High Mast Light Pole Foundation Design

High Mast Light Pole Foundation Design is generally undertaken in the same manner as any concrete spread or pad foundation. The principle is to make the foundation large enough so that the overturning moment does not exceed the maximum bearing capacity of the soil.

As high mast light poles are standard fixtures they are often designed using standard foundation types which depend on the size of the mast and its location. The High Mast Light Pole Design Spreadsheet includes a unique High Mast Light Pole Foundation Design Spreadsheet which allows the user to specify a suitable high mast lighting foundation in seconds, from one of three typical high mast foundation design types.

The overturning moment depends on the height of the mast, the size and number of lanterns and on the location. This is explained in detail on our High Mast Wind Loading and High Mast Light Pole Wind Pressure pages.

Soil Allowable Maximum Bearing Capacity

High mast pole foundation design is usually based on the assumption that the underlying soil will not fail if the foundation limits the bearing pressure to a set value called the allowable maximum bearing capacity. The maximum bearing capacity of the soil is the pressure at which the soil starts to fail. This is a critical parameter and must be ascertained before detailed high mast lighting foundation design can begin. The bearing capacity of a soil can only be determined from site tests such as plate bearing tests, CPTs or SPTs. This should be undertaken by a suitable qualified civil or geotechnical engineer.

For preliminary design there have been a number of very general guidelines for the design of high mast pole foundations which include standard designs based on one or two assumed values for the allowable maximum bearing pressure. Below is one example taken from the Abacus High Mast lighting foundation design brochure.

These values are only for use in preliminary design and the bearing capacity must be checked with site measurements before detailed design is done. However this does give a handy guide for preliminary high mast light pole foundation design.

Types of subsoil	Condition of subsoil	Field test applicable	Approximate allowance bearing pressure kN/m²
Rock	Not inferior to sandstone, limestone or firm chalk	Requires at least a pneumatic or other mechanically operated pick for excavation	1000
Gravel, sand	Compact	Requires pick for excavation. Wooden peg 50mm² in cross section is hard to drive beyond 150mm	Dense to very dense 150-400 Loose to medium dense 50-250
Clay, sandy clay	Firm	Can be moulded by substantial pressure with the fingers and excavated with graft or spade	50-100
Sand*, silty sand*, clayey sand*	Loose	Can be excavated with a spade. Wooden peg 50mm² in cross section can be easily driven	<75
Silt*, clay*, sandy clay*, silty clay*	Soft	Fairly easily moulded with the fingers and readily excavated	<75
Silt*, clay*, sandy clay*, silty clay*	Very soft	Natural sample in winter conditions exudes between fingers when squeezed in fist	<75

High Mast Light Pole Foundation Types

As described above for general and good soil conditions where there are no site specific restrictions on foundation size or depth, there are three main types of standard foundations commonly used for high mast light pole foundations. These are described below.

1- Un-Reinforced Concrete High Mast Light Pole Foundation – Passive

This high mast lighting foundation type consists of an unreinforced block of concrete which resists overturning by mobilizing both the vertical and lateral bearing capacities of the surrounding soils. The mobilized soil pressures are illustrated in the below diagram.

To mobilize these lateral bearing capacities, this type of high mast light pole foundation can only be installed in stiff, cohesive soils. A relatively high minimum soil bearing capacity of 150kN/m is required. To achieve this underlying soils are likely to be stiff clay or compacted sand or gravelly soils. Care must be taken to ensure that any over dig is backfilled in such a way that the lateral bearing capacities of the surrounding soils is still able to be mobilized to resist the overturning moment. If the backfill is not suitably compacted and installed correctly it will not be able to mobilize the lateral bearing capacity of the surrounding soils and this type of high mast light foundation will not be appropriate. The below table shows the required sizes for unreinforced passive concrete high mast lighting pole foundations to resist defined overturning moments. This is taken from the BADRY High Mast brochure.

O.T.M (kNm)	Bearing pressure (kN/m²)	A Width (mm)	B depth (mm)
3	150	650	750
4	150	700	800
5	150	750	800
6	150	750	900
8	150	850	950
10	150	900	950
15	150	950	1100
20	150	1050	1200
30	150	1200	1250
40	150	1250	1300
50	150	1350	1400
75	150	1450	1600
100	150	1600	1700
150	150	1800	1850
200	150	1950	2000
300	150	2250	2150
400	150	2450	2250
500	150	2700	2300
750	150	3050	2600

2- Un-Reinforced Concrete High Mast Light Pole Foundation – Non-Passive

This high mast lighting foundation type consists of an unreinforced block of concrete which resists overturning by mobilizing only the vertical bearing pressures of the underlying soils. The mobilized soil pressures are illustrated in the below diagram.

