



VILLAGE HOUSING ASSESSMENT FOR THE VILLAGE OF MERTARVIK

FOR DOWL ENGINEERS AND NEWTOK VILLAGE

JUNE 14, 2017



BETTISWORTH^{NORTH}

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EXECUTIVE SUMMARY

Bettisworth North and our consultants have completed a condition survey of the housing modules located on JBER for the Denali Commission and DOWL Engineers. Our findings show the modules to be in very good condition for the Anchorage location they have been designed for, and that they have been well maintained over the 10 year life of the units.

The units were originally designed as dormitories, which required extensive life safety systems including sprinkler, fire alarm, and emergency lighting systems. Using these as duplex and fourplex units will require removal of these systems, which will be less expensive to accomplish and easier to maintain in the new village location.

Architectural modifications are a response to code deficiencies and operation features. The code deficiencies would include replacing the bedroom windows with egress compliant type in the same window openings, and code compliant entrance stairs and porches. The attic ventilation arrangement would surely introduce snow into the attics in the new village location, causing long term moisture problems. An underfloor soffit would be required in lieu of the insulated crawlspace skirting in the current configuration. These should be addressed in the plan to move the modules to elevated foundations.

Operational improvements would include converting a bedroom into a living room/ dining room and renovating the kitchens to provide adequate storage and proper appliances, such as a range. A limited amount of new flooring and repairs to doors and frames would also be required.

Operationally, the walls, roof, and floors of these units do not have the recommended amount of insulation to be energy efficient, and would most likely result in higher heating fuel costs in the village. However, they do have a minimally acceptable amount of insulation making the units overall on par with traditional HUD type housing from 10-15 years ago. Consequently, we have recommended improving the thermal envelope with monthly heating costs in mind.

Structural alterations would include a new foundation system and confirming the lateral bracing is adequate for the new higher wind loads in the village.

Mechanical alterations would include a new heating system, which could be a central plant serving multiple units or oil-fired heating systems in each unit. This also includes a way to heat hot water, since the current heating appliances are gas fired.

The alternative of not providing running water or sewer in the dwellings has been considered but not thoroughly discussed in our report. This alternative would most likely require removal of many of the primary plumbing fixtures in the dwellings, including showers, toilets, and sink piping.

Electrical alterations should include converting the electrical panels from three phase power to single phase power, and considering changing all the electrical fixtures to LED both inside and out.

ARCHITECTURAL

General



Exterior of laundry unit



Entrance to bedroom unit



Kitchen in unit

On June 1, 2017 Bettisworth North conducted a site inspection of the modular housing units on JBER with structural engineer Colin Maynard of BBFM Engineers, mechanical engineer Calvin Hay, and electrical engineer Brett Bingham of HZA Engineering to assess the suitability of rehabilitating the modules for use in the new community of Mertarvik, Alaska. The team conducted spot check of units TBK25, TBK29, TBK32, TBK37, and TBK38. Generally, all the units are in similar, good condition, most likely due to an intensive maintenance contract held for the complex. The following are the particulars of our assessment. There are 19 modules containing fourplex units only and 19 modules containing fourplex units with a laundry room attached to the end of the module. The plans are included on the following page.

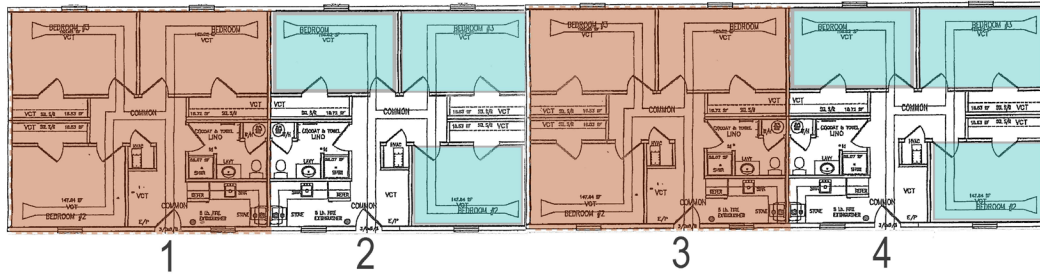
The goal of our study is to approve the use of these modules in the new townsite location. The solution would be cost-effective and, with limited retrofit, could cost less than new construction of housing units. If the modules can be obtained at little or no cost, and with limited retrofit cost, it would be a good solution to satisfy this housing need. However, our study shows that this decision needs to be made very carefully, given the configuration and conditions of these modules.

