FIRE SPRINKLER SYSTEMS IN NEW SCHOOL CONSTRUCTION

EXECUTIVE DEVELOPMENT

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ABSTRACT

A disagreement existed between the Fort Scott Fire Department and Unified School District #234 regarding the interpretation and application of Kansas regulations and the locally adopted fire code concerning the need for a fire sprinkler system in new school construction. The fire department required a sprinkler system due to a lack of required fire flow at the site. The school district did not want to install a sprinkler system due to additional costs. The purpose of this research paper was to describe alternative methods of determining the need for a fire sprinkler system and to identify potential solutions, if any, that would provide adequate fire protection and be acceptable to the fire department and the school district.

Historical and descriptive research methods were employed to answer the following questions:

1. Is there a need to provide adequate fire flow and/or a fire sprinkler system in new school construction?

2. Are there any nationally recognized standards for determining required fire flow and the need for a fire sprinkler system in new school construction?

3. How are other states reviewing fire flow requirements and the need for a fire sprinkler system in new school construction?

4. Are there any potential code allowances, construction modifications, or design alternatives that could be applied locally to new school construction that would provide adequate fire protection and be cost effective for the school district?

A search for applicable literature was conducted via the internet and a literature review was conducted at the National Fire Academy. A written survey of all 50 state fire marshal offices was conducted to determine how other states regulate new school construction.

Results of the survey revealed that there is a need to provide adequate fire protection or a fire sprinkler system in new school construction due to an analysis of past school fires with and without sprinkler systems. There are nationally recognized codes and standards for determining required fire flow and the need for a fire sprinkler system in new school construction. The majority of states that review new school construction for required fire flow use the Uniform Fire Code for determining those requirements. A potential alternative was examined that would reduce construction costs and provide the building with a fire sprinkler system.

Recommendations from this research project were to require the school district to provide adequate fire flow or install a fire sprinkler system, support the adoption of the current edition of the Uniform Building Code and Uniform Fire Code in the state of Kansas, and present an alternative approach in building design that would provide the building with a fire sprinkler system and reduce construction costs to the school district.

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INTRODUCTION

Interpretation and enforcement of laws, building, and fire codes is a very controversial issue in the City of Fort Scott. Even though the City has continually adopted the current edition of the Uniform Building Code and Uniform Fire Code since 1988, the enforcement of such is challenged at every opportunity. Another local tax supported entity, Unified School District #234, has questioned and challenged the validity of the Fort Scott Fire Department's attempts at enforcing applicable codes.

The problem is that there currently exists a vast disagreement between the Fort Scott Fire Department and Unified School District #234 (USD #234) on the interpretation, application and enforcement of Kansas regulations and the locally adopted fire code concerning the need for an automatic fire sprinkler system in the proposed new middle school. The fire department required a fire sprinkler system because the available fire flow did not meet minimum requirements as set by the fire code. The school district does not want to install a fire sprinkler system because of additional costs.

The purpose of this research paper is to describe alternative methods of determining the need for a fire sprinkler system and to identify potential solutions, if any, that would provide adequate fire protection and be acceptable to the fire department and the school district. The historical and descriptive research methods were chosen to answer the following questions:

1. Is there a need to provide adequate fire flow and/or a fire sprinkler system in new school construction?

2. Are there any nationally recognized standards for determining required fire flow and the need for a fire sprinkler system in new school construction?

3. How are other states reviewing fire flow requirements and the need for a fire sprinkler system in new school construction?

4. Are there any potential code allowances, construction modifications, or design alternatives that could be applied locally to new school construction that would provide adequate fire protection and be cost effective for the school district?

BACKGROUND AND SIGNIFICANCE

In April of 1996, Unified School District #234 patrons voted to construct a new middle school. After much controversy in the community, the school board decided to construct the new building near the city limits on an elevated piece of land. The proposed building is of mixed construction types of Type II-1 hour (42,800 square feet) and Type II-N (65,700 square feet) for a total of 108,000 square feet.

In the state of Kansas, plans for new school construction projects are submitted to the Kansas Department of Education (Kansas State Fire Marshal, 1996a). New school construction is required to be in compliance with the 1991 edition of the Uniform Building Code. Plan reviews by the Kansas Department of Education or Kansas State Fire Marshal are cursory and are intended to identify deviations from the adopted codes before construction. Neither the Kansas Department of Education nor the Kansas State Fire Marshal reviews new school construction projects for fire flow requirements. This issue is given to local authorities having jurisdiction if they desire to enforce any

such requirements. Since the City of Fort Scott has adopted the 1997 edition of the Uniform Fire Code, the fire department uses table A-III-A-1 to establish minimum fire flow requirements.

