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APPENDIX A. RESIDENTIAL CERTIFICATION TESTS

The purpose of ACM testing is to demonstrate that candidate software submitted for approval successfully integrates Compliance Manager into the candidate software. This includes testing a variety of both inputs and reporting to ensure that buildings are being accurately modeled under the rules established by the Energy Commission.

A test data set with specific description and details of the tests, inputs, and a spreadsheet of compliance results is available from the Energy Commission to assist vendors in preparing the certification tests. The tests are based on the Energy Commission 2100 ft^2, 2700 ft^2 and 6960 ft^2 new construction prototypes and the 1665 ft^2 addition/alteration prototype described in Section F.

A. Test Data Set (TDS) Descriptions

The TDS runs are based on the prototypes described in Section F. below. The exact details of the TDS runs are provided in the form of reference software input files, currently an .ribd format.

Tests T01, T02 and T03 show that the compliance software matches the standard design in all climate zones for the three prototype buildings. The glass and walls are equally distributed, with no overhangs modeled. The prototype buildings (as shown in Table A-1) for these tests are named S2100, S2700 and S6960. The “S” indicates that the building is in the standard configuration.

Tests T04, T05 and T06 run the prototype buildings using actual building features such as unequal glass and wall distribution, overhangs and other non-prescriptive requirements. The standard design for these tests will be equal to the standard design in Tests T01-T03. The prototype buildings for these tests are named P2100, P2700 and P6960. The “P” indicates that the building is in the proposed configuration.

Tests T07, T08, T09 and T11 are based on a single prototype in a single climate zone - T01R12. Test T07 models common compliance measures and test T08 runs water heating variations. T09 test multiple orientations. T11 tests source energy calculations.

Test T10 covers multifamily central water heating starting with on T03R12 inputs.

Tests T12 and T13 cover existing plus addition plus alteration calculations using P1665 prototype for climate zone 12.

Additional tests will be added as needed to reasonably test candidate software against the reference as features are added or changed. There will also be non-numeric tests added to verify that the candidate software can complete the compliance process by generating reports.

Table A-1 contains a list of the tests.

Table A-1: Test Data Set Files and Descriptions

Test #	Run #	# of Runs	Description	Prototype
			Standard and Proposed Design Tests	
T01	R01-R16	16	Standard Design Test	S2100
T02	R01-R16	16	Standard Design Test	S2700
T03	R01-R16	16	Standard Design Test	S6960
T04	R01-R16	16	Proposed Design Test	S2100
T05	R01-R16	16	Proposed Design Test	S2700
T06	R01-R16	16	Proposed Design Test	S6960
T07			**Common Measures in Climate Zone 12**[1]	
T07	R01	1	Package A	T04R12
T07	R02	1	Fenestration U 0.40/S 0.40	T04R12
T07	R03	1	Wall R13	T04R12
T07	R04	1	Ceiling R49	T04R12
T07	R05	1	Furnace AFUE 92	T04R12
T07	R06	1	Air Conditioner SEER 16/EER 14	T04R12
T07	R07	1	No Cool Vent	T04R12
T07	R08	1	Ducts 2% Leakage	T04R12
T07	R09	1	Insulation Construction Quality Improved	T04R12
T07	R10	1	Air Leakage CAH50 2.0	T04R12
T08			**Water Heating in Climate Zone 12**[2]	
T08	R01	1	Package A	T04R12
T08	R02	1	Parallel Piping	T04R12
T08	R03	1	Small Tankless EF 0.80/Input 195000/0 gal	T04R12
T08	R04	1	Large Tankless RE 0.76/Input 300000/0 gal	T04R12
T08	R05	1	Large Storage RE 0.77/Input 100000/75 gal/Stby 0.01	T04R12
T08	R06	1	Large Storage RE 0.77/Input 100000/75 gal/Stby 0.03	T04R12
T08	R07	1	Electric Resistance EF 0.92/Input 4500	T04R12
T08	R08	1	Heat Pump EF 2.4/Input 4500	T04R12
T08	R09	1	2 Water Heaters using multiplier	T04R12
T08	R10	1	2 Water Heaters using 2 entries	T04R12

1. Tests have the same standard design as T01R12.
2. Some tests will have a standard design different than T01R12.

Test #	Run #	# of Runs	Description	Prototype
T09			**Multiple Orientation, Climate Zone 12**	
T09	R01	1	Single Standard Front 45	T04R12
T09	R02	1	East Standard	T04R12
T09	R03	1	South Standard	T04R12
T09	R04	1	West Standard	T04R12
T09	R05	1	North Standard	T04R12
T09	R06	1	Single Proposed Front 45	T04R12
T09	R07	1	East Proposed	T04R12
T09	R08	1	South Proposed	T04R12
T09	R09	1	West Proposed	T04R12
T09	R10	1	North Proposed	T04R12
T10			**Multi Family Water Heating in Climate Zone 12**[3]	
T10	R01	1	8 Storage	T06R12
T10	R02	1	8 Storage 2 Systems	T06R12
T10	R03	1	8 Large Storage	T06R12
T10	R04	1	2 Large Storage Central Solar	T06R12
T10	R05	1	2 Large Storage Central Solar Recirc	T06R12
T10	R06	1	2 Large Storage Central Recirc	T06R12
T10	R07	1	2 Small Instant Central Solar	T06R12
T10	R08	1	2 Small Instant Central Solar Recirc	T06R12
T10	R09	1	1 Indirect Central Solar	T06R12
T10	R10	1	1 Indirect Central Solar Recirc	T06R12
T11			**Source Energy in Climate Zone 12**[4]	
T11	R01	1	Package A	T04R12
T11	R02	1	Package A no Natural Gas	T04R12
T11	R03	1	Electric DHW	T04R12
T11	R04	1	Electric DHW no Natural Gas	T04R12
T11	R05	1	Heatpump DHW	T04R12
T11	R06	1	Heatpump DHW no Natural Gas	T04R12
T11	R07	1	Heatpump HVAC	T04R12
T11	R08	1	Heatpump HVAC no Natural Gas	T04R12

