

**DESIGNING A FIRE STATION FOR TODAY AND THE FUTURE**

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## ABSTRACT

Miami Township Fire Department covers a 26 square mile area in southwest Ohio. Over the past decade the department and community have seen rapid growth. The facilities that the department currently utilizes are outdated, aging and were built when the department was operated by a volunteer system.

The problem is that the department lacks a model for how a fire station should be designed for today's workforce within Miami Township. All four fire stations range between 32 and 55 years of age. The purpose of this project was to create a guideline that the department can follow when designing fire stations in the future.

This project utilized the action and survey research methods to obtain information to answer the questions: (1) What are the elements included in the design of office / living space areas? (2) What are the elements included in the apparatus bay design? (3) What other functions should the fire stations serve? (4) What should be included in a fire station for the future?, and (5) Who should be involved in the design process?

The procedure used included an Internet search, review of several trade journals, and an internal survey. A random sampling of the department was used to obtain information from a cross section of the department.

The results from the surveys showed the majority of personnel felt that separate and equal facilities, separated sleeping quarters and appropriate storage and equipment

areas were necessary in the design. The data revealed that (1) fire stations should also serve as emergency operation centers (2) be designed for larger apparatus and staffing and (3) designed by using a committee format. Therefore, it is recommended to the executive staff that a guideline be created using the research data obtained and utilized in the design process of facilities for the future.

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## INTRODUCTION

In 2002, the department hired a new chief; he had two major assignments to handle right from the start. (1) Improve the low manning problem that existed and (2) develop a long-range plan to remodel or replace outdated fire stations. Three of four stations are more than forty years old while the remaining station is thirty-two years old. These buildings were built in an era when the fire department utilized volunteers who responded from home. These buildings were meant to house fire apparatus and equipment; they were not intended for overnight stays. The current staffing for day-to-day operations was set at 11 on duty personnel in 2002, and is projected to be at 15 in the year 2003. As it stands now, the limits of the current facilities are nearing, or have already been reached.

The problem is that the department lacks a design model of how a fire station needs to be designed for today's workforce. In 1989, when the first full-time members were hired; the department was mainly comprised of men. A short time later, the first full-time female member was hired, and since then more female members have been employed. Although the demographics of the department have changed, the stations have not.

The purpose of this research project is to create a guideline that the department can utilize when designing fire stations in the future. This guideline will be specific to Miami Township, and not be in a "generic" format. This will allow the department to design facilities that will fit its current and projected needs. All guesswork will be

removed and replaced with facts and research data. The department will then have an understanding of design requirements based on the functions they serve and take into account the desires of the men and women who staff them. The department will also become more knowledgeable and better prepared when the design process begins.

The action and survey research method was used in the process of this project to obtain answers to the following questions.

1. What are the elements included in the design of office / living space areas?
2. What are the elements included in the apparatus bay design?
3. What other functions should these fire stations serve? (EOC, disaster shelter, community rooms, training centers, etc, etc)
4. What should be included in a fire station for the future?
5. Who should be involved in the design process?

### **Background and Significance**

The Miami Township Fire Department is a “full service” department providing fire, rescue and EMS service, as well as many additional services to the citizens and occupants of approximately a 26 square mile area. Miami Township horseshoes two moderately sized cities and operates out of four fire stations. Three are staffed on a 24/7 basis. The remaining station is staffed “in house” Monday through Friday until 10 pm after which paid on-call volunteers respond from home. This station will soon be staffed similar to the other stations.

The fire department is supported by money it receives from two levies. A three and a three and a half mill levy generate 1.7 million and 1.8 million respectively. The fire department started billing non-residents for EMS services in July of 2002 with an annual income estimated at approximately \$400,000.

The fire department is comprised of 32 career, 30 part-time in house and several paid on-call volunteers. With-in the last year, the department has hired a fire chief, two 24/48-deputy chiefs, and three full-time firefighter-paramedics and has just finished the process of hiring an administrative forty-hour deputy chief.

