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Commercials:

Got Fire? Anticipate Collapse....

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A recent video clip making its way around the cyber fireground clearly depicted a very close-call and resulting near miss event to four firefighters at a four alarm fire involving a commercial building that housed an established insulation manufacturer and installation contractor.

The video shows within a very compressed time frame, the progression of rapidly deteriorating interior conditions, the adverse effects on the building's structural systems and the results from the loss of load transfers that lead to a catastrophic wall collapse narrowly missing the crew of firefighters who were operating a hand line in the vicinity of an exterior overhead door.

Fortunately the injuries sustained to the firefighters were minor in nature; however the consequences and results from this collapse could have been far different and significantly more severe.

Following a series of repeated viewings of the video clip and with each successive viewing, it became readily apparent that there was a lot more to these images of the collapse and the cursory focus on the resulting near miss event. Closer examination of the video clip and the still frames brought to light some obvious conditions and indicators that easily become lost in the rapidity of the sequence of the collapse; which really has the true story to be told.

It's the mechanism and sequence of the collapse, the dynamics of the building's performance and the building indicators that provide a training opportunity in further examining key factors, presenting insights that could be a focus for operational and command personnel at future incidents with common parameters and gaining some mental models in recognition-primed decision making that contribute to the naturalistic decision-making process.

If you know what to be looking for, then when you see it, you may be able to anticipate, project and implement in rapid succession appropriate measures dictated by the incident.

Four Alarm Commercial Building Fire with Collapse: Fire Photo by Ben Goldberry

In an effort to promote additional insights and bring forward these fundamental observations and experienced-based presumptions extended from these and other news video images, still photographs, additional reporting research and examination, and a review of other published media resources; the following observations presented in this overview brief are being conveyed to increase firefighter, company and command level awareness of key collapse indicators such as those present at this commercial fire and to further the concept of adaptive fireground management principles and increase awareness of fundamental building performance indicators and principles to help you increase your intuitive observations skills and translate them into proactive operational actions on the fireground-before an adverse condition occurs.[i.e., being five steps ahead of the fire conditions].

Although this briefing makes use of the images and conditions depicted in the video clip and encountered by the fire department evident in the images; the subsequent commentary and insights provided are not meant to provide direct or indirect opinions, renderings, criticism or censure towards the conduct of operations or the management of the incident by the respective department and it's firefighting, command and support personnel who operated at the actual fire and experienced this near miss event first-hand.

We are grateful that the events of this alarm precluded anything worst occurring given the potential seriousness of the prevailing incident conditions and commend the fire department and it's firefighters that provide these exceptional services each and every day to the citizens they serve and to the community they protect, in mitigating this serious fire; safely and successfully.

This incident and the resulting near-miss captured by the videographer provides the Fire Service with an exceptional opportunity given today's far reaching capabilities of eMedia, this web site and direct and indirect readers, links, tweets, likes, reposting's, uploads, downloads and sharing an opportunity to share the consequences of an extreme close-call and learn from it in a positive and constructive manner, so that firefighters, company officers, commanders and support personnel can better predict with knowledge, insight and at times intuition a better understanding of buildings and the structures and occupancies we operate within on the fireground.

There are numerous inherent indicators present at every incident scene we operate at that. As is in this near miss event and building collapse; it's sometimes the subtle things that need to gain the attention of operating companies and personnel and the ability to rapidly process, recognize and react.

Remember this: Building Knowledge = Firefighter Safety.

