Province / District / Example Neighborhood · Example Sheet Sheet Example Block Block Example Parcel Parcel

PILE FOUNDATION DESIGN REPORT

Proje Name

TBDY 2018 · Chapter 16 — Pile Foundations

Information	Value
Report date	10.11.2026
Revision	00
Project author	—
Firm preparing the report	—
Client	—
Design situation	Earthquake (derived from scenario)
Earthquake design class (DTS)	1
Source of identity information	User entered MANUALLY (pile module used standalone)

Table 1: Report identification

APPROVALS

Project author	Structural inspection	Public authority

Table 2: Approval fields (left blank for signature)

> This report was produced with the GeoteknikPro Studio · Piled Foundations module. The calculations were made according to the principles of Chapter 16 of the Turkish Building Earthquake Code (published 18 March 2018, Official Gazette no. 30364 repeated) and the provisions of TS 500. The results depend on the entered soil parameters and structural loads; interpretation and the final engineering decision are the responsibility of the engineer preparing the report.
>
> MISSING IDENTIFICATION INFORMATION: Proje müellifi · Firma. Bu alanlar raporda '—' görünür; hesap sonuçları bundan ETKİLENMEZ, ama resmî kuruma verilecek nüshada doldurulmaları gerekir.

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SYMBOLS USED

Symbol	Note	Unit
Q_s	Pile shaft (friction) resistance	kN
Q_u	Pile tip (end-bearing) resistance	kN
Q_t	Total bearing capacity, $Q_s + Q_u$	kN
Q_n	Negative shaft friction (drag) load	kN
Q_{tv}	Design bearing capacity (TBDY Eq. 16.15a)	kN
N_d	Design axial load per pile	kN
H	Lateral load share per pile	kN
M(z)	Bending moment vs. depth	kNm
V(z)	Shear force vs. depth	kN
y(z)	Horizontal displacement	m
$u_{ff}(z)$	Free-field (kinematic) displacement envelope	m
β_G	Kinematic group reduction factor (TBDY Eq. 16C.1)	—
p-multiplier	Static lateral group reduction factor (row-based)	—
R	Kinematic internal force reduction coefficient (= 2.5)	—
k_v	Pile vertical spring stiffness	kN/m
N_s	Modulus of subgrade reaction (Winkler)	kN/m³
ρ	Longitudinal reinforcement ratio, A_s/A_g	—
M_r	Section flexural strength (under N_d)	kNm
V_r	Section shear strength	kN
β	Angular distortion (differential settlement / span)	—

Table 3: Symbols, descriptions and units used in the report

Throughout the report, forces are in kN, lengths in m, and stresses in kPa. Depths are POSITIVE downward from the ground surface, and elevations are relative to the project datum.

1. INTRODUCTION AND SCOPE

This report contains the analyses and calculations for the PILE FOUNDATION design of the Proje Name project, planned to be built at Province / District / Example Neighborhood · Example Sheet Pafta Example Block Ada Example Parcel Parsel. The pile foundation; has been examined under the headings of vertical bearing capacity, settlement, behavior under lateral load (p-y), seismic effects (inertial and kinematic), and section reinforced-concrete check.

Design case: Earthquake (derived from scenario) — 2 tabakanın negatif sürtünme bayrağı yok sayıldı. 1 layer(s) liquefied (active).

Application arm of lateral loads h: 1.3 m (RadyeUstu)

1.1. Site and Project Information

Information	Value
Province	Province
District	District
Neighborhood	Example Neighborhood
Sheet	Example Sheet
Block	Example Block
Parcel	Example Parcel
Plot area	9999
Coordinates (latitude / longitude)	38.476587 / 27.364783
Terrain slope	%6
Building use	Residence
Structural system	Concrete System

Table 4: Parcel and proje kimlik bilgileri

> The information in this table is read from the main program's (GeoteknikRapor) 'Land / Project Information' screen. When the Pile Foundations module is used on its own, the fields are blank and the user is prompted before the report is generated;; the program does NOT generate this information.

1.2. Report Summary Results

Quantity	Result
Pile type · diameter · length	ForeKazik · 80 cm · 20 m
Number of piles · spacing (s/D)	70 · 3 m (3.75)
Design bearing capacity Q_{tv}	1279 kN
Most loaded pile N_{max}	3433 kN
Settlement (t-z)	not computed in this report
Design moment (combined)	529.5 kNm
Design shear (combined)	321.1 kN

Quantity	Result
Selected reinforcement	16Ø20 + Ø10/10 cm
Section check	M_d/M_r = 0.54 (satisfied) · V_d/V_r = 0.34 (satisfied)

Table 5: Report summary results

2. IDEALIZED SOIL PROFILE

The borehole, field and laboratory studies carried out on site have been examined in the geotechnical report, and in light of this data, an idealized soil profile representing the soil mass has been established. Groundwater level: 6 m (elevation -6).

Layer	Depth	γ [kN/m³]	Shear strength
Clayey sand	0–3 m	17.66	phi' = 28°
Low-plasticity clay	3–10 m	18.15	c_u = 90 kPa
Silty sand	10–19 m	18.44	phi' = 30°
High-plasticity silt	19–24 m	17.46	phi' = 24.77°

Table 6: Idealized soil profile and design parameters

3. PILE GEOMETRY AND LAYOUT

Information	Value
Pile type	ForeKazik
Diameter	80 cm
Length	20 m
Kesit (A · I · EA · EI)	A = 5026.5 cm² · I = 2010619 cm⁴ · EA = 15984918 kN · EI = 639397 kNm² — Moment of inertia derived from solid circle: I = πD⁴/64 = 0.020106 m⁴.
Pile head depth	3.5 m (kot -3.5)
Number of piles	70
Spacing between axes	3 m
s/D ratio	3.75
Concrete class	C30/37
Raft thickness	1.3 m

Table 7: Pile and cap geometry

The ratio of the pile center-to-center spacing to the diameter is s/D = 3.75, and the group effect (p-multiplier and β_G) has been determined based on this ratio.

No.	X [m]	Y [m]
K1	2	18.64
K2	6	18.64

No.	X [m]	Y [m]
K3	10	18.64
K4	14	18.64
K5	18	18.64
K6	22	18.64
K7	26	18.64
K8	30	18.64
K9	34	18.64
K10	38	18.64
K11	2	15.64
K12	6	15.64
K13	10	15.64
K14	14	15.64
K15	18	15.64
K16	22	15.64
K17	26	15.64
K18	30	15.64
K19	34	15.64
K20	38	15.64
K21	2	12.64
K22	6	12.64
K23	10	12.64
K24	14	12.64
K25	18	12.64
K26	22	12.64
K27	26	12.64
K28	30	12.64
K29	34	12.64
K30	38	12.64
K31	2	9.64
K32	6	9.64
K33	10	9.64
K34	14	9.64
K35	18	9.64

No.	X [m]	Y [m]
K36	22	9.64
K37	26	9.64
K38	30	9.64
K39	34	9.64
K40	38	9.64
K41	2	6.64
K42	6	6.64
K43	10	6.64
K44	14	6.64
K45	18	6.64
K46	22	6.64
K47	26	6.64
K48	30	6.64
K49	34	6.64
K50	38	6.64
K51	2	3.64
K52	6	3.64
K53	10	3.64
K54	14	3.64
K55	18	3.64
K56	22	3.64
K57	26	3.64
K58	30	3.64
K59	34	3.64
K60	38	3.64
K61	2	0.64
K62	6	0.64
K63	10	0.64
K64	14	0.64
K65	18	0.64
K66	22	0.64
K67	26	0.64
K68	30	0.64

No.	X [m]	Y [m]
K69	34	0.64
K70	38	0.64

Table 8: Pile layout coordinates

4. VERTICAL BEARING CAPACITY

The pile bearing capacity is obtained from the sum of the shaft friction and tip resistance,; reduced with partial factors per TBDY 2018 Eq. 16.15a, with any negative skin friction (drag) load deducted, if present.

Quantity	Value
Shaft resistance Q_s	1202 kN
Toe resistance Q_u	955 kN
Total Q_t	2157 kN
Negative friction Q_n	none — negative skin friction is not considered in the SEISMIC design situation (downdrag is a long-term effect; marked in 2 layer(s))
Design bearing capacity Q_{tv}	1279 kN
Calculation path	Eq. 16.15a: Qs/1.50 + Qu/2.00

Table 9: Vertical bearing capacity components

Layer	f_s	Source
Low-plasticity clay	40.5 kPa	α method — Tomlinson/Skempton bored (in stiff clay 0.45; α = 0.45) · otomatik: pile tipinden
Silty sand	0 kPa	LIQUEFIED (f_s = 0 — a liquefied layer is not allowed to bear load)
High-plasticity silt	47.8 kPa	β method — fore/CFA (K = 1.00·K_0 · δ = 1.00·ϕ', Burland 1973) (K = 0.58, K_0 = 0.58) · cap API RP 2A Tablo 6.4.3-1 · very loose (δ = 15° row) · δ = ϕ' − 5° = 19.8° → 47.8 kPa → TAVAN YÖNETTİ (65 → 48 kPa)

Table 10: Unit shaft friction by layer

5. SETTLEMENT

Settlement has been calculated in two ways: a simple beam based on elastic shortening, and a load-transfer solution based on spring (t-z · q-z) curves. The load-transfer solution has been taken as the basis for design.

Quantity	Value
Simple branch	42.2 mm
t-z load transfer	not computed in this report
Load reaching the toe	not computed in this report

Table 11: Pile head settlement

6. STRUCTURAL LOADS AND PILE LOAD ENVELOPE

The loads on each pile head have been solved separately for every row of the combination table and enveloped pile by pile: the most unfavorable case for a given pile may come from a different combination.

Kombinasyon adedi: 34 · most loaded pile: 3433 kN (G'+Q'-Ey-0.3Ex+0.3Ez) · least loaded: 444 kN (0.9G'+Ey'+0.3Ex'-0.3Ez) · largest lateral share: 479 kN · largest service (G+Q): 2358 kN

Pile	N_{max} [kN]	Governing combination	N_{min} [kN]	H_{maks} [kN]	$N_{service}$ [kN]
K38	3433.2	G'+Q'-Ey-0.3Ex+0.3Ez	807.2	315.8	2333.1
K33	3389	G'+Q'-Ey'-0.3Ex'+0.3Ez	899.7	318.1	2357.7
K28	3340.9	G'+Q'-Ey-0.3Ex+0.3Ez	794.9	313	2272.9
K39	3337.8	G'+Q'-Ex-0.3Ey+0.3Ez	806.5	340.2	2280.5
K48	3320.3	G'+Q'-Ey-0.3Ex+0.3Ez	809.3	320.4	2264.2
K23	3287	G'+Q'-Ey'-0.3Ex'+0.3Ez	906.2	321.9	2297.3
K32	3286.8	1.4G+1.6Q	1107.7	337.2	2326.8
K43	3273	G'+Q'-Ey'-0.3Ex'+0.3Ez	909.4	314.2	2296.9
K29	3155.2	G'+Q'-Ex-0.3Ey+0.3Ez	799.1	371.2	2175.7
K42	3103	1.4G+1.6Q	1065.2	368.7	2196.8
K62	3082	1.4G+1.6Q	1175.4	397.4	2182
K2	3081	1.4G+1.6Q	1140.2	331.6	2181.3
K49	3052.1	G'+Q'-Ex-0.3Ey+0.3Ez	806.7	337.3	2117.6
K22	3048.3	1.4G+1.6Q	1042.2	334	2158
K5	3029.6	1.4G+1.6Q	1121.3	325.9	2144.2
K65	3026.9	1.4G+1.6Q	1147.2	323	2142.2
K4	3007.9	1.4G+1.6Q	1054.1	327.8	2128.9
K64	3002.5	1.4G+1.6Q	1079.4	321.1	2125.1
K9	3001	1.4G+1.6Q	983.7	399.8	2124.7
K18	2989.4	G'+Q'-Ey-0.3Ex+0.3Ez	827.5	323.8	2083.2
K53	2985.5	1.4G+1.6Q	944.2	321.2	2113.4
K13	2982.4	1.4G+1.6Q	931.6	325.8	2111.2
K69	2969.7	1.4G+1.6Q	1015.1	332	2102.5
K6	2963.6	1.4G+1.6Q	1095.6	324.2	2097.5
K3	2962.1	1.4G+1.6Q	1028.4	329.7	2096.8
K66	2961.6	1.4G+1.6Q	1141.7	325.1	2096.1
K63	2958.4	1.4G+1.6Q	1057.4	334	2094.2
K7	2952.8	1.4G+1.6Q	1013.9	322.5	2090

Pile	N_{max} [kN]	Governing combination	N_{min} [kN]	H_{maks} [kN]	$N_{service}$ [kN]
K67	2945.6	1.4G+1.6Q	1060.3	327.3	2084.9
K58	2940.5	G'+Q'-Ey-0.3Ex+0.3Ez	846.9	325	2061.3
K8	2920.9	1.4G+1.6Q	944.2	335.8	2067.6
K68	2906.3	1.4G+1.6Q	986.7	329.5	2057.4
K70	2530.3	1.4G+1.6Q	891.9	450.5	1791.6
K10	2262.8	1.4G+1.6Q	772.7	478.9	1602.2
K1	2024.1	1.4G+1.6Q	806	442.5	1433.2
K52	1994.5	1.4G+1.6Q	715.7	390.6	1412.1
K61	1893.8	1.4G+1.6Q	772.3	475.8	1340.9
K19	1839.1	1.4G+1.6Q	542	394	1302.1
K37	1757.2	G'+Q'-Ey-0.3Ex+0.3Ez	463.5	313.4	1202.4
K12	1742	1.4G+1.6Q	616.8	332.1	1233.3
K31	1716.4	1.4G+1.6Q	650.8	458.2	1215.2
K41	1714.1	1.4G+1.6Q	658	463.4	1213.5
K21	1713.4	1.4G+1.6Q	655.9	453	1213.1
K34	1710	G'+Q'-Ey'-0.3Ex'+0.3Ez	444.2	316.1	1164.9
K35	1709.1	G'+Q'-Ey'-0.3Ex'+0.3Ez	531.7	314.2	1187.9
K36	1701.9	G'+Q'-Ey-0.3Ex+0.3Ez	545.3	312.4	1192.4
K30	1701.6	G'+Q'-Ex-0.3Ey+0.3Ez	500	466.8	1203.2
K40	1699.9	G'+Q'-Ex-0.3Ey+0.3Ez	482.7	462.7	1191.7
K27	1697.1	G'+Q'-Ey-0.3Ex+0.3Ez	459.2	314.6	1166.3
K47	1696.1	G'+Q'-Ey-0.3Ex+0.3Ez	468.8	318	1169.7
K59	1690.4	1.4G+1.6Q	511.9	334.3	1196.8
K25	1685.7	G'+Q'-Ey'-0.3Ex'+0.3Ez	541.4	318.1	1180.8
K50	1684.1	1.4G+1.6Q	502.8	458.6	1192.4
K45	1679.2	G'+Q'-Ey'-0.3Ex'+0.3Ez	542.5	313.6	1178.4
K51	1675.9	1.4G+1.6Q	661.7	468.6	1186.6
K11	1674.6	1.4G+1.6Q	656.5	447.8	1185.7
K44	1664.5	G'+Q'-Ey'-0.3Ex'+0.3Ez	452.2	312.2	1143.7
K24	1662.3	G'+Q'-Ey'-0.3Ex'+0.3Ez	448.8	320	1139.3
K15	1655.9	1.4G+1.6Q	569.7	322	1172
K26	1652.8	G'+Q'-Ey-0.3Ex+0.3Ez	541.7	316.3	1165
K46	1646.9	G'+Q'-Ey-0.3Ex+0.3Ez	548.5	315.8	1165.1

Pile	N_{max} [kN]	Governing combination	N_{min} [kN]	H_{maks} [kN]	$N_{service}$ [kN]
K55	1641.3	1.4G+1.6Q	571.3	318.3	1161.6
K20	1630.9	1.4G+1.6Q	512.9	472.8	1154.8
K16	1622.5	1.4G+1.6Q	561.5	320.3	1148.4
K56	1619.3	1.4G+1.6Q	574.9	320.4	1146.1
K60	1608.5	1.4G+1.6Q	518.6	454.6	1138.9
K54	1601.9	1.4G+1.6Q	506.9	316.4	1133.9
K14	1588.7	G'+Q'-Ey'-0.3Ex'+0.3Ez	495.4	323.9	1120.8
K17	1537.4	G'+Q'-Ey-0.3Ex+0.3Ez	469.9	318.6	1082
K57	1536.5	1.4G+1.6Q	487.1	322.6	1087.6

Table 12: Load envelope per pile

7. PILED RAFT — LOAD SHARING AND STIFFNESS

Total applied to the raft: 200754 kN · carried by the piles: 163271 kN (%81.3) · remaining on soil (raft base): 37483 kN (%18.7)

λ = bu raporda hesaplanmamıştır · rijit sayılabilecek en büyük aralık: bu raporda hesaplanmamıştır → bu raporda hesaplanmamıştır

Raft step: not defined

8. BEHAVIOR UNDER LATERAL LOAD (p-y)

Behavior under lateral load has been solved using p-y springs in layered soil. The group effect is represented with row-based p-multipliers,; and if both components of the load are present together, the solution has been performed as COUPLED (biaxial).

