

NISTIR 7069

*Trends in Firefighter Fatalities
Due to Structural Collapse,
1979-2002*

Lori D. Brassell
David D. Evans



Sponsored in part by:
Department of Homeland Security
Federal Emergency Management Agency
United States Fire Administration

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

NISTIR 7069

***Trends in Firefighter Fatalities
Due to Structural Collapse,
1979-2002***

Lori D. Brassell
David D. Evans
*Fire Research Division
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899*

November 2003



FEMA

Department of Homeland Security
Tom Ridge, *Secretary*
Federal Emergency Management Agency
Michael D. Brown, *Under Secretary of
Emergency Preparedness and Response*
United States Fire Administration
R. David Paulison, *Administrator*



U.S. Department of Commerce
Donald L. Evans, *Secretary*
Technology Administration
Phillip J. Bond, *Under Secretary for Technology*
National Institute of Standards and Technology
Arden L. Bement, Jr., *Director*

Abstract

Between the years 1979 and 2002 there were over 180 firefighter fatalities due to structural collapse, not including those firefighters lost in 2001 in the collapse of the World Trade Center Towers. Structural collapse is an insidious problem within the fire fighting community. It often occurs without warning and can easily cause multiple fatalities.

As part of a larger research program to help reduce firefighter injuries and fatalities the U.S. Fire Administration (USFA) funded the National Institute of Standards and Technology (NIST) to examine records and determine if there were any trends and/or patterns that could be detected in firefighter fatalities due to structural collapse. If so, these trends could be brought immediately to the attention of training officers and incident commanders and investigated further to determine probable causes.

Table of Contents

I. Introduction..... 2
II. Data Collection 2
III. Analysis 3
IV. Findings and Discussion – 1994-2002 4
V. Findings and Discussion – 1979-2002 4
VI. Conclusions..... 5
VII. Acknowledgments 6
VIII. References..... 7
Appendix A: Crosstabulations of Collapse Data (Burt Table)..... A-1
Appendix B: Table A – Original Firefighter Data..... B-1
Appendix B: Table B – Original Firefighter Data (cont’d)..... B-4

List of Figures

Table 1 - Findings from the Chi Square Test	4
Figure 1 - Fatalities and Incidents per Year (1994- 2002).....	13
Figure 2 - Fatalities by Month	13
Figure 3 - Fatalities by Time of Incident	14
Figure 4 - Fatalities by Age	14
Figure 5 - Fatalities by Years of Experience	15
Figure 6 - Fatalities by Rank	15
Figure 7 - Fatalities by Activity.....	16
Figure 8 - Fatalities by Nature of Death	16
Figure 9 - Fatalities By Activity and Duty Type	17
Figure 10 -Fatalities by Cause of Death and Duty Type	17
Figure 11 -Fatalities By Month and Rank	18
Figure 12 -Fatalities By Activity and Cause of Death.....	18
Figure 13 -Fatalities By Cause of Death and Property Type.....	19
Figure 14 -Fatalities by Cause of Death and Nature of Death.....	19
Figure 15 -Fatalities By Property Type and Status.....	20
Figure 16 -Fatalities By Activity and Status.....	20
Figure 17 -Fatalities By Activity and Property Type	21
Figure 18 -Fatalities By Month and Nature of Death	21
Figure 19 -Fatalities Due to Structural Collapse per Year (1979-2002)	22
Figure 20 -Fatalities by Cause of Death	23
Figure 21 -Fatalities by Fixed Property Type.....	24

Trends in Firefighter Fatalities Due to Structural Collapse 1979-2002

I. Introduction

Between the years 1979 and 2002 there were over 180 firefighter fatalities due to structural collapse, not including those firefighters lost in 2001 in the collapse of the World Trade Center Towers. Structural collapse is an insidious problem within the fire fighting community. It often occurs without warning and can easily cause multiple fatalities.

As part of a larger research program to help reduce firefighter injuries and fatalities the U.S. Fire Administration (USFA) funded the National Institute of Standards and Technology (NIST) to examine records and determine if there were any trends or patterns that could be detected in firefighter fatalities due to structural collapse. If so, these trends could be brought immediately to the attention of training officers and incident commander and investigated further to determine probable causes.

II. Data Collection

Data for fires resulting in a firefighter fatality caused by a structural collapse were collected for the years 1994 through 2002 [Tables 1 & 2, Appendix B] from the USFA National Fallen Firefighters Memorial Database [1], which requires each firefighter to meet the criteria determined by the National Fallen Firefighters Foundation [2]. Supplemental data was obtained from investigation and statistical reports provided by the USFA, the National Institute for Occupational Safety and Health (NIOSH), the National Fire Protection Association (NFPA), and various periodicals [3-80]. Both NFPA and NIOSH have published recommendations for preventing injury and death due to structural collapse as a result of their investigations of specific incidents [14, 54]. This study does not deal in depth with individual incidents, but looks for trends in the fatality data as classified in existing databases.

In 2001, an extraordinary 341 firefighters died in the collapse of the two 110-story towers of the World Trade Center in New York City. Although these deaths clearly involved structural collapse, they are not included in this analysis. In a separate building and fire safety investigation, NIST is studying the factors contributing to the probable cause (or causes) of post-aircraft-impact collapse of the two 110-story towers (World Trade Center buildings 1 and 2) and the 47-story World Trade Center Building (Number 7) to provide a technical basis for developing improved building and fire codes, standards, and practices.

Some collapse incidents in the firefighter fatality data set were the result of explosions. This study is limited to collapse as the result of the progressive weakening of structures by fire. Therefore, firefighter fatalities that were identified in the data set as the result of an explosion inside or outside of a structure were not included in this study.

The scope of this study is limited to the available data described above. This data was analyzed to determine any obvious trends in firefighter fatalities in structure collapse. Additional data and further study is required to determine probable causes.

III. Analysis

This study examined data from structural collapse incidents that occurred from 1994 to 2002 involving one or more firefighter fatalities in which fire weakened to failure structural members of a building resulting in the complete or partial collapse of any part of the structure, excluding the cases described above. Several data parameters were analyzed for each incident, including the time of the incident, the property type of the structure, the firefighter's age, years of experience, status (i.e., career or volunteer), nature and cause of death, and activity at the time of death. In the case of rank, individuals ranked higher than captain were designated chief officers. Any dual-trained firefighter (e.g., firefighter/paramedic) was designated as firefighter.

In order to analyze the distribution of the data among the parameters, frequency tables were created for each variable. The cumulative frequencies were also calculated for each of the ordinal variables (i.e., age, rank, time, month, and years of experience). The data were then arranged in an indicator matrix, where the indicator matrix (X) has one row for each fatality and one column for each parameter category. The product of the indicator matrix (X) and its transpose (X^T) is called a Burt table ($X^T X$) [81]. The partitions of the Burt table, shown in Appendix A, are two-way cross-tabulations that show the frequency distribution of the data between two parameters (e.g., cause of death versus nature of death). These tables were used to explore any relationships between parameters. Pearson Chi-Square tests were performed on each two-way table to test the significance of any relationship between the two parameters [81]. Note, however, that a statistically significant relationship does not indicate a causal relationship.

The 1994-2002 data were also compared to results reported in two earlier NFPA reports addressing firefighter fatalities due to structural collapse [13, 14]. These reports analyzed data from incidents that occurred from 1979-1988 and 1983-1992, respectively. The raw data from these reports were not available. In order to make comparisons, several categories of the data were restructured for the data for the more recent years in order to fit the criteria established in the NFPA reports. For instance, in the historical reports the category for cause of death only had the two parameters "Caught or Trapped" and "Struck by/ Contact with Object." Data collected for the years 1994-2002 included "Exposure" and "Fell or jumped" as additional causes of death (as designated by the USFA Memorial database). Cases that belonged to the latter two categories were realigned with the criteria established in the NFPA reports. For example, the cause of death of a firefighter who fell through a floor during a fire attack and was unable to escape or be rescued would be designated in the USFA database as "Fell or jumped." To compare this case to the NFPA reports the cause of death would be reassigned to "Caught or Trapped."

IV. Findings and Discussion – 1994-2002

Between the years 1994 and 2002 there were 63 deaths caused by structural collapse in a total of 47 fires (Figure 1). Of these deaths, over two-thirds occurred within the first six months of the year and over one-half occurred in the first three months (Figure 2). Over 42 % of deaths with known incident times occurred in the first eight hours of the day (12:00 A.M. – 7:59 A.M.) (Figure 3). Victims of structural collapse were part of several age groups, experience levels, and ranks and were involved in several activities (Figure 4, Figure 5, Figure 6, and Figure 7). Over 44 % of deaths involved career firefighters with six or more years of experience. A majority of the victims (over 65 %) were involved in fire attack or advancing hose (Figure 7). The nature of firefighter deaths in collapsed structures is categorized as asphyxiation, burns, internal trauma, and other causes. Over 42 % of fatalities (27 deaths) were by asphyxiation (Figure 8).

The Pearson Chi Square test was used to test for any statistical relationships between variables. Table 1 shows the relationships between variables found to be statistically significant using this test. The significance level (α) used was 0.01, which indicates that there is a 1 % chance that there actually is no relationship between the variables listed in Table 1.

Table 1 - Findings from the Chi Square Test

Variable 1	Variable 2	Observations	Figures
Activity	Duty Type	65.08 % (41 deaths) were attacking fire on the fireground .	Figure 9
Cause of Death	Duty Type	69.84 % (44 deaths) were caught or trapped on the fireground .	Figure 10
Month	Rank	44.44 % (28 deaths) had the rank of firefighter and died in the first 3 months of the year.	Figure 11
Activity	Cause of Death	50.79 % (32 deaths) were caught or trapped while attacking fire .	Figure 12
Cause of Death	Property Type	42.86 % (27 deaths) were caught or trapped in a residential property.	Figure 13
Cause of Death	Nature of Death	50.79 % (32 deaths) were caught or trapped and died of asphyxiation and burns .	Figure 14
Property Type	Status	33.33 % (21 deaths) were career firefighters in a residential area.	Figure 15
Activity	Status	36.51 % (23 deaths) were career firefighters who were attacking fire .	Figure 16
Activity	Property Type	34.92 % (22 deaths) were attacking a fire on a residential property .	Figure 17
Month	Nature of Death	44.44 % (28 deaths) died of burns or asphyxiation in the first 3 months of the year.	Figure 18

Each of these relationships is shown graphically in Figures 9 through 18.

V. Findings and Discussion – 1979-2002

The data set for the years 1994 to 2002 was compared to two NFPA studies of earlier data. In this comparison several findings were made. Since 1979, the number of deaths caused by structural collapse has steadily declined (Figure 19). In addition to the decline in deaths involving structural collapse there are two significant findings in these comparisons. One of these findings concerns the cause of death and the other addresses property type.

In the studies of earlier data, incidents involving structural collapse are generally divided into two categories. In the first, a firefighter is generally caught or trapped inside a

structure and cannot escape or be rescued because of the collapse or partial collapse of a structure. The firefighter usually runs out of air supply or succumbs to burns. The second category involves those that were struck and severely injured by some part of a collapsing structure, usually while working on the outside.

In the two NFPA studies of earlier data, a relatively constant 60 % of firefighter deaths in structures were caught or trapped, while the remaining 40 % were struck by or had hard contact with an object. In the years 1994 to 2002, however, over 85 % of the fatalities (54 deaths) were caused by a firefighter being caught or trapped inside a structure (Figure 20).

Another shift in the years 1994 to 2002 from earlier years involves the property type of the collapsing structures. Structural collapses occurred in several different property types. However, the percentage of firefighter deaths in collapses that occur on residential property has risen over recent years. The two NFPA reports each cover ten-year periods. In each of those ten-year periods residential structures were involved approximately 14 percent of the time. However in the nine-year period of 1994-2002, 51 % of the fatalities (33 deaths) occurred in residential structures (Figure 21). This shows there is a significantly larger percentage of a death occurring in a residential structure in the years 1994 to 2002 than in two earlier ten-year samples.

VI. Conclusions

The analysis for trends of the collected data showed:

- ❖ The number of collapse fatalities on an annual basis has declined since 1979.
- ❖ Compared to limited historical data, the percentage of collapse fatalities that occurred in residential properties has increased.
- ❖ Collapse fatalities are generally caused two ways: by being caught or trapped in the structure or by being struck by an object. Compared to limited historical data, the percentage of collapse fatalities caused by being caught or trapped in the structure has increased.
- ❖ A majority (over 65 %) of collapse fatalities occurred during fire attack.
- ❖ Over half of collapse fatalities occurred during the first three months of the year and over 42 % occurred in the first eight hours of the day (Midnight to 8:00 AM).

Further study and additional data are needed to determine probable causes for the observed trends. For example, it would be interesting to know which are the major factors causing the observed increase residential fire collapse fatalities as a fraction of the total losses. Determining the probable causes for the observed trends would provide the fire service with additional information useful in firefighter training and incident command.

VII. Acknowledgments

The authors would like to thank William Troup of the USFA and Rita Fahy of the NFPA for all of their help with the collection and verification of the data presented in this report and Ana Ivelisse Aviles, Ph.D. of NIST for statistical analysis. They would also like to thank all of the fire departments that provided additional information about the incidents so that each could be classified accurately.

VIII. References

- [1] *National Fallen Firefighters Memorial Database*. United States Fire Administration. April 9, 2003 <http://www.usfa.fema.gov/applications/ffmem/ffmem_search.cfm>.
- [2] *National Fallen Firefighters' Memorial Criteria for Inclusion*. United States Fire Administration. April 9, 2003 <<http://www.usfa.fema.gov/inside-usfa/criteria.cfm>>.
- [3] “Ala. Firemedic Dies After Falling Through Floor.” *Firehouse* Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [4] “Arson Blaze Claims Two Houston Bravest.” *Firehouse* Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [5] Bartley, Nancy, “Jury Awards widow \$5.6 million in Pang fire death.” *Seattle Times* Oct. 5, 1999 <<http://archives.seattletimes.nwsource.com/cgi-bin/texis.cgi/web/vortex/display?slug=pang&date=19991005&query=Pang+Fire>>.
- [6] “Camden County, New Jersey Community Remembers Fallen Fire Chief.” *Firehouse* July 8, 2002 <<http://www.firehouse.com/>>.
- [7] Casey, Heather. “NJ Firefighter Loses 3-Month Battle.” *Firehouse* Mar. 26, 2001 <<http://www.firehouse.com/>>.
- [8] Casey, Heather. “Two Missouri Firefighters Killed, Third Seriously Injured in House Blaze.” *Firehouse* Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [9] *Dallas Fire-Rescue Investigation Report, Firefighter Fatality-Vincent L. Davis, Six-Alarm Fire at 2707 W. Ninth Street, February 11, 2002*. Dallas Fire-Rescue Department. <<http://www.dallasfirerescue.com/firefatalityinvestigation.pdf>>.
- [10] Duval, Robert, *Fire Fighter Fatalities, Marks, Mississippi, August 29, 1998*, Quincy, MA: National Fire Protection Association, Fire Investigations Division, 1999.
- [11] “Fallen North Carolina Bravest Brought Home.” *Firehouse* Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [12] Fascia, Carrie, “Fallen Firefighter Mourned”, *Ken-Ton Bee-Headline News* **15** (30), (May 28, 1997).
- [13] “Fire Fighter Deaths in Structural Collapses, 1979-1988.” Quincy, MA: National Fire Protection Association, Fire Analysis and Research Division, Aug. 1989.
- [14] “Fire Ground Fatalities As A Result of Structural Collapse, 1983 – 1992.” Quincy, MA: National Fire Protection Association, Fire Analysis and Research Division, Aug. 1993.
- [15] “Fire Traps Ohio Firefighter in Basement.” *Firehouse* Mar 9, 2001 <<http://www.firehouse.com/>>.

