Low Relaxation High Tensile Steel Strands For Pre-stressed Concrete (LRPC)

DP Wire®

D.P. WIRES LIMITED

An IS/ISO 9001:2015 Company

INTRODUCTION

D.P. Wires Limited is promoted by **D.P. Group** of Industries which is one of the leading steel wire manufacturers in the Country. It's technological and financial strength has placed the group in favorable position to meet the needs of steel wire and construction industries. The group started the production of steel wires in the year 1971, thus has immense experience in manufacturing and marketing of steel wires in different specifications. The group is having capacity to manufacture 50,000 MT Steel wire annually. Later on over visionary **Chairman Shri Kantilalji Kataria** envisaged that the Indian construction industry has grown up to use Low Relaxation High Tensile Steel Strands (LRPC).

D.P. Group has been producing LRPC strands since April 2003. Our brand name is **'D.P. Wires Ltd.'** and in a short span of period, our product has been approved by prestigious construction authorities and companies.

D.P. Group is providing wide range of Steel Wire. Low Relaxation Pre-stressed Concrete Strands, Normal Relaxation Pre-stressed Concrete Wire and Strands. Apart from strands we are also manufacturing 4.00 mm PC Wires, 3x3 Ply, 9.5 Dry LRPC etc. as per Indian as well as international standards. Group has entrenched the company as one of the leading manufacturer of steel wires in the country.

Our company's aim is to give economical solution with best quality products and services to our customers in the Pre-stress concrete industry.

With this objective in the mind we have appointed the most capable professional team in the industry. Their talents and total commitment permit D.P. Wires Limited to competitively provide quality products technical assistance etc. Our extensive knowledge of steel wire making allows us to serve the customer efficiently with the latest products and information available to the Pre-stress concrete industry.

D.P. Wires Limited is the leading manufacturer of world class products & services. Our manufacturing facility is located in Ratlam (M.P.) India. Utilizing the most advanced technology in the industry, this modern facility is suited to meet the demand of today's engineering requirements. With quick access to all national and international trade routes, our factory location makes dispatch and shipping easy and economical to almost various destination in the country.

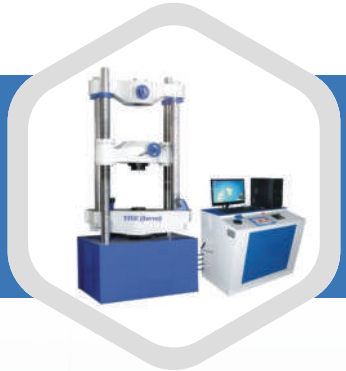
Quality Control

D.P. Wires Limited manufacturing quality control policy is to adhere to the highest standard of the quality. All employees are required to strictly adhere to all published quality control standards at all times. Quality assurance is an attribute that must prevail among all employees and that attribute copied with a strong quality control programme, will ensure the highest quality product possible.

Quality Policy

Quality control & research laboratory will perform concurrent testing to assure control over all products. The laboratory will also be capable of supporting, manufacturing, product development and research needs. To this end D.P. Wires is sensitive to quality assurance suggestions offered by plant and field personnel, and welcomes suggestion from its customers also.

On 30th Dec. 2003 after passing an audit, D.P. Wires has been awarded ISO 9001:2008 certification by the joint accreditation system of Australia, New Zealand (JAS-ANZ). The ISO 9001-2000 series of standards was developed by the international organization of standardization (ISO) as a common set of quality requirements for international commerce.



