AGENDA

PTI DC-80 Repair, Rehabilitation & Strengthening Committee

Wednesday, May 9, 2018
1:00 PM to 5:30 PM
Minneapolis Hilton

Voting Members Present (x of y)

Tracy Naso, Chair	Wiss, Janney, Elstner Associates, Inc.
Hamid Ahmady	Suncoast Post-Tension, Ltd.
Cory Brett	SGH
Genmiao (Jimmy) Chen	Parsons Brinkerhoff
James Donnelly	Wiss, Janney, Elstner Associates, Inc.
Clyde Ellis	VSL
Christopher Fulton	Halsall
Liao Haixue	Vector Corrosion Technologies
Gabriel Jimenez	Walter P. Moore
Don Kline	Kline Engineering & Consulting, LLC
John Mancuso	Sutton, Kennerly & Associates
Richard Mitchell	Vector Corrosion Technologies
Daniel Moser	Walker Parking Consultants
Douglas Sarkkinen	Otak
Slava Tkachuk	Ready Cable, Inc.
Edgar Zuniga, TAB Contact, V	Dywidag-Systems International, USA, Inc.
Amy Dowell, NV	PTI Staff

Associate Members Present

Noli Alarcon	Timothy Haahs and Associates, Inc.
Garth Fallis	Vector Corrosion Technologies
Roger Frenn	DSI
Hee-Taik Lee	Korea Institute of Nuclear Safety
Ralf Leistikow	Wiss, Janney, Elstner Associates, Inc.
Sivakumar Munuswamy	Thornton Tomasetti, Inc.
Daniel Rosa	Vector Corrosion Technologies
Otto Schwarz	Ryan Biggs | Clark Davis Engineering and Surveying, P.C.
Hanif Shariff	Read Jones Christofferson, Ltd.
Ed Underhill	Freyssinet

Visitors Present

ACTION ITEMS FROM LAST / THIS MEETING

Item #	Subject	Action	Responsible	Deadline / Completed
1	FAQ: Making Inspection Recesses	Update document to include approved changes Update figure to add a partial-depth, top surface crack	Brett Sarkkinen	2/18 Update?
2	FAQ: Testing force in existing tendons	Change to TN format Initiate Ballot	Naso-Dowell Staff	3/27/18-4/27/18
3	Webinar Modules	Draft outline for webinar modules from DC80.3-12 Document	Munuswamy	5/1/18
4	Update DC80.3-12	Develop recommendations and make assignments.	Naso Fallis	Update?
5	Update DC80.2-10	Review and propose any updates if needed.	Kline	Update?
6	Repair Specification	Finalize and send to print	Naso/Staff	
7	External Strengthening	Draft from PT Manual – turn into guide specification	Kline/Moser	Update?

Agenda Item	Expected Outcome / Actions Taken
A. General A.1 Call to Order A.2 Introductions A.3 Committee Roster / Changes A.4 PTI Antitrust Policy	A.3 Ed Underhill joined as an associate member.
B. Agenda & Minutes B.1 Approval of Agenda B.2 Approval of Minutes from 10/5/18 (Meeting ballot required)	B.2 Vote on Minutes from 10/5/18 approval Motion / Second: Name / Name Result: X-X-X (Y-N-A)
C. Actions Taken Between Meetings C.1 Letter Ballots (1801) C.2 Web Meetings (none)	C.1 Ballot DC-80-1801: TN-Force in Existing Tendons ends 4/27/18
1. Action Item 1: (Webinar Modules) 1.1. Review outline	1.1 Draft outline attached for review / discussion (Attachment 1.1)

