

THE DOMES STUDENT HOUSING

Field Investigation Report



DECEMBER 2010



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THE DOMES STUDENT HOUSING FIELD INVESTIGATION REPORT

EXECUTIVE SUMMARY

The Domes Student Housing project, otherwise known as Baggins End, was opened in the fall of 1972 as an experimental cooperative housing project. It is comprised of fourteen single story, 24-foot diameter, double-occupancy, geodesic domes each having a living area, kitchen, bathroom, bedroom, and loft. Each dome was built by students under the supervision of a contractor and is constructed of three to four inches of polyurethane foam surrounded by a fiberglass shell.

This report includes visual observations and recommendations from a series of site visits of the Domes per the request of UC Davis Student Housing to assess the current condition of the housing units after an evaluation of Dome #10 exposed life safety and energy efficiency concerns. The building evaluations here focus primarily on the structural integrity of each unit, the condition of the heating, ventilating and air conditioning system, and the electrical system and its components. The following assessments have been made by licensed Engineers and are based on the 2007 California Building Code. They only apply if the building is renovated or the client wishes to bring the buildings up to current code. These recommendations are meant as a guide to Student Housing to better inform them of the technical issues surrounding these housing units as they weigh decisions to upgrade and/or repair significant deficiencies within them.

Based on the inspection of Domes #2 thru #15 their physical condition should be considered sub-standard with respect to providing suitable living conditions for UC Davis students. Additionally, the necessary renovation work may trigger codes that will result in significant upgrades and/or replacements of other building elements and systems which should be considered before beginning any work.

STRUCTURAL

A cursory inspection and an examination of the historical photographs revealed that the lofts are wood framed beam, girder, and post construction. The historical photos also showed interior walls that were pre-built with single top plates. Each Dome has a unique loft framing plan so no record drawings are available for the loft framing, they did show a floor framing plan that showed a raised floor, but the field visit revealed a concrete floor slab. Historical photos were consistent with the field visit and showed the concrete floor slab construction as well.

The Domes were found to be in generally good condition for a structure built in the 1972 time period. There was no visible deterioration of the outside shell, except for the delamination in Dome #10. The loft wood framing members were found to be in good condition, without splits, checks, or sags in the framing. However, there are three commonly noted deficiencies which were discussed in the field during the inspection process. For specific structural recommendations per dome refer to Appendix B.

Condition A

Deficiency: The pre-built interior walls were designed to be non-bearing walls hence they were built with only a single top plate. However during construction, these walls became bearing walls which supported beams and girders. See photo S-1 in Appendix A.

Recommendation: Bearing walls need to have double top plates. This condition appears to be the same at all of the Domes and should be further investigated and remedied.

Condition B

Deficiency: Support columns were found missing at the intersection of multiple floor girders at Dome #10 and at Dome #12. See photos S-2 and S-3 in Appendix A.

Recommendation: The columns should be reinstalled, or, because the girders are probably supported by cantilever beams projecting out from the top of interior walls, a more detailed structural analysis is needed to identify the load path and make sure that beam hangers are provided, in lieu of toe nailing.

Condition C

Deficiency: Most of the column to girder connections were found to have adequate metal connection plates/ties but some columns were found to have minimal connection supporting the girder, at the top of the column. See photo S-4 in Appendix A. Some were toe nailed and some had insufficient metal straps.

Recommendation: A more detailed investigation should be done at each Dome and metal connections should be added at places where only toe nails are found.

MECHANICAL

Each Dome was constructed to the minimum required ventilation and plumbing system for residential occupancy. The operable windows and a single turbine ventilator provide natural ventilation. There is no air conditioning equipment to provide cooling however a wall mounted electric unit heater provides space heating to the main core. Heating hot water is supplied by a domestic electric water heater at each dome. Several instances of non-compliance to the California Building and Mechanical codes were consistently found throughout the Dome Housing.

