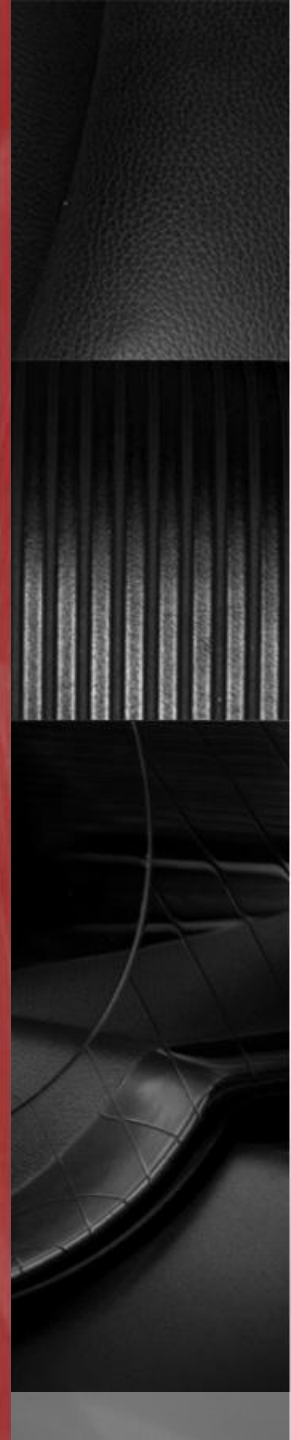
Introduction to Special Inspections on VA Tech Properties.

Presented by
the VA Tech Office of the University Building Official.



Before we begin....

- This presentation should run about 60-80 minutes
- Time for questions will be provided during the last 15 minutes
- Please turn off all cells/pagers/etc.
- We will have a short review questionnaire at the end of this presentation

Change is the Key to the Future

Past Practice at VT is not the model for the future.

Observations of the Past

- Effectively, no building code inspections (No Building Code Official on Campus)
- Code related inspections generally limited to State Fire Marshall
- Construction Inspection, Special Inspection, Misc. Inspections generally comingled and not well utilized
- Many reports appear to be “received and filed” with little VT oversight or review of results
- Minimal or ineffective outdated special inspection program
- Minimum construction “inspection”, not to be confused with “observation”
- Work is often Contract/Contractor Driven (vs. quality or compliance driven)

Basic Definitions

- Building Code Inspections
- Construction Inspections
- Special Inspections
- Third party independent inspections
- Fire Code Inspections

Construction Inspections

- Normally related to the requirements of contract payments, milestones, contractor coordination, Owners due diligence or better business practice by the project team

  Examples:

  Roof Coring

  Roof Thermograph

  California Bearing Ratio Test

Building Code Inspections

- Specified in VUSBC
- Can be done, and in large projects normally done, as a series of partials that comprise the total as elements are ready
- Trades (Mechanical, Electrical and Plumbing) break into separate rough in and finals

Special Inspection

- Been in building codes since the late 70's/early 80's
- Currently governed by VUSBC/IBC Section 1704
- Focused on structural elements because of past building failures due to "value engineering" efforts
- A birth-build process for structural elements (and other issues added more recently)
  - Fabrication Plant Certification
  - Documents (Design drawings, shop drawings, mix designs, etc.)
  - Material Certification
  - Fabrication Certifications
  - Proper Material Received
  - Welder and Contractor Certifications
  - Materials installed correctly
- New Program for 2009 (per approved construction drawings) VUSBC Code Cycle
- BCOM Program is poorly defined and outdated based on practices in the rest of Virginia
- Past Practice at VT misses a lot of issues and adds unnecessary items as "SI"

Third Party/Independent Inspection

- Used to fill gaps due to schedule
- Used to address special or unique cases or design elements
- Need prior discussion/written approval by University Building Official if it is to be applied to code issue or inspection.
- Any inspection done for the due diligence contract administration, etc. can be done without the UBO authorization.

Fire Code Inspections

- Separate State Organization and Line of Authority
- Managed by Deputy State Fire Marshall
- Done independent of UBO in some cases
- Done in cooperation with UBO in some cases limited
- Some limited crossover in Building and Fire Code Inspections
- Building code more applicable in construction phase
- Fire code more applicable after CO is issued

Inspection versus Observation

- Inspection denotes:
  - Measurements
  - Verification
  - Numbers
  - Details
- Observation denotes:
  - No measurements
  - General overview
  - Cursory
  - Lack of detail

Putting Aside the Building Code, Construction, Independent and Fire Inspection, what are the details regarding Special Inspections?

First …..a short review of the background of Special Inspections… the history informs us to both how and why we do them and how they should be done.

First a short review of the background

Special Inspections “Poster Child Event”
The Kansas City Hyatt Regency Hotel

- Kansas City, Missouri
- June, 1981
- 114 people killed
- 200 injured

Hyatt Regency Hotel

Kansas City, Missouri

- Design Began 1976
- Construction Completed in 1980
- 750 Guest Rooms
- 45 Floors
- 3 Parts:

  Tower with Guest Rooms and Restaurant

  Function Block (conference rooms, etc.)

  Connecting Atrium, 4 stories, 3 hanging walkways connecting tower and function rooms

Hyatt Regency Hotel

Owner:	Crown Center Redevelopment
Owner Testing Agent:	H & R Inspection and General Testing
Prime Design Firm:	PBNDML Architects
Project Engineer:	GCE International
Structural Engineer:	GCE International
Senior Project Designer:	GCE International
General Contractor:	Eldridge Company
Fabrication and Erection of Walkways:	Havens Steel Co.

Hyatt Regency Hotel

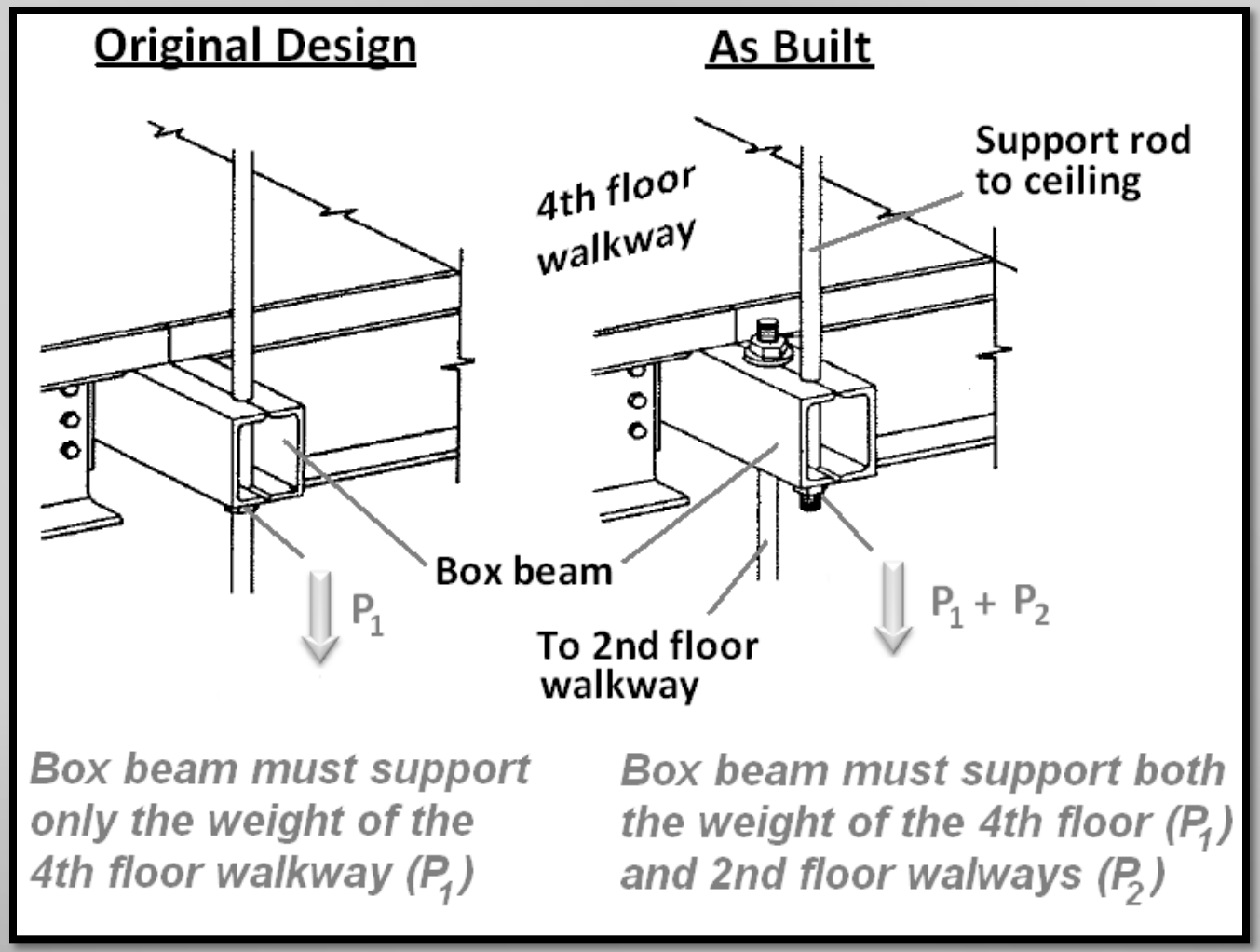
(information taken from a) Engineering Ethics, Lessons Learned: Kansas City Hyatt Walkway Collapse and b) NASA Publication, Systems Failure case studies, May 2008, "Two Rods Don't Make it Right")

