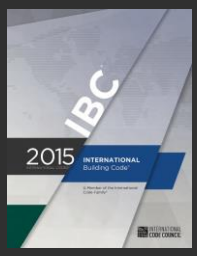
BCS Building Consultation Services

NEBOEA
53rd Conference
UMass, Amherst, MA
October 7-9, 2019

Presented by Erik C. Wight, CBO

SPECIAL INSPECTIONS

1



- This presentation is an independent project of the instructor and is not endorsed by the International Code Council. It is not intended to be a design manual, but is to be utilized an educational tool leading to a better application and understanding of the code.

2

Why Required?

3

- To ensure specialty trades /components that require special knowledge and expertise are in compliance with IBC and approved construction documents

3

4

Hartford civic center roof collapse

5

- https://youtu.be/qM3pkTRlzA4

5

7

OUTLINE:

- Why required
- When required
- Who is qualified
- Who approves
- What is required
- Pre-construction meetings
- Statement of Special Inspection
- Submittals / Forms
- Categories of Special Inspections
- Historic Failures
- Useful websites

7

8

History of Special Inspections

- 1927 UBC gave Building Inspector power to determine when required "Registered inspector"
- 1943 "Registered Inspector" reinforced concrete design >2000 psi / masonry design >50% UBC / all structural welding
- 1961 "Special Inspector"" 1st appeared in UBC
- 1976 1st in code BOCA (initially structural components)
- 1996 BOCA (nonstructural components added)

8

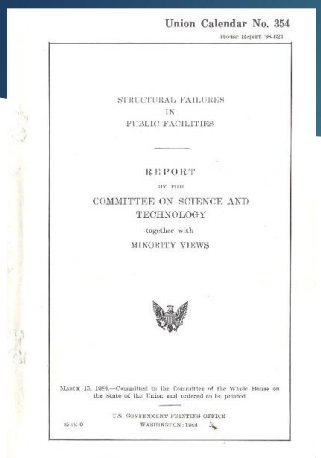
9

Tacoma Narrows Bridge

- • The most famous bridge failure in the U.S.
- • It was originally opened to traffic July 1, 1940.
- • It collapsed four months later, November 7, 1940, at 11:00 am.
- • It had been exhibiting signs of aeroelastic flutter since it opened.
- The bridge was built with shallow plate girders instead of deep stiffening trusses used on railroad bridges.
- • The solid plate girders have a larger surface area to "catch" the wind.
- • Open trusses have a smaller area through which wind can pass through.
- • The bridge, under 42 mph winds, experienced rolling undulations resulting in a 0.2 Hz torsional vibration mode with amplitudes of up to 28 ft.

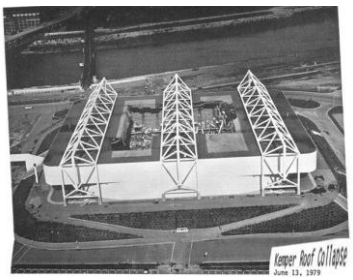
9

10


Union Calendar No. 354

STRUCTURAL FAILURES IN PUBLIC FACILITIES

REPORT BY THE COMMITTEE ON SCIENCE AND TECHNOLOGY together with MINORITY VIEWS



Kemper Arena Roof Collapse, Kansas City, 1979

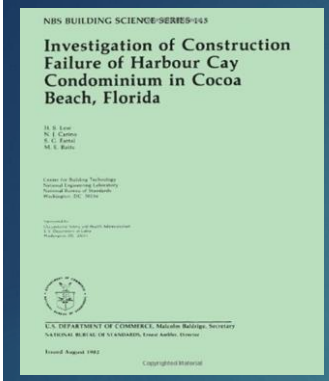
- Caused by inadequate roof drains
- Ponding water on roof
- Miscalculated hanger bolt strengths

11


"I think we can agree that the bridge collapsing is not a good thing."

- 1970s-1980s, number of notable structural failures Kemper Arena, the Hartford Coliseum, a building in Cocoa Beach Florida, and Kansas City Hyatt. As a result, the House of Representatives held hearings into the issue. House Report 98-621 in 1984, identified the absence of the SER on the project site as a significant contributing factor in avoiding future failures.
- *"Professional organizations…should make every effort to ensure that provisions are written into building codes and adopted in the public forum which make the on-site presence of the structural engineer mandatory during the construction of structural components on public facilities."*
- *Central Issue; "Are there common problems associated with structural failures, the elimination of which would decrease the number of failures?"*

11


NBS BUILDING SCIENCE SERIES 143

Investigation of Construction Failure of Harbour Cay Condominium in Cocoa Beach, Florida

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, Secretary
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

Issued August 1982

Copyrighted Material

12

Harbor Cay Condominium 5-story flat plate residential development project Cocoa Beach Florida that collapsed during construction on March 27, 1981. 11 workers killed 27 injured. as workers were completing its framework by pouring concrete for the roof. The accident led to more rigorous enforcement of engineering and construction codes in Florida and elsewhere.

Cause

The collapse was due to numerous errors in design and construction. The concrete slabs were only 8 inches (200 mm) thick and should have been 11 inches (280 mm) thick to satisfy the American Concrete Institute's Building Code minimum.

12

On March 2, 1973, tragedy struck the Skyline Plaza complex in Bailey's Crossroads, Virginia. One of the complex's towering apartment buildings collapsed, leaving a huge, eerie cloud of dust and debris where it once stood. Perhaps surprisingly, construction hadn't even completed at the time of the disaster. The building was not due to open until August.

Although there was no flaw in the design per se, the forms supporting the concrete columns on the 22nd floor were prematurely removed. The cement hadn't yet hardened completely and couldn't bear the weight of the 24th floor. The failure of these columns put an increased amount of pressure on the rest of the columns on the 23rd floor until the entire floor buckled and slammed down on the floor below. The building had not been engineered to withstand such a huge increased load, and the tremendous weight proved catastrophic. Each floor gradually succumbed and plummeted onto the story below in a devastating ripple effect. Fourteen construction workers died and 34 were injured. Michael Hill, 31, ran all the way down the stairs from the 23rd floor when he saw cracks appear in the ceiling. He made it to the fourth floor when he was forced to jump out of a window. He broke both his arms but survived.

13

13

Key Players

14

Registered design professional

Structural engineer of record

Testing agency

Special Inspector

- A Special Inspection Agency & Special inspectors are third party licensed professional engineers and architects who oversee the construction and sign off of your project.

1. Objective, competent, independent
2. Adequate equipment (periodically calibrated)
3. Experienced personnel (conducting, supervising & evaluating tests)

Approved Agencies

Contractor

Building Department

15

- Standard Specification for Agencies engaged in construction Inspection and/or Testing - (ASTM E 329)

Designation: E 329 – 07

Standard Specification for
Agencies Engaged in Construction Inspection and/or Testing[1]

1. Scope*

1.1 This specification defines the minimum requirements for inspection agency personnel or testing agency laboratory personnel, or both, and the minimum technical requirements for equipment and procedures utilized in the testing and inspection of construction and materials used in construction.

1.2 Criteria is provided for evaluating the capability of agency to properly perform designated tests on construction materials, and establishes essential elements relative to staffing the organization, personnel, facilities, and quality systems of the agency. This specification may be supplemented by more specific criteria and requirements for particular projects.

1.3 This specification can be used as a basis to evaluate an agency and is intended for use in qualifying and/or accrediting agencies, public or private, engaged in the testing and inspection of construction and materials. These materials include concrete, steel, soil, masonry and bituminous materials.

1.4 A certificate of accreditation, including the scope of accreditation, is required to comply with this standard.

1.5 The users of an accredited agency must review the agency's scope of accreditation to ensure the agency has been accredited for its authorized competence to perform the specific tests or inspections required by the user.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A 880 Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys

C 1077 Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

C 1093 Practice for Accreditation of Testing Agencies for Unit Masonry

D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

E 4 Practices for Force Verification of Testing Machines

E 543 Specification for Agencies Performing Nondestructive Testing

E 605 Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members

E 736 Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

E 694 Guide for Calibration and Testing Laboratory Accreditation Systems General Requirements for Operation and Recognition

E 1515 Practice for Application of Sprayed Fire Resistive Materials (SFRMs)

E 2174 Practice for On-Site Inspection of Installed Fire Stops

E 2393 Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

2.2 *AASHTO Standard:*

R 18 Standard Recommended Practice for Establishing and Implementing a Quality System for Construction Materials Testing Laboratories

2.3 *ANSI ISO/IEC Standard:*

17025 General Requirements for the Competence of Calibration and Testing Laboratories

2.4 *AWS Document:*

D1.1 Structural Welding Code, Steel

16

Pre-construction meetings

- BUILDING OFFICIAL IN CHARGE
- ATTENDED BY ALL PARTIES TO DISCUSS INSPECTION/TESTINGPROGRAM
- UNDERSTAND ROLES &RESPONSIBILITIES
- SET THE STAGE
- EXPECTATIONS
- SCHEDULES OF SERVICES
- COMMUNICATION PROTOCOL
- DOCUMENTATION & SUBMITTALS & DISTRIBUTION
- INSPECTIONS & REPORTS

16

17

Statement of Special Inspections → Submittals

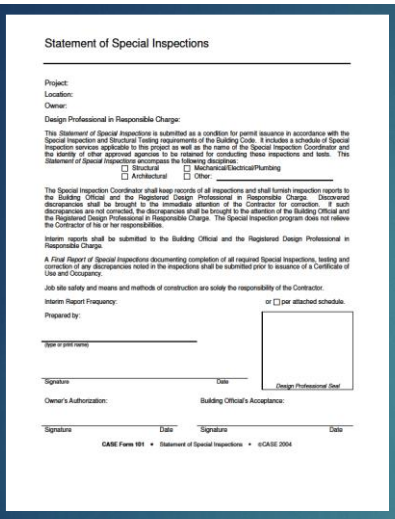
Continuous vs. Periodic

Continuous inspection = 100% of work as being performed.

Periodic inspection = frequency of inspection varies depending on size and complexity of project.(specified on Statement of Special Inspections by RDP)

17

18



Statement of Special Inspections

Project:
Location:
Owner:
Design Professional in Responsible Charge:

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. This *Statement of Special Inspections* encompass 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 be brought to the immediate attention of the Contractor for 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.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: or ☐ per attached schedule.

Prepared by:

(type or print name)

Signature Date

Design Professional Seal

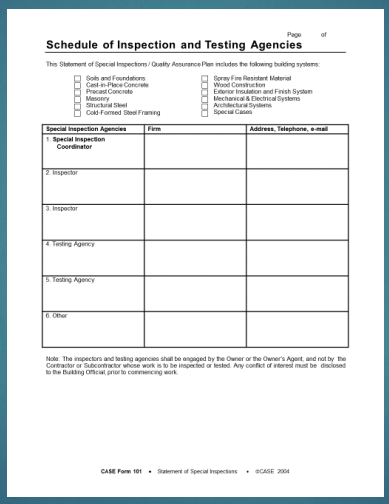
Owner's Authorization:

Signature Date

Building Official's Acceptance:

Signature Date

CASE Form 101 • Statement of Special Inspections • ©CASE 2004



Page of

Schedule of Inspection and Testing Agencies

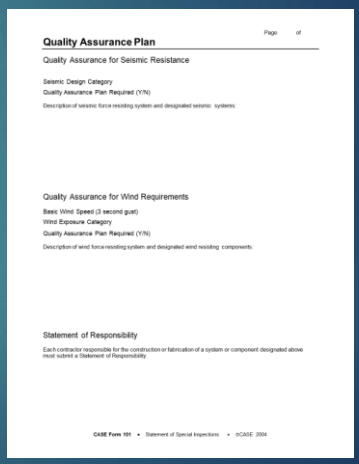
This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

☐ Soils and Foundations
☐ Cast-in-Place Concrete
☐ Precast Concrete
☐ Masonry
☐ Structural Steel
☐ Cold-Formed Steel Framing
☐ Spray Fire Resistant Material
☐ Wood Construction
☐ Exterior Insulation and Finish System
☐ Mechanical & Electrical Systems
☐ Architectural Systems
☐ Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. **Special Inspection Coordinator**		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

CASE Form 101 • Statement of Special Inspections • ©CASE 2004



Page of

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category
Quality Assurance Plan Required (Y/N)
Description of seismic force resisting system and designated seismic systems

Quality Assurance for Wind Requirements

Basic Wind Speed (3 second gust)
Wind Exposure Category
Quality Assurance Plan Required (Y/N)
Description of wind force resisting system and designated wind resisting components

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility

CASE Form 101 • Statement of Special Inspections • ©CASE 2004

18

19

Responsibilities:

- Special Inspector
  - Review plans /specs
  - Id at job site
  - Observe work
  - Report nonconformities
  - Submit progress reports
  - Submit final report
- Owner
  - Responsible for funding the Special Inspection program

19

20

Responsibilities:

- RDP
- Submit Statement of Special Inspections
- Materials /systems/components/work with duties stated
- Type & extent of each special inspection naming individual or firm
- Type & extent of each test
- Respond to field discrepancies
- Review shop drawings and submit revisions

20

21

Responsibilities:

- Contractor
- Submit statement of responsibility to Building Official – awareness of program
- Provide access to plans
- Retain special inspector records
- Building Official
- Approve special inspection program / fabricators / inspectors
- Monitor activities
- Issue orders as needed
- Review inspection reports
- Inspections as needed & final > all reports & closure docs received

21

- **Structural Observations:**
  - Owner or owner's rep employ design professional who shall provide a statement of frequency & extent of inspections

22

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector Structural
ICC-SWSI	Steel and Welding Special Inspector Spray-
ICC-SFSI	Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector

Other

22

MINIMUM QUALIFICATIONS FOR SPECIAL INSPECTORS
(Fabricators/Special Inspection Agencies/Testing Labs/Laboratory Technicians)

A. FABRICATORS

A.1. Fabricators: Not Registered or Approved (IBC 2015 Section 1704.2.5.1)

The designated Special Inspector and/or Special Inspection Agency inspecting the Fabricator Shop for compliance with Section 1704.2.5.1 of the _____Building Code 2015 (MBC 2015) shall be pre-approved by the Building Department for the specified Category of the fabrication prior to Building Permit issuance. See the specific Category information for minimum qualifications criteria:

- For Structural Steel – See Category B
- For Concrete – See Category C
- For Structural Wood – See Category E

A.2. Fabricators: Registered and Approved (IBC 2012 Section 1704.2.5)

Special Inspections are not required for work done on the premises of a registered and approved Fabricator that has a current accreditation from the International Accreditation Services (IAS), a current certification from a nationally recognized organization, or an equivalent certification. Equivalencies are subject to review and acceptance by the_____Building Department and shall be performed by an approved Special Inspection Agency in accordance with applicable provisions of Sections 1703 and 1704.2.5.2.

