National Concrete Bridge Council

2026 NCBC WEBINAR SERIES

Overview of the new PTI/ASBI M-50 Technical Note on Unducted Post-Tensioning with Epoxy Coated Strand

August 19, 2026

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National Concrete Bridge Council

NCBC Webinar Series 2026

September 16: ICRI Guides for Investigation, Assessment, and Repair of Reinforced Concrete Bridges

October 21: Anchoring to Concrete Part 3: Post-installed reinforcing bars and an overview of grouted joints with confinement

November 18: Silica Fume Sustainable / Low Carbon Concrete

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National Concrete Bridge Council

Industry Events 2026

Sep 9-12: PCI Committee Days, San Antonio, TX

Sep 30-Oct 2: PTI Committee Days, San Antonio TX

Oct 11-14: ACI Convention, Atlanta, GA

Oct 15-18: NRMCA Concrete Works, Nashville, TN

Oct 29: Webinar- Overview of ANSI/PCI 142-24 Specification for Precast Prestressed Concrete Piles at 2:00 pm CT

Nov 8-11: ASBI Convention, San Antonio, TX

Nov 15-18: CRSI Fall Meeting, Chicago, IL

Dec 1-2: World Bridge Engineering Conference, Miami, FL

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Presenters

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Greg Hunsicker Shahid
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Presentation

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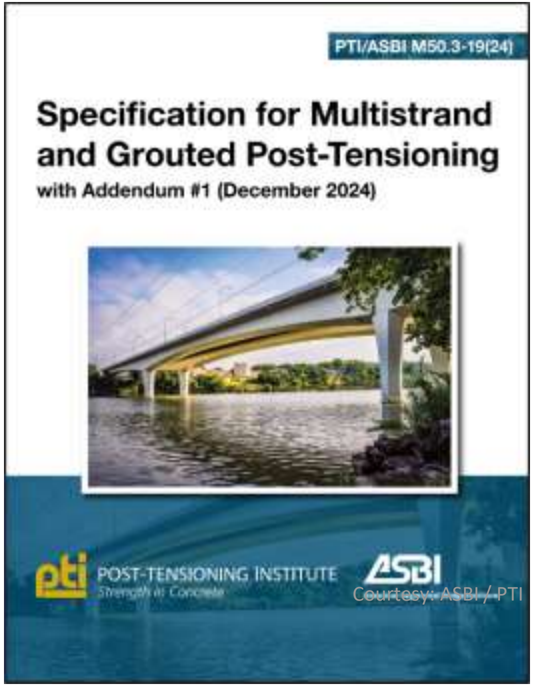
PTI/ASBI M-50 Technical Note

Un-ducted External Post-Tensioning with Epoxy Coated Strand (ECS)

- PTI/ASBI M50 Committee – Scope, Stakeholders, Consensus Process
- Provide practical information and guidance on the requirements for durable post-tensioning systems
- New, innovative, and underutilized technologies
- Themes: Extending service life and improved durability, more easily inspectable, maintainable, replaceable
- Un-ducted External Post-Tensioning with Epoxy Coated Strand (ECS) is an existing and actively utilized technology



Courtesy: ASBI / PTI

POST-TENSIONING INSTITUTE
Strength in Concrete

ASBI
American Segmental Bridge Institute

PTI/ASBI M-50 Technical Note

Un-ducted External Post-Tensioning with Epoxy Coated Strand (ECS)

- Task group on Un-ducted External Post-Tensioning with Epoxy Coated Strand (ECS) within the PTI/ASBI M50 Committee
- TechNote including specification
- Complement current *PTI/ASBI M50.3-19(24) Specification for Multistrand and Grouted Post-tensioning*
- Incorporate current practice with Un-ducted External Post-Tensioning with (ECS).

