# BEST PRACTICES

## EMERGENCY ACCESS IN HEALTHY STREETS


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# STATEMENT OF THE ISSUE

## OVERVIEW

In recent decades, planners, engineers, and other stakeholders have been rethinking the way we design our streets and communities. For much of the latter half of the 20$^{th}$ century, concern for automobility dominated street design, land use controls, and infrastructure priorities. This produced wide, fast streets and sprawling suburban development. Recently, this paradigm has shifted, and many seek to design streets with broader goals in mind: to serve bicyclists, pedestrians, and transit, to function as public space, to facilitate economic activity, to encourage and enable physical activity, and to ensure the safety of all road users. The street designs that meet these ends often involve traffic calming, road diets, and other treatments which slow cars and narrow the traveled way.

Simultaneously, our emergency response providers, primarily fire departments, are seeking ways to reduce the time it takes to arrive to the scene of an emergency call. Every minute of a medical call, fire or other emergency, is critical to preserve lives and property. Cities and counties often use emergency response time as an evaluation measure. Further, responders require physical space in order to deploy their equipment at the scene, space which may be constrained by street design. Thus, emergency responders often oppose narrower, slower streets, as they perceive that these street designs will increase response times or impede their ability to respond at the scene.

### International Fire Code (IFC)

Emergency responders have powerful means to influence street design because of the International Fire Code (IFC). The IFC is developed by the International Code Council, a private non-profit organization formed in 1994 to develop comprehensive construction codes. The leverage of the IFC results from states and/or local jurisdictions adopting it. Most states, including California, have adopted it and require local jurisdictions to comply. The most relevant codes to this paper include (International Code Council, 2012):

- A requirement for a minimum of 20 feet of unobstructed street width
- A requirement that traffic calming measures be approved by local fire code officials

The local fire department has the legal authority to stop construction of new streets and modifications to existing streets if they deem designs fall out of compliance.

We now have two public interests moving in opposite directions that both value safety and health. Public health professionals, planners, engineers, residents, and other stakeholders seek ways to reduce speeding and motor vehicle crashes. Emergency responders seek to reduce emergency response time. Both have legitimate aims, and fortunately, with coordination and cooperation, achieving these goals does not need to be an either-or proposition. With careful design of streets and thoughtful purchase of emergency equipment, street designers can coordinate with fire departments to reach mutually beneficial public policy.

The purpose of this paper is to collect previous research on this topic and to highlight best practices. This paper is funded by the Los Angeles County Department of Public Health through a Renewing Environments for Nutrition, Exercise and Wellness (RENEW) grant. RENEW is funded by the U.S. Health and Human Services (HHS) and the Centers for Disease Control and Prevention's (CDC) Communities Putting Prevention to Work initiative. We hope this paper will serve as a resource to foster changes in design, policy and practice that allow Los Angeles County's cities as well as communities across the US to have both safe, healthy streets and rapid emergency access.

## EMERGENCY RESPONDERS' NEEDS

### Need for Rapid Emergency Response

Emergency calls must receive a rapid response in order to save lives and reduce property damage. For example, cardiac arrest requires nearly instant response. According to the Red Cross, brain damage can occur within four to six minutes after cardiac arrest (2013). Brain damage is likely between six and ten minutes and certain after 10 minutes (Lambert and Meyer, 2006). After a cardiac arrest, survival chances decrease by 10% for each minute defibrillation is delayed (American Red Cross, 2013).

*Flashover fire. Credit: Ryan Snyder.*

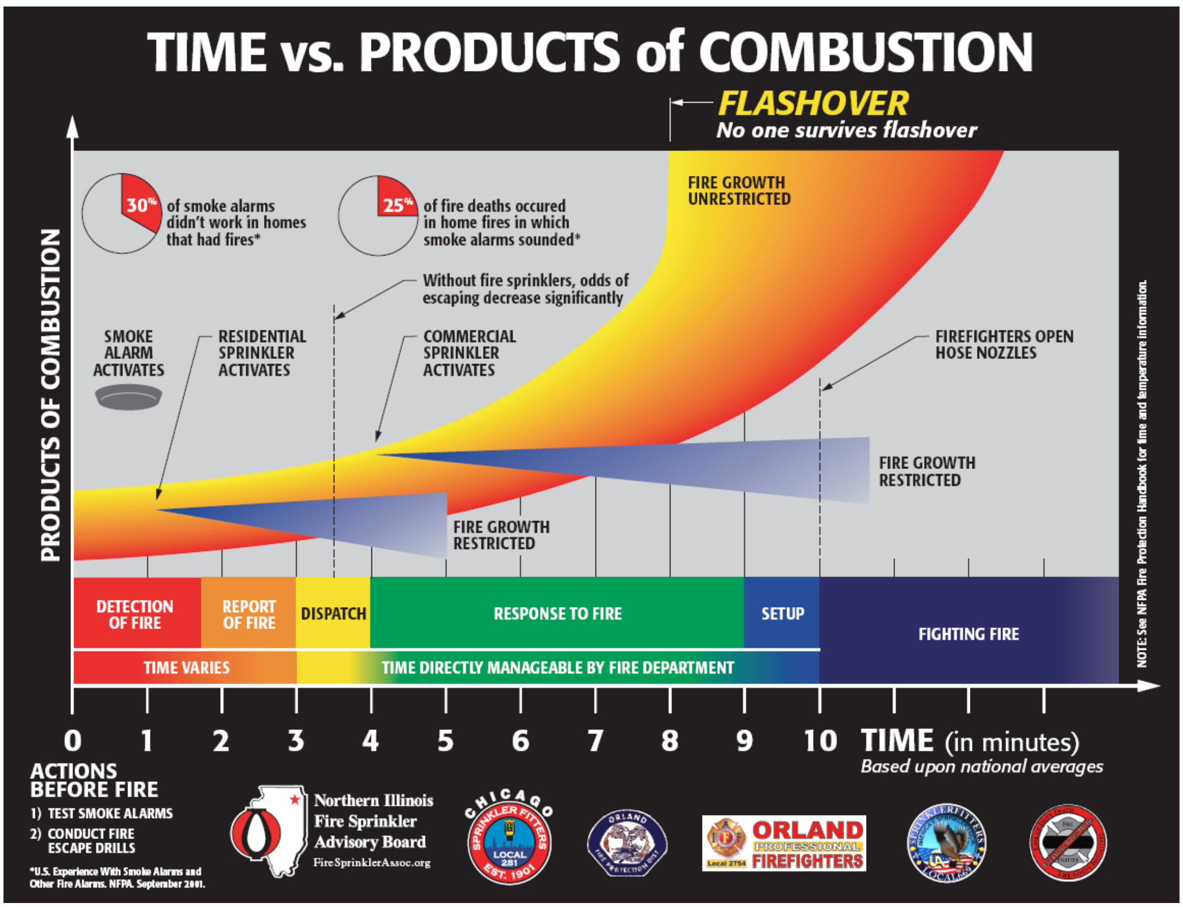
A similar urgency holds for fire emergencies. Fires reach a critical point called flashover. Flashover occurs when flammable vapors escape room contents, igniting an entire room. Temperatures can exceed 1,000 degrees Fahrenheit. Prior to flashover, fires are more easily extinguished with less effort and water. Once flashover occurs, smoke and heat reduce the chances of safe evacuation, and property damage becomes much greater. The chance of firefighters becoming injured or dying in fires also greatly increases. Because flashover typically happens within six to nine minutes after the start of a fire, arriving within this timeframe is crucial to saving lives and property, as well as reducing costs (Olympia, WA Fire Department, 2004). Moreover, as Figure 1 shows, the time it takes for a fire truck to travel from the station to the site of the fire is only one of several steps that must take place after a fire is detected. Fire departments must perform the "dispatch" and "response to fire" steps in Figure 1 as quickly as possible because they do not have control over how much time elapses during detection and reporting of the fire.

