ENGINEERING SURVEY REPORT #6

BUILDING DB-2, DB-3, DA-5, DA-6A, DA-7, DB-8, DB-8A, DB-9, DB-9A,

DB-10, DB-11, DB-13, DB-13A, DB-13B,

DB-19 THROUGH DB-22, DB-25, DB-26,

DA-28, DA-28A, DB-29, DB-802, 2-51, 2-51A,

DB4 VP1, DB4AVP1, DB10 VP1, AND DB10 VP2

AT

LOAD LINE 2

RAVENNA ARMY AMMUNITION PLANT

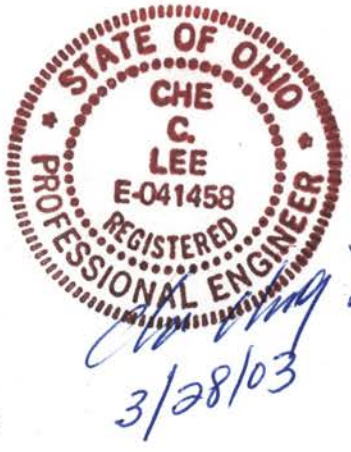
RAVENNA, OHIO

March 27, 2003

***Prepared for*:**

MKM ENGINEERS, INC.

8451 State Route 5, Bldg. 1038
Ravenna, Ohio 44266



3/28/03

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7.0 APPENDIX

1.0 INTRODUCTION

United Engineering Associates, LLC (UEA) was retained by MKM Engineering Inc. to provide structural engineering surveys and recommendations related to pre-demolition activities for various buildings inside Load Line 2 and 3 areas at the Ravenna Army Ammunition Plant in Ravenna, Ohio. MKM Engineers, Inc. is the prime contractor for the U.S. Army Operations Support Command to disassemble, decontaminate, and dispose of explosive process equipment and piping, including steam pipes, conduits, fire suppression pipes etc. that exist in the buildings where explosive operations have taken place at load lines 2, 3 & 4 of the Ravenna Army Ammunition Plant.

This report covers the results of the engineering survey conducted on March 6th and 11th, 2003 on the buildings and walkway structures in Load Line 2 that were not covered by the previous engineering survey report #1, dated August 5, 2002. Buildings DB-4 &4A, DB-4-WN & WS, DB-4A-WN & WS, and DA-6 were covered in report #1.

Thirty buildings, and approximately 7000 feet of steel framed walkways connecting the buildings at Load Line 2 were inspected on March 6th and 11th, 2003 to evaluate their structural conditions, overall structural stability, and integrity related to the burning of these facilities, and the building demolition operations.

These buildings, facilities, and walkways are scheduled to be decontaminated, burned, and demolished. Prior to the burning and demolition operations, all remaining asbestos roof and wall panels need to be removed to prevent any uncontrolled release of asbestos fibers during the burning and demolition operations. Following the asbestos removal operations, MKM personnel will be on site to perform the burning preparation activities, which include building modications for the placement of the dunnage materials.

Recommendations of locations and details of building alterations to provide the access openings for the placement of dunnage into the buildings for burning operations are included in this report.

All existing design drawings available have been reviewed for locating the access openings on the exterior non-load bearing walls and for the evaluation of the existing structural systems. For those buildings without record drawings for review, our recommendations are based on the information obtained from the field inspections.

All thirty buildings and steel framed walkways inspected are more than sixty years old. Except for a few buildings, the corrugated asbestos roof panels and wall panels have been removed from these buildings. As a result, all buildings are in very poor condition.

Section 2.0 Background, of this report gives a brief background of Load Line 2 at the Ravenna Army Ammunition Plant. Section 3.0 describes the purpose of UEA's survey included in this report. Section 4.0 presents a description of buildings surveyed for this report. Section 5.0 presents the findings from the walk-through survey and Section 6.0 provides UEA's recommendations and conclusions.

2.0 BACKGROUND

Load Line 2 at the Ravenna Army Ammunition Plant in Ravenna, Ohio was a fuze and booster line where explosive operations took place. Within the fenced area, Load Line 2 has many buildings and facilities scattered throughout a large area. Approximately 7000 feet of steel framed walkways exist between buildings.

The Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio was built in 1940 to produce artillery, mortar shell bombs, and components for ammunition through 1943 and was reactivated during the Korean and Vietnam Wars. The facility was deactivated completely in 1993.

Except for buildings DB-4, DB-4A, DB-13 & 13A, and DB-26, the corrugated asbestos roofing has been removed from the buildings and also from the steel walkways. Thus, the remaining structural steel structures are now exposed to the atmosphere. As a result, all the steel exposed to the atmosphere inside Load Line 2 is heavy corroded.

MKM' s scope work at Load Line 2 includes the complete burning, demolition and removal of all buildings after the operations of the asbestos removal from the buildings.

3.0 PURPOSE

The purpose of the walk-through engineering survey is to evaluate the general structural conditions or hazards related to the safety, integrity, and stability of the buildings or structures. It was not intended to inspect every single member, or steel connection of the buildings/ structures. It was also not intended to locate, identify or measure every single deficiency of the structures or connections. There are many areas such as the roof that were not accessible for a closer survey.

It is therefore the responsibility of the asbestos contractor to verify and inspect each local structural deficiency such as rusted-out steel members or connections related to the safety of his work prior to the transite removal operations.

The purpose of the engineering survey of the building and structures in Load Line 6 prior to the asbestos removal operations is to:

A. Identify any structural safety hazards related to the burning operations.
B. Identify the possibility of an unexpected collapse of the structures or portion of the structures.
C. Assess the conditions of the overall structural integrity, stability, and safety.
D. Locate and identify any sustained structural damages, distresses or deformations that would affect the strength and integrity of the structures.
E. Recommend the locations and details of building alterations or modifications to provide the access for the placement of dunnage.
F. Prepare and submit a written report summarizing the conclusions and recommendations regarding the asbestos removal operations.

4.0 DESCRIPTION OF BUILDING SURVEY

Forty-two buildings are scattered in a large fenced area inside the Load Line 2 of the Ravenna Army Ammunition Plant in Ravenna, Ohio.

Five buildings inside Load Line 2, Boiler House DC-1 and the four cyclic buildings- DB-27, 27A, 27B, & 27C are not required for inspection in accordance with the contract.

Of the thirty-seven buildings requiring inspection, seven buildings were inspected in July 2002 and were covered in the engineering survey report #1, dated August 5, 2002. These building were Building DB- 4, DB-4-WN & WS, DB-4A, DB-4A-WN & WS, and DB-6.

Except for those buildings indicated above, this report covers all the remaining buildings inside Load Line 2.

5.0 FINDINGS AND DISCUSSIONS

A. Steel walkways between buildings

All the walkways between the buildings inside Load Line 2 are identical in design. The typical walkway structure is a moment resistant steel frame at approximately ten feet spacing and is on an elevated structural concrete slab at about 4 feet above finished grade. The steel frame consists of W6 columns and a W6 overhead crossbeam ten feet above the floor. The roof purlins are light gauge C4 channels and the girts supporting the sidewall of the walkway are three light steel angles L3x3. The longitudinal vertical bracing consists of ¾-inch diameter diagonal rods are at every 70 feet spacing. The corrugated asbestos roofing and wall panels have been removed leaving the remaining steel frames to corrode. At the bottom of each column, the column base plates and anchor bolts are severely corroded.

A walkway steel column approximately 10 feet south of the building DB-26 is found to be **partially unsupported at the base** due to damage to the concrete platform. It is recommended that this section of the walkway be to be sealed off.

All the open walkway steel frames at the Load Line 2 are in poor condition. However, with all roofing and wall panels removed, there are not significant forces on the structure. Without any major deficiencies, the open walkway frames are still stable and safe except for the section indicated above.

B. Buildings DB-2, DB-9, DB-9A, DB-11, DB-19 and DA-5

The six buildings are identical in size and design. These buildings are one–story steel truss frame structures with non-load bearing exterior brick/tile walls and are on an elevated concrete floor. The buildings are 20 feet wide by 30 feet long and are about 18 feet high at the ridge. Each building has an 8-foot wide walkway platform, a canopy along one side of the building, and a tile partition wall that divides the building into two rooms.

The building floor is a 6-inch slab on grade. The walkway platform is a 6-inch elevated structural slab about 4 feet above grade.

The existing roof construction consists of corrugated asbestos roofing supported on C8 steel channels at approximately 4 feet spacing at the top of trusses. The typical steel frame of the buildings is a triangular roof truss spanning between two steel columns. The truss frames are at 15 feet spacing. The steel columns are all encased in brick pilasters. Sag rods are at the one-third points of the roof purlin.

The asbestos roofing and wall panels of these buildings have been removed. With the asbestos roofing removed from the roof and canopy, the remaining roof steel is heavily rusted and the canopy's supporting frame is severely corroded. All steel is in **poor condition.** However, there were no major steel deficiencies, missing members, rusted-through steel members or connections, or structural damages to the steel members observed. The roof steel is not in any danger of collapse.

The roof system including the asbestos panels was designed to provide the diaphragm action for the building and to transfer the wind loads on the walls to the foundation. With the asbestos roof panels removed, **the remaining structure is an incomplete load-resisting structure** for lateral loads and the building is weakened for resisting lateral wind forces.

UEA recommends that all personnel to stay away from the buildings during the time when the wind speed is more than 35 mile per hour.

All the exterior tile walls of these buildings are in very **poor condition** due to weathering. The tile walls have showed signs of severe deterioration and are spelled at various locations.

The exterior walls are non-load bearing tile walls and can be modified at the double door to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door and adjacent wall from floor to the bottom of steel beam at the roof level as shown on the building plan in the section 6 of this report.

It should be advised that the portions of the existing tile walls or individual tile blocks might **fall unexpectedly** due to the impact during the wall removal operations. Therefore, exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

C. Building DB-3

The building is a large one–story long span steel truss structure on elevated concrete slabs and has a high monitor bay at the middle portion of the span. The building is approximately 50 feet wide by 350 feet long and is about 28 feet high at the ridge. There is an 8-feet wide elevated concrete platform with a canopy around the perimeter of the building. The east and west exterior walls are non-load bearing exterior brick/tile walls. The north and south end walls are load bearing concrete walls.

The building floor is a 6-inchslab on grade and the walkway platform is a 6-inch elevated structural slab about 4 feet above grade.

The typical steel frame of the building is a manufacturing type long span steel truss spanning between the end columns and having a high monitor bay in the middle of the span. The truss frames are at 20 feet spacing and the steel columns are encased in the brick pilasters. Sag rods are at the one-third points of the C12 channels and there is horizontal cross bracing at the bottom of the trusses.

The asbestos roofing at the high and low roof and the canopy has been removed leaving the roof steel exposed to the atmosphere. The remaining roof steel is heavily rusted and canopy's supporting frame is severely corroded. All steel is in **poor condition.** However, there are no major steel deficiencies, missing or rusted-through steel members, or structural damages to the steel framing observed, thus the roof steel is not in any danger of collapse without the roof loads.

The roof system including the asbestos panels was designed to provide the diaphragm action for the building and to transfer the wind loads on the walls to the foundation. With the asbestos roof panels removed, **the remaining structure is an incomplete load-resisting structure** for lateral loads and the building is weakened for resisting lateral wind forces.

UEA recommends that all personnel to stay away from the buildings during the time when the wind speed is more than 35 mile per hour.

All the exterior tile walls of these buildings are in very **poor condition** due to weathering. The exterior tile walls have showed signs of severe deterioration and are spalled at various locations.

The exterior tile/brick walls at the east and west sides of the building are non-load bearing walls and can be modified at the double door to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door and adjacent wall from the floor to the bottom of steel beam at the roof level as shown on the building plan in section 6 of this report.

It should be noted that the portions of the existing tile walls or individual tile blocks might **fall unexpectedly** due to the impact during the wall removal operations. Therefore, exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

D. Explosive Preparation Building DA-6A

The existing Explosive Building, DA-6, is a one-story concrete structure with steel purlins and is on elevated concrete slabs. The building is approximately 30 feet by 41 feet in plan dimensions and about 25 feet high. A concrete bearing wall in the middle of the building divides it into two equal halves. A low roof wooden addition is attached to the north side of the building and a concrete platform with a canopy is at the west side of the building.

The north and south end walls are load bearing concrete walls of 12-inch thickness. The east and west sidewalls are non-load-bearing tile walls.

The asbestos roof panels have been removed while the steel purlins with sag rods were left in place.

The original roof system consisted of corrugated asbestos roof panels fastened to the top of steel purlins, which are also connected together by the sag rods at the one-third points of the purlins. The roof system including the asbestos panels was designed to provide the lateral support for the exterior walls at the roof level through diaphragm action and also to transfer the wind loads on the walls to the foundation. With the asbestos roof panels removed, **the remaining structure is an incomplete load-resisting structure** for external loads including the lateral wind loads on the walls and is significantly weakened.

Except for moderate rust to the steel, there were no major structural deficiencies in roof steel observed. Without the roof loads, the existing structure is safe for the burning operations. However, the existing concrete walls become unstable after the roof steel is removed at the stage of demolition since the walls will not be supported at the roof level.

The exterior tile/brick walls along the east and west sides of the building are non-load bearing walls and can be modified at the double door to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door and adjacent wall from the floor to the bottom of steel beam at the roof level as shown on the building plan in section 6 of this report.

The existing tile walls have showed signs of severe deterioration and are spalled at various locations. Exercise safety precaution and provide protection measures for construction personnel during the wall removal operations for the access opening. Portions of the existing tile walls or individual tile blocks might **fall unexpectedly** due to the impact during wall removal operations.

E. Building DA-7 and DA-21

The two buildings are identical in size and design. The two buildings are one–story steel truss structures with non-load bearing exterior brick/tile walls on elevated concrete slabs. The buildings are 20 feet wide by 30 feet long in plan dimensions and are 18 feet high at the ridge. Each building has an 8- feet walkway platform and a canopy along the west side of the building. A tile partition wall divides each building into two halves. The building floors are 6-inch concrete slab on grade and the walkway platforms are 6-inch elevated structural slabs about 4 feet above grade.

The typical steel frame of the buildings is a triangular roof truss spanning between two steel columns. The truss frames are at 15 feet spacing. The steel columns are all encased in the brick pilasters. Sag rods are at the one-third points of the joists and there is horizontal cross bracing at the bottom of the trusses.

The asbestos roofing and wall panels of these buildings have been removed. With the asbestos roofing removed from the roof and canopy, the remaining roof steel is heavily rusted and the canopy's supporting frame is severely corroded. All steel is in **poor condition.** However, there were no major steel deficiencies, missing members, rusted-through steel members or connections, or structural damages to the steel members observed. The roof steel is not in any danger of collapse.

The roof system including the asbestos panels was designed to provide the diaphragm action for the building and to transfer the wind loads on the walls to the foundation. With the asbestos roof panels removed, **the remaining structure is an incomplete load-resisting structure** for lateral loads and the building is weakened for resisting lateral wind forces.

UEA recommends that all personnel to stay away from the buildings during the time when the wind speed is more than 35 mile per hour.

All the exterior tile walls of these buildings are in very **poor condition** due to weathering. The tile walls have showed signs of severe deterioration and are spalled at various locations.

The exterior walls are non-load bearing tile walls and can be modified to provide the required access openings for the placement of dunnage for burning operations. The ideal locations are at the existing door openings. It was observed during the inspection that the tile/brick wall above the door was not properly anchored to the roof steel beam parallel to the wall. It is likely that a whole section of the wall might fall during the operation to make the access opening. Exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

F. Building DB-8, DB-8A, and DB-22

The three change house buildings are similar in design but different in size. These three buildings are two–story structures. The first story is a concrete structure with concrete columns, slabs, and walls. The second story is a steel truss frame structure with a tile/brick wall exterior and is about 18 feet high at the ridge. At the second floor level, there is a 5 feet wide cantilever concrete catwalk with steel pipe handrails along the perimeter of the building.

Building DB-8 is 30 feet by 110 feet in plan dimensions. Building DB-8A is 30 feet by 92 feet and has a wooden walkway bridge from the service road to the second floor. Building DB-22 is 30 feet by 56 feet.

The typical steel frame of the buildings is a triangular steel truss spanning between two steel columns. The truss frames are at 15 feet spacing. The steel columns are all encased in brick pilasters. Sag rods are at the one-third points of the C8 steel purlins and cross bracing was provided.

The asbestos roofing has been removed leaving the roof steel exposed to the atmosphere. The remaining roof steel is heavily corroded.

All the roof steel is in **poor condition.** However, there were no major steel deficiencies, missing members, rusted-through steel members or connections, or structural damages to the steel members observed. The roof steel is not in any danger of collapse.

All the exterior tile walls of these buildings are in very **poor condition** due to weathering. The tile walls have showed signs of severe deterioration and are spalled at various locations. Chips from the spalled tile were observed on the catwalk floor at all three buildings.

As mentioned before, portions of the existing tile walls or individual tile block might **fall unexpectedly** due to the impact during the wall removal operations. Exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

The exterior tile walls of the second story are non-load bearing walls and can be modified to provide the required access openings for the placement of dunnage for burning operations at the door locations.

At the Building DB-8, at the middle portion of the east catwalk, portions of the concrete slabs have spalled off along the outside edge leaving some steel pipe handrail posts unsupported and reinforcing steel exposed. **It is recommended that the east catwalk be sealed off.**

At the Building DB-8A, the wooden walkway bridge from the service road to the second floor catwalk is completely decayed. The bridge floor planks and supporting beams are completely rotten. **The walkway bridge shall be sealed off.**

G. Building DB-10

The building is a large one–story structure on an elevated concrete slab with a high monitor bay at the middle portion of the span. The building is approximately 50 feet wide by 200 feet long and is about 28 feet high at the ridge of high monitor bay. Load bearing concrete walls of 12-inch thickness in the east-west direction divide the building into 20 bays.

There is an 8-foot wide elevated concrete platform with a canopy around the perimeter of the building. The exterior walls of platforms have been removed with the steel framing remaining.

The building floor is a 6-inch concrete slab on grade and the walkway platform is a 6-inch elevated structural slab at the elevation about 3 feet above grade.

The east and west exterior walls are non-load bearing exterior tile/brick walls. The north and south end walls are 12-inch load bearing concrete walls.

The typical structural system of the building is a combination of parallel load bearing concrete walls and roof steel framings. Concrete walls of 12-inch thickness at 20 feet spacing support the steel purlins, C9x13.4, and the steel framed monitor bay in the middle portion of the span.

The asbestos roofing at the high and low roof and the canopy has been removed leaving the roof steel exposed to the atmosphere. The remaining roof steel is heavily rusted, and the canopy's supporting frame is severely corroded. All steel is in **poor condition.** Several window sashes at the high monitor bays were severely corroded and hanging loosely at the supporting steel frames. There is a possibility these window sashes might fall down due to impact from wall removal operations or high wind. Except for severely rusting to the steel, there were no other major steel deficiencies observed.

The original roof system consisted of corrugated asbestos roof panels fastened to the top of steel purlins, which are also connected together by the sag rods at the one-third points of the purlins. The roof system, including the asbestos panels, was designed to provide the lateral support for the exterior walls at the roof level through diaphragm action and to transfer the wind loads on the walls to the foundations. With the asbestos roof panels being removed, the remaining structure is an incomplete load-resisting structure and the structure is weakened for the lateral wind loads on the building.

The exterior tile walls of the buildings are in very **poor condition** due to weathering. The tile walls have showed signs of severe deterioration and are spalled at various locations. Portions of the existing tile walls or individual tile blocks might **fall unexpectedly** due to the impact from the wall removal operations. Exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

The exterior tile/brick walls at the east and west sides of the building are non-load bearing walls and can be modified at the double door to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door and adjacent wall from the floor to the bottom of steel beam at the roof level as shown on the building plan in section 6 of this report.

It shall be noted that the existing concrete walls become unstable after the roof steel is removed since the walls will not be supported at the roof level.

H. Building DB-13

The building is a one–story long span steel truss structure on elevated concrete slabs and having a high monitor bay in the middle portion of the span. The building is approximately 50 feet wide by 80 feet long and is about 28 feet high at the ridge and was built next to buildings DB-13A & 13B and DB-26. A corridor along the east side of the building separates it from the building DB-13B. To the north of the building is the wooden building DB-13A. To the south of the building is building DB-26. There is a 9-foot wide elevated concrete walkway platform with a canopy along the west side of the building continuing from building DB-13A through Building DB-13 to building DB-26.

The building floor is a 6-inchslab on grade and the walkway platform is a 6-inch elevated structural slab about 4 feet above grade.

The east and west exterior walls are non-load bearing tile/brick walls. The north and south end walls are load bearing concrete walls.

The structural framing system of the building is a combination of interior steel truss frames supporting the C9 purlins and concrete end walls. The typical interior steel truss frame of the building is a manufacturing type, long span, and steel truss spanning between the end columns and having a high monitor bay in the middle of the span. Steel columns are encased in brick pilasters. Sag rods are at the one-third points of the C9 channels and there is horizontal cross bracing at the bottom of the trusses.

The asbestos roofing at the high and low roof and the canopy has been removed leaving the roof steel exposed to the atmosphere. The remaining roof steel is heavily rusted and the canopy's supporting frame is severely corroded. All steel is in **poor condition.** Except for severe corrosion, there were no major steel deficiencies, missing or rusted-through steel members, or structural damages to the steel framing observed, thus the roof steel is not in any danger of collapse without the roof loads.

The entire exterior tile walls along the east and west sides of the building are in very **poor condition** due to weathering. These walls are non-load bearing walls and can be modified to provide the required access openings for the placement of dunnage if necessary. However, the existing building has several large openings for access.

I. Building DB-13A

Located to the north of the building DB-13, Building DB-13A is a one story wooden structure on an elevated concrete floor. There is a T-shape earth-filled timber barricade in the middle of the building that divides the building into three sections- the east, west, and the south sections. The entire roof, roof trusses, and most roof support beams have been removed leaving the remaining wooden structure to decay. Both the east and west exterior stud walls have fallen down, and the north exterior stud wall, with the asbestos siding removed, has partially collapsed.

In the east and west sections of the building, the only remaining structures are two rows of free standing columns running in the north-south direction with a continuous beam at the top of the columns. These remaining freestanding wood frames have decayed and are unstable. Thus, they will eventually fall down.

In the south section of the building located to the south of the timber barricade, the columns, some of the beams in both the north-south and east-west directions at ceiling level, and a section of the stud wall frame standing unsupported above the ceiling along the original ridge are still in place. With the roof removed, all these remaining wood members have decayed due to weathering. The unsupported stud wall frame might collapse unexpectedly any time and might cause the remaining wood framing of the ceiling to fall down.

The remaining structures of this building are structurally **unstable and the might collapse unexpectedly.** UEA's recommendation is to seal off this area. At the demolition stage, all the work should be performed from outside the building, and begin at the top of the remaining structure and then proceed downward.

The existing earth-filled timber barricade appears to be stable and is not in danger of collapse.

J. Building DB-13B

Located to the east of the building DB-13 and separated by a corridor, Building DB-13B is a one–story, long span, steel truss structure with metal siding and a metal roof decking and is on elevated concrete slabs. The overall size of the building is approximately 84 feet wide by 140 feet long and is about 28 feet high. There is an 8-foot wide elevated concrete platform along the east exterior wall of the building. The east and west exterior walls are non-load bearing exterior brick/tile walls. The north and south end walls are load bearing concrete walls.

The building floor is a 6-inchslab on grade and the walkway platform is a 6-inch elevated structural slab about 4 feet above grade.

The typical steel frame of the building is a long span, arch shape, steel truss spanning between the end columns. The truss frames are at 20 feet spacing supporting the steel joists at approximately 4-foot spacing. There are truss sway-frames and horizontal cross bracing at the bottom chords of the trusses.

The roof metal deck is moderately rusted, but the steel joists and trusses are severely corroded. All steel is in **poor condition.** However, there were no major steel deficiencies, missing or rusted-through steel members, or structural damages to the steel framing observed.

The exterior wall system is metal siding supported by girts at 4-foot spacing. The siding and the girts are still in reasonable condition.

Along the east side of the building, there are several large rolled-up door openings of more than 16-foot width and can be used for access opening for the placement of dunnage.

K. Building DB-20

Located next to the Building DB-3, the building is a rectangular concrete frame structure with a brick exterior and is on an elevated concrete floor slab. The overall size of the building is approximately 25 feet by 45 feet by 18 feet high.

The roof of the building is a concrete structural slab system encased together with concrete beams and girders, which are supported by the concrete columns. Except for minor cracking at the two corner columns, the concrete building framing is still in reasonably good condition.

The exterior walls are non-load bearing brick walls and are in poor condition. The east and the north walls have several horizontal cracks above the windows. UEA recommends that the access opening for the dunnage placement be located at the south wall. The southeast windows and the brick wall between two concrete columns can be removed from the concrete floor to the top of the brick wall as shown on the building plan.

L. Building DB-25

The building is a small masonry structure on an elevated concrete slab about 4 feet above grade. The building is 12 feet wide by 15 feet long in plan dimensions and is about 14 feet high at the ridge.

The east and west walls are non-load bearing concrete block walls. The north and south brick walls are load-bearing walls. The exterior walls are in poor condition.

Four C8 steel roof purlins supported the corrugated asbestos roofing that now has been removed. These purlins are severely rusted but without major structural deficiencies.

The exterior walls are in poor condition, it is recommended not to modify the existing wall for the access opening but to use the existing 3-foot wide man door on the south wall.

M. Building DB-26

Located to the south of the Buildings DB-13 and DB-13B, this building is a one-story structure on an elevated concrete slab. The overall size of the building is approximately 130 feet by 70 feet in plan dimensions. There is a 9-foot wide elevated concrete walkway platform with a canopy along the west side of the building.

Building DB-26 is a building complex consisting of two different structures. The west structure is a wooden building with a triangular roof. The east structure is a flat roof building with low roofs at the east and south sides of the building.

1. East structure

   The east structure of the building, located to the south of Building DB-13B, is a flat roof building and has a steel frame structure with steel columns, steel trusses and non-load bearing stud walls at the east and south sides of the building. The roof consists of composition roofing over the wood planks, which are supported on 2x12 wooden

Joists at a 2-foot spacing. A low-roof, 8-foot wide, enclosed porch is attached to the east side of the building.

Except for minor roof leaks, the roof system and the roof steel are still in reasonable condition. The wall panels at the south side have been removed leaving the remaining wood frame to decay. However, the south wall is not a load-bearing wall.

UEA recommends that the access opening for the placement of dunnage be located at the south wall between the double door and the window. The window, the door, and the stud wall at the southeastern corner of this wall from the concrete floor to the bottom of the wooden eave beam above can be removed. **Do not damage the eave beam during the wall modification operations.**

The low-roof enclosed porch at the east side of the building is a wooden frame structure with wooden roof joists at a 2-foot spacing. The east exterior stud wall is a load-bearing wall. With the wall panels removed, the remaining wood frames have decayed. UEA recommends **that the entire porch be sealed off. The wooden porch structure at the east side of the building is in danger of collapse.**

2. West structure

The west structure of the building, located to the south of the building DB-13, is a combination of wood frame structures, concrete bearing walls, and steel structures supporting the high roof monitor bay, steel monorails and equipment inside the building. The northern half of the building has a wood-framed drop ceiling.

The west exterior wall and the east wall are concrete load bearing walls supporting the wooden triangular trusses at a 2-foot spacing.

The asbestos roofing in the north portion of the building has been removed and the remaining wooden roof structures and ceiling frames are severely decayed and are in poor condition.

There is a large door opening at the south wall of the building that can be used for the access opening for the dunnage placement.

