



DISPELLING THE MYTH ABOUT UNBONDED PT BUILDINGS

Christopher Fulton, B.Sc.(Eng.)

Lindsey Tourand, P.Eng.

Parsons Brinkerhoff Halsall Inc.



POST-TENSIONING INSTITUTE®
Stressing the Stronger Concrete Solution



Reference: Seinfeld, Keith 2011, *Demolition of a Nearly-New Seattle Tower*, photograph, viewed 28 April 2014
<<http://www.kplu.org/post/demolition-nearly-new-seattle-tower>>

Deterioration of Unbonded PT

Moisture during construction

Moisture during service

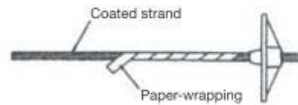
Mechanical damage



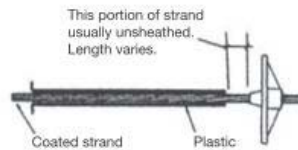
POST-TENSIONING INSTITUTE®
Stressing the Stronger Concrete Solution

The Evolution of Unbonded PT

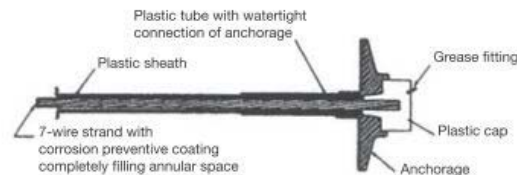
Paper-wrapped
1955 – 1975+



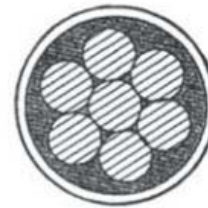
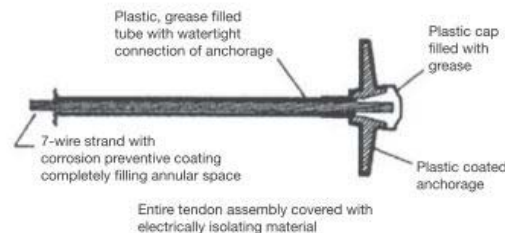
Plastic Sheath
1960 – Present



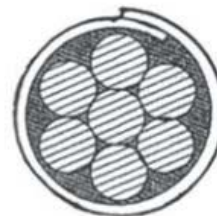
1985 PTI Recommended System



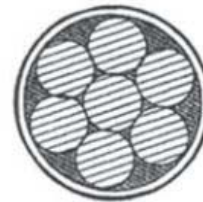
Electrically Isolated Tendon



Push-Through Preformed Tube
Strand pushed through as grease is applied.



Heat-Sealed
Formed from flat strip as grease is applied.



Extruded
Formed by extruding over strand as grease is applied.

Reference: Schupack, M., "Corrosion Protection for Unbonded Tendons," *Concrete International*, February 1991

The Study

Goal of the study was to answer:

What is Tendon Failure Rate?

What is the Cause of Failure?

The Study

Data Collected:

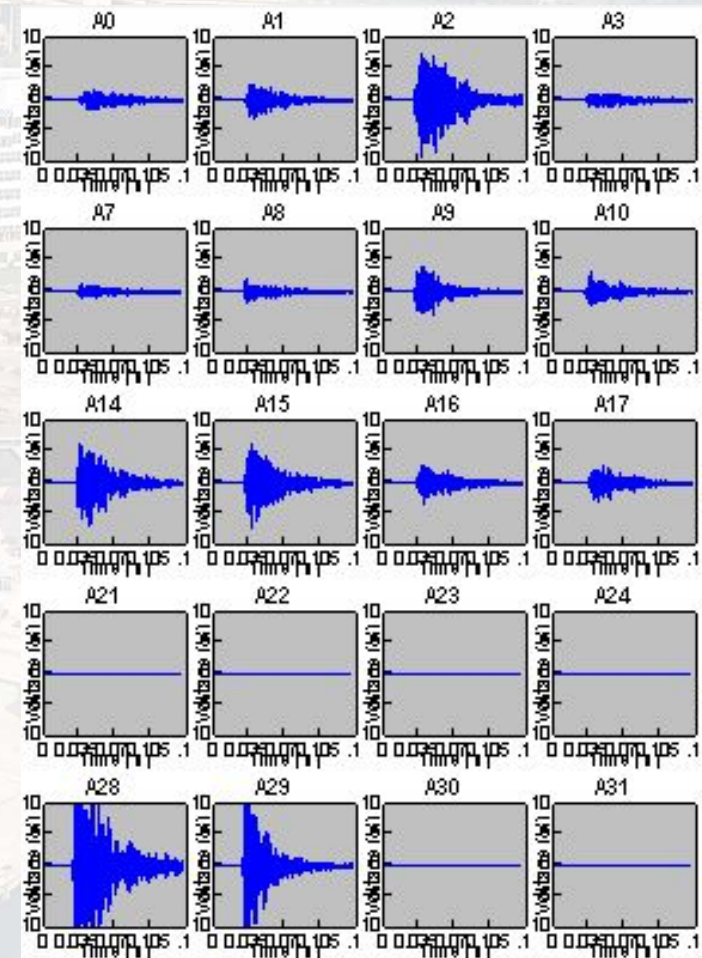
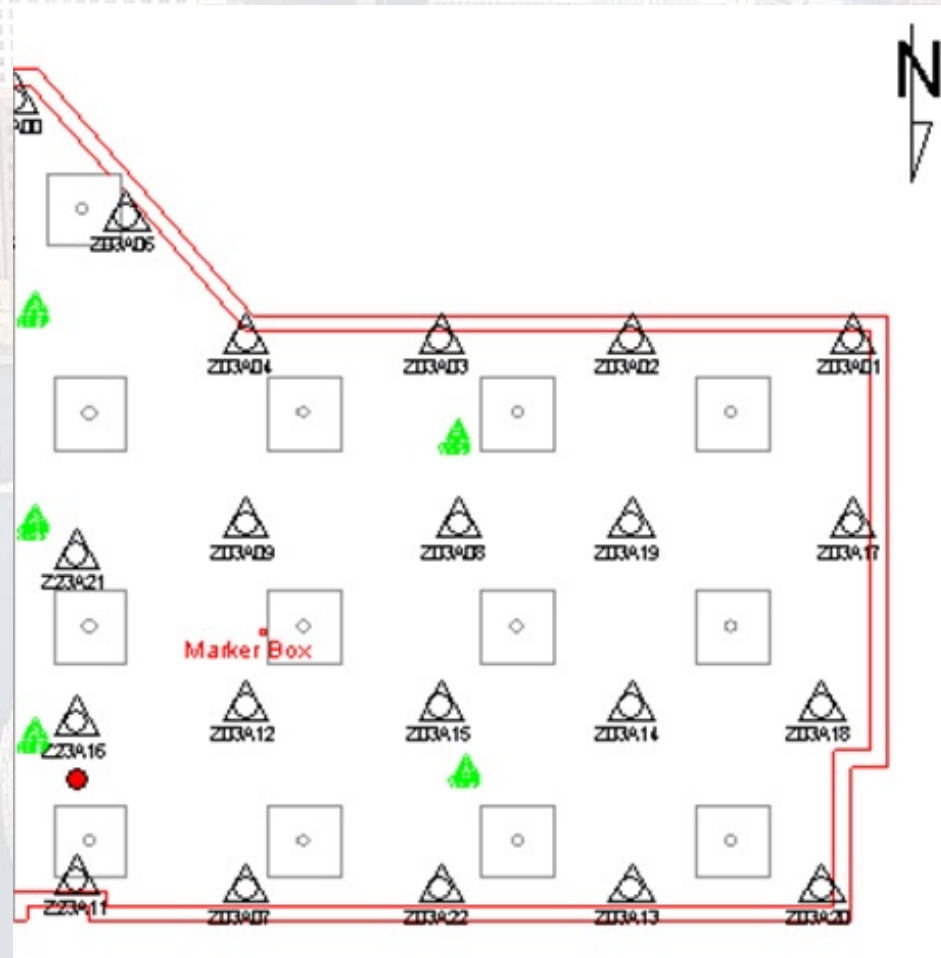
Acoustic Monitoring Records for 26 Structures

