Fire Service Plans for Development Sites

The effectiveness of emergency response and firefighting operations is directly related to proper site design. All fire service features shall meet the International Fire Code, as adopted and amended. Other applicable standards can be found in the Iowa Statewide Urban Design and Specifications (SUDAS).

The following guidelines are based mainly on material covered in Chapters 5 & 9 and Appendices B, C and D of the International Fire Code (2018). This is intended as a starting point and a summary of main fire service elements relevant to site design. A more thorough review of source materials is recommended for project specific design.

The following requirements must be addressed when submitting an Administrative Site Development Plan. These shall be included on a separate Fire Service Plan sheet and/or other sheets in the plan set as applicable. For minor site plans, your Case Manager can help you determine whether the Fire Service Plan or certain elements of it are needed. Use the following checklist to assure that the Fire Service Plan requirements are met:

1. **Fire flow (Appendix B)** ___
2. **Hydrants (Appendix C)**
   a. Located along a fire lane ___
   b. Sufficient quantity of hydrants ___
   c. Appropriate spacing ___
   d. Radial coverage without obstructions depicted ___
   e. Hose Pull and Hose Lay depicted and unobstructed ___
3. **Fire Apparatus Access Roads (Fire Lanes)**
   a. Hard surfaced ___
   b. Width and vertical clearance ___
   c. Code-compliant turnaround ___
   d. Turning radii met ___
   e. Located around structures where applicable ___
4. **Other**
   a. Compliant gates ___
   b. Appropriate number of access points ___
   c. Post-indicator valve (where applicable) ___
   d. Locations of KNOX Boxes for emergency access ___

Fire Flow

In general, the calculation area for fire flow requirements is based on the total gross area of the structure, including any area under the horizontal projections of the roof of the structure. Portions of the building that are separated by fire walls without openings and constructed in accordance with the International Building Code, may be considered as separate areas for the purposes of fire flow calculations. For type IA and type IB construction, the calculation shall be based on the area of the three largest successive floors.

FIRE-FLOW CALCULATION AREA (square feet)					FIRE FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

Table 1. Minimum Required Fire Flow and Flow Duration for Buildings (source: Table B105.1(2)-IFC-2018)

The City has records for fire flow tests performed by the Utilities and Fire Departments. Test results may be used to analyze fire flow availability at a given site. The City also has a hydraulic model of the public

water distribution system. The design professional may request fire flow information (via mailto:water-gis@cedar-rapids.org). City staff will review records to determine whether an existing flow test is available in the vicinity of a site. If there is not an applicable test available, a new field test may be requested. The scheduling of a new test is subject to weather conditions and staff availability. On a limited basis, City staff may be able to provide a simulated fire flow within the public system in lieu of a field test based upon hydraulic modeling.

Fire Hydrants

Fire hydrant spacing along public and private streets shall be according to Section 4C-1. E of the SUDAS Design Manual. In general, a maximum hydrant spacing of no more than 450 feet in single family residential districts and no more than 300 feet in all other districts apply. However, there are exceptions related to the street curvature and geometric design (see paragraphs 4C-1E.3 a through c of the SUDAS Design manual).

Fire hydrants on private sites must be located along a fire lane with quantity and spacing according to the International Fire Code. Refer to Table 2. Please note that the required minimum number of hydrants is based on unobstructed coverage of structures **and** fire flow. In other words, one hydrant may provide adequate fire flow, but additional hydrants may be needed to satisfy the coverage.

Hydrants shall be located so that no part of any structure, above ground tanks or fueling stations shall be more than three hundred feet (400'*) from a fire hydrant as measured along an approved fire lane as the fire hose is laid off the fire truck. In no case shall this distance be measured across wooded or landscaped areas, through fences, through ditches or across paved areas which are not designed and maintained as fire lanes. (*Note the maximum distance may be increased to 600’ for R-3 and U occupancies, or as otherwise approved by the fire code official).

Fire hydrant coverage radius for structures should not exceed 300 feet in single family residential districts and 150 feet in all other districts.

Fire hydrants must be located on the same side of a public street as the structures it is intended to serve and must be accessible at all times. Parking stalls are not permitted to be located between the fire hydrant and the fire apparatus access road. A three foot (3') clear space is required on all sides of the fire hydrant.

