushover-0.3Ex+Ey Acc	0.66	1.07	1.62	PASS
Pushover-Ex+0.3Ey Acc	3.61	2.36	0.66	FAIL

Table 170: The outcomes of the SLV pushover analysis for a five-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.26	7.07	1.34	PASS
Pushover-X Acc	5.18	3.50	0.68	FAIL
Pushover+Y Acc	0.42	1.08	2.59	PASS
Pushover-Y Acc	0.41	2.54	6.23	PASS
Pushover+X Acc + e	5.28	6.96	1.32	PASS
Pushover-X Acc + e	5.15	3.50	0.68	FAIL
Pushover+Y Acc + e	0.41	1.08	2.66	PASS
Pushover-Y Acc + e	0.42	2.54	6.06	PASS
PushoverEx+0.3Ey Acc	5.41	6.59	1.22	PASS
Pushover0.3Ex+Ey Acc	0.81	2.10	2.61	PASS
Pushover-0.3Ex+Ey Acc	0.84	1.55	1.85	PASS
Pushover-Ex+0.3Ey Acc	4.95	3.22	0.65	FAIL

Table 171: The outcomes of the SLC pushover analysis for a five-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.25	1.25	1.00	FAIL
Pushover-X Acc	0.84	1.05	1.24	PASS
Pushover+Y Acc	0.12	0.59	4.90	PASS
Pushover-Y Acc	0.13	0.51	3.86	PASS
Pushover+X Acc + e	1.28	1.36	1.06	PASS
Pushover-X Acc + e	0.84	1.05	1.26	PASS
Pushover+Y Acc + e	0.12	0.49	4.16	PASS
Pushover-Y Acc + e	0.14	0.51	3.75	PASS
PushoverEx+0.3Ey Acc	1.12	1.66	1.49	PASS
Pushover0.3Ex+Ey Acc	0.25	0.90	3.55	PASS
Pushover-0.3Ex+Ey Acc	0.27	0.78	2.85	PASS
Pushover-Ex+0.3Ey Acc	0.81	1.05	1.29	PASS

Table 172: The outcomes of the SLD pushover analysis for five-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.89	6.27	1.28	PASS
Pushover-X Acc	3.30	2.87	0.87	FAIL
Pushover+Y Acc	0.27	2.65	9.88	PASS
Pushover-Y Acc	0.30	1.83	6.07	PASS
Pushover+X Acc + e	5.00	6.37	1.28	PASS
Pushover-X Acc + e	3.27	2.87	0.88	FAIL
Pushover+Y Acc + e	0.26	3.24	12.39	PASS
Pushover-Y Acc + e	0.31	1.73	5.52	PASS
PushoverEx+0.3Ey Acc	4.37	6.12	1.40	PASS
Pushover0.3Ex+Ey Acc	0.59	2.99	5.04	PASS
Pushover-0.3Ex+Ey Acc	0.64	1.17	1.82	PASS
Pushover-Ex+0.3Ey Acc	3.19	2.58	0.81	FAIL

Table 173: The outcomes of the SLV pushover analysis for five-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.89	6.27	1.28	PASS
Pushover-X Acc	3.30	2.87	0.87	FAIL
Pushover+Y Acc	0.27	2.65	9.88	PASS
Pushover-Y Acc	0.30	1.83	6.07	PASS
Pushover+X Acc + e	5.00	6.37	1.28	PASS
Pushover-X Acc + e	3.27	2.87	0.88	FAIL
Pushover+Y Acc + e	0.26	3.24	12.39	PASS
Pushover-Y Acc + e	0.31	1.73	5.52	PASS
PushoverEx+0.3Ey Acc	4.37	6.12	1.40	PASS
Pushover0.3Ex+Ey Acc	0.59	2.99	5.04	PASS
Pushover-0.3Ex+Ey Acc	0.64	1.17	1.82	PASS
Pushover-Ex+0.3Ey Acc	3.19	2.58	0.81	FAIL

Table 174: The outcomes of the SLC pushover analysis for five-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.28	2.05	1.60	PASS
Pushover-X Acc	1.22	0.74	0.61	FAIL
Pushover+Y Acc	0.25	0.78	3.15	PASS
Pushover-Y Acc	0.24	1.13	4.76	PASS
Pushover+X Acc + e	1.30	2.05	1.57	PASS
Pushover-X Acc + e	1.20	0.74	0.61	FAIL
Pushover+Y Acc + e	0.24	0.78	3.21	PASS
Pushover-Y Acc + e	0.24	1.13	4.67	PASS
PushoverEx+0.3Ey Acc	1.29	1.92	1.49	PASS
Pushover0.3Ex+Ey Acc	0.45	1.10	2.43	PASS
Pushover-0.3Ex+Ey Acc	0.48	0.38	0.80	FAIL
Pushover-Ex+0.3Ey Acc	1.16	0.65	0.55	FAIL

Table 175: The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.99	6.14	1.23	PASS
Pushover-X Acc	4.76	2.49	0.52	FAIL
Pushover+Y Acc	0.58	0.78	1.34	PASS
Pushover-Y Acc	0.56	2.15	3.87	PASS
Pushover+X Acc + e	5.10	6.14	1.21	PASS
Pushover-X Acc + e	4.71	2.49	0.53	FAIL
Pushover+Y Acc + e	0.57	0.78	1.37	PASS
Pushover-Y Acc + e	0.57	1.94	3.43	PASS
PushoverEx+0.3Ey Acc	5.04	5.64	1.12	PASS
Pushover0.3Ex+Ey Acc	1.06	1.50	1.41	PASS
Pushover-0.3Ex+Ey Acc	1.13	1.25	1.10	PASS
Pushover-Ex+0.3Ey Acc	4.56	2.31	0.51	FAIL

Table 176: The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.85	8.30	1.21	PASS
Pushover-X Acc	6.53	3.41	0.52	FAIL
Pushover+Y Acc	0.74	1.07	1.45	PASS
Pushover-Y Acc	0.71	2.97	4.20	PASS
Pushover+X Acc + e	6.99	8.19	1.17	PASS
Pushover-X Acc + e	6.47	3.41	0.53	FAIL
Pushover+Y Acc + e	0.73	1.07	1.48	PASS
Pushover-Y Acc + e	0.72	2.66	3.69	PASS
PushoverEx+0.3Ey Acc	6.91	7.56	1.09	PASS
Pushover0.3Ex+Ey Acc	1.35	2.10	1.55	PASS
Pushover-0.3Ex+Ey Acc	1.54	1.72	1.12	PASS
Pushover-Ex+0.3Ey Acc	6.25	3.14	0.50	FAIL

Table 177:The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.74	1.49	0.86	FAIL
Pushover-X Acc	1.11	1.59	1.43	PASS
Pushover+Y Acc	0.20	0.88	4.29	PASS
Pushover-Y Acc	0.21	0.72	3.44	PASS
Pushover+X Acc + e	1.79	1.60	0.89	FAIL
Pushover-X Acc + e	1.09	1.50	1.37	PASS
Pushover+Y Acc + e	0.20	0.88	4.36	PASS
Pushover-Y Acc + e	0.21	0.72	3.39	PASS
PushoverEx+0.3Ey Acc	1.49	1.58	1.06	PASS
Pushover0.3Ex+Ey Acc	0.41	1.49	3.61	PASS
Pushover-0.3Ex+Ey Acc	0.41	0.96	2.33	PASS
Pushover-Ex+0.3Ey Acc	1.05	1.40	1.33	PASS

Table 178:The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.81	7.34	1.08	PASS
Pushover-X Acc	4.35	2.81	0.64	FAIL
Pushover+Y Acc	0.48	3.02	6.29	PASS
Pushover-Y Acc	0.49	1.85	3.77	PASS
Pushover+X Acc + e	7.00	7.34	1.05	PASS
Pushover-X Acc + e	4.27	2.90	0.68	FAIL
Pushover+Y Acc + e	0.47	3.02	6.40	PASS
Pushover-Y Acc + e	0.50	1.85	3.71	PASS
PushoverEx+0.3Ey Acc	5.82	6.63	1.14	PASS
Pushover0.3Ex+Ey Acc	0.97	3.08	3.18	PASS
Pushover-0.3Ex+Ey Acc	0.97	1.34	1.39	PASS
Pushover-Ex+0.3Ey Acc	4.11	2.80	0.68	FAIL

Table 179: The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.35	9.79	1.05	PASS
Pushover-X Acc	5.97	3.84	0.64	FAIL
Pushover+Y Acc	0.61	4.09	6.69	PASS
Pushover-Y Acc	0.62	2.46	3.94	PASS
Pushover+X Acc + e	9.61	9.79	1.02	PASS
Pushover-X Acc + e	5.86	3.93	0.67	FAIL
Pushover+Y Acc + e	0.60	4.09	6.80	PASS
Pushover-Y Acc + e	0.63	2.46	3.89	PASS
PushoverEx+0.3Ey Acc	7.99	8.84	1.11	PASS
Pushover0.3Ex+Ey Acc	1.24	4.23	3.42	PASS
Pushover-0.3Ex+Ey Acc	1.44	1.82	1.26	PASS
Pushover-Ex+0.3Ey Acc	5.64	3.74	0.66	FAIL

Table 180:The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.49	2.05	1.37	PASS
Pushover-X Acc	1.30	0.55	0.43	FAIL
Pushover+Y Acc	0.40	0.19	0.48	FAIL
Pushover-Y Acc	0.33	1.35	4.06	PASS
Pushover+X Acc + e	1.49	2.05	1.37	PASS
Pushover-X Acc + e	1.30	0.55	0.43	FAIL
Pushover+Y Acc + e	0.41	0.19	0.47	FAIL
Pushover-Y Acc + e	0.33	1.25	3.83	PASS
PushoverEx+0.3Ey Acc	1.45	1.80	1.24	PASS
Pushover0.3Ex+Ey Acc	0.50	0.20	0.39	FAIL
Pushover-0.3Ex+Ey Acc	0.57	0.28	0.50	FAIL
Pushover-Ex+0.3Ey Acc	1.26	0.55	0.44	FAIL

Table 181:The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.83	5.06	0.87	FAIL
Pushover-X Acc	5.09	1.57	0.31	FAIL
Pushover+Y Acc	1.42	0.19	0.13	PASS
Pushover-Y Acc	0.78	1.77	2.26	PASS
Pushover+X Acc + e	5.84	5.17	0.89	FAIL
Pushover-X Acc + e	5.07	1.48	0.29	FAIL
Pushover+Y Acc + e	1.44	0.19	0.13	FAIL
Pushover-Y Acc + e	0.77	1.46	1.90	PASS
PushoverEx+0.3Ey Acc	5.68	4.56	0.80	FAIL
Pushover0.3Ex+Ey Acc	1.79	0.20	0.11	FAIL
Pushover-0.3Ex+Ey Acc	2.09	0.28	0.14	FAIL
Pushover-Ex+0.3Ey Acc	4.92	1.47	0.30	FAIL

Table 182: The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.00	6.79	0.85	FAIL
Pushover-X Acc	6.99	2.12	0.30	FAIL
Pushover+Y Acc	1.99	0.29	0.14	PASS
Pushover-Y Acc	1.00	2.40	2.40	PASS
Pushover+X Acc + e	8.01	7.00	0.87	FAIL
Pushover-X Acc + e	6.96	2.03	0.29	FAIL
Pushover+Y Acc + e	2.01	0.29	0.14	FAIL
Pushover-Y Acc + e	0.98	2.08	2.13	PASS
PushoverEx+0.3Ey Acc	7.79	6.14	0.79	FAIL
Pushover0.3Ex+Ey Acc	2.48	0.39	0.16	FAIL
Pushover-0.3Ex+Ey Acc	2.87	0.47	0.16	FAIL
Pushover-Ex+0.3Ey Acc	6.75	2.02	0.30	FAIL

Table 183: The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.42	1.74	1.22	PASS
Pushover-X Acc	1.05	1.10	1.04	PASS
Pushover+Y Acc	0.33	1.25	3.77	PASS
Pushover-Y Acc	0.32	0.93	2.96	PASS
Pushover+X Acc + e	1.42	1.74	1.22	PASS
Pushover-X Acc + e	1.05	1.10	1.04	PASS
Pushover+Y Acc + e	0.32	1.25	3.86	PASS
Pushover-Y Acc + e	0.32	0.93	2.89	PASS
PushoverEx+0.3Ey Acc	1.39	1.82	1.31	PASS
Pushover0.3Ex+Ey Acc	0.51	1.88	3.71	PASS
Pushover-0.3Ex+Ey Acc	0.55	0.66	1.20	PASS
Pushover-Ex+0.3Ey Acc	1.04	1.00	0.96	FAIL

Table 184:The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.56	6.30	1.13	PASS
Pushover-X Acc	4.12	2.74	0.67	FAIL
Pushover+Y Acc	0.78	3.95	5.07	PASS
Pushover-Y Acc	0.74	1.86	2.52	PASS
Pushover+X Acc + e	5.56	6.30	1.13	PASS
Pushover-X Acc + e	4.11	2.74	0.67	FAIL
Pushover+Y Acc + e	0.76	3.47	4.55	PASS
Pushover-Y Acc + e	0.76	1.86	2.46	PASS
PushoverEx+0.3Ey Acc	5.44	6.73	1.24	PASS
Pushover0.3Ex+Ey Acc	1.27	3.37	2.65	PASS
Pushover-0.3Ex+Ey Acc	1.64	1.42	0.86	FAIL
Pushover-Ex+0.3Ey Acc	4.09	2.73	0.67	FAIL

Table 185: The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with HCB on stiff clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.63	8.47	1.11	PASS
Pushover-X Acc	5.65	3.66	0.65	FAIL
Pushover+Y Acc	0.99	5.40	5.43	PASS
Pushover-Y Acc	0.94	2.59	2.74	PASS
Pushover+X Acc + e	7.63	8.47	1.11	PASS
Pushover-X Acc + e	5.64	3.66	0.65	FAIL
Pushover+Y Acc + e	0.97	4.72	4.86	PASS
Pushover-Y Acc + e	0.97	2.59	2.66	PASS
PushoverEx+0.3Ey Acc	7.46	9.08	1.22	PASS
Pushover0.3Ex+Ey Acc	1.62	4.51	2.79	PASS
Pushover-0.3Ex+Ey Acc	2.31	1.89	0.82	FAIL
Pushover-Ex+0.3Ey Acc	5.61	3.65	0.65	FAIL

Table 186:The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.45	0.71	1.57	PASS
Pushover-X Acc	0.48	0.59	1.24	PASS
Pushover+Y Acc	0.03	0.30	8.64	PASS
Pushover-Y Acc	0.04	0.30	7.58	PASS
Pushover+X Acc + e	0.46	0.71	1.55	PASS
Pushover-X Acc + e	0.48	0.59	1.24	PASS
Pushover+Y Acc + e	0.03	0.30	8.79	PASS
Pushover-Y Acc + e	0.04	0.30	7.50	PASS
PushoverEx+0.3Ey Acc	0.43	0.71	1.63	PASS
Pushover0.3Ex+Ey Acc	0.07	0.50	7.33	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.30	4.25	PASS
Pushover-Ex+0.3Ey Acc	0.52	0.59	1.15	PASS

Table 187:The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with Globigerina limestone on stiff clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.30	3.34	2.56	PASS
Pushover-X Acc	1.37	2.57	1.87	PASS
Pushover+Y Acc	0.06	1.39	22.37	PASS
Pushover-Y Acc	0.07	1.21	16.94	PASS
Pushover+X Acc + e	1.32	3.34	2.53	PASS
Pushover-X Acc + e	1.36	2.67	1.96	PASS
Pushover+Y Acc + e	0.06	1.39	22.76	PASS
Pushover-Y Acc + e	0.07	1.21	16.77	PASS
PushoverEx+0.3Ey Acc	1.18	2.83	2.39	PASS
Pushover0.3Ex+Ey Acc	0.13	1.99	15.15	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.59	4.37	PASS
Pushover-Ex+0.3Ey Acc	1.44	2.27	1.58	PASS

Table 188: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with Globigerina limestone on stiff clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.87	4.56	2.44	PASS
Pushover-X Acc	1.95	3.46	1.77	PASS
Pushover+Y Acc	0.08	2.28	30.09	PASS
Pushover-Y Acc	0.09	1.71	19.66	PASS
Pushover+X Acc + e	1.89	4.56	2.41	PASS
Pushover-X Acc + e	1.95	3.56	1.83	PASS
Pushover+Y Acc + e	0.07	2.38	31.95	PASS
Pushover-Y Acc + e	0.09	1.61	18.32	PASS
PushoverEx+0.3Ey Acc	1.71	3.84	2.24	PASS
Pushover0.3Ex+Ey Acc	0.16	2.79	17.40	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.89	5.37	PASS
Pushover-Ex+0.3Ey Acc	2.01	3.06	1.53	PASS

Table 189:The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with Globigerina limestone on stiff clay subsoil

Three Unit – Aggregate Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.49	0.51	1.03	PASS
Pushover-X Acc	0.70	0.79	1.13	PASS
Pushover+Y Acc	0.03	0.20	5.78	PASS
Pushover-Y Acc	0.05	0.20	4.24	PASS
Pushover+X Acc + e	0.49	0.40	0.83	FAIL
Pushover-X Acc + e	0.69	0.79	1.15	PASS
Pushover+Y Acc + e	0.03	0.20	5.87	PASS
Pushover-Y Acc + e	0.05	0.20	4.18	PASS
PushoverEx+0.3Ey Acc	0.51	0.81	1.57	PASS
Pushover0.3Ex+Ey Acc	0.06	0.20	3.23	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.30	4.16	PASS
Pushover-Ex+0.3Ey Acc	0.63	0.69	1.09	PASS

Table 190:The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with HCB on stiff clay subsoil

Three Unit – Aggregate Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.68	3.03	1.80	PASS
Pushover-X Acc	2.65	2.97	1.12	PASS
Pushover+Y Acc	0.06	2.18	35.25	PASS
Pushover-Y Acc	0.08	0.81	9.55	PASS
Pushover+X Acc + e	1.67	3.03	1.81	PASS
Pushover-X Acc + e	2.58	2.97	1.15	PASS
Pushover+Y Acc + e	0.06	2.09	34.20	PASS
Pushover-Y Acc + e	0.09	1.21	14.14	PASS
PushoverEx+0.3Ey Acc	1.67	2.72	1.63	PASS
Pushover0.3Ex+Ey Acc	0.12	2.09	18.00	PASS
Pushover-0.3Ex+Ey Acc	0.14	2.18	15.59	PASS
Pushover-Ex+0.3Ey Acc	2.16	2.77	1.28	PASS

Table 191: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with HCB on stiff clay subsoil

Three Unit – Aggregate Structure - HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.34	4.04	1.73	PASS
Pushover-X Acc	3.51	3.96	1.13	PASS
Pushover+Y Acc	0.08	2.98	39.36	PASS
Pushover-Y Acc	0.10	1.11	10.76	PASS
Pushover+X Acc + e	2.33	4.14	1.78	PASS
Pushover-X Acc + e	3.43	3.96	1.16	PASS
Pushover+Y Acc + e	0.07	2.88	38.67	PASS
Pushover-Y Acc + e	0.10	1.71	16.41	PASS
PushoverEx+0.3Ey Acc	2.33	3.73	1.60	PASS
Pushover0.3Ex+Ey Acc	0.14	2.79	19.69	PASS
Pushover-0.3Ex+Ey Acc	0.17	2.97	17.44	PASS
Pushover-Ex+0.3Ey Acc	2.84	3.76	1.32	PASS

Table 192: The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with HCB on stiff clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.66	1.02	1.56	PASS
Pushover-X Acc	0.64	0.59	0.91	FAIL
Pushover+Y Acc	0.08	0.59	7.34	PASS
Pushover-Y Acc	0.09	0.51	5.93	PASS
Pushover+X Acc + e	0.67	1.13	1.68	PASS
Pushover-X Acc + e	0.64	0.59	0.92	FAIL
Pushover+Y Acc + e	0.08	0.59	7.47	PASS
Pushover-Y Acc + e	0.09	0.51	5.85	PASS
PushoverEx+0.3Ey Acc	0.67	1.22	1.83	PASS
Pushover0.3Ex+Ey Acc	0.14	0.80	5.79	PASS
Pushover-0.3Ex+Ey Acc	0.15	0.29	2.01	PASS
Pushover-Ex+0.3Ey Acc	0.64	0.49	0.77	FAIL

Table 193:The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.41	5.22	2.17	PASS
Pushover-X Acc	2.33	2.15	0.92	FAIL
Pushover+Y Acc	0.16	1.19	7.33	PASS
Pushover-Y Acc	0.17	1.42	8.15	PASS
Pushover+X Acc + e	2.48	5.22	2.11	PASS
Pushover-X Acc + e	2.30	2.24	0.98	FAIL
Pushover+Y Acc + e	0.16	1.19	7.48	PASS
Pushover-Y Acc + e	0.18	1.52	8.60	PASS
PushoverEx+0.3Ey Acc	2.44	4.79	1.97	PASS
Pushover0.3Ex+Ey Acc	0.32	1.99	6.20	PASS
Pushover-0.3Ex+Ey Acc	0.34	1.08	3.14	PASS
Pushover-Ex+0.3Ey Acc	2.26	2.05	0.91	FAIL

Table 194: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.27	7.07	2.16	PASS
Pushover-X Acc	3.16	2.93	0.93	FAIL
Pushover+Y Acc	0.20	1.78	9.02	PASS
Pushover-Y Acc	0.21	1.92	9.08	PASS
Pushover+X Acc + e	3.35	7.07	2.11	PASS
Pushover-X Acc + e	3.13	3.03	0.97	FAIL
Pushover+Y Acc + e	0.19	1.88	9.72	PASS
Pushover-Y Acc + e	0.22	2.02	9.41	PASS
PushoverEx+0.3Ey Acc	3.29	6.42	1.95	PASS
Pushover0.3Ex+Ey Acc	0.39	2.69	6.88	PASS
Pushover-0.3Ex+Ey Acc	0.42	1.47	3.47	PASS
Pushover-Ex+0.3Ey Acc	3.07	2.73	0.89	FAIL

