

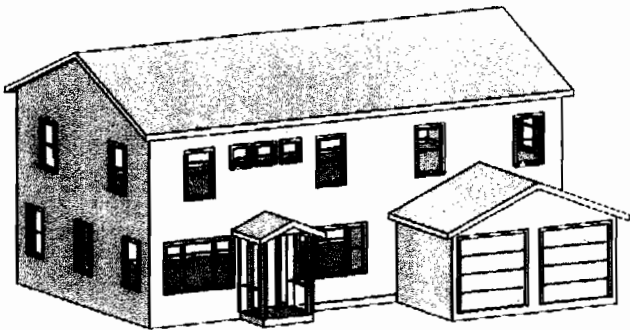
# Residential Housing Starts and Prototypes

2008 California Building Energy Efficiency Standards

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## Purpose

The purpose of this proposal is to update the housing start information used to weight calculations for statewide impact and to update and expand the building prototypes used to analyze proposed standard changes.

## Overview

Description	<p>This proposal has two parts:</p> <ol style="list-style-type: none"><li>1. Updating the housing start information used to determine statewide impacts. Data will be expanded to separately account for multifamily construction.</li><li>2. Updating and expanding the building prototypes used to analyze proposed standard changes. Multiple single family will be included and a separate multifamily prototype is proposed.</li></ol>
Type of Change	<p>Analysis assumptions. Housing start information and the building prototypes are used during the standards development process to estimate the statewide impact of energy and demand savings.</p> <p>No changes to the Standards, Residential Manual, forms, etc. are required due to this proposal. It would be appropriate to include the prototype descriptions and drawings in a document like the ACM for future reference and to modify ACM tests to use these prototypes as building examples.</p>
Energy Benefits	<p>While this proposal does not directly change the stringency of the standards, having prototypes that are more representative of current construction practice may improve the reliability of the analysis completed as part of the standards development process. Including a multifamily prototype will make analysis of this sector more accurate.</p>
Non-Energy Benefits	<p>Updates the housing start and building prototype information to more closely match current construction practice in California.</p>
Environmental Impact	n/a
Technology Measures	n/a
Performance Verification	n/a

Cost Effectiveness	While the housing start information and the prototypes are not subject to meeting cost effectiveness criteria, updating this information may affect the features included in the standards when cost effectiveness is considered as the proposed prototypes are different than the existing prototype. For example, the proposed prototypes have different areas, layouts and the introduction of a multifamily prototype could all affect cost effectiveness calculations.
Analysis Tools	Can be modeled with existing software tools.
Relationship to Other Measures	See discussion under cost effectiveness.

## Methodology

### Housing Starts

Housing start information is used during the standards development process to aggregate the impact of energy efficiency measures across the state. This is critical due to the large variation in climates in California and the trend of increased construction in inland climates that have significant cooling loads. Housing starts also vary from year to year as different regions of the state experience growth at different rates.

As part of the 2008 process, this data will be updated, and data will be provided on multifamily housing starts in addition to single family housing starts. Coupled with expanded prototypes described elsewhere in this report, this will enable a more accurate estimate of the energy and demand savings due to changes in the standards.

Data from the non-profit Construction Industry Research Board (CIRB)<sup>1</sup> has been used for each of the last several standards updates. As part of this proposal, 2005 CIRB building permit information by county and was assigned to the climate zones described in the Joint Appendices<sup>2</sup> with the assistance of Consol, Inc.

CIRB splits residential new construction into two categories. Single family includes detached, semi-detached and townhouse units. Condominiums are included in single family when they are separated by an air space or an unbroken ground to roof party wall or firewall. Multifamily includes duplexes, 3-4 unit structures and apartment type structures with 5 units or more. Multifamily also includes condominium units

### Single Family Prototypes

Since the early 1990's, a 1761 ft<sup>2</sup> two story prototype has been used when estimating and evaluating the life cycle cost effectiveness and statewide impact of proposed changes. Since this prototype was

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<sup>1</sup> [www.cirbdata.com](http://www.cirbdata.com)

<sup>2</sup> Joint Appendices for the 2005 Building Energy Efficiency Standards, CEC, 2005

developed, home sizes have grown substantially, and an increasing portion of newly constructed homes have two stories.

