NYSERDA RetrofitNY
Market Characterization Study:

Building Stock Assessment and Architectural Profiles of Predominant New York State Multifamily Building Types

Final Report | Report Number 20-20 | June 2020

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Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

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Final Report

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Notice

Abstract

New York State's ambitious energy and retrofit goals toward decarbonization require the development of novel approaches and technologies for integration in the State's existing building stock. This research focuses on characterizing New York State multifamily housing stock by (1) analyzing previously collected building data provided by New York State Energy Research and Development Authority (NYSERDA) and (2) categorizing low- and mid-rise buildings into major types by major features, including: vintage of original construction, exterior wall structure, cladding material, gross square footage, number of stories, and envelope area. In addition, random samples of photographic documentation were studied to verify details of records in the list data provided and to confirm visual details found in architectural standards and other historical documentation. The results include detailed architectural profiles of seven major multifamily building types, with further description regarding predominant construction trends and styles in each type.

Keywords

Multifamily, housing, envelope, enclosure, retrofit, façade, historical buildings

Acknowledgments

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Acronyms, and Abbreviations, and Definitions

Affordable Housing:	Housing in which at least 25% of building households earn less than or equal to 80% of Area Median Income.
Dwelling Unit (DU):	This refers to an apartment, typically rental unit in multifamily buildings, irrespective of size or number of rooms.
Gross Square Footage (GSF):	This refers to total horizontal building area, including circulation and service space in addition to leasable or occupied space.
Low-Rise Building:	Building with one to three stories.
Mid-Rise Building:	Building with four to seven stories.
High-Rise Building:	Building with eight or more stories.
New York State (NYS):	All counties in New York State, including the five boroughs of New York City.
New York City (NYC):	The five boroughs of New York City (New York, Bronx, Queens, Kings, Richmond).

Executive Summary

New York State Energy Research and Development Authority's (NYSERDA) RetrofitNY program is scaling the market for deep energy retrofits by developing standardized solutions for retrofitting existing buildings. This market study, which segments the State's multifamily building stock based on attributes of the building envelope, is intended to help manufacturers develop new integrated, whole-building retrofit-solutions that target net zero energy performance.

The study analyzes an existing data set of New York State housing stock with the majority of multifamily buildings falling into four segments: prewar low-rise buildings, prewar mid-rise buildings, postwar low-rise buildings, and low-rise buildings built between 1978 and 2006. This study defines "low-rise" as buildings one to three stories tall and "mid-rise" as buildings four to seven stories tall. High-rise buildings of more than eight stories were outside the scope of this investigation. Each of the four major housing segments contains subsegments distinguished by exterior wall construction material. Seven building types defined by vintage, height, and construction material (masonry or wood frame) were selected for detailed analysis of building attributes that would be of interest to retrofit panel manufacturers, including massing, cladding materials, roof construction system, and exterior wall R-value and window-to-wall ratio.

Within each of the major building types identified, building characteristics key to defining the retrofit market were researched through a combination of data analysis (as described in the following sections) and examination of architectural standards, historical records, and case studies of predominant styles of building within each type. These features are summarized in the below snapshot excerpt from Table 13, which appears in its entirety in Section 3: Conclusions. Categories are sorted from top to bottom by vintage groups and building height. Those groups are then subdivided by the seven major building types identified in this study, along with building characteristics determined important by NYSERDA, including structural and cladding materials, overall dimensions, Gross Square Footage (GSF), envelope area, and other features.

Table ES-1. Summary Excerpt from Table 13

See section 2.3 for further detail.

SUMMARY OF KEY MARKET CHARACTERISTICS FOR MAJOR MULTIFAMILY BUILDING TYPES IN NEW YORK STATE								
Segment Description	**Vintage**	Pre-1940		Pre-1940	1940 - 1978		1979 - 2006	
	Building Height (Stories)	1 to 3		4 to 7	1 to 3		1 to 3	
Segment Characteristics	**Count, MF Bldgs in NYS[2]**	396,343		46,258	171,793		84,792	
	%, MF Bldgs in NYS[3]	38.67%		4.51%	16.76%		8.27%	
	Total Floor Area[4] (GSF)	1,160,883,262		1,248,583,402	2,683,558,039		1,112,456,713	
	Total Exterior Wall Area[5] (SF)	1,164,243,036		534,264,627	700,535,956		355,906,065	
Typical Individual Building Characteristics[1]	**Type**	1	2	3	4	5	6	7
	Structural Material	Masonry	Wood Frame	Masonry	Wood Frame	Masonry	Wood Frame	Masonry
	Cladding Materials	Brick, stone, stucco	Brick veneer, wood, stucco	Brick, stone, stucco	Brick veneer, wood, stucco	Brick, stone, stucco	Brick veneer, wood, stucco	Brick, stone, stucco
	Number of Stories	3	3	4 to 7	3	3	3	3
	Average Bldg Floor Area (GSF)	2,400 - 6,000	1,200 - 4,800	4,800 - 45,000	9,000 - 10,800; 100,000 or more for complexes	9,000 - 10,800; 100,000 or more for complexes	14,400 - 22,500; 100,000 or more for complexes	14,400 - 22,500; 100,000 or more for complexes
	Average Envelope Area (SF)	1,400 - 7,200	3,500 - 6,000	2,700 - 24,000	9,100 - 10,500; 75,000 or more for complexes	9,100 - 10,500; 75,000 or more for complexes	11,200 - 14,000; 75,000 or more for complexes	11,200 - 14,000; 75,000 or more for complexes
	Width (FT)	20 - 40	20 - 40	30 - 90	100 - 120	100 - 120	120 - 150	120 - 150
	Depth (FT)	40 - 50	30 - 40	40 - 70	30	30	40 - 50	40 - 50
	Height (FT)	35	35 - 40[5]	45 - 75	35	35	35	35
	# Units	2 to 4	2 to 4	4 to 45	10 to 20 per building; up to 200 for complexes	10 to 20 per building; up to 200 for complexes	10 to 20 per building; up to 200 for complexes	10 to 20 per building; up to 200 for complexes
	Unit Area (GSF)	500 - 1,600	500 - 1,600	500 - 1,600	500 - 1600	500 - 1600	800 - 2000	800 - 2000
	WWR (%)	10 to 20	10 to 20	10 to 20	10 to 15	10 to 15	10 to 15	10 to 20
	R-value, Wall	2 to 4	3 to 5	2 to 5	6 to 7	3 to 5	10 to 12	12 to 15
	R-value, Roof	2 to 4	1 to 2	2 to 4	3 to 4	2 to 4	4 to 5	22 to 24

Notes:

1. Average characteristics of predominant types within each segment, based on summary statistics (Tables 12 + 13) and analysis of individual building records
2. From Table 8
3. From Table 9
4. From Table 10
5. Height assumed to the ridge line (top of pitched roof)

1 Introduction

New York State Energy Research and Development Authority's (NYSERDA) RetrofitNY program is working to scale the market for deep energy retrofits by developing standardized solutions for retrofitting existing buildings. Initially, the program is focusing on multifamily[1] affordable[2] housing, where high-performance retrofits have the potential to significantly reduce energy use while improving resident well-being.

RetrofitNY is based on Energiesprong, a successful European program that has retrofitted thousands of units of affordable housing in the Netherlands, France, the United Kingdom, Germany, and Italy since 2013 and constructed an equal number of new units using the same methodology. The Energiesprong approach uses innovative building technologies and processes, including high-performance, low-cost panelized exterior wall systems; high-performance, low-cost roofing systems with integrated photovoltaics; all-electric integrated mechanical systems ("energy pods"); and a turn-key project delivery model.

As it adapts the Energiesprong model to the New York State context, NYSERDA is working with the building industry to develop similar technical solutions tailored to this market. Specifically, NYSERDA has identified the need for an offsite-manufactured, high-performance wall panel system designed specifically for retrofit applications to achieve cost parity with what owners currently spend on their business-as-usual renovations. NYSERDA commissioned this study to assist manufacturers in developing such a panel system, though it is also expected to prove useful for sizing the mechanical systems and on-site renewables needed, in conjunction with the envelope treatment, to achieve net zero energy performance.

This study characterizes existing multifamily housing stock in New York State. It identifies the predominant building typologies, estimates their quantity and regional distribution, and characterizes their exterior envelope construction and cladding systems and other building attributes. The information will provide market insight to assist manufacturers in developing panel products to serve this emerging retrofit market.

2 Analysis of New York State Residential Building Inventory

2.1 Data Sources and Data Accuracy

2.1.1 Overview of the New York State Residential Building Inventory

This study uses data on New York State housing stock compiled by ICF International, Inc. (ICF), a global consulting and technology services company, as part of their report, New York Residential Building Stock and Energy Cost Analysis, submitted to NYSERDA on December 22, 2017. The report, commissioned by NYSERDA to support the development (1) of the RetrofitNY program, included an inventory of multifamily residential buildings in the State, (2) of energy consumption profiles for common building types, and (3) and energy cost-savings analysis of proposed deep energy retrofit strategies for each building type.

To develop the residential building inventory, ICF reviewed 22 building data sources, prioritized the data based on their content, and merged them into a single data set containing approximately 5 million records. A summary of the database content and development methodology is presented below, and a full description can be found in the ICF final report.[3]

In evaluating data for inclusion in the residential building inventory, ICF prioritized data sets that included individual building-level data that was available for the whole State and relevant to building energy use. Data sets were classified into one of three tiers based on their comprehensiveness. Tier 1 included comprehensive data that could create a framework for the inventory. Tier 2 included geographically or demographically limited data that could infill Tier 1. Tier 3 included data suitable for informing the study, but not for inclusion in the inventory. All other data sources were omitted.[4]

ICF first merged the two Tier 1 data sources: NYGIS, which includes tax parcel data, and Experian, which includes household-level consumer marketing data. Data fields were prioritized based on completeness, and their nomenclature was standardized prior to merging. Spatial data, including unique address, county, and other location fields, were used to match records between the two data sets. The merged database was evaluated for completeness by comparing it to the number of U.S. Census Housing Units. Tier 2 data sources were then prioritized and individually merged into the database in a similar process to the Tier 1 merge.

2.1.2 Data Completeness

Because the original data sources had varying levels of completeness in each data category, the final database also has varying levels of completeness. Completeness of data fields such as building type and vintage was relatively high across the entire database. Completeness of data fields related to building construction type and cladding material was low, especially for entries in New York City (Table 1). We assume that the database is most useful for assessing aggregated statistics for categories with a high level of completeness, and that the data is less reliable for categories with a low level of completeness.

Table 1. Percentage of Complete Data

Source: ICF Residential Building Inventory

PERCENTAGE OF COMPLETE DATA			
Field Name	NYC	NYS	
	Five Boroughs	UpstateCounties	All Counties
Region	100	100	100
County	100	100	100
Address	100	100	100
City	100	100	100
Borough	100	0	19.91
Zip Code	95.24	86.05	87.88
Affordable	100	100	100
Year Built	97.5	91.45	92.65
Vintage	97.5	91.44	92.65
Building Type	98.42	97.28	97.5
Building Construction	0.05	0.01	0.02
Exterior Wall	5.42	53.22	43.7
Building Count	87.12	1.05	18.18
Building Area	87.86	58.6	64.42
Floor Count	92.05	52.35	60.25
Building Height	92.05	52.35	60.25
Unit Size Range	63.57	74.44	72.28
Unit Count	98	74.84	79.45
Unit Count_Property	1.89	1.05	1.22
Fuel Type	5.25	49.13	40.4
Heat Type	5.32	66.81	54.57
Cooling Type	0.24	18.38	14.77
Boiler Type	0.09	0	0.02
Utilities	0	53.03	42.48
Owner Name	6.84	1.04	2.19
Project Name	1.93	0.02	0.4

Calculation is performed with data in raw format. Duplicate entries are not removed

2.1.3 Unique IDs

Although the database contains a Record ID field, designed to be used as a unique identifier, the Address field is the only category in the merged data sets that can be used to link entries back to their original source. Tracing an entry back to its source would likely be impractical due to differences in data formatting between the original and final data sets. Initially, this raised concern due to the possibility of overlapping records. However, using the County and/or Zip Code fields in addition to the Address field reduces the possibility of overlapping records with the same address. For example, the database contains eight records with the address 1 Grand Street from eight different cities and six different counties (Table 2).

Table 2. Overlapping Addresses

Source: ICF Residential Building Inventory

RecordID	County	Address	City	Zip Code	Year Built	Vintage	Building Type
141893	BROOME	1 GRAND ST	BINGHAMTON	13903	1930	Pre-1940	Single Family
1060071	FULTON	1 GRAND ST	JOHNSTOWN	12095	1930	Pre-1940	Single Family
1627188	MONTGON	1 GRAND ST	AMSTERDAM	12010	1928	Pre-1940	Multifamily
2523423	ORANGE	1 GRAND ST	GOSHEN	10924	1919	Pre-1940	Single Family
2523424	ORANGE	1 GRAND ST	NEWBURGH	12550	1900	Pre-1940	Single Family
2725720	OTSEGO	1 GRAND ST	ONEONTA	13820	1990	1979-2006	Multifamily
3263213	SUFFOLK	1 GRAND ST	SMITHTOWN	11787	1979	1979-2006	Single Family
3962333	ULSTER	1 GRAND ST	HIGHLAND	12528	1900	Pre-1940	Multifamily

2.1.4 Duplicate Records

After merging the Tier 1 and Tier 2 data sets, ICF analyzed the database to identify potentially duplicate records. They identified approximately 396,000 duplicates (about 7% of the database) due to variations in building postal codes and street addresses. Per ICF's report, these duplicates were resolved and removed from the database.[5]

Our analysis suggests that ICF may have intentionally duplicated records for properties that included multiple buildings on a single lot.[6] For example, when the Building Count field associated with an address was greater than 1, the entry was duplicated to create a separate record for each building on the lot. It appears that this approach disproportionately affected affordable housing, as these properties often contain multiple buildings on a single tax lot. The number and proportion of duplicate records varies by county, ranging from 0.02% to 50% of the total number of entries for a particular county (Table 3). Our analysis includes these duplicates and is based on the assumption that the records were duplicated intentionally.

2.1.5 Single-Unit Multifamily Buildings

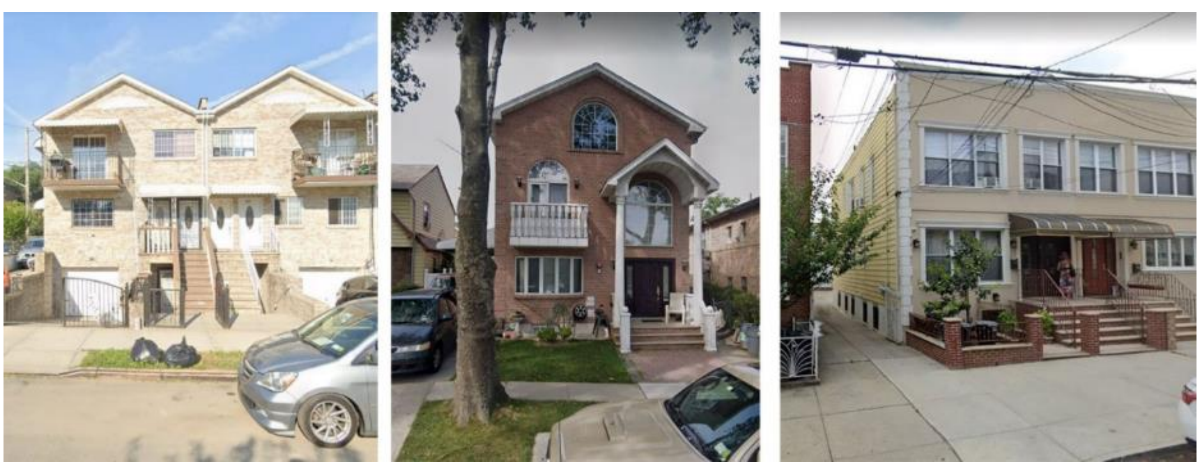
The ICF database include 147,920 records for multifamily buildings that only contain a single unit. Of these, 147,550 buildings are located in New York City and 370 are located elsewhere in the State (Table 3). To investigate whether these are true multifamily buildings, or mis-categorized single-family buildings, we cross-referenced a small sample of records from New York City with images of building exteriors and information from the New York Department of Buildings.[7]

Table 3. Count of Single-Unit Multifamily Buildings in NYC and NYS

	NY Upstate	NYC	NYS
Pre-1940	136	113814	113950
1940-1978		22225	22225
1979-2006	134	9672	9806
2007-Present	100	1789	1889
NA		50	50
Total	370	147550	147920

Most of the buildings sampled were classified as two-family dwellings for tax purposes, but photographs suggest that they are being occupied as either single-family or two-family buildings. For example, some buildings had only one entry door visible from the street, while others had two doors (Figure 1). Because of the ambiguity of the buildings' occupancy, we have included these records in our overall count of multifamily buildings but identified them as single-unit buildings in detailed analysis.

Figure 1. Examples of Single-Unit Multifamily Buildings in the Bronx, Queens, and Brooklyn



2.1.6 Data Sources for New York City

The ICF database incorporates New York City Primary Land Use Tax Lot Output (PLUTO) as a Tier 2 data set.[8] PLUTO contains detailed tax lot, building stock, geographic, and administrative data for each tax lot in New York City. Due to the large number of multifamily buildings in the City, we felt that it would be useful to analyze the data at a higher level of geographic resolution. For this reason, we used the geospatial version of the PLUTO database, MapPLUTO, to visualize City housing stock at the Community District level, rather than using county-level data from the ICF data set.[9]

2.1.7 Conclusions

Considering the qualities noted above, we believe that the ICF database is an appropriate data source for this study. We are in general agreement with ICF's choice of data sources and their methodology, and we agree with their decision to check the final data set against the U.S. Census for completeness. Moreover, mapping and statistical analysis of the ICF data yielded results that matched our expectations, given our knowledge of architectural history and building technology.

2.2 Predominant New York State Multifamily Housing Types

2.2.1 Methodology

This study identifies predominant multifamily housing typologies in New York State. These types are segments of the housing stock that are similar in form and function, while differing in individual characteristics, such as architectural style. Many different attributes define a building type, including massing, site configuration, age, ownership, cost, construction materials, and fuel source. This study focuses on attributes related to the building envelope—windows, walls, and roof—because it is intended to support the development of new products for envelope retrofits.

We identified building age, size, and construction material as the key attributes defining building envelope construction. This approach is aligned with similar studies. A 2016 study from Building Energy Exchange segmented New York City's multifamily buildings into 12 types based on age, height, and fuel type.[10] A 2017 study from Chicago-based Elevate Energy used age, size, ownership structure, and energy use for a similar segmentation exercise.[11] The Pratt Center's EnergyFit project segmented Brooklyn buildings by age, size, construction material, and fuel type to develop standardized energy-efficient retrofit measures.[12]

The choice of construction material is closely related to building age and building size. Most structures use building materials and systems that were widely available at the time of their construction. Building size—and especially building height—is a primary factor in determining the structural system.[13] The ICF database had relatively high levels of completeness for building age (vintage) and building height. Categories for building construction and exterior wall systems had low levels of completeness and were not included in our initial analysis (Table 4).

Table 4. Data Completeness for Select Fields

Source: ICF Residential Building Inventory

DATA COMPLETENESS			
	NYC	NYS	
Field Name	Five Boroughs	UpstateCounties	All Counties
Vintage	97.5	91.44	92.65
Building Construction	0.05	0.01	0.02
Exterior Wall	5.42	53.22	43.7
Building Height	92.05	52.35	60.25

Calculation is performed with data in raw format. Duplicate entries are not removed

2.2.2 Initial Segmentation

We began by analyzing the number and location of multifamily housing buildings in New York State as a percentage of the total housing stock. The majority of multifamily buildings in the State are located in New York City, with concentrations in Brooklyn and Queens. Upstate, multifamily buildings represent less than 10% of the total housing stock, as measured by number of buildings (Table 5).

We divided the multifamily housing stock into twelve segments, based on building age and height. The ICF database groups data for building age into four classes: Pre-1940, 1940–1978, 1979–2006, and 2007–present. Data for building height is grouped into three classes: low-rise (one to three stories), mid-rise (four to seven stories) and high-rise (eight+ stories).

Only four of the twelve segments contained a significant number of multifamily buildings. Most multifamily buildings in New York State are prewar low-rise structures (38.67%). The next most common segment is postwar low-rise structures (16.76%), followed by low-rise buildings built between 1979 and 2006 (8.27%). The final segment, prewar mid-rise structures (4.51% of New York State), are located primarily in New York City. Together, these four types account for 68% of the total multifamily housing stock in the State (Table 6). Excluding the 290,929 records that are missing data for vintage, building height, or both, these four segments constitute 95% of the multifamily building stock in New York State. Geographically, the State's multifamily buildings are concentrated in urban centers, with older buildings located closer to city centers and newer buildings located in adjacent counties (Figure 2–Figure 11). Section 3.2 Appendix 1: Segmentation Results by County includes a tabular breakdown of the county-level data.

Table 5. Predominant Multifamily Building Segments in New York State

Source: ICF Residential Building Inventory

Region	Building Type	Count	Percentage
NYS	Single Family	3778031	85.26%
	Multifamily	421691	9.52%
	N/A	120700	2.72%
	Other	110999	2.50%
NYC	Multifamily	603338	54.78%
	Single Family	187829	17.05%
	Single Family Detached	180560	16.39%
	Single Family Attached or Semi-Detached	107053	9.72%
	N/A	17453	1.58%
	Other	5093	0.46%

Table 6. Multifamily Buildings in New York State

Source: ICF Residential Building Inventory

Percentage and Count of Multifamily Residential Buildings in NY State and NYC							
		NY State		NY Upstate		NYC	
Vintage	Building Height	Multifamily Building Count	Percentage of Multifamily Building	Multifamily Building Count	Percentage of Multifamily Building	Multifamily Building Count	Percentage of Multifamily Building
Pre-1940	Low-Rise	396,343	38.67%	101,360	24.04%	294,983	48.89%
	Mid-Rise	46,258	4.51%	261	0.06%	45,997	7.62%
	Hi-Rise	1,530	0.15%	13	0.00%	1,517	0.25%
	NA	101,155	9.87%	95,736	22.70%	5,419	0.90%
1940-1978	Low-Rise	171,793	16.76%	48,394	11.48%	123,399	20.45%
	Mid-Rise	7,530	0.73%	535	0.13%	6,995	1.16%
	Hi-Rise	3,970	0.39%	59	0.01%	3,911	0.65%
	NA	52,351	5.11%	38,678	9.17%	13,673	2.27%
1979-2006	Low-Rise	84,792	8.27%	21,176	5.02%	63,616	10.54%
	Mid-Rise	5,879	0.57%	153	0.04%	5,726	0.95%
	Hi-Rise	1,017	0.10%	21	0.00%	996	0.17%
	NA	45,288	4.42%	34,818	8.26%	10,470	1.74%
2007-Present	Low-Rise	11,015	1.07%	2,086	0.49%	8,929	1.48%
	Mid-Rise	3,493	0.34%	33	0.01%	3,460	0.57%
	Hi-Rise	480	0.05%	0	0.00%	480	0.08%
	NA	5,043	0.49%	3,477	0.82%	1,566	0.26%
NA	Low-Rise	3,879	0.38%	3,568	0.85%	311	0.05%
	Mid-Rise	362	0.04%	82	0.02%	280	0.05%
	Hi-Rise	21	0.00%	7	0.00%	14	0.00%
	NA	82,830	8.08%	71,234	16.89%	11,596	1.92%
Total Count		1,025,029	100.00%	421,691	99.99%	603,338	100.00%