Pile	N [kN]	head settlement [mm]	maks M [kNm]	maks V [kN]	y_o [mm]
K38	3433.2	0	510.8	312	2.95
K33	3389	0	454.9	289.1	2.43
K28	3340.9	0	501.6	307.5	2.87
K39	3337.8	0	454.1	286.1	2.47
K48	3320.3	0	520.1	316.6	3.02
K23	3287	0	449	286.1	2.38
K32	3286.8	0	0.9	1.8	0
K43	3273	0	474	298.4	2.57
K29	3155.2	0	444.6	281.3	2.4

Pile	N [kN]	head settlement [mm]	maks M [kNm]	maks V [kN]	y_o [mm]
K42	3103	0	0.9	1.8	0
K62	3082	0	0.9	1.8	0
K2	3081	0	0.9	1.8	0
K49	3052.1	0	463.7	290.9	2.54
K22	3048.3	0	0.9	1.8	0
K5	3029.6	0	0.9	1.8	0
K65	3026.9	0	0.9	1.8	0
K4	3007.9	0	0.9	1.8	0
K64	3002.5	0	0.9	1.8	0
K9	3001	0	1.3	2.7	0
K18	2989.4	0	492.5	303	2.8
K53	2985.5	0	0.9	1.8	0
K13	2982.4	0	0.9	1.8	0
K69	2969.7	0	0.9	1.8	0
K6	2963.6	0	0.9	1.8	0
K3	2962.1	0	0.9	1.8	0
K66	2961.6	0	0.9	1.8	0
K63	2958.4	0	0.9	1.8	0
K7	2952.8	0	1	1.9	0
K67	2945.6	0	0.9	1.8	0
K58	2940.5	0	529.5	321.1	3.09
K8	2920.9	0	1.1	2.2	0
K68	2906.3	0	0.9	1.8	0
K70	2530.3	0	1	1.9	0
K10	2262.8	0	1.6	3.4	0
K1	2024.1	81.27	0.9	1.8	0
K52	1994.5	74.55	0.9	1.8	0
K61	1893.8	53.63	0.9	1.8	0
K19	1839.1	44.09	1	2	0
K37	1757.2	32.17	504.1	309.7	2.87
K12	1742	30.67	0.9	1.8	0
K31	1716.4	28.15	0.9	1.8	0
K41	1714.1	27.92	0.9	1.8	0

Pile	N [kN]	head settlement [mm]	maks M [kNm]	maks V [kN]	y_o [mm]
K21	1713.4	27.85	0.9	1.8	0
K34	1710	27.52	458.2	290.2	2.46
K35	1709.1	27.44	461.6	291.5	2.49
K36	1701.9	26.73	497.7	307.4	2.81
K30	1701.6	26.7	451.6	283.8	2.47
K40	1699.9	26.53	461.1	288.6	2.54
K27	1697.1	26.25	494.8	305.1	2.8
K47	1696.1	26.16	513.4	314.2	2.95
K59	1690.4	25.6	0.9	1.8	0
K25	1685.7	25.13	455.8	288.6	2.45
K50	1684.1	24.97	1.1	2.1	0
K45	1679.2	24.49	467.5	294.4	2.54
K51	1675.9	24.17	0.9	1.8	0
K11	1674.6	24.04	0.9	1.8	0
K44	1664.5	23.04	464.1	293.2	2.5
K24	1662.3	22.82	452.3	287.3	2.41
K15	1655.9	22.19	0.9	1.8	0
K26	1652.8	21.89	488.3	302.8	2.73
K46	1646.9	21.31	507.1	312	2.88
K55	1641.3	20.76	0.9	1.8	0
K20	1630.9	0	1.4	2.9	0
K16	1622.5	0	0.9	1.8	0
K56	1619.3	0	0.9	1.8	0
K60	1608.5	0	1.1	2.1	0
K54	1601.9	0	0.9	1.8	0
K14	1588.7	8.35	446.5	284.4	2.37
K17	1537.4	7.49	485.6	300.6	2.73
K57	1536.5	7.48	0.9	1.8	0

Table 13: Pile-by-pile solution results

Run: 36 lateral + 31 axial, separate runs · Lateral diagrams vary from pile to pile. · most settled: K1 → 81.27 mm

9. DESIGN ENVELOPE — INERTIAL + KINEMATIC

The effects from the structure (inertial) and from the soil (kinematic), per TBDY 16C.5 — have been combined SECTION BY SECTION using the absolute sum rule. The combination has been performed separately for each pile;; and the governing share may vary from pile to pile.,

Quantity	Value
Combination rule	TBDY 16C.5 — absolute sum
Worst combined moment	529.5 kNm
Governing pile	K58
Depth	0 m
Governing share	EYLEMSİZLİK (kinematik yok) (kinematiğin payı %0)
Contribution of the kinematic effect	inertial only 529.5 kNm → combined 529.5 kNm (0%)
Worst combined shear	321.1 kN

Table 14: Design envelope summary

Pile	Row	β_G	$M_{inertial}$ [kNm]	$M_{kinematic}$ [kNm]	$M_{COMBINED}$ [kNm]	$V_{COMBINED}$ [kN]	Governing
K58	—	1.00	529.5	0	529.5	321.1	INERTIA (no kinematics)
K48	—	1.00	520.1	0	520.1	316.6	INERTIA (no kinematics)
K47	—	1.00	513.4	0	513.4	314.2	INERTIA (no kinematics)
K38	—	1.00	510.8	0	510.8	312	INERTIA (no kinematics)
K46	—	1.00	507.1	0	507.1	312	INERTIA (no kinematics)
K37	—	1.00	504.1	0	504.1	309.7	INERTIA (no kinematics)
K28	—	1.00	501.6	0	501.6	307.5	INERTIA (no kinematics)
K36	—	1.00	497.7	0	497.7	307.4	INERTIA (no kinematics)
K27	—	1.00	494.8	0	494.8	305.1	INERTIA (no kinematics)
K18	—	1.00	492.5	0	492.5	303	INERTIA (no kinematics)
K26	—	1.00	488.3	0	488.3	302.8	INERTIA (no kinematics)
K17	—	1.00	485.6	0	485.6	300.6	INERTIA (no kinematics)
K43	—	1.00	474	0	474	298.4	INERTIA (no kinematics)
K45	—	1.00	467.5	0	467.5	294.4	INERTIA (no kinematics)
K44	—	1.00	464.1	0	464.1	293.2	INERTIA (no kinematics)
K49	—	1.00	463.7	0	463.7	290.9	INERTIA (no kinematics)
K35	—	1.00	461.6	0	461.6	291.5	INERTIA (no kinematics)
K40	—	1.00	461.1	0	461.1	288.6	INERTIA (no kinematics)
K34	—	1.00	458.2	0	458.2	290.2	INERTIA (no kinematics)
K25	—	1.00	455.8	0	455.8	288.6	INERTIA (no kinematics)
K33	—	1.00	454.9	0	454.9	289.1	INERTIA (no kinematics)

Pile	Row	β_G	$M_{inertial}$ [kNm]	$M_{kinematic}$ [kNm]	$M_{COMBINED}$ [kNm]	$V_{COMBINED}$ [kN]	Governing
K39	—	1.00	454.1	0	454.1	286.1	INERTIA (no kinematics)
K24	—	1.00	452.3	0	452.3	287.3	INERTIA (no kinematics)
K30	—	1.00	451.6	0	451.6	283.8	INERTIA (no kinematics)
K23	—	1.00	449	0	449	286.1	INERTIA (no kinematics)
K14	—	1.00	446.5	0	446.5	284.4	INERTIA (no kinematics)
K29	—	1.00	444.6	0	444.6	281.3	INERTIA (no kinematics)
K10	—	1.00	1.6	0	1.6	3.4	INERTIA (no kinematics)
K20	—	1.00	1.4	0	1.4	2.9	INERTIA (no kinematics)
K9	—	1.00	1.3	0	1.3	2.7	INERTIA (no kinematics)
K50	—	1.00	1.1	0	1.1	2.1	INERTIA (no kinematics)
K60	—	1.00	1.1	0	1.1	2.1	INERTIA (no kinematics)
K8	—	1.00	1.1	0	1.1	2.2	INERTIA (no kinematics)
K19	—	1.00	1	0	1	2	INERTIA (no kinematics)
K7	—	1.00	1	0	1	1.9	INERTIA (no kinematics)
K70	—	1.00	1	0	1	1.9	INERTIA (no kinematics)
K1	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K2	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K3	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K4	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K5	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K6	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K11	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K12	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K13	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K15	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K16	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K21	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K22	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K31	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K32	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K41	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K42	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K51	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)

Pile	Row	β_G	$M_{inertial}$ [kNm]	$M_{kinematic}$ [kNm]	$M_{COMBINED}$ [kNm]	$V_{COMBINED}$ [kN]	Governing
K52	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K53	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K54	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K55	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K56	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K57	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K59	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K61	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K62	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K63	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K64	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K65	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K66	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K67	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K68	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)
K69	—	1.00	0.9	0	0.9	1.8	INERTIA (no kinematics)

Table 15: Pile-by-pile design envelope (inertial + kinematic)

9.1. GRUP AZALTMASI β_G — COMBINATION BY COMBINATION

Eq. 16C.1 constructs β_G from two things: the pile's row number IN THE LOAD DIRECTION and the s/D in that direction. The row number depends on the direction; — a pile that is row 1 when the earthquake comes from x may be row 4 when it comes from y. Because TBDY 4.4.2's %100 + %30 rule produces eight separate directions, β_G CHANGES from combination to combination. The table below recounts the rows using each combination's own horizontal resultant angle (θ) and recalculates β_G. The row is blank for a combination without earthquake: the kinematic effect is the earthquake itself, and β_G is undefined for a combination with no direction (writing either 1.00 or 0.20 would be false).

Quantity	Value
Mode	SINGLE DIRECTION (combination's own sign and θ)
Number of seismic combinations	34
Governing combination (LARGEST β_G)	94
Governing β_G	G'+Q'-Ex'+0.3Ey'+0.3Ez
Table 16.1: Summary of β_G combination scan	0.935

Table 16: Summary of the β_G combination scan

Combination	θ [°]	β_G min	β_G maks	β_G avg	Row
1.4G+1.6Q	41	0.643	0.866	0.665	4
G+Q	42	0.638	0.864	0.660	4
G'+Q'+Ex-0.3Ey+0.3Ez	11	0.825	0.934	0.843	4
G'+Q'+Ex+0.3Ey+0.3Ez	16	0.810	0.929	0.829	4
G'+Q'-Ex-0.3Ey+0.3Ez	196	0.810	0.929	0.829	4
G'+Q'-Ex+0.3Ey+0.3Ez	191	0.825	0.934	0.843	4
G'+Q'+Ey-0.3Ex+0.3Ez	22	0.783	0.918	0.801	4
G'+Q'+Ey+0.3Ex+0.3Ez	19	0.797	0.924	0.816	4
G'+Q'-Ey-0.3Ex+0.3Ez	199	0.797	0.924	0.816	4
G'+Q'-Ey+0.3Ex+0.3Ez	202	0.782	0.918	0.801	4
G'+Q'+Ex'-0.3Ey'+0.3Ez	11	0.825	0.934	0.843	4
G'+Q'+Ex'+0.3Ey'+0.3Ez	15	0.811	0.929	0.830	4
G'+Q'-Ex'-0.3Ey'+0.3Ez	195	0.811	0.929	0.830	4
G'+Q'-Ex'+0.3Ey'+0.3Ez	191	0.826	0.935	0.844	4
G'+Q'+Ey'-0.3Ex'+0.3Ez	20	0.791	0.921	0.810	4
G'+Q'+Ey'+0.3Ex'+0.3Ez	18	0.801	0.925	0.821	4
G'+Q'-Ey'-0.3Ex'+0.3Ez	198	0.801	0.925	0.821	4
G'+Q'-Ey'+0.3Ex'+0.3Ez	200	0.790	0.921	0.809	4
0.9G'+Ex-0.3Ey-0.3Ez	11	0.825	0.934	0.843	4
0.9G'+Ex+0.3Ey-0.3Ez	16	0.810	0.929	0.829	4
0.9G'-Ex-0.3Ey-0.3Ez	196	0.810	0.929	0.829	4
0.9G'-Ex+0.3Ey-0.3Ez	191	0.825	0.934	0.843	4
0.9G'+Ey-0.3Ex-0.3Ez	22	0.782	0.918	0.801	4
0.9G'+Ey+0.3Ex-0.3Ez	19	0.797	0.924	0.816	4
0.9G'-Ey-0.3Ex-0.3Ez	199	0.797	0.924	0.816	4
0.9G'-Ey+0.3Ex-0.3Ez	202	0.782	0.918	0.801	4
0.9G'+Ex'-0.3Ey'-0.3Ez	11	0.825	0.934	0.843	4
0.9G'+Ex'+0.3Ey'-0.3Ez	15	0.811	0.929	0.830	4
0.9G'-Ex'-0.3Ey'-0.3Ez	195	0.811	0.929	0.830	4
0.9G'-Ex'+0.3Ey'-0.3Ez	191	0.825	0.935	0.844	4
0.9G'+Ey'-0.3Ex'-0.3Ez	20	0.790	0.921	0.810	4
0.9G'+Ey'+0.3Ex'-0.3Ez	18	0.801	0.925	0.821	4
0.9G'-Ey'-0.3Ex'-0.3Ez	198	0.801	0.925	0.821	4

Combination	θ [°]	β_G min	β_G maks	β_G avg	Row
0.9G'-Ey'+0.3Ex'-0.3Ez	200	0.790	0.921	0.809	4

Table 17: Kombinasyon kombinasyon β_G (Denk. 16C.1)

row Mode: TEK YÖN (kombinasyonun kendi işareti ve θ'sı). β_G was calculated with Eq. 16C.1 in the OWN direction (θ) of EACH combination, with the row numbers recounted; 94 distinct β_G values resulted in 34 seismic combinations. Governing the design (LARGEST β_G): G'+Q'-Ex'+0.3Ey'+0.3Ez → β_G = 0.935. β_G MULTIPLIES the kinematic moment, so the worst case is the large β_G. β_G VARIES from combination to combination: the horizontal resultant of each combination ($\pm1.0E_x \pm 0.3E_y \cdot \pm0.3E_x \pm 1.0E_y$) gives a different θ; when θ changes, the ROW number of the pile and s/D in that direction change. READING THE DIRECTION: if the load direction is +X, the piles move toward +X and EACH PILE BEARS against the soil IN FRONT OF IT (on the +X side). No one is in front of the column farthest toward +X: it bears against virgin soil, its spring is the stiffest, it attracts the MOST load and is reduced the LEAST (row 1, $\beta_G \approx 0.82 \cdot s/D = 3$). Each column behind bears against the loosened trace of the one in front; the reduction increases. β_{G1} is FIXED at 0.20 after the FOURTH row (Eq. 16C.1), so the gradient flattens after four steps — in a group of 11 columns, the last seven columns get the same color. In a combination with the opposite sign, the roles swap exactly. SIRA KADEMELERİ (örnek: '1.4G+1.6Q' · θ = 41°): 1. sıra → β_G 0.818 (3 kazık) · 2. sıra → β_G 0.735 (5 kazık) · 3. sıra → β_G 0.668 (7 pile(s)) · 4 and beyond → β_G 0.643 (55 piles)

9.2. β_G — COMBINATION × ROW DISTRIBUTION

Each row is a combination; the cells show the ROW number in that combination's direction and the β_G of that row (the number of piles in that row is shown in parentheses). If β_G varies from pile to pile within a row, — it is given as a range, since s/D can vary from pile to pile, and burying it in an average would hide the difference.

