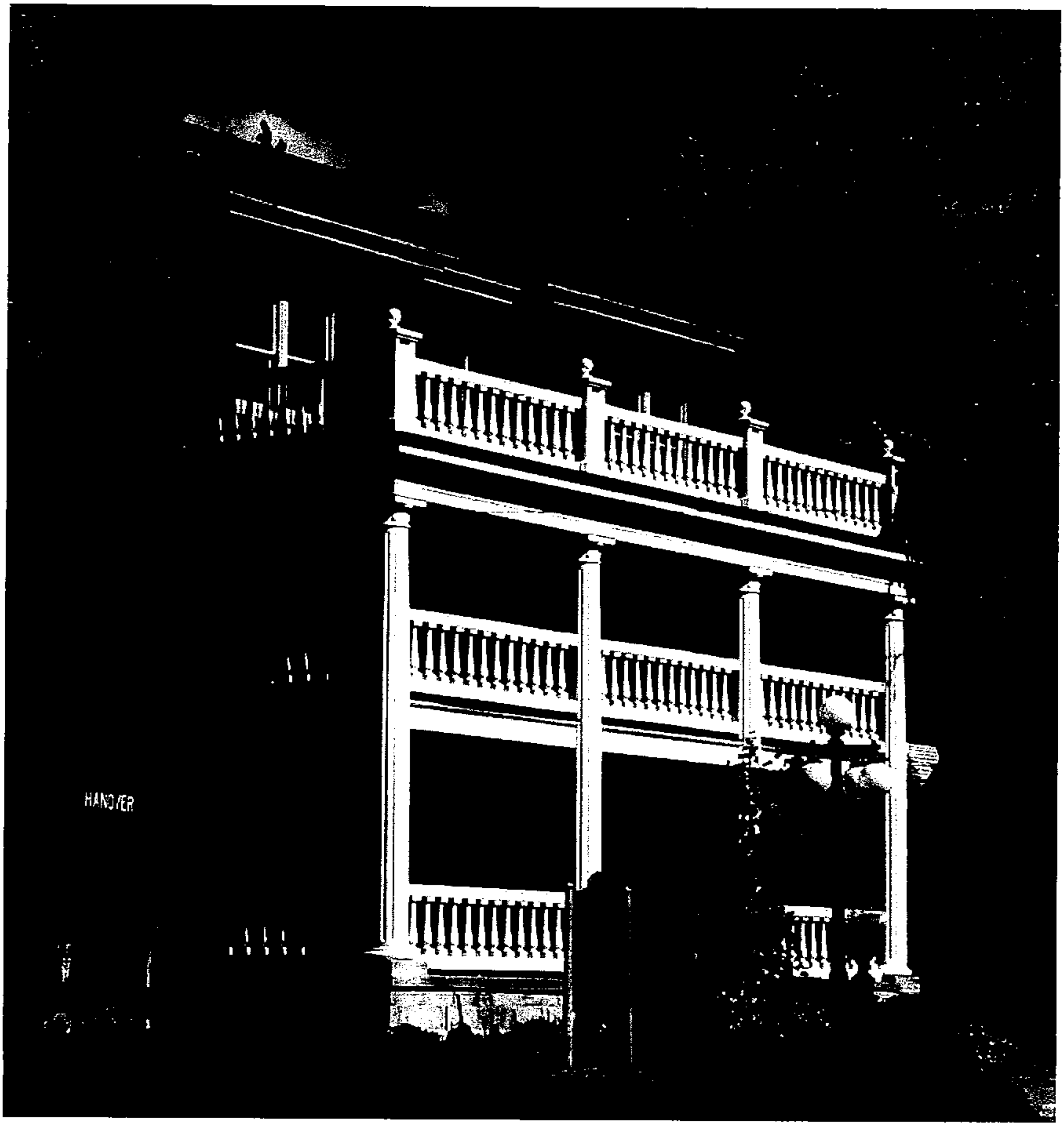
May 2005

Long Term Plan for the Rehabilitation of the Belrockton Museum and Community Center



SMITHGROUP

Long-Term Plan for Rehabilitation of the Belrockton Museum and Community Center

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Long-Term Plan for Rehabilitation of the Belrockton Museum and Community Center

This document is a long-term plan for the rehabilitation of the Belrockton Museum and Community Center. This plan refines and modifies the *Recommendations for Repair* report prepared by SmithGroup in 1996 (that report is included in Appendix 1). Specifically, updates to that report include a mechanical feasibility study, programming and layout changes based on the current goals and intentions of the Museum and City for use of the building, a preliminary structural engineering inspection and report, a code analysis of the building per the new *2003 Michigan Rehabilitation Code for Existing Buildings*, and an updated preliminary budget for the work.

This long-term plan includes recommendations for work to be undertaken during 2005, with funds currently available. This work is considered Phase 1. The remainder of the work is prioritized in Phases 2 through 4.

Exterior Repairs and Restoration

The long-term plan for the Belrockton Museum and Community Center includes all recommendations for exterior repairs and restoration as set forth by SmithGroup per its 1996 Exterior Analysis, with exception of those already undertaken. (See Appendix 1 for full copy of that report.) It is recommended that this work be undertaken as soon as possible to prevent further deterioration and provide a weather-tight and more energy-efficient building. Based on current funding, this work is included in Phases 2 and 3.

Site Modifications

The recommendations set forth in 1996 by SmithGroup remain as part of the Long-Term Plan, with exception of the landscape, which has already been beautifully completed. In addition to the recommendations for a new parking lot, work should also be undertaken to separate the storm and sanitary sewer line, followed by landscape restoration. A proposed site plan is included with the conceptual architectural drawings. Based on level of priority, this work is included in Phases 1 and 2.

Life-Safety and Barrier-Free Modifications per Code

After years of planning, the 2003 *Michigan Rehabilitation Code for Existing Buildings* was recently implemented in the State of Michigan. This new code allows flexibility for existing and historic buildings to meet life-safety requirements utilizing different strategies than those that may be required for new buildings. This flexibility is intended to preserve the historic and character defining features of buildings, while at the same time, providing the level of life-safety that is required today.

SmithGroup undertook a code analysis of the Belrockton following the provisions of the Michigan Rehabilitation code For Existing Buildings – this analysis is included in Appendix 4. This analysis was subsequently reviewed with the City Building Official and Fire Marshal to gain consensus that with the proposed modifications, the Belrockton will meet current code requirements for life-safety and barrier-free accessibility. Modifications to the building required per this analysis are incorporated in the conceptual architectural plans, and are recommended to be undertaken as the phases progress.

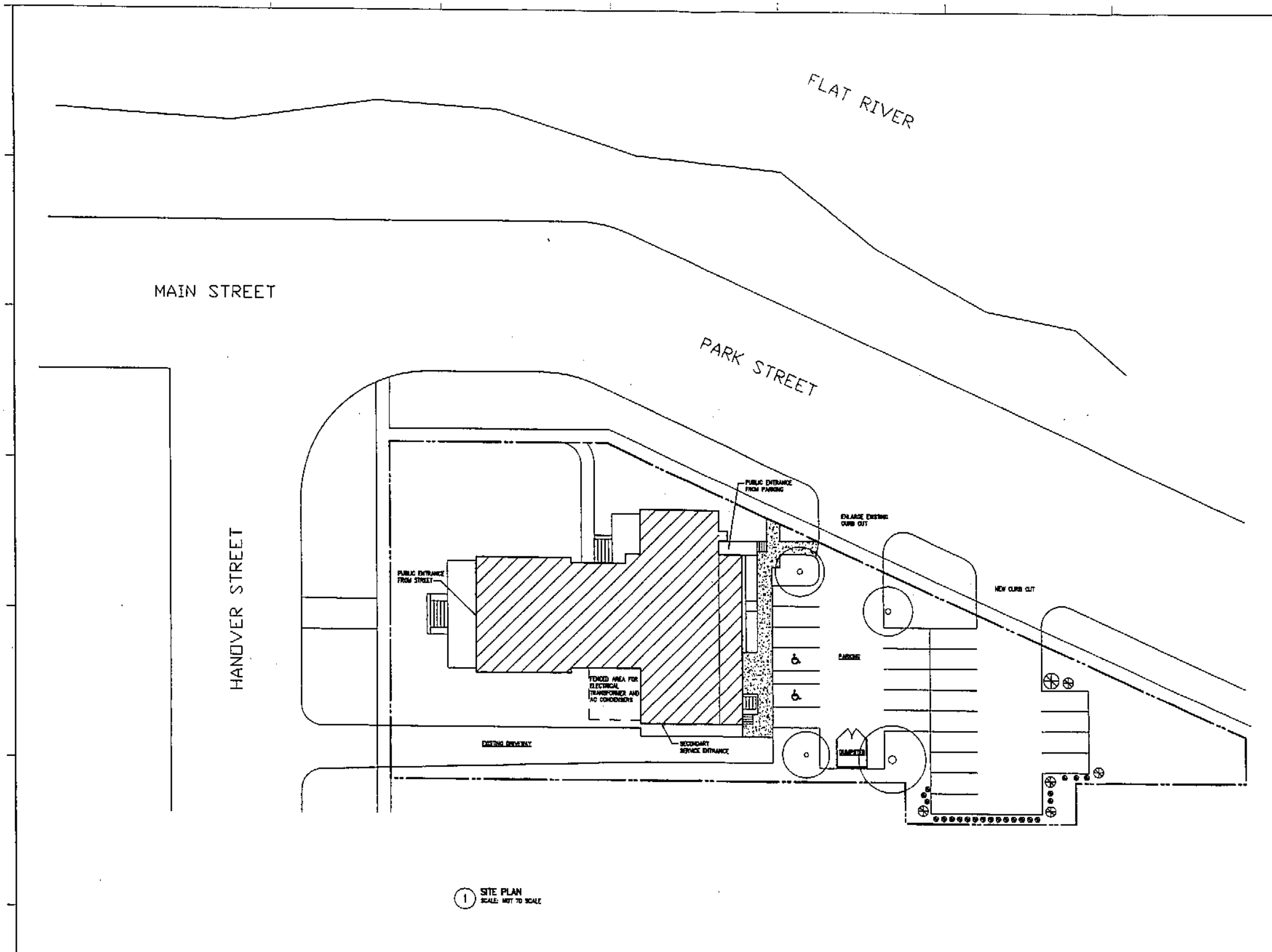
Structural Implications
Steve Rudner of Robert Darvas Associates, P.C. inspected the current structural systems of the Belrockton in January 2005. Following that review, he prepared a report regarding his observations, calculations relative to loading, and recommendations for structural upgrades. A complete copy of his report is in included in Appendix 2. Modifications to the building required per his preliminary inspection and report are incorporated in the conceptual architectural plans, and are recommended to be undertaken as the phases progress.

Mechanical System
Tom Rowan of SmithGroup undertook a review of the current mechanical systems of the building in January 2005. Following that review, he has prepared a preliminary feasibility study, including descriptions and recommendations for current systems and equipment and two options/alternatives for new heating and cooling systems for the building. A complete copy of his report is in included in Appendix 3. Modifications to the building required per this feasibility study (mechanical rooms, etc.) are incorporated in the conceptual architectural plans, and per current funding objectives are planned to be undertaken as part of Phase 1.

Programming / Conceptual Space Layout

The conceptual floor plans on the following pages indicate the proposed layout for the building. These architectural plans reflect changes to the interior layout of the building to:

- Meet the current goals and intentions for use of the building
- Meet the requirements of the *2003 Michigan Rehabilitation Code for Existing Buildings*
- Incorporate required structural modifications related to programming changes
- Incorporate changes for the new mechanical system (mechanical rooms and equipment)



BELROCKTON
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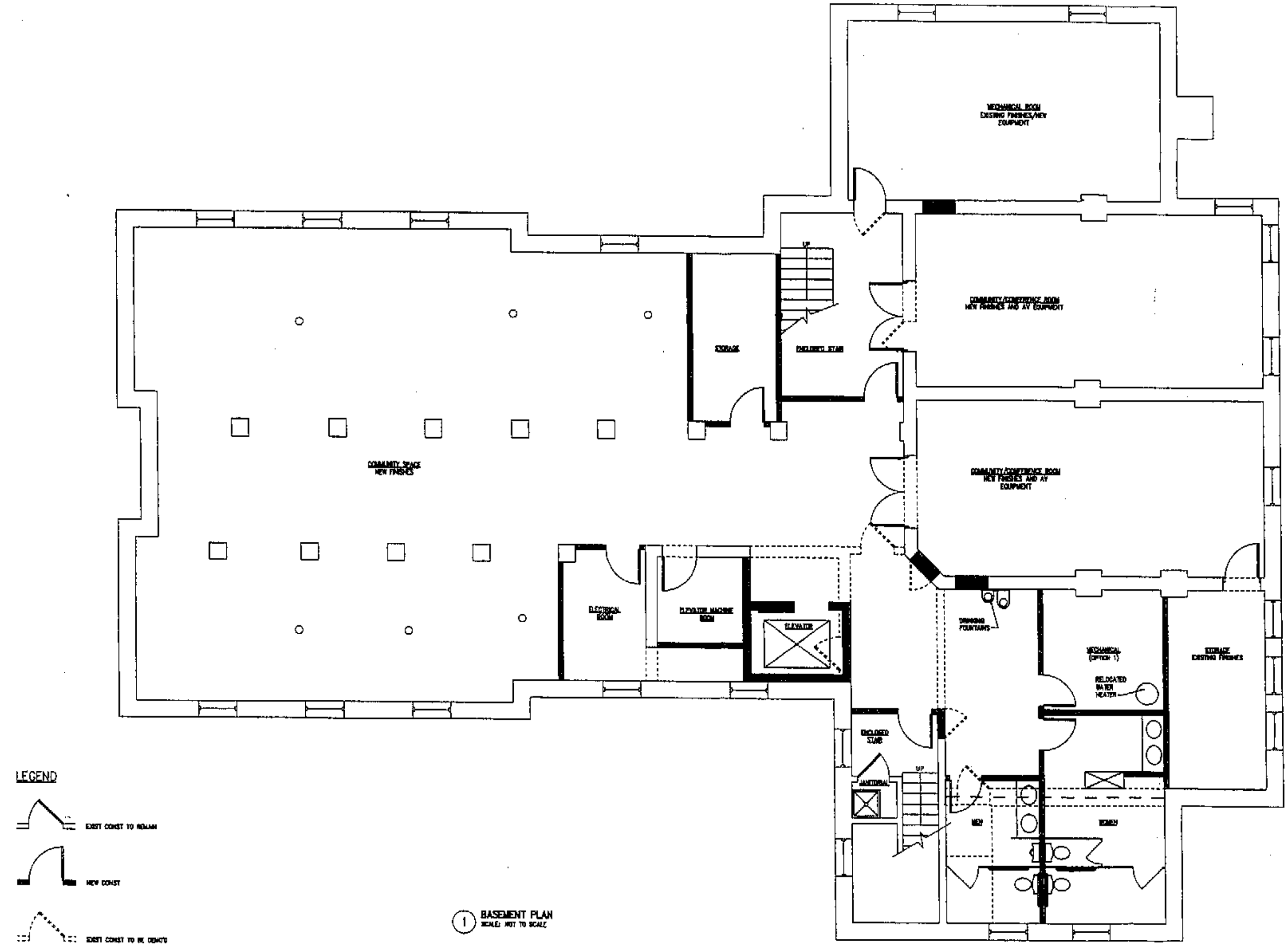
NOT FOR CONSTRUCTION

SITE PLAN

NOT TO SCALE

21972.000

A1



1 BASEMENT PLAN
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ISSUED FOR	REV	DATE
PRELIMINARY REVIEW		8 FEB 05
OWNER REVIEW		7 MAR 05
FINAL REPORT		16 MAY 05

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

PROJECT NORTH

DRAWING TITLE
BASEMENT PLAN

SCALE
NOT TO SCALE

PROJECT NUMBER
21972.000

DRAWING NUMBER
A2

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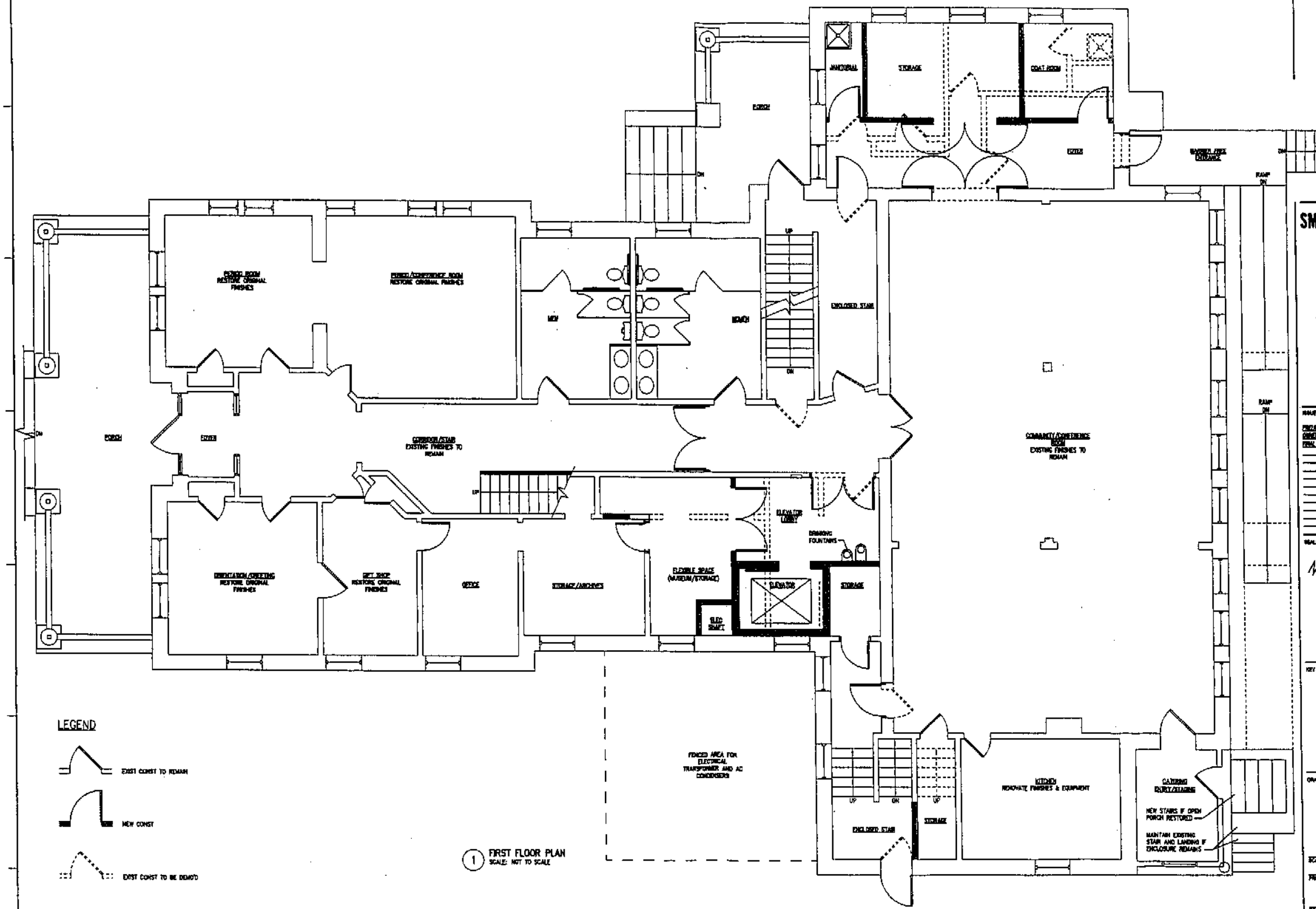

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PRELIMINARY REVIEW		8 FEB 05
OWNER REVIEW		7 MAR 05
FINAL REPORT		26 MAY 05

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

PROJECT NORTH

DRAWING TITLE

FIRST FLOOR PLAN

SCALE

NOT TO SCALE

PROJECT NUMBER

21972.000

DRAWING NUMBER

A3

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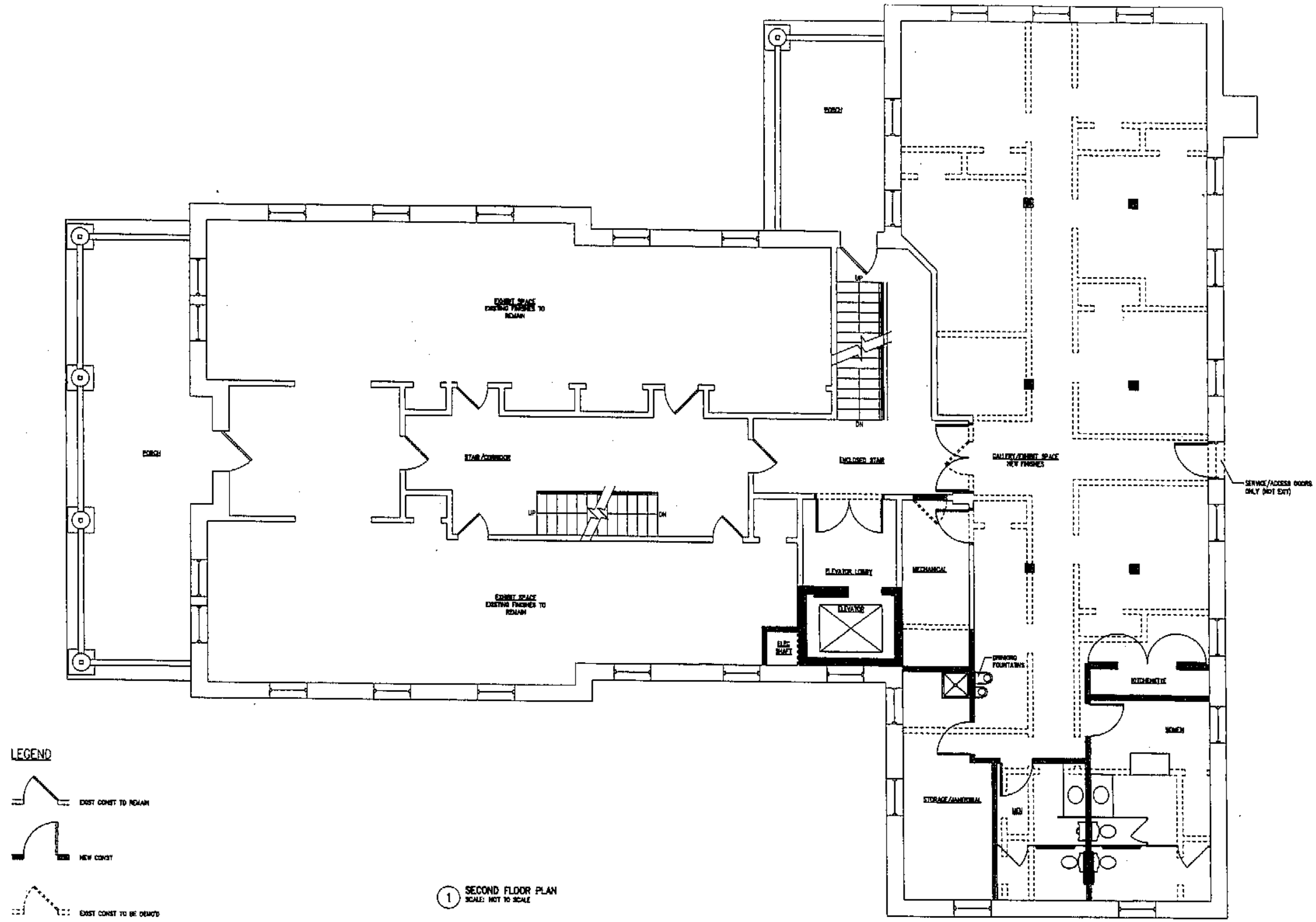

1 SECOND FLOOR PLAN
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PRELIMINARY REVIEW		8 FEB 05
OWNER REVIEW		1 MAR 05
FINAL REPORT		16 MAY 05

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

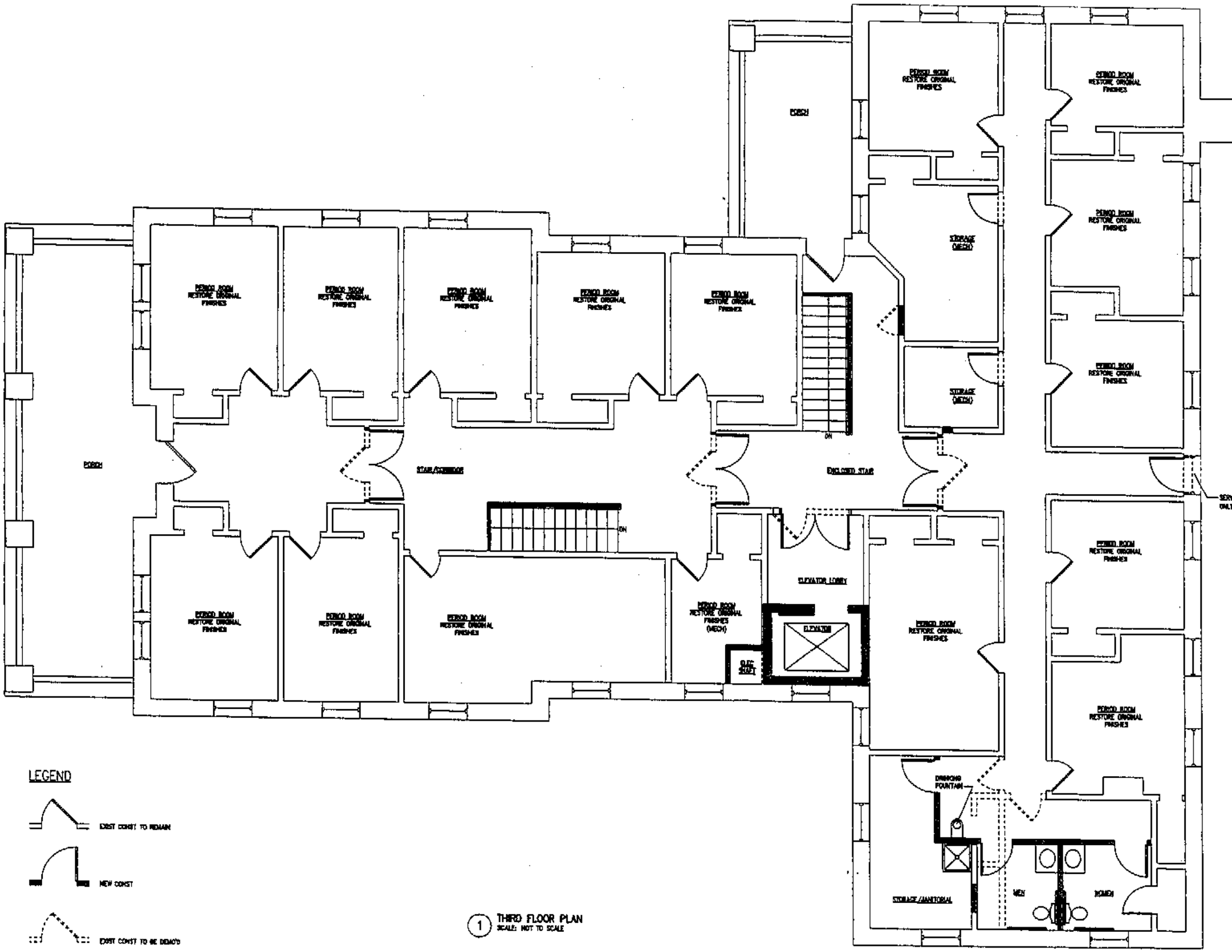
PROJECT NORTH

DRAWING TITLE
SECOND FLOOR PLAN

SCALE
NOT TO SCALE

PROJECT NUMBER
21972.000

DRAWING NUMBER
A4



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FINAL REPORT		16 MAY 05

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

PROJECT NORTH

DRAWING TITLE
THIRD FLOOR PLAN

NOT TO SCALE

SCALE
PROJECT NUMBER 21972.000
DRAWING NUMBER **A5**

Belrockton Museum and Community Center
Phasing and Costs

The following phases are based upon current funding objectives of the Museum and City, existing conditions, and proposed efficient progress toward completion of entire building (complete first floor, then second, then third, followed by basement). The associated preliminary estimates of cost are "broad brush" and reflect the conceptual level of detail that is included in this report. Further, these costs are based upon 2005 construction dollars, and escalation will need to be considered for phases undertaken in future years.

Phase 1 – 2005 Construction
Construction items per current City funding objectives:

Work to be designed by SmithGroup and bid by general contractor:	
New mechanical (heating and cooling) systems for entire building:	$100,000
Install elevator and related layout (walls, doors, finishes, electrical and lighting at elevator lobbies) modifications:	$150,000
Existing north and south stair modifications – structural upgrades, code enclosures (walls and doors), extend north stair to basement	$40,000
Miscellaneous code and other modifications: New corridor doors (pair at first floor, two pairs at third floor), electrical room in basement, electrical shaft new elevator shaft	$10,000
10% Design Contingency per conceptual level	$30,000
Architectural and Engineering Fees – 10% of Construction Cost (Construction Documents and CA)	$33,000
Work to be undertaken by City of Belding with own staff and contractor (Not part of A/E scope or bid to general contractor)	
Electrical upgrades: new service, transformer, subfeeds, breakers, panels and subpanels	$20,000
Fire alarm system for entire building:	$15,000
Separate storm and sanitary sewers, landscape restoration:	$7,500
Restoration finishes at west portion of third floor (plaster/drywall, flooring, painting, trim, etc.) No funding available for this work – to be undertaken with volunteer labor and services	$0
Total Phase 1 Budget	**$405,500**

Phase 2

Emergency lighting at first and second floors; complete remaining exterior repairs; complete layout and finishes at first and second floors:

New barrier-free accessible entrance – ramp, entry, interior modifications at northeast portion of building (foyer, coat room, janitorial):	$35,000
Structural upgrades per code and structural inspection:	$15,000
Exterior Repairs – Clean, repair and repoint brick and limestone; clean and repair terra cotta cornice	$130,000
Repair windows and install storm windows	$75,000
Complete layout and finishes at first floor – finishes at west rooms, SE porch modifications	$50,000
Complete layout, structural upgrades, finishes, lighting and electrical, kitchenette, access door at second floor – east gallery / exhibit area	$75,000
Drinking fountain at first floor; barrier-free signage at all floors	$3,000
Bathrooms and drinking fountain at second floor:	$20,000
Install emergency lighting at first and second floors:	$10,000
Parking Lot:	$50,000
10% Design Contingency per conceptual level	$46,000
Architectural and Engineering Fees (Construction Documents and CA)	$51,000
Total Phase 2 Budget	**$560,000**

Phase 3

Complete layout, finishes and electrical/lighting at third floor; insulate and attic ventilation; renovate kitchen at first floor:

Insulate roof and install attic ventilation:	$8,000
West portion of third floor: Complete finishes (flooring, paint, trim, etc.), Electrical and lighting	$50,000
East portion of third floor: Complete layout, bathrooms and drinking fountain, finishes, lighting and electrical, emergency lighting, access door at east wall third floor:	$90,000
Renovate kitchen at first floor – equipment, cabinetry, finishes	$22,000
20% Design Contingency per conceptual level	$34,000
Architectural and Engineering Fees (Construction Documents and CA)	$20,000
Total Phase 3 Budget	**$224,000**

Phase 4

Complete layout, finishes and electrical/lighting basement; extend southeast stair to basement (2nd exit):

Complete layout, bathrooms and drinking fountain, finishes, lighting and electrical, emergency lighting, extend south stair to basement:	$75,000
20% Design Contingency per conceptual level	$15,000
Architectural and Engineering Fees (Construction Documents and CA)	$10,000
Total Phase 4 Budget	**$100,000**

June 17, 1996

Janice Mehney, Secretary
Belding Museum Board
The Belrockton
108 Hanover Street

Belding, MI 48809

Re: Belrockton Existing Conditions and
Recommendations for Repair

Dear Mrs. Mehney,

This letter presents observations and final recommendations for repairs and restoration work at the Belrockton Dormitory, currently the Belding Museum and the Community Center. They are based on visual observations made at the Belrockton by Gene Hopkins and Deborah Thom of Architects Four, Inc. on October 6 and June 10, 1996. This report has been prepared at the request of the Belding Museum Board and is a preliminary road map to be used in evaluating a proposed millage, and for planning purposes. More detailed investigation would be required to produce contract documents for rehabilitation and restoration.