The need for rapid response to fires and other emergencies is reflected in the National Fire Protection Association's (NFPA) NFPA 1710, Standard for Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Career Fire Departments. It recommends that fire departments strive to meet the response time goals shown in Table 1, where response time is defined as the time from when the fire station receives the alarm to when the initial responding company arrives on the scene of the incident and initiates mitigation efforts (National Fire Protection Association, 2010). This document recommends the following emergency response time goals (Cummings, 2012):

**TABLE 1.** *Response time goals.*

| NFPA 1710 RESPONSE TIME GOAL | TIME IN SECONDS (MINUTES) FOR 90% OF INCIDENTS |
|---|---|
| First Engine Company at a Fire Suppression Incident | 320 seconds (5 minutes 20 seconds) |
| First responder with an Automatic External Defibrillator (AED) at an Emergency Medical Services (EMS) incident | 300 seconds (5 minutes) |
| First Advanced Life Support (ALS) responder on scene of an EMS incident | 540 seconds (9 minutes) |

**FIGURE 1.** *Time vs. products of combustion.*




## Street Design Factors That Affect Response Times

Once the emergency vehicle has been dispatched, the time required for emergency responders to reach an emergency can be determined using the following formula:

*Response time = average speed x distance to emergency.*

Streets that allow firefighters to travel to an emergency at higher speeds, or that allow firefighters to travel a shorter distance from their home base to an emergency, reduce response times. Street design factors that allow firefighters to travel to an emergency with shorter average response times include:

- Short blocks
- Connected street networks
- Alleys
- Wide streets that allow unobstructed clear width, enough room to pass other vehicles (moving and parked)
- Wide lanes
- Multiple lanes
- Parking prohibitions
- Large curb radii
- Lack of constraints along the route (traffic signals, stop signs, traffic circles, curb extensions, speed humps, chicanes, other traffic calming measures)
- Lack of features that limit the ability of firefighters to cross the centerline of the street (medians, pedestrian islands, etc.)

## Street Design Factors that Affect Responders' Ability to Work at the Scene

Firefighters need room to deploy equipment and personnel. They also want to keep firefighters and equipment out of the collapse zone of buildings.

When working at the scene of an incident, fire departments usually need to accomplish some or all of the following tasks:

- Open cab doors so that firefighters can exit the vehicle
- Retrieve equipment from compartments on the side of vehicles
- Retrieve ground ladders from the vehicle

- Connect fire hoses to pumps on the fire engine
- Move equipment and vehicles around or beside the first fire vehicle to arrive at the scene
- Keep firefighters and equipment at a safe distance from a building's collapse zone, if possible
- When using an aerial ladder, deploy stabilizers (a.k.a. outriggers) to prevent the ladder truck from tipping over when the ladder is extended to the side of the vehicle

The space that emergency responders need to be able to accomplish these tasks can vary considerably, depending on (1) the kind of fire apparatus and other emergency response equipment chosen by a department, (2) the type of incident, and (3) the design of the neighborhood's streets, building design and street network. For example, where zoning allows for tall buildings (over 35 feet), the streets will need to accommodate aerial ladder trucks. Aerial ladder trucks are not needed in neighborhoods where no tall buildings exist or will be built, so the streets need not be designed to allow an aerial ladder truck to deploy its stabilizers. In suburban and rural communities that have no tall buildings, the fire department fleet frequently will not include an aerial ladder truck.

## STREET DESIGN

This section reviews the research on what makes streets safe, healthy, environmentally responsible, economically successful, and livable. This research explains why street designers want the flexibility to design streets with less than 20 feet of unobstructed street width, apply traffic calming measures, and engage in other design practices that narrow streets, reduce lanes, and slow cars.

