

Running Head: MIXED-USE OCCUPANCY ANALYSIS

Executive Analysis of Fire Service Operations in Emergency Management

Analysis of Mixed-use Occupancy Target Hazards in Uptown Shelby North Carolina

William P. Hunt

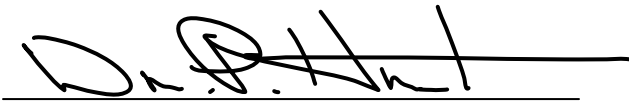
Shelby Fire & Rescue Department

Shelby, North Carolina

February 2008

Certification Page

I hereby certify that this paper constitutes my own product, that where the language of others I set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

William P. Hunt

Abstract

This project analyzed the mixed-use occupancy target hazards in Uptown Shelby, North Carolina. A descriptive research methodology was performed consisting of on-site analysis of properties in the Uptown Commercial District, case study analysis of mixed-use properties from across the nation, and, a survey of building industry professionals. The research answered questions concerning general and specific characteristics of mixed-use occupancy, the inherent life and property risks, the implications on tactical operations and risk reduction initiatives. The results showed that the mixed-use occupancies in Uptown Shelby present significant life and property risks for the community and tactical challenges for the Fire Department. The report made recommendations in the areas of community planning, prevention and operations.

Table of Contents

Abstract.....	3
Table of Contents	4
Introduction	5
Background and Significance.....	6
Literature Review.....	12
Procedures.....	25
Results.....	27
Discussion	48
Recommendations.....	52
References	56

Appendices

Appendix A; Uptown Mixed-use Occupancy.....	59
Appendix B; The Plaza, Salisbury, North Carolina.....	60
Appendix C; The Riverlofts at Tobacco Row, Richmond, Virginia.....	61
Appendix D; Eighth & Pearl Mixed-use, Boulder, Colorado.....	62
Appendix E; Mason Square, 208 South Washington Street.....	63
Appendix F; Lafayette Place, 200 South Lafayette Street.....	64
Appendix G; White Building, 119 East Marion Street.....	65
Appendix H The Eifirds Building, 214 South Lafayette Street.....	66
Appendix I; Pre-Fire Survey Form.....	67
Appendix J; Building Development/Industry Professionals Survey	68

Introduction

Risk has always been a part of the human experience. As a matter of routine, people constantly weigh the potential outcomes of their actions, or inaction, against the probabilities of occurrence. However, in today's modern technical society, the consequences of risk can have profound and far reaching effects. In the urban setting, planning at a variety of levels is a critical toward identifying, managing and mitigating risks to the community.

The research problem is that residential occupancy utilized in mixed-use occupancy development in the Historic Uptown Shelby District pose unique occupant life safety risks and present operational challenges for the Shelby Fire and Rescue Department. Left unchecked, these risks could lead to increased property damage, injuries and loss of life. The purpose of this research is to provide the foundation for a sustainable plan which identifies the existing residential target hazards in mixed use occupancy and applies the appropriate protective tools of prevention and operations to reduce risk to an acceptable or manageable level. This project utilizes a descriptive research approach which will identify generalized and community specific risks associated with mixed-use occupancies. First, a risk analysis of target sites in the Uptown Shelby Commercial District will be performed to identify specific hazards. Next more general hazards will be addressed through case study analysis of properties in other communities. Finally, a survey of building industry professionals will be performed to assess other community approaches to risk reduction in mixed-use development projects. The research will answer the following questions;

- What are the identifying design, construction and occupant characteristics of mixed-use residential/commercial occupancy?
- What are the general and specific risks to life and property in these types of properties?
- How do the factors of design, construction and occupancy in local mixed use development affect the tactical operations of the Fire Department?
- How are other communities mitigating life and property risks in mixed-use property development?

Background and Significance

Effective planning is critical to the viability, sustainability and the livability of city's and towns. Regardless of size, the elements of land use, economic development, transportation and population demographics all come together to affect the overall quality of life and help shape a community's future. In recent years there has been a renaissance in American cities as people seek alternatives from clogged commuting routes, big box store sprawl, and, tract developments with look-alike houses. For city leaders, planners and developers, capitalizing on this renewed interest often means looking toward redeveloping the urban landscape. The transformation of downtowns and neighborhoods into appealing, compact and livable spaces which provide essential conveniences and modern amenities are essential to attracting people into cities and towns to live, work and play. These efforts factor toward the long term vitality of the urban community.

For over fifty years, The National Trust for Historic Preservation has dedicated its mission to saving historic buildings and revitalizing America's communities (2007).

A private, non-profit organization, The National Trust uses a multifaceted approach to place services, resources, advocacy and leadership at the grassroots level which work to stem the tide of the disappearance and deterioration of historically significant structures, traditional neighborhoods, and, communities throughout the United States. A program within the National Trust is *The National Trust Main Street Center*. The focus of the center is the reinvigoration of older, traditional business districts through historic preservation, incremental economic development and a strategy of adaptive reuse of existing infrastructure. Since its inception in 1970, the center has established state and regional Main Street programs throughout the United States. In 1980, the City of Shelby was selected as one of eight North Carolina communities to participate in the Main Street Program. Over the last twenty years, through the coordinated efforts of the local Main Street Program, Uptown Shelby has developed into a vibrant district incorporating business, shopping-entertainment, government and residential space in a ten square block area. In 2007, capitalizing on the district's twenty year track record, the City of Shelby embarked on a ambitious plan to attract new entertainment venues, infill development, improve pedestrian access and encourage the continued renovation and adaptive reuse of properties within in the Uptown Commercial District.

The City of Shelby is located in the Central Piedmont Region of North Carolina along the southwestern the foothills of the Blue Ridge Mountains. Settled in 1841 from land donated for the establishment of a seat of government for Cleveland County, Shelby was incorporated as a town in 1843 under the General Statutes of North Carolina (Eades, 2003). Over the last 160 years, Shelby has grown from a handful of people at a crossroads community, to a city center of more than 21,000 residents with a mixture of

residential, business and industrial development covering 20.4 square miles. The City's tax base is valued at more than 1.5 billion dollars with the City operating within an average annual budget of over 86 million dollars ("Comprehensive Annual Financial Report" (CAFR), 2006). The operating budget is divided into three activity sectors. The *Governmental Activities* sector finances traditional services such as public safety, sanitation, recreation and public works. In 2006, governmental services accounted for \$15,819,187.00 of the total operating budget (p. 8). The *Business Activities* sector finances the business operations of the City's for profit electric, water and sewer, and natural gas utility operations, and, the Shelby-Cleveland County Regional Airport. In 2006, business services accounted for \$55,808,678.00 of the total operating budget (p. 8). Finally, the City's *Fiduciary Fund* sector accounts for funds held in reserve for administrative government purposes, commissions, and aid to agencies (p. 12).

Prudent community planning includes identifying those risks which pose threats to the community's quality of life and developing methods which work toward drawing those threats toward a manageable level risk for the environment, residents and industry. Thus, disaster and crisis planning and management are crucial aspects of overall community planning. Further, since the fire service is typically the first responder in a crisis or disaster situation, and, all communities share the risk of fire to their population (Compton & Granito, 1967/2002), the local fire department must be considered as a major contributor toward the management of risk within a community.

In the City of Shelby, fire protection is provided through an all career municipal department under the authority of the city government for the corporate and satellite city limits. The services the department provides to the community include fire

suppression, pre-hospital emergency care, technical rescue, disaster mitigation, safety education and, building code enforcement with an average operating budget of \$3,015,575.00. Additionally, the department is a partner with Cleveland County providing technical hazardous materials response, and, specialized rescue services, including a regional urban search and rescue team. The Fire and Rescue department maintains three shifts of seventeen personnel, which operate four fire companies based out of three fire stations. The authorized staffing of the department is fifty-four. The Shelby Fire & Rescue Fire Department enjoys a protection class four rating from the Insurance Services Organization.

The significance of this project lay in the relationship of risk between the residential/commercial mixed-use properties in Uptown Shelby and the protective capability of the Fire and Rescue Department. After Shelby's inclusion in the *North Carolina Main Street Program*, the city underwent an aggressive campaign to rehabilitate the Uptown Commercial District. Soon after the formation of the *Uptown Shelby Foundation*, a master plan for the district was developed which encouraged reinvigoration of vacant, abandoned or underutilized buildings within the district through adaptive reuse of the real estate. The plan recommended a mixed-use approach which typically involves incorporating commercial or retail occupancy at street level, and, residential occupancies on upper floors. Prior to 1980, there were no residential occupancies in the uptown district. However, by 1995 over forty residential occupancy units were within the boundaries of the Historic Uptown Shelby Commercial District. In 2007, Shelby partnered with *Uptown Shelby Foundation* and *Destination Cleveland County* in the creation of the *Shelby's Center City Master Plan*. The document sets a

future course for the district by leveraging past success through urban planning, smart growth initiatives and capitalizing on the growing niche market of urban living settings among singles, young couples and retiring baby-boomers (Arnett Muldrow & Associates, 2007). Recently, two significant mixed use projects have been announced (Appendix A). In March Shelby's first new construction urban infill mixed use project was unveiled. When completed, *The Marington on the Square* will feature commercial/retail tenant space on street level with an additional three floors of residential condominiums. Additionally the project will feature an underground parking garage. In September an adaptive reuse redevelopment project was approved by Shelby City Council for the City owned Farmers Market property. The project includes adapting two historical buildings for commercial and residential occupancy along with the construction of townhome condominiums on a vacant portion of the property. Further, other properties in Uptown Shelby have residential/commercial mixed use rehabilitative projects under various stages of development. The combination of these projects will serve to more than triple the residential occupancy space in the Uptown Shelby Commercial District, bringing with it, an associated increase in risk to life and property within the district.

