POST-TENSIONING INSTITUTE

Stressing the Stronger Concrete Solution™

2018 PTI Proceedings

May 6-9, 2018 | Hilton Minneapolis | Minneapolis, MN, USA

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2018 Technical Sessions

Links to the technical session presentations are available from the following pages. Navigate to the session of interest and select "presentation" to view. Please note that not all sessions were approved for publication.

Technical Session 1—Bridges

What's New in the DC-45 Stay Cable Recommendations, Seventh Edition

Benjamin Soule, SYSTRA IBT

To inform the audience on the additions and modifications made to the Stay Cable Recommendations, including deviation saddle prequalification, modifications to fire provisions, and qualification of damping systems.

Video | Presentation

East 6th Avenue Bridge, Orizaba, Mexico

José-Luis Quintana, MEXPRESA

East 6th Avenue Vehicle Bridge is a cable stayed post-tensioned concrete structure crossing a busy railway on an urban area in Orizaba, Central Mexico. The street-congested area conditioned the vertical alignment, the access ramps having to start very close to the crossing, thus imposing a very slender deck, just 0.82 m (2 ft 8 in.) deep. The only solution was a stayed central span of 80 m (260 ft) and massive use of post-tensioning for the deck. The Construction had to face a constant double deck train crossing, which called for reduced dimensions of the stay lower anchorages and support structures, which made the stressing operations challenging.

Due to the small general dimensions, pylons could not be hollow to allow for upper stay anchorages; thus, a cradle solution was implemented to transmit the differential live loads to the still-thick, rigid pylons.

The presentation will show how the post-tensioning and cable stays were accommodated, and how the stressing operations were performed to have the construction finished on scheduled time.

Video | Presentation

Lesner Bridge Replacement Project

Mohammad Rabi, Freyssinet Inc.

Lesner Bridge is a key bridge in Virginia Beach, VA. The East and Westbound bridges were built in 1957 and 1958, respectively, and have become structurally deficient to accommodate the greater loads across the deck. To accommodate the new clearance requirement between the piers, the horizontal clearance has been increased in the new built segmental bridges to 150 ft, with the main span 225 ft long. The main contractor is Mclean Contracting Company and Freyssinet was the post tensioning supplier. The presentation will cover current progress, schedule, and the post-tensioning applications which are successfully being used in the project. The presentation will also cover the benefits of conducting a site-specific PT training session.

Video | Presentation

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Development of a New Generation, High-Strength Post-Tensioned Anchorage Bar

Jared Brewe, Simpson Gumpertz & Heger
Neal Anderson, Simpson Gumpertz & Heger

The new signature, steel arch bridge for I-74 over the Mississippi River is connected to the abutments by high-strength, post-tensioned anchorage bars. To achieve a design 100-year service life for the anchorage bars in an exposed condition, a literature review and experimental study was performed to develop a robust, high-strength, post-tensioned bar system that provides improved corrosion resistance. Five candidate materials, including three stainless steels, a carbon steel, and a galvanized carbon steel, were tested. Full-scale specimens were specially fabricated for the test program to replicate actual conditions.

The physical, material, and corrosion testing program included tensile, coupling and end nut, stress relaxation, hardness, toughness, galling, critical pitting temperature, stress corrosion cracking, hydrogen embrittlement, and inelastic behavior testing. A duplex stainless steel demonstrated superior corrosion resistance while the other precipitation hardened stainless steels performed poorly in corrosion testing. The study concluded that the duplex stainless steel is the preferred material, with the conventional plain high-strength, carbon steel bar with a robust corrosion protection system as an alternate. The project team selected the duplex stainless steel for the project with slight design modifications.

Video | Presentation

Technical Session 2—Grouted Tendon Investigation

Session Moderator: Stephen Pessiki

Corrosion Tests of Greased and/or Grouted Strands and Unbonded Single-Strand Tendons Covered with/without Grout

Thomas Kang, Seoul National University
In-Seok Yoon, Induk University

For unbonded PT nuclear containments, a newer type of multi-strand unbonded tendons have been recently applied in several countries such as France, Russia, and India. Mutiple greased and high-desnisty polyethylene (HDPE)-sheathed (extruded) strands are inserted in each duct, where cement grout is filled in prior to post-tensioning. Then the post-tensioning is applied after grout is hardened. It is still an unbonded system because strands are covered by PT coating and HDPE sheathing, not in contact with grouting. This system is definitely applicable to bridge and other structures and can be a viable option to multi-strand grouted tendons or multi-strand unbonded tendons with flexible fillers.

