**Chapter 19 Design Approaches**

19.1 General

Chapter 19 shall be utilized for design approaches.

19.2 General Design Approaches

The requirements of Section 19.2 shall apply to all sprinkler systems unless modified by a specific section of Chapter 19 or Chapter 20.

19.2.1

A building or portion thereof shall be permitted to be protected in accordance with any applicable design approach at the discretion of the designer.

19.2.2\* Adjacent Hazards or Design Methods

For buildings with two or more adjacent hazards or design methods, the following shall apply:

Where areas are not physically separated by a draft curtain, barrier, or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding design basis shall extend 15 ft (4.6 m) beyond its perimeter.

The requirements of 19.2.2(1) shall not apply where the areas are separated by a draft curtain, or barrier located above an aisle, where the aisle has a minimum 2 ft (600 mm) horizontal separation from the adjacent hazard on each side, or a partition that is capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area.

The requirements of 19.2.2(1) shall not apply to the extension of more demanding criteria from an upper ceiling level to beneath a lower ceiling level where the difference in height between the ceiling levels is at least 2 ft (600 mm), located above an aisle, where the aisle has a minimum 2 ft (600 mm) horizontal separation from the adjacent hazard on each side.

19.2.3

For hydraulically calculated systems, the total system water supply requirements for each design basis shall be determined in accordance with the procedures of Section 27.2 unless modified by a section of Chapter 19 or Chapter 20.

19.2.4 Water Demand

19.2.4.1\*

The water demand requirements shall be determined from the following:

Occupancy hazard fire control approach and special design approaches of Chapter 19

Storage design approaches of Chapter 20 through Chapter 25

Special occupancy approaches of Chapter 26

19.2.4.2\*

The minimum water demand requirements for a sprinkler system shall be determined by adding the hose stream allowance to the water demand for sprinklers.

19.2.5 Water Supplies

19.2.5.1

The minimum water supply shall be available for the minimum duration specified in Chapter 19.

19.2.5.2\*

Tanks shall be sized to supply the equipment that they serve.

19.2.5.3\*

Pumps shall be sized to supply the equipment that they serve.

19.2.6 Hose Allowance

19.2.6.1 Systems With Multiple Hazard Classifications

For systems with multiple hazard classifications, the hose stream allowance and water supply duration shall be in accordance with one of the following:

The water supply requirements for the highest hazard classification within the system shall be used.

The water supply requirements for each individual hazard classification shall be used in the calculations for the design area for that hazard.

\* For systems with multiple hazard classifications where the higher classification only lies within single rooms less than or equal to 400 ft2 (37 m2) in area with no such rooms adjacent, the water supply requirements for the principal occupancy shall be used for the remainder of the system.

19.2.6.2\*

Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a private fire hydrant, whichever is closer to the system riser.

19.2.6.3

Where inside hose connections are planned or are required, the following shall apply:

A total water allowance of 50 gpm (190 L/min) for a single hose connection installation shall be added to the sprinkler requirements.

A total water allowance of 100 gpm (380 L/min) for a multiple hose connection installation shall be added to the sprinkler requirements.

The water allowance shall be added in 50 gpm (190 L/min) increments beginning at the most remote hose connection, with each increment added at the pressure required by the sprinkler system design at that point.

19.2.6.3.1

Where the system is a combined sprinkler/standpipe system (Class I or Class III) and the building is fully sprinklered in accordance with NFPA 13, no inside hose demand shall be required at any of the standpipe outlets.

19.2.6.4\*

When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 16.15.2, the following shall apply:

The sprinkler system demand shall not be required to be added to standpipe demand as determined from NFPA 14.

Where the combined sprinkler system demand and hose stream allowance of Table 19.3.3.1.2 exceeds the requirements of NFPA 14, this higher demand shall be used.

For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Figure 19.3.3.1.1 shall be added to the requirements given in NFPA 14.

19.2.7\* High Volume Low Speed (HVLS) Fans

The installation of HVLS fans in buildings equipped with sprinklers, including ESFR sprinklers, shall comply with the following:

The maximum fan diameter shall be 24 ft (7.3 m).

