FIRE HOUSE LOCATION PLANNING

A large part of a city's expenditures goes for public safety -- police and fire service. Total manpower and equipment and the organization and administration of the fire department determine the amount of fire protection the city gets for its dollars. Strategic location of fire stations and a smoothly operating pattern of response to alarms make the difference between life and death, salvage and destruction.

The magnitude of the problem is indicated by statistics: in the year 1956 alone, 10,600 people were killed and an estimated $989,290,000 worth of property was damaged or destroyed by fires in the United States.

Initial capital outlay or construction costs for a fire station are relatively insignificant when compared with the upkeep year after year. Therefore, savings are realized over a period of time if the total number of fire stations is kept to a minimum. One properly located fire station can provide more protection than several poorly located stations. As one city report pointed out, "the use of a comprehensive plan for fire station location will save the tax-payer many thousands of dollars annually by gaining maximum protection from a minimum of personnel."

The study of a fire station location can cover a limited geographical area, as did the one made in 1940 for Engine Company No. 6, then housed at the Goodwill fire station in Concord, New Hampshire, and the studies made in 1951 and 1952 for the relocation of fire stations 2, 3, and 5 in Evanston, Illinois.

Other cities -- Anchorage, Alaska; Hoboken, New Jersey; Kansas City, Missouri; Richmond, San Francisco, and San Jose, California; Springfield, Massachusetts; and Wichita, Kansas -- have made citywide plans for their fire fighting systems. All of these cities found that re-

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location of stations* would improve their fire protection for the same amount of money.

This report deals with two aspects of fire house location: the distribution of fire stations throughout the city in appropriate service areas, and the selection of adequate sites within each service district. Suggested strategy for carrying out a fire house location plan is also outlined. Priority, timing, and financing are discussed.

The fire station location studies PLANNING ADVISORY SERVICE examined for this study are listed in a selected bibliography at the end of the report. Supplementary references useful in evaluating fire protection services or preparing a fire station location plan are also listed.

Development of Modern Fire Protection Services

The first fire fighting equipment was undoubtedly a bucket. It is reported, for instance, that in New York City leather buckets were the only protection against fire until two fire "engines" were imported from England in 1731.

The first fire fighting "engine" or apparatus, the siphone, has been attributed to the Greeks of the fourth century, B. C. However, improvements have been made only gradually. The first apparatus was not even horse-drawn -- it was dragged by men. Fire engines were not horse-drawn in New York City until about 1828. And motorized equipment did not come into use until about 1907.

The duties, as well as the equipment, of the fire department have slowly changed. At first the fireman's efforts were devoted to extinguishing fires after they had broken out. Later, efforts were made to prevent fires. Inspecting buildings and educating the public in fire safety became part of the fireman's duties. Detecting arson logically became a job assigned to fire fighters who were trained to notice suspicious circumstances.

Being a fireman became a full-time job as innovations in equipment were made and duties expanded. Unfortunate experience had taught the lesson that a trained and smoothly operating fire force gets better results than an untrained one. Now volunteers serve in only small towns. The big city career fireman may even have taken special courses at a university to augment his regular training.

"Good deeds" are a traditional activity of firemen. According to reputation, they revive the asphyxiated, rescue the trapped -- whether child or kitten -- and collect toys for distribution to the children of the needy.

*"Relocation," as used in this report, refers to a change in the location of fire fighting equipment and personnel; not to the physical relocation of the building.
The administration of fire fighting services has become more complex since the days of the bucket brigade, but traces of former practices remain. Borrowed army titles and terms are still used. There are still fire captains and lieutenants, and the fire fighting force is divided into companies and battalions. ("Company" is a term for the basic fire fighting unit, composed of a fire engine, its equipment, and crew.)

Fire protection has gained department status in most municipal governments. In a few small cities and towns, fire protection and police services are now combined in a consolidated public safety department.

Personnel policies have stiffened. Physical requirements -- height, weight, age -- are set and enforced. In an attempt to get a "higher grade" of men, fire stations have been designed for comfort and convenience, as well as utility. The theory is that a happy crew is more efficient than a discontented crew. Firemen must work as a team and morale is important.

The full-time fireman spends a considerable amount of time at the fire station. Days may pass before he is called to fight a fire, yet he must be ready for action at any time. According to the 1956 Municipal Year Book (International City Managers' Association, 1313 East 60th Street, Chicago 37), firemen work shifts of 24 hours on and 24 hours off in 75 per cent of the cities reporting. The next most popular arrangement is 10 hours on duty during the day and 14 hours on duty during the night, swapping once a month. Other arrangements are 9, 11, or 48 hours on each shift.

The fire house is the fireman's home away from home. A dormitory, kitchen, and recreational and educational facilities are needed. Even a laundry may be provided for washing and drying clothing soaked and soiled while fighting fires.

The modern fire department requires a greater variety of facilities for its increased functions. There is the fire apparatus to be housed: engines -- pumpers, hose trucks, and ladder trucks -- the chief's car; and emergency equipment, such as an ambulance. Hose-drying towers are still used in many cities, although they have been replaced to some extent by drying cabinets, which require less space.

