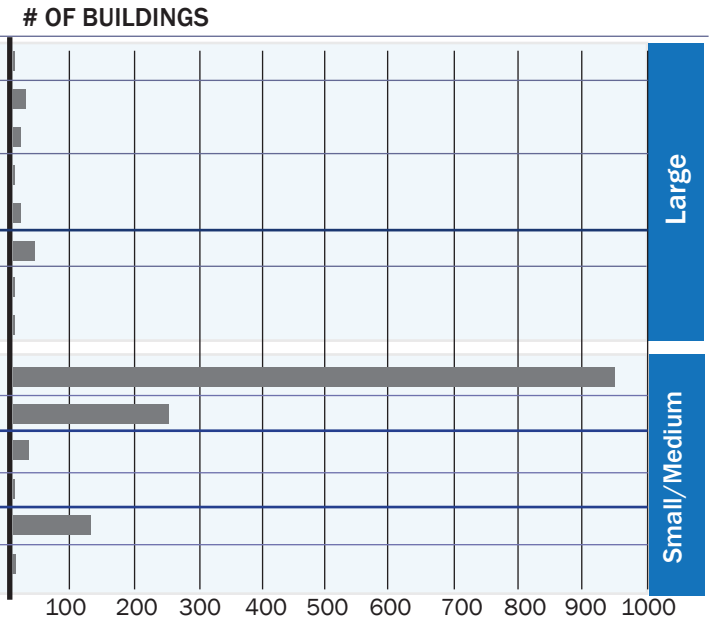
BUILDING AND SITE GUIDELINES

BUILDING TYPOLOGY

The Building and Site Guidelines for resiliency to flooding and extreme heat focus on durable, cost-effective methods for addressing water infiltration and thermal performance. Many of the solutions are dependent upon the characteristics of the building's structure, enclosure, and site. Some of the proposed guidelines will be more effective on larger buildings, as others will be more suitable for small/medium buildings. The DHCD building portfolio is diverse and the table below shows the distribution of buildings according to their construction type defined by structure, enclosure, and size.

LHA BUILDINGS BY CONSTRUCTION TYPE

STRUCTURE	ENCLOSURE	SIZE
Steel Frame	Metal Panel Enclosure	(4-7 Floors)
	Masonry Enclosure	(4-7 Floors)
		(8-20 Floors)
	Concrete Panel Enclosure	(4-7 Floors)
		(8-20 Floors)
Concrete Frame	Masonry Enclosure	(4-7 Floors)
	Concrete Panel Enclosure	(8-20 Floors)
		(4-7 Floors)
Wood Frame	Wood Siding Enclosure	(1-4 Floors)
	Masonry Enclosure	(1-3 Floors)
Steel Frame	Masonry Enclosure	(1-3 Floors)
	Concrete Panel Enclosure	(1-3 Floors)
Concrete Frame	Masonry Enclosure	(1-3 Floors)
	Concrete Panel Enclosure	(1-3 Floors)



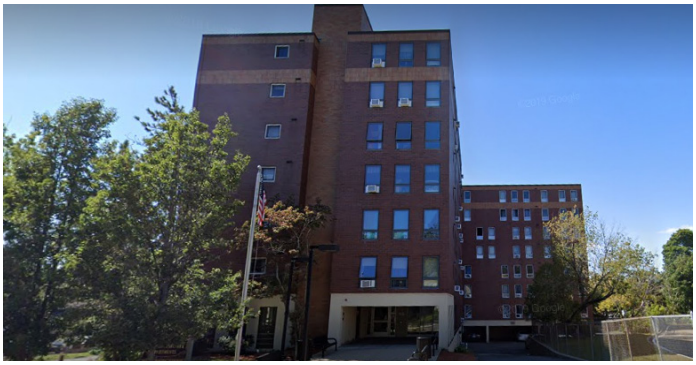
SMALL/MEDIUM BUILDINGS

The most common construction type for small/medium buildings is wood frame, wood or masonry enclosure. Small building developments are likely to have multiple small buildings with individual mechanical and electrical equipment.

