Technical data PF19004
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Burial Strength for EFLEX Square

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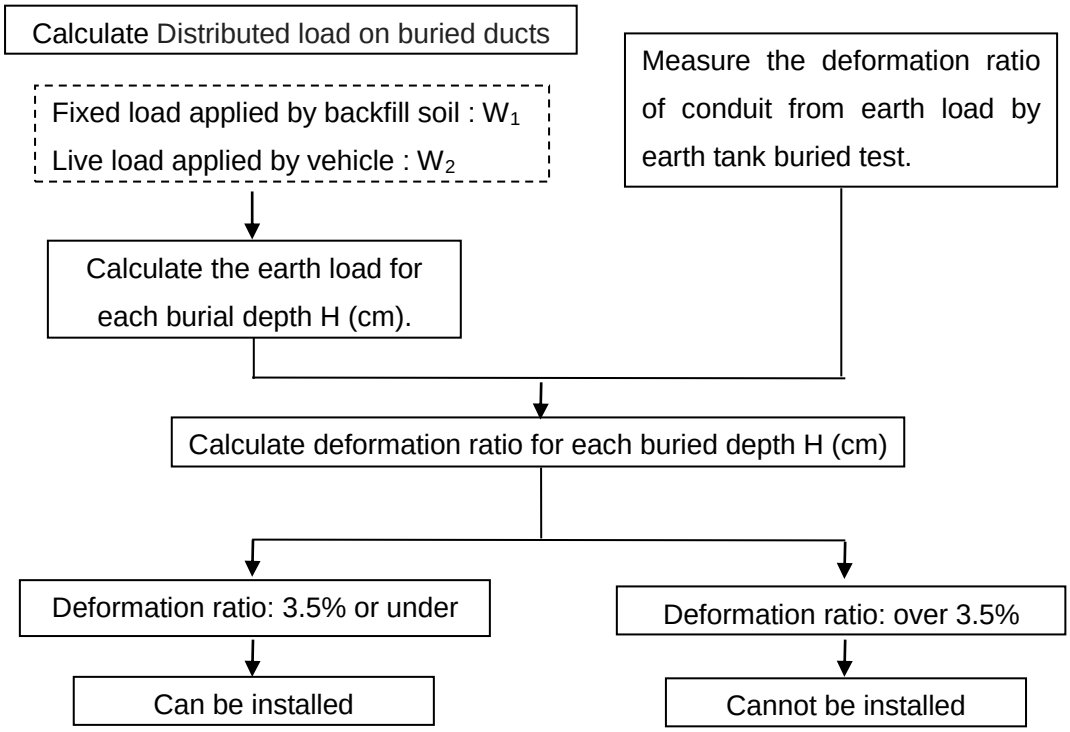
This report is the strength of EFLEX Square when buried.

1. Process to judge if the EFLEX Square can be installed underground.

The process, to judge if ducts can be installed underground or not by calculating the deformation ratio for each burial depth H (cm), is shown as below. Allowable deformation rate which is 3.5% is based on the strength evaluation standard written in “JIS C3653 Annex 3”.



2. How to calculate the distributed load on buried EFLEX Square

Distributed load on buried EFLEX Square is calculated based on the manual written in “Electric wire common groove” issued by Road Management Technology Center

(1) Fixed load by back fill soil

$$W_1 = \gamma \cdot H$$

W_1 : Fixed load applied by back fill soil (kPa)

γ : Unit Weight 18.62(kN/m^3)

H : Burial depth (m)

(2) Live load by vehicle

Vehicle is stated as 25 ton truck and whose specification is as below Table 1. And impact coefficient is stated as 0.4 when burial depth is less than 1m or 0.3 when burial depth is more than 1m considering the impact from live load.

Table 1. Specification of load from vehicle

Load	Total Load W (tf)	Axle load by one rear wheel (kN)	Wheel load by one rear wheel (kN)	Distance of adjacent axle (m)	Ground contact width of rear wheel b (m)	Ground contact Length of rear wheel a (m)
T25	25	98	49	1.3	0.5	0.2

Distributed load of live load (earth load) is calculated from burial depth using following formula.