The number and spacing of fire hydrants shall not be less than shown in Table 2 below.

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS[a, b, c, f, g] (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT[d, f, g]
1,750 or less	1	500	250
1,751–2,250	2	450	225
2,251–2,750	3	450	225
2,751–3,250	3	400	225
3,251–4,000	4	350	210
4,001–5,000	5	300	180
5,001–5,500	6	300	180
5,501–6,000	6	250	150
6,001–7,000	7	250	150
7,001 or more	8 or more[e]	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

a. Reduce by 100 feet for dead-end streets or roads.

b. Where streets are provided with median dividers that cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis.

c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

d. Reduce by 50 feet for dead-end streets or roads.

e. One hydrant for each 1,000 gallons per minute or fraction thereof.

f. A 50-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1 of the *International Fire Code*.

g. A 25-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.2 or 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*.

h. The fire code official is authorized to modify the location, number and distribution of fire hydrants based on site-specific constraints and hazards.

Table 2. Number and Distribution of Fire Hydrants
(source: Table C102.1-IFC-2018)

Existing fire hydrants on public streets may be included in the maximum hydrant spacing and requirements of Table 2. Existing fire hydrants on adjacent properties are allowed to be considered available provided that a fire access road extends between properties and that a fire access easement be established (and no obstructions are present to prevent use of hydrants).

A Fire Department Connection (FDC) is required for all buildings utilizing an automatic sprinkler system. The FDC must be located within 100 feet of a fire hydrant.

Hose Pull and Hose Lay (Figure 1)

A: Hose Pull (Distance from Fire Engine to Building): Represents the amount of fire hose that firefighters must pull from the engine to reach to and around the structure. Hose pull may not exceed 150’ to any exterior first floor portion of the structure. Hose pull must be reflected and calculated on the firefighter access paths, and cannot go through or over walls, hedges, cars, buildings, etc.

B: Hose Lay (Distance from Fire Engine to a Hydrant): Represents the amount of supply hose that must be laid out of the back of the fire engine to bring water from the closest fire hydrant to the fire engine.

Hose lay is measured along the vehicle path of travel in the fire lane, not “as the crow flies.” Hose lay cannot exceed 250 feet from the nearest hydrant to the staged fire engine.

C: Hydrant Spacing (Distance between Hydrants): The distance between hydrants serving the building shall not exceed maximum distances in Table 2, as measured along the fire lane. Hydrants located on portions of the fire lane that do not serve the building do not need to be evaluated for spacing relative to each other, only with respect to hydrants that do serve the structure. For example, when evaluating hydrant placement for the building shown in the diagram below, C1 may exceed the hydrant spacing requirements, while C2 and C3 cannot. The “Average Spacing” from Table 2 shall be maintained to prevent multiple hydrants from being concentrated in only one portion of the fire lane.