In this presentation, such an innovative newer system is introduced and a series of corrosion tests for several types of strand specimens are reported. The specimen types include bare strands, extruded strands with and without HDPE-sheathing removed, grouted strands, greased and grouted strands (assuming the worst case scenario that all the plastic sheath is damaged during threading), and grouted extruded strands (i.e., newer system).

Video | Presentation

NDT Investigation of PT Ducts

David Corbett, Proceq SA

Pulse echo technology is the most promising technology currently available for investigating the grouting condition of PT ducts. This presentation reviews the work that has been done in this field in various parts of the world, which will illustrate what can and cannot be expected from an NDT assessment. It will go on to discuss how pulse echo technology is developing and what is still needed to best fulfill this application. Finally, examples of measurements made on both grouted and non-grouted sections of PT ducts using the latest state-of-the-art pulse echo technology will be presented.

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Video | Presentation

Enhanced Radiographic Void Detection in Grouted Post-Tensioned Construction Using Photon Attenuating Inclusions

Stephen Pessiki, Lehigh University

Advancements in radiographic imaging equipment, such as field-portable MeV X-ray generators, have made radiography a viable method for field evaluation of concrete infrastructure. One application of particular importance is grout void detection in the tendons and tendon anchorage regions of post-tensioned concrete bridges.

A major obstacle to the use of radiography for grout void detection in post-tensioned construction is that X-ray attenuation in grout is similar to the attenuation in the surrounding concrete. In order to improve radiographic void detection in grouted construction, this paper investigates the use of grouts with photon attenuating inclusions (PAI). PAI are high atomic number materials (such as $BaCO^3$) that possess advantageous X-ray attenuation properties, which are embedded within the grout, for the purpose of increasing its X-ray attenuation characteristics, thereby enhancing void detection capabilities.

This paper presents experimental data from radiographic imaging of conventional and PAI cementitious grouts to evaluate candidate PAI materials and concentrations in terms of augmenting radiation attenuation of the grout material. Additional tests were made to evaluate the effect of PAI on grout compression strength.

Video | Presentation

Locating Voids in Bonded Post-Tensioned (PT) Ducts and Other Non-Destructive Testing (NDT)

Paul S. Fisk, NDT Corporation

Post-tensioning (PT) makes possible the cost-effective construction of high-quality segmental bridges. In recent years, problems with voids and soft grout in PT ducts have been discovered. Open voids and soft grout create an environment where strand corrosion can occur. If these conditions are not detected and remediated, PT strands could fail, compromising the bridge. Cost-effective ways of locating voids and quantifying soft grout conditions in PT ducts are important for planning proactive remedial actions.

NDT Corporation has successfully used various non-destructive testing methods to identify specific locations within internal and external PT ducts where grout voids and soft grout exist. Results are verified by drilling a small hole to the duct, opening the duct to verify grout condition, and document PT tendon corrosion with video bore scope imaging. The results of these investigations allowed engineers to determine appropriate repair methods and prepare bid documents. Non-destructive quality assurance (QA) testing is also conducted on repaired (re-grouted) PT ducts that document a successful repair approach.

This presentation will share recent PT duct investigation results by discussing the processes that are becoming used for assessing these types of bridges.

Video | Presentation

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Remediation of Post-Tensioning Tendons Containing Defective Grout

Satyajeet Patil, University of Florida

Bridge girders in the United States commonly have multi-strand PT tendons. The PT tendons are constructed by placing ducts inside bridge girders and then post-tensioning the strands into the ducts. These ducts are filled with cementitious grout to bond the tendons to surrounding concrete and provide corrosion protection to the tendons. Defects are found in this grout in some recently constructed bridges. Soft grout is one of the primary defects discovered. Soft grout consists of segregated and unhardened grout with free moisture and is often accompanied by corroded strands. To inhibit further corrosion and repair the soft grout, two grout remediation methods were evaluated. The first method is hydrodemolition, which involves removing soft grout out of tendons using a pressurized water jet. The second method is drying of soft grout by using dry air to remove free moisture out of the tendons. This presentation will cover the implementation and evaluation of these techniques and provide an insight on its effectiveness for practical use in bridge remediation.