Figure 2. Number of Multifamily Buildings in New York State

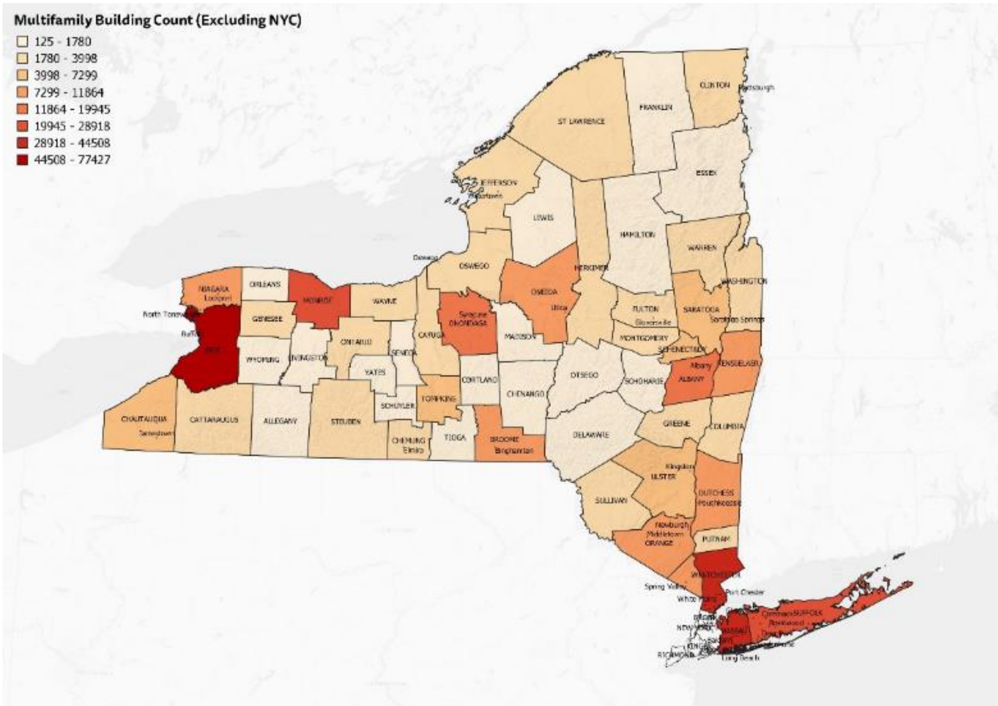


Figure 3. Number of Multifamily Buildings in New York City

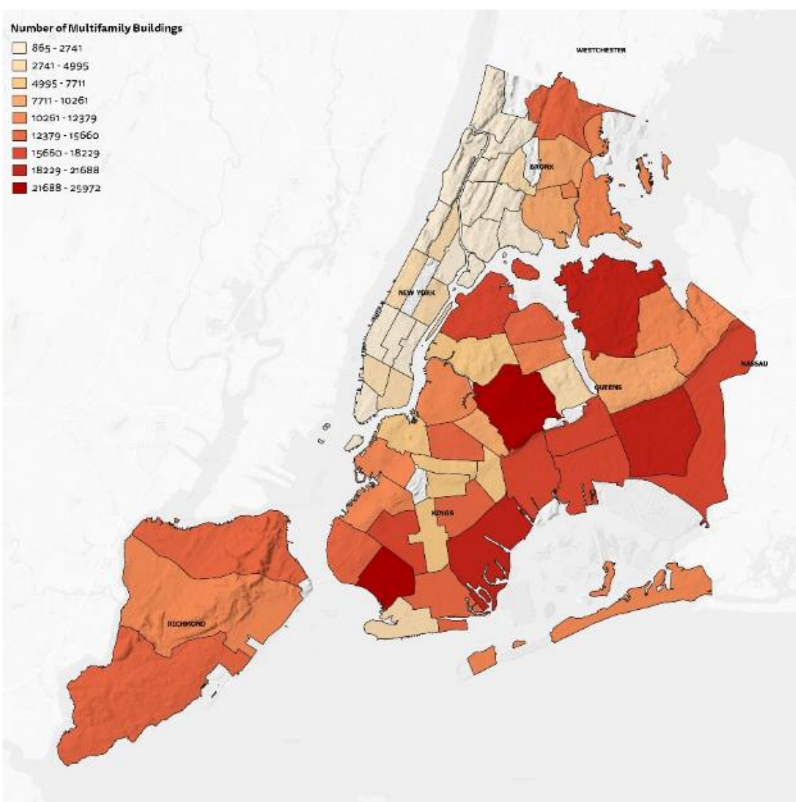


Figure 4. Low-Rise Buildings (Pre-1940) in New York State

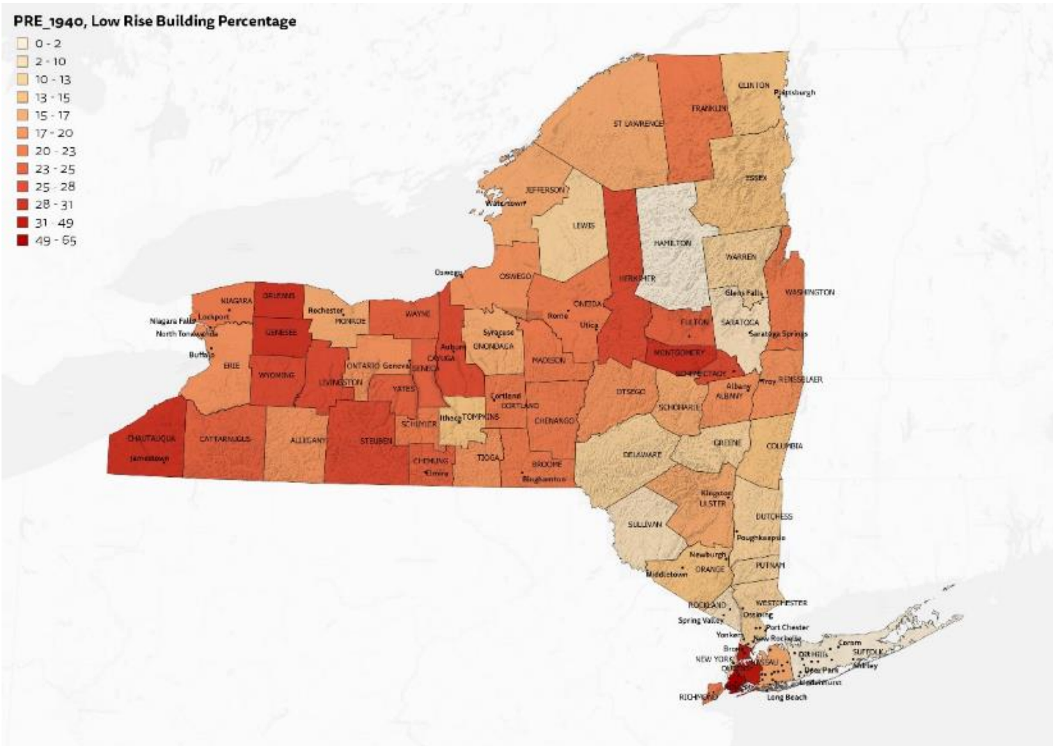


Figure 5. Mid-Rise Buildings (Pre-1940) in New York State

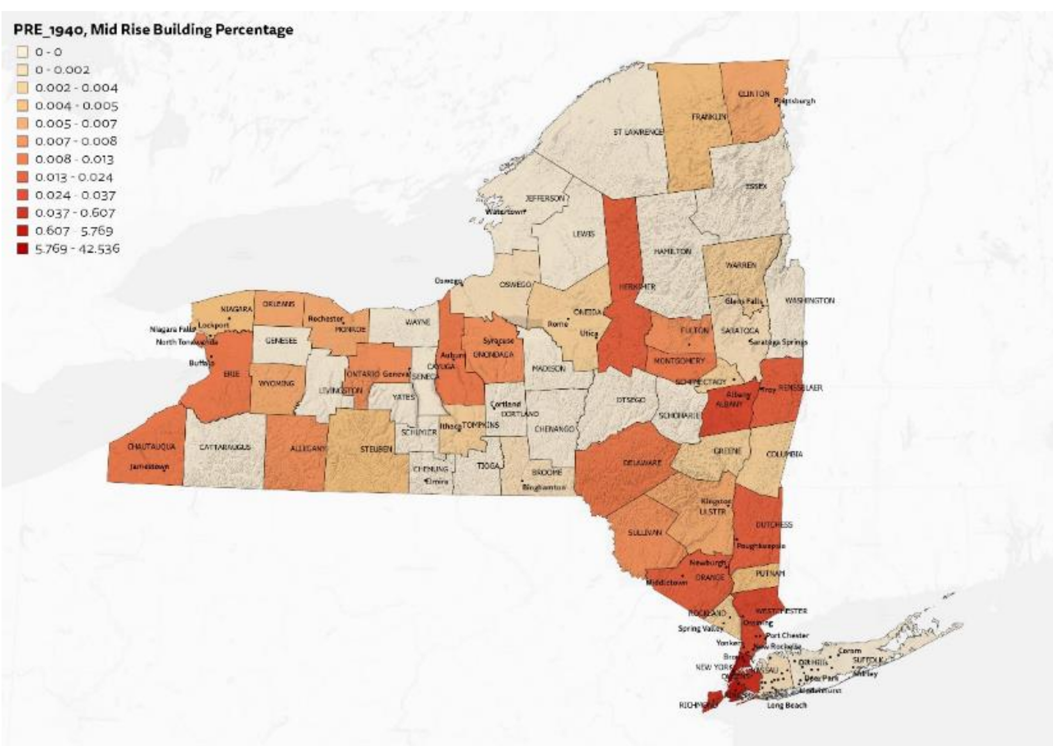


Figure 6. Low-Rise Buildings (1940–1978) in New York State

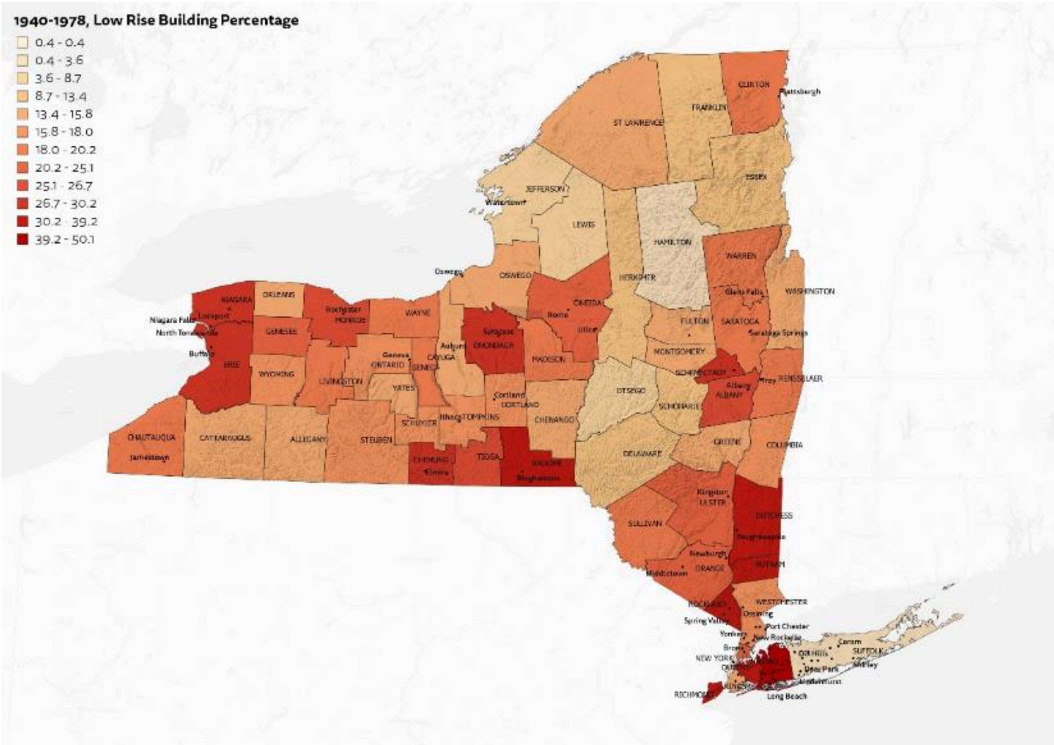


Figure 7. Low-Rise Buildings (1979–2006) in New York State

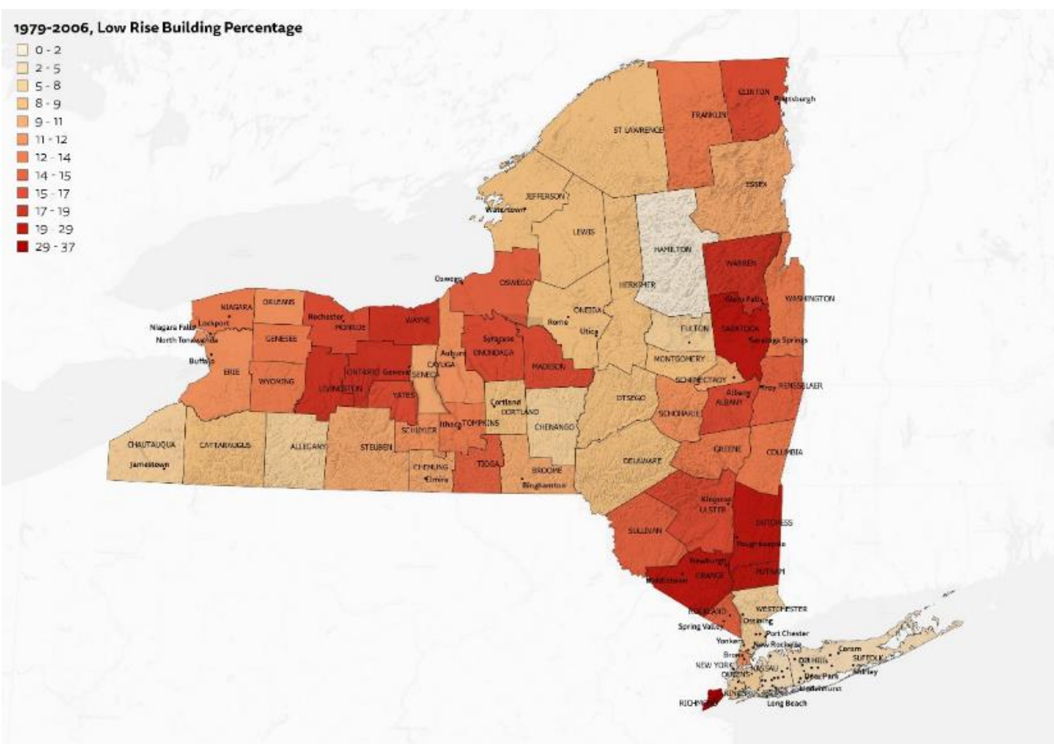


Figure 8. Low-Rise Buildings (Pre-1940) in New York City

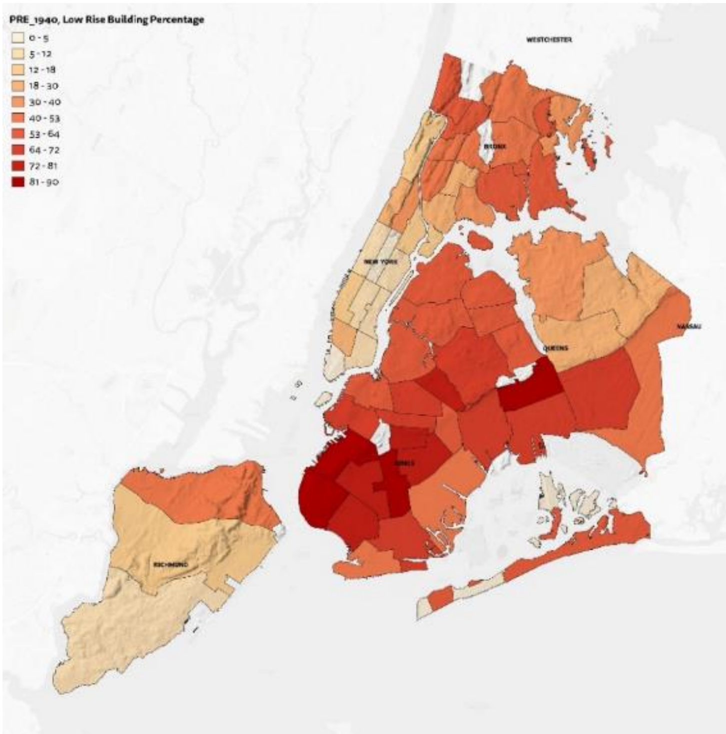


Figure 9. Mid-Rise Buildings (Pre-1940) in New York City

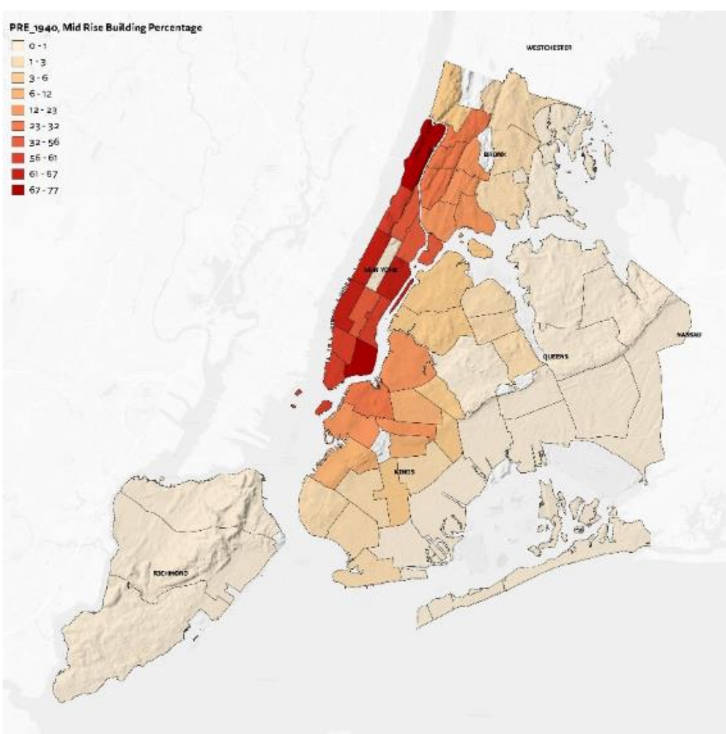


Figure 10. Low-Rise Buildings (1940–1978) in New York City

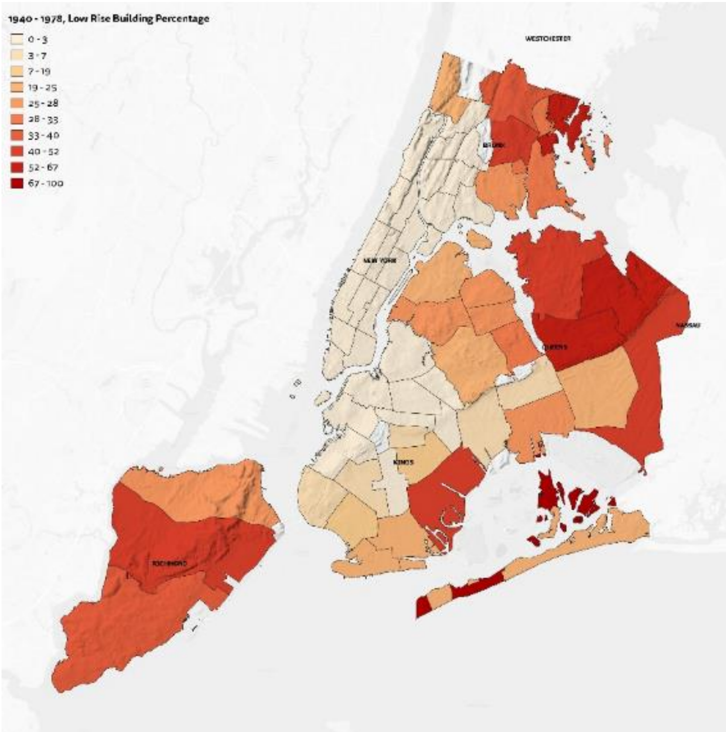
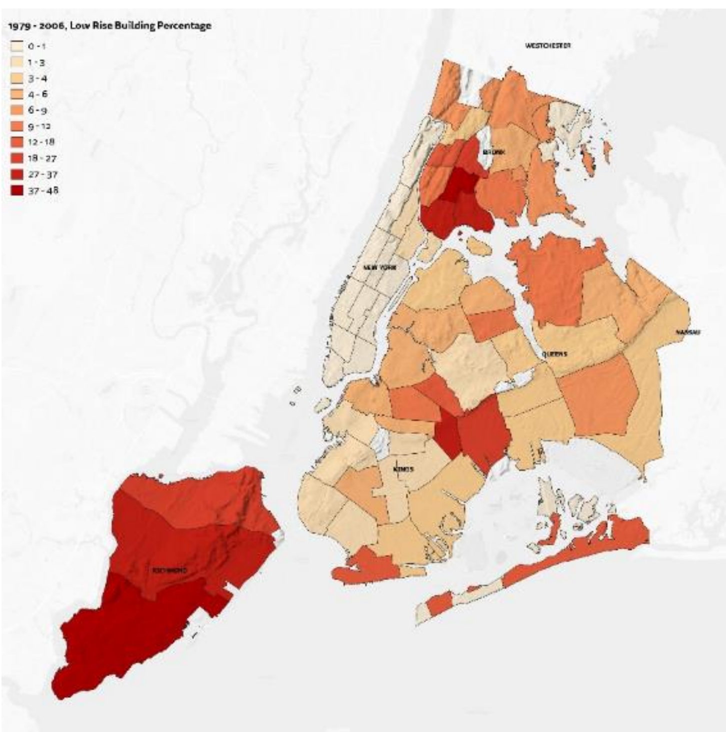


Figure 11. Low-Rise Buildings (1979–2006) in New York City



2.2.3 Segment Size

The number of buildings in a segment is not a reflection of the size of the segment in terms of floor area, facade area, or overall market opportunity. Many multifamily buildings in New York State are small (fewer than five units), representing relatively little floor area and facade area per structure. Multifamily buildings with fewer than five units are not eligible for NYSERDA program funding, so it is important to characterize the size of each segment by the number of units, in addition to vintage and building height.

Table 7. Count of Multifamily Buildings by Vintage, Height, and Number of Units

Source: ICF Residential Building Survey

Vintage	Building Height	Unit Cut	NY Upstate		NYC		NYS	
			MF Bldg #	MF Bldg %	MF Bldg #	MF Bldg %	MF Bldg #	MF Bldg %
Pre-1940	Low-Rise	Single	84	0.0%	113646	19.7%	113730	13.8%
		2-4	84056	34.3%	164762	28.5%	248818	30.2%
		≥5	17220	7.0%	16575	2.9%	33795	4.1%
	Mid-Rise	Single	0	0.0%	164	0.0%	164	0.0%
		2-4	81	0.0%	6462	1.1%	6543	0.8%
		≥5	180	0.1%	39371	6.8%	39551	4.8%
	NA	Single	52	0.0%	4	0.0%	56	0.0%
		2-4	11518	4.7%	107	0.0%	11625	1.4%
		≥5	1762	0.7%	897	0.2%	2659	0.3%
1940-1978	Low-Rise	Single	0	0.0%	22212	3.8%	22212	2.7%
		2-4	28446	11.6%	96710	16.8%	125156	15.2%
		≥5	19948	8.1%	4477	0.8%	24425	3.0%
	Mid-Rise	Single	0	0.0%	9	0.0%	9	0.0%
		2-4	62	0.0%	223	0.0%	285	0.0%
		≥5	473	0.2%	6763	1.2%	7236	0.9%
	NA	Single	0	0.0%	4	0.0%	4	0.0%
		2-4	14741	6.0%	6600	1.1%	21341	2.6%
		≥5	10807	4.4%	5408	0.9%	16215	2.0%
1979-2006	Low-Rise	Single	134	0.1%	9564	1.7%	9698	1.2%
		2-4	10668	4.3%	50658	8.8%	61326	7.5%
		≥5	10374	4.2%	3394	0.6%	13768	1.7%
	Mid-Rise	Single	0	0.0%	108	0.0%	108	0.0%
		2-4	13	0.0%	2202	0.4%	2215	0.3%
		≥5	140	0.1%	3416	0.6%	3556	0.4%
	NA	2-4	15660	6.4%	6980	1.2%	22640	2.8%
		≥5	13821	5.6%	2918	0.5%	16739	2.0%
2007-Present	Low-Rise	Single	100	0.0%	1742	0.3%	1842	0.2%
		2-4	937	0.4%	6843	1.2%	7780	0.9%
		≥5	1049	0.4%	340	0.1%	1389	0.2%
	Mid-Rise	Single	0	0.0%	27	0.0%	27	0.0%
		2-4	1	0.0%	936	0.2%	937	0.1%
		≥5	32	0.0%	2497	0.4%	2529	0.3%
	NA	Single	0	0.0%	20	0.0%	20	0.0%
		2-4	1318	0.5%	529	0.1%	1847	0.2%
		≥5	1646	0.7%	778	0.1%	2424	0.3%
Total			245323	100%	577346	100%	822669	100%

Table 7 shows the count and percentage of buildings in each segment with one unit, two to four units, and five or more units. Statewide, low-rise buildings with two to four units are the predominant type, accounting for 30%, 15% and 7.5% of the total count of multifamily buildings in the State, depending on the vintage. Prewar mid-rise buildings with five or more units are the next most common type, constituting 4.8% of the total count of multifamily buildings. Postwar midrise buildings with five or more units constitute 0.9% of the total count of multifamily buildings.

The total floor area and facade area of each segment can be calculated using the Building Area category in the ICF database. Data dictionaries provided by ICF indicate that Building Area represents the "square footage of the building," or the building "conditioned floor area (CFA), or any other floor area data which can be used to find it."[14] The original data sources include several different floor area metrics, including residential square footage and building gross floor area (Figure 13).[15] We assume that the majority of records use data from Tier 1 data sources (Experian and NY GIS), which report "home building square footage" and "square footage of living area (residential)," respectively.[16] We also assume that this data reflects the gross square foot (GSF) area of the residential portion of each building.

Figure 12. Tier 1 and Tier 2 Data Sources for Building Area

Building Area (sq ft)
Bldg Area_PLUTO
Bldg Res Sq Ft_HCR SAMIS
Home Base SF_Exp
Home Building SF_Exp
Multifamily GFA_LL84
Property GFA_LL84
Property Res Sq Ft_HCR SAMIS
Property_Sqft_HCR DHCR
Res Area_PLUTO
Sq Ft_NYCHA
Sq. Ft per Building_HCR DHCR
Square Footage_GIS

Table 8 shows the total building floor area in gross square feet (GSF) for each building segment, grouped by vintage, height, and number of units. Postwar low-rise buildings constituted the largest percentage of floor area (17.7%, or 1,294,634,772 sf). This number is driven primarily by postwar low-rise buildings in New York City. Prewar mid-rise buildings constituted the next largest segment (16.6% or 1,214,397,840 sf), the majority of which are in New York City. The third largest segment was prewar low-rise buildings (8.9% or 647,824,198 sf).

Table 8. Building Floor Area (GSF), Grouped by Vintage, Height, and Number of Stories

Source: ICF Residential Buildings Survey

Vintage	Building Height	Unit Cut	NY Upstate		NYC		NYS	
			Bldg Area %	Bldg Area (GSF)	Bldg Area %	Bldg Area (GSF)	Bldg Area %	Bldg Area (GSF)
Pre-1940	Low-Rise	Single	0.0%	139,200	3.6%	241,141,690	3.3%	241,280,890
		2-4	33.0%	196,109,075	6.7%	451,715,123	8.9%	647,824,198
		≥5	7.7%	45,779,465	3.4%	225,998,709	3.7%	271,778,174
	Mid-Rise	Single	0.0%	0	0.0%	750,066	0.0%	750,066
		2-4	0.1%	728,000	0.5%	32,707,496	0.5%	33,435,496
		≥5	1.0%	6,047,545	18.0%	1,208,350,295	16.6%	1,214,397,840
	NA	Single	0.1%	338,520	0.0%	9,268	0.0%	347,788
		2-4	1.8%	10,945,410	0.0%	557,837	0.2%	11,503,247
		≥5	1.2%	7,338,106	2.3%	154,113,694	2.2%	161,451,800
1940-1978	Low-Rise	Single	0.0%	0	2.9%	192,014,356	2.6%	192,014,356
		2-4	11.8%	70,334,700	18.2%	1,224,300,072	17.7%	1,294,634,772
		≥5	10.9%	64,851,816	2.7%	178,522,010	3.3%	243,373,826
	Mid-Rise	Single	0.0%	0	0.0%	90,133	0.0%	90,133
		2-4	0.2%	1,036,500	0.0%	870,121	0.0%	1,906,621
		≥5	2.3%	13,929,266	6.5%	438,365,998	6.2%	452,295,264
	NA	Single	0.0%	0	0.0%	13,696	0.0%	13,696
		2-4	2.4%	14,005,451	3.1%	205,523,499	3.0%	219,528,950
		≥5	4.2%	25,136,635	5.9%	394,911,143	5.7%	420,047,778
1979-2006	Low-Rise	Single	0.0%	176,600	7.8%	524,027,400	7.2%	524,204,000
		2-4	5.0%	29,738,090	5.1%	342,279,760	5.1%	372,017,850
		≥5	8.5%	50,684,683	2.5%	165,550,180	3.0%	216,234,863
	Mid-Rise	Single	0.0%	0	0.1%	5,658,197	0.1%	5,658,197
		2-4	0.0%	291,400	1.9%	125,450,434	1.7%	125,741,834
		≥5	1.2%	7,214,077	5.1%	339,978,110	4.8%	347,192,187
	NA	2-4	2.0%	11,846,220	0.1%	7,310,647	0.3%	19,156,867
		≥5	3.7%	21,827,395	0.9%	57,057,780	1.1%	78,885,175
2007-Present	Low-Rise	Single	0.0%	125,000	0.1%	4,634,055	0.1%	4,759,055
		2-4	0.5%	3,184,975	0.8%	53,167,204	0.8%	56,352,179
		≥5	1.2%	7,015,946	0.2%	11,272,675	0.3%	18,288,621
	Mid-Rise	Single	0.0%	0	0.0%	166,834	0.0%	166,834
		2-4	0.0%	2,200	0.1%	7,605,176	0.1%	7,607,376
		≥5	0.1%	711,200	1.2%	79,855,739	1.1%	80,566,939
	NA	Single	0.0%	0	0.0%	67,064	0.0%	67,064
		2-4	0.1%	775,667	0.0%	801,001	0.0%	1,576,668
		≥5	0.8%	4,650,029	0.5%	35,455,578	0.5%	40,105,607
Total			100.0%	594,963,171	100.0%	6,710,293,040	100.0%	7,305,256,211

Table 9 shows the total building exterior wall area, which is estimated from the available data. The following assumptions were made to fill in missing information:

- Building Footprint. Footprint information is not included in the ICF database. The footprint area is estimated by dividing building area by number of stories.
- Building Dimensions. Building dimensions (length and width) are not included in the database. While some building types have common dimensions (for example, buildings on 25-foot lots in New York City), there is wide variability in building size and shape statewide. We estimated the building perimeter by taking the square root of the building footprint area, which assumes a square building.
- Massing. Information about how many buildings in each segment are fully detached, semi-attached, and attached is not available. Building massing has a significant impact on exterior wall area, as attached buildings have fewer exterior walls. The analysis assumes fully detached buildings, which is likely more accurate for upstate counties.
- Floor-to-Floor Height. In the study floor-to-floor height is estimated at 10 feet. Actual FTF could be higher for larger buildings.

The exterior wall area was calculated using the equation below. This value does not include the roof area.

Total Facade Area = SUM((√'Building Area') * 4 * 10 * 'Floor Count')

2.2.4 Building Construction Materials

Each segment in the data set includes subsegments defined by construction material, including structural system and cladding material. The ICF data set includes information on construction material and exterior wall (cladding) material. As mentioned previously, both categories have a low level of completeness (see Table 4), with substantially incomplete construction materials. Table 10 includes a count of the most common exterior wall materials reported for each segment. Materials with significant representation in the data set include aluminum siding, wood siding, brick, and stucco.

We believe this data on exterior wall material to be inaccurate, due to the small sample size and the lack of correspondence with our expectations based on knowledge of historical building systems. Further, we found inaccurate material descriptions when cross-referencing database entries with online photographs (available from Google Maps Street View). We determined that exterior wall and cladding materials were better evaluated using secondary sources. Based on a review of these sources, we identified masonry (brick, concrete block, and reinforced concrete) and frame (primarily wood frame) as the major structural systems defining building subtypes. Common cladding materials include brick on masonry walls, and wood siding, brick veneer, and stucco on wood frame walls. Our methodology is described in greater detail in Section 2.1 Detailed Architectural Profiles of Predominant Multifamily Building Types.

Table 9. Facade Area (SF), Grouped by Vintage, Height, and Number of Units

Buildings lacking information on number of stories ("N/A" in Table B) were not included in this data set.

Vintage	Building Height	Unit Cut	NY Upstate		NYC		NYS	
			Ext Wall Area %	Ext Wall Area (GSF)	Ext Wall Area %	Ext Wall Area (GSF)	Ext Wall Area %	Ext Wall Area (GSF)
Pre-1940	Low-Rise	Single	0.0%	191,588	10.8%	301,872,806	9.3%	302,064,394
		2-4	47.7%	227,114,067	18.2%	505,883,722	22.5%	732,997,789
		≥5	9.7%	45,947,453	3.0%	83,233,400	4.0%	129,180,853
	Mid-Rise	Single	0.0%	0	0.0%	886,581	0.0%	886,581
		2-4	0.1%	550,146	1.2%	34,463,151	1.1%	35,013,298
		≥5	0.5%	2,608,918	17.8%	495,755,830	15.3%	498,364,747
1940-1978	Low-Rise	Single	0.0%	0	2.9%	76,815,533	2.5%	76,815,533
		2-4	14.7%	70,091,331	15.3%	389,828,479	15.2%	459,919,810
		≥5	10.5%	50,094,431	2.6%	40,276,947	3.8%	90,371,378
	Mid-Rise	Single	0.0%	0	0.0%	72,336	0.0%	72,336
		2-4	0.1%	572,064	0.0%	911,843	0.0%	1,483,907
		≥5	1.7%	8,071,433	11.2%	311,630,763	9.8%	319,702,196
1979-2006	Low-Rise	Single	0.1%	258,008	3.7%	103,656,090	3.2%	103,914,097
		2-4	5.7%	27,135,365	6.0%	167,566,663	6.0%	194,702,028
		≥5	7.0%	33,235,514	0.9%	24,054,425	1.8%	57,289,940
	Mid-Rise	Single	0.0%	0	0.1%	1,772,792	0.1%	1,772,792
		2-4	0.0%	153,853	1.0%	28,596,836	0.9%	28,750,690
		≥5	0.6%	2,757,873	2.3%	64,916,977	2.1%	67,674,850
2007-Present	Low-Rise	Single	0.0%	170,091	0.2%	5,137,218	0.2%	5,307,308
		2-4	0.6%	2,789,250	1.0%	28,086,653	0.9%	30,875,903
		≥5	0.8%	3,960,830	0.1%	2,873,851	0.2%	6,834,680
	Mid-Rise	Single	0.0%	0	0.0%	166,881	0.0%	166,881
		2-4	0.0%	4,195	0.2%	5,823,666	0.2%	5,827,861
		≥5	0.1%	341,080	1.3%	37,138,266	1.1%	37,479,346
Total			100.0%	476047490.4	100.0%	2711421710	100.0%	3187469200

Table 10. Count of Exterior Wall Material, Grouped by Vintage and Building Height

Number and Percentage of Multifamily Buildings in New York City, New York State and New York Upstate.
Missing values have been labeled and counted as 'NA'.
Percentages are calculated using the total number of multifamily buildings in New York State

Vintage	Building Height	Exterior Wall	NYS		NY Upstate		NYC	
			MF Bldg #	MF Bldg %	MF Bldg #	MF Bldg %	MF Bldg #	MF Bldg %
Pre-1940	Low-Rise	NA	285360	72.00%	5542	5.47%	279818	94.86%
		Aluminum	41778	10.54%	41730	41.17%	48	0.02%
		Siding-Wood	25338	6.39%	25223	24.88%	115	0.04%
		Other	14907	3.76%	14	0.01%	14893	5.05%
		Stucco	19823	5.00%	19795	19.53%	28	0.01%
		Brick	7869	1.99%	7810	7.71%	59	0.02%
	Mid-Rise	NA	45890	99.20%	190	72.80%	45700	99.35%
		Aluminum	25	0.05%	13	4.98%	12	0.03%
		Siding-Wood	89	0.19%	9	3.45%	80	0.17%
		Other	144	0.31%	4	1.53%	140	0.30%
		Stucco	14	0.03%	9	3.45%	5	0.01%
		Brick	90	0.19%	35	13.41%	55	0.12%
	NA	NA	96033	94.94%	90627	94.66%	5406	99.76%
		Aluminum	2382	2.35%	2382	2.49%	0	0.00%
		Siding-Wood	1382	1.37%	1375	1.44%	7	0.13%
		Other	8	0.01%	4	0.00%	4	0.07%
		Stucco	1090	1.08%	1090	1.14%	0	0.00%
		Brick	206	0.20%	205	0.21%	1	0.02%
1940-1978	Low-Rise	NA	122336	71.21%	7665	15.84%	114671	92.93%
		Aluminum	17656	10.28%	17634	36.44%	22	0.02%
		Siding-Wood	9774	5.69%	9717	20.08%	57	0.05%
		Other	8630	5.02%	47	0.10%	8583	6.96%
		Stucco	3995	2.33%	3987	8.24%	8	0.01%
		Brick	7353	4.28%	7304	15.09%	49	0.04%
	Mid-Rise	NA	7416	98.49%	507	94.77%	6909	98.77%
		Aluminum	4	0.05%	3	0.56%	1	0.01%
		Siding-Wood	8	0.11%	6	1.12%	2	0.03%
		Other	74	0.98%	2	0.37%	72	1.03%
		Stucco	5	0.07%	5	0.93%	0	0.00%
		Brick	16	0.21%	11	2.06%	5	0.07%
	NA	NA	49562	94.67%	36029	93.15%	13533	98.98%
		Aluminum	1252	2.39%	1252	3.24%	0	0.00%
		Siding-Wood	502	0.96%	495	1.28%	7	0.05%
		Other	162	0.31%	38	0.10%	124	0.91%
		Stucco	229	0.44%	228	0.59%	1	0.01%
		Brick	573	1.09%	566	1.46%	7	0.05%
1979-2006	Low-Rise	NA	64841	76.47%	3748	17.70%	61093	96.03%
		Aluminum	10205	12.04%	10179	48.07%	26	0.04%
		Siding-Wood	5246	6.19%	5196	24.54%	50	0.08%
		Other	2327	2.74%	7	0.03%	2320	3.65%
		Stucco	812	0.96%	717	3.39%	95	0.15%
		Brick	1029	1.21%	1003	4.74%	26	0.04%
	Mid-Rise	NA	5797	98.61%	135	88.24%	5662	98.88%
		Aluminum	6	0.10%	3	1.96%	3	0.05%
		Siding-Wood	8	0.14%	5	3.27%	3	0.05%
		Other	52	0.88%	0	0.00%	52	0.91%
		Stucco	7	0.12%	5	3.27%	2	0.03%
		Brick	4	0.07%	2	1.31%	2	0.03%
	NA	NA	44761	98.84%	34395	98.79%	10366	99.01%
		Aluminum	135	0.30%	135	0.39%	0	0.00%
		Siding-Wood	191	0.42%	187	0.54%	4	0.04%
		Other	155	0.34%	58	0.17%	97	0.93%
		Stucco	16	0.04%	15	0.04%	1	0.01%
		Brick	24	0.05%	22	0.06%	2	0.02%
2007-Present	Low-Rise	NA	9481	86.07%	725	34.76%	8756	98.06%
		Aluminum	961	8.72%	958	45.93%	3	0.03%
		Siding-Wood	241	2.19%	231	11.07%	10	0.11%
		Other	148	1.34%	0	0.00%	148	1.66%
		Stucco	98	0.89%	96	4.60%	2	0.02%
		Brick	73	0.66%	67	3.21%	6	0.07%
	Mid-Rise	NA	3480	99.63%	33	100.00%	3447	99.62%
		Aluminum	1	0.03%	0	0.00%	1	0.03%
		Siding-Wood	3	0.09%	0	0.00%	3	0.09%
		Other	8	0.23%	0	0.00%	8	0.23%
		Brick	1	0.03%	0	0.00%	1	0.03%
	NA	NA	5016	99.46%	3451	99.25%	1565	99.94%
		Aluminum	11	0.22%	11	0.32%	0	0.00%
		Siding-Wood	9	0.18%	9	0.26%	0	0.00%
		Other	1	0.02%	0	0.00%	1	0.06%
		Brick	4	0.08%	4	0.12%	0	0.00%

2.2.5 Average Building Characteristics

In addition to aggregate data on building count, floor area, and facade area, the team compiled building-level data to profile the typical building in each segment. Table 11 and 12 include information on the average building area (GSF), building footprint (sf), number of dwelling units, and dwelling unit area by vintage, building height, and number of units. To improve accuracy, outliers were removed from the data set by filtering out entries in the 10th and 90th percentile. The median average was used for all calculations, as the data set is skewed toward lower values.

Despite this, we think that average data for buildings with greater than 20 units may be inaccurate, due to several factors: small sample size, predominance of building types (such as senior and assisted living) with a large number of relatively small units, and incorrect reporting of unit numbers for apartment complexes with multiple buildings on the same lot.

Appendix B: Data Distribution of Average Building Statistics includes histograms of the data in Tables 11 and 12, which illustrate the distribution of data underlying the reported averages.

Table 11. Average Building Characteristics by Vintage, Building Height, and Number of Units, Pre-1940–1978

Vintage	Building Height	Unit Cut	Building Count			Avg Bldg Area (sqft)			Av Facade Area			Avg Bldg Footprint (sqft)			Avg # Du			Avg DU Area (sqft)		
			NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS
Pre-1940	Low-Rise	Single	113,646	84	113,730	2,144	2,000	2,144	2,651	2,530	2,650	1,043	1,000	1,042				1,822	2,000	1,822
		2-4	164,762	84,056	248,818	2,586	2,200	2,412	2,980	2,683	2,840	1,133	1,100	1,116	2	3	2	1,060	867	1,000
		5-9	15,342	16,237	31,579	4,650	2,100	3,600	4,709	2,592	3,950	1,575	1,050	1,320	6	7	7	813	786	813
		10-19	866	539	1,405	5,019	2,500	3,727	4,908	2,939	4,157	1,513	1,100	1,250	12	15	13	798	913	807
		20-49	143	183	326	6,768	2,600	2,700	5,548	2,919	3,098	1,746	1,080	1,175	34	35	35	993	860	896
		50+	224	261	485	1,800	2,100	2,050	2,239	2,653	2,623	900	1,000	1,000				1,024	773	986
	Mid-Rise	Single	164			3,780		3,780	4,719		4,719	1,057		1,057				2,360		2,360
		2-4	6,462	81	6,543	4,443	4,400	4,440	5,273	5,276	5,273	1,143	1,125	1,143	4	3	4	1,272	1,333	1,275
		5-9	11,042	47	11,089	6,400	6,500	6,400	6,145	6,125	6,145	1,573	1,650	1,573	8	7	8	929	1,086	929
		10-19	11,537	36	11,573	7,794	8,700	7,798	6,308	6,197	6,308	1,837	2,250	1,838	14	15	14	825	883	825
		20-49	12,771	61	12,832	9,040	2,100	9,038	5,887	3,666	5,872	1,972	1,511	1,972	26	35	26	857	1,011	857
		50+	4,021	36	4,057	4,184	7,900	6,042	3,578	3,533	3,555	2,355	1,975	2,355				957	946	957
	NA	Single	4	52	56	2,317	6,510	6,510										1,768		1,768
		2-4	107	11,518	11,625	2,388	2,000	2,000							3	3	3	860	850	850
		5-9	112	1,535	1,647	2,994	1,900	1,900							7	7	7	1,356	857	864
		10-19	154	63	217	3,532	3,800	3,658							15	15	15	1,522	930	933
		20-49	250	66	316	5,813	2,100	4,886							35	35	35	1,761	951	1,651
		50+	381	98	479		1,800	1,800										1,148	1,080	1,113
1940-1978	Low-Rise	Single	22,212			2,110		2,110	2,592		2,592	1,040		1,040				1,848		1,848
		2-4	96,710	28,446	125,156	2,280	2,200	2,269	2,800	2,713	2,771	1,090	1,200	1,109	2	2	2	1,029	950	1,010
		5-9	2,285	18,406	20,691	4,190	2,100	2,100	4,429	2,713	2,771	1,467	1,250	1,267	7	7	7	764	829	814
		10-19	911	841	1,752	7,396	5,400	6,012	5,483	5,719	5,719	1,830	1,200	1,333	13	15	15	1,079	923	929
		20-49	585	415	1,000	8,194	5,100	5,700	5,343	4,964	5,090	1,000	1,133	1,117	30	35	35	1,027	769	898
		50+	696	286	982	1,700	3,700	3,250	2,771	4,741	4,561	1,425	1,000	1,050				1,342	989	1,342
	Mid-Rise	Single	9			3,560		3,560	4,773		4,773	890		890						
		2-4	223	62	285	4,402	5,650	4,704	5,060	5,879	5,181	1,137	1,500	1,220	3	3	3	1,423	1,575	1,467
		5-9	320	129	449	6,500	7,150	6,637	6,207	6,400	6,248	1,625	1,938	1,685	7	7	7	971	1,300	1,071
		10-19	312	103	415	8,265	7,950	8,178	6,502	6,739	6,538	1,765	2,500	1,864	14	15	15	863	833	842
		20-49	1,818	75	1,893	9,133		9,133		2,191	2,191	2,044		2,044	35	35	35	998	1,059	1,004
		50+	4,313	166	4,479	1,600	6,900	4,250	5,060		5,060		767	767				985	911	984
	NA	Single	4			3,424		3,424												
		2-4	6,600	14,741	21,341	2,778	2,000	2,000							2	2	2	1,090	900	900
		5-9	998	8,302	9,300	7,128	2,100	2,100							7	7	7	1,775	1,431	1,431
		10-19	904	1,223	2,127	5,138	6,600	6,600							15	15	15	1,628	853	947
		20-49	2,108	732	2,840	1,950	4,900	4,100							35	35	35	1,723	1,150	1,453
		50+	1,398	550	1,948		6,600	6,600										1,222	1,007	1,158

Table 12. Average Building Characteristics by Vintage, Height, and Number of Units, 1979–Present

Vintage	Building Height	Unit Cut	Building Count			Avg Bldg Area (sqft)			Av Facade Area			Avg Bldg Footprint (sqft)			Avg # Du			Avg DU Area (sqft)		
			NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS	NYC	NY	NYS
1979-2006	Low-Rise	Single	9,564	134	9,698	2,288	1,500	2,280	2,725	2,117	2,713	1,094	750	1,088				2,026	1,400	2,000
		2-4	50,658	10,668	61,326	2,520	2,500	2,500	3,113	2,884	3,036	1,074	1,350	1,101	2	2	2	1,106	1,050	1,100
		5-9	2,362	8,985	11,347	4,313	2,400	2,500	4,491	2,884	2,993	1,403	1,350	1,350	7	7	7	851	1,186	1,014
		10-19	576	684	1,260	7,891	4,000	4,597	6,020	5,695	5,695	2,312	1,200	1,200	12	15	15	1,083	845	933
		20-49	374	488	862	2,150	4,900	4,800	3,301	4,767	4,698	1,075	1,200	1,200	35	35	35	1,152	818	903
		50+	82	217	299	1,900	3,500	2,700	2,466	4,040	3,836	950	1,100	1,100				994	865	917
	Mid-Rise	Single	108			4,900		4,900	5,048		5,048	1,300		1,300						
		2-4	2,202	13	2,215	4,000	3,350	4,000	5,029	5,336	5,029	1,052	988	1,052	3	3	3	1,312	825	1,312
		5-9	1,313	28	1,341	6,480	6,000	6,475	5,999	5,879	5,999	1,599	1,525	1,599	7	7	7	993	1,229	994
		10-19	768	9	777	8,400	6,400	8,397	6,358	6,450	6,386	1,920	1,900	1,920	14	15	14	1,102	1,013	1,093
		20-49	658	29	687	8,250	1,700	8,220		4,523	4,523	2,032		2,032	29	35	29	1,053	1,324	1,063
		50+	677	74	751	6,913		6,913		2,800	2,800	988		988				947	937	947
	NA	2-4	6,980	15,660	22,640	2,420	4,000	3,910							2	3	3	1,020	1,100	1,088
		5-9	1,560	12,255	13,815	2,840	5,227	5,100							7	7	7	991	1,431	1,431
		10-19	362	770	1,132	3,220	8,100	6,600							15	15	15	1,987	857	860
		20-49	548	520	1,068		5,600	5,600							35	35	35	1,657	926	1,480
		50+	448	276	724	2,800	6,050	5,400										1,107	989	1,066
2007-Present	Low-Rise	Single	1,742	100	1,842	2,448		2,448	2,828		2,828	1,190	1,300	1,196				2,076	1,250	2,024
		2-4	6,843	937	7,780	2,826	2,600	2,812	3,394	3,046	3,365	1,080	1,400	1,102	2	3	2	1,154	1,100	1,148
		5-9	272	793	1,065	6,078	3,700	4,400	5,398	3,857	4,415	1,897	1,500	1,600	7	7	7	1,073	1,142	1,104
		10-19	39	143	182	7,978	1,800	1,900	5,767	6,450	6,425	2,309	1,500	1,500	12	15	15	1,022	1,082	1,038
		20-49	26	69	95		2,100	2,100		4,507	4,507		1,600	1,600	27	35	35	1,113	938	1,073
		50+	3	44	47		4,200	4,200		5,090	5,090		1,200	1,200				913	993	991
	Mid-Rise	Single	27			4,132		4,132	5,142		5,142	1,033		1,033						
		2-4	936	1	937	4,204	2,200	4,202	5,060	4,195	5,060	1,095		1,095	3	3	3	1,498	733	1,495
		5-9	972	3	975	6,810	7,400	6,811	6,246	6,882	6,248	1,648	1,850	1,648	8	7	8	1,000	1,057	1,002
		10-19	649	20	669	8,034		8,034	6,312		6,312	1,838	2,500	1,875	13	14	13	999	817	983
		20-49	525	4	529	8,015	9,600	8,473	4,983		4,983	2,253	2,400	2,254	29	35	29	1,079		1,079
		50+	351	5	356	6,126		6,126				2,039		2,039				1,049	1,020	1,039
	NA	Single	20			2,768		2,768										2,400		2,400
		2-4	529	1,318	1,847	3,011	4,150	3,068							2	2	2	1,200	1,167	1,200
		5-9	362	1,263	1,625	5,995	5,150	5,477							7	7	7	969	1,029	1,014
		10-19	109	168	277	6,710	4,400	6,300							15	15	15	1,126	1,203	1,126
		20-49	127	138	265		5,050	5,050							35	35	35	1,535	1,264	1,423
		50+	180	77	257		8,350	8,350										1,191	989	1,160

3 Detailed Architectural Profiles of Predominant Multifamily Building Types

3.1 Overview Summary

Part 2 of the Multifamily Market and Architectural Survey study comprises detailed architectural profiles of the most prevalent multifamily building typologies in New York State. The profiles include architectural details of the building envelope of each type, and major subtypes where variation significantly changes thermal and moisture performance of the envelope, roof construction, or cladding materials. Profiles also include additional information relevant to the development of retrofit or new construction approaches involving recladding or application of panelized systems. Such additional information, listed in each section, includes (1) building construction type, such as masonry, wood frame, or concrete; (2) fenestration types, patterns, and estimated Window-to-Wall Ratios (WWRs); and (3) descriptions of architectural ornamentation where it features predominantly within the building type and is likely to impact approaches that involve the envelope. Multiple methods of analysis were used in the construction of the architectural profiles outlined in this study and are detailed in the following section.

