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QUANTIFYING WASTE GENERATED FROM BUILDING REMODELING

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FACILITIES ENGINEERING
ENVIRONMENT

QUANTIFYING WASTE GENERATED FROM BUILDING REMODELING

1. Purpose. This Public Works Technical Bulletin (PWTB) transmits guidance on determining and managing solid wastes generated from remodeling projects.

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.

3. References.

a. Army Regulation (AR) 200-1, "Environmental Protection and Enhancement," 21 February 1997.

b. AR 420-49, "Utility Services," 28 April 1997.

c. Memo, PDASA (I&E), 18 January 2001, "Deconstruction and Re-Use of Excess Army Buildings."

d. PWTB 420-49-32, "Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste," 16 July 2001.

4. Discussion.

a. AR 420-49 contains policy on the proper management of municipal solid wastes, including construction wastes.

b. Many Army construction projects involve remodeling or renovation of existing buildings to serve a new function. Waste from these projects can significantly contribute to an installation's total solid waste stream. Although waste from remodeling is less than from demolition projects, quantities of waste generated are not known due to the diverse nature of these projects. This PWTB describes a method for determining waste quantity from remodeling projects, and applies this method to three typical Army examples.

c. Appendix A contains the estimation method, Army examples, and an extensive list of conversion factors used.

5. Points of Contact. HQUSACE is the proponent for this document. The POC at HQUSACE is Mr. Malcolm E. McLeod, CEMP-RI, 202-761-0206, or e-mail: Malcolm.E.Mcleod@HQ02.usace.army.mil.

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APPENDIX A

INTRODUCTION

Much has been written and discussed on the subject of solid wastes from construction and demolition projects. Demolition materials are especially easy to quantify by simply weighing (usually done in any case) all the debris and estimating material proportions. Relatively little has been written regarding wastes from renovation, or remodeling projects. "Renovation" is hard to define and it's hard to make comparisons because these projects vary greatly in scope. Renovation projects might include everything from interior cosmetic changes, to re-roofing, to a complete "gut" of the building.

The U.S. Environmental Protection Agency (EPA) reports [USEPA 1998] that remodeling projects typically produce more waste than construction projects per equivalent floor area. This is because remodeling usually involves the two steps of removing, then installing building components, with both activities generating waste. They estimate that remodeling waste comprises 44 percent of the total C/D waste stream overall (1996), with residential remodeling contributing a higher fraction.

Table A-1 shows remodeling waste data that the EPA gleaned from a few sources.

Table A-1. Waste Generation Rates for Selected Remodeling Projects [USEPA 1998].

Project Type	**Size (ft^2)**	**Total Waste (lb)**	**Waste Generation Rate (lb/ft^2)**
Kitchen and room addition	560	11,020	19.7
Bathroom	40	2,883	72.1
Kitchen	150	9,600	64.0
Total House	1,330	26,000	19.6

As this table shows, waste generation rates vary greatly depending on the type of project; therefore, any general discussion of remodeling wastes is of questionable value. The EPA report referenced here does have some additional data regarding specific types of projects.

This Public Works Technical Bulletin (PWTB) looks at three Army renovation projects, selected to be representative of typical jobs across the Army. The goal is to calculate, in detail, the types of waste materials that these projects generate. This will allow project managers to plan the work with a focus on recycling. For example, if we know that a given project will generate so many tons of scrap steel from a particular activity, then we can plan to have a recycling container on site to receive this material at the appropriate time. Often, renovation projects are (or could be) phased, such that a given type of waste material would be generated all at one time. Project managers can replicate this exercise for different projects.

This PWTB does not directly address recycling avenues for specific waste streams. This information is available in other sources, e.g., PWTB 420-49-32, *Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste* [Dolan 1999] and the NAHB Research Center's publications, including *A Field Guide for Residential Remodelers* [Meyer 2001].

The bulk of the data presented in this report was generated through "quantity take offs" based on the construction specifications and drawings. The methodology used is described in detail in the next section. The materials to remove as described in the specifications were verified in the field and are shown in the attached figures.

Projects selected for description in this appendix are:

- A large, multi-wing building at Fort Bragg, converted to modern office space
- A family housing duplex at Fort Campbell, stripped and reconfigured with minimal structural changes
- A barracks at Fort Bragg, completely stripped down to concrete and steel structure, then rebuilt.

U.S. standard units of measure are used throughout this appendix. A table of conversion factors for Standard International (SI) units is provided below.

Table A-2. SI Conversion Factors.

1 ft	=	0.305 m
1 yd	=	0.9144 m
1 sq ft	=	0.093 m^2
1 sq yd	=	0.836 m^2
1 cu yd	=	0.764 m^3
1 lb	=	0.453 kg
°F	=	(°C x 1.8) + 32

1. Quantifying Waste Materials

1.1 General

The prediction of waste generation from a remodeling or renovation project would allow for development of a recycling project plan (or waste management plan). It would allow the recycling project manager to perform accurate economic analysis, market identification, and plan for storage/handling. Accurately predicting the quantity of individual waste materials from a remodeling project is problematic, however.

The quantity of materials can be estimated using several different approaches. It is not certain, however, that the predicted amount of materials will be the total amount that can be recycled. Factors such as the methods of demolition, segregation, and collection will greatly influence the amount of material that can be recycled.

Accurately measuring the individual building components is also problematic. Some materials are not readily available for measurement, or are difficult to measure, particularly if the building is in use. Often, the ceilings, walls, or floors will have to be opened to identify types and amounts of materials. In most cases, this should be a minor difficulty since the part of the building in question has already been identified for renovation and can be deconstructed to determine these amounts. If physical inspection is impractical, then the next best source of information may be the original blueprints, or "as-built" drawings for the building.

1.2 Quantifying From the Demolition Specification

A remodeling project is awarded to a contractor through a bid process. Included in this solicitation for bid are specifications and drawings for completion of the work. All demolition work to be done as part of the remodel will need to conform to the specifications and contract drawings. While it will not give you specific quantities of materials, the demolition specification may provide some valuable information on the salvage and recycling of identified materials.

Often specifications will include clauses requiring the salvage or recycling of materials.

This method will only provide a qualitative description of materials to recycle. One must refer to the drawings for quantities.

1.3 Quantifying From Drawings

Most renovation or remodeling projects will have blueprints with revisions and notes indicating what changes are required for the project. The demolition phase of the work will be described in separate drawings. Based on the drawings included as part of the bid solicitation, the contractor develops a cost for doing the job. R.S. Means' *Building Construction Cost Data* and *Facilities Maintenance and Repair Data* provide some cost data for selective demolition and removal of building components. The *US Army Job Order Contract (PDS99) Unit Price Book* also provides a demolition cost for removing mechanical and electrical equipment, framing members, finishes, and other building materials and components. These references provide typical unit cost and production rates (e.g., linear feet of stud wall removed per hour). These factors can be applied to the specific materials and dimensions found in the building to be remodeled.

A set of drawings usually includes site plans, floor plans, elevations, and details along with schedules and plans for HVAC and plumbing for both the demolition and the new construction. To determine the demolition and removal of the existing building materials, you will need to look at all of the drawings that reference demolition. The demolition plans will indicate what tasks need to be done. These tasks are outlined in detail in numbered notes on the blueprints. For example, a note may read:

> "Remove 10' tall wood stud and GWB as indicated."

First, you want to find all places on the drawing which reference that note number. Next, using an architectural or engineering scale, total up the quantities of materials. This may be a two-step process. In the above example, the total linear feet (ft) and square foot (ft^2) of wall is calculated. Once the quantity of each material class has been estimated, the next step is to transform this information into either weight or volume estimates. Some references are available that may assist in specifically determining the quantity of each material. The American Society of Civil Engineer's (ASCE's) *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-95), for example, lists the minimum design dead loads for different building components and systems. Another source for dead loads and system weights for various building assemblies is R.S. Means *Assemblies Cost Data*.

Example: According to the ASCE 7-95, frame partitions with 2x4-ft wood studs and 1/2-inch drywall on each side have a minimum design dead load of 8 lb/ft^2. Using this measurement, 44 ft of 10-ft tall wood stud and gypsum wallboard (GWB or drywall) partition, for example, one would calculate the quantity of demolition waste as follows:

$$(440\ ft^2 \times 8\ lb/ft^2) / (2000\ lb/ton) = 1.76 \text{ tons of waste}$$

The materials are combined here to determine the quantity of waste. If no recycling will take place, then total tons of waste will give an estimate of the quantity of waste going to a landfill. For hauling purposes, this weight of materials may need to be converted to volume. Table 1-1 lists some typical volume-weight conversions for wood, cardboard, drywall, and mixed waste.

Table 1-1. Weight-Volume Conversions for Common Remodeling Waste Materials [Yost 1997].

Material	**lb/yd^3**	**yd^3/ton**
Wood	300	6.7
Cardboard	30-100	20-50
Drywall	400	5
Rubble	1400	1.4
Mixed waste	350	5.7

If the materials will be separated for the purpose of recycling, however, then "tons of waste" is too broad and does not give an accurate assessment of recyclable materials. The next step is to estimate the materials that make up that wall: 2x4-ft wood studs (10-ft tall), 1/2-inch thick drywall (two sides). GWB, if clean, can be recycled in some markets. In a remodeling project, however, the chances of the drywall being clean without finishes such as paint or wallpaper, is highly unlikely. The only component of this wall partition that has a potential for recycling is the 10-ft long, 2x4-ft wood studs. For salvage or recycling, the number of studs as well as the board feet (bf)[1] of lumber can be quickly calculated.

1.4 Quantifying From Building Survey

Some drawings are more inclusive than others, so it is important to read the specification and bid solicitation carefully, and visit the job site in person to survey the building. Building surveys address construction type and materials, configuration of the major building systems, and descriptions of materials and components necessary to develop a reasonable take-off of materials' quantities. Whenever feasible, a survey of the actual building should be done to verify the information on the drawings.

The drawings will not include detailed information on the condition of the materials present. Exact finishes on the floors and walls are typically not indicated on the drawings. It may state that exterior wood siding shall be removed, but the condition of that siding is not known. The condition of the siding and type of wood will determine whether this material is salvageable for recycling or must be disposed of as solid waste.

[1] A board foot represents a volume of wood 1 inch thick by 12 inches wide by 12 inches long. The nominal dimensions are used for this calculation, e.g., use 2 and 4 rather than the actual measurements of a "2x4."

2.0 Fort Bragg Barracks to Office Conversion

The first building selected for study at Fort Bragg is a multi-wing, 3 story building that was built early in the 20th century. It has served many purposes over its lifetime, mostly barracks and office space. The remodeling project involves refurbishing and partial reconfiguration of the interior. The exterior, all structural elements, and some interior partitions will remain. The next several photographs (Figures 2-1 through 2-10) show the major features of the building and much of the interior that will be removed.

One-third of the building (one "wing") has already been remodeled, and is not addressed here. The data presented in Table 2-1, and following tables, reflect the remodeling of two wings. Therefore, the calculated material quantities could be divided by two to get an average "per wing" total.

Figure 2-1. Front entrance, multi-wing 3-story building at Fort Bragg.

Figure 2-2. Front facade, selected building at Fort Bragg.

Figure 2-3. Side of selected building at Fort Bragg.

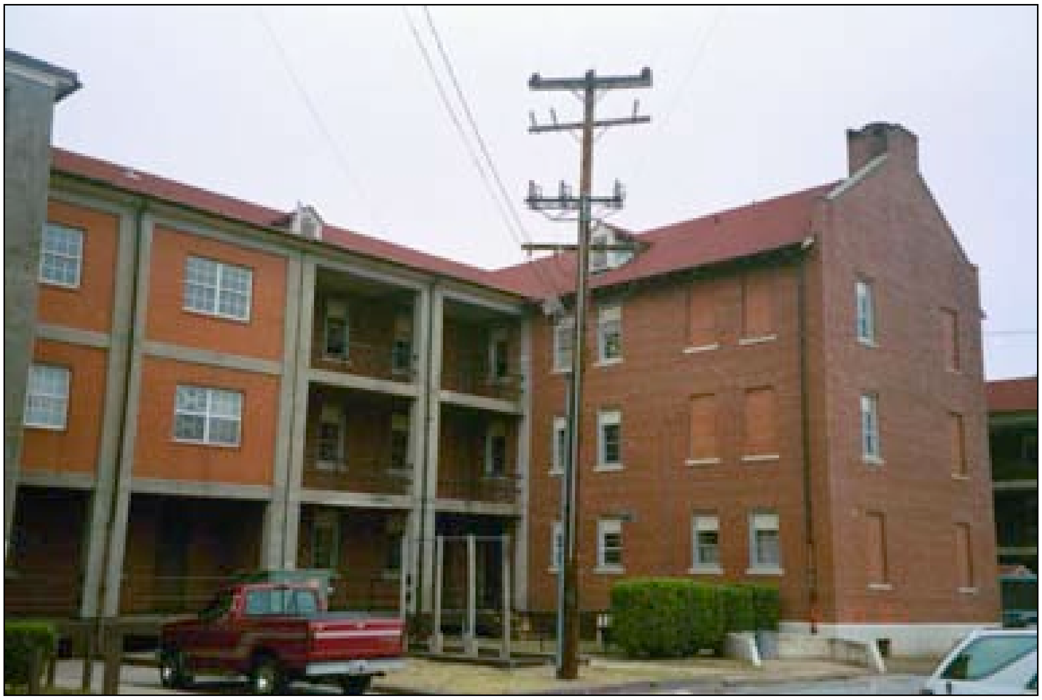

Figure 2-4. Rear view of selected building at Fort Bragg.

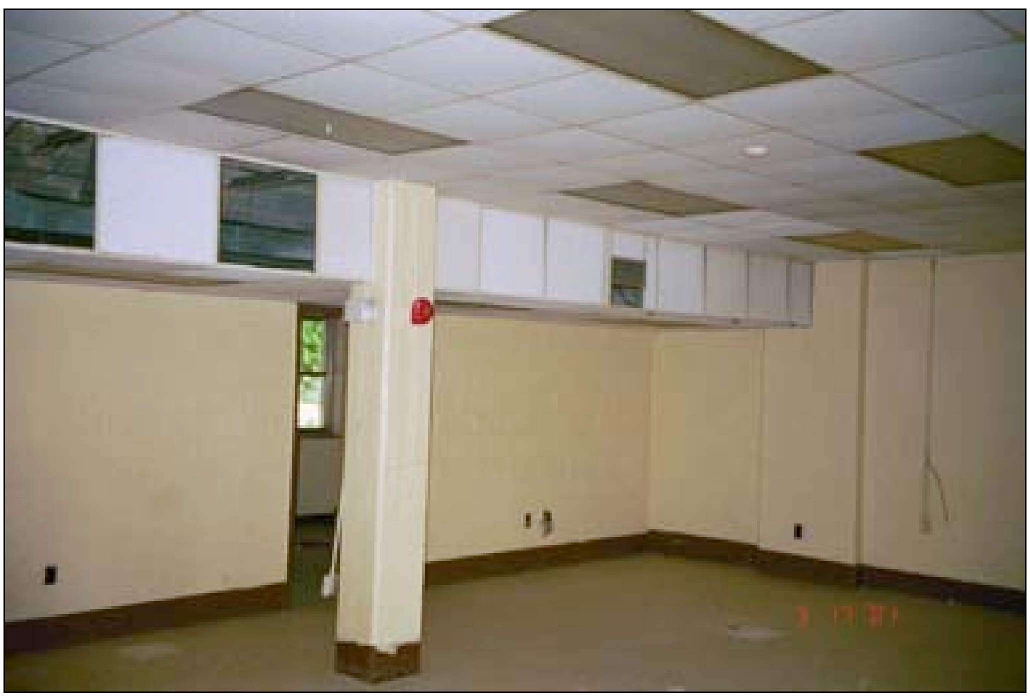

Figure 2-5. Room inside selected building at Fort Bragg.