Table 195:The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.80	0.82	1.02	PASS
Pushover-X Acc	0.65	0.69	1.06	PASS
Pushover+Y Acc	0.07	0.30	4.08	PASS
Pushover-Y Acc	0.09	0.41	4.49	PASS
Pushover+X Acc + e	0.80	0.82	1.02	PASS
Pushover-X Acc + e	0.65	0.69	1.06	PASS
Pushover+Y Acc + e	0.07	0.30	4.13	PASS
Pushover-Y Acc + e	0.09	0.41	4.39	PASS
PushoverEx+0.3Ey Acc	1.05	1.22	1.15	PASS
Pushover0.3Ex+Ey Acc	0.12	0.50	4.09	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.39	2.88	PASS
Pushover-Ex+0.3Ey Acc	0.77	0.59	0.76	FAIL

Table 196:The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.12	4.79	1.54	PASS
Pushover-X Acc	2.39	3.24	1.36	PASS
Pushover+Y Acc	0.14	3.26	23.06	PASS
Pushover-Y Acc	0.19	1.42	7.60	PASS
Pushover+X Acc + e	3.12	4.79	1.53	PASS
Pushover-X Acc + e	2.37	3.33	1.41	PASS
Pushover+Y Acc + e	0.14	2.96	21.26	PASS
Pushover-Y Acc + e	0.19	1.42	7.38	PASS
PushoverEx+0.3Ey Acc	4.13	4.46	1.08	PASS
Pushover0.3Ex+Ey Acc	0.27	3.38	12.35	PASS
Pushover-0.3Ex+Ey Acc	0.32	1.57	4.95	PASS
Pushover-Ex+0.3Ey Acc	3.02	2.84	0.94	FAIL

Table 197: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.12	4.79	1.54	PASS
Pushover-X Acc	2.39	3.24	1.36	PASS
Pushover+Y Acc	0.14	3.26	23.06	PASS
Pushover-Y Acc	0.19	1.42	7.60	PASS
Pushover+X Acc + e	3.12	4.79	1.53	PASS
Pushover-X Acc + e	2.37	3.33	1.41	PASS
Pushover+Y Acc + e	0.14	2.96	21.26	PASS
Pushover-Y Acc + e	0.19	1.42	7.38	PASS
PushoverEx+0.3Ey Acc	4.13	4.46	1.08	PASS
Pushover0.3Ex+Ey Acc	0.27	3.38	12.35	PASS
Pushover-0.3Ex+Ey Acc	0.32	1.57	4.95	PASS
Pushover-Ex+0.3Ey Acc	3.02	2.84	0.94	FAIL

Table 198: The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.88	1.35	1.54	PASS
Pushover-X Acc	0.85	0.48	0.57	FAIL
Pushover+Y Acc	0.16	0.69	4.40	PASS
Pushover-Y Acc	0.16	0.81	5.24	PASS
Pushover+X Acc + e	0.89	1.35	1.52	PASS
Pushover-X Acc + e	0.84	0.48	0.57	FAIL
Pushover+Y Acc + e	0.15	0.69	4.48	PASS
Pushover-Y Acc + e	0.16	0.81	5.13	PASS
PushoverEx+0.3Ey Acc	0.84	1.44	1.71	PASS
Pushover0.3Ex+Ey Acc	0.25	0.89	3.61	PASS
Pushover-0.3Ex+Ey Acc	0.27	0.29	1.07	PASS
Pushover-Ex+0.3Ey Acc	0.81	0.48	0.59	FAIL

Table 199:The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.43	5.09	1.48	PASS
Pushover-X Acc	3.32	2.31	0.69	FAIL
Pushover+Y Acc	0.37	0.69	1.87	PASS
Pushover-Y Acc	0.37	1.73	4.74	PASS
Pushover+X Acc + e	3.47	4.98	1.44	PASS
Pushover-X Acc + e	3.30	2.31	0.70	FAIL
Pushover+Y Acc + e	0.36	0.69	1.91	PASS
Pushover-Y Acc + e	0.37	1.73	4.64	PASS
PushoverEx+0.3Ey Acc	3.29	4.74	1.44	PASS
Pushover0.3Ex+Ey Acc	0.58	1.09	1.88	PASS
Pushover-0.3Ex+Ey Acc	0.64	1.36	2.13	PASS
Pushover-Ex+0.3Ey Acc	3.18	2.02	0.63	FAIL

Table 200: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.71	6.85	1.45	PASS
Pushover-X Acc	4.56	3.08	0.68	FAIL
Pushover+Y Acc	0.46	0.98	2.14	PASS
Pushover-Y Acc	0.46	2.34	5.13	PASS
Pushover+X Acc + e	4.76	6.75	1.42	PASS
Pushover-X Acc + e	4.52	3.08	0.68	FAIL
Pushover+Y Acc + e	0.45	0.98	2.19	PASS
Pushover-Y Acc + e	0.47	2.34	5.00	PASS
PushoverEx+0.3Ey Acc	4.52	6.38	1.41	PASS
Pushover0.3Ex+Ey Acc	0.74	1.59	2.15	PASS
Pushover-0.3Ex+Ey Acc	0.81	1.85	2.27	PASS
Pushover-Ex+0.3Ey Acc	4.33	2.78	0.64	FAIL

Table 201:The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.55	1.34	0.53	FAIL
Pushover-X Acc	0.82	0.58	0.71	FAIL
Pushover+Y Acc	0.13	0.59	4.47	PASS
Pushover-Y Acc	0.16	0.61	3.94	PASS
Pushover+X Acc + e	2.55	1.34	0.53	FAIL
Pushover-X Acc + e	0.81	0.68	0.84	FAIL
Pushover+Y Acc + e	0.13	0.59	4.55	PASS
Pushover-Y Acc + e	0.16	0.61	3.89	PASS
PushoverEx+0.3Ey Acc	1.47	1.23	0.84	FAIL
Pushover0.3Ex+Ey Acc	0.22	0.79	3.54	PASS
Pushover-0.3Ex+Ey Acc	0.25	0.39	1.57	PASS
Pushover-Ex+0.3Ey Acc	0.77	0.58	0.75	FAIL

Table 202:The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.37	6.70	0.65	FAIL
Pushover-X Acc	3.22	3.39	1.05	PASS
Pushover+Y Acc	0.30	3.82	12.69	PASS
Pushover-Y Acc	0.36	1.53	4.20	PASS
Pushover+X Acc + e	10.37	6.81	0.66	FAIL
Pushover-X Acc + e	3.15	3.39	1.08	PASS
Pushover+Y Acc + e	0.29	3.92	13.31	PASS
Pushover-Y Acc + e	0.37	1.53	4.14	PASS
PushoverEx+0.3Ey Acc	5.74	6.34	1.10	PASS
Pushover0.3Ex+Ey Acc	0.52	3.56	6.79	PASS
Pushover-0.3Ex+Ey Acc	0.58	1.75	3.00	PASS
Pushover-Ex+0.3Ey Acc	3.01	2.80	0.93	FAIL

Table 203: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	14.23	8.97	0.63	FAIL
Pushover-X Acc	4.41	4.55	1.03	PASS
Pushover+Y Acc	0.37	5.19	14.17	PASS
Pushover-Y Acc	0.46	2.14	4.71	PASS
Pushover+X Acc + e	14.23	9.07	0.64	FAIL
Pushover-X Acc + e	4.29	4.55	1.06	PASS
Pushover+Y Acc + e	0.36	5.29	14.77	PASS
Pushover-Y Acc + e	0.46	2.14	4.62	PASS
PushoverEx+0.3Ey Acc	7.88	8.49	1.08	PASS
Pushover0.3Ex+Ey Acc	0.67	4.85	7.26	PASS
Pushover-0.3Ex+Ey Acc	0.74	2.33	3.15	PASS
Pushover-Ex+0.3Ey Acc	4.05	3.86	0.95	FAIL

Table 204:The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.03	1.46	1.42	PASS
Pushover-X Acc	1.01	0.48	0.48	FAIL
Pushover+Y Acc	0.28	0.68	2.42	PASS
Pushover-Y Acc	0.27	1.13	4.21	PASS
Pushover+X Acc + e	1.04	1.46	1.41	PASS
Pushover-X Acc + e	1.00	0.48	0.48	FAIL
Pushover+Y Acc + e	0.28	0.78	2.79	PASS
Pushover-Y Acc + e	0.27	1.13	4.15	PASS
PushoverEx+0.3Ey Acc	1.00	1.44	1.44	PASS
Pushover0.3Ex+Ey Acc	0.41	1.08	2.62	PASS
Pushover-0.3Ex+Ey Acc	0.47	0.38	0.82	FAIL
Pushover-Ex+0.3Ey Acc	0.97	0.48	0.49	FAIL

Table 205:The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.02	5.63	1.40	PASS
Pushover-X Acc	3.94	2.49	0.63	FAIL
Pushover+Y Acc	0.66	0.68	1.03	PASS
Pushover-Y Acc	0.63	1.96	3.09	PASS
Pushover+X Acc + e	4.07	5.63	1.38	PASS
Pushover-X Acc + e	3.90	2.49	0.64	FAIL
Pushover+Y Acc + e	0.65	0.78	1.19	PASS
Pushover-Y Acc + e	0.64	1.85	2.89	PASS
PushoverEx+0.3Ey Acc	3.93	5.26	1.34	PASS
Pushover0.3Ex+Ey Acc	0.97	1.08	1.12	PASS
Pushover-0.3Ex+Ey Acc	1.11	1.15	1.04	PASS
Pushover-Ex+0.3Ey Acc	3.80	2.29	0.60	FAIL

Table 206: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.51	7.61	1.38	PASS
Pushover-X Acc	5.40	3.35	0.62	FAIL
Pushover+Y Acc	0.84	0.97	1.16	PASS
Pushover-Y Acc	0.80	2.68	3.33	PASS
Pushover+X Acc + e	5.58	7.61	1.36	PASS
Pushover-X Acc + e	5.35	3.35	0.63	FAIL
Pushover+Y Acc + e	0.83	1.07	1.28	PASS
Pushover-Y Acc + e	0.82	2.57	3.15	PASS
PushoverEx+0.3Ey Acc	5.39	7.12	1.32	PASS
Pushover0.3Ex+Ey Acc	1.24	1.48	1.20	PASS
Pushover-0.3Ex+Ey Acc	1.45	1.63	1.13	PASS
Pushover-Ex+0.3Ey Acc	5.21	3.05	0.58	FAIL

Table 207:The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.00	0.63	0.63	FAIL
Pushover-X Acc	0.76	0.67	0.88	FAIL
Pushover+Y Acc	0.24	0.97	4.12	PASS
Pushover-Y Acc	0.26	0.82	3.21	PASS
Pushover+X Acc + e	1.01	0.63	0.62	FAIL
Pushover-X Acc + e	0.77	0.67	0.87	FAIL
Pushover+Y Acc + e	0.23	0.97	4.21	PASS
Pushover-Y Acc + e	0.26	0.82	3.14	PASS
PushoverEx+0.3Ey Acc	1.21	1.34	1.11	PASS
Pushover0.3Ex+Ey Acc	0.38	0.98	2.58	PASS
Pushover-0.3Ex+Ey Acc	0.46	0.38	0.84	FAIL
Pushover-Ex+0.3Ey Acc	0.76	0.57	0.75	FAIL

Table 208:The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.90	5.32	1.36	PASS
Pushover-X Acc	2.95	3.54	1.20	PASS
Pushover+Y Acc	0.55	3.88	7.02	PASS
Pushover-Y Acc	0.60	1.55	2.56	PASS
Pushover+X Acc + e	3.94	5.32	1.35	PASS
Pushover-X Acc + e	2.98	3.63	1.22	PASS
Pushover+Y Acc + e	0.54	3.10	5.74	PASS
Pushover-Y Acc + e	0.62	1.55	2.50	PASS
PushoverEx+0.3Ey Acc	4.74	6.71	1.42	PASS
Pushover0.3Ex+Ey Acc	0.90	3.64	4.06	PASS
Pushover-0.3Ex+Ey Acc	1.08	1.92	1.78	PASS
Pushover-Ex+0.3Ey Acc	2.95	3.04	1.03	PASS

Table 209: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.36	7.20	1.34	PASS
Pushover-X Acc	3.97	4.78	1.20	PASS
Pushover+Y Acc	0.70	5.23	7.44	PASS
Pushover-Y Acc	0.77	2.17	2.81	PASS
Pushover+X Acc + e	5.40	7.20	1.33	PASS
Pushover-X Acc + e	4.02	4.88	1.21	PASS
Pushover+Y Acc + e	0.69	4.26	6.20	PASS
Pushover-Y Acc + e	0.79	2.17	2.75	PASS
PushoverEx+0.3Ey Acc	6.50	9.08	1.40	PASS
Pushover0.3Ex+Ey Acc	1.14	4.97	4.35	PASS
Pushover-0.3Ex+Ey Acc	1.37	2.59	1.89	PASS
Pushover-Ex+0.3Ey Acc	3.98	4.09	1.03	PASS

Table 210:The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.40	1.93	1.37	PASS
Pushover-X Acc	1.31	0.37	0.28	FAIL
Pushover+Y Acc	0.41	0.77	1.87	PASS
Pushover-Y Acc	0.36	1.35	3.77	PASS
Pushover+X Acc + e	1.43	1.93	1.35	PASS
Pushover-X Acc + e	1.29	0.37	0.29	FAIL
Pushover+Y Acc + e	0.40	0.77	1.91	PASS
Pushover-Y Acc + e	0.36	1.35	3.74	PASS
PushoverEx+0.3Ey Acc	1.36	1.79	1.32	PASS
Pushover0.3Ex+Ey Acc	0.55	1.18	2.16	PASS
Pushover-0.3Ex+Ey Acc	0.57	0.19	0.33	FAIL
Pushover-Ex+0.3Ey Acc	1.26	0.37	0.29	FAIL

Table 211:The outcomes of the SLD pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.49	6.63	1.21	PASS
Pushover-X Acc	5.13	2.51	0.49	FAIL
Pushover+Y Acc	0.97	0.77	0.79	FAIL
Pushover-Y Acc	0.84	1.97	2.35	PASS
Pushover+X Acc + e	5.60	6.53	1.17	PASS
Pushover-X Acc + e	5.07	2.51	0.50	FAIL
Pushover+Y Acc + e	0.95	0.77	0.81	FAIL
Pushover-Y Acc + e	0.85	1.87	2.20	PASS
PushoverEx+0.3Ey Acc	5.33	6.01	1.13	PASS
Pushover0.3Ex+Ey Acc	1.48	1.18	0.80	FAIL
Pushover-0.3Ex+Ey Acc	1.66	1.14	0.68	FAIL
Pushover-Ex+0.3Ey Acc	4.93	2.41	0.49	FAIL

Table 212: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.53	8.88	1.18	PASS
Pushover-X Acc	7.04	3.44	0.49	FAIL
Pushover+Y Acc	1.40	1.06	0.76	FAIL
Pushover-Y Acc	1.07	2.70	2.52	PASS
Pushover+X Acc + e	7.68	8.77	1.14	PASS
Pushover-X Acc + e	6.95	3.44	0.50	FAIL
Pushover+Y Acc + e	1.35	1.06	0.79	FAIL
Pushover-Y Acc + e	1.08	2.59	2.40	PASS
PushoverEx+0.3Ey Acc	7.32	8.12	1.11	PASS
Pushover0.3Ex+Ey Acc	2.06	1.68	0.81	FAIL
Pushover-0.3Ex+Ey Acc	2.34	1.61	0.69	FAIL
Pushover-Ex+0.3Ey Acc	6.77	3.24	0.48	FAIL

Table 213:The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.20	0.74	0.62	FAIL
Pushover-X Acc	0.93	0.66	0.71	FAIL
Pushover+Y Acc	0.36	1.34	3.67	PASS
Pushover-Y Acc	0.36	1.04	2.87	PASS
Pushover+X Acc + e	1.20	0.74	0.61	FAIL
Pushover-X Acc + e	0.92	0.66	0.72	FAIL
Pushover+Y Acc + e	0.36	1.34	3.75	PASS
Pushover-Y Acc + e	0.37	1.04	2.82	PASS
PushoverEx+0.3Ey Acc	1.46	1.46	1.00	FAIL
Pushover0.3Ex+Ey Acc	0.52	1.07	2.07	PASS
Pushover-0.3Ex+Ey Acc	0.57	0.47	0.83	FAIL
Pushover-Ex+0.3Ey Acc	0.88	0.56	0.64	FAIL

Table 214:The outcomes of the SLD pushover analysis for a seven-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.69	6.45	1.37	PASS
Pushover-X Acc	3.63	3.68	1.01	PASS
Pushover+Y Acc	0.86	3.54	4.13	PASS
Pushover-Y Acc	0.85	1.88	2.20	PASS
Pushover+X Acc + e	4.72	6.45	1.37	PASS
Pushover-X Acc + e	3.61	3.77	1.05	PASS
Pushover+Y Acc + e	0.84	3.25	3.88	PASS
Pushover-Y Acc + e	0.87	1.88	2.16	PASS
PushoverEx+0.3Ey Acc	5.72	6.24	1.09	PASS
Pushover0.3Ex+Ey Acc	1.33	3.81	2.87	PASS
Pushover-0.3Ex+Ey Acc	1.60	2.27	1.42	PASS
Pushover-Ex+0.3Ey Acc	3.46	3.28	0.95	FAIL

Table 215: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with HCB on stiff clay subsoil.

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.44	8.67	1.35	PASS
Pushover-X Acc	4.98	5.00	1.00	FAIL
Pushover+Y Acc	1.09	4.78	4.39	PASS
Pushover-Y Acc	1.14	2.61	2.30	PASS
Pushover+X Acc + e	6.47	8.67	1.34	PASS
Pushover-X Acc + e	4.95	5.09	1.03	PASS
Pushover+Y Acc + e	1.07	4.40	4.12	PASS
Pushover-Y Acc + e	1.17	2.61	2.23	PASS
PushoverEx+0.3Ey Acc	7.85	8.32	1.06	PASS
Pushover0.3Ex+Ey Acc	1.69	5.17	3.06	PASS
Pushover-0.3Ex+Ey Acc	2.10	3.02	1.44	PASS
Pushover-Ex+0.3Ey Acc	4.75	4.40	0.93	FAIL

Table 216:The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.43	0.71	1.63	PASS
Pushover-X Acc	0.46	0.59	1.30	PASS
Pushover+Y Acc	0.04	0.30	8.37	PASS
Pushover-Y Acc	0.04	0.30	7.09	PASS
Pushover+X Acc + e	0.43	0.71	1.65	PASS
Pushover-X Acc + e	0.46	0.59	1.30	PASS
Pushover+Y Acc + e	0.04	0.30	8.48	PASS
Pushover-Y Acc + e	0.04	0.30	7.05	PASS
PushoverEx+0.3Ey Acc	0.38	0.70	1.84	PASS
Pushover0.3Ex+Ey Acc	0.06	0.40	6.29	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.40	5.87	PASS
Pushover-Ex+0.3Ey Acc	0.54	0.59	1.10	PASS

Table 217:The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.22	3.33	2.74	PASS
Pushover-X Acc	1.28	2.57	2.01	PASS
Pushover+Y Acc	0.06	1.59	24.80	PASS
Pushover-Y Acc	0.08	1.21	15.89	PASS
Pushover+X Acc + e	1.20	3.33	2.78	PASS
Pushover-X Acc + e	1.29	2.57	1.99	PASS
Pushover+Y Acc + e	0.06	1.59	25.13	PASS
Pushover-Y Acc + e	0.08	1.21	15.79	PASS
PushoverEx+0.3Ey Acc	1.05	2.92	2.78	PASS
Pushover0.3Ex+Ey Acc	0.12	1.99	16.55	PASS
Pushover-0.3Ex+Ey Acc	0.13	0.59	4.56	PASS
Pushover-Ex+0.3Ey Acc	1.56	2.27	1.46	PASS

Table 218: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.76	4.54	2.58	PASS
Pushover-X Acc	1.84	3.47	1.88	PASS
Pushover+Y Acc	0.08	2.28	29.19	PASS
Pushover-Y Acc	0.09	1.71	18.44	PASS
Pushover+X Acc + e	1.74	4.54	2.62	PASS
Pushover-X Acc + e	1.86	3.47	1.87	PASS
Pushover+Y Acc + e	0.08	2.48	32.15	PASS
Pushover-Y Acc + e	0.09	1.61	17.25	PASS
PushoverEx+0.3Ey Acc	1.55	3.93	2.54	PASS
Pushover0.3Ex+Ey Acc	0.15	2.79	19.01	PASS
Pushover-0.3Ex+Ey Acc	0.16	0.89	5.61	PASS
Pushover-Ex+0.3Ey Acc	2.10	3.07	1.46	PASS

Table 219: The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.47	0.40	0.86	FAIL
Pushover-X Acc	0.73	0.79	1.09	PASS
Pushover+Y Acc	0.04	0.20	5.63	PASS
Pushover-Y Acc	0.05	0.20	4.01	PASS
Pushover+X Acc + e	0.48	0.40	0.85	FAIL
Pushover-X Acc + e	0.73	0.79	1.09	PASS
Pushover+Y Acc + e	0.03	0.20	5.69	PASS
Pushover-Y Acc + e	0.05	0.20	3.92	PASS
PushoverEx+0.3Ey Acc	0.49	0.60	1.24	PASS
Pushover0.3Ex+Ey Acc	0.06	0.20	3.45	PASS
Pushover-0.3Ex+Ey Acc	0.07	0.30	4.15	PASS
Pushover-Ex+0.3Ey Acc	0.62	0.69	1.12	PASS

