

4.1.2 - 06

CODE ANALYSIS



Code

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HVAC

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Electrical

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Plumbing

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Fire Protection

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Commissioning

NE Metro Regional Vocational Technical School

Wakefield, Massachusetts

Code Report

May 6, 2021

**Sullivan Code Group
R.W. Sullivan Engineering**

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Introduction

The Northeast Metro Regional Vocational Technical School project includes the construction of a new vocational high school in Wakefield, MA. The following is a list of applicable codes:

Code Type	Applicable Code (Model Code Basis)
Building	780 CMR: Massachusetts State Building Code, 9 th Edition (2015 International Building Code)
Fire Prevention	527 CMR: Massachusetts Fire Prevention Regulations (2015 NFPA 1) M.G.L. Chapter 148 Section 26G – Sprinkler Protection
Accessibility	521 CMR: Massachusetts Architectural Access Board Regulations
Electrical	527 CMR 12.00: Massachusetts Electrical Code (2020 National Electrical Code)
Elevators	524 CMR: Massachusetts Elevator Code (2013 ASME A17.1)
Mechanical	2015 International Mechanical Code (IMC)
Plumbing	248 CMR: Massachusetts Plumbing Code
Energy Conservation	2018 International Energy Conservation Code

1. Occupancy Classification:

Non-Separated Mixed Uses:

- Use Group A-3 (Gymnasium)
- Use Group B (Offices)
- Use Group E (Educational)

The assembly spaces including the Cafeteria and Auditorium are considered part of the Use Group E occupancy. However, the Gymnasium has not been considered part of the Use Group E occupancy, since it could be used by the general public for outside events not directly associated with the school (780 CMR 303.1.3).

Also, the building will contain hazardous materials. The quantity of hazardous materials must be maintained below the exempt limits per control area in order to avoid a Use Group H classification (780 CMR 307.1 & 414). Since the building will be one control area, the total quantity of hazardous materials throughout the building cannot exceed 100% of the maximum allowable quantities (MAQ) contained in 780 CMR Table 307.1(1). In addition, each floor individually also cannot exceed the percentage of the MAQ shown in the following table (780 CMR Table 414.2.2).

Floor	Percentage of the Maximum Allowable Quantity
Lower Level	75%
1 st Floor	100%
2 nd Floor	75%
3 rd Floor	50%
4 th Floor	50%

2. Min. Construction Type:

Type IB Construction (noncombustible, 2-hr rated)

3. Height and Area Limitations:

The following table summarizes the height and area limitations for Use Group E based on Type IB construction:

Code Reference	Use Group E	
	Height	Area
<u>780 CMR Tables 504.3, 504.4 & 506.2:</u> Tabular Value	6 St. (180 ft)	UL
<u>780 CMR Section 506.2</u> Frontage Increase	-	-
Allowed Height and Area	6 St. (180 ft)	UL
Actual Height and Area	4 St.	~135,000 ft²

4. Fire Resistance Ratings:

The following fire resistance ratings are required in accordance with 780 CMR Table 601 and various sections of the code.

Building Element	Fire Resistance Rating (Hrs)
Primary Structural Frame ^A	2 ^{B,C}
Exterior Bearing Walls	2
Interior Bearing Walls	2 ^{B,C}
Exterior Non-Bearing Walls	Based on FSD
Interior Non-Bearing Walls	0
Floor Construction	2 ^C
Roof Construction	1 ^D

A. Includes beams, trusses, floor members, etc. having a direct connection to the columns (780 CMR 202).

B. Fire resistance ratings of structural frame and bearing walls are permitted to be reduced by one hour but not less than 1 hour rated where supporting a roof only.

C. Not less than the rating supported (780 CMR 707.5, 709.4. and 712.4).

D. Fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below.

Building Element		Fire Resistance Rating (Hrs)	Opening Protectives (Hrs)
Exit Access Corridors (780 CMR 1020.1)		0	0
Stair Shafts (780 CMR 1023.2) ^A		2	1½
Other Shafts (780 CMR 713.4)		2	1½
Elevator Machine Room (780 CMR 3005.4)		2	1½
Emergency Electrical Room (527 CMR 12.00 700-10(D)(2))		2 ^B	1½
Emergency Generator Room – Level 1 Installation (NFPA 110 Section 7.2.1.1)		2	1½
Electrical Vault (if needed) (NFPA 70 Section 110.31(A))		3 hours	
Electrical Closets	With Sprinklers	0	
	Without Sprinklers	2	
Fuel Oil Storage > 660 gallons		2	1½
Furnace room where any piece of equipment is over 400,000 Btu per hour input		Smoke resistant ^C	
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower		Smoke resistant ^C	
Refrigerant machinery room		Smoke resistant ^C	
Paint shops		1 hour and provide automatic fire-extinguishing system	
Laboratories and vocational shops		Smoke resistant ^C	
Laundry rooms over 100 square feet		Smoke resistant ^C	
Waste and linen collection rooms over 100 square feet		Smoke resistant ^C	
Fire pump room (780 CMR 913.2.1)		1 hour ^D	

- A. If exterior walls expose the stair at an angle of less than 180 degrees either the stair wall or adjacent wall must be 1 hour rated with ¾ hour opening protectives for a distance of 10 feet from the stair wall (780 CMR Section 1023.7).
- B. No rating is required for the room when fully sprinklered, however a 2-hr rating is still required for the emergency feeder-circuit wiring and rooms containing an emergency generator (NFPA 110 Section 7.2.1.1).
- C. Where smoke resistant construction and automatic fire-extinguishing system are permitted, accessory occupancies shall be separated from the remainder of the building by construction capable of resisting the passage of smoke and doors shall be self- or automatic-closing upon detection of smoke.
- D. Location and access to the fire pump room shall be pre-planned with the fire department. The room must be directly accessed from the exterior or through a 1 hour fire resistance rated passageway that connects to the exterior (NFPA 20 Section 5.12.1.1.3).

Fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions, or any other wall required to have protected openings or penetrations must be

identified with signs or stenciling within accessible concealed spaces (i.e. floor-ceiling, attic spaces) at 30 ft. intervals (780 CMR 703.7).

5. Stages

The stage areas must comply with 780 CMR 410. It is assumed that the stage height is less than 50 feet. The following requirements must be met.

- Stages must be constructed of materials as required for floors for the type of construction of the building unless the finished floor is constructed of wood or approved non-combustible materials and openings through stage floors shall be equipped with tight-fitting, solid wood trap doors with approved safety locks (410.3.1).
- Galleries, gridirons, and catwalks shall be constructed of approved materials consistent with the requirements of the type of construction of the building (410.3.2).
- Combustible materials used for sets and scenery shall meet NFPA 701 fire propagation performance criteria (410.3.6).
- Emergency ventilation shall be provided for stages larger than 1,000 square feet and follow one of the below (410.3.7).
 - Two or more heat activated roof vents with aggregate opening of not less than 5% of stage area.
 - Smoke control system that maintains a smoke layer interface not less than 6 feet above the highest level of the assembly seating.
- Stage shall be separated from other parts of the building including dressing rooms and scene docks by 1 hour-rated construction (410.5.1).
- Appurtenant rooms to the stage, such as dressing rooms, scene shop, and storerooms, must be separated by 1 hour-rated construction for each other (410.5.2).
- Means of egress on each side of the stage must be provided (410.6.1)

6. Exterior Wall Openings & Fire Resistance Rating:

The exterior wall rating requirements and opening limitations are based on the fire separation distance for each wall. The fire separation distance is measured perpendicular to the exterior wall to the centerline of a public street, an interior lot line, or an imaginary lot line between two buildings on the same lot (780 CMR 702.0). Since the fire separation distance is more than 20 ft. for the entire perimeter of the building, the exterior walls are not required to be rated and the allowable area of openings is not limited (780 CMR Table 602 and Table 705.8).

7. Vertical Floor Openings

Vertical openings are required to comply with 780 CMR 712. The building contains many floor openings that are enclosed in 2 hour fire resistance rated shafts including the exit stairs, elevators, and mechanical chases. The exit stair enclosures will contain glazing that must be fire resistance rated glazing that passes ASTM E119 unless an alternative design is approved that allows the use of sprinkler protected glazing (780 CMR Table 716.5 & 1023.4).

There will also be numerous unprotected floor openings that connect the 1st and 2nd Floor of the building, including the main Lobby, Cafeteria, and Auditorium that are allowed per 712.1.9.

An alternative design is also requested to allow for sprinkler protected glass, 2 hour rated fire barrier walls, or a combination thereof on the 3rd and 4th Floors to separate the upper levels from the floor openings that communicate to the lower floors, including the Gymnasium and Media Center. Since the floor openings will be completely separated from the upper 2 stories, the unprotected floor openings would be equivalent to an allowed two story floor opening that connects the 1st and 2nd Floors in accordance with 780 CMR 712.1.9.

8. Finishes:

Interior Finish

The interior finish of walls and ceilings in exits and corridors must comply with the code for new construction as shown in the table below.

Walls & Ceilings (IBC Table 803.11)

Building Component	Use Group A-3	Use Group B & E
Exit Enclosures and Passageways	Class B	Class B
Corridors	Class B	Class C
Rooms & Enclosed Spaces	Class C	Class C

Note that where exit stairs and exit access corridors serve all use groups, the most restrictive interior finish is required.

New Floor Finishes

Since the building will be equipped with an automatic sprinkler system, traditional floor coverings such as wood, vinyl, and other resilient floor coverings as well as carpeting passing the DOC FF-1 pill test are allowed throughout the building, including all exits, exit passageways and exit access corridors (780 CMR Section 804.4.2).

Exterior Finish

Exterior wall finishes must fully comply with the requirements of 780 CMR 14. Combustible materials are permitted to be used as an exterior wall finish for

this building in accordance with 780 CMR Section 1406.0; however, all exterior wall finishes and architectural trim located greater than 40 feet above grade plane must be constructed of approved noncombustible materials and must be secured to the wall with metal or other approved noncombustible brackets (780 CMR Section 1406.2.2). Additionally, combustible exterior wall finish is limited to 10% of the exterior wall surface area where the fire separation distance is 5 ft or less.

The use of foam plastic materials as part of the exterior wall assembly must comply with 780 CMR 26. The wall assembly must be tested in accordance with NFPA 285 (780 CMR 2603.5.5). Note that this test standard is a full scale assembly test. We recommend confirming with the manufacturer that the foam plastic insulation is part of an approved NFPA 285 assembly or complies with one of the alternative standards listed in 780 CMR Section 2604.1.

9. Means of Egress:

The calculated occupant load for the proposed floor plans, the corresponding required number of exits, the provided number of exits, and the provided egress capacity are summarized below (780 CMR Table 1004.1.2, Table 1006.3.1, and 1005.3). See Code Diagram plans for detailed egress calculations.