POST-TENSIONING INSTITUTE
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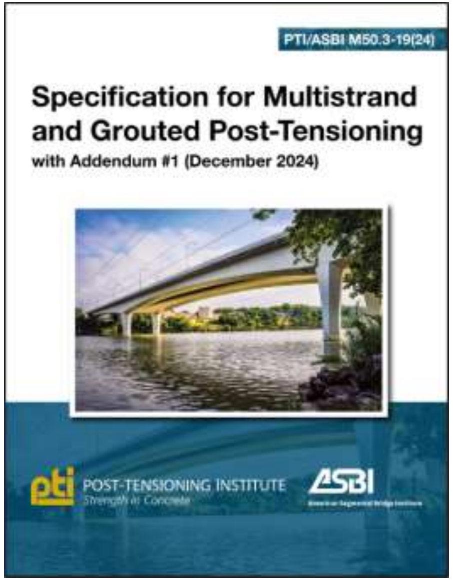
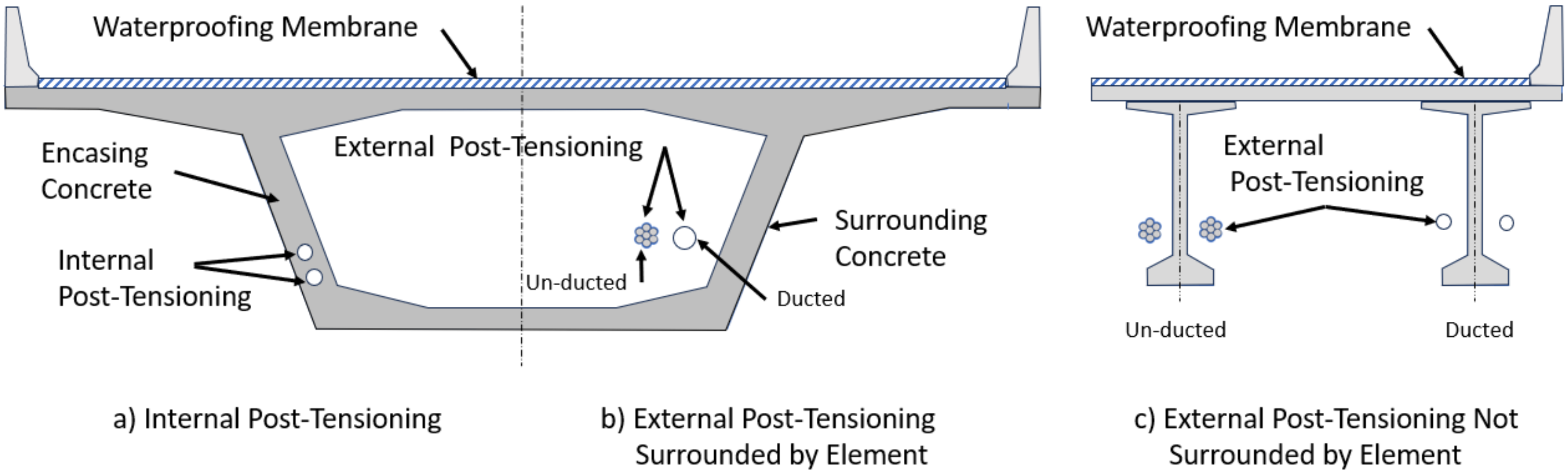


Courtesy: ASBI / PTI

Core message: A Technote was developed by the PTI/ASBI M50 Committee which describes and establishes requirements for Un-ducted External Post-Tensioning with Epoxy Coated Strand

Un-ducted External ECS Tendons



Courtesy: fib TG5.14, Holt

Core message: External unducted-ungrouted ECS tendons are a readily available option that can be used in standard tendon arrangements.

Un-ducted External ECS Tendons

- Epoxy coated strand in the US and Worldwide
- Extensive experience and successful implementation of external unducted epoxy coated strand tendons in Japan for over 30 years
- 2026 NCBC WEBINAR SERIES

  Unducted Epoxy-Coated Strand in Practice:
  The Laurel Fork Bridge - June 10, 2026

Core message: Previous experience has shown external unducted-ungrouted ECS tendons are a viable option for durable post-tensioned tendons.

Un-ducted External ECS Tendons

Durability and resiliency

Installation

Inspectability and maintainability

Replaceability

Core message: External unducted ECS tendons offer benefits in durability, installation, visual inspection and maintenance, and replaceability.

What Is Epoxy-Coated Prestressing Strand?

- Prestressing strand with a factory-applied epoxy coating
- Base strand manufactured to ASTM A416/A416M
- Coated product specified under ASTM A882/A882M
- The coating protects:
  - The outside of the strand
  - The internal voids between the individual wires

Core message: This is not jobsite-applied paint. It is a manufactured prestressing product with defined material and coating requirements.

Epoxy-Coated Strand: A U.S. Invention

1981 Invented by Florida Wire & Cable in the USA as Flo-Gard. Original patent has since expired.

1991 Added to ASTM as A882.

1992 Filled version introduced — epoxy inside and outside. Filled ECS is all that is produced today.

30+ Years Refined and adopted at scale for external tendons in Japan.

Today Returning to U.S. bridge practice — Laurel Fork and the M-50 Technical Note.

How ECS differs from epoxy-coated rebar

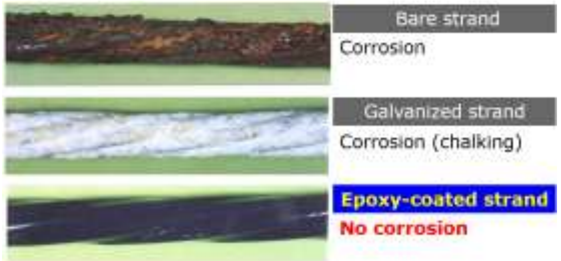
- Surface preparation: 6 steps vs. 2 steps
- Cleaning: chemical vs. shot blast
- Coating at crown: 15–45 mils vs. 7–16 mils
- Pinholes allowed: none vs. avg. 1 per linear foot

Core message: Different products developed for different applications — the rebar comparison understates ECS on every axis that matters.

