UTRACON

Bonded Post-Tensioning Systems Using Strands

Company Profile

Utracon Group of Companies (Utracon) was established in 1998 in Singapore with the aim to provide specialist engineering design and construction services to our clients. Backed by a strong team of engineers and professionals, Utracon established its name in the region as a reliable specialist that has the capabilities of performing the following services:

- Design and construction methods for both building and civil engineering structures.
- Design, supply and installation of both internal and external prestressing systems.
- Design, supply and installation of fiber reinforced plastics (FRP) and other structural strengthening methods.
- Design, fabrication and erection of temporary structures and system formwork (to suit construction of bridges, egg shaped digesters, elevated water towers, etc.).
- Design and precasting of building and civil engineering structural components.
- Supply and installation of bridge products, e.g. bearings and expansion joints.

Over the years, Utracon has established itself in the following overseas markets:

- South East Asia – Singapore, Malaysia, Indonesia, Vietnam, Myanmar, Brunei, Cambodia, Laos
- South Asia – India, Sri Lanka, Bangladesh
- Eastern Africa - Uganda
- Micronesia – Guam

Through our Singapore's licensee agreement with DYWIDAG Systems International (DSI), Utracon is the authorised supplier of the following DSI patented products:

- DYWIDAG Bonded Post-tensioning Systems Using Strands and Bars
- DYWIDAG Unbonded Post-tensioning Systems Using Strands and Bars
- DYWIDAG External Post-tensioning System

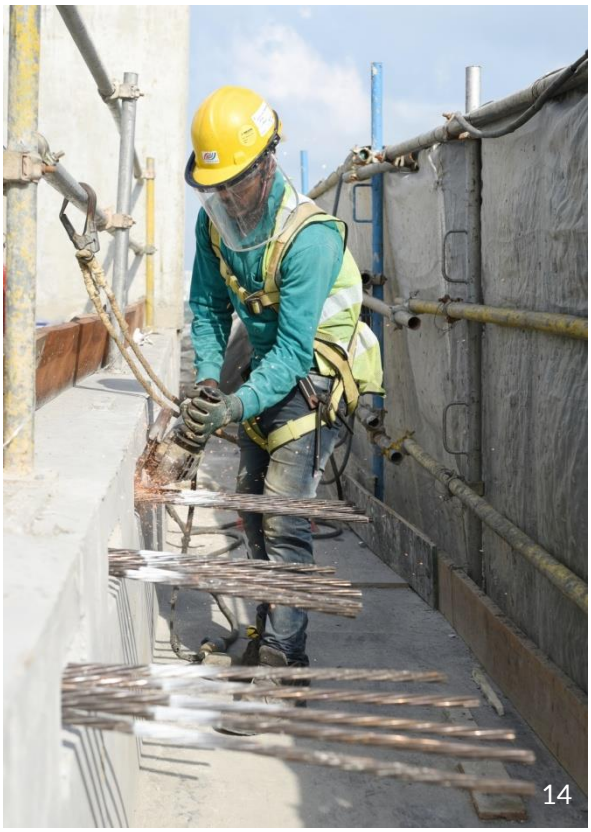
Through the cooperation between DSI and Sumitomo (SEI) Steel Wire Corporation, Utracon is also accessible to the latter's Japanese technology, e.g. epoxy coated strands and bars, etc.

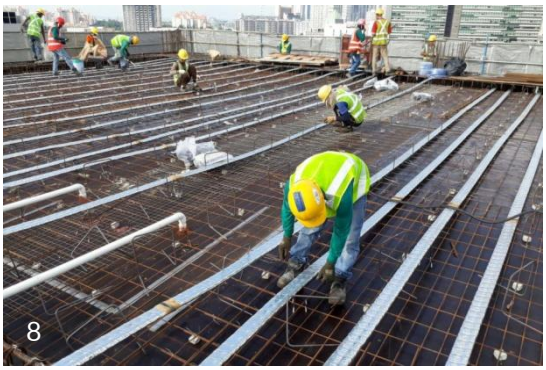
Egg-shaped digesters post-tensioned by Utracon

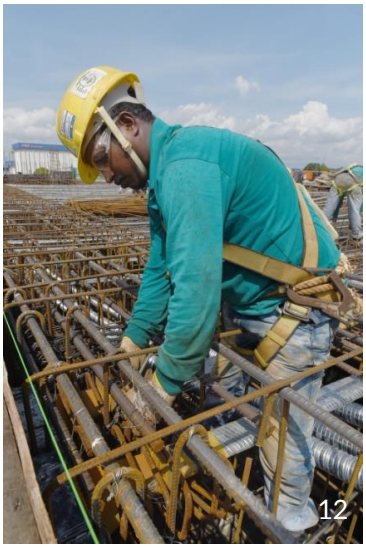
Contents

Post-Tensioning – Supply, Delivery & Installation Works

1. Production of ducts
2. Inspection of incoming materials
3. Maintenance of equipment
4. Post-tensioning R&D
5. In-house training centre
6. On-site training of workers
7. Delivery of materials
8. Laying of tendon
9. Securing of tendon

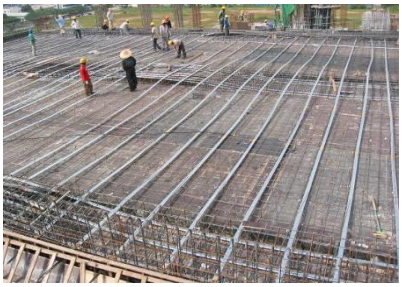






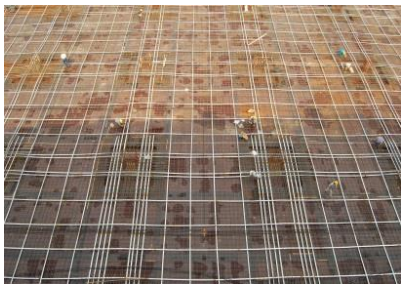
10. Pushing of strand
11. Forming of bond end anchorage
12. Installation of stressing anchorage
13. Stressing of tendon
14. Cutting of strand
15. Filling up of recess former voids
16. Mixing of grout
17. Grouting of tendon

Various PT slab systems



PT beam & slab

PT beam with PC slab



PT flat slab

DYWIDAG Bonded Post-Tensioning System is a world renown system which complies to all international specifications and recommendations. This system is suitable for all applications and is widely used throughout the world in bridges and civil engineering structures, e.g. water tanks, LNG tanks, stay cable structures, etc.