The Kansas State Fire Marshal (1996a, p. 2) states,

The school owner and the designer shall work with local authorities toward resolution of fire department access, water supply, zoning requirements, and drainage issues. Local authorities may require a school site to provide fire department access and adequate water supplies or allow the option for the building to be fully sprinklered to compensate for these requirements if they have the Uniform Fire Code or other related site requirements previously adopted. (Attorney General Opinion No. 79-28 & 80-14).

The fire department required a minimum fire flow of 6,114 gallons per minute with a minimum flow duration of four hours (Uniform Fire Code, 1997, table A-III-A-1). The minimum required flow may be reduced up to 75% when the building is provided with an automatic fire sprinkler system, but not less than 1,500 gallons per minute. A 75% reduction in required fire flow calculates to 1,528 gallons per minute.

The City of Fort Scott requested a review of the City's ability to provide the minimum required fire flow from Professional Engineering Consultants, P.A.. Rood (K. L. Rood, letter, November 6, 1997) suggested water system improvements with associated costs of approximately $597,000.00 could achieve a fire flow of 2,250 gallons per minute for a duration of two hours. Rood (K. L. Rood, letter, November 6, 1997) also suggested that the middle school could provide their own booster station and private water line to meet their needs. The fire department offered to

reduce the required fire flow more than the 75% allowed by the fire code if the school district would install a fire sprinkler system.

Several concerns were issued from the school district to the city manager including that there is a much higher water volume required at the new middle school than is available at the existing high school, the building meets the requirements of the Uniform Building Code which deals with life safety, the code indicates that fire flow requirements may be modified downward by the chief in rural areas or small communities where the development of full fire flow requirements is impractical, and it appears water could be pumped from the bottom to the top of the hill and give as much water as any location in Fort Scott.

The school district requested a review of the proposed building and Uniform Fire Code fire flow requirements from Poole Fire Protection Engineering. Dryden (S. Dryden, letter, December 16, 1997) reported that he developed an equivalent level of protection using NFPA 1231, Standard on Water Supplies for Suburban and Rural Fire Fighting. Dryden (S. Dryden, letter, December 16, 1997) stated, "...the fire flow for this building is 1988 gallons per minute for a duration of 2 hours. See calculation 1. I feel that this is a more applicable fire flow than the UFC requirements since it incorporates the occupancy of the building and the UFC requirements do not." Cox (K. Cox, personal communication, December 18, 1997) reported that the building is designed to the Kansas Department of Education regulations which only require the building to be in compliance with the Uniform Building Code. He said that the City of Fort Scott should not enforce water supply fire codes because the city does not currently have adequate water supplies in all areas of the city.

Madison (B. Madison, personal communication, December 18, 1997) reported that the cost of a fire sprinkler system was not considered in the initial planning stages.

Since there was an obvious disagreement between fire officials and the school district on how the Kansas regulations and local codes are interpreted and enforced, the city manager became very involved in trying to solve this problem. The political impact of this problem on school and city officials is not yet fully realized since the problem has not been resolved at the time of this research project. The intent of this research project is to find an acceptable solution to the problem that may be applied to this school construction project and also serve as a tool to improve the planning process of future school construction projects. Problem solving is a part of the National Fire Academy Executive Development course. Fire chiefs are expected to be problem solvers by finding acceptable, agreeable solutions to complex problems.

LITERATURE REVIEW

The School Fire Problem

Bruno (1994) described a school fire in Collingwood, Ohio that occurred in 1908. A coroner's inquest into this multiple life loss fire recommended that schools be protected by sprinkler systems. Fifty years later, in 1958, a fire at the Our Lady of the Angels School in Chicago took more lives. Bruno (1994, p. 10) states, "...fire swept through Our Lady of the Angels School in Chicago, killing 93 children and three nuns. This disaster never should have happened, for, in the words of the National Fire Protection Association's special report, there were '...no new lessons to be learned, only old ones tragically re-emphasized.'" Also discussing the Our Lady of the Angels

fire, NFPA Journal (1996, p. 72) reported, “Contributing to the catastrophe were the lack of sprinklers and detectors.” NFPA Journal (1996, p. 72) also stated, “...an arsonist started the fire in a pile of garbage under a stairway in the school’s basement.”

Bruno (1996, p. 10) further emphasizes the potential killing power of school fires by stating, “...all it takes is one school fire to create a tragic disaster in which dozens of children are killed.” Bruno (1996, p. 10) also reported, “This is the richest country in the world, but children are going to die in unsafe buildings and we have understaffed fire companies because some cheapskates want to save a few bucks on their taxes.”