The HVLS fan shall be centered approximately between four adjacent sprinklers.

The vertical clearance from the HVLS fan to sprinkler deflector shall be a minimum of 3 ft (0.9 m).

All HVLS fans shall be interlocked to shut down immediately upon a waterflow alarm. Where the building is protected with a fire alarm system, this interlock shall be in accordance with the requirements of NFPA 72.

19.3 Occupancy Hazard Fire Control Approach for Spray Sprinklers

19.3.1 General

19.3.1.1\*

The water demand requirements shall be determined by either the pipe schedule method in accordance with 19.3.2 or the hydraulic calculation method in accordance with 19.3.3.

19.3.1.2 Occupancy Classifications

19.3.1.2.1

Occupancy classifications for this standard shall relate to sprinkler installations and their water supplies only.

19.3.1.2.2

Occupancy classifications shall not be used as a general classification of occupancy hazards.

19.3.1.2.3

Occupancies or portions of occupancies shall be classified according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles, and the presence of flammable and combustible liquids, using the definitions contained in 4.3.2 through 4.3.7.

19.3.1.2.4

Classifications shall be as follows:

Light hazard

Ordinary hazard (Groups 1 and 2)

Extra hazard (Groups 1 and 2)

Special occupancy hazard (see Chapter 26)

19.3.2 Water Demand Requirements — Pipe Schedule Method

19.3.2.1

Table 19.3.2.1 shall be used in determining the minimum water supply requirements for light and ordinary hazard occupancies protected by systems with pipe sized according to the pipe schedules of Section 27.5.

Table 19.3.2.1 Water Supply Requirements for Pipe Schedule Sprinkler Systems

Occupancy Classification Minimum Residual Pressure Required Acceptable Flow at Base of Riser (Including Hose Stream Allowance) Duration (minutes)

psi bar gpm L/min

Light hazard 15 1 500—750 1900—2850 30—60

Ordinary hazard 20 1.4 850—1500 3200—5700 60—90

19.3.2.2

Pressure and flow requirements for extra hazard occupancies shall be based on the hydraulic calculation methods of 19.3.3.

19.3.2.3

The pipe schedule method shall be permitted as follows:

Additions or modifications to existing pipe schedule systems sized according to the pipe schedules of Section 27.5

Additions or modifications to existing extra hazard pipe schedule systems

New systems of 5000 ft2 (465 m2) or less

New systems exceeding 5000 ft2 (465 m2) where the flows required in Table 19.3.2.1 are available at a minimum residual pressure of 50 psi (3.4 bar) at the highest elevation of sprinkler

19.3.2.4

Table 19.3.2.1 shall be used in determining the minimum water supply requirements.

19.3.2.5

The lower duration value of Table 19.3.2.1 shall be acceptable only where the sprinkler system waterflow alarm device(s) and supervisory device(s) are electrically supervised and such supervision is monitored at an approved, constantly attended location.

19.3.2.6\* Residual Pressure

19.3.2.6.1

The residual pressure requirement of Table 19.3.2.1 shall be met at the elevation of the highest sprinkler.

19.3.2.6.2 Friction Loss Due to Backflow Prevention Valves

19.3.2.6.2.1

When backflow prevention valves are installed on pipe schedule systems, the friction losses of the device shall be accounted for when determining acceptable residual pressure at the top level of sprinklers.

19.3.2.6.2.2

The friction loss of this device [in psi (bar)] shall be added to the elevation loss and the residual pressure at the top row of sprinklers to determine the total pressure needed at the water supply.

19.3.2.7

The lower flow figure of Table 19.3.2.1 shall be permitted only where the building is of noncombustible construction or the potential areas of fire are limited by building size or compartmentation such that no open areas exceed 3000 ft2 (280 m2) for light hazard or 4000 ft2 (370 m2) for ordinary hazard.

