

# DESIGN PRINCIPLES AND PERFORMANCE SPECIFICATIONS FOR URBAN POST-DISASTER INTERIM HOUSING UNITS

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## Introduction

### Design Principles

- Overview
- Universal Design
- Factory Pre-Finished
- Permanency
- Climate

### Performance Specifications

- Design Concept
- Utility Services Concept
- Unit Design
- Neighborhood Configurations
- Plan Layout and Features: Utility Unit
- Kitchen
- Bathroom
- Storage
- Living/Dining Room
- Bedroom (also applies to “Bedroom” Unit)

### Building Design

- Fire Safety
- Doors and Windows
- Sound Attenuation
- Exterior Finishes and Weather Resistance

### Life Safety

- Means of Egress
- Fire Suppression
- Standpipe

### Building Systems

- Structural
- Delivery, Installation and Demobilization

## Mechanical, Electrical and Plumbing Systems

- Heating, Ventilation and Air-Conditioning
- Electrical
- Communications
- Water Heating
- Potable Water, Sanitary and Storm Water Disposal
- Domestic Water Supply
- Sanitary Drainage Disposal
- Storm Water Disposal
- Protection from Freezing

### Annex

### Compliance with Codes and Regulations

- Code Compliance
- Occupancy Classification
- Construction Classification

### Zoning Considerations

- Fire District
- Height and Area
- Distance between Building Complexes

## Introduction

The design of post-disaster housing includes more than what a building or an apartment looks like; the way it is manufactured, transported, and assembled all contribute to how fast it can arrive, how well it serves the occupants, and how easily it can be removed and reused. To provide deployable housing that is humane, healthy, durable and sustainable, cities need to take all these factors into account.

This document helps cities obtain post-disaster housing that suits the needs of urban areas quickly and cost-effectively. Created by the NYC Emergency Management Department and the NYC Department of Design and Construction, it outlines a reliable, start-to-finish approach to house residents quickly, comfortably and safely. The guidance here addresses the design, fabrication, delivery, and installation of deployable housing that has been improved through lessons learned in creating and inhabiting the Urban Post-Disaster Housing Prototype in NYC. It is intended to serve as the basis of a Request for Proposals. All agencies that procure post-disaster manufactured housing ask for different information presented in different forms. This document's organization reflects various proposal requirements from the Federal Emergency Management Agency, the U.S. Army Corps of Engineers, the U.S. Department of Housing and Urban Development, the NYC Department of Design and Construction, and the NYC Department of Housing Preservation and Development.

A well-designed solicitation leads to well-designed buildings, yet in the aftermath of disaster there is often pressure to make hasty decisions. When it comes to deployable housing, this can mean poor design decisions and expensive mistakes that are replicated thousands of times. This document is the core of a procurement package that offers a tested, value-engineered approach to quality deployable post-disaster housing for cities. Additionally, it sets a baseline for quality and outlines the key requirements for urban post-disaster housing in a way that can be easily customized for any city.

Local codes affect the cost, time and material requirements of a project. Vendors need to know where the greatest flexibility is so they can optimize the design. The specification helps cities communicate this in two ways: 1) by calling out where local codes have the biggest impact and 2) by requesting specific information not required in a typical project. In areas where local codes can have a big impact, specific NYC codes are used as examples: this shows where jurisdictions need to insert local requirements. To reduce the time it takes housing units to arrive after disaster, adapt this specification to a jurisdiction's requirements beforehand and identify preferred vendors in advance.

### Background

An earlier version of this document, issued by the U.S. Army Corps of Engineers as part of a request for proposals, was created as the basis for the country's first Urban Post-Disaster Interim Housing prototype. This version incorporates best practices from the processes of designing, manufacturing, procuring, permitting, delivering, occupying and maintaining the prototype.

## Design Principles

### Overview

These Design Principles and Performance Specifications establish the minimum requirements for the design, construction and deployment of urban “Interim Housing Units” following a disaster. The Interim Housing Unit (IHU) provides multi-family, multi-story housing for beyond the twenty-four-month period specified by FEMA. Recognizing that interim housing is often in place longer than originally intended, these specifications call for construction quality equal to local building codes.