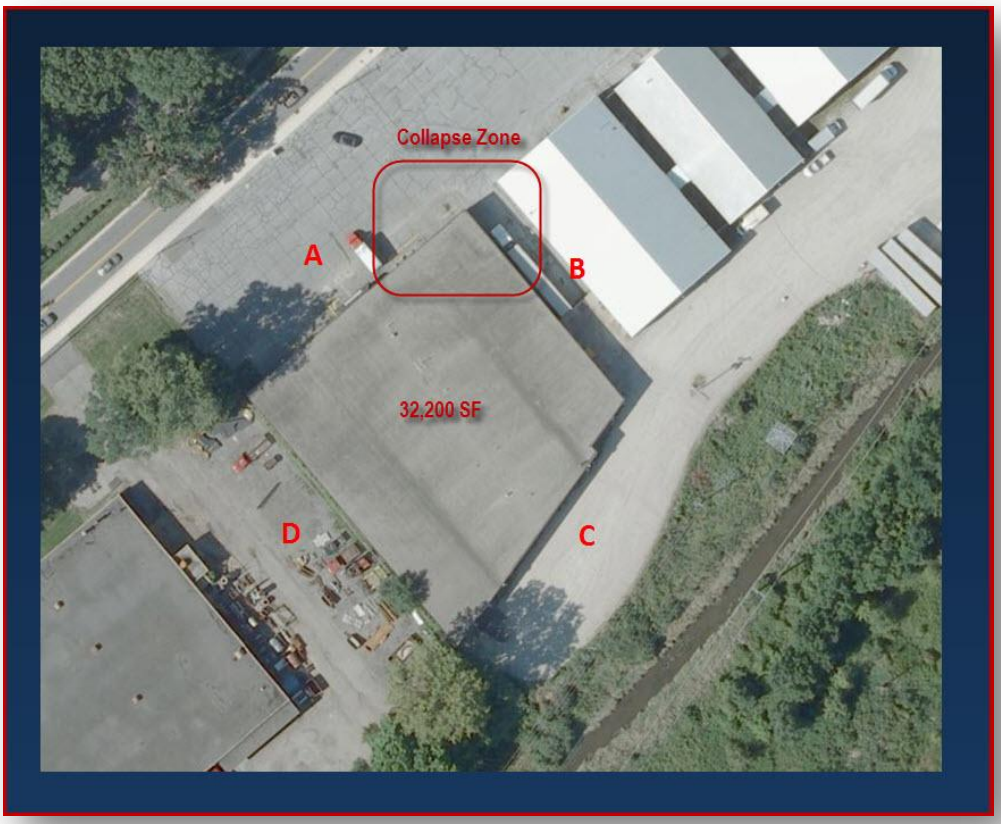
As a generality; it's important to note that given heavy fire involvement in a structure (*got fire*), adaptive fireground management considerations would promote conservative considerations to *anticipate and expect collapse (degraded or compromise; limited or catastrophic).*

In the case of fires in commercial occupancies and buildings with;

- ***Large Square footage/Floor areas***
- ***Significant fire loads***
- ***Large open structural system spans lacking compartmentation,***
- ***Unprotected steel components and assemblies***
- ***No Sprinkler Systems***
- ***Omitted, compromised or degraded passive or active protective or suppression systems***
- ***Significant openings along the exterior building envelope***
- ***Significant opening on the roof enclosure***
- ***Deep seated fires or rapidly escalating and extending fires***

It is mission critical to comprehend and understand your department's operational capabilities and the necessary deployment demands for fire suppression, fire flow and phased operations.

Respect these buildings for the occupancy risk they present and not the typical occupancy type that we develop our strategies, incident action plans and tactical deployments. It's a lot more than that, with far greater consequences that may be very unforgiving.



Aerial Plan of Building and Collapse Area A-B

The Building

The fire incident involved a single story commercial building occupying approximately 32, 200 square feet of area on a multiple building site with proximal exposures. Manufacturing, warehousing and offices comprised the building's operational use. An aerial plan view shows the geographical building scene divisions and the location and relationship of the Alpha- Bravo Side collapse zones that affected operations and resulted in the close-call and firefighter near-miss. The proximity of exposures, physical layout and orientation can be further assessed.

A review of public documents and records, incident reports and various media resources provided the following insights;

Overview Details

Alpha Street Side View- Adapted from Google Street maps

The view of the alpha street side identifies the building front facade, its main office entrance (center between dual overhead doors on the left and right). Pronounced on the alpha side facade is the presence of four (4) equally spaced overhead (OH) doors that provide direct access into the building's interior. The subsequent collapse area is depicted at the A-B corner with special attention drawn to relationship of the wall plane and OH door proximity.

The relationship and this wall surface (area square footage) and the presence of the OH door opening to the wall/ roof interface area that subsequently became compromised and collapsed is critical in further understanding the mechanism of the collapse sequence and also the positive effect it had on the survivability of the firefighters who were within the collapse zone at the time of the wall failure.

Don't Always Stress the Corners

It's been a common practice and fundamental fireground consideration to define the corner of a typical building as having safety considerations and prominence in the context of ladder company operations, laddering and roof work and in the placement of personnel and positioning of fireground operations.