Two of the lobby atrium catwalks designed by G.C.E. were to be suspended one under the other by six (6) continuous 1 ¼" round rods anchored in the ceiling with nuts at each elevation locked in place to hold the decking in place. In the aftermath review it was noted that in the construction drawings prepared by the structural engineer of record, G.C.E., that "G.C.E. …… structural drawings …… contained only some of the atrium steel specifications. …… omitted …… the connection between the atrium walkways and the support rods. It was not uncommon to omit some connection details, such as the walkway connectors that G.C.E. expected to be completed by Havens ……"

Hyatt Regency Hotel

By using continuous rods, Havens would have had to thread the entirety of the steel rods below the 4th floor in order to screw on the nuts to hold the 2nd floor walkway in place. To simplify the process, Havens altered the design to a two rod system, where the rods from the 2nd floor would attach separately to the 4th floor beams, and the 4th floor rods would attach to the same beams and connect to the roof. This change was intended to make fabrication and connection of the steel rods easier and faster. However, this essentially doubled the load on the 4th floor walkway beams, as these beams now supported the 2nd floor walkway as well.

Hyatt Regency Hotel



Hyatt Regency Hotel

Havens prepared 42 structural shop drawings to return to G.C.E. for final approval. Included in these drawings were changes to the atrium design, as well as that part of the walkway. The new shop drawings for the two rod system were submitted to the structural engineers, G.C.E., for final approval. In February of 1979, the plans were approved and signed by the program engineer at G.C.E. After the collapse, National Bureau of Standards (NBS) investigators could not find any final calculations for the loads at each connection.

Hyatt Regency Hotel

On July 17, 1981, nearly one year after its completion, the Hyatt Regency Hotel in Kansas City, Missouri filled its lobby atrium with guests participating in and watching the evening “tea dance.” Suspended above the atrium lobby floor were the walkways designed to connect both sides of the 2nd, 3rd, and 4th floors. Shortly into the dance, two of the walkways, packed with spectators, collapsed onto the crowded atrium floor below. The event was triggered by a failure in the connection between a supporting rod and the box beam of the fourth floor walkway. This disaster killed 114 people and injured 200 more, which at the time was the deadliest structural disaster in U.S. history.

Hyatt Regency Hotel

It was determined that all parties involved had a responsibility to identify and recognize the walkway as a safety critical suspended load, which warranted special consideration and care. During construction in 1979, the atrium roof had collapsed, prompting G.C.E. to ask Crown Center Redevelopment for an on-site inspection of the entire site. Three different requests were denied due to the additional costs.

It was determined that clear delineation of accountability was absent with shared design responsibilities, numerous contractors and sub-contractors, and overlapping design verification processes. PBNDML failed to exercise oversight of support contractors. And the Kansas City Division of Public Works Department failed to provide adequate oversight and evaluation of design documents when it approved of the original design, which NBS investigators said violated the building codes even before the design change. The Public Works Department denied that it had been notified of or had approved of the design change.

Results and Lessons

- 114 Persons Died, 200 persons injured
- Structural Engineer and Project Engineer guilty of
  - Gross negligence
  - Misconduct
  - Unprofessional conduct
  - Loss of licenses
- Structural Engineer of Record was determined to be responsible for special conditions and can not pass details off to contractor/subcontractors.
- Special inspections for many projects as a new layer of required inspection
- Importance of clear communication between all parties
- Importance of clear responsibility for all parties

- Redefined legal responsibilities for owners, contractors, professionals and code officials
- Attention to details in each step by all parties, a lot of people were killed or hurt due to what appeared to many to be a simple change in the bolting pattern!

How do Special Inspections work in detail?

Determine the need and extent of special inspections based on

- Nature of project scope (foundation, concrete, masonry, steel, etc.)
- When required to be designed by a design professional according to the Virginia Uniform Statewide Building Code (Related Laws Package Chart A)
- Application of special or tested assemblies, examples such as:
  - Piles, Piers or Special Foundations
  - Smoke control and smoke exhaust systems
  - EIFS or Spray fire resistant materials
  - Special cases described in VUSBC/IBC Section 1704.13

Assuming we have determined we need special inspections……..

Have Responsible Design Professional prepare the Statement of Special Inspections

- Define the responsible parties (Special Inspections, Testing Agency, Other Specialty Agents)
- Define the specific tests or inspections
- Define interim and final reporting

HECO-6A

Building Permit Number: _____

VIRGINIA TECH STATEMENT OF SPECIAL INSPECTIONS

2009 VUSBC

PROJECT

PERMIT APPLICANT

PRIMARY RDP OF RECORD

STRUCTURAL ENGINEER OF RECORD

This ***Statement of Special Inspections*** is submitted as a condition for permit issuance in accordance with the Special inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. The Statement of Special Inspections encompasses the following disciplines:

☐ Structural ☐ Mechanical/Electrical/Plumbing ☐ Architectural ☐ Other: _____

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall not be brought to the immediate attention of the Contractor for the correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities. Interim Reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A Final Report of Special Inspections documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Jobsite safety is solely the responsibility of the contractor. Materials and activities to be inspected are not to include the contractor's equipment and methods used to erect or install the materials listed. All fees/costs related to the performance of Special Inspections shall be the responsibility of the Owner. Additionally, the undersigned (RDP or SER) are only acknowledging that the items enumerated on the Schedule of Special Inspections are consistent with the required design elements, the applicable sections of the Virginia Uniform Statewide Building Code, and their area of expertise.

REVIEW, AUTHORIZATION & ACCEPTANCE

Permit Applicant *(If not Owner)*:
Signature / date:
Printed Name:

Owner's Authorization *(If other than Applicant)*:
Signature / date:
Printed Name:

Primary RDP of Record: *(Review and Acceptance of Schedule)*
Signature / date:
Printed Name:

SER of Record: *(Review and Acceptance of Schedule)*
Signature / date:
Printed Name:

Building Official's Acceptance:
Signature / date:
Printed Name:

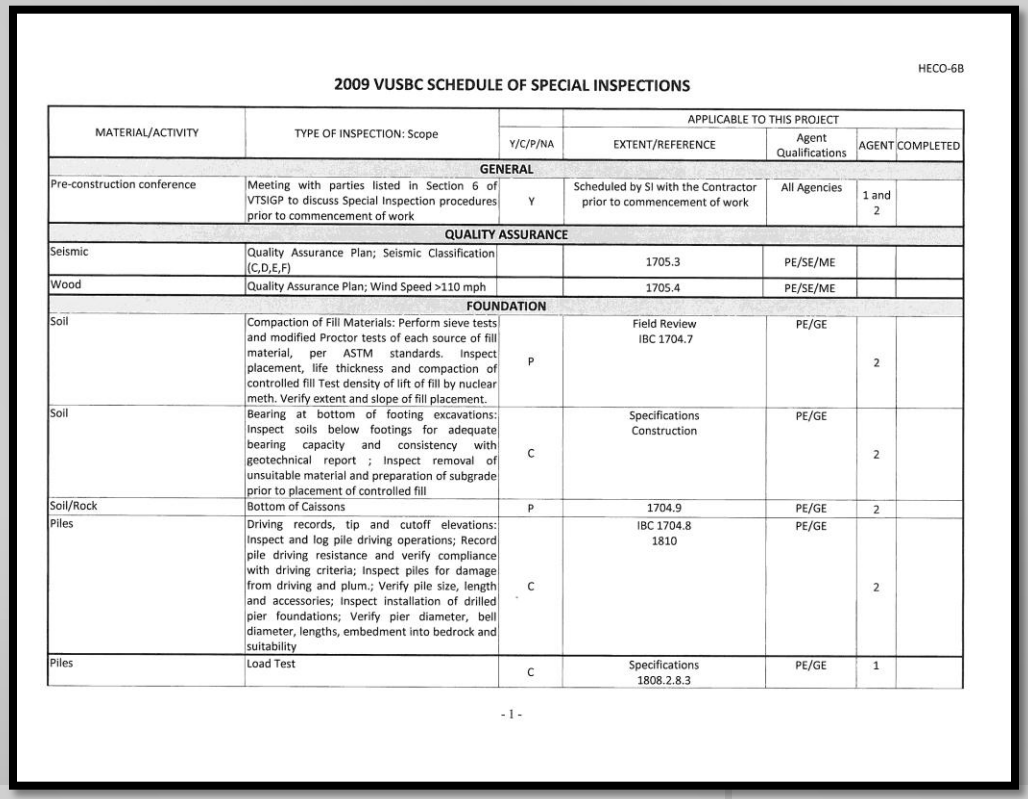
Licensed Professional Seal

SCHEDULE OF SI PREPARED BY:
Virginia RDP Seal of SSI Preparer

Printed Name of the Preparer of the Schedule (on line above)

