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RESURGAM CITY OF PORTLAND, MAINE
Reviewed for Code Compliance
Inspections Division
Approved with Conditions
Date: 10/31/13

EQUIVALENCY FOR 414 FORE STREET, PORTLAND,

To: Cpt. Chris Pirone, Portland Fire Department
Asst. Fire Marshal Richard McCarthy, State Fire Marshal's Office
Ms. Jeanie Bourke, City of Portland Planning & Urban Development Office

From: Jeffrey L. DeMaine, P.E.

CC: Richard Borrelli, Sr. Architect, Harriman Associates

Date: September 17, 2013

Subject: Gould Restaurant – Equivalency Documentation

As permitted by NFPA 101 – Section 1.4 and IBC Section 104.11, the following documentation provides technical backup for our equivalent design approach at the proposed Gould Restaurant at 414 Fore Street in Portland, Maine. This documentation is only applicable to this address and is not transferable to other properties/buildings.

APPLICABLE CODES AND REQUIREMENTS

NFPA 101

NFPA 101 – 2009 edition has been adopted by the City of Portland as well as the State of Maine. The following sections are applicable to this equivalency approach (actual text has been modified where it is not applicable). Each section is also provided with additional discussion / comments for further use later in the document.

Definitions

- **NFPA 101 - 3.3.178.2 Assembly Occupancy Definition** - An occupancy (1) used for a gathering of 50 or more persons for deliberation, worship, entertainment, eating, drinking, amusement, awaiting transportation, or similar uses; or (2) used as a special amusement building, regardless of occupant load.

  Restaurants and drinking establishments with an occupant load of fewer than 50 people are typical classified as a Mercantile Occupancy.

- **NFPA 101 - 3.3.178.9 Mercantile Occupancy Definition -** An occupancy used for the display and sale of merchandise.

- **NFPA 101 - 3.3.61 Dwelling Unit** - One or more rooms arranged for complete, independent housekeeping purposes with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation.
- **NFPA 101 - 3.3.61.1 One- and Two-Family Dwelling Unit** - A building that contains not more than two dwelling units with independent cooking and bathroom facilities.

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Since the building contains less than 2 dwelling units, the residential portion of the b classified as a Two-Family Dwelling unit. There are limits to the number of occupan dwelling unit per NFPA 101, but based on the size of each unit, it appears that the lin reached (3 or less non-familiar occupants).

Restaurant

- **NFPA 101 - 36.1.4.2.1 -** Mercantile occupancies shall be sub-classified as follows:
  (2) Class B, as follows:
  (a) All mercantile occupancies of more than 3,000 ft^2, but not more than 30,000 ft^2, aggregate gross area and occupying not more than three stories for sales purposes
  (b) All mercantile occupancies of not more than 3,000 ft^2 gross area and occupying two or three stories for sales purposes
  (3) Class C, all mercantile occupancies of not more than 3,000 ft^2 gross area and used for sales purposes occupying one story only.

  The total area of mercantile space within the building is approximately 1,900 ft^2. Since the mercantile occupancies are connected (via the open stair), the classification of the restaurant is Class B. However, if each floor was considered as separate tenants (1-hour separation and sprinklered building), each floor would be classified as a Class C mercantile space.

- **NFPA 101 - 36.2.4.1 -** Exits shall comply with the following, except as otherwise permitted by NFPA 101 36.2.4.2 through 36.2.4.5:
  (1) The number of means of egress shall be in accordance with NFPA 101 Section 7.4.
  (2) Not less than two separate exits shall be provided on every story.
  (3) Not less than two separate exits shall be accessible from every part of every story.

  Each floor of the restaurant is provided with a single grade level exit to the exterior.

- **NFPA 101 - 36.2.4.2 -** Exit access, as required by NFPA 101 36.2.4.1(3), shall be permitted to include a single exit access path for the distances permitted as common paths of travel by NFPA 101 36.2.5.3.