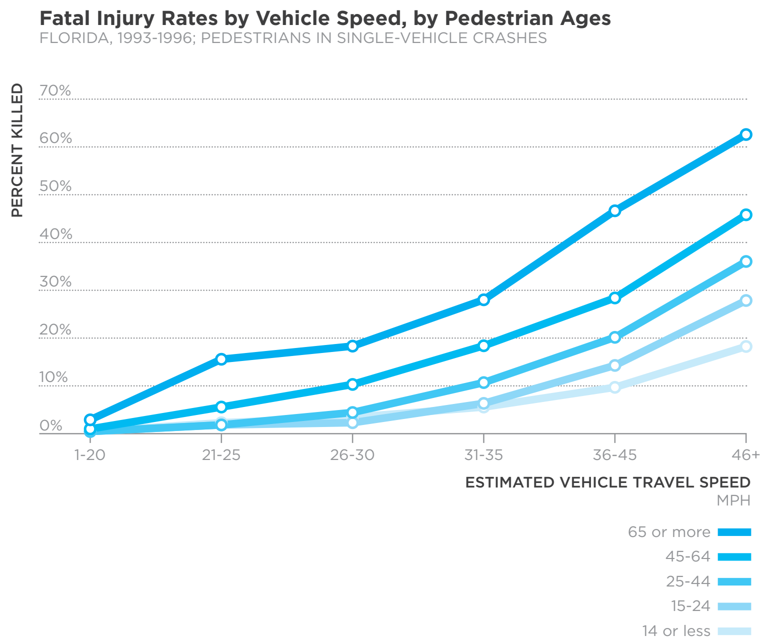
Measures that allow for large fire vehicles to travel at high speeds generally allow and encourage high-speed driving by all vehicles, and the result can be a significant decrease in safety for all users of the streets. Similarly, designs which make it easy for fire vehicles to cross the centerline of streets, such as eliminating raised medians, make it possible for all vehicles to cross the centerline easily, which can result in increases in head-on collisions and other types of collisions. In short, street designs that enable high-speed driving and maneuvering can improve emergency response times, but frequently worsen traffic safety. Further, as this section will explain, these designs compromise our ability to design streets that serve a number of other important community goals.

## Safety

The preponderance of evidence indicates that high vehicle speeds cause traffic deaths, particularly pedestrian deaths. Leaf and Preusser, in their 1999 review of the literature conducted for the National Highway Traffic Safety Administration, find that higher vehicle speeds are strongly associated with both greater likelihood of crash occurrence and greater severity of pedestrian injury. Leaf and Preusser analyze a database of over 23,000 pedestrian-involved crashes where the police report contained an officer's estimate of the pre-crash vehicle speed (1999). Figure 2 shows the stark correlation between vehicle speed and the likelihood that a pedestrian will be killed. In 122 U.S. counties, Lambert and Meyer found that speed limits significantly correlate with rates of fatal pedestrian crashes (2006).

Several studies find a correlation between residential street width and traffic fatalities. Swift et. al. conducted regression analyses on 20,000 crash records from Longmont, Colorado (Swift, Painter, and Goldstein, 1997). After eliminating crashes where some significant factor aside from street design probably caused the crash (i.e. snow or icy conditions, drunk driving), they examine physical street design features at each crash location. They find that the number of crashes per mile of street per year rises exponentially with the width of the street. Moreover, street width explains 73% of the variation in crash rates. The study concluded that 36-foot wide streets have 485% more injury collisions than 24-foot wide streets. However, in their analysis of pedestrian fatality and serious injury crashes in Florida, Leaf and Preusser (1999) found that roadway width is unrelated

**FIGURE 2.** *Fatal injury rates by vehicle speed by pedestrian ages.*




to the speed of striking vehicles. The relationship between width and increased crashes may be uniquely strong for residential streets. It may also be mediated through variables other than speed.

## Health

Due to the safety problems with wide and fast streets, both real and perceived, these streets are less conducive to walking, bicycling, using a wheelchair, skateboarding and other modes of active transportation. A body of public health research links rapidly rising rates of obesity to a built environment that discourages active transportation. Numerous surveys conducted by pollsters (Gallup, 2008; Harris, 1991), cities, and consultants routinely find that the primary factors that prevent people from bicycling and walking more are the lack of safe streets, sidewalks, and street crossings. In order to entice more people to walk, bicycle or wheel, we have to make our streets safer. Much of making our streets safer relates to slowing vehicle speeds.

## Energy and Environment

Transportation consumes 28% of the energy used in the United States, with most of this consumption being due to motor vehicle use (US Energy Information Administration, 2012). Making walking, bicycling and transit more attractive could significantly curtail transportation-related energy use.

According to the National Household Travel Survey (Federal Highway Administration, 2009) 39% of personal trips in US metropolitan areas are less than 3 miles long, and 17% are less than 1 mile. Yet 47% of all trips less than 1 mile and 69% of trips less than 3 miles are taken by car. A great opportunity exists to enable people to choose to walk and bike for these short trips. Research indicates that improvements in street design to make walking and bicycling safer and more convenient result in more people walking and biking (Pucher and Buehler, 2012). Furthermore, most transit trips begin with a walking or bicycling trip. Making the trip to the bus stop or transit station safer and more attractive by walking or bicycling would encourage transit use.

Motor vehicles produce large amounts of air pollution as well as greenhouse gases (GHG). Of GHG emissions in the US, 28% come from the transportation sector (US Department of Transportation, 2006). Making walking, bicycling and transit more attractive could significantly reduce transportation-related GHG emissions.

## Economy

Street design impacts our economy in several ways. First, wide streets are more expensive to construct and maintain than narrower streets since they have more surface to pave and maintain. Second, wide streets and multi-lane streets create higher speeds and reduce the likelihood that motorists will stop (Rosales, 2006), which impedes pedestrian access to businesses along these streets. Retail streets that are easy for pedestrians to cross effectively bring all of the stores and restaurants closer to shoppers, making it more likely they will patronize them. Third, enabling more people to walk, cycle and take transit can save households the money they spend on daily transportation. The average household in the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area spent $12,154 per year on transportation between 2005 and 2009 (Center for Neighborhood Technology, 2012).