The following National Fabricator Certifying Organizations are recognized and acceptable by the _____Building Department:

- The American Institute of Steel Construction (AISC) for Fabricators of Structural Steel
- American Steel Joist Institute (SJI) for Fabricators of Steel Joists
- Precast/Prestressed Concrete Institute for Fabricators of Precast and Prestressed Concrete
- Truss Plate Institute (TPI) for Fabricators of Wood Trusses

B. STRUCTURAL STEEL

B. 1. Steel – High Strength Bolting:

The Special Inspector shall comply with at least one of the Education and Experience Requirements and at least one of the Certification Requirements noted below:

23

Submittals:

24

- Certificates of Compliance:
A. Fabrication
B. Seismic non-structural components, supports, and attachments
C. Seismic designated systems
D. Open web steel joists, and joist girders

- Pre-construction tests SHOTCRETE
- Weldability reports. AWS D1.4. (ACI 318Rebar)
- Mill-test reports rebar resist earthquake induced flexural or axial forces, special moment frames, special structural walls or coupling beams (Seismic Design Categories B, C, D, E or F)

24

25

Who Approves

- QUALIFIED BY BUILDING OFFICIAL
- *ASTM E 329* STANDARD SPEC FOR AGENCIES ENGAGED IN CONSTRUCTION INSPECTION, TESTING, OR SPECIAL INSPECTION
- *ASTM E699* STANDARD PRACTICE FOR EVALUATION OF AGENCIES INVOLVED IN TESTING, QUALITY ASSURANCE, AND EVALUATING OF BUILDING COMPONENTS

25

Statement of Special Inspections

- Detailed list of testing / inspection requirements
- Submitted with building permit application
- Written by RDP
- Ids materials /systems / components /work
- Type &extent of each test
- .

http://www.seam.org/sitask/SEAM--Structural%20Special%20Inspections%20Master.doc

26

Submittals /forms

Forms

- Statement of Special Inspections
- Contractor Statement of Responsibility
- Special Inspections Record
- Special Inspections Daily /Weekly Report
- Special Inspections Final Report
- Get template forms at: www.iccsafe.org/content/special-inspection-manual

27

27

CATEGORIES

28

- On Site Fabricators
- Soils
- Concrete
- Deep Driven Foundations
- Structural Steel
- Masonry
- Spray on Fire-Resistant Materials (SFRM)
- Mastic & Intumescent Fire-Resistant Coatings
- EIFS
- Fire-Resistant Penetrations & Joints
- Smoke Control Systems
- Seismic Resistance
- Wind Resistance
- Certain Architectural & MEP Components
- Wood (Long Span Trusses & High Load diaphragm)
- Special Cases

28

On Site Fabricators

29

- Steel frame AISC cert
- (structural AISC 360 / seismic AISC 341)
- Welds (CJP = complete joint penetration)
- Nondestructive testing (NDT)
- Certificate of Compliance
- Accreditation Program IAS AC472

29

On Site Fabricators

30

- Structural members
- Load-bearing or lateral load-resisting members
- Assemblies

- Exceptions:
- Not required when fabricators maintain approved detailed fabrication & QC procedures (Approval based on review of fab & QC procedures & periodic inspection by BO
- NR where fabricator is registered and approved.

30

On Site Fabricators

31

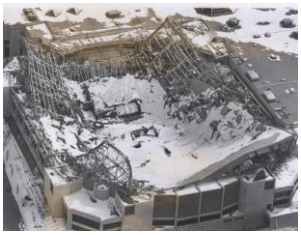
- Upon completion submit
- Certificate of Compliance to owner & BO.

31

Hartford Civic Center

- built in 1975, seated 10,507 In the early morning of January 18, 1978, just hours after the University of Connecticut Men's Basketball team defeated the University of Massachusetts Amherst, the weight of snow from the day's heavy snowstorm on a faultily constructed roof caused the Civic Center's roof to collapse. determined the reason for the collapse was the Civic Center being one of the very first buildings designed on a computer which caused problems for the building crew during construction, such as the measurements of beams being so precise that the beams had to be modified and forced to fit together.

32



The Hartford Courant

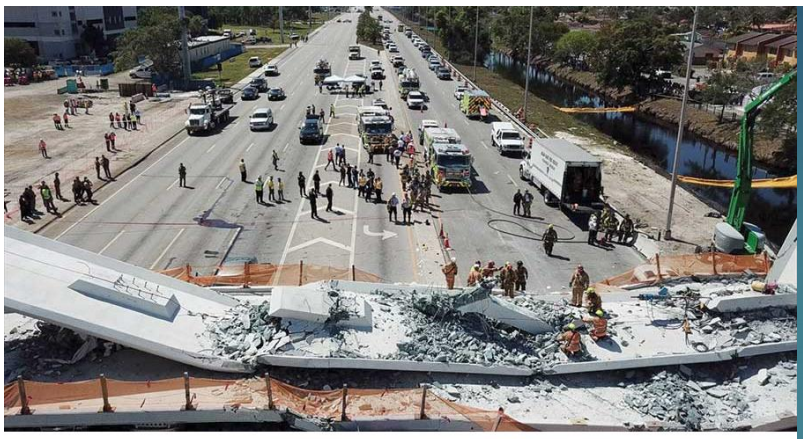
Civic Center's Coliseum Roof Collapses During Heavy Storm; No One Is Injured

Crowd Left Hours Earlier

Civic Center Wreckage

Disaster To Cause Economic Havoc in City

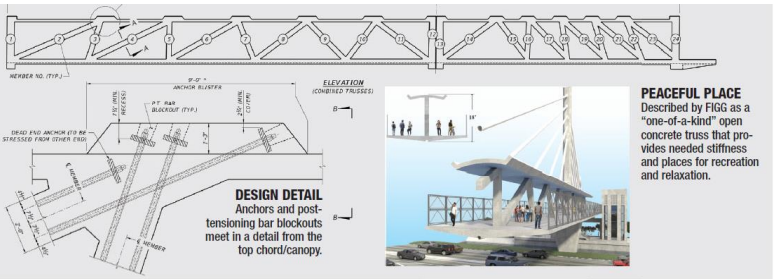
32



33

The FIGG engineer of record Thiel testified a technical presentation regarding the crack and concluded that there were no safety concerns that the crack did not compromise the structural integrity of the bridge.

The structure appeared to fail at its north end. According NTSB investigator Abdel Mesih, so that at the time of the collapse, crews were working on one of the diagonal members at the north end of the structure, modifying post-tensioning force that is designed to strengthen the diagonal member."



33

Cast-in-Place Concrete Page of

Item	Agency # (Qualif.)	Scope
1. Mix Design	ACI-CCI ICC-RCSI	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.
2. Material Certification		
3. Reinforcement Installation	ACI-CCI ICC-RCSI	Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters.
4. Post-Tensioning Operations	ICC-PCSI	Inspect placement, stressing, grouting and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied and wrapped. Record tendon elongations.
5. Welding of Reinforcing	AWS-CWI	Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.
6. Anchor Rods		Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.
7. Concrete Placement	ACI-CCI ICC-RCSI	Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064).
9. Curing and Protection	ACI-CCI ICC-RCSI	Inspect curing, cold weather protection and hot weather protection procedures.
10. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE 2004

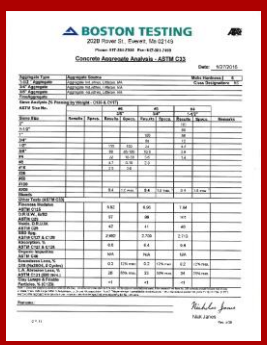
34

Concrete

34

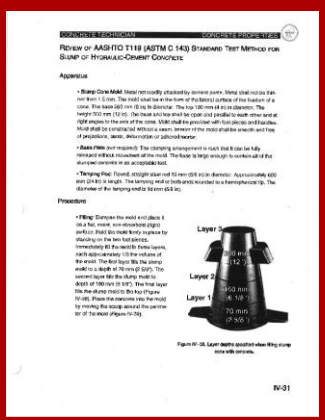
Job Task lists

- Concrete:
- Review approved plans / specs
- Submit progress reports
- Notify of deviations
- Final summary report
- Concrete quality: batch tickets / sampling / field testing / specimen id / site storage / protection / transport to testing lab /communication
- Reinforcement / formwork /placement / curing


BOSTON TESTING

2026 Rover St., Everett, MA 02149

Concrete Aggregate Analysis - ASTM C33


CONCRETE TECHNICIAN — CONCRETE STRENGTH TESTS

REVIEW OF AASHTO T119 (ASTM C 143) STANDARD TEST METHOD FOR SLUMP OF HYDRAULIC-CEMENT CONCRETE

Apparatus

Procedure

IV-31

35

Admixtures

- Admixtures are those ingredients in concrete other than portland cement, water, and aggregates that are added to the mixture immediately before or during mixing. Admixtures can be classified by function as follows:
- 1. Air-entraining admixtures
- 2. Water-reducing admixtures
- 3. Plasticizers
- 4. Accelerating admixtures
- 5. Retarding admixtures
- 6. Hydration-control admixtures
- 7. Corrosion inhibitors
- 8. Shrinkage reducers
- 9. Alkali-silica reactivity inhibitors
- 10. Coloring admixtures
- 11. Miscellaneous admixtures such as workability, bonding, damp proofing, permeability reducing, grouting, gas-forming, anti-washout, foaming, and pumping admixtures

36

Cast-in-Place Concrete Page of

Item	Agency # (Qualif.)	Scope
1. Mix Design	ACI-CCI ICC-RCSI	*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.*
2. Material Certification		
3. Reinforcement Installation	ACI-CCI ICC-RCSI	*Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters*
4. Post-Tensioning Operations	ICC-PCSI	*Inspect placement, stressing, grouting and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied and wrapped. Record tendon elongations.*
5. Welding of Reinforcing	AWS-CWI	*Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.*
6. Anchor Rods		*Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.*
7. Concrete Placement	ACI-CCI ICC-RCSI	*Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.*
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064).*
9. Curing and Protection	ACI-CCI ICC-RCSI	*Inspect curing, cold weather protection and hot weather protection procedures.*
10. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE 2004

Precast Concrete Page of

Item	Agency # (Qualif.)	Scope
1. Plant Certification / Quality Control Procedures ☐ Fabricator Exempt	ACI-CCI ICC-RCSI	*Review plant operations and quality control procedures.*
2. Mix Design	ACI-CCI ICC-RCSI	*Inspect concrete batching operations and verify compliance with approved mix design*
3. Material Certification		
4. Reinforcement Installation	ACI-CCI ICC-RCSI	*Inspect size, spacing, position and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials.*
5. Prestress Operations	ICC-PCSI	*Inspect placement, stressing, grouting and protection of prestressing tendons*
6. Connections / Embedded Items		
7. Formwork Geometry		
8. Concrete Placement	ACI-CCI ICC-RCSI	*Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.*
9. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064).*
10. Curing and Protection	ACI-CCI ICC-RCSI	*Inspect curing, cold weather protection and hot weather protection procedures.*
11. Erected Precast Elements	PE/SE	*Inspect erection of precast concrete including member configuration, connections, welding and grouting.*
12. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE 2004

37

38

Problems:

- HONEYCOMBING
- CURLING
- POP-OUTS
- SPALLING

38

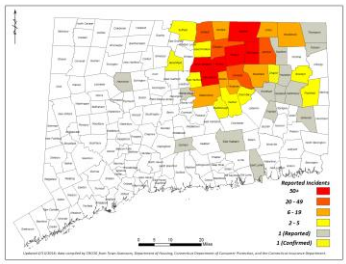


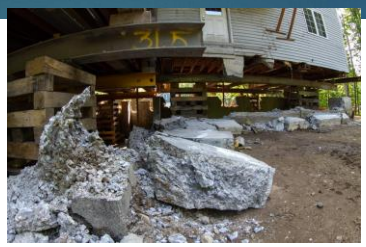
39

TESTING curing test specimens ASTM C192 lab / ASTM C31 field)

39

40





Pyrite and pyrrhotite are minerals known as iron sulfides. When iron sulfides are exposed to water and oxygen, a series of chemical reactions breaks down the iron sulfides and forms new minerals called sulfates. These sulfates take up more space than the original iron sulfides. As they grow, the new sulfate minerals push against the surrounding rock, causing it to swell and crack.