Agenda Item	Expected Outcome / Actions Taken
1.2. Identify task group to work on slides / script	
2. Action Item 2: (Update to DC80.3-xx) 2.1. Review possible updates	2.1
3. Action Item 3: (TN – Testing Force in Existing Tendons) 3.1 Ballot DC-80-1801 ends 4/27/18	3.1 Review ballot results – resolve negatives if necessary or schedule web meeting
4. Action Item 4: Repair Tape Survey Review 4.1 Review results	4.1
E. New Business E.1 Button head guide specification	E.1 Button head specification information was pulled out of the guide specification – Is there a need to create a new document to cover this repair in a new document?
F. Next Meeting 2018 PTI Committee Days, Colorado Springs, CO September 26-27, 2018 Web Meetings:	
G. Adjourn	

AGENDA / MEETING EXHIBITS

Exhibit #	Subject
Roster / A.4	Sign-In Sheet / PTI Anti-Trust Policy
B.2	Minutes from 10/5/18
1.1	Draft outline for repair webinar

MINUTES

PTI DC-80 Repair, Rehabilitation & Strengthening Committee

Thursday, October 5, 2017
1:00 PM to 5:00 PM
CasaMagna Marriott Cancún Resort

Voting Members Present (7 of 17)

Tracy Naso, Chair	Wiss, Janney, Elstner Associates, Inc.
Hamid Ahmady	Suncoast Post-Tension, Ltd.
James Beicker	J.L. Beicker Company
Cory Brett	SGH
Genmiao (Jimmy) Chen	Parsons Brinkerhoff
James Donnelly	Wiss, Janney, Elstner Associates, Inc.
Clyde Ellis	VSL
Christopher Fulton	Halsall
Liao Haixue	Vector Corrosion Technologies
Gabriel Jimenez	Walter P. Moore
Don Kline	Kline Engineering & Consulting, LLC
John Mancuso	Sutton, Kennerly & Associates
Richard Mitchell	Vector Corrosion Technologies
Daniel Moser	Walker Parking Consultants
Douglas Sarkkinen	Otak
Slava Tkachuk	Ready Cable, Inc.
Edgar Zuniga, TAB Contact, V	Dywidag-Systems International, USA, Inc.
Amy Dowell, NV	PTI Staff

Associate Members Present

Noli Alarcon	Timothy Haahs and Associates, Inc.
Garth Fallis	Vector Corrosion Technologies
Roger Frenn	DSI
Hee-Taik Lee	Korea Institute of Nuclear Safety
Ralf Leistikow	Wiss, Janney, Elstner Associates, Inc.
Sivakumar Munuswamy	Thornton Tomasetti, Inc.
Torry Oram	Smid Construction
Daniel Rosa	Vector Corrosion Technologies
Otto Schwarz	Ryan Biggs | Clark Davis Engineering and Surveying, P.C.
Hanif Shariff	Read Jones Christofferson, Ltd.

Visitors Present

Joe Harrison	LMS Group
Russ Price	Suncoast Post-Tension
Doug Schlegel	Consultant
Jonathan Smith	Coast Concrete
Rod White	Millennium

ACTION ITEMS FROM LAST / THIS MEETING

Item #	Subject	Action	Responsible	Deadline / Completed
1	FAQ: Making Inspection Recesses	Update document to include approved changes Update figure to add a partial-depth, top surface crack	Brett Sarkkinen	
2	FAQ: Testing force in existing tendons	Change to TN format Initiate Ballot	Naso Staff	
3	Webinar Modules	Draft outline for webinar modules from DC80.3-12 Document	Munuswamy	5/1/18
4	Update DC80.3-12	Develop recommendations and make assignments.	Naso Fallis	
5	Update DC80.2-10		Kline	