A city may need to maximize the number of temporary housing units deployed for displaced residents. In order to meet this need, government may procure the Interim Housing Unit from multiple vendors depending on the capacity of each vendor to produce, deliver and deploy the unit. To accomplish this goal, the Interim Housing Units will incorporate standardized factory-manufactured modular housing units and construction specifications that are adaptable for both temporary and permanent use. The specifications will also identify certain urban considerations where it makes sense to depart from FEMA’s requirements. The Interim Housing Unit must be rapidly deployable, transportable by truck, rail and by cargo ship and must be able to be disassembled and stored off-site for future reassembly and re-use.

In order to achieve the production and rapid deployment of the Interim Housing Units, proposals should demonstrate a modular design and standardized manufacturing process. In order to accelerate the production schedule, the use and incorporation of pre-manufactured readily available components, such as modular bathrooms and kitchen pods is encouraged. Similarly, other factors such as innovative production that demonstrate

the vendor’s capability to quickly produce, transport and deploy a maximum number of units should also be defined.

This design concept focused on two proposed entries from NYCEM’s “What if NYC...” design competition that used modified ISO shipping containers or shipping container technology and pre-manufactured modular construction methods. Other unit types including Factory Built Housing, Manufactured Housing (HUD-Code), Modular Housing, Panelized Housing and other alternative dwelling units that meet or exceed this NYCEM Design Standard and Performance Specification will also be considered.

### Universal Design

In an effort to facilitate the development of a standard layout universally accessible to everyone, the vendor’s proposal should incorporate the principles of Universal Design. Design layouts of all units should comply with the minimum requirements of the Americans with Disabilities Act (ADA) without the need for adaptation or specialization. Each unit should prioritize inclusive design that goes above and beyond stated codes. Universal Design Recommendations from the prototype study are called out throughout this document.

### Factory Pre-Finished

The Interim Housing Unit should be factory pre-finished, transported, and installed with no or minimal field finishing work, including the interior walls and partitions. The Interim Housing Unit should be deployed to the selected site ready to be connected to existing municipal utilities or temporary services. The unit should be transported and installed at the site fully furnished, with appliances, utility hook-ups, and accessories such as ramps and stair towers such that the unit is ready for habitation.

## **Permanency**

The Interim Housing Unit should be designed as a “temporary-to-permanent” solution. The vendor should demonstrate and document design features that make it structurally feasible to install individual and/or stacked multiple dwelling units on permanent foundation systems, connect the unit to permanent municipal utilities, expand the living and common spaces, and to integrate the Interim Housing Unit into the larger permanent structure. They should be able to be relocated and re-used.

## **Climate**

The units should focus on passive heating and cooling, as appropriate to climate, and maximize natural light and air.

## **Performance Specifications**

### **Design Concept**

These specifications call for standard, but flexible, design elements and construction methods that can be combined to accommodate a range of family sizes. The design concept envisions a basic “Utility” dwelling unit module that is configured as a studio or one-bedroom apartment and includes all central requirements such as a kitchen, a bathroom, a living/dining/bedroom, electric power distribution, plumbing and mechanical distribution, and any necessary equipment. In addition to the core module, a standard “Bedroom” unit would incorporate additional living spaces (without plumbing service) to accommodate two additional bedrooms. The “Bedroom” unit would connect to the “Utility” unit in various configurations to form a larger family dwelling unit when needed. While the language in this document generally refers to a bedroom as being a space where two adults could share a queen-sized bed, this space can be furnished and customized to accommodate each household.

Alternate design concepts that can meet this specification will also be considered.

### **Utility Services Concept**

Interim housing may use existing utility connections in areas designated by the city, or temporary connections that use “off-grid” systems with a self-contained power, water and waste supply. Preferred sources should be indicated at the time of the event. Units should use electrical power only, as gas lines are considered to be hazardous in post-disaster sites.