  The common path of travel from the most remote point to the exterior within each floor of the restaurant is 75 feet or less. This would allow a mezzanine within a Class B mercantile to have only a single access path.

- **NFPA 101 - 36.2.4.3 -** A single means of egress shall be permitted in a Class C mercantile occupancy, provided that the travel distance to the exit or to a mall pedestrian way (*see NFPA 101 36.4.4.2*) does not exceed 75 ft.

  The travel distance from the most remote point to the exterior within each floor of the restaurant is 75 feet or less.

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- **NFPA 101 - 36.3.1 Protection of Vertical Openings -** Any vertical opening sha accordance with NFPA 101 Section 8.6, except under the following conditions:
  (1) In Class A or Class B mercantile occupancies protected throughout by an app supervised automatic sprinkler system in accordance with NFPA 101 9.7.1.1(vertical openings shall be permitted at one of the following locations:
    (a) Between any two floors
    (b) Among the street floor, the first adjacent floor below, and the adjacent floor (or mezzanine) above
  (2) In Class C mercantile occupancies, unprotected openings shall be permitted between the street floor and the mezzanine.

  The open stair between the two floors of the restaurant is within a Class B mercantile since the building will be fully protected with an automatic sprinkler system. If the spaces were considered Class C, no sprinkler protection would be required.

- **NFPA 101 - 36.3.5.1 -** Mercantile occupancies shall be protected by an approved automatic sprinkler system in accordance with NFPA 101 9.7.1.1(1) as follows:
  (1) Throughout all mercantile occupancies three or more stories in height
  (2) Throughout all mercantile occupancies exceeding 12,000 ft^2 in gross area
  (3) Throughout stories below the level of exit discharge where such stories have an area exceeding 2500 ft^2 and are used for the sale, storage, or handling of combustible goods and merchandise
  (4) Throughout multiple occupancies protected as mixed occupancies in accordance with NFPA 101 6.1.14 where the conditions of NFPA 101 36.3.5.1(1), (2), or (3) apply to the mercantile occupancy

  The restaurant would not be required for this code requirement to be protected by an automatic sprinkler system since it is less than 3 stories, less than 12,000 sq.ft. in gross area, and has less than 2,500 sq.ft. below the level of exit discharge.

- **NFPA 101 - 36.3.4.1 Detection, Alarm, and Communications Systems** - Class A mercantile occupancies shall be provided with a fire alarm system in accordance with NFPA 101 Section 9.6.

  The restaurant is not required to be protected by a fire alarm system since it is not a Class A mercantile. However, a fire alarm system will be included as part of the project to provide early notification of occupants within the building of an event.

<u>Residential</u>

- **NFPA 101 - 24.1.2.3 -** Multiple dwelling units of a residential occupancy shall be permitted to be located above a nonresidential occupancy only where one of the following conditions exists:
  (1) Where the dwelling unit of the residential occupancy and exits therefrom are separated from the nonresidential occupancy by construction having a minimum 1-hour fire resistance rating.
  (2) Where the nonresidential occupancy is protected throughout by an approved, supervised automatic sprinkler system in accordance with NFPA 101 Section 9.7.
  (3) Where the nonresidential occupancy is protected by an automatic fire detection system in accordance with NFPA 101 Section 9.6.

  The dwelling units will be separated from the Restaurant by a 2-hour fire separation.

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- **NFPA 101 - 24.2.2.1.1 -** In dwellings or dwelling units of two rooms or more, ev room and every living area shall have not less than one primary means of escape secondary means of escape.
- **NFPA 101 - 24.2.2.1.2 -** A secondary means of escape shall not be required wher following conditions are met:
  (1) The bedroom or living area has a door leading directly to the outside of the b the finished ground level.
  (2) The dwelling unit is protected throughout by an approved automatic sprinkler system in accordance with NFPA 101 - 24.3.5.