3.2 Methods and Approach

For each vintage category, starting from pre-1940, the team initially identified major building types by exterior wall construction as described in the ICF data. The accuracy of material descriptions were verified by (1) cross-referencing several entries with CoStar[17] data to confirm envelope material characteristics and (2) comparing historical codes and photo-documentation of sites to further verify building envelope structural, insulation, and cladding properties. This multistep verification was necessary due to a number of inaccuracies previously identified in the ICF data. For vintage categories spanning the most recent time frames (e.g., 2007–present), construction detail and envelope design practices were cross-referenced with more widely available current code requirements and industry standard design reference materials.

The first method of analysis employed in the development of the architectural profiles was the production of drafted envelope drawings from the seven primary multifamily building types identified as part of the report for Task 1: Building Stock Assessment, which analyzed multifamily housing data from a report provided by NYSERDA.[18] For each of the seven major multifamily building types identified, the drafted drawings describe in detail the wall construction type, including envelope layering and thicknesses, estimated roof and wall R-values,[19] and roof and foundation connections.

The second method of analysis consisted of consultation with historical sources and experts from within the Syracuse University community. Major sources consulted in this study include: Bird Library, the King + King Architectural Library (both housed on Syracuse University's main campus), the International Masonry Institute, the United States Preservation Society, and multiple online sources of historical construction guides (See 2.4 References for a complete list).

The information produced in this step was combined with the originally provided report data to develop complete profiles, as the report data did not include a sufficient number of accurate records of building insulation, construction type, envelope layering systems, or WWRs. Archival photographs, Google Earth, and manual photo-documentation were also combined to provide necessary visualization of records, so that visual checks could be performed to (1) confirm descriptions, (2) identify discrepancies and correct data, and (3) provide previously unavailable data pertaining to major types and subtypes. The resulting information enabled further development of profiles and inclusion of significant characterizing details.

The third method included referencing current codes and construction guides and involved consulting a range of published sources. Major sources referenced in this phase of the study include: the International Code Council (ICC), the International Building Code (IBC), the National Fire Protection Association (NFPA), the Building Science Corporation, several Architectural Standards books and guides, and product manufacturer's specifications for certain genericized components whose detailing has been established as the industry standard (e.g., Tyvek). Full reference information for each source can be found in the reference section appended to the main report.

Finally, a random sample of 100 records was taken from the data NYSERDA provided for four counties across different geographic locations in New York State. New York County, Onondaga County, Albany County, and Erie County were selected. Counties from different regions of New York State were selected to capture regionally specific building characteristics, as these were not defined using visual information in the data originally provided. The group of records defining the random sample for the three counties is appended to the main report in 3.4 Appendix 3: Random Samples of Three NYS Counties. Visual checks were performed on this record and documented where discrepancies were noted between the data originally provided and the appearance of the physical address of the record. Although these discrepancies are noted individually in appendix 3, general trends of note across all three counties included: (1) miscounts of number of units; (2) inaccurate reporting of exterior cladding materials; and (3) omission of basement-level rentals in the original data in building story counts.

Variations and subtypes for each major type are defined in each section by key characteristics that affect envelope performance, including the application of materials, roof type, and major ornamental features that are relevant for the present analysis. These are discussed within individual sections for major types, along with the significance of distinct features.

Several historical sources of drawings from within architectural and construction guides were used. Images from references are included where relevant. All sources are listed in full in the reference section following the main report. Documentation of pre-1940 construction demanded a wide range of historical source material, which informed the wall section drawings for those types.

Architectural Graphic Standards (AGS) is a particularly useful source for contemporaneous details of historic building construction systems. This sourcebook of building construction details was first published in 1932 and is currently in its 12th edition (2016). The book is an excellent resource for tracking incremental changes to building technology and construction practices in the United States over the 20th century, due to consistent format, its wide use by design professionals, and the accuracy of content, which has been edited by the American Institute of Architects since 1970.[20] Information in AGS Summaries, which follow discussions of each type, summarize relevant details found in the standard.

3.3 Detailed Architectural Profiles of Major Building Types and Relevant Subtypes

The preceding step in this study, Task 1: Building Stock Assessment, identified seven major multifamily building types in New York State. In the task, the following types were organized primarily by the vintage (year of original construction) identified within the data provided by NYSERDA:

- Type 1: Pre-1940, one to three story, masonry
- Type 2: Pre-1940, one to three story, wood frame
- Type 3: Pre-1940, four to seven story, masonry
- Type 4: 1940-1978, one to three story, wood frame
- Type 5: 1940-1978, one to three story, masonry
- Type 6: 1978-present, one to three story, wood frame
- Type 7: 1978-present, one to three story, masonry

These categories demonstrate construction innovations over time, such as manufacturing and new materials during and after World War II. The types and subtypes are here organized in the order listed.

3.3.1 Type 1: Pre-1940, One- to Three-Story Masonry

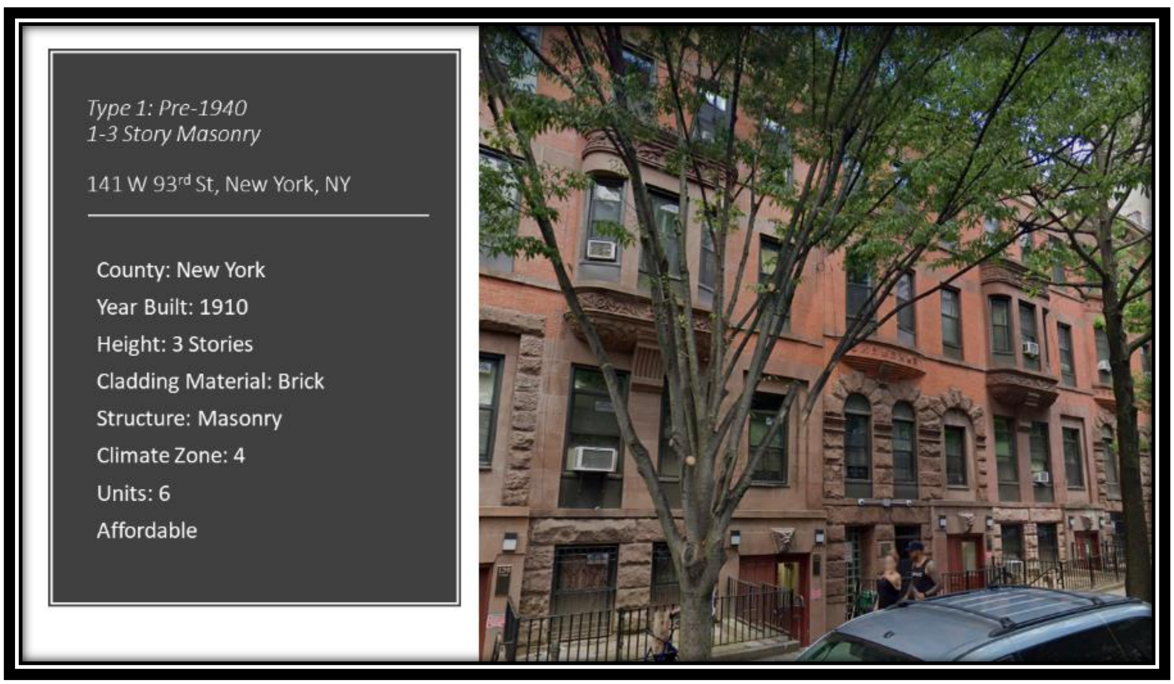
Type 1 is defined by a height of one to three stories, and load-bearing exterior masonry walls, commonly with two-wythe brick construction. In multistory buildings, or in the lower foundation stories of buildings, three-wythe brick construction was typical. Site cast concrete, rubble foundations, or sand layered with stone were used. Air gaps of approximately 1 inch or more were often placed between wythes of brick to provide an insulative cavity and dimensional stability. Insulation was not prevalent during this time period, though some historical guides note drywall filler or cellulose between masonry layers, which provided some additional insulative value. Because this specification appears in few historical guides, and because insulation is rarely found in contemporary retrofit projects that require deconstruction of walls, it is concluded that this practice was less common.

Within Type 1, subtypes are defined by differences in roof configuration, envelope composition, and foundation design. Shown in the following pages are examples of those having flat roofs accompanied by parapet walls, and those having pitched roofs supported by wood framing, along with common layering systems of brick, concrete, and other materials in the envelope and foundation, producing a total R-value of approximately R-2 to R-4. Ranges are given for all R-values due to considerable differences in manufacture and detailing of materials, which affect conductivity and building energy use, particularly space heating in the winter. Another major factor influencing the building's energy use is the window to wall ratio (WWR).[21] Buildings in the Type 1 classification typically have lower WWRs than contemporary buildings, and are commonly rated under 15%. Larger-scale buildings originally intended for factory uses and later converted to multifamily constitute exceptions to this general trend. Glazed openings consist primarily of single-pane windows, which perform thermally very poorly by present-day standards; however, in many of these larger-scale buildings that were later renovated for energy efficiency, the glazing units are replaced with new wood or vinyl units.

Constructed in 1910, 141 W 93rd St serves as an example of the predominant building type for low-rise masonry construction. In low-rise buildings, load-bearing brick masonry walls were typically constructed as two single-wythe layers with an air gap between, or as mass masonry with multiple-wythe layers of brick. Rubble was sometimes used as fill. Until fiberglass became widely used for insulation starting in the 1930s, little or no insulation was present.

Cross-referencing the provided data with historical records indicates that the low-rise brick masonry detached construction type typically held five units or more, while attached townhouses originally designed as single family, are seen in two- to four-unit configurations. Flat-roof masonry building types are distributed across New York State, with higher percentages of total building stock per county appearing in upstate counties. The provided data does not include basement levels for many records; therefore, while a basement is visible in the 141 W 93rd St image below (Figure 13), the building is recorded as only three stories, which is an important discrepancy between the provided data and real conditions of leased square footage and numbers of rental units.

Figure 13. A New York County Example of a Building Recorded as a Three-Story Masonry Attached Multifamily Type



Building gross square footage for Type 1 varies between subtypes throughout New York State, with larger footprints in upstate counties, but often having fewer stories, or with commercial storefronts on the street level. Masonry multifamily row houses referred to as "brownstones" in Brooklyn are often composed primarily of brick, often with a sandstone veneer, and have flat roofs. These buildings are often three to four stories of occupied space if basement units are included in the count (which is not typical) and commonly range between 2000 and 3600 square feet (see Table 11). Units are typically divided up by floor level, with standard plans dividing floor area lengthwise between stairs and living space; however, since cellar levels frequently open onto back gardens, a single unit often comprises both the cellar and parlor level, resulting in per-unit square footages that vary widely. Several records from the ICF data did not include cellar levels at all, a discrepancy which omits 1000 square feet or more of gross floor area per building but is consistent with the per-story count of the building code. It should be noted that while discrepancies between ICF data and empirically-confirmed visual data are described to some extent in this report, quantitative corrections to the data are not made regarding number of stories and square footage, as a comprehensive source having superior accuracy across all types is not currently available. Stone ornamentation is prevalent in the rowhouse construction, and covers archways, lintels, and other decorative elements around framed openings.

Following the Type 1 wall section line drawings, additional examples of buildings falling within Type 1 (Figure 18) are arrayed to demonstrate the range of major features that vary within the type, including roof construction, significant ornamentation, floor plan geometry, and WWR. As shown, in addition to the brownstone configuration, this type also has pitched-roof variations and simple flat-roof rectangular configurations divided by a central circulation corridor. The buildings vary in width, with examples shown in the range of 30 ft. to 40 ft. in width and 40 ft. to 50 ft. in depth. In many examples, cast in place concrete foundations are visible, which is consistent with the AGS drawing recommendations for foundations of this period. For flat-roof masonry buildings of this type (Type 1b in Figure 17), the glazed area is significantly concentrated on the street-facing façade, as this type was commonly constructed as attached or row house configurations; therefore, the bulk of the WWR area consists of glazed openings largely on the street-facing façades. With detached variations, where pitched roofs are more common (Type 1a in Figure 16), the glazed area is more often seen to be distributed more evenly on all sides of the envelope. The geometry of floor plans varies more significantly with pitched-roof variations, with jogs and irregularities in the design, resulting in complex envelope geometries. As shown in Figure 18: Additional Examples of Type 1 Variation in New York State in the Genesee St example, the porch is cut out of the parlor level plan, with the upper level overhanging. Because many buildings of this type were originally large single-family houses, individual aesthetic expression through variation in plan and elevation were more common than is found in the block types. Below are listed characteristics representative of the most common variations within this type:

Characteristics Representative of Type 1:

- Gross square footage: approximately 2400–4000 sf per building
- Interior unit square footage: from 500–1600 sf each
- Window to wall ratio: between 10–20%, with variation in the size and placement of openings
- Envelope area:[22] from 2000–4000 sf for the envelope, not including roof area, with attached rowhouses on the low end, and detached box types on the high end with four exposed sides

For additional summary characteristics of Type 1, refer to Table 13. Market Characterization Summary.

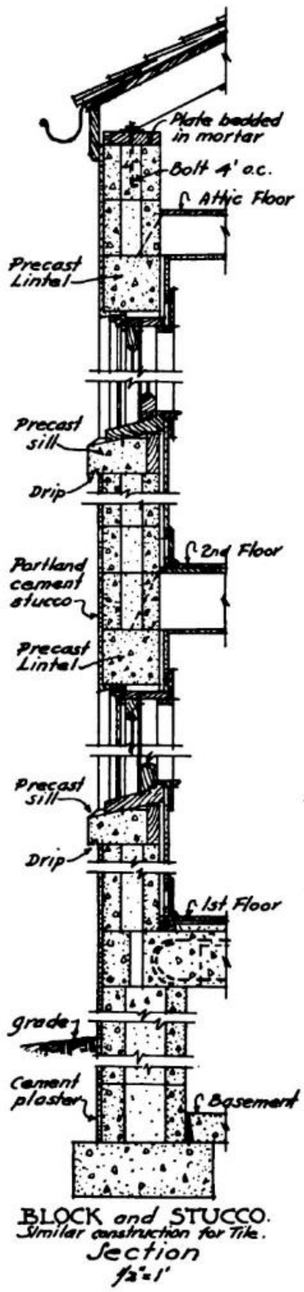
As seen in Figure 17 and Figure 18, flat built-up roofed buildings are often seen with parapet façade walls and rectangular floor plans, with little to no jogging or irregularities in the footprint geometry, as they were designed for dense urban configurations where streets were planned to be walkable (prior to the advent of automobiles). In these configurations, masonry buildings typically shared party, or parting-walls, which divided the two buildings. To make structures less susceptible to the spread of fire, it became increasingly common later in this vintage to space buildings 5–10 ft. apart, as opposed to attached row house configurations. In such cases, small glazed openings appear on side walls, and constitute a small portion of the total WWR. Therefore, these buildings can appear from the front façade to have a high WWR, but the front and rear facing façades typically represent less than half of the building envelope area. Though small, these openings assisted with ventilation and admitted daylight to spaces closer to the center of floor plates. In some cases, additional new glazed openings were incorporated in the decades since original construction. These additional openings, which are often less consistent in size and positioning along the side elevations, may have been incorporated as a measure to satisfy fire code requirements for egress when these buildings were divided up into smaller apartments. Ornamentation can similarly be observed in this type to be concentrated at the street-facing façade and is incorporated most consistently at the cornice and around glazed openings and parlor-level doors.

Figure 14. Summary of Characteristics of Type 1 Buildings

Type 1: Pre-1940 1 - 3 Story Masonry	
General	Source: Architectural Grahpic Standards, 1932 (1st) Edition
Foundation	Cast in place concrete or rubble
Wall Construction	Solid brick and concrete block most common structural materials. Other materials included reinforced concrete and hollow clay tile.
	Brick could be 2-wythe (8" thick), 3-wythe (12.5" thick), or hollow (2 single-wythe walls connected with brick bond courses or metal ties for structural integrity, min 10" thick).
	Face brick could also be bonded to concrete walls forming a solid masonry wall (no air gap).
	Taller buildings had thicker walls. 8" for brick buildings up to 40'; 1'-0" – 1'-4" for brick buildings up to 55 feet (per NYC building codes).
Cladding Materials and Ornament	Face brick, stucco, or cut stone (brownstone, limestone common in NY).
	Ornament common, particularly around windows, doors and roofs (cornices, eaves). Ornament could be made of stone (window sills, cornice, coping), wood (cornice), terracotta (cornice).
Floor Construction	Wood joists pocketed into the brick for smaller buildings
	Reinforced concrete for larger buildings
	Steel (transitional masonry) only for high-rise and commercial buildings
Roof Construction	Pitched roofs shingles (asbestos, wood) over wood plank and wood rafters
	Flat (low-slope) roofs typically built-up membranes (tar / asphalt) over wood plank and wood joists
Renovation	Very likely that roofs and windows have been replaced over time.
	Mass masonry walls may have been insulated on the interior (with materials like fiberglass insulation), or may be uninsulated.

Figure 15. Concrete Block with Stucco Finish (AGS, 1932)

Right: Solid and hollow masonry wall types. Minimum thickness of masonry walls (AGS, 1932).



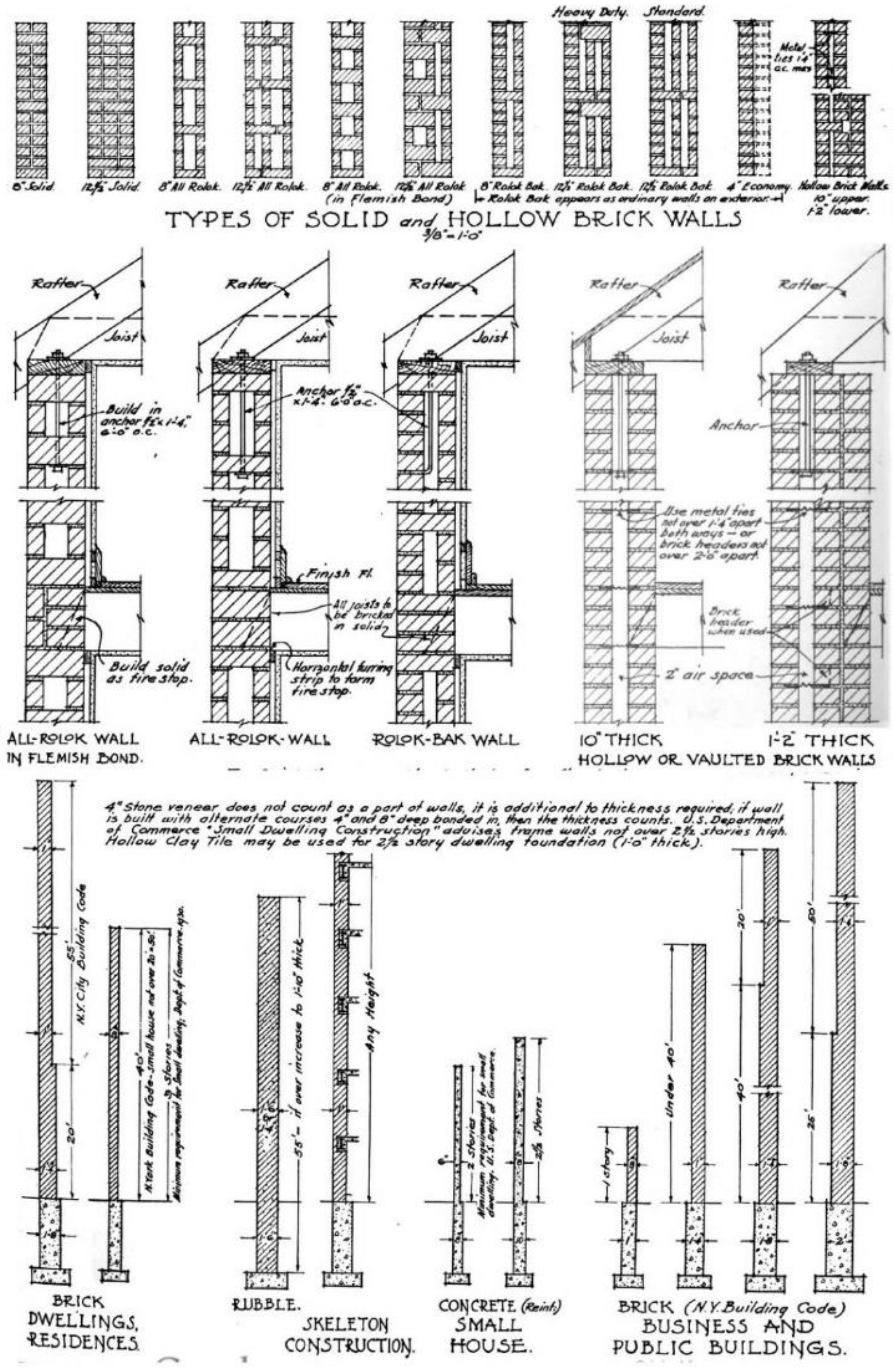
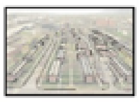
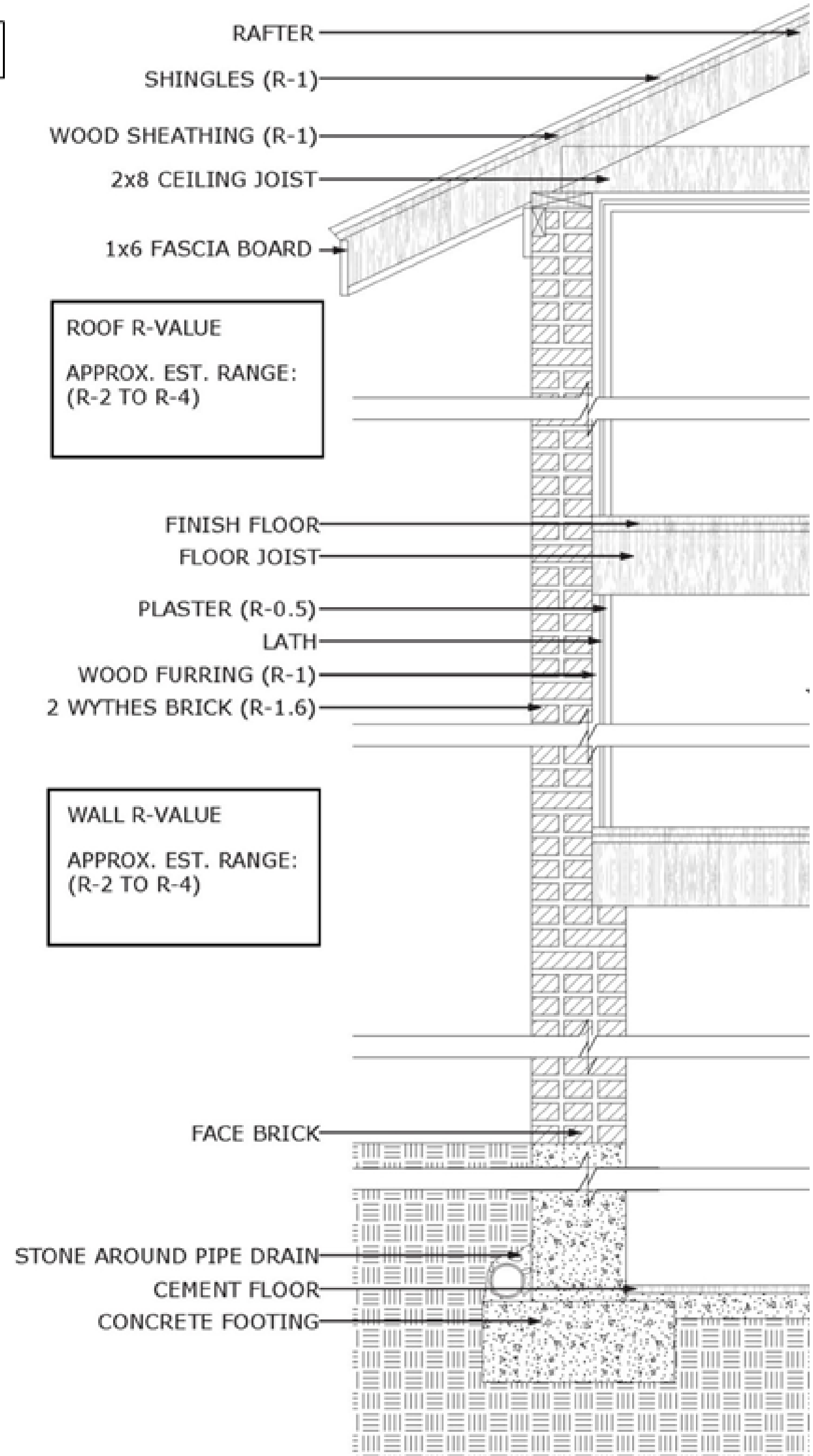


Figure 16. An Example of a Type 1 Pre-1940, One- to Three-Story Masonry Wall Section with Pitched Roof

Type 1a: Pre-1940 1-3-Story Masonry



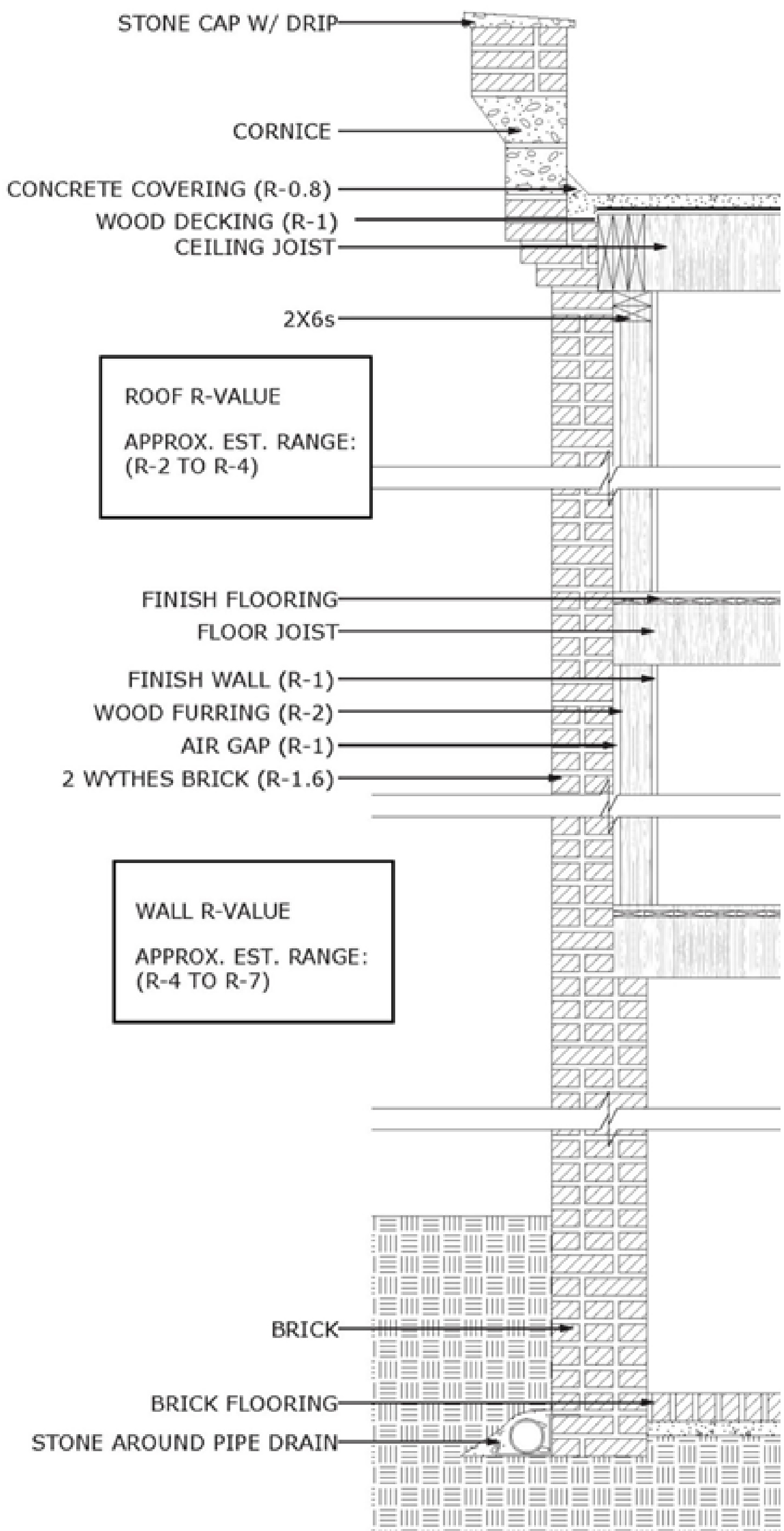


Note: R-values for material layers are taken from the Department of Energy, the ASHRAE Handbook of Fundamentals, Architectural Standards and historical guides (full list in Reference section).

R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 17. An Example of a Type 1 Pre-1940, One- to Three-Story Masonry Wall Section with Flat Roof

Type 1b: Pre-1940 1-3-Story Masonry



R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 18. Additional Examples of Type 1 Variation in New York State

Type 1 Additional Examples
Pre-1940 1-3-Story Masonry

447 Washington Ave
Albany County
Year built: 1900
Units: 2

487 Hamilton St
Albany County
Year built: 1890
Units: 7

338 Green St
Onondaga County
Year built: 1910
Units: 8

318 E Division St
Onondaga County
Year built: 1910
Units: 5

320 Burnet Ave
Onondaga County
Year built: 1890
Units: 4

2111 E Genesee St
Onondaga County
Year built: 1900
Units: 6

715 New Scotland Ave
Albany County
Year built: 1930
Units: 2

12 Danker Ave
Albany County
Year built: 1933
Units: 2

50 Judson St
Albany County
Year built: 1900
Units: 5

3.3.2 Type 2: Pre-1940, One- to Three-Story Wood Frame

Type 2 is defined by a height of one to three stories and wood frame construction atop concrete or similar cementitious foundation. As noted with masonry construction from this period, insulation was not yet prevalent, though infrequently cellulose fill was specified between wood framing elements in original graphic standard drawings. Pitched gable roofs predominate this type and are composed of wood rafters of 2 x 6, 2 x 8, and less commonly, 2 x 4 dimensional lumber, supporting wood sheathing and wood or asphalt shingles. Wall construction most commonly consisted of 2 x 6 or 2 x 4 wood framing with wood sheathing, building paper, and wood siding. In the representative example of this type shown in Figure 22, these layers comprise an envelope with a range of R-3 to R-5, which is poor by present-day standards. For the few buildings that may have included insulation, it was not of a performance quality comparable with present-day products such as extruded foam or fiberglass, and loose organic material like paper or cellulose would have settled and degraded considerably over a period of 100+ years; therefore, it is estimated that Type 2 buildings overall had very low insulative value, and typically no more than R-5.

Original features, such as roof shingles and siding, are among those most commonly replaced with modern materials, given the necessity for frequent replacement and degradation of unpainted wood shakes and shingles. Today, this building type is typically clad in either newer wood or vinyl siding, and asphalt roof shingles. These changes, however, do not constitute a significant improvement in R-value, so are left off of the drawings depicting the construction of the original architecture.

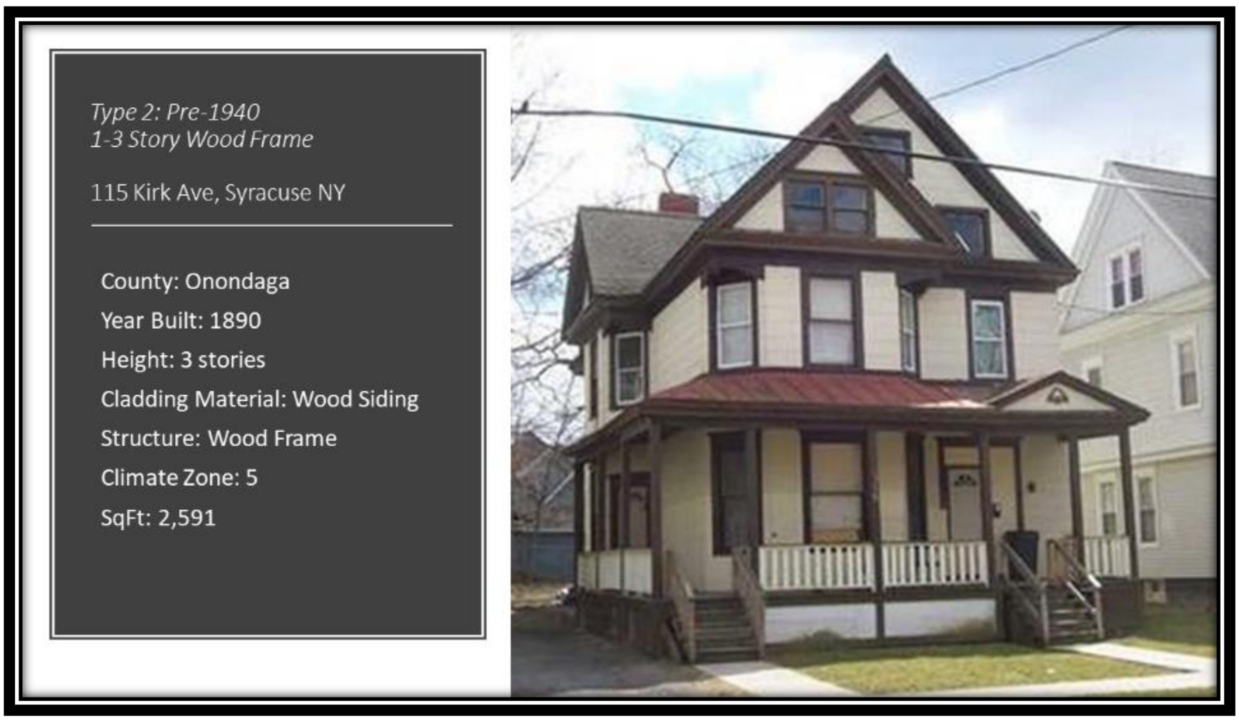
The image below (Figure 19) shows a representative example of the low-rise, wood-frame multifamily building type for the pre-1940 time frame. This type is represented by a significant number of two to four-unit buildings, which are found in greater percentages of total building stock in upstate counties such as Onondaga and Albany. As with Type 1, Type 2 was originally constructed for single-family homes, and later converted into multiunit affordable and market-rate rental properties, increasing the Type 2 total building stock in the area. Construction materials and practices accommodated some degree of customization in floor plan and roof shape. The drawings and graphic standard reference images provided in the following pages depict a typical assembly for an example of Type 2. Listed below are the characteristics representative of the variation:

Characteristics Representative of Type 2:

- Gross square footage: approximately 1200–2600 sf per building
- Interior unit square footage: from 500–1600 sf each
- Window to wall ratio: between 10–20%, with variation in the size and placement of openings
- Envelope area: from 2500–4000 sf for the envelope not including roof area

For additional summary characteristics of Type 2, refer to Table 13. Market Characterization Summary.

Figure 19. An Example of One- to Three-Story Wood Frame Construction Originally Built as a Single-Family Home, Now Classified as Multifamily



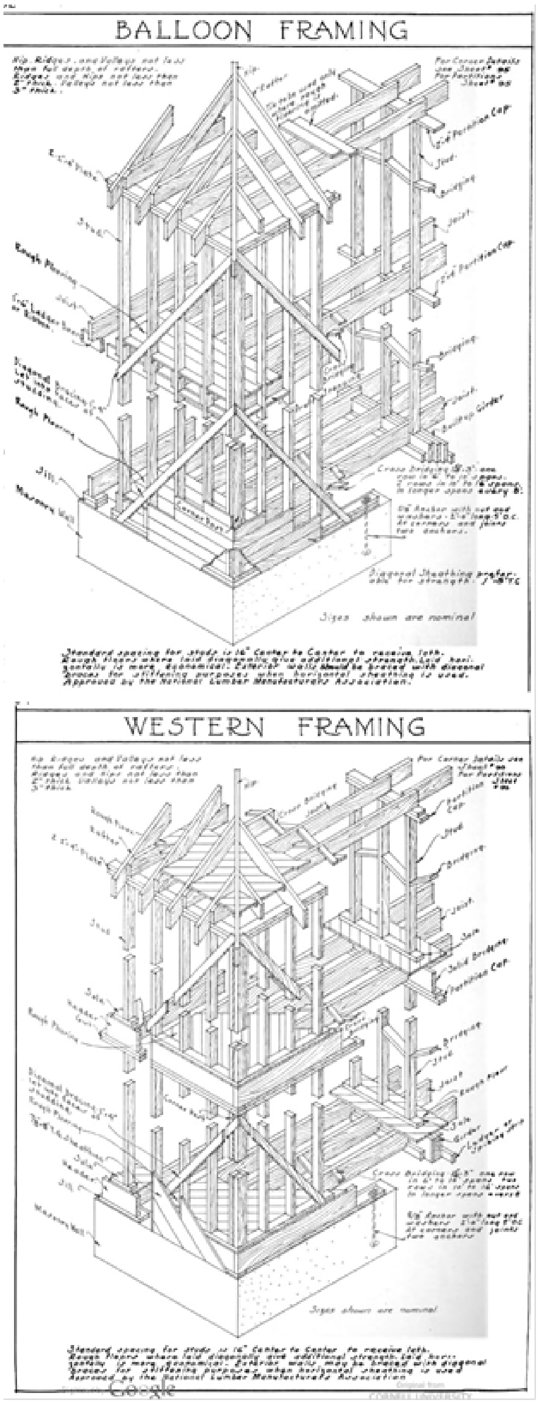
Variations within Type 2 are common in floor plan geometry, which often includes jogs, semi-hexagonal or rectangular protrusions, and porches. In addition, the type varies in roof style, which often include multiple pitch angles, ridge beams, and roofline directions, as well as sets of protruding dormer windows. Discrepancies between listings of record in the original data and visual information for this category are noted in Appendix 3: Random Samples of Three NYS Counties. Visual checks from photo documentation confirmed that several buildings listed as having 10–19 units were in fact no more than approximately 2000 sf. It is concluded that single-family houses or multifamily buildings with fewer units were misreported, or that some other error was made in the counting of units for a large number of records in this category. The examples of Type 2 shown in Figure 23 are those listed as above five units, which is the minimum requirement for eligibility in the NYSERDA multifamily program. However, it should be noted that the number of units may in actuality be less than five for the buildings shown.

