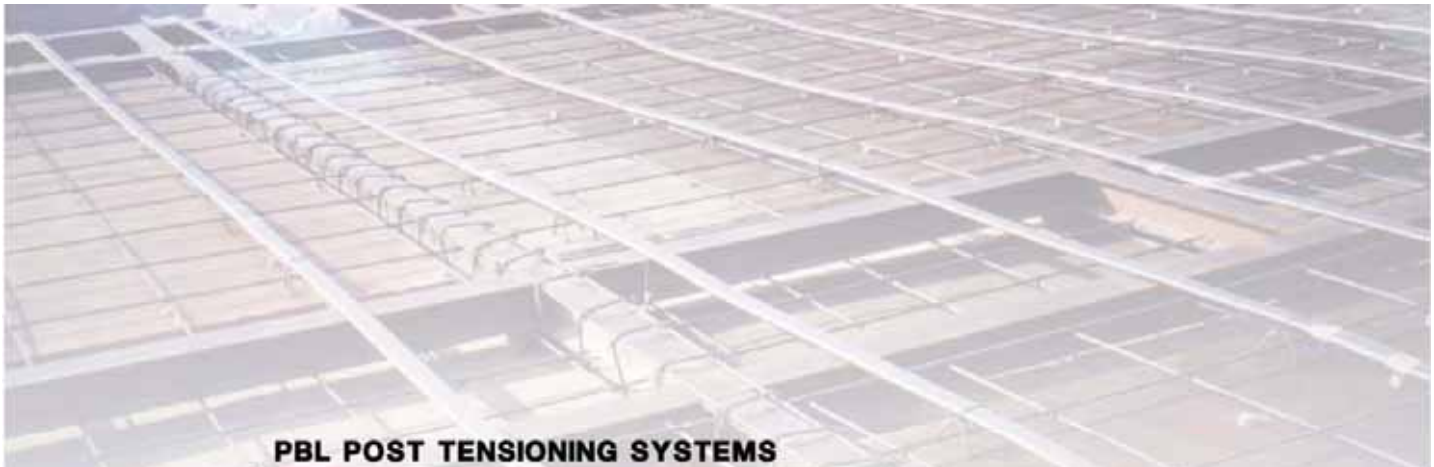
PBL®

PBL GROUP

POST-TENSIONING SYSTEMS



PBL POST TENSIONING SYSTEMS

The PBL post tensioning systems as one of the specialist products of the PBL Group Ltd. is manufactured with the satisfaction of the quality control system and conforming to the requirements of international standards such as standard acceptant of PTI and BS 4447. PBL Post tensioning systems has been approved for use by government departments, local authorities, engineering consultancies, multinational construction companies and organizations.

SYSTEMS FEATURES AND PRODUCTS

PBL post tensioning systems have the following significant features and advantages.

- Wide selection of anchorage types.
- Products are provided with full range of tendon sizes from single strand with up to 31 nos of 0.5" strands and 22 nos of 0.6" strand. Bigger tendon sizes are also available upon request.
- Anchorage adaptable for both strand of 0.5" (12.7 mm., 12.9 mm.) and 0.6" (15.24 mm., 15.7 mm.) according to standard ASTM A 416 or BS 5896
- Advanced stressing jacks equipped with automatic stressing heads and power wedge seating devices.
- The systems available in any number of stressing steps and sequences

SCOPE OF SERVICES

Based on its extensive and proven experience in the highly specialized area of post tensioning construction, PBL offers a comprehensive range of professional services including.-

- Project and technical feasibility studies.
- Consulting services and designs covering all aspects of structural engineering, if required in co-operation with associated consultants.
- Contractor consulting
- Supplies of quality controlled post tensioning materials, products and equipments.
- Complete wupply and field installation to its clients satisfaction.

Through its long and consistent commitments to research and development over the years, PBL has developed and produced many new innovative products, design and construction methods to assure that the systems provided are safe, reliable and cost effective.

Products

PBL Superforces Post Tensioning Systems For Slab, Type SF.

The systems are primary designed to suit for the post tension slabs and shallow depth structures such as in the transverse post tension of bridge deck slab and most of building slabs. The systems are available for both single strand and multi strand flat duct systems.

