



BUILDING INSPECTION SAFETY PROGRAM MANUAL CHAPTER 5, REFERENCE # 9.4

June 19, 2018

STRUCTURAL INTEGRITY INSPECTIONS FOR LIGHTWEIGHT AND ALTERNATE BUILDING MATERIALS

1. INTRODUCTION

- 1.1 The Fire Department is aware of the increased use of building materials used throughout the building industry that are both lightweight and have the potential to rapidly increase the spread of fire. Cost savings, speed of construction and energy conservation are major factors driving the continued research and development of lightweight and alternative building materials. The widespread use of these materials may be found in all types of buildings. One or more of these structural materials may be used in new construction, as well as existing buildings presently undergoing renovations and/or enlargements. Fire resistance demonstrations and major building collapse under fire conditions have indicated the very real potential for early collapse and rapid fire spread when these types of construction components are used.
- 1.2 The goal of Structural Integrity inspections is for field units to become aware of the use of lightweight and alternative building materials within their response area. This will allow field units an opportunity to develop a tactical response plan and create or update a CIDS entry alerting all responding units of the potential dangers on the fire ground.

2. LIGHTWEIGHT AND ALTERNATIVE BUILDING MATERIALS

- 2.1 The use of certain lightweight and alternative building materials may impact the structural integrity of a building and should be considered when developing a tactical response. The Fire Department has identified 6 types of lightweight and alternative building materials which are of particular concern to field units:

- Prefabricated Laminated Wood I joists/ I-beams (I-BEAM)
- Metal Plate Connected (MPC-Gang Nails) Parallel-Chord Wood Floor or Roof Trusses (TRUSS)
- Light Gauge Cold-Formed Steel Structural Members (Metal C Joists) (LIGHT-GAGE)
- Wood Structural elements fabricated off-site (OFF-SITE)
- High-load diaphragms (DIAPHRAGM)
- Exterior Insulation Finish Systems (EIFS)

6 TYPES

6
TYPES

3. FDNY STRUCTURAL INTEGRITY INSPECTIONS

- 3.1 Through partnership with the Department of Buildings (DOB), the FDNY will be notified anytime a contractor files the required, notification of intent, to use any of the lightweight building materials (mentioned in Section 2.1) or EIFS. This information is required to be entered by the contractor on the DOB Technical Report (TR-1) form, as part of the DOB application process, which is necessary to receive a valid DOB Work Permit (PW-1). The information gained from the DOB TR-1 form will generate a DOB Structural Integrity Alert Location Report, to the FDNY, through a shared database identifying the addresses where the lightweight construction materials or EIFS will be used.
- 3.2 Structural Integrity inspections for Light Weight material or EIFS are automatically scheduled by RBIS as per permits issued by DOB. Units should ensure that these inspections are completed within 14 days. In some cases, construction has been completed and the officer may be unable to verify the existence of certain types of Light Weight material. In this case the officer should add the Light Weight material or EIFS to CIDS (ex: Truss Metal Plate Connected, Prefabricated Wood I-Beam, Light Gage Steel etc.) based on the information provided in the "Structural Integrity Details" on the RBIS Pre-inspection screen. 14 DAYS

4. FDNY FIELD UNIT RESPONSIBILITIES

- 4.1 The Administrative Company Fire Prevention Coordinator shall ensure the following:

4.1.1 Structural Integrity inspections scheduled in RBIS are completed within 14 days.

4.1.2 Create/update appropriate building profile in RBIS under the Buildings tab.

4.1.3 Include in the CIDS program as per section 3.2.

* * **Note:** When EFIS information is entered into CIDS the lightweight (LW) designation shall not be used. The concern with the EIFS application is for fire spread not structural collapse. (See AUC 362-EFIS)

4.1.4 Follow guidelines of the CDA Program – (See Chapter 3, Addendum 2, CDA Guide) if upon inspection you find the building meets the criteria for CDA Risk Based Inspections.

Note: If the company officer feels that the building should be added to the CDA Program, they should email the BISP Unit (BISP@fdny.nyc.gov) with full particulars and reason for changing status to a CDA.

5. LIGHTWEIGHT/ALTERNATIVE BUILDING MATERIAL DESCRIPTIONS

5.1 PREFABRICATED LAMINATED WOOD I JOIST/I-BEAMS

This type of support system is primarily comprised of 1/2" oriented strand board (OSB) or 3/8"- 1/2" plywood web members, and 2x3" or 2x4" wood flanges. The web is fitted and glued into a routed slot in the top and bottom flanges. In some cases, they may span lengths of over 60 feet. The strength of the beam is a function of the mass of the flange and the depth of the web. These beams are usually connected to load bearing walls with sheet metal joist hangers. > 60 FT

These I-beams are pre-engineered, and may come with openings in the web to accommodate utilities. In other instances, builders will bore holes in the web for plumbing, electrical lines, and HVAC ductwork, thus compromising its strength. A fire-retardant material sprayed on the beam will tend to dry out the wood over time, making it brittle and further reducing its strength. Once the ignition temperature has been reached during a fire, a laminated wood I-beam will burn rapidly. The sheet metal brackets holding the beams in place may also fail when exposed to fire or high heat.

Any proposed use of lightweight wood "I" beams shall comply with the Department of Buildings Technical Policy and Procedure Notice (TPPN) 8/92. TPPN 8/92 is specific concerning the following requirements for this type of construction:

- * **Fire Stopping** "The space between the ceiling and the floor or roof above shall be divided into approximately equal areas not greater than 500 square feet." < 500 FT

Construction "The cutting of openings for ducts, pipes, conduit, etc. in laminated wood "I" beams shall be considered fabrication and, therefore, subject to controlled inspection."