Video | Presentation

Technical Session 3—PT Bridges and Multistrand PT

Session Moderator: Brian Merrill

PT Box Girder Design Manual—Going Forward

Brian Merrill, Wiss, Janney, Elstner & Associates
Reggie Holt, FHWA

This presentation will introduce the new PT Box Girder Bridge Design Manual developed for the FHWA. PTI Committee DC-40, Bridges, is now responsible for updates and upgrades to the manual. The presentation will also outline the new tasks planned for the committee.

Video not available | Presentation

PT Bridges: Diagnosing and Remediating Corrosive Condition

Dallas Montgomery, Burgess & Niple Inc.
Siva Venugopalan, Siva Corrosion Services
Bruce Osborn, Structural Technologies, LLC (VSL)

Beneath the surface of visibly sound concrete bridges lies a potentially significant disease that can cause corrosion and deterioration. If left untreated, it can shorten the service life and reduce the load-carrying capacity of post-tensioned (PT) bridges. PT bridges built before the early 2000s are susceptible to structural deficiencies. This is due to the poor grouting materials and construction procedures that were utilized at that time. Accessing and determining the condition of bridge tendons—the primary structural element on PT structures—requires a team experienced with the most current testing procedures.

Without the knowledge of what factors are driving deterioration, the solution may not be effective. The goal is not just to identify symptoms, but to determine, treat, and cure the underlying disease.

This presentation will discuss two case studies in detail in which this team of experts, who have collaborated for more than 12 years, have diagnosed and repaired post-tensioned bridges.

Video not available | Presentation

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Fatigue Testing of Unbonded Tendons with Flexible Filler

Dr. Natassia Brenkus, The Ohio State University

The presentation covers recently completed laboratory testing on multi-strand unbonded tendons with flexible filler materials subjected to a cyclic loading. The intent of the test was to evaluate unbonded multi-strand tendons in bridge applications for 1) potential for fretting fatigue; 2) wedge or anchorage issues; and 3) diabolo-deviator interaction.

Video | Presentation

GTI Plant Expansion—PT Industrial Floor

Asit Baxi, Baxi Engineering, Inc.
Larry Krauser, General Technologies, Inc.

This presentation will cover the design and construction of GTI's (General Technologies) recent Plant Expansion. GTI chose to use grouted tendons for their very heavily loaded foundation slab. Baxi Engineering and GTI facilitated the engineering and construction of this very unique slab. The presentation will cover the design, specialty details, and construction of this slab along with its performance in service to date.

Video | Presentation

Technical Session 4—Building Case Studies and SOG

Session Moderator: Tony Childress

Minnesota Landmarks Powered by Post-Tensioning: A Case Study

Jon Wacker, HGA Architects + Engineers

Innovative structural designs using post-tensioned concrete have played an important role in shaping and expanding multiple landmark buildings in the Minneapolis/St. Paul region including the Ordway Center for the Performing Arts, Weisman Art Museum, and University of Minnesota's Science Teaching and Student Services Building. Learn how unique applications of unbonded post-tensioning tendons were used to deliver these architectural jewels in tight urban settings. These projects incorporated multiple distinct design solutions including: kinked raker beams with post-tensioning anchors located on different building levels, curved tendon layouts to accommodate non-rectilinear building geometry, and stacked transfer girders to redistribute discontinuous column loads without increasing structural depths. Case studies for each of these projects will be presented covering the design, detailing, and construction challenges encountered. As a whole, these projects display the incredible flexibility post-tensioned concrete systems provide designers for accommodating challenging project constraints while delivering distinctive buildings.

Video | Presentation

The Arundel—PT Residential Building Straddles Existing Below Grade Tanks

Katherine Farley, Kline Engineering & Consulting, LLC
Layth Hussein, Kline Engineering & Consulting, LLC

The Arundel is a 15-story, 233-unit ultra luxury apartment building strategically located along the Baltimore Washington Parkway between the two cities. The building structure consists of post-tensioned CIP plates with shear walls for the lateral load-resisting system founded on auger cast piles. The most challenging aspect of the project was that the building was placed directly over existing below-grade SWM tanks. This required a unique approach for the foundations that includes a 4 ft thick PT transfer plate supported on piles. Other challenges include long cantilevers at the balconies, and transfer girders using bonded PT over a drive-through section of the building. The project was completed in the fall of 2017.