The analysis is divided into five main categories: "History and Significance", "Exterior", "Interior", "Life Safety and Barrier Free", and "Mechanical/Electrical". Within each section, individual materials and elements are described, the condition is evaluated, and recommendations for repairs are made. Because the Belrockton is an historic building on the State Register of Historic Places, the recommendations are made in accordance with *The Secretary of Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings*. The recommendations are followed by approximate budget costs and priorities.

BUILDING HISTORY AND SIGNIFICANCE

The Belrockton Dormitory was constructed 1906 by the Belding Brothers Silk Manufacturing Company to house 125 single women working in the Belding silk mills. It is the only one remaining of three such dormitories. The Belrockton continued as a dormitory for about thirty years, until the silk mills closed as the industry and the economy declined in 1935. In 1943, the National Youth Administration took over the building and converted it into a high school student recreation center. The dining room was changed into a dance floor, and other first floor areas were used for pool tables and the manager's apartment. The porches were removed and the second and third floors were sealed off in the 1940's, and remain largely unoccupied to this day.

The Belrockton was purchased by the City of Belding in 1950, and today it is the home of the Belding Museum, and the Community Center. The Museum was founded in 1987 and is open to the public. The Museum has recently renovated portions of the first and second floors for exhibit space. The Community Center is used by the Euchre Club, Alcoholics Anonymous, the Boxing Club, the Historical Society, the Silk City Quilters and other local organizations that use the large meeting room and kitchen.

The building was put on the State Register of Historic Sites in 1990, and a historic marker was installed on site in 1993. The Belrockton was placed on the register because it is architecturally attractive and more importantly it is a good example of the industrial practice of caring for and supervising its employees on and off the job in a communal setting.

EXTERIOR ANALYSIS AND RECOMMENDATIONS

General Description

The Belrockton is a three story brick and limestone "T" shaped symmetrical building with Classical detailing. A typical exterior elevation is divided into four horizontal sections: a limestone base, rusticated brick at the first floor, smooth brick at the second and third floor, and a terra-cotta cornice. Approximately 120 wood double hung windows and 40 fixed sash windows are spaced regularly along the facades. The roof is flat, and is not visible from the street. The primary entrance is from the West, into the long end of the "T". The doors are in the slightly recessed center of three vertical bays. The existing portico and concrete steps are not original, but replace the historic three story wood balconies and limestone steps. There is a second porch in the Northwest corner of the "T", which is also a replacement for the historic balconies. A third entrance and concrete ramp has been added to the East, or rear, elevation.

Exterior Analysis

Limestone Base

The limestone base is approximately 5 feet high, is continuous around the perimeter of the building, and is capped with a projecting coved limestone sill. The limestone is smooth and laid in an ashlar pattern with narrow mortar joints. The base stones are in good condition overall, with a few exceptions. Only a few of the stones are cracked, and these are minor cracks that can be patched. Approximately 25% of the mortar joints have weathered and need to be repointed. The surface is dirty or stained in some places. At the down spouts on the Northwest and Southwest corners, this is a particular problem because the down spouts are leaking and there are water and rust stains as well as green algae stains. There is a similar problem at the side porch, where water runs unchannelled off the top of the porch roof. In addition to minor scattered holes and patches, there is a 30 S.F. area of concrete infill at the former side porch. There are also three stones that have been patched with concrete at the new side porch steps. The joint between the steps and the stone is inelastic, therefore the movement of the concrete has pulled and damaged the stone. A similar situation exists on the East elevation where an inelastic joint and movement of the chimney has damaged another four stones.

The limestone cap under the first floor windows is also in good condition. No cracked stones were noted, and fewer than ten stones have been chipped. However all of the mortar joints have weathered or deteriorated, and this is causing problems. The cap is built of two pieces - a projecting rectangular piece and a cove under the projection. Water penetrates the open joints at the top, and freeze thaw action forces the joint between the cap and the cove to expand. This shifts the cap up, and leaves a space for more water to run off the cap and behind the cove, which is a potentially serious problem that will raise the cap and sills and let water in behind the limestone base. At this time, there are only about five cap and cove stones which have moved enough that they need to be reset.

Brick Masonry

The brick masonry is a terra-cotta color hard fired brick in a running bond pattern. The mortar joints are fine, untinted, and very close to the brick surface. Overall, 50% of the mortar joints have weathered and need to be repointed. With a few exceptions, the walls appear to be structurally sound. The masonry is adhered to the substrate, and there is no evidence of bowing. Other problems, and specific causes of the deterioration are described below.

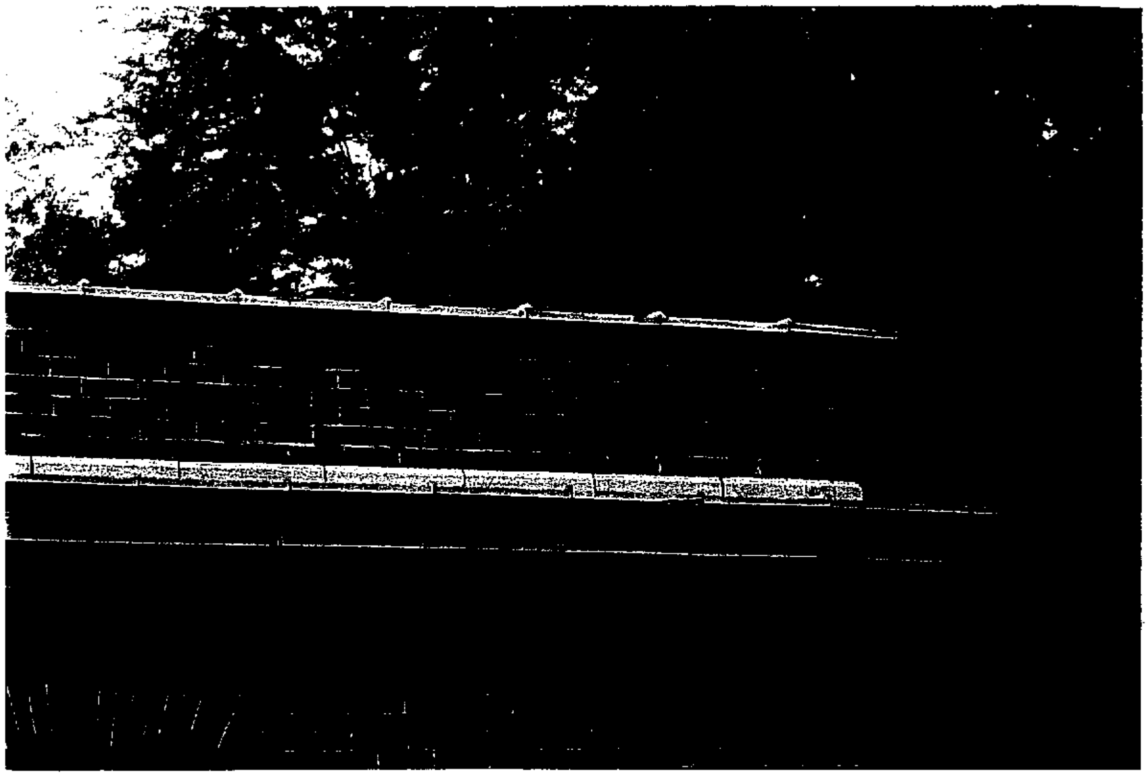
The first floor is detailed with masonry in a running bond pattern with projecting belt courses to simulate the look of rusticated stone. In general this portion of the masonry is in better condition than the rest of the building. A limestone band, which also forms the sills for the second floor windows, wraps around the building and divides the first floor from the second and third floors. There are a two courses of corbelled masonry below this band. Staining, mortar deterioration, and some spalling and cracking is concentrated in this corbelled area. The deterioration is caused by open sky facing joints on the limestone band that let in water. The sealant between the window frames and the limestone sill has aged and cracked, and this may also allow water to enter the masonry wall. Furthermore, because there isn't a grooved drip edge on the underside of the limestone, some of the water that runs off the sill, is pulled back to the wall, and wicks back into the mortar. The staining is a combination of leeching of minerals in the brick and a chalky accumulation of paint that has run off the cornice.

The second and third floor walls are masonry in a smooth running bond pattern. This portion of the facade has the usual amount of mortar deterioration, but there is more cracked and spalling masonry than on the first floor. Most of the damage is concentrated around the window openings, especially at the window heads. The second floor windows heads are detailed with bricks in a fanned pattern and limestone keystones. The third floor windows have the same fanned brick pattern, but no limestone. Steel lintels support the outer whythe of masonry, but wood lintels are visible from the interior and support the inner whythes. Water has entered through deteriorated joints, and has been channeled by the vertical joints in the fan pattern back toward the steel lintels. The lintels have probably rusted and expanded, in addition to the typical freeze thaw expansion of the mortar. The force of the movement has shifted the bricks slightly. In some cases the result is fine cracks in the mortar joints running diagonally from the window corners, and in others the bricks themselves have cracked. It is more of a problem on the East elevation, where the unoccupied second and third floors are unheated. All of these areas can be repaired without replacing the lintels, or resetting the bricks. However, it is a severe problem on the West elevation, where the bricks are cracked and visibly loose and sagging at the corners of two windows. The situation is made even worse by the fact that leaking down spouts add more water.

There is about 150 S.F. of brick that has been painted to cover the damage where the historic porches were removed, and 30 S.F. of mismatched brick infill in former door openings on the West elevation. There is 5 S.F. of bricks chipped and broken by impact.

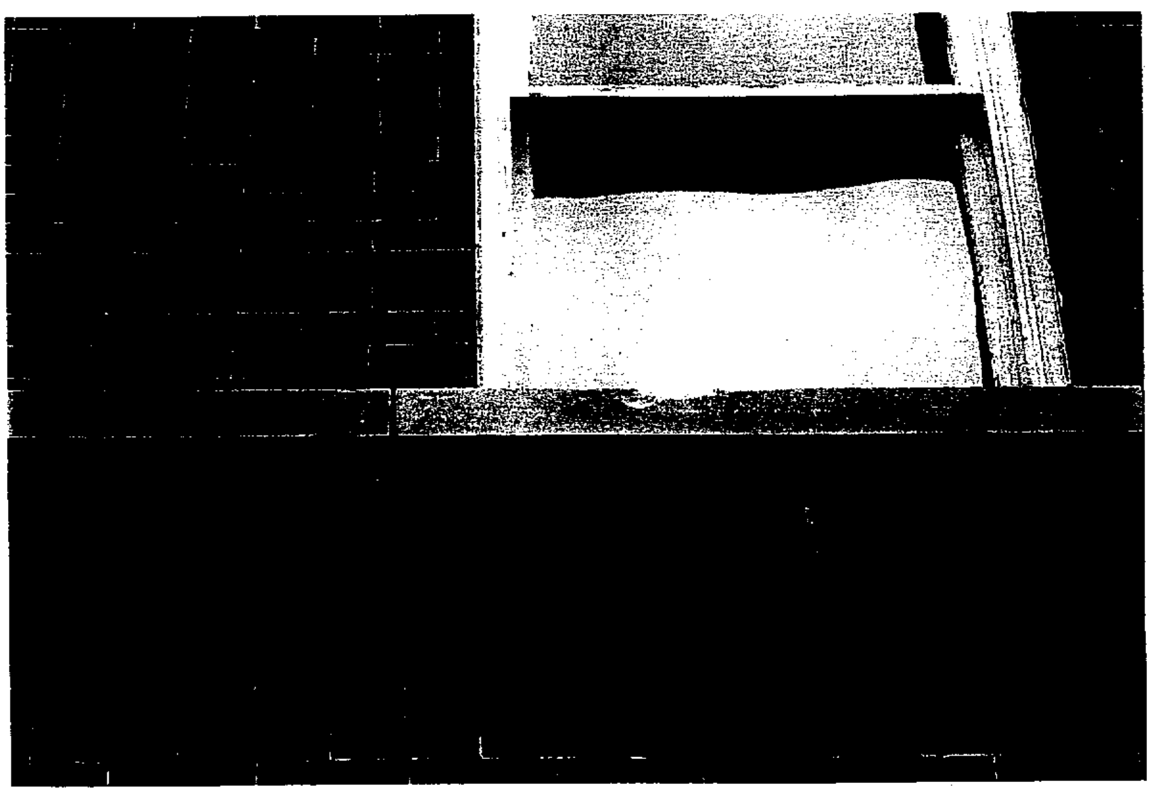
Window and Doors

There are approximately 160 original wood windows at the Belrockton. Forty of them are small fixed sash basement windows in the limestone base. The remaining windows are one over one double hung windows measuring 3' x 5'. The windows are in fair to good condition, with the first



(Above) The joints in the terra-cotta cornice are open and allow water to enter. This will eventually crack the terra-cotta and cause it to become loose, sag, or fall off. The mortar joints in the parapet section above the cornice are especially deteriorated because the roof flashing lets water into the mortar joints.

(Below) The corbelled brick courses below the second floor windows are typically stained by water and cornice paint residue. The sky facing joints in the limestone sill, and the sealant between the window frame and surrounding stone and brick have deteriorated. Water can enter into these joints.



(Left) The steel lintel over this window on the West elevation is rusted because water has entered into deteriorated mortar joints. Freeze thaw action in and between the joints has forced the bricks to crack and shift. The down spout also traps water against the wall which increases the problem. This is an extreme case which exists in four locations on the West elevation.

(Below) Open mortar joints in the limestone allow water to enter. Freeze thaw action then shifts the cap stone and the coved stone below. The shifted cap stone has cracked the corner bricks. In this instance, the down spout has trapped more water against the building, and rust and algae stains are present.

floor and second floor Museum windows in the best condition, and the windows on the third floor in the worst conditions. There is one boarded up window on the second floor, and four boarded up basement windows. All windows need to be repainted, weather-stripped, and recaulked. There are about 25 broken glass panes. About half of the sash cords are broken, which makes the windows difficult or impossible to operate. Most of the sash lifts and locks are in place, but about 25% are missing or broken. The sash and frames are in pretty good condition, with the exception of the third floor windows where water has caused some rot at the meeting rails, and splitting of joints. Nonetheless, all of the sash seem repairable. There are historically inappropriate aluminum storm windows on the first floor windows, and aluminum screens on the basement windows.

On the front elevation, the aluminum front door and sidelights are anachronistic. The original second and third floor doors to the balcony have been removed, and the openings have been filled with masonry and small windows. On the South side there is one original door with a non-historic screen door to the basement in fair condition. The three wood and glass doors at the North side porch may be original. They lack weather stripping and thresholds, and water is blowing into the building. The back door and screen door are later additions.

Cornice

A denticulated terra-cotta cornice runs around the building perimeter at about 3 feet from the top of the roof line. There is a brick parapet wall above the cornice, which is topped by another terra-cotta cove cornice. This area of masonry in particularly poor condition. There is extensive mortar deterioration, staining, and loose brick.

The terra cotta cornices on the building are in good condition and show no signs of significant deterioration or loss of structural integrity. However, the mortar joints between the terra cotta pieces are in need of replacement. In most places the mortar is missing so it is only a matter of time before water penetration will cause significant damage to the terra cotta, which is a very expensive material to replace. The terra-cotta appears to have a chalky coating of paint. As described above, this coating is washing down the building and the pigmented residue is accumulating under the second floor windows.

Roof

The roof is not the original roof. Some years ago it was replaced with a built-up roof with insulation installed over the existing wood roof boards. The extensive plaster damage at the third floor indicates the roof is leaking. It is in need of immediate replacement. Some of the roof boards may have also rotted due to water penetration. The parapet flashing has pulled away from the parapets leaving a gap of up to 1/2". This is in need of immediate attention because the gap allows water into the roof structure and then into the building as well as into the parapet wall. As mentioned above, the parapet wall is in poor condition.

The built up roof over the meeting room at the East is also deteriorated, and the gutters are clogged with leaves and branches. There is not evidence of leaking on the interior, however the tin ceiling would conceal damage for a long time. The small roof over the side porch, aside from being anachronistic, is catching and dumping water on the porch, limestone, and brick masonry. The walls around this roof are stained. The portico roof is asphalt shingles in good condition, but this whole structure is historically inappropriate. As discussed above, the down spouts from this roof are leaking and causing damage to the adjacent stone and brick.

Porches
The building has gone through several exterior modifications. The current front porch is not original, the side porch has been modified and an exterior barrier free ramp has been installed at the back. The original front porch was a three story wood balcony supported on fluted wood columns. The wood structure sat on a limestone porch base, which remains. The limestone base is in fair condition. All of the joints need to be repointed, and half of the stones are stained with dirt and algae. Almost all of the stones are spalling near the mortar joints. The original steps were probably limestone, but they have been replaced with concrete steps. There was also a wood balustrade around the porch at each level, and no handrails on the steps. The present tube steel handrail is historically inappropriate.

There was a similar three story porch with balconies and a limestone base on the North side, which has been removed. The foundations for this porch are still visible. The small concrete porch and steps are historically inappropriate.

Landscape issues
There is some vegetation very close to the base of the building. These plants can trap water at the vulnerable limestone base. On the South side, the grade is only slightly below the basement window sills, and water could run into the basement windows. Trees on the North and South have branches very close or touching the brick.

Exterior Recommendations

Limestone
- Repoint limestone where needed, approximately 25% of the base, and all of the cap and horizontal banding, and all of the porch base.
- Reset several limestone cap stones.
- Install elastic joint between chimney and limestone.
- Remove concrete patching and replace spalled stones.
- Concrete patching at the side porch can remain until porch is restored.
- Consolidate cracked stones.
- Clean all limestone with a low pressure detergent and water wash.

Brick
- Repoint mortar joints where needed, approximately 50%.
- Replace spalled, cracked, or chipped brick.
- Rebuild detached areas on West elevation.
- Remove mismatched brick infill on West elevation.
- It is not necessary to install new steel lintels.
- Clean all brick with a low pressure detergent and water wash.
- Painted brick areas can remain until the porches are restored.

Windows and doors
- Repair rotted or split window sash.
- Repair broken glass.
- Repair broken sash cords.
- Replace missing sash locks and sash lifts.
- Weatherstrip all windows.

- Paint all windows.
- Install new sealant around all windows.
- Remove plywood infill, and replace with windows to match originals.
- Remove anachronistic aluminum storm windows and if storms are desired, replace with interior storms.
- Repaint all doors.
- Weatherstrip all doors
- Remove aluminum front door and replace with historically appropriate doors.
- Remove screen doors.

<u>Cornice</u>
- Remove paint from terra-cotta.
- Repoint all joints, and inspect for loose terra-cotta pieces.

<u>Roof and Drainage</u>
- Remove existing roof and flashing. Install a new roof and flashing over the main building and the meeting room. Replace rotted roof boards.
- In the long term, remove the porch roofs as a part of the porch restoration. In the interim, repair the existing down spouts and install splash blocks under the down spouts. Add gutters and a down spout to the side porch roof.

<u>Porches</u>
- Repoint the limestone base.
- Using photographic evidence, replicate the original porches, starting with the front porch.
- Remove brick infill and replace doors on West Elevation.

<u>Landscape</u>
- Remove planting from building base
- Trim trees.
- Slope grade away from window sills to provide positive drainage.

INTERIOR ANALYSIS AND RECOMMENDATIONS

Interior Analysis

The original interior had 40 sleeping rooms on the upper floors and a dining room, kitchen and sitting rooms on the first floor. The rooms are organized around a central East/West corridor and open stairwell off of the corridor. There is a total of 14,150 S.F. on the first, second and third floors, and another 4,720 S.F. in the full basement. The entire first floor, and the west half of the second floor are finished and occupied.

The occupied areas have been changed considerably over the years, but the central corridor and stair still retains much of the original historic fabric including interior doors, door hardware, door casings, wood base, chair rails, stair railings and newel posts. Most of the woodwork has been overpainted, except for the stairways which have been partially refinished. The plaster ceilings have been covered with glued on ceiling tiles. There is an acoustical suspended ceiling in the foyer. The plaster above this ceiling has been removed, and the original wood lath is exposed. The carpet is relatively new and in good condition. The walls have been recently painted, and there is only minor chipping at corners.

The former sitting rooms off of the corridor are now used for Museum exhibits. On the first floor, all of these rooms have been redecorated and wallpapered. The paper is in good condition, although not necessarily in keeping with the historic finishes. The ceilings in these rooms are also glued on ceiling tiles over the original plaster. Wood trim, as described for the corridor, is still in place in these rooms. Two of the first floor rooms have been converted into public toilet rooms. The walls are paneled and there is sheet vinyl on the floors. The toilet partitions are painted plywood. All of the finishes and fixtures are dated, worn, and historically inappropriate. The restrooms do not meet Barrier Free code. This is explained in the Barrier Free section below. Two other areas are unfinished - the stairwell in the northeast corner of the "T" and the room across the hall to the south near the basement door. The stairwell has been partially renovated, but trim and final coats of paint and varnish weren't applied, and the room is currently used for storage. Some walls in the room near the basement entry have been stripped down to bare studs and ceiling framing is exposed.

The original dining room on the east end was expanded to include a portion of the original kitchen and the large room is currently used as a meeting room. The original pressed metal dining room ceiling remains in good condition. A five foot long portion of the cornice and 10 S.F. of the ceiling have been repaired with mismatched sheet metal. The ceiling over the original kitchen portion is drywall. The dining room floor is unfinished hardwood, but the kitchen portion of the room is sheet vinyl. Because the hardwood floor is unprotected, it is getting stained and scuffed. The original plaster walls and columns have been covered with paneling. The original five panel doors remain, but the door and window trim has been removed and replaced with narrow wood trim to match the paneling. All of the finishes are in good condition, but they are historically inappropriate.

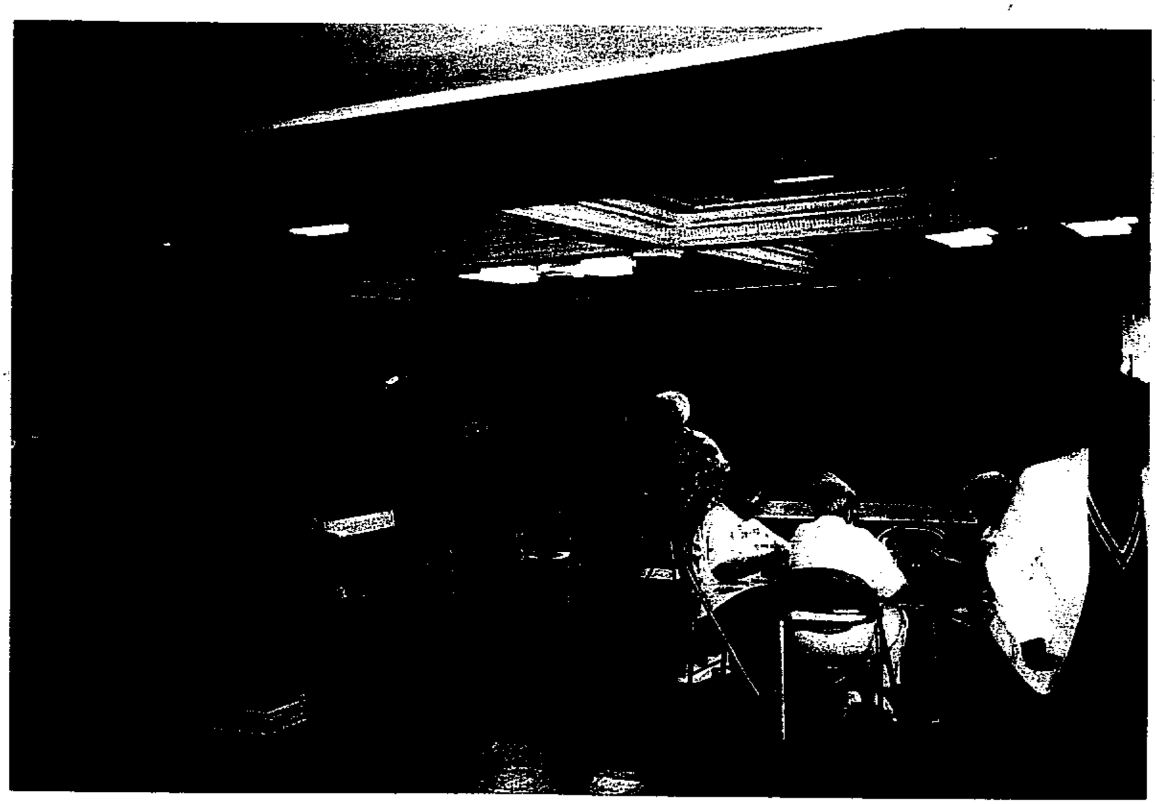
A small kitchen, with two electric ranges, a refrigerator and a sink is situated to the South of the meeting room. The walls are paneled, the ceiling is covered with glued on ceiling tiles, and the floor is sheet vinyl with a wood base. Again, although the finishes are not in bad shape, they are dated, worn, and historically inappropriate. If the kitchen is to be used for commercial or large functions, some changes may be required by the health department.

On the second floor, the West end rooms and corridor have been renovated, with new finishes and trim and drywall walls and ceilings. Original partition walls have also been removed to provide larger exhibit areas. These rooms are in good condition, although there has been some water damage where water has leaked through the roof and third floor.

The entire third floor and east half of the second floor are unoccupied. The second floor and part of the third floor on the east end have been gutted, but it is not clear why this was done. Plaster has been removed from the walls exposing the exterior masonry walls and the interior wood studs. All doors and wood trim and hardware have been removed, and has been left in the demolished areas. The west end of the third floor has not been demolished, but it is in poor condition due to neglect and water damage. Nearly all of the plaster ceiling has delaminated and fallen to the floor. The plaster walls are also water damaged and are delaminating. The wood trim has its original transparent finish, but this has cracked, or "alligatored". There is an original shower room on the third floor. None of the fixtures are in place, and the finishes are in poor condition like the rest of the third floor. These areas are also being used for storage of various museum artifacts, unwanted refuse and things left behind over the last 50 years.

(Left) The third floor ceiling and walls are severely water damaged, and the plaster has delaminated. In this case, some of the plaster was replaced with homosote boards which have also become water saturated and are bulging an sagging.

(Below) The meeting room is made up of the original dining room (with a tin ceiling) and a portion of the original kitchen. Renovation plans include removal of the wood paneling, installing new lighting, finishing the original wood floor, and replacing the partial vinyl floor with a wood floor.



The basement was dry and exhibited no indication of water infiltration. First floor framing, visible from the basement, is 2x12's at 16" o/c. in good, undeflected, condition. Most of the basement has been painted and is used by the Boxing club. The remaining portions are used for storage and mechanical space.

Interior Recommendations

•Restore corridor and first floor exhibit rooms including:

Remove glued on ceiling tiles or suspended ceiling and restore original plaster ceilings, or replace with drywall ceilings.
Repaint with appropriate historic colors.
Strip and refinish wood trim.
Apply varnish to recently refinished stairwell.

•Finish north stairwell and room adjacent to basement door including:

Paint.
Apply finish coat to refinished stairwell wood trim.
Install wood trim.
Install drywall on exposed studs.
Remove paneling and repair plaster.
(Note that repairs to the south room should be coordinated with potential elevator installation in this area.)

•Renovate toilet rooms including:

Remove and replace all finishes.
Install new toilet partitions.
Install new fixtures. Review layout and fixture selection with respect to barrier free requirements.

•Refinish meeting room including:

Finish hardwood floor in meeting room.
Replace vinyl flooring in meeting room with wood floor.
Remove paneling from meeting room walls, and repair existing plaster beneath.
Remove meeting room door and window trim and replace with historic.
Patch pressed metal ceiling with pieces that are closer to the original.
Possibly apply a textured wallpaper and wood crown molding to the remaining ceiling to ease the contrast with the pressed metal ceiling.

•Renovate kitchen including:

Renovate kitchen finishes and cabinets.
Possibly update appliances as required by use or health code.

•Basement

It is assumed that the basement will stay as is, and no recommendations or costs have been made for this area.

•<u>Finish second and third floors including:</u>
Remove construction debris. Save architectural elements and hardware.
New plaster or drywall walls and ceilings.
Refinish and reinstall salvaged doors and trim.
Install new carpet.
Paint in appropriate historic colors.
Removal of existing original partition walls is strongly discouraged.

BARRIER FREE AND LIFE SAFETY

Barrier Free and Life Safety Analysis

The building currently does not meet the State of Michigan Construction Code for barrier free access. A concrete ramp has been installed at the rear of the building for access to the first floor. Although the ramp serves its purpose, and has certainly *increased* accessibility, it is not in compliance with current codes. The slope is greater than 1:12, and the intermediate landing is too short. Also, it is 52" wide whereas the requirement for exterior ramps is 60"wide. There is not enough clearance between the ramp slope and the door swing. The handrails are not up to code because there are too many open spaces that a person's leg, or a wheel could slip through and over the edge. The rear door itself is also not in compliance. The door knob requires a twisting action that is often not possible for people with disabilities. There isn't enough clearance between the latch side and the nearest wall. Most importantly, the only means of egress for the handicapped is through an unfinished storage space that is only reached by traveling through the assembly room. This is unsafe, and not allowed. The storage area is 1 1/2" below the level of the meeting room. A temporary wood wedge has been installed to make the transition.

There is no barrier free access to the upper floors. Preliminary code research indicates that a Special Elevating Device (SED)would not be allowed for this building. Special lifting devices are only allowed to travel 15', but the distance from grade to the third floor is approximately 25 feet. It may be possible to get approval from the State to use the SED, but a full size elevator may be required.

Access through the first floor is somewhat limited. The minimum required door clearance for a wheelchair is 32", but the typical interior door clearance is 30". It would be difficult for a person in a wheelchair, or with a walker, to move in between the exhibits. The restrooms do not meet current barrier free requirements, although grab bars have been installed and two stalls have been enlarged to make it easier for the handicapped.

Exit signs, smoke detectors and emergency lighting have recently been installed in the building corridors and stairways. Building code requires two enclosed means of egress from each floor. Currently neither of the stairways are enclosed with fire rated walls. It is likely that a variance could be obtained to leave the central stairway unenclosed, but it may be required to either provide a new enclosed stairwell, or to enclose the existing north stairwell. The building is also taller than it is allowed to be per current code for its construction type and assembly use. Code limits unsprinklered assembly buildings of masonry exterior and wood interior to 2 stories and 30". Although a variance may be granted, this is another code issue to be dealt with. Enclosed stairs and building limits will become more of an issue when and if the Museum expands to the second and third floor. At that time the building will probably be scrutinized more closely and previously acceptable situations may need to be altered.

Other life safety issues are lack of guardrails on the front and side porch, lack of handrails on the side porch, and rear and side exits obstructed by goods in storage.

