THE INCREASING NEED OF DEEP FOUNDATIONS FOR SKYSCRAPERS & LARGE STRUCTURES

WHAT DO DEEP FOUNDATIONS DO AND WHY ARE THEY USED MORE OFTEN NOW THAN EVER?

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WHY ARE DEEP FOUNDATIONS NEEDED

Have you ever found yourself looking at a towering skyscraper or massive structure wondering how do those structures withstand the elements and support all of that weight? In this article, we will take a look at skyscrapers and massive structures like the Eiffel Tower to see how the ground they are placed on needs to be prepared below the surface to support these structures. Soil, sand, and clay near the surface of the earth will not support loads of a skyscraper. Most people’s first thought is the vertical loads of such structures, but imagine the horizontal loads these sails in the sky will face in wind storms. That is why they often require a deep foundation system like caissons / drilled piers, micropiles, or driven pile to be installed down to the bedrock to transfer the load. In this article, we will take a look at the first structure ever built over 300 meters high, discuss just how extravagant the foundation below the surface is to support this masterpiece, and why deep foundations are needed more today.
First, we will look at one of the most famous structures in the world and the first building to tower over 300 meters. The deep foundation system of the Eiffel Tower is extremely critical as it supports the massive 10,000-ton structure that was 984 feet at its highest point when constructed until the TV antenna was added to the building in 1957, bringing the peak to 1,063 feet. If that was not challenging enough back in 1887, the site they selected was known to flood. Due to less than desirable soil conditions along the river, Gustave Eiffel decided to install a dual foundation system. The system furthest from the river was a dry system, and a compressed air system was used near the river. The compressed air system meant they blasted the foundation with some metal components that had been used in underwater construction to strengthen the foundation.
When the construction of the foundations started for the Eiffel Tower in 1887, the dump trucks they had back then consisted of two-horse or single horse dumpers, and the excavation was by men with shovels. It is incredible that with all of this manual labor, the project only had one death, and it was not even during work. In the picture on the right, you can see a sketch of a caissons/pier being built on the Eiffel Tower. This picture shows just how much labor was used to ensure the foundation for this iconic structure would withstand the test of time. When the Eiffel tower was erected, it became the tallest structure in the world. The Eiffel Tower remained the tallest structure in the world form 1889 until 1930.
Understanding how extensive the deep foundation of superstructures needs to be, why are more deep foundations being used nowadays? It is relatively simple to understand why the demand for deep foundations is on the rise. As cities grow more significant, more people want to live in the big cities, and with only so much space in our popular metropolitan areas, demand drives us to build vertically. When evaluating development vertically, we realize that most of the premium building sites are already taken, and this encourages the building of massive structures and buildings on non-optimum land. When heavier loads are applied in soil with less than optimum bearing capacity, we need to have more extensive deep foundation systems installed to depths that will provide the proper bearing capacity. Just like the Eiffel Tower’s foundation near the water, poor conditions often require going to greater depths to support such superstructures.
Singapore is a prime example where the country has reclaimed land to build massive structures on like the Marina Bay Sands that you see in the picture above. This architectural master piece’s sum of dead and live loads is 1,348,076,816 lbs and is designed to withstand horizontal loads of 7,287,100 pounds. To support these loads, they had to install an extensive deep foundation system using five massive cofferdams, with the two largest ones being 120 meters in diameter. The Drilled Piers / Bored Piles to support this architectural masterpiece go 240 feet below the surface to reach a layer of stiff-to-hard old alluvium. This structure is a prime example of how building big on less than optimum land is becoming more common and requires extensive deep foundation work. If you would like to learn more about the Marina Bay Sands project, I recommend you google Marina Bay Sands Hotel Arch 631. The site is also in the references.
TEXT REFERENCES

History: 10 Things You May Not Know About the Eiffel Tower.

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Foundations of the Eiffel Tower: Study of the basement and choice of the final location.

Marina Bay Sands Hotel: Arch 631.

EXPLORE THE MARINA BAY SANDS WITH US: Analysis & Description.
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