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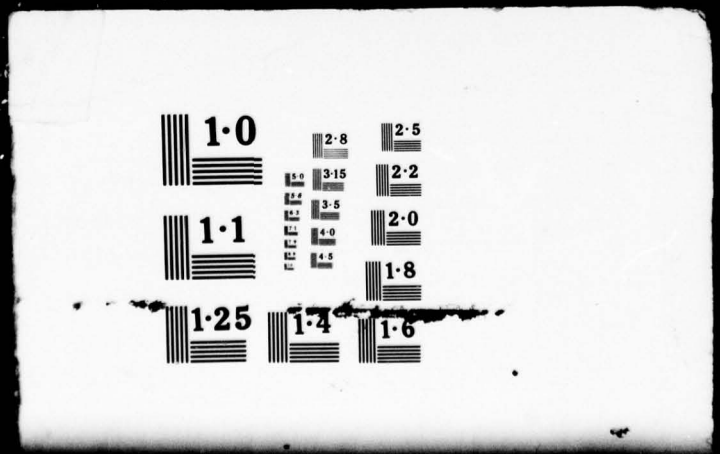

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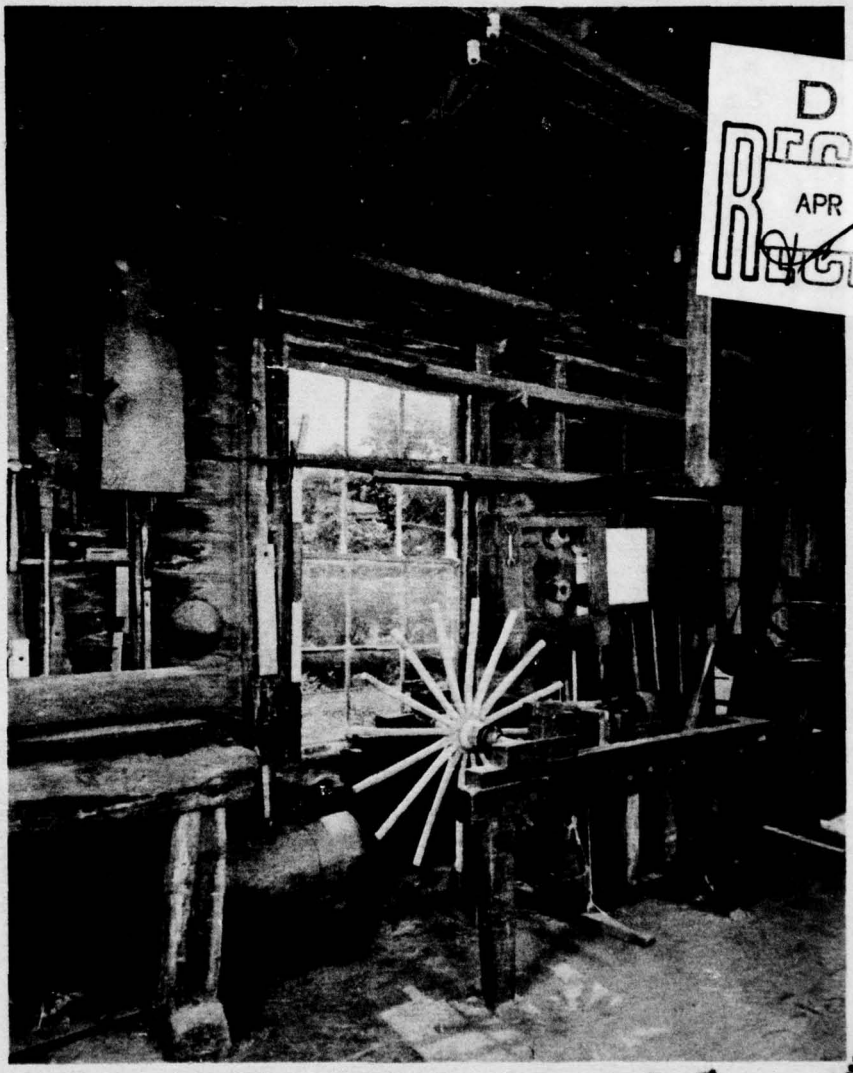
HISTORIC STRUCTURE REPORT

GRUBER WAGON WORKS



PHILADELPHIA DISTRICT
U.S. ARMY CORPS OF ENGINEERS

JOHN MILNER ASSOCIATES
WEST CHESTER, PENNSYLVANIA

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The purpose of this historic structure report was to review the documented history of Gruber Wagon Works located in Berks County, Pa., study its existing condition and formulate a plan for its functional restoration to be undertaken by U.S. Army Corps of Engineers, Philadelphia District. Drawings of the structure are included in report.

