Chapter 4

Inclined Interface Plate and Supporting System

A steel interface plate is designed and constructed to simulate inclined rock face near the retaining structure. As shown in Fig. 4.1, the plate and its supporting system are developed to fit in the NCTU non-yielding retaining-wall facility. The interface plate consists of two parts: (1) steel plate; and (2) reinforcement steel beams. The supporting system consists of the following three parts: (1) top supporting beam; (2) base supporting frame; and (3) fixing plate. Details of the interface plate and its supporting system are introduced in the following sections.

4.1 Inclined Interface Plate

4.1.1 Steel Interface Plate

A steel plate is 2.10 m-long, 1.497 m-wide, and 0.0045 m-thick as shown in Fig. 4.2 and Fig. 4.3. The unit weight of the steel plate is 76.52 kN/m^3 and its total mass is 110.34 kg (1.08 kN). A layer of anti-slip material (Safety-walk, 3M) is attached on the steel plate to simulate the friction that acts between the backfill and rock face as illustrated in Fig. 4.2 (a) and Fig. 4.3 (b). For the inclination angle $\alpha = 45^o$, the length of the interface plate should be at least 2.12 m. On the other hand, due to the soil bin of NCTU non-yielding wall facility is 1.5 m-wide, the steel plate has to smaller than it.

Based on these reasons, the steel plate was designed and constructed of 2.10 m-long and 1.497 m-wide so that the interface plate could be placed into the soil bin accurately.

4.1.2 Reinforcement with Steel Beams

To achieve an at-rest condition, the steel plate material should be nearly rigid. To simulate the hard rock face, and to increase the rigidity of the thin steel plate, the steel plate is reinforced with 5 × 8 steel L-beams of longitudinal and transverse directions to the back of steel plate. Section of the steel L-beam (65 mm × 65 mm × 8 mm) was chosen as the reinforced material. It was illustrated in Fig. 4.2 (b), Fig. 4.2 (c), and Fig. 4.3 (b). Due to the loading of backfill acts on the steel plate is the maximum for inclination angle $\alpha = 45^{o}$ in this investigation, the deflection of steel plate at longitudinal direction is estimated after reinforcement by moment-area method. Considered the backfill with a unit weight γ = 16.5 kN/m^3 and internal friction angle = 40.1° filled up to 1.5 m. Amount of plate deflection under loading is considered and estimated after reinforcement by Moment-area Method is about 0.002 m. Therefore the interface plate with reinforcement can be simulated as a hard rock face.

4.2 Supporting System

The steel interface plate must accurately fit into non-yielding retaining-wall facility of NCTU. To keep the steel interface plate stable, the supporting system was designed and constructed. The supporting system was composed of the following three parts: (1) base supporting frame; (2) top supporting beam; (3) fixing steel plate, as shown in Fig. 4.4 and Fig. 4.5. Top-view of the base supporting frame is illustrated in Fig. 4.6.

4.2.1 Top Supporting Beam

In Fig. 4.1 and Fig. 4.4, the top supporting steel beam is placed at the back of the interface plate and fixed on the fixing plates of the non-yielding wall. Details of top supporting beam are illustrated in Fig. 4.8. The section of supporting steel beam is 65 mm × 60 mm × 8 mm and its length is 1950 mm. Two fixing plates installed on walkway are used to fix the top supporting beam. The fixing plate is illustrated in Fig. 4.5 (a) and Fig. 4.6.

4.2.2 Base Supporting Frame

The base supporting frame placed on the base plate of the soil bin is shown in Fig. 4.7. The frame is 1.485 m-long, 1.2 m-wide, and 0.125 m-thick. Due to the variation of interface inclined angle α, the base supporting frame has to move toward or away from the wall. In Fig. 1.4, when α becomes larger (i.e. $\alpha = 80^{o}$), the base supporting frame must move near to the model wall. On the contrary, when α becomes smaller (i.e. $\alpha = 45^{o}$), to keep the interface plate hinged to the base of the wall, the frame have to move away from the model wall. In Fig. 4.7, the base supporting frame has four adjustable stands. By turning the screw rod attached to the adjustable stand, and spacing between supporting frame and the end wall.

4.3 Different Interface Inclinations

Different interface inclinations associated with this investigation are shown in Fig. 4.9 to Fig. 4.13. Fig. 4.9 shows the test condition for inclination angle $\alpha = 0^{o}$. Ottawa sand was pluviated into the soil bin without using the interface plate and supporting system. Fig. 4.10 to Fig. 4.13 show the arrangement of interface plate and backfill conditions for $\alpha = 45^{o}$, 60^{o}, 70^{o} and 80^{o}.