1) Distributed load with burial depth is 0.4m or under

$$W_2 = \frac{P}{(2H+a)(2H+b)}$$

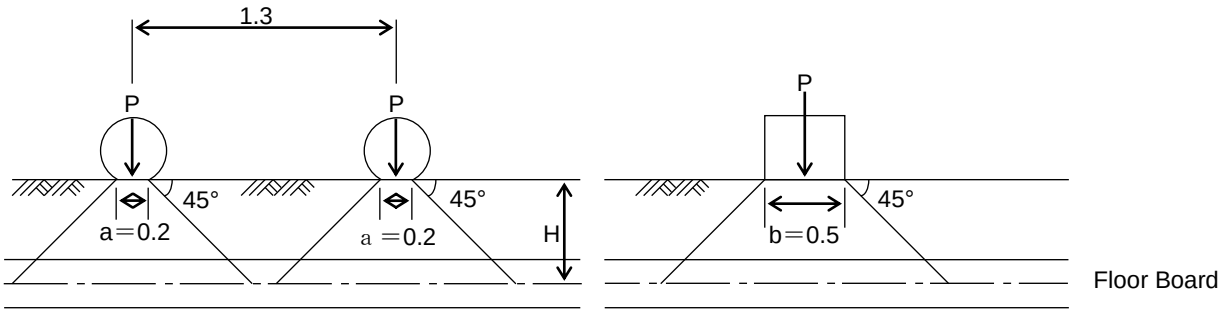
W_2 : Live load by vehicle (kPa)

P : Wheel load by one rear wheel × (1+Impact coefficient)

a : Ground contact Length of rear wheel (m)

b : Ground contact width of rear wheel (m)

H : Burial depth (m)

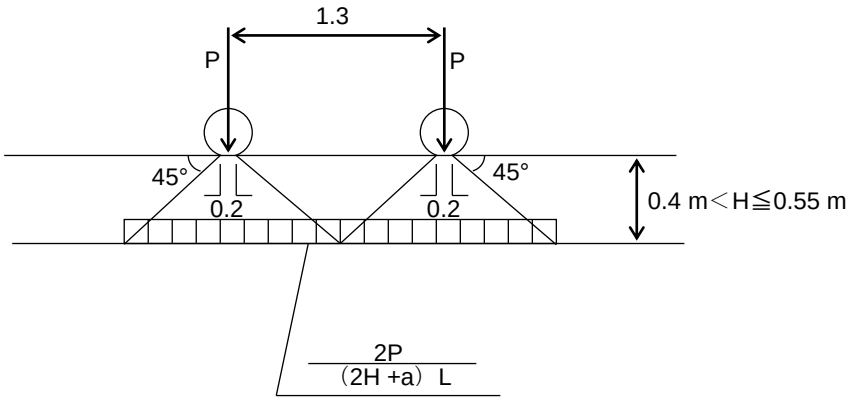


2) Distributed load with burial depth between 0.4m and 0.55m.

$$W_2 = \frac{2P}{(2H + a) \cdot L}$$

L：Vehicle occupancy width　2.75　(m)

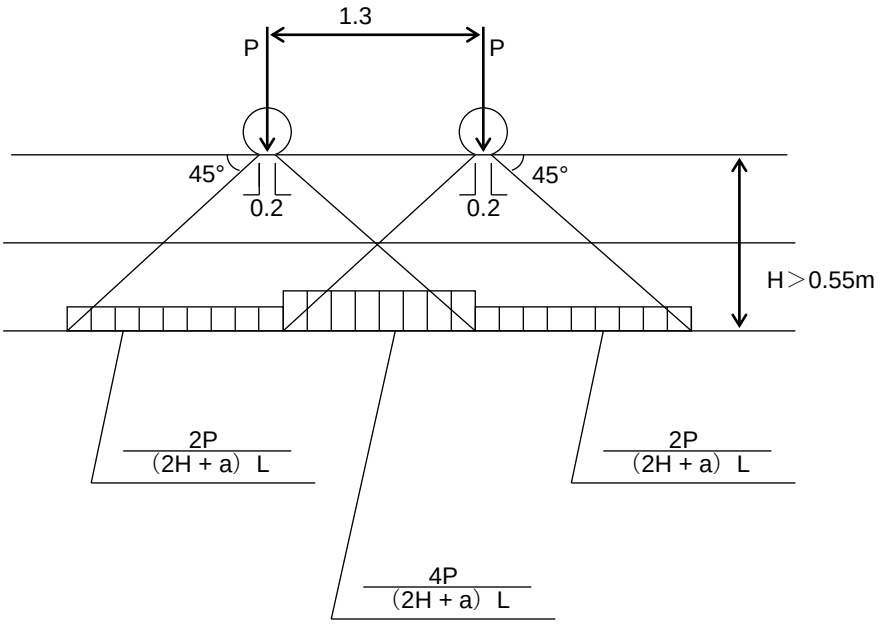
Burial Depth: 0.4m ~ 0.55m



3) Distributed load with burial depth over 0.55m and load of each adjacent axle are overlapped.