All four of the current facilities were built between 1948 and 1958. The station that is considered to be headquarters was rebuilt in 1971 at a different location. During that time, the department consisted of all volunteers that responded from home. These buildings only purpose was to house the fire apparatus and equipment. None contained overnight accommodations. Over the past decade and a half, three of the four stations have had various modifications completed due to personnel and equipment changes.

Below are listed some of the major areas of concern that the department must address in the near future:

- Inadequate ventilation for apparatus (all stations)
- Little to no space for physical fitness equipment (all stations)
- Cramped restroom and shower facilities (all gender neutral)

- Inadequate dormitory space in all stations (all are small open bunkrooms)
- One station has had an office transformed into a dormitory that holds two bunks
- No equipment decontamination areas (all stations)
- Very limited storage space for equipment other than apparatus

### **Fire station #47**

Built in 1958, handles fire and rescue protection for the southwest portion of Miami Township. There are currently four pieces of apparatus assigned to this station. Three of which are located inside, while the fourth is placed outside.

Station 47 is a two bay, two-level building with a dayroom, open office space and kitchen all combined into one. There are no formal kitchen facilities, only a small refrigerator and microwave exist. There were plans to construct a formal kitchen area but they have been stricken through the budget process. This building is located just east of the township service center and has very little parking space during the workday. This station is operated from Monday to Friday between the hours of 06:00 to 22:00 with one career 40 hour and one in-house standby person.

### **Fire station #48**

Built in 1948, handles fire and EMS protection for the Northeast portion of Miami Township. There are currently five pieces of apparatus assigned to this station.

Station 48 is a one level building with three back in bays. It is located within the City of Moraine corporation limits. The station has little room for expansion due to houses on both sides and proximity to a major intersection. This station is also the last remaining station heated by a boiler and water pipe system. There is very little room left for storage inside or out in the apparatus bay, and the department has stopped using the hose tower for it's intended purpose and now uses it to store spare air bottles, extra fire hose and miscellaneous equipment. The dormitory is an open type room with four beds, with an extra bed added to the lieutenant's office in 2001. This station is staffed on a 24-hour basis with four to six personnel.

#### **Fire station #49**

Built in 1953, handles fire and EMS protection for the northwest portion of Miami Township. There are currently three pieces of apparatus assigned to this station.

This building has two levels, and is similar in design to station 47. The dayroom, office space, and kitchen are all combined into one large open area. In 1996, an ALS paramedic unit was added and this station was staffed on a 24-hour basis. The dormitory was previously an office before being converted. This year there will be a third person added to this stations staffing.

In 1997, an outdated piece of fire apparatus was to be replaced; and the new piece of apparatus was too large for the existing structure. A section of land on the opposite side of the parking lot was utilized to construct a pole style barn to house it.

This station has recently had a new leach field installed due to the failure of the previous system. During times of substantial rainfall, flooding problems caused the system to back up into the station through the drains.

### **Fire station 50 (Headquarters)**

Originally built in 1958, was rebuilt in 1971 at its current location and handles fire and EMS protection for the southeast portion of Miami Township. The primary response district contains mostly business, retail stores, single-family homes, multiple family apartment complexes, and is the busiest fire station in the township. There are currently eight pieces of apparatus assigned to this station, some inside and some out.

This building has one level with three drive-through bays. This station is attached to the government offices, and is located next to the police department. There is some room for expansion of this facility on the west side only. The dormitory is an open type room with four bunks. Five to six personnel staff this station on a 24-hour basis.

In 1994, a fire levy increase was placed on the ballot to help fund the construction of a new fire station, which was to be built on the west side of Miami Township. As part of the ammunition to get the levy passed, the department was going to improve medical service in this area by placing an ALS paramedic unit in this station. The levy passed and apparatus was purchased. Delays occurred, and partly due to rising costs of construction, the project was terminated.

## Literature Review

A literature review was completed in the process of this research project to aid in finding pertinent information associated with design layouts for new fire stations, new trends and ideas that are currently available, what has been used at other departments and what kinds of designs or layouts would be desired by the inhabitants of these facilities.