N. Building DA-28 and DA-28A

The two buildings are small concrete block wall structures with flat roofs. The buildings are 9 feet wide by 10 feet long by about 10 feet high. The exterior walls are load bearing concrete block walls and are in poor condition.

The roof construction consists of composition roofing over wooden planks, which are supported by 2"x 6" wooden joists at a 2-foot spacing. The roof planks and joists have rotten with holes and are **in very poor condition.**

The exterior concrete block walls are load-bearing walls and are in poor condition. Do not widen the man door for the access opening for the placement of dunnage. Instead, use the existing 3-foot man door for the access opening.

O. Building DB-29

Located to the south of the Building DB-26, the building is a small one-story masonry structure with a flat roof. The building is 12 feet wide by 12 feet long by about 8 feet high. The exterior walls are load bearing concrete block/brick masonry walls and are in good condition.

The roof construction consists of composition roofing over wooden planks which are supported by 2"x6" wooden joists at a 2-foot spacing. The roof is leaking. The roof planks and the joists have decayed and are in poor condition. However the roof is not in danger of collapse.

The exterior walls are load bearing concrete block/brick masonry walls and are in good condition. There is a 3-foot wide man door at the south wall.

Do not widen the man door for access opening for the placement of dunnage. Instead, use the existing man door for the access opening.

P. Building DB-802

The building is a large one–story, long span, steel truss structure with a brick exterior on elevated concrete slabs. The building is approximately 110 feet wide by 400 feet long and is about 28 feet high at the ridge. There is an 8-foot wide elevated concrete walkway platform along the north, east, and west sides of the building.

The building floor is a slab-on-grade and the walkway platform is an elevated structural slab about 4 feet above grade. A wooden ramp at the southwestern corner of the building provides access from the building to the finished grade.

The typical steel frame of the building is a long span, triangular-shape, steel truss supported by four columns- two-end columns and two interior columns. The truss frames are at 20 feet spacing and the steel end columns are encased in brick pilasters. Sag rods are at the one-third points of the C12 channels and there are sway frames and horizontal cross bracing at the bottom of the trusses.

The roof construction of the buildings consists of composition roofing over wooden planks, which are supported on C12 steel purlins at approximately 4 feet spacing. The roof planks have severely rotten. Some roof planks have fallen off leaving many large holes in the roof at the various locations.

The roof steel and columns are severely corroded. However, there were no major steel deficiencies, missing or rusted-through members and connections, or structural damages to the steel framing observed. Thus, the roof steel is not in any danger of collapse.

All the exterior tile walls of these buildings are in **poor condition** due to weathering. The exterior walls have showed signs of severe deterioration and are spalled at various locations.

There are many large doors, 14 feet wide by 10 feet high, along the east and west walls of the building. These can be used for the placement of dunnage for burning operations.

It should be noted that pieces of rotten roof planks might **fall unexpectedly**. Exercise safety precautions and provide protection measures for the construction personnel working inside the building.

UEA also recommends that the wooden ramp at the southwestern corner of the building be sealed off. The wooden ramp has severely decayed.

Q. Building DB10VP1 and DB10VP2

The two small buildings are 12 feet wide by 12 feet long by about 15 feet high. The west walls of the buildings are concrete wall. The other three walls of the buildings are tile walls and are in poor condition. The roof purlins are C8 steel channels.

The exterior walls are load-bearing walls and are in poor condition. There is a 3-foot wide man door at the northern tile wall. Modifications to the wall for the access opening are not recommended. Use the existing man door for access opening.

R. Building DB4VP1 and DB4AVP1

The two buildings are small tile/brick structures with flat roofs. The buildings are 10 feet wide by 10 feet long by about 10 feet high. The exterior walls are load bearing concrete block walls and are in poor condition.

The roof construction consists of composition roofing over wooden planks, which are supported by 2"x 6" wooden joists at a 2-foot spacing.

At Building DB4VP1, the wooden roof has rotted and has been destroyed by wind. The remaining roof rubble is hanging loosely at the top **and might collapse at anytime.**

The exterior tile walls are load-bearing walls and have vertical cracks at joints with wall separations. **The tile walls are in very poor condition.**

At Building DB4AVP1, the wooden roof is rotten with large holes **and is in very poor condition.** The exterior tile walls are load- bearing walls and have severely decayed. The tile walls are in poor condition.

UEA recommends that all personnel do not stay inside the Building DB4VP1. Use the existing 3-foot man door for the access opening for the placement of dunnage.

S. Building 2-51

The building is a steel truss structure with a brick exterior and is about 20 feet by 30 feet by 16 feet high at the ridge.

The typical steel frame of the building is a triangular steel truss spanning between two steel columns. The truss frames are at 15- foot spacing. The purlins are C8 steel channels with cross bracing. Sag rods are at the one-third points of the purlins.

With the asbestos roofing removed, the roof steel is severely corroded and is in poor condition. However the open roof steel structure is not in danger of collapse.

The exterior tile walls are non-load bearing walls and are in **poor condition** due to weathering. The east wall can be modified to provide the access opening for the placement of dunnage. The two 3-foot wide doors and the brick walls in between (at the southeastern corner of the wall) can be removed from the ground slab to the bottom of the steel beam above.

T. Building 2-51A

Located next to Building 2-51 and sharing a common wall, Building 2-51A is a concrete block wall structure with wooden framed partition walls and ceiling frames. The overall building size is about 33 feet wide by 60 feet long by 16 feet high. Wooden framed partition walls divide the building into several rooms. The exterior walls are load bearing concrete block walls.

The roof and roof trusses have been removed, which leaves the remaining structure to decay. Without the roof and the trusses, the four exterior concrete block walls are structurally unsupported at the roof level. These four walls might collapse under the strong wind conditions.

UEA recommends that all personnel stay away from the buildings when the wind speed is more than 35 miles per hour.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Most of the buildings inside Load Line 2 are in very poor condition. Except for a few buildings, most buildings have had the asbestos roofing removed, leaving the remaining structures completely exposed to the atmosphere. As a result, the remaining structures have rapidly deteriorated due to weathering.

All of the roof framing steel of the buildings inside Load Line 2 is severely corroded. However, no major steel deficiencies, missing or rusted-through members and connections, or structural damages to the steel framing were observed, thus, no roof steel was found to be in any danger of collapse.

The access openings for the placement of dunnage into the buildings for the burning operations should be located at the non-load bearing walls of each building. In general, the full width of the door, the adjacent window, and the brick wall in between can be removed from the concrete floor to the bottom of the steel or concrete beams above. For large buildings, the ideal locations for the openings are at the third bay from the end walls of the buildings. For other smaller buildings, recommended opening locations are shown on the individual building floor plans.

1. In general, the exterior tile/brick walls of the buildings inside Load Line 2 have severely deteriorated and are in **very poor condition**. Portions of the existing tile/brick walls or individual tile blocks might **fall unexpectedly** due to the impact during the wall removal operations. Exercise safety precautions and provide protection measures for the construction personnel during the wall removal operations for the access openings.

2. For the wood building, DB-13A, the remaining portions of the building are structurally **unstable and might collapse unexpectedly.** UEA' s recommendation is to seal off this building. During the demolition stage, all the demolition operations should be executed from outside of the building, and begin at the top of the remaining structure and then proceed downward.

3. At Building DB-8, in the middle section of the east catwalk, portions of the concrete slabs have spalled off along the outside edge and six steel pipe handrail posts are unsupported. **It is recommended that the east catwalk be sealed off.**

4. At Building DB-8A, the wooden walkway bridge from the service road to the second floor catwalk has completely decayed. **The walkway bridge should be sealed off.**

5. The roof of Building DB-802 is in **very poor** condition. The wooden planks of the roof have decayed and many large holes at various locations. Advanced warning should be given to all personnel working inside the building. Precautionary and protective measures should be provided to the demolition personnel during the asbestos removal and demolition operations.

6. The wooden ramp at the southwestern corner of Building DB-802 has severely decayed. **It is recommended that the wooden ramp be sealed off.**

7. At Building DB-26, the east exterior stud wall is a load-bearing wall. With the wall panels removed, the remaining wood frames have decayed. UEA recommends **that the entire porch be sealed off. The wooden porch structure at the east side of the building is in danger of collapse.**

8. At Building 2-51A, with the roof and roof trusses removed, the exterior concrete block walls of the building are structurally unsupported at the roof level. These four walls might collapse under the strong wind conditions.

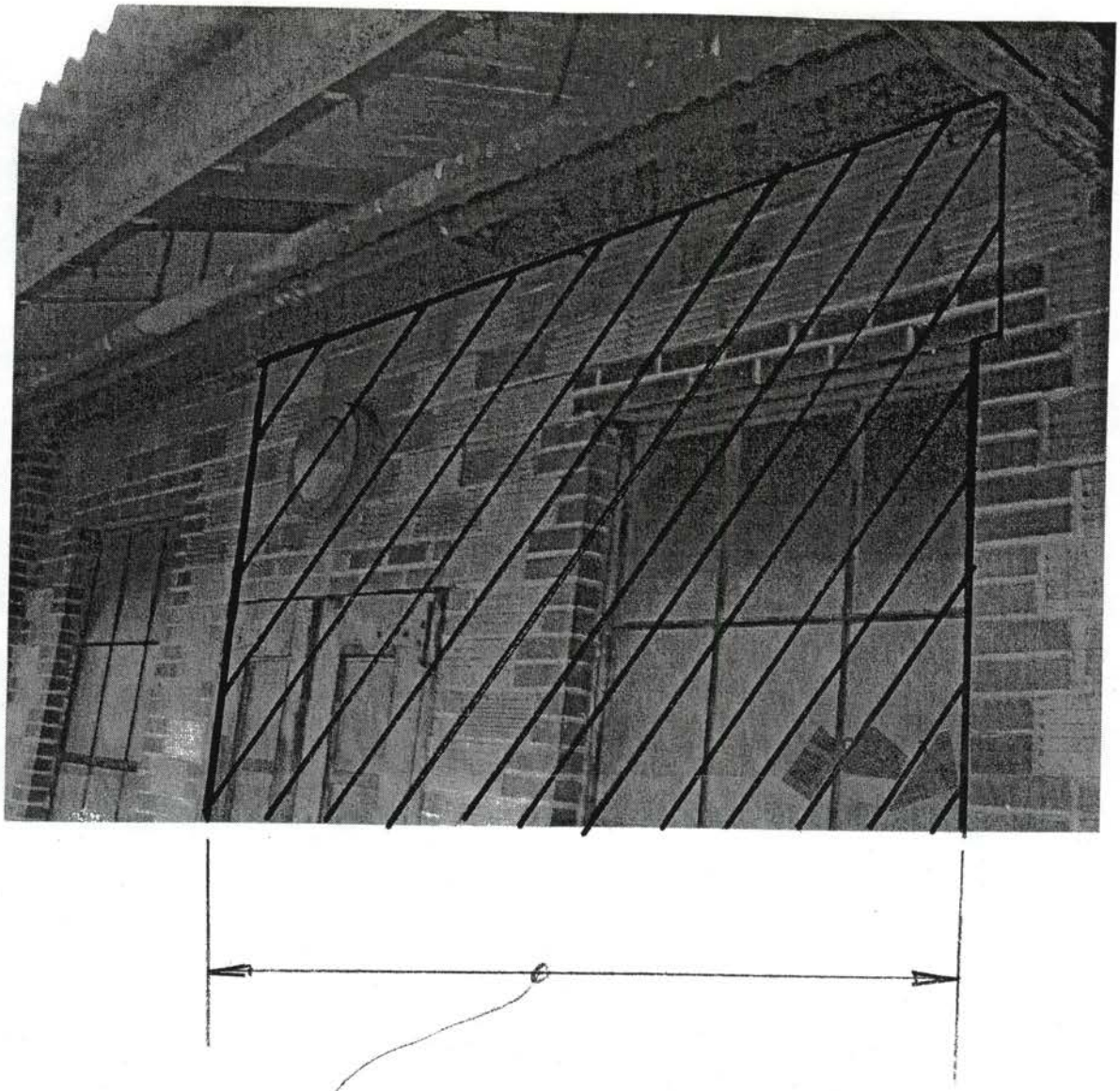
   UEA recommends that all personnel stay away from the buildings when the wind speed is more than 35 miles per hour.

9. At Building DB4VP1, the wooden roof has rotted and has been destroyed by wind. The remaining roof rubble is hanging loosely at the top **and might collapse at anytime. UEA recommends that all personnel do not stay inside the Building DB4VP1.**

10. A walkway steel column approximately 10 feet south of the building DB-26 is found to be **partially unsupported at the base** due to damage to the concrete platform. It is recommended that this section of the walkway be sealed off.

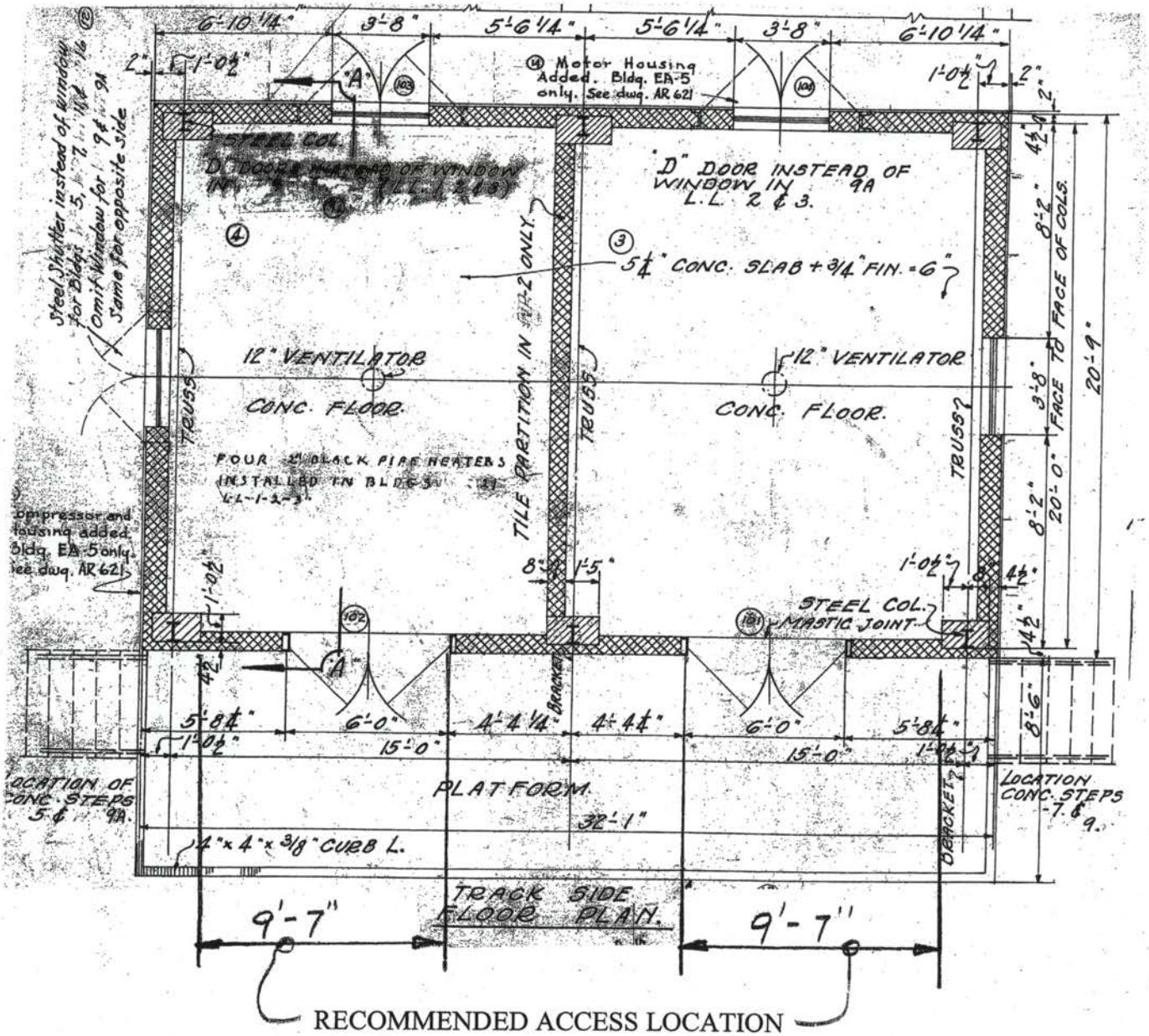
11. Additional recommendations for all buildings with open roof:
    Buildings and all of their components are designed to be stable and self-supporting after they are built to become complete structures. A building without roof decking (corrugated asbestos panels or metal decks) or horizontal bracing to provide the roof diaphragm action is not a complete structure and is considered to be partially stable with reduced structural capacity to resist the external wind loads applied to the structure or its components such as exterior brick walls, interior partition walls, etc.

    In the case of the buildings with open roof in Load Line 2, UEA recommends that all personnel to stay away from these buildings when the wind speed is more than 35 miles per hour. The strong wind loads could cause the walls (bearing walls, non-bearing walls, and interior partition walls) and other building components to collapse.



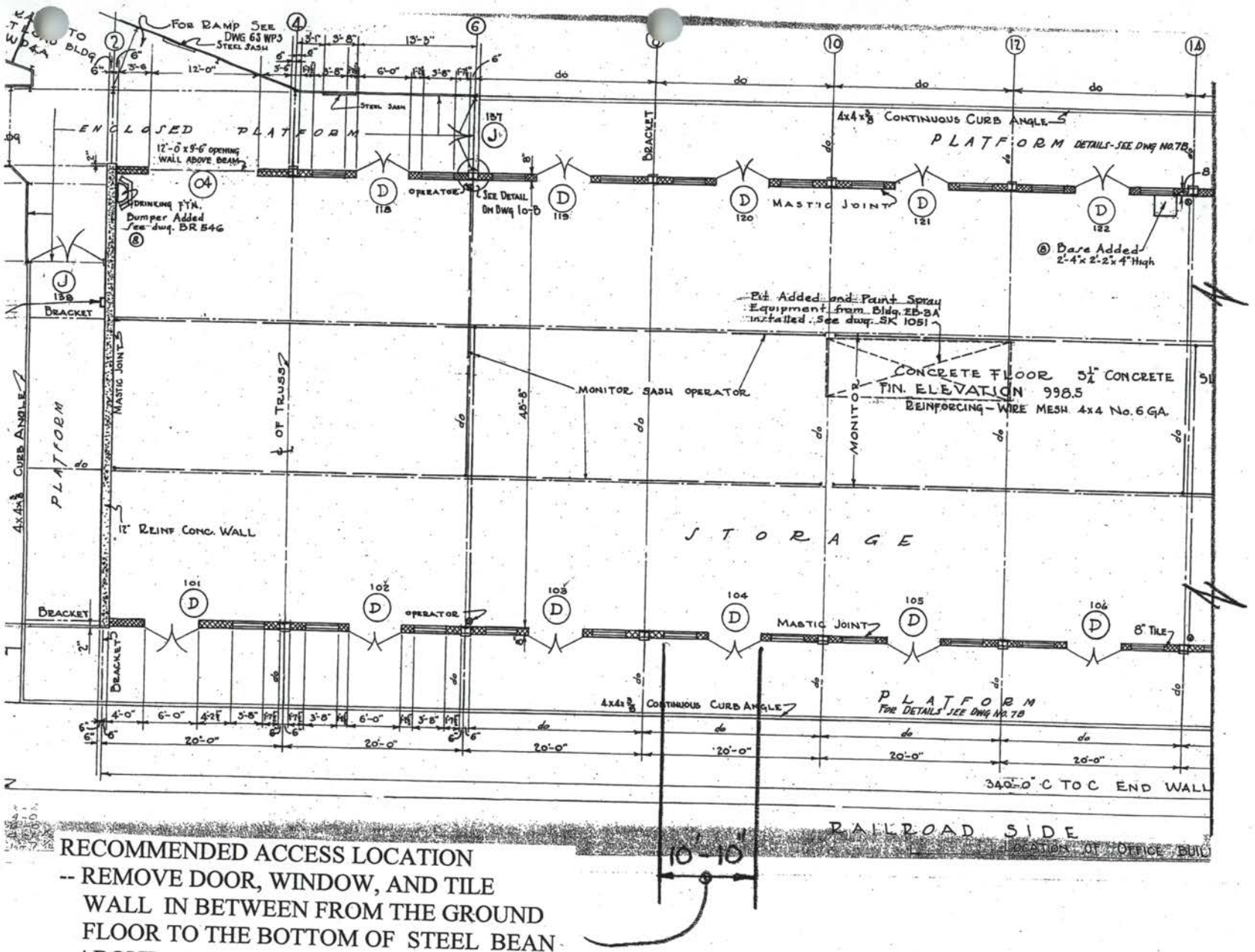
REMOVE DOOR, WINDOW AND THE TILE INSIDE THE SHADED AREA FORM CONCRETE FLOOR TO THE TOP OF WALL OR TO THE BOTTOM OF STEEL BEAM ABOVE. —AT NON-LOAD BEARING WALL ONLY.

TYPICAL ACCESS OPENING DETAIL



RECOMMENDED ACCESS LOCATION
-- REMOVE DOUBLE DOOR AND TILE WALL FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

BUILDING DB-2, 9, 9A, 11, 19 & DA-5

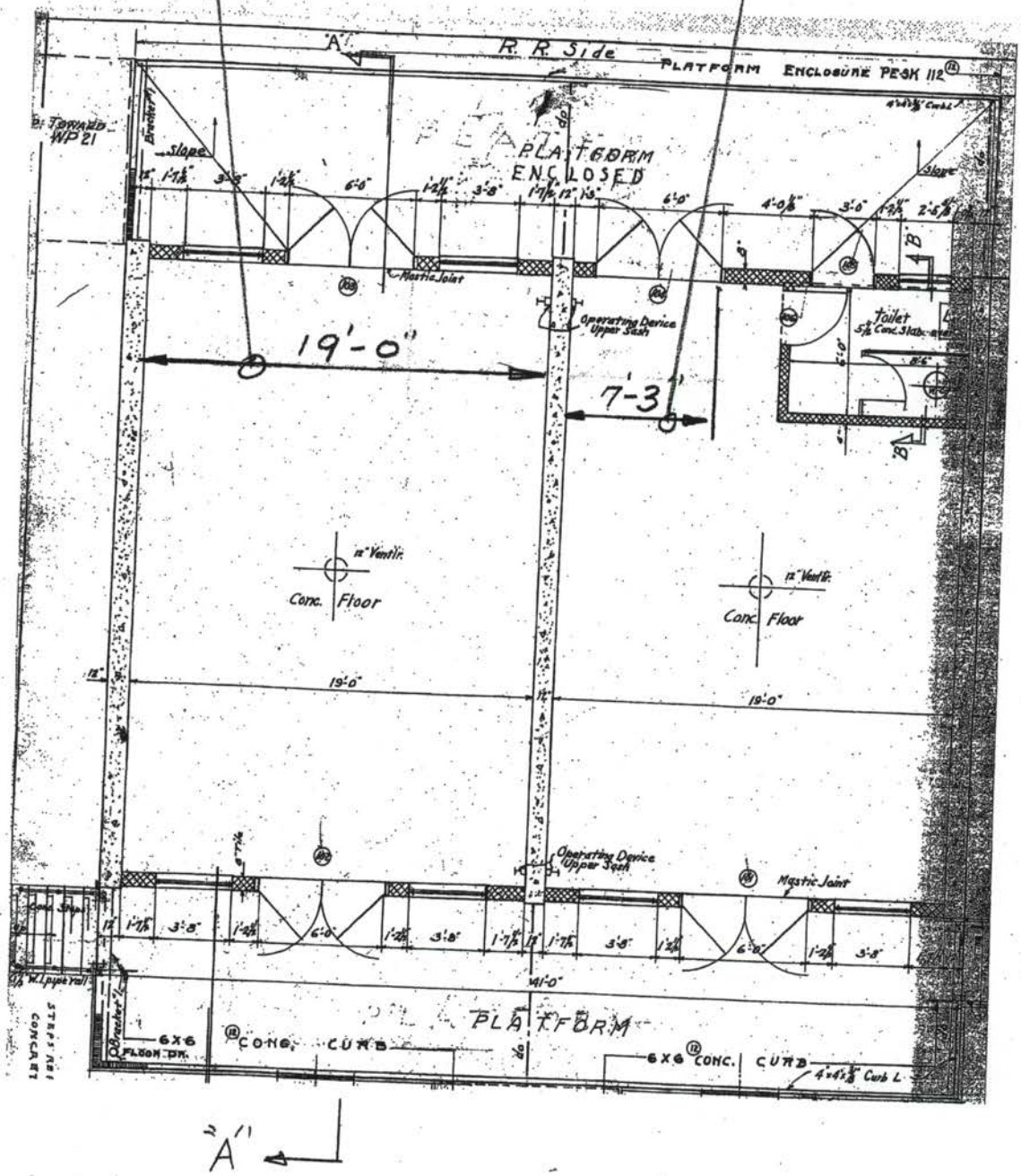


RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE GROUND FLOOR TO THE BOTTOM OF STEEL BEAN ABOVE.

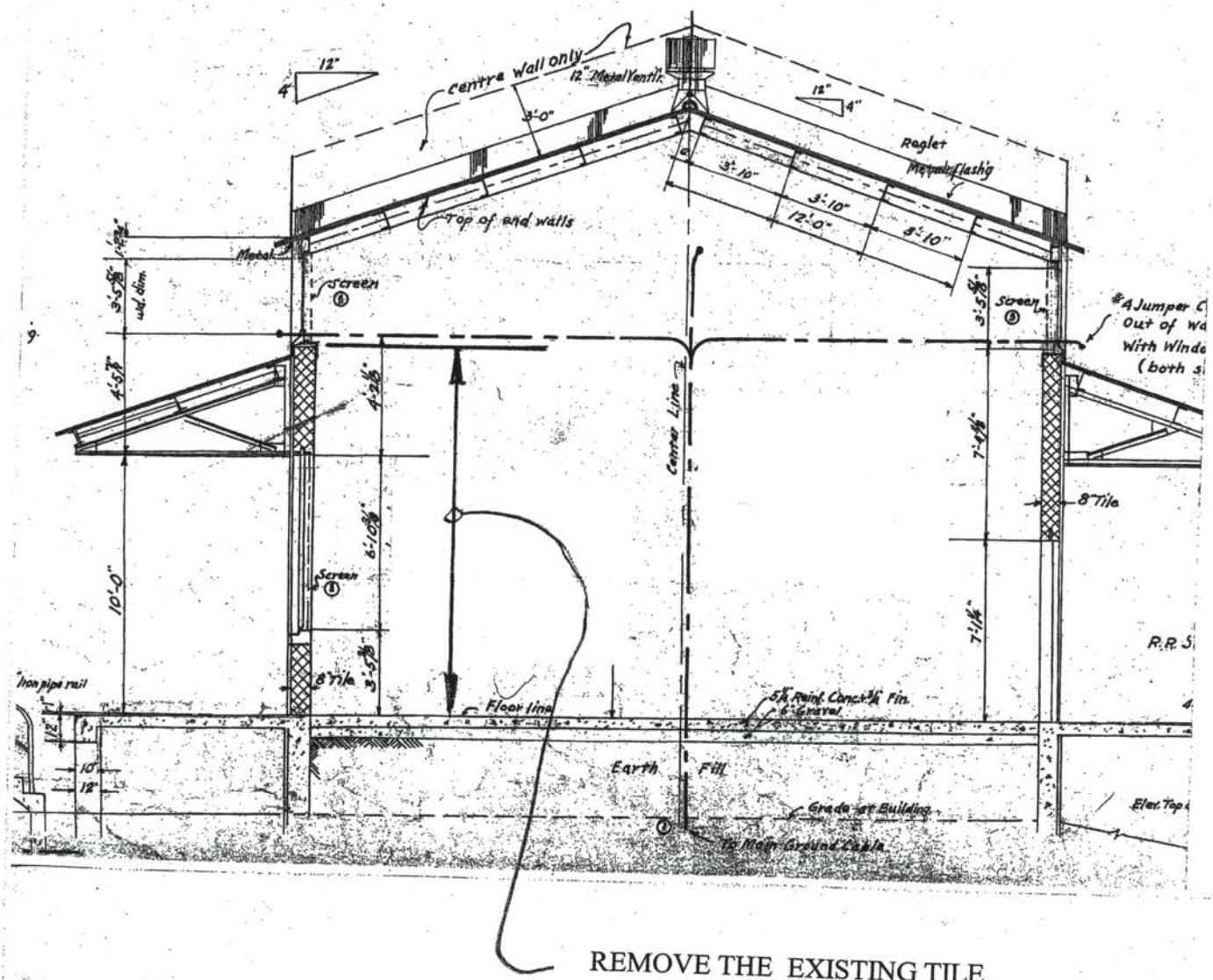
PARTIAL BUILDING PLAN

BUILDING DB-3

RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE GROUND FLOOR TO THE BOTTOM OF STEEL ANGLE ABOVE. SEE CROSS SECTION "A-A" AND SECT"B-B" FOR DETAILS.



