



**NIST Technical Note
NIST TN 2266**

Plumbing System Models for a Set of Reference Buildings

Stephen Zimmerman
Andrew Persily

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Building Energy and Environment Division

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NIST TN 2266
September 2023

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Abstract

Reference buildings have been defined previously and successfully applied to energy and indoor air quality analyses, providing a platform for consistent comparisons between different building design and operation scenarios. One such set of reference buildings, the National Institute of Standards and Technology's (NIST) suite of homes, is a collection of dwellings developed to represent 80 % of the U.S. housing stock at the time of their development. A second set is the Department of Energy's commercial prototype building models, which is a collection of buildings developed to represent U.S. commercial and institutional buildings. These building models allow for the assessment of new technologies and the resulting impacts on building energy efficiency, ventilation, and indoor air quality.

A building's premise plumbing system plays a critical role in managing water quality and efficiency by bringing in clean, potable water and removing wastewater and can impact health and safety of building occupants. Using models to evaluate the performance of premise plumbing systems can be useful but most studies have considered different buildings with different plumbing systems. To support more consistent modeling efforts, NIST has developed premise plumbing system models for three residential buildings and four commercial buildings and has made them available for researchers and industry to analyze system performance, new technologies, and design & operation strategies. This report describes the seven plumbing system designs, how they were developed and how they can be accessed.

Keywords

analysis; dwelling; potable; premise plumbing; reference building.

Table of Contents

Acknowledgments	v
1. INTRODUCTION	1
2. REFERENCE BUILDINGS	2
2.1. Residential Buildings	2
2.1.1. Single Family, Detached Home – Floor Plan DH-A(7)	2
2.1.2. Single Family, Detached Home – Floor Plan DH-F(4)	3
2.1.3. Mid-rise Apartment – Floor Plan APT-3A(9)	4
2.2. Commercial Buildings	5
2.2.1. Medium Office	6
2.2.2. Stand-Alone Retail	7
2.2.3. Primary School	8
2.2.4. Full-Service Restaurant	9
3. CONCLUSION	10
References	10
Appendix A. NIST Premise Plumbing Systems Website Content	12
Appendix B. Architectural Basis of Design	13

List of Tables

Table 1. Description of reference buildings.	2
Table A1. Outline of NIST’s Premise Plumbing Systems website content.	12

List of Figures

Fig. 1. Layout for DH-A(7) without architectural design update or plumbing system.	3
Fig. 2. Architectural update for DH-A(7), including the plumbing system.	3
Fig. 3. Layout for DH-F(4) without architectural design update or plumbing system.	4
Fig. 4. Architectural update for DH-F(4), including the plumbing system.	4
Fig. 5. Layout for APT-3A(9) without architectural design update or plumbing system.	5
Fig. 6. Architectural update for APT-3A(9), including the plumbing system for one apartment unit and the first-floor laundry facility.	5
Fig. 7. Layout for the Medium Office without architectural design update or plumbing system.	6
Fig. 8. Architectural update for the Medium Office, including the plumbing system.	6
Fig. 9. Layout for the Stand-Alone Retail building without architectural design update or plumbing system.	7
Fig. 10a. Architectural update for the Stand-Alone Retail building, highlighting the restroom.	7
Fig. 10b. Architectural update for the Stand-Alone Retail building, highlighting the mechanical room.	8
Fig. 11. Layout for the Primary School without architectural design update or plumbing system.	8
Fig. 12. Architectural update for the Primary School’s Corridor Pod 2, including the plumbing system.	9
Fig. 13. Layout for the Full-Service Restaurant without architectural design update or plumbing system.	9
Fig. 14. Architectural update for the Full-Service Restaurant, including the plumbing system.	10

Acknowledgments

This project was done in collaboration with Louviere, Stratton & Yokel (LSY) Architects and Laboratory Planners under Agreement #1333ND20DNB190015. The authors would like to thank their colleagues at LSY – Tribhuvan Tuladar, Vigen Yedigarian, and Heather Johnson – for their contributions to the architectural and plumbing system designs. The authors also thank Daniel Gilmore of NIST for his assistance throughout this effort.

1. INTRODUCTION

Premise plumbing constitutes an essential component of the built environment by providing access to clean, potable water and a safe, reliable means of removing wastewater from homes, businesses, and other institutions. The design and operation of plumbing systems impact water and energy consumption, as well as the health and safety of building occupants. A recent NIST report discusses the drivers and technical challenges affecting premise plumbing system design and performance and identifies a range of research needs to address those challenges [3]. One method for evaluating the performance and the impacts of plumbing systems is by modelling, for example, with EPANET [4]. Whatever modeling tool that is employed, it is useful to consider well-documented reference buildings to enable comparison across modelling studies. Reference buildings have previously been developed for energy analyses to support the development of commercial/institutional building energy efficiency standards [5]. One such set of reference buildings, the National Institute of Standards and Technology's (NIST) suite of homes, is a collection of dwellings developed to represent 80 % of the U.S. housing stock at the time of their development [1]. A second set is the Department of Energy's commercial prototype building models, which is a collection of buildings developed to represent U.S. commercial and institutional buildings [2]. These same reference buildings have been further developed to support airflow and indoor air quality analysis. Documentation of the NIST residential buildings and DOE commercial/institutional buildings includes a layout or floorplan for each building and some limited HVAC system components. However, this documentation does not include plumbing fixtures or water distribution piping.

Based on NIST's effort to identify research needs in the field of premise plumbing [3], NIST developed premise plumbing system models for a subset of these existing reference buildings. Specifically, NIST selected three residential buildings and four commercial/institutional buildings to enhance with premise plumbing systems. To develop these designs, NIST contracted with architectural & engineering firm Louviere, Stratton & Yokel (LSY) Architects and Laboratory Planners. LSY designed these premise plumbing systems for each building based on the following codes, guidelines, and standards: the International Residential Code (IRC) 2018 [6], the International Building Code (IBC) 2018 [7], the International Plumbing Code (IPC) 2018 [8], the Americans with Disabilities Act Accessibility Guidelines (ADAAG) 2010 [9], and the National Fire Protection Association (NFPA) 101-2018 [10]. The LSY effort is described in detail in the basis of design document developed to document their efforts (See **Appendix A**).

Table 1 lists the seven reference buildings for which premise plumbing systems were defined. In all cases, certain architectural design elements had to be added, e.g., restroom and kitchen appliances, to support the plumbing designs. In addition to the architectural updates and plumbing system floor plans for these buildings, three dimensional schematics of the plumbing systems have been developed in the form of Revit files. All of these files are listed in **Appendix A** and available for download on the NIST Premise Plumbing Systems website at the following web address: <https://www.nist.gov/el/energy-and-environment-division-73200/premise-plumbing-research-nist/current-activities-0>.

Table 1. Description of reference buildings.

BUILDING SOURCE	NAME	FLOOR AREA (m ²)	FLOORS	BATHROOMS	KITCHEN
NIST suite of homes	Single family, detached home (DH-A(7))	107	1	1	Yes
	Single family, detached home (DH-F(4))	329	3	2.5	Yes
	Mid-rise Apartment (APT-2A(7))	2300	4	31	Yes
DOE prototype building models	Medium Office	4980	3	6	No
	Stand-Alone Retail	2290	1	2	No
	Primary School	6870	1	28	Yes
	Full-Service Restaurant	511	1	2	Yes

2. REFERENCE BUILDINGS

NIST defined premise plumbing systems for seven reference buildings, three residential and four commercial/institutional, which are described in **Sec. 2.1** and **Sec. 2.2** respectively. These descriptions include schematic floor plans for the buildings, which are relatively low resolution. **Appendix B** includes the higher resolution images.

2.1. Residential Buildings

This section describes the three residential buildings for which plumbing systems were designed: two single family, detached homes and a midrise apartment building. All three of the buildings originate from NIST’s suite of homes discussed earlier [1]. **Sec 2.1.1** through **Sec. 2.1.3** discuss these three buildings in further detail.

2.1.1. Single Family, Detached Home – Floor Plan DH-A(7)

Floor Plan DH-A(7) consists of a single floor with one bathroom and a kitchen. **Figure 1** below is the floor plan for this single family, detached home. The original building layout did not include plumbed bathroom or kitchen fixtures, such as a sink, a toilet or a dishwasher; nor did it include plumbed laundry appliances.

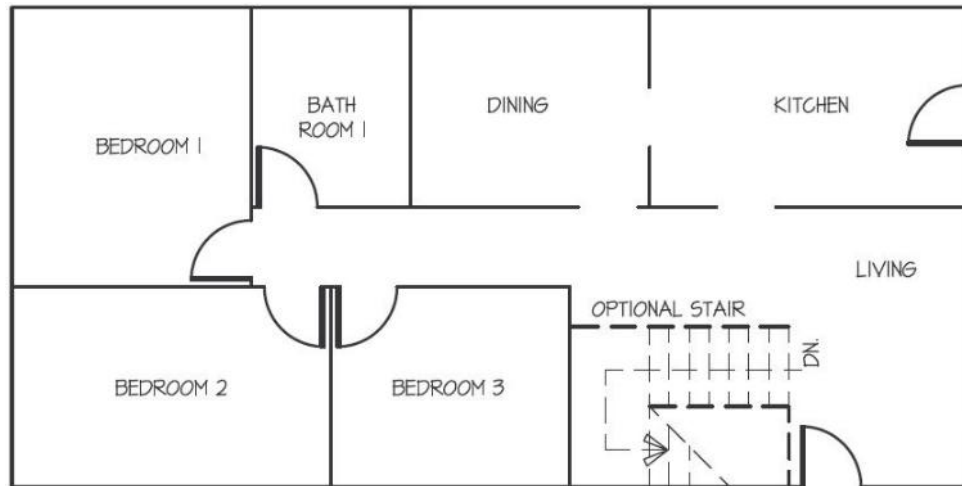


Fig. 1. Layout for DH-A(7) without architectural design update or plumbing system.

As shown in **Figure 2**, the architectural design updates for Floor Plan DH-A(7) include adding a mechanical closet for housing the water heater as well as a closet for the clothes washer and dryer. Plumbing fixtures, such as sinks, a toilet, and a bathtub, and water lines for appliances, such as a clothes washer, a refrigerator, and a dishwasher, have been added.

