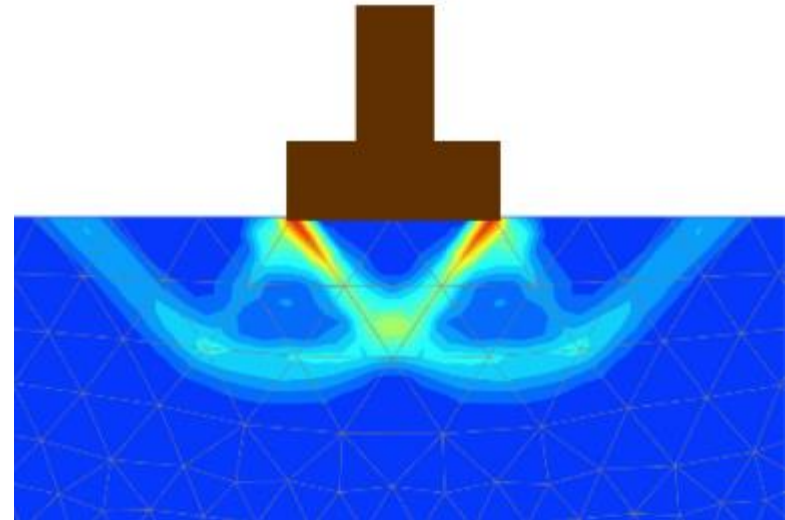


플랜트토목설계팀 기술개발과제

HGEO-FDN 전파 교육

플랜트토목설계팀



2022.12.19.

1. HGEO-FDN

2. Program Tutorial Manual

1) 직접기초

2) 말뚝기초

3) Micro Pile

3. Program Status

가장 사용하기 쉽다는 것이 가장 만들기 어렵다.



플랜트 토목 이란 ??

- 상부 플랜트 설비의 설치를 위한 준비 작업
- 땅을 정리하고, 길을 내고, 각종 설비의 기초와 철골에 대한 설계와 시공

우리 현엔 플랜트토목설계팀은 ??

- 상부 설비의 안전한 설치를 위한 Steel Structure & Concrete Foundation 설계 → 세계 1등.
- 그러나 Foundation의 지지력 → 지반조사보고서 혹은 지반팀에서~~

HGEO-FDN의 목적은 ??

- 통상적인 토목설계를 일시에!! 일괄적으로!! : One Stop Design
- 간단한 지반조사 자료만 있으면 직접기초/말뚝기초의 지지력은 자동적으로!! : Auto Calculated Foundation
- 모든 팀원이 동일한 지반 조건이면 동일한 지지력을!! : Uniform Process

1. HGEO-FDN

HGEO-FDN은 진짜 왜 ??

지금 우리에게 지반조사 결과만 있다.

그런데 직접기초 사이즈별 근입심도별 지지력이 얼마야 ?
그런데 말뚝기초 형식별 사이즈별 지지력이 얼마야 ?

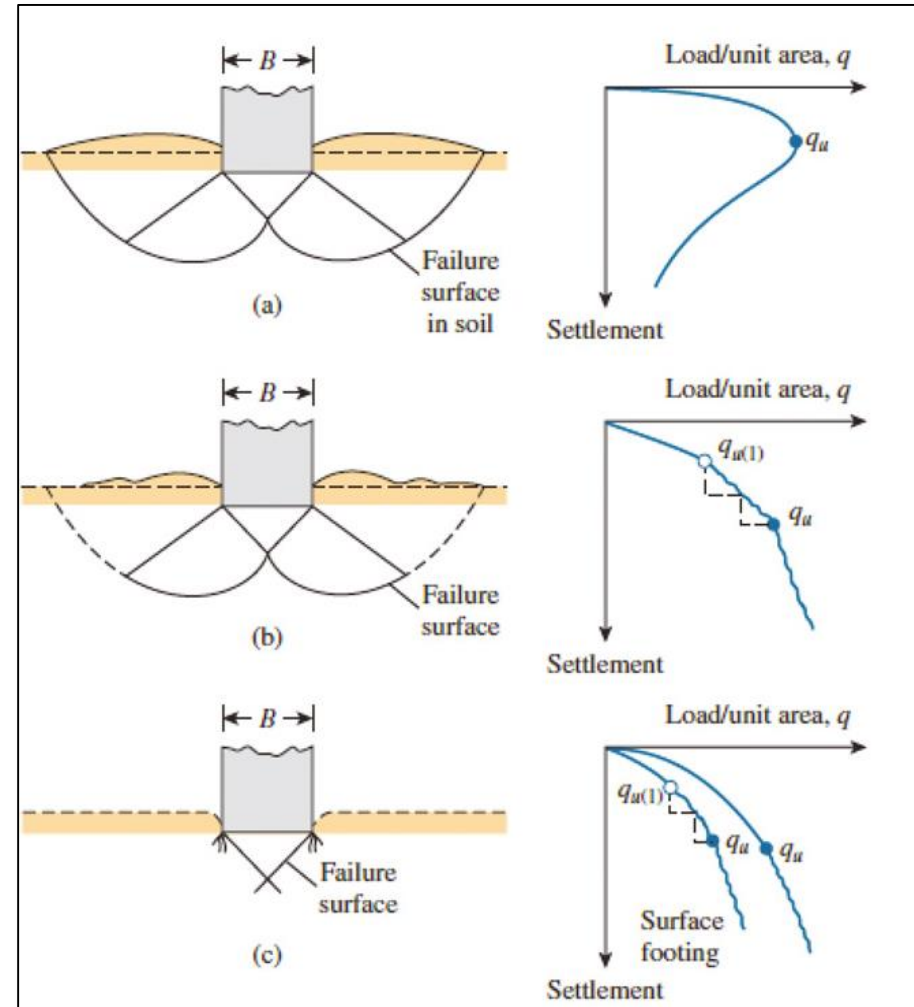
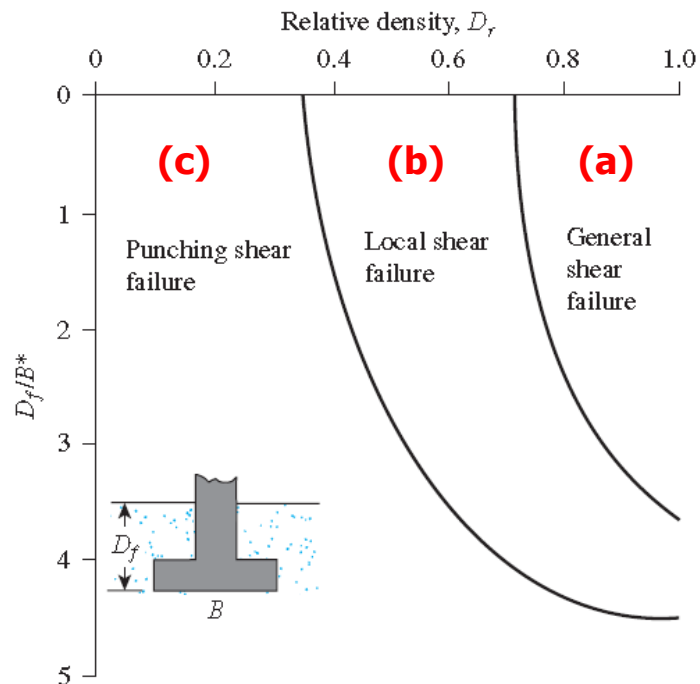


그럼 HGEO-FDN 돌려봐~~!!

직접기초 지지력 산정

■ 직접기초의 지지력 산정방법 선정 @@

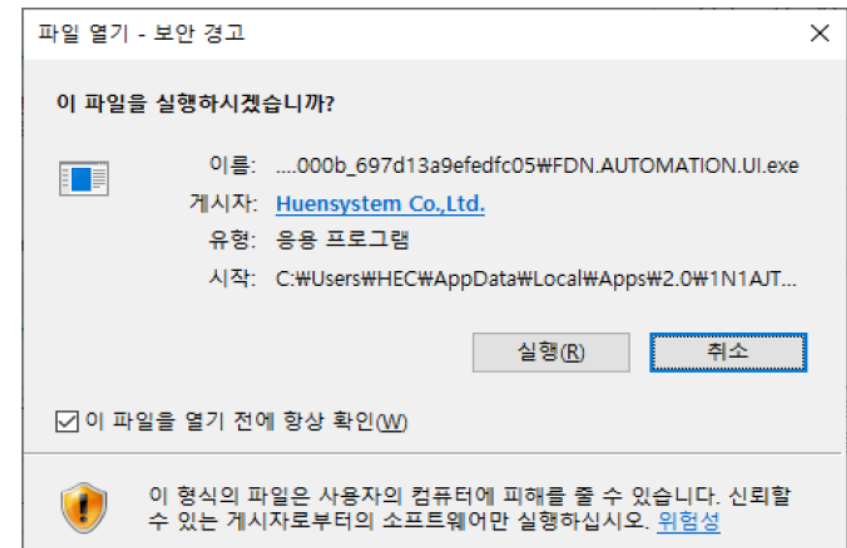
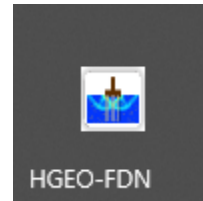
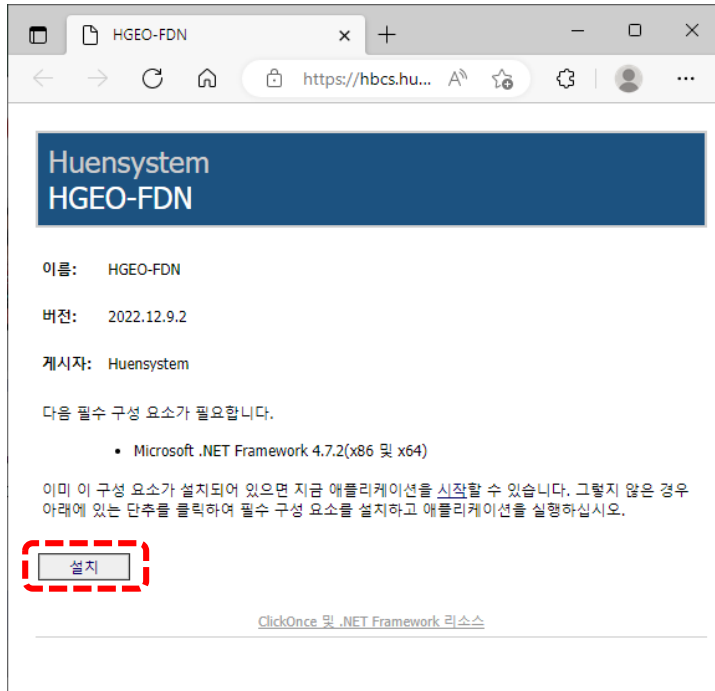
- Terzaghi (1943)
- Meyerhof (1963)
- Hansen (1970)
- Vesic (1975) etc.



