The Mexico City Earthquake

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Introduction

Mexico City, home to more than twenty million people, is a metropolis shaped by both triumphs and tragedies. One of the most vibrant cultural and economic centers in the Americas, the city also stands as a stark reminder of nature’s unpredictable power. Its very foundation—soft, water-laden sediments left by the extinct Lake Texcoco—renders it uniquely vulnerable to earthquakes. Over the past century, this vulnerability has turned distant seismic events into local crises, etching indelible scars into the city’s landscape and collective memory.

This book, *The Mexico City Earthquake: History of a Disaster*, is a comprehensive history of catastrophic earthquakes that have shaped the capital, focusing above all on the defining events of 1985 and 2017. The narrative begins with an exploration of the city’s unstable geology and chronicles how seismic forces, working invisibly beneath the surface, have triggered some of the most destructive urban disasters in modern history. Through the stories of buildings toppled, communities shattered, and lives upended, we seek to understand not only the science of these events but their profound human impact.

We will journey through the moments of chaos and heartbreak, from the initial tremors on both infamous mornings in September, to the heroic and at times improvised citizen rescues in the rubble. The response from authorities—both its failings and its victories—will be examined closely, as well as the enduring social, political, and economic consequences these disasters wrought on the sprawling capital. From the ashes of destruction, Mexico City's citizens forged new traditions of civic engagement and mutual aid that continue to influence disaster response and governance nationwide.

Beyond recounting these pivotal events, the book delves into the evolving landscape of disaster preparedness and the never-ending effort to fortify a city at constant risk. We investigate the transformation of building codes, the challenges of regulating new and informal construction, and the advent of early warning systems that have become lifelines for millions. As the book unfolds, the unique interplay of nature, negligence, resilience, and reform reveals itself as the very fabric of Mexico City’s seismic history.

Ultimately, this is a story of both vulnerability and resilience. By studying the Mexico City earthquakes—not only as physical phenomena but as catalysts of change—we hope to illuminate lessons valuable to all cities built on uncertain ground. The legacy of the earthquakes is written not just in concrete and statistics, but in the enduring spirit and solidarity of a people determined to prepare for an unquiet future.

CHAPTER ONE: Mexico City: A City Built on a Lake

To truly understand Mexico City's relationship with earthquakes, one must first grasp the very ground it stands upon—or rather, the lack thereof. This sprawling megacity, a vibrant tapestry of ancient history and modern dynamism, is famously, and perilously, built on the soft, silty remnants of an ancient lakebed. It’s a geological quirk that has, time and again, amplified distant tremors into devastating local catastrophes, shaping not only the city's skyline but also the very lives of its inhabitants.

Imagine, if you will, a vast basin nestled amidst towering mountains and volcanoes. This is the Valley of Mexico, and at its heart once lay a complex system of interconnected lakes. The largest of these was Lake Texcoco, a sprawling body of water that, particularly during the rainy season, could expand to cover an area of around 1,500 square kilometers (580 sq mi). This wasn't a singular, static lake, but a dynamic system with both freshwater and saline sections, fed by snowmelt from surrounding glaciers in cooler periods and by springs and runoff in more recent times.

The Aztecs, drawn by the fertile soils, chose an island in Lake Texcoco in the early 1300s as the site for their magnificent capital, Tenochtitlan. They were masterful engineers, constructing dikes and causeways to manage the fluctuating water levels and connect their island city to the mainland. This ingenious system allowed for advanced agriculture, like the famous chinampas, or floating gardens, which provided sustenance for their thriving population.

However, the arrival of the Spanish conquistadors marked a dramatic shift in the valley's hydrology. Driven by a desire to prevent the frequent flooding that plagued the city, and perhaps also by a different understanding of urban planning, the Spanish embarked on a monumental project to drain the lakes. This grand hydraulic endeavor, known as the *Desagüe*, began in the 17th century and continued for centuries, fundamentally altering the landscape.

What remained after the waters receded was not firm, stable ground, but a legacy of the lake itself: deep, soft silt and volcanic clay sediments, saturated with water. These lacustrine deposits, varying in depth from a mere seven meters to a remarkable thirty-seven meters (or even more than one hundred meters in some areas), now form the foundation of much of Mexico City. This is where the city’s inherent vulnerability truly lies.

Think of it like a bowl of gelatin. When you shake the bowl, the gelatin jiggles far more intensely than the hand holding it. That's essentially what happens to Mexico City during an earthquake. The soft, water-laden sediments of the ancient lakebed act as

an amplifier, dramatically magnifying seismic waves as they travel through the ground. This phenomenon, known as seismic amplification, can make the shaking in the city's lake zone up to five times greater than in areas with more stable, rocky foundations. Some studies even suggest that amplification in the lakebed zone can be 100 to 500 times greater at certain frequencies compared to hill-zone sites outside the city.

Furthermore, this soft, saturated soil is prone to another insidious hazard: soil liquefaction. When intense seismic shaking occurs, these saturated soils can lose their solid structure and behave like a liquid. Imagine quicksand; during liquefaction, the ground can become similarly unstable, causing buildings to lose their foundation support and dramatically settle, or even sink. This was a significant contributing factor to the widespread damage observed in past earthquakes.

To better understand these varying ground conditions and their impact on seismic response, Mexico City is generally divided into three distinct seismic zones. The first is the "ridge zone," characterized by firm, rocky terrain, typically found in the southern and southwestern parts of the city. This zone experiences relatively lower seismic amplification.

Next, there's the "transition zone," which, as its name suggests, lies between the firm ground and the soft lakebed. Here, the soils are a mix of sands and silts, with occasional clay layers, offering an intermediate level of stability.

Finally, and most critically for earthquake vulnerability, there is the "lake zone." This zone encompasses the areas built directly on the very soft lacustrine deposits of the former Lake Texcoco, including central areas like Cuauhtémoc, Venustiano Carranza, and Iztapalapa. It is in this zone that seismic waves are most dramatically amplified, turning what might be a moderate tremor elsewhere into a violent, destructive oscillation.

The distinction between these zones is not merely academic; it dictates how buildings respond to seismic events and, consequently, where the greatest risks lie. The low-frequency seismic waves generated by distant earthquakes resonate with the natural "pitch" of the lakebed, which has a natural vibration cycle of about 2.5 seconds. This resonance effect means that buildings of certain heights—particularly those between 5 and 15 stories—are more susceptible to damage as they vibrate at similar frequencies to the amplified ground motion. Older, shorter colonial buildings, paradoxically, have often fared better in earthquakes because their structural frequencies do not align with this resonant frequency.

Beyond the immediate geological composition, the city faces ongoing challenges related to its unique foundation. The extraction of groundwater from the aquifers beneath the city, a necessity for a growing population, has led to significant land

subsidence. In some areas, the city has sunk by more than seven meters (23 feet) since 1891, and parts of the city center dropped over a meter between 1948 and 1951 alone. This uneven sinking can cause stress on buildings and infrastructure, further complicating seismic resilience efforts.

The very act of building on a drained lakebed has created a complex urban environment where every tremor serves as a reminder of the ground's inherent instability. This fundamental geological reality is the stage upon which the tragic history of Mexico City's earthquakes has unfolded. It is this unique vulnerability that transforms distant seismic ruptures into powerful, localized forces, a phenomenon that has repeatedly tested the city’s resolve and forced it to adapt and evolve in the face of nature’s relentless power. The story of Mexico City's earthquakes, therefore, is as much a geological narrative as it is a human one.

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