3. Some tests will have a standard design different than T03R12.
4. Some tests will have a standard design different than T01R12

Test #	Run #	# of Runs	Description	Prototype
T11	R09	1	Heatpump HVAC & DHW	T04R12
T11	R10	1	Heatpump HVAC & DHW no Natural Gas	T04R12
T12			**E+A+A Base & Windows**[5]	
T10	R01	1	E 1440 ft^2 as New Construction	P1665
T10	R02	1	E 1440 ft^2 as Addition/Alteration	P1665
T10	R03	1	EA 1665 ft^2	P1665
T10	R04	1	EAA Ceiling R38 Verified	P1665
T10	R05	1	EAA Ceiling R38 Verified Wind U 0.41/S 0.36	P1665
T10	R06	1	EAA Ceiling R38 Verified Wind U 0.41/S 0.36 Verified	P1665
T10	R07	1	EAA Ceiling R38 Verified Wind U 0.40/S 0.35	P1665
T10	R08	1	EAA Ceiling R38 Verified Wind U 0.40/S 0.35 Verified	P1665
T10	R09	1	EAA Ceiling R38 Verified Wind U 0.39/S 0.34	P1665
T10	R10	1	EAA Ceiling R38 Verified Wind U 0.39/S 0.34 Verified	P1665
T13			**E+A+A Walls & HVAC**[5]	
T10	R01	1	EAA Ceiling R38 Verified Wall R11	P1665
T10	R02	1	EAA Ceiling R38 Verified Wall R11 Verified	P1665
T10	R03	1	EAA Ceiling R38 Verified Wall R13	P1665
T10	R04	1	EAA Ceiling R38 Verified Wall R13 Verified	P1665
T10	R05	1	EAA Ceiling R38 Verified HVAC Worse	P1665
T10	R06	1	EAA Ceiling R38 Verified HVAC Worse Verified	P1665
T10	R07	1	EAA Ceiling R38 Verified HVAC Equal	P1665
T10	R08	1	EAA Ceiling R38 Verified HVAC Equal Verified	P1665
T10	R09	1	EAA Ceiling R38 Verified Better	P1665
T10	R10	1	EAA Ceiling R38 Verified Better Verified	P1665

5. Standard design varies with features and verification.

B. Test Data Set

The test data set is maintained by the Energy Commission and made available to vendors. This data consists of:

1. The reference program input files (currently .ribd files) for all runs that describe all inputs for each run.

2. The test data set spreadsheet that describes each test and compares the current reference results to the candidate results to determine if it passes the numeric results test. The results for the reference software will be imported using the AnalysisResults.csv file generated by CBECC-Res reference software. Results for the candidate software may be imported or manually entered.

3. Additional intermediate results and reports for a small subset of runs that is used to demonstrate that the candidate software is capable of completing the entire compliance process of input, run, and reporting. These results will be verified either by visual review or with the use of a file comparison utility program.

C. Software Vendor Requirements

Candidate software needs to:

1. Secure the latest copy of the test data set from the Energy Commission.
2. Create input files in the candidate software's user interface to match those in the test data set.
3. Run the test data set and load the results into the spreadsheet to verify that the results match.
4. Compare the intermediate results and reports to verify that the results match, as described in the test data set spreadsheet

D. Submittals for Approval

Submittals to the Energy Commission requesting approval shall include:

1. Access to the candidate software in a manner that allows the Energy Commission to use the software.
2. All files necessary to compare results to the test data set, including the input files, the results spreadsheet and the specified intermediate results and reports.
3. Any other documentation required in the ACM Approval Manual or the ACM Reference Manual.

The Energy Commission will review the test data set results to verify that the software works and that the documentation meets ACM requirements.

E. Compliance Manager Updates

When new versions of Compliance Manager or its components become available, the Energy Commission will run the test data set to verify that the results match. If the results do not match, but it is determined that the new results are the correct results, the test data set will be updated to substitute the results of the new version as the test data set.

F. Prototype Buildings

One-Story Prototype

Figure A-1 through Figure A-3 and Table A-2 define the 2100 ft^2 prototype.

Note that the glass area and distribution provided on these drawings is only to show a realistic image of the home. Glass area and orientation for impact and cost effectiveness is set using a glass distribution typical of California homes. Glass area, distribution and other details for the ACM tests are specified in the test data set.