### Research Question #1

What are the elements included in the design of office / living space areas?

“Kitchen Design 101” states “Sizing the kitchen is one of the key factors for successful kitchen design.” ([www.firestationdesign.com](http://www.firestationdesign.com), 2002) It also states “Establishing an understanding of how the firefighters prepare meals and how many people will be using the space at the same time are very important facts to ascertain.” ([www.firestation.com](http://www.firestation.com), 2002) Under another heading, this article states, “A typical question is what is the desired relationship between the dayroom and the kitchen.” ([www.firestation.com](http://www.firestation.com), 2002) It continues to state “Some departments want a totally open environment and mixing of the spaces and functions, while other departments prefer to separate the dayroom from the kitchen and dining to afford TV viewers a little peace and quiet.” ([www.firestationdesign.com](http://www.firestationdesign.com), 2002)

In the “Design issues and guidelines section”, it explains the differences between Dorm rooms and bunkrooms. Dorm rooms are separate sleeping quarters and

bunkrooms are everyone together in a room. ([www.firestation.com](http://www.firestation.com), 2002) It also lists pro's and cons for both styles of sleeping quarters.

In the article "Gender specific or neutral spaces" it explains that "With integrated crews of men and women firefighters, the question becomes "how to provide facilities for both sexes," redefining how these spaces work together in today's fire stations." ([www.firestationdesign.com](http://www.firestationdesign.com), 2002) It also states "This question of gender specific or neutral living spaces will need to be addressed for current and future department operations in both new construction and renovation." ([www.firestationdesign.com](http://www.firestationdesign.com), 2002)

## Research Question #2

What are the elements included in the apparatus bay design?

"A designated cleaning area shall be provided in each fire station facility for the purposes of cleaning personal protective equipment, portable equipment, and other clothing. The cleaning area shall have proper ventilation, lighting, and drainage connected to a sanitary sewer system or septic system." (NFPA 1581, 2000, section 3-7.1)

"Fire departments that provide emergency medical operations shall provide or have access to disinfecting facility for the cleaning and disinfecting of emergency medical equipment." (Section 3-8.1) Also that "Medical equipment shall be disinfected at a fire station only where a disinfecting facility that meets the requirements of Section 3-8 is provided." (Section 3-8.1)

“Where cleaning provided by the fire department is conducted in fire stations, the fire department shall provide at least one washing machine and clothes dryer for the purpose of cleaning personal protective equipment and station/work uniforms in the designated cleaning area.” (Section 3-5.2)

“Ensemble elements storage areas shall be clean, dry, and well ventilated.” (NFPA 1851, 2001, Section 7.1.3) It goes on to say that “Ensembles and ensemble elements shall not be stored in contact with hydraulic fluids, solvents, hydrocarbons, hydrocarbon vapors, or other contaminants.” (Section 7.1.8)

In the book *Safety and Health Considerations for the Design of Fire and Emergency Medical Service Stations* explains that “stations designed with drive through features are usually less likely to have vehicular problems” (USFA, 1997, page 26)

### Research Question #3

What other functions should these fire stations serve? (EOC, disaster shelter, community rooms, training centers, etc, etc)

Functions of fire stations can sometimes differ from community to community. In the article “Community Spaces” it states that, “addressing community needs by providing an on-site space where various neighborhood activities can take place has become increasingly added to the programs of many fire stations.”

([www.firestationdesign.com](http://www.firestationdesign.com), 2002)

The Fire protection handbook explains, “The building where the fire equipment is to be housed must be designed to withstand the forces of man and nature.” (Fire Protection Handbook, 2003, 7-237)

“If a separate space for training is desired, then it should be set up as a classroom. The room should be spacious, provide desks for the personnel to use, contain blackboards, allow space for slide and overhead projectors, provide adequate space for display of training materials, and contain equipment for multimedia presentations and interactive training.” (The Fire Protection Handbook, 2003, p. 7-241)

#### Research Question #4

What should be included in a fire station for the future?