Barrier Free and Life Safety Recommendations

- The existing ramp might be approved if new hand and guardrails were added.
- While the rear ramp and entrance is to remain in use, install new lever door hardware. Provide permanent and stable transition between rear foyer and the meeting room floor.
- Install a new elevator, or if allowed a smaller, less expensive, Special Lifting Device.
- Renovate first floor restrooms including new sinks, urinals, grab bars at appropriate mounting heights and to allow required clearances at doors and around fixtures.
- Install a sign at the front door indicating the location of barrier free entrance, and a sign at the Barrier Free toilet rooms.
- It is not feasible to widen all the interior doorways, but it may be possible to obtain a variance and keep the existing clearance.
- Railings will be provided around the porches as a part of the porch restoration, but in the interim, install temporary railings.
- Do not store items in corridors or in front of doors. These would be dangerous in an emergency.
- Determine if an enclosed stairwell will be required.

MECHANICAL /ELECTRICAL

Mechanical/Electrical Analysis

The original building was heated with steam heat (radiators). It was also electrified, with a light fixture in every room. The current heating system is a mix of steam heat, forced air, and electric base board heat. A new furnace has been installed on the second floor to heat the exhibit areas. This furnace was reportedly sized to also service the East half of the second floor, but this area is currently unheated. The entire third floor is unheated, with no systems connected to this floor. There is a mix of fluorescent and incandescent, and track lighting throughout the building. None of the fixtures appear to be original, and many are historically inappropriate. The electrical wiring in the exhibit spaces is not up to date, and probably not up to code. There are a limited number of electrical outlets, and little central switching for lighting control.

Mechanical/Electrical Recommendations

- Remove fluorescent lights. In corridors and main public rooms, replace with historically compatible fixtures. In exhibit rooms, replace with lighting as needed to display artifacts.
- Upgrade electrical wiring, including installation of switching and outlets as required by electrical codes.
- Extend forced hair heat from second floor furnace to the east end.
- Provide heat to third floor. This could be done by extending the existing radiator heat, or by installing a new furnace and ductwork for forced are heat.
- Upgrade first floor heating system. Either repair radiator heat, or install forced air heat.

BUDGET COSTS AND PRIORITIES

The costs below are based on current (June 1996) data, and are approximate. They do not take market fluctuations or inflation into account.

Urgent items (1-2 years)

Repair roof	$28,000
Temporarily repair drainage at front and side porch	300
Repoint and repair brick	25,050
Repoint and repair limestone	12,750
Clean brick and limestone (this is not an urgent, but should be done with other masonry repairs while scaffolding is in place)	16,500
Clean and repoint terra-cotta cornice	13,000
Subtotal for Urgent Items	*95,600*
Plus contingency and professional fees (15%)	*14,340*
Total Approximate Cost of Urgent Items	***$109,940***

High Priority Items (3-5 years)

Barrier Free Items	
Renovate 1st floor restrooms for Barrier Free	$18,500
Install Elevator (allowance) (if S.E.D. is approved, approx. cost is $45,000)	75,000
Add Barrier Free Signage	200
Add Barrier Free door hardware	200
Modify Rear Ramp	2,000
Life Safety Items	
Add handrails and guardrails	1,200
Provide safe and clear passage to exits.	By owner
Fire rated enclosure of north stair (if required)	15,000
Repair windows	32,000
Repair existing doors	750
Replace aluminum front door with historically appropriate doors	5,000
Subtotal for High Priority Items	*149,850*
Plus contingency and professional fees	*22,477*
Total Approximate High Priority Items	***172,327***

Second Priority Items (5-10 years)

Landscape items .... By owner

Interior Renovations

Remodel kitchen. $7,500
Remodel/restore Meeting room 27,500
Finish Second and Third floors 110,000
Finish North stairwell area and South storage room area 5,500
Remove glued on ceiling in first floor exhibit rooms and 6,500
in first floor corridor, repair plaster.
Apply finish coat of varnish to stairway 250
Paint corridor walls with historic colors 750

Electrical and Mechanical Items 90,000
New light fixtures
New wiring
Heating
Extend Second floor system
New Third floor system
Repair First floor system

Subtotal for Second Priority Items $248,000
Plus contingency and professional fees $37,200
Total Approximate Second Priority Items.. $285,200

Long Term Items (10 years and beyond)

Restore front porch, including doors to balconies $60,000

Restore side porch 30,000

Strip and refinish all first and second floor painted woodwork. 15,000

Install interior storm windows 16,000

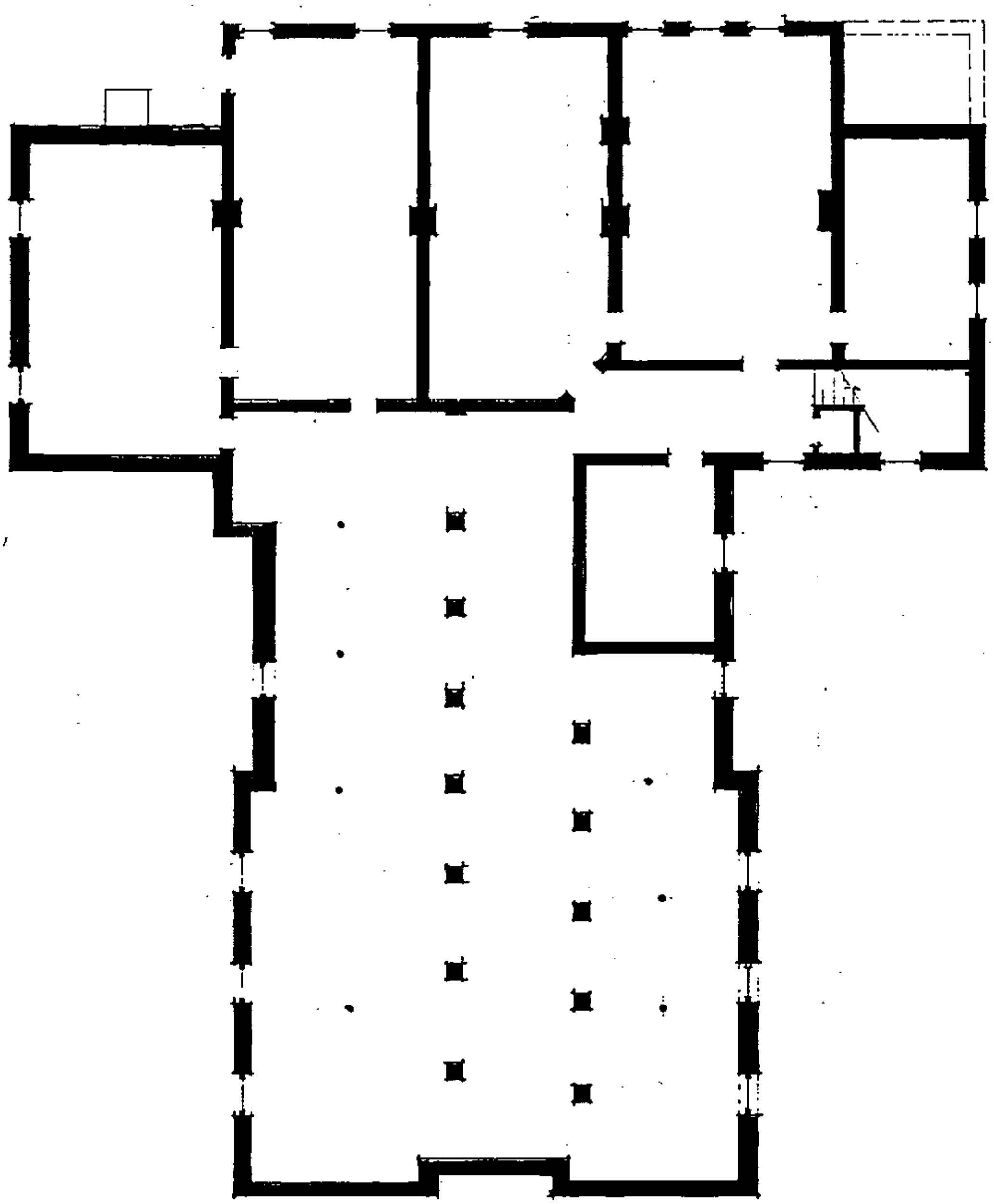
Subtotal for Long Term Items $121,000
Plus contingency and professional fees $18,150
Total Approximate Cost of Long Term Items $139,150

TOTAL APPROXIMATE COST OF ALL ITEMS 706,617

Sincerely,

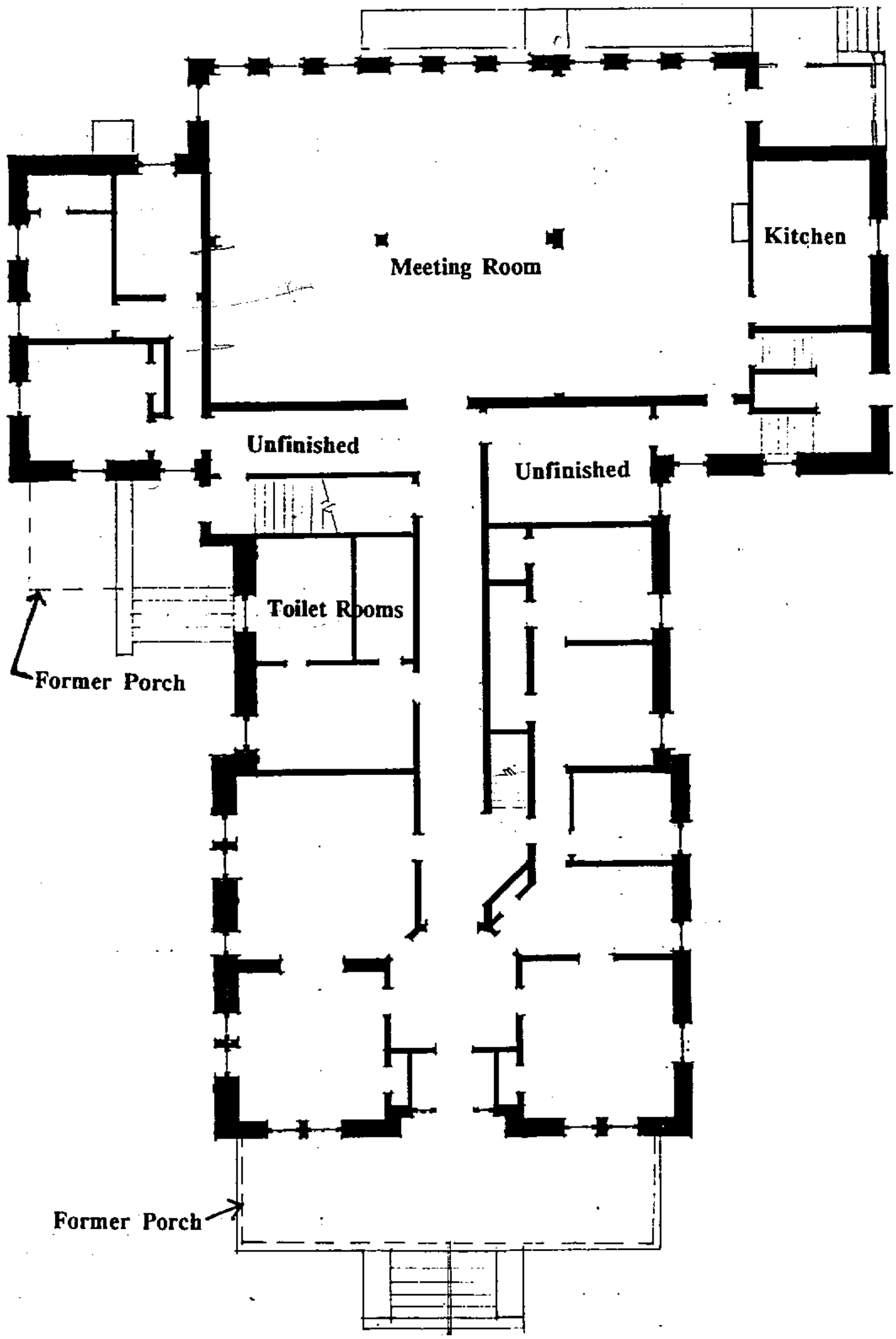
Deborah Thom, Architects Four Inc.

dt / L061296 Belrockton Report

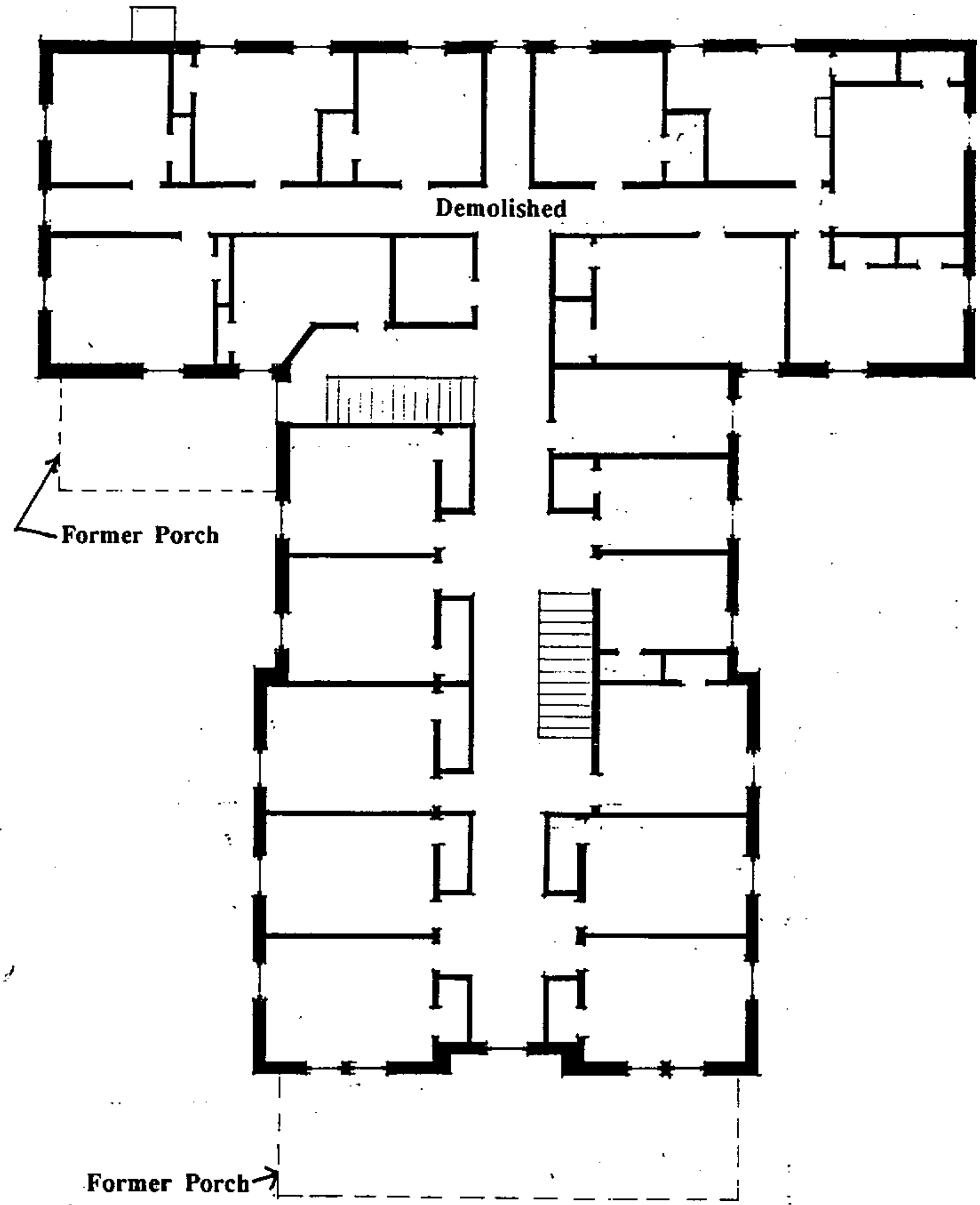


EXISTING BASEMENT

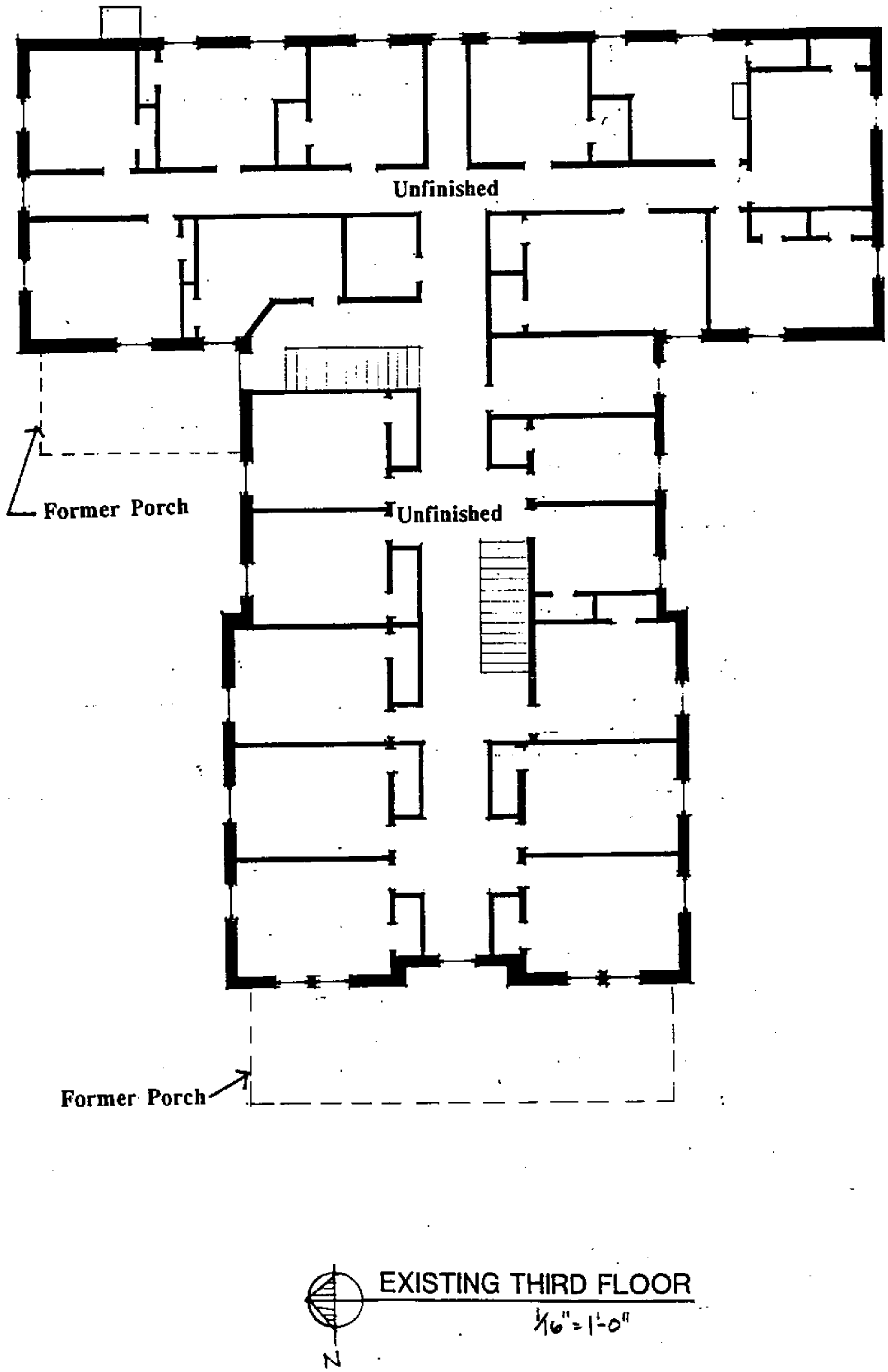
1/16" = 1'-0"



EXISTING FIRST FLOOR
1/16" = 1'-0"



EXISTING SECOND FLOOR
1/16" = 1'-0"
N



EXISTING THIRD FLOOR
1/16" = 1'-0"

Belrockton Museum

Belding, Michigan

Inspection & Report

Inspection Date: January 17, 2004

Report Date: January 20, 2004

Robert Darvas Associates, P.C.
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ASSOCIATE
ALEKSEY I. NEYMAN

January 20, 2005

Michelle Trombley
SmithGroup, Inc.
11- W. Miller Ave.
Ann Arbor, MI 48104

Re: Belrockton Museum
Belding, Michigan

Dear Mrs. Trombley:

On Monday, January 17, 2005 at your request I inspected the Belrockton Museum with you. The purpose of my inspection was to become familiar with the structure and to gather as much information about the structural system as possible without demolition of existing finishes beyond those already demolished by the Owner. Also, I am to calculate the floor live load where there is sufficient information to be able to do so, and discuss the Owner's desire to eliminate the second floor walls within the rear (east) wing of the building. Following are my observations, results of calculations, and recommendations.

Observations

General

The building is a historic three-story masonry bearing wall building with a full basement, built as a dormitory for silk factory workers in 1906. The floor and roof framing are wood frame. The present use is as a historical museum and also a community center. There are presently two interior stairs that serve the second and third floor. These stairs are not enclosed. They are straight runs without switch back, or intermediate landings, and have decorative wooden railings. There are presently no elevators, and only the main floor has handicap access via a ramp at the rear of the building. The interior walls are plaster on wood lath. The exterior walls appear to have plaster applied to wood lath over firring strips that are attached to the masonry. Original ceilings are plaster on wood lath affixed directly to the bottom of the joists.

First Floor Structure

The structure of the first floor is almost entirely visible from the basement. There is a ceiling in the hallway leading to the stairs that hides the structure above the hallway and the remainder can be observed to be 2 x 12's spaced at 16" center to center. The 2 x 12's span from exterior walls to a line of multiple 2 x 12 beams in the front (west) wing, and between masonry bearing walls in the rear (east) wing. I recorded the exact spans and member sizes to be able to make load calculations. The condition of most of the framing was good; although some pieces had been cut for previous plumbing and/or wiring. The 2 x 12 members that fall below original partitions above have been doubled or tripled and also the spans of the double or triple members has been cut in half by the placement of a pipe column at roughly mid-span of these joists that support partitions. There are two continuous beams that span between numerous 17" square brick piers extending along the central area of the front (west) portion of the basement. The beams are made-up of six 2 x 12's each. The splice locations between the various plies appear to be random and the splices do not all fall above the supports. The plies are bolted together. There is a similar beam located between a portion of the basement below the kitchen and the adjacent basement space. It was noted that there is no solid blocking between the joists at locations where they bear above beams. This lack of proper blocking was noted at the other floors as well , where joists bear above stud bearing walls.

The exterior basement walls are board formed concrete up to approximately 5'-6" above the basement floor and then brick above that. The joists bear into pockets in the masonry walls. Headers above the basement windows are wood with the ends of the joists cut to have a tongue extending to bear. There were no joist hangers at these locations, although there were some joist hangers used at the headers around the chimney. One of the two plies of the header at the chimney has some significant splits in it.

The bottom of the first floor joists are approximately 7'-11 ½" above the slab and the bottom of the wood beams are 6'-10 ½" above the slab.

Second Floor

The majority of the second floor framing cannot be observed due to the plaster ceiling and wood floor, however in the rear wing above the large first floor bingo hall, the plaster has been removed from the walls and ceiling and a few floor boards have been cut out to expose some of the framing in this area. It is desired, by the Owner, to omit all of the partitions in this area to have a large room rather than the numerous small rooms as it has been historically. I was able to see and measure a small portion of the second floor structure of the east wing, which I recorded in my notes. The framing is 2 x 12"s at 18" spacing supported on steel beams. The east exterior wall of the second and third level does not lie above the exterior wall at the first floor, but is offset by about twelve feet. This heavy two-story tall exterior masonry bearing wall is supported on a twin 15" deep 'I' beam that spans between 18" deep steel girders spanning east-west. I have recorded the size of the limited amount of this steel structure, which could be seen. It was curious that the twin 15" 'I' beam appeared to sit on a 12" tall wood block above the 18" steel girder with no real bolted connection of any kind that I could see.

Third Floor

The only portions of the third floor structure that can be viewed directly are at the rear (east) wing, where the second and third floor plaster has been demolished. The floor framing of the east wing is 2 x 12" @ 16" c/c spanning east-west, except in the southeast corner area where they span north-south and the west half of the central east-west corridor where they also span north-south. The east wall of the north-south corridor is a 2 x 6 wall between the third and second floor and the 2 x 12 joists are all spliced above this wall indicating that it is a load bearing wall. It is desired to remove this wall on the second level; however this bearing wall is to remain above the third floor to support the ceiling joists and roof rafters, which are also spliced above this wall line.

Roof Framing

The building has a slightly sloped flat roof with a very shallow attic that varies in height with the roof slope. The plaster ceiling is supported on 2 x 6 ceiling joists that span between various walls. The ceiling joists that are visible mostly follow the span direction of the 2 x 10 roof rafters, but not in all locations. In the southeast corner of the rear wing, the ceiling joists span north-south while the rafters span east-west. This is also true above the northwest corridor in the central portion of the back wing. West of the main stair hall in the front (west) wing there is an interior roof drain. There are single 2 x 10 ridge and valley beams radiating out in four diagonal directions from the drain location. These diagonally placed ridge and valley beams are flush with and interrupt the north-south spanning rafters. The interrupted rafters are mitered to fit the diagonal 2 x 10 valley or ridge and are simply toe-nailed in place. The bearing of the diagonal 2 x 10's at the vicinity of the roof drain is poor with the cut ends bearing on ceiling framing.

Exterior

The exterior masonry appeared to be in fairly good condition. Several stone lintels above basement window openings are cracked. The masonry at the top of both chimneys appears to need some maintenance. The chimney for the boiler that runs up the exterior of the building in the northeast corner of the back wing has frozen waterfalls of ice protruding from several locations on the east face.

Results of Calculations

Assumed structural design values for the historic framing:

Allowable Bending Stress fb= .... 1760 psi
Allowable Horizontal Stress fv=.. 120 psi
Modulus of Elastically 'E' .... 1,760,000 psi

These are appropriate for old growth lumber in good condition. My calculations indicate the following:

1. Joist spans up to approximately sixteen feet are acceptable to meet the load requirements for public spaces (100 psf live load). It appears that in the rear wing at the second floor there are two bays with spans of approximately sixteen feet and one bay with an eighteen foot span. The underside of this 18 feet span appears to have a plaster ceiling, while the other spans have a pressed metal ceiling and I am assuming there is no plaster beneath it. The joists in the 18 feet span may need to be doubled with new LVL joists to achieve the required load capacity. The 2 x 12 @ 16" c/c, which span approximately sixteen feet are likely sufficient, particularly if there is no plaster hiding behind the pressed metal ceiling. (Plaster adds approximately ten pounds per square feet of load and requires a span divided by 360 deflection limitation).

2. Most of the first floor joists span 16 feet or less, however at least three spans exceed this length. The joists in these spans may need to be doubled or a beam introduced to shorten their span if they are required to have 100 psf live load capacities.

3. The two interior beam lines made of random length plies of 2 x 12's in the west wing of the basement support all three floors and the roof. These beams are not structurally adequate if all three floors are to have a 100 psf live load requirement. If the building is to function as a house-museum the historic building code gives some leeway to the strict interpretation of code issues and it may be possible to limit occupancy on the upper floors to avoid replacing the two beam lines. This would be a problem if the building is also a community center, unless that function is confined to the east end of the first floor as it is at this time.

   A similar beam made up of six (6) 2 x 12's is found in the basement between the space below the kitchen and the adjacent room to the north. This beam presently has a wood stud wall built tight below it. This stud wall should not be removed unless the beam is strengthened or a column added here.

4. The actual pattern of framing within the second floor of the east wing cannot be fully understood with the small amount of it that was exposed during my January 17 visit. There are many steel or iron beams and it appears there are also pipe column that contribute to the support of the second floor and ultimately the third floor and roof above. It will be necessary to gain a complete understanding of these beams and columns before recommending a course of action to provide a large room in the east wing at the second floor, particularly if the room is to be used for public assembly, requiring 100 psf live load.

Discussion

1. Code Compliance
   Chapter 10 of the "Michigan Rehabilitation Code for Existing Buildings" has to do with historic buildings. It gives some leeway from strict interpretation of structural requirements and permits the limiting of occupancy to avoid meeting the structural capacity required of new construction. It also permits stair rails that do not meet current standards. It may be possible to utilize this code to advantage in the analysis of the Belrockton Museum. Chapter 10 is only a few pages long and is attached to this report. I will need to know the uses of the proposed spaces in the building to be able to do a complete calculations.

2. Creation or Large Second Floor Room

   In order to remove all of the partitions on the second floor in the east wing it will be necessary to provide beam and column support to the third floor and roof above. If the third floor structure is to remain as it is, then a grid of beams at the underside of the third floor with columns extending down to the second floor may be all that is required. The ideal location for columns is directly above the columns in the first floor meeting room.

There must obviously be a beam located directly below the east corridor wall above, which is not aligned with the first floor columns, so perpendicular beams will be required to transfer the load to the column locations, similar to how the load of the east exterior masonry wall is supported above the large first floor room.

3. Existing Stairs and Railings

The existing stairs and railings are very weak structurally. The stringers are not visible, but are notched for the treads which overhang the stringers so that there is likely only 5" of actual continuous wood. The stairs are straight run stairs so the stinger has a long span. These stringers have developed a permanent deflection causing the stairs to tilt. When you stand next to a stair, while people walk up and down, there is additional deflection that is very apparent. These stairs will require remedial work to be made structurally safe unless occupancy of upper floors is limited.

The stair rails are also very weak and while the code gives some leeway here, they should be improved in my opinion.

4. Plaster Ceilings

The plaster on wood lath ceilings are partially demolished on the third floor. I would recommend removing the remainder of the third floor plaster, and replacing with drywall. The plaster relies on the long mushroom shaped plaster keys that form as the first layer of plaster and is trowelled onto the spaced apart wood lath. As repeated cycles of yearly change in humidity coupled with inevitable roof leaks over the years can cause sufficient swelling of the wood lath to pinch and break the keys. This can result in the plaster falling away from the wood lath. I have also witnessed a case where the nails adhering the wood lath rusted and failed dropping an entire ceiling to the floor all at once. Plaster weighs 10 psf vs. 2 psf for drywall. Drywall is installed with bugle head screws that are much larger in diameter than the very small nails used to adhere wood lath. So unless there is some very good reason to retain the plaster ceilings, I recommend replacing them with drywall were possible.

5. Sound Insulation

While not a structural issue I feel, I must comment on the desire to have a large room on the second floor from the standpoint of acoustic separation. If the pressed metal ceiling does not have plaster beneath it, there will be little of mass to provide acoustic separation between the upper and lower spaces here. This needs to be considered when deciding how the spaces will be used, particularly if they are to be used at the same time.

6. Egress Requirements

While the addition of an elevator to the building will permit handicap access to all levels, the egress stairs fall short of modern requirements for fire safety in two respects. Neither one is enclosed and neither one leads directly to the exterior. Will the higher occupancy that will go along with a large space on the second floor be acceptable with only the present stairs, which are in open spaces common to the hallway?

7. Thermal Insulation

It is unclear if there is any thermal insulation at the roof. There is none visible within the attic. It is possible that there is some rigid insulation above the roof boards under the roof membrane. If there is insulation above the roof boards, venting of the attic space will not be required. However if insulation is to be placed at the third floor ceiling, proper attic ventilation should be added.

The exterior masonry walls do not appear to have any thermal insulation. I do not recommend adding any thermal insulation to the inside surface of these masonry walls as the lack of insulation and resulting heat loss through the walls helps to keep them dry and reduces freeze-thaw cycles that would be more frequent if the walls were to receive insulation on the inside face. This heat loss will help preserve the exterior masonry.

Conclusions

As your plans develop further, and the space utilization becomes known, I can further refine my calculations. If the desire to provide a large open space on the second floor of the east wing is to be accomplished, I will need to see enough of the second floor framing to be able to completely understand and measure it. This will require additional demolition.