Figure A-1: One-Story Prototype Front View

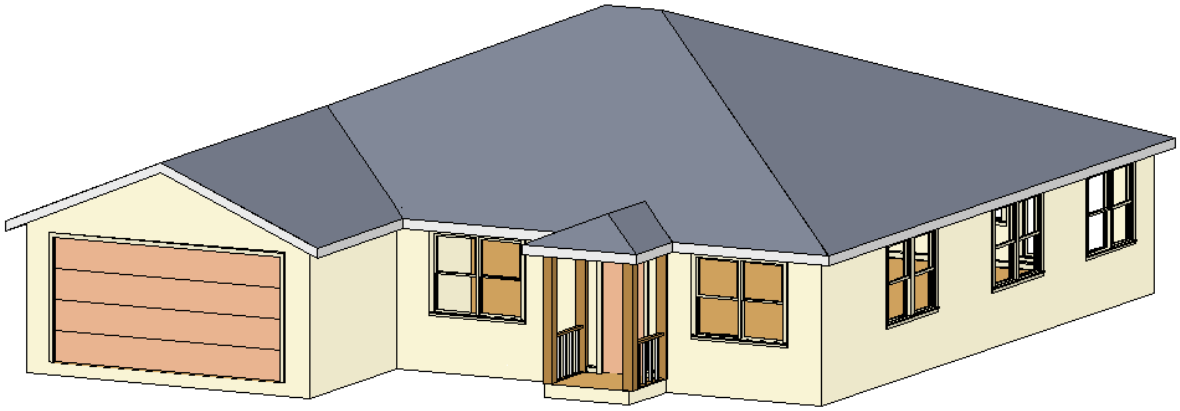

Figure A-2: One-Story Prototype Back View

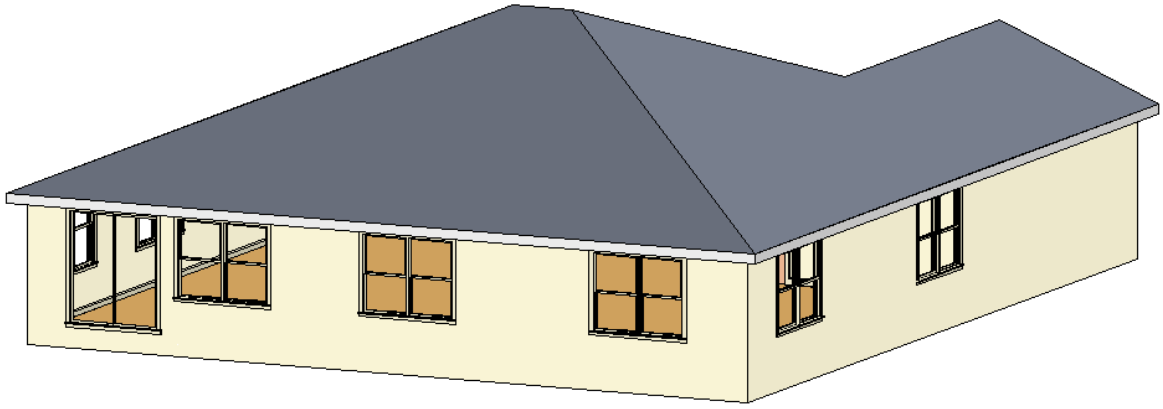

Figure A-3: One-Story Prototype Floor Plan

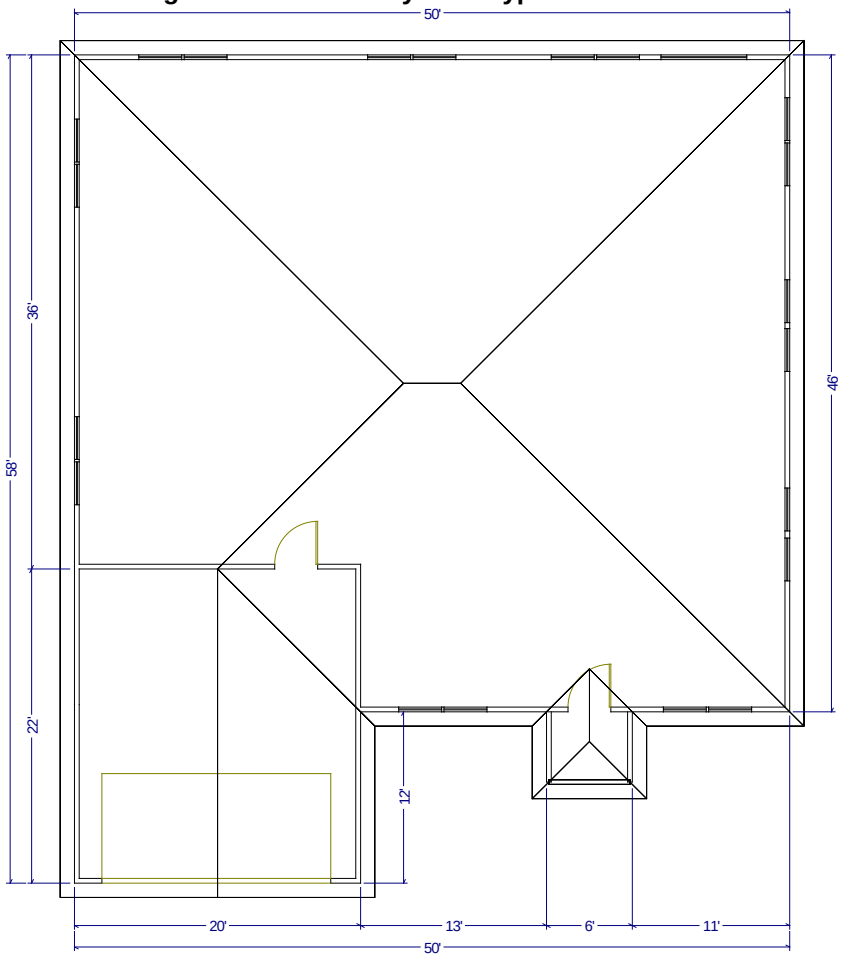

Table A-2: One-Story Prototype Description

Component	Description
Ceiling height	9 ft
Conditioned floor area	2100 ft^2
Gross areas	
Slab	2100 ft^2
Slab perimeter, outside	162 ft
Slab Garage	440 ft^2
Slab perimeter, garage	54 ft from garage to outside
Ceiling	2100 ft^2, vented attic
Front wall	270 ft^2
Front garage wall	180 ft^2
Left wall	324 ft^2
Left garage wall	90 ft^2
Back wall	450 ft^2
Right wall	414 ft^2
Garage front wall	180 ft^2 from garage to outside
Garage left wall	198 ft^2 from garage to outside
Garage right wall	108 ft^2 from garage to outside
Doors	
Front door	20 ft^2
Garage door	20 ft^2
Garage car door	128 ft^2
Overhangs	1 ft (when modeled)

Two-Story Prototype

Figure A-4 through Figure A-7 and Table A-3 define the 2700 ft^2 prototype.