2. Program Tutorial Manual

Program START

- 제작업체인 휴엔시스템 서버 접속 필요 : <http://hbcs.huen.biz>



2. Program Tutorial Manual

Program 돌려보기

■ Sample 지반조사

Tỷ lệ Scale	Lớp Layer	Chiều dày Thickness (m)	Độ sâu Depth (m)	Cao độ Elevation (m)	Mẫu và thí nghiệm SPT Sample and Standard Penetration Test				Địa tầng Stratigraphy	MÔ TẢ DESCRIPTION	
					Ký hiệu Symbol	Độ sâu(m) Depth(m)	Giá trị SPT SPT Value	Biểu đồ / Chart of N30 10 20 30 40 50			
1	1A	3.50			SPT1	1.0-1.45	4/6/7 N30=13	13		Clay Layer GL(-) 0.0~5.0m	
2					U1	1.6-2.00					
3					SPT2	2.0-2.45	3/6/8 N30=14	14			
4	2	2.20	3.50	2.25	SPT3	3.0-3.45	5/7/9 N30=16	16			
5					U2	3.6-4.00					
6					SPT4	4.0-4.45	3/3/4 N30=7	7			
7	4	7.30	5.70	0.05	SPT5	5.0-5.45	3/4/4 N30=9	9		Sand Layer GL(-) 5.0m ~	
8					U3	6.1-6.50					
9					SPT6	6.5-6.95	3/5/8 N30=13	13			
10					U4	7.8-8.00					
11					SPT7	8.0-8.45	6/8/10 N30=18	18			
12					U5	9.3-9.50					
13					SPT8	9.5-9.95	5/7/10 N30=17	17			
14					U6	10.6-11.00					
15					SPT9	11.0-11.45	7/10/13 N30=23	23			
16			13.00	-7.25	U7	12.3-12.50					
17					SPT10	12.5-12.95	9/16/21 N30=37	37			
18					U8	13.8-14.00					
19					SPT11	14.0-14.45	22/58/50 N30>100	>50			
20					U9	15.3-15.50					
21					SPT12	15.5-15.95	27/82/50 N30>100	>50			



Sample BH-47

2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ 직접기초 지지력 계산

지지력과 지내력

구 분	지 지 력[支 持 力] Bearing Capacity OR Bearing Power	지 내 력[地 耐 力] Bearing Capacity of Soil
정 의	- 지반 또는 말뚝 등이 지지할 수 있는 최대하중, 또는 하중강도로서 극한지지력이라고도 한다. - 한마디로 모든 물체의 극한지지력	- 지반이 구조물에 피해를 주지 않는 정도의 침하량에서 버틸 수 있는 지지력, 즉 허용지지력을 말한다. - 한마디로 땅의 허용지지력
용어사례	말뚝(깊은 기초)의 지지력(o) 말뚝의 지내력(x)	얕은 기초의 지내력(o) 얕은 기초의 지지력(o)

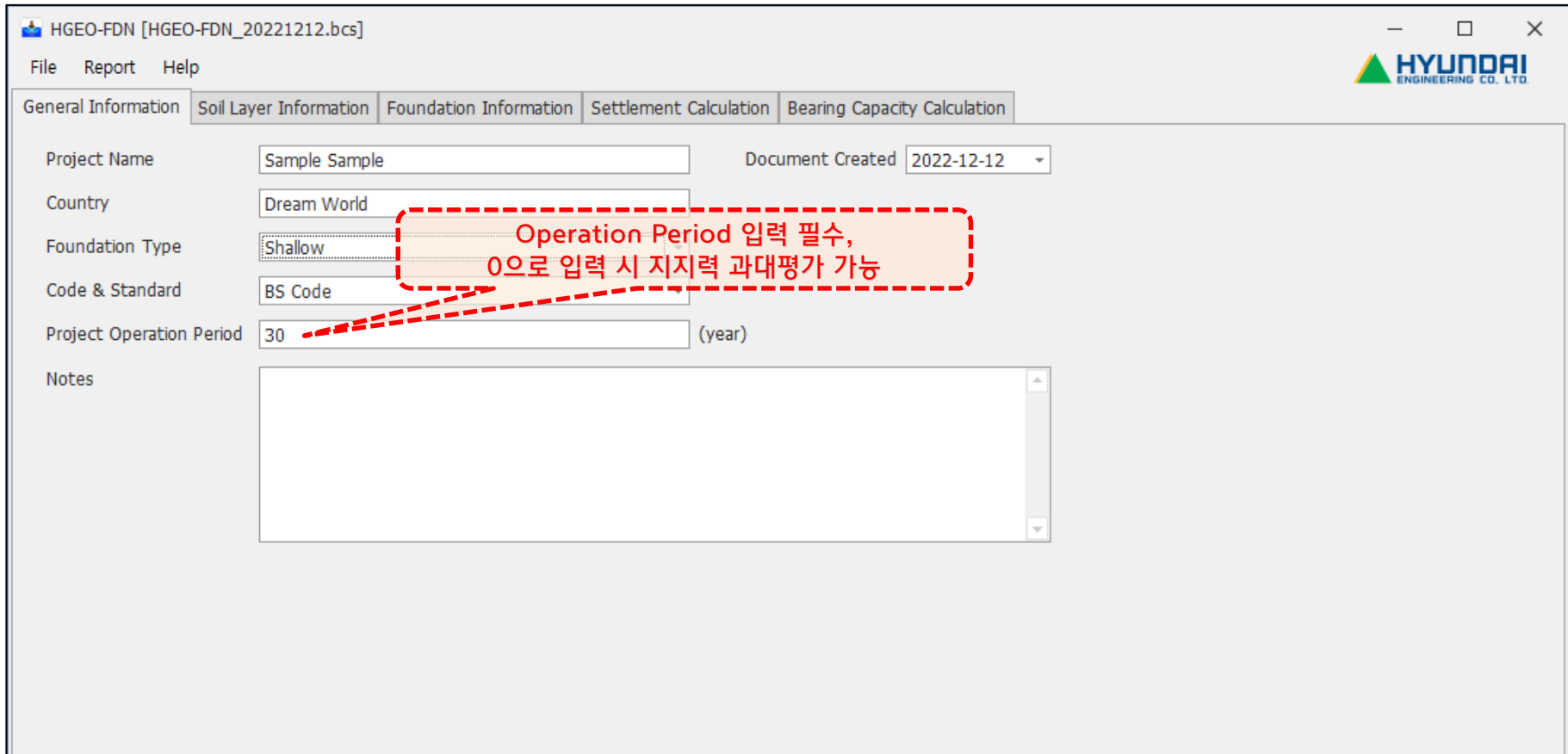
HGEO → 우리 부서는 지지력 뿐만 아니라 허용 침하에 대한 안정성도 함께 고려해야 하기 때문에 지내력 개념으로 설계 진행.

2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ General Information

HGEO → Foundation Type > Shallow 로 선택.



