

**Dynamic Prototype BIM Manual for a 4-Airman Dormitory – V2.0**  
**May 11, 2009**

Developed by:  
 Air Force Center for Engineering and the Environment  
 Ralph "Rick" Sinkfield, YD-03, DAF – Project Manager  
 Email: rick.sinkfield@brooks.af.mil



## TABLE OF CONTENTS

### INTRODUCTION

<b>Executive Summary</b> _____	<b>2</b>
<b>Goals</b> _____	<b>2</b>
<b>Scope and Use</b> _____	<b>2-3</b>
Program Assumptions	
Kit of Parts	

### GUIDELINE INTEGRATION

<b>Site Design</b> _____	<b>3-4</b>
Tool Utilization Strategies	
<i>Siting Requirements</i>	
<i>Circulation</i>	
<i>Establishing the Model</i>	
Additional Requirements and Integration Concepts	
<i>Parking &amp; Site Considerations</i>	
<i>Site Amenities</i>	
<i>Landscape Architecture</i>	
<b>Building Design</b> _____	<b>4-6</b>
Tool Utilization Strategies	
<i>Building Configuration</i>	
<i>Interior/Exterior Relationships</i>	
<i>Noise Considerations</i>	
<i>Architecture</i>	
<i>Interior Design</i>	
<b>Specifications</b> _____	<b>6-7</b>
Tool Utilization Strategies	
<b>LEED Checklist</b> _____	<b>7</b>
Tool Utilization Strategies	
<b>Software Requirements</b> _____	<b>7</b>
Additional Requirements	

### LIST OF ILLUSTRATIONS

Illustration 1 – Square Footage Comparison_____	<b>8</b>
Illustration 2 – Unit Plans_____	<b>9-10</b>
Illustration 3 – Assembled Plan Examples_____	<b>11-12</b>
Illustration 4 – File Directory Structure Example_____	<b>13</b>
Illustration 5 – Duplication Example_____	<b>14</b>
Illustration 6 – Group Manipulation Example_____	<b>15</b>

### REFERENCES

Unaccompanied Housing Design Guide  
<http://www.afcee.af.mil/shared/media/document/AFD-070919-082.pdf>



## INTRODUCTION

### Executive Summary

The intent of this Dynamic Prototype BIM (Building Information Model) Manual is to describe the process for utilizing the electronic design tool to improve efficiency and effectiveness in the implementation of the Unaccompanied Housing Design Guide. Dynamic Prototype is a flexible design model that leverages the advantages of BIM to standardize components of a building type (in this case a 4-airman dormitory) through a schematic 3D model. Design models can vary from performance criteria to prescriptive criteria depending on the number of variables. For 4-airman dormitories the prototype is utilizing a kit-of-parts approach. The kit-of-parts models are broken down into disciplines (Architecture, Structure, Mechanical, Electrical/Telecom, Plumbing, and Fire Suppression). Version 2.0 contains a model for each discipline. This manual coordinates with Chapter 3 – Facility Design of the Unaccompanied Housing Design Guide describing the use of the Dynamic Prototype in relation to the recommended development of design within the existing guide.

### Goals

The goal is to provide vital information from the Unaccompanied Housing Design Guide as well as lessons learned from installations in a BIM platform that will allow A/Es to quickly and easily produce 4-Airman dormitory project designs.

### Scope and Use

In accordance with the Unaccompanied Housing Design Guide the kit-of-parts models created meet the minimum net living area (NLA) requirements along with the gross module area (GMA) as specified within the guide (*See Illustration 1 – Square Footage Comparison for specific page references & Illustration 2 – Unit Plans for each unit available within the kit-of-parts model*). Additional assumptions for the models were made to test the assembly of the kit-of-parts models into a building that meets the gross building area (GBA). Examples of these arrangements can be found on *Illustration 3 – Assembled Plan Examples*. The assumptions for Version 2.0 are as follows:

1. Program Assumptions
  - 4-Airman Dormitory (E-1 – E-4 modules).
  - 144 Airman Dormitory is the bases for conceptual engineering and sizing requirements.
  - 4-Airman Dorm Units meet the minimum net living area requirements
  - Commons Area is the most flexible and will require manipulation for site adaptation and installation-specific functional requirements
  - Mechanical, Electrical, Telecommunication, and other building utility spaces will need to be designed and integrated depending upon the location and specific installation requirements.
  - Structural CMU, as one of the recommended systems by the Unaccompanied Housing Design Guide, is only a baseline for the design of these units. Other building systems should be explored based on installation-specific requirements.
  - Building envelope systems may be applied based on installation-specific requirements.
  - Unit configurations (A-C) have been approved by AF/A7CAH.
  - Other reconfigurations of the units must meet the requirements listed in the Unaccompanied Housing Design Guide.
2. Kit of Parts
  - a. Architectural
    - i. Kit-of-Parts include: Unit A, Unit B, Unit C.1, Unit C.2, Unit C.3, Common Space, and Stairs.



