

# Discussion on Anti-Seismic Design of Buildings in Soil Liquefaction Zone

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## Abstract

The area around Shilin MRT Station in Taipei, Taiwan is located in the high soil liquefaction potential area, due to its proximity to the ancient channel of the Keelung River. This case is analyzed and studied by visiting the infrastructure of three nearby new buildings. In this study, buildings with more than 30 years which are located in high soil liquefaction potential area are also used as research objects, and self-developed app are used to measure whether the buildings are stable enough.

## Motivation

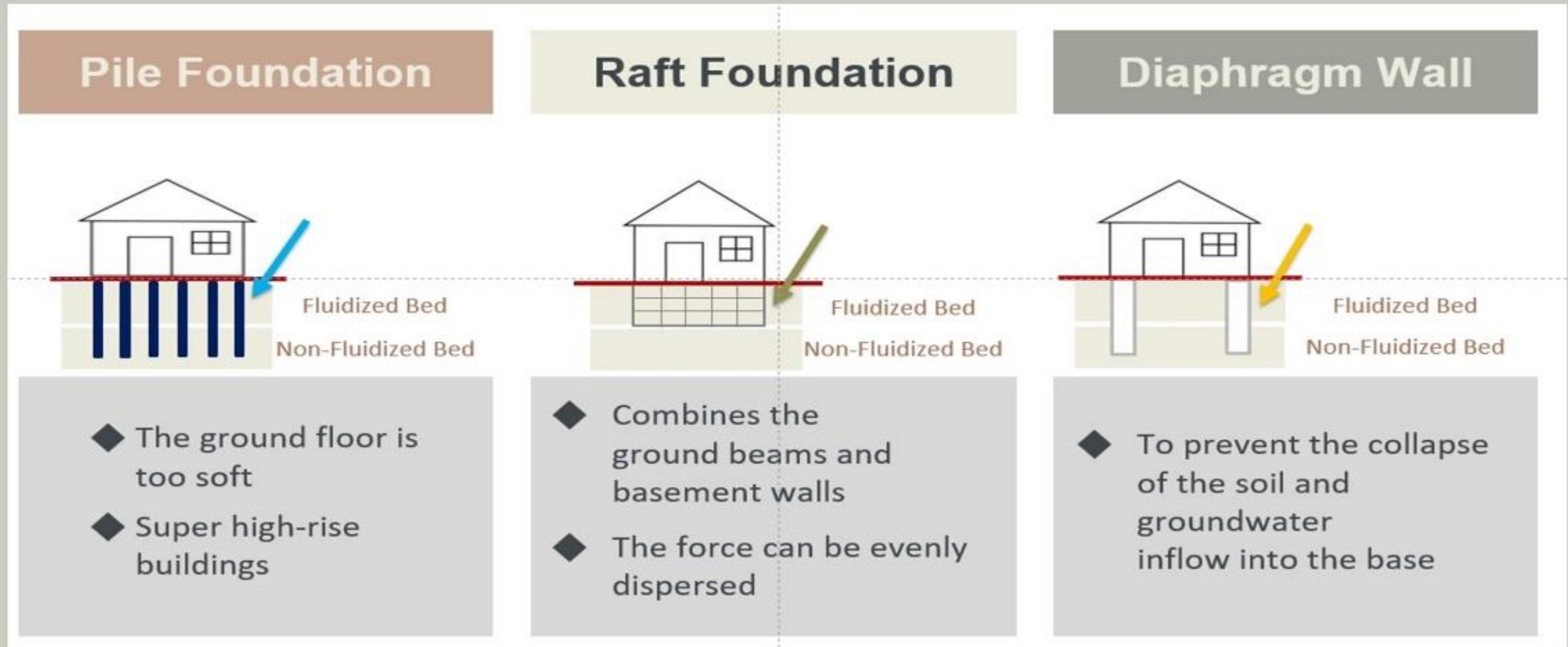
1. Explore how the new buildings around Shilin MRT Station (in high soil liquefaction potential area) strengthen the foundation seismic structure and prevent soil liquefaction disasters.
2. There are more than 600,000 old buildings with more than 30 years in Taipei City, such as in the high soil liquefaction potential area, when the earthquake strikes, it is easy to cause the house to tilt and cause potential harm.