HGEO-FDN [HGEO-FDN_20221212.bcs]

File Report Help

General Information | Soil Layer Information | Foundation Information | Settlement Calculation | Bearing Capacity Calculation

Project Name: Sample Sample Document Created: 2022-12-12

Country: Dream World

Foundation Type: Shallow

Code & Standard: BS Code

Project Operation Period: 30 (year)

Notes:

Operation Period 입력 필수,
0으로 입력 시 지지력 과대평가 가능

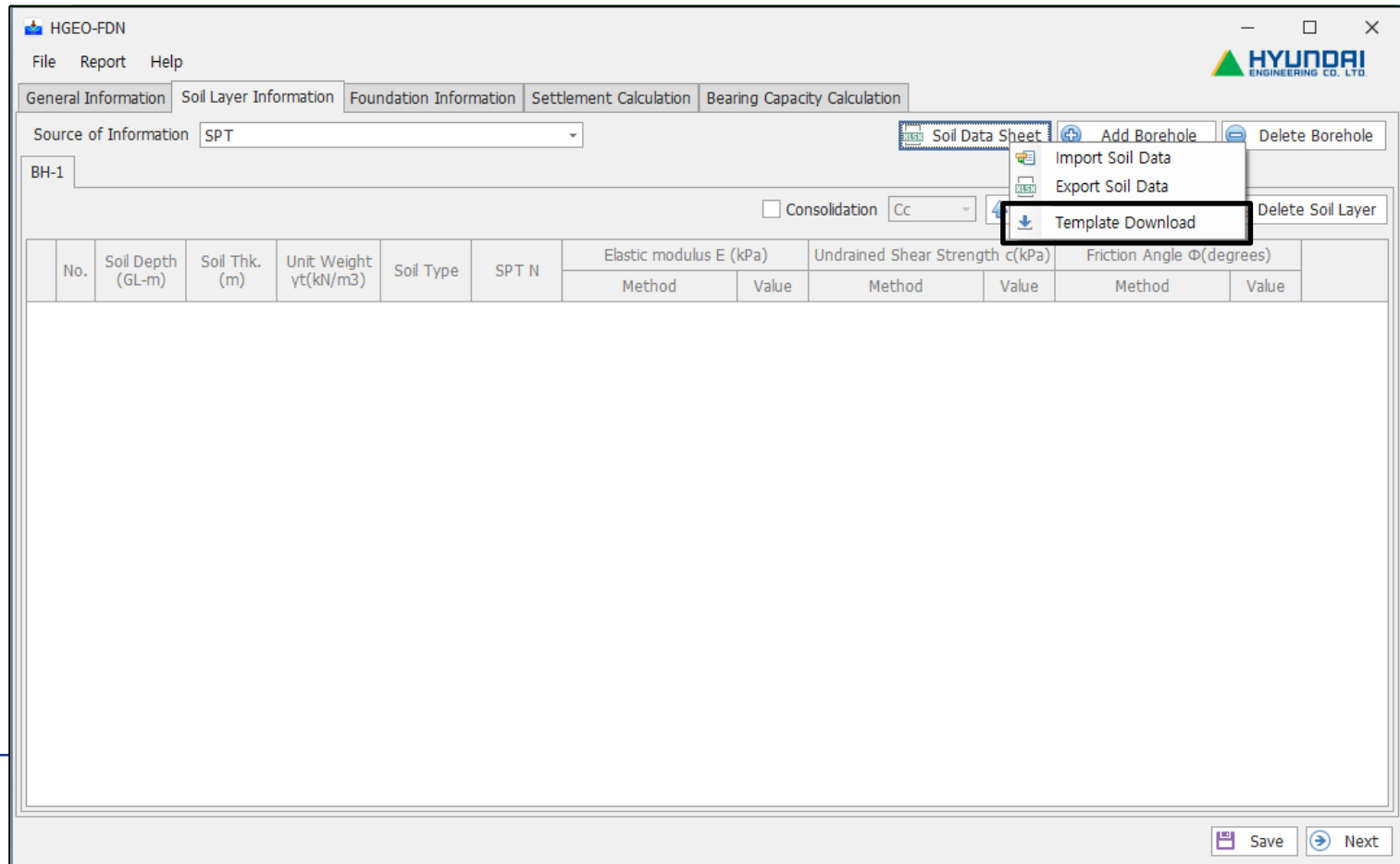
HGeo-FDN [HBCS_직접기초.bcs]
 File Report Help
 General Information Soil Layer Information Foundation Information Settlement Calculation Bearing Capacity Calculation
 Source of Information SPT
 BH-1
 Soil Data Sheet Add Borehole Delete Borehole
 Consolidation Cc Add Soil Layer Delete Soil Layer
 Change Borehole Name
 Change Borehole Name
 Borehole Name BH-47
 Apply Cancel
 Save Completed!
 일부 프로젝트에서 압밀침하를 고려한 지지력 평가 수행되어 이에 대한 기능을 추가되었음(즉시침하 + 압밀침하 ≤ 25mm)
 다만, 압밀침하의 경우 계산 과정보다 지반정수 판정이 더욱 중요한 사항이므로 지반그룹 검토가 필요한 사항임
 연약지반 출현 → 반드시 지반그룹에 검토 의뢰

2. Program User Manual

Program 둘러보기 – 1) 직접기초

■ Soil Layer Information

HGEO → Soil Data Sheet 탭에서 Borehole Template 다운로드 → No., Soil Depth, Unit Weight, Soil Type, SPT N 입력하여 저장 → 프로그램 내에서 Import하여 Borehole data 입력 가능



HGEO-FDN

File Report Help

General Information **Soil Layer Information** Foundation Information Settlement Calculation Bearing Capacity Calculation

Source of Information SPT

BH-1

☐ Consolidation Cc

Soil Data Sheet Add Borehole Delete Borehole

Import Soil Data

Export Soil Data

Template Download

Delete Soil Layer

No.	Soil Depth (GL-m)	Soil Thk. (m)	Unit Weight γ_t (kN/m ³)	Soil Type	SPT N	Elastic modulus E (kPa)		Undrained Shear Strength c(kPa)		Friction Angle Φ (degrees)	
						Method	Value	Method	Value	Method	Value

Save Next

2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ Foundation Information

HGEO → 우리 부서에서 실제 적용하는 기초의 폭(B) & 길이/폭 비율(L/B Ratio) & 근입심도(Df)에 대한 Comb. 적용 가능

HGEO-FDN [HGEO-FDN_20221212.bcs]

File Report Help

General Information | Soil Layer Information | **Foundation Information** | Settlement Calculation | Bearing Capacity Calculation

Information

Unit Weight of Water (kN/m³) 지하수위 심도

Groundwater Depth d (m)

Footing Type

Foundation Matrix Type

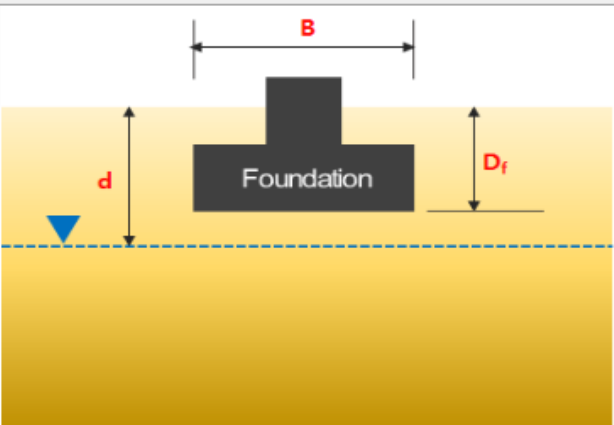
Foundation Width B (m)

L/B Ratio

Foundation Depth Df (m)

Foundation Type Add Delete

Customized
Foundation Width B (m)
Foundation L/B Ratio
Foundation Depth Df (m)



2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ Settlement Calculation

HGEO → 지내력 설계 기준이 되는 허용침하량 / 침하량 산정 방법

HGEO-FDN [HGEO-FDN_20221212.bcs]

File Report Help

General Information Soil Layer Information Foundation Information Settlement Calculation Bearing Capacity Calculation

Calculation Purpose Target Settlement (mm) 25

Settlement Calculation Method Schmertmann's Settlement Calculation

$$S_i = C_1 C_2 (q - q') \sum \frac{I_z}{E} \Delta z$$

Additional Method

Equation from the Theory of Elasticity

Stress Distribution for Consolidation Settlement Calculation Boussinesq's Method

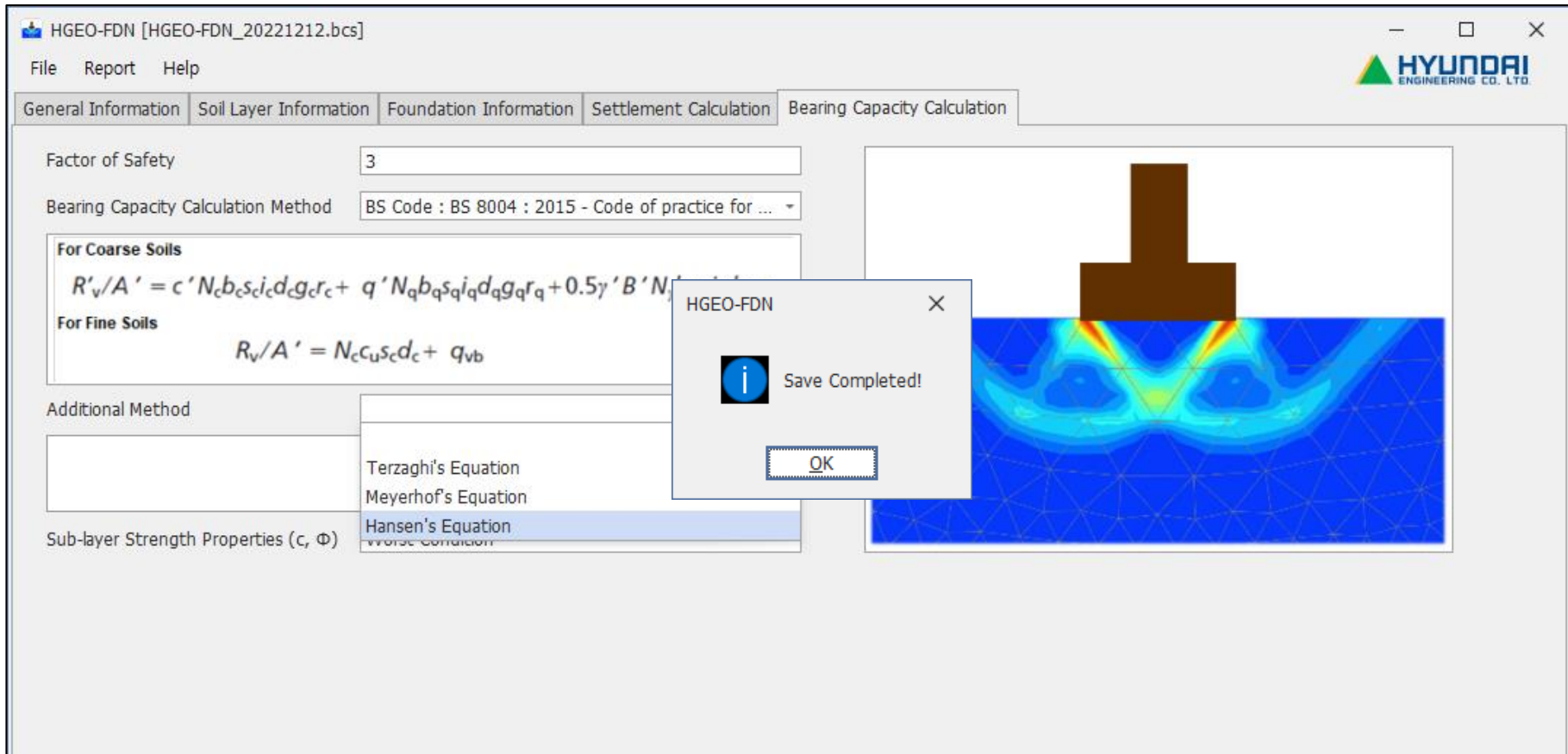
The diagram illustrates the stress distribution for consolidation settlement calculation. It shows two cases: $L/B = 1$ and $L/B \geq 10$. For $L/B = 1$, the stress distribution is shown with a rectangular load of width B and depth D_f , and a stress profile with points $z_1 = 0.5B$ and $z_2 = 2B$. For $L/B \geq 10$, the stress distribution is shown with a rectangular load of width B and depth D_f , and a stress profile with points $z_1 = B$ and $z_2 = 4B$. The diagrams show the load q , the stress $q' = \gamma D_f$, and the stress profile $q'_z(z)$.