Figure 20. Summary of Characteristics of Type 2 Buildings

Type 2: Pre-1940, 1 - 3 Story Wood Frame	
General	Source: Architectural Grahpic Standards, 1932 (1st) Edition
Foundation	Cast in place concrete or rubble
Wall Construction	Wood studs in "Balloon" or "Western" (new called Platform) framing
Cladding Materials and Ornament	Wood cladding (shingles or strips) over builders paper and wood plank
	Stucco and brick veneer over wood frame also possible
	Ornament likely to be wood (for wood frame) and stone or masonry (for masonry veneer / stucco)
Thermal and Moisture Control	No insulation shown in details. Uninsulated foundation, walls, and roofs common.
	Research on insulation in the US was conducted between 1937 and 1942, leading to implementation of thermal /moisure control practices postwar.
Floor Construction	Wood plank on wood joists
Roof Construction	Pitched roofs shingles (asbestos, wood) over wood plank and wood rafters
	Flat (low-slope) roofs typically built-up membranes (tar / asphalt) over wood plank and wood joists. Less common but possible, especially for attached structures.
Renovation	Very likely that roofs and windows have been replaced over time.
	Wood shingles may also have been replaced or overclad with a low-maintenance material (like aluminum or vinyl)

Figure 21. Type 2 Framing

Left: Balloon and Platform Framing (AGS, 1932). Right: Wood Framing Wall Types, Water Table and Eave Details (AGS, 1932).



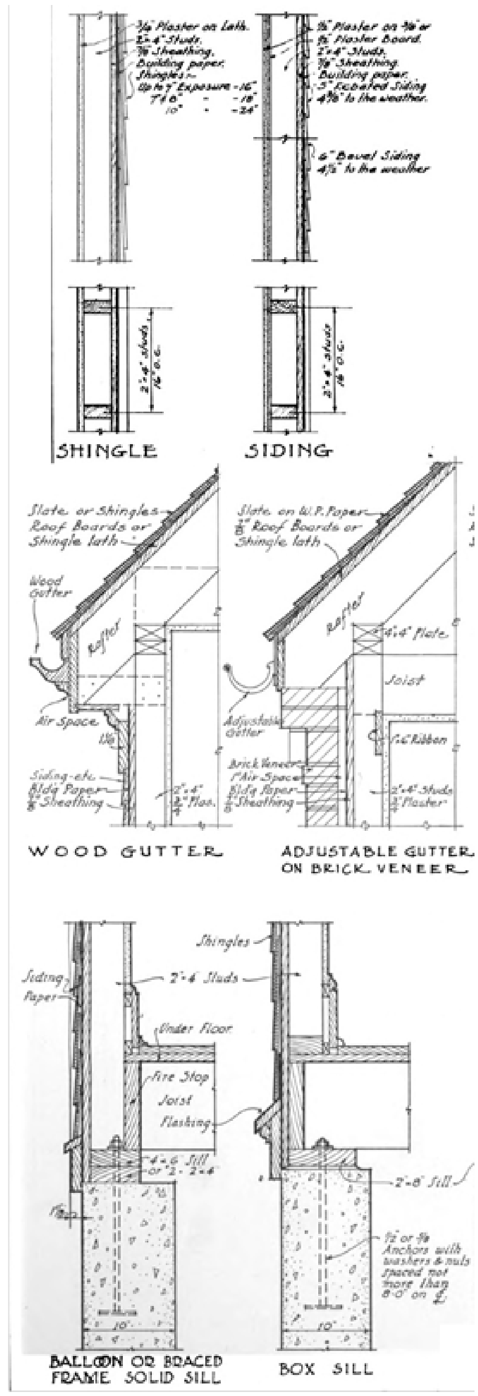
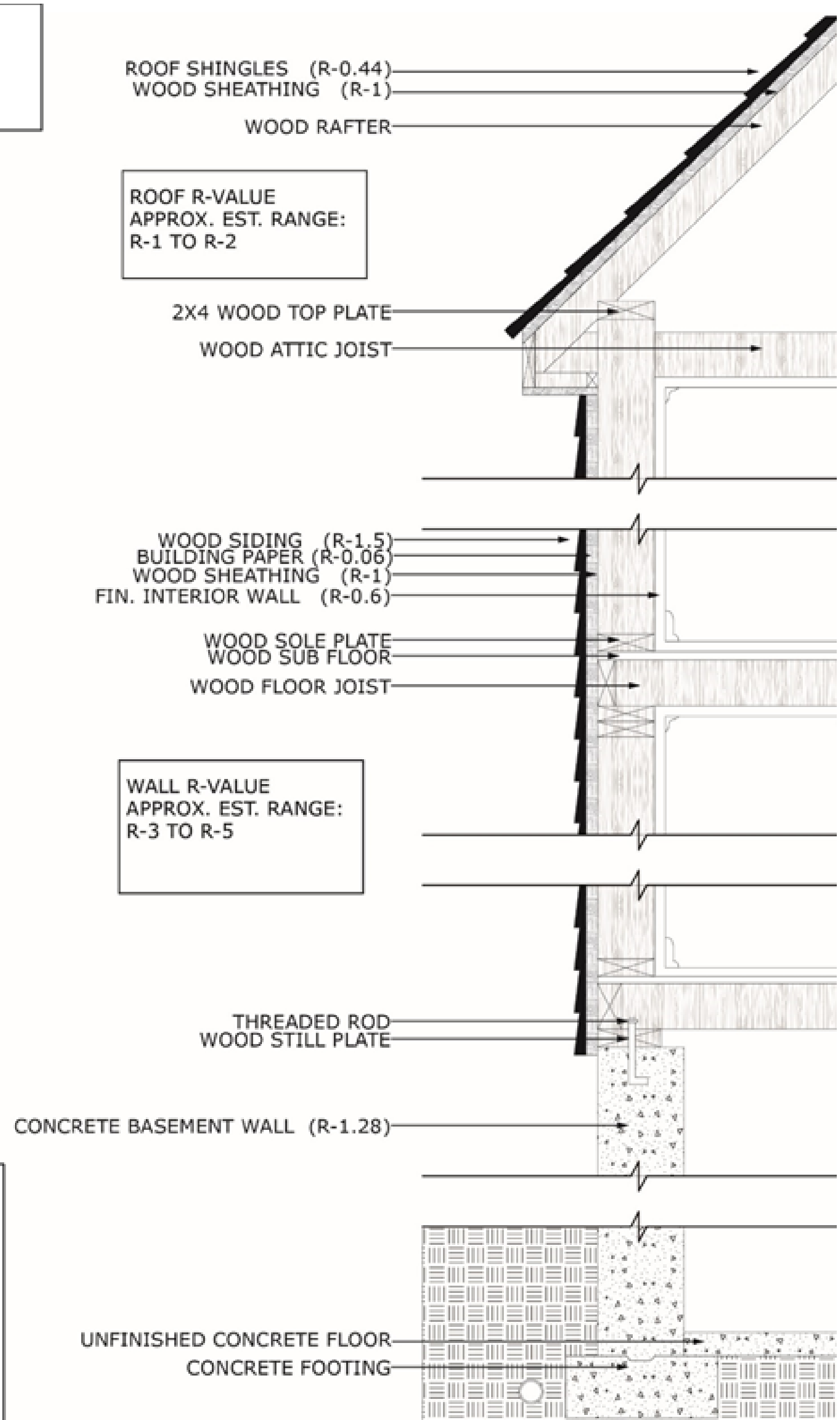


Figure 22. An Example of Type 2 Pre-1940, Wood Frame Construction

Type 2: Pre-1940

1-3-Story Wood Frame



R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 23. Additional Examples of Type 2 Buildings Demonstrating the Range of Variation in Window to Window Ratio, Geometry, and Gross Square Foot

Type 2 Additional Examples
Pre-1940 1-3-Story Wood Frame

519 Richmond Ave
Onondaga County
Year built: 1910
Units: NA

108 Coleridge Ave
Onondaga County
Year built: 1920
Units: 4

102 Lydell St
Onondaga County
Year built: 1900
Units: NA

1114 E Genesee St
Onondaga County
Year built: 1890
Units: 10

109 Brookford Rd
Onondaga County
Year built: 1935
Units: 10

1225 Butternut St
Onondaga County
Year built: 1920
Units: 5

10 Fennell St
Onondaga County
Year built: 1840
Units: 5

478 Washington Ave
Albany County
Year built: 1895
Units: 5

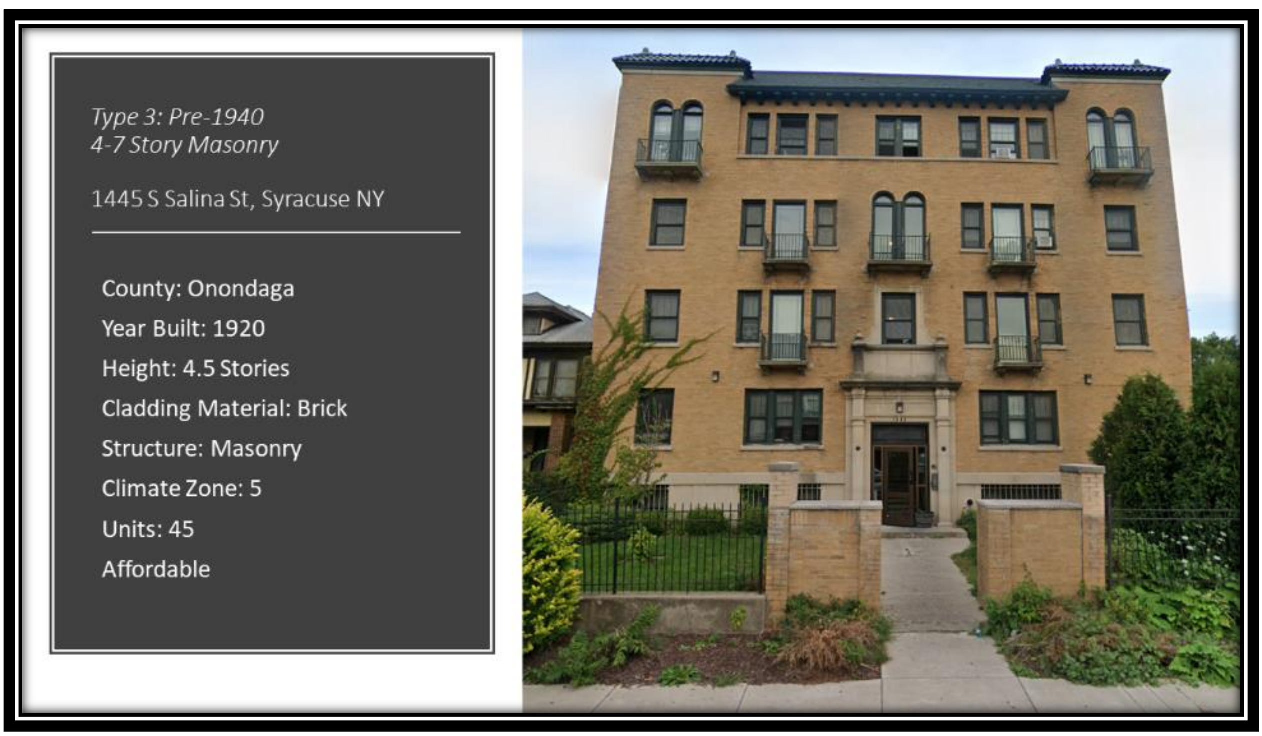
102 Woodlawn Ave
Albany County
Year built: 1933
Units: 3

3.3.3 Type 3: Pre-1940, Four- to Seven-Story Masonry

Type 3 is defined by buildings recorded as having a height of four to seven stories, which in this report is described as mid-rise, with primarily masonry exterior walls. In buildings exceeding three stories, exterior walls were commonly constructed of riveted steel or reinforced concrete with masonry tile exterior cladding, as seen in Figure 27. R-values for this type do not diverge significantly from those of Type 1, and are estimated at between R-2 and R-4, as seen in Figure 28 and Figure 29. Foundations of this type are most commonly cast in place concrete, with sand or rubble beneath slabs. Due to ornamentation, logistical challenges, and projections like balconies, renovation from the exterior is not common. In addition, steel fire stairs are seen attached to the street-facing side (in detached variations) and rear elevations.

The mid-rise masonry building type appeared prior to 1940 predominantly in New York City and the surrounding boroughs, with significantly fewer examples in upstate counties by comparison. Roofs were most often low-slope, built-up roofs, sometimes with ornamental clay tile roof sections that typically do not extend back beyond the facade, as seen in Figure 24 at 1445 S Salina St, an example from 1920.

Figure 24. An Example of a Four- to Seven-Story Masonry Wall Type from the Prewar Era



Buildings of this type are largely rectangular in plan, but often have courtyards with entry conditions pushed back from the primary façade or other variations in plan. The purpose of this approach was to facilitate ventilation and access to daylight. As such, while the street-facing façade is still treated with the most ornamentation, WWR area is more evenly distributed across the other façade elevations than is found in Type 1. WWRs in this type are greater overall than those of lower-height buildings, with larger glazing units more regularly spaced. It is more common in Type 3 than in Type 2 to see that the original architecture is clearly intended as a multifamily building, in comparison to examples from other types which appear to have been adapted to multifamily purposes at a later time. Gross floor areas for this type average from 4000 to over 7000 square feet, as seen in Table 11. However, variation in square footage is substantial, even within the same exterior structural wall construction and envelope classification. As seen in Figure 30, unit quantities and square footage range widely between examples shown. For example, 131 W 130th St, a four-story version of the brownstone variation described in Type 1, is in an attached rowhouse configuration with envelope wall area exposed only on the street-facing and garden-facing façades. This configuration is no more than 30 ft. wide and 40 ft. deep, with a GSF per floor of approximately 1,200, and a total building GSF of 4,800. The total exposed envelope area on this example is no more than 2,400 square feet. Whereas, another example using a similar exterior cladding material and intricate stone ornamentation at 112 W 144th St is approximately 45,000 square feet, and is detached with an approximately 90 ft. x 70 ft. footprint and a 77 ft. to 85 ft. height, for a total exposed exterior envelope area exceeding 25,000 square feet. Regardless of scale, ornamentation is here concentrated again in the cornice and around glazed openings but is less dominant as an overall percentage of façade area. Decorative lintels over windows are common, and variation in types of masonry (e.g., stone to brick) are seen from the lower to upper levels of the exterior cladding.

Characteristics Representative of Type 3

- Gross square footage: ranging from approximately 4,800 for the common large attached rowhouses, to 45,000 sf or more for large floor plate variations found typically in New York County
- Interior unit square footage: from 500–1600 sf each
- Window to wall ratio: between 10–20%, with openings concentrated at front and back for the rowhouses, and in typically much more regular configurations for the large floor plate variations in New York County
- Envelope area: from 3,300–25,000 sf for the envelope not including roof area

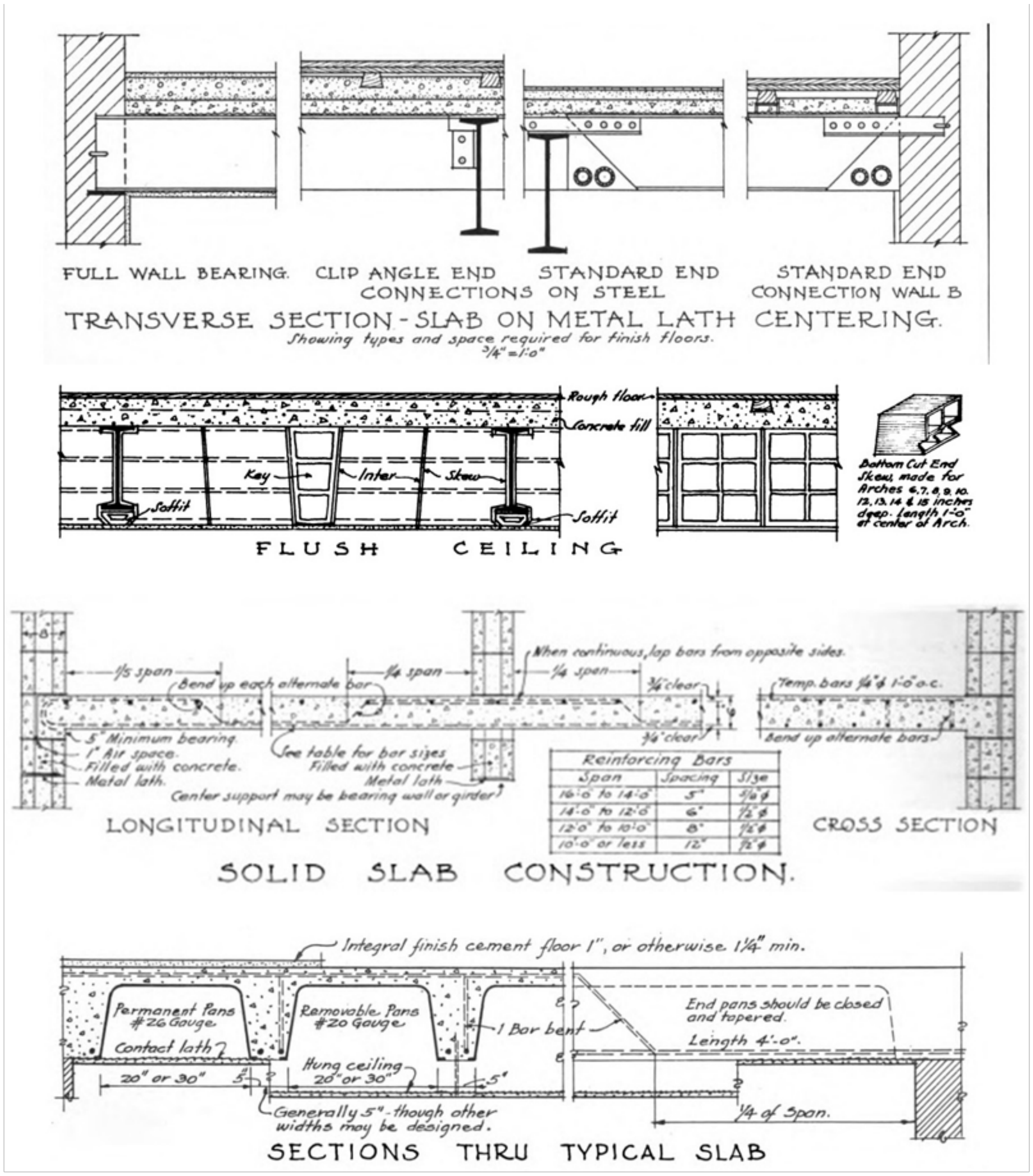
For additional summary characteristics of Type 3, refer to Table 13: Market Characterization Summary.

Figure 25. Summary of Characteristics of Type 3 Buildings

Type 3: Pre-1940 4-7-Story Masonry	
General	Source: Architectural Graphic Standards, 1932 (1st) Edition
Foundation	Cast in place concrete
Wall Construction	Similar to pre-war low-rise masonry with more robust more robust structural system (i.e., thicker walls, concrete floors in lieu of wood, more likely to have concrete block or reinforced concrete walls in lieu of solid brick).
Cladding Materials and Ornament	Face brick, stucco, potentially stone
	Stone / terracotta ornament likely at base, windows/doors, and cornice
Thermal and Moisture Control	No insulation shown in details. Uninsulated foundation, walls, and roofs common.
Floor Construction	Likely reinforced concrete
Roof Construction	Likely to be flat (low-slope) roofs only; pitched roofs partial or decorative only (ie: mansard roof)
Renovation	Very likely that roofs and windows have been replaced over time.
	Mass masonry walls may have been insulated on the interior (with materials like fiberglass insulation), or may be uninsulated.

Figure 26. Steel and Concrete Floor Systems

Source: AGS, 1932



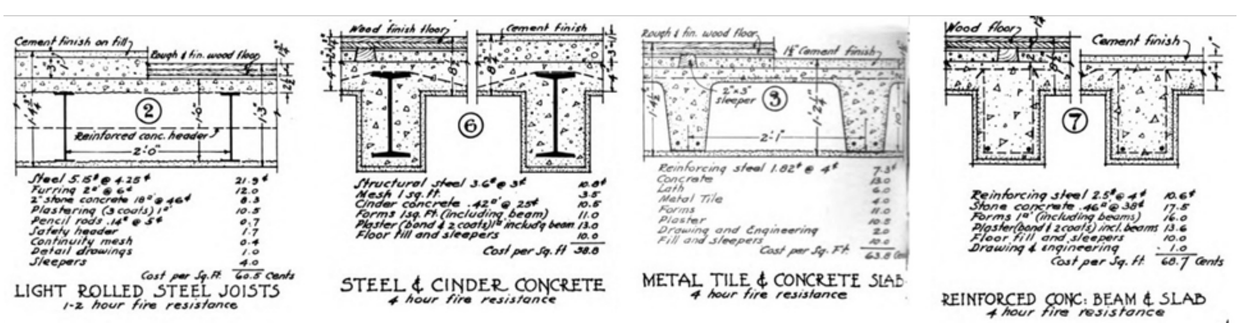


Figure 27. Examples of Steel and Concrete Floor-to-Wall Connections

Source: AGS, 1932

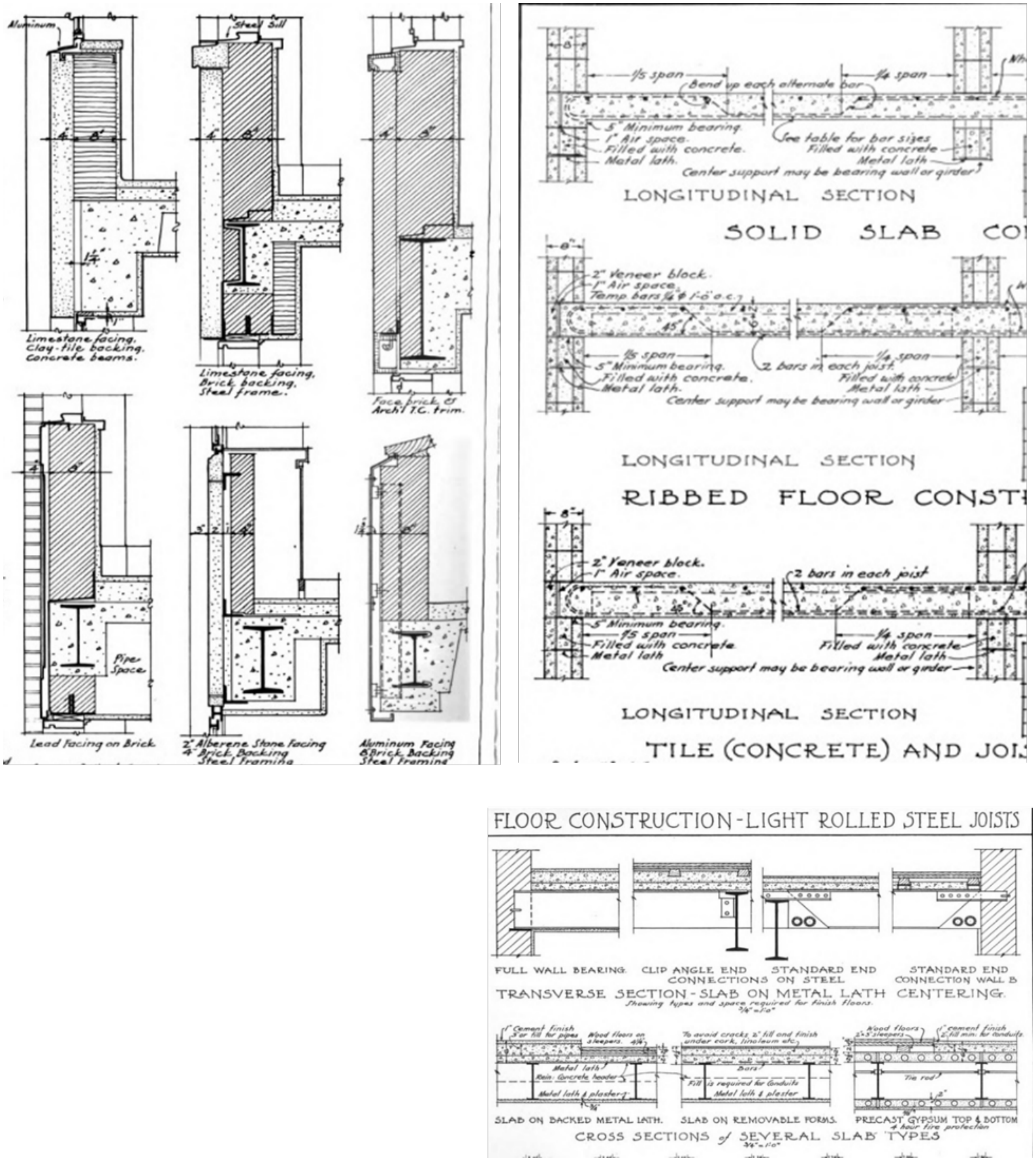
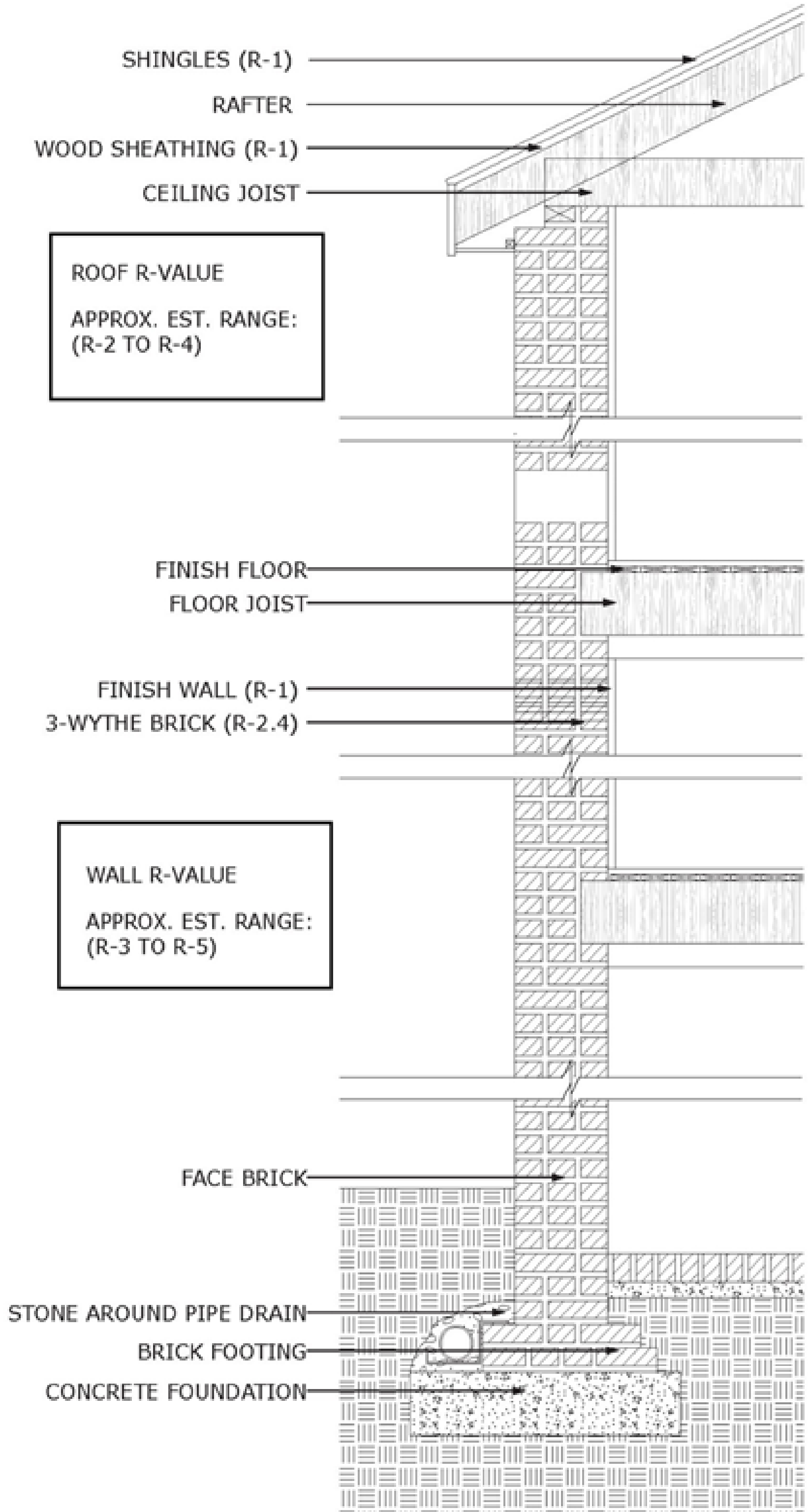


Figure 28. An Example of Type 3 Pre-1940, Four- to Seven-Story Masonry Construction with Multi-Wythe Wall Composition and Less Common Pitched-Roof Variation

Type 3: Pre-1940

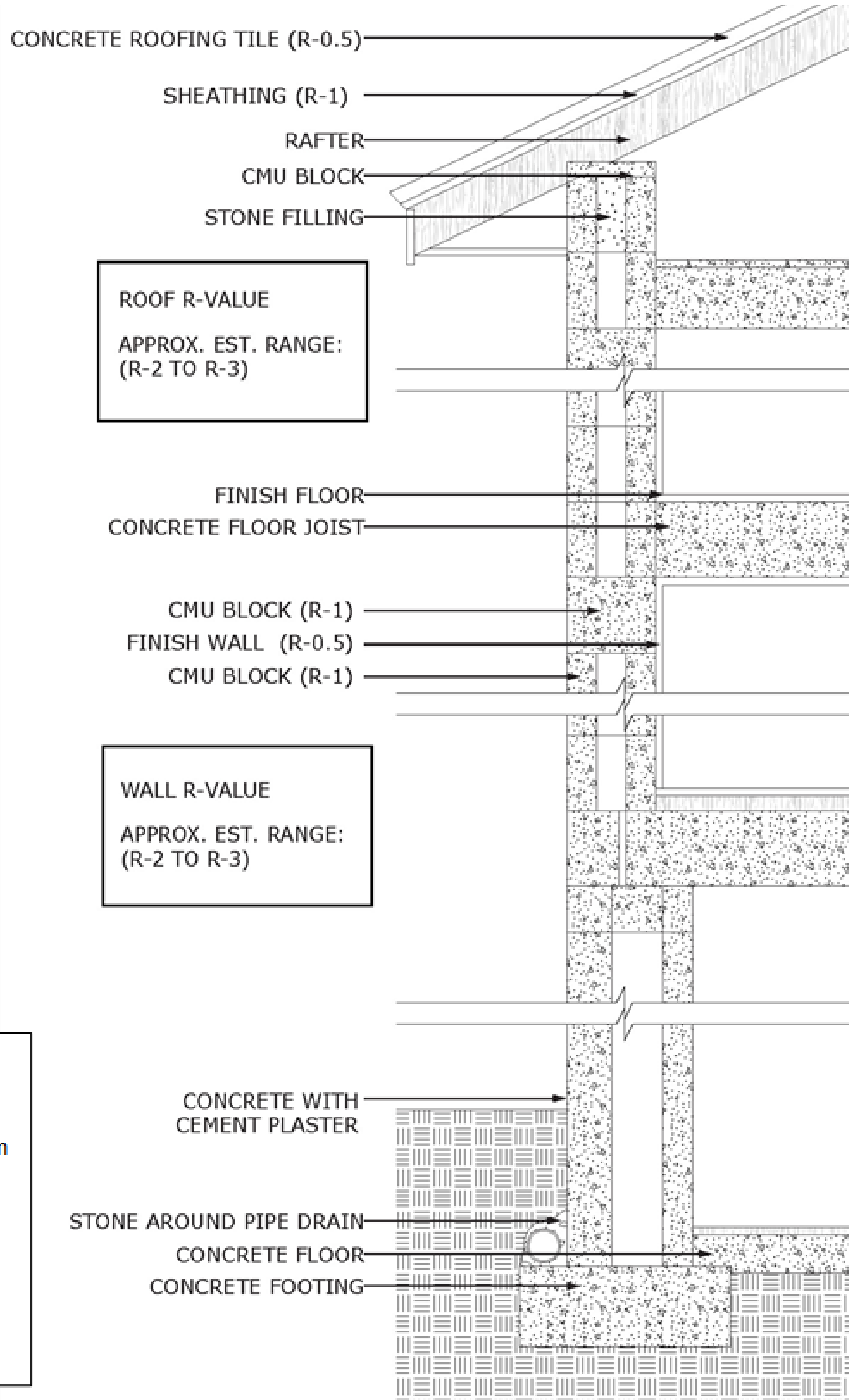


R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 29. An Example of Type 3 Pre-1940, Construction with Cavity Wall Composition

Type 3: Pre-1940

4-7-Story Masonry



R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 30. Additional Examples of Type 3 Records Demonstrating Variation in Floor Plan and Geometry, Gross Square Foot, and Ornamentation

Type 3 Additional Examples
Pre-1940 4-7-Story Masonry

131 W 130th St
New York County
Year built: 1910
Units: 5

1 Audubon Ave
New York County
Year built: 1910
Units: 55

108 Park Ter E
New York County
Year built: 1925
Units: 34

99 Madison St
New York County
Year built: 1900
Units: 8

113 E 31st St
New York County
Year built: 1920
Units: 19

112 W 144th St
New York County
Year built: 1910
Units: 47

200 W 55th St
New York County
Year built: 1909
Units: 14

208 W 133rd St
New York County
Year built: 1910
Units: 15

25 HIllside Ave
New York County
Year built: 1920
Units: 287

3.3.4 Type 4: 1940–1978, One- to Three-Story Wood Frame

Type 4 is defined by buildings recorded as having a height of one to three stories with primarily wood frame construction, built originally in the years during and after World War II, which was a period of construction and manufacturing innovation. Either balloon or platform (also referred to as "Western") framing was used for the primary structure. In the earlier part of the period, planks were used over framing elements; whereas, in the latter years of the period, wood sheathing in 4 ft. x 8 ft. sheets were developed and became prevalent in the building industry. Other developments in the exterior envelope led to greater variation in material finishes, including face or veneer brick, wood paneling or shingles, stucco, and stone in varying configurations on the façade. Foundations in this type are concrete, typically cast in place, but also in concrete masonry units (CMU). Foundation slabs are layered over of gravel or sand. Wall construction details sometimes included wood fiber or other low-R-value insulation between wood framing elements, and in the latter part of the period, fiber insulation in attics became commonplace.

One- to three-story buildings constituted 56% of available records with data for the vintage category spanning 1940–1978 for Onondaga county. For this vintage, low-rise wood frame construction building types again represent a significant proportion of building stock, as in 4475 Candlelight Lane shown in Figure 31. A major shift in envelope insulation performance was seen at the end of the period due to developments in building code mandating insulation in wall and roof construction. This vintage category was then the last to be characterized by poor insulation in the envelope.

Figure 31. An Example of One- to Three-Story Wood Frame Constructed Multifamily Attached Housing from the Mid-1960s

Pitched gable roofs, simple shed roofs, and multiple ridge levels were all common variations on roof geometries for Type 4. Roof construction included wood rafters, sometimes an insulation layer, and wood planks which later became sheathing. Shingles were originally of asphalt or wood that have likely been replaced since installation. Fenestration varies widely for this type, and trends over time included horizontal band or clerestory windows, vertically oriented, and smaller glazed openings. These changes in glazed openings represented the departure from strictly natural ventilation systems towards a reliance on air conditioning, and smaller openings reflected an emerging awareness of energy saving measures.

Floor plans for this type vary significantly, along with gross the square footage. Plan geometries include elongated rectangular forms for higher numbers of units or designs more reminiscent of traditional single-family homes for properties with smaller numbers of units (i.e., less than five). Geometric variation also extends to façade configurations, where part or the entire second-story envelope protrudes out slightly over first stories. These configurations are often marked by a change in material. As with other characteristics of this type, such patterns vary widely in their proportion and application. A representative variation in Type 4 is the bar building as shown above and also in several examples in Figure 35, with clerestory or picture glazing patterns in relatively regular configurations, and with wood siding commonly accompanied by accents of face brick. Even though properties of larger scale in this type can range up to over 100,000 square feet, frequently such projects are seen in modular arrangements of several long bar building forms, whether attached or detached from one another, rather than one monolithic rectangular building. This characteristic exposes a significant amount of surface area at the exterior envelope, producing total envelope areas exceeding 75,000 square feet in large complexes with a single owner, such as in the example shown in Figure 31 at Candlelight Lane. The component "bar" building modules, however, are commonly 10–20 units each, at approximately 500–1600 square feet per unit.