In the article “Trends in station design” under the heading of planned growth, the author “Cautions about the tendency to build a station that fits perfectly at the moment but leaves no room for future growth.” ([www.stationstyle.com](http://www.stationstyle.com), 1999)

#### Research Question #5

Who should be involved in the design process?

In “Kitchen design 101” it states, “The answer starts with the formation of a station design committee. This committee should have representatives from the

department as well as firefighters from each shift of the specific station under design.”  
([www.firestationdesign.com](http://www.firestationdesign.com), 2002)

The literature review uncovered information on design ideas and trends that are currently being utilized in the construction of today's fire stations. As a result of the survey to the random members of the department, the results gathered closely matched what was found during the literature search. Together, all information assisted in formulating a design guideline for the department.

### **Procedures**

The search for information for this project started with an Internet search for Fire station design plans. Several websites were located that communicated trends and ideas in the design of new fire stations. As the links to some of these websites were viewed, several NFPA standards, books, and magazines became available. To gain information from the current members of the department, a survey form was created and deployed.

The survey was distributed to a random cross section of member's in the department in an effort to represent the organization as a whole. The names on the current personnel roster were placed in alphabetical order. The names of the fire chief, fire inspector, secretarial staff, members on leave of absence, and the author of this report were omitted. The remaining names were used to compile a list of survey recipients.

A coin was flipped with heads equaling one and tails equaling two. The outcome of the coin toss decided the starting point for the survey recipient list of names. For example, heads, start with the first name on the list and utilize every other name from that point on, or tails, start with the second name on the list and utilize every other name from that point.

A survey form was created with a list of questions. These questions were either in a yes / no format, or had a pick list to choose from. An explanation and instructional sheet was included with the survey to explain the reasons for the survey.

One limitation of the survey was noted as being the presumption that all surveys would not be returned. As an unexpected turn of events, survey forms were returned from unlikely respondents and vice versa. Also a place for a name was provided and required to aid with the internal validity of the survey process. The survey forms, when returned, were secured and dated; and information collected was then tallied and compiled for insertion into the department's design guideline.

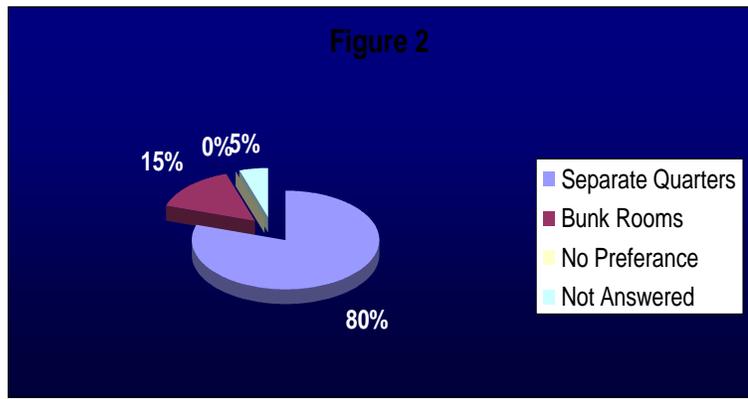
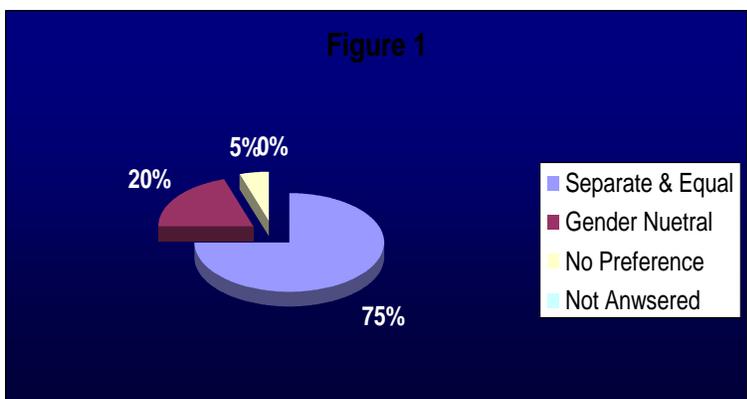
## **RESULTS**