Please let me know if I can be of further assistance in this project.

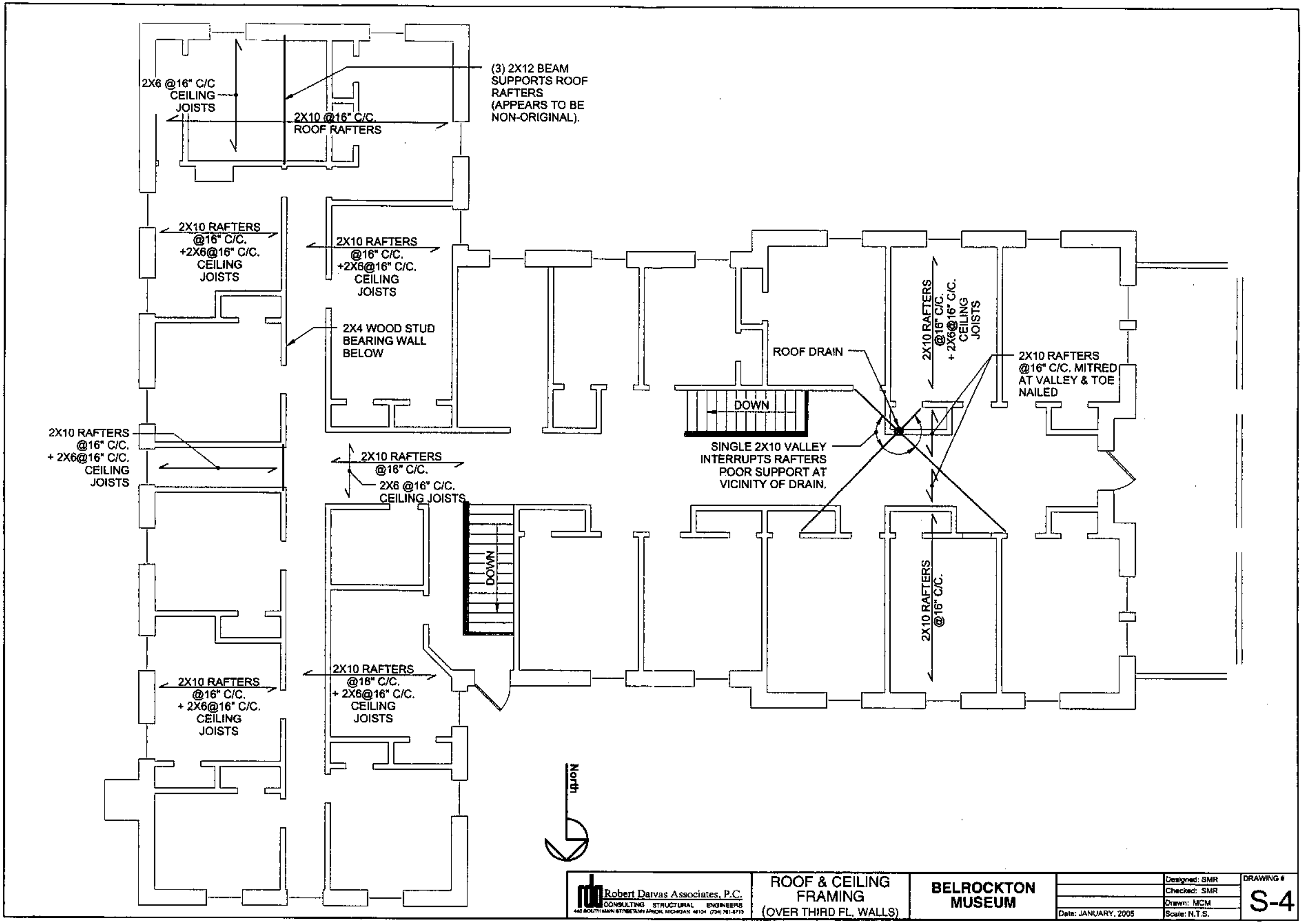
Respectfully submitted,

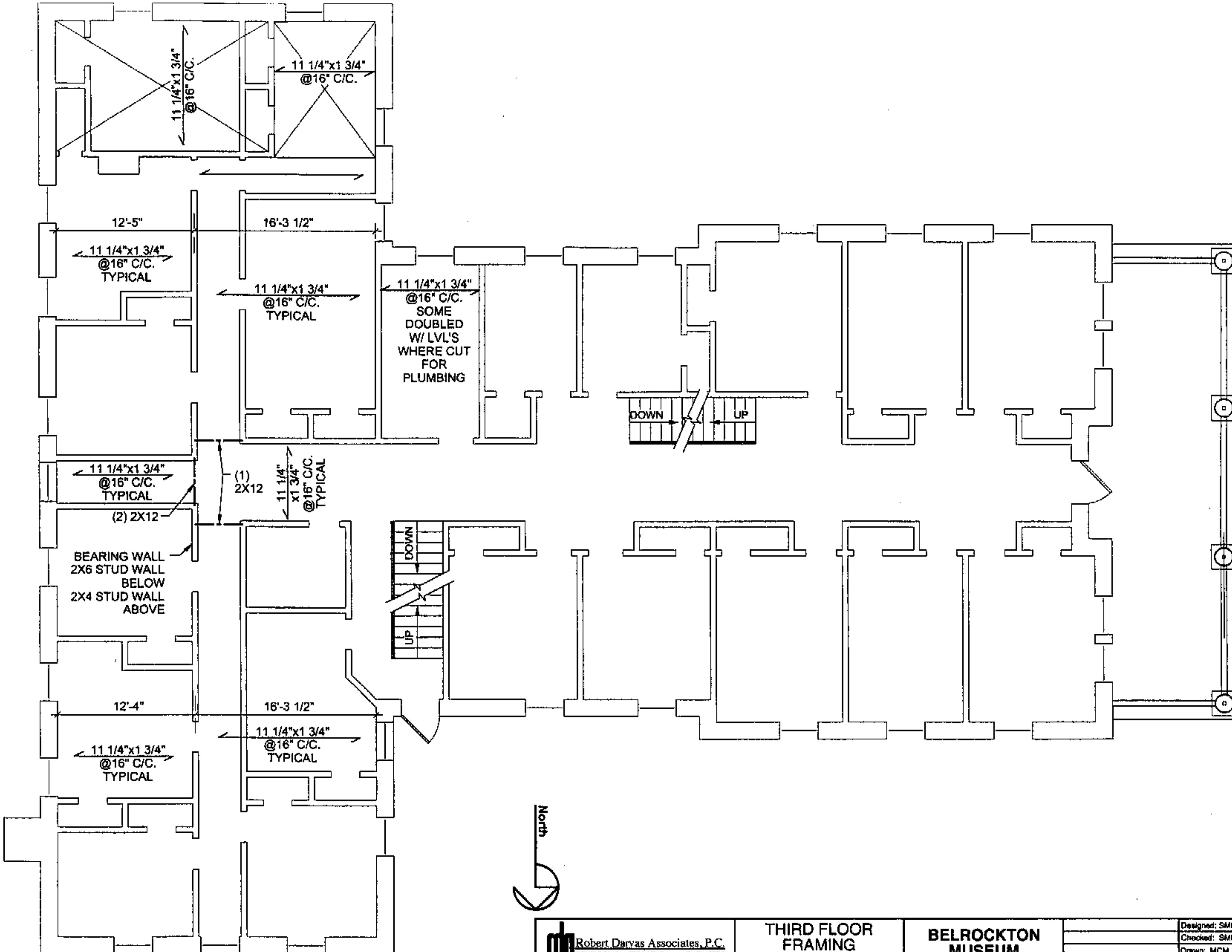
Robert Darvas Associates, P. C.

Stephen M. Rudner, P. E.

SMR/dw

Enc:


(3) 2X12 BEAM SUPPORTS ROOF RAFTERS (APPEARS TO BE NON-ORIGINAL).
2X6 @16" C/C CEILING JOISTS
2X10 @16" C/C. ROOF RAFTERS
2X10 RAFTERS @16" C/C. +2X6@16" C/C. CEILING JOISTS
2X10 RAFTERS @16" C/C. +2X6@16" C/C. CEILING JOISTS
2X4 WOOD STUD BEARING WALL BELOW
2X10 RAFTERS @16" C/C. + 2X6@16" C/C. CEILING JOISTS
2X10 RAFTERS @16" C/C.
2X6 @16" C/C. CEILING JOISTS
DOWN
2X10 RAFTERS @16" C/C. + 2X6@16" C/C. CEILING JOISTS
2X10 RAFTERS @16" C/C. + 2X6@16" C/C. CEILING JOISTS
ROOF DRAIN
DOWN
SINGLE 2X10 VALLEY INTERRUPTS RAFTERS POOR SUPPORT AT VICINITY OF DRAIN.
2X10 RAFTERS @16" C/C. + 2X6@16" C/C. CEILING JOISTS
2X10 RAFTERS @16" C/C. MITRED AT VALLEY & TOE NAILED
2X10 RAFTERS @16" C/C.
North
Robert Darvas Associates, P.C.
CONSULTING STRUCTURAL ENGINEERS
ROOF & CEILING FRAMING
(OVER THIRD FL. WALLS)
BELROCKTON MUSEUM
Date: JANUARY, 2005
Designed: SMR
Checked: SMR
Drawn: MCM
Scale: N.T.S.
DRAWING #
S-4



Robert Darvas Associates, P.C.
CONSULTING STRUCTURAL ENGINEERS

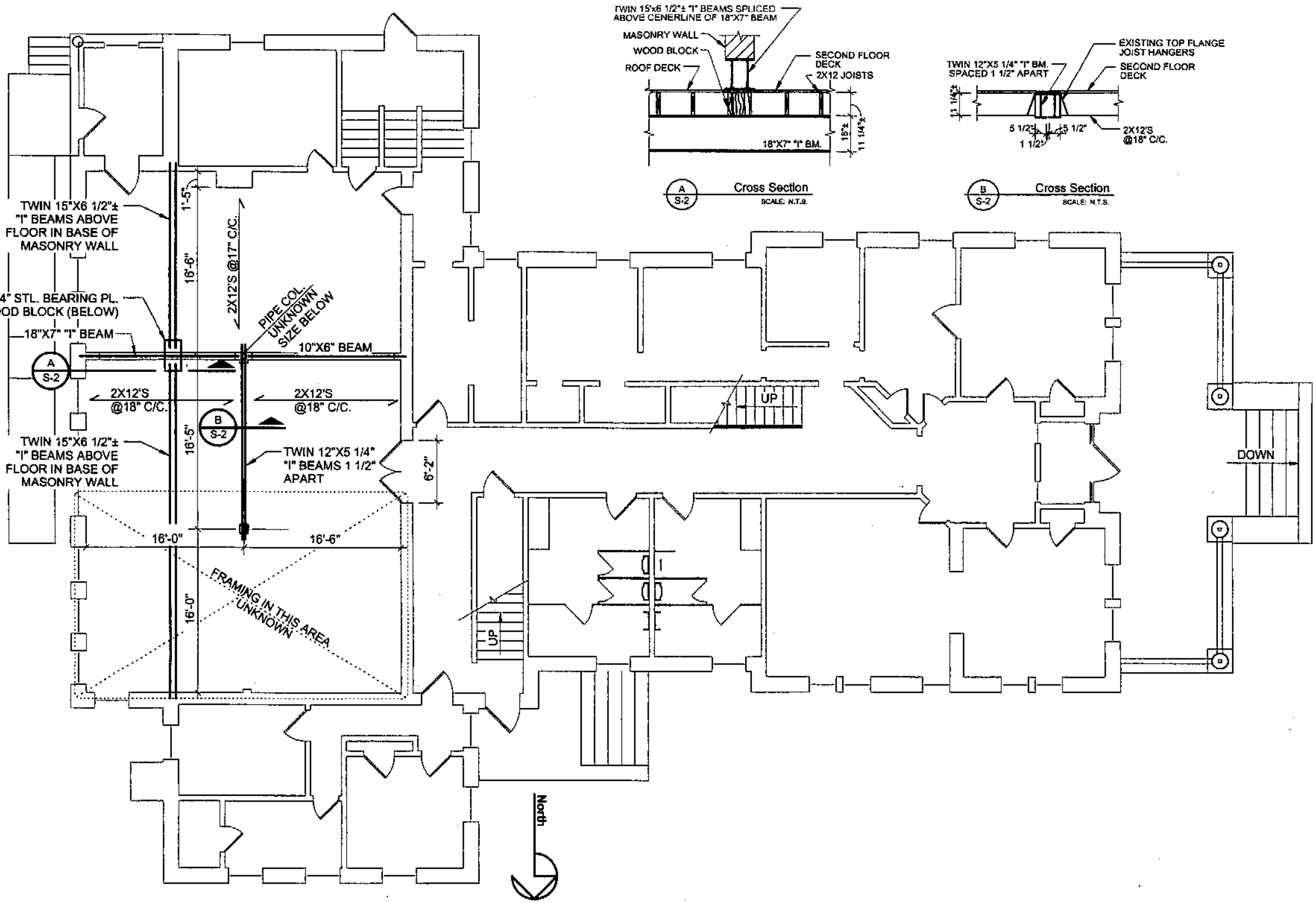
THIRD FLOOR FRAMING
(OVER SECOND FL. WALLS)

BELROCKTON MUSEUM

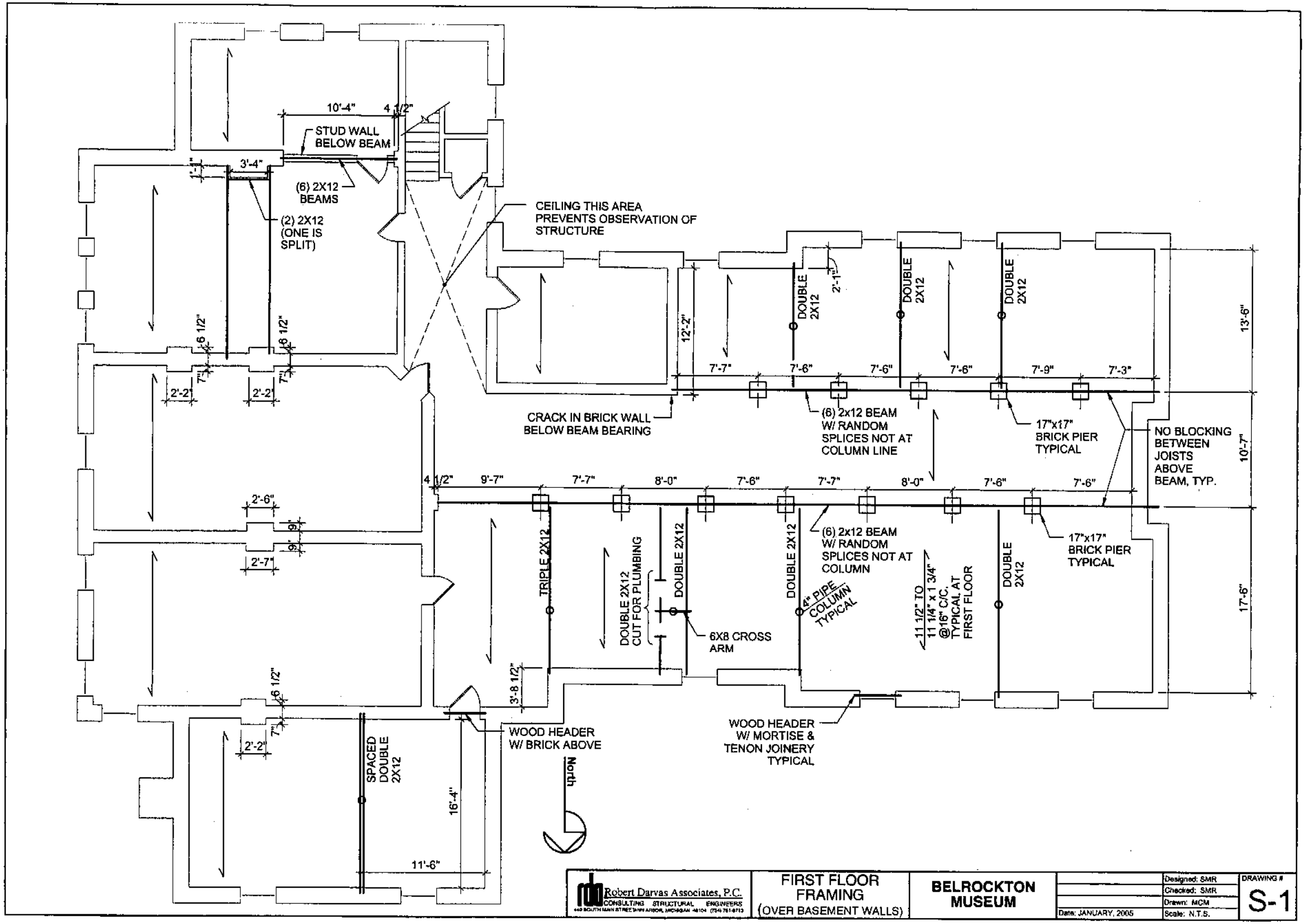
Date: JANUARY, 2005

Designed: SMR
Checked: SMR
Drawn: MCM
Scale: N.T.S.

DRAWING #
S-3



Robert Darvas Associates, P.C. CONSULTING STRUCTURAL ENGINEERS	SECOND FLOOR FRAMING (OVER FIRST FL. WALLS)	BELROCKTON MUSEUM	Date: JANUARY, 2005	Designed: SMR Checked: SMR Drawn: MCM Scale: N.T.S.	DRAWING # S-2



10'-4"
4 1/2"
STUD WALL BELOW BEAM
3'-4"
(6) 2X12 BEAMS
(2) 2X12 (ONE IS SPLIT)
CEILING THIS AREA PREVENTS OBSERVATION OF STRUCTURE
12'-2"
2'-1"
DOUBLE 2X12
DOUBLE 2X12
DOUBLE 2X12
13'-6"
7'-7"
7'-6"
7'-6"
7'-6"
7'-9"
7'-3"
CRACK IN BRICK WALL BELOW BEAM BEARING
(6) 2x12 BEAM W/ RANDOM SPLICES NOT AT COLUMN LINE
17"x17" BRICK PIER TYPICAL
NO BLOCKING BETWEEN JOISTS ABOVE BEAM, TYP.
10'-7"
4 1/2"
9'-7"
7'-7"
8'-0"
7'-6"
7'-7"
8'-0"
7'-6"
7'-6"
(6) 2x12 BEAM W/ RANDOM SPLICES NOT AT COLUMN
17"x17" BRICK PIER TYPICAL
TRIPLE 2X12
DOUBLE 2X12 CUT FOR PLUMBING
DOUBLE 2X12
6X8 CROSS ARM
DOUBLE 2X12
4" PIPE COLUMN TYPICAL
11 1/2" TO 11 1/4" x 1 3/4" @16" C/C. TYPICAL AT FIRST FLOOR
DOUBLE 2X12
17'-6"
6 1/2"
7"
2'-2"
6 1/2"
7"
2'-2"
2'-6"
9"
9"
2'-7"
6 1/2"
7"
2'-2"
3'-8 1/2"
WOOD HEADER W/ BRICK ABOVE
WOOD HEADER W/ MORTISE & TENON JOINERY TYPICAL
SPACED DOUBLE 2X12
16'-4"
11'-6"
North
Robert Darvas Associates, P.C.
CONSULTING STRUCTURAL ENGINEERS
FIRST FLOOR FRAMING (OVER BASEMENT WALLS)
BELROCKTON MUSEUM
Date: JANUARY, 2005
Designed: SMR
Checked: SMR
Drawn: MCM
Scale: N.T.S.
DRAWING #
S-1

KUDNER

"Serving Michigan . . . Serving You"

Michigan Rehabilitation Code for Existing Buildings

Incorporating the International Existing Building Code, 2003 Final Draft, Dated August 2001

Michigan Department of Consumer & Industry Services
BUREAU OF CONSTRUCTION CODES

CHAPTER 10
HISTORIC BUILDINGS

SECTION 1001
GENERAL

1001.1 Scope. It is the intent of this chapter to provide means for the preservation of historic buildings. Historical buildings shall comply with the provisions of this chapter relating to their repair, alteration, relocation and change of occupancy.

1001.2 Report. A historic building undergoing repair, alteration, or change of occupancy shall be investigated and evaluated. If it is intended that the building meet the requirements of this chapter, a written report shall be prepared and filed with the code official by a registered design professional when in the opinion of the official, such a report is necessary. Such report shall be in accordance with Chapter 1 and shall identify each required safety feature in compliance with this chapter and where compliance with other chapters of these provisions would be damaging to the contributing historic features. In high seismic zones, a structural evaluation, describing, as a minimum, a complete load path and other earthquake–resistant features shall be prepared. In addition, the report shall describe each feature not in compliance with these provisions and demonstrate how the intent of these provisions is complied with in providing an equivalent level of safety.

1001.3 Special occupancy exceptions - museums. When a building that is in Use Group R–3 is also used for Group A, B or M purposes such as museum tours, exhibits and other public assembly activities, or for museums less than 3000 s.f. (279 m^2) the code official may make a determination that the Use Group is B when life–safety conditions can be demonstrated in accordance with Section 1001.2. Adequate means of egress in such buildings, which may include a means of maintaining doors in an open position to permit egress, a limit on building occupancy to an occupant load permitted by the means of egress capacity, a limit on occupancy of certain areas or floors, and/or supervision by a person knowledgeable in the emergency exiting procedures, shall be provided.

1001.4 Flood hazard areas. In flood hazard areas:

1. If a historic building will continue to be listed or eligible for listing as a historic building, then work proposed to be undertaken is not considered to be a substantial improvement.
2. If all work proposed constitutes substantial improvement, including repairs, work required due to a change of occupancy, and alterations, then the existing building shall comply with *International Building Code* Section 1612.

SECTION 1002
REPAIRS

1002.1 Requirements. Repairs to any portion of a historic building or structure shall be permitted with original or like materials and original methods of construction, subject to the provisions of this chapter.

1002.2 Dangerous buildings. When a historic building is determined to be dangerous no work shall be required except as necessary to correct identified unsafe conditions.

1002.3 Relocated buildings. Foundations of relocated historic buildings and structures shall comply with the *International Building Code*. Relocated historic buildings shall otherwise be considered a historic building for the purposes of this code. Relocated historic buildings and structures shall be so sited that exterior wall and opening requirements comply with the *International Building Code* or the compliance alternatives of this code.

1002.4 Repairs and alterations, general. Historic buildings undergoing repairs or alterations shall comply with all of the applicable requirements of Chapter 4 except as specifically permitted in this chapter.

1002.5 Replacement. Replacement of existing or missing features using original materials shall be permitted. Partial replacement for repairs that match the original in configuration, height and size shall be permitted. Such replacements shall not be required to meet the materials and methods requirements in Section 401.2.

> **Exception:** Replacement glazing in hazardous locations shall comply with the safety glazing requirements of Chapter 24 of the *International Building Code*.

SECTION 1003
FIRE SAFETY

1003.1 General. Every historic building that does not conform to the construction requirements specified in this code for the occupancy or use and that constitutes a distinct fire hazard as defined herein shall be provided with an approved automatic fire–extinguishing system as determined appropriate by the code official. However, an automatic fire–extinguishing system shall not be used to substitute for, or act as an alternate to, the required number of exits from any facility.

1003.2 Means of egress. Existing door openings and corridor and stairway widths of less than that specified elsewhere in this code may be approved, provided that in the opinion of the code official there is sufficient width and height for a person to pass through the opening or traverse the means of egress. When approved by the code official, the front or main exit doors need not swing in the direction of the path of exit travel, provided other approved means of egress having sufficient capacity to serve the total occupant load are provided.

1003.3 Transoms. In fully sprinklered buildings of Groups R–1, R–2 or R–3 Occupancy existing transoms in corridors and other fire–rated walls may be maintained if fixed in the closed position. A sprinkler shall be installed on each side of the transom.

1003.4 Interior finishes. The existing finishes of walls and ceilings shall be accepted when it is demonstrated that they are the historic finishes.

1003.5 Stairway enclosure. In buildings of three stories or less, exit enclosure construction shall limit the spread of smoke by the use of tight–fitting doors and solid elements. Such elements are not required to have a fire rating.

1003.6 One–hour fire resistant assemblies. Where one–hour fire–resistive construction is required by these provisions, it need not be provided regardless of construction or occupancy when the existing wall and ceiling finish is wood or metal lath and plaster.

1003.7 Glazing in fire–rated systems. Historic glazing materials in interior walls required to have one–hour fire rating may be permitted when provided with approved smoke seals and when the area affected is provided with an automatic sprinkler system.

1003.8 Stairway railings. Grand stairways shall be accepted without complying with the handrail and guardrail requirements. Existing handrails and guards at all stairs shall be permitted to remain, provided they are not structurally dangerous.

1003.9 Guards. Guards shall comply with Sections 1003.9.1 and 1003.9.2.

1003.9.1 Height. Existing guards shall comply with the requirements of Section 405.

1003.9.2 Guard openings. The spacing between existing intermediate railings or openings in existing ornamental patterns shall be accepted. Missing elements or members of a guard may be replaced in a manner that will preserve the historic appearance of the building or structure.

1003.10 Exit signs. Where exit sign or egress path marking location would damage the historic character of the building, alternate exit signs are permitted with approval of the code official. Alternative signs shall identify the exits and egress path.

1003.11 Automatic fire–extinguishing systems.

1003.11.1 Every historical building which cannot be made to conform to the construction requirements specified in the *International Building Code* for the occupancy or use, and which constitutes a distinct fire hazard shall be deemed to be in compliance if provided with an approved automatic fire extinguishing system.

Exception: When an alternative life–safety system is approved by the code official.

1003.11.2 An automatic fire extinguishing system shall not be used to substitute for or act as an alternative to the required number of exits from any facility.

SECTION 1004
CHANGE OF OCCUPANCY

1004.1 General. Historic buildings undergoing a change of occupancy shall comply with the applicable provisions of Chapter 3, except as specifically permitted in this chapter. When Chapter 3 requires compliance with specific requirements of Chapter 4, Chapter 5, or Chapter 6 and when those requirements are subject to the exceptions in Section 1002, the same exceptions shall apply in this section.

1004.2 Building area. The allowable floor area for historic buildings undergoing a change of occupancy shall be permitted to exceed the allowable areas specified in Chapter 5 of the *International Building Code* by 20 percent.

1004.3 Location on property. Historic structures undergoing a change of use to a higher hazard category, in accordance with Section 812.4.4 may use alternative methods to comply with the fire–resistance and exterior opening protective requirements. Such alternatives shall comply with Section 1001.2.

1004.4 Required occupancy separations of one–hour may be omitted when the building is provided with an approved automatic sprinkler system throughout.

1004.5 Roof covering. Regardless of occupancy or Use Group, roof–covering materials not less than Class C shall be permitted where a fire–retardant roof covering is required.

1004.6 Means of egress. Existing door openings and corridor and stairway widths less than those that would be acceptable for nonhistoric buildings under these provisions shall be approved, provided that in the opinion of the code official, there is sufficient width and height for a person to pass through the opening or traverse the exit and that the capacity of the exit system is adequate for the occupant load, or where other operational controls to limit occupancy are approved by the code official.

1004.7 Door swing. When approved by the code official, existing front doors need not swing in the direction of exit travel, provided other approved exits having sufficient capacity to serve the total occupant load are provided.

1004.8 Transoms. In corridor walls required to be fire rated by these provisions, existing transoms may be maintained if fixed in the closed position and fixed wired glass set in a steel frame or other approved glazing shall be installed on one side of the transom.

> **Exception:** Transoms conforming to Section 1003.4 shall be accepted.

1004.9 Finishes. Where finish materials are required to have a flame–spread classification of Class III or better, existing nonconforming materials shall be surfaced with an approved fire–retardant paint or finish.

> **Exception:** Existing nonconforming materials need not be surfaced with an approved fire–retardant paint or finish when the building is equipped throughout with an automatic fire–suppression system installed in accordance with the *International Building Code* and the nonconforming materials can be substantiated as being historic in character.

1004.10 One–hour fire resistant assemblies. Where one–hour fire resistant construction is required by these provisions, it need not be provided regardless of construction or occupancy where the existing wall and ceiling finish is wood lath and plaster.

1004.11 Stairs and railing. Existing stairways shall comply with the requirements of these provisions. The code official shall grant alternatives for stairways and railings if alternative stairways are found to be acceptable or if judged as meeting the intent of these provisions. Existing stairways shall comply with Section 1003.

> **Exception:** For buildings less than 3000 s.f. (279 m^2), existing conditions permitted to remain at all stairs and rails.

1004.12 Exit signs. The code official may accept alternate exit sign locations where such signs would damage the historic character of the building or structure. Such signs shall identify the exits and exit path.

1004.13 Exit stair live load. Existing historic stairways in buildings changed to Use Groups R-1 and R-2 shall be accepted where it can be shown that the stairway can support a 75 pounds per square foot (366 kg/m^2) live load.

1004.14 Natural light. When it is determined by the code official that compliance with the natural light requirements of Section 811.1.1 will lead to loss of historic character or historic materials in the building, the existing level of natural lighting shall be considered acceptable.

1004.15 Accessibility requirements. The provisions of Section 812.5 shall apply to buildings and facilities designated as historic structures that undergo a change of occupancy, unless technically infeasible. Where compliance with the requirements for accessible routes, ramps, entrances, or toilet facilities would threaten or destroy the historic significance of the building or facility, as determined by the authority having jurisdiction, the alternative requirements of Sections 1005.1.1 through 1005.1.5 of the *International Building Code* for that element shall be permitted.

SECTION 1005
ALTERATIONS

1005.1 Accessibility requirements. The provisions of Section 506 shall apply to buildings and facilities designated as historic structures that undergo alterations, unless technically infeasible. Where compliance with the requirements for accessible routes, ramps, entrances, or toilet facilities would threaten or destroy the historic significance of the building or facility, as determined by the code official, the alternative requirements of Sections 1005.1.1 through 1005.1.5 of this code for that element shall be permitted.

> **1005.1.1 Site arrival points.** At least one main entrance shall be accessible.

> **1005.1.2 Multilevel buildings and facilities.** An accessible route from an accessible entrance to public spaces on the level of the accessible entrance shall be provided.

> **1005.1.3 Entrances.** At least one main entrance shall be accessible.

>> **Exception:** If a main entrance cannot be made accessible, an employee or service entrance that is unlocked while the building is occupied shall be made accessible.

> **1005.1.4 Toilet and bathing facilities.** Where toilet rooms are provided at least one accessible toilet room complying with Section 1108.2.1 of the *International Building Code* shall be provided.

1005.1.5 Ramps. The slope of a ramp run of 24 inches (610 mm) maximum shall not be steeper than one unit vertical eight units horizontal (12-percent slope).