Example: Lee Fort Terrace - Salem Housing Authority is characterized as Small/Medium by wood frame, masonry enclosure, single story.

LARGE BUILDINGS

The most common construction type for large buildings are steel or concrete masonry structure with masonry enclosure. Large building developments are likely to have elevators and centralized mechanical and electrical equipment.



Example: McCarthy Building - Melrose Housing Authority is characterized as Large by masonry frame, masonry enclosure, seven stories.

Larger buildings built to higher construction requirements for frame/ structure are more likely to be resistant to structural water damage and be more resistant to hydrostatic pressure. Smaller buildings with wood/steel structural frame are most likely to require additional enclosure or site improvements to increase flood resiliency. Smaller buildings tend to shed heat more effectively while larger buildings gain and maintain internal heat more readily and are more likely to require cooling, especially during extreme heat events. about the unique characteristic of a property, consult an architect and engineer about the most durable cost-effective method for addressing water infiltration and thermal performance in a building.

RESILIENCE BEST PRACTICES

The Design Guidelines provide a range of strategies for enhanced resiliency of buildings through the implementation of systematic building component improvements. Below are the best practices from each guideline section grouped by structure/enclosure, building systems, and site to provide a more comprehensive overview of how to apply the guidelines to projects.

Building Strategies

Resilient Structure and Enclosure **The most effective wall assemblies are well insulated, air and water tight to keep flooding out and maintain comfortable indoor temperature.**	Climate Hazard 			**Guideline Section**
Repairing or improving the thermal performance of **masonry** at all properties should always be done with attention to managing moisture and permeability as well as thermal performance.			◆	04 20 00 Unit Masonry
Use **wood** building materials which are considered flood damage resistant, meaning they can withstand direct contact with water for at least 72 hours without being significantly damaged.	◆	◆		06 10 00 Rough Carpentry 06 20 00 Finish Carpentry
For some residential buildings, the Massachusetts Energy Code requires a **continuous air barrier** assembly for new construction buildings or additions at opaque exterior walls or soffits, including joints and junctions to abutting constructions to control air movement through the wall. The air barrier also serves as a liquid-water drainage plane when flashed to discharge water to the exterior.	◆	◆		07 10 00 Waterproofing and Dampproofing
The most **effective wall assemblies** have a primary **water barrier** (the exterior cladding: brick, clapboards, shingles, etc.) and a secondary, vapor-open, bulk water barrier (house wrap with all joints taped, peel-and-stick membrane, liquid-applied air and water barrier, or other product).			◆	07 20 00 Building Insulation & Moisture Protection
Making improvements to **roof drainage** will help buildings address water penetration and structural failures. Improving roof insulation at the eaves of sloped roofs will reduce the freeze-thaw cycling of ice and snow on the roof that leads to ice dams.	◆		◆	07 30 00 Asphalt Roof Shingles
Resilient buildings in areas that experience frequent wind driven rain should include a **pressure neutral rainscreen** when installing fiber cement board, brick, masonry, or wood siding.	◆	◆		07 40 00 Siding
When designing new small buildings, architects should design **roof overhangs**, durable perimeter foundation, and siding materials to minimize the need for gutters. Gutters have traditionally been a high maintenance item.	◆			07 45 00 Gutters and Downspouts
Standard built, up asphalt, rubber, black EPDM, or other dark roofs can reach temperatures of 150°F or more in the summer sun. A **light-colored "cool roof"** under the same conditions could stay more than 50°F cooler.			◆	07 50 00 Membrane Roofing
In coastal areas it is important to **lap flashing and moisture barriers** correctly, and to use sealed tapes and products. At roof to wall intersections, use flashing with longer vertical edges. Tape the top step of flashing with a 4-inch or wider self-adhering roof tape, and lap the house wrap or building paper over the flashing and tape that as well.	◆			07 62 00 Sheet Metal Trim and Flashing