Agenda Item	Expected Outcome / Actions Taken
A. General A.1 Call to Order: A.2 Introductions A.3 Committee Roster / Changes A.4 PTI Antitrust Policy A.5 Annual Report	A.1 2:08 p.m. A.3 The committee welcomes Ralf Leistikow (WJE).
B. Agenda & Minutes B.1 Approval of Agenda B.2 Approval of Minutes from 5/3/17 (Meeting ballot required)	 B.2 Vote on Minutes approval from 5/3/17 Motion / Second: Kline/ Donnelly Result: 7-0-0 (Y-N-A) Minutes are approved.
C. Actions Taken Between Meetings C.1 Letter Ballots (1701) C.2 Web Meetings (none)	 C.1 Ballot 1701 – PT Strand Investigation Recess FAQ:
1. Action Item 1: (Guide Specification for Repair) 1.1 Respond to TAB Comments	 1.1 Respond to TAB Comments (Attachment 1.1)

Agenda Item	Expected Outcome / Actions Taken
	Motion to find all the proposed TAB editorial responses to Guide Specification acceptable: Donnelly/Moser 7-0-0
2. Action Item 2: (FAQ: Making Inspection Recesses) 2.1 Resolve negatives	2.1 Resolve negatives from Ballot 1701 (Attachment 2.1). Brett to update document to include changes and also search for term changes throughout the document (e.g. “installing” to creating”, water contamination to water intrusion, PT coating vs. grease, excavation vs. removal, Ground Penetrating Radar (GPR), etc.). Reviewed technical comments: Naso 2/5 comment: resolution in attached file. motion/second: Moser/Zuniga 7-0-0 Ahmady 4/11 comment: resolution in attached file. motion/second: Donnelly/Sarkkinen 7-0-0 Reviewed editorial comments: Acceptance and proposed changes in attached file. Sarkkinen volunteers to update the figure and add a partial-depth, top surface crack.
3. Action Item 3: (FAQ: Testing Force in Existing Tendons) 3.1 update	3.1 Update: Sending out to ballot.
4. Action Item 4: (Guide for Strengthening of Concrete Structures by Means of External Post-Tensioning) 4.1 Update	4.1 Update (on hold waiting for new PT Manual chapter from Kline / Moser): In progress.
5. Action Item 5: (Repair Terminology) 5.1 Update	5.1 Update / Mitchell.

Agenda Item	Expected Outcome / Actions Taken
6. <u>Action Item 6: (Testing force in existing tendons TN)</u> 6.1 Update	6.1 Update / Ahmady. Naso to change from FAQ format to Tech Note format.
7. <u>Action Item 7: (Sheathing Repair Tape TN)</u> 7.1 Sheathing repair tape technical note	7.1 Update. Brett: in progress. Working with Amy to publish during Cancun meeting.
E. <u>New Business</u> E.1 Webinar module based on repair guide E.2 Review of documents and identification of those in need of revision E.3 Discuss possible Technical Session topics / presenters	E.1 Identify topics and form TG with anticipated schedule for each module. Suggested modules include basic investigation and case studies Go through the repair manual and identify potential candidates for web modules: Munuswamy. Start with DC-80. Target consultants seeking PDH's initially. Draft of these topics by Mpls. E.2 PTI DC80.1-02 Controlled Demolition of an Unbonded Post-Tensioned Concrete Slab. Re-name as a "case study." Freshen up to make look like it's more updated (fonts, etc). Check terminology. PTI DC80.2-10 Creating Openings and Penetrations in Existing Slabs with Unbonded PT Kline volunteers to update PTI DC80.3-12 Guide for Evaluation and Repair of Unbonded Post-Tensioned Concrete Structures This is a joint document with ICRI. Garth and Tracy will meet to develop recommendations and make assignments. E.3 discuss possible contributions to the Technical Sessions from the committee members or their associates Bonded tendon repairs? Buttonhead repairs? No assignments yet – waiting for volunteers.