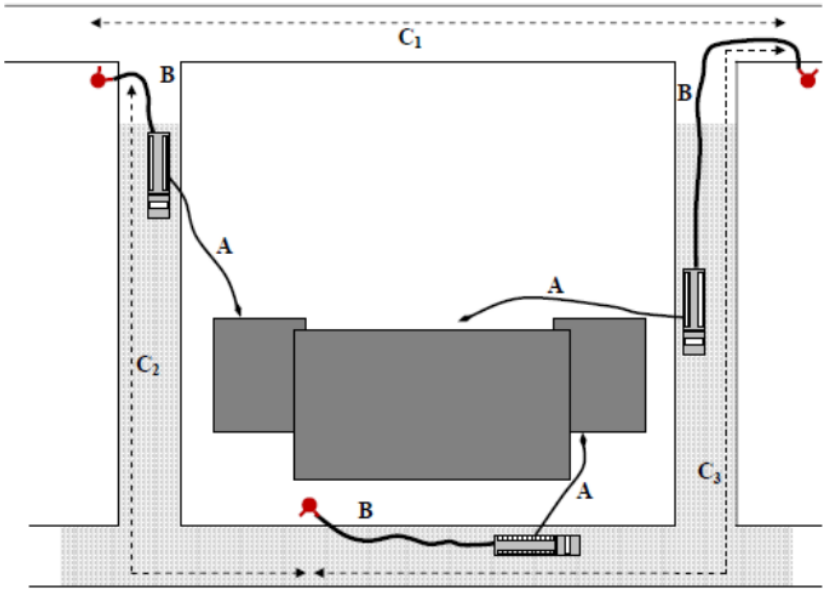

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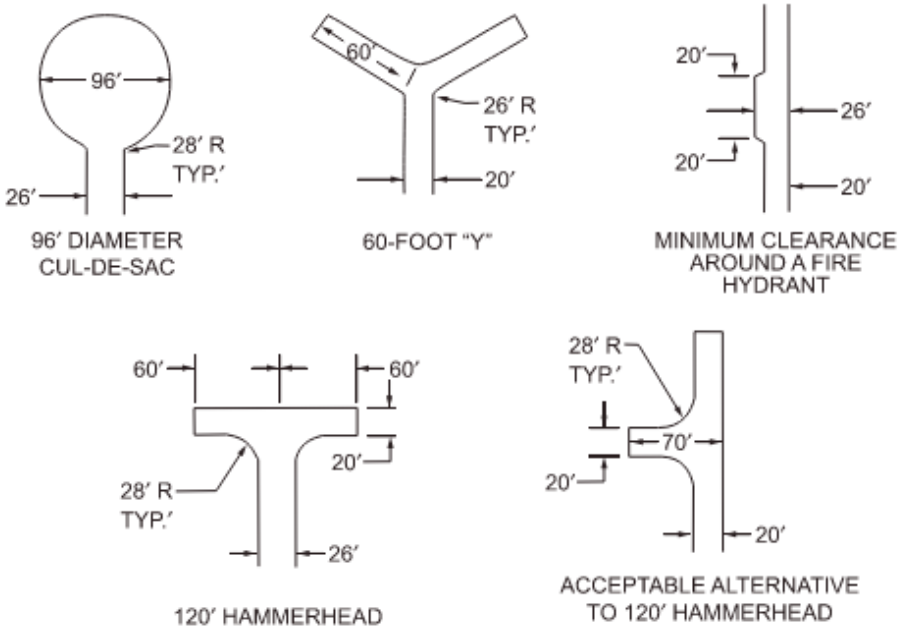
Figure 1. Illustration of Hose Pull and Hose Lay
(source: Laguna Beach Fire Department)

Fire Apparatus Access Roads

Fire apparatus access roads shall be designed and constructed according to the following:

1. Portland cement concrete or hot mix asphalt surface with aggregate base, material thicknesses according to SUDAS.
2. Support the imposed loads of fire apparatus (74,000 lbs.)
3. According to Municipal Code-Chapter 37, Section 37.14 - 503.2.1 , have a minimum width of 28 feet and have a minimum unobstructed vertical clearance of 13 feet 6 inches. Note that there are conditions under which the width may be reduced such as when access roads will be exclusively used for fire apparatus or under exceptions as approved by the fire code official. Please refer to Section 37.14-503.1 of Municipal Code for additional discussion about exceptions for minimum width and vertical clearance.
4. Fire apparatus access roads in excess of 150 feet shall provide a turnaround as provided for in Figure 2.

5. All fire lanes shall meet the turning radii for an aerial truck shown in Figure 3.
6. Fire apparatus access roads shall extend within 225 feet (sprinklered throughout) or 150 feet (non-sprinklered) of all portions of building for the purposes of extended a fire hose. See Figure 4.



For SI: 1 foot = 304.8 mm.

Figure 2. Acceptable Turnarounds
(source: Figure D103.1-Appendix D of IFC 2018)