Special Inspector:
Signature / date:

Printed Name:
SI Company Name:



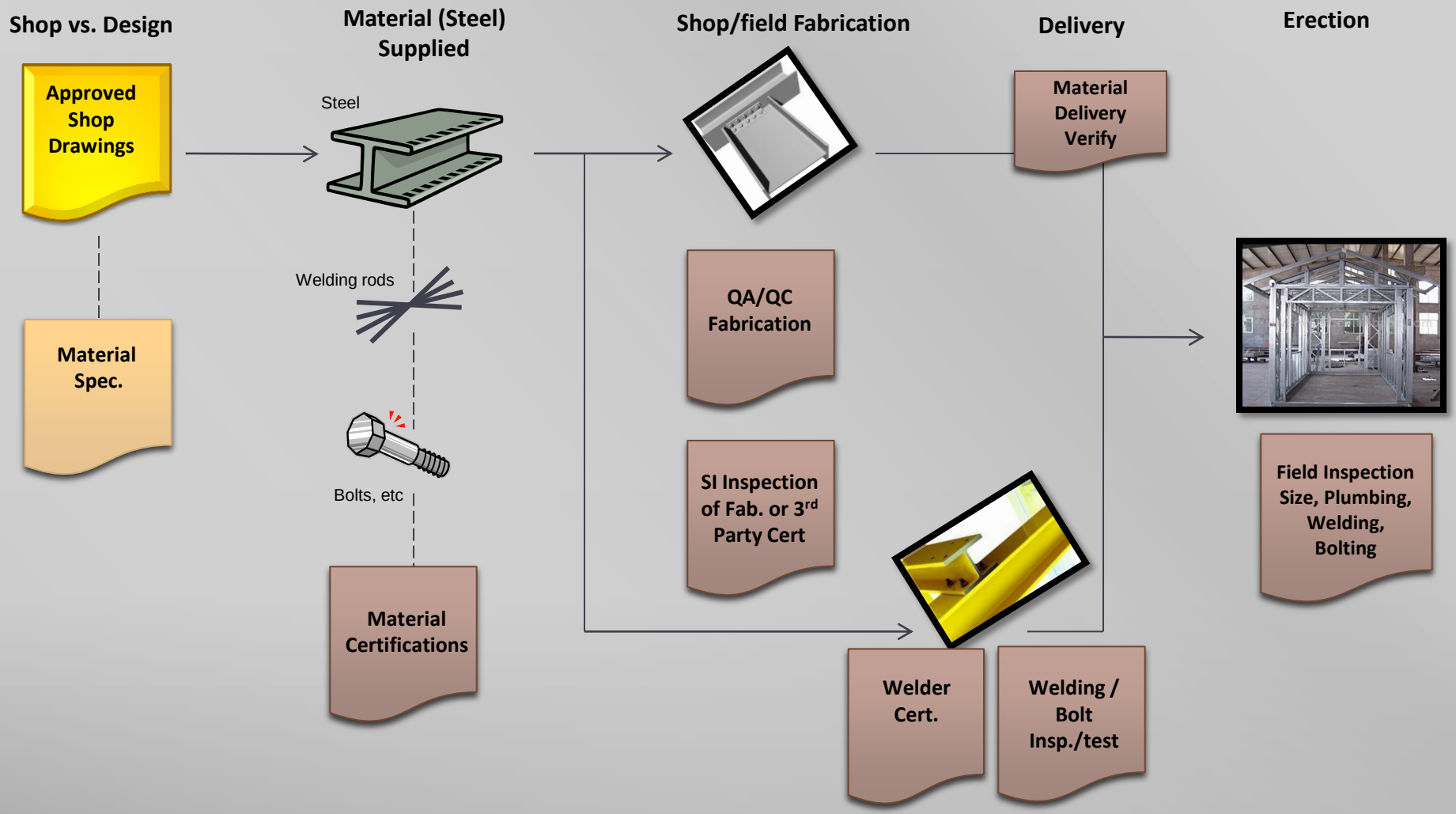
HECO-6B

2009 VUSBC SCHEDULE OF SPECIAL INSPECTIONS

MATERIAL/ACTIVITY	TYPE OF INSPECTION: Scope	APPLICABLE TO THIS PROJECT				
		Y/C/P/NA	EXTENT/REFERENCE	Agent Qualifications	AGENT	COMPLETED
GENERAL						
Pre-construction conference	Meeting with parties listed in Section 6 of VTSIGP to discuss Special Inspection procedures prior to commencement of work	Y	Scheduled by SI with the Contractor prior to commencement of work	All Agencies	1 and 2	
QUALITY ASSURANCE						
Seismic	Quality Assurance Plan; Seismic Classification (C,D,E,F)		1705.3	PE/SE/ME		
Wood	Quality Assurance Plan; Wind Speed >110 mph		1705.4	PE/SE/ME		
FOUNDATION						
Soil	Compaction of Fill Materials: Perform sieve tests and modified Proctor tests of each source of fill material, per ASTM standards. Inspect placement, life thickness and compaction of controlled fill Test density of lift of fill by nuclear meth. Verify extent and slope of fill placement.	P	Field Review IBC 1704.7	PE/GE	2	
Soil	Bearing at bottom of footing excavations: Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report ; Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill	C	Specifications Construction	PE/GE	2	
Soil/Rock	Bottom of Caissons	P	1704.9	PE/GE	2	
Piles	Driving records, tip and cutoff elevations: Inspect and log pile driving operations; Record pile driving resistance and verify compliance with driving criteria; Inspect piles for damage from driving and plum.; Verify pile size, length and accessories; Inspect installation of drilled pier foundations; Verify pier diameter, bell diameter, lengths, embedment into bedrock and suitability	C	IBC 1704.8 1810	PE/GE	2	
Piles	Load Test	C	Specifications 1808.2.8.3	PE/GE	1	

- 1 -

Understand, special inspections is a program not just a series of field tests….example: steel