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(6) GRUBER WAGON WORKS,
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(10) Robert W. /De Silets
Charles A. /Parrott, III

U. S. Army Engineer District
Philadelphia
Corps of Engineers, U. S. Army
Second and Chestnut Streets
Philadelphia, Pennsylvania 19106

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by

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(John) Milner Associates
West Chester, Pennsylvania

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INTRODUCTION

The Gruber Wagon Works is a rare, intact remnant of the industrial technology of the past century. Its significance has resulted in a National Register of Historic Places listing and designation as a National Historic Landmark. The Wagon Works has been relocated from its original site at Mt. Pleasant, Pennsylvania to a Berks County interpretative parkland, the Red Bridge Historic Area near Reading. This new site is along the Tulpehoken Creek approximately five miles east and downstream from the old site.

The Wagon Works relocation resulted from the creation of a reservoir by the new Blue Marsh Dam across Tulpehoken Creek. It is to be stabilized, restored to operating condition and open to the public as a museum of industrial technology. Relocation and restoration is the responsibility of the U. S. Army Corps of Engineers specifically authorized by the Water Resources Development Act of 1976 (PL 94-587):

> Sec. 129.(a) The project for Blue Marsh Lake, Berks County, Pennsylvania, a part of the plan for the comprehensive development of the Delaware River Basin, as authorized by Section 201 of the Flood Control Act of 1962 (76 Stat. 1183), is hereby modified to authorize and direct the Secretary of the Army, acting through the Chief of Engineers, to relocate and restore intact the historic structure and associated improvements known as the Gruber Wagon Works located on certain Federal lands to be innundated upon completion of the project, at an estimated cost of $922,000.
>
> (b) Upon completion of the relocation and restoration of the Gruber Wagon Works at a site mutually agreeable to the Secretary of the Army and the County of Berks, Title to the Structure and associated improvements and equipment shall be transferred to the County of Berks upon condition that such County agree to maintain such historic property in perpetuity as a public museum at no cost to the Federal Government.