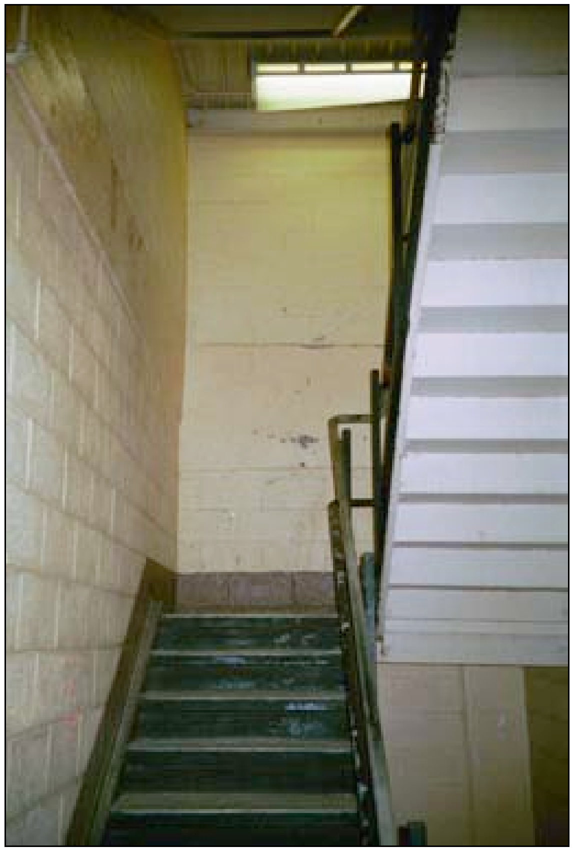

Figure 2-6. Stairs inside selected building at Fort Bragg.

Figure 2-7. Corridor inside selected building at Fort Bragg.

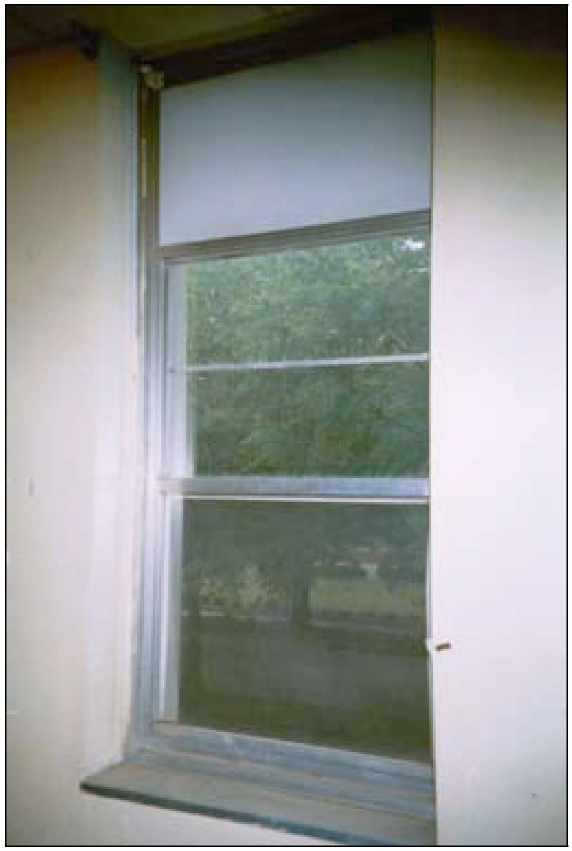

Figure 2-8. Window inside selected building.

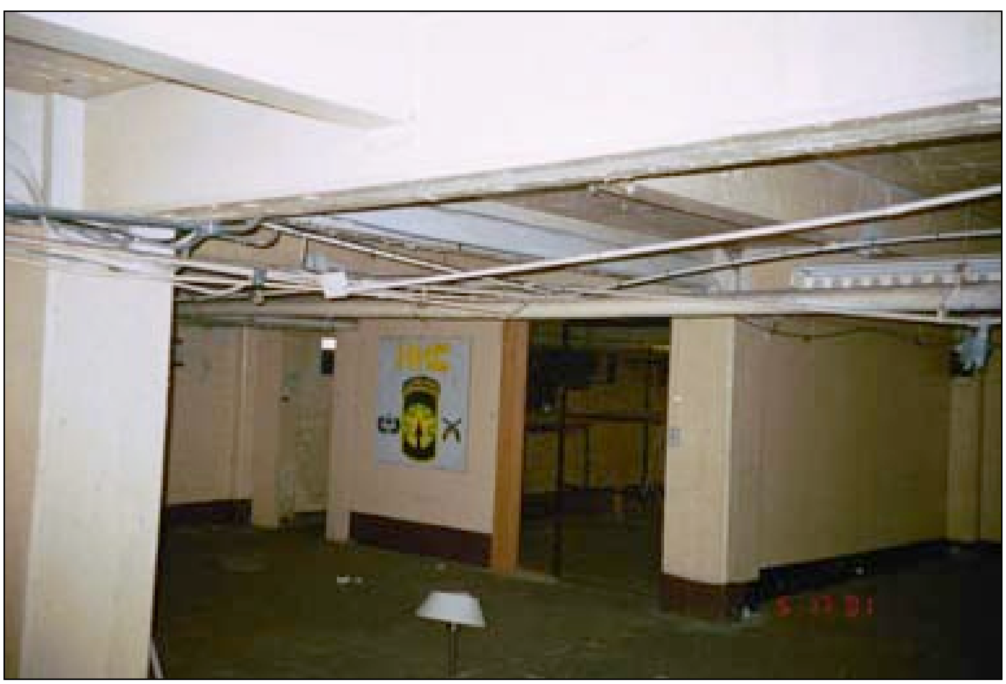

Figure 2-9. Basement of selected building at Fort Bragg.

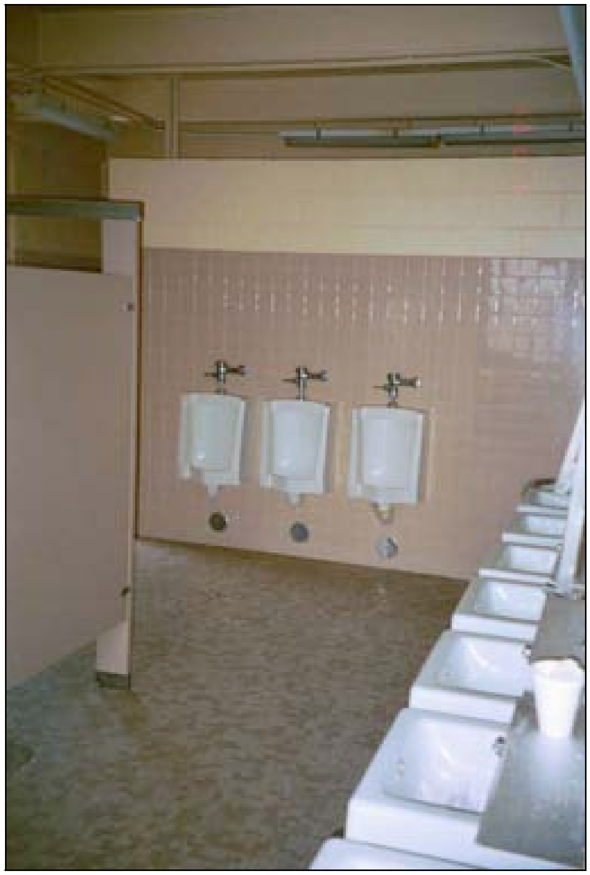

Figure 2-10. Latrine in selected building at Fort Bragg.

These numbered notes in the table below are from the renovation drawings of an old barracks at Fort Bragg. These include quantities for Wing "B" and Wing "C". Wing "A" was previously remodeled. The text and figures in RED (not in all caps and not in italics) indicate calculations derived from the demolition instruction. The text in BLUE (italics) reflects items to be removed as a unit rather than pounds or feet of material.

Table 2-1. Basement demolition plan.

DEMOLITION NOTES	**lb**	**bf**	**yd^3**
1. REMOVE 8'-8" TALL WOOD STUD AND PLYWOOD/PANELING WALL AS INDICATED.			
Stud wall = 194 ft (.75 +1) = 147 studs (5.33 bf/stud)		784	
1681 ft^2 = (2 x 4 wood stud, plywood, two sides = 7 lb/ft^2) = 11,770 lb	11770		
2. REMOVE HOLLOW METAL DOOR, DOOR FRAME, AND ASSOCIATED FINISH HARDWARE.			
(1) Single door 32" (7') = 18.67 ft^2 (6.5 lb/ft^2) = 121.3 lb	121		
(3) Single door 36" = 21 ft^2 (6.5) = 136.5 lb (3)	410		
(1) Double door 60" (7') = 35 ft^2 (6.5 lb/ft^2) = 228	228		
(1) Double door 64" (7') = 37.33 ft^2 (6.5 lb/ft^2) = 242	242		
(8) door hardware			
3. REMOVE VAULT DOOR, FRAME AND ASSOICATED HARDWARE.			
Single vault door 42" (1) = 24.5 ft^2 (9 lb/ft^2)	221		
Frame = 17.5 ft (1.4 ft/ft)	25		
(1) door hardware			
4. REMOVE WOOD DOOR, WOOD FRAME AND ASSOCIATED FINISH HARDWARE.			
(1) Single door 34" (7') = 19.83 ft^2 (5 lb/ft^2) = 99 lb	99		
(2) Single door 36" (7') = 21 ft^2 (5) 105 lb (2) = 210 lb	210		
(1) Double door 58" (7') = 33.83 ft^2 (5) = 169 lb	169		
Wood frame: 78 ft (1/4" thick)(4" wide) = 78(.083) = 6.5 bf		6.5	
78 ft (0.25 lb/ft) = 19.5	19.5		
(5) door hardware			
5. REMOVE 8'-8" TALL WOOD STUD AND GWB WALL AS INDICATED.			
Stud wall = 21.5 ft (.75 +1) =17 studs (5.77 bf/ft^2) = 98 bf		98	
Wood studs with 1/2 gyp each side = 186 ft^2 (8 lb/ft^2)	1488		
6. REMOVE PANELING AND FURRING AS INDICATED.			
Wing C: 815 ft^2 wall (0.4 lb/ft^2)	326		
7. REMOVE STEEL STAIR NOSINGS.			
102 ft (3 stair wells, 34 stairs, 3' wide)	102		
8. REMOVE WOODEN STEPS, RAILS, PLYWOOD WALLS AND ROOF COMPLETE.			
8 steps 4'-10" wide, located in a 6' x 6' appendage			
9. REMOVE LOUVER AND FRAME COMPLETE.			
Wing B: (2) 14' x 8'-8" wing C: (1) 14' x 8'-8", (1) 11' x 8'-8" = 216.66 ft^2 (1.16 lb/ft^2)	251		
10. REMOVE ACOUSTICAL CEILING SYSTEM COMPLETE.			
18' x 32' = 576 ft^2 ceiling (0.8 lb/ft^2) = 460.8 lb	461		

DEMOLITION NOTES	lb	bf	yd^3
11. REMOVE STEEL BARE GRILLE AND FRAME AT BASEMENT WINDOWS.			
Typical of (33) windows 3'-3" x 2-6" (approx.) 12 ft of trim per window			
12. REMOVE STEEL DOOR, FRAME AND ASSOCIATED HARDWARE.			
5' Double door in stairwell = 35 ft^2 (6.5 lb/ft)	228		
Frame = 19 ft (1.4 lb/ft)	26.6		
(2) door hardware			
13. REMOVE CHAIN LINK FENCE.			
(8'-8" tall) 36.5 ft = 316. 3 ft^2 (.696 lb/ft^2) = 220 lb	220		
(7) corner/end posts (2-1/2" O.D.); 60 ft (3.315 lb/ft)	199		
(4) support/middle posts (1-5/8" O.D.); 35 ft (1.431 lb/ft)	50		
14. REMOVE 7'-3" CMU WALL TO UNDERSIDE OF CONCRETE BEAM (6")			
14 ft or 101.5 ft^2 (35 lb/ft^2)	3553		
15. SAW CUT CONCRETE FLOOR ABOVE AS INDICATED ON SHEET S1.			
Slab thickness 4" in mechanical rooms (14.5' x 17.5') = 254 ft^2 (.012 yd^3/ft^2) =3 yd^3			3
Stone concrete, per inch = 12 lb/ft^2 per inch: (48 lb/ft^2) = 12192 lb	12192		
16. REMOVE WINDOW AND FRAME COMPLETE.			
(5) windows 3'-3" x 2-6" = 8 ft^2 per window = 40 ft^2 (8 lb/ft^2)	320		
(approx.) 12 ft of trim per window (0.25 lb/ft^2)	3		
17. REMOVE CHAIN LINK DOOR AND ALL ASSOCIATED HARDWARE.			
(1) 3.5' door and (1) 4' door = 65 ft^2 (.696 lb/ft^2) + (4) posts (2.315 lb/ft)	126		
18. REMOVE HOLLOW METAL DUTCH DOOR, HOLLOW METAL FRAME AND ALL ASSOCIATED HARDWARE.			
(1) 2.5' door = 17.5 ft^2 (6.5 lb/ft^2)	114		
17.5 ft of frame (1.4 lb/ft^2)	25		
(1) door hardware			
19. REMOVE GWB FURRING.			
130 ft^2 of wall. Furring strips 1" x 3" = 0.75 ft/ft^2 = 173.3 ft (.25 lb/ft)	43		
0.1875 bf/ft^2 OR 0.25 bf/ft = 25 bf		25	
20. REMOVE PLYWOOD COMPLETE.			
11.5' x 8'-8" = 100 ft^2 @ 1.5 lb/ft^2 = 150 lb of ½" plywood or 0.5 bf per ft^2 = 50 bf	150	50	
21. REMOVE PLYWOOD RACK COMPLETE.			
40 ft or (2) 16' x 4' = (2) 64 = 128 ft^2 (0.5 bf/ft^2); 128 ft^2 (1.5 lb/ft^2) = 192 lb	192	64	
GENERAL NOTES:			
1. SEE SHEETS R25-29 FOR ABATEMENT PLANS FOR FLOORS, WALLS, AND CEILINGS.			
2. REMOVE ALL BLINDS, DRAPES, WINDOW COVERINGS, AND ASSOCIATED HARDWARE COMPLETE AT ALL WINDOWS.			
3. COORDINATE DEMOLITION WORK WITH ABATEMENT PLANS, SHEETS R1-R5, FOR SEQUENCE OF CONSTRUCTION FOR ABATEMENT OF FLOORS, WALLS, AND CEILINGS.			
4. FIELD-VERIFY ALL CONDITIONS PRIOR TO BEGINNING			

DEMOLITION NOTES	**lb**	**bf**	**yd^3**
DEMOLITION WORK. DOCUMENTS WERE BASED ON CONDITION OF BUILDING AT TIME OF SURVEY.			