This type of high mast light pole foundation can be designed to accommodate any level of maximum bearing capacity. For this reason this type of foundation is often used in high mast foundation design when soil conditions are poor or unknown. However, for soft soils, clays and silts additional geotechnical advice is recommended to ensure that the high mast lighting foundation is suitable. For this reason the standard high mast light pole foundation designs are given for soils with maximum bearing capacities greater than 75kn/m. Three levels are specified, those over 75kn/m, over 100kn/m and over 150kn/m. The below table shows the required sizes for unreinforced non-passive concrete high mast light pole foundations to resist defined overturning moments. This is taken from the BADRY High Mast brochure.

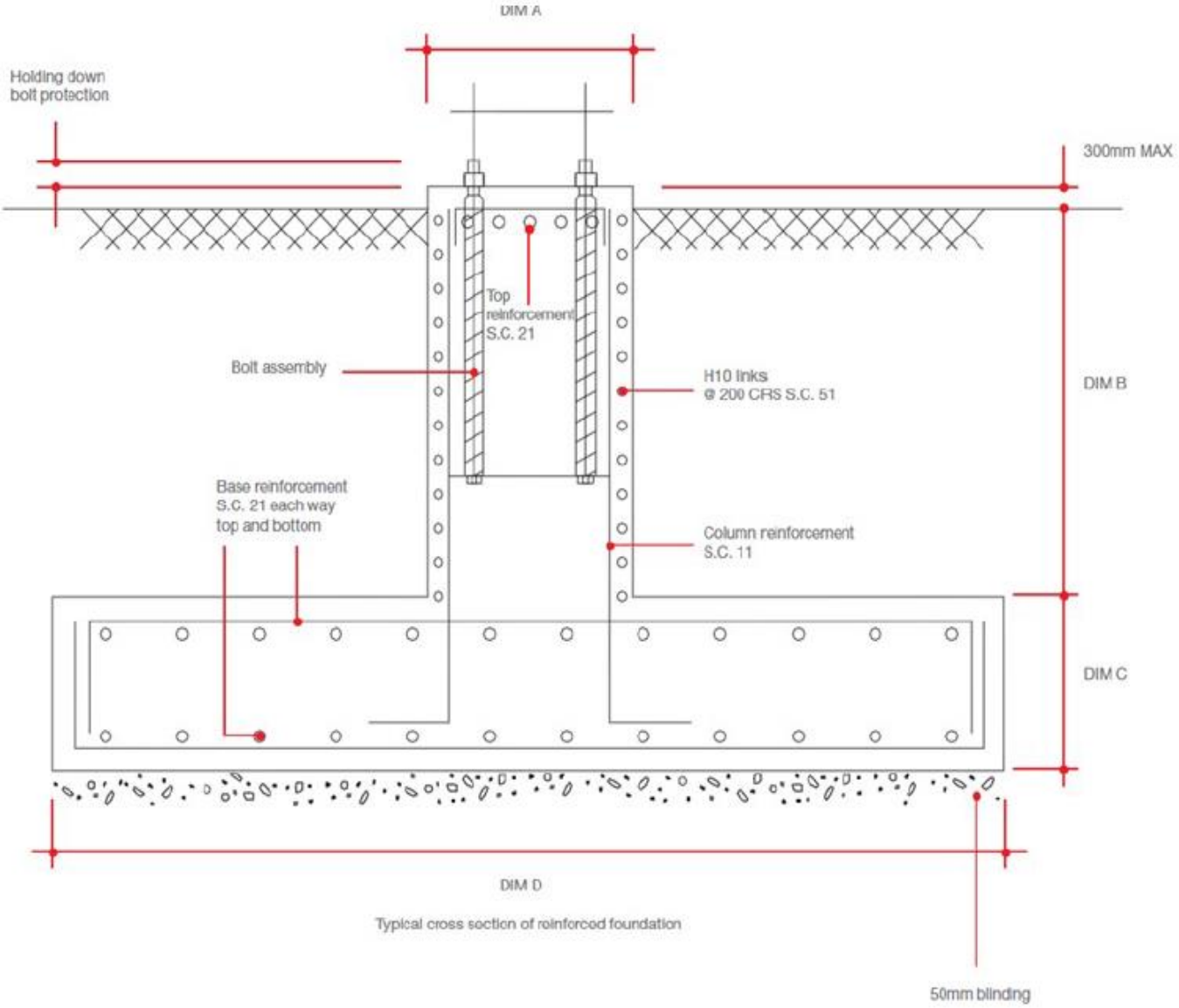
O.T.M (kNm)	Bearing pressure (kN/m^2)	A Width (mm)	B depth (mm)
3	75	880	590
3	100	880	590
3	150	880	590
4	75	950	625
4	100	950	625
4	150	950	625
5	75	1050	675
5	100	1050	675
5	150	1050	675
6	75	1100	700
6	100	1100	700
6	150	1100	700
8	75	1150	725
8	100	1150	725
8	150	1150	725
10	75	1250	775
10	100	1250	775
10	150	1250	775
15	75	1400	850
15	100	1350	825
15	150	1350	825
20	75	1500	900
20	100	1500	900
20	150	1500	900
30	75	1700	1000
30	100	1700	1000
30	150	1700	1000