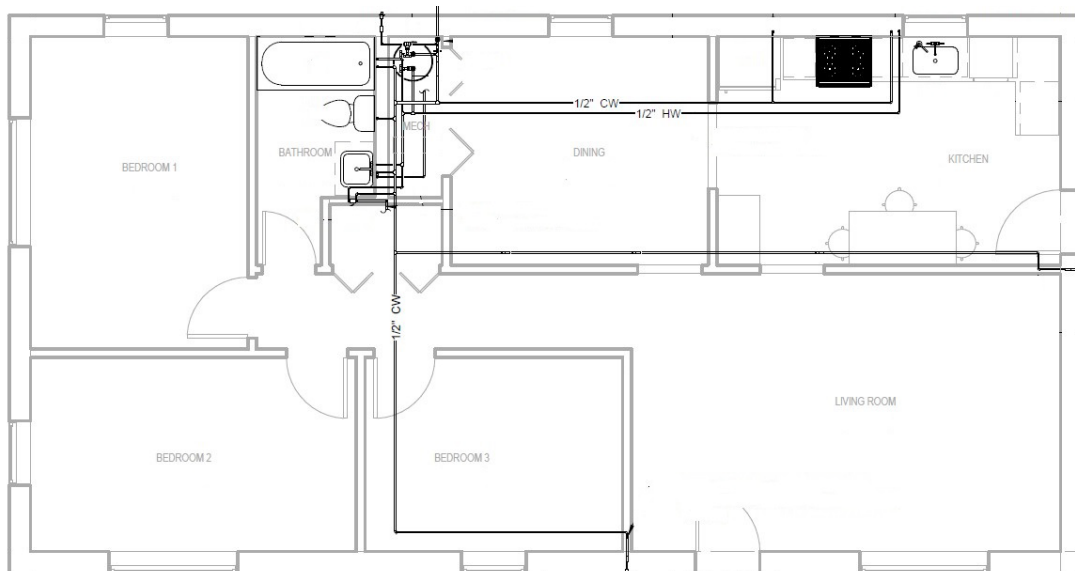


Fig. 2. Architectural update for DH-A(7), including the plumbing system.

2.1.2. Single Family, Detached Home – Floor Plan DH-F(4)

Floor Plan DH-F(4) is a single family, detached home, with two floors and a basement. It has two full bathrooms, one half bathroom (no bathtub/shower), and a kitchen. **Figure 3** below illustrates the floor plan for this single family, detached home. The original building layout did not include plumbed bathroom or kitchen fixtures, such as sinks, toilets, or a dishwasher; nor did it include plumbed laundry appliances.



Fig. 3. Layout for DH-F(4) without architectural design update or plumbing system.

As shown in **Figure 4**, the architectural design for Floor Plan DH-F(4) includes adding a mechanical closet for housing the water heater as well as a closet for the clothes washer and dryer. Plumbing fixtures, such as sinks, toilets, and bathtubs, and water lines for appliances, such as a clothes washer, a refrigerator, and a dishwasher, have been added.



Fig. 4. Architectural update for DH-F(4), including the plumbing system.

2.1.3. Mid-rise Apartment – Floor Plan APT-3A(9)

Floor Plan APT-3A(9) is a multi-family residential building with four floors, each containing eight individual apartment units. Each unit has one full bathroom and a single kitchen. **Figure 5** below illustrates the floor plan for the Mid-rise Apartment. The original building layout did not include plumbed bathroom or kitchen fixtures, such as sinks or toilets; nor did it include plumbed laundry appliances.

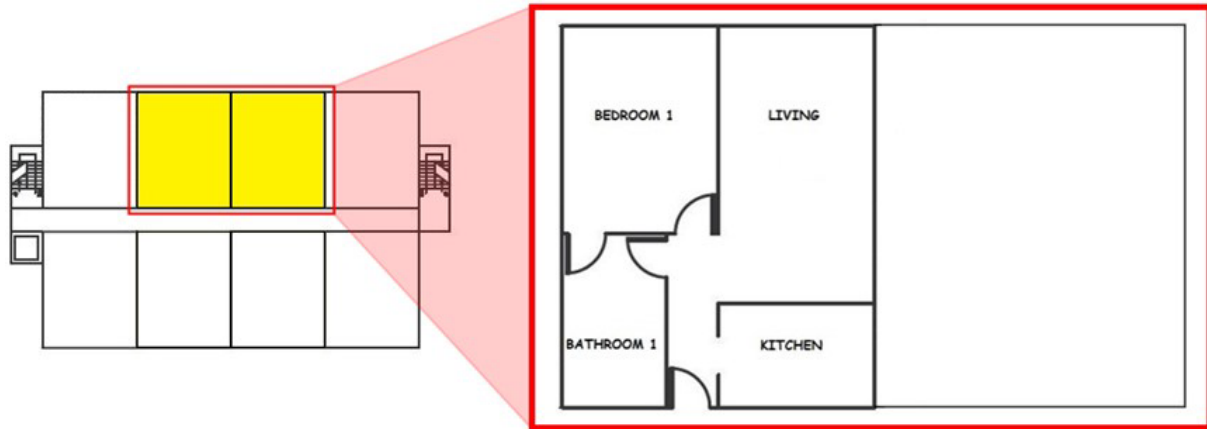


Fig. 5. Layout for APT-3A(9) without architectural design update or plumbing system.

As shown in **Figure 6**, the architectural design updates for Floor Plan APT-3A(9) include converting one of the first-floor units into a mechanical room for housing the water heaters as well as a laundry facility for the community clothes washers and dryers. Plumbing fixtures, such as sinks, toilets, and bathtubs, and water lines for appliances, such as a clothes washer, a refrigerator, and a dishwasher, have been added to each of the remaining 31 individual units.

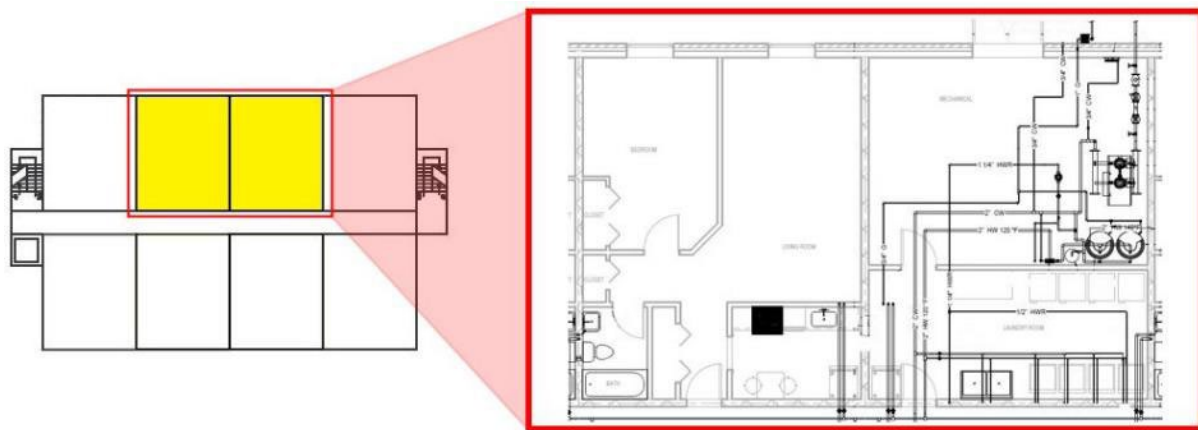


Fig. 6. Architectural update for APT-3A(9), including the plumbing system for one apartment unit and the first-floor laundry facility.

2.2. Commercial Buildings

This section describes the four commercial and institutional buildings for which plumbing systems were designed: a medium-sized office building, a stand-alone retail building, a primary school, and a full-service restaurant building. All four of the buildings originate from the Department of Energy's commercial prototype building models as described in the 2019 report by Ng, *et al* [3]. **Sec 2.2.1** through **Sec. 2.2.4** discuss these four buildings in further detail.

2.2.1. Medium Office

The Medium Office has three floors to accommodate multiple office spaces. Each floor has space designated for a restroom. **Figure 7** below illustrates the floor plan for the Medium Office. The original building layout did not include plumbed restroom fixtures – such as a sink with faucets or toilets.

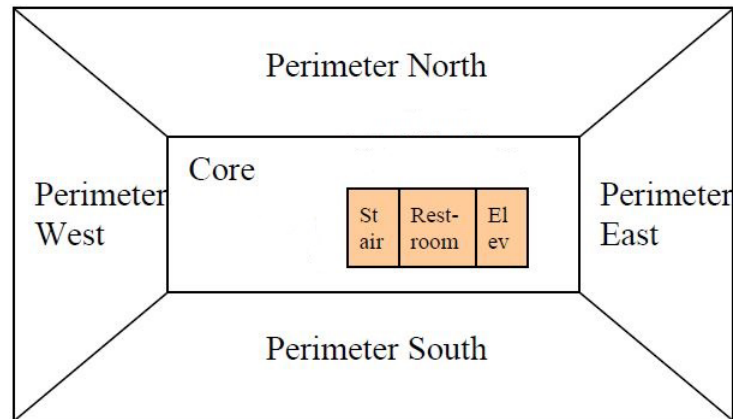


Fig. 7. Layout for the Medium Office without architectural design update or plumbing system.

As shown in **Figure 8**, the architectural design updates for the Medium Office include adding a mechanical room for housing the water heaters on the first floor, a breakroom on each floor to accommodate a sink and janitorial closet, as well as separating the single restroom space into men's and women's restrooms. Plumbing fixtures, such as sinks and toilets, have been added to each of the three floors.

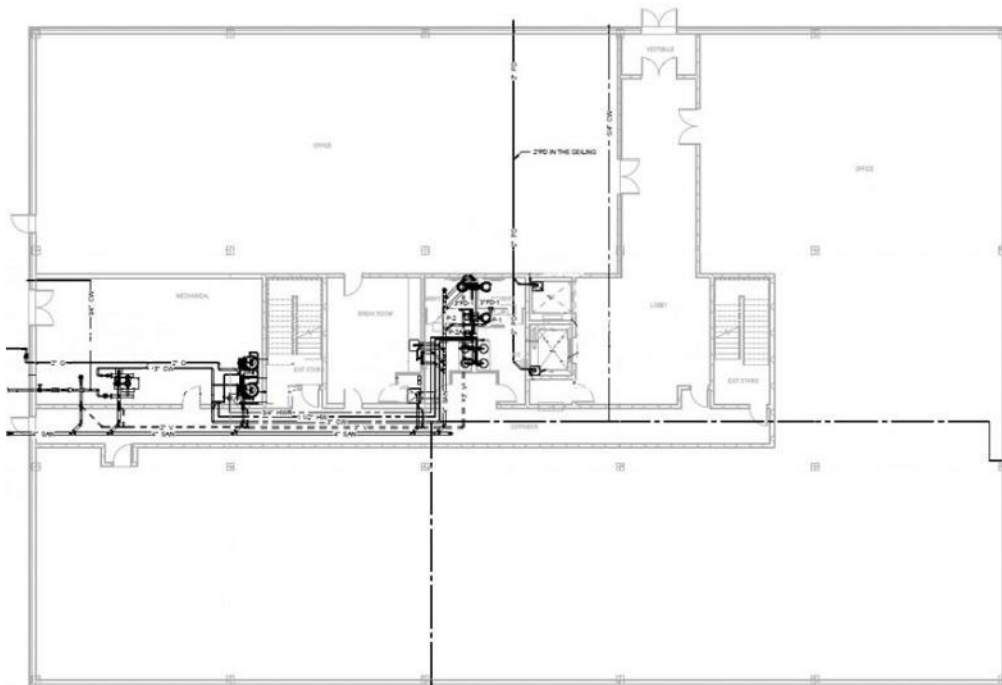


Fig. 8. Architectural update for the Medium Office, including the plumbing system.