## Research Process

1. Through the characteristics of three different architectural cases, the seismic construction methods of individual underground foundations are analyzed, and the reasons for their structural design are discussed.
2. Through the development of mobile APP function, the inclination rate of the appearance of the houses can be quickly detected anytime and anywhere, also the measured values can be recorded regularly, and used as reference information for professional technicians to judge the restoration or reconstruction of old buildings.
3. Discuss the countermeasures of the buildings in different countries which are located in the high soil liquefaction potential area.

Country	Anti-Liquefaction Countermeasures
Japan	Iron Plates & Drainage Pipes
America	Deep Soil Mixing (DSM) \ Cement Deep Soil Mixing (CDSM)
Taiwan	Raft Foundation & Pile Foundation & Geological Improvement



## Process

1. Pile foundation: When the ground floor is too soft to withstand too much pressure, or when there is a super high-rise building, a pile foundation is needed to avoid the subsidence or tilting of the building.
2. Raft foundation: It combines the ground beams and basement walls. The load of the building columns or walls are transmitted to the ground, which is able to reduce the damage of the earthquakes.
3. Diaphragm Wall: It is able to prevent the collapse of the soil and groundwater inflow into the base. Also, it can be part of the foundation structure.



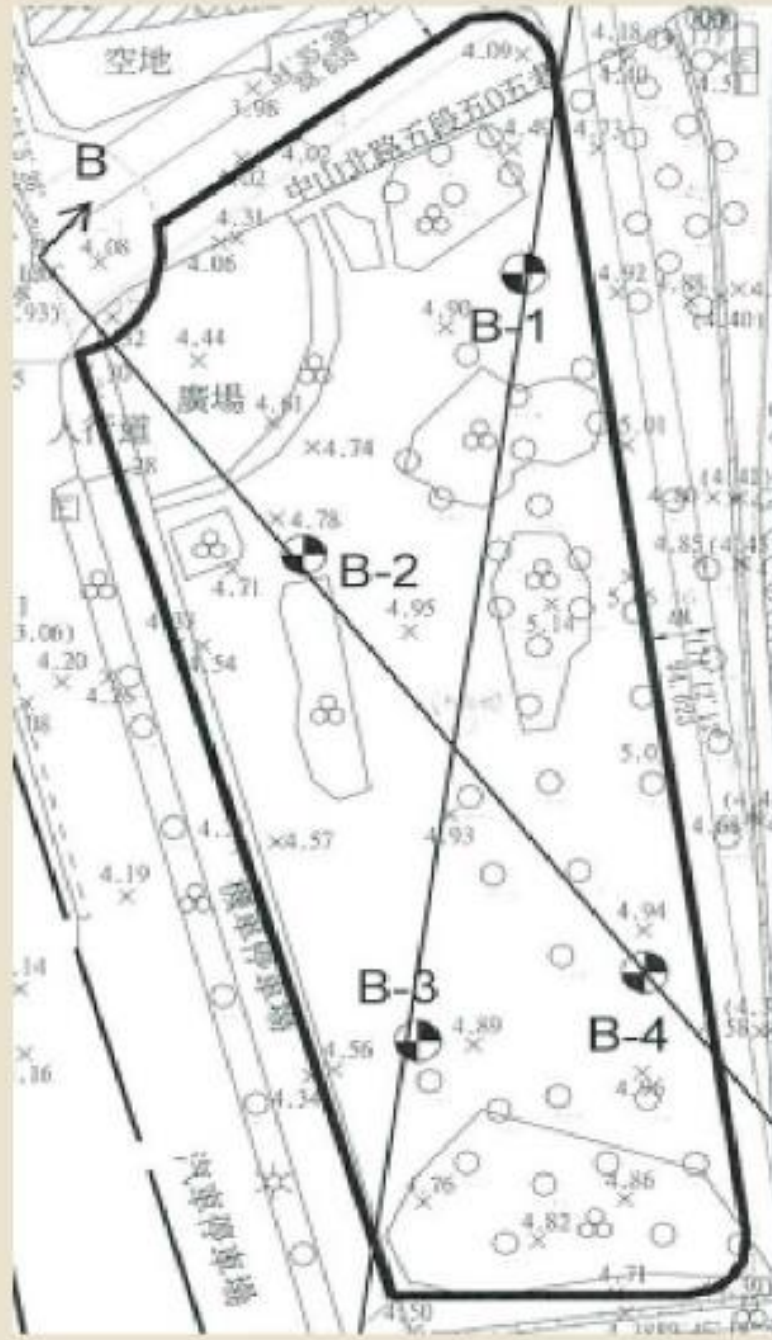
Shilin MRT Station TOD  
New Construction  
Project