Each “Utility” module should be designed and engineered to incorporate a common utility chase(s) or riser(s) for electrical, sewer, water and other common services that might be required. The chase or riser should be arranged to align vertically and horizontally with other stacked “Utility” units, and also should be attached to “Bedroom” units, to permit the easy and quick connection of services in stacked, side-by-side or clustered complex arrangements.

In anticipation of labor shortages, as much interior plumbing should be assembled off-site as possible.

### **Unit Design**

The overall exterior dimensions of the vendor’s proposed standard modular should be within the maximum limits established for highway, rail and cargo ship transport.

The typical exterior footprint ranges for a “Utility” dwelling unit, and a “Bedroom” unit, are below:

- Studio “Utility” Dwelling Unit:  
260 – 300 square feet
- One-Bedroom “Utility” Dwelling Unit:  
300 – 480 square feet
- Three-Bedroom Dwelling Unit (“Utility” + “Bedroom” module):  
600 – 960 square feet

The minimum clear interior unit room width should be 8'-0" per NYC Building Code Section BC 1208.1.

The minimum interior finished ceiling height should be 8'-0" per NYC Building Code Section BC 1208.2.

### **Neighborhood Configurations**

The Interim Housing Units should be stacked in clusters of multiple-dwelling complexes. Separate core units may be used to accommodate laundry units, secured storage, mail rooms, and mechanical equipment for servicing the clustered IHU arrangements.

### **Plan Layout and Features: Utility Unit**

Floor space and clearances should comply with minimum requirements of the ADA for all units. Several aspects of Universal Design are critical to the plan layout.

### **Kitchen**

Provide a complete all-electric adaptable kitchen (no gas or propane appliances) in compliance with the ADA, including all the following features:

- Kitchen Cabinets: Overhead and under-counter kitchen cabinets with countertops; kitchen cabinets and countertops should be constructed from metal or alternate acceptable durable materials resistant to moisture, mold, abuse, and delaminating. For purposes of efficient and rapid deployment, consider the readily available modular kitchen unit or the standard pre-manufactured "off the shelf" component. Custom designed units should be avoided.
- Universal Design Recommendations: Stainless steel sink with a water-saving, single-lever faucet with handheld spray is preferred. Prioritize multiple low cabinets for people with limited reach.

- Refrigerator: 14.4 cu. ft. minimum Energy Star-compliant frost-free with freezer. 100% of the refrigerator and 50% of the freezer must be at maximum, 54" above floor per the ADA.
- Microwave: Minimum 1.2 cu. ft. microwave or 2 cu. ft. convection microwave with child lock.
- Range & Oven: Minimum 24" electric cooking range. Also provided should be a one-piece construction range hood, lighted and power-vented.
- Dishwasher, Washer, and Dryer: not included.

### **Bathroom**

One full bathroom must be provided in each "Utility" One Bedroom Dwelling Unit. Connecting a "Three-Bedroom" Unit does not require additional bathrooms.

Bathroom designs should be based on a Universal design layout. In compliance with the ADA Section 4.21, a roll-in type shower (no bathtub) with a shower curtain, curtain rod and curtain hooks, a drop down seat and grab bars should be provided. A wall-hung or floor-mounted lavatory with clear knee clearance and a wall hung or floor mounted 1.28 gallon water saver closet should be included. The height of the water closet should comply with ADA Section 4.16. A removable under-lavatory vanity is acceptable.

Use recessed or surface wall mounted medicine cabinet with tilting shatterproof mirror. Wall mounted grab bars, locations and size compliant with the ADA.

In the event of a material shortage or as a cost-saving measure, all first floor units should have grab bars installed and the units above them should have blocking installed such that grab

bars can be installed at a later time. The blocking location should be indicated on the architectural plan and match on all floors.

Bathroom floor space, clearances, and accessories should all comply with ADA requirements.

Bathrooms should include an adequately sized exhaust fan capable of exhausting a minimum 50 CFM (for an intermittent fan) or 20 CFM (for a continuous fan) of air, vented and ducted to the outside in compliance with the NYC Building Code. The exhaust fan should be 1.5 sones or quieter and Energy Star compliant.