Table 220:The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.58	3.02	1.92	PASS
Pushover-X Acc	2.86	2.98	1.04	PASS
Pushover+Y Acc	0.06	2.08	32.85	PASS
Pushover-Y Acc	0.09	0.81	8.95	PASS
Pushover+X Acc + e	1.60	3.02	1.89	PASS
Pushover-X Acc + e	2.86	2.98	1.04	PASS
Pushover+Y Acc + e	0.06	2.08	33.17	PASS
Pushover-Y Acc + e	0.09	1.21	13.05	PASS
PushoverEx+0.3Ey Acc	1.60	2.71	1.70	PASS
Pushover0.3Ex+Ey Acc	0.11	1.99	18.61	PASS
Pushover-0.3Ex+Ey Acc	0.14	2.28	16.22	PASS
Pushover-Ex+0.3Ey Acc	2.05	2.87	1.40	PASS

Table 221: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.21	4.13	1.87	PASS
Pushover-X Acc	3.76	4.07	1.08	PASS
Pushover+Y Acc	0.08	2.78	35.86	PASS
Pushover-Y Acc	0.11	1.11	10.08	PASS
Pushover+X Acc + e	2.24	4.13	1.85	PASS
Pushover-X Acc + e	3.76	4.07	1.08	PASS
Pushover+Y Acc + e	0.08	2.78	36.22	PASS
Pushover-Y Acc + e	0.11	1.71	15.16	PASS
PushoverEx+0.3Ey Acc	2.23	3.62	1.62	PASS
Pushover0.3Ex+Ey Acc	0.13	2.69	20.60	PASS
Pushover-0.3Ex+Ey Acc	0.17	3.07	17.94	PASS
Pushover-Ex+0.3Ey Acc	2.67	3.86	1.44	PASS

Table 222:The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.62	0.92	1.49	PASS
Pushover-X Acc	0.60	0.59	0.97	FAIL
Pushover+Y Acc	0.08	0.59	7.13	PASS
Pushover-Y Acc	0.09	0.51	5.66	PASS
Pushover+X Acc + e	0.61	0.92	1.50	PASS
Pushover-X Acc + e	0.60	0.59	0.98	PASS
Pushover+Y Acc + e	0.08	0.59	7.23	PASS
Pushover-Y Acc + e	0.09	0.51	5.59	PASS
PushoverEx+0.3Ey Acc	0.60	1.01	1.68	PASS
Pushover0.3Ex+Ey Acc	0.13	0.70	5.33	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.39	2.74	PASS
Pushover-Ex+0.3Ey Acc	0.64	0.59	0.92	FAIL

Table 223:The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.19	5.20	2.38	PASS
Pushover-X Acc	2.14	2.26	1.05	PASS
Pushover+Y Acc	0.17	1.28	7.64	PASS
Pushover-Y Acc	0.18	1.42	7.69	PASS
Pushover+X Acc + e	2.15	5.20	2.41	PASS
Pushover-X Acc + e	2.12	2.26	1.06	PASS
Pushover+Y Acc + e	0.16	1.38	8.39	PASS
Pushover-Y Acc + e	0.19	1.42	7.56	PASS
PushoverEx+0.3Ey Acc	2.09	4.77	2.28	PASS
Pushover0.3Ex+Ey Acc	0.30	1.69	5.63	PASS
Pushover-0.3Ex+Ey Acc	0.34	0.98	2.92	PASS
Pushover-Ex+0.3Ey Acc	2.27	2.06	0.91	FAIL

Table 224: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.99	7.03	2.35	PASS
Pushover-X Acc	2.93	3.04	1.04	PASS
Pushover+Y Acc	0.20	1.78	8.69	PASS
Pushover-Y Acc	0.22	1.92	8.57	PASS
Pushover+X Acc + e	2.95	7.03	2.39	PASS
Pushover-X Acc + e	2.91	3.04	1.05	PASS
Pushover+Y Acc + e	0.20	1.88	9.34	PASS
Pushover-Y Acc + e	0.23	1.92	8.42	PASS
PushoverEx+0.3Ey Acc	2.86	6.39	2.23	PASS
Pushover0.3Ex+Ey Acc	0.37	2.29	6.26	PASS
Pushover-0.3Ex+Ey Acc	0.41	1.38	3.33	PASS
Pushover-Ex+0.3Ey Acc	3.08	2.74	0.89	FAIL

Table 225:The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.75	0.81	1.08	PASS
Pushover-X Acc	0.89	0.69	0.77	FAIL
Pushover+Y Acc	0.08	0.39	4.93	PASS
Pushover-Y Acc	0.10	0.41	4.10	PASS
Pushover+X Acc + e	0.77	0.81	1.05	PASS
Pushover-X Acc + e	0.85	0.69	0.81	FAIL
Pushover+Y Acc + e	0.08	0.39	4.98	PASS
Pushover-Y Acc + e	0.10	0.41	4.01	PASS
PushoverEx+0.3Ey Acc	1.16	1.11	0.96	FAIL
Pushover0.3Ex+Ey Acc	0.12	0.40	3.28	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.49	3.61	PASS
Pushover-Ex+0.3Ey Acc	0.81	0.59	0.73	FAIL

Table 226:The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.95	5.18	1.75	PASS
Pushover-X Acc	3.50	3.35	0.96	FAIL
Pushover+Y Acc	0.16	2.96	18.49	PASS
Pushover-Y Acc	0.21	0.81	3.86	PASS
Pushover+X Acc + e	3.03	5.18	1.71	PASS
Pushover-X Acc + e	3.31	3.35	1.01	PASS
Pushover+Y Acc + e	0.16	3.16	19.98	PASS
Pushover-Y Acc + e	0.22	0.81	3.76	PASS
PushoverEx+0.3Ey Acc	4.54	4.45	0.98	FAIL
Pushover0.3Ex+Ey Acc	0.27	2.97	10.92	PASS
Pushover-0.3Ex+Ey Acc	0.32	1.77	5.58	PASS
Pushover-Ex+0.3Ey Acc	3.16	2.85	0.90	FAIL

Table 227: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.99	6.91	1.73	PASS
Pushover-X Acc	4.81	4.53	0.94	FAIL
Pushover+Y Acc	0.19	4.04	20.73	PASS
Pushover-Y Acc	0.26	1.12	4.36	PASS
Pushover+X Acc + e	4.11	7.01	1.70	PASS
Pushover-X Acc + e	4.55	4.53	1.00	PASS
Pushover+Y Acc + e	0.19	4.24	22.04	PASS
Pushover-Y Acc + e	0.26	1.12	4.25	PASS
PushoverEx+0.3Ey Acc	6.23	5.96	0.96	FAIL
Pushover0.3Ex+Ey Acc	0.33	4.07	12.26	PASS
Pushover-0.3Ex+Ey Acc	0.39	2.36	6.12	PASS
Pushover-Ex+0.3Ey Acc	4.31	3.83	0.89	FAIL

Table 228:The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.80	1.13	1.42	PASS
Pushover-X Acc	0.80	0.58	0.73	FAIL
Pushover+Y Acc	0.16	0.69	4.21	PASS
Pushover-Y Acc	0.16	0.82	4.97	PASS
Pushover+X Acc + e	0.80	1.13	1.41	PASS
Pushover-X Acc + e	0.79	0.58	0.74	FAIL
Pushover+Y Acc + e	0.16	0.69	4.29	PASS
Pushover-Y Acc + e	0.17	0.82	4.93	PASS
PushoverEx+0.3Ey Acc	0.77	1.23	1.59	PASS
Pushover0.3Ex+Ey Acc	0.24	0.89	3.73	PASS
Pushover-0.3Ex+Ey Acc	0.27	0.39	1.43	PASS
Pushover-Ex+0.3Ey Acc	0.78	0.48	0.62	FAIL

Table 229:The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.12	4.95	1.58	PASS
Pushover-X Acc	3.12	2.33	0.75	FAIL
Pushover+Y Acc	0.38	0.69	1.79	PASS
Pushover-Y Acc	0.39	1.73	4.50	PASS
Pushover+X Acc + e	3.15	4.95	1.57	PASS
Pushover-X Acc + e	3.09	2.33	0.75	FAIL
Pushover+Y Acc + e	0.38	0.69	1.83	PASS
Pushover-Y Acc + e	0.39	1.73	4.46	PASS
PushoverEx+0.3Ey Acc	3.02	4.60	1.53	PASS
Pushover0.3Ex+Ey Acc	0.56	0.99	1.76	PASS
Pushover-0.3Ex+Ey Acc	0.64	1.27	1.98	PASS
Pushover-Ex+0.3Ey Acc	3.06	2.03	0.66	FAIL

Table 230: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.24	6.60	1.56	PASS
Pushover-X Acc	4.23	3.10	0.73	FAIL
Pushover+Y Acc	0.48	0.98	2.03	PASS
Pushover-Y Acc	0.49	2.35	4.80	PASS
Pushover+X Acc + e	4.28	6.60	1.54	PASS
Pushover-X Acc + e	4.19	3.10	0.74	FAIL
Pushover+Y Acc + e	0.47	0.98	2.07	PASS
Pushover-Y Acc + e	0.49	2.35	4.74	PASS
PushoverEx+0.3Ey Acc	4.04	6.24	1.55	PASS
Pushover0.3Ex+Ey Acc	0.71	1.39	1.94	PASS
Pushover-0.3Ex+Ey Acc	0.82	1.75	2.15	PASS
Pushover-Ex+0.3Ey Acc	4.13	2.80	0.68	FAIL

Table 231:The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.52	1.23	0.49	FAIL
Pushover-X Acc	0.80	0.68	0.85	FAIL
Pushover+Y Acc	0.15	0.59	3.98	PASS
Pushover-Y Acc	0.19	0.61	3.29	PASS
Pushover+X Acc + e	2.54	1.23	0.48	FAIL
Pushover-X Acc + e	0.78	0.68	0.87	FAIL
Pushover+Y Acc + e	0.15	0.59	4.03	PASS
Pushover-Y Acc + e	0.19	0.61	3.24	PASS
PushoverEx+0.3Ey Acc	1.93	1.12	0.58	FAIL
Pushover0.3Ex+Ey Acc	0.23	0.69	3.04	PASS
Pushover-0.3Ex+Ey Acc	0.25	0.49	1.97	PASS
Pushover-Ex+0.3Ey Acc	0.79	0.58	0.73	FAIL

Table 232:The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.86	6.97	0.71	FAIL
Pushover-X Acc	3.15	3.22	1.02	PASS
Pushover+Y Acc	0.35	3.61	10.45	PASS
Pushover-Y Acc	0.44	1.53	3.51	PASS
Pushover+X Acc + e	9.93	7.07	0.71	FAIL
Pushover-X Acc + e	3.07	3.22	1.05	PASS
Pushover+Y Acc + e	0.34	3.61	10.58	PASS
Pushover-Y Acc + e	0.45	1.53	3.45	PASS
PushoverEx+0.3Ey Acc	7.54	6.10	0.81	FAIL
Pushover0.3Ex+Ey Acc	0.53	4.04	7.57	PASS
Pushover-0.3Ex+Ey Acc	0.58	1.94	3.35	PASS
Pushover-Ex+0.3Ey Acc	3.11	2.91	0.94	FAIL

Table 233: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	13.53	9.32	0.69	FAIL
Pushover-X Acc	4.29	4.29	1.00	FAIL
Pushover+Y Acc	0.42	4.89	11.50	PASS
Pushover-Y Acc	0.56	2.05	3.67	PASS
Pushover+X Acc + e	13.63	9.43	0.69	FAIL
Pushover-X Acc + e	4.16	4.29	1.03	PASS
Pushover+Y Acc + e	0.42	4.89	11.69	PASS
Pushover-Y Acc + e	0.57	2.15	3.79	PASS
PushoverEx+0.3Ey Acc	10.35	8.23	0.80	FAIL
Pushover0.3Ex+Ey Acc	0.68	5.50	8.09	PASS
Pushover-0.3Ex+Ey Acc	0.74	2.62	3.56	PASS
Pushover-Ex+0.3Ey Acc	4.20	3.88	0.92	FAIL

Table 234:The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.13	1.69	1.49	PASS
Pushover-X Acc	1.07	0.47	0.44	FAIL
Pushover+Y Acc	0.27	0.78	2.88	PASS
Pushover-Y Acc	0.26	1.03	4.02	PASS
Pushover+X Acc + e	1.15	1.69	1.47	PASS
Pushover-X Acc + e	1.06	0.47	0.45	FAIL
Pushover+Y Acc + e	0.27	0.78	2.94	PASS
Pushover-Y Acc + e	0.26	1.13	4.31	PASS
PushoverEx+0.3Ey Acc	1.09	1.56	1.44	PASS
Pushover0.3Ex+Ey Acc	0.42	0.99	2.33	PASS
Pushover-0.3Ex+Ey Acc	0.47	0.29	0.61	PASS
Pushover-Ex+0.3Ey Acc	1.03	0.38	0.37	FAIL

Table 235:The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.44	5.79	1.30	PASS
Pushover-X Acc	4.20	2.46	0.59	FAIL
Pushover+Y Acc	0.64	0.78	1.22	PASS
Pushover-Y Acc	0.60	1.75	2.91	PASS
Pushover+X Acc + e	4.49	5.69	1.27	PASS
Pushover-X Acc + e	4.16	2.46	0.59	FAIL
Pushover+Y Acc + e	0.62	0.78	1.25	PASS
Pushover-Y Acc + e	0.62	1.95	3.17	PASS
PushoverEx+0.3Ey Acc	4.25	5.52	1.30	PASS
Pushover0.3Ex+Ey Acc	1.00	1.19	1.19	PASS
Pushover-0.3Ex+Ey Acc	1.11	1.25	1.13	PASS
Pushover-Ex+0.3Ey Acc	4.04	2.26	0.56	FAIL

Table 236: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.09	7.79	1.28	PASS
Pushover-X Acc	5.77	3.31	0.57	FAIL
Pushover+Y Acc	0.81	1.07	1.32	PASS
Pushover-Y Acc	0.76	2.36	3.09	PASS
Pushover+X Acc + e	6.16	7.69	1.25	PASS
Pushover-X Acc + e	5.71	3.31	0.58	FAIL
Pushover+Y Acc + e	0.79	1.07	1.35	PASS
Pushover-Y Acc + e	0.78	2.67	3.40	PASS
PushoverEx+0.3Ey Acc	5.83	7.40	1.27	PASS
Pushover0.3Ex+Ey Acc	1.27	1.58	1.25	PASS
Pushover-0.3Ex+Ey Acc	1.45	1.73	1.19	PASS
Pushover-Ex+0.3Ey Acc	5.54	3.11	0.56	FAIL

Table 237:The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.93	0.52	0.56	FAIL
Pushover-X Acc	0.76	0.68	0.89	FAIL
Pushover+Y Acc	0.25	0.97	3.88	PASS
Pushover-Y Acc	0.27	0.72	2.71	PASS
Pushover+X Acc + e	0.93	0.52	0.56	FAIL
Pushover-X Acc + e	0.76	0.68	0.89	FAIL
Pushover+Y Acc + e	0.25	0.97	3.93	PASS
Pushover-Y Acc + e	0.29	0.83	2.87	PASS
PushoverEx+0.3Ey Acc	1.32	1.23	0.93	FAIL
Pushover0.3Ex+Ey Acc	0.37	1.08	2.92	PASS
Pushover-0.3Ex+Ey Acc	0.43	0.48	1.11	PASS
Pushover-Ex+0.3Ey Acc	0.81	0.58	0.71	FAIL

Table 238:The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.63	7.45	2.05	PASS
Pushover-X Acc	2.94	3.28	1.12	PASS
Pushover+Y Acc	0.59	3.67	6.27	PASS
Pushover-Y Acc	0.63	1.34	2.15	PASS
Pushover+X Acc + e	3.65	7.45	2.04	PASS
Pushover-X Acc + e	2.95	3.28	1.11	PASS
Pushover+Y Acc + e	0.58	3.57	6.20	PASS
Pushover-Y Acc + e	0.68	1.65	2.44	PASS
PushoverEx+0.3Ey Acc	5.18	6.85	1.32	PASS
Pushover0.3Ex+Ey Acc	0.87	4.21	4.86	PASS
Pushover-0.3Ex+Ey Acc	1.02	2.21	2.17	PASS
Pushover-Ex+0.3Ey Acc	3.15	2.97	0.94	FAIL

Table 239: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.98	10.06	2.02	PASS
Pushover-X Acc	3.97	4.44	1.12	PASS
Pushover+Y Acc	0.75	5.02	6.74	PASS
Pushover-Y Acc	0.80	1.86	2.33	PASS
Pushover+X Acc + e	5.01	10.06	2.01	PASS
Pushover-X Acc + e	3.98	4.44	1.12	PASS
Pushover+Y Acc + e	0.73	4.83	6.58	PASS
Pushover-Y Acc + e	0.86	2.28	2.64	PASS
PushoverEx+0.3Ey Acc	7.10	9.15	1.29	PASS
Pushover0.3Ex+Ey Acc	1.10	5.62	5.10	PASS
Pushover-0.3Ex+Ey Acc	1.30	2.97	2.29	PASS
Pushover-Ex+0.3Ey Acc	4.27	4.03	0.94	FAIL

Table 240:The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.27	1.69	1.33	PASS
Pushover-X Acc	1.23	0.47	0.38	FAIL
Pushover+Y Acc	0.43	0.67	1.56	PASS
Pushover-Y Acc	0.36	1.35	3.72	PASS
Pushover+X Acc + e	1.29	1.69	1.31	PASS
Pushover-X Acc + e	1.21	0.47	0.39	FAIL
Pushover+Y Acc + e	0.42	0.67	1.59	PASS
Pushover-Y Acc + e	0.37	1.35	3.66	PASS
PushoverEx+0.3Ey Acc	1.26	1.66	1.32	PASS
Pushover0.3Ex+Ey Acc	0.54	0.98	1.81	PASS
Pushover-0.3Ex+Ey Acc	0.57	0.28	0.50	FAIL
Pushover-Ex+0.3Ey Acc	1.19	0.38	0.32	FAIL

Table 241:The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.97	6.55	1.32	PASS
Pushover-X Acc	4.81	2.55	0.53	FAIL
Pushover+Y Acc	1.05	0.67	0.64	FAIL
Pushover-Y Acc	0.85	1.87	2.19	PASS
Pushover+X Acc + e	5.05	6.55	1.30	PASS
Pushover-X Acc + e	4.75	2.55	0.54	FAIL
Pushover+Y Acc + e	1.01	0.67	0.66	FAIL
Pushover-Y Acc + e	0.87	1.87	2.16	PASS
PushoverEx+0.3Ey Acc	4.92	5.93	1.20	PASS
Pushover0.3Ex+Ey Acc	1.51	0.98	0.65	FAIL
Pushover-0.3Ex+Ey Acc	1.67	1.14	0.68	FAIL
Pushover-Ex+0.3Ey Acc	4.64	2.44	0.52	FAIL

Table 242:The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.82	8.77	1.29	PASS
Pushover-X Acc	6.60	3.49	0.53	FAIL
Pushover+Y Acc	1.58	0.96	0.61	FAIL
Pushover-Y Acc	1.09	2.60	2.39	PASS
Pushover+X Acc + e	6.93	8.77	1.27	PASS
Pushover-X Acc + e	6.52	3.49	0.54	FAIL
Pushover+Y Acc + e	1.54	0.96	0.62	FAIL
Pushover-Y Acc + e	1.10	2.60	2.35	PASS
PushoverEx+0.3Ey Acc	6.76	8.01	1.19	PASS
Pushover0.3Ex+Ey Acc	2.15	1.37	0.64	FAIL
Pushover-0.3Ex+Ey Acc	2.34	1.52	0.65	FAIL
Pushover-Ex+0.3Ey Acc	6.37	3.28	0.52	FAIL

Table 243:The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.12	0.52	0.47	FAIL
Pushover-X Acc	0.90	0.67	0.74	FAIL
Pushover+Y Acc	0.38	1.43	3.76	PASS
Pushover-Y Acc	0.39	1.05	2.68	PASS
Pushover+X Acc + e	1.13	0.52	0.46	FAIL
Pushover-X Acc + e	0.89	0.67	0.75	FAIL
Pushover+Y Acc + e	0.37	1.43	3.83	PASS
Pushover-Y Acc + e	0.40	1.05	2.64	PASS
PushoverEx+0.3Ey Acc	1.65	1.34	0.81	PASS
Pushover0.3Ex+Ey Acc	0.51	1.16	2.28	PASS
Pushover-0.3Ex+Ey Acc	0.55	0.47	0.86	FAIL
Pushover-Ex+0.3Ey Acc	0.93	0.57	0.61	FAIL

Table 244:The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.39	6.69	1.52	PASS
Pushover-X Acc	3.52	3.44	0.98	FAIL
Pushover+Y Acc	0.89	3.52	3.94	PASS
Pushover-Y Acc	0.92	1.99	2.17	PASS
Pushover+X Acc + e	4.41	6.69	1.52	PASS
Pushover-X Acc + e	3.50	3.44	0.98	FAIL
Pushover+Y Acc + e	0.87	3.52	4.03	PASS
Pushover-Y Acc + e	0.93	1.89	2.02	PASS
PushoverEx+0.3Ey Acc	6.47	6.89	1.07	PASS
Pushover0.3Ex+Ey Acc	1.28	4.26	3.32	PASS
Pushover-0.3Ex+Ey Acc	1.49	2.45	1.65	PASS
Pushover-Ex+0.3Ey Acc	3.66	3.12	0.85	FAIL

Table 245: The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with HCB on stiff clay subsoil.