Training facilities include drill towers several stories high, with sufficient space to maneuver around them, and study rooms. Repair shops are needed to keep fire apparatus in working order. New equipment is sometimes built when the repair shop is not busy otherwise and the budget permits. Operating a modern fire department requires more record keeping and more elaborate communications than did the bucket brigade. Facilities for these functions may require extra space at the fire house, or be located in separate buildings.
1. Inventory Existing Facilities

The first step in preparing a fire station location plan is to make an inventory of existing stations to see what can be retained, what should be replaced, and what added. An inventory will reveal some surprising things. For instance, it was discovered during the course of an inventory of fire stations made in San Francisco in 1952 that the oldest fire house in use was built in 1876. The newest was opened in 1951. The Report on a Plan for the Location of Firehouses in San Francisco states that "between these two extremes every condition and age of structure is represented in the firehouse system. Some of the oldest structures are by no means the worst. Some that appear most substantial would be the first to collapse in a severe earthquake."

Remodeled fire houses built before the era of motor vehicles are not uncommon in this city. Although studies revealed the need for replacement, remodeling, or relocation of fire stations, these improvements have been postponed. This was especially true during World War II. A thorough investigation of fire fighting facilities often uncovers a system that calls for extensive revision.

In making an inventory of fire houses, a form should be prepared in advance. Outlines used for this purpose were followed in the studies for the San Jose Fire Stations Location Plan and the Kansas City Master Plan for the Location of Fire Stations. The following form includes all points covered in each outline. Explanations appear in parentheses.

Outline for Fire Station Inventory

Fire station number or name:
Location: (Street address)
Date built:
Type of construction: (Number of stories, wood frame, brick, etc.)
Condition of structure: (Excellent, fair, poor, etc.)
Estimated remaining life:
Apparatus capacity:
Adequacy of apparatus space: (Ample, adequate, inadequate, sufficient, etc.)
Number of men accommodated:
Adequacy of living quarters: (Evaluate dormitory, dining, sanitary and recreation facilities.)
Equipment located at station: (Number of each company, type of equipment, description, date built, manufacturer.)
Disposition in fire station plan: (Retain, abandon, relocate, remodel,

Privately owned facilities should also be inventoried. Some industries and businesses that provide their own protection could be more efficiently served by the city fire department. In Anchorage, the Alaska Railroad maintained fire protection that duplicated city services. Two fire engines
were housed in the middle of a railroad yard. After an inventory was com-
pleted, arrangements were made to turn the railroad equipment over to the
city in exchange for city fire department protection. The city and county
of San Francisco have one fire company serving the San Francisco Interna-
tional Airport. Engine Company No. 1 of the Kansas City, Missouri fire de-
partment is located at the municipal airport.

However, the crash and fire equipment at an airport must be available for
every landing. It cannot be used away from the airport to fight a resi-
dential or industrial fire. Only equipment that need not be at hand for
every landing can be sent to fight fires in the community.

In Fire Protection for Anchorage it is asserted that "the Anchorage Inter-
national Airport -- if it ever becomes the responsibility of a local fire
fighting agency -- will have to have a fire company of its own with such
specialized equipment that it could not be used for normal residential or
commercial area protection. This company would have to be in addition to
the ideal distribution shown on the map, according to insurance rating stand-
ards." (Because of the many small private planes in use in the area, the
Anchorage airport is an especially busy one.)

Other uses besides airports, such as oil drilling or refining, may present
special fire fighting problems and require special facilities not regularly
supplied by the city.

Fire fighting facilities maintained by adjacent political subdivisions
should also be considered. An area may be covered adequately with less
equipment, or covered better with the same equipment, if privately owned
facilities or those maintained by neighboring political subdivisions serve
outside their borders. Little saving is gained unless arrangements are
made to exchange protection.

Training facilities also should be evaluated when an inventory of fire
stations is made. In one city, investigation revealed that the special
training equipment did not work, and that drainage was inadequate to handle
the streams of water used in practice. Firemen practiced only irregularly
and at a site other than the training station outside the city.

Repair shops that are a part of fire department facilities should also be
checked to be sure that they are adequate.

2. Determine Service Areas

Fire stations are unlike other public facilities, such as schools, li-
braries, and shopping centers, in that they are only headquarters for a
service performed away from the site.

The response and area of activity of fire companies in San Francisco,
described in the following passage, is typical except for the emphasis on
citywide service and the response of three fire companies to a first alarm
in all districts. Conditions in San Francisco -- an unusually high per-
percentage of lot coverage throughout the city, hilly terrain, prevalence of timber construction, and the threat of earthquakes -- account for these differences.

Service area boundaries for each firehouse, represented by the number of fire boxes to which they respond on a first alarm, overlap for each box with two other companies, for three companies respond to each first alarm. Normally these are the three companies nearest the point of the alarm. But, in every case, other companies are assigned in a strict order to fill in if any one of the companies in prior order is engaged elsewhere.

...Thus the community district boundaries of the Land Use Plan, although they are useful in determining the relative amount of coverage in each community, do not in any way limit the area that the companies included within them will serve in the course of even normal activity...Each company and each piece of equipment is a city-wide facility.