For drainage, a positive pitch for the walk in shower drain should be provided to prevent water pooling within the bathroom area.

### **Storage**

Storage opportunities are to be maximized.

Universal Design Recommendation: Ample storage and closet space with adjustable and removable storage shelving should be provided which is compliant with the ADA Section 4.25. Adjustable shelving should allow hung items to be accessed from a seated height.

### **Living/Dining Room**

The dining area should include a surface and seating to accommodate 4-6 adults and provide circulation space for accessory furniture.

The living room area should include a sleeper sofa bed and sufficient circulation space to accommodate typical living room furniture. A Murphy-type bed may also be considered for a studio or a one-bedroom unit. A built-in or attached credenza and desk should also be provided.

### **Bedroom (also applies to “Bedroom” Unit)**

Each bedroom should accommodate one full-sized bed or two twin-sized beds with adequate

circulation and turning space, along with a closet or wardrobe with ADA compliant doors.

Universal Design Recommendation: An electrical plug for wheelchair charging or additional medical equipment should be easily reachable from the bed.

## **Building Design**

### **Fire Safety**

Egress Windows: Each dwelling unit should provide emergency and outside window openings in each sleeping room or occupied space (including living rooms with sofa beds), unless the space has an exit door, in compliance with NYC Building Code Article BC 1029 and with the NYC Fire Code.

Smoke Detectors: Each kitchen, living room and sleeping space should have combination smoke and carbon monoxide detectors, with built-in audible and visual alarms compliant with the National Fire Prevention Association Standard 72, and the NYC Building Code. Detectors should be hard wired to the electrical circuits with battery backup.

Fire Extinguishers: Each dwelling unit should be equipped with one 5-lbs dry chemical A-B-C fire extinguisher that is compliant with or exceeding the requirements of the National Fire Prevention Association Standard 10, and is easily accessible in the kitchen area.

### **Doors and Windows**

The building envelope should reflect the principles related to climate considerations, natural light, ventilation, and air quality.

All primary windows and sliding glass doors should be insulating and fully weather-sealed, and should comply with the latest edition of the AAMA 1701.2, “Voluntary Standard Primary Window and

Sliding Glass Door for Utilization in Manufactured Housing.”

The design and construction of all swinging exterior passage doors should also meet or exceed the requirements of the latest edition of AAMA 1702.2, “Voluntary Standard Swinging Exterior Passage Door for Utilization in Manufactured Housing.”

Exterior doors should have two independent locks with separate keys and be capable of being opened from the inside without a tool or key. The height of locks, latches and other locking mechanisms on the inside of exterior and interior doors should comply with the ADA 4.2.5 and 4.2.6. Additionally, all exterior doors should have a vision peep-hole at a height compliant with the ADA.

All operable windows should have latches and locking mechanisms that prevent the windows from being opened from the outside. The latches and locking mechanisms should be able to be manually opened from the inside without the use of a tool or key.

Universal Design Recommendation: Handles should be able to be used with a closed fist.

All operable windows should be equipped with removable non-corrosive insect screens.

If windows and glass doors are to be equipped with blinds, these should first be approved as being safe for children.

Child-protective guards should be provided for all operable windows above the first floor in compliance with NYC Code, Rules and Ordinances.

### **Sound Attenuation**

Each dwelling unit, including fenestration and exterior envelope assemblies, should achieve a composite building sound attenuation value equal

to or greater than 30 OITC based on a maximum indoor noise level of 45 dBA.

### **Exterior Finishes and Weather Resistance**

Exterior exposed surfaces: Materials should be designed to present a uniform and aesthetically pleasant appearance. Exterior material and/or cladding should be non-combustible, durable, moisture, mold and weather resistant, corrosion resistant and maintenance free. All fasteners should be corrosion resistant and designed to resist wind, snow and rain. The vendor should demonstrate a uniform aesthetic appearance for the Interim Housing Unit in multi-family building complexes and clustered arrangements.