Functional Organization

The organization of the units includes (3) bedrooms, each with a closet; a small kitchen with two-burner stove top, microwave oven/fan unit, and single stainless steel sink; and a bathroom with a small vanity, toilet, shower unit, and a closet that contains the gas-fired water heater. Although the new town-site would be used as apartments, the existing modules are set up as hotel type occupancies. This is described further in the code summary below.

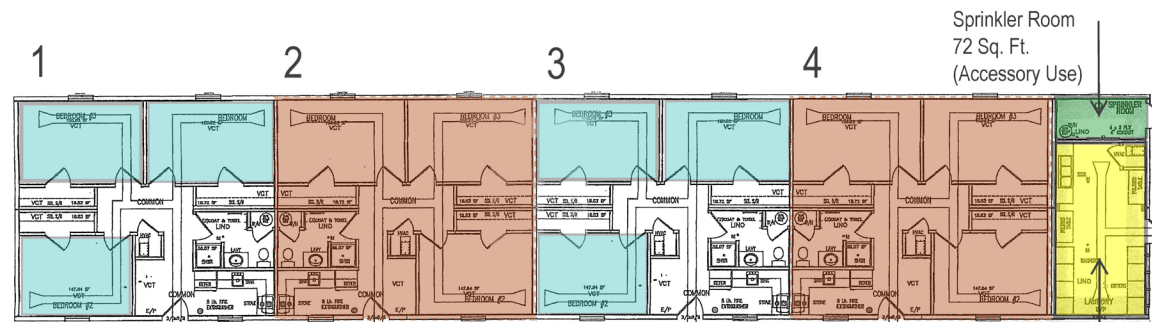
To use these modules as apartments, some living space would need to be provided, as currently there is no living or dining area within the units. It may be feasible to convert these into two-bedroom units with the third bedroom designated as the living room. The kitchens are very small for a family, with limited storage space and no oven or four burner cooktop. A single sink would also make dish washing difficult. The current configuration is also lacking a place to facilitate dining. We anticipate a family would need space for a dining table to support four to six people. The units are currently set up with running water and full sewer services however, it is unknown if water and sewer is available at the new location.

The current entrance to each unit is a single door which opens directly into the hallway. It is likely an entry vestibule would need to be added to each unit to protect the entry from driving snow and rain, and provide a place to store outdoor gear, boots, and heavy coats. There is no entry closet of any type currently in the unit, although a closet or coat hooks could easily be added.



64-ft Barracks Module

1,750 Sq. Ft. Building Area



76-ft Barracks Module

2,078 Sq. Ft. Building Area



64-FT Barrack Module.

(2) Dwelling Units at 875 Sq. Ft. each = 1,750 Sq. Ft.

Total Area = 1,750 Sq. Ft.

76-FT Barrack Module

(2) Dwelling Units at 875 Sq. Ft. each = 1,750 Sq. Ft.

1) Sprinkler Room at 72 Sq. Ft. = 71 Sq. Ft.

1) Laundry Room at 256 Sq. Ft. = 256 Sq. Ft.

Total Area = 2,077 Sq. Ft.



Typical bedroom



Interior of bedroom



Damaged strike protection plate
(Typical for bedrooms)



Cracking vinyl tile at module connection



Damaged bedroom door



Damaged plastic laminate countertops

Building Conditions

Interiors: The interior finishes of each unit are in good condition. The walls are finished with vinyl covered gypsum board which has held up very well over time. The face layer gypsum board is backed by quarter inch thick gypsum panels, most likely for durability and to prevent holes caused by abuse. Closet doors in the bedrooms are generally in good condition. Each closet also has a closet organizer for hanging and storing clothing which are in good condition. Doors in the unit are solid core wood face veneer with metal frames. There are several bedroom doors that are damaged, and in one case the frame is broken loose from the jam. The lock set on the bedroom doors have been retrofitted with strike protection plates which have quite a bit of damage. It appears the doors have been exposed to frequent attempts to gain entrance when locked.