Note that the glass area and distribution provided on these drawings is only to show a realistic image of the home. Glass area and orientation for impact and cost effectiveness is set using a glass distribution typical of California homes. Glass area, distribution and other details for the ACM tests are specified in the test data set.

Figure A-4: Two-Story Prototype Front View

Figure A-5: Two-Story Prototype Back View

Figure A-6: Two-Story Prototype Floor Plan – 1st Floor

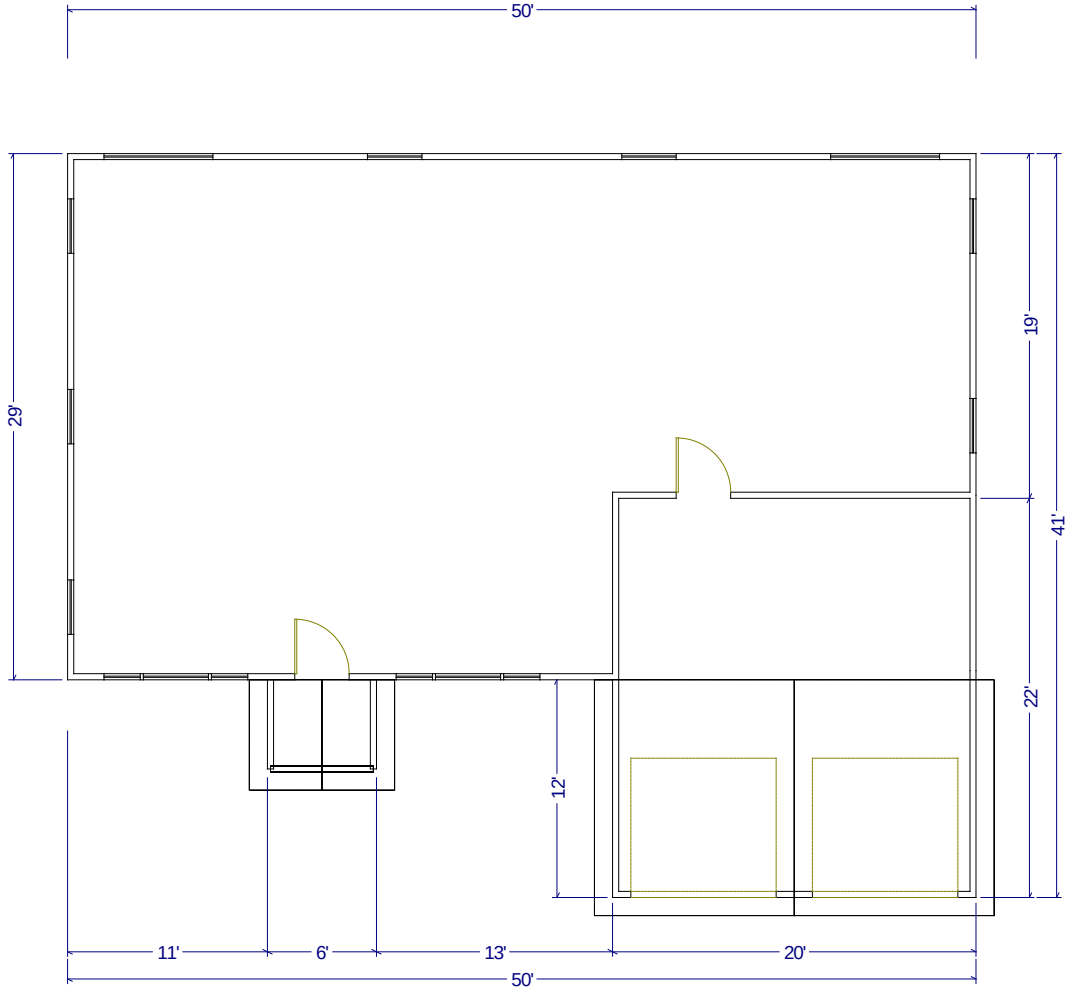

Figure A-7: Two-Story Prototype Floor Plan – 2nd Floor

Table A-3: Two-Story Prototype Description

Component	**Description**
Ceiling height	9 ft with 1 ft between floors
Conditioned floor area	2700 ft^2
Gross areas	
Slab	1250 ft^2
Slab perimeter, outside	128 ft
Slab, garage	440 ft^2
Slab perimeter, garage	54 ft from garage to outside
Ceiling	1450 ft^2, vented attic
Floor over garage	200 ft^2
Front wall	728 ft^2
Front garage wall	180 ft^2
Front garage kneewall	42 ft^2
Left wall	551 ft^2
Back wall	950 ft^2
Right wall	461 ft^2
Right garage wall	90 ft^2
Garage front wall	180 ft^2 from garage to outside
Garage left wall	108 ft^2 from garage to outside
Garage right wall	198 ft^2 from garage to outside
Doors	
Front door	20 ft^2
Garage door	20 ft^2
Garage car door	128 ft^2
Overhangs	1 ft (when modeled)

Multifamily Prototype

The multifamily prototype is a 6960 ft^2 eight-unit two-story apartment building consisting of four 780 ft^2 (26 ft wide by 30 ft deep) one-bedroom apartments and four 960 ft^2 (32 ft wide by 30 ft deep) two-bedroom apartments. The units share common walls and either common floors or ceilings. Multiples of this layout may be combined to represent other typical multifamily configurations.