Corner Building Operational considerations have included, but limited to;

- ***Provides a potentially safe(er) area of operational refuge***
- ***Provides a location to safely position ground ladders for roof access/egress***
- ***Provides a location that has a potential higher degree of assurance for maintaining structural integrity in the event of a collapse condition of an outer wall***
- ***Will not fail in a catastrophic or monolithic manner due to the postulated presence of structural members on the vicinity of either the wall enclosure and/or the roofing structural system and assemblies***
- ***The design and construction configuration and orientation of the ninety degree angle of the building's outer wall envelope (at the corner) provides predicated inherent structural stability***
- ***The typical type of structural or envelope construction may have a resulting ninety degree building corner having a more robust resistance to collapse and compromise due to the various types of enclosure systems (methods and materials) and assemblies and needed stability per engineering principles***

In this instance (as shown in the Alpha side street view), the presence of the large overhead door in close proximity to the corner wall intersection and transition (A-B side), actually makes this position, fireground proximity and travel paths highly prone to early and complete collapse potential in the event of a loss of the wall-roof component or assembly integrity or in the load bearing/transfer capabilities of the wall-roof assembly.

- ***The presence and identification of a corner configuration similar to this in a commercial structure should result in a higher degree of considerations and risk assessment when formulation and deploying operational assignments and in the placement of personnel for task assignments in this proximity.***
- ***This operational area should be considered as a candidate for designation as a collapse zone based upon projected or defined operational considerations, incident conditions and predictive building characteristics, systems, materials and fire dynamics and conditions.***

Alpha-Bravo Corner of Subsequent Collapse Aerial View

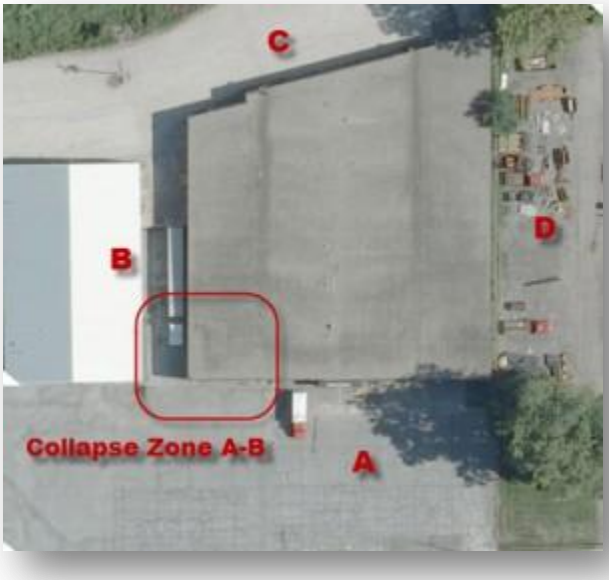
The view from the Alpha-Bravo Corner shows the collapse zones at grade and the affected area size.

As noted in the preceding narrative, the presence of the overhead door opening along the perimeter wall enclosure and outer envelope creates a risk area that would require monitoring, periodic reconnaissance and assessment during subsequent operations to determine structural stability and potential adverse conditions.
The proximity of the opening in relationship to the corner wall, roof support and structural span of the opening results in a very delicate balance of forces, loads, reliance and dependence that must be maintained for structural integrity and equilibrium.

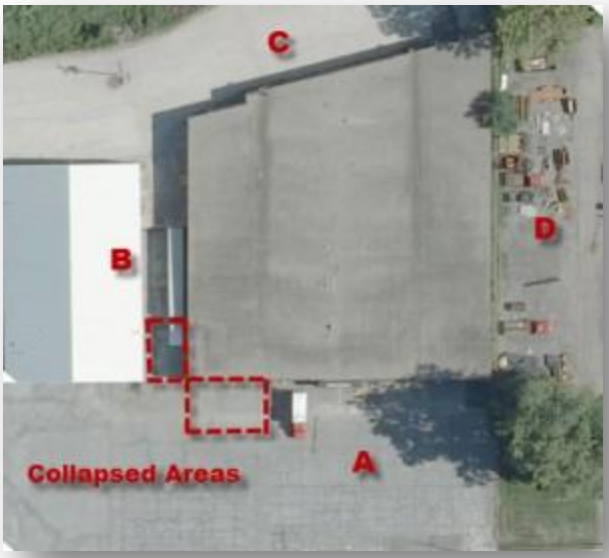
- *The entire perimeter of the alpha side could be considered for a restricted collapse zone just in terms of wall opening alone sans the degree of actual or projected interior fire impingement or fire involvement.*

Take some time to view the video clip a few times over before proceeding to the next sequence of fame images.

