

ERDC/CERL TR-00-24

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Condition Assessment of Building 6237, Old Hospital Complex, Fort Carson, CO

by Thomas R. Napier and Sheila A. McCarthy

August 2000



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Condition Assessment of Building 6237, Old Hospital Complex, Fort Carson, CO

Fort Carson Cultural Resources Management Series
Contribution 2

ERDC/CERL TR-00-24

August 2000

Foreword

This study was conducted for the U.S. Army Directorate of Environmental Compliance and Management (DECAM), Fort Carson, CO, under project number FTC096F030, "Feasibility Study for Adaptive Reuse of Building 6237, Old Hospital Complex, Fort Carson, CO." Funding was provided by Military Interdepartmental Purchase Request 9FFCCHH148, dated 9 March 1999. The technical monitor was Mr. Stephen Chomko, DECAM.

The work was performed by the Land and Heritage Conservation Branch (CN-C) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigators were Ms. Sheila McCarthy and Mr. Thomas Napier. Mr. Robert Riggins is Branch Chief (CEERD-CN-C), and Dr. John Bandy is Division Chief (CEERD-CN). The CERL technical editor was Ms. Gloria Wienke, Information Technology Laboratory.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Commander is COL James S. Weller. The Acting Director of CERL is Dr. Alan W. Moore.

Grateful appreciation is expressed to those who supported this project with their efforts and resources. Special thanks goes to Mr. Stephen Chomko, DECAM, Cultural Resources Program Manager. Mr. Chomko served as Technical Point of Contact for the project and provided all-around support. Mr. Nick Palotto, Directorate of Environmental Compliance and Management, Environmental Compliance Division, provided the environmental documents (asbestos, lead-based paint, radon) associated with the building. Ms. Pat Smith and Mr. Larry Chappell, Directorate of Public Works, Facilities Branch, provided assisted with access into the building. Mr. Larry Lakin, Directorate of Public Works, Project Management Branch, was invaluable in locating the much needed architectural drawings for the building.

Preface

The architectural studies reported in this document are an important part of the Fort Carson Cultural Resources Management Program. The goal of the program is to maintain the military training mission while protecting significant cultural and environmental resources. The current study is part of an integrated plan that takes a long-term systematic approach to meeting identification, evaluation, and resource protection requirements mandated by the National Historic Preservation Act. This project is a valuable addition to our knowledge of the history of Fort Carson during World War II and to the resources of central Colorado. Under a cooperative agreement, the U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory provides architectural assistance in meeting Fort Carson's cultural resources goals.

The first Federally funded cultural resources survey on Fort Carson began in 1978. Since then Fort Carson has used a multidisciplinary approach combining archeological theory and historical methods with geological, geomorphological, botanical, and statistical techniques and procedures to focus its efforts to locate, evaluate, and protect significant cultural resources. Architectural studies have identified significant structures dating to the homestead era and World War II. In addition, professional studies and consultations with Native American tribes have resulted in the identification of National Register of Historic Places eligible sites and districts. All major prehistoric and historic cultural periods recognized on the Great Plains and Rocky Mountains are represented by the cultural resources on Fort Carson and the Pinon Canyon Maneuver Site. Sites of the Paleoindian, Archaic, and Ceramic stages are present, as are sites from the Fur Trade era, 19th century Hispanic and Euroamerican settlements, early 20th century homesteading and ranching, and World War II and Cold War era military sites.

The Cultural Resources Management Program is in the Directorate of Environmental Compliance and Management. The directorate is tasked with maintaining Fort Carson's compliance with Federal, state, and local environmental laws and mandates. Because decisions affecting one resource will affect other resources, the decisions we make today will affect the condition of Department of Army lands and resources for future training, research, and recreation. Mission requirements, training resources, wildlife, range, soil, hydrology, air, and recrea-

tion influence cultural resources management decisions. Integrating compliance and resource protection concerns into a comprehensive planning process reduces the time and effort expended on the compliance process, minimizes conflicts between resource protection and use, allows flexibility in project design, minimizes costs, and maximizes resource protection.

Federal laws protect the resources on Fort Carson and the Pinon Canyon Maneuver Site. Theft and vandalism are Federal crimes. Protective measures ensure that Army activity does not inadvertently affect significant cultural sites. Fort Carson does not give out site location information nor are sites developed for public visitation. Similar resources are located in the Picketwire Canyonlands where public visits can be arranged through the U.S. Forest Service, Comanche National Grasslands in La Junta, Colorado.

Fort Carson endeavors to make results of the resource investigations available to the public and scientific communities. Technical reports on cultural resources are on file at the Fort Carson Curation Facility (Building 2420) and the Colorado State Historic Preservation Office and are available through the National Technical Information Service, Springfield, VA. Selected reports have been distributed to public libraries in Colorado. Three video programs produced by Fort Carson are periodically shown on Public Broadcasting Stations. Non-technical reports on the prehistory, history, and rock art of southeastern Colorado have been distributed to schools and libraries within the state. Fort Carson continues to demonstrate that military training and resource protection are mutually compatible goals.

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Directorate of Environmental Compliance and Management
Fort Carson, Colorado
August 2000

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The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

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1 Introduction

Background

The Old Hospital Complex (OHC) at Fort Carson, CO, consists of 59 buildings, most of which were built in 1942 and 1943 (Figure 1-1). They were to be "temporary" facilities. The complex includes administrative buildings, clinics, surgical and medical wards, living quarters, dining facilities, recreation facilities, and utilities (Figure 1-2). Following World War II (WWII), the OHC continued to perform various missions. Many of the buildings had been converted to quarters or administrative facilities. With the opening of Evans Hospital in 1986, the use of the OHC as a medical facility was discontinued. However, several buildings remain occupied.

The history of the OHC is documented in a report funded by the Directorate of Environmental Compliance and Management (DECAM), Fort Carson, CO, and developed by the National Park Service (NPS) (Connor and Schneck 1996). Therefore, no further discussion of the OHC's history is repeated here.

The majority of the OHC buildings will be, or already have been demolished. However, 15 buildings, including Building 6237, will be retained. The exterior of 14 buildings and their connecting hallways, located in the southeast corner of the complex, will be restored. According to the Memorandum of Agreement between Fort Carson and the Colorado State Historic Preservation Officer (SHPO), portions of the exterior and interior of Building 6237 will be restored to its original WWII form.

Building 6237, located on the west side of the complex, is under consideration for renovation, possibly as a new DECAM facility. The building is a Hospital Ward facility, designated as a "Standard Ward, Type HSW-98." It is a two-story building, consisting of a central core area that contained doctors' offices, group bathrooms, nurses' stations, kitchens, and private patient rooms. Flanking the core areas, at each end (north and south) of the building, were open patient wards. Two-story open porches are located on the east side of the building adjacent to each open ward.

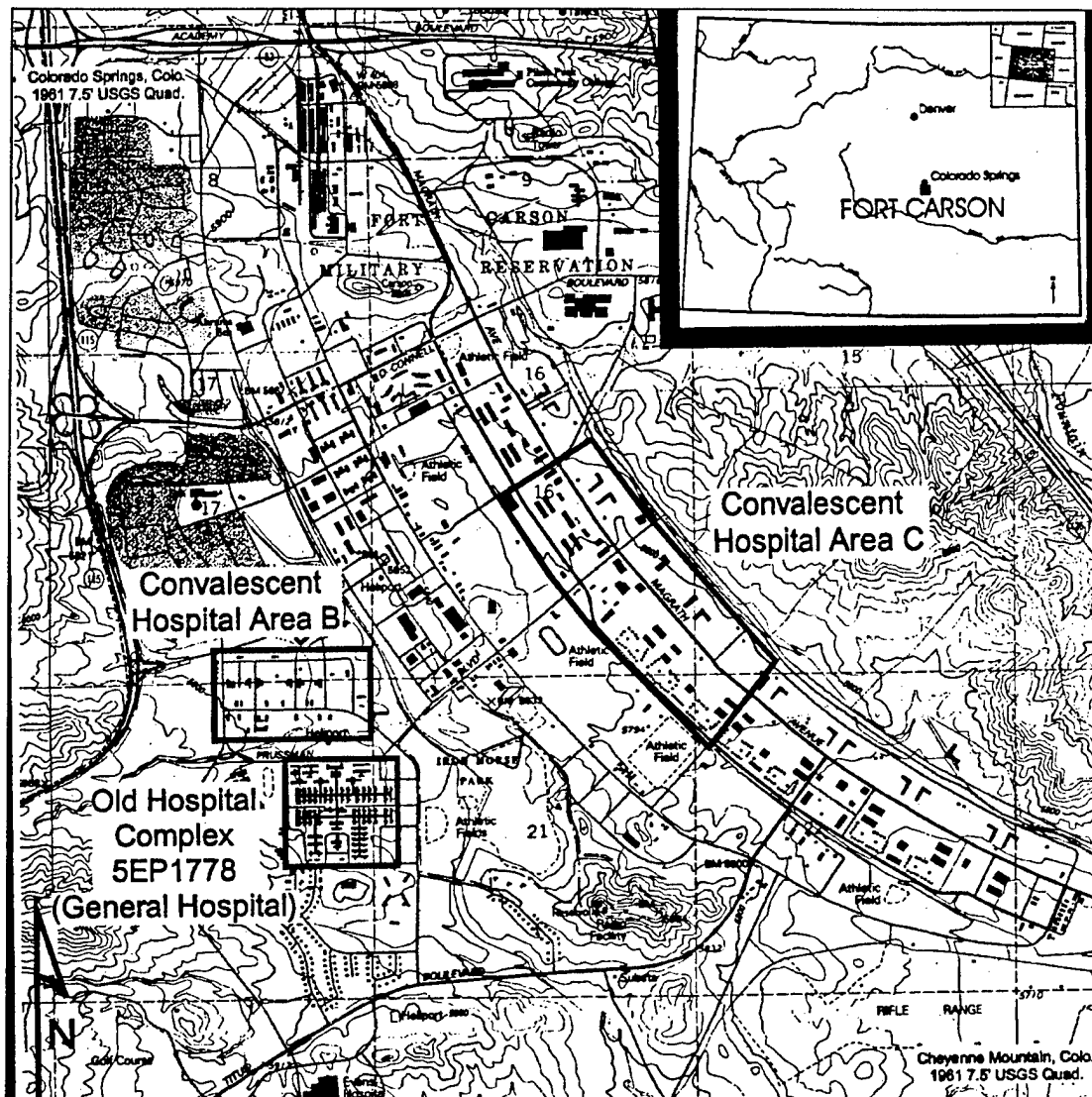


Figure 1-1. Fort Carson cantonment and the location of the Old Hospital Complex.

Over the years, Building 6237's open wards and porches on the first floor have been partitioned into individual rooms. The second floor plan remains generally intact, although the porches have been enclosed. New aluminum windows were installed in the 1980s.

Building 6237 has not served as a hospital ward since 1985. The building was used for military exercises during the late 1980s. During the early 1990s, the building served as temporary administration and storage space for different units and organizations on post. The building has been unoccupied for the past 5 years. Although electrical services and steam heat, supplied by a central plant, remain active, the building is in a general state of disrepair, although not seriously deteriorated.

Researchers at the Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) have developed expertise and a reputation for excellence in work related to historic buildings. Because of this experience, the level of assistance to installations with compliance issues, and the capabilities to develop design concepts for restoration and adaptive reuse, DECAM sought ERDC/CERL's services. DECAM's requirements included assessing the building's condition and determining its potential for adaptive reuse.

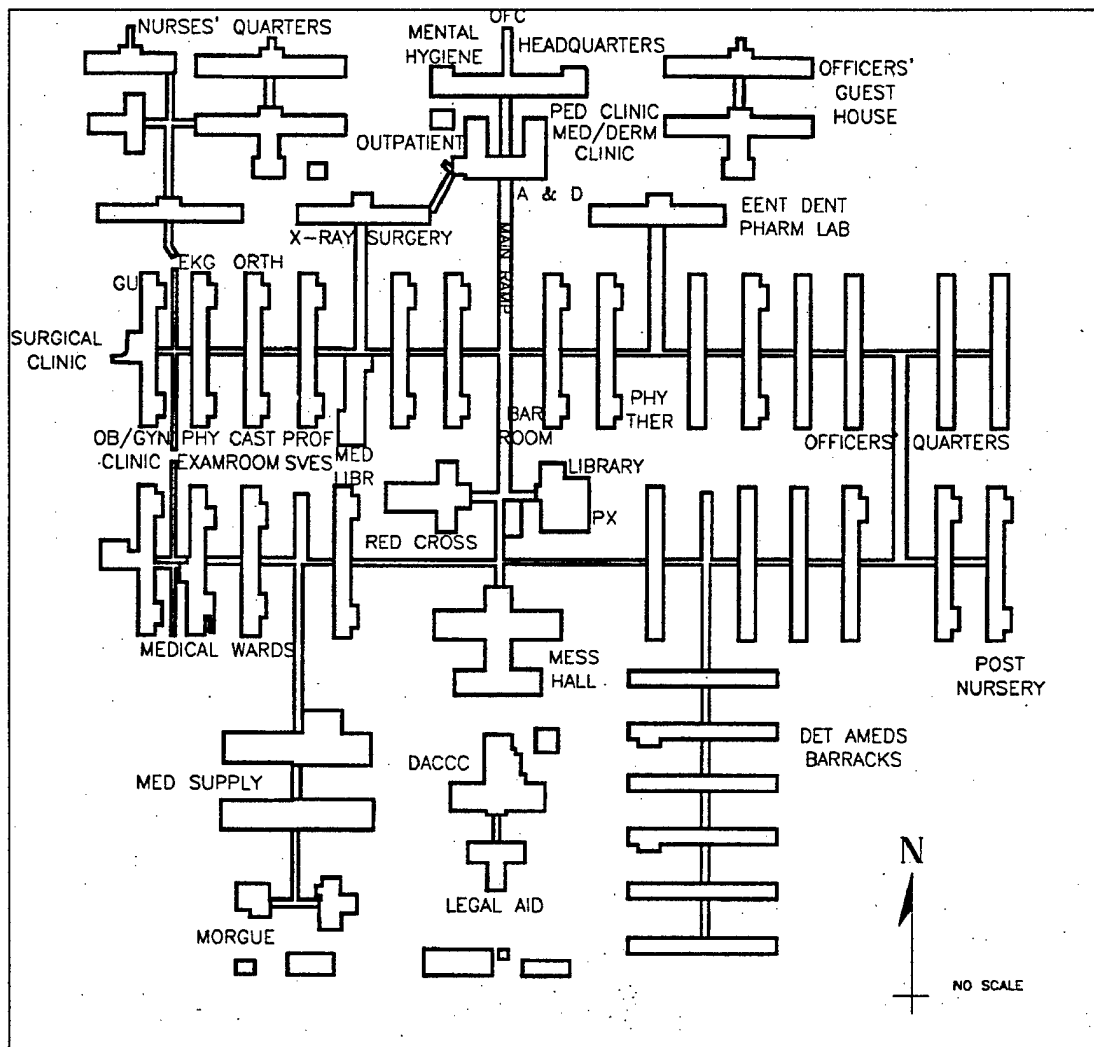


Figure 1-2. Historic building functions.

Objective

The objective of this work was to assess the present condition of Building 6237. This assessment is a first step in determining the feasibility of renovating the building for use by DECAM as an administrative and operations facility. The

focus of this assessment is the overall integrity of the major building systems, including evidence of failure or performance problems, and the potential for continued serviceability.

Approach

Descriptions of the Old Hospital Complex were reviewed to familiarize researchers with the overall architectural characteristics and building construction. Construction documents for Building 6237 were not available at the time of the inspection. Standard architectural floor plans and first floor framing plans for "Standard Ward, Type HSW-98" were referenced. As-built drawings were not available to researchers for review.

Researchers performed an on-site inspection of Building 6237 on 20 through 22 April 1999. An assessment protocol was developed to promote a systematic and thorough examination of critical building components. Observations were noted according to this protocol. The Construction Specifications Institute's UNIFORMAT™ was used as the basis of this assessment protocol. UNIFORMAT™ is a systems-based building taxonomy (as opposed to materials-based) and is well suited to building inspection and performance evaluation.

The thorough inspection was conducted by physically observing all major building elements in all locations within the building. In general, the assessment was conducted in a qualitative manner. Measurements were taken, level and plumb were verified, and members and materials were visually examined. Where appropriate, materials were probed to determine if any deterioration had taken place. Photographs were taken to illustrate the condition of building elements. Specific conditions were photographed. No instrumentation or other analytical devices were used. The method of examination for each building element is described below.

The focus of the assessment was the overall integrity of the building. Therefore, emphasis was placed on structural systems, exterior envelope components, and the major interior construction systems. The mechanical and electrical systems were not examined in detail at this time since they would essentially be replaced in a renovation.

The presence of asbestos-containing building materials (ACBM) and lead-based paint (LBP) is documented in "Asbestos Survey Building 6237" conducted for DECAM by ENSR of Denver, CO, in 1996. Information from ENSR's survey was

used in the current integrity assessment. No further evaluation of hazardous materials was done for this assessment.

Researchers were fortunate to find two buildings (6240 and 6241) similar to Building 6237 that were being prepared for demolition. The exterior paint was stripped, revealing the cinder block construction in detail. Interior finishes were removed, revealing framing details. The opportunity to observe these features, where they would be concealed in Building 6237, was extremely valuable in this assessment.

Mode of Technology Transfer

The findings of this assessment will be forwarded as a Technical Report (by the ERDC/CERL) to the Fort Carson DECAM for their use in determining whether renovating Building 6237 is feasible. Subsequent assessment steps would include identifying occupants' requirements, developing an architectural program and design concept, cost estimates, and cost comparisons. The final feasibility determination will be made by Fort Carson personnel.

Units of Weight and Measure

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

SI conversion factors		
1 in.	=	2.54 cm
1 ft	=	0.305 m
1 sq in.	=	6.452 cm ²
1 sq ft	=	0.093 m ²
1 lb	=	0.453 kg

2 Building Description

Building 6237 is a narrow rectangular two-story building. Its exterior dimensions are 32 ft - 4 in. wide and 262 ft long; the long dimension is oriented north-and-south. Two-story porches are located on the east side of the building. They measure 39 ft - 4 in. wide and project 12 ft - 4 in. from the building. The roof is a simple 3:12 gabled roof, and the eave height is approximately 22 ft above grade.

In plan, the building is configured as a center core of individual patient rooms, doctors' offices, nurses' stations, washrooms, and kitchens, flanked on each end by an open patient ward. Enclosed stairwells and sunrooms are located at each end of the building. The core area is configured as a double loaded corridor. Rooms are approximately 12 ft deep, and most are 8 to 10 ft wide. Open wards are the width of the building and approximately 72 ft long. The first and second floor plans are essentially the same. A lateral corridor bisects the building in the east-west direction, connecting it with the building to the east. The floor plan is essentially symmetrical around the lateral centerline.

The foundation consists of a cast-in-place concrete continuous footing and wall around the building perimeter, with two rows of cast-in-place concrete piers at the interior. There is crawl space under the first floor, and no basement at any location within the building.

Exterior walls are cinder block. Single windows are spaced regularly along the building's length, and at the end walls.

First and second floor framing consists of wood joists. The first floor joists are supported by the exterior masonry walls, and built-up beams spanning the foundation piers. The second floor joists are supported by the masonry wall at the exterior, and at the interior by bearing walls at the building's core and built-up beams in the open wards. These beams are supported by interior wood columns and pilasters in the masonry firewalls. Floor sheathing boards are laid diagonally across the joists. Although it could not be determined by physical inspection, Douglas Fir was reported to be the framing material used in the OHC buildings.

Roof framing consists of wood rafters, supported at the exterior walls and knee walls at the building's interior. The knee walls, in turn, are carried by second

floor bearing walls and built-up beams and columns. Roof sheathing boards are laid perpendicular to the rafters.

Five lateral firewalls define six "bays" in the building's plan. They are constructed of cinder block, and are located between the stairwells and open wards, between the open wards and core areas, and across the center of the core area at the south wall of the east-west corridor. The firewalls extend continuously from interior foundation walls to the underside of the roof sheathing.

Over the years, the open porches had been infilled with masonry and used as enclosed spaces. The open wards on the first floor had been partitioned into individual spaces. Two X-ray rooms had been added and various flooring and wall finishes had been added.

It is evident that Building 6237 has received very little maintenance since it was vacated, although it is not dilapidated by any means. Exterior paint is seriously deteriorated and the exterior walls exhibit cracking. However, the roof is not deteriorated. The second floor plan appears to be generally original. While somewhat neglected, Building 6237 appears not to have suffered any significant damage since it was last occupied.

3 Building Assessment

General

The following building systems and components were examined:

- Substructure, including perimeter foundation walls and interior piers.
- Superstructure, including roof framing and sheathing, floor framing and sheathing (where observable), interior load-bearing walls and columns, and exterior load-bearing walls.
- Exterior closure, including exterior walls, windows, exterior doors, soffits, and fascia.
- Roofing, including shingles, flashing, and vents.
- Interior construction, including partition construction and finishes, flooring, and ceiling finishes.

It is assumed that any partitioning, doors, windows, mechanical equipment, and other items that were added to Building 6237 since its original WWII occupancy would be removed when renovating the building. Such items would either be removed in total, replaced with historically appropriate components, or reconfigured to satisfy the requirements of its future occupants. Therefore, emphasis was placed on the features that would remain with the restored facility.