  The building will be provided with an NFPA 13 sprinkler system per condition (2), therefore, a secondary means of escape is not required.

- **NFPA 101 - 24.3.4 Detection, Alarm, and Communications Systems -** Smoke alarms or a smoke detection system shall be provided in accordance with either 24.3.4.1 or 24.3.4.2, as modified by 24.3.4.3.
- **NFPA 101 - 24.3.4.1 -** Smoke alarms shall be installed in accordance with 9.6.2.10 in the following locations:
  (1) All sleeping rooms
  (2) Outside of each separate sleeping area, in the immediate vicinity of the sleeping rooms
  (3) On each level of the dwelling unit, including basements
- **NFPA 101 - 24.3.4.2 -** Dwelling units shall be protected by an approved smoke detection system in accordance with Section 9.6 and equipped with an approved means of occupant notification.

  The building will be provided with an approved fire alarm / detection system as required by NFPA 101 / NFPA 72.

MAINE UNIFORM BUILDING AND ENERGY CODE (MUBEC)

Maine (and the City of Portland) has adopted the 2009 editions of the ICC family of codes. This includes the International Building Code (IBC) and the International Existing Building Code (IEBC). The IEBC is the scoping document that is used to determine the extent of compliance during a renovation. This renovation is considered a change in occupancy. The Work Area method was used to evaluate this project.

INTERNATIONAL EXISTING BUILDING CODE

- **IEBC 101.5.2 Work area compliance method -** Repairs, alterations, additions, changes in occupancy and relocated buildings complying with the applicable requirements of Chapters 5 through 13 of this code shall be considered in compliance with the provisions of this code.
- **IEBC 405.1 Scope -** Level 3 alterations apply where the work area exceeds 50 percent of the aggregate area of the building.
- **IEBC 405.2 Application -** Level 3 alterations shall comply with the provisions of IEBC Chapters 7 and 8 for Level 1 and 2 alterations, respectively, as well as the provisions of IEBC Chapter 9.
- **IEBC 406.1 Scope –** Change in occupancy provisions apply where activity is classified as a change in occupancy as defined in IEBC Chapter 2.
- **IEBC 406.1 Application –** Changes in occupancy shall comply with the provisions of IEBC Chapter 9.

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The project entails a change in occupancy for the first and second floors. Theref Chapter 9 was reviewed initially. In addition, the work is greater than 50% of th area of the building and is a Level 3 alteration, in which Chapter 6, 7, and 8 was

- **IEBC 901.3 Change of occupancy classification -** Where the occupancy classif building changes, the provisions of IEBC Sections 902 through 912 shall apply. T change of occupancy classification within a use group as well as a change of occupancy classification from one use group to a different use group.
- **IEBC 901.3.1 Partial change of occupancy classification -** Where a portion of an existing building is changed to a new occupancy classification, IEBC Section 912 shall apply.

The change in occupancy classification occurs within a separated use building. Therefore, the restaurant space will comply with IBC. Since the Residential portion of the building is being modified (removal of the interior stair), the existing residential units are required to comply with a Level 3 renovation.

- **IEBC 903.1 General -** Building elements and materials in portions of buildings undergoing a change of occupancy classification shall comply with IEBC Section 912.
- **IEBC 904.1 General -** Fire protection requirements of IEBC Section 912 shall apply where a building or portions thereof undergo a change of occupancy classification.
- **IEBC 905.1 General -** Means of egress in portions of buildings undergoing a change of occupancy classification shall comply with IEBC Section 912.

The building elements, fire protection systems, and means of egress will comply with IEBC Sections below.