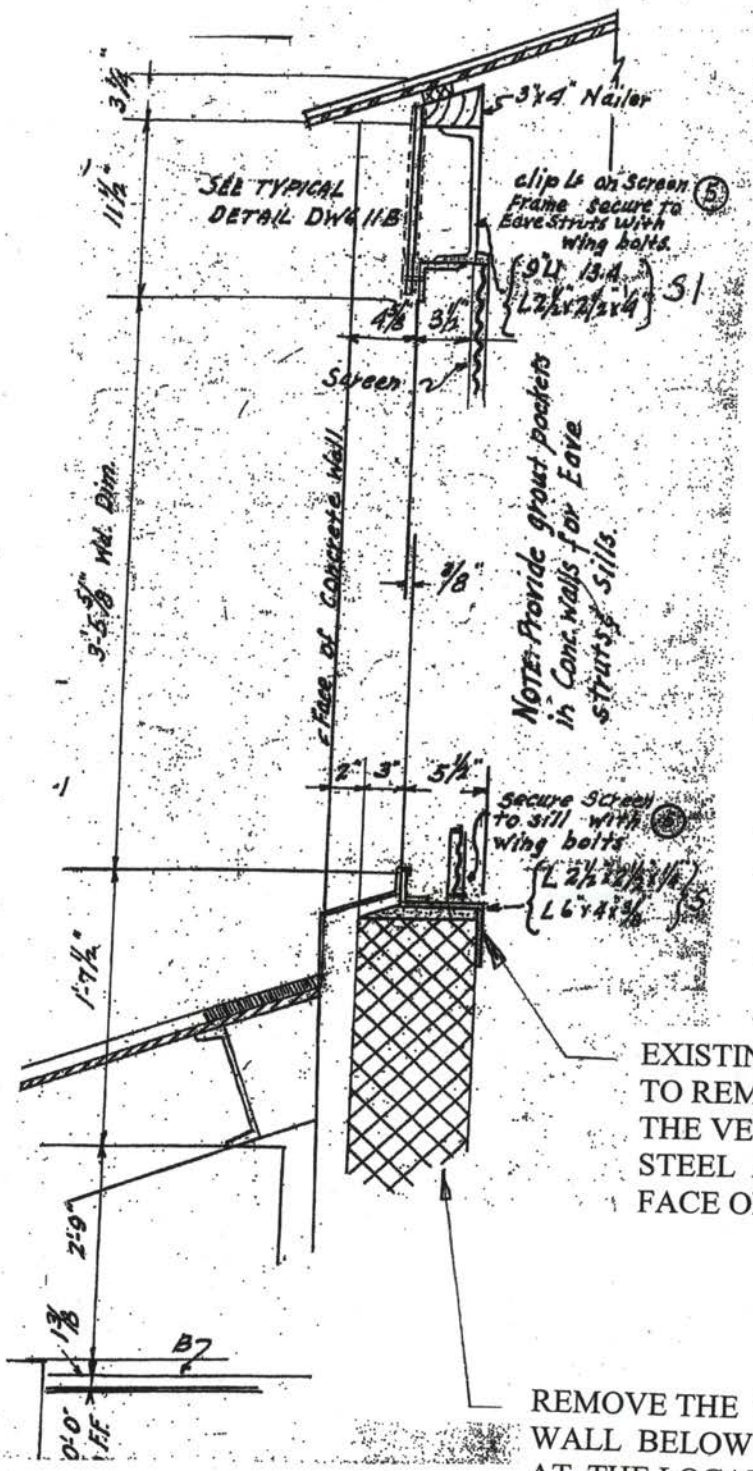
BUILDING DA- 6 & 6A



REMOVE THE EXISTING TILE WALL BELOW THE STEEL ANGLE AT THE LOCATIONS SHOWN ON BUILDING PLAN.

SECTION A-A

BUILDING DA- 6 & 6A

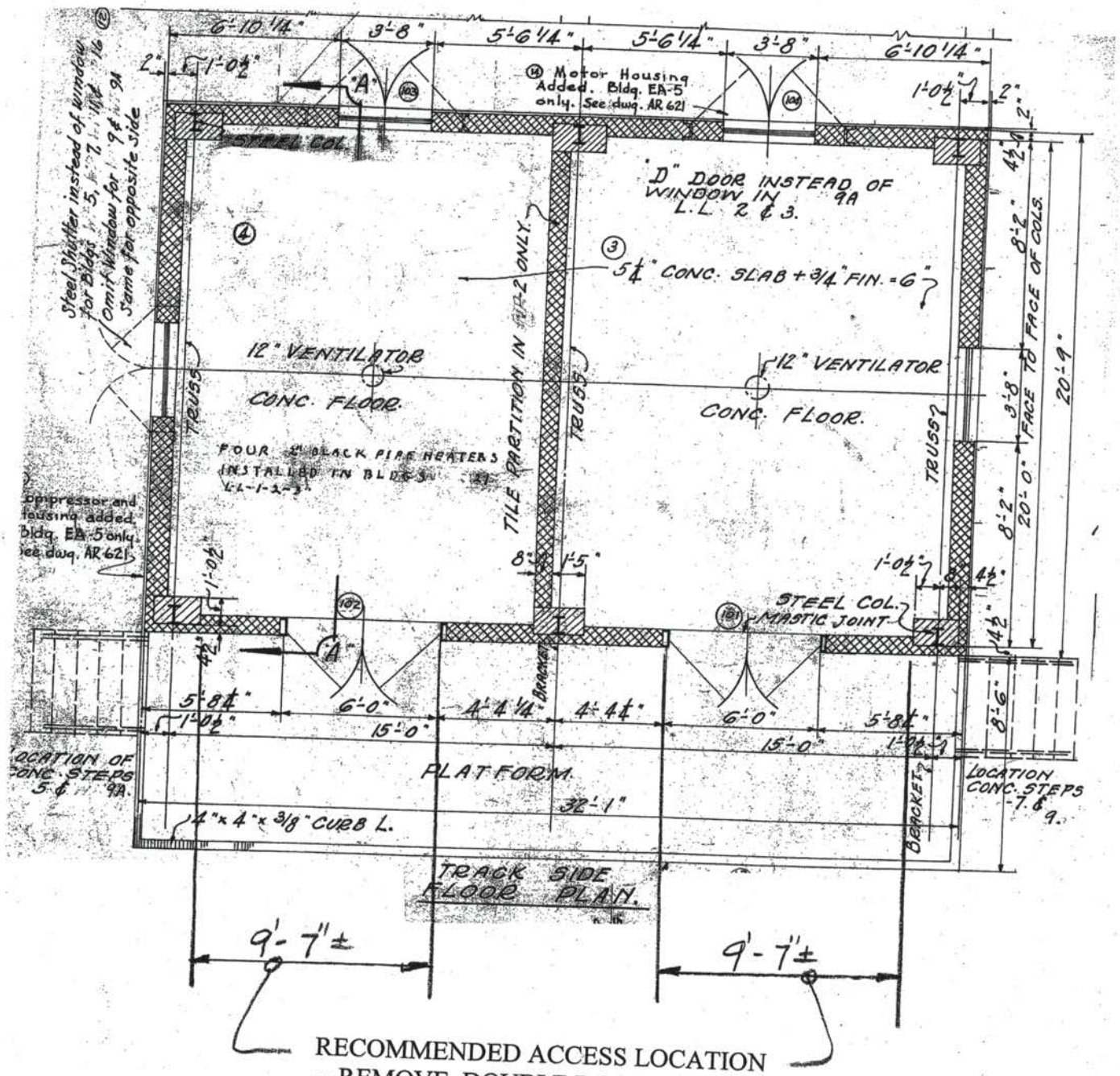


EXISTING STEEL ANGLE, L6X4, TO REMAIN -- DO NOT DAMAGE THE VERTICAL LEG OF THE STEEL ANGLE AT THE INSIDE FACE OF WALL.

REMOVE THE EXISTING TILE WALL BELOW THE STEEL ANGLE AT THE LOCATIONS SHOWN ON BUILDING PLAN.

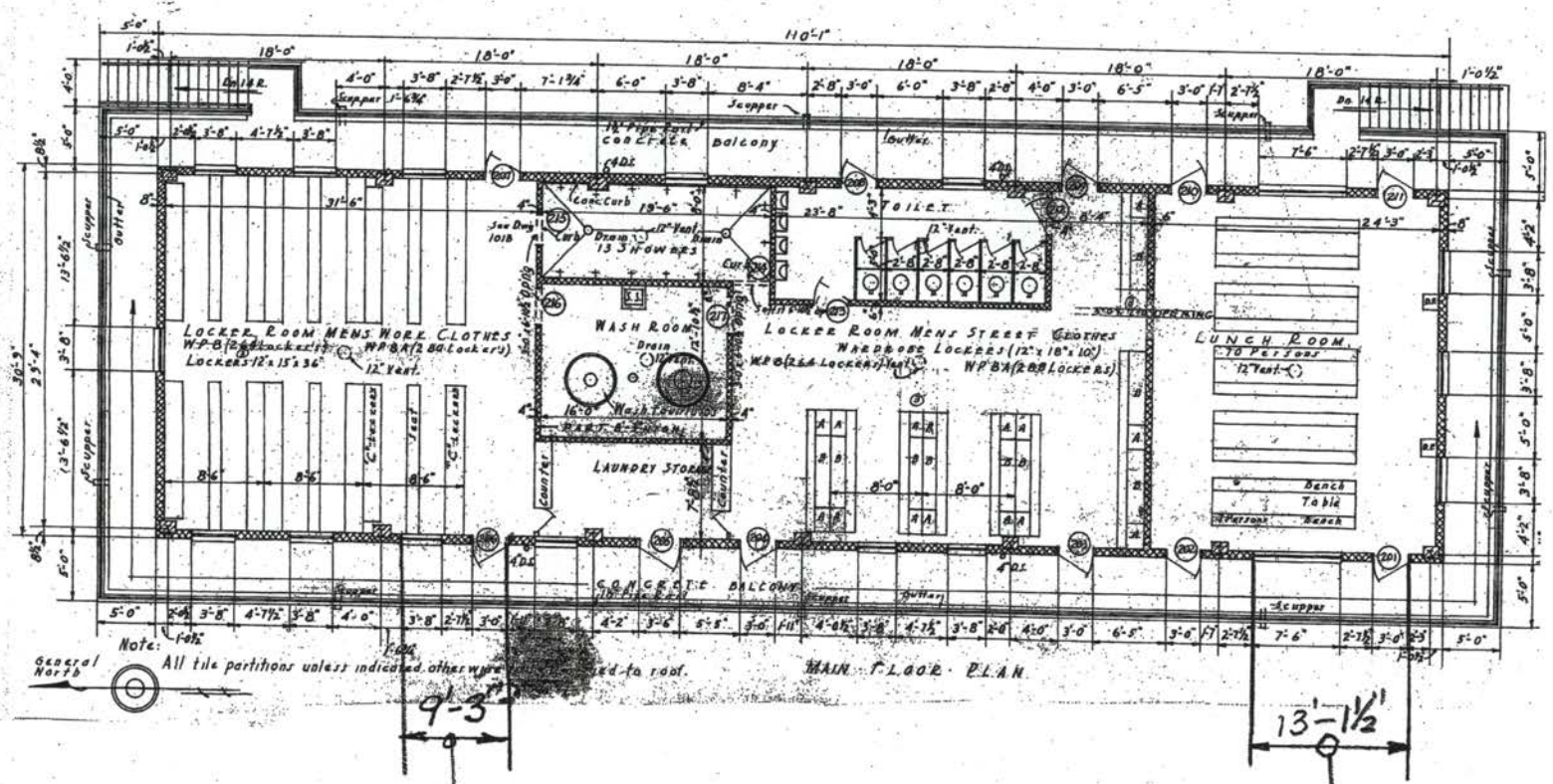
SECTION B-B

BUILDING DA- 6 & 6A



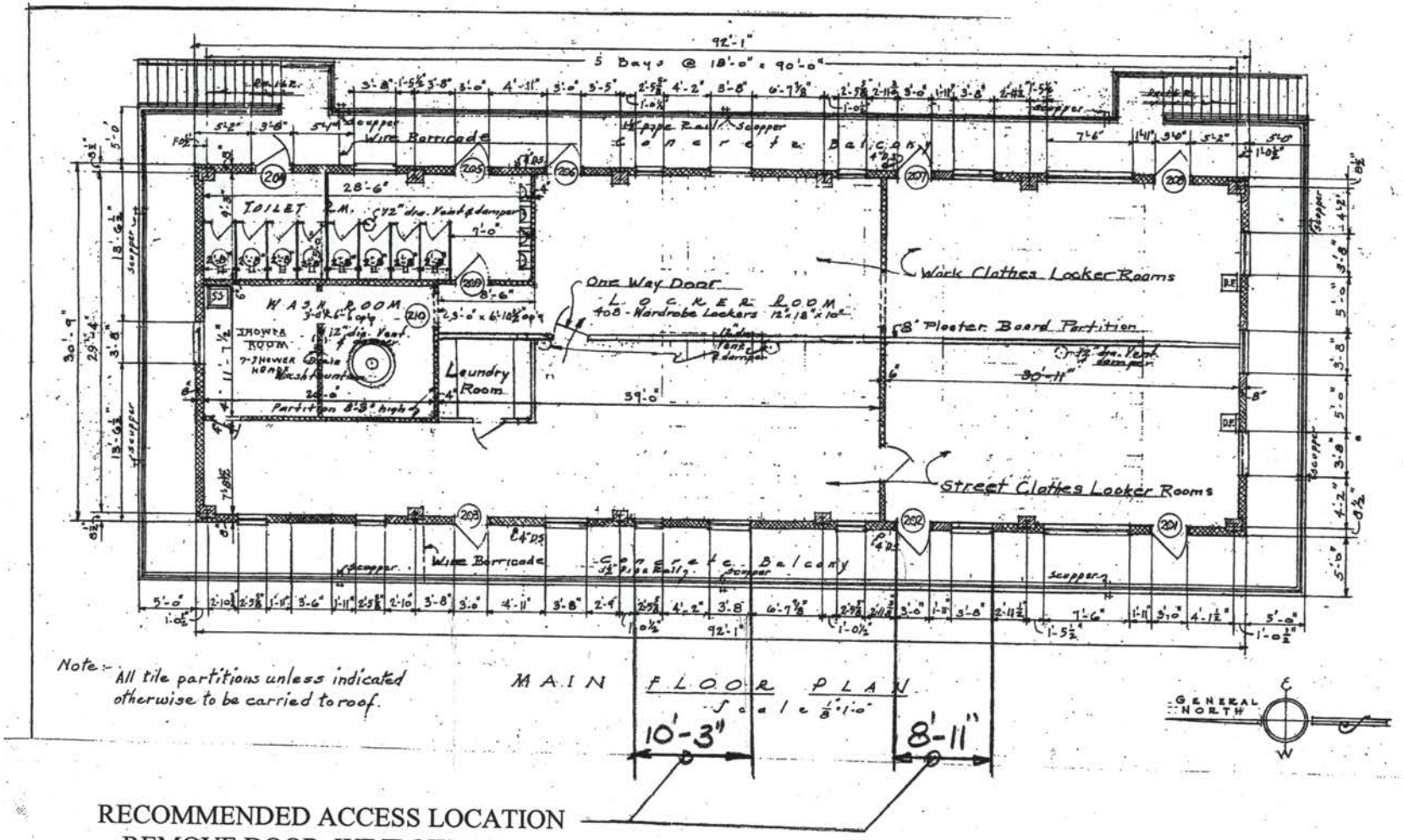
RECOMMENDED ACCESS LOCATION
-- REMOVE DOUBLE DOOR AND TILE WALL FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

BUILDING DA-7 & DA-21



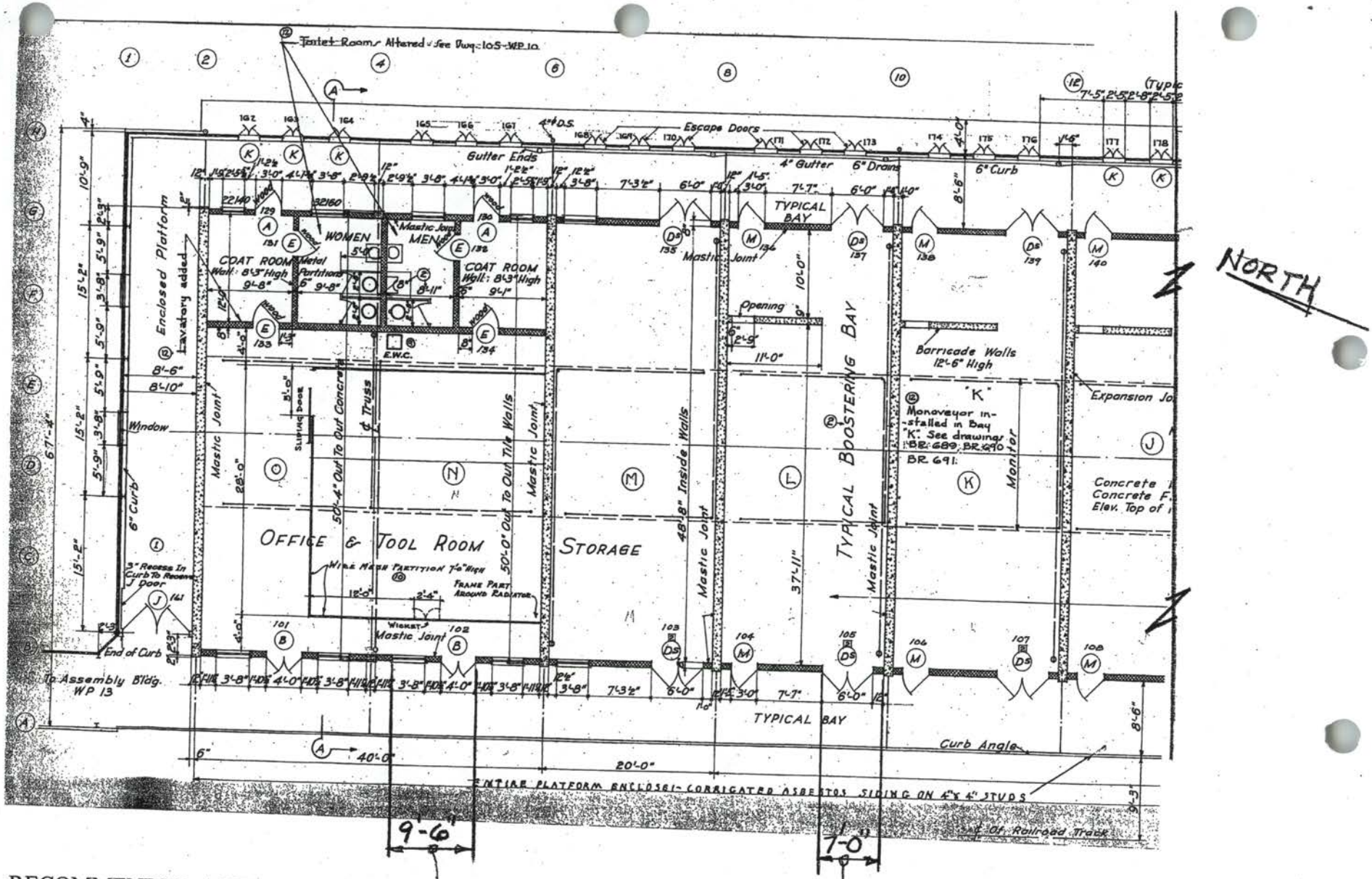
RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

BUILDING DB-8



RECOMMENDED ACCESS LOCATION -- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

BUILDING D8-8A

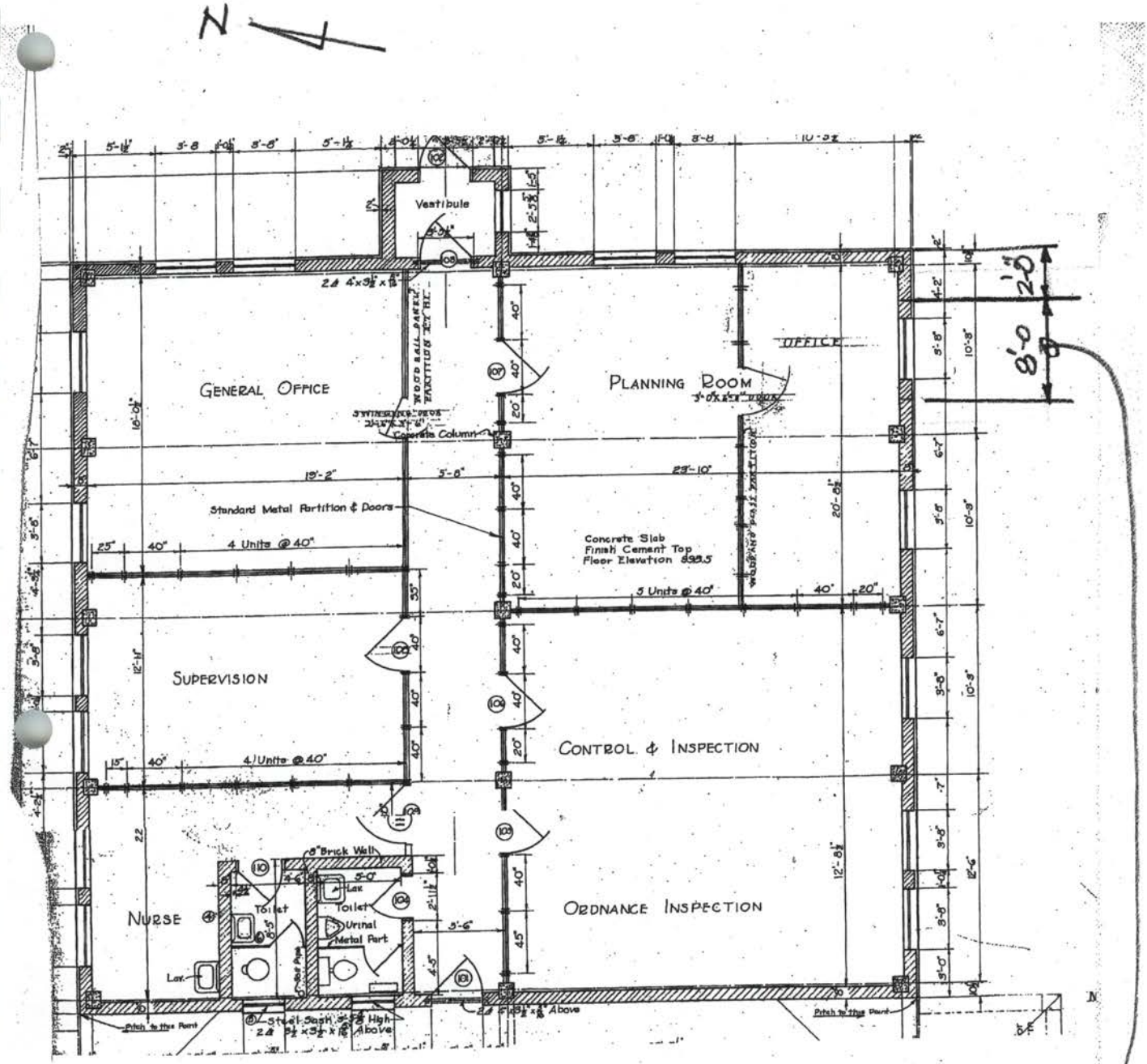


RECOMMENDED ACCESS LOCATION -- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE GROUND FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

RECOMMENDED ACCESS LOCATION -- REMOVE DOUBLE DOOR AND TILE WALL FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

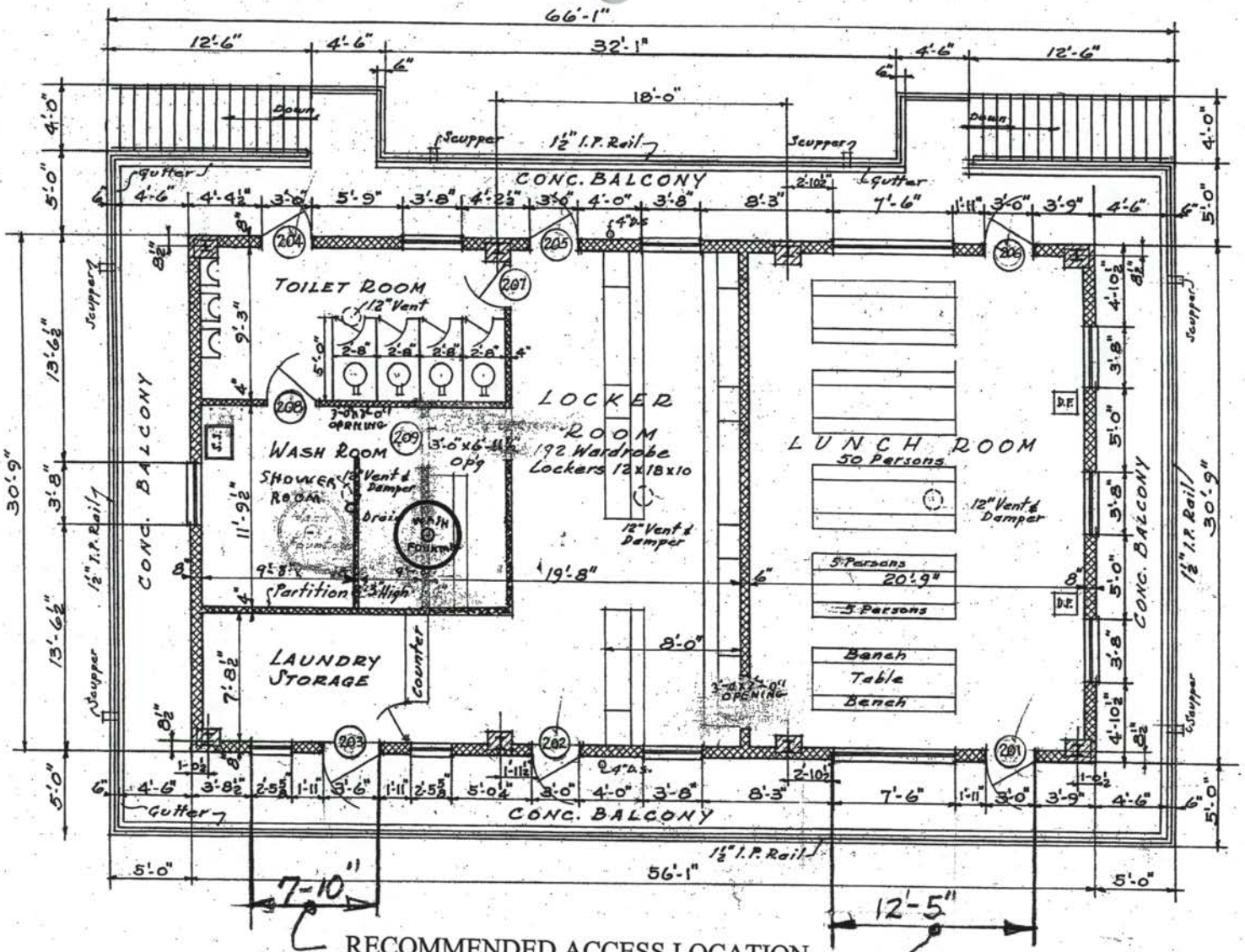
PARTIAL BUILDING PLAN

BUILDING DB-10



RECOMMENDED ACCESS LOCATION
-- REMOVE WINDOW, AND BRICK AT LOCATION SHOWN FROM FLOOR TO THE BOTTOM OF CONCRETE BEAM ABOVE. DO NOT DAMAGE THE CONCRETE COLUMNS

