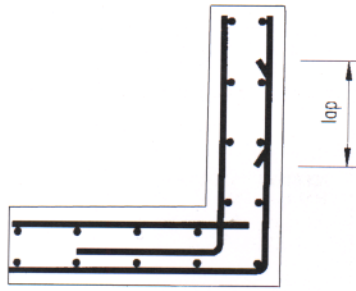
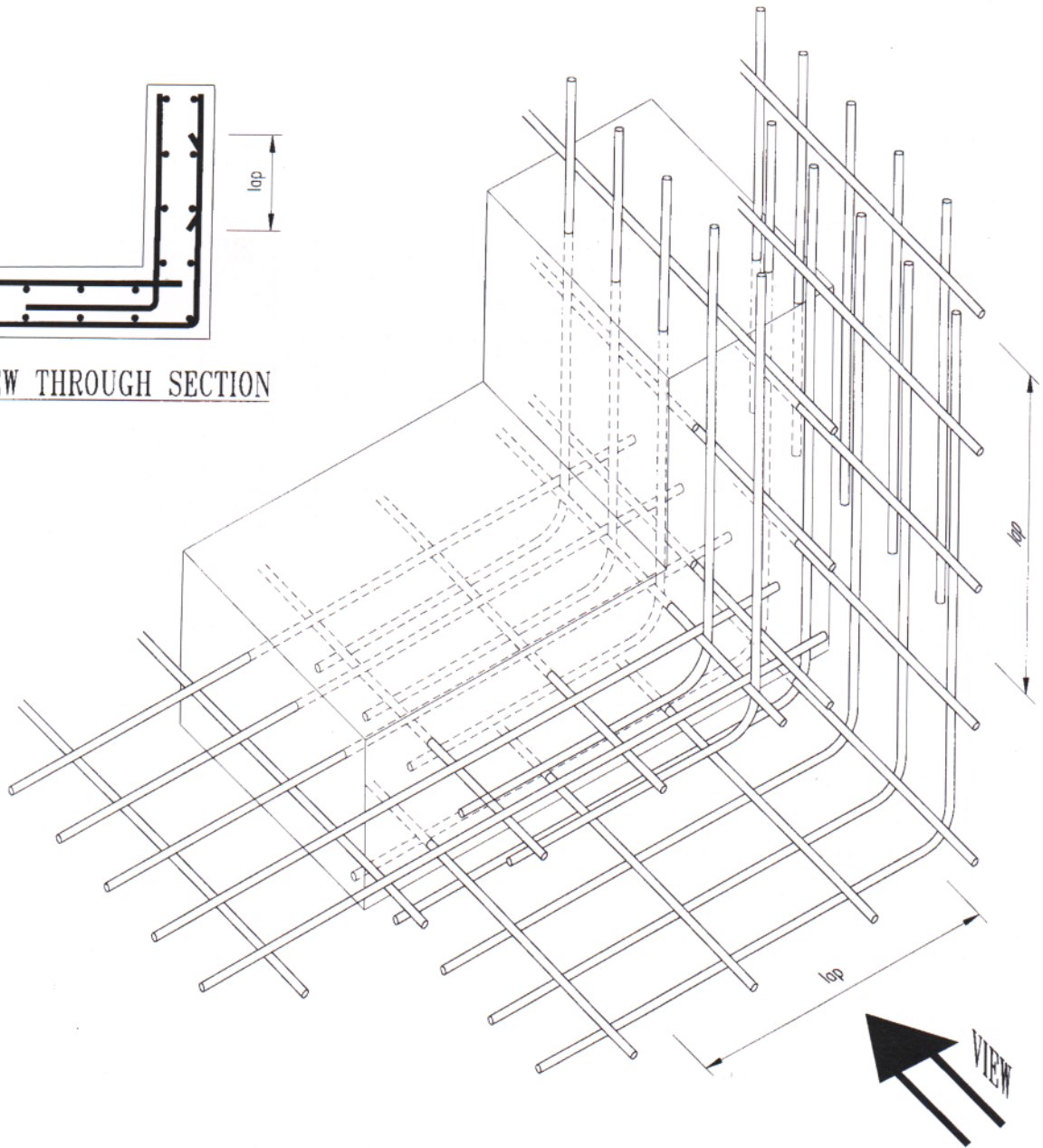

SECTION FIVE

**PILECAP
REINFORCEMENT**



VIEW THROUGH SECTION



BALCONY SPANDREL PANELS

SECTION FIVE : PILECAP REINFORCEMENT

This Section enables engineer to specify prefabricated reinforcement details for reinforced concrete pilecaps for single pile to 5-pilegroup. The pilecaps include those on precast concrete driven piles and bored piles.