Four Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.02	8.99	1.49	PASS
Pushover-X Acc	4.83	4.68	0.97	FAIL
Pushover+Y Acc	1.14	4.76	4.19	PASS
Pushover-Y Acc	1.21	2.73	2.25	PASS
Pushover+X Acc + e	6.05	8.99	1.49	PASS
Pushover-X Acc + e	4.80	4.68	0.97	FAIL
Pushover+Y Acc + e	1.11	4.76	4.27	PASS
Pushover-Y Acc + e	1.27	2.62	2.07	PASS
PushoverEx+0.3Ey Acc	8.87	9.25	1.04	PASS
Pushover0.3Ex+Ey Acc	1.63	5.71	3.49	PASS
Pushover-0.3Ex+Ey Acc	1.91	3.30	1.73	PASS
Pushover-Ex+0.3Ey Acc	5.02	4.25	0.85	FAIL

Table 246:The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with HCB on stiff clay subsoil.

Appendix D.3
Results for Structures on Ground Type C (Weak Clay)

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.90	1.66	1.84	PASS
Pushover-X Acc	0.90	2.12	2.35	PASS
Pushover+Y Acc	0.02	0.30	12.44	PASS
Pushover-Y Acc	0.02	0.30	12.83	PASS
Pushover+X Acc + e	0.90	1.55	1.72	PASS
Pushover-X Acc + e	0.90	2.12	2.34	PASS
Pushover+Y Acc + e	0.02	0.30	12.66	PASS
Pushover-Y Acc + e	0.02	0.30	12.70	PASS
PushoverEx+0.3Ey Acc	0.86	1.65	1.92	PASS
Pushover0.3Ex+Ey Acc	0.10	0.70	7.07	PASS
Pushover-0.3Ex+Ey Acc	0.10	0.49	4.85	PASS
Pushover-Ex+0.3Ey Acc	0.85	1.93	2.28	PASS

Table 247:The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.89	4.04	1.40	PASS
Pushover-X Acc	2.80	2.12	0.76	FAIL
Pushover+Y Acc	0.05	0.70	15.03	PASS
Pushover-Y Acc	0.05	1.41	30.97	PASS
Pushover+X Acc + e	2.90	4.04	1.40	PASS
Pushover-X Acc + e	2.81	2.12	0.75	FAIL
Pushover+Y Acc + e	0.05	0.70	15.28	PASS
Pushover-Y Acc + e	0.05	1.41	30.66	PASS
PushoverEx+0.3Ey Acc	2.63	3.71	1.41	PASS
Pushover0.3Ex+Ey Acc	0.20	1.71	8.75	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.79	3.93	PASS
Pushover-Ex+0.3Ey Acc	2.45	1.93	0.79	FAIL

Table 248: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.92	5.39	1.38	PASS
Pushover-X Acc	3.80	2.89	0.76	FAIL
Pushover+Y Acc	0.06	1.10	19.21	PASS
Pushover-Y Acc	0.06	1.91	34.20	PASS
Pushover+X Acc + e	3.92	5.49	1.40	PASS
Pushover-X Acc + e	3.80	2.89	0.76	FAIL
Pushover+Y Acc + e	0.06	1.00	17.77	PASS
Pushover-Y Acc + e	0.06	1.91	33.86	PASS
PushoverEx+0.3Ey Acc	3.60	4.95	1.38	PASS
Pushover0.3Ex+Ey Acc	0.24	2.31	9.65	PASS
Pushover-0.3Ex+Ey Acc	0.25	1.09	4.40	PASS
Pushover-Ex+0.3Ey Acc	3.37	2.61	0.77	FAIL

Table 249:The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.99	1.44	1.45	PASS
Pushover-X Acc	0.78	1.16	1.50	PASS
Pushover+Y Acc	0.02	0.20	9.46	PASS
Pushover-Y Acc	0.02	0.10	4.87	PASS
Pushover+X Acc + e	0.99	1.44	1.46	PASS
Pushover-X Acc + e	0.78	1.16	1.49	PASS
Pushover+Y Acc + e	0.02	0.20	9.60	PASS
Pushover-Y Acc + e	0.02	0.20	9.19	PASS
PushoverEx+0.3Ey Acc	1.04	1.95	1.87	PASS
Pushover0.3Ex+Ey Acc	0.08	0.30	3.70	PASS
Pushover-0.3Ex+Ey Acc	0.08	0.30	3.54	PASS
Pushover-Ex+0.3Ey Acc	0.83	1.75	2.12	PASS

Table 250:The outcomes of the SLD pushover analysis for a three-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.42	3.60	1.05	PASS
Pushover-X Acc	2.32	3.30	1.42	PASS
Pushover+Y Acc	0.04	2.19	53.61	PASS
Pushover-Y Acc	0.04	1.71	42.65	PASS
Pushover+X Acc + e	3.39	3.60	1.06	PASS
Pushover-X Acc + e	2.34	3.20	1.37	PASS
Pushover+Y Acc + e	0.04	2.19	54.36	PASS
Pushover-Y Acc + e	0.04	1.81	42.67	PASS
PushoverEx+0.3Ey Acc	3.65	3.39	0.93	FAIL
Pushover0.3Ex+Ey Acc	0.15	1.31	8.61	PASS
Pushover-0.3Ex+Ey Acc	0.16	1.48	9.43	PASS
Pushover-Ex+0.3Ey Acc	2.38	3.11	1.31	PASS

Table 251: The outcomes of the SLV pushover analysis for a three-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.59	4.94	1.08	PASS
Pushover-X Acc	3.21	4.47	1.39	PASS
Pushover+Y Acc	0.05	2.99	59.48	PASS
Pushover-Y Acc	0.05	2.31	46.94	PASS
Pushover+X Acc + e	4.55	4.94	1.09	PASS
Pushover-X Acc + e	3.23	4.37	1.35	PASS
Pushover+Y Acc + e	0.05	2.99	60.32	PASS
Pushover-Y Acc + e	0.05	2.41	46.29	PASS
PushoverEx+0.3Ey Acc	4.85	4.51	0.93	FAIL
Pushover0.3Ex+Ey Acc	0.19	1.81	9.71	PASS
Pushover-0.3Ex+Ey Acc	0.19	2.08	10.76	PASS
Pushover-Ex+0.3Ey Acc	3.28	4.18	1.27	PASS

Table 252:The outcomes of the SLC pushover analysis for a three-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.32	2.24	1.69	PASS
Pushover-X Acc	1.32	1.86	1.41	PASS
Pushover+Y Acc	0.07	0.50	7.47	PASS
Pushover-Y Acc	0.06	0.50	8.07	PASS
Pushover+X Acc + e	1.33	2.24	1.69	PASS
Pushover-X Acc + e	1.32	1.86	1.41	PASS
Pushover+Y Acc + e	0.07	0.50	7.63	PASS
Pushover-Y Acc + e	0.06	0.50	7.92	PASS
PushoverEx+0.3Ey Acc	1.26	2.33	1.85	PASS
Pushover0.3Ex+Ey Acc	0.21	0.91	4.31	PASS
Pushover-0.3Ex+Ey Acc	0.22	0.68	3.13	PASS
Pushover-Ex+0.3Ey Acc	1.26	1.78	1.41	PASS

Table 253: The outcomes of the SLD pushover analysis for a four-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.77	5.77	1.21	PASS
Pushover-X Acc	4.77	1.86	0.39	FAIL
Pushover+Y Acc	0.12	0.79	6.41	PASS
Pushover-Y Acc	0.12	1.51	12.96	PASS
Pushover+X Acc + e	4.78	5.77	1.21	PASS
Pushover-X Acc + e	4.77	1.86	0.39	FAIL
Pushover+Y Acc + e	0.12	0.79	6.54	PASS
Pushover-Y Acc + e	0.12	1.51	12.73	PASS
PushoverEx+0.3Ey Acc	4.54	5.41	1.19	PASS
Pushover0.3Ex+Ey Acc	0.50	2.13	4.28	PASS
Pushover-0.3Ex+Ey Acc	0.51	0.78	1.52	PASS
Pushover-Ex+0.3Ey Acc	4.53	1.78	0.39	FAIL

Table 254: The outcomes of the SLV pushover analysis for a four-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.47	7.69	1.19	PASS
Pushover-X Acc	6.47	2.61	0.40	FAIL
Pushover+Y Acc	0.15	1.09	7.18	PASS
Pushover-Y Acc	0.14	2.11	14.78	PASS
Pushover+X Acc + e	6.48	7.69	1.19	PASS
Pushover-X Acc + e	6.46	2.61	0.40	FAIL
Pushover+Y Acc + e	0.15	1.09	7.33	PASS
Pushover-Y Acc + e	0.15	2.11	14.51	PASS
PushoverEx+0.3Ey Acc	6.15	7.21	1.17	PASS
Pushover0.3Ex+Ey Acc	0.62	2.84	4.56	PASS
Pushover-0.3Ex+Ey Acc	0.65	1.07	1.66	PASS
Pushover-Ex+0.3Ey Acc	6.14	2.43	0.40	FAIL

Table 255:The outcomes of the SLC pushover analysis for a four-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.34	1.37	1.03	PASS
Pushover-X Acc	1.16	1.51	1.30	PASS
Pushover+Y Acc	0.05	0.30	5.54	PASS
Pushover-Y Acc	0.05	0.30	5.54	PASS
Pushover+X Acc + e	1.35	1.48	1.09	PASS
Pushover-X Acc + e	1.16	1.51	1.30	PASS
Pushover+Y Acc + e	0.05	0.30	5.68	PASS
Pushover-Y Acc + e	0.05	0.30	5.52	PASS
PushoverEx+0.3Ey Acc	1.91	4.51	2.36	PASS
Pushover0.3Ex+Ey Acc	0.18	0.61	3.40	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.39	2.28	PASS
Pushover-Ex+0.3Ey Acc	1.06	1.52	1.43	PASS

Table 256:The outcomes of the SLD pushover analysis for a four-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.81	5.91	1.23	PASS
Pushover-X Acc	4.18	2.84	0.68	FAIL
Pushover+Y Acc	0.10	3.88	38.34	PASS
Pushover-Y Acc	0.10	1.91	18.69	PASS
Pushover+X Acc + e	4.88	6.01	1.23	PASS
Pushover-X Acc + e	4.18	2.84	0.68	FAIL
Pushover+Y Acc + e	0.10	3.78	38.26	PASS
Pushover-Y Acc + e	0.10	1.91	18.61	PASS
PushoverEx+0.3Ey Acc	6.88	5.45	0.79	FAIL
Pushover0.3Ex+Ey Acc	0.41	2.22	5.48	PASS
Pushover-0.3Ex+Ey Acc	0.39	1.08	2.78	PASS
Pushover-Ex+0.3Ey Acc	3.67	2.65	0.72	FAIL

Table 257: The outcomes of the SLV pushover analysis for a four-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure - HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.53	8.02	1.23	PASS
Pushover-X Acc	5.58	3.88	0.69	FAIL
Pushover+Y Acc	0.12	5.27	42.44	PASS
Pushover-Y Acc	0.13	2.62	20.84	PASS
Pushover+X Acc + e	6.61	8.12	1.23	PASS
Pushover-X Acc + e	5.58	3.88	0.69	FAIL
Pushover+Y Acc + e	0.12	5.07	41.83	PASS
Pushover-Y Acc + e	0.13	2.62	20.74	PASS
PushoverEx+0.3Ey Acc	9.32	7.34	0.79	FAIL
Pushover0.3Ex+Ey Acc	0.50	3.03	6.09	PASS
Pushover-0.3Ex+Ey Acc	0.47	1.47	3.10	PASS
Pushover-Ex+0.3Ey Acc	4.92	3.60	0.73	FAIL

Table 258:The outcomes of the SLC pushover analysis for a four-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.79	2.77	1.55	PASS
Pushover-X Acc	1.76	1.87	1.07	PASS
Pushover+Y Acc	0.13	0.89	6.67	PASS
Pushover-Y Acc	0.13	0.71	5.64	PASS
Pushover+X Acc + e	1.79	2.66	1.48	PASS
Pushover-X Acc + e	1.75	1.87	1.07	PASS
Pushover+Y Acc + e	0.13	0.89	6.79	PASS
Pushover-Y Acc + e	0.13	0.71	5.55	PASS
PushoverEx+0.3Ey Acc	1.71	2.85	1.67	PASS
Pushover0.3Ex+Ey Acc	0.38	1.33	3.47	PASS
Pushover-0.3Ex+Ey Acc	0.40	0.77	1.94	PASS
Pushover-Ex+0.3Ey Acc	1.68	1.80	1.07	PASS

Table 259:The outcomes of the SLD pushover analysis for a five-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.45	6.64	1.03	PASS
Pushover-X Acc	6.33	1.87	0.30	FAIL
Pushover+Y Acc	0.28	1.19	4.28	PASS
Pushover-Y Acc	0.26	2.02	7.89	PASS
Pushover+X Acc + e	6.45	6.53	1.01	PASS
Pushover-X Acc + e	6.30	1.87	0.30	FAIL
Pushover+Y Acc + e	0.27	1.19	4.38	PASS
Pushover-Y Acc + e	0.26	2.02	7.73	PASS
PushoverEx+0.3Ey Acc	6.14	6.14	1.00	FAIL
Pushover0.3Ex+Ey Acc	0.90	2.65	2.95	PASS
Pushover-0.3Ex+Ey Acc	0.93	0.77	0.83	FAIL
Pushover-Ex+0.3Ey Acc	6.05	1.80	0.30	FAIL

Table 260: The outcomes of the SLV pushover analysis for a five-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.75	8.86	1.01	PASS
Pushover-X Acc	8.58	2.59	0.30	FAIL
Pushover+Y Acc	0.34	1.58	4.66	PASS
Pushover-Y Acc	0.31	2.73	8.68	PASS
Pushover+X Acc + e	8.74	8.75	1.00	FAIL
Pushover-X Acc + e	8.55	2.59	0.30	FAIL
Pushover+Y Acc + e	0.33	1.58	4.76	PASS
Pushover-Y Acc + e	0.32	2.73	8.51	PASS
PushoverEx+0.3Ey Acc	8.33	8.22	0.99	FAIL
Pushover0.3Ex+Ey Acc	1.14	3.57	3.12	PASS
Pushover-0.3Ex+Ey Acc	1.35	1.06	0.78	FAIL
Pushover-Ex+0.3Ey Acc	8.21	2.43	0.30	FAIL

Table 261:The outcomes of the SLC pushover analysis for a five-story, single-unit structure built with Globigerina limestone on weak clay subsoil.

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.65	1.20	0.73	FAIL
Pushover-X Acc	1.62	1.73	1.07	PASS
Pushover+Y Acc	0.12	0.59	5.12	PASS
Pushover-Y Acc	0.11	0.40	3.57	PASS
Pushover+X Acc + e	1.65	1.20	0.72	FAIL
Pushover-X Acc + e	1.61	1.73	1.08	PASS
Pushover+Y Acc + e	0.11	0.59	5.25	PASS
Pushover-Y Acc + e	0.12	0.50	4.15	PASS
PushoverEx+0.3Ey Acc	1.83	2.05	1.12	PASS
Pushover0.3Ex+Ey Acc	0.35	1.12	3.19	PASS
Pushover-0.3Ex+Ey Acc	0.32	0.68	2.09	PASS
Pushover-Ex+0.3Ey Acc	1.47	1.65	1.12	PASS

Table 262:The outcomes of the SLD pushover analysis for a five-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.93	7.17	1.21	PASS
Pushover-X Acc	5.82	3.10	0.53	FAIL
Pushover+Y Acc	0.23	4.16	17.92	PASS
Pushover-Y Acc	0.22	1.72	7.64	PASS
Pushover+X Acc + e	5.94	7.17	1.21	PASS
Pushover-X Acc + e	5.81	3.10	0.53	FAIL
Pushover+Y Acc + e	0.22	4.16	18.50	PASS
Pushover-Y Acc + e	0.25	2.22	9.02	PASS
PushoverEx+0.3Ey Acc	6.59	6.36	0.97	FAIL
Pushover0.3Ex+Ey Acc	0.82	2.34	2.84	PASS
Pushover-0.3Ex+Ey Acc	0.85	1.26	1.49	PASS
Pushover-Ex+0.3Ey Acc	5.29	2.84	0.54	FAIL

Table 263: The outcomes of the SLV pushover analysis for a five-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.04	9.57	1.19	PASS
Pushover-X Acc	7.89	4.20	0.53	FAIL
Pushover+Y Acc	0.28	5.65	19.83	PASS
Pushover-Y Acc	0.28	2.32	8.42	PASS
Pushover+X Acc + e	8.06	9.57	1.19	PASS
Pushover-X Acc + e	7.87	4.20	0.53	FAIL
Pushover+Y Acc + e	0.28	5.55	20.12	PASS
Pushover-Y Acc + e	0.30	3.03	10.03	PASS
PushoverEx+0.3Ey Acc	8.93	8.62	0.97	FAIL
Pushover0.3Ex+Ey Acc	1.05	3.21	3.06	PASS
Pushover-0.3Ex+Ey Acc	1.38	1.74	1.26	PASS
Pushover-Ex+0.3Ey Acc	7.17	3.85	0.54	FAIL

Table 264: The outcomes of the SLC pushover analysis for a five-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.42	3.11	1.29	PASS
Pushover-X Acc	2.38	1.78	0.75	FAIL
Pushover+Y Acc	0.26	1.08	4.24	PASS
Pushover-Y Acc	0.24	1.01	4.26	PASS
Pushover+X Acc + e	2.43	3.11	1.28	PASS
Pushover-X Acc + e	2.36	1.78	0.75	FAIL
Pushover+Y Acc + e	0.25	0.99	3.93	PASS
Pushover-Y Acc + e	0.24	1.01	4.18	PASS
PushoverEx+0.3Ey Acc	2.31	3.41	1.48	PASS
Pushover0.3Ex+Ey Acc	0.71	1.75	2.48	PASS
Pushover-0.3Ex+Ey Acc	0.73	0.76	1.03	PASS
Pushover-Ex+0.3Ey Acc	2.28	1.71	0.75	FAIL

Table 265: The outcomes of the SLD pushover analysis for a six-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.73	6.00	0.69	FAIL
Pushover-X Acc	8.56	1.78	0.21	FAIL
Pushover+Y Acc	0.60	1.08	1.80	PASS
Pushover-Y Acc	0.56	2.23	3.99	PASS
Pushover+X Acc + e	8.76	6.00	0.68	FAIL
Pushover-X Acc + e	8.51	1.78	0.21	FAIL
Pushover+Y Acc + e	0.59	0.99	1.67	PASS
Pushover-Y Acc + e	0.57	2.13	3.74	PASS
PushoverEx+0.3Ey Acc	8.32	5.57	0.67	FAIL
Pushover0.3Ex+Ey Acc	1.66	2.37	1.43	PASS
Pushover-0.3Ex+Ey Acc	2.16	0.76	0.35	FAIL
Pushover-Ex+0.3Ey Acc	8.22	1.71	0.21	FAIL

Table 266: The outcomes of the SLV pushover analysis for a six-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	11.83	8.07	0.68	FAIL
Pushover-X Acc	11.61	2.46	0.21	FAIL
Pushover+Y Acc	0.77	1.48	1.93	PASS
Pushover-Y Acc	0.71	3.04	4.27	PASS
Pushover+X Acc + e	11.88	8.07	0.68	FAIL
Pushover-X Acc + e	11.53	2.46	0.21	FAIL
Pushover+Y Acc + e	0.75	1.38	1.84	PASS
Pushover-Y Acc + e	0.73	2.84	3.91	PASS
PushoverEx+0.3Ey Acc	11.29	7.50	0.66	FAIL
Pushover0.3Ex+Ey Acc	2.11	3.29	1.56	PASS
Pushover-0.3Ex+Ey Acc	3.04	1.04	0.34	FAIL
Pushover-Ex+0.3Ey Acc	11.15	2.31	0.21	FAIL

Table 267: The outcomes of the SLC pushover analysis for a six-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.32	1.24	0.53	FAIL
Pushover-X Acc	2.24	2.36	1.05	PASS
Pushover+Y Acc	0.22	0.79	3.62	PASS
Pushover-Y Acc	0.20	0.61	2.97	PASS
Pushover+X Acc + e	2.33	1.24	0.53	FAIL
Pushover-X Acc + e	2.23	2.36	1.06	PASS
Pushover+Y Acc + e	0.21	0.79	3.69	PASS
Pushover-Y Acc + e	0.21	0.61	2.91	PASS
PushoverEx+0.3Ey Acc	2.26	1.67	0.74	FAIL
Pushover0.3Ex+Ey Acc	0.63	1.64	2.58	PASS
Pushover-0.3Ex+Ey Acc	0.58	0.95	1.66	PASS
Pushover-Ex+0.3Ey Acc	2.00	2.11	1.06	PASS

Table 268: The outcomes of the SLD pushover analysis for a six-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.34	4.39	0.53	FAIL
Pushover-X Acc	8.06	3.15	0.39	FAIL
Pushover+Y Acc	0.51	3.26	6.35	PASS
Pushover-Y Acc	0.48	2.43	5.10	PASS
Pushover+X Acc + e	8.38	4.50	0.54	FAIL
Pushover-X Acc + e	8.04	3.15	0.39	FAIL
Pushover+Y Acc + e	0.50	3.16	6.28	PASS
Pushover-Y Acc + e	0.49	1.82	3.72	PASS
PushoverEx+0.3Ey Acc	8.13	6.67	0.82	FAIL
Pushover0.3Ex+Ey Acc	1.49	2.66	1.79	PASS
Pushover-0.3Ex+Ey Acc	1.66	1.43	0.86	FAIL
Pushover-Ex+0.3Ey Acc	7.22	2.91	0.40	FAIL

Table 269: The outcomes of the SLV pushover analysis for a six-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	11.31	5.85	0.52	FAIL
Pushover-X Acc	10.93	4.28	0.39	FAIL
Pushover+Y Acc	0.64	4.34	6.82	PASS
Pushover-Y Acc	0.58	3.24	5.55	PASS
Pushover+X Acc + e	11.36	6.08	0.53	FAIL
Pushover-X Acc + e	10.90	4.28	0.39	FAIL
Pushover+Y Acc + e	0.62	4.24	6.83	PASS
Pushover-Y Acc + e	0.60	2.43	4.04	PASS
PushoverEx+0.3Ey Acc	11.03	8.89	0.81	FAIL
Pushover0.3Ex+Ey Acc	2.09	3.58	1.71	PASS
Pushover-0.3Ex+Ey Acc	2.42	1.91	0.79	FAIL
Pushover-Ex+0.3Ey Acc	9.79	3.96	0.41	FAIL

