PHC PILE

World's most popular pile

Samuda construction Ltd

TK BHABAN,13 KARWAN BAZAR (8TH & 9TH FLOOR), KARWAN BAZAR,DHAKA-1215

Samuda construction Ltd

WHY PHC PILE ?

- **50 Years of Maintenance Free Performance Without Special Surface Treatment.**
- **Lower Cost Than Steel and Cast-In-Situ Piles.**
- **Best Choice for The Environment.**
- **Suitable for Installation in A Variety of Soil Conditions**
- **Lower Weight Prevents Damage in Transport and Installation.**
- **High Buckling Resistance and No Cracking Due To 70 MPa Concrete and 7 MPa Prestressing.**

Samuda construction Ltd

BACKGROUND :

Pretensioned High-Performance Concrete (PHC) piles were first invented in Japan in the 1970's as a means to provide a solid base for building structures in a rapidly growing and earthquake prone country. Since their invention in Japan, PHC piles have been used widely in developed countries such as USA, Germany, Italy, as well as Korea, Singapore, Malaysia, Thailand, Indonesia, Vietnam and played a key role in rapid development of China and southeast Asia.
PHC pile is one of the types of piles are widely used in the world construction, for example in building and bridge. PHC pile is a prestressed concrete pile with circular hollow section.

OVERVIEW :

PHC piles are hollow, precast and prestressed concrete piles, in sizes generally ranging from 300 to 600 mm outside diameter, that are fabricated by prestressing methods. The dimension of PHC pile that is generally used according to Japan Industrial Standard (JIS) 5335 1987.
PHC pile is one of the types of piles are widely used in the world construction, for example in building and bridge. PHC pile is a prestressed concrete pile with circular hollow section. It is advisable to analysing of methods of increasing the strength and reliability of PHC pile due to earthquake loads, either by modifying the longitudinal reinforcement and confinement. In addition, it is about the failure patterns of PHC pile due to seismic loads.

FEATURES :

High design bearing power :

With concrete design strength of 80 -100 MPa it has higher strength than traditional Bored & PC Pile design strength. Thus, economical design is possible.

High resistance against hitting

Because combination between aggregate and cement paste is extremely strong by steam curing, compressive strength of the concrete is considerably high. This means that it has high resistance against hitting, and for this, it has high constructability, so it is economic. Also, even if the numbers of driving are increased, it can be reached to the bearing layer because percentage of damage during driving is low.

Economical design :

Not only it has huge design bearing capacity and high resistance, but also high strength pile production is possible in short time due to auto clave curing, it is economical that it can be con- structed without any delay on the construction by changing the length depending on the ground condition

Few drying shrinkage :

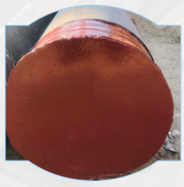
From the test result by the centrifugal force test piece, concrete cured by steam curing has smaller drying shrinkage and creep.

Excellent chemical resistance :

PHC PILE receives excellent result rather than Pre cast PILE for chemical resistance. This is because that composition of cement hardener is closed by steam curing and adhesion between cement paste and aggregate is strong

Higher Bending moments :

If compared in a point view of destruction bending moment and axial force of PC, PHC PILE, as axial force N is increased; destruction bending moment of PHC PILE is getting larger than PC



APPLICATIONS :

Any Important Project, Foundations and Soil Improvement Are the First Stage of Development. For Over 40 Years, PHC Piles Have Provided the Safest, Fastest and Most Economical Solution as A Foundation for Major Infrastructure and Investments.