- **IEBC 912.1 General -** The provisions of this section shall apply to buildings or portions thereof undergoing a change of occupancy classification. This includes a change of occupancy classification within a group as well as a change of occupancy classification from one group to a different group. Such buildings shall also comply with IEBC Sections 902 through 911. The application of requirements for the change of occupancy shall be as set forth in IEBC Sections IEBC 912.1.1 through 912.1.4. A change of occupancy, as defined in IEBC Section 202, without a corresponding change of occupancy classification shall comply with IEBC Section 901.2.
- **IEBC 912.1.1 Compliance with Chapter 8 -** The requirements of IEBC Chapter 8 shall be applicable throughout the building for the new occupancy classification based on the separation conditions set forth in IEBC Sections 912.1.1.1 and 912.1.1.2.
    - **IEBC 912.1.1.1 Change of occupancy classification without separation.** Where a portion of an existing building is changed to a new occupancy classification and that portion is not separated from the remainder of the building with fire barriers having a fire-resistance rating as required in the IBC for the separate occupancy, the entire building shall comply with all of the requirements of IEBC Chapter 8 applied throughout the building for the most restrictive occupancy classification in the building and with the requirements of this chapter.
    - **IEBC 912.1.1.2 Change of occupancy classification with separation.** Where a portion of an existing building that is changed to a new occupancy classification and that portion is separated from the remainder of the building with fire barriers having a fire-resistance rating as required in the IBC for the separate occupancy, that portion shall comply with all of the requirements of IEBC Chapter 8 for the new occupancy classification and with the requirements of this chapter.

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The change in occupancy classification occurs within a separated use building. hour fire resistance rated floor ceiling assembly will be provided between the sec restaurant and the residential space on the Third Floor. Therefore, the restaurar First and Second Floors) is required to comply with IBC related to the change in

- **IEBC 912.1.2 Fire protection and interior finish -** The provisions of IEBC Sec 912.3 for fire protection and interior finish, respectively, shall apply to all buildings undergoing a change of occupancy classification.
- **IEBC 912.1.3 Change of occupancy classification based on hazard category -** The relative degree of hazard between different occupancy classifications shall be determined in accordance with the categories specified in IEBC Tables 912.4, 912.5 and 912.6. Such a determination shall be the basis for the application of IEBC Sections 912.4 through 912.7.

- **IEBC 912.2 Fire protection systems -** Fire protection systems shall be provided in accordance with IEBC Sections 912.2.1 and 912.2.2.
- **IEBC 912.2.1 Fire sprinkler system -** Where a change in occupancy classification occurs that requires an automatic fire sprinkler system to be provided based on the new occupancy in accordance with Chapter 9 of the IBC, such system shall be provided throughout the area where the change of occupancy occurs.
- **IEBC 912.2.2 Fire alarm and detection system -** Where a change in occupancy classification occurs that requires a fire alarm and detection system to be provided based on the new occupancy in accordance with Chapter 9 of the IBC, such system shall be provided throughout the area where the change of occupancy occurs. Existing alarm notification appliances shall be automatically activated throughout the building. Where the building is not equipped with a fire alarm system, alarm notification appliances shall be provided throughout the area where the change of occupancy occurs and shall be automatically activated.

  The entire building will be provided with an automatic sprinkler system as well as a fire alarm system in accordance with the IBC.

- **IEBC 912.4 Means of egress, general -** Hazard categories in regard to life safety and means of egress shall be in accordance with IEBC Table 912.4.
- **IEBC 912.4.2 Means of egress for change of use to equal or lower hazard category -** When a change of occupancy classification is made to an equal or lesser hazard category (higher number) as shown in IEBC Table 912.4, existing elements of the means of egress shall comply with the requirements of IEBC Section 805 for the new occupancy classification. Newly constructed or configured means of egress shall comply with the requirements of Chapter 10 of the IBC.

  Based on IEBC Table 912.4, the hazard category is not being increased. The category for the restaurant is 3 (since each floor is classified as a Use Group A-2 per IBC) and the existing space is 3 (since the existing use is a mercantile – Use Group M). Although a stair is being removed from the residential units, the residential units comply with IBC (See below).