We have well equipped inhouse Physical, Mechanical & Metallurgical testing facilities as per National/International Standards

OUR VALUED CLIENTS

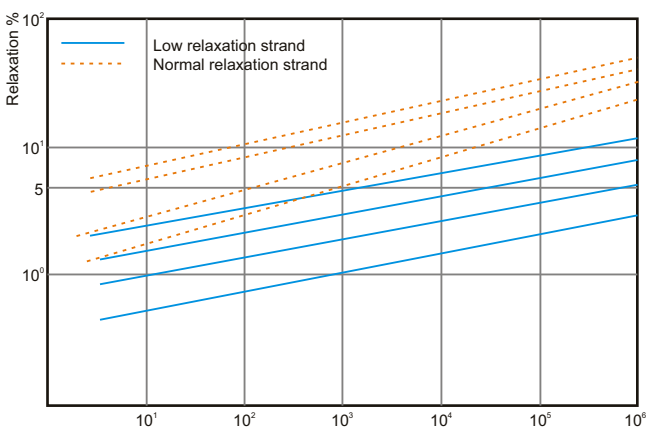
- National Highways Authority of India (NHAI)
- Public Works Division (PWD)
- Nuclear Power Corporation
- Kolkata Metro Railways
- Gujarat Metro Rail Corporation
- Bhopal Metro Rail Corporation
- Indore Metro Rail Corporation
- Delhi Metro Rail Corporation
- Maharashtra Metro Rail Corporation
- National Thermal Power Corporation
- IT Parks & Multistoried Complex By Private Contractors
- Pre Fabricated Buildings

To meet the customer's requirement consistently by providing

Best of quality with best service at reasonable rates to enable us to delight our customers.

Table 1:
Relaxation Value for Normal & Low relaxation stand
at different temperatures
(Initials stress= 0.75 X Specified Characteristic Strength)

Relaxation Losses (%)						
Temp.	Grade	Time (Hours)				
		10	100	1000	10,000	100,000
20°C	LR	0.54	0.78	1.1	1.7	2.2
	NR	1.08	3.1	5.0	8.3	16.0
40°C	LR	1.0	1.5	2.0	2.8	3.9
	NR	2.9	4.8	7.8	13.0	20.0
60°C	LR	1.6	2.2	3.0	4.3	5.0
	NR	5.8	8.4	13.0	18.0	28.0
80°C	LR	2.5	3.5	4.9	5.8	9.0
	NR	7.3	11.0	17.0	24.0	34.0



Graphic 1: Graphical representation of relationship between Relaxation Losses, Time and Temperature.

Loss of prestress in concrete structure

This occurs naturally over a period of time due to certain factors such as elastic shortening / shrinkage / creep in concrete, relaxation of steel is the single largest source of loss of prestress.

Relaxation Loss

Relaxation loss is the loss of stress with time, in a stressed tendon maintained at a constant length. It is measured as the maximum loss at 1000 hours, as a percentage of the stress applied (normally 70%), at a specified temperature (Normally 20^0 C)

Application

Our products are used for construction of major bridges, silos, buildings, dams, atomic reactors buildings, stadium, airport hanger, precast segment etc.

Making of Low Relaxation LRPC Strands.