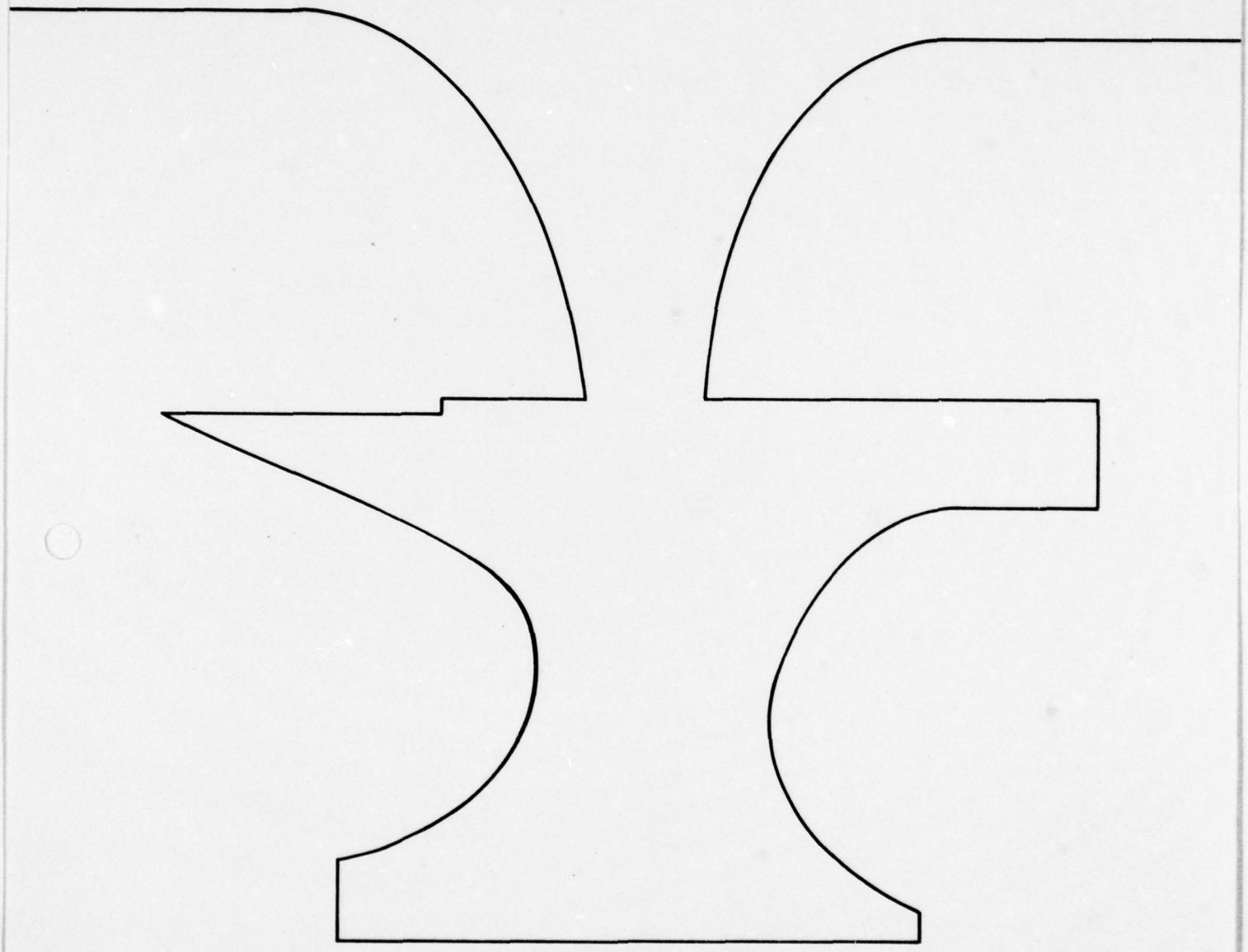
The purpose of this Historic Structures Report has been to review the documented history of this important structure, study its existing condition, and formulate a plan for its functional restoration within the allocation. The report is prerequisite to establishing a scope of work for the con-

tract documents and construction program to follow.

This study has been prepared under contract DACW61-78-C-0038 with the U. S. Army Engineer District, Philadelphia, Corps of Engineers, The contracted professional firm for the study is John Milner Associates, West Chester, Pennsylvania, John D. Milner, AIA, principal. The report has been prepared under the direction of Michael B. Allen, project manager. Principal authors are Robert L. DeSilets, R.A. and Charles A. Parrott, III, R.A. with graphic exhibits by Raymond F. Waechter, Jr., and assistance by the following consultants:

Structural Engineering:	The Keast and Hood Company Philadelphia, Pennsylvania Carl Baumert, P.E.
Museum Planning:	Joseph Wetzel Associates Stamford, Connecticut Michael Robbins, Ph.D.
Mechanical Engineering:	Anderson and Mahaffey Wilmington, Delaware Russell Anderson, P.E.

The assistance of the U. S. Army Engineer District, Philadelphia, Corps of Engineers, General Design Section, Engineering Division, is gratefully acknowledged. Particularly the efforts of Mr. Brian Heverin, Chief of the Division and Mr. William Zink, Project Engineer, were vital to the production of the final report.



DEVELOPMENTAL HISTORY

Reference 1. Description of Development

Wagon making by Franklin H. Gruber began in the 1870's on his farm in Blue Marsh, which was located about three miles south of the original Pleasant Valley site of the Gruber Wagon Works. F. H. Gruber had worked in his brother's wheelwright shop in Mt. Pleasant in the 1860's following his apprenticeship with his cousin in Robesonia. Beginning by building wagons out of his existing farm buildings, F. H. Gruber soon found it

Plate A1-2A necessary to build a two story frame shop at the Blue Marsh farm as the business began to expand; he had to contract out the blacksmithing portion of the work.

Plate A1-2B The move to Pleasant Valley, on the Reading/Bernville Road a short distance up the Licking Creek tributary of Tulpehocken Creek was made in 1884, the year after the completion of the nucleus of the existing shop.