Combination	θ [°]	ROW → β_G (count)
1.4G+1.6Q	41	S1: 0.82~0.87 (3) · S2: 0.74~0.80 (5) · S3: 0.67~0.72 (7) · S4: 0.64~0.66 (55)
G+Q	42	S1: 0.81~0.86 (3) · S2: 0.73~0.80 (5) · S3: 0.66~0.71 (7) · S4: 0.64~0.66 (55)
G'+Q'+Ex-0.3Ey+0.3Ez	11	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.82~0.83 (49)
G'+Q'+Ex+0.3Ey+0.3Ez	16	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
G'+Q'-Ex-0.3Ey+0.3Ez	196	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
G'+Q'-Ex+0.3Ey+0.3Ez	191	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.82~0.83 (49)
G'+Q'+Ey-0.3Ex+0.3Ez	22	S1: 0.90~0.92 (7) · S2: 0.86~0.86 (2) · S3: 0.81~0.83 (7) · S4: 0.78~0.79 (54)
G'+Q'+Ey+0.3Ex+0.3Ez	19	S1: 0.924 (7) · S2: 0.87~0.87 (2) · S3: 0.83~0.84 (7) · S4: 0.80~0.81 (54)
G'+Q'-Ey-0.3Ex+0.3Ez	199	S1: 0.924 (7) · S2: 0.87~0.87 (2) · S3: 0.83~0.84 (7) · S4: 0.80~0.81 (54)
G'+Q'-Ey+0.3Ex+0.3Ez	202	S1: 0.90~0.92 (7) · S2: 0.85~0.86 (2) · S3: 0.81~0.83 (7) · S4: 0.78~0.79 (54)
G'+Q'+Ex'-0.3Ey'+0.3Ez	11	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.83~0.83 (49)
G'+Q'+Ex'+0.3Ey'+0.3Ez	15	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
G'+Q'-Ex'-0.3Ey'+0.3Ez	195	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
G'+Q'-Ex'+0.3Ey'+0.3Ez	191	S1: 0.935 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.83~0.83 (49)
G'+Q'+Ey'-0.3Ex'+0.3Ez	20	S1: 0.921 (7) · S2: 0.86~0.86 (2) · S3: 0.82~0.83 (7) · S4: 0.79~0.80 (54)

Combination	θ [°]	ROW → β_G (count)
G'+Q'+Ey'+0.3Ex'+0.3Ez	18	S1: 0.925 (7) · S2: 0.85~0.87 (7) · S3: 0.83~0.83 (3) · S4: 0.80~0.81 (53)
G'+Q'-Ey'-0.3Ex'+0.3Ez	198	S1: 0.925 (7) · S2: 0.85~0.87 (7) · S3: 0.83~0.83 (3) · S4: 0.80~0.81 (53)
G'+Q'-Ey'+0.3Ex'+0.3Ez	200	S1: 0.91~0.92 (7) · S2: 0.86~0.86 (2) · S3: 0.82~0.83 (7) · S4: 0.79~0.80 (54)
0.9G'+Ex-0.3Ey-0.3Ez	11	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.82~0.83 (49)
0.9G'+Ex+0.3Ey-0.3Ez	16	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
0.9G'-Ex-0.3Ey-0.3Ez	196	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
0.9G'-Ex+0.3Ey-0.3Ez	191	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.82~0.83 (49)
0.9G'+Ey-0.3Ex-0.3Ez	22	S1: 0.90~0.92 (7) · S2: 0.85~0.86 (2) · S3: 0.81~0.83 (7) · S4: 0.78~0.79 (54)
0.9G'+Ey+0.3Ex-0.3Ez	19	S1: 0.924 (7) · S2: 0.87~0.87 (2) · S3: 0.83~0.84 (7) · S4: 0.80~0.81 (54)
0.9G'-Ey-0.3Ex-0.3Ez	199	S1: 0.924 (7) · S2: 0.87~0.87 (2) · S3: 0.83~0.84 (7) · S4: 0.80~0.81 (54)
0.9G'-Ey+0.3Ex-0.3Ez	202	S1: 0.90~0.92 (7) · S2: 0.85~0.86 (2) · S3: 0.81~0.83 (7) · S4: 0.78~0.79 (54)
0.9G'+Ex'-0.3Ey'-0.3Ez	11	S1: 0.934 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.83~0.83 (49)
0.9G'+Ex'+0.3Ey'-0.3Ez	15	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
0.9G'-Ex'-0.3Ey'-0.3Ez	195	S1: 0.929 (7) · S2: 0.86~0.87 (7) · S3: 0.84~0.84 (3) · S4: 0.81~0.82 (53)
0.9G'-Ex'+0.3Ey'-0.3Ez	191	S1: 0.935 (7) · S2: 0.87~0.88 (7) · S3: 0.84~0.85 (7) · S4: 0.83~0.83 (49)
0.9G'+Ey'-0.3Ex'-0.3Ez	20	S1: 0.921 (7) · S2: 0.86~0.86 (2) · S3: 0.82~0.83 (7) · S4: 0.79~0.80 (54)
0.9G'+Ey'+0.3Ex'-0.3Ez	18	S1: 0.925 (7) · S2: 0.85~0.87 (7) · S3: 0.83~0.83 (3) · S4: 0.80~0.81 (53)
0.9G'-Ey'-0.3Ex'-0.3Ez	198	S1: 0.925 (7) · S2: 0.85~0.87 (7) · S3: 0.83~0.83 (3) · S4: 0.80~0.81 (53)
0.9G'-Ey'+0.3Ex'-0.3Ez	200	S1: 0.91~0.92 (7) · S2: 0.86~0.86 (2) · S3: 0.82~0.83 (7) · S4: 0.79~0.80 (54)

Table 18: Combination × row β_G distribution

The row number is recounted in EACH combination's OWN direction: a pile may be row 1 in one combination and row 4 in another. You are in SINGLE DIRECTION (diagnostic) mode: the row and β_G come from the same direction and are tracked one-to-one. The two-direction envelope must be used IN DESIGN.

10. PILE REINFORCED CONCRETE SECTION AND REINFORCEMENT

The section has been checked under the N-M-V demand from the design envelope using circular section P-M interaction and the TS 500 shear provisions. The reinforcement arrangement is proposed by the program and can be modified by the user;; the VALID arrangement is given in the report.

Quantity	Value
Longitudinal reinforcement	16 × Ø20 (A_s = 50.3 cm²)
Transverse reinforcement (tie)	Ø10 confinement · stem pitch 10 cm · head zone (2Ø = 1.6 m) pitch ≤ 10 cm
Cover · steel class	7.5 cm · B420C

Quantity	Value
Total area A_s	50.3 cm²
Reinforcement ratio ρ	%1.00
Demand N_d · M_d · V_d	N_d = 2940 kN · M_d = 529.5 kNm · V_d = 321.1 kN (TASARIM ZARFI · pile 58 · governing share INERTIA (no kinematics) · β_G = 1.00 (sıra 0) · 'G'+Q'-Ey-0.3Ex+0.3Ez')
Bending capacity $M_r(N_d)$	987 kNm
M_d/M_r	0.54 (satisfied)
Shear strength V_r	932.7 kN
V_d/V_r	0.34 (satisfied)
Yield moment M_y	987 kNm
Source of the layout	Entered MANUALLY by the designer

Table 19: Pile section reinforcement and check results

> TBDY 16.10.2.3: longitudinal reinforcement ratio ρ ≥ %1.0 for DTS 1·1a·2·2a, ρ ≥ %0.8; the tie spacing must be ≤ 20 cm, and ≤ 10 cm over the first 2Ø length at the pile head. The section has been solved with the SHAFT spacing (conservative side);; the confinement zone is shown separately in the drawings. for DTS 3·3a·4·4a

10.1. Burkulma Denetimi (narin / mikro pile(s))

Buckling has been checked for slender piles passing through soil with weak lateral support: P_{cr} = 300811 kN (critical layer: Silty sand).

10.2. Pile–Raft Anchorage and Hook Development

The anchorage of the pile longitudinal reinforcement into the raft has been checked for the MOST CRITICAL PULLOUT case. The hook geometry (inner bend diameter, tail) has been determined with the applicable values, and the CUT (development) length has been calculated.

Quantity	Value
Critical case	K58 · G'+Q'-Ey-0.3Ex+0.3Ez · tension 0 kN · head moment 529.5 kNm
Governing demand	BENDING (head moment)
Bar tension	217 kN/bar (σ_s = 690.7 MPa · f_{yd} = 365.2 MPa)
Anchorage length ℓ_b	0.686 m
Anchorage solution · factor	KANCA 90° · factor 0.70
Required length	0.48 m
Available straight length	1.2 m
Verdict	PASSES
Bend angle · inner bend diameter	90° · inner bend diameter 120 mm
Straight + arc + tail	113 + 11 + 24 cm
DEVELOPMENT (cut) length	148 cm

Table 20: Hook / anchorage development (most critical pullout case)

10.3. Quantity Take-off and Approximate Cost

The reinforcement quantity has been derived from the cut length, based on the stock bar length and lap-splice assumption. The tie/spiral length is calculated as a HELIX (including the pitch);; the ring and Z-bar cage reinforcement are separate line items. The line-item quantities are THEORETICAL; — waste appears only in the order line.

Item	Reinforcement	Ø [mm]	Count	Total length [m]	kg/m	Weight [kg]
1	Longitudinal reinforcement	20	2.240	25.317.6	2.469	62.512
2	Spiral / helix	10	2.520	29.653.5	0.617	18.305
3	Ring reinforcement (horizontal hoop)	16	350	687.1	1.580	1.086
4	Z-bars (cross bracing inside the cage)	16	560	2.858.2	1.580	4.517

Table 21: Reinforcement quantity take-off (item by item)

Quantity	Value
Number of piles · total length	70 adet · 1.400.0 m
Concrete (net / order)	703.72 / 738.90 m³
Drilling	1.400.0 m
Steel (theoretical / order)	86.420 kg / 89.012 tons
Reinforcement ratio	122.8 kg/m³
Longitudinal lap splice (TS 500 Art. 9.2)	60Ø kabul · ℓ0 = 1.2 m (60Ø) · 1 bindirme/hat · LAP TRANSVERSE REINFORCEMENT (TS 500 Art. 9.2.7): Ø_hoop 10 ≥ max(Ø/3; 8) = 8 mm ✓ · s ≤ min(D/4; 20 cm) = 20 cm · ≥ 6 turns along the lap (1.2 m) → SAĞLANIYOR 8–9.2 m (STEM): s = 10 cm, 12 turns ✓
Raft step (elevator pit etc.)	NONE — no raft step/pit zone defined
Uncounted rigid inclusion	None — uncounted rigid inclusion (jet grouting) not defined
Approximate cost	9.111.511 TL (steel 2.447.834 + concrete 3.583.678 + drilling 3.080.000 TL)

Table 22: Quantity take-off summary and approximate cost

> The approximate cost is derived ONLY from material (steel · concrete) and drilling unit prices;; prices are entered by the user. Transportation, formwork, labor, site setup, waste disposal, and VAT ARE NOT INCLUDED IN THIS FIGURE. This is a PRELIMINARY COST estimate, not a bid.

11. GROUP BEARING CAPACITY (TBDY 16.9.3.3)

Σ tekil = 89530 kN · block failure = 762448 kN · KARAR = 89530 kN (Σ TEKİL)

12. CONCLUSION AND EVALUATION

As a result of the analyses above, it is proposed to construct the foundation system with 70 80 cm-diameter, 20 m-long ForeKazik piles. The design bearing capacity is Q_{tv} = 1279 kN, and the axial load on the most loaded pile is at the level of 3433 kN. The section check gives M_d/M_r = 0.54 (satisfied) and V_d/V_r = 0.34 (satisfied).

The section and anchorage checks in this report are satisfied. WARNING: the design axial load of the most heavily loaded pile, N_{max} = 3433 kN, exceeds the design bearing capacity Q_{tv} = 1279 kN (N_{max}/Q_{tv} = 2.68). In a piled raft part of the load is carried by raft–soil contact (pile share in this solution 81.3%); piles may be used as settlement reducers working close to their capacity. This comparison should be assessed together with the load sharing and settlement results.

12.1. Program Decision and Remark Lines

The lines below are the decision and warning texts produced by the calculation branches themselves; they show which assumption was made where.