Design pile capacity is based on pile material strength. Engineer shall use his own discretion when soil parameters governing the design of pile capacity. Engineer shall liaise with fabricators for feasible cage. When machine fabrication is not possible for reinforcement bar above 16mm diameter or due to their bars arrangement, manual fabrication could be adopted.

5.1 Design Considerations

1. Annotation for pilegroup reference number with its specific type, size and number of piles are shown in the following examples.

Example (1): 1RP150 from Pilecap Design Table 'RP1', where,
1RP – Denotes single pile for precast reinforced concrete driven pile
150 – Denotes 150mm x 150mm precast reinforced concrete driven pile size

Example (2): 5BP450 from Pilecap Design Table 'BP1', where,
5BP – Denotes 5 Pilegroup for bored pile
450 – Denotes 450mm diameter bored pile size

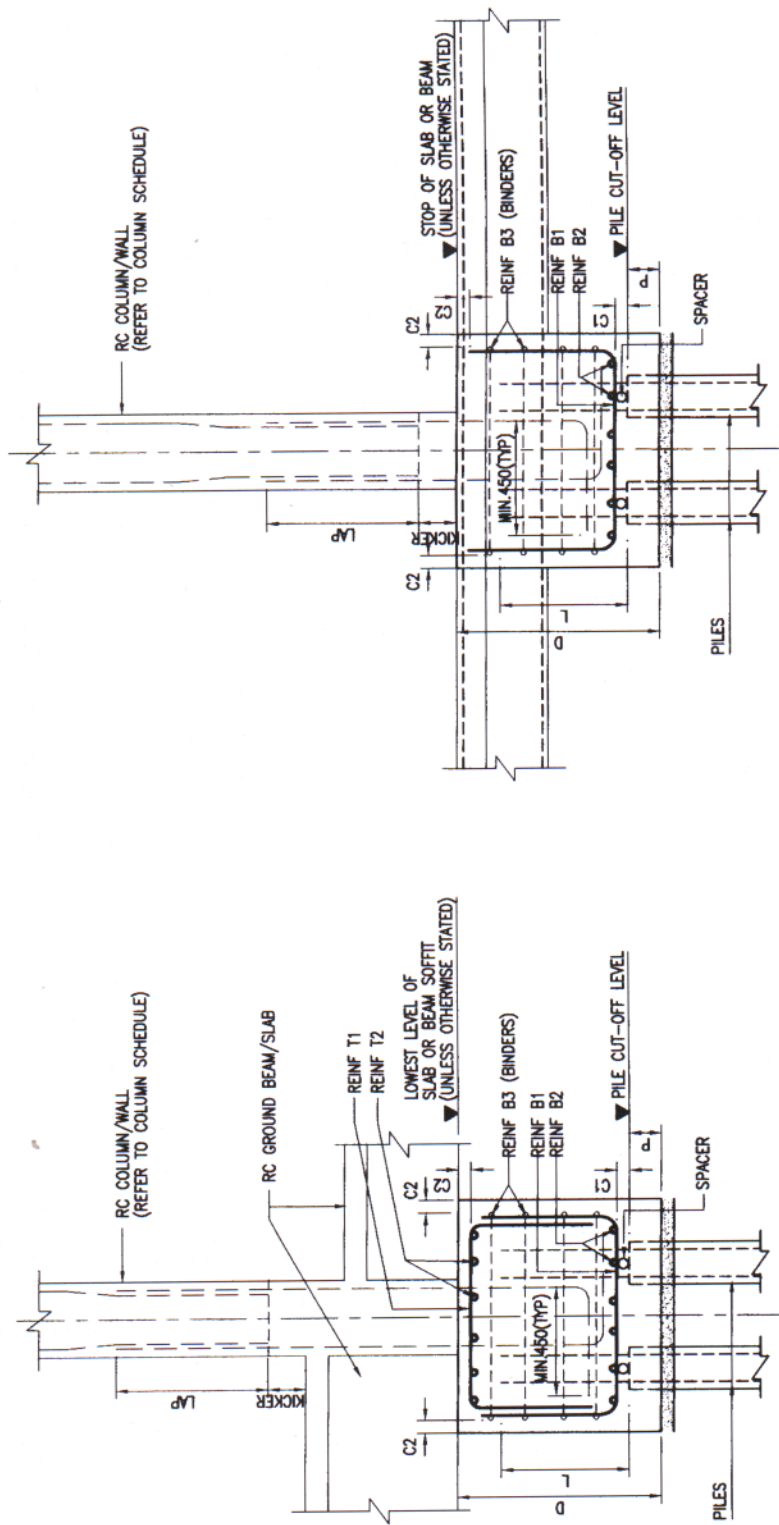
2. Pile working capacity based on material strength is used in the pilecap design.