- ii. Unit A is intended to be assembled for interior, double-loaded corridor configurations (*Refer to Illustration 3 – Assembled Plan Examples*).
  - iii. Units B and all the C's are intended for exterior, single or double-loaded configurations (*Refer to Illustration 3 – Assembled Plan Examples*).
- b. Structural
    - i. Kit-of-Parts include: Unit A, Unit B, Unit C.1, and Stairs
  - c. Mechanical
    - i. Kit-of-Parts include: Unit A (Hot/Arid, Hot/Humid, and Cold/Arid climates), Unit B (Hot/Arid, Hot/Humid, and Cold/Arid climates), Unit C.1 (Hot/Arid, Hot/Humid, and Cold/Arid climates), and Chiller Yard (Hot/Arid, Hot/Humid, and Cold/Arid climates)
  - d. Electrical
    - i. Kit-of-Parts include: Unit A, Unit B, Unit C.1 and Stairs
  - e. Plumbing
    - i. Kit-of-Parts include: Unit A, Unit B, and Unit C.1
  - f. Fire Protection
    - i. Kit-of-Parts include: Unit A, Unit B, and Unit C.1

## **GUIDELINE INTEGRATION**

### **Site Design**

#### *Tool Utilization Strategies*

1. Siting Requirements
  - Establish whether an interior or exterior circulation scheme will be employed.
  - Utilize the kit-of-parts to assemble the initial massing model.
  - Group units before multiplying the units to take advantage of BIM.
  - Configure model to the appropriate site dimensions and established setback requirements listed in the Unaccompanied Housing Design Guide and other references.
  - After multiplying units into assembled massing model, “exclude” duplicated elements such as party-walls (*Refer to Illustration 5 for Duplication Example*).
2. Circulation
  - Ideas and concepts should be explored through other mediums quickly before narrowing the concepts to the selected proposition.
  - Establish site circulation to maximize building site efficiency.
  - Create outdoor spaces that are extensions of the building entrances allowing for small groups to stop and gather.
  - After all site circulation constraints and siting requirements have been established the A/E should utilize the prototype tool to configure the initial massing model.
3. Establishing the Model
  - A/E is responsible for establishing a clear File Directory Structure (*Refer to Illustration 4 – File Directory Structure Example*).
  - See Attachment F to the contract for full extent of BIM related deliverables.

#### *Additional Requirements and Integration Concepts*

1. Parking & Site Considerations
  - All disciplines need to have their own model that is linked to the master model.
  - All work shall be in 3D with associated parametric information and linked to the master model.



- Establish finish floor and floor-to-floor elevations early in the process.
  - Coordinate utilities between all disciplines early in the process.
2. Site Amenities
    - Small structures shall reside within discipline models.
    - In the example of site furniture and site lighting establish the furniture in the landscape architect's model and the site lighting in the electrical engineer's.
    - Coordinate site amenities early and allocate the work to the responsible disciplines.
  3. Landscape Architecture
    - Like Civil, the work developed within the discipline of landscape architecture is very specific to the installation and should be developed in 3D with associated data to inform and develop the coordination between other disciplines.

## **Building Design**

### *Tool Utilization Strategies*

1. Structural
  - Prototypes offer two main systems: 1) Load bearing CMU walls with concrete + 2) Load bearing CMU with steel.
  - Other systems shall be explored after initial massing is determined.
  - A/E shall provide cost analysis on 3 structural systems that satisfy Unaccompanied Housing Design Guide requirements.
  - A/E will need to run new load calculations and resize members and spacing depending upon final building configuration.
2. Heating, Ventilation and Air Conditioning (HVAC)
  - Prototypes provide a starting point for the A/E with systems that already meet Air Force design criteria.
  - Three climate zones were used to create the models.
  - Systems and equipment in the model such as diffusers, ductwork, piping, FCU's, etc. are all place holders. Actual sizes and selections to be determined by A/E.
  - Location of the building and type of unit will determine the unit climate zone the A/E selects as a starting point for the HVAC system design.
  - Alternative HVAC systems may be proposed on a life cycle cost analysis basis. The systems utilized must enable the building to meet the requirements of EPAct 2005 as well as LEED.
  - A/E will need to run new load calculations for the actual climate zone in order to properly select equipment, size ductwork, select diffusers/grilles, and size piping. The configuration of mechanical chases can be adjusted for each site location depending on Base requirements.
  - Overall building systems such as outside air pretreatment, exhaust air collection, and method of chilled and heating water production to be determined by A/E.
  - All HVAC equipment such as diffusers, and FCU's are linked to schedules. Any changes made to equipment data within the model will automatically update the associated schedules.
  - All equipment, ductwork, piping, diffusers, dampers, etc. have been created as families within the model.
  - Locations of hydronic valves to be determined by A/E.
3. Plumbing
  - The plumbing model consists of plumbing fixtures, domestic CW piping, domestic HW piping, and sanitary waste/vent piping.
  - The plumbing models are drawn as the ground floor units to show the underslab sanitary piping. The floors above will not require horizontal sanitary piping throughout the unit.