Shilin Paper Mill Hotel New  
Construction Project

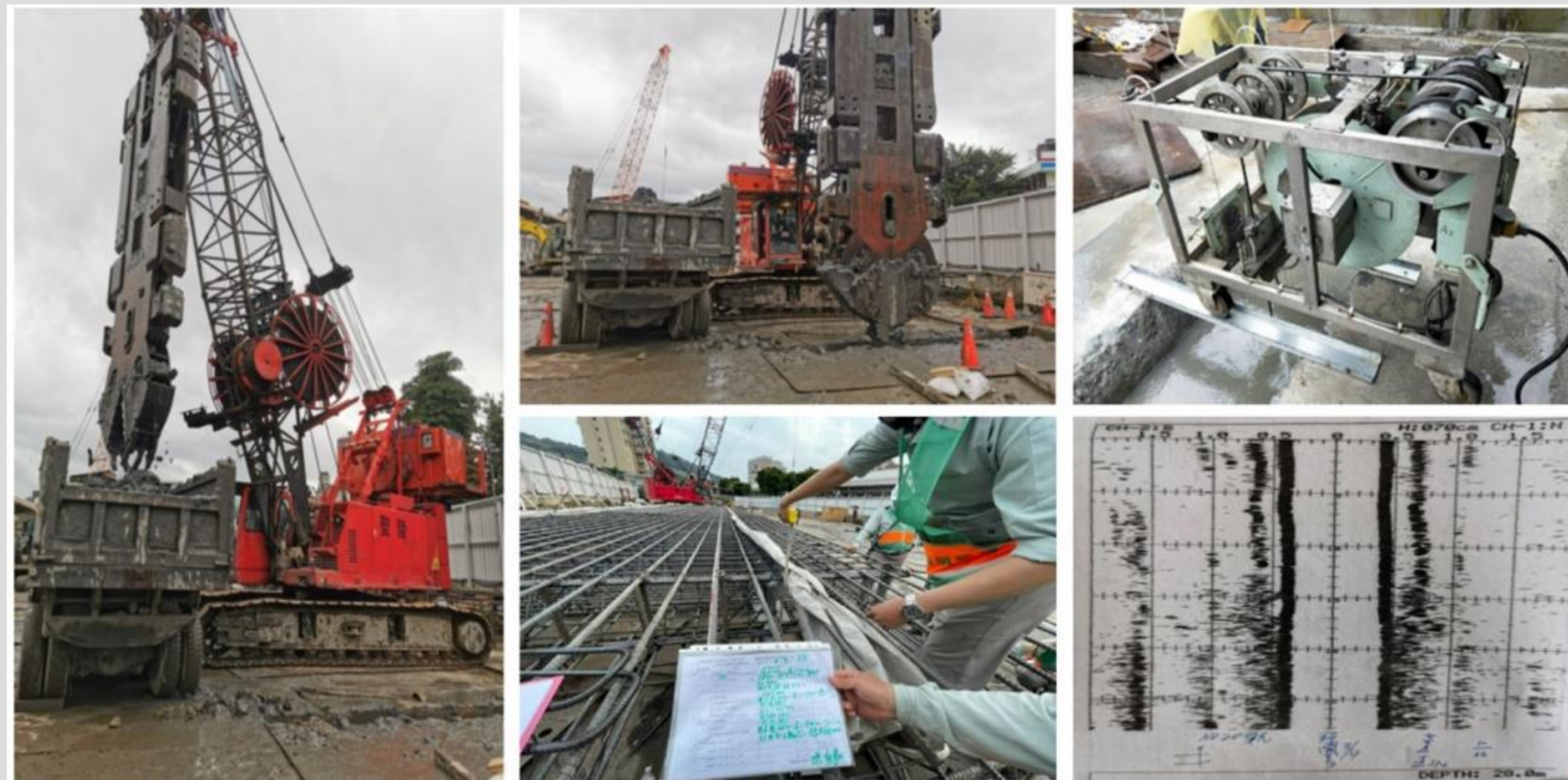


Humble Stone  
New Construction Project



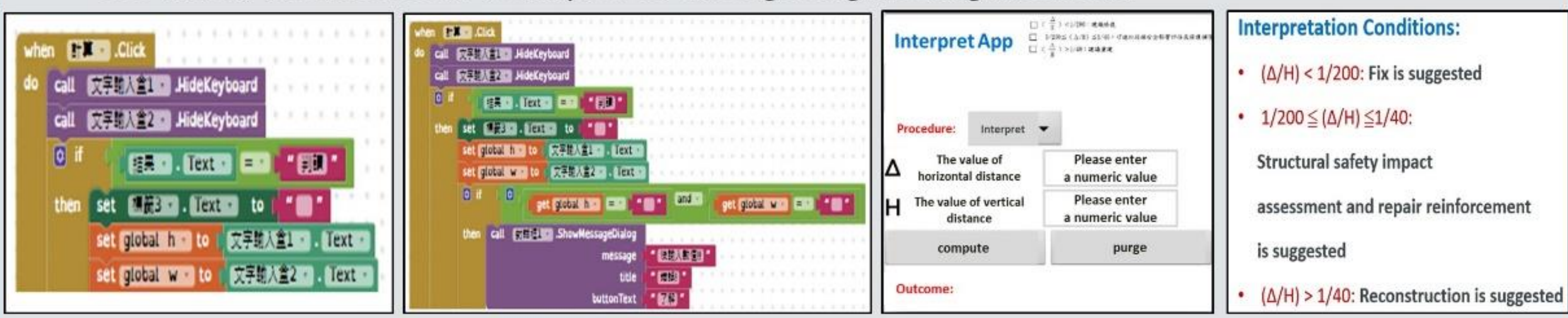
## Method

Scheme analysis and explanation:  
Since Shilin MRT Station is located in a high-potential area, through on-the-spot investigation of new buildings around the station, it was learned that there are at least 3 holes for geological drilling.



## Result

1. Most of the new buildings in Taiwan use a raft foundation, pile foundation, diaphragm wall, Cross Wall, Barrette or carry out Geological Improvements and combine other methods in order to stabilize the buildings.
2. In order to check if the old buildings with more than 30 years are stable enough, we can check it through the self-developed APP as the reference information for the restoration or reconstruction of old buildings.
3. The appropriate housing infrastructure is selected through careful geological drilling analysis, so that even residents in areas with high soil liquefaction potential area do not have to worry too much, because it can be improved through engineering methods.