SECTION 1006
STRUCTURAL

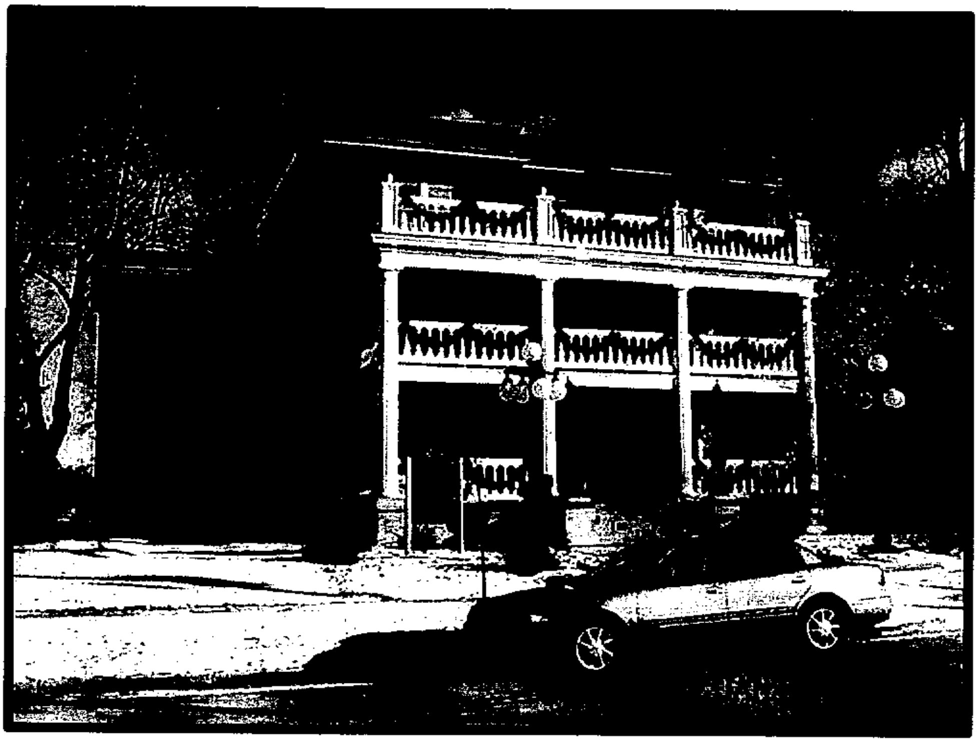
1006.1 General. Historic Buildings shall comply with the structural provisions of this code.

Exception : The code official shall be authorized to accept existing floors and approve operational controls that limit the live load on any such floor.

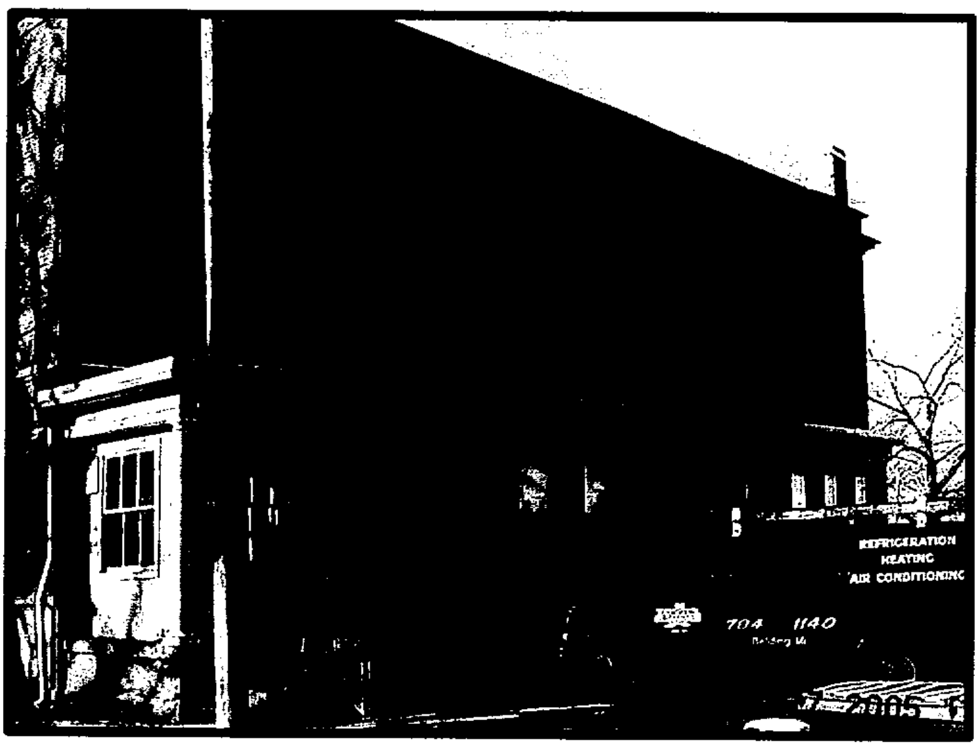
1006.2 Unsafe structural elements. Where determination is made by the code official that a component or a portion of a building or structure is dangerous, as defined in this code, and is in need of repair, strengthening or replacement by provisions of this code, only that specific component or portion shall be required to be repaired, strengthened or replaced.

Belrockton Museum

Inspection by: RDA -Stephen M. Rudner P.E.



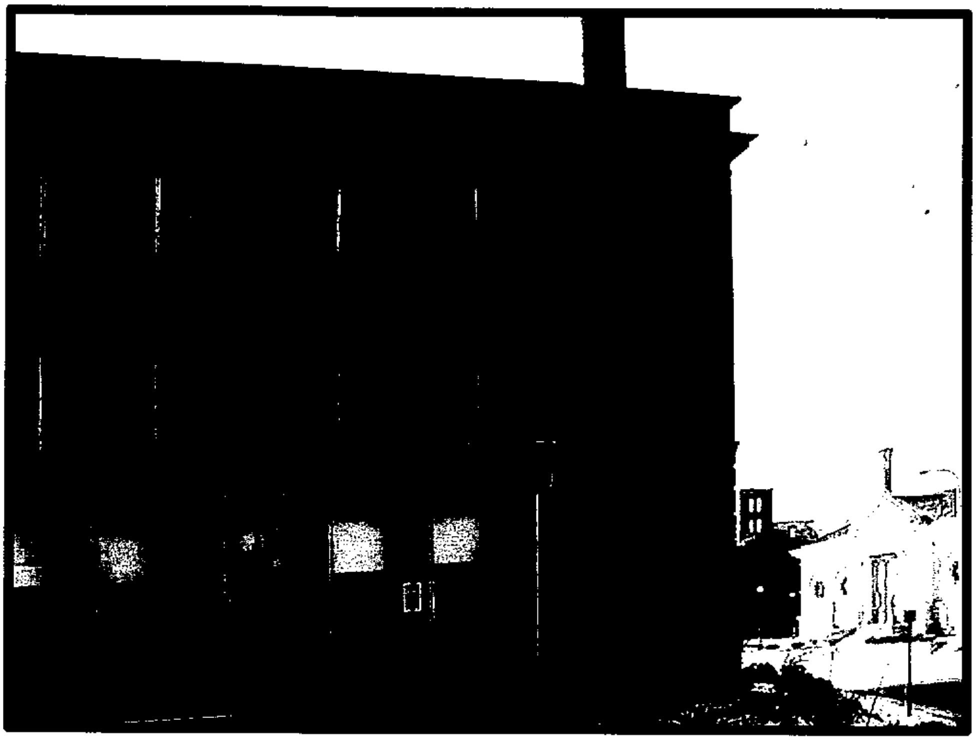
1. WEST ELEVATION



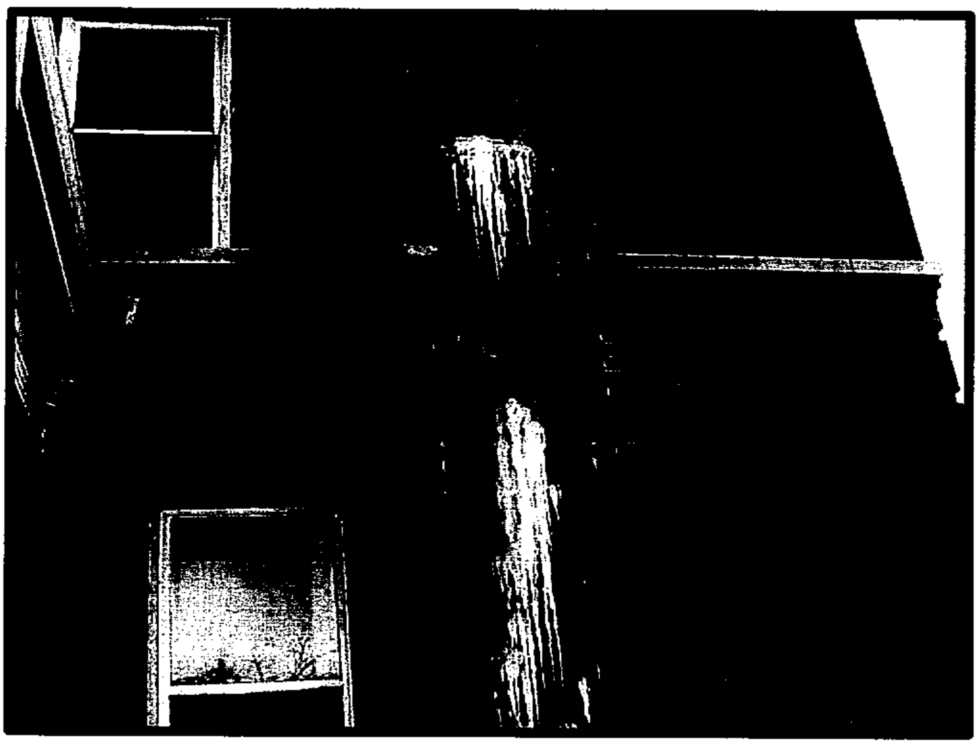
2. EAST SIDE.

Belrockton Museum

Inspection by: RDA -Stephen M. Rudner P.E.



3. EAST SIDE - NOTE: ICICLE'S COMING OUT OF CHIMNEY.



4. CLOSEUP OF ICICLE'S COMING FROM CHIMNEY ON EAST SIDE OF BUILDING.

Belrockton Museum

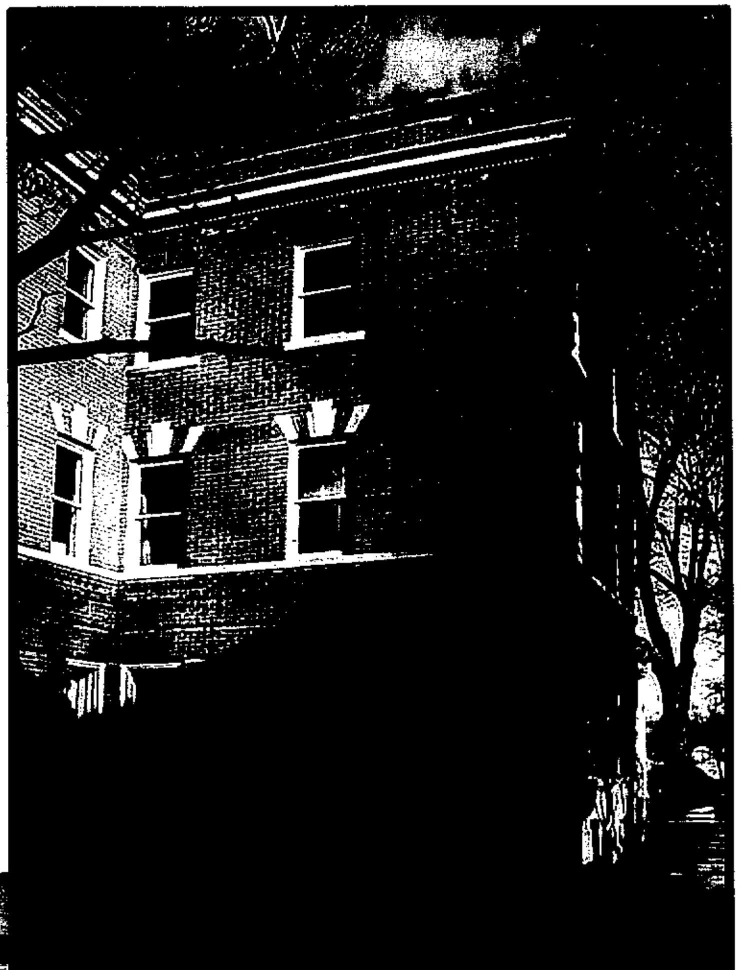
Inspection by: RDA -Stephen M. Rudner P.E.

5. CLOSEUP OF ICICLE'S COMING FROM CHIMNEY ON EAST SIDE OF BUILDING.

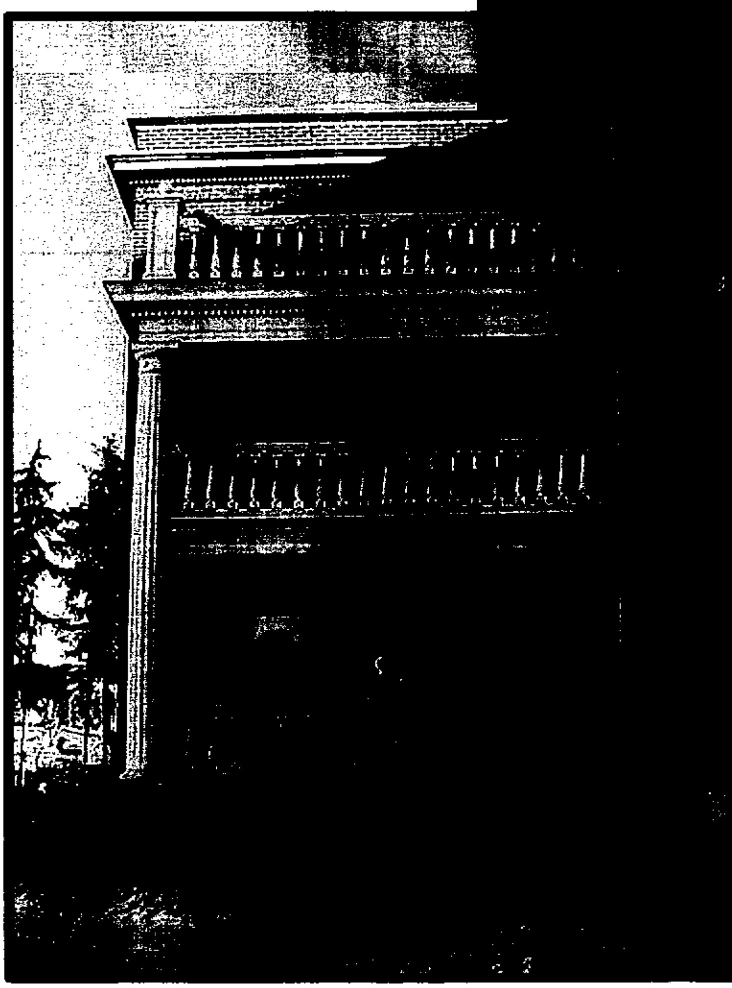
6. SOUTH SIDE.

Belrockton Museum

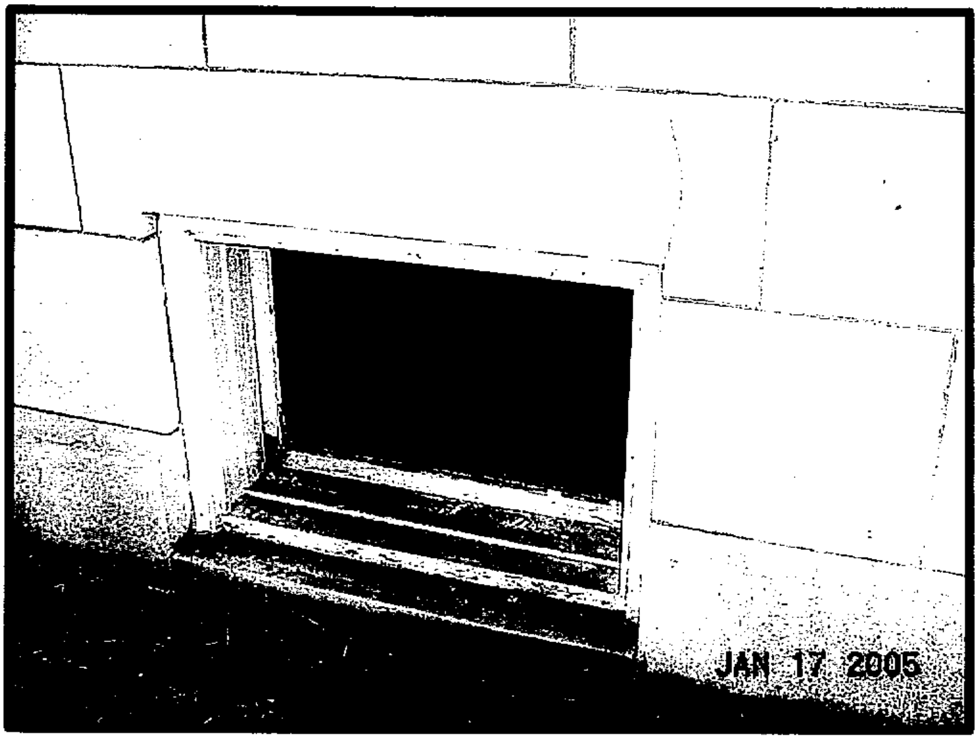
Inspection by: RDA -Stephen M. Rudner P.E.



7. SOUTH EXTENSION OF EAST WING.

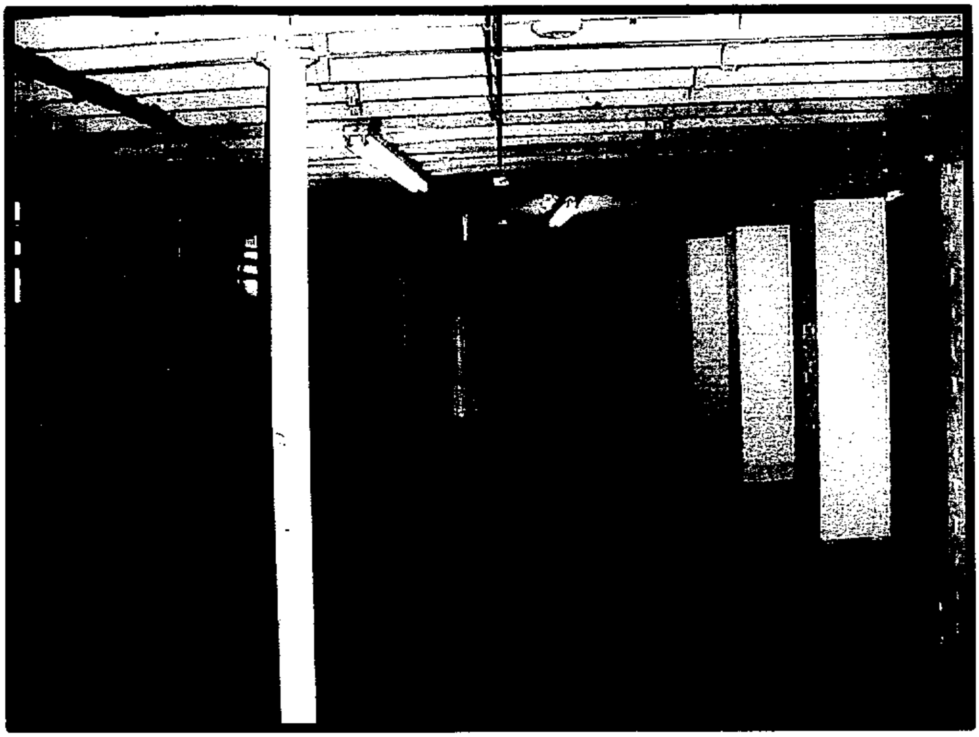


8. NORTH EXTENSION OF EAST WING.

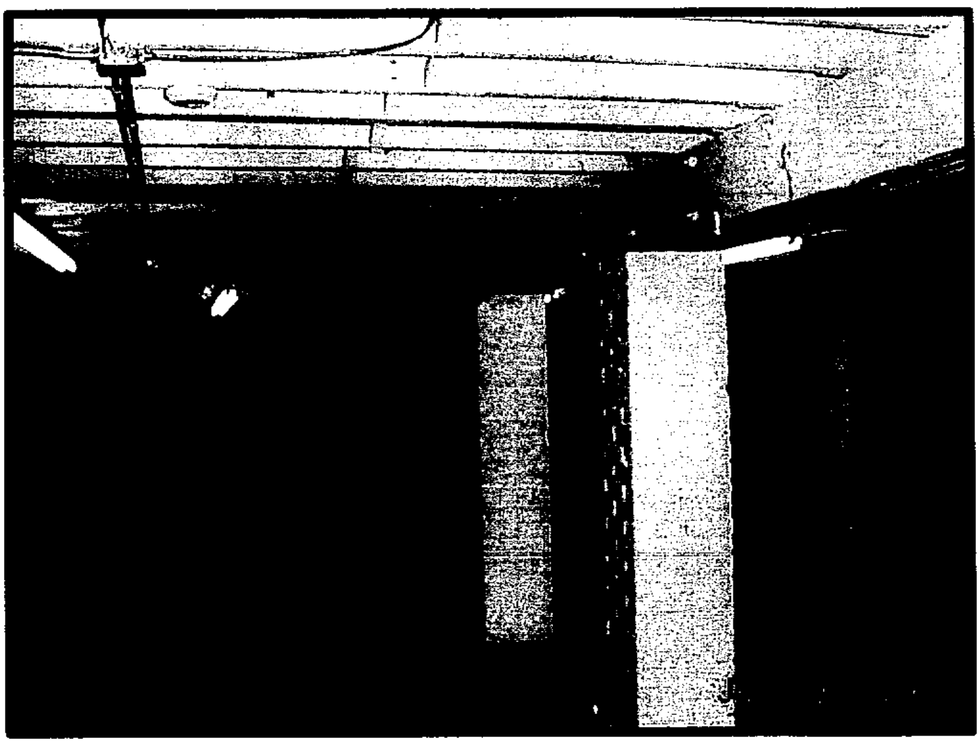


9. CRACKED STONE LINTEL ABOVE BASEMENT WINDOW OPENING.

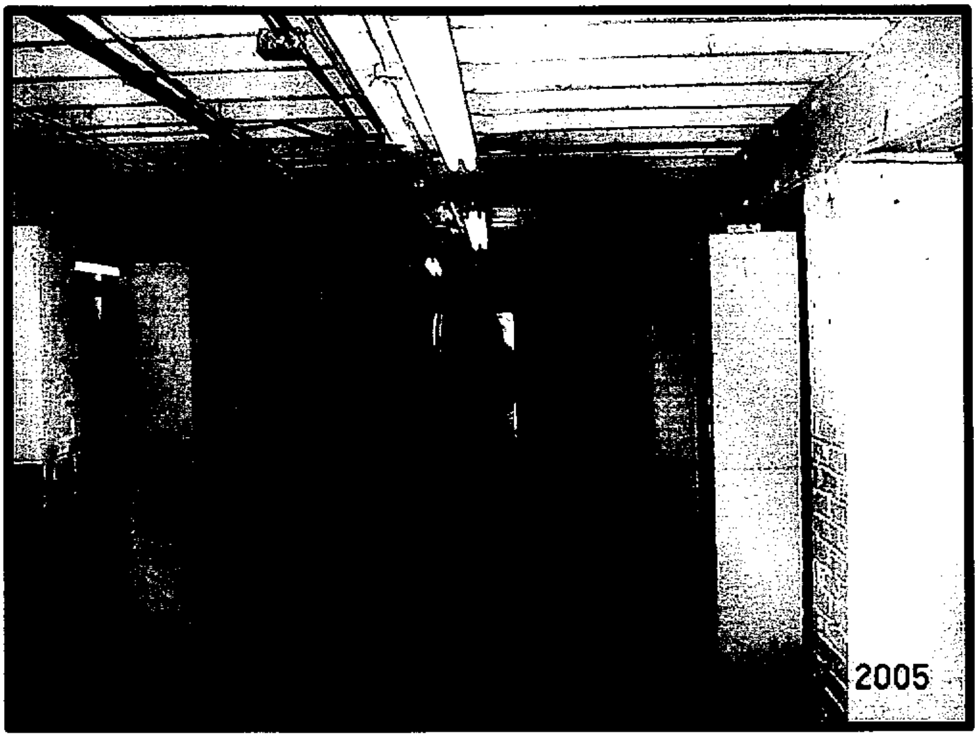
10. BASEMENT LOOKING N. EAST.
NOTE: COLUMN SUPPORTS DOUBLE JOIST BELOW PARTITION LOCATION ABOVE.



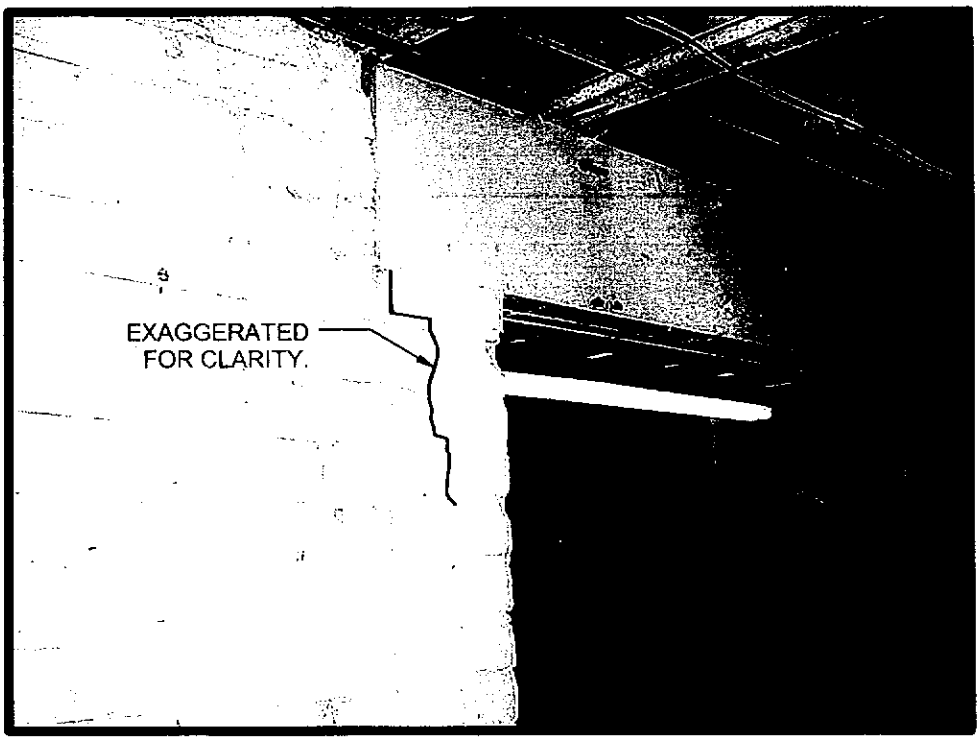
11. BASEMENT LOOKING EAST.



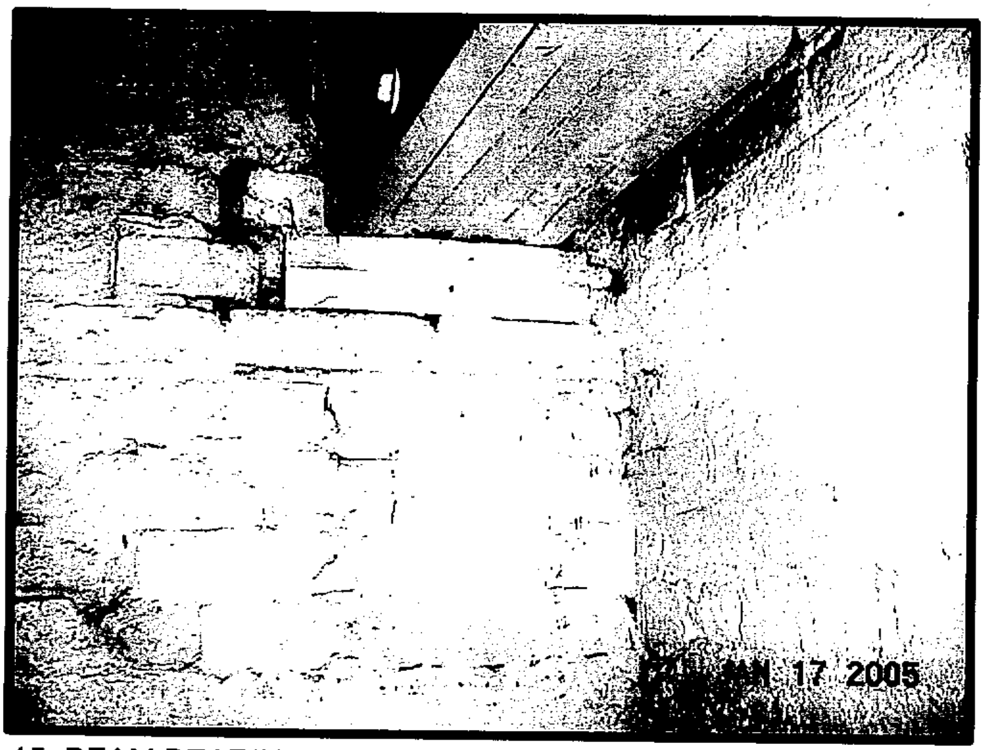
12. BASEMENT LOOKING S. EAST.



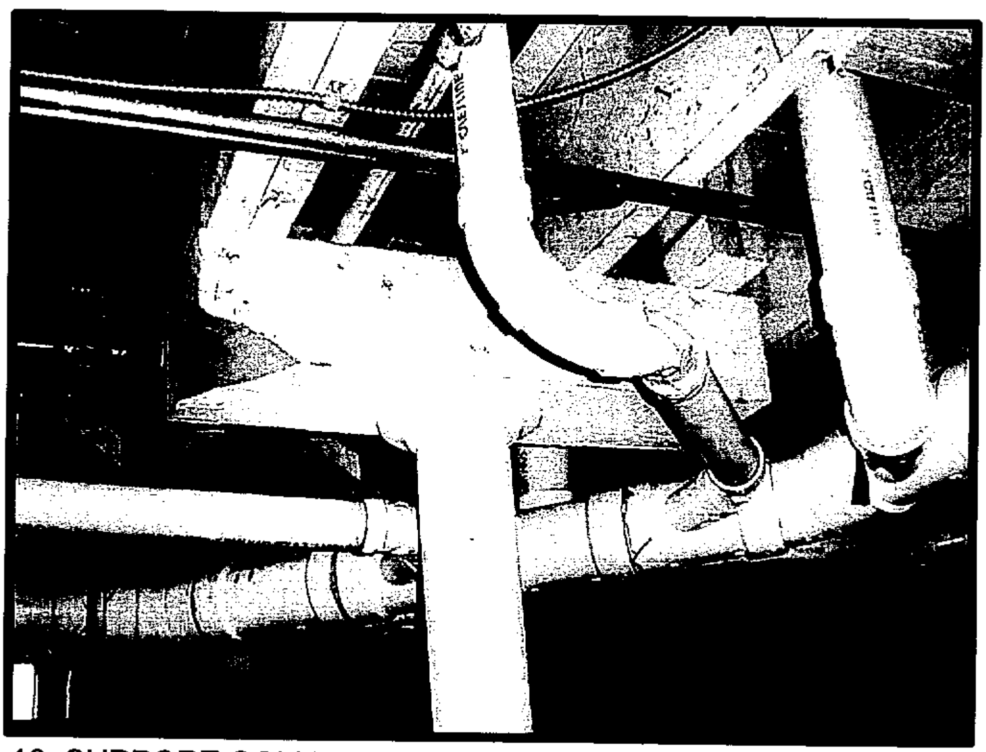
13. BASEMENT LOOKING EAST IN CENTER BAY.
    NOTE: BEAMS OF (6) 2X12'S BOLTED TOGETHER.