The building was divided into six “bays” along the long dimension, corresponding with the plan features and the placement of lateral masonry firewalls. These are:

- North stairwell
- North open ward
- North center core
- South center core
- South open ward
- South stairwell

Refer to Figures 3-1 and 3-2 for first and second floor bay divisions. Discussions of features and observations are referenced and keyed to floor plans illustrated in Figures 3-3 and 3-4 as Point A, Point B, etc.

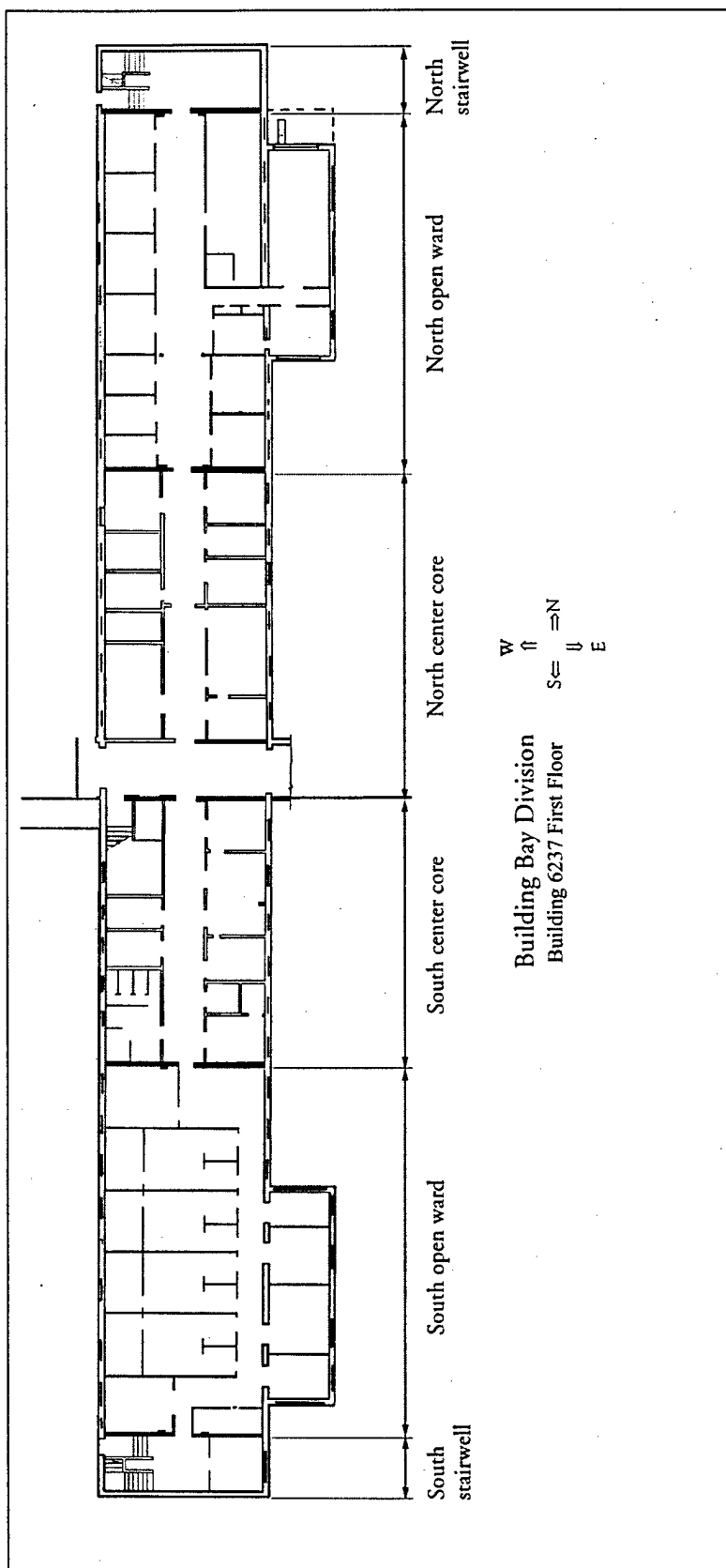


Figure 3-1. First floor building bay division.

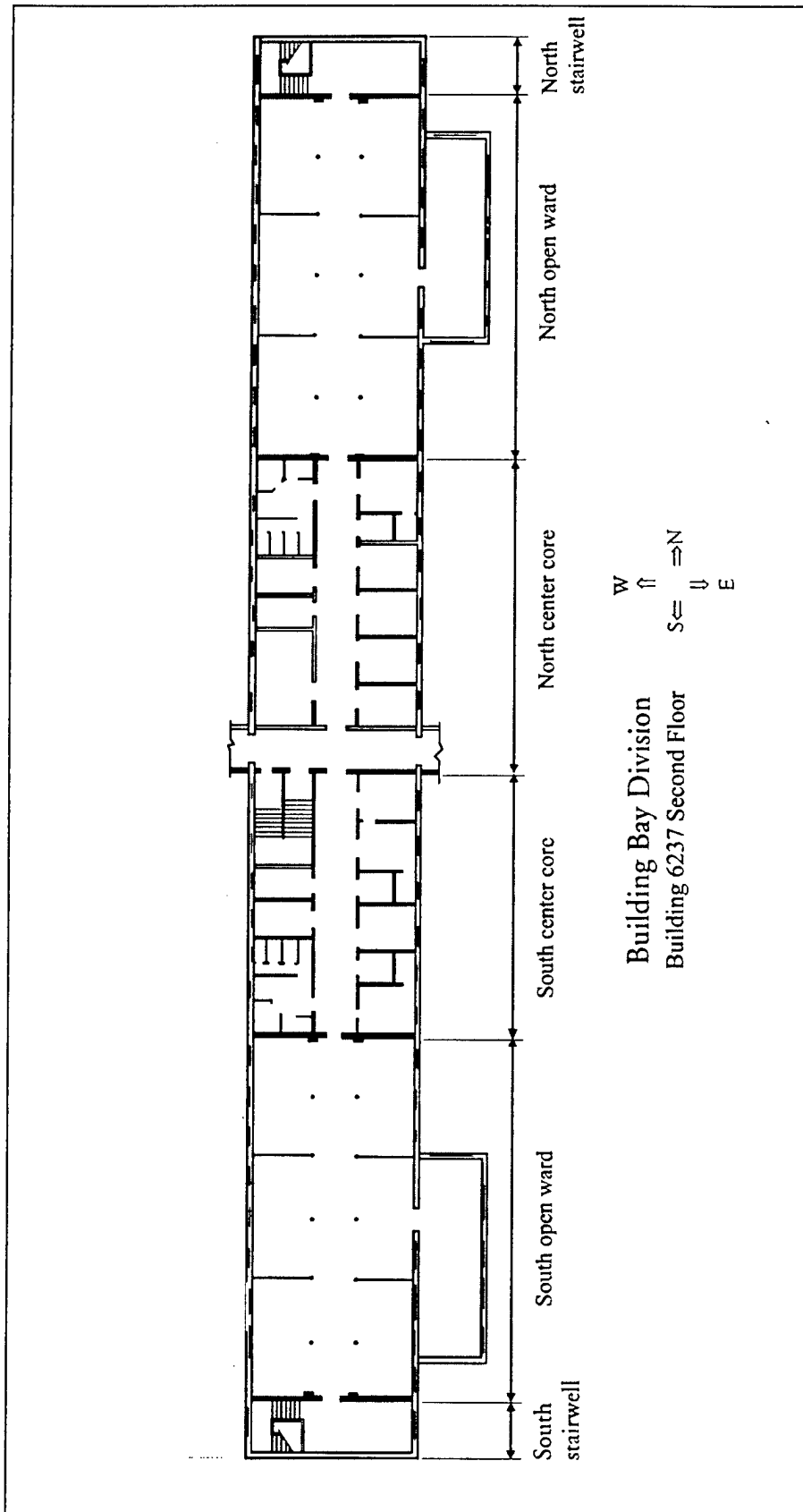


Figure 3-2. Second floor building bay division.

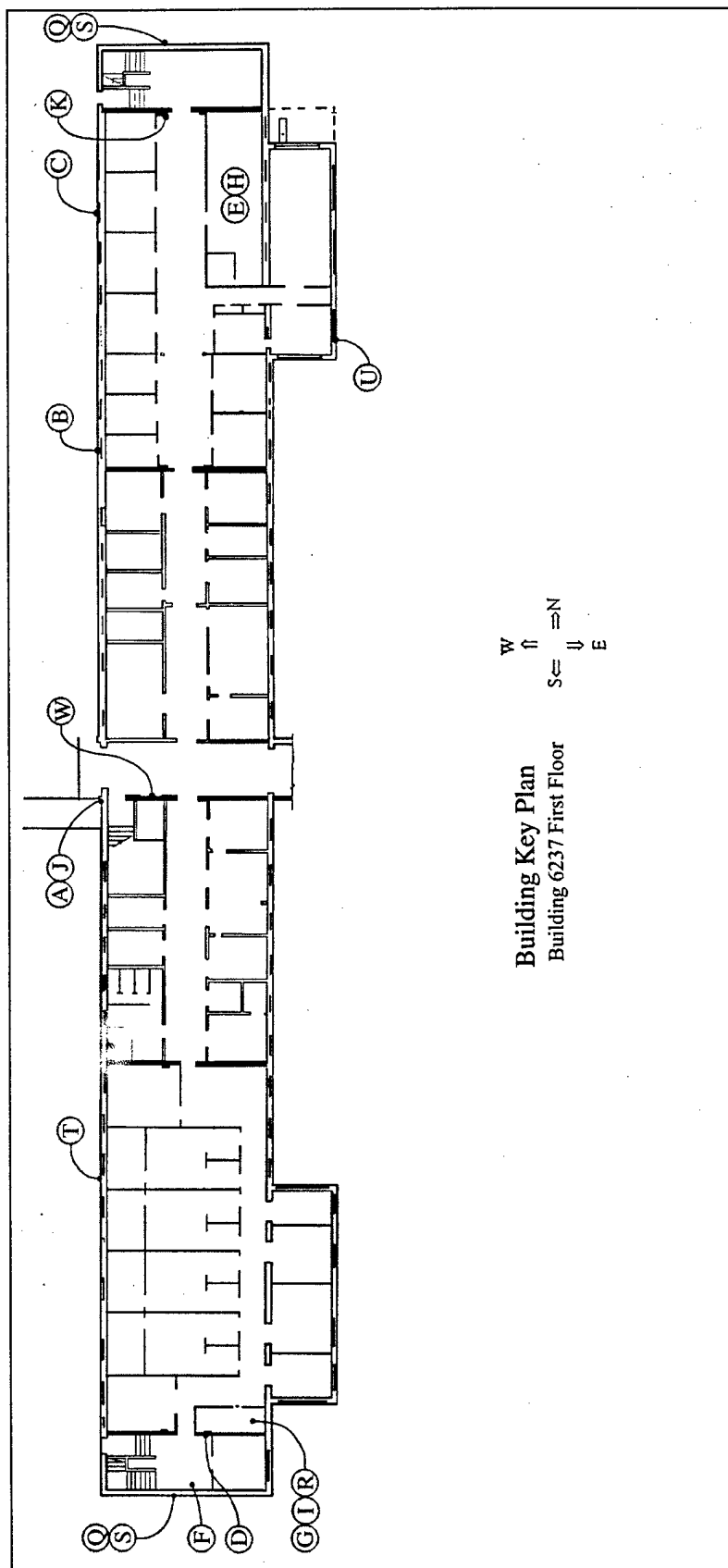


Figure 3-3. First floor key plan.

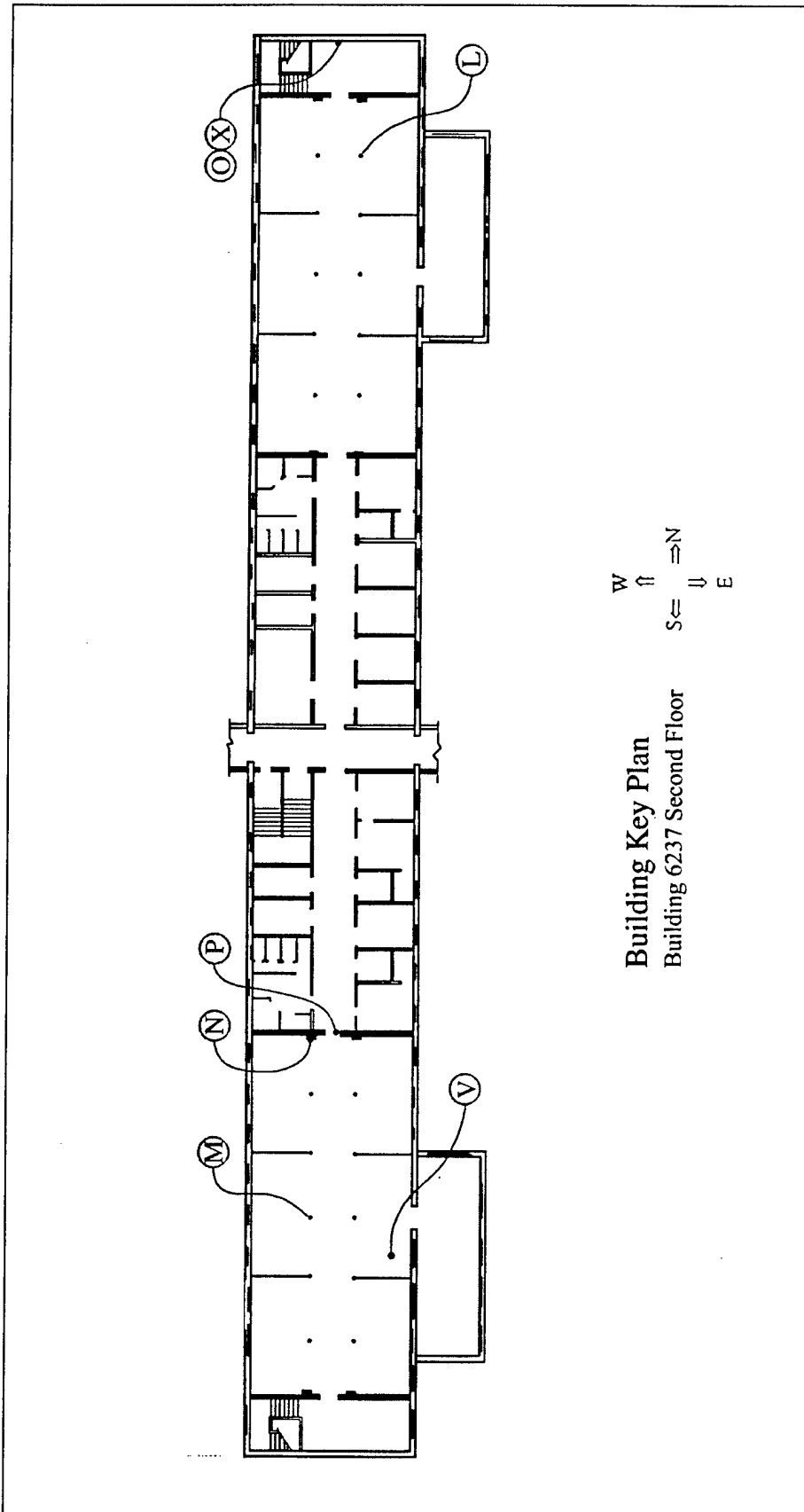


Figure 3-4. Second floor key plan.

Substructure

The foundation wall was observed around its entire perimeter from the exterior and interior. Interior piers and the foundation walls supporting the firewalls were observed from each crawl space bay. Any occurrence of cracking, deformation, deflection in either horizontal or vertical plane, differential settlement, heaving, lateral displacement, leakage, concrete spalling or deterioration, exposed reinforcing steel, and other signs of distress in any foundation components was noted.

Footings

All footings were buried below grade and, therefore, were not observable. The condition of the foundation walls and piers suggests that the footings are performing as intended (see the following sections).

Perimeter Foundation Walls

No severe cracking or deformations were observed from either the exterior or interior of the perimeter foundation. There were few hairline cracks. Cracks appeared in many locations in the exterior block walls. However, they stop at the top of the foundation wall and do not appear to be caused by differential settlement of the foundation.

Much of the foundation wall was below grade at the exterior, and was concealed from view. Where cracks were observed in the exterior wall at grade, the grade line was scraped away until the foundation wall was visible. In no case was the foundation cracked in these locations.

There were two locations in the west exterior wall where cracking was serious: one at the south center entry door (Point A and Figure 3-5), and one adjacent to the ninth* window from the north (Point B and Figure 3-6). However, no cracking or settling was observed in the exterior foundation wall at these locations.

* Windows are counted from either the north or south end of the building starting in the open wards. The stairwell/sunroom windows are not counted.



Figure 3-5. Detail of cracking.

A line was strung at various locations of the exterior wall to check for level. The block work was straight and level, and did not exhibit any signs of settlement.

No seepage or leaking through the perimeter foundation was evident, with one exception. The top of the foundation wall was stained at the interior of the west side of the north ward bay (Point C), somewhat resembling seepage staining. However, this stain was small (roughly 2 SF) and isolated.

Interior Foundation Walls and Piers

No cracking or deformations were observed in the interior foundation walls, with one exception. One crack was observed in the base of the firewall between the south stairwell and the south ward bay, immediately to the east of the access panel, but not at the pilaster (Point D). This crack did continue into the foundation wall. However, it was approximately 1/16 in. at its widest, and no differential movement was observed on either side of this crack (Figure 3-7).

Piers were located in two rows along the long dimension of the building, spaced at 12 ft. Each row is located 12 ft from the exterior wall, trisecting the building's width into spans of 12 ft, 8 ft, and 12 ft. They support built-up beams that carry first floor joists and wood columns at the open ward ends of the building. No cracks, settling, or other deformations were observed in any of the piers. By observation, they appeared to be aligned as intended. A level was placed on a few piers in each crawl space bay; each was plumb.



Figure 3-6. Detail of cracking adjacent to ninth window from north.



Figure 3-7. Crack adjacent to access panel.

Three concrete piers are located under the X-ray room at the east side of the north end of the building (Point E). They appear to have been installed independently of the original foundation, possibly to support additional equipment. One pier is badly honeycombed. However, picking at it, even strenuously, did not dislodge any concrete materials, suggesting the concrete was not consolidated during the pier's installation. Furthermore, none of these piers supported any structural members.

One pier detail is of interest. The pier tops appear not to have been screeded level when the concrete was placed. The floor beams are not always in complete and uniform contact with the pier tops. At the piers, the beams are nailed into vertical steel straps embedded into the pier tops. Perhaps this detail was conceived to expedite construction by allowing greater tolerance in the elevation of the pier tops. The beams could be placed, leveled, and nailed through the straps independent of the pier's top surface. There appeared to be no adverse effects.

Basement/Crawl Space Fireproofing and Firestopping

Masonry firewalls separate the crawl space into six bays. Access panels were installed in the masonry walls between bays. Doors were constructed of wood-framed panels, faced with a hardboard sheet similar to Masonite. Self-closing hinges suggest that these doors were intended to remain closed at all times, presumably to retard fire propagation. These panels were all propped open, and steam and condensate return piping and various other building utilities were routed through them. Other penetrations had been made throughout the building's life. The integrity of the firewalls is, therefore, compromised. The appropriate fire stopping details and sealants at penetrations must be incorporated into the renovation design.

Basement/Crawl Space Vapor Retarder and Insulation

The first floor was not insulated. No dampproofing or vapor retarders were observed. There were no signs that mildew or moisture accumulation ever existed within the crawl spaces. Crawl space vents had been installed around the building perimeter spaced at approximately 24 ft. However most of these had been covered over the years. There were no other dampproofing materials or techniques observed. Still, the arid climate appears to have prevented moisture problems. A gunite "floor" had been installed in the crawl spaces; its function is to encapsulate asbestos-contaminated soil and any contribution to moisture control would be incidental.

Summary: Substructure

The foundation system appears to be performing as intended. No cracking, deformations, differential settlement, movement, or other signs of distress or deterioration were observed. The fire separation barriers were compromised by penetrations, and would have to be upgraded during renovation. Moisture appears not to be a problem, although attention should still be given to venting in a renovation design.

Superstructure

All structural components were examined in all locations of the building. Where framing members were exposed (i.e., in the attic spaces and crawl spaces) observations were made in all locations throughout the building. Where framing members were concealed, the floor or wall assemblies were examined for signs of distress. Any occurrence of cracking, deformation, deflection in either the horizontal or vertical planes, differential settlement, lateral displacement, leakage, material deterioration, and other signs of distress in any structural components was noted.

First Floor Framing and Sheathing

The first floor is framed with 2 X 8s, spanning the building in three simple spans of approximately 12 ft, 8 ft, and 12 ft across the building's width. Floor joists are spaced at 20 inches. At the exterior walls, the joists bear in pockets chopped into the cinder block wall. The joists bear directly on block, and there is no blocking between joists. At the interior, joists bear on built-up beams consisting of double 2 X 12s. Beams are carried by the interior piers and pilasters in the firewalls and end walls. As described previously, the beams do not always bear completely flush on the piers, but are supported by steel straps embedded in the pier tops. Solid blocking between joists at the interior beams prevents overturning. There is one row of cross bridging within each span. Occasionally, a solid piece of 2 X 8 will substitute for cross bridging. Floor sheathing consists of nominal 1 in. boards placed diagonally across the joists.

The first floor exhibited no signs of extraordinary bounce or deflection when walking, bouncing, or jumping at any location. Considering this is a wood framed floor, it seemed rigid in all locations. No further instrumentation or analytical measures were taken regarding dead or live loading performance.