- The piping within the units has been sized in accordance with Uniform Plumbing Code (UPC) but will need verification by A/E.
  - Sizes for plumbing risers to be determined by A/E based on the actual building height.
  - Overall building plumbing systems such as the method of producing domestic hot water to be determined by A/E.
  - Location(s) of water heaters either in centralized location or multiple locations to be determined by A/E.
  - All piping, and plumbing fixtures have been created as families within the model and are intended as place holders for routing purposes. Actual sizes to be determined by A/E.
4. Building Configuration
- Building Circulation – In developing the site circulation the building circulation will become apparent. In deciding the building’s circulation the A/E should be aware that the units presented are intended for two distinct building circulation concepts:
    - i. Corridor Access (Unit A)
    - ii. Balcony/Breezeway Access (Unit B and all C’s)
  - In developing the model it is required to use the provided kit-of-parts as a starting point. Each unit is a group and should remain a group to leverage the efficiency of BIM. As the A/E assembles the building there will be a need to change a group to create a corner unit or the roof. However, it is encouraged that the A/E creates new groups for these units so when one unit is changed within the group all the rest are updated. By the time the A/E begins Construction Documents and is solely developing details there may come a logical point to not utilize groups any longer in this manner, but it is the recommendation of this manual that this particular building type could benefit greatly by the use of groups. (*Refer to Illustration 6 for Group Manipulation Example*).
5. Interior/Exterior Relationships
- Building Circulation – Develop a clear path of travel, consider egress distances and associated site considerations to design not only the location of the hardscapes but the surrounding landscape and the creation of outdoor gathering areas.
  - Civil and Landscape Models – 3D models that work with the specified BIM platform shall be developed concurrently with the other disciplines and maintained as a linked and integral part of the project development.
6. Noise Considerations
- Wall types – Develop clear requirements as per the Unaccompanied Housing Design Guide and manipulate existing wall types as needed.
7. Architecture
- Building Envelope – Designs shall amplify the local architectural character through the development of the building envelope.
  - Glazing Systems – The prototypes have windows as current place holders within the wall types. The ultimate size and quantities depend upon installation requirements and building envelope design.
  - Coordinate chases within units after mechanical system is selected as there may be the opportunity to eliminate chases (specifically those associated with base board heaters in the corner of each bedroom).
8. Interior Design
- Comprehensive Interior Design – The furniture provided within the model only dictates the scale and placement of furniture for the units. A/E’s should develop a comprehensive interior design package per installation requirements.



- Finishes and Materials – The prototype units have the Air Force's preference modeled and the guidelines list some options. The A/E may explore other options as long as they meet or exceed the materials' characteristics listed.
  - Bathrooms and Kitchens – The prototype units provide cabinets and millwork for dimensional purposes only. The A/E can alter the style, countertops, and back splashes to fit the appropriate aesthetics of that particular installation.
9. Electrical
- Electrical prototypes include lighting, receptacles, telephone, cable, light switches, fans, fire detection, and personnel alerting systems located within the units.
  - Models also have the distribution equipment created however this will need to be reconsidered as the design is assembled and the A/E establishes the full extent of the buildings power requirements.
  - Exterior lighting and other associated work with the buildings exterior or landscape will be developed as part of the local installation design.
  - Actual building electrical loads and service to be determined by A/E.
10. Fire Protection
- Sprinkler heads are laid out in accordance with NFPA 13, *Installation of Sprinkler Systems*.
  - There is flexibility within the model to relocate heads depending upon modifications in the floor plan to meet base needs.
  - Any relocation of sprinkler heads must still be in accordance with NFPA 13.
  - Fire alarm equipment has been laid out within the model in accordance with NFPA 72, *National Fire Alarm Code*.

## Specifications

### Tool Utilization Strategies

1. ESspecs for Revit 4.1 with MASTERSPEC 2004
  - ESspecs links specifications sections with objects in the Prototypes through the use of assembly codes listed within each objects property elements.
  - After all of the specification sections have been properly bound to the objects within Revit notes on drawings will be coordinated, listing the same language tied to the specification language. Text will be consist and concise.
  - Specifications for the prototypes have been developed based upon the Unaccompanied Housing Design Guide and the developed Prototypes
  - Other specifications specific to the development of the full design at local installations will need to be developed. Some of these include:
    - Civil associated specifications
    - Landscape associated specifications
    - Foundation systems
    - Building envelope
    - Roof structure
2. Linking ESspecs for Prototypes
  - A Microsoft SQL database will be provided on the website for download. This database will contain all information related to the prototype project manual. This also holds the bindings to each Revit file.
  - E-Specs for Revit should be installed per installation instructions given by InterSpec (<http://www.e-specs.com/>).
  - E-Specs for Revit plug-in should also be installed per installation instructions given by InterSpec (<http://www.e-specs.com/>).
  - Special interaction will be required to ensure that the database file downloaded is set as the main database file during installation.



- A uniformClassifications.txt file will be provided which contains information on bindings from and to Revit and E-Specs. This must be placed in the following directory: C:\Program Files\Revit Architecture 2009\Program
- Once files have been downloaded all questions and problems related to integration and setup of E-Specs should be directed to InterSpec @ 888-50-SPECS.

## **LEED Checklist**

### *Tool Utilization Strategies*

1. LEED 2009 Checklist
  - Consolidates all points from Federal Mandates and creates an initial starting point for the A/E to utilize.