(i) For Grade 45 Precast Reinforced Concrete Driven Piles :-
Pile Working Capacity (in kN) = $\frac{(45)\text{N/mm}^2 \times (\text{Pile Area})\text{mm}^2 \times (10^{-3}) \text{ kN}}{4}$

(ii) For Grade 35 Bored Piles :-
Pile Working Capacity (in kN) = $\frac{(35)\text{N/mm}^2 \times (\text{Pile Area})\text{mm}^2 \times (10^{-3}) \text{ kN}}{5}$

3. Load factor 1.5 to pile working capacity is adopted in the pilecap design.
4. Piles spacings of 3.0 and 2.5 times are adopted for precast reinforced concrete driven pile and bored pile respectively subject to engineer's requirement.
5. Pile penetration of 100mm and 125mm are used in the pilecap design for precast reinforced concrete driven piles and bored piles respectively unless otherwise required by engineer.
6. Individual pile deviation from its true position is taken to be 75mm in the design.
7. Concrete covers to all sides and from pile cut-off level to nearer reinforcement are taken as 50mm unless otherwise specified by engineer.
8. Steel reinforcement of f_y , 460 N/mm² and concrete characteristic strength, f_{cu} , 35 N/mm² are adopted in the design. The use of other grade of concrete and/or larger concrete covers are subjected to engineer's requirement such as when severe exposure is to be met.
9. Provisional of 0.13% of concrete sectional area of pilecap for top layers of reinforcement and pile's reinforcement anchorage length are subjected to Engineer's requirement.
10. Horizontal binder reinforcement is taken as 25% of the main reinforcement areas of pilecap.
11. Engineer shall carry out his own check to ensure design shear stress along column perimeter is not exceeding $0.8\sqrt{f_{cu}}$ or 5 N/mm², whichever the lesser. Recommended minimum critical column perimeter shown in the design tables shall be taken as a guide.

5.2 Standard Notation For Pilecap For Precast Reinforced Concrete Driven Piles and Bored Piles

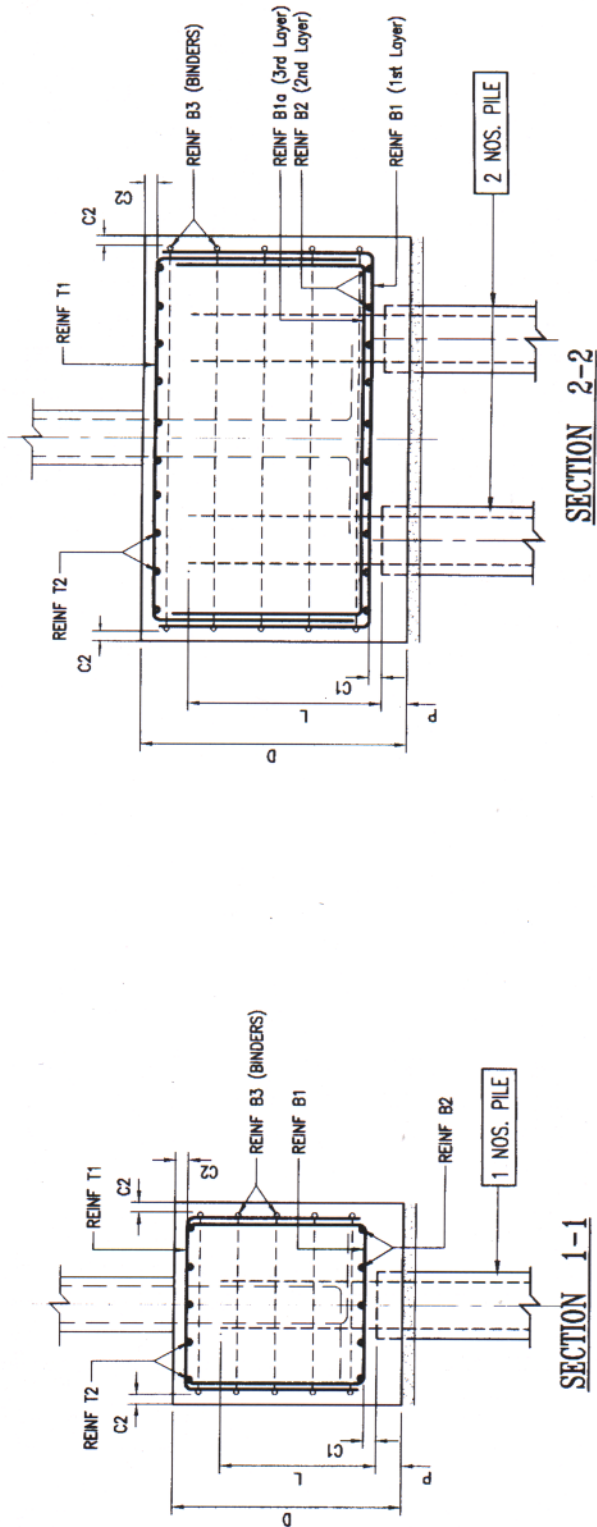
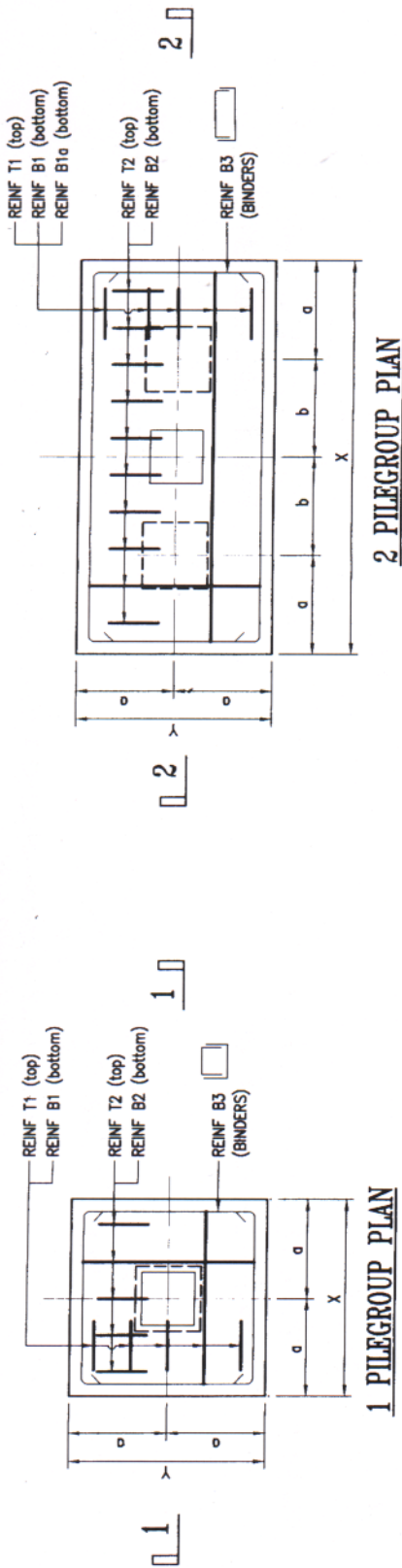