2.2.2. Stand-Alone Retail

The Stand-Alone Retail building has a single floor which serves as a single retail unit. The unit has one restroom. **Figure 9** below illustrates the floor plan for the Stand-Alone Retail building. The original building layout did not include plumbed bathroom fixtures.

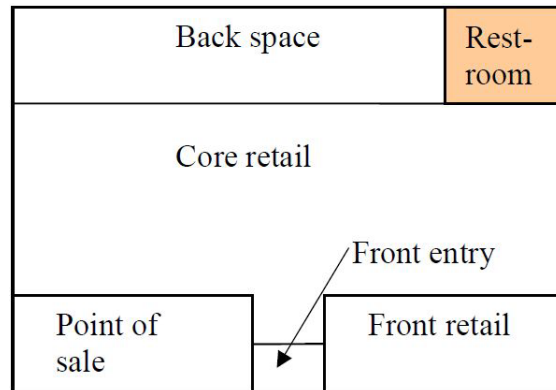


Fig. 9. Layout for the Stand-Alone Retail building without architectural design update or plumbing system.

As shown in **Figure 10a** and **Figure 10b**, the architectural design updates for the Stand-Alone Retail building include adding a mechanical room for housing the water heaters, a janitorial closet, as well as separating the single restroom space into men's and women's restrooms. Plumbing fixtures, such as sinks and toilets, have been added to the unit.

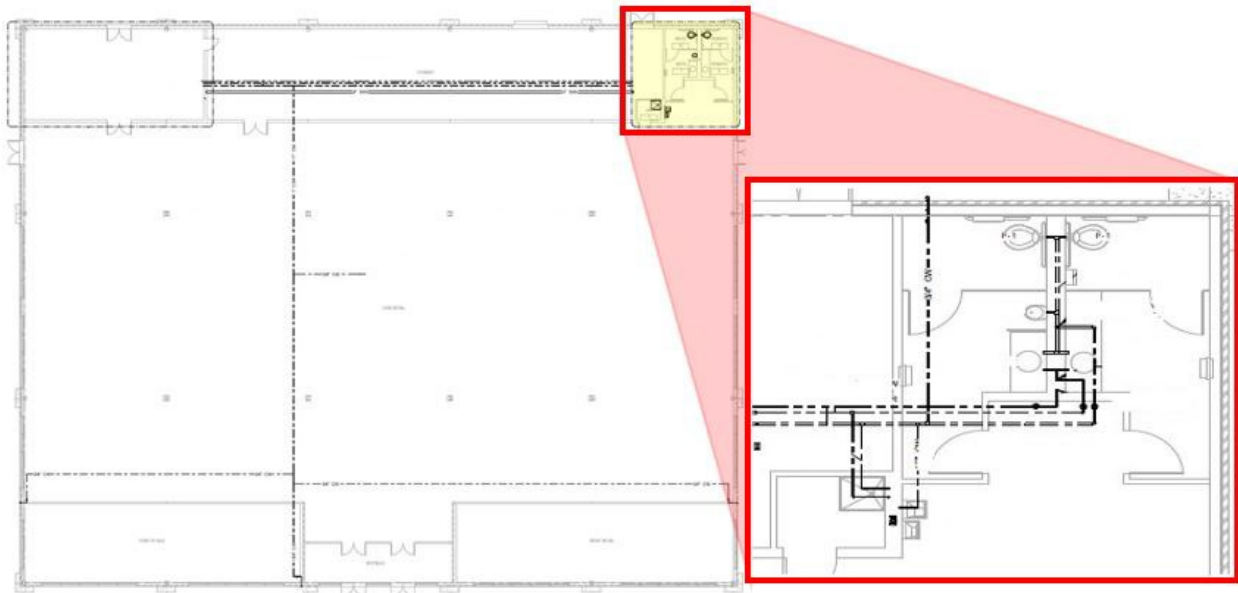


Fig. 10a. Architectural update for the Stand-Alone Retail building, highlighting the restroom.

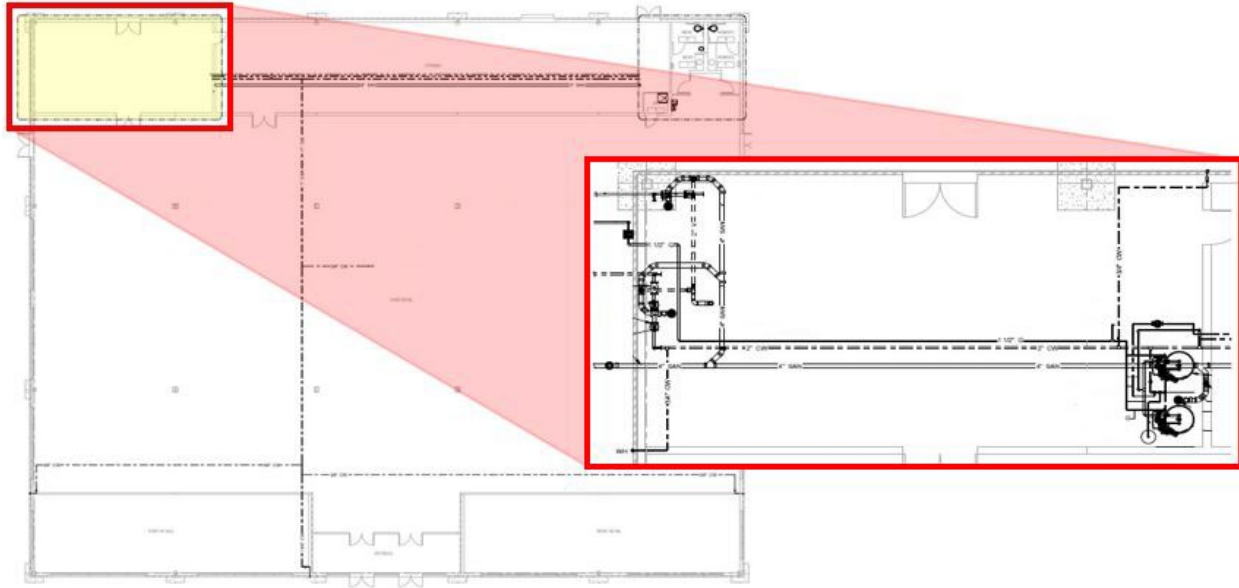


Fig. 11b. Architectural update for the Stand-Alone Retail building, highlighting the mechanical room.

2.2.3. Primary School

The Primary School has a single floor, with the main corridor branching out into three separate corridor pods. The main corridor has a space designated for bathroom use, a kitchen, and a dedicated mechanical room. **Figure 11** below shows the floor plan for the Primary School. The original building layout did not include bathroom or kitchen fixtures, such as sinks or a dishwasher; nor did it include plumbed mechanical room equipment.

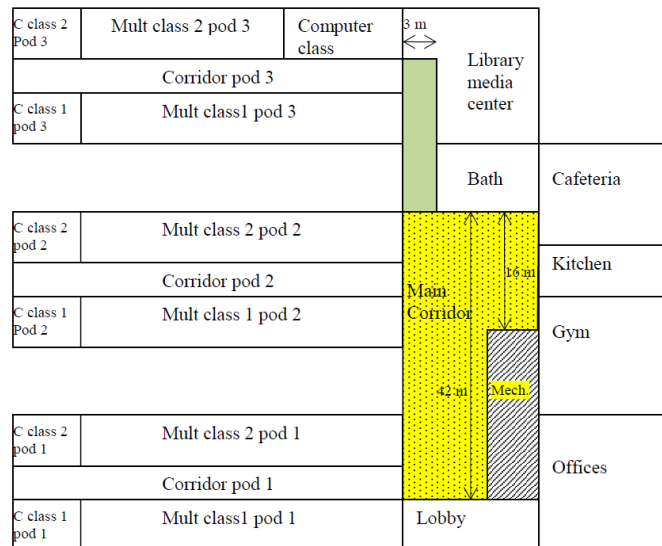


Fig. 12. Layout for the Primary School without architectural design update or plumbing system.

As shown in **Figure 12**, the architectural design updates for the Primary School's corridor pods include dividing the pods into individual classrooms with sinks and faucets, adding water fountains to corridor hallways, and adding restrooms to the corridor. Additional updates include adding a

locker room and restrooms to the gym, as well as dividing the space designated for offices into individual office spaces. Plumbing fixtures, such as sinks and toilets, and water lines for appliances, such as a dishwasher and water fountains, have also been added to the building.

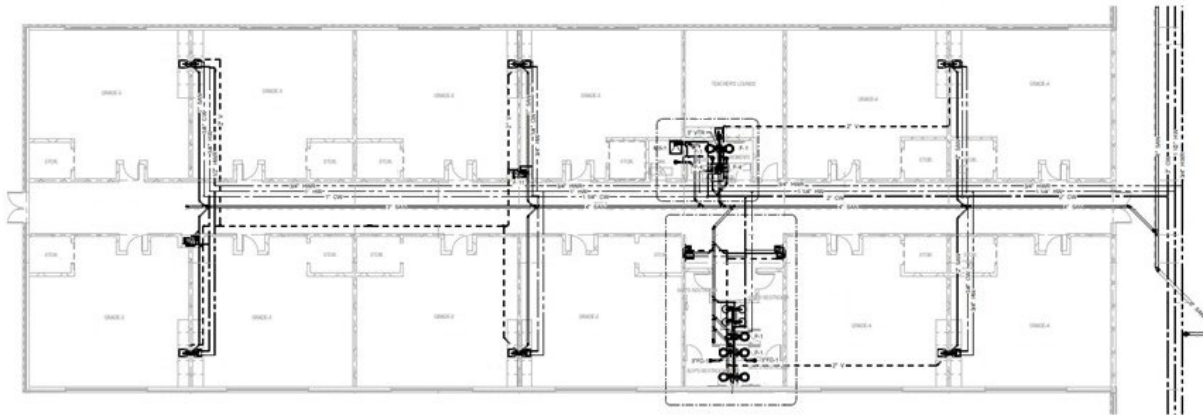


Fig. 13. Architectural update for the Primary School's Corridor Pod 2, including the plumbing system.