Table 270: The outcomes of the SLC pushover analysis for a six-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.97	3.86	1.30	PASS
Pushover-X Acc	2.90	1.59	0.55	FAIL
Pushover+Y Acc	0.40	2.06	5.11	PASS
Pushover-Y Acc	0.37	1.43	3.85	PASS
Pushover+X Acc + e	3.00	3.86	1.29	PASS
Pushover-X Acc + e	2.87	1.67	0.58	FAIL
Pushover+Y Acc + e	0.39	1.96	4.97	PASS
Pushover-Y Acc + e	0.38	1.43	3.78	PASS
PushoverEx+0.3Ey Acc	2.84	4.14	1.46	PASS
Pushover0.3Ex+Ey Acc	0.94	2.39	2.55	PASS
Pushover-0.3Ex+Ey Acc	0.95	0.65	0.68	FAIL
Pushover-Ex+0.3Ey Acc	2.80	1.53	0.55	FAIL

Table 271: The outcomes of the SLD pushover analysis for a seven-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.71	7.95	0.74	FAIL
Pushover-X Acc	10.44	1.59	0.15	FAIL
Pushover+Y Acc	0.95	2.06	2.18	PASS
Pushover-Y Acc	0.87	2.55	2.93	PASS
Pushover+X Acc + e	10.80	7.95	0.74	FAIL
Pushover-X Acc + e	10.35	1.67	0.16	FAIL
Pushover+Y Acc + e	0.93	1.96	2.11	PASS
Pushover-Y Acc + e	0.89	2.45	2.76	PASS
PushoverEx+0.3Ey Acc	10.22	7.33	0.72	FAIL
Pushover0.3Ex+Ey Acc	2.55	3.12	1.22	PASS
Pushover-0.3Ex+Ey Acc	3.16	0.65	0.21	FAIL
Pushover-Ex+0.3Ey Acc	10.09	1.53	0.15	FAIL

Table 272: The outcomes of the SLV pushover analysis for a seven-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	14.52	10.73	0.74	FAIL
Pushover-X Acc	14.15	2.23	0.16	FAIL
Pushover+Y Acc	1.21	2.84	2.36	PASS
Pushover-Y Acc	1.11	3.47	3.13	PASS
Pushover+X Acc + e	14.63	10.73	0.73	FAIL
Pushover-X Acc + e	14.03	2.30	0.16	FAIL
Pushover+Y Acc + e	1.18	2.75	2.32	PASS
Pushover-Y Acc + e	1.13	3.26	2.89	PASS
PushoverEx+0.3Ey Acc	13.86	9.80	0.71	FAIL
Pushover0.3Ex+Ey Acc	3.32	4.26	1.28	PASS
Pushover-0.3Ex+Ey Acc	4.30	0.93	0.22	FAIL
Pushover-Ex+0.3Ey Acc	13.68	2.10	0.15	FAIL

Table 273:The outcomes of the SLC pushover analysis for a seven-story, single-unit structure built with Globigerina Limestone on weak clay subsoil.

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.87	1.52	0.53	FAIL
Pushover-X Acc	2.72	2.90	1.07	PASS
Pushover+Y Acc	0.35	1.28	3.64	PASS
Pushover-Y Acc	0.32	0.82	2.58	PASS
Pushover+X Acc + e	2.90	1.52	0.52	FAIL
Pushover-X Acc + e	2.70	3.07	1.14	PASS
Pushover+Y Acc + e	0.34	1.28	3.73	PASS
Pushover-Y Acc + e	0.32	0.82	2.57	PASS
PushoverEx+0.3Ey Acc	2.77	1.84	0.67	FAIL
Pushover0.3Ex+Ey Acc	0.89	1.96	2.21	PASS
Pushover-0.3Ex+Ey Acc	0.83	1.12	1.36	PASS
Pushover-Ex+0.3Ey Acc	2.41	2.77	1.15	PASS

Table 274: The outcomes of the SLD pushover analysis for a seven-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.35	4.80	0.46	FAIL
Pushover-X Acc	9.81	3.07	0.31	FAIL
Pushover+Y Acc	0.82	3.92	4.77	PASS
Pushover-Y Acc	0.74	2.85	3.85	PASS
Pushover+X Acc + e	10.44	4.68	0.45	FAIL
Pushover-X Acc + e	9.74	3.15	0.32	FAIL
Pushover+Y Acc + e	0.80	3.92	4.89	PASS
Pushover-Y Acc + e	0.75	2.45	3.28	PASS
PushoverEx+0.3Ey Acc	9.97	7.02	0.70	FAIL
Pushover0.3Ex+Ey Acc	2.28	2.78	1.22	PASS
Pushover-0.3Ex+Ey Acc	2.39	1.31	0.55	FAIL
Pushover-Ex+0.3Ey Acc	8.68	2.85	0.33	FAIL

Table 275: The outcomes of the SLV pushover analysis for a seven-story, single-unit structure built with HCB on weak clay subsoil.

One Unit – Detached Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	14.04	6.44	0.46	FAIL
Pushover-X Acc	13.30	4.15	0.31	FAIL
Pushover+Y Acc	1.05	5.30	5.05	PASS
Pushover-Y Acc	1.00	3.87	3.87	PASS
Pushover+X Acc + e	14.15	6.32	0.45	FAIL
Pushover-X Acc + e	13.20	4.23	0.32	FAIL
Pushover+Y Acc + e	1.02	5.30	5.19	PASS
Pushover-Y Acc + e	1.06	3.36	3.17	PASS
PushoverEx+0.3Ey Acc	13.51	9.44	0.70	FAIL
Pushover0.3Ex+Ey Acc	3.20	3.84	1.20	PASS
Pushover-0.3Ex+Ey Acc	3.33	1.78	0.53	FAIL
Pushover-Ex+0.3Ey Acc	11.77	3.86	0.33	FAIL

Table 276: The outcomes of the SLC pushover analysis for a seven-story, single-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.76	1.02	1.34	PASS
Pushover-X Acc	0.76	0.79	1.03	PASS
Pushover+Y Acc	0.04	0.30	8.03	PASS
Pushover-Y Acc	0.04	0.30	7.43	PASS
Pushover+X Acc + e	0.76	0.92	1.20	PASS
Pushover-X Acc + e	0.76	0.79	1.03	PASS
Pushover+Y Acc + e	0.04	0.30	8.15	PASS
Pushover-Y Acc + e	0.04	0.30	7.29	PASS
PushoverEx+0.3Ey Acc	0.70	0.91	1.31	PASS
Pushover0.3Ex+Ey Acc	0.09	0.50	5.29	PASS
Pushover-0.3Ex+Ey Acc	0.10	0.40	4.08	PASS
Pushover-Ex+0.3Ey Acc	0.74	0.69	0.92	FAIL

Table 277:The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.24	3.36	1.50	PASS
Pushover-X Acc	2.16	2.65	1.23	PASS
Pushover+Y Acc	0.07	0.80	11.25	PASS
Pushover-Y Acc	0.08	1.31	16.96	PASS
Pushover+X Acc + e	2.25	3.46	1.54	PASS
Pushover-X Acc + e	2.15	2.65	1.23	PASS
Pushover+Y Acc + e	0.07	1.29	18.55	PASS
Pushover-Y Acc + e	0.08	1.41	17.96	PASS
PushoverEx+0.3Ey Acc	2.04	3.15	1.54	PASS
Pushover0.3Ex+Ey Acc	0.18	1.80	9.92	PASS
Pushover-0.3Ex+Ey Acc	0.19	0.69	3.69	PASS
Pushover-Ex+0.3Ey Acc	1.99	2.26	1.13	PASS

Table 278: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.11	4.58	1.47	PASS
Pushover-X Acc	3.02	3.54	1.17	PASS
Pushover+Y Acc	0.09	2.09	24.03	PASS
Pushover-Y Acc	0.09	1.81	19.12	PASS
Pushover+X Acc + e	3.13	4.68	1.50	PASS
Pushover-X Acc + e	3.01	3.54	1.17	PASS
Pushover+Y Acc + e	0.09	2.29	26.72	PASS
Pushover-Y Acc + e	0.10	1.91	19.84	PASS
PushoverEx+0.3Ey Acc	2.86	4.26	1.49	PASS
Pushover0.3Ex+Ey Acc	0.22	2.40	10.78	PASS
Pushover-0.3Ex+Ey Acc	0.23	0.99	4.30	PASS
Pushover-Ex+0.3Ey Acc	2.81	3.14	1.12	PASS

Table 279:The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.81	0.61	0.75	FAIL
Pushover-X Acc	0.92	1.38	1.49	PASS
Pushover+Y Acc	0.04	0.20	5.37	PASS
Pushover-Y Acc	0.05	0.20	4.46	PASS
Pushover+X Acc + e	0.81	0.61	0.75	FAIL
Pushover-X Acc + e	0.94	1.48	1.58	PASS
Pushover+Y Acc + e	0.04	0.20	5.44	PASS
Pushover-Y Acc + e	0.05	0.20	4.39	PASS
PushoverEx+0.3Ey Acc	0.78	0.81	1.04	PASS
Pushover0.3Ex+Ey Acc	0.08	0.30	3.56	PASS
Pushover-0.3Ex+Ey Acc	0.10	0.30	3.06	PASS
Pushover-Ex+0.3Ey Acc	0.93	1.97	2.11	PASS

Table 280:The outcomes of the SLD pushover analysis for a three-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.66	3.25	1.22	PASS
Pushover-X Acc	2.99	2.96	0.99	FAIL
Pushover+Y Acc	0.07	2.09	29.62	PASS
Pushover-Y Acc	0.09	1.41	16.53	PASS
Pushover+X Acc + e	2.66	3.25	1.22	PASS
Pushover-X Acc + e	3.06	2.96	0.97	FAIL
Pushover+Y Acc + e	0.07	1.99	28.54	PASS
Pushover-Y Acc + e	0.09	1.41	16.27	PASS
PushoverEx+0.3Ey Acc	2.43	3.04	1.25	PASS
Pushover0.3Ex+Ey Acc	0.16	1.80	11.49	PASS
Pushover-0.3Ex+Ey Acc	0.19	1.29	6.88	PASS
Pushover-Ex+0.3Ey Acc	2.92	2.95	1.01	PASS

Table 281: The outcomes of the SLV pushover analysis for a three-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.64	4.36	1.20	PASS
Pushover-X Acc	4.06	4.04	1.00	FAIL
Pushover+Y Acc	0.09	2.88	33.30	PASS
Pushover-Y Acc	0.10	2.01	19.23	PASS
Pushover+X Acc + e	3.64	4.47	1.23	PASS
Pushover-X Acc + e	4.14	4.04	0.98	FAIL
Pushover+Y Acc + e	0.09	2.68	31.37	PASS
Pushover-Y Acc + e	0.11	2.01	18.92	PASS
PushoverEx+0.3Ey Acc	3.35	4.05	1.21	PASS
Pushover0.3Ex+Ey Acc	0.19	2.40	12.49	PASS
Pushover-0.3Ex+Ey Acc	0.23	1.78	7.76	PASS
Pushover-Ex+0.3Ey Acc	3.96	3.94	0.99	FAIL

Table 282:The outcomes of the SLC pushover analysis for a three-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.13	1.45	1.28	PASS
Pushover-X Acc	1.06	0.77	0.73	FAIL
Pushover+Y Acc	0.09	0.59	6.28	PASS
Pushover-Y Acc	0.10	0.51	5.18	PASS
Pushover+X Acc + e	1.13	1.45	1.28	PASS
Pushover-X Acc + e	1.06	0.77	0.73	FAIL
Pushover+Y Acc + e	0.09	0.59	6.37	PASS
Pushover-Y Acc + e	0.10	0.51	5.09	PASS
PushoverEx+0.3Ey Acc	1.06	1.44	1.36	PASS
Pushover0.3Ex+Ey Acc	0.19	0.70	3.71	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.39	2.01	PASS
Pushover-Ex+0.3Ey Acc	1.01	0.68	0.67	FAIL

Table 283: The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.01	5.28	1.32	PASS
Pushover-X Acc	3.67	2.32	0.63	FAIL
Pushover+Y Acc	0.18	0.89	4.96	PASS
Pushover-Y Acc	0.19	1.52	8.11	PASS
Pushover+X Acc + e	4.00	5.28	1.32	PASS
Pushover-X Acc + e	3.65	2.41	0.66	FAIL
Pushover+Y Acc + e	0.18	1.09	6.17	PASS
Pushover-Y Acc + e	0.19	1.62	8.47	PASS
PushoverEx+0.3Ey Acc	3.65	5.04	1.38	PASS
Pushover0.3Ex+Ey Acc	0.43	2.40	5.52	PASS
Pushover-0.3Ex+Ey Acc	0.46	1.08	2.37	PASS
Pushover-Ex+0.3Ey Acc	3.40	2.22	0.65	FAIL

Table 284: The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.36	7.14	1.33	PASS
Pushover-X Acc	4.92	3.19	0.65	FAIL
Pushover+Y Acc	0.22	1.29	5.84	PASS
Pushover-Y Acc	0.23	2.12	9.26	PASS
Pushover+X Acc + e	5.34	7.14	1.34	PASS
Pushover-X Acc + e	4.90	3.28	0.67	FAIL
Pushover+Y Acc + e	0.22	1.88	8.68	PASS
Pushover-Y Acc + e	0.23	2.22	9.49	PASS
PushoverEx+0.3Ey Acc	4.91	7.10	1.45	PASS
Pushover0.3Ex+Ey Acc	0.53	3.20	6.00	PASS
Pushover-0.3Ex+Ey Acc	0.56	1.47	2.63	PASS
Pushover-Ex+0.3Ey Acc	4.59	2.99	0.65	FAIL

Table 285:The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.24	0.93	0.75	FAIL
Pushover-X Acc	0.92	0.78	0.85	FAIL
Pushover+Y Acc	0.08	0.30	3.50	PASS
Pushover-Y Acc	0.10	0.30	3.06	PASS
Pushover+X Acc + e	1.24	0.93	0.74	FAIL
Pushover-X Acc + e	0.91	0.78	0.85	FAIL
Pushover+Y Acc + e	0.08	0.30	3.58	PASS
Pushover-Y Acc + e	0.10	0.40	3.99	PASS
PushoverEx+0.3Ey Acc	1.16	1.13	0.97	FAIL
Pushover0.3Ex+Ey Acc	0.18	0.50	2.78	PASS
Pushover-0.3Ex+Ey Acc	0.20	0.49	2.48	PASS
Pushover-Ex+0.3Ey Acc	0.87	0.68	0.78	FAIL

Table 286:The outcomes of the SLD pushover analysis for a four-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.45	5.55	1.25	PASS
Pushover-X Acc	3.07	2.62	0.85	FAIL
Pushover+Y Acc	0.16	2.97	18.92	PASS
Pushover-Y Acc	0.19	1.62	8.49	PASS
Pushover+X Acc + e	4.48	5.66	1.26	PASS
Pushover-X Acc + e	3.04	2.72	0.89	FAIL
Pushover+Y Acc + e	0.15	2.87	18.69	PASS
Pushover-Y Acc + e	0.20	1.62	8.26	PASS
PushoverEx+0.3Ey Acc	4.14	4.91	1.19	PASS
Pushover0.3Ex+Ey Acc	0.41	2.80	6.85	PASS
Pushover-0.3Ex+Ey Acc	0.46	1.18	2.55	PASS
Pushover-Ex+0.3Ey Acc	2.88	2.33	0.81	FAIL

Table 287: The outcomes of the SLV pushover analysis for a four-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.02	7.40	1.23	PASS
Pushover-X Acc	4.18	3.60	0.86	FAIL
Pushover+Y Acc	0.19	4.06	21.07	PASS
Pushover-Y Acc	0.23	2.22	9.52	PASS
Pushover+X Acc + e	6.07	7.61	1.25	PASS
Pushover-X Acc + e	4.14	3.69	0.89	FAIL
Pushover+Y Acc + e	0.19	3.96	21.01	PASS
Pushover-Y Acc + e	0.24	2.22	9.25	PASS
PushoverEx+0.3Ey Acc	5.54	6.65	1.20	PASS
Pushover0.3Ex+Ey Acc	0.50	3.86	7.72	PASS
Pushover-0.3Ex+Ey Acc	0.57	1.57	2.77	PASS
Pushover-Ex+0.3Ey Acc	3.93	3.20	0.81	FAIL

Table 288:The outcomes of the SLC pushover analysis for a four-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.43	1.69	1.18	PASS
Pushover-X Acc	1.40	0.76	0.54	FAIL
Pushover+Y Acc	0.18	0.79	4.33	PASS
Pushover-Y Acc	0.18	0.81	4.55	PASS
Pushover+X Acc + e	1.43	1.69	1.18	PASS
Pushover-X Acc + e	1.39	0.76	0.54	FAIL
Pushover+Y Acc + e	0.18	0.79	4.41	PASS
Pushover-Y Acc + e	0.18	0.81	4.46	PASS
PushoverEx+0.3Ey Acc	1.47	1.67	1.14	PASS
Pushover0.3Ex+Ey Acc	0.34	0.90	2.67	PASS
Pushover-0.3Ex+Ey Acc	0.35	0.39	1.11	PASS
Pushover-Ex+0.3Ey Acc	1.34	0.66	0.49	FAIL

Table 289:The outcomes of the SLD pushover analysis for a five-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.13	5.27	1.03	PASS
Pushover-X Acc	5.06	2.55	0.50	FAIL
Pushover+Y Acc	0.41	0.79	1.91	PASS
Pushover-Y Acc	0.40	1.83	4.55	PASS
Pushover+X Acc + e	5.16	5.17	1.00	FAIL
Pushover-X Acc + e	5.03	2.55	0.51	FAIL
Pushover+Y Acc + e	0.40	0.79	1.96	PASS
Pushover-Y Acc + e	0.41	1.83	4.43	PASS
PushoverEx+0.3Ey Acc	5.29	4.91	0.93	FAIL
Pushover0.3Ex+Ey Acc	0.79	1.50	1.90	PASS
Pushover-0.3Ex+Ey Acc	0.82	1.07	1.29	PASS
Pushover-Ex+0.3Ey Acc	4.83	2.36	0.49	FAIL

Table 290: The outcomes of the SLV pushover analysis for a five-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.96	7.07	1.02	PASS
Pushover-X Acc	6.86	3.50	0.51	FAIL
Pushover+Y Acc	0.50	1.08	2.14	PASS
Pushover-Y Acc	0.49	2.54	5.16	PASS
Pushover+X Acc + e	6.99	6.96	1.00	FAIL
Pushover-X Acc + e	6.81	3.50	0.51	FAIL
Pushover+Y Acc + e	0.49	1.08	2.20	PASS
Pushover-Y Acc + e	0.51	2.54	5.02	PASS
PushoverEx+0.3Ey Acc	7.17	6.59	0.92	FAIL
Pushover0.3Ex+Ey Acc	1.01	2.10	2.09	PASS
Pushover-0.3Ex+Ey Acc	1.15	1.55	1.35	PASS
Pushover-Ex+0.3Ey Acc	6.55	3.22	0.49	FAIL

Table 291:The outcomes of the SLC pushover analysis for a five-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.82	1.25	0.69	FAIL
Pushover-X Acc	1.23	1.05	0.85	FAIL
Pushover+Y Acc	0.15	0.59	3.92	PASS
Pushover-Y Acc	0.16	0.51	3.09	PASS
Pushover+X Acc + e	1.86	1.36	0.73	FAIL
Pushover-X Acc + e	1.22	1.05	0.86	FAIL
Pushover+Y Acc + e	0.15	0.49	3.33	PASS
Pushover-Y Acc + e	0.17	0.51	3.00	PASS
PushoverEx+0.3Ey Acc	1.62	1.66	1.02	PASS
Pushover0.3Ex+Ey Acc	0.32	0.90	2.84	PASS
Pushover-0.3Ex+Ey Acc	0.34	0.78	2.28	PASS
Pushover-Ex+0.3Ey Acc	1.19	1.05	0.89	FAIL

Table 292:The outcomes of the SLD pushover analysis for a five-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.55	6.27	0.96	FAIL
Pushover-X Acc	4.43	2.87	0.65	FAIL
Pushover+Y Acc	0.32	2.65	8.23	PASS
Pushover-Y Acc	0.36	1.83	5.06	PASS
Pushover+X Acc + e	6.69	6.37	0.95	FAIL
Pushover-X Acc + e	4.38	2.87	0.65	FAIL
Pushover+Y Acc + e	0.31	3.24	10.32	PASS
Pushover-Y Acc + e	0.38	1.73	4.60	PASS
PushoverEx+0.3Ey Acc	5.85	6.12	1.05	PASS
Pushover0.3Ex+Ey Acc	0.74	2.99	4.03	PASS
Pushover-0.3Ex+Ey Acc	0.80	1.17	1.46	PASS
Pushover-Ex+0.3Ey Acc	4.25	2.58	0.61	FAIL

Table 293: The outcomes of the SLV pushover analysis for a five-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.88	8.36	0.94	FAIL
Pushover-X Acc	5.95	3.82	0.64	FAIL
Pushover+Y Acc	0.40	3.64	9.20	PASS
Pushover-Y Acc	0.44	2.54	5.73	PASS
Pushover+X Acc + e	9.07	8.57	0.94	FAIL
Pushover-X Acc + e	5.88	3.82	0.65	FAIL
Pushover+Y Acc + e	0.39	4.33	11.22	PASS
Pushover-Y Acc + e	0.46	2.44	5.30	PASS
PushoverEx+0.3Ey Acc	7.93	8.19	1.03	PASS
Pushover0.3Ex+Ey Acc	0.94	4.06	4.30	PASS
Pushover-0.3Ex+Ey Acc	1.30	1.65	1.27	PASS
Pushover-Ex+0.3Ey Acc	5.70	3.53	0.62	FAIL