Characteristics Representative of Type 4:

- Gross square footage: approximately 5000–16,000 sf per building; up to 100,000 for large complexes
- Interior unit square footage: from 500–1600 sf each
- Window to wall ratio*:* between 10–15%, with smaller-scaled, regularly placed glazed openings
- Envelope area: from 3500–10,000 sf per bar building module for the envelope not including roof area but in large complexes ranging up to 75,000 sf or greater

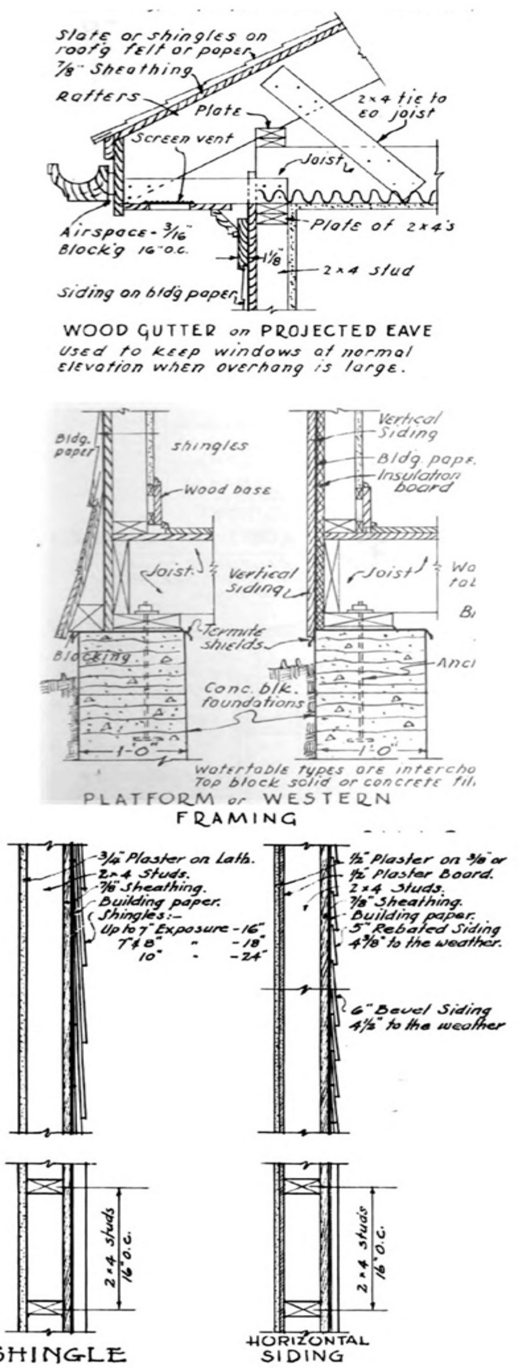
For additional summary characteristics of Type 4, refer to Table 13: Market Characterization Summary.

Figure 32: Summary Characteristics of Type 4 Buildings

Type 4: 1940 – 1978, 1 - 3 Story Wood Frame	
General	There is a significant change in building technology and construction systems pre- and post-1940, and from 1940 to 1979. Details from both the 1950s and 1970s were reviewed to suggest how buildings at the beginning and end of this period will differ.
	Source: Architectural Graphic Standards, 1956 (5th) and 1970 (6th) Editions
Foundation	Cast in place concrete or concrete block.
Wall Construction	*1950s*
	Wood frame. Balloon frame or "Western" (Platform) framing method.
	Plank / board common (no plywood sheathing)
	1970s
	Wood frame. Balloon frame or Platform framing.
	Sheathing (plywood) for floors and walls replaces plank.
	Air space called out behind brick veneer on wood stud.
Cladding Materials and Ornament	Brick veneer, wood shingle, wood siding, or stucco
Thermal and Moisture Control	*1950s*
	"Builders' felt"/ "Builder's paper" (tar paper) shown under wall and roof shingles. Hydrophobic layer controlling bulk water (but not air or moisture)
	Sheathing indicated as "insulation board" in some details. Material could be fiberboard or gypsum. Likely providing little thermal resistance.
	Insulation not shown between studs
	Some insulation shown in attic ceilings (material not specified)
	No insulation in floors or around foundations
	1970s
	Insulation typically not shown between studs (a few details have fibrous insulation in stud cavities)
	Fibrous insulation shown and called out in attics
	No insulation in floors or around foundations
Floor Construction	Wood joists with plank (1950s) or plywood (1970s) floor sheathing
Roof Construction	Likely to be pitched roof on wood rafters with shingles (asphalt, asbestos, or wood)
	Insulation located above the ceiling of the top floor (cold roof design)
Renovation	Roofs, wood cladding, and windows likely replaced or overclad since original construction.
	Brick veneer likely original
	Insulation may have been added in stud cavities or to attics since construction

Figure 33. Type 4: Contruction Details

Right: Wood Frame Wall Types, Watertable, and Eave Details (AGS, 1956). Left: Brick Veneer, Wood Shingle, and Stucco on Wood Frame Details (AGS, 1970).



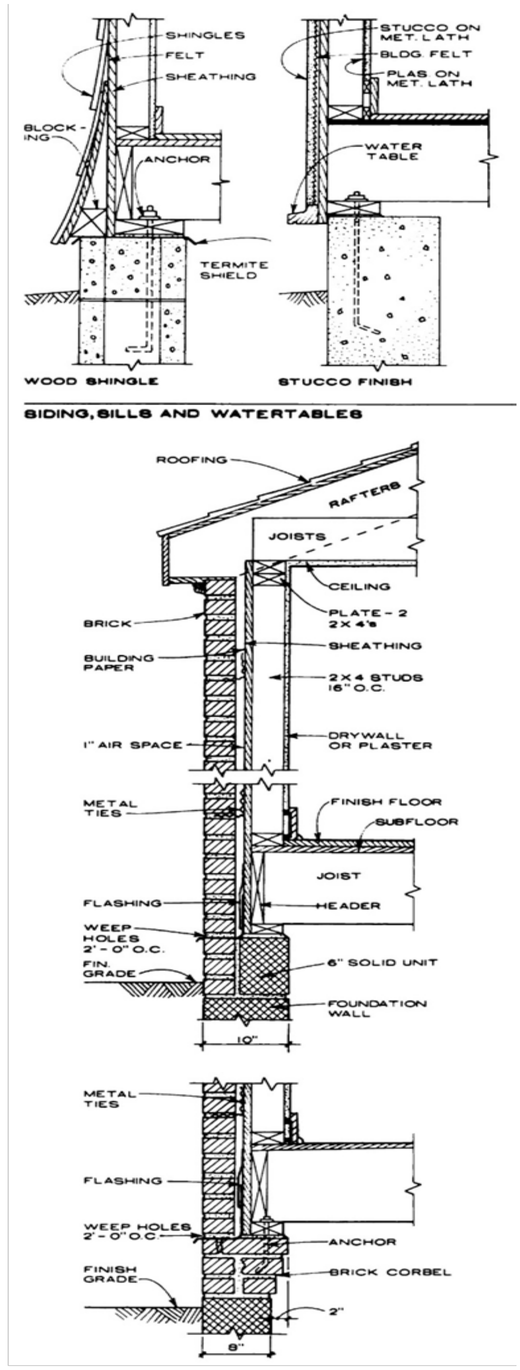


Figure 34. Example of Type 4 1940–1978 One- to Three-Story Wood Frame Construction with Early Integration of Insulation in the Wall

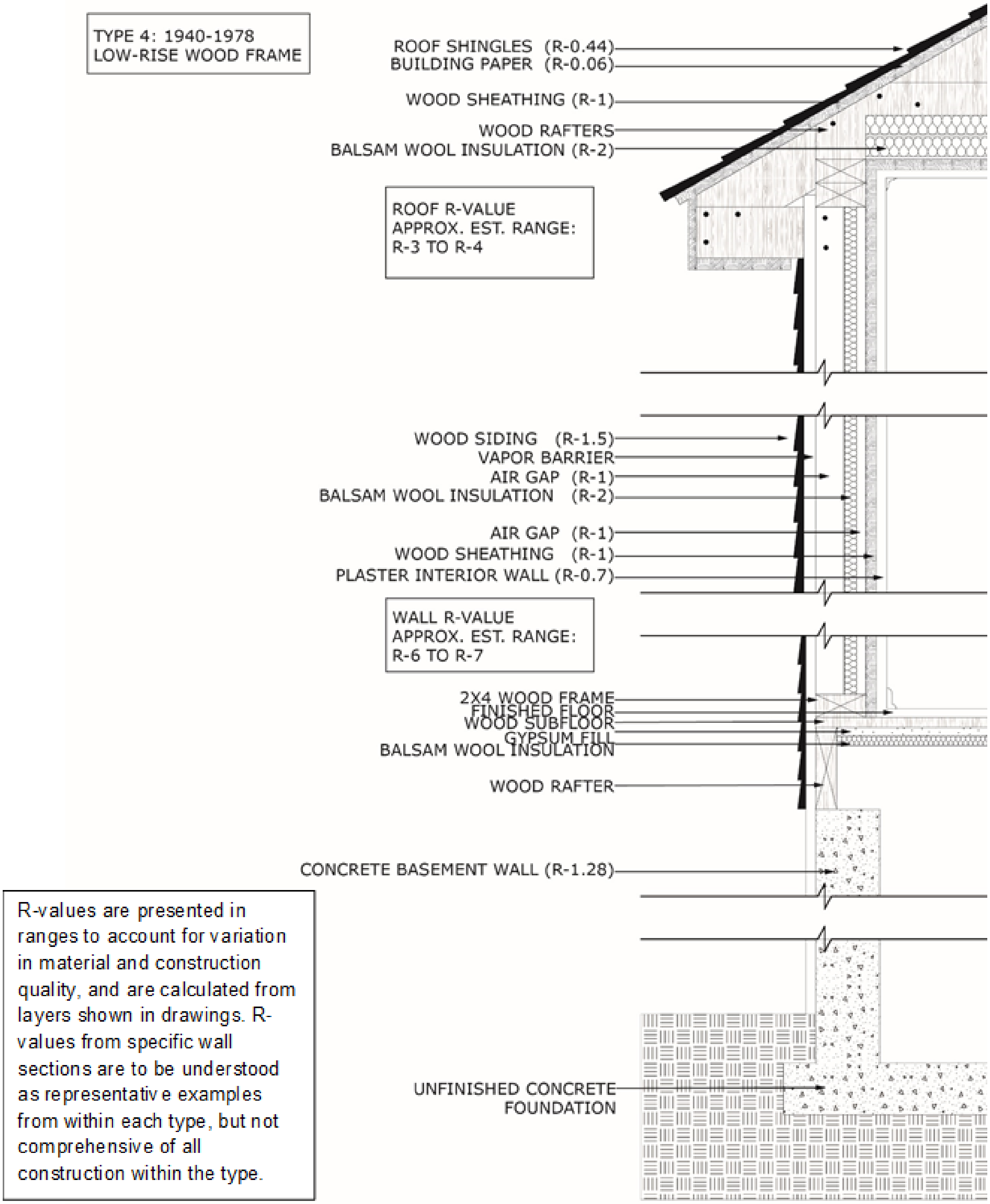
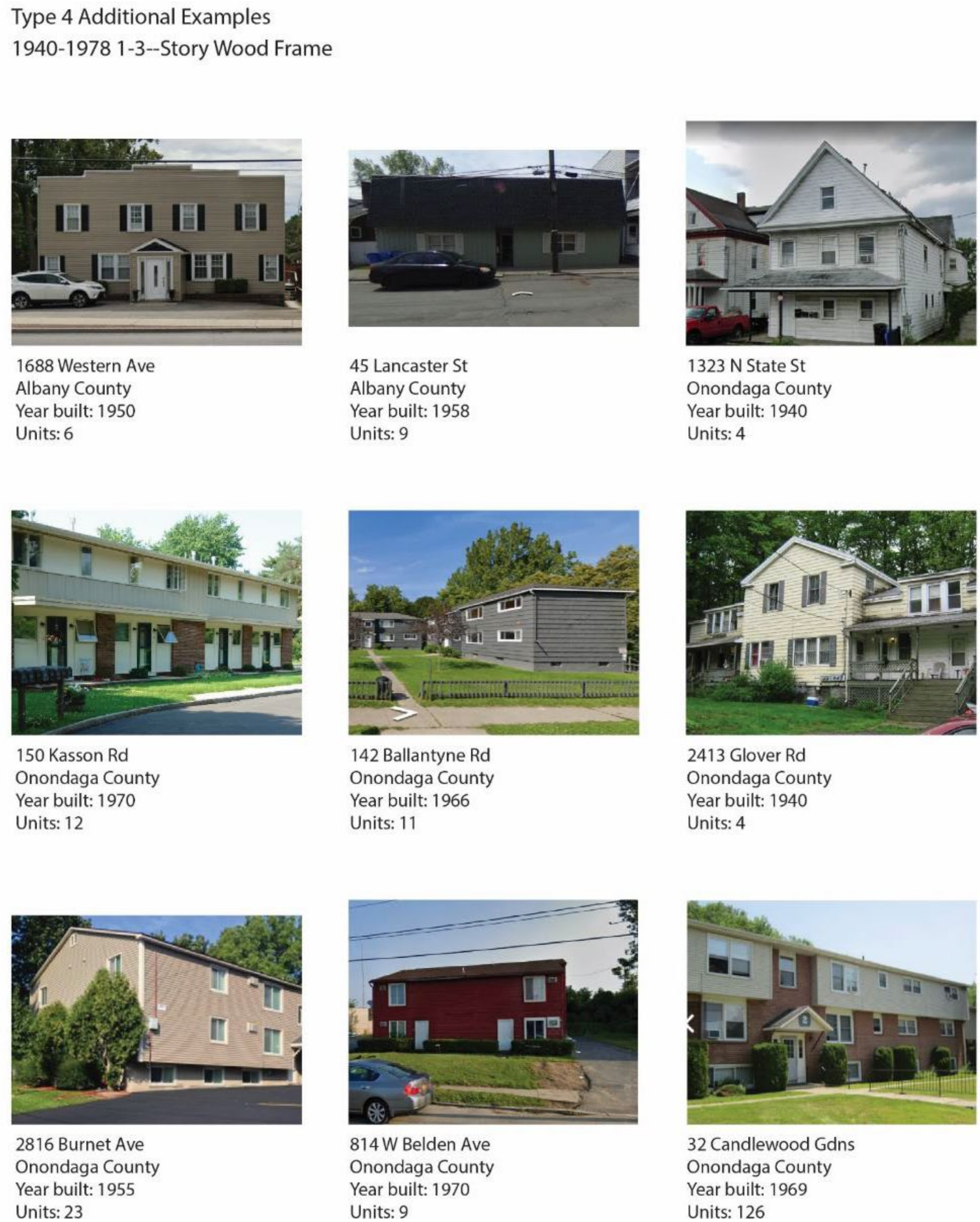


Figure 35. Additional Images of Type 4 Buildings

The images demonstrate the significant range in important parameters including WWR, GSF, plan shape, overall geometry, cladding materials, and roof and envelope configurations.

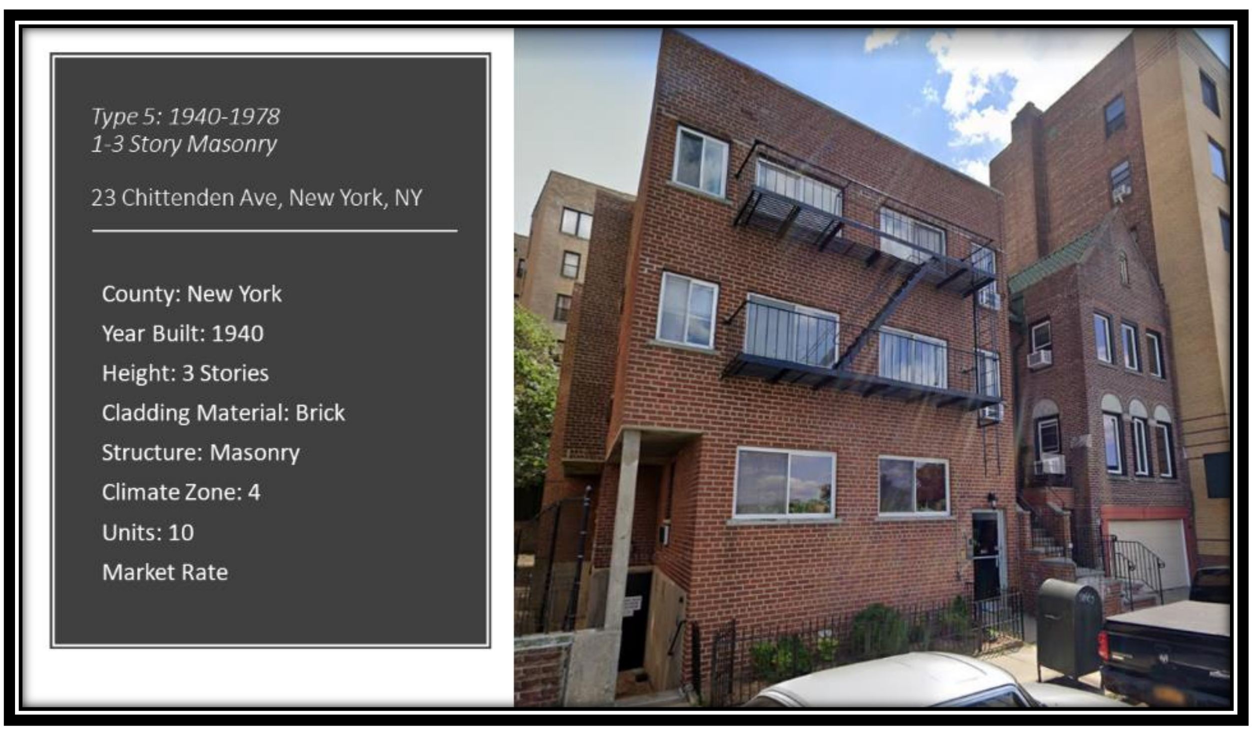


3.3.5 Type 5: 1940–1978, One- to Three-Story Masonry

Type 5 is defined by buildings of one to three stories in height, whose primary exterior structural walls are composed of masonry. Significant differences in masonry construction in this vintage period include the introduction of concrete as a predominant structural wall material, which became integrated with brick load-bearing walls. Foundation and basement walls are seen constructed of CMU or cast in place concrete, with the addition of precast concrete panels which were assembled onsite. Instead of multiple wythes of brick, face, or veneer brick was layered in front of CMU or precast concrete with an air gap. Interior finishes for this type originally included plaster and lath, gypsum board, or wood paneling.

Low-rise brick masonry buildings continued to be constructed in the affordable housing sector, as shown below in Figure 36 at 23 Chittenden Avenue but did not predominate upstate as a significant percentage of multifamily buildings for the vintage category as compared to wood frame structures. Development of low-rise structures in New York City for this vintage category typically took place in Queens, the Bronx, Staten Island, and other areas with commercial density and high rated smaller-scale housing outside Manhattan or downtown Brooklyn.

Figure 36. An Example of a One- to Three-Story Masonry Building



Roofs in Type 5 can vary widely, though flat (low-slope) roofs with parapet walls or simple cornices consisting of bands of metal or wood are frequent. Highly irregular roof geometries are also common, with stylistic interpretations of classic roofs such as Mansard and Gambrel types with large glazed or punched openings appearing through roof layers. Fenestration patterns, as in Type 4, vary from large glazed areas to small inset openings designed to control thermal fluctuations.

Insulation was not frequently specified in this type, though as in Type 4, attic insulation began to appear with greater frequency toward the end of the vintage period. Generally, during this time period, it should be noted that a series of building technology innovations began to appear that increased the variability of architecture and construction approaches and methods; therefore, as seen in the examples in Figure 40 as well as in Appendix 3: Random Samples of Three NYS Counties, a wide range can be observed today. Features that are present in the representative type shown in Figure 36 include smaller-scaled and fewer glazed openings than are seen with types from previous vintages, banding of concrete or other ornamental materials, and low-slope, built-up roofs. As with the wood frame construction types concurrent with this time period, some properties are recorded as having many modules or smaller buildings that make up a large complex; however, the units are arranged similarly in "bar" configurations to those in Type 4.

Characteristics Representative of Type 5:

- Gross square footage: approximately 5,000–16,000 sf per building; up to 100,000 for large complexes with repeating building modules
- Interior unit square footage: from 500–1600 sf each
- Window to wall ratio: between 10–15%, with smaller-scaled, regularly placed glazed openings
- Envelope area: from 3500–10,000 sf per bar building module for the envelope not including roof area but in large complexes ranging up to 75,000 sf or greater

For additional summary characteristics of Type 5, refer to Table 13: Market Characterization Summary.

Figure 37: Summary Characteristics of Type 5 Buildings

Type 5: 1940 – 1978, 1 - 3 Story Masonry	
General	There is a significant change in building technology and construction systems pre- and post-1940, and from 1940 to 1979. Details from both the 1950s and 1970s were reviewed to suggest how buildings at the beginning and end of this period will differ.
	Source: Architectural Graphic Standards, 1956 (5th) and 1970 (6th) Editions
Foundation	Cast in place concrete or concrete block.
Wall Construction	*1950s*
	Hollow brick wall construction with 2" airspace behind face brick.
	Concrete block wall (CMU) with face brick or stucco
	New materials, such as precast concrete (factory or sitecast) and gypsum block introduced (uncommon in practice – gypsum was common for interior partitions and roofs, but not exterior walls). Structural clay tile also included; not common for residential.
	Furring, plaster and lath finish on inside of wall
	1970s
	Brick bearing walls shown with reinforced concrete floors
	First mention of "cavity wall" construction. CMU block interior, face brick exterior, no insulation.
	Solid brick include reinforcing (grout and rebar); hollow brick includes metal ties.
Cladding Materials and Ornament	Face brick or stucco
Thermal and Moisture Control	*1950s*
	No insulation shown in brick cavity walls
	Rigid Insulation shown in foundation details – at exterior of footings and separating interior concrete slab from footings
	1970s
	First inclusion of information on building physics (thermal and moisture flow of the envelope in AGS. Tables listing vapor permeance and thermal transmittance of common building materials and instructions for heat flow and condensation risk assessment calculations.
	Common insulation materials include fiberglass ("cellular glass"), mineral wool, extruded and blown polymers (polyurethane, polystyrene)
Floor Construction	Wood joists or reinforced concrete slabs pocketed into brick
Roof Construction	*1950s*
	Pitched wood roof with shingles
	Low-slope wood roof with built-up roofing
	Flat concrete roof with built-up roofing
	New materials, such as poured and precast gypsum block, precast concrete plank, and composite metal deck, appear for the first time. Likely uncommon in low-rise residential.
	1970s
	Shingle (asphalt, asbestos) or built-up (asphalt / asbestos hot mop) are the primary materials (other than metal)
Renovation	Roofs and windows likely replaced or overclad since original construction.
	Masonry cladding likely original

Figure 38. Type 5: Construction Details

Left: Brick Cavity Wall and Brick Details (AGS, 1956). Right: Brick Cavity Wall on CMU (AGS, 1970).

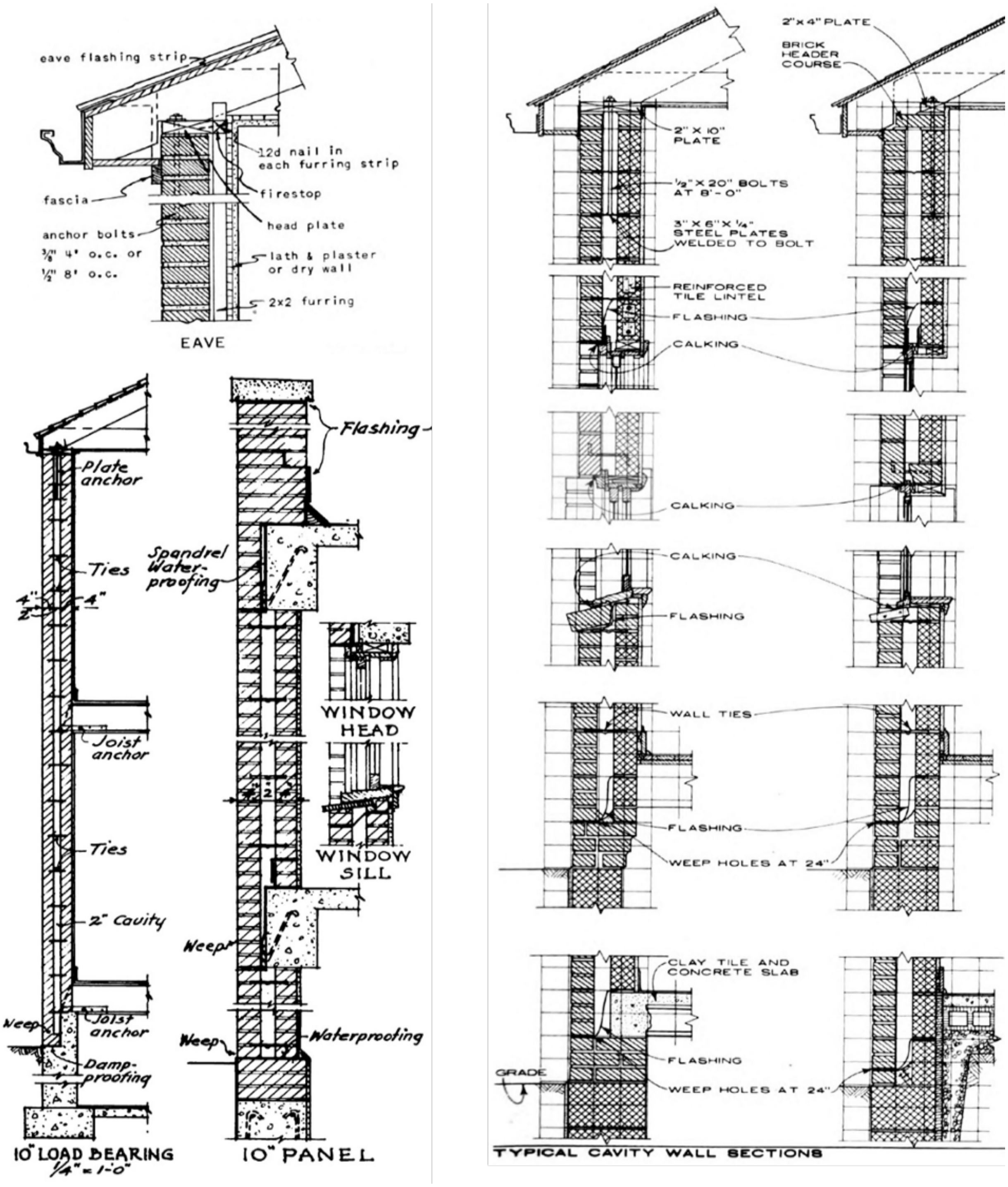


Figure 39. An Example of Type 5 Wall Construction with Flat Roof Parapet

Inset images demonstrate common variation in wall-to-floor configuration.

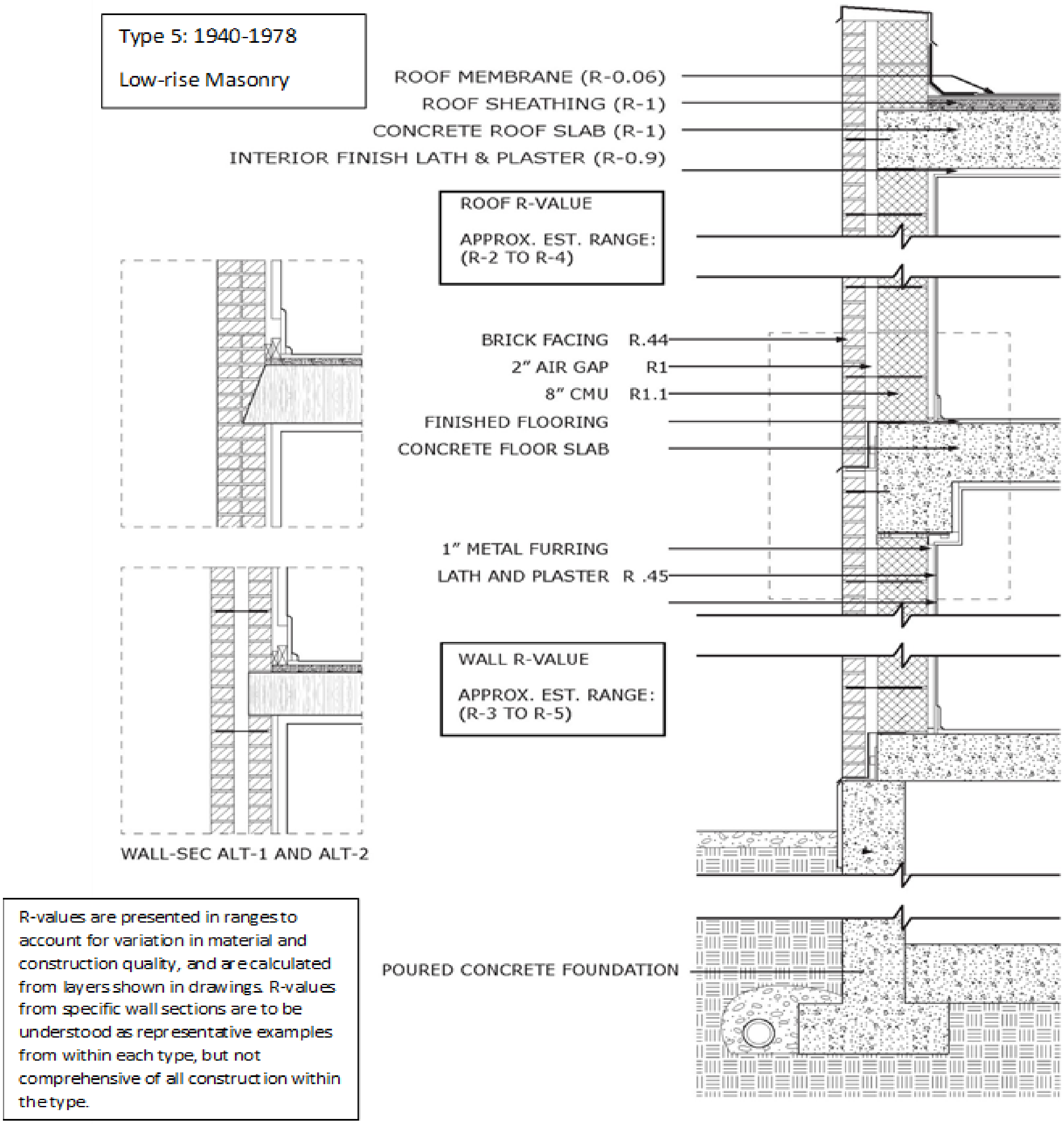
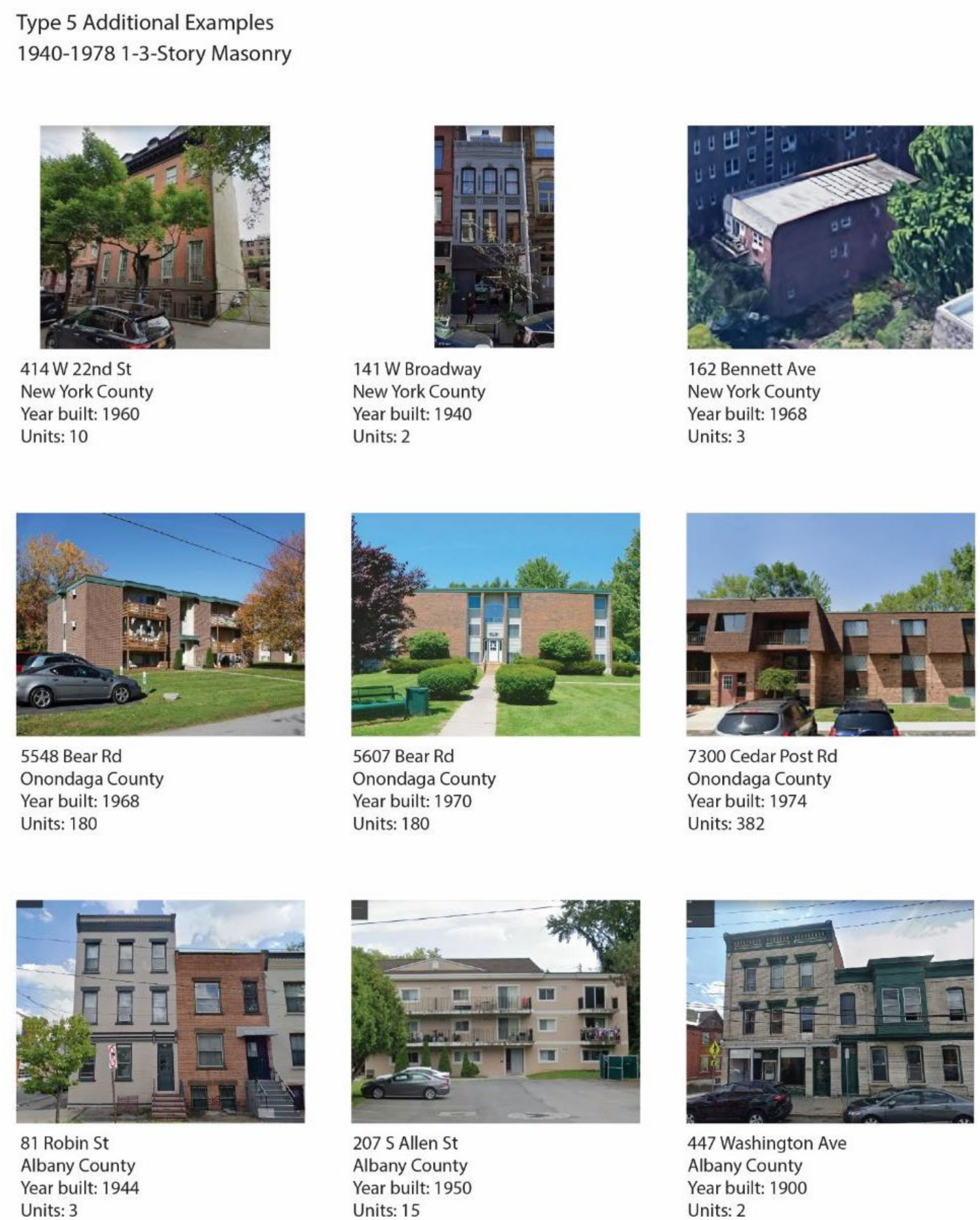


Figure 40. Additional Examples Demonstrating Variation within Type 5 Records

Significant variation expressed in roof shape, envelope configuration and cladding materials.



3.3.6 Type 6: 1979–2006, One- to Three-Story Wood Frame

Type 6 is defined by buildings of one to three stories with primarily wood frame structure. Less common structural systems within this type include light-gauge steel, hybrid construction with pre- or site-cast concrete, or CMU, and Structural Insulated Panels (SIPS) or other composite structural panel systems. Major innovations during the 1979–2006 time period that distinguish buildings of this type from others include (1) the emergence of insulation in exterior walls and roof systems as a predominant specification; (2) a wide array of material options and building technologies from which to choose; and (3) architectural geometries and envelope designs that reflect the rapid expansion and rising popularity of sustainable principles and practices.

For the vintage category spanning 1979–2006, building types diversified with innovations in steel, concrete, and glazing; however, major building types of wood-clad, wood frame, low-rise construction and masonry-clad concrete or wood frame constituted the majority of multifamily buildings, and comprised a significant number of affordable multifamily buildings. Prevalent practices, as represented by 226 Oak Street in Onondaga County in Figure 41 below, were typified by tighter envelope sealing and insulation.

Figure 41. An Example of One- to Three-story Wood Frame Constructed Multifamily Housing from 1980

Wool, fiberglass, and extruded polystyrene foams are commonly seen applied in this type as insulation, typically between framing elements, and to a lesser extent, Icynene and other expanding spray foams. Insulation materials and integration practices during this vintage period have been engineered to produce high R-value wall and roof assemblies in accordance with energy-saving principles. The difference in R-value between a wall from 1979 and a wall from 2019 could be greater than R-20, depending on the materials and techniques used. Fiberglass insulation, for example, was widely used in the 1980s, and has an R-value slightly lower than Expanded Polystyrene (EPS); however, the different application techniques of these materials result in highly variable airtightness and insulation performance outcomes for exterior walls. For this reason, as well as the development of newer and more airtight envelope detailing techniques, the reported range of R-values is large.

Advances in membrane roof design and technology, material envelope systems such as rot-proof vinyl siding, and glazing technologies over this period improved building performance while maintaining design cost-effectiveness. Vapor and moisture control layers, architectural detailing and construction installation methods improved thermal and moisture performance. Innovation in foundation design, such as insulation under slabs towards the latter part of the vintage period, improved thermal performance as well. Numerous envelope-based insulation, screening, and other types of technologies are also seen in buildings constructed during this time; however, these systems are not examined in drawing here because traditional frame systems still predominate. In addition, while lightweight metal framing has been applied increasingly in the past several decades, wood framing overwhelmingly predominates and thus remains the focus of Type 6.

Finally, Postmodernism, Brutalism, New Urbanist architecture and other movements influenced the multifamily residential sector in a variety of ways. Today a large overhang constituting the full second story of building may protrude out over the first story as an aesthetic massing strategy. Dynamic and complex roof shapes can be seen influencing several American housing styles, as well as revivals of Neo-classical and European styles. Large building volumes can be divided with jogs and roof elevation changes or display mass-produced façade ornamentation in contrast to the ornamentation in earlier periods.

Floor plan configurations and gross floor area vary widely for this type. On one end of the spectrum lies the trend toward multibuilding complexes that often result in hundreds of thousands of square feet per project. On the other end of the spectrum lies the conversion of single-family houses into multifamily residences, particularly common in upstate counties and often leading to great variation in dwelling unit size. In general, an overall increase in dwelling unit size during this period resulted in larger building footprints and greater cubic volumes of conditioned space. Characteristics representative of the common variation of Type 6 shown in Figure 41 include smaller, regularly-spaced glazed openings, often in standard 3 ft. x 5 ft. or similar sizes, and long “bar” modules making up complexes or attached configurations with a large amount of exposed envelope surface area. The major distinguishing feature is the increasing size of complexes during the time frame, with several of the examples shown in this report exceeding 100 units. A smaller building module is selected as the representative type shown above; however, since the large complexes are frequently composed of smaller building modules with between 10–20 units.