BUILDING DB-20



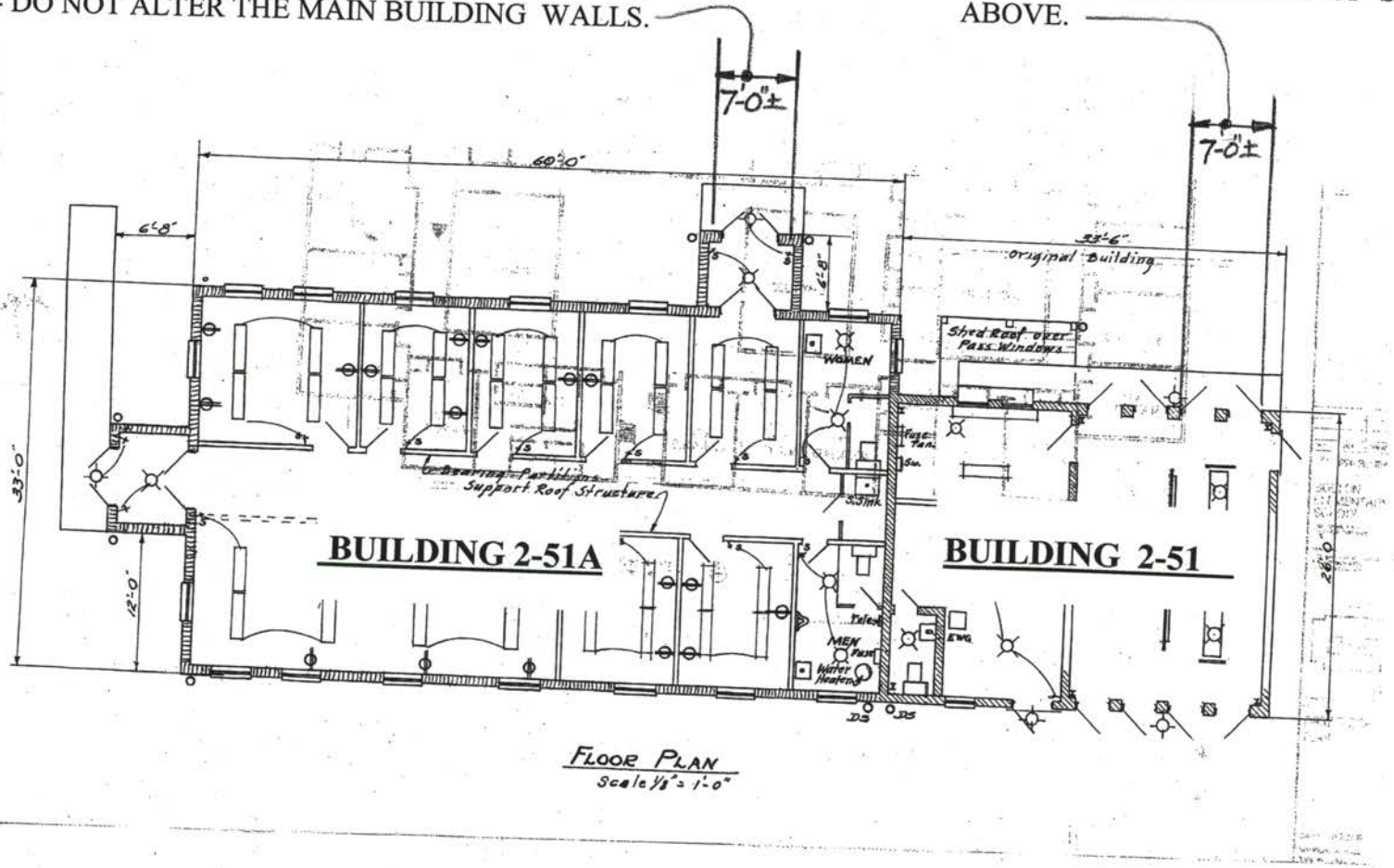
RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

General NORTH

BUILDING DB-22

RECOMMENDED ACCESS LOCATION
--REMOVE APPROX. 1 FOOT OF CONCRETE BLOCK WALL AT BOTH SIDES OF THE EXISTING DOOR. FROM GROUND FLOOR TO THE TOP OF WALL.
-- DO NOT ALTER THE MAIN BUILDING WALLS.

RECOMMENDED ACCESS LOCATION
-- REMOVE TWO MAN DOORS, AND TILE WALL IN BETWEEN FROM GROUND FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.



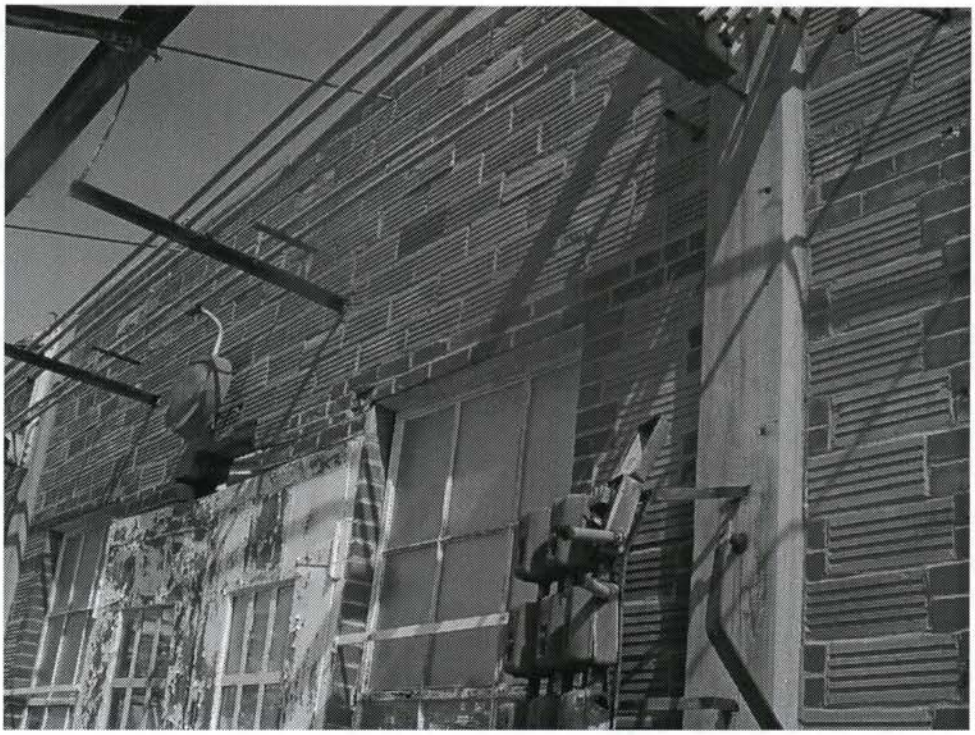
FLOOR PLAN
Scale 1/8" = 1'-0"