UPS Bonded Post-Tensioning System is a very efficient flat anchorage system designed by Utracon in house engineers and tested in independent laboratories to comply with the latest international codes.

As a leading post-tensioning specialist, Utracon had constructed more than 10 million square meter of post-tensioned floor since 1998 worldwide. It has accumulated a great deal of experience and knowhow in the application of post-tensioning, which helped it to fine-tune the design of its UPS flat anchorage system.

To-date, UPS Bonded Post-tensioning System has been used extensively in the construction of buildings and civil engineering projects in South East Asia, India, Sri Lanka, The Middle East and Africa.

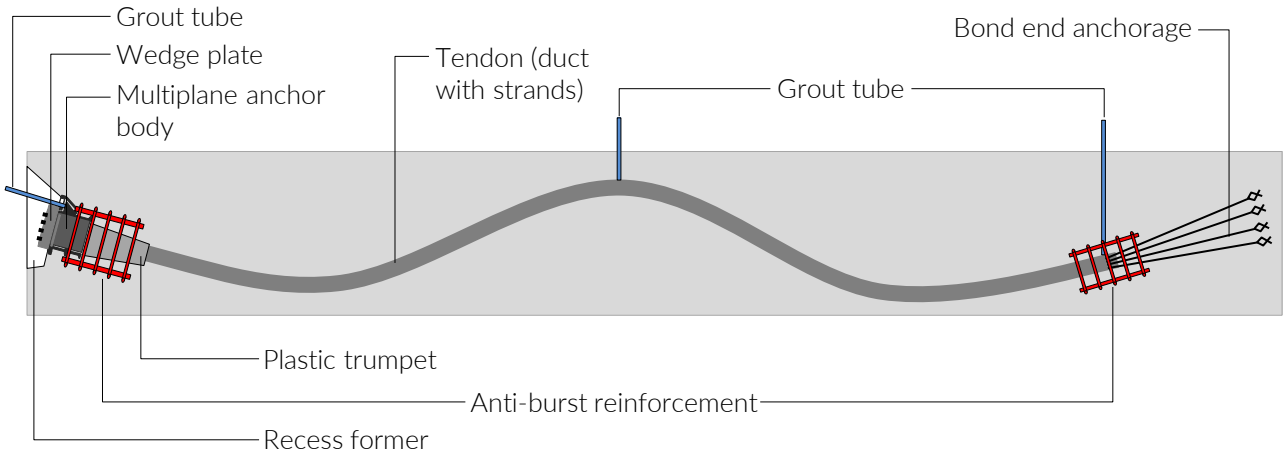
Post-tensioned high rise buildings in Singapore

Strands are made up of 7 individual cold-drawn wires; 6 helically wound outer wires and one centre wire (king wire). Strands can be supplied either bare, galvanized or epoxy-coated without any loss in strength.

Bare strands

Epoxy coated strands

Components of an Internal Post-Tensioned Tendon



Technical Data

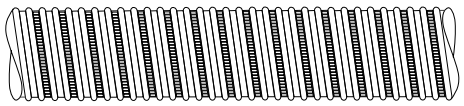
Strand Type		0.5”		0.6”		0.62”		
Code/Specification		BS 5896 Y1860S7	ASTM A416 Grade 270	BS 5896 Y1860S7	ASTM A416 Grade 270	BS 5896 Y1770S7	BS 5896 Y1860S7	ASTM A416 Grade 270
Nominal diameter	mm	12.9	12.7	15.2	15.2	15.7	15.7	15.7
Ultimate strength, f_{pk}	N/mm²	1860	1860	1860	1860	1770	1860	1860
Cross-sectional area	mm²	100	98.7	139	140	150	150	150
Weight	g/m	781	780	1086	1100	1172	1172	1200
Ultimate load	kN	186	184	259	261	266	279	279
Yield load, $f_{p0.1k}$	kN	164(1)	165.3(2)	228(1)	234.6(2)	234(1)	246(1)	251.4(2)
Modulus of elasticity	N/mm²	~ 195,000						
Relaxation(3) after 1000 hours	%	Max. 2.5						

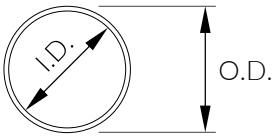
note:
(1) Yield measured at characteristic value of 0.1% proof load.
(2) Yield measured at 1% extension.
(3) Applicable for relaxation Class 2 according to BS 5896 and SS475: or low relaxation complying with ASTM A416.

Metal corrugated ducts are produced from hot-dipped galvanized steel sheet on special tubeformer machines.

These thin-walled (0.25mm – 0.60mm), ribbed sheet metal ducts provide high rigidity that can withstand being embedded in concrete without deformation. The duct corrugation provides excellent bond behaviour between the tendon and concrete.

Metal ducts also provide a fair secondary corrosion protection to the strands. Primary protection is provided by the alkalinity of grout and concrete.