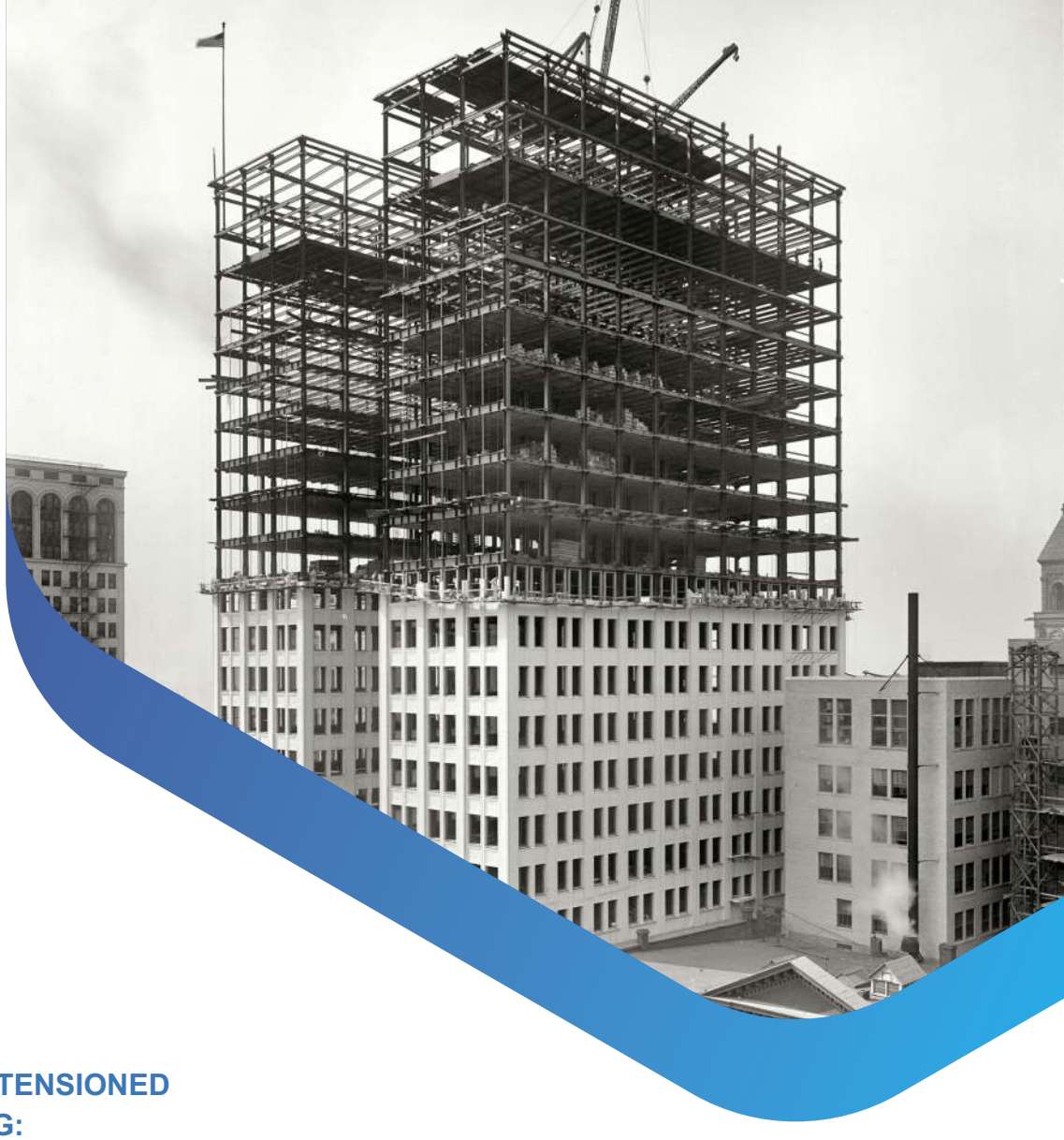
The low relaxation properties of steel strands are achieved by a process called 'Stabilising'. In this thermo mechanical process, also known as hot stretch process, the PC strand is stretched to a predetermined value to creep, thereby reducing 'Relaxation loss'.

We have been able to achieve a high degree of process standardization leading to better control on the manufacturing process. Coupled with world class technology, our products enjoy a very good reputation among the users.

ADVANTAGES OF LOW RELAXATION LRPC STEEL STRANDS – A SUPERIOR PRODUCT

The world over, low relaxation Pre-stressed concrete strands have almost completely replaced the normal relaxation strands due to numerous advantages over normal relaxation strands such as:

1. Saving in concrete due to reduced size of structural member.
2. Lower relaxation losses which are 2.5% max. after 1000 hours.
3. 'Hot Strech' process which is used for manufacturing LRPC,
   a. Eliminates failure of the strand at the size under normal conditions.
   b. Gives a nearly straight strand, thereby eliminating the extra post-straightening treatment.
4. Upto 10% reduction in pre stressing steel is possible.
5. Higher yield point.
6. Higher proof stress (0.2% elongation).
7. Better performance at ambient and elevated temperature.
8. Saving in the number of anchorages, ducts, sheaths, wedges and labour. This leads to overall reductions in cost.
9. Higher fatigue and corrosion resistance.
10. Lower weight per unit length of the strand.
11. Uniform stress – strain relation.