2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ Bearing Capacity Calculation

HGEO → 적용 안전율 / 극한 지지력 산정 방법



HGEO-FDN [HGEO-FDN_20221212.bcs]

File Report Help

General Information Soil Layer Information Foundation Information Settlement Calculation Bearing Capacity Calculation

Factor of Safety

Bearing Capacity Calculation Method

For Coarse Soils

$$R_v/A' = c' N_c b_c s_c i_c d_c g_c r_c + q' N_q b_q s_q i_q d_q g_q r_q + 0.5 \gamma' B' N_{\gamma} b_{\gamma} s_{\gamma} i_{\gamma} d_{\gamma} g_{\gamma} r_{\gamma}$$

For Fine Soils

$$R_v/A' = N_c c_u s_c d_c + q_{vb}$$

Additional Method

- Terzaghi's Equation
- Meyerhof's Equation
- Hansen's Equation
- Worse condition

Sub-layer Strength Properties (c, Φ)

HGEO-FDN

Save Completed!

OK

2. Program Tutorial Manual

Program 둘러보기 – 1) 직접기초

■ Result & Export

HGEO → Report > Expert to Excel 를 통해 계산 결과 확인 > Preview 확인 가능

Result & Export

Result & Export

Borehole

☒ BH-47

Calculation Method

Settlement

☒ Schmertmann's Settlement Calculation
☐ Equation from the Theory of Elasticity

Preview

Foundation Matrix

Borehole Name	Div.	B = 1m			B = 2m			B = 3m			
		L/B=1	L/B=2	L/B=3	L/B=1	L/B=2	L/B=3	L/B=1	L/B=2	L/B=3	
BH-47	Df 1m	105.1	97.77	93.78	64.8	58.9	54.7	48.6	46.8	45.3	
	Df 2m	109.6	103.1	96.7	70.8	67.5	65	60.9	60.7	60.3	
	Df 3m	92.2	92	91.5	87.7	86.1	84.7	82.5	83.2	83.2	

Foundation Type

Borehole Name	Depth	Size (LxB)	Name	Result
---------------	-------	------------	------	--------

Preview

Calculation

Export

Close

2. Program Tutorial Manual

Program 돌려보기 – 1) 직접기초

■ Result & Export

HGEO → Report > Expert to Excel 를 통해 계산 결과 확인 > Export로 Output 생성 가능



BH-47

Result & Export

Result & Export

Borehole

All Select

☒ BH-47

Foundation (Width x Length x Df)

All Select

☒ Matrix form

Calculation Method

Settlement

☒ Schmertmann's Settlement Calculation
☐ Equation from the Theory of Elasticity

Bearing Capacity

☒ BS Code : BS 8004 : 2015 - Code of practice for foundation
☐ Terzaghi's Equation
☐ Meyerhof's Equation
☐ Hansen's Equation

Preview

Calculation

Export

Close

HGEO-FDN

?

Save Completed! Do you want to open the folder?

Yes

No

Matrix					
Foundation Depth (m)	B (m)	DESIGN BEARING CAPACITY (kPa)			
		L/B = 1	L/B = 2	L/B = 3	
1	1	105.1	103.7	99.5	
	2	64.8	58.9	54.7	
	3	48.6	46.8	45.3	
	4	44.3	42.8	41.5	
	5	41.5	41.3	41	
2	1	109.6	103.1	96.7	
	2	70.8	67.5	65	
	3	60.9	60.7	60.3	
	4	60.3	59.5	58.7	
	5	58.9	59.4	59.6	
3	1	92.2	92	91.5	
	2	87.7	86.1	84.7	
	3	82.5	83.2	83.2	
	4	84.3	83.8	83	
	5	84	83.7	83.1	

Program 둘러보기 – 2) 말뚝기초

- 말뚝기초 지지력 계산

Pile Bearing Capacity

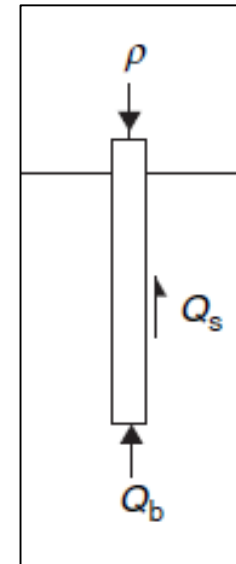
$$Q_{ult} = Q_b + Q_s - W_p$$

Q_{ult} : 말뚝의 극한지지력

Q_b : 말뚝의 선단지지력, $q_b \cdot A_b$
(q_b : 단위선단지지력, A_b : 말뚝선단의 면적)

Q_s : 말뚝의 주면마찰저항, $f_s \cdot A_s$
(f_s : 단위주면마찰저항, A_s : 말뚝주면의 면적)

W_p : 말뚝의 자중

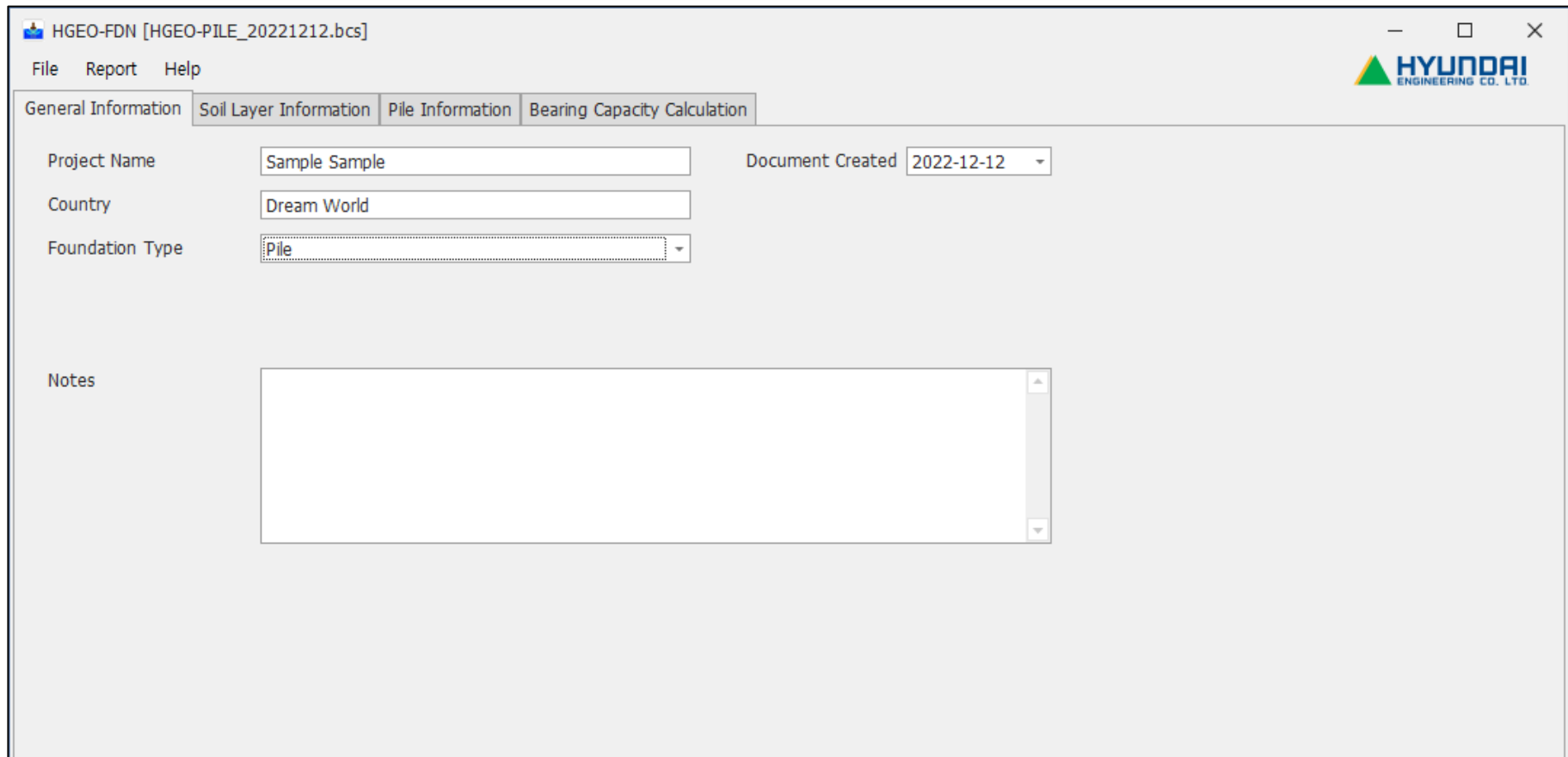


2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

- General Information

HGEO → Foundation Type > Pile 로 선택.