Young (1993, p. 29) stated, “The USA suffers particularly badly, incurring not only property loss but also life loss. It is not surprising, therefore, that they have already moved to sprinkler protection for many schools particularly on the West Coast.”

According to Karter (1997), in the United States in 1996, an estimated 8,500 structure fires occurred in educational property causing an estimated $65,000,000.00 in property loss. The National Fire Data Center (1997) reported that the NFPA, in 1994, reported that for the first time, juvenile firesetters accounted for the majority of all those arrested on arson charges. “This growing problem is cause for serious concern and deserves more attention from policymakers.” In Kansas, from 1990-1996, there were 488 structure fires in educational facilities causing $4,904,927.00 dollar loss with incendiary or suspicious being reported as the leading cause of these fires (Kansas State Fire Marshal, 1995, 1996b, 1997).

The writings of Bruno, the NFPA Journal, Young, and the reviewed statistics of school fires influenced this research project by clearly establishing that fires in schools can kill children. It is also

apparent that there is a great potential for an increase in school fires because of the growing problem of juvenile firesetters, who are occupants of our schools.

The Sprinkler System Impact on School Fires

Tremblay (1994) reported that a single sprinkler extinguished a flammable liquid fueled fire in an unoccupied Florida high school. According to the article, the second floor had been covered with flammable liquid and was ignited by a long string fuse. The sprinkler prevented ignition of the remainder of the accelerant.

Nisja (1994) made several observations about three school fires, all occurring in Minnesota in April of 1994. The first fire occurred in a high school with sprinklers installed in only the stage and gymnasium areas. The fire spread to the area of the sprinklers but no farther. The damage estimate was between $7,000,000.00 and $8,000,000.00 and was limited to the unsprinklered portion of the building. The second fire occurred at a high school that had been recently upgraded with a sprinkler system. The fire was extinguished by two sprinklers. An investigation showed a liquid accelerant was involved in the ignition of the fire. The third fire occurred at another high school at about the same time as the second fire. The school had been retrofitted with a sprinkler system in 1988. Eleven sprinklers quickly extinguished the fire in which liquid accelerant was again suspected as being ignited. The combined fire dollar loss of the schools with complete sprinkler systems was $150,000.00, compared to the $7,000,000.00 - $8,000,000.00 loss at the school without a complete sprinkler system. Nisja (1994, p. 43) stated, “Even though other factors were present which negatively contributed to these fires, such as interior flame spread, accelerant fires, and

propped open fire doors, automatic sprinkler protection overcame these obstacles and allowed these investments of the community to continue operation."

Tremblay (1995) reported that sprinklers saved a Minnesota school that was under construction. Paper wrapping was ignited by a machine exhaust pipe. Workers extinguished the remains of the blaze with a fire extinguisher. A fire in a Virginia high school ignited by a fluorescent light ballast was controlled by two sprinklers, causing only $500.00 loss (Tremblay, 1996). Another Virginia high school fire started in a boiler room and was controlled by the sprinkler heads in that room (Courtney, 1996). The $25,000.00 damage was mostly to the furnace where the fire originated. Tremblay (1997) reported that a sprinkler system extinguished a fire in a high school ceramic shop. Paper placed too close to a kiln ignited and fire spread to wall coverings. Even though the fire occurred after normal school hours, the building was occupied. Two sprinkler heads activated and controlled the fire.

The NFPA Journal and Nisja influenced this research project by providing evidence that fire sprinkler systems greatly reduce the amount of property loss in school fires.

A Review of National Standards and Codes

The 1991 edition of the Uniform Building Code (1991, chap. 38) requires school basements larger than 1500 square feet to be sprinklered. The 1994 and 1997 editions of the Uniform Building Code (1994, 1997, chap. 9) require new schools to be sprinklered unless additional exit doors are installed in classrooms or the building is subdivided by two-hour fire rated walls into compartments not greater than 20,000 square feet. Water supply requirements are consistent throughout the 1991, 1994, and 1997 editions of the Uniform Fire Code. A 75% reduction in fire flow requirements is

allowed as an exception when the building is provided with an automatic fire sprinkler system (Uniform Fire Code, 1991, 1994, 1997, table A-III-A-1).

The 1997 edition of the Standard Building Code (1997) does not require new schools to be sprinklered. The 1994 edition of the Standard Fire Prevention Code (1994) states that fire hydrants shall be provided to meet the necessary flow requirements as determined by the fire official.

The 1996 edition of the BOCA National Building Code (1996, chap. 9) requires an automatic fire suppression system in schools with a fire area exceeding 20,000 square feet.