Visual Review of 246 Tendon Failures from 7 Structures

Background on Acoustic Monitoring



Background on Acoustic Monitoring

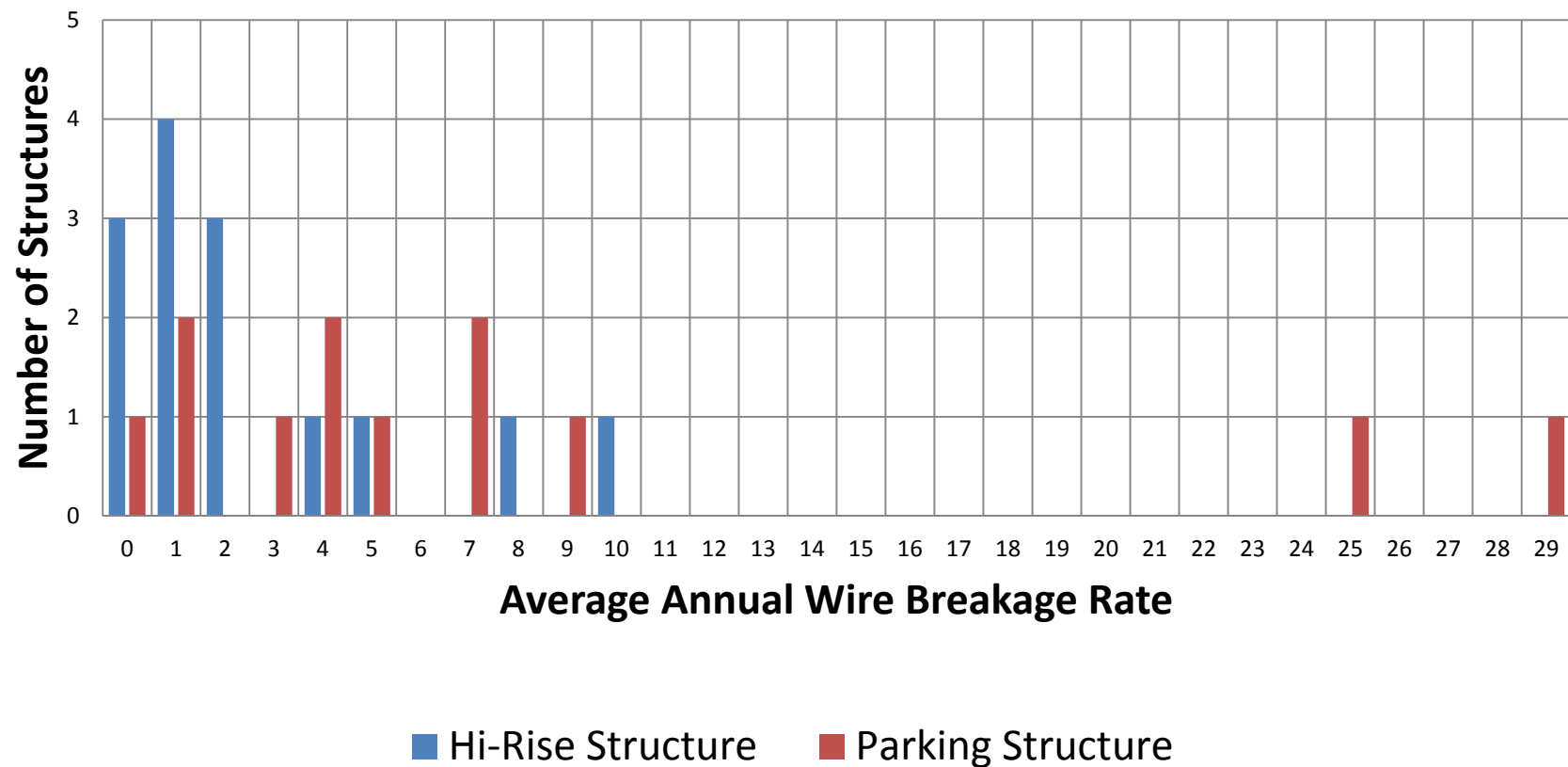


An aerial photograph of a city waterfront, likely Baltimore, Maryland. In the foreground, a large white ship is docked at a pier. Behind it, a modern building with a curved facade and columns is visible, with the word "NAUTICUS" on its side. The background features a dense urban skyline with various skyscrapers and buildings. The water is calm, and the sky is clear.