For the 2008 standards, two single family prototypes are proposed, a one story and a two story. When estimating either the cost effectiveness or statewide impact, runs will be completed for each of these prototypes, then weighted by the fraction of homes with one or two stories. Equal glass areas on each orientation will be used, and the results will also be weighted by the glass area distribution used in the 2005 standards update.

In the past, the Construction Industry Research Board collected information on house size. However, they have discontinued this effort. To get reliable data on house size and number of stories, a number of stakeholders were contacted. Responses were received from Consol, Inc., RLW Analytics Inc., Roseville Electric and the Sacramento Municipal Utility District (SMUD).

## Analysis and Results

### Housing Starts

Table 1 shows the proposed housing starts by climate zone for the 2005 calendar year.

Table 1 – Housing Starts by Climate Zone

2005 CIRB Building Permits						
Climate	Single Family	Multi Family	Total	Single Family	Multi Family	Total
1	350	35	385	0.2%	0.1%	0.2%
2	2816	1441	4257	1.8%	2.7%	2.0%
3	4853	5594	10446	3.1%	10.5%	5.0%
4	4158	3554	7712	2.7%	6.7%	3.7%
5	1172	355	1527	0.8%	0.7%	0.7%
6	6313	6083	12396	4.1%	11.4%	6.0%
7	4203	3929	8132	2.7%	7.4%	3.9%
8	3377	2935	6312	2.2%	5.5%	3.0%
9	4336	4562	8898	2.8%	8.6%	4.3%
10	23819	4956	28775	15.4%	9.3%	13.8%
11	10382	868	11250	6.7%	1.6%	5.4%
12	32062	5079	37142	20.7%	9.6%	17.9%
13	19015	3332	22347	12.3%	6.3%	10.7%
14	15606	6858	22464	10.1%	12.9%	10.8%
15	14034	1881	15915	9.1%	3.5%	7.7%
16	8338	1691	10029	5.4%	3.2%	4.8%
Total	154834	53153	207987	100.0%	100.0%	100.0%

### Single Family Prototypes

Tables 2, 3 and 4 summarize the data collected as part of this proposal. The weighed values use the fraction of the relevant sample size to weight the results. Using the weighted results from this sample

rounded to the nearest 100 ft<sup>2</sup>, it is proposed to use a 2100 ft<sup>2</sup> one story and a 2700 ft<sup>2</sup> two story as the prototype homes.

Table 2 – Single Family Sample Description

Sample Description			
Source	Sample	Type	Description
Consol, Inc.	7000	Median	2005/2006 data
Roseville Electric	993	Average	2005 Roseville Electric Advantage Home participants
SMUD	6690	Average	2005 SMUD Advantage Home participants
RLW Analytics Inc.	6850	Average	2002/2003 Energy Star Home Data
Total	21533		

Table 3 – Single Family Floor Area Summary

Floor Area (ft <sup>2</sup> )		
	One Story	Two Story
Consol, Inc.	2126	2873
Roseville Electric	2176	2348
SMUD	1954	2585
RLW Analytics Inc.	2196	2570
Average	2113	2594
Weighted	2097	2663

Table 4 – Single Family Number of Stories Summary

Number of Stories (%)		
	One Story	Two Story
SMUD	50%	50%
RLW Analytics Inc.	39%	61%
Average	45%	55%
Weighted	45%	55%

**One Story Prototype**

Figures 1, 2, 3 and Table 5 define the 2100 ft<sup>2</sup> 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.