ADVANTAGES OF POST-TENSIONED FLAT SLABS IN BUILDING:

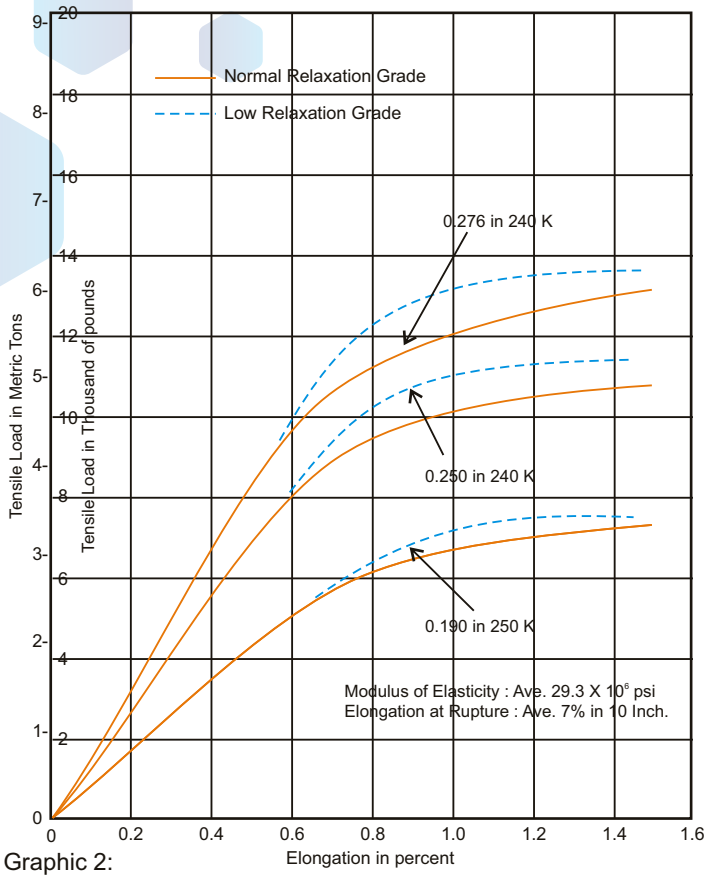
The main advantages of post – tensioned floors over conventional reinforced concrete in-situ floors, may be summarized as follows:

1. Increased clear spans.
2. Thinner slabs.
3. Lighter structures.
4. Faster speed of work.
5. Reduced cracking and deflection.
6. Increased headroom
7. Better water – tightness.
8. The reduced slab weight leads to smaller column and saving in the foundation work.
9. Large spans are possible which permit a more flexible arrangement of partition walls.
10. There are also some situations where the height of the building is limited, in which the reduced storey height has allowed additional storey to be constructed within the building envelope.
11. As the slab is virtually crack-free and the deflection due to live load is very small, the quality is improved and the durability of the structure is increased.
12. By arranging the tendons is supports strip, crossing the idealized punching shear cylinder, the punching shear conditions are considerably improved.
13. The reinforcement quantity is considerably reduced.
14. The formwork can be removed at an earlier concrete age because the deflections due to creep and shrinkage are significantly less important.

These advantages normally result in significant saving in overall cost of the project.