Means of Egress

Floor	Occupant Load	Number of Exits		Exit Capacity (persons)
		Required	Provided	
Lower Level	702	3	5	1,133
1 st	2,910	4	8	4,733
2 nd	2,469	4	6	2,507
3 rd	1,471	4	4	1,873
4 th	1,257	4	4	1,873

Where means of egress from floors above and below converge at an intermediate level, the capacity of the means of egress from the point of convergence shall not be less than the sum of the two floors (780 CMR 1005.6).

General Egress Requirements:

- Maximum exit access travel distance must be less than 250 ft (300 ft allowed from Use Group B spaces) (780 CMR Table 1017.2).
- Maximum dead-end corridor length must be less than 20 ft or 2.5 times the least width of space (up to 50 ft is permitted in Use Group B & E spaces) (780 CMR 1020.4).
- All rooms or spaces with an occupant load greater than 49 people or a travel distance over 75 ft (100 ft in Use Group B areas) must be provided with two egress doors swinging in the direction of egress and illuminated

exit signs at each exit (780 CMR Table 1006.2.1 & Sections 1010.1.2.1 & 1013.1). Boiler rooms require two means of egress if the room is greater than 500 sqft. and includes individual fuel-fired equipment greater than 400,000 Btuh input capacity.

- Doors serving more than 49 people in group E and A occupancies must swing in the direction of egress and be provided with panic hardware (780 CMR 1010.1.10).
- All means of egress lighting and exit signs throughout the building must be provided with an emergency power supply to assure continued illumination for not less than 1.5 hours in case of primary power loss (780 CMR 1008.2 & 1008.3.4).
- Remote means of egress must be separated by $\frac{1}{3}$ of the diagonal dimension of the room or space they serve (780 CMR 1007.1.1). The distance between exits must be measured in a straight line between exit doors / paths.
- Roofs and penthouses containing elevator equipment that must be accessed for maintenance are required to be accessed by a stairway (780 CMR 1011.12.1). Permanent means of access to any roof containing mechanical equipment must be provided in accordance with the Mechanical Code.
- All exits must discharge to the exterior of the building except that a maximum of 50% of the number and capacity of the exit enclosures are allowed to exit through areas on the level of discharge if the exit enclosures discharge to a free and unobstructed path of travel to an exterior exit that is readily visible from the discharge of the exit enclosure; the entire area of the level of exit discharge is separated from areas below by construction consistent with the rating of the exit enclosure; and the egress path and all areas open to the egress path on the level of exit discharge must be fully sprinklered (780 CMR 1028.1).
- An approved barrier must be provided at the level of exit discharge where a stair enclosure continues below its level of exit discharge (780 CMR 1023.8).
- A two-way communication system is required at each elevator landing on accessible floors that are one or more stories above or below the level of exit discharge (780 CMR 1009.8).
- At least one passenger elevator must be sized to accommodate the loading and transportation of an ambulance gurney or stretcher sized 24" wide by 84" long with 5" radius corners (524 CMR 17.40(1)).

10. Required Fire Protection Systems:

- NFPA 13 sprinkler system (780 CMR Table 903.2 & M.G.L. c148 s26G)
- Fire alarm system with emergency voice/alarm communication capabilities (780 CMR 907.2.3)
- Emergency responder radio coverage (780 CMR 916)
- Carbon monoxide detection in accordance with 780 CMR 915 and 527 CMR 1 chapter 13.
- Fire extinguishers (780 CMR 906.1)

11. Energy Code Provisions

The project is subject to the provisions of the 2018 International Energy Conservation code with Massachusetts Amendments (Massachusetts Energy Code).