Single strand - unbonded tendon systems

The single strand system is normally adapted for unbonded tendon which the strand is greased and PE coated for corrosion protection as well as reducing friction. The strand is gripped in single strand anchorage type. To provide for a corrosion protection system the anchorage is encapsulated by a special plastic cap after the stressing and the strand end has been cut.

Anchorage components

1. POCKET FORMER
2. WEDGE
3. ANCHOR PLATE CASTING
4. ANCHORAGE BURSTING REINFORCEMENT
5. P.E. CONNECTOR
6. UNBONDED STRAND GREASED AND P.E. COATED
7. ENCAPSULATED PLASTIC ANCHOR CAP

Stressing anchorage data

Strand Dia.	0.5" (12.7 mm.)	0.6" (15.2 mm.)
No. of Strand	1	1
Type of Anchorage	SF 105	SF 106
Ultimate Tensile Force, KN	186	265
Stressing Force at 0.8 U.T.S, KN	149	212
Jack Type	V 16	V 24

The same anchorage for stressing anchorage can be used as intermediate stressing anchorage and dead end anchorage. For dead end anchorage, the wedge is pre-seated in the anchorage by applying nominal force to the strand using the stressing Jack.

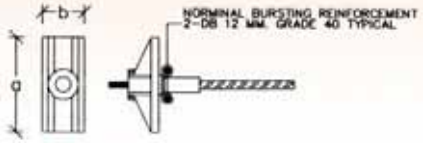
Alternatively a loop dead end anchorage can be used in which case the strand are formed in loop shape around the loop bearing plate and stressing anchorage are used at the stressing ends of the loop tendon.

A norminal reinforcing bar of 2 DB 12 grade 40 is normally provided behind the stressing anchorage to act as brusting reinforcement in the anchorage zone.

Dead end anchorage

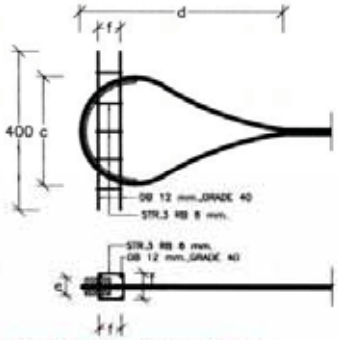
Loop dead end anchorage for unbonded tendon

1. LOOP DEAD END
2. LOOP PLATE
3. BURSTING REINFORCEMENT



Anchorage dimensions, mm.

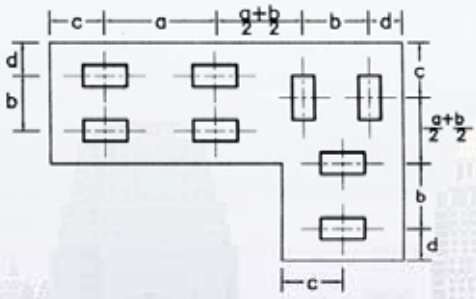
Strand Dia.	a	b
SF-105	100	60
SF-106	135	75



Loop dead end dimensions, mm.

Strand Dia.	c	d	e	f
0.5"	300	600	50	100x100
0.6"	450	750	50	125x125

Anchorage spacings and edge distances



Dimensions, mm.

Anchorage	a	b	c	d
SF-100	200	120	100	60
SF-106	270	150	135	75

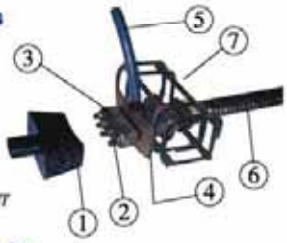
Notes - Minimum reinforcement behind anchorage shall be provided as shown
- Minimum concrete cylindrical strength at time of prestressing 25 N/mm2

Multistrand flat duct – bonded tendon systems

The multistrand flat duct systems is normally adapted for bonded tendon. The strands are individually gripped in one flat anchor head unit and tramsmits their prestressing forces by mean of flat type anchor plate casting unit. The strands are stressed individually by mean of a mono strand jack. The strands are contained in one flat duct which is made of corrugated galvanized or non-galvanized metal. To ensure corrosion protection and to give adequate bond strength, the tendons are filled with suitable cement grout mix after complete stressing of the strands.