BUILDING 2-51 AND 2-51A

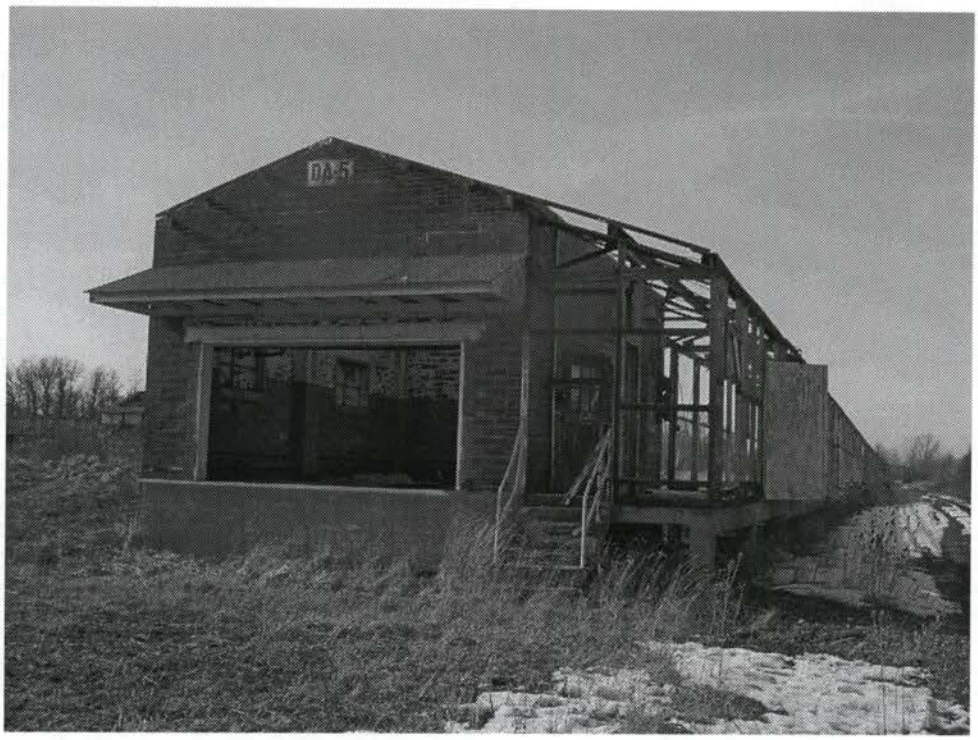
BUILDING DB-2

BUILDING DB-3

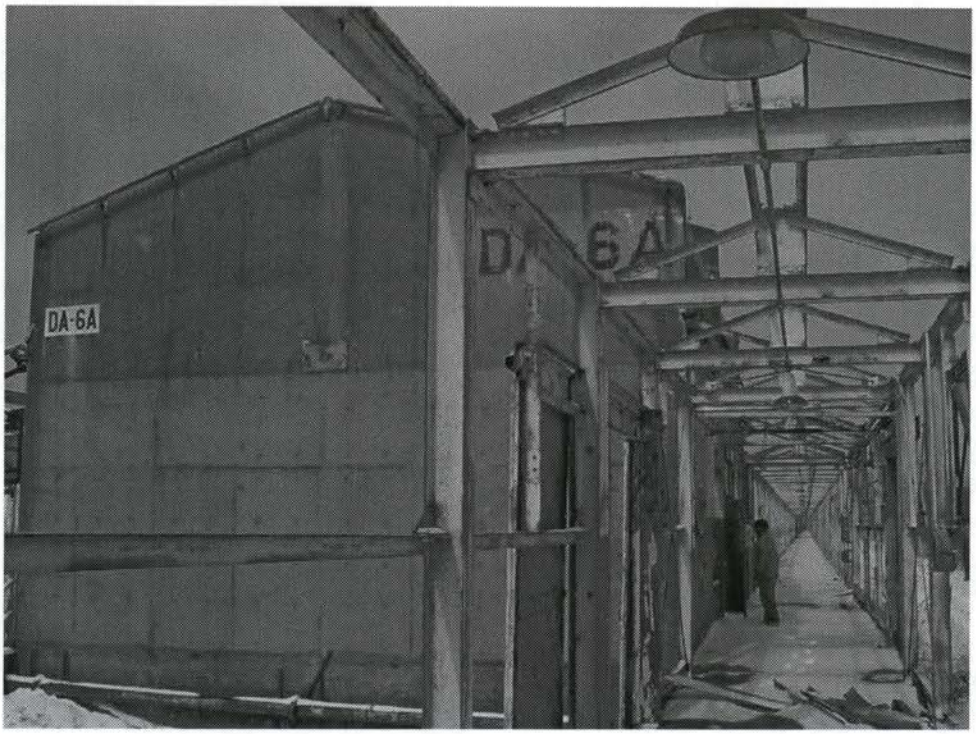
BUILDING DB-3



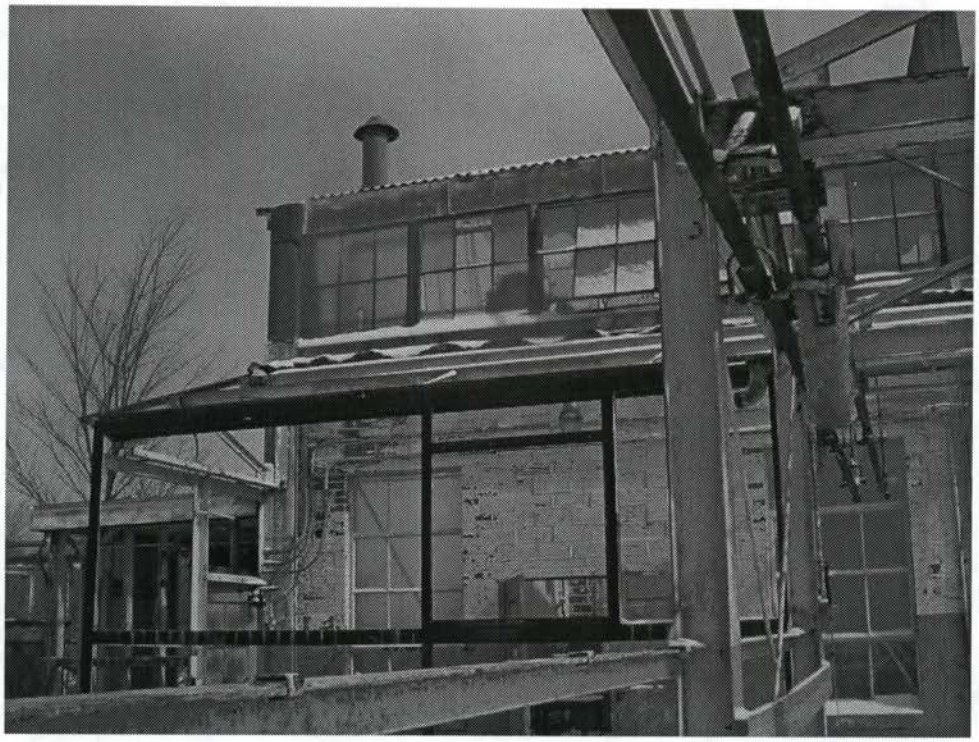
BUILDING DB-3



BUILDING DA-5

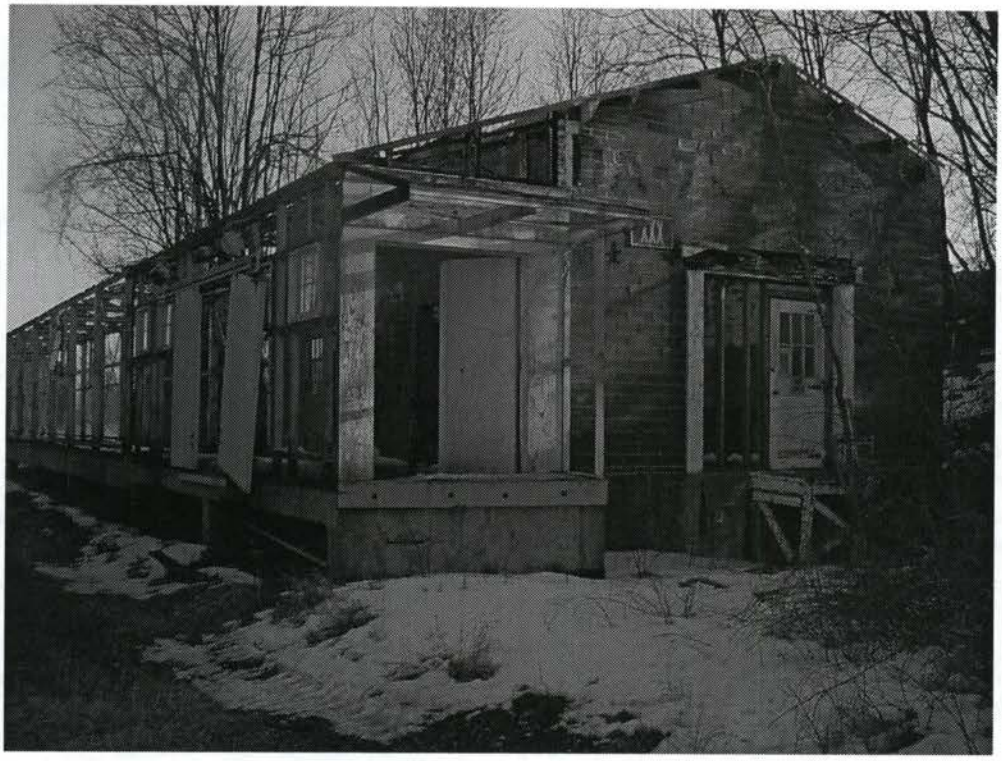


BUILDING DA-6A



BUILDING DA-6A

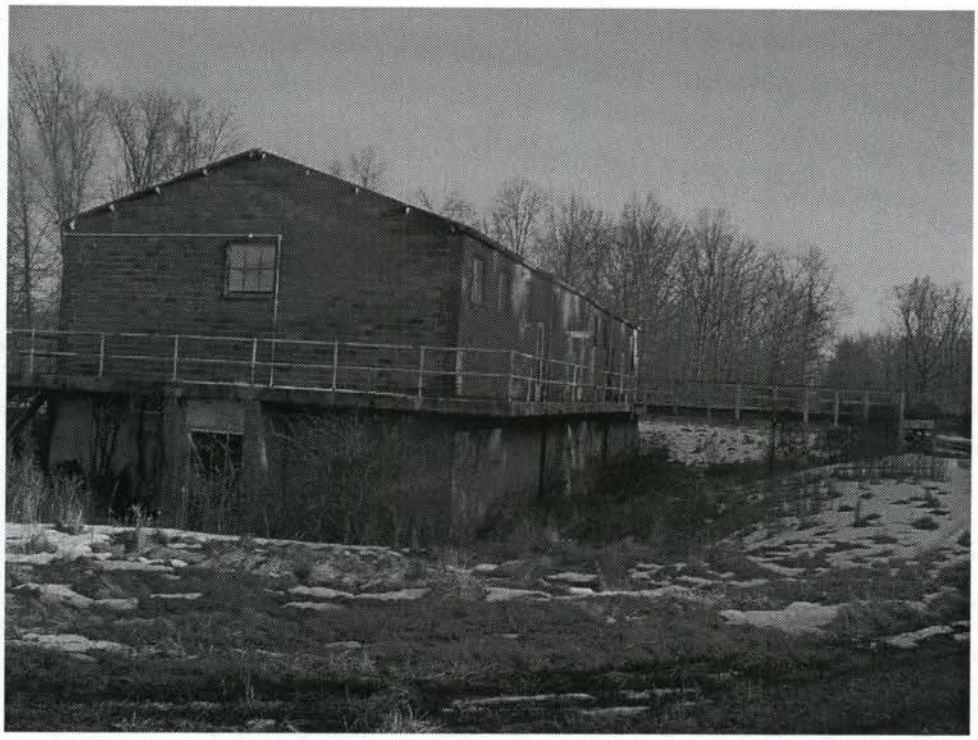
BUILDING DA –6A



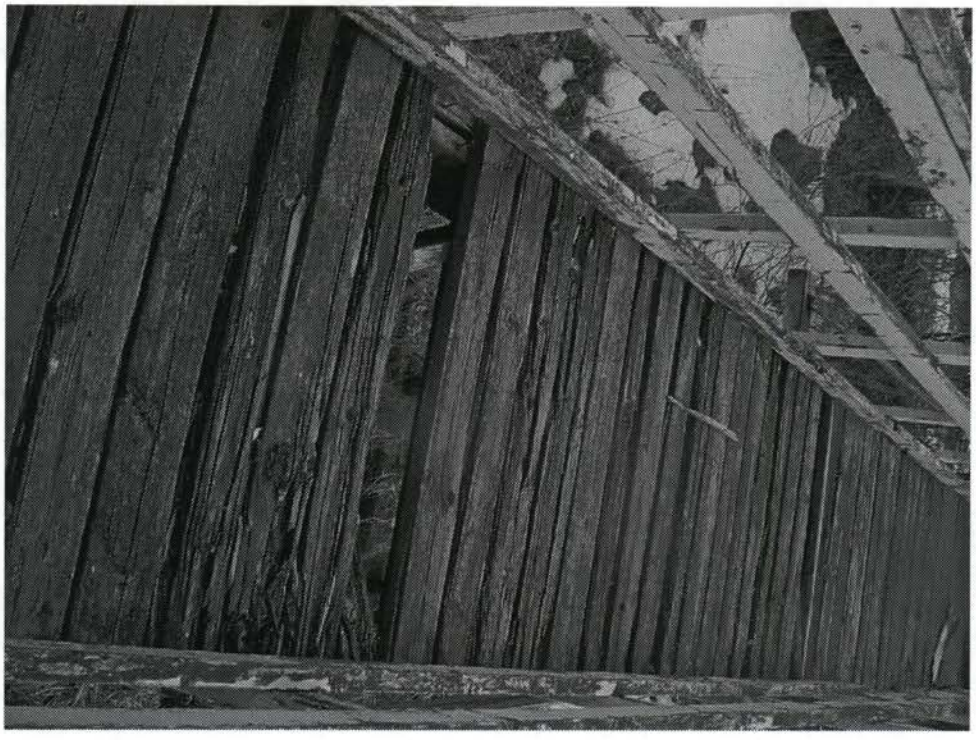
BUILDING DA-7

BUILDING DB-8

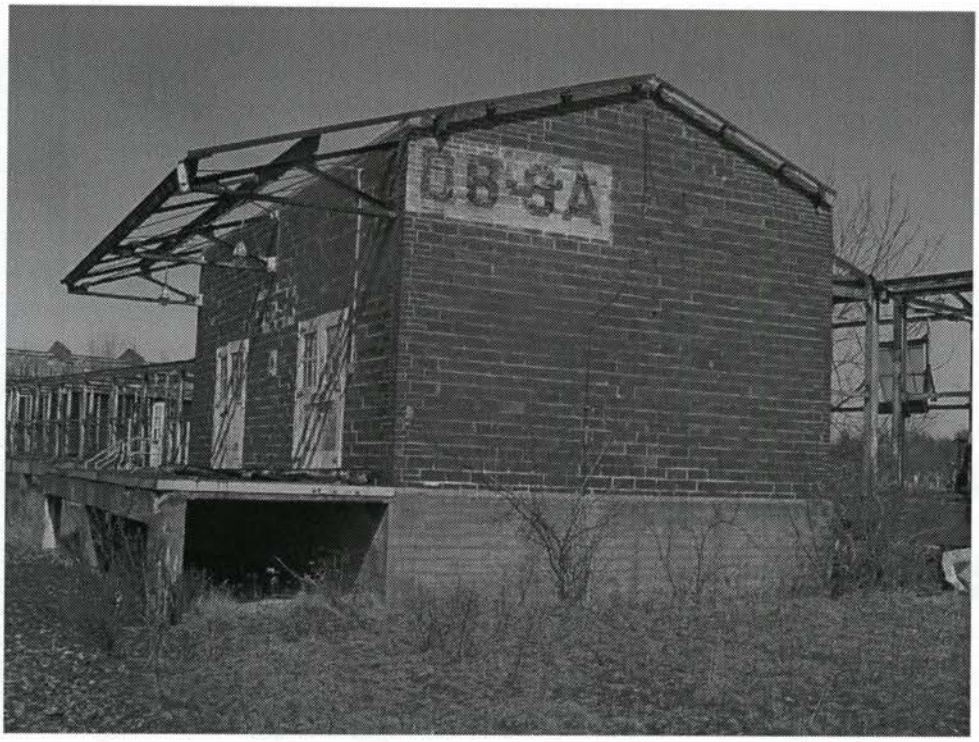
BUILDING DB-8



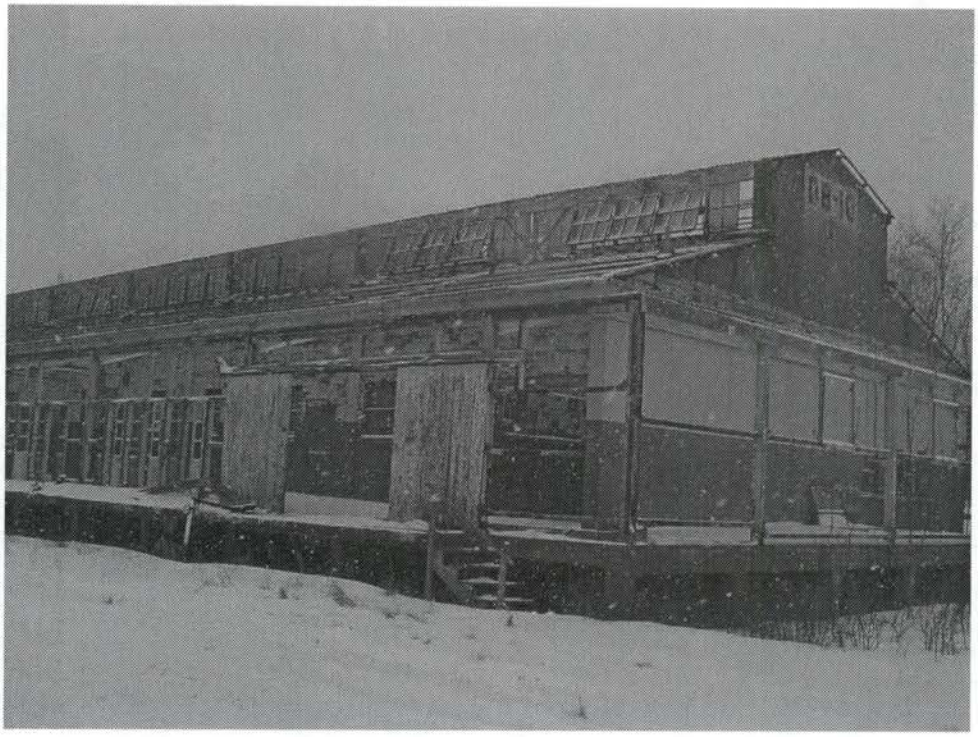
BUILDING DB-8A



BUILDING DB-8A

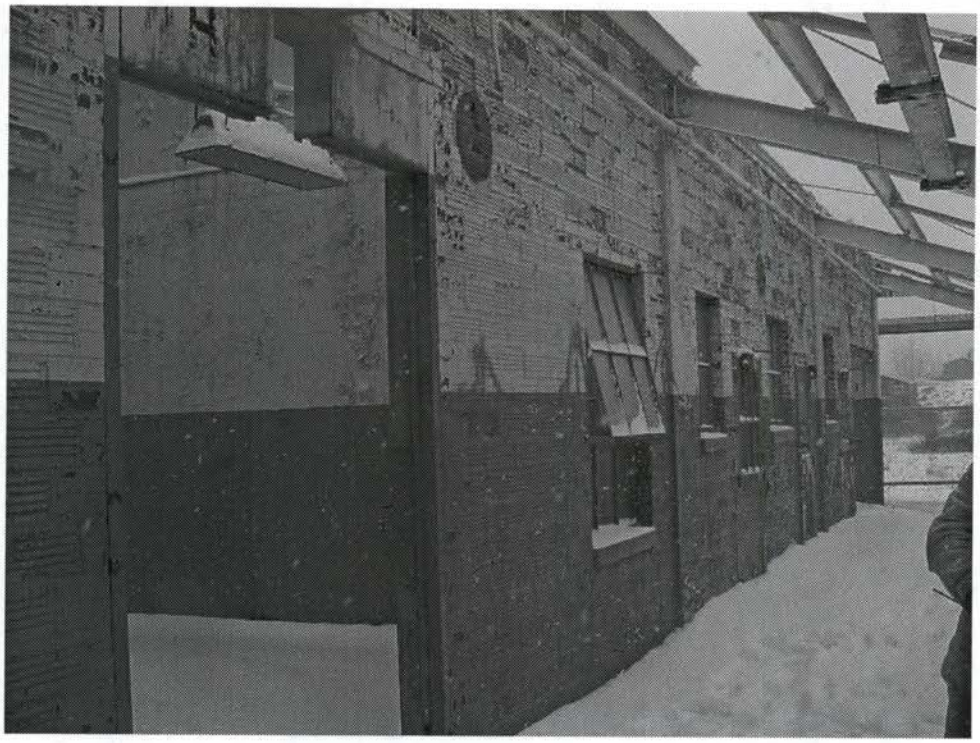


BUILDING DB-9A

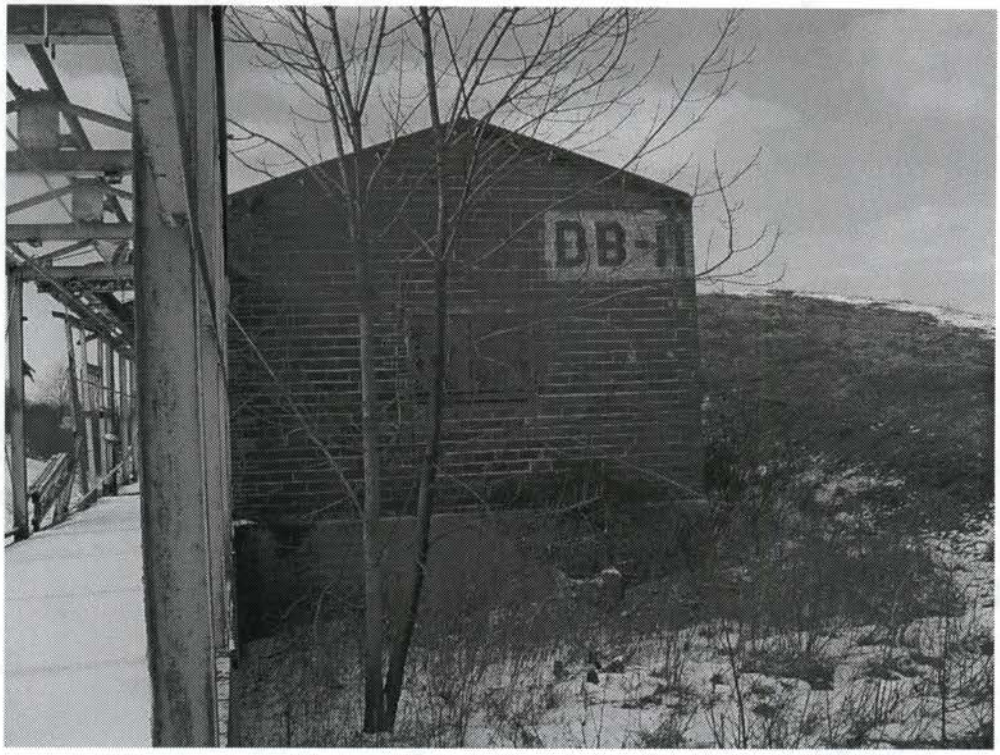


BUILDING DB-10

BUILDING DB-10



BUILDING DB-10



BUILDING DB-11

BUILDING DB-13

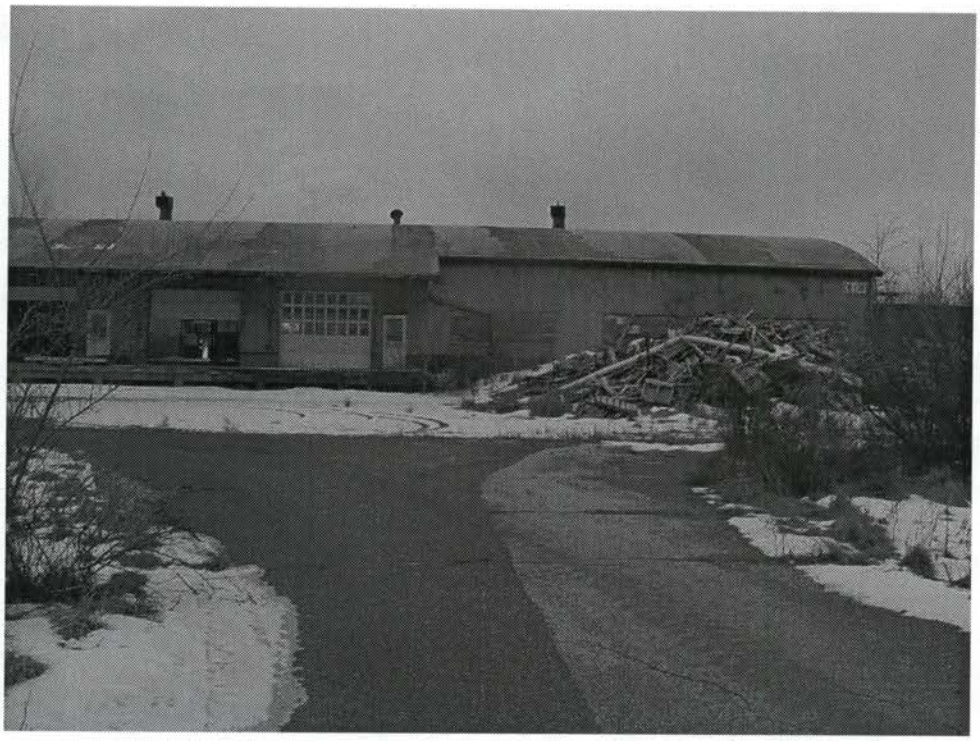
BUILDING DB-13

BUILDING DB-13A

BUILDING DB-13A

BUILDING DB-13A

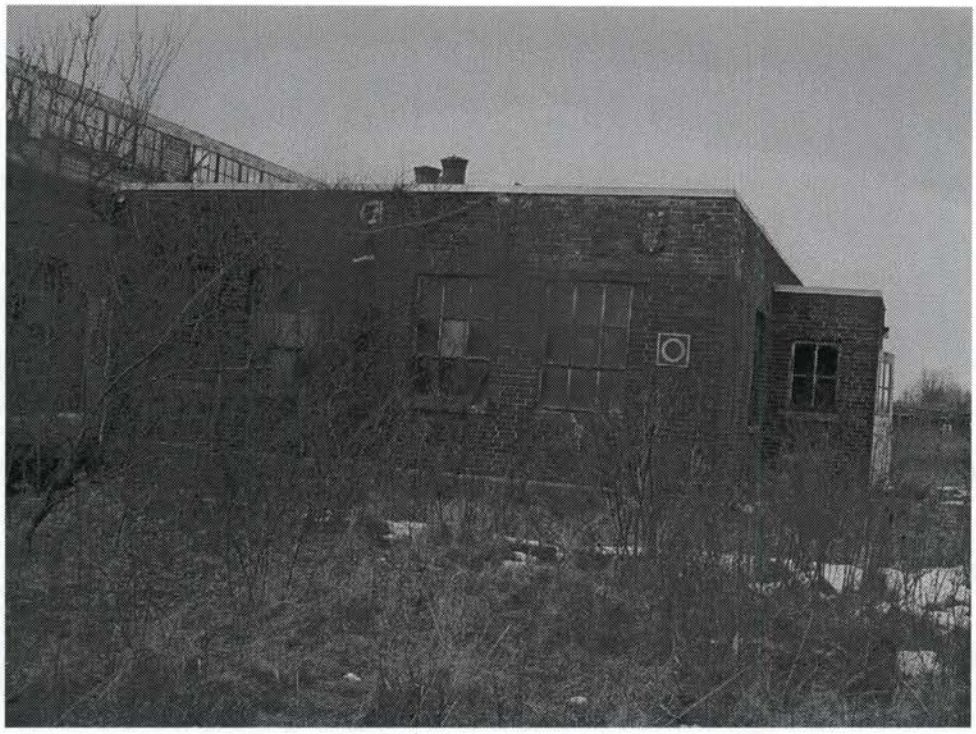
BUILDING DB-13A



BUILDING DB-13B

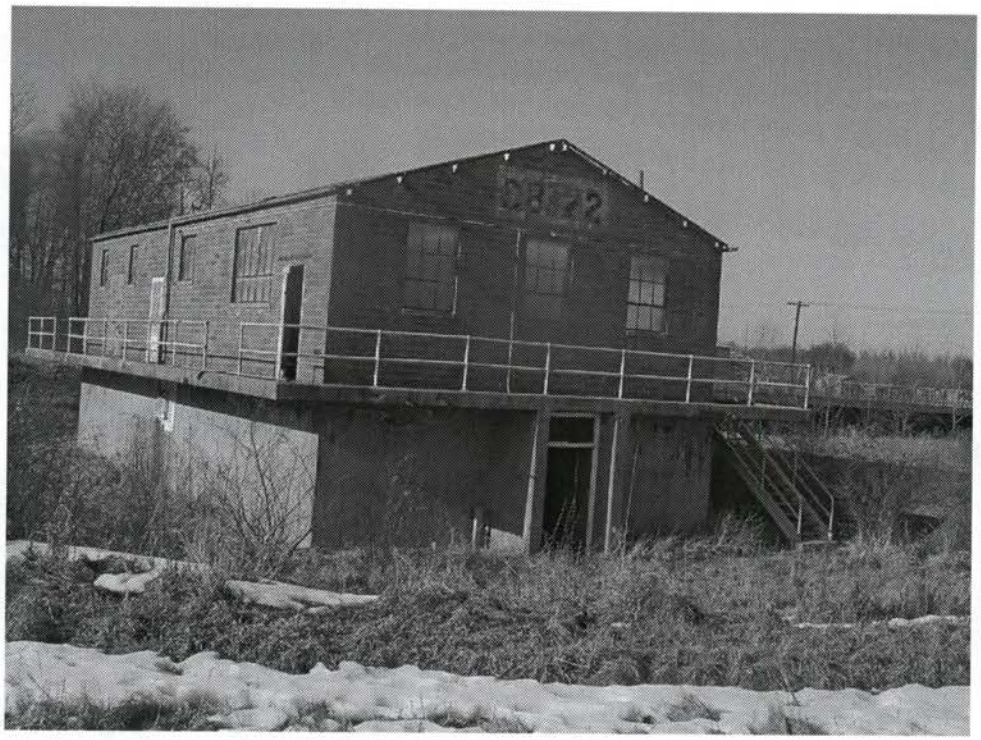
BUILDING DB-13B

BUILDING DB-19

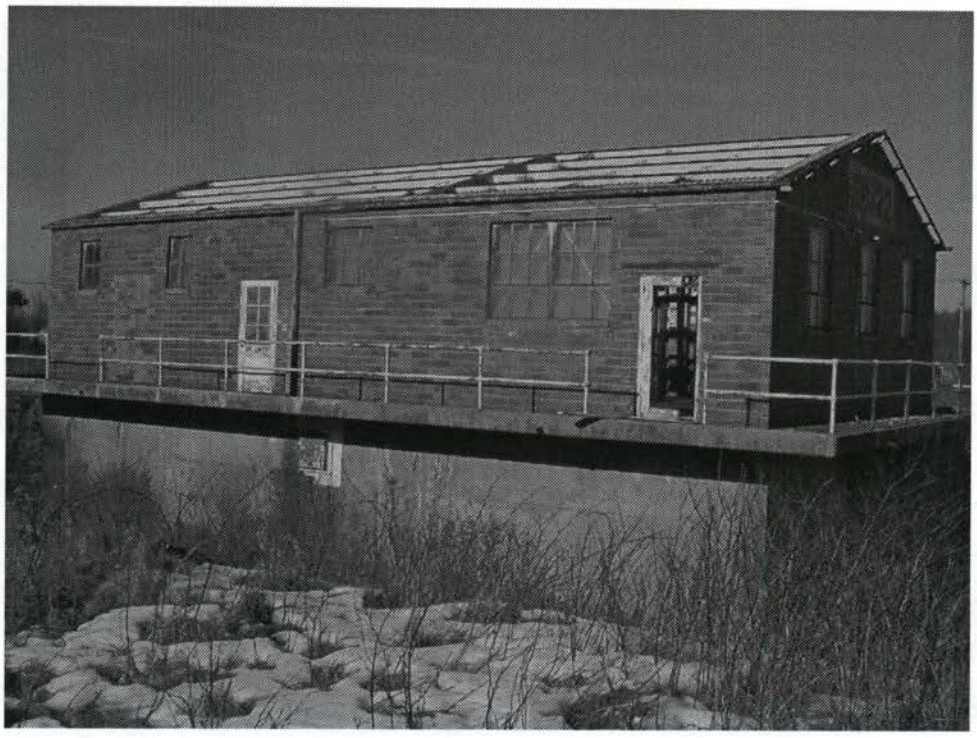


BUILDING DB-20

BUILDING DA-21



BUILDING DB-22

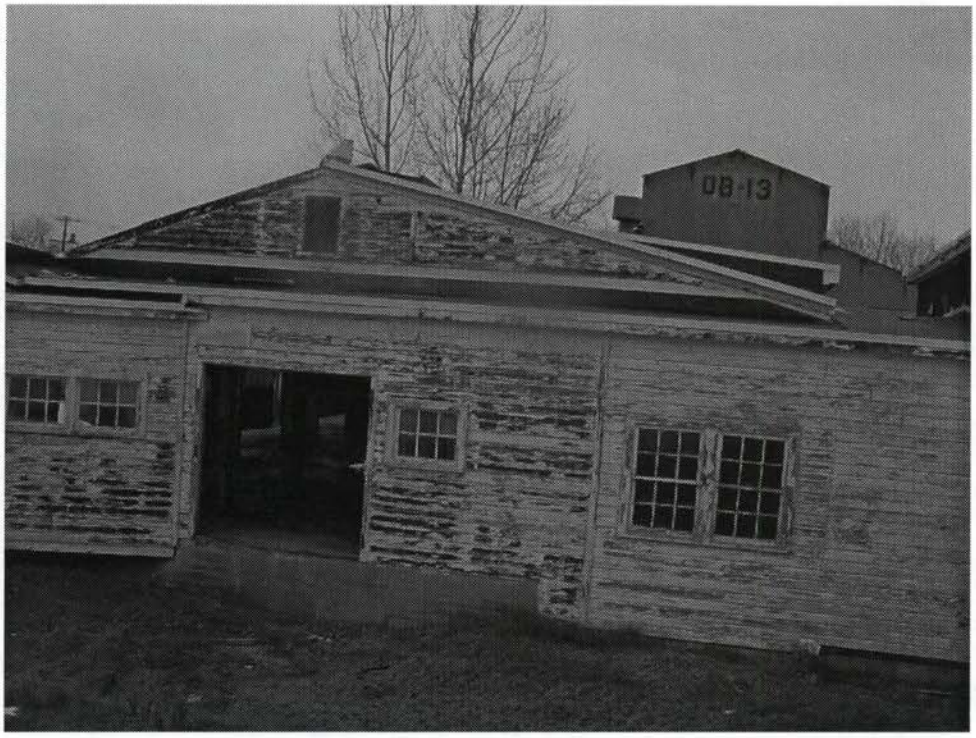


BUILDING DB-22

BUILDING DB-25

BUILDING DB-26

BUILDING DB-26



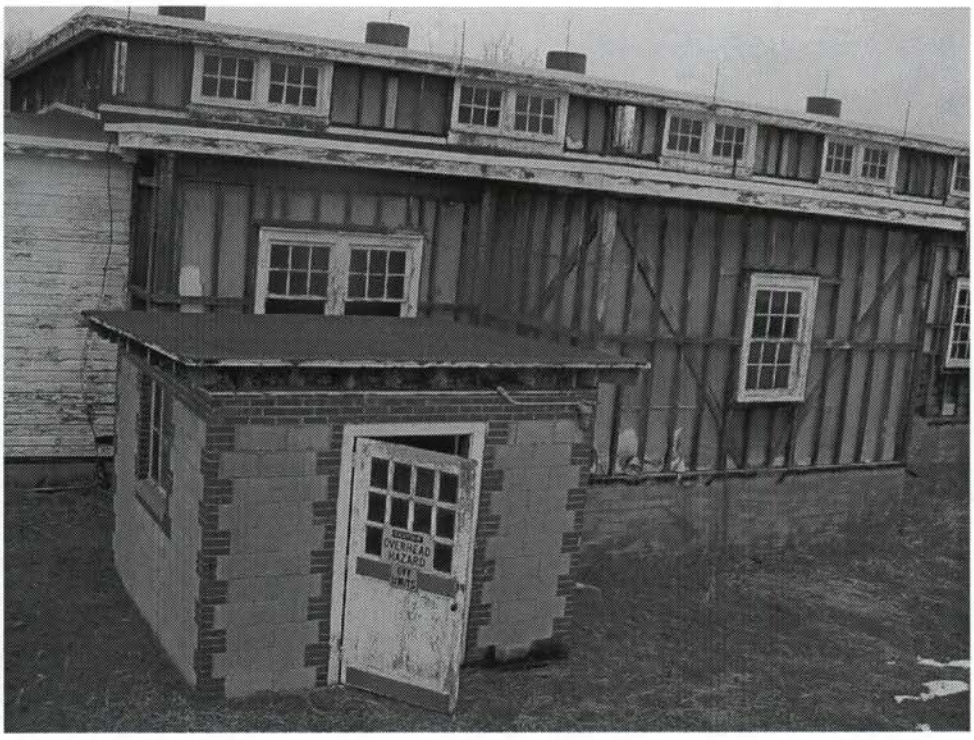
BUILDING DB-26

BUILDING DB-26

BUILDING DA-28

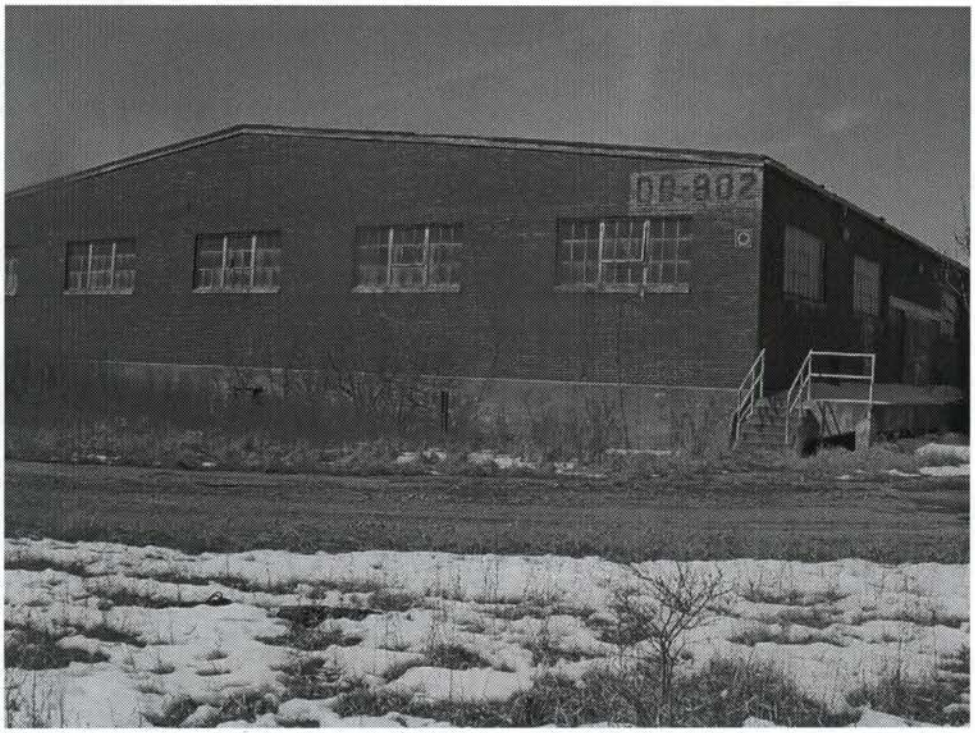
BUILDING DA-28

BUILDING DA-28A



BUILDING DB-29

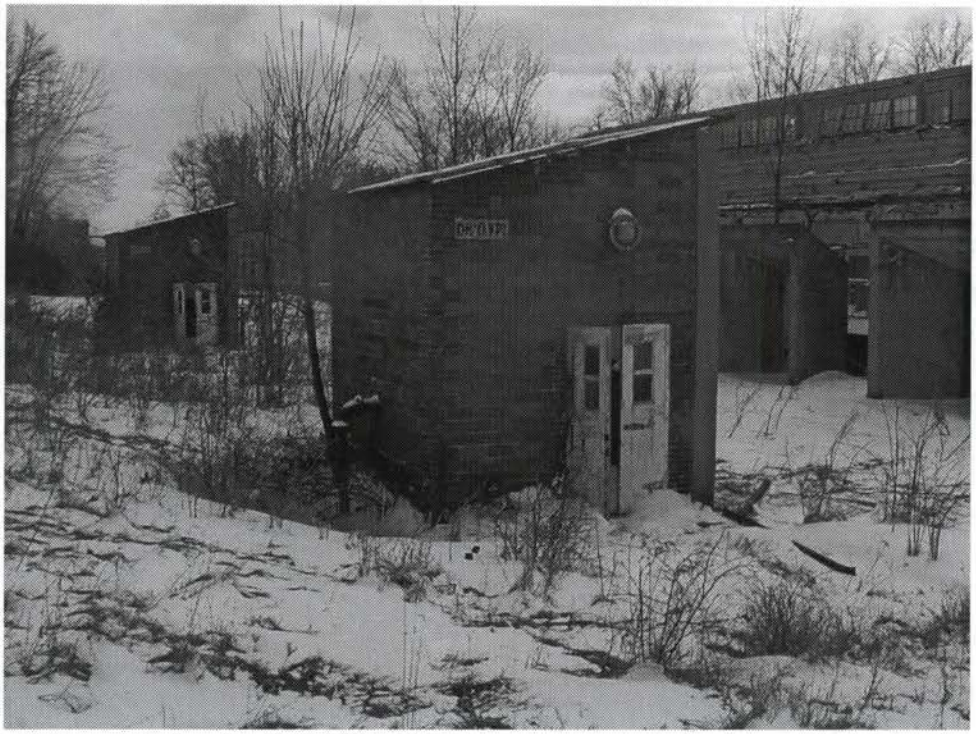
BUILDING DB-802



BUILDING DB-802

BUILDING DB-802

BUILDING DB-802

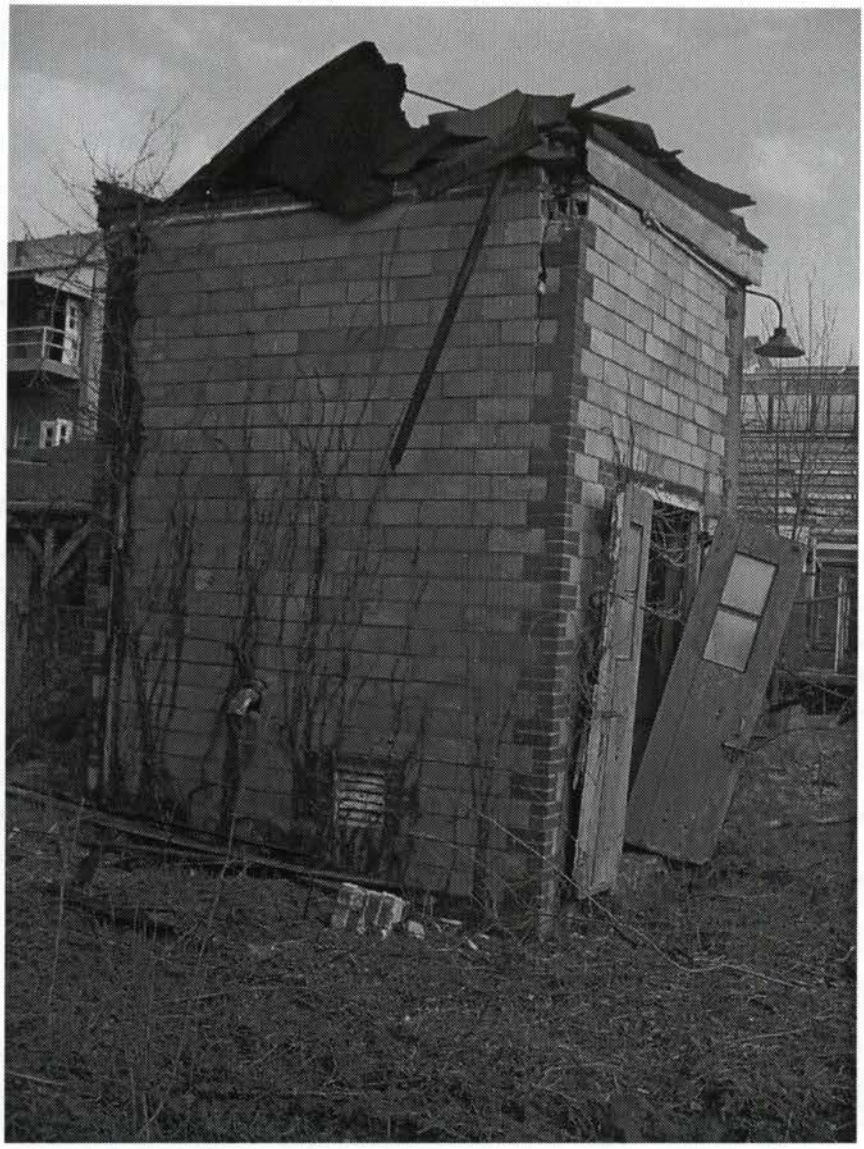


BUILDING DB10VP1

BUILDING DB10VP2

BUILDING DB4VP1

BUILDING DB4VP1



BUILDING DB4VP1

BUILDING DB4VP1

BUILDING DB4AVP1

BUILDING 2-51 & 2-51A

ENGINEERING SURVEY REPORT #1

BUILDING DB-4, DB-4-WN, DB-4-WS,
DB-4A, DB-4A-WN, DB-4A-WS, DA-6

AT
LOAD LINE 2

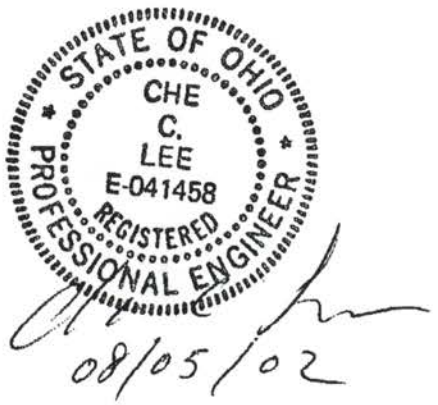
RAVENNA ARSENAL ARMY AMMUNITION PLANT
RAVENNA, OHIO

AUGUST 5, 2002

Prepared for:

MKM ENGINEERS, INC.

