Current Practice

Feasibility study on using sheet pile as mitigation measure for road failure alongside of canal in Thailand

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Central part of Thailand is located in a river deposit soil which consists of a thick soft to very soft clay layer on the top deposit, namely Bangkok clay, underlain by stiff clay and sand layer. These types of soft soils are very sensitive to deformations and have low shear strength. Many parts of the central part area are utilized as agricultural zone. A road alongside of irrigation canal has been used for transportation of agricultural products from plantation to a market. However, some of irrigation canals are exploited as flood drainage. These misuse and low bearing capacity of soil were caused many failure of the road as shown in **Photo 1**. In addition, one of the main reason for road failure comes from water level inside a canal. During drought season, soil under canals show large settlement due to lowering of groundwater levels. In addition, slope of canal tends to increase due to water erosion. As a result, canal is vulnerable to collapse when water level is decreasing.

At present, mitigation measure that is employed to prevent the problems is construction of retaining wall between road pavement and canal as displayed in **Figure 1**. Combination of concrete pile with concrete sheet wall has been chosen for protecting of road slope failure (**Figure 2**). The length of concrete retaining wall is approximately 16 km and specification is shown in **Table 1**. However, some retaining walls were collapse during drought season due to slope failure of soil under canal. It can be said that an interlock force between concrete pile and concrete sheet pile is not enough to prevent a slope failure.

Steel sheet pile wall could be one of possible solution for permanently solving the problems. Use of steel sheet pile become popular because it is reusable. Furthermore, price of steel material tends to reduce in Thailand because there is more import from China and increasing number of manufacturers. The major advantage of this type of wall is it provides resistance during installation stresses. The sheets must be driven into the ground and they contain high resistance to the force of being driven down. The pile length is easily adaptable and can be welded or connected for suitable work.

Photo 1 Road settlement alongside of irrigation area canal

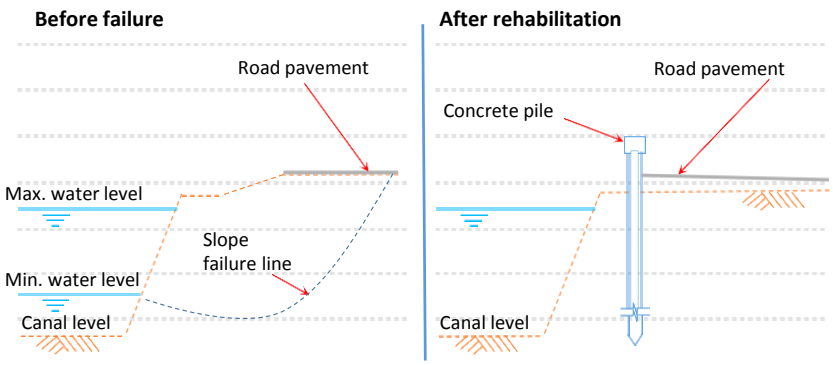


Figure 1 Typical section of roadway along a canal

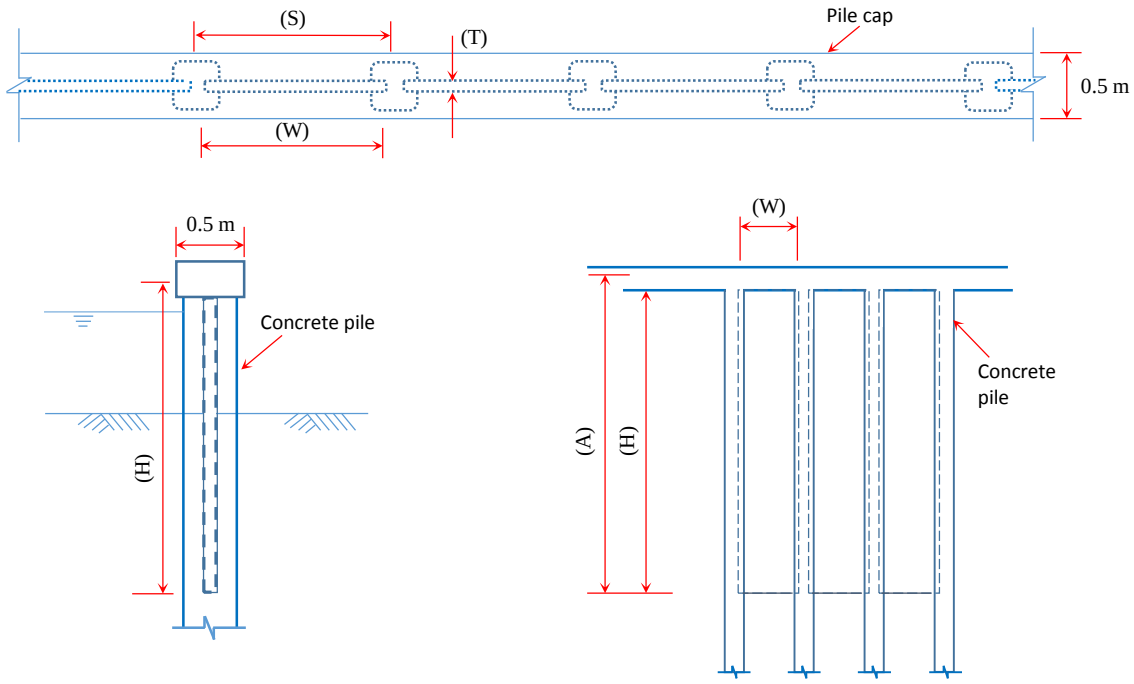


Figure 2 Detail of concrete retaining wall

Conventional methods for installation of steel sheet pile are percussion and vibratory. These methods produce noise and vibration to nearby existing structures or roadways. The vibration can cause fatigue or resonant frequency to structures and disturbance to the soil slope. As a result, it leads cracks to those structures or it will trigger a reduction of soil stability. In addition, these conventional methods require large working area for a machine and temporary platform. Occasionally, a nearby transportation system need to be shut down or rerouted for installation of retaining wall. Non-staging method or GRB system (Giken Reaction Base) proposed by Giken may be used to tackle these problems. This technique could construct retaining wall directly without any temporary platform.