Corrosion Protection Mechanism

- The epoxy fills the interstitial voids between wires
- The coating provides a barrier to moisture and chlorides
- Adhesion to individual wires limits corrosion propagation
- Where local coating damage occurs, corrosion stays local rather than migrating along the strand

3,000 Hour Salt Fog Test



No corrosion migration nor loss of epoxy adhesion

Core message: High durability against chlorides. Damage stays local.

ECS Material Standards — and What Changed in 2026

- ECS is covered by ASTM A882/A882M — coating thickness, adhesion, holiday detection, mechanical performance, and relaxation
- Related standards: ISO 14655 (international) and JSCE-E 141-2023 (Japan)
- ECS must be treated as a prestressing product, not merely as a coated steel product

The 2026 revision to ASTM A882/A882M

- Maximum relaxation reduced from 6.5% to 3.5%
- Epoxy adhesion requirements increased

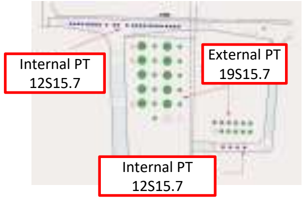
Standard Specification for
Filled Epoxy-Coated Seven-Wire Steel Prestressing Strand[1]

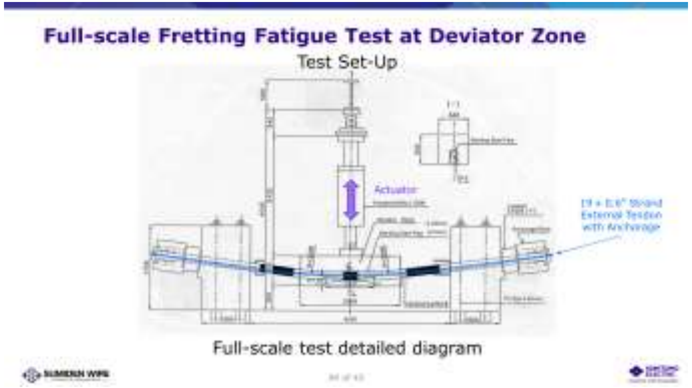
Why ECS Fits Un-ducted External PT

- Corrosion protection is factory applied directly to the strand
- The tendon is external and accessible
- The tendon is un-ducted over much of its length, allowing inspection
- Benefits: improved inspectability, potential replaceability, reduced dependence on full-length grout, factory-controlled protection

# of Wire Breaks @ Full-scale fretting fatigue at a deviator — 3 million cycles

13	4	0
Bare strand	HDPE-coated (steel exposed)	Epoxy-coated (no steel exposed)

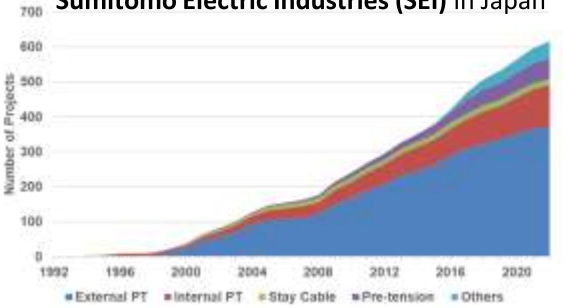




Experience in Japan

- Japan has used epoxy-coated strand in external PT applications for over 30 years
- ECS has become widely accepted there for external tendon applications
- The experience includes > 300 un-ducted and un-grouted external tendon projects
- **No in-service issues have been reported**
- The Technical Note draws confidence from this long-term record of use

>600 projects using ECS supplied by **Sumitomo Electric Industries (SEI)** in Japan



Typical External Tendon System in Japan

Core message: New to many U.S. users, but not experimental globally.

Lessons Learned from Long-Term Use

- Proper strand production and quality control
- Correct bite-through wedges
- ECS-compatible anchorages
- Careful handling and installation
- Protection from coating damage
- Attention to UV exposure
- Proper detailing at deviators and anchorages
- System-level qualification

Core message: The technology works when it is treated as a system — which is where Shahid picks up.

Handling, UV Exposure, and Repair

- ECS should be protected from abrasion, sharp edges, strand-on-strand rubbing, and improper uncoiling
- Tendon prefabrication is strongly recommended
- Long-term direct UV exposure should be avoided
- Coating damage can be identified visually, with holiday detectors, or with thickness gauges
- Repairs use an approved two-part epoxy procedure — patches provide the same or better adhesion and corrosion resistance as the original coating

Core message: The coating is robust, but it must be respected during construction.