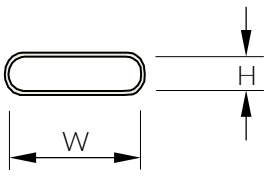




Dimensions of Corrugated Round Duct

No. of Strands in Duct		Round Duct	
Type 0.5"	Type 0.6" / 0.62"	I.D. (mm)	O.D. (mm)
07	05	50	55
09	07	65	70
12	09	75	80
15	12	80	85
20	15	90	95
27	19	95	100
32	22	100	105
37	27	110	115
--	31	120	125
--	37	130	135

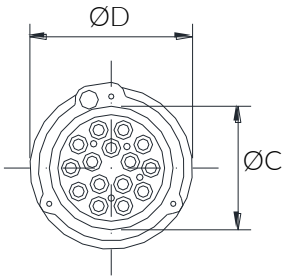
Internal dimensions of flat ducts:



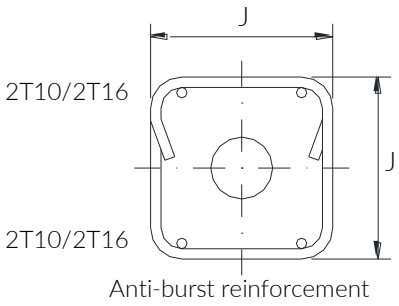
Dimensions of Corrugated Flat Duct

No. of Strands in Duct		Flat Duct	
Type 0.5"	Type 0.6" / 0.62"	W (mm)	H (mm)
3	2	45	20
--	3	60	20
4 - 5	4	75	20
6	5	90	20

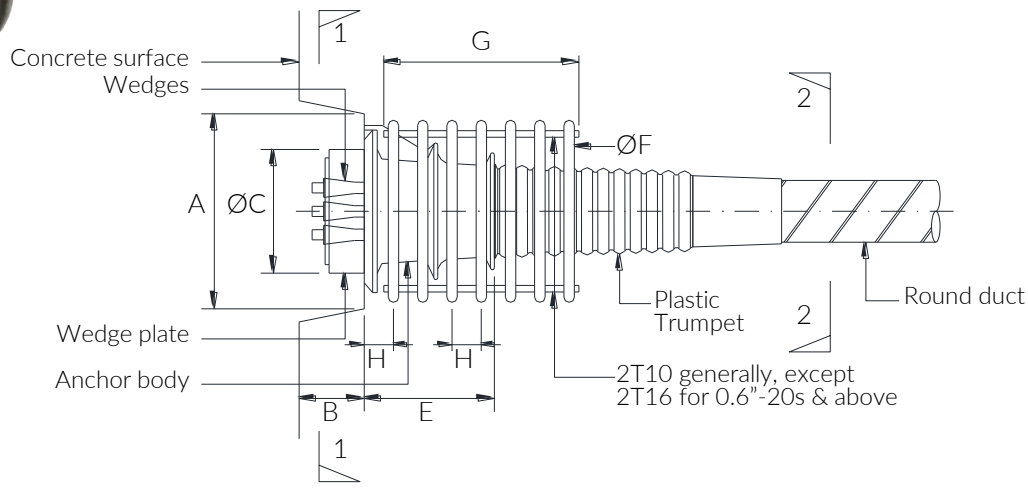
note:
(1) Details, dimensions and system designs are subject to change without notice.



Section 1



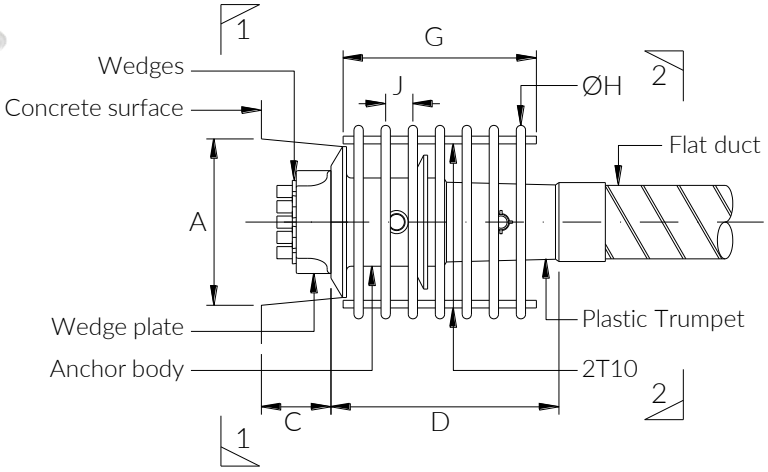
Section 2

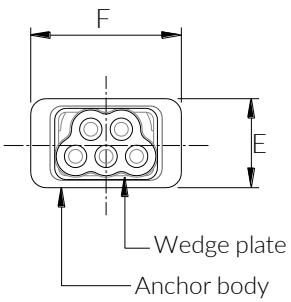


DSI Multiplane Anchorage (MA) & Anti-burst Reinforcement Data

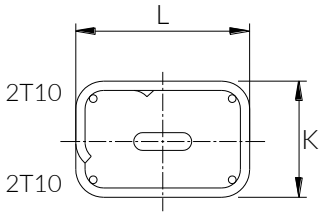
Type 0.5"	Type 0.6"/ 0.62"	Technical Data					Anti-burst Reinforcement				
		A	B	ØC 0.5"/0.6"	ØD	E	ØF	G	H	J	No. of Links
7	5	200	100	117	150	90	T16	210	45	170	4
9	7	220	100	130	170	100	T16	250	45	185	5
12	9	230	100	140/145	190	125	T16	275	45	240	6
15	12	270	100	160/170	220	180	T16	300	45	280	7
20	15	300	100	180/190	250	200	T16	320	45	320	7
27	19	330	120	200/210	280	220	T16	365	45	360	8
32	22	360	120	220	305	220	T16	410	45	400	9
37	27	390	120	240	330	240	T20	400	50	430	8
--	31	435	120	270	385	350	T20	500	50	480	10
--	37	470	135	270	420	350	T20	550	50	530	11

note:
(1) For type 0.6"/0.62", maximum UTS of strand applicable is 279kN.
(2) The above configurations can be substituted with equivalent helical reinforcement.
(3) Details, dimensions and system designs are subject to change without notice.