O.T.M (kNm)	Bearing pressure (kN/m^2)	A Width (mm)	B depth (mm)
40	75	1900	1100
40	100	1800	1050
40	150	1800	1050
50	75	2100	1200
50	100	1900	1100
50	150	1900	1100
75	75	2400	1350
75	100	2200	1250
75	150	2200	1250
100	75	2650	1475
100	100	2400	1350
100	150	2300	1300
150	75	3200	1750
150	100	2700	1650
150	150	2500	1400
200	75	3900	2100
200	100	3000	1650
200	150	2700	1500
300	100	3500	1900
300	150	3100	1700
400	100	2100	3900
400	150	3400	1850
500	100	4500	2400
500	150	3600	1950
750	150	4100	2200

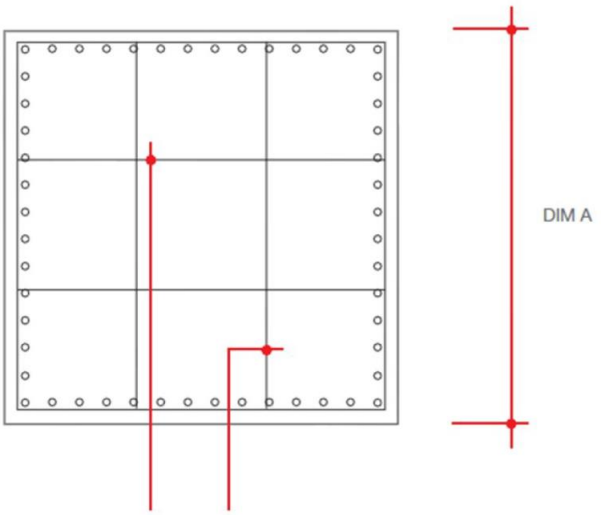
3- Reinforced Concrete High Mast Light Pole Foundation

This high mast lighting foundation type consists of a reinforced concrete pad foundation with a plinth which resists overturning by mobilizing the vertical bearing pressures of the underlying soils.

A standard example detail drawing is shown below, For a 30m high mast foundation drawings with AutoCAD versions are provided for High Mast Light Pole Design Spreadsheet.



Typical cross section of reinforced foundation



Similar to the non-passive high mast light pole foundation design, standard reinforced concrete pad foundations can be designed to accommodate any level of maximum bearing capacity. However, for soft soils, clays and silts additional geotechnical advice is recommended to ensure that the high mast foundation design is suitable. For this reason the standard high mast lighting foundation designs are given for soils with maximum bearing capacities greater than 75kn/m. Three levels are specified, those over 75kn/m, over 100kn/m and over 150kn/m. The below table shows the required sizes for standard reinforced concrete pad foundations to resist defined overturning moments. This is taken from the BADRY High Mast brochure.

O.T.M. (kNm)	Bearing pressure (kN/m²)	A (mm)	B (mm)	C (mm)	D (mm)	Base reinforcement (Each way S.C. 21)	Column reinforcement (All round S.C. 11)	Top reinforcement (Each way S.C. 21)
75	75	1100	950	600	2400	H16@250 t and b	H20@225	
75	150	1100	950	600	2050	H16@250 t and b	H20@225	
100	75	1100	950	600	2600	H16@250 t and b	H20@225	
100	150	1100	950	600	2300	H16@250 t and b	H20@225	
150	75	1100	1350	600	2900	H16@250 t and b	H20@225	
150	150	1100	1350	600	2500	H16@250 t and b	H20@225	
200	75	1100	1350	600	3200	H16@250 t and b	H20@225	
200	150	1100	1350	600	2750	H16@250 t and b	H20@225	
300	75	1500	1350	750	3700	H16@200 t and b	H20@150	
300	150	1500	1350	750	3100	H16@200 t and b	H20@150	
400	75	1500	1500	750	4100	H16@200 t and b	H20@150	H16@175
400	150	1500	1500	750	3400	H16@200 t and b	H20@150	
500	75	1500	1500	750	4400	H16@200 t and b	H20@150	
500	150	1500	1500	750	3700	H16@200 t and b	H20@150	
750	75	1500	1500	750	5000	H16@200 t and b	H20@125	
750	150	1500	1500	750	4200	H16@200 t and b	H20@125	
1000	75	1500	1850	750	5500	H20@250 t and b	H25@150	
1000	150	1500	1850	750	4700	H20@250 t and b	H25@150	
1250	75	1500	1850	750	5900	H20@200 t and b	H25@125	
1250	150	1500	1850	750	5000	H20@200 t and b	H25@125	
1500	75	1500	1850	1000	6800	H20@150 t and b	H32@175	
1500	150	1500	1850	1000	5400	H16@150 t and b	H32@175	

