Frequently Asked Questions

Historic dimensional changes in the anchorage, wedge and strand for the 0.5 in. (12.7 mm) diameter Prestressed Concrete (PC) single strand unbonded system

Answers from the PTI DC-80 Repair, Rehabilitation & Strengthening Committee April 2025 • Issue No. 17

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Q: What changes over time have been applied to the 0.5 in. (12.7 mm) diameter single strand system anchorage wedge cavity and wedges dimensions?

Single strand system anchorages are regulated by PTI M10.2: Specification for Unbonded Single Strand Tendons, which provides minimum performance criteria for materials and requirements for the fabrication and installation of tendons. This includes requirements for the anchorage and wedges.

Even though the design of an anchor to meet those specifications is specific to each PT manufacturer, the overall geometry and dimensions for each manufacturer's anchor has always been very similar.

Some changes were adopted by the industry that impact today's installation, and are especially worth noting when performing a repair:

1. The anchor's wedge cavity center hole was enlarged in the mid-1990s. This change allowed an extruded strand to be placed through the anchor with its sheathing in place, even as the thickness of the sheathing requirement was increased by PTI specifications. The sheathing in the wedge cavity is removed prior to the installation of the wedges and the stressing operation. This provides better protection for the strand tail and the wedge cavity during the installation process.

2. Wedge length was changed, also in the mid 1990s, and, in general, shortened from 1.3 in. (33 mm) to 1.2 in. (30.5 mm) for 0.5 in. (12.7 mm) strand systems. Note that the dimensions for the wedges are the same for the various grades of strand steel: the 250 ksi (1,723.7 MPa) strand has (and always had) a nominal diameter slightly smaller than a grade 270 strand steel. Therefore, the wedges will sit deeper in the wedge cavity when using a grade 250 strand.

3. In the 1970s and early 1980s, some PT manufacturers used a four-degree angle on the anchor and wedge, while others used a seven-degree angle. There was also a system that used a 10-degree angle, as late as 1977. By the late 1980s almost all suppliers changed to the seven-degree wedge. Several issues influenced standardization, the main one being inadvertent mixing of systems that caused substantial tendon failures and repairs.

Q: What changes over time have been applied to the lay (as described below) of the wires and nominal area of the PC strand?

1. The nominal area of the 0.5 in. (12.7 mm) PC strand currently varies with its grade. Grade 250 strand has a nominal area slightly smaller than the grade 270 strand (See Fig.2.1.1).

   The nominal area of 250 ksi (1,723.7 MPa) low relaxation strand has been specified to be 0.144 $in.^2$ (3.658 mm^2) since the first edition of ASTM A416, published in 1957. Similarly, the nominal area for the 270 ksi (1,861.6 MPa) has not changed and has always been specified to be 0.153 $in.^2$ (3.886 mm2).

TABLE 1 Breaking Strength Requirements			
Nominal Diameter of Strand, in. [mm]	Minimum Breaking Strength of Strand, lbf [kN]	Steel Area of Strand, in.^{2} [mm^2]	Weight [Mass] of Strand lb/1000 ft [kg/1000 m]
Grade 250 [1725]			
0.25 [6.4]	9 000 [40.0]	0.036 [23]	122 [182]
0.313 [7.9]	14 500 [64.5]	0.058 [37]	197 [294]
0.375 [9.5]	20 000 [89.0]	0.080 [52]	272 [405]
0.438 [11.1]	27 000 [120]	0.108 [69.7]	367 [548]
0.500 [12.7]	36 000 [160]	0.144 [92.9]	490 [730]
0.600 [15.2]	54 000 [240]	0.216 [139]	737 [1090]
Grade 270 [1860]			
0.375 [9.53]	23 000 [102]	0.085 [55]	290 [430]
0.438 [11.1]	31 000 [138]	0.115 [74.2]	390 [580]
0.500 [12.7]	41 300 [184]	0.153 [98.7]	520 [780]
0.520 [13.2]	45 000 [200]	0.167 [108]	570 [840]
0.563 [14.3]	51 700 [230]	0.192 [124]	650 [970]
0.600 [15.2]	58 600 [261]	0.217 [140]	740 [1100]
0.620 [15.7]	62 800 [279]	0.231 [150]	780 [1200]
0.700 [17.8]	79 400 [353]	0.294 [190]	1000 [1500]

Fig. 2.1.1—ASTM A416-18 Table 1 for Low Relaxation strand.

Previous versions of ASTM A416 reference Low Relaxation and Normal Relaxation 250 ksi (1,723.7 MPa) strand. In these versions the area and the breaking strength for Low Relaxation and Normal Relaxation 0.5 in. (12.7 mm) strand was identical.