A second example…..A VT Favorite

Precast concrete elements…… the special inspection requires,

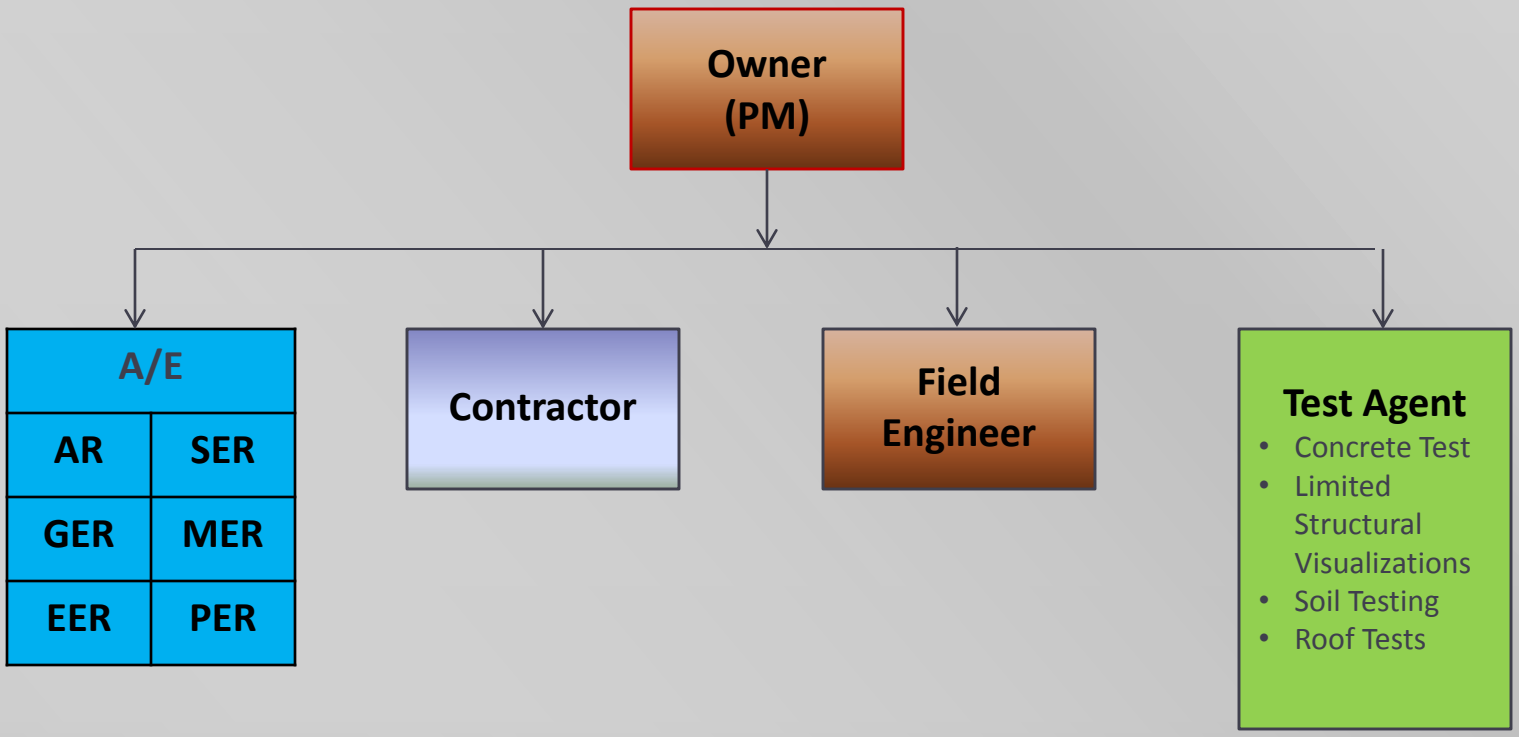
MATERIAL/ACTIVITY	TYPE OF INSPECTION: Scope		APPLICABLE TO THIS PROJECT			
		Y/C/P/NA	EXTENT/REFERENCE	Agent Qualifications	AGENT	COMPLETED
Precast	Plant Certification/Quality Control of Manufacturer: Review plant operations and quality control procedures ☐ Fabricator Exempt	P	1704.2	ACI CCI ICC-RCSI		
Precast	Shop drawings of precast: Verify compliance with specified design loads and specification; verify on-site conditions match shop drawing details		Specifications	PE/SER		
Precast	Erection of precast: Inspect erection of precast concrete including member configuration, connections, welding and grouting	P	1704.4	PE/SE		
Precast	Inspection of Connections: Inspect size, positioning and embedment of connections. Inspect concrete placement and consolidation around anchors	P	1704.4	PE/SE		
Anchor Rods	Anchors cast or drilled and anchored in concrete: Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors	P	1912	ACI-CCI ICC-RCSI		

- Review shop documents for conformance with specifications/design
- Review in plant quality assurance and third party certification or visit plant to verify
- Review precast when it arrives to verify it is correct compared to shop drawings
- Inspect installation and connections

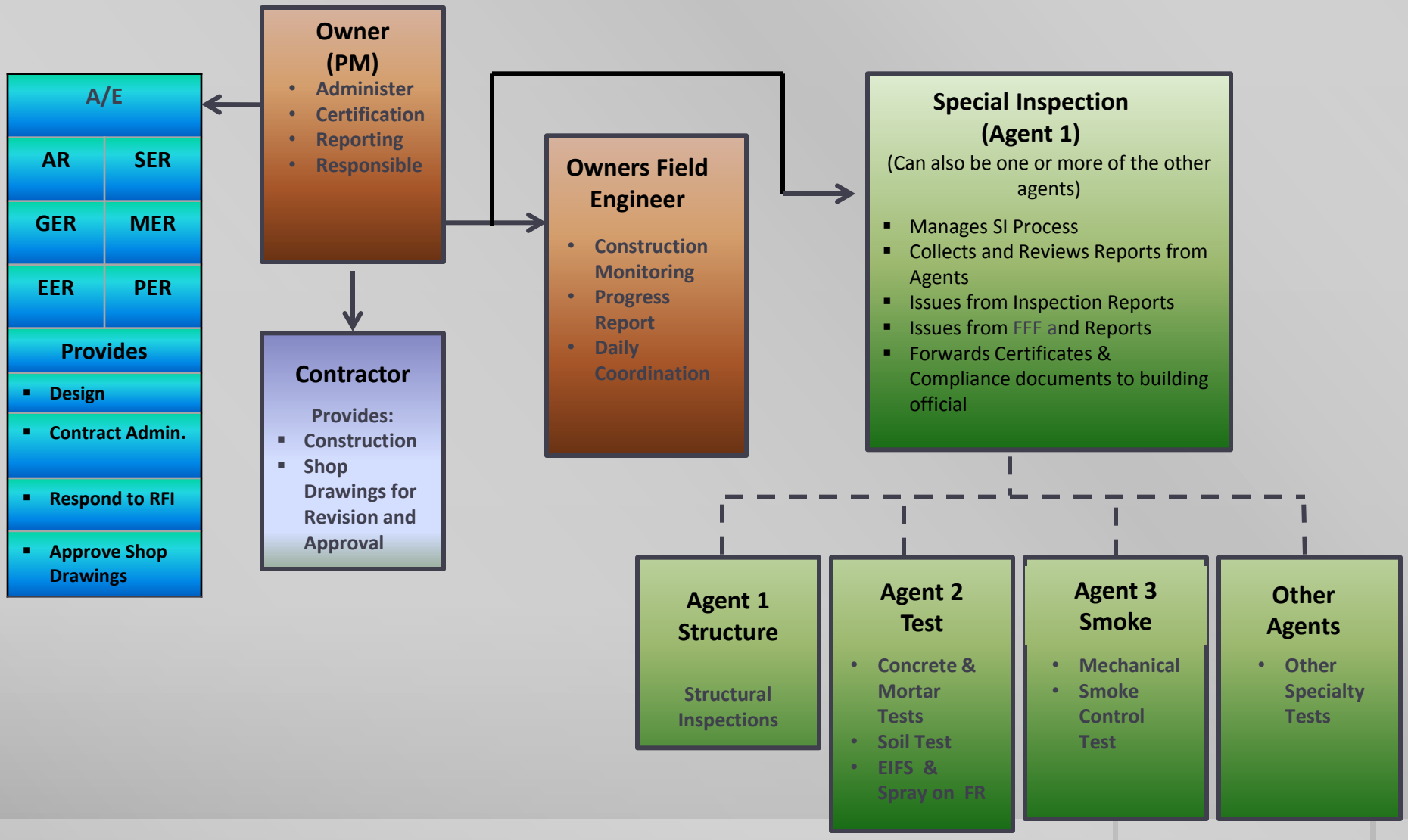
The Project Manager (PM) or Responsible Design Professional (RDP) shall provide the Special Inspector with copies of all approved submittals

- Approved Construction Drawings
- Mix designs for concrete
- Mix designs for mortar
- Shop drawings for reinforcement
- Shop drawings for steel
- Shop drawings for precast concrete
- Welder certification
- Material certification
- Fabrication plant certifications or third party inspection certifications
- Other information as required to fully understand and inspect/test elements during construction

So who has been doing what to date?



So who should do what?



To start, the special inspector shall hold a preconstruction meeting & clearly discuss the process with

- Owner
- Contractor
- Subs
- University Code Official

The intent is to clearly illustrate issues related to

- Scheduling
- Inspection
- Coordination
- Reports and potential for back charges

The special inspector shall

- Review the design and specifications
- Gather, review and verify possession of correct shop drawings, mix designs, plant fabrication certifications, material certifications, etc.
- Manage site visits to inspect construction
  - Rebar size, clearance, laps, conformance to design, etc.
  - Curing
  - Footing width, depth, forms, etc.
  - Framing, plumbing, anchorage, etc.
  - etc.
- Manage site and lab tests to verify
  - Soil density and capability, etc.
  - Concrete temperature, scump, air, delivery time, strength, etc.
  - Mortar strength and related quality
  - etc.