For its part, the Shelby Fire and Rescue Department is typical of suburban city fire departments in that it is operationally prepared to service structural fires occurring in one and two family dwellings. This is where the majority of structural fires occur in Shelby. However, the department is less prepared to service structural fires occurring in a mixed-occupancy commercial building. Traditionally the department's approach to fires in commercial structures has emphasized property preservation relying heavily

upon common occupancy types, built in fire protection measures, and, a reasonable assumption that people within the building will be awake, be alerted, and will have the time to self-evacuate in the event of a fire. Current strategic wisdom in commercial building fires is challenged in mixed-use properties. Mixed-use properties present unique and significant operational problems because multiple occupancy types exist under one roof and the behavior of residential occupants cannot be easily predicted. During a fire, residents may be asleep and fail hear an evacuation signal, or may simply choose to ignore evacuation signals. These factors significantly complicate fire department operations and illustrate the reality that the Shelby Fire and Rescue Department is currently is ill-prepared for the dynamic life-safety and property preservation problems of a fire in a mixed-use occupancy in the Historic Uptown Shelby Commercial District.

This body of research supports the United States Fire Administration's operational objectives of assisting communities toward developing comprehensive, all-hazard risk reduction plans, and, toward the reduction of loss of life among target age groups, and firefighters, from fire related hazards. This project relates to the Community Risk/Capability Assessment Unit of the National Fire Academy's *Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM)* course in the Executive Fire Officer Program. The unit of instruction focused on the importance of comprehensive risk assessment at the local level where community stakeholders identify threats to the quality of life, seek to mitigate those threats to a manageable level of risk, and analyze the capability of community resources to respond to the threats to the community. The unit emphasized that a successful return to a state of normalcy

after a significant incident, crisis, or disaster is predicated upon prior preparation through the examination of risk exposure based on empirical and quantifiable data. Further, risk analysis must be coupled with a comprehensive capability assessment which critically examines public, private and governmental assets, and, the capability to marshal those assets in the face of threats to a community's quality of life ("EAFSOEM", 2007).

Literature Review

Introduction

Planning for a crisis or disaster is an important aspect of overall community planning. It is critical for community leaders and planners to have a fundamental grasp on the community's susceptibility to the given threats in and to their community. The affect of a disaster or crisis on a community depends on many factors. Severity, frequency, and duration of the incident are common indicators. Additionally, other issues such as population demographics, local economy and the significance of the impact area must be factored as well. However, these planning efforts often fall short because local planners and leaders often concentrate efforts toward major disasters with little to no attention paid other types of problems on the assumption that smaller scale crisis can be adequately managed. This misguided notion opens a community to significant risk exposure because the potential for everyday crises are not analyzed for their impact on the community as a whole, or, for the capability of community to effectively mitigate risk and respond needed resources to the event. This literature review will introduce the risk potential of mixed use occupancies through the exploration of the elements of mixed use occupancy, urban revitalization, shifting

population trends, and risk reduction from the perspective of life and property preservation. Additionally an introduction of selected case studies and the selected properties for the research is provided in this section.

Mixed use occupancy

For the purpose of zoning, regulation and enforcement, buildings in the United States are classified according to their intended use. The *International Code Council* (2006) classifies buildings into broad occupancy classifications which include; places of assembly, business establishments, educational facilities, factory/industrial buildings, properties housing hazardous products/processes, mercantile establishments, storage facilities and places of residence (p. 14). North Carolina has adopted the International Code with certain amendments as the *North Carolina Building Code (NCBC)*. A cross referenced sub-code of the NCBC is the *North Carolina Rehabilitation Code (NCRC)* (2002). The NCRC applies to existing buildings undergoing significant renovation. This document is utilized in situations where because of structural limitations, or, for significant historical reasons, a building undergoing renovation or rehabilitation cannot be rehabilitated to the current standards of the Building Code (p. 1).

Since many buildings do not necessarily fit neatly into one single occupancy classification, the term *mixed-use occupancy* has become widely used to describe those types of properties. A mixed-use occupancy can be defined as two or more compatible building occupancy classifications contained within a single structure. An example of mixed-use occupancy is the pairing of mercantile establishments with business type operations. However, a growing trend in mixed use approaches, and one of the more popular, is the integration of residential occupancy with various commercial type

occupancies. This approach is especially popular in urban and suburban redevelopment areas, where land space is at a premium and there is a desire to create compact, amenity filled multi-dimensional neighborhoods. This typically takes the form of apartments and condominiums sharing space with offices, restaurants, shops, arenas and public spaces. Since the trend is common in historic restoration and adaptive reuse development, the *NCRC* includes a section which addresses mixed use buildings. Specifically, each portion of the building must be separately classified according use. Residential use must be separated from the other non-residential uses by a minimum of one-hour rated fire walls and/or ceiling systems, and, fire suppression systems must be designed for the most restrictive occupancy requirements (p. 143). Additionally, all mixed use rehabilitation must adhere to the basic and supplemental requirements as outlined in the document (pp 41-44).

Although many find the trend in mixed-use development new, the fact is, the practice of mixing occupancies has a long history. In Europe, where developable land has historically been at a premium, the practice is critical to providing adequate living, shopping and working space for Europeans. Prior to World War II, mixed occupancies were common in cities and towns across the United States. Flynn, (2003) comments that today's mixed use projects typically mimic what downtown America used to look like. After the war, as the suburban boom began, the practice of single occupancy buildings along with single occupancy zoning practices began in earnest in an effort to compartmentalize city's according land use. The rationale of single occupancy zoning was to simplify codes and ordinances, and, to preserve property values by preventing the placement of incompatible occupancies within the same area. For local fire

departments single occupancy zoning became a planning tool for the deployment of resources. The placement of stations, apparatus and staff could be simplified by considering the specific occupancy zone. For instance, the resources devoted to a predominantly residential zoned fire district would be considerably different than the resources devoted to a factory/industrial zoning area. However, for all the benefits of single occupancy zoning, the practice contributed to poor land management resulting in urban decay, suburban sprawl and an associated gridlock on the nation's road system (Flynn, 2003). In the 1990's, a reexamination of how land is used in the United States and the related effects upon infrastructure, economies and the environment led to the rise of the *New Urbanism* planning movement.

New urbanism and revitalization

New urbanism is a back to the future approach to land use where the sprawl-producing development encountered in traditional separate-use zoning is rejected in favor of practices which encourage compact, high density development. This approach to land use promotes development on a more human scale by facilitating compatible multiple use zoning, integration of public spaces and transportation alternatives (Hall & Porterfield, 2001). A major component of new urbanism is the mixed use occupancy. In order to achieve the compact, high density requirements, buildings which can serve as living, working and shopping/entertainment space are commonly woven into the fabric of projects. A typical building may have space devoted to commercial/retail, residential living, and gathering spaces such as eateries and entertainment venues.

Advocates of new urbanism tout the principles ability to mitigate traffic congestion, halt sprawl, and encourage the redevelopment of urban centers (Flynn,

2003). Cities like Albuquerque, New Mexico, Cambridge Massachusetts, and Charleston, West Virginia have realized an economic infusion in their communities in the form of infrastructure rehabilitation, job creation and civic presence through projects emphasizing the principles of new urbanism (Gurwitt, 2007). However, there is growing criticism of new urbanism. Some planners contend that in an effort to right past land use wrongs, new urbanism is being applied too broadly and creating new problems. Phillips (2007) found that projects in many smaller suburban and more rural communities have failed to live up to expectations because the physical confines and infrastructure of larger urban communities are not present. Typically, small towns and rural communities do not possess the public transportation systems and the self-contained downtowns which are a critical component for these types of projects, nor, are essential public services, such as fire protection, mature enough to meet the required service demands of a multiple use high density zoning environment. Finally, issues of safety are of relevance in mixed-use occupancies which incorporate residential living space. In these occupancies large buildings with undivided spaces are combined with sleeping and living areas. These conditions work together to increase overall hazard to life and property. In fire situations, fire crews may be overwhelmed by the complexity of the incident. The sheer size of the building coupled with the occupant load can significantly reduce the capability of fire crews to place hose lines between the fire and affected occupants (Norman, 2005).

However, despite mounting criticism, the case for new urbanism continues to be made in the venue of downtown revitalization as projects incorporating new urbanism principles continue to be a staple method in redevelopment projects. This is due in

large part that many of the ingredients needed to support high density, multi-use projects already exist in most downtowns (Hall & Porterfield, 2001). Mature street networks and pedestrian ways, a mixture of appealing architecture, an established business core along with an ample supply of existing structures for mixed use rehabilitation projects are major attractors driving the downtown redevelopment boom (Flynn, 2003). This not limited to large urban centers. Mid-range and smaller cities such as Bangor, Maine; Salisbury, North Carolina; and Sheboygan Falls, Wisconsin have experienced success comparable to that of larger urban cities in their own downtown redevelopment efforts (McMahon, 1999). In smaller communities, key elements for success hinge upon developing smaller scale projects which include residential living space and contribute to the existing character of the area (Segedy & Daniels, 2007). Downtown residents in smaller city's and towns often cite quality of life benefits such as a sense of community, access to public space, and proximity to shopping and entertainment as major attractions to living in an urban setting (Steuteville & Langdon, 2003). For business owners, increased pedestrian traffic from residents and visitors, proximity to compatible businesses, competitive rents, and appealing streetscapes are often quoted as major reasons for locating in the downtown (5-12). This blending of residential and commercial occupancy in downtown districts has created a symbiotic relationship epitomizing the live, work and play doctrine of community building under the new urbanism banner. These efforts have transformed once derelict and neglected areas into vibrant, productive, and income producing districts for American cities and towns.

Shifting population trends

The population demographics in the United States are rapidly changing. Baby boomers, those born between 1945 and 1964, and, Millennial's, those born between 1978 and 2000 are now the largest generations in the U.S., and both are having a huge influence on American culture and values. Housing is one area where their influence is readily apparent. Increasingly, Boomers and Millennial's, are challenging the long held housing traditions of single family subdivision homes in the outer suburb and rural areas for non-traditional housing in mixed use urban locations (Kali, 2007). It is important to note here that the influx of Boomers and Millennial's to urban style living not limited to large city's, as the downtowns of smaller cities and towns are quickly becoming residential havens for both generations (Segedy & Daniels, 2007).