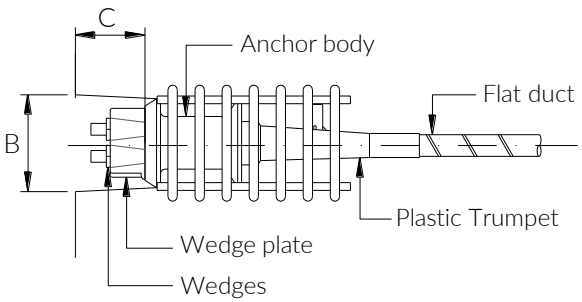


Section 1



Anti-burst reinforcement

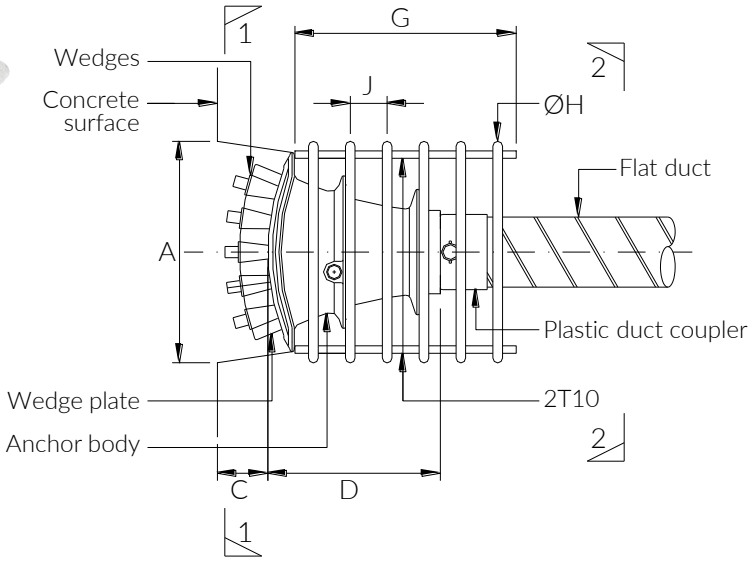
Section 2

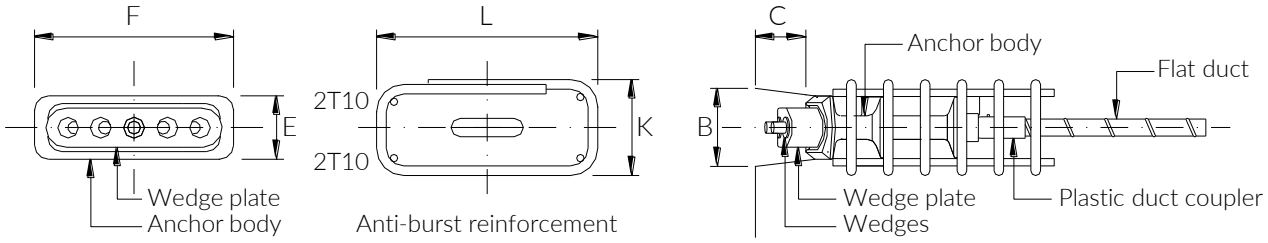


UPS Flat Anchorage (SA) & Anti-burst Reinforcement Data

Type 0.5”	Type 0.6”/ 0.62”	Technical Data						Anti-burst Reinforcement					
		A	B	C	D	E	F	G	ØH	J	K	L	No. of Links
3	3	210	100	90	300	80	185	200	T12	50	115	225	4
4, 5	4	200	125	90	300	105	180	200	T12	50	140	225	5
6	5	215	125	90	300	115	195	250	T12	35	160	225	7

note:
(1) For type 0.6”/0.62”, maximum UTS of strand applicable is 266kN.
(2) The above configurations can be substituted with equivalent helical reinforcement.
(3) Details, dimensions and system designs are subject to change without notice.



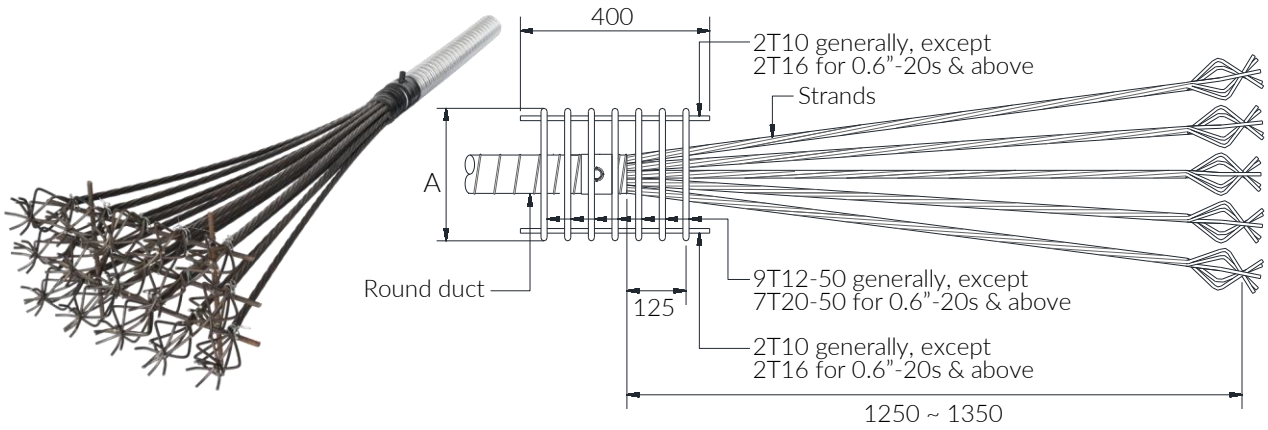


UPS Flat Anchorage (FA) & Anti-burst Reinforcement Data

Type 0.5”	Type 0.6”/ 0.62”	Technical Data						Anti-burst Reinforcement					
		A	B	C	D	E	F	G	ØH	J	K	L	No. of Links
3	2	180	90	81	120	80	160	150	T10	50	130	200	3
4, 5	4	233	106	81	203	86	203	300 (200)	T10 (T12)	50	130	250	6 (4)
--	5	300	106	90	234	86	270	350 (300)	T10 (T12)	50	130	300	8 (6)

