HIGH PERFORMANCE
PRETENSIONED SPUN
HIGH STRENGTH

CONCRETE PILES

PCI
Precast/Prestressed Concrete Institute

QUALITY SYSTEM
SIRIM
UKAS MANAGEMENT SYSTEMS
074

CERTIFIED TO ISO 9001:2015
CERT. NO. : QMS00120

ICP PILES®

Introduction

INDUSTRIAL CONCRETE PRODUCTS SDN BHD (ICP) is the first commercial manufacturer of SPUN HIGH STRENGTH CONCRETE PILES (ICP PILES) in Malaysia. Presently, ICP is the largest manufacturer in South East Asia.

ICP Piles are circular hollow in cross-section and are manufactured in sizes ranging from diameter 250mm to 1,200mm with lengths varying from 6m to 18m in single piece.

ICP Piles have been used extensively as foundation piles for power stations, highrise buildings, civil engineering works, bridges, marine structures, harbors and etc.

ICP Piles are exported to Bangladesh, Brunei, Canada, Carribean, Indonesia, Maldives, Myanmar, New Zealand, Pakistan, Philippines, Samoa, Singapore, Sri Lanka, the Middle East, USA, and Vietnam.

ICP Piles is a certified Green Product under SIRIM Eco Label and MyHIJAU in Malaysia, and Green Label in Singapore, reflecting our commitment to reduce our impact on the environment.

Gardens By The Bay, Singapore

Club Mediterranean, Maldives

Temburong Bridge, Brunei

General Specification

ICP PILES

STANDARDS

ICP Pretensioned Spun High Strength Concrete Piles are manufactured to comply with MS 1314 : Part 4:2004 and generally comply with JIS A 5373:2016. ICP piles are modified to suit ACI 543R-74(80) - Recommendation for Design, Manufacture and Installation of Prestressed Concrete Piles, BS 8004:2015+A1:2020 on foundations and BS EN 1992-1-1:2023 on structural use of concrete. Concrete complies with SS EN 206 : 2014 – Specification of Concrete.

In particular, the method of manufacture, the dimensional tolerances and requirements for bending strength of the main body and joint comply with JIS A 5373:2016.

MATERIALS

Aggregates – Coarse aggregates shall be 20mm granite. Fine aggregates shall be clean river sand or washed mining sand.
Cement – Ordinary Portland cement to BS EN 197 -1 : 2011.
Prestressing Steel – High frequency induction heat treated bars manufactured to JIS G 3137 : 2020 or equivalent.
Spiral Wire – Hard drawn wire to BS 4482.

CONCRETE STRENGTH

Minimum concrete cube strength:

at transfer of prestress	30N/mm²
at 28 days - Grade 80 pile	80N/mm²

JOINT

The joint is constructed to have the same performance as the main body particularly in respect of bending strength. All ICP Piles will be supplied with steel extension plates for splicing.

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

All ICP piles will be supplied either open ended, with a flat shoe or with other type of shoes such as x-pointed shoe, rock shoe and pipe 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 ICP Piles have the typical markings as below:

ICP	Company's initials
MS 1314 : Part 4	Malaysian Standard
60B800	Pile size and class
190102	Date of cast (yy/mm/dd)
001L3	Serial number and factory code
12E	12m long, extension

ICP
MS1314: Part 4
60B800
190102
001L3
12E

Logo as Trademark

Others markings if used, for shoes, S for starter (Flat shoe / X -pointed shoe/ Rock shoe / Pipe shoe).

STANDARD LENGTHS

ICP Piles are available in lengths of 6m to 18m subject to certain limitations.

TECHNICAL DATA

Technical data of our standard piles are given in the tables on the next page. Please note that the axial loads represent the structural capacities of the piles. Actual working load depends on the soil conditions and the pile slenderness ratio. Appropriate reduction of axial loads should be applied for:

a) marine structures;
b) piles subjected to bending;
c) high upstand;
d) piles driven through very poor top stratum;
e) raking piles, etc.

DEFINITIONS

ICP Piles : High Performance Pretensioned Spun High Strength Concrete Piles
MS : Malaysian Standard
JIS : Japanese Industrial Standard
ACI : American Concrete Institute
BS : British Standard
CSA : Canadian Standard Association
SS : Singapore Standard
EN : European Standard