$$W_2 = \frac{4P}{(2H + a) \cdot L}$$

Burial Depth: 0.55m or over



3. Earth pressure for each burial depth

Earth load for each burial depth is shown as below Table 2. following the calculation in clause 2. And earth load whose safety ratio S is 3 is shown in Table 2.

Table 2. Burial Depth and Earth load

Burial Depth 〔m〕	Fixed load (1) 〔kPa〕	Live load (2) 〔kPa〕	Earth load when 25 ton truck is driving over ((1)+(2)) 〔kPa〕	Earth load when 25 ton truck is driving over((1)+(2)) (Safety ratio S=3) 〔kPa〕
0.3	5.6	78.0	83.6	250.8
0.4	7.4	52.8	60.2	180.6
0.5	9.3	41.6	50.9	152.8
0.6	11.2	71.3	82.5	247.5
0.8	14.9	55.4	70.3	211.9
1	18.6	42.1	60.7	182.1
1.2	22.3	35.6	58.9	173.8
1.5	27.9	29.0	56.9	170.7
2	37.2	22.1	59.3	177.9
2.5	46.6	17.8	64.4	193.2
3	55.9	14.9	70.8	212.4
3.5	65.2	12.9	78.1	234.3
4	74.5	11.3	85.8	257.4
4.5	83.8	10.1	93.9	281.8
5	93.1	9.1	102.2	306.6

4. Measuring deformation ratio from earth load by burial test using earth tank

1) Purpose

To measure compressive strength of EFLEX Square by earth load.

2) Test method

1. Lay sand below the duct and compact it inside the earth tank.
2. Install the duct on the sand.
3. Cover the sand with 300mm thickness from top of the duct and compact it.
4. Put the loading board made of metal on the loading surface.
5. After applying a load, measure the earth load and deformation ratio.

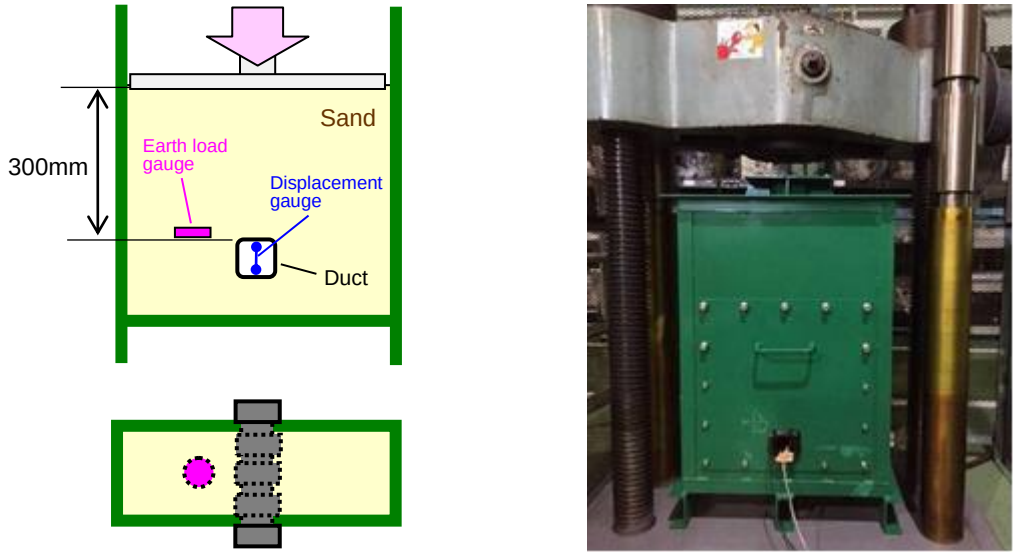


Figure.1 Test method

3) Test sample

EFLEX Square φ 50, 81, 100, 130 and 150.