Agenda Item	Expected Outcome / Actions Taken
F. <u>Next Meeting</u> 2018 PTI Convention, - Minneapolis, MN – May 6-9, 2018 Web Meetings:	
G. <u>Adjourn</u>	Adjourned at 3:57 pm

<u>AGENDA</u> / MEETING EXHIBITS

Exhibit #	Subject
Roster / A.4	Sign-In Sheet / PTI Anti-Trust Policy
1.1	Response to TAB comments on Guide Specification

POST-TENSIONING INSTITUTE®

Committee Attendance Sheet

Committee: DC-80 **Date:** 10/5/17

Meeting Location: Cancun

*** I have read, understand, and agree to comply with PTI Anti-Trust Policy (attached).**

Note to Committee members and visitors: All Committee meetings of the Post-Tensioning Institute should be conducted in a manner encouraging free and open discussion and debate of agenda items and matter properly before that Committee. Committee members and visitors are cautioned that such discussion and debate is solely for the purposes of the Charter of the Committee and PTI business. To that end, Committee discussions and debates are not considered public in nature, and, as such are to be held in confidence and do not become the official policy of PTI until properly reported, balloted, and published pursuant to procedures established by or by the adoption by the PTI Board of Directors. Committee members and visitors shall not quote, publish, use, or make use of, any oral or written drafts, drawings, calculations, or other materials, which are uttered or transcribed during the course of such meetings.

#	Name	Company	Voting/ Associate/ Guest	E-Mail	Policy*
1	Trach Naso	WJE	V	tnaso@wje.com	TNN
2	Cory Brett	SGH	V	crbrett@sgh.com	CBB
3	Amy Dowell	PTI	Staff		AMD
4	Don Kline	Kline Engineering	V		
5	EDGAR ZUNIGA	DSI	V		EZ
6	Rod White	Millennium	G	nova_steel@hotmail.com	RW
7	GARTH FANNS	VECTOR	A		GF
8	DAN MOSER	WALKER	V	dan.moser@walkerconsultants.com	D.M
9	Doug Sarkkinen	otak, Inc	V	douglas.sarkkinen@otak.com	DS
10	Jim Donnelly	WJE	V	JDONNELLY@WJE.com	JPD
11	JOE HARRISON			jharrison@lmsgroup.ca	
12	Jonathan Smith	Coast Concrete	G	jonathan@coastcc.com	JB
13	Russell Price	Suncoast PT	G	r.price@suncoast-pt.com	
14	Doug Schlegel	Consultant	G	doug.schlegel@verizon.net	DJS
15	SIVA MUNUSWAMY	Thornton Tomasetti	A	smunuswamy@thorntontomasetti.com	

PTI Committee: TAB – Technical Advisory Board	Ballot-TAB-1704		October 5, 2017
Document Title: DC-80 Repair Specification – DC-80 Response to TAB Compliance Check			

Ballot Item #	Page #	Line #	Comment: G / T / E*	*G = General T = Technical E = Editorial **Comments and Proposed Solutions**	Proposed Comment Resolution
1				In the Proposed Response ballot item 1 shows that the DC80 voting was Y/N/A as 9/3/0. I didn't see anywhere the Negatives and resolutions.	Response to TAB was letter-re-balloted in Ballot DC-80-1601 subsequent to Long Beach meeting. No negatives were identified during the vote. Therefore this item is resolved and accepted by Committee.
9				In section 1.2 References - B.5. : The #9 comment from TAB indicates inserting "ACI 423.4R-14 Report on Corrosion and Repair of Unbonded Single-Strand Tendons" but the document now indicates ACI 432.4R. I am not that familiar with ACI documents but which number is correct? It could easily be a typo error in either document.	The title is correct in the responses to TAB comments. When the revised text was added to the guide spec, the "3" and "2" were inadvertently transposed. This has been corrected in the guide spec.
77				Resolution of bullet item 77 recognizes that restoration of sheathing is not required if hardware is contained in a watertight enclosure before stressing. The new document does not reflect the resolution as well as does not fully address initial comment. New document: • Page 9/10 section 3.4 item G states that openings must stay open during stressing "leave boxouts". This is not always the case as for safety reasons, the couplers can be stressed after concreting as long as the coupler is encased in a watertight enclosure and can move within that enclosure • Page 9/10 section 3.4 item L talks only about heat shrinks (no mention of watertight enclosure), as well as heat shrinks placed after stressing (nothing for before stressing if coupler is embedded in concrete). • Page 6 section 2.3 item F: only heat shrinks are mentioned. Need to mention other alternatives Proposed resolution: add text to reflect the above.	Text has been added/revised at the three sections identified and one additional section as follows: • At Section 3.4, Item G: Change "must" to "should" in 4th line, and add ", or to contain couplers in a watertight enclosure filled with PT coating that is encased in concrete prior to stressing" after "… move during stressing" in 6th line. • At Section 3.4, Item L: At beginning of Item 3.4L.4, add "Install protection for couplers, and central stressing couplers to