Heating, Ventilating and Air Conditioning

There is adequate natural ventilation due to the operable windows and the sheet metal turbine ventilator at the peak of the dome, however the sheet metal materials on the turbine have deteriorated and may require replacement. The Dome structure is not air tight and air leakage is rampant, in conjunction with poorly insulated walls and single pane windows, there is considerable energy loss. There is also no mechanical exhaust in either the kitchen or bathroom areas.

Deficiencies: 2007 California Building Code (CBC), Section 1203.4.2.1 requires bathrooms to be mechanically ventilated, all Dome bathrooms are not in compliance. 2007 California Mechanical Code (CMC), Section 916.1 (B) requires mechanical ventilation above the cooking range when combustible material is directly located above it, such as in Dome #10, see photo M-1 in Appendix A, the current kitchen ventilation in this dome is not in compliance.

Recommendations: Refer to Appendix B for specific HVAC recommendations for each dome.

Plumbing

Each Dome unit is equipped with a basic plumbing system that includes fixtures, piping supports, backflow prevention devices, and an electric domestic hot water heater. Most existing piping needs to be insulated and properly supported.

Deficiencies: Per 2007 CMC, Section 508.2 the water heater tanks in the majority of the domes are not properly supported for seismic protection, see photo M-2 in Appendix A. In almost half of the domes, the sanitary sewer vent pipe exits the exterior wall horizontally as in Dome #3, see photo M-3 in Appendix A. Vent pipes must be terminated vertically through the wall as required in 2007 CMC, Section 906.1. There is a hose bib connection for each Dome; however the hose connection is missing the proper type of backflow preventer as indicated in 2007 CMC, Section 603.2.3, see photo M-4 in Appendix A. Installation of backflow prevention devices must be approved by the Authority Having Jurisdiction and be tested by a Certified Backflow Assembly tester. If required by Authority Having Jurisdiction also provide protection for freezing.

Recommendations: Refer to Appendix B for specific plumbing recommendations for each dome.

ELECTRICAL

Each Dome was constructed to comply with the National Electrical Code requirements for residential wiring in the 1972 time period. Electrical service is fed to the site via the Campus 12.47KV medium voltage distribution system and a pad mounted transformer that steps it down to 120/208-volt system with distribution to each Dome. Each Dome has a 100-amp main circuit breaker panel with branch breakers serving the dome. At the peak of the Dome, there is a smoke detector adjacent to the turbine ventilator that might be exposed to water damage during heavy rain pour that the Fire Department is recommending to relocate away from the ventilator, see photo E-1 in Appendix A.

General: The inspection and subsequent review found that the electrical equipment in each dome is in fair to good condition, and it remains serviceable. Key components of the electrical system are approximately 38 years old and thus are approaching the end of expected service life.

Deficiencies: Conditions within the electrical system that are not in compliance with the 2007 National Electrical Code (NEC) are Ground-Fault Circuit-Interrupter (GFCI outlets) protection in the Kitchen (NEC-210.8), and Arc-Fault Circuit-Interrupter protection of circuits serving bedrooms (NEC-210.12). Outlets were located near and on the floor throughout the Domes, although NEC does not

require minimum mounting heights of plug outlets, The Americans with Disabilities Act (ADA) will dictate the minimum height of outlets for compliance, see photo E-2 in Appendix A.

Recommendations: Refer to Appendix B for specific electrical recommendations for each dome.

APPENDIX A

Structural

S-1: Dome #15, Condition A, at the hot water heater closet.



S-2: Dome #10, Condition B, Intersection of girders.



S-3: Dome #12, Condition B, Intersection of girders.



S-4: Dome #14, Condition C, inadequate column to girder connection



Mechanical

M-1: Dome #10, combustible material above cooking range.



M-2: Dome #4, water heater tank not properly braced.



M-3: Dome #3, horizontal termination of sanitary sewer vent piping.



M-4: Dome #12, improper backflow prevention device.



Electrical

E-1: Dome #5, Smoke detector vulnerable to water damage.