Floors in the units are vinyl tile with some sheet vinyl in the bathrooms. There is some cracking in the vinyl where the modules join at the floor level, but generally the vinyl is in good condition. There are some areas where the vinyl has come loose with chipped corners, but this is very limited. Rubber base is used throughout and is in good condition.

The ceilings are textured gypsum board, and are in very good shape. All of the electrical and communication devices are surface mounted on the gypsum board ceiling. The gypsum board supports approximately 12 inches of insulation in the attic space, so recessed devices would be difficult to install. As noted in the electrical narrative, the light fixtures have 48' T-8 fluorescent (FL) tube bulbs. If these units are retrofitted, we would recommend new LED light fixtures be installed for energy efficiency and longevity. FL tubes would also be difficult to replace in the village.

Casework in these units is generally of low-quality, with lightweight drawer slides and standard weight hinges. The drawer and door fronts are three-quarter inch thick solid oak. Countertops are plastic laminate with plastic laminate edges, and are damaged in several areas. If these units were converted to support the village-based family, it is likely the entire kitchen would need to be renovated to a more durable solution, with proper storage and amenities.



Damaged insect window screen



Aluminum exterior window



Exterior view of unit



Damaged steel entrance canopy

Exteriors: The exterior construction of the modules matches the construction drawings provided by the manufacturer, with 2x6 exterior walls filled with batt insulation and aluminum windows glazed with double pane glazing. Penetrations in the exterior wall outlets appears to match the construction drawings, which required sealing of all holes and outlet boxes with foam. Our investigation showed this to be the case. The exterior walls are sheathed with plywood, and then covered with metal siding which has been attached with screws. The exterior walls appear to be well sealed, with no visual signs of water penetration. There is a vapor retarder behind the gypsum board, which was apparent when we pulled the cover plates for the outlets.

The roof is covered with metal roofing at a 2:12 pitch in a gable configuration. We did not gain access to the roof, but our observation of the attic showed a dry, weather tight condition. We did note numerous roof penetrations for attic vents, flues, and plumbing vents. It may be advisable to reseal all these penetrations before these modules are shipped to Arctic Alaska, considering they have been in use for 15 years.

Exterior windows are fabricated aluminum, in a double hung configuration, with double pane insulating glass. Most of the exterior insect screens have been damaged and would need replacement. The bedroom windows are not fitted with proper emergency egress windows. The current configuration allows a clear opening of 31 inches wide by 15 inches high. Code requires an egress window at each sleeping room with a clear opening of 20 inches wide by 24 inches high (5.0 SF). The IBC Code has an exception to this requirement if the building is sprinkled, however Alaska State amendments do not allow this exception. Because the building was never permitted by the state, the military would have allowed the exception as stated. When these units are moved and then permitted by the State of Alaska, new egress windows would be required on all bedroom openings.

There is a steel entrance stair and canopy over each unit entrance. The stairs are not constructed to meet current code and are starting to rust. The canopies over these entries have been damaged in many units by snow and ice.

Counters and downspouts are installed at each unit. Many of the downspouts are damaged or missing elements.

Thermal Envelope: The thermal envelope consists of R-19 batt insulation walls, R-36 batt insulation attics, and R-19 batt insulation in the floor. The State of Alaska has not adopted an energy code, however the Municipality of Anchorage has adopted the International Energy Efficiency Code. Current minimum code requirements for Anchorage (Zone 7) are Walls R-21, Attic R-49, and Floor R-38. Current good practice shows that following the minimum thermal values in the code will result in excessive energy used during winter months, which would be even more exacerbated in rural Western Alaska, which is Zone 8. The Cold Climate Housing Research Center recommends an R-60 thermal envelope in all Arctic areas of the state. Many other regulatory agencies require a continuous layer of thermal insulation on the exterior side of wood studs to thermal bridging. If these modules are moved, we would recommend removing all of the siding, adding a layer of insulation and an air barrier, replacing the aluminum windows with vinyl triple pane egress windows, and applying new siding to meet current code.