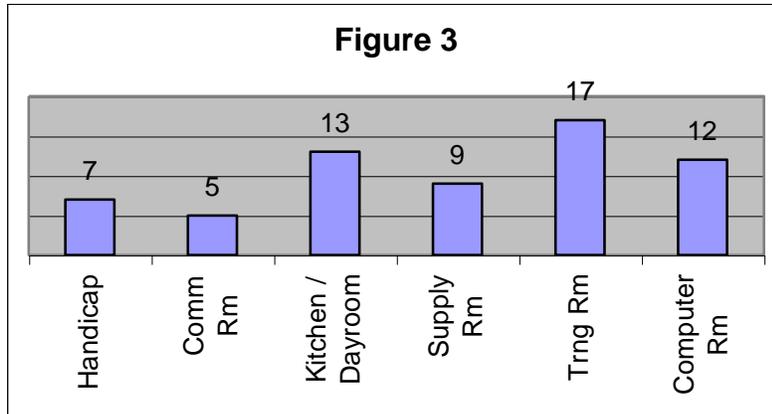
From the 33 surveys that were distributed, 20 were returned. The response and feedback were tabulated and examined to answer the following research questions.

### **Results for research question #1**

What are the elements included in the design of office / living space areas?

Seventy five percent of those returning surveys prefer to have separate and equal restroom and shower facilities made available, while 20 percent prefer gender neutral. 65 percent prefer that the dayrooms and kitchens be separated. 60 percent wish to see computer rooms included for reporting and project assignments. 85 percent want designated training rooms included. Shown in figures 1-3 are the results from the returned surveys.

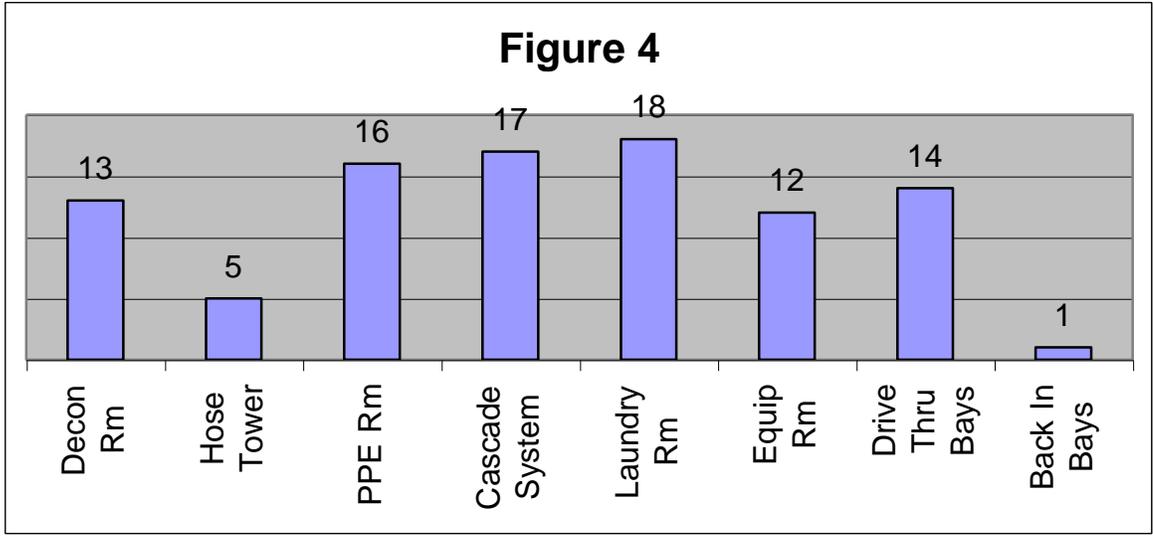




### **Results for research question #2**

What are the elements included in the apparatus bay design?