Table 294:The outcomes of the SLC pushover analysis for a five-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.86	2.05	1.10	PASS
Pushover-X Acc	1.77	0.74	0.42	FAIL
Pushover+Y Acc	0.31	0.78	2.52	PASS
Pushover-Y Acc	0.30	1.13	3.81	PASS
Pushover+X Acc + e	1.90	2.05	1.08	PASS
Pushover-X Acc + e	1.75	0.74	0.42	FAIL
Pushover+Y Acc + e	0.30	0.78	2.57	PASS
Pushover-Y Acc + e	0.30	1.13	3.73	PASS
PushoverEx+0.3Ey Acc	1.87	1.92	1.02	PASS
Pushover0.3Ex+Ey Acc	0.57	1.10	1.95	PASS
Pushover-0.3Ex+Ey Acc	0.60	0.38	0.64	FAIL
Pushover-Ex+0.3Ey Acc	1.69	0.65	0.38	FAIL

Table 295:The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.69	6.14	0.92	FAIL
Pushover-X Acc	6.38	2.49	0.39	FAIL
Pushover+Y Acc	0.73	0.78	1.07	PASS
Pushover-Y Acc	0.69	2.15	3.10	PASS
Pushover+X Acc + e	6.83	6.14	0.90	FAIL
Pushover-X Acc + e	6.31	2.49	0.39	FAIL
Pushover+Y Acc + e	0.71	0.78	1.10	PASS
Pushover-Y Acc + e	0.71	1.94	2.74	PASS
PushoverEx+0.3Ey Acc	6.75	5.64	0.84	FAIL
Pushover0.3Ex+Ey Acc	1.33	1.50	1.13	PASS
Pushover-0.3Ex+Ey Acc	1.49	1.25	0.83	FAIL
Pushover-Ex+0.3Ey Acc	6.11	2.31	0.38	FAIL

Table 296:The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.07	8.30	0.91	FAIL
Pushover-X Acc	8.64	3.41	0.39	FAIL
Pushover+Y Acc	0.93	1.07	1.16	PASS
Pushover-Y Acc	0.88	2.97	3.36	PASS
Pushover+X Acc + e	9.25	8.19	0.88	FAIL
Pushover-X Acc + e	8.56	3.41	0.40	FAIL
Pushover+Y Acc + e	0.91	1.07	1.18	PASS
Pushover-Y Acc + e	0.90	2.66	2.95	PASS
PushoverEx+0.3Ey Acc	9.15	7.56	0.83	FAIL
Pushover0.3Ex+Ey Acc	1.76	2.10	1.20	PASS
Pushover-0.3Ex+Ey Acc	2.23	1.72	0.77	FAIL
Pushover-Ex+0.3Ey Acc	8.28	3.14	0.38	FAIL

Table 297: The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.53	1.49	0.59	FAIL
Pushover-X Acc	1.62	1.59	0.98	FAIL
Pushover+Y Acc	0.26	0.88	3.43	PASS
Pushover-Y Acc	0.26	0.72	2.75	PASS
Pushover+X Acc + e	2.61	1.60	0.61	FAIL
Pushover-X Acc + e	1.59	1.50	0.94	FAIL
Pushover+Y Acc + e	0.25	0.88	3.49	PASS
Pushover-Y Acc + e	0.26	0.72	2.71	PASS
PushoverEx+0.3Ey Acc	2.17	1.58	0.73	FAIL
Pushover0.3Ex+Ey Acc	0.52	1.49	2.89	PASS
Pushover-0.3Ex+Ey Acc	0.52	0.96	1.86	PASS
Pushover-Ex+0.3Ey Acc	1.53	1.40	0.92	FAIL

Table 298: The outcomes of the SLD pushover analysis for a six-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.13	7.34	0.80	FAIL
Pushover-X Acc	5.83	2.81	0.48	FAIL
Pushover+Y Acc	0.60	3.02	5.03	PASS
Pushover-Y Acc	0.61	1.85	3.01	PASS
Pushover+X Acc + e	9.39	7.34	0.78	FAIL
Pushover-X Acc + e	5.72	2.90	0.51	FAIL
Pushover+Y Acc + e	0.59	3.02	5.12	PASS
Pushover-Y Acc + e	0.62	1.85	2.97	PASS
PushoverEx+0.3Ey Acc	7.80	6.63	0.85	FAIL
Pushover0.3Ex+Ey Acc	1.21	3.08	2.54	PASS
Pushover-0.3Ex+Ey Acc	1.40	1.34	0.96	FAIL
Pushover-Ex+0.3Ey Acc	5.51	2.80	0.51	FAIL

Table 299: The outcomes of the SLV pushover analysis for a six-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	12.38	9.79	0.79	FAIL
Pushover-X Acc	7.91	3.84	0.49	FAIL
Pushover+Y Acc	0.77	4.09	5.35	PASS
Pushover-Y Acc	0.83	2.46	2.96	PASS
Pushover+X Acc + e	12.72	9.79	0.77	FAIL
Pushover-X Acc + e	7.75	3.93	0.51	FAIL
Pushover+Y Acc + e	0.75	4.09	5.44	PASS
Pushover-Y Acc + e	0.86	2.46	2.86	PASS
PushoverEx+0.3Ey Acc	10.57	8.84	0.84	FAIL
Pushover0.3Ex+Ey Acc	1.55	4.23	2.73	PASS
Pushover-0.3Ex+Ey Acc	2.09	1.82	0.87	FAIL
Pushover-Ex+0.3Ey Acc	7.47	3.74	0.50	FAIL

Table 300:The outcomes of the SLC pushover analysis for a six-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.17	2.05	0.94	FAIL
Pushover-X Acc	1.89	0.55	0.29	FAIL
Pushover+Y Acc	0.54	0.19	0.35	FAIL
Pushover-Y Acc	0.42	1.35	3.25	PASS
Pushover+X Acc + e	2.17	2.05	0.94	FAIL
Pushover-X Acc + e	1.89	0.55	0.29	FAIL
Pushover+Y Acc + e	0.55	0.19	0.35	FAIL
Pushover-Y Acc + e	0.41	1.25	3.06	PASS
PushoverEx+0.3Ey Acc	2.11	1.80	0.85	FAIL
Pushover0.3Ex+Ey Acc	0.72	0.20	0.27	FAIL
Pushover-0.3Ex+Ey Acc	0.83	0.28	0.34	FAIL
Pushover-Ex+0.3Ey Acc	1.83	0.55	0.30	FAIL

Table 301: The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.81	5.06	0.65	FAIL
Pushover-X Acc	6.82	1.57	0.23	FAIL
Pushover+Y Acc	1.94	0.19	0.10	FAIL
Pushover-Y Acc	0.98	1.77	1.81	PASS
Pushover+X Acc + e	7.83	5.17	0.66	FAIL
Pushover-X Acc + e	6.80	1.48	0.22	FAIL
Pushover+Y Acc + e	1.96	0.19	0.10	FAIL
Pushover-Y Acc + e	0.96	1.46	1.52	PASS
PushoverEx+0.3Ey Acc	7.61	4.56	0.60	FAIL
Pushover0.3Ex+Ey Acc	2.42	0.20	0.08	FAIL
Pushover-0.3Ex+Ey Acc	2.80	0.28	0.10	FAIL
Pushover-Ex+0.3Ey Acc	6.59	1.47	0.22	FAIL

Table 302:The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.59	6.79	0.64	FAIL
Pushover-X Acc	9.25	2.12	0.23	FAIL
Pushover+Y Acc	2.69	0.29	0.11	FAIL
Pushover-Y Acc	1.25	2.40	1.92	PASS
Pushover+X Acc + e	10.61	7.00	0.66	FAIL
Pushover-X Acc + e	9.21	2.03	0.22	FAIL
Pushover+Y Acc + e	2.72	0.29	0.11	FAIL
Pushover-Y Acc + e	1.22	2.08	1.71	PASS
PushoverEx+0.3Ey Acc	10.31	6.14	0.60	FAIL
Pushover0.3Ex+Ey Acc	3.31	0.39	0.12	FAIL
Pushover-0.3Ex+Ey Acc	3.82	0.47	0.12	FAIL
Pushover-Ex+0.3Ey Acc	8.93	2.02	0.23	FAIL

Table 303:The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with Globigerina limestone on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.07	1.74	0.84	FAIL
Pushover-X Acc	1.53	1.10	0.72	FAIL
Pushover+Y Acc	0.42	1.25	3.02	PASS
Pushover-Y Acc	0.39	0.93	2.36	PASS
Pushover+X Acc + e	2.07	1.74	0.84	FAIL
Pushover-X Acc + e	1.53	1.10	0.72	FAIL
Pushover+Y Acc + e	0.41	1.25	3.09	PASS
Pushover-Y Acc + e	0.40	0.93	2.31	PASS
PushoverEx+0.3Ey Acc	2.02	1.82	0.90	FAIL
Pushover0.3Ex+Ey Acc	0.68	1.88	2.79	PASS
Pushover-0.3Ex+Ey Acc	0.79	0.66	0.83	FAIL
Pushover-Ex+0.3Ey Acc	1.52	1.00	0.66	FAIL

Table 304:The outcomes of the SLD pushover analysis for a seven-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.45	6.30	0.85	FAIL
Pushover-X Acc	5.51	2.74	0.50	FAIL
Pushover+Y Acc	0.98	3.95	4.05	PASS
Pushover-Y Acc	0.93	1.86	2.01	PASS
Pushover+X Acc + e	7.45	6.30	0.84	FAIL
Pushover-X Acc + e	5.51	2.74	0.50	FAIL
Pushover+Y Acc + e	0.95	3.47	3.64	PASS
Pushover-Y Acc + e	0.95	1.86	1.97	PASS
PushoverEx+0.3Ey Acc	7.28	6.73	0.92	FAIL
Pushover0.3Ex+Ey Acc	1.59	3.37	2.12	PASS
Pushover-0.3Ex+Ey Acc	2.25	1.42	0.63	FAIL
Pushover-Ex+0.3Ey Acc	5.48	2.73	0.50	FAIL

Table 305:The outcomes of the SLV pushover analysis for a seven-story, two-unit structure built with HCB on weak clay subsoil.

Two Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	10.10	8.47	0.84	FAIL
Pushover-X Acc	7.48	3.66	0.49	FAIL
Pushover+Y Acc	1.24	5.40	4.35	PASS
Pushover-Y Acc	1.48	2.59	1.74	PASS
Pushover+X Acc + e	10.10	8.47	0.84	FAIL
Pushover-X Acc + e	7.47	3.66	0.49	FAIL
Pushover+Y Acc + e	1.21	4.72	3.89	PASS
Pushover-Y Acc + e	1.53	2.59	1.69	PASS
PushoverEx+0.3Ey Acc	9.88	9.08	0.92	FAIL
Pushover0.3Ex+Ey Acc	2.03	4.51	2.22	PASS
Pushover-0.3Ex+Ey Acc	3.16	1.89	0.60	FAIL
Pushover-Ex+0.3Ey Acc	7.43	3.65	0.49	FAIL

Table 306:The outcomes of the SLC pushover analysis for a seven-story, two-unit structure built with HCB on weak clay subsoil.

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.64	0.71	1.11	PASS
Pushover-X Acc	0.66	0.69	1.05	PASS
Pushover+Y Acc	0.04	0.30	7.13	PASS
Pushover-Y Acc	0.05	0.30	6.23	PASS
Pushover+X Acc + e	0.63	0.71	1.12	PASS
Pushover-X Acc + e	0.66	0.69	1.04	PASS
Pushover+Y Acc + e	0.04	0.30	7.24	PASS
Pushover-Y Acc + e	0.05	0.30	6.18	PASS
PushoverEx+0.3Ey Acc	0.59	0.71	1.21	PASS
Pushover0.3Ex+Ey Acc	0.09	0.50	5.51	PASS
Pushover-0.3Ex+Ey Acc	0.09	0.30	3.18	PASS
Pushover-Ex+0.3Ey Acc	0.63	0.59	0.94	FAIL

Table 307:The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.01	1.52	0.76	FAIL
Pushover-X Acc	2.04	1.38	0.68	FAIL
Pushover+Y Acc	0.08	1.39	17.55	PASS
Pushover-Y Acc	0.09	1.21	13.22	PASS
Pushover+X Acc + e	1.99	1.72	0.87	FAIL
Pushover-X Acc + e	2.05	1.38	0.67	FAIL
Pushover+Y Acc + e	0.08	1.49	19.10	PASS
Pushover-Y Acc + e	0.09	1.21	13.12	PASS
PushoverEx+0.3Ey Acc	1.84	1.52	0.82	PASS
Pushover0.3Ex+Ey Acc	0.17	1.50	8.70	PASS
Pushover-0.3Ex+Ey Acc	0.18	0.59	3.32	PASS
Pushover-Ex+0.3Ey Acc	1.91	1.48	0.77	FAIL

Table 308: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.81	2.13	0.76	FAIL
Pushover-X Acc	2.85	1.97	0.69	FAIL
Pushover+Y Acc	0.10	2.28	23.48	PASS
Pushover-Y Acc	0.11	1.71	15.26	PASS
Pushover+X Acc + e	2.78	2.33	0.84	FAIL
Pushover-X Acc + e	2.87	1.87	0.65	FAIL
Pushover+Y Acc + e	0.10	2.38	24.88	PASS
Pushover-Y Acc + e	0.11	1.71	15.14	PASS
PushoverEx+0.3Ey Acc	2.60	2.12	0.82	FAIL
Pushover0.3Ex+Ey Acc	0.21	2.09	9.93	PASS
Pushover-0.3Ex+Ey Acc	0.22	0.89	4.05	PASS
Pushover-Ex+0.3Ey Acc	2.69	2.07	0.77	FAIL

Table 309:The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.70	0.51	0.72	FAIL
Pushover-X Acc	1.02	0.79	0.78	FAIL
Pushover+Y Acc	0.04	0.20	5.02	PASS
Pushover-Y Acc	0.05	0.20	3.70	PASS
Pushover+X Acc + e	0.69	0.40	0.58	FAIL
Pushover-X Acc + e	1.00	0.79	0.79	FAIL
Pushover+Y Acc + e	0.04	0.20	5.11	PASS
Pushover-Y Acc + e	0.06	0.20	3.66	PASS
PushoverEx+0.3Ey Acc	0.75	0.81	1.08	PASS
Pushover0.3Ex+Ey Acc	0.08	0.20	2.64	PASS
Pushover-0.3Ex+Ey Acc	0.09	0.30	3.33	PASS
Pushover-Ex+0.3Ey Acc	0.92	0.69	0.75	FAIL

Table 310:The outcomes of the SLD pushover analysis for a three-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.28	3.03	1.33	PASS
Pushover-X Acc	3.43	2.97	0.87	FAIL
Pushover+Y Acc	0.08	2.18	29.08	PASS
Pushover-Y Acc	0.10	0.81	7.89	PASS
Pushover+X Acc + e	2.27	3.03	1.34	PASS
Pushover-X Acc + e	3.35	2.97	0.89	FAIL
Pushover+Y Acc + e	0.07	2.09	28.21	PASS
Pushover-Y Acc + e	0.10	1.21	11.69	PASS
PushoverEx+0.3Ey Acc	2.27	2.72	1.20	PASS
Pushover0.3Ex+Ey Acc	0.14	2.09	14.92	PASS
Pushover-0.3Ex+Ey Acc	0.17	2.18	12.93	PASS
Pushover-Ex+0.3Ey Acc	2.77	2.77	1.00	FAIL

Table 311: The outcomes of the SLV pushover analysis for a three-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.15	4.04	1.28	PASS
Pushover-X Acc	4.59	3.96	0.86	FAIL
Pushover+Y Acc	0.09	2.98	32.29	PASS
Pushover-Y Acc	0.13	1.11	8.84	PASS
Pushover+X Acc + e	3.13	4.14	1.32	PASS
Pushover-X Acc + e	4.50	3.96	0.88	FAIL
Pushover+Y Acc + e	0.09	2.88	31.72	PASS
Pushover-Y Acc + e	0.13	1.71	13.49	PASS
PushoverEx+0.3Ey Acc	3.15	3.73	1.18	PASS
Pushover0.3Ex+Ey Acc	0.17	2.79	16.21	PASS
Pushover-0.3Ex+Ey Acc	0.21	2.97	14.37	PASS
Pushover-Ex+0.3Ey Acc	3.77	3.76	1.00	FAIL

Table 312:The outcomes of the SLC pushover analysis for a three-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.96	1.02	1.07	PASS
Pushover-X Acc	0.94	0.59	0.63	FAIL
Pushover+Y Acc	0.10	0.59	5.88	PASS
Pushover-Y Acc	0.11	0.51	4.74	PASS
Pushover+X Acc + e	0.97	1.13	1.16	PASS
Pushover-X Acc + e	0.93	0.59	0.63	FAIL
Pushover+Y Acc + e	0.10	0.59	5.97	PASS
Pushover-Y Acc + e	0.11	0.51	4.68	PASS
PushoverEx+0.3Ey Acc	0.97	1.22	1.26	PASS
Pushover0.3Ex+Ey Acc	0.17	0.80	4.63	PASS
Pushover-0.3Ex+Ey Acc	0.18	0.29	1.61	PASS
Pushover-Ex+0.3Ey Acc	0.93	0.49	0.53	FAIL

Table 313:The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.20	5.22	1.63	PASS
Pushover-X Acc	3.09	2.15	0.70	FAIL
Pushover+Y Acc	0.19	1.19	6.08	PASS
Pushover-Y Acc	0.21	1.42	6.77	PASS
Pushover+X Acc + e	3.27	5.22	1.60	PASS
Pushover-X Acc + e	3.06	2.24	0.73	FAIL
Pushover+Y Acc + e	0.19	1.19	6.21	PASS
Pushover-Y Acc + e	0.21	1.52	7.14	PASS
PushoverEx+0.3Ey Acc	3.21	4.79	1.49	PASS
Pushover0.3Ex+Ey Acc	0.39	1.99	5.17	PASS
Pushover-0.3Ex+Ey Acc	0.42	1.08	2.58	PASS
Pushover-Ex+0.3Ey Acc	3.00	2.05	0.68	FAIL

Table 314: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.33	7.07	1.63	PASS
Pushover-X Acc	4.20	2.93	0.70	FAIL
Pushover+Y Acc	0.24	1.78	7.44	PASS
Pushover-Y Acc	0.26	1.92	7.49	PASS
Pushover+X Acc + e	4.43	7.07	1.59	PASS
Pushover-X Acc + e	4.16	3.03	0.73	FAIL
Pushover+Y Acc + e	0.23	1.88	8.01	PASS
Pushover-Y Acc + e	0.26	2.02	7.76	PASS
PushoverEx+0.3Ey Acc	4.35	6.42	1.47	PASS
Pushover0.3Ex+Ey Acc	0.47	2.69	5.69	PASS
Pushover-0.3Ex+Ey Acc	0.51	1.47	2.87	PASS
Pushover-Ex+0.3Ey Acc	4.09	2.73	0.67	FAIL

Table 315: The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.16	0.82	0.70	FAIL
Pushover-X Acc	0.94	0.69	0.73	FAIL
Pushover+Y Acc	0.09	0.30	3.27	PASS
Pushover-Y Acc	0.11	0.41	3.59	PASS
Pushover+X Acc + e	1.16	0.82	0.70	FAIL
Pushover-X Acc + e	0.94	0.69	0.73	FAIL
Pushover+Y Acc + e	0.09	0.30	3.30	PASS
Pushover-Y Acc + e	0.12	0.41	3.51	PASS
PushoverEx+0.3Ey Acc	1.53	1.22	0.79	FAIL
Pushover0.3Ex+Ey Acc	0.15	0.50	3.27	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.39	2.31	PASS
Pushover-Ex+0.3Ey Acc	1.12	0.59	0.52	FAIL

Table 316: The outcomes of the SLD pushover analysis for a four-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.16	4.79	1.15	PASS
Pushover-X Acc	3.17	3.24	1.02	PASS
Pushover+Y Acc	0.17	3.26	19.13	PASS
Pushover-Y Acc	0.22	1.42	6.31	PASS
Pushover+X Acc + e	4.17	4.79	1.15	PASS
Pushover-X Acc + e	3.15	3.33	1.06	PASS
Pushover+Y Acc + e	0.17	2.96	17.64	PASS
Pushover-Y Acc + e	0.23	1.42	6.14	PASS
PushoverEx+0.3Ey Acc	5.53	4.46	0.81	FAIL
Pushover0.3Ex+Ey Acc	0.33	3.38	10.29	PASS
Pushover-0.3Ex+Ey Acc	0.38	1.57	4.13	PASS
Pushover-Ex+0.3Ey Acc	3.96	2.84	0.72	FAIL

Table 317: The outcomes of the SLV pushover analysis for a four-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.59	6.42	1.15	PASS
Pushover-X Acc	4.31	4.41	1.02	PASS
Pushover+Y Acc	0.21	4.44	21.26	PASS
Pushover-Y Acc	0.28	1.92	6.98	PASS
Pushover+X Acc + e	5.61	6.42	1.15	PASS
Pushover-X Acc + e	4.28	4.51	1.05	PASS
Pushover+Y Acc + e	0.21	3.95	19.16	PASS
Pushover-Y Acc + e	0.28	1.92	6.79	PASS
PushoverEx+0.3Ey Acc	7.49	6.09	0.81	FAIL
Pushover0.3Ex+Ey Acc	0.40	4.57	11.36	PASS
Pushover-0.3Ex+Ey Acc	0.47	2.16	4.63	PASS
Pushover-Ex+0.3Ey Acc	5.28	3.82	0.72	FAIL