Note
Design code: TBDY 2018 — Turkish Building Earthquake Code
side-by-side interaction: on — Reese & Van Impe (2001) / GROUP, secondary source (r = 0.64·(s/D)^{0}.34, s/D < 3.75; neighbours multiplied; static p-multiplier only, not applied to β_G)
SIVILAŞMIŞ 'Siltli kum': f_s = 0 · p-y ×0.10 uygulanıyor. Bayrağın kaynağı: zemin ekranında ELLE işaretlendi.
Tip (BEREZANTZEV 1961 chart — Tomlinson Figure 4.13 / Poulos & Davis Figure 3.9 approximate reading, ±%15): N_q = 9.6 (ϕ = 24.8°, L/D = 25) · σ'$_v$(uç) = 263.2 kPa → 2529 kPa · tavan 1900 kPa (API RP 2A Tablo 6.4.3-1 · very loose (δ = 15° row) · δ = ϕ' − 5° = 19.8° → 1.9 MPa) → q_u = 1900 kPa. ϕ = 24.8° abak sınırına (25–45°) kırpıldı; ('Yüksek plastisiteli silt')
Qs = 1202 kN · Qu = 955 kN → Q_{tv} = 1279 kN (Denk. 16.15a: Qs/1.50 + Qu/2.00).
⚠ Çalışma yükü (2358 kN) tasarım dayanımını (1279 kN) AŞIYOR — oturma yine hesaplandı ama kapasite yetmiyor; önce 16.14 sağlanmalı.
Shortening: (Q_b + 0.5·Q_s)·L/(A·E) = (1156 + 0.5·1202)·20/(0.5027·31.8e6) → ξ_{eff} = 0.75 (Vesić 1977; friction pile 0.5 · end-bearing pile 1.0).
Poulos–Davis (1980) elastic: E_s(avg) = 32 MPa · L/d = 25 · K = E_p/E_s = 995 · h/L = 1.03 · ν = 0.30 → I_0 = 0.070 · R_k = 1.15 · R_h = 0.37 · R_v = 0.94 → I = 0.0280 · s = P·I/(E_s·D) = 2358·0.0280/(31973·0.8) = 2.6 mm (approximate chart reading ±20%; reported ALONGSIDE the simple column).
s = shortening 2.2 mm + base 40 mm = 42.2 mm (simple approach — uniform transfer + 5%·D base assumption).
The curve was cut at 2049 kN — no convergence in the softening/peak region (progressive failure limit).
⚠ The working load (2358 kN) is ABOVE what the t-z/Q-z system can carry — no convergence. Characteristic peak ≈ 2157 kN (less with softening).
P_{cr} = 2·√(EI·k) = 300811 kN — critical layer 'Siltli kum' (k = 35380 kPa; EI = 639397 kNm²). If there is a FREE length above ground, it is not modeled here — that part must be checked separately as a column.
⚠ NO KINEMATIC SHARE: the design envelope is inertial ONLY. If you run Method III (the envelope must have been fetched), this screen also includes kinematics. The program DOES NOT FABRICATE a kinematic moment

Note
— it does not assume zero; it ignores it and says so.
CONNECTION RULE: TBDY 16C.5 ABSOLUTE SUM (comes from the settings — this arm does not SELECT a rule, it applies it).
DESIGN ENVELOPE: 70 piles combined. WORST combined |M| = 529.5 kNm — pile 58 · at 0 m depth · governing share EYLEMSİZLİK (kinematik yok) (kinematic share 0%) · combination 'G'+Q'-Ey-0.3Ex+0.3Ez'.
COMBINED SHEAR: worst |V| = 321.1 kN (pile 58). Shear was combined by the SAME rule as moment (16C.4.2.2 average · R · same combination rule); the section check uses this shear.
HOOK GEOMETRY (90°): inner bend diameter 6Ø = 120 mm (ACI 318 Table 25.3.1 · 6Ø for Ø ≤ 25, 8Ø for Ø ≥ 28) · kuyruk 12Ø = 24 cm.
DEVELOPED (CUTTING) LENGTH = straight 113 cm + bend arc 11 cm + tail 24 cm = 148 cm. The arc is measured along the bar AXIS: $L_{arc} = \theta \cdot (r_{in} + Ø/2) = 90° \times (6 + 1)$ cm.
PULL-OUT DEMAND — governing: FLEXURE (head moment). Tension 0 kN / 16 bars = 0 kN/bar · from flexure 217 kN/bar (M = 529.5 kNm · kol ≈ 0.80 × 0.61 m · ≈5 bars on the tension side). Bar stress σ_s = 690.7 MPa (f_{yd} = 365.2 MPa → ratio 1.00).
THE BENDING ALLOWANCE IS AN APPROXIMATE ESTIMATE: the exact bar force comes from the section solution (P-M equilibrium state). The program takes the larger value and states which one it is; it does not claim exactness.
ANCHORAGE: ℓ_b = $0.12 \cdot (f_{yd}/f_{ctd}) \cdot Ø$ = 0.686 m (alt sınır 20Ø = 0.4 m · f_{ctd} = 1.28 MPa) × çarpan 0.70 → GEREKEN 0.48 m; MEVCUT düz boy (radye h 130 cm − kırılma 10 cm) 1.2 m → ✓ SAĞLIYOR.
DIAGNOSTIC (does NOT CHANGE the verdict): length proportional to actual stress ℓ_req = $ℓ_b \cdot (\sigma_s/f_{yd})$ = 0.686 m. The verdict is given on the full ℓ_b, assuming the bar MAY YIELD — this is what TS 500 requires, and it keeps the same number as the connection screen in 0.58.0.
TOTAL: 70 piles · 1400 m total length · steel 86.420 kg theoretical → ORDER 89.012 tons with 3% waste · concrete 703.72 m³ net → 738.9 m³ with 5% waste · reinforcement ratio 122.8 kg/m³.
ITEM QUANTITIES ARE THEORETICAL: waste appears only in the ORDER line — adding waste item by item would be double counting.
Lap length is taken as a MULTIPLE OF DIAMETER (same as Excavation Support: 60Ø); the TS 500 lap calculation depending on concrete class and f_{yd} is not performed. This is an ASSUMPTION and can be changed in the settings.
LAP TRANSVERSE REINFORCEMENT (TS 500 Art. 9.2.7): Ø_hoop 10 ≥ max(Ø/3; 8) = 8 mm ✓ · s ≤ min(D/4; 20 cm) = 20 cm · ≥ 6 turns along the lap (1.2 m) → SAĞLANIYOR
8–9.2 m (STEM): s = 10 cm, 12 turns ✓
APPROXIMATE COST: steel 2.447.834 TL (by ORDER tonnage) + concrete 3.583.678 TL (by volume incl. waste) + drilling 3.080.000 TL = 9.111.511 TL. Prices come FROM THE SETTINGS, the program does not know prices; transport, formwork, labor, site setup and VAT are NOT INCLUDED IN THIS FIGURE.

Table 23: Decision and remark lines of the calculation arms

13. REFERENCES

[1] Turkish Building Earthquake Code (TBDY 2018), Chapter 16 and Annex 16C, Official Gazette 18.03.2018, No. 30364 (repeated).

[2] TS 500 — Requirements for Design and Construction of Reinforced Concrete Structures, TSE.

[3] Communiqué on the Principles of Soil and Foundation Investigation Practice and Report Format, Official Gazette 09.03.2019, No. 30709 (repeated).

[4] API RP 2A-WSD; Matlock (1970); Reese et al. (1974) — p-y curves.

[5] Vijayvergiya (1977); Randolph and Wroth (1978) — t-z / q-z springs.

[6] O'Neill and Reese (1999) — rock-socketed piles.

[7] Nikolaou et al. (2001) — kinematic moment estimation.

[8] Fellenius (1984, 2006) — neutral plane and drag load.

APPENDICES — FIGURES

The figures below are diagrams generated by the program. The figure for an analysis that has not been run is NOT included: plotting an empty axis would create the false impression that it was "calculated".

FIGURES

> The figures below are generated from CALCULATED results; no figure is included for a branch that was not calculated (empty axes would suggest it was calculated). The axes and the source of each figure are stated below it.

A · 3D VIEWS

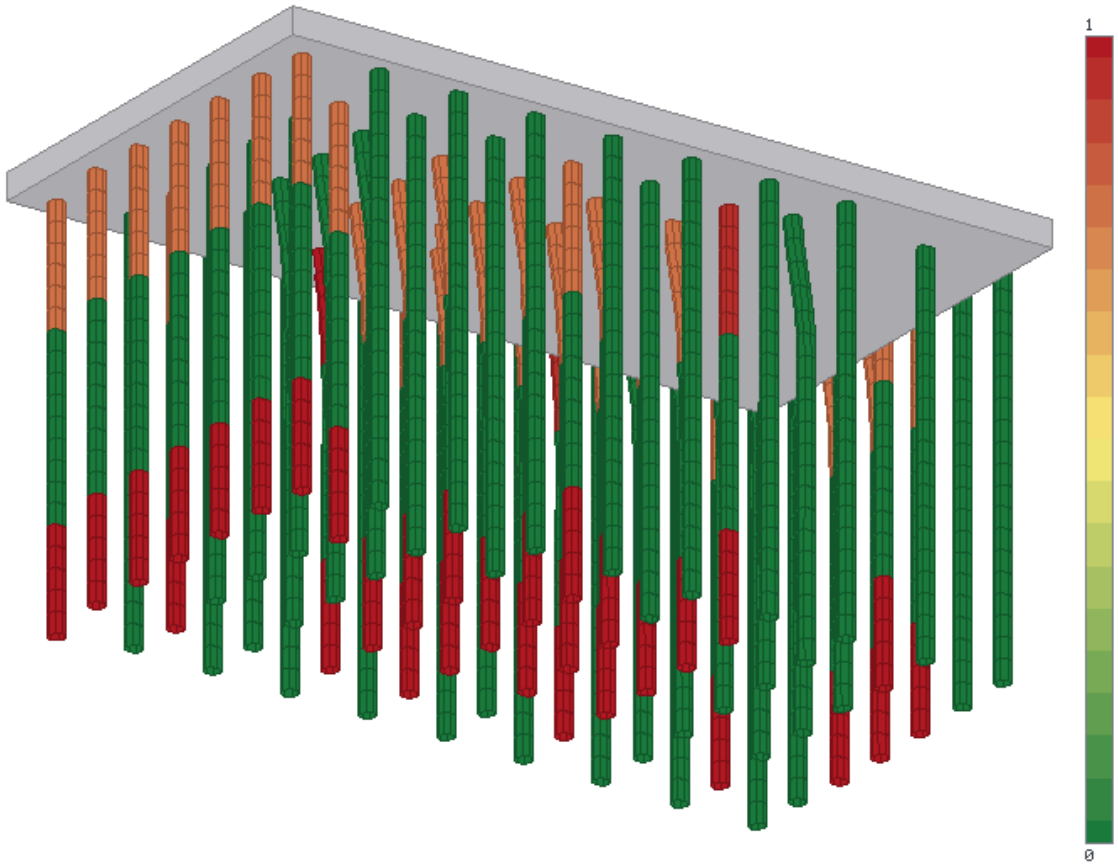


Figure 1: 3D · shaft mobilization t/t_{max}

The color is the ratio of the mobilized shaft friction to t_{max} at each depth (0 = none, 1 = fully mobilized). Zones approaching red have EXHAUSTED their friction; beyond that point additional settlement is transferred to the tip. DISCLAIMER: this view is a 3D DRAWING of the 1D SPRING MODEL (p-y · t-z · q-z) — it is NOT a 3D continuum finite element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED to make them visible.

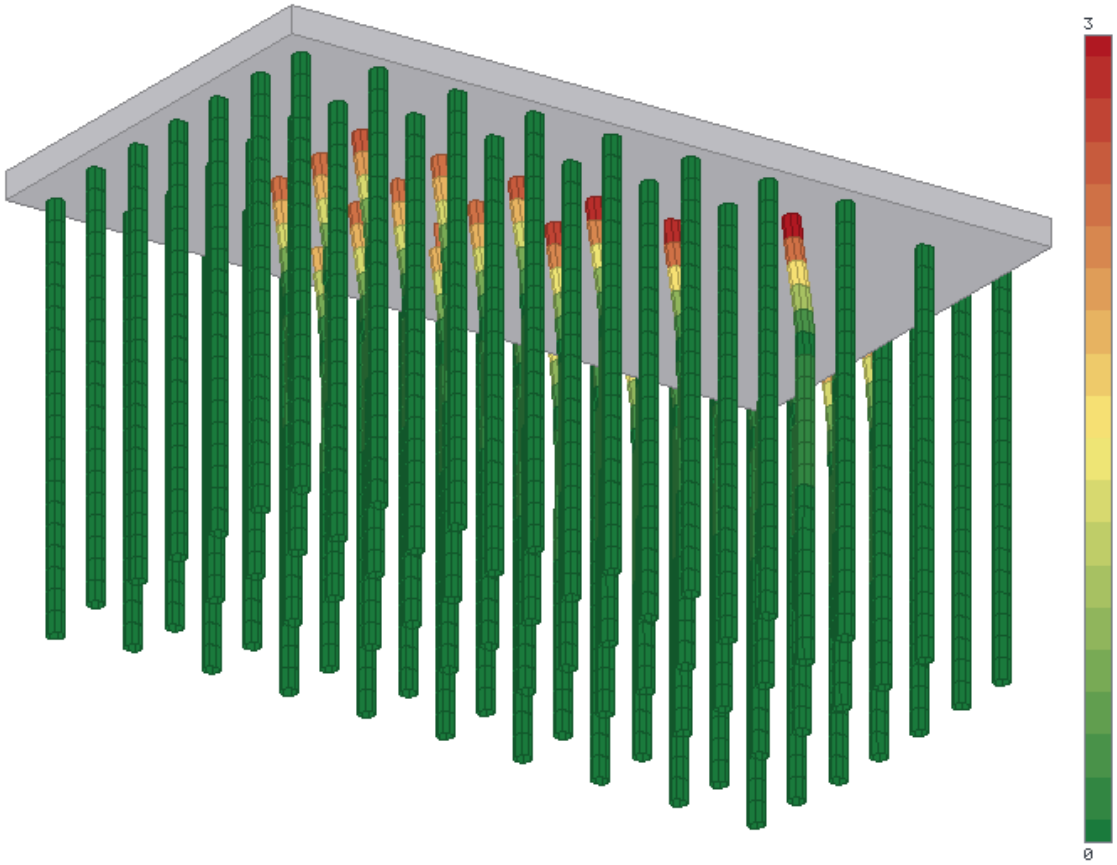


Figure 2: 3D · lateral displacement |y(z)| [mm]

The deformed shape is exaggerated to make it VISIBLE (the exaggeration factor is written in the scene notes). The color is the magnitude of |y|. DISCLAIMER: this view is a 3D DRAWING of the 1D SPRING MODEL (p-y · t-z · q-z) — it is NOT a 3D continuum finite element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED to make them visible.

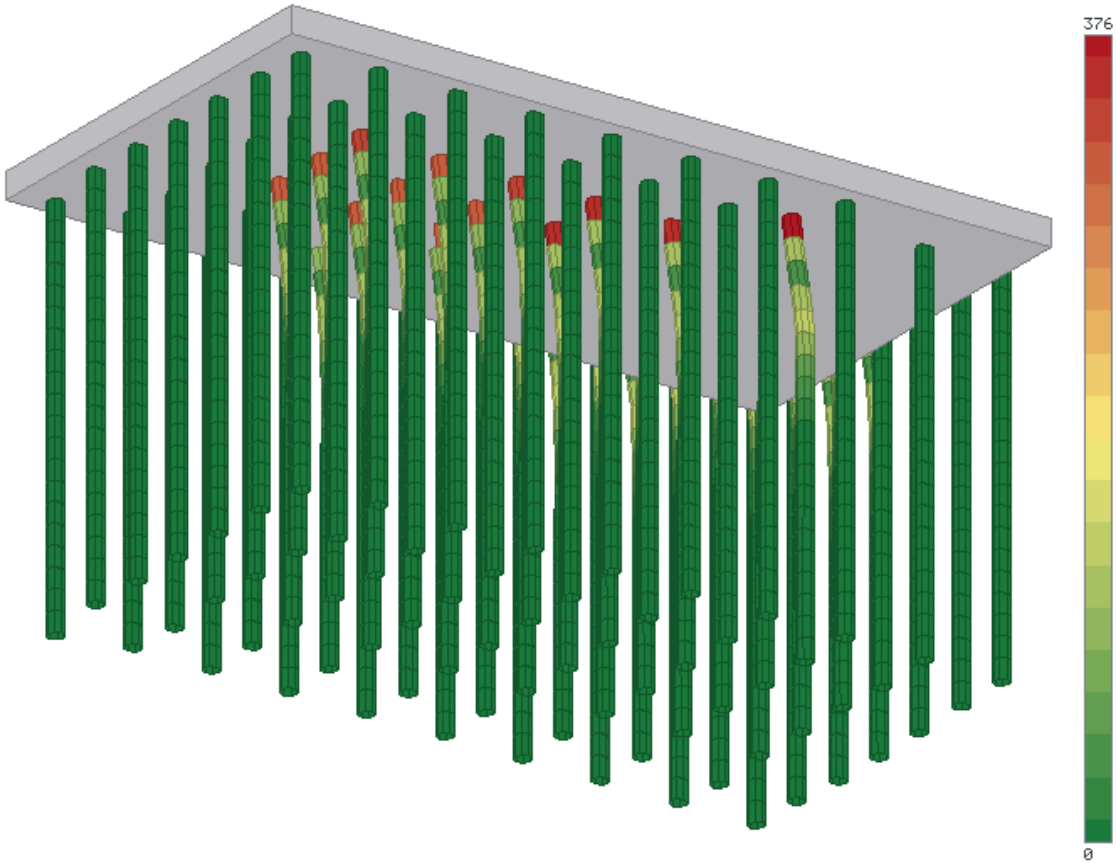


Figure 3: 3D · bending moment |M(z)| [kNm]

The color is the magnitude of |M|; the sign of the moment is NOT in this picture (for the sign, see the M(z) curves in section B). DISCLAIMER: this view is a 3D DRAWING of the 1D SPRING MODEL (p-y · t-z · q-z) — it is NOT a 3D continuum finite element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED to make them visible.