## **Software Requirements**

### *Additional Requirements*

1. Autodesk Revit 2009 or higher (latest Service Pack)
  - Revit was utilized in developing the Prototypes and shall be utilized in developing all discipline models.
2. E-Specs for Revit (latest release) with MASTERSPEC 2004
  - E-Specs for Revit 4.1 was utilized in developing the Prototypes specifications and shall be utilized in developing the specifications throughout the completion of design.
  - MASTERSPEC 2004 licenses must be purchased as E-Specs uses MASTERSPEC 2004 format.
  - E-Specs and Masterspec are separate entities and each require the purchase of software/Licenses which can be coordinated through InterSpec.
  - Software licensing agreements will supersede all information in this document and must be followed.





Illustration 1 – Square Footage Comparison

Unaccompanied Housing for 4-Airmen Dormitories - Square Footage Comparison

E1-E4 Module Areas (NLA)	Unit A (144)	Unit B (144)	Unit C (144)	Notes
1 Bedroom 1	129	129	129	min. bedroom width 10'-0" (p. 15) - required
2 Bedroom 2	129	129	129	min. bedroom width 10'-0" (p. 15) - required
3 Bedroom 3	129	129	129	min. bedroom width 10'-0" (p. 15) - required
4 Bedroom 4	129	129	129	min. bedroom width 10'-0" (p. 15) - required
5 Bathroom 1	35	35	35	exclude from net living area (NLA) calculations (p. 15)
6 Bathroom 2	35	35	35	exclude from net living area (NLA) calculations (p. 15)
7 Bathroom 3	35	35	35	exclude from net living area (NLA) calculations (p. 15)
8 Bathroom 4	35	35	35	exclude from net living area (NLA) calculations (p. 15)
9 Closet 1	20	20	20	exclude from net living area (NLA) calculations (p. 15)
10 Closet 2	20	20	20	exclude from net living area (NLA) calculations (p. 15)
11 Closet 3	20	20	20	exclude from net living area (NLA) calculations (p. 15)
12 Closet 4	20	20	20	exclude from net living area (NLA) calculations (p. 15)
13 Laundry	10	10	10	included in living room (p.31)
14 HVAC	10	10	10	included in living room (p.31)
15 Kitchen/Dining	45	40	35	included in living room (p.31)
16 Living	166	190	175	min. room width 11'-0" (p. 15) recommended
<b>17 NET TOTAL</b>	<b>967</b>	<b>986</b>	<b>966</b>	refer to page 15 for NLA calculation requirements
<b>Common Support Areas (NLA)</b>				
18 Multi-Purpose	270	270	270	min. net required (p.32)
19 Supply Storage	100	100	100	min. net required (p.32)
20 Office	0	0	0	part of the multi-purpose room (78 sqft)
21 Vending	25	25	25	min. net required (p.32)
22 Bathroom	100	100	100	min. net required (p.32)
23 Bulk Storage	1196	1196	1196	1196 sqft = (70.6 cuft. per person * 144 people) / 8.5 ft tall
24 Utility	0	0	0	8% of building gross is recommendation
<b>25 NET TOTAL</b>	<b>1691</b>	<b>1691</b>	<b>1691</b>	
26 Stairs + Balconies	5132	4171	3821	refer to page 18 for calculation requirements
<b>27 BLDG CIRC</b>	<b>5132</b>	<b>4171</b>	<b>3821</b>	
<b>28 GMA</b>	<b>307</b>	<b>307</b>	<b>307</b>	refer to page 17 for calculation requirements
<b>29 GBA *</b>	<b>352</b>	<b>353</b>	<b>345</b>	refer to page 18 for calculation requirements

\* Calculations are based on demonstration Assembled Plan Examples at Illustration 3