However, both generations are choosing to live downtown for different reasons. Millennial's are attracted to downtown for culturally diverse living environments, the ability to shorten commuting time, and to be within walking distance to shopping and entertainment venues (Houstoun, 2007). An interesting trend here is the rising number of families living downtown. After having children, many Millennial's are choosing to continue living downtown because they do not want to give up the urban living experience to which they have become accustomed (Groc, 2007). Boomers, on the other hand, are attracted to downtown for stability. Attractive and safe communities, the ability to have relationships with neighbors and quick access to medical care services are high priority items. As the first wave of Boomers reach retirement age this decade, many downtowns are preparing for this growing market by beginning to cater to the needs of this active and upscale aging population (Thomason, 2007). Handicapped

accessible housing, niche shopping, and medical services are becoming common features in downtown as Boomer's continue to choose to live in the urban core. (p. 2).

Factors of risk reduction

The changing economics and demographics occurring in American downtown districts should not go unnoticed by local community leaders and planners, especially those charged with reducing and mitigating injury and property risk. As urban centers of all sizes continue to redevelop into vibrant districts for homes, businesses and gathering spaces, the long held assumption of downtown as a work center to be abandoned after dark is functionally obsolete and giving way to a new reality of an economically viable multi-dimensional district. This new reality is changing the dynamics of risk in urbanized areas across the county. This new risk set must be factored in new and existing community planning efforts related to reducing risk exposure for disaster and crisis events which may affect downtown areas. Further, it is critical for the local public safety agencies tasked with protecting the community to have knowledge of new and emerging risk factors so that proper response of resources may be implemented in a time of crisis (Jenkins, 2005).

Major risks in any emergent event include the actions taken, or not taken, by people during an event. Human behavior is directly correlated to how people perceive and process the information through their senses (Hughes & MacCollum, 2005). A person who is awake and oriented at the time of an emergent event is more likely to perceive and react favorably to a threat than someone who is asleep. This is of particular concern in residential mixed-use occupancy where people may be shopping, eating, conducting business and sleeping at the same time. When evacuation signals

are activated to warn of an emergency in a building, alert and oriented people may fail to heed the warning because they do not perceive that an emergency exists. In this situation it is common that people will act favorably only when actually sense the emergency such as the smell or sight of smoke. When people are asleep the issue is more acute. In evacuation situations people may fail to act favorably because they are not sufficiently alert to make a logical decision, or, they are not awakened at all (Hasover, Beck, & Bennetts, 2007).

Another risk consideration in mixed-use occupancies is the types of occupancies contained within the structure, and their proximity to one another. This is especially important where residential occupancy factors into the equation. Since a variety of commercial type establishments may be present under one roof, the activities of a commercial enterprise will factor significantly in determining overall risk (Hughes & MacCollum, 2005). For instance, a restaurant in a residential/commercial mixed-use occupancy will present with a different risk matrix set from that of a mixed-use occupancy where general business offices are housed with residential apartments. Further, the proximity of the various occupancy classes to one another within the structure must factor into the overall risk assessment (Hasover, Beck, & Bennetts, 2007). For instance, calculations of risk will substantially increase where residential occupancies are located directly over or beside a commercial occupancy with a restaurant tenant as opposed to the same residential occupancies being housed one or more floors away from the restaurant.

Yet another major consideration is exit way accessibility. The ability of occupants to access exits in the event of the need for an evacuation of the building is

critical during a crisis event and plays a significant role on the outcome. Egress design, condition and physical location play a significant role in determining overall risk (Hughes & MacCollum, 2005) which must be analyzed by planners. This is especially important in rehabilitated buildings where the number of exit pathways and the overall design may not be to modern building standards (NCRC, 2005).

Other factors to consider in risk reduction efforts are the construction of the building, built-in fire protection measures, municipal systems and the overall accessibility for first responders. However, for effective risk reduction to take place, it is critical that emergency responders are aware of the risks in the community and factor them into their response plans (Turner, 2005).

Case studies

The Plaza, located at 100 West Innes Street in Salisbury, North Carolina is a historic landmark building and serves as the centerpiece for the bustling downtown district (Appendix B). Originally constructed in 1912 as the Grubb building, the seven story steel and concrete structure housed a variety of retail establishments and offices (Downtown Salisbury, 2004). However, by the sixties, the building had fallen into decline, and by the mid- seventies, the upper floors were largely vacant and derelict. In 1991, the entire building was rehabilitated into its current mixed-use occupancy configuration. The street level first floor was subdivided and developed for retail space, while the second and third floors retained their use as office tenant space. The remaining four floors were redeveloped into twenty residential apartments ranging in size from 700 to 1,200 square feet (Lambert, 1991).

The former factory and warehouse space of the *American Tobacco and Cigar Co.* in Richmond, Virginia has become home to the urban rehabilitation, mixed-use occupancy development known as *The River Lofts at Tobacco Row*. Completed in 2000, the project sought to establish a dense urban residential community infused with service related industries, retail shopping and entertainment venues to compliment downtown. The complex consists of three multi-story turn of the century buildings which have been rehabilitated into residential condominiums, numerous office and retail spaces, and two restaurants. Additionally, a historically accurate addition to one of the buildings houses a large grocery chain store (Appendix C). The project has been a catalyst for infill redevelopment along the James River waterfront, and has been one of the keys to attracting residents, shoppers and business into downtown Richmond (McManus, 2001).

The mixed-use project located at 8th and Pearl Streets in downtown Boulder, Colorado was constructed in 2001 as a transition from the downtown to the adjacent residential neighborhood. The project blends with the historic character of the area utilizing changes in elevation and color variations of brick facades found in surrounding buildings (Appendix D). Fronting Pearl Street, two floors of commercial tenant space include a bakery, a coffee house and business office spaces. Situated on the side streets behind and connected to the commercial space are five row style two story residential townhomes (Wolff, 1999).

Study properties

In 1924 Charlotte (NC) architect Willard G. Rogers was commissioned to design a temple headquarters for the *Cleveland Lodge of the Ancient, Free and Accepted Masons of*

North Carolina. His design, an Egyptian revival, four story brick edifice became a focal point in Shelby at its location at 203 South Washington Street (Appendix E). When completed in 1925, the Masonic Temple was city's tallest building. Originally, the upper two floors were dedicated for use by the Masons, including a large meeting hall on the fourth floor, with retail and office space comprising the lower floors. In the early 1980's the building was rehabilitated as *Mason Square*. In its new iteration, the lower two floors remained dedicated to office/retail, and the upper two floors were renovated into sixteen residential apartments. This property represented Uptown Shelby's first foray into residential living space (Eades, 2003).

The two story Belk-Royster Building was constructed in 1923 by Dr. Stephen S. Royster and housed the Belk Department store until 1982. The original footprint of the building consisted of a significant portion of the 200 block of South Lafayette Street. After remaining vacant for nearly ten years, the building was rehabilitated as *Lafayette Place* in the early 1990's (Eades, 2003). As portions of the building were demolished to make way for parking, the expansive street-level retail space was subdivided into smaller tenant spaces, and the upper levels were converted into twelve loft style residential condominiums (Appendix F).

The White Building, constructed in 1926, is a two story brick masonry building fronting the 200 block of West Marion Street, and is representative of the typical construction practices in American downtowns in the early twentieth century (Appendix G). Through its history, the building has been home to numerous tenants and has undergone several renovations (Eades, 2003). In 1990, the building underwent a significant renovation which included subdividing several street level tenant spaces,

and, a conversion of portions of the second floor from office space into eight residential apartments.

The Efirds Building at 214 South Lafayette Street was constructed by Zebulon and Enos Beam in 1924 to replace an earlier wooden structure on the site which had burned (Eades, 2003). The three story building served as commercial tenant space and offices for over seven decades. In 1998, the entire building underwent a major rehabilitation. The upper floors were adapted to residential occupancy from office use and the street fronts were completely renovated for retail and office use. In its current use, two retail/commercial tenants are located on street level, and seven residential condominiums are housed on the upper floors (Appendix H).

Summary

This review discussed the characteristics of mixed-use occupancies and the risks and hazards to life and property they bring when residential living space is introduced into the occupancy matrix. Professional standards and literature were consulted to describe the defining elements of mixed use occupancy and discuss where these types of buildings are commonly found. Additionally, the case studies and the local study properties for this project were introduced. The research in this review affirms that community planning should be based upon the unique needs of a community and that local planners are in the best position to evaluate and mitigate the unique risks in the community.

Procedures

Problem/Purpose

A community's successful recovery from a crisis or disaster is predicated on identifying the prevailing hazards facing the community and developing mitigation and response protocols prior the occurrence of an event. Future focused planning allows a community to react more efficiently and effectively, and, return more quickly to a state of normalcy after a crisis or a disaster. Since all communities face the threat of fire, local hazard mitigation plans must factor the various threats that fire places on the population. The purpose of this research project is to provide for the foundation for a sustainable plan that identifies the existing residential target hazards in mixed use development and apply the appropriate protective tools of prevention and operations to reduce risk exposure in residential/commercial mixed-use occupancies to an acceptable or manageable level. The research is conducted in three phases. First, the project analyzes general and specific risks among the targeted mixed-use properties in Shelby. Secondly, a more global look at risk in mixed-use occupancy development is conducted through a case study analysis of specific mixed-use projects throughout the United States. Finally, various sectors of the building industry are compiled in a surveyed to determine involvement in mixed-use projects and the integration of hazard mitigation strategies. The descriptive research method is utilized for this project.