Ballot Item #	Page #	Line #	Comment: G / T / E*	*G = General T = Technical E = Editorial **Comments and Proposed Solutions**	Proposed Comment Resolution
					provide watertight enclosure per Par. 3.5I. If heat-shrink tubing is used, shrink ~~heat-shrink~~ tubing into position to encapsulate …" • At Section 2.3, Item F.1: After "If coupler is not already fully encapsulated, install" add "protection for couplers and central stressing couplers to provide watertight enclosure, such as" and add comma after "heat-shrink tubing" • Also, revise the beginning of Section 3.5 Item I.1 as follows: "Unless supplied with encapsulation, protect all new couplers and center stressing couplers in a watertight enclosure. If heat-shrink tubing is used to provide watertight enclosure, place heat-shrink tubing over …"

Attachment 1.1

PTI DC-80 Repair and Rehabilitation Committee

An outline of a workshop based on the repair guide to introduce the evaluation and repair of existing post-tensioned (PT) concrete structures. PT systems discussed include both unbonded single-strand tendons and button wire systems.

To help the committee to determine length and to segment it into smaller pieces that can be achieved.

Referenced document: PTI DC80.3-12/ICRI 320.6 Guide for Evaluation and Repair of Unbonded Post-Tensioned Concrete Structure.

Discussion Topics:

Session 1: Evaluation and Report

Session 2: Repair and Strengthening

Session 1: Evaluation and Report

1. 1 – Introduction

Brief introduction to prestressed concrete, various methods of prestressing, distinguish between Reinforced and prestressed concrete. Distinguish between pre-tensioning and post-tensioning. Scope and Topics covered within this presentation. Various types of post-tensioning systems – historical perspective.

1. 2 – Evaluation process

i. *General* – Review of the structure's history.
ii. *Evaluation scope* – establish its purpose and scope to avoid a complete, exhaustive inspection of the entire structure. Emphasis on performing a visual and nondestructive examination of representative typical conditions and specific conditions identified as critical. Explain limitations and risk associated with the evaluation to educate the owner for better understanding and acceptance to limit the liability.
iii. *Document review* – Structural drawings and specifications - Architectural drawings - information on waterproofing and accessibility - Post-tensioning shop drawings - Stressing records - As-built drawings - Investigation reports and plans and specifications for previous repairs - Loading and use history - Construction documentation - Operational and maintenance review - water leaks or crack locations
iv. *Service condition* – Environment - moisture, aggressive chemicals, or excessive loading can contribute to corrosion associated with concrete cracking and deterioration. Understand and address environmental influences causing the deterioration, and the effects minimized. - Exterior climate - exposure to moisture - Interior climate - High humidity or moisture combined with concrete carbonation - chlorides and moisture exposure - deicing salts, coastal regions where airborne chlorides - water infiltration - chloride ions causing corrosion - delaminate and spall,

leading to exposure of the post-tensioning system to moisture and chlorides and, subsequently, corrosion of prestressing steel. Moisture infiltration – Condensation - Historical exposures - Industrial or use-specific environments - Aggressive chemicals, high humidity, and high carbon dioxide levels - Original construction deficiency - noncompliance of the project specifications and recommended standards.