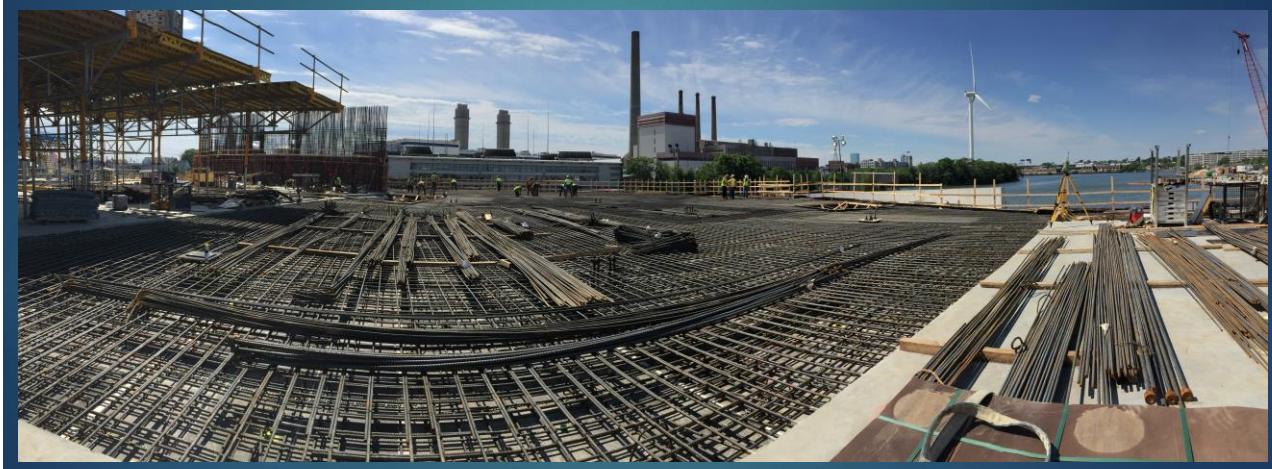
IRON SULFIDE FROM A QUARRY WILLINGTON, CT

41 TOWNS AFFECTING 35,000+ HOMES BUILT (1983- 2015)

NORTH, EAST, AND CENTRAL CONNECTICUT

40

41



41

Deep Driven Foundations

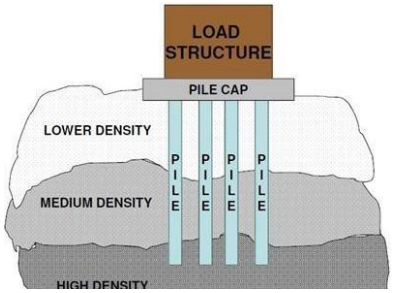
42

Pile Foundations

End bearing

Friction

- Wood / concrete / steel
- Concrete piles are precast, that is, made at ground level, and then driven into the ground by hammering. Steel H-piles can also be driven into the ground. These can take very heavy loads, and save time during construction, as the pile casting process is eliminated. No protective coating is given to the steel, as during driving, this would be scraped away by the soil. In areas with corrosive soil, concrete piles should be used.



42

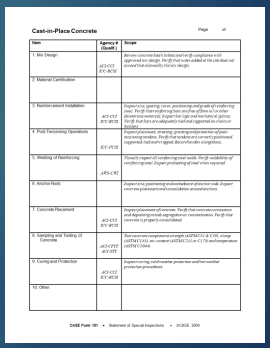
43

43

Deep Driven Foundations

44

Pile foundations no firm bearing strata at any reasonable depth and loading is uneven.
when a firm bearing strata exists, but at such a depth that it makes the strip or spread footing uneconomical.
when pumping of subsoil water would be too costly
Whereas pier foundations are preferred where,
the top strata consists of decomposed rock, overlying a strata of sound rock. In such conditions pile driving becomes very difficult, hence pier foundations are used.
Also in the case of stiff clays, which offer a lot of resistance to driving of a bearing pile, pier foundations can be conveniently used



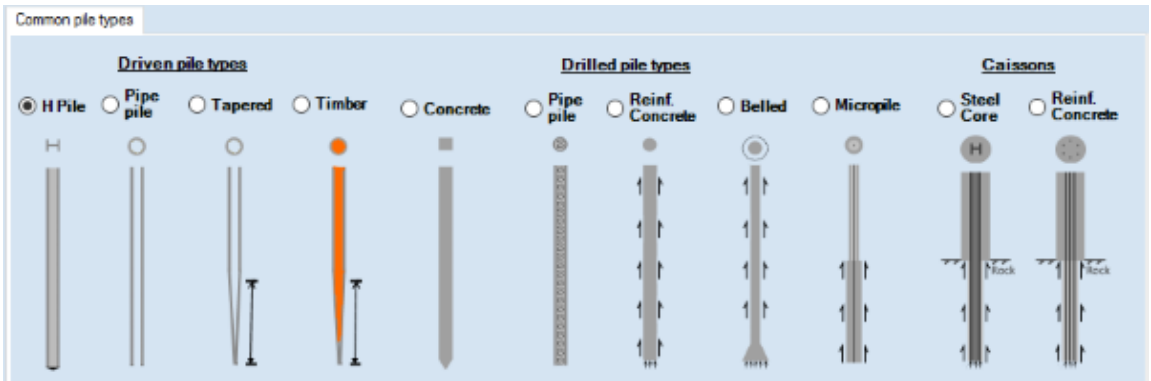
Cast-in-Place Concrete

Item	Agency # (Qual#'s)	Scope
1. Mix Design	ACI-CCI ICC-IAC50	All in-situ concrete batch tickets and mill certificates with approved mix designs. Verify that mix was added at the site does not exceed that allowed by mix design.
2. Material Certification		
3. Reinforcement Installation	ACI-CCI ICC-IAC50	Inspect size, spacing, cover, positioning and splices of reinforcing steel. Verify that reinforcing bars are free of dirt, oil or other foreign materials that could reduce bond with the concrete. Verify that bars are adequately tied and supported in forms or footings.
4. Post Tensioning Operations	ICC-IAC50	Inspect placement, stressing, grouting and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied and the capped. Record tendon elongations.
5. Welding of Reinforcing	AWS-CWI	Visually inspected all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.
6. Anchor Rods		Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.
7. Concrete Placement	ACI-CCI ICC-IAC50	Inspect placement of concrete. Verify that concrete consistency and depositing speed, segregation or contamination. Verify that concrete is properly consolidated.
8. Sampling and Testing of Concrete	ACI-CFTT ACI-CCI	Test concrete compressive strength (ASTM C172 & C39), slump (ASTM C143), air content (ASTM C231 or C173) and temperature (ASTM C1064)
9. Curing and Protection	ACI-CCI ICC-IAC50	Inspect curing, cold weather protection and hot weather protection procedures.
10. Other		

CASE Form 101 • Statement of Special Inspections • IAC&I 2004

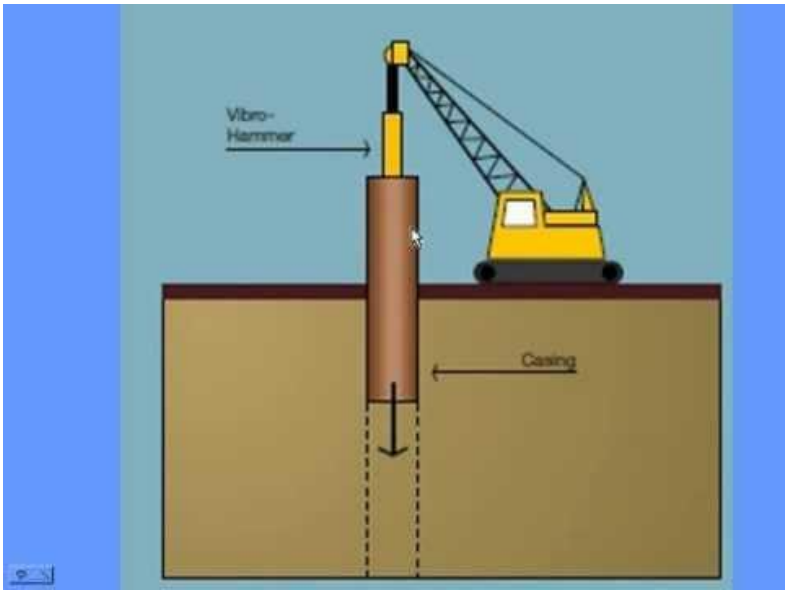
44

45



45

46



46

47

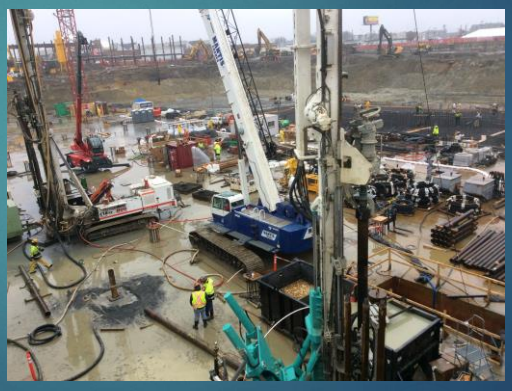
47

48

48

PILE FOUNDATIONS:

a) End bearing piles
b) Friction piles
c) Combined end bearing and friction piles
d) Compaction piles
e) Dolphin and Fender piles
f) Anchor piles
g) Tension or Uplift piles
h) Sheet and Batter Piles



49

49

Pier (Caisson) Foundations

50

- Types of Pier Foundations include:
- 1) Masonry Piers
- 2) Drilled Caissons :
- (a) Concrete in Steel shell Pier
- (b) Drilled Concrete Pier
- (c) Concrete and Steel core in Steel shell pier.

50

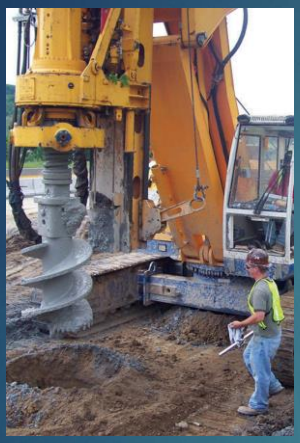
51

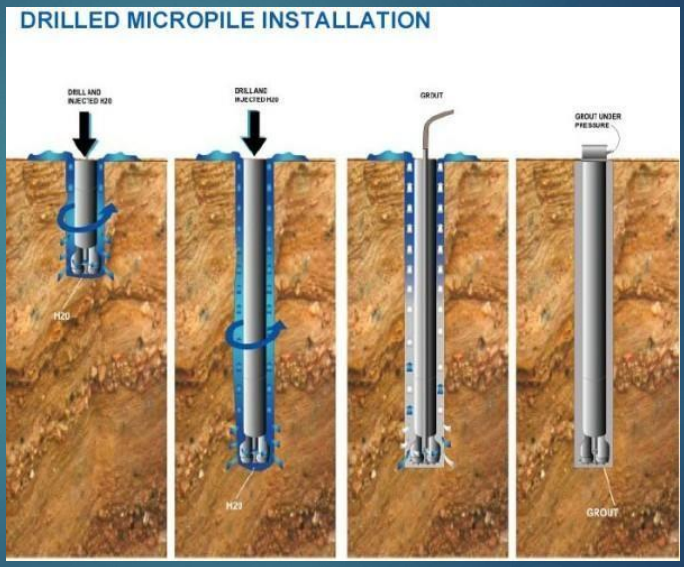
Types of Caissons

•Box caissons are watertight boxes that are constructed of heavy timbers and open at the top. They are generally floated to the appropriate location and then sunk into place with a masonry pier within it.
•Excavated caissons are just as the name suggests, caissons that are placed within an excavated site. These are usually cylindrical in shape and then back filled with concrete.
•Floating caissons are also known as floating docks and are prefabricated boxes that have cylindrical cavities.
•Open caissons are small cofferdams that are placed and then pumped dry and filled with concrete. These are generally used in the formation of a pier.
•Pneumatic caissons are large watertight boxes or cylinders that are mainly used for under water construction