Note that "normal relaxation" was also called "stress relieved," and the use of normal relaxation prestressing strand in the post-tensioning industry faded away in the early 1980s and was eliminated from ASTM A416 in 2013.

2. Primary differences were in the relaxation properties and the minimum yield load. Minimum yield load was 85% of minimum breaking strength in Normal Relaxation. Minimum yield load is 90% in low relaxation strands. Refer to Fig. 2.1.1.

   The "lay of the strand" refers to the stranding direction of the six outer wires around the straight center (king) wire. This is referred to as "Left-Hand (LH)" or "Right-Hand (RH)" lay, as shown in the Fig. 2.2.1 to 2.2.3.

   LH lay strand has been the convention for U.S. manufacturers and the use of PC strands since at least the 1960s. It was due to early strand manufacturers in the U.S. being supplied with gears to produce LH lay. Other strand manufacturers in the world may have had gears for RH lay. Today, PC steel manufacturers in the U.S. are capable of producing RH lay when specially ordered for any grade or diameter, such as when needed to couple an older existing PC strand with a new strand during a repair operation. In modern manufacturing practice, all PC strands made in the U.S. and most international strands are LH lay strands.

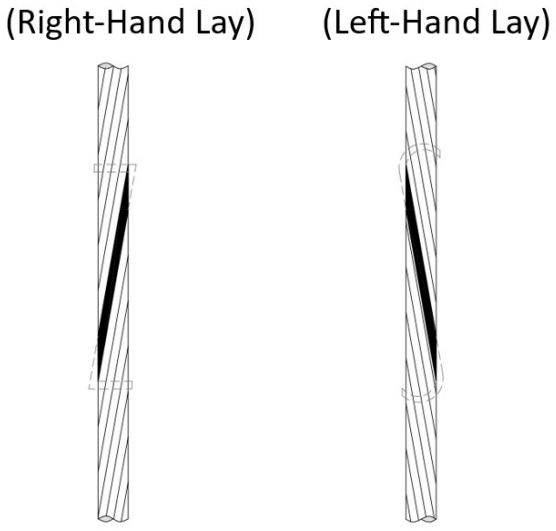

Fig. 2.2.1—Right- and Left-hand lay.

Right-Hand Lay

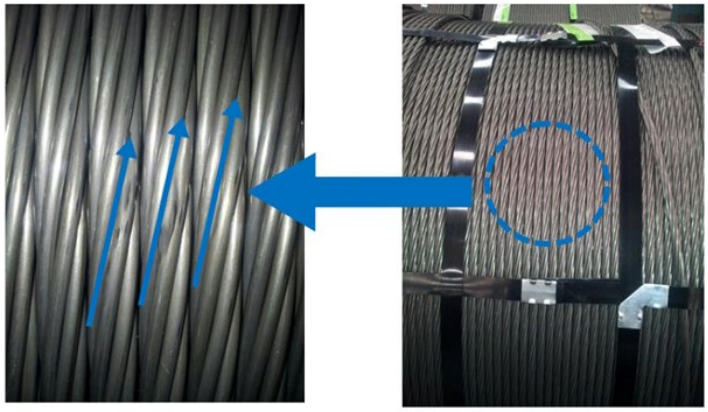

Fig. 2.2.2—Right-Hand (RH) Lay, blue arrow indicates direction.

Left-Hand Lay

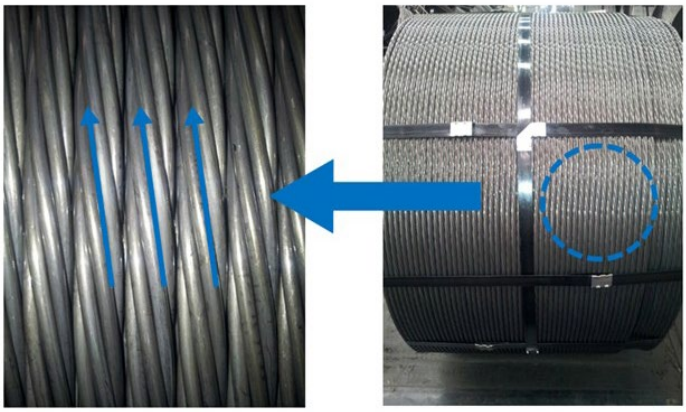

Fig. 2.2.3—Left-Hand (LH) Lay, blue arrow indicates direction.

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Frequently Asked Questions, April 2025
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