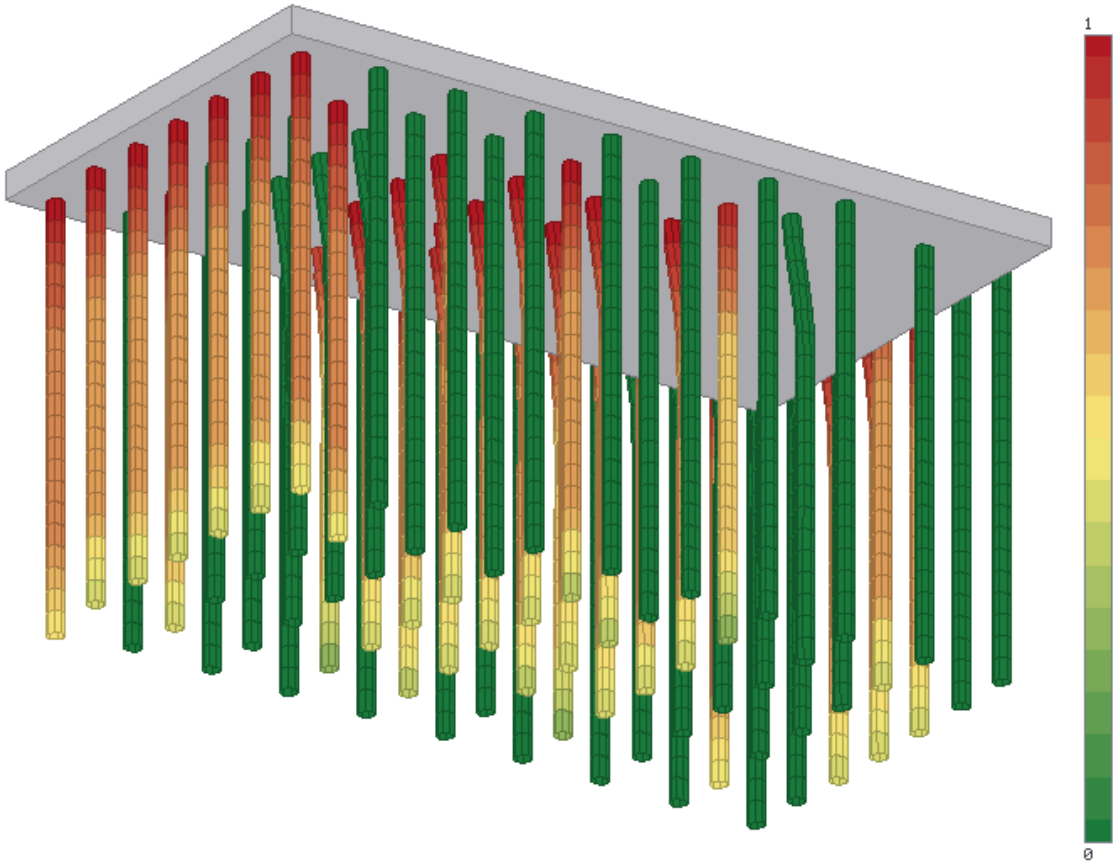


Figure 4: 3D · load transfer $N(z)/N_{head}$

> It is NOT a Her kazık KENDİ baş kuvvetine normalize edilmiştir: 1.0 baştaki yük, 0.4 ucun hâlâ taşıdığı paydır. ŞERH: bu görüntü 1B YAY MODELİNİN (p-y · t-z · q-z) 3B ÇİZİMİDİR — 3D continuum finite-element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED so they are visible.

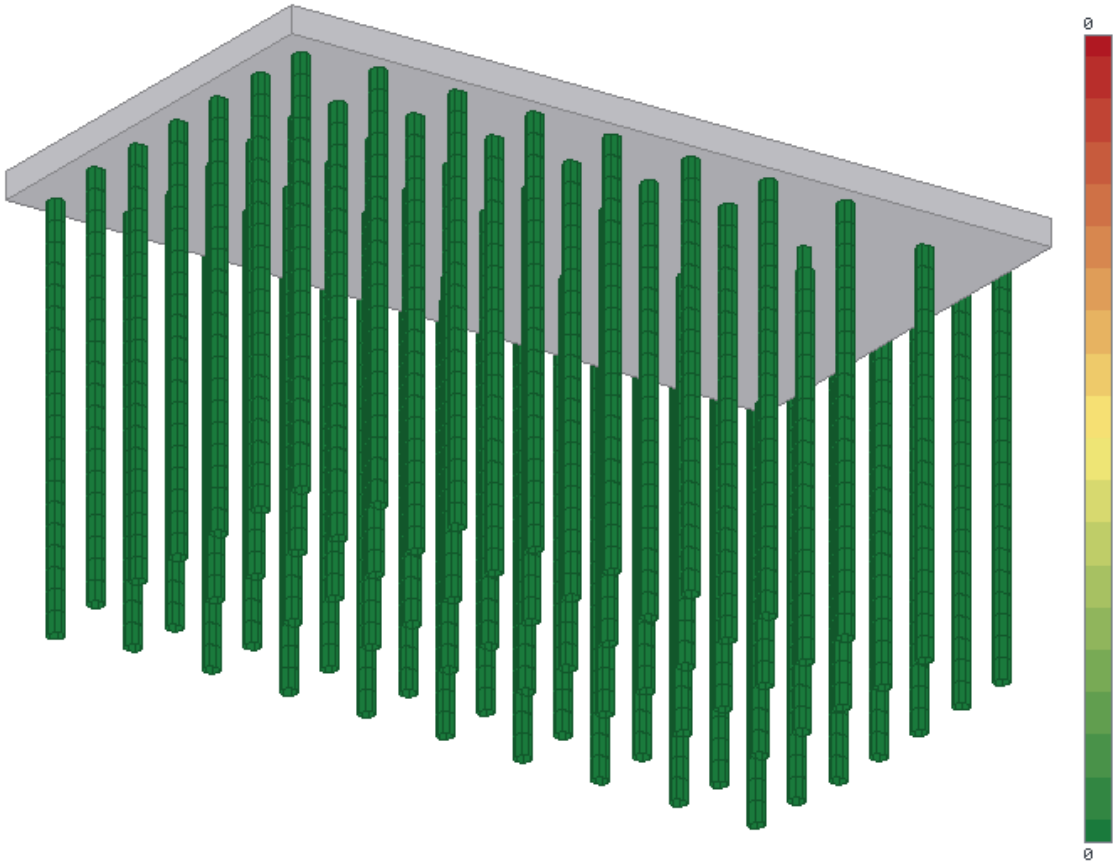


Figure 5: 3D · kinematic moment ONLY |M_kin(z)|

This is the share imposed by the soil (TBDY Annex 16C · Method III, reduced by R = 2.5). Inertia from the structure is NOT INCLUDED in this picture. DISCLAIMER: this view is a 3D DRAWING of the 1D SPRING MODEL (p-y · t-z · q-z) — it is NOT a 3D continuum finite element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED to make them visible.

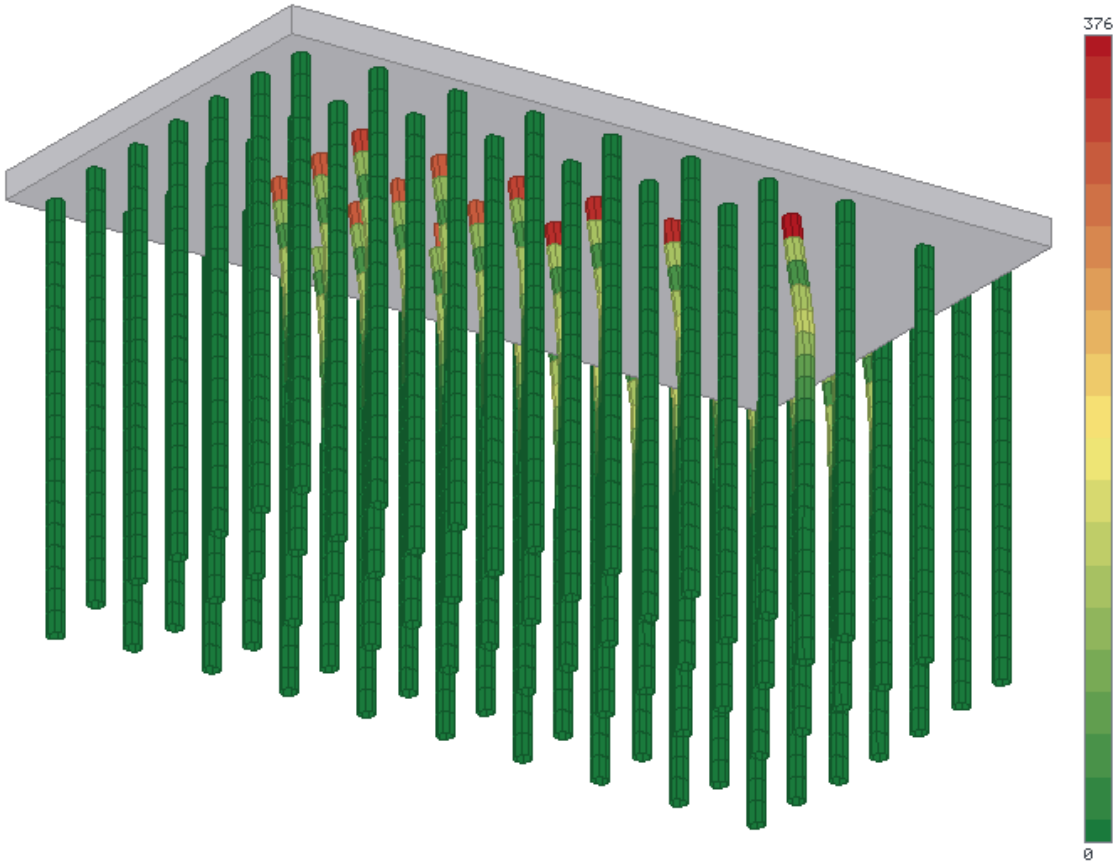


Figure 6: 3D · COMBINED moment |M(z)| (entering design)

> Inertial + kinematic are summed with the combination rule in the settings. The section check and reinforcement selection use this. DISCLAIMER: this view is a 3D DRAWING of the 1D SPRING MODEL (p-y · t-z · q-z) — it is NOT a 3D continuum finite element solution. The soil is not solved and not colored; pile-to-pile interaction is represented only by the p-multiplier and β_G. Displacements are EXAGGERATED to make them visible.

B · PILE INTERNAL FORCES and DISPLACEMENTS

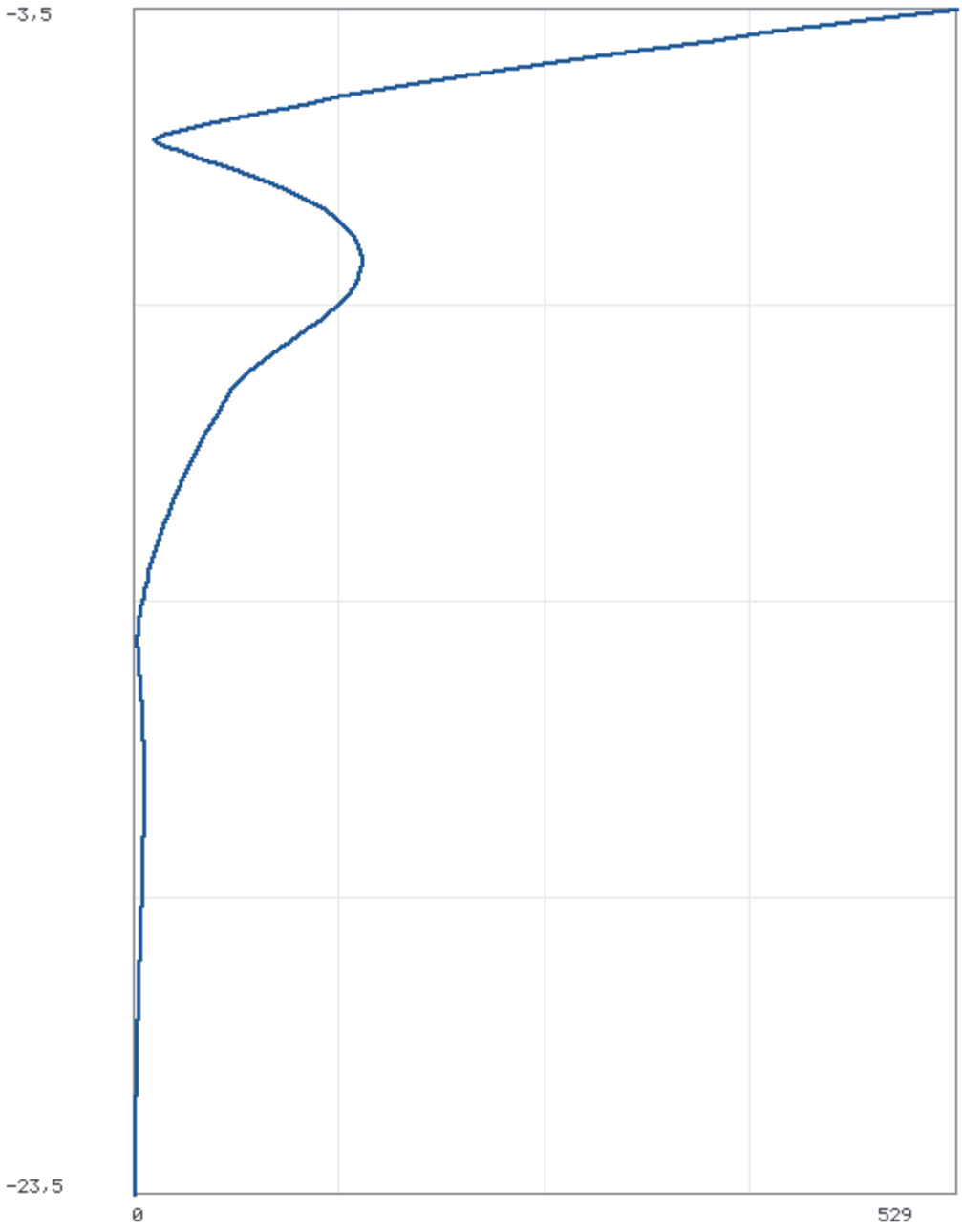


Figure 7: M(z) — pile 58 (with largest moment)

> Horizontal axis: moment M [kNm] · vertical axis: elevation [m]. The curve comes from the N-governed case of combination 'G'+Q'-Ey-0.3Ex+0.3Ez'; p-multiplier 0.67. Max |M| = 529.5 kNm.