4) Test result

Deformation ratio of EFLEX Square by earth load are shown in Figure.2, 3, 4, 5 and 6.

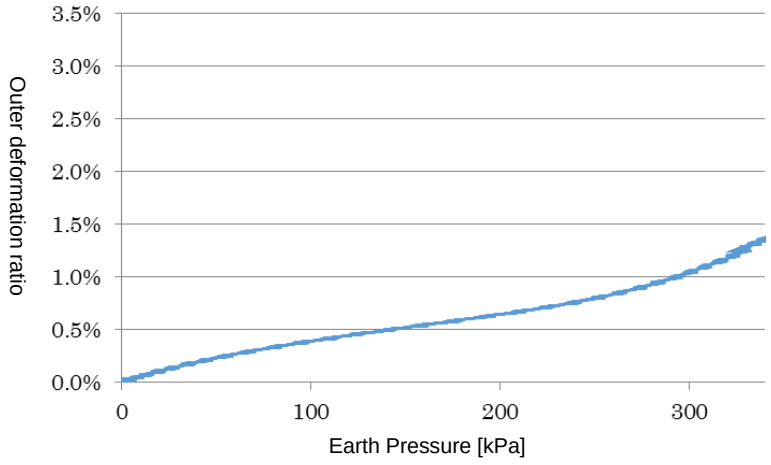


Figure.2 φ50 test result

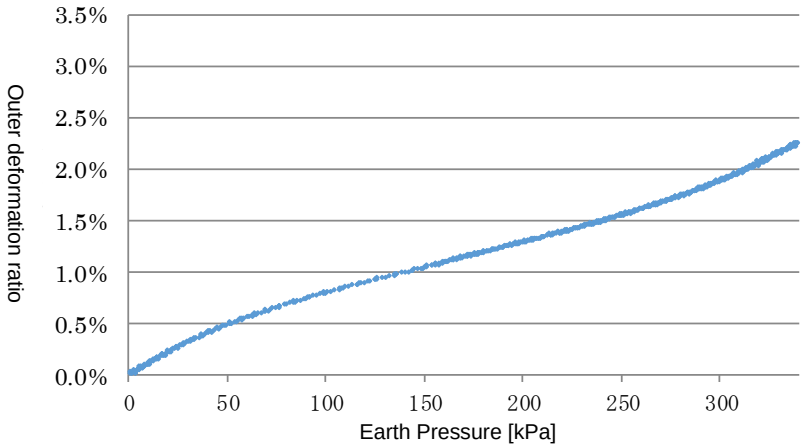


Figure.3 φ81 test result

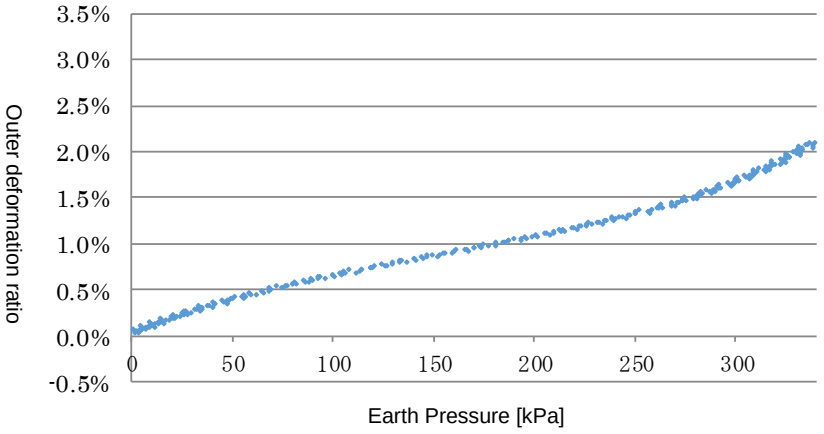


Figure.4 φ100 test result

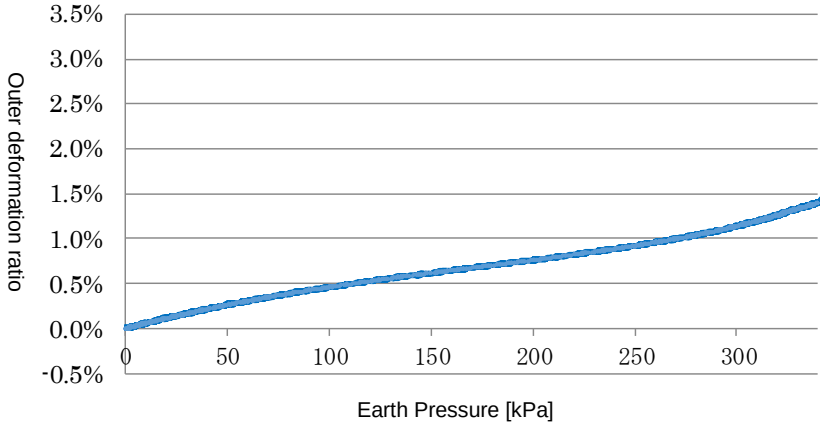


Figure.5　φ130 test result

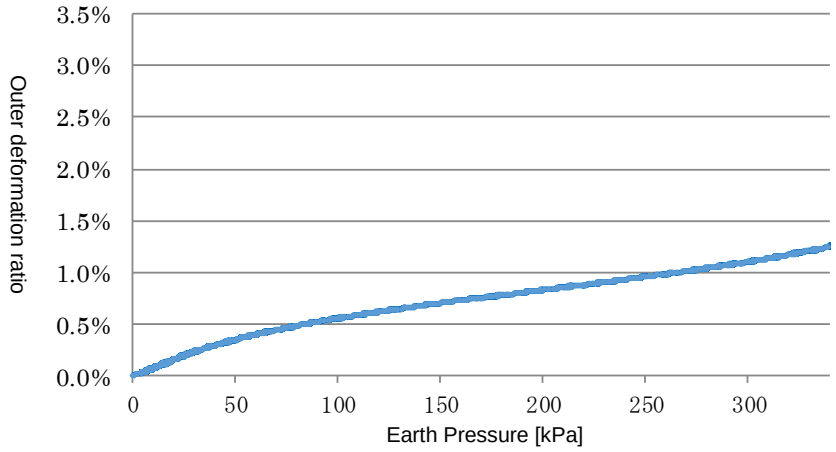


Figure.6　φ150 Test result

5. Strength of EFLEX Square when buried.

Deformation ratio for each burial depth when 25 ton truck running over, are shown in below Table 3. Referring Table 3. , it can be judged that it is ok to install the EFLEX Square in burial depth between 0.3m to 5.0m. This is because deformation ratio in this range are under 3.5%. (However, if the road is covered by pavement, burial depth have to be measured from the bottom side of pavement and must be 0.3m or over.)

Table 3. Burial Depth and Deformation ratio