Figure 1 - One Story Prototype Front View

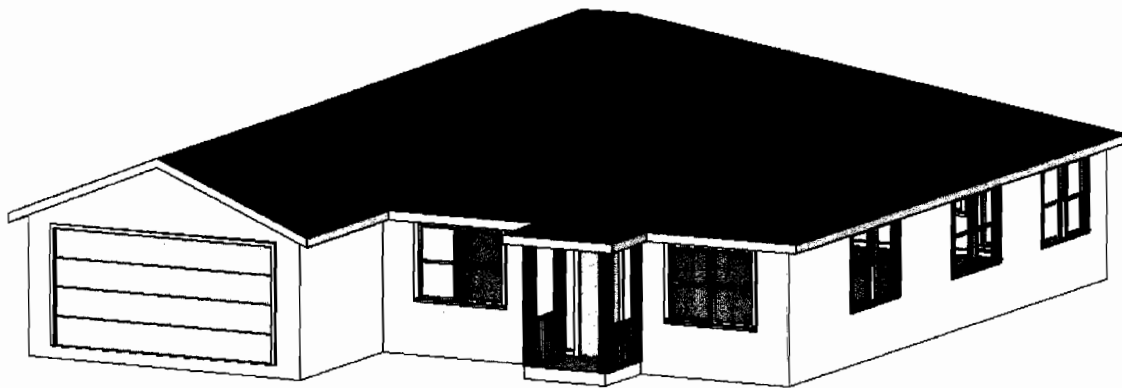


Figure 2 - One Story Prototype Back View

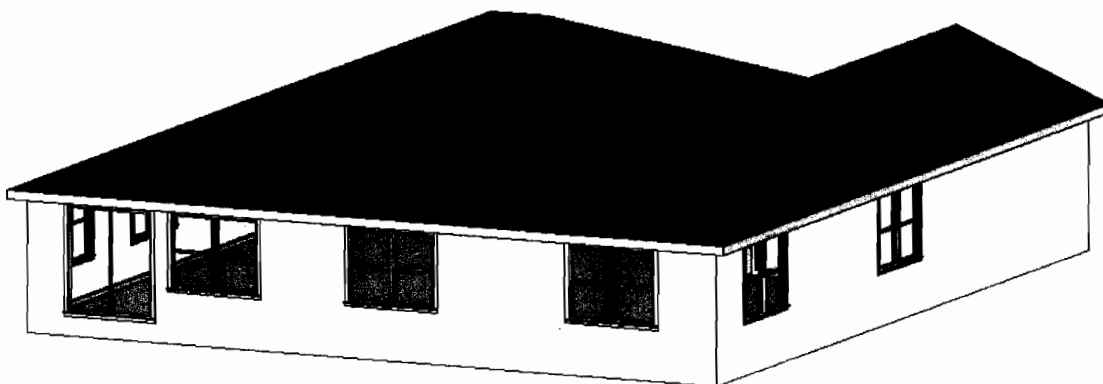


Figure 3 - One Story Prototype Floor Plan

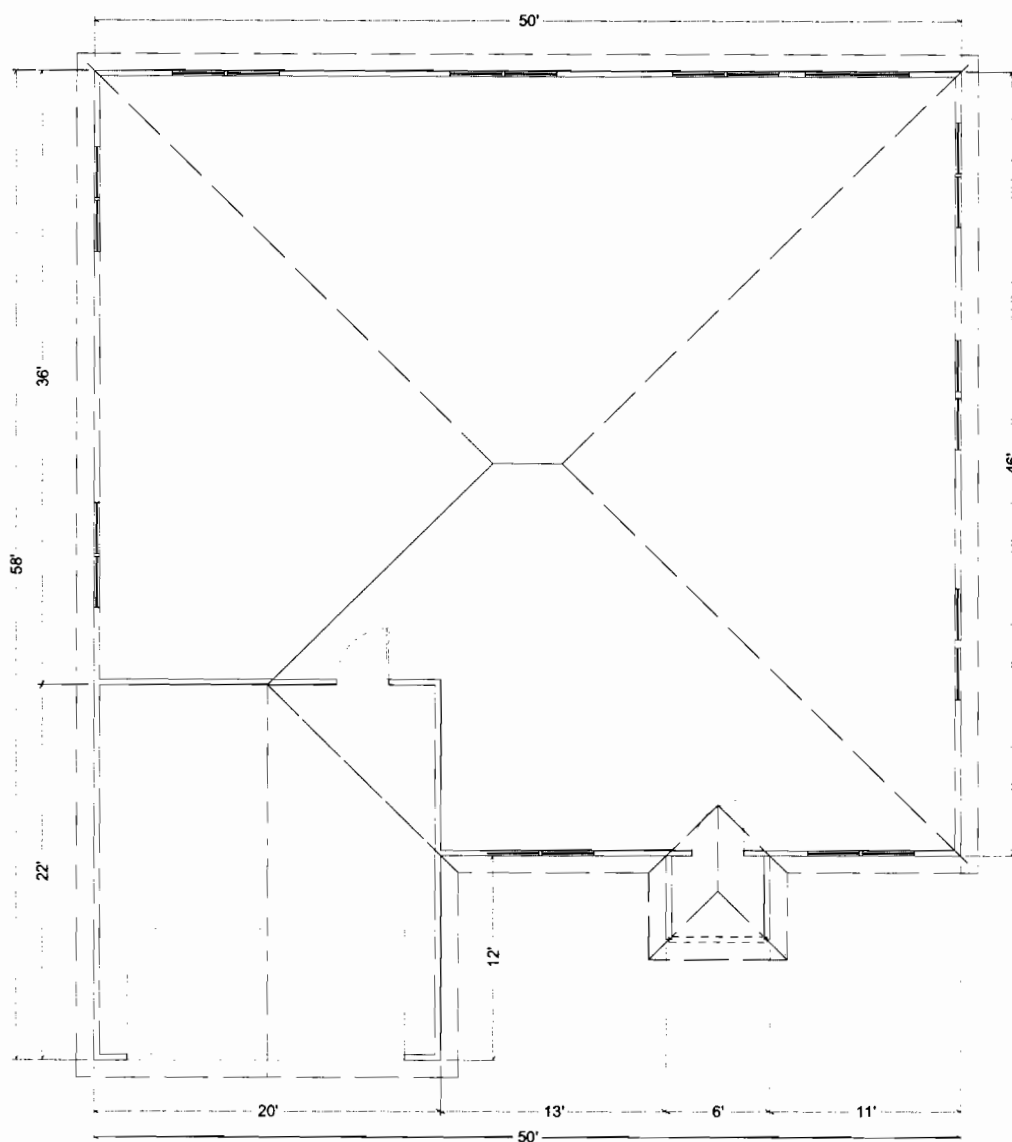


Table 5 – One Story Prototype Description

Component	Description
Ceiling height	9 ft
Conditioned floor area	2100 ft <sup>2</sup>
Conditioned volume	18900 ft <sup>3</sup>
Gross areas	
Slab	2100 ft <sup>2</sup>
Slab perimeter, outside	162 ft
Slab perimeter, garage	30 ft
Ceiling	2100 ft <sup>2</sup> , vented attic
Front wall	270 ft <sup>2</sup>
Front garage wall	180 ft <sup>2</sup> , shaded
Left wall	324 ft <sup>2</sup>
Left garage wall	90 ft <sup>2</sup> , shaded
Back wall	450 ft <sup>2</sup>
Right wall	414 ft <sup>2</sup>
Doors	
Front door	20 ft <sup>2</sup>
Garage door	20 ft <sup>2</sup>
Overhangs	1 ft (when modeled)



**Two Story Prototype**

Figures 4, 5, 6, 7 and Table 6 define the 2700 ft<sup>2</sup> 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.