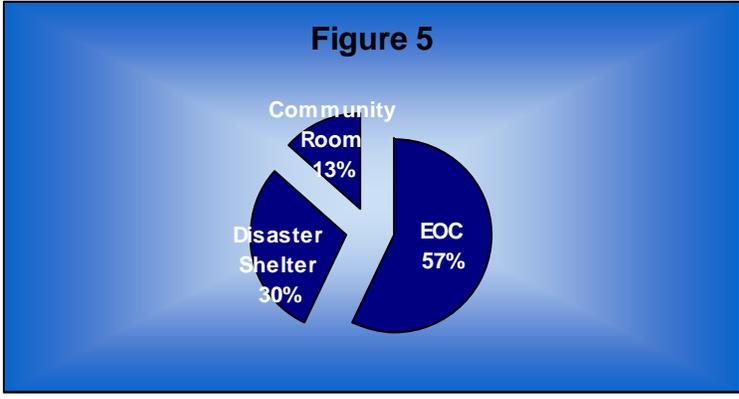
Members of the department felt that the apparatus bay should have decontamination, laundry, gear storage and station supply rooms included in the design. 80 percent would like to see a hydrant placed on the property. 85 percent felt a cascade system was necessary, while 70 percent felt that drive through bays should be included. Back in bays received very little response; while a small percentage of the surveys tallied felt hose towers were important. Shown in figure 4 are the results from the returned surveys.



**Results for research question #3**

What other functions should these fire stations serve? (EOC, disaster shelter, community rooms, training centers, etc, etc)

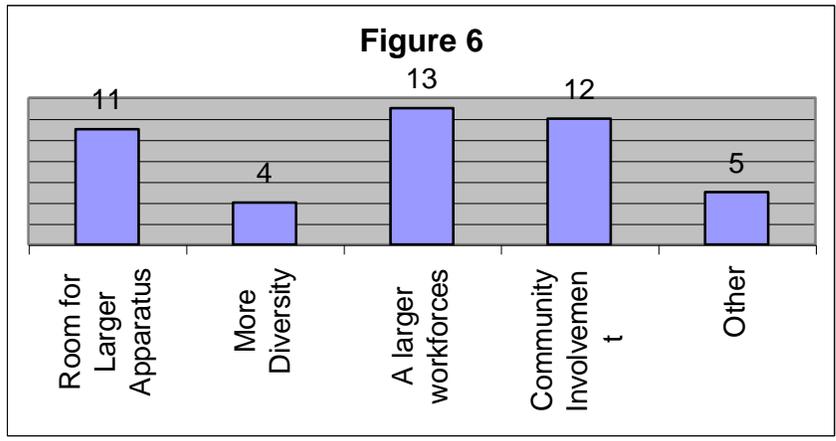
Eighty-five percent of those returning surveys indicated that fire stations should also be utilized as emergency operations centers, while 45 percent chose disaster shelters as another possible use. 85 percent felt that the stations should have interior training rooms included, and 45 percent wished to see designated exterior training grounds. Shown in figure 5 are the results.



**Results for research question #4**

What should be included in a fire station for the future?

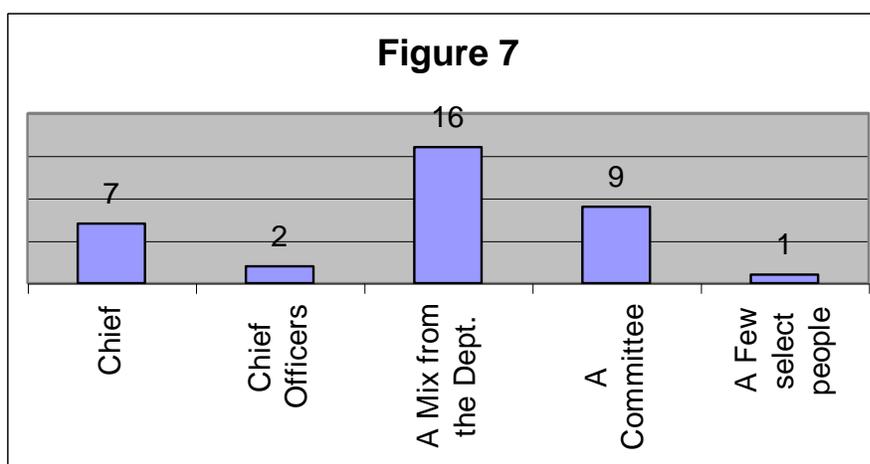
Sixty-five percent believe that the fire stations in the future should be designed in preparation for a larger workforce. 55 percent feel that there should be room made available for new and larger, and surprisingly with all of the threats associated with national and local security, 60 percent feel that more community involvement should be considered. There was little response in regards to designing either one or two story fire stations. Result shown in figure six.



