construction inspection & review

**Supervision Practices - IBC**

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<th>Verification and Inspection</th>
<th>Required Verification and Inspection of Steel Construction</th>
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<td>Material verification of high-strength bolts, nuts, and washers</td>
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<td>Identification markings to conform to ASTM standards specified in the approved construction documents</td>
<td>X</td>
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5. Inspection of welding:
   a. Structural steel: X
   X
   1) Complete and partial penetration groove welds.
   2) Multiple pass welds.
   3) Single pass fillet welds, \( \geq 1/8" \)
   4) Single pass fillet welds, \( < 1/8" \)
   5) Finger and dash welds.
   6) Reinforcing steel: X
   X
   a) Verification of weldability of reinforcing steel other than ASTM A 706.
   b) Reinforcement steel with flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement.
   c) Shear reinforcement.
   d) Other reinforcing steel.
   e) Inspection of steel frame joint details for compliance with approved construction documents:
      a) Details such as bracing and stiffening.
      b) Member locations.
      c) Application of joint details at each connection.

**Office Hours**

Professor Anne Nichols (845-6540)

Office Hours:

- **December 9 (Wednesday)**
- **December 10 (Thursday)**
- **December 11 (Friday)**
- **December 14 (Monday)**
- **December 15 (Tuesday)**

Office Hours not available at this time. Link to posted schedule.
Steel Construction

- proper grade material
  - high strength bolts
- quality welds
- proper bolted conditions (ex. sc)
- fabrication and erection of steel frame connection details

Concrete Construction

- proper placement of all reinforcement
  - welding
  - splices
- mix design
  - slump
  - in-situ strength
    - cast cylinders
    - cylinder cores – if needed

Supervision Practices - IBC

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<th>Inspection and Inspection</th>
<th>Continuous</th>
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For (c) and (d), 1 inch = 25.4 mm.

Supervision Practices - IBC
Construction Supervision

• proper placement of all reinforcement

• prism construction
  – masonry
  – mortar

• hot/cold weather protection

• clear cavity

Wood Construction

• structural members
  – avoid damage
  – must be protected from exposure to weather and water

• connections & bracing

Fire and Life Safety

• for the Design Professional
  – by Carl Wren, P.E.
  Chief Engineer, Austin Fire Department
  • Nuclear/Radiation Safety Engineering,
  ~29 years in Fire Protection – Former Commissioner, Texas Commission on Fire Protection, Former Member of Texas Task Force 1 - Firefighter, EMT, & Fire Inspector
  – guest lecture excerpts 2004 & 2008

Fire and Life Safety

• consequences, ex. 2005
  – 3,675 deaths
  – 17,925 injuries
  – $10,672,000,000 in property loss

• behavior & dynamics
  – a rapid (exponential growth), self sustaining oxidation process accompanied by the evolution of heat and light of varying intensities
**Fire and Life Safety**

- **human viability impacts**
  - heat, smoke, oxygen deprivation
  - CO produced by combustion
- **controlling factors of fire**
  - available fuel supply
    - furniture, structure, other contents
  - available oxidizer
    - ventilated or unventilated, chemical oxidizers
  - impact of design, construction, occupancy

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**Fire and Life Safety**

- **development – heat transfer**
  - conduction, convection, radiation
  - exponential
    - quickly exceed $500^\circ C$ ($932^\circ F$) even $>650^\circ C$ ($1200^\circ F$) at the ceiling of a confined fire within 4 to 5 minutes
    - post flashover (uncontrolled ventilation) $\sim600^\circ F$ to $>1800^\circ F$ within a matter of seconds

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**Fire and Life Safety**

- fire resistive construction (I-FR, IA)
  - concrete and protected steel
  - may or may not be compartmented
  - typical construction for high-rises
- typical hazards
  - fires are generally content fires
  - not a severe “collapse” hazard
  - spalling of concrete
  - central HVAC as a smoke travel path (also floor/ceiling penetrations and voids)
  - hazards may be most obvious on floor above fire floor
  - seek assistance in evaluating severe structural damage

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**Fire and Life Safety**

- **high rise fires**
  - 1911 Triangle Shirtwaist Company NY, NY
  - 1980 MGM Grand Hotel Las Vegas, NV
  - 1986 Dupont Plaza San Juan, Puerto Rico
  - 1988 1st Interstate Bank Los Angeles, CA
  - 1991 One Meridian Plaza Philadelphia, PA
Fire and Life Safety

