



Fire Engineering

Structural and Occupancy Risk Assessment In Structural Firefighting

By Lt. Mike Mason (Ret.) DGFD

In order to be effective and safe on the fireground all ranks should have a thorough knowledge of building construction with some basic understanding of a buildings dynamics under fire conditions. Commanders providing risk management control in correlation with firefighter safety during structure fires with the understanding of a buildings construction definitively influences injuries and deaths to firefighters. The fast paced fireground dynamic has many critical relationships as it pertains to buildings and their occupancy types. Firefighters and their varied ranks carry different relationships within the fireground dynamic during structure fires due to different focuses of responsibilities within what they are doing in the moment. A commander has the overall view of the dynamic risk and management of a fire and his fireground. Company officers and firefighters should be zeroing in on situational awareness as it relates to the construction features, occupancy type and firefighter survival during a firefight. Situational awareness with firefighters must recognize the basic systems and assemblies of the structures they are fighting fire in as well as the basic materials and methods that make up the structure. Just a simple overview and understanding of what type of building we are engaging will go a long way in recognizing our injury and survival potentials. Recognitions such as; are we engaging balloon frame, platform frame, lightweight truss, new construction vs. older construction, cock lofts, or knee walls; these are just a few construction features firefighters need to be concerned about when fighting fire within structures. Understanding the fundamentals of a structures make up along with its occupancy potentials affects its fire behavior as well as determines the effectiveness of our firefighting as well as our safety.

The operational mitigation of structure fires is affected by all who perform on the fireground. If you don't generally understand how a building will react under fire conditions you may be putting yourself at great risk while those commanding fires put themselves in the uncomfortable position of reacting after the fact instead of controlling and being ahead of the game. Commanders and forward operations chiefs should think about the factors and components of good risk management as it relates to the structural environment.

Structural Dynamic Risk Assessment

- 1. The Risk Assessment Profile Fire Dynamic Of The Structure**
- 2. The Basic Construction Type**
- 3. The Occupancy Profile or Type**
- 4. The Buildings Systems, Materials and Assembly Methods**
- 5. Firefighter Survival Profile Before, During and After Initiating Offensive Fire Attack**

Operational Integrity and Mitigation Risk Assessment

- 1. Sizing Up Fire Dynamics and Fire Behavior**
- 2. Buildings Resource Requirements, Staffing, Apparatus, Fire Flows**
- 3. Building Performance and Reactions Under Fire Conditions**
- 4. Building Performance and Reactions Under Variable Load Stresses**
- 5. Stability and Degradation Before, During and After The Firefight**
- 6. Movement Of Fire and Products of Combustion/Speed and Pressure**
- 7. Flow Path Considerations Coordinated With Suppression Activities**
- 8. Ventilation Controlled vs. Ventilation Limited Actions On Arrival**

It is important to note that along with the main priority of fire extinguishment is the occupancy profile decision to save lives within the interior of a structure. Statics show that many firefighters have been badly injured as well as killed in their abilities to provide a sound decision process when it comes to the presence of occupants in a structure as well as their survivability within these structures when relating to fire conditions. Most of the time the resulting profile revealed that no occupants were ever in many of these structures at the time of the fire or the decision process to enter the structure to search and rescue what was never present from the onset.