Anchorage components

1. POCKET FORMER
2. WEDGES
3. ANCHOR HEAD TYPE SF
4. ANCHOE PLATE CASTING TYPE SF
5. GROUT VENT
6. CORRUGATED METAL FLAT DUCT
7. ANCHORAGE BURSTING REINFORCEMENT



Stressing anchorage data

Strand Dia.	0.5"	(12.7 mm.)		0.6"	(15.2 mm.)	
Tendon Type	305	405	505	206	306	406
No. of Strand	3	4	5	2	3	4
Anchor Head Type	SF305	SF405	SF505	SF206	SF306	SF406
Anchor Plate Casting Type	SF305/206	SF405/306	SF505/406	SF305/206	SF405/306	SF505/406
Ultimate Tensile Force Per Tendon, KN	558	744	930	558	837	1,116
Stressing Force at 0.8 U.T.S., KN	446	595	744	446	670	892
Flat duct inside dimension /mm. x mm.	63.5 x 20 or 50 x 20	63.5 x 20	76.5 x 20	63.5 x 20 or 50 x 20	63.5 x 20	76.5 x 20
Jack Type	V16	V16	V16	V24	V24	V24

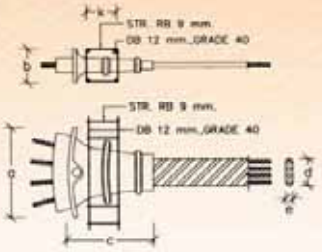
The same anchorage for stressing anchorage can be used as dead end anchorage in which case the wedges are preseated in the anchor head unit by applying norminal force to the strand using the stressing jack.

Alternatively a bulb dead end anchorage can be used with simpler solution and more cost effective. In this case each strand is formed into a bulb shape by means of special bulb forming jack.

Bursting reinforcement should be provided at the anchorage zone for both stressing anchorage and dead end anchorage type.

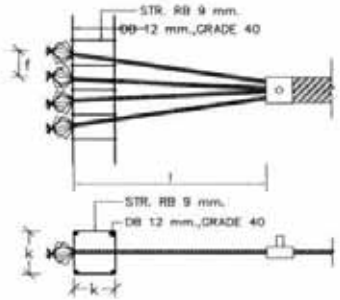
Dead end anchorage

1. BULB DEAD END
2. P.C. STRAND
3. GROUT VENT WITH MASTIC SEAL TAPE
4. CORRUGATED METAL FLAT DUCT
5. BURSTING REINFORCEMENT



Anchorage dimensions, mm.

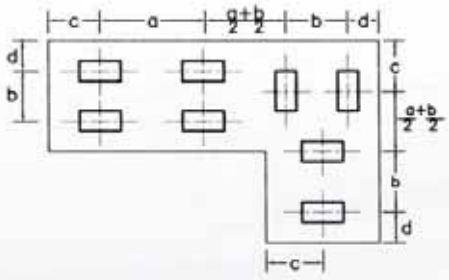
Anchorage	a	b	c	d	e	k
SF-305/206	153	85	140	50 or 63.5	20	100x100
SF-405/306	185	85	170	63.5	20	100x100
SF-505/406	230	85	190	76.5	20	125x125



Bulb dead end dimensions, mm.

Strand Dia.	f	l	k
0.5"	75	600	100x100
0.6"	100	750	125x125

Anchorage spacings and edge distances



Dimensions, mm.

Anchorage	a	b	c	d
SF-305/206	225	145	130	75
SF-405/306	330	150	165	75
SF-505/406	410	150	205	75

Notes - Minimum reinforcement behind anchorage shall be provided as shown
- Minimum concrete cylindrical strength at time of prestressing 25 N/mm2

Products

PBL Post Tensioning Systems For Multi Strand Round Duct, Type M.

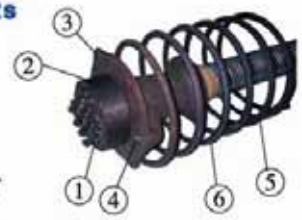
The systems are commonly used in bridge construction as well as other civil engineering structures such as silo, water tank etc. The systems normally adapted for bonded tendons. The tendon consists of a bundle of strand with a norminal diameter of 0.5" (12.7 mm.) or 0.6" (15.2 mm.). The number of strands per tendon can be from 4 strands up to 31 strands of diameter 0.5" or 22 strands of diameter 0.6". The strands in the tendons are contained in one round duct which is made of corrugated galvanized or non-galvanized metal.