The 1997 edition of the National Fire Protection Association (NFPA) Life Safety Code 101, 1997 edition, requires portions of educational facilities below the level of exit discharge to have an automatic sprinkler system installed (NFPA, 1997). NFPA 1231 Water Supplies for Suburban and Rural Firefighting, uses a formula for determining minimum water supplies calculated in gallons, not gallons per minute (NFPA, 1993). The formula factors in cubic feet of the structure, an occupancy hazard classification number, and a construction classification number. NFPA Appendix F (NFPA, 1993, p. 51) states,

> Far sighted rural fire departments are big boosters of automatic sprinkler protection. With more sprinklered buildings being constructed in rural areas, many rural fire departments are just beginning to understand the friend the fire service has in automatic sprinkler protection. The sprinkler system provides the fire department with built-in hose line protection. The sprinkler heads and piping are in place and ready to put water (other extinguishing agents can be used) on any fire. Also, the record of the sprinkler system is superior. NFPA records show that 96% of all fires in sprinklered buildings are controlled or extinguished by the sprinkler system, with a large

percentage of these fires controlled by no more than two or three heads. In the 3 to 4 percent with unsatisfactory performance, the following human failures have been noted:

(a) Sprinkler system was shut off and not in service.

(b) Fire department shut off water to sprinkler heads before the fire was completely extinguished.

(c) Fire department robbed sprinkler system of water supply.

(d) Fire department did not use fire department connection.

(e) Sprinkler system was not designed to protect existing contents or occupants.

The review of model fire codes and NFPA 1231 influenced this project by revealing that only the Uniform Fire Code and NFPA 1231 actually provide a guide or formula for determining required fire flow and they are vastly different from each other. Both of these documents, however, encourage the installation of a fire sprinkler system. The review of the model building codes influenced this research project by showing that designers can easily omit fire sprinkler systems from new school construction because of the available code exceptions.

The Cost of Fire Sprinkler Systems

According to Endthoff (1997b), a new school in Texas was constructed without a fire sprinkler system. The local school board decided not to install a sprinkler system because of costs, inadequate water supply, type of construction, and not enough insurance savings. The school was designed to the 1994 edition of the Standard Building Code even though there were no local or state codes adopted. Fire fighters and city officials expressed their desire to have the building sprinklered, but the board was not receptive. Endthoff reported that the school board was given flawed

information. They were told that the building would be designed for students to exit safely, but no information was given on what happens to the fire in the building. The board was told that the water supply was not adequate for a fire sprinkler system, yet a sprinkler system requires only a fraction of the water required for a standpipe system. Endthoff (1997b, p. 10) stated,

> The board was told fire sprinklers would raise the cost of construction by more than $240,000.00. By using the fire sprinkler advantages permitted in the Standard Building Code, however, the cost of construction could have actually been reduced by installing fire sprinklers.

Endthoff (1997b, p. 12) further emphasized the cost savings achieved by adding a fire sprinkler system and the importance of educating architects and school boards by stating,

> We should make sure that the first question every school board asks a prospective architect is: "How much more will the school cost with fire sprinklers?" If the architect responds with anything but "They won't cost you money, they will save you money," the board should recognize there is a reason not to hire him.

An example of cost savings by installing a fire sprinkler system was given by Endthoff (1997a). A 40,500 square feet single story school designed to the 1994 edition of the Standard Building Code can have an increase in allowable area and a reduced type of construction by installing a fire sprinkler system. The cost savings from Type II construction to Type VI UP construction was estimated at $921,000.00 minus the cost of the sprinkler system of $60,000.00. Endthoff (1997a, p. 4) concluded, "Fire sprinkler systems cannot only provide additional life and property protection, they can permit lower construction costs."

Endthoff influenced this research project dramatically by demonstrating that the installation of a fire sprinkler system can actually reduce construction costs if the architect will consider the code advantages given with the installation of a fire sprinkler system. Endthoff also influenced this research because he wrote about flawed information given to a school board concerning fire, water supply and associated costs of a fire sprinkler system which are very similar arguments to those presented by the local school district against installing a fire sprinkler system in the new Fort Scott Middle School.

PROCEDURES

Definition of Terms

Automatic Fire Extinguishing System. A system of equipment and devices which detects a fire and discharges an approved fire extinguishing agent onto or in the area of a fire (Uniform Fire Code, 1997). In this research project, automatic fire sprinkler system, fire sprinkler system, and sprinkler system all refer to an automatic fire extinguishing system that discharges water onto or in the area of a fire. The terms sprinkler head and sprinkler refer to that part of a fire sprinkler system that open and discharge water onto or in the area of a fire.

Fire Flow. The flow rate of a water supply, measured at 20 psi (kPa) residual pressure, that is available for firefighting.

Fire Area. The floor area, in square feet, used to determine the required fire flow.