**Example '1' : Typical Pilecap Sectional Detail
with Slab or Beam on Top**

**Example '2' : Typical Pilecap Sectional Detail
with Slab or Beam Case Together**

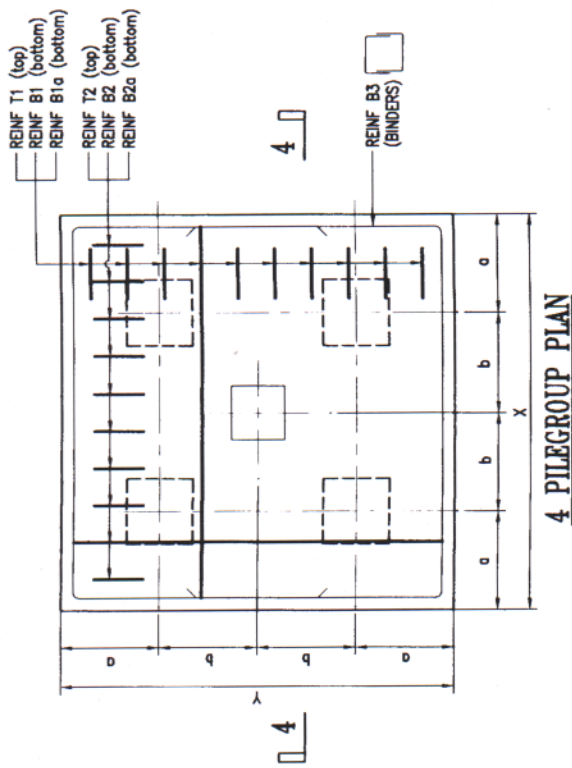
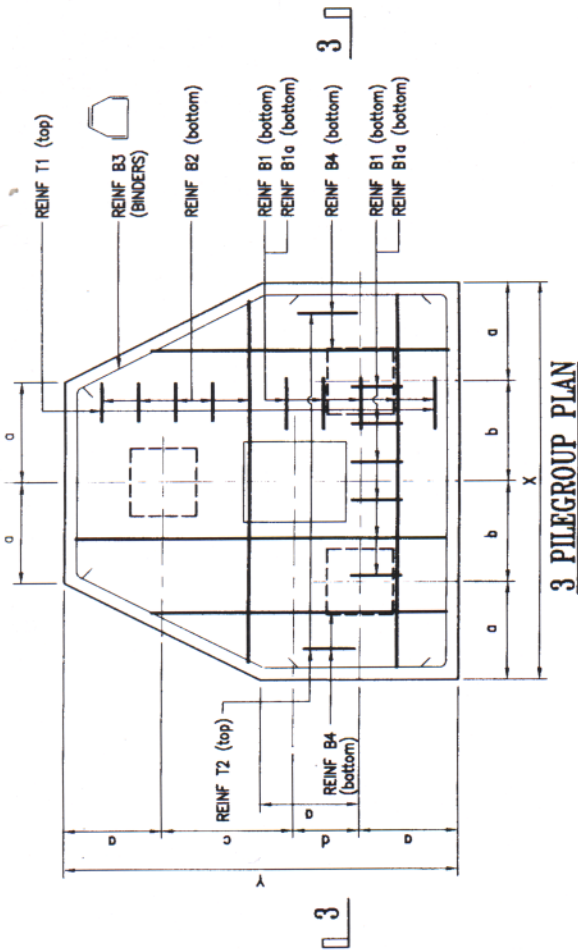
- NOTES**
- (1) Provision of Top Layers of Reinforcements (T1 and T2) and Pile's Reinforcement Anchorage Length (L) are subjected to Engineer's requirement.
 - (2) Concrete Covers, C1 and C2 = 50 mm.
 - (3) Pile Penetration, P = 100 mm (for Precast Reinforced Concrete Driven Pile).
= 125 mm (for Bored Pile).