1. 3 – Field investigation/nondestructive evaluation -

visible concrete deterioration, repairs, and exposed structural elements. Sequence of construction - tendon profile; construction joints; intermediate stressing locations; and end anchorages, particularly at the stressing end.

i. *Scope of investigation and frequency of testing* - areas to be evaluated - sample size - estimated total number of tendons, likelihood of corroded strands, percentage of the building exposed to a corrosive environment, and amount of reserve capacity in the structure. Higher-risk exposure conditions, additional sampling if corrosion identified, and the structure classified as high-risk. Report on Limitations of the investigation

ii. *Visual examination* –

a. document widespread or severe cracking as it may indicate a serious problem within the structure. Crack length and width data, leakage and corrosion. Loss of prestressing force, load-carrying capacity, water infiltration.
b. Visible deflections shows structural problem, also indicate construction problems, materials problems, overloading, or other issues that should be identified and investigated.
c. Tendon eruption at slab/beam edge or at low or high points or at a location of minimal cover indicating entire tendon force is lost.
d. Anchorage zones – observe any sign of damages at the stressing ends having less protective concrete cover and are more susceptible to water penetration. Check concrete near the anchorages for indications of distress.
e. Check anchorage pocket grout material for cracking, shrinkage, spalling, and disintegration, which may lead to water and contaminant intrusion.
f. Efflorescence around anchor pocket grout may be an indication that moisture has penetrated into the tendon and is leaching out of the anchor pocket. Delamination and spalling - carefully map and evaluate quantity, frequency, and location of spalls and delamination. Delamination around anchorages indicate a reduction in the structural integrity.
g. Exposed tendon sheathing is an indication of possible damage to the sheathing and potential for prestressing steel corrosion.
h. Review construction and expansion joints for the presence of efflorescence, leakage, rust staining, delamination, and spalling. Tendons are particularly susceptible to corrosion damage due to Efflorescence and leakage.
i. Observe Rust stains, as they are one of the most direct indicators of ongoing and advanced deterioration of metal within the concrete member.
j. Presence of PT coating stains is typically indicative of a breach in extruded sheathing.

k. Concrete penetrations and modifications - check for evidence of previous coring, drilling, and cutting; the existence of post-installed fasteners; or other concrete removal activities.
l. Previous repair - Previous repairs should be reviewed and incorporated into new repairs with caution and only after careful examination.
m. Overlays – can impose additional dead loads potentially overloading the structure.
n. Freezing-and-thawing damage – due to lack of air entrainment or an inadequate air-void system.
o. Curing compounds, coatings, and waterproofing - document the condition of any membrane or coating system, as damaged waterproofing may provide a pathway for moisture and chloride ingress to the post-tensioning system.

iii. *Instrument testing:* Develop testing program to complement the results of the visual examination.

a. Acoustic testing/hammer sounding - chain-drag and hammer sounding to determine the extent of concrete delamination.
b. Impact echo - to detect cracks, voids, honeycombing, and debonding in concrete structures as well as locate delamination caused by the corrosion of steel.
c. Impulse response - to locate delamination caused by steel reinforcement corrosion, debonding, poor concrete consolidation, and honeycombing in concrete structures.
d. Cover meter - to electromagnetically locate and determine the concrete cover over nonprestressed and prestressed reinforcement with reasonable accuracy.
e. Ground-penetrating radar/impulse radar - to locate tendons and reinforcing bars in slabs, joists, beams, and walls and to pick up voids and poorly consolidated regions.
f. Radiography/X-ray - to precisely locate tendons in a structural member - may detect breaks or fractures in individual wires – limitations - Access on two sides of the structure is generally required. The radioactive source used to expose the film poses a significant health hazard - local evacuation of the structure by persons not involved in the testing. relatively expensive.
g. Rebound hammer/Windsor probe/pulse velocity/pullout – to estimate relative compressive strength of the concrete.
h. Corrosion potential testing - identify active areas of nonprestressed reinforcement corrosion.
i. Acoustic monitoring - continuous monitoring of post-tensioned structures. Accelerometer, a piezoelectric device, detects the acoustic energy released when a tensioned wire or strand fails. not a repair. does not determine the preexisting condition of a structure,
j. Strand-break detection - to determine the locations of strand breaks through magnetic charge