The first floor is generally quite level. A level was placed at several locations to measure level both parallel and perpendicular to the direction of the joists. The first floor is virtually dead level at its center span. Some minor sagging was observed at the outer (east and west) spans at several locations. As expected, the floor was high at the interior beams. The slope was greatest immediately adjacent to the beams, toward the exterior walls. However, this sag was hardly perceptible without a level in most cases. In only one location, at the east side of the south center core, was the floor as much as a half-bubble off of level. The floor was generally level at mid-span (i.e., halfway to the exterior wall). It was also observed that several layers of underlayment and flooring were installed throughout the years, and that the flooring surface was somewhat irregular in

places. Beams were found to be virtually dead level where tested at several random locations. Some minor splitting was observed at the ends of many beams where they were nailed to the straps embedded in the piers (Figure 3-8). However, no other signs of distress, deflection, or delamination were observed. At the center cores, cementitious material was packed under beams (i.e., "grouted") at the pier tops, presumably to affect more uniform bearing. Perhaps this was done by the crews installing the gunite cover in the crawl space floors. Bearing joists directly on the irregular surface of a pocket chopped in cinder block is not an accepted practice, by contemporary standards. However, no adverse effects in the floor structure were observed relative to this detail.

Some slope was also observed in the southeast corner of the building, in the former stairwell (Point F). A room had been built in the east end of this room, in which was installed a *Trane* air handling unit (AHU). No additional support was installed under the AHU in the southeast corner of the building. It is assumed that the additional load of the AHU contributes to the floor deflection. However, no calculations or further analysis were performed to verify this assumption. From below, all joists in this area were closely examined. None showed any signs of distress or excessive deflection. It is assumed this AHU will be removed during renovation.

The floor surface was spongy and unstable in the bathroom areas, especially the bathroom that was added at the southeast corner of the former open ward at the south end.

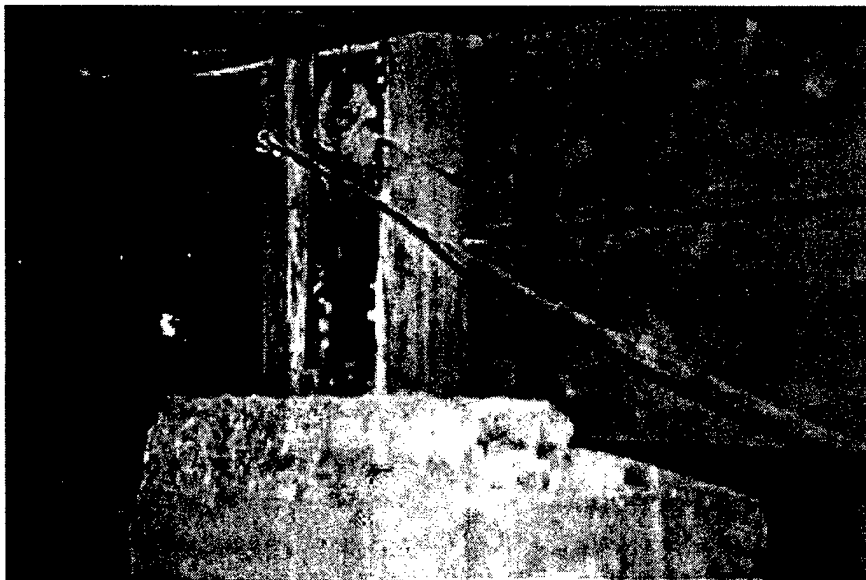


Figure 3-8. Beam/strap detail in crawl space.

The floor system appeared straight and true when examined from the crawl spaces below. Pencil marks were observed, presumably made during construction, and members were still aligned to those marks. Several joists were tested for level, especially where a slope was detected from the top. While not all joists were perfectly dead level, none exhibited the degree of slope seen from the top. This may suggest the subfloor and/or layers of underlayment and flooring may contribute more to the floor surface not being level than do the structural members themselves.

The joists themselves appeared to be clean, straight, and mostly free from checks and knots. One joist was observed at the west span of the former south open ward with a knot hole in the bottom (tension) edge, at approximately mid-span. No cracking or excessive deflection was observed. All holes that were drilled into joists were done so at the joists' neutral axes.

Occasionally a floor framing member was discolored. Upon closer examination, however, it was decided that the member may have been used for some other purpose prior to its installation in the floor. Upon probing, all such members were found to be as sound as the others. No material deterioration was evident.

One floor joist at the east span of the former south open ward (under the shower room) was cracked near its tension edge (Point G). However, this joist was cut away from the interior beam at one time to provide space for a sanitary drain-pipe. Rather than bearing on the beam, it now hangs from 2 X 8 blocking nailed between the adjacent joists. It would be impossible now to determine whether this modification contributed to the cracking. This joist, however, is as level as the others and does not appear to be deforming. If any renovation is to take place, this detail should be upgraded.

Occasionally, the joist spacing resulted in a joist falling directly on a column line. Where this occurs, there is no beam to carry the joist. A single 2 X 8 block is nailed to the column as a "haunch" to carry the joist. While no deflection, dislocation, or separation was evident, this haunch detail should probably be upgraded to provide a full 3 in. of bearing for the joist during renovation.

The floor sheathing appeared to be clean, straight, and mostly free from checks and knots. Some knot holes were observed, but these were covered by subfloor, underlayment, and flooring. At one location in the south center core, a small piece of sheathing (approximately 6 sq in.) was missing. It appeared to be knocked out, possibly by an impact from above. There was no further splitting or cracking in this board. No soft spots or other problems were observed because of these voids.

The sheathing under the bathroom areas was clearly water-stained. However, probing indicated it is as solid as anywhere else in the building. No softness or deterioration was evident. The sponginess felt from the floor surface is, therefore, assumed to be due to deteriorated underlayment and finish floor.

Cross bridging was occasionally missing. Rarely was it nailed tightly to the joists. One school of thought believes that wood cross bridging contributes more to labor-intensive futility than to floor stiffness. Absence of bridging should cause no concern.

There are three access panels in the floor of the X-ray room in the east side of the former north ward bay (Point H). If adaptive reuse is to occur, these scuttles should be framed and sheathed.

The floor system's design criteria must be considered with respect to future occupancy types and loading criteria. Both the 1997 *Uniform Building Code* and the American Society of Civil Engineers' ASCE 7, *Minimum Design Loads for Buildings and Other Structures* (which is used by USACE) require a minimum distributed live loading of 50 pounds per square foot (PSF) for office occupancy, and a concentrated load of 2,000 lb. However, ASCE 7 also requires design for a distributed floor live load of 100 PSF for lobbies and first floor corridors, and 80 PSF for corridors above the first floor. Preliminary evaluation of the building's floor system indicates it should be sufficient for 50 PSF and 80 PSF floor live loading criteria. The Fort Carson Directorate of Public Works (DPW) indicates that other OHC buildings, as well as WWII vintage wood frame buildings, have been converted to office occupancies with no adverse structural behaviors. Overloading with document storage, equipment, or other excessive dead loading could possibly result in excessive floor deflection.

Second Floor Framing and Sheathing

The second floor is framed similar to the first floor, with 2 X 8s spanning the building in three simple spans of 12 ft, 8 ft, and 12 ft. Although floor framing was concealed in Building 6237, it was exposed in Buildings 6240 and 6241; detailing is assumed to be the same in all these buildings. At the exterior, the joists bear on the ledge created by the transition of the exterior wall from 12-in. block at the first floor to 8-in. block at the second floor. The joists bear directly on block; there is no plate. There is 2 X 4 blocking at the joist ends to prevent overturning. In the open ward interiors, the joists bear on built-up beams consisting of triple 2 X 12s that are approximately 12 ft long. The beams are supported by solid wood columns approximately 8 in. square. Beams bear atop the columns with additional bearing area created by bolting "haunches" to the col-

umn tops. A "beam pocket" is created by lapping 2 X 8s over the outer surfaces of the column; the beams are bolted through this beam pocket (Figure 3-9). Within the center core of the building, joists are carried by load-bearing 2 X 4 stud walls. Solid blocking between joists at the beams and bearing walls prevents overturning. There is one row of cross bridging within each span. Floor sheathing consists of nominal 1-in. boards placed diagonally across the joists.

The second floor exhibited no extraordinary bounce or deflection when walking, bouncing, or jumping on the floor at any location. Footsteps could be heard from below, and jumping rattled ceiling-hung light fixtures at the first floor. However, this was not considered to be excessive for a wood-framed floor. No further instrumentation or analytical measures were taken regarding dead or live loading performance.

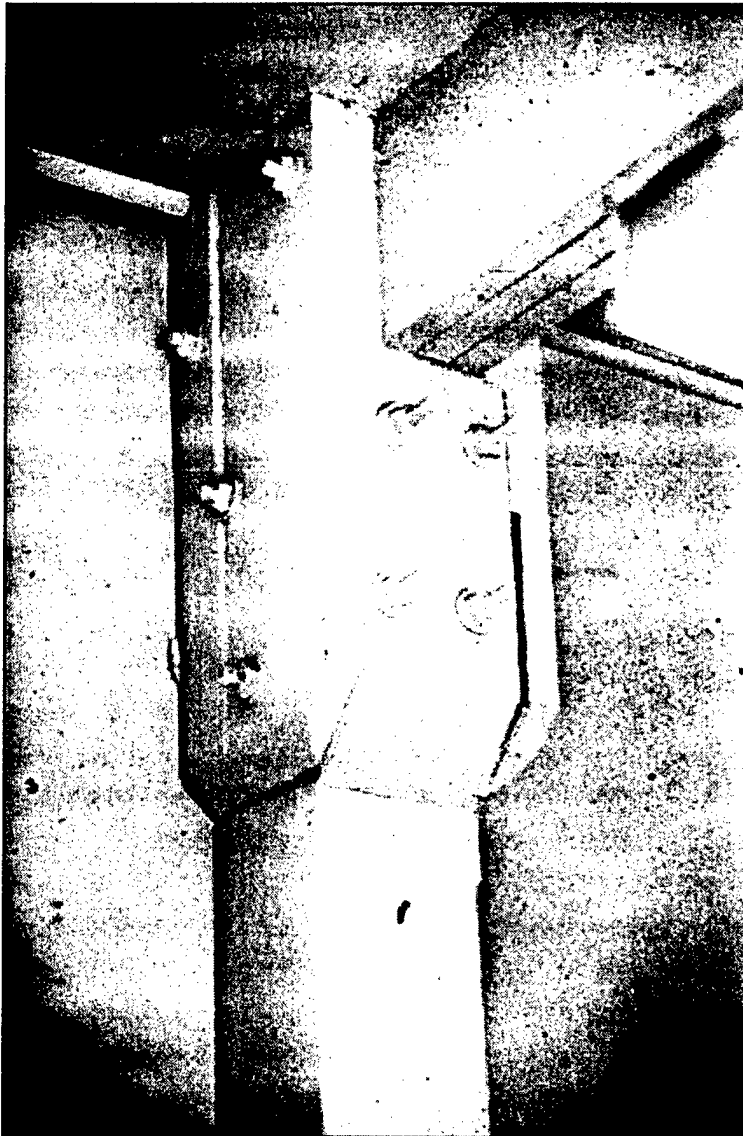


Figure 3-9. Beam pocket detail.

Very little cracking was observed in first floor ceilings, except in the added bathroom at the east side of the former south ward (Point I and Figure 3-10). A severe crack occurs in the east wall and ceiling adjacent to a window. However, no extraordinary deflection or slope is detected in the second floor above. The condition at this window is discussed under Load-Bearing Exterior Walls (p 42).



Figure 3-10. Cracking in southwest bathroom above the window, first floor.

The second floor is generally quite level at all locations. A level was placed at several locations to measure level both parallel and perpendicular to the direction of the joists. A very minor slope was detected in the porch floors on the east side of the building, away from the building toward the east walls of the porches. If adaptive reuse is to take place, the slope of the flooring should be increased, if possible, to improve drainage, as these spaces will be open and exposed to rain and snow.

Similar to the first floor, the second floor surface was spongy in the group bathroom areas. Since no structural deformation is apparent from below, it is assumed that the sponginess is due to underlayment and finish flooring, not joists and sheathing.

The open wards of the first floor have been converted to smaller rooms. All of the columns supporting the second floor have been enclosed by partitions, although most are still at least partially visible. The beams supporting the second floor

are visible in places. Where accessible, columns were found to be plumb. Load-bearing walls and partitions enclosing the columns were also found to be plumb. Beams, where visible, were not cracked, split, delaminated, or twisted. There was no evidence of excessive cracking, movement, deflection, or deformation in load-bearing members supporting the second floor.

Splitting has occurred at almost all of the wood members forming the "beam pockets." The individual wood pieces from which these beam pockets were made had separated in many locations. However, this splitting and separation appears to have been stable for quite some time, as the splits are filled with paint, and no further cracking has occurred. No lateral dislocation of beams was observed. There was no splitting or deformation observed in the haunches, which may also carry vertical loads.

Cracking was observed in the interior finish of the west wall of the center stairwell, where the stairwell opening's north header joins the west wall (Point J and Figure 3-11). This may indicate some movement in the header at this location. This connection detail should be examined and upgraded if necessary, if the finishes are removed during renovation.

A vertical crack appears in the firewall separating the north stairwell from the former north open ward on the first floor, at the west pilaster (Point K and Figure 3-12). The crack is evident in the plaster finish on both sides of this wall. The masonry is concealed. There was no significant deflection in the floor above, and no cracking or settlement observed in the foundation below.

Interior Stairs

Construction of the lowest flight of stairs in the north and south stairwells could be observed from the stairwell crawl space. Otherwise, stair construction was concealed. However, stair framing was exposed in Building 6241 where detailing is assumed to be similar to Building 6237.

Both the north and south stairs are approximately 3 ft - 9 in. wide. Three 2 X 10 stringers are nailed to the floor framing at the head and foot of the flight. Stringers adjacent to masonry walls were not anchored to the masonry, although an occasional nail was hammered through the stringer into the masonry. Treads are nominal 1-in. boards. Risers are closed with nominal 1-in. boards.



Figure 3-11. Cracking in wall of center stairs.

The center stairs are approximately 5 ft wide and are constructed similarly to the north and south stairs. There are, however, two center stringers in this stair.

Overall, the stairs appeared to be in good repair. Some bouncing and deflection was detected when jumping and bouncing on the north and south stairs. Normal walking did not produce any excessive bouncing. No other instrumentation or analytical methods were used to determine stair loading performance. One tread and riser was loosening in the south stairs.



Figure 3-12. Vertical crack in firewall, first floor north ward.

Roof Framing and Sheathing

The roof is a simple 3:12 gable roof, framed with 2 X 8 rafters spaced at 16 inches. Rafters are carried by the exterior block walls, and bear on plates bolted to the walls. Anchor bolts were visible above the plate, although it was impossible to determine by observation how they are anchored into the block wall. Rafters are toe-nailed to the plates. Rafters are carried mid-span by 2 X 4 knee walls in the attic which, in turn, are carried by double 2 X 12 beams at the open wards, and by load-bearing 2 X 4 stud walls in the center cores of the building. A 2 X 8 ridge board locates the rafters at the ridge. At the open wards, the beams

are carried by solid wood columns approximately 8 in. square, and by pilasters in the cinder block firewalls. "Beam pockets" are formed by lapping 2 X 8 pieces alongside the columns, similar to the columns supporting the second floor beams. There are no additional "haunch" pieces. Roof sheathing consists of nominal 1 in. boards placed perpendicular to the rafters, and spaced approximately ½ in. apart.

Second floor ceiling joists are 2 X 8s, spanning the width of the building in three simple spans, similar to the floors' construction.

When viewed from the ground, each side of the gable appears to be quite flat and straight (Figure 3-13). The ridge appears to be flat and straight. No sagging was evident in any part of the roof. No further inspection was conducted from the outside.

When viewed from below (from the attic spaces), the roof framing system appeared to be straight and true (Figures 3-14 and 3-15). Rafters were generally free from checks and knots. Pencil marks were observed, presumably made during construction, and members were still aligned with the marks. Structural members and sheathing appeared to be clean, with no evidence of water damage, or even staining. The bottom edges of rafters, in all locations, were aligned, with no saddles or sagging observable. There was no visible nail pulling, splitting, dislocation, or other sign of distress to suggest excessive uplifting at the eaves. Ridge boards were level and straight. The only irregularity observed in ridge boards was due to the slightly different dimensions of each individual 2 X 8. Knee walls were plumb, with no dislocation observed. Several ceiling joists were tested for level in several locations within each building bay. Some cracking was observed in ceiling surfaces (see "Ceiling Finishes" under Interior Construction). The joists above, however, were found to be level, with no signs of deflection or deformation.

At the north and south wards, the beams and columns supporting the roof structure were observed to be generally straight and sound. No excessive deflection, deformation, or evidence of distress was observed. Columns were plumb and beams were straight and level. Upon probing, there was no evidence of material deterioration.

At the north and south center cores, the corridor walls (bearing walls) were observed to be generally straight and sound. No excessive deflection, deformation, or evidence of distress was observed. Bearing walls were plumb.

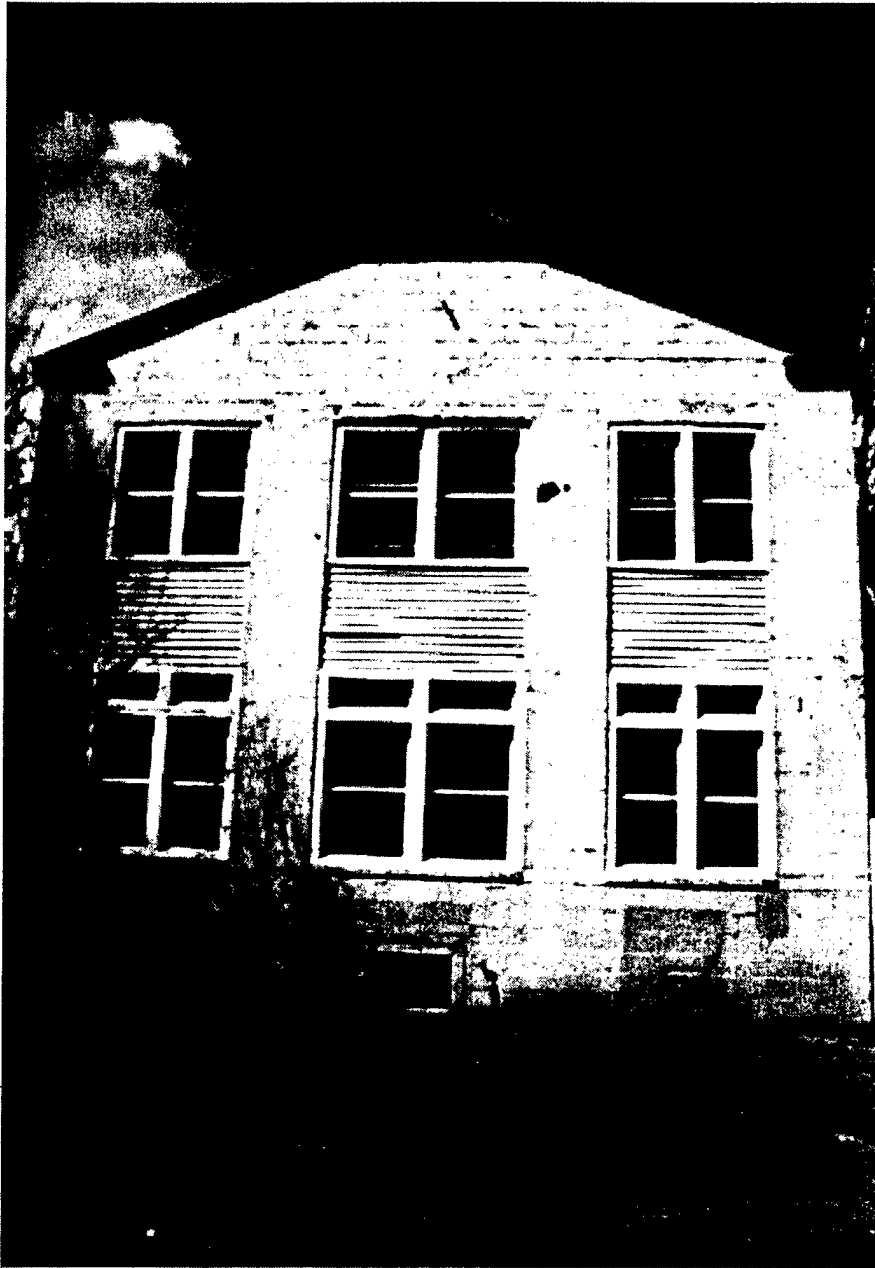


Figure 3-13. Gable end.