Illustration 2 – Unit Plans

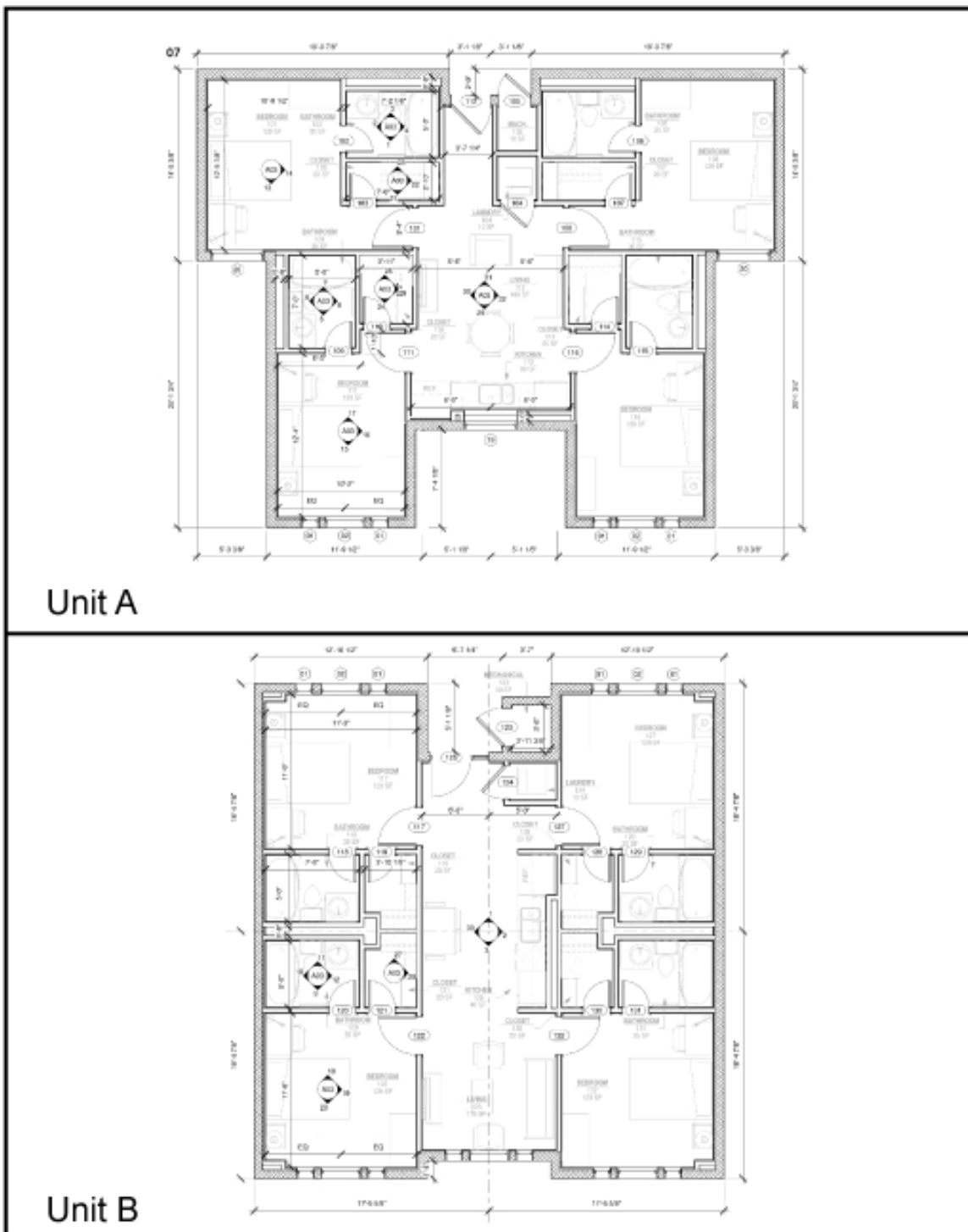




Illustration 2 – Unit Plans