- [16] Frazier, Eric and Moore, Robert F., "Officials say fire that injured firefighter began at stove." The Charlotte Observer Mar. 6, 2002
<<http://www.charlotte.com/mld/observer/news/local/2800404.htm>>.
- [17] GIGLIOTTI, READSHAW, ROBINSON, COWELL, DeLUCA, DERMODY, FAJT, FARMER, GAMBLE, HABAY, ITKIN, KAISER, LAUGHLIN, LEVDANSKY, MARKOSEK, MAYERNIK, MICHLOVIC, OLASZ, PETRONE, PETTIT, PISTELLA, PRESTON, TRELLO, VAN HORNE, and WALKO, *Recognizing Captain Thomas A. Brooks, firefighter Patricia Conroy and firefighter Marc Kolenda, all members of the Pittsburgh Fire Department, The General Assembly of Pennsylvania HR 72* (March 6, 1995).
- [18] Gilchrist, Josh. "Firefighter dies from burns." NBC 6 Mar. 7, 2003
<http://www.nbc6.com/news/local/nbc6-0306-early_dies.c5b3fe.html>.
- [19] Glassman, William J. "Three Firefighters and Three Sisters Killed in Gloucester City, New Jersey." Firehouse July 5, 2002 <<http://www.firehouse.com/>>.
- [20] *Fallen Brothers: Gloucester City Collapse*. 2002
<<http://www.firefightinglinks.com/gloucestercollapse.html>>.
- [21] Iannone, Dave. "Iowa Firefighter Falls Through Roof." Firehouse Sept. 15, 2002
<<http://www.firehouse.com/>>.
- [22] Iannone, Dave and Slepicka, Lon, "Two New York Firefighters Killed in House Fire, Collapse." Firehouse Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [23] "Indiana Firefighter dies Battling House Fire." Firehouse Jan. 12, 1999
<<http://www.firehouse.com/>>.
- [24] "In Memory of Two Heroes." <<http://www.hampton-roads.net/>>.
- [25] Isner, Michael S., *Fire Investigation Report: Automobile Parts Store Fire, Two Fire Fighter Fatalities, Chesapeake, Virginia, Mar. 18, 1996*. National Fire Protection Association (1996).
- [26] Isner, Michael S. and Foley, Stephen, N., *Fire Investigation Report: Carpet Store Fire One Fire Fighter Fatality, Branford CT, Nov. 28, 1996*. National Fire Protection Association (1996).
- [27] Isner, Michael S. and Smeby, L. C., Jr., *Fire Investigation Report: One-Family Dwelling Fire, Three Fire Fighter Fatalities, Pittsburgh, Pennsylvania, Feb. 14, 1995*. National Fire Protection Association (1995).
- [28] Kern, Ida. "Clipper Mill Fire." 1995
<<http://www.geocities.com/CapeCanaveral/Hangar/6290/>>.
- [29] Madden, Eddie M., Cagle, Casey, and Broun, Paul C., *Kennon Loy Williams - regrets at passing*, Georgia Senate **SR 96** (February 24, 1999).
- [30] "Mayor Giuliani and Fire Commissioner Von Essen Honor Fallen Firefighter Louis Valentino." New York City Website Feb. 5, 1997
<<http://www.ci.nyc.ny.us/html/om/html/97/sp068-97.html>>.

- [31] “Mayor Giuliani Honors the Memory of Fallen Fire Lieutenant John M. Clancy.” New York City Website Jan. 8, 1997 <<http://www.ci.nyc.ny.us/html/om/html/97/sp012-97.html>>.
- [32] McLees, Mark J. “Syracuse Firefighter Killed Assisting Investigators.” Firehouse Jan. 20, 1999 <<http://www.firehouse.com/>>.
- [33] “Memorial and Information Page.” Hyattsville Volunteer Fire Department Oct. 30, 1997 <<http://www.hyattsvillefd.org/sgtcarter.html>>.
- [34] Meyers, Brian D. Jr. “Schuyler Hose Company Memorials.” Fire-EMS Network Mar. 1, 1997 <<http://www.fire-ems.net/firedept/view/SchuylervilleNY/mems/>>.
- [35] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Sudden Roof Collapse of a Burning Auto Parts Store Claims the Lives of Two Fire Fighters - Virginia, 96-17* (1996).
- [36] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Floor Collapse in a Single Family Dwelling Fire Claims the Life of one Fire Fighter and Injures Another - Kentucky, 97-04* (1997).
- [37] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Commercial Structure Fire Claims the Life of One Fire Fighter - California, 98F-07* (July 24, 1998).
- [38] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Sudden Floor Collapse Claims the Lives of Two Fire Fighters and Four Are Hospitalized with Serious Burns in a Five-Alarm Fire - New York, 98F-17* (November 30, 1998).
- [39] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Fire Fighter Dies While Fighting Warehouse Fire When Parapet Wall Collapses - Vermont, 98F-20* (November 9, 1998).
- [40] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Commercial Building Fire Claims the Lives of Two Volunteer Fire Fighters - Mississippi, 98-F-21* (March 19, 1999).
- [41] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Single Family Dwelling Fire Claims the Life of a Volunteer Fire Fighter - Indiana, 99F-02* (June 4, 1999).
- [42] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Floor Collapse Claims the Life of One Fire Fighter and Injures Two - California, 99-F03* (March 27, 2000).
- [43] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Roof Collapse in Arson Church Fire Claims the Life of Volunteer Fire Fighter - Georgia, 99F-04* (April 27, 1999).
- [44] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Fire Investigator Dies After Being Struck by a Chimney That Collapsed During an Origin and Cause Fire Investigation - New York, 99F-06* (May 14, 1999).

- [45] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Restaurant Fire Claims the Life of Two Career Fire Fighters - Texas*, **F2000-13** (February 7, 2001).
- [46] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Residential Structure Fire Claims the Life of One Career Fire Fighter - Alabama*, **F2000-26** (August 3, 2001).
- [47] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Volunteer Assistant Chief Dies During a Controlled-Burn Training Evolution - Delaware*, **F2000-27** (May 1, 2001).
- [48] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Volunteer Fire Fighter Dies and Another Fire Fighter is Injured During Wall Collapse at Fire at Local Business - Wisconsin*, **F2001-09** (December 21, 2001).
- [49] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Residential Fire Claims the Lives of Two Volunteer Fire Fighters and Seriously Injures and Assistant Chief - Missouri*, **F2001-15** (November 20, 2001).
- [50] National Institute of Occupational Safety and Health, *Death in the Line of Duty: Career Fire Fighter Dies After Falling Through the Floor Fighting a Structure Fire at a Local Residence - Ohio*, **F2001-16** (February 28, 2002).
- [51] National Institute of Occupational Safety and Health, *Death in the Line of Duty: First Floor Collapse During Residential Basement Fire Claims the Life of Two Fire Fighters (Career and Volunteer) and Injures a Career Fire Fighter Captain New York*, **F2002-06** (May 15, 2003).
- [52] National Institute of Occupational Safety and Health, *Death in the Line of Duty: One Career Fire Fighter Dies and Another Is Injured After Partial Structural Collapse - Texas*, **F2002-07** (January 29, 2003).
- [53] National Institute of Occupational Safety and Health, *Death in the Line of Duty: One Career Fire Fighter Dies and a Captain is Hospitalized After Floor Collapses in Residential Fire - North Carolina*, **F2002-11** (January 31, 2003).
- [54] National Institute of Occupational Safety and Health, *NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters due to Structural Collapse*, **DHHS (NIOSH) Publication No. 99-146** (August 1, 1999).
- [55] "NFPA Reports Details Texas Church LODDs." *Firehouse* Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [56] "Oakland, Calif. Firefighter Dies in 6-Alarm Blaze." *Firehouse* Jan. 14, 1999 <<http://www.firehouse.com/>>.
- [57] "Ohio Firefighter Trapped in Fire Succumbs to Injuries." *Firehouse* Mar. 20, 2001 <<http://www.firehouse.com/>>.
- [58] "Philadelphia Firefighter Dies After Blaze." *Firehouse* May 5, 1999 <<http://www.firehouse.com/>>.

- [59] Raffa, Frank. "Signal 5-5-5 For The 766th Time." Nov. 2, 2002 <<http://members.aol.com/fd347/5555766.htm>>.
- [60] Riccardi, Nicholas and Yi, Daniel. "L.A. Firefighter Killed in Blaze." Los Angeles Times Mar.9, 1998.
- [61] Rigg, Nancy J. "A City Mourns Its Fallen Heroes." 9-1-1 Magazine 1998 <<http://www.9-1-1magazine.com/magazine/1998/0598/depts/ppt.html>>.
- [62] Schell, Rob. "A Tribute to a Fallen Companion." Vermont Emergency Medical Services Sept. 1998 <<http://www.state.vt.us/health/ems/emstoday/sept1998.pdf>>.
- [63] Slepicka, Lon. "Collapse Kills Wisconsin Firefighter." Firehouse Feb. 26,2001 <<http://www.firehouse.com/>>.
- [64] Slepicka, Lon. "Dallas Firefighter Killed in Collapse at Six-Alarm Fire." Firehouse Feb. 12, 2002 <<http://www.firehouse.com/>>.
- [65] Slepicka, Lon. "NBC Dateline 'Firehouse' Stories Portray Station Reality." Firehouse Aug. 1, 2002 <<http://www.firehouse.com/>>.
- [66] Slepicka, Lon. "South Carolina Firefighter Loses Battle With Injuries." Firehouse Apr. 15, 2002 <<http://www.firehouse.com/>>.
- [67] "Supreme Sacrifice - 12/27." Firehouse.com Forums 1997 <<http://www.firehouse.com/>>.
- [68] "Texas Firefighting Tragedy." Firehouse Apr. 8, 1999 <<http://www.firehouse.com/>>.
- [69] Trappe, Christoph. "Fire that Claimed Muscatine, Iowa Firefighter Ruled Accidental" Firehouse Sept.18, 2002 <<http://www.firehouse.com/>>.
- [70] Trappe, Christoph. "Muscatine, Iowa Firefighter Dies While Fighting Blaze." Firehouse Sept 17, 2002 <<http://www.firehouse.com/>>.
- [71] United States Fire Administration, *Analysis Report on Firefighter Fatalities in the United States in 1994*, (September 1, 1995).
- [72] United States Fire Administration, *Firefighter Fatalities in the United States in 1995*, (August 1, 1996).
- [73] United States Fire Administration, *Firefighter Fatalities in the United States in 1996*, (August 1, 1997).
- [74] United States Fire Administration, *Firefighter Fatalities in the United States in 1997*, (August 1, 1998).
- [75] United States Fire Administration, *Firefighter Fatalities in the United States in 1998*, (August 1, 1999).
- [76] United States Fire Administration, *Firefighter Fatalities in the United States in 1999*, (July 1, 2000).
- [77] United States Fire Administration, *Firefighter Fatalities in the United States in 2000, FA-215* (August 1, 2001).

- [78] United States Fire Administration, *Fire Fighter Fatalities in the United States in 2001*, **FA-237** (August 1, 2002).
- [79] Wernimont, Jeff. "John Goessling." 1999 <yourtruehero.org>.
- [80] Wilma, David. "Four firefighters die in Pang arson fire in International District on January 5, 1995." May 22, 2002 <<http://www.seattle/KingCo.HistoryLink.org>>.
- [81] StatSoft, Inc. (2003). *Electronic Statistics Textbook*. Tulsa, OK: StatSoft. <<http://www.statsoft.com/textbook/stathome.html>>.

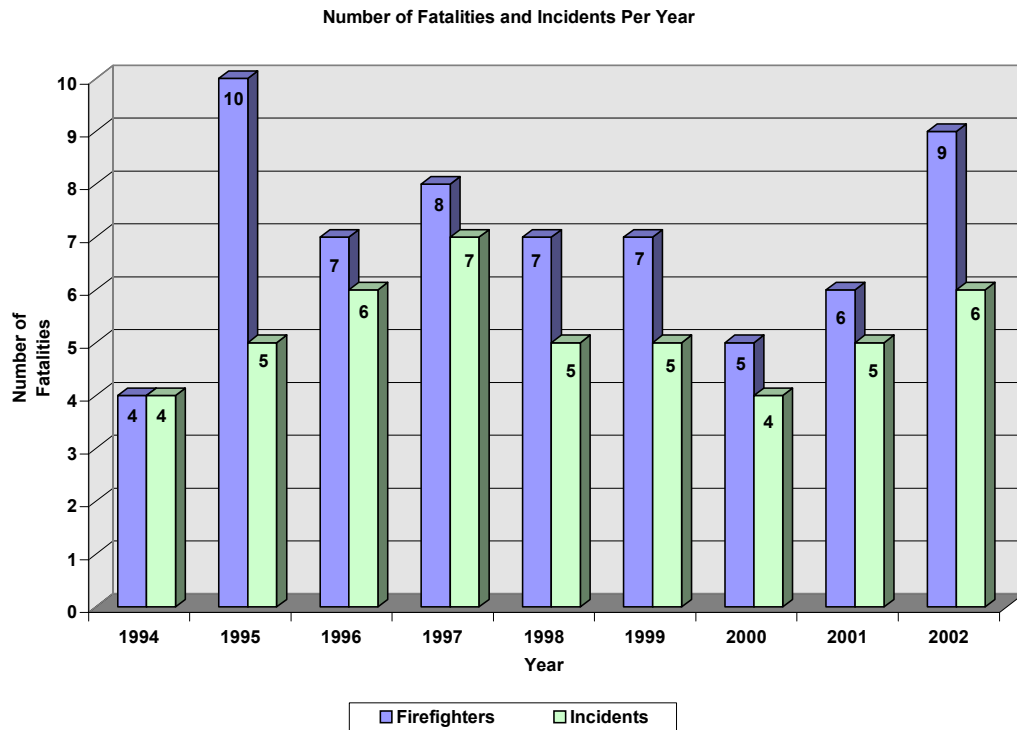


Figure 1- Fatalities and Incidents per Year (1994- 2002)