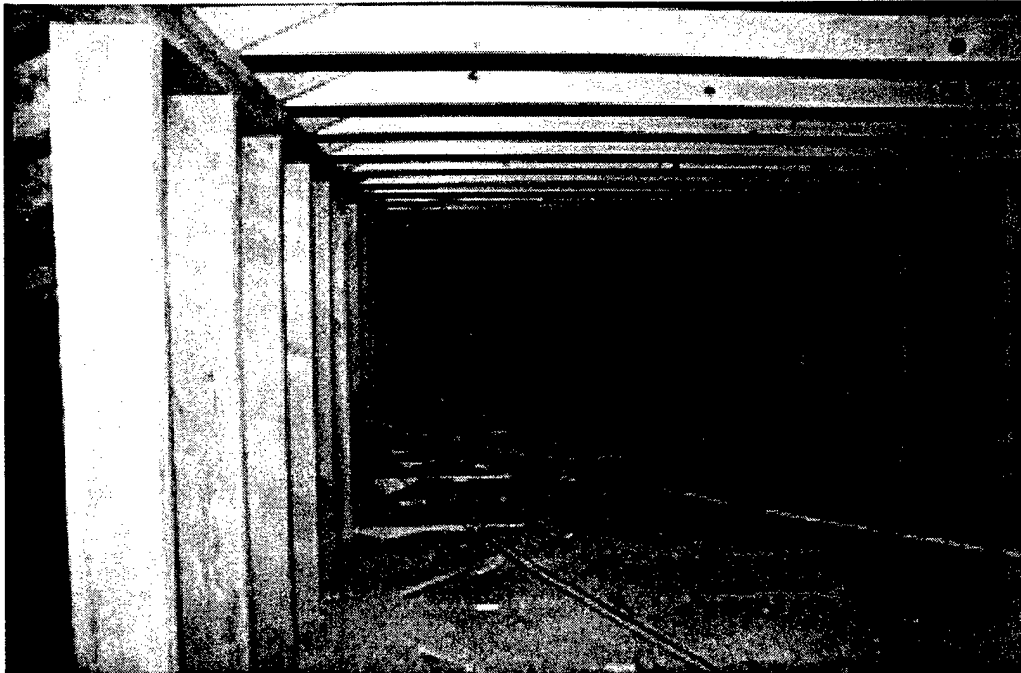


Figure 3-14. Roof framing — rafters and knee walls.

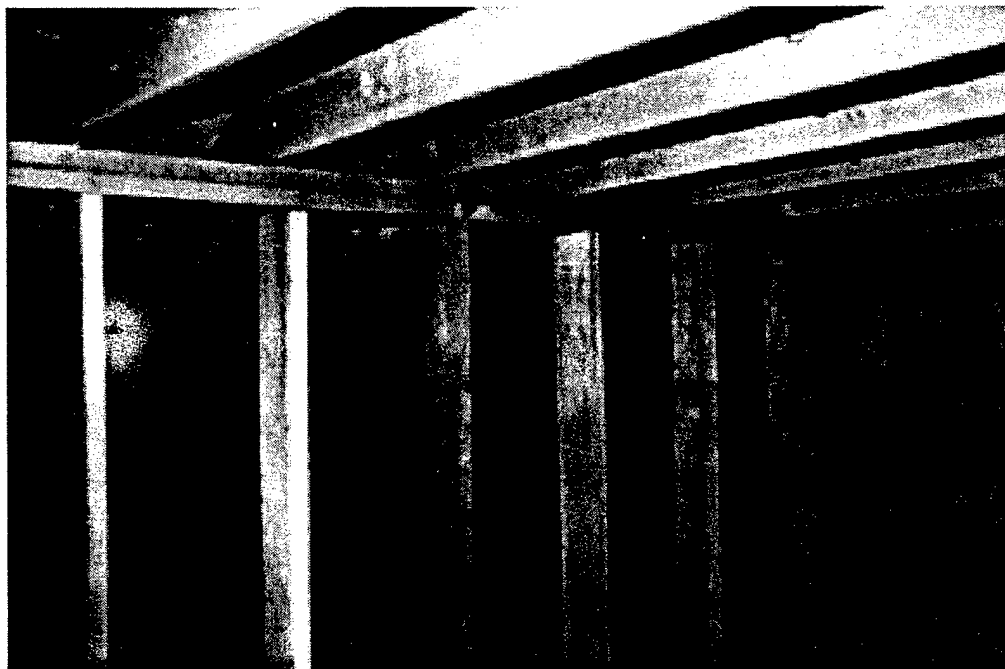


Figure 3-15. Roof framing — view of knee walls.

There were, however, a few observations of note, although none suggests any structural deficiency in the roof system. These are as follows.

Several columns in the south open ward were split vertically at approximately mid height. The largest split occurs in the first column from the south end on

the west side, and is approximately ½-in. wide and almost 3-in. deep (Point L and Figure 3-16). These splits had been patched for some time, and most appeared only as surface flaws until probed. They were filled with a gauze-like material and patched with putty or spackling compound of some sort. These splits appeared to be quite stable, as the paint that covered them was completely intact. There was no other material deterioration evident. This would suggest a problem in lumber curing rather than an overstressing of the column.

Vertical splitting had occurred at the “beam pockets” at the tops of the columns at the bolts (Figure 3-17). These pieces do not carry vertical loads, and no lateral dislocation of the beams was observed. Paint was evident within these splits, suggesting that they had been stable for quite some time.

Some minor horizontal splitting had occurred at the beams where they were bolted to the “beam pockets.” These, too, appeared stable, as paint could be seen within the splits, and no further growth of the splits was evident.

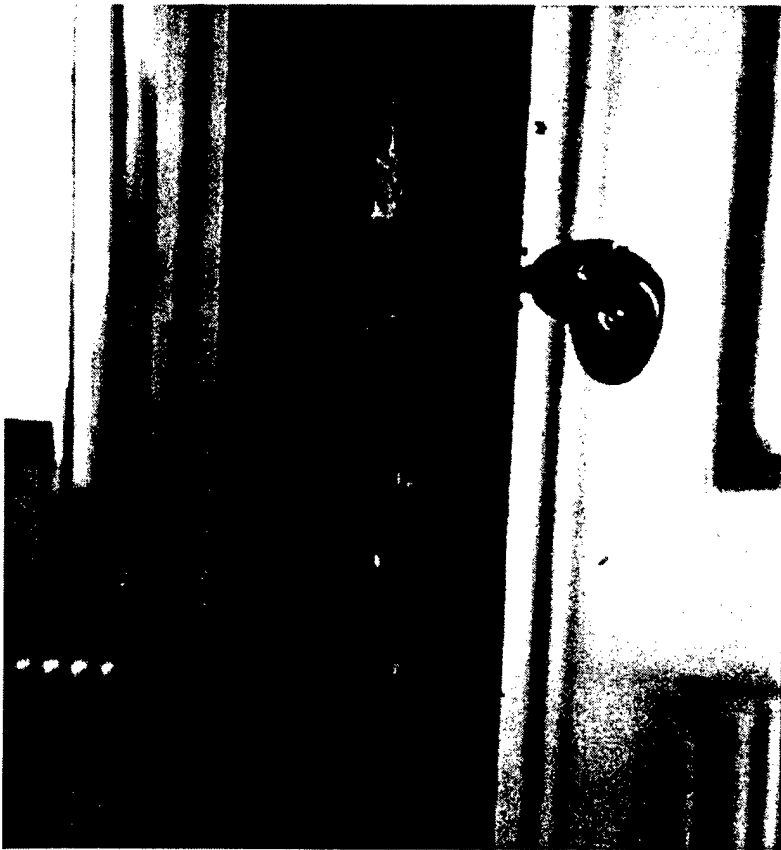


Figure 3-16. Vertical split in column.

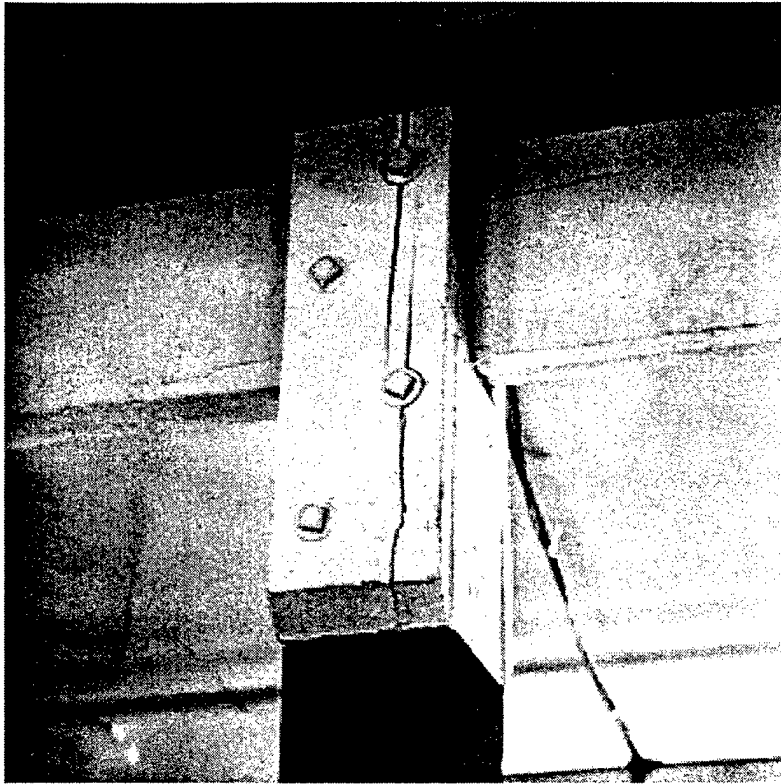


Figure 3-17. Splitting at beam pocket.

In the south open ward, the third column from the south on the west side was clearly twisted, although it was still plumb (Point M and Figure 3-18). There appeared to be no other deformations because of the twist. Again, this may be more a lumber curing problem than evidence of structural movement.

The north end of the beam on the west side of the south open ward is carried by a pilaster in the firewall (Point N). Cracking in the plaster below this beam was observed (Figure 3-19). There was a space of approximately $\frac{1}{2}$ in. under the beam, suggesting that the beam may not be bearing flush on the pilaster. Apparently this allowed the beam to settle slightly and crush the plaster finish. However, there was no other evidence of structural movement (Figure 3-20).

Ceiling cracks were observed at both open wards and both stairwell areas. Most cracking was minor, and followed the outlines of the sheet lath. No serious deflections were observed in ceiling joists above the cracked areas. However, the ceiling in the north stairwell was seriously cracked above the center window in the north endwall, and the ceiling finish is beginning to sag at this crack (Point O). Water damage was apparent. However, there appears to be no damage to the roof structure. The lintel over that window opening may have contributed to water penetration (see "Load-Bearing Exterior Walls").

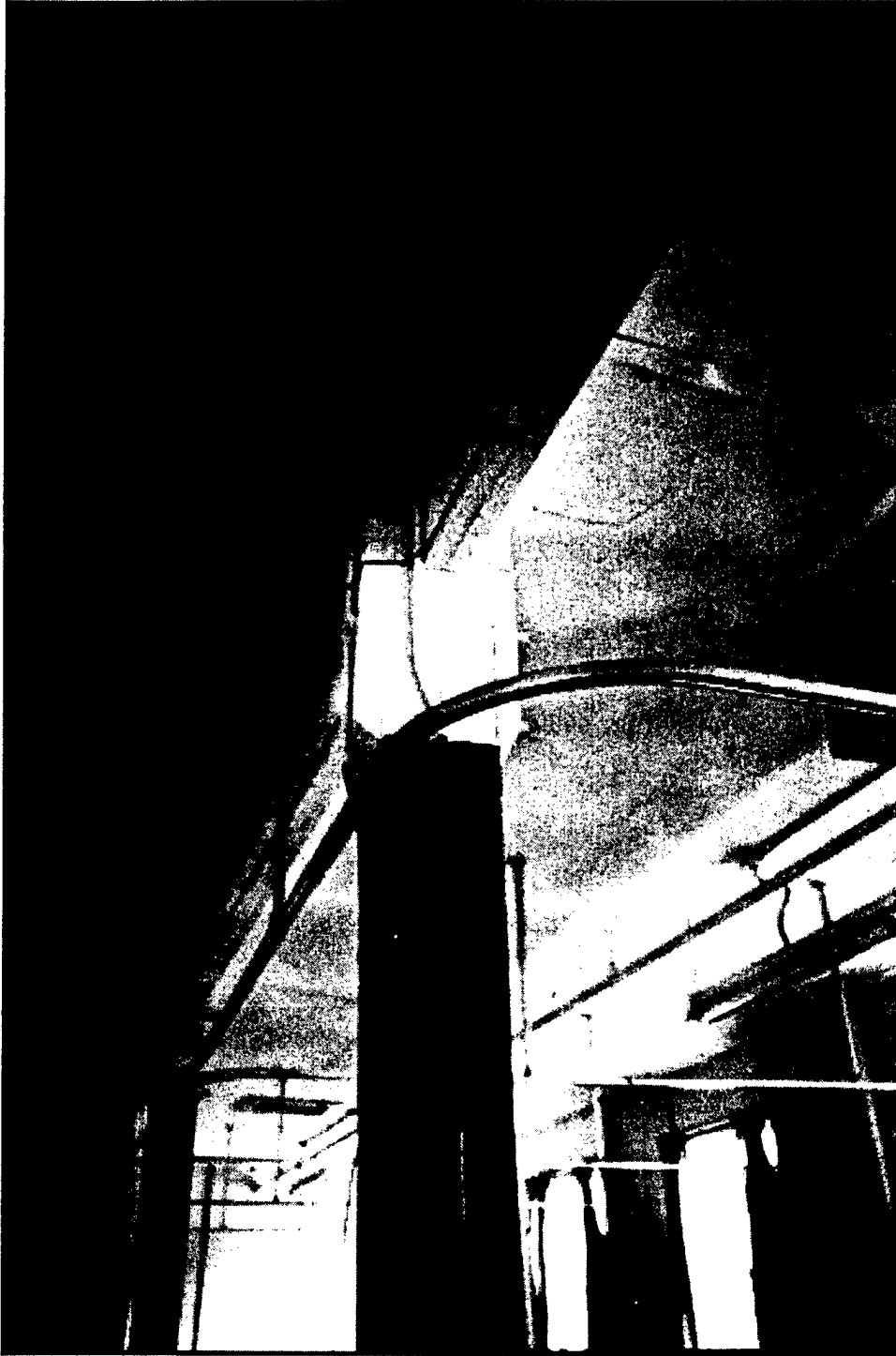


Figure 3-18. Twisted column in open ward.

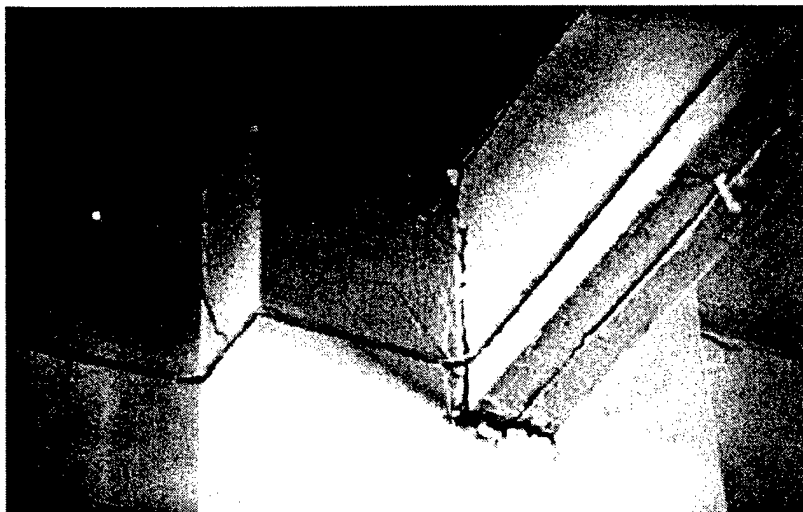


Figure 3-19. Cracking at beam/pilaster connection.



Figure 3-20. Gap below beam.

Roof Construction Fireproofing and Firestopping

Access panels were installed in the firewalls between attic bays. Doors were constructed of wood-framed panels, faced with a pressed fiber board sheet similar to Masonite. These panels were all propped open, and cables were routed through them. Other penetrations in the firewalls had been made throughout the building's life. One series of penetrations was for the sprinkler system installed in the attic space. There is a gap between the top of the masonry wall and the bottom of the roof sheathing. At the firewall separating the south open ward from the south center core, this gap was at least 2 in. (Point P). The integrity of the firewall was, therefore, compromised. The appropriate fire stopping details and sealants at penetrations must be incorporated into an adaptive reuse design.

Load-Bearing Exterior Walls

Exterior walls consisted of load-bearing cinder block, 12 in. thick at the first floor, and 8 in. thick at the second floor. Window and door openings were spanned by steel reinforced cinder block lintels. The block material was concealed by paint on Building 6237, but was exposed on Buildings 6240 and 6241, which had just been stripped.

Cracking was observed throughout the exterior cinder block walls. Cracks typically radiated from the corners of window openings, and followed the stair-step pattern of the mortar joints (Figure 3-21). Occasionally cracks would split blocks vertically. Cracks were generally minor, 1/8 in. or less, although larger gaps occurred where mortar was deteriorated or absent (Figure 3-22). Exterior walls showed no evidence of vertical displacement. Framed assemblies carried by exterior walls were found to be level. Windows could be opened and closed without binding. No signs of bowing in either a vertical or horizontal direction were observed at any exterior wall; they were straight and plumb.



Figure 3-21. Stair-step cracking.



Figure 3-22. Mortar gaps at window sills.

Rubble from the demolition of a similar OHC building was examined. There was no joint reinforcing observed in this building and it is, therefore, assumed that there is no reinforcing in Building 6237.

Serious distress was observed at some lintels. Lintels on the end walls (north and south walls) apparently had been parged several times, and were bulging noticeably (Point Q and Figure 3-23). On the west wall, first floor lintels had been replaced with concrete lintels, presumably reinforced (Figure 3-24). The second floor lintels appeared to be intact and exhibited no cracking. On the east wall, all the cinder block lintels remained, and most first floor lintels were seriously cracked (Figure 3-25). The most severely cracked was in the east wall, at the southernmost window of the former open ward (Point R and Figure 3-26). Deformation of almost an inch was seen in the interior trim at that window's head. Severe cracking has occurred in the interior wall and ceiling immediately adjacent to that window. Ceiling cracking was also observed adjacent to the center window in the south endwall. The lintel over that opening had apparently been cracked, and had been parged over. Water penetration through this lintel may have contributed to the ceiling cracking.



Figure 3-23. Parged and bulging lintel.

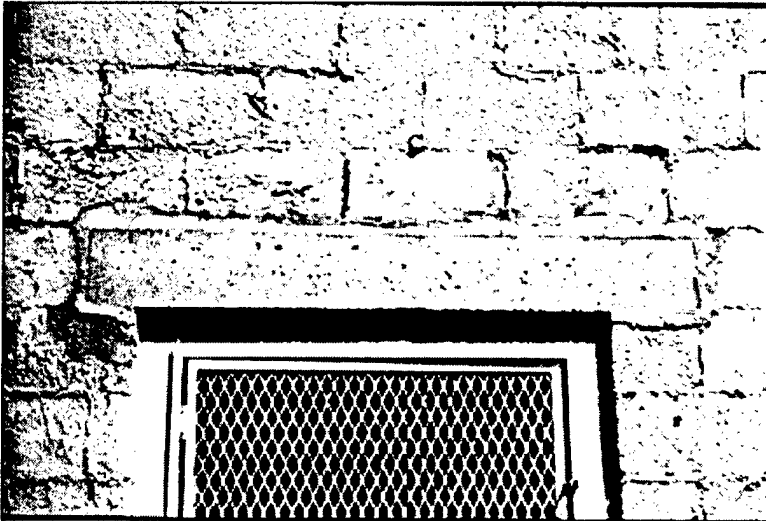


Figure 3-24. Concrete lintel replacement.



Figure 3-25. First floor lintel.



Figure 3-26. Most severe cracking at southeast window.

Cracked lintels were observed in Buildings 6240 and 6241, where the exterior paint and interior finishes were removed. It was clear that the reinforcing had become rusted, flaked, and spalled the cinder block cover, exposing the reinforcing (Figure 3-27). It is not apparent whether the cracks were originally caused by loading forces, or whether water penetration caused corrosion of the reinforcing, and weakened the lintels.

The condition of the exterior walls as a weather barrier is discussed further later in this report.



Figure 3-27. Exposed reinforcing in lintel (adjacent building).

Summary: Superstructure

With the exception of the reinforced cinder block lintels at the first floor east windows, all structural elements of the building appear to be sound and intact. No serious deflections, deformations, or other signs of structural movement or distress were observed. Structural materials appeared to be sound and intact. There was virtually no evidence of deterioration. There was no evidence of moisture or water damage to structural members. Although the load-bearing exterior masonry walls are cracked, the cracking does not indicate any sort of structural failure. Overall, the building's structural systems appear to be performing as intended.

Floor loading capacity must be considered. The floor system should be sufficient for the 50 PSF and 80 PSF distributed live loading criteria published by the Uniform Building Code and ASCE 7. The 100 PSF criteria cited by ASCE 7 may be problematic. However, DPW experience in converting OHC and other WWII vintage buildings to office occupancies indicates that floor loading should not create structural deficiencies. Load limitations must be recognized in a renovation design, and overloading by future occupants must be prevented. Sufficiency of the floor system for the intended occupancy and their functional requirements must be verified with the DPW once an adaptive reuse design is developed.

If adaptive reuse takes place, the remaining reinforced cinder block lintels would have to be replaced, at least at the first floor openings. Fire separation barriers in the attic would have to be upgraded at penetrations, gaps, and access scuttles.

Exterior Closure

All exterior closure components were examined in all locations of the building. Any occurrence of cracking, deformation, leakage, weathering, material deterioration, and other signs of distress in any wall or roof components would be noted.

Exterior Wall Construction and Skin

Observations regarding the wall system's structural performance are discussed above. The remainder of this discussion involves performance as a weather barrier.

The exterior paint will be removed regardless of the building's disposition. Therefore, no further discussion of the paint condition is necessary. The total exterior wall area of the building (not including the addition on the west side) is over 20,000 SF. This figure also includes window area. Actual painted masonry area is roughly 18,000 SF.

The masonry wall system exhibited extensive cracking, although it was generally intact. The two most serious cracks (one on the west wall and one on the east wall) are described above.

Again, structural movement does not appear to be the primary cause of cracking. If the structure is stable, the weather barrier performance of the wall can be restored by closing joints and cracks.