Handling, UV Exposure, and Repair

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- Long-term direct UV exposure should be avoided
- Coating damage can be identified visually, with holiday detectors, or with thickness gauges
- Repairs use an approved two-part epoxy procedure — patches provide the same or better adhesion and corrosion resistance as the original coating

Core message: Field repairs are possible with minimal effort and training

Key Takeaways — Epoxy-Coated Strand

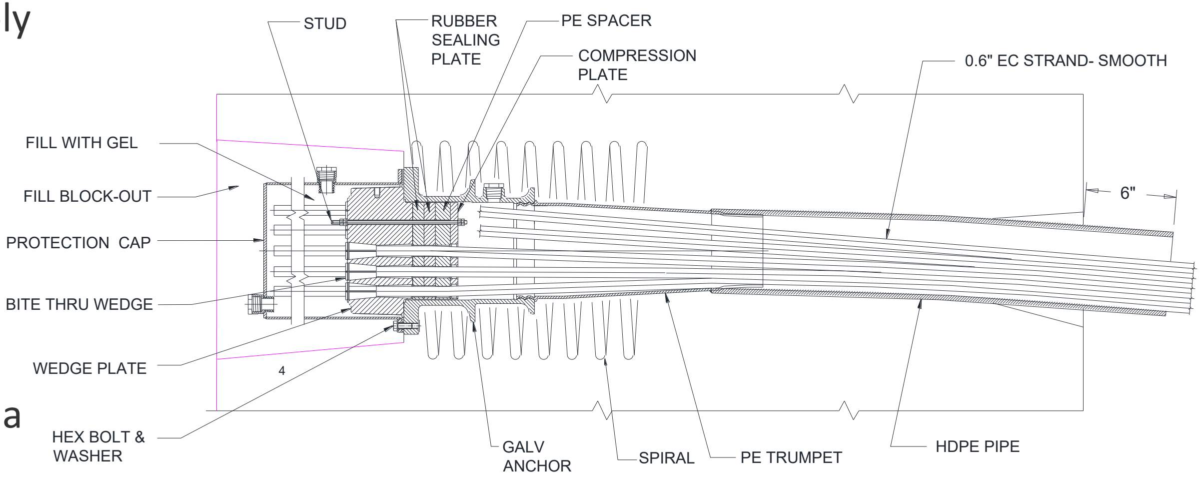
1. ECS is a mature prestressing product with an ASTM material standard — strengthened again in 2026
2. Factory-applied corrosion protection covers both external and internal strand surfaces
3. A strong record of use in Japan for external tendon applications
4. Well suited to systems where inspectability and replaceability matter
5. The Technical Note gives the U.S. industry a practical pathway to use it correctly

ECS PT System Design, Qualification, Components, and Field Implementation

Shahid Islam, Ph.D., F.PTI, Technical Director, North America

System-Level Thinking

- Epoxy coated strand is not simply standard bare strand with a coating on it
- Strand, wedges, anchorages, deviators, protection details, installation, and stressing methods must work together
- The Technical Note emphasizes a qualified PT system



Strand | Wedges | Anchorages

Deviators | Installation | Stressing

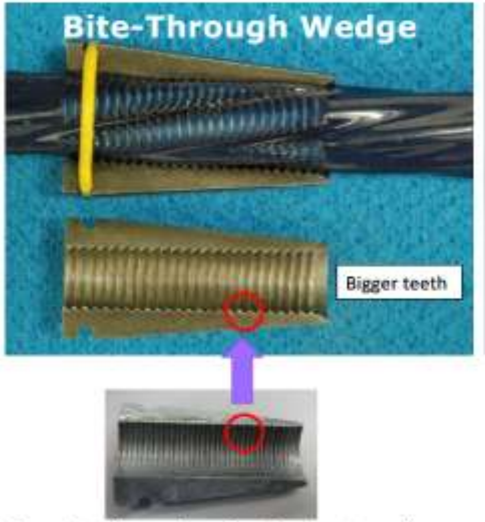
Design Considerations Overview

- Durability, Inspection and replaceability
- Anchorage and deviator detailing
- Tendon protection at critical locations
- Friction coefficient
- Seating loss
- Tendon vibration
- Coordination with the PT system supplier

Core message: The Technical Note identifies what needs to be addressed — without requiring the audience to master every detail today.