Figure 4 - Two Story Prototype Front View

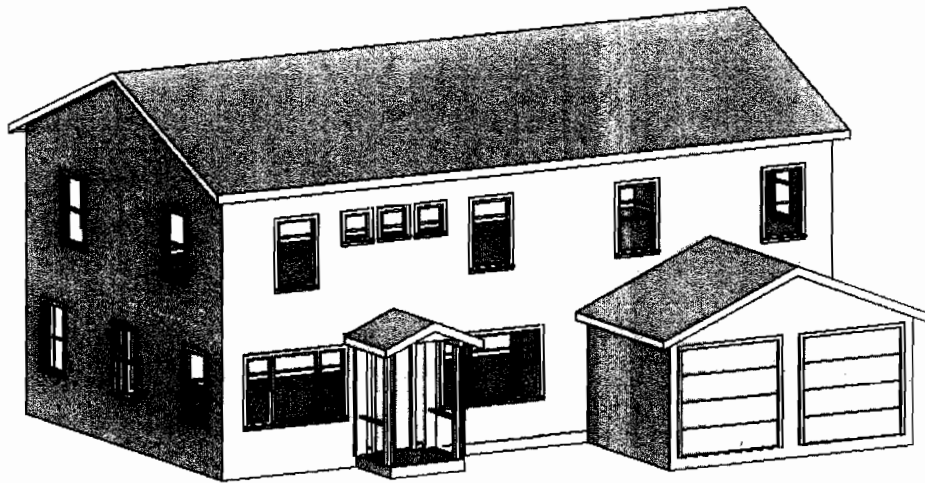
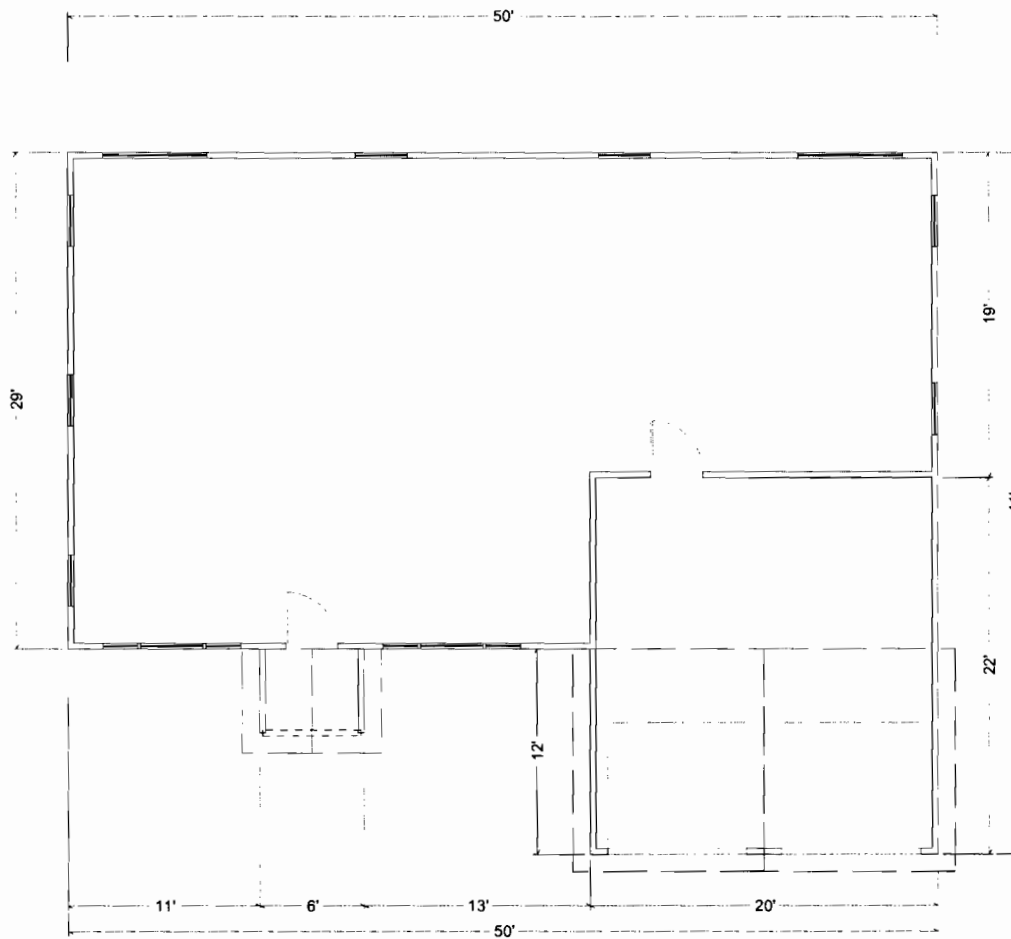