5.2 MPC PARALLEL-CHORD WOOD FLOOR AND ROOF TRUSSES

This type of support system is made up of 2x3" or 2x4" wooden web and chord members connected with sheet metal gusset plates (also referred to as gang nails). Since these connections only penetrate 1/4" - 1/2" into the wooden truss member, the gang nails are the weakest point of the support system. When exposed to fire and/or high heat, failure at the point of connection should be expected before failure of the structural wood components. 1/4 - 1/2 IN

When lightweight wood trusses are exposed to fire, high heat, or prolonged exposure to water, the gang nails may loosen and fail, causing the entire span of that particular truss section to fail. The surface-to-mass ratio of the wood trusses provides an abundant fuel source, and the air supply in the concealed truss void allows for rapid horizontal extension. Due to the open-web characteristic of the truss system, fire which has entered a ceiling (trussloft) or roof space (cockloft/attic) may likely affect all truss supports on that level, creating the potential for a large-scale collapse of the area supported by the affected trusses.

Another type of open-web wood joist uses finger joints and glue to connect the web and the chords. The finger joints are approximately 3/4" deep; and, similar to parallel cord wood truss without the metal gusset plate, these trusses can be expected to fail rapidly when exposed to fire and/or high heat.

5.3 **LIGHT GAUGE STEEL STRUCTURAL MEMBERS (METAL C-JOISTS)**

This type of support system uses lightweight cold-formed steel joists to support the floors and/or roof. Although these joists are designed to replicate the dimensions of a 2x10" wood joist, they are engineered with a significant decrease in mass (1/8" thick web) and are extremely susceptible to the effects of fire. In order to stabilize the building, the joists must be braced with strapping and/or blocking to prevent them from twisting. 1/8 in

Metal C-Joists may come with pre-drilled holes for plumbing and electrical lines. A newer type of C-Joist, with design characteristics similar to lightweight parallel chord wood truss, has larger openings that allows for the easier running of utilities, and the potential for fire and heat spread is significantly greater. When exposed to fire and/or high heat, these lightweight steel joists will lose strength and fail rapidly.

- * A heavy fire and smoke condition on a floor or in the cellar accompanied by little or no smoke condition on the floor or floors above may be an indication of a concrete or gypsum floor poured over corrugated steel (Q-decking) supported by C-Joists. The additional dead load may lead to early floor collapse; caution should be used at fires in buildings with this type of construction.

5.4 **WOOD STRUCTURAL ELEMENTS FABRICATED OFFSITE**

Wood structural elements are routinely prefabricated offsite and shipped to a storage area or construction site, where they are kept until needed. The likelihood that these key structural components are transported and stored properly, without damage from impact, moisture or corrosion must be called into question.

If these key building components are weakened prior to their installation into a structure, they will not only possess the hazards we would expect to encounter but the likelihood of early collapse when any type of load is applied or fire condition is present drastically increases.

5.5 **HIGH-LOAD DIAPHRAGMS**

- * 5.5.1 A diaphragm is a flat structural unit acting like a deep, thin beam. The term "diaphragm" is usually applied to roofs and floors. This construction system can be used when designing a building for lateral loads, such as those generated by wind or earthquakes.

5.5.2 When designing a building for lateral loads such as those generated by wind or earthquakes, a design engineer may have several alternatives. Lateral loads may be transferred to the foundation via braced frames or rigid frames, diagonal rods, or other methods. Where structural panels are used for the roof, floors, or walls in a building, lateral loads can be accommodated through the use of these ordinary vertical load-bearing elements.

5.5.3 This type of construction is easily adaptable to conventional light frame construction typically used in residences, apartment buildings and offices. The same concept is equally adaptable to larger warehouses and similar industrial or commercial buildings.

5.6 EXTERIOR INSULATION FINISH SYSTEMS (EIFS)

5.6.1 EIFS is a lightweight, synthetic, cladding system found on building exteriors. It consists of three layers: the innermost, insulation layer composed of foam plastic insulation; the middle, reinforcing fiberglass mesh; and the outermost, finish-coat layer (usually a cement-based polymer). The system can be glued or mechanically fastened to the exterior wall of the structure. Understanding the various layers will help in the identification of an EIFS installation, particularly when the structure is damaged or under construction.

3 LAYERS

* 5.6.2 The component of primary concern during firefighting operations is the innermost sheathing layer of Foam Plastic Insulation (FPI). The FPI layer should be considered combustible since it is essentially a thermoplastic, styrofoam material (typically 1/4" to 8" thick). The rate of heat release for thermoplastics can be three to five times higher than that of ordinary combustibles, such as wood or paper. If the system is compromised and the FPI ignited, expect high heat conditions, rapid flame spread, and dense black smoke.

1/4" - 8"
3-5x

5.6.3 For further description and standard operating procedures when encountering Exterior Insulation Finish Systems while at a fire operation or during BISP refer to AUC 362.

6. ACTIONS FOR NON COMPLIANCE OF THE ABOVE REQUIREMENTS

During the site inspection, **if the company officer determines** that an address reported on the FDNY Structural Integrity Report does not comply with these requirements or appear to be compromised, the company officer should initiate the following:

Notify the Battalion Chief on duty to respond to assess the situation. If appropriate, the Battalion Chief should either call DOB to the scene, initiate vacate procedures or send a DOB High Priority Referral Report, indicating such non-compliance.

NOTIFY
BC TO
RESPOND

BY ORDER OF THE FIRE COMMISSIONER AND CHIEF OF DEPARTMENT