Characteristics Representative of Type 6:

- Gross square footage: approximately 7,500–20,000 sf per building; up to 100,000 for complexes
- Interior unit square footage: from 800–2000 sf each
- Window to wall ratio: between 10–15%, with smaller-scaled, regularly placed glazed openings
- Envelope area: from 3500–10,000 sf per bar building module for the envelope not including roof area but in large complexes ranging up to 75,000 sf or greater

For additional summary characteristics of Type 6, refer to Table 13: Market Characterization Summary.

Figure 42. Summary of Characteristics of Type 6 Buildings

Type 6: 1979 – Present, 1 - 3 Story Wood Frame	
General	Building technology and details are similar between 1988 and 2000.
	Source: Architectural Graphic Standards, 1988 (8th) and 2000 (10th) Editions
Foundation	Reinforced concrete or concrete block foundations
	Rigid insulation included on foundation walls – both interior and exterior options shown
Wall Construction	Platform framing
	Fibrous insulation included in the stud cavity.
	Sheathing (gypsum wallboard) as interior finish in lieu of plaster and lath
	Alternative types of wall construction (double stud, log cabin, SIPs, etc) included; likely not used widely in practice
Cladding Materials and Ornament	Wood siding / shingles, brick veneer
Thermal and Moisture Control	Energy" chapter includes climate-specific and passive strategies.
	Strategies for insulating wood structures include interior vapor control layer. All insulation is between studs – no exterior insulation
	Common types of insulation include: fiberglass, mineral wool, extruded polystyrene, polyurethane, and polyisocyanurate
Floor Construction	Wood joists with plywood sheathing
Roof Construction	Pitched wood roof with asphalt shingles
	Fibrous insulation included between rafters
	Built up roofing (similar to previous editions)
	New single -ply roofing materials such as PVC and EPDM, which include rigid insulation above the roof deck
	New protected membrane roof detail with insulation on top of the roof deck above the membrane.
Renovation	More recent construction (within past 20 – 30 years) may still have original insulation, cladding, windows and roofs (20 – 30 year lifespan for these elements)

Figure 43. Examples of Brick Veneer on Wood/Metal Framing and Insulation

Brick Veneer on Wood/Metal Framing (LEFT, AGS 2000). Insulation at foundations, low-slope and pitched roofs (RIGHT, AGS 1988).

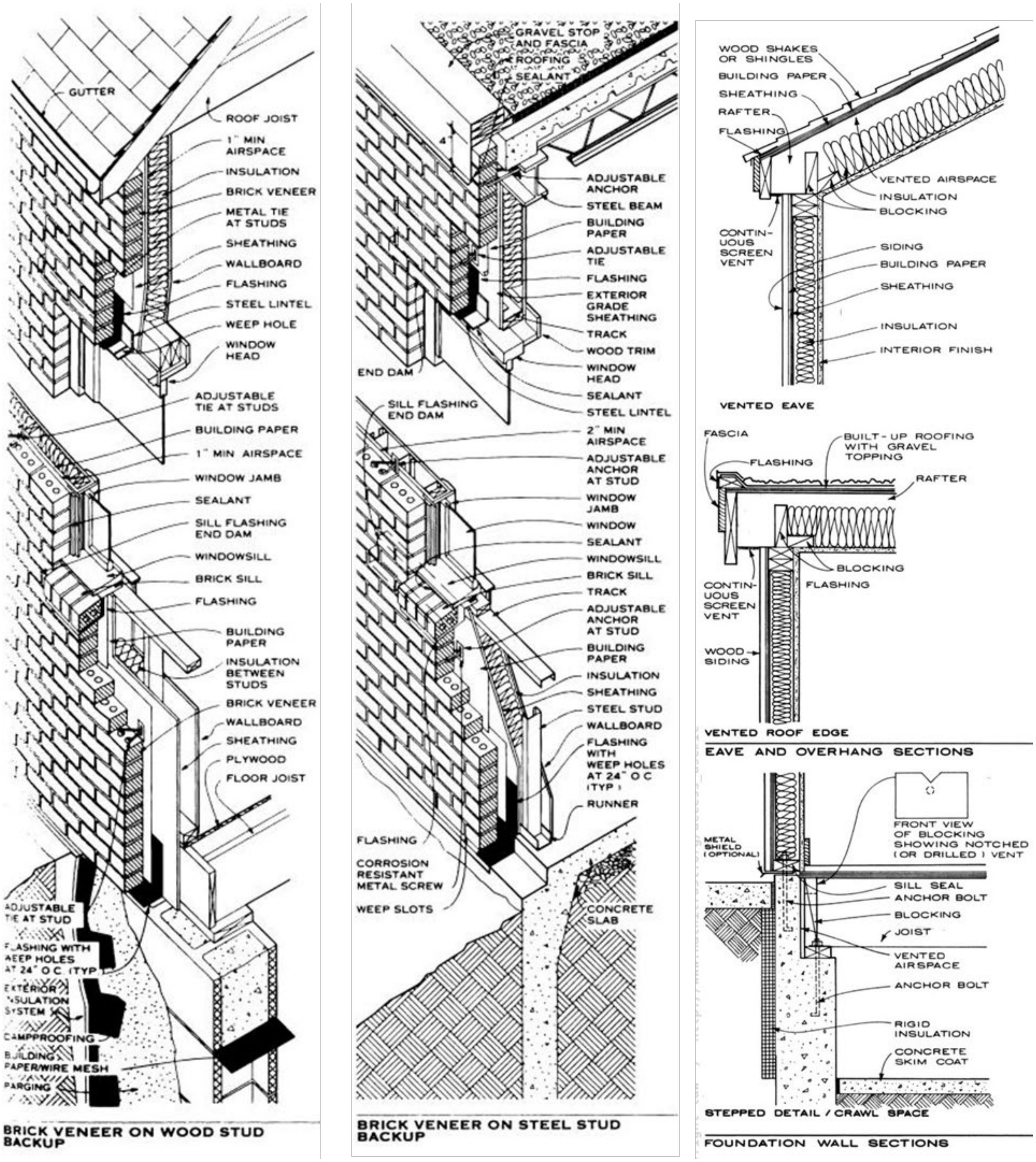
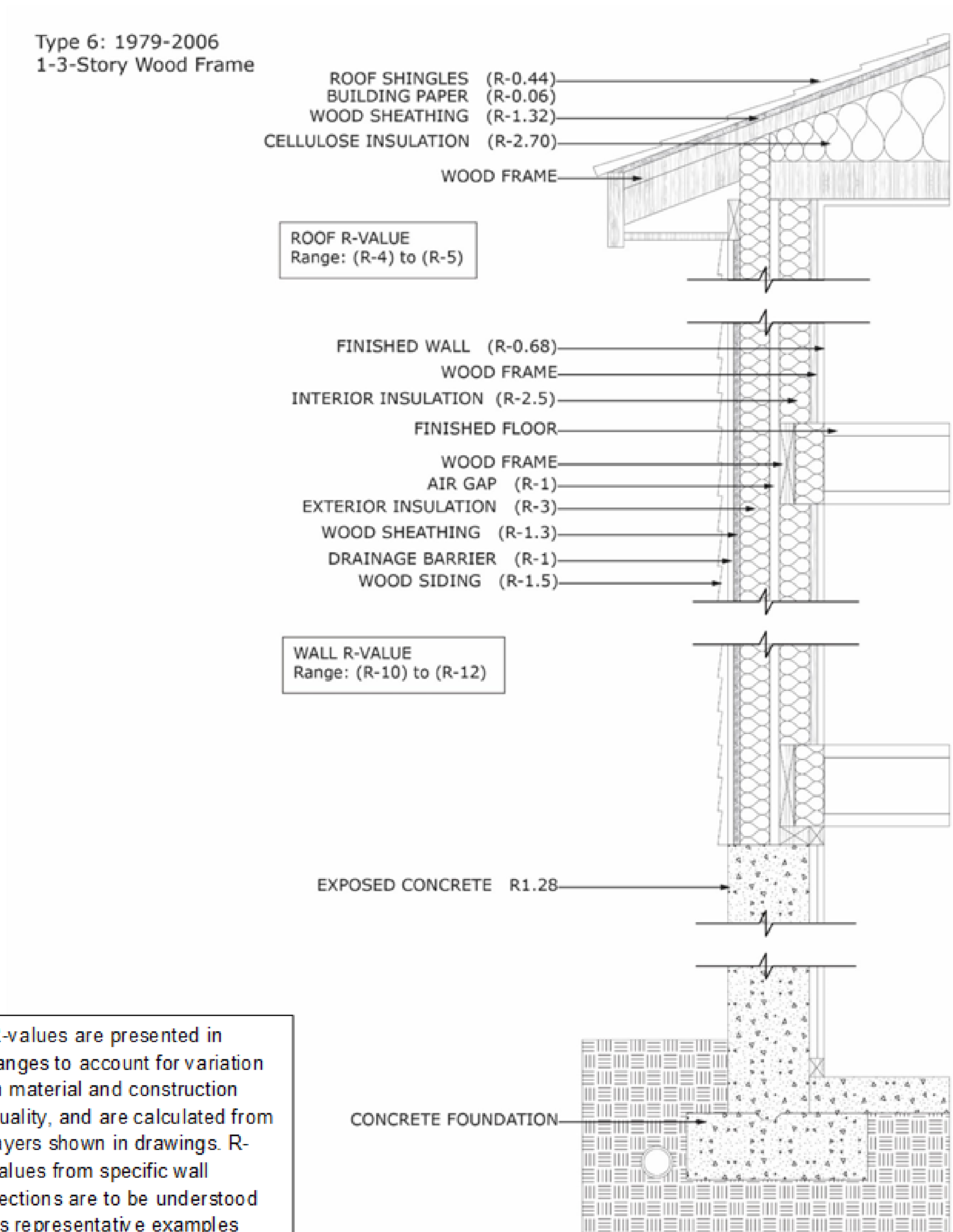
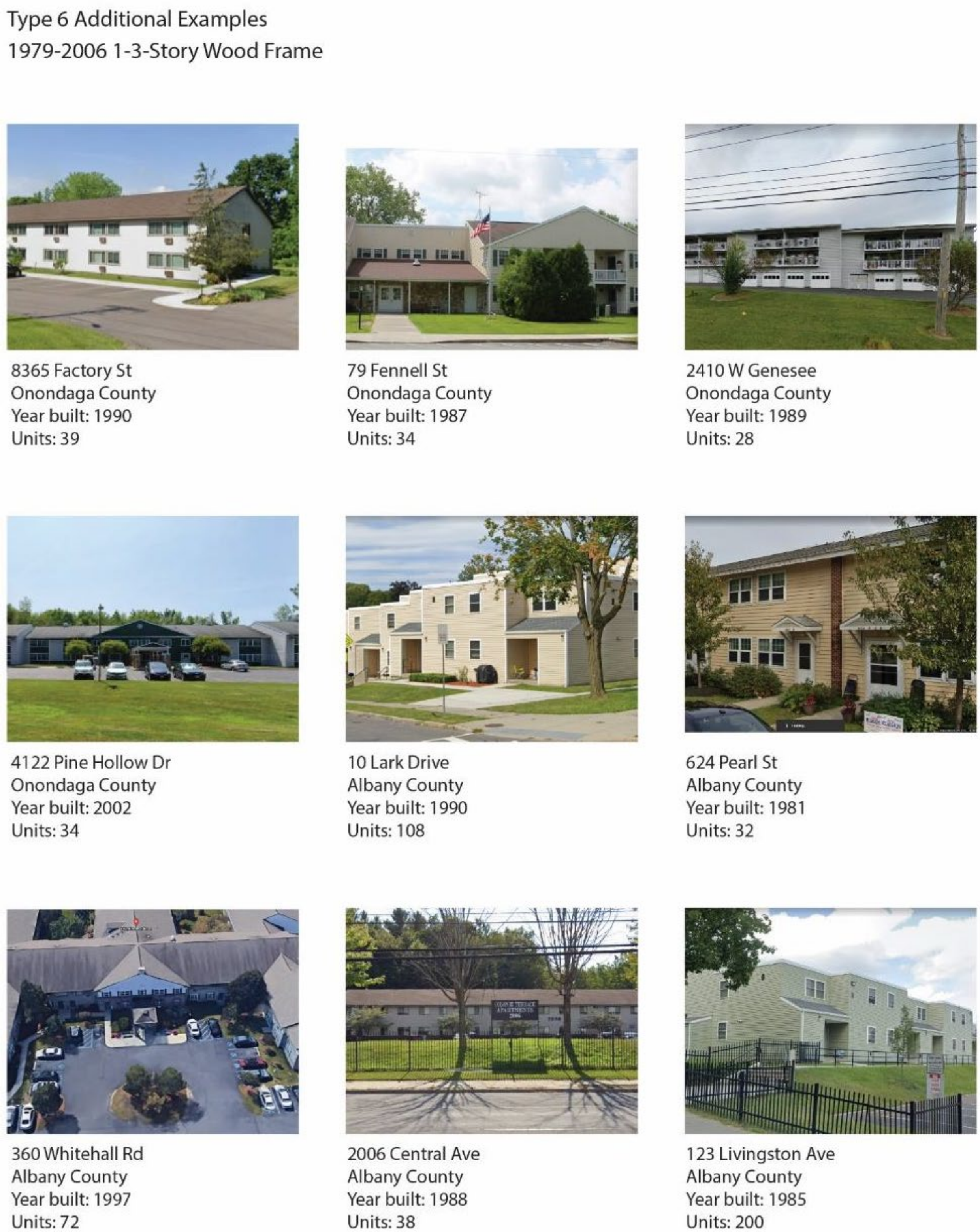


Figure 44. Example of Type 6 Construction with Integration of Insulation Layers in both Wall and Roof Composition



R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

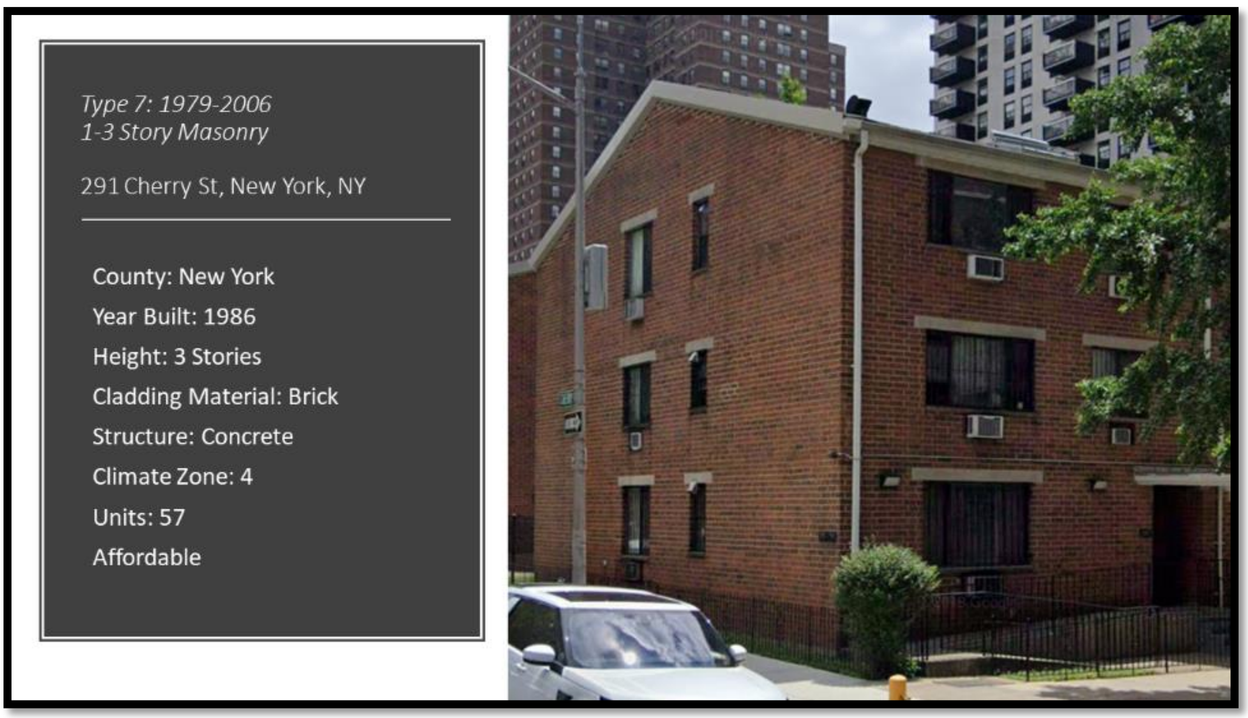
Figure 45. Image Array Depicting Additional Type 6 Records Illustrating the Range in GSF, Envelope Configuration, Roof Shape, and Overall Geometry



3.3.7 Type 7: 1979–Present One- to Three-Story Masonry

Type 7 is defined by one- to three-story buildings with primarily masonry structure. During the vintage period of 1979–2006 for masonry building types, major identifying trends included: (1) the evolving structural composition of walls and roof systems; (2) the ubiquity of insulation layering; and, (3) the wide variety of exterior cladding materials. Overall building geometries did not diverge as significantly as with wood frame structures during this time period, due in large part to the comparative plasticity of wood construction relative to the rigidity of masonry while maintaining cost-effectiveness. Particularly in examples of affordable housing in Type 7 as seen below (Figure 46), building geometries are relatively simple, openings in the envelope are smaller in proportion than in prewar examples, and façade elements are often highly regular and express modularity, which can contribute to cost savings.

Figure 46. A Representative Example of Affordable Housing in the One- to Three-Story Masonry Construction Type Built in the 1980s



Wall construction for this type is commonly composed of concrete masonry units (CMU) with a stone, brick, stucco, or other masonry veneer. This layering strategy enabled the aesthetic demand for a wide variety of materials to be met without sacrificing cost-effectiveness. A unique innovation for the time period was the introduction of continuous insulation in the composition of the wall layering, resulting in higher R-values for wall assemblies. Roof construction can be seen with a similar treatment, with rigid insulation integrated into built-up, low-slope compositions. In the latter part of the period, insulation also appears around the foundation walls and finally, under the slab. The design and detailing of envelopes overall became more sophisticated and able to respond to increased demand for thermal performance. An associated trend for Type 7 is the significant rise in the number of variations in masonry wall layering, the use of thermal breaks, insulation, cladding, and anchoring innovations.

Floor plan and overall building geometries are generally more conservative than those found within wood frame types; however, the aesthetic demand for multiple materials within a single building façade resulted in some emergence of hybrid constructions, often with concrete lower stories and wood or metal frame upper stories. The approach is common in examples with commercial or mixed-use zoning, where corresponding uses are combined in a single building.

Ornamentation for Type 7, as seen in wood frame buildings, is found in a range of materials that are prefabricated and cost-effective, such as cast-concrete medallions, column details, quoins and other embellishments (Figure 48-49 and appendix 3). As with wood frame buildings, masonry buildings benefited from advances in glazing technology. High-performance double- or triple-pane glazed units rose to prominence in the latter part of the time period, as with Type 6, in response to wide-reaching sustainability initiatives. The trend toward smaller glazed openings coincided with this as another energy-saving measure. Most buildings in the residential sector in New York State in this type are mechanically heated and cooled, so large openings are not necessary for ventilation purposes. Other features of façades include balconies, which are commonly constructed of concrete, with metal railings, and pediments which sometimes serve as vented attic space or mechanical equipment storage or simply as decorative extensions of the façade, recalling the parapet walls of historical types. As shown in the representative example in New York County in Figure 46, common variations are characterized by regularly spaced glazed openings across the envelope, minimal ornamentation in particular on affordable housing variations, and a large amount of exposed envelope surface area.

Characteristics Representative of Type 7:

- Gross square footage: between 10,000–20,000 sf for building modules; up to 100,000 for large complexes
- Interior unit square footage: from 800–2000 sf each
- Window to wall ratio: between 10–20%, with regularly placed glazed openings in a range of sizes
- Envelope area: from 7,000–25,000 sf for the envelope not including roof area for the example selected but in large complexes ranging up to 75,000 sf or greater

For additional summary characteristics of Type 7, refer to Table 13. Market Characterization Summary.

Figure 47. Summary of Characteristics of Type 7 Buildings

Type 7: 1979 – Present, 1 - 3 Story Masonry	
General	Building technology and details are similar between 1988 and 2000.
	Source: Architectural Graphic Standards, 1988 (8th) and 2000 (10th) Editions
Foundation	Reinforced concrete foundations
Wall Construction	Single-wythe CMU Wall with stucco finish
	Mutli-Wythe CMU Walls. Brick veneer grouted to CMU (no air cavity); interior rigid insulation
	Brick Veneer on CMU with interior rigid insulation and with continuous rigid exterior insulation (first instance of continuous insulation)
	Brick Veneer on Metal Stud, with fibrous insulation between studs
Cladding Materials and Ornament	Brick veneer, stucco
Thermal and Moisture Control	Fibrous and rigid insulation shown in details
Floor Construction	Structural steel with concrete on metal deck
	Reinforced concrete
Roof Construction	Primarily flat roofs
	Built-up roofing
	Single-ply roofing
	Rigid insulation shown in roof details
Renovation	More recent construction (within past 20 – 30 years) may still have original insulation, cladding, windows and roofs (20 – 30 year lifespan for these elements)

Figure 48. Examples of Mass and Cavity CMU Walls

Note cavity wall with exterior continuous insulation at right (AGS, 2000).

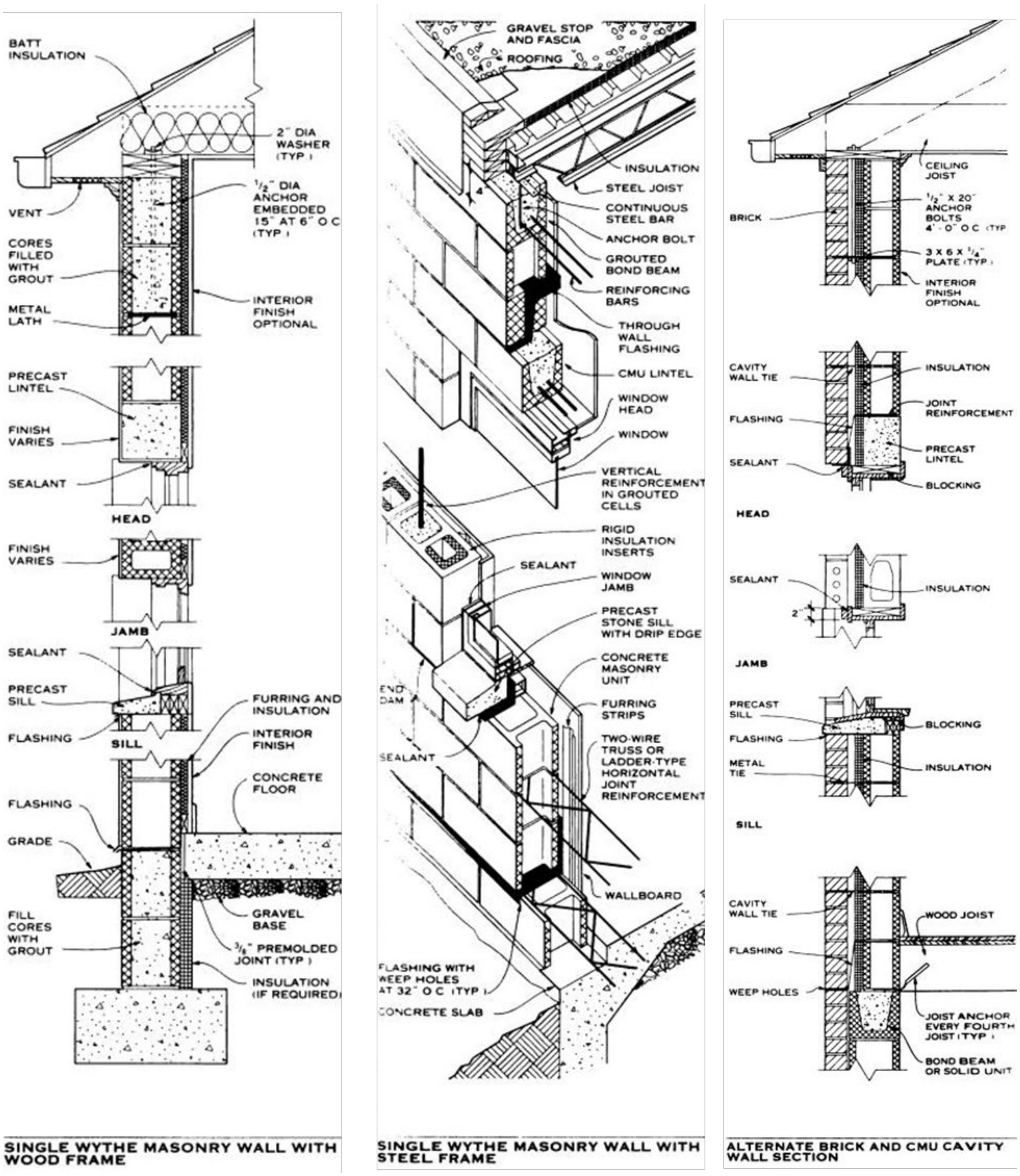
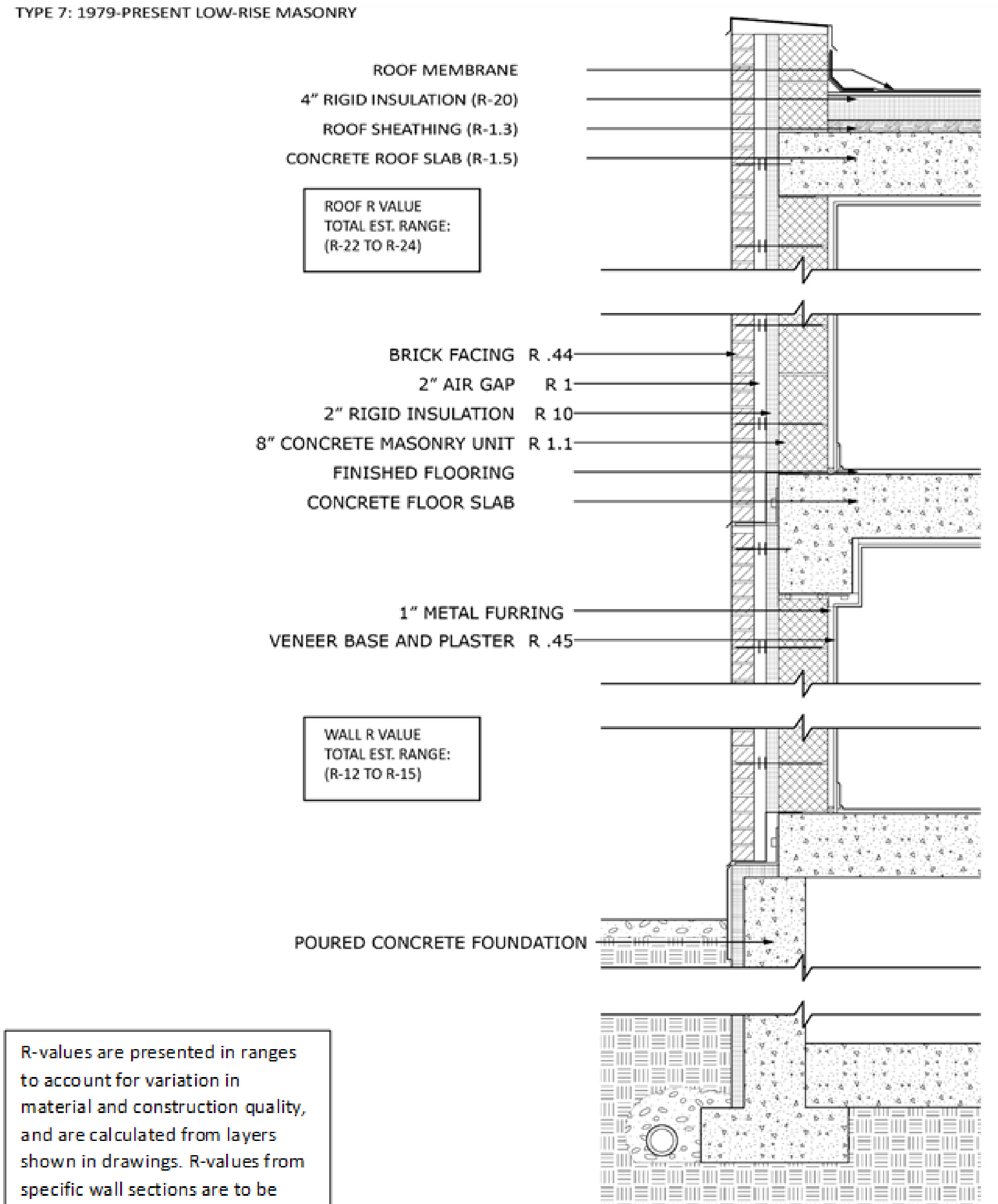


Figure 49. Example of Type 7 Wall Construction with Flat Roof Variation

TYPE 7: 1979-2006 1-3 STORY MASONRY



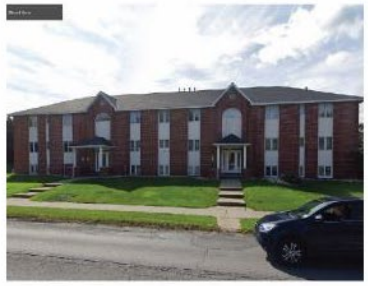
R-values are presented in ranges to account for variation in material and construction quality, and are calculated from layers shown in drawings. R-values from specific wall sections are to be understood as representative examples from within each type, but not comprehensive of all construction within the type.

Figure 50. Image Array Illustrating Additional Variation in Type 7 Records

The images include envelope configuration, roof shape, WWR, exterior ornamentation and secondary structures such as fire stairs, balconies, and entry awnings.

Type 7 Additional Examples
1979-2006 1-3-Story Masonry

25 Elberon Pl
Albany County
Year built: 1980
Units: 6



447 Washington Ave
Albany County
Year built: 1980
Units: 18

151 Charles St
New York County
Year built: 1989
Units: 6

403 E 57th St
New York County
Year built: 1984
Units: 4

110 Comstock Ave
Onondaga County
Year built: 1993
Units: 12

100 La Madre Way
Onondaga County
Year built: 1993
Units: 50

107 Trolley Barn Ln
Onondaga County
Year built: 1980
Units: 39

689 N Clinton St
Onondaga County
Year built: 1980
Units: 120

4320 S Salina St
Onondaga County
Year built: 2007
Units: 90

4 Conclusions

The two major components of this study as presented in sections 2 and 3 of this report, combined an analysis of previously acquired data with an examination of typologically representative examples of multifamily buildings in New York State. In section 2, an assessment of the ICF data set revealed inaccuracies which rendered a true estimation of the market size and distribution challenge; however, the data was sufficient to rationalize a categorization of major predominant multifamily building types, and to demonstrate the distribution of those types across NYS. The categorization into seven major types was supported in section 3 by cross-referencing with historical sources and architectural standards to produce detailed architectural profiles and drawings of representative examples of each type. Within the representative examples, the analysis focused on exterior envelope construction and overall building geometry, factors which directly affect exterior wall area and structural capacity. Each example, representing a common configuration of square footage, geometry, and envelope components within the type, was assessed for R-value according to the configuration of envelope layers shown, along with an estimation of a range of Window-to-Wall ratios. These analyses were supported with observations using samples of individual records for each type.

Analysis of the ICF data set identified four major segments, defined by vintage and building height, that constitute most multifamily buildings in New York State. Each segment includes subsegments defined by predominant construction materials. Historical sources identified masonry and wood frame as the primary construction systems for multifamily residential buildings under eight stories. We described seven building typologies, defined by vintage, height, and construction materials, in detail in the second half of the report, identifying key characteristics, such as massing, cladding materials, roof profile, and exterior wall construction, that impact the feasibility of retrofitting these buildings with high-performance envelope systems.

The market opportunity for high-performance retrofits represented by each of these segments is summarized in Table 13 which synthesizes information from previous tables on the total size of each segment (count, floor area, and facade area), the average characteristics of its buildings (dimensions, height, floor area, number of dwelling units), and other key characteristics of the exterior wall, such as R-value and window-to-wall ratio. WWRs are given as a broad range in this table in order to account for variations discussed in the text descriptions referring to drawings of representative examples for each type. Where common envelope layering systems were illustrated in wall sections, R-value ranges were added up using specific information about material layers shown. Finally, the total square footage breakdown of the distribution of each of the major vintage categories across the State and then by county, are shown in Figure 51 and Figure 52, respectively. These breakdown charts refer to the vintage categories shown in the preceding tables, and illustrate clear similarities between upstate counties, particularly Albany and Onondaga, in the higher concentrations of one- to three-story building square footage from buildings constructed in the 1940–1978 vintage. In New York County, approximately 20% of the GSF is made up of pre-1940, four- to seven-story buildings, whereas this type is nearly negligible with regard to percentage of square footage. In New York County, as well as across the State; however, one- to three-story buildings from 1940–1978 occupy the greatest quantity of square footage.

Table 13. Market Characterization Summary

Segment Description		Segment Characteristics				Typical Individual Building Characteristics[1]												
Vintage	Building Height (Stories)	Count, MF Bldgs in NYS[2]	%, MF Bldgs in NYS[3]	Total Floor Area[4] (GSF)	Total Exterior Wall Area[5] (SF)	Type	Structural Material	Cladding Materials	Average Floor Area (GSF)	Average Envelope Area (SF)	Width (FT)	Depth (FT)	Height (FT)	# Units	Unit Area (GSF)	WWR (%)	R-value, Wall	R-value, Roof
Pre-1940	1 to 3	396,343	38.67%	1,160,883,262	1,164,243,036	1	Masonry	Brick, stone, stucco	2,400 - 4,000	2,000 - 4,000	20 - 40	40 - 50	30 - 40	2 to 4	500 - 1,600	10 to 20	2 to 4	2 to 4
						2	Wood Frame	Brick veneer, wood, stucco	1,200 - 2,600	2,500 - 4,000	20 - 40	30 - 40	30 - 40[5]	2 to 4	500 - 1,600	10 to 20	3 to 5	1 to 2
Pre-1940	4 to 7	46,258	4.51%	1,248,583,402	534,264,627	3	Masonry	Brick, stone, stucco	4,800 - 45,000	3,000 - 25,000	30 - 90	40 - 70	45 - 85	4 to 45	500 - 1,600	10 to 20	2 to 5	2 to 4
1940 - 1978	1 to 3	171,793	16.76%	2,683,558,039	700,535,956	4	Wood Frame	Brick veneer, wood, stucco	5,000 - 16,000; up to 100,000 for complexes	3,500 - 10,000; up to 75,000 for complexes	100 - 120	30	30	10 to 20 per building; up to 200 for complexes	500 - 1600	10 to 15	6 to 7	3 to 4
						5	Masonry	Brick, stone, stucco	5,000 - 16,000; up to 100,000 for complexes	3,500 - 10,000; up to 75,000 for complexes	100 - 120	30	30 - 40	10 to 20 per building; up to 200 for complexes	500 - 1600	10 to 15	3 to 5	2 to 4
1979 - 2006	1 to 3	84,792	8.27%	1,112,456,713	355,906,065	6	Wood Frame	Brick veneer, wood, stucco	7,500; up to 100,000 for complexes	3,500 - 10,000; up to 75,000 for complexes	120 - 150	40 - 50	30 - 40	30 per building; up to 200 for complexes	800 - 2000	10 to 15	10 to 12	4 to 5
						7	Masonry	Brick, stone, stucco	10,000; up to 100,000 for complexes	7,000 - 25,000; up to 75,000 for complexes	120 - 150	40 - 50	30 - 40	30 per building; up to 200 for complexes	800 - 2000	10 to 20	12 to 15	22 to 24

Notes:

1. Average characteristics of predominant types within each segment, based on summary statistics (Tables 13 + 14) and analysis of individual building records
2. From Table 8
3. From Table 9
4. From Table 10
5. Height assumed to the ridge line (top of pitched roof)

Figure 51. Breakdown of Total Gross Square Footage from Vintage Segments in New York State

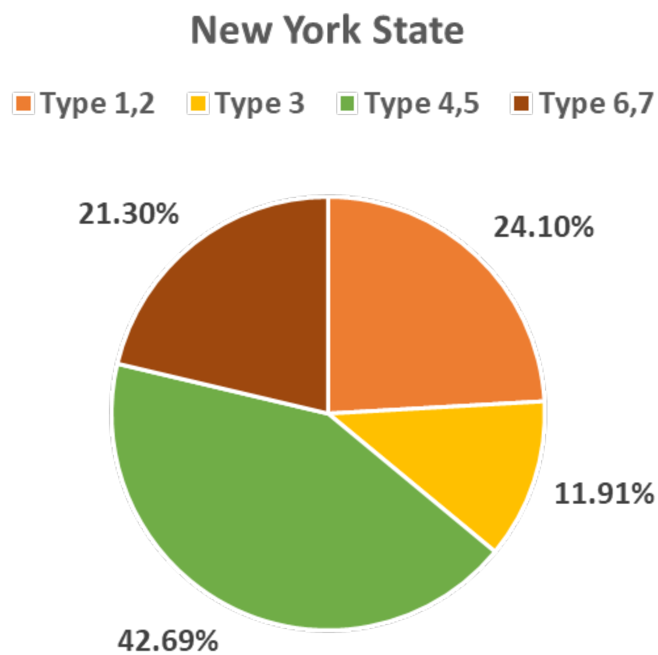
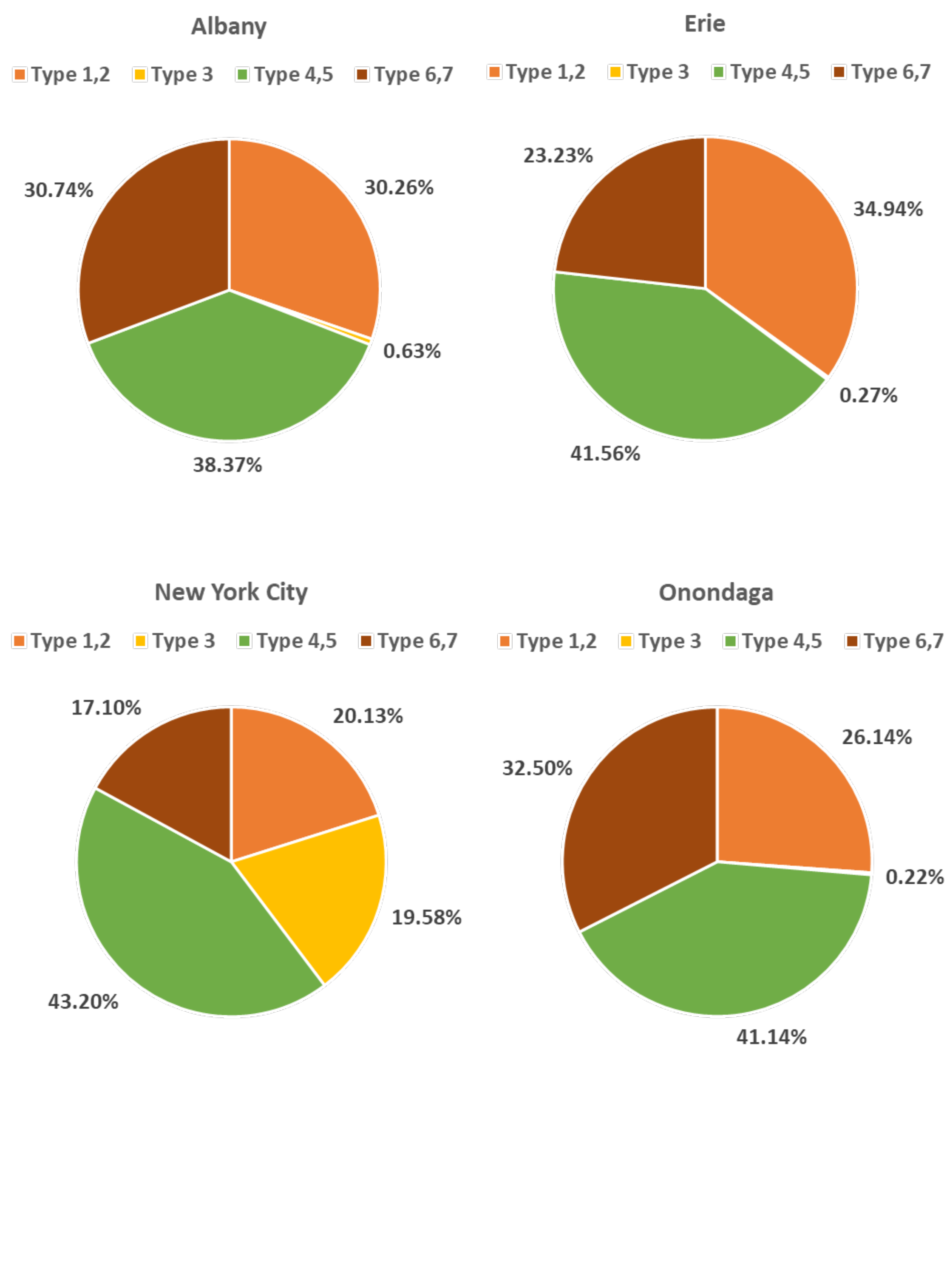


Figure 52. Breakdown of Gross Square Footage for Major Vintage Categories by County

Refer to Table 15.