This videographer of this video was Aaron Dohring. (all rights reserved)



Aerial Overhead view of the building perimeter walls along the four divisions (A-D) with the A-B corner that subsequently experienced the wall-roof compromise and resulting collapse.



The A-B corner and the affected ground areas around the collapse zone. Considerations for a collapse zone area on the A-B corner would have resulted in a minimum distance of twenty five (25) feet from the building base for all operations within this area. The collapse zone on the Bravo side extends into the exposure building due to its close proximity.

Always consider the building envelope materials of construction and systems present on the building. The use of concrete masonry units (CMU) is common, as is the use of pre-cast concrete and cast-in place and tilt-up concrete construction panels.

Variations in collapse dynamics and mechanisms of collapse may result in sizable increases in collapse zone distances from the building base with consideration for monolithic or partial wall collapse as well as safety considerations for bounce and travel over long distances of modular assembly building pieces (i.e. concrete blocks, brick veneer or material chunks).

We have not discussed collapse considerations for other building envelope systems such as metal panelized systems since these have entirely different collapse considerations and profiling, not applicable to this incident and assessment insights.

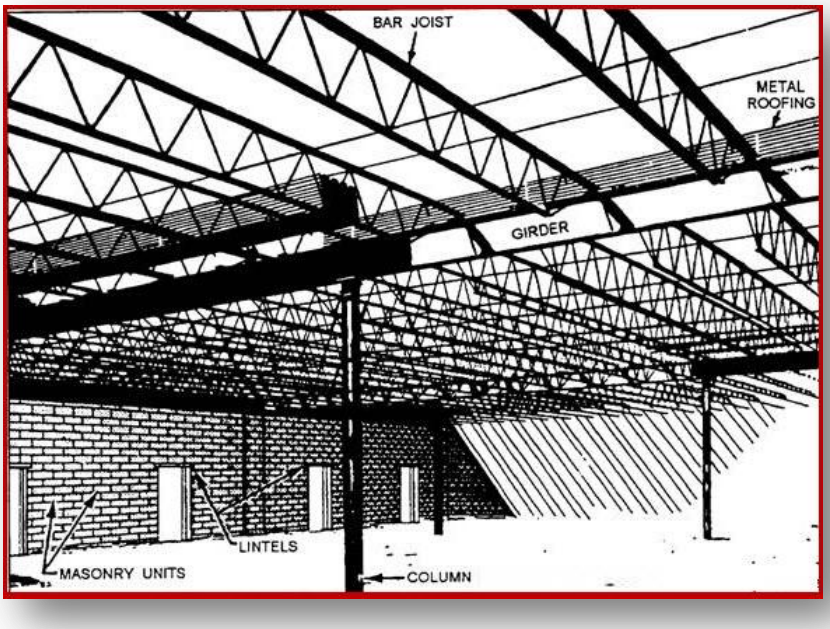
The same is true when considering operating and collapse considerations at commercial buildings with ordinary construction or heavy timber systems (Type or Class III and IV). These too have different rules of predictive building performance and collapse safety considerations.