Therefore, feasibility study has been performed. U steel sheet pile with 400mm width (typical size in Thailand) is selected to design for proposed retaining wall. Typical drawing of U sheet pile retaining wall is described in **Figure 3**. Long U sheet pile (L=15m) and short U sheet pile (L=6m) are connected alternatively. Long sheet pile is designed as structural element for resisting main lateral load and short sheet pile is designed as non-structural element for preventing water penetration.

Specification	Unit (m)		
	Type I	Type II	Type III
Size of concrete pile	40 x 40 cm	30 x 30 cm	40 x 40 cm
Length of concrete pile	9-15	9	9-15
Spacing of concrete pile (S)	1.00	1.00	1.00
Spacing for concrete (A)	5.30	5.30	5.30
Width of concrete sheet (W)	0.75	0.85	0.75
Height of concrete sheet (H)	5.00	5.00	5.00
Thickness of concrete sheet (T)	0.10	0.10	0.10

Table 1 Specification of typical concrete retaining wall

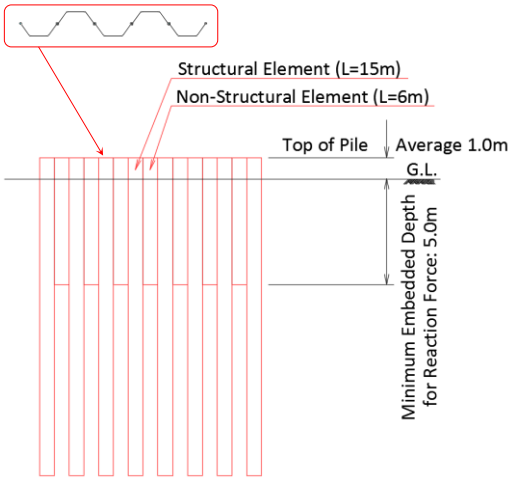
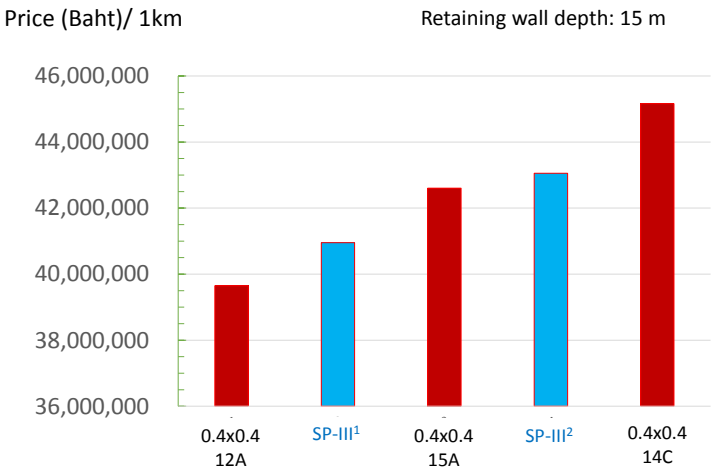


Figure 3 Drawing of U steel sheet pile wall (SP-III A)

	Description	Spacing (m)	Section Modulus Z (cm^3)	Section Modulus Z (cm^3/m)	Moment of inertia I		Elastic Modulus E x 10^8 (kN/m^2)	EI (kNm^2/m)
					(cm^4)	(cm^4/m)		
Concrete Retaining wall	0.40x0.40m	1,000	11,447	4,579	228,933	91,573	0.25	22,893
Steel sheet pile wall	SP-III A	400	-	760	-	11,400	2.10	23,940

Table 2 A comparison between concrete retaining wall and steel sheet pile wall

From **Table 2**, it could be seen that steel sheet pile wall can be used as substitute for concrete retaining wall because EI value of proposed steel sheet pile wall is higher than existing concrete retaining wall. Typical price of concrete retaining wall and steel sheet pile wall including material, workforce and instruments are summarized in **Figure 4**. Type of concrete pile retaining structure are divided by size of the pile, length of pile and quantity of reinforcement of pile cap. A price difference between SP-III[1] and SP-III[2] come from an approximately range of installation price by Silent Piler in Thailand. A comparison price shows that price of Steel sheet pile wall is between the highest and the lowest price of concrete retaining wall. Therefore, steel sheet pile wall could be considered as alternative solution to solve a collapse of concrete retaining wall during drought season. In addition, a restoration process of road failure due to wall collapse need to clear a slide pavement as shown in **Photo 2**. As the less requirement of temporary platform area for the Press-in Method, the installation of new retaining wall and remove of debris pavement during the restoration process can be conducted simultaneously which is the great benefit to the rehabilitation time. Finally, It is inevitable that an adverse effects caused by vibration and noise become more and more serious due to limited space, sloped working area and environmental concern. Silent technology is a promising solution that can handle these difficulties. As a result, there is an opportunity for Silent technology in the Thailand market.



Note: SP-III[1] for installation price = 400 baht/m²
SP-III[2] for installation price = 600 baht/m²

Figure 4 Comparison price between concrete retaining wall and steel sheet pile all

Photo 2 Restoration process of road settlement