Research Design

The first phase of the research analyzes community specific risks of mixed use occupancies. The Historic Uptown Shelby Commercial District is the study area for the project and serves to contain the research to a specific area. To begin the research a map

is generated by the City of Shelby Planning Department showing the boundaries of the district and the parcels with residential/commercial mixed occupancies (Appendix A). Then site visits to the selected properties are conducted to identify site specific hazards. A Shelby Fire and Rescue Pre-fire plan form is utilized to provide a basis for analyzing each study property for construction features, built-in protection measures, occupant egress, occupancy hazards and fire department operations (Appendix I).

In the second phase, the more generalized risks of mixed use occupancies are analyzed. For this part of the research, completed project case studies are obtained from design and architectural firms in the United States. The projects studied cover the spheres of adaptive reuse, commercial and residential district rehabilitation, industrial redevelopment and urban infill. To maintain research continuity, the same format used to analyze the case studies are utilized for analysis of the selected case studies.

The third phase of the research project surveys professionals within various sectors of the building industry (Appendix J). An internet survey distributed through email invites architects, developers, planners, inspectors and preservationists throughout the United States to participate. The survey asks respondents a series of questions concerning the protective strategies they have designed, utilized, or advocated for in the mixed use projects they have had affiliation with in the last five years.

Finally, in the Results section, the project returns to the original research questions posed and provides analysis gleaned from the research and from the literature review.

Results

Case Study Results

The Plaza, Salisbury, North Carolina.

The case study analysis of The Plaza (Appendix B) found the building to be of substantial construction. The building is of fire resistive construction and features a substructure of steel reinforced concrete columns and beams with a brick and limestone façade. The building is seven stories in height and has one below grade level. Interior walls are traditional plaster on wire lath. Upper floor window openings are common double hung and are operational. In the 1991 renovation, the building was divided by occupancy by fire walls and distance separation into three distinct zones. The street level is dedicated to commercial/retail, the second for office space and, floors three through seven are reserved for residential occupancy.

Built-in protection measures include a modern fire detection system, a class one standpipe system and a partial sprinkler system. The features of the detection system include smoke and heat detectors throughout the building, audible and visual warning devices, duct detection in HVAC and remote access to the fire alarm control from keypads located at each main entrance. The system services the entire building and is monitored by a third party provider. The standpipe system is located in the center stairwell and has access to all seven levels, the basement and the roof. However, the standpipe system does serve the first level, street-front tenant spaces. The sprinkler system serves only the basement level. Separate fire department connections are provided for both systems.

For residential and office occupant egress, the building is served by two protected stair towers. The center tower provides egress for all floors, the basement and the roof, while the second stair tower serves the first floor through seventh floor and the roof. The basement is served by an additional exit directly to the outside ground level. Three of the street level commercial tenant spaces are served by secondary exits which empty into a common protected corridor leading to the outside. The fourth tenant space has direct secondary access to outside. The building is served by two elevators which feature automatic ground floor return, and, firefighter access override capability.

The most significant commercial occupancy hazard within The Plaza is the bistro-café located on the first floor street front. The café is a full service restaurant and the main hazards of the occupancy stem from cooking operations. All other street level tenants are service and merchandize related and mostly pose hazards related to their contents. The occupancies of neighboring buildings do not pose significant threat to the building.

A fire or other crisis event in this building may present significant challenges for fire department operations. The height of the building makes access and evacuation of the upper floor residential units problematic. Although two stairwells are provided, access and egress may be hampered by a large scale evacuation of residents and workers. Additionally, the sixth and seventh floor may not be reached by aerial ladders. However, the building is located on a corner lot and is reasonably accessible on three sides.

The River Lofts at Tobacco Row, Richmond, Virginia.

The construction of the River Lofts at Tobacco Row (Appendix C) is representative of early twentieth century industrial construction. Each of the three buildings features an exterior of brick with interior supporting beams and columns consisting of massive wooden members. The buildings retain much of their original hardwood flooring. The roof system is a laminated wood deck system with the addition of a modern rubber bladder roof covering overlay system. The open factory floors on each level have been subdivided for commercial/retail and residential spaces. The first floor of each building is wholly devoted to commercial/retail with the second floor mostly reserved for office spaces, and the remaining floors dedicated to residential living space. During the rehabilitation project modern construction techniques and materials, such as gypsum wall board and lightweight support members were used to subdivide the open manufacturing space into smaller tenant space. Modern plumbing, electrical wiring and HVAC systems were added throughout the building to facilitate the change in occupancy use. It is important to note the original twelve to fourteen foot open ceiling heights with exposed beams were retained.

There are several built-in protection measures serving the property, the most prominent being the fire sprinkler systems which protect buildings. The existing sprinklers systems were brought up to modern standards with new valve work, replacement piping and new sprinkler heads. The systems are supplied through a looped water main system on the property and connected to the municipal water supply. Additionally, a fire pump which draws water from the James River backs up the sprinkler system. Secondly, the restaurant occupancies have extensive additional spot fire protection provided in the kitchen areas. Each cooking ventilation system is

fitted with an extinguishing system which may be activated manually or automatically. Activation of the extinguishing system shuts down all cooking operations. Finally, all protection systems are coordinated through a fire alarm and detection system. The system monitors the sprinkler and extinguishment systems for activation. The system also monitors a network of smoke and heat detectors located throughout each building. Remote control panels for the alarm and detection system are located at strategic locations.

During the rehabilitation, all methods of egress were totally modernized in each of the buildings. Three fire-rated protected stairways were installed in each building; one in the center and the remaining two located at the opposite ends of each building. Each building has modern elevators featuring automatic ground floor return, and, firefighter access override capability. The first level tenant spaces and restaurants have additional egress capability according to their specific occupancy requirements.

The most significant hazards to occupants stem from density. Situated on roughly two city blocks the 370 residential, office, and retail/commercial occupancies are in close proximity to each other. A crisis originating out of a fire in the commercial/retail or office areas will have an immediate affect on the residents in terms exposure to fire and the ability to rapidly evacuate. However, the residential areas are buffered from the commercial spaces by at least one floor of office tenant space.

From an operational standpoint, the sprinkler system provides a strategic advantage for fire department operations. However, major the obstacles to effective operations stem from accessibility. During the rehabilitation, areas between the buildings were converted to open plaza space and are not accessible by fire apparatus.

This creates the situation of needing to stretch longer hose lays to access some areas of the building. Further, streets around the buildings were narrowed and offer on street parking which may hinder setting up aerial ladders and positioning fire engines for fire operations.

Eighth and Pearl Mixed-use, Boulder, Colorado.

The Eighth and Pearl Street's mixed-use project (Appendix D) consists of two buildings of modern construction. Built in 1999, both buildings are multi-level and are of wood frame construction with masonry veneer walls. The buildings make extensive use of engineered wood building components such as wood trusses, lightweight laminated beams and composite wood sheathing. Additionally, an appreciable amount of structural steel is used throughout the structure for beams and columns. The commercial/retail portions of the property generally front Eighth Street and are housed on two levels. The street level tenant spaces are service and retail oriented, while the second floor suites house a variety of offices. In each building, the commercial/retail space is separated from the residential units by a two hour rated fire wall. The residential portion each building on the property consists of four row style townhouses. Each townhouse is each two stories in height, with an attic loft area, and each unit is separated from the other with a one hour rated fire separation.

Built-in protection measures are limited to mostly fire wall separations. As discussed above, the commercial/retail portions of the building are separated from the residential townhomes by a fire wall, and, each residential unit has a fire rated separation from neighboring units. In the commercial section, a supervised fire detection system is present. Audible and visual warning indicators are provided and

manual pull stations are located at each exit. The supervised alarm system does not cover the residential portion. In the townhomes, smoke detectors are provided on each floor; however, there is no interconnection of the smoke detectors between units. Additionally spot is extinguishment provided in the tenant space housing a café. The extinguishing system is located in the hood system in the cooking area.

Egress for the street level commercial/retail tenants is via the main business entrance and a secondary point of egress located at the rear of the tenant space. The secondary exit discharges directly to the outside. The second floor office suites discharge into a hallway which is served a protected stairwell discharging to the exterior. A secondary exit for the office suites is provided by access to an outdoor second floor patio which has an outside stair way to the ground level. For the residential units egress is handled through a front and rear entrance.

The occupancy hazards are principally related to proximity of other tenants and occupancy uses. While the residential units are significantly separated from the commercial tenants, there is more risk exposure for the residences located in the same building on the property as the café. Secondly, the residential occupancies were designed more or less as attached single-family homes which resulted in protection measures being limited. For example, the smoke detectors are not interconnected among other residential units, or with the commercial/retail portion. Thus a fire occurring in one part of the property may go unnoticed by residents until the fire becomes significant.

Fire department operations in this building present challenges for firefighters. A critical component for operational success is early detection and notification of the fire

department while a fire is contained within a specific tenant space. A delayed response by the fire department can prove disastrous if the fire is able to breach separations between tenant spaces, or, gain hold of the void spaces. Further, since the building is built of lightweight engineered products, early collapse should be expected during a fire or any other assault to the structural integrity of the building.

Study Area Analysis

Mason Square, 208 South Washington Street.

The construction features of Mason Square (Appendix E) include a steel frame substructure with a brick and limestone exterior. The building is four stories in height and has a partial basement for services. A rooftop penthouse houses elevator mechanicals and the rooftop contains HVAC units. The interior walls are a mix between traditional wire lath and plaster, and, modern gypsum wallboard. Upper floor window openings are modern double hung sash replacements and are fully operational.

The built-in protection features include a full fire sprinkler system, and, fire alarm and detection system. During a 2007 renovation of the property, the fire sprinkler system was retrofitted to comply with the current building code. A fire department connection is provided at the rear of the building. In the same renovation, a new fire alarm and detection system was installed. The system supervises the sprinkler system and monitors the heat and smoke detectors located throughout the occupied and service areas of the building. In the event of an alarm all HVAC systems are shut down. The system features audible and visual warning devices. A remote fire alarm control panel is located at the front entry. It is important to note that the in the 2007

renovation, the entire second floor was redesigned for a single tenant. During the renovation most of the interior partition walls were removed to facilitate an open office plan.