Table 2-2. First floor demolition plan

DEMOLITION NOTES: FIRST FLOOR DEMOLITION PLAN	lb	bf	yd^3
1. REMOVE 8" CMU WALL AS INDICATED TO RECEIVE NEW DOOR.			
Door openings (7'): (3) 3'-0", (2) 3'-2", (1) 3'-4" = 130 ft^2 (35 lb/ft^2)	4550		
2. REMOVE PLYWOOD SHELF, SHUTTER, AND ASSOCIATED HARDWARE.			
(2) 1.5' x 4' shelf/ shutter = 12 ft^2 @1.5 lb/ft^2 = 18 lb of ½" plywood or 0.5 bf/ft^2	18	6	
3. REMOVE ACOUSTICAL CEILING SYSTEM COMPLETE.			
Total = 9,383 ft^2 x 0.8 lb/ft^2 = 7506 lb = 2.75 tons	7506		
4. REMOVE WOOD DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE.			
(26) single door (3') = 546 ft^2 (5 lb/ft^2)	2730		
(2) double exterior (5.5') = 77 ft^2 (9 lb/ft^2)	693		
Metal frame = 522 ft (1.4 lb/ft)	731		
5. REMOVE HOLLOW METAL DOOR, HOLLOW METAL FRAME AND ASSOCIATED FINISH HARDWARE.			
(17) single 3' interior doors = 357 ft^2 (6.5 lb/ft^2)	2320		
(7) double 5'-6' interior doors = 270 ft^2 (6.5 lb/ft^2)	1755		
Metal frame = 458 ft (1.4 lb/ft^2)	641		
(31) door hardware			
6. REMOVE STEEL STAIR NOSINGS.			
(2) interior stairwells with 20 stairs = 40 stairs (3') = 120 ft	120		
7. REMOVE 10'-0" HIGH WOOD STUD AND GWB AS INDICATED.			
Wood studs = 48.5 ft (.75) +1 = 38 studs (6.667 bf/stud) = 253 bf		253	
4.5 ft GWB one side = 45 ft^2 (6 lb/ft^2) = 270 lb	270		
44 ft interior partition wall GWB both sides = 440 (8 lb/ft^2) = 3520 lb	3520		
8. REMOVE TOILET PARTITION.			
(2) partitions 3.5' long, approx. 7' high = 49 ft^2 (3.25 lb/ft^2)	159		
9. REMOVE CERAMIC FLOOR AND SETTING BASE.			
1" mortar bed: 8.5' x 10' = 85 ft^2 (23 lb/ft^2)	1955		
10. REMOVE PLUMBING FIXTURES; TOILET ACCESSORIES, INCLUDING: MIRRORS, MEDICINE CABINETS, SOAP DISPENSERS AND PAPER TOWEL DISPENSERS. REFER TO PLUMBING DEMOLITION DRAWING P-4 FOR ADDITIONAL INFORMATION.			
(2) toilets			
(1) urinal			
(2) sinks			
11. REMOVE PLYWOOD ARCH COMPLETE.			
Arch plywood 1/2" thick = 0.5 bf/ft^2 (10 ft^2)		5	
Corridor arch 5' wide (7 lb/ft^2) (10 ft^2) = 70 lb	70		
12. REMOVE LOUVER COMPLETE.			
(2) louvers to exist duct chase (2' x ?) = 8 ft^2 (1.16 lb/ft^2)	9		
13. REMOVE PLYWOOD INFILL COMPLETE.			
Window 3.5' x 6' = 21 ft^2 (1.5 lb/ft^2) = 32 lb; 21 ft^2 (0.5 bf/ft^2)	32	10.5	

DEMOLITION NOTES: FIRST FLOOR DEMOLITION PLAN	lb	bf	yd^3
14. SAW CUT CONCRETE FLOOR SLAB, SEE MECH DRAWINGS.			
Small rectangular slabs indicated on drawings: (12" x 8"), (10" x 6"), (24" x 16"), (24" x 5.5'), (10" x 6"), (14" x 14"), (10" x 10"), (10" x 16"), (10" x 6"?), (10" x 6"?), (14" x 14"), (24" x 16"), (25" x 5.5'), (22' x 14"), (12" x 12"), (12" x 12"), (10" x 6"), (10" x 6") = 100 ft^2 4" thick slab: 100 ft^2 (48 lb/ft^2) = 4800 lb; 100 ft^2 (.012 yd^3/ft^2) = 1.2 yd^3	4800		1.2
15. REMOVE GWB CEILING COMPLETE.			
(85 ft^2) (2 lb/ft^2) = 170 lb	170		
16. REMOVE ELECTRIC WATER COOLER.			
(1) water cooler			
17. REMOVE WOOD STUD, PLYWOOD WALLS AND ROOF COMPLETE, AS WELL AS THE DOORS AND HARDWARE AS INDICATED.			
???Exterior stairwell from basement 12 ft (.75 +1) = 10 studs (6.667 bf/stud) = 67 bf		67	
Plywood 120 ft^2 (0.5 lb/ft^2) = 60 bf		60	
Stud wall, plywood 2 sides = 7 lb/ft^2 (120 ft^2) = 840 lb	840		
Roof 6' x 6' (flat) = 36 ft^2 (6.5 lb/ft^2)	234		
18. REMOVE 12" X 12" ACT GLUED TO UNDERSIDE OF CONCRETE DECK.			
Corridor from wing b to wing c: (5.75' x 130') = 748 ft^2 (1 lb/ft2) = 748 lb	748		
19. REMOVE WALL PANELING COMPLETE.			
23 ft x 10' = 230 ft^2			
1/8" = 0.44 lb/ft^2 (230 ft^2) = 101 lb	101		
20. REMOVE MAIL BOXES COMPLETE.			
wood mailboxes located in (1.5' x 4' x tall) opening			
21. REMOVE 11'-0: TALL, 8" CMU WALL AS INDICATED.			
18.5 ft (10') = 180 ft^2 (35 lb/ft^2) = 6300 lb = 1.4 tons	6300		
22. REMOVE PLYWOOD PANEL COMPLETE.			
(3) 4' panels x 4'? height = 48 ft^2 (1.5 lb/ft^2); 48 ft^2 (0.5 bf/ft^2)	72	24	
23. REMOVE BULLETIN BOARD COMPLETE.			
(1) 24" long bulletin board x 4' tall = 8 ft^2 (1.5 lb/ft^2)	12		
GENERAL NOTES:			
1. ROOM NUMBERS 118A, 127, 128, 129, 130, AND 136A NOT USED ON THIS SHEET.			
2. MASONRY OPENING (MO) REFERS TO FLOOR RENOVATION PLAN FOR ADDITIONAL INFORMATION.			
3. COORDINATE DEMOLITION WORK WITH ABATEMENT PLANS, SHEETS R1-55, FOR SEQUENCE OF CONSTRUCTION FOR ABATEMENT OF FLOORS, WALLS, AND CEILINGS.			
4. REMOVE ALL BLINDS, DRAPES, WINDOW COVERINGS, AND ASSOCIATED HARDWARE COMPLETE AT ALL WINDOWS.			
5. FIELD-VERIFY ALL CONDITIONS PRIOR TO BEGINNING DEMOLITION WORK. DOCUMENTS WERE BASED ON CONDITION OF BUILDING AT TIME OF ORIGINAL SURVEY.			

Table 2-3. Second floor demolition plan

DEMOLITION NOTES: SECOND FLOOR DEMOLITION PLAN	**lb**	**bf**	**yd^3**
1. REMOVE 11'-10" TALL MAXIMUM, 8" CMU WALL AS INDICATED.			
(2) 96 ft in bathrooms = 192 ft (11.83) = 2271 ft^2 (46 lb/ft)	104466		
2. REMOVE WINDOW AND WINDOW FRAME COMPLETE.			
(6) 6.5' x 5' = 195 ft^2 (2) 3' x 2' = 12 ft^2	1656		
3. REMOVE ACOUSTICAL CEILING TILE AND TRACK.	25,482		
4. REMOVE WOOD DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE.			
(4) 28" (2) 30" (32) 36" all 7' = 65.3 + 35 + 672 = 772.3 ft^2 DOOR	3,862		
65.3 + 33 + 544 = 642.3 ft FRAME	899		
5. REMOVE HOLLOW METAL DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE.			
(4) 3' x 7' = 84 ft^2 DOOR (6.5) = 546 lb	546		
68 ft FRAME (1.4) = 95	95		
(4) door hardware			
6. REMOVE STEEL STAIR NOSINGS.			
(2) interior stairwells with 20 stairs = 40 stairs (3') = 120 ft 4" wide	120		
7. REMOVE ALL EXISTING ROOFING MATERIALS, JOISTS, AND ANY BRIDGING COMPLETE.			
See 17. On first floor demolition plan			
8. REMOVE SHOWER CURB.			
13 ft 8" wide 4" thick (29 lb/ft) (.008 yd^3/ft)	377		0.1
9. REMOVE PLUMBING FIXTURES; TOILET ACCESSORIES, INCLUDING: MIRRORS, MEDICINE CABINETS, SOAP DISPENSERS, AND PAPER TOWEL DISPENSERS. REFER TO PLUMBING DEMOLITION DRAWING P-4 FOR ADDITIONAL INFORMATION.			
(17) toilets			
(6) urinals			
(21) sinks			
(14) shower heads			
10. REMOVE TOILET AND SHOWER PARTITIONS.			
110 ft x 5' tall = 550 ft^2 (3.25 lb/ft^2)	1788		
11. REMOVE CERAMIC FLOOR TILE AND SETTING BASE.	19,936		
12. REMOVE LOUVER COMPLETE.			
13. REMOVE ELECTRIC WATER COOLER.			
(2) drinking fountains			
14. REMOVE WINDOW & WINDOW FRAME COMPLETE AND PORTION OF THE EXISTING WALL BELOW THE WINDOW FOR NEW DOOR INSTALLATION.			
3'-4" wide x 5'? = 16.7 ft^2 (8 lb/ft^2)	133		
3'-4" x 3' = 10 ft^2 WALL (46 lb/ft^2)	460		
15. REMOVE EXISTING BRICK AND BLOCK INFILL COMPLETE WHERE ORIGINAL DOOR WAS INSTALLED FOR NEW DOOR			

DEMOLITION NOTES: SECOND FLOOR DEMOLITION PLAN	lb	bf	yd^3
INSTALLATION.			
(2) (3'-4" x 7') = 47 ft^2 (47 lb/ft^2)	2209		
16. REMOVE 6" CMU AS INDICATED TO INSTALL ACCESS PANEL.			
(2) 1.5' x 4'? = 12 ft^2 (35 lb/ft^2)	420		
17. REMOVE PANELING COMPLETE.			
18 + 15.5 + 18 + 12.5 = 64 ft (10') = 640 ft^2 paneling 1/4" thick?	512		
18. REMOVE BULLETIN BOARD COMPLETE.			
3' x 4' = 12 ft^2 (2.4 lb/ft^2)	29		
GENERAL NOTES:			
1. ROOM NUMBERS 215, 216, 241, AND 242 ARE NOT USED ON THIS SHEET.			
2. MASONRY OPENING (MO) REFERS TO FLOOR RENOVATION PLAN FOR ADDITIONAL INFORMATION.			
3. COORDINATE DEMOLITION WORK WITH ABATEMENT PLANS, SHEETS R1-R5, FOR SEQUENCE OF CONSTRUCTION FOR ABATEMENT OF FLOOR, WALLS, AND CEILINGS.			
4. REMOVE ALL BLINDS, DRAPES, WINDOW COVERINGS, AND ASSOCIATED HARDWARE COMPLETE AT ALL WINDOWS.			
5. FIELD-VERIFY ALL CONDITIONS PRIOR TO BEGINNING DEMOLITION WORK. DOCUMENTS WERE BASED ON CONDITION OF BUILDING AT THE TIME OF ORIGINAL SURVEY.			

Table 2-4. Third floor demolition plan

DEMOLITION NOTES: THIRD FLOOR DEMOLITION PLAN	lb	bf	yd^3
1. REMOVE 11'-10" TALL MAXIMUM, 8" CMU WALL AS INDICATED.			
(2) 96 ft in bathrooms = 192 ft (46 lb/ft)	8832		
2. REMOVE WINDOW AND WINDOW FRAME COMPLETE.			
(6) 6.5' x 5' (2) 3' x 2'			
3. REMOVE BATT INSULATION, ACOUSTICAL CEILING TILE, AND TRACK.			
8594 ft^2 (2.8 lb/ft^2)	24,063		
8594 ft^2 Batt Insulation 6" thick (.6 lb/ft^2)	5,156		
4. REMOVE WOOD DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE.	4085		
Metal frame 16.3 (5) + 17 (35) = 82 + 595 = 677 ft	948		
(40) door hardware			
5. REMOVE HOLLOW METAL DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE.			
(2) 36" x 7' = 42 ft^2 DOOR	273		
17 + 17 = 34 ft FRAME	48		
(2) door hardware			
6. REMOVE STEEL STAIR NOSINGS.			
(20) stairs (3') = 60 ft 4" wide	60		
7. REMOVE TOILET AND SHOWER PARTITIONS.			
110 ft x 5' tall = 550 ft^2	1788		
8. REMOVE SHOWER CURB.			
13 ft 8" wide 4" tall	377		0.1
9. REMOVE PLUMBING FIXTURES, TOILET ACCESSORIES, INCLUDING: MIRRORS, MEDICINE CABINETS, SOAP DISPENSERS, AND PAPER TOWER DISPENSERS. REFER TO PLUMBING DEMOLITION DRAWING P-4 FOR ADDITIONAL INFORMATION.			
(17) toilets			
(6) urinals			
(21) sinks			
(14) shower heads			
Accessories			
10. REMOVE CERAMIC FLOOR TILE AND SETTING BASE.	19,936		
11. NOT USED.			
12. REMOVE WINDOW & WINDOW FRAME COMPLETE AND PORTION OF THE EXISTING WALL BELOW WINDOW FOR NEW DOOR INSTALLATION.			
3'-4" wide x 5' = 16.7 ft^2 (8 lb/ft^2)	133		
3'-4" x 3' = 10 ft^2 WALL (46 lb/ft^2)	460		
13. REMOVE ELECTRIC WATER COOLER.			
(2) water coolers			
14. REMOVE EXISTING BRICK AND BLOCK INFILL COMPLETE ORIGINAL DOOR WAS INSTALLED FOR NEW DOOR INSTALLATION.			

DEMOLITION NOTES: THIRD FLOOR DEMOLITION PLAN	lb	bf	yd^3
(2) (3'-4" x 7') = 47 ft^2 (48 lb/ft^2)	2256		
15. REMOVE HOLLOW METAL DOOR, HOLLOW METAL FRAME, AND ASSOCIATED FINISH HARDWARE, DOOR TO ATTIC.			
(2) 36" x 7' = 42 ft^2 DOOR	273		
17 + 17 = 34 ft FRAME	48		
(2) door hardware			
16. REMOVE LOUVER COMPLETE.			
2' x ?			
17. SAW CUT CONCRETE SLAB BETWEEN THIRD FLOOR CEILING/ATTIC FLOOR. SEE MECH DRAWINGS.	1152		
GENERAL NOTES:			
1. ROOM NUMBERS 315, 316, 317, 342, 343 AND 344 ARE NOT USED ON THIS SHEET.			
2. MASONRY OPENING (MO) REFERS TO FLOOR RENOVATION PLAN FOR ADDITIONAL INFORMATION.			
3. COORDINATE DEMOLITION WORK WITH ABATEMENT PLANS, SHEETS R1-R5, FOR SEQUENCE OF CONSTRUCTION FOR ABATEMENT OF FLOORS, WALLS, AND CEILINGS.			
4. REMOVE ALL BLINDS, DRAPES, WINDOW COVERINGS, AND ASSOCIATED HARDWARE COMPLETE AT ALL WINDOWS.			
5. FIELD-VERIFY ALL CONDITIONS PRIOR TO BEGINNING DEMOLITION WORK. DOCUMENTS WERE BASED ON CONDITION OF BUILDING AT TIME OF ORIGINAL SURVEY.			