Figure A-8 through Figure A-11 and Table A-4 define the 6960 ft^2 prototype.

Note that the glass area and distribution provided on these drawings is only to show a realistic image of the home. Glass area and orientation for impact and cost effectiveness is set using a glass distribution typical of California construction. Glass area, distribution and other details for the ACM tests are specified in the test data set.

Figure A-8: Multifamily Prototype Front View

Figure A- 9: Multifamily Prototype Back View

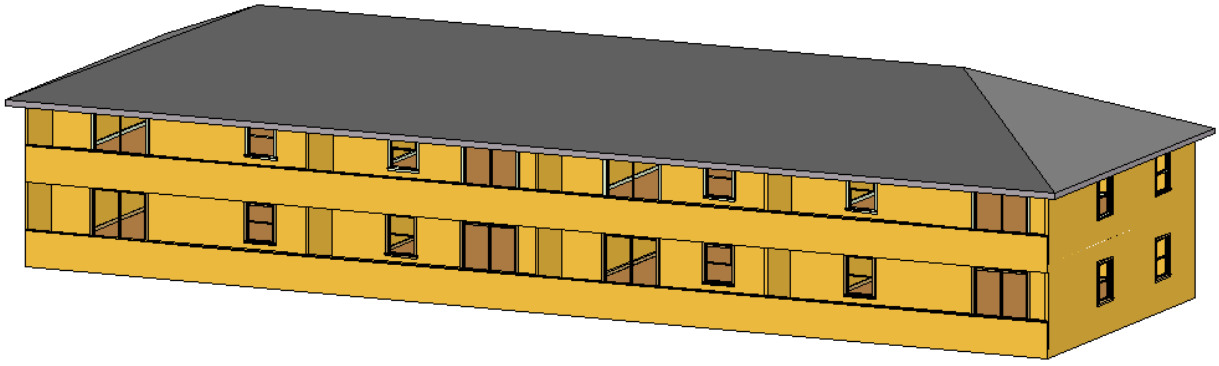

Figure A-10: Multifamily Prototype Floor Plan – 1st Floor

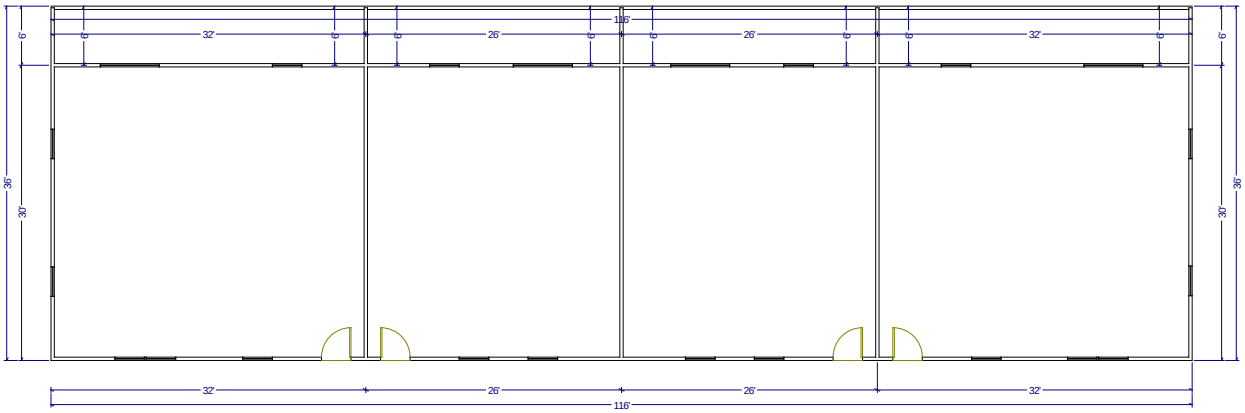

Figure A-11: Multifamily Prototype Floor Plan – 2nd Floor

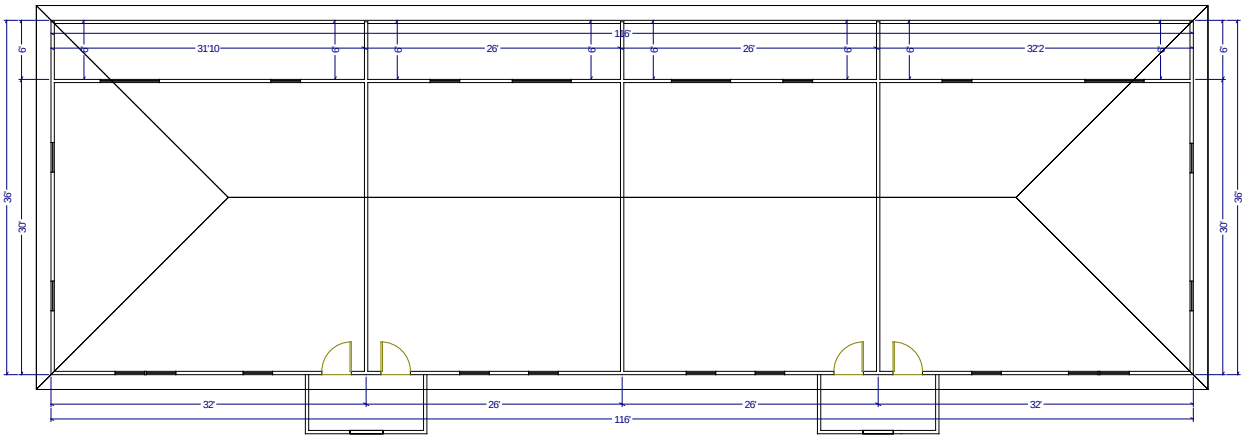

Table A-4: Multifamily Prototype Description

Component	Description
Ceiling height	8 ft with 1 ft between floors
Conditioned floor area	6960 ft^2
Dwelling units	8
Gross areas	
Slab	3480 ft^2
Slab perimeter, outside	292 ft
Ceiling	3480 ft^2, vented attic
Front wall	1972 ft^2
Left wall	510 ft^2
Back wall	1972 ft^2
Right wall	510 ft^2
Doors	
Front door	160 ft^2
Overhangs	1 ft (when modeled)

Addition/Alteration Prototype

Figure A-12 through Figure A-14 define the addition/alteration 1665 ft^2 prototype without the addition.

Figure A-15 through Figure A-16 and Table A-5 define the addition/alteration with the addition.