The strands are individually gripped in one anchor head unit and transmits their prestressing forces by mean of anchor plate casting unit type M. For all anchor size a special spiral reinforcement are provided behind the anchor plate casting to give adequate splitting reinforcement for bursting stresses developed at the anchorage zone. The strands in tendon are stressed simultaneously by mean of a multi strand stressing jack from capacity 1,100 KN up to 5,000 KN. In case of small size tendon unit such as type M405 the strands can also be stressed individually by mean of mono jack.

To ensure corrosion protection and to give adequate bond strength, the tendons are filled with suitable cement grout mix after complete stressing of the strands.

Anchorage components

1. WEDGES
2. ANCHOR HEAD TYPE M
3. ANCHOE PLATE CASTING TYPE M
4. GROUT INLET
5. CORRUGATED METAL ROUND DUCT
6. ANCHORAGE SPIRAL REINFORCEMENT



Stressing anchorage data

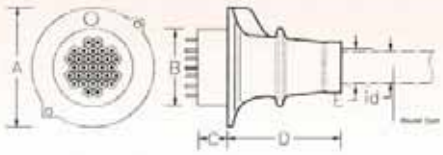
Number of strands Dia. 0.5" (12.7 mm.)	4	7	12	19	31
Tendon Type	405	705	1205	1905	3105
Ultimate Tensile Force Per Tendon, KN	747	1302	2232	3534	5766
Stressing Force at 0.8 U.T.S., KN	595	1042	1786	2827	4613
Duct ID, mm	45	55	70	85	105
Jack Type	V16	M110	M200	M300	M500

Number of strands Dia. 0.6" (15.2 mm.)	4	7	12	19	22
Tendon Type	406	706	1206	1906	2206
Ultimate Tensile Force Per Tendon, KN	1116	1953	3348	5301	6138
Stressing Force at 0.8 U.T.S., KN	893	1562	2678	4241	4910
Duct ID, mm	50	65	80	100	110
Jack Type	M110	M200	M300	M500	M500

The same anchorage can be used as dead end anchorage in which case the strands are gripped by means of wedges and are secured by springs and covered with cap fastened against anchor plate casting to prevent intrusion of cement slurry into the anchorage.

In case of prestressing continuity is required, the tendons are coupled by means of anchorage coupling connected to the stressed anchorage at the stressing joint. The anchorage couplings are available for each type of anchor size.

PBL multi strand anchorage type M with round duct

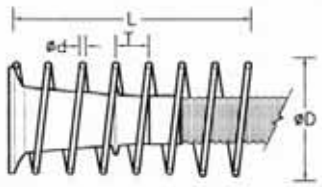


Anchorage dimensions, mm.

Strand Dia.	Nos of Strand					
0.5"	4	7	12	19	31	-
0.6"	-	4	7	12	19	22
A	150	175	230	285	350	360
B	88	110	150	180	230	250
C	50	50	52	65	80	80
D	83	140	225	295	395	440
E	52	65	80	95	115	120
0.5" ID	45	55	70	85	105	-
0.6" ID	-	50	65	80	100	110

Spiral reinforcement for anchorage type M

for 25 N/mm2. concrete cylindrical strength at prestressing

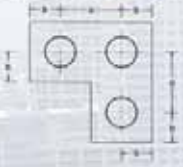


Dimensions, mm.

Type		405	705	1205	1905	3105
Spiral Outside Dia.	D	180	215	280	355	465
Length	L	250	300	350	400	480
Dia	d	12	14	16	18	22
Pitch	T	50	50	50	50	60
Number Of Pitch	n	5	6	7	8	8

Type		406	706	1206	1906	3106
Spiral Outside Dia.	D	190	250	335	440	450
Length	L	300	350	400	480	540
Dia	d	12	14	18	20	22
Pitch	T	50	50	50	60	60
Number Of Pitch	n	6	7	8	8	9

Anchorage spacings and edge distances.