The integrity of the mortar joints appears to be the major problem with the masonry wall. The following can cause cracking in mortar joints, although specific cause-and-effect relationships cannot be determined simply by visual observation.

- Cracking due to shrinkage may have occurred almost immediately after construction if the mortar dehydrated (not uncommon in arid climates), or the porous texture of the cinder block absorbed too much water out of the mortar mix. Other contaminants or workmanship performance could also have contributed.
- There were no control joints in the masonry walls.
- Thermal movement may have caused cracking, especially when the building is oriented north-and-south, and the long, unbroken expanses of wall have the east and west exposures.
- Cracking can also result if the mortar is harder than the block. Without material analysis, however, this is only speculation.

Window sills were constructed as soldier courses of cinder bricks. At several sills, gaps were observed between the ends of the soldier course and adjacent block. These gaps were wider than the standard 3/8-in. mortar joint, suggesting that the window opening may have been slightly wider than designed, or the soldier course was slightly compressed while it was being laid. In either case, joints at one end of several sills were considerably wider than they should have been, necessitating a greater volume of mortar. The mortar appears to have shrunk away from the block, opening the joint to moisture damage (Figure 3-28).

Examples of outstanding masonry workmanship and material integrity were seen in Buildings 6240 and 6241, where the exterior paint and interior finishes were stripped away. Examples of similar cracking problems were also observed in these buildings. This would suggest that performance could have varied crew-to-crew, building-to-building, or even within a building.

Regardless of the cause, it is evident that extensive repointing and painting is necessary to restore weather resistance integrity. Whether the entire wall surface must be repointed, or whether there may be areas where mortar is intact can be evaluated when the old paint is removed. There is approximately 18,000 SF of exterior masonry surface. If the structure is stable, recurrence of cracking is not imminent. Consideration must be given to mortar, sealant, and paint materials and their compatibility with the type of block used for these buildings. Consideration must also be given to providing some measure of stress relief in the exterior walls to accommodate thermal movement and minor structural movements.



Figure 3-28. Shrunken mortar.

Exterior Wall Vapor Retarder and Insulation

The interior of the exterior wall construction was not observable in Building 6237. However, the rubble of the demolished similar building contained no wall insulation or vapor retardant membrane. Therefore, it is assumed that there is no wall insulation or vapor retarder in Building 6237.

During the inspection, it was not possible to inspect for condensation under typical occupancy conditions. The absence of occupants and moisture-generating activities, low ambient humidity, and steam radiators heating full time would prevent any condensation under present conditions.

If renovation is to occur, the potential for condensation on the interior surfaces of exterior walls must be considered. The most critical avenue for heat loss is typically the roof assembly. However, considering the building's proportions and exterior wall surface, the heat loss through the walls may be problematic. The advisability of insulating the exterior walls must be determined as part of the adaptive reuse design process. If the exterior walls are not insulated, the potential for condensation must be taken into account in the design and performance of the ventilation system. If insulation will be added to the exterior walls, it will presumably be applied to the interior of the exterior walls. In that case, the location of the dew point within the wall construction must be determined. Condensation within the insulation must be avoided. Any condensation occurring within the wall construction must be given an avenue to vent out. The existing radiant heat would be beneficial from the perspective of controlling moisture.

One of the few architecturally defining features of the building is the panels between first and second floor windows at the stairwells. They are presently covered in vinyl siding. However, wood clapboard siding is present in similar buildings in the complex. This siding is framed into openings (similar to window framing) in the masonry wall (Point S and Figure 3-29). The vinyl would have to be removed and the original clapboard siding restored or replaced with a historically correct profile.

Exterior Soffits

Soffits and rake trim are simple dimension lumber and crown molding. If the building is to be renovated to its original appearance, it is assumed these items would be replaced. They were not inspected up close or physically probed. The overhang at the eaves is 6 inches. The rake trim at the gable is applied directly to the masonry end wall. The soffit and fascia boards were observed from the ground, and from the roof of the addition on the west side of the building.



Figure 3-29. Original clapboard siding in stairwells.

The eave trim appears to be generally intact throughout the main portion of the building. The paint is generally intact. Warping and shrinkage are evident. Warping generally has only opened up gaps in the eave trim (evidenced by daylight visible from the attic spaces), although one fascia board on the west side is severely warped (Point T and Figure 3-30). It is apparent this is caused by the lumber drying out, as opposed to structural movement.

The eave trim at the porches appears to be in much worse condition (Point U and Figure 3-31). Peeling and discoloration of the paint are evident from the ground. As the roofs over the porches are nominally flat, roof leakage is more likely to occur. As the roof structure has been enclosed by ceilings, venting is less likely to occur. If renovated, upgrading roof drainage details at the porches will be critical. Keeping the roof and floor structures open at the porches is recommended, at least from the perspective of managing moisture.



Figure 3-30. Warped fascia board.

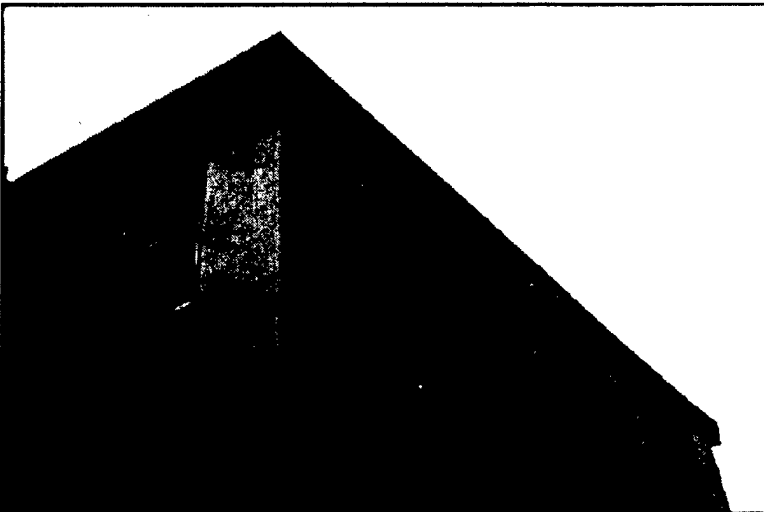


Figure 3-31. Deteriorating trim.

Exterior Windows and Exterior Doors

The windows on the two porches on the east sides of the building are currently double-hung wood with six-over-six sashes. Although they are not part of the original design, they appear to be quite old, possibly having been relocated from elsewhere in the building or the OHC. These windows would be removed if the porches are restored to their original open design.

All other windows had been replaced in the late 1980s with aluminum double-hung windows. If the building is restored or renovated, these will be replaced with historically appropriate windows. Therefore, no further discussion of the windows' condition is necessary.

The window openings appear to have remained square and true. The majority of the windows were opened during the inspection, and could be raised and lowered without binding. The window assemblies appear to be water tight, as no major water damage at window sills or around window openings was evident. The condition of the reinforced cinder block lintels at the window heads is discussed above.

All three exterior doors are nonoriginal, and will likely be replaced during renovation. Similar to the window openings, there was no evidence of leakage or distortion at the door/wall interface. Cracking in the masonry at the central (west) entrance door did not distort that door's opening or interfere with its swing or closure.

Exterior Louvers, Grills, and Screens

Steel grills were installed in the exterior wall above the foundation to ventilate the crawl space. They were spaced at approximately 26 ft in the east and west walls, and two were installed in each end wall. They were approximately 8 X 16 in. and were framed into the masonry as the block was being laid. All of the original grates have been removed, most by cutting the grate away from the frame. The frames remain in the masonry. Plywood covers have been nailed onto the walls over the openings, presumably to reduce cold air flow below the first floor. The grills would have to be replaced with historically appropriate versions. Removing the existing frames from the masonry, or working with them in place, may be somewhat problematic. Consideration should also be given to installing operable vents that can be closed in winter.

A louver was installed for the AHU in the southeast corner of the building. If renovation is to occur, this would be replaced with the historically correct window detailing.

Roof Vapor Retarder and Insulation

It is assumed that there is no vapor retarder installed at the ceiling of Building 6237. No vapor retarding material was observed in Buildings 6240 and 6241, or others in the vicinity that were demolished or being prepared for demolition.

Gable end vents were installed in the end walls at the ridge. Two dormer-type attic vents had been installed within each bay between fire walls, one on each side of the roof. While venting at the eaves was apparently not designed into the roof structure, daylight along the eaves was observed throughout the attic spaces.

Nominally 8 in. of blown-in fibrous insulation had been installed in the ceiling. This achieves an insulating value of approximately R-20. If renovation is to occur, insulation would have to be upgraded; R-38 is recommended.

There were no signs that mildew or moisture accumulation were ever a problem within the attic spaces. The arid climate prevented moisture problems. If renovation is to occur, consideration must be given to future occupancy types, upgraded ceiling insulation, the likelihood of moisture migrating through the ceiling, location of the dewpoint within the roof/ceiling assembly, and preserving the existing vent performance. While infiltration at the eaves is fugitive at present, eave venting should be considered in renovation.

Roof Shingles

Roofing consists of light gray interlocking asphalt shingles. It is assumed that renovation will involve replacing the roofing system. Roofing was observed from the ground. No closer inspection was performed.

The roofing appeared to be relatively new and generally in very good condition. There were no detached shingles. No shingles were curled at their corners. Rows of shingles were aligned; no distortion in the weathering surface was observed. There was no observable difference in condition between the east and west sides of the building.

Asphalt impregnated roofing paper was visible from the attic between spaces in the roof sheathing boards. The paper appeared to still be pliable, and no brittleness or cracking was detected.

There was evidence that roofing deterioration and leakage had occurred in the past, after the ceiling insulation was installed. In the south open ward and south center core of the attic crumbled red shingles and roofing paper appeared in lines atop the insulation, corresponding with the spaces between the roof sheathing boards (Point V).

Roofing Flashing and Sheet Metal

Very little flashing or sheet metal work was seen in the roofing system. Again, it is assumed that these items will be replaced during a renovation.

No edge trim for roof sheathing was seen at the eaves or gable ends.

The roof vents were flashed at their bottom edges. From the attic spaces, the galvanized steel flashing appeared to be intact.

There were no gutters and downspouts; it is assumed they were not part of the building's original design. The major adverse consequence of allowing runoff to fall directly to the ground is that it erodes the grade immediately adjacent to the foundation. This issue is discussed below.

Roof Specialties

Triangular wood louver vents were installed dormer-style in the roof, two within each attic bay. The rough openings framed into the roof structure were sound and intact. The majority of the wood vent frames exhibited warping and shrinking away from the rough openings. Although water stained, no wood material showed any evidence of deterioration, even when probed vigorously.

Summary, Exterior Closure

The exterior closure systems are generally intact. No evidence of leakage was observed. The exterior wall was cracked throughout, mostly at the mortar joints. However, no other deformation was observed, and the cracking appears not to be structural. Exterior wall paint is seriously deteriorated. The roofing system appears to be quite sound and no evidence of failure was observed. Doors and windows appeared to maintain their weather barrier performance, although these would have to be replaced during a renovation.

All exterior paint will be removed regardless of the building's disposition. If renovation is to take place, a significant portion of the exterior wall area will have to be repointed, and exterior walls must be painted. Whether repointing the entire wall area is required, or whether selective repointing is feasible, must be determined after the paint is removed. Consideration must be given to the selection of mortar, sealant, and paint materials. Once the exterior surface is restored, the wall system should remain serviceable.

The existing roofing is not new, although it appears to be intact and serviceable. It is common to replace the roof as part of a renovation, so it is assumed this will be the case for Building 6237, regardless of the roof's present condition.

The thermal performance of the building envelope and potential for condensation must be considered during the renovation design. Heating and ventilation criteria would have to address whether insulation and vapor retarders can be up-

graded or not. Heat gain, thermal transmission, and condensation factor must be considered when selecting glazing materials.

DPW personnel indicate that fire resistiveness of the exterior wall system should not be an issue due to the separation between buildings, as they currently exist. It is assumed that after demolition of the adjacent OHC buildings, the appropriate separation will be maintained in planning and design of adjacent buildings.

Interior Construction

Whether the existing condition of interior systems is relevant or not depends largely on future occupants' requirements for the building and the design for the adaptive reuse or renovation. However, as these issues have not yet been resolved, it is premature to conduct a comprehensive survey of all interior spaces and components. Therefore, the original design is used as a "benchmark" for observation and discussing these systems' condition.

Observations of interior systems were approached in a much more general manner than for the structural and closure systems. Interior systems were visually examined using a spot-check method, not a comprehensive method. It is assumed that applied finishes that have accumulated over the years (such as wall coverings, flooring, paneling, etc.) would be removed during renovation. Only finished surfaces or substrate that may possibly be relevant to an adaptive reuse or renovation design were examined. Level and plumb were checked at various locations. Any significant cracking, warping, distortion, damage, or other signs of distress were noted, where such occurrences were common or where they suggest a systemic problem. Isolated occurrences were not noted.

Flooring

The vast majority of finish flooring is resilient flooring material of several types. There is some carpeting on the second floor. It is assumed that all flooring will be replaced during an adaptive reuse or renovation. There is approximately 20,500 SF of finished flooring in the building (see note below). It is assumed that there are at least two layers of flooring and two layers of underlayment throughout the building, although three layers were observed in some places.

Hardwood flooring was also observed in some group bathrooms where finish flooring layers had peeled away. The National Park Service report on the OHC references hardwood floors in many buildings within the complex. It is assumed that, if hardwood flooring does exist, it will remain in-place. If adaptive reuse or

renovation takes place, flooring materials would be selected based on their historic appropriateness and responsiveness to future occupants' requirements. It is also assumed that, if hardwood flooring exists in the group bathroom areas, it would require replacement with a subflooring material of equal thickness prior to installing a finish floor. There is approximately 1,200 SF of group bathroom space.

ENSR's asbestos survey indicates there is 12 SF of asbestos-containing flooring material in one room on the first floor, at the west side of the south center core area.*

Base

The original base material is wood, and consists of 1-in. board with moldings. Several coats of paint were evident. In some areas rubber base molding was applied over the wood base. The original base is present in the stairwells, the open wards, much of the hallways, and many of the rooms in both the core areas and added partitions in the former open wards on the first floor. No measurements were made, but at least half of the original base remains intact. The base is in generally good condition, is not significantly damaged, and remains firmly attached.

It is uncertain at this time whether the base can be kept or not. Replacing the flooring will require removal of at least the shoe molding. If wainscots or wall surfaces must be replaced, the entire base would have to be removed. It is questionable that base materials will be in suitable condition to be reinstalled once they are removed. If not and in consultation with the SHPO the base mold would have to be replaced with an historically correct profile.

Partition Construction

Partition construction is concealed in Building 6237, although reasonable assumptions can be made by examining holes in the partitions. Partition framing, however, is observable in Buildings 6240 and 6241. Original partitions (in the central core areas) are constructed of 2 X 4 stud walls. Sheet lath is nailed to the

* Exterior dimensions of the building plan were used in calculating floor area. The actual area of finish flooring (i.e., net building area) will be less. The porches on the east side of the building were included in this figure, although the one-story addition on the west side was not. ENSR's asbestos survey indicates the building area is approximately 22,360 SF. Apparently, this does include the one-story addition.

studs, over which a finished coat of plaster is laid. It was not possible to determine whether any other materials were used in partition construction. Approximately 230 linear feet (LF) of original wood framed partitioning form the center core areas of each floor, or approximately 4,800 SF of partitions in total. This figure does NOT include the load-bearing walls in the corridors, or the lateral masonry firewalls.

In general, the original partition construction (i.e., framing), both on the first and second floors, appears to be quite sound. Partitions were generally plumb and did not exhibit excessive bulging or distortion. No lateral displacement was observed at the floor or ceiling. If adaptive reuse or renovation is to take place, the original partition construction should remain serviceable, pending the spatial requirements of future occupants.

Wall Finishes

Original partition and wall finishes are painted plaster. Sheet lath is nailed to studs in framed walls, and a plaster finish coat is laid over the sheet lath. Masonry exterior walls and firewalls are plastered. Sheet lath is furred to the masonry, onto which a plaster finish coat is laid.

In various locations, vinyl wall covering and paneling have been added, although these will likely be removed during a renovation. A 4-ft wainscot is installed in the center lateral hallways on both floors, in places in the longitudinal hallways on both floors, and in the stairwells at both ends of the building. The wainscot is a pressed fiberboard similar to Masonite and has been painted. This wainscot appears in some of the center core rooms, and not in others. A laminate finish similar to Marlite is applied to the small private bathrooms in the center core areas of the building, and the group bathroom areas.

The plaster wall finish in the core areas, both within the rooms and in the hallways, appears to be in overall sound condition. However, there are numerous cracks and defects, most of which appear to be cosmetic. Damage from attached items and penetrations has also occurred throughout these areas. Damage appears behind radiators, where constant heating has spalled the finish coat away from the sheet lath (Figure 3-32). This damage occurs at almost every radiator, and there is at least one radiator in each room. In some places, plywood or Masonite boards have been nailed to the wall behind the radiator.

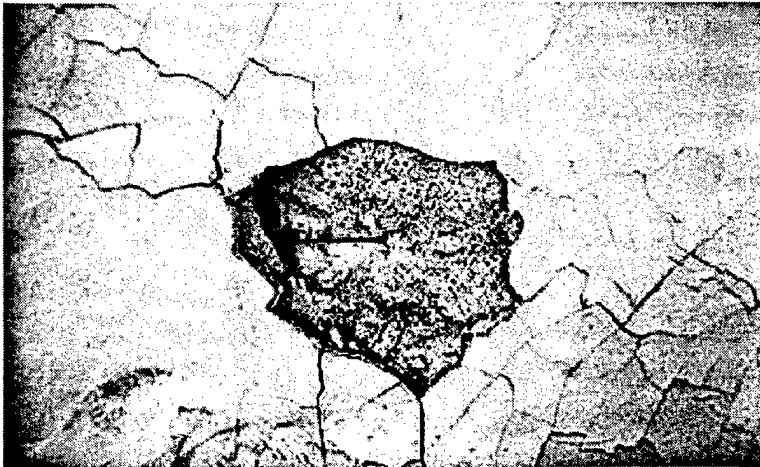


Figure 3-32. Spalled plaster behind radiators.

The plaster wall finish in the open wards on the second floor generally appears to be in sound condition, with the exception of areas behind radiators, which are located at each window. Cosmetic cracking appears, usually around window corners, and there is damage from attachments and penetrations throughout these spaces as well.

The plaster wall finish in the stairwells generally appears to be sound, again with the exception of the damage behind radiators. A crack in the firewall separating the north stairwell from the former open ward at the first floor may be problematic, as may the cracking at the exterior wall of the center stairwell (refer to Points K and J, respectively). While the structure is stable overall, stability at these locations should be verified during renovation.

Removing partitions from the former open wards and porches on the first floor is likely to damage the finish on the interiors of the exterior walls extensively. There are more than 20 floor-to-ceiling intersections of these partitions with the original wall surfaces. Removing the wall surface and lead lining from two X-ray rooms at the former north open ward will likely destroy the original plaster surfaces. The crack at the southeast corner of the former south open ward may also be problematic (refer to Point I and Figure 3-10).

If adaptive reuse is to occur, the interior wall finishes within the porches on the east side of the building, roughly 1,200 SF, would have to be removed. It is assumed that the original finished surface is painted masonry.

Overall, it appears that repairing existing plaster in the center core areas, hallways, and stairwells would be possible (see below regarding ACBM). As previously discussed, the structure appears to be stable, so recurring cracking is not necessarily imminent. The feasibility of repairing existing plaster finishes in the

former open wards on the first floor is doubtful, especially if these areas may be reconfigured for a future occupant. If adaptive reuse is to occur, removing and replacing wall finishes in these areas may be the only practical solution.

If the steam heating system remains as part of the adaptive reuse design, precautions should be taken to prevent future plaster damage at radiators. Consideration should also be given to incorporating control joints or other stress relief measures in plaster surfaces to reduce future cracking.

The laminated finishes in the private bathrooms remain generally in good condition. The laminated finishes in the group bathrooms are heavily damaged from moisture and physical damage. Where it remains, the pressed fiberboard wainscot is in reasonably good condition.

Future occupants must be considered when evaluating space division, plumbing, electrical distribution, communications, and other building services that are typically accommodated within interior walls. Removal of abandoned services and installation of new services may disturb a considerable area of existing wall finish. Maintaining access to building services for future expansion or upgrade must also be considered.

The sheet lath is an ACBM; appropriate protective measures for construction activities must be provided. The sheet lath can remain in place, but the extent to which it will be repaired, or disturbed by reconfiguring the spatial arrangement and upgrading building services, is yet to be determined.

Once these issues are resolved, cost estimates must be developed. The most economical option can then be identified. Therefore, any discussion of interior wall finish condition must be treated as preliminary at this time.

Interior Windows and Doors

One interior window (nurses' station) was located in each open ward at the fire-wall, four in total. If this configuration were to be restored, any infill would have to be removed and historically appropriate windows or frames reinstalled.

A significant number of the interior doors in the core areas of the building appeared to be either original or of similar vintage; perhaps half or more. Hardware sets were generally not original. Doors, frames, and hardware would require repair and refinishing in most cases.

Most of the fire doors in the central corridors appeared to be replacements. If restoration takes place, the fire doors and frames would have to be replaced with assemblies conforming to fire separation, closure, and egress requirements, and as appropriate for historic renovation purposes.

The door between the first floor corridor and access to the hot water tank and crawl space was missing (Point W). A detached door was present in the hallway, although it was not verified whether this is the matching door or not. The door frame would have to be repaired.