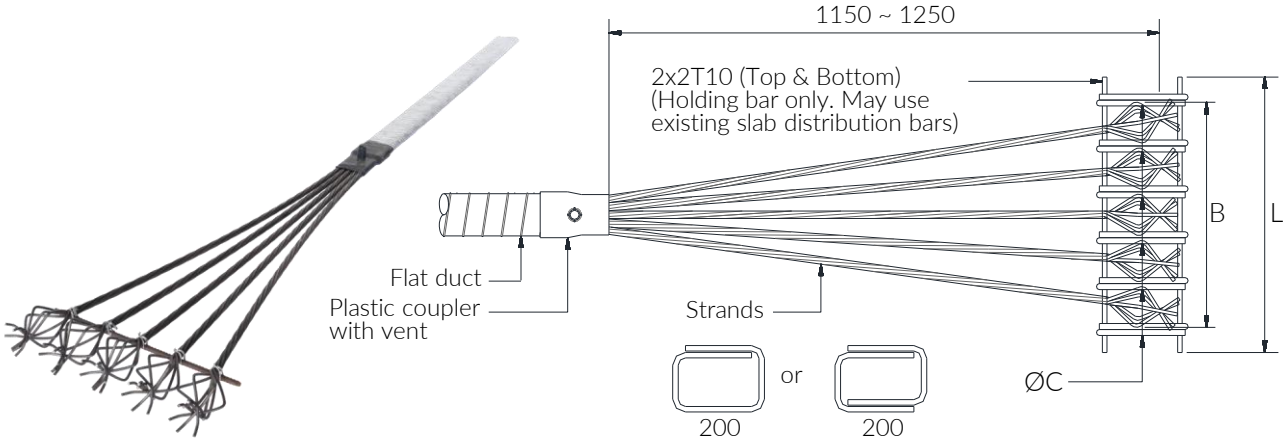
note:
(1) For type 0.6”/0.62”, maximum UTS of strand applicable is 266kN.
(2) The above configurations can be substituted with equivalent helical reinforcement.
(3) * For slab thickness <200mm, K = 115mm.
(4) Details, dimensions and system designs are subject to change without notice.

Bond End Anchorage for Multistrand Tendon



Dimension A:
200 for 0.5"-12s / 0.6"-9s & below
250 for 0.5"-13s to 27s / 0.6"-10s to 19s
400 for 0.5"-28s / 0.6"-20s & above

Bond End Anchorage for Flat Tendon



* Anti-burst reinforcement only required for slab thinner than minimum required thickness, T

Type 0.5"	T	L	B	ØC	No. of Link
3	180	370	270	T10	4
4	180	460	360	T12	5
5	180	550	450	T12	6
6	180	640	540	T12	7

Type 0.6" /0.62	T	L	B	ØC	No. of Link
2	180	310	210	T10	3
3	180	415	315	T12	4
4	200	520	420	T12	5
5	220	625	525	T12	6

note:
(1) Details, dimensions and system designs are subject to change without notice.

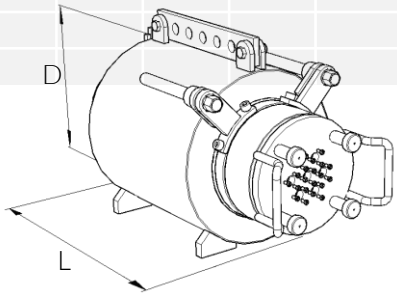
Model	Available Size	
	Type 0.5”	Type 0.6”/0.62”
Coupler P	N/A	5s 9s 12s 15s 19s 27s
Coupler R	9s 12s 15s 20s 27s 32s 37s	5s 19s 7s 22s 9s 27s 12s 31s 15s 37s
Coupler F	4s 5s	4s 5s
Coupler S	3s 4s 5s 6s	3s 4s 5s
	• For special case use only • Positioning of couplers may be altered to suit design and site requirements	
Compression Fitting	Yes	Yes

Note:
Full details of the above products will be made available upon request.

Hydraulic Jacks

CH9008/4DA CH7008DA CH4006DA CH2006/4DA CH258/4DA

Strand Type Jack	0.5” 0.6” / 0.62”	01 01	07 05	09 07	12 09	15 12	20 15	27 19	32 22	37 27	-- 31	-- 37
CH258/4DA		●										
CH1504DA			●									
CH2004DA			●	●								
CH2006DA			●	●	●							
CH2206/8DA			●	●	●							
CH3006DA						●	●					
CH4006DA							●	●				
CH5004DA							●	●	●			
CH7008DA									●	●	●	
CH7504DA										●	●	
CH9008/4DA											●	●