1. 4 – Field investigation and exploratory evaluation:

tendons can corrode or fail without showing any external evidence, thus requiring physically inspect the post -tensioning hardware by a professional with post-tensioned structure evaluation experience. Formulate detailed plan of action on types and locations of removals required,

establish safety precautions, and outline the required equipment and procedures to perform the work including exploratory field investigation tools and techniques.

i. *Anchorage inspection* – at the stressing end or intermediate anchorage locations. Observe general condition of the grout plug and the grout material in the stressing pocket, bond of the grout to the concrete, and condition of the concrete in the area of the construction joint anchorage. As necessary, perform a lift-off test developed by the repair contractor and reviewed by the licensed design professional to determine the force in a tendon. A sudden post-tensioned strand release is possible. This strand can be removed for evaluation and for determination of the break location.

ii. *Strand tendon testing*:
   a. Screwdriver penetration test – with a flat blade end of a screwdriver. If the strand is partially or completely detensioned, it may be possible to separate them. highly subjective, erroneous conclusions, potential for damage, influenced by friction between the wires, and center wire cannot usually be tested –
   b. In-place strand tension test - exposing a length of strand by concrete removal - attach test frame to the strand a lateral force is hydraulically applied in increments. The tensile force in the strand is estimated based on the deflections measured –
   c. High- and low-point inspection - high point - most vulnerable to moisture, chlorides, surface spalling, and exposure to saw cutting and jackhammering performed during surface repairs. Low points - the first low point could collect significant moisture. Remove the sheathing to observe the condition of the PT coating, prestressing steel, sheathing, and possible presence of moisture. Location-excavate the concrete-inspect the condition of the sheathing-condition of the prestressing steel-inspect for corrosion or pitting-repair sheathing and replace the PT coating at inspection location-
   d. Borescope, fiber scope, and video scope - to check for the presence of corrosion, wire failures, and moisture - observe the condition of grout pockets and anchorages along slab and beam edges covered by exterior finishes.
   e. Corrosion evaluation - identifies wet and dry tendons - moisture content of the air inside the plastic tendon sheath.
   f. Strand extraction - To evaluate the mechanical and chemical properties of the prestressing steel – evaluate reduction of load-carrying capacity before extraction.
   g. PT coating inspection and testing - visual inspection of the PT coating. Clean and free of debris, rust, and liquid - emulsified or milky-colored, if contaminants present consider laboratory testing.

iii. *Concrete/structural member evaluation*:
   a. Core – obtain samples with extreme care – for strength analysis
   b. Load test – perform full-scale load test to determine the load capacity - does not provide information relative to the condition of specific tendons.

1. 5 – Laboratory testing and analysis

i. Laboratory concrete testing
   a. Compressive strength with core samples

b. Petrographic examination - a microscopic examination of concrete that determines the characteristics and composition of the concrete and evaluates its type, condition, strength, and serviceability. Provides information on
    i. Freezing-and-thawing resistance;
    ii. Sulfate attack;
    iii. Alkali-aggregate reactivity;
    iv. Aggregate-cement paste durability;
    v. Carbonation;
    vi. Cracking/delamination;
    vii. Chemical attack; and
    viii. Concrete permeability.
c. Chloride content: the presence of chloride ions dramatically affects rate of deterioration of concrete structures.
d. Carbonation - causes a reduction in the pH of the concrete making the concrete more conducive to corrosion