RESILIENCE BEST PRACTICES

	Climate Hazard			Guideline Section
				
Creating a **waterproof barrier** in a section of wall to make it impermeable may require the use of sealants applied directly to the exterior surface of the building to seal walls and floors.	◆			07 90 00 Sealants
Fiberglass, vinyl and metal **exterior doors and frames** are preferred for reasons of overall cost-effectiveness and durability, and the consideration of resilience reinforces this preference.	◆	◆	◆	08 10 00 Doors and Frames
Shading devices, operable windows and screens can be integrated into the design to help reduce temperature-related climate impacts, including overheating during heat waves.			◆	08 40 00 Entrances and Storefronts
Windows play an important role in minimizing the negative effects of climate hazards like extreme heat and flooding, by providing daylighting, improved thermal performance, enabling emergency egress, and providing building occupant comfort.	◆	◆	◆	08 50 00 Windows
To avoid corrosion of **exterior hardware,** use hot-dip galvanized steel or stainless-steel hardware. Stainless steel hardware is acceptable in virtually all locations, but hot-dip galvanized hardware may not be appropriate in every location.		◆		08 70 00 Hardware
<u>Resilient Interiors</u> **Building materials installed in floodable spaces—including framing, wallboard, flooring and ceiling paneling—should be able to survive water exposure without major damage, promoting mold or mildew, or absorbing contaminants. Building materials below the design flood elevation (DFE) should be able to withstand contact with flood waters for up to 72 hours without requiring more than cosmetic repairs.**				
Construct **walls** with a horizontal gap between wallboard to prevent moisture. Use non-paper-faced gypsum below the wallboard with latex based paint. Use ridged, closed cell insulation in the lower section of the wall.	◆	◆	◆	09 20 00 Gypsum
Install **slip resistant waterproof flooring** such as textured tile in common areas to both resist flood water damage and to help prevent injury during egress in the event floors become wet.	◆	◆		09 30 00 Tile
Where flooding is a concern, consider removal of existing **flooring** and installation of an alternative such as ceramic, vinyl plank, or another water-resistant tile.	◆	◆		09 64 00 Wood Flooring
Consider the combination of materials when planning **flood resistant floors** such as tile or polished concrete. Using a wood subfloor, however, would trap moisture in the subfloor assembly, possibly leading to mold or rot.	◆	◆		09 65 00 Resilient Flooring
Avoid the use of carpet in areas where flooding is a concern such as basements, below grade spaces, and on concrete sub floors.	◆	◆		09 68 00 Carpet
If flooding is a concern, consider the types of materials to be painted and which type of **paint** is most appropriate.	◆	◆		09 90 00 Painting
Raise **elevator components** above the design flood elevation (DFE), and mitigate flooding in elevator pits by waterproofing the interior of the pit and installing sump pumps.	◆	◆		14 20 00 Elevators

RESILIENCE BEST PRACTICES

Building Systems Strategies

Building systems should always be located or protected up to the DFE and be designed for efficiency to reduce energy costs and emissions.	Climate Hazard: PRECIPICATION	Climate Hazard: STORM SURGE	Climate Hazard: EXTREME HEAT	Guideline Section
To accommodate **future battery storage**, locate any central solar photovoltaic inverters in a location with additional room for a battery system (at least 10' x 10') or near an exterior wall for a battery to be located outside.	◆	◆	◆	07 07 00 Solar Photovoltaic Systems
Consider installing a permanent **exterior electrical connection** so that temporary generators can be connected to emergency circuits if no permanent backup generator is located on site.	◆	◆	◆	21 00 00 Fire Suppression
Raise domestic hot water heater above the Design Flood Elevation (DFE). Install backwater valves to prevent storm and sanitary sewer backups related flooding events.	◆	◆		22 00 00 Plumbing
When **central HVAC equipment** is replaced, it should be located or moved from locations where flooding is a risk to prevent water from damaging components.	◆	◆	◆	23 00 00 Heating Ventilation & Air Conditioning
Reducing or eliminating **central heating systems** and baseboard electric resistance heating equipment, which are often located in basements or on first floors, enables heating and cooling systems to be located in residential units	◆	◆	◆	23 80 00 Air Source Heat Pumps
Raise **electrical equipment, conduit, panels, and wiring** above the Design Flood Elevation (DFE), and seal penetrations through buildings.	◆	◆		26 00 00 Electrical
Seal penetrations through outside walls, especially where service runs underground.	◆	◆		28 00 00 Electronic Safety and Security