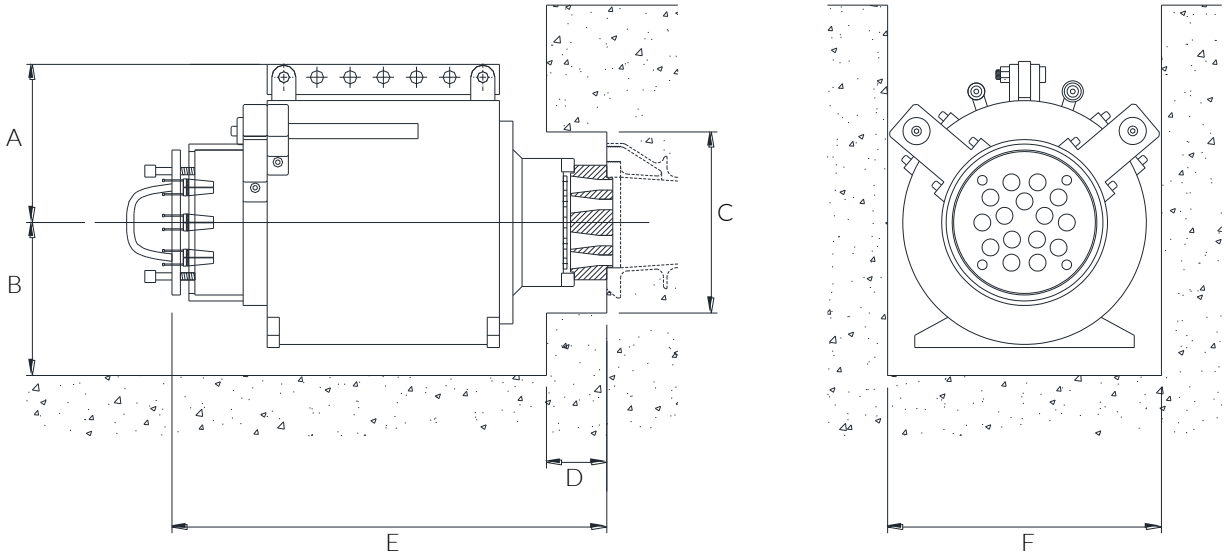


Technical Data

Jack	Stroke (mm)	Piston Area (cm^2)	Capacity (kN)	Weight* (kg)	Length, L (mm)	Diameter, D (mm)
CH258/4DA	200/100	33.25	250	24/16	530/335	118
CH1504DA	100	230.31	1500	130	335	275
CH2006/4DA	150/100	304.00	2000	225/160	555/345	320/300
CH2206/8DA	150/200	324.00	2200	270/290	555/600	350/355
CH3006DA	150	465.50	3000	400	685	405
CH4006DA	150	602.40	4000	525	650	460
CH5004DA	100	804.50	5000	505	415	508
CH7008DA	200	1004.00	7000	1230	860	630
CH7504DA	100	1269.99	7500	695	425	600
CH9008/4DA	200/100	1776.56/1507.96	9000	1650/770	1010/425	700/640

Note:
* Weight with gripping assembly

Block-Out-Dimensions

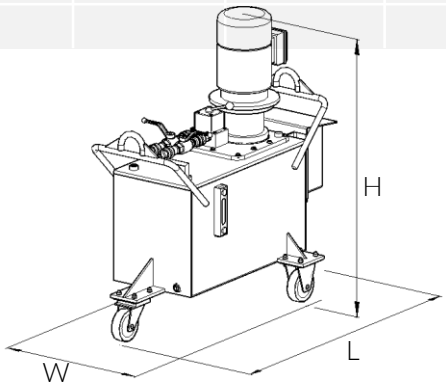


Model	A	B	C	D	E	F
CH 1504 DA	250	180	230	50	430	400
CH 2004 DA	250	180	250	50	455	400
CH 2006 DA	250	180	205	100	685	450
CH 2206 DA	275	195	180	100	750	450
CH 2208 DA	275	195	180	100	800	450
CH 3006 DA	315	235	280	110	810	530
CH 4006 DA	350	270	300	120	855	600
CH 5004 DA	360	280	330	75	615	620
CH 7008 DA	385	305	360	80	920	750
CH 7504 DA	410	330	390	75	615	720
CH 9004 DA	420	340	390	90	630	770
CH 9008 DA	450	370	400	300	1200	800

Hydraulic Pumps

R11.2 U6.4 MPE-10 MPE-5 U70 U60

Jack / Pump	CH258DA	CH2006DA	CH2206DA	CH3006DA	CH4006DA	CH7008DA	CH9008DA
U60	●						
U70	●	●	●	●	●		
MPE-5	●	●	●	●	●		
MPE-10					●	●	●
U6.4					●	●	●
R11.2 - 11.2						●	●



Technical Data

Pump	Operating Pressure (Bar)	Capacity* V/min (l/min)	Effective Oil Amount (l)	Weight (kg)	Dimension L x W x H (mm)
U60	700	1.1	5	30	290 x 240 x 180
U70	700	1.6	44	135	600 x 310 x 350
MPE-5	700	3.5	70	250	560 x 750 x 940
MPE-10	700	6.5	120	257	560 x 800 x 1100
U6.4	700	6.4	70	310	1400 x 700 x 1100
R11.2-11.2	550	11.2 / 22.4	170	615	2000 x 800 x 1000

note:
* Capacity of flow rate at 500 bar working pressure

Grouting Equipment

	Model	Max. Injection Pressure (Bar)	Max. Capacity (l/min)	Weight (kg)	Dimension L x W x H (mm)
	Mixer & Pump SD6503-1 A single-phase power combined mixer suitable for mixing grout with W/C ratio of > 0.38	15	20	300	1500 x 650 x 1700
	Mixer & Pump SD6503-3 A three-phase power combined mixer suitable for mixing grout with low W/C ratio of 0.33	15	30	300	1500 x 650 x 1700
	Mixer MX6503 A three-phase power colloidal mixer to be used in conjunction with a pump or combined mixer to produce grout with W/C ratio of 0.30 and above	--	--	300	1500 x 650 x 1700
	Mixer & Pump CMP-150 A three-phase power high capacity colloidal mixer-agitator-pump used to produce grout with W/C ratio of 0.30 and above	15	40	490	2000 x 1000 x 1600

Ancillary PT Equipment

	Equipment	Power (HP)	Weight (kg)	Dimension: L x W x H (mm)
	Pusher S6/M60SP High powered pusher and suitable for pushing strands in bridge projects where tendons are longer than 150m	30	1210	1800 x 1000 x 1900
	Pusher SSP3 Compact design and suitable for pushing strands in building projects where tendons are up to 80m long	3	70	720 x 450 x 600