19.3.3 Water Demand Requirements — Hydraulic Calculation Methods

19.3.3.1 General

19.3.3.1.1

The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer:

Density/area curves of Figure 19.3.3.1.1 in accordance with the density/area method of 19.3.3.2

The room that creates the greatest demand in accordance with the room design method of 19.3.3.3

Special design areas in accordance with 19.3.3.4

FIGURE 19.3.3.1.1 Density/Area Curves.

19.3.3.1.2

The minimum water supply shall be available for the minimum duration specified in Table 19.3.3.1.2.

Table 19.3.3.1.2 Hose Stream Allowance and Water Supply Duration Requirements for Hydraulically Calculated Systems

Occupancy Inside Hose Total Combined Inside and Outside Hose Duration (minutes)

gpm L/min gpm L/min

Light hazard 0, 50, or 100 0, 190, or 380 100 380 30

Ordinary hazard 0, 50, or 100 0, 190, or 380 250 950 60—90

Extra hazard 0, 50, or 100 0, 190, or 380 500 1900 90—120

19.3.3.1.3

The lower duration values in Table 19.3.3.1.2 shall be permitted where the sprinkler system waterflow alarm device(s) and supervisory device(s) are electrically supervised and such supervision is monitored at an approved, constantly attended location.

19.3.3.1.4 Restrictions

When either the density/area method or room design method is used, the following shall apply:

\* For areas of sprinkler operation less than 1500 ft2 (140 m2) used for light and ordinary hazard occupancies, the density for 1500 ft2 (140 m2) shall be used.

For areas of sprinkler operation less than 2500 ft2 (230 m2) for extra hazard occupancies, the density for 2500 ft2 (230 m2) shall be used.

19.3.3.1.5 Unsprinklered Combustible Concealed Spaces

19.3.3.1.5.1\*

When using the density/area or room design method, unless the requirements of 19.3.3.1.5.2 are met for buildings having unsprinklered combustible concealed spaces, as described in 9.2.1 and 9.3.18, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft2 (280 m2).

(A)

The design area of 3000 ft2 (280 m2) shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed space.

(B)

The term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

19.3.3.1.5.2

The following unsprinklered concealed spaces shall not require a minimum area of sprinkler operation of 3000 ft2 (280 m2):

Noncombustible and limited-combustible concealed spaces with minimal combustible loading having no access. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

Noncombustible and limited-combustible concealed spaces with limited access and not permitting occupancy or storage of combustibles. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

Combustible concealed spaces filled entirely with noncombustible insulation.

\* Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are directly attached to the bottom of solid wood joists or solid limited-combustible construction or noncombustible construction so as to create enclosed joist spaces 160 ft3 (4.5 m3) or less in volume, including space below insulation that is laid directly on top or within the ceiling joists in an otherwise sprinklered concealed space.

Concealed spaces where rigid materials are used and the exposed surfaces comply with one of the following in the form in which they are installed in the space:

The surface materials have a flame spread index of 25 or less and the materials have been demonstrated to not propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the form in which they are installed in the space or

The surface materials comply with the requirements of ASTM E2768, Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test).

Concealed spaces in which the exposed materials are constructed entirely of fire-retardant-treated wood as defined by NFPA 703.

Concealed spaces over isolated small rooms not exceeding 55 ft2 (5.1 m2) in area.

Vertical pipe chases under 10 ft2 (0.9 m2), provided that in multifloor buildings the chases are firestopped at each floor using materials equivalent to the floor construction, and where such pipe chases contain no sources of ignition, piping shall be noncombustible, and pipe penetrations at each floor shall be properly sealed.

Exterior columns under 10 ft2 (0.9 m2) in area formed by studs or wood joists, supporting exterior canopies that are fully protected with a sprinkler system.

\* Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are attached to the bottom of composite wood joists either directly or on to metal channels not exceeding 1 in. (25 mm) in depth, provided the adjacent joist channels are firestopped into volumes not exceeding 160 ft3 (4.5 m3) using materials equivalent to 1/2 in. (13 mm) gypsum board, and at least 31/2 in. (90 mm) of batt insulation is installed at the bottom of the joist channels when the ceiling is attached utilizing metal channels.