2.2.4. Full-Service Restaurant

The Full-Service Restaurant has a single floor, which consists of a dining room, a kitchen, and a restroom. **Figure 13** below illustrates the floor plan for the Full-Service Restaurant. The original building layout did not include plumbed bathroom or kitchen fixtures, such as sinks or a dishwasher.

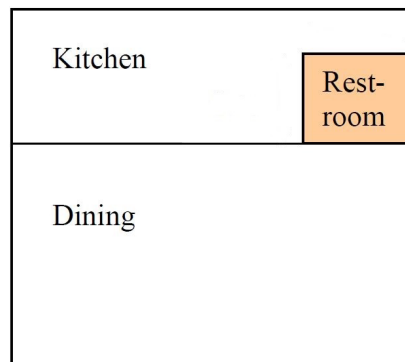


Fig. 14. Layout for the Full-Service Restaurant without architectural design update or plumbing system.

Figure 14 shows the architectural design updates for the Full-Service Restaurant that include converting the bathroom space into separate men's and women's restrooms, addition of a mechanical room for housing the water heater, and the addition of a janitorial closet. Plumbing fixtures, such as sinks and toilets, and water lines for appliances, such as a refrigerator and a dishwasher, have also been added.

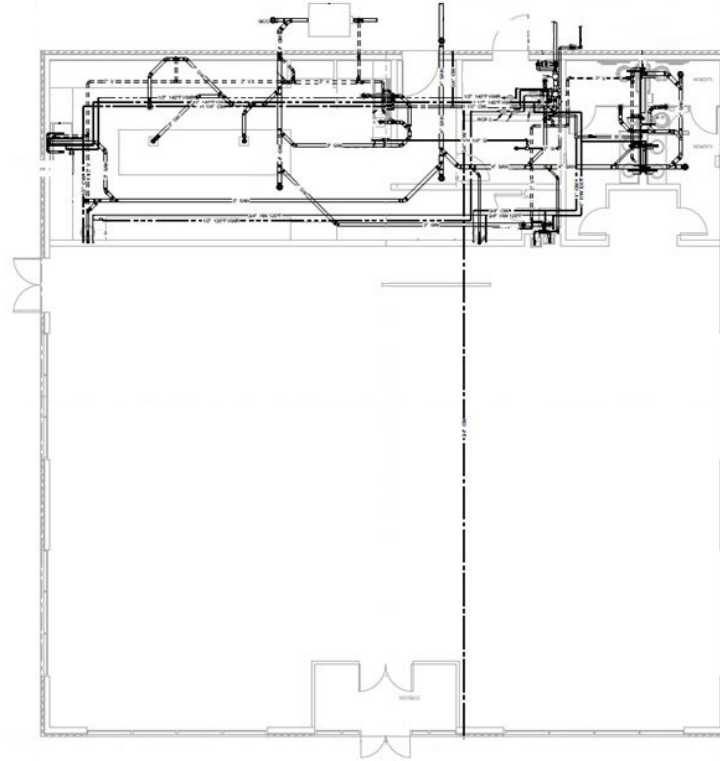


Fig. 15. Architectural update for the Full-Service Restaurant, including the plumbing system.

3. CONCLUSION

NIST developed plumbing systems for three residential and four commercial buildings that had previously been used for energy and IAQ analyses. That effort involved defining the seven reference buildings in sufficient detail to support the plumbing designs, which was done by contracting with an architectural & engineering firm. As part of the architectural design, all the features of these buildings needed to define the plumbing systems were specified, e.g., interior partitions, appliances, and plumbing fixtures. The availability of these building and plumbing system designs, including three-dimensional schematics, will allow researchers, industry groups and others to analyze plumbing system performance, evaluate new plumbing technologies, and compare plumbing system design and operation strategies on a consistent basis.

References

- [1] Persily, A., Musser, A., and Leber, D. (2006) A Collection of Homes to Represent the U.S. Housing Stock. National Institute of Standards and Technology, Gaithersburg, MD, NISTIR 7330. <https://doi.org/10.6028/NISTIR.7330>
- [2] Ng, L.C., Musser, A., Persily, A.K., and Emmerich, S.J. (2019) Airflow and Indoor Air Quality Models of DOE Prototype Commercial Buildings. National Institute of Standards and Technology, Gaithersburg, MD, NIST TN 2072. <https://doi.org/10.6028/NIST.TN.2072>
- [3] Persily, A., Yashar, D., Milesi Ferretti, N., Ullah, T., and Healy, W. (2020) Measurement Science Research Needs for Premise Plumbing Systems. National Institute of Standards and Technology, Gaithersburg, MD, NIST TN 2088. <https://doi.org/10.6028/NIST.TN.2088>

- [4] EPA (2023). EPANET. United States Environmental Protection Agency.
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- [6] ICC (2018). International Residential Code. International Code Council.
- [7] ICC (2018). International Building Code. International Code Council.
- [8] ICC (2018). International Plumbing Code. International Code Council.
- [9] ADAAG (2010). Americans with Disabilities Act Accessibility Guidelines.
- [10] NFPA 101: Life Safety Code, 2018 Edition. In NFPA National Fire Codes Online.
Retrieved from <http://codesonline.nfpa.org>

Appendix A. NIST Premise Plumbing Systems Website Content

This appendix consists of **Table A1**, which lists files that can be accessed through NIST’s Premise Plumbing Systems website found here: <https://www.nist.gov/el/energy-and-environment-division-73200/premise-plumbing-research-nist/current-activities-0>

Table A2. Outline of NIST’s Premise Plumbing Systems website content.

FILENAME	FILE TYPE	DESCRIPTION
NIST.TN.2266	PDF	Descriptions of project scope, building designs and key systems features
NIST_Reference_Building_Plumbing_Models_BOD		Outline of applicable codes, guidelines and standards used in architectural updates and plumbing system design
NIST_Reference_Building_Plumbing_Models_Architectural_Drawings		Floor plans illustrating the architectural layout for each of the seven buildings
NIST_Reference_Building_Plumbing_Models_Plumbing_Drawings		Floor plans illustrating the plumbing system layout for each of the seven buildings
ARCH_Single_Family_Detached_(DH-A(7))	RVT	3-D layout of the architecture for building DH-A(7)
PLUM_Single_Family_Detached_(DH-A(7))		3-D layout of the plumbing system for building DH-A(7)
ARCH_Single_Family_Detached_(DH-F(4))		3-D layout of the architecture for building DH-F(4)
PLUM_Single_Family_Detached_(DH-F(4))		3-D layout of the plumbing system for building DH-F(4)
ARCH_Midrise_Apartment_(APT-2A(7))		3-D layout of the architecture for building APT-2A(7)
PLUM_Midrise_Apartment_(APT-2A(7))		3-D layout of the plumbing system for building APT-2A(7)
ARCH_Medium_Office		3-D layout of the architecture for the Medium Office
PLUM_Medium_Office		3-D layout of the plumbing system for the Medium Office
ARCH_Stand_Alone_Retail		3-D layout of the architecture for the Stand-Alone Retail building
PLUM_Stand_Alone_Retail		3-D layout of the plumbing system for the Stand-Alone Retail building
ARCH_Primary_School		3-D layout of the architecture for the Primary School
PLUM_Primary_School		3-D layout of the plumbing system for the Primary School
ARCH_Full_Service_Restaurant		3-D layout of the architecture for the Full-Service Restaurant building
PLUM_Full_Service_Restaurant		3-D layout of the plumbing system for the Full-Service Restaurant building

Appendix B. Architectural Basis of Design

This appendix contains the document developed by LSY outlining applicable codes, guidelines, and standards for adding architectural features and determining the plumbing fixture requirements, count and locations for all seven buildings.



National Institutes of Standard and Technology

Standard Building
Plumbing System Models

Gaithersburg, Maryland

Basis of Design

Arch Final Submission
LSY No. 21042

February 04, 2022

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National Institute of Standards and Technology

Standard Building
Plumbing System Models

Gaithersburg, Maryland

Basis Of Design

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Table of Contents

1.0	Executive Summary.....	1
2.0	Architectural Basis of Design.....	2
2.1	Applicable Codes, Guidelines and Standards	2
2.2	New Work Scope.....	2
2.3	Description of Building Types	3
2.3.1	Residential Building Types	3
2.3.2	Mid-Rise Apartment Building	4
2.3.3	Commercial Building Types	4
3.0	Plumbing Basis of Design.....	8
3.1	Applicable Codes, Guidelines and Standards.....	8
3.1.2	Residential Building Type	8
a.	Single Detached – Single story.....	8
A.	General Requirements.....	8
b.	Single Detached – Multi story.....	11
A.	General Requirements.....	11
c.	Multi-family mid-rise apartment building.....	15
A.	General Requirements.....	15
3.1.3.	Commercial Building Type.....	20
a.	Medium office.....	20
A.	General Requirements.....	20
b.	Stand-alone retail.....	23
A.	General Requirements.....	23
c.	Primary school.....	27



A. General Requirements.....	27
d. Full-service restaurant.....	31
A. General Requirements.....	31

5.0 APPENDIX:

5.1 Appendix A – Architectural - Code Analysis

5.2 Appendix B – Plumbing - Cut Sheets

5.3 Appendix C – Correspondence

5.4 Appendix D – Scope of Work



1.0 Executive Summary

- 1.1.** NIST intends to produce a set of plumbing models to establish a baseline for standardization and uniformity in the sphere of water consumption in Residential and Commercial Buildings across the country. LSY has been tasked under work Order # 1333ND21FNB730248 to produce the design and calculations for NIST to achieve this goal.

We know that Buildings are one of the highest consumers of water resources but the industry and Builders lack guidelines and practices to streamline the use of this valuable natural resource. These designs are intended for reference and use by researchers, and, various private and public stakeholders to support standardized analysis of plumbing system performance in buildings for the future. This plumbing systems design will be published in the subsequent submissions.

The design is not specific to any particular region or location, but it is for general use and understanding only. This study will help to establish a process for comparative research, peer reviews and evaluation of comparable projects, and to make educated decisions in implementing water intensive building projects. These documents however, will not be used for actual construction nor for submission to permit departments for construction approvals. The design document is based on prevalent IRC, IBC-2018 for architectural design and the Plumbing Design is based on IPC International Plumbing Code 2018 (IPC-2018).



2.0 Architectural Basis of Design

2.1. Applicable Codes, Guidelines, and Standards

- | | |
|------------------|--|
| a. IRC 2018 | International Residential Code |
| b. IBC 2018 | International Building Code |
| c. IPC 2018 | International Plumbing Code |
| d. ADA 2010 | Americans with Disabilities Act Accessibility Guidelines |
| e. NFPA 101-2018 | National Fire Protection Association |

2.2. New Work Scope

Architectural scope of the Project consists of determining the plumbing fixtures requirements, count and locations for all building types in a Revit model generated based on the conceptual schematic sketch of the building types provided in the NIST scope (see Appendix D).