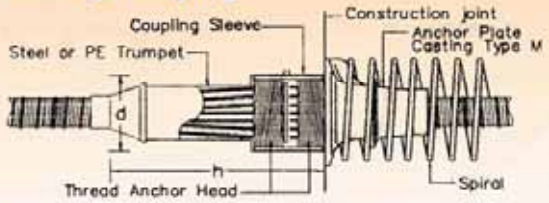


Dimensions	Anchorage Type				
mm.	M 405	M 705	M 1205	M 1905	M 3105
a	200	250	330	410	525
b	110	140	170	210	265

Dimensions	Anchorage Type				
mm.	M 406	M 706	M 1206	M 1906	M 3106
a	225	300	390	490	525
b	125	155	200	250	265

Notes - Minimum reinforcement behind anchorage shall be provided as shown
- Minimum concrete cylindrical strength at time of prestressing 25 N/mm2

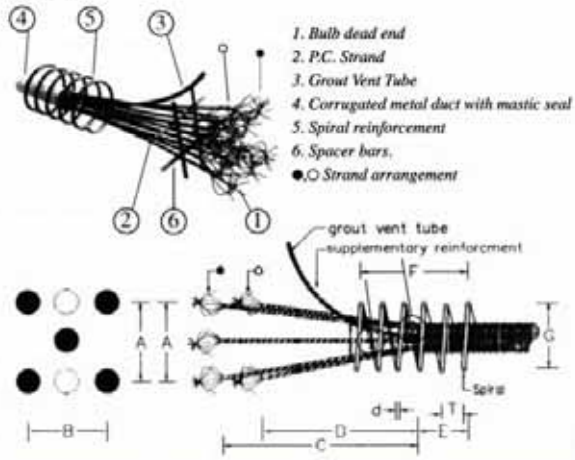
Anchorage coupling



	Strand Dia. 0.5"				Strand Dia. 0.6"				
Number Of Strands	7	12	19	31	4	7	12	19	22
Coupling Type	705	1205	1905	3105	406	706	1206	1906	2206
Length h, mm.	420	565	655	775	420	565	655	775	815
Diameter d, mm.	156	206	247	307	156	206	247	307	337

Dead end anchorage

Bulb anchorage can be effectively used as dead end anchorage. In this case each strand is formed into a bulb shape by means of special bulb forming Jack. The strands are arranged in pattern and number as shown for each type of tendon. Spiral reinforcement is required at the anchorage as shown



1. Bulb dead end
2. P.C. Strand
3. Grout Vent Tube
4. Corrugated metal duct with mastic seal
5. Spiral reinforcement
6. Spacer bars.
●,○ Strand arrangement

No. of Strand	4	7	12	19	22	31
Strand Arrangement						
Strand Dia 0.5"						
A , mm.	125	175	200	250	-	400
B , mm.	125	175	250	400	-	450
C , mm.	600	750	750	900	-	1200
D , mm.	-	600	600	750	-	1050
Strand Dia 0.6"						
A , mm.	175	200	250	300	350	-
B , mm.	175	250	400	450	450	-
C , mm.	750	900	1050	1050	1050	-
D , mm.	-	750	750	900	900	-

Notes : Supplmentary reinforcements
a) Longitudinal bar
3DB12 grade 40 for 4,7,12 strands
4DB12 grade 40 for 19,22,31 strands
b) Stirrups DB12 grade 40 @ 0.10 along length of longitudinal bar

Spiral for bulb dead end anchorage

for 25 N/mm.2 concrete cylindrical strength at prestressing

Dimensions, mm.

Type		405	705	1205	1905	3105
Spiral Outside Dia.	G	120	150	215	250	280
Length	F/E	250/150	300/150	350/150	400/175	450/200
Dia	d	12	14	16	18	22
Pitch	T	50	50	50	50	60
Number Of Pitch	n	5	6	7	8	9

Type		406	706	1206	1906	3106
Spiral Outside Dia.	G	150	215	250	280	280
Length	F/E	300/150	350/150	400/175	450/200	450/200
Dia	d	12	14	18	20	22
Pitch	T	50	50	50	50	50
Number Of Pitch	n	6	7	8	9	9

Mono strand stressing jack

Jack data, mm.

Jack Type	V16	V24
Stand Dia,	0.5"	0.6"
Overall Length, mm.	540	540
Width , mm.	215	240
Thickness , mm.	72	80
Weight , kg.	25	30
Stroke , mm.	240	240

Multi strand stressing jack

Type Of Stressing Unit		M 110	M 200	M 300	M 500
Max. Jack Force	kN	1100	2000	3000	5000
Stressing Unit Weight	kg	160	260	410	710
Jack Stroke	mm	200	200	200	200
Stressing Unit Length	a mm	595	620	675	740
Strand Length	b mm	710	750	810	890
Jack Diameter	c mm	270	330	400	500

Products

PBL Post Tensioning Equipments.