Occupant egress is served by two stairways. The front egress is an internal stairwell which is original to the building. During the 1980 rehabilitation of Mason Square, modern fire doors were added to each floor access and the lobby discharge area was enclosed to provide additional protection. The original wood stair and rail system remains. The rear egress was added to the exterior of the building during the 1980 renovation and consists of a protected stair tower discharging directly to the outside street level. The stair tower is of similar construction materials as the building. The above grade level floors have access to both stairways. The residential units discharge into a common hallway which discharge to the stair tower exits. The ground floor has direct access to the outside street level. The building is served by a single elevator located at the front and it features automatic ground floor recall and fire fighter override capabilities.

The occupancy hazards presenting at this property are similar to those cited in the case studies. Currently the ground floor consists of six office suites and the second floor is devoted to one tenant space. Moving people from the sixteen residential units on the upper floors to the outside ground level in the event of an emergency seems to be the most prominent hazard.

For fire department operations, the sprinkler system offers a strategic advantage. Further, the building is situated on a corner lot with wide streets and offers three sides of contact for operations. However, the stair system can be a roadblock for operations.

To reserve the protected stair tower for evacuation, fire operations on upper floors will have to be coordinated through the internal stairwell which may hinder quick access by responders. The rooftop HVAC units do not present a significant dead load of the roof system.

Lafayette Place, 200 South Lafayette Street

The original construction of Lafayette Place (Appendix F) is typical ordinary construction. However, the site visit revealed a significant amount of unprotected steel beams, girders and columns retrofitted to the structure during the 1990 rehabilitation for the purpose increase building stability. One of the more interesting features in the current building configuration is the parking area in the rear of the building. During the rehabilitation project, to make way for needed tenant parking, a significant portion of the rear of the building was demolished. The roof, floors and interior wall systems of the building were removed, leaving original exterior masonry walls intact. A system of steel girders and columns were installed to provide stability to the unsupported walls. What remains is a paved exterior parking area and the entrances to the residential portion of the building.

The most significant built-in protection measure is the standpipe system which serves the residential portion of the building. The standpipe is a class-two wet system and is connected to a dedicated four inch supply main. A fire department connection to the system is not provided. A control valve for fire department use is provided at the foot of each residential stairway. There is no hose provided for occupant use. A limited fire detection system consisting of individual hardwired smoke detectors is provided in each tenant space. Separation of tenant spaces consists of fire separations between each

of the ground floor commercial/retail tenant spaces and fire rated ceilings to provide separation from the residential units above. Wall and ceiling separations are rated at two hours.

For the commercial/retail spaces occupant egress is facilitated by two exits directly to the outside. One exit discharges to the front at street level and the second discharges into the rear parking area. The twelve condominiums are grouped by four units around one of three open air vestibules served by an open air stairway discharging to the parking area.

The primary occupancy hazard in Lafayette Place lies in the ability of residential occupants to escape in the event of a fire. As already noted, egress from any of the individual condominiums is limited to one route. The only alternative in the event a stairway is compromised by a fire or other crisis is by the street front windows. There is negligible hazard from the current commercial/retail tenants on the first floor. However, a large restaurant located in the building next door to Lafayette Place is a potential hazard since the integrity of the fire wall between the two buildings cannot be confirmed. Finally, the site visit revealed weakness in the wall systems in the form of cracks and evidence of past repair to the masonry walls.

Fire department operations in this building present significant challenges. Although a network of alleys surrounds the building, access to the building is limited. The alley network is narrow and within the collapse zone of the building which hinders any fire department operations from the rear of the building, and, given the overall condition of the masonry walls, early collapse should be suspected. Compounding this problem is the normal access to the residential units is at the rear of the building.

Further, aerial ladder access from the front is hindered by several mature live oak trees lining the street. These conditions limit ready access by fire apparatus and personnel.

The White Building, 119 East Marion Street.

The White Building (Appendix G) consists of two adjoined separate buildings. The front portion is two and a half stories and features ordinary construction of double width masonry walls of brick with wood columns and joists. The rear section is one story and is of similar construction as the front portion. During numerous renovations, the two buildings were co-joined and are now considered a single occupancy. It is important to note that numerous unprotected steel columns and beams have been added for additional support throughout the building as it has changed through the years. The ground floor consists of eight office tenant spaces of various sizes, and, the second floor houses two office tenants and eight residential apartments. The site visit found significant weakness in the wall systems in the form of cracks and evidence of past repair to the masonry walls.

The White Building has limited built-in protection measures. The original fire wall separation between the original buildings is breached in numerous locations for the purpose of expanding tenant spaces and for utility access. A hardwired basic smoke detector system is present; however, the detectors are not zoned and only provide warning for the designated tenant space. The separation of residential occupancy from commercial/retail occupancy consists of a fire rated drop ceiling system and the original ceiling. A rating for the original ceiling cannot be determined. The second floor offices are not separated from the residential apartments.

Occupant egress for the office spaces in is typically through the main entrance since most of the tenant spaces are small; however, the larger office suites have a secondary exit directly to the outside. The residential units on the second floor are served by two stair wells on the opposite ends of the building. The front stairway is unprotected and runs a straight line without a landing from the upstairs hall to the street level. The second stair is protected and is a conventional landing design and discharges into the rear parking lot.

The site visit of the property found that hazards specifically related to non-residential occupancy are limited since all of the tenants are of an office type occupancy. This leaves the major occupant hazard as the ability of residential occupants to effectively escape during a fire or other crisis. The major problem hindering evacuation is the integrity of the front stairway. Since it is unprotected, a significant hazard potential exists in that it can be easily compromised in a fire situation thus leaving the only other means of escape through the rear stair way exit. A paint store located next door to the study property poses a proximal risk.

With regard to fire department operations significant tactical consideration must be given to life safety of the residential occupants and toward the structural integrity of the building. As already noted, the front stair way leading to the second floor is unprotected. A fire in the first floor tenant space near the stair channel can compromise the stairway, thus making evacuation from the front impossible. Further, the operations of fire crews will be hampered as they will be forced utilize the same route for access as the occupants are using for egress. Considering structural integrity, in light of the deteriorated masonry, breached fire separations, and the significant

presence of retrofitted steel members, firefighters should expect early structural collapse during a fire or other crisis which assaults the integrity of the building. However, firefighters gain a strategic advantage in the form of accessibility. The building offers access from three sides in the form of a relatively clear street frontage, a large parking lot to the rear and an alley to one side of the building.

The Eifirds Building, 214 South Lafayette Street.

The Eifirds Building (Appendix H) is of ordinary construction consisting of double-width brick exterior walls and wooden support columns and beams. Interior wall finishes are a combination of plaster on wire lath, and, modern gypsum wall board. The building is two and a half stories in height with a full basement. During the site visit it was noted that numerous steel beams and columns were installed for extra support. All of the steel members are unprotected. The building has a flat roof with a parapet. A modern bladder roof system has been laid over the original decking. Window openings are common casement style and are fully operational. The tenant space consists of two commercial/retail space on the first floor and seven residential apartments located on the second floor. A system of two-hour fire rated separations are used to subdivide the uses of the building by occupancy.

Built-in protection measures for the building are quite impressive. During the 1999 renovation, the property was retrofitted with a fire sprinkler system, and, a fire alarm and detection system. The fire sprinkler system is a wet valve system and serves the entire building. The fire alarm and detection system consists of smoke and heat detectors located throughout the building along with audible and visual warning

devices. There are manual pull stations at each exit in the commercial/retail spaces and at the exits in the second floor hallway serving the residential apartments.

Each commercial/retail space is served by two exits. The first being the primary street side entrance and the second at the rear of the tenant space. The rear exit for both tenant spaces discharges into a protected vestibule with a door leading to the outside rear parking area. The residential apartments on the second floor are served by a common hallway and two remote exits. The first is located at the front of the building and consists of a protected stairway which discharges to the street level. A automatically closing fire door is located at the head of the stairs to fully protect the stairway. The second exit consists of an attached outside steel stair way which discharges to the rear parking area.

Much like the White Building, the main occupancy hazards within in the Eifird's Building originates from the non-commercial application. However, in this case the extensive rehabilitation of the property mitigates those hazards significantly. The combination of active fire protection from the sprinkler system and early warning from the fire alarm and detection system offers significant risk reduction benefits. Further, the compartmentalization by occupancy also works to reduce life hazard risks. Like the other study properties, there is a concern for evacuation, although residential tenants only have to travel one floor to street level, and, there are only seven residential units utilizing two egress paths.

As a result of the built-in protection measures and the relatively small footprint of the building, the fire department gains a significant strategic advantage for operations involving fires. The active fire protection systems and the warning

capability allow occupants time to escape in the event of a fire if they are alerted and respond favorably to an evacuation signal. Further, the systems allow the fire department to begin extinguishment operations while the fire is in a smaller state of growth. However, because of the buildings age, elements of building construction play significantly into fire department operations. Evidence of settling and some deterioration of the masonry are present. Further, as already noted, unprotected steel reinforcements were installed during the rehabilitation to provide stabilization. Firefighters should expect early building collapse in a fire or any other assault on the buildings integrity.

Building Professionals Survey

Two-hundred ten survey instruments were returned for analysis. The survey asked eight questions concerning industry affiliation of the survey taker, involvement in mixed-use building projects and what types of risk reduction methods have been incorporated into those projects. (Appendix J)

The survey was distributed to a cross section of professionals in the building industry. Of the returned instruments 39% came from code enforcement officials, 32% were from urban planners and 17% came from preservation/revitalization officials. The remainder of instruments came from architects (8%) and developers (5%).