It should be noted that fireboxes are going out of style. When they are replaced by a modern telephone and radio communication system, the time it takes to alert the fire department and dispatch fire equipment to the scene of a fire is shortened. A better communications system is one of the factors that will increase the effectiveness of fire companies.

The following observations, which show how mechanized equipment influences service areas, were also made in the San Francisco study:

The selection of a firehouse site fifty years ago involved an animal's ability to pull a piece of equipment up or down a steep hill. However, more recent locations have been influenced by this obsolete criteria simply because these more recent structures have had to be located in relation to the older ones. If the original site was a good one for other and still valid reasons, all is well, but today this is not always the case. Also, the rate of speed of a horse pulling a piece of fire-fighting equipment influenced the spacing of houses in certain areas. Needless to say a modern engine will change this rate enough to permit a different and wider spacing.

The need for fire protection and time-distance from the station to the points that are to be served are the major criteria determining distribution of fire houses. Factors that affect these criteria are discussed in the following sections.

High-Value Districts -- All property that can burn needs fire protection, but high-value districts are usually given greatest coverage. In most cities, areas of high-value property and concentrated development coincide. Therefore, the amount of property damaged or destroyed by even a small fire in a high-value district is relatively large, and the danger of the fire spreading is great unless extra safeguards are taken.
Illustration 1

From: Pattern for Fire Stations -- Master Plan 1956
City Planning Commission
Wichita, Kansas
One or more fire stations are usually located close to high-value districts. The total number of companies serving the district will depend on the layout, construction, area covered by development, and kinds of uses. The central business district is served by more fire companies than any other single district. Other commercial areas and industries are considered high-value property.

The value of property is recorded for tax purposes. An estimate of future values can be made on the basis of uses proposed for the area in the master plan. The zoning ordinance permits uses and sets requirements for construction in various residential, commercial, and industrial districts. Subdivision records will give a running account of developments in new areas, indicating value changes.

The map following, Illustration 1, reproduced from the Wichita, Kansas Pattern for Fire Stations, shows present and projected high-value areas in that city.

Population Density -- It is important to know the total population and the distribution of population within the city when planning fire services. Population figures for the territory surrounding the city are also pertinent because fringe areas may become part of the city. Also, the city may sell fire services to individual properties or political subdivisions that lack it. Population data are available from the decennial census, special studies, and projections of populations and densities.

Types of land use also determine heavy concentrations of population. Hospitals, schools, theaters, and multiple dwellings increase the need for fire protection in terms of lives to be saved. The number of ladder companies and special equipment needed depends on the distribution of buildings of different heights.

Fire District Regulations -- Most large cities and many small municipalities have fire district regulations, either as a part of the building code or as a separate ordinance. Within fire district boundaries buildings must be constructed of materials that will not burn at all or will not burn easily. Commercial and industrial districts, under the zoning ordinance, are usually within fire limits. Fire district regulations are based on the characteristics of the area and are designed to minimize fires and conflagrations, especially in and near congested, high-value districts.

If there is more than one fire district, the first usually covers roughly the central business district; the second covers adjacent areas -- extension of the retail district along main thoroughfares; the third covers general commercial and industrial districts; and the fourth extends over general residential areas and all areas not covered in the other three districts. An example of a fire district map, taken from the Fire Stations Location Plan of San Jose, California, is reproduced as Illustration 2.

If fire districts are established, they serve as a guide for fire station needs. The first fire district, for example, should be covered by more apparatus than other districts.
National Board of Fire Underwriters Standards -- In order to set minimum insurance rates, which will cover losses and allow a profit, fire underwriters have made a science of calculating risks. The findings of insurance company researchers are useful to cities because the same conditions that make a city or piece of property a good risk for an insurance company also minimize the city's fire losses.

Municipalities also use fire underwriters' criteria as a guide to improving their fire fighting facilities, because meeting these standards may improve the city's rating. A better rating for the city will be reflected in reduced insurance rates for property owners.

The National Board of Fire Underwriters carries on engineering, statistical, and educational work, supported by the stock fire insurance companies that form its membership. The organization maintains a staff of engineers to study conditions and suggest measures to reduce fire hazards in cities. This service is given free to municipalities.

All cities with more than 25,000 population are classified and assigned a rating by the NEFU. (Cities with populations of 25,000 or less are similarly graded by rating agencies in the different states. See listing in Handbook of Fire Protection, published by the National Fire Protection Association.) The NEFU standards on which classification is based are presented in A Standard Schedule for Grading Cities and Towns of the United States with Reference to Their Fire Defenses and Physical Condition. Cities have relied heavily on NEFU standards in preparing fire station location plans.

The NEFU has derived formulas for roughly determining the number of pumper or hose companies required in municipalities. Rules for determining the number of ladder companies required are also given. These standards are based on total population and the number and distribution of buildings of different heights.