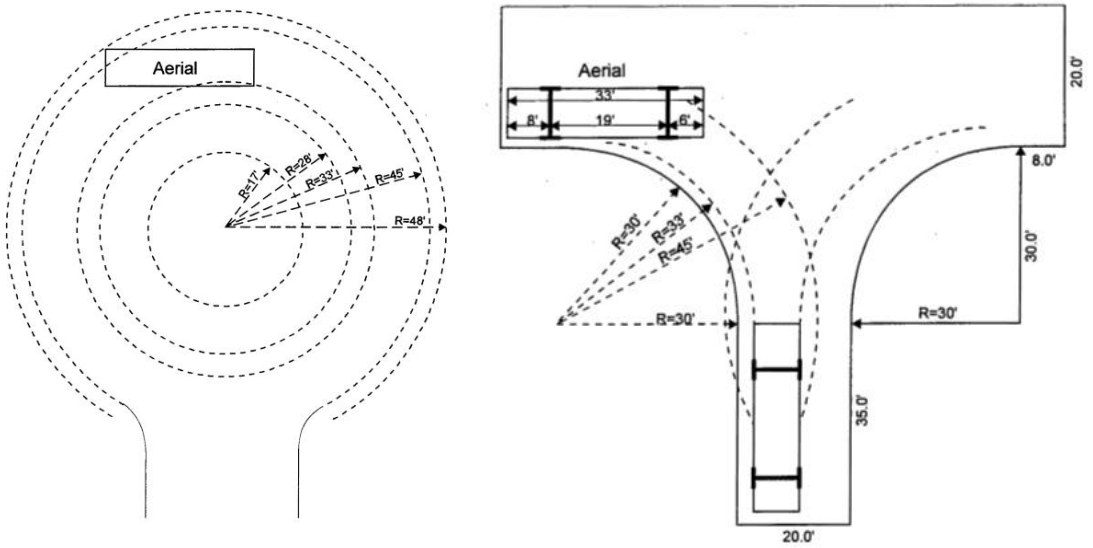


Figure 3. Turning Radii Within Turnarounds
(source: City of College Station-Site Design Specifications).

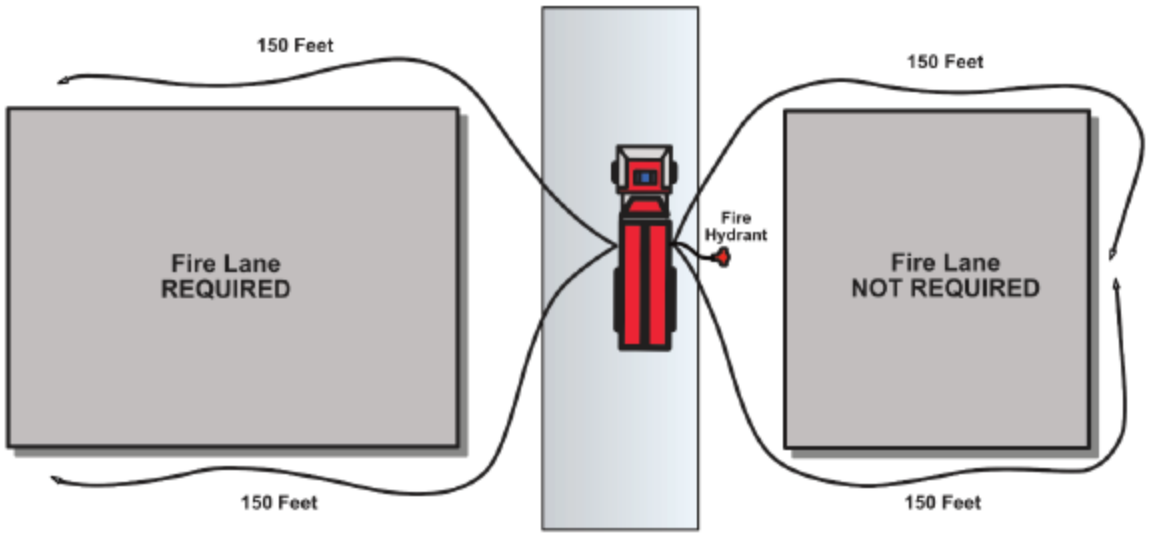


Figure 4. Requiring Fire Apparatus Access Roads
(source: Grand Junction, CO Fire Department).

Aerial Fire Apparatus Access Roads

For all structures or portions of structures, including parapets and other obstructions to the roof of the building, exceeding 30 feet in height, an aerial fire apparatus access road shall be required parallel to one entire side of the building to provide access to the roof of the structure. Aerial fire apparatus access roads shall be a minimum of 26 feet in width and be located within a minimum of 15 feet and a maximum of 30 feet from the building. Overhead utilities shall not be located within an aerial fire apparatus access road. (Section D105- IFC 2018) See Figure 5 below for explanation.