- **IEBC 801.1 Scope -** Level 3 alterations as described in Section 405 shall comply with the requirements of this chapter.
- **IEBC 801.2 Compliance -** In addition to the provisions of this chapter, work shall comply with all of the requirements of IEBC Chapters 6 and 7. The requirements of IEBC Sections 703, 704 and 705 shall apply within all work areas whether or not they include exits and corridors shared by more than one tenant and regardless of the occupant load.

  The restaurant will comply with IEBC Chapters 6 and 7.

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- **IEBC 804.2 Fire alarm and detection systems -** Fire alarm and detection syster with IEBC Sections 704.4.1 and 704.4.3 shall be provided throughout the buildin with the IBC.

- **IEBC 804.2.1 Manual fire alarm systems -** Where required by the IBC, a manu system shall be provided throughout the work area. Alarm notification appliances shall be provided on such floors and shall be automatically activated as required by the IBC.
  Exceptions:
  1. Alarm-initiating and notification appliances shall not be required to be installed in tenant spaces outside of the work area.
  2. Visual alarm notification appliances are not required, except where an existing alarm system is upgraded or replaced or where a new fire alarm system is installed.
- **IEBC 804.2.2 Automatic fire detection -** Where required by the IBC for new buildings, automatic fire detection systems shall be provided throughout the work area.

  The building will be provided with a new fire alarm system as required by IBC.

- **IEBC 703.2 Vertical openings -** Existing vertical openings shall comply with the provisions of IEBC Sections 703.2.1, 703.2.2 and 703.2.3.
- **IEBC 703.2.1 Existing vertical openings -** All existing interior vertical openings connecting two or more floors shall be enclosed with approved assemblies having a fire-resistance rating of not less than 1 hour with approved opening protectives.
  Exceptions:
  1. Where vertical opening enclosure is not required by the IBC or the IFC.
  3. The enclosure shall not be required where:
     3.2. All of the following conditions are met:
        3.2.1. The communicating area has a low hazard occupancy or has a moderate hazard occupancy that is protected throughout by an automatic sprinkler system.
        3.2.2. The lowest or next to the lowest level is a street floor.
        3.2.3. The entire area is open and unobstructed in a manner such that it may be assumed that a fire in any part of the interconnected spaces will be readily obvious to all of the occupants.
        3.2.4. Exit capacity is sufficient to provide egress simultaneously for all occupants of all levels by considering all areas to be a single floor area for the determination of required exit capacity.
        3.2.5. Each floor level, considered separately, has at least one half of its individual required exit capacity provided by an exit or exits leading directly out of that level without having to traverse another communicating floor level or be exposed to the smoke or fire spreading from another communicating floor level.
  12. One- and two-family dwellings.

- **IEBC 703.2.3 Supplemental stairway enclosure requirements -** Where the work area on any floor exceeds 50 percent of that floor area, stairways that are part of the means of egress serving the work area shall, at a minimum, be enclosed with smoke-tight construction on the highest work area floor and all floors below.
  Exception: Where stairway enclosure is not required by the IBC 1016.1.

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Based on a fully sprinklered building, the open stair within the restaurant is perm since it is not part of the means of egress.

- **IEBC 705.1 Scope -** The requirements of this section shall be limited to work are exits or corridors shared by more than one tenant within the work area in which I alterations are being performed, and where specified they shall apply throughout which the work areas are located or otherwise beyond the work area.
- **IEBC 705.2 General -** The means of egress shall comply with the requirements of this section.
  Exceptions:
  1. Where the work area and the means of egress serving it complies with NFPA 101.

  The work area within the residential portion of the building and its means of egress comply with NFPA 101 (see sections above). The work area within the restaurant and its means of egress complies with the sections below.