The total number of fire companies arrived at by using the NEFU formulas and rules may or may not be sufficient to cover the city adequately. Formulas prescribe a minimum number of companies, but time-distance factors may increase the number actually needed. The first-due company must arrive quickly for any fire. When serious fires occur, sufficient companies should promptly reinforce the first-due company. In large cities, two or more fires may occur at the same time and covering one fire should not leave the rest of the city unprotected. The NEFU has developed location standards calculated to meet these requirements. Its recommended maximum distances in travel miles between types of districts and the nearest pumper and ladder companies are shown in the table on the following page.

Fireboat protection standards for cities with occupied wharf frontage of at least one mile have also been drawn up by NEFU. Ability to reach waterfront developments -- whether industrial, commercial, or residential -- by fireboat, although not required by NEFU standards, greatly improves the accessibility and, therefore, the protection of some areas.
HYPOTHETICAL RESPONSE PATTERNS OF FIRE COMPANIES TO MULTIPLE SIMULTANEOUS BUILDING FIRES

Illustration 4

From: Master Plan for the Location of Fire Stations; 1955
City Plan Commission, Kansas City, Missouri
Illustrations 5 and 6

From: Report on a Plan for the Location of Firehouses in San Francisco; 1952
San Francisco Department of City Planning
<table>
<thead>
<tr>
<th>District</th>
<th>Recommended distance in miles</th>
<th>From pumper, hose, or pumper-ladder company</th>
<th>From Ladder Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-value (commercial, industrial, institutions)</td>
<td>3/4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>1 1/2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Scattered development</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

The NEFU standards are based on studies of past conditions and performance records in cities. When NEFU classifies a city, deficiency points are given for features that deviate from established standards. The total number of deficiency points that can be given to a fire department accounts for only 30 per cent of the total deficiency points that can be assigned to a city, so a city's rating reflects the condition of fire houses only in part.

Cities are given a numerical grade ranging from one through ten. The fewer deficiency points a city receives, the better its rating. The best rating is one, the worst ten. In a city classified two, fire insurance rates for individual properties will usually start at a base rate lower than the base rate for properties in a city graded three, although there is a variation between states because of state laws.

Insurance premium payments may be lowered and a saving made if the NEFU rating is improved. This possibility is pointed out in Fire Protection for Anchorage.

Mercantile property owners have their rates pared down by almost 10 per cent each time the city gains a full class in its insurance rating. Dwelling owners gain a rate reduction of approximately 7.5 per cent with each gain in class rating.

In dollars and cents, it is estimated that a gain in one class would mean an annual saving of approximately $48,000 for mercantile owners in Anchorage and $20,000 for dwelling owners -- a net saving of $68,000 a year.

Such anticipated savings are a strong inducement to cities to follow NEFU criteria in fire station planning. However, a city that relies only on the NEFU formula when planning its fire stations may end up with an inadequate and inefficient system.

The NEFU standards are drawn up to help fire insurance companies estimate their risks when insuring property. Fire insurance companies' prime
responsibility is to pay fire damage claims, which is, of course, a strong
incentive to set standards that keep fire risks as low as possible. A city,
however, has an even greater responsibility -- that of preventing and mini-
mizing fires and loss of life and property.

The standards can be used as a guide. But it is up to the city to adapt the
standards -- for instance, to evaluate the locations of fire stations in re-
lation to costs and over-all plans for a fire fighting system; to study the
variables of climate, topography, barriers, and traffic congestion that af-
fect the time it takes a fire engine to travel three-quarters of a mile; and
to determine what areas need more fire fighting equipment than the standards
require -- a low-value area with a high population density.

San Francisco Service Area Standards: Of the reports examined, all except
the Report on a Plan for the Location of Firehouses in San Francisco relied
to some extent on NFBU standards and consultants. In San Francisco, the
planning and fire departments collaborated on the study of fire house loca-
tions and together developed standards different from those of NFBU. Neither
NFBU standards nor NFBU engineers' advice seems to have been used. In the
San Francisco study, all primary service districts have a radius of one-half
mile from the station, which is one-quarter mile less than the shortest
radius recommended by NFBU (see table page 9). The usual consideration of
access and density are balanced, however, and the pattern of distribution of
fire houses in San Francisco appears similar to that in other cities. The
greatest number of fire stations is concentrated in high-value and high-
density areas.

Fire houses are farther apart in less densely settled areas. The map, Il-
ustration 5, shows existing fire stations and the proposed disposition of
them. Illustration 6 indicates the effect of the other criteria previously
discussed on future fire house locations.

It is interesting to note that NFBU gave San Francisco a rating of two in
1951 -- which was surpassed by a rating of one in only five cities in the
United States. (Cities are rated about every ten years and this is the most
recent rating for San Francisco.)

Fire Department Records -- The past experience of a fire department is a
valuable guide to the city's fire protection needs. A well run fire depart-
ment keeps extensive records. With these, the planning and fire departments
can compile maps and tables that tell what actually has happened. Illustra-
tion 3, reproduced from the San Jose Fire Stations Location Plan, shows the
principal mercantile district, the central business district, the location of
hazardous conditions, and places where fires causing more than $5,000 worth of
damage have occurred during the study period of about six years.