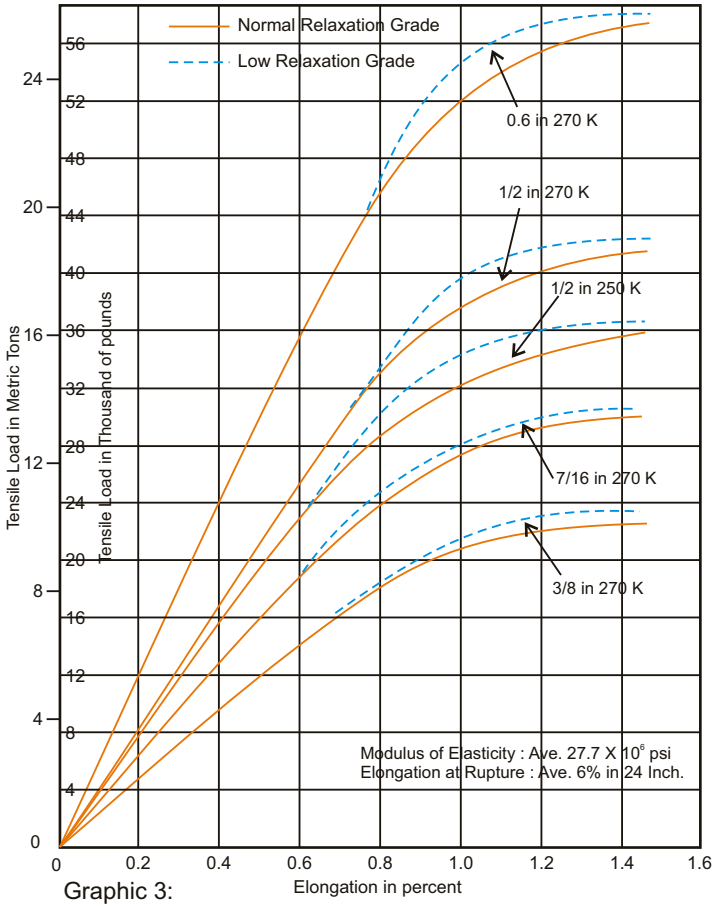
Technical Information

Typical Load Elogation Curves



Graphic 2:

Seven Wire Strand



Graphic 3:

SPECIFICATIONS OF PRE-STRESSED CONCRETE STRANDS

Table 2 :

PC STRANDS - NORMAL RELAXATION

INDIAN SPECIFICATION IS 6006 : 2014

Standard	Nominal Dia-mm	Nominal Area (Approx) (mm2)	Tol mm	Min. Breaking strength		0.2% poof strength		Min Elong%	Nominal wt (Approx)		Diff. between Core wire & Outer wire %	Lay Length	Chemical Composition %
				N	Kg	N	Kg		lbs/1000	Kg/Km			
IS 6006/83	3 mm 3ply	21.2	± 0.03	38250	3,902	32,460	3,311	3.5 (GL=200mm)	111.6	166	-	24-36d	S = .04 max S = .04 max
IS 6006/83 Class - 1	9.5mm 3ply	51.6	± 0.03	89000	9,069	75,600	7,704	3.5 (GL=600mm)	272	405	1.5	12-16d	S = .04 max S = .04 max
	11.1mm 7ply	70.3	± 0.40	20,100	12,238	102,300	10,424		373.0	555	1.5		
	12.7mm 7 ply	92.9	± 0.40	160,100	16,314	136,200	13,879		490.6	730	1.5		
	15.2mm 7 ply	138.7	± 0.40	240,200	24,476	204,200	20,808		735.2	1,094	1.5		
IS 6006/83 Class - 2	9.5mm 3ply	54.8	+ 0.66 - 0.15	102,300	10,424	87,200	8,865	3.5 (GL=600mm)	2.923	435	1.5	12-16d	S = .04 max S = .04 max
	11.1mm 7ply	74.2	+ 0.66 - 0.15	137,500	14,052	117,200	11,943		393.1	585	1.5		
	12.7mm 7 ply	98.7	+ 0.66 - 0.15	183,700	18,719	156,100	15,907		520.8	775	1.5		
	15.2mm 7 ply	140.0	+ 0.66 - 0.15	260,700	26,565	221,500	22,571		740.5	1102	1.5		

* d = Single wire dia : mm
* D = Strand wire dia : mm

P C STRANDS - LOW RELAXATION

Table 3 :