### Social Interaction and Livability

*Walking to school. Credit: Ryan Snyder.*

Streets with less traffic and slower traffic enable people to interact more. Research conducted by (Appleyard, 1981) showed a distinct correlation between traffic volumes and the number of acquaintances people have. The research showed that people had more friends and more contact with their neighbors on streets with less traffic than those with more.

Narrower and slower streets create more livable communities than wide, high-speed streets (Rosales, 2006). In neighborhoods where children can safely walk to school, to the park or to visit friends, children grow up more independently and place fewer burdens on their parents to transport them. Many older adults don't drive and walk slowly. When they can cross streets and walk to the store, dry cleaners, doctor's office, friends' homes, parks or places of worship, they experience healthier and more independent lives.

Building streets for speed compromises our humanity. Where streets are built at a human scale, people have higher quality of life than along streets built for vehicle movement.

## BEST PRACTICES

The need for rapid emergency response need not clash with street designers' other goals. This section describes some practices that create healthy and livable streets that do not conflict with rapid response, falling into three broad categories. First, we discuss the fact that prevention of crashes is a goal that both emergency responders and street designers share.

Next, we enumerate street and community design practices that can improve response times. At minimum, the practices listed do not worsen response times, and some of them can actually improve response times. Finally, we de-

**TABLE 2.** *Comparison of fire-related and traffic related injuries and fatalities.*

| FIRE-RELATED FATALITIES | TRAFFIC-RELATED FATALITIES | FIRE-RELATED INJURIES | TRAFFIC-RELATED INJURIES |
|---|---|---|---|
| 2,640 | 32,885 | 13,350 | 2,239,000 |

*Sources: Fire-related statistics are from the US Center for Disease Control, Fire Deaths and Injuries, 2010. Traffic-related statistics are from the US National Highway Traffic Safety Administration, 2010.*

scribe best practices that facilitate successful emergency response and do not conflict with healthy street design.

## PREVENTING CRASHES

Public health officials and advocates call attention to the preventive aspect of thoughtful street design. By preventing traffic crashes we can reduce injuries and fatalities, and thus the need for emergency response. Since many emergency response calls attend to traffic crashes, reducing the number and severity of these can significantly reduce these calls. Table 2 compares fire-related fatalities and injuries to traffic-related fatalities and injuries. It shows that traffic fatalities and injuries far outnumber those that are fire related. There are five traffic fatalities for every one fire-related fatality. There are 167 traffic injuries for every fire-related injury.

Designing for healthy streets can also save lives, lengthen lives, and improve the quality of life by offering the opportunity for active transportation. Inactive life styles are leading to rapidly growing rates of obesity, diabetes and related heart problems.

## STREET AND COMMUNITY DESIGN BEST PRACTICES

### Compact Neighborhoods

Average response times are shorter in compact neighborhoods. When all other factors are equal, compact neighborhoods have shorter response distances, because the average distance from the fire station to neighborhood homes is shorter. When communities sprawl outwards, with homes built further and further from firehouses, it becomes increasingly costly and difficult for emergency responders to maintain ideal response times.

In their 2006 study of traffic crashes in 122 U.S. counties in the U.S. National Highway Traffic Safety Administration's (NHTSA) Fatal Accident Reporting System, Lambert and Meyer found that average emergency response times in ex-urban areas were greater than average response times in urban areas (10.7 minutes and 7.6 minutes respectively) (Lambert and Meyer, 2006). Moreover, in their regression model of emergency response times to 244 crashes, they find that greater population density is associated with lower response times.

In Los Angeles, response times also vary by density. In denser, central neighborhoods the Los Angeles Fire Department (LAFD) usually beats the 6-minute standard to reach rescues. But in the hillside neighborhoods stretching from Griffith Park to Pacific Palisades, the LAFD doesn't meet the standard nearly 85% of the time (Linthicum, Welsh, and Lopez, 2012).

Those promoting healthy, active, walkable communities favor compact neighborhoods because they bring many origins and destinations close and within walking and bicycling distance. These neighborhoods are also more transit conducive, because more people live within the access shed of any given transit line.

## Street Connectivity

Street connectivity particularly stands out as an area of agreement between fire departments and advocates for healthier streets.

Highly connected street networks with short blocks offer emergency responders several advantages. First, they allow emergency responders more routing options to reach

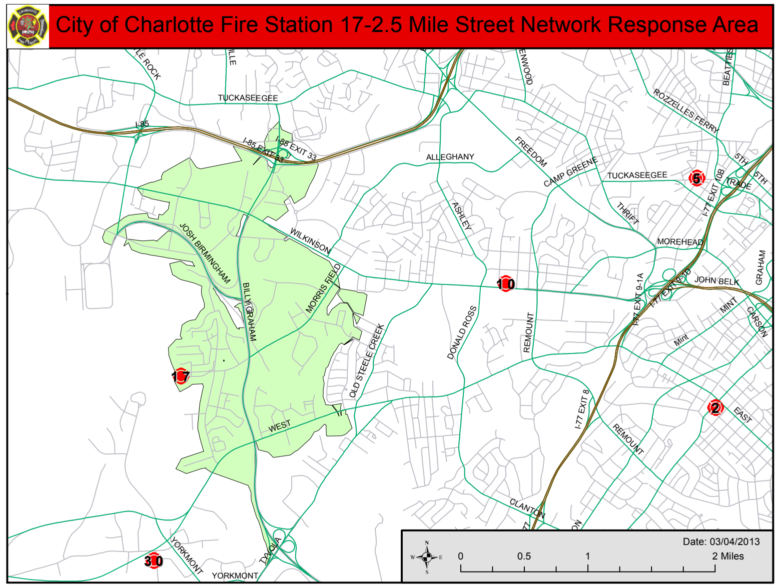



*Figure 3. Fire department access shed on a well connected street network. Source: Charlotte Fire Department.*