TENDON FABRICATION LINE
WITH AUTOMATIC TENDON CUT OFF

WIGA PRELO SYSTEM. FOR FORCE-ELONGATION
MEASURING. THE LCD MONITOR AND COMPUTERISED
PRINT OUT PROVIDES PRECISE RECORD
OF THE STRESSING OPERATION

STRAND PUSHER

MODERN EXTRUSION LINE FOR GREASED
AND POLYETHYLENE
COATED UNBONDED TENDON

BULB DEAD END FORMING JACK

MODERN COLLOIDAL GROUTING MACHINE FOR
EFFECTIVE GROUTING OF TENDONS TO ENSURE BOND
AND CORROSION PROTECTION

CORRUGATED DUCT MAKING MACHINE

POST-TENSIONING SYSTEMS

Applications

PBL post tensioning systems consist of a number of unique anchorage types which are available for adaptation to almost any site conditions and applications including.-

- Construction of bridges and buildings.
- Structural repairs and strengthening
- Marine structures
- Tanks and silos
- Ground and rock anchors
- Cable stayed structures
- Many others application.

POST TENSION SLABS IN BUILDINGS

STRESSING OF
PBL SUPER FORCES
TYPE SF 405 BY MONO
STRAND JACK V16

PBL SUPERFORCES
POST TENSION
SYSTEM FOR
MULTISTRAND
FLAT DUCT BONDED
TENDON TYPE SF 405

PROJECT : THE EMPORIUM,
SUKHUMVIT 24, BANGKOK 40
STORIES HIGHRISE TOWER
WITH 10 LEVEL PARKING BUILDING

PROJECT : BANGKOK GARDEN
15 TOWERS OF 18 STORIES
- 20 STORIES BUILDING

PROJECT : NAPALAI PLACE, HADYAI
46 STORIES RESIDENTIAL
CONDOMINIUM

POST TENSION GIRDERS FOR BRIDGE STRUCTURES

STRESSING OF PBL MULTI STRAND TENDON
SYSTEM TYPE M 1905

COMPLETED 36.00 M SPAN POST TENSION
GIRDER FOR STANDARD PEDESTRIAN BRIDGE

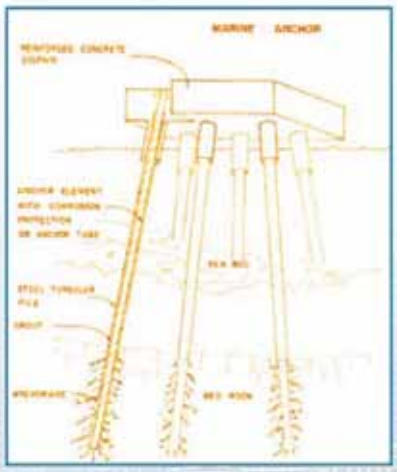
POST TENSION GIRDER PC 8801, 8802
FOR STANDARD HIGHWAY PEDESTRIAN BRIDGE

STANDARD HIGHWAY GIRDER 30.00 M. SPAN

POST TENSION GIRDER, MARINE WHARF
KAO LAN, CHOLBURI

SOIL AND ROCK ANCHORS

ROCK ANCHOR OF MARINE ANCHOR FOR MARINE STRUCTURES
TRC REFINERY JETTY MABTAPUT RAYONG THAILAND



POST-TENSIONING SYSTEMS

SAFETY PRECAUTIONS FOR POST-TENSIONING OPERATIONS

Precautions to be taken before stressing

Storage and handling of materials

1. Store all strand carefully and ensure that they are not damaged or lacerated in any way. All tendons should be stored far enough above the ground to avoid rust and corrosion that could be caused by storage in standing water or snow. Tendons without protective covering, which must be stored for extended periods of time, should be sheltered in such a way as to protect them from the elements.
2. Ensure that operatives wear gloves and other appropriate safety clothing when handling prestressing tendons.
3. Be careful when handling coils of high-tensile steel wire and strand as they may 'whip back' with force if not securely bound.