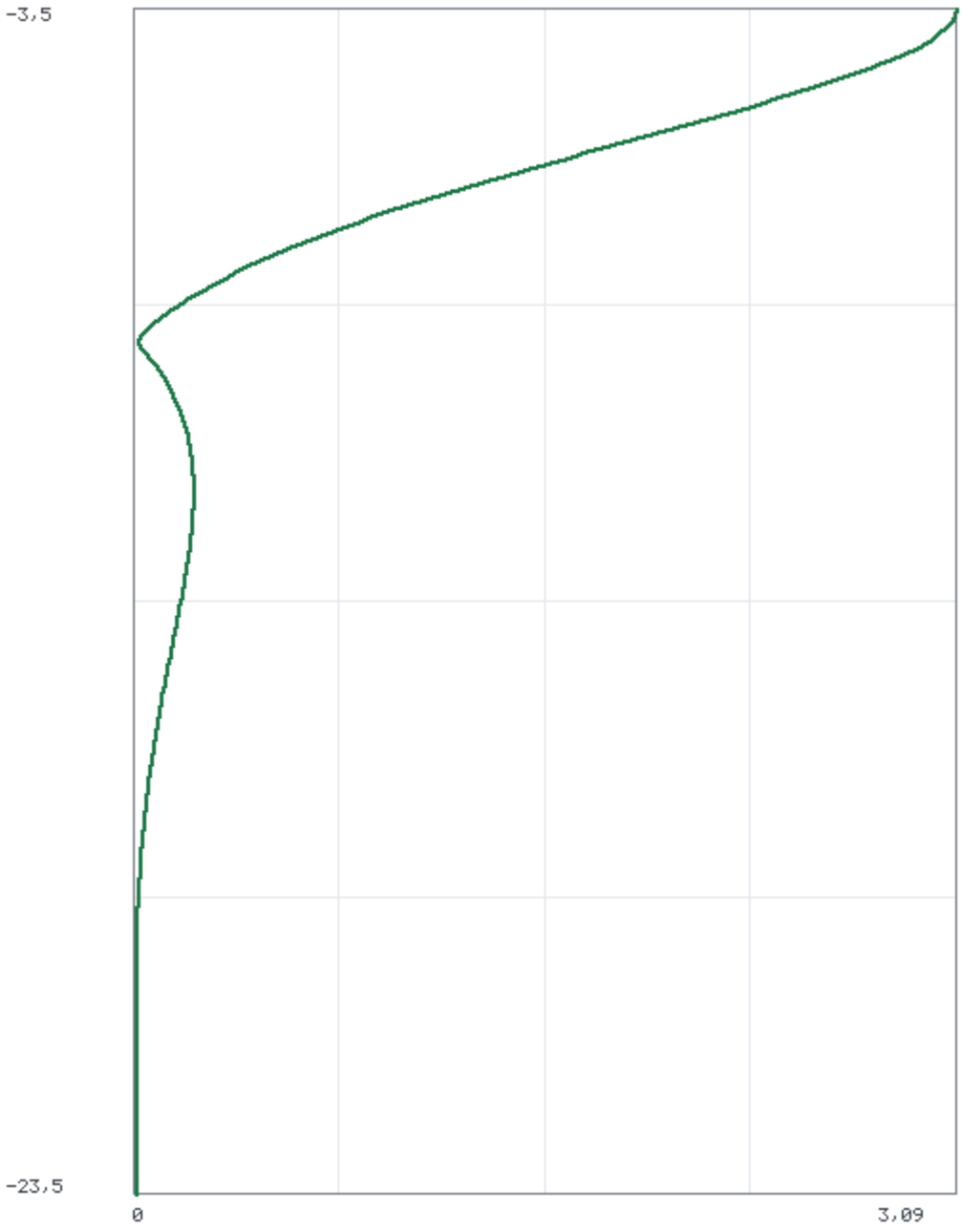


Figure 8: y(z) — pile 58 lateral displacement

> Horizontal axis: y [mm] · vertical axis: level [m]. Since 0.62.0 the main chain solves COUPLED (biaxial) when both load components are present and passes the RESULTANT downstream; with a single component the planar solver runs.

C · KINEMATIC and DESIGN ENVELOPE

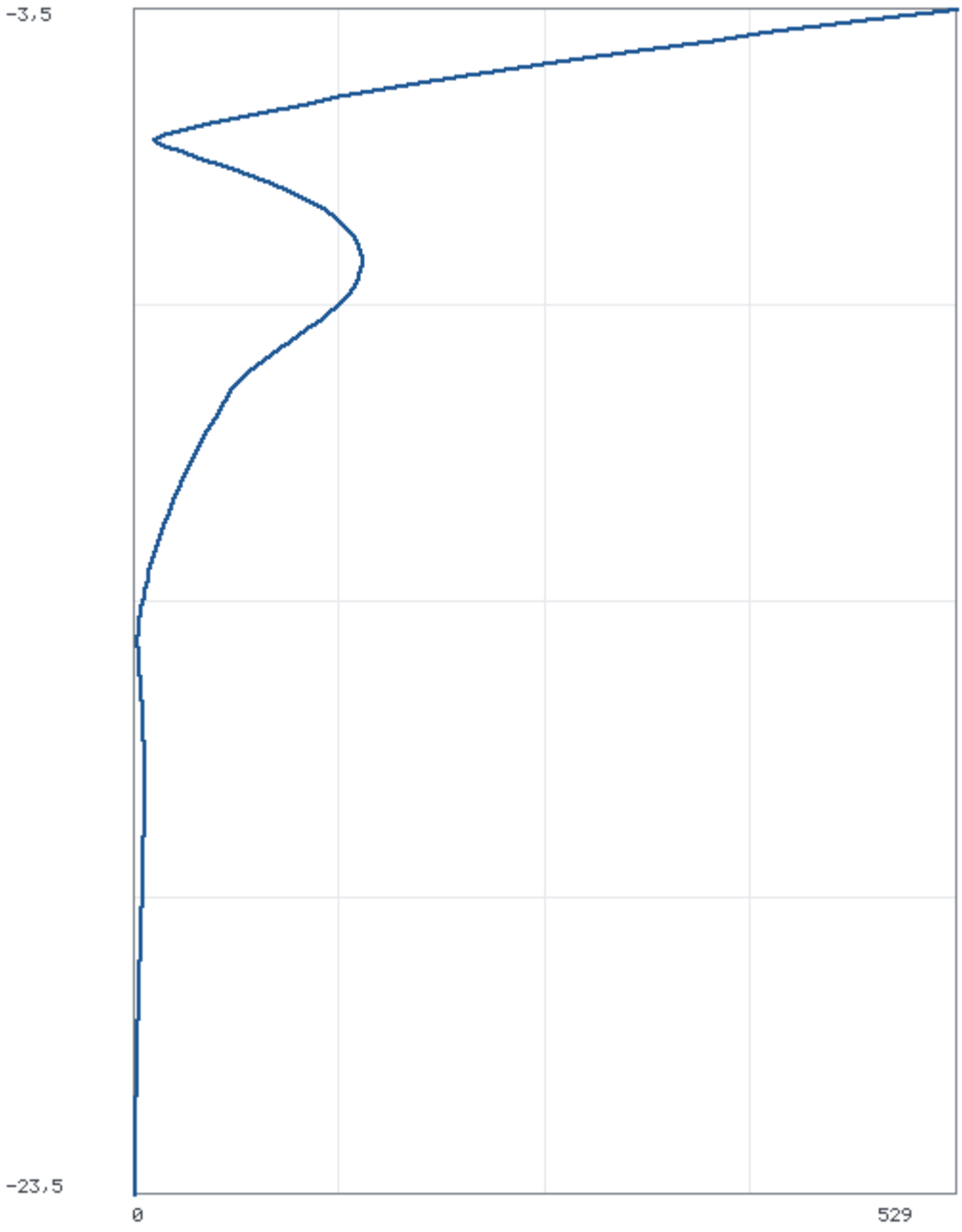


Figure 9: M(z) INERTIAL — pile 58 (from the structure)

> Horizontal axis: moment M [kNm] · vertical axis: level [m]. This curve is ONLY the share from the structure; kinematics does not enter this figure. Max |M| = 529.5 kNm.

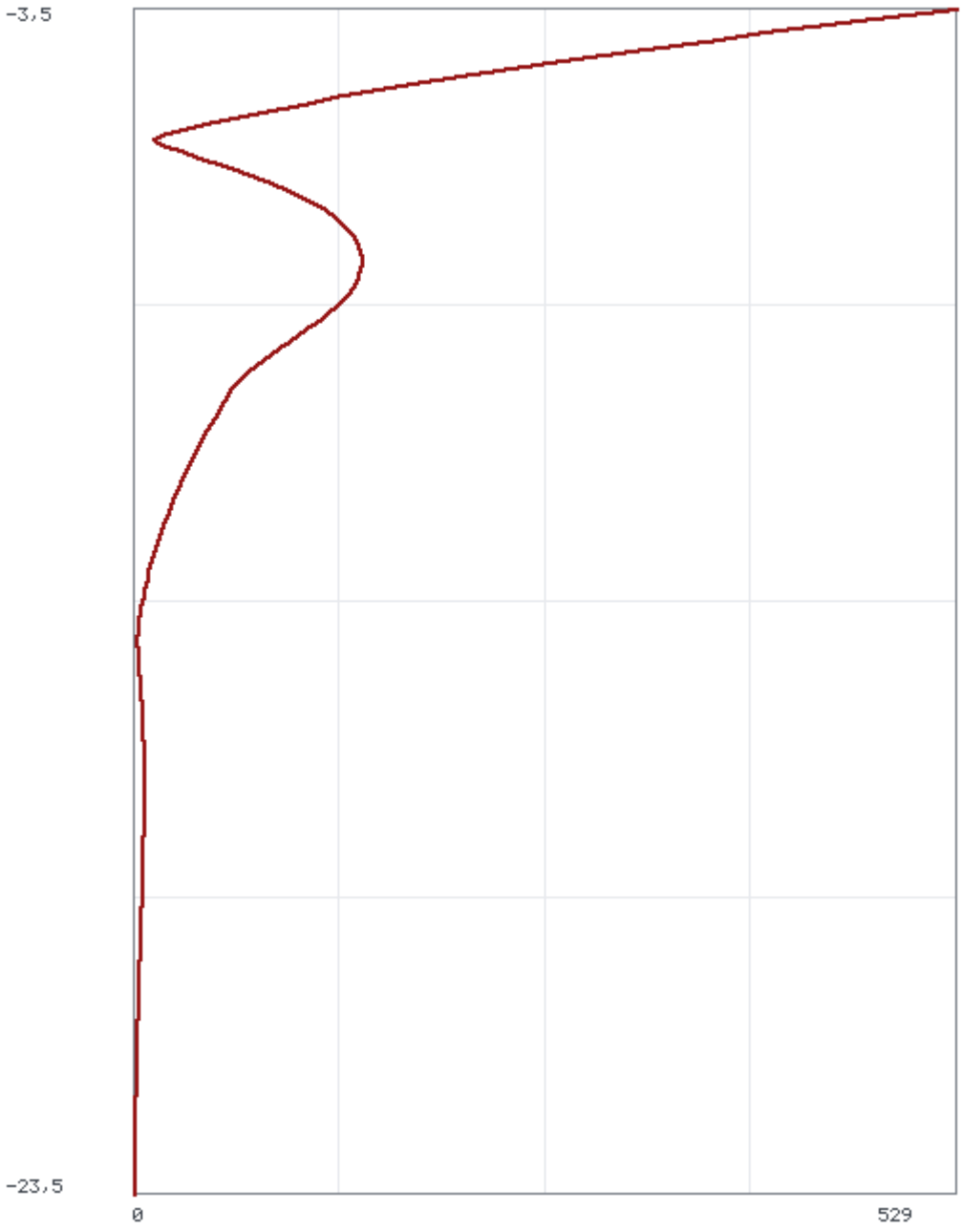


Figure 10: M(z) COMBINED — pile 58 (ENTERS DESIGN)

> Combination rule: TBDY 16C.5 absolute sum. Governing share INERTIA (no kinematics); max |M| = 529.5 kNm (at 0 m depth). The section check and reinforcement selection are fed from this curve.

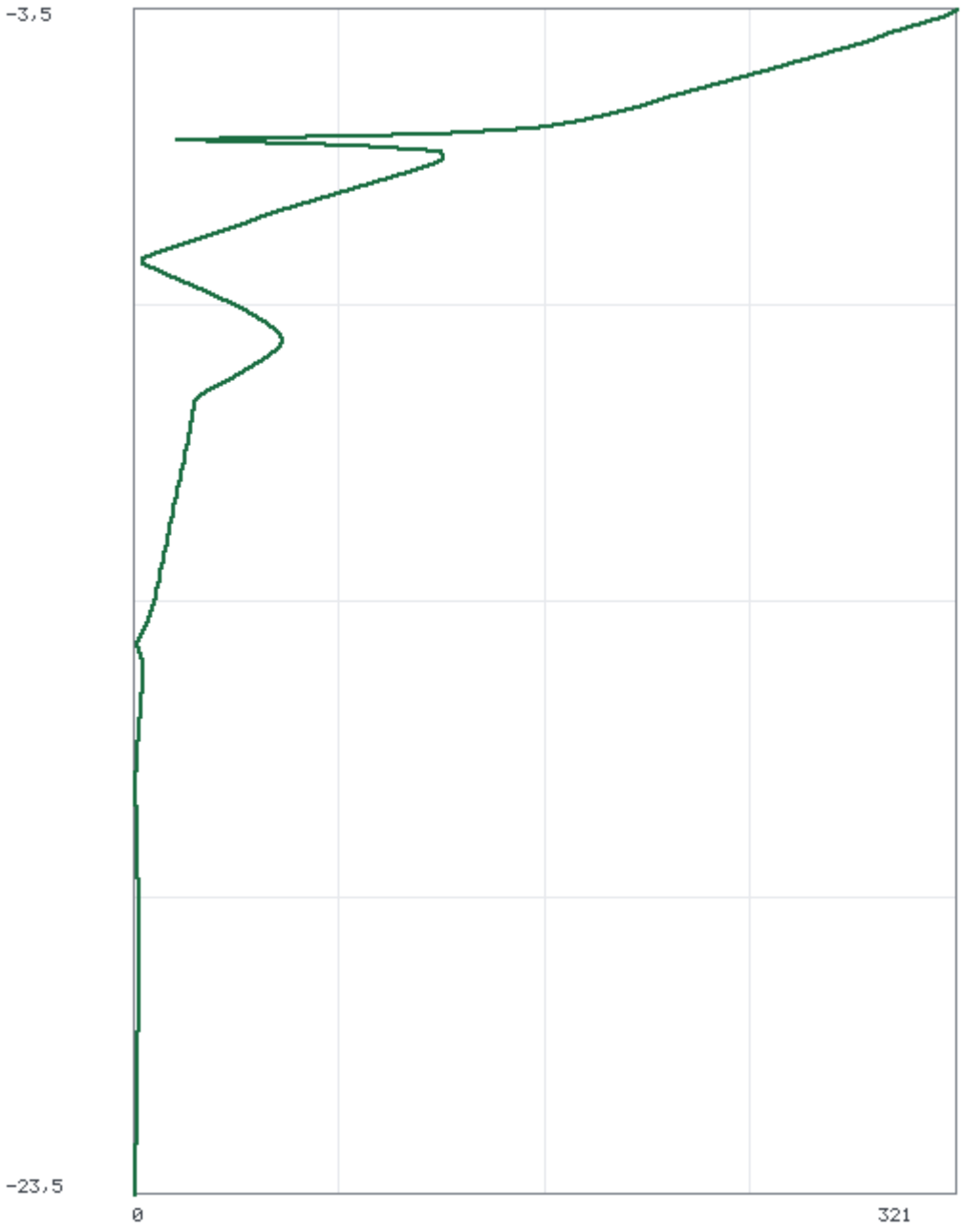


Figure 11: V(z) COMBINED — pile 58 (enters the tie calculation)

> Horizontal axis: shear force V [kN] · vertical axis: level [m]. Shear is combined with the SAME rule as moment (16C.4.2.2 average · R). Max |V| = 321.1 kN.