INDIAN SPECIFICATION : IS 14268 : 2017

Class	Nom.dia. of strand	Tol mm	Nom. area of strand - mm2	Min. braking strength of strand		0.2 Proof load (90%) of breaking strength		Min. % of Elong GL = 600 mm	Nom. wt. of strand (Approx)	Relaxation Loss - %	Chemical Composition %
				KN	KN	KN	KN		Kg/Km		
I	9.50	± 0.40	51.6	89.0	9078	80.1	8170	3.5	405	2.5 max at 70 % of specified min. Breaking strength after 1000 hours	S = .04 max S = .04 max
	11.1	± 0.40	69.7	120.1	12250	108.1	11026		548		
	12.7	± 0.40	92.9	160.1	16330	144.1	14698		730		
	15.2	± 0.40	139.4	240.2	24500	216.2	22052		1094		
I	9.5	+ 0.66 - 0.15	54.8	102.3	10434	92.1	9394	3.5	432	1.8 max at 70 % of specified min. Breaking strength after 100 hours	S = .04 max S = .04 max
	11.1	+ 0.66 - 0.15	74.2	137.9	14065	124.1	12658		582		
	12.7	+ 0.66 - 0.15	98.7	183.7	18787	165.3	16860		775		
	15.2	+ 0.66 - 0.15	140.2	260.7	26592	234.6	23929		1102		

Table 4 :

BRITISH SPECIFICATION BS 5896 : 2012

Type of strand	Nominal Diameter	Tolerance on		Nominal Area of Strand	Nominal Tensile Strength	Specified Characterstic Breaking Strength	Specified Characterstic 0.1% proof load	Load at 1% elongation	Tolerance on			Minimum Elongation at max load $L_o \geq 500mm$	Nominal mass
		Dia	Cross sectional area & mass						Initial load (% of actual breaking load)	max after Relax Chass I	Relax 1000 hrs Relax Class 2		
	mm	mm		mm^2	N/ mm^2	KN	KN	KN					Kg/100m
7 Wire Standard	9.3	+ 0.30 - 0.15	+ 4%	52	1770	92	78	81	For all strands			For all stands 3.5%	408
	11.0			71	1770	125	106	110	60%	4.5%	1.0%		557
	12.5	+ 0.40 - 0.20	- 2%	93	1770	164	139	144	70%	8.0%	2.5%		730
	15.2			139	1670	232	197	204	80%	12.0%	4.5%		1090
7 Wire Standard	9.6	+ 0.30 - 0.15	+ 4%	55	1860	102	87	90					432
	11.3			75	1860	139	118	122					590
	12.9	+ 0.40 - 0.20	- 2%	100	1860	186	156	163					785
	15.7			150	1770	265	225	233					1180

Table 5 :

ASTM SPECIFICATION A416

Grade	Nominal Dia. of Strand		Tolerance		Nominal area of Strand		Min. Breaking strength of Strand		Min. Load at 1% Extension		Min. % Elongation GL = 600 mm	Nominal weight of Strand (Approx)		1000 hr relaxation Loss
	Inch	mm	Inch	mm	$Inch^2$	mm^2	lb	KN	lb	KN		lb/ 1000 ft	Kg/ 1000 m	
250	3/8	9.53	± 0.016	± 0.41	0.08	51.61	20000	89.00	18000	80.10	3.5	272	405	2.5 max at 70% of specified min breaking strength 3.5% max ar 80% of specified min breaking strength.
	7/16	11.11			0.108	69.68	27000	120.10	24300	108.10		367	548	
	½	12.70			0.144	92.90	36000	160.10	32400	144.10		490	730	
	.6	15.24			0.216	139.35	54000	240.20	48600	216.20		737	1094	
270	3/8	9.53	+ 0.026 - 0.006	+ 0.66 - 0.015	0.085	54.84	23000	102.30	20700	92.10	3.5	290	432	
	7/16	11.11			0.115	74.19	31000	137.90	27900	124.10		390	582	
	½	12.70			0.153	98.71	43300	183.70	37170	165.30		520	775	
	.6*	15.24			0.217	140.00	58600	260.70	52740	234.60		740	1102	

On request DPWL can manufacture LRPC strands conforming to JIS G 3536:2014, Australian Standard AS 1311:1987, ASTM A416 & BS 5896:2012.