PHC Piles Are Most Effective Solutions in The Following Uses:

- ***Bridge Piers as Deep Foundation or Pier Piles***
- ***High Rise Buildings***
- ***Petroleum and Gas Tanks, Water and Sewage, Waste Water Treatment Plants***
- ***Marine Structures and Harbors***
- ***Equipment Foundation Solutions for Petroleum, Gas and Steel Plants***
- ***Water Treatment Plant***
- ***Liquefaction Mitigation***

PHC

pile

PHC piles have an extremely high tensile strength which avoid cracks occurring in the pile structure before and during installation (transportation and driving stages) and after installation (service loads and ground movement).
Transportation of piles as well as the tensions created during pile driving is the main cause of tensile stress. Due to the inborn weakness of concrete against tensile stress, cracks typically occur in ordinary reinforced concrete pile sections.
In traditional piles, tensile strength is provided by steel rebar. Unfortunately, the reinforcing bars deform longitudinally during transport and installation and consequently sectional cracks are created in concrete.
In corrosive environments, these cracks lead to damage to steel and concrete by penetration of chlorine ion, sulphates, alkaline reactions, etc. To complicate matters more, inspection and evaluation of integrity of traditional concrete piles after installation are challenging as these elements are not accessible by visual inspection.
Some consultants mainly focus on the superstructure and calculate pile structural strength and resistance, whereas serviceability load during transportation, erection and installation must also be calculated.
Australian standard piling – design and installation emphasizes the requirements and procedures of considering serviceability loads in pile design. If superstructure loads, transportation and installation influences, seismic loads, ground movements, adhesion of soils and parameters of durability and design life mentioned in section 6 of Australian standard as 2159 are considered, the parameters of pile design, in corrosive environments, traditional non-prestressed piles must be excluded as an option.
Centrifugally manufactured concrete creates a higher density, hardened concrete compared to cast-in-place method making sure that no cracks are created along the shaft of the pile when pre-stressing is added. this means no damage to the piles during transportation and installation. to summarize, prestressed manufactured piles result in very high strength concrete guaranteeing the durability and design life of piles after installation.

Samuda construction Ltd

Comparison

Sort	Bored Pile	Precast Pile	PHC Pile
Application of Load	Good Resistance but not as good as PHC pile	Weak Resistance against shear and moment	Excellent resistance against shear force, tensile force and moment
Constructability	Excavation and Temporary casing driving make construction difficult	It can penetrate soft layer soil strata, hence difficult	It can be applied in hauling and welding withoutproblems
Supporting Force	Securing Force is easy	Penetration of this pile is much lower, not securing the supporting force	Penetration of driving pile is much higher thanPrecast pile, securing the supporting force- In case of pre-excavating embeddedpile, secure the tow supporting forcewith End-Close pile. Excellent than steelpipe pile, Bored pile, Precast Pile
Economics	Economics is poorer	Costlier	Excellent economy than steel pipe, Bored & Precast Pile - Price is table relatively
Pile Head	Breaking pile head is time consuming	Same as Bored Pile	No loss of pre-stressing and no crack occurs when cutting the pile head for the head arrangement
Bending Moment	Relatively good	Lower Bending moment results in shear failure	Bending resistance capacity is much higher than Bored & Precast Pile
Installation Time Period	Typically takes longer than other two type of pile	Installation hampers due to low penetration capacity	Quicker & Faster than Both
Durability	Durable in mode of construction	Breaks in hard soil strata	Higher spinning results in Durable construction
Quality Control	Maintaining quality is difficult	It is usually constructed in yard, hence poorer quality.	As factory made, quality is superior

Safety in PHC Piles :

- ***Structural Stability***
- ***Excellent construction quality***
- ***Economic***

General Specification

Standards :

PHC pile comply with MS 1214:part 4 2004 and also generally complies with JIS A 5337:1987. PHC Piles are modified to suit BS-8004:1986- Foundations and BS 8110:1997 – Structural Use of Concrete. Concrete complies with SS EN 206-1:2009-Specification of Concrete.

Material :

Aggregates- Coarse Aggregates shall be 20 mm stone. Fine aggregate shall be clean river sand or washed mining sand.

Cement-Portland cement complies with MS 522:2007

Prestressing Steel- High frequency induction heat treated bars manufactured to JIS G 3137:1994 or equivalent.
Spiral Wire- Hard drawn wire.