Seating Loss and Bite-Through Wedges

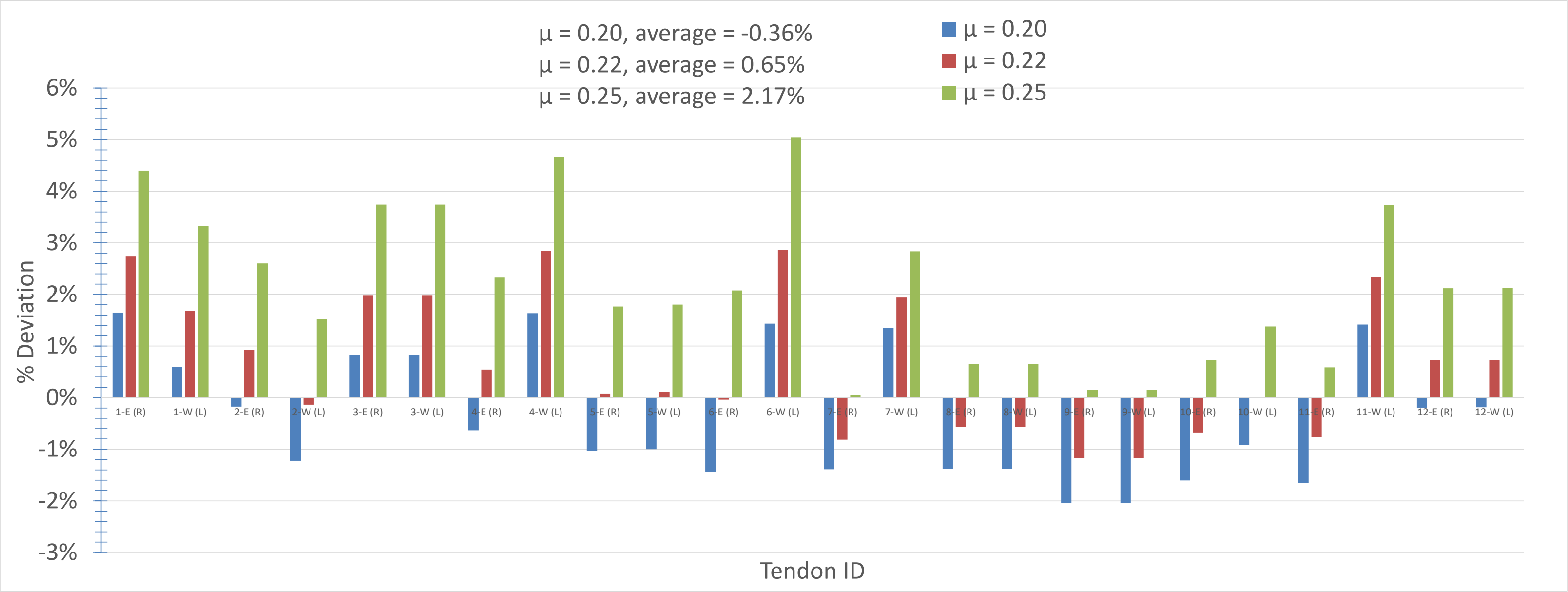
- ECS requires bite-through wedges
- The wedges penetrate the epoxy coating and grip the steel without stripping it
- Seating loss is typically greater than for bare strand
- Actual seating loss depends on:
  - Wedge design
  - Anchorage system
  - Stressing jack- friction or power seating
    - Range 7/8” to ½”



Standard wedge for bare strand

Core message: Anchorage seating behavior differs from conventional bare-strand PT. Power seating makes seating loss smaller and prevents any slippage of strand

Friction Coefficient



Core message: Based on two projects (6+24 tendons) done in USA, recommended angular friction coefficient is 0.17-0.21 /rad

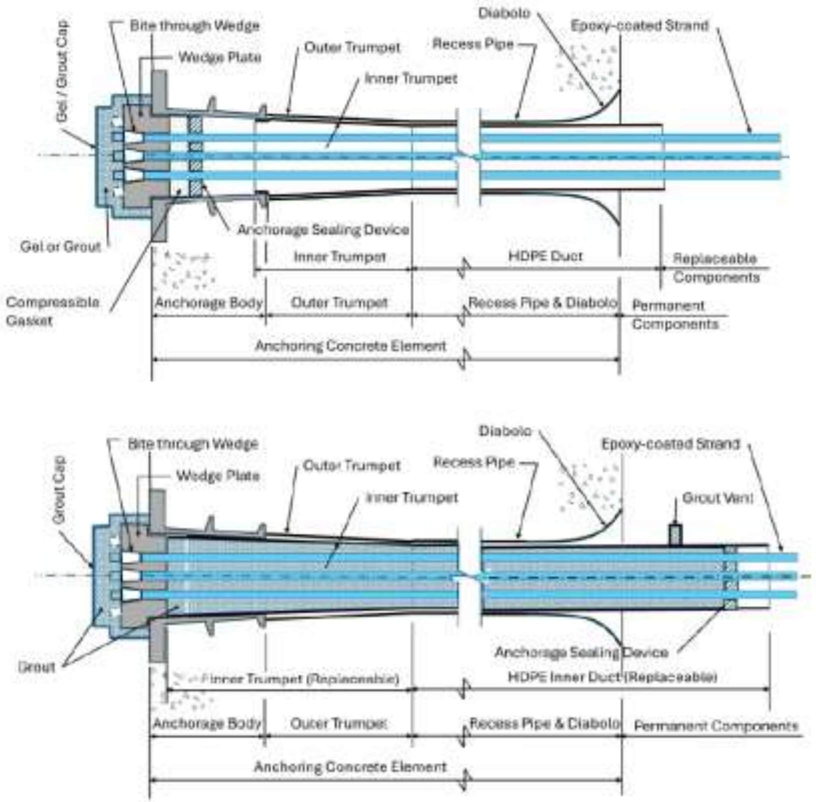
Tendon Vibration

- Un-grouted, un-ducted external tendons may visibly vibrate more when impacted
- The absence of grout means less damping than in grouted systems
- The Technical Note recommends checking tendon vibration relative to the structure's vertical vibration frequency
- The goal is to avoid resonance

Core message: A design consideration — but international experience has not shown it to be an in-service problem when properly addressed.