One way to evaluate the effectiveness of present fire station locations is to
itemize station numbers, areas of primary service in square miles, equipment
located at each station (number of companies and types), and the number of
runs made by each company over a given period of time.
The work load for each company and the service to each area should be comparable, although not necessarily the same. For instance, in a high-value or densely populated area that is small geographically the itemized list may show a large number of fire companies to handle numerous runs. On the other hand, in a district that is large but sparsely populated there may be only one company and fewer runs, which is not necessarily an indication of poor distribution of services.

Schedules of response to alarms are planned in advance so that the company or companies housed at each station have pre-arranged assignments. The number of companies that respond to a first alarm and to subsequent alarms depends on the fire hazard in the area where the fire breaks out, the size of the city, and the total fire fighting force. More companies turn out for an alarm for a fire in a high-value or congested area than for a fire in a sparsely settled residential district. In a very small city, a single fire company answers all first alarms. Additional equipment must be summoned from outside the city. In a large city, such as San Francisco, two or more companies may respond to every first alarm. At subsequent alarms, additional fire companies from one or more fire stations respond.

When "running cards" or pre-arranged assignments are prepared, a schedule for covering a district left unprotected while that district's fire fighting equipment is in action is also worked out.

Illustration 4, taken from the Kansas City, Missouri Master Plan for the Location of Fire Stations, shows a hypothetical response pattern to cover two fires occurring in the same service area at the same time. The running time to a fire from a station outside the service area should be short enough so that equipment can arrive promptly. Gaps in the fire protection system may be discovered from experience or in the process of arranging schedules of response.

Access to Area Served -- Barriers that block the way of fire apparatus reduce the effective service area of a fire station. Topographical features, such as hills, rivers, flat land subject to flood, and man made developments, such as railroad yards and tracks, freeways, airports and shopping centers (which must be skirted), and traffic congestion, are the principal barriers.

The time required to make runs from a fire station to different points within its service area is the best measure of the effect of barriers that must be passed. Trial and actual runs should be timed, and the average time-distance to various points should be recorded. The delay caused by some barriers is fairly predictable. However, estimates of the time required to make a run should allow for fluctuating conditions at different times of day and night and during different seasons of the year.

Plotting Service Area Boundaries -- In cities with a gridiron street layout, the boundary equidistant from a fire house site, measured in travel-miles, would be diamond shaped, as shown in Illustration 7, from the Anchorage plan. The pattern of fire station service areas throughout a city with a predominantly gridiron street system is shown in Illustration 8, taken from the Wichita report. It is composed of diamond or irregular diamond shaped areas, some of which overlap.
In some studies, service area boundaries have been outlined with circles of three-quarters, one and a half, or three miles in radius, based on NFPU standards. Drawing circular boundaries with a compass is less realistic than measuring distances from the station in travel-miles, but the loss in accuracy is negligible if the resulting map is considered schematic rather than realistic.

3. Select Sites

The following description is part of the analysis made of an existing fire house being considered for relocation. It is taken from the South-End Fire Station Study of Concord, New Hampshire. The disadvantages of the site described indicate conditions to be avoided in selecting new sites.

The immediate surroundings and location of the fire station are significant. The building covers nearly all of the area of the lot on which it stands. On the South State Street side the walls of the structure are set back only two to five feet from the street line, while the south side of the structure (facing Concord Street) has a set-back of eight to fifteen feet. The fire truck, on leaving the station, must pull into Concord Street before the apparatus has cleared the building. Whichever direction it takes, a ninety degree turn must be executed as the truck clears the station door. If it is necessary to go north on South State Street, a 180 degree turn must be made by a truck with an over-all length of 27 feet using a short turning radius of 25 feet. A run in the opposite direction requires a ninety degree turn onto South Main Street at a point less than 350 feet from the station. Furthermore, there is a sharp drop of about twelve feet in the street level from Concord Street onto South Main Street.

The station is located next door to Concord's largest theatre. During the afternoon and evening performances, streets are usually crowded with parked cars.

Principles Listed in Fire Station Plans -- The San Francisco planning and fire departments developed the following location principles. They cover both distribution throughout the city and selection of adequate sites.

Principles Applied to the Location of New Firehouses
1. In general, firehouses should be distributed throughout the city so that each firehouse has a primary service area extending within a radius of one-half mile. This spacing should vary in relation to population densities, building intensities and types of construction, the pattern of trafficways, and with the relative degree of fire-hazard.

2. Firehouses should be located on streets close to and leading into major or secondary thoroughfares.
Illustration 7

From: Fire Protection for Anchorage -- Preliminary Plan; 1955
City Planning Commission, Anchorage, Alaska
Illustration 8

From: Pattern for Fire Stations --
Master Plan 1956
City Planning Commission
Wichita, Kansas

Existing fire stations and service areas

Proposed fire stations and service areas
3. Firehouses should be so located that no topographic barriers require time-consuming detours within the primary service area of each firehouse.

4. Firehouses should be located in or near areas of relatively high population densities or adjacent to commercial areas where the normal activity on the streets is greater than that occurring on a residential access street in a low-density area.

5. Firehouse sites should be of sufficient size to allow provision of adequate sleeping, eating, and recreational space for the total number of men to be housed at any one time.