Ceiling Finishes

Ceilings are painted plaster, similar to the wall finishes. Sheet lath is nailed to floor or ceiling joists, onto which a plaster finish coat is laid.

Ceiling finishes were generally intact in the corridor and rooms in the core areas of the building, on both first and second floors. Cracking was evident throughout, although it appears to be generally cosmetic. In addition to light fixtures, there are penetrations throughout the ceiling surfaces, such as steam pipes, sprinkler pipe hangars, and assorted other utilities and building services. The 4-in. sanitary drainage piping from the second floor group bathrooms penetrates ceilings on the first floor below.

Cracking appears throughout the former open wards on the first floor, although it appears to be cosmetic with one exception. As previously discussed, a serious crack appears in the ceiling of the bathroom addition in the southeast corner of the former south open ward (refer to Point I). In addition to ceiling fixtures, penetrations and attached items appear throughout, most notably sprinkler pipe hangars. A heating, ventilating, and air conditioning (HVAC) duct is suspended from the ceiling in the former south open ward, continuing into the south central core corridor.

Removing the partitioning in the former first floor open wards will likely create considerable damage to the ceiling. There is roughly 600 LF of partition to be removed, and it is distributed throughout these areas.

The plaster finish in the second floor open ward ceilings appears generally to be sound. Cracking occurs throughout, mostly around the attic scuttles, and conforms to the sheet lath outline. Here, too, the cracking appears to be cosmetic, as the ceiling and roof structures appear to be stable. Sheet lath is not detaching from the ceiling joists. Again, there are penetrations and attached items throughout, most notably sprinkler pipe hangars and privacy curtain tracks.

The plaster finish in the stairwell ceilings appears generally to be sound. Some cracking appears. Cracking appears around the vertical steam pipe penetrating through the first floor ceilings in both stairwells. Cracking mostly conforms to the sheet lath outline and appears to be cosmetic with one exception. A serious ceiling crack appears over the middle window at the second floor ceiling of the north stairwell (Point X). The sheet lath is separating from the ceiling framing slightly. As previously discussed, water penetration may be a contributor to this damage.

If the porches on the east side of the building are to be restored to their original open configuration, ceiling finishes (approximately 1,900 SF) would have to be removed.

Overall, it appears that repairing existing ceilings in the center core areas, hallways, and stairwells would be possible (see below regarding ACBM). As previously discussed, the structure appears to be stable, so recurring cracking is not necessarily imminent. The feasibility of repairing existing plaster finishes in the former open wards on the first floor is doubtful, especially if these areas may be reconfigured for a future occupant. If restoration is to occur, removing and replacing ceiling finishes in these areas may be the only practical solution.

If the steam heating system remains as part of the adaptive reuse design, precautions should be taken to prevent future plaster damage where steam pipes penetrate ceilings. Consideration should also be given to incorporating control joints or other stress relief detailing in the open ward ceilings, if they are to remain open spaces.

As the sheet lath is an ACBM, the ability to retain existing finishes must be verified, and the appropriate protective measures for construction activities must be determined. If this material must be removed from the building, the discussion of repairing ceiling finishes is moot. ENSR's asbestos survey estimates that approximately 14,000 SF of ceiling finish would have to be removed.

Furthermore, consideration must be given to the requirements of space division for future occupants, electrical distribution, communications, and other building services that are typically accommodated through ceilings and interstitial spaces. Removing abandoned services and installing new services may disturb a considerable area of existing ceiling finish. Maintaining access for future power, lighting, electronics, and communications cable management must also be considered. Once these issues are resolved, cost estimates can be developed. The most economical option can then be identified. Therefore, any discussion of the condition of ceiling finishes must be treated as preliminary at this time.

Summary: Interior Construction

Discussing the condition of interior construction systems is largely speculative without resolving the space and design requirements of the future occupants. Referring to the original design, however, can be a useful point of departure in considering the potential for adaptive reuse or restoration.

It is assumed that the partitioning added to the first floor open wards will have to be removed during an adaptive reuse or restoration. The original partition construction appears to be generally sound and intact. No serious deflections or deformations in nonload-bearing elements were observed. The basic framing itself ought to remain serviceable, where the existing spatial configuration is compatible with future occupants' space requirements.

Flooring finishes would have to be removed and replaced throughout the building.

Wall and ceiling finishes in the center core areas, stairwells, and second floor open wards are generally sound and intact, although cracking is evident throughout these areas. However, the cracking does not appear to be caused by structural movement, so continued cracking is not necessarily imminent. Penetrations such as plumbing, sprinkler hangers, and fixtures also deface the finish. There are few instances of physical damage, and they are not extensive. Heat damage on walls behind radiators is widespread. Paneling and vinyl wall covering appear in some areas, and it is assumed they would be removed in a renovation.

Removing existing partitions in the former first floor open wards is likely to damage wall and ceiling finishes significantly. While repairing these finishes may be possible, it may be more practical to remove them and refinish these spaces.

With the possible exception of the former first floor open wards, repairing interior walls and ceilings would certainly be possible. Whether it is actually feasible to retain and repair the existing construction, or to remove and reconstruct, must still be determined. In order to do so, the following must be considered.

- Whether or not the existing sheet lath, which is an ACBM, can be retained, or whether it must be removed regardless of the finishes' condition.
- Compatibility of the existing (original) space configuration with future occupants' functional and space requirements.
- Accommodation of building services. Provision of electrical power, lighting systems, electronics, and communication systems will have a significant ef-

fect on the wall and ceiling systems' construction, as will requirements for access to these components and flexibility to adapt throughout the building's service life.

Once these issues are resolved, specific quantities of work can be determined, costs estimated, and cost comparisons made to identify the most economically viable solution.

A significant number of original (or similar to original) interior doors remain in the building. However, virtually all doors and frames will require some repair, upgraded hardware, and refinishing. While a significant amount of original base remains, its useability will depend on whether or not it will have to be removed during a renovation.

The building should be able to accommodate fire safety requirements. According to DPW personnel, a 1-hour fire resistance is required for the interior corridor walls. The interior construction should provide this performance. Where the plaster finish may be removed, fire resistant gypsum board can also provide the required 1-hour fire resistance, when applied according to the Uniform Building Code (UBC). The required exit passage widths and distances, fire resistance, and stairway construction can be accomplished within the existing configuration. Provisions for the required exit signage, illumination, railings, hardware, and other fire safety requirements must be incorporated into the renovation design.

Building Services

Because the emphasis of this assessment is on the basic integrity of the building, only a cursory observation of building services was performed. If renovation is to take place, it is anticipated that building services would require substantial upgrading. The following observations are made in the context of describing potential opportunities or problems for renovation.

Plumbing

Water service has been discontinued, so the plumbing systems' performance could not be observed.

The original design includes the following water supply, fixture rough-ins, and drain/waste/vent (DWV) systems, which remain in place:

- Four group bathrooms (two on each floor), each consisting of three toilets, one urinal, four lavatories, and two showers (one of which was formerly a bathtub). All fixtures remain in place (Figure 3-33).
- Four lavatory rooms (two on each floor), each consisting of one bidet and one lavatory. Some bidet fixtures remain in place (Figure 3-34).
- Six private patient rooms (three on each floor), each having one toilet and one lavatory. Toilets and some lavatory fixtures remain in place (Figure 3-35).
- Four service closets (two on each floor), each having one janitor's sink, which remain in place (Figure 3-36).

Assuming the supply and DWV systems are intact, it appears that the group bathroom facilities could certainly be upgraded and made serviceable for future occupants. More sanitary fixtures and lavatories are in place than would be required for an occupancy of up to 300 employees (assuming equal numbers of men and women). Replacing fixtures, adapting for men's and woman's facilities, and upgrading specialties (such as toilet partitions, counters, etc.) should be straightforward. If the 4-in. cast iron DWV pipe visible from the first floor is typical of each group bathroom, piping should be sufficient for the fixture count.

The DWV piping for the group bathrooms on the second floor intrudes into first floor spaces. Assuming this system is intact and performs as intended, the only problem this may create for a renovation is aesthetic.

Numerous additional sinks and lavatories have been added since the building's original occupancy, mostly in the former open wards on the first floor. An additional shower and lavatory room was added in the former south open ward on the first floor. Removing the fixtures, supply piping, and DWV should be straightforward, as it is accessible from the crawl space.

Domestic hot water is heated by a central tank located adjacent to the center stairway. It is heated from the central steam plant. Even if this water heater is still operable, it is questionable that a large-capacity central water heater is an appropriate method for providing domestic hot water. Locating smaller water heaters with restroom facilities may provide a more efficient solution.



Figure 3-33. Group bathroom.

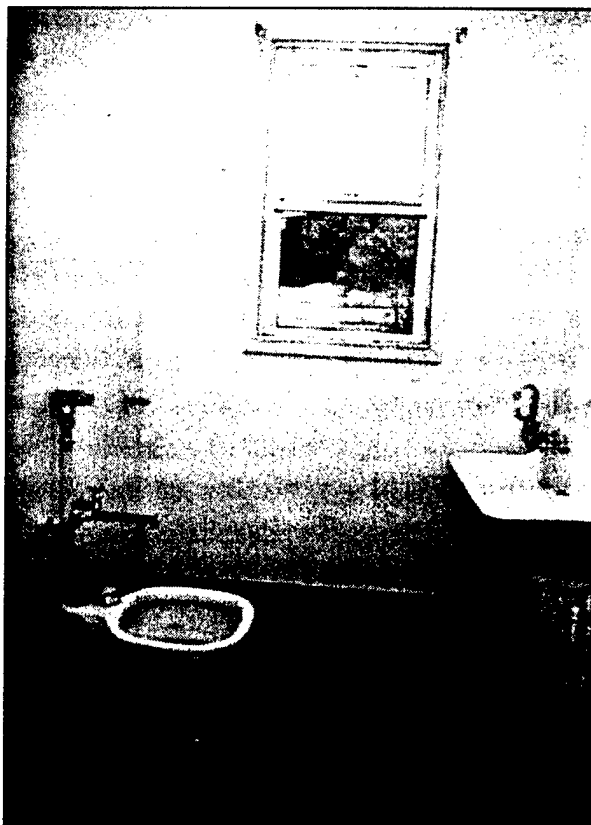


Figure 3-34. Lavatory room.

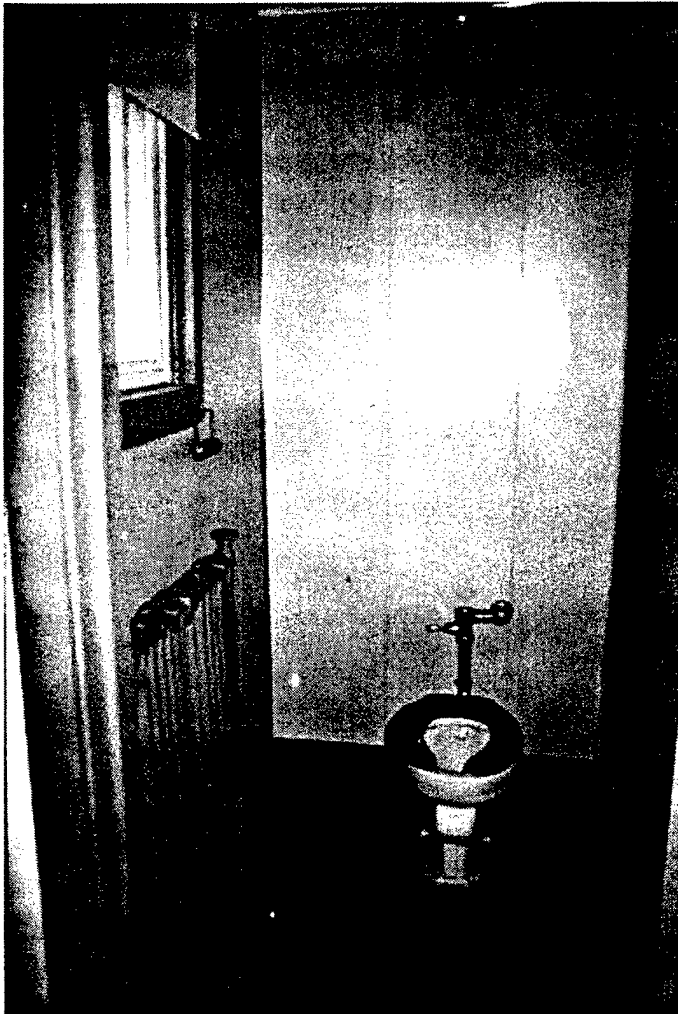


Figure 3-35. Private bathroom.

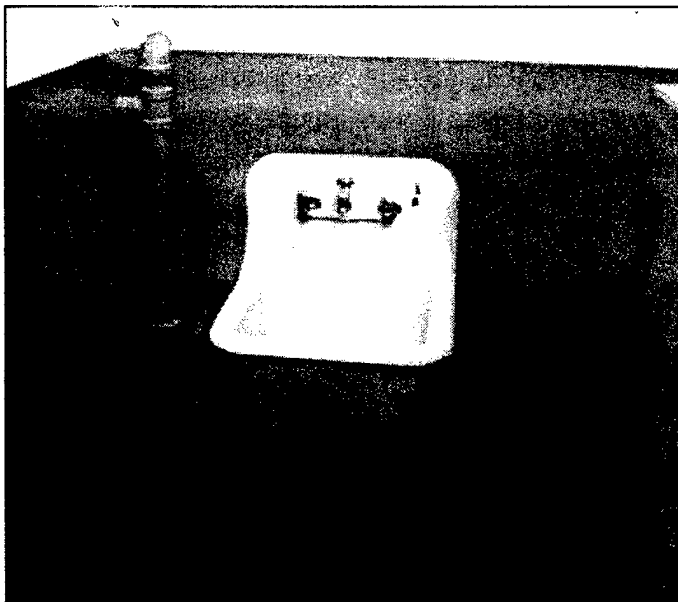


Figure 3-36. Service closet.

HVAC

Most of the steam radiators remain in place. Radiators were heating in all areas of the building. However, it was reported that the steam distribution system is not controllable, as valves have been removed or modified to be permanently "open." If the existing steam heat system will be retained in a renovation, controls at the building, branches or zones (if so configured), and at the individual radiators will have to be repaired or upgraded.

Alternative approaches to heating and cooling should also be explored. Placing forced air handling units in attic and crawl spaces may be feasible. Zoning the east and west sides of the building separately also should be considered.

There is no mechanical ventilation for the building. There is no mechanical cooling for the building. It is assumed that the added air conditioning compressor/condenser and air handling unit will be removed in a renovation.

Fire Suppression

The performance of the sprinkler system was not verified. However, the inspection log at the control valve located on the first floor indicates that regular inspections are still being conducted. The sprinkler system's condition would have to be verified as part of the renovation design.

Electrical Distribution, Lighting

No assessment was made of the electrical systems. Electrical service is still live for the light fixtures.

Summary: Building Services

An assessment of the building services will have to be performed to determine their suitability for a renovation design. Costs involved with upgrading these systems can then be estimated, and economically viable alternatives can be determined.

Assuming water supply and DWV systems are serviceable, there is ample capacity for future occupants' sanitary fixture and lavatory requirements.

While the steam heat system is operational, its performance must be verified. Control must be restored to distribution to and within the building in order for it to remain viable.

Alternatives for HVAC and domestic hot water supply may provide more efficient and better performing solutions for future occupants.

Site

Site work was not within the scope of this condition assessment. However, runoff drainage at the building perimeter is of concern relative to the building's condition and performance. At the west side of the building, the site slopes west-to-east. Runoff will drain toward the foundation. Furthermore, erosion from runoff falling directly off of the roof has created trenches along the east and west walls at the foundation. The concrete stoops at the entries on the north and south stairwells were flush with the thresholds, and appeared to provide little drainage away from the door openings.

If renovation is to take place, site grading and paving must ensure drainage away from the foundation. A durable apron or landscape material should also protect the grade around the perimeter from erosion caused by roof runoff.

4 Conclusions and Recommendations

Any renovation work will have to be coordinated with the Colorado State Historic Preservation Office, according to the National Historic Preservation Act, the Secretary of the Interior's Standards and Guidelines for Rehabilitation, and the Fort Carson Memorandum of Agreement. The extent to which interior and exterior features will have to be restored to their original design, or the extent to which they may be altered and upgraded to meet future occupants' requirements must still be determined. Therefore the following conclusions are offered with the caveat that design requirements and renovation opportunities are subject to change.

Building 6237 is in generally sound condition. The only significant deterioration occurs in architectural systems and finishes that would commonly be replaced during an adaptive reuse or restoration.

Foundation and structural systems appear to be sound and intact, and performing as intended. No excessive deflections, distortions, settlement, or other structural distress was observed. Structural members and components appear to be sound and intact. No deterioration was observed, with the exception of reinforced cinder block lintels at the first floor windows on the east wall, and all lintels on the endwalls. These lintels are severely cracked and spalled, and would have to be replaced in a renovation.

The live loading capacity of the floor systems must be considered. The floor systems' design should be sufficient for the UBC's criterion for distributed load in an office occupancy. This is also the general loading criterion cited by ASCE 7, which is adapted by USACE. Although the floor system may not conform to uniform live loading criteria for lobbies and corridors, the Fort Carson DPW's experience with converting OHC buildings to office occupancies has indicated no adverse structural behavior. Loading limitations must be recognized in the renovation design.

Exterior closure systems appear to be generally sound and intact. Exterior wall paint is seriously deteriorated, but would be removed whether the building is renovated or demolished. Cracking occurs throughout the exterior masonry walls, although the vast majority of this cracking is at mortar joints. No differential settlement or structural distress is evident. Repointing and repainting

exterior walls should restore their performance as a weather barrier. Consideration must be given to the selection of paint, sealant, and mortar materials and their compatibility with the cinder block masonry. The infill masonry and windows now closing the porches would have to be removed to restore their original open configuration. Shingle roofing is in generally good condition, although this too would ordinarily be replaced in a renovation. A historically appropriate style and color of shingle would have to be selected. The built-up roofing at the porches would have to be replaced. Adequate drainage in these areas must be ensured. Exterior trim is minimal and utilitarian in nature, and could be replaced with common dimension lumber if necessary. If renovation takes place, all aluminum replacement windows and exterior doors would have to be replaced with historically appropriate windows and doors.

It is premature to perform a detailed condition assessment of interior construction without knowing future occupants' design requirements, and how the existing interior configuration will or will not be compatible with their space requirements. Requirements for building services, especially electrical power, lighting, electronics, and communications systems, will have a significant impact on the feasibility of retaining existing interior systems.

All partitioning added in the first floor open wards would have to be removed to restore their original open configuration, (unless retaining the current configuration is acceptable to SHPO). All flooring would have to be removed and replaced in kind or with appropriate replacement material. There is one isolated location where asbestos was detected in a flooring material; this will have to be removed.

Whether it is reasonable to repair existing wall and ceiling systems, or whether removing and replacing them is more functionally and economically practical, depends on the future occupants' design requirements. As a point of reference, however, the original interior wall and ceiling finishes appear to be fundamentally sound. Cracking and damage occurs throughout the building. However, it is possible that this damage could be repaired in most locations. Wall and ceiling finishes in the former open wards on the first floor, however, will be extensively damaged by removing the partitions, and replacing these finishes may be the only practical approach. As the sheet lath used for interior walls and ceilings is an ACBM, disturbing or removing this material must be accomplished under controlled conditions, including the appropriate protective measures for construction personnel.

Where the original floor plan remains essentially intact, the majority of interior doors and trim appear to be original or similar to original. However, all doors and door frames will require repair and refinishing. Hardware will most likely

have to be upgraded to satisfy future occupants' requirements and fire separation and egress requirements. If existing wall finishes must be removed, existing base will also have to be removed. It is questionable that, once removed, base will be suitable for reinstalling.

The condition and potential serviceability of mechanical and electrical services will have to be assessed if renovation is to be considered further. The existing capacity for sanitary fixtures and lavatories should be ample for future occupants' restroom requirements. It is likely that domestic water heating systems can be identified that are more effective and economical than the existing central hot water tank. Obsolete plumbing components should be able to be removed. If the existing steam heating system is retained in a renovation, controls must be restored. Mechanical ventilation will have to be provided. The necessity for air conditioning must also be determined. It is likely that more effective and economical HVAC systems can be identified if renovation is to take place. A sprinkler system services the building, and appears to be regularly inspected. Its performance, however, would have to be verified as part of a renovation design.

Existing site grading allows runoff to drain toward the building on the west side. Roof runoff erodes the grade adjacent to the foundation. Renovation design will have to address site grading and protection of the grade at the building perimeter.

A Memorandum of Agreement (MOA) between Fort Carson and the Colorado SHPO states that portions of the exterior and interior of Building 6237 will be restored to its original WWII form. A condition assessment was therefore performed to determine if it was economically feasible to adapt Building 6237 to a new use.

Building 6237 was found to be fundamentally sound. With the exception of removing the asbestos-containing exterior paint and sheet lath, renovation tasks should be conventional. As the building is essentially utilitarian in purpose and architectural character, renovation to an original appearance should not be complex. Readily available materials and labor skills can more than likely be applied to renovating the building. However, to meet the requirements in the MOA, portions of the building must be restored to its original WWII appearance. The extent of the restoration must be determined in consultation with the Colorado SHPO.

Renovation should render the building functional and serviceable for an administrative-type occupancy. Although a design program has not yet been devel-

oped, the building should be able to accommodate a variety of functions and configurations.

If the building were to be demolished, all ACBM would have to be removed. If the building is renovated, the sheet lath may remain if it is undisturbed and will not be exposed to habitable spaces (per DECAM). Therefore, renovation will reduce the ACBM removal requirements.