The gross floor area of each building type has been provided in the concept sketches which is the occupiable floor areas plus the exterior wall, beyond the interior space. The interior wall is part of the given gross floor area.

Plumbing fixture types, location, and counts are designed per applicable code. A detailed plumbing design and calculation will be generated for the respective model for the study. See the Plumbing section for more detailed information.

The Building Types are as follows:

2.2.1. Residential:

- a. Single Family, detached home-Floor plan DH-A(7)
(Total Floor Area: 1,152 sq ft).
- b. Single Family, detached home-Floor plan DH-F(4)
(Total Floor Area: 3,546 sq ft).
- c. Mid-rise Apartment (Floors:4; Units/Floor:8: Floor area/Unit:702 sq ft,
Total Floor Area: 24,780 sq ft).

2.2.2. Commercial:

- a. Medium Office (Floors:3)
(Total Floor Area: 53,628 sq ft).



- b. Stand-alone Retail (Floors:1)
(Total Floor Area: 24,692 sq ft).
- c. Primary School (Floors:1)
(Total Floor Area: 73,958 sq ft)
- d. Full-Service Restaurant (Floors:1)
(Total Floor Area: 5,500 sq ft)

2.3. Description of Building Types

2.3.1. RESIDENTIAL BUILDING TYPE

a. Single Family detached - Single Story: (Total Floor Area: 1,152 sq ft).

The house is a Residential type building consisting of three Bedrooms, Living room, Kitchen and Dining room. There is one common bathroom, and washer dryer unit in a closet. A mechanical closet with a water heater and a AHU are provided for the house The Garage is shown as optional.

The kitchen is equipped with a refrigerator with ice maker, oven with exhaust, dishwasher with disposal, and a countertop kitchen cabinet with sink.

There will be two outdoor hose bibs one in front and one at the back. The bedrooms will be provided with egress complaint windows per code requirement

b. Single Family Detached - Multi Level: (Total Floor Area: 3,546 sq ft).

The house is a Residential type building multi-level and it consists of three Bedrooms on second floor with a common Bathroom. The Living room, Kitchen, Dining room, and Powder room are on the first floor. The house consists of a Basement with a Bedroom, Family room, Den and a Bathroom. Washer and dryer will be located in the Basement along with the mechanical room with a water heater and an AHU.

Stairs connect the three floors is required for the multi-level house type.

The kitchen is equipped with a refrigerator with ice maker, oven with exhaust, dishwasher with disposal, and a countertop kitchen cabinet with sink. There will be two outdoor hose bibs one in front and one at the back.

Bedrooms will be provided with egress complaint windows per code requirement.



c. Mid-rise Apartment Building Type- 4 Storied – R-2 (Total Floor Area: 24,913 sq ft).

This building type is multi-storied with four floors and consists total of 31 dwelling units, eight units per floor and seven on the first floor. One unit in the first floor is dedicated for a common laundry room and mechanical/ electrical room.

Each unit has one Bedroom, Living room, Kitchen and a Bathroom.

The Kitchen is equipped with a refrigerator with ice maker, oven with exhaust, dishwasher with disposal, and a countertop kitchen cabinet with sink.

The laundry facility shall be common for all units and is located on the first floor. The laundry room shall have three pairs of washer/ dryer units.

The mechanical room for the building will also be located on the first floor adjacent to the laundry room. One elevator, service size, and ADA compliant is located at one end of the hallway and two exit stairways have been provided for egress, as per code. The bedroom windows shall be egress complaint per code as second means of exit at every level.

ADA Adaptable Units

Per ADA section 233.1.1 at least 5% of the dwelling units, but no fewer than one, shall provide for mobility features complying with 809.2 thru 809.4 with accessible route per 206 sections of ADA standards 2010. Two units in the building have been designed to fulfill this ADA requirement. The units are located on the first floor. These units, though constructed similarly to the rest of the units in the building, are adaptable and have provision to be convertible to ADA complaint units, as per above mentioned sections when the need arises for accommodating handicapped individual occupying the unit.

The ADA layout of the unit has been depicted in the drawing as an option in the Mid-Rise Apartment Building Type drawings. Wood Blockings in walls to be pre-installed ready for conversion so no major demolition will be necessary. The entry closet door will have to be removed along with closet back wall for the conversion. The bathroom lavatory and tub will have to be replaced with ADA complaint shower unit with head wall.



2.3.2. COMMERCIAL BUILDING TYPE

a. Medium Office (Floors:3) (Total Floor Area: 53,607 sq ft).

This is a medium sized office building located anywhere in the country and is classified as Business Occupancy, **B**. Each floors are open for one tenant with a core in the middle. The elevators, exit stairs, rest room and break room comprise the core of the building. Shown are two floors; one typical floor plan and the other is the first floor with entry foyers and exit pathway per code.

There is only one break room per floor. The plumbing requirement for this facility per IPC/IBC Table 2902.1 is 3 WC and 3 Lavatory for Occupancy load of total 120 persons

(See Code Analysis on Drawings in Appendix 1 for more details).

b. Stand-Alone Retail (Floors:1) (Total Floor Area: 24,697 sq ft).

The Stand-Alone Retail Store is classified as Mercantile Occupancy **M**. It is a a basic typical small size Retail store, It has a front retail and main product display area. The back of the store is the warehouse area and is designed with a restroom facility for the occupancy load per code. No specific location or jurisdiction has been identified for the store location thus a generic layout of the building is envisioned. The plumbing requirement for this facility per IPC/IBC Table 2902.1 is 2 WC and 2 Lavatory for Occupancy load of total 360 persons

(See Code Analysis on Drawings in Appendix 1 for more details).

c. Primary School (Floors:1) (Total Floor Area: 74,143 sq ft *)

The Primary School is an educational facility, grades K-6 , classified Education, E occupancy. The classroom blocks and the main common area block comprise the school building. The classroom blocks consist of three sections or pods each housing students from grades K-6. The kindergarten and 6 grades of students each have 4 groups or classes totaling 28 classes of children. With an average of 25 students per class, the student population at the school will be approx.700 students.

Note* - The final Sq footage of the school footprint is slightly larger than the value in the building description provided by NIST by 145.0 sq.ft by nature of the room sizes and exterior wall layout of the building type.



The classes are distributed as follows:

- Pod 1 houses Kindergarten classes and First Graders
- Pod 2 houses Grade 2, 3, 4
- Pod 3 houses Grade 5 and 6 with Computer Lab located here.

Plumbing in primary schools is quite intensive. Kindergarten and Grade 1 will have a bathroom facility within each classroom with child sized water closet and a lavatory. All classrooms will have a hand washing sink located on the same side as the teacher's wall.

Teachers' lounges are located, one in each pod, with a breakroom and a toilet room for the teachers' exclusive use. Each pod will also have a common restroom facility in the hallway accessible to kids from the hallway.

The main block of the building consists of the shared program areas like the Library, Cafeteria and Kitchen, Gym, Administrative Offices, Mechanical Rooms and the main entry and lobby. The cafeteria kitchen is designed with a commercial kitchen and dishwashing facility along with additional commercial sinks in the food prep area. A locker room and bathroom facility with storage area are also provided for cafeteria staff in this area of the building.

The Gymnasium is designed with a large equipment storage room along with the PE Teacher and staff room with appropriate locker room and shower facility.

The school Administration Area is located next to the main Entry / Lobby and includes the Principal's office and other school administrative office. A conference room with break room is also provided with separate restrooms for the male and female occupants of the office area.

The Mechanical Rooms are in the middle of the building and surrounded by other program spaces. Typically, the Mechanical Rooms, are located on an outside wall for ease of utility connection and access to load/unload equipment for maintenance. A maintenance office and a bathroom/ locker are designed for maintenance personnel. A central restroom is located in the main block of the building next to the library, cafeteria, gym and the main hallway. All plumbing fixtures count are per Code with the associated janitorial room, staff and supplies.

The plumbing requirement for this facility per IPC/IBC Table 2902.1 is 29 WC and 29 Lavatory and 16 Drinking fountains around the school area for



Occupancy load of total 1399 persons including a school student population of around 700

(See Code Analysis on Drawings in Appendix 1 for more details).

d. Full-Service Restaurant (Floors:1) (Total Floor Area: 5,570 sq ft)

This Full-Service Restaurant is Assembly Occupancy, A-2. The Full-service Kitchen is located at the back of the building with required dishwashing area and dry dishes storage. Cold storage and dry storage area are located at the back service entrance and the main food preparation area is provided with multiple handwash sinks as required for good hygiene. The connection to the main dining area is thru a wide doorless opening for convenience and two-way traffic. A line-of-sight block screen wall provides privacy.

e. The plumbing requirement for this facility per IPC/IBC Table 2902.1 is 4 WC and 2 Lavatory for Occupancy load of total 275 persons

(See Code Analysis on Drawings in Appendix 1 for more details).

Note - The final Sq footage of each building type differ slightly within reasonable range between 10.0 sq. ft. to 70.0 sq. ft. by nature of the room sizes and exterior wall layout of the building type.



3.0 Plumbing Basis of Design

3.1. Applicable Codes, Guidelines, and Standards

- a. IRC 2018 International Residential Code
- b. IBC 2018 International Building Code
- c. ADAAAG 2016 Americans with Disabilities Act Accessibility Guidelines
- d. IPC 2018 International plumbing code
- e. NFPA 101-2018 National Fire Protection Association

3.1.2. RESIDENTIAL BUILDING TYPE

- a. **Single family detached - Single Story: (Total Floor Area: 1,152 sq ft).**

A. General Requirements

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Residential Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatory faucets shall be maximum 2.2 GPM. Water Closets shall be floor mounted, 1.6 GPF maximum. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof hose bibs shall be provided one in front of the building and one in the back. Hose bibs shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.



Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

Table P1: Plumbing Fixture Schedule	
Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	White, Vitreous China, Floor Mounted, Elongated Bowl, flush tank, solid plastic seats, closed front with a lid. 1.6 gpf max.
Lavatory	White, Vitreous China, undermount type, manual lever type faucets, 4" on center, 2.2 gpm max flow rate. Coordinate Lavatory Holes with Faucet Selection.
Kitchen Sink	18 Gauge Top Mount Stainless Steel Single Sink, (1) Hole, gooseneck faucet, brass construction with chrome plated finish with pull-out hose and dishwashing soap dispenser. Garbage disposer shall be 1/2HP, 120v. 2.2 gpm max.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Tub/shower	Enameled cast iron tub with tub and shower trim, diverter valve, tub filler, shower arm, fixed shower head on the wall and grab bars. Provide pressure balance valve with replaceable ceramic cartridge. Shower head shall be 2.5 gpm max.
Laundry wash box	Plastic with 2" drain and with 1/4 turn valves for hot and cold water and water hammer arrestors.
Ice maker valve box	Plastic with 1/2" water connection with 1/4 turn valve for cold water and water hammer arrestor.
Dishwasher	Provide 5/8" discharge pipe and connect to the garbage disposer dishwasher fitting, with an air gap loop. provide a 1/2" hot water piping with a shut off valve.