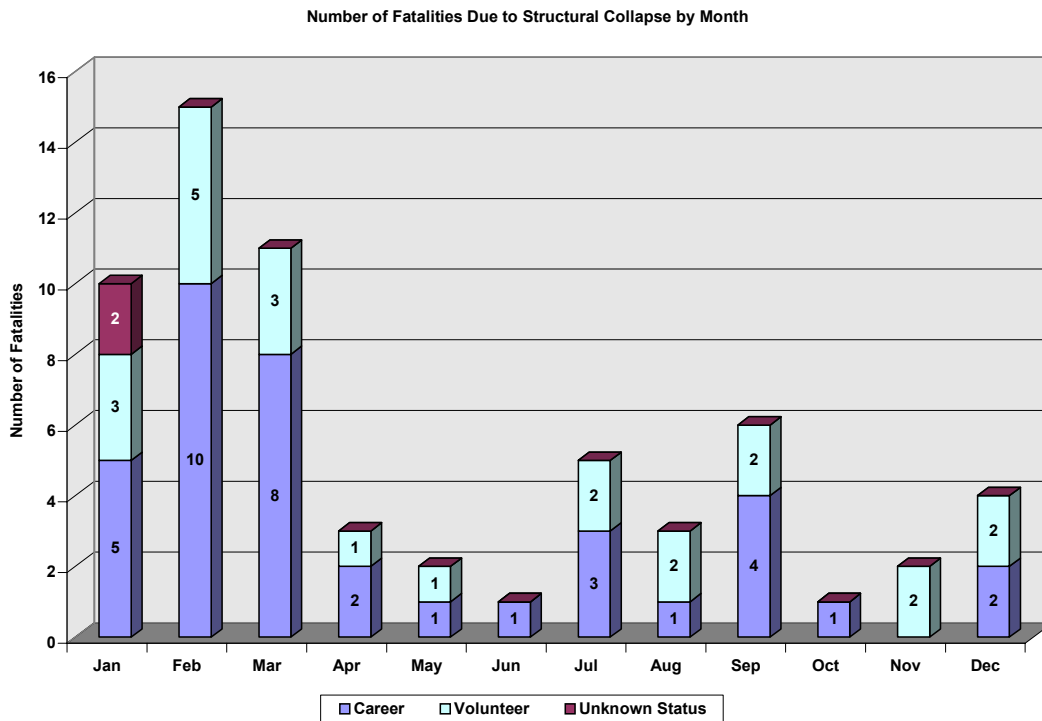


Figure 2 - Fatalities by Month

Number of Fatalities due to Structural Collapse by Time of Incident

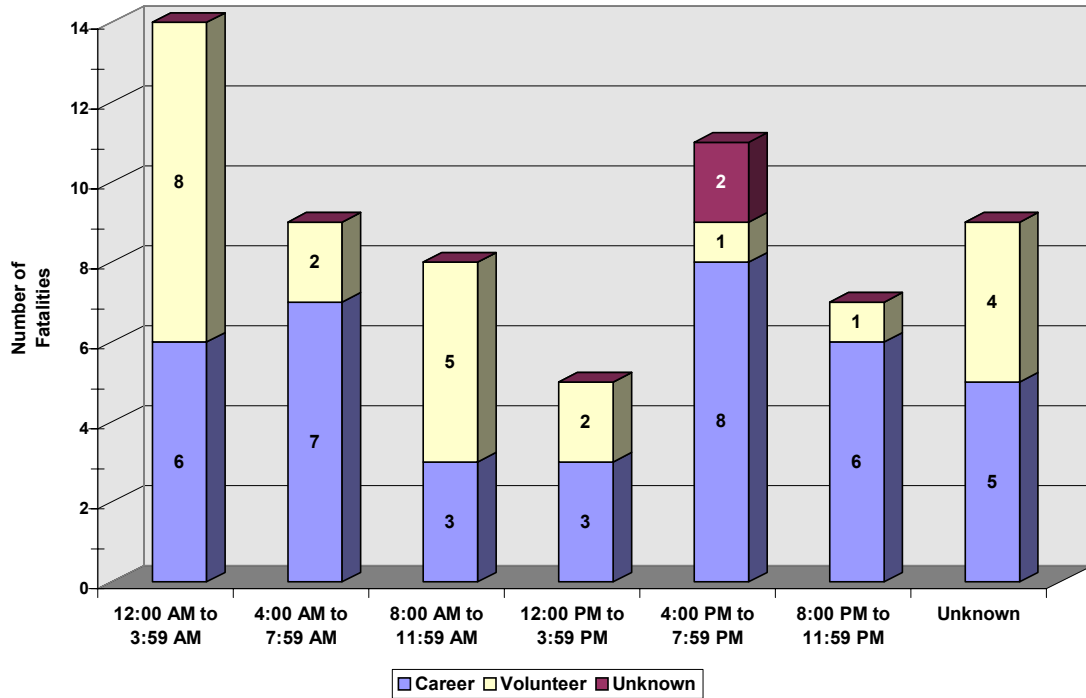


Figure 3 - Fatalities by Time of Incident

Number of Firefighter Fatalities due to Structural Collapse by Age

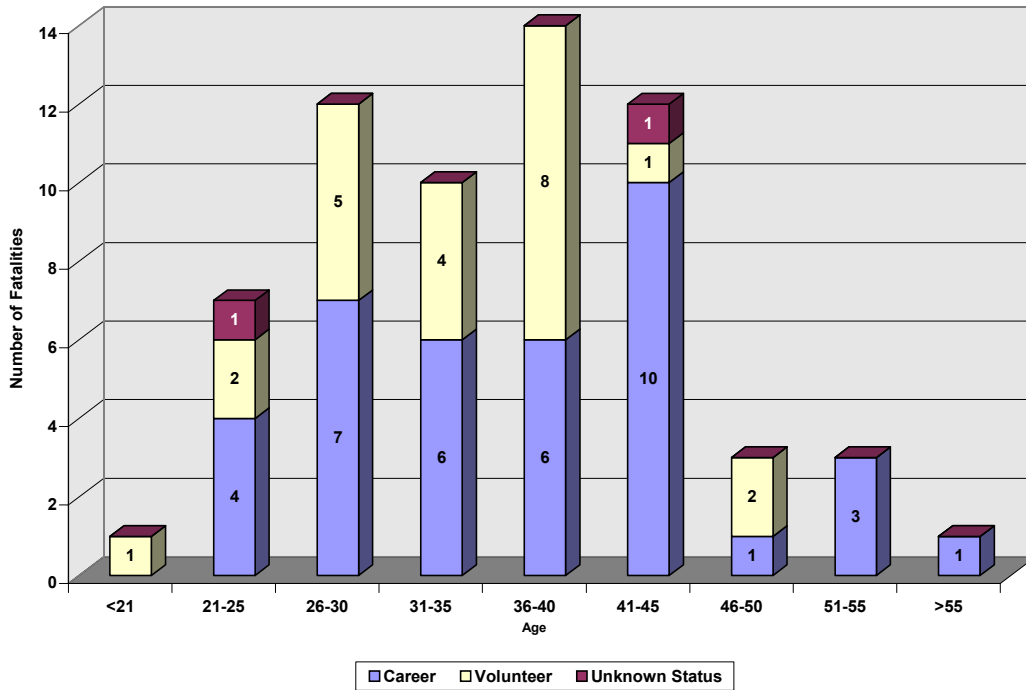


Figure 4 - Fatalities by Age

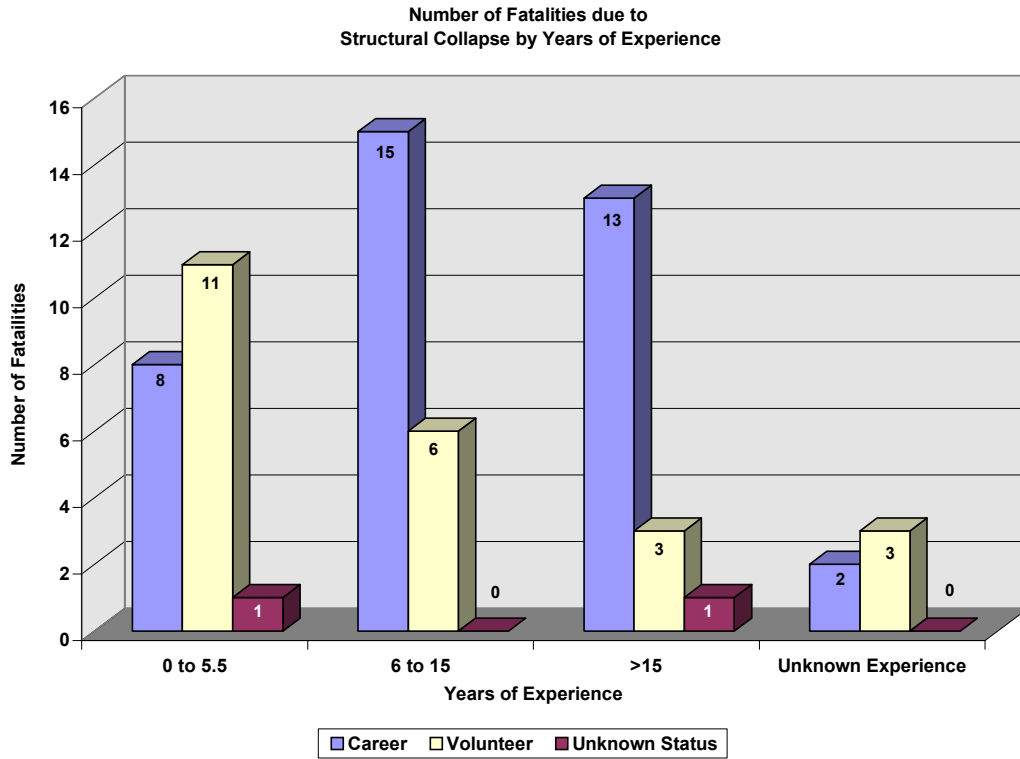


Figure 5 - Fatalities by Years of Experience

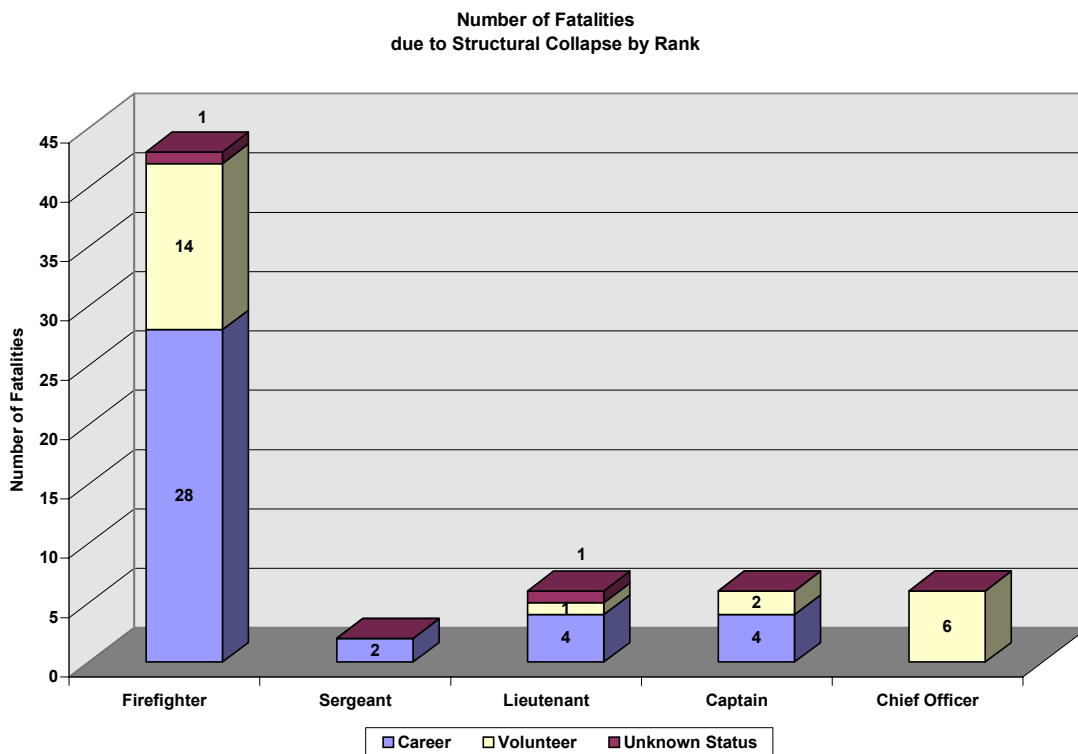


Figure 6 - Fatalities by Rank

Number of Firefighter Fatalities due to Structural Collapse by Activity Type

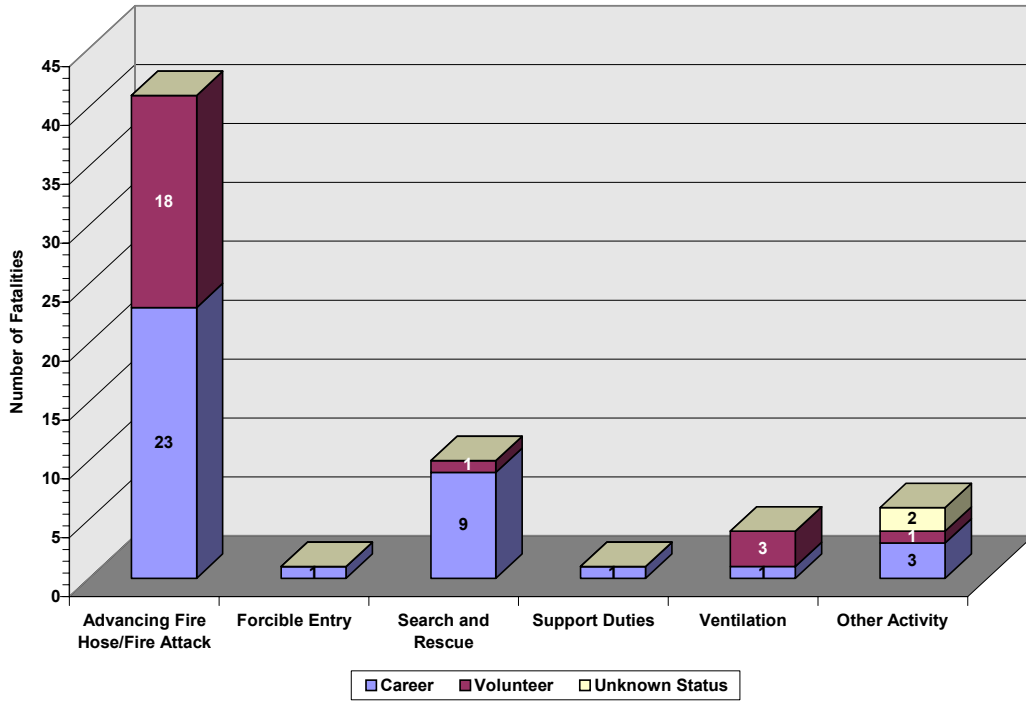


Figure 7 - Fatalities by Activity