- **IEBC 705.3 Number of exits -** The number of exits shall be in accordance with IEBC Sections 705.3.1 through 705.3.3.
- **IEBC 705.3.1 Minimum number -** Every story utilized for human occupancy on which there is a work area that includes exits or corridors shared by more than one tenant within the work area shall be provided with the minimum number of exits based on the occupancy and the occupant load in accordance with the IBC. In addition, the exits shall comply with IEBC Sections 705.3.1.1 and 705.3.1.2.
- **IEBC 705.3.1.1 Single-exit buildings -** Only one exit is required from buildings and spaces of the following occupancies:
  1. In Group A, B, E, F, M, U and S occupancies, a single exit is permitted in the story at the level of exit discharge when the occupant load of the story does not exceed 50 and the exit access travel distance does not exceed 75 feet.

  The First and Second Floors of the building are each provided with a grade level egress door to the exterior. Each floor has a calculated occupant load of less than 50 and a travel distance from the most remote area of 75 feet or less.

INTERNATIONAL BUILDING CODE

As referenced by the IEBC, the IBC is applicable for all new construction and change of occupancies. The following section describes the number of exits required from each story.

- **IBC 303.4 Assembly Group A-2.** Assembly uses intended for food and/or drink consumption including restaurants, taverns and bars.
- **IBC 303.1.1 Small buildings and tenant spaces.** A building or tenant space used for assembly purposes with an *occupant load* of less than 50 persons shall be classified as a Group B occupancy.

  The Use Group for the restaurant is Use Group A-2, based on a total occupant load of the tenant space of greater than 50 people, but each floor has an occupant load less than 50 people.

- **IBC 1021.2 Exits from stories.** Two exits, or exit access stairways or ramps providing access to exits, from any story or occupied roof shall be provided where one of the following conditions exists:
  1. The occupant load or number of dwelling units exceeds one of the values in IBC Table 1021.2(1) or 1021.2(2).

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2. The exit access travel distance exceeds that specified in IBC Table 1021. 1021.2(2) as determined in accordance with the provisions of Section 10

Exceptions:

1. Rooms, areas and spaces complying with Section 1015.1 with exits that c directly to the exterior at the level of exit discharge, are permitted to have

The restaurant area is required to be compliant with IBC. Since each floor of the restaurant exits to a level of exit discharge, each floor is allowed to have a single exit (IBC 705.3.1.1 (1)) via IEBC 805 and 912.4.2). In addition, the residential floors are permitted to only have a single means of egress as it is compliant with NFPA 101 (as permitted by IEBC 705.2).

COMPLIANCE ALTERNATIVES / ANALYSIS

Based on the code review above, the main issue that requires a compliance alternative is the number of means of egress for each floor within a Class B mercantile occupancy in accordance with NFPA 101 provisions. If classified as Class C (NFPA 101), a single exit is permitted by NFPA 101. Two exits are required for each floor if classified as a Class B (NFPA 101) mercantile occupancy regardless of the size of each floor / space.

NUMBER OF MEANS OF EGRESS

A comparison between the design (single exit) and a two exit approach was completed. For the two exit approach, a second exit was assumed for each floor. This exit would be assumed to be a compliant straight run stair, without any intermediate landings. The dimensions of the stair are as follows: 94 inches in height, 7 inch by 11 inch treads, 44 inches wide, and a 36 inch door leaf.

To evaluate the level of safety within the restaurant (First and Second Floors), the time to egress from each floor was calculated using the method detailed within the SFPE Handbook Chapter 13. Appendix B of this report shows the basic outline of the required egress times. Only movement times were calculated since detection, alarm, recognition, reaction, and pre-movement times would be the same for either considered egress arrangements.

Based on the calculations (see Appendix A), the time to egress from each floor to the exterior is as follows:

	Total time to the exit
Single exit – First Floor	32 seconds
Two exits – First Floor	38 seconds
Single exit – Second Floor	33 seconds
Two exits – Second Floor	41 seconds

As seen in the above numbers, occupants in a building with the two exits spend a longer time within the building than occupants that are only provided with a single exit to the exterior at each floor.