Typical Interior

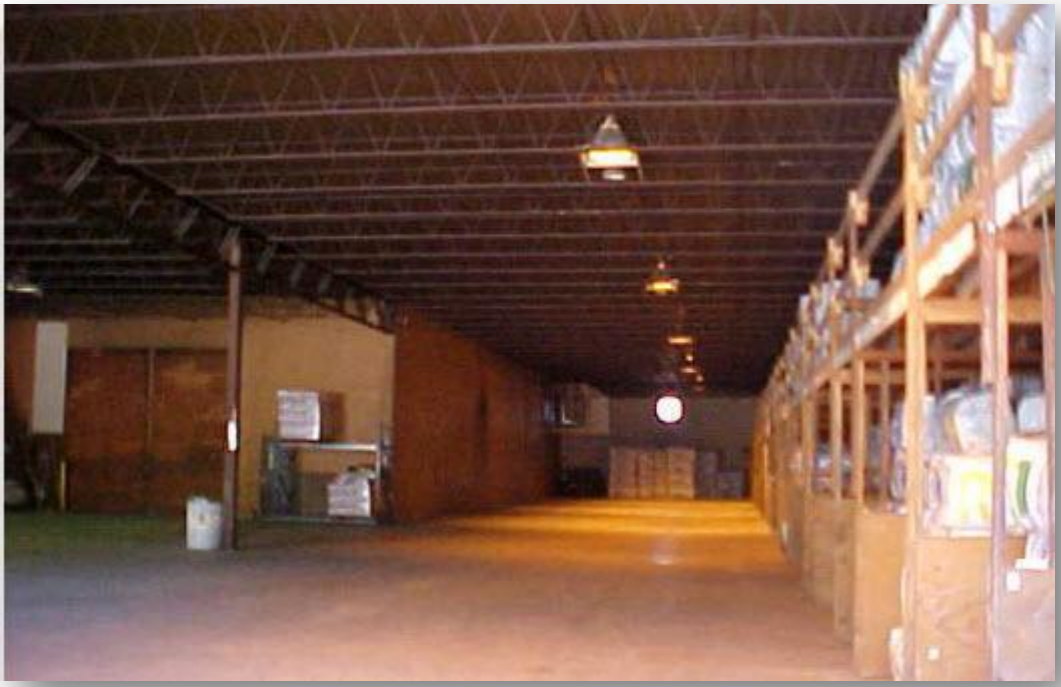
The interior of the building included unprotected steel components and assemblies consisting of steel columns, beams and open web steel joists. These common and conventional structural support systems provided large free clear spans, common for typical warehouse and commercial occupancies.

The presence and operability of functional fire suppression sprinkler system coupled with passive and active protective devices and compartmentation can help support proactive and aggressive fire suppression efforts in those conditions that have appropriate risk determinations and balanced risk-gain benefits.

The presence of unprotected steel components (Truss, column, structural beams etc.) and assemblies requires an understanding of the effects of flame and heat impingement, rate of heat release and fire dynamics, potential for movement and displacement of structural components and effect on assemblies, systems and connections and the effect on structural stability, integrity and building load transfers and displacement that all can adversely affect building performance, integrity and collapse potential



Typical Structural System and Components

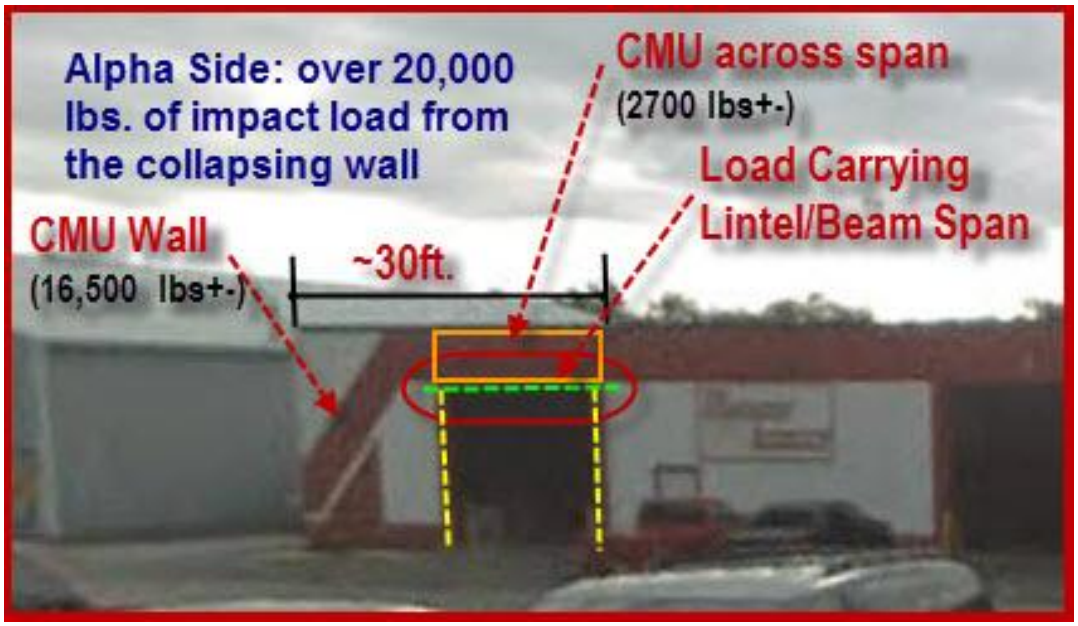


Interior View with Steel Columns, Open Web Steel bar Joists and Beams

Typical Open Web Steel Bar Joists w Metal Roof Deck

Large clear spans provided by the open web steel bar joists allowed for considerable free floor space typical of commercial warehouse occupancies.