Regarding involvement in mixed-use projects, most respondents estimated a 10%-29% involvement (38.7%), or, reported a less than 10% involvement (35%) over the last five years in mixed-use projects. The remainder of respondents recorded a 30%-59% involvement (11.3%), or a 60%-100% (14.2%) in mixed-use projects. Concerning residential occupancy in mixed use projects, the survey found the results at

the extremes of the scale. Most survey respondents reported either less than 10% (39%), or, 60%-100% involvement (31.4%) in mixed use projects which used a residential occupancy in the project. Further, most (68.8%) found their involvement in projects with mixed use occupancies increased in the last five years. Most projects were located in commercial rehabilitation districts (57.9%) or were part of an urban infill development project (42.1%). Additionally, many of the projects involved an adaptive reuse of an existing building (41.1%). A surprise finding was among survey respondents was the percentage of mixed-use projects in rural areas (29%). Respondents also reported projects in residential areas (15%) and in industrial Brownfield redevelopment areas (13.1%).

Survey respondents reported a variety of protection measures incorporated into their projects. Overwhelmingly, fire sprinklers systems (84.7%) and fire detection systems (89.8%) are the most common methods along with fire walls and separations (79.6%). Many respondents also reported the practice of upgrading existing fire sprinkler (42.9%) and fire detection systems (48%). Spot extinguishing systems (48%) such as hood systems were also chosen by respondents.

Concerning methods of egress, modernized exit signage (73.5%) was selected most by respondents. Survey respondents also chose additional paths of exit travel (69.9%), modification of existing exit ways (59%) and modernized door systems (50.6%) as methods that have been included in projects. An interesting note is that protected stair tower's was selected by a significant amount of the survey respondents (43.4%).

Finally, survey respondents were asked about additional protective measures in mixed-use projects. By far, most reported they had included fire wall separation by

occupancy type (79.2%). Audible and visual evacuation signals (74%), protected stairs and exit ways (65.5%), and fire department access to property (62.5%) were the most popular methods. Other measures chosen included automatic notification of fire department (59.4%), warning systems for visual and hearing impaired (36.5%) and automatic shut-down of HVAC systems (34.4%) were chosen.

Summary of Research Questions

What are the identifying design, construction and occupant characteristics of mixed-use residential/commercial occupancy?

The research in this project concludes there are no hard characteristics with which to identify or classify mixed-use residential/commercial occupancies. These occupancies may be found in a variety of settings but are most commonly located in urban and suburban downtown districts, former industrial areas, and traditional residential neighborhoods. Further, mixed-use occupancies are increasingly being found in new construction projects as the trend toward compact/high density development continues in United States. However, the majority of mixed use occupancies continue to be found in existing construction within the sphere of adaptive reuse projects in a variety of settings. With adaptive reuse, almost any style or type of building can fulfill a mixed-occupancy use. As shown in the research, high rise buildings, factories, mercantile store buildings and common low rise structures all can be readily adapted for mixed use. A common thread among residential mixed-use occupancy is how space within the occupancy is utilized. The research found that the typical arrangement of occupancies is to place commercial/retail tenant spaces on street level and locate residential occupancies on upper floors. With regard to the occupancy

characteristics, the research found that residential apartments and condominiums routinely coexist with most commercial type occupancies such as restaurants, offices, shops and public gathering spaces.

What are the general and specific risks to life and property in these types of properties?

The general risks inherent in residential/commercial mixed-occupancies are linked to the hazards of residential housing density, the proximity to commercial operations and in the overall quality and age of the structure. The presence of multi-family housing in mixed-use occupancies increases risk to life and property much in the same way as do traditional apartment buildings. With the concentration of residential tenant spaces, a fire or other crisis has the potential to directly and indirectly affect a greater amount of people. However, this risk is exacerbated when commercial occupancies are placed proximal to residential occupancies. While the actual mix of tenants in the commercial spaces will drive actual risk exposure, the introduction of various commercial, retail and service operations along with residential living space serve to increase overall risk exposure on both sides of the equation. Residential tenants are affected by the various activities of businesses, the fire loading of products and stock, and the increased occupant loading from normal business operations. Commercial tenants are exposed to increased risk principally by the human behavior of the residential occupants where careless or reckless behavior results in fires or other crisis. Finally, the overall quality and age of the building in question comes into play when factoring risk exposure. Since residential/commercial mixed-use is most commonly seen in older existing buildings undergoing adaptive reuse rehabilitation, the issue becomes critical. Principally, as buildings age, building components tend to

deteriorate which necessitates the need for structural repairs during rehabilitation. Further, these buildings often require major design and structural modifications to meet the needs of the new occupancy use. Frequently a rehabilitation project introduces lightweight building components and breaches existing fire separations. These situations must be factored by emergency responders when faced with a variety of scenarios as these materials and practices affect the structural integrity of a building.

With regards to of the specific risks in the study properties, the research found that in the study properties the life and property risk is proportional to the overall quality of the rehabilitation of the building. A recurring theme encountered in the site visits was that as the quality of the rehabilitation of a property increased, so did the protective measures. For example, the overall rehabilitation projects at *Mason Square* and the *Eifird's Building* were of high quality in terms of attention paid to the overall quality of work and in retaining the original character of the building. Both of these buildings have the most developed protective measures. Active protection systems, and, protected egress features were found at those properties where the rehabilitation was of higher quality. A significant risk at some properties is the occupants ability, especially residential, to evacuate. *Lafayette Place* and *The White Building* in particular expose occupants to higher life safety risk in the form of inadequate routes of egress. Another significant risk exposure for occupants in the study properties comes from the overall general condition of the building being considered. Principally because of age, most of the study properties possess significant structural impairment, which typically required some form of stabilization when the building was rehabilitated. The structural impairments increase risk for occupants and responders in that early building collapse

can be expected. Further, the integrity of fire walls separating buildings cannot be determined. A fire in an adjacent building has the potential of spreading to other buildings through breached or deteriorated fire walls. Thus a fire in an adjacent building has to be considered as a significant threat to the occupants. Finally, the research found that the generalized risks in mixed-use occupancies discussed above were present in the study properties.

How do the factors of design, construction and occupancy in local mixed use development affect the tactical operations of the Fire Department?

The characteristics of the mixed-use occupancies in Shelby have significant affect on the strategic operations of the Fire Department. Like other fire departments in smaller towns, the bulk of the structural fire incidents the Fire Department answers are in one and two family dwellings. As a result, the tactical considerations and operational readiness of the Fire Department reflect that reality in that the emphasis of staffing, equipment and tactical training are based on serving fires in traditional residential occupancies. The problem here is that applying that resource and tactical mindset may not be adequate to bring a fire or other crisis in a mixed-use occupancy to a favorable conclusion. From a design and occupancy perspective, the residential/commercial mixed-use occupancies present significant tactical concerns because of the proximity of residential and commercial space. Further, these buildings tend to be of significant size and incorporate multiple tenants. With regards to construction, the buildings are of advanced age and through the years have seen deterioration of structural components. Additionally, in many cases, structural components have been altered or removed and have had lightweight building materials

installed in their place. Taken together, these factors clearly show that the current initial response to a residential/commercial mixed-use occupancy is not capable of servicing a structural fire beyond the incipient stage.

How are other communities mitigating life and property risks in mixed-use property development?

The research for this project found that other communities are using a variety of modalities to mitigate and reduce the life and property risks encountered in mixed-use occupancies. In the case studies active protection systems and compartmentalization by occupancy are used in coordination for the purpose of making these buildings safer places to live and work. Principally, fire sprinkler systems, and, fire alarm and detection systems are utilized to gain a margin of safety through early warning and suppression along with barriers and buffers placed between residential and commercial spaces. The survey results seem to support the practices in the case studies. Responses showed that the installation of new and the retrofitting of existing fire sprinkler and standpipe systems to be common practice for risk reduction. Additionally, survey results showed rehabilitation projects include significant use of early warning capability in the form of fire alarm and detection systems. Other ways localities are looking at reducing risk in mixed-use occupancy include modernization of existing egress features, additional paths of egress and separation by occupancy. Finally, as was shown in the case studies and highlighted in the survey, mixed-use rehabilitation projects make significant use of separation by occupancy. The research found that less hazardous tenant space, such as offices, is typically used as a buffer in conjunction with built in fire separations. This has the effect of placing as much physical space possible

between residential occupancy from the more hazardous commercial occupancy types within the building.

Summary

The findings of this report are based on the evidence presented in the case studies, local study properties and a survey of building professionals. The findings of the research indicate that these types of occupancies are most typically found in a variety of urbanized settings where there an existing supply of structures for rehabilitation, and, are becoming increasingly common in new construction. The risks to life and property are derived from the proximity of commercial and residential space and dictated by the actual commercial tenants, the protective measures and the condition of the structure. Further, the findings found that tactical operations of the Fire Department are significantly affected with respect to the size of the building and the proximity of residential and commercial space. Finally, the findings of the report conclude that other communities are mitigating risk in these types of occupancies through construction features, active fire protection systems and occupancy segregation.

Discussion

The need for comprehensive prior planning for the crisis or disaster's which may befall a community cannot be stressed enough. In order to adequately protect the community, leaders from public, private and government disciplines must come together to address the broad spectrum of risk exposure to the community and develop plans and resources which work together to bring that exposure to a manageable level.