Roof Surfaces: Roofs should be covered in appropriate roofing systems with durable material equivalent to a 10-15 year warranty type system, and secured to resist wind forces in compliance with the NYC Building Code. Roof surfaces should be pitched to provide positive drainage to an integral drainage system, gutters or other acceptable drainage methods. Refer to “Storm Water Disposal” elsewhere in this document. “Cool roofs” preferred.

All exterior openings, such as windows, doors, drainpipes, etc., should be sealed and caulked to prevent air and moisture penetration and to resist the entrance of rodents.

## **Life Safety**

### **Means of Egress**

Required means of egress systems, including, but not limited to the number of exit stairs, the maximum travel distance, components such as doors, clear width and height; minimum illumination, signage, etc. should comply with NYC Building Code Chapter 10.



## Fire Suppression

### *Fire Suppression System:*

Article BC 903.2.8 of the NYC Building Code requires all residential type occupancies, with the exception of one- and two-family detached dwellings that are smaller than three stories in height, be provided with an automatic sprinkler system. In a post-disaster environment, a reliable municipal source of water may not be available or sufficient for sprinkler systems where the Interim Housing Unit is located. The fire suppression system should be designed to integrate all available site municipal utilities and /or temporary water sources. Based on the source water supply condition, availability for fire pumps should be provided, if needed.

### *Water-Based Fire Suppression System:*

Water-based automatic fire sprinkler system should be designed and implemented in compliance with NYC Building Code Section BC 903 for R2 occupancy. The provision of a sprinkler system should not be considered for increase in permitted limits of building area, height, and egress and construction classification.

A visual/audible device should be located on the exterior of the Interim Housing Units, visible from a public way, providing alarm notification upon activation of the fire sprinkler system.

The vendor should submit system testing and independent listing agency documentation for approval and acceptance by the NYC Fire Department (FDNY) for this type of use.

## Standpipe

For complex clustered site arrangements, a standpipe system should be designed and provided in compliance with NYC Building Code Section BC 905 as required for the proposed building complex height and total floor area as prescribed in Section BC 905.3.1.

## Building Systems

### Structural

#### *Connections:*

Each Interim Housing Unit module should be engineered and constructed to support vertical live and dead loads, wind and seismic forces prescribed by the NYC Building Code for Interim Housing Unit modules stacked up to four stories maximum with pre-engineered connections. Individual, stacked and combined dwelling unit arrangements should be engineered to resist lateral forces including wind and seismic in addition to live and dead loads in compliance with the NYC Building Code.

#### *Temporary Foundations:*

Excavation and construction of permanent foundation systems may not be viable in a disaster recovery situation and in some cases will not be considered. Pre-engineered temporary foundation systems should be provided to support singular and stacked Interim Housing Units Dwelling Units at various locations, terrain and surface conditions, such as asphalt paved parking fields, lawns, parkland, side-walks/street, etc. Temporary foundation systems may include, but not be limited to platforms, pre-cast or steel grade beams, piles, fiber concrete columns, anchors, or similar.

The Interim Housing Units should be designed and pre-engineered to provide appropriate anchorage to the temporary foundations including tie-down of the Interim Housing Units and temporary foundation required for securing to the ground.

The soil conditions encountered for the location of the Interim Housing Units may vary. The design for the pre-engineered temporary foundation systems should assume a conservative soil bearing capacity of one kip per square foot. Standard modular IHU units should accommodate various interchangeable



foundation systems and the vendor may propose different types of systems appropriate for various soil and bearing conditions. The vendor should perform test borings as necessary at the selected site to confirm soil and bearing capacity and conditions.

*Amenities:*

Pre-engineered and modular amenities should be provided which are compliant with the ADA, such as stair towers, platforms and landings, ramps, decks, walkways, etc. Each should be pre-assembled and engineered for quick deployment and installation in the field. Public space amenities such as bicycle racks, benches and play equipment should be considered. For efficiency and economy, standard modular, readily available pre-manufactured systems should be used.