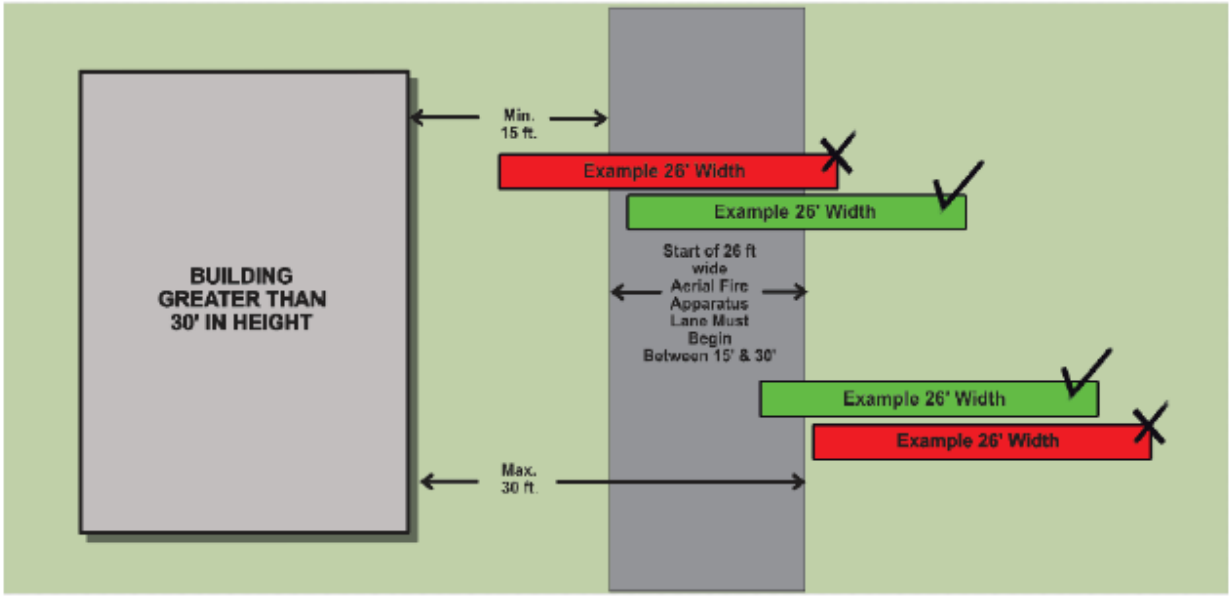


Figure 5. Locating Aerial Fire Apparatus Access Roads
(source: Grand Junction, CO Fire Department).

Fire Apparatus Access Road Gates

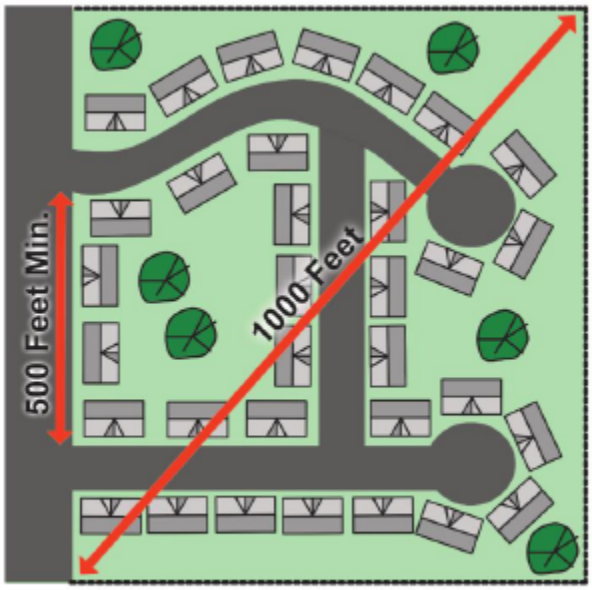
Gates obstructing a fire lane must have a minimum width of 20 feet and utilize either swinging or sliding gates. All security gates must have a Knox key box and manual operation must be able to be by one person. Gates may not be locked with a pad lock or chain. (Section D103.5-IFC 2018)

Number of Accesses to a Development

Developments of single or two-family dwellings where the number of dwelling units exceeds 100* shall be provided with two separate and approved fire apparatus access roads. For subdivisions of single or two-family dwellings, the fire apparatus access roads shall be streets designed according to SUDAS. (Section D107.1- IFC 2018)

Mixed use or multiple-family residential projects having more than 100 dwelling units require a second point of ingress / egress from the development to the public right-of-way. In the case that the units have an approved fire suppression system, the number of dwelling units requiring a second point of ingress / egress is 200. (Section D106.1- IFC 2018)

Where two fire apparatus access roads are required, they shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the property or area to be served, measured in a straight line between accesses. (Section D107.2- IFC 2018) See Figure 6 below for an example, actual site layout and dimensions may vary.