Table 2-5. Basement demolition plan - HVAC

BASEMENT DEMOLITION PLAN – HVAC:	**lb**	**bf**	**yd^3**
(2) WATER HEATERS			
(1) BOILER			
(1) 80 GALLON EXPANSION TANK			
(1) 40 GALLON EXPANSION TANK			
(1) SYSTEM PUMP			
(3) EXHAUST FAN			
(1) AIR COOLED WATER CHILLER (9' x 20' = 180 ft^2)			
(2) AIR HANDLING UNIT			
(1) UNDERGROUND FUEL TANK (8' x 20' = 160 ft^2)			
(1) ELECTRIC HEATER			
(2) FIRE DAMPER			
3/4" LTWS (TEMPERED WATER SUPPLY) 58 ft (1.13 lb/ft)	66		
3/4" LTWR (TEMPERED WATER RETURN) 56 ft (1.13 lb/ft)	63		
3/4" HWR (HOT WATER HEATING RETURN) UP 8 ft (1.13 lb/ft)	9		
2" HW (HOT WATER HEATING SUPPLY) UP 8 ft (1.75 lb/ft)	14		
2-1/2" DTWS (DRINKING WATER SUPPLY) 98 ft (2.48 lb/ft)	243		
2-1/2" DTWR (DRINKING WATER RETURN) 189 ft (2.48 lb/ft)	469		
3" HW (HOT WATER HEATING SUPPLY) 73 ft (3.33 lb/ft)	243		
4" CWR (CONDENSER WATER RETURN) 65 ft (5.38 lb/ft)	350		
4" CWS (CONDENSER WATER SUPPLY) 77 ft (5.38 lb/ft)	414		
4" ∅ 108 ft (10.79 lb/ft)	1165		
6" ∅ 7 ft (18.97 lb/ft)	133		
10" ∅ 9.25 ft (40.48LB/ft)	374		
14" ∅ 12.5 ft (54.75 lb/ft)	684		
18" ∅ 2 ft (70.59 lb/ft)	141		
60x24 44 ft	728		
48x16 18 ft	229		
30x32 97 ft	1192		
40x30 14 ft	195		
34x30 46 ft	584		

Table 2-6. First floor demolition plan - HVAC

FIRST FLOOR DEMOLITION PLAN – HVAC:	lb	bf	yd^3
(15) TU (2' X 4')			
(1) T – THERMOSTAT			
(1) GRILLE BLW			
30x30 RA 2.5 ft	31		
8x6 9 ft	28		
10x6 30 ft	103		
10x8 6.5 ft	25		
10x10 29 ft	122		
12x6 16 ft	61		
12x10 122 ft	559		
14x6 12.5 ft	53		
14x8 25 ft	115		
16x8 15.5 ft	92		
16x10 125 ft	669		
24x16 16 ft	129		
42x14 18 ft	201		

Table 2-7. Second floor demolition plan - HVAC

SECOND FLOOR DEMOLITION PLAN – HVAC:	lb	bf	yd^3
(10) TU			
(7) T (THERMOSTAT)			
(1) M			
8x8 43 ft	147		
10x8 35 ft	135		
12x6 16.5 ft	63		
12x8 87 ft	365		
12x10 79 ft	362		
12x12 19 ft	95		
14x10 17 ft	85		
14x12 28 ft	150		
16x8 18.5 ft	92		
16x10 109 ft	583		
16x12 26 ft	150		
18x10 21 ft	121		
24x16 32 ft	258		
ELECTRICAL CONDUIT 18 ft			
(2)ELECTRICAL BOXES			

Table 2-8. Third floor demolition plan - HVAC

THIRD FLOOR DEMOLITION PLAN – HVAC:	**lb**	**bf**	**yd^3**
(11) TU			
(6) T-THERMOSTAT			
(1) M			
8x6 45 ft	137		
10x8 74 ft	282		
12x6 75 ft	286		
12x8 37 ft	155		
12x10 81 ft	371		
14x10 19 ft	95		
14x12 31.5 ft	169		
16x8 37.5 ft	186		
16x10 81 ft	434		
16x12 26 ft	150		
18x10 21 ft	121		
24x16 32 ft	258		
ELECTRICAL CONDUIT 18 ft			
(2) ELECTRICAL BOXES			

Table 2-9. Attic demolition plan - HVAC

ATTIC DEMOLITION PLAN – HVAC:	**lb**	**bf**	**yd3**
6" ∅ 52 ft (18.97 lb/ft)	986		
16" ∅ 6 ft (62.58 lb/ft)	375		
12x8 34 ft	143		
12x12 35 ft	174		
18x18 14.5 ft	106		
18x20 9 ft	70		
24x14 27.5 ft	211		
24x22 2.5 ft	24		
26x30 6 ft	68		

Table 2-10. Basement demolition plan - Plumbing

BASEMENT DEMOLITION PLAN – PLUMBING:	lb	bf	yd^3
CONTRACTOR IS RESPONSIBLE FOR REMOVING ALL COMPONENTS OF THE EXISTING PLUMBING SYSTEM, INCLUDING ALL HOT WATER HEATERS, EXPANSION TANKS, SUPPLY PIPING, RECIRCULATION PIPING, SANITARY PIPING, VENT PIPING, FIXTURES, ETC.			
3" SAN (SANITARY) 13 ft (1.903 lb/ft)	25		
4" SAN (SANITARY) 255 ft (2.782 lb/ft)	709		
3/4" HB (?)32 ft (1.13 lb/ft)	36		
3/4" HWR (HOT WATER HEATING RETURN) 304 ft (1.13 lb/ft)	344		
1" CW (COLD WATER SUPPLY) 145 ft (0.655 lb/ft)	95		
1" HW (HOT WATER HEATING SUPPLY) 83.5 ft (0.655 lb/ft)	55		
2-1/2" CW (COLD WATER SUPPLY) 122 ft (2.48 lb/ft)	208		
2-1/2" HW (HOT WATER SUPPLY) 84 ft (2.48 lb/ft)	208		
1-1/2" HW (HOT WATER SUPPLY) 169 ft (1.14 lb/ft)	193		
3" CW (COLD WATER) 43 ft (3.33 lb/ft)	143		
(3) FD- Floor Drains			
(2) WATER HEATER			
(1) BOILER (4.5' x 7')			
(1) DOMESTIC HW RECIRC PUMP			

Table 2-11. First floor demolition plan - plumbing

FIRST FLOOR DEMOLITION PLAN – PLUMBING:	lb	bf	yd^3
3" SAN (SANITARY) 59 ft (1.903 lb/ft)	112		
4" SAN (SANITARY) 128 ft (2.782 lb/ft)	356		
3/4" HW (HOT WATER SUPPLY) 76 ft (1.13 lb/ft)	86		
2" CW (COLD WATER SUPPLY) 44 ft (1.75 lb/ft)	77		
1-1/2" HW (HOT WATER SUPPLY) 187 ft (1.14 lb/ft)	213		
1" CW (COLD WATER SUPPLY) 93 ft (0.655 lb/ft)	61		

Table 2-12. Second floor demolition plan - plumbing

SECOND FLOOR DEMOLITION PLAN – PLUMBING:	lb	bf	yd^3
(10) FD - Floor Drains			
3" SAN (SANITARY) 18 ft (1.903 lb/ft)	34		
4" SAN (SANITARY) 220 ft (2.782 lb/ft)	612		
2" CW (COLD WATER SUPPLY) 70 ft (1.75 lb/ft)	123		
3/4" HW (HOT WATER SUPPLY) 104 ft (1.13 lb/ft)	118		
1" CW (COLD WATER) 103 ft (0.655 lb/ft)	67		
1-1/2" HW/CW (HOT/COLD WATER RETURN) 132 ft (1.14 lb/ft)	150		

Table 2-13. Third floor demolition plan - plumbing

THIRD FLOOR DEMOLITION PLAN – PLUMBING:	**lb**	**bf**	**yd^3**
(10) FD - Floor Drains			
3" SAN (SANITARY) 18 ft (1.903 lb/ft)	34		
4" SAN (SANITARY) 220 ft (2.782 lb/ft)	612		
2" CW (COLD WATER) 70 ft (1.75 lb/ft)	123		
3/4" HW (HOT WATER) 350 ft (1.13 lb/ft)	396		
1" CW (COLD WATER) 103 ft (0.655 lb/ft)	67		
1-1/2" HW/CW (HOT/COLD WATER RETURN) 132 ft (1.14 lb/ft)	150		

Table 2-14. Basement floor lighting and power demolition plan

BASEMENT FLOOR LIGHTING & POWER DEMOLITION PLAN:	**lb**	**bf**	**yd^3**
(25) Fluorescent lighting fixtures (1x8)			
(12) Fluorescent lighting fixtures (2x4)			
(11) Fluorescent lighting fixtures (1x4)			
(41) Duplex receptacle			
(30) Ceiling mounted duplex receptacle			
(16) Ceiling mounted down lighting fixture			
(24) Switches			
(3) antenna outlets			
(2) HD			
(1) Fire alarm pull			
1. DISCONNECT AND REMOVE ELECTRICAL CONNECTION, DISCONNECT SWITCH AND/OR STARTER, AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
(6) motors and (1) switch to be removed from AHU and BOILER			
2. DISCONNECT AND REMOVE EXISTING PANEL AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE FEEDER CONDUIT AND WIRING SERVING THIS PANEL. COORDINATE REMOVAL WITH DEMOLITION POWER RISER DIAGRAM, SHEET E19.			
(2) panels 3.5' wide			
3. DISCONNECT AND REMOVE EXISTING PANEL AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE FEEDER CONDUIT AND WIRING SERVING THIS PANEL. COORDINATE REMOVAL WITH DEMOLITION POWER RISER DIAGRAM, SHEET E19.			
(2) panel 20" wide			
4. EXISTING PANEL MDPN SHALL REMAIN. DISCONNECT AND REMOVE SERVICE CONDUIT AND WIRING FEEDING PANEL. COORDINATE WITH ELECTRICAL SERVICE SEQUENCE OF CONSTRUCTION.			
Misc. wiring			
5. DISCONNECT AND REMOVE ELECTRICAL CONNECTION AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
(1) CATV cabinet			
6. DISCONNECT EXISTING EQUIPMENT FROM ALL POWER AND COMMUNICATION SERVICES. REMOVE EQUIPMENT AND TURN			

BASEMENT FLOOR LIGHTING & POWER DEMOLITION PLAN:	lb	bf	yd^3
OVER TO GOVERNMENT. TELECOMMUNICATON SERVICE DROP TO BUILDING SHALL BE REMOVED.			
(2) EMCS MUX AND POWER CONDITIONER			
7. EXISTING CABLE TELEVISION SERVICE PEDESTAL. DISCONNECT AND REMOVE SERVICE CABLES FROM SECONDARY SIDE OF SERVICE PEDESTAL. COORDINATE TERMINATION OF TELEVISION SERVICE WITH CABLE UTILITY COMPANY FOR DEMOLITION AND RE-ROUTING OF SERVICE.			
8. DISCONNECT AND REMOVE SERVICE FEEDERS FROM TRANSFORMER TO PANEL INDICTED. CONDUIT MAY BE ABANDONED UNDERGROUND WHERE IT DOES NOT INTERFERE WITH NEW CONSTRUCTION.			
223 ft conduit (1" steel conduit?) = 1.6 lb/ft	357		
9. DISCONNECT PRIMARY FEEDERS AT POLE AND AT PRIMARY SIDE OF EXISTING TRASFORMER. PULL CABLING FROM UNDERGROUND CONDUIT AND SAVE FOR REUSE AFTER INSTALLATION OF NEW TRANSFORMER.			
10. REMOVE EXISTING 75O KVA AND CONCRETE PAD COMPLETE. TURN EXISTING TRANSFORMER OVER TO FT. BRAGG PUBLIC WORKS.			
Transformer			
11. CONNECT EXISTING PANEL MDPN TO NEW TEMPORARY SERVICE FEEDERS. TEMPORARY SERVICE CABLES MAY PENETRATE BUILDING THROUGH EXISTING WINDOW. COORDINATE WITH DEMOLITION POWER RISER DIAGRAM, THIS SHEET.			

Table 2-15. First floor lighting and power demolition plan

FIRST FLOOR LIGHTING & POWER DEMOLITION PLAN:	lb	bf	yd^3
(141) Fluorescent lighting fixtures (2x4)			
(11) Fluorescent lighting fixtures (1x4)			
(80) receptacles			
(33) HD			
(5) wall mounted lighting fixtures			
(26) S inside circle - sprinkler?			
(52v) switches			
(11) fire alarm pulls			
(1) Ceiling mounted down lighting fixture			
(13) exit lights			
(37) antenna/telephone outlets			
(10) emergency lighting			
(5) clocks			
1. DISCONNECT AND REMOVE ELECTRICAL CONNECTION, DISCONNECT SEITCH AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
Switch for existing chiller			
2. DISCONNECT AND REMOVE EXISTING PANEL AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE FEEDER CONDUIT AND WIRING SEERVING THIS PANEL. COORDINATE REMOVAL WITH DEMOLITIO POWER RISER DIAGRAM, SHEET E19.			
(2) panels 6" x 24"			
3. DISCONNECT AND REMOVE ELECTRICAL CONNECTION AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
Typical of 14 motors			
4. DISCONNECT AND REMOVE EXISTING EQUIPMENT AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE ALL ASSOCIATED CONDUIT AND WIRING.			
(1) Mechanical equipment panel			
(1) Telephone backboard			
(2) CATV cabinets			
5. FIRE ALARM TELEPHONE INTERFACE FOR WING A SHALL REMAIN IN SERVICE UNTIL CHANGE OVER TO NEW TELECOMMUNICATIONS SERVICE. COORDINATE RELOCATION TO NEW TELECOMMUNICATIONS SERVICE BACKBOARD TO MINIMIZE DOWN TIME TO FIRE ALARM SIGNAL TRANSMITTER FOR WING A.			

Table 2-16. Second floor lighting and demolition plan

SECOND FLOOR LIGHTING & POWER DEMOLITION PLAN:	**lb**	**bf**	**yd^3**
(30) Fluorescent lighting fixtures (2x4)			
(74) Fluorescent lighting fixtures (1x4)			
(153) receptacles			
(46) HD			
(6) wall mounted lighting fixtures			
(10) S inside circle - sprinkler?			
(56) switches			
(10) fire alarm pulls			
(4) exit lights			
(44) antenna/telephone outlets			
(10) emergency lighting			
1. DISCONNECT AND REMOVE ELECTRICAL CONNECTION AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
(2) panels 6" x 24"			
2. DISCONNECT AND REMOVE EXISTING EQUIPMENT AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE ALL ASSOCIATED CONDUIT AND WIRING.			
Typical of 10 motors			
3. DISCONNECT AND REMOVE EXISTING EQUIPMENT AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE ALL ASSOCIATED CONDUIT AND WIRING.			
(1) CATV cabinet			
(1) telephone panel			

Table 2-17. Third floor lighting and power demolition plan

THIRD FLOOR LIGHTING & POWER DEMOLITION PLAN:	lb	bf	yd^3
(30) Fluorescent lighting fixtures (2x4)			
(78) Fluorescent lighting fixtures (1x4)			
(152) receptacles			
(45) HD			
(5) wall mounted lighting fixtures			
(15) S inside circle - sprinkler?			
(60) switches			
(7) fire alarm pulls			
(5) exit lights			
(52) antenna/telephone outlets			
(10) emergency lighting			
1. DISCONNECT AND REMOVE EXISTING PANEL AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE FEEDER CONDUIT AND WIRING SERVING THIS PANEL. COORDINATE REMOVAL WITH DEMOLITION POWER RISER DIAGRAM, SHEET E19.			
(2) panels 6" x 24"			
2. DISCONNECT AND REMOVE ELECTRICAL CONNECTION AND ALL ASSOCIATED CONDUIT AND WIRING BACK TO PANEL FROM WHICH IT IS SERVED.			
Typical of 10 motors			
3. DISCONNECT AND REMOVE EXISTING EQUIPMENT AND ASSOCIATED COMPONENTS. DISCONNECT AND REMOVE ALL ASSOCIATED CONDUIT AND WIRING.			
(1) CATV cabinet			

For this renovation project at Fort Bragg, the total demolition plans for Wings B and C (NOT including Wing A) will produce 165 tons of waste. These totals DO NOT include Wing A that was previously remodeled. Out of the 165 tons of waste, wood and concrete wastes make up 1453 bf and 4.7 yd^3 respectively.

This 165 tons of waste does NOT include the items in blue (listed below), which are things that can be reused directly (as opposed to recycled). Often, an installation will have many contemporary buildings which might require spare parts. Alternatively, the contractor may wish to keep or sell these things if they are relatively recent, or have some historic architectural value.