5.3 Standard Notation for Pilecap For Single Pile And 2 Pilegroup



- NOTES**
- (1) Provision of Top Layers of Reinforcements (T1 and T2) and Pile's Reinforcement Anchorage Length (L) are subjected to Engineer's requirement.
 - (2) Concrete Covers, C1 and C2 = 50 mm.
 - (3) Pile Penetration, P = 100 mm (for Precast Reinforced Concrete Driven File).
= 125 mm (for Bored File).

5.4 Standard Notation For Pilecap For 3 Pilegroup and 4 Pilegroup

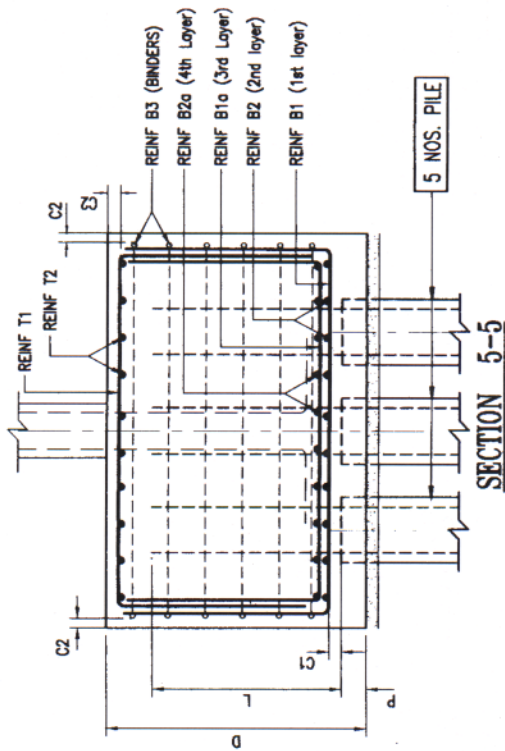
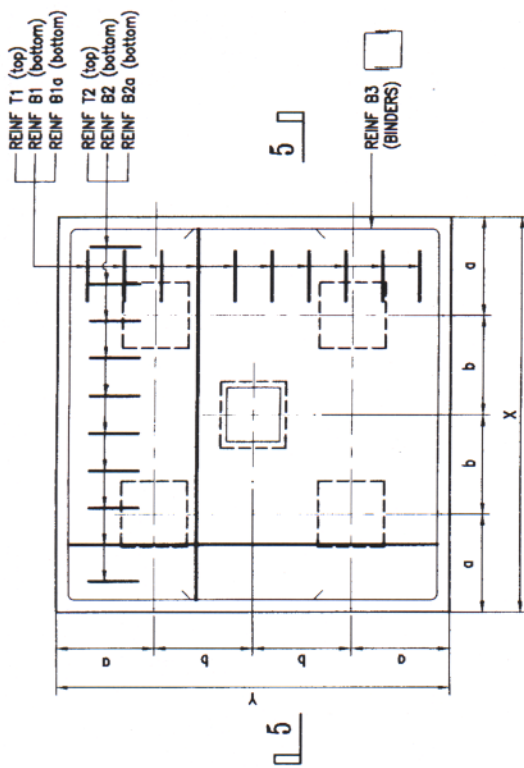


NOTES (1) Provision of Top Layers of Reinforcements (T1 and T2) and Pile's Reinforcement Anchorage Length (L) are subjected to Engineer's requirement.

(2) Concrete Covers, $C1$ and $C2 = 50$ mm.