CONCRETE STRENGTH
Minimum concrete cube strength:
at transfer of prestress- 30 N/mm2
at 28 days - **Grade 80 pile- 80 N/mm2**

JOINT:

The joint is designed to have the same performance as the main body particularly in respect of bending strength.

LIFTING POINTS:

For piles up to 12m length, piles shall be lifted by using steel hooks at both ends. For piles exceeding 12m, piles shall be lifted by wrapping wire ropes around the piles at the marked lifting points.

PILE SHOE :

PHC Piles will be supplied either open ended, with a flat shoe or with an X-pointed shoe.

CURING :

After casting, the piles are steam cured. When the concrete reaches the specified transfer strength, the piles are demoulded, marked and checked for quality. The piles can normally be transported and driven after three days from the date of casting, or when the cube strength reaches 70 N/mm2.

IDENTIFICATION :

All PHC Piles have the typical markings as below:
Company's Initial Standard
Pile Size and Class
Date of Cast (yy/mm/dd)
Serial No & Factory Code
Pile Length and Type

STANDARD LENGTHS

PHC Piles are available in lengths of 6m to 12m (can be jointed upto 46m) subject to certain limitations.

DELIVERY

Within approximately 7-15 days from the date of production

Samuda construction Ltd

Standard Grade 80 Pile

Class A (Effective Prestress ≥ 4.0 N/mm^2)

Nominal Diameter	Nominal Thickness	Length	Prestressing Bar		Area of Concrete	Section Modulus	Bending Moment		Recommended Max Structural Load	Effective Prestress
			9mm	10.7mm			Cracking	Ultimate		
mm	mm	m	no	no	mm^2	x1000 mm^3	Knm	Knm	ton	N/mm^2
300	55	6-12	6	-	43,595	2,383	27.5	54.1	82	5.80
400	65	6-12	10	-	68,408	5,106	42.7	61.8	132	4.30
500	80	6-12	10	-	105,558	9,888	82.3	115.9	204	4.84
600	90	6-12	12	-	144,199	16,586	148.8	222.5	276	4.53

Class B (Effective Prestress ≥ 5.0 N/mm^2)

Nominal Diameter	Nominal Thickness	Length	Prestressing Bar		Area of Concrete	Section Modulus	Bending Moment		Recommended Max Structural Load	Effective Prestress
			9mm	10.7mm			Cracking	Ultimate		
mm	mm	m	no	no	mm^2	x1000 mm^3	Knm	Knm	ton	N/mm^2
300	60	6-12	6	-	46,501	2,393	26.81	58.01	85	6.4
400	80	6-12	10	-	80,425	5,643	53.7	92.70	148	5.5
500	90	6-12	10	-	115,925	10,518	95.9	154.50	221	5.1
600	100	6-12	14	-	157,080	17,546	163.1	259.6	295	5.3

Class C (Effective Prestress ≥ 7.0 N/mm^2)

Nominal Diameter	Nominal Thickness	Length	Prestressing Bar		Area of Concrete	Section Modulus	Bending Moment		Recommended Max Structural Load	Effective Prestress
			9mm	10.7mm			Cracking	Ultimate		
mm	mm	m	no	no	mm^2	x1000 mm^3	Knm	Knm	ton	N/mm^2
300	65	6-12	6	-	49,250	2,453	27.88	59.01	84	8.5
400	80	6-12	12	-	80,425	5,748	69.7	148.3	147	8.1
500	90	6-12	15	-	115,925	10,670	120.3	231.7	215	7.3
600	100	6-12	20	-	157,080	17,761	198.0	370.8	291	7.0

***A single pile can be jointed upto 45m**

Standard Grade 80 Pile

Class AB

Nominal Diameter	Nominal Thickness	Length	Prestressing Bar		Area of Concrete	Section Modulus	Bending Moment		Recommended Max Structural Load	Effective Prestress
			9mm	10.7mm			Cracking	Ultimate		
mm	mm	m	no	no	mm^2	x1000 mm^3	Knm	Knm	ton	N/mm^2
300	70	6-12	6	-	51,841	2,508	30	50	129	6.37
400	95	6-12	-	10	93,131	5,965	74	132	233	8.03
500	125	6-14		12	150,829	11,831	136	226	322	6.16
600	130	6-14	-	16	196,113	19,518	223	374	374	6.13

***A single pile can be joint upto 45 m**

Formula for Axial Load:

Based on BS 8004:1984 the maximum allowable axial stress that maybe applied to a pile acting as short strut should be one quarter of specified works cube strength at 28 days less the prestress after losses.