- (96) door hardware
- (214) blinds, drapes, window coverings and associated hardware complete at all windows
- (36) toilets
- (13) urinal
- (44) sinks
- (5) water cooler
- (14) shower heads
- (4) WATER HEATERS
- (2) BOILER
- 80 GALLON EXPANSION TANK
- 40 GALLON EXPANSION TANK
- SYSTEM PUMP

- EXHAUST FAN
- AIR COOLED WATER CHILLER (9' x 20' = 180 ft^2)
- AIR HANDLING UNIT
- UNDERGROUND FUEL TANK (8' x 20' = 160 ft^2)
- ELECTRIC HEATER
- FIRE DAMPER
- (14) THERMOSTAT
- ELECTRICAL BOXES
- (23) Floor Drains
- (25) Fluorescent lighting fixtures (1x8)
- (213) Fluorescent lighting fixtures (2x4)
- (877) Fluorescent lighting fixtures (1x4)
- (426) Duplex receptacle
- (30) Ceiling mounted duplex receptacle
- (17) Ceiling mounted down lighting fixture
- (16) wall mounted lighting fixtures
- (193) Switches
- (136) antenna/telephone outlets
- (29) Fire alarm pull
- (6) motors and (1) switch to be removed from AHU and BOILER
- panels 3.5' wide
- panel 20" wide
- CATV cabinet
- transformers
- (22) exit lights
- (30) emergency lighting
- clocks
- Switch for existing chiller
- panels 6" x 24"
- Wiring and conduit typical of (34) motors
- Mechanical equipment panel
- telephone panel

3.0 Fort Campbell Duplex Family Housing Upgrade

The second building type selected for study is a family housing unit (FHU) duplex at Fort Campbell. This FHU type is quite common across the Army (see Figure 3-1 through 3-7). Renovation activities include:

* remove central carport
* remove selected drywall-wood stud partitions to reconfigure rooms
* remove and replace all kitchen appliances and cabinets
* remove and replace all bath fixtures
* construct garages at both ends of the duplex

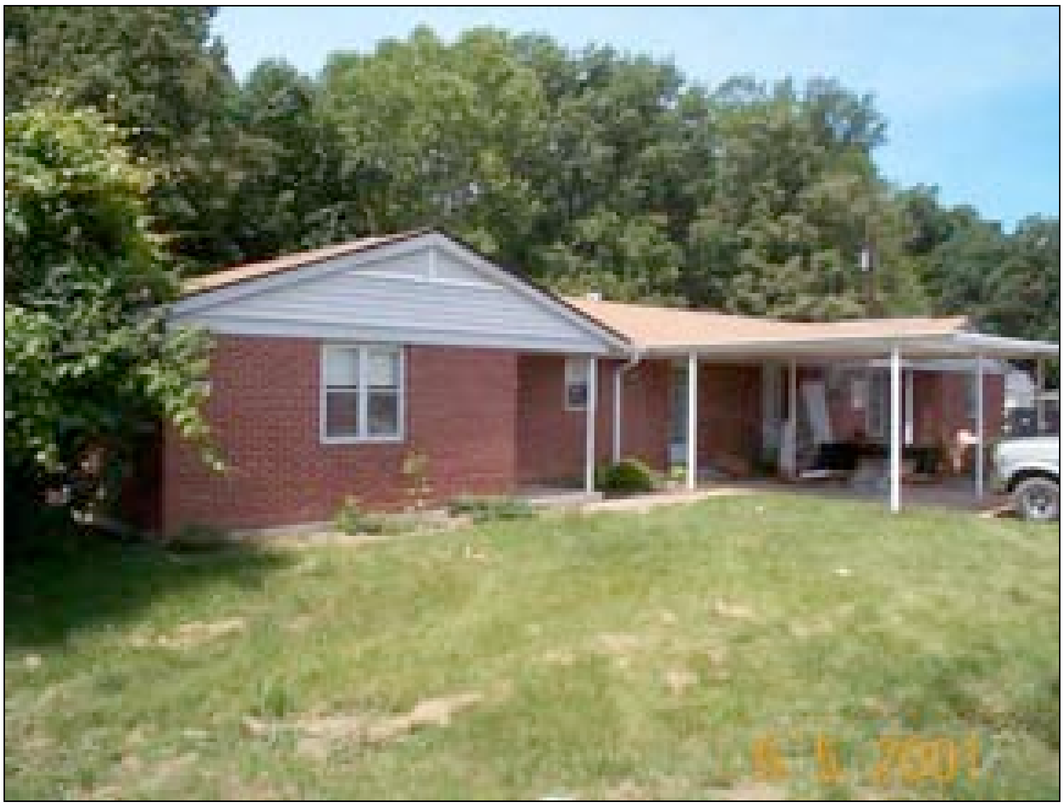

Figure 3-1. Front of FHU duplex at Fort Campbell.

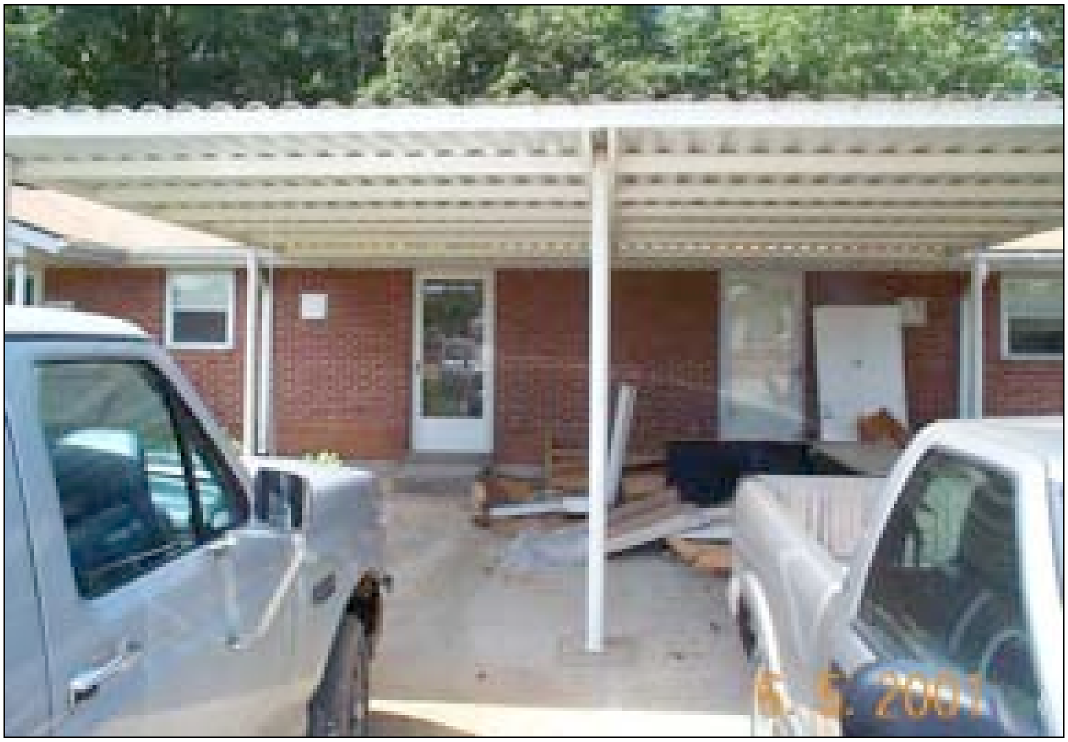

Figure 3-2. Carport of FHU duplex at Fort Campbell.

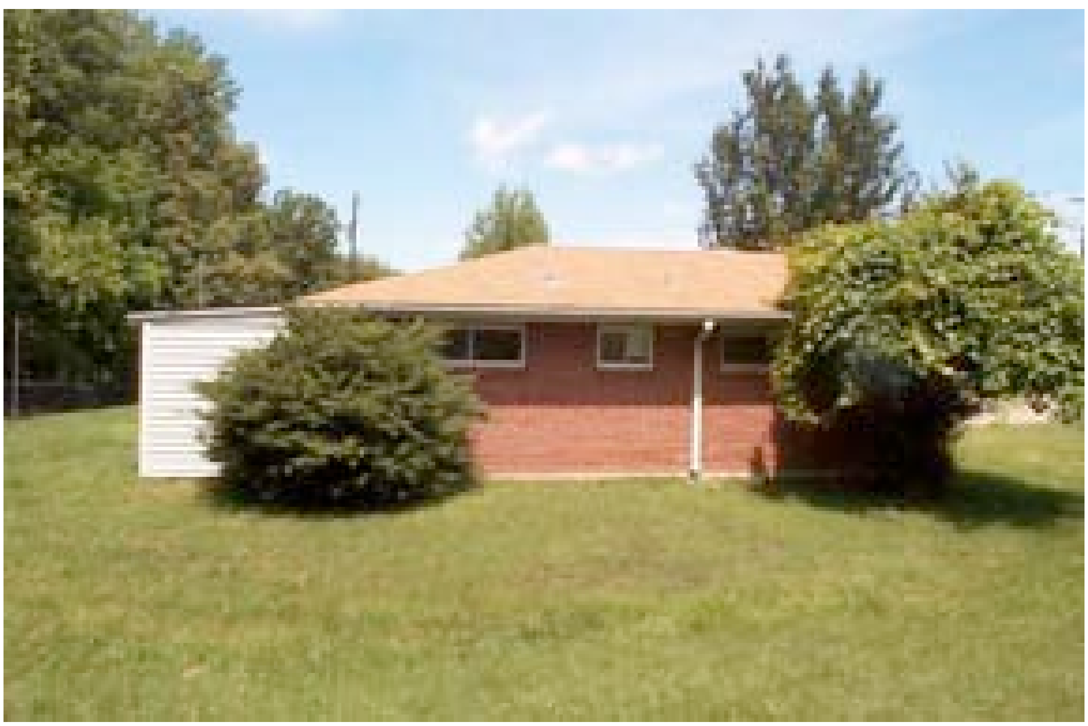

Figure 3-3. Side view of FHU duplex at Fort Campbell.

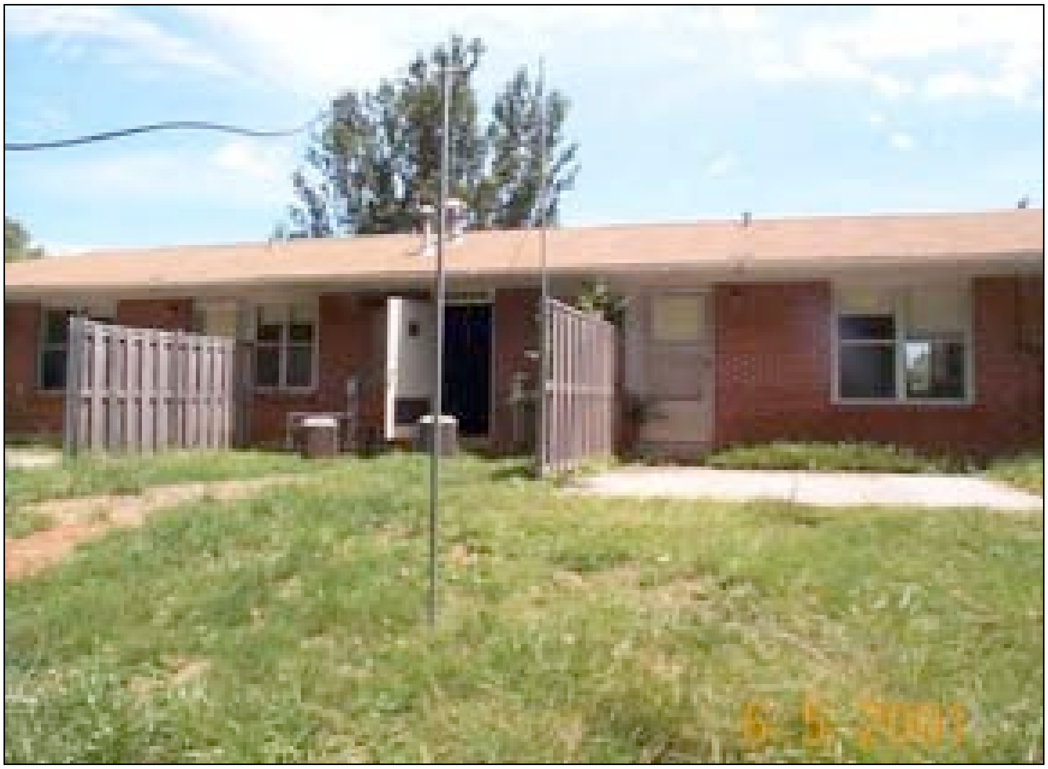

Figure 3-4. Back of FHU duplex at Fort Campbell.

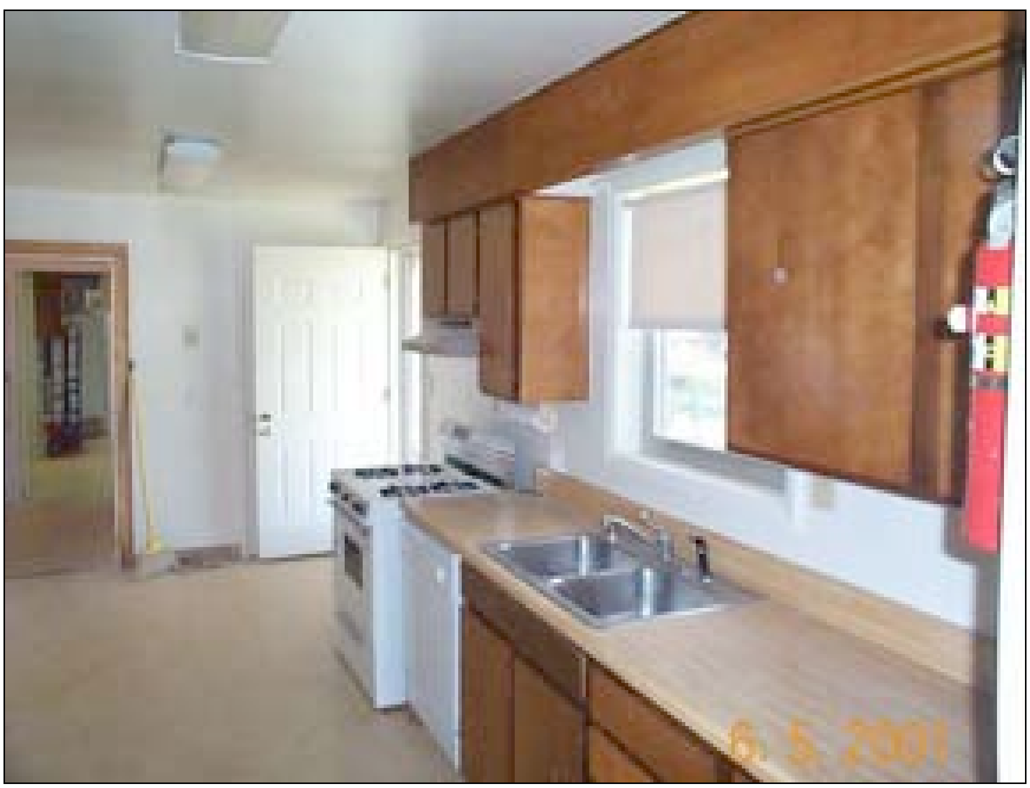

Figure 3-5. Kitchen in FHU duplex at Fort Campbell.

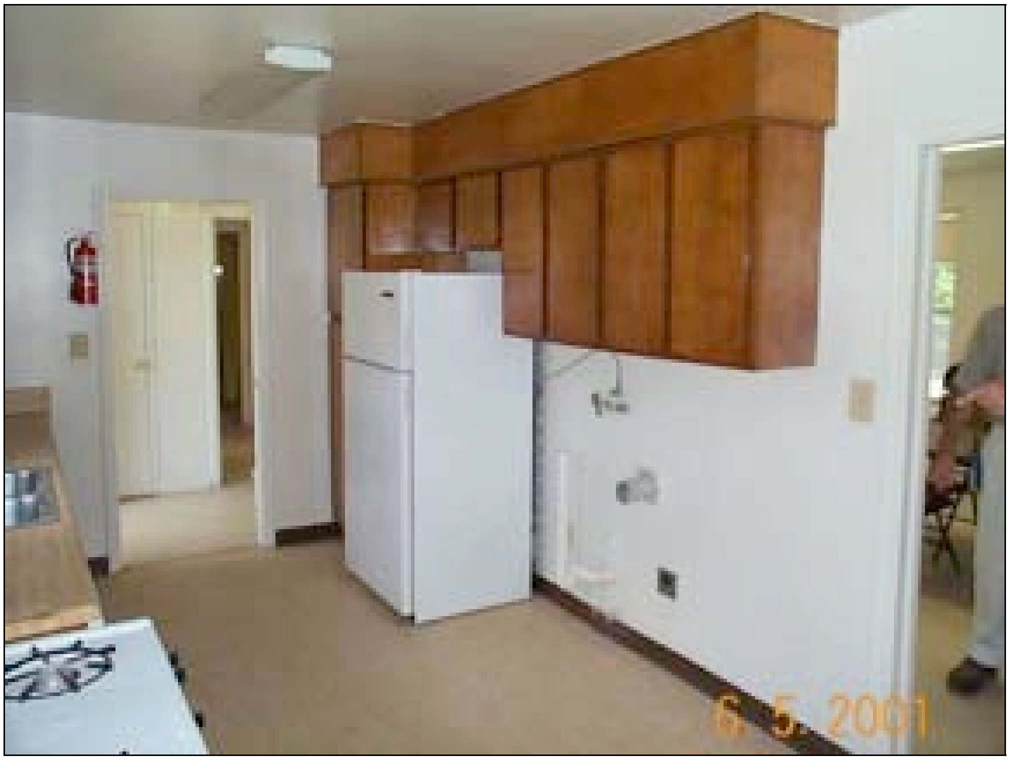

Figure 3-6. Second view of kitchen in FHU duplex.

