2016 PTI Convention
Long Beach, California

Technical Session 5
PT Buildings II
Post-Tensioning Codes Vs Practices – a need for trained engineering professionals

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www.ThorntonTomasetti.com
Presentation Goals:

• Reasons For **Delegation** of Post-tensioned Concrete.

• An Over View is Presented of the Building **Codes** Including ACI, South Florida Building Code on Requirements on Delegation of Design.

• **Benefits** of Having a Well-Trained Engineers from the Universities.

• Suggestions on **PTI Initiatives** to Increase the Number of Trained **PT Design** Professionals.
Our Practices

- Sustainability
- Façade Engineering
- Weidlinger Protective Design
- Weidlinger Transportation
- Forensics
- Weidlinger Applied Science
- Renewal
- Property Loss Consulting
- Construction Engineering
- Structural Engineering
Our Locations

5 Continents
1200 Engineers, Architects and Professionals
38 Offices
54 Countries

Reach

Boston, Massachusetts
Chicago, Illinois
Washington, D.C.
San Diego, California
San Francisco, California
Portland, Maine
Philadelphia, Pennsylvania
Newark, New Jersey
New York, Madison Ave
New York, Wall Street
Newark, New Jersey
Philadelphia, Pennsylvania
Portland, Maine
San Diego, California
San Francisco, California
Seattle, Washington
São Paulo, Brazil
Toronto, CA
Washington, D.C.
West Hartford, Connecticut

Ft. Lauderdale, Florida
Irvine, California
Kansas City, Missouri
Los Angeles, California
Marina del Rey, California
Miami, Florida
Cupertino, California
New York, Austin, Texas
Austin, Texas
Denver, Colorado
Beijing, China
Christchurch, New Zealand
Ho Chi Minh City, Vietnam
Mumbai, India
Moscow, Russia
Hong Kong, China
Shanghai, China
UAE
London, UK (Head Office)
London, UK (PLC City Office)
Moscow, Russia
Beijing, China
Hong Kong, China
Shanghai, China
UAE
London, UK (PLC City Office)
Bristol, UK
Edinburgh, UK
Glasgow, UK
London, UK (Head Office)
London, UK (PLC City Office)
Moscow, Russia
Beijing, China
Hong Kong, China
Shanghai, China
UAE
Ho Chi Minh City, Vietnam
Christchurch, New Zealand

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Thornton Tomasetti
Sivakumar Munuswamy Ph.D.,
Senior Project Engineer at Thornton Tomasetti

Dr. Munuswamy Earned his Ph.D., from Florida Atlantic University. He has 34 Years of Experience in Structural Engineering Including More Than 12 Years of Prestressed Concrete Structures and Currently Work with Thornton Tomasetti, Fort Lauderdale, FL.

His Areas of Expertise include Prestressed Concrete, Post-tensioned Floor Systems, Punching Shear Behavior of Flat Plates, Inspection and Evaluation of Existing Reinforced Concrete Structures, Steel Structural Systems, Creep and Shrinkage Behavior of Concrete Structures, Material Testing, and Computer Applications.

As an Adjunct Faculty at Florida Atlantic University, He Teaches Concrete and Steel Design Courses, and Structures for Architects.
Typically in a Design-Bid-Build Projects, The **Structural Engineer of Record (SEOR)** Designs all Aspects of Project.

Construction Cost, Competitive Design Fees, Hectic Design and Construction Schedules may Pressure SEOR, to **Delegate Design Responsibilities** of Even **Primary Structural Components**, such as **Floor Systems**.
What are “Primary Structural Components”? 

Council of American Structural Engineers (CASE) National Guidelines Define the Primary Structural System as: “The Completed Combination of Elements Which Serve to Support the Building’s Self Weight, the Applicable Live Load Which is Based Upon the Occupancy and Use of the Spaces, the Environmental Loads Such as Wind, Seismic, and Thermal”.