E · RAFT SLAB

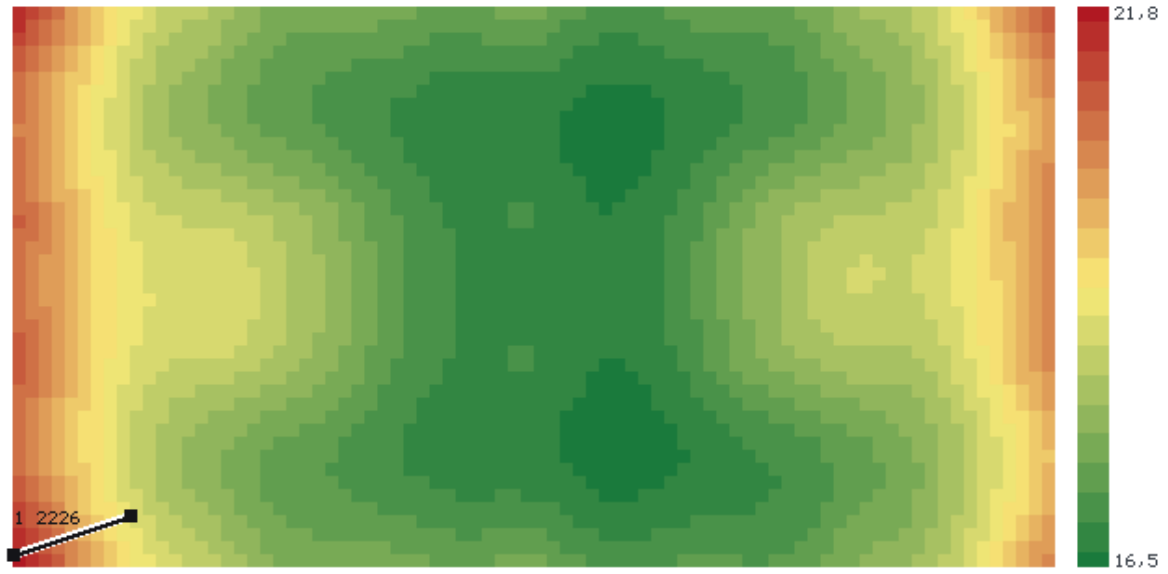


Figure 12: Radye oturma haritası [mm] · distorsiyon çizgisiyle

Renk skalası düğüm çökmesini gösterir (sağdaki şeritte uç değerler yazılıdır). Gri hücreler poligonun DIŞINDA kalan, çözüme girmeyen elemanlardır. MUTLAK oturma yapının battığını, FARKLI oturma yapıyı ZORLAYANI gösterir. Koyu çizgi EN BÜYÜK AÇISAL DİSTORSİYONUN bulunduğu çifti gösterir: β = 1/2226 (sınır 1/500) · artık oturma farkı 2.1 mm / 4.69 m. Rijit dönme ÇIKARILMIŞTIR; ölçü boyu kaynağı: üst yapı elemanı MERKEZLERİ (26 eleman) — medyan en yakın komşu.

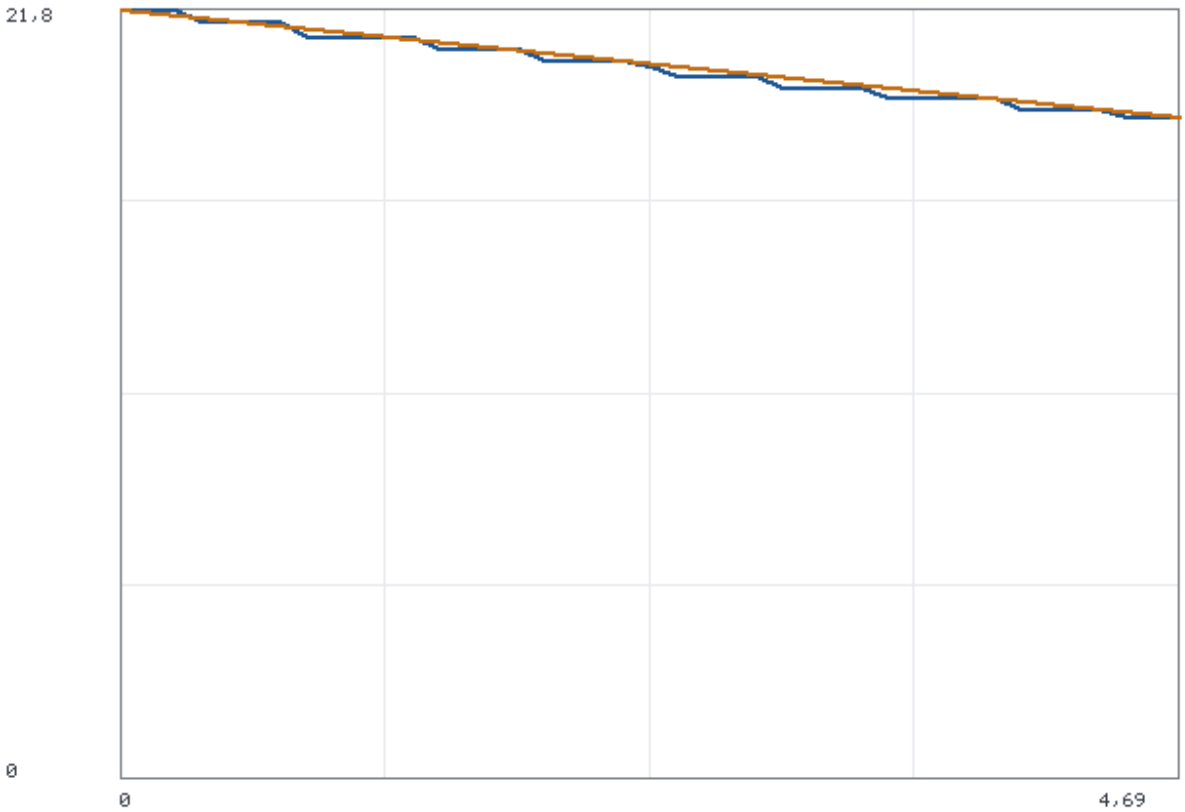


Figure 13: Settlement profile and SLOPE — line with the distortion found

Yatay eksen: hat boyunca uzaklık [m] · düşey eksen: oturma [mm]. Mavi eğri gerçek oturma profili; turuncu doğru iki ucu birleştiren RİJİT EĞİMDİR. Açısal distorsiyon, eğriyle doğru arasındaki ARTIK farktan doğar: β = 1/2226 (sınır 1/500 · SINIR İÇİNDE).

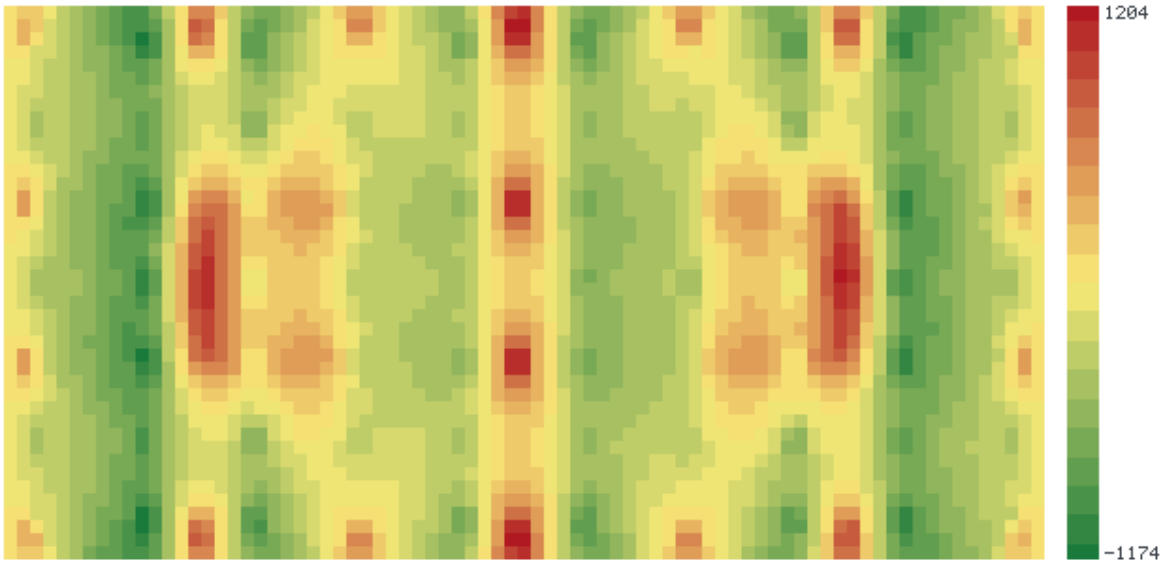


Figure 14: Raft slab M_x map [kNm/m]

Element-center bending moment (governing the reinforcement in the x direction). Max |M_x| = 1203.8 kNm/m. Kirchhoff thin plate assumption: there is no shear deformation and no torsional degree of freedom at the node.

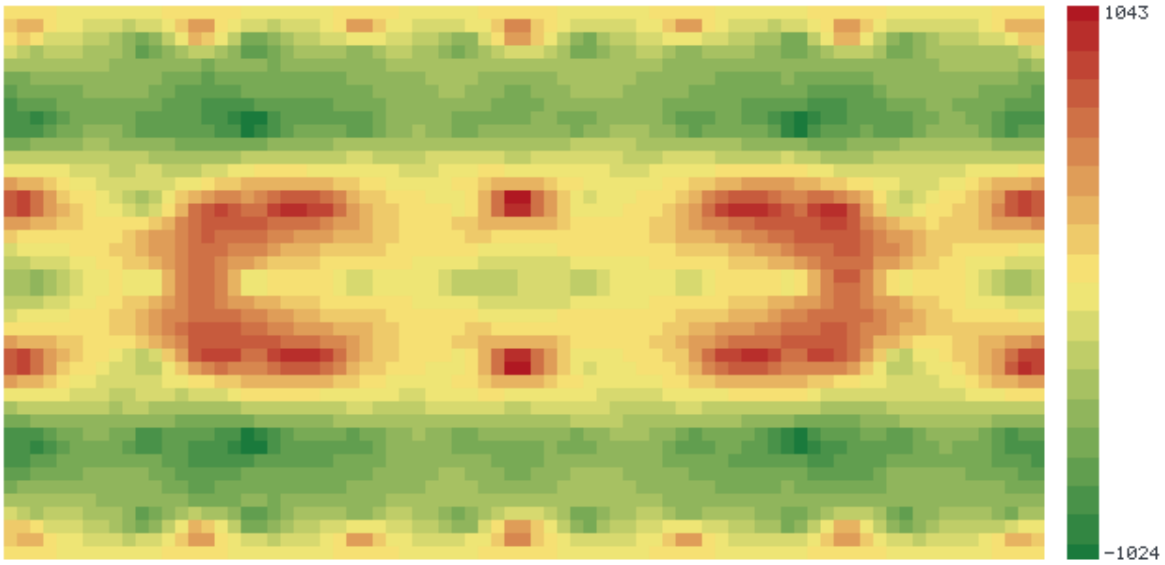


Figure 15: Raft slab M_y map [kNm/m]

Element-center bending moment in the y direction. Max |M_y| = 1043.1 kNm/m.

D · SOIL SPRINGS (p-y · t-z · q-z)

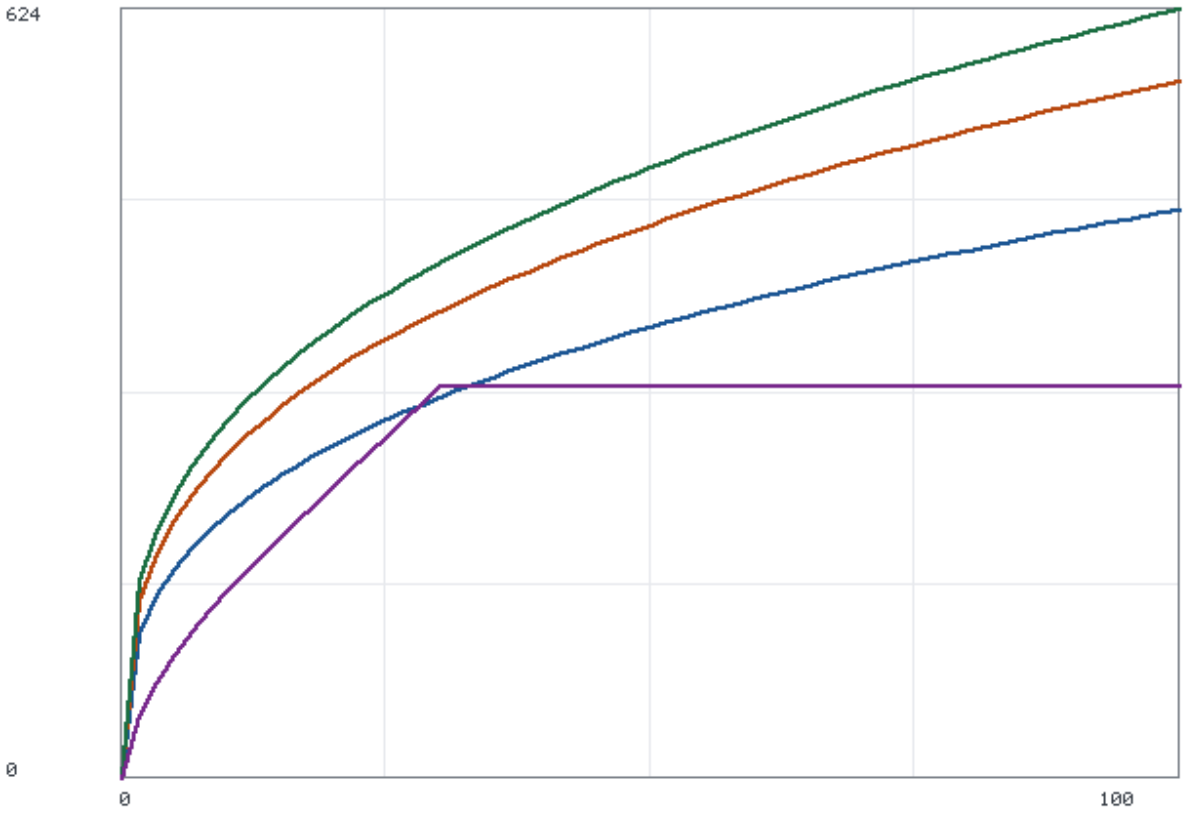


Figure 16: p-y curves — at four depths

Yatay eksen: y [mm] · düşey eksen: p [kN/m]. Kazık başından ölçülen z = 2 m (kot -5.5) · z = 4 m (kot -7.5) · z = 6 m (kot -9.5) · z = 8 m (kot -11.5) derinlikleri içindir; hangi p-y modelinin koştuğu (Matlock · Reese · Welch-Reese · API · Rollins · zayıf kaya · c-ϕ) zemin tablosunun 'p-y modeli' sütunundan gelir ve rapor metninde tabaka tabaka yazılıdır.