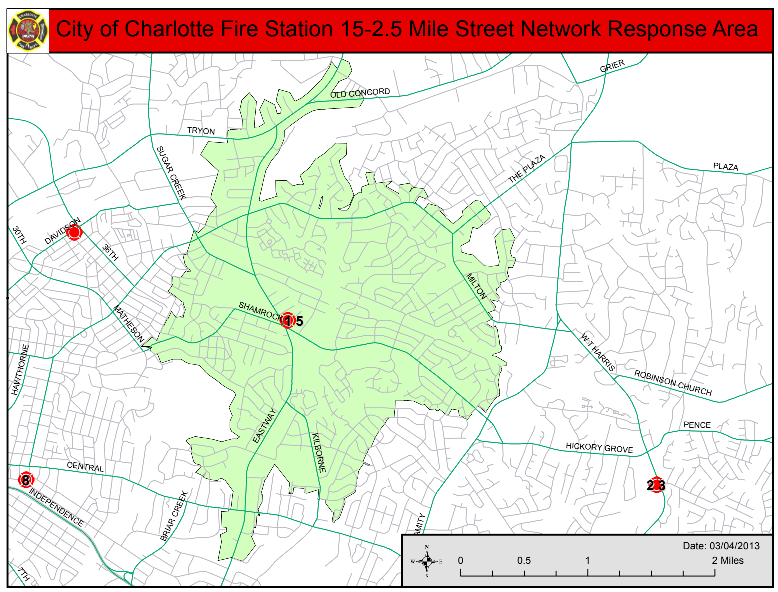



*Figure 4. Fire department access shed on a poorly connected street network. Source: Charlotte Fire Department.*

their emergency. Second, routes are in general more direct, and responders can access emergencies faster. Third, responders can approach burning buildings from more than one side, which also allows greater access to the fire. This is especially true with alleys. Finally, fire departments can cover much more territory with the same personnel and equipment in highly connected street networks.

Charlotte, North Carolina periodically examines emergency response coverage areas in three neighborhood types, with varying levels of street connectivity. They found that a fire station in the most interconnected neighborhood could provide service to more than three times as many commercial and residential units as could a station in the least connected neighborhood (Charlotte, NC Fire Department, 2013). Figures 3 and 4 illustrate their research. Both show the access shed within 2.5 linear centerline miles from the station. On the disconnected streets in Area 17, this access shed is only 2.8 square miles in size, while on the connected streets of Area 15 the access shed is 5.5 square miles in size.

Advocates for healthier streets favor connected streets because they spread traffic and reduce the necessity for multi-lane streets. Two-lane streets operate slower, are more comfortable to ride a bicycle on, and are easier and safer for pedestrians to cross. They also provide much more direct access and shorten distances from origins to destinations than less connected street networks. This makes walking and bicycling more convenient, and it shortens walking distance to transit stops.

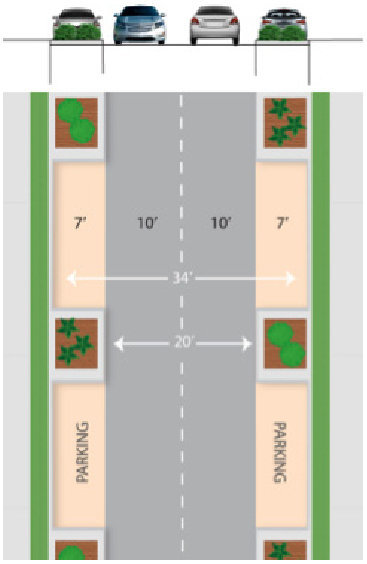
## Street Design

Five street design techniques accommodate emergency access while slowing traffic:

- Parking placement strategies
- Mountable curbs
- Use of surface materials and paint
- Roundabouts
- Appropriate use of traffic calming measures

### *Parking Placement Strategies*

Some parking placement strategies maintain the 20-foot clearance required by the IFC, and also can slow traffic. They include the following:



*Inset parking. Credit: Michele Weisbart.*

**Inset parking.** Extending curbs out midblock and at intersections insets parking and can make the street feel narrow. With the curb extended the width of the parking lane, the street width can be as narrow as 20 feet where these curbs exist.

**Valley gutters.** Valley gutters lay between the parking and travel lanes, causing the street and parking to slope towards one another. This narrows the feel of the street.

**Fire hydrants and parking.** Prohibiting parking and extending the curb at fire hydrants can create extra space to maneuver and access the hydrants.

**Parking on one side of the street.** Permitting parking on only one side of the street allows the streets to be constructed to as narrow as 27 feet while preserving 20 feet of clearance. Where parking utilization rates are low, parking can be permitted on both sides of streets narrower than 36 feet while still maintaining emergency access.

### *Mountable Curbs*

Mountable curbs rise up from the street a few inches. They discourage most motorists from driving on them, but allow trucks and buses to drive over them if need be. Mountable curbs can be placed on any street feature that constrains the navigable width for emergency vehicles: curb extensions, roundabouts, traffic circles, medians, or islands.

### *Use of Surface Materials and Paint*

**Use of surface materials.** Varying surface materials and colors visually narrow the feel of a street, yet allow for emergency vehicles to drive on them. These can be used on the sides of streets, for parking lanes and as curbless medians. In Seattle's High Point neighborhood alleys have 20 feet of clearance with 16 feet of pavement.

Valley gutters (red area). Credit: Ryan Snyder.

Mountable curb. Credit: Ryan Snyder.

Calming with street materials. Credit: Ryan Snyder.

**Bike lanes.** On-street bike lanes not only accommodate bicyclists, they provide separation between motor vehicles and pedestrians. Coloring bike lanes between the white stripes narrows the feel of the street. Bike lanes also provide extra space for emergency vehicles to operate and create larger turning radii at intersections.

### *Roundabouts*

Roundabouts reduce intersection delays while simultaneously slowing motor vehicles. Where roundabouts replace traffic signals average travel time can be reduced. Although they slow vehicles at the intersection, they also reduce delay and make travel speeds steadier.