Plate A2-1 The new building at Pleasant Valley was a fully integrated factory. It contained specialized work spaces for wagon making: a bench shop where the wheels were assembled and wagon parts fitted; a wood shop, which contained mechanically operated woodworking equipment, where wooden parts were cut out and shaped; the blacksmith shop where the iron parts were fabricated and fitted to the wooden parts produced in the other two areas; and the paint shop and new wagon storage areas on the second floor.

Plates A1-1 and A2-2 The original building, with the addition to the Wood Shop in 1885 (constructed with reused timber from a dismantled farm shop), contained several mechanically powered wood-working machines which were powered by a

Plate A7-2 20" diameter Reliance turbine located in a wheel pit in the cellar. The turbine was powered by water impounded by a dam across Licking Creek. Water was conducted to the encased turbine via a buried wrought iron pipe penstock.

By 1896 the power requirements of the shop had outstripped the capacity of the turbine and another addi-
Plate A2-3 tion was built to contain separate rooms to house a steam engine and its boiler to augment the turbine.

Originally, access to the paint ship was gained by pulling wagons up portable ramps to the second floor. This tedious method was eliminated when one of three additions in 1905 was added to the front of the building. It contained a hand-operated elevator. Also in 1905,
Plate A2-4 an addition to the blacksmith shop provided space for the first mechanically powered metal work tools, and a bay windowed addition was added to serve as an office.

The next year, 1906, saw the final change in the prime
Plate A1-7B mover. The turbine and steam engine both were removed and replaced with a new 15 h.p. Otto gasoline engine (its last patent date was September 11, 1894). This single horizontal cylinder engine has an overall form similar to many steam engines of the period. Some of the obvious basic differences were the complex of functions operated from the external cam shaft, the double flywheels to smooth out the single acting percussive power stroke, the cam actuated sparking lever and the absence of a boiler. Cooling water was provided from
Plate A7-2 a suction pump run by the engine itself and located in the former turbine pit. The gasoline tank was buried outside and was evident only by its supply and return lines projecting into the floor. Provision of this engine allowed the addition of most of the machine shop power tools and greatly increased the capacity

of the plant.

Plates A2-5 and A2-6 The last two additions to the building came in 1908 and 1910. The former was provided primarily for the cold press hydraulic tire setter which eliminated the age-old method of heat shrinking the wrought iron tire onto the wooden wheel. The latter addition provided the additional space to add two more forges behind the original two at the west end of the building. It also provided another wagon body and chassis erecting bay adjacent to the new blacksmith stations.

Plate A7-3

Plate A1-4A An iron storage shed was added, possibly c.1896, beyond the end of the blacksmith shop. Long lengths of wrought iron bar stock were stored in its pigeon hole racks which extended through to the other end of the shed.

Plates A6-24A and E-1 The main drive shaft runs longitudinally along the south interior wall of the original structure. Several machines are driven from beneath the first floor either directly from the main shaft or by counter shafts belt driven from the main shaft. The rest of the machinery is driven from shafting mounted beneath the second floor in the Wood Shop and Blacksmith/Machine Shop.

Plate E-3

Another significant physical addition to the building was the electric lighting system. It was installed in 1912, shortly after the opening of the first AC generating plant in the immediate area of Bernville, about four miles west of Pleasant Valley. Although the knob and tube insulator two-wire layout is typical of AC lighting systems of that period, it is of special interest because of its complete exposure throughout the building. It provided bare bulb task lighting to most of the work stations.

Franklin H. Gruber's four sons were also involved in the business. At the peak of its business activity, in the decade between 1910-1920, the Wagon Works employed up to twenty men producing stock farm wagons, standard hay beds, and any number of specialized wagons (such as heavy freight wagons, lumber wagons, ice wagons, ore wagons, etc.). All were made to order.

Plate A1-8

Abruptly after 1920 the wagon business gave way to the mass produced motor truck. Although the Grubers also began to make truck bodies, the entire business quickly fell off. The three surviving Gruber brothers retired in 1935 and what remained for Franklin P. Gruber, the grandson of F. H. Gruber, was essentially an active repair business that tapered off after World War II. An occasional new wagon was made as late as the 1950's, and F. P. Gruber maintained the Wagon Works virtually unchanged from its 1920 condition until the shop was singled out by the events of the 1970's.