The estimated cost to renovate the building essentially to its original configuration (including upgraded washroom facilities and new electrical and mechanical systems) is approximately \$84/SF. However, ACBM removal and demolition would cost approximately \$25 to \$30/SF. Therefore, the cost of a renovated Building 6237 would be roughly \$60 to \$65/SF. Current USACE guidance (PAX newsletter 3.2.2, March 1999) states new construction of a General Purpose Administrative facility to be approximately twice that amount. Therefore, further development of a renovation strategy for Building 6237 is recommended. This will involve the following:

- Develop programmatic requirements
 - The requirements for the facility will have to be articulated by the occupant. These will include descriptions of organizational units and the activities, equipment, personnel, and schedule and operations of each.
- Develop a design program
 - Verify with the SHPO the exterior and interior elements to be restored to original appearance or configuration, and elements that can be modified to accommodate the new occupants.
 - Define space requirements for each organizational unit and function.
 - Define environmental requirements (acoustics, illumination, thermal comfort) of functions, activities, and spaces. Consider the nature of activities and functions, and compatibility of the interior core spaces and open ward spaces with functional requirements.
 - Define requirements for equipment and supporting building services. Determine plumbing system demands and verify the capacity of the existing system. Determine heating demand and verify the capacity of the steam distribution system. Determine cooling demand. Determine lighting and electrical power demand. Determine requirements for electronics and communications systems, and how distribution can be accommodated within the historic context of the building.
 - Identify requirements for future space and building services reconfiguration, and how the flexibility to reconfigure can be accommodated within the historic context of the building.

The following issues must be addressed when developing the renovation design.

- Verify the capacity of the floor system to accommodate the intended occupancy. Verify whether replacing any second floor joists (south open ward, east wall) will be required, or whether replacing the lintel (see below) and releveling the floor framing will be sufficient.
- Verify fire safety and code compliance.
- The lintels in the north and south walls will most likely require replacement, as will the lintel at the south end of the east wall (refer to Chapter 3, Figure 3-10 for location). Verify the integrity of the remaining cinderblock lintels. Further replacement may be required.
- Consider the compatibility of the exterior paint system with the cinder block surface when selecting the exterior paint system.
- Replace exterior windows and doors with historically appropriate windows and doors. Fabricate porch screens and balustrades to resemble the original configuration.
- As the interior sheet lath contains crysotile (an ACBM), removing any plaster finish will require environmental control and disposal as a hazardous material. Therefore, repairing surfaces is preferable to replacement where possible. For cost estimating, an assumption was made that all plaster wall and ceiling finishes in the former open wards on the first floor will require replacement. Once the partitioning has been removed, verify whether any of the finish can be repaired, in lieu of replacement.
- If the existing steam heat system is retained, verify the capacity of the distribution system within the building. When selecting a radiator type and placement, consider the effects of heat on plaster finishes, and the need to shield or protect wall surfaces.
- Select cooling equipment that can be installed unobtrusively. Avoid exterior pad-mounted equipment and visible ductwork that conflicts with the historical nature of the building. Consider placing equipment and distribution systems in the attic and crawl space.
- Install distribution of electrical power, lighting, electronics, and communications systems unobtrusively, consistent with the historical nature of the building. While concealed cabling would be unobtrusive, it will also be more difficult and costly to install. Given the ceiling heights in the building, a troffer (tray or channel) design can be developed that can conceal wiring and cabling through the central corridors and into the enclosed spaces. Discrete cable and power drops can also be developed if office landscape systems (integrated space division and furnishings) are used in the open ward spaces. Troffers can also allow access to cabling for modification and upgrade, while respecting the architectural character of the building's interior features.

- Monitor the estimated construction cost as design requirements are clarified and the renovation design is developed to enable tradeoffs between cost and design features, and to verify the reasonableness and affordability of the design.

5 Cost Analysis

General Approach

A schematic, or “budget,” cost estimate for renovating Building 6237 was developed based on site visits and the condition assessment.

For the purposes of a schematic estimate, assumptions were made about the work required for renovation. Work items are listed in detail in the Appendix, and are summarized as follows:

- Building 6237 would be renovated essentially to its original configuration. The original interior space layout would remain.
- The exterior would be renovated to its original appearance as closely as practical.
- In general, all interiors would be finished similar to their original condition.
- Each existing group washroom would be remodeled to contemporary functionality.
- The existing central steam supply would be used for heating. Distribution components and controls within the building would be replaced.
- New air conditioning would be added in a discrete manner.
- The electrical systems would essentially be removed and reconstructed.
- No other sitework beyond the building’s 5-ft line is included in this estimate.
- Demolition of the one-story “addition” to the west side of the building is not included in this estimate.

Considerations for building code compliance include: construction type, fire resistiveness of the interior corridor walls and lateral fire walls, egress location and travel distance, presence of sprinklers in the attic, sanitary fixture count, and provision of a wheel chair accessible building entry.

Materials and components shown in the estimate were selected for their appropriateness to the facility type and characteristics of the building. Where a specific requirement or performance was unknown, the more conservative option was selected. In many instances, alternative material types of either higher or lower price could be substituted.

As there is no definitive design or design program on which to base an estimate, a complete description of the work and detailed cost estimate cannot be made. Therefore, it must be cautioned that this budget estimate is intended as a point of departure for further decisions, programming, and design development. It is inappropriate to use this estimate as a Government Estimate for bidding purposes.

Cost Data Sources

R. S. Means publications were used for the vast majority of cost items. These included:

Building Construction Cost Data, 1999.

Assemblies Cost Data, 1999.

Facilities Maintenance and Repair Cost Data, 1999.

It is normally inadvisable to mix cost data sources within one estimate. However, as the R. S. Means publications all use the same database, the cost data is consistent.

Prices for removing ACBM were taken from the "Asbestos Survey, Building 6237, Fort Carson, Colorado," by ENSR. These prices were attributed in that report to the Fort Carson JOC price schedule.

Where no published cost line items corresponded specifically to work items required for Building 6237, approximations were made.

Quantity Take-off

Quantities were taken off from a "Standard Ward, Type HSW-98" first and second floor plan. Quantities were measured as accurately as the source data allowed. Waste factors were included.

While these drawings did not provide the detail that would have appeared on as-built documents, they were suited for the purposes. The drawings and site visit together enabled us to take-off quantities of all structural and architectural elements that could be taken off with a level of accuracy appropriate for a budget-level cost estimate.

Quantities for mechanical and electrical items that were not evident in the available drawings were approximated using "The Whitestone Building Maintenance and Repair Cost Reference" (1998).

In some instances, quantities represent an assumption that 100 percent of an item will require removal, replacement, repair, or similar task. If further analyses indicate only partial removal, replacement, or repair is necessary, that item's quantity and total cost can be reduced.

Direct, Indirect, and Overhead Costs

Bare costs for materials, labor, and equipment are provided in the R. S. Means *Building Construction Cost Data*. Total with Subcontractors' Overhead and Profit (Subs O&P) is also provided in the *Building Construction Cost Data*.

Subs O&P is embedded in the Material, Labor, and Equipment costs taken from Means *Assemblies Cost Data* and *Facilities Maintenance and Repair Cost Data*; it is not broken out separately. Where these sources were used for the estimate, a Subs O&P factor was backed out of the bare costs for the purposes of totaling bare material, labor, and equipment and bare totals. A 23 percent factor was used for all work except electrical, for which a factor of 50 percent was used. These factors approximate Subs O&P factors that appear in the Means *Building Construction Cost Data* Unit Price Pages. The total cost, however, was included in the "Total w/Subs O&P" column, as shown in these two Means sources.

Only a single total cost figure was available for the removal of ACBM. A 20 percent markup was assumed for the JOC, and a "Bare Total" backed-out accordingly.

As these tasks are primarily labor tasks, that figure was placed in the "Labor" column of the estimate (Appendix), rather than assuming a materials, equipment, and labor split.

To be conservative, Subs O&P was applied to all work. However, it is unlikely that the General Contractor will actually subcontract all work.

Colorado sales tax of 3.0 percent was added to material prices.

Cost totals were adjusted for a Colorado Springs location using a factor (multiplier) of 1.03, per HQUSACE guidance. Note that the 1999 R. S. Means *Building*

Construction Cost Data provides a weighted average of 1.007 for materials and 0.803 for installation, or a total weighted average of 0.908.

A 15 percent contingency was added to the adjusted Direct Cost totals. A 15 percent factor was added to cover Job Indirect costs as well as General Conditions. An 8 percent General Contractor's Overhead and Profit was added on the total of Direct, Contingencies, Job Indirect, and General Conditions.

Cost Summary

The cost estimate is summarized as follows (all line items include Subs O&P):

B. Shell	\$ 266,464
C. Interiors	\$ 336,761
D. Services	\$ 350,295
G. Sitework	\$ 13,418
Total, Incl. Location Adjustment and State Sales Tax	\$ 995,968
Total, Incl. Contingency, Job Indirect General Conditions, and GC O&P, say	\$1,423,000

References

"Asbestos Survey Building 6237, Fort Carson, Colorado." (Located at the Directorate of Environmental Compliance and Management, Office of: Asbestos/Lead Program Manager), ENSR, Denver, Colorado, November 1996.

Assemblies Cost Data. R.S. Means Company, Inc., Kingston, Massachusetts, 1999.

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Connor, Melissa A. and James Schneck. *The Old Hospital Complex (5EP1778) Fort Carson, Colorado*. Midwest Archeological Center, Lincoln, Nebraska, 1996.

Facilities Maintenance and Repair Cost Data. R.S. Means Company, Inc. Kingston, Massachusetts, 1999.

Minimum Design Loads for Buildings and Other Structures, ASCE 7. American Society of Civil Engineers, ASCE Publications, Reston, Virginia, 1997.

PAX Newsletter 3.2.1. Area Cost Factor Indexes, Headquarters, US Army Corps of Engineers, Washington, DC, 31 March 1999.

The Whitestone Building Maintenance and Repair Cost Reference, Fourth Annual Edition, 1998.

Uniform Building Code. International Conference of Building Officials, Whittier, California, 1997.

Appendix: Work Items and Costs

Table 1. Fort Carson, CO, Building 6237 renovation work items and costs.

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
A. SUBSTRUCTURE										
No work included										
B. SHELL										
B10 Superstructure										
B1010 Floor Construction										
Floor Joists										
<u>First Floor:</u>										
Ledger to support floor joists at columns, 2X8	BC	061 122		0.08	MBF	540.00 43.20	875.00 70.00		1415.00 113.20	1975.00 158.00
Remove floor hatches in x-ray room	BC	020 706		2	EA	0.00	54.50 109.00	0.00	54.50 109.00	86.00 172.00
Frame at floor hatch openings joists, 2X8	BC	061 114		0.04	MBF	545 21.80	299 11.96	0.00	844 33.76	1075 43.00
Subfloor at floor hatch openings 3/4 CDX T&G	BC	061 164	0200	42	SF	0.58 24.36	0.35 14.70	0.00	0.93 39.06	1.19 49.98
Add for misc. floor framing joists, 2X8	BC	061 114		0.2	MBF	545 109.00	299 59.80	0.00	844 168.80	1075 215.00
Remove subfloor at Open Ward shower	BC	020 712		120	SF	0.00	0.36 43.20	0.00	0.36 43.20	0.57 68.40
Subfloor at Open Wards 3/4 CDX T&G	BC	061 164	0200	144	SF	0.58 83.52	0.35 50.40	0.00	0.93 133.92	1.19 171.36
Remove subfloor at core area washrooms	BC	020 712		850	SF	0.00	0.36 306.00	0.00	0.36 306.00	0.57 484.50
Subfloor at washrooms 3/4 CDX T&G	BC	061 164	0200	1020	SF	0.58 591.60	0.35 357.00	0.00	0.93 948.60	1.19 1213.80
<u>Second Floor:</u>										
Remove / repair floor framing at SE corner of Open Ward	BC	020 714		72	LF	0.00	0.37 26.64	0.00	0.37 26.64	0.57 41.04

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Floor framing joists, 2X8	BC	061 114		0.12	MBF	545 65.40	299 35.88	0.00	844 101.28	1075 129.00
Remove subfloor at SE corner of Open Ward	BC	020 714		144	SF	0.00	0.36 51.84	0.00	0.36 51.84	0.57 82.08
Subfloor 3/4 CDX T&G	BC	061 164	0200	172	SF	0.58 99.76	0.35 60.20	0.00	0.93 159.96	1.19 204.68
Structural Interior Walls Supporting Floors										
Firestop penetrations in lateral fire walls	BC	072 701	0110	60	EA	9.60 576.00	13.65 819.00	0.00	23.25 1395.00	32.00 1920.00
Remove access scuttles in fire walls	BC	020 706		15	EA	0.00	73.00 1095.00	0.00	73.00 1095.00	1.15 17.25
Access scuttles in fire walls steel, 2" X 2", 1 hr rated	BC	083 054		15	EA	159.00 2385.00	24.50 367.50	0.00	183.50 2752.50	213.00 3195.00
Floor Construction Firestopping										
Firestop steam pipe penetrations	BC	072 701	0150	200	EA	5.80 1160.00	6.80 1360.00	0.00	12.60 2520.00	17.15 3430.00
B1020 Roof Construction										
Roof Construction Vapor Retarder, Air Barrier, and Insulation										
Insulation blown cellulose, R 38	BC	072 101	0120	16940	SF	0.41 6945.40	0.29 4912.60	0.15 2541.00	0.85 14399.00	1.07 18125.80
Roof Construction Firestopping										
Pack gap at top of fire walls	BC	072 701	0710	420	LF	5 2100.00	1.75 735.00	0.00	6.75 2835.00	8.25 3465.00
SUBTOTAL B10 SUPERSTRUCTURE						14205.04	10153.08	2541.00	26899.12	32660.35

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
B20 Exterior Closure										
B2020 Exterior Walls										
Exterior Walls										
Remove existing exterior paint, incl. environmental controls	JOC			12000	SF	0.00	4.17 50040.00	0.00	4.17 50040.00	5.00 60000.00
SEE NOTE ON UNIT PRICE, BELOW										
Remove cinder block lintels	BC	020 732	0280	380	SF	0.00	1.08 410.40	0.22 83.60	1.30 494.00	1.94 737.20
Precast lintels 8" high X 8" thick, 5'-12' long	BC	034 802		520	LF	8.85 4602.00	4.13 2147.60	0.58 301.60	13.56 7051.20	16.8 8736.00
Repoint exterior block, incl. scaffolding, 1st floor	FM&R	4.1-510		57	CSF	0.00	198.00 11286.00	0.00	198.00 11286.00	329.50 18781.50
Repoint exterior block, incl. scaffolding, 2nd floor	FM&R	4.1-510		57	CSF	0.00	232.00 13224.00	0.00	232.00 13224.00	422.50 24082.50
Remove siding at stairwell spandrels	BC	020 726		180	SF	0.00	0.45 81.00	0.00	0.45 81.00	0.71 127.80
Siding cedar, beveled, 1/2" X 4"	BC	074 609		200	SF	2.02 404.00	0.87 174.00	0.00	2.89 578.00	3.59 718.00
Paint exterior block 2 coats, spray	BC	099 124	0540	11400	SF	0.05 570.00	0.07 798.00	0.00	0.12 1368.00	0.16 1824.00
Exterior Louvers, Grills, and Screens										
Remove existing vent frames	Est.			32	EA	0.00	10.00 320.00	0.00	10.00 320.00	12.5 400.00
Operable dampers and grills	BC	157 482		32	EA	27.00 864.00	10.60 339.20	0.00	37.60 1203.20	46.00 1472.00
Remove crawlspace access Scuttles	BC	020 706	0200	2	EA	0.00	10.75 21.50	0.00	10.75 21.50	16.9 33.80
Access scuttles fire rated w/ lock, metal 24"X36"	BC	083 054		2	EA	210.00 420.00	27.50 55.00	0.00	237.50 475.00	274.00 548.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Exterior Wall Balcony (Porch) Walls and Railings										
Remove windows from porches	BC	020 734		20	EA	0.00	13.200	0.00	13.200	21.000
							264.00	0.00	264.00	420.00
Remove block infill from porch openings	BC	020 732	0280	480	SF	0.00	1.08	0.22	1.30	1.94
							518.40	105.60	624.00	931.20
Porch railings custom, architectural grade	BC	064 310	0010	120	LF	12.00	5.75		17.75	22.50
						1440.00	690.00	0.00	2130.00	2700.00
Screens and frames 1-1/8" frames	BC	086 152	0100	1200	SF	2.95	1.16		4.11	5.10
						3540.00	1392.00	0.00	4932.00	6120.00
Paint porch rails prime and 2 coats	BC	099 112	0130	120	LF	0.74	3.83		4.58	6.75
						88.80	459.60	0.00	549.60	810.00
Paint screen frames prime and 2 coats, latex	BC	099 120	0410	120	LF	0.12	0.63		0.75	1.10
						14.40	75.60	0.00	90.00	132.00
Exterior Soffits and Fascia										
<u>Main Building:</u>										
Remove fascia board, assume 100% replacement	BC	020 714		524	LF	0.00	0.43		0.43	0.68
							225.32	0.00	225.32	356.32
Remove soffit board assume 100% replacement	BC	020 714		524	LF	0.00	0.34		0.34	0.54
							178.16	0.00	178.16	282.96
Fascia board pine, 1 X 10	BC	062 220		524	LF	0.92	0.97		1.89	2.54
						482.08	508.28	0.00	990.36	1330.96
Soffit board pine, 1 X 6	BC	062 220		524	LF	0.70	0.87		1.57	2.14
						366.80	455.88	0.00	822.68	1121.36
Paint soffit and fascia prime and 2 coats, latex	BC	099 120	0410	524	LF	0.12	0.63		0.75	1.10
						62.88	330.12	0.00	393.00	576.40
<u>Porches:</u>										
Remove fascia board, 1 X 10 assume 100% replacement	BC	020 714		130	LF	0.00	0.43		0.43	0.68
							55.90	0.00	55.90	88.40

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Replace fascia board pine, 1 X 10	BC	622 20		130	LF	0.92 119.60	0.97 126.10	0.00	1.89 245.70	2.54 330.20
Paint fascia board prime and 2 coats, latex	BC	099 120	0410	130	LF	0.00	0.43 55.90	0.00	0.43 55.90	0.68 88.40
B2020 Exterior Windows										
Remove aluminum windows E&W walls	BC	020 734	0200	116	EA	0.00	10.75 1247.00	0.00	10.75 1247.00	16.90 1960.40
Remove aluminum windows stainwells	BC	020 734	0280	18	EA	0.00	34.50 621.00	0.00	34.50 621.00	54.00 972.00
Windows, wood double hung, insul. glass, incl trim and screen (mat'l cost 2X for custom)	BC	086 124	0250	116	EA	360.00 41760.00	24.50 2842.00	0.00	384.50 44602.00	449.87 52184.34
Windows, wood double hung, insul. glass, incl trim and screen (mat'l cost 2X for custom)	BC	086 124	0280	18	EA	450.00 8100.00	27.5 495.00	0.00	477.50 8595.00	558.68 10056.15
B2030 Exterior Doors										
Remove ext. door 3'X7", single leaf	BC	020 706	0200	3	EA	0.00	10.75 32.25	0.00	10.75 32.25	16.90 50.70
Remove ext. door 6'X7", double leaf	BC	020 706	0220	3	EA	0.00	14.30 42.90	0.00	14.30 42.90	22.50 67.50
Remove ext. door frame 3'X7", single leaf	BC	020 706	2200	3	EA	0.00	13.65 40.95	0.00	13.65 40.95	21.50 64.50
Remove ext. door frame 6'X7", double leaf	BC	020 706	2200	3	EA	0.00	13.65 40.95	0.00	13.65 40.95	21.50 64.50
Exterior door, 3'X7", solid core incl hardware, finished	A	A4.6-100	2700	3	EA	1260.00 3780.00	280.00 840.00	0.00	1540.00 4620.00	1875.00 5625.00
Exterior door, 6'X7", solid core incl hardware, finished	A	A4.6-100	2700	2	EA	2000.00 4000.00	400.00 800.00	0.00	2400.00 4800.00	3000.00 6000.00
SUBTOTAL B20 EXTERIOR CLOSURE										
						70614.56	91234.01	490.80	162340.57	209794.09

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
B30 Roofing										
B3010 Roof Covering										
Shingle and Roofing Tiles										
Fall protection, guard post, bracket, and nylon rope	Est			1	LS	600.00	100.00		700.00	875.00
						600.00	100.00	0.00	700.00	875.00
Gable										
Tear off roofing Shingles	BC	020 726	4000	9600	SF	0.00	0.25	0.00	0.25	0.39
						2400.00	2400.00	0.00	2400.00	3744.00
30# felt underlayment	BC	073 104	0825	106	SQ	5.54	3.32	0.00	8.77	11.70
						587.24	351.92	0.00	929.62	1240.20
Asphalt strip shingles, class A	BC	073 104	0455	106	SQ	43.00	44.00	0.00	87.00	124.00
260 lb, pneumatic nailed						4558.00	4664.00	0.00	9222.00	13144.00
Porches										
Tear off roofing built-up	BC	020 726	3001	900	SF	0.00	0.98	0.00	0.98	1.55
						882.00	882.00	0.00	882.00	1395.00
Single ply roofing	BC	075 302	4800	10	SQ	87.00	34.00	63.50	127.35	161.00
EPDM, 60 mil fully adhered						870.00	340.00	63.50	1273.50	1610.00
Flashing										
Remove flashing coping, sheet metal, to 12" wide	BC	020 726	2650	440	LF	0.00	0.72	0.00	0.72	1.13
						316.80	316.80	0.00	316.80	497.20
Replace flashing, lead coated copper, fabric backed, 5 oz	BC	076 204	6200	490	SF	1.70	0.77	0.00	2.47	3.07
						833.00	377.30	0.00	1210.30	1504.30
SUBTOTAL B30 ROOFING										
						7448.24	9432.02	63.50	16934.22	24009.70
SUBTOTAL B. EXTERIOR CLOSURE										
						92267.84	110819.11	3095.30	206173.91	266464.14
subs o&p=158K										