Site Strategies

Resilient sites should maximize planting and pervious surfaces to mitigate stormwater flooding and heat.				
Use **light colored pavement** (high albedo) and open grid pavement to help reduce heat impacts. Open grid and permeable pavements help absorb stormwater. Some materials will require modified maintenance practices.	◆		◆	32 10 00 Asphalt Paving
If site flooding is a concern, a **retaining wall or deployable flood barriers** could be added around the perimeter of the building.	◆	◆		32 30 00 Site Improvements
When planning landscaping, consider the potential flood mitigation and cost savings opportunities that **Low Impact Development (LID), or green infrastructure**, may present. LID techniques, such as implementation of bioswales or rain gardens (for stormwater management) also have co-benefits including area beautification and localized temperature moderation.	◆		◆	32 90 00 Landscaping
When updating sewer lines to a building, consider including **backwater valves**.	◆	◆		33 00 00 Site Utilities
When refurbishing or relocating **septic tanks and leech fields**, be mindful of Design Flood Elevations.	◆	◆		33 36 00 Septic Systems

SMALL/MEDIUM DEVELOPMENT STRATEGIES

The graphic below demonstrates a suite of potential strategies for wood frame, wood enclosure and wood frame, masonry enclosure buildings, the most common small/medium construction types in the DHCD portfolio. For wood frame, wood enclosure buildings in flood zones, elevating the building may also be possible.

Emergency Generator

Raise electrical equipment, conduit, panels, and wiring above the Design Flood Elevation (DFE) Consider the backup power needs of residents, especially if they are expected to shelter in place during power outages. Size backup generators to the critical loads identified.

Solar Panels

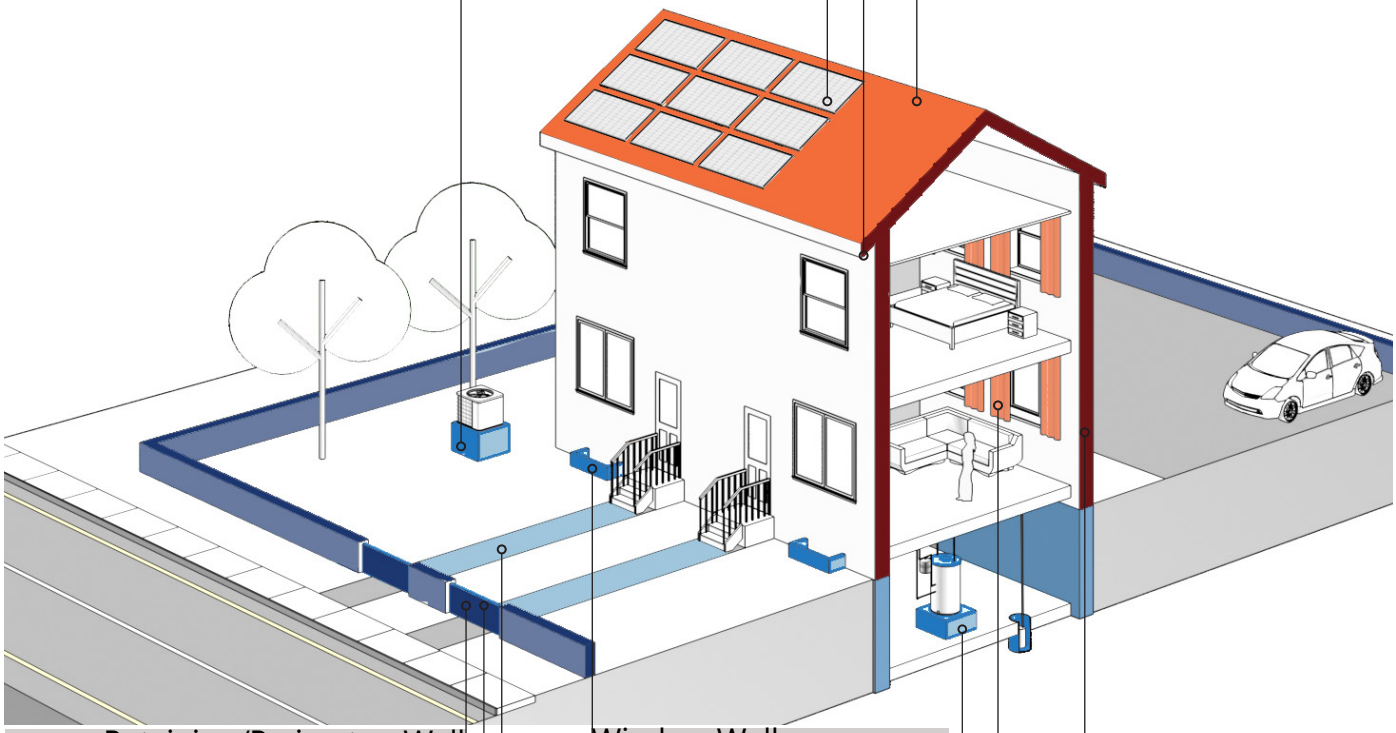
A roof replacement offers an ideal time to evaluate the orientation of the roof for future installation of solar photovoltaic (PV) or solar thermal domestic hot water heating systems.