DISCUSSION

The building, as a whole, is required to comply with both NFPA 101 as well as the IBC / IEBC for this renovation. The code requirements for each are very similar. The overarching goal of each code is to provide occupants with a safe environment as well as allow them to safely egress during an emergency.

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The base requirement for egress is to have multiple separated egress paths from any spac are some exceptions. As seen in the code discussion above, the IEBC does not require th to be compliant with the IBC, only the work area. Therefore, each floor within the restau to have a single means of egress.

Per NFPA 101, the number of means of egress for each space is driven by the type of me (Class B or Class C). The requirements state that each story is required to have two separate exits since the mercantile space is located on two floors. However, as seen in the analysis, the number of exits does not improve the egress time to exit the building, even if a separate new stair enclosure is provided.

As stated in the code requirements above, the restaurant will be separated from the remainder of the building by 2-hour fire resistance rated construction. In addition, the entire building will be provided with a NFPA 13 compliant sprinkler system as required by IBC and a NFPA 72 compliant fire alarm system as required by IBC. Currently, neither a sprinkler system nor a fully compliant fire alarm system is provided within the building. These additional fire protection features will increase the life safety of this building.

CONCLUSIONS

Based on the egress time calculations, the travel distances for the occupants of the restaurant, and the addition of the sprinkler and fire alarm systems, we feel that the design provides an equivalent level of safety for the occupants in comparison to the prescriptive code requirements.

If there are any questions about the above comments, please do not hesitate to contact me.

Sincerely,

Jeffrey DeMaine, P.E.

Reviewed By:

W. Mark Cummings, P.E.

APPENDIX A

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HYDRAULIC MODEL IN ASSESSING EMERGENCY MOVEMENT
(CHAPTER 13 – SFPE HANDBOOK 4TH EDITION)

Assumptions: Queuing will occur.
Maximum specific flow of egress (occurs at population density of 0.175
All occupants start evacuating the floor at the same time
Occupants will use doors on each floor equally (50% at each door / exit)
Maximum travel distance from most remote point to an exit door = 75 ft.

Abbreviations: W_e = Effective Width
CW = Clear width of egress element
BLW = Boundary Layer Width (See Table 3-13.1)
(6 inches for doors, 6 inches for stairs)
F_s = Specific Flow (Equation 6 – Page 3-380)
F_c = Calculated Flow (Equation 8 – Page 3-381)
S = Speed of Movement (See Equation 5)
D = Population density = 0.175 persons/ft^2 (see assumption above)
k = Constant for Speed equation (k) (see Table 3-13.2)
(275 for doorways/corridors, 212 for 7 inch x 11 inch stairs)
a = Constant in Speed equation (2.86) (see Equation 5)

First Floor – Single Exit – Calculated occupant load of 46 people

Egress dimensions: Two door leafs (34 inches clear width each)

Required equations and results for each door leaf:

- W_e = CW – BLW = 34 – 12 = 22 inches = 1.8 ft
- S = k – a k D = 275 – (2.86*275*0.175) = 137.4 ft/min
- F_s = S * D = 137.4 * 0.175) = 24.0 persons / min / ft
- $F_c = F_s * W_e$ = 24.0 * 1.833 = 44.1 persons / min

Since there are two doors and queuing occurs, it is assumed that each door is used equally; therefore the calculated exit time from each door is half of the total population divided by the Calculated Flow, which equals **32 seconds**.

Second Floor – Single Exit – Calculated occupant load of 48 people

Egress dimensions: Two door leafs (34 inches clear width each)

Required equations and results for each door leaf:

- W_e = CW – BLW = 34 – 12 = 22 inches = 1.8 ft
- S = k – a k D = 275 – (2.86*275*0.175) = 137.4 ft/min
- F_s = S * D = 137.4 * 0.175 = 24.0 persons / min / ft
- $F_c = F_s * W_e$ = 24.0 * 1.833 = 44.1 persons / min

Since there are two doors and queuing occurs, it is assumed that each door is used equally; therefore the calculated exit time from each door is half of the total population divided by the Calculated Flow, which equals **33 seconds**.