(3) Pile Penetration, $P = 100$ mm (for Precast Reinforced Concrete Driven Pile).
 $= 125$ mm (for Bored Pile).

5.5 Standard Notation For Pilecap For 5 Pilegroup



- NOTES**
- (1) Provision of Top Layers of Reinforcements (T1 and T2) and Pile's Reinforcement Anchorage Length (L) are subjected to Engineer's requirement.
 - (2) Concrete Covers, C1 and C2 = 50 mm.
 - (3) Pile Penetration, P = 100 mm (for Precast Reinforced Concrete Driven Pile).
= 125 mm (for Bored Pile).

5.6 Pilecap Design Tables For Precast Reinforced Concrete Driven Piles

Pilegroup Reference	Pilegroup Working Capacity (kN)	Pilecap Parameters (mm)							Reinforcement Details							Minimum Column Perimeter Req'd (mm)
		X	Y	D	a	b	c	d	Reinf B1	Reinf B2	Reinf B4	Reinf B3	Reinf T1	Reinf T2		
															Reinf B1	
1RP 150	250	700	700	700	350				6T13	6T13		5T13	6T13	6T13	6T13	200
2RP 150	500	1200	700	700	350	250			6T13	10T13		5T13	6T13	6T13	10T13	350
3RP 150	750	1200	1150	800	350	250	300	150	7T16	4T13	2T13	5T13	11T13	11T13	11T13	450
4RP 150	1000	1200	1200	700	350	250			10T13	10T13		5T13	10T13	10T13	10T13	650
5RP 150	1250	1400	1400	700	350	350			13T13	13T13		5T13	13T13	13T13	13T13	800
1RP 175	340	700	700	700	350				6T13	6T13		5T13	6T13	6T13	6T13	250
2RP 175	680	1250	700	800	350	275			6T13	11T13		5T13	6T13	6T13	11T13	400
3RP 175	1020	1250	1150	800	350	275	300	150	6T16	4T13	2T13	5T13	10T13	10T13	10T13	600
4RP 175	1360	1250	1250	800	350	275			8T16	8T16		5T13	8T16	8T16	8T16	750
5RP 175	1700	1500	1500	800	350	400			12T16	12T16		5T13	12T13	12T13	12T13	950
1RP 200	450	700	700	700	350				6T13	6T13		5T13	6T13	6T13	6T13	300
2RP 200	900	1300	700	800	350	300			6T16	11T13		5T13	6T13	6T13	11T13	500
3RP 200	1350	1300	1230	800	350	300	350	180	8T16	4T13	2T13	5T13	12T13	12T13	12T13	750
4RP 200	1800	1300	1300	800	350	300			11T16	11T16		5T13	11T13	11T13	11T13	1000
5RP 200	2250	1600	1600	800	350	450			15T16	15T16		5T16	15T13	15T13	15T13	1250
1RP 250	700	700	700	700	350				6T13	6T13		5T13	6T13	6T13	6T13	450
2RP 250	1400	1450	700	1000	350	375			6T20	10T16		7T13	6T13	6T13	10T16	600
3RP 250	2100	1450	1360	1000	350	375	440	220	8T20	6T13	3T13	7T13	14T13	14T13	14T13	900
4RP 250	2800	1450	1450	1000	350	375			10T20	10T20		7T13	10T16	10T16	10T16	1200
5RP 250	3500	1800	1800	1000	350	550			14T20	14T20		7T16	14T16	14T16	14T16	1450
1RP 275	850	700	700	700	350				6T13	6T13		5T13	6T13	6T13	6T13	550
2RP 275	1700	1550	700	1100	350	425			5T25	12T16		7T13	5T16	5T16	12T16	650
3RP 275	2550	1550	1450	1100	350	425	500	250	6T25	6T16	3T16	7T13	12T16	12T16	12T16	950
4RP 275	3400	1550	1550	1100	350	425			12T20	12T20		7T13	12T16	12T16	12T16	1300
5RP 275	4250	1900	1900	1100	350	600			16T20	16T20		7T16	16T16	16T16	16T16	1600