The San Francisco fire department emphasizes the advantage of having sites on side streets close to and leading into major or secondary thoroughfares, rather than directly on thoroughfares where traffic is heavy. Fire apparatus leaving the station has less conflict with moving traffic and makes a safer entrance into the main stream of traffic at the intersection.

The following are desirable but not mandatory characteristics of a fire station site. They were drawn up by the Missouri Inspection Bureau, which rates cities and towns in Missouri with less than 25,000 population.

1. It should not be on a heavily traveled street because of difficulty and danger in entering the traffic stream.

2. It should not be on a major corner because of the difficulty in making "U" turns of short radius out of the station house.

3. A site on the crest of a rise is preferable to one on the side or bottom of a slope. The run should begin downhill to gain speed quickly. Good sight distances, however, are more important than slope.

4. A wide street allows for maneuver space for apparatus.

5. It is better to run into an area of concentrated value than to have the station located there.

6. There should be easy access to arterial streets leading to all sections of the service district.

7. One-way streets are not desirable, as they do not allow for zigzagging through intersections in heavy traffic.

8. Station should not be located at the near side of a traffic light because traffic may back up so as to block egress from the station.

Site Criteria for Repair Shops and Training Facilities -- Facilities for repairing equipment and training are parts of the fire protection system that require site planning. Some of the points to be considered
are brought out in the Kansas City, Missouri study, summarized below.

1. Locate maintenance shops and training school together so that personnel and equipment from the shops can be used in the training program.

2. Design the school building and repair shop for joint use.

3. The site should be large enough to accommodate all facilities without crowding. Five acres is the estimated area needed for a site for combined services.

4. The site should be convenient to, but not within, the high value district of the center of the city so that companies in training and reserve equipment will be readily available if needed for fire fighting.

5. The site should be in a district zoned for heavy industry so the smoke and water used in training will create the least annoyance to neighboring uses.

The brief evaluation of training facilities that follows was made in the Master Plan for Springfield, Massachusetts:

The present Drill School is located at the Dwight Street station. This station occupies an extremely small site in a congested area. Ladder drill and pumper training are extremely difficult.

These are the recommendations made in the Springfield Master Plan.

It is strongly recommended that the Drill School be moved to the Armory Street station. This station abuts 38 acres of vacant Park Department land: The area immediately adjacent to the station should be transferred to the Fire Department and developed for drill purposes. There is ample land for classroom, drill tower, cistern, hydrant exercises, etc. More than enough land would still be available for recreational development as proposed in the Recreation Chapter.

Lot Dimensions and Orientation -- Acquiring a properly located site large enough to accommodate a modern fire house is usually difficult and often seems impossible. As a result, a multiple-story fire house is sometimes built on a small lot, although a single-story building is recommended to avoid the use of a pole or stairway for rapid descent to the main floor. The number of companies and pieces of equipment housed at a fire station limit the service rendered from it, and the capacity of a fire station will affect its total dimensions.

The Kansas City report states that "the dimensions of an ideal fire station site will be about 140 feet deep with frontages of 100, 125 or 150 feet for one-, two- and three-door houses respectively."

Stations may be built to meet future needs or designed so that additions of one or two companies may be made. Because a new station is usually needed at another location before it is desirable to greatly increase the concentra-
tion of equipment at a given station, the decision is between building a two- or three-company station, not between a two- or ten-company station.

The fire house should be placed on the lot so that equipment can be driven through a back entrance, if that is possible, rather than backed in through the front. The advantage of ingress at the rear should be considered as a factor in site selection. A plot plan providing for ingress at the rear for a proposed fire station in Concord, New Hampshire is shown in Illustra-
tion 9.

Park Sites -- Suggestions to take park land for fire department facilities are frequently made. The San Francisco study recommends public land or vacant sites in order "to minimize the displacement of private values." It also points out that the amount of space that a fire station occupies is governed to a great extent by the character of the area and the value of the land where it is located.

Open land reserved or developed for parks is often coveted for building sites for other public uses because it constitutes the last large tracts of vacant space, and because those coveting it consider it to be obtainable "without cost to the city." For instance, the Anchorage central fire sta-
tion, located in city hall, was crowded by expanding municipal services, as well as by its own staff and facilities. Traffic slowed down rapid exit from the station, training facilities were lacking. The central station could not be relocated at any great distance. Considering the necessary space and accessibility to traffic arteries, the present city ball park was described as "the most desirable location for a new central fire station."

Both sides of the controversy of whether fire stations belong in public parks were discussed in two articles and an editorial in The American City for October 1954. According to one report, park locations have worked satisfactorily in Kansas City, Kansas. Economies in acquiring a site for the station and in providing park improvements, the pleasant environment for the firemen, and added interest for spectators in the park who like to watch fire station operations were reasons given for the success of the park location.

The major objection to a fire station in a park is that it is one more use encroaching on open space for recreation, which in most cities is already insufficient. It is a case of robbing Peter to pay Paul. The gain for the fire department is offset by usually irreparable loss for the park department. The loss of park land is seldom repaid in kind: open space where it is needed.