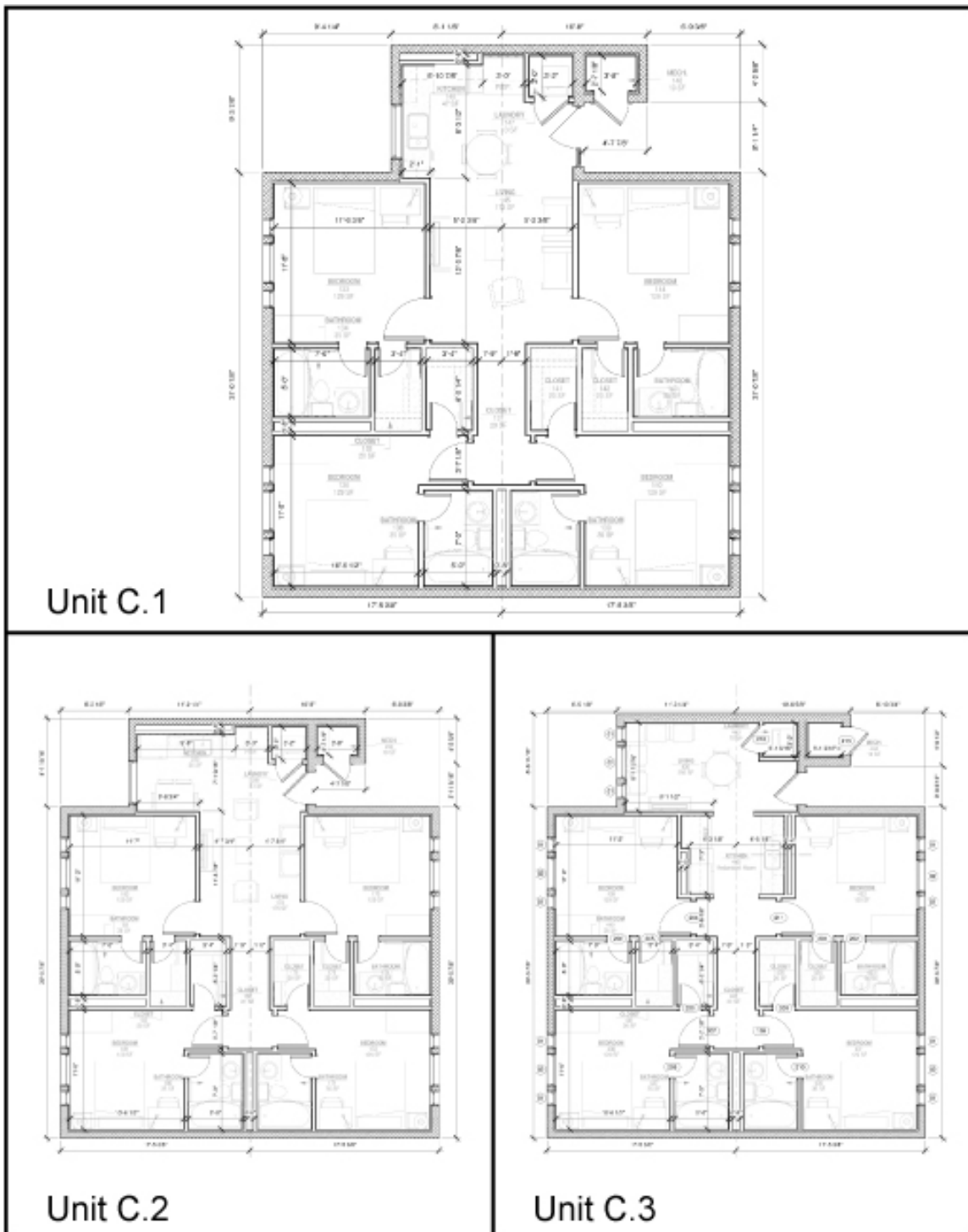




Illustration 3 – Assembled Plan Examples

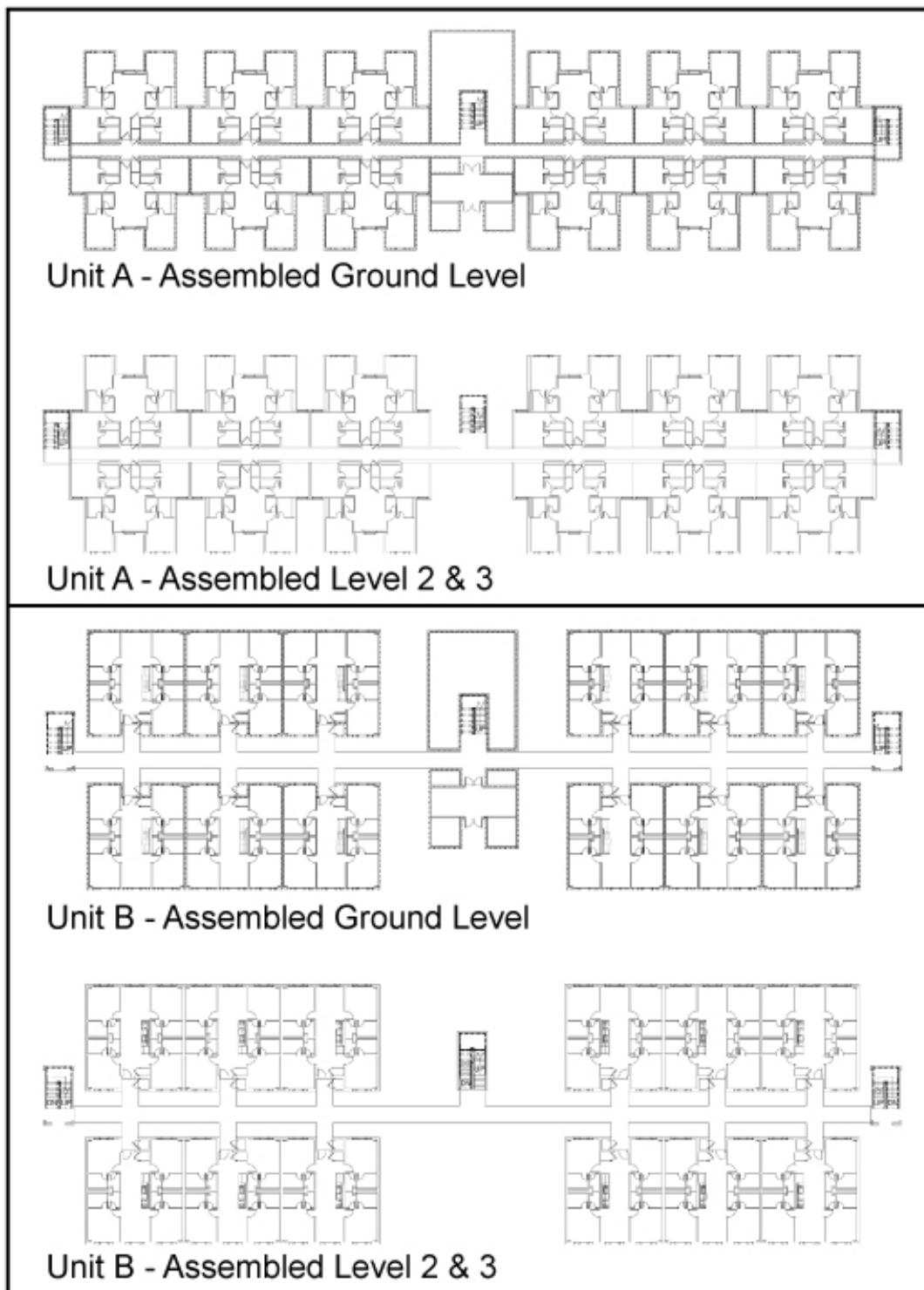