The screenshot displays the HGEO-FDN software window with the title bar "HGEO-FDN [HGEO-PILE_20221212.bcs]". The menu bar includes "File", "Report", and "Help". The "General Information" tab is selected, showing fields for "Project Name" (Sample Sample), "Country" (Dream World), and "Foundation Type" (Pile). A "Document Created" field shows the date "2022-12-12". A "Notes" section with a text area is also visible. The Hyundai Engineering Co., Ltd. logo is in the top right corner.

Field	Value
Project Name	Sample Sample
Country	Dream World
Foundation Type	Pile
Document Created	2022-12-12

2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

■ Soil Layer Information

HGEO → 직접기초와 동일한 절차. (직접기초를 위해 기입된 자료 활용 가능)

HGEO-FDN [HGEO-PILE_20221212.bcs]

File Report Help

General Information Soil Layer Information Pile Information Bearing Capacity Calculation

Source of Information SPT

BH-47

Groundwater Level(GL-m) 0 ERr (Energy Efficiency) 60

Soil Data Sheet Add Borehole Delete Borehole

Add Soil Layer Delete Soil Layer

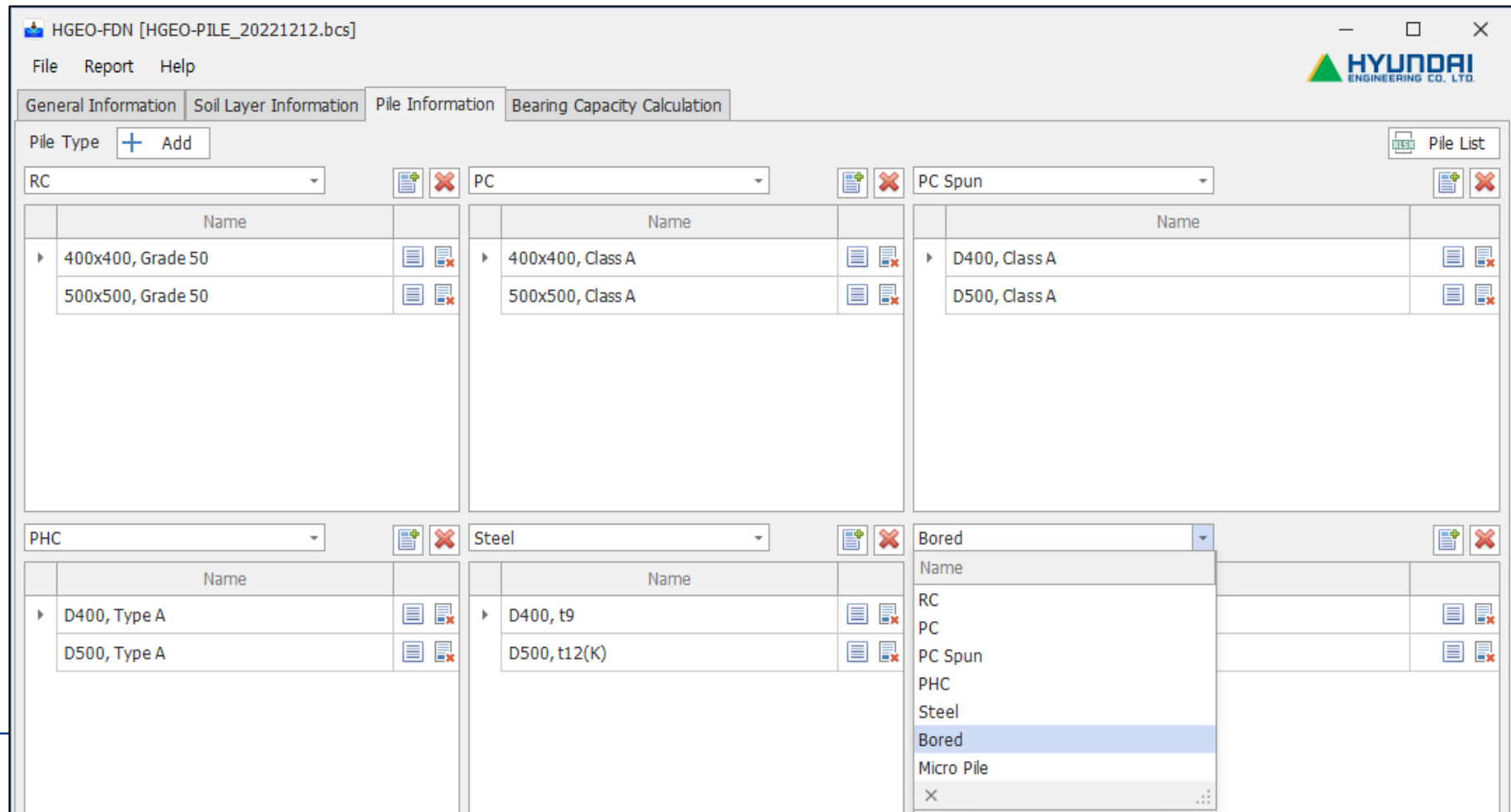
No.	Soil Depth (GL-m)	Soil Thk. (m)	Unit Weight (kN/m ³)	Soil Type	SPT N	Elastic modulus E (kPa)		Undrained Shear Strength c(kPa)		Friction Angle Φ (degrees)		Skin Friction
						Method	Value	Method	Value	Method	Value	
1	1.0	1.0	18.0	Clay	13	E=400N	5,200	C=6.25N	78.00	User		<input checked="" type="checkbox"/>
2	2.0	1.0	18.0	Clay	14	E=400N	5,600	C=6.25N	84.00	User		<input checked="" type="checkbox"/>
3	3.0	1.0	18.0	Clay	16	E=400N	6,400	C=6.25N	96.00	User		<input checked="" type="checkbox"/>
4	4.0	1.0	18.0	Clay	7	E=400N	2,800	C=6.25N	42.00	User		<input checked="" type="checkbox"/>
5	5.0	1.0	18.0	Clay	8	E=400N	3,200	C=6.25N	48.00	User		<input checked="" type="checkbox"/>
6	6.5	1.5	18.0	Sand	13	E=1000N	13,000	User		$\Phi=\sqrt{12N+15}$	27	<input checked="" type="checkbox"/>
7	8.0	1.5	18.0	Sand	18	E=1000N	18,000	User		$\Phi=\sqrt{12N+15}$	30	<input checked="" type="checkbox"/>
8	9.5	1.5	18.0	Sand	17	E=1000N	17,000	User		$\Phi=\sqrt{12N+15}$	29	<input checked="" type="checkbox"/>
9	11.0	1.5	18.0	Sand	23	E=1000N	23,000	User		$\Phi=\sqrt{12N+15}$	32	<input checked="" type="checkbox"/>
10	12.5	1.5	18.0	Sand	37	E=1000N	37,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>
11	14.0	1.5	18.0	Sand	50	E=1000N	50,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>
12	15.5	1.5	18.0	Sand	50	E=1000N	50,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>
13	17.0	1.5	18.0	Sand	50	E=1000N	50,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>
14	18.5	1.5	18.0	Sand	50	E=1000N	50,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>
15	20.0	1.5	18.0	Sand	50	E=1000N	50,000	User		$\Phi=\sqrt{12N+15}$	36	<input checked="" type="checkbox"/>

2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

■ Pile Information

HGEO → 적용 가능한 Pile Type에 대하여 6가지 종류까지 동시 계산 가능.