Number of Fatalities due to Structural Collapse By Nature of Death

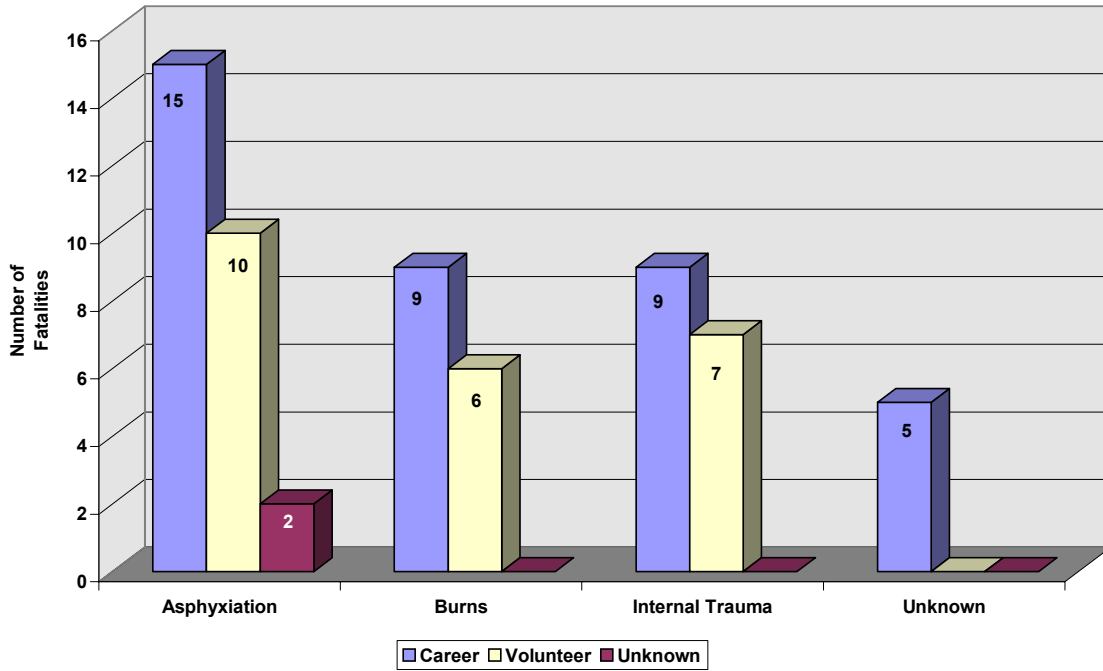


Figure 8 - Fatalities by Nature of Death

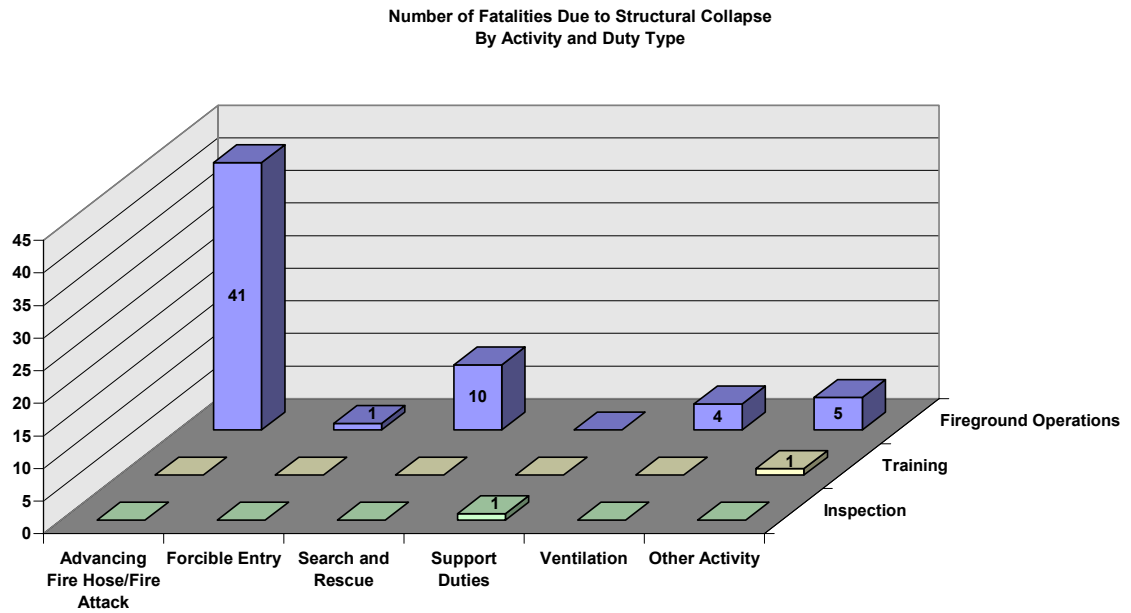


Figure 9 - Fatalities By Activity and Duty Type

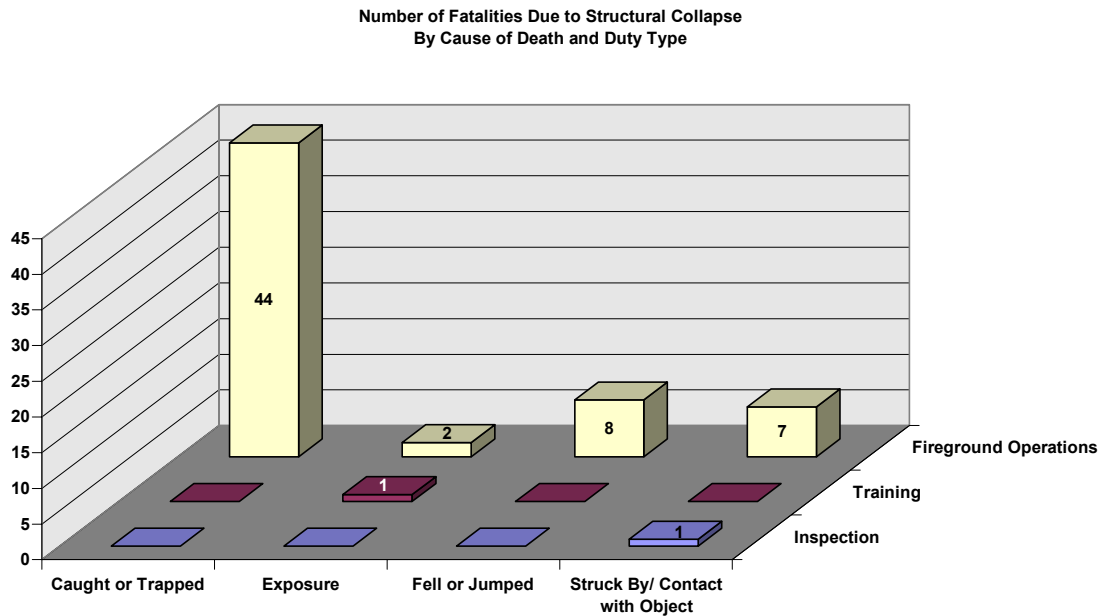


Figure 10 - Fatalities by Cause of Death and Duty Type

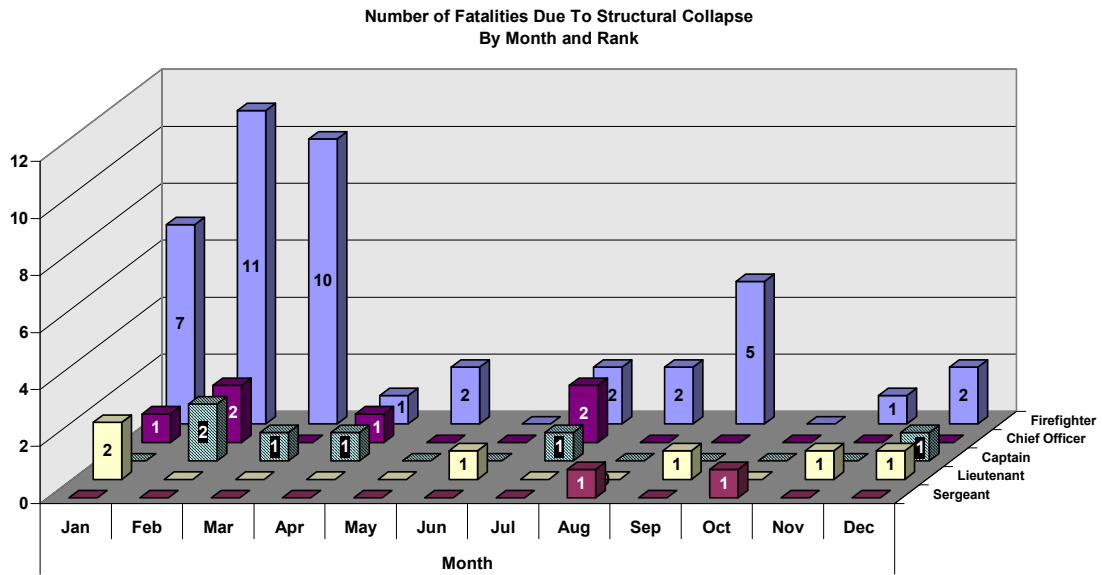


Figure 11 - Fatalities By Month and Rank

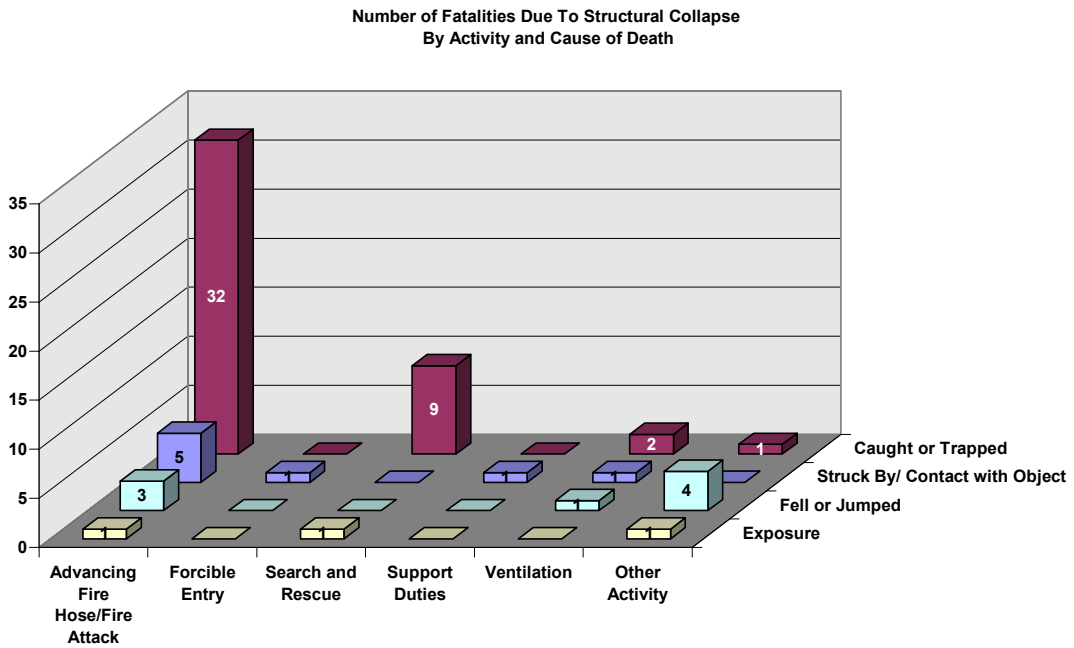


Figure 12 - Fatalities By Activity and Cause of Death

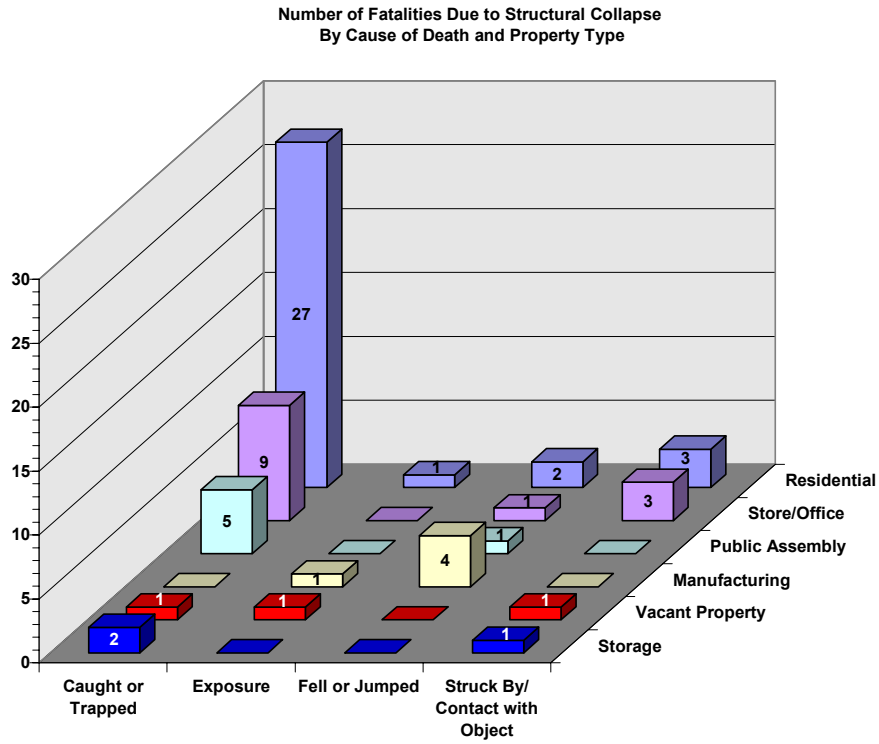


Figure 13 - Fatalities By Cause of Death and Property Type

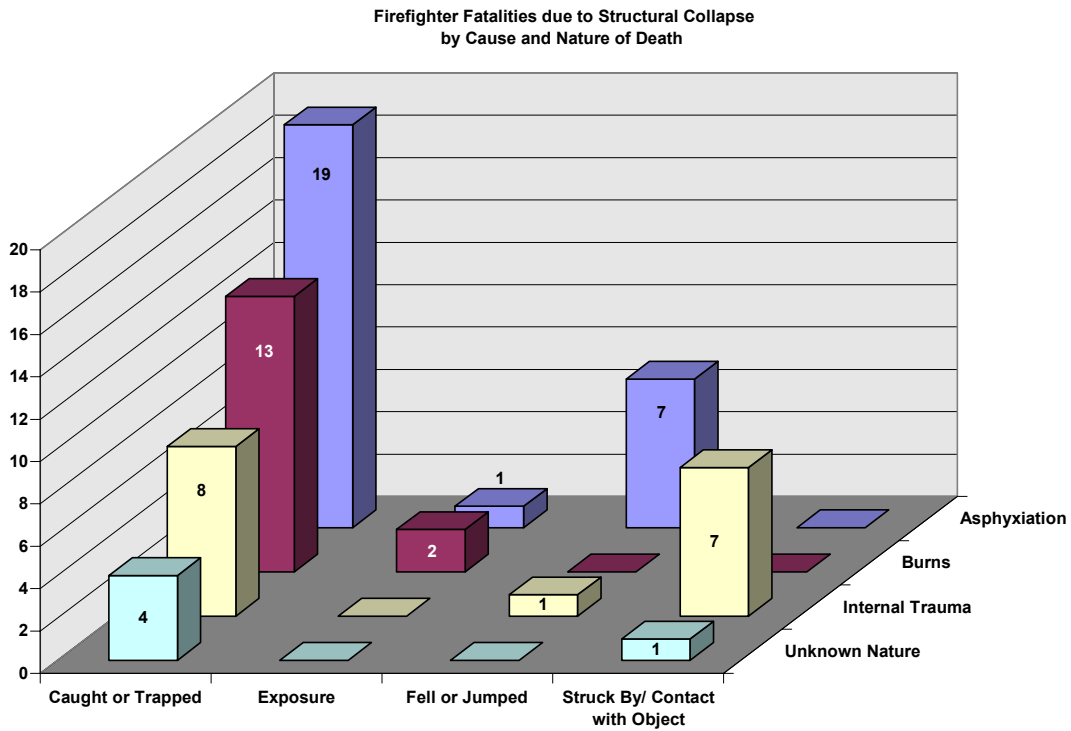


Figure 14 - Fatalities by Cause of Death and Nature of Death