The American City editorial suggests that cities try out the Kansas City proposal without absorbing open space needed for recreation. When new fire stations are needed in residential areas, it is recommended that cities acquire sites for them adjoining and in addition to open land acquired for public recreation. The fire department personnel will receive the benefits of a park-side location without robbing another municipal department.

Zoning -- Although the type of district -- residential, commercial, or in-
dustrial -- in which a fire station is located is important, locating a fire station seldom becomes a zoning issue. Most ordinances do not specify in which districts fire houses may be located. Fire stations are treated as public services and may be placed in any district, provided the location is approved by the planning commission. Some ordinances list fire houses as permitted uses in particular zones only, but also include a clause to the effect that fire stations, like other public uses, may be permitted where needed, provided the site is approved.

For instance, the Los Angeles zoning ordinance (1955) first lists "Public services, including electric distributing substations, fire or police station, telephone exchange, and the like," as permitted uses in the C2 Commercial Zone. "Public utilities and public service uses or structures" are also listed as conditional uses that may be permitted in any zone if the planning commission "finds that the proposed location of any such uses will be in harmony with the various elements and objectives of the Master Plan."

The San Francisco report, however, warns that "locating a firehouse on a quiet residential street is apt to bring about some resistance from the adjacent home owners. Answering a fire call is a noisy operation which is not confined neatly into the wakeful hours of day." Furthermore, residential streets, often curved and not as wide as through streets, are unsuitable for the rapid departure of a fire engine.

Site Evaluation -- After a number of possible sites have been suggested, it is often difficult to narrow the choice to one. If two or more sites are proposed for a fire station, a check list may be used to compare each site with the others on the basis of a given set of criteria. The following check list was used to evaluate possible fire station sites in Evanston, Illinois. "Yes" in the body of the table indicates that the particular site possesses the corresponding attribute listed in the column headed "criteria," and "no" indicates that the site is not satisfactory in this respect.

A fire station is located within its service area in relation to where it is most needed, as well as in relation to time-distance. Fixed barriers and differences in types of development shift the mid-point of the service area in times of need. Tabulating pertinent data helped to settle the question of whether a particular fire station should be located east or west of the railroad tracks in Evanston, Illinois.

The area to be served by fire station #2 is bounded by the lake on the east, the city limits on the south and west, Greenleaf Street to Asbury and Dempster Street to the lake on the north. The area between Asbury and the west city limits is also served by station #4. It is believed desirable to locate the fire station in the relative center of the population to be served.

The question of whether the station should be east or west of the C.N.S.& M. Railroad was considered. A summary of engine #2 runs, 1945-1950, indicates: [See page 18]
Criteria

1. Location in general area where protection needed?  
   - McCormick & Central Bridge St. & Reese  
   - yes  
   - no  
   - Simpson & Forestview  
   - yes  
   - Central & Bennett Central Pk. & Grant  
   - yes  
   - yes

2. Suitable for use by Fire Department?  
   a. ease of reaching all territory?  
      - no  
      - no  
      - fair  
      - yes  
      - yes  
   b. avoidance of congested streets?  
      - yes  
      - no  
      - no  
      - yes  
      - yes  
   c. ease of entrance and exit from station?  
      - yes  
      - no  
      - yes  
      - yes  
      - yes

3. Adequate size?  
   a. depth?  
      - no  
      - yes  
      - yes  
      - yes  
      - yes  
   b. room for expansion?  
      - no  
      - no  
      - no  
      - no  
      - yes
   c. light and architectural effect?  
      - yes  
      - yes  
      - yes  
      - yes  
      - yes

4. Suitable character of neighborhood?  
   - yes  
   - yes  
   - yes  
   - yes  
   - yes

5. Not detrimental to neighborhood?  
   - yes  
   - yes  
   - yes  
   - yes  
   - fair

6. Little objection from neighbors?  
   - yes  
   - yes  
   - yes  
   - yes  
   - no

7. Ease of acquisition?  
   a. one owner?  
      - yes  
      - no  
      - yes  
      - yes  
      - yes  
   b. vacant property or cheap improvements?  
      - yes  
      - yes  
      - yes  
      - yes  
      - yes
   c. can be purchased without legal action?  
      - yes  
      - ?  
      - ?  
      - ?  
      - yes

8. Reasonable cost?  
   - yes  
   - no  
   - ?  
   - no  
   - yes
Engine #2 runs east of the railroad track

Run Runs Bldgs. Others Values Loss
432 150 252 $14,439,510.00 $225,207.46

Engine #2 runs west of the railroad track

Run Runs Bldgs. Others Values Loss
740 281 459 $31,287,775.25 $299,998.17

In view of this analysis and the anticipated growth of population west of the railroad, it is thought advisable to locate the station west of the tracks.

PROGRAMMING

The program for fire house development should, of course, be carried out within the scope of a capital improvement program, which covers the construction undertaken by all of the city's operating departments.

Timing -- Some location studies state the time during which the plan will be in effect, or the length of time required to carry out the proposed program. A few studies give specific details for carrying out the plan. The Wichita plan, for example, includes "territory expected to be covered by the major urban concentration within the next twenty years."