Research Methodology

The research was historical in that part of the literature review was conducted to identify the school fire problem and to establish the effect of fire sprinkler systems in school fires. The research was also descriptive in that part of the literature review was conducted to describe how other national codes or standards address fire flow or fire sprinkler system requirements for new school construction, to describe how other states review new school construction, to identify how the installation of a fire sprinkler system effects construction costs, and to identify potential solutions for providing adequate fire protection in terms of available fire flow or the installation of a fire sprinkler system.

The literature review was initially started in November of 1997 via the internet. The National Fire Academy's website (http://www.usfa.fema.gov/) was accessed to search for applicable literature utilizing the Learning Resource Center's on-line card catalog. The actual literature review was conducted at the National Fire Academy Learning Resource Center in January of 1998. The literature review was subdivided into four separate areas to organize the material into useful information intended to support the purpose of the research project. The four areas were the school fire problem, the impact of fire sprinklers on school fires, a review of national standards and codes, and the cost of fire sprinkler systems.

A survey to determine how other states review new school construction projects for required fire flow and the need for a fire sprinkler system was conducted in January of 1998. A survey was faxed to all fifty state fire marshal offices, with thirty-four returned, using the 1996 edition of the National Directory of Fire Chiefs to obtain telephone and fax numbers. In some cases, correct telephone numbers were obtained through telephone information services and the fire marshal offices

were called to obtain the correct fax number. A copy of the survey form is included in the Appendix.

Assumptions and Limitations

It was assumed that the state fire marshal offices would have knowledge of how new school construction projects are reviewed in their respective states. The survey is limited because it is a general survey of how new school construction is reviewed across each state in the country and does not provide any information directly from local jurisdictions similar to Fort Scott.

RESULTS

1. Is there a need to provide adequate fire flow and/or a fire sprinkler system in new school construction?

Yes, there have been multiple life loss fires in schools (Bruno, 1994) and as long as there are fires in schools, adequate fire protection must be provided. Fires continue to occur in our schools where we send our children (Kansas State Fire Marshal, 1995). In 1994, juvenile firesetters accounted for the majority of those arrested on arson charges (National Fire Data Center, 1997). In the literature review, ten school fires were reviewed. Out of these ten fires, four were reported as arson and six were unintentional or an unreported cause. Also, seven out of the 10 fires reviewed were controlled by a fire sprinkler system, with the most amount of damage reported of $25,000.00. Two out of the ten fires had no sprinkler system and each had multiple loss of life. One of the ten fires had a partial sprinkler system and incurred seven to eight million dollars of property loss. The

literature showed that there is a need for adequate fire flow or a fire sprinkler system to protect the lives of school children and to contain property losses to a minimum.

2. Are there any nationally recognized standards for determining required fire flow and the need for a fire sprinkler system in new school construction?

In the literature review of national standards and codes, several editions of the Uniform Building Code and Uniform Fire Code, the Standard Building and Fire Prevention Code, the 1996 edition of the BOCA National Building Code, the 1997 edition of NFPA 101 Life Safety Code, and NFPA 1231 were reviewed. To answer this question with more clarity, the current edition of the reviewed standards and codes were considered. From the literature review, fire flow requirements were addressed in three of the codes and standards reviewed, the Uniform Fire Code (1997), the Standard Fire Prevention Code (1997), and NFPA 1231 (1993). Out of these three, the Uniform Fire Code and NFPA 1231 offered a guide or a formula for calculating a minimum amount of water supply for a building. The Standard Fire Prevention Code required that fire hydrants be provided to meet the flow requirements of the fire official.

The need for a fire sprinkler system in new school construction was found to be required in the Uniform Building Code (1997) with exceptions allowed for additional exits from classrooms to the outside or for subdividing the building with two-hour rated fire walls into compartments not greater than 20,000 square feet. The BOCA National Building Code required a fire sprinkler system in schools with a fire area exceeding 20,000 square feet (BOCA National Building Code, 1996) and the Standard Fire Prevention Code did not require new schools to be sprinklered (Standard Fire Prevention Code, 1997). NFPA 101 Life Safety Code required portions below the level of exit

discharge in new schools to be sprinklered (NFPA, 1997). All reviewed standards and codes except one addressed the need for a fire sprinkler system, or at least a partial one, to be installed in new school construction. Even though NFPA 1231 addresses water supply, Appendix F of this standard encourages the use of fire sprinkler systems. Further emphasizing the importance of a fire sprinkler system, NFPA 1231 Appendix F, (NFPA, 1993, p. 51) stated, " NFPA records show that 96% of all fires in sprinklered buildings are controlled or extinguished by the sprinkler system, with a large percentage of these fires controlled by no more than two or three heads."