TABLE RP2 : SCHEDULE OF PILECAP DETAILS FOR PRECAST REINFORCED CONCRETE DRIVEN PILES

Pilegroup Reference	Pilegroup Working Capacity (kN)	Pilecap Parameters (mm)								Reinforcement Details								Minimum Column Perimeter Req'd (mm)
		X	Y	D	a	b	c	d	Reinf B1	Reinf B2	Reinf B4	Reinf B3	Reinf T1	Reinf T2				
1RP 300	1010	800	800	700	400	400			7T13	7T13		5T13	7T13	7T13	7T13	650		
2RP 300	2020	1700	800	1100	400	450			6T25	13T16		7T13	6T16	13T16	750			
3RP 300	3030	1700	1580	1100	400	450	260	260	7T25	6T16	3T16	7T13	13T16	13T16	1150			
4RP 300	4040	1700	1700	1100	400	450			13T25	13T25		7T16	13T16	13T16	1500			
5RP 300	5050	2100	2100	1100	400	650			15T25	15T25		8T16	15T16	15T16	1900			
1RP 350	1380	800	800	700	400	400			7T13	7T13		5T13	7T13	7T13	900			
2RP 350	2760	1850	800	1200	400	525			7T25	15T16		8T13	7T16	15T16	950			
3RP 350	4140	1850	1730	1200	400	525	620	310	9T25	6T16	3T16	8T13	15T16	15T16	1400			
4RP 350	5520	1850	1850	1100	400	525			15T25	15T25		5T13	15T16	15T16	2050			
5RP 350	6900	2300	2300	1100	400	750			20T25	20T25		8T20	20T16	20T16	2600			
1RP 375	1580	800	800	800	400	400			7T13	7T13		5T13	7T13	7T13	850			
2RP 375	3160	1950	800	1250	400	575			7T28	16T16		8T13	7T16	16T16	1050			
3RP 375	4740	1950	1820	1250	400	575	720	360	8T28	6T20	3T20	8T16	14T20	14T20	1550			
4RP 375	6320	1950	1950	1200	400	575			17T25	17T25		8T16	17T16	17T16	2150			
5RP 375	7900	2400	2400	1200	400	800			22T25	22T25		9T20	22T16	22T16	2650			
1RP 400	1800	850	850	800	425	425			6T16	6T16		5T13	6T16	6T16	1000			
2RP 400	3600	2050	850	1250	425	600			8T28	18T16		9T13	8T16	18T16	1150			
3RP 400	5400	2050	1900	1400	425	600	700	350	7T32	6T20	3T20	9T16	13T20	13T20	1550			
4RP 400	7200	2050	2050	1250	425	600			17T28	17T28		8T20	17T16	17T16	2300			
5RP 400	9000	2550	2550	1250	425	850			21T28	21T28		10T20	21T16	21T16	2900			
1RP 450	2280	900	900	800	450	450			7T16	7T16		5T13	7T16	7T16	1250			
2RP 450	4560	2250	900	1400	450	675			8T32	21T16		9T16	8T16	21T16	1300			
3RP 450	6840	2250	2070	1400	450	675	780	390	9T32	6T20	3T20	9T16	15T20	15T20	1950			
4RP 450	9120	2250	2250	1250	450	675			21T28	21T28		10T20	21T16	21T16	2950			
5RP 450	11400	2850	2850	1250	450	975			28T28	28T28T		9T25	28T16	28T16	3650			

5.7 Pilecap Design Tables For Bored Piles

TABLE BP1: SCHEDULE OF PILECAP DETAILS FOR BORED PILES

Pilegroup Reference	Pilegroup Working Capacity (kN)	Pilecap Parameters (mm)								Reinforcement Details								Minimum Column Perimeter Req'd (mm)
		X	Y	D	a	b	c	d	Reinf B1	Reinf B1a	Reinf B2	Reinf B2a	Reinf B4	Reinf B3	Reinf T1	Reinf T2		
1BP 450	1110	1000	1000	700	500				8T13		8T13			3T13	8T13	8T13	750	
2BP 450	2220	2200	1000	1150	500	600			8T25		16T16			6T13	8T16	16T16	800	
3BP 450	3330	2200	2050	1150	500	600	700	350	9T25		8T16		4T16	6T16	17T16	17T16	1200	
4BP 450	4440	2200	2200	1150	500	600			20T20		20T20			8T16	20T16	20T16	1600	
5BP 450	5550	2600	2600	1150	500	800			19T25		19T25			10T16	20T16	20T16	2000	
1BP 500	1370	1000	1000	700	500				8T13		8T13			3T13	8T13	8T13	950	
2BP 500	2740	2300	1000	1150	500	650			9T25		18T16			5T16	9T16	18T16	1000	
3BP 500	4110	2300	2140	1150	500	650	760	380	11T25		8T20		4T20	7T16	19T16	19T16	1500	
4BP 500	5480	2300	2300	1150	500	650			18T25		18T25			10T16	18T16	18T16	2000	
5BP 500	6850	2800	2800	1150	500	900			23T25		23T25			9T20	23T16	23T16	2500	
1BP 600	1980	1100	1100	800	550				10T13		10T13			4T13	10T13	10T13	1150	
2BP 600	3960	2600	1100	1400	550	750			7T32		24T16			10T13	7T20	24T16	1150	
3BP 600	5940	2600	2420	1400	550	750	880	440	9T32		10T20		5T20	9T16	19T20	19T20	1750	
4BP 600	7920	2600	2600	1400	550	750			16T32		16T32			9T20	16T20	16T20	2300	
5BP 600	9900	3300	3300	1400	550	1100			20T32		20T32			9T25	20T20	20T20	2850	
1BP 700	2690	1200	1200	800	600				11T13		11T13			5T13	11T13	11T13	1550	
2BP 700	5380	3000	1200	1400	600	900			11T32		18T20			11T16	11T20	18T20	1550	
3BP 700	8070	3000	2760	1500	600	900	1040	520	13T32		12T20		6T20	9T20	25T20	25T20	2150	
4BP 700	10760	3000	3000	1400	600	900			22T32		22T32			9T25	22T20	22T20	3100	
5BP 700	13450	3700	3700	1400	600	1250			29T32		29T32			12T25	29T20	29T20	3900	
1BP 800	3520	1300	1300	800	650				11T16		11T16			4T23	11T13	11T13	2000	
2BP 800	7040	3300	1300	1500	650	1000			8T32	8T32	21T20			9T20	8T25	21T20	1900	
3BP 800	10560	3300	3040	1500	650	1000	1160	580	10T32	10T32	14T20		7T20	12T20	21T20	21T20	2800	
4BP 800	14080	3300	3300	1500	650	1000			14T32	14T32	14T32			14T25	14T25	14T25	3750	
5BP 800	17600	4200	4200	1500	650	1450			20T32	20T32	20T32			10T32	20T25	20T25	4700	