12. Accessibility for Persons with Disabilities

Massachusetts Architectural Access Board Regulations

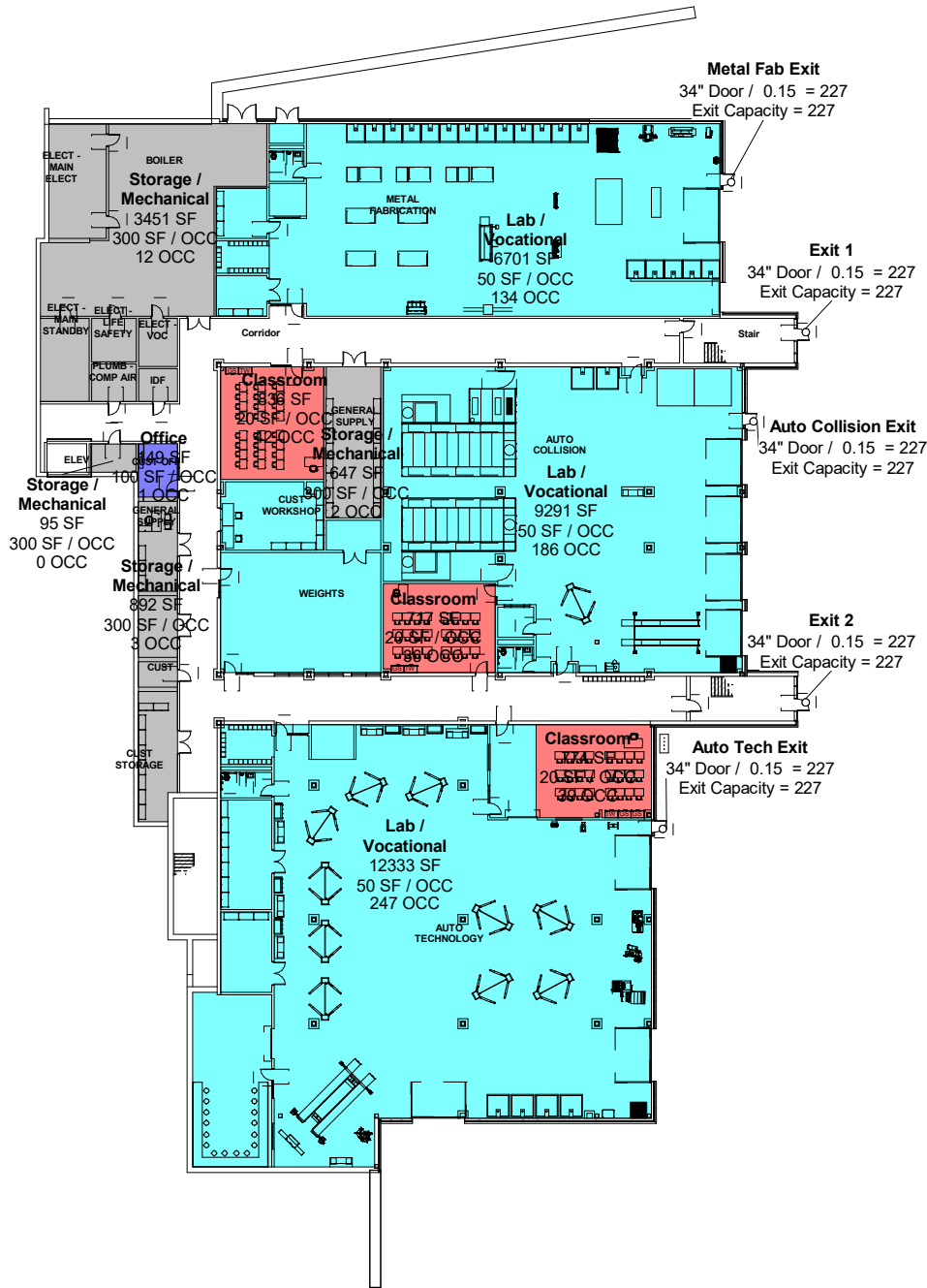
All areas open to the general public are required to comply with the requirements of the Massachusetts Architectural Access Board (521 CMR). This section includes the following major provisions:

- All public entrances must be accessible (521 CMR 25.1).
- All public and common use areas must be accessible and provided with an accessible route thereto (521 CMR Section 12.2.2 and 20.1).
- Accessible toilet rooms must be provided (521 CMR 30.1).
- Where tables, study carrels, computer workstations or fixed seating is provided at least 5% with a minimum of one of each item must be accessible (521 CMR Section 12.2.2).
- The auditorium and gymnasium must be provided with accessible seating and features in accordance with 521 CMR Chapter 14).

American's with Disabilities Act

The ADA Guidelines are not enforced by the Commonwealth of Massachusetts, they can only be enforced through a civil lawsuit or complaint filed with the U.S. Department of Justice. All public and common use areas must be accessible.

Although the provisions of the MAAB do not apply to employee only areas, the ADAAG requires that employee only work spaces must be designed to allow employees to approach, enter, and exit the work area. However, the work areas are not required be provided with accessible features (i.e. shelves, etc.).