Illustration 3 – Assembled Plan Examples

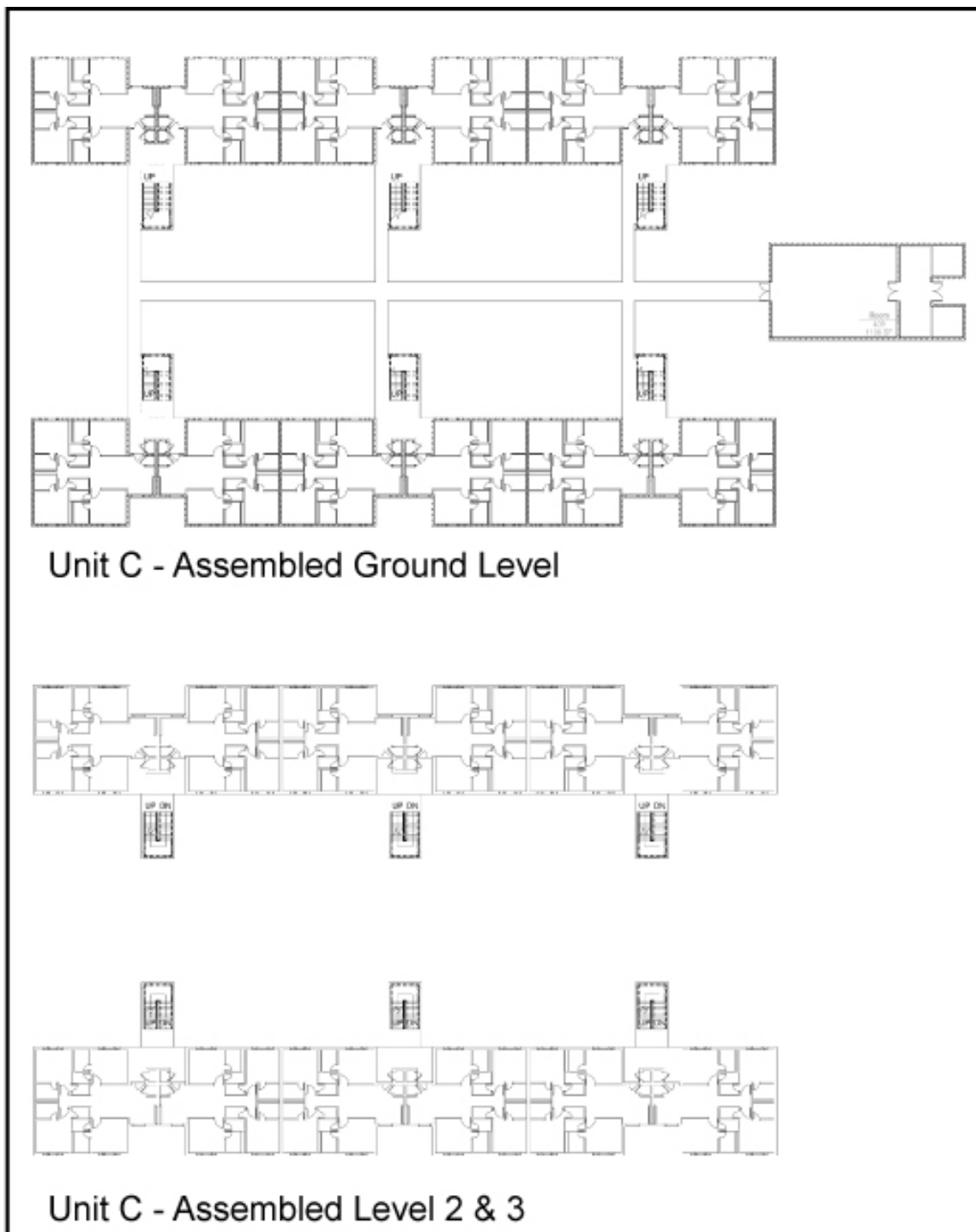
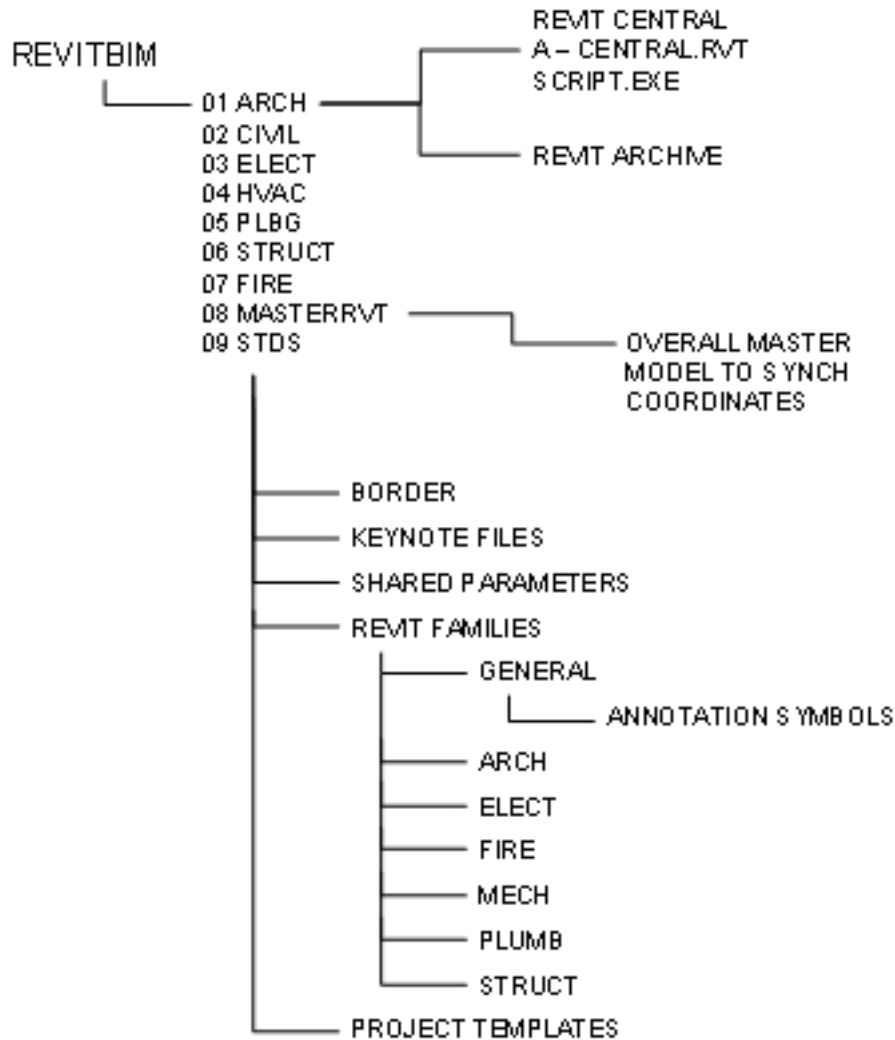