Cavities within unsprinklered wall spaces.

19.3.3.2 Density/Area Method

19.3.3.2.1 Water Supply

19.3.3.2.1.1

The water supply requirement for sprinklers only shall be calculated from the density/area curves of Figure 19.3.3.1.1 or from Chapter 26 where density/area criteria are specified for special occupancy hazards.

19.3.3.2.1.2

When using Figure 19.3.3.1.1, the calculations shall satisfy any single point on the appropriate density/area curve.

19.3.3.2.1.3

When using Figure 19.3.3.1.1, it shall not be necessary to meet all points on the selected curves.

19.3.3.2.2 Sprinklers

19.3.3.2.2.1

The densities and areas provided in Figure 19.3.3.1.1 shall be for use only with spray sprinklers.

19.3.3.2.2.2

Quick-response sprinklers shall not be permitted for use in extra hazard occupancies or other occupancies where there are substantial amounts of flammable liquids or combustible dusts.

19.3.3.2.2.3

For extended coverage sprinklers, the minimum design area shall be that corresponding to the hazard in Figure 19.3.3.1.1 or the area protected by five sprinklers, whichever is greater.

19.3.3.2.2.4

Extended coverage sprinklers shall be listed with and designed for the minimum flow corresponding to the density for the hazard as specified in Figure 19.3.3.1.1.

19.3.3.2.3 Quick-Response Sprinklers

19.3.3.2.3.1

Where listed quick-response sprinklers, including extended coverage quick-response sprinklers, are used throughout a system or portion of a system having the same hydraulic design basis, the system area of operation shall be permitted to be reduced without revising the density as indicated in Figure 19.3.3.2.3.1 when all of the following conditions are satisfied:

Wet pipe system

Light hazard or ordinary hazard occupancy

20 ft (6.1 m) maximum ceiling height

No unprotected ceiling pockets as allowed by 10.2.9 and 11.2.8 exceeding 32 ft2 (3.0 m2)

No unprotected areas above cloud ceilings as allowed by 9.2.7

Note:

for U.S. Customary Units

Note: y = —4.8x+ 54.6 for S.I. Units

For ceiling height ≥10 ft and ≤ 20 ft,

For ceiling height <10 ft, y = 40

For ceiling height >20, y = 0

For SI units, 1 ft = 0.31 m.

FIGURE 19.3.3.2.3.1 Design Area Reduction for Quick-Response Sprinklers.

19.3.3.2.3.2

The number of sprinklers in the design area shall never be less than five.

19.3.3.2.3.3

Where quick-response sprinklers are used on a sloped ceiling or roof, the maximum ceiling or roof height shall be used for determining the percent reduction in design area.

19.3.3.2.4 Sloped Ceilings

The system area of operation shall be increased by 30 percent without revising the density when the following types of sprinklers are used on sloped ceilings with a pitch exceeding 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent) in nonstorage applications:

Spray sprinklers, including extended coverage sprinklers listed in accordance with 11.2.1(4), and quick-response sprinklers

CMSA sprinklers

19.3.3.2.5\* Dry Pipe and Double Interlock Preaction Systems

For dry pipe systems and double interlock preaction systems, the area of sprinkler operation shall be increased by 30 percent without revising the density.

19.3.3.2.6 High-Temperature Sprinklers

Where high-temperature sprinklers are used for extra hazard occupancies, the area of sprinkler operation shall be permitted to be reduced by 25 percent without revising the density, but not to less than 2000 ft2 (185 m2).

19.3.3.2.7

Where K-11.2 (160) or larger sprinklers are used with Extra Hazard Group 1 or Extra Hazard Group 2 design curves and 19.3.3.1.1, the design area shall be permitted to be reduced by 25 percent but not below 2000 ft2 (185 m2), regardless of temperature rating.

19.3.3.2.8\* Multiple Adjustments

19.3.3.2.8.1

Where multiple adjustments to the area of operation are required to be made in accordance with 19.3.3.2.3, 19.3.3.2.4, 19.3.3.2.5, or 19.3.3.2.6, these adjustments shall be compounded based on the area of operation originally selected from Figure 19.3.3.1.1.