Number of Fatalities Due to Structural Collapse
By Property Type and Status

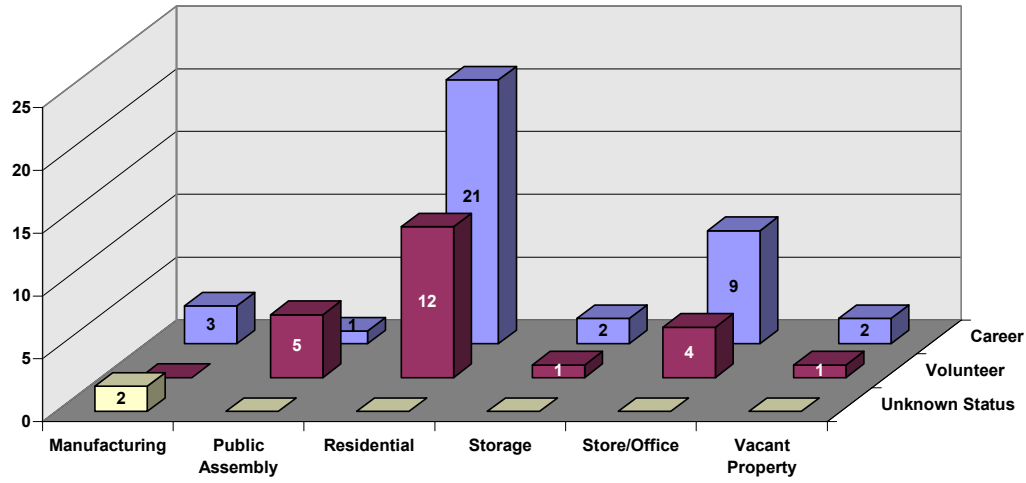


Figure 15 - Fatalities By Property Type and Status

Number of Fatalities Due to Structural Collapse
By Activity and Status

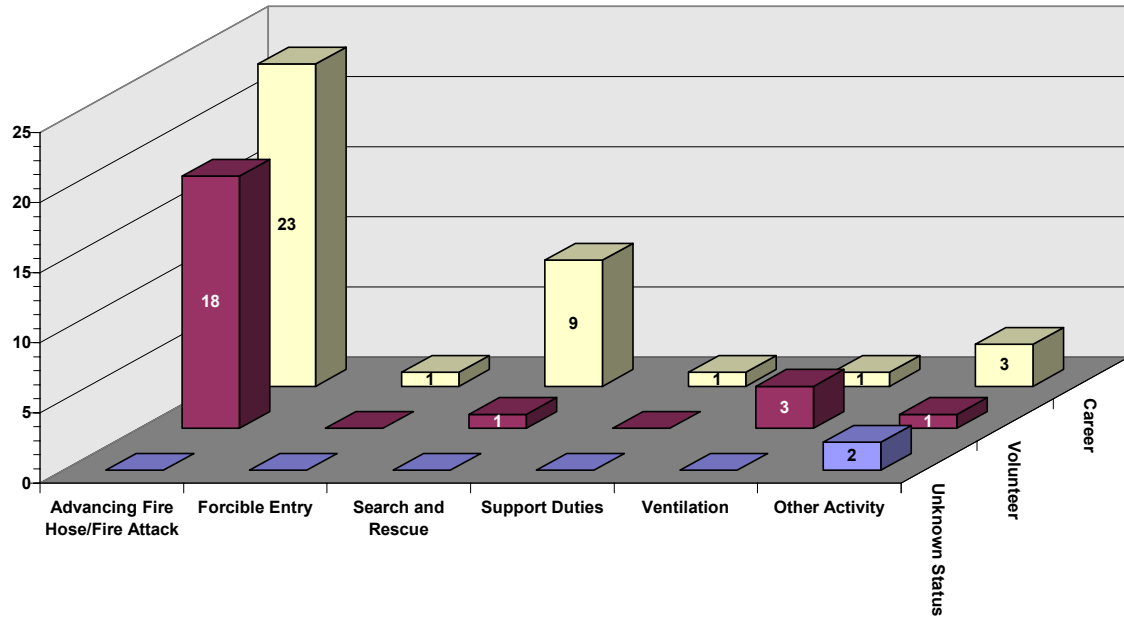


Figure 16 - Fatalities By Activity and Status

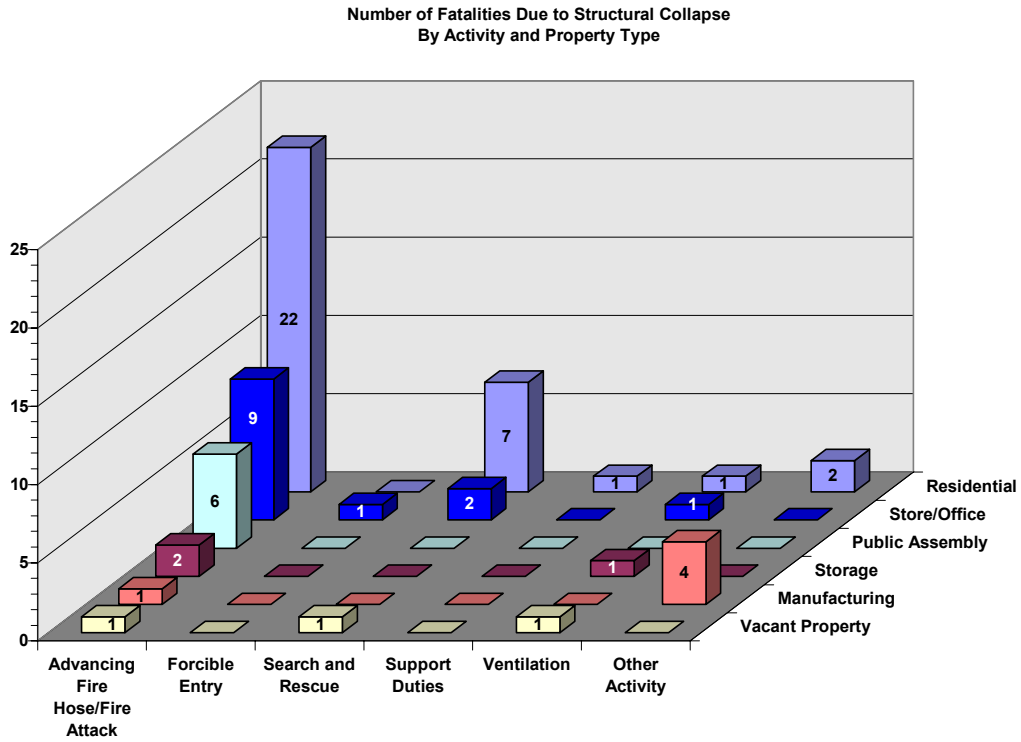


Figure 17 - Fatalities By Activity and Property Type

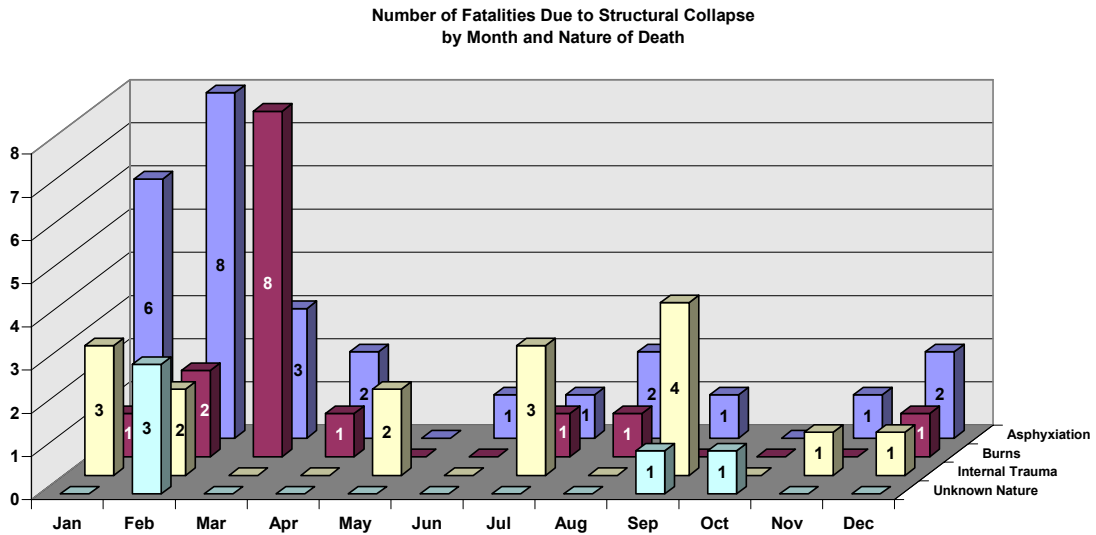


Figure 18 - Fatalities By Month and Nature of Death

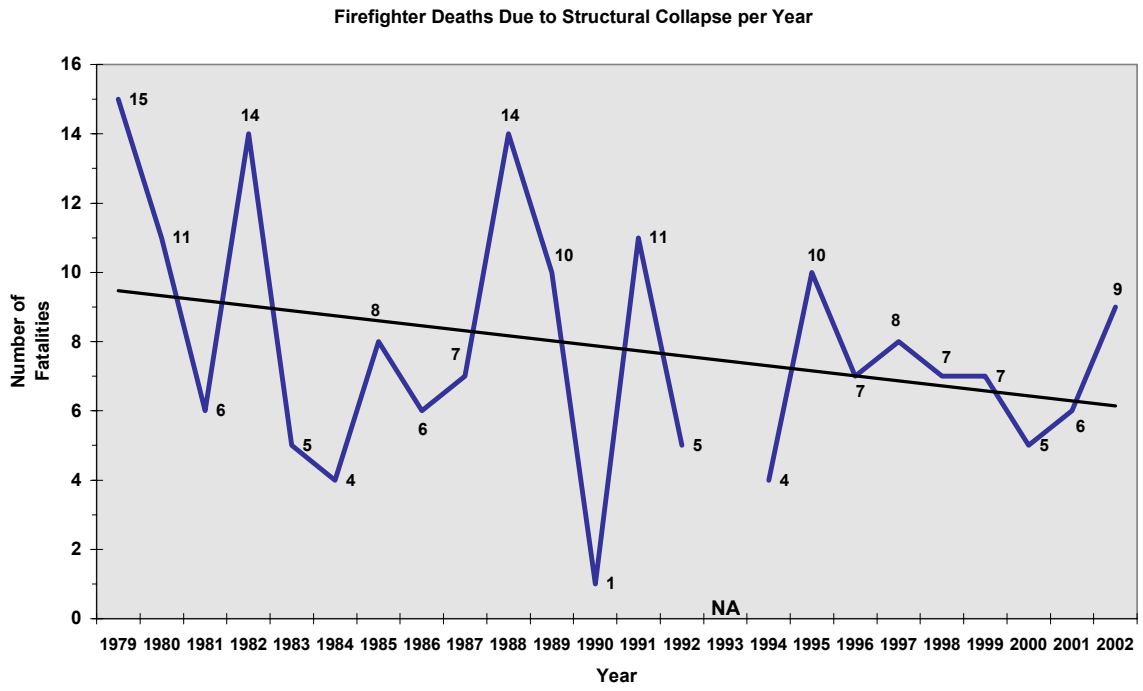
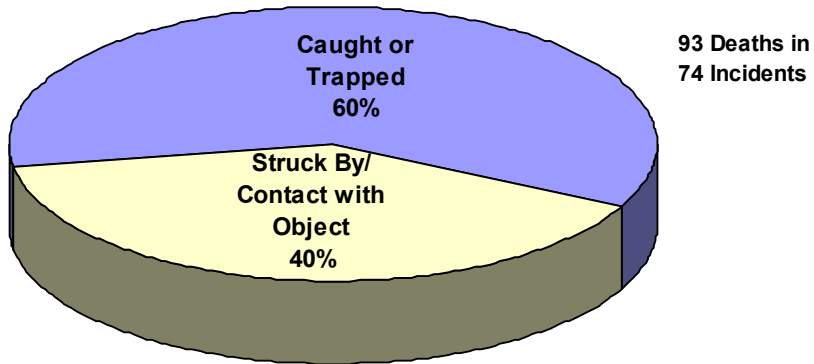
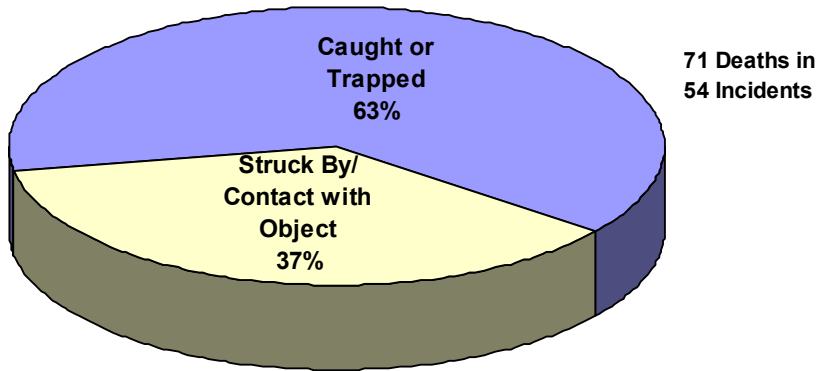


Figure 19 - Fatalities Due to Structural Collapse per Year (1979-2002)