4153 Bluebonnet Drive
Stafford, Texas 77477



Prepared by:

BAT Associates, Inc.
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Cleveland, Ohio 44131

TABLE OF CONTENTS

1.0 INTRODUCTION

BAT Associates, Inc. (BAT) was contracted by MKM Engineers, Inc. to perform engineering surveys on buildings and structures inside the load lines 2 & 3 of the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio. MKM Engineers, Inc. is the prime contractor for the U.S. Army Operations Support Command to disassemble, decontaminate, and dispose explosive process equipment and piping including steam pipes, conduits, fire supression pipes etc. that exist in buildings where explosive operations have taken place at the load lines 2 & 3 of the Ravenna Army Ammunition Plant. Prior to performing the disassembly/decontamination operations, an asbestos subcontractor needs to remove the existing asbestos involved in the operation, including corrugated asbestos building sidings and roof panels at the different locations of the buildings.

The walk-through engineering survey is to evaluate the general structural conditions or hazards related to the safety, integrity, and stability of the buildings or structures. It was not intended to inspect every single member, element, or steel connection of the buildings/ structures. It was also not intended to locate, identify or measure every single deficiency of the structures or connections. There are expected to be areas such as the roof that may not accessible for a close survey. It is therefore the responsibility of the asbestos contractor to verify and inspect each local structural deficiency such as rusted-out steel members or connections related to the safety of his work prior to the transite removal operations.

This report covers the results of the initial survey for the load line 2 buildings where asbestos panel removal operations are to be completed beginning the week of August 5, 2002. Section 2.0 Background, of this report gives a brief background of the Ravenna Army Ammunition Plant and the operations that lead up to the current contract. Section 3.0, Purpose, describes the purpose of BAT's survey included in this report. Section 4.0 presents a Description of Buildings Surveyed for this report. Section 5.0 presents the Findings from the walk-through survey and Section 6.0 provides BAT's recommendations and Conclusions.

2.0 BACKGROUND

Ravenna Army Ammunition Plant (RVAAP) is a military installation having more than 21,000 acres. The plant is located off the Ohio State Route 5 at the east end of Ravenna, Ohio and is about 20 miles east of Akron.

The plant was built in 1940 to produce artillery, mortar shell bombs and components for ammunition through 1943 and was reactivated during the Korean and Victnam Wars. The facility was deactivated completely in 1993.

In 1998 about 16,000 acres of the plant were transferred over to the control of the Ohio Army National Guard excluding the production, housing and administrative areas. It was found that the plant has many "areas of concern" for potential contamination by explosives, heavy metals, asbestos, and other chemicals left over from munition manufacture and disposal. The Army's Industrial Operations Command has announced plans for a 10-year cleanup of the plant. It was estimated that the monitoring of the sites would go on for up to 30 years.

3.0 PURPOSE

The purpose of the engineering survey of the building and structures in load line 2 prior to the asbestos removal operations is to:

A. Identify any structural safety hazards related to the removal operation for the corrugated asbestos siding, roof panels and process-related asbestos.
B. Identify the possibility of an unplanned collapse of the structures or portion of the structures due to the operations of the asbestos removal.
C. Assess the condition of the overall structural integrity, stability, and safety for the operations of the asbestos removal.
D. Locate and identify any sustained structural damages, distresses or deformations that would affect the strength and integrity of the structures.
E. Prepare and submit a written report summarizing the conclusion and recommendations regarding the asbestos removal operations.

4.0 DESCRIPTION OF BUILDING SURVEY

With the assistance of Mr. Lew Kovarik of MKM Engineers, Inc., Frank Lee from BAT conducted the walk-through engineering survey to evaluate the structural hazard, integrity and condition related to the asbestos removal operations on the Melt Load Building DB-4, DB-4-A, DA-6 and four small annexes DB-4--WN & WS, DB-4-A-WN &WS next to the DB-4 & 4A Buildings on July 31, 2002. These are the buildings in load line 2 that require asbestos removal.

5.0 FINDINGS

A. Melt Load Building, DB-4A

Melt Load Building DB-4A was built in 1941 and has not been in use for decades. The main building is a three-story concrete frame structure with concrete columns, beams and structural slabs at the 2nd and 3rd floors and brick walls at the east and west sides. The main building is approximately 51 feet by 50 feet in plan dimensions and about 44 feet high at the ridge. There is a six-foot wide balcony with steel pipe handrails around the three sides of the building on the second and third floors (see the attached 3rd floor plan and building cross section). The second and third floors each have six-inch concrete slabs and steel stairs between floors. The roof system consists of steel purlins at approximately four-foot spacing with corrugated asbestos roof panels fastened to the purlins. Corrugated asbestos siding panels were provided along the balcony from the third floor to the roof. These asbestos wall panels span vertically and are fastened to the balcony slabs at the bottom and to the continuous steel angles, L 5 x 3, at the top. Steel brackets off the building walls at approximately 6 feet spacing provide the supports for the continuous angles. The continuous angles and their supporting brackets can be removed after the removal of the siding panels.

On the ground floor, there are several canopies with corrugated asbestos roofing and wall panels built around the building. Canopy support frames are typically designed for dead weight of the structures and roof snow loads including snow drift. Therefore, it should be reminded that stepping on top of the canopy by the workers during asbestos removal operations is not recommended.

There are many steel beams underneath the second floor slabs of the building to provide the supports for piping, overhead conveyors, monorails, equipment, etc. These steel beams are not building framing members and can be removed after the removal of the items they were designed to support.

The existing sixty-year-old building has not been in use for decades, but the concrete structure including the balcony slabs seems to be in reasonably good condition. There are no major structural damages, deformations, or modifications observed.

The siding panel support steel, steel angles and brackets seem to be in reasonable conditions. The siding panel supporting steel can be removed after the transite walls are removed.

The major deficiency observed related to the operation of asbestos panel removal is that the fasteners of the asbestos walls and roof panels to the support steel are heavily corroded. These fasteners may give way unexpectedly during the removal operation.

B. Melt Load Building, DB-4

Building DB-4 is the same size, shape and general condition as building DB-4A, except there are no siding panels present on the third floor of building DB-4

C. Washout Annex DB-4-WN & WS and DB-4A-WN & WS

Annex DB-4-WN &WS at Melt Load Building DB-4 and annex DB-4A-WN & WS at Melt Building DB-4A are one-story concrete buildings with brick faces. These buildings are approximately 16 feet by 25 feet in plan dimensions and about 14 feet high. The roof system consists of corrugated asbestos roofing supported on steel purlins at approximately 5 feet spacing.

No major structural hazards observed related to the removal operations of the asbestos roofing. However heavily rusted roofing fasteners should be expected.

D. Explosive Preparation Building, DA-6

The existing Explosive Building, DA-6, is a one-story concrete frame structure with a brick exterior. The building is approximately 33 feet by 40 feet in plan dimensions and about 25 feet high. The roof system consists of corrugated asbestos roof panels supported on steel purlins at approximately 5 feet spacing. A concrete bearing wall in the middle of the building divides the building into two halves, an east half and a west half. The east half of the asbestos roof panels have been removed and the steel purlins were left in place. These exposed steel purlins are holding the top of the east wall in place. Both north

and south walls are non-load –bearing brick walls with a 10 feet wide by 8 feet high door opening in the middle of east and west room (see attached roof frame plan for detail information).

The roof system, consisting of corrugated asbestos roof panels fastened to the top of steel purlins which are also connected together by the sag rods at equal spacing at the web of the steel purlins to act as a roof diaphragm, was designed to provide the lateral support for the walls at the roof level through diaphragm action and to transfer the wind loads on the walls to foundations. Building walls including bearing walls or non-bearing walls are typically designed to be simply supported at the roof and at the foundation. With the asbestos roof panels, which provided the roof diaphragm action, being removed at the east half of the building, the remaining purlins and the three walls at the east half of the building are significantly weakened. Even though the asbestos removal operation is at the west end of the building, it should be advised to avoid any impacts or imposing any loads, including stepping on the exposed steel purlins or walls by the workers, in the east half of the building during asbestos removal operation.

There is no structural deficiency observed in the west half of the buildings where transite roofing panels are to be removed.

E. Walkways between Buildings DB-4 and DA-6 and between DB-4A and DA-6A.

These walkways originally had roof and wall panels. As surveyed, the roof and wall panels have been removed leaving open steel framing, mostly angles. The asbestos removal contractor requests permission to cut one or more sections of the remaining steel framing in the walkways to provide access for their work.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Building structures and materials age and deteriorate with time and with exposure to natural hazards and environments. All the buildings surveyed in load line 2 are more than sixty years old and have been abandoned without maintenance for decades. All concrete structures in the seven buildings surveyed, however, are still in reasonable condition for asbestos removal operations without noticeable distress, deformations, and sustained damages to the buildings or structural members. All transite wall and canopy supporting structures is light structural steel using angles or channels. However no major deficiency observed at these supporting frames.

Based on the results of the survey, the conclusions and recommendations are as follows:

1. The asbestos contractor should verify and locate each local support structural condition such as rusted -out steel member or connection related to his work prior to the transite removal operations.

2. The fasteners for the roof and wall panels are heavily rusted. It is possible that some fasteners might be sheared off unexpectedly during the panel removal operations. Precaution

should be exercised and protection for the workers should be provided during the asbestos removal operations.

3. All transite panel removal operations must be executed from outside the buildings to prevent injury from falling objects and possible damage to asbestos panels or sag rods between purlins.

4. The contractor shall include a fall protection plan in its safety plan for all work done above grade level. The fall protection plan must meet the requirements of OSHA and the DOD.

5. Stepping on the canopy roof or balcony roof by workers during transite panel removal operation should be avoided since these roofs are only supported by light steel frame structures.

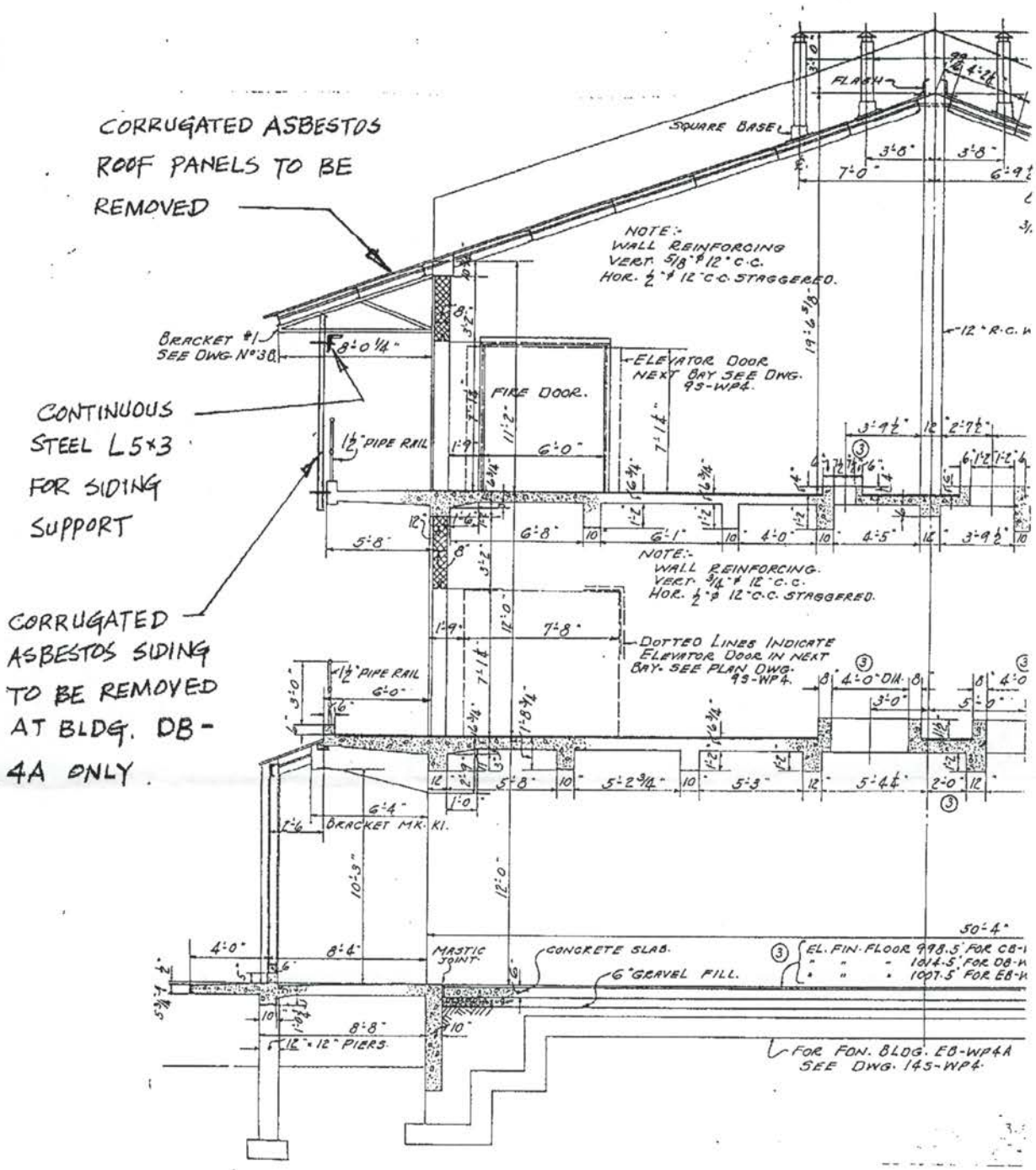
6. At the east half of the building DA-6, stepping on the exposed steel purlins or imposing equipment weights to these purlins should be prohibited to avoid impacts on the weakened structure without the roof diaphragm.

7. For the main roof where the asbestos panels are supported by steel purlins, the asbestos contractor has stated a need to walk on the roof during panel removal operations. BAT recommends the following actions to protect workers during this operation:

    a. Limit the maximum total weight of a worker including the tools and equipment carried to not exceed 200 pounds. As a reference, in accordance with the present steel roof deck design criteria of the Steel Deck Institute (SDI), roof decks are designed for construction live loads of 20 pounds per square foot uniform load or 150 pounds concentrated load on a one foot wide section of deck. Without the original design information and considering the age of these structures, a conservative approach and judgment should be exercised.
    b. Because of the suspect condition of panel fasteners, the contractor's fall protection plan should address the possibility of unexpected fastener failure.

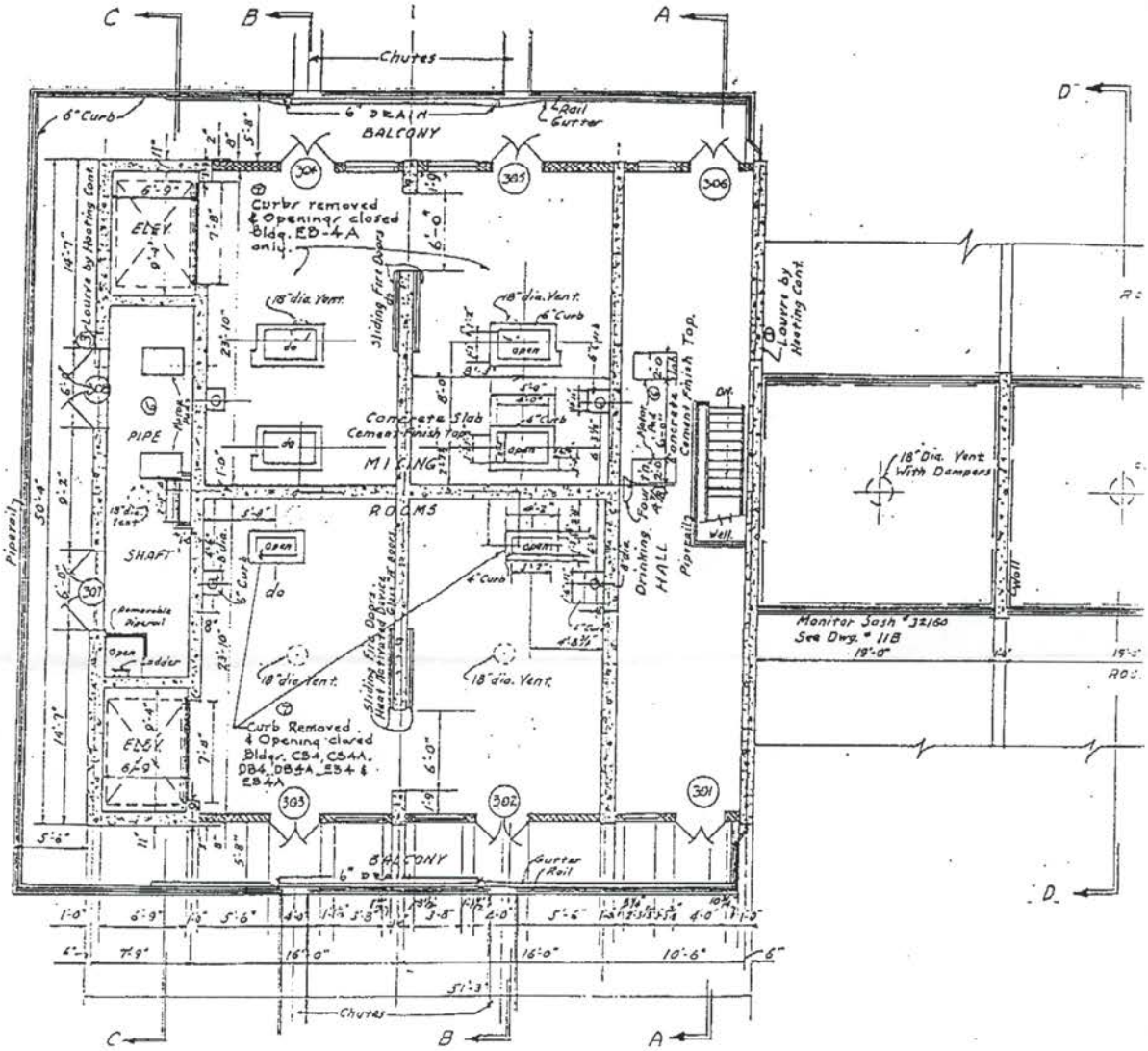
8. All the buildings surveyed in load line 2 except Building DB-6 appear structurally adequate for the asbestos removal operation provided that no heavy equipment is supported by the structures during demolition and no heavy impact loads are imposed. For Building DB-6, all the asbestos removal operations should avoid the east portion of the building, however, the west half appears to be structurally sound (see the discussion the Finding Section for details).

9. For the access points through the existing walkways, existing light steel structures may be cut. However, BAT recommends that vertical cross bracing be added by using 5/8 inch diameter steel rod, bolted to existing steel columns at the end bay next to the access points.



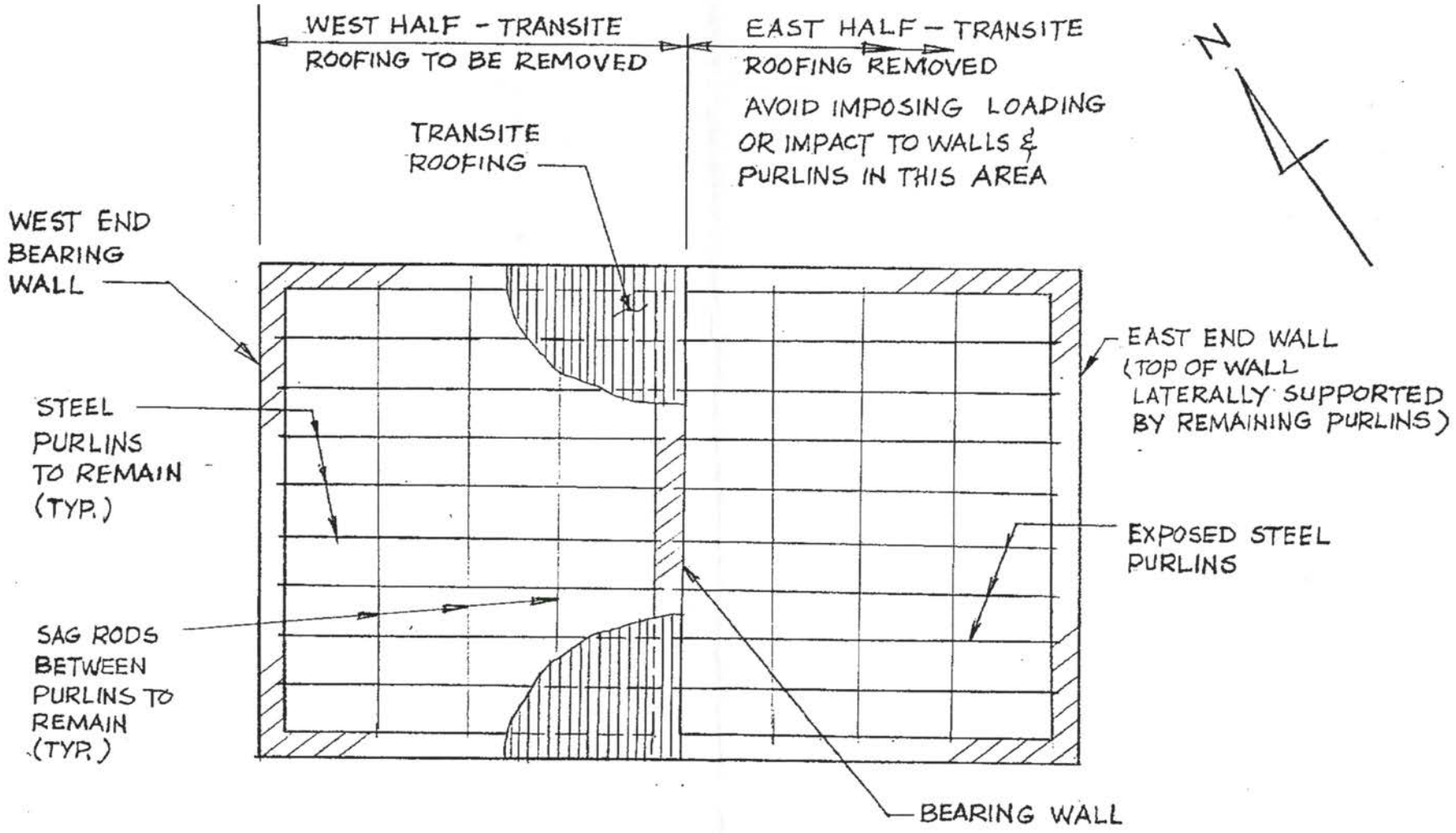
BUILDING CROSS SECTION

BUILDING DB-4 & 4A



3RD FLOOR PLAN

BUILDING DB-4 & 4A



ROOF FRAMING PLAN

BUILDING DA-6

NO SCALE

UNITED ENGINEERING ASSOCIATES
981 Keynote Circle, Suite 29
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Phone : (216) 351- 8211 • Fax : (216) 351 – 8013

FAX

TO : Mr. Brian Stockwell	FROM: Frank C. Lee
COMPANY : MKM Engineers, Inc.	DATE : 3/17/03
FAX : 330-358-2924	PAGES (INCLUDING COVER SHEET) : 9
PHONE: 330-358-2920	
RE :	

COMMENTS :

Beian,

As promised, I am sending you the advanced report for Building DA-6, DB-8, 8A, and DB-22 today so you can start field work on these buildings. I shall finish the rest of the report this week.

Please do not hesitate to call me if you have any questions. Thank you.

D. Explosive Preparation Building, DA-6

The existing Explosive Building, DA-6, is a one-story concrete structure with steel purlins and is on elevated concrete slabs. The building is approximately 30 feet by 41 feet in plan dimensions and about 25 feet high. A concrete bearing wall in the middle of the building divides it into two equal halves. A low roof wooden addition is attached to the north side of the building and a concrete platform with a canopy is at the west side of the building.

The north and south end walls are load bearing concrete walls of 12-inch thickness. The east and west sidewalls are non-load-bearing tile walls.

The asbestos roof panels have been removed while the steel purlins with sag rods were left in place.

The original roof system consisted of corrugated asbestos roof panels fastened to the top of steel purlins, which are also connected together by the sag rods at the one-third points of the purlins. The roof system including the asbestos panels was designed to provide the lateral support for the exterior walls at the roof level through diaphragm action and also to transfer the wind loads on the walls to the foundation. With the asbestos roof panels removed, **the remaining structure is an incomplete load-resisting structure** for external loads including the lateral wind loads on the walls and is significantly weakened.

Except for moderate rust to the steel, there were no major structural deficiencies in roof steel observed. Without the roof loads, the existing structure is safe for the burning operations. However, the existing concrete walls become unstable after the roof steel is removed at the stage of demolition since the walls will not be supported at the roof level.

The exterior tile/brick walls along the east and west sides of the building are non-load bearing walls and can be modified at the double door to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door and adjacent wall from the floor to the bottom of steel beam at the roof level as shown on the building plan in section 6 of this report.

The existing tile walls have showed signs of severe deterioration and are spalled at various locations. Exercise safety precaution and provide protection measures for construction personnel during the wall removal operations for the access opening. Portions of the existing tile walls or individual tile blocks might **fall unexpectedly** due to the impact during wall removal operations.

F. Building DB-8, DB-8A, and DB-22

The three change house buildings are similar in design but different in size. These three buildings are two–story structures. The first story is a concrete structure with concrete columns, slabs, and walls. The second story is a steel truss frame structure with a tile/brick wall exterior and is about 18 feet high at the ridge. At the second floor level, there is a 5 feet wide cantilever concrete catwalk with steel pipe handrails along the perimeter of the building.

Building DB-8 is 30 feet by 110 feet in plan dimensions. Building DB-8A is 30 feet by 92 feet and has a wooden walkway bridge from the service road to the second floor. Building DB-22 is 30 feet by 56 feet.

The typical steel frame of the buildings is a triangular steel truss spanning between two steel columns. The truss frames are at 15 feet spacing. The steel columns are all encased in brick pilasters. Sag rods are at the one-third points of the C8 steel purlins and cross bracing was provided.

The asbestos roofing has been removed leaving the roof steel exposed to the atmosphere. The remaining roof steel is heavily corroded.

All the roof steel is in **poor condition.** However, there were no major steel deficiencies, missing members, rusted-through steel members or connections, or structural damages to the steel members observed. The roof steel is not in any danger of collapse.

All the exterior tile walls of these buildings are in very **poor condition** due to weathering. The tile walls have showed signs of severe deterioration and are spalled at various locations. Chips from the spalled tile were observed on the catwalk floor at all three buildings.