HGEO-FDN [HGEO-PILE_20221212.bcs]

File Report Help

General Information Soil Layer Information Pile Information Bearing Capacity Calculation

Pile Type + Add

RC PC PC Spun

Name
400x400, Grade 50
500x500, Grade 50

Name
400x400, Class A
500x500, Class A

Name
D400, Class A
D500, Class A

PHC Steel Bored

Name
D400, Type A
D500, Type A

Name
D400, t9
D500, t12(K)

Name
RC
PC
PC Spun
PHC
Steel
Bored
Micro Pile

2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

■ Bearing Capacity Calculation

HGEO → 각 말뚝 형식별 적용되는 지지력 공식 및 제한치 선정 / 범용 기준 Default 설정



말뚝기초
지지력공식

HGEO-FDN [HBSC_말뚝기초.bcs]

File Report Help

General Information | Soil Layer Information | **Pile Information** | Bearing Capacity Calculation

Factor of Safety		Information	
Compression	3	Unit Weight of Water (kN/m ³)	9.81
Tension	3	Final Grade Level (m EL)	0
		Pile Cutoff Level (GL m)	-2

Calculation Method for Pile Axial Resistance

Precast Concrete Pile & Steel Pile

Side Resistance		Limitation of side resistance	
Sandy Soil	SPT N	Sandy Soil	125
Clayey Soil	α method	Clayey Soil	125
Factor of Correlation	2		

Toe Resistance		Limitation of toe resistance	
Sandy Soil	SPT N	Sandy Soil	12000
Clayey Soil	Nc method	Clayey Soil	12000
Factor of Correlation	200		

Bored Pile

Side Resistance		Limitation of side resistance	
Sandy Soil	β method	Sandy Soil	200
Clayey Soil	α method	Clayey Soil	200

Toe Resistance		Limitation of toe resistance	
Sandy Soil	SPT N	Sandy Soil	4300
Clayey Soil	Nc* method	Clayey Soil	4300
Factor of Correlation	57.4		

Save Next

2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

■ Bearing Capacity Calculation _ Reference

말뚝종류	Reference	적용										
		구분	추정	상한								
PC, PHC, Steel	구조물기초설계기준											
	<table><tr><th>구분</th><th>단위면적당 극한선단지지력 $q_B(\text{kN/m}^2)$</th><th>단위면적당 극한주면마찰력 $f_s(\text{kN/m}^2)$</th><th>비고</th></tr><tr><td>매입말뚝</td><td>200N ($\leq 12,000$)(사질토) 6c_u ($\leq 12,000$)(점성토)</td><td>2.5N ($N \leq 50$)(사질토) 0.8c_u ($c_u \leq 125$)(점성토)</td><td>도로교설계기준해설 (2008) 및 건축기초구조설계 기준 (2005)</td></tr></table>	구분	단위면적당 극한선단지지력 $q_B(\text{kN/m}^2)$	단위면적당 극한주면마찰력 $f_s(\text{kN/m}^2)$	비고	매입말뚝	200N ($\leq 12,000$)(사질토) 6 c_u ($\leq 12,000$)(점성토)	2.5N ($N \leq 50$)(사질토) 0.8 c_u ($c_u \leq 125$)(점성토)	도로교설계기준해설 (2008) 및 건축기초구조설계 기준 (2005)	주면 마찰	- 모래, $f_s = 2 \cdot N$ - 점토, $f_s = \alpha \cdot c_u$	125 kPa
	구분	단위면적당 극한선단지지력 $q_B(\text{kN/m}^2)$	단위면적당 극한주면마찰력 $f_s(\text{kN/m}^2)$	비고								
	매입말뚝	200N ($\leq 12,000$)(사질토) 6 c_u ($\leq 12,000$)(점성토)	2.5N ($N \leq 50$)(사질토) 0.8 c_u ($c_u \leq 125$)(점성토)	도로교설계기준해설 (2008) 및 건축기초구조설계 기준 (2005)								
FHWA(Driven Pile)	<table><tr><td>$f_s = 2\bar{N}' \leq 100 \text{ kPa}$</td><td>$q_t = 400\bar{N}'_0 + \frac{(40\bar{N}'_B - 40\bar{N}'_0)D_B}{b} \leq 400\bar{N}'_B$</td></tr><tr><td>$f_s = c_u = \alpha c_u$</td><td>$q_p = c_u N_c$</td></tr></table>	$f_s = 2\bar{N}' \leq 100 \text{ kPa}$	$q_t = 400\bar{N}'_0 + \frac{(40\bar{N}'_B - 40\bar{N}'_0)D_B}{b} \leq 400\bar{N}'_B$	$f_s = c_u = \alpha c_u$	$q_p = c_u N_c$	선단 지지	- 모래, $q_p = 200 \cdot N$ - 점토, $q_p = 9 \cdot c_u$	12,000 kPa				
$f_s = 2\bar{N}' \leq 100 \text{ kPa}$	$q_t = 400\bar{N}'_0 + \frac{(40\bar{N}'_B - 40\bar{N}'_0)D_B}{b} \leq 400\bar{N}'_B$											
$f_s = c_u = \alpha c_u$	$q_p = c_u N_c$											
Bored Pile	구조물기초설계기준											
	<table><tr><th></th><th></th><th>$f_s = \beta \sigma_v'$ $\beta = 1.5 - 0.135 \sqrt{Z}$, $0.25 < \beta < 1.20$ Z, σ_v'은 각각 임의토층 중앙부 위치의 깊이 및 유효응력, f_s의 한계값은 200 kPa</th><th>Reese & O'Neill (1999)</th></tr><tr><td>현장타설 콘크리트</td><td>57.4N (미보정 $N \leq 75$) 4309.2 (미보정 $N > 75$) (극한값 또는 선단 직경의 5% 침하량에서의 값)</td><td></td><td></td></tr></table>			$f_s = \beta \sigma_v'$ $\beta = 1.5 - 0.135 \sqrt{Z}$, $0.25 < \beta < 1.20$ Z, σ_v' 은 각각 임의토층 중앙부 위치의 깊이 및 유효응력, f_s 의 한계값은 200 kPa	Reese & O'Neill (1999)	현장타설 콘크리트	57.4N (미보정 $N \leq 75$) 4309.2 (미보정 $N > 75$) (극한값 또는 선단 직경의 5% 침하량에서의 값)			주면 마찰	- 모래, $f_s = \beta \cdot N$ - 점토, $f_s = \alpha \cdot c_u$	200 kPa
			$f_s = \beta \sigma_v'$ $\beta = 1.5 - 0.135 \sqrt{Z}$, $0.25 < \beta < 1.20$ Z, σ_v' 은 각각 임의토층 중앙부 위치의 깊이 및 유효응력, f_s 의 한계값은 200 kPa	Reese & O'Neill (1999)								
	현장타설 콘크리트	57.4N (미보정 $N \leq 75$) 4309.2 (미보정 $N > 75$) (극한값 또는 선단 직경의 5% 침하량에서의 값)										
FHWA(Drilled Shaft)	- $N \leq 75$ 1999 $q_p(\text{kPa}) = 57.4N \leq 4300$, $N \leq 50$ 2010 $q_{BN}(\text{tsf}) = 0.60 N_{60} \leq 30 \text{ tsf}$	선단 지지	- 모래, $q_p = 57.4 \cdot N$ - 점토, $q_p = 9 \cdot c_u$	4,300 kPa								

2. Program Tutorial Manual

Program 돌려보기 – 2) 말뚝기초

■ Result & Export

HGEO → Report > Export to Excel 를 통해 계산 결과 확인 > Single Pile Result 확인 가능

Result & Export

Single Pile Result

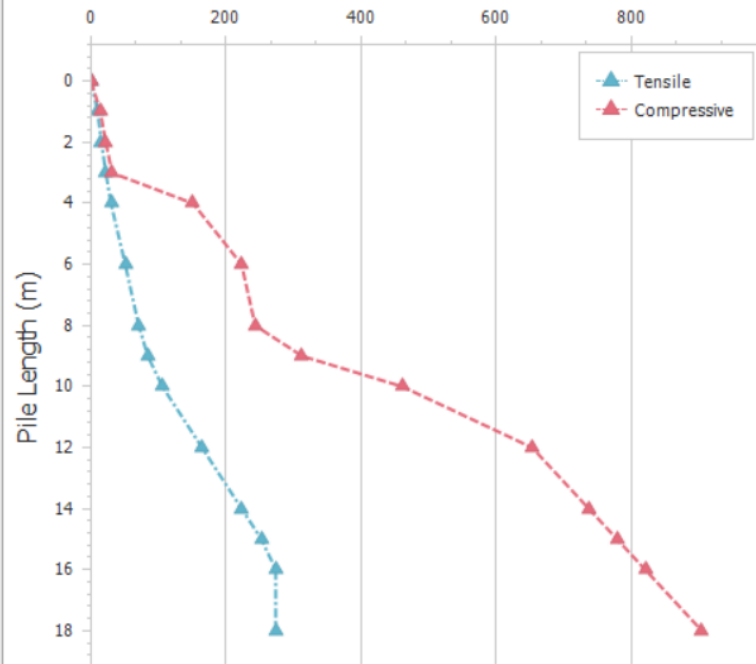
Borehole No. BH-47

Pile Type PHC (D400, Type A)

Calculation

Save chart image

Pile Capacity (kN)



No.	Soil ... (m)	Eleva... (m EL)	Soil Layer Information				N60	Overburden St...		α, β factor for ...		Calculation for Shaft		
			Soil T...	Unit ...	SPT N	Shear...		Effec...	Effec...	α	β	f_s (kPa)	R_s (kN)	Σ
1	1	-1.0	Clay	18.0	13	78	13	8.2	4.1					
2	1	-2.0	Clay	18.0	14	84	14	16.4	12.3	0.31		26.0		
3	1	-3.0	Clay	18.0	16	96	16	24.6	20.5	0.34		32.6	41.0	
4	1	-4.0	Clay	18.0	7	42	7	32.8	28.7	0.45		19.1	24.0	
5	1	-5.0	Clay	18.0	8	48	8	41.0	36.9	0.47		22.5	28.2	
6	1	-6.0	Sand	18.0	13		13	49.1	45.0			26.0	32.7	
7	2	-8.0	Sand	18.0	18		18	65.5	57.3			36.0	90.5	
8	2	-10.0	Sand	18.0	17		17	81.9	73.7			34.0	85.5	
9	1	-11.0	Sand	18.0	23		23	90.1	86.0			46.0	57.8	
10	1	-12.0	Sand	18.0	37		37	98.3	94.2			74.0	93.0	
11	2	-14.0	Sand	18.0	50		50	114.7	106.5			100.0	251.3	
12	2	-16.0	Sand	18.0	50		50	131.0	122.9			100.0	251.3	
13	1	-17.0	Sand	18.0	50		50	139.2	135.1			100.0	125.7	1,
14	1	-18.0	Sand	18.0	50		50	147.4	143.3			100.0	125.7	1,
15	2	-20.0	Sand	18.0	50		50	163.8	155.6			100.0	251.3	1,