General

1. Ensure that sightseers are kept away from stressing operations.
2. Display a large sign ATTENTION-STRESSING IN PROGRESS-KEEP CLEAR to warn other workmen and passers by.
3. Fence off the area around the unit being stressed so that no unauthorised person can approach during stressing operations.
4. Where stressing is carried out from staging, an adequate area should be provided for personnel and equipment access. The area provided should be sufficient for the operatives to work in safety and to allow inspection by the engineer. Hand rails shall be provided where necessary.
5. Wear safety helmets during stressing operations.
6. Do no permit welding near high-tensile prestressing steel. A drop of molten metal, if applied to the tendon, will change its mechanical properties and promote the possibility of premature failure. The damage caused by inadvertent heating will not be detected during a visual inspection.
7. Do not use an acetylene torch to cut to length or to trim tendons before stressing since the heat affected zone will extend several inches from the cut and the jack jaws may grip the mechanically weakened area. Use snips or an abrasive wheel. The cutting action should be not less than one diameter from the permanent anchor or from the jack gripping position.
8. Prestressing steel should not be used for earthing electrical equipment of any kind including welding equipment. When an electric are jumps to or from the tendon the molecular structure is altered and loss of strength occurs. Lightning conductors should be routed clear of tendons and their anchorages.
9. Check all equipment befor use. Keep all equipment clean and in a workmanlike condition. Badly maintained equipment gives rise to trouble and consequently is dangerous. Refer to the manufacturer's instructions.
10. When assembling the tendon check each individual, strand for obvious damage or defects.

It is important to keep the tendon free from heavy rust and loose scale. A light film of rust is not harmful but heavy flaking and surface pitting are dangerous. If in doubt, clean with a wire brush and examine. If necessary test the material to ensure that the tendon is safe and according to specifications.

11. Do not allow the permanent anchorage components to become rusty. A film of surface oxide is permissible but not hard scale which cannot be removed by wire brushing.
12. Ensure that the anchorage mating faces are clean so that wedges or nuts are free to seat.
13. The thread of bars, nuts and couplers must be cleaned and thread protecting wrappings should be removed at the last moment before use. Paraffin must not be used as a cleaning fluid.
14. Arrange for stressing to take place as soon as possible after the grips have been positioned.

Precautions to be taken during stressing

1. Do not become casual because you have stressed hundreds of cables before. The forces you are handling are enormous and carelessness may lead to loss of life.

2. Regular examination of hydraulic hoses is essential and care should be taken when re-connecting hoses to preclude the ingress of dirt.

3. Use only self-sealing couplings for hydraulic pressure pipes and take particular care that no bending stresses are applied to end connections.

4. Use only hydraulic equipment supplied with a by-pass valve which is pre-set to a maximum safety load before stressing.

5. The maximum load gauge reading (preferably of the load cell type) and the maximum extension reading must be specified to the operators before stressing commences. If the load gauge reading reaches the specified figure, the stressing operation should be stopped, and the load should only be further increased with the permission of the engineer or his representative.

6. The dynamometer, load cell, or console gauges of each jack must be checked at frequent intervals against a master gauge and the site engineer furnished with a calibration chart. Alternatively, a suitable calibrated proving ring or dead weight tester must be used so that a test can be made at the specified intervals.

7. Double-check the grips for fixing of tendons to the prestressing jack before stressing. Keep the wedges clean and free from dirt. Remember that the wedge teeth do not last forever.

8. During stress operations never stand behind a jack or in line with anchorages at non-jacking ends.

9. Tension tendons to a low initial stress and re-check wedges, fixings and the position of the jack.

10. check the fixing at the non-jacking end.

11. Ensure that a competent person is available at the non-jacking end to check on the anchorages, particularly during the initial stages of stressing, to ensure that wedges are pulling in and seating.

12. Double-check tendon fixings before transfer of load to anchorage.

HEAD OFFICE ADDRESS : 8/11 Soi Amornphan-nivet4 (Viphavadi44)
Viphavadi-Rangsit Road, Lardyao, Jatujak,
Bangkok THAILAND 10900

TELEPHONE : 662 5620765-9
FAX : 662 5620764
E-MAIL : PBLGROUP@PBL-THAILAND.COM
FACTORY : 152/4 Moo 3, Thanyaburi-Lumlookka Road,
Klong 7 Rangsit, Thanyaburi
Pathumthani 12110

TELEPHONE : 662 9042687-9
FAX : 662 9042686
http://www.PBL-THAILAND.com