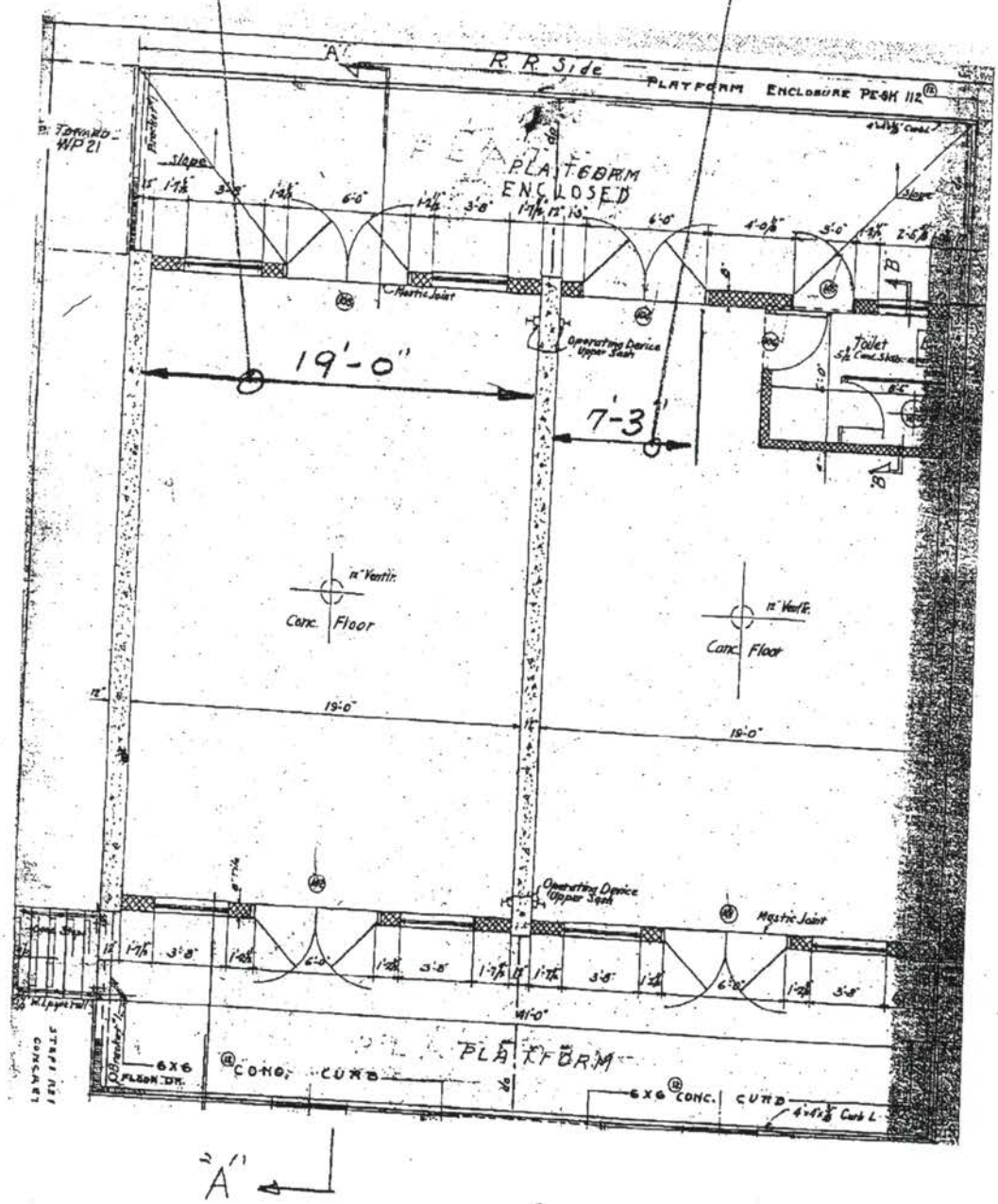
As mentioned before, portions of the existing tile walls or individual tile block might **fall unexpectedly** due to the impact during the wall removal operations. Exercise safety precautions and provide protection measures for construction personnel during the wall removal operation for the access opening.

The exterior tile walls of the second story are non-load bearing walls and can be modified to provide the required access openings for the placement of dunnage for burning operations at the door locations.

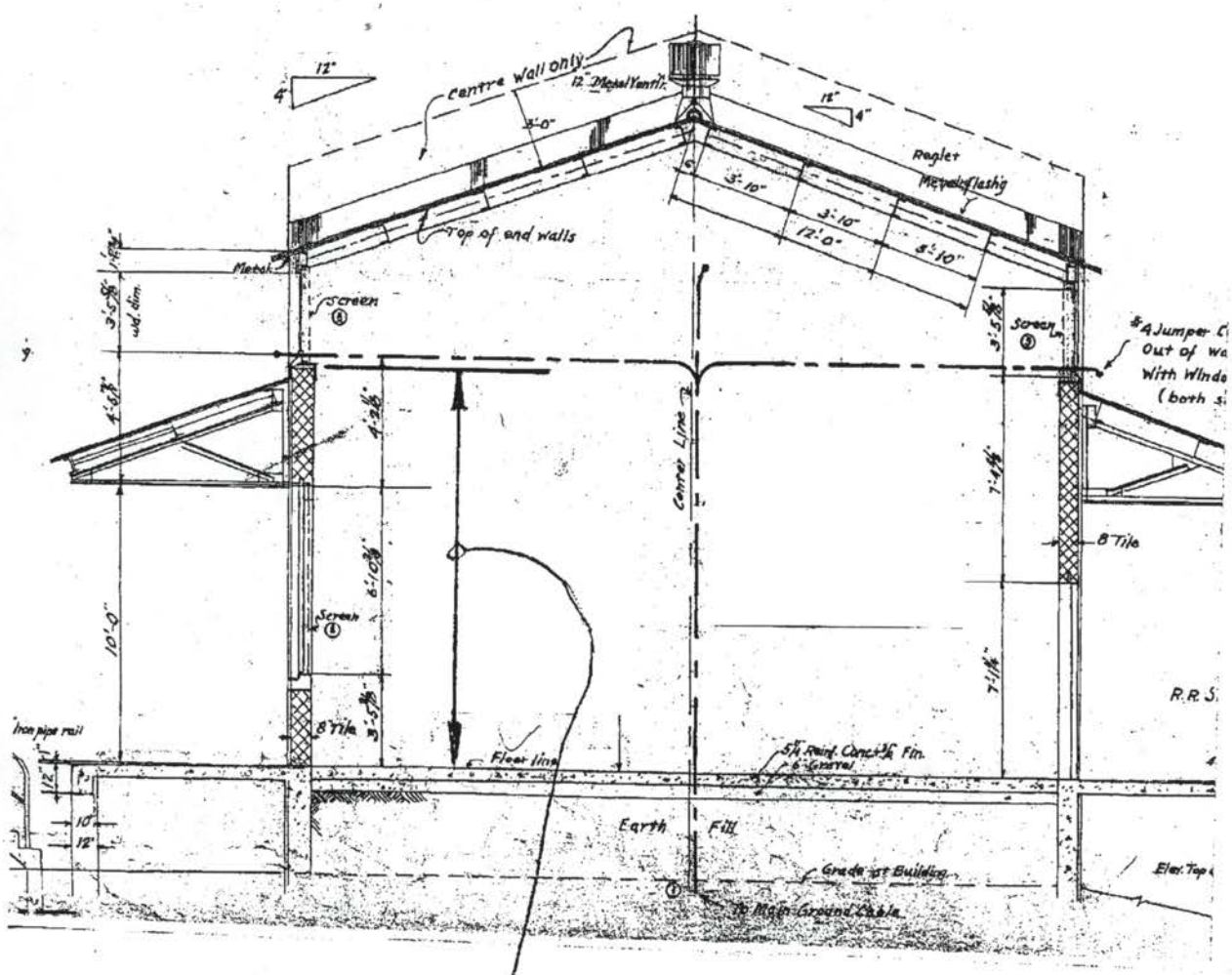
At the Building DB-8, at the middle portion of the east catwalk, portions of the concrete slabs have spalled off along the outside edge leaving some steel pipe handrail posts unsupported and reinforcing steel exposed. **It is recommended that the east catwalk be sealed off.**

At the Building DB-8A, the wooden walkway bridge from the service road to the second floor catwalk is completely decayed. The bridge floor planks and supporting beams are completely rotten. **The walkway bridge shall be sealed off.**

RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE GROUND FLOOR TO THE BOTTOM OF STEEL ANGLE ABOVE. SEE CROSS SECTION "A-A" AND SECT"B-B" FOR DETAILS.



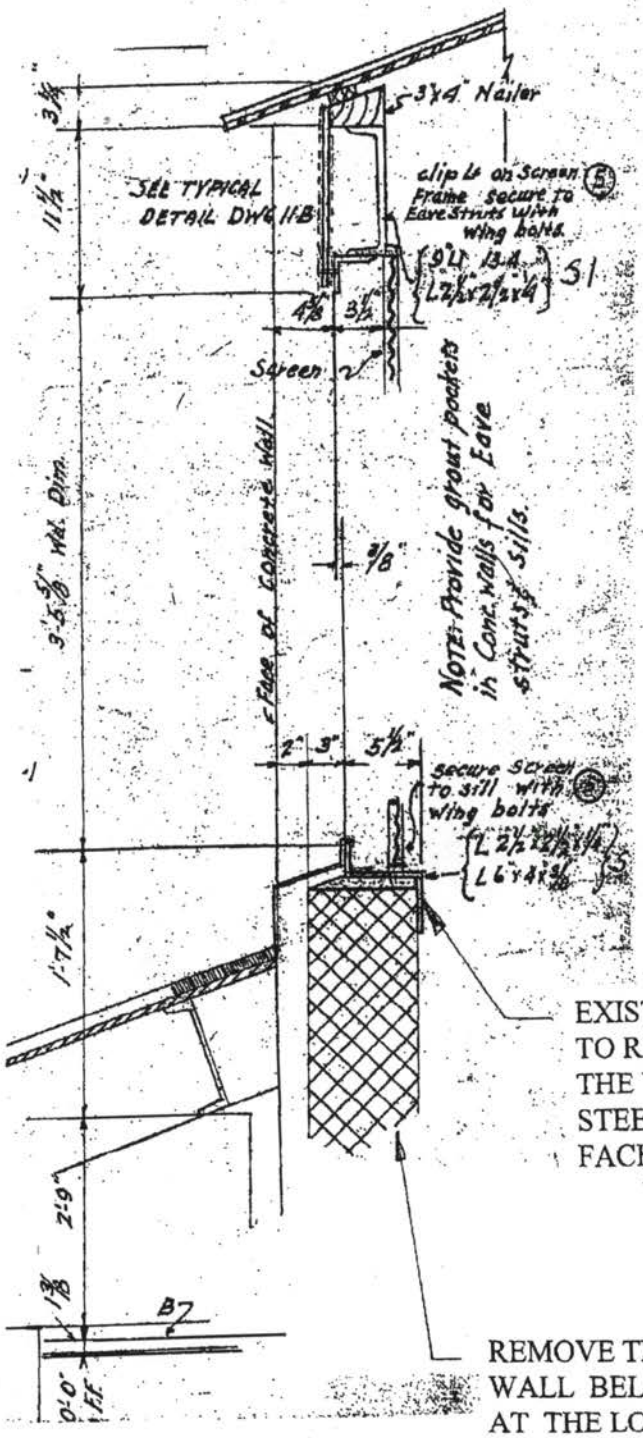
BUILDING DA-6



REMOVE THE EXISTING TILE WALL BELOW THE STEEL ANGLE AT THE LOCATIONS SHOWN ON BUILDING PLAN.

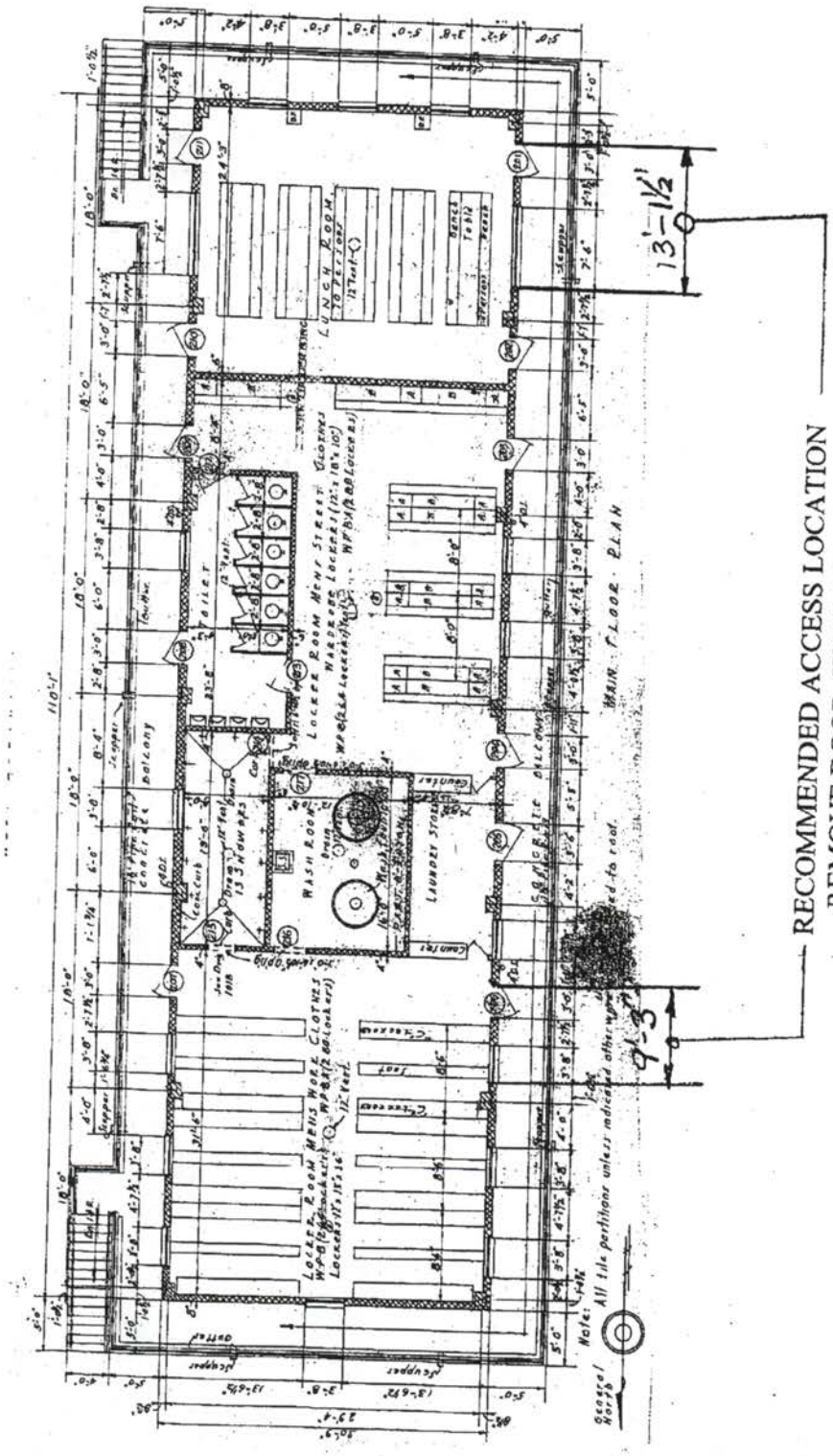
SECTION A-A

BUILDING DA-6

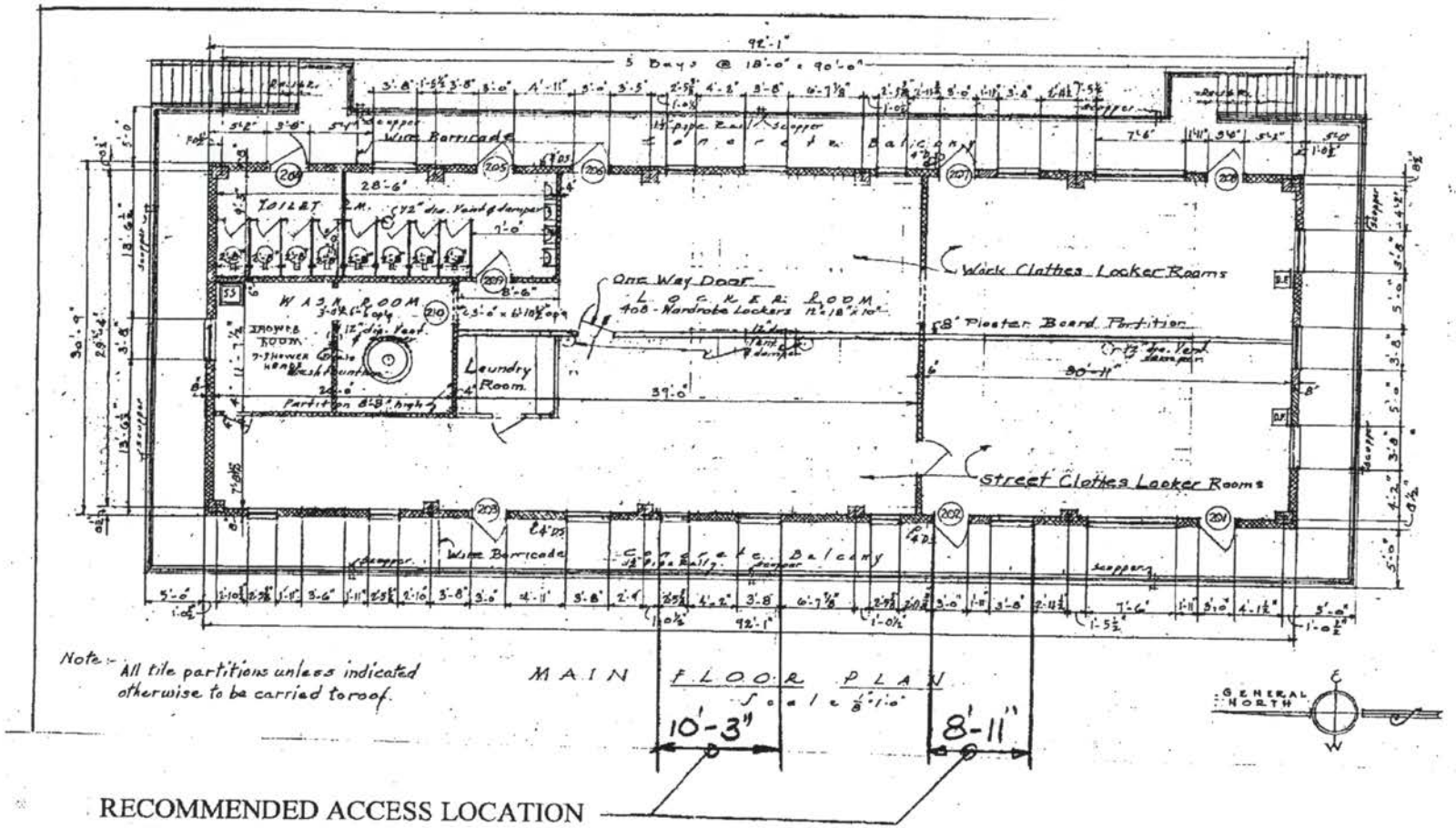


SECTION B-B

BUILDING DA-6

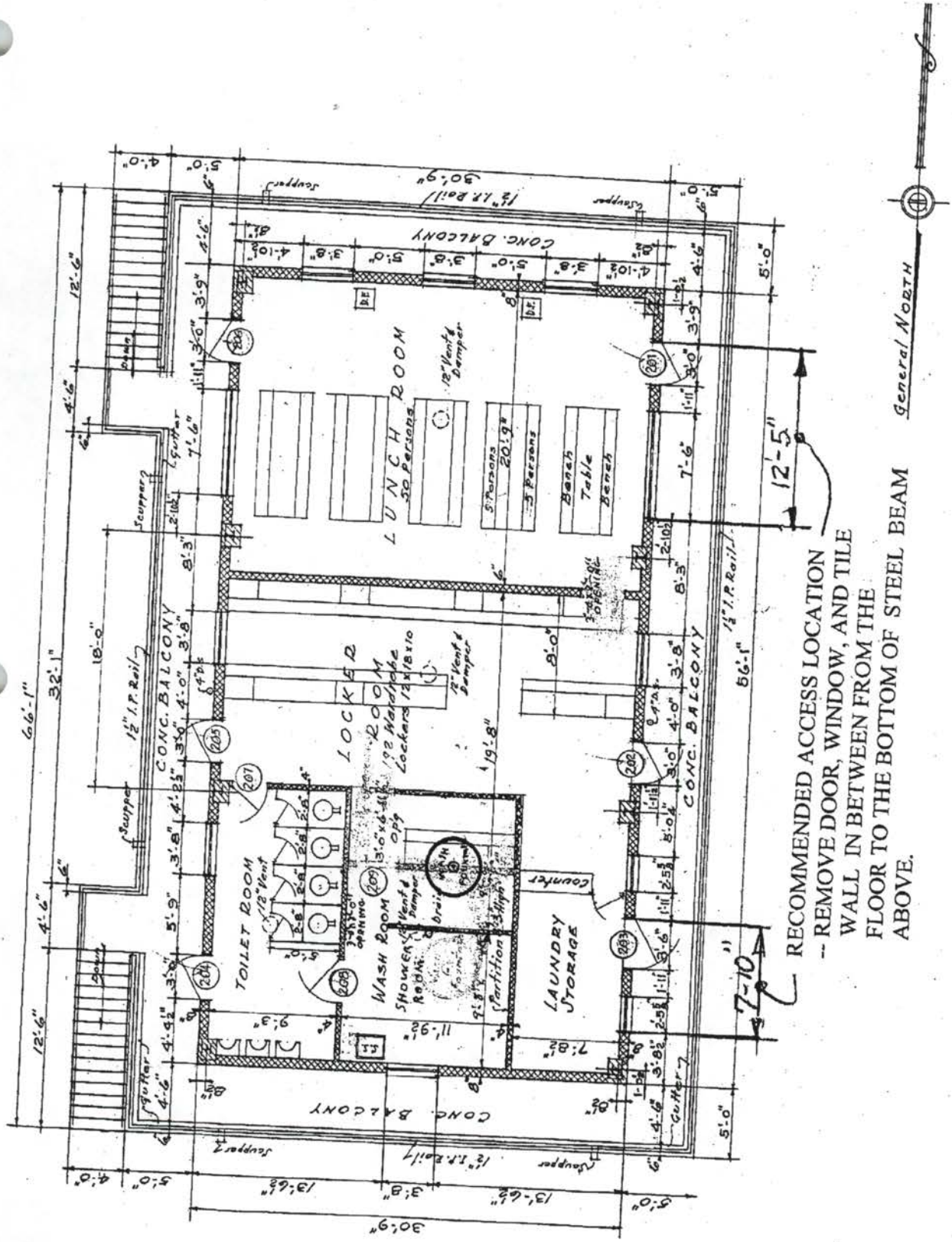


BUILDING DB-8



RECOMMENDED ACCESS LOCATION
-- REMOVE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM THE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

BUILDING D8-8A



BUILDING DB-22

UNITED ENGINEERING ASSOCIATES
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FAX

TO : Mr. Brian Stockwell	FROM: Frank C. Lee
COMPANY : MKM Engineers, Inc.	DATE : 4/7/03
FAX : 330-358-2924	PAGES (INCLUDING COVER SHEET) :
PHONE: 330-358-2920	

RE : Revised Engineering Survey Report #1

COMMENTS :

REVISON TO

ENGINEERING SURVEY REPORT #1

**BUILDING DB-4, DB-4-WN, DB-4-WS,
DB-4A, DB-4A-WN, DB-4A-WS, DA-6**

**AT
LOAD LINE 2**

**RAVENNA ARSENAL ARMY AMMUNITION PLANT
RAVENNA, OHIO**

AUGUST 5, 2002

REVISED ON APRIL 4, 2003

***Prepared for*:**

MKM ENGINEERS, INC.

**4153 Bluebonnet Drive
Stafford, Texas 77477**

***Prepared by*:**

**BAT Associates, Inc.
981 Keynote Circle
Suite 29
Cleveland, Ohio 44131**

TABLE OF CONTENTS

1.0 INTRODUCTION

This revision was made to provide the updates and recommendations for the access openings for dunnage placement and equipment removal in Building DB-4, DA-6 and DB-4A. The addendum to the original report is shown in italics.

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A. Melt Load Building, DB-4A

Melt Load Building DB-4A was built in 1941 and has not been in use for decades. The main building is a three-story concrete frame structure with concrete columns, beams and structural slabs at the 2nd and 3rd floors and brick walls at the east and west sides. The main building is approximately 51 feet by 50 feet in plan dimensions and about 44 feet high at the ridge. There is a six-foot wide balcony with steel pipe handrails around the three sides of the building on the second and third floors (see the attached 3rd floor plan and building cross section). The second and third floors each have six-inch concrete slabs and steel stairs between floors. The roof system consists of steel purlins at approximately four-foot spacing with corrugated asbestos roof panels fastened to the purlins. Corrugated asbestos siding panels were provided along the balcony from the third floor to the roof. These asbestos wall panels span vertically and are fastened to the balcony slabs at the bottom and to the continuous steel angles, L 5 x 3, at the top. Steel brackets off the building walls at approximately 6 feet spacing provide the supports for the continuous angles. The continuous angles and their supporting brackets can be removed after the removal of the siding panels.

On the ground floor, there are several canopies with corrugated asbestos roofing and wall panels built around the building. Canopy support frames are typically designed for dead weight of the structures and roof snow loads including snowdrift. Therefore, it should be reminded that stepping on top of the canopy by the workers during asbestos removal operations is not recommended.

There are many steel beams underneath the second floor slabs of the building to provide the supports for piping, overhead conveyors, monorails, equipment, etc. These steel beams are not building framing members and can be removed after the removal of the items they were designed to support.

The existing sixty-year-old building has not been in use for decades, but the concrete structure including the balcony slabs seems to be in reasonably good condition. There are no major structural damages, deformations, or modifications observed.

The siding panel support steel, steel angles and brackets seem to be in reasonable conditions. The siding panel supporting steel can be removed after the transite walls are removed.

The wooden catwalk structure on the roof has rotted, Do not step on the wooden catwalk at any time during the asbestos removal operations.

Except for the wooden catwalk, the only major deficiency observed related to the operation of the asbestos panel removal is that the fasteners of the asbestos walls and roof panels to the support steel are heavily corroded. These fasteners may give way unexpectedly during the removal operation.

All concrete walls of the building are load-bearing walls and should not be modified or removed. All tile/brick walls at the northern and southern sides of the of the building are non-load bearing walls and can be removed to provide the required access opening for either dunnage placement or the removal of the equipment inside the building. Recommended access opening locations for each room on the second and third floors of the building are shown on page 8 and 9.

The concrete balcony floors on the second and third floor are cantilevered slabs. They were designed for uniformly distributed human traffic load only (60 to 80 pounds per square foot) in accordance with the building code design requirements. It is important to not overload the balcony slabs during the equipment removal operation. Overload the cantilevered slabs by heavy equipment weight could cause the balcony slabs to collapse.

Therefore, it is necessary to disassemble the heavy equipment on the second and third floors into smaller sections prior to moving them out of the building to ensure that the canopy slabs are not overloaded.

B. Melt Load Building, DB-4

Building DB-4 is the same size, shape and general condition as building DB-4A, except there are no siding panels present on the third floor of building DB-4

C. Washout Annex DB-4-WN & WS and DB-4A-WN & WS

Annex DB-4-WN &WS at Melt Load Building DB-4 and annex DB-4A-WN & WS at Melt Building DB-4A are one-story concrete buildings with brick faces. These buildings are approximately 16 feet by 25 feet in plan dimensions and about 14 feet high. The roof system consists of corrugated asbestos roofing supported on steel purlins at approximately 5 feet spacing.

No major structural hazards observed related to the removal operations of the asbestos roofing. However heavily rusted roofing fasteners should be expected.

D. Explosive Preparation Building, DA-6

The existing Explosive Building, DA-6, is a one-story concrete frame structure with a brick exterior. The building is approximately 33 feet by 40 feet in plan dimensions and about 25 feet high. The roof system consists of corrugated asbestos roof panels supported on steel purlins at approximately 5 feet spacing. A concrete bearing wall in the middle of the building divides the building into two halves, an east half and a west half. The east half of the asbestos roof panels have been removed and the steel purlins were left in place. These exposed steel purlins are holding the top of the east wall in place. Both north and south walls are non-load –bearing brick walls with a 10 feet wide by 8 feet high door opening in the middle of east and west room (see attached roof frame plan for detail information).

The roof system, consisting of corrugated asbestos roof panels fastened to the top of steel purlins which are also connected together by the sag rods at equal spacing at the web of the steel purlins to act as a roof diaphragm, was designed to provide the lateral support for the walls at the roof level through diaphragm action and to transfer the wind loads on the walls to foundations. Building walls including bearing walls or non-bearing walls are typically designed to be simply supported at the roof and at the foundation. With the asbestos roof panels, which provided the roof diaphragm action, being removed at the east half of the building, the remaining purlins and the three walls at the east half of the building are significantly weakened. Even though the asbestos removal operation is at the west end of the building, it should be advised to avoid any impacts or imposing any loads, including stepping on the exposed steel purlins or walls by the workers, in the east half of the building during asbestos removal operation.

There is no structural deficiency observed in the west half of the buildings where transite roofing panels are to be removed.