Figure 5 - Two Story Prototype Back View



Figure 6 - Two Story Prototype Floor Plan – 1<sup>st</sup> FloorFigure 7 - Two Story Prototype Floor Plan – 2<sup>nd</sup> Floor

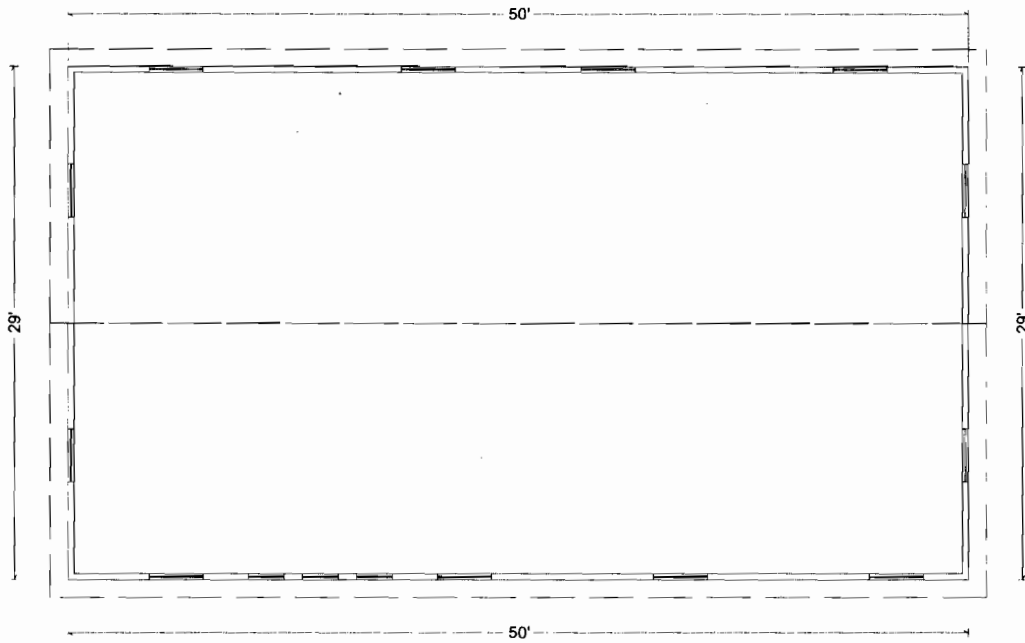


Table 6 – Two Story Prototype Description

<b>Component</b>	<b>Description</b>
Ceiling height	9 ft
Conditioned floor area	2700 ft <sup>2</sup>
Conditioned volume	25750 ft <sup>3</sup>
Gross areas	
Slab	1250 ft <sup>2</sup>
Slab perimeter, outside	128 ft
Slab perimeter, garage	30 ft
Ceiling	1450 ft <sup>2</sup> , vented attic
Floor over garage	200 ft <sup>2</sup>
Front wall	270 ft <sup>2</sup>
Front garage wall	180 ft <sup>2</sup> , shaded
Left wall	551 ft <sup>2</sup>
Back wall	950 ft <sup>2</sup>
Right wall	461 ft <sup>2</sup>
Right garage wall	90 ft <sup>2</sup> , shaded
Doors	
Front door	20 ft <sup>2</sup>
Garage door	20 ft <sup>2</sup>
Overhangs	1 ft (when modeled)

**Multifamily Prototype**

For 2008, a 6960 ft<sup>2</sup> eight unit two story apartment building consisting of four 780 ft<sup>2</sup> (26 ft wide by 30 ft deep) one bedroom apartments and four 960 ft<sup>2</sup> (32 ft wide by 30 ft deep) two bedroom apartments is proposed. The units share common walls and either common floors or ceilings. Multiples of this layout may be combined to represent other typical multifamily configurations.