Table 318:The outcomes of the SLC pushover analysis for a four-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.28	1.35	1.06	PASS
Pushover-X Acc	1.24	0.48	0.39	FAIL
Pushover+Y Acc	0.20	0.69	3.52	PASS
Pushover-Y Acc	0.19	0.81	4.19	PASS
Pushover+X Acc + e	1.29	1.35	1.05	PASS
Pushover-X Acc + e	1.23	0.48	0.39	FAIL
Pushover+Y Acc + e	0.19	0.69	3.59	PASS
Pushover-Y Acc + e	0.20	0.81	4.11	PASS
PushoverEx+0.3Ey Acc	1.22	1.44	1.18	PASS
Pushover0.3Ex+Ey Acc	0.31	0.89	2.89	PASS
Pushover-0.3Ex+Ey Acc	0.34	0.29	0.86	FAIL
Pushover-Ex+0.3Ey Acc	1.18	0.48	0.41	FAIL

Table 319: The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.60	5.09	1.11	PASS
Pushover-X Acc	4.45	2.31	0.52	FAIL
Pushover+Y Acc	0.45	0.69	1.52	PASS
Pushover-Y Acc	0.45	1.73	3.85	PASS
Pushover+X Acc + e	4.64	4.98	1.07	PASS
Pushover-X Acc + e	4.42	2.31	0.52	FAIL
Pushover+Y Acc + e	0.44	0.69	1.56	PASS
Pushover-Y Acc + e	0.46	1.73	3.76	PASS
PushoverEx+0.3Ey Acc	4.41	4.74	1.07	PASS
Pushover0.3Ex+Ey Acc	0.73	1.09	1.50	PASS
Pushover-0.3Ex+Ey Acc	0.80	1.36	1.71	PASS
Pushover-Ex+0.3Ey Acc	4.24	2.02	0.48	FAIL

Table 320: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.23	6.85	1.10	PASS
Pushover-X Acc	5.98	3.08	0.51	FAIL
Pushover+Y Acc	0.55	0.98	1.77	PASS
Pushover-Y Acc	0.55	2.34	4.25	PASS
Pushover+X Acc + e	6.30	6.75	1.07	PASS
Pushover-X Acc + e	5.92	3.08	0.52	FAIL
Pushover+Y Acc + e	0.54	0.98	1.82	PASS
Pushover-Y Acc + e	0.56	2.34	4.15	PASS
PushoverEx+0.3Ey Acc	5.91	6.38	1.08	PASS
Pushover0.3Ex+Ey Acc	0.93	1.59	1.72	PASS
Pushover-0.3Ex+Ey Acc	1.02	1.85	1.82	PASS
Pushover-Ex+0.3Ey Acc	5.66	2.78	0.49	FAIL

Table 321: The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.71	1.34	0.36	FAIL
Pushover-X Acc	1.20	0.58	0.49	FAIL
Pushover+Y Acc	0.16	0.59	3.57	PASS
Pushover-Y Acc	0.19	0.61	3.15	PASS
Pushover+X Acc + e	3.71	1.34	0.36	FAIL
Pushover-X Acc + e	1.17	0.68	0.58	FAIL
Pushover+Y Acc + e	0.16	0.59	3.64	PASS
Pushover-Y Acc + e	0.20	0.61	3.11	PASS
PushoverEx+0.3Ey Acc	2.14	1.23	0.57	FAIL
Pushover0.3Ex+Ey Acc	0.28	0.79	2.83	PASS
Pushover-0.3Ex+Ey Acc	0.31	0.39	1.25	PASS
Pushover-Ex+0.3Ey Acc	1.12	0.58	0.52	FAIL

Table 322: The outcomes of the SLD pushover analysis for a five-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	13.89	6.70	0.48	FAIL
Pushover-X Acc	4.31	3.39	0.79	FAIL
Pushover+Y Acc	0.36	3.82	10.57	PASS
Pushover-Y Acc	0.45	1.53	3.42	PASS
Pushover+X Acc + e	13.89	6.81	0.49	FAIL
Pushover-X Acc + e	4.19	3.39	0.81	FAIL
Pushover+Y Acc + e	0.35	3.92	11.09	PASS
Pushover-Y Acc + e	0.46	1.53	3.35	PASS
PushoverEx+0.3Ey Acc	7.70	6.34	0.82	FAIL
Pushover0.3Ex+Ey Acc	0.66	3.56	5.43	PASS
Pushover-0.3Ex+Ey Acc	0.73	1.75	2.40	PASS
Pushover-Ex+0.3Ey Acc	3.96	2.80	0.71	FAIL

Table 323: The outcomes of the SLV pushover analysis for a five-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	18.83	8.97	0.48	FAIL
Pushover-X Acc	5.77	4.55	0.79	FAIL
Pushover+Y Acc	0.44	5.19	11.72	PASS
Pushover-Y Acc	0.55	2.14	3.90	PASS
Pushover+X Acc + e	18.83	9.07	0.48	FAIL
Pushover-X Acc + e	5.63	4.55	0.81	FAIL
Pushover+Y Acc + e	0.43	5.29	12.22	PASS
Pushover-Y Acc + e	0.56	2.14	3.83	PASS
PushoverEx+0.3Ey Acc	10.43	8.49	0.81	FAIL
Pushover0.3Ex+Ey Acc	0.84	4.85	5.81	PASS
Pushover-0.3Ex+Ey Acc	1.10	2.33	2.12	PASS
Pushover-Ex+0.3Ey Acc	5.32	3.86	0.73	FAIL

Table 324: The outcomes of the SLC pushover analysis for a five-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.65	1.69	1.02	PASS
Pushover-X Acc	1.56	0.47	0.30	FAIL
Pushover+Y Acc	0.34	0.78	2.30	PASS
Pushover-Y Acc	0.32	1.03	3.22	PASS
Pushover+X Acc + e	1.67	1.69	1.01	PASS
Pushover-X Acc + e	1.55	0.47	0.31	FAIL
Pushover+Y Acc + e	0.33	0.78	2.35	PASS
Pushover-Y Acc + e	0.33	1.13	3.44	PASS
PushoverEx+0.3Ey Acc	1.58	1.56	0.99	FAIL
Pushover0.3Ex+Ey Acc	0.53	0.99	1.86	PASS
Pushover-0.3Ex+Ey Acc	0.59	0.29	0.49	FAIL
Pushover-Ex+0.3Ey Acc	1.50	0.38	0.25	FAIL

Table 325: The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.20	5.22	0.97	FAIL
Pushover-X Acc	3.09	2.15	0.44	FAIL
Pushover+Y Acc	0.19	1.19	0.98	FAIL
Pushover-Y Acc	0.21	1.42	2.33	PASS
Pushover+X Acc + e	3.27	5.22	0.95	FAIL
Pushover-X Acc + e	3.06	2.24	0.44	FAIL
Pushover+Y Acc + e	0.19	1.19	1.00	FAIL
Pushover-Y Acc + e	0.21	1.52	2.53	PASS
PushoverEx+0.3Ey Acc	3.21	4.79	0.97	FAIL
Pushover0.3Ex+Ey Acc	0.39	1.99	0.95	FAIL
Pushover-0.3Ex+Ey Acc	0.42	1.08	0.89	FAIL
Pushover-Ex+0.3Ey Acc	3.00	2.05	0.42	FAIL

Table 326: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.07	7.79	0.97	FAIL
Pushover-X Acc	7.64	3.31	0.43	FAIL
Pushover+Y Acc	1.01	1.07	1.06	PASS
Pushover-Y Acc	0.96	2.36	2.47	PASS
Pushover+X Acc + e	8.15	7.69	0.94	FAIL
Pushover-X Acc + e	7.56	3.31	0.44	FAIL
Pushover+Y Acc + e	0.99	1.07	1.08	PASS
Pushover-Y Acc + e	0.98	2.67	2.72	PASS
PushoverEx+0.3Ey Acc	7.72	7.40	0.96	FAIL
Pushover0.3Ex+Ey Acc	1.79	1.58	0.88	FAIL
Pushover-0.3Ex+Ey Acc	2.13	1.73	0.81	FAIL
Pushover-Ex+0.3Ey Acc	7.33	3.11	0.42	FAIL

Table 327: The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.45	0.63	0.43	FAIL
Pushover-X Acc	1.11	0.67	0.60	FAIL
Pushover+Y Acc	0.29	0.97	3.30	PASS
Pushover-Y Acc	0.32	0.82	2.56	PASS
Pushover+X Acc + e	1.46	0.63	0.43	FAIL
Pushover-X Acc + e	1.12	0.67	0.60	FAIL
Pushover+Y Acc + e	0.29	0.97	3.37	PASS
Pushover-Y Acc + e	0.33	0.82	2.51	PASS
PushoverEx+0.3Ey Acc	1.76	1.34	0.76	FAIL
Pushover0.3Ex+Ey Acc	0.48	0.98	2.06	PASS
Pushover-0.3Ex+Ey Acc	0.57	0.38	0.67	FAIL
Pushover-Ex+0.3Ey Acc	1.11	0.57	0.51	FAIL

Table 328: The outcomes of the SLD pushover analysis for a six-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.23	5.32	1.02	PASS
Pushover-X Acc	3.88	3.54	0.91	FAIL
Pushover+Y Acc	0.69	3.88	5.62	PASS
Pushover-Y Acc	0.76	1.55	2.05	PASS
Pushover+X Acc + e	5.28	5.32	1.01	PASS
Pushover-X Acc + e	3.93	3.63	0.92	FAIL
Pushover+Y Acc + e	0.68	3.10	4.59	PASS
Pushover-Y Acc + e	0.77	1.55	2.00	PASS
PushoverEx+0.3Ey Acc	6.35	6.71	1.06	PASS
Pushover0.3Ex+Ey Acc	1.12	3.64	3.25	PASS
Pushover-0.3Ex+Ey Acc	1.35	1.92	1.42	PASS
Pushover-Ex+0.3Ey Acc	3.89	3.04	0.78	FAIL

Table 329: The outcomes of the SLV pushover analysis for a six-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.09	7.20	1.02	PASS
Pushover-X Acc	5.23	4.78	0.91	FAIL
Pushover+Y Acc	0.88	5.23	5.95	PASS
Pushover-Y Acc	1.16	2.17	1.87	PASS
Pushover+X Acc + e	7.15	7.20	1.01	PASS
Pushover-X Acc + e	5.29	4.88	0.92	FAIL
Pushover+Y Acc + e	0.86	4.26	4.96	PASS
Pushover-Y Acc + e	1.20	2.17	1.81	PASS
PushoverEx+0.3Ey Acc	8.60	9.08	1.05	PASS
Pushover0.3Ex+Ey Acc	1.43	4.97	3.48	PASS
Pushover-0.3Ex+Ey Acc	2.02	2.59	1.28	PASS
Pushover-Ex+0.3Ey Acc	5.24	4.09	0.78	FAIL

Table 330: The outcomes of the SLC pushover analysis for a six-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.04	1.93	0.94	FAIL
Pushover-X Acc	1.91	0.37	0.19	FAIL
Pushover+Y Acc	0.52	0.77	1.49	PASS
Pushover-Y Acc	0.45	1.35	3.02	PASS
Pushover+X Acc + e	2.08	1.93	0.93	FAIL
Pushover-X Acc + e	1.88	0.37	0.20	FAIL
Pushover+Y Acc + e	0.50	0.77	1.53	PASS
Pushover-Y Acc + e	0.45	1.35	2.99	PASS
PushoverEx+0.3Ey Acc	1.98	1.79	0.90	FAIL
Pushover0.3Ex+Ey Acc	0.79	1.18	1.50	PASS
Pushover-0.3Ex+Ey Acc	0.83	0.19	0.23	FAIL
Pushover-Ex+0.3Ey Acc	1.83	0.37	0.20	FAIL

Table 331: The outcomes of the SLD pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.36	6.63	0.90	FAIL
Pushover-X Acc	6.88	2.51	0.37	FAIL
Pushover+Y Acc	1.35	0.77	0.57	FAIL
Pushover-Y Acc	1.05	1.97	1.88	PASS
Pushover+X Acc + e	7.50	6.53	0.87	FAIL
Pushover-X Acc + e	6.79	2.51	0.37	FAIL
Pushover+Y Acc + e	1.30	0.77	0.59	FAIL
Pushover-Y Acc + e	1.06	1.87	1.76	PASS
PushoverEx+0.3Ey Acc	7.14	6.01	0.84	FAIL
Pushover0.3Ex+Ey Acc	2.01	1.18	0.59	FAIL
Pushover-0.3Ex+Ey Acc	2.27	1.14	0.50	FAIL
Pushover-Ex+0.3Ey Acc	6.61	2.41	0.36	FAIL

Table 332: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.97	8.88	0.89	FAIL
Pushover-X Acc	9.32	3.44	0.37	FAIL
Pushover+Y Acc	2.05	1.06	0.52	FAIL
Pushover-Y Acc	1.34	2.70	2.02	PASS
Pushover+X Acc + e	10.16	8.77	0.86	FAIL
Pushover-X Acc + e	9.20	3.44	0.37	FAIL
Pushover+Y Acc + e	1.99	1.06	0.53	FAIL
Pushover-Y Acc + e	1.35	2.59	1.92	PASS
PushoverEx+0.3Ey Acc	9.69	8.12	0.84	FAIL
Pushover0.3Ex+Ey Acc	2.87	1.68	0.58	FAIL
Pushover-0.3Ex+Ey Acc	3.20	1.61	0.50	FAIL
Pushover-Ex+0.3Ey Acc	8.96	3.24	0.36	FAIL

Table 333: The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with Globigerina limestone on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.74	0.74	0.42	FAIL
Pushover-X Acc	1.35	0.66	0.49	FAIL
Pushover+Y Acc	0.46	1.34	2.94	PASS
Pushover-Y Acc	0.45	1.04	2.29	PASS
Pushover+X Acc + e	1.75	0.74	0.42	FAIL
Pushover-X Acc + e	1.34	0.66	0.49	FAIL
Pushover+Y Acc + e	0.45	1.34	3.00	PASS
Pushover-Y Acc + e	0.46	1.04	2.26	PASS
PushoverEx+0.3Ey Acc	2.13	1.46	0.68	FAIL
Pushover0.3Ex+Ey Acc	0.71	1.07	1.52	PASS
Pushover-0.3Ex+Ey Acc	0.83	0.47	0.57	FAIL
Pushover-Ex+0.3Ey Acc	1.29	0.56	0.44	FAIL

Table 334: The outcomes of the SLD pushover analysis for a seven-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.29	6.45	1.03	PASS
Pushover-X Acc	4.87	3.68	0.76	FAIL
Pushover+Y Acc	1.07	3.54	3.31	PASS
Pushover-Y Acc	1.09	1.88	1.72	PASS
Pushover+X Acc + e	6.32	6.45	1.02	PASS
Pushover-X Acc + e	4.83	3.77	0.78	FAIL
Pushover+Y Acc + e	1.05	3.25	3.11	PASS
Pushover-Y Acc + e	1.13	1.88	1.66	PASS
PushoverEx+0.3Ey Acc	7.66	6.24	0.81	FAIL
Pushover0.3Ex+Ey Acc	1.66	3.81	2.30	PASS
Pushover-0.3Ex+Ey Acc	2.05	2.27	1.11	PASS
Pushover-Ex+0.3Ey Acc	4.63	3.28	0.71	FAIL

Table 335: The outcomes of the SLV pushover analysis for a seven-story, three-unit structure built with HCB on weak clay subsoil

Three Unit – Aggregate Structure – HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	8.52	8.67	1.02	PASS
Pushover-X Acc	6.60	5.00	0.76	FAIL
Pushover+Y Acc	1.36	4.78	3.51	PASS
Pushover-Y Acc	1.73	2.61	1.51	PASS
Pushover+X Acc + e	8.57	8.67	1.01	PASS
Pushover-X Acc + e	6.55	5.09	0.78	FAIL
Pushover+Y Acc + e	1.33	4.40	3.30	PASS
Pushover-Y Acc + e	1.77	2.61	1.47	PASS
PushoverEx+0.3Ey Acc	10.39	8.32	0.80	FAIL
Pushover0.3Ex+Ey Acc	2.19	5.17	2.36	PASS
Pushover-0.3Ex+Ey Acc	2.93	3.02	1.03	PASS
Pushover-Ex+0.3Ey Acc	6.25	4.40	0.70	FAIL

Table 336: The outcomes of the SLC pushover analysis for a seven-story, three-unit structure built with HCB on weak clay subsoil

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.42	0.71	1.70	PASS
Pushover-X Acc	0.46	0.59	1.30	PASS
Pushover+Y Acc	0.03	0.30	10.02	PASS
Pushover-Y Acc	0.04	0.30	8.53	PASS
Pushover+X Acc + e	0.41	0.71	1.72	PASS
Pushover-X Acc + e	0.46	0.59	1.28	PASS
Pushover+Y Acc + e	0.03	0.30	10.15	PASS
Pushover-Y Acc + e	0.04	0.30	8.48	PASS
PushoverEx+0.3Ey Acc	0.37	0.70	1.92	PASS
Pushover0.3Ex+Ey Acc	0.06	0.40	7.04	PASS
Pushover-0.3Ex+Ey Acc	0.06	0.40	6.45	PASS
Pushover-Ex+0.3Ey Acc	0.64	0.59	0.93	FAIL

Table 337: The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.23	3.33	2.71	PASS
Pushover-X Acc	1.28	2.57	2.01	PASS
Pushover+Y Acc	0.06	1.59	27.90	PASS
Pushover-Y Acc	0.07	1.21	17.92	PASS
Pushover+X Acc + e	1.21	3.33	2.75	PASS
Pushover-X Acc + e	1.29	2.57	1.99	PASS
Pushover+Y Acc + e	0.06	1.59	28.26	PASS
Pushover-Y Acc + e	0.07	1.21	17.82	PASS
PushoverEx+0.3Ey Acc	1.04	2.92	2.81	PASS
Pushover0.3Ex+Ey Acc	0.11	2.09	19.77	PASS
Pushover-0.3Ex+Ey Acc	0.11	0.59	5.19	PASS
Pushover-Ex+0.3Ey Acc	1.49	2.27	1.52	PASS

Table 338: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.83	4.54	2.49	PASS
Pushover-X Acc	1.90	3.47	1.82	PASS
Pushover+Y Acc	0.07	2.28	32.65	PASS
Pushover-Y Acc	0.08	1.71	20.67	PASS
Pushover+X Acc + e	1.80	4.54	2.52	PASS
Pushover-X Acc + e	1.92	3.47	1.81	PASS
Pushover+Y Acc + e	0.07	2.48	35.95	PASS
Pushover-Y Acc + e	0.08	1.61	19.35	PASS
PushoverEx+0.3Ey Acc	1.59	3.93	2.47	PASS
Pushover0.3Ex+Ey Acc	0.13	2.79	21.47	PASS
Pushover-0.3Ex+Ey Acc	0.14	0.89	6.34	PASS
Pushover-Ex+0.3Ey Acc	2.03	3.07	1.51	PASS

Table 339:The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.65	0.40	0.62	FAIL
Pushover-X Acc	1.06	0.79	0.75	FAIL
Pushover+Y Acc	0.04	0.20	4.90	PASS
Pushover-Y Acc	0.06	0.20	3.46	PASS
Pushover+X Acc + e	0.66	0.40	0.61	FAIL
Pushover-X Acc + e	1.06	0.79	0.75	FAIL
Pushover+Y Acc + e	0.04	0.20	4.95	PASS
Pushover-Y Acc + e	0.06	0.20	3.37	PASS
PushoverEx+0.3Ey Acc	0.68	0.60	0.88	FAIL
Pushover0.3Ex+Ey Acc	0.07	0.20	2.87	PASS
Pushover-0.3Ex+Ey Acc	0.09	0.30	3.32	PASS
Pushover-Ex+0.3Ey Acc	0.90	0.69	0.77	FAIL

Table 340: The outcomes of the SLD pushover analysis for a three-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.15	3.02	1.41	PASS
Pushover-X Acc	3.68	2.98	0.81	FAIL
Pushover+Y Acc	0.08	2.08	27.10	PASS
Pushover-Y Acc	0.11	0.81	7.40	PASS
Pushover+X Acc + e	2.18	3.02	1.39	PASS
Pushover-X Acc + e	3.68	2.98	0.81	FAIL
Pushover+Y Acc + e	0.08	2.08	27.37	PASS
Pushover-Y Acc + e	0.11	1.21	10.80	PASS
PushoverEx+0.3Ey Acc	2.18	2.71	1.25	PASS
Pushover0.3Ex+Ey Acc	0.13	1.99	15.41	PASS
Pushover-0.3Ex+Ey Acc	0.17	2.28	13.46	PASS
Pushover-Ex+0.3Ey Acc	2.61	2.87	1.10	PASS

Table 341: The outcomes of the SLV pushover analysis for a three-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
3 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.98	4.13	1.39	PASS
Pushover-X Acc	4.89	4.07	0.83	FAIL
Pushover+Y Acc	0.09	2.78	29.43	PASS
Pushover-Y Acc	0.13	1.11	8.29	PASS
Pushover+X Acc + e	3.02	4.13	1.37	PASS
Pushover-X Acc + e	4.88	4.07	0.83	FAIL
Pushover+Y Acc + e	0.09	2.78	29.71	PASS
Pushover-Y Acc + e	0.14	1.71	12.46	PASS
PushoverEx+0.3Ey Acc	3.02	3.62	1.20	PASS
Pushover0.3Ex+Ey Acc	0.16	2.69	16.95	PASS
Pushover-0.3Ex+Ey Acc	0.21	3.07	14.79	PASS
Pushover-Ex+0.3Ey Acc	3.57	3.86	1.08	PASS