Properties of ICP Piles

Nominal Diameter		Nominal Wall Thickness		Length		Nominal Weight		Prestress Bar Dia			Area of Concrete		Section Modulus		Effective Prestress f_{pc} or f_{ce}		CSA				ACI							
								7.1mm (.28")	9.0mm (.35")	10.7mm (.42")							Cracking Moment M_{cr}	Factored Moment $\emptyset M_{ro}$	Service Axial Load N	Factored Axial Load $\emptyset P_{ro}$	Cracking Moment Capacity M_{cr}		Nominal Moment Capacity $\emptyset M_n$		Service Axial Load N		Nominal Axial Load $\emptyset P_n$	
mm	in	mm	in	m	ft	kg/m	lb/ft	No.	No.	No.	mm²	in²	x1000mm³	in³	N/mm²	psi	kN-m	kN-m	kN	kN	kips-ft	kN-m	kips-ft	kN-m	kips	kN	kips	kN
250	9.8	55	2.2	6-12	20-39	88	59	7			33,694	52.2	1,435	87.6	7.08	1,027	17	29	814	910	13	18	25	34	160	712	273	1,214
300	11.8	60	2.4	6-15	20-49	118	79	10			45,239	70.1	2,394	146.1	7.08	1,027	30	49	1,072	1,215	23	31	43	58	214	952	366	1,628
350	13.8	70	2.8	6-15	20-49	160	108		8		61,575	95.4	3,786	231.0	7.05	1,022	46	75	1,487	1,662	34	46	65	88	293	1,303	499	2,219
400	15.7	80	3.1	6-15	20-49	209	140		10		80,425	124.7	5,701	347.9	7.03	1,020	67	108	1,968	2,178	51	69	93	126	385	1,711	655	2,912
450	17.7	80	3.1	6-18	20-59	242	163		12		92,991	144.1	7,679	468.6	7.03	1,020	93	149	2,250	2,511	70	95	127	172	443	1,970	755	3,358
500	19.7	90	3.5	6-18	20-59	301	202			10	115,925	179.1	10,579	645.5	6.91	1,002	123	195	2,856	3,145	92	125	166	225	555	2,468	944	4,198
600	23.6	100	3.9	6-18	20-59	408	274			14	157,080	243.5	17,761	1,083.8	7.1	1,030	210	330	3,835	4,252	158	214	281	381	751	3,339	1,278	5,684
700	27.6	110	4.3	6-18	20-59	530	356			20	203,889	316.0	27,498	1,678.0	7.5	1,088	345	542	4,832	5,478	259	351	468	635	966	4,296	1,650	7,341
800	31.5	120	4.7	6-18	20-59	667	448			24	256,354	397.3	39,966	2,438.9	7.3	1,059	488	759	6,167	6,913	366	496	649	880	1,220	5,425	2,080	9,253
900	35.4	130	5.1	6-18	20-59	818	550			28	314,473	487.4	55,622	3,394.2	7.1	1,030	659	1,015	7,679	8,476	494	670	862	1,169	1,503	6,685	2,558	11,379
1000	39.4	140	5.5	6-18	20-59	983	661			36	378,248	586.3	75,188	4,588.2	7.4	1,073	926	1,435	9,052	10,187	695	942	1,226	1,662	1,797	7,992	3,067	13,641
1200	47.2	150	5.9	6-18	20-59	1,286	865			46	494,801	766.9	119,966	7,320.8	7.12	1,033	1,517	2,323	11,685	13,280	1,091	1,480	1,915	2,597	2,355	10,479	4,017	17,870

NOTE: We can redesign to suit customer's requirement, if quantity is sufficient.

(Subject to change without prior notice)

CSA code formula

$N = 0.45\, f'_c\, A_c - f_{pc} A_p$

$\emptyset P_{ro} = 0.85\, [\alpha_1 \emptyset_c f'_c\, (Ac - Ap) - f_{pi}\, A_p]$

$M_{cr} = (f_{ce} + f_r) S_b$ where $f_r = 0.6\lambda\sqrt{f'_c}$

$\emptyset M_{ro} = 0.85\, (\alpha_1 \emptyset_c f'_c\, A_c\, d_c - \Sigma f_{pi}\, A_{pi}\, d_{pi})$

ACI code formula

$N = (0.33\, f'_c - 0.27 f_{pc}) A_g$

$\emptyset P_n = 0.85[0.75[0.85 f'_c\, (Ac - Ap) - f_{pi}\, A_p]]$

$M_{cr} = (f_{pc} + f_r) S_b$ where $f_r = 7.5\lambda\sqrt{f'_c}$

$\emptyset M_n = 0.90\, (0.85 f'_c\, A_c\, d_c - \Sigma f_{pi}\, A_{pi}\, d_{pi})$

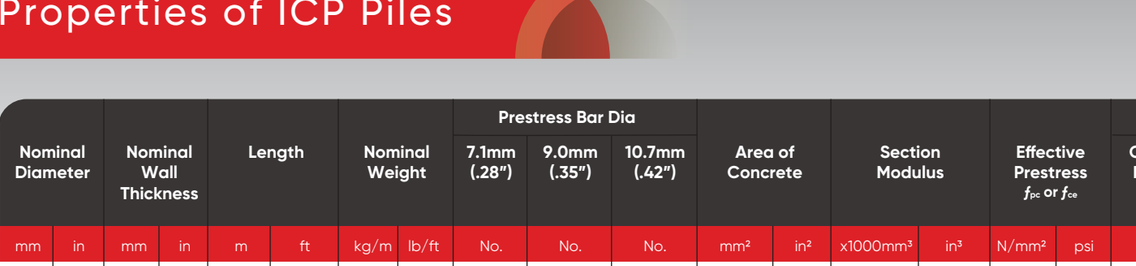
f'_c = 70 MPa (10.15 ksi)

f_{pu} = 1420 MPa (205.9 ksi)

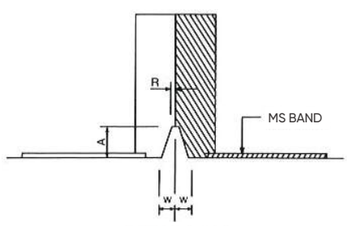
$f_{pr} = (0.60 f_{pu} - \epsilon_c E_{ps})$

Axial resistance based on short column structural capacity only.