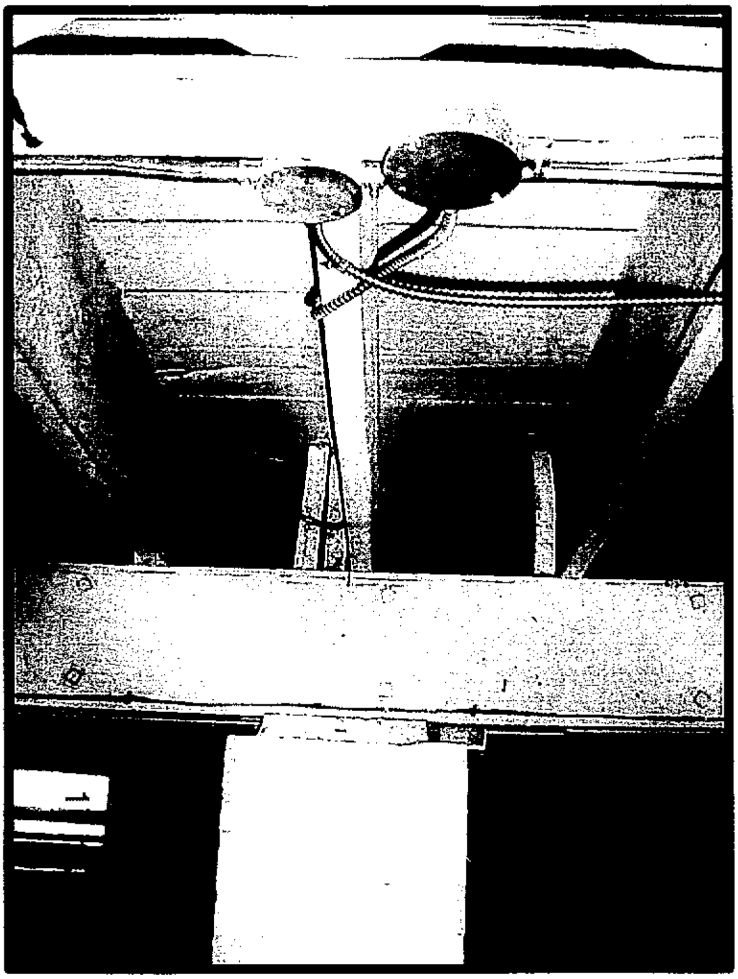
14. CRACKED BRICK AT BEAM BEARING IN BASEMENT.



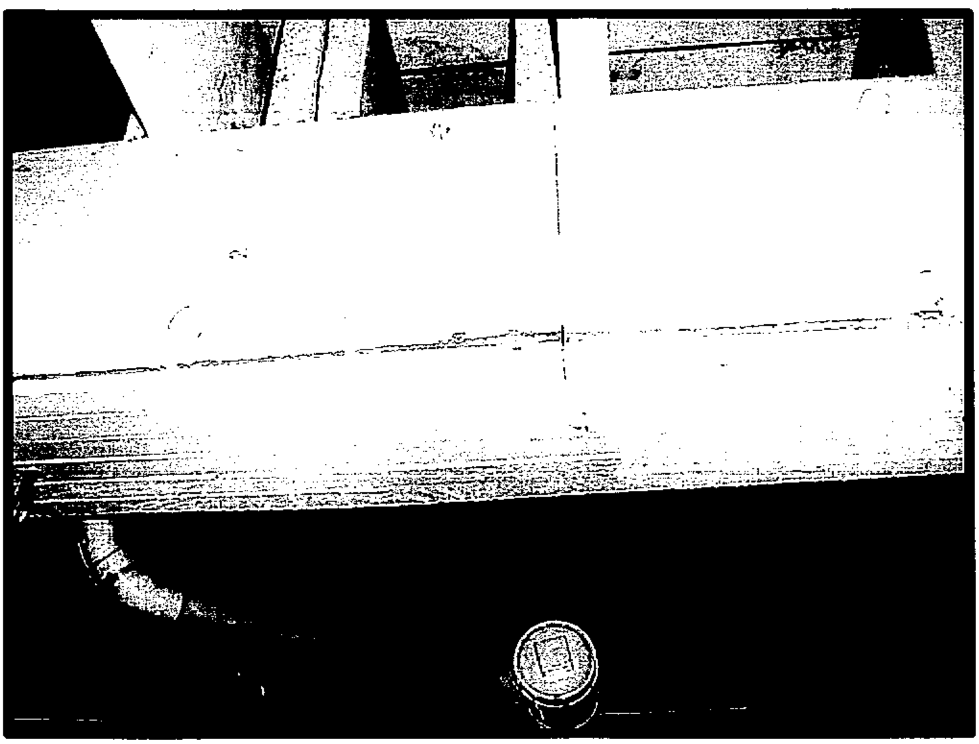
15. BEAM BEARING AT WEST BASEMENT WALL.



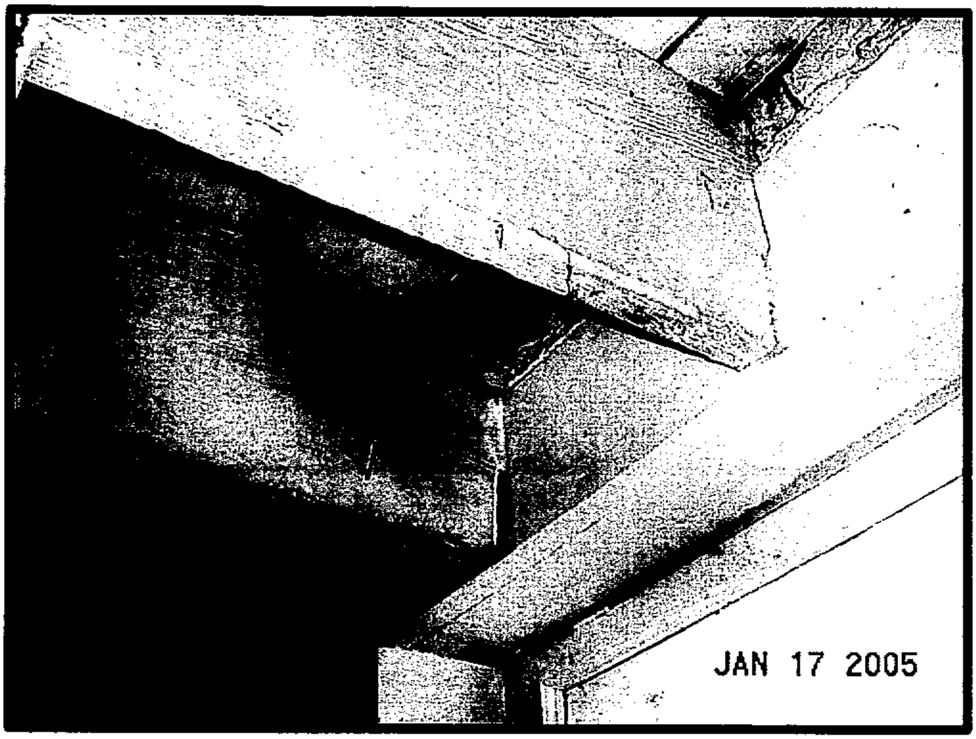
16. SUPPORT COLUMN AND CROSS ARM AT CUT JOISTS BELOW BATHROOM ABOVE. ONE SECTION OF CUT JOIST IS ONLY 14" LONG, BALANCED ON EAST END OF CROSS ARM BEAM.



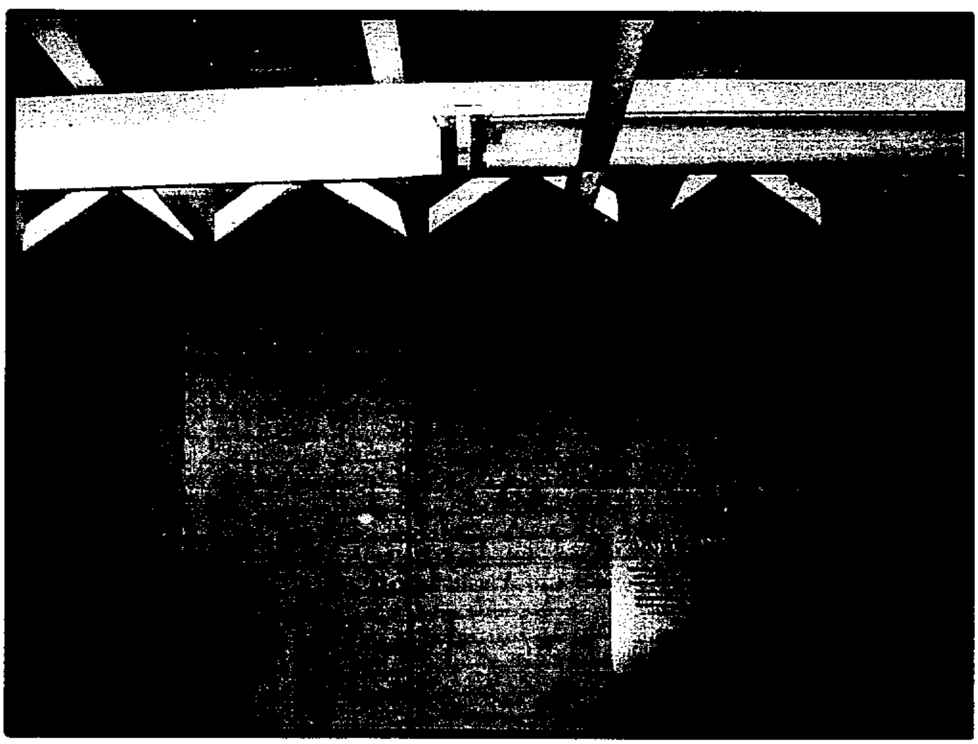
17. TYPICAL BRICK PIER WITH (6) 2X12 BEAM
NOTE: LACK OF BLOCKING BETWEEN JOISTS ABOVE BEAM.



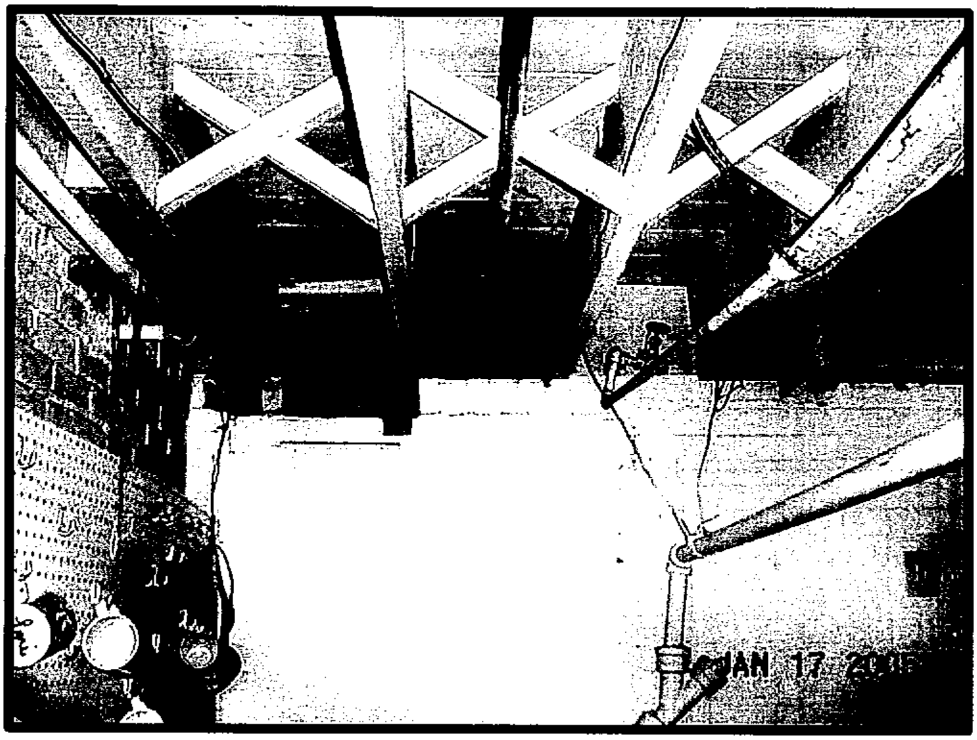
18. (6) 2X12 BEAM WITH RANDOM SPLICES - NOT AT COLUMN LOCATIONS.



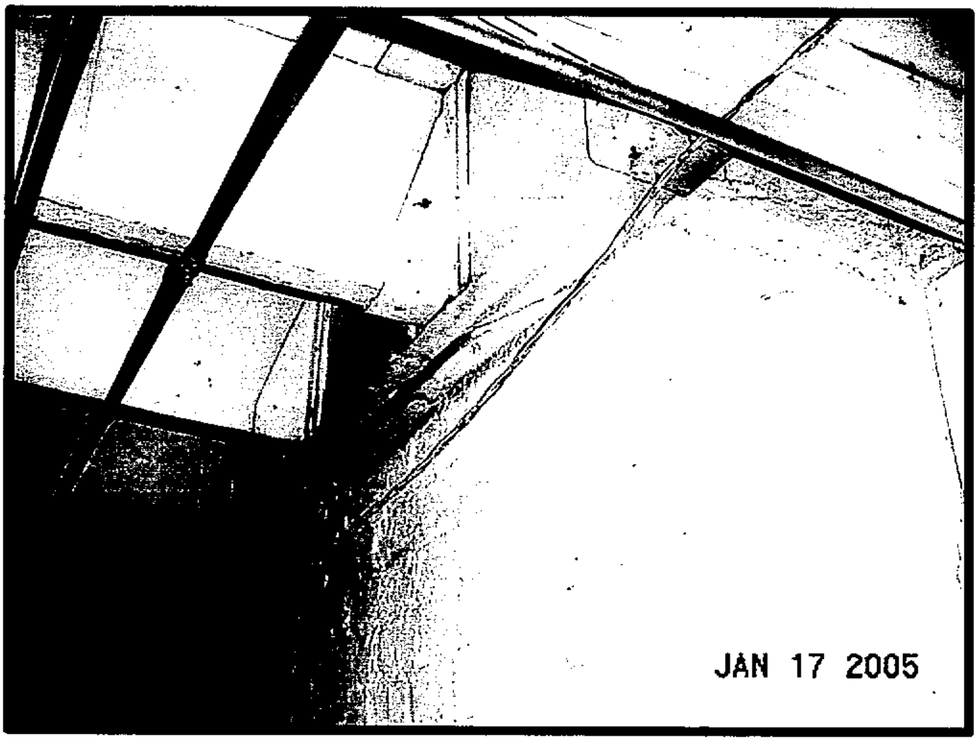
19. JOISTS BEARING INTO WOOD LINTEL AT BASEMENT WINDOW. NO JOIST HANGERS.



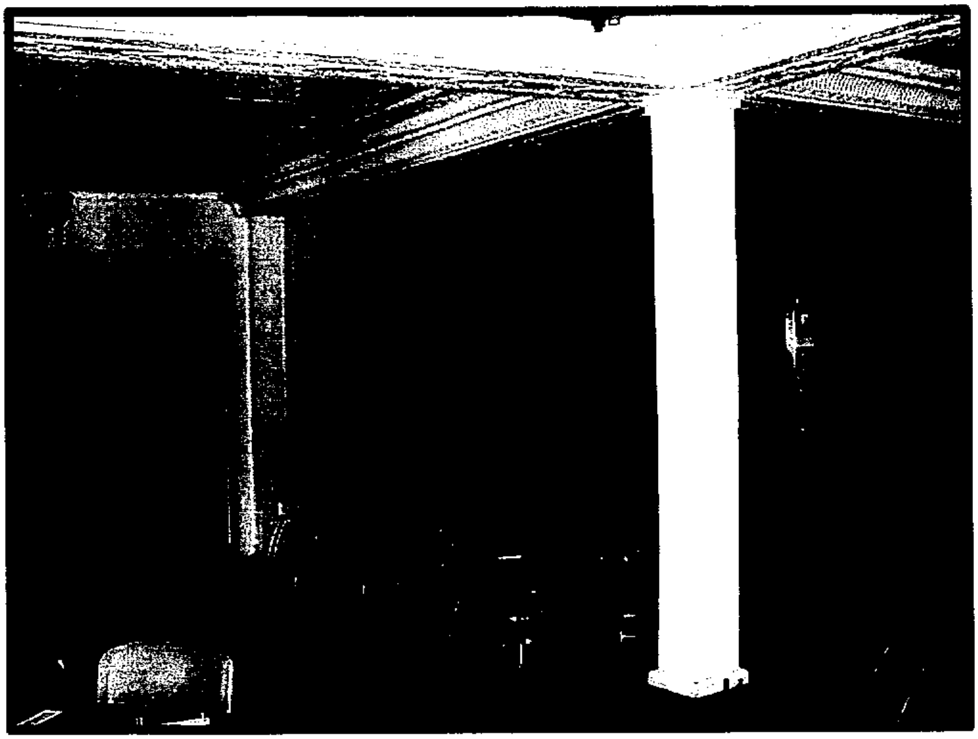
20. EXCESSIVE SIZE OF HOLE CUT IN MASONRY FOR PIPE HAS INTERRUPTED JOIST BEARING.



21. EXCESSIVE SIZE OF HOLE CUT IN MASONRY FOR PIPE HAS INTERRUPTED JOIST BEARING.



22. SPLIT HEADER AT CHIMNEY IN BASEMENT NOTE: JOIST HANGERS.



23. FIRST FLOOR "LARGE HALL" LOOKING SOUTH WEST.

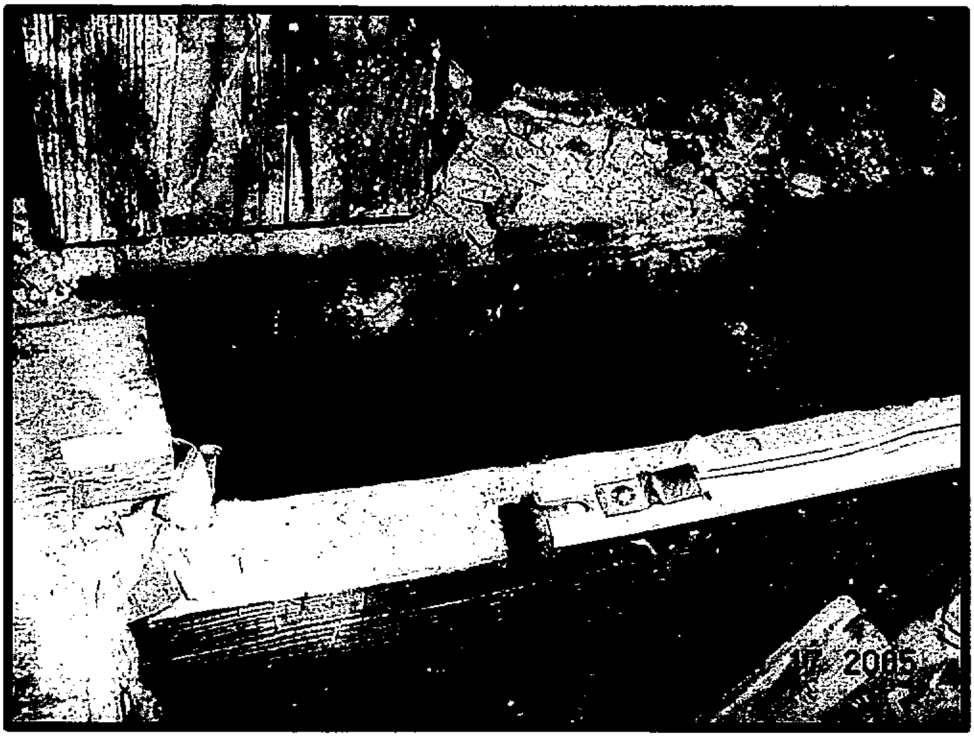
24. "LARGE HALL" LOOKING EAST. NOTE: PRESSED METAL CEILING TO THE LEFT AND POSSIBLE PLASTER OR DRYWALL CEILING TO THE RIGHT.

25. TWIN 12"x5 1/4" "I" BEAMS IN FLOOR ABOVE LARGE HALL.
NOTE: JOIST HANGERS STRAPPED ACROSS TOP OF BEAMS.

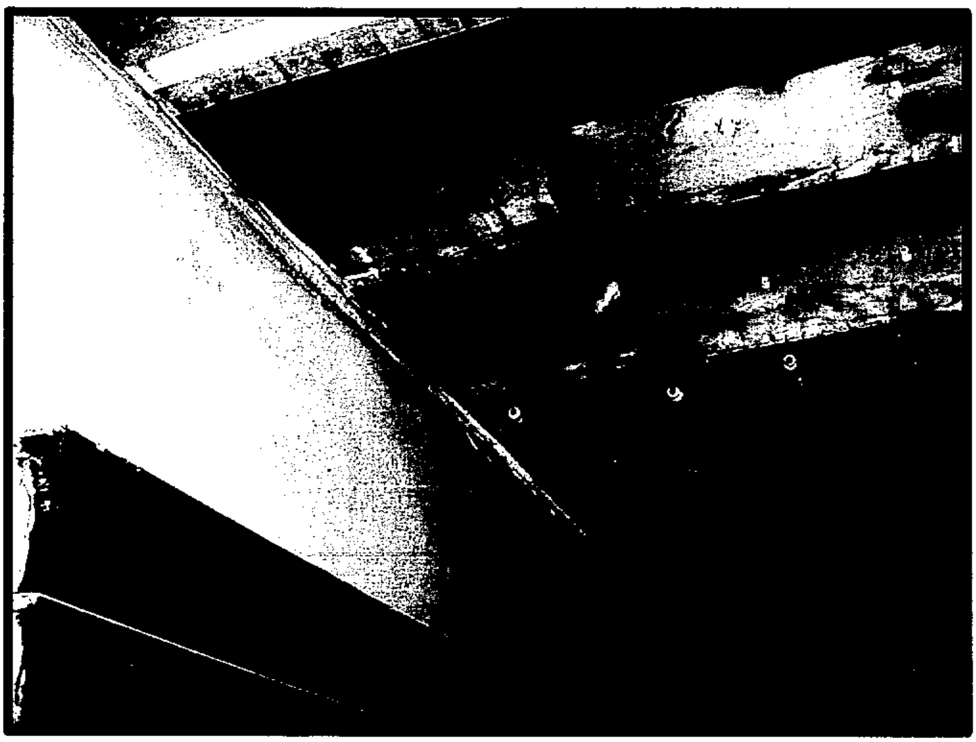
26. TWIN 15" "I" BEAMS SIT ON WOOD BLOCK ABOVE 18" x7" "I" BEAM. THE TWIN "I" BEAMS SIT ABOVE THE FLOOR AND SUPPORT THE EAST EXTERIOR MASONRY WALL ABOVE THE SECOND FLOOR.

27. CLOSE-UP OF TWIN 15" "I" BEAMS SUPPORTING EAST EXTERIOR WALL ABOVE THE SECOND FLOOR.

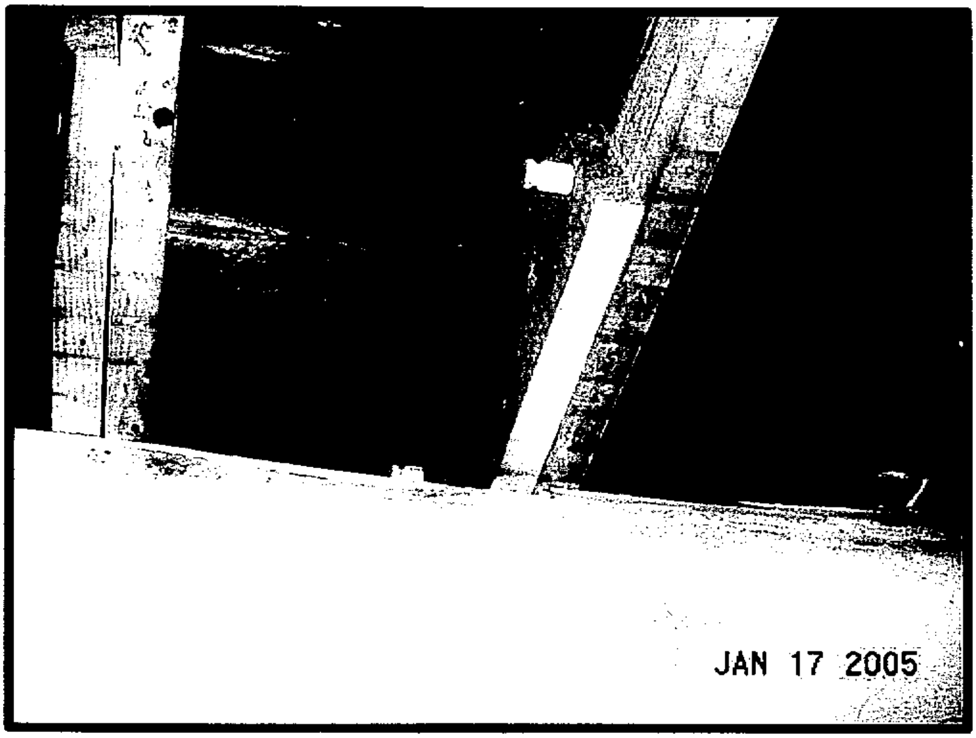
28. CLOSE-UP OF 1 1/4" THICK BEARING PLATE BELOW DOUBLE 15" "I" BEAM BEARING ON WOOD BLOCK.



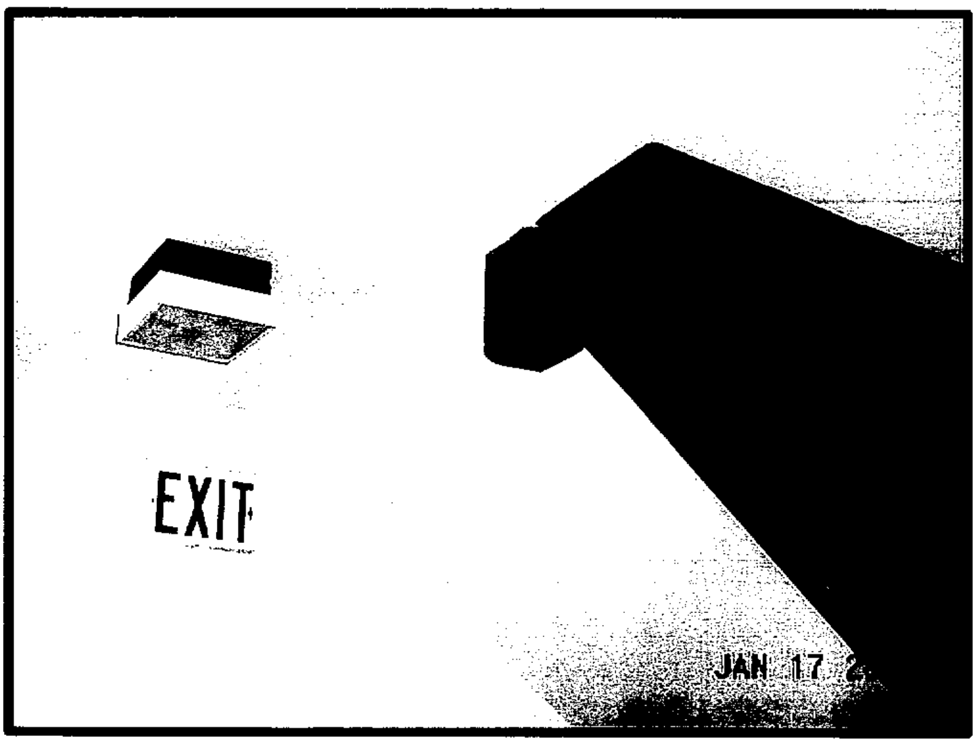
29. TWIN 15" "I" BEAMS PLUS 1 1/4" THICK BEARING PLATE SITTING ON WOOD BLOCK ABOVE 18" GIRDER.



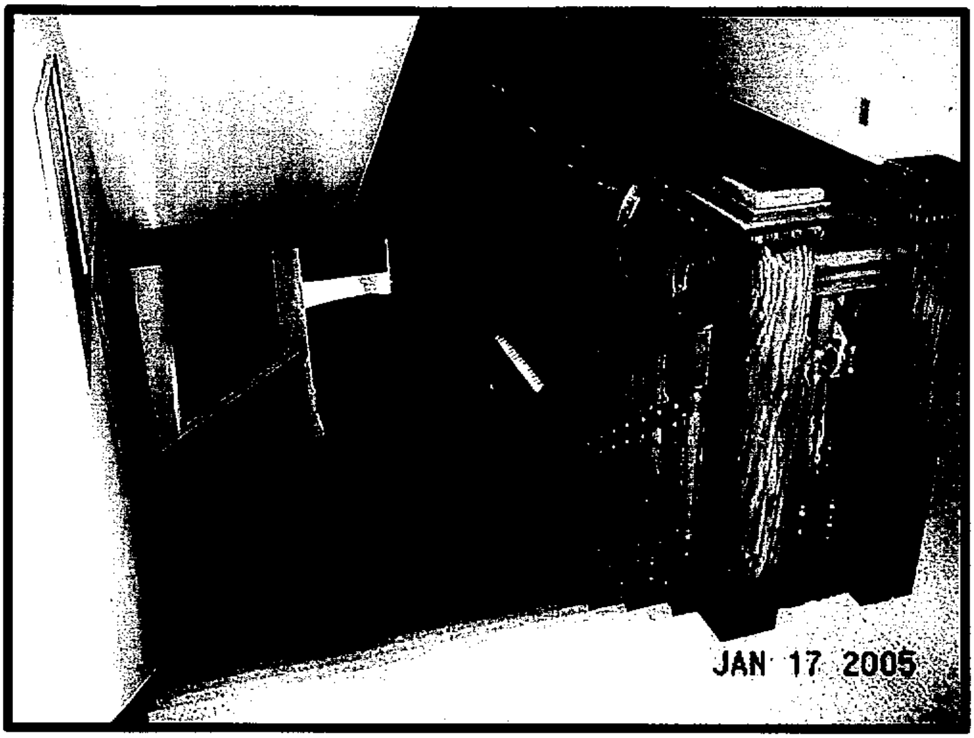
30. IN EAST WING. EAST CORRIDOR WALL IS BEARING WALL FOR ROOF, CEILING, AND THIRD FLOOR.