### **Results for research question #5**

Who should be involved in the design process?

Of the surveys received, 80 percent felt that a mix of the department or committee should be used in the design process. 35 percent felt the fire chief should be solely involved. The results show that the members of the department feel that a committee should oversee the design planning for future fire stations. Figure 7 shows the results.



### **DISCUSSION**

After an exhaustive literature search for information, there was not a significant amount of information gathered that matched the type of research project that was being conducted. There were similar topics found, but after reading the material, most seemed outdated and non-useful.

Although the information that was gathered from current websites, NFPA standards and books on the subject of fire station designs proved to be useful in gaining a starting point, the survey results further cemented the facts and assisted with the formulation of the department's design guideline.

Upon analysis of the survey's findings, a large portion was found to closely match the expected results. There were a small number of surprises noted, one of which was the percentage of members who felt a hydrant should be located on the property. There was no explanation for this result, but one might expect it to be linked to a training issue. Another surprise was the small percentage of results that felt secured parking areas should be utilized. This was somewhat surprising, especially during the recent times where national security has been placed on high alert.

Understanding that the literature review findings and survey results closely match and relate to each other, the organization should work diligently to ensure that future construction of fire stations meet the needs of the workforce of today and beyond.

### **Recommendations**

Using the results from the survey, a design guideline should be created for the department to use when designing facilities in the future. This guideline would aid the project planners or committee members, and allow the members of the department to feel they have played a part in the design process. The guideline would list headings for

the major components within the structure, as well as a general category that encompasses the entire property.

The major headings that shall be utilized are General, office space, living space, and apparatus bay. Under each heading, criteria that should be included or considered in the design preparation will be listed.

It is the opinion of the author that an organized plan based on specific guidelines in collaboration with departmental members offers the best chance for success when designing a fire station for the future.

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## APPENDIX A

### Fire Station Survey

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. Would you like to see our department have gender neutral or Separate and equal facilities for men and women?

\_\_\_\_\_ Separate and equal

\_\_\_\_\_ Gender neutral

2. Would you like to see our department utilize large bunkrooms or separated sleeping quarters in the future?

\_\_\_\_\_ Bunkrooms

\_\_\_\_\_ Separate sleeping quarters

3. What choices listed below do you think must be included in a fire station design?

(Check all that apply)

\_\_\_\_\_ Handicap accessible

\_\_\_\_\_ Training rooms / areas

\_\_\_\_\_ Community Rooms

\_\_\_\_\_ Computer rooms

\_\_\_\_\_ Deacon rooms

\_\_\_\_\_ Laundry rooms

\_\_\_\_\_ Hose tower

\_\_\_\_\_ Equipment rooms

\_\_\_\_\_ Station supply rooms

\_\_\_\_\_ Hydrant on property

\_\_\_\_\_ Gear storage rooms

\_\_\_\_\_ Separate kitchen and day rooms

\_\_\_\_\_ Cascade system

\_\_\_\_\_ Secure Parking Areas

\_\_\_\_\_ Designated exterior training grounds

4. What choices listed below do you feel would be desired but not a necessity in a fire station?

(Check all that apply)