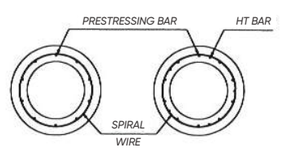
Sectional Details of ICP Piles



Dia Of Pile D	Throat Thickness A	W	Root R
mm	mm	mm	mm
250	8.5	4.0	1.5
300	8.5	4.0	1.5
350	8.5	4.0	1.5
400	10	4.5	1.5
450	10	4.5	1.5
500	12	5.0	1.5
600	12	5.0	1.5
700	12	5.0	1.5
800	14	6.0	2.0
900	14	6.0	2.0
1000	18	6.0	2.0
1200	20	6.0	2.0



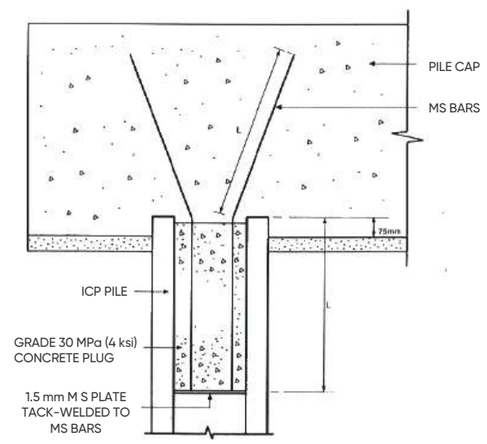
DETAILS "A"



SECTION A-A SECTION B-B

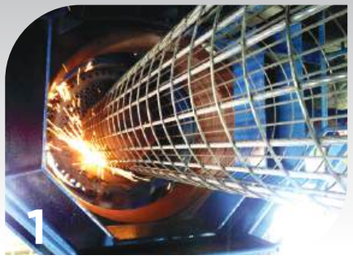
Bonding ICP Piles Into Pile Cap

As the PC bars are bonded with concrete, ICP Piles may be cut off at any Point. The piles need not be stripped down to expose the bars in order to be bonded to the pile cap (refer to the sketch below). If the piles are not subjected to tensile loads, the recommended m.s. bars are considered adequate.



Dia Of Pile	MS Bars		
	Quantity	Dia.	L
mm	mm	mm	mm
250	4	12	500
300	4	12	500
350	5	12	550
400	5	12	700
450	5	15	800
500	6	15	900
600	8	15	1000
700	8	18	1200
800	8	20	1400
900	10	25	1500
1000	12	25	1500
1200	20	25	2000

Manufacturing Process



CAGE MAKING/MOULD SETTING

PC bars in coil form are straightened and cut to correct lengths. The ends are warm-headed to form button heads. The bars are passed through the cage forming machine where spiral wire is automatically spot-welded at the correct spacings. End plates are fitted to the cage. The whole cage is then placed onto the bottom half mould.

STRESSING

The PC bars are stressed against the mould through a central shaft and stressing plate. The stressing is being carried out in a single operation. This ensures uniformity of stress in all the PC bars and hence straightness of the pile.

PILE SPINNING

The pile is then compacted by the centrifugal spinning machine. Spinning process squeezes out excess water, thus increases the concrete strength.

CONCRETE FEEDING

Concrete from the computerised batching plant is discharged into a feeding hopper. The concrete is then fed into the mould by pumping.*

STEAM CURING

The pile is sent to the steam tank for rapid curing process in order to achieve the required transfer strength for early demoulding.

DEMOULDING

After demoulding, final QC inspection is carried out according to the quality manual specification.

*Note: For open concrete feeding, concrete is fed into the mould before stressing.

Special Features of ICP Piles

ICP PILES

AREAS OF APPLICATION

- Bridges
- Piled Embankments
- Building Foundations
  - ▶ High rise, industrial and government projects.
- Marine Structures
- Civil Engineering Works
- Heavy Industries

PRODUCT ATTRIBUTES

- Steam curing enables faster production rate and delivery to project sites.
- Can be customized to suit project requirements.
- Spinning process results in more durable concrete with high resistance to corrosion.
- High strength concrete up to grade 100 enables piles to be driven through hard strata.
- Can be manufactured from 250mm to diameter 1200mm and a maximum single length of 18 metres for export to North American market.
- Environmental friendly installation by hydraulic jacking equipment which is free of noise, air pollution and vibration.
- Prestressed concrete provides higher bending moment capacity compared to conventional reinforced concrete piles.

OMA 1, Commercial cum Residential Complex, Vancouver, Canada

Palm Harbor Marina, Pensacola, Florida, USA

TBP Jetty, Obi Island, Indonesia

Westport Marina, Victoria, Canada

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