*Structural Integrity:*

Each pre-assembled Interim Housing Unit should be engineered and constructed to remain structurally sound during transport and installation.

**Delivery, Installation and Demobilization**

The Interim Housing Units shall be delivered and installed by the vendor's personnel or by a third-party contractor hired by the vendor. Proposals should include detailed installation plans and information regarding any required training. They should arrive ready for hook-up to permanent municipal electric, sewage and water or temporary utility services as further described in this document.

Interim Housing Units should not require more than two weeks of finish work on site. All interior finishes, partitions, doors and windows, and fixtures should be included with delivery; vendor should not assume these are available at the site.

The vendor should provide plans for removal. Installation methods and structural systems should allow the site to be restored to its original condition.

## **Mechanical, Electrical and Plumbing Systems**

### **Heating, Ventilation and Air-Conditioning**

Each Interim Housing Unit should be equipped with a Heating, Ventilation and Air Conditioning (HVAC) system (with warranty) capable of maintaining living space winter conditions of maximum 72F (22C) and summer conditions of minimum 75F (24C) with 50-55% relative humidity. All heating and cooling systems must meet Energy Star qualifications.

Interim Housing Units should have a minimum Air Exchange Rate per Hour (ACH) of .35 (35%) of outdoor air being introduced into the unit per hour. Ventilation should be in addition to any natural ventilation from windows and/or doors. Documentation must be provided to show how all supply and return air is extracted, delivered and distributed.

Units should be designed to meet industry minimum standards for residential ventilation and acceptable indoor air quality per the American Society of Heating, Refrigeration, and Air-Conditioning Section 62 (ASHRAE 62).

Electric baseboard radiation, and through wall heat pumps with electric resistance supplement as required, or a combination of both are acceptable for HVAC services. Also acceptable are packaged HVAC units that require wall louvers for heat rejection.

In all cases, adequate zoning for individual spaces is preferred. Sound criteria shall be as recommended by ASHRAE or other recognized authority. See also Sound Attenuation.

## Electrical

Electrical design should comply with Article 550 of the NYC Electrical Code. Utility service for Interim Housing Units dwelling units should be all-electric. (Gas service will not be available at the temporary housing sites. Use of propane is not allowed).

Metering the units: a master meter should be installed for each cluster of units, including accommodation for combined services such as lighting, and sub-meters for each unit. Utility bills are to be available for individual units.

Electric service entrance connection at each Interim Housing Unit should be located on the exterior in vandal-proof, locked and weather proof junction boxes. Alternately, a secure utility room or locked box for master connections to electrical service and utilities may be provided. The incorporation of concealed and vandal-proof modular troughs for quick-connect power and telecom distribution is acceptable and recommended.

All wiring should be concealed in flexible or rigid conduit. All wire should be copper with a ground conductor.

All interior and exterior lighting should use commercially available fluorescent, compact fluorescent or LED lamps. All outdoor lighting shall be controlled by photocell; if none are available, timers are acceptable and should be included. All interior lighting fixtures should be ceiling or wall mounted with shatterproof lenses. Use of custom or long lead lighting fixtures should be avoided. All electrical hardware should be vandal-proof. All receptacles and switches should be heavy-duty industrial type with ground-fault circuit interrupter (GFCI).

Lighting Control: the height of lighting controls should comply with the ADA 4.27.3. A means to control at least one source of bedroom light from one bedside location should be provided.

Universal Design Recommendation: Off-the-shelf large rocker switches preferred.

Access panels at the interior of each unit should be accessible to the resident, facilitating quick connection and maintenance of services.

## Communications

Phone and Data: Each unit should be provided with at least one telephone, data and cable connection to be located in the living room. A service entrance connection should be located on the exterior in vandal-proof, locked and weather proof boxes. Alternatively, all-wireless internet service can be considered.

## Water Heating

An independent supply of hot water should be provided to each Interim Housing Unit and should be capable of delivering an adequate supply of hot water to all plumbing fixtures and equipment as required. Choices on heating and plumbing systems should weigh system cost versus availability of equipment and speed of production.