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
C. INTERIORS										
C10 Interior Construction										
C1010 Partitions										
Fixed Partitions										
Remove lead lining from X-Ray rooms	Estimat'd			1330	SF	0.00	1.50 1995.00	0.00	1.50 1995.00	2.10 2793.00
Remove partitions, 1st fl Opn. W/d. wood stud, 2 sides, plaster board	BC	020 732	2300	6600	SF	0.00	1.02 6732.00	0.00	1.02 6732.00	1.61 10626.00
Remove partitions, washrooms, wood stud, 2 sides, plaster board	BC	020 732	2300	320	SF	0.00	1.02 326.40	0.00	1.02 326.40	1.61 515.20
Remove partitions, S. stairwell wood stud, 2 sides, plaster board	BC	020 732	2300	115	SF	0.00	1.02 117.30	0.00	1.02 117.30	1.61 185.15
Remove block infill at nurses' station windows	BC	020 732	0280	80	SF	0.00	1.08 86.40	0.22 17.60	1.30 104.00	1.94 155.20
Partitions at washrooms WR drywall on wood studs	A	A6.1-510	2400	360	SF	1.15 414.00	1.65 594.00	0.00	2.80 1008.00	4.25 1530.00
Interior Windows										
Window at nurses' station, wood insul. glass, incl trim and screen	BC	086 124	0200	4	EA	272.00 1088.00	24.50 98.00	0.00	296.50 1186.00	346.91 1387.62
Interior Doors										
Remove doors from 1st fl Open Wards	BC	020 706	0500	40	EA	0.00	8.60 344.00	0.00	8.60 344.00	13.50 540.00
Remove door frames from 1st fl Open Wards	BC	020 706	2200	40	EA	0.00	13.65 546.00	0.00	13.65 546.00	21.50 860.00
Refinish corridor doors and frames	FM&R	6.4-420	1020	46	EA	3.04 139.84	24.10 1108.60	0.00	27.14 1248.44	43.10 1982.60
Replace locksets	FM&R	6.4-420	1010	46	EA	64.50 2967.00	28.50 1311.00	0.00	93.00 4278.00	128.00 5888.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Interior Fire Doors										
Remove fire doors from Corridors	BC	020 076	0500	13	EA	0.00	8.60 111.80	0.00	8.60 111.80	13.50 175.50
Remove fire door frames from Corridors	BC	020 076	2200	13	EA	0.00	13.65 177.45	0.00	13.65 177.45	21.50 279.50
Door frame, knock down 16 ga. B label	BC	081 118	5400	13	EA	90.00 1170.00	29.00 377.00	0.00	119.00 1547.00	145.00 1885.00
Fire door birch face, B label, 3' X 7" (mat'l 2X for custom)	BC	082 070	0090	13	EA	340.00 4420.00	36.50 474.50	0.00	376.50 4894.50	440.51 5726.57
Fabricated Compartments and Cubicles										
Toilet partitions floor mounted, painted metal	A	A6.1-870	0680	10	EA	355.00 3550.00	79.00 790.00	0.00	433.00 4330.00	620.00 6200.00
Urinal screens flange supported, painted metal	A	101 602	1428	8	EA	165.00 1320.00	69.00 552.00	0.00	234.00 1872.00	330.00 2640.00
Entrance screens floor mounted, painted metal	A	A6.1-870	1100	4	EA	165.00 660.00	37.00 148.00	0.00	202.00 808.00	280.00 1120.00
Toilet, Bath, and Laundry Accessories										
Shelves, mirrors, TP holders, towel dispensers Etc.	BC	108 200 various		4	EA	300.00 1200.00	100.00 400.00	0.00	400.00 1600.00	500.00 2000.00
Storage Shelving										
Shelving in janitors closets plywood, 3/4", w/ edge, 24' wide	BC	062 304	0700	800	SF	2.35 1880.00	3.12 2496.00	0.00	5.47 4376.00	7.50 6000.00
SUBTOTAL C10 INTERIOR CONSTRUCTION						18808.84	18785.45	17.60	37601.89	52489.34

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
C20 Stairs										
C2010 Stair Construction										
Wood Stair Construction										
Remove and replace steps assume 25% replacement	FM&R	6.9-420	0040	66	SF	12.5	1452.00	0.00	34.53	48.65
						825.00			2278.98	3210.90
C2020 Stair Finishes										
Resilient Stair Finishes										
Rubber treads and nosing 5/16" thick, colors	BC	096 781	0400	264	SF	6.75	1782.00	0.00	8.60	10.20
						488.40			2270.40	2692.80
Stair Railings and Balustrades										
Balustrade at stairs, one side Pine	BC	062 224	3500	120	LF	1.43	171.60	0.00	4.30	6.10
						344.40			516.00	732.00
Paint balustrade wood trim 3 coats	BC	099 220	7450	120	LF	0.07	8.40	0.00	0.68	1.01
						73.20			81.60	121.20
SUBTOTAL C20 STAIR CONSTRUCTION						3414.00		0.00	5146.98	6756.90
C30 Interior Finishes										
C3010 Wall Finishes										
Wall Paneling										
Remove green laminate Wainscot	BC	020 720	2000	2160	SF	0.17	0.00	0.00	0.17	0.27
						367.20			367.20	583.20
Remove fiberboard wainscot estimated 50% existing	BC	020 720	2000	1400	SF	0.17	0.00	0.00	0.17	0.27
						238.00			238.00	378.00
Replace fiberboard wainscot estimated 50%	BC	062 554	0050	1540	SF	0.330	508.20	0.00	1.200	1.730
						1339.80			1848.00	2664.20
Remove misc. wall paneling	BC	020 720	2000	400	SF	0.17	0.00	0.00	0.17	0.27
						68.00			68.00	108.00
Add wainscot molding	BC	062 554	2100	770	LF	0.32	246.40	0.00	1.19	1.72
						669.90			916.30	1324.40

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Plaster Wall Finishes										
Remove plaster walls in 1st fl	JOC			6000	SF		2.78		2.78	3.34
Open Wards, plaster on sheet lath incl. environmental controls						0.00	16680.00	0.00	16680.00	20040.00
Remove plaster walls, misc utility access, incl env. controls	JOC			1000	SF		2.78		2.78	3.34
						0.00	2780.00	0.00	2780.00	3340.00
Repair plaster walls, assume 4% plaster wall area	FM&R	6.5-201	0010	250	SY	13.90	57.00	9.34	80.24	121.00
						3475.00	14250.00	2335.00	20060.00	30250.00
Gypsum Board Wall Finishes										
GWB in 1st fl Open Wards 1/2", nailed to studs/furring taped and finished	BC	092 608	0350	4620	SF	0.24	0.45		0.69	0.98
						1108.80	2079.00	0.00	3187.80	4527.60
Drywall casing/corner bead galv. Steel	BC	092 804	0010	10	CLF	15.90	75.00		91.40	136.00
						159.00	750.00	0.00	914.00	1360.00
Tile Wall Finishes										
Ceramic wainscot @ washrooms Walls, interior, thinset, 4-1/4" sq	BC	093 102	5400	1830	SF	2.210	2.030		4.240	5.400
						4044.30	3714.90	0.00	7759.20	9882.00
Wall Carpet										
Remove misc. wall carpet	BC	020 732	5040	400	SF		0.42		0.42	0.64
						0.00	168.00	0.00	168.00	256.00
Painted Wall Finishes										
Paint interior walls, spray 3 coats, light clean and paint	BC	099 224	1280	26600	SF	0.10	0.12		0.22	0.30
						2660.00	3192.00	0.00	5852.00	7980.00
For latex, deduct, 25% materials	BC	099 224	4120							
Trim and Wall Decoration										
First Floor Open Wards	BC	062 208	05.500	880	LF	1.25	1.09		2.34	3.10
Base, stock, pine, 4-1/2" high						1100.00	959.20	0.00	2059.20	2728.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Paint base, 3 coats		099 220	7450	880	LF	0.07 61.60	0.61 536.80	0.00	0.68 598.40	1.01 888.80
<u>Core Areas and Stairwells</u>										
Refinish base assume 50%	FM&R	6.2-110	0030	1000	LF	0.16 160.00	0.69 690.00	0.00	0.85 850.00	1.32 1320.00
Remove base assume 50% damaged	BC	020 720	3000	1000	LF	0.00	0.29 290.00	0.00	0.29 290.00	0.45 450.00
Base, stock, pine, 4-1/2" high assume 50%	BC	062, 208	0550	1000	LF	1.25 1250.00	1.09 1090.00	0.00	2.34 2340.00	3.10 3100.00
Paint base, 3 coats	BC	099 220	7450	1000	LF	0.07 70.00	0.61 610.00	0.00	0.68 680.00	1.01 1010.00
<u>C3020 Floor Finishes</u>										
Remove ACM flooring	JOC			12	SF	0.00	16.25 195.00	0.00	16.25 195.00	19.50 234.00
Remove resilient floor (misc carpet incl)	BC	020 712	0800	18935	SF	0.00	0.22 4165.70	0.13 2461.55	0.35 6627.25	0.5 9467.50
Remove underlayment, nailed	BC	020 712	4000	18935	SF	0.00	0.36 6816.60	0.00	0.36 6816.60	0.57 10792.95
<u>Wood Strip Flooring</u>										
Refinish wood floor in 1st fl Open Wards, 2 coats poly	BC	095 604	7500	4400	SF	0.65 2860.00	0.43 1892.00	0.00	1.08 4752.00	1.39 6116.00
Refinish porch floors 2 coats	BC	095 604	7800	1780	SF	0.65 1157.00	0.43 765.40	0.00	1.08 1922.40	1.39 2474.20
<u>Resilient Flooring</u>										
Underlayment plywood, 3/8"	BC	061 168	0010	2300	SF	0.66 1518.00	0.29 667.00	0.00	0.95 2185.00	1.19 2737.00
Resilient flooring, 1st fl vinyl sheet, .125" thick, avg. stairs and 50% core area	BC	096 601	8200	2300	SF	1.63 3749.00	0.93 2139.00	0.00	2.56 5888.00	3.16 7268.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Carpet										
Carpet, 1st fl, 50% of core carpet tile, hard back, 26 oz	BC	096 900	0110	190	SY	28.50 5415.00	1.42 269.80	0.00	29.92 5684.80	33.00 6270.00
Carpet tile, all 2nd fl, except stairwells and washrooms	BC	096 900	0110	880	SY	28.50 25063.00	1.42 1249.60	0.00	29.92 26329.60	33.00 29040.00
C3030 Ceiling Finishes										
Plaster Ceiling Finishes										
Remove plaster ceiling at 1st fl Open Wards, incl env. controls	JOC			4400	SF	0.00	3.75 16500.00	0.00	3.75 16500.00	4.50 19800.00
Remove plaster ceiling, misc, utility access, incl env. controls	JOC			400	SF	0.00	3.75 1500.00	0.00	3.75 1500.00	4.50 1800.00
Repair plaster ceiling assume 2% ceiling finish	FM&R	6.7-110	0010	1400	SY	6.95 9730.00	27.75 38850.00	0.66 924.00	35.36 49504.00	55.10 77140.00
Gypsum Board Ceiling Finishes										
Remove GWB from porch ceilings	BC	020 702	0200	1780	SF	0.00	0.43 765.40	0.00	0.43 765.40	0.68 1210.40
GBW ceilings in 1st fl Open Wards, 5/8" FR, tape and finish	BC	092 608	3150	4400	SF	0.30 1320.00	0.57 2508.00	0.00	0.87 3828.00	1.23 5412.00
Painted Ceiling Finishes										
Paint ceilings, smooth finish 3 coats, spray	BC	099 224	1280	18900	SF	0.10 1890.00	0.12 2268.00	0.00	0.22 4158.00	0.30 5670.00
Paint porch ceilings wood framed, 2 coats, spray	BC	099 220	9240	1780	SF	0.1 178.00	0.33 587.40	0.00	0.43 765.40	0.62 1103.60
Add for ceilings, 25% labor	BC	099 224	1800				25.00% 146.85			
For latex, deduct 10% materials	BC	099 224	4120			-10.00% -17.80				
SUBTOTAL C30 INTERIOR FINISHES						67722.50	130846.30	5720.55	204312.15	277515.45
SUBTOTAL C. INTERIORS						89945.34	151362.75	5738.15	247061.02	336761.69 subs o&p = 156K

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
D. SERVICES										
D20 Plumbing										
D2010 Plumbing Fixtures										
Water Closets										
Remove existing WC incl rough-in	BC	020 724	1400	20	EA	0.00	32.50 650.00	0.00	32.50 650.00	49.50 990.00
Water closets, flush valve, floor mounted, incl. rough-in	A	A8.1-470	2120	12	EA	432.00 5184.00	364.00 4368.00	0.00	796.00 9552.00	930.00 11160.00
Urinals										
Remove existing urinals incl. rough-in	BC	020 724	1520	4	EA	0.00	37.50 150.00	0.00	37.50 150.00	56.50 226.00
Urinals in remodeled washrooms		8.1-450	2040	4	EA	360.00 1440.00	408.00 1632.00	0.00	768.00 3072.00	905.00 3620.00
Lavatories										
Remove existing lavatories wall hung, incl. rough-in	BC	020 724	1200	22	EA	0.00	26.00 572.00	0.00	26.00 572.00	39.50 869.00
Lavatories, wall hung, incl. rough-in and trim	A	A8.1-433	2240	12	EA	396.00 4752.00	384.00 4608.00	0.00	780.00 9360.00	915.00 10980.00
Sinks										
Remove existing lab/equip sinks wall hung, incl. rough-in	BC	020 724	1300	6	EA	0.00	32.50 195.00	0.00	32.50 195.00	49.50 297.00
Showers										
Remove existing showers incl. rough-in	BC	020 724	1140	6	EA	0.00	52.00 312.00	0.00	52.00 312.00	79.00 474.00
Drinking Fountains										
Water cooler, electric, wall hung incl. rough-in	A	A8.1-460	1840	2	EA	555.00 1110.00	284.00 568.00	0.00	839.00 1678.00	965.00 1930.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Water cooler, electric, wall hung accessible, incl. rough-in	A	A8.1-460, 1920	1920	2	EA	1227.00	284.00	0.00	1511.00	1705.00
						2454.00	568.00	0.00	3022.00	3410.00
D2020 Domestic Water Distribution										
Water Supply Equipment										
Remove existing HW tank	Estimat'd			1	EA	0.00	900.00	0.00	900.00	1200.00
						0.00	900.00	0.00	900.00	1200.00
Remove HW piping to 2nd fl, 2"-4" dia., metal	BC	020 724	2050	40	LF	0.00	1.74	1.74	0.00	2.63
						0.00	69.60	69.60	0.00	105.20
Water heaters, each washroom electric, commercial	A	A8.1-160, 1820	1820	4	EA	2000.00	552.00	0.00	2552.00	2890.00
						8000.00	2208.00	0.00	10208.00	11560.00
SUBTOTAL D20 PLUMBING						22940.00	16800.60	69.60	39671.00	46821.20
D30 HVAC										
D3040 HVAC Distribution										
Air Distribution Systems										
Remove duct from south 1st fl	BC	020 718, 1300	1300	120	LF	0.00	2.02	0.00	2.02	3.18
Open Ward, 12"- 14" X 16" -18"						0.00	242.40	0.00	242.40	381.60
Exhaust fans in washrooms incl ducts, wiring, louvers	Estimat'd			4	EA	600.00	200.00	0.00	800.00	1000.00
						2400.00	800.00	0.00	3200.00	4000.00
Steam Distribution Systems										
Remove existing radiators	FM&R	8.3-076	0010	100	EA	0.00	32.00	0.00	32.00	50.00
						0.00	3200.00	0.00	3200.00	5000.00
Fin tube radiation system, comm., not incl. boiler and piping	A	A8.3-161	2000	16940	SF	1.25	1.75	0.00	3.00	4.00
						21175.00	29645.00	0.00	50820.00	67760.00
Terminal and Packaged Units										
Remove AC unit, pad mounted	FM&R	8.4-215	2030	1	EA	0.00	720.00	0.00	720.00	1125.00
						0.00	720.00	0.00	720.00	1125.00

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
Remove AHU from S. stairwell	FM&R	8.4-375	6030	1	EA	0.00	795.00	0.00	795.00	1250.00
DX fan coil AC unit, offices incl. ducts and controls, 20,000 SF per SF of building	A	A8.4-250	3680	16940	SF	3.13 53022.20	3.01 50989.40	0.00	6.14 104011.60	7.21 122137.40
SUBTOTAL D30 HVAC						76597.20	86391.80	0.00	162989.00	201654.00
D40 Fire Protection										
D4030 Fire Protection Specialties										
Fire extinguisher cabinet recessed, glass door	BC	105 220	0040	4	EA	46.00 184.00	58.50 234.00	0.00	134.00 536.00	172.00 688.00
SUBTOTAL D40 FIRE PROTECTION						184.00	234.00	0.00	536.00	688.00
D50 Electrical										
Remove elect. components, distribution, devices, fixtures	Estimat'd			16940	SF	0.00	0.50 8470.00	0.00	0.50 8470.00	0.75 12705.00
Electrical services, lighting, distribution, equipment, per SF	A	R114 610		16940	SF	1.00 16940.00	2.00 33880.00	0.00	3.00 50820.00	4.72 79956.80
Fire and security, per SF	A	R9.0-110				0.10 0.00	0.20 0.00	0.00	0.30 0.00	0.40 0.00
Back up power, per SF	A	R9.0-110		16940		0.10 1694.00	0.25 4235.00	0.00	0.35 5929.00	0.50 8470.00
SUBTOTAL D50 ELECTRICAL						18634.00	46585.00	0.00	65219.00	101131.80
SUBTOTAL D. SERVICES						118355.20	150011.40	69.60	268415.00	350295.00
										subs o&p=119K

E. EQUIPMENT and FURNISHINGS
Not incl.

Item	Source	Ref.	L.I.#	Quantity	Units	Mat'l	Lab.	Equip.	Bare Total	Total w/Subs O&P
F. SPECIAL CONSTRUCTION and DEMOLITION										
Selective demolition incl w/ other line items										
G. SITEWORK										
G10 Site Preparation										
G1030 Site Earthwork										
Grading										
Finish grade within 5' line wheel mounted end loader	BC	022 238	1500	50	CY	0.00	0.87 43.50	0.68 34.00	1.55 77.50	2.09 104.50
Erosion Protection										
Stone mulch at bldg perimeter	BC	029 516	1600	37	CY	40.50 1498.50	18.95 701.15	0.00	59.45 2199.65	74.50 2756.50
SUBTOTAL G10 SITE PREPARATION										
						1498.50	744.65	34.00	2277.15	2861.00
G20 Site Improvements										
G2030 Pedestrian Paving										
Stairs and Ramps										
Remove entry stoops and ramp slab on grade, 6" , mesh reinf	BC	020 754	0420	250	SF	0.00	2.57 642.50	0.53 132.50	3.1 775.00	4.62 1155.00
Handicap ramp, 5' wide w/ 2 rails & check walls	BC	033 130	4535	30	LF	108.00 3240.00	106.00 3180.00	3.06 91.80	217.06 6511.80	290.00 8700.00
Entry stoops, slab on grade 8" textured finish. W.o. forms or reinf	BC	033 130	5020	75	SF	1.62 121.50	0.59 44.25	0.02 1.50	2.23 167.25	2.7 202.50
Add for stoop forms and reinf lump sum	Est			2	EA	75.00 150.00	125.00 250.00	0.00	200.00 400.00	250.00 500.00
SUBTOTAL G20 SITE IMPROVEMENTS										
						3511.50	4116.75	225.80	7854.05	10557.50
SUBTOTAL G. SITEWORK										
						5010.00	4861.40	259.80	10131.20	13418.50 subs o&p=3K

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				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Thomas R. Napier and Sheila A. McCarthy				5d. PROJECT NUMBER MIPR	
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14. ABSTRACT The Old Hospital Complex (OHC) at Fort Carson, CO, was constructed in 1942 and 1943 during America's entry into World War II. The OHC originally contained wards, clinics, mess halls, support services, administration, recreation, and utility structures. The OHC was determined eligible for the National Register of Historic Places under Criterion A (association with an event, World War II). The determination of eligibility was required through Section 106 of the National Historic Preservation Act of 1966 when the Department of the Army began consideration of the 1994 OHC Utilization Plan. The Plan called for the demolition of many buildings in the Complex. Building 6237 and several other buildings would be retained; however, they would require extensive interior renovation to allow for adaptive reuse. Building 6237 was originally constructed as a standard hospital ward. The Directorate of Environmental Compliance and Management, in accordance with the Memorandum of Agreement between Fort Carson and the Colorado State Historic Preservation Office, is required to conduct a condition assessment and cost analysis for the potential adaptive reuse of Building 6237. This study identifies the current condition of the building and the costs associated with converting the building into administration space.					
15. SUBJECT TERMS Fort Carson, CO Cultural Resources Management building assessment Hospital building rehabilitation					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 102	19a. NAME OF RESPONSIBLE PERSON Sheila A. McCarthy
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