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First Floor – Two Exits – Calculated occupant load of 46 people

Egress dimensions: Two door leafs (34 inches clear width each) to the exterior
Doors into and out of stair are 34 inches clear width
Stairs are straight run with an elevation change of 7ft 10 inch inch x 11 inches treads

Required equations and results for any door leaf:

- W_e = CW – BLW = 34 – 12 = 22 inches = 1.8 ft
- S = k – a k D = 275 – (2.86*275*0.175) = 137.4 ft/min
- F_s = S * D = 137.4 * 0.175 = 24.0 persons / min / ft
- F_c = F_s * W_e = 24.0 * 1.8 = 44.1 persons / min

Required equations and results for the stair:

- W_e = CW – BLW = 44 – 12 = 32 inches = 2.7 ft
- S = k – a k D = 275 – (2.86*212*0.175) = 105.9 ft/min
- F_s = S * D = 105.9 * 0.175 = 18.5 persons / min / ft
- F_c = F_s * W_e = 24.0 * 1.8 = 49.4 persons / min

Since there are two exits, it is assumed that half of the occupants uses each exit (23 people each exit). The time for occupants to egress through the grade level exit doors (queuing occurs at each door equally) is **16 seconds**.

The time for occupants to travel the stair is based on the Speed of Movement and the distance. The distance is assumed to be **14.5 feet** (based on the floor to floor elevation and the conversion factor (1.85) in Table 3-13.7). The total travel time on a stair is distance divided by the speed, which is **9 seconds**. Therefore, the total time to exit via the stairs is determined by adding the time to get through the door (**32 seconds**) and to get down the stair (**9 seconds**).

The maximum egress time from the First Floor is via the stair which is a total of **38 seconds**.

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Second Floor – Two Exits – Calculated occupant load of 48 people

Egress dimensions: Two door leafs (34 inches clear width each) to the exterior
Doors into and out of stair are 34 inches clear width
Stairs are straight run with an elevation change of 7ft 10 inch inch x 11 inches treads

Required equations and results for any door leaf:

- W_e = CW – BLW = 34 – 12 = 22 inches = 1.8 ft
- S = k – a k D = 275 – (2.86*275*0.175) = 137.4 ft/min
- F_s = S * D = 137.4 * 0.175 = 24.0 persons / min / ft
- F_c = F_s * W_e = 24.0 * 1.8 = 44.1 persons / min

Required equations and results for the stair:

- W_e = CW – BLW = 44 – 12 = 32 inches = 2.7 ft
- S = k – a k D = 275 – (2.86*212*0.175) = 105.9 ft/min
- F_s = S * D = 105.9 * 0.175 = 18.5 persons / min / ft
- F_c = F_s * W_e = 24.0 * 2.7 = 49.4 persons / min

Since there are two exits, it is assumed that half of the occupants uses each exit (24 people each exit). The time for occupants to egress through the grade level exit doors (queuing occurs at each door equally) is **16 seconds**.

The time for occupants to travel the stair is based on the Speed of Movement and the distance. The distance is assumed to be **14.5 feet** (based on the floor to floor elevation and the conversion factor (1.85) in Table 3-13.7). The total travel time on a stair is distance divided by the speed, which is **9 seconds**. Therefore, the total time to exit via the stairs is determined by adding the time to get through the door (**33 seconds**) and to get down the stair (**9 seconds**).

The maximum egress time from the First Floor is via the stair which is a total of **41 seconds**.

APPENDIX B – EGRESS TIME MODEL (SFPE)
AVAILABLE SAFE ESCAPE TIME (ASET) VS. REQUIRED SAFE ESCAPE TIM

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Figure 3-12.1. ***Egress time model.***