51

52





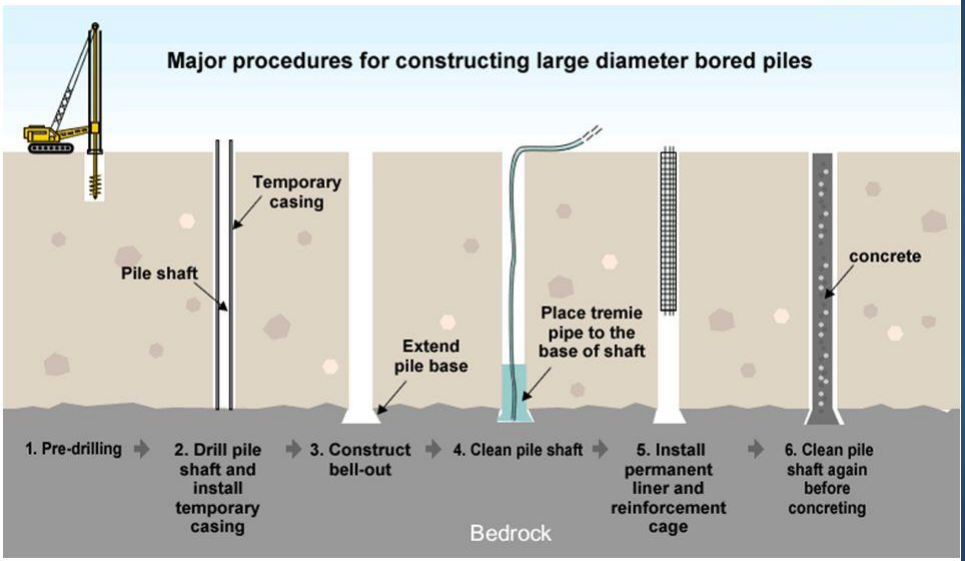
52

53

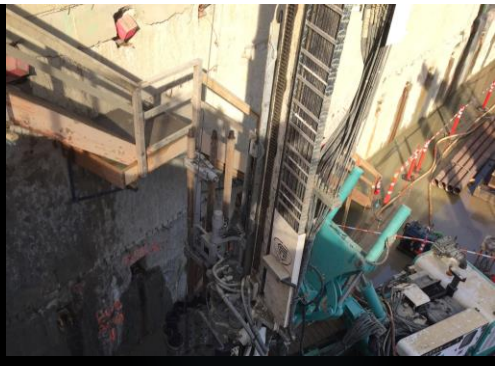
Deep foundations

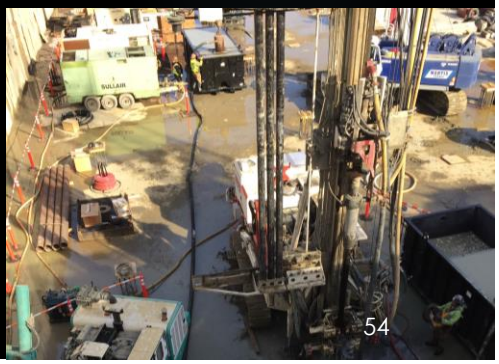
Types of deep foundations

Bored piles



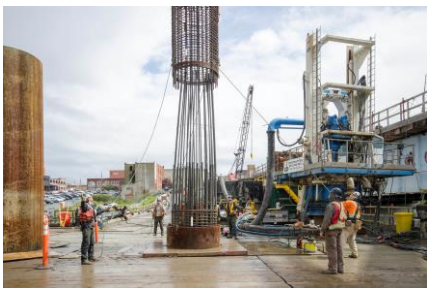
53





54

55

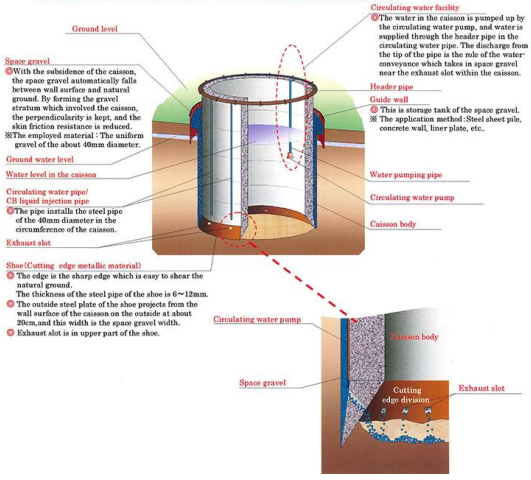


55

56

- The non-loading installation method
- The method which does not cause subsidence and collapse of the peripheral ground
- The applicable method for all strata

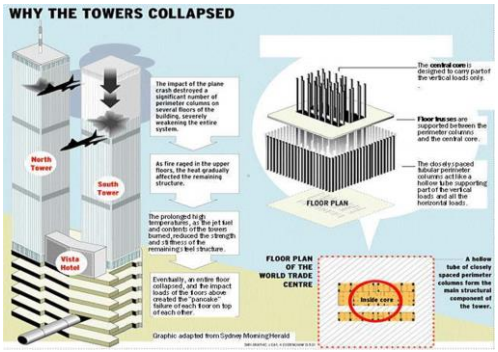
The mechanism of SS caisson method

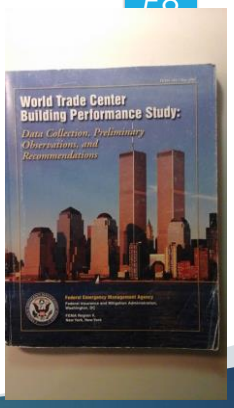


56

57

57





Structural Steel

58

Structural Steel Page of

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures ☐ Fabricator Exempt	AWS/AISC-SSI ICC-SWSI	*Review shop fabrication and quality control procedures.*
2. Material Certification	AWS/AISC-SSI ICC-SWSI	*Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes*
3. Open Web Steel Joists		*Inspect installation, field welding and bridging of joists.*
4. Bolting	AWS/AISC-SSI ICC-SWSI	*Inspect 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 connections.*
5. Welding	AWS-CWI ASNT	*Visually inspect all welds. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds.* *Ultrasonic testing of all full-penetration welds.*
6. Shear Connectors	AWS/AISC-SSI ICC-SWSI	*Inspect size, number, positioning and welding of shear connectors. Inspect studs for full 360 degree flash. Ring test all shear connectors with a 3 lb hammer. Bend test all questionable studs to 15 degrees.*
7. Structural Details	PE/SE	*Inspect steel frame for compliance with structural drawings, including bracing, member configuration and connection details.*
8. Metal Deck	AWS-CWI	*Inspect welding and side-lap fastening of metal roof and floor deck.*
9. Other:		

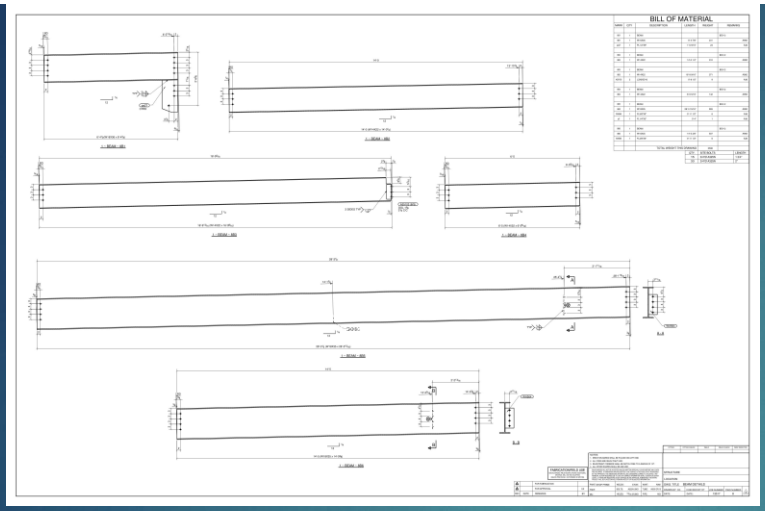
CASE Form 101 • Statement of Special Inspections • ©CASE 2004

59

Job Task lists

- Structural Steel:
- Review approved plans / specs
- Submit progress reports
- Notify of deviations
- Final summary report stating in compliance
- Verify shapes and bolts proper type, size, grade and condition
- Verify type, quantity, location and frequency of tests
- Witness prep of id test samples and testing on materials
- High-strength bolting – faying surfaces / sequence of bolt tightening /observe bolt-tension tests
- Frame orientation /details and member sizes
- Column bases (hole sies, clearance for grouting)

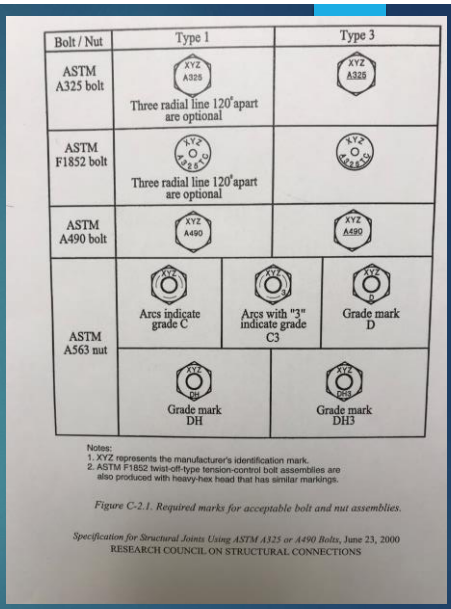
59



STEEL SHOP DRAWINGS

HIGH STRENGTH BOLTS (ASTM A325 & A490)

PRETENSIONED / SLIP CRITIAL JOINTS (FAYING SURFACES)



Bolt / Nut	Type 1	Type 3
ASTM A325 bolt	XYZ A325 Three radial line 120° apart are optional	XYZ A325
ASTM F1852 bolt	XYZ F1852 Three radial line 120° apart are optional	XYZ F1852
ASTM A490 bolt	XYZ A490	XYZ A490
ASTM A563 nut	XYZ Arcs indicate grade C; XYZ Arcs with "3" indicate grade C3; XYZ D Grade mark D	XYZ DH Grade mark DH; XYZ DH3 Grade mark DH3

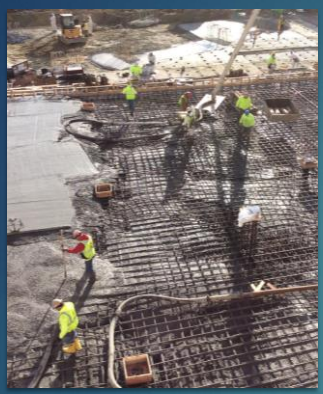
Notes:
1. XYZ represents the manufacturer's identification mark.
2. ASTM F1852 twist-off-type tension-control bolt assemblies are also produced with heavy-hex head that has similar markings.

Figure C-2.1. Required marks for acceptable bolt and nut assemblies.

Specification for Structural Joints Using ASTM A325 or A490 Bolts, June 23, 2000
RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS

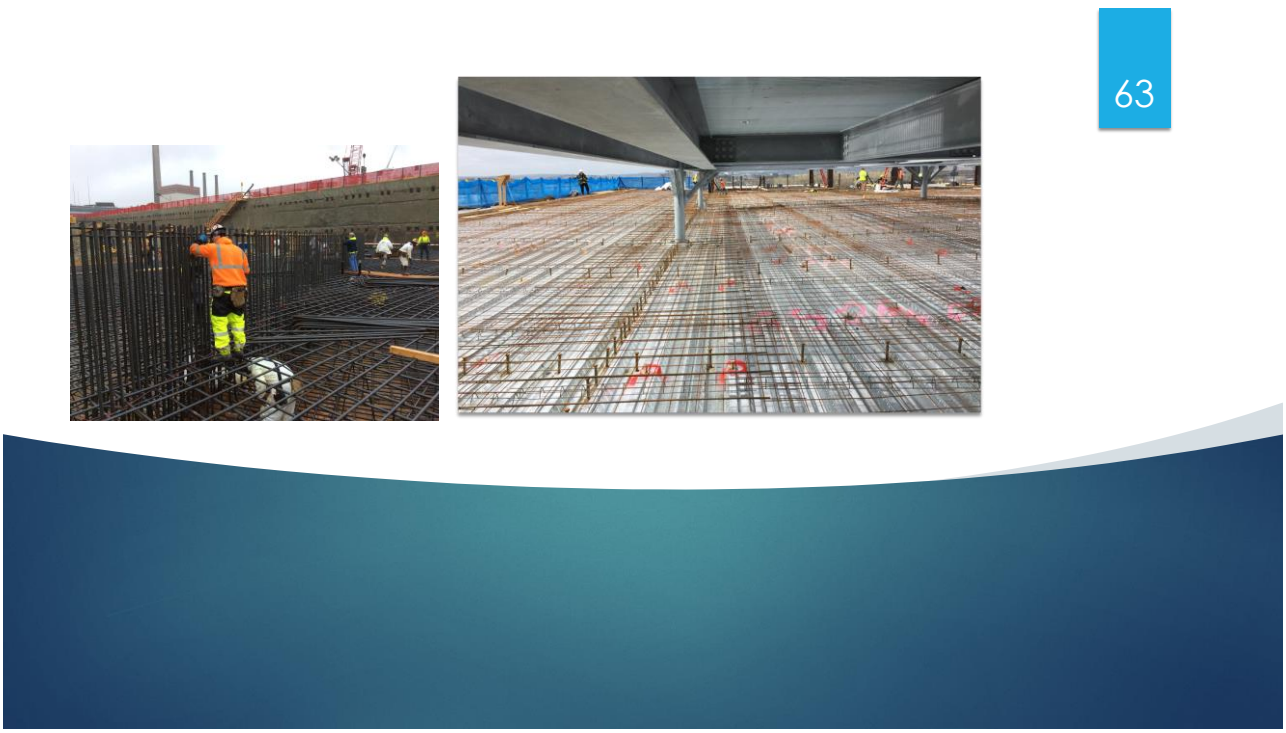
60

61

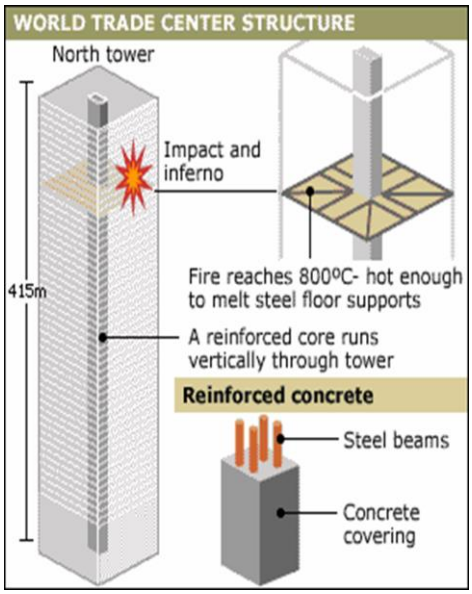


61

62

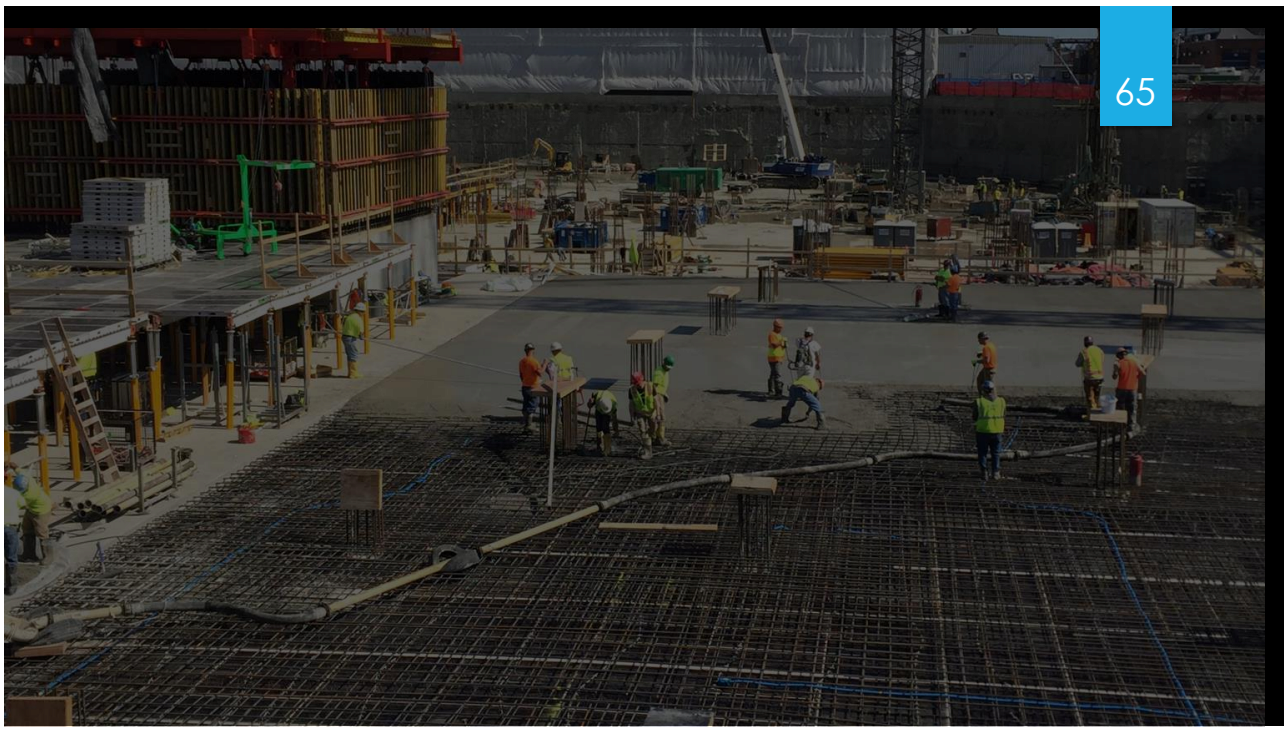


63


WORLD TRADE CENTER STRUCTURE
North tower
Impact and inferno
415m
Fire reaches 800ºC- hot enough to melt steel floor supports
A reinforced core runs vertically through tower
Reinforced concrete
Steel beams
Concrete covering

64

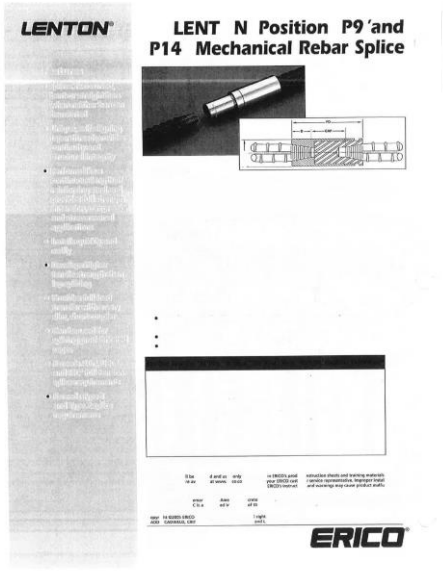
64



65

65

66



Reinforcing Steel and Concrete Placement Checklist

- ☐ Check the field drawing and compare to our latest approved drawings (revision number and date)
- ☐ Check the bar size, type of steel and grade of steel
- ☐ Check bar spacing and count bars verifying it is within tolerance
- ☐ Check bar shapes (bend dimensions and radius)
- ☐ Check leg orientation
- ☐ Check bar lap splices
- ☐ Check for any embeds and additional bars required at embeds and openings
- ☐ Check stirrup spacing
- ☐ Check rebar tying
- ☐ Check rebar supports (chairs, bolsters etc.)
- ☐ Check surface condition of bars (oil, excessive rust etc.)
- ☐ Check epoxy coating if required (also check for touch up at cuts)
- ☐ Check rebar cover and clearance
- ☐ Check certification of testing technician
- ☐ Check concrete technician's testing and storage procedures
- ☐ Check required mix design against truck delivery ticket

66

67

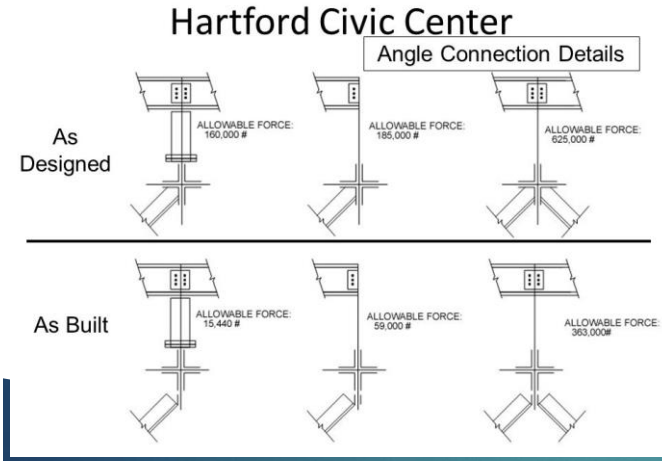
BIG DIG CEILING PANEL COLLAPSE

- The collapse of the ceiling structure began with the simultaneous creep-type failure of several anchors embedded in epoxy in the tunnel's roof slab. Each of the panel's intersecting connection points consists of several individual bolts anchored into the roof slab concrete. The failure of a group of anchors set off a chain reaction which caused other adjacent connection groups to creep then fail, dropping 26 short tons (24,000 kg) of concrete to the roadway below.

The National Transportation Safety Board determined that the probable cause of the July 10, 2006 ceiling collapse was the use of an epoxy anchor adhesive with poor creep resistance, that is, an epoxy formulation that was not capable of sustaining long-term loads

Adhesive anchor failures – resulted in a fatality and indictments $54 million cost

67



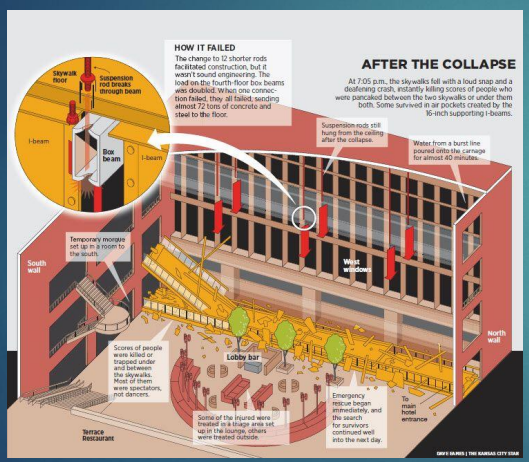
68

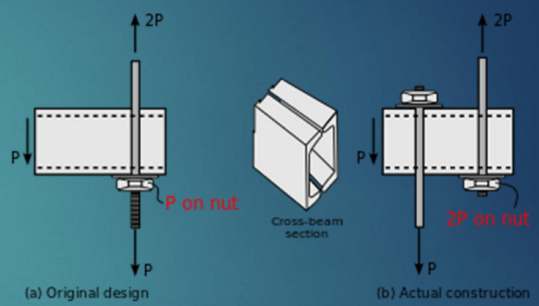
Hartford Civic Center

68

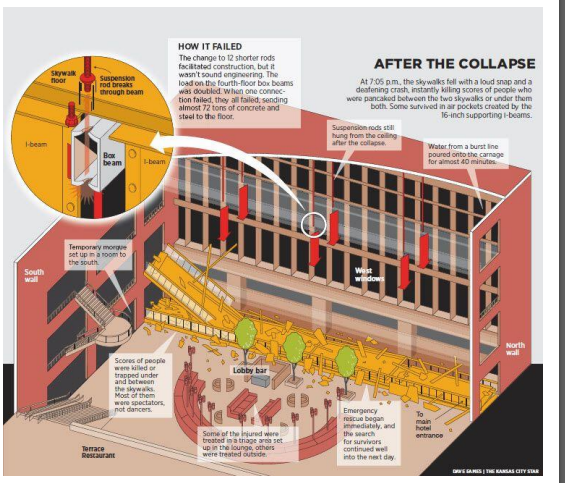
Hyatt Regency Pedestrian Bridge Collapse
7/17/81
114 Deaths / 200 injured

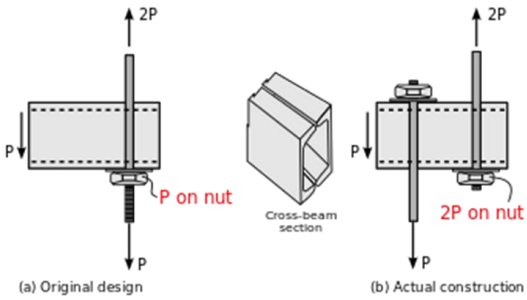
69





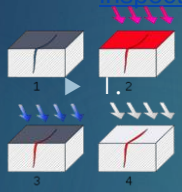
69



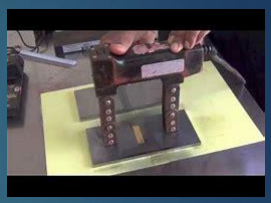


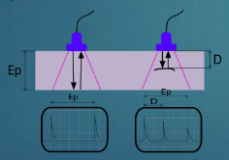
WELD Tests AWS

- Non destructive Tests: Welds may be tested using NDT techniques such as industrial radiography or industrial CT scanning using X-rays or gamma rays, ultrasonic testing, liquid penetrant testing, magnetic particle inspection or via eddy current.



Section of material with a surface-breaking crack that is not visible to the naked eye.
Penetrant is applied to the surface.
Excess penetrant is removed.
Developer is applied, rendering the crack visible.





Principle of ultrasonic testing. LEFT: A probe sends a sound wave into a test material. There are two indications, one from the initial pulse of the probe, and the second due to the back wall echo. RIGHT: A defect creates a third indication and simultaneously reduces the amplitude of the back wall indication. The depth of the defect is determined by the ratio D/E_p.

72

Job Task lists

- Structural Steel:
- Welding – base metals /filler metals / gases
- Frequency of tests
- Destructive & nondestructive testing
- American Welding Society (AWS) cert welders

72

Welds

73

- WELD QUALITY
- DESIGN
- MATERIALS
- WELD PROCEDURE
- MANNER OF APPLICATION
- INSPECTION PROGRAM

- ANSI Z49.1 SAFETY IN WELD, CUTTING, AND ALLIED PROCESSES
- ANSI QC1 STANDARD FOR AWS CERT. OF WELD. INSP.