Skirting at access doors



View into attic



End gable vents



View into crawlspace

Currently, the modules are set on gravel pads on temporary foundation cribbing with insulated skirting from the bottom of the floor to the top of the gravel surface. The skirting is rigid insulation with a rating of R-19 attached to metal siding. If the modules are moved, a new R-38 soffit would need to be constructed under the units to protect the underfloor utilities from freezing. It is likely that the modules would be placed on an elevated foundation system, so the soffit would need to be protected on the bottom side with a steel liner panel, or painted wood sheathing.

As stated previously, the double pane aluminum windows are not the proper egress size, and would likely condense excessively in an Arctic environment, leading to moisture problems. A triple pane vinyl casement type window would perform much better thermally in the new location, and would meet the egress code requirements. This type of window would also be fitted with insect screens on the interior, protected against the elements.

The attics appear to be properly vented as cold roofs, with gable endvents, ridge vents, and eave vents. In Arctic conditions, these types of venting result in snowdrifts in the attic, which leads to water penetration, and eventually mold. If the modules are moved, baffled gable end vents would need to be added at the very least, and the ridge vents possibly removed. It appears additional venting was needed in the attics based on the observation of attic vents poking out of the metal roofing. Any alteration of the venting system could possibly lead to ice damming and other issues. It may be more prudent to apply rigid insulation on the top of the plywood roof deck and then have a new metal roof added, making these a warm roof solution. This would alleviate the need for a vented roof attic, and may give additional space to retrofit water and heating piping overhead if needed.

Code Deficiencies: Because the modules would be required to gain State of Alaska Fire Marshal approval to be installed in their new location, there are several code deficiencies which would need to be addressed in the new configuration. These are summarized below:

- + The first note on the code approval is that triplex and duplex/single family residences do not require State of Alaska approval. If the modules are assembled as duplex units, no Fire Marshal approval is required. However, a fourplex unit does require Fire Marshall approval. Attic access hatches are too small to meet code as they need to be a minimum of 20" x 30" in size per 18 c.
- + The entrance stairs to each unit are constructed of steel with steel handrails/guardrails. However, the current guardrails are not constructed to limit the passage of a 4 inch diameter sphere. The riser heights also exceed the code limit of 7 inches.
- + The windows from the bedrooms are not sufficiently sized to meet the clear egress requirements of the code. Since they are double hung windows, they are not able to be altered to meet code. The current configuration allows a clear opening of 31 inches wide by 15 inches high. Code requires an egress window



Small attic hatch



Sprinkler notification equipment



Interior view of piping

at each sleeping room with a clear opening of 20 inches wide by 24 inches high (5.0 SF).

- + The modules are provided with sprinklers throughout, but to satisfy the code for an R-2 apartment style occupancy, sprinklers are not required. The sprinkler system would need to be removed entirely if these units are re-purposed, and cannot be abandoned in place. The sprinkler piping is routed in the crawl space and surface mounted in each unit.
- + The thermal envelope upgrade is not a code requirement, but strongly recommended to keep utility costs within a manageable limit for the tenants.

ADA Requirements: For alterations to existing buildings, if the “building” contains more than 15 dwelling units, then accessibility requirements trigger for 2% to be accessible. Moving the modules as fourplex or duplex units should not trigger ADA requirements.

Architectural Summary

To renovate the modular building units for reuse in the new village of Mertarvik, Alaska, and gain State Fire Marshal approval to do so, the following architectural elements would need to be renovated or replaced:

- + Reconfiguration of the units to provide an adequate kitchen, dining, and living area. The three bedroom units would most likely become two bedroom units.
- + Addition of an entry vestibule, with new stairs and entry decks to conform to the new height and foundation type.
- + Improvement to the thermal envelope with new exterior skin of rigid insulation/furring and new siding. Target R-30 minimum walls/floor.
- + Addition of insulation to the roof by adding rigid insulation and converting to a warm roof system with a heated attic. Target R-40 minimum.
- + Building new, insulated under floor soffits to protect under floor utilities.
- + Replacement of windows with higher efficiency, egress sized windows with new screens.
- + Enlargement of attic access hatches for fire access.
- + Replacement of flooring in approximately 10% of each unit.
- + Replacement of fluorescent light fixtures with new LED fixtures.