Study Part 1 – Review of Acoustic Monitoring Records

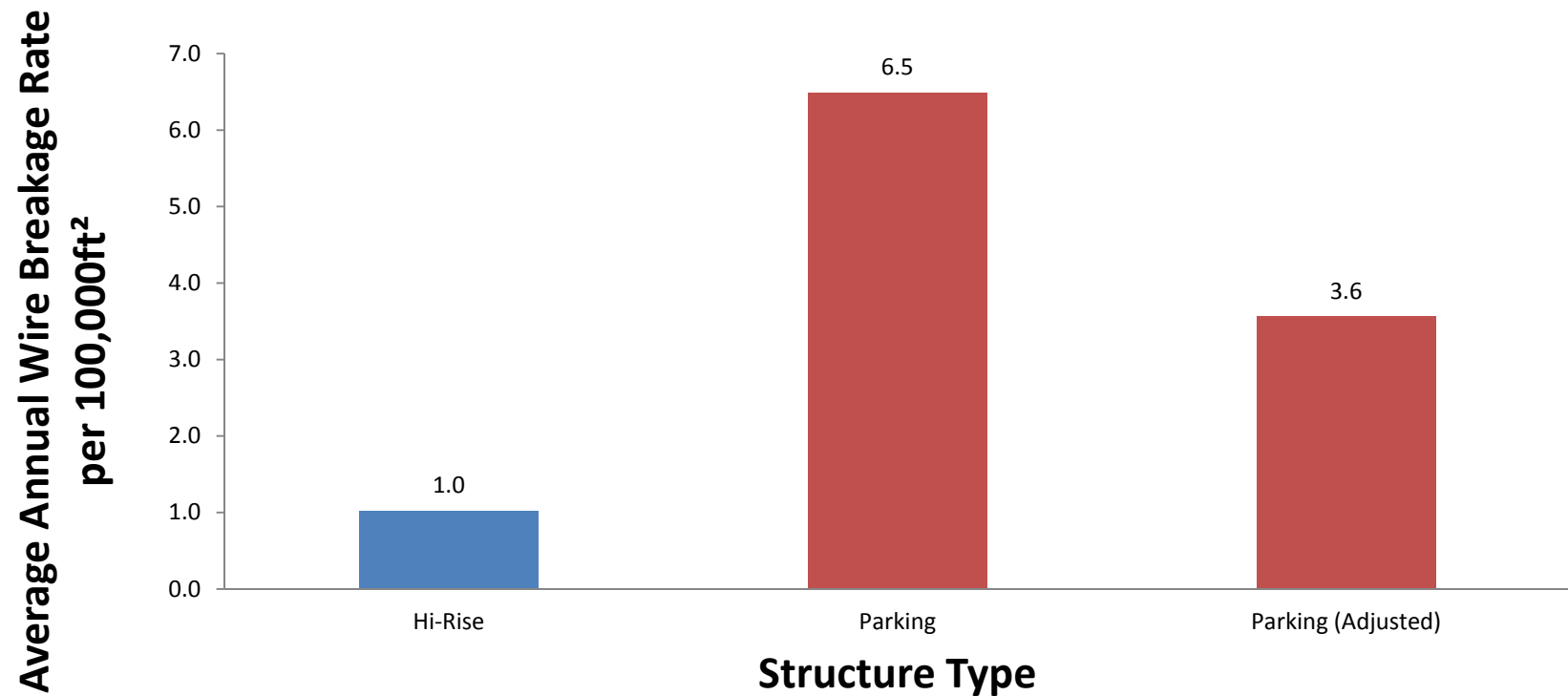
Breakage Rates

Average Annual Wire Breakage Rate by Structure Type



Breakage Rates

Average Annual Wire Breakage Rate per 100,000ft² by Structure Type





Study Part 2 – Review of Tendon Failure Causes

Causes of Tendon Failure

Corrosion from Moisture



Causes of Tendon Failure

Mechanical Damage



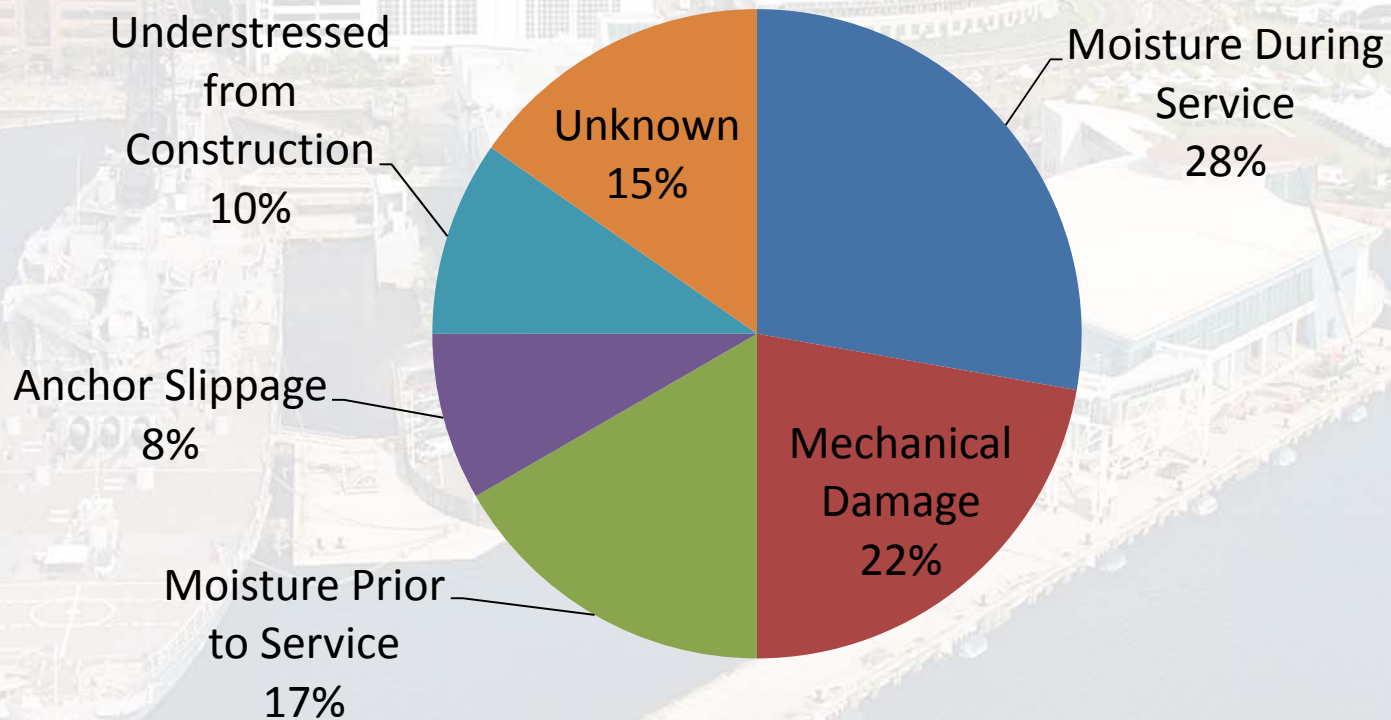
Causes of Tendon Failure

Anchor Slippage



Causes of Tendon Failure

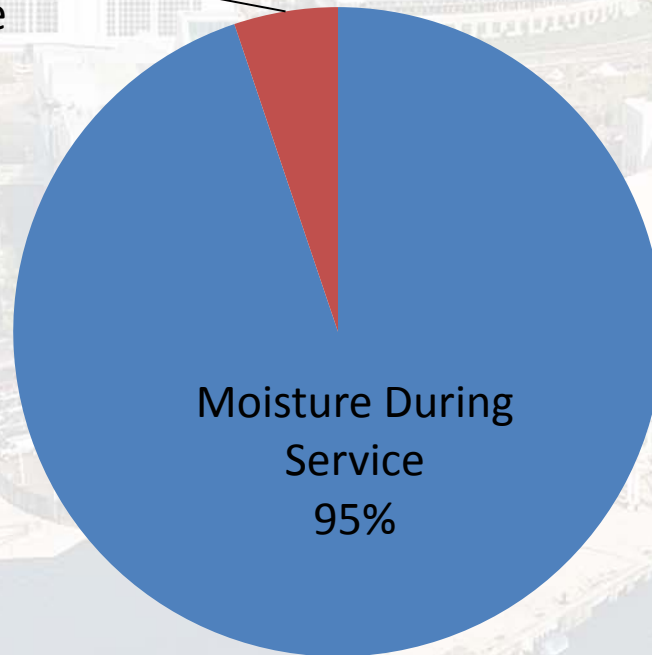
Causes of Post-Tensioned Tendon Failures in Interior Spaces (72 Tendon Sample Size)



Causes of Tendon Failure

Causes of Post-Tensioned Tendon Failure in Exterior Slabs (174 Tendon Sample Size)

Moisture Prior
to Service
5%



Moisture During
Service
95%

What Does It All Mean?

Large percentage of PT tendon failures are the result of moisture entry or mechanical damage during service. These failures can be mitigated through regular preventative maintenance

The stigma that unbonded PT structures are unpredictable and costly to maintain may not be deserved

Special Thanks

Study Co-Authored by Stephan Trepanier,
Partner at Edison Engineering

Acoustic Monitoring data provided by Pure
Technologies Limited

DISPELLING THE MYTH ABOUT UNBONDED PT BUILDINGS

Questions?

Christopher Fulton, B.Sc.(Eng.)

Lindsey Tourand, P.Eng.

Parsons Brinkerhoff Halsall Inc.



POST-TENSIONING INSTITUTE®
Stressing the Stronger Concrete Solution