Replaceability

- Replaceability must be considered during design
- The system is generally replaceable at the tendon level
- Replacing individual strands within a multi-strand tendon is usually not practical unless the system is specifically designed for it
- Detensioning and replacement require planning, access, and safety procedures



Core message: A major benefit — but it needs to be designed from the beginning.

System Qualification

Anchorage load transfer

Anchorage tensile efficiency

Fatigue resistance

Wedge plate testing

Deviator / diabolo performance

Leak tightness of sealed or ducted anchorage sections

Core message: The system must be qualified for this application — the tendon is unbonded and external.

System Qualification

- Ensure that the anchorages develop at least 95% of the actual ultimate tensile strength of the prestressing steel, when tested in an unbonded state, without exceeding the anticipated anchor set. See PTI M50.3-19 Section 4.4.1
- Test anchorage in accordance with EAD 160004-00-0301, where the tendon should be subjected to 2m cycle fatigue loading with upper stress of 0.65 GUTS and stress amplitude of 80 MPa.
- Wedge plates and wedges shall meet the requirements of PTI's "Acceptance Standards for Post-Tensioning systems," section 4.1. Provide self-centering wedge plates to facilitate alignment with the bearing plate.
- For special anchorage, perform load transfer test per AASHTO LRFD Bridge Construction Specifications

System Qualification

- In case of grouting injection, the entire anchorage including the sealing device should be tested as per fib bulletin 75 – annex B.1 (for PL2). Test setup must be modified to accommodate for the presence of EC strands.
- In case of gel injection, the entire anchorage including the sealing device should be tested as per PTI DC45.1-18 Section 4.1.6.1 “leak test”, with the exception that the specimen is not previously subjected to a fatigue test.

Major Components

Tendon and anchorage

- Epoxy-coated prestressing strand
- Bite-through wedges
- Wedge plates and anchorages
- Anchorage sealing devices
- Permanent caps
- Corrosion-inhibiting material at anchorage zones

Deviation and protection

- Diabolo deviators
- Smooth HDPE pipe at deviators

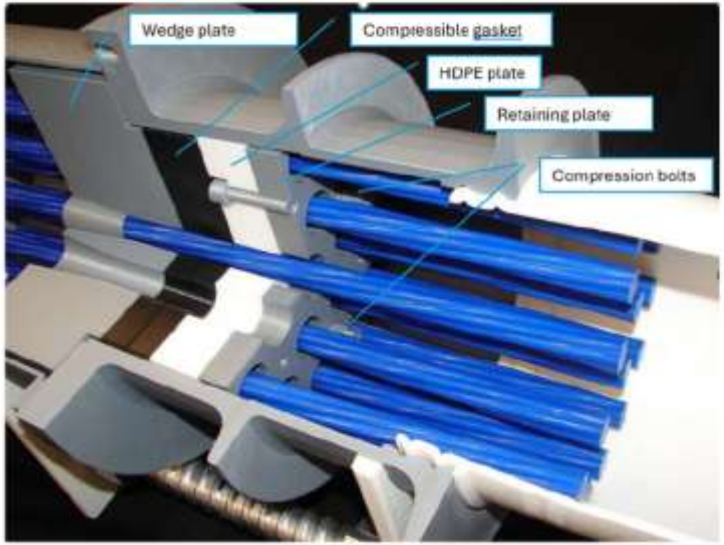
Installation

- Temporary installation supports
- Strand compactors or wedded pulling eye
- Pulley system
- Guide roller for curved path
- Elephant nose at top deck, curved mechanism at bottom deck and booms

Core message: Familiar-looking components, but with details and performance requirements specific to ECS tendons.

Anchorages and Sealing

- The anchorage zone needs special attention because the wedges penetrate the coating
- Corrosion-inhibiting material is used in the anchorage area
- Sealing devices retain gel, grout, or other approved material
- Anchorage detailing must allow protection, inspection, and proper stressing



Core message: The free length may be un-ducted, but the anchorage zone still needs intentional corrosion protection.

Diabolos and Deviators

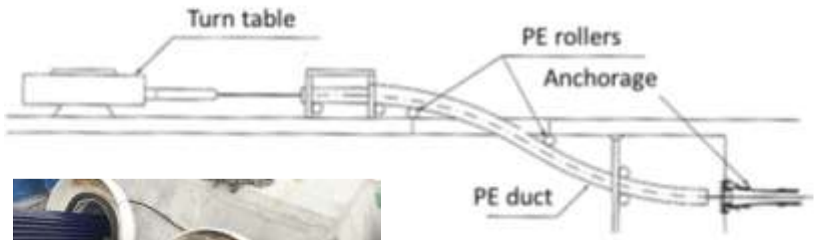
- Diabolos guide the tendon through concrete deviators and diaphragms
- Smooth HDPE pipe protects the coating from abrasion
- Deviator geometry and radius are important
- The Technical Note includes guidance for minimum radii and protective pipe dimensions
- Oversized details are recommended — tight ducts at pier heads and deviator blocks have been a reported field difficulty

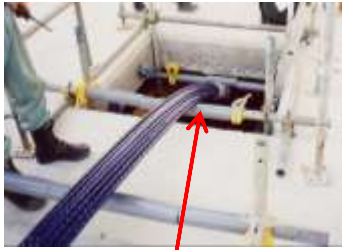
Tendon Size	Min Radius at Deviator, ft	Min ID of HDPE Pipe, in
7-06	9.8	3.0
12-06	9.8	3.5
15-06	9.8	4.5
19-06	9.8	4.5
22-06	11.5	5.0
27-06	11.5	5.0
31-06	13.1	5.5
37-06	13.1	5.5

Core message: Deviators are one of the most important detailing areas for successful performance.