Roof Overhang

When designing new 1-2 story buildings, architects should design ample roof overhangs, durable perimeter foundation and siding materials to minimize the need for gutters.

Cool Roof

Avoid dark brown and black shingles because they tend to build up and retain heat, and have a shorter lifespan.



Retaining/Perimeter Wall

Retaining walls can be used to manage flood and landslide risk. Retaining walls must be designed to withstand earth load and hydrostatic pressure to insure a long-lasting installation. Temporary flood barriers may be installed at entrances and deployed in advance of an anticipated flood events.

Design Flood Elevation

Build walls, waterproof materials, and building systems protection to the design flood elevation as defined by FEMA or municipal guidelines when available.

Window Well

Protect window wells by building up the walls at least six inches to protect from flash flooding.

Permeable Pavement

Permeable pavement and open grid pavement can reduce surface runoff and increase water infiltration rates into soils which may be useful in managing stormwater.

Elevate Mechanical Equipment

Elevating mechanical equipment off the ground in basements minimizes risk from flooding.

Insulation

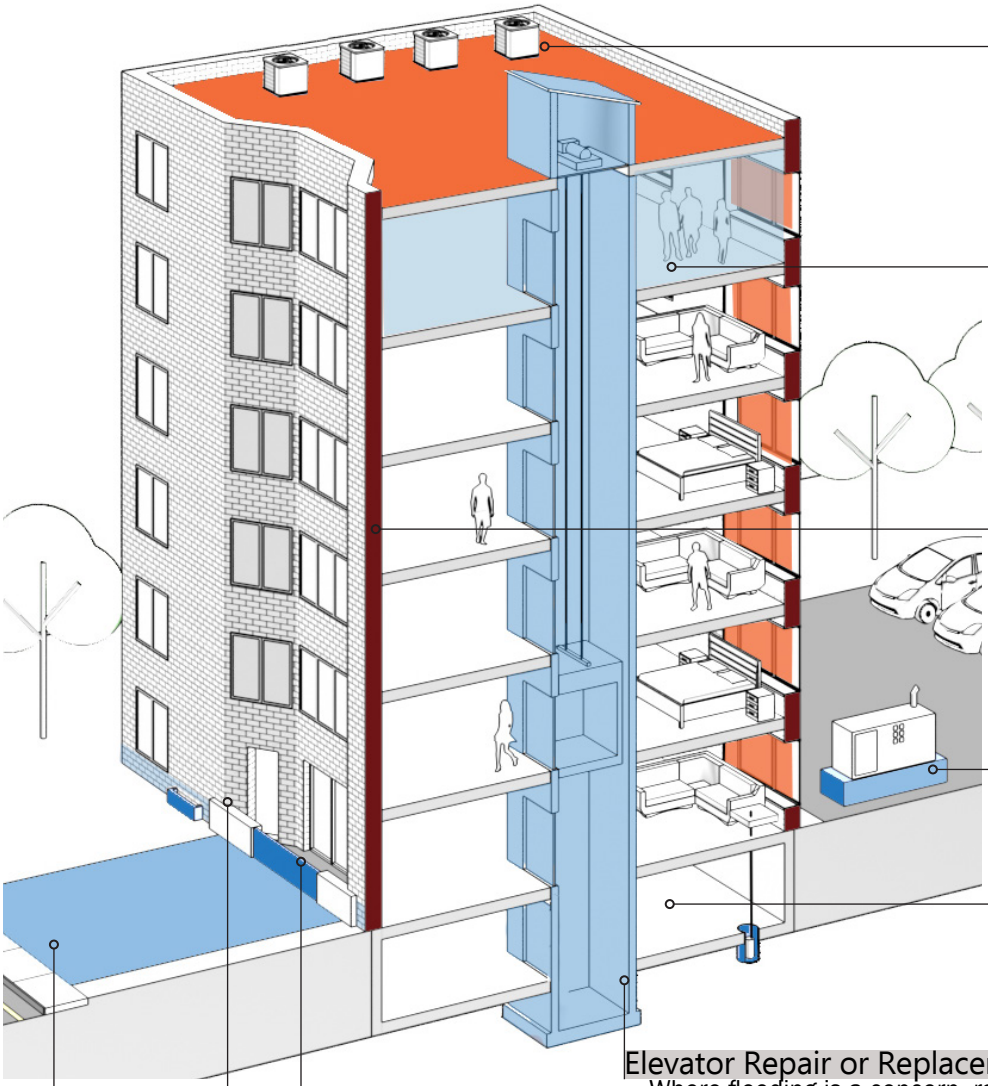
Well insulated, airtight buildings with appropriate vapor control keep heat inside in winter and can be cooled more efficiently in summer.

Windows

Shading windows reduces the amount of solar heat gain in the interior of the building, thereby reducing cooling loads during the summer months and leading to lower indoor temperatures during power outages when the cooling system is not operational.

LARGE DEVELOPMENT STRATEGIES

The graphic below demonstrates a suite of potential strategies for a concrete frame, masonry enclosure building, the most common large construction type in the DHCD portfolio.