A self-contained hot water generation system using electric power for all plumbing fixtures and equipment requiring hot water should be provided.

In order to avoid the requirements of a re-circulation system to maintain the hot water temperature, a distance of twenty (20) feet from the hot water heater to the farthest fixture as per the NYC Plumbing Code should not be exceeded.

The hot water heater should be suitable for the type of building structure and should be capable of providing the minimum total demand including recovery/storage requirements.

### **Potable Water, Sanitary and Storm Water Disposal**

In a post-disaster environment, municipal water, sanitary and storm water disposal may be adversely affected. Such services may not be available for a short or extended period, or available services may be limited. The vendor's proposal should demonstrate the ability of the Interim Housing Units to connect to permanent municipal services when available, including water, sanitary and storm water disposal. If services are not available the vendor should demonstrate how the system can connect to alternate water storage and purification systems, and wastewater collection and/or treatment systems.

Temporary and permanent services should incorporate the following:

#### **Domestic Water Supply**

An adequate potable water supply, acceptable and approved by the New York City Department of Health and Mental Hygiene and the New York City Department of Environmental Protection (DEP), should be provided to each Interim Housing Unit Dwelling Unit for drinking, cooking, and bathing purposes.

Domestic water may be supplied from a city water main, on site water storage, water trucks or a combination thereof. Supplied potable water should connect to a central, pre-assembled domestic water service for each building complex or series of complexes per site, with metering and backflow protection, for quick installation in the field in compliance with DEP Rules and Regulations.

#### **Sanitary Drainage Disposal**

Sanitary drainage should be disposed of in compliance with local code.

Sanitary drainage from plumbing fixtures for

each Interim Housing Unit should be conveyed by gravity to a central point within each building housing complex, where it should then connect to the municipal sewer line when available. If no sewer line is available, sanitary disposal should be conveyed by an approved alternative method, including but not limited to:

- A central or localized holding tank that can be pumped out by a sewage disposal service and disposed of as permitted by federal, state or local authorities.
- Connection of sanitary system disposal from temporary systems to available permanent municipal disposal services should be subject to approval by the New York City Department of Environmental Protection. The vendor should provide technical sanitary system design information in their proposal, including calculations. This information will be evaluated by the DEP at the time for switch over from temporary to permanent services in order to assure that the municipal system will not be overtaxed. If sanitary disposal from the Interim Housing Units cannot be conveyed by gravity, then a receiver tank with ejector pumps should be used to convey the discharge into a gravity line. The discharge should not be permitted to pressurize the street sewer.

#### **Storm Water Disposal**

Storm water drainage should be disposed of in an acceptable manner in compliance with local code. Drainage for the site should be based on the layout of the Interim Housing Units so that there will be no flooding within the area.

Storm water drainage from the site should be conveyed to the municipal storm or combination storm/sanitary sewer line when available. If a sewer line is not available, storm disposal should be conveyed to approved alternative methods

provided by the vendor, including but not limited to:

- Drywells where feasible. Percolation tests should be performed at the site prior to design and installation of the drywells.
- A central or localized holding tank that can be pumped out by a disposal service and disposed of as permitted by federal, state or local Authorities.
- Storm water may discharge on unpaved areas such as lawns provided that storm water will flow away from buildings toward unpaved areas on the same site that will accommodate the rainfall.

### **Protection from Freezing**

All system piping design and installation should be protected from freezing. Appropriate insulation and/or heat trace as necessary should be provided.

All above ground or shallow buried piping, water supply or sanitary disposal should be protected from freezing by appropriate methods including insulation, heat tracing, etc. as necessary. Any bends in above ground piping require cleanouts with adequate maintenance space for snaking.

All above-ground piping shall be protected from damage resulting from vehicles, pedestrians and vandalism as required.