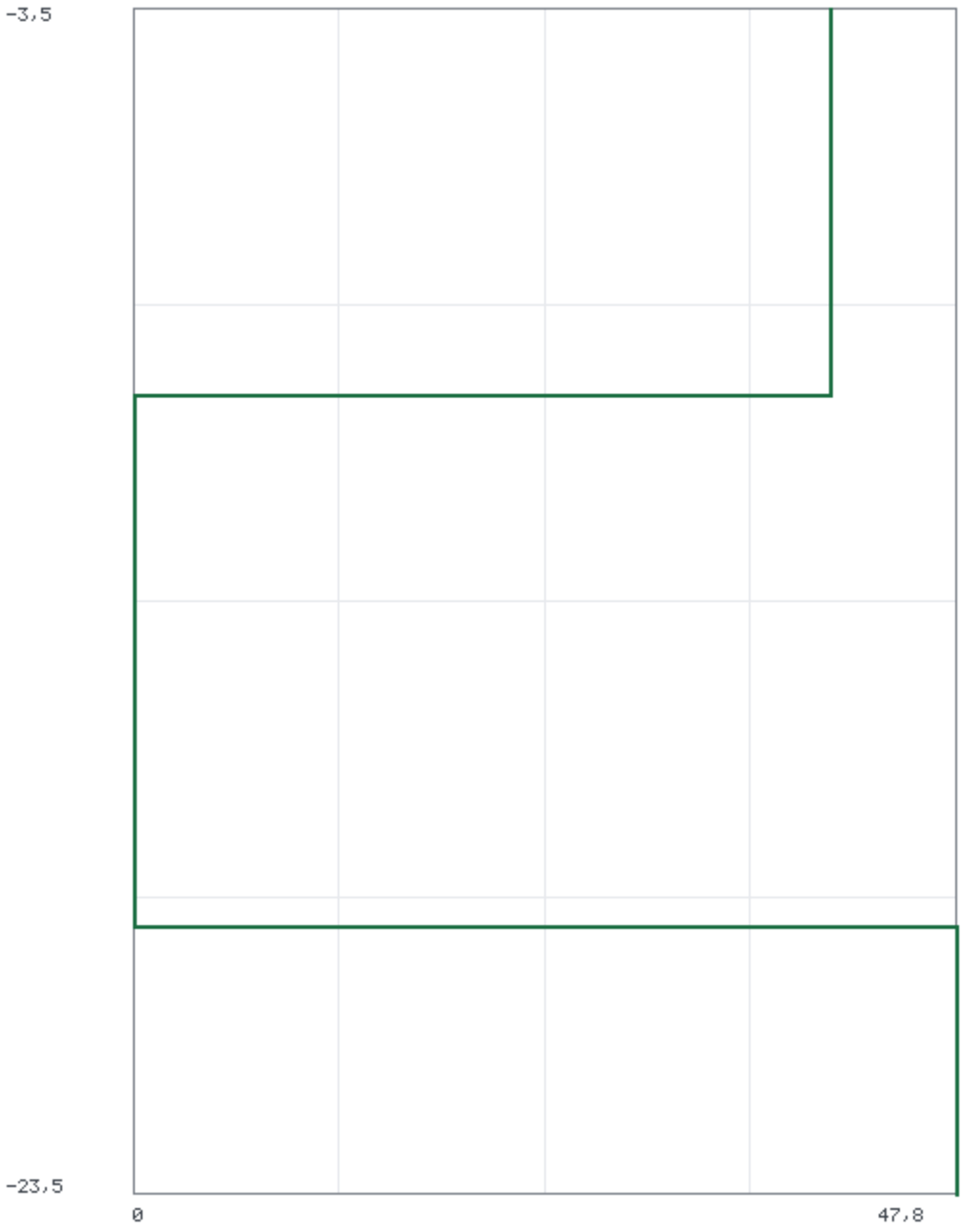


Figure 17: Shaft friction $t_{max}(z)$ [kPa]

> Horizontal axis: unit shaft friction t_{max} [kPa] · vertical axis: elevation [m]. The jumps at layer transitions are the soil profile itself; in layers where f_s is entered manually, that value is used as-is (the program does not override it).

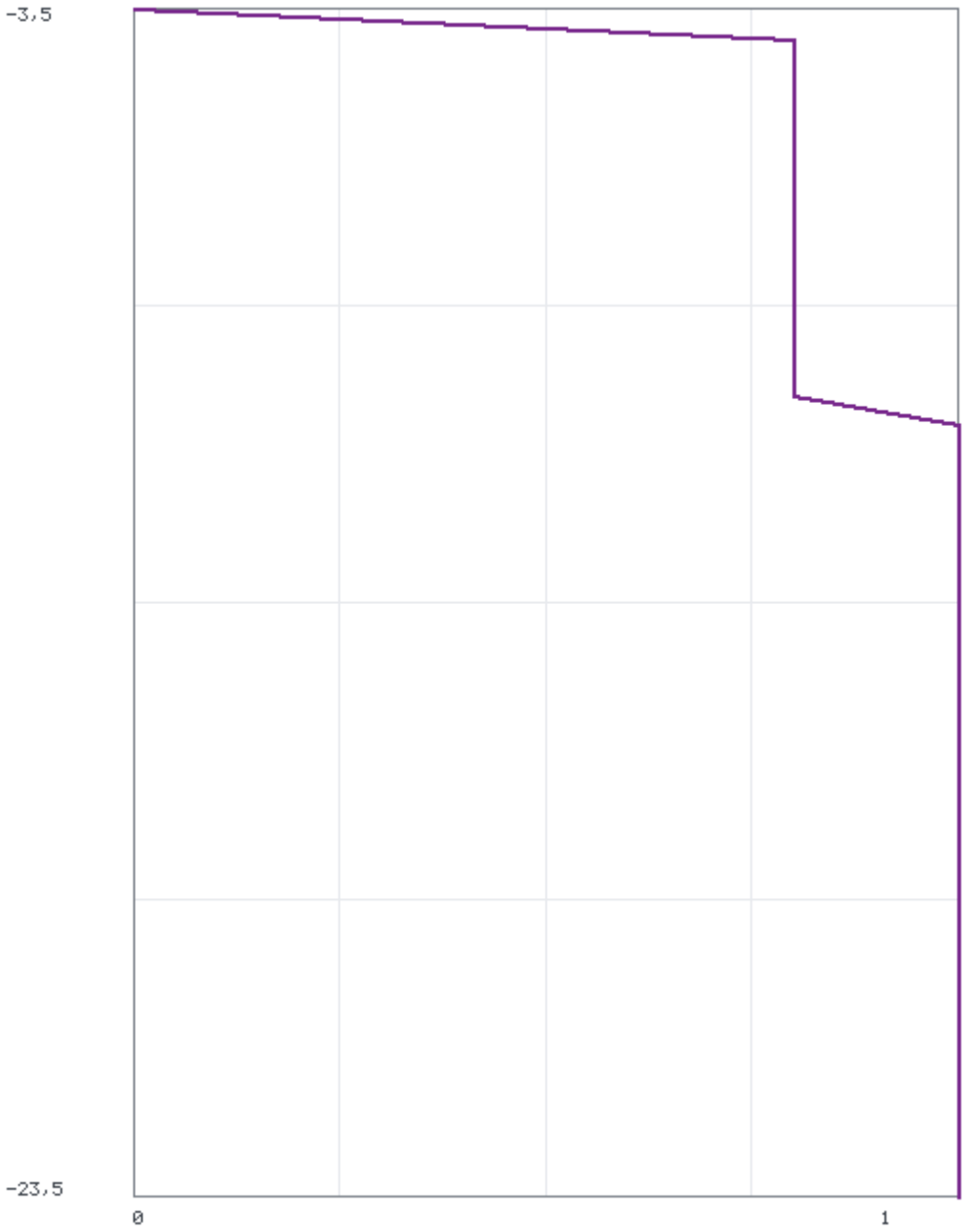


Figure 18: MOBILIZATION ratio $t/t_{max}(z)$

> Horizontal axis: ratio (0…1) · vertical axis: level [m]. Shows how much of the t-z spring is mobilized at which depth; the residual ratio in clay comes from the settings (0.80).

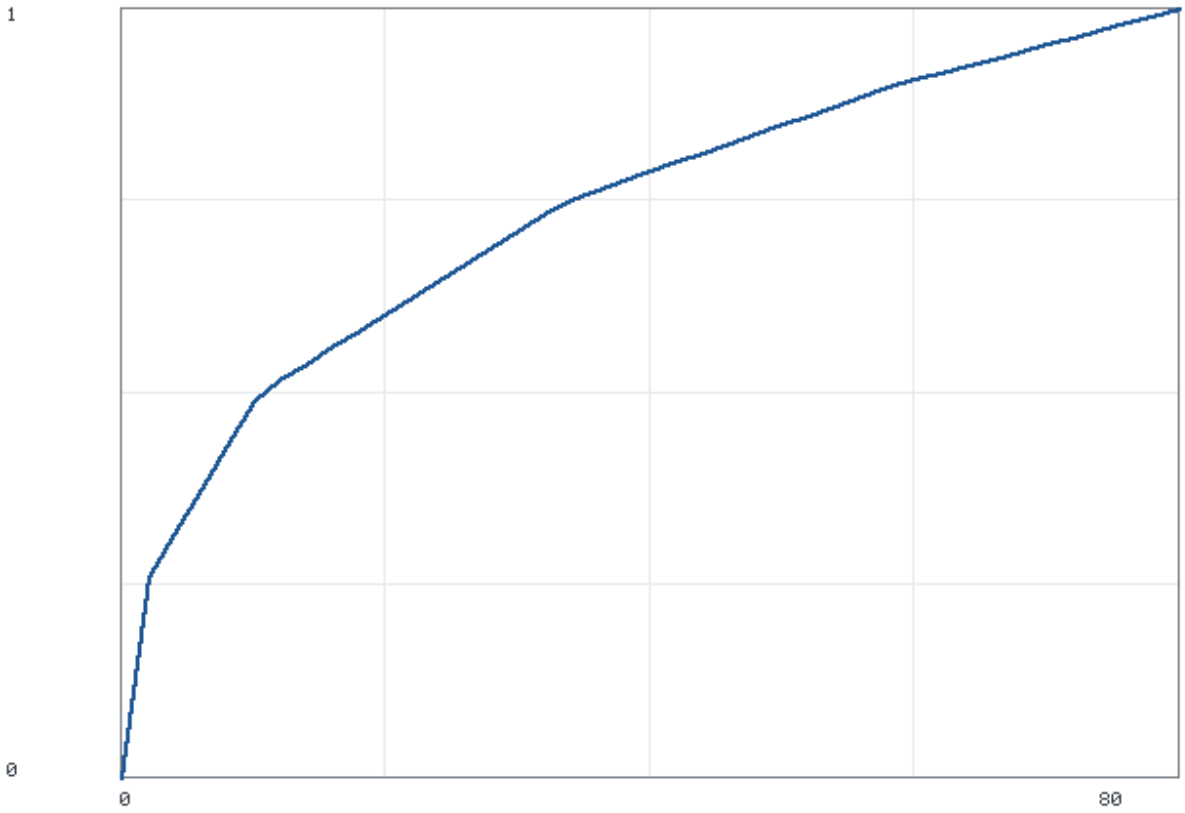


Figure 19: TOE SPRING q-z (normalized)

Horizontal axis: tip settlement [mm] · vertical axis: q/q_{max}. Tip resistance is mobilized at a LARGER settlement than shaft friction; pile başı oturmasının çoğu bu eğriden gelir. Uç tabakası: Yüksek plastisiteli silt (Silt).

F · SECTION CHECK (P-M)

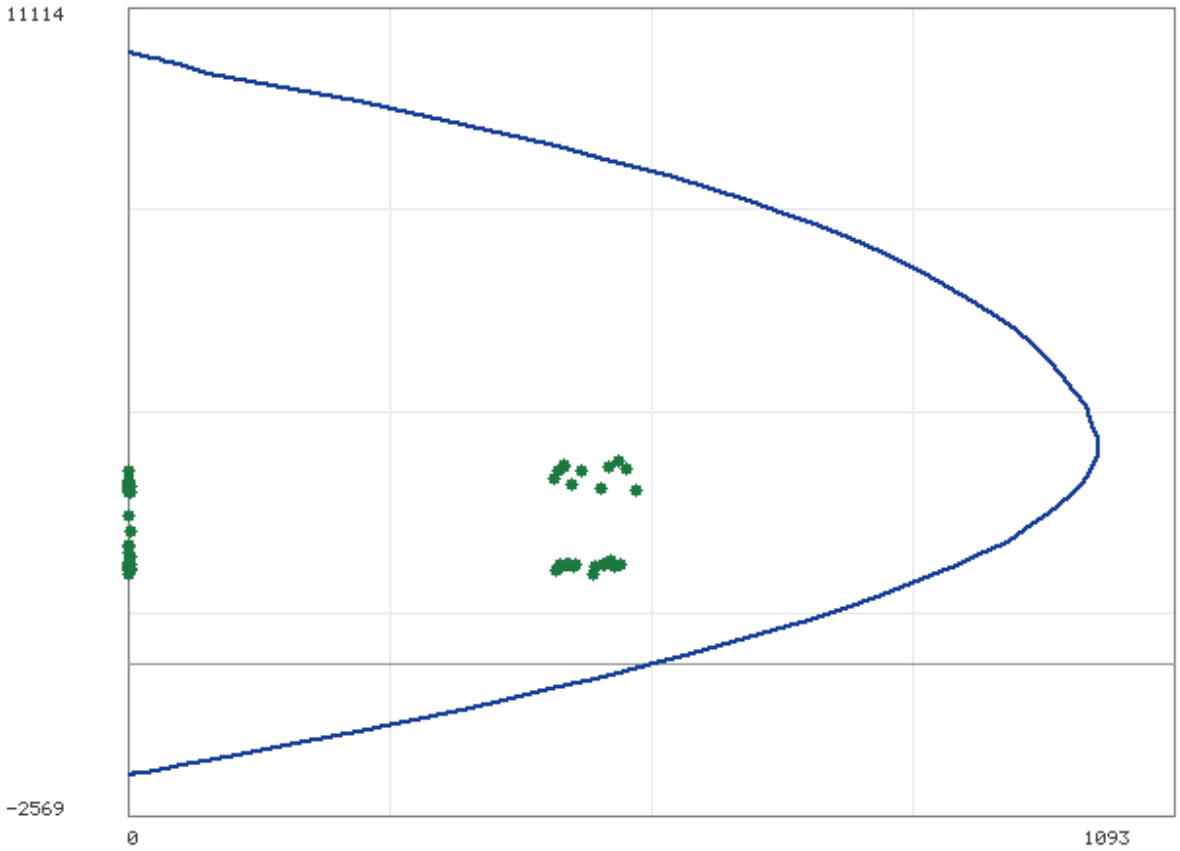


Figure 20: P-M interaction envelope and PILE DEMAND CLOUD

Yatay eksen: |M| [kNm] · düşey eksen: N [kN] (basınç +, çekme −). Mavi kapalı eğri kesitin taşıyabildiği (N, M) çiftleridir; eğrinin SOLUNDA kalan nokta güvenli, sağında kalan değildir. Nokta rengi KARARDIR: yeşil sağlıyor, kırmızı sağlamıyor. Kesit Ø80 cm · 16Ø20 · fret Ø10/10 cm · C30 / B420C · ρ = %1.00; saf çekme -1836 kN … saf basınç 10381 kN. 70 talep noktasından hiçbiri zarfın dışında DEĞİLDİR. Çekmeye giren kazık yoktur. YÖNETEN nokta K47 · G'+Q'-Ey-0.3Ex+0.3Ez: N = 1696.1 kN · M_d = 513.4 kNm · M_r = 862.6 kNm · kullanım = 0.595. Sıralama ölçütü en büyük moment DEĞİL, kullanım oranıdır: P-M zarfı N ile değiştiği için küçük eksenli bir nokta daha büyük momentli bir noktadan kritik olabilir. M ekseni MUTLAK değerdir (kesit simetrik).