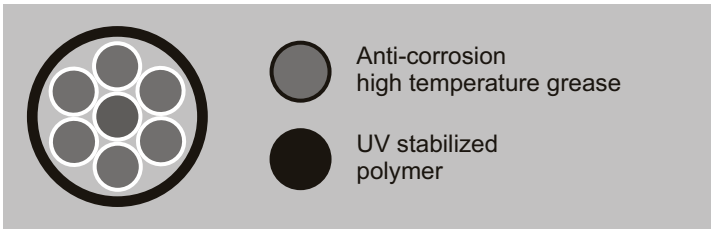
Introducing for the first time in India

Galvanized LRPC Strands : Apart from bright LRPC strands for some application, particularly in the case of extreme corrosive environment. D.P. Wires LRPC strands provides the additional protection required & can manufacture Bonded & Unbonded strands as per customers' requirements.

PE Coated Strands

Grease filled – Bonded & Unbounded LRPC strand for post Tensioning : This speciality LRPC strand may be bright or galvanized depending upon the environment is coated with a corrosion resistant / water repellent – high temperature grease / wax to fill the interstices between the wires followed by a co-extrusion of an UV stabilized polymer layer with thickness (Min. 0.5mm, max as per customer's requirement). D.P. Wires Galvanized unbounded LRPC strands has an excellent durability & provides perfect protection against corrosion through tricomplimentary nested barrier formed by (A) galvanization followed by (B) anti-corrosive. Water repellent – grease / wax coating in the intrinsic (C) UV Stabilized polymer sheath. This particular arrangement also enables monitoring of strands, by replacing a post-tensioned strand at regular interval.

Specification of PE coated Bonded & Unbounded strand. As per ASTM A-416-2006. Grade-1860/ IS-14268/1995 Class II Sheathing material: Polyethylene or Polypropylene. Minimum Density: 0.941/cm^3, Minimum thickness: 0.75mm to 1.25mm. Grease coating: 30 to 35 gms per meter.



Application	LRPC Variants	Sheathening Thickness (mm) Min.	Sheathening Thickness (mm) Max.	Polymer Type (UV Stabilized)ΨΨ	Zinc Coating Weigh g/m²
Post Tensioning Stay Cables	Unbonded (Grease Filled) Bonded	0.5	A per Customer's Requirement	PP-Standard Colour Orange or PE-Standard Colour black	190-340

Properties of Sheathed Galvanized/Bright LRPC Strand Post Tensioning/Stay Applications