\_\_\_\_\_ Drive thru bays

\_\_\_\_\_ Back in bays

\_\_\_\_\_ Training rooms / areas

\_\_\_\_\_ Community rooms

\_\_\_\_\_ Computer room's

\_\_\_\_\_ Hose tower

\_\_\_\_\_ Equipment rooms

\_\_\_\_\_ Supply rooms

\_\_\_\_\_ Hydrant on property

\_\_\_\_\_ One story station

\_\_\_\_\_ Two story station

\_\_\_\_\_ Separate kitchen and day rooms

\_\_\_\_\_ Gear storage room

\_\_\_\_\_ Cascade system

\_\_\_\_\_ Secure Parking Areas

5. What should we be thinking about for the future?

- New and larger apparatus
- More diversity in the department
- More Community involvement
- Larger workforce
- Other

If other checked, explain

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6. What other functions should our fire stations serve as?

- E.O.C.
- Community Room
- Disaster Shelter

7. Who should be involved in the design process?  
(Check all that apply)

- Fire Chief
- Chief Officers
- A mix of the department
- A committee
- A few select individuals

**Thank you for taking the time to complete this survey, your participation sincerely appreciated.**

**When completed, please return to my mailbox at Station 50.**

## APPENDIX B

### Fire station survey Results

Question #1	Separate and equal	15		
	Gender neutral	4		
	No preference	1		
	Not answered	0		
Question #2	Bunkrooms	3		
	Separate quarters	16		
	No preference	0		
	Not answered	1		
Question #3	Handicap accessible	7	Training rooms / areas	17
	Community Rooms	5	Computer rooms	12
	Decontamination rooms	13	Laundry rooms	18
	Hose tower	5	Equipment rooms	12
	Station supply rooms	9	Hydrant on property	16
	Gear storage rooms	16	Separate kitchen / day	13
	Cascade system	17	Secure Parking Areas	5
	Exterior training grounds	13		
Question #4	Drive thru bays	14	Back-in bays	1
	Training rooms / areas	4	Community Rooms	6
	Computer rooms	8	Hose tower	8
	Equipment rooms	4	Supply rooms	3
	Hydrant on property	4	One-story station	6
	Two story station	4	Separated kitchen / day	7
	Gear storage room	6	Cascade system	6
	Secure Parking Areas	5		
Question #5	New and larger apparatus	11	Community involvement	12
	More diversity	4	Larger workforce	13
	Other	7		
Question #6	EOC	17	Community Room	4
	Disaster Shelter	9		
Question #7	Fire Chief	7	Chief Officers	2
	A mix of the department	16	Committee	9
	A few select individuals	1		

## APPENDIX C

# Miami Township Fire Department

Montgomery County, Ohio

### Guideline for designing fire stations

#### General

Hydrant on property  
Exterior training areas  
Secured employee parking

#### Office areas

Designated computer rooms  
Adequate flat workspace  
Sufficient space for filing cabinets

- Departmental forms
- Staff usage

Training rooms (20-25 capacity)

- With appropriate audio/visual aid devices

#### Living spaces

Separate and equal facilities for men and women  
Separated sleeping quarters

- Sized for six to ten members
- Individual personal locker space
- Individual study locations
- Room for future staffing

Separated kitchen facilities

- Outfitted with commercial grade appliances
- Sized for six to ten members

Designated areas for Emergency Operations Centers or disaster shelters

## **Apparatus Bays**

Cascaded systems and compressors

Decontamination rooms

- Hands free or foot operated equipment
- Adequate room for cleaning and drying of equipment

Personnel Protective equipment rooms

- Well lit
- Well ventilated
- Moisture free

Station supply rooms

- Adequate storage space for station supplies
- Adequate storage space for vehicle supplies

Drive through apparatus bays preferred

Equipment maintenance rooms

- Adequate space for storage of tool required to help maintain structure

Laundry rooms with equipment for:

- Personnel protective equipment
- Uniforms/duty wear
- Contaminated clothing
- Cleaning solvent storage

Adequate room for future or larger apparatus