### *Appropriate Use of Traffic Calming Measures*

Walkable Communities and the Local Government Commission produced a detailed book called Emergency Response: Traffic Calming and Traditional Neighborhood Streets (Burden and Zykofsky, 2001). The book provides guidance on where to use which type of traffic calming measures and the pros and cons related to emergency access. Recommendations of the book include:

- Cities with the most effective traffic calming rely on active partnerships between residents, engineers, policymakers and emergency response personnel.
- Traffic calming can increase response time, but need not do so if carefully planned. If combined with removal of some stop signs, traffic calming can reduce response time.

- Speed humps shouldn't be used on primary emergency response routes. They can damage ladders, cabinets and other equipment and accessories. Some firefighters have been injured while fire trucks drove over speed humps.
- Speed tables, sometimes called raised sidewalks, are preferred over speed humps since they impede emergency equipment and access less than speed humps while providing significant calming benefits.
- Roundabouts and mini traffic circles generally speed emergency access while calming traffic. They eliminate the queues often experienced at stop and signal-controlled intersections.
- Well-designed curb extensions at intersections prohibit motor vehicle parking and do not hinder access or turning. They generally aid emergency access. Where delay occurs, it is usually minor.
- Chicanes, humps and tables should not be placed along major emergency access routes. Visual and linear traffic control measures, on the other hand, such as gateways, medians, landscaping, colored bike lanes and similar measures, have no negative impact on emergency responders.
- Traffic calming has significant safety benefit. Seattle neighborhoods have seen a 93% reduction in crashes along streets with traffic calming.
- Street closures can greatly impact emergency access and response time. Any closures should retain access by emergency vehicles, pedestrians and bicyclists.
- Stop signs are not traffic calming. They increase response time and are often overused. Replacing stop signs with mini traffic circles, roundabouts, raised intersections or curb extensions can improve response time while slowing traffic.
- Speed pillows can effectively slow traffic, yet do not impede emergency access. They provide a good substitute for speed humps.
- Medians and landscaping can calm traffic without impacting response time.

### Land Use Controls

There are several land use controls that can improve emergency access without relying upon wide, fast, clear streets. Controlling building height and requiring setbacks can improve access for fire vehicles and reduce or eliminate the need for aerial ladder trucks. Land use measures can also address issues of tree spacing, height, etc. Limiting development in high-hazard areas reduces the need for emergency services. Coastal and wetlands preservation laws limit development in areas that are prone to hurricanes and floods. Urban growth boundaries, urban limit lines, open space preserves and clear boundaries between communities create defensible fire lines and allow for greater use of controlled burns. The Mid-Peninsula Regional Open Space District in Northern California practices controlled burns in open space preserves. Oregon, Tennessee, and Sonoma and Ventura counties in California have all enacted urban growth boundaries or urban limit lines.

### Sprinkler Requirements

Sprinklers in buildings can significantly reduce the intensity of fires as well as allow firefighters more time to arrive before fires grow out of control. Further, it takes water flows of 1,687 gallons per minute to extinguish fires in buildings that have sprinklers, while buildings without sprinklers need a spray of 6,750 gallons per minute, nearly a fourfold increase (Congress for the New Urbanism, 2009).

## EMERGENCY ACCESS BEST PRACTICES

Emergency responders want the streets on which they will drive fire apparatus to have certain minimum dimensions for two major reasons: (1) firefighters and other emergency responders need to be able to reach the emergency quickly, and (2) when at the scene of the incident, they require enough room to deploy equipment and fight fires. The amount of room they need to respond to any given incident depends on what kind of equipment the responders will be deploying.

## Background

### *Types of Incidents*

In the United States, fire departments and other emergency responders often handle a wide range of fire and rescue missions. Depending on the department, these may include:

- Medical emergencies, such as heart attacks and strokes
- Road crashes, which may require the use of extrication equipment such as the "Jaws of Life"
- Fires in low-rise structures that require only ground ladders for the response
- Fires in mid-rise and high-rise structures, which firefighters will fight with a combination of both aerial ladder trucks and other tactics
- Wildfires and rescue operations ranging from swift water rescue to mountain rescue to avalanche rescue

Nearly 2/3 (65%) of fire department calls across the United States are for medical aid. Only 5% are for fires. The remainder are for mutual aid (4%), hazardous materials (2%) and other hazardous responses (1%). About 8% are false alarms, and 14% are classified as "other" (Karter, 2010). These statistics vary from community to community. The Los Angeles County Fire Department reports that 72% of their calls are for emergency medical services and less than 3% are for fires. (Los Angeles County Fire Department, 2011)

### *Mutual Aid Obligations*

Most fire departments have mutual aid obligations that require them to respond to fires in other communities. This means that most fire departments have to respond to fires that may take place in communities with different types of streets and terrain, sometimes in hillside and woodland communities with narrow streets, even if such streets do not exist in their own community. So they need vehicles


Charlotte, NC Fire Heavy Rescue firefighter opens roll-up cabinet doors. Credit: Patrick Siegman.


Charlotte, NC Fire Heavy Rescue truck with roll-up cabinet doors. Credit: Patrick Siegman.

that can respond to various situations. This may necessitate those departments purchasing fire engines and trucks that can access narrow streets and traffic calmed streets.

## Equipment Best Practices

Being mindful of street limitations when equipment is purchased can enable firefighters to perform their necessary functions on slower and narrower streets. The following lists equipment strategies that work more adeptly on narrower and slower streets.

### *Retrieving Equipment from Side Compartments*

Many departments which respond to incidents in neighborhoods with smaller streets choose roll-up doors for the equipment compartments on their vehicles. The adjacent photo shows a heavy rescue truck used by the Charlotte, NC Fire Department with roll up doors. Other fire engines and trucks, however, are equipped with swing-out doors, which require more room for the firefighters working around the vehicle.

### *Ground Ladder Retrieval*

Some departments, such as the San Francisco Fire Department, keep ground ladders attached to the sides of fire engines, and retrieve them manually. Other departments use motorized ladder racks. These racks typically


*San Francisco fire engines with ground ladders and side-mount pumps. Credit: Patrick Siegman.*

keep the ground ladders stored on top of the vehicle, and swing down the sides of the vehicle to bring them within the reach of firefighters. Motorized ladder racks typically require more clearance room at the side of the fire engine.