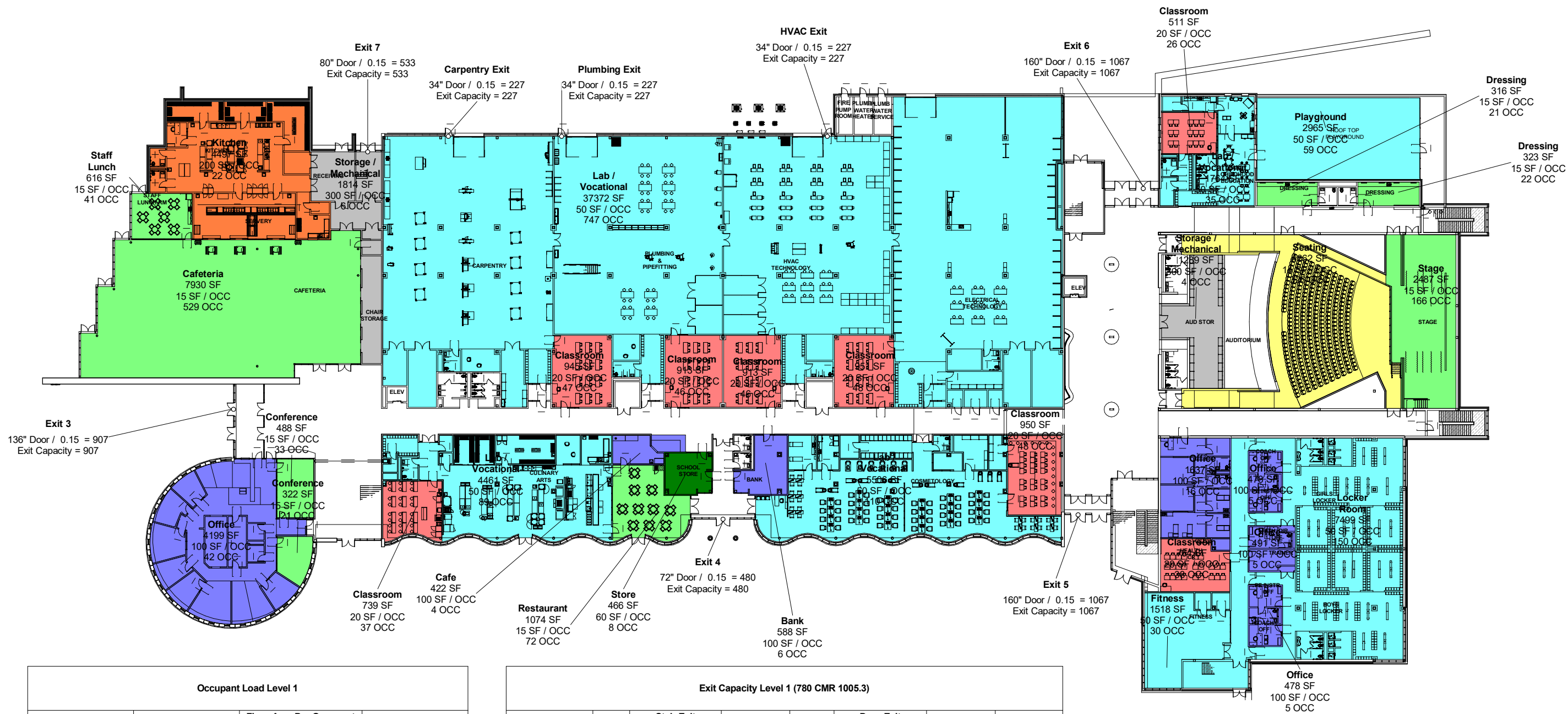


Occupant Load Level 0			
Use	Floor Area	Floor Area Per Occupant (SF / OCC)	Occupant Load
Classroom	2328 SF	20	116.4
Lab / Vocational	28325 SF	50	566.5
Office	149 SF	100	1.5
Storage / Mechanical	5086 SF	300	17.0
	35888 SF		701.3

Exit Capacity Level 0 (780 CMR 1005.3)							
Exit	Stair Width	Stair Exit Allowance (in / person)	Stair Capacity (persons)	Door Width	Door Exit Allowance (in / person)	Door Capacity (persons)	Exit Capacity (persons)
Auto Collision Exit				34"	0.15	227	227
Auto Tech Exit				34"	0.15	227	227
Exit 1				34"	0.15	227	227
Exit 2				34"	0.15	227	227
Metal Fab Exit				34"	0.15	227	227

1133

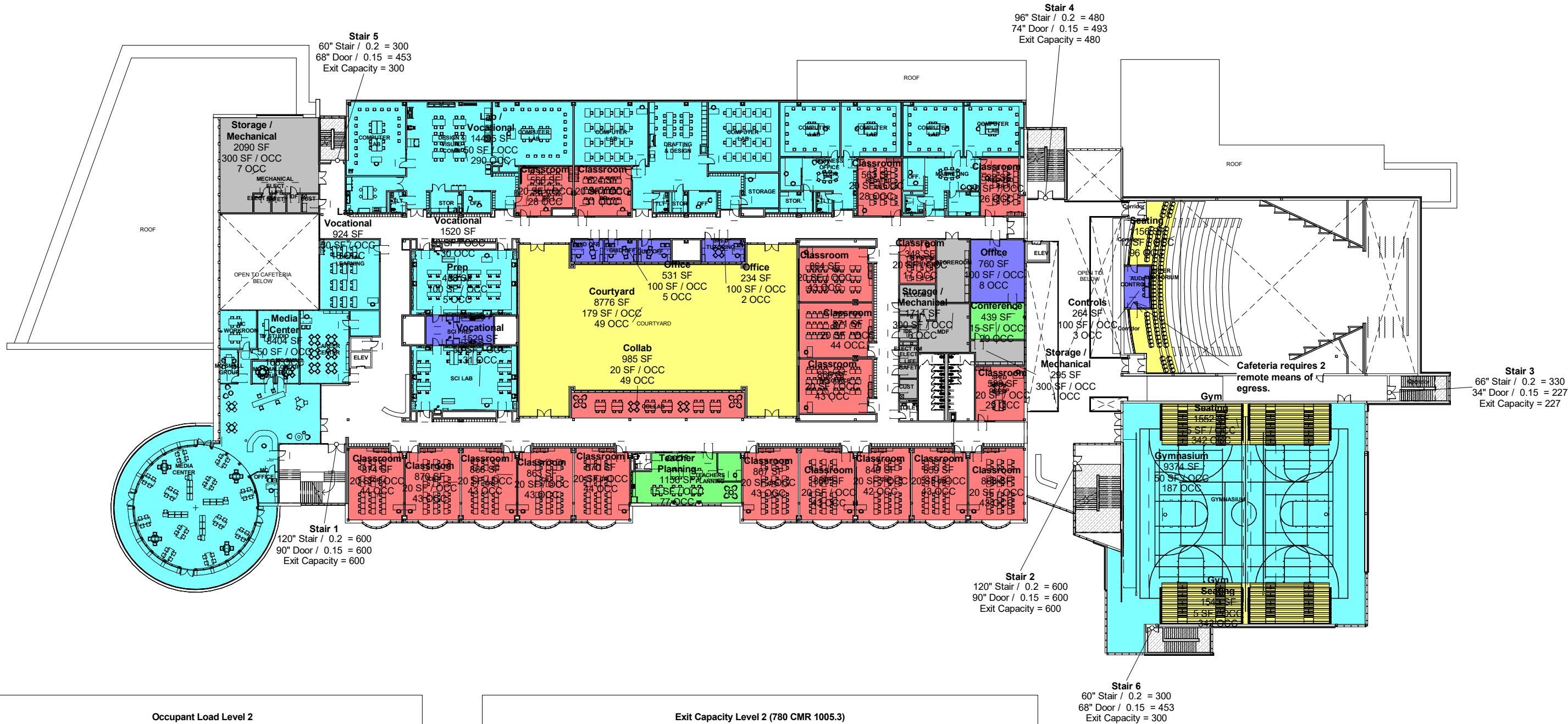
Occupant Load Densities (780 CMR TABLE 1004.1.2)	
<div></div> Actual Population	Assembly with Fixed Seats; Posted Occupant Load
<div></div> 15 Net S.F. / Occ.	Assembly without Fixed Seats - Unconcentrated (Tables and Chairs)
<div></div> 20 Net S.F. / Occ.	Classrooms
<div></div> 50 Net S.F. / Occ.	Educational - Shops and Laboratories; Reading Rooms
<div></div> 50 Gross S.F. / Occ.	Exercise and Fitness Areas; Locker Rooms
<div></div> 60 Gross S.F. / Occ.	Retail
<div></div> 100 Gross S.F. / Occ.	Office Areas
<div></div> 200 Gross S.F. / Occ.	Kitchen
<div></div> 300 Gross S.F. / Occ.	Storage / Mechanical