Installation Method

- The Technical Note recommends the pull method with preassembled multi-strand tendons
- Preassembly helps:
  - Maintain strand parallelism & prevent crossing
  - Reduce strand-on-strand rubbing
  - Protect the coating
- Strand compactors and other alignment devices may be used
- Hand pushing is viable for short tendons with additional care





Protection (PVC or PE pipe)

Core message: Installation practice drives both coating protection and constructability.

Prefab & Pulling Method

- Tendons are prefabbed

Cable forming frame

Welding of Pulling eye

Cable grip

Bundling

Taping

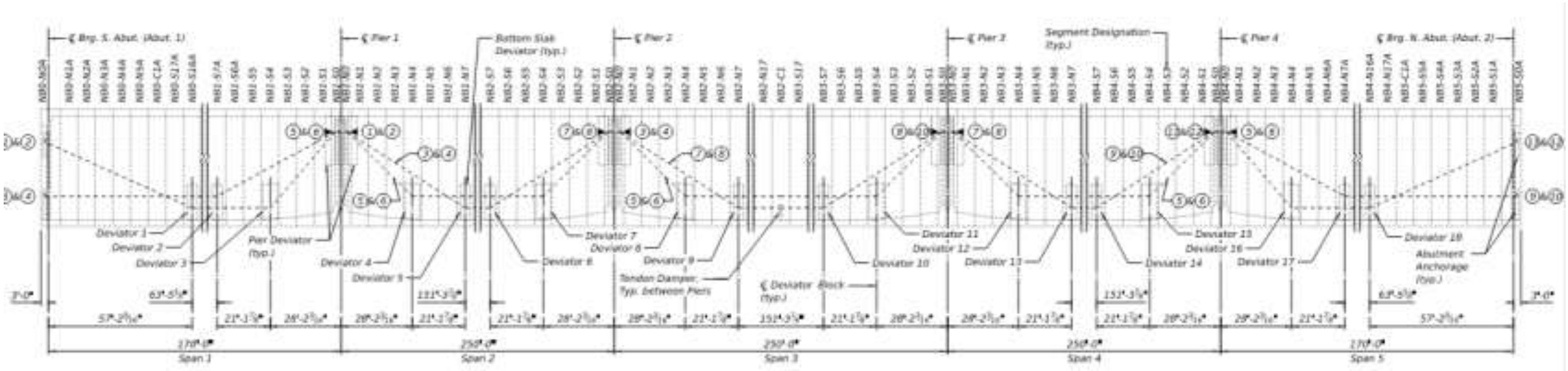
Core message: Installation practice drives both coating protection and constructability.

Stressing, Finishing, and Field QC

- Multi-strand stressing is required, with ECS-compatible stressing wedges
- Wedges must be inspected for damage, rust, dirt, and epoxy residue
- Seating loss should be verified during stressing
- Strand tails must be cut with abrasive saw
- Finishing includes permanent protection caps and final anchorage sealing before acceptance
- Coating damage should be inspected and repaired

Core message: Field quality control is essential — and should be specified before construction begins.

IL-39 NB-Kishwaukee River Bridge Tendon Replacement



5 Spans

Two 170’ (52m) and three 250’ (76m)

Tendon Lengths Varies:

182 ft (55m) to 772 ft (235m)

IL-39 NB-Kishwaukee River Bridge Tendon Replacement

- Two grouted external tendons in NB bridge failed in 2023 and 2025
- To make sure all 24 external tendons in SB bridge are in good conditions Magneto Inductive testing and force measurement of all tendons were performed and traffic moved to SB bridge
- All 22 remaining tendons were de-tensioned in controlled manner and removed from NB bridge
- Emergency tendon replacement carried out during winter months in IL. Cold weather made grouting impractical within the required schedule & epoxy coated un-ducted tendon was selected
- Tendons fabricated at top bridge deck and pulled through holes at top deck and then through deviators inside the bridge. All 24 tendons installed and stressed successfully
- Largest (24 tendons with longest tendon of 775 ft) and complex project with EC strand un-ducted external tendons in North America

Core message: Valuable where replacement must happen fast and grouting impossible.