Over the last 25 years the American fire service has prided itself in the aggressive interior fire attack as well as its ability in aggressive life rescue. It is only until recently that our focus is beginning to shift from aggressive established fireground orders to a more risk determination effort at structural fires. Today's fires are not what they used to be from the past. UL (Underwriters Laboratory) as most the fire service knows has recently concentrated studies regarding the new fire ground as compared with legacy construction of the past. Most of the research was center around ventilation practices and flow path studies but also revealed through these studies was the incredible heat release rates along with the developments faster growing fires in the modern residential environment. Firefighters as well as chiefs are now focusing on combining elements of risk when combating fire in order to provide a wider net of safety before committing firefighters to interior operations. The risks that were taken in the past as accepted are now being challenged resulting in some principles and practices changing for the better while other changes seem to be tying our hands. We should not allow some of these challenges or changes to decrease a firefighter's aggressive determination but rather learn to balance and correct carelessness within our operations. Creating a proactive situational aware firefighter for the fireground as well as commanders and chiefs is what should be the goal. Relating occupancy risk, building construction, strategies and tactics into the overall action plan can help identify the overall firefighting risk at any given incident. Another word what is the projected building's risk profiling revealing to us in order to determine the right and safe actions that need to be done down at the task level. Down at the fire company level and its officers is truly where the rubber is meeting the road; but it is also where we all too often encounter serious injuries and sometimes death. Operational strategies at structural fires should be under constant review and when needed should provide for adjustments and modifications that help us improve our tactics at the next incident. Commanders as well as firefighters each in their own way should apply a risk-benefit analysis that accounts for safety and survivability profiling at each incident. These safety practices and survivability awareness profiles need to be engrained into the fire service because of the increased dangers involved in the modern structural fire environment. The modern fire environment includes many areas of risk due to lightweight construction features, broader designs in open floor plans, tighter constructed widows along with the addition of interior furnishings all of which are pushing the envelope to earlier flashover conditions.

The Structure-Occupancy Correlation

- **The Building Construction**
- **Fire Dynamics Within The Structure**

- **Occupancy Profiling and Rescue Profiling**
- **Strong Incident Command Presence**
- **Determine The Overall Level of Operational Safety**

During structural fire attack there are many assignments on the fireground that carry inherent risks. The many varieties of occupancies and structures carry with them varying degrees of risk and these risks should be defined in order to apply the proper strategic and tactical methods that are appropriate for each occupancy type. Many times we work off of known given principles that have occurred at previous incidents and their occupancy types while correlating the tactics and strategies from one fire while applying what we know to the next fire. The successful and not so successful incidents are part of our risk benefit analysis that we apply to a similar structure or fire incident. We rely heavily on our operational experiences that fill our tool box from one fire to the next and this is a part of every firefighter's ability to analyze the risk benefit analysis of his actions on the fireground.

Expected Structural Performance Considerations

1. **Compare To Previous Structures With Similar Fire Involvement**
2. **Accessibility/Ingress/Egress/ Forcible Entry**
3. **Expectations of Fire Travel**
4. **Fire Involvement/Compartmentalized or Not**
5. **Duration of Time and Existing Fire Conditions vs. Fire Attack Progress**
6. **Content and Fire Load /Increasing or Decreasing**
7. **Water Flow Onto The Fire and Into The Building**

These structural performance considerations help us provide some bases of predictability in regards to the buildings reactions involved in fire and under fire attack. The predictability factor is always influenced by our awareness of the scope, size and severity of fire involvement at any given structure while relating to what we see and know to the structure, its occupancy and the fire encountered.

Before the 1980's the fire service and its members were able to measure with certain degree of predictability how a certain building type would perform and react under fire conditions. This was based in experiencing structural fires that involved dimensional lumber types of construction or also known as Conventional Construction. Since then structural systems have

drastically changed into what is known as Lightweight or Engineered Constructional Systems which have very little predictability. Recognizing these systems and their incorporation into the buildings we fight fire in have finally made a deep impact on how we perform and commit firefighters to offensive and defensive procedures on the fireground. The modern day fire service is now basing its operating procedures into increasing our concerns much more into the safety and survival needs of firefighters on the fireground as they pertain to these new Engineered Construction Systems. We should be adjusting and altering our strategic and tactical way of performing at today's fires. Unless we can ascertain for sure that a building is a conventional construction type we should be treating and operating under the assumptions that all buildings are predominated with engineered constructional systems new and old. Commanders and first in officers must learn the importance of risk profiling a structure with what we now know to be built with engineered systems. This then is also incorporated with the occupancy profile of a structure to help determine survivability of not only civilians but also our firefighters that are providing rescue to them.