STRUCTURAL

The housing on Joint Base Elmendorf is modular housing designed in accordance with the 2003 International Building Code. Four modules are used to make up four units. As a fourplex, the Alaska State Fire Marshal has jurisdiction and currently requires use of the 2012 International Building Code. The original structural design loads and the current design loads for Newtok are:

<u>Load Case</u>	<u>Original Design</u>	<u>Newtok Criteria</u>
Snow	Pg = 50 psf	Pg = 30 psf
	Pf = 40 psf	Pf = 21 psf
Wind	115 mph (ASD)	159 mph (LRFD)
	Exposure B	Exposure C
	qz = 18 psf	qz = 47 psf (LRFD)
		qz = 28 psf (ASD)
Seismic	Ss = 1.50	Ss = 0.184
	S1 = 0.55	S1 = 0.088
	Sds = 1.0	Sds = 0.196
	S1s = 0.55	Sd1 = .0140
	Bearing/Shear walls with Plywood Sheathing	
	R = 6.5	R = 6.5
	Cs = 0.154	Cs = 0.030
	Category D	Category C

Therefore, the snow and seismic loads would be less than these facilities were designed to resist. On the other hand, the wind loads would be considerably higher. An analysis would be necessary to determine whether the existing diaphragms and shear walls would be adequate to resist these higher loads. However, given the number of walls and the limited windows and other openings, they appear likely to be sufficient.

The roof construction is plywood sheathing on plate-connected wood trusses spanning between the exterior longitudinal walls and interior walls or beams. The interior and exterior bearing walls have plywood sheathing. The floor construction is plywood sheathing on 2x8 floor joists supported by a steel frame. The steel frame has been designed to support the structure on site and, with the addition of six axles, transport the modules.

The units came with packaged stair entry structures which are constructed from steel tubes and channels. With some exceptions, they seem to be in good condition but may not be useful in Newtok, as the modules may need to be elevated more for the new foundation system and soffit. Similar stair and ramp structures can be designed to account for the greater elevation.

The units themselves are in good condition. There was no sign of deterioration. It is our conclusion that these modules can be moved to Newtok and be used with little, if any, structural modification. However, a lateral analysis will need to be conducted as part of the design for the new foundation system.

MECHANICAL

Plumbing Systems

Utility Service: Each modular building is presently served by buried water and sewer services. The utility services enter the modules at the skirted crawlspace and piping is routed horizontally through the skirted crawlspace to the point where it connects to the modular plumbing systems.

Cold/Hot Water Distribution: Record drawings indicate cold and hot water piping is located below the building, above a woven polyethylene bottom barrier. The cold and hot water piping was not readily visible under the building, but based on observed floor penetrations, the record drawings appear to be correct. Cold and hot water distribution to fixtures appears to be a mix of PEX and CVPC. The existing cold and hot water distribution piping seems to be in good condition.

Hot Water Generation: Domestic hot water is produced by various gas-fired water heaters. There is one water heater that serves each three bedroom unit (four per module), and one water heater that serves the laundry room (where applicable). Each water heater is located in a closet with a drain pan. The drain is piped through the crawlspace to the outside. The existing hot water heaters appear to be in good condition.

Waste & Vent: Waste and vent piping appear to be routed above the woven polyethylene bottom barrier similar to the cold/hot water piping. Waste and vent piping consists of ABS piping serving applicable fixtures. Waste piping is collected and routed to the buried sewer and vent piping is collected and routed through various vents through roof assemblies. The existing waste and vent piping appear to be in good condition.

Fixtures: Each three bedroom unit is provided with a kitchen sink, water closet, bathroom, shower, and floor drain. The laundry area is provided with four washer boxes, a laundry sink, and floor drain. The fixtures are residential quality and appear to be in good condition.