Figure A-12: Addition/Alteration Prototype Front View without Addition

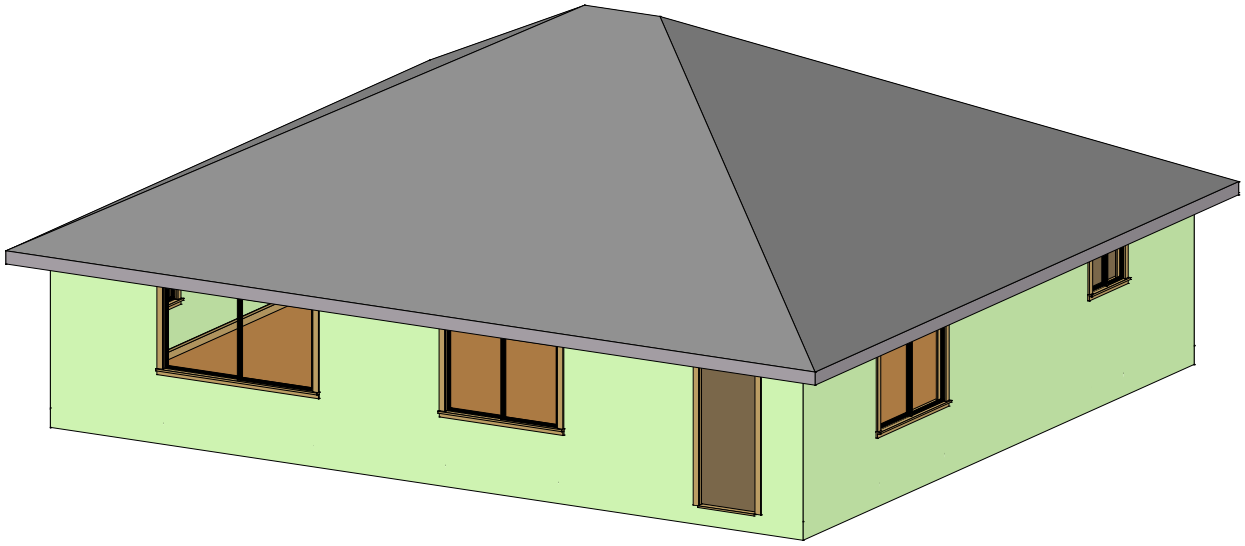

Figure A-13: Addition/Alteration Prototype Back View without Addition

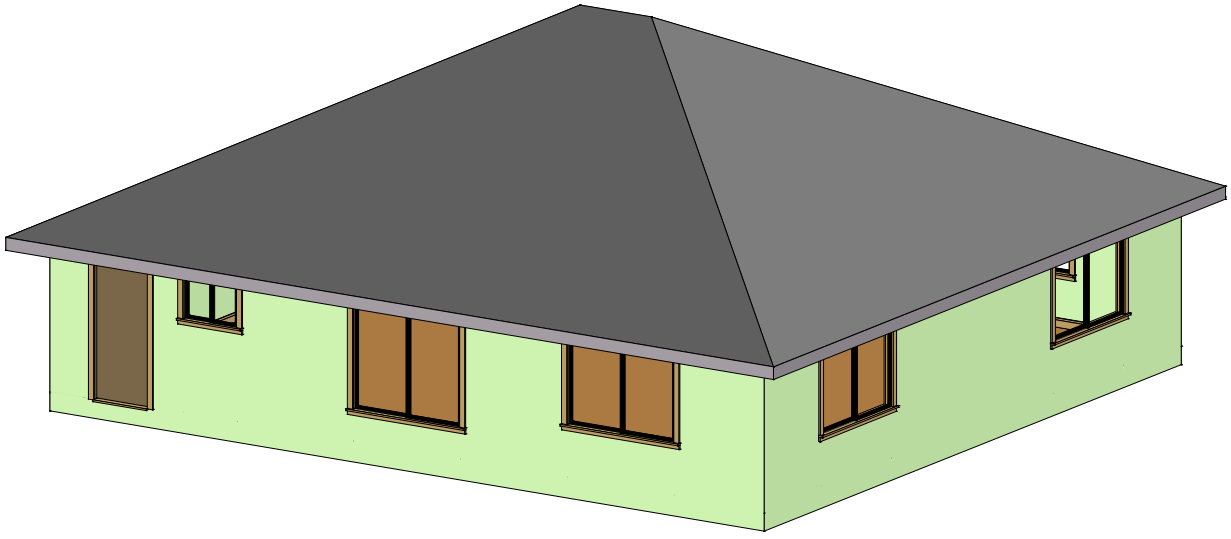

Figure A-14: Addition/Alteration Prototype Floor Plan without Addition

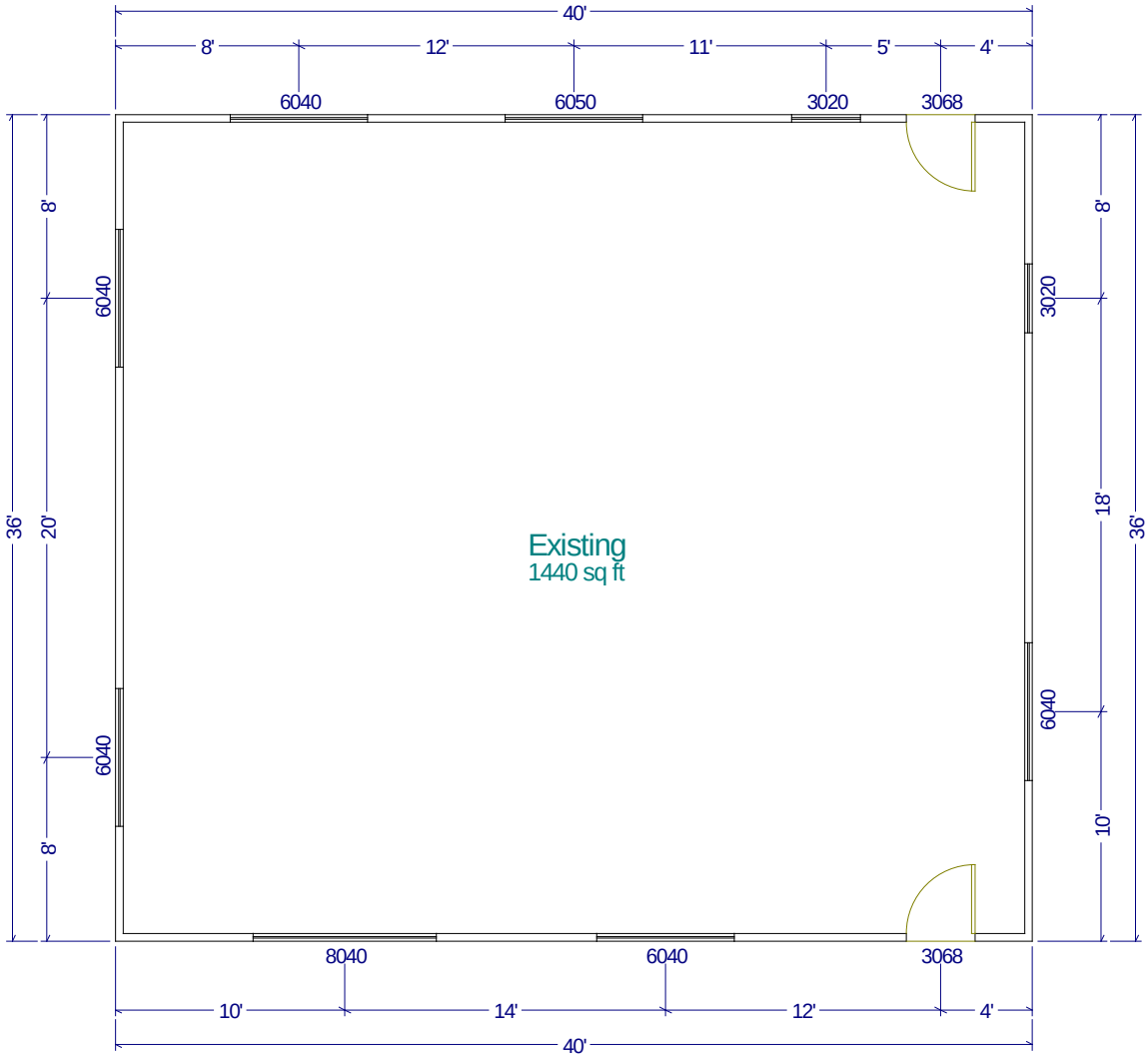

Figure A-15: Addition/Alteration Prototype Back View with Addition

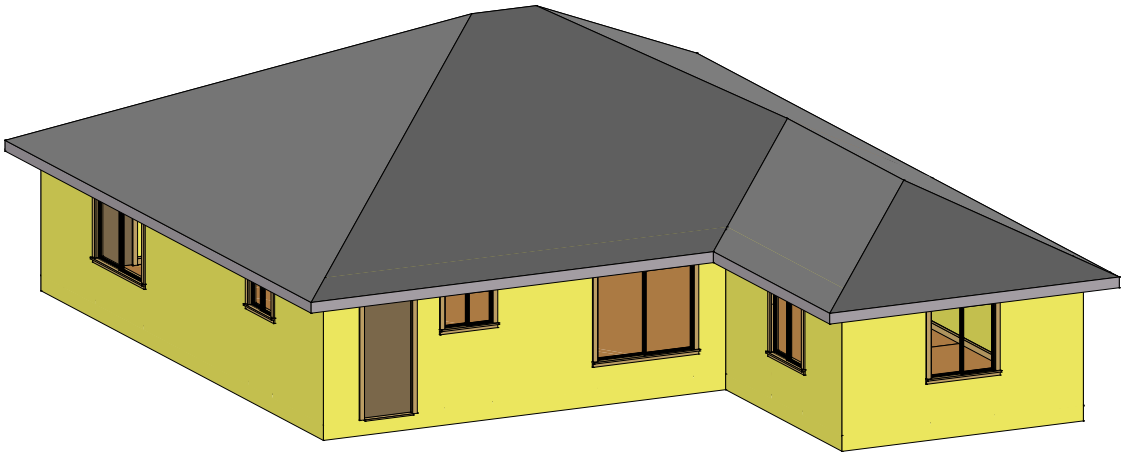

Figure A-16: Addition/Alteration Prototype Floor Plan with Addition