Ten years was the period set by the San Francisco fire department for replacement of the existing fire station system. Priorities for putting the plan into effect are not indicated in the study because staging a program for site acquisition and construction are deemed "the primary responsibility of the Fire Department."

The Anchorage report advises that fire stations in fringe areas should not be built for use for more than 25 years:

The evolution of new fire fighting techniques is such that methods may change drastically. Zoning policies may change and communities may develop differently than now anticipated. Some sudden new development could readily make today's modern, well-located stations obsolete and poorly situated in a relatively short time.

It also points out that providing the amount of equipment required to meet standards for a fringe area may result in what appears to be an excess. However, it also points out, the "excess" of equipment allows for considerable population increase before it is necessary to increase fire station facilities.

The San Jose report was designed as the nucleus for a projected master plan for fire protection to serve the community "for at least the next
From: South-End Fire Station Study; 1940
City Planning Board and Fire Board, Concord, New Hampshire

CITY PLANNING BOARD
SCALE 1"=50'  NOV 1, 1939

TENTATIVE PLOT PLAN
PROPOSED FIRE STATION
FIRE STATION DEVELOPMENT PROGRAM

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TOTAL $429,500.00

KEY

PLANNING SITE SELECTION AND PURCHASE
DESIGN
CONSTRUCTION COMPLETION

SUMMARY
30 years." A four-year development program is presented for carrying out the plan for fire house location. The section discussing the development program is reproduced here.

**Program for Fire Station Development.**  
A plan of any kind has little value unless it is conceived from a realistic viewpoint. In other words, to have real merit it must be capable of effectuation at reasonable cost and within a reasonable period of time. In the case of the Fire Stations Locations Plan here under consideration the real test of feasibility is a workable program of construction, equippage, staffing, and financing which must show unmistakably that the Plan may be realized within a reasonable period of time and within the limits of the city's financial resources. The problem, in short, is this: how much will it cost and how long will it take to transfer this Plan from paper into three-dimensional reality?

**A. Schedule.**

A program for new fire station development in San Jose must involve several distinct steps in which a rigid time sequence must be observed. These steps are listed below:

1. Preparation and adoption of Fire Stations Locations Plan.  
2. Selection and purchase of individual sites.  
3. Engagement of one or more architectural design firms.  
4. Letting of construction contracts.  
5. Equippage, staffing and commencement of operations.

Experience has shown that in general a minimum period of two years is required between initiation of studies for a city-wide Fire Stations Locations Plan and the actual placement in service of a new fire station structure.

The demonstration of need for each new fire station will in part determine its construction priority. The relocation of existing structures to tie in adequately with currently operative stations should also be considered in establishing priorities.

A schedule has been developed (Chart 2) which should, insofar as possible, satisfy the priority ratings of proposed improvements and at the same time retain efficiency of system operation. . . . At this writing it appears that the entire Plan as proposed could be realized within 4 years.

**Priorities --** Other strategy for carrying out a location plan is given in the other reports.

Although the plan will be carried out in stages, the San Francisco report strongly recommends that vacant sites be acquired immediately even if not required for construction until a second or third stage in the development program. Otherwise sites may not be available when they are needed.
The Kansas City study warns that when the site of a fire station is changed, several changes may have to be made at one time so that all areas will be protected during the transition period. A new station usually has to be built before an old one is abandoned.

"The priority for construction is different for relocating stations or new stations in built up areas of the central city than for areas at the fringe or soon to be annexed," the Kansas City study points out. Fast developing areas, those first slated for annexation, and those with the most pressing needs receive priority over more slowly developing areas not due for annexation, it is explained.

The importance of having a sufficient water supply available when a fire station is put into use in fringe areas is also pointed out.

Under the Wichita plan, the city anticipates taking over county fire stations as the city expands, and county stations will be built further out.

Financing -- Distribution of and sites for fire houses are the location aspects of a fire station development program, but in developing a realistic plan financing must also be taken into account.

In San Jose, a bond issue to finance fire protection improvements was approved in November 1952, a year before the Fire Stations Location Plan was published. Estimated site costs and construction costs for relocated and additional stations are listed in tabular form in the study. Assessed valuations of the various properties are also given. The following observation is made, tying in proposed new improvements with the entire fire protection system.

It should be recognized, however, that structural costs alone are but a part of the capital outlay necessary to obtain adequate fire protection. Additional apparatus and equipment will be needed not only for new structures but also for certain existing structures whose usefulness is presently limited. In order to achieve a standard commensurate with the proposed, necessary physical plant, personnel will also be needed -- men to command and men to operate needed apparatus. Equipment and personnel needs for the past two, the present, and two future fiscal years are indicated.

It is understood that in Kansas City, Missouri the cost of moving fire stations from the path of the freeway will be paid out of freeway funds. The timing of these relocations will depend on freeway construction progress. The stations involved do not appear in the table listing priorities for fire station construction.

The San Francisco planning team estimated that the sale of abandoned fire station sites would probably yield funds equal to, if not greater than, the amount needed for new sites. This assumption would hold true if sites in the central area are reduced in number and if newly acquired sites are on vacant land in outlying areas where property costs are lower.
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