1979-1988



1983-1992



1994-2002

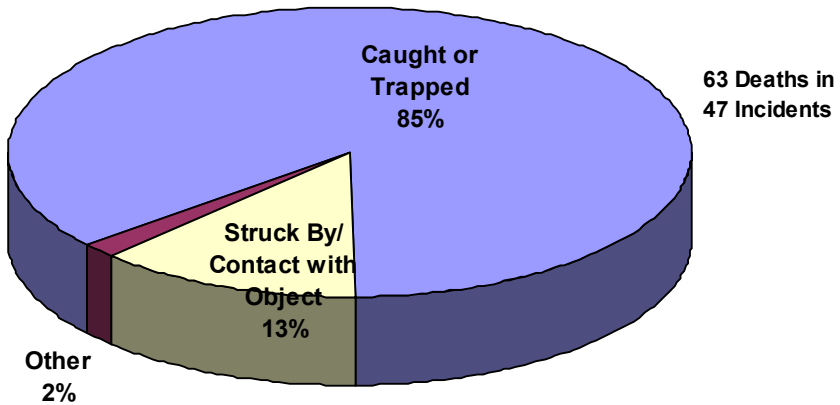
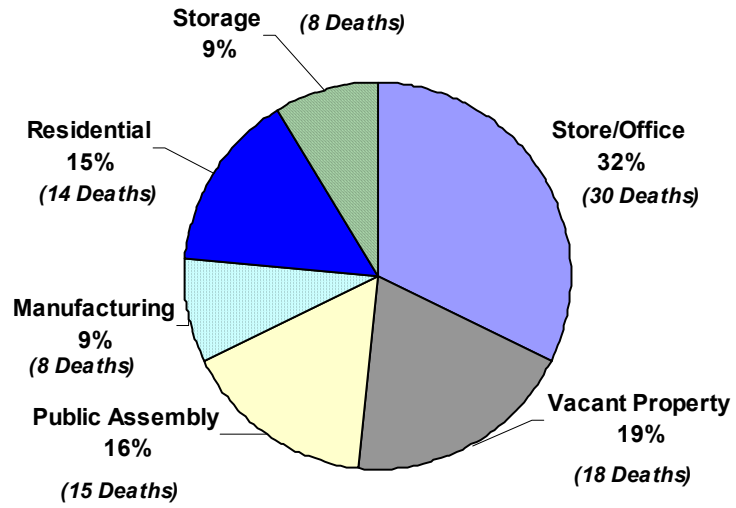
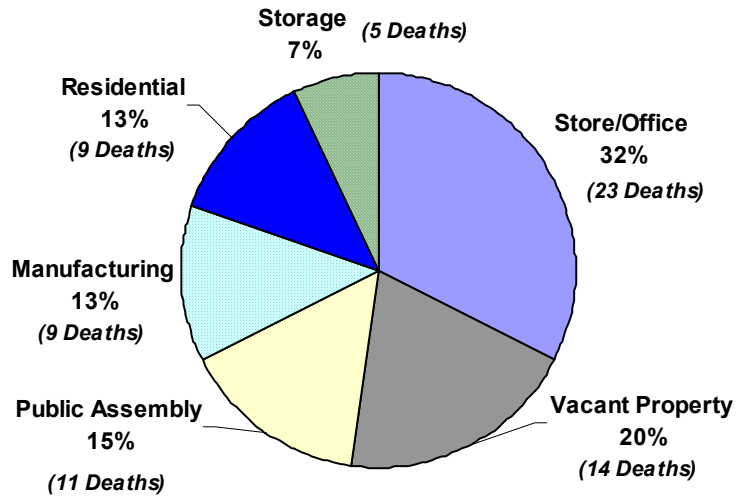


Figure 20 - Fatalities by Cause of Death

1979-1988



1983-1992



1994-2002

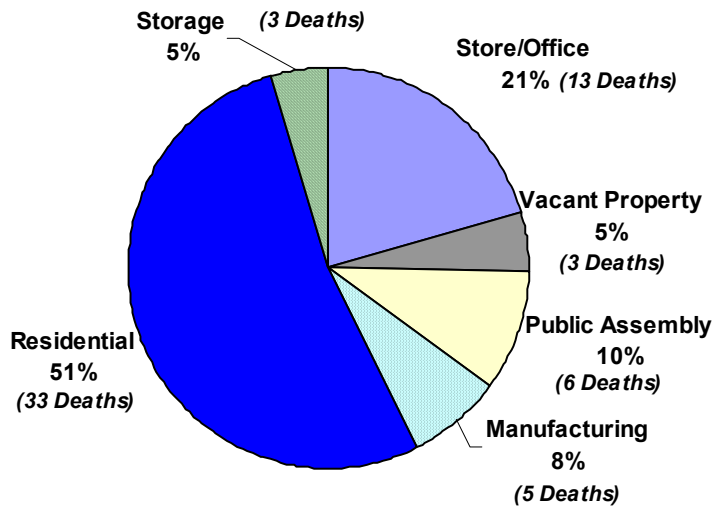


Figure 21 - Fatalities by Fixed Property Type

Appendix A: Crosstabulations of Collapse Data (Burt Table)

	Status			Duty Type			Years of Experience				Cause of Death				Nature of Death			
	Career	Volunteer	Unknown Status	Fireground Operations	Inspection	Training	0 to 5.5	6 to 15	>15	Unknown Experience	Caught or Trapped	Exposure	Fell or Jumped	Struck By/ Contact with Object	Asphyxiation	Burns	Internal Trauma	Unknown Nature
Career	38	0	0	37	1	0	8	15	13	2	28	2	4	4	15	9	9	5
Volunteer	0	23	0	22	0	1	11	6	3	3	16	1	2	4	10	6	7	0
Unknown Status	0	0	2	2	0	0	1	0	1	0	0	0	2	0	2	0	0	0
Fireground	37	22	2	61	0	0	20	20	16	5	44	2	8	7	26	15	15	5
Inspection	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0
Training	0	1	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0
0 to 5.5	8	11	1	20	0	0	20	11	0	0	13	0	4	3	11	4	4	1
6 to 15	15	6	0	20	0	1	0	21	0	0	15	2	1	3	9	5	5	2
>15	13	3	1	16	1	0	0	0	17	0	12	1	2	2	5	4	6	2
Unknown Experience	2	3	0	5	0	0	0	0	0	5	4	0	1	0	2	2	1	0
Caught or Trapped	28	16	0	44	0	0	13	15	12	4	44	0	0	0	19	13	8	4
Exposure	2	1	0	2	0	1	0	2	1	0	0	3	0	0	1	2	0	0
Fell or Jumped	4	2	2	8	0	0	4	1	2	1	0	0	8	0	7	0	1	0
Struck By/ Contact with Object	4	4	0	7	1	0	3	3	2	0	0	0	0	8	0	0	7	1
Asphyxiation	15	10	2	26	0	1	11	9	5	2	19	1	7	0	27	0	0	0
Burns	9	6	0	15	0	0	4	5	4	2	13	2	0	0	0	15	0	0
Internal Trauma	9	7	0	15	1	0	4	5	6	1	8	0	1	7	0	0	16	0
Unknown Nature	5	0	0	5	0	0	1	2	2	0	4	0	0	1	0	0	0	5
00:00 to 07:59	13	10	0	23	0	0	7	8	7	1	17	1	3	2	10	3	8	2
08:00 to 15:59	6	7	0	11	1	1	4	6	3	0	11	1	0	1	6	5	2	0
16:00 to 23:59	14	2	2	18	0	0	6	4	6	2	11	0	4	3	7	4	4	3
Unknown Time	5	4	0	9	0	0	3	3	1	2	5	1	1	2	4	3	2	0
Firefighter	28	14	1	42	1	0	19	14	7	3	32	0	5	6	19	10	10	4
Sergeant	2	0	0	2	0	0	0	0	1	1	2	0	0	0	0	1	0	1
Lieutenant	4	1	1	6	0	0	0	2	4	0	2	1	2	1	3	1	2	0
Captain	4	2	0	6	0	0	1	2	3	0	5	1	0	0	3	2	1	0
Chief Officer	0	6	0	5	0	1	0	3	2	1	3	1	1	1	2	1	3	0
Advancing Fire Hose/Fire Attack	23	18	0	41	0	0	12	17	9	3	32	1	3	5	16	10	11	4
Forcible Entry	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0
Search and Rescue	9	1	0	10	0	0	2	2	5	1	9	1	0	0	3	4	2	1
Support Duties	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0
Ventilation	1	3	0	4	0	0	3	0	0	1	2	0	1	1	2	1	1	0
Other Activity	3	1	2	5	0	1	2	2	2	0	1	1	4	0	6	0	0	0
Manufacturing	3	0	2	5	0	0	2	0	3	0	0	1	4	0	4	1	0	0
Public Assembly	1	5	0	6	0	0	4	2	0	0	5	0	1	0	3	2	1	0
Residential	21	12	0	31	1	1	8	13	9	3	27	1	2	3	11	10	9	3
Storage	2	1	0	3	0	0	0	0	1	2	2	0	0	1	1	1	1	0
Store/Office	9	4	0	13	0	0	5	4	4	0	9	0	1	3	7	0	4	2
Vacant Property	2	1	0	3	0	0	1	2	0	0	1	1	0	1	1	1	1	0
<21	0	1	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0
21-25	4	2	1	7	0	0	6	1	0	0	5	0	1	1	4	1	1	1
26-30	7	5	0	11	0	1	5	5	0	2	10	1	0	1	5	3	4	0
31-35	6	4	0	10	0	0	3	5	1	1	6	1	2	1	4	3	3	0
36-40	6	8	0	14	0	0	3	4	6	1	12	1	0	1	4	6	2	2
41-45	10	1	1	11	1	0	1	5	5	1	5	0	5	2	8	1	2	1
46-50	1	2	0	3	0	0	1	1	1	0	2	0	0	1	1	1	1	0
51-55	3	0	0	3	0	0	0	0	3	0	2	0	0	1	0	0	2	1
>55	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0
January	5	3	2	9	1	0	4	0	4	2	4	0	5	1	6	1	3	0
February	10	5	0	15	0	0	4	9	1	1	13	0	0	2	8	2	2	3
March	8	3	0	11	0	0	3	5	3	0	10	1	0	0	3	8	0	0
April	2	1	0	2	0	1	0	2	1	0	2	1	0	0	2	1	0	0
May	1	1	0	2	0	0	1	1	0	0	0	0	1	1	0	0	2	0
June	1	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0
July	3	2	0	5	0	0	1	1	3	0	5	0	0	0	1	1	3	0
August	1	2	0	3	0	0	2	0	0	1	2	0	1	0	2	1	0	0
September	4	2	0	6	0	0	3	0	3	0	3	0	0	3	1	0	4	1
October	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1
November	0	2	0	2	0	0	0	1	0	1	1	0	0	1	1	0	1	0
December	2	2	0	4	0	0	2	2	0	0	2	1	1	0	2	1	1	0

Appendix A: Crosstabulations of Collapse Data (Burt Table) page 2

	Time				Rank					Activity Type					
	00:00 to 07:59	08:00 to 15:59	16:00 to 23:59	Unknown Time	Firefighter	Sergeant	Lieutenant	Captain	Chief Officer	Advancing Fire Hose/Fire Attack	Forcible Entry	Search and Rescue	Support Duties	Ventilation	Other Activity
Career	13	6	14	5	28	2	4	4	0	23	1	9	1	1	3
Volunteer	10	7	2	4	14	0	1	2	6	18	0	1	0	3	1
Unknown Status	0	0	2	0	1	0	1	0	0	0	0	0	0	0	2
Fireground	23	11	18	9	42	2	6	6	5	41	1	10	0	4	5
Inspection	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0
Training	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1
0 to 5.5	7	4	6	3	19	0	0	1	0	12	1	2	0	3	2
6 to 15	8	6	4	3	14	0	2	2	3	17	0	2	0	0	2
>15	7	3	6	1	7	1	4	3	2	9	0	5	1	0	2
Unknown Experience	1	0	2	2	3	1	0	0	1	3	0	1	0	1	0
Caught or Trapped	17	11	11	5	32	2	2	5	3	32	0	9	0	2	1
Exposure	1	1	0	1	0	0	1	1	1	1	0	1	0	0	1
Fell or Jumped	3	0	4	1	5	0	2	0	1	3	0	0	0	1	4
Struck By/ Contact with Object	2	1	3	2	6	0	1	0	1	5	1	0	1	1	0
Asphyxiation	10	6	7	4	19	0	3	3	2	16	0	3	0	2	6
Burns	3	5	4	3	10	1	1	2	1	10	0	4	0	1	0
Internal Trauma	8	2	4	2	10	0	2	1	3	11	1	2	1	1	0
Unknown Nature	2	0	3	0	4	1	0	0	0	4	0	1	0	0	0
00:00 to 07:59	23	0	0	0	14	1	2	2	4	17	0	5	0	1	0
08:00 to 15:59	0	13	0	0	10	0	0	1	2	9	0	1	1	1	1
16:00 to 23:59	0	0	18	0	13	0	3	2	0	10	1	3	0	0	4
Unknown Time	0	0	0	9	6	1	1	1	0	5	0	1	0	2	1
Firefighter	14	10	13	6	43	0	0	0	0	28	1	7	1	3	3
Sergeant	1	0	0	1	0	2	0	0	0	1	0	0	0	1	0
Lieutenant	2	0	3	1	0	0	6	0	0	2	0	2	0	0	2
Captain	2	1	2	1	0	0	0	6	0	5	0	1	0	0	0
Chief Officer	4	2	0	0	0	0	0	0	6	5	0	0	0	0	1
Advancing Fire Hose/Fire Attack	17	9	10	5	28	1	2	5	5	41	0	0	0	0	0
Forcible Entry	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0
Search and Rescue	5	1	3	1	7	0	2	1	0	0	0	10	0	0	0
Support Duties	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0
Ventilation	1	1	0	2	3	1	0	0	0	0	0	0	0	4	0
Other Activity	0	1	4	1	3	0	2	0	1	0	0	0	0	0	6
Manufacturing	1	0	4	0	2	0	2	1	0	1	0	0	0	0	4
Public Assembly	1	3	1	1	3	0	0	2	1	6	0	0	0	0	0
Residential	13	8	9	3	25	0	2	2	4	22	0	7	1	1	2
Storage	0	0	2	1	2	1	0	0	0	2	0	0	0	1	0
Store/Office	7	2	2	2	9	1	1	1	1	9	1	2	0	1	0
Vacant Property	1	0	0	2	2	0	1	0	0	1	0	1	0	1	0
<21	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0
21-25	3	1	3	0	7	0	0	0	0	4	1	1	0	0	1
26-30	5	2	2	3	8	1	0	2	1	8	0	2	0	1	1
31-35	2	2	3	3	7	0	1	0	2	4	0	2	0	2	2
36-40	5	5	3	1	9	1	1	2	1	10	0	3	0	1	0
41-45	5	1	4	2	7	0	2	2	1	8	0	1	1	0	2
46-50	2	0	1	0	1	0	1	0	1	2	0	1	0	0	0
51-55	0	1	2	0	3	0	0	0	0	3	0	0	0	0	0
>55	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0
January	3	2	5	0	7	0	2	0	1	4	0	1	1	0	4
February	9	3	2	1	11	0	0	2	2	11	0	4	0	0	0
March	2	6	2	1	10	0	0	1	0	8	0	2	0	0	1
April	0	1	1	1	1	0	0	1	1	2	0	0	0	0	1
May	1	0	0	1	2	0	0	0	0	2	0	0	0	0	0
June	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0
July	3	0	2	0	2	0	0	1	2	4	0	1	0	0	0
August	2	0	0	1	2	1	0	0	0	1	0	0	0	2	0
September	1	1	3	1	5	0	1	0	0	3	1	0	0	2	0
October	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0
November	1	0	1	0	1	0	1	0	0	2	0	0	0	0	0
December	0	0	1	3	2	0	1	1	0	3	0	1	0	0	0