HVAC Systems

Heat: Heat to each module is generally provided by gas-fired furnaces. There is one furnace that serves each three bedroom unit (four per module), one that serves the laundry room (where applicable), and one that serves and is located in and the crawlspace. The furnaces serving the dwelling areas and laundry rooms are located in closets and supply underfloor duct work to floor registers. Return air is by means of a central return air grille at the furnace closet. The underfloor duct system was not visible and record drawings indicate it is located above the woven polyethylene bottom barrier, similar to plumbing piping. Each furnace is controlled by a programmable wall mounted thermostat. The existing gas-fired furnaces appear to be in good condition.

Ventilation: Occupant ventilation appears to be provided by operable windows.

Miscellaneous Exhaust: The modular buildings include a variety of miscellaneous exhaust systems including residential range exhaust, bathroom exhaust, a general exhaust fan located in the central corridor of each three bedroom unit, a general exhaust fan in the laundry room, and dryer venting to the exterior. Exhaust fans are individual ceiling mounted type and discharge either through roof caps or wall caps.

Fire Protection

Wet Pipe Sprinkler: The modulars are provided with NFPA 13R, wet pipe sprinkler systems. Water supply for the sprinkler system is provided by the buried water service main and serves a sprinkler riser located in a utility room adjacent to the laundry room. Each riser assembly serves four, 64 foot building modules. A portion of the sprinkler piping from one module to the adjacent module is routed underground. Sprinkler distribution piping within the modules is primarily plastic pipe, and is exposed in some locations.

Mechanical Summary

The primary mechanical system challenges associated with the use of the existing modules in Mertarvik are:

- + Fuel source.
- + Keeping the mechanical systems presently located in the skirted crawlspace of the building within an insulated and heated enclosure.

For the purpose of this report we assume:

- + The fuel source in Mertarvik will be fuel oil.
- + The modules will be provided with an insulated and heated enclosure such that the mechanical systems within the crawlspace may be reused.

If propane were a practical fuel source, the existing gas-fired appliances could most likely be converted to propane-firing at minimal cost. However, we doubt that the necessary propane storage and transport facilities would be available in the community. Therefore, the use of propane was not considered viable. Direct vent toyo-stove type heaters could also be considered, but would need to be sized appropriately and dispersed to meet the heating load.

Assumptions

Plumbing Systems

- + **Utility Service:** We anticipate new water and sewer service would be provided to the modules and routed within the insulated and heated enclosure under the building.
- + **Cold/Hot Water Distribution:** We anticipate existing cold and hot water distribution systems will be connected to utility services as applicable and reused in their present configuration.
- + **Hot Water Generation:** The existing gas-fired water heaters will need to be removed and replaced with hot water generation devices applicable to the available energy supply. We are doubtful that the closets that presently house the water heaters are large enough to house oil-fired water heaters due to the additional space required for the burner assembly. It may be possible to enlarge the closet, use an electric water heater, or an indirect-fired water heater connected to a boiler water system.
- + **Waste & Vent:** We anticipate existing waste and vent piping systems will be connected to utility services as applicable and reused in their present configuration.
- + **Fixtures:** We anticipate existing fixtures will be reused in their present configuration.

HVAC Systems

- + **Heat:** The existing gas-fired furnaces would need to be removed and replaced with heating devices applicable to the available energy supply. We are doubtful that the closets that presently house the furnaces are large enough to house oil-fired furnaces due to the additional space required for the burner assembly. Also, the use of an oil-fired furnace in an enclosure under the building will most likely be difficult with respect to venting, and is a potential fire hazard. We suggest construction of a centralized boiler plant(s) that serve multiple units with heated glycol piping. It may be possible to use a portion of the laundry room for this function. The glycol piping systems would serve fan-coil units located in the existing furnace closets and connected to existing duct distribution systems. In addition, the heated glycol piping could also supply domestic water heating equipment. As previously discussed, smaller dispersed toyo-stove type heaters could also be considered.
- + **Ventilation:** We anticipate occupant ventilation will continue to be provided by operable windows.
- + **Miscellaneous Exhaust:** We anticipate existing miscellaneous exhaust systems will be reused in their present configuration.