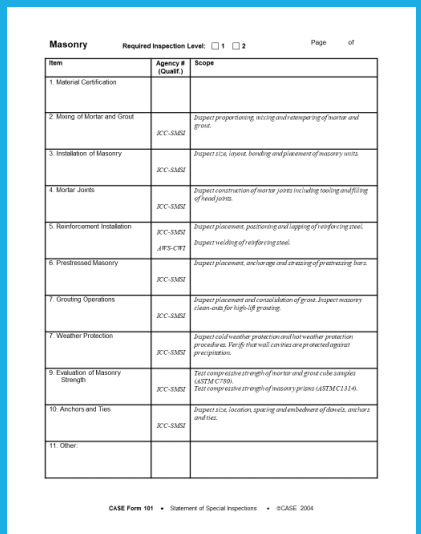
73

74

- review drawings & specs
- check procedure & performance quality
- establish hold points
- establish documentation plan
- review material documentation
- examine base material
- examine fitup & alignment of joints
- review storage of welding consumable

74

Masonry



Masonry Required Inspection Level: ☐ 1 ☐ 2 Page of

Item	Agency # (Qualif.)	Scope
1. Material Certification		
2. Mixing of Mortar and Grout	ICC-SMSI	*Inspect proportioning, mixing and retempering of mortar and grout.*
3. Installation of Masonry	ICC-SMSI	*Inspect size, layout, bonding and placement of masonry units.*
4. Mortar Joints	ICC-SMSI	*Inspect construction of mortar joints including tooling and filling of head joints.*
5. Reinforcement Installation	ICC-SMSI AWS-CWI	*Inspect placement, positioning and lapping of reinforcing steel.* *Inspect welding of reinforcing steel.*
6. Prestressed Masonry	ICC-SMSI	*Inspect placement, anchorage and stressing of prestressing bars.*
7. Grouting Operations	ICC-SMSI	*Inspect placement and consolidation of grout. Inspect masonry clean-outs for high-lift grouting.*
7. Weather Protection	ICC-SMSI	*Inspect cold weather protection and hot weather protection procedures. Verify that wall cavities are protected against precipitation.*
9. Evaluation of Masonry Strength	ICC-SMSI	*Test compressive strength of mortar and grout cube samples (ASTM C780).* *Test compressive strength of masonry prisms (ASTM C1314).*
10. Anchors and Ties	ICC-SMSI	*Inspect size, location, spacing and embedment of dowels, anchors and ties.*
11. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE 2004

75

- Mortar (ASTM C1142 /C780)
- Grout (ASTM C1019 compressive test)
- Autoclaved Aerated Concrete is a Lightweight, Load-bearing, High-insulating, Durable building product, which is produced in a wide range of sizes and strengths. **AAC Blocks** is lightweight and compare to the red bricks AAC blocks are three times lighter.
- Low lift grout < 5 feet
- High lift grout ≤ 24 feet

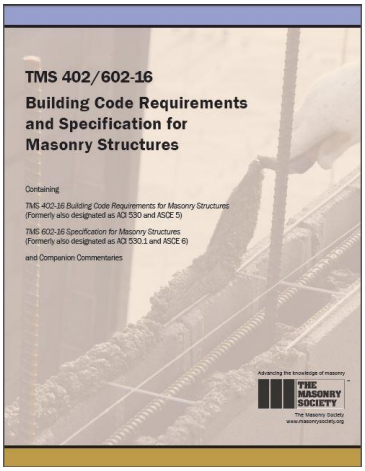
75

76

Job Task lists

- Masonry:
- Review approved plans / specs
- Submit progress reports
- Notify of deviations
- Final summary report stating in compliance
- Verify brick / block /cement / lime / aggregates / reinforcement, etc per specs
- Placement / weather conditions
- Grout placement / cleanouts

- 2 levels of inspection for masonry.
- Level 2 inspections "engineered masonry" in essential facilities (hospitals, police stations, firehouses, etc.). more items are identified as continuous
- All other masonry is subject to Level 1 inspections.



76

77

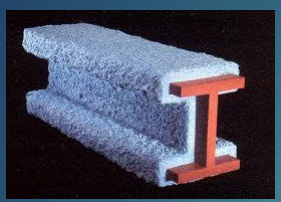
- ASTM C 270 Standard Specifications for Mortar for Unit Masonry
- ASTM C 476 Standard Specification for Grout for Masonry
- ASTM C 780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and reinforced Unit Masonry
- ASTM C 1019 Standard Test Method for sampling and Testing Grout
- ASTM C 1314 REV B Standard Test Method for Compressive Strength of Masonry Prisms

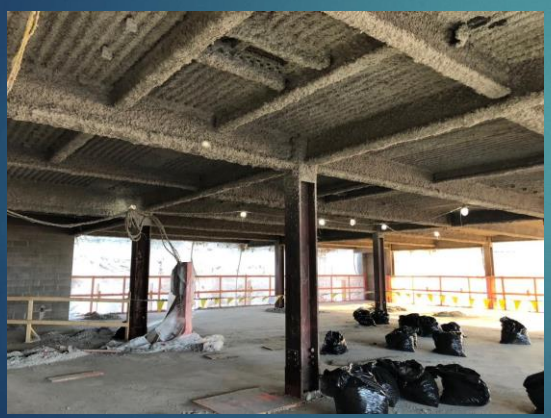
77

Sprayed Fire-Resistant Materials

78

78





Spray-Applied Fire Resistant Material Page of

Item	Agency # (Qualif.)	Scope
1. Material Specifications		
2. Laboratory Tested Fire Resistance Design	ICC-SFSI	*Review UL fire resistive design for each rated beam, column, or assembly.*
3. Schedule of Thickness	ICC-SFSI	*Review approved thickness schedule.*
4. Surface Preparation	ICC-SFSI	*Inspect surface preparation of steel prior to application of fireproofing*
5. Application	ICC-SFSI	*Inspect application of fireproofing.*
6. Curing and Ambient Condition	ICC-SFSI	*Verify ambient air temperature and ventilation is suitable for application and curing of fireproofing.*
7. Thickness	ICC-SFSI	*Test thickness of fireproofing (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.*
8. Density	ICC-SFSI	*Test the density of fireproofing material (ASTM E605).*
9. Bond Strength	ICC-SFSI	*Test the cohesive/adhesive bond strength of fireproofing ASTM E736). Perform not less than one test for each 10,000 SF.*
10. Other:		

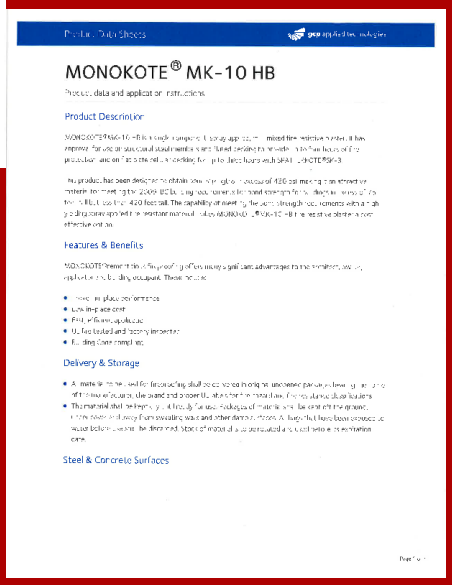
CASE Form 101 • Statement of Special Inspections • ©CASE 2004

79

Job Task lists

- Spray-applied fireproofing:
- Proper storage
- Site conditions
- Ventilation
- Field testing /thickness and
- Condition of finished application


CERTIFICATE OF COMPLIANCE


MONOKOTE® MK-10 HB

Product Description

Features & Benefits

Delivery & Storage

Steel & Concrete Surfaces

80

Results From NIST-Sponsored Tests at UL

Test	Description	Times to Reach End-Point Criteria (min)					Test Terminated (min)	Standard Fire Test Rating		
		Temperature on Unexposed Surface		Steel Temperatures		Failure to Support Load		ASTM E 119-61	ASTM E 119-00	
		Average (Ambient +250°F)	Maximum (Ambient +325°F)	Average (1100°F)	Maximum (1300°F)			Rating (hr)	Re-strained Rating (hr)	Unre-strained Rating (hr)
1	35 ft, restrained, ¾ in fireproofing	---	111	66	62	***	* 116	1½	1½	1
2	35 ft, unrestrained, ¾ in fireproofing	---	---	76	62	***	** 146	2	---	2
3	17 ft, restrained, ¾ in fireproofing	180	157	86	76	***	** 210	2	2	1
4	17 ft, restrained, ½ in fireproofing	---	58	66	58	***	* 120	¾	¾	¾

* Imminent collapse ** Vertical displacement exceeded capability to measure accurately *** Did not occur

NIST

81

81

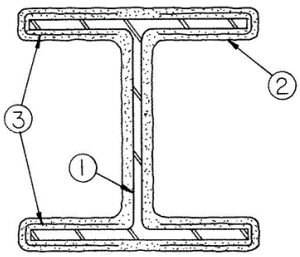
Delaminated spray fireproofing on a steel beam, directly above an unfirestopped control joint in a fire-resistance rated concrete block wall, August 2000, Cambrian College, Sudbury, Ontario, Canada.

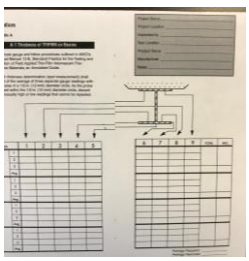
8. Spray-Applied Fire Resistive Materials* — Applied by mixing with water and spraying in more than one coat to the joist and deck surfaces to the final min thicknesses shown above. The crest areas above the joist shall be filled with Spray-Applied Fire Resistive Materials. All surfaces must be clean and free of dirt, loose scale and oil. Min avg and min ind density of 15/14 pcf respectively. Min avg and min ind density of 19/18 pcf respectively for Types 7GP and 7HD. For method of density determination, refer to Design Information Section.

82

82

83





Mastic & Intumescent Coatings

83

84

84

85

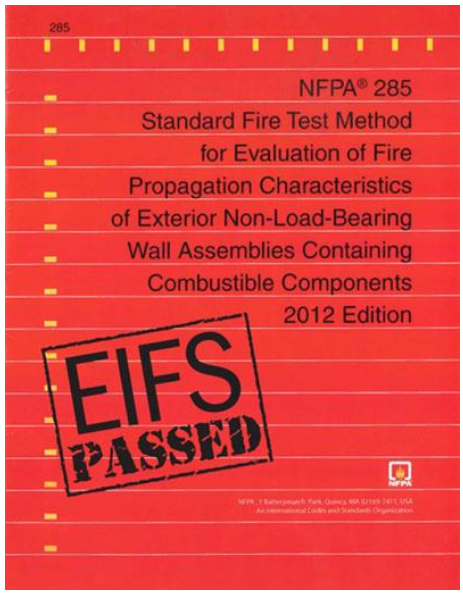
PosiTector® *6000*

Coating Thickness Gages for ALL Metal Substrates

Rugged, fully electronic coating thickness gauges use magnetic and eddy current principles to measure coating thickness on both ferrous and non-ferrous metals, accurately and quickly

- Ready to measure – no calibration adjustment required for most applications
- Solvent, acid, oil, water, and dust resistant – weatherproof
- Wear resistant ruby probe tip, for long-lasting calibration
- PosiTector interchangeable platform – attach any PosiTector probe to a single gage body
- USB, WiFi, and Bluetooth connectivity to PosiSoft PC, Mac, and Smartphone software
- Certificate of Calibration showing traceability to NIST or PTB included (Long Form)

85



86

Exterior Insulation & Finish Systems (EIFS)

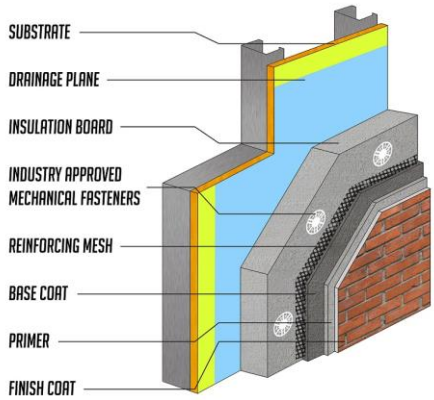
86

87

Exterior Insulation & Finish Systems (EIFS) Page of

Item	Agency # (Qualif.)	Scope
1. Material Submittals		
2. Condition of Substrate		
3. Application of Foam Plastic Board		
4. Application of Coatings		
5. Application of Mesh		
6. Ambient Condition and Curing		
7. Flashing and Joint Details		
8. Sealants/Caulks		
9. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE 2004



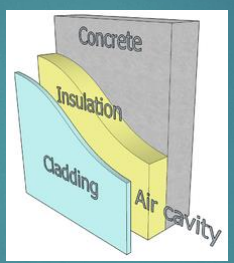
87

88

The EIFS had additional decorative components applied to it. These were large shapes that contained significant thicknesses of EPS and these components were not covered with EIFS lamina. The analysis concluded that they did not meet the requirements of the 1991 UBC

88

89



GRENFELL TOWER IN THE EARLY MORNING OF 14 JUNE 2017. THE BURNT CLADDING IS VISIBLE ON THE OUTSIDE OF THE BUILDING.