31. KNEE WALL SUPPORTS ROOF RAFTERS WHOLE CEILING JOIST BEAR ON WALL TOP PLATE.

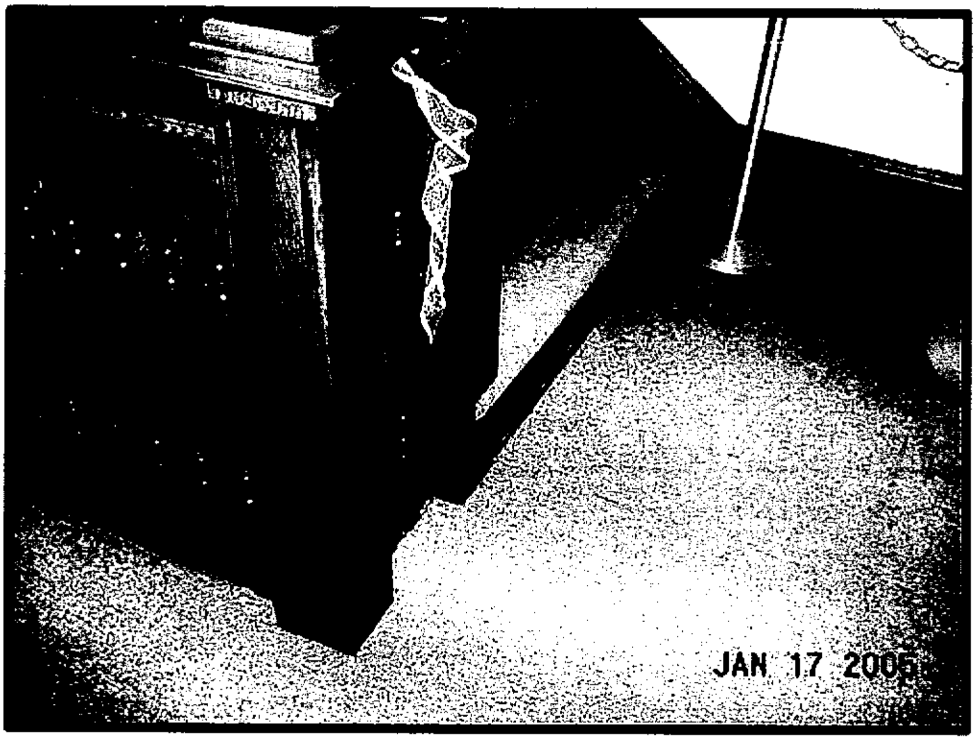


32. GENERAL DESIGN OF STAIRS.

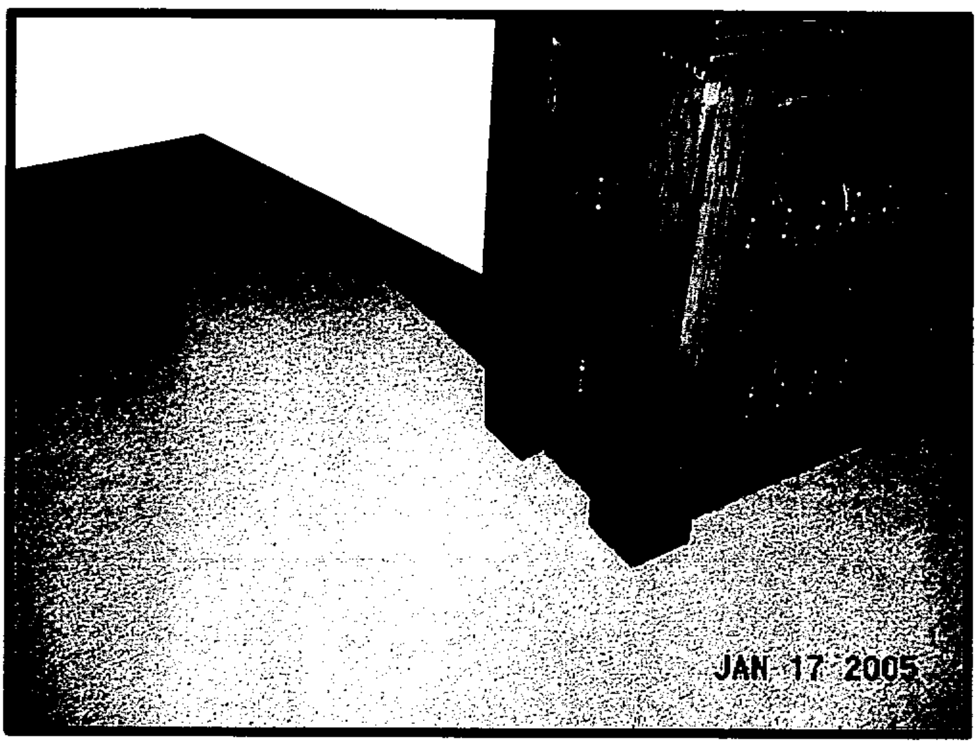


33. STAIRS & RAIL.

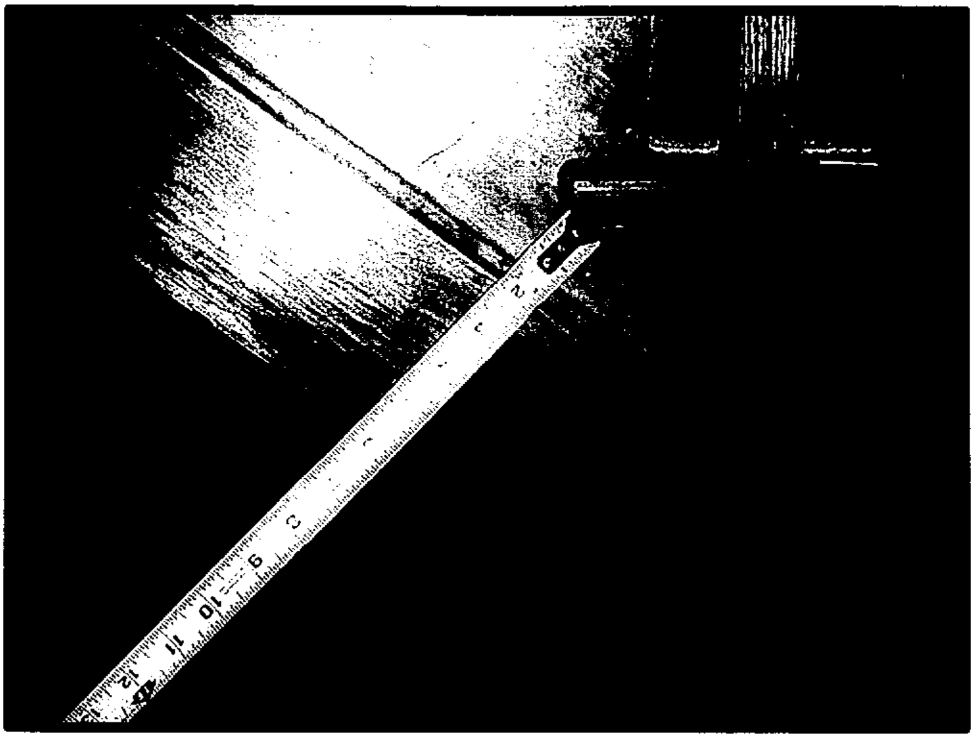
34. STAIR & RAIL.



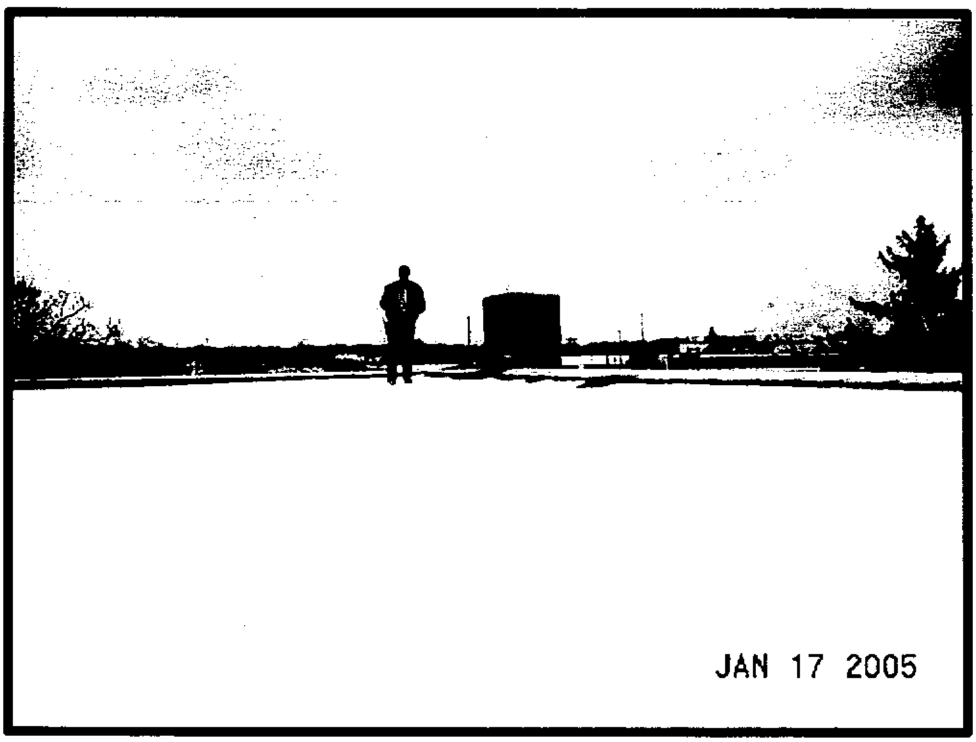
35. STAIR RAIL.



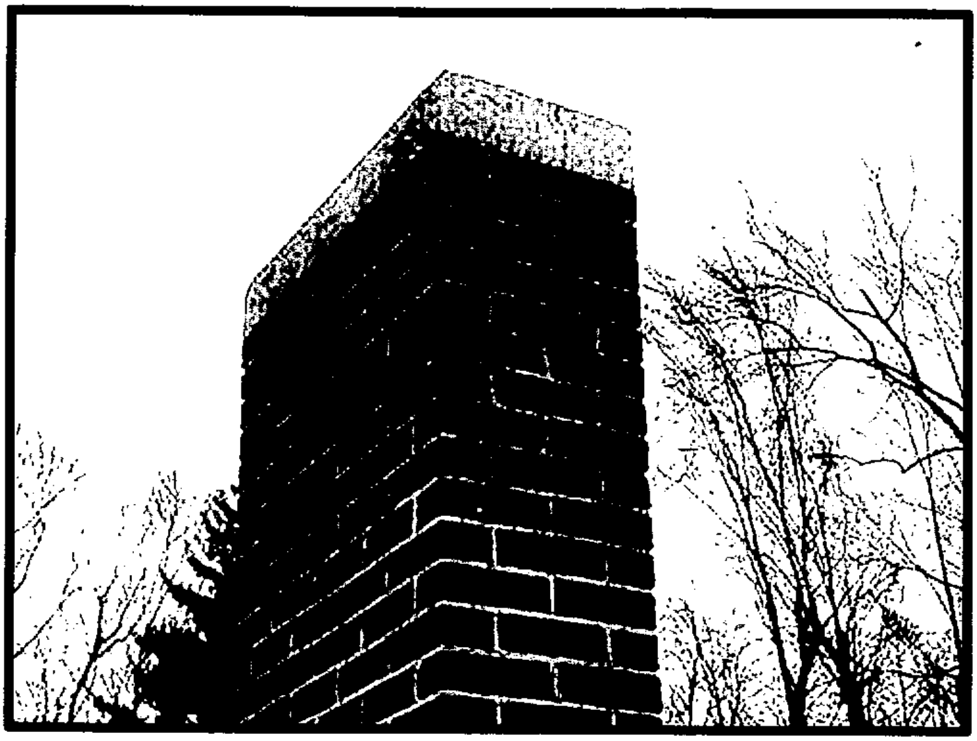
36. STAIR RAIL.



37. STAIR STRINGER LIKELY HAS 5" DEPTH AVAILABLE FOR STRUCTURE BEHIND TRIM AND FINISHES.



38. ROOF.



39. CHIMNEY ON ROOF HAS SOME CRACKS IN CAP.

Mechanical Systems
Feasibility Study

The Belrockton
Museum and Community Center
Belding, Michigan

Revised May 12, 2005

SmithGroup Incorporated

Contents

I. Introduction

The Belding Museum and Community Center, located in the Belrockton, Belding, Michigan, has been designated as a Michigan Historical Site. The facility, built in 1906 by the Belding Brothers and Company, was designed in the Classical Revival style. The facility, one of three structures designed, was originally used as a boarding house for the single women employed in the local silk mills. The building has served many tenants during it existence, including housing for the National Youth Administration, a youth center and its current designation as the Belding Museum and Community Center.

The Belding Museum occupies three floors of the Belrockton. Thousands of items are currently on display. A partial list of artifacts includes wooden musical instruments, wooden iceboxes and early refrigerators, linens, photographs, medical equipment, along with early weaponry.

The mechanical systems throughout the facility reflect the nearly 100 years of use since its construction. Many of the original mechanical components in the facility remain in active use today and have not undergone substantial changes other than periodic maintenance and replacement of failed components. However, the radiation originally designed to serve the upper floors has since been disconnected. The most substantial upgrade to the mechanical system in the facility came when replacement boilers and a forced air heating system serving selected areas of the second floor level were installed in 2001.

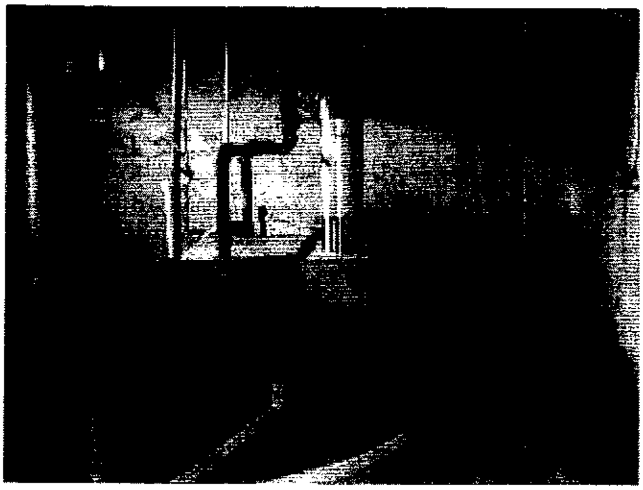
The entire facility was once heated by a low-pressure steam system that was popular when the housing complex was built. The steam is now used predominantly to heat the first floor of the building using cast iron steam radiators. There are very few mechanical devices on this type of a system that can produce failure, allowing the longevity of such a system.

The existing mechanical systems currently in use today do not support a conservational environment. To support such critical surroundings, a new mechanical system would have to be installed and the existing steam system demolished. Preceding the facility assessment and options 1 and 2 for the reconstruction of the mechanical systems, supporting conservational thoughts and design criteria for a conservational environment follow in Appendix A.

II. Central Steam, Hydronics, Heating and Piping

A. Steam Generating System

Boiler #1



Description: The existing steam distribution system, currently serving only selected areas, is supplied from a natural gas fired steam boiler manufactured by Weil-McLain and is positioned in the basement boiler room. This boiler was installed as part of a boiler replacement project in 2001. The boiler, model EGH-85-PIN, is rated at 350,000 BTU/hr input, 280,000 BTU/hr output, when fueled by natural gas. The boiler is complete with a standing pilot ignition system, electric water feeder, 24volt low water cut off, and a Huffman watchman condensate pump. The boiler is functioning sufficiently and is capable of meeting the demand load for which it serves.

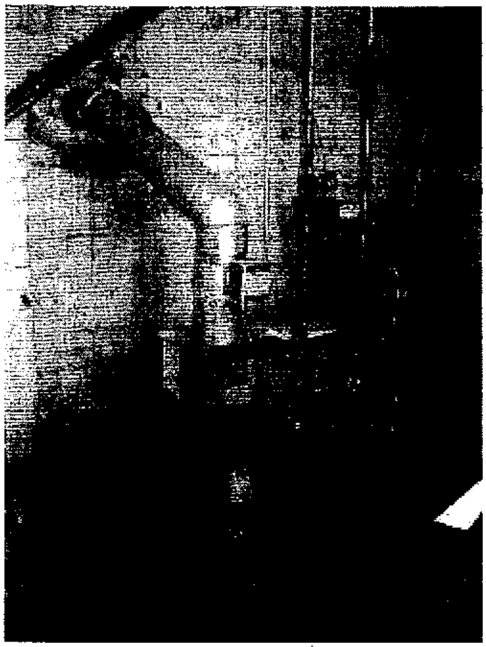
The boiler is equipped with a back draft damper. Boiler stack gases are routed through the breeching to an existing brick chimney. The boiler breeching appears to be in good condition, however, the chimney shows sign of deterioration and additional review of the structural characteristics will need to be completed.

Recommendation:

Short Term: Perform yearly scheduled maintenance.

Long Term: Demolish the steam system.

Boiler #2

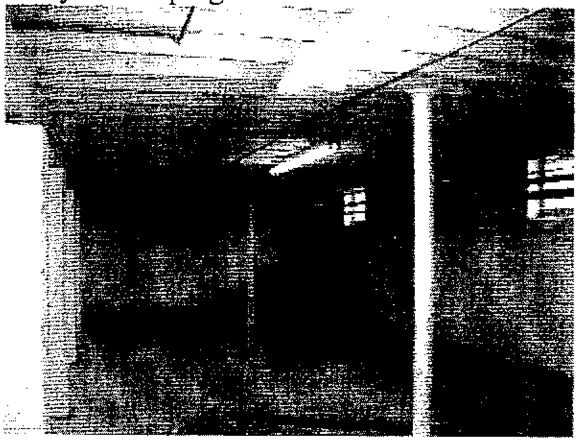


Description: This boiler was installed as part of apartment addition to the complex and is currently inoperable. The boiler is located in the smaller basement mechanical room. The baseboard radiation is still in existence and currently is located in the west rooms of the first floor. The boiler, model M-75 AGB, is rated at 75,000 BTU/hr input, 54,000 BTU/hr output, when fueled by natural gas.

Recommendation:

Short Term: Demolish boiler and associated components.

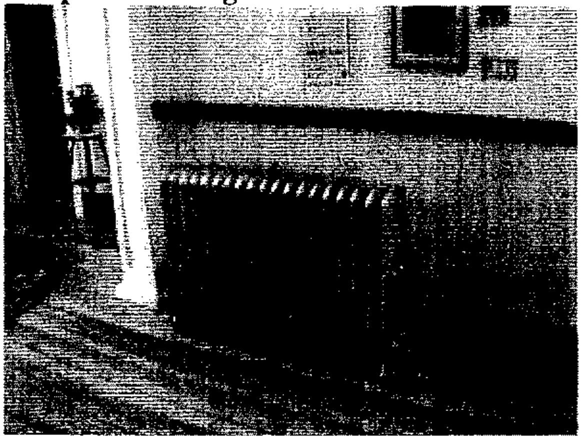
B. System Piping



Description: The steam piping is original to the building. A visual inspection of the piping system found serious problems. From leaking condensate pipes, deteriorated valves / fittings along with the mixture of schedule 40, copper and galvanized, the piping should be considered to be a total loss and should be replaced. It is not recommended at this time that additional non-destructive testing of the components be completed.

Short Term: Demolish piping.

C. Space Heating



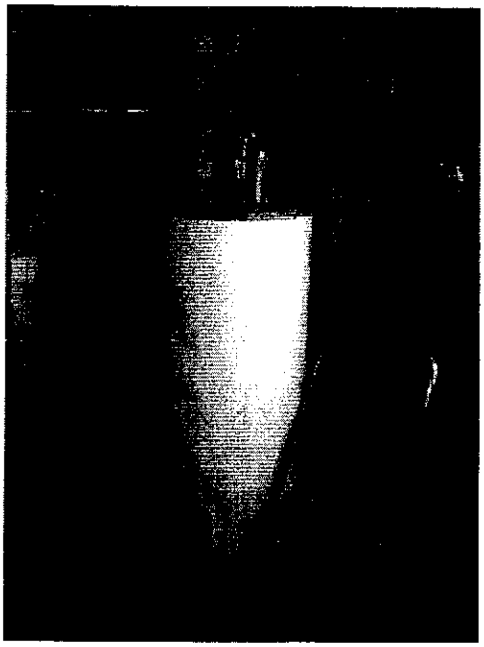
Description: Heating of the space on the first floor is from the original cast iron radiators. The radiators are original to the building. This type of a steam system has few components allowing the system to achieve its long life cycle. Each radiator is equipped with individual shut-off valves, air vents and steam traps. Excessive water hammer in the system was witnessed during the field visit alerting us to the potential of multiple problems within the steam system.

Recommendation:

> **Short Term:** Perform yearly scheduled maintenance.
>
> **Long Term:** Convert steam system to hot water. Keep radiators in place for historical aesthetics.

D. Domestic Hot Water Heater

Hot Water Tank #1



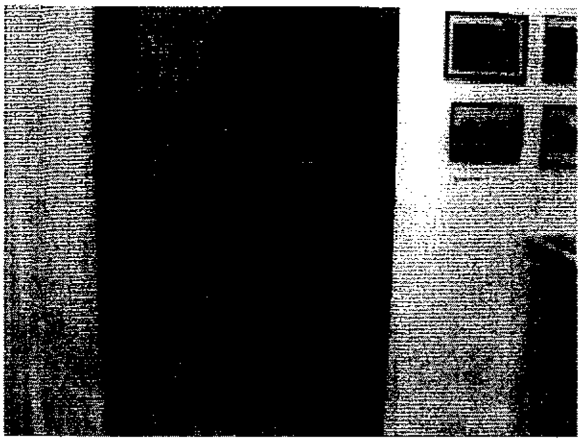
Description: The existing domestic hot water heater is a natural gas fired Ruud. The hot water heater, Model #FLG-40, is a 40 gallon tank with a BTU/hr rating of 26,000. The tank appears to be in good working order and should be capable of serving the needs for the facility for the foreseeable future.

Recommendation:

Short Term: Routine maintenance.

Long Term: Replace at the end of service life.

E. Furnace #1



Description: The existing second floor heating system is a high efficient, Tempstar Furnace, Model # NUGS125AKO1. The furnace input rating is 125,000 BTU/hr. The blower section is a DD12-11AT and is rated at 1200 CFM. The heating system is located in the second floor mechanical room and is sized to only serve partial second floor areas.

Supply air ductwork is encased in a soffit that runs along the interior wall portions of the exhibit spaces on either side of the central corridor/main stair. Air is returned to the unit by a single wall mounted grill located in the southern second floor exhibit space. No operational issues at this time are known.

Recommendation:

Short Term: Perform yearly scheduled maintenance

Long Term: Replace at the end of its service life.

III. Heating / Cooling Options 1 and 2

A. Introduction

The facility is heated through a variety of steam heating system components along with a forced-air furnace. Currently the facility is without any form of mechanical cooling or mechanical ventilation to meet the demands of space comfort, preserve artifacts or to address code related fresh air issues. The steam heating system has known mechanical issues mostly due to age, deferred maintenance, incompatible piping materials, and other operational related issues. The following sections will breakdown the system redesign into two options. The first option details a more residential type system whose attributes are simplicity, control and economics while the second approach is centered around a more typical commercially designed environmental system.

The original design of this facility incorporated a philosophy that the mechanical systems were to unobtrusively blend into the architecture of the facility. The original designers took great care in ensuring that mechanical elements were not obtrusive to its environment. This design ethic as well as the desire to maintain the historic character of this facility and surrounding properties, creates some unique challenges to providing a source of heating and cooling for interior space conditioning systems.

For this reason, we have incorporated two options for providing primary heating and cooling services. One option that respects the original character and historic nature of the site and a second that may not fully respond to this need but could be a more economical solution.

B. Heating / Cooling Options 1,2

Option 1

The first option consists of the demolition of the existing steam boiler, boiler flue, steam supply and return piping along with the baseboard heating elements that are located along the perimeter of the west first floor rooms. In all cases, the existing radiators would remain in place to help preserve the historical characteristics of the facility. The existing radiators would be reused with the hot water system, however, their BTU output would be de-rated due to the temperature difference of using steam and hot water. A new heating hot water boiler system would be designed to serve the entire basement along with the entire first floor with exception of the community room. This would require a new heating hot water boiler, duel circulating pumps (one pump for back-up), chemical treatment, new perimeter baseboard radiation, new supply and return piping, zone valves, controls, along with new boiler breaching. Critical issues surrounding the usage of the existing chimney for routing of the boiler gases still need to be addressed. It may be possible to install new stainless steel flue lining, however, during the field visit visible forms of ice had accumulated on the outside surface of the chimney, adding the potential for masonry repairs.

Under Option 1, cooling of the first floor Community Room would be in the form of a forced air furnace with a DX cooling unit located outside on grade in the grass area just west of the stair, between first floor and basement. As an alternate this unit could be located on the roof. The unit would have an estimated footprint of 3'x3', and if located on grade would require post protection. For this purpose, a new mechanical room in the basement needs to be designed. This room would roughly be the size of the upstairs furnace room and could be located along the south end of the basement below the community room. A new supply and return air duct distribution system would be installed directly below the community room, and outside ventilation air to meet the demands of the current building code would be introduced into the system. Supply and return air diffusers would be located in the floor along the perimeter of the Community Room. With the usage of a high efficient furnace the flue gases will be sidewall vented. With no archival type storage in this location, cooling is not a necessity but a matter of customer choice, and could be designated as future work.

At the Owner's option, cooling for the first floor (other than the Community Room) can also be introduced. This will require a forced air system with a mechanical room located either in the basement or at the first floor. Careful coordination with architectural design will be required for locations of new floor supply and return air ducts, as well as location of duct distribution in the basement. Ducts will reduce headroom in the basement.

Conditioning of the second floor would continue with the existing approach of utilizing forced air equipment. The existing furnace will remain or be replaced, depending on cost. A second forced air unit similar in size and capacity to the system that currently serves the exhibit areas would be installed in a new or expanded mechanical room. Both furnaces could be located into a common mechanical room in east end, near the connection of the "T" of the building. Insulated supply and return air ductwork would be encased in a soffit or would be ceiling hung. Flue gases would be vented vertical to the roof avoiding aesthetic sidewall issues. Cooling would be in the form of a split system with the condensing units being roof mounted. The rooftop-mounted equipment would be located near the SE corner of the building to minimize sight lines from street. A piping chase to the roof would be installed to route the cooling line set. A system disconnect along with unit lighting would be required at each condensing unit.

Humidification in the form of a Dri-Steam type unit with a stainless steel boiling chamber would be installed on each forced air furnace. It is recommended at this time that space humidity not exceed 15% r.h. in the winter months. This is to maintain the structural integrity of the building and avoid window condensation.

Conditioning of the third floor would be identical in system approach to the second floor. Twin forced-air furnaces complete with cooling, a duct distribution system, humidification and controls would be designed to accommodate the needs of the spaces. Both units would be house in a common mechanical room preferably in the east end, near the connection of the "T" of the building. Ductwork can be located within the attic, above the ceiling, to minimize introduction of soffits at the third floor. Again the condensing units would be roof mounted and the flue gases would be vented to the roof structure.

If air conditioning of the environment is deemed not to be critical and future addition of a cooling system is not to be considered, then perimeter radiation with hot water from the new boiler system would be utilized for space heating needs.

The advantages of using this approach are simplicity, control, cost and maintenance. The associated "in-house" zone units consist of simple air-cooled refrigerant based air-conditioning units along with natural gas-fired heating systems. A properly installed system along with the indoor equipment can be expected to have a life cycle of 20-25 years.

The disadvantages to this type of system are aesthetics of baseboard radiators, soffits introduced into the build out of a historical building, rooftop and/or grade mounted units, equipment life cycles along with limited ability to maintain a conservational environment, however, current environmental conditions would be greatly improved.

Option 2

The second option consists of the addition of a conventional air-cooled chiller to meet the demands for space cooling along with the demolition of the existing steam system. The air-cooled chiller would be sized to accommodate the loading of the entire complex. The chiller would be located on grade due to its weight. This equipment would have an estimated footprint of 8'x8', and ultimately would require approximately 28' x 20" to accommodate a suitable enclosure or screening. Chilled water piping would be trenched into the facility. Chemical treatment, thermal expansion, air separation, along with a duel-pumping system would be incorporated into the basement mechanical room. Piping distribution would be of schedule 40 and type L copper.

Indoor air handling would consist of modular designed equipment. Each floor would have an individual air handler that would serve the needs of heating, cooling, ventilation and humidification. Each unit would come equipped with chilled water coils, heating hot water coils, humidification section, air blender, access panels, fan section and controls. Each floor would require a space of 200 square feet for associated mechanical equipment and devices and should be centrally located. A new central duct distribution system would be designed for each floor. The second floor forced air system would be demolished but could be modified for budget constraints.

The existing natural gas steam boiler would be demolished and a new heating hot water system would be installed to provide heating hot water to the individual air-handlers. Duel circulating pumps, air expansion, chemical control and supply / return piping would be incorporated into the design.

The advantages of using a centralized system approach are system integrity, tighter environmental conditioning along with longer equipment life cycles. A properly installed and maintained central system can produce life cycles of 40 years for the indoor equipment.

The disadvantages to this type of system are noise, aesthetics and maintenance costs issues. The expected life cycle of an air-cooled chiller is approximately 15-20 years and costs associated with factory support can be expected. The average maintenance agreement on a chiller this size should be expected to reach $3000 / year versus $1000 / year for residential split systems.

C. Summary and Comparison of Options

Both options may be adjusted to accommodate options for size, arrangement, and ultimate capacity. All equipment selections for heating and cooling equipment will be based on standard ASHRAE design criteria for this region of the country (0° F winter outside temperature and 89° F summer outside temperature with a coincident wet bulb temperature of 73°F.)

Option 1

Aesthetics:	Original radiators remain and are operational. Perimeter baseboard radiation. Cooling unit for Community Room mounted at grade or rooftop. Multiple condensing units located on the roof. Soffits for duct distribution at 2nd and 3rd floors.
Life-Cycle:	20 – 25 years
Initial Cost:	$112,000
Yearly Maintenance Cost:	$1000

Option 2

Aesthetics:	Original radiators remain and are not operational. Large enclosed area for exterior grade unit. Soffits for ducts at 1st, 2nd and 3rd floors. Noise.
Life-Cycle:	40 years for indoor equipment, 15-20 yrs for chillers.
Initial Cost:	$225,000
Yearly Maintenance Cost:	$3,000

IV. Appendix A

MUSEUM CONSERVATION ENVIRONMENT DESIGN ISSUES

Conservation environment primarily refers to the maintenance of internal space temperatures, humidity, and cleanliness conditions, with appropriate control accuracy and stability, to provide conditions that are conducive to preservation, protection, and conservation of the collection.

There has long been general agreement by conservators that temperatures in the range of 68 °F to 72 °F, and humidities in the range of 45 %RH to 55 %RH were effective conservation conditions. Other aspects of the environment, such as lighting types and intensities, filtration efficiencies, etc., have also been included in museum standards with general agreement of acceptable standards or ranges of suitability. Until relatively recent times, however, there has not been a substantial body of reliable research data demonstrating clear cause and effect relationships between temperature, humidity, and the degree of physical damage or long term deterioration of collection materials. This is especially true relative to control accuracy and fluctuations in temperature and humidity, either as short term or long-term fluctuations.

Over the last several decades a great deal of research has been dedicated to this subject and the determination of the most effective conservation environment has become an extremely technical science with well documented cause and effect relationships. This knowledge base includes development of the physics and chemistry associated with material deterioration or damage, effects of changing environment or periodic changes, speed of change, and the proper matching of these conditions to collection materials.

The determination of the most effective conservation environment must also be developed with an understanding of a museum's particular needs for exhibiting the objects and program development, especially when multiple material types are to be displayed in a common area either simultaneously, or through changing exhibits. The determination of the desired environment needs the special skills of the conservationist who is not only expert in the material science, but who also understands the museum's operational needs, and can help the museum evaluate the costs, benefits, and risks of environment issues.

Museum architects and engineers also try to maintain a working knowledge of conservation requirements and current research. Architects and engineers should not however be considered conservationists and should not be relied upon to be sufficiently knowledgeable in this complex conservation science, or to have sufficient knowledge of the museums operations and management needs, to establish the most appropriate conservation environment criteria. The design team must rely on the museum conservation department to establish the primary interior environmental criteria and the museum management and curatorial staff to weigh the flexibility and environmental needs of exhibit spaces.

Because conservation environment requirements can strongly impact the building and systems design, and can have substantial cost impacts, the design architects and engineers should also be involved in the final resolution and selection of the environmental criteria. In this regard, the following paragraphs are intended to document typical museum design criteria and provide a discussion of conservation environment requirements.

ASHRAE Suggested Criteria

ASHRAE (the American Society of Heating, Refrigeration, and Air Conditioning Engineers) discusses museum conservation environment criteria in chapter 20 of the 1999 Handbook of HVAC Applications. ASHRAE suggests several categories or "classes" of temperature and humidity control appropriate for museum environments. These different classes have been developed to help distinguish between an optimum design standard and other approaches, which either increase or decrease risk. It should be noted, that while the ASHRAE technical committee authoring this chapter includes conservationists, neither ASHRAE, or this committee, should be considered as representing the museum conservation community. The ASHRAE chapter on museum design does not discuss chemical air quality or lighting criteria.

The ASHRAE suggested control classes and criteria are as follows.

Class AA – Intended for "major institutions with the mandate and resources to prevent even tiny risks":
Class A - Intended as the "optimum" for most museums and galleries" (Two sets of criteria are provided giving essentially equal risk.)
Class B, & C – Intended for small or limited institutions and possibly "the best that can be accomplished" in certain historic buildings.