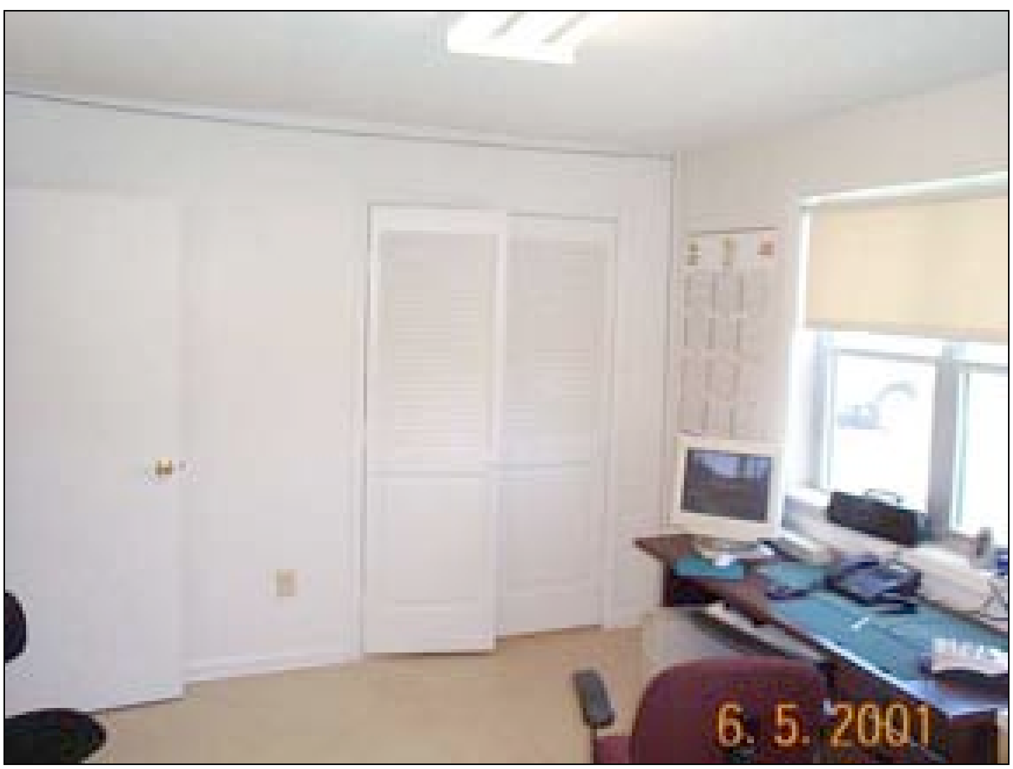

Figure 3-7. Bedroom in FHU duplex at Fort Campbell.

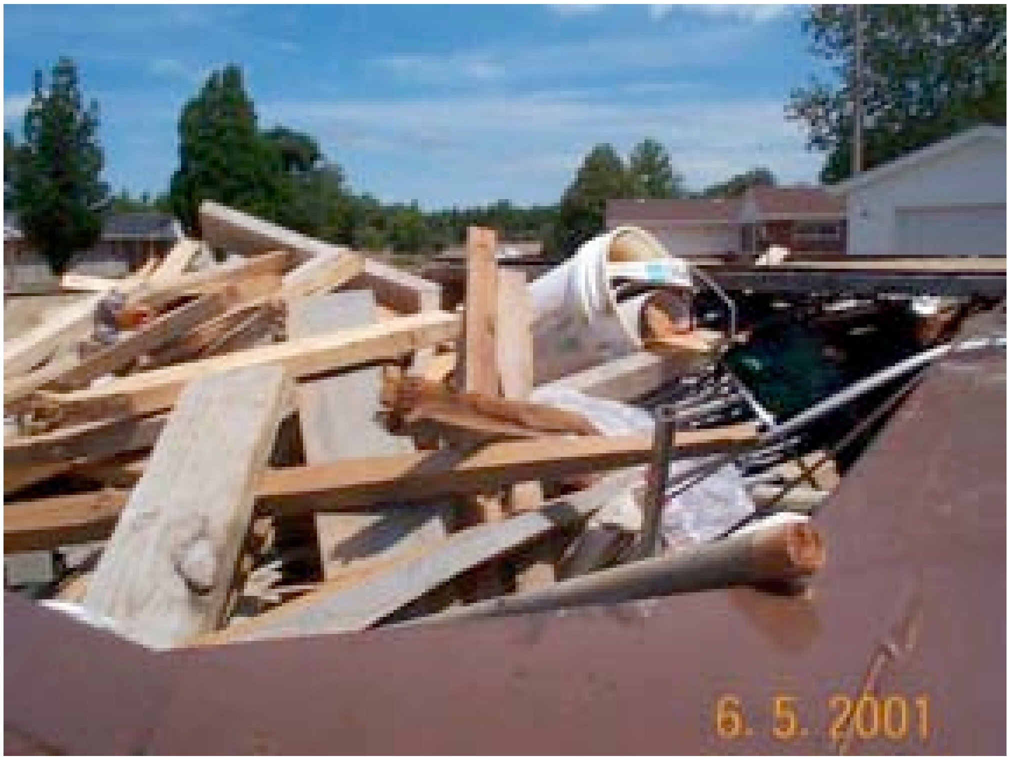

Figure 3-8. Accumulated waste, Fort Campbell remodeling site.

Unless noted, the quantity take-off totals in red in Table 3-1 are for one-half of the duplex unit. Each half is identical so the numbers below should be doubled for each duplex removed. Quantities shown below are best estimates based on demolition plans and site visits.

Table 3-1. Remodeling data for duplex FHU at Fort Campbell.

REFERENCED DEMOLITION NOTES	lb	bf	yd^3
1. REMOVE EXISTING WNDOW UNITS & FRAMES, INSECT SCREEN, AND ALL SEALANT. EXISTING BRICK SILL TO REMAIN EXCEPT AT LOCATIONS WHERE WNDOWS ARE TO RE BLOCKED-UP. REMOVE INTERIOR WOOD TRIM & VINYL SHADES. TRIM CONTAINS LEAD PAINT. (SEE DWG. H-1)			
Remove all windows = 8 total (see sizes below)			
Kitchen: (3' x 3.5') = 1; (3.5' x 4') = 1 Total ft^2 = 24.5	196		
Bedrooms: (6' x 2.5') = 2; (3' x 4') =1 Total ft^2 = 42	336		
Bathroom: (3' x 2.5') =1 Total ft^2 = 7.5	60		
Living Room: (5' x 4') =1; (3' x 4') =1 Total ft^2 = 32	256		
Trim: 120 ft (assuming 1/4" thick, 4" wide) = (.083)(120) = 9.96 or ~ 10 bf	30	10	
Vinyl Shades = 8			
2. REMOVE EXISTING EXTERIOR DOORS AND/OR ALUMINUM SCREEN DOORS, INCLUDING FRAMES, TRIM, PERIMETEFT SEALANT, AND HARDWARE. (SEE DWG. H-1)			
Total exterior doors: 3 + 1 exterior utility door (1 per duplex)			
Front: (3.75' x 7.5') = 1; (3.5' x 7.5') =1 Total ft^2 = 54.375	435		
Rear: (3.5' x 7.5') = 1; (4'x 7.5') = ½ Total ft^2 = 41.25	330		
Screen Doors: 3 Total ft^2 = 80.625	161		
Trim: 56 ft (assuming ¼" thick, 4" wide) = (.083)(56) = 4.65 or ~ 5 bf	14	5	
3. REMOVE EXISTING EXTERIOR STORAGE APPENDAGE COMPLETELY, INCLUDING FOUNDATION, FLOOR SLAB, WALLS, AND ROOF.			
(8.5' x 5.25') = 44.625 ft^2	2150		
4" concrete slab = 0.535 yd^3	2167		0.535
Reinforcement = 46 lb	46		
Vinyl siding on 3 sides: ft^2 surface area = 42 + 68 + 68 – 23 =155 ft^2	71.3		
???Foundation:			
4. REMOVE EXISTING METAL CARPORT STRUCTURE COMPLETELY, INCLUDING FOUNDATION, FLOOR SLAB. METAL POSTS AND METAL ROOF. (SEE DWG H-1) LOCATIONS OF CARPORTS VARY, SEE CML DRANNOS FOR EXACT LOCATION BY UNIT ADDRESS.			
CENTER CARPORT *(**divide by 2 for single unit of duplex**)*			
(20' x 20') = 400 ft^2			
Corrugated metal roof: 400 ft^2			
(Standard b22 gage painted roof deck is 1.51 lb/ft2) (400 ft^2) = 604 lb	**300**		
(24 gage 7/8" corrugated is 140 lb per square) = 4 squares (140) = 560 lb			
4" concrete slab = 4.8 yd^3 concrete OR 6" concrete slab = 7.6 yd^3	**15390**		**3.8**
Reinforcement: 4" = 412 lb; 6" = 606 lb	**303**		
Footings (2' x 2' x 12"): 0.333 yd^3 (6) = 2 yd^3 concrete	**4050**		**1**
???Metal posts: 6 @ 8'			
???Metal supports for corrugated roof: 7 @ 20' long			
END CARPORT (one for each unit of duplex)			
(12' x 20') = 240 ft^2			
Corrugated metal roof = 240 ft^2 (1.51 lb/ft2) = 362 lb (22 gage) OR 336 lb (24	350		

gage)			
4" concrete slab = (240)(.012) = 2.88 yd^3 OR 6" concrete slab = (240)(.019) = 4.56 yd^3	18468		4.56
Reinforcement: 4" = 247 lb; 6" = 364 lb	364		
Footings (2' x 2' x 12"): 0.333 yd^3 (4) = 1.3 yd^3	5265		1.3
???Metal posts: 4 @8'			
???Metal supports for corrugated roof: 4 @ 20' long			
5. REMOVE EXISTING FLASHINGS AT LOCATIONS WHERE VENTS ARE TO BE REMOVED. (SEE MECHANICAL DWGS.)			
(1) roof vent = .003 ton	6		
Flashing: (1) ft = .00036 ton	0.72		
6. REMOVE PARTS OF EXISTING ROOF, FASCIA SOFFIT, GUTTERS, DOWNSPOUTS AND SPLASHBLOCKS AS REQUIRED FOR GARAGE ADDITION.			
Gutter: 40 ft	20		
Fascia/soffit: 27 ft	40.5	20.25	
7. REMOVE EXISTING SIDING, TRIM, AND LOUVER AT GABLE ONLY. EXISTING SUBSTRATE TO REMAIN.			
Louver: 3.5 ft^2 (1 LB/SF) = 3.5 lb	3.5		
Vinyl Siding: 60 ft^2	27.6		
8. REMOVE EXISTING LOUVER ABOVE EXTERIOR MECHANICAL DOOR.			
8" x 32" = 1.78 ft^2	2		
9. REMOVE EXISTING WOOD ATIC ACCESS PANEL AND TRIM.			
Wood Panel: (28" x 28") = 5.4 ft^2 (.75) = 4 bf	13	4	
(3/4" plywood: 1 ft^2 = .75 bf)			
Trim: 8 ft = 0.664 bf	2	0.664	
(1/4" thick, 4" tall = 0.083 bf/ft)			
10. EXISTING BUILDING SIGN FROM THE SIDE ELEVATION WHEN REQUIRED FOR NEW CONSTRUCTION AND TAG, STORE, AND SALVAGE FOR REUSE.			
Salvage for reuse			
11. REMOVE ALL BRACKETS, CLIPS, AND OTHER MISCELLANEOUS ITEMS ASSOCIATED WTH ELECTRICAL AND PLUMBING DEMOLITION. (SEE MECH. & ELEC. DWGS. AND DWG. H-1)			
???Metal clip in rear elevation			
12. EXISTING MTL. MAILBOX, HOUSE NUMBER. SIGN AND NAMEPLATE MOUNTING BRACKET TO REMAIN.			
13. REMOVE CONC. WALK AND LANDING. (SEE CIVIL DWGS.)			
ND-2AF (middle carport): (17'x 3') + (3' x 3') = 60 ft^2 @ 4" slab = 0.72 yd^3 concrete	**2916**		**0.72**
ND-2A (end carport): (26' x 3') + (2' x 6.5') + (3' x 3') = 100 ft^2 @ 4" slab = 1.2 yd^3 concrete	4860		1.2
14. DEMO. AND NEW AREA SHOWN IS APPROXIMATE (SEE PLUMBING & ELECTRICAL DWGS.)			
Approximate ft^2 = 65 ft^2			
4" slab: (.012)(65) = 0.78 yd^3 OR 6" slab: (.012)(65) = 1.235 yd^3	5001		1.235
15. REMOVE EXISTING SHELVING AND SUPPORTS (SEE DRAWING H-1)			
Can't find a reference to 15 on the drawings			

16. REMOVE EXISTING DOOR SILL AT HANDICAPPED UNITS.			
Unit ND-2AH has a door sill @ 3.5 ft	1		
17. REMOVE EXISTING INTERIOR WOOD STUD FRAMING AND GYPSUM WALLBOARD FINISH COMPLETELY AS INDICATED FOR NEW WORK. PROVIDE SHORING AS REQUIRED FOR LOAD BEARING WALLS.			
52.25 ft of stud wall to be removed = 300 bf	3344	300	
836 ft^2 of gypsum board to be removed = 1672 lb	1672		
18. REMOVE EXISTING VINYL FLOORING ADHESIVE COMPLETELY THROUGHOUT THE ROOM.			
880 ft^2 of vinyl flooring (1.33 lb/ft2) = 1170.4	1170.4		
19. REMOVE EXISTING BASE (VINYL IN KITCHEN AREA AND WOOD IN THE OTHER SPACES IN THE UNIT.			
Base trim in kitchen (vinyl): 31 ft (4") = 124 ft^2 (1.33) = 165 lb	165		
Base trim (wood): 158 ft (assuming ¼" thick, 4" wide) = (.083)(158) = 13 bf	40	13	
20. REMOVE CONCRETE PATIO, WOOD FENCE, AND CONC. MECH. PAD, (SEE CIVIL DWGS.)			
Patio: (15' x 12.5') + (3' x 3') = 196.5 ft^2			
4" slab = (196.5) (.012) = 2.358 yd^3	9432		2.358
Mechanical Pad: (4' x 4') = 16 ft^2			
6" slab = (16) (0.19) = .304 yd^3	1152		0.304
21. REMOVE EXISTING CERAMIC TILE FROM FLOOR AND IN BATHROOM AREA. REMOVE EXISTING THRESHOLD. REMOVE ALL BATHROOM ACCESSORIES AND PLUMBING FIXTURES. FOR PLUMBING FIXTURES REFER TO MECHANICAL DRAWINGS.			
Ceramic tile floor: 96 ft^2 + Ceramic tile walls: 90 ft^2 = 186 ft^2 tile	558		
Plumbing Fixtures: Toilet (1); Tub (1); Sink (1)			
Accessories: T.P. holder (1); Shower curtain rod (1); Towel bars (3); 22" Vanity cabinet (1)			
22. REMOVE EXISTING WALL AND BASE KITCHEN CABINETS, PLYWD. KITCHEN CABINETS SOFFIT, COUNTERTOPS, BACKSPLASH AND ANY OTHER MISCELLANEOUS SUPPORTS. REMOVE KITCHEN APPLIANCES AND RANGE HOOD. SEE MECH DWGS.			
Base cabinets = 10 ft	400		
Upper cabinets = 8 ft	160		
Pantry (8') = 2 ft	120		
Countertop: 7 ft = 14 ft^2	60		
Soffit: 12 ft = 14 ft^2	21	10.5	
Appliances: Stove, Refrigerator, Washer and Dryer			
Range Hood (1)			
23. REMOVE EXISTING INTERIOR DOORS, FRAMES, TRIM, AND HARDWARE. (SEE DWG. H-1)			
Closet doors: (3 sets) = 84 ft^2	210		
Interior doors: (7) = 122.5 ft^2	306		
Trim: 170 ft (assuming 1/4" thick, 4" wide) = (.083)(170) =14.11 or ~ 14 bf	43	14	
Door Hardware			
24. REMOVE EXISTING SHELVES, ROD, AND SUPPORTS. (SEE DWG. H-1)			
5 Shelves in pantry (12" depth): 57.5 ~ 58 ft = 29 bf	87	29	

5 Shelves in Hall Closet (12" depth): 15 ft = 7.5 bf	23	7.5	
Bedroom Closets: 12 ft = 6 bf	18	6	
???Supports: Wood blocking			
FROM MECHANICAL & PLUMBING NOTES			
ELECTRICAL			
Ceiling mounted luminaires (12)			
Wall mounted (2)			
Light switches (15)			
Duplex receptacles (22)			
Telephone outlet (4)			
HVAC			
(1) Air conditioning unit 2 ton (7kw)			
Flexible duct work ~ 30 ft	126		
Wall register & duct ~ 48 ft	202		
Duct from range hood ~ 1 ft	2		
Dryer vent (4") ~ 8-10 ft	8		
PLUMBING			
Gas Pipe (2" galvanized steel) = 206 ft	754		
Waste & Vent Pipe (2" copper) = 75 ft	87		
Water Heater (1)			
TOTALS (using bold numbers - middle carport)[2]	**54654**	**420**	**10**
TOTALS (using non-bold numbers - end carport)	61041	420	11.5
TOTAL SUMS OF MATERIALS (AVG.)	**29 TONS**	**420 bf**	**10.75** yd^3

For the Fort Campbell duplex housing units, a single unit of the 2-unit duplex will produce 29 tons of waste. Out of the 29 tons of waste, wood and concrete wastes make up 420 bf and 10.75 yd^3 respectively. This 29 tons of waste does NOT include the items in blue (in Table 3-1), which are summarized in the following list:

- Vinyl Shades (8)
- Toilet (1)
- Tub (1)
- Sink (1)
- T.P. holder (1)
- Shower curtain rod (1)
- Towel bars (3)
- 22" Vanity cabinet (1)
- Base cabinets (24") = 10 ft
- Upper cabinets (12") = 8 ft
- Pantry (24" x 8') = 2 ft
- Stove (1)

[2] There are two different site layouts

- Refrigerator (1)
- Washer (1)
- Dryer (1)
- Range Hood (1)
- Door Hardware
- Ceiling mounted luminaires (12)
- Wall mounted (2)
- Light switches (15)
- Duplex receptacles (22)
- Telephone outlet (4)
- Air conditioning unit (7kw) 2 ton (1)
- Water Heater (1)

Figures 3-9 to 3-14 show the same housing units after the remodeling project.