### *Deploying Stabilizers for Aerial Ladder Trucks*

Some American fire departments use aerial ladder trucks that require 19' of width to fully deploy the truck's stabilizers. Other departments, particularly those in older communities with many narrow streets, use ladder trucks with stabilizers that fully deploy in less than 15 feet of width, and which can be short jacked (i.e., deployed at less than full width, or fully extended on just one side of the fire truck) within a width of less than 9 feet. For example, Nantucket, Massachusetts, has purchased a Rosenbauer Raptor ladder truck with stabilizers that have a maximum spread of 14 feet 9 inches when fully deployed, and which occupy 8 feet 3 inches of width when short jacked.

### *Connecting Fire Hoses to Pumps on Side-Mount Versus Rear-Mount Pumpers*

Many American fire departments use fire engines (also known as pumpers) with side-mount pumps. Firefighters using a fire engine with side-mount pumps must have room to work beside the engine to connect hoses, and fire hoses charged with water must then have room to run from the pump to wherever the hose is being deployed. However, as

*Side-mount pumper, Daytona, FL.
Credit: Oshkosh Corporation.*

described in recent articles in Fire Chief (Cavette, 2008) and Fire Apparatus Magazine (Petrillo, 2011), rear-mount pumpers are growing in popularity among American fire departments. On rear-mount pumpers, fire hoses are attached at the rear of the vehicle, making it substantially easier for firefighters to connect hoses when working in close quarters.

### *Purchasing an Appropriate Fleet of Vehicles*

As mentioned above, a majority of emergency calls serve medical purposes. A relatively small portion of calls responds to actual fires. Fire departments can purchase more ambulances. Ambulances are smaller and can more easily navigate through skinny streets and traffic calmed streets. Ashland, Oregon has adopted this practice. Their normal dispatch practice sends ambulances to medical emergencies not involving vehicle crashes. They send both ambulances and fire engines to motor vehicle crashes in case of fire or need to evacuate.

### *Fire Trucks*

Most fire departments custom order new trucks. In newer American cities, fire apparatus is sometimes chosen on the assumption that all streets will be wide, and that many streets will be cul-de-sacs. By contrast, in older cities and towns, whether in Europe or the United States, fire apparatus and emergency response tactics are often adapted to handle the many existing narrow streets in these communities. Many older cities, such as Boston, San Francisco, Seattle, and many others, have hundreds of blocks of narrow streets. In these cities it is common to find local streets that have just 10 feet to 14 feet of clear width between parked vehicles, since these were typical dimensions for local streets in the United States before World War II. Fire departments in these communities typically purchase vehicles and adopt tactics that allow them to function effectively on these existing streets. Milwaukee, Wisconsin purchased fire engines specifically for older neighborhoods that have excellent turning radii. Piedmont, California ordered highly maneuverable fire engines for use in responding to fires on existing narrow streets in hillside neighborhoods. Departments that respond to fires and emergencies in rural and wilderness areas—especially in rugged mountain and forest terrain—often purchase vehicles that are designed to handle narrow, windy roads and tracks.

By contrast, fire departments in new communities may have few or no streets with less than 20 feet of clear width, and may have chosen all of their fire apparatus on the assumption that they would be responding to emergencies only on these wide streets. When communities are planning their street designs and their fire equipment purchases, it is essential that they consider the interaction between the two.

If a community already has many blocks of neighborhood streets with less than 20 feet of clear width, then it is likely that the fire department already has the fire apparatus, staff, training and equipment needed to handle these streets. In this situation, using similar street dimensions in a new neighborhood in that community usually poses no new challenges for the fire department. On the other hand, if a new neighborhood with narrow streets is planned for a community where the department has little or no experience with firefighting on similar streets, then greater care is required. In this situation, either (1) the streets need to be adapted to the fire department's current equipment, or (2)new equipment will need to be purchased. Given the expense involved in purchasing new equipment, and the relatively long equipment replacement cycles in many communities, communities may need to adopt both short-term and long-term strategies. In the short term, use only street designs and traffic calming measures which accommodate the needs of current equipment, and in the long-term, purchase new equipment that is more maneuverable and adaptable. The most maneuverable equipment in the existing fleet can be prioritized for use in neighborhoods that have designs for slower streets.

# COLLABORATION

Greater collaboration between fire departments and transportation, planning and health departments offers significant potential to maintain expedient emergency access while designing healthier, safer, more livable streets. Too often these departments operate in silos and proceed without considering multiple objectives. The International Fire Code has taken important aspects of street design out of the hands of the people that know street design for the purpose of maintaining rapid response times. While few would argue against the value of rapid emergency response, street design affects other important community goals that are compromised when we focus only on emergency response. By working together, communities can design streets that meet a variety of community goals.

## EXAMPLES OF SUCCESSFUL COLLABORATIVE PROCESSES

Collaborative exercises are underway in different communities throughout the US. The Congress for the New Urbanism (CNU) Emergency Response and Street Design Initiative has been the most notable. In 2007 CNU partnered with the US Environmental Protection Agency and fire marshals from across the country to reconcile the growing desire for appropriately sized streets with the needs of emergency responders. To inaugurate the process, urban planners, transportation engineers and fire marshals convened in a workshop in Austin, Texas. Neil Lipski, former Deputy Fire Chief of Milwaukee, Wisconsin teamed with transportation engineer Peter Swift to draft a new section of the Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities street manual. The project team also drafted proposed recommendations to the International Fire Code to empower local jurisdictions with flexibility on the requirement for 20 feet of clear space on streets. The proposal went to the International Code Council and was rejected. However, the effort set the stage for greater collaboration.