E-2: Dome #3, electrical outlet located at floor



APPENDIX B

Dome Investigation Recommendations Table

Date Evaluated	Dome #	Structural	HVAC	Plumbing	Electrical
11/9/2010	2	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Relocate exterior electrical pull box from directly under water hose bib. Relocate outlet on mezzanine floor. Add GFI protection to Kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/9/2010	3	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate Piping. Install proper type of backflow preventer. Reroute vent piping to terminate vertically through wall. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Install cover for LB type fitting for conduit penetrating the wall. Add GFI protection and waterproof cover for duplex receptacle mounted at base of bathroom floor, OR eliminate completely if not in use. Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/9/2010	4	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Install proper type of backflow preventer. Install vacuum breaker on exterior hose bib. Reroute vent piping to terminate vertically through wall. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/9/2010	5	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Replace 6-plug capacity outlet at right side of kitchen sink with regular duplex outlet. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/23/2010	6	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Install piping supports Insulate piping Repair hot water faucet in kitchen to turn in the correct direction. Repair hot water faucet in bathroom to turn in the correct direction. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/23/2010	7	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Install piping supports Reroute vent piping to terminate vertically through wall. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/23/2010	8	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports Repair hot water faucet in bathroom to turn in the correct direction. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.

11/23/2010	9	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Reroute vent piping to terminate vertically through wall. Add seismic bracing to hot water tank 	<ul style="list-style-type: none"> Install cover on house panelboard. Add GFI protection to kitchen outlets at counter area. Replace 6-plug capacity outlet at right side of kitchen sink with regular duplex outlet. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
7/14/10	10	<ul style="list-style-type: none"> Repair delamination on exterior shell. Columns should be reinstalled with beam hangers at the intersection of multiple floor girders. More detailed investigation of structural integrity of bedroom loft recommended. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation Install metal ventilating hood above the cooking surface OR remove kitchen cabinet above range. 	<ul style="list-style-type: none"> Insulate piping. Install piping supports. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add GFI protection for bathroom outlets. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits. Install Smoke detector in loft bedroom area.
11/23/2010	11	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Install piping supports Insulate piping Fix hot water faucet in kitchen to turn in the correct direction 	<ul style="list-style-type: none"> Relocate exterior electrical pull box from directly under water hose bib. Install blank cover on surface mounted pull box in bathroom. Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/16/2010	12	<ul style="list-style-type: none"> Columns should be reinstalled with beam hangers at the intersection of multiple floor girders. 	<ul style="list-style-type: none"> Unblock 2nd floor - ventilator opening. Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer Add access panels for valves. Reroute vent piping to terminate vertically through wall. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/16/2010	13	<ul style="list-style-type: none"> More detailed investigation recommended to confirm actual construction of bearing wall top plates, support columns, and connections. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer Add access panels for valves. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/16/2010	14	<ul style="list-style-type: none"> Install metal connections at column to girder connections and where only toe nails are found. 	<ul style="list-style-type: none"> Unblock 2nd floor - ventilator opening. Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer Add access panels for valves. Repair hot water faucet in bathroom to turn in the correct direction. Add seismic bracing to hot water tank. Repair or replace hot water handle in kitchen. 	<ul style="list-style-type: none"> Add GFI protection to kitchen outlets at counter area. Evaluate smoke detector and replace if defective. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.
11/16/2010	15	<ul style="list-style-type: none"> Add double top plates to load bearing interior walls. 	<ul style="list-style-type: none"> Install bathroom exhaust fan. Replace roof top turbine ventilator Suggested Energy Improvements: <ul style="list-style-type: none"> Seal building envelope to correct air leakage Upgrade to double-pane windows Improve wall insulation 	<ul style="list-style-type: none"> Insulate piping Install piping supports. Install proper type of backflow preventer Add access panels for valves. Install vacuum breaker on exterior (wall?) hose bib. Add seismic bracing to hot water tank. 	<ul style="list-style-type: none"> Cover enclosure at stove to conceal wall heater wiring. Add GFI protection to kitchen outlets at counter area. Evaluate smoke detector and replace if defective. Add Arc-Fault Circuit-Interrupter protection to bedroom circuits.