– non-combustible or limited combustible construction (II-H, II-A)
  • metal, masonry, or concrete wall construction with metal roof
– typical hazards
  • unprotected lightweight steel roof joist & W’s
  • roofs typically flat with combustible weather covering
  • ignition of built-up roofing may be above ceilings ABOVE fire sprinklers
  • concentrated roof loading by HVAC units, etc.
  • steel expands and loses 40% capacity after ~10 min at 593°C (1100°F)

Fire and Life Safety

– ordinary construction (III)
  • freestanding masonry or brick walls
  • solid wood joist flooring and roofing (typical within older buildings)
  • wood truss assemblies (typical in newer buildings)
– typical hazards
  • combustible concealed spaces
  • peaked roof concealed spaces
  • lack of or damaged draft or fire stopping
  • decorative parapet walls
  • “fire cut” beams

Fire and Life Safety

– heavy timber construction
  • wood frame or large cross section
    (8 in. min vertical members and 6 in. min horizontal members)
– typical hazards
  • high fuel load exclusive of contents
  • masonry wall collapse
    (similar to ordinary construction)
  • may survive long exposure, but control in advanced stages may be very difficult
  • radiant heat exposures may be extreme

Fire and Life Safety

– wood frame construction
  • light weight wood members typically consisting of wood 2 x’s
– typical hazards
  • entire frame is part of fuel package
  • small dimension timber can be compromised more quickly than heavy timber
  • Braced Frame (mortised connections), Platform (sectional framing & multi-story), and Balloon Framing (fire & smoke travel paths)
  • failure of wood frame bearing walls may trigger simultaneous collapse of floors and/or roof
Fire and Life Safety  
(from DHS training program)

- type V wood frame truss construction

![Image of a truss construction](image1.png)

Figure 4—Metal tooth plate connectors like those shown are used extensively in lightweight parallel and pitch chord trusses. The multi-tooth plates are embedded into the wood fiber using high pressure.

Fire and Life Safety

- what can I do?
  - break up the fuel continuity during construction and in the completed project:
    - fire barriers
    - open spaces
    - fire resistive and noncombustible construction
  - even the use of simple gypsum wallboard partitions and closed doors can help

Fire and Life Safety

- what can I do?
  - utilize wood carefully, install attic draft stops, early and correctly

![Image of wood frame truss construction](image2.png)

Fire and Life Safety

- what can I do?
  - utilize fire detection and suppression systems wisely

![Image of fire suppression system](image3.png)
**Fire and Life Safety**

- what can I do?
  - consider your occupants and realistic opportunities for people to escape

- push for the durability of fire resistive coatings to be re-evaluated and improved

- consider the abilities and resources of firefighting and rescue personnel near your projects
  - be realistic
  - how they can reach the scene of the emergency

- use the rule of thumb of the emergency services - risk vs. benefit
  - risk (invest) a lot for a life (maybe even another life)
  - risk little for little gain

- but again be realistic
  - we cannot and will not eliminate all risk
Fire and Life Safety
- know the applicable codes
- understand the code and standards development processes
  - International Code Council (a consortium of ICBO, BOCA and SBCCI)
  - meant to create a single consistent series of codes for the USA (world?)
  - National Fire Protection Association (NFPA)

Fire and Life Safety
- NFPA 1, Fire Prevention Code (New UFC)
- NFPA 70, National Electrical Code
- NFPA 5000, Building Code (vs. IBC)

Fire and Life Safety
- International Code Series – e.g.
  - International Building Code (IBC)
  - International Fire Code (IFC)

Fire and Life Safety
- many other standards and codes
  - NFPA 14, Standpipes (Hose Systems)
  - NFPA 13, Fire Sprinkler Standard
Fire and Life Safety

- NFPA 70, National Electrical Code (NEC)

- ANSI A-17.1 & A-17.3 Elevators

Fire and Life Safety

- NFPA 72, Fire Detection and Alarm

- performance based codes
  - NFPA 101, chapter 5
  - 2003 ICC Performance for Buildings and Facilities
  - NFPA 5000, chapter 5
Fire and Life Safety

• references
5. FIRE LOSS IN THE UNITED STATES DURING 2003, by Michael J. Karter Jr., National Fire Protection Association, Fire Analysis & Research Division, Quincy, MA, September 2004

Structural “History”

• by building system and relevance
www.en.wikipedia

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• by building system and relevance

Final Exam Material
• my list:
  – systems focus
    • general behavior, resistance to lateral loading (shear walls, etc.)
    • hazard considerations
    • behavior of elements
      – beams & columns (statics)
      – continuous beams, cables, arches, rigid frames, plates, grids, membranes, shells, nets

Final Exam Material
• my list (cont'd):
  – code and design requirements
    • methodologies by materials
    • construction supervision
  – system selection
    • wood, steel, concrete, masonry
    • component types
    • connections
    • foundations