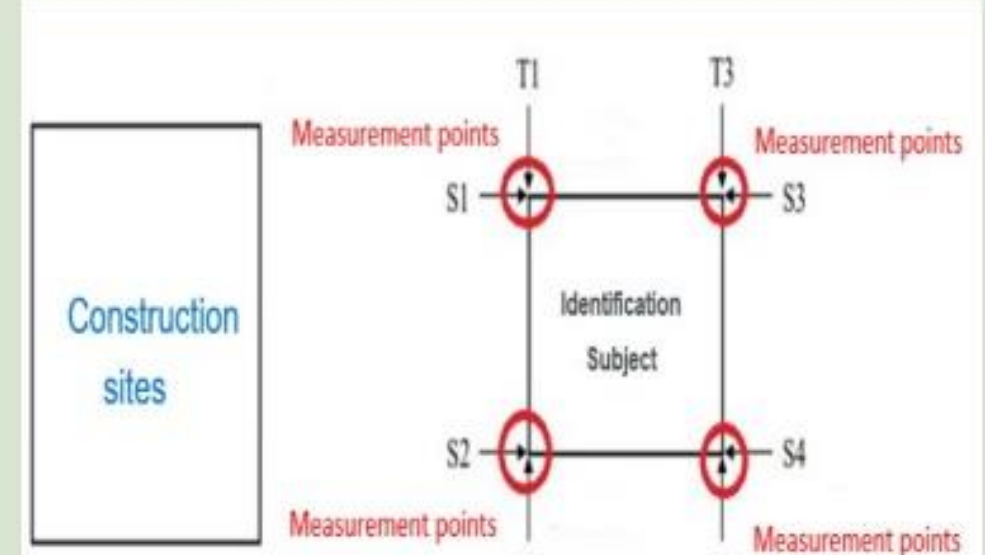
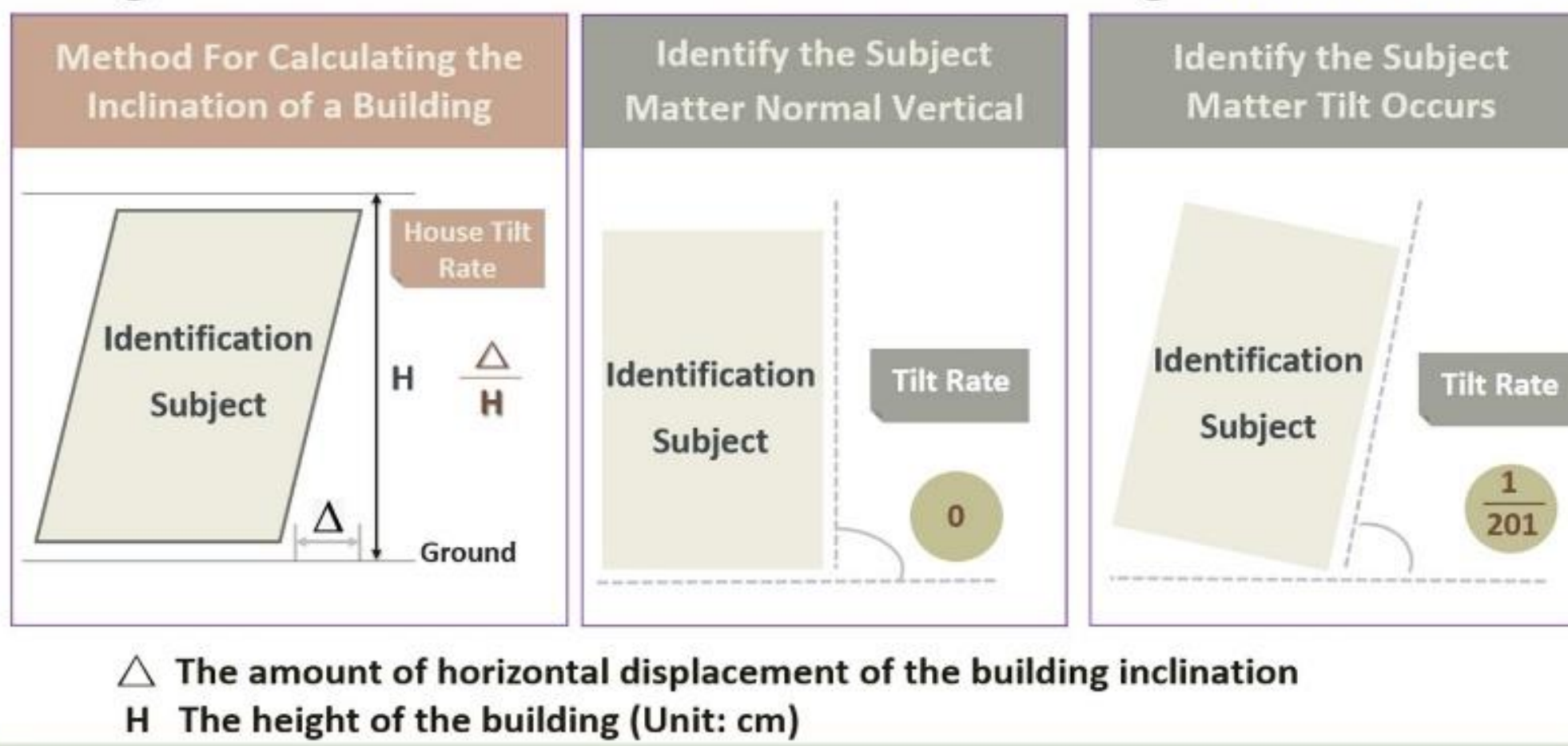
## Future Plan

1. Upgrade the App to a 3-in-1 tilt measurement tool that is also achieves four advantages: "Easy to learn", "Easy to conduct", "Is able to conduct it anytime and anywhere", and "Is able to spend less money".
2. Continue to collect data on soil liquefaction area construction, and conduct more extensive analysis and discussion.

## Discussion

1. Before that, we only discussed how to stabilize the new buildings which are located in the high soil liquefaction potential area, but how do we check if the old buildings with more than 30 years are stable enough?
2. We can check it through the self-developed APP as the reference information for the restoration or reconstruction of old buildings.

### Judgment of Inclination Rate of Old Buildings Over 30 Years



## Conclusion

1. Arouse public's attention to the building structural safety and foundation designs of buildings in high potential areas.
2. Develop an app to regularly detect changes in the inclination rate of old buildings, in order to prevent disasters and take preventive measures.

New Building Projects	Pile Foundation	Raft Foundation	Diaphragm Wall	Cross Wall	Barrette	Geological Improvement
Shilin MRT Station TOD	V	V	V	V	V	
Shilin Paper Mill Hotel		V	V	V	V	
Humble Stone	V	V	V			V