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type "K" copper.



Sanitary piping: Soil, waste and vent piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Storm piping: Storm piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" closed cell type pipe insulation and shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

Kitchen sink shall be provided with a 1/2HP, 120v, plug in garbage disposer with dishwasher discharge connection. Disposer shall have sound insulation.

D. Domestic water system

Domestic water service shall be 1" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer of the type required by the Authority Having Jurisdiction. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

In jurisdictions requiring fire sprinkler system in residential occupancies, domestic service size shall be 2" (or as required based on hydraulic calculations).

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).



Hot and cold-water piping shall be provided to the lavatories, tub/shower unit, kitchen sink and the laundry wash box. Hot water shall be provided to the dishwasher. Cold water piping shall be provided to the water closets and the ice maker in the refrigerator.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

E. Hot Water Supply

Domestic use hot water for the residence shall be generated by a nominal 40 gallon, 4.5 kw, 240v, 1 ph electric water heater, with a minimum uniform energy factor of 0.92. 1st hour recovery shall be 55 gallons minimum. Hot water shall be set to 120°F. Provide a plastic drain pan under the water heater with a 1" sch 40 PVC drain-pipe on the side of the pan, routed to a floor drain with indirect discharge, in the event the water heater develops a leak. Pressure and temperature relief valve from the water heater shall discharge into the drain pan. Provide a 5 gallon expansion tank tapped to the cold piping of the water heater. The above sizing is based on State Water Heater sizing software.

F. Sanitary Waste System

Sanitary waste from toilets, lavatories, tub/showers, kitchen sinks and the laundry wash boxes shall be conveyed by gravity via a 4" sanitary main to underground exterior sewage piping.

Provide a 2" (or 3" if required by the AHJ) floor drain in the laundry room.

Provide a galvanized steel drain pan under the washer in the laundry with a 1" drain pipe piped to the floor drain in the same room, via indirect discharge and an air gap.

G. Storm Drainage System

Rainwater from roof areas will be conveyed by gutters and downspouts exterior to the building system. Final method of storm drainage shall conform to the architectural features and the type of roofing.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

H. Natural Gas System (where natural gas is available)

7" w.c. uninterruptible gas service shall be provided where natural gas is available to serve the gas fired HVAC systems and gas oven. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture.

**Piping Material:**

Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.

b. Single family detached - Multi Story: (Total Floor Area: 3,546 sq ft).**A. General Requirements**

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Residential Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatoryfaucets shall be maximum 2.2 GPM . Water Closets shall be floor mounted, flush tank, 1.6 GPF maximum. Shower heads shall be 2.5 gpm max. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof hose bibs shall be provided one in front of the building and one in the back. Hose bibs shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

Table P1: Plumbing Fixture Schedule	
Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	White, Vitreous China, Floor Mounted, Elongated Bowl, flush tank, solid plastic seats, closed front with a lid. 1.6 gpf max.



Lavatory	White, Vitreous China, undermount type, manual lever type faucets, 4" on center, 2.2 gpm max flow rate. Coordinate Lavatory Holes with Faucet Selection.
Kitchen Sink	18 Gauge Top Mount Stainless Steel Single Sink, (1) Hole, gosseneck faucet, brass construction with chrome plated finish with pull-out hose and dihwashing soap dispenser. Garbage disposer shall be 1/2HP, 120v. 2.2 gpm max.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Tub/shower	Enameled cast iron tub with tub and shower trim, diverter valve, tub filler, shower arm, fixed shower head on the wall and grab bars. Provide pressure balance valve with replaceable ceramic cartridge. Shower head shall be 2.5 gpm max.
Laundry wash box	Plastic with 2" drain and with 1/4 turn valves for hot and cold water and water hammer arrestors.
Ice maker valve box	Plastic with 1/2" water connection and with 1/4 turn valve for cold water and water hammer arrestor.
Dishwasher	Provide 5/8" discharge pipe and connect to the garbage disposer dishwasher fitting, with an air gap loop.provide a 1/2" hot water piping with a shut off valve.

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type "K" copper.

Sanitary piping: Soil, waste and vent piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Storm piping: Storm piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts



shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" closed cell insulation and shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

Kitchen sink shall be provided with a 1/2HP, 120v, plug in garbage disposer with dishwasher discharge connection. Disposer shall have sound insulation.

D. Domestic water system

Domestic water service shall be 1" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer of the type required by the Authority Having Jurisdiction. . Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

In jurisdictions requiring fire sprinkler system in residential occupancies, domestic service size shall be 2" (or as required based on hydraulic calculations).

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).

Hot and cold-water piping shall be provided to the lavatories, tub/shower unit, bathrooms, kitchen sink and the laundry wash box. Hot water shall be provided to the dishwasher. Cold water piping shall be provided to the ice maker in the refrigerator.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

**E. Hot Water Supply**

Domestic use hot water for the residence shall be generated by a nominal 50 gallon, 4.5 kw, 240v, 1 ph electric water heater, with a minimum uniform energy factor of 0.92. Hot water shall be set to 120°F. 1st hour recovery shall be 62 gallons minimum. Provide a plastic drain pan under the water heater with a 1" sch 40 PVC drain-pipe on the side of the pan, routed to a floor drain with indirect discharge, in the event the water heater develops a leak. Pressure and temperature relief valve from the water heater shall discharge into the drain pan. Provide a 5 gallon expansion tank tapped to the cold piping of the water heater. The above sizing is based on State Water Heater sizing software.

F. Sanitary Waste System

Sanitary waste from toilets, lavatories, tub/showers, kitchen sinks and the laundry wash boxes shall be conveyed by gravity via a 4" sanitary main to underground exterior sewage piping.

Provide a 2" (or 3" if required by the AHJ) floor drain in the laundry room.

Provide a galvanized steel drain pan under the washer in the laundry with a 1" drain pipe piped to the floor drain in the same room, via indirect discharge and an air gap.

G. Storm Drainage System

Rainwater from roof areas will be conveyed by gutters and downspouts exterior to the building system.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

H. Natural Gas System (where natural gas is available)

7" w.c. uninterruptible gas service shall be provided where natural gas is available to serve the gas fired HVAC systems and gas oven. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture.

Piping Material:

Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.



- c. Multi-family Midrise Apartment Building Type 4 storied – R-2**
(Floors:4; Units/Floor:8: Floor area/Unit:702 sq ft,
Total Floor Area: 24,780 sq ft).

A. General Requirements

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Building Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatory faucets shall be maximum 2.2 GPM . Water Closets shall be floor mounted, flush tank, 1.6 GPF maximum. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof wall hydrants in lockable cast iron valve boxes one on each of the 4 sides of the building. Wall hydrants shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Provide an elevator sump pump, rated for 50 gpm and 20' of head. Discharge indirectly to storm or sanitary sewer as required by the AHJ.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

Table P1: Plumbing Fixture Schedule	
Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	White, Vitreous China, Floor Mounted, Elongated Bowl, flush tank, solid plastic seats, closed front with a lid. 1.6 gpf max.
Lavatory	White, Vitreous China, undermount type, manual lever type faucets, 4" on center, 1.5 gpm max flow rate. Coordinate Lavatory Holes with Faucet Selection. 2.2 gpm max.



Kitchen Sink	18 Gauge Top Mount Stainless Steel Single Sink, (1) Hole, gosseneck faucet, brass construction with chrome plated finish with pull-out hose and dihwashing soap dispenser. Garbage disposer shall be 1/2HP, 120v. 2.2 gpm max.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Tub/shower	Enameled cast iron tub with tub and shower trim, diverter valve, tub filler, shower arm, fixed shower head on the wall and grab bars. Provide pressure balance valve with replaceable ceramic cartridge and high temperature limit control. Shower head shall be 2.5 gpm max.
Laundry wash box	Plastic with 2" drain and with 1/4 turn valves for hot and cold water and water hammer arrestors.
Ice maker valve box	Plastic with 1/2" water connection and with 1/4 turn valve for cold water and water hammer arrestor.
Dishwasher	Provide 5/8" discharge pipe and connect to the garbage disposer dishwasher fitting, with an air gap loop.provide a 1/2" hot water piping with a shut off valve.

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type 'K' copper.

Sanitary piping: Soil, waste and vent piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Storm piping: Storm piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts



shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" fiberglass with factory-applied jacket conforming to ASTM C 547. Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

Kitchen sink shall be provided with a 1/2HP, 120v, plug in garbage disposer with dishwasher discharge connection. Disposer shall have sound insulation.

D. Domestic water system

Domestic water service shall be 2" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer (BFP) of the type required by the Authority Having Jurisdiction (DCVA type BFP ASSE-1015 or RPZ type BFP ASSE-1013). Estimated domestic water demand load is 65 gpm, based on 183 Supply Fixture Units. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

Maximum velocity in the cold water piping shall be 8 FPS and maximum velocity in the hot water system shall be 5 FPS.

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).

Hot and cold-water piping shall be provided to the lavatories, tub/shower units, bathrooms, kitchen sink and the laundry wash boxes in the common laundry room. Hot water shall be provided to the dishwasher. Cold water piping shall be provided to the ice maker in the refrigerator.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.



Ensure a minimum water pressure of 40 psi on the 4th floor, for proper operation of the showers. If the incoming water pressure on the first floor is less than 75 psi, provide a duplex domestic booster pump, sized for 50 gpm per pump (100 gpm total) and adequate boost pressure to provide the 40 psi pressure on the 4th floor. Domestic booster pump shall be 208v, 3 ph

E. Hot Water Supply

Domestic use hot water for the bathrooms, kitchen sinks, dishwashers and the common laundry shall be generated by two high efficiency, condensing type natural gas water heaters, each 100 gallon, 199 MBH, with a minimum thermal efficiency of 95% Hot water shall be set to 140°F. Provide a master thermostatic mixing valve, high/low type with discharge temperature set to 120°F.

Provide a single 35 gallon expansion tank (such as ST-35-CL or equal). Connect to the cold water pipe serving the water heaters with a check valve in the cold water pipe.

F. Sanitary Waste System

Sanitary waste from toilets, lavatories, tub/showers, kitchen sinks and the laundry wash boxes shall be conveyed by gravity via a 6" sanitary main to underground exterior sewage piping. Estimated demand load is 229 Drainage Fixture Units (DFU).