Appendix A: Crosstabulations of Collapse Data (Burt Table) page 3

	Fixed Property Use						Age									
	Manufacturing	Public	Residential	Storage	Store/Office	Vacant	<21	21-25	26-30	31-35	36-40	41-45	46-50	51-55	>55	
Career	3	1	21	2	9	2	0	4	7	6	6	10	1	3	1	
Volunteer	0	5	12	1	4	1	1	2	5	4	8	1	2	0	0	
Unknown Status	2	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
Fireground	5	6	31	3	13	3	1	7	11	10	14	11	3	3	1	
Inspection	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
Training	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	
0 to 5.5	2	4	8	0	5	1	1	6	5	3	3	1	1	0	0	
6 to 15	0	2	13	0	4	2	0	1	5	5	4	5	1	0	0	
>15	3	0	9	1	4	0	0	0	0	1	6	5	1	3	1	
Unknown Experience	0	0	3	2	0	0	0	0	2	1	1	1	0	0	0	
Caught or Trapped	0	5	27	2	9	1	1	5	10	6	12	5	2	2	1	
Exposure	1	0	1	0	0	1	0	0	1	1	1	0	0	0	0	
Fell or Jumped	4	1	2	0	1	0	0	1	0	2	0	5	0	0	0	
Struck By/ Contact with Object	0	0	3	1	3	1	0	1	1	1	1	2	1	1	0	
Asphyxiation	4	3	11	1	7	1	1	4	5	4	4	8	1	0	0	
Burns	1	2	10	1	0	1	0	1	3	3	6	1	1	0	0	
Internal Trauma	0	1	9	1	4	1	0	1	4	3	2	2	1	2	1	
Unknown Nature	0	0	3	0	2	0	0	1	0	0	2	1	0	1	0	
00:00 to 07:59	1	1	13	0	7	1	0	3	5	2	5	5	2	0	1	
08:00 to 15:59	0	3	8	0	2	0	1	1	2	2	5	1	0	1	0	
16:00 to 23:59	4	1	9	2	2	0	0	3	2	3	3	4	1	2	0	
Unknown Time	0	1	3	1	2	2	0	0	3	3	1	2	0	0	0	
Firefighter	2	3	25	2	9	2	1	7	8	7	9	7	1	3	0	
Sergeant	0	0	0	1	1	0	0	0	1	0	1	0	0	0	0	
Lieutenant	2	0	2	0	1	1	0	0	0	1	1	2	1	0	1	
Captain	1	2	2	0	1	0	0	0	2	0	2	2	0	0	0	
Chief Officer	0	1	4	0	1	0	0	0	1	2	1	1	1	0	0	
Advancing Fire Hose/Fire Attack	1	6	22	2	9	1	1	4	8	4	10	8	2	3	1	
Forcible Entry	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	
Search and Rescue	0	0	7	0	2	1	0	1	2	2	3	1	1	0	0	
Support Duties	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
Ventilation	0	0	1	1	1	1	0	0	1	2	1	0	0	0	0	
Other Activity	4	0	2	0	0	0	0	1	1	2	0	2	0	0	0	
Manufacturing	5	0	0	0	0	0	0	1	0	1	1	2	0	0	0	
Public Assembly	0	6	0	0	0	0	1	0	2	1	0	1	1	0	0	
Residential	0	0	33	0	0	0	0	4	6	4	9	7	1	2	0	
Storage	0	0	0	3	0	0	0	0	1	0	1	0	0	1	0	
Store/Office	0	0	0	0	13	0	0	2	2	2	3	2	1	0	1	
Vacant Property	0	0	0	0	0	3	0	0	1	2	0	0	0	0	0	
<21	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
21-25	1	0	4	0	2	0	0	7	0	0	0	0	0	0	0	
26-30	0	2	6	1	2	1	0	0	12	0	0	0	0	0	0	
31-35	1	1	4	0	2	2	0	0	0	10	0	0	0	0	0	
36-40	1	0	9	1	3	0	0	0	0	0	14	0	0	0	0	
41-45	2	1	7	0	2	0	0	0	0	0	0	12	0	0	0	
46-50	0	1	1	0	1	0	0	0	0	0	0	0	3	0	0	
51-55	0	0	2	1	0	0	0	0	0	0	0	0	0	3	0	
>55	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	
January	4	1	5	0	0	0	0	2	0	2	0	4	1	1	0	
February	0	3	7	0	4	1	1	1	6	1	1	4	1	0	0	
March	1	0	8	0	2	0	0	1	1	2	6	1	0	0	0	
April	0	0	2	0	1	0	0	0	1	1	0	1	0	0	0	
May	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	
June	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	
July	0	0	5	0	0	0	0	1	1	1	2	0	0	0	0	
August	0	0	0	1	2	0	0	1	1	1	0	0	0	0	0	
September	0	0	2	1	2	1	0	1	0	1	1	0	0	2	1	
October	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	
November	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	
December	0	2	1	0	0	1	0	0	1	1	1	1	0	0	0	

Appendix A: Crosstabulations of Collapse Data (Burt Table) page 4

	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
Career	5	10	8	2	1	1	3	1	4	1	0	2
Volunteer	3	5	3	1	1	0	2	2	2	0	2	2
Unknown Status	2	0	0	0	0	0	0	0	0	0	0	0
Fireground	9	15	11	2	2	1	5	3	6	1	2	4
Inspection	1	0	0	0	0	0	0	0	0	0	0	0
Training	0	0	0	1	0	0	0	0	0	0	0	0
0 to 5.5	4	4	3	0	1	0	1	2	3	0	0	2
6 to 15	0	9	5	2	1	0	1	0	0	0	1	2
>15	4	1	3	1	0	1	3	0	3	1	0	0
Unknown Experience	2	1	0	0	0	0	0	1	0	0	1	0
Caught or Trapped	4	13	10	2	0	1	5	2	3	1	1	2
Exposure	0	0	1	1	0	0	0	0	0	0	0	1
Fell or Jumped	5	0	0	0	1	0	0	1	0	0	0	1
Struck By/ Contact with Object	1	2	0	0	1	0	0	0	3	0	1	0
Asphyxiation	6	8	3	2	0	1	1	2	1	0	1	2
Burns	1	2	8	1	0	0	1	1	0	0	0	1
Internal Trauma	3	2	0	0	2	0	3	0	4	0	1	1
Unknown Nature	0	3	0	0	0	0	0	0	1	1	0	0
00:00 to 07:59	3	9	2	0	1	0	3	2	1	1	1	0
08:00 to 15:59	2	3	6	1	0	0	0	0	1	0	0	0
16:00 to 23:59	5	2	2	1	0	1	2	0	3	0	1	1
Unknown Time	0	1	1	1	1	0	0	1	1	0	0	3
Firefighter	7	11	10	1	2	0	2	2	5	0	1	2
Sergeant	0	0	0	0	0	0	0	1	0	1	0	0
Lieutenant	2	0	0	0	0	1	0	0	1	0	1	1
Captain	0	2	1	1	0	0	1	0	0	0	0	1
Chief Officer	1	2	0	1	0	0	2	0	0	0	0	0
Advancing Fire Hose/Fire Attack	4	11	8	2	2	0	4	1	3	1	2	3
Forcible Entry	0	0	0	0	0	0	0	0	1	0	0	0
Search and Rescue	1	4	2	0	0	1	1	0	0	0	0	1
Support Duties	1	0	0	0	0	0	0	0	0	0	0	0
Ventilation	0	0	0	0	0	0	0	2	2	0	0	0
Other Activity	4	0	1	1	0	0	0	0	0	0	0	0
Manufacturing	4	0	1	0	0	0	0	0	0	0	0	0
Public Assembly	1	3	0	0	0	0	0	0	0	0	0	2
Residential	5	7	8	2	1	1	5	0	2	0	1	1
Storage	0	0	0	0	0	0	0	1	1	0	1	0
Store/Office	0	4	2	1	1	0	0	2	2	1	0	0
Vacant Property	0	1	0	0	0	0	0	0	1	0	0	1
<21	0	1	0	0	0	0	0	0	0	0	0	0
21-25	2	1	1	0	0	0	1	1	1	0	0	0
26-30	0	6	1	1	1	0	1	1	0	0	0	1
31-35	2	1	2	1	0	0	1	1	1	0	0	1
36-40	0	1	6	0	0	0	2	0	1	1	2	1
41-45	4	4	1	1	1	0	0	0	0	0	0	1
46-50	1	1	0	0	0	0	1	0	0	0	0	0
51-55	1	0	0	0	0	0	0	0	2	0	0	0
>55	0	0	0	0	0	0	0	0	1	0	0	0
January	10	0	0	0	0	0	0	0	0	0	0	0
February	0	15	0	0	0	0	0	0	0	0	0	0
March	0	0	11	0	0	0	0	0	0	0	0	0
April	0	0	0	3	0	0	0	0	0	0	0	0
May	0	0	0	0	2	0	0	0	0	0	0	0
June	0	0	0	0	0	1	0	0	0	0	0	0
July	0	0	0	0	0	0	5	0	0	0	0	0
August	0	0	0	0	0	0	0	3	0	0	0	0
September	0	0	0	0	0	0	0	0	6	0	0	0
October	0	0	0	0	0	0	0	0	0	1	0	0
November	0	0	0	0	0	0	0	0	0	0	2	0
December	0	0	0	0	0	0	0	0	0	0	0	4

Appendix B: Table A – Original Firefighter Data

<u>ID</u>	<u>Age</u>	<u>Gender</u>	<u>Rank</u>	<u>Status</u>	<u>Years in Service</u>	<u>Date of Death</u>	<u>Cause of Death</u>	<u>Nature of Death</u>	<u>State</u>	<u>Emergency Duty?</u>	<u>Duty Type</u>
1	27	Male	Firefighter	Volunteer		2/27/1994	Caught or Trapped	Burns	Michigan	TRUE	Fireground Operations
2	28	Male	Sergeant	Career		8/3/1994	Caught or Trapped	Burns	Kentucky	TRUE	Fireground Operations
3	58	Male	Lieutenant	Career	36	9/11/1994	Caught or Trapped	Internal Trauma	Florida	TRUE	Fireground Operations
4	44	Male	Firefighter	Career	2.5	12/24/1994	Fell or Jumped	Asphyxiation	Wisconsin	TRUE	Fireground Operations
5	25	Male	Firefighter	Unknown	3	1/5/1995	Fell or Jumped	Asphyxiation	Washington	TRUE	Fireground Operations
6	35	Male	Firefighter	Career	4	1/5/1995	Fell or Jumped	Asphyxiation	Washington	TRUE	Fireground Operations
7	43	Male	Lieutenant	Unknown	22	1/5/1995	Fell or Jumped	Asphyxiation	Washington	TRUE	Fireground Operations
8	45	Male	Lieutenant	Career	24	1/5/1995	Fell or Jumped	Asphyxiation	Washington	TRUE	Fireground Operations
9	27	Male	Firefighter	Career	1.2	2/14/1995	Caught or Trapped	Asphyxiation	Pennsylvania	TRUE	Fireground Operations
10	43	Female	Firefighter	Career	8	2/14/1995	Caught or Trapped	Asphyxiation	Pennsylvania	TRUE	Fireground Operations
11	42	Male	Captain	Career	13	2/14/1995	Caught or Trapped	Asphyxiation	Pennsylvania	TRUE	Fireground Operations
12	33	Male	Firefighter	Career	9	3/8/1995	Caught or Trapped	Asphyxiation	Kansas	TRUE	Fireground Operations
13	25	Male	Firefighter	Career	1.5	9/16/1995	Struck By/ Contact with Object	Internal Trauma	Maryland	TRUE	Fireground Operations
14	35	Male	Lieutenant	Career	9	12/31/1995	Exposure	Burns	New York	TRUE	Fireground Operations
15	37	Male	Firefighter	Career	12	2/5/1996	Caught or Trapped	Unknown	New York	TRUE	Fireground Operations
16	32	Male	Firefighter	Career	10	3/18/1996	Caught or Trapped	Asphyxiation	Virginia	TRUE	Fireground Operations
17	38	Male	Firefighter	Career	15	3/18/1996	Caught or Trapped	Asphyxiation	Virginia	TRUE	Fireground Operations
18	43	Male	Captain	Career	26	4/23/1996	Caught or Trapped	Asphyxiation	Nebraska	TRUE	Fireground Operations
19	31	Male	Firefighter	Volunteer	5	9/29/1996	Struck By/ Contact with Object	Internal Trauma	Illinois	TRUE	Fireground Operations
20	36	Male	Firefighter	Volunteer		11/27/1996	Caught or Trapped	Asphyxiation	Connecticut	TRUE	Fireground Operations
21	36	Male	Firefighter	Volunteer	15	12/27/1996	Caught or Trapped	Asphyxiation	Georgia	TRUE	Fireground Operations