Occupant Load Level 1			
Use	Floor Area	Floor Area Per Occupant (SF / OCC)	Occupant Load
Bank	588 SF	100	5.9
Cafe	422 SF	100	4.2
Cafeteria	7930 SF	15	528.7
Classroom	6685 SF	20	334.3
Conference	810 SF	15	54.0
Dressing	639 SF	15	42.6
Fitness	1518 SF	50	30.4
Kitchen	4497 SF	200	22.5
Lab / Vocational	49104 SF	50	982.1
Locker Room	7499 SF	50	150.0
Office	7283 SF	100	72.8
Playground	2965 SF	50	59.3
Restaurant	1074 SF	15	71.6
Seating	4662 SF	14	326.0
Staff Lunch	616 SF	15	41.0
Stage	2487 SF	15	165.8
Storage / Mechanical	3103 SF	300	10.3
Store	466 SF	60	7.8
	102346 SF		2909.2

Exit Capacity Level 1 (780 CMR 1005.3)							
Exit	Stair Width	Stair Exit Allowance (in / person)	Stair Capacity (persons)	Door Width	Door Exit Allowance (in / person)	Door Capacity (persons)	Exit Capacity (persons)
Carpentry Exit				34"	0.15	227	227
Exit 3				136"	0.15	907	907
Exit 4				72"	0.15	480	480
Exit 5				160"	0.15	1067	1067
Exit 6				160"	0.15	1067	1067
Exit 7				80"	0.15	533	533
HVAC Exit				34"	0.15	227	227
Plumbing Exit				34"	0.15	227	227
							4733

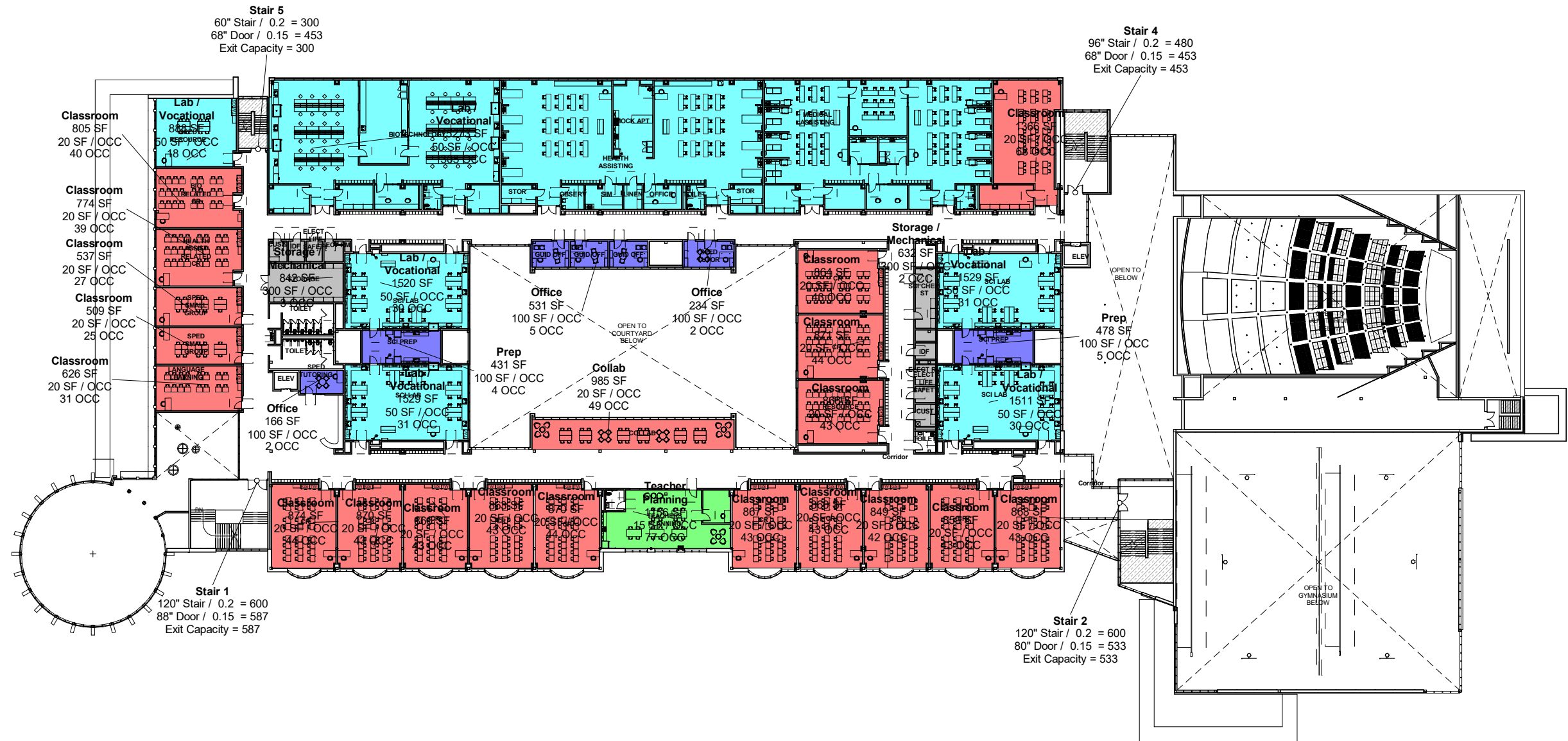
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<div></div> 60 Gross S.F. / Occ.	Retail
<div></div> 100 Gross S.F. / Occ.	Office Areas
<div></div> 200 Gross S.F. / Occ.	Kitchen
<div></div> 300 Gross S.F. / Occ.	Storage / Mechanical