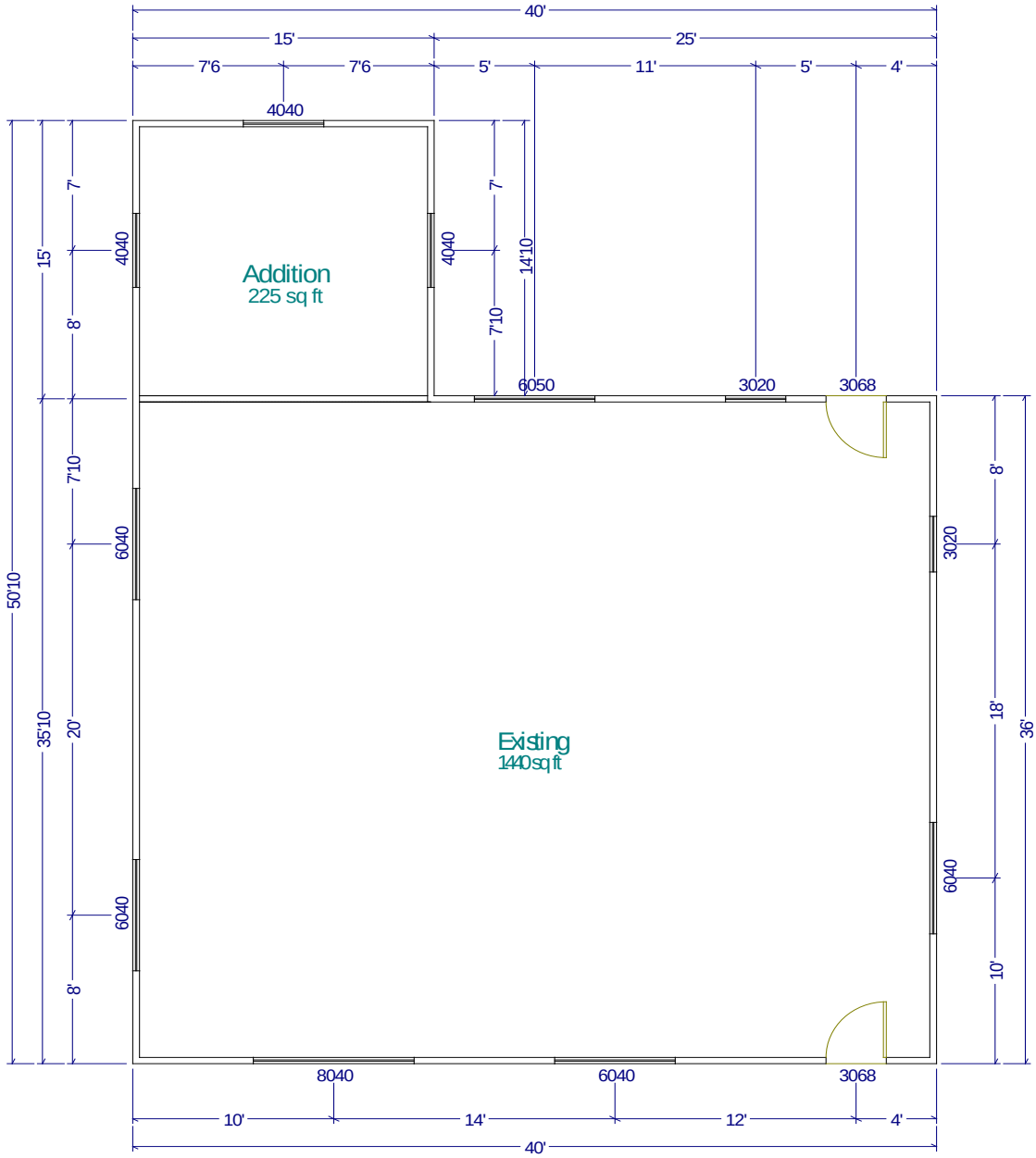

Table A-5: Addition/Alteration Prototype Description

Component	Description
Ceiling height	8 ft
Existing floor area	1440 ft^2
Addition floor area	225 ft^2
Gross areas	
Existing Slab	1440 ft^2
Addition Slab	225 ft^2
Exisiting Slab perimeter	137 ft
Addition Slab perimeter	45 ft
Existing Ceiling	1440 ft^2, vented attic
Addition Ceiling	225 ft^2, vented attic
Existing Front wall	320 ft^2
Existing Left wall	288 ft^2
Addition Left wall	120 ft^2
Existing Back wall	320 ft^2
Addition Back wall	120 ft^2
Existing Right wall	288 ft^2
Addition Right wall	120 ft^2
Windows	
Existing Front Window 1	24 ft^2
Existing Front Window 2	32 ft^2
Existing Left Window 1	24 ft^2
Existing Left Window 2	24 ft^2
Addition Left Window	16 ft^2
Addition Back Window	16 ft^2
Existing Right Window 1	6 ft^2
Existing Right Window 2	24 ft^2
Addition Right Window	16 ft^2
Doors	
Existing Front door	20 ft^2
Existing Back door	20 ft^2