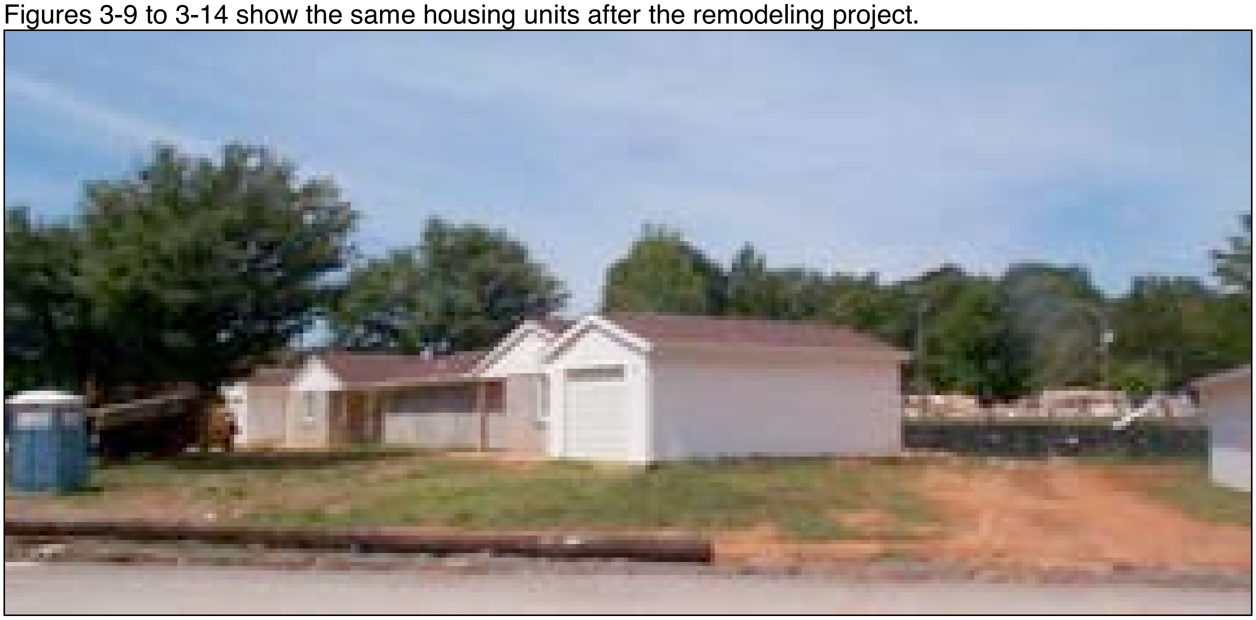

Figure 3-9. Remodeled FHU duplex at Fort Campbell.

Figure 3-10. Front of remodeled FHU duplex at Fort Campbell.

Figure 3-11. Front brick on remodeled FHU duplex.

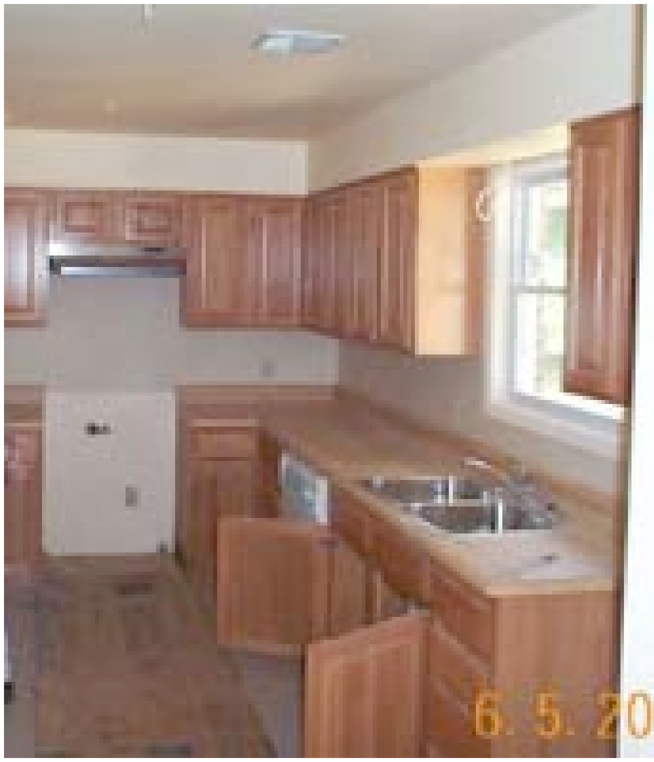

Figure 3-12. Remodeled kitchen in Fort Campbell duplex.

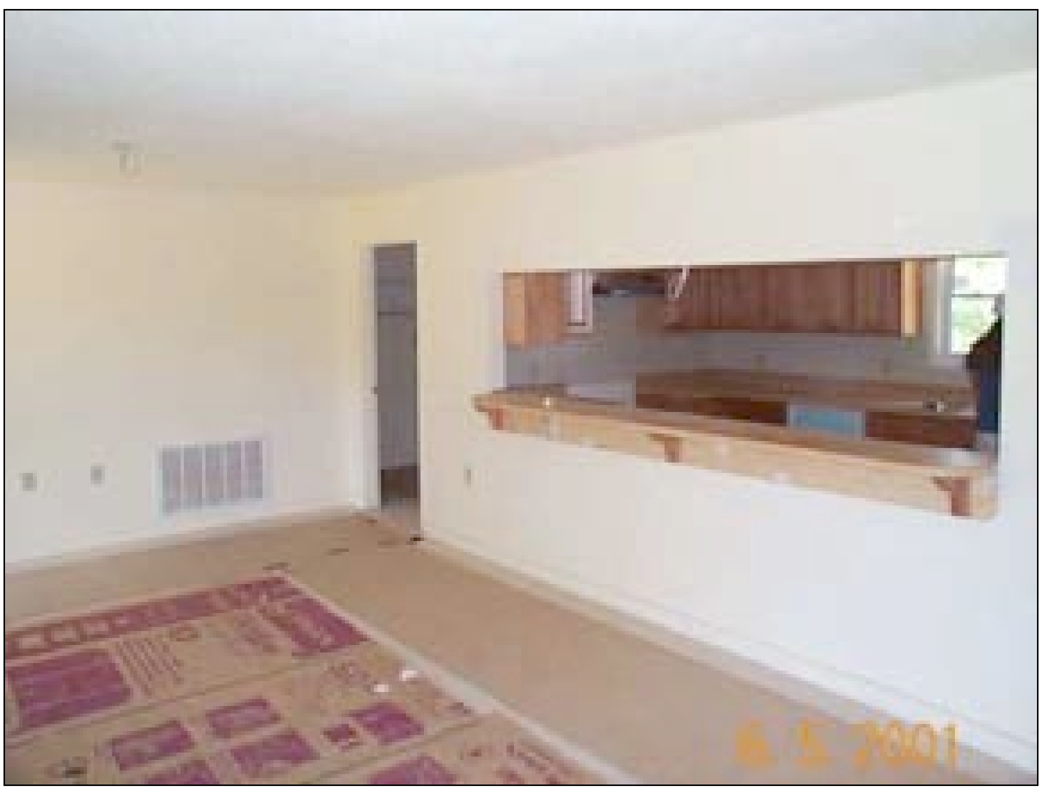

Figure 3-13. Remodeling of Fort Campbell duplex.

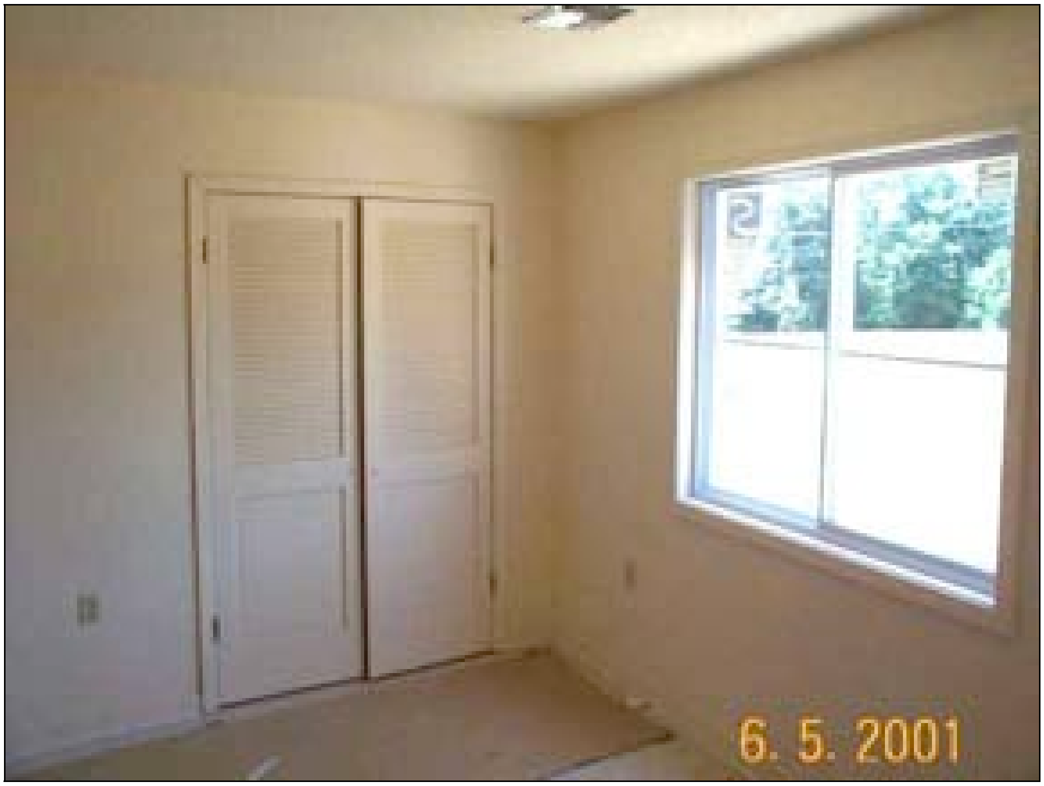

Figure 3-14. Remodeled bedroom in Fort Campbell duplex.

4.0 Fort Bragg Barracks Upgrade

The third building selected for study is a "rolling pin" style barracks at Fort Bragg. This is a whole barracks renewal project where all of the building is removed down to the concrete structure. The goal was to reconstruct the barracks to make the living conditions more apartment-like and desirable to improve soldier retention.

The quantities in Table 4-1 were calculated from the original construction drawings, with the assumption that everything is removed, except for the structural elements. This was double-checked against field photographs (Figures 4-1 through 4-3). Quantities are based on floor plans for a rolling-pin 3-story brick barracks (nominal ft^2 = 37,292).

Figure 4-1. Project sign, Fort Bragg.

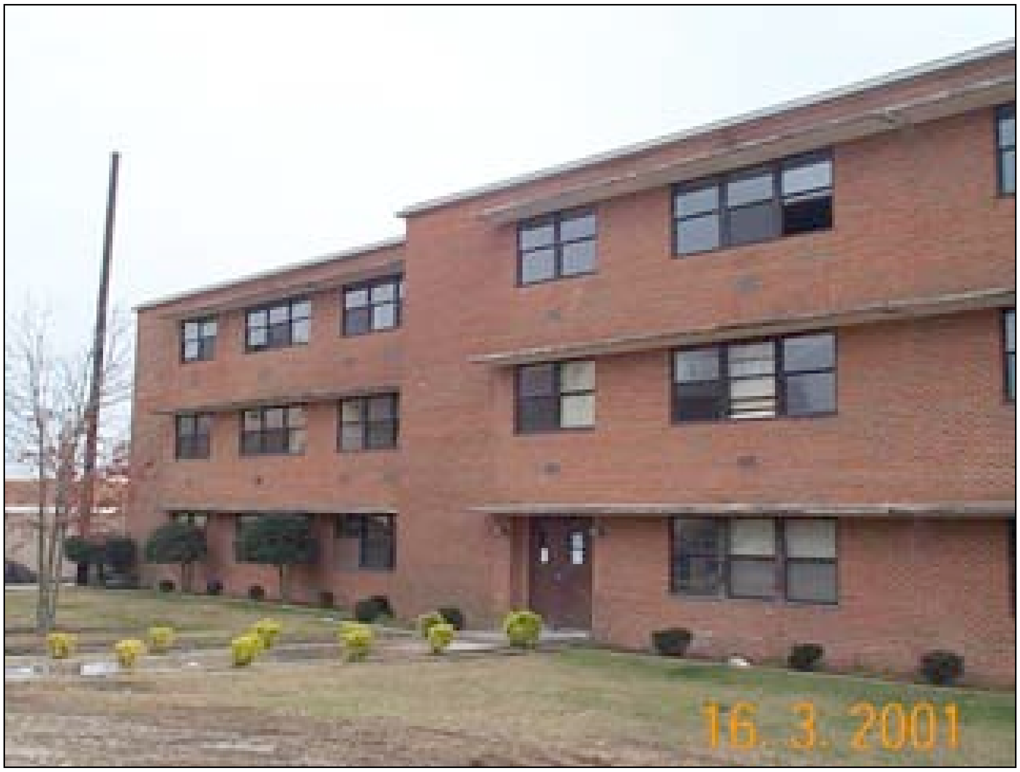

Figure 4-2. Fort Bragg barracks before remodeling.