Fire Protection

- + **Wet Pipe Sprinkler:** The water supply systems in rural communities do not typically have sufficient flow and pressure to serve wet pipe sprinkler systems. It is our understanding that the sprinkler system is not technically required. If it is desirable to reuse the sprinkler system, further information would be necessary regarding water utility capacities. A water storage and pumping system may be required.

ELECTRICAL

General

There was no electrical power to any of the modules and therefore proper operation of the electrical systems and components were not able to be verified.

Electrical Service and Distribution

Electrical Service: Each module has main electrical equipment on the exterior of the building that includes a main incoming gutter for electrical service connection with distribution to four (five where laundry and sprinkler room is provided), 125 amp, 120/208 volt, and 3 phase fused main disconnects, each supplying power to a dwelling unit (and laundry room where provided) panel. There are no utility meters, or CT Enclosures for connection of the utility metering equipment.

Power Systems

Panels: There is one panel board that serves each three bedroom unit (four per module) and one panel board that serves the laundry and sprinkler rooms (where applicable). The panel in the laundry room is rated 125 amp, 120/208 volt, 3 phase while the panels in units are rated 150 amps, 120/208 volt, 3 phase. The panels are Eaton Cutler Hammer type, have a 125 amp main breaker and are supplied by #2 copper conductors from a 125 amp fused disconnect on the exterior of the module. The panels have separate neutral and ground bars, appear to be in good operating condition, and have physical spare capacity for additional circuits to be added in the future. The circuit breakers are rated for 10,000 amperes interrupting current. Arc-fault circuit breakers have been provided for circuits supplying bedroom outlets in compliance with the edition of the National Electrical Code (NEC) that was in use at the time of design and construction. The current NEC also requires these combination type arc-fault breakers for circuits throughout most of the dwelling unit, not just in bedrooms. The arc-fault breakers are not the "combination type" that is required by the current NEC.

Receptacles: The quantity and locations of receptacles within the rooms and spaces appears to be adequate and compliant with the electrical code. There were no receptacles located on the exterior of the module, however. All receptacles were

installed recessed into the walls. Receptacles are 20 amp, 125 volt rated, grounding type with connections to equipment grounding conductors. The receptacles were not the tamper-resistant type that are required by the current edition of the NEC. Receptacles located in the bathrooms and kitchens where serving the counter tops were GFCI type. The receptacles serving the refrigerators were located within 6' of the kitchen sink, but were not GFCI type, as required by the current edition of the NEC. Receptacles in the laundry room were not GFCI type, as is required by the current edition of the NEC.

Lighting Systems

Interior Lighting: The majority of the interior lighting is comprised of linear 4' surface mounted fluorescent fixtures with T8 lamps and acrylic wraparound lens. Additional incandescent socket fixtures were located in the water heater and furnace spaces, and round residential style surface mount fixtures were mounted in the bathrooms and kitchens over the sinks. The fixtures appeared to be in decent shape. Except for the incandescent porcelain sockets, which were pull-string controlled, lighting in each individual space is controlled by on/off toggle switches.

Exit Signage/Emergency Lights: A combination exit sign and emergency light is located just inside the door of each unit, laundry room, and sprinkler room. The exit/emergency lights appear to be in good condition, however it is anticipated that the batteries have been discharged and will need to be replaced. There is no emergency egress illumination at any of the exterior landings.

Exterior Lighting: Each module has 2-3 different styles of exterior light fixtures. Each module has commercial grade wall pack type fixtures located adjacent to each exterior man door. These fixtures utilize compact fluorescent lamps and are controlled via on/off toggle switches located inside the doors. There are additional wall pack fixtures located between the unit doors and full cutoff area lights on the ends of some of the modules to provide general illumination. The record drawings indicate that these fixtures utilize HID lamping and are controlled by photocell controls. All of the fixtures appeared to be in decent shape.

Specialty Systems

Telecommunication: Each bedroom has a telecommunication outlet and television outlet, with category 6 cabling routed to either that module's sprinkler room or, if the building does not have a sprinkler room, to the adjacent modules's sprinkler room where it is terminated to a patch panel. The television cabling is routed to an exterior mounted demarcation box on the corner of each module.