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Appendix A: Segmentation Results by County

Tabular Data for Figure 1. Number of Multifamily Buildings in New York State

County	Number of Multifamily Buildings	Percentage of Multifamily Buildings
ALBANY	19,945	17.04%
ALLEGANY	1,084	4.40%
BROOME	9,195	12.77%
CATTARAUGUS	2,303	5.88%
CAYUGA	2,505	7.28%
CHAUTAUQUA	5,779	9.71%
CHEMUNG	3,884	10.00%
CHENANGO	1,314	6.13%
CLINTON	2,388	7.11%
COLUMBIA	2,390	7.94%
CORTLAND	1,665	8.57%
DELAWARE	1,333	4.67%
DUTCHESS	8,157	7.99%
ERIE	77,427	19.42%
ESSEX	1,377	6.55%
FRANKLIN	1,178	6.04%
FULTON	2,963	10.90%
GENESEE	1,924	8.72%
GREENE	1,974	7.48%
HAMILTON	125	1.94%
HERKIMER	2,576	8.80%
LEWIS	505	3.73%
LIVINGSTON	1,492	6.46%
MONROE	28,918	8.59%
MONTGOMERY	3,300	16.94%
NASSAU	36,829	8.04%
NIAGARA	8,575	9.46%
ONONDAGA	19,146	10.29%
ONTARIO	2,318	4.71%
ORANGE	11,864	9.22%
ORLEANS	1,122	6.49%
OSWEGO	3,703	6.50%
OTSEGO	1,514	5.30%
PUTNAM	1,914	4.99%
RENSSELAER	10,811	16.83%
ROCKLAND	9,234	7.89%
SARATOGA	7,299	7.57%
SCHENECTADY	6,622	11.19%
SCHOHARIE	773	5.87%
SCHUYLER	438	5.19%
SENECA	675	4.59%
ST LAWRENCE	2,699	5.23%
STEUBEN	3,138	7.34%
SUFFOLK	24,559	4.08%
SULLIVAN	2,159	5.36%
TIOGA	1,478	7.27%
TOMPKINS	4,527	11.65%
ULSTER	5,939	7.64%
WARREN	2,200	6.48%
WASHINGTON	1,968	7.53%
WAYNE	2,150	5.58%
WESTCHESTER	44,508	16.89%
WYOMING	1,052	6.17%
YATES	557	4.51%
MADISON	1,780	6.24%
ONEIDA	10,441	11.35%
JEFFERSON	3,998	7.41%

Tabular Data for Figure 2. Number of Multifamily Buildings in New York City

Community District	Number of Multifamily Residential Buildings	Number of Buildings	Percentage of Multifamily Residential Buildings
101	860	989	86.96%
102	3684	4333	85.02%
103	3644	3851	94.62%
104	2664	2873	92.73%
105	888	1122	79.14%
106	2137	2389	89.45%
107	3991	4302	92.77%
108	4223	5189	81.38%
109	1973	2110	93.51%
110	3826	4055	94.35%
111	2354	2463	95.57%
112	2124	2219	95.72%
201	2411	3026	79.68%
202	1877	2082	90.15%
203	2432	2917	83.37%
204	2478	2675	92.64%
205	2546	2901	87.76%
206	3162	3590	88.08%
207	2742	3393	80.81%
208	2449	4836	50.64%
209	9552	12118	78.82%
210	11349	19075	59.50%
211	9209	14295	64.42%
212	15584	23280	66.94%
301	12321	13131	93.83%
302	6456	7374	87.55%
303	14906	15826	94.19%
304	10229	10695	95.64%
305	16558	21533	76.90%
306	11337	12589	90.05%
307	11618	12931	89.85%
308	7087	7667	92.44%
309	5633	8300	67.87%
310	13891	23376	59.42%
311	23270	28436	81.83%
312	17614	23161	76.05%
313	4977	6984	71.26%
314	7174	16145	44.43%
315	15345	29119	52.70%
316	5989	7778	77.00%
317	15360	23908	64.25%
318	21435	43151	49.67%
401	18232	21550	84.60%
402	7707	9870	78.09%
403	13387	18554	72.15%
404	11223	13995	80.19%
405	25970	39575	65.62%
406	4230	14026	30.16%
407	20050	45846	43.73%
408	9610	29347	32.75%
409	17469	28358	61.60%
410	16241	36117	44.97%
411	11507	38217	30.11%
412	21650	57397	37.72%
413	17897	69490	25.75%
414	12362	20145	61.37%
501	15632	45457	34.39%
502	10789	35626	30.28%
503	14013	49459	28.33%

Tabular Data for Figures 3–10 (Pre-1940 Multifamily Buildings)

	VINTAGE	Pre-1940							
	BUILDING HEIGHT	Hi-Rise	Hi-Rise_%	Mid-Rise	Mid-Rise_%	Low-Rise	Low-Rise_%	NA	NA_%
NY Upstate	ALBANY	0	0.00%	43	0.04%	21,147	18.06%	9,936	8.49%
	ALLEGANY	0	0.00%	2	0.01%	4,655	18.91%	3,915	15.90%
	BROOME	0	0.00%	1	0.00%	15,779	21.91%	7,849	10.90%
	CATTARAUGUS	1	0.00%	0	0.00%	9,742	24.88%	6,071	15.51%
	CAYUGA	2	0.01%	4	0.01%	9,363	27.23%	5,411	15.74%
	CHAUTAUQUA	0	0.00%	8	0.01%	17,733	29.80%	9,687	16.28%
	CHEMUNG	1	0.00%	0	0.00%	9,881	25.44%	4,246	10.93%
	CHENANGO	1	0.00%	0	0.00%	4,692	21.87%	3,354	15.63%
	CLINTON	0	0.00%	2	0.01%	5,121	15.24%	2,858	8.51%
	COLUMBIA	0	0.00%	1	0.00%	4,164	13.83%	4,929	16.38%
	CORTLAND	0	0.00%	0	0.00%	4,294	22.10%	2,243	11.54%
	DELAWARE	0	0.00%	3	0.01%	3,128	10.97%	3,391	11.89%
	DUTCHESS	4	0.00%	23	0.02%	13,010	12.75%	4,821	4.73%
	ERIE	2	0.00%	37	0.01%	79,646	19.97%	74,767	18.75%
	ESSEX	0	0.00%	0	0.00%	3,161	15.05%	3,904	18.58%
	FRANKLIN	3	0.02%	1	0.01%	3,980	20.40%	3,417	17.51%
	FULTON	0	0.00%	2	0.01%	6,866	25.26%	4,736	17.43%
	GENESEE	0	0.00%	0	0.00%	6,734	30.53%	2,945	13.35%
	GREENE	0	0.00%	1	0.00%	3,142	11.90%	3,732	14.14%
	HAMILTON	0	0.00%	0	0.00%	119	1.85%	1,267	19.65%
	HERKIMER	0	0.00%	6	0.02%	7,739	26.44%	4,960	16.95%
	JEFFERSON	0	0.00%	0	0.00%	9,164	16.99%	10,664	19.78%
	LEWIS	0	0.00%	0	0.00%	1,593	11.76%	2,734	20.19%
	LIVINGSTON	0	0.00%	0	0.00%	6,539	28.31%	2,046	8.86%
	MADISON	0	0.00%	0	0.00%	5,865	20.58%	3,251	11.41%
	MONROE	1	0.00%	22	0.01%	56,811	16.87%	51,249	15.22%
	MONTGOMERY	0	0.00%	2	0.01%	5,787	29.70%	4,001	20.54%
	NASSAU	0	0.00%	10	0.00%	76,073	16.60%	3,333	0.73%
	NIAGARA	0	0.00%	4	0.00%	18,760	20.70%	9,012	9.95%
	ONEIDA	0	0.00%	3	0.00%	19,840	21.57%	9,329	10.14%
	ONONDAGA	4	0.00%	14	0.01%	31,389	16.87%	20,365	10.94%
	ONTARIO	3	0.01%	4	0.01%	9,331	18.96%	4,741	9.63%
	ORANGE	0	0.00%	31	0.02%	18,906	14.70%	8,829	6.86%
	ORLEANS	0	0.00%	1	0.01%	5,184	29.97%	3,004	17.37%
	OSWEGO	1	0.00%	1	0.00%	10,539	18.49%	10,090	17.71%
	OTSEGO	0	0.00%	0	0.00%	5,190	18.17%	5,086	17.80%
	PUTNAM	2	0.01%	2	0.01%	4,035	10.52%	1,599	4.17%
	RENSSELAER	1	0.00%	13	0.02%	12,888	20.07%	10,846	16.89%
	ROCKLAND	0	0.00%	4	0.00%	8,653	7.40%	5,849	5.00%
	SARATOGA	0	0.00%	1	0.00%	9,421	9.77%	4,943	5.13%
	SCHENECTADY	0	0.00%	2	0.00%	16,731	28.28%	5,466	9.24%
	SCHOHARIE	1	0.01%	0	0.00%	2,126	16.14%	1,864	14.15%
	SCHUYLER	0	0.00%	0	0.00%	1,886	22.36%	1,435	17.01%
	SENECA	0	0.00%	0	0.00%	3,603	24.49%	2,373	16.13%
	ST LAWRENCE	0	0.00%	0	0.00%	8,677	16.82%	10,264	19.90%
	STEUBEN	0	0.00%	2	0.00%	11,673	27.29%	5,854	13.69%
	SUFFOLK	0	0.00%	3	0.00%	1,855	0.31%	2,689	0.45%
	SULLIVAN	0	0.00%	3	0.01%	3,597	8.93%	4,406	10.94%
	TIOGA	0	0.00%	0	0.00%	3,909	19.22%	2,336	11.49%
	TOMPKINS	0	0.00%	1	0.00%	5,800	14.93%	3,854	9.92%
	ULSTER	0	0.00%	5	0.01%	12,971	16.68%	8,413	10.82%
	WARREN	0	0.00%	1	0.00%	4,368	12.87%	2,834	8.35%
	WASHINGTON	0	0.00%	0	0.00%	5,575	21.33%	3,601	13.78%
	WAYNE	0	0.00%	0	0.00%	9,283	24.11%	4,481	11.64%
	WESTCHESTER	3	0.00%	84	0.03%	33,765	12.81%	6,324	2.40%
	WYOMING	0	0.00%	1	0.01%	4,697	27.56%	3,144	18.45%
	YATES	0	0.00%	0	0.00%	3,066	24.81%	1,448	11.72%
NYC	BRONX	19	0.02%	6,127	5.77%	45,443	42.78%	822	0.77%
	KINGS	60	0.02%	15,716	4.76%	215,317	65.27%	2,509	0.76%
	NEW YORK	1,499	2.61%	24,389	42.54%	6,094	10.63%	1,686	2.94%
	QUEENS	5	0.00%	2,817	0.61%	228,500	49.24%	517	0.11%
	RICHMOND	0	0.00%	87	0.06%	33,076	23.00%	154	0.11%

Tabular Data for Figures 3–10 (1940–1978 Multifamily Buildings)

	VINTAGE	1940-1978							
	BUILDING HEIGHT	Hi-Rise	Hi-Rise_%	Mid-Rise	Mid-Rise_%	Low-Rise	Low-Rise_%	NA	NA_%
NY Upstate	ALBANY	3	0.00%	46	0.04%	31,235	26.68%	10,075	8.61%
	ALLEGANY	0	0.00%	0	0.00%	3,422	13.90%	3,111	12.64%
	BROOME	0	0.00%	22	0.03%	24,093	33.45%	8,625	11.98%
	CATTARAUGUS	0	0.00%	0	0.00%	6,057	15.47%	4,028	10.29%
	CAYUGA	2	0.01%	2	0.01%	4,960	14.42%	2,862	8.32%
	CHAUTAUQUA	0	0.00%	4	0.01%	11,977	20.13%	6,411	10.77%
	CHEMUNG	1	0.00%	3	0.01%	11,636	29.95%	3,228	8.31%
	CHENANGO	0	0.00%	0	0.00%	2,963	13.81%	2,067	9.64%
	CLINTON	0	0.00%	3	0.01%	6,661	19.82%	3,232	9.62%
	COLUMBIA	0	0.00%	3	0.01%	5,420	18.01%	4,327	14.38%
	CORTLAND	1	0.01%	3	0.02%	3,419	17.59%	1,887	9.71%
	DELAWARE	0	0.00%	0	0.00%	3,042	10.67%	3,628	12.72%
	DUTCHESS	2	0.00%	6	0.01%	33,365	32.70%	8,427	8.26%
	ERIE	9	0.00%	14	0.00%	115,527	28.97%	42,579	10.68%
	ESSEX	0	0.00%	2	0.01%	2,599	12.37%	3,273	15.58%
	FRANKLIN	2	0.01%	1	0.01%	2,402	12.31%	1,709	8.76%
	FULTON	0	0.00%	1	0.00%	4,084	15.03%	4,285	15.77%
	GENESEE	0	0.00%	1	0.00%	5,026	22.79%	1,829	8.29%
	GREENE	0	0.00%	1	0.00%	4,007	15.18%	4,149	15.72%
	HAMILTON	0	0.00%	0	0.00%	231	3.58%	2,608	40.45%
	HERKIMER	0	0.00%	3	0.01%	3,922	13.40%	3,222	11.01%
	JEFFERSON	1	0.00%	9	0.02%	4,672	8.66%	5,523	10.24%
	LEWIS	0	0.00%	0	0.00%	958	7.07%	1,779	13.14%
	LIVINGSTON	0	0.00%	0	0.00%	4,446	19.25%	1,432	6.20%
	MADISON	1	0.00%	0	0.00%	5,757	20.20%	2,670	9.37%
	MONROE	16	0.00%	9	0.00%	88,262	26.22%	32,989	9.80%
	MONTGOMERY	0	0.00%	3	0.02%	2,980	15.30%	1,875	9.62%
	NASSAU	0	0.00%	14	0.00%	229,500	50.08%	7,291	1.59%
	NIAGARA	2	0.00%	3	0.00%	25,996	28.69%	9,484	10.47%
	ONEIDA	1	0.00%	12	0.01%	22,765	24.75%	11,380	12.37%
	ONONDAGA	5	0.00%	12	0.01%	56,278	30.24%	19,638	10.55%
	ONTARIO	1	0.00%	2	0.00%	8,350	16.97%	4,185	8.50%
	ORANGE	0	0.00%	14	0.01%	32,261	25.08%	10,894	8.47%
	ORLEANS	0	0.00%	0	0.00%	2,545	14.71%	1,649	9.53%
	OSWEGO	1	0.00%	3	0.01%	8,860	15.55%	6,482	11.37%
	OTSEGO	0	0.00%	1	0.00%	2,491	8.72%	2,275	7.96%
	PUTNAM	1	0.00%	0	0.00%	15,037	39.19%	3,540	9.23%
	RENSSELAER	0	0.00%	2	0.00%	12,663	19.72%	5,906	9.20%
	ROCKLAND	0	0.00%	27	0.02%	39,273	33.58%	26,843	22.95%
	SARATOGA	0	0.00%	3	0.00%	19,224	19.94%	6,533	6.78%
	SCHENECTADY	0	0.00%	5	0.01%	16,980	28.70%	7,109	12.01%
	SCHOHARIE	0	0.00%	0	0.00%	1,711	12.99%	1,331	10.11%
	SCHUYLER	0	0.00%	1	0.01%	1,412	16.74%	852	10.10%
	SENECA	0	0.00%	0	0.00%	2,906	19.75%	1,548	10.52%
	ST LAWRENCE	1	0.00%	4	0.01%	7,416	14.38%	6,936	13.45%
	STEUBEN	0	0.00%	2	0.00%	7,657	17.90%	3,423	8.00%
	SUFFOLK	0	0.00%	2	0.00%	16,185	2.69%	192,648	31.97%
	SULLIVAN	1	0.00%	1	0.00%	7,809	19.38%	7,116	17.66%
	TIOGA	0	0.00%	0	0.00%	5,411	26.61%	1,873	9.21%
	TOMPKINS	0	0.00%	4	0.01%	6,490	16.71%	2,429	6.25%
	ULSTER	1	0.00%	9	0.01%	18,737	24.09%	9,806	12.61%
	WARREN	2	0.01%	2	0.01%	6,401	18.86%	4,895	14.42%
	WASHINGTON	0	0.00%	0	0.00%	3,864	14.78%	2,237	8.56%
	WAYNE	0	0.00%	0	0.00%	7,786	20.22%	3,316	8.61%
	WESTCHESTER	18	0.01%	417	0.16%	46,732	17.73%	42,642	16.18%
	WYOMING	0	0.00%	0	0.00%	2,768	16.24%	1,628	9.55%
	YATES	0	0.00%	1	0.01%	1,954	15.81%	1,199	9.70%
NYC	BRONX	1,007	0.95%	1,265	1.19%	26,409	24.86%	2,146	2.02%
	KINGS	734	0.22%	2,368	0.72%	46,071	13.96%	3,152	0.96%
	NEW YORK	1,859	3.24%	1,232	2.15%	244	0.43%	1,716	2.99%
	QUEENS	345	0.07%	2,083	0.45%	160,699	34.63%	10,857	2.34%
	RICHMOND	58	0.04%	243	0.17%	48,424	33.68%	853	0.59%

Tabular Data for Figures 3–10 (1979–2006 Multifamily Buildings)

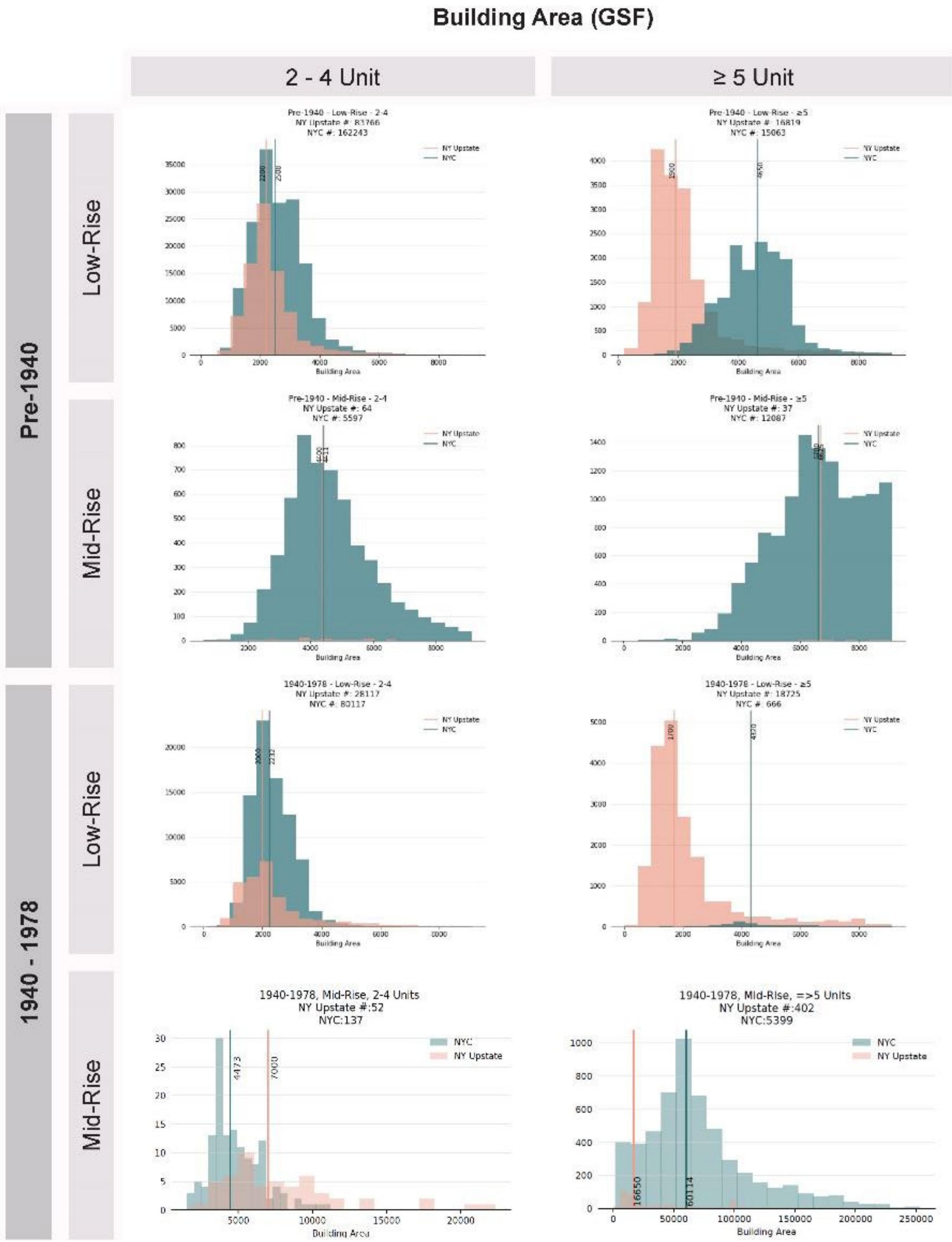
	VINTAGE	1979-2006							
	BUILDING HEIGHT	Hi-Rise	Hi-Rise_%	Mid-Rise	Mid-Rise_%	Low-Rise	Low-Rise_%	NA	NA_%
NY Upstate	ALBANY	2	0.00%	6	0.01%	18,976	16.21%	11,832	10.11%
	ALLEGANY	0	0.00%	0	0.00%	1,863	7.57%	6,025	24.47%
	BROOME	1	0.00%	5	0.01%	7,445	10.34%	5,197	7.22%
	CATTARAUGUS	0	0.00%	1	0.00%	3,522	9.00%	6,934	17.71%
	CAYUGA	0	0.00%	2	0.01%	3,867	11.25%	6,266	18.22%
	CHAUTAUQUA	0	0.00%	2	0.00%	4,419	7.43%	6,558	11.02%
	CHEMUNG	0	0.00%	2	0.01%	3,990	10.27%	3,578	9.21%
	CHENANGO	0	0.00%	0	0.00%	1,583	7.38%	5,006	23.34%
	CLINTON	0	0.00%	2	0.01%	5,729	17.05%	7,775	23.14%
	COLUMBIA	0	0.00%	1	0.00%	3,779	12.55%	5,599	18.60%
	CORTLAND	2	0.01%	0	0.00%	1,838	9.46%	3,626	18.66%
	DELAWARE	0	0.00%	0	0.00%	2,336	8.19%	7,902	27.71%
	DUTCHESS	0	0.00%	5	0.00%	23,600	23.13%	12,575	12.32%
	ERIE	3	0.00%	7	0.00%	46,181	11.58%	21,506	5.39%
	ESSEX	0	0.00%	0	0.00%	2,213	10.53%	4,286	20.40%
	FRANKLIN	0	0.00%	0	0.00%	2,379	12.19%	3,727	19.10%
	FULTON	0	0.00%	0	0.00%	2,134	7.85%	3,727	13.71%
	GENESEE	0	0.00%	1	0.00%	2,810	12.74%	1,993	9.04%
	GREENE	0	0.00%	0	0.00%	3,290	12.47%	6,322	23.95%
	HAMILTON	0	0.00%	0	0.00%	136	2.11%	1,604	24.88%
	HERKIMER	0	0.00%	0	0.00%	2,362	8.07%	5,535	18.91%
	JEFFERSON	0	0.00%	2	0.00%	4,954	9.19%	11,391	21.12%
	LEWIS	0	0.00%	0	0.00%	1,153	8.51%	3,362	24.83%
	LIVINGSTON	0	0.00%	0	0.00%	4,316	18.68%	3,065	13.27%
	MADISON	0	0.00%	0	0.00%	4,877	17.11%	4,252	14.92%
	MONROE	1	0.00%	2	0.00%	54,165	16.09%	32,767	9.73%
	MONTGOMERY	0	0.00%	1	0.01%	1,591	8.17%	2,355	12.09%
	NASSAU	0	0.00%	3	0.00%	22,555	4.92%	8,770	1.91%
	NIAGARA	2	0.00%	2	0.00%	11,771	12.99%	7,267	8.02%
	ONEIDA	2	0.00%	5	0.01%	8,559	9.31%	11,811	12.84%
	ONONDAGA	2	0.00%	7	0.00%	31,230	16.78%	15,090	8.11%
	ONTARIO	0	0.00%	4	0.01%	9,485	19.28%	8,705	17.69%
	ORANGE	1	0.00%	54	0.04%	30,927	24.04%	16,558	12.87%
	ORLEANS	0	0.00%	0	0.00%	1,933	11.17%	2,439	14.10%
	OSWEGO	0	0.00%	1	0.00%	8,009	14.05%	10,174	17.85%
	OTSEGO	0	0.00%	0	0.00%	2,404	8.42%	6,846	23.97%
	PUTNAM	1	0.00%	1	0.00%	8,574	22.35%	3,222	8.40%
	RENSSELAER	0	0.00%	0	0.00%	9,602	14.95%	7,858	12.24%
	ROCKLAND	0	0.00%	117	0.10%	16,919	14.47%	14,614	12.49%
	SARATOGA	0	0.00%	3	0.00%	27,741	28.77%	17,853	18.52%
	SCHENECTADY	0	0.00%	0	0.00%	6,306	10.66%	4,330	7.32%
	SCHOHARIE	0	0.00%	0	0.00%	1,527	11.59%	3,098	23.52%
	SCHUYLER	0	0.00%	0	0.00%	981	11.63%	1,299	15.40%
	SENECA	0	0.00%	0	0.00%	1,592	10.82%	1,751	11.90%
	ST LAWRENCE	0	0.00%	1	0.00%	4,552	8.83%	9,518	18.45%
	STEUBEN	0	0.00%	1	0.00%	4,403	10.29%	7,354	17.19%
	SUFFOLK	0	0.00%	6	0.00%	31,268	5.19%	210,785	34.98%
	SULLIVAN	0	0.00%	10	0.02%	5,997	14.88%	8,433	20.93%
	TIOGA	0	0.00%	2	0.01%	3,028	14.89%	2,550	12.54%
	TOMPKINS	1	0.00%	14	0.04%	5,168	13.30%	10,386	26.74%
	ULSTER	1	0.00%	1	0.00%	12,148	15.62%	11,164	14.36%
	WARREN	1	0.00%	1	0.00%	6,541	19.27%	6,262	18.45%
	WASHINGTON	0	0.00%	0	0.00%	3,548	13.58%	5,181	19.82%
	WAYNE	0	0.00%	0	0.00%	7,104	18.45%	4,725	12.27%
	WESTCHESTER	11	0.00%	89	0.03%	19,289	7.32%	46,227	17.54%
	WYOMING	0	0.00%	0	0.00%	2,282	13.39%	1,795	10.53%
	YATES	0	0.00%	0	0.00%	1,959	15.85%	1,878	15.20%
NYC	BRONX	65	0.06%	896	0.84%	12,244	11.53%	3,645	3.43%
	KINGS	94	0.03%	2,726	0.83%	21,730	6.59%	5,215	1.58%
	NEW YORK	829	1.45%	975	1.70%	261	0.46%	4,612	8.04%
	QUEENS	61	0.01%	1,363	0.29%	29,365	6.33%	11,829	2.55%
	RICHMOND	7	0.00%	191	0.13%	52,514	36.52%	3,028	2.11%

Tabular Data for Figures 3–10 (2007–Present Multifamily Buildings)

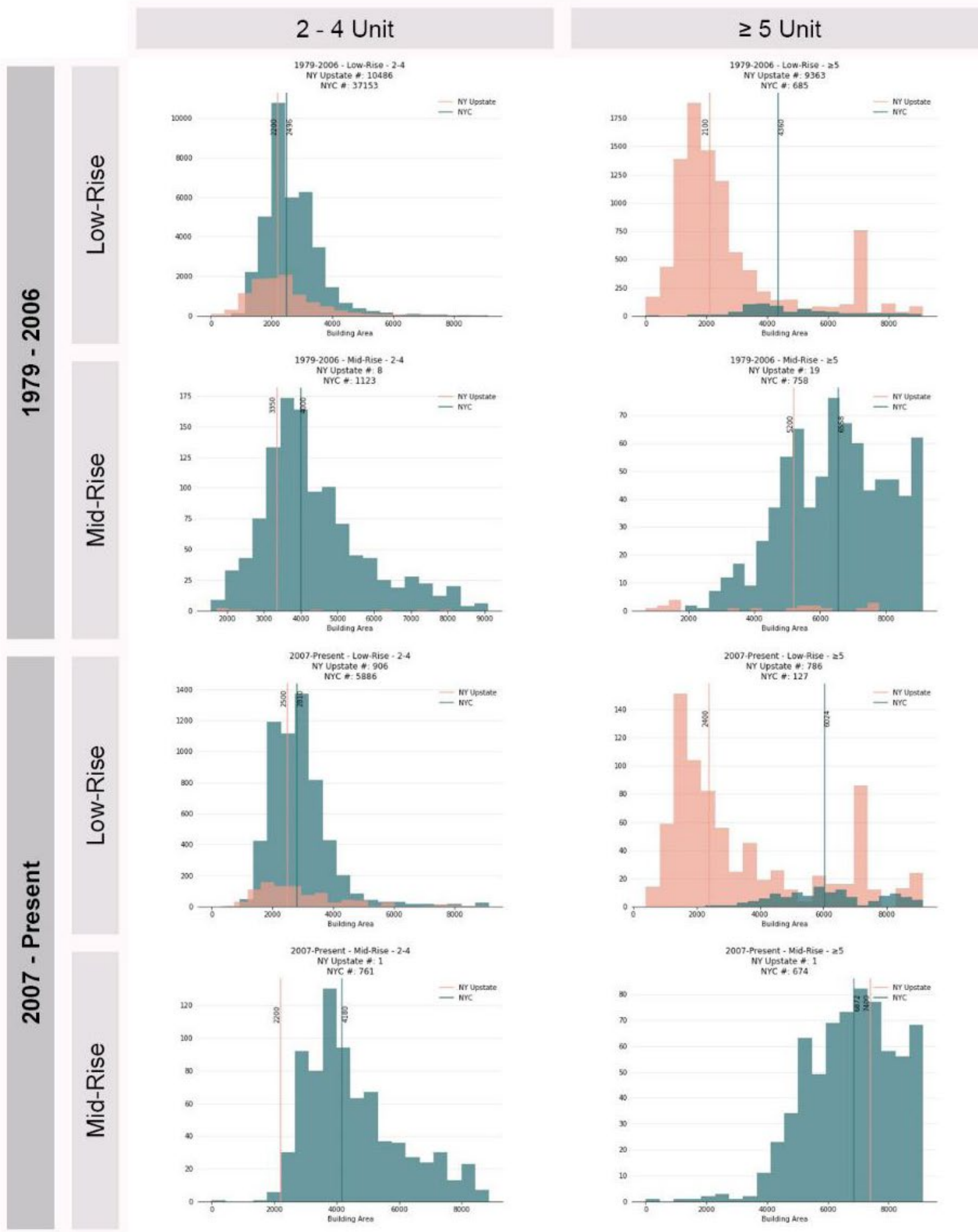
	VINTAGE	2007-Present							
	BUILDING HEIGHT	Hi-Rise	Hi-Rise_%	Mid-Rise	Mid-Rise_%	Low-Rise	Low-Rise_%	NA	NA_%
NY Upstate	ALBANY	0	0.00%	22	0.02%	1,946	1.66%	3,271	2.79%
	ALLEGANY	0	0.00%	0	0.00%	227	0.92%	1,174	4.77%
	BROOME	0	0.00%	0	0.00%	407	0.57%	806	1.12%
	CATTARAUGUS	0	0.00%	0	0.00%	324	0.83%	1,639	4.19%
	CAYUGA	0	0.00%	0	0.00%	389	1.13%	977	2.84%
	CHAUTAUQUA	0	0.00%	1	0.00%	536	0.90%	1,319	2.22%
	CHEMUNG	0	0.00%	0	0.00%	366	0.94%	984	2.53%
	CHENANGO	0	0.00%	0	0.00%	158	0.74%	952	4.44%
	CLINTON	0	0.00%	0	0.00%	616	1.83%	1,121	3.34%
	COLUMBIA	0	0.00%	0	0.00%	298	0.99%	1,205	4.00%
	CORTLAND	0	0.00%	1	0.01%	200	1.03%	780	4.01%
	DELAWARE	0	0.00%	0	0.00%	158	0.55%	1,772	6.21%
	DUTCHESS	0	0.00%	0	0.00%	2,310	2.26%	2,659	2.61%
	ERIE	0	0.00%	1	0.00%	6,488	1.63%	4,743	1.19%
	ESSEX	0	0.00%	0	0.00%	259	1.23%	1,119	5.33%
	FRANKLIN	0	0.00%	0	0.00%	245	1.26%	1,197	6.14%
	FULTON	0	0.00%	0	0.00%	238	0.88%	719	2.65%
	GENESEE	0	0.00%	0	0.00%	231	1.05%	250	1.13%
	GREENE	0	0.00%	0	0.00%	336	1.27%	1,163	4.41%
	HAMILTON	0	0.00%	0	0.00%	12	0.19%	371	5.75%
	HERKIMER	0	0.00%	0	0.00%	240	0.82%	966	3.30%
	JEFFERSON	0	0.00%	0	0.00%	1,180	2.19%	5,024	9.32%
	LEWIS	0	0.00%	0	0.00%	194	1.43%	1,294	9.56%
	LIVINGSTON	0	0.00%	0	0.00%	370	1.60%	524	2.27%
	MADISON	0	0.00%	0	0.00%	572	2.01%	913	3.20%
	MONROE	0	0.00%	1	0.00%	6,294	1.87%	4,841	1.44%
	MONTGOMERY	0	0.00%	0	0.00%	209	1.07%	387	1.99%
	NASSAU	0	0.00%	2	0.00%	3,881	0.85%	2,122	0.46%
	NIAGARA	0	0.00%	0	0.00%	2,395	2.64%	1,194	1.32%
	ONEIDA	0	0.00%	0	0.00%	916	1.00%	1,907	2.07%
	ONONDAGA	0	0.00%	1	0.00%	6,342	3.41%	1,917	1.03%
	ONTARIO	0	0.00%	0	0.00%	1,818	3.69%	2,122	4.31%
	ORANGE	1	0.00%	0	0.00%	3,331	2.59%	3,498	2.72%
	ORLEANS	0	0.00%	0	0.00%	131	0.76%	257	1.49%
	OSWEGO	0	0.00%	0	0.00%	701	1.23%	1,566	2.75%
	OTSEGO	0	0.00%	0	0.00%	296	1.04%	1,209	4.23%
	PUTNAM	0	0.00%	0	0.00%	493	1.28%	588	1.53%
	RENSSELAER	0	0.00%	0	0.00%	1,126	1.75%	1,701	2.65%
	ROCKLAND	0	0.00%	1	0.00%	1,571	1.34%	2,093	1.79%
	SARATOGA	0	0.00%	1	0.00%	3,605	3.74%	5,464	5.67%
	SCHENECTADY	0	0.00%	0	0.00%	744	1.26%	737	1.25%
	SCHOHARIE	0	0.00%	0	0.00%	163	1.24%	836	6.35%
	SCHUYLER	0	0.00%	11	0.13%	166	1.97%	314	3.72%
	SENECA	0	0.00%	0	0.00%	155	1.05%	386	2.62%
	ST LAWRENCE	0	0.00%	0	0.00%	616	1.19%	2,537	4.92%
	STEUBEN	0	0.00%	0	0.00%	453	1.06%	1,351	3.16%
	SUFFOLK	0	0.00%	0	0.00%	1,147	0.19%	12,889	2.14%
	SULLIVAN	0	0.00%	1	0.00%	535	1.33%	2,032	5.04%
	TIOGA	0	0.00%	0	0.00%	265	1.30%	494	2.43%
	TOMPKINS	0	0.00%	0	0.00%	745	1.92%	2,628	6.77%
	ULSTER	0	0.00%	0	0.00%	1,092	1.40%	2,235	2.87%
	WARREN	0	0.00%	0	0.00%	640	1.89%	1,440	4.24%
	WASHINGTON	0	0.00%	0	0.00%	389	1.49%	941	3.60%
	WAYNE	0	0.00%	0	0.00%	619	1.61%	695	1.81%
	WESTCHESTER	0	0.00%	13	0.00%	1,347	0.51%	2,763	1.05%
	WYOMING	0	0.00%	0	0.00%	197	1.16%	335	1.97%
	YATES	0	0.00%	0	0.00%	263	2.13%	406	3.29%
NYC	BRONX	50	0.05%	423	0.40%	1,807	1.70%	748	0.70%
	KINGS	113	0.03%	1,841	0.56%	2,814	0.85%	1,186	0.36%
	NEW YORK	279	0.49%	354	0.62%	21	0.04%	3,322	5.79%
	QUEENS	71	0.02%	1,070	0.23%	5,371	1.16%	2,144	0.46%
	RICHMOND	2	0.00%	21	0.01%	3,297	2.29%	611	0.42%