3. How are other states reviewing fire flow requirements and the need for a fire sprinkler system?

Table of Survey Results

Y	N	
28	5	**1. Does your state regulate new school construction?**
		1a. If no, please state how new school construction projects are regulated.
		1 - Board of Education and Capital Development Board
		4 - Local authority having jurisdiction
		1b. If yes, state the name of the code and edition that new school construction is required to comply with.
		3 - 1997 Uniform Building Code (UBC) and Uniform Fire Code (UFC)
		1 - 1994 UBC and UFC

1 - 1994 UBC and 1991 UFC with state amendments

1 - 1994 UBC

2 - 1994 UBC with state amendments

1 - 1991 UBC

1 - 1991 UBC with state amendments

1 - 1988 UBC and UFC

1 - 1997 Standard Building Code and National Fire Protection Association (NFPA)

1 - 1994 Standard Fire Prevention Code and 1991 NFPA

1 - 1996 Building Officials and Code Administrators (BOCA) National Building Code

2 - 1996 BOCA National Building Code and 1997 NFPA 101

1 - 1988 BOCA National Building Code and 1994 NFPA 101

2 - 1997 NFPA 101

1 - 1997 NFPA 101 with state amendments

2 - 1994 NFPA 101

1 - 1991 NFPA 101 with state supplement

5 - Use their own state building code

2. Which state agency has jurisdiction in approving new school construction?

8 - State fire marshal

2 - State fire and local building official

2 - State fire marshal and department of education

1 - State fire marshal and construction industries

1 - State fire marshal and department of public instruction

1 - State fire prevention division

1 - State fire marshal, local building/ fire officials, and state building codes division

1 - Department fire and building services

1 - State fire marshal and department of commerce and insurance

2 - Department of education

1 - Department of education and local school districts

1 - Department of education and local jurisdictions

1 - Department of education and office of commissioner of insurance

1 - Division of state architects, office of regulatory services

1 - State building commission

1 - Division of industrial compliance

1 - Department of consumer business affairs, building codes division

1 - Department of housing and building construction, division of codes

Y N

14 6 **3. Is the project reviewed for fire flow requirements?**

3a. If yes, what reference or criteria is used to determine minimum fire flow requirements?

2 - 1997 UFC Table A-III-A-1

2 - 1994 UFC Table A-III-A-1

1 - 1991 UFC Table A- III-A-1

2 - UFC

1 - 1994 UFC Table A-III-A-1 with state amendments

1 - UFC and NFPA

2 - 1988 NFPA 1231

1 - NFPA 1

1 - NFPA 291

1 - NFPA 13

Y N

12 2 **3b. If yes, is a fire sprinkler system an allowed exception to meeting minimum fire flow requirements?**

3c. If yes, please state any other compensatory provisions allowed, other than a fire sprinkler system, as an exception to meeting fire flow requirements.

10 - None

1 - Letter from local fire chief stating utility cannot provide enough water stating he doesn't want hydrant installed

1 - Improved type of construction

1 - Mutual aid agreements

1 - Water shuttle operations

3d. If a fire sprinkler system is accepted to reduce minimum fire flow requirements, how are the minimum fire flow requirements established?

7 - UFC Table A-III-A-1

2 - NFPA 13

1 - NFPA 291

1 - Conditional

1 - Minimum water flow available

Y	N	
4	2	**3e. If no, are local building and fire jurisdictions allowed to enforce local fire flow requirements?**
17	11	**4. Does your state require new school construction to be provided with an automatic fire sprinkler system?**

4a. If yes, please state any exceptions allowed to this requirement.

10 - Per code requirements

2 - None

2 - Under 20,000 square feet

1 - Under 10,000 square feet

2 - Only sprinkler below level of exit discharge and above 4 stories high

Y	N	
7	4	**4b. If no, are local fire jurisdictions allowed to require a fire sprinkler system in new school construction if their local code requires it?**

Out of the 50 surveys that were sent out, one to each state, 33 were returned for a 66% return ratio. Of these 33 returns, 28 respondents reported that their state does regulate new school construction. Of the five respondents whose state does not regulate new school construction, four of them stated it was the responsibility of local jurisdictions and one stated that it was the Board of Education and Capital Development Board. Of the returned surveys, 85% indicated that new school construction is regulated at the state level.

A plurality of respondents, 39%, stated they used some edition of the Uniform Building Code to regulate new school construction. Several of these states use the Uniform Fire Code or state amendments to supplement the Uniform Building Code requirements.

Regarding which state agency has jurisdiction for approving new school construction, the state fire marshal was listed either solely or in conjunction with another agency in 61% of the 28 states that stated they review new school construction. The state department of education was listed in 14% of these 28 states as having jurisdiction for approving new school construction.