There are several parallels to be drawn from the results of the study as compared with the research of others highlighted in the project. With regard to the identifying characteristics of mixed-use occupancies the study results found that almost any building can be designed or modified to serve a mixed use. This is illustrated in the results of the study as the properties highlighted in the research were of varied design disciplines which included a factory, a former department store and an example of new construction. This factor is further supported in the background research. Flynn (2003) noted that downtown's are havens for mixed-use occupancy specifically because of the presence of buildings with a variety of architectural designs and functional purpose. Further, Thomason (2007) showed that with the growing urbanization of America along with emerging trends in housing; non-traditional living spaces, such as mixed-use, are becoming more common. In looking at the risks produced in mixed-use occupancy the study results found that the major life and property hazards in residential/commercial mixed-use are linked to the proximity of the residential and commercial tenant spaces. This is supported by the findings of Hughes and MacCollum (2005) in the area of human behavior during evacuation situations. They found that when people are awakened to an evacuation signal that they are less likely to respond favorably than those who are awake at the time of the evacuation signal. This translates to an increased life safety risk for occupants in mixed-use occupancies where residential and commercial occupancies are under one roof. In analyzing the affects of mixed-use occupancies on the tactical operations of the Fire Department, the analysis of the study properties found a host of factors in residential/commercial mixed-use occupancies which present tactical obstacles for the Fire Department. One of those obstacles is

accessibility. The research indicated that firefighters will typically experience difficulty reaching many portions, especially residential areas, of a mixed-use occupancy.

Turner's (2005) research in indentifying target hazard properties highlights this problem. His research found that the effectiveness of tactical loss control and life safety interventions is hampered when personnel do not have adequate accessibility to a building during a fire or other crisis event.

The conclusions to be drawn from this research project are varied. First, the demographics of residential housing in Shelby will significantly change in the coming years. With the continuing popularity of the new urbanism planning movement, the changing housing trends among Baby-Boomer's and Millennial's, coupled with the continued urbanization of the Charlotte Metropolitan Region, the mix and location of housing in Shelby will be altered. While single family dwellings will continue to be popular, there will be a growing market in Shelby for non-traditional housing such as residential/commercial mixed-use environments. And while the Uptown Commercial District will certainly see the most growth in non-traditional housing, there is every indication that the practice will spread to other areas of the City. Secondly, the results of this study show that the Shelby Fire and Rescue Department will be significantly challenged to operationally service a fire or other crisis in a mixed-use occupancy. The results of the research show that residential/commercial mixed-use occupancies present significant tactical problems in the form of building scale, fire loading and life safety and any event of significance in one of the study properties will quickly exceed the capability of the initial response of the Fire Department. Finally, the results show that

the inherent risks in mixed-use occupancies can be effectively managed through the use of active protection features such as fire sprinkler systems and fire alarm and detection systems along with built-in measures such as fire walls and compartmentalization.

The implications for the Shelby Fire and Rescue Department are significant. As discussed earlier, a fire or other crisis in one of the study properties will quickly overwhelm the resources of the Fire Department. This assertion was recently played out during an incident in the Uptown Commercial District where a restaurant adjacent to *Lafayette Place* caught fire (Wilson, 2007). During the fire, smoke penetrated the fire wall separating the two buildings forcing the evacuation of the residents of five apartments and required additional resources above and beyond those controlling the fire to monitor for fire extension in the adjacent occupancies. This event underscores that a rapid and overwhelming response is required to effectively manage any significant fire or crisis in a mixed-use occupancy to a successful conclusion. As residential/commercial mixed-use occupancy becomes more common in Shelby, the probability of a fire or other crisis occurring in these types of occupancies is going to increase. Therefore it is critical for the planning stakeholders in Shelby to develop sustainable prevention methods and resource deployment practices which work together to bring overall risk exposure in local mixed-use occupancies to a manageable level.

Recommendations

Introduction

The findings of this report conclude that residential/commercial mixed-use occupancies in the Historic Uptown Shelby Commercial District present the community with significant exposure to risk to life and property should a fire, other crisis, or a major disaster affect one or more of the properties in the district. This section will discuss several recommendations to consider in reducing overall risk exposure and to provide for more efficient operations for the Fire and Rescue Department.

Community Planning and Risk Reduction

There are several recommendations from a planning perspective for this report. First, it is recommended that the Shelby Comprehensive Land-use Plan factor life safety and property preservation when planning for long term land use. Specifically, planners should look at issues of urbanization and population density and their direct effects on protective services. Secondly, it is recommended that the Shelby Hazard Mitigation Plan be updated to include commercial/residential mixed-use occupancies in the list of target hazards. A method to plot the locations of all such properties within the City should be included. Finally, it is recommended that Fire Department personnel conduct a pre-plan of all commercial/residential occupancies in the Uptown Historic Commercial District, and the plans be digitally stored for access by the incident commander.

Prevention recommendations

This project offers several opportunities to reduce specific and overall risk exposure in residential/commercial mixed-use properties in Shelby. A

recommendation of this report is that a representative from the Fire Department be appointed to the Shelby Land Development Steering Committee. The steering committee consists of interested citizens, local developers, business owners, and, city government representatives whose purpose is to provide guidance for the development of a new comprehensive land use plan for Shelby. Representation of the Fire Department will ensure that property preservation and life safety issues will be considered in the development of long term land use planning decisions. Secondly, this report recommends the City adopt specific policy and/or local ordinance to require plan review by the Fire Marshal's Office in existing structures. Code enforcement and plan review is coordinated through the City of Shelby Building Inspection's Department with the City Fire Marshal's Office administering the fire code portion. The Fire Marshal's office reviews all new construction blueprints and site plans. However, there is no policy or practice for existing construction. Specifically this report recommends that in cases of where renovation or rehabilitations result in a change of occupancy, where more than fifty percent of a property is rehabilitated, or, the property is located within the boundaries of the primary fire limits; a project plan will be required to be submitted for review by the Fire Marshal's Office. Finally, this report recommends representation from the Fire Department to the Shelby Planning and Zoning Board. The board consists of citizens, business owners and government representatives. The board monitors land use in the City, interprets current zoning ordinances and make zoning regulation recommendations to the City Council. A fire and life safety advocate on the board will ensure that life and property preservation

concerns will be factored when requests for zoning changes and land use variances are submitted to the board for consideration.

Operational recommendations

There are several recommendations for the Fire Department to consider which will serve to increase the effectiveness of fire department operations in residential/commercial mixed-use occupancies. These recommendations have an added benefit enhancing the overall operational capability of the department in a variety of operational incidents. First, it is recommended the Fire Department increase the number of resources initially assigned to all commercial type incidents. This report recommends assigning a third engine-company to enhance incident stabilization operations, and the provision of a squad company to assist with the incident support operations. Secondly, the minimum staffing for the initial response assignment should be set at fourteen personnel so that essential tasks may be coordinated according to NFPA 1710. Next, it is recommended to staff the Fire Department's ladder truck as a dedicated company. The department should work toward assigning a permanent supervisory position along with three additional personnel to the truck. During incident operations, the apparatus, equipment and personnel assigned to the truck should be dedicated toward providing necessary support tasks which compliment incident stabilization activities by the engine companies. Finally, it is recommended the Fire Department develop a resource response protocol beyond the initial assignment. As the severity of an incident increases, an automatic tiered response of additional resources to the incident should be applied. Incidents involving confirmed fires, building collapse or hazardous material release in commercial type structures should be

assigned additional resources beyond the initial assignment to increase the likelihood of bringing the incident to a positive outcome.

Summary

The recommendations given this section are proposed out of the research and analyses contained in this report and are intended to provide methodologies for local planners to identify and reduce risk in mixed-use occupancies, and, improve the response capability of the Shelby Fire and Rescue Department to incidents within these occupancies. Implementation some- or all- of the recommendations will facilitate reducing overall risk exposure of the City of Shelby and increase capability of the Fire and Rescue Department to defend against threats to the community's quality of life.

References

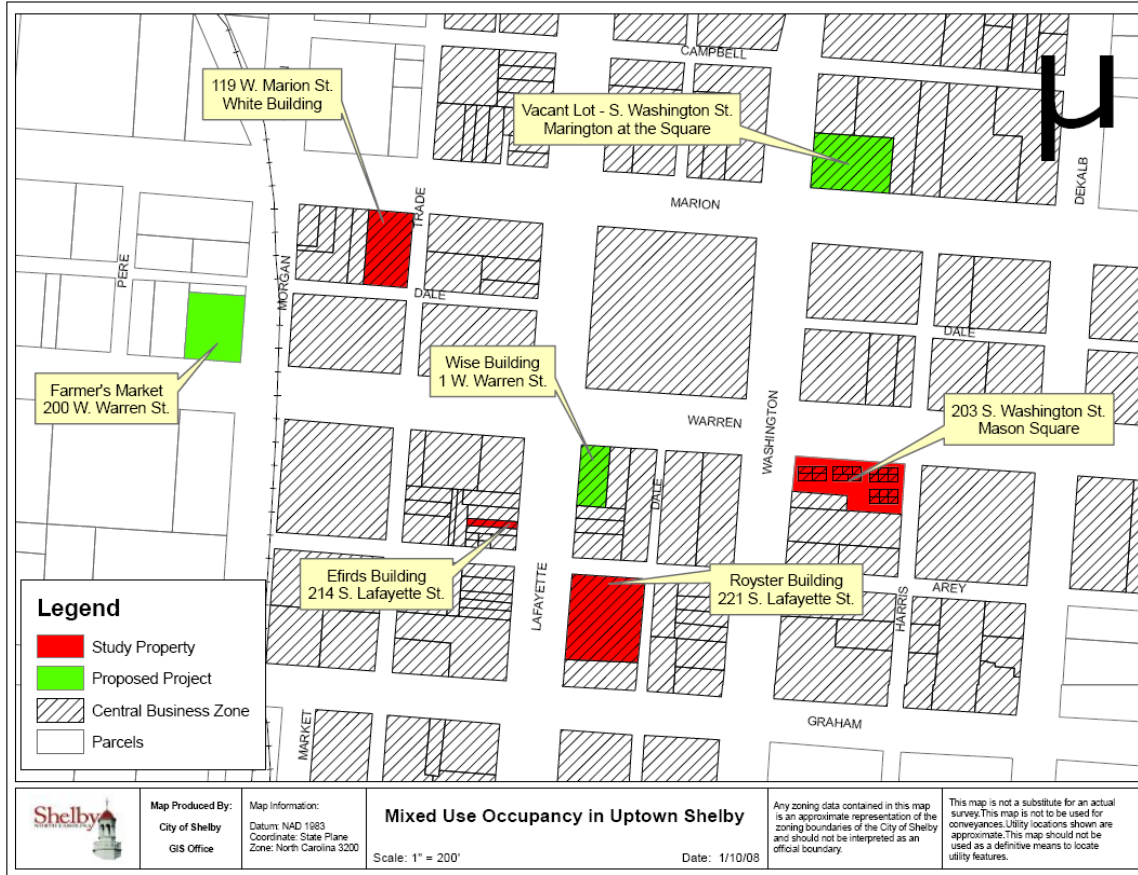
- Arnett Muldrow & Associates. (May 1, 2007). *Center city master plan; Shelby, North Carolina* (1). Greenville, SC: 'Arnette Muldrow'.
- Comprehensive annual financial report (CAFR)* City of Shelby Finance Department.
- Compton, D. & Granito, J. (Eds.). (2002). *Managing fire and rescue services* (Rev. ed.). Washington D.C.: International City/County Management Assn. (Original work published 1967).
- Downtown Salisbury. (2004). *The Plaza* (Rev. ed.) [Brochure]. Salisbury, NC: Downtown Salisbury Incorporated.
- Eades, B. (2003). *Archetctural perspectives of Cleveland County North Carolina* (1st ed.). Shelby, NC: Cleveland County Historic Preservation Task Force.
- Executive analysis of fire service operations in emergency management (EAFSOEM). Student manual* (2nd Edition) [Data file]. Emmitsburg, MD: National Fire Academy.
- Flynn, L. (2003). *Drivers and keys to mixed-use development*. Building Design and Construction, 1(3). Retrieved from; www.uli.org/AM/Template.cfm?Section=Search&template=CM/HTMLDisplay.cfm/htm
- Groc, I. (2007). *Family friendly*. Planning Magazine, (June), Retrieved November 5, 2007, from <http://www.planning.org/planning/member/2007jun/famfriendly.htm>
- Gurwitt, R. (2007). *Deals and deals*. Governing, 21(2), 44-54.
- Hall, K., & Porterfield, G. (2001). *Community by design; New urbanism for suburbs and small communities* (Rev. ed.). New York, NY: McGraw-Hill.
- Hasover, A., Beck, V., & Bennetts, I. (2007). *Risk analysis in building fire safety engineering* (1st. ed.). London: Elsevier Ltd.