Appendix B: Data Distribution of Average Building Statistics

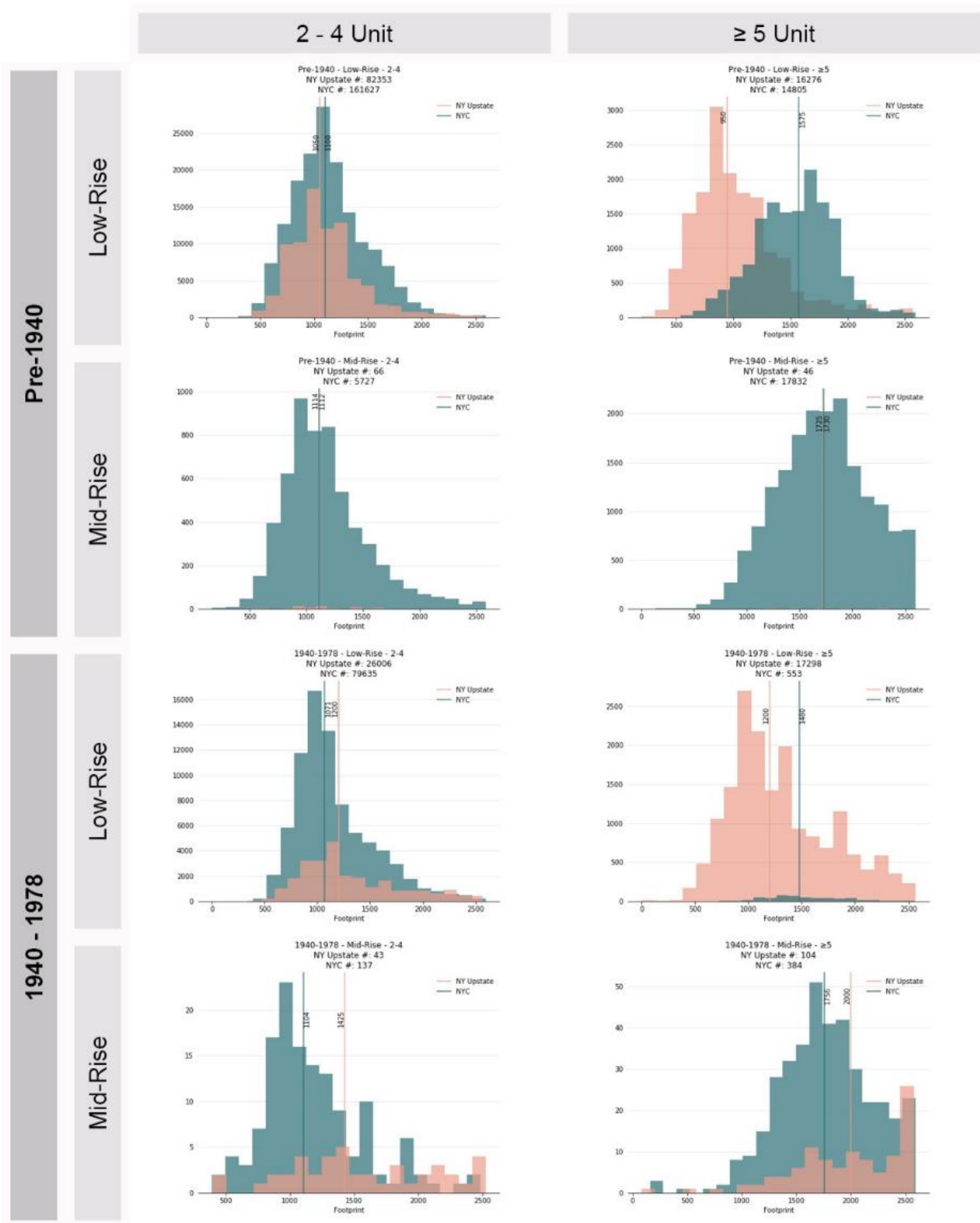
Histograms illustrating data distribution for average building statistics in Tables 13 and 14



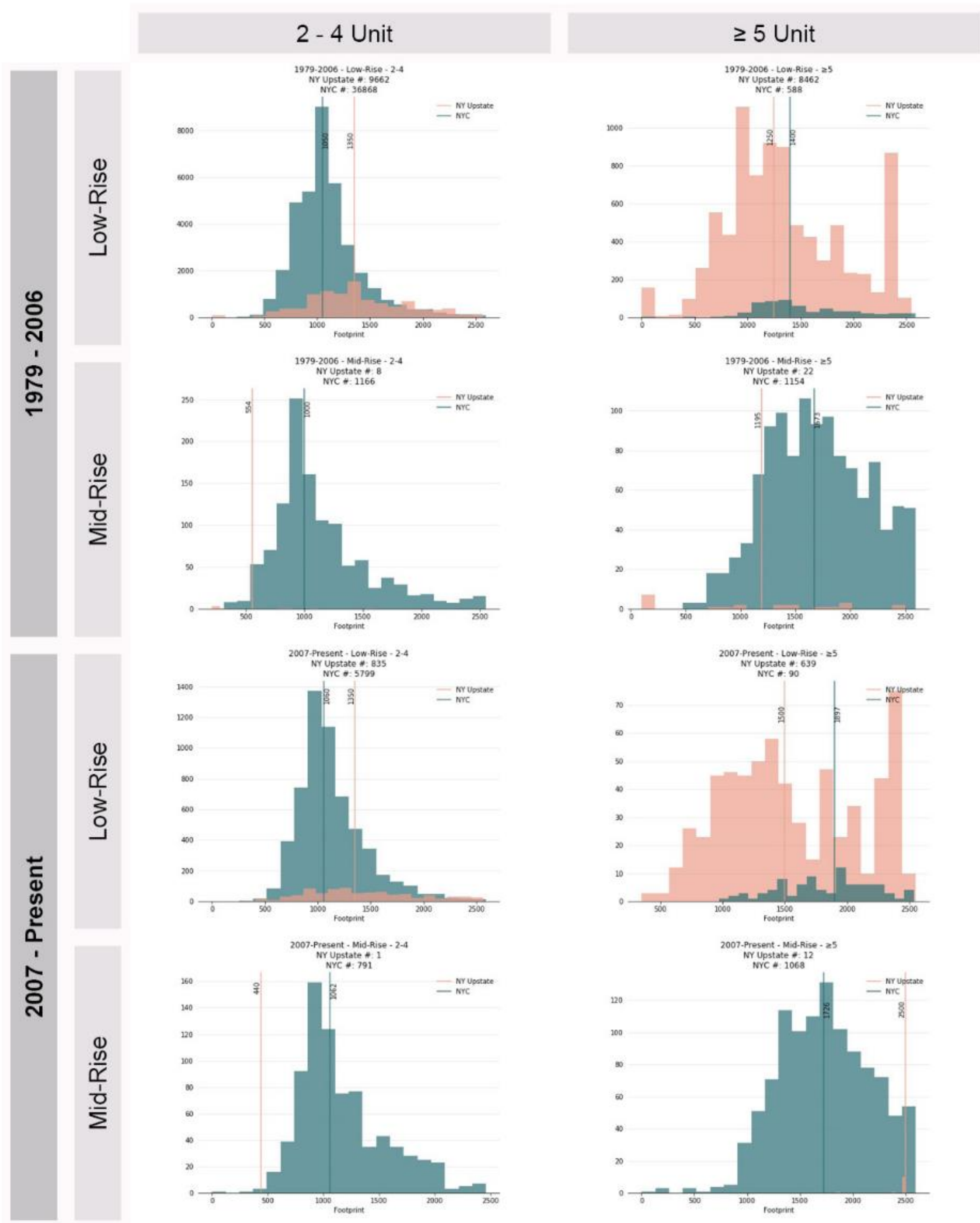
Building Area (GSF)



Building Footprint (SF)



Building Footprint (SF)

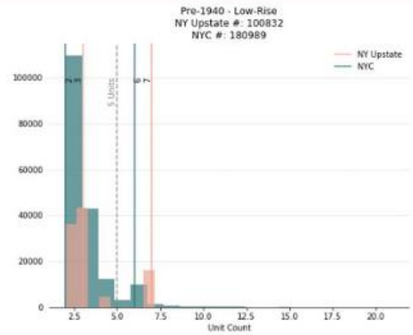


Unit Counts

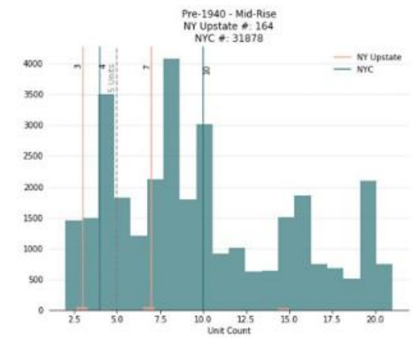
2 - 4 and ≥ 5 Units

Pre-1940

Low-Rise

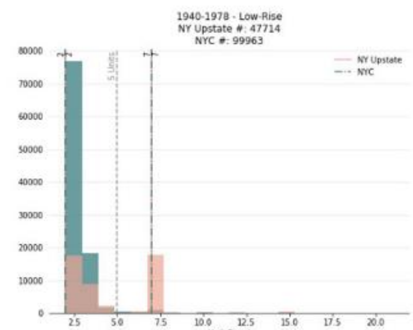


Mid-Rise

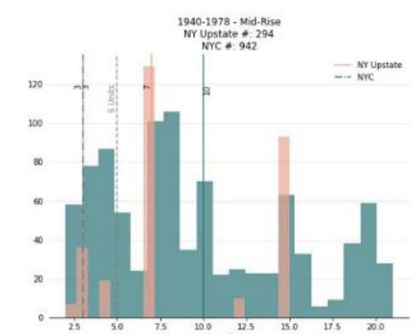


1940 - 1978

Low-Rise



Mid-Rise

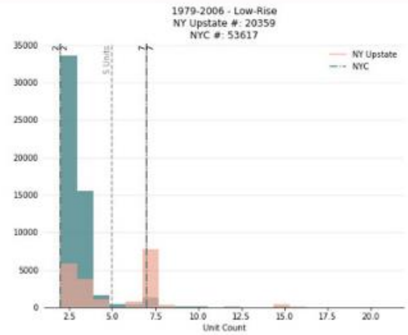


Unit Counts

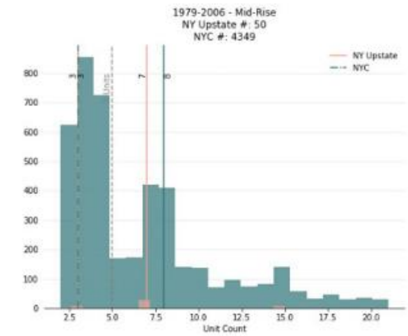
2 - 4 and ≥ 5 Units

1979 - 2006

Low-Rise

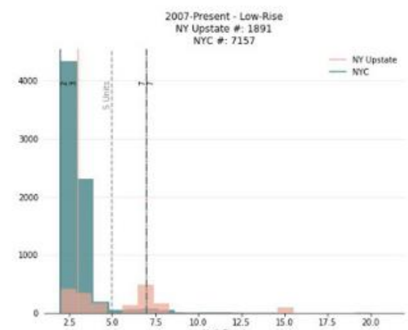


Mid-Rise

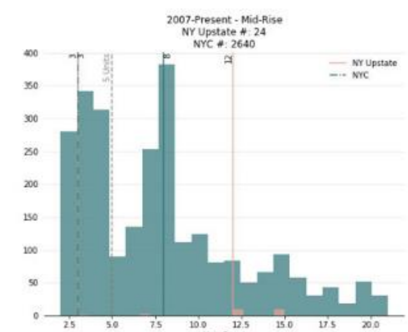


2007 - Present

Low-Rise



Mid-Rise



Appendix C: Random Samples of Three NYS Counties

NYC County Random Sampling of 50 Records from ICF Data

	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check* Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #1	131 W 130th St	1910	1		5	1	Stone	Stone		Wood Frame		2%	
Record #2	1 Audubon Ave	1910	1		55	1	Brick	Brick		Wood Frame		7%	
Record #3	108 Park Ter E	1925	1		34	1	Brick	Brick		Wood Frame		6%	
Record #4	99 Madison St	1900	1		8	1	Brick	Brick		Wood Frame		3%	
Record #5	113 E 31st St	1920	1		19	1	Brick	Brick		Wood Frame		2%	
Record #6	112 W 144th St	1910	1		47	1	Brick	Brick		Mass Masonry		5%	
Record #7	200 W 55th St	1909	1		14	1	Brick	Brick		Mass Masonry		2%	
Record #8	208 W 133rd St	1910	1		15	1	Brick	Brick	Asphalt	Mass Masonry		2%	
Record #9	25 Hillside Ave	1920	1		287	1	Brick	Brick	Asphalt	Mass Masonry		6%	
Record #10	301 W 152nd St	1920	1		22	1	Brick	Brick	Asphalt	Mass Masonry		6%	
Record #11	309 W 103rd St	1921	1		4	1	Brownstone	Brownstone		Wood Frame		2%	
Record #12	511 W 173 ST	1896	1		4	1	Brick	Brick		Wood Frame		3%	
Record #13	13 Bleecker St	1910	1		1	1	Brick	Brick		Mass Masonry		3%	

NYC County Random Sampling of 50 Records from ICF Data															
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*						
									Roof Material	Structure	Window Frame Type	WW R (Est.)			
Record #14	478 9th Ave	1930	1		3	1	Brick	Brick		Mass Masonry		2%			
Record #15	77 W 118th St	1909	1		7	1	Brownstone	Brownstone		Mass Masonry		1%			
Record #16	212 W 20th St	1938	1		17	1	Brick	Brick		Mass Masonry	Metal	6%			
Record #17	136 W 13th St	1880	1		12	1	Brick	Brick		Mass Masonry		2%			
Record #18	155 W 71st St	1940	1		55	1	Brick	Brick		Mass Masonry		8%			
Record #19	14 W 9th St	1940	1		12	1	Stone	tone/ Stucco		Mass Masonry		2%			
Record #20	28 E 29th St	1970	1		7	1	Brick	Brick		Mass Masonry		3%			
Record #21	414 W 22nd St	1960	1		10	1	Brick	Brick		Mass Masonry		4%			
Record #22	646 Tenth Ave	1960	1		18	1	Brick	Brick		Mass Masonry		11%			

Onondaga County Random Sampling of 50 Records from ICF Data														
									This information all provided through Visual Check				
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #1	102 Lydell St	1900	1	N/A	N/A		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	6%	
Record #2	519 Richmond Ave	1910	1	N/A	N/A		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	6%	
Record #3	108 Coleridge Ave	1920	1	7405.2	4		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	8%	
Record #4	1215 Milton Ave	1900	1	4791.6	10		Siding Wood	Siding Wood + Stone	Asphalt	Wood Frame	Wood	7%	
Record #5	1114 E Genesee St	1890	1	14702	10		Brick	Stucco	Stone	Mass Masonry	Stone	8%	
Record #6	300 S Salina	1855	1	25378	67	ess units	Brick	Brick	Stone	Mass Masonry	Stone	5%	
Record #7	203 E Water St	1890	1	1742.4	9		Brick	Brick	Stone	Mass Masonry	Stone	11%	
Record #8	205 N Townsend St	1900	1	3001.3	26		Brick	Brick	Stone	Mass Masonry	Stone	8%	
Record #9	210 W Division St	1920	1	79392	87		Brick	Brick	Stone	Mass Masonry	Metal	26%	
Record #10	303 S Alvord St	1900	1	3049.2	3		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	15%	
Record #11	215 Ash St	1930	1	3049.2	9	ess units	Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	9%	
Record #12	109 Brookford Rd	1935	1	17851	10		Siding Wood	Siding Wood and Brick	Asphalt	Wood Frame	Stone	17%	
Record #13	1225 Butternut St	1920	1	7405.2	5		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	11%	
Record #14	10 Fennell St	1840	1	5662.8	5	ess units	Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	11%	

Onondaga County Random Sampling of 50 Records from ICF Data													
									This information all provided through Visual Check				
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #15	320 Burnet Ave	1823	1	3920.4	4		Brick	Brick	Stone	Mass Masonry	Wood	11%	
Record #16	477 James St	1890	1	8712	38		Brick	Brick	Stone	Mass Masonry	Wodd	8%	
Record #17	318 E Division St	1910	1	3484.8	5	ess units	Brick	Brick	Stone	Mass Masonry	Stone	5%	
Record #18	2111 E Genesee St	1900	1	12898	6		Brick	Brick	Asphalt	Mass Masonry	Stione	13%	
Record #19	338 Green St	1910	1	8276.4	8	ess units	Brick	Brick	Asphalt	Mass Masonry	Wood	12%	
Record #20	1119 W Onondaga St	1940	1	N/A	7		Brick	Brick	Asphalt	Mass Masonry	Wood	9%	
Record #21	1505 E Genesee St	1948	1	13721	35		Brick	Brick	Stone	Mass Masonry	Stone	12%	
Record #22	1119 N Townsend St	1950	1	41269	58		Brick	Brick	Asphalt	Mass Masonry	Stone	6%	
Record #23	1000 Bellevue Ave	1940	1	7326.8	18		Brick	Brick	Stone	Mass Masonry	Stone	19%	
Record #24	301 Columbus Ave	1945	1	13878	107		Brick	Brick	Stone	Mass Masonry	Stone	14%	
Record #26	1323 N State St	1940	1	3560	4		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	4%	
Record #27	150 Kasson Rd	1970	3	3484.8	12		Siding Wood	Siding Wood and Brick	Asphalt	Wood Frame	Wood	27%	
Record #28	142 Ballantyne Rd	1966	3	45738	11		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	22%	
Record #29	2413 Glover Rd	1940	1	21170	4		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	14%	
Record #30	814 W Belden Ave	1970	1	18901	9	ess units	Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	8%	

Onondaga County Random Sampling of 50 Records from ICF Data

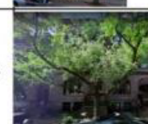
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check* Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #31	2813 Burnet Ave	1965	1	6534	23		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	11%	
Record #33	5548 Bear Rd	1968	20	19511	168		Brick	Brick & shingles	Stone	Mass Masonry	Wood	10%	
Record #34	34 Candlewood Gdns	1969	8	426017	126		Brick & shingles	Brick & shingles	Asphalt	Mass Masonry	Wood	17%	
Record #35	5607 Bear Rd	1970	20	412513	180		Brick	Brick & shingles	Asphalt	Mass Masonry	Wood	10%	
Record #36	7300 Cedar Post Rd	1974	15	181645	382		Brick	Brick	Asphalt	Mass Masonry	Stone	12%	
Record #37	244 Croly St	1970	1	1E+06	16		Brick	Brick & shingles	Asphalt	Mass Masonry	Wood	9%	
Record #38	110 Comstock Ave	1993	1	188806	12		Brick	Brick	Asphalt	Mass Masonry	Stone	13%	
Record #39	501 S Crouse Ave	1980	1	74052	176		Brick	Brick	Stone	Mass Masonry	Stone	9%	
Record #40	460 N Franklin St	1990	1	17860	141		Brick	Brick	Stone	Mass Masonry	Stone	13%	
Record #41	220 Herald Pl	2000	1	49898	27		Brick	Brick	Stone	Mass Masonry	Stione	12%	
Record #42	3052 Amesbury Dr	1984	1	52978	8	ess units	Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	17%	
Record #43	4671 Brickyard Falls Rd	1996	1	175111	20		Siding Wood	Siding Wood and Brick	Asphalt	Wood Frame	Wood	9%	
Record #44	8365 Factory St	1990	1	196020	39		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	12%	
Record #45	79 Fennell St	1987	1	81893	34		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	13%	
Record #46	2410 W Genesee St	1989	1	40075	28		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	25%	

Onondaga County Random Sampling of 50 Records from ICF Data

	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*				
									Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #47	634 Gifford St	1985	2	139392	15		Brick	Brick & shingles	Asphalt	Mass Masonry	Wood	29%	
Record #48	100 La Madre Way	1993	1	211702	50		Brick	Brick & shingles	Asphalt	Mass Masonry	Wood	7%	
Record #49	4122 Pine Hollow Dr	2002	1	74052	34		Brick	Wood Siding	Asphalt	Wood Frame	Wood	10%	
Record #50	107 Trolley Barn Ln	1980	1	76666	39		Brick	Brick	Asphalt	Mass Masonry	Stone	15%	
Record #51	689 N Clinton St	1980	1	N/A	120		Brick	Brick	Stone	Mass Masonry	Stone	7%	
Record #52	208 W Water St	2016	1	44431	41		Siding Wood	Brick	Stone	Mass Masonry	Stone	6%	
Record #53	324 W Water St	2014	1	17576	75		Brick	Brick	Stone	Mass Masonry	Metal	6%	
Record #54	220 S Warren St	2013	1	1E+06	66		Brick	Brick	Stone	Mass Masonry	Metal	11%	
Record #55	6715 Buckley Rd	2011	1	134557	131		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	9%	
Record #56	2223 E Genesee St	2014	1	176457	50		Siding Wood	Siding Wood and Brick	Stone	Wood Frame	Wood	16%	
Record #57	6100 Deep Glade Dr	2007	3	190357	36		Siding Wood	Siding Wood and Brick	Asphalt	Wood Frame	Wood	12%	
Record #58	7272 Henry Clay Blvd	2009	1		32		Siding Wood	Siding Wood	Asphalt	Wood Frame	Wood	15%	
Record #59	721 N Clinton St	2014	1	78844	75		Brick	Brick	Stone	Mass Masonry	Stone	20%	
Record #60	4320 S Salina St	2007	8	N/A	90		Brick	Brick	Asphalt	Mass Masonry	Stone	12%	

Albany County Random Sampling of 50 Records from ICF Data														
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*					
									Roof Material	Structure		Window Frame Type	WWR (Est.)	
Record #1	306 State St, Albany	1859	1	7300	8		Wood Siding	Brick	Built-Up	Masonry		Wood	10%	
Record #2	310 State St, Albany	1876	1	-	5		Wood Siding	Brick	Built-Up	Masonry		Wood	10%	
Record #3	5 Madison Pl, Albany	1848	-	-	5		Wood Siding	Brick	Built-Up	Masonry		Wood	7%	
Record #4	429 Clinton Ave, Albany	1920	-	3600	4		Aluminum	Brick	Built-Up	Masonry		Wood	5%	
Record #5	328 Hudson Ave, Albany	1877	-	4000	5		Brick		Built-Up	Masonry		Wood	5%	
Record #6	572 Madison Ave, Albany	1873	1	3200	6		Brick		Built-Up	Masonry		Wood	5%	
Record #7	523 Clinton Ave, Albany	1870	1	4200	18		Brick		Built-Up	Masonry		Wood	13%	
Record #8	357 Morris St, Albany	1900	1	-	31		Brick		Built-Up	Masonry		Wood	27%	
Record #9	342 State St, Albany	1886	1	-	5		Brick		Built-Up	Masonry		Wood	8%	
Record #10	11 S Lake Ave, Albany	1929	3	99900	96		Brick		Built-Up	Masonry		Wood	28%	

Albany County Random Sampling of 50 Records from ICF Data														
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*					
									Roof Material	Structure		Window Frame Type	WWR (Est.)	
Record #11	8 Madison Pl, Albany	1848	1	7300	6		Wood Siding	Brick	Built-Up	Wood Frame		Wood	3%	
Record #12	239 N Pearl St, Albany	1848	1	2600	3		Brick		Built-Up	Wood Frame		Wood	5	
Record #13	487 Hamilton St, Albany	1890	1	2100	7	Less Units	Aluminum	Vood Siding	Built-Up	Wood Frame		Wood	5%	
Record #14	478 Washington Ave, Albany	1895	1	3900	5		Wood Siding		Asphalt	Wood Frame		Wood	7%	
Record #15	2 Central Ave, Cohoes	1900	3	2400	5		Aluminum	Vood Siding	Built-Up	Wood Frame		Wood	17%	
Record #16	115 S Lake Ave, Albany	1900	1	4000	5		Wood Siding	Vood Siding	Asphalt	Wood Frame		Wood	15%	
Record #17	192 N Pearl St, Albany	1900	1	7800	4		Wood Siding	Brick	Built-Up	Wood Frame		Wood	10%	
Record #18	549 Mercer St, Albany	1900	1	3000	4		Aluminum	Vood Siding	Asphalt	Wood Frame		Wood	13%	
Record #19	469 Ontario St, Albany	1920	1	2800	6	Less Units	Wood Siding		Asphalt	Wood Frame		Wood	16%	
Record #20	70 Dana Ave, Albany	1926	1	2600	3		Wood Siding		Built-Up	Wood Frame		Wood	6%	

Albany County Random Sampling of 50 Records from ICF Data														
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*					
									Roof Material	Structure		Window Frame Type	WWR (Est.)	
Record #21	502 Clinton Ave, Albany	1870	1	3400	5		Brick		Built-Up	Masonry		Wood	5%	
Record #22	367 Madison Ave, Albany	1880	1	4400	5		Brick		Built-Up	Masonry		Wood	5%	
Record #23	146 Clinton St, Albany	1890	1	1840	3		Brick		Built-Up	Masonry		Wood	7%	
Record #24	137 Madison Ave, Albany	1894	1	4000	9		Wood Siding	Brick	Built-Up	Masonry		Wood	3%	
Record #26	126 Lancaster St, Albany	1895	1	4000	4		Stone		Built-Up	Masonry		Wood	3%	
Record #27	56 2nd Ave, Albany	1900	1	7400	7		Brick		Built-Up	Masonry		Wood	7%	
Record #28	137 Clinton St, Albany	1900	1	2100	6		Brick		Built-Up	Masonry		Wood	7%	
Record #29	447 Washington Ave, Albany	1900	2	2300	2		Aluminum	Wood Siding	Built-Up	Wood Frame		Wood	7%	
Record #30	137 Knox St, Albany	1910	1	3300	47	Less Units	Brick		Metal	Masonry		Wood	10%	
Record #31	400 Delaware Ave, Albany	1926	2	14500	47		Brick		Built-Up	Masonry		Wood	18%	

Albany County Random Sampling of 50 Records from ICF Data														
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*				
									Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #33	68 Morris St, Albany	1940	1	8200	9		Brick		Built-Up	Masonry	Wood	4%	
Record #34	6 S Lake Ave, Albany	1940	1	2200	66		Brick		Built-Up	Masonry	Wood	20%	
Record #35	24 Hart St, Cohoes	1950	-	7300	4		Brick		Built-Up	Masonry	Wood	16%	
Record #36	71 Canvass St, Cohoes	1958	1	23500	22		Brick		Built-Up	Masonry	Wood	12%	
Record #37	186 Green St, Albany	1965	4	7900	437	Less Units	Brick		Asphalt	Masonry	Wood	20%	
Record #38	500 16th St, Watervliet	1967	1	4900	69		Brick		Built-Up	Masonry	Wood	20%	
Record #39	420 Sand Creek Rd, Albany	1970	3	900	600		Aluminum	Brick	Built-Up	Masonry	Wood	11%	
Record #40	19 Remsen St, Cohoes	1972	1	-	64		Brick		Built-Up	Masonry	Wood	18%	
Record #41	12 California Ave, Albany	1974	1	99900	131		Brick		Built-Up	Masonry	Wood	25%	
Record #42	2 Thurlow Ter, Albany	1975	1	-	135		Brick		Built-Up	Masonry	Wood	18%	

Albany County Random Sampling of 50 Records from ICF Data

	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*				
									Roof Material	Structure	Window Frame Type	WWR (Est.)	
Record #43	133 Dana Ave, Albany	1940	1	-	6		Wood Siding		Built-Up	Wood Frame	Wood	25%	
Record #44	1688 Western Ave, Albany	1950	1	5100	6		Wood Siding		Built-Up	Wood Frame	Wood	11%	
Record #45	3 Garner St, Cohoes	1953	1	-	4		Wood Siding		Built-Up	Wood Frame	Wood	14%	
Record #46	45 Lancaster St, Cohoes	1958	1	5500	9	Less Units	Wood Siding		Built-Up	Wood Frame	Wood	4%	
Record #47	40 Main St, Ravena	1958	1	4700	4		Wood Siding		Asphalt	Wood Frame	Wood	15%	
Record #48	236 Saratoga St, Cohoes	1958	1	5000	8		Wood Siding		Asphalt	Wood Frame	Wood	20%	
Record #49	32 S Main St, Voorheesville	1960	1	-	7		Wood Siding		Built-Up	Wood Frame	Wood	18%	
Record #50	39 Jeanette St, Albany	1940	2	10800	14		Brick		Built-Up	Masonry	Wood	10%	
Record #51	81 Robin St, Albany	1944	1	3600	6		Brick		Built-Up	Masonry	Wood	6%	
Record #52	93 Lexington Ave, Albany	1950	1	5500	5		Brick		Built-Up	Masonry	Wood	6%	

Albany County Random Sampling of 50 Records from ICF Data

	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*					
									Roof Material	Structure		Window Frame Type	WWR (Est.)	
Record #53	207 S Allen St, Albany	1950	1	20300	15		Brick		Asphalt	Masonry		Wood	14%	
Record #54	100 Morris St, Albany	1955	1	11500	16		Brick		Built-Up	Masonry		Wood	10%	
Record #55	202 Ontario St, Cohoes	1958	1	2300	16		Aluminum	Brick	Built-Up	Masonry		Wood	9%	
Record #56	264 S Allen St, Albany	1960	2	8600	11		Brick		Built-Up	Masonry		Wood	20%	
Record #57	305 New Scotland Ave, Albany	1960	1	35400	33		Brick		Built-Up	Masonry		Wood	15%	
Record #58	1135 Western Ave, Albany	1965	1	7400	8		Brick		Asphalt	Masonry		Wood	11%	
Record #59	712 N Pearl St, Menands	1978	1	21400	10		Brick		Built-Up	Masonry		Wood	10%	
Record #60	50 Prescott St, Albany	1982	1	1300	101		Aluminum	Brick	Built-Up	Masonry		Wood	12	
Record #61	1700 Western Ave, Albany	1988	1	70300	96		Brick		Built-Up	Masonry		Wood	27%	
Record #62	426 Whitehall Rd, Albany	1984	1	-	90		Brick		Built-Up	Masonry		Wood	18%	

Albany County Random Sampling of 50 Records from ICF Data														
	Address	Date of Construction	No. of Buildings	SF	No. of Units	Visual Check	Exterior Cladding Material	Visual Check	*This information all provided through Visual Check*					
									Roof Material	Structure		Window Frame Type	WWR (Est.)	
Record #63	1545 Broadway, Watervliet	1979	1	99900	136		Brick		Built-Up	Masonry		Wood	15%	
Record #64	2006 Central Ave, Albany	1988	1	40200	38		Wood Siding		Asphalt	Wood Frame		Wood	25%	
Record #65	360 Whitehall Rd, Albany	1997	1	77400	72		Wood Siding		Asphalt	Wood Frame		Wood	20%	

Reference Notes for Appendix C: Random Samples of Three NYS Counties

Source Title	Author	Content and Location	Vintage
R-values of Insulation and Other Building Materials	Arch Tool Box	chart	
R-Value and Densities Chart	Project Lead The Way	chart	
Dettails for Conventional Wood Frame Construction	American Forest & Paper Association	pg 21	pre 1940
Structural Systems Wood Platform Framing	Dustin Winter & Eric Okerstrom	pg 7	pre 1940
BSI-033: Evolution	Joseph Lstiburek	Platform Frame Diagram	1940-1978
Modern Homes: Their Design and Construction	American Builder Publishing Corp	pg 231 Gypsum Construction	pre 1940
Small Homes Data book: 1940 Edition	National Home Builders Bureau, Inc.	pg 124 & 218/374	1940-1978
The Book of Modern Homes	Sears, Roebuck and Co	pg 46-48/58	1940-1978

Endnotes

1 The data set used in this study identifies multifamily buildings having one or more units. NYSERDA defines multifamily buildings (i.e., buildings eligible for multifamily program funding) as having five or more units. See 1.3.1.5 for a discussion of the classification of buildings with a single unit as multifamily housing.

2 NYSERDA defines affordable housing as housing in which at least 25% of building households earn less than or equal to 80% of Area Median Income.

3 ICF International, "New York Residential Building Stock and Energy Cost Analysis," 22 December 2017, page 8-16.

4 ICF (2017), page 10.

5 ICF (2017), page 16.

6 This information comes from the data files associated with the ICF report. In the 'Building Count' tab of the file 'Field Descriptions_MASTER_v3 2017-01-05.xls,' there is a note questioning whether to duplicate rows with more than one building per lot.

7 "Street View," Google Maps (www.googlemaps.com: accessed 1 June 2020). "Buildings Information System," NYC Department of Buildings (a810-bisweb.nyc.gov/bisweb/bsqpm01.jsp, accessed June 1, 2020).

8 NYC Department of City Planning, "PLUTO and MapPLUTO," www1.nyc.gov/site/planning/data-maps/open-data/dwn-pluto-mappluto.page. Accessed March 11, 2020.

9 New York City contains 59 community boards, each of which represents a Community District. NYC Department of City Planning, "Community District Profiles," communityprofiles.planning.nyc.gov/. Accessed March 11, 2020.

10 Building Energy Exchange, "Retrofitting Affordability," November 2016, be-exchange.org/report/retrofitting-affordability/. Accessed March 11, 2020.

11 Elevate Energy, "Segmenting Chicago Multifamily Housing to Improve Energy Efficiency Programs," January 2017, www.elevateenergy.org/document/segmenting-chicago-multifamily-housing-improve-energy-efficiency-programs/. Accessed March 11, 2020. See also: Elevate Energy, "Making Sense of Your Multifamily Building Stock: A Framework for Cities and Municipalities," January 2017, www.elevateenergy.org/document/multifamily-segmentation-framework/. Accessed March 11, 2020.

12 Pratt Center, "Energyfit NYC Final Report," July 17, 2018, www.prattcenter.net/research/energyfit-nyc-final-report. Accessed March 11, 2020.

13 Our initial analysis considers building height, as opposed to other size metrics like floor area or number of units, because this category is closely related to building construction material.

14 ICF, "NYSERDA Database Data Dictionary_04 25 17.doc" and "Tier 2 Relevant Data Fields and Data Dictionary.xls"

15 ICF, "Field Descriptions_MASTER_v3 2017-01-05.xls"

16 ICF, "NYSERDA Data Field Master Crosswalk v2 12-19-16.xls"

17 CoStar is a real estate industry database with records of properties that include material attributes, square footage, and other features with which the ICF database could be cross-referenced to verify certain details.

18 Relevant information from the unpublished report can be located in Appendix 1

19 R-value is the Architecture, Engineering, and Construction (AEC) industry standard measure of insulation value, or how well a material or multilayer composition of materials resists heat transfer via conduction. A higher R-value indicates better insulative performance.

20 "History of Architectural Graphic Standards Online," www.graphicstandards.com/product-history/

21 Window to wall ratio (WWR) is a percentage that expresses total glazed envelope area, including frames, over total wall area, excluding roof area.

22 As in Part 1, 10-ft is used as the floor to floor height for envelope area rough calculations

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