Burial Depth	Vertical earth load when 25 ton truck running over (Safety ratio S=3)	Deformation Ratio (%)				
〔m〕	〔kPa〕	φ50	φ81	φ100	φ130	φ150
0.3	250.6	0.8	1.6	1.3	0.9	1.0
0.4	180.7	0.6	1.2	1.0	0.7	0.8
0.5	152.7	0.5	1.1	0.9	0.6	0.7
0.6	247.3	0.8	1.5	1.3	0.9	1.0
0.8	211.0	0.7	1.3	1.1	0.8	0.9
1	182.2	0.6	1.2	1.0	0.7	0.8
1.2	173.9	0.6	1.2	1.0	0.7	0.8
1.5	170.7	0.6	1.2	1.0	0.7	0.8
2	177.9	0.6	1.2	1.0	0.7	0.8
2.5	193.1	0.6	1.3	1.1	0.7	0.8
3	212.4	0.7	1.4	1.1	0.7	0.9
3.5	234.1	0.7	1.5	1.3	0.9	0.9
4	257.3	0.8	1.6	1.3	1.0	1.0
4.5	281.6	0.9	1.8	1.5	1.0	1.0
5	306.6	1.0	1.9	1.7	1.2	1.1

<Reference> Deformation Ratio of the EFLEX Square with multi stack

Deformation Ratio of the EFLEX Square with multi stack is tested with same way referred in clause 4. At this test, it is found out that deformation ratio with multi stack is smaller than one with single stack. This means, as long as it is evaluated with single stack, there will be no problem when installed with multi stack.