Provide a 4" floor drain with trap primer in the common laundry room.

G. Storm Drainage System

Rainwater from roof areas will be conveyed interior roof drains and rain leaders or by gutters and downspouts exterior to the building system. Final method of storm drainage shall conform to the architectural features and the type of roofing.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

If interior drainage is utilized, storm lateral shall be minimum of 8" sized for 6,250 sq ft.

H. Natural Gas System (where natural gas is available)

7" w.c. or 2.0 psi uninterruptible gas service shall be provided to serve the gas fired HVAC systems and the gas fired water heaters. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture. Piping shall be sized



for the maximum pressure drop of 0.5" to the farthest fixture for 7" w.c system and for 1.0 psi pressure drop for 2.0 psi system.

Piping Material:

Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.

3.1.3. COMMERCIAL BUILDING TYPE

a. Medium Office (Floors:3) (Total Floor Area: 53,628 sq ft).

A. General Requirements

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Building Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans. All plumbing fixtures shall be type.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatories shall have auto sensor type faucets, battery operated. Water Closets shall be wall mounted, flush valve, (1.60 GPF maximum), with auto flush sensors, battery operated and heavy-duty, cast-iron wall supports. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof wall hydrants in lockable cast iron valve boxes one on each of the 4 sides of the building. Wall hydrants shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Provide an elevator sump pump, rated for 100 gpm and 20' of head. Discharge indirectly to storm or sanitary sewer as required by the AHJ.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

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Table P1: Plumbing Fixture Schedule

Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	ADA and non-ADA, White, Vitreous China, Wall- Mounted, Elongated Bowl, flush valves, auto flush sensors, battery operated with solid plastic seats, open front without a lid. Max. 1.6 gpf
Urinal	ADA and non-ADA, White, Vitreous China, Wall- Mounted, flush valves, auto flush sensors, battery operated. Max. 1.0 gpf
Lavatory	White, Vitreous China, undermount type, auto sensor, battery operated faucets, center, single hole, 0.25 gallon maximum metering per cycle.
Kitchen Sink	18 Gauge Top Mount Stainless Steel Single Sink, (1) Hole, gooseneck faucet, brass construction with chrome plated finish with pull-out hose and dishwashing soap dispenser. Garbage disposer shall be 1/2HP, 120v. 2.2 gpm max.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Electric water cooler	ADA, bi-level, stainless steel
Ice maker valve box	Plastic with 1/2" water connection and with 1/4 turn valve for cold water and water hammer arrestor.

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type "K" copper.

Sanitary piping: above-ground Soil, waste and vent piping shall be hubless Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping.



Storm piping: Storm piping shall be hubless Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping. All roof drains and horizontal storm drainage piping shall be insulated with 1" fiberglass pipe insulation with all service jacket.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" fiberglass with factory-applied jacket conforming to ASTM C 547. Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

Kitchen sink shall be provided with a 1/2HP, 120v, plug in garbage disposer with dishwasher discharge connection. Disposer shall have sound insulation.

D. Domestic water system

Domestic water service shall be 3" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer (BFP) of the type required by the Authority Having Jurisdiction (DCVA type BFP ASSE-1015 or RPZ type BFP ASSE-1013). Estimated domestic water demand load is 90 gpm, based on 204 Supply Fixture Units. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

Maximum velocity in the cold water piping shall be 8 FPS and maximum velocity in the hot water system shall be 5 FPS.

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).



Hot and cold-water piping shall be provided to the lavatories and break room sinks. Cold water piping shall be provided to the flush valve water closets, urinals and ice maker in the refrigerator.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

Ensure a minimum water pressure of 40 psi on the 3rd floor, for proper operation of the flush valve water closets. If the incoming water pressure on the first floor is less than 70 psi, provide a duplex domestic booster pump, sized for 65 gpm per pump (130 gpm total) and adequate boost pressure to provide the 40 psi pressure on the 3rd floor. Domestic booster pump shall be 208v, 3 ph (or 460v, 3 ph, based on the electric service available).

E. Hot Water Supply

Domestic use hot water for the bathrooms, mop sinks and the break room sinks shall be generated by a 100 gallon, 36 kw, 208v, 3 ph I electric water heater, with a minimum uniform energy factor of 0.92. Hot water shall be set to 140°F.

Provide a single 35 gallon expansion tank tapped to the cold piping of the water heater with a check valve in the cold water pipe.

If natural gas is available, provide a gas fired water heater, 100 gallons and 150,000 MBH, high efficiency (95%+) sealed combustion water heater. Set hot water to 140°F. Provide a 35 gallon expansion tank (such as ST-35-CL or equal). Provide a thermostatic mixing valve with discharge temperature set to 120°F. Provide a hot water recirculating pump, sized for 10 gpm and 30 ft head for temperature maintenance of the hot water system.

F. Sanitary Waste System

Sanitary waste from toilets, urinals, lavatories, kitchen sinks, electric water coolers, and the floor drains shall be conveyed by gravity via a 6" sanitary main to underground exterior sewage piping. Estimated demand load is 75 Drainage Fixture Units (DFU). 6" Sanitary sewer will allow adequate capacity for any future expansion and addition of fixtures, even though a 4" sanitary sewer would be adequate for the current load.

Provide 4" floor drains with trap primers in the mechanical room as well as in each bathroom.

G. Storm Drainage System

Rainwater from roof areas will be conveyed interior roof drains and rain leaders.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system



shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

Storm lateral shall be minimum of 10" sized for 18,000 sq ft.

H. Natural Gas System (wh natural gas is available)

7" w.c. or 2.0 psi uninterruptible gas service shall be provided where natural gas is available to serve the gas fired HVAC systems and the water heaters. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture for 7" w.c system and for 1.0 psi pressure drop for 2.0 psi system.

Piping Material: Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.

b. Stand-alone Retail (Floors:1) (Total Floor Area: 24,692 sq ft).

A. General Requirements

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Building Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans. All plumbing fixtures shall be type..

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatories shall have auto sensor faucets, battery operated maximum 0.25 gallons per metering cycle. Water Closets shall be wall mounted, flush valve (1.6 GPF maximum), with auto flush sensors, battery- operated and heavy-duty, cast-iron wall supports. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof wall hydrants in lockable cast iron valve boxes one on each of the 4 sides of the building. Wall hydrants shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

**Table P1: Plumbing Fixture Schedule**

Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	ADA and non-ADA, White, Vitreous China, Floor- Mounted, Elongated Bowl, flush tanks with solid plastic seats, open front without a lid. Max. 1.6 gpf
Urinal	ADA and non-ADA, White, Vitreous China, Wall- Mounted, flush valves, auto flush sensors, battery operated. Max. 1.0 gpf
Lavatory	White, Vitreous China, undermount type, auto sensor, battery operated faucets, center, single hole, 0.25 gallon maximum per metering cycle.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and ¾" Hose Thread on Spout.
Electric water cooler	ADA, bi-level, stainless steel

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type "K" copper.

Sanitary piping: above-ground Soil, waste and vent piping shall be hub less Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping.

Storm piping: Storm piping shall be hub less Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping. All roof drains and horizontal storm drainage piping shall be insulated with 1" fiberglass pipe insulation with all service jacket.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.



Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" fiberglass with factory-applied jacket conforming to ASTM C 547. Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

D. Domestic water system

Domestic water service shall be 2" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer (BFP) of the type required by the Authority Having Jurisdiction (DCVA type BFP ASSE-1015 or RPZ type BFP ASSE-1013). Estimated domestic water demand load is 75 gpm. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

Maximum velocity in the cold-water piping shall be 8 FPS and maximum velocity in the hot water system shall be 5 FPS.

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).

Hot and cold-water piping shall be provided to the lavatories, and break room sinks. Cold water piping shall be provided to the flush valve water closets. Also six 1-1/2" taps, valved and capped shall be provided in the ceiling of the retail space for connection to future retail store fixtures.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

E. Hot Water Supply

Domestic use hot water for the bathrooms, mop sinks and the break room sinks shall be generated by individually placed water heater in each future retail space. Water heaters shall be sized based on the demand of each retail space.



A 30 gallon, 4.5 kw electric water heater shall be provided for the public bathrooms and the mop sink. Set the hot water at the water heater to 120°F.

F. Sanitary Waste System

Sanitary waste from toilets, urinals, lavatories, kitchen sinks, electric water coolers, and the floor drains shall be conveyed by gravity via a 4" sanitary main to underground exterior sewage piping.

Provide a 4" floor drains with trap primers in the mechanical room as well as in each bathroom.

Several cleanouts shall be provided for future connection of plumbing fixtures from the future retail stores.

Provide four 4" VTRs for future retail spaces

G. Storm Drainage System

Rainwater from roof areas will be conveyed interior roof drains and rain leaders.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

Storm lateral shall be minimum of 12" sized for 25,000 sq ft.

H. Natural Gas System (where natural gas is available)

7" w.c. or 2.0 psi uninterruptible gas service shall be provided where natural gas is available to serve the gas fired HVAC systems. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture for 7" w.c system and for 1.0 psi pressure drop for 2.0 psi system.

Piping Material:

Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.

**c. Primary School (Floors:1) (Total Floor Area: 73,958 sq ft)****A. General Requirements**

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Building Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans. All plumbing fixtures shall be type.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatories shall have auto sensor faucets, battery-operated maximum 0.25 gallons per metering cycle. Water Closets shall be wall mounted, flush valve (1.6 GPF maximum), with auto flush sensors, battery-operated and heavy-duty, cast-iron wall supports. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof wall hydrants in lockable cast iron valve boxes one on each side of the building. Wall hydrants shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.

Table P1: Plumbing Fixture Schedule	
Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	ADA and non-ADA, White, Vitreous China, Wall- Mounted, Elongated Bowl, flush valves, auto flush sensors, battery operated with solid plastic seats, open front without a lid. Max. 1.6 gpf. Kid's height water closets and lavs shall be provided in the Kindergarten and 1-st grade wing
Urinal	ADA and non-ADA, White, Vitreous China, Wall- Mounted, flush valves, auto flush sensors, battery operated. Max. 1.0 gpf
Lavatory	White, Vitreous China, undermount type in the group bathrooms and wall mounted in the individual bathrooms, auto sensor, battery



	operated faucets, center, single hole, 0.25 gallons max per metering cycleflow rate. Thermostatic mixing valves shall be provided at each lav with discharge set to 105 F.
Sink	Classroom sinks shall be 18 Gauge Top Mount Stainless Steel Single Sink, (1) Hole, gosseneck faucet, brass construction with chrome plated finish. Thermostatic mixing valves shall be provided at each sink with discharge set to 105 F. 2.2 gpm max.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Electric water cooler	ADA, bi-level, stainless steel
Ice maker valve box	Plastic with 1/2" water connection with 1/4 turn valve for cold water and water hammer arrestor.