Foundation

Soil	**Compaction of Fill Materials:** Perform sieve tests and modified Proctor tests of each source of fill material, per ASTM standards. Inspect placement, life thickness and compaction of controlled fill Test density of lift of fill by nuclear meth. Verify extent and slope of fill placement.	P	1704.7 Field Review	PE/GE	2	
Soil	**Bearing at bottom of footing excavations**: Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report ; Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill	C	1704.7 Specifications Construction	PE/GE	2	
Soil/Rock	**Bottom of Caissons**	P	1704.9	PE/GE	2	
Piles	**Driving records, tip and cutoff elevations**: Inspect and log pile driving operations; Record pile driving resistance and verify compliance with driving criteria; Inspect piles for damage from driving and plum.; Verify pile size, length and accessories; Inspect installation of drilled pier foundations; Verify pier diameter, bell diameter, lengths, embedment into bedrock and suitability	C	1704.8 1810	PE/GE	2	
Piles	**Load Test**	C	Specifications 1808.2.8.3	PE/GE	1	
Reinforcement Bar	**Size and Placement in foundations:** Inspect size, spacing, cover, positioning, and grade of reinforcing steel. Verify that reinforcing bars are free from oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters.	C	ACI 318 1709.4.4 1901.2	ACI CCI ICC-RNSI	2	
Piers	**Size and placement of reinforcement bar:** Inspect size, spacing, cover, positioning, and grade of reinforcing steel. Verify that reinforcing bars are free from oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters.	C	ACI 1901.2 1704.4	ACI CCI ICC-RNSI	2	

Concrete

Concrete	**Ready mix plant quality control**: Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design, as permitted by ASTM C94.	P	1704.4 Specifications ACI Submittal & Field Review	ACCI CCI ICC-RNSI	1
Concrete	**Mix design tests and certificates:** See notes B, C & D – submit appropriate certificate	P	1704.4.1 Specifications		1
Reinforcing Steel	**Shop drawings of reinforcing steel**: Verify compliance with specified design loads and specifications ; verify on site conditions match shop drawing details		Drawings, Specifications, Note A, B, C, D	PE/SER	1
Reinforcing Steel	**Placement of Reinforcing Steel**: Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free from oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters.	C	1704.4 ACI Specifications	ACCI CCI ICC-RNSI	2
Reinforcing Steel	**Welding**: Visually inspect all reinforcing steel wide	P	1704.4 Specifications		
Formwork	**Design, placement and shoring:** Visually inspect placement, bracing and general construction of formwork; review design of formwork	P	1906.1 ACI 318 VUSBC 1704.4	ACI CCI ICC-RCSI	
Formwork	**Removal and Reshoring**: Ensure implementation of shoring removal schedule is established and controlled	P	1906.2 VUSBC 1704.4	ACI CCI ICC-RCSI	
Concrete	**Sampling and Testing**: Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air content (ASTM C231 or C173) and temperature (ASTM C1064)	C	1704.4 1905.6	ACI- CFTT ACI-STT	
Concrete	**Mix proportions and Mix on Delivery Tickets**: Verify Use	P	1704	ACI CCI ICC-RCSI	
Concrete	**Placement procedures**: Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.	C	1905.9 1905.10	ACI CCI ICC-RCSI	
Concrete	**Curing temperatures and techniques**: Inspect curing, cold weather and hot weather protection procedures	P	1905.11 ACI	ACI CCI ICC-RCSI	

Pre-stressed Concrete

Prestressed	**Prestressing procedures and forces**: Inspect placement, stressing, grouting and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied, and wrapped. Record tendon elongations.	C	1704.4	ICC-PCSI
Prestressed	**Shop drawings of prestressed units**: Verify compliance with specified design loads and specifications; verify on site conditions match shop drawing details	C	1704.4	ICC-PCSI PE/SE

Pre-Cast Concrete

Precast	**Plant Certification/Quality Control of Manufacturer**: Review plant operations and quality control procedures ☐ Fabricator Exempt	P	1704.2	ACI CCI ICC-RCSI
Precast	**Shop drawings of precast**: Verify compliance with specified design loads and specification; verify on-site conditions match shop drawing details		Specifications	PE/SER
Precast	**Erection of precast**: Inspect erection of precast concrete including member configuration, connections, welding and grouting	P	1704.4	PE/SE
Precast	**Inspection of Connections**: Inspect size, positioning and embedment of connections. Inspect concrete placement and consolidation around anchors	P	1704.4	PE/SE
Anchor Rods	**Anchors cast or drilled and anchored in concrete**: Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors	P	1912	ACI-CCI ICC-RCSI

Masonry

Material Certification	**Certificates, Tests and Technical Data**: For clay and/or concrete masonry-submittal and field review meeting all specifications ☐ Fire Resistant rate assemblies included		1704.5 1708.1 ACI 530.1	PE/SE
Reinforcing Steel	**Shop Drawings**: Verify compliance with specified design loads and specifications; verify on site conditions match shop drawing details		Specs. 1704.5	PE/SER
Reinforcing Steel	**Condition, Size, Location, Spacing of Reinforcing Steel**: Inspect size, location, condition, spacing and lapping or reinforcing steel Inspect welding of reinforcing steel	C	1704.5 ACI 530.1	ICC-SMSI AWS-CWI
Mixing of Mortar and Grout	**Proportioning and Mixing**: Inspect proportioning, mixing and retempering of mortar and grout	C	1704.5 ACI 530.1	ICC-SMSI
Installation of Masonry	**Application & Installation**: Inspect size, layout, bonding and placement of masonry units	P	1704.5 ACI 530.1	ICC-SMSI
Mortar Joints	**Application & Installation**: Inspect construction of mortar joints including tooling and filling of head joints	P	1704.5 ACI 530.1	ICC-SMSI
Prestressed Masonry	**Application & Installation**: Inspection placement, anchorage and stressing of prestressing bars	P	1704.5 ACI 530.1	ICC-SMSI
Grouting Operations	**Application & Installation**: Inspect placement and consolidation of grout. Inspect masonry clean-outs for high lift grouting	C	1704.5 ACI 530.1	ICC-SMSI
Weather Protection	Cold, Hot and Rainy Weather protection investigation	P	1704.5 ACI 530.1	ICC-SMSI
Evaluation of Masonry Strength	**Testing/Review of strength**: Test compressive strength of mortar (ASTM C780) and grout specimen samples (ASTM C1019). Test compressive strength per unit strength method (ASTM C140)	P	1704.5 ACI 530.1.1	ICC-SMSI
Anchors and Ties	**Inspection of anchorages**: Inspect size, location, spacing and embedment of dowels, anchors and ties	P	1704.5 ACI 530.1	ICC-SMSI
Seismic	Reinforcing (Seismic Design Cat. “c”)	P	1704.8.1	PE/SE

Steel

Steel Member Fabricator	**Plant Certification/Quality Control of Manufacturer**: Review shop fabrication and quality control procedures ☐ Fabricator Exempt	P	1704.2	AWS/AISC-SSI ICC-SWSI
Material Certification	**Manufacturer's Certificate of Compliance Structural Steel**: Review certified mill reports and identification markings for wide-flange shapes	P	1704.3	AWS/AISC-SSI ICC-SWSI
Material Certification	**Manufacturer's Certificate of Compliance; bolts, nuts, washers and connectors**: Review certified mill reports and identification markings for high strength bolts, nuts and welding electrodes	P	1704.3	AWS/AISC-SSI ICC-SWSI
Open Web Steel Joists	**Inspection of joists installation**: Inspect installation, field welding and bridging of joists	P	1704.3	
Steel Framing Drawings	**Shop drawings review**: verify compliance with specified design loads and specifications		Specifications	PE/SER
Erection-Bolting	**Installation of High-strength Bolts**: Inspect installation and tightening of high strength bolt. Verify that splines have separated from tension control bolts. Verify proper tightening sequence	P	1704.3.3 AISC 360	AWS/AISC-SSI ICC-SWSI
Erection-Bolting	**Installation of Slip-critical bolts**: Inspection installation and tightening of high strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip critical connectors	C	1704.3.3 AISC 360	AWS/AISC-SSI ICC-SWSI
Erection-Welding	**Welding**: Visually inspect all welds. Inspect pre-heat, post-heat, and surface preparation between passes. Verify size and length of fillet weld Ultrasonic testing of all full penetration welds	C	1704.3.1 1707.2 AWS	AWS CWI ASNT
Erection-Shear Connections	**Steel Framing and Connections**: Inspect size, number, positioning and welding of shear connectors. Inspect studs for full 360 degree flash. Ring test all shear connectors with a 3lb hammer. Bond test all questionable studs to 15 degrees	P	1704.3.2	AWS/AISC-SSI ICC-SWSI
Structural Details	**Inspection of Structural Details**: Inspect steel frame for compliance with structural drawings, including bracing, member configuration and connection details	P	1704.3.2	PE/SE
Metal Decking	**Inspection of metal deck connections**: Inspect welding and side up lap fastening of metal roof and floor deck	P	1704.3	AWS-CWI