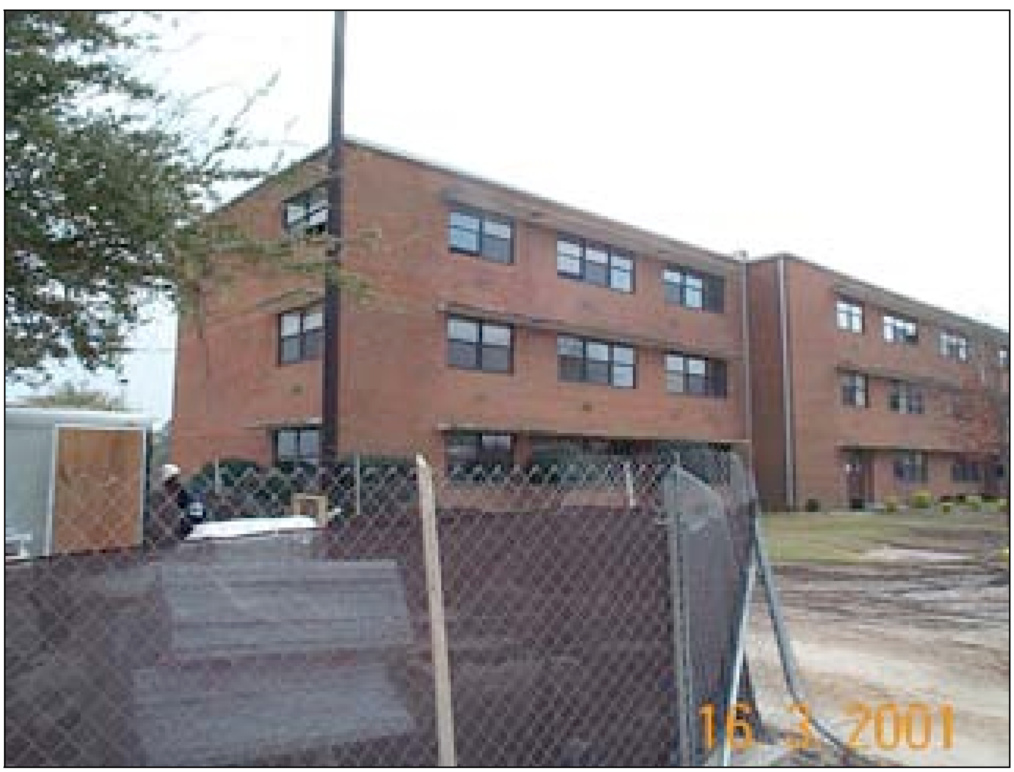

Figure 4-3. Second view of Fort Bragg barracks.

Table 4-1. Remodeling data from rolling-pin barracks.

ROLLING PIN DEMOLITION	lb	yd^3
CONCRETE		
10" mechanical room foundation (12' x 135 ft = 1620 ft^2)	202,500	50
12" mechanical room foundation (12' x 17 ft = 204 ft^2)	30,375	7.5
10" basement foundation (4' x 565 ft = 2260 ft^2)	283,500	70
6" concrete pad (2' x 4') = 8 ft^2 (3) = 24 ft^2	1728	0.43
6" concrete pad (2' x 2.5') = 5 ft^2	360	0.08
2' x 2' Footings = 26 ft	15,730	3.85
1' x 2' Footings = 28 ft	8484	2.07
1' x 1' Footings = 11 ft	1661	0.407
Concrete joist floor 20" wide bay = 27104 ft^2 (.027 yd^3/ft^2) = 732 yd^3	3,008,544	732
5" slab on grade mechanical room floor = 740 ft^2	44,400	11
ROOF		
Cement tile roof 13552 ft^2	203,280	
EXTERIOR WALLS		
4" common brick (15,775 ft^2)(46 lb/ft^2)	725,650	
INTERIOR WALLS		
6" CMU first floor = 717 ft (8') = 5736 ft^2	200,760	50
6" CMU second floor = 997 ft (8') = 7976 ft^2	279,160	69
6" CMU third floor = 997 ft (8') = 7976 ft^2	279,160	69
WINDOWS		
(58) type w1 (12' X 5') = 60 ft^2 (8 lb/ft^2)	27,840	
(22) type w2 (8' x 5') = 40 ft^2 (8 lb/ft^2)	7040	
(8) type w3 (4' x 5') = 20 ft^2 (8 lb/ft^2)	1280	
DOORS		
(4) exterior double door (5.5' x 7') = 38. 5 ft^2 (9 lb/ft^2)	1386	
(153) single interior doors (3' x 7') = 21 ft^2 (5 lb/ft^2)	16,065	
(8) double doors (5' x 7') = 35 ft^2 (5 lb/ft^2)	1400	
(4) double doors in stairway (6' x 7') = 42 ft^2 (9 lb/ft^2)	1512	
(1) Main Entrance (6' x 7') = 42 ft^2 (9 lb/ft^2)	378	
PLUMBING		
(14) Urinals		
(22) Toilets		
(26) Sinks		
(3) Scrub sinks		
(4) Showers		
TOTALS	5,342,193 (2,671 tons)	1,065

NOTE: These quantities were taken from the building plans. In a remodeling project, not all of these quantities would be calculated and other quantities not listed here would need to be included. From the plan, exact quantities of items such as light fixtures, floor tiles, pipes, ducts, etc., are not known.

As shown in Figures 4-4 through 4-6, the transformation of the rolling-pin barracks was dramatic. Residents receive a much improved living space, and the exterior appearance is much more pleasant.

Figure 4-4. Barracks remodeling project at Fort Bragg.

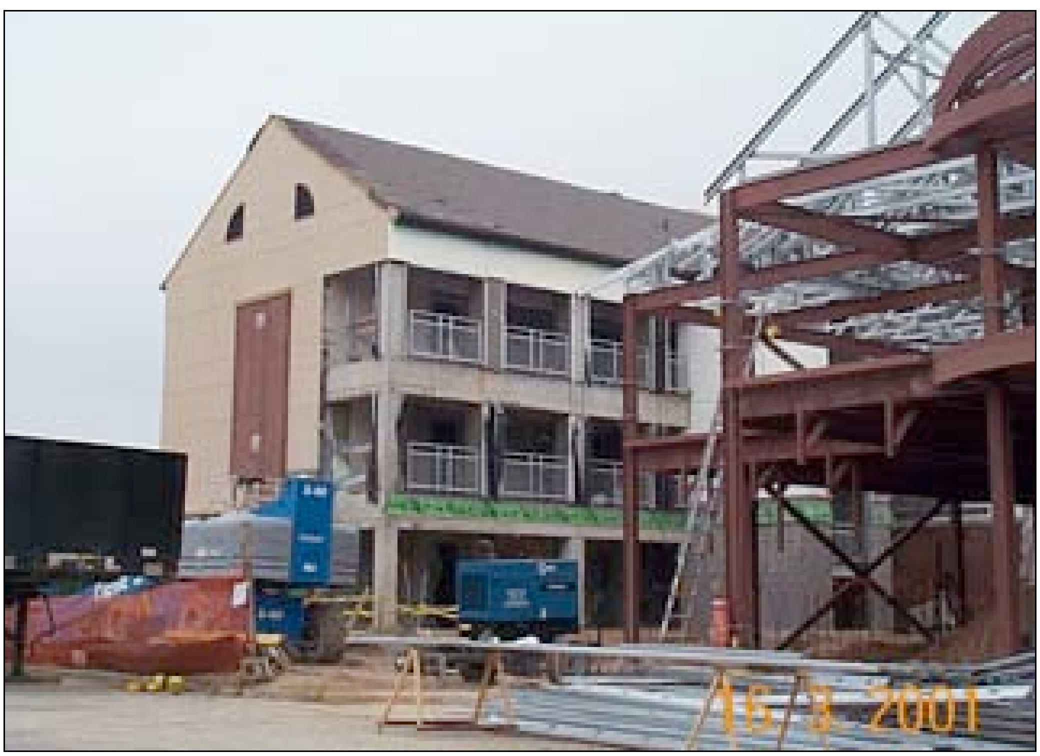

Figure 4-5. Second view of barracks remodeling project.

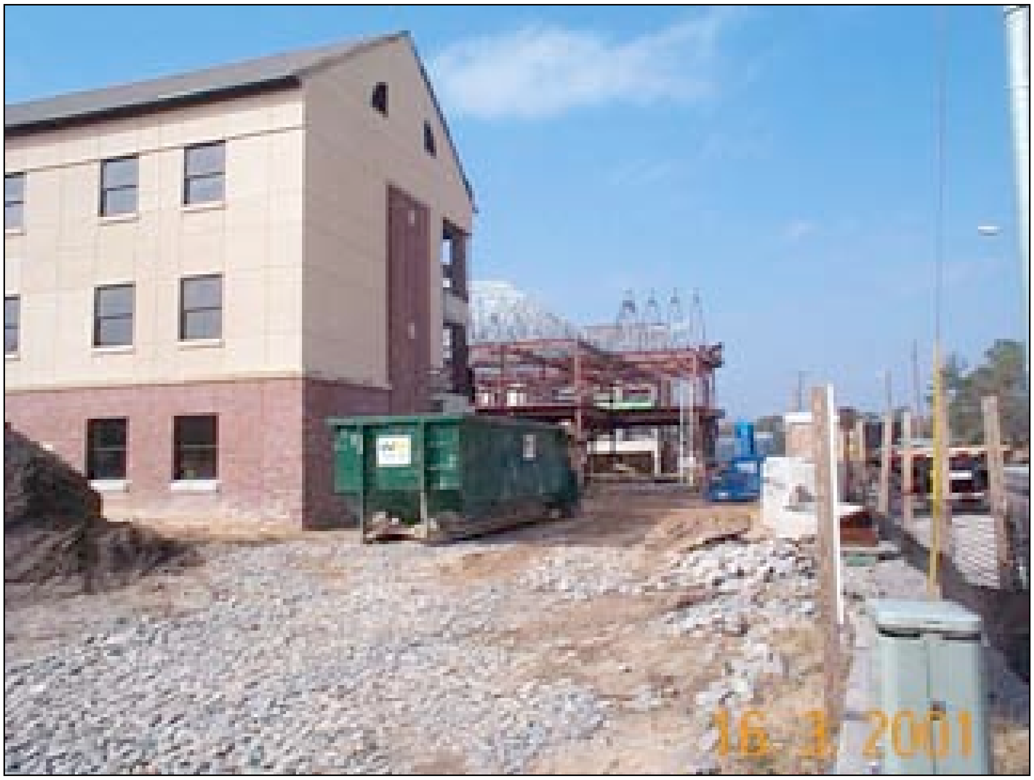

Figure 4-6. Another view of rolling-pin barracks remodeling.

5.0 Extensive List of Weights of Building Components

This list of material weights has been compiled from many different sources, including American Society of Civil Engineers (ASCE), Associated General Contractors (AGC), US Army Corps of Engineers (USACE) databases, and manufacturers. CERL staff had to develop a few of the values internally. These values were used to quantify the waste materials from the Army remodeling projects studied in this report.

Table 5-1. Door-related weight conversions

Door Type	Weight (lb/unit)
windows, glass, frame, and sash	$8/ft^2$
wood trim 4" wide	0.25/ft
door (2-1/4" thick white pine)	$4.5/ft^2$
door (1-3/4" thick solid core)	$5/ft^2$
door (2-1/4" thick oak)	$9/ft^2$
door (1-3/4" thick hollow core)	$2.5/ft^2$
exterior door (same as window)	$8/ft^2$
hollow metal	$6.5/ft^2$
hollow metal door frame	1.4/ft
screen door (1/4 door)	$2/ft^2$

Table 5-2. Concrete weight conversions

Form of Concrete	Weight (lb/unit)
reinforced concrete (stone)	$4,050/yd^3$

reinforced concrete (stone)	$150/ft^3$
concrete fill per inch thickness	$12/ft^2$
concrete floor, plain per 1" thickness	$12/ft^2$
concrete floor, reinforced 1"	$12.5/ft^2$
concrete curb, 4" high x 8" thick (.008 yd^3/ft)	29/ft
6" concrete slab (unreinforced)	$72/ft^2$
10" thick foundation wall	$125/ft^2$
12" thick foundation wall	$150/ft^2$
Footings 1' x 1' including reinforcing	$151/ft^2$
Footings 1' x 2' including reinforcing	303/ft
Footings 2' x 2' including reinforcing	605/ft
Concrete joist 20" wide form, 6" depth of slab	$111/ft^2$

Table 5.3. Wall surface weight conversions

Siding/Wall Covering	**Weight (lb/unit area)**
vinyl siding	46/square
plywood (1/2")	$1.5/ft^2$
plywood (3/4")	$2.4/ft^2$
gypsum (1/2")	$2/ft^2$
plywood (1/8" thick), e.g.,paneling	$0.4/ft^2$

Table 5-4. Flooring weight conversions

Floorcovering	Weight (lb/ft2)
vinyl flooring/trim, 1/8"	1.33
ceramic tile, glazed wall 3/8"	3
Ceramic tile floor, 1" mortar bed	23
Ceramic tile floor, 1/2" mortar bed	16
Ceramic tile floor, 3/4"	10

Table 5-5. Miscellaneous sheet metal weight conversions

Metals	Weight (lb/unit)
gutters (.032" thick)	0.471/ft
louvers 16 ga. Galvanized or cold rolled steel	2.042/ft^2
louvers 14 ga. Extruded aluminum alloy	0.913/ft^2
louvers 12 ga. Extruded aluminum alloy	1.16/ft^2

Table 5-6. Miscellaneous metal fence and pipe weight conversions

Metal Duct	Weight (lb/unit)
Gas Pipe (2" galvanized steel)	3.66/ft
Waste & Vent Pipe (2"" copper)	1.164/ft
steel stair nosings	1/ft
Chain-link fence fabric	0.696/ft^2
Chain-link fence corner/end posts (2-1/2"" O.D.)	2.315/ft
Chain-link fence support/middle posts (1-5/8" O.D.)	1.431/ft
Galvanized steel H posts	3.26/ft
Aluminum H posts	1.25/ft
Roll formed steel line posts 1.625" x 1.875"	2.34/ft
Roll formed steel brace rails and top rails 1.25"" x 1.625"	1.35/ft

Table 5-7. Wall structure weight conversions

Walls	Weight (lb/unit)
2" x 4" studs, 8' high, = 5.33 bf/stud	0.75(ft) +1
2" x 4" studs, 10' high, = 6.667 bf/stud	0.75(ft) +1
2 x 4 studs, 1/2" gyp each side	8/ft^2
6" Drywall on wood studs	10/ft^2
2 x 4 wood stud, plywood, two sides	7/ft^2
plywood (1/8" thick), e.g., paneling	0.4/ft^2
6" cmu wall, lightweight, gwb	35/ft^2
8" cmu wall, lightweight, gwb	47/ft^2
8" concrete block, lightweight, no gwb	35/ft^2
8" concrete block, stone or gravel, no gwb	55/ft^2
8" hollow cmu wythes 24" o.c. grout spacing	46-54/ft^2
8" solid conc. Block, (stone aggregate lightweight)	67/ft^2 (48/ft^2)
8" hollow conc. Block (stone aggregate)	55/ft^2 (38/ft^2)
4" Brick, low absorption	46/ft^2
Furring 1" x 3" wood strips	.25/ft

Gypsum furring, 1" x 3" wood strips 0.75 ft per ft^2	0.25 bf/ft
Gypsum furring, 1" x 3" wood strips 0.75 ft per ft^2	0.1875 bf/ft^2

Table 5-8. Partition weight conversions

Misc. Partitions	Weight (lb/ft)
Removable steel partitions	4
Toilet partitions (1/2 of hollow metal door)	3.25

Table 5-9. Ceiling and roof weight conversions

Ceilings/Roof	Weight (lb/ft)
Acoustical tile unsupported per 1/2"	0.8
Acoutical Fiber Board	1
Suspended Steel Channel System	2
Batt Insulation (per 1" thickness)	0.1 - 0.4
Built-up Roof tar & gravel	5.5
Built-up Roof	6.5
Cement tile roof	15

Table 5-10. Piping weight conversions

Piping	Weight (lb/ft)
3/4" steel pressure tubing	1.13
4" steel pipe	10.79
6" steel pipe	18.97
10" steel pipe	40.48
14" steel pipe	54.75
16" steel pipe	62.58
18" steel pipe	70.59
1" copper tubing (type L and ACR)	0.655
1-1/2" copper tubing (type L and ACR)	1.14
2" copper tubing (type L and ACR)	1.75
2-1/2" copper tubing (type L and ACR)	2.48
3" copper tubing (type L and ACR)	3.33
4" copper tubing (type L and ACR)	5.38
3" PVC (schedule 80)	1.903
4" PVC (schedule 80)	2.782
electrical conduit (1/2" steel)	0.82
electrical conduit (1" steel)	1.6

Table 5-11. Cabinet weight conversions

Cabinets	Weight (lb/ft)
wood upper wall cabinets	20
wood lower base cabinets	40

6.0 References

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7.0 Acronyms and Glossary

∅ - diameter

bf - board foot or board feet

Board foot - A board foot represents a volume of wood 1 inch thick by 12 inches wide by 12 inches long. The nominal dimensions are used for this calculation, e.g., use 2 and 4 rather than the actual measurements of a "2x4."

EPA - U.S. Environmental Protection Agency

FHU - Family Housing Unit

ft^2 - square foot or square feet

GBW - gypsum wallboard (drywall)

Quantity Take Off - A method of estimating quantities of construction materials, usually based on drawings.

yd^3 - cubic yard