Close

2. Program Tutorial Manual

Program 둘러보기 – 2) 말뚝기초

■ Result & Export

HGEO → Report > Expert to Excel 를 통해 계산 결과 확인 > Export로 Output 생성 가능

Result & Export

Result & Export

Driven & Board Pile

Borehole

☒ BH-47

Micro Pile

Borehole

☐ BH-1

1. Project Name : Sample Sample

2. General Information

Final Grade Level (m EL)	Pile Cutoff Level (FGL m)	Borehole ref. No	Groundwater Depth d (m)	of Water	Efficiency)
0 m EL	-2	BH-47	0 m	9.81 kN/m ³	60%

3. Pile Information

Bored

- Diameter (m)	0.4	Pile_Bored D400_20221212	Pile_PC 400x400, Class A_20221212
- Pile area (m ²)	0.126	Pile_PC Spun 400, Class A_20221	Pile_PHC D400, Type A_20221212
- Pile Net area (m)	0.126		
- Pile Weight (kN/m)	3.14		
- f'ck (con'c compressive strength, MPa)	30	Pile_RC 400x400, Grade 50_2022121	Pile_Steel D400, t9_20221212
- Structural capacity(compression) (kN)	942		
- Structural capacity(uplift) (kN)	197		

Single Pile Result

Calculation

Export

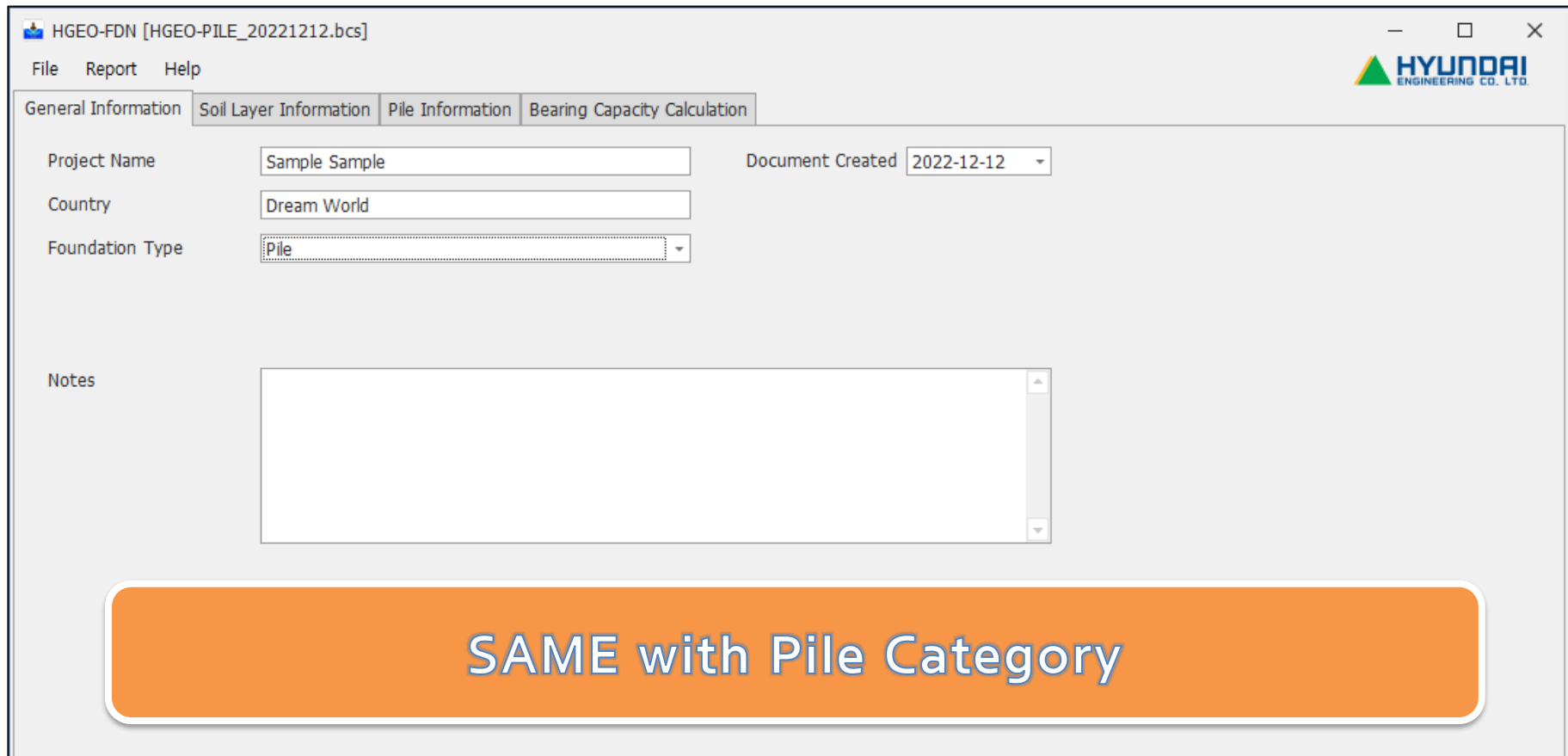
Close

2. Program Tutorial Manual

Program 둘러보기 – 3) Micro Pile

- General Information

HGEO → Foundation Type > Pile 로 선택.



The screenshot shows the HGEO-FDN software interface with the file name [HGEO-PILE_20221212.bcs]. The menu bar includes File, Report, and Help. The main window has four tabs: General Information, Soil Layer Information, Pile Information, and Bearing Capacity Calculation. The General Information tab is active, displaying the following fields:

- Project Name: Sample Sample
- Country: Dream World
- Foundation Type: Pile (selected from a dropdown menu)
- Document Created: 2022-12-12 (selected from a date dropdown)
- Notes: A large text area for entering notes.

At the bottom of the interface, there is a large orange button with the text "SAME with Pile Category".

2. Program Tutorial Manual

Program 둘러보기 – 3) Micro Pile

■ Soil Layer Information

HGEO → 기존에 기입된 Soil Layer Information은 Micro Pile에는 반영되지 않음.

HGEO-FDN [HGEO-PILE_20221212.bcs]

File Report Help

General Information Soil Layer Information Pile Information Bearing Capacity Calculation

Source of Information SPT

BH-47

Groundwater Level(GL-m) 0 ERr (Energy Efficiency) 60

Add Soil Layer Delete Soil Layer

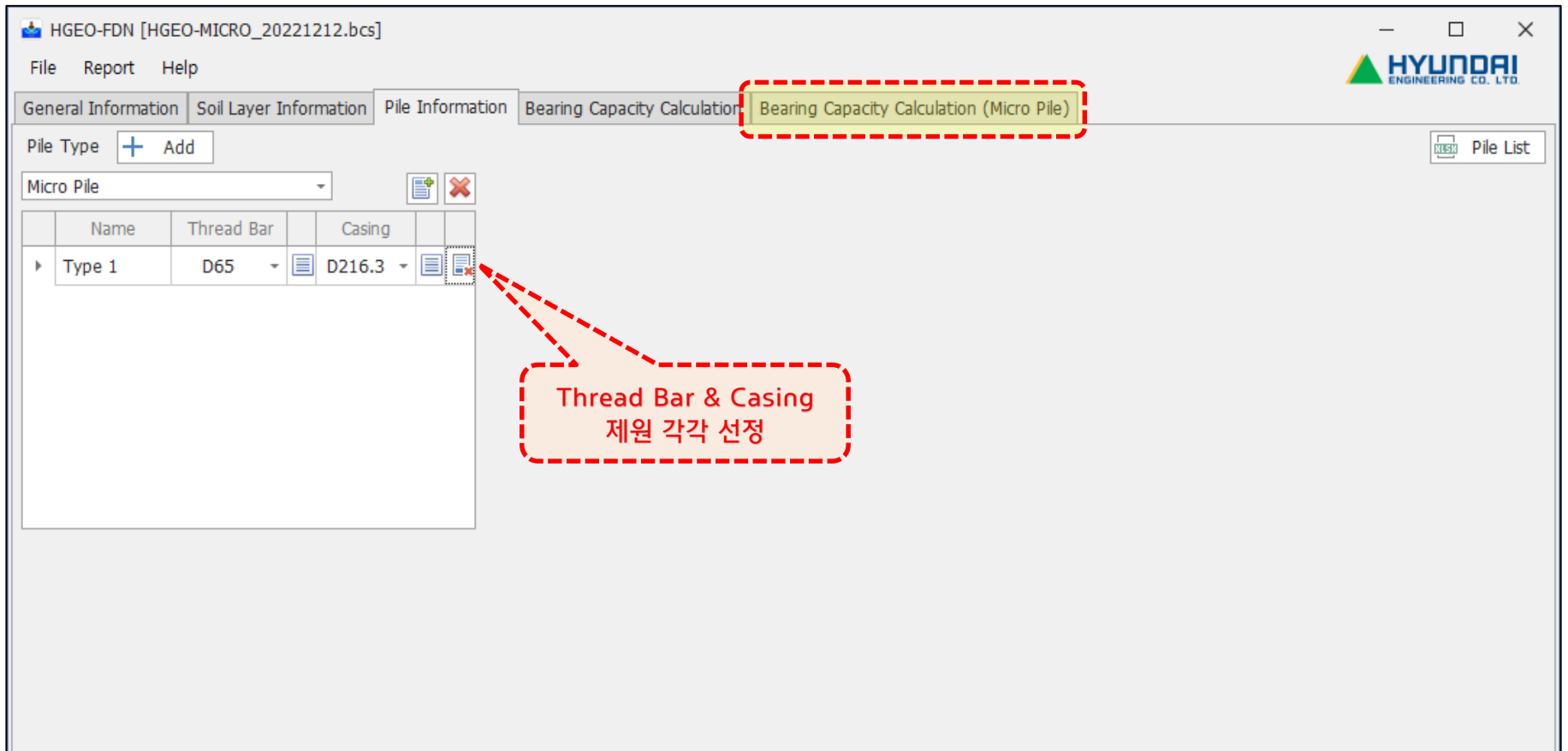
No.	Soil Depth (GL-m)	Soil Thk. (m)	Unit Weight (kN/m ³)	Soil Type	SPT N	Elastic modulus (kPa)	Strength c(kPa)	Friction Angle Φ(degrees)	Skin Friction
						Method	Value	Method	Value
1	1.0	1.0	18.0	Clay	13	C=6.25N	78.00	User	✓
2	2.0	1.0	18.0	Clay	12	C=6.25N	84.00	User	✓
3	3.0	1.0	18.0	Clay	11	C=6.25N	96.00	User	✓
4	4.0	1.0	18.0	Clay	10	C=6.25N	42.00	User	✓
5	5.0	1.0	18.0	Clay	9	C=6.25N	48.00	User	✓
6	6.5	1.5	18.0	Clay	17	E=1000N	13,000	Φ=√12N + 15	27
7	8.0	1.5	18.0	Clay	17	E=1000N	18,000	Φ=√12N + 15	30
8	9.5	1.5	18.0	Clay	17	E=1000N	17,000	Φ=√12N + 15	29
9	11.0	1.5	18.0	Clay	23	E=1000N	23,000	Φ=√12N + 15	32
10	12.5	1.5	18.0	Sand	37	E=1000N	37,000	Φ=√12N + 15	36
11	14.0	1.5	18.0	Sand	50	E=1000N	50,000	Φ=√12N + 15	36
12	15.5	1.5	18.0	Sand	50	E=1000N	50,000	Φ=√12N + 15	36
13	17.0	1.5	18.0	Sand	50	E=1000N	50,000	Φ=√12N + 15	36
14	18.5	1.5	18.0	Sand	50	E=1000N	50,000	Φ=√12N + 15	36
15	20.0	1.5	18.0	Sand	50	E=1000N	50,000	Φ=√12N + 15	36