N= fca X A

= ¼ (fcu-fpe) X A

Where, N = maximum allowable axial load

A = cross-section area of concrete fca

fca = permissible compressive strength of concrete

fcu = specified compressive strength of concrete

fpe = effective prestress in concrete

CODE:

- *ACI 543R*
- *PCI Prestressed concrete piling committee*

Pa = Ag(0.33 fc'– 0.27fpc)

where

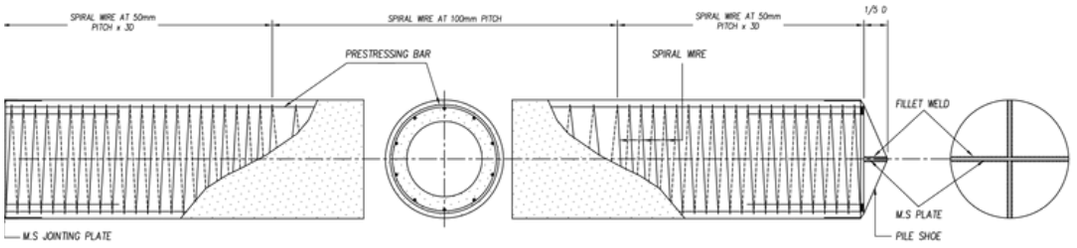
Pa = allowable service level axial load

Ag = gross cross-sectional area of pile

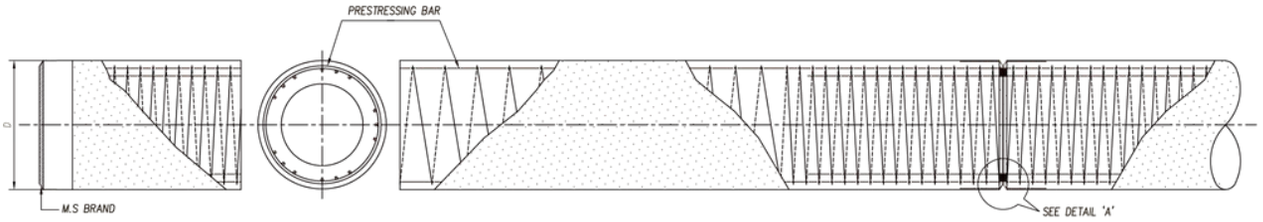
fc' = 28-day compressive strength of concrete