Lately, Post-tensioning Floor Systems, a Widely Recognized Structural System for its Efficiency and Durability, a Primary Structural System is Delegated to the Specialty Structural Engineers (SSE) To Perform Design.
**Why?**

- Deficient U.S. Educational System* Leading to Lack of Trained Engineers
- Cost and Time effectiveness

* The State of Post-Tensioned Concrete Education
Are universities in the United States missing opportunities to advance this important technology? by Kenneth B. Bondy, October 2014 Concrete international
Some Structural Engineering Firms Believe That the Liability and Responsibility can be Divested, by Delegating Design Responsibilities, Contrary to Many Professional Engineering Board's Requirements.

“You can delegate authority, but you cannot delegate responsibility”
Surprisingly the Engineering Boards Align with the Market Trend and Industry Practices.


Post-Tensioning – Codes Vs Practices; a need for trained engineering professionals
Building Code Requirements for Structural Concrete (ACI 318-11)
An ACI Standard
and Commentary

1.2 — Contract documents

1.2.1 — Contract documents for all structural concrete construction shall bear the seal of a licensed design professional. These contract documents shall show:

(h) Magnitude and location of prestressing forces;

(l) Minimum concrete compressive strength at time of post-tensioning;

(m) Stressing sequence for post-tensioning tendons;
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An ACI Standard

Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

Reported by ACI Committee 318

1.7—Licensed design professional
   1.7.1 All references in this Code to the licensed design professional shall be understood to mean the person who is licensed and responsible for, and in charge of, the structural design or inspection.

1.8—Construction documents and design records
   1.8.1 The licensed design professional shall provide in the construction documents the information required in Chapter 26 and that required by the jurisdiction.
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26.10—Additional requirements for prestressed concrete

26.10.1 Design information:

(a) Magnitude and location of prestressing forces.
(b) Stressing sequence of tendons.
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1999 BROWARD COUNTY EDITION
Effective date: January 1, 1999

308 STATEMENTS OF THE STRUCTURAL RESPONSIBILITY OF ARCHITECTS AND PROFESSIONAL ENGINEERS

Structural Engineer of Record: The Florida Registered Professional Engineer who develops the structural design criteria and structural framing concept for the structure, performs the analysis and is responsible for the preparation of the Structural construction Documents. The Structural Engineer of Record is cautioned that the delegation of design does not necessarily relieve the Structural Engineer of Record of any responsibility in the design of the structure. These procedures are a reminder to Professional Engineers that, in affixing their seal to structural drawings of the structural entity they have accepted responsibility for the design of the structural entity.

2510.2 STATEMENT OF RESPONSIBILITIES OF ARCHITECTS AND PROFESSIONAL ENGINEERS ON THE DESIGN OF CAST-IN PLACE POST-TENSIONED CONCRETE STRUCTURAL SYSTEMS:

(a) The structural construction documents shall show the magnitude and location of all prestressing forces and all design assumptions.

(b) The Structural Engineer of Record and/or the Architect of Record shall require the submission of calculations and installation drawings from a Specialty Engineer for post-tensioning systems for review by the Structural Engineer of Record's and/or the Architect of Record's review as an indication that his or her intent has been understood and that specified criteria have been used. The installation drawings shall provide full details of materials to be used including necessary accessories and instructions for construction and shall identify the specific project and shall bear the impressed seal, signature and date of the Specialty Engineer who prepared them.
61G15-31.004 Design of Cast-in-Place Post-Tensioned Concrete Structural Systems.

[(2) If the engineer of record elects to delegate the responsibility for preparation of calculations and installation drawings to a delegated engineer for the post-tensioning system(s), the Engineer of Record shall require the submission of installation drawings for review by the engineer of record. Calculations shall also be submitted by the delegated engineer which show sufficient information to confirm that the number and size of tendons provided are adequate to provide the prestressing forces shown on the structural engineering documents. ]

Rulemaking Authority 471.033(2), 471.008 FS. Law Implemented 471.033(1)(g) FS. History—New 1-26-93, Formerly 21H-31.004, Amended 9-28-10. (FBPE)
I, ________________________________, the Engineer of Record for the project identified above, HEREBY CERTIFY that I have reviewed the shop drawings for the post-tension cables for said project, and that said drawings are in conformance with my design.