IL-39 NB-Kishwaukee River Bridge Tendon Replacement

Preparation of 775 ft long tendon bundling, pulling, welding eyes and installation

IL-39 NB-Kishwaukee River Bridge Tendon Replacement

Stressed Tendon

Wedges seated nicely

Core messages:

1. Extra care must be taken to place jack between already stressed tendon
2. Power Seating preferred. Measured anchor set was 0.5".

IL-39 NB-Kishwaukee River Bridge Tendon Replacement

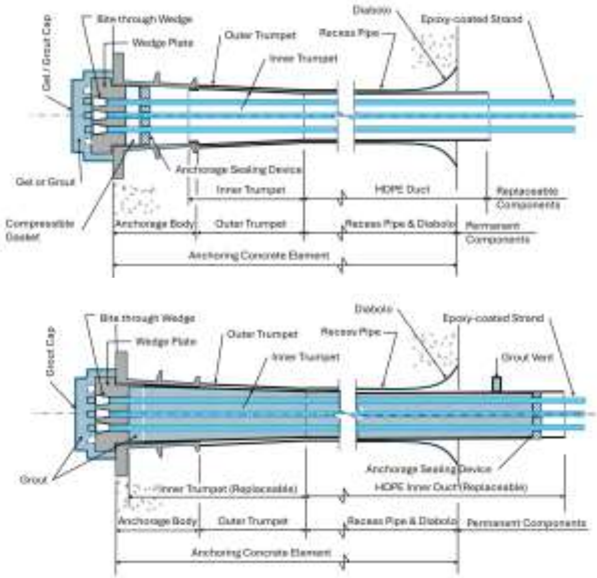
Core message: With experienced personnel and proper installation techniques, ECS un-ducted tendon system is durable, faster construction and makes future inspection simpler.

Key Takeaways — Design and Field Implementation

1. ECS tendons require attention to seating loss, vibration, replaceability, and system qualification
2. Anchorages, deviators, sealing, and installation methods are central to successful use
3. Friction and elongation verification are handled as part of normal PT design and supplier coordination
4. The technology is field deployable — but it requires proper specifications and qualified systems
5. The Technical Note gives practical guidance on some details that are not required in standard PT practice

Appendix A: Turning the Technical Note into Project Specifications

- Appendix A provides a sample special provisions for epoxy-coated PC strand un-ducted external tendons.
- Incorporates the current industry practice informed by international experience
- Part 1: Introduction, Background, Design Considerations, System Qualifications, Components, Installation
- Part 2: Appendix A - Special Provisions for Epoxy-coated PC Strand Un-ducted External Tendons



Courtesy: ASBI / PTI

Core message: A sample special provision for epoxy-coated strand un-ducted external tendons is included as Appendix A of the TechNote.

Appendix A:

Special Provisions for Epoxy-coated PC Strand Un-ducted External Tendons

1.0 Prestressing Steel

2.0 Epoxy Coated Strand

2.1 General, 2.2 Quality, 2.3 Handling and Storage

3.0 PTS Testing and Components

3.1 Testing, 3.2 Anchorage Body, 3.3 Corrugated/Smooth Duct, 3.4 Permanent Protection Caps, 3.5 Heat Shrink Sleeves, 3.6 Sealing Device, 3.7 Anchorages, 3.8 Inlets and Vents

4.0 Designs

4.1 Anchorage and seating loss, 4.2 Elastic Modulus, 4.3 Relaxation, 4.4 Deviators, 4.5 Protection for free-length of in-place tendons

5.0 Installation

5.1 General, 5.2 Pre-installation Inspection, 5.3 Quality control program, 5.4 Anchorage, 5.5 Protective ducts at deviators, 5.6 Transportation, 5.7 Storage, 5.8 Installation, 5.9 Deviation fabrication and arrangement, 5.10 Stressing, 5.11 System Drawings

Core message: Appendix A addresses the items relevant to ECS un-ducted external tendons including the strand, the overall post – tensioning system, and its installation based on current industry practice.

Appendix A – Specification Highlights

- ECS must conform to ASTM A882/A882M.
- ECS-compatible bite-through wedges are required.
- Handling and storage requirements outlined.
- Precautions with respect to long-term direct UV exposure.
- PT system testing is required to qualify the systems including fatigue.
- Deviators require proper geometry and HDPE protection.
- Multi-strand stressing requirements.
- Strand installation requirements.
- Coating damage must be inspected and repaired using approved procedures.
- PT System drawings show all temporary and permanent components.

Courtesy: Sumiden

Core message: Appendix A addresses the unique items relevant to ECS un-ducted external tendons and complements existing PTI/ASBI M50.3 specification.

Appendix A:

Special Provisions for Epoxy-coated PC Strand Un-ducted External Tendons

PTI/ASBI M50 Committee

- Broad cross-section of stakeholders
- Consensus process
- Complements PTI/ASBI M50.3 Specification

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Sample Special Provision

- Basis for a project specification
- Adapted to project

Existing Technology

- International experience
- Implemented practices

Source: FHWA-PL-23-009

Core message: Appendix A is a sample special provisions that can be adapted to a project.

Question and Answer Session

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