19.3.3.2.8.2

If the building has unsprinklered combustible concealed spaces, the rules of 19.3.3.1.5 shall be applied after all other modifications have been made.

19.3.3.3 Room Design Method

19.3.3.3.1\*

The water supply requirements for sprinklers only shall be based upon the room that creates the greatest demand.

19.3.3.3.2

The density selected shall be that from Figure 19.3.3.1.1 corresponding to the occupancy hazard classification and room size.

19.3.3.3.3

To utilize the room design method, all rooms shall be enclosed with walls having a fire-resistance rating equal to the water supply duration indicated in Table 19.3.3.1.2.

19.3.3.3.4

If the room is smaller than the area specified in Figure 19.3.3.1.1, the provisions of 19.3.3.1.4(1) and 19.3.3.1.4(2) shall apply.

19.3.3.3.5

Minimum protection of openings shall be as follows:

Light hazard — Nonrated automatic or self-closing doors.

Light hazard with no opening protection — Where openings are not protected, calculations shall include the sprinklers in the room plus two sprinklers in the communicating space nearest each such unprotected opening unless the communicating space has only one sprinkler, in which case calculations shall be extended to the operation of that sprinkler. The selection of the room and communicating space sprinklers to be calculated shall be that which produces the greatest hydraulic demand. For light hazard occupancies with unprotected openings in walls, a minimum lintel of depth of 8 in. (200 mm) is required for openings and the opening shall not exceed 8 ft (2.4 m) in width. It shall be permitted to have a single opening of 36 in. (900 mm) or less without a lintel, provided there are no other openings to adjoining spaces.

Ordinary and extra hazard — Automatic or self-closing doors with appropriate fire resistance ratings for the enclosure.

19.3.3.3.6

Where the room design method is used and the area under consideration is a corridor protected by a single row of sprinklers with protected openings in accordance with 19.3.3.3.5, the maximum number of sprinklers that needs to be calculated is five or, when extended coverage sprinklers are installed, all sprinklers contained within 75 linear feet (23 linear meters) of the corridor.

19.3.3.3.7

Where the area under consideration is a corridor protected by a single row of sprinklers with unprotected openings, in a light hazard occupancy, the design area shall include all sprinklers in the corridor to a maximum of five or, when extended coverage sprinklers are installed, all sprinklers within 75 linear feet (23 linear meters) of the corridor.

19.3.3.4 Special Design Areas

19.3.3.4.1

Where the design area consists of a building service chute supplied by a separate riser, the maximum number of sprinklers that needs to be calculated is three, each with a minimum discharge of 15 gpm (57 L/min).

19.3.3.4.2\*

Where an area is to be protected by a single line of sprinklers, the design area shall include all sprinklers on the line up to a maximum of seven.

19.3.3.4.3

Sprinklers in ducts as described in Section 8.9 and 9.3.9 shall be hydraulically designed to provide a discharge pressure of not less than 7 psi (0.5 bar) at each sprinkler with all sprinklers within the duct flowing.

19.3.3.4.4 Stair Towers

Stair towers, or other construction with incomplete floors, if piped on independent risers, shall be treated as one area with reference to pipe sizes.

19.4 Special Design Approaches

19.4.1 Residential Sprinklers

19.4.1.1\*

The design area shall be the area that includes the four adjacent sprinklers that produce the greatest hydraulic demand.

19.4.1.2\*

Unless the requirements of 19.3.3.1.5.2 are met for buildings having unsprinklered combustible concealed spaces, as described in 9.2.1 and 9.3.18, the minimum design area of sprinkler operation for that portion of the building shall be eight sprinklers.

19.4.1.2.1\*

The design area of eight sprinklers shall be applied only to the portion of the residential sprinklers that are adjacent to the qualifying combustible concealed space.