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Hybrid Design: Post-Tensioned Slabs with Concrete Columns and Masonry Walls for Lateral Load Resistance

Samuel Rubenzer, FORSE Consulting

This presentation will cover the benefits of using masonry walls together with post-tensioned (PT) concrete slabs and concrete columns to form a hybrid frame for lateral resistance. PT concrete slabs are required to have a slip plane when supported by concrete walls, because of the concrete walls' resistance to lateral movement, which then reduces the post-tensioning effect on the concrete slabs. If the PT concrete slab is built without the slip plane, the concrete wall will also have a significant and unnecessary force from post-tensioning. Masonry walls can be constructed at a later date, allowing the post-tensioning force time to compress the slab.

This presentation will cover project examples and show software models to demonstrate the benefits to both the wall and the slab.

Video | Presentation

The New Guide for Performance Evaluation of SOG Foundations

Tony Childress, Childress Engineering Services, Inc.

Mr. Tony Childress, P.E., S.E. will be providing an introduction to Post-Tensioning Institute (PTI) publication DC10.8-18, "Guide for Performance Evaluation of Slab-on-Ground Foundations." In his presentation, Tony will explain how the publication is intended to be used in the evaluation of slab-on-ground foundations. The publication is intended for use in evaluating the performance of low-rise buildings with slab-on-ground foundation for residential and similar construction. The guidelines, in the publication, are appropriate for use in evaluation of post-tensioned and non-post-tensioned slab-on-ground foundations constructed on any soil condition. The publication only briefly addresses cause and mitigation of foundation movement, areas where Tony has extensive background. Deeper discussion relative to cause and mitigation will be available, based on available time.

Video | Presentation

Technical Session 5—Building Design, Construction, and Repair

Session Moderator: Don Kline

Pacific Manor Post-Tensioned Parking Garage Structural Repairs

Liao Haixue, Vector Corrosion Technologies

Pacific Manor is a nine-story condominium built in the early 1970s, located in Honolulu, Hawaii. The building is constructed of paper-wrapped post-tensioned concrete slabs spanning to reinforced concrete beams, columns, and walls.

Corrosion-induced concrete spalling and fracturing of the tendons in the parking garage slabs located at the lower levels of the building resulted in extensive repairs several years ago. However, as the spalling and fracturing continued to occur at a significant rate after these repairs, a second design team engaged by the building owners instituted immediate shoring of portions of the garage and recommended replacement of the lower levels, which would be very costly and require vacating the building. The owners then engaged MKE Associates LLC and Vector Corrosion Technologies Inc. to investigate the cause of the continued spalling, the effect it had on the structural integrity of the building, and to develop a more cost-effective repair scheme.

Video | Presentation

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Button Head Tendon Repairs: Repair Approaches and Recent Experiences
Andrew J. Lobbestael, WJE

The presentation will include: a brief overview of the button head tendon system; discuss repair approaches to perform anchorage and splice repairs; discuss the pros and cons of repairing with strand versus button head wires; and finally, the presentation will discuss tips or lessons learned from recent repair projects.

Video | Presentation

Restraint to Shortening (RTS) Cracks and their Mitigation in Unbonded Post-Tensioned Buildings
Asit Baxi, Baxi Engineering

This presentation will summarize the soon-to-be-published revisions that are currently being made by Building Design Committee DC-20 to the existing PTI document on this topic, which was published in 1988. The revisions incorporate the current state of practice on restraint cracking and mitigation techniques. Different approaches to estimate shortening will be presented followed by design examples and current detailing practices to handle crack mitigation.

Video | Presentation

State of Practice for the Use of Temperature and Shrinkage PT Parallel to Beams in One-Way Slabs
Don Kline, Kline Engineering & Consulting, LLC

Post-tensioning has been used for temperature and shrinkage reinforcement parallel to beams in one-way slabs for over 50 years. ACI 318 recognized the value of PT as temperature and shrinkage reinforcement by including it in every issue of the code since 1983. This presentation will discuss the proper use of PT for temperature and shrinkage reinforcement. It will also present an analytical study using both plane frame and FE analysis showing the benefits of PT when used for temperature and shrinkage reinforcement. The study will also show that temperature and shrinkage PT has no detrimental effects on the performance of the beams.

