Chapter 4

VERTICAL INTERFACE PLATE AND SUPPORTING SYSTEM

To study the earth pressure on the retaining wall near a rock face, a vertical interface plate was developed to fit in the non-yielding retaining wall facility of NCTU. The system consists of two parts: (1) steel interface plate; and (2) supporting system. Details of the interface plate and supporting system are described in section 5.1 and section 5.2, respectively. Process and steps to install the interface plate to the NCTU non-yielding wall facility are also introduced in this chapter.

4.1 Vertical Interface Plate

To simulate a vertical rock face, a vertical steel interface plate covered with a layer of Safety-Walk (anti-slip material) was designed and constructed. Details of the vertical interface plate are described as follows.

4.1.1 Steel Interface Plate

The steel interface plate in Fig. 4.1 is 2.1 m-long, 1.497 m-wide, and 4.5 mm-thick. To simulate the hard rock face, and to increase the rigidity of the thin steel plate, 5 ╳ 8 steel L-beams in longitudinal and transverse directions to the back of steel interface plate as shown in Fig. 4.1(b) and Fig. 4.2(b). The width and height of the soil bin of NCTU non-yielding wall facility is 1.5 m and 1.6 m (Fig. 3.1). The steel interface plate was designed to be 1.497 m-wide so that the plate could be placed into the soil bin accurately. For all experiment in this thesis, the length of the interface plate should be at least 1.5 m. The unit weight of the steel used is 76.52 kN/m^3 and total mass of the steel interface plate is 110.344 kg (1.08 kN). As shown in Fig. 4.2(a), the surface of the steel interface plate was covered with a layer of Safety-Walk to simulate the friction on the rough rock face.

4.1.2 Steel Beam Reinforcement

As illustrated in Fig. 4.1(b) and Fig. 4.2(b), to reduce the deflection occurring on the steel interface plate, five and eight steel L-beams were reinforced at longitudinal and transverse directions at the back of steel interface plate. Section of the steel L-beam is 65 mm × 65 mm × 8 mm.

Considered the backfill with a unit weight γ = 15.6 kN/m^3 and an internal friction angle ϕ = 31.3° filled up to 1.5 m. Based on Jaky's formula, assuming the resultant forces P_o = 5.62 kN/m acting at the elevation of 0.3H above the wall base. The maximum deflection of the reinforced interface plate under the lateral loading is estimated by the Moment-area Method is about 1.87 mm. This deflection is equal to only 0.12% of the wall height H.

4.2 Supporting System

To ensure the interface plate to remain vertically and stable, supporting system behind the steel plate was developed. The supporting system consists of the following three parts: (1) top supporting beam; (2) base supporting frame; and (3) base spacing plate.

4.2.1 Top Supporting Beam

In Fig. 4.3(a) and (b), the section area of the top supporting beam is 65 mm × 65 mm × 8 mm and its length is 1950 mm. In Fig. 4.3(c), the beam is placed at the back of the interface plate and it is fixed on the fixing steel plate on the soil bin with screws.

The top supporting beam and the interface plate are connected with a C-clamp to keep the interface plate vertical.

4.2.2 Base Supporting Frame

In Fig. 4.4(a) through (b), four types of base supporting frames were fabricated to achieve different spacing d between interface plate and model wall. Dimension of the frames includes: (1) 1487 × 1210 × 125 mm; (2) 1467 × 845 × 125 mm; (3) 1195 × 297 × 125 mm; and (4) 1195 × 130 × 125 mm. Among the four base supporting frames, the 1195 × 297 × 125 mm frame shown in Fig. 4.4(f) has no adjustable stand. It is to be used with the other three base supporting frames to achieve the desired base supporting distance. In Fig. 4.5, with the spacing d = 900 mm, the spacing between the interface plate and the end wall is 555 mm. Neither frame is appropriate to support the base of the interface plate. Under this situation, the combination of the 1195 × 297 × 125 mm and 1195 × 130 × 125 mm frames are adopted. By turning the screw rod attached to the adjustable stand, base supporting frame can be moved toward or away from the wall to achieve the desired distance between the end wall and the interface plate.

4.2.3 Base Spacing Plate

To ensure the spacing d between the interface plate and model wall, and to keep the interface plate vertical, base spacing plates are placed between the wall and the interface, as shown in Fig. 4.6. Fig. 4.7 shows the dimensions of the base spacing plates. Plates used for this study include four pieces of 100 × 50 × 17.5 mm, three pieces of 300 × 200 × 17.5 mm, two pieces of 500 × 400 × 17.5 mm, and two pieces of 700 × 400 × 17.5 mm base spacing plates. For different spacing d desired for this study, a combination of the four types of base spacing plates could be arranged. Fig. 4.7 shows, for the spacing d = 900 mm between the wall and interface, two 300 × 200 × 17.5 mm and two 700 × 400 × 17.5 mm spacing plates are arranged to achieve the desired spacing d = 900 mm. With the help of base supporting frame and base spacing plated, the interface plate would remain vertical and stable during testing.

4.3 Procedure to install Interface Plate

Typical steps to install the interface plate into the soil bin, for example d = 900 mm, are described as follows.

1. In Fig. 4.6, 32 holes were drilled on the two fixing plates attached to the soil bin. Through the holes, the top supporting beam is connected as the top support for the interface plate.
2. As illustrated in Fig. 4.5, 1195 × 297 × 125 mm and 1195 × 130 × 125 mm base supporting frames are placed between the end wall and the interface plate.
3. As shown in Fig. 4.8, two 300 × 200 × 17.5 mm and two 700 × 400 × 17.5 mm base spacing plates are placed between the model wall base and the interface plate.
4. Hoist the interface plate and put in into the soil bin carefully, then connect the interface plate to the top supporting beam with a C-clamp.
5. Rotating the adjustable stands to push the base supporting frame toward the interface plate until the frame can not move. Now the interface plate is confined horizontally by the base spacing plate and base supporting frame.
6. The interface plate is 1497 mm-wide and the soil bin is 1500 mm-wide, there is a 3 mm-interval existing between the interface and side-wall. In this study, papers are folded and stuffed into the interval to prevent the soil leaking through the interval. The plastic sheets hung on the side-wall bent toward the interface plate is also an effective method to prevent backfill leaking.
7. Two side walls of the soil bin are lubricated with plastic-sheets to simulate the plain strain condition, as shown in Fig. 4.9.
8. Dry Ottawa sand is filled into the soil bin up to 1.5 m, and earth pressure is

measured by the soil pressure transducers on the model wall. Test results regarding the earth pressure at-rest near a rough rock surface is obtained.

4.4 Different Distances d between Interface Plate and Model Wall

To estimate the effects of a nearby rock face on earth pressure at-rest near a vertical rock face, different spacing d between the interface plate and model wall are investigaed. Variation of spacing d of 1500, 1100, 900, 700, 500, 400, 300, 200, 100, and 50 mm are adopted for this study (Fig. 4.10). Fig. 4.11 shows the arrangement for the maximum spacing d = 1500 mm and Fig. 4.12 shows that for the minimum spacing d = 50 mm. For loose sand, experiments were conducted for spacing d = 1500 to 50 mm. For compacted sand, due to the width of the compactor plate (90 mm), experiment were conducted for d = 1500 to 100 mm only.