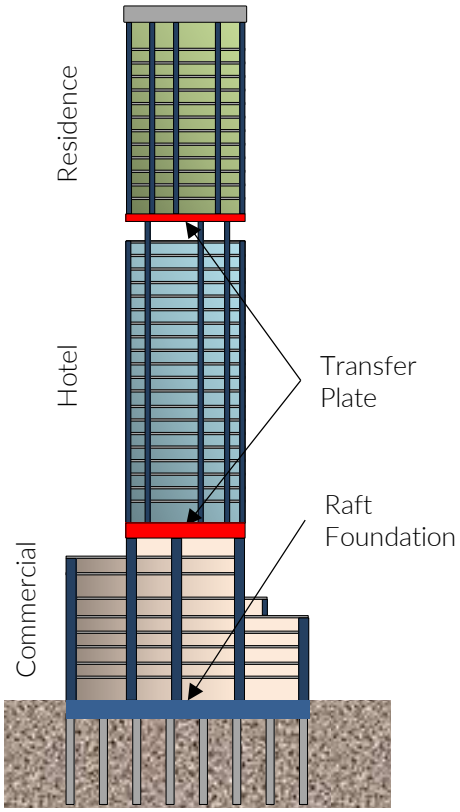
	Equipment	Capacity (Ton)	Weight (kg)	Dimension: L x W x H (mm)
	Compression Fitting Machine	50	53	600 x 190 x 190
	Bulb End Former	3	18	580 x 200 x 200

Note:
Full details of the above products will be made available upon request.

Post-Tensioned Transfer Plate & Raft Foundation

By incorporating post-tensioning design in raft and transfer plate, the following advantages can be realised:

- Thinner and lighter structure
- Simplified formwork (as compared to transfer beams)
- Less falsework for transfer plate due to lighter self weight
- Higher productivity on site as overall steel tonnage (rebar + PT) to be installed is reduced significantly



Transfer Plate

Raft Foundation

Vertical Tendon

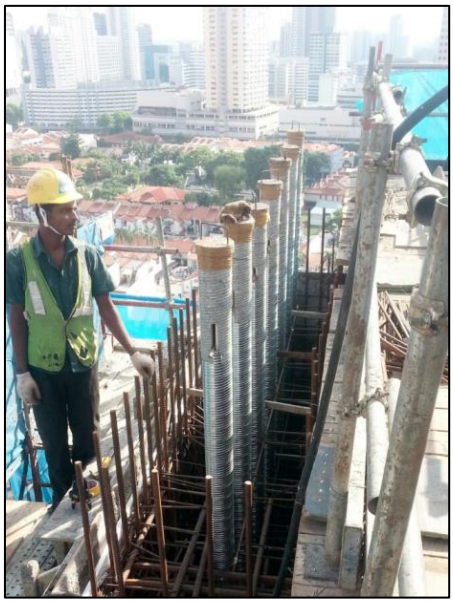
Vertical post-tensioned tendons and prestressing bars are sometimes installed in vertical members (e.g. walls and columns) of odd-shaped high rise towers (e.g. structures with large cantilever):

- to control deflection and tilt of structure during different phases of construction
- to control and limit long term deflection to acceptable levels

Stressing of vertical tendons in progress

Special steel boxes to contain the very high bursting forces of closely spaced vertical tendons

The Duo, Singapore, where both of its towers' walls are post-tensioned due to the unbalanced geometry of the structure.



Installation of vertical tendons' ducts prior to concreting

External Post-Tensioning for Bridge Construction

Due to its ease of installation, maintenance, inspection and replaceability, external post-tensioned tendon is very popular with Engineers in contemporary bridge construction.

The tendons can either be grouted or ungrouted, and can come with duct or without duct (e.g. when epoxy strand is used).

Individual lengths of HDPE ducts are joined together by mirror welding technique.

Stressing of external tendons

Completed external tendons

Replaceable DSI MA anchorages are used in external tendons

Post-Tensioned Steel Truss

Post-tensioning is frequently being incorporated in a steel structure design to improve its design capacity.

It is an effective approach to reduce the overall weight of the steel structure in order to facilitate handling and to reduce lifting capacity of cranes on site. Post-tensioned tendons are only installed after the steel structure is being erected into position and then stressed in a sequence as required in design.

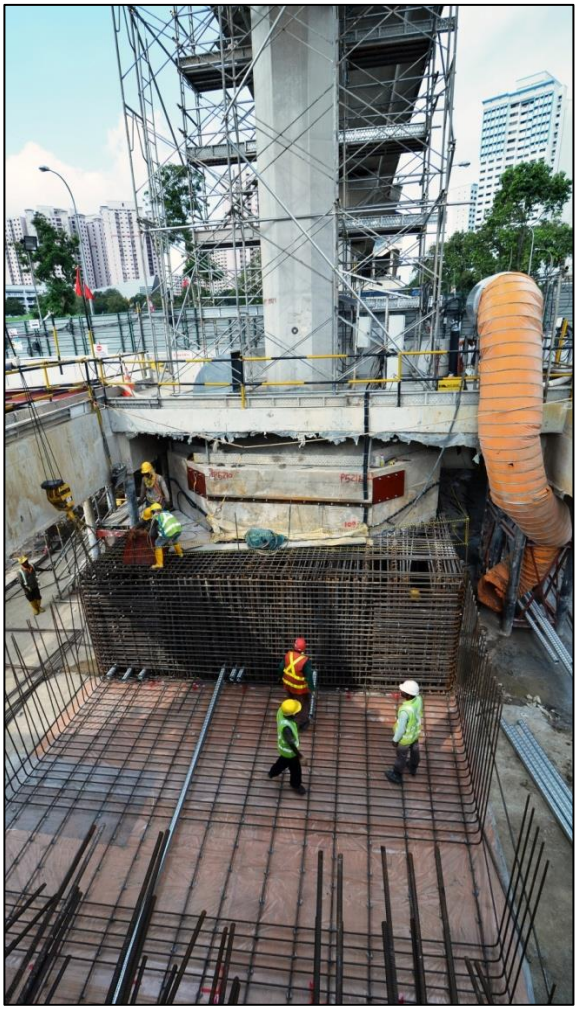
This enormous steel transfer beam is being constructed over an existing 16 storey building which in turn will support an additional 13 new floor slabs above it.