O.T.M. (kNm)	Bearing pressure (kN/m²)	A (mm)	B (mm)	C (mm)	D (mm)	Base reinforcement (Each way S.C. 21)	Column reinforcement (All round S.C. 11)	Top reinforcement (Each way S.C. 21)
2000	75	2000	2000	1000	7000	H20@250t and b	H25@150	
2000	100	2000	2000	1000	6000	H20@250t and b	H25@150	
2000	150	2000	2000	1000	5500	H20@250t and b	H25@150	
3000	75	2100	2000	1250	7750	H20@200t and b	H25@150	
3000	100	2100	2000	1250	7000	H20@200t and b	H25@150	
3000	150	2100	2000	1250	6250	H20@200t and b	H25@150	
4000	75	2100	2000	1500	8500	H20@175t and b	H32@150	
4000	100	2100	2000	1500	7750	H20@175t and b	H32@150	
4000	150	2100	2000	1500	7000	H20@175t and b	H32@150	
5000	75	2100	2000	1500	9000	H20@175t and b	H32@150	
5000	100	2100	2000	1500	8250	H20@175t and b	H32@150	
5000	150	2100	2000	1500	7500	H20@175t and b	H32@150	H16@175
6000	75	2500	2000	1500	9500	H20@250t and b	H32@150	
6000	100	2500	2000	1500	8750	H20@250t and b	H32@150	
6000	150	2500	2000	1500	8000	H20@250t and b	H32@150	
7000	75	2500	2000	1500	10000	H25@225t and b	H32@150	
7000	100	2500	2000	1500	9250	H25@225t and b	H32@150	
7000	150	2500	2000	1500	8250	H25@225t and b	H32@150	
8000	75	2600	2000	1500	10500	H32@200b + H25@250t	H32@150	
8000	100	2600	2000	1500	9600	H25@225t and b	H32@150	
8000	150	2600	2000	1500	8700	H25@225t and b	H32@150	
9000	75	2600	2000	1500	11000	H32@175b H25@225t	H32@125	
9000	100	2600	2000	1500	10000	H25@200t and b	H32@125	
9000	150	2600	2000	1500	9000	H25@225t and b	H32@125	

Concrete Speciation's for High Mast Light Pole Foundation Design

The concrete used for unreinforced high mast lighting foundations should be a minimum of C20/25. For reinforced concrete high mast light pole foundations a minimum C28/35 grade should be specified. A minimum cement content of 300kg/m and maximum water to cement ratio of 0.60 should be specified. Coarse aggregate size should be 20mm nominal.

Reinforcement should be high tensile steel with a yield stress of 485N/mm.

Cover to all reinforcement should be a minimum of 40mm. Links to column section to be H10@200 c/c – shape code 51 to BS8666: 2005-plus H10 internal lacers at 450 max centers horizontal and 250 centers vertical shape code 99.

The concrete should be left for at least 14 days before any loading including the installation of the high mast light pole.

Site specific ground conditions should be considered such as ground water level and any potential ground contamination effects.

Holding Down Bolts

The holding down bolts must be installed in accordance with the manufacturer's recommendations. A typical detail is shown below. The bolts should be tightened to the specified torque, as shown in the below table;

Bolt size and grade	Projection (mm)	Torque (Nm)
M16*500 long grade 4.6	125	25
M20*500 long grade 4.6	125	50
M24*600 long grade 4.6	125	160
M30*800 long grade 4.6	150	310
M24*880 long grade 8.8	150	425
M30*1220 long grade 8.8	150	850
M36*1200 long grade 8.8	175	1450
M36*1350 long grade 8.8	175	1450
M36*1590 long grade 8.8	175	1450
M42*1700 long grade 8.8	210	2350
M48*1870 long grade 8.8	210	3500