Video | Presentation

Technical Session 6—Building Design and Construction

Session Moderator: Neel Khosa / Tim Christle

Using Simple 2D Plans Generated from 3D Scan Data to Alleviate Owner's Concerns About PT
Florian Aalami, ADAPT

This presentation will describe our experience gained during a 1-year 3D laser scanning project we carried out on the 55 Hudson Yards project in NYC. Many projects are 3D laser scanned, but the unique angle we will focus on is how we post-processed the volumes of 3D scan data to deliver a very simple 2D plan of tendons for each level of the project. The developer's main concern was rentability of NYC office space that had "live" post-tensioning in it. Tenants are used to being able to make their own tenant improvements and any hindrance to this flexibility would have limited their leasing activities. Working with the owner's project team, we devised a very simple method to capture the location of post-tensioning and make it easily accessible to any future tenant. This presentation provides a practical angle to how the complex and overwhelming data captured during 3D laser scanning can be presented to building owners in a simple and easy-to-digest format.

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PT Building Design and Construction: Best Engineering/Design Practices

Carl Schneeman, Walker Consultants

Video | Presentation

PT Building Design and Construction: Best PT Supplier/Installer Practices

Neel Khosa, Amsysco, Inc.

Video | Presentation

PT Building Design and Construction: Best Contractor/Builder Practices

Victor Bretting, JVP Contracting & Consulting

Video | Presentation

PT Building Design and Construction: Panel Discussion

Carl Schneeman, Walker Consultants
Neel Khosa, Amsysco, Inc.
Victor Bretting, JVP Contracting & Consulting

The objective of this 75-minute session is to present practical guidance and recommendations regarding the continuum of a PT building project. Best practices will be presented by representatives from three of the key participating team members in the project process. The Structural Engineer-of-Record, the PT Supplier/Installer, and the Structural Concrete Sub-Contractor. The Engineer will focus on PT slab and beam design and detailing decisions, how overall structure design choices affect PT, plus cost-effective and efficient design and detailing practices. He will also provide guidance for technical specifications and how they should be tailored to each specific project. The PT Supplier/Installer will discuss estimating, bidding, and review of the construction documents; recommendations for submittals, samples, and PT shop drawings; and proper fabrication, supply plus field installation and stressing practices. The Contractor will discuss how design, detailing, specifying, and material supply decisions ultimately impact the construction process. He will review the construction and pour sequence, phasing, and other logistics that go into the assembly of the PT building structure from ground up, plus lessons learned. Lastly, these three project representatives will join forces in a round-table panel discussion to collaborate with responses to frequently asked questions and new questions posed by the session attendees.

Video | Presentation

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Program Book/Awards Book

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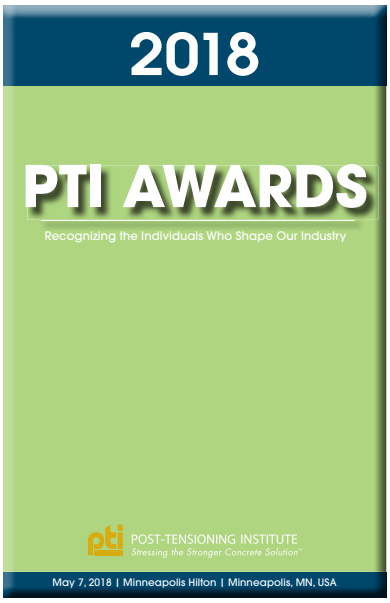

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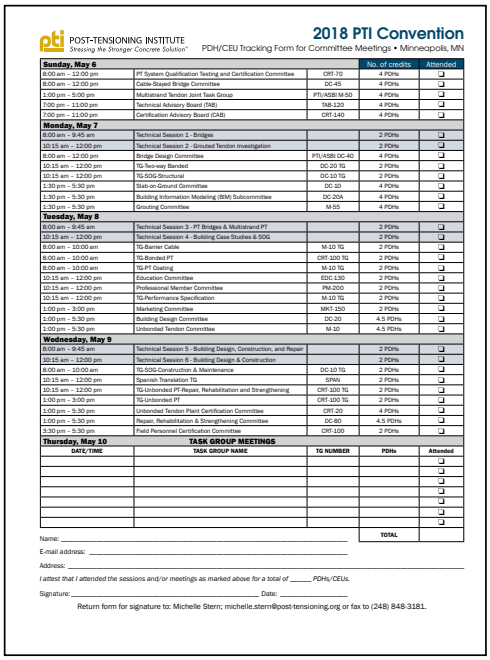

POST-TENSIONING INSTITUTE
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2018 PTI Convention
PDH/CEU Tracking Form for Committee Meetings • Minneapolis, MN