Cold Formed Steel Framing

Member Sizes		P	1707.3	
Material Thickness		P	1707.3	
Material Properties		P	1707.3	
Mechanical Connections	Fastening per code and drawings	P	1707.3	
Welding		P	1707.3	
Framing Details		P	1707.3	
Trusses	**Shop Drawings**: Verify compliance with specified design loads and specifications; verify on site conditions match shop drawing details	P	1707.3	PE/SER
Permanent Truss Bracing	Truss placement, fastening and anchorage	P	1707.3	

Wood

Wood Pre-Fabrication	**Plant Certification/Quality Control of Manufacturer**: Inspect shop fabrication and quality control procedures for wood truss plant ☐ Fabricator Exempt	P	1704.2
Material Grading	Grade Stamp		Specifications, 2301.1.8 2303
Connections	Fastening per code and drawings	P	Specifications, 1704.6

Framing and Details

Diaphragms and Shearwalls	Inspect size, configuration, blocking and fastening of shearwalls and diaghrams. Verify panel grade and thickness	P	1704.6.1	
Trusses	**Shop Drawings**: Verify compliance with specified design loads and specifications; verify on site conditions match shop drawing details		Specifications	PE/SER
Trusses	Truss placement, fastening and anchorage	P	Specifications, 1704.6	
Laminates	**Shop drawings:** Verify compliance with specified design loads and specifications; verify on site conditions match shop drawing details		Specifications	PE/SER
Laminates	Identification per shop drawings		Specifications	
Plywood	Grade stamp & thickness		Specifications, 1704.6.1	

Spray on Fire Resistant Material (SFRM)

Material Specifications	Manufacturer's Data		Specifications	PE/SE/PPE
Laboratory Tested Fire Resistance Design	Review Third-party fire resistive design assembly (eg. UL, FM, etc.) for each rated beam, column, or assembly		1704.12	ICC-SFSI
Schedule of Thickness	Review approved thickness schedule		1704.12.4	
Surface Preparation	Inspect surface preparation of steel prior to application of SFRM		1704.12.2	
Application	Inspect application of SFRM		1704.12.3	
Curing and Ambient Condition	Verify ambient temperature and ventilation is suitable for application and curing of SFRM		1704.12.3	
Thickness	Test thickness of SFRM (ASTM E605). Perform a set of thickness measurements for every 1,000 SF of floor and roof assemblies and on not less than 25% of rated beams and columns		1704.12.4	
Density	Test density of SFRM material (ASTM E605)		1704.12.5	
Bond Strength	Test the cohesive/adhesive bond strength of SFRM (ASTM E736). Perform not less than one test for each 10,00 SF.		1704.12.6	

Mastic and Intumescent Fire Resistant Coating

Application	**Inspect mastic and intumescent fire resistant coatings applied to structural elements and decks, in accordance with AWCI 12-B**: Verify thickness and application of coatings prescribed in fire-resistant design.	P	1704.13 AWCI 12-B	ICC-SFSI

Exterior Insulation and Finish Systems (EIFS)

Material Submittal		Specifications, 1704.14	EDI-EIFS
Condition of Substrate		Specifications, 1704.14	EDI-EIFS
Application of Foam Plastic Board	P	Specifications, 1704.14	EDI-EIFS
Application of Coatings	P	Specifications, 1704.14	EDI-EIFS
Application of Mesh	P	Specifications, 1704.14	EDI-EIFS
Ambient Condition and Curing	P	Specifications, 1704.14	EDI-EIFS
Flashing and Joint Details	P	Specifications, 1704.14	EDI-EIFS
Sealants/Caulk	P	Specifications, 1704.14	EDI-EIFS

Architectural/Mechanical/Electrical Systems

Components	Storage Racks		1707.6 ASCE 7
Wall Panels and Veneers	Architectural Exterior Cladding	P	1707.7 ASCE 7
Suspended Ceiling	Periodic Anchorage Inspection	P	1707.6 ASCE 7
Access Floors	Periodic Anchorage Inspection	P	1707.6 ASCE 7
Partitions	Periodic Anchorage Inspection	P	1707.7 ASCE 7
Mechanical Systems	Mechanical, HVAC & Piping	P	1707.8 1708.5
Electrical Systems	Emergency & Standby Power Systems	P	1707.8 1708.5
Fire Wall Assemblies	Manufacturer's Data		Specifications
Fire Wall Assemblies	Placement of Materials		Drawings, Specifications

Smoke Control

Ducts	Device location and air duct leakage	P	1704.16	PE/FPE/ME
System	Pressure difference, flow measurements & detection testing	P	1704.16	PE/FPE/ME
Controls	Activation sequence	P	1704.16	PE/FPE/ME

Focus on documentation and report

The Special Inspector is responsible to provide reports to the owner, building official and responsible design professionals at a minimum. Reports must be:

- Sealed by the SI who must be a design professional
- Clear, Concise and Specific
  (no more “general conformance”)
  (what was inspected, what was found, and did it comply or not)
  (provide a plan or sketch to show when inspected)
- Timely
  (30 daily requests delivered on the end of the month is not timely)
  (24 hours is timely)

Special Inspection, Current level of reporting

SITE OBSERVATION REPORT

Date Of Observation:	June 15, 2011	**Project:**	VT West End Market CPS
		Project Number:	**Task Number(s):**
		Building Permit No.:	
Arrival Time:	8:55 AM, 1:50 PM	**Departure Time:**	12:50 PM, 5:05 PM
Contractor:	Branch & Associates	**Superintendent:**	Dustin Olin
Air Temp ° F:	High near 75	**Weather:**	Sunny

Observations and Recommendations:

I observed HT Bowling place trench backfill over the new water line west of Addition #3. The contractor placed VDOT #21A backfill material and compacted it with a trench roller. The average lift thickness was between 8 and 12 inches.

Seven field density tests were performed today by the nuclear test method. The field density tests appear to indicate relative compaction to at least 95 percent of the maximum dry density in accordance with ASTM D 698, Standard Proctor at the locations and grades tested. Field density test elevations are based on data supplied by the contractor and/or the project plans. The specification requirement for this project is 95 percent compaction according to the same standard. It is our opinion that the compacted structural fill placed today has been placed and compacted in general accordance with the project specifications. Please see the attached sketch for approximate limits of fill placement and field density test locations.

Greystar placed about 3 CY of concrete in a small section of the existing building near the exposed aggregate patio northeast of Addition #1. At this location, the reinforcing steel observed appeared to be in general conformance with the project plans and specifications.

I also observed the placement of concrete for the location referenced above. Slump and temperature tests were performed on samples of the fresh concrete placed. No cylinders were molded for compression testing. The plastic properties of the fresh concrete tested appear to generally conform to the project plans and specifications.

Superior Steel tightened bolts and welded end plates and kickers in Addition #3.

The professional engineer is represented on-site solely to observe operations of the contractor identified, form opinions and report those opinions to the client. The presence and activities of the engineer's representative do not relieve the contractor's obligation to meet contractual requirements. The contractor retains sole responsibility for site safety and the methods and sequence of construction. We have performed our services in accordance with generally accepted geotechnical engineering practices. We make no warranty; either express or implied, as to the professional services provided.

A final report is the instrument of service of a professional engineer. Any conclusions drawn from this report should be discussed and evaluated by the professional engineer involved.

Special Inspection, symptom of problems ……

Special Inspection Report

SITE OBSERVATION REPORT

Date Of Observation:	June 15, 2011	**Project:**	VT West End Market CPS
		Project Number:	**Task Number(s):**
		Building Permit No.:	
Arrival Time:	8:55 AM, 1:50 PM	**Departure Time:**	12:50 PM, 5:05 PM
Contractor:	Branch & Associates	**Superintendent:**	Dustin Olin
Air Temp ° F:	High near 75	**Weather:**	Sunny

Observations and Recommendations:

I observed HT Bowling place trench backfill over the new water line west of Addition #3. The contractor placed VDOT #21A backfill material and compacted it with a trench roller. The average lift thickness was between 8 and 12 inches.

State whether or not Action complies w/ Const. Docs.

Seven field density tests were performed today by the nuclear test method. The field density tests appear to indicate relative compaction to at least 95 percent of the maximum dry density in accordance with ASTM D 698, Standard Proctor at the locations and grades tested. Field density test elevations are based on data supplied by the contractor and/or the project plans. The specification requirement for this project is 95 percent compaction according to the same standard. It is our opinion that the compacted structural fill placed today has been placed and compacted in general accordance with the project specifications. Please see the attached sketch for approximate limits of fill placement and field density test locations.

Greystar placed about 3 CY of concrete in a small section of the existing building near the exposed aggregate patio northeast of Addition #1. At this location, the reinforcing steel observed appeared to be in general conformance with the project plans and specifications.

Provide Map/Sketch to show location of inspection

APPEARED .... GENERAL !