Occupant Load Level 2			
Use	Floor Area	Floor Area Per Occupant (SF / OCC)	Occupant Load
Classroom	14452 SF	20	722.6
Collab	985 SF	20	49.2
Conference	439 SF	15	29.2
Controls	264 SF	100	2.6
Courtyard	8776 SF	179	49.0
Gym Seating	3095 SF	5	684.0
Gymnasium	9374 SF	50	187.5
Lab / Vocational	18468 SF	50	369.4
Media Center	8404 SF	50	168.1
Office	1525 SF	100	15.2
Prep	468 SF	100	4.7
Seating	1156 SF	12	96.0
Storage / Mechanical	4099 SF	300	13.7
Teacher Planning	1156 SF	15	77.1
	72660 SF		2468.3

Exit Capacity Level 2 (780 CMR 1005.3)							
Exit	Stair Width	Stair Exit Allowance (in / person)	Stair Capacity (persons)	Door Width	Door Exit Allowance (in / person)	Door Capacity (persons)	Exit Capacity (persons)
Stair 1	120"	0.2	600	90"	0.15	600	600
Stair 2	120"	0.2	600	90"	0.15	600	600
Stair 3	66"	0.2	330	34"	0.15	227	227
Stair 4	96"	0.2	480	76"	0.15	507	480
Stair 5	60"	0.2	300	68"	0.15	453	300
Stair 6	60"	0.2	300	68"	0.15	453	300
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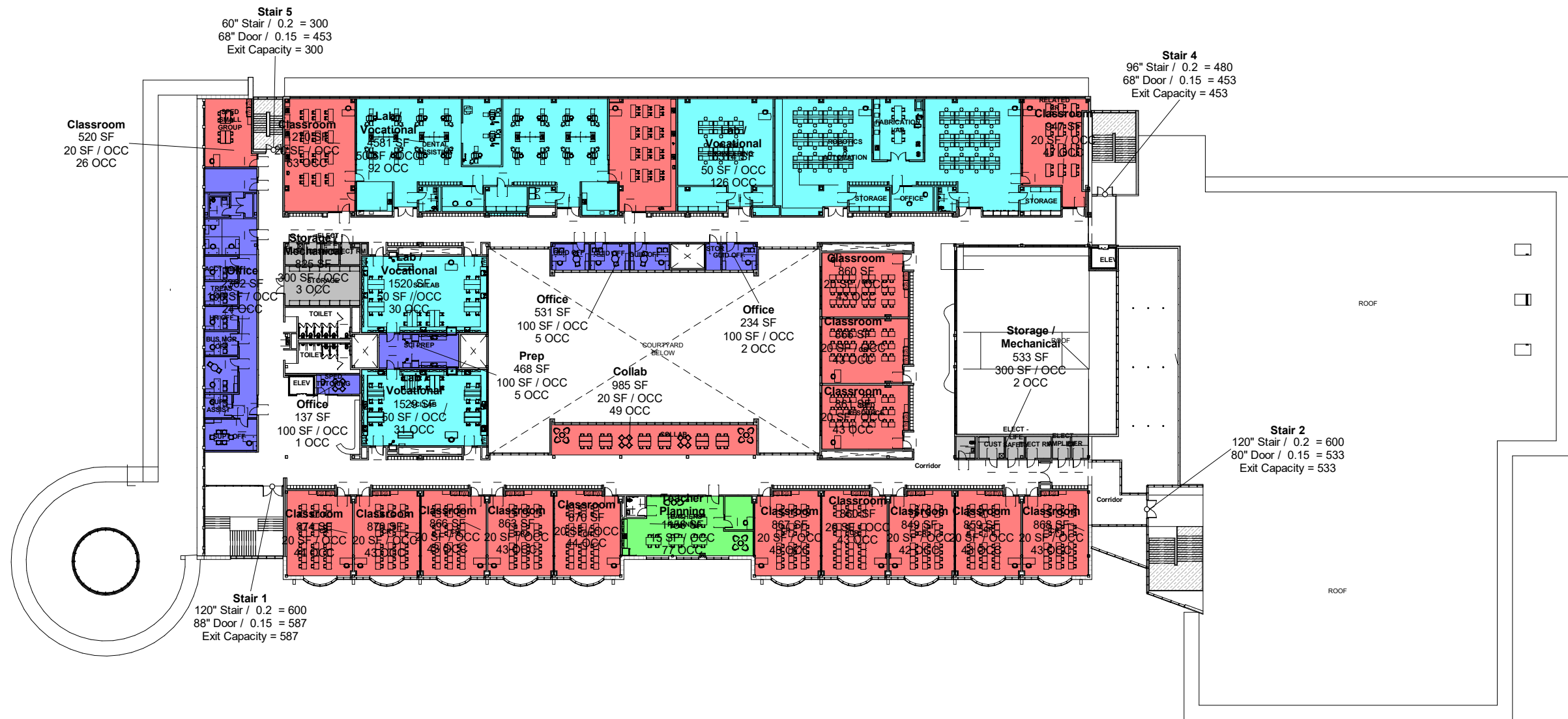
Occupant Load Densities (780 CMR TABLE 1004.1.2)	
Actual Population	Assembly with Fixed Seats; Posted Occupant Load
15 Net S.F. / Occ.	Assembly without Fixed Seats - Unconcentrated (Tables and Chairs)
20 Net S.F. / Occ.	Classrooms
50 Net S.F. / Occ.	Educational - Shops and Laboratories; Reading Rooms
50 Gross S.F. / Occ.	Exercise and Fitness Areas; Locker Rooms
60 Gross S.F. / Occ.	Retail
100 Gross S.F. / Occ.	Office Areas
200 Gross S.F. / Occ.	Kitchen
300 Gross S.F. / Occ.	Storage / Mechanical