			No. of credits	Attended
Sunday, May 6				
8:00 am – 12:00 pm	PT System Qualification Testing and Certification Committee	CRT-70	4 PDHs	❑
8:00 am – 12:00 pm	Cable-Stayed Bridge Committee	DC-45	4 PDHs	❑
1:00 pm – 5:00 pm	Multistrand Tendon Joint Task Group	PTI/ASBI M-50	4 PDHs	❑
7:00 pm – 11:00 pm	Technical Advisory Board (TAB)	TAB-120	4 PDHs	❑
7:00 pm – 11:00 pm	Certification Advisory Board (CAB)	CRT-140	4 PDHs	❑
Monday, May 7				
8:00 am – 9:45 am	Technical Session 1 - Bridges		2 PDHs	❑
10:15 am – 12:00 pm	Technical Session 2 - Grouted Tendon Investigation		2 PDHs	❑
8:00 am – 12:00 pm	Bridge Design Committee	PTI/ASBI DC-40	4 PDHs	❑
10:15 am – 12:00 pm	TG-Two-way Banded	DC-20 TG	2 PDHs	❑
10:15 am – 12:00 pm	TG-SOG-Structural	DC-10 TG	2 PDHs	❑
1:30 pm – 5:30 pm	Slab-on-Ground Committee	DC-10	4 PDHs	❑
1:30 pm – 5:30 pm	Building Information Modeling (BIM) Subcommittee	DC-20A	4 PDHs	❑
1:30 pm – 5:30 pm	Grouting Committee	M-55	4 PDHs	❑
Tuesday, May 8				
8:00 am – 9:45 am	Technical Session 3 - PT Bridges & Multistrand PT		2 PDHs	❑
10:15 am – 12:00 pm	Technical Session 4 - Building Case Studies & SOG		2 PDHs	❑
8:00 am – 10:00 am	TG-Barrier Cable	M-10 TG	2 PDHs	❑
8:00 am – 10:00 am	TG-Bonded PT	CRT-100 TG	2 PDHs	❑
8:00 am – 10:00 am	TG-PT Coating	M-10 TG	2 PDHs	❑
10:15 am – 12:00 pm	Education Committee	EDC-130	2 PDHs	❑
10:15 am – 12:00 pm	Professional Member Committee	PM-200	2 PDHs	❑
10:15 am – 12:00 pm	TG-Performance Specification	M-10 TG	2 PDHs	❑
1:00 pm – 3:00 pm	Marketing Committee	MKT-150	2 PDHs	❑
1:00 pm – 5:30 pm	Building Design Committee	DC-20	4.5 PDHs	❑
1:00 pm – 5:30 pm	Unbonded Tendon Committee	M-10	4.5 PDHs	❑
Wednesday, May 9				
8:00 am – 9:45 am	Technical Session 5 - Building Design, Construction, and Repair		2 PDHs	❑
10:15 am – 12:00 pm	Technical Session 6 - Building Design & Construction		2 PDHs	❑
8:00 am – 10:00 am	TG-SOG-Construction & Maintenance	DC-10 TG	2 PDHs	❑
10:15 am – 12:00 pm	Spanish Translation TG	SPAN	2 PDHs	❑
10:15 am – 12:00 pm	TG-Unbonded PT-Repair, Rehabilitation and Strengthening	CRT-100 TG	2 PDHs	❑
1:00 pm – 3:00 pm	TG-Unbonded PT	CRT-100 TG	2 PDHs	❑
1:00 pm – 5:30 pm	Unbonded Tendon Plant Certification Committee	CRT-20	4 PDHs	❑
1:00 pm – 5:30 pm	Repair, Rehabilitation & Strengthening Committee	DC-80	4.5 PDHs	❑
3:30 pm – 5:30 pm	Field Personnel Certification Committee	CRT-100	2 PDHs	❑

Thursday, May 10 **TASK GROUP MEETINGS**

DATE/TIME	TASK GROUP NAME	TG NUMBER	PDHs	Attended
				❑
				❑
				❑
				❑
				❑
				❑
				❑
			TOTAL	

Name: _____

E-mail address: _____

Address: _____

I attest that I attended the sessions and/or meetings as marked above for a total of _____ PDHs/CEUs.

Signature: _____ Date: _____

Return form for signature to: Michelle Stern; michelle.stern@post-tensioning.org or fax to (248) 848-3181.

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Lunch

JSW Stud Rails
Afternoon Refreshment Break

info-gel
Morning Refreshment Break

GERDAU
Lunch

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2018 PTI Committee Days

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