Of the 33 returned surveys, 14, or 42%, reported they review new school construction projects for fire flow, while six do not. The other 13 did not answer this question. Of those 14 states that review for fire flow requirements, 64% use the Uniform Fire Code, at least in part, to determine minimum fire flow requirements, as opposed to 36% who use some part of the NFPA standards.

Sprinkler systems are allowed as exceptions to meeting minimum fire flow requirements in 86% of those states who review for fire flow requirements. Also, 71% of the 14 states that review for fire flow requirements do not allow any other compensatory provision, other than a fire sprinkler system, as an exception to meeting fire flow requirements. From the 12 states who allow a fire sprinkler system as an exception to meeting fire flow requirements, 58% of them use the Uniform Fire Code Table A-III-A-1 to establish the reduced minimum fire flow requirements. Of the six states who reported they do not review for fire flow requirements, 67% allow local fire and building jurisdictions to enforce fire flow requirements.

Of the 28 states who stated they review new school construction, 17 or 61%, require automatic fire sprinkler systems in new schools. Two allow no exceptions and 10 allow exceptions according to their code requirements. Of the 11 states who reported they do not require an automatic sprinkler system in new schools, 64% allow local fire jurisdictions to require one if their local code requires it.

To summarize the results of the survey, the majority of reporting states review new school construction at the state level. The most widely used code for this review is an edition of the Uniform Building Code and the state fire marshal was listed most frequently as the state agency designated to approve new school construction. Forty-two percent of the responding states review the project for fire flow with the majority using the Uniform Fire Code Table A-III-A-1 as the criteria to determine minimum required fire flow. No exception was allowed to meeting fire flow requirements, other than a fire sprinkler system, in 71% of the states who review for fire flow requirements. Also, a majority of reporting states who review new school construction require a fire sprinkler system to be installed and the majority of these only allow exceptions to this requirement that are in the applicable code. The majority of reporting states that do not require minimum fire flow requirements or a fire sprinkler system will allow local fire jurisdictions to enforce local requirements on these two issues.

4. Are there any potential code allowances, construction modifications, or design alternatives that could be applied locally to new school construction that would provide adequate fire protection and be cost effective?

Endthoff's (1997a) writings were the most unexpected findings that were discovered in the literature review. By using the allowances provided in the codes for installing a fire sprinkler system,

the building has better fire protection, improved life safety, and the school district would save money in construction costs. The type of construction is reduced which reduces the construction costs, but the allowable floor area is increased because of the fire sprinkler system.

From the survey, only four exceptions to meeting required fire flow were stated other than the provision of a fire sprinkler system. A letter from the local chief stating he does not want a hydrant installed due to inadequate water, mutual aid agreements, water shuttle operations, and an improved type of construction were listed as acceptable exceptions to meeting fire flow requirements. The only other construction modifications or design alternatives found are stated as exceptions in the reviewed codes and were referred to in the survey.

Fay (R. Fay, letter, January 15, 1998) stated that a proposed new code called The International Code 2000 has similar language to the 1997 edition of the Uniform Building Code in requiring new schools to be sprinklered. The exceptions allowed would be to have additional exits from classrooms and assembly rooms to the exterior or to use area separation walls to limit undivided space to 20,000 square feet.

DISCUSSION

The study results parallel the findings of others found in the literature review. There is a fire problem in schools, fire sprinkler systems have a great impact on this school fire problem, nationally recognized codes and standards are used by a majority of states who reported they review new school construction, and exceptions allowed outside of the code requirements are few. No state reported, however, about the cost advantages of installing a fire sprinkler system as outlined by

Endthoff (1997a). This is an unexpected potential solution that probably has the most significant impact on solving the local problem of new school construction. His approach to solving the money problem as perceived by school districts is within code requirements. This potential solution could satisfy the code requirements and contain costs, a win-win situation for fire departments and school districts. Even more beneficial than just satisfying the interests of the fire department and the school district, is that a fire sprinkler system would be installed in the school that would provide fire protection to our children and protect the community's investment in a new school.

An interpretation of the study results is that most states require new schools to be constructed to a nationally recognized code or standard. Unfortunately, some are using outdated editions of their codes and some of these codes and standards do not fully address fire flow requirements and do not require a fire sprinkler system to be installed in new school construction. Most reporting states indicated that if they do allow exceptions to fire flow requirements and fire sprinkler systems, it is only per the code requirements. The survey, however, did not take into account the political pressures that may influence their decisions to enforce the code by the letter or to modify the requirements based on some other person's advice. Also, the study results showed that a wide variety of codes and standards are used throughout our country to regulate new school construction, which provides little hope for consistent code enforcement in new school construction throughout the country.