- Houstoun, L. (2007). *Living downtown*. Planning Magazine,(February), Retrieved October 24, 2007, from <http://www.planning.org/planning/member/2007feb/downtown.htm>.
- Hughes, R., & MacCollum, D. (2005). *Building design and construction hazards* (Rev. ed.). Tucson, A.Z.: Lawyers and Judges Publishing.
- International Building Code* (North Carolina State Fire Code) [Data file]. Country Club Hills, Ill: International Code Council.
- Jenkins, T. (2005). *Knowing your enemy-The target hazards of Sand Springs, Oklahoma* (RR#37891). Emmitsburg, M.D.: National Fire Academy.
- Kali, K. (2007). *New generation of urban neighborhoods*. American Planning Association, Retrieved October 22, 2007, from <http://www.planning.org/conferencecoverage/2007/sunday/urbanneighborhoods.htm>.
- Lambert, A. (1991). *The Plaza, Salisbury, NC*. (Available from Lambert and Tate Architecture, 2500 Devine Street. Columbia, S.C. 29202).
- McMahon, E. (Winter, 1999). *Why downtown housing is in demand*. Planning Commissioners Journal, 33, p. 2.
- McManus, G. (2001). *The river lofts at tobacco row*. (Available from Forest City Enterprises, 1615 L Street, Washington D.C., 20036).
- National trust for historic preservation. (2007). *About the national trust*. Retrieved October, 4, 2007 from <http://www.nationaltrust.org/about>
- Norman, J. (2005). *Fire officers handbook of tactics* (3rd. ed.). Saddle Brook, NJ.: Pennwell.
- North Carolina rehabilitation code* (Edition 2005) [Data file]. Raleigh, NC: North Carolina Department of Insurance.

- Phillips, D. (2007). *The cult of new urbanism*. (The New Planner). Retrieved October 29, 2007, from American Planning Association Web site: <http://www.planning.org/thenewplanner/member/2007fall/newurbanizm.htm>.
- Segedy, J., & Daniels, T. (June 2007). *Small town design: Getting it right*. Retrieved October 29, 2007, from American Planning Association. Web site:<http://www.planning.org/planning/member/2007jun/smalltowndesign.htm>.
- Steuteville, R., & Langdon, P. (Eds.). (2003). *New urbanism: Comprehensive report and best practices guide* (3rd ed.). Ithaca, N.Y.: New Urban Publications.
- Thomason, P. (2007). *Boomer's on main street*. Main Street News, 243(9), 2-4.
- Turner, R. (2005). *Risk assessment for the city of Jefferson City Tennessee* (RR#39104). Emmitsburg, M.D.: National Fire Academy.
- Wolff, J. (1999). *Eight and Pearl mixed use*. (Available from Wolff Lyon Architects, 777 Pearl Street, Suite 210 Boulder, Colorado 80302).

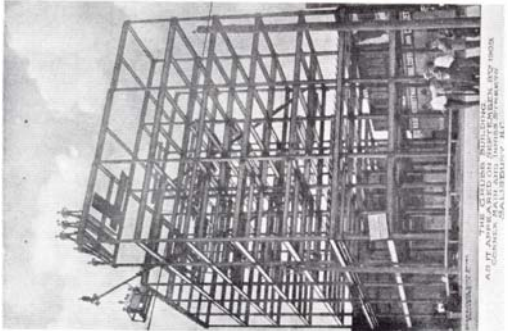
Appendix A

Uptown Mixed-use Occupancy



Appendix B

The Plaza, Salisbury, North Carolina



Begun in 1909, Grubb Building. Frank Milburn served as architect for Henry Clay Grubb's undertaking, 7 stories.

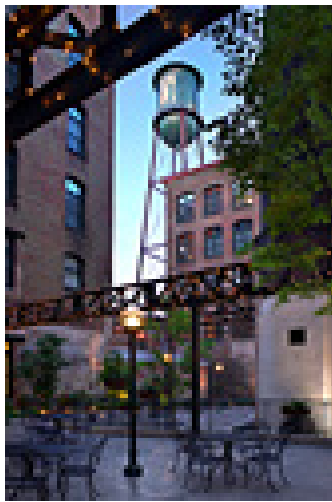


Grubb Building and North Main Street, SALISBURY, N. C.

Grubb building showing arboretum atop. Rotary Club organized here in 1920. The entire top floor dedicated to Old Hickory Club.

Appendix C

The River Lofts at Tobacco Row, Richmond, Virginia



Appendix D

Eighth and Pearl Mixed-use, Boulder, Colorado



Appendix E

Mason Square, 208 South Washington Street



Appendix F

Lafayette Place, 200 South Lafayette Street



Appendix G

The White Building, 119 East Marion Street



Appendix H

The Eifirds Building, 214 South Lafayette Street



Appendix J

Building/Development Industry Professionals Survey

Thank you for willingness to complete this survey. By participating you are contributing in a tangible way to the body of professional research in the fire service. The answers you provide to the questions below will be used to gauge generalized and community specific risks associated with mixed-use development. The survey will contribute toward reducing the risk of injury and death from fire in residential mixed use occupancies in Shelby through the development of a sustainable plan which incorporates the protective tools of prevention and operations. The results will this survey be cited in reports to the City of Shelby and the National Fire Academy.

1. Which of the following best describes your affiliation with the building industry.
 - a. Architectural design
 - b. Development/construction
 - c. Urban planning
 - d. Code enforcement
 - e. Preservation/revitalization

2. Over the last five years, approximately what percentage of the development projects you have been involved with incorporated a mixed-use approach?
 - a. Less than 10%?
 - b. 10 to 30%
 - c. 30 to 60%
 - d. 60 to 100%

3. Of those projects, approximately what percentages have included a residential component?
 - a. Less than 10%?
 - b. 10 to 30%
 - c. 30 to 60%
 - d. 60 to 100%

4. Over the last five years, would you say that your involvement in projects involving mixed use have;
 - a. increased over the time period
 - b. decreased over the time period
 - c. essentially remained constant over the time period
 - d. no applicability, have had no involvement

5. Which of the following best describes projects you have typically been involved with?
(Check all that apply)
 - a. Urban infill development
 - b. Commercial district rehabilitation
 - c. Brownfield redevelopment
 - d. Property rehabilitation
 - e. Rural development
 - f. Adaptive reuse

6. What type(s) of fire protection measures have been incorporated into the projects you have been involved with? (Check all that apply)
 - a. Installation of sprinkler/standpipe systems
 - b. Installation of fire detection systems
 - c. Installation of spot extinguishing systems (ie: hood systems, including residential)
 - d. Use and upgrade of an existing sprinkler/standpipe systems
 - e. Use and upgrade of an existing fire detection systems
 - f. Fire walls/separations
 - g. Areas of refuge

7. If you have had involvement rehabilitative projects, what types of occupant egress strategies have been included in the project? (Check all that apply)
 - a. Protected stair towers
 - b. Additional exit ways
 - c. Modifications of existing exit ways
 - d. Modernized exit signage
 - e. Modernized door systems

8. Have the projects you have been involved with provided any of the following protective measures? (Check all that apply)
 - a. Automatic notification of the fire department
 - b. Audible and visual notification/warning to occupants
 - c. Fire department access to property (lock boxes)
 - d. Specialized warning systems for visually and hearing impaired
 - e. Pressurized stairwells
 - f. Protected stairwells/exit ways
 - g. Automatic shut down of HVAC systems
 - h. Fire wall separation by occupancy type
 - i. Additional fire sprinkler or alarm sensing devices in void spaces and/or mechanical systems