Conformance means that all applied post-tensioning loads, mild reinforcement and shear reinforcement are in accordance with my design drawings.
The Codes of Practices (Example: AISC and SJI) have Explicit Specifications on Delegation.
AISC Code of Standard Practice – 2010 # 3.1.2 - 2010

AISC Code of Standard Practice (COSP, AISC 303-10)
Delegate connection design to a licensed engineer working for fabricator.

Three options available:
1. Provide complete connection design
2. Connections be selected or completed by a steel detailer (using tables from AISC Manual?)
3. Delegated to a licensed professional engineer working for the fabricator.

Though this provision (3) is introduced in 2010, the practice existed since the 1960s.


Delegation is only for connections not the entire flooring system.
[T]he Steel Joist Institute (SJI) 2010 Code of Standard Practice for Steel Joists and Joist Girders (#2.3) requires that the SEOR shall “Calculate and Provide the Magnitude and Location of ALL JOIST and JOIST GIRDER LOADS”. The Term “ALL” Implies a Level of Completeness that Might not be Achievable by the SEOR.

What is Delegated?

Delegated Design By Case Guidelines Committee Structure Magazine Sep, 2013
Licensing Boards Amend the Duties and Responsibilities of the Structural Engineer of Records (SEOR) to Reflect the Industry Practices, Latest Being the FBPE.
61G15-31.004 Design of Cast-in-Place Post-Tensioned Concrete Structural Systems.

(1) Structural engineering documents shall show the complete structural configuration and loading requirements of the post-tensioned system including: member sizes, type of post-tensioning system, location of all prestressing tendons (in plans and elevation), magnitude of all prestressing forces, and all design assumptions.

(2) If the engineer of record (EOR) elects to delegate the responsibility for preparation of calculations. Calculations shall also be submitted by the delegated engineer which show sufficient information to document that the number and size of tendons provided are adequate to carry all loads shown on the structural engineering documents.

(3) It is the responsibility of the EOR for the structure to review the post-tensioning system installation drawings.

(4) The effect of post-tensioning on other parts of the structure is the responsibility of the EOR.

Rulemaking Authority 471.033(2), 471.008 FS. Law Implemented 471.033(1)(g), (j) FS. History-New 1-26-93, Formerly 21H-31.004, Amended 9-28-10, 2-28-16.
(61G15-31.004 - 2) If The Engineer Of Record (EOR) Elects To Delegate The Responsibility;

Calculations Shall also be Submitted by the Delegated Engineer which Show Sufficient Information to Document that the Number and Size of Tendons Provided are Adequate to Carry All Loads Shown on the Structural Engineering Documents.

FBPE; amended 9-28-10, 2-28-16.
What Should We Do?

As an Institution, PTI Should

- Increase its Participation in Education Through Funding Professorships, Research, and Doing More Design Seminars for Practicing Engineers.
- Sponsor “Professor’s Seminar*,” Similar to PCA Seminars.

* The State of Post-Tensioned Concrete Education
Are universities in the United States missing opportunities to advance this important technology?
by Kenneth B. Bondy, October 2014 Concrete international
As an Institution, **PTI Needs to Take an Initiative to Convince the Universities Through ABET of the Urgency to Include Prestressed Concrete Design as A Fundamental Design Topic as Part of the Undergraduate Structural Engineering Curriculum.**
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- Well Trained Engineers Provide Best Possible Solutions, More Efficient and Optimized PT Design for Successful Project Development and Outcome.

- Both the Structural Engineering Firms and Vendors Benefit from Well-Trained Engineers from the Universities With an Added Advantage of Expertise in the Competitive Market Place.
THANK YOU!

DISCUSSIONS!

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