<u>ID</u>	<u>Age</u>	<u>Gender</u>	<u>Rank</u>	<u>Status</u>	<u>Years in Service</u>	<u>Date of Death</u>	<u>Cause of Death</u>	<u>Nature of Death</u>	<u>State</u>	<u>Emergency Duty?</u>	<u>Duty Type</u>
22	47	Male	Engineer	Volunteer	4	1/1/1997	Caught or Trapped	Burns	New York	TRUE	Fireground Operations
23	33	Male	Firefighter	Career		1/11/1997	Caught or Trapped	Internal Trauma	Louisiana	TRUE	Fireground Operations
24	43	Male	Assistant Chief	Volunteer		1/26/1997	Fell or Jumped	Asphyxiation	Wisconsin	TRUE	Fireground Operations
25	21	Male	Firefighter	Career	0	2/6/1997	Caught or Trapped	Unknown	California	TRUE	Fireground Operations
26	29	Male	Firefighter	Career	7	2/6/1997	Caught or Trapped	Internal Trauma	California	TRUE	Fireground Operations
27	29	Male	Firefighter	Career	7	2/17/1997	Caught or Trapped	Asphyxiation	Kentucky	TRUE	Fireground Operations
28	27	Male	Firefighter	Volunteer	2.5	5/24/1997	Struck By/ Contact with Object	Internal Trauma	New York	TRUE	Fireground Operations
29	38	Male	Sergeant	Career	19	10/24/1997	Caught or Trapped	Unknown	Washington, D.C.	TRUE	Fireground Operations
30	38	Male	Captain	Career	17	3/8/1998	Exposure	Burns	California	TRUE	Fireground Operations
31	48	Male	Lieutenant	Career	21	6/6/1998	Caught or Trapped	Asphyxiation	New York	TRUE	Fireground Operations
32	40	Male	Captain	Career	20	7/4/1998	Caught or Trapped	Burns	New York	TRUE	Fireground Operations
33	21	Male	Firefighter	Volunteer	4	8/29/1998	Caught or Trapped	Asphyxiation	Mississippi	TRUE	Fireground Operations
34	35	Male	Firefighter	Volunteer	3	8/29/1998	Fell or Jumped	Asphyxiation	Mississippi	TRUE	Fireground Operations
35	54	Male	Firefighter	Career	35	9/5/1998	Struck By/ Contact with Object	Internal Trauma	Vermont	TRUE	Fireground Operations
36	27	Male	Captain	Volunteer	1	12/31/1998	Struck By/ Contact with Object	Internal Trauma	Georgia	TRUE	Fireground Operations
37	22	Male	Firefighter	Volunteer	1	1/9/1999	Caught or Trapped	Asphyxiation	Indiana	TRUE	Fireground Operations
38	52	Male	Firefighter	Career	29	1/10/1999	Caught or Trapped	Internal Trauma	California	TRUE	Fireground Operations
39	43	Male	Fire Investigator	Career	20	1/19/1999	Struck By/ Contact with Object	Internal Trauma	New York	FALSE	Fire Prevention/Inspection
40	20	Male	Firefighter	Volunteer	2	2/15/1999	Caught or Trapped	Asphyxiation	Texas	TRUE	Fireground Operations
41	29	Male	Captain	Volunteer	6	2/15/1999	Caught or Trapped	Asphyxiation	Texas	TRUE	Fireground Operations
42	35	Male	Assistant Chief	Volunteer	14	2/15/1999	Caught or Trapped	Burns	Texas	TRUE	Fireground Operations
43	41	Male	Firefighter	Career	7	5/3/1999	Fell or Jumped	Internal Trauma	Pennsylvania	TRUE	Fireground Operations
44	30	Female	Firefighter	Career	5.5	2/14/2000	Caught or Trapped	Asphyxiation	Texas	TRUE	Fireground Operations

<u>ID</u>	<u>Age</u>	<u>Gender</u>	<u>Rank</u>	<u>Status</u>	<u>Years in Service</u>	<u>Date of Death</u>	<u>Cause of Death</u>	<u>Nature of Death</u>	<u>State</u>	<u>Emergency Duty?</u>	<u>Duty Type</u>
45	44	Male	Firefighter	Career	18.5	2/14/2000	Caught or Trapped	Asphyxiation	Texas	TRUE	Fireground Operations
46	33	Male	Firefighter/Paramedic	Career	8	4/20/2000	Caught or Trapped	Burns	Alabama	TRUE	Fireground Operations
47	27	Male	Second Assistant Chief	Volunteer	6	4/30/2000	Exposure	Asphyxiation	Delaware	FALSE	Training
48	36	Male	Firefighter/Secretary	Volunteer	2	9/24/2000	Caught or Trapped	Asphyxiation	Texas	TRUE	Fireground Operations
49	46	Male	Assistant Chief	Volunteer	6	2/26/2001	Struck By/ Contact with Object	Internal Trauma	Wisconsin	TRUE	Fireground Operations
50	39	Male	Firefighter	Volunteer	1.5	3/18/2001	Caught or Trapped	Burns	Missouri	TRUE	Fireground Operations
51	36	Male	Firefighter	Volunteer	2.5	3/18/2001	Caught or Trapped	Burns	Missouri	TRUE	Fireground Operations
52	38	Male	Firefighter	Career	20	3/20/2001	Caught or Trapped	Burns	Ohio	TRUE	Fireground Operations
53	37	Male	Firefighter	Volunteer	18	3/25/2001	Caught or Trapped	Burns	New Jersey	TRUE	Fireground Operations
54	22	Male	Firefighter	Career	4	7/12/2001	Caught or Trapped	Asphyxiation	South Carolina	TRUE	Fireground Operations
55	42	Male	Firefighter	Career	10	2/11/2002	Caught or Trapped	Unknown	Texas	TRUE	Fireground Operations
56	23	Male	Firefighter	Career	7	3/6/2002	Caught or Trapped	Burns	North Carolina	TRUE	Fireground Operations
57	28	Male	Firefighter/Paramedic	Career	2	3/7/2002	Caught or Trapped	Burns	New York	TRUE	Fireground Operations
58	41	Male	Firefighter/Paramedic	Career	12	3/7/2002	Caught or Trapped	Burns	New York	TRUE	Fireground Operations
59	30	Male	Firefighter	Career	13	7/4/2002	Caught or Trapped	Internal Trauma	New Jersey	TRUE	Fireground Operations
60	31	Male	Chief	Volunteer	17	7/4/2002	Caught or Trapped	Internal Trauma	New Jersey	TRUE	Fireground Operations
61	40	Male	Deputy Chief	Volunteer	23	7/4/2002	Caught or Trapped	Internal Trauma	New Jersey	TRUE	Fireground Operations
62	53	Male	Firefighter	Career	27	9/14/2002	Caught or Trapped	Unknown	Iowa	TRUE	Fireground Operations
63	36	Male	Lieutenant	Volunteer	6	11/1/2002	Struck By/ Contact with Object	Internal Trauma	Pennsylvania	TRUE	Fireground Operations

Appendix B: Table B – Original Firefighter Data (cont’d)

<u>ID</u>	<u>Activity Type</u>	<u>Incident Date</u>	<u>Time</u>	<u>Location</u>	<u># Killed</u>	<u>Flashover?</u>	<u># of Alarms</u>	<u>Report Time</u>	<u>Arrival time</u>	<u>Fixed Property Use</u>
1	Advancing Hose Lines/ Fire Attack	2/27/1994		Auburn Hills, Michigan	1	FALSE	1			Residential
2	Ventilation	8/3/1994		Louisville, Kentucky	1	FALSE	1			Storage
3	Advancing Hose Lines/ Fire Attack	9/11/1994	4:00	Miami, Florida	1	FALSE	1			Store/Office
4	Advancing Hose Lines/ Fire Attack	12/24/1994		Milwaukee, Wisconsin	1	FALSE	1			Public Assembly
5	Other	1/5/1995	19:00	Seattle, Washington	4	FALSE	5			Manufacturing
6	Other	1/5/1995	19:00	Seattle, Washington	4	FALSE	5			Manufacturing
7	Other	1/5/1995	19:00	Seattle, Washington	4	FALSE	5			Manufacturing
8	Other	1/5/1995	19:00	Seattle, Washington	4	FALSE	5			Manufacturing
9	Advancing Hose Lines/ Fire Attack	2/14/1995	0:23	Pittsburgh, Pennsylvania	3	FALSE	5	0:22	0:27	Residential
10	Advancing Hose Lines/ Fire Attack	2/14/1995	0:23	Pittsburgh, Pennsylvania	3	FALSE	5	0:22	0:27	Residential
11	Advancing Hose Lines/ Fire Attack	2/14/1995	0:23	Pittsburgh, Pennsylvania	3	FALSE	5	0:22	0:27	Residential
12	Other	3/8/1995		Mission, Kansas	1	FALSE	1			Residential
13	Forcible Entry	9/16/1995	22:12	Baltimore, Maryland	1	FALSE	9			Store/Office
14	Search and Rescue	12/31/1995		New York, New York	1	FALSE	2			Vacant Property
15	Advancing Hose Lines/ Fire Attack	2/5/1996	16:40	Brooklyn, New York	1	FALSE	3	15:40		Store/Office
16	Advancing Hose Lines/ Fire Attack	3/18/1996	11:50	Chesapeake, Virginia	2	FALSE	4	11:29	11:35	Store/Office
17	Advancing Hose Lines/ Fire Attack	3/18/1996	11:50	Chesapeake, Virginia	2	FALSE	4	11:29	11:35	Store/Office
18	Advancing Hose Lines/ Fire Attack	4/23/1996		Omaha, Nebraska	1	FALSE	4			Store/Office
19	Ventilation	9/29/1996		Herrin, Illinois	1	FALSE	1			Vacant Property
20	Advancing Hose Lines/ Fire Attack	11/27/1996	16:24	Branford, Connecticut	1	FALSE	1			Storage
21	Advancing Hose Lines/ Fire Attack	12/27/1996		Cumming, Georgia	1	FALSE	1			Residential
22	Advancing Hose Lines/ Fire Attack	1/1/1997	1:30	Schuylerville, New York	1	TRUE	1			Public Assembly

<u>ID</u>	<u>Activity Type</u>	<u>Incident Date</u>	<u>Time</u>	<u>Location</u>	<u># Killed</u>	<u>Flashover?</u>	<u># of Alarms</u>	<u>Report Time</u>	<u>Arrival time</u>	<u>Fixed Property Use</u>
23	Search and Rescue	1/10/1997	23:16	New Orleans, Louisiana	1	FALSE	1			Residential
24	Advancing Hose Lines/ Fire Attack	1/26/1997	5:30	Conover, Wisconsin	1	FALSE	1			Residential
25	Search and Rescue	2/6/1997	4:00	Stockton, California	2	FALSE	2			Residential
26	Search and Rescue	2/6/1997	4:00	Stockton, California	2	FALSE	2			Residential
27	Advancing Hose Lines/ Fire Attack	2/17/1997	1:41	Lexington, Kentucky	1	FALSE	1	0:09	0:13	Vacant Property
28	Advancing Hose Lines/ Fire Attack	5/5/1997		Kenmore, New York	1	FALSE	1			Store/Office
29	Advancing Hose Lines/ Fire Attack	10/24/1997	6:30	District of Columbia	1	FALSE	4	6:20		Store/Office
30	Advancing Hose Lines/ Fire Attack	3/8/1998	2:42	Los Angeles, California	1	FALSE	1	2:20	2:24	N/A
31	Search and Rescue	6/5/1998	19:46	Brooklyn, New York	2	FALSE	5	20:22	20:25	Residential
32	Search and Rescue	6/5/1998	19:46	Brooklyn, New York	2	FALSE	5	20:22	20:25	Residential
33	Advancing Hose Lines/ Fire Attack	8/29/1998	1:27	Marks, Mississippi	2	FALSE	1	0:56	1:02	Store/Office
34	Ventilation	8/29/1998	1:27	Marks, Mississippi	2	FALSE	1	0:56	1:02	Store/Office
35	Advancing Hose Lines/ Fire Attack	9/5/1998	23:32	St. Johnsbury, Vermont	1	FALSE	1	23:32	23:37	Storage
36	Advancing Hose Lines/ Fire Attack	12/31/1998	22:20	Homer, Georgia	1	FALSE	1	21:23	21:33	Public Assembly
37	Advancing Hose Lines/ Fire Attack	1/9/1999	2:15	Worthington, Indiana	1	FALSE	1	1:52	2:04	Residential
38	Advancing Hose Lines/ Fire Attack	1/10/1999	11:15	Oakland, California	1	FALSE	6	10:42	10:46	Residential
39	Support Duties	1/19/1999	12:50	Syracuse, New York	1	FALSE	0			Residential
40	Advancing Hose Lines/ Fire Attack	2/15/1999	10:41	Lake Worth, Texas	3	FALSE	3			Public Assembly
41	Advancing Hose Lines/ Fire Attack	2/15/1999	10:41	Lake Worth, Texas	3	FALSE	3			Public Assembly
42	Advancing Hose Lines/ Fire Attack	2/15/1999	10:41	Lake Worth, Texas	3	FALSE	3			Public Assembly
43	Advancing Hose Lines/ Fire Attack	5/3/1999	4:31	Philadelphia, Pennsylvania	1	FALSE	1			Residential
44	Search and Rescue	2/14/2000	5:01	Houston, Texas	2	FALSE	3	4:31	4:39	Store/Office
45	Search and Rescue	2/14/2000	5:01	Houston, Texas	2	FALSE	3	4:31	4:39	Store/Office

<u>ID</u>	<u>Activity Type</u>	<u>Incident Date</u>	<u>Time</u>	<u>Location</u>	<u># Killed</u>	<u>Flashover?</u>	<u># of Alarms</u>	<u>Report Time</u>	<u>Arrival time</u>	<u>Fixed Property Use</u>
46	Advancing Hose Lines/ Fire Attack	4/20/2000	18:13	Center Point, Alabama	1	FALSE	1	16:30	16:33	Residential
47	Other	4/30/2000	9:41	Greenwood, Delaware	1	FALSE	1			Residential
48	Ventilation	9/24/2000	10:10	Livingston, Texas	1	FALSE	1			Residential
49	Advancing Hose Lines/ Fire Attack	2/25/2001	7:30	Grantsburg, Wisconsin	1	FALSE	1	5:00	6:00	Store/Office
50	Advancing Hose Lines/ Fire Attack	3/18/2001	12:30	Osceola Missouri	2	TRUE	1	0:25	0:29	Residential
51	Advancing Hose Lines/ Fire Attack	3/18/2001	12:30	Osceola Missouri	2	TRUE	1	0:25	0:29	Residential
52	Search and Rescue	3/8/2001	12:31	Cleves, Ohio	1	FALSE	3	13:00	13:01	Residential
53	Search and Rescue	1/1/2001	2:15	West Deptford, New Jersey	1	FALSE	1			Residential
54	Advancing Hose Lines/ Fire Attack	6/16/2001	17:00	Lexington, South Carolina	1	FALSE	1			Residential
55	Advancing Hose Lines/ Fire Attack	2/11/2002	17:30	Dallas, Texas	1	FALSE	6	17:30		Residential
56	Advancing Hose Lines/ Fire Attack	3/4/2002	12:22	Mecklenburg, North Carolina	1	FALSE	1			Residential
57	Advancing Hose Lines/ Fire Attack	3/7/2002	20:00	Pompey, New York	2	FALSE	1			Residential
58	Advancing Hose Lines/ Fire Attack	3/7/2002	20:00	Pompey, New York	2	FALSE	1			Residential
59	Advancing Hose Lines/ Fire Attack	7/4/2002	1:30	Gloucester City, New Jersey	3	FALSE	8	1:36	1:39	Residential
60	Advancing Hose Lines/ Fire Attack	7/4/2002	1:30	Gloucester City, New Jersey	3	FALSE	8	1:36	1:39	Residential
61	Advancing Hose Lines/ Fire Attack	7/4/2002	1:30	Gloucester City, New Jersey	3	FALSE	8	1:36	1:39	Residential
62	Advancing Hose Lines/ Fire Attack	9/14/2002	22:30	Muscatine, Iowa	1	FALSE	1			Residential
63	Advancing Hose Lines/ Fire Attack	11/1/2002	0:10	Coal Township, Pennsylvania	1	FALSE	1			Residential