The study showed examples of school fires with little or no fire protection in place that resulted in multiple life loss or substantial property loss. One of today's arguments from the school district is that the building was designed to provide safe egress for the occupants. It seems no consideration

was given to the destruction of the building in the event of a fire. If the school district believes that they will not have a fire in the building, they are probably wrong since the majority of those arrested on arson charges are now juveniles (National Fire Data Center, 1997). The codes and standards found in the literature review are referred to frequently by the states reporting in the survey. The majority of states reported that they only allow exceptions to the code requirements as outlined in the code. It should be of value to the school district to know that the majority of reporting states require a fire sprinkler system in new school construction and only allow exceptions per the code requirements and of the states who review fire flow requirements, the majority use the same Uniform Fire Code requirements as adopted locally in Fort Scott. This study will strengthen the fire department's position of requiring adequate fire protection in the new middle school and in future new school construction. The finding of Endthoff's cost advantages of installing a fire sprinkler system in new school construction (Endthoff, 1997a) will further strengthen the position of the fire department for wanting a fire sprinkler system because it virtually takes away the school district's primary argument of not having enough money and could actually save them much more money than the cost of a sprinkler system.

RECOMMENDATIONS

The study showed that there is a need to provide adequate fire protection in new school construction. Adequate minimum fire flow should be provided according to the locally adopted Uniform Fire Code table A-III-A-1 or require a fire sprinkler system to be installed as an exception. There is no justification provided in this study to warrant disregarding these requirements. The majority of reporting states who require new school construction to be reviewed for fire flow

requirements use this same criteria for determining the minimum fire flow requirement and only allow a fire sprinkler system to be used as an exception. Other codes or standards should not be used in conjunction with the Uniform Fire Code on the local level because it would add to the confusion of which code to enforce or not to enforce and could cause additional conflict. One purpose of this study was to reduce the conflict and find an agreeable solution.

A letter supporting the adoption of the current edition of the Uniform Building Code and Uniform Fire Code at the state level should be sent to the Kansas State Fire Marshal. This would assist in providing a more consistent, unified approach to approving new school construction in our state. The issue of required fire flow and sprinkler system installment would be addressed and decided early in the process. Handing off these two issues to local fire jurisdictions to resolve with the school district after they have received approval to build a school from the Kansas State Board of Education would be eliminated. The letter should also recommend that the Kansas State Fire Marshal, not the Kansas State Board of Education, will have the authority to review and approve plans for building and fire code compliance. This would also put Kansas in line with the majority of the reporting states in the survey.

A summary of Endthoff's approach to reducing costs by installing a fire sprinkler system should be presented to Unified School District #234 for their review and consideration. This recommendation satisfies a portion of the study's purpose to find a potential solution that would provide adequate fire protection and contain costs for the school district.

All the recommendations could change the way that new school construction is reviewed and approved in Kansas and the City of Fort Scott. They would reduce conflict and disagreement on the

interpretation, application, and enforcement of Kansas regulations and the locally adopted fire code concerning the need for a fire sprinkler system in new school construction.

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APPENDIX

Survey

Code Enforcement of New School Construction

Y N 1. Does your state regulate new school construction?

1a. If no, please state how new school construction projects are regulated and return survey._____

_____

_____

1b. If yes, state the name of the code and the edition that new school construction is required to comply with and complete the remainder of this survey._____

2. Which state agency has jurisdiction in approving new school construction?_____

Y N 3. Is the project reviewed for fire flow requirements?

3a. If yes, what reference or criteria is used to determine minimum fire flow requirements?_____

Y N 3b. If yes, is a fire sprinkler system an allowed exception to meeting minimum fire flow requirements?

3c. If yes, please state any other compensatory provisions allowed, other than a fire sprinkler system, as an exception to meeting fire flow requirements. _____

_____

3d. If a fire sprinkler system is accepted to reduce minimum fire flow requirements, how are the reduced minimum fire flow requirements established? _____

_____

Y N 3e. If no, are local building and fire jurisdictions allowed to enforce local fire flow requirements?

Y N 4. Does your state require new school construction to be provided with an automatic fire sprinkler system?

4a. If yes, please state any exceptions allowed to this requirement?

_____

_____

Y N 4b. If no, are local fire jurisdictions allowed to require a fire sprinkler system in new school construction if their local code requires it?

Please return this survey by mail or **fax to: 316.223.8110**

Jeff Davis
Fort Scott Fire Department
1604 S National Ave.
Fort Scott, KS. 66701

◊ Please check if you desire a copy of the results of this survey sent to you.

Name of Your State: _____