Cool Roof

Standard built up asphalt, rubber, black EPDM, or other dark roofs can reach temperatures of 150°F or more in the summer sun. A light-colored "cool roof" under the same conditions could stay more than 50°F cooler.

Community Room

Back-up the community room to an emergency generator and cooling system to shelter in place during power outages.

Dry Floodproofing

Creating a waterproof barrier in a section of wall to make it impermeable may require the use of sealants which are applied directly to the exterior surface of the building to seal exterior walls and floors. This is desirable below the DFE.

Elevate Mechanical Equipment

Elevating mechanical equipment off the ground in basements minimizes risk from flooding.

Resilient Materials

Flood damage resistant materials should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE), if known.

Elevator Repair or Replacement

Where flooding is a concern, raise elevator components that can be elevated out of sump pits and above the design flood elevation (DFE), and take steps to mitigate flooding in elevator pits by waterproofing the interior of the pit and installing sump pumps tied to a backup power source.

Temporary Barriers

Temporary barriers can be quickly deployed, generally in less than 24 hours depending operational availability and size of deployment. Consult an engineer to see if this is a viable strategy as flood barriers may put stresses on the building structure and may conflict with the building code

Design Flood Elevation

Build walls, waterproof materials, and building systems protection to the design flood elevation as defined by FEMA or municipal guidelines when available.

Permeable Pavement

Permeable pavement and open grid pavement can reduce surface runoff and increase water infiltration rates into soils which may be useful in managing stormwater.