Supply and Packing

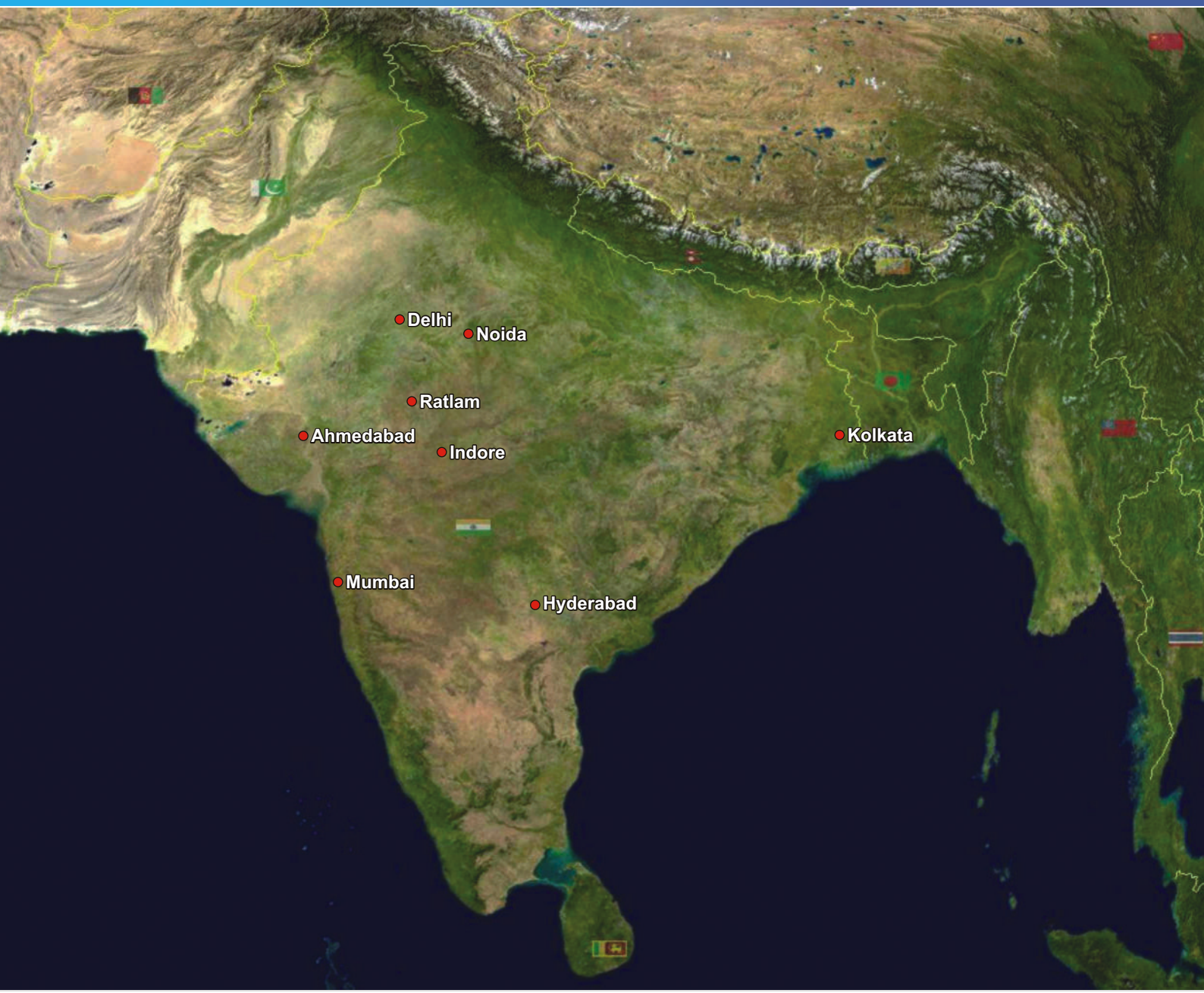
The strands are supplied in **cheese coils** of min. 1 MT to max. 4 MT, ID-750mm, OD-1500mm & Length-1000 mtr. to 4000 mtr; so that the strands can be conveniently pulled from the center of the coil. If required coils can be supplied in special water soluble rust preventive oil for corrosion resistance. Coils are normally packed in the following manner.

1. Strapping of coils at six places.
2. Wrapping with VPI paper.
3. Wrapping with LD-Polythene film.
4. Wrapping with one side LD laminated bituminized jute.
5. Strapping.

Storage, Handling and use

Low relaxation strands for Pre-stressed concrete have superior mechanical & chemical characteristics and are utilized under very severe conditions close to the limit of their yield point. Thus best possible care is required in all stages of transportation, handling, storage and use. The following precautions are essential while handling and using pre stressing steel.

1. Steel cutting should be effected with abrasive disc cutters or shears and never with electric arc or gas flame.
2. The steel should be stored in a covered warehouse with good air circulation. For storage in the outdoors, stack reels above ground level, duly covered, however allowing good air condition to avoid condensation.
3. Avoid exposing steel to concentrated sources of heat as they can seriously alter the micro structure of the steel and hence change its characteristics and mechanical properties.
4. For long storage, it is advisable to apply protective coatings.



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