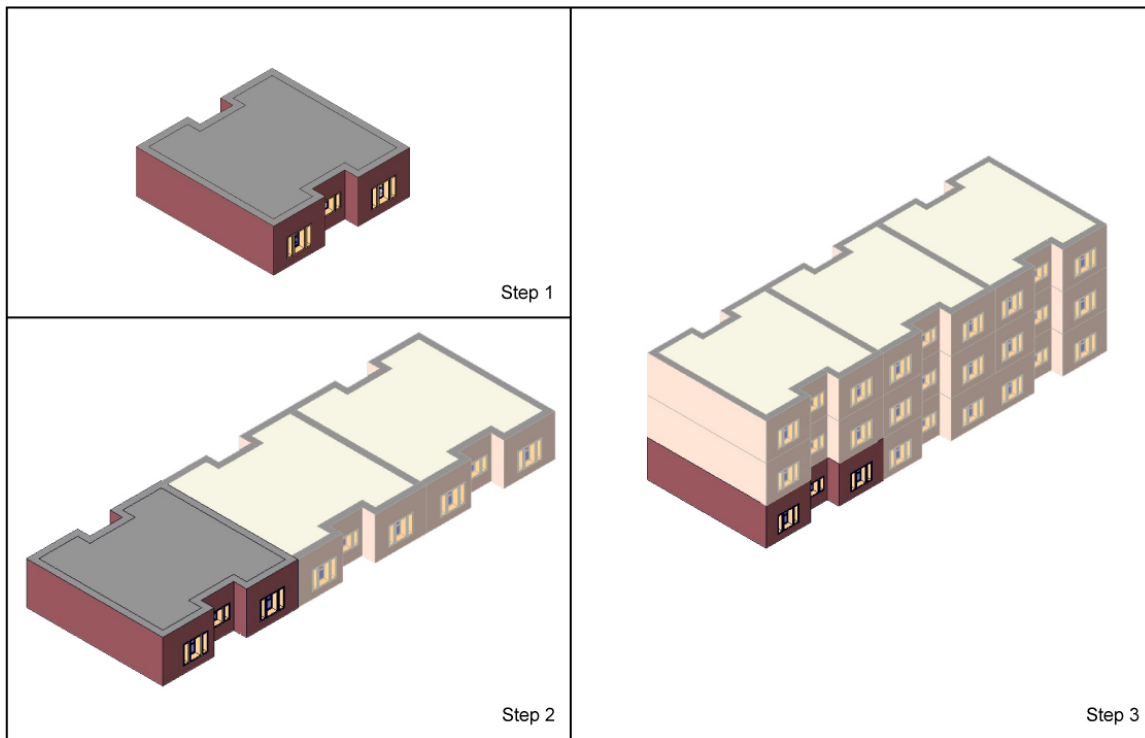
Illustration 4 – File Directory Structure Example

## FILE DIRECTORY STRUCTURE





*Illustration 5 – Duplication Example*



*Illustration 6 – Group Manipulation Example*