TABLE BP2: SCHEDULE OF PILECAP DETAILS FOR BORED PILES

Pilegroup Reference	Pilegroup Working Capacity (kN)	Pilecap Parameters (mm)										Reinforcement Details								Minimum Column Perimeter Req'd (mm)				
		X	Y	D	a	b	c	d	Reinf B1	Reinf B1a	Reinf B2	Reinf B2a	Reinf B4	Reinf B3	Reinf T1	Reinf T2								
1BP 900	4450	1400	1400	800	700				12T16		12T16			5T13	12T16	12T16						12T16	12T16	2550
2BP 900	8900	3700	1400	1500	700	1150			10T32	10T32	24T20			13T20	10T20	24T20							24T20	2400
3BP 900	13350	3700	3410	1600	700	1150	1340	670	13T32	13T32	16T20	13T32	8T20	10T25	29T20	29T20							29T20	3300
4BP 900	17800	3700	3700	1600	700	1150			19T32	19T32	19T32	19T32		10T32	19T25	19T25							19T25	4400
5BP 900	22250	4600	4600	1600	700	1600			25T32	25T32	25T32	25T32		13T32	25T25	25T25							25T25	5500
1BP 1000	5500	1500	1500	800	750				10T20		10T20			6T13	10T20	10T20							10T20	3150
2BP 1000	11000	4000	1500	1500	750	1250			15T32	15T32	25T20			11T25	15T16	25T20							25T20	2950
3BP 1000	16500	4000	3690	1650	750	1250	1460	730	16T32	16T32	18T20	16T32	9T20	14T25	34T20	34T20							34T20	3950
4BP 1000	22000	4000	4000	1600	750	1250			24T32	24T32	24T32	24T32		12T32	24T25	24T25							24T25	5250
5BP 1000	27500	5100	5100	1600	750	1800			35T32	35T32	35T32	35T32		17T32	35T20	35T20							35T20	6550
1BP 1100	6650	1600	1600	900	800				10T20		10T20			6T13	10T20	10T20							10T20	3250
2BP 1100	13300	4400	1600	1800	800	1400			15T32	15T32	22T25			12T25	15T20	22T25							22T25	2900
3BP 1100	19950	4400	4030	2100	800	1400	1620	810	17T32	17T32	16T25	17T32	8T25	14T25	33T25	33T25							33T25	3650
4BP 1100	26600	4400	4400	2100	800	1400			25T32	25T32	25T32	25T32		13T32	25T25	25T25							25T25	4850
5BP 1100	33250	5500	5500	2100	800	1950			34T32	34T32	34T32	34T32		17T32	34T25	34T25							34T25	6050
1BP 1200	7920	1700	1700	1000	850				10T20		10T20			6T13	10T20	10T20							10T20	3400
2BP 1200	15840	4700	1700	2100	850	1500			16T32	16T32	27T25	16T32		13T25	16T20	27T25							27T25	2900
3BP 1200	23760	4700	4310	2100	850	1500	1740	870	21T32	21T32	18T25	21T32	9T25	13T32	39T25	39T25							39T25	4300
4BP 1200	31680	4700	4700	2400	850	1500			27T32	27T32	27T32	27T32		15T32	30T25	30T25							30T25	4950
5BP 1200	39600	6000	6000	2400	850	2150			39T32	39T32	39T32	39T32		19T32	39T25	39T25							39T25	6200