89

EIFS

90

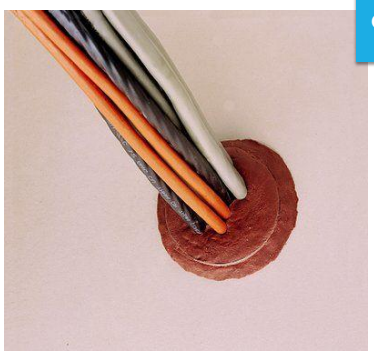
- association of the wall &ceiling industry (awci)
- astm c1397
- impact resistance /application conditions / anchoring other elements
- workmanship issues: lack of sealant & joint performance
- inadequate or lack of proper flashing
- water penetration
- substrate damage
- variation in workmanship
- varied & inconsistent texturing of finish coat

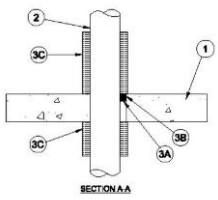
90

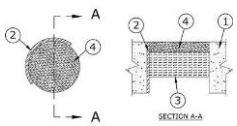
Fire Resistant Penetrations & Joints

91

- High-Rise Buildings
- Risk Category III Buildings
- Assembly >300 occupants
- School >250 occupants
- >12 Grade >500 occupants
- Health Care Facilities (I-2) >50 occupants (no surgery or emerg. Treatment)
- Jails (I-3)
- Other occupancies >5000 occupants
- Risk Category IV Buildings
- Special Cases: Usual design /situations not addressed in Code







91

92

- Passive fire protection
- Fire-resistive compartmentation
- Minimize property damage slow spread of fire & combustion products
- Firestop products vs. firestop systems
- International Firestop Council (IFC)
- Manufacturer's : Hilti, STI, 3M,….
- Firestop systems
- ASTM Standards
- Firestop inspectors

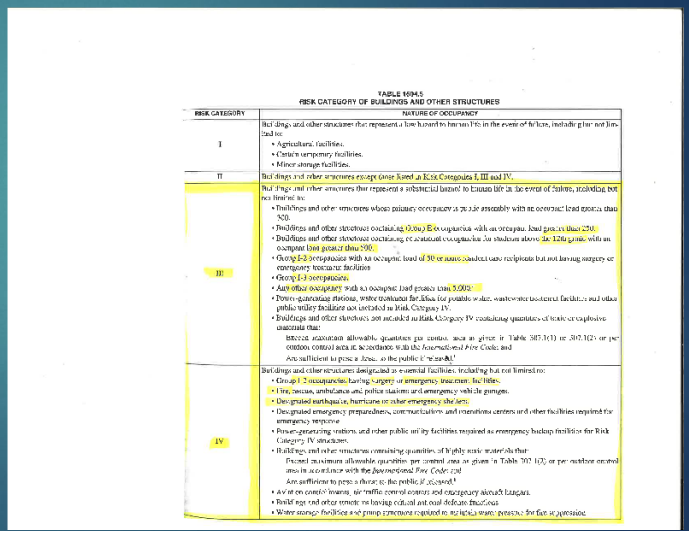


TABLE 1604.5
RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing elementary school, secondary school or day care facilities with an occupant load greater than 250. • Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500. • Group I-2 occupancies with an occupant load of 50 or more resident care recipients but not having surgery or emergency treatment facilities. • Group I-3 occupancies. • Any other occupancy with an occupant load greater than 5,000. • Power-generation stations, water treatment for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the International Fire Code; and Are sufficient to pose a threat to the public if released.[1]
IV	Buildings and other structures designated as essential facilities, including but not limited to: • Group I-2 occupancies having surgery or emergency treatment facilities. • Fire, rescue, ambulance and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communication and recovery centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures. • Buildings and other structures containing quantities of highly toxic materials that: Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the International Fire Code; and Are sufficient to pose a threat to the public if released.[1] • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water storage facilities and pump structures required to maintain water pressure for fire suppression.

92

93

- F-RATING - time in hours that a firestop system will prevent the passage of flames through an opening, remain in place, and not permit the projection of a water stream ASTM E814 or UL 1479.
- T-RATING - time in minutes required for the temperature on the unexposed surface of a firestop system or any penetrating item to rise 325oF above the ambient temperature ASTM E814 or UL 1479.
- INTUMESCENT - ability of firestop to swell, inflate, or expand with heat. Some firestop sealants will intumesce when exposed to the intense heat of fire causing them to close gaps or voids in through-penetration openings.
- Annular space -**space between a penetrant and whatever surrounds it**, such as the sides of an opening or a sleeve

93

94

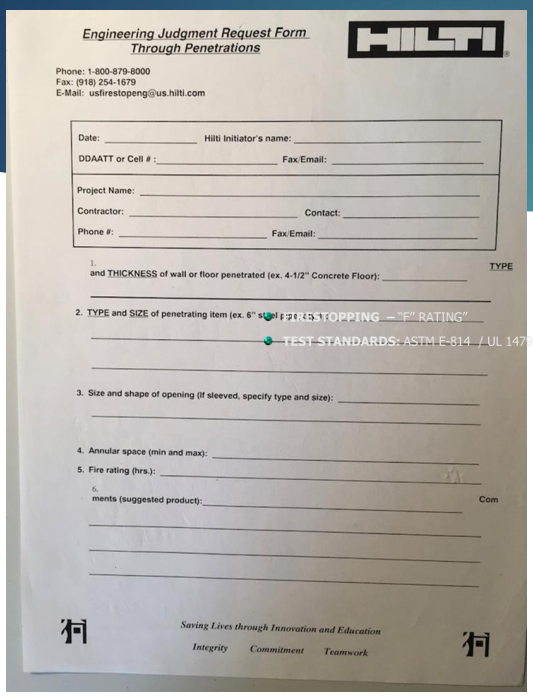
- https://www.youtube.com/watch?v=4o8dRs1R6O0
- MGM Grand Hotel Fire Las Vegas1980

TYPES

- Wrap strips
- Collar & pipe chock devices
- Putty
- Pillows
- Composite sheets
- Mortar
- Duct wrap
- Endothermic material

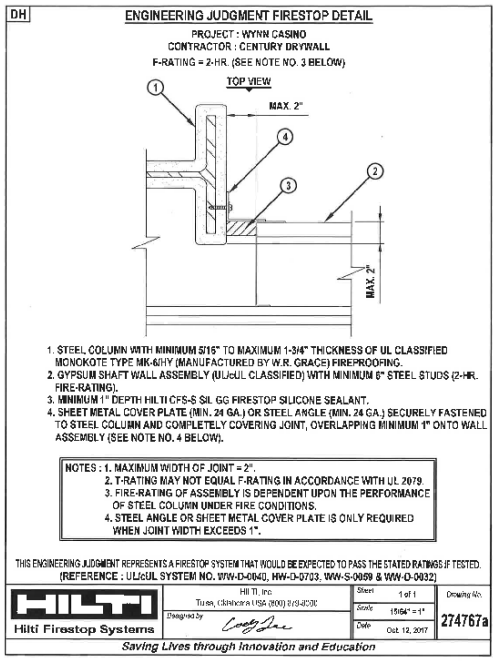
94

95



- Qualified installer
- Engineering Judgements (EJ)
- Include sample
- Fire resistance design manual
- Testing & Listed assemblies
- Through penetrations
- Construction joints
- Construction Specification Institute (CSI)
- labeling

95


DH

ENGINEERING JUDGMENT FIRESTOP DETAIL

PROJECT : WYNN CASINO
CONTRACTOR : CENTURY DRYWALL
F-RATING = 2-HR. (SEE NOTE NO. 3 BELOW)

TOP VIEW

1. STEEL COLUMN WITH MINIMUM 5/16" TO MAXIMUM 1-3/4" THICKNESS OF UL CLASSIFIED MONOKOTE TYPE MK-6/HY (MANUFACTURED BY W.R. GRACE) FIREPROOFING.
2. GYPSUM SHAFT WALL ASSEMBLY (UL/cUL CLASSIFIED) WITH MINIMUM 6" STEEL STUDS (2-HR. FIRE-RATING).
3. MINIMUM 1" DEPTH HILTI CFS-S SIL GG FIRESTOP SILICONE SEALANT.
4. SHEET METAL COVER PLATE (MIN. 24 GA.) OR STEEL ANGLE (MIN. 24 GA.) SECURELY FASTENED TO STEEL COLUMN AND COMPLETELY COVERING JOINT, OVERLAPPING MINIMUM 1" ONTO WALL ASSEMBLY (SEE NOTE NO. 4 BELOW).

NOTES : 1. MAXIMUM WIDTH OF JOINT = 2".
2. T-RATING MAY NOT EQUAL F-RATING IN ACCORDANCE WITH UL 2079.
3. FIRE-RATING OF ASSEMBLY IS DEPENDENT UPON THE PERFORMANCE OF STEEL COLUMN UNDER FIRE CONDITIONS.
4. STEEL ANGLE OR SHEET METAL COVER PLATE IS ONLY REQUIRED WHEN JOINT WIDTH EXCEEDS 1".

THIS ENGINEERING JUDGMENT REPRESENTS A FIRESTOP SYSTEM THAT WOULD BE EXPECTED TO PASS THE STATED RATINGS IF TESTED.
(REFERENCE : UL/cUL SYSTEM NO. WW-D-0040, HW-D-0703, WW-S-0059 & WW-D-0032)

HILTI
Hilti Firestop Systems

HILTI, Inc.
Tulsa, Oklahoma USA (800) 879-8000

Designed by

Sheet 1 of 1
Scale 15/64" = 1"
Date Oct. 12, 2017

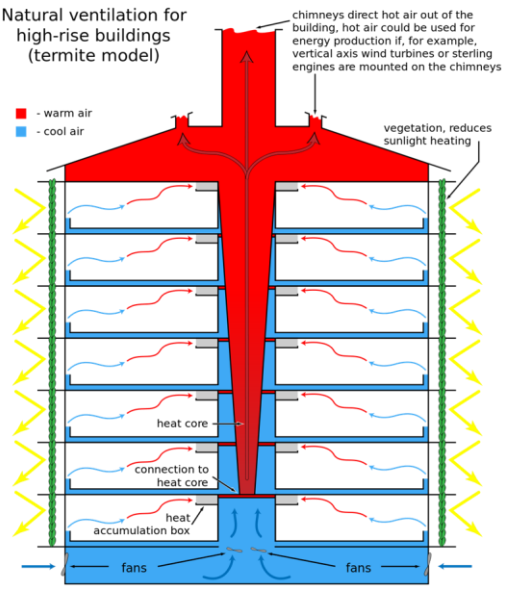
Drawing No. 274767a

Saving Lives through Innovation and Education

96

ASTM E 2174 Penetrations ASTM E2393 Joint Systems

96



97

Smoke Control Systems

97

• Pressurization method • Airflow design method • Exhaust method

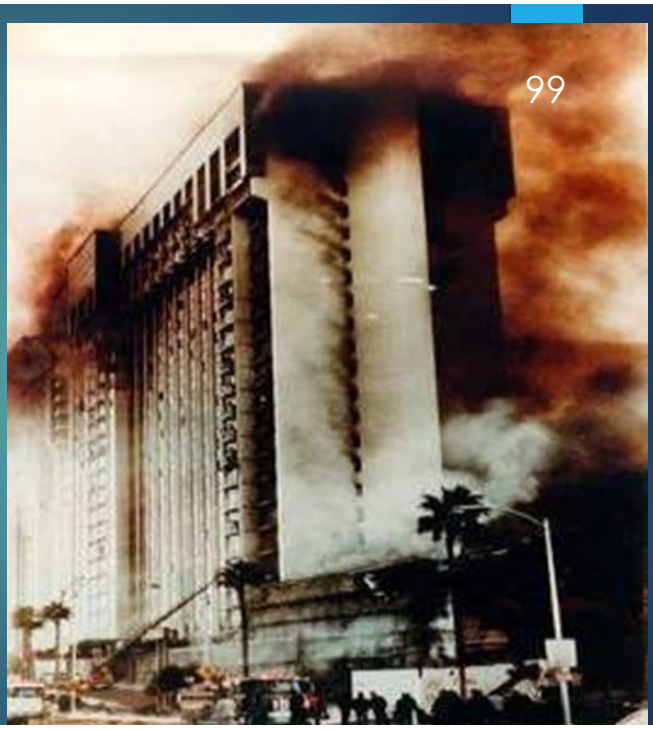
98

- Atriums > 2 stories -exhaust
- Underground Buildings
- High-Rises
- Malls
- Jails

98

- MGM Fire 85 deaths /635 injuries

99



99

100

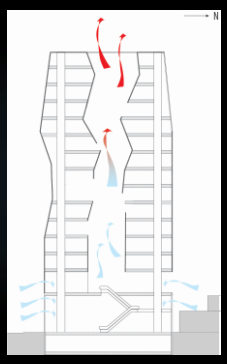
- Smoke layer
- Smoke evacuation high positive airflow
- Firefighter's smoke control station
- Passive vs. active design
- Computer modeling

100

NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, was developed and introduced in 2012 to assist project teams with the process.