The exterior tile walls are non-load bearing walls and can be modified to provide the required access openings for the placement of dunnage for burning operations. The recommended access is to remove the double door, adjacent window, and the tile wall in between from the floor to the bottom of steel beam at the roof level.

E. Walkways between Buildings DB-4 and DA-6 and between DB-4A and DA-6A.

These walkways originally had roof and wall panels. As surveyed, the roof and wall panels have been removed leaving open steel framing, mostly angles. The asbestos removal contractor requests permission to cut one or more sections of the remaining steel framing in the walkways to provide access for their work.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Building structures and materials age and deteriorate with time and with exposure to natural hazards and environments. All the buildings surveyed in load line 2 are more than sixty years old and have been abandoned without maintenance for decades. All concrete structures in the seven buildings surveyed, however, are still in reasonable condition for asbestos removal operations without noticeable distress, deformations, and sustained damages to the buildings or structural members. All transite wall and canopy supporting structures is light structural steel using angles or channels. However no major deficiency observed at these supporting frames.

Based on the results of the survey, the conclusions and recommendations are as follows:

1. The asbestos contractor should verify and locate each local support structural condition such as rusted -out steel member or connection related to his work prior to the transite removal operations.

2. The fasteners for the roof and wall panels are heavily rusted. It is possible that some fasteners might be sheared off unexpectedly during the panel removal operations. Precaution should be exercised and protection for the workers should be provided during the asbestos removal operations.

3. All transite panel removal operations must be executed from outside the buildings to prevent injury from falling objects and possible damage to asbestos panels or sag rods between purlins.

4. The contractor shall include a fall protection plan in its safety plan for all work done above grade level. The fall protection plan must meet the requirements of OSHA and the DOD.

5. Stepping on the canopy roof or balcony roof by workers during transite panel removal operation should be avoided since these roofs are only supported by light steel frame structures.

6. At the east half of the building DA-6, stepping on the exposed steel purlins or imposing equipment weights to these purlins should be prohibited to avoid impacts on the weakened structure without the roof diaphragm.

7. For the main roof where the asbestos panels are supported by steel purlins, the asbestos contractor has stated a need to walk on the roof during panel removal operations. BAT recommends the following actions to protect workers during this operation:

a. Limit the maximum total weight of a worker including the tools and equipment carried to not exceed 200 pounds. As a reference, in accordance with the present steel roof deck design criteria of the Steel Deck Institute (SDI), roof decks are designed for construction live loads of 20 pounds per square foot uniform load or 150 pounds concentrated load on a one foot wide section of deck. Without the original design information and considering the age of these structures, a conservative approach and judgment should be exercised.

b. Because of the suspect condition of panel fasteners, the contractor's fall protection plan should address the possibility of unexpected fastener failure.

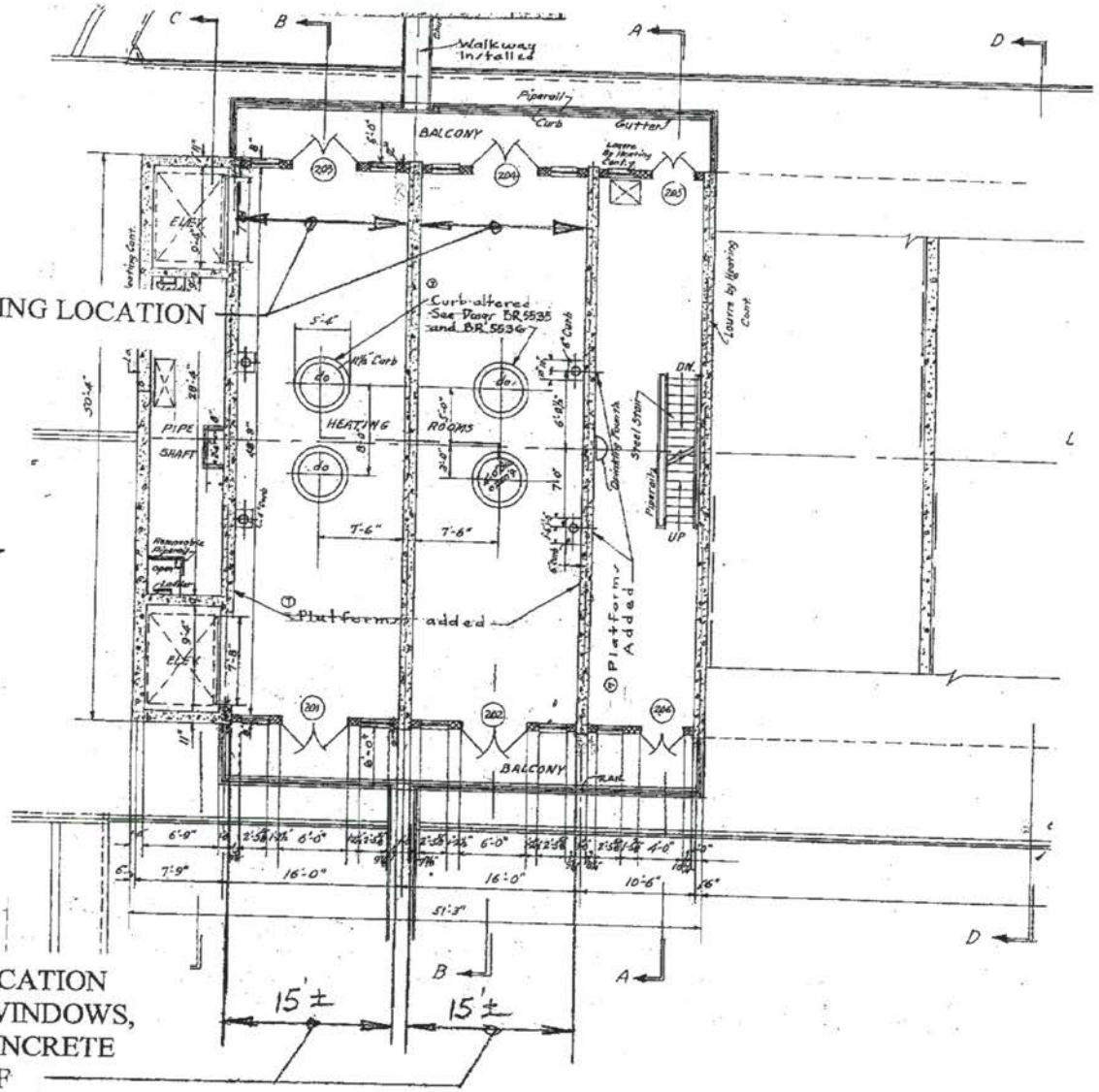
8. All the buildings surveyed in load line 2 except Building DB-6 appear structurally adequate for the asbestos removal operation provided that no heavy equipment is supported by the structures during demolition and no heavy impact loads are imposed. For Building DB-6, all the asbestos removal operations should avoid the east portion of the building, however, the west half appears to be structurally sound (see the discussion the Finding Section for details).

9. For the access points through the existing walkways, existing light steel structures may be cut. However, BAT recommends that vertical cross bracing be added by using 5/8 inch diameter steel rod, bolted to existing steel columns at the end bay next to the access points.

10. ***The wooden roof catwalk structures have severely rotted in Building DB-4 and DB-4A.*** *Do not step on the wooden catwalk during the asbestos removal operations.*

11. *For the heavy equipment on the second and third floors of the Building DB-4 and DB-4A, it is necessary to disassemble the heavy equipment into smaller sections prior to moving them out of the building to ensure that the canopy slabs are not overloaded during the operations.*

OPTIONAL ACCESS OPENING LOCATION



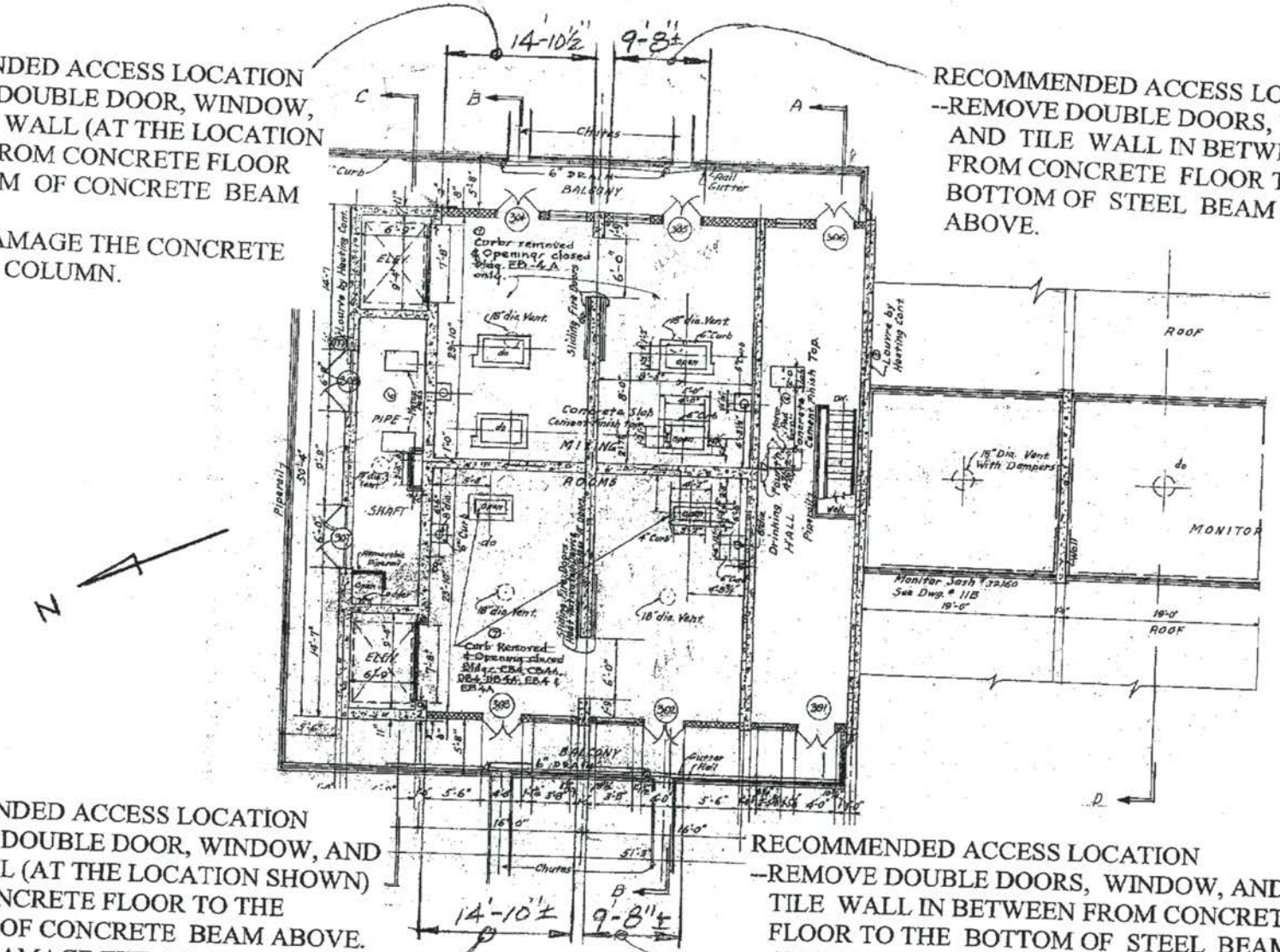
RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOOR, WINDOWS, AND TILE WALL FROM CONCRETE FLOOR TO THE BOTTOM OF CONCRETE ABOVE.

SECOND FLOOR PLAN

BUILDING DB- 4 AND DB- 4A

RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOOR, WINDOW, AND TILE WALL (AT THE LOCATION SHOWN) FROM CONCRETE FLOOR TO BOTTOM OF CONCRETE BEAM ABOVE.
--DO NOT DAMAGE THE CONCRETE BEAM AND COLUMN.

RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOORS, WINDOW, AND TILE WALL IN BETWEEN FROM CONCRETE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.



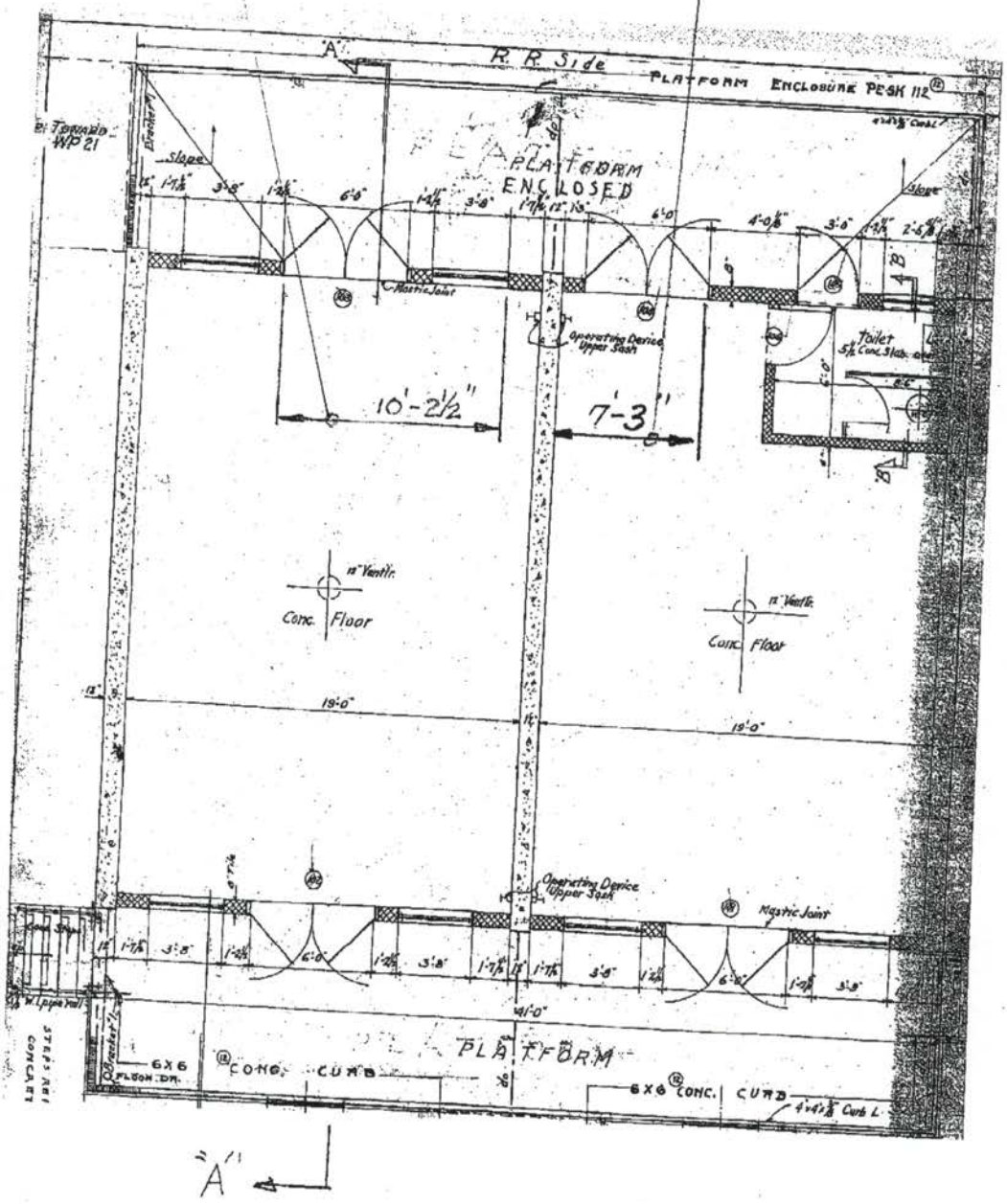
RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOOR, WINDOW, AND TILE WALL (AT THE LOCATION SHOWN) FROM CONCRETE FLOOR TO THE BOTTOM OF CONCRETE BEAM ABOVE.
DO NOT DAMAGE THE CONCRETE BEAM AND COLUMN.

RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOORS, WINDOW, AND TILE WALL IN BETWEEN FROM CONCRETE FLOOR TO THE BOTTOM OF STEEL BEAM ABOVE.

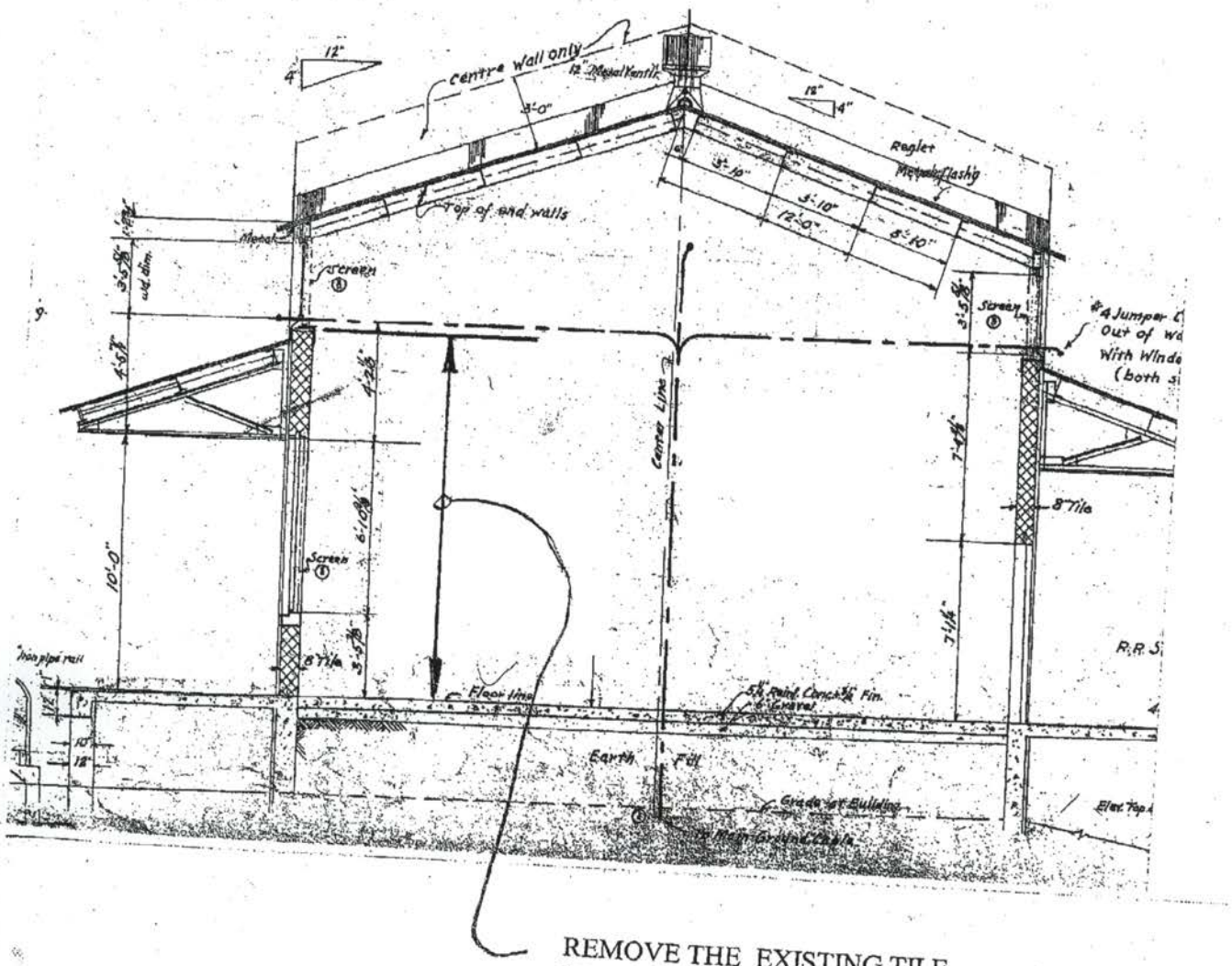
THIRD FLOOR PLAN

BUILDING DB- 4 AND DB- 4A

RECOMMENDED ACCESS LOCATION
--REMOVE DOUBLE DOOR, WINDOW, AND TILE WALL IN BETWEEN FROM CONCRETE FLOOR TO BOTTOM OF STEEL ANGLE ABOVE. SEE CROSS SECTION "A-A" AND SECTION "B-B" FOR DETAILS



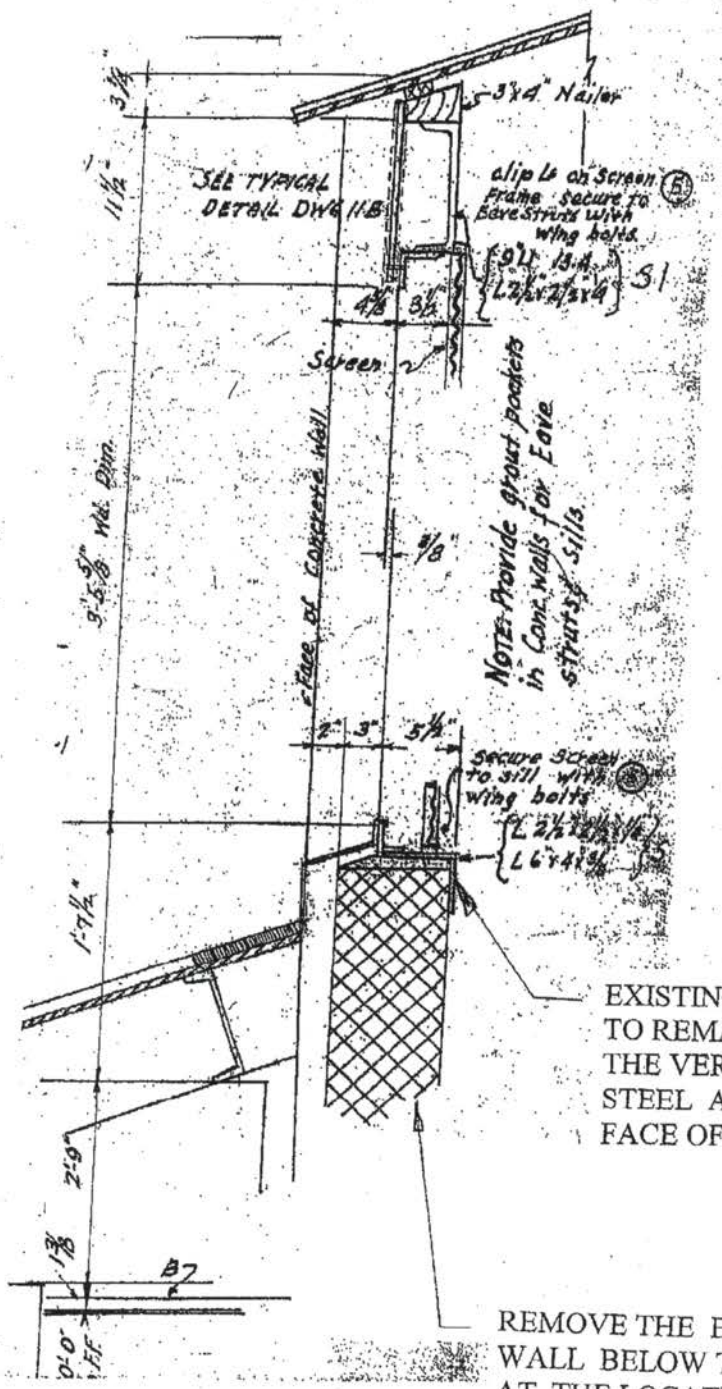
BUILDING DA-6



REMOVE THE EXISTING TILE WALL BELOW THE STEEL ANGLE AT THE LOCATIONS SHOWN ON BUILDING PLAN.

SECTION A-A

BUILDING DA- 6

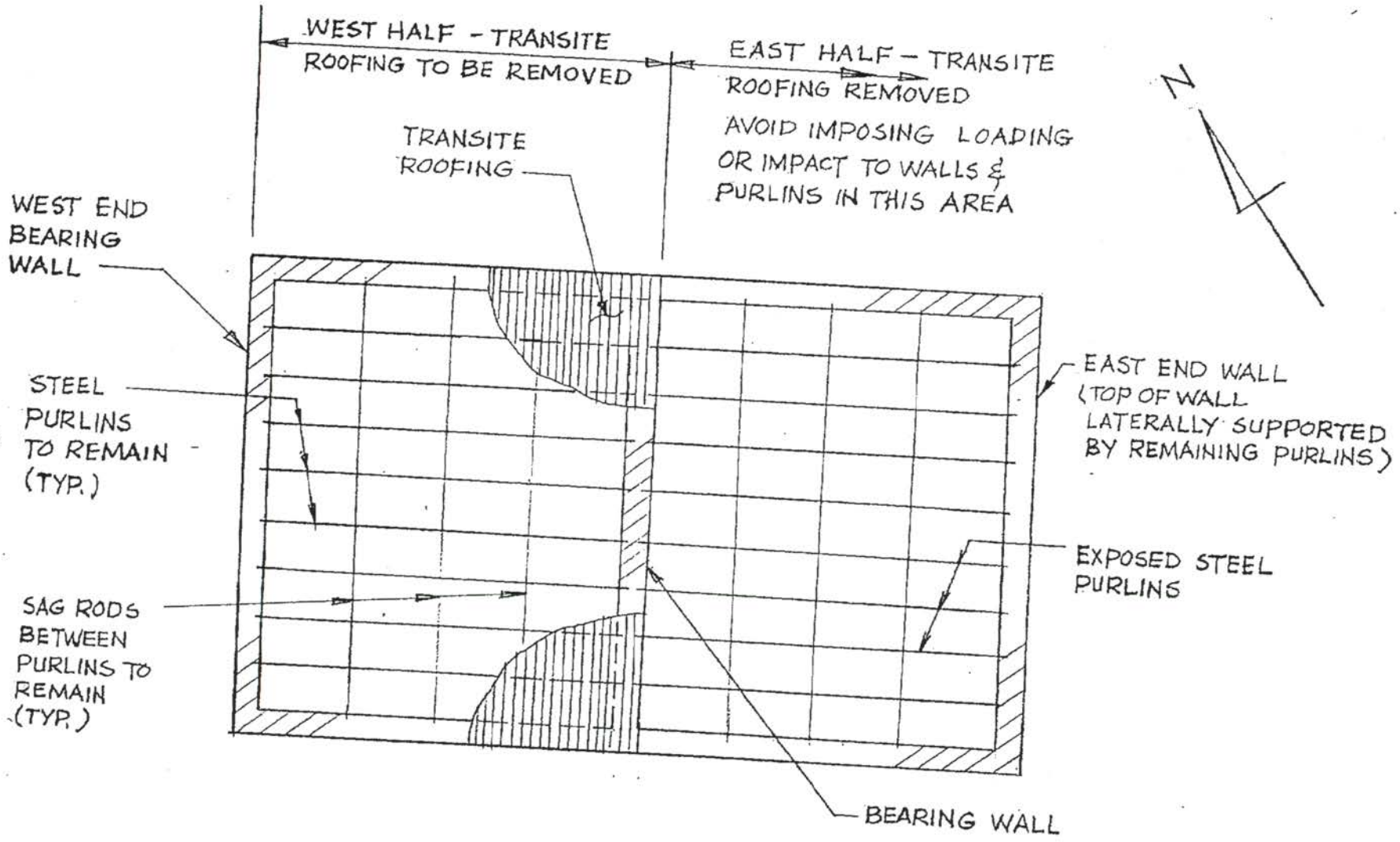


EXISTING STEEL ANGLE, L6X4, TO REMAIN -- DO NOT DAMAGE THE VERTICAL LEG OF THE STEEL ANGLE AT THE INSIDE FACE OF WALL.

REMOVE THE EXISTING TILE WALL BELOW THE STEEL ANGLE AT THE LOCATIONS SHOWN ON BUILDING PLAN.

SECTION B-B

BUILDING DA- 6



ROOF FRAMING PLAN

BUILDING DA-6

NO SCALE