ii. Laboratory prestressing steel testing

a. Visual inspection: observe the surface condition and classify - five relative corrosion conditions.
    i. None
    ii. Surface
    iii. Mild pitting
    iv. Intermediate pitting
    v. Severe pitting
b. Tensile testing: assess residual strength of corrosion-damaged strands,
c. Chemical analysis and metallurgical testing: to verify sensitivity to embrittlement failures.
d. Metallography: examine and document fracture characteristics and micro-structural features of the prestressing steel.
e. Hydrogen embrittlement testing: to verify for poor-quality, severely strain-aged prestressing steel wire
f. SEM/EDS analysis: microscopic evaluation of prestressing steel wire material, to analyze the presence of contaminants, such as chlorides that promote corrosion, or sulfides that can cause embrittlement.
g. Protective PT coating testing: perform tests for contamination by water-soluble ions, water-absorption potential, and the melting point.

1. 6 – Structural analysis –

performed to determine the effect that existing conditions have on structural integrity and load capacity and whether a deteriorated structure requires repairs. Analysis results that indicate structural overstress conditions and reduced load-carrying capacity should be clearly noted in the final report.

1. 7 – Evaluation report –

summarize the results of the entire investigation - indicate the scope and limitations of the investigation and include recommendations for further evaluation and testing if required. The results of the structural analysis should also be included. Include current and future strength and serviceability concerns. Recommendations on potential repair procedures, costs, and the effects of the repair procedures and construction operations on the structure and its occupants.

END OF SESSION 1

Attachment 1.1

Session 2: Repair

2. 1 – Introduction and preparation

i. Project repair team
ii. Design considerations
iii. Repair contract types
iv. Scope of work
    a. Post-tensioning system
    b. Submittals
    c. Qualifications
    d. Quality control
    e. Quality assurance

2.2 – Plans and specifications

i. General notes
ii. Plans
iii. Products
iv. Submittals and installation drawings
v. Pre-bid meeting
vi. Construction meetings
vii. Execution

2.3 – Safety

i. Concrete
ii. Post-tensioning system
iii. Shoring

2.4 – Concrete removal

2.5 – Repair of tendons

i. Tendon detensioning
    a. General considerations
    b. Tendon saw cutting
    c. Tendon flame cutting
    d. Detensioning at anchorage with flame cutting
    e. Detensioning at anchorage with lift-off
    f. Detensioning using remote control demolition
ii. Tendon splicing
    a. Single-strand tendon
        1. splice chuck coupler
        2. torque- stressing splice coupler
        3. Center-stressing splice coupler
    b. Button-head wire system
        1. Threaded rod

2. Button-head wire splice
3. Center stressing (Y-splice)

c. Combination of Button Head and Single-strand system

iii. Tendon anchorage repair
a. Monostrand system
1. End anchorage
2. Intermediate anchorage
b. Button-head wire system

iv. Strand and tendon replacement

v. Tensioning
a. Stressing procedures and equipment
b. Design and repair forces
c. Other considerations

vi. Post-tensioning system durability
1. Single-strand tendon protective systems
a. Anchorage
b. Splice
c. Sheathing repair
2. Button-head wire protective systems
a. Anchorage
b. Splice

vii. Prestressing steel and anchorage protection
1. Direct application methods
a. Galvanizing
b. Epoxy coating
c. Heat-shrink sleeves and wraps
2. Other protective systems
a. Cathodic protection
b. Chemical injection
c. Drying and recoating

viii. Concrete placement
1. Repair area preparation
2. Concrete placement
3. Stressing pockets

ix. Concrete protection
1. Joints and cracks
2. Bond line between new repair materials and substrate
3. Expansion joints
4. Concrete surface

x. Maintenance and Monitoring

2.6 – Strengthening with post-tensioning
1. EPT applied to one-way slabs
2. EPT applied to beams and girders

3. EPT applied to two-way slabs
4. Fireproofing of EPT systems

2.7 – Record documents and closeout