Note the use of what appears to be combustible wood storage and staging areas that could have could potentially contribute towards increased fire intensity, extension and further contribute towards adverse effects on the unprotected structural steel components and assemblies.



Alpha Side Collapse Area Details: OH Door Pre-Collapse Insights

Pre-Collapse Operations on Alpha side with personnel in close proximity to the building perimeter

Pre-Collapse view of Operations on the Alpha side with personnel in close proximity, (within [a] collapse zone) to the building perimeter. It is evident that the degree of interior fire extension and involvement presumes a cautious deployment and placement of personnel in safe operational areas. When operating in such close proximity to the building wall and envelope, it becomes increasingly challenging for company officers and company personnel to monitor overall building performance indicators that may be prevalent or dominant from a view point further away from the building.

Fire extension, smoke conditions, component or assembly movement or displacement may be readily defined and identified from a vantage point away from the building, requiring additional independent operational assignments within the division if resources allow. Otherwise, officers are encouraged to get a big picture view and increase their span of vision of the building and progressing fire conditions and building performance

The pre-collapse frame image above identifies the building roof line in relationship to the ground operations, smoke conditions and also the directional flow of the elevated master stream [upper right corner]. The initial stage of the wall compromise and collapse can be seen in the Bravo wall pulling away. When watching the video, pay close attention first to the stream direction and flow and them at the location and movement of the wall, which is followed in rapid succession with the full wall collapse.

Close examination of the initial video frames shows the rapid displacement of the portion of the Bravo wall and outward collapse towards the B-Exposure (alleyway) Refer to the Aerial Plan for orientation. The A-B Collapse is progressing from the Bravo side to the Alpha side as loads are being transferred in rapid progression with further collapse expected.

The frame image above shows the bravo wall failing outward with the resulting loss in structural support of the roofing deck assembly.

Rapid fire migration and extension is evident after the wall section collapse with increased flames visible. In the video, one firefighter quickly recognizes the imminent collapse and reacts.

A significant section of wall area is present at the A-B side and progressing from the building corner to the left jamb of the overhead (OH) door. This area and the area directly above the OH door opening is calculated to weigh over 20,000 lbs.

The early identification and establishment of collapse zone(s) is mission critical especially at commercial buildings due to the considerations for rapidly changing operational conditions that may be a result of or influenced by the following;

- *lack of knowledge or understanding of the building's construction, systems and characteristics*
- *lack of adequate resources, skills and or capabilities for selected phase operations*
- *fire loading, combustibles, flammables and other products*
- *Last of or loss of compartmentation*
- *fire and protective systems failures or inoperability*
- *unapproved alterations, additions and renovations to the building, systems and occupancy*
- *transitions for offensive to defensive operational phases, which at times may results in operating position postures too close to the building*
- *failure to recognize situational factors that will drive appropriate operational phasing and task deployments*
- *lack of building performance knowledge*
- *not considering occupancy risk versus treating the building/fire relationship based upon occupancy type*
- *not recognizing key collapse indicators and failing to implement timely actions [proactively versus reactionary]*
- *being four steps behind the fire conditions evident instead of implementing adaptive fireground management insights [five steps ahead of the evident fire]*
- *use precise coordination when placing elevated master streams into operations with ground personnel operating within close quarters*
- *understand the effects of master streams on the integrity of building features, assemblies and components*

The image frame above shows personnel operating within an imminent collapse zone directing hand lines into the interior fire area. Further examination of the video frames clearly shows one firefighter quickly recognizing that a collapse is occurring and attempts to alert the other personnel to retreat. Simultaneously to the collapse progression, the crew immediately retreats away from the collapsing wall and falling building materials.