101

- FPE Computer Modeling (CONTAM)
- Smoke controls systems: tested 2X (during ductwork erection & at completion)
- Goal: keep smoke level > walking surfaces & stop smoke migration
- Older systems just ventilated an area
- Tests verifying commissioning (generally performance based) outline in statement of special inspection
- Movement of smoke:



- Stack Effect
- Elevator Piston Effect
- Wind Pressure
- Leakage
- Passive Smoke Control (Draft Curtains, Smoke Vents
- Active Smoke Control Methods (Exhaust, Pressurization, Airflow)

101

TOXIC GASES

102

- Smoke Zones- hor exits / stair encl / stair entr. /stages / & floors as passive smoke zones
- Smoke Exhaust Systems – underground buildings / atria
- Smoke proof Exit Enclosures & Pressurized Stairwells- underground buildings / high rise buildings

102

Testing

103

- Erection of ductwork prior to concealing (leakage testing/device location recording)
- Prior to Certificate of Occupancy (pressure difference /flow measurements & control verification)

103

104

Seismic Resistance

104

105

Seismic

Id seismic systems and force-resisting systems
Cat. D, E or F with ≥1 following conditions:

Risk Category III or IV
Structure height > 75 feet >base
(ASCE 7)
Category E Risk Category I or II > 2 stories > grade
Judgement by registered design professional
When required by Building Official

105

Seismic

106

- ASCE 7/design.medeek.com/resources/seismic/sdc.html
- https://hazards.atcouncil.org/#/

- Earthquake loads maximum considered
- Default Class D
- Storage racks
- Architectural components
- MEP components
- Seismic isolation systems

106

The use of the blue reflective glass in a steel tower wasn't a good decision: entire windowpanes has been detached and crashed to the sidewalk. The police had to close off the sidewalks when the winds reached the speed of 45 mph. Five years after the tower's completion, in 1973, every single windowpanes (10,344 of them) were replaced.

107

Then it was discovered that the tower swayed to a dangerous degree. The tower required "interior reinforcing to prevent walls and partitions from cracking in high winds,"

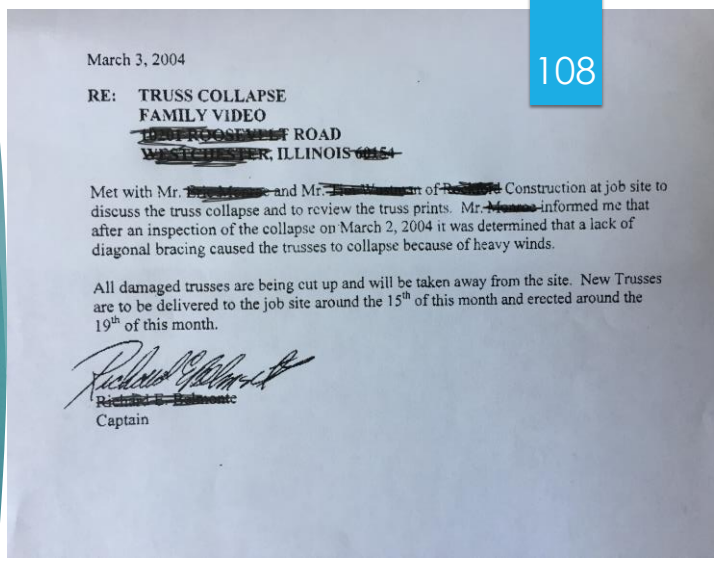
Wind Resistance

107

- **Wind**
- Id main force-resisting system and components
- **Wind >110 MPH ≥1 Conditions:**

A. Risk Category III or IV
B. Building height > 75 feet
C. Required by either Design Professional or Building Official

108



March 3, 2004

RE: TRUSS COLLAPSE
FAMILY VIDEO
[redacted] ROAD
[redacted], ILLINOIS [redacted]

Met with Mr. [redacted] and Mr. [redacted] of [redacted] Construction at job site to discuss the truss collapse and to review the truss prints. Mr. [redacted] informed me that after an inspection of the collapse on March 2, 2004 it was determined that a lack of diagonal bracing caused the trusses to collapse because of heavy winds.

All damaged trusses are being cut up and will be taken away from the site. New Trusses are to be delivered to the job site around the 15th of this month and erected around the 19th of this month.

[redacted]
Captain

108

108

Architectural Components

109

- Seismic Categories D, E or F
- Erection & fastening of:
- Exterior cladding
- Interior &exterior nonbearing walls
- Interior & exterior veneer

- *Exceptions: <30', grade for cladding / nonbearing walls / veneers
- Veneers ≤ 5 PSF
- Interior nonbearing walls ≤ 15 PSF

109

MEP Components

110

- Anchorage of :
- Emergency equipment & standby power (SDC categories C, D, E, or F)
- Other electrical equipment (SDC categories E or F)
- Hazardous materials piping and ductwork (SDC categories C, D, E, or F)
- Vibration isolation systems requiring ≤1/4 inch clearance between equipment support

110

Wood (Long Span Trusses & High Load Diaphragm)

111

- clear span is ≥ 60 ft
- Temporary Installation Restraint/Bracing
- Permanent Individual Truss Member Restraint
- Diagonal Bracing

111

Bryant College roof collapse

112

- https://www.necn.com/news/new-england/Building-Collapse-Reported-at-Bryant-College-in-RI-323589151.html
- Smithfield , RI

112

113

Wood Construction Page of

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures ☐ Fabricator Exempt		*Inspect shop fabrication and quality control procedures for wood truss plant.*
2. Material Grading		
3. Connections		
4. Framing and Details		
5. Diaphragms and Shearwalls		*Inspect size, configuration, blocking and fastening of shearwalls and diaphragms. Verify panel grade and thickness.*
6. Prefabricated Wood Trusses		*Inspect the fabrication of wood trusses.*
7. Permanent Truss Bracing		
8. Other:		

CASE Form 101 • Statement of Special Inspections • ©CASE: 2004

113

Special Cases

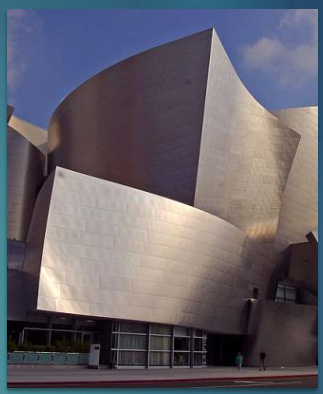
114

alternate construction materials & systems
unusual design applications
materials & designs not in Code installed per manufacturer's instructions
Building Official discretion

The **Aldar Headquarters** building is the first circular building of its kind in the Middle East. It is located in Al Raha, Abu Dhabi, United Arab Emirates.
The shape of this building is achieved through the use of structural diagrid, a diagonal grid of steel.[2]
The building features the following elevators:
•12 passenger elevators
•2 service elevators
•3 mono space elevators
•1 circular hydraulic lift
•2 dumbwaiters
•23 floor

114

115



115

116

Additional Categories for SI ?

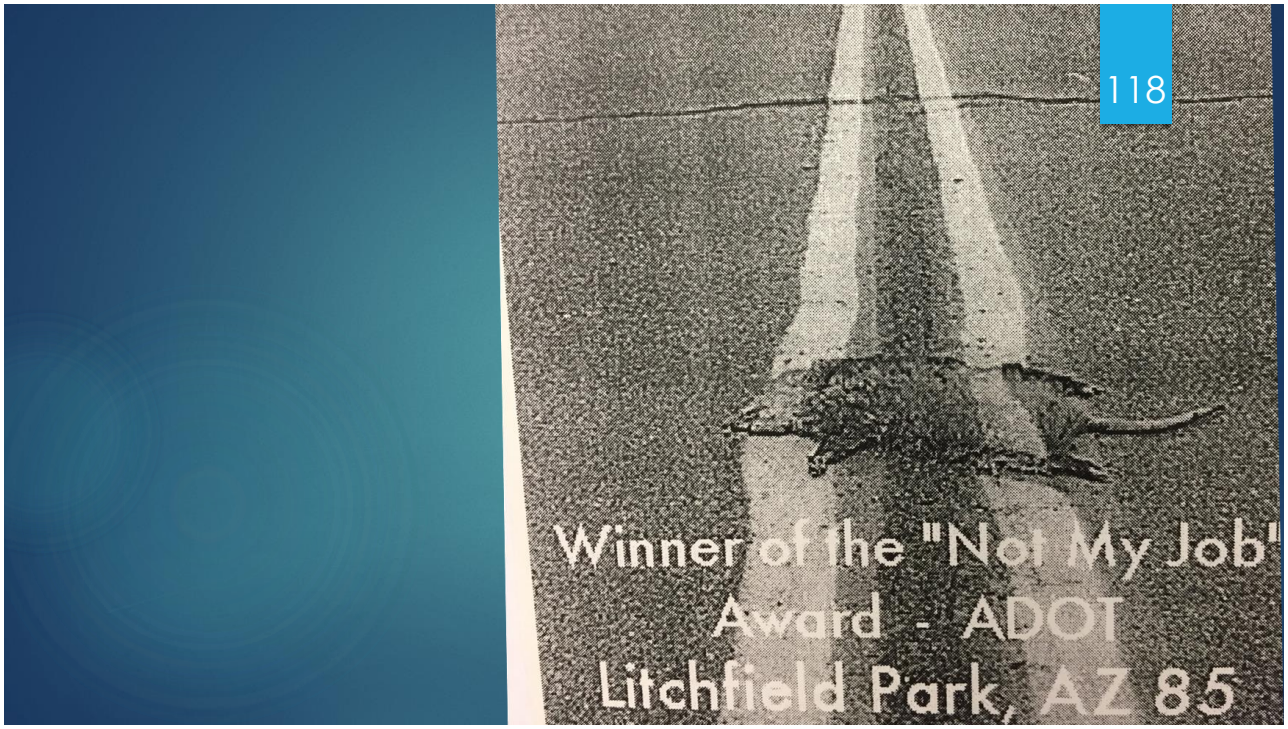
116

117

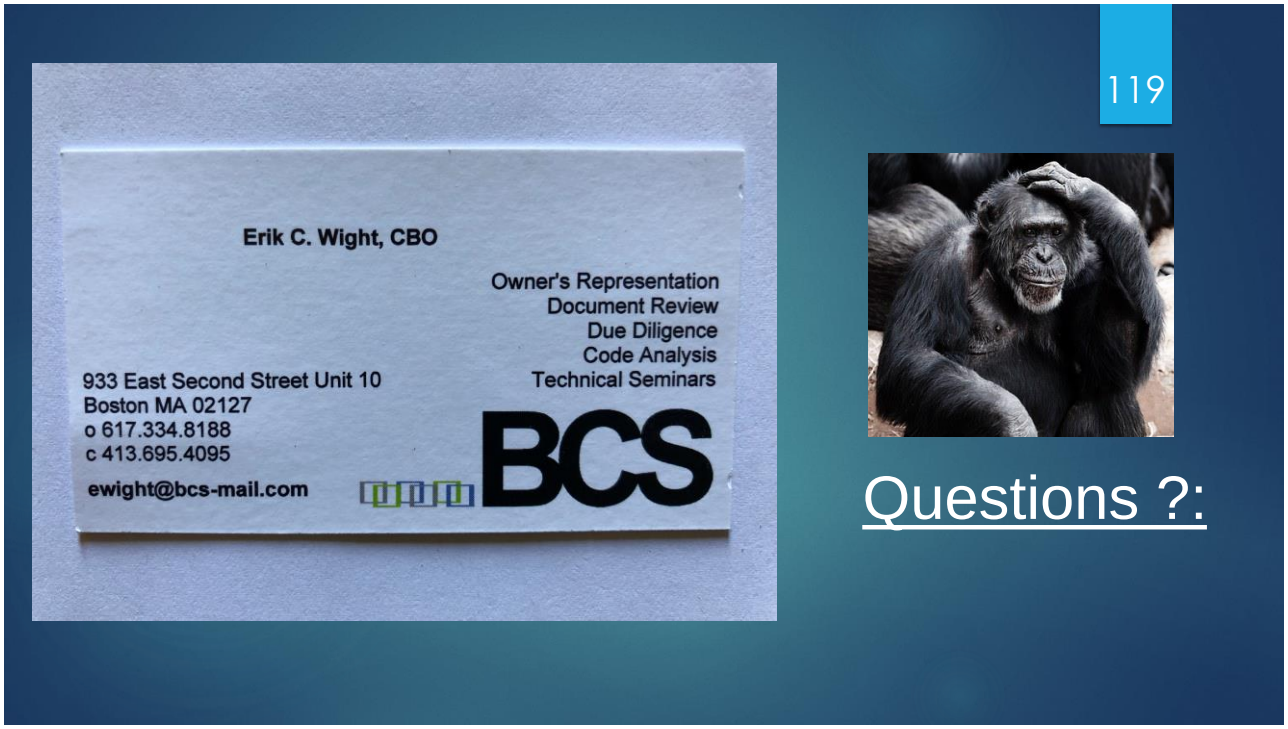
New England Testing Labs

COMPRESSION TESTS (ASTM C 39)

117


118
Winner of the "Not My Job"
Award - ADOT
Litchfield Park, AZ 85

118


119
Erik C. Wight, CBO
Owner's Representation
Document Review
Due Diligence
Code Analysis
Technical Seminars
933 East Second Street Unit 10
Boston MA 02127
o 617.334.8188
c 413.695.4095
ewight@bcs-mail.com
BCS
Questions ?:

119

120

Helpful Links

- Websites:
- UL assemblies: productspec.ul.com
- ASTM: ASTM.org
- INTERNATIONAL FIRESTOP COUNCIL: firestop.org
- Council of American Structural Engineers (CASE)

120