Table 342: The outcomes of the SLC pushover analysis for a three-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	0.90	0.92	1.02	PASS
Pushover-X Acc	0.88	0.59	0.67	FAIL
Pushover+Y Acc	0.10	0.59	5.70	PASS
Pushover-Y Acc	0.11	0.51	4.53	PASS
Pushover+X Acc + e	0.89	0.92	1.03	PASS
Pushover-X Acc + e	0.88	0.59	0.67	FAIL
Pushover+Y Acc + e	0.10	0.59	5.79	PASS
Pushover-Y Acc + e	0.11	0.51	4.47	PASS
PushoverEx+0.3Ey Acc	0.88	1.01	1.15	PASS
Pushover0.3Ex+Ey Acc	0.16	0.70	4.27	PASS
Pushover-0.3Ex+Ey Acc	0.18	0.39	2.19	PASS
Pushover-Ex+0.3Ey Acc	0.93	0.59	0.63	FAIL

Table 343: The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	2.92	5.20	1.78	PASS
Pushover-X Acc	2.86	2.26	0.79	FAIL
Pushover+Y Acc	0.20	1.28	6.35	PASS
Pushover-Y Acc	0.22	1.42	6.39	PASS
Pushover+X Acc + e	2.88	5.20	1.81	PASS
Pushover-X Acc + e	2.84	2.26	0.79	FAIL
Pushover+Y Acc + e	0.20	1.38	6.96	PASS
Pushover-Y Acc + e	0.23	1.42	6.28	PASS
PushoverEx+0.3Ey Acc	2.79	4.77	1.71	PASS
Pushover0.3Ex+Ey Acc	0.36	1.69	4.69	PASS
Pushover-0.3Ex+Ey Acc	0.41	0.98	2.42	PASS
Pushover-Ex+0.3Ey Acc	3.01	2.06	0.68	FAIL

Table 344: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.98	7.03	1.77	PASS
Pushover-X Acc	3.91	3.04	0.78	FAIL
Pushover+Y Acc	0.25	1.78	7.16	PASS
Pushover-Y Acc	0.27	1.92	7.07	PASS
Pushover+X Acc + e	3.93	7.03	1.79	PASS
Pushover-X Acc + e	3.88	3.04	0.78	FAIL
Pushover+Y Acc + e	0.24	1.88	7.70	PASS
Pushover-Y Acc + e	0.28	1.92	6.95	PASS
PushoverEx+0.3Ey Acc	3.83	6.39	1.67	PASS
Pushover0.3Ex+Ey Acc	0.44	2.29	5.18	PASS
Pushover-0.3Ex+Ey Acc	0.50	1.38	2.76	PASS
Pushover-Ex+0.3Ey Acc	4.10	2.74	0.67	FAIL

Table 345: The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.10	0.81	0.74	PASS
Pushover-X Acc	1.30	0.69	0.53	FAIL
Pushover+Y Acc	0.10	0.39	3.94	PASS
Pushover-Y Acc	0.12	0.41	3.28	PASS
Pushover+X Acc + e	1.13	0.81	0.72	FAIL
Pushover-X Acc + e	1.23	0.69	0.56	FAIL
Pushover+Y Acc + e	0.10	0.39	3.98	PASS
Pushover-Y Acc + e	0.13	0.41	3.21	PASS
PushoverEx+0.3Ey Acc	1.69	1.11	0.66	FAIL
Pushover0.3Ex+Ey Acc	0.15	0.40	2.62	PASS
Pushover-0.3Ex+Ey Acc	0.17	0.49	2.89	PASS
Pushover-Ex+0.3Ey Acc	1.17	0.59	0.50	FAIL

Table 346: The outcomes of the SLD pushover analysis for a four-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.90	5.18	1.33	PASS
Pushover-X Acc	4.69	3.35	0.71	FAIL
Pushover+Y Acc	0.19	2.96	15.35	PASS
Pushover-Y Acc	0.25	0.81	3.21	PASS
Pushover+X Acc + e	4.02	5.18	1.29	PASS
Pushover-X Acc + e	4.44	3.35	0.75	FAIL
Pushover+Y Acc + e	0.19	3.16	16.59	PASS
Pushover-Y Acc + e	0.26	0.81	3.13	PASS
PushoverEx+0.3Ey Acc	6.09	4.45	0.73	FAIL
Pushover0.3Ex+Ey Acc	0.33	2.97	9.10	PASS
Pushover-0.3Ex+Ey Acc	0.38	1.77	4.65	PASS
Pushover-Ex+0.3Ey Acc	4.22	2.85	0.67	FAIL

Table 347: The outcomes of the SLV pushover analysis for a four-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
4 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.25	6.91	1.32	PASS
Pushover-X Acc	6.36	4.53	0.71	FAIL
Pushover+Y Acc	0.24	4.04	17.10	PASS
Pushover-Y Acc	0.31	1.12	3.60	PASS
Pushover+X Acc + e	5.40	7.01	1.30	PASS
Pushover-X Acc + e	5.99	4.53	0.76	FAIL
Pushover+Y Acc + e	0.23	4.24	18.17	PASS
Pushover-Y Acc + e	0.32	1.12	3.51	PASS
PushoverEx+0.3Ey Acc	8.25	5.96	0.72	FAIL
Pushover0.3Ex+Ey Acc	0.40	4.07	10.14	PASS
Pushover-0.3Ex+Ey Acc	0.47	2.36	5.06	PASS
Pushover-Ex+0.3Ey Acc	5.57	3.83	0.69	FAIL

Table 348: The outcomes of the SLC pushover analysis for a four-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.16	1.13	0.98	FAIL
Pushover-X Acc	1.16	0.58	0.50	FAIL
Pushover+Y Acc	0.20	0.69	3.37	PASS
Pushover-Y Acc	0.21	0.82	3.98	PASS
Pushover+X Acc + e	1.17	1.13	0.97	PASS
Pushover-X Acc + e	1.15	0.58	0.51	FAIL
Pushover+Y Acc + e	0.20	0.69	3.43	PASS
Pushover-Y Acc + e	0.21	0.82	3.94	PASS
PushoverEx+0.3Ey Acc	1.12	1.23	1.09	PASS
Pushover0.3Ex+Ey Acc	0.30	0.89	2.98	PASS
Pushover-0.3Ex+Ey Acc	0.34	0.39	1.14	PASS
Pushover-Ex+0.3Ey Acc	1.14	0.48	0.42	FAIL

Table 349: The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.14	4.95	1.19	PASS
Pushover-X Acc	4.14	2.33	0.56	FAIL
Pushover+Y Acc	0.48	0.69	1.44	PASS
Pushover-Y Acc	0.48	1.73	3.60	PASS
Pushover+X Acc + e	4.19	4.95	1.18	PASS
Pushover-X Acc + e	4.09	2.33	0.57	FAIL
Pushover+Y Acc + e	0.47	0.69	1.47	PASS
Pushover-Y Acc + e	0.49	1.73	3.57	PASS
PushoverEx+0.3Ey Acc	3.95	4.60	1.17	PASS
Pushover0.3Ex+Ey Acc	0.70	0.99	1.41	PASS
Pushover-0.3Ex+Ey Acc	0.80	1.27	1.58	PASS
Pushover-Ex+0.3Ey Acc	4.03	2.03	0.50	FAIL

Table 350: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.55	6.60	1.19	PASS
Pushover-X Acc	5.55	3.10	0.56	FAIL
Pushover+Y Acc	0.58	0.98	1.68	PASS
Pushover-Y Acc	0.59	2.35	3.98	PASS
Pushover+X Acc + e	5.61	6.60	1.18	PASS
Pushover-X Acc + e	5.49	3.10	0.56	FAIL
Pushover+Y Acc + e	0.57	0.98	1.72	PASS
Pushover-Y Acc + e	0.60	2.35	3.93	PASS
PushoverEx+0.3Ey Acc	5.30	6.24	1.18	PASS
Pushover0.3Ex+Ey Acc	0.89	1.39	1.55	PASS
Pushover-0.3Ex+Ey Acc	1.02	1.75	1.72	PASS
Pushover-Ex+0.3Ey Acc	5.41	2.80	0.52	FAIL

Table 351: The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	3.67	1.23	0.34	FAIL
Pushover-X Acc	1.17	0.68	0.58	FAIL
Pushover+Y Acc	0.18	0.59	3.18	PASS
Pushover-Y Acc	0.23	0.61	2.63	PASS
Pushover+X Acc + e	3.69	1.23	0.33	FAIL
Pushover-X Acc + e	1.14	0.68	0.60	FAIL
Pushover+Y Acc + e	0.18	0.59	3.22	PASS
Pushover-Y Acc + e	0.24	0.61	2.59	PASS
PushoverEx+0.3Ey Acc	2.80	1.12	0.40	FAIL
Pushover0.3Ex+Ey Acc	0.28	0.69	2.43	PASS
Pushover-0.3Ex+Ey Acc	0.31	0.49	1.58	PASS
Pushover-Ex+0.3Ey Acc	1.16	0.58	0.50	FAIL

Table 352: The outcomes of the SLD pushover analysis for a five-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	13.21	6.97	0.53	FAIL
Pushover-X Acc	4.19	3.22	0.77	FAIL
Pushover+Y Acc	0.42	3.61	8.64	PASS
Pushover-Y Acc	0.55	1.53	2.80	PASS
Pushover+X Acc + e	13.31	7.07	0.53	FAIL
Pushover-X Acc + e	4.06	3.22	0.79	FAIL
Pushover+Y Acc + e	0.41	3.61	8.78	PASS
Pushover-Y Acc + e	0.56	1.53	2.76	PASS
PushoverEx+0.3Ey Acc	10.10	6.10	0.60	FAIL
Pushover0.3Ex+Ey Acc	0.67	4.04	6.06	PASS
Pushover-0.3Ex+Ey Acc	0.72	1.94	2.68	PASS
Pushover-Ex+0.3Ey Acc	4.11	2.91	0.71	FAIL

Table 353: The outcomes of the SLV pushover analysis for a five-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
5 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	17.91	9.32	0.52	FAIL
Pushover-X Acc	5.63	4.29	0.76	FAIL
Pushover+Y Acc	0.51	4.89	9.52	PASS
Pushover-Y Acc	0.70	2.05	2.94	PASS
Pushover+X Acc + e	18.04	9.43	0.52	FAIL
Pushover-X Acc + e	5.46	4.29	0.79	FAIL
Pushover+Y Acc + e	0.50	4.89	9.68	PASS
Pushover-Y Acc + e	0.71	2.15	3.03	PASS
PushoverEx+0.3Ey Acc	13.70	8.23	0.60	FAIL
Pushover0.3Ex+Ey Acc	0.85	5.50	6.47	PASS
Pushover-0.3Ex+Ey Acc	1.07	2.62	2.46	PASS
Pushover-Ex+0.3Ey Acc	5.50	3.88	0.71	FAIL

Table 354: The outcomes of the SLC pushover analysis for a five-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.49	1.46	0.98	FAIL
Pushover-X Acc	1.46	0.48	0.33	FAIL
Pushover+Y Acc	0.35	0.68	1.94	PASS
Pushover-Y Acc	0.34	1.13	3.37	PASS
Pushover+X Acc + e	1.51	1.46	0.97	FAIL
Pushover-X Acc + e	1.45	0.48	0.33	FAIL
Pushover+Y Acc + e	0.35	0.78	2.23	PASS
Pushover-Y Acc + e	0.34	1.13	3.32	PASS
PushoverEx+0.3Ey Acc	1.46	1.44	0.99	FAIL
Pushover0.3Ex+Ey Acc	0.52	1.08	2.10	PASS
Pushover-0.3Ex+Ey Acc	0.59	0.38	0.65	FAIL
Pushover-Ex+0.3Ey Acc	1.41	0.48	0.34	FAIL

Table 355: The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.38	5.63	1.05	PASS
Pushover-X Acc	5.27	2.49	0.47	FAIL
Pushover+Y Acc	0.82	0.68	0.82	FAIL
Pushover-Y Acc	0.79	1.96	2.48	PASS
Pushover+X Acc + e	5.45	5.63	1.03	PASS
Pushover-X Acc + e	5.22	2.49	0.48	FAIL
Pushover+Y Acc + e	0.82	0.78	0.95	FAIL
Pushover-Y Acc + e	0.80	1.85	2.31	PASS
PushoverEx+0.3Ey Acc	5.27	5.26	1.00	FAIL
Pushover0.3Ex+Ey Acc	1.21	1.08	0.89	FAIL
Pushover-0.3Ex+Ey Acc	1.40	1.15	0.82	FAIL
Pushover-Ex+0.3Ey Acc	5.09	2.29	0.45	FAIL

Table 356: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.30	7.61	1.04	PASS
Pushover-X Acc	7.15	3.35	0.47	FAIL
Pushover+Y Acc	1.24	0.97	0.79	FAIL
Pushover-Y Acc	1.01	2.68	2.66	PASS
Pushover+X Acc + e	7.39	7.61	1.03	PASS
Pushover-X Acc + e	7.08	3.35	0.47	FAIL
Pushover+Y Acc + e	1.04	1.07	1.03	PASS
Pushover-Y Acc + e	1.02	2.57	2.52	PASS
PushoverEx+0.3Ey Acc	7.14	7.12	1.00	FAIL
Pushover0.3Ex+Ey Acc	1.79	1.48	0.83	FAIL
Pushover-0.3Ex+Ey Acc	2.12	1.63	0.77	FAIL
Pushover-Ex+0.3Ey Acc	6.90	3.05	0.44	FAIL

Table 357: The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.35	0.52	0.38	FAIL
Pushover-X Acc	1.10	0.68	0.61	FAIL
Pushover+Y Acc	0.31	0.97	3.10	PASS
Pushover-Y Acc	0.33	0.72	2.17	PASS
Pushover+X Acc + e	1.36	0.52	0.38	FAIL
Pushover-X Acc + e	1.11	0.68	0.61	FAIL
Pushover+Y Acc + e	0.31	0.97	3.15	PASS
Pushover-Y Acc + e	0.36	0.83	2.29	PASS
PushoverEx+0.3Ey Acc	1.93	1.23	0.64	FAIL
Pushover0.3Ex+Ey Acc	0.46	1.08	2.33	PASS
Pushover-0.3Ex+Ey Acc	0.54	0.48	0.88	FAIL
Pushover-Ex+0.3Ey Acc	1.17	0.58	0.49	FAIL

Table 358: The outcomes of the SLD pushover analysis for a six-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	4.86	7.45	1.53	PASS
Pushover-X Acc	3.88	3.28	0.85	FAIL
Pushover+Y Acc	0.73	3.67	5.02	PASS
Pushover-Y Acc	0.78	1.34	1.72	PASS
Pushover+X Acc + e	4.89	7.45	1.52	PASS
Pushover-X Acc + e	3.89	3.28	0.84	FAIL
Pushover+Y Acc + e	0.72	3.57	4.96	PASS
Pushover-Y Acc + e	0.85	1.65	1.95	PASS
PushoverEx+0.3Ey Acc	6.94	6.85	0.99	FAIL
Pushover0.3Ex+Ey Acc	1.08	4.21	3.88	PASS
Pushover-0.3Ex+Ey Acc	1.27	2.21	1.73	PASS
Pushover-Ex+0.3Ey Acc	4.18	2.97	0.71	FAIL

Table 359: The outcomes of the SLV pushover analysis for a six-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – HCB				
6 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.59	10.06	1.53	PASS
Pushover-X Acc	5.23	4.44	0.85	FAIL
Pushover+Y Acc	0.93	5.02	5.39	PASS
Pushover-Y Acc	1.29	1.86	1.44	PASS
Pushover+X Acc + e	6.63	10.06	1.52	PASS
Pushover-X Acc + e	5.24	4.44	0.85	FAIL
Pushover+Y Acc + e	0.92	4.83	5.26	PASS
Pushover-Y Acc + e	1.32	2.28	1.73	PASS
PushoverEx+0.3Ey Acc	9.40	9.15	0.97	FAIL
Pushover0.3Ex+Ey Acc	1.38	5.62	4.07	PASS
Pushover-0.3Ex+Ey Acc	1.86	2.97	1.60	PASS
Pushover-Ex+0.3Ey Acc	5.60	4.03	0.72	FAIL

Table 360: The outcomes of the SLC pushover analysis for a six-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.85	1.69	0.91	FAIL
Pushover-X Acc	1.79	0.47	0.26	FAIL
Pushover+Y Acc	0.54	0.67	1.25	PASS
Pushover-Y Acc	0.45	1.35	2.98	PASS
Pushover+X Acc + e	1.88	1.69	0.90	FAIL
Pushover-X Acc + e	1.77	0.47	0.27	FAIL
Pushover+Y Acc + e	0.53	0.67	1.27	PASS
Pushover-Y Acc + e	0.46	1.35	2.93	PASS
PushoverEx+0.3Ey Acc	1.83	1.66	0.91	FAIL
Pushover0.3Ex+Ey Acc	0.77	0.98	1.28	PASS
Pushover-0.3Ex+Ey Acc	0.82	0.28	0.34	FAIL
Pushover-Ex+0.3Ey Acc	1.73	0.38	0.22	FAIL

Table 361: The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	6.66	6.55	0.98	FAIL
Pushover-X Acc	6.44	2.55	0.40	FAIL
Pushover+Y Acc	1.53	0.67	0.44	FAIL
Pushover-Y Acc	1.07	1.87	1.75	PASS
Pushover+X Acc + e	6.76	6.55	0.97	FAIL
Pushover-X Acc + e	6.37	2.55	0.40	FAIL
Pushover+Y Acc + e	1.49	0.67	0.45	FAIL
Pushover-Y Acc + e	1.08	1.87	1.73	PASS
PushoverEx+0.3Ey Acc	6.60	5.93	0.90	FAIL
Pushover0.3Ex+Ey Acc	2.09	0.98	0.47	FAIL
Pushover-0.3Ex+Ey Acc	2.28	1.14	0.50	FAIL
Pushover-Ex+0.3Ey Acc	6.22	2.44	0.39	FAIL

Table 362: The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure – Globigerina Limestone				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	9.02	8.77	0.97	FAIL
Pushover-X Acc	8.73	3.49	0.40	FAIL
Pushover+Y Acc	2.26	0.96	0.42	FAIL
Pushover-Y Acc	1.36	2.60	1.91	PASS
Pushover+X Acc + e	9.17	8.77	0.96	FAIL
Pushover-X Acc + e	8.63	3.49	0.40	FAIL
Pushover+Y Acc + e	2.21	0.96	0.43	FAIL
Pushover-Y Acc + e	1.41	2.60	1.85	PASS
PushoverEx+0.3Ey Acc	8.94	8.01	0.90	FAIL
Pushover0.3Ex+Ey Acc	2.97	1.37	0.46	FAIL
Pushover-0.3Ex+Ey Acc	3.20	1.52	0.47	FAIL
Pushover-Ex+0.3Ey Acc	8.43	3.28	0.39	FAIL

Table 363: The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with Globigerina limestone on weak clay subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	1.63	0.52	0.32	FAIL
Pushover-X Acc	1.31	0.67	0.51	FAIL
Pushover+Y Acc	0.48	1.43	3.00	PASS
Pushover-Y Acc	0.49	1.05	2.14	PASS
Pushover+X Acc + e	1.64	0.52	0.32	FAIL
Pushover-X Acc + e	1.30	0.67	0.51	FAIL
Pushover+Y Acc + e	0.47	1.43	3.07	PASS
Pushover-Y Acc + e	0.50	1.05	2.11	PASS
PushoverEx+0.3Ey Acc	2.41	1.34	0.56	FAIL
Pushover0.3Ex+Ey Acc	0.68	1.16	1.70	PASS
Pushover-0.3Ex+Ey Acc	0.79	0.47	0.60	FAIL
Pushover-Ex+0.3Ey Acc	1.36	0.57	0.42	FAIL

Table 364: The outcomes of the SLD pushover analysis for a seven-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	5.88	6.69	1.14	PASS
Pushover-X Acc	4.72	3.44	0.73	FAIL
Pushover+Y Acc	1.12	3.52	3.16	PASS
Pushover-Y Acc	1.17	1.99	1.71	PASS
Pushover+X Acc + e	5.91	6.69	1.13	PASS
Pushover-X Acc + e	4.69	3.44	0.73	FAIL
Pushover+Y Acc + e	1.09	3.52	3.22	PASS
Pushover-Y Acc + e	1.22	1.89	1.54	PASS
PushoverEx+0.3Ey Acc	8.66	6.89	0.80	FAIL
Pushover0.3Ex+Ey Acc	1.60	4.26	2.65	PASS
Pushover-0.3Ex+Ey Acc	1.86	2.45	1.32	PASS
Pushover-Ex+0.3Ey Acc	4.90	3.12	0.64	FAIL

Table 365: The outcomes of the SLV pushover analysis for a seven-story, four-unit structure built with HCB on weak clay subsoil.

Four Unit – Aggregate Structure - HCB				
7 Floors (Seismic Levels)				
Analysis	Total Lateral Deflections		Safety Factor	Check
	Demand	Capacity	α	
Pushover+X Acc	7.97	8.99	1.13	PASS
Pushover-X Acc	6.39	4.68	0.73	FAIL
Pushover+Y Acc	1.42	4.76	3.35	PASS
Pushover-Y Acc	1.83	2.73	1.49	PASS
Pushover+X Acc + e	8.01	8.99	1.12	PASS
Pushover-X Acc + e	6.34	4.68	0.74	FAIL
Pushover+Y Acc + e	1.39	4.76	3.42	PASS
Pushover-Y Acc + e	1.89	2.62	1.38	PASS
PushoverEx+0.3Ey Acc	11.74	9.25	0.79	FAIL
Pushover0.3Ex+Ey Acc	2.17	5.71	2.63	PASS
Pushover-0.3Ex+Ey Acc	2.69	3.30	1.23	PASS
Pushover-Ex+0.3Ey Acc	6.64	4.25	0.64	FAIL

Table 366: The outcomes of the SLC pushover analysis for a seven-story, four-unit structure built with HCB on weak clay subsoil.