I also observed the placement of concrete for the location referenced above. Slump and temperature tests were performed on samples of the fresh concrete placed. No cylinders were molded for compression testing. The plastic properties of the fresh concrete tested appear to generally conform to the project plans and specifications.

Superior Steel tightened bolts and welded end plates and kickers in Addition #3.

Provide location

The professional engineer is represented on-site solely to observe operations of the contractor identified, form opinions and report those opinions to the client. The presence and activities of the engineer's representative do not relieve the contractor's obligation to meet contractual requirements. The contractor retains sole responsibility for site safety and the methods and sequence of construction. We have performed our services in accordance with generally accepted geotechnical engineering practices. We make no warranty; either express or implied, as to the professional services provided.

A final report is the instrument of service of a professional engineer. Any conclusions drawn from this report should be discussed and evaluated by the professional engineer involved.

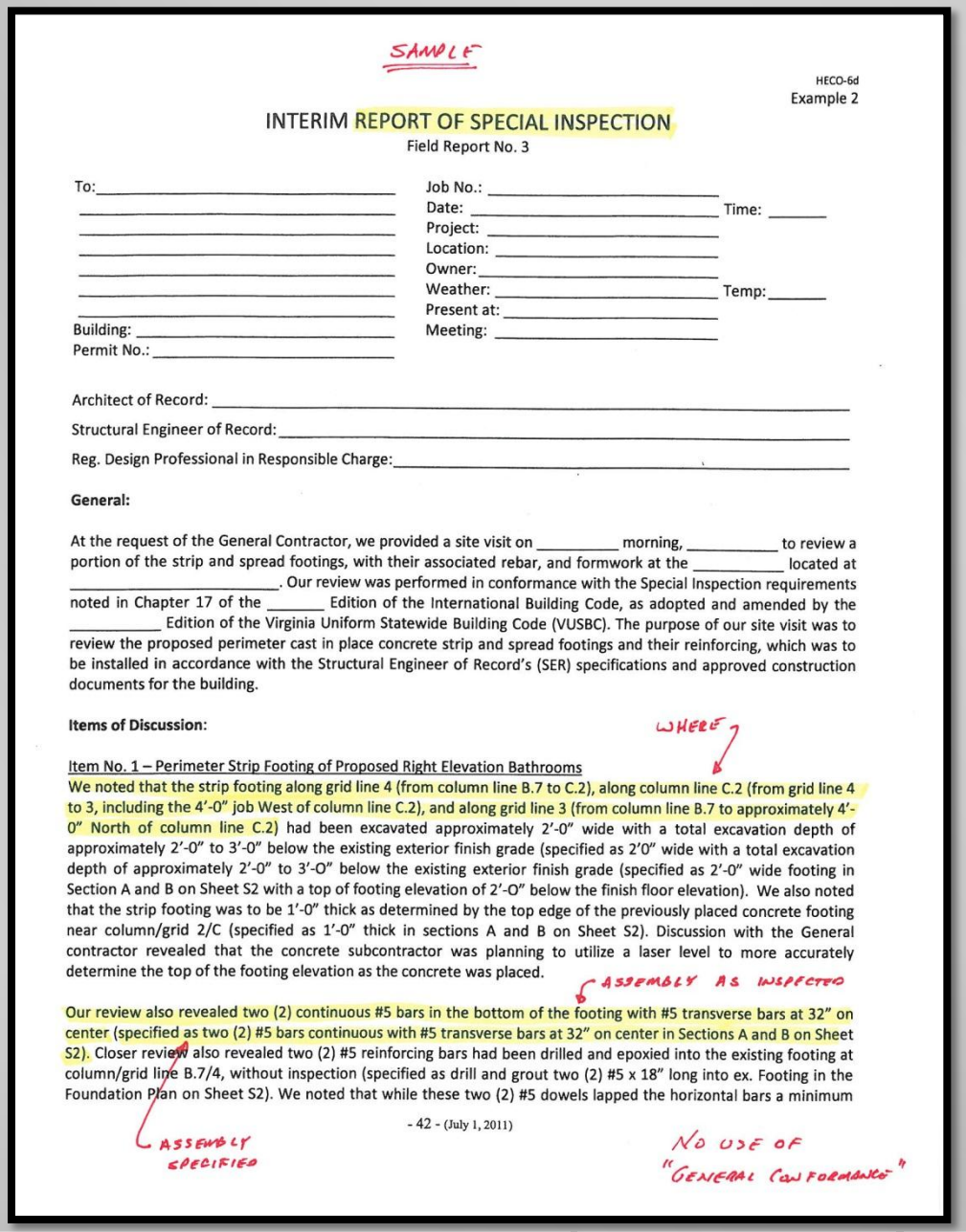
Phrases such as "General Conformance" are

Not Acceptable

other issues as noted

Special Inspections

Preferred and Expected level of attention to detail in reports



SAMPLE

HECO-6d
Example 2

INTERIM REPORT OF SPECIAL INSPECTION
Field Report No. 3

To: _____
_____
_____
_____
_____
_____
_____
Building: _____
Permit No.: _____

Job No.: _____
Date: _____ Time: _____
Project: _____
Location: _____
Owner: _____
Weather: _____ Temp: _____
Present at: _____
Meeting: _____

Architect of Record: _____
Structural Engineer of Record: _____
Reg. Design Professional in Responsible Charge: _____

General:

At the request of the General Contractor, we provided a site visit on _____ morning, _____ to review a portion of the strip and spread footings, with their associated rebar, and formwork at the _____ located at _____. Our review was performed in conformance with the Special Inspection requirements noted in Chapter 17 of the _____ Edition of the International Building Code, as adopted and amended by the _____ Edition of the Virginia Uniform Statewide Building Code (VUSBC). The purpose of our site visit was to review the proposed perimeter cast in place concrete strip and spread footings and their reinforcing, which was to be installed in accordance with the Structural Engineer of Record's (SER) specifications and approved construction documents for the building.

Items of Discussion:

WHERE

Item No. 1 – Perimeter Strip Footing of Proposed Right Elevation Bathrooms
We noted that the strip footing along grid line 4 (from column line B.7 to C.2), along column line C.2 (from grid line 4 to 3, including the 4'-0" job West of column line C.2), and along grid line 3 (from column line B.7 to approximately 4'-0" North of column line C.2) had been excavated approximately 2'-0" wide with a total excavation depth of approximately 2'-0" to 3'-0" below the existing exterior finish grade (specified as 2'0" wide with a total excavation depth of approximately 2'-0" to 3'-O" below the existing exterior finish grade (specified as 2'-0" wide footing in Section A and B on Sheet S2 with a top of footing elevation of 2'-O" below the finish floor elevation). We also noted that the strip footing was to be 1'-0" thick as determined by the top edge of the previously placed concrete footing near column/grid 2/C (specified as 1'-0" thick in sections A and B on Sheet S2). Discussion with the General contractor revealed that the concrete subcontractor was planning to utilize a laser level to more accurately determine the top of the footing elevation as the concrete was placed.

ASSEMBLY AS INSPECTED

Our review also revealed two (2) continuous #5 bars in the bottom of the footing with #5 transverse bars at 32" on center (specified as two (2) #5 bars continuous with #5 transverse bars at 32" on center in Sections A and B on Sheet S2). Closer review also revealed two (2) #5 reinforcing bars had been drilled and epoxied into the existing footing at column/grid line B.7/4, without inspection (specified as drill and grout two (2) #5 x 18" long into ex. Footing in the Foundation Plan on Sheet S2). We noted that while these two (2) #5 dowels lapped the horizontal bars a minimum

ASSEMBLY SPECIFIED

NO USE OF "GENERAL CONFORMANCE"

Inspections

- Contractor shall call for inspection prior to placing concrete, gypsum wallboard, etc. or covering any work governed by the VUSBC.
- Inspections is not “monitoring” or “observations”, inspections confirm or report based on facts, measurements, or data. Observations are general in nature.
- Contractor can not deviate from the approved construction documents.
- SI can not recommend alternate designs or remedial measures
- Separate the services of Geotechnical contract administration from construction inspection and special inspection through contrast or clear management techniques.
- The contractor must communicate with the design professionals to address issues, deviations, problems or incomplete details. Use RFI’s and get revised detail and instructions.
- Have alternates, drawings or sketches for remedial work or design changes approved by the UBO office prior to installation and inspection.