Within the span of four seconds, the wall compromise occurs and collapses on the ground at the A-B corner and immediate area on the alpha side. The slightly monolithic manner in which the wall plane first peels away and progressively collapsed is interesting for a CMU wall. Possibly due to the outward collapse of the Bravo wall, followed by the rapid succession of failure of the roof-wall connection interface resulted in a transitional downward force that pushed the alpha side wall outward allowing gravity to work its force

When operating in close proximity to a heavily involved forward interior condition [exterior position] it is important to maintain focused situational awareness and either directly maintain or delegate responsibilities for observations of fire and smoke progress and conditions while monitoring key functional building performance indicators and collapse pre-cursors.

Additionally, always re-evaluate the effectiveness of deployed and operational hose lines, streams and in water application to ensure they are adequate for the degree of fire suppression being undertaken and the corresponding fire flow requirements. Don't just assume, determine with validity. [Refer to Tactical Entertainment, CommandSafety.com]

Obscured by the rapidly defining smoke which is a result of the developing and extending collapse, the frame image 04 below depicts the beginning of the compromise and collapse sequence commencing as a result of the Bravo wall compromise and collapse sequence at the B-A corner that will subsequently peel towards the Alpha side and continue up to the outermost jamb of the overhead door.

Pay particular attention to the first three to four seconds of the video clip and review the video clip over a few times; looking at the operating elevated master stream that is clearly visible and operating from the upper right part of the screen through the smoke plume; follow the direct orientation and stream flowing directly towards the bravo wall plane, and presumed penetrating into/through the roof deck or impacting through the metal roof deck and wall-roof assembly area at the upper roof edge.

Image 04

Frame image 04 depicts the rapidly deteriorating conditions that are evident as the collapse sequence continues and the overhead door jamb (left) buckling and adjacent wall failing by way of an outward curl or peel away commencing from the upper (left image) A-B corner at the roof line and then peeling and failing from upper left to right.

Image 05

The leading edge of the outward collapsing wall plane (yellow dotted line) is failing with the greatest material concentration occurring at the A-B edge outward. Fortunately the presence and location of the overhead door opening lessened the amount and location of wall material (concrete masonry units-CMU) and contributed to a void area being present and not fully impacting the firefighters who were operating within this collapse zone.

In other words, had this been a solid full wall collapse, the likelihood for significant firefighter injury would have resulted.

The effects of wall/roof compromise should be of focused consideration and monitoring when managing incidents of this size and magnitude in similar occupancies and building features. Flame and heat impingement can and will affect the structural integrity of lintels spans, beams and truss connection along roof lines and connections. Look for signs of impingement, degradation or compromise. Watch for signs of probable inward/outward or curtain- wall collapse.

Image 06

The remaining images, frames 06 and 07 depict the location of the firefighters to the wall collapse, the relationship to the wall and roof system and the degree of wall area that became compromised and collapsed.

Image 07

This brief video clip and these accompanying briefing insights provided a tremendous opportunity to examine in a non-critical manner an actual near miss collapse event and operational discernments that provide a focused training an awareness opportunity.

When given the time to analyze and assess, some things become so apparent and self-revealing that we might prematurely say why didn't someone pick up that or those conditions while conducting operations at [an] incident. It is dependent on a wide variety of factors, conditions and parameters that are difficult at times to identify and harder yet to fully identify as common or contributing factors, errors or omissions.

It's not always that easy; but contradictory – *some time it really is (or should be) that easy.*

Some things on the fireground may not be prone to being so readily identifiable or recognized.

It all depends what you're looking for and whether you have the necessary insights, knowledge and skill sets. Incident priorities, demands, situational focus, awareness or disconnect all may have a part in how and incident is managed and mitigated.

It goes back directly on knowing what to look for and when; at what type of building with which type of occupancy and under what stage or stages of fire development and combat operations or engagement you might be in. It complex, it takes time and experience and learning's.

There are numerous factors to be cognizant of in operations involving commercial buildings and occupancies; with special considerations and a diligent focus on a wide degree of facets on the fireground during combat fire engagement.

You need to start somewhere, thus the investment in these observations and insights for this event. Open your eyes on the fireground, there is so much to take in and respond to; if you know what to look for and can process what you're seeing.

It is mission critical to comprehend and understand your department's operational capabilities and the necessary deployment demands for fire suppression, fire flow and phased operations.

Respect these buildings for the occupancy risk they present and not the typical occupancy type that we develop our conventional strategies, incident action plans and tactical deployments. It's a lot more than that, with far greater consequences; that may be very unforgiving.

Links:

- http://www.journalgazette.net/article/20111031/LOCAL07/310319957