Figures 8, 9, 10, 11 and Table 7 define the 6960 ft<sup>2</sup> 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.

Figure 8 – Multifamily Prototype Front View

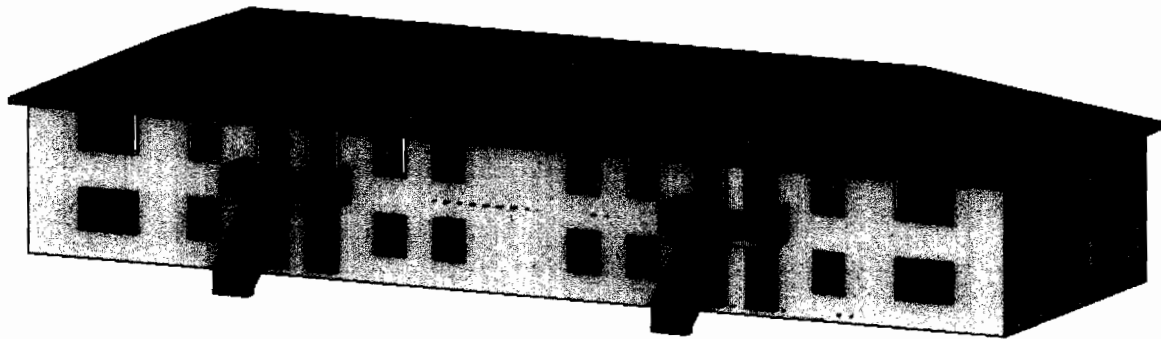


Figure 9 – Multifamily Prototype Back View

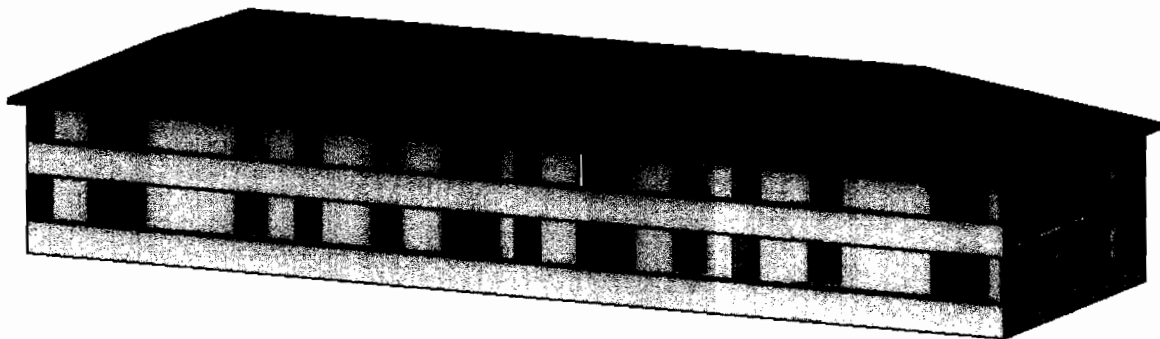


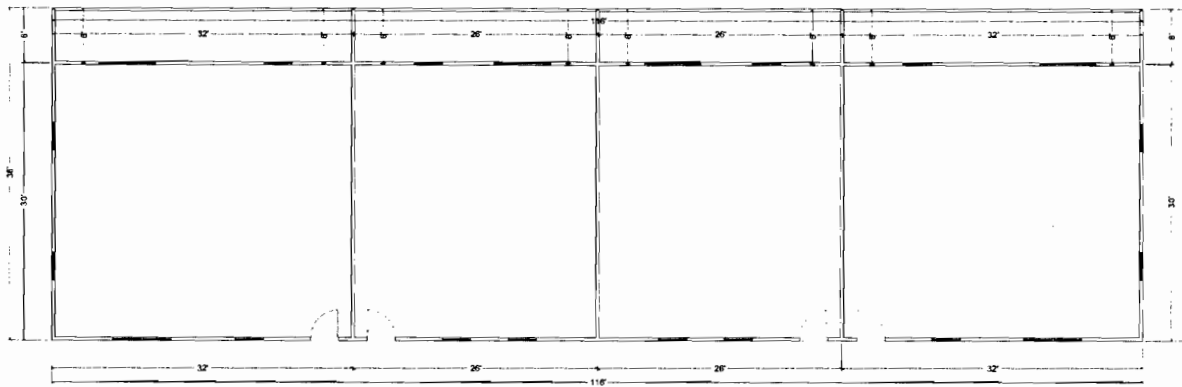
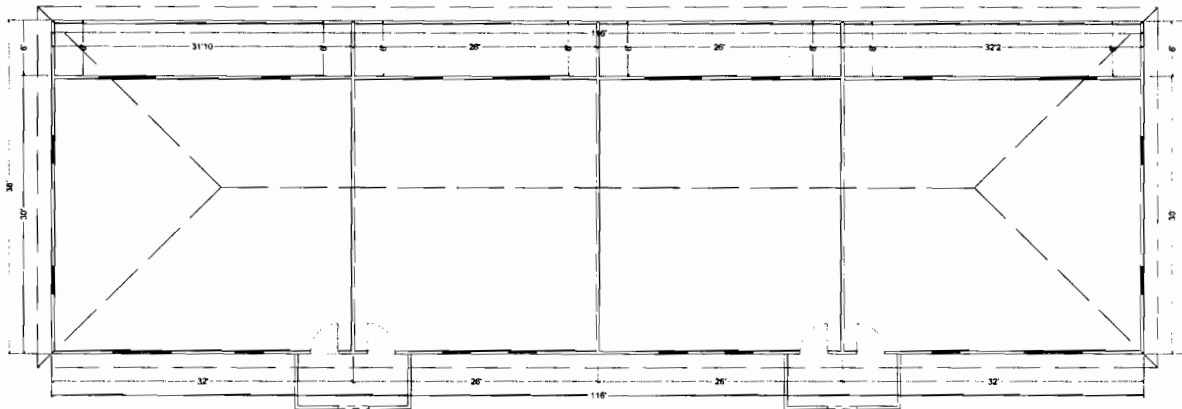
Figure 10 - Multifamily Prototype Floor Plan – 1<sup>st</sup> FloorFigure 11 – Multifamily Prototype Floor Plan – 2<sup>nd</sup> Floor

Table 6 – Two Story Prototype Description

Component	Description
Ceiling height	8 ft
Conditioned floor area	6960 ft <sup>2</sup>
Conditioned volume	118320 ft <sup>3</sup>
Dwelling units	8
Gross areas	
Slab	3480 ft <sup>2</sup>
Slab perimeter, outside	292 ft
Ceiling	1450 ft <sup>2</sup> , vented attic
Front wall	1972 ft <sup>2</sup>

Left wall	510 ft2
Back wall	1972 ft2
Right wall	510 ft2
Doors	
Front door	160 ft2
Overhangs	1 ft (when modeled)

## **Recommendations**

This proposal recommends the use of the housing start information shown in Table 1 and the 2100 ft2, 2700 ft2 and 6960 ft2 8 dwelling multifamily building as prototypes for assessing impacts and cost effectiveness of standard changes.

## **Material for Compliance Manuals**

The drawings and tables shown for the prototypes should be added to the ACM manual or other appropriate document for future reference.

## **Bibliography and Other Research**

See section on Methodology.

## **Appendices**

None