fpc = effective prestress in the pile after losses

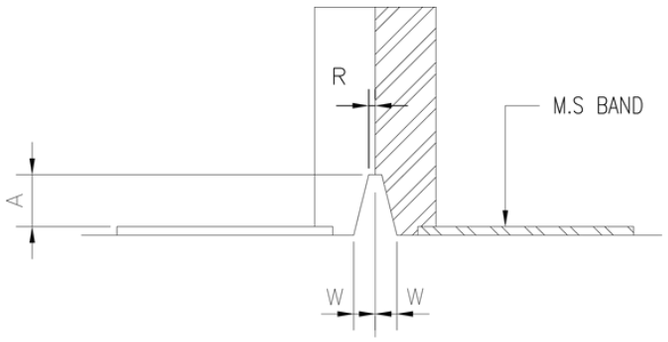
Sectional Details of PHC Piles



STARTER PILE



EXTENTION PILE

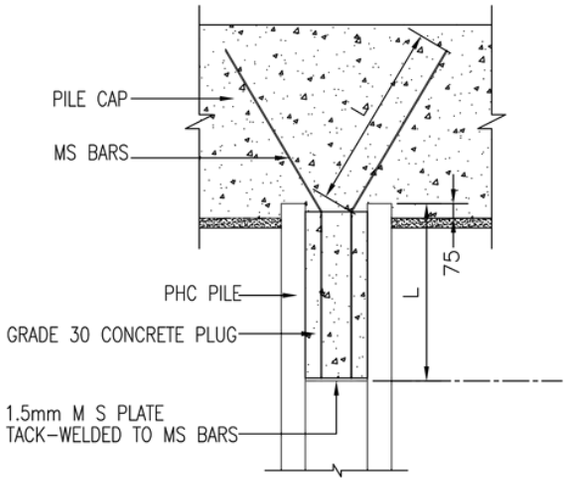


JOINT WELDING DETAILS

Dia of pile D	Throat thickness A	W	Root R
mm	*mm*	*mm*	*mm*
300	8.5	4	2
400	10	4.5	2
500	12	5	2
600	12	5	2

Bonding into Pile cap

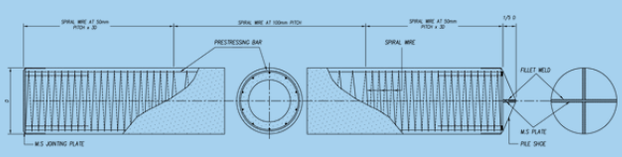
Dia of pile D	MS Bars		
	Quantity	Dia	L
mm	*nos*	*mm*	*mm*
300	4	12	500
400	5	12	700
500	6	16	900
600	8	16	1000



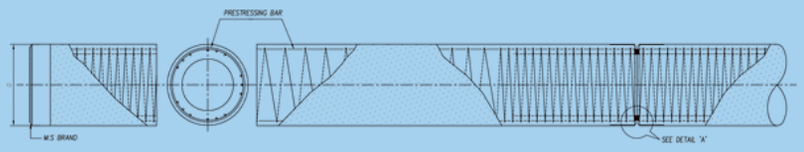
TYPICAL PILE STARTER BARS INTO PILECAPS

As the PC bars are bonded with concrete, PHC piles may be cut off at any point. The piles need not be stripped down to expose the bars and can be bonded to the pile cap as shown in the above sketch. If the piles are not subjected to tensile loads, the recommended M.S. bars are considered adequate

Pile

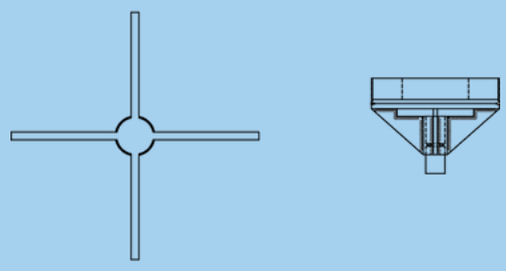


STARTER

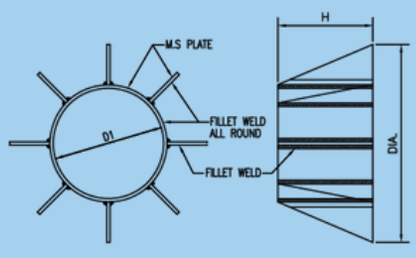


EXTENSION

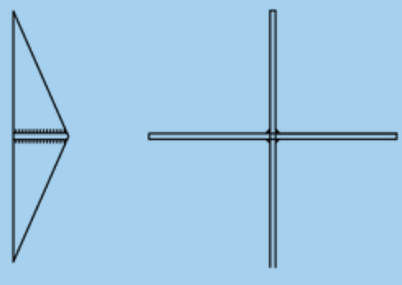
Shoes



ROCK SHOE



PIPE SHOE



X- POINTED SHOE

Samuda
construction Ltd

Samuda construction Ltd

Contact :

Address :
T.K. Bhaban (8th & 9th Floor), 13, Karwan Bazar, Dhaka -1215
Telephone No: +880 25501238-42
+880 9612302010

Website: www.samudaconstruction.com
E-mail : sales.construction@scclbd.com
Mobile No: +8801958601095