Risk Profile of a Structure

- **Are There Engineered Systems Involved?**
- **What Are The Structures Material Elements?**
- **What Are The Methods of Construction or Assembly?**
- **What Type of Fire Load Makes Up The Interior?**
- **What Type of Design Features Make Up The Interior?**

By conducting constructional risk profiling we can help determine our strategic and tactical aspects of our firefight. By profiling we can apply considerations regarding hose line size, fire flow rates, staffing and apparatus demands which help us determine an offensive or defensive posture while improving the overall safety of our operations. Controlling our aggressive behaviors without interrupting our spirit to win on the fireground now needs to be reevaluated and redefined because of the modern day structural systems. This along with the higher heat release rates from fire loads within the new structural environment requires us to assess our strategic and tactical operations into a more productive mindset of safety and survivability for our members. We should be looking at structures and their occupancies as they pertain to risk rather than a classification of type. If we can realize this and incorporate it into our actions when responding and arriving at structural fires we can improve our strategic firefighting operations into a solid base of safety and protection of the decisions and tasks being performed that may jeopardize us. When looking at or analyzing structures and their occupancy potentials the following risk profiling should influence our fire response regarding the first-in companies.

The Risk Profile For Structure and Occupancy Determined Response

- **Potential Occupancy/Day/Night**
- **Building Construction/Building Assembly Systems**
- **Building Size**
- **Building Location and Access**
- **Projected Interior/Exterior Fire Load**

After determining the above response criteria for our members and our apparatus we then arrive on the fireground and begin our strategic and tactical actions which still can leave us open to precarious possibilities that may injure or kill firefighters. Whether an offensive or defensive posture is being undertaken heavy considerations along with a continual size-up of the building and its performance under fire attack is effecting the interaction of firefighters. What's changing and contributing to the fire environment and the structure involved; is fire behavior, interaction of firefighters, occupancy and the buildings structural components with the latter many times failing unannounced. We need to employ and correlate an occupancies associated risks along with its structural nature.

Occupancy Risk vs. Type

- **Single Family Residential/Large/Small/Single-Story/Multi-Story**
- **Multiple Occupancy/Large/Small/Single-Story/Multi-Story/Apartment/Condo/Transient/Special Needs**
- **Business/Single-Story/Multi-Story/Connected Strip Mall**
- **Industrial/Large/Small/Hazards/Workers Shifts**
- **Storage/Large/Small/Compartmentalized/Hazards**
- **Assembly/Multiple Stories or Single Story Arena/Fire, Collapse and Evacuation**
- **Institutional/Single or Multiple Stories/Hazards/Special Needs**

The above occupancy lists should be associated with our action plans when trying to weigh the risk factors when fighting and containing fires while also saving lives. Firefighters and their commanders should apply and review considerations pertaining to risk regarding the above occupancies.

Fire Dynamic Considerations In Occupancies

- 1. Controlling Fire/Fire Compartment/Containment**
- 2. Engineered Structural Systems /Conventional Structural Systems**
- 3. Exposures/Affects of Smoke and Fire Spread**
- 4. Fire Behavior Within The Structure/To The Structure/Degradation**
- 5. Risk Exposure To Firefighters/Increasing or Decreasing**

By reviewing a buildings structural dynamic along with its predictable performance under fire conditions we should be able to assemble an incident action plan incorporating the operational task of firefighters that leans to a safer and more controlled fireground. Fire departments and their overall operating procedures at structural fires should entail a more dynamic approach to the possible exposed risks that they take. We don't have to abandon our aggressive attitude for interior structural firefighting but rather keep in our minds that a more dynamic assessment of the moment is warranted to avoid firefighter deaths that go along with our precarious actions. Committing firefighters to interior structural firefighting is downright dangerous and will hold everyone accountable if the unthinkable should occur. Many departments across America build their SOG's off of adrenaline based actions that promote glamorous images of aggressive firefighting that they think will win them high praise. Nothing could be further from the truth. Even many firefighters take unnecessary risks putting themselves, their co-workers and even civilians in harms way in order to feed this ego adrenaline high of what they think is this value based glamorous image of firefighting. Firefighters have a tendency to stay too long in the wrong place after the task is done or put themselves into adrenaline based environments within compartmentalized areas fully involved in fire thinking they will win every time. Winning isn't worth your department or family experiencing a line of duty death based on pure adrenaline decision making.