PT tendons are installed after the steel structure is completed. The entire beam is then encased in concrete.

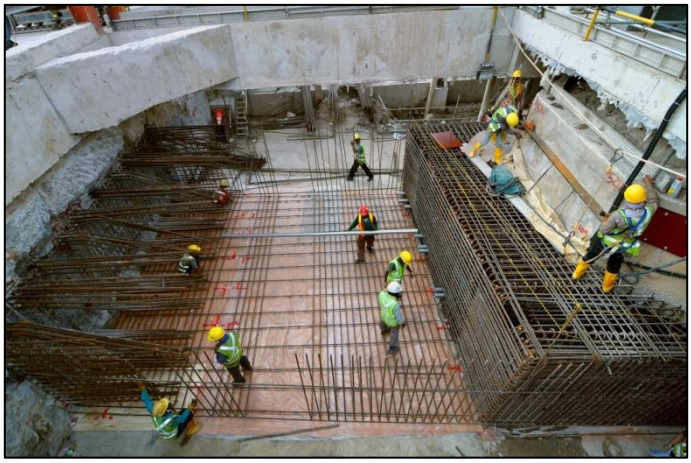
The top flange of a steel truss is strengthened with PT tendons to increase its cantilever capacity. The PT tendons are encased with concrete and stressed to its designed load.

Underpinning of Piers with Controlled Deflection

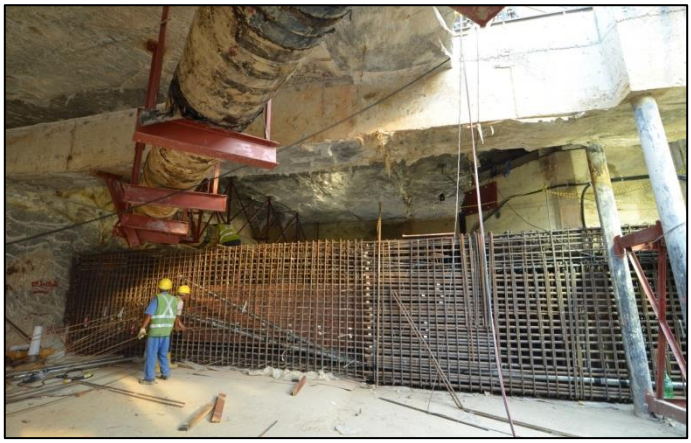
Through stage stressing and close monitoring of upward deflection of the post-tensioned beams, the viaduct's existing foundation could be cut off and its load transferred permanently to the underpinning beams with controlled accuracy and movement.



Existing piling exposed for the construction of underpinning beams beneath it.



Heavy starter bars transfer the stressing forces from the PT beams into the diaphragm walls.



Underpinning PT beams spanned underneath the pier and across 2 newly constructed diaphragm walls.

For MRT Contract 912, the traffic above the viaduct remained open throughout the entire operation of the underpinning works.

HEAD OFFICE

SINGAPORE
Utracon Corporation Pte Ltd
5, Joo Koon Way, Singapore 628944
Tel : +65 6415 3078
Fax : +65 6863 1928
Email : utracon@utracon.com

REGIONAL OFFICES

SINGAPORE
Utracon Structural Systems Pte Ltd
5, Joo Koon Way, Singapore 628944
Tel : +65 6415 3078
Fax : +65 6863 1928
Email : utracon@utracon.com

MALAYSIA
Utracon Structural Systems Sdn Bhd
Kuala Lumpur Office:
Suite A-11-03, 11th Floor,
Lobby 1 Block A,
Wisma Damansara Intan,
No. 1 Jalan SS20/27,
47400 Petaling Jaya,
Selangor, Malaysia
Tel : +603 7710 8818
Fax : +603 7118 2983
Email : utraconmsia@utracon.com
: utraconkl@utracon.com

Johor Bahru Office:
No. 51-01 & 51-02, Jalan Molek 1/8,
Taman Molek, 81100 Johor Bahru,
Johor, Malaysia
Tel : +607 355 9799
Fax : +607 354 8799
Email : utraconmsia@utracon.com

INTERNATIONAL
Utracon Overseas Pte Ltd
5, Joo Koon Way, Singapore 628944
Tel : +65 6415 3078
Fax : +65 6863 1928
Email : utracon@utracon.com

VIETNAM
Utracon Vietnam Co., Ltd.
HCMC Office:
3rd Floor, LA 03-05,
Lexington Building,
67 Mai Chi Tho Avenue,
An Phu Ward, District 2,
Ho Chi Minh City, Vietnam
Tel : +84 28 2253 9588
Fax : +84 28 2253 9589
Email : utraconvn@utracon.com

Hanoi Office:
3rd Floor, CT1 Van Khe Building,
Van Khe Urban Area,
Ha Dong District,
Hanoi, Vietnam
Tel : +84 24 6325 2182
Fax : +84 24 6325 2187
Email : utraconvn@utracon.com

MYANMAR
Utracon Myanmar Co., Ltd.
Unit 08-03, Level 8, Crystal Tower,
Junction Square,
Between Pyay Road and Kyun Taw Road,
Kamaryut Township, Yangon, Myanmar
Tel : +925 0513 089
Email : utraconmm@utracon.com

SRI LANKA
Utracon Overseas Pte Ltd
(Sri Lanka Branch)
7A, N. J. V. Cooray Mawatha,
Rajagiriya, Sri Lanka
Tel : +94 1128 77446
Fax : +94 1128 77442
Email : utraconlk@utracon.com

UGANDA
Utracon Overseas Pte Ltd
(Uganda Branch)
Plot 6, Kyemba Close, Nalufenya,
Mpumudde/Kimaka Division,
Jinja Municipality, Uganda
Email : utraconug@utracon.com

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