Class	Description	Temperature Set-Point (°F)	Humidity Set-Point (%RH)	Short Term Fluctuations (°F)	Short Term Fluctuations (%RH)	Seasonal Adj. to Set Point
AA	Precision control No seasonal changes	59 to 77	50	+/-4	+/-5	No RH adj. T +/- 9
A1	Precision control Some gradients or Seasonal change Not both	59 to 77	50	+/-4	+/-5	RH +/-10% T +9 /- 18
A2	Precision control Some gradients or Seasonal change Not both	59 to 77	50	+/-4	+/-10	No RH adj. T +9 /- 18

B	Precision control Some gradients plus Seasonal change	59 to 77	50	+/-9	+/-10	+ & - 10% RH T +18 /- as req'd
C	Prevent all high risk extremes	59 to 77	50	within 25 to 75% RH year-round.	None	

Environment Criteria & Conservation Issues

To fully evaluate the appropriateness of the current suggested design criteria, the relationships of environment to conservation of the collection must be understood and carefully evaluated against the findings of current research. Likewise the criteria must be developed by carefully evaluating the risks to the collection and the cost, flexibility, and implementation issues. An additional issue, the ability to borrow art for special exhibitions, may also restrict the Museum's ability to refine certain criteria. The following paragraphs describe the fundamental environment and conservation relationships, the evolution of current criteria, and current research directions.

Criteria Evolution & Direction

Conservation environment criteria have been developed based on several primary or fundamental relationships between preservation and environment and has evolved over several decades. Early criteria emerged as certain cause and effect relationships, primarily concerning temperature and humidity, became apparent. Without detailed scientific data, early criteria simply targeted controlled cool environments with moderate humidity. The standard of 70 °F and 50 %RH was actually established as a condition which appeared to work best. This standard was really a guess based on what had apparently worked the best in history. The need for reasonable accuracy, and especially stability, was also apparent but in the absence of detailed scientific data, was set at levels achievable with the mechanical systems and controls available in that day. Over the years the requirements for stability or accuracy have become more and more strict, partly as a function of new control technology becoming available, and also from conservationists desiring greater safety and pushing the edge of design capabilities. The strictness in stability criteria has not evolved from research. While research has confirmed that the basic criteria are "generally" valid, it has identified many different temperature and humidity conditions, which are most appropriate for different materials. Research may also be demonstrating that the current day perceived needs for extreme stability can also not be supported. Current research appears to be identifying somewhat broader ranges of stability as acceptable with much greater definition of the specific conditions and mechanisms of damage or deterioration to specific objects.

In many ways, the advancing body of research and data is making the determination of appropriate environment criteria more difficult. We know that different objects need different conditions and levels of stability. Uniform environments for multiple collection items are now considered somewhat of a compromise in the care of objects. Current research has confirmed some of the early criteria assumptions, advanced the understanding of many criteria/preservation relationships, and even redirected some aspects of criteria development.

Temperature Criteria

The specific temperature of exhibit spaces is not generally recognized as critical to the majority of museum collection items. This is not quite true however, depending on the type of material. Temperature criteria have actually evolved as a compromise between preservation and creating an environment acceptable to museum patrons.

The specific temperature can be extremely important to materials that are subject to deterioration by oxidation and hydrolysis, (and other numerous chemical reactions) such as organic materials, many older papers, photographs, and numerous types of records. Lower temperatures slow chemical oxidation and hydrolysis reactions. It is because of this that most archival facilities store most records at very low temperatures. For instance, it is generally accepted that lowering the temperature of most paper created in the 1800's from 68°F to 60°F, will double its remaining life expectancy. The effects of these reactions (and specific temperature) in objects such as oil paintings, wood, metals, etc., (materials with lower activation energy rates) are not as strong, and lower temperatures are not as beneficial.

Virtually all materials however have an additional temperature influence. Materials become stiffer and more prone to damage at low temperatures. Paints embrittle at low temperatures. Most paints have a glass transition temperature (temperature below the elastic state) between 43 °F to 5 °F, and should not be subjected to such low temperature conditions. At these conditions paints are very prone to cracking and flaking.

All materials are subject to mechanical damage due to stress and strain created by dimensional and flexibility changes resulting from temperature and humidity fluctuations. Materials expand and contract as a function of their individual coefficients of thermal expansion and changes in temperature. (Changes in humidity have similar and even more substantial effects as described later.)

Changes in museum temperature, caused by a lack of control accuracy and stability, were thought to be very critical in past decades, causing dimensional changes in materials that are restrained from movement. An oil painting for example has the paint layers restrained by the canvas and also by various layers of paint. The frame also restrains the canvas. It would appear obvious that if the coefficients of thermal expansion are different for the mutually restrained materials, and the temperature change is sufficiently large, differential movement will occur and damage will result. Recent research however appears to indicate that the coefficients of thermal expansion for the majority of museum collection objects and their associated restrained layers are sufficiently small that the movements resulting from temperature changes remain in the elastic region over much larger ranges in temperature than previously thought. As long as the dimensional change remains in the elastic region, the material will not experience strain or stress damage. The research also appears to indicate that even large numbers of temperature change cycles do not have a measurable impact on the art if the resulting dimensional changes remain in the elastic range of the materials involved.

The importance of specific temperature, and temperature stability, has therefore relaxed somewhat during the last several years. Conservators may be adopting a view that allows the degree of temperature accuracy or stability to be relaxed unless extremely critical materials are involved in the collection. Obviously, objects with high coefficients of thermal expansion, such as magnetic tape, certain metals, and metals with special coatings, do exist, and the degree of accuracy necessary should be established through careful evaluation of the special collection items housed.

Relative Humidity

The effects or relative humidity on collection materials are in many ways similar to those associated with temperature. These effects are however more pronounced and also include other effects. Relative humidity may be the single most important conservation environment issue.

The first and most obvious issue related to humidity is damage caused by mold, mildew, and fungus. Possibly more art has been damaged over time by this type of organic attack than by any other mechanism. These issues have been extremely well researched and we have excellent guidance on how to prevent or limit the growth of molds. Research quite clearly demonstrates that relative humidities below 60% effectively prevent the growth of mold and mildew. Most mold DNA helices collapse near 55%RH (relative humidity). Elevated humidities, above approximately 70%, can allow mold to grow in as little as several months. Levels above 85%RH can allow mold growth in as little as one week. Museum environments are therefore kept well below the 60%RH level.

The second most well known effect of humidity is that of hydration or dehydration. Drying and shrinkage of materials is a common concern for anyone with fine furniture. As the material shrinks or swells, stresses are developed internally and with adjacent restrained materials. Furniture glue joints loosen and wood can even crack or deform. When most organic materials, such as wood, dry to very low levels, below approximately 20% to 25% equilibrium relative humidity (ERH), irreversible damage occurs as chemically bound water is removed. The material undergoes a physical change as chemical bonding changes. The most appropriate humidity range to inhibit the effects of swelling and shrinkage in most organic materials, and the more sever condition of chemical water dehydration and chemical bond deterioration (cross-linking), is currently thought to be approximately 35%RH to 55%RH.

Most objects include minerals, either as their basic material structure or as coatings and often as pollutants. Minerals hydrate, dehydrate, or deliquesce (become liquid) depending on the relative humidity. Salt (NaCl) becomes liquid at approximately 76%RH. If humidity conditions are sufficiently high, or low, sever hydration/dehydration of minerals can cause complete disintegration of sensitive objects. Hydration also catalyzes related chemical reactions with the environment and with adjacent chemicals. Today's urban environments include many pollutants, such as sulfur dioxide, which react with many materials to form acids. These acids attack virtually all materials and, over time, can severely damage the collection materials. Humidity and moisture catalyze hydrolysis reactions accelerating the dissociation of dissolved minerals within a compound and sugars (glucose to starch) within organic compounds. It is because of these specific issues, that conservators are now becoming reluctant to set a particular humidity standard as appropriate for the majority of objects. These issues are of critical importance to archival facilities and becoming increasing concerns in museum environments. For instance many coppers and bronze objects may have several critical humidities. While it may be generalized that relative humidities above approximately 70% are dangerous, and most materials have a range of humidities to which they are tolerant, the current view of hydrolysis and hydration/dehydration effects no longer supports a common safe humidity set point for many collection items. This issue appears to be moving museum conservators to desire individually adjustable humidity set-points in galleries and the ability to establish different set-points on a gallery-by-gallery basis.

Dimensional changes in restrained materials, such as paint on canvas, or ink on parchment, cause stress and strain to be developed. If dimensional changes are outside the elastic range of any associated or commonly restrained materials, the materials will permanently deform and differential movement between the materials can occur. Both conditions typically result in permanent and irreparable damage to the object. Changes in the equilibrium relative humidity of most none metallic objects have been found to cause greater dimensional changes than those caused by temperature change. Recent research and testing (primarily by Erhardt and Mecklenburg) however, indicates that the humidity induced dimensional changes in many collection items such as paint on canvas and paint on panel stay within the elastic range of the associated materials for much larger changes in humidity than previously thought. For paintings, ivory, and wood with various finishes, this range may be as large as 35%RH to 60%RH. Historically, this limit was thought to be in the range of only +/-5% RH. This research also appears to indicate that the number of cycles of change does not have a deleterious effect. Loading cycles within the 1,000s have not revealed damage if the dimensional changes have remained in the elastic region. Certain materials however, are known to be extremely sensitive to even minute fluctuations in dimension. Ink on parchment for instance may flake at very minor changes in dimension. Extremely sensitive materials are best cared for in microclimate devises, such as display cases, where even minor fluctuations in humidity can be buffered.

Obviously, the specific humidity tolerances, or stability, to be established by criteria, must still be judged in conjunction with the variety of collection items involved, and the degree of flexibility desired for the display of objects in a common area. If numerous objects must be maintained in microclimate cases due to relaxed stability environments, the museum may be substantially limited in creating exhibits and displays that show the collection in the most effective way.

Current research however, seems to be inverting the previous humidity criteria philosophy. Instead of a generalized single humidity set-point, controlled to very high degrees of stability, research may be promoting the use of overall-lower individual humidity set-points which are adjustable on a space-by-space basis, with indication that highly stable control or excessive accuracy is not always warranted.

Seasonal Adjustment

Some museums, primarily those in which collections are housed in historic buildings, have operated with different temperature and humidity set-points for summer and winter. This approach provides a lower humidity during the winter months to help protect the historic building walls from damaging condensate. The extent of set-point seasonal adjustment is typically developed based on the condition of the walls and windows, the vapor retarding characteristics of the walls, and condensation resistance of the window systems. The change in set-point is controlled to occur very gradually, over several months.

Seasonal adjustment has not been developed as a conservation strategy because it is beneficial to the art. It is not particularly beneficial and its acceptance depends on acceptance of several relatively current research findings. Conservation research has determined that many collection items can tolerate greater ranges of humidity and temperature change than previously thought. This is primarily a finding that the dimensional changes caused by humidity and temperature changes remain in the elastic region of most materials for these increased humidity and temperature changes. This issue is discussed above for humidity and temperature. The extremes of the changes that can be tolerated obviously vary by object material type and even by construction methods (furniture/wood joints), and must be evaluated carefully. The flexibility to display different collection items will obviously be hindered by large humidity and temperature ranges.

The conservation research appears to indicate that for many collection items, such as paintings, that this range could be as high as 35% RH to 6o% RH. This amount of change (+/- 12.5% RH) would be pushing the limits of the research and would be viewed as dangerous by many conservators, even in light of this research.

When seasonal adjustments are made however, they often include changes from 35% to 50%, 15%RH differential or +/-7.5 %RH. While this some what lower differential would normally still be unacceptable as a short term fluctuation, and would require substantial faith in the current research to accept, it is more acceptable as a long term change due to the benefits of creep.

Research has found that when material dimensions are caused to change by stresses imposed over extended time, they elongate or compress with approximately half of the developed stress as for short-term changes. The material fibers creep to a new dimension. This is a well know phenomenon of wood structural design which has more recently been applied to conservation research and multiple materials. The lower stress change in dimension is termed stress relaxation.

Because of this stress relaxation benefit, a long-term change of +/-10% RH may be considered approximately equivalent to a short-term fluctuation of +/-5%.

This is however somewhat misleading without considering the control accuracy or stability, which can be achieved, in actual practice. A long-term change of +/-10% is really equivalent to the equivalent +/-5% short-term effect (stress relaxed), plus the +/-5% control stability, or a resulting short-term change of +/-10%RH. In similar fashion, a long-term change of +/-20% would be equivalent to a short-term +/-15%, not +/-10%

ASHRAE offers this approach as equivalent standards of care for Class A criteria. Unfortunately, for the reasons described above, the approach is somewhat misleading in the way that it is presented and appears to be a more minor change than will be truly experienced.

An additional concern centers on the possibility of a system failure or power outage if such an event were to occur at the extremes of the humidity swing for seasonal adjustment. Such an occurrence would almost certainly cause greater damage than if a more conventional approach were followed.

If seasonal changes are to be employed, they should always be viewed in combination with the short-term control stability, and viewed as additive changes. For instance a long-term change of 10%RH is equivalent to a short-term 5%RH swing, or +/-2.5%RH. If the controls can maintain +/-5%RH stability, the combined effect is +/-7.5%RH (5% + 2.5%), and equivalent to subjecting the objects to a short term 15%RH change in humidity, i.e. similar to changing from 35%RH to 50%RH as a short term adjustment.

Air Quality

As for many building types that require a clean environment, museums require high efficiency filtration. Filters with ASHRAE dust spot efficiencies of 95% are the common choice. Although more efficient filters are available, they are extremely expensive to own and operate. The museum conservation community has not suggested a need for higher efficiencies is needed.

An additional air quality issue centers on gaseous pollutants. Specifically sulfur dioxide, ozone, and nitrogen dioxide (and other nitrogen oxides). These specific contaminants are products of our industrialization and urban environments, and have formed a new threat to collection items not present in past decades.

Sulfur dioxide deteriorates collection materials by reacting in air with oxygen to form sulfuric acid. The sulfuric acid freely attacks marble, limestone, frescoes, cellulose, silk, iron, leathers, and many other materials. Nitrogen oxides form mild nitric acid, affecting similar materials. Ozone is a powerful oxidizer and as such attacks almost all organic materials, such as paintings, textiles, leather, fur, etc.

These gases can be cleaned from the air by gas-phase filtration. This type of filter "adsorbs" the gases in activated carbon at an average efficiency of 90% to 95%. Unfortunately, no definitive standards exist at this time that defines the most appropriate concentrations of these gases for museum environments. A variety of museums and archival facilities have suggested specific concentrations that may be acceptable, however none of these appear to be considered a standard at this time.

A variety of testing however has been done to demonstrate the deterioration of thin coupon plates of silver and copper compounds when exposed to various concentrations of these gases. These deterioration rates have then been used to indicate safe levels. For instance, deterioration at less than approximately 40 angstroms in 30 days for silver plates would indicate a very pure environment and probably less than 0.35 ppb (parts per billion) of these gasses. Deterioration at a rate of approximately 100 angstroms in 30 days may indicate more nearly a factor of ten times more gas concentration, or approximately 3.5 ppb.

The 0.35 ppb sulfur dioxide exposure level also constitutes one of the lowest measurable exposure levels. Conservationists have surmised that if these exposure level results in a deterioration rate of 40 angstroms in 30 days, then the gas really should be eliminated completely. While full elimination is not a practical solution, very small levels can and should be maintained due to the aggressiveness and severe potential of these three pollutants. Some conservators have postulated that more harm has been done to collection items in the last 50 years by these pollutants than during the last two thousand years.

Lighting and Illumination

The lighting and illumination criteria are intended to minimize exposure to ultraviolet light and to limit the overall exposure to the radiation spectrum. Deterioration of objects by lighting (and daylight) occurs through photolysis (direct alteration of the molecular structure by UV wavelengths), photochemical reactions (aging and fading), and by thermochemical reactions (heating by absorption of infrared wavelengths).

Conservation of the collection would benefit from the lowest lighting levels achievable. Unfortunately, a sufficient amount of lighting must be present to allow patrons to view the exhibits. All sources of light should be provided with full UV protection. It must be left to each conservator to determine and control the acceptable durations of exposure to both artificial and natural light.

Belrockton Museum and Community Center

Code Analysis
2003 Michigan Rehabilitation Code for Existing Buildings (MRCEB)

This code analysis is based on the following:

- The building qualifies as an historic building per Chapter 2 of the MRCEB; as it is listed on the State Register of Historic Places.
- Proposed scope of alterations to the building are classified as Level 3 per Chapter 3 of the MRCEB if all work proposed in the Feasibility Study/Five-Year Plan were to be undertaken at the same time.
- Scope of alterations to the building that are proposed for completion in Phase 1 during 2005-2006 are classified as Level 2 per the MRCEB.

A code analysis of the Belrockton (as follows) presents that with proposed modifications, the building will be in compliance with the *2003 Michigan Rehabilitation Code for Existing Buildings* per requirements of *Chapter 10 Historic Buildings*. Note that all items listed in italics are direct text from the code.

<u>MRCEB– Chapter 10 – Historic Buildings</u>

1001.2 Report. *...If it is intended that the building meet the requirements of this chapter, a written report shall be prepared and filed with the code official by a registered design professional when such a report is necessary in the opinion of the official.*

The following is such report, as prepared by Michelle S. Trombley, AIA of the SmithGroup.

Four requirements of report:

1. *Report shall be in compliance with Chapter 1 of the MRCEB.*
2. *Report shall identify each required safety feature that is in compliance with this chapter.*
3. *Report shall identify where compliance with other chapters of these provisions would be damaging to the contributing historic features.*
4. *The report shall describe each feature that is not in compliance with these provisions and shall demonstrate how the intent of these provisions is complied with in providing an equivalent level of safety.*

<u>1. Report shall be in compliance with Chapter 1 of the MRCEB.</u>
Applicable sections:
101.4 Existing Buildings – *The legal occupancy of any building existing on the date of adoption of this code shall be permitted to continue without change....*
This code analysis is based on the building occupancy classification of A-3, as defined in the Michigan Building Code for museums, community halls and exhibition space.
101.5 Maintenance – *Buildings and parts thereof shall be maintained in a safe and sanitary condition. The provisions of the International Property Maintenance Code shall apply to the maintenance of existing buildings and premises....*

SmithGroup hereby informs the City of Belding that the building is to be maintained per the *International Property Maintenance Code* to be in compliance with the MRCEB.

101.6 Safeguards during construction. - *All work covered in this code, including any related demolition, shall comply with the requirements of Chapter 13.*
SmithGroup hereby informs the code official and the City of Belding that all future construction documents prepared by SmithGroup for alterations to the Belrockton will include specifications for complying with Chapter 13 of the MRCEB.

104.2.1 Preliminary Meeting. – *When requested by the owner or owner's agent, the building official shall meet with the owner or owner's agent to discuss plans for the proposed work or change of occupancy before the application for a construction permit in order to establish the specific applicability of the provisions of this code.*
The Owner, Architect, Building Official, and Fire Marshall will participate in such a preliminary meeting on February 17, 2005. (Doug Hoffman, Building Official participated in discussions with SmithGroup via telephone.)

2. Report shall identify each required safety feature that is in compliance with this chapter.

Section 1003 Fire Safety
1003.2 General – The building is in compliance, as an automatic fire-extinguishing system is not required, due to the building conforming to the construction requirements specified in this code for its occupancy. (With proposed modifications, the building conforms to Chapter 7 for Level 3 with allowed exceptions of Chapter 10 for Historic Buildings, for A-3 occupancy.)

1003.3 Means of egress. – The building is in compliance with the following modifications.
- A new barrier-free entrance/exit will be constructed at northeast corner of building.
- All new interior doors will meet or exceed the required width for means of egress and will swing in the path of travel.

1003.4 Transoms – N/A as there are no transoms in the building.

1003.5 Interior Finishes – The building is in compliance. Some historic finishes (plaster on lath) will remain, or be replaced in-kind if necessary, at means of egress, exits, corridors and stair enclosures.

1003.6 Stairway Enclosure – The building is in compliance with the following modifications/assumptions.
- All existing doors leading onto stair enclosures will be verified to be tight-fitting and repaired or replaced when not.
- Front/Main Stair: Enclosure at first floor is considered west portion of corridor. Doors leading to four front rooms will remain closed when rooms not in use. Doors to toilet rooms will remain closed when not in use. New doors leading to east corridor will be held open on electromagnetic hold-open devices attached to the fire alarm system. New doors at east and west ends of stair enclosure/corridor at second and third floors will be held open on electromagnetic hold-open devices attached to the fire alarm system.

- Back/North Stair: New stair run will be constructed to extend stair to basement. New partition walls and doors constructed at all floors to enclose stair. New pairs of doors at east wall of stair enclosure at second and third floors will be held open on electromagnetic hold-open devices attached to fire alarm system.
- South Stair between basement and first floor: New partition walls, wall infill, and doors to enclose stair. Second stair between first floor and basement removed and floor infilled.

1003.7 One-hour fire-resistant assemblies. The building is in compliance, as all existing wall and ceiling finishes at stair enclosures and corridors is wood lath and plaster. All new walls constructed in these areas will be one-hour fire-resistant.

1003.8 Glazing in fire-resistance-rated systems. N/A

1003.9 Stairway Railings The building is in compliance with the following modifications.

- The existing wood handrails and guards (balustrades) at the front/main stair and the back/north stair will be structurally upgraded per specifications of structural engineer.
- New railings and guards at the new back/north stair between first floor and basement will be designed per 2003 Michigan Building Code.

1003.10 Guards The building is in compliance, as existing ornamental patterns are acceptable.

1003.11 Exit Signs The building is in compliance with the following modifications.

- Exit signs and egress signage will be designed and installed per 2003 Michigan Building Code. Any and all existing signage that is in compliance will remain; if not in compliance will be replaced.

1003.12 Automatic fire-extinguishing systems Due to the building not constituting a distinct fire hazard, an automatic fire-extinguishing system is not required to deem the building in compliance.

3. Report shall identify where compliance with other chapters of these provisions would be damaging to the contributing historic features.

1. Requirement for Level 1 (and thus Level 2 and 3) to make kitchen handicapped accessible (per 1109.4 of the 2003 Michigan Building Code). To modify the existing kitchen for accessibility will require removal of existing cabinetry and equipment, as well as widening existing door into kitchen. It is recommended that upgrading the kitchen for accessibility be incorporated into a long-term plan for the building.
2. Requirement for Level 2 (and thus Level 3) to enclose back/north stair with one-hour fire-resistance assemblies per 603.2.1: *All existing interior vertical openings connecting two or more floors shall be enclosed with approved assemblies having a fire-resistance rating of not less than 1 hour with approved opening protectives.*
   - Currently the vertical opening only connects three stories (first, second and third floors) and meets exception 4 of 603.2.1, as its current wall and ceiling finishes meet archaic material requirements for 30 minute rating and new wall and door

construction will meet requirements for 1 hour rating. However, it is proposed to extend this stair to the basement to provide a second means of egress/exit from the basement level.

- It will be damaging to contributing historic features to provide a 1-hour enclosure as it would involved removal of historic wall and ceiling finishes (plaster on wood lath) and historic wood doors and trim.

3. Requirement for Levels 2 and 3 for finishes in exits and corridors to meet Class A requirements – Flame spread 0-25; smoke-developed index 0-450; per 603.4: *The interior finish of walls and ceilings in exits and corridors in any work area shall comply with the requirements of the International Building Code.*
   - It is unclear if the existing wood lath and plaster wall and ceiling finishes conform to Class A. If they do not, it will be damaging to contributing historic features to remove them. Further, it will be damaging to apply fire-retardant coatings as it will alter the appearance of the historic walls and ceilings.
   - New finishes that meet Class A requirements will be installed at new walls and ceilings.

4. The report shall describe each feature that is not in compliance with these provisions and shall demonstrate how the intent of these provisions is complied with in providing an equivalent level of safety.

There are no features that are not in compliance with these provisions (2003 MRCEB). With proposed modifications (as detailed above and in separate Level 3 document), the building complies with Chapter 7 for Level 3 Alterations with allowed provisions for historic building per Chapter 10.

Belrockton Museum and Community Center

Code Analysis
2003 Michigan Rehabilitation Code for Existing Buildings (MRCEB)

MRCEB Chapter 7
Alterations--Level 3

The following modifications are proposed to the Belrockton Museum and Community Center to bring it into compliance with the provisions of Chapter 7 of the MRCEB, with exceptions allowed per Chapter 10 – Historic Buildings. Code analysis has revealed that the building is in compliance with all other requirements of Chapter 7, with allowed Chapter 10 exceptions, that are not specifically listed below.

Per Chapter 7, in addition to the provisions of Chapter 7, the building shall also comply to the requirements of Chapters 4, 5 and 6 of the MRCEB. Required modifications to comply with these sections are also listed below.

503 – All new interior finishes and carpet that is installed will comply with flame spread and radiant flux requirements of the *International Building Code.*

503 – All construction documents and specifications for work on the building will state that all new work material and methods shall comply with *ICC Electrical Code, International Building Code, Energy Conservation Code, International Mechanical Code* and *International Plumbing Code.*

506.1 Accessibility (MBC 3409.6.1) – Accessible drinking fountains will be installed in the building.

506.1 Accessibility (MBC 3409.7.1) – Appropriate directional signage will be installed at the front/west and side/south doors indicating location of accessible entrance at east/parking lot side of building.

506.1 Accessibility (MBC 3409.8.1) – Accessible route will be provided from site arrival point (barrier-free parking spaces) to the new accessible entrance at east side of building.

506.1 Accessibility (MBC 3409.8.3) – New accessible entrance will be constructed at northeast corner of building.

506.1 Accessibility (MBC 1106) – New parking lot will include appropriate number of accessible parking spaces located shortest possible route to accessible building entrance.

506.1 Accessibility (MBC 1109.2) – All new toilet rooms will be accessible. (Existing first floor toilet rooms are also accessible.)

506.1 Accessibility (MBC 1109.6) – New elevator will be accessible.

506.1 Accessibility (MBC 1110.1 – New signage with International Symbol of Accessibility will be installed accessible parking spaces, accessible areas of refuge, accessible entrances, and accessible toilet rooms.

601.3 - All construction documents and specifications for work on the building shall include new construction elements, components, systems and spaces that comply the *International Building Code*.

604.4 and 704.2 – An approved fire alarm system will be installed. Manual fire alarm system shall be provided, as well as automatically activated alarm notification devices per *IBC*.

605.7 and 705.2 – Means-of-egress lighting will be installed per the International Building Code.

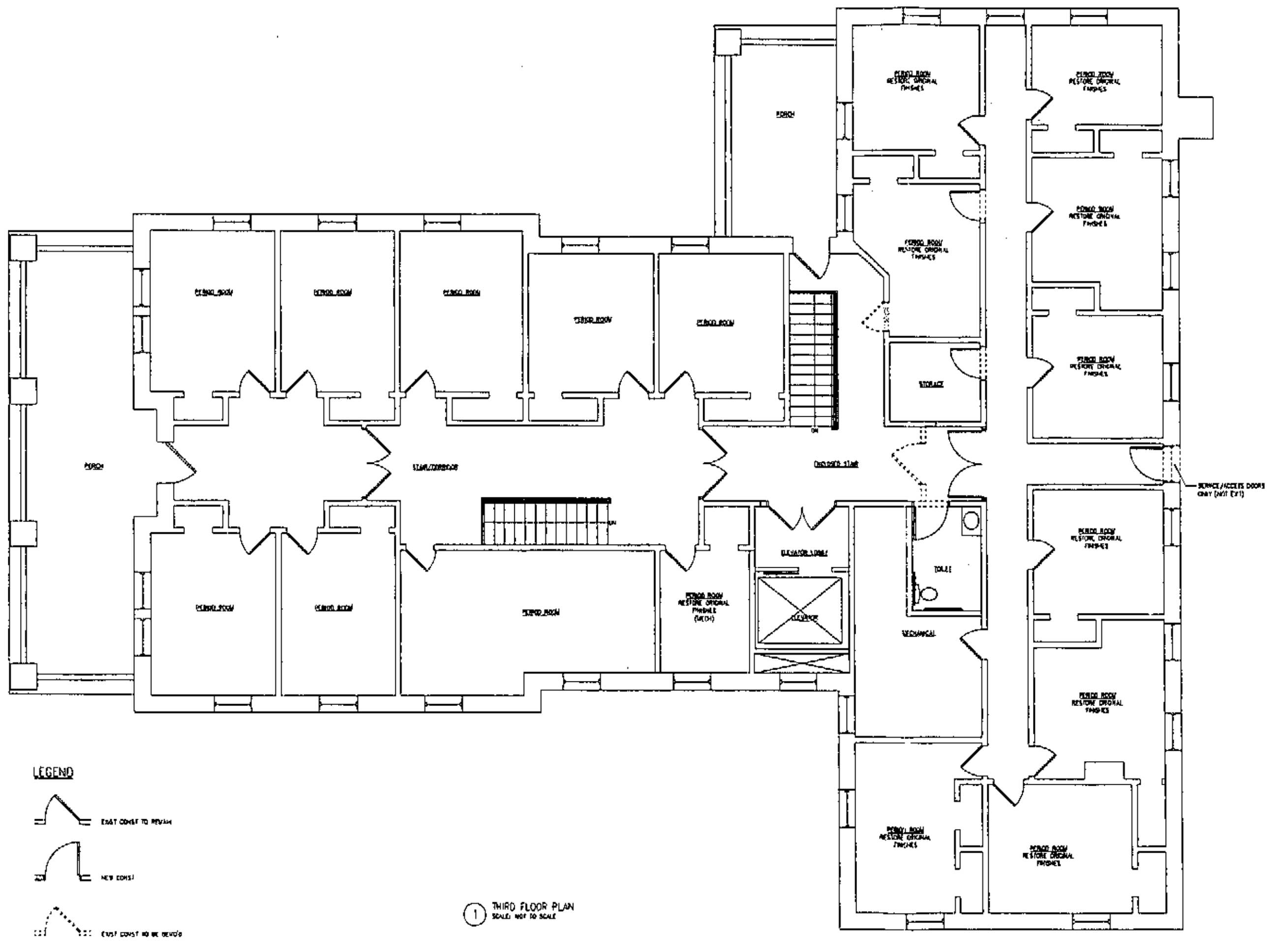
607 and 707 Structural – The building will be structurally upgraded, in accordance with the *International Building Code* requirements as listed in Chapters 6 and 7 of the MRCEB, to mitigate any current deficiencies and to upgrade to meet proposed loading requirements for public spaces (100 psf live load). These include, but are not limited to:

- Doubling joists with new LVL joists at 18' spans of first floor (portion of rear wing).
- Doubling joists or installing beams at three locations where first floor joists spans exceed 16'.
- Replace two main east-west beam lines at first floor structure (basement).
- Design and installation of grid of beams at underside of the third floor with columns extending down to second floor to allow for removal of partition walls at east wing of second floor to modify into open gallery space.
- Existing stairs and railings will be structurally upgraded.
- Third floor plaster and lath ceilings, which are structurally unsound, will be replaced with drywall.

Prior to preparation of any construction documents for structural documents, an engineering evaluation and analysis will be provided to the code official.

608 Electrical – All existing and new electrical systems will comply with Section 608.

609 Mechanical – Natural and/or mechanical ventilation will be provided, per code, as part of the new mechanical system for the building.



BELROCKTON
MUSEUM
BELDING, MI

SMITHGROUP
architecture engineering interiors planning

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NOT FOR CONSTRUCTION

THIRD FLOOR PLAN

NOT TO SCALE

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