Fire Alarm: Each module has residential style, standalone smoke detectors located in the bedrooms and in the hallway outside, leading from the bedrooms. The detectors are 120 volt, hardwired type and appear to be interconnected, but do not appear to have a battery back-up. The detectors list a date of September 5, 2002 making them 15 years old. A single standalone carbon monoxide detector is located in each unit in

the hallway just outside of the bedrooms. The detector does not have battery back-up capabilities, and has a manufacture date of May 2005, making them 12 years old. Building fire alarm system hornstrobes and pullstations are located in each unit, laundry room, and sprinkler room. The fire alarm control panel however has been removed.

Electrical Summary

Assumptions

Electrical Service

- + We anticipate new electrical utility service will be provided and connected to the modular buildings by the utility company. We anticipate the electrical utility can accommodate 120/208 volt, 3 phase power to each module. The existing electrical gutter and main disconnects on each module would need to be removed and replaced with new electrical service equipment conforming with the serving utility company's standards. We anticipate the service equipment will need to be suitable for overhead utility connection and have 4 meters (5 meters if laundry/sprinkler room is included) each with circuit breaker main disconnects for connection to the building's panels.

Panels

- + If 3 phase utility power is available, we anticipate the existing electrical panelboards will be reused. If 3 phase utility power is not available, the existing 3 phase electrical panels will need to be removed and replaced with 120/240 volt, single phase panels and new circuit breakers. In order to comply with the current edition of the NEC, existing circuit breakers serving outlets in the kitchens, hallways, closets, laundry rooms, and similar areas would need to be removed and replaced with new combination arc-fault type circuit breakers.

Receptacles

- + For compliance with the current edition of the NEC, the electrical receptacles in the units would need to be replaced with tamper-resistant type receptacles and the refrigerator receptacle would need to be GFCI protected. The 20 amp, 120 volt receptacles in the laundry room will also need to be replaced with GFCI type receptacles.

Lighting Systems

- + **Interior Lighting:** We anticipate the existing lighting fixtures and controls would be reused in their present configuration; however, considering the relamping of the existing FL tubes, it may be advisable to consider new LED fixtures throughout the units. This would improve energy efficiency and extend any relamping for 10-12 years.

- + ***Exit Signage/Emergency Lights:*** It is anticipated the batteries in the existing combination exit sign/emergency light fixtures would need to be replaced to provide illumination for a minimum of 90 minutes as required by the IBC. It is our understanding that the exit signage and emergency illumination in the units is not technically required and could be removed. To comply with the current edition of the IBC, additional exterior emergency egress illumination would need to be provided outside at the stair landing of each exit that requires interior emergency illumination.
- + ***Exterior Lighting:*** Compact fluorescent ballasts and lamps typically do not start or operate well in cold temperatures. It is recommended that the existing wall pack fixtures with compact fluorescent lamps be removed and replaced with new fixtures utilizing LED or HID lighting more suitable for cold temperatures. It is anticipated that the existing wall mounted fixtures utilizing HID lighting and the lighting controls for all exterior lights will remain for reuse.

Specialty Systems

- + ***Telecommunication:*** It is anticipated that existing telecommunication and television components and associated wiring will remain for reuse. It is anticipated new telecommunication utility service would be provided and connected to the modules by the utility company, and that new raceways, boxes, risers, weatherheads, etc. would need to be installed to accommodate connection to the utility service.
- + ***Fire Alarm:*** Due to the age of the residential standalone smoke and carbon monoxide detectors, we believe they should be removed and replaced with new detectors (hardwire and battery backup). It is our understanding that the modules' fire alarm systems are not technically required, and since the fire alarm panels are missing, existing building fire alarm system components such as hornstrobes, pull stations, detectors, etc. should be removed. If it is desirable to have a building fire alarm system and reuse the existing fire alarm system components, a compatible fire alarm control panel would need to be installed in each module. However, half of the modules do not have a dedicated or common space for the fire alarm panel to be located.