Occupant Load Level 3			
Use	Floor Area	Floor Area Per Occupant (SF / OCC)	Occupant Load
Classroom	15863 SF	20	793.2
Collab	985 SF	20	49.2
Conference	0 SF	15	29.2
Lab / Vocational	22250 SF	50	445.0
Office	931 SF	100	9.3
Prep	909 SF	100	9.1
Space	0 SF	308	53.4
Storage / Mechanical	1475 SF	300	4.9
Teacher Planning	1156 SF	15	77.1
	43568 SF		1470.3

Exit Capacity Level 3 (780 CMR 1005.3)							
Exit	Stair Width	Stair Exit Allowance (in / person)	Stair Capacity (persons)	Door Width	Door Exit Allowance (in / person)	Door Capacity (persons)	Exit Capacity (persons)
Stair 1	120"	0.2	600	88"	0.15	587	587
Stair 2	120"	0.2	600	80"	0.15	533	533
Stair 4	96"	0.2	480	68"	0.15	453	453
Stair 5	60"	0.2	300	68"	0.15	453	300
							1873

Occupant Load Densities (780 CMR TABLE 1004.1.2)	
 Actual Population	Assembly with Fixed Seats; Posted Occupant Load
 15 Net S.F. / Occ.	Assembly without Fixed Seats - Unconcentrated (Tables and Chairs)
 20 Net S.F. / Occ.	Classrooms
 50 Net S.F. / Occ.	Educational - Shops and Laboratories; Reading Rooms
 50 Gross S.F. / Occ.	Exercise and Fitness Areas; Locker Rooms
 60 Gross S.F. / Occ.	Retail
 100 Gross S.F. / Occ.	Office Areas
 200 Gross S.F. / Occ.	Kitchen
 300 Gross S.F. / Occ.	Storage / Mechanical



Occupant Load Level 4			
Use	Floor Area	Floor Area Per Occupant (SF / OCC)	Occupant Load
Classroom	15119 SF	20	755.9
Collab	985 SF	20	49.2
Lab / Vocational	13945 SF	50	278.9
Office	3264 SF	100	32.6
Prep	468 SF	100	4.7
Space	0 SF	308	53.4
Storage / Mechanical	1358 SF	300	4.5
Teacher Planning	1156 SF	15	77.1
	36294 SF		1256.3

Exit Capacity Level 4 (780 CMR 1005.3)							
Exit	Stair Width	Stair Exit Allowance (in / person)	Stair Capacity (persons)	Door Width	Door Exit Allowance (in / person)	Door Capacity (persons)	Exit Capacity (persons)
Stair 1	120"	0.2	600	88"	0.15	587	587
Stair 2	120"	0.2	600	80"	0.15	533	533
Stair 4	96"	0.2	480	68"	0.15	453	453
Stair 5	60"	0.2	300	68"	0.15	453	300

1873

Occupant Load Densities (780 CMR TABLE 1004.1.2)	
Actual Population	Assembly with Fixed Seats; Posted Occupant Load
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200 Gross S.F. / Occ.	Kitchen
300 Gross S.F. / Occ.	Storage / Mechanical



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Project: NE Metro Tech

Date: May 28, 2021

Scale: N.T.S.

Level 4
Egress