PAST

- Special Inspections are not done in accordance with the VUSBC or current practice within Virginia
- BCOM too far away to efficiently handle details, including Special Inspections.
- Few building code inspections
- Different types of inspections jumbled and done “selectively” with minimal documentation
- From our experience and observation, here at VT construction not strictly held to construction documents
- From our experience and observation, here at VT there is poor or little schedule management required or applied
- From our experience and observation, here at VT, work is often Contractor and Sub-Contractor driven

Future

- Special Inspections practices to be brought up to date and will conform to the VUSBC and current practice within Virginia.
- UBO on site and can address details
- Full suite of code required inspections will be prepared
- Non Code related inspection and issues shall be pulled out and handled outside Code Officials office
- Construction to be more VT driven for example contractors must schedule for test and inspections
- Document & code driven, for example contractors held strictly to the approved documents or communicate with designers for additional information
- A&E firms may have more RFI’s and VT will need to demand more attention to details prior to construction.

Results

- Attention to Detail
- More RFI's are possible to get the A/E to address issues during construction
- Contractor/PM will need to plan for inspection
- Contractor/PM will need to get, review and submit documents to UBO office
- Additional contracts possible due to separation and better definition of professional testing services
- Improved identification of the costs of special tests versus construction. Tests and potential areas to reduce cost through better oversight.
- Better Construction Outcomes

Summary

- Define required inspections for each project based on the project scope
- **Contract for special inspections as a program, not a series of individual tests**
- Separate the processes of inspections and tests into the different categories and manage them as required
- PM or Designer should call for Special Inspections prior to work being covered up. The failure to be ready will result in a rejection and re-inspections
- PM or Designer Shall have special inspection done just before building code inspection
- PM or Designer Shall review all inspection reports for deviations, potential RFI's, potential back charges and incorrect schedules
- Note the, Project Manager's or permit applicants must read and review all RFI's, inspection reports, submittals, etc. Our office will mark up and/or reject any inspection report that fails to clearly describe the inspection and results.

- The agents conducting special inspections need to be managed and not allowed to simply remain on site waiting to be utilized. Contractors need to schedule work and inspections to minimize the time required to provide for tests and inspections. Failed inspections need to be charged back to the contractor

“Common Issues”

Should the Statement of Special Inspections be written by the Structural Engineer of Record?

Should the Statement of Special Inspections be written by the Structural Engineer of Record?

The Statement of Special Inspections should be written by the design team (each member using their respective expertise) with this activity being led by the Prime Designer.

Procurement of Special Inspection is Required through the Designer of Record.

Procurement of Special Inspection is Required through the Designer of Record.

Procurement of Special Inspections can be performed though one of two "fundamental options" with multiple variations. Two key options are available for procurement of SI:

1. The Special Inspector and agents may be selected as a Qualified Independent Firm.
2. The Special Inspector and agents may be selected through contract with the responsible designer's.

** Although only two "key procurement options" exist the resulting potential contractual relationships with designers, materials testing agents and special inspections providers can be widely varied.

Examples:

1. SI is contracted with a single Independent Firm who will also provide the Materials Testing services.
2. SI is contracted with a single Independent Firm, however a separate firm will provide Materials Testing services.
3. SI is contracted with multiple Independent Firms (based on expertise) some with Materials Testing services. some without
4. SI is contracted with the design team and the design team hires sub-consultants to perform the required Inspections
5. SI is contracted with the design team and the design firms perform all of the SI.
6. More…

The Designer of Record knows the design best and as a result is best suited to be the Special Inspector of Record.

The Designer of Record knows the design best and as a result is best suited to be the Special Inspector of Record.

It is the intent of Special Inspection that the designers be involved and aware of the construction, ideally on site to inspect the work. In addition, the Designer of Record was selected through a process as a result of their design capabilities. As the designer, they would be most familiar with the design loads and assumptions applied in the calculations. So they are normally the best option based on understanding of the design intent.

Often, they are not local and can not provide that service so another firm or person is required. Also in some cases, design firms may not make good inspection or testing firms. When selecting a Special Inspector careful consideration should be given to "Inspection Qualifications."

The Statement of Special Inspections can/should limit the frequency of (periodic) inspections.

The Statement of Special Inspections can/should limit the frequency of (periodic) inspections.

IBC Chapter 17 Special Inspection, Periodic. The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

Inspections are generally driven by the contractor and his ability to manage the process. Well organized projects will have large areas to inspect at once, plan ahead, seek answers before inspections, and verify work to prevent call backs or rejections while keeping the work on schedule. Poorly organized projects will have small areas inspected, repeated and failed inspections and have more difficulty staying on schedule.

The Statement of Special Inspections should never limit the frequency of periodic inspections. The discretion of periodicity should remain with the Designer of Record and the Special Inspector of Record and should be based in part on the quality of previously inspected work.

Besides the impact of the project size, the number of inspections is governed by the number of times the contractor calls for an inspection and how often the work fails to pass.

The Statement of Special Inspections can/should limit the frequency of (periodic) inspections.

Due to the observations we have made of lapses in the inspection process, unless otherwise specified and allowed by code, everything covered by the SI is to be inspected. There are two methods, periodic and continuous.

Here at VT, Periodic inspections will be applied to mean the whole assembly can be inspected by periodic visits (Inspect 100% of the footing by seeing it in stages…think of it as partials). It does not mean inspection is some percentage of the whole (inspect 10% of the footings).

Here at VT, Continuous is applied to mean the inspector needs to see the entire process from start to finish as the task is being performed by the contractor.

Example: Placing concrete is a continuous inspection because the process of placement (truck time, water added, placement, vibration, etc) is important to the final result, so an agent of the SI needs to monitor, sample, etc the process as it occurs continuously. But the SI does not need to stand and watch the contractor dig the trench and place the rebar before placement. The footing excavation can be inspected as sections are ready for a pour, i.e. periodic based on when ready.

So the contractor will prepare the partial excavation, place the rebar, call for an inspection for the subsoil and rebar, etc. and the SI can leave the site. Then the SI testing agent will monitor/test/record the delivery and placement of concrete during the pour continuously. This would be repated on the next footing segment or period.

Special Inspections should only be performed when requested by the contractor.

Special Inspections should only be performed when requested by the contractor.

Special Inspections should be performed when requested by the contractor and on an intermittent basis based on the work involved to assure consistent quality of construction.

For example, the contractor may not call to have the SI verify the curing process after a pour. The SI should make it a point to visit the site and verify curing, saw cuts, etc. The SI also needs to address various administrative verifications, such as fabrication plant verification without being contacted by the contractor.

Special Inspections fees can be budgeted for 3% of total constructed cost.

Special Inspections fees can be budgeted for 3% of total constructed cost.

Special Inspections fees may be budgeted for during pre-design, however, further budgeting exercises will prove useful through DD to more accurately anticipate SI fees. Special Inspections Budget Considerations:

- Structural Frame Material Type
- Size of Project
- Ultimate Use of Completed Building
- Seismic Design Category
- Wind Exposure Category
- Deep Foundations
- Quality Control Program
- Contractors schedule and program (ex: few large concrete pours versus lots of small concrete pours)
- Separate special inspection from other non-regulatory inspections

Special Inspections is just an additional layer of cost on a building project.

Special Inspections is just an additional layer of cost on a building project.

Example of impact of inspections, excerpt from 1997 UBC:
2107.1.2 Allowable Masonry Stresses.

When quality assurance provisions do not include requirements for special inspections the allowable stresses for masonry in section 2107 (Working Stress Design of Masonry) shall be reduced by one half.

Special Inspections is Quality Assurance of constructed building elements which has resulted in an increased certainty of material performance. This certainty has allowed for cost savings through the reduction of safety factors.

It can be argued that Special Inspection is the process that keeps “value engineering” which cuts costs from being dangerous or life threatening.

The Special Inspector's contract may be held by the contractor.

The Special Inspector's contract may be held by the contractor.

VUSBC Section 1703, Approved Agency:

1703.1.1 – Independence. …shall be objective, competent and independent from the contractor responsible for the work being inspected…

1703.1.2 – Equipment. …shall have adequate equipment to perform tests…

1703.1.3 – Personnel. …shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.

Beyond the obvious conflict of interest, to maintain "Independence" the Special Inspector's contract cannot be held by the contractor.

Special Inspections are required only for the specific systems called out in VUSBC/IBC Chapter 17.

Special Inspections are required only for the specific systems called out in VUSBC/IBC Chapter 17.

Not so fast….

VUSBC/IBC 1704.13 Special Cases.
Special Inspections shall be required for proposed work that is, in the opinion of the building official, unusual in its nature, such as but not limited to the following examples:

1. Construction materials and systems that are alternatives to materials and systems prescribed by this code.
2. Unusual design applications of materials described in this code
3. Materials and systems required to be installed in accordance with manufacturer's instructions that are not prescribed in this code…

- Examples of Special Case Special Inspections:
  - fire-caulking
  - steam pipe installation
  - Sprinkler systems
  - standpipe systems
  - site storm drainage and more…

- **Special Inspections of materials and systems other than specifically prescribed in Chapter 17 may be required per building official requirement / approval.**