Note: *Main road containing two access points to development should not be a dead-end.*

Figure 6. Locating Two Fire Apparatus Access Roads (source: Grand Junction, CO Fire Department).

* Cedar Rapids amended the Fire Code to increase the allowable number of dwelling units from 30 to 100.

Post-Indicator valves: for buildings where a water-based fire sprinkler system is proposed, the post-indicator valve should be shown on building plans, and onsite plans where one is located outside the building.

According to Section 37.22-903.7 of Municipal Code the following layout options are acceptable where the fire isolation valves are provided prior to the fire protection riser:

1. A Post Indicator Valve (PIV) installed in accordance with NFPA 24 Standard. The PIV must be located not closer than 3 ft. from a building, regardless of building wall height. PIVs shall not obstruct pedestrian/accessible routes, or the use of parking spaces.
2. A wall mounted Post Indicator Valve. Wall mounted valves will generally be required in Urban Zoning Districts.
3. An approved main isolation valve in a fire-rated fire pump room accessible from an exterior access door without going through another room.
4. An approved main isolation valve in a fire rated stair enclosure and accessible from an exterior access door without going through another room.

For a combined dual domestic/fire service connection to the water main, there must be an exterior split between the lines and separate shut-off for each line shown on the site plan. A typical layout is shown below.

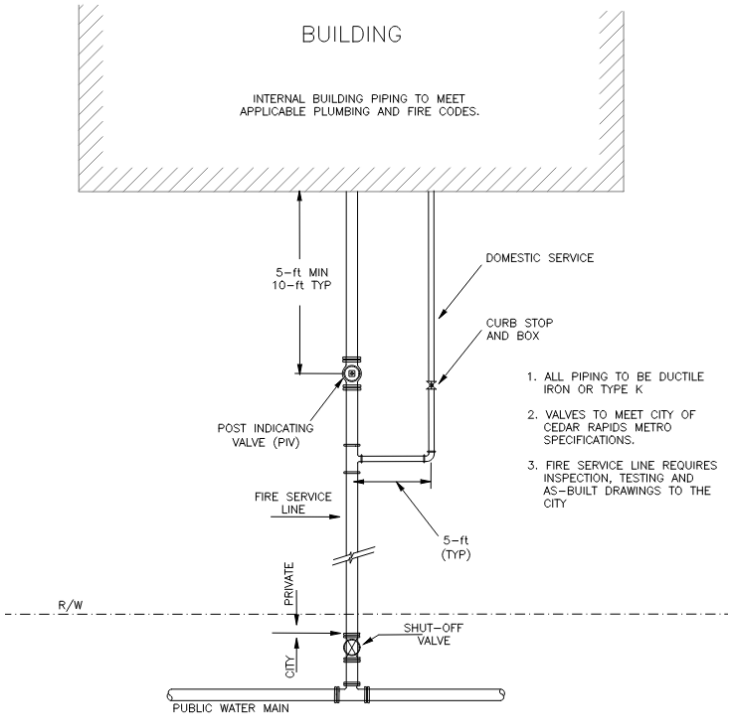


Figure 7. Typical Fire/Domestic External Water Service Split (source: City of City Rapids-Utilities Dept.)

Alternatively, there can be separate service line connections for the domestic and fire to the City main provided that separate shut-off valves are provided for each line (and post-indicator on the fire line per Section 37.22-903.7 of the Municipal Code).

References

1. Cedar Rapids Code of Ordinances (2022)
2. International Fire Code (2018)
3. SUDAS (Statewide Urban Design and Specifications) Design and Standard Specifications Manuals (2022)
4. Cedar Rapids General Supplement to Design Manual (2022)
5. Cedar Rapids General Supplemental Specifications to SUDAS Standard Specifications (2022)
6. Laguna Beach Fire Department-Site Access Plan (FDSAP) Submittal Checklist
7. City of College Station-Site Design Specifications
8. Grand Junction Fire Department – Fire Department Access (2021)