The Local Government Commission organized and facilitated many workshops around the country. They typically covered topics including:

- Street networks
- Culs-de-sac
- Conflicts between fire codes and street manuals
- Fire fighting in existing neighborhoods with narrow streets
- Street width and traffic safety
- Building design
- Performance standards

The workshops also convene work groups that mix emergency responders with planners and advocates for safe streets to identify common ground, as well as areas of disagreement.

Workshops were conducted at several New Partners for Smart Growth conferences. Special daylong workshops with fire marshals and planners were held with the Los Angeles County Fire Department, the Orange County Fire Agency and the Petaluma Fire Department.

The Local Government Commission wrote up case studies in Seattle, Memphis and Hercules, California (Tracy, 2007).

- The High Point development project in Seattle, Washington was a national model in sustainable drainage design as well as healthy street design. Some residential streets in High Point are 25 feet wide. The fire marshal signed off on the street designs partially due to the well-connected street network.
- Hercules, California adopted a form-based code for its Waterfront District. The code includes 26-foot wide streets with parking on one side and edge drives that are only 19 feet wide. This agreement was reached between the fire department and Redevelopment Agency after the plan required sprinklers in the single-family housing units.
- The Harbor Town development project in Memphis, Tennessee presents an excellent example of collab-

oration between developers, fire officials and city planners. The developers wanted to replicate the old neighborhoods in Memphis that have small homes and narrow streets. They included the Memphis Fire Department in early discussions of the project. The City Traffic Engineer couldn't agree to the narrow streets as public, so they became private with a gate and are serviced by the fire department. The fire department posseses a device to open a wide exit gate that allows them entry. This project includes streets with 28 feet of width and parking on both sides. Some streets with landscaped medians and parking on one side were designed with 18 to 20 feet between the curbs. They also negotiated and agreed upon street trees and location of utilities that allow convenient fire access.

## OPPORTUNITIES FOR COLLABORATION

Ongoing collaboration involving planners, transportation engineers, emergency responders and public health officials can help bring about more consensus on street design issues. Schools, neighborhood associations and other community groups should be brought in on comprehensive planning efforts, as well as on individual projects that affect them. The specific stakeholders depend on the jurisdiction. Any planners or engineers involved with determining street design, street cross sections, intersection design and traffic calming should be included. Within the fire departments the people making policy on these same issues need to be at the table. This should include both officials from planning as well as operations. Sometimes operations emergency responders are more familiar with the practical abilities they have to maneuver their vehicles and equipment, and are able to approve street widths and designs that the fire department planners assume are unworkable.

## Adopting New Street Standards

The process of adopting new street standards, whether at the state or local level, provides an excellent opportunity for emergency responders, street designers, and many other stakeholders to collaborate, because community values are encoded in street standards in so many ways. New street standards provide the opportunity to enact many of the best practices listed in this paper. In particular, states and other jurisdictions can choose to reconsider their adoption of the IFC in order to enable a more collaborative process for establishing street standards.  States may also enable local jurisdictions to make local amendments to the IFC, as is the case in Nevada.

There are two notable examples where states have chosen not to adopt the IFC. Neither Oregon nor Washington requires local jurisdictions to adhere to the IFC. They permit cities to design streets with clearances of less than 20 feet. Oregon uses Neighborhood Street Design Guidelines. The Oregon Office of the State Fire Marshal, the Oregon Fire Chiefs' Association and the Oregon Fire Marshals' Association endorse these guidelines. They include street cross sections of 20 feet without on-street parking, 24 feet with parking on one side, and 28 feet with parking on both sides. The guidelines also provide for periodic breaks in parking with driveways and no parking areas, so that 20 feet is available at intermittent locations along the streets.

Comprehensive plans, such as General Plans and Mobility Plans often include street cross section designs as well as identification of primary fire access routes. Some local jurisdictions prepare separate street design standards and guidelines outside of their General Plans and Mobility Plans. Setting traffic calming policies and procedures is also at the intersection of healthy streets and emergency access. These efforts all call for collaboration.

On a project basis, new large developments that alter street cross sections, sidewalk widths and intersections create a need to work together. The project developers need to be involved in these planning efforts along with the previously mentioned stakeholders.

## Comparative Costs

When designing streets and neighborhoods, setting code requirements for buildings, establishing fire stations, purchasing firefighting equipment and vehicles, and setting staffing levels, communities must necessarily consider costs. Ideally, communities should work to consider the impact of different choices on both public sector budgets (e.g., the public works department's cost to maintain and reconstruct streets, and the fire department's costs for fire stations, equipment and staff), and the costs to citizens (e.g., the effects of code requirements and street design requirements on housing costs). Some questions to consider include the following.

Regarding fire equipment choices:

*What effect will different vehicle and equipment choices have on the fire department's costs for equipment and staffing?* As a rule, fire departments' costs for staffing are substantially larger than the department's costs for purchasing and maintaining equipment. As a result, one of the most significant issues for a fire department is whether a different equipment choice will increase or decrease staffing costs.

Regarding neighborhood and street designs:

- *What effect will different street network designs (e.g., disconnected networks with many cul-de-sacs versus highly connected street networks) have on the number of fire stations, fire vehicles and firefighters needed to maintain acceptable emergency response times?*
- *What effect will different neighborhood densities have on the number of fire stations, fire vehicles and firefighters needed to maintain acceptable emergency response times?*

- *What effect will different street width requirements have on the cost of housing?* Generally, the initial cost of building streets in a neighborhood is borne by homebuilders, who pass along the cost to homebuyers as part of the purchase price of the home.
- *What effect will different street widths have on the public works departments' costs to maintain streets?*

## CONCLUSION

As a society we value quick response when emergencies arise. We also value health, safety from traffic crashes, livable neighborhoods, and places where people of all ages can feel comfortable walking and bicycling. Collectively, we need to reduce the use of motor vehicles to curtail energy consumption and release of GHG emissions. In order to accomplish these latter goals, we need to design streets built for human scale and activity rather than motor vehicle speed. Each community has different challenges, so collaboration between local fire departments, urban planners, transportation engineers and public health officials will be invaluable to meeting these goals.

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