## **Annex**

### **Compliance with Codes and Regulations**

#### *Code Compliance*

Building codes are one of the best ways to mitigate the effects of local hazards. Post-disaster housing should be as safe and well-designed as any other housing, and should comply with current local codes. The 2014 NYC Construction Code was in effect at the time the prototype was created and is referenced in this document. Subsequent code

updates and revisions in NYC and elsewhere should govern when Interim Housing Units based on these specifications are commissioned. Where these NYC code references appear, local governments should insert their equivalent requirements.

Universal Design Recommendation: Where FEMA, HUD or local codes conflict, the strictest should govern.

The Interim Housing Units constructed to these design guidelines and performance specifications must comply with the following codes and standards in effect at time of contract award:

1. New York City Construction Codes consisting of:
  - a. New York City Building Code (NYCBC)
  - b. New York City Plumbing Code (NYCPC)
  - c. New York City Mechanical Code (NYCMC)
2. New York City Electrical Code (NYCEC)
3. New York City Fire Code (NYCFC)
4. New York City Energy Conservation Code (NYCECC)
5. New York State Energy Conservation Construction Code (NYSECCC)
6. Americans with Disabilities Act (ADA) Standards for Accessible Design
7. New York City Department of Environmental Protection (DEP)
8. New York City Housing Maintenance Code (NYCHMC)
9. New York State Multiple Dwelling Law (NYSML)
10. National Fire Protection Association (NFPA)
11. National Sanitation Foundation (NSF)
12. American Architectural Manufacturers Association (AAMA)
13. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

### **Occupancy Classification**

Based on the New York City Building Code, Section BC310.1.2, the Interim Housing Unit building complex is classified as Residential Occupancy R2, which includes apartment-type multiple dwellings and apartment hotels.

The Interim Housing Units are typically arranged as a multiple dwelling complexes, stacked four stories maximum, as buildings above four stories are required to have an elevator. The total number of dwelling units in each complex depends on the size and configuration of available sites and compliance with the NYC Building Code.

### **Construction Classification**

Construction classification for all elements of Interim Housing Units should comply with NYC Building Code Table 601 and table 602 for Type IIA and Type IIIA construction.

Fire resistance ratings for Type IIA and Type IIIA construction should not be reduced as otherwise permitted by Table 601, footnote 'd' for automatic sprinkler systems.

## **Zoning Considerations**

### **Fire District**

The Interim Housing Units may be located at any site within the five boroughs of New York City. For IHU's all portions of the boroughs of Manhattan, Bronx, Brooklyn, Queens and Staten Island shall be deemed located in the Fire District, including areas in the Fire Limits Maps annotated on NYC Building Code Appendix D as outside the Fire District. Building construction limits noted in Table 503 and Table 603 for R2 occupancy should apply as prescribed for structures located in the Fire District.

### **Height and Area**

The design of the Interim Housing Unit multiple dwelling complexes should comply with the height and area limits prescribed in NYC Building Code Chapter 5, Table 503 for R2 occupancy group and Type IIA and IIIA construction. Type V construction is excluded.

The building height increase permitted for automatic sprinkler systems per NYC Building Code Section BC 504.2 should not apply. The maximum stacked building complex height should be four (4) stories. Elevators in building four (4) stories or less in height are not required. (Refer to NYC Building Code Section BC 3002.4)

An area increase permitted for frontage per NYC Building Code Section BC 506.2 and for automatic sprinkler systems per Section BC 506.3 should not apply.

An unlimited area permitted for buildings of Type IIA and IIIA construction per NYC Building Code Section BC 507.13 should not apply.

### **Distance between Building Complexes**

The distance between Interim Housing Unit building complexes on an individual site or between units and existing buildings on an adjoining site should comply with Table 602 for R2 occupancy and type of construction.

Zoning regulations regarding setback, yard and separation distances may be waived during a declared emergency and disaster recovery. A minimum separation of 20 feet should be provided between an Interim Housing Unit building complex frontage and other Interim Housing Unit building complexes located on a common site. This is necessary in order to provide access for adequate light and ventilation and building access for Fire Department and other emergency services.







**NYC**  
Emergency  
Management