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type 'K' copper.

Sanitary piping: above-ground Soil, waste and vent piping shall be hubless Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping.

Storm piping: Storm piping shall be hubless Cast Iron Pipe, No Hub type shall conform to ASTM A 74 underground piping shall be hub and spigot cast iron, service class piping. All roof drains and horizontal storm drainage piping shall be insulated with 1" fiberglass pipe insulation with all service jacket.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces.



Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic hot and cold water-piping insulation shall be 1" fiberglass with factory-applied jacket conforming to ASTM C 547. Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

D. Domestic water system

Domestic water service shall be 4" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer (BFP) of the type required by the Authority Having Jurisdiction (DCVA type BFP ASSE-1015 or RPZ type BFP ASSE-1013). Estimated domestic water demand load is 160 gpm, based on approximately 700 Supply Fixture Units. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

Maximum velocity in the cold water piping shall be 8 FPS and maximum velocity in the hot water system shall be 5 FPS.

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).

Hot and cold-water piping shall be provided to the bathrooms, classroom sinks, water coolers, mop sinks and the fixtures in the kitchen.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

E. Hot Water Supply

Domestic use hot water for the bathrooms, mop sinks and classroom sinks shall be generated by two high efficiency, condensing type natural gas water heaters, each 100 gallon, 199 MBH, with a minimum thermal efficiency of 95%. Hot water shall be set to 140°F. Provide a master thermostatic mixing valve, high/low type with discharge temperature set to 120°F. Provide point of use thermostatic mixing valve at each lavatory and sink to provide 105°F.

Provide 1-1/4" hot water recirculating piping and hot water recirculation pump, sized for 10 gpm and 30 ft head for temperature maintenance of the hot water system.



Provide a single 53 gallon expansion tank tapped to the cold piping of the water heater (similar to Amtrol ST-447-C) with a check valve in the cold water.

For the kitchen provide an independent natural gas fired high efficiency, condensing type water heater, 100 gallon, 199 MBH, with a minimum efficiency of 95% Hot water shall be set to 140°F. Three compartment sink and the kitchen sinks and the dishwasher shall be served with 140°F hot water. Hand sinks shall be served by the two water heaters which also serve the classroom sinks and the bathrooms at 120°F. Provide a thermostatic mixing valve with discharge temperature set to 120°F to the hand sinks.

Provide a 3/4" hot water recirculating piping and hot water recirculation pump, sized for 3 gpm and 20 ft head for temperature maintenance of the kitchen hot water system.

Provide a single 35 gallon expansion tank tapped to the cold piping of the water heater (similar to Amtrol ST-35CL) with a check valve in the cold water.

F. Sanitary Waste System

Sanitary waste from toilets, urinals, lavatories, kitchen sinks, electric water coolers, and the floor drains shall be conveyed by gravity via a 6" sanitary main to underground exterior sewage piping. Depending on the invert elevation of the site sewer piping, multiple laterals may have to be utilized. Estimated demand load is 320 Drainage Fixture Units (DFU).

Provide 4" floor drains with trap primers in the mechanical room as well as in each bathroom.

Provide 3" and 4" sanitary floor sinks with half grates in the kitchen to accept indirect waste from the vegetable sink and other fixtures which come into contact with food.

Provide a 1500 gallon concrete, underground grease interceptor for the kitchen,

Located outside of the building. Final size of the grease interceptor shall be coordinated with the requirements of the local jurisdiction.

G. Storm Drainage System

Rainwater from roof areas will be conveyed interior roof drains and rain leaders.

Roof drainage system shall be designed for a 100-year storm return frequency and a 60-minute period of duration/concentration. Emergency drainage system shall be designed for a 100-year storm return frequency and a 60-minute



period of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

Storm laterals shall be three 12" pipes sized for 75,000 sq ft total.

H. Natural Gas System (where natural gas is available)

7" w.c. or 2.0 psi uninterrupted gas service shall be provided where natural gas is available to serve the gas fired HVAC systems and the water heaters. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture for 7" w.c system and for 1.0 psi pressure drop for 2.0 psi system.

Piping Material: Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.

a. Full-Service Restaurant (Floors:1) (Total Floor Area: 5,500 sq ft)

A. General Requirements

All plumbing work shall be in accordance with 2018 International Plumbing Code, International Building Code and the requirements of the Authority Having jurisdiction.

Plumbing fixture quantities, locations and types shall be in compliance with the referenced codes and the configuration shown on the Architectural plans. All plumbing fixtures shall be type.

B. Plumbing Fixtures:

Vitreous-china and enameled cast-iron plumbing fixtures shall be white. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chrome plated. Supplies and stops for lavatories shall be brass with chrome plated finish. Lavatories shall have auto sensor faucets, battery-operated maximum 0.25 gallons per metering cycle Water Closets shall be wall mounted, flush valve (1.6 GPF maximum), with auto flush sensors, battery-operated and heavy-duty, cast-iron wall supports. All plumbing fixtures will be provided water service by the city domestic water service. Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required. See plumbing fixture list below and cut sheets in plumbing fixture section of the appendix.

Freeze proof wall hydrants in lockable cast iron valve boxes one on each side of the building. Wall hydrants shall be provided with vacuum breakers and shall have shut off valves inside the building in accessible locations.

Plumbing fixture flow rates shall comply with the requirements of IPC table 604.4.



Table P1: Plumbing Fixture Schedule	
Description	BASIS OF DESIGN (OR EQUAL)
Water Closet	ADA and non-ADA, White, Vitreous China, Wall- Mounted, Elongated Bowl, flush valves, auto flush sensors, battery operated with solid plastic seats, open front without a lid. Max. 1.6 gpf.
Urinal	ADA, White, Vitreous China, Wall- Mounted, flush valves, auto flush sensors, battery operated. Max. 1,0 gpf
Lavatory	White, Vitreous China, undermount type, auto sensor, battery operated faucets, center, single hole, 0.25 gallons maximum per metering cycle. Thermostatic mixing valves shall be provided at each lav with discharge set to 105 F.
Sink	3 compartment sink for grease laden pots and pans and two compartment sink for the vegetables. Sinks shall be 18 gauge stainless steel with 3- Hole, gooseneck faucets, brass construction with chrome plated finish. Hand sinks shall be wall mounted and shall be provided with thermostatic mixing valves with discharge set to 105 F.
Service Sink	Service Sink, One Piece Precast Terazzo w/3" Chrome Plated Brass Drain Chrome Plated Service Faucet with Vacuum Breaker, Pail Hook and 3/4" Hose Thread on Spout.
Electric water cooler	ADA, bi-level, stainless steel
3-compartment sink	18 ga, type 304 stainless steel min, three 16"x20", 12" deep with wall mounted lever type faucets.
Hand sink	Wall mounted, 18 ga, type 304 stainless steel with wall mounted level type faucets

C. Plumbing Materials:

Domestic water piping: Above ground water piping shall conform to ASTM B 88, Type L hard-drawn copper. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to ASME B16.26. Below ground domestic water piping shall be type 'K' copper.



Sanitary piping: Soil, waste and vent piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Storm piping: Storm piping shall be schedule 40 PVC, solid core to conform to ASTM D 2665 with fittings made to conform to ASTM D 3311 to fit schedule 40 PVC piping.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces. Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69.

Domestic water-piping insulation shall be 1" fiberglass with factory-applied jacket conforming to ASTM C 547. Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

D. Domestic water system

Domestic water service shall be 2" copper type "L". Service entry shall be provided with a main shut off valve and backflow preventer (BFP) of the type required by the Authority Having Jurisdiction (DCVA type BFP ASSE-1015 or RPZ type BFP ASSE-1013). Estimated domestic water demand load is 56 gpm, based on approximately 64 Supply Fixture Units. Piping throughout the building will be sized per IPC code and based on acceptable plumbing practices.

Maximum velocity in the cold-water piping shall be 8 FPS and maximum velocity in the hot water system shall be 5 FPS.

Provide a water meter of a type required inside or outside the building in a meter crock, as required by the AHJ.

Provide pressure reducing valve when the incoming water pressure exceeds 80 psi. Provide pressure gauges at the service entry and after the pressure reducing valve (pressure gauge downstream of pressure reducing valve if such a valve is required).



Hot and cold-water piping shall be provided to the bathrooms, mop sink and the fixtures in the kitchen.

All plumbing fixtures shall be provided with isolation valves for servicing or replacing the fixture.

E. Hot Water Supply

Domestic use hot water for the bathroom, mop sink, kitchen sinks and the dish machine shall be generated by a high efficiency, condensing type natural gas water heater, 100 gallon, 199 MBH, with a minimum thermal efficiency of 95%. Hot water shall be set to 140°F. Provide a high/low type thermostatic mixing valve with discharge temperature set to 120°F for the lavatories and the kitchen hand sinks. Provide point of use thermostatic mixing valve at each lavatory and hand sink to provide 105°F

Provide a 12 gallon expansion tank tapped to the cold piping of the water heater.

Provide 3/4" hot water recirculating piping and hot water recirculation pump, sized for 5 gpm and 15 ft head for temperature maintenance of the hot water system.

F. Sanitary Waste System

Sanitary waste from toilets, urinals, lavatories, kitchen sinks, electric water coolers, and the floor drains shall be conveyed by gravity via a 4" sanitary main to underground exterior sewage piping.

Provide 4" floor drains with trap primers in the mechanical room as well as in each bathroom.

Provide 3" and 4" sanitary floor sinks with half grates in the kitchen to accept indirect waste from the vegetable sink and other fixtures which come into contact with food.

Provide a 1500 gallon concrete, underground grease interceptor for the kitchen,

Located outside of the building. Final size of the grease interceptor shall be coordinated with the requirements of the local jurisdiction.

G. Storm Drainage System

Rainwater from roof areas will be conveyed interior roof drains and rain leaders.

Roof drainage system shall be designed for a 100 year storm return frequency and a 60 minute period of duration/concentration. Emergency drainage system shall be designed for a 100 year storm return frequency and a 60 minute period



of duration/concentration. Drainage shall be conveyed to the designated on-site storm water management basins.

Storm laterals shall be an 8" pipe sized for 5,500 sq ft total.

H. Natural Gas System (where natural gas is available)

7" w.c. or 2.0 psi uninterrupted gas service shall be provided where natural gas is available to serve the gas fired HVAC systems and the water heaters. Piping shall be sized for the maximum pressure drop of 0.5" to the farthest fixture for 7" w.c system and for 1.0 psi pressure drop for 2.0 psi system.

Piping Material: Natural Gas piping system; Schedule 40 black steel pipes with threaded and welded joints and fittings per NFPA 54. ASTM A 53; Type E or S; Grade B; Schedule 40.