19.4.1.2.2

The term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

19.4.1.3

Unless the requirements of 19.4.1.4 are met, the minimum required discharge from each design area sprinkler shall be the greater of the following:

In accordance with minimum flow rates indicated in the sprinkler listings

In rooms or compartments greater than 800 ft2 (74 m2), calculated based on delivering a minimum of 0.1 gpm/ft2 (4.1 mm/min) over the design area in accordance with the provisions of 9.5.2.1

In rooms or compartments 800 ft2 (74 m2) or less calculated based on delivering a minimum of 0.1 gpm/ft2 (4.1 mm/min) over the room or the compartment using the area of the room divided by the number of sprinklers in the room

19.4.1.4

For modifications or additions to existing systems equipped with residential sprinklers, the listed discharge criteria less than 0.1 gpm/ft2 (4.1 mm/min) shall be permitted to be used.

19.4.1.4.1

Where replacing residential sprinklers manufactured prior to 2003 that are no longer available from the manufacturer and that are installed using a design density less than 0.05 gpm/ft2 (2.04 mm/min), a residential sprinkler with an equivalent K-factor (± 5 percent) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

19.4.1.5

Where areas such as attics, basements, or other types of occupancies are outside of dwelling units but within the same structure, these areas shall be protected as a separate design basis in accordance with Section 19.2.

19.4.1.6

Hose stream allowance and water supply duration requirements shall be in accordance with those for light hazard occupancies in Table 19.3.3.1.2.

19.4.2 Exposure Protection

19.4.2.1\*

Piping shall be hydraulically calculated in accordance with Section 27.2 to furnish a minimum of 7 psi (0.5 bar) at any sprinkler with all sprinklers facing the exposure operating.

19.4.2.2

Where the water supply feeds other fire protection systems, it shall be capable of furnishing total demand for such systems as well as the exposure system demand.

19.4.3 Water Curtains

19.4.3.1

Sprinklers in a water curtain such as described in 9.3.5 or 9.3.13.2 shall be hydraulically designed to provide a discharge of 3 gpm per lineal foot (37 L/min per lineal meter) of water curtain, with no sprinklers discharging less than 15 gpm (57 L/min).

19.4.3.2

For water curtains employing automatic sprinklers, the number of sprinklers calculated in this water curtain shall be the number in the length corresponding to the length parallel to the branch lines in the area determined by 27.2.4.2.

19.4.3.3

For a deluge system water curtain providing proscenium opening protection in accordance with 9.3.13.2, the water curtain shall be calculated to supply all of the open sprinklers attached thereto.

19.4.3.4 Sprinklers Under Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction With Members 3 ft (0.9 m) or Less on Center and Slope Having Pitch of 4 in 12 or Greater

19.4.3.4.1

Where sprinkler spacing does not exceed 8 ft (2.4 m) measured perpendicular to the slope, the minimum sprinkler discharge pressure shall be 7 psi (0.5 bar).

19.4.3.4.2

Where sprinkler spacing exceeds 8 ft (2.4 m) measured perpendicular to the slope, the minimum sprinkler discharge pressure shall be 20 psi (1.4 bar).

19.4.3.4.3

Hose stream allowance and water supply duration requirements shall be in accordance with those for light hazard occupancies in Table 19.3.3.1.2.

19.4.3.5

If a single fire can be expected to operate sprinklers within the water curtain and within the design area of a hydraulically calculated system, the water supply to the water curtain shall be added to the water demand of the hydraulic calculations and shall be balanced to the calculated area demand.

19.4.4 Sprinkler-Protected Glazing

Where the sprinkler-protected glazing is required to comply with 9.3.15, the water supply duration for the design area that includes the window sprinklers shall be not less than the required rating of the assembly.

19.4.4.1

For sprinkler-protected glazing, the number of sprinklers calculated for the glazing shall be the number in the length corresponding to the length parallel to the branch lines in the area determined by 27.2.4.2.

19.4.4.2

Hydraulic design calculations shall include a design area selected to include ceiling sprinklers adjacent to the sprinkler-protected glazing.

19.5 Deluge Systems

Open sprinkler and deluge systems shall be hydraulically calculated according to applicable standards.