2. Program Tutorial Manual

Program 둘러보기 – 3) Micro Pile

■ Pile Information

HGEO → Pile Type 中 Micro Pile 선택 > 별도의 Bearing Capacity Calculation 생성



2. Program Tutorial Manual

Program 돌려보기 – 3) Micro Pile

■ Bearing Capacity Calculation (Micro Pile)

HGEO → Structural Design & Geotechnical Design 별도 작성 必

HGEO-FDN [HGEO-MICRO_20221212.bcs]

File Report Help

General Information Soil Layer Information Pile Information Bearing Capacity Calculation Bearing Capacity Calculation (Micro Pile)

Factor of Safety

Compression

Tension

Materials

Type

Bar Dia. = mm, f_y = MPa

Casing Dia. = mm, f_y = MPa

Grouting F_c = MPa

Structural Design

Maximum Axial Compression Load P_c = kN

Head Condition

Maximum bending moment by L-pile M_{max} = kNm

Allowable Horizontal Load by L-pile Q_{ha} = kN

Horizontal Displacement by L-pile Sh = mm

Information

Final Grade Level (m EL)

Unit Weight of Water (kN/m³)

Geotechnical Design

BH-47

	Soil	Soil Depth (m)	Soil Thk. (m)	τ_u (kN/m ²)	Side Friction (kN)	Ultimate Capacity (kN)
	1	10	10	0		
	2	20	10	0		
	3	25	5	90	381.7	381.7
▶	4	28	3	180	458	839.7

Allowable Compression Capacity $P_{compression}$ = kN

Allowable Tension Capacity P_{uplift} = kN

Bearing Plate ☐

지반 지지력 평가

복합응력 검토를 위해 L-pile 해석 필요
따라서, Micropile은 간단히 지반지지력만 평가하시고
상세평가는 지반그룹 검토 필요.

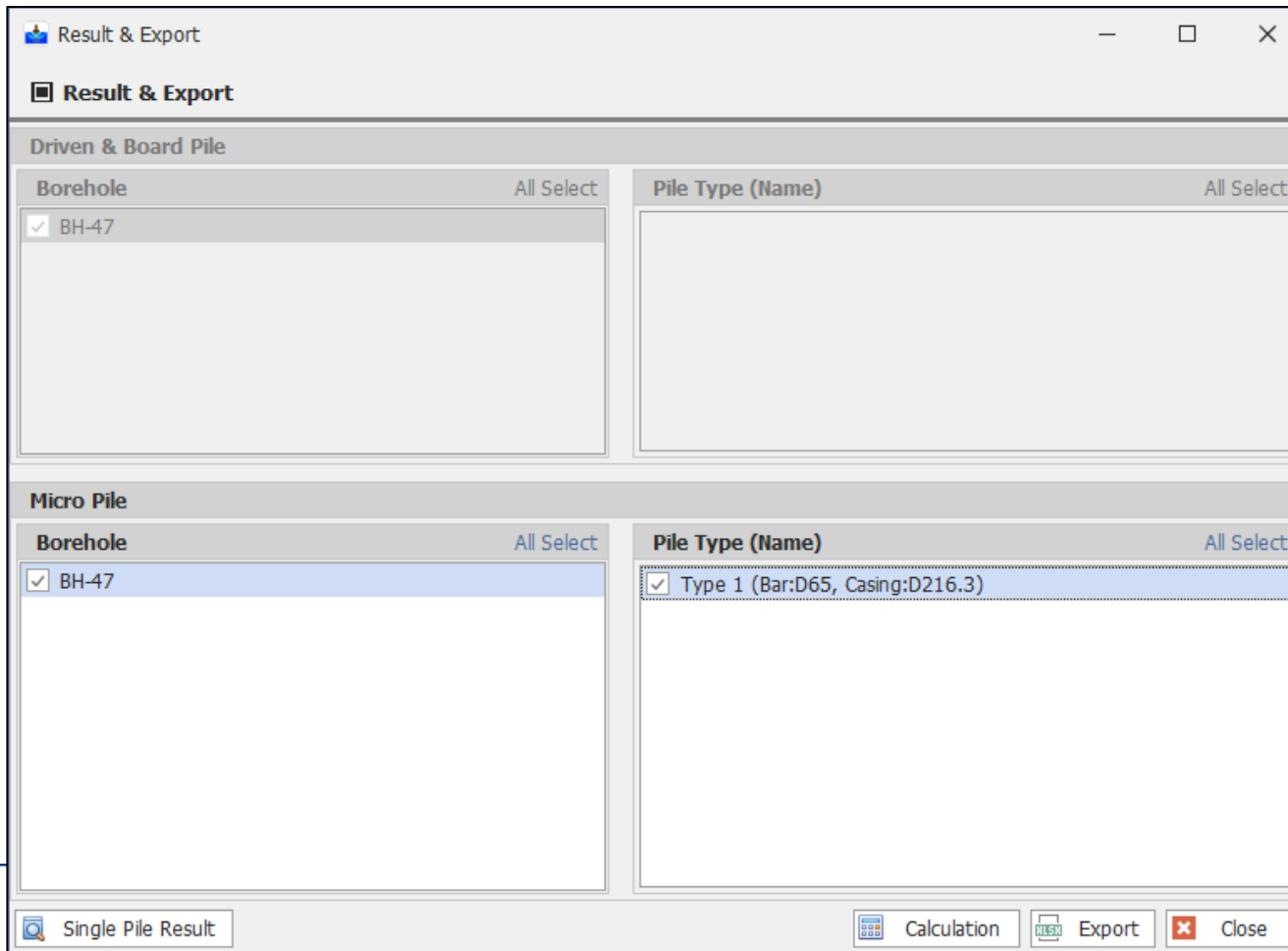
마이크로파일 → 상세평가는 반드시 지반그룹에 검토 의뢰

2. Program Tutorial Manual

Program 둘러보기 – 3) Micro Pile

■ Result & Export

HGEO → Report > Expert to Excel 를 통해 계산 결과 확인.



Result & Export

Result & Export

Driven & Board Pile

Borehole All Select

☒ BH-47

Pile Type (Name) All Select

Micro Pile

Borehole All Select

☒ BH-47

Pile Type (Name) All Select

☒ Type 1 (Bar:D65, Casing:D216.3)

Single Pile Result

Calculation Export Close



MicroPile_BAR
CASING D216.3_20

Micro Pile_BAR D65,
CASING D216.3
_20221212

3. Program Status

HGEO-FDN은 현재 ??

AS IS

SPT에 의한 지지력 산정 가능

말뚝기초의 지지력 최소값 제공

Bored Pile의 N값 지지력 산정

Micro Pile Soil Layer 별도 작성

휴엔시스템 서버 Base 운영

TO BE

CPT, PMT에 의한 지지력 보완~~!!

시공법/재료별 상세 지지력 보완~~!!

연암 UCS 강도에 의한 지지력 보완~~!!

Soil Layer 공유 가능하도록 보완~~!!

실행 프로그램 자체 운영~~!!

End of Document