2. Significance of the Wagon Works

The special significance of the Wagon Works lies primarily in its almost completely intact survival at a point where its physical development had virtually stopped some sixty years ago. It has been identified as probably the most complete surviving example of any integrated manufacturing enterprise of its scale and antiquity. Many historic industrial buildings yet survive in the United States, and many of them are of high architectural merit in their own right. But none of them identified so far exhibit the completeness of structure, prime mover, power transmission system, mechanical and manual powered major machinery and full complement of hand tools and other furnishings, including several of its own products, to the extent of the Gruber Wagon Works.

Bib. 4

The Wagon Works also appears to be the last significant surviving example of a fully integrated American wagon manufactory of the hundreds that once existed in this country. It had the capability of producing every part, except axles and bearings, that made up the typical American farm wagon, including the ability to completely manufacture wagon wheels, the most complicated part, using power equipment.

Its collection of original powered woodworking and machine tools is unparalleled. One of nearly all the basic woodworking and machine shop mechanically powered stationary tools, as well as specialized wheel making machinery, is included. Together they provide a collection that would probably be impossible to assemble with the integrity and antiquity these machines possess. That it today is both a potential museum and yet completely authentic is of special importance.

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This importance has been recognized by various museums and historic preservation organizations including the Smithsonian Institution, the Historic American Engineering Record, the Pennsylvania Historical and Museum Commission, the National Register of Historic Places and the National Survey of Historic Sites and Buildings. All have variously pointed out its unique survival and unequivocal national significance.

Reference 1. Origin of Corps Involvement

The Philadelphia Engineer District, Corps of Engineers, began planning the Blue Marsh Lake project as part of the Delaware River Basin water resources development authorized by Congress in the Flood Control Act of 1962 (Public Law 87-874). As part of this initial planning, an archeological survey of the reservoir area was performed in 1965 for the National Park Service by Temple University. The conclusion was that the area contained no sites of national significance. Presumably the survey was directed toward archeological resources and was limited only to the identification of nationally important sites. The existing preservation legislation guiding this survey was the Historic Sites Act of 1935 (P.L. 74-292), from which the National Historic Landmark program originated. Since this survey served as the sole basis of cultural resources evaluation of the reservoir area, no consequent concern was immediately expressed towards historic preservation.

The following year the National Historic Preservation Act (NHPA) of 1966 (P.L. 89-665) was passed. It established the National Register of Historic Places which provided the apparatus to begin the expanded and accelerated listing of "districts, sites, buildings, structures and objects significant in American history, architecture, archeology and culture". The act established a nomination process by which each of the states nominates properties of national significance and those of state and local significance as well. A program to provide grant monies in an amount not to

exceed fifty percent of the preservation costs established. The NHPA also requires that all Federal agencies take into account the effect of Federal projects on any property that is included in the National Register of Historic Places.

Real estate appraisal work began in the Blue Marsh reservoir area in 1970. Eventually, Corps personnel gained access to the Gruber Wagon Works. Immediately, it was apparent that the Wagon Works was a rare find. Totally intact, it seemingly had survived from a single point in time where its physical development had virtually stopped some fifty years before.

The Corps was aware of the NHPA, and its Federal agency requirements. Though the structure had not been listed on the National Register, Federal agencies then were not required to either initiate such listing or determine the eligibility of such listing. With their "discovery" of the Wagon Works, and an anticipation of its significance, the Philadelphia Engineer District requested an assessment of it by the Pennsylvania Historical and Museum Commission (PHMC) and the Northeast Regional Office of the National Park Service (NPS). This field inspection took place on July 9, 1970. At this early date, the Corps was already exploring both the possibility of relocating the structure out of the area to be flooded and also in acquiring the non-real estate items contained within the Wagon Works. The Corps at that time had no authorization to do more than simply acquire real property. It was hopeful of receiving some form of financial assistance from the Pennsylvania Historical and Museum Commission and/or the National Park Service following inclusion of the Wagon Works in the National Register.

2. Listing in the National Register of Historic Places

The field inspection and subsequent research and investigation resulted in the nomination of the Wagon Works for listing in the National Register. This nomination was prepared by PHMC which is the designated agency in the Commonwealth of Pennsylvania to administer programs established by the NHPA. The Wagon Works was officially entered in the National Register on June 2, 1972.

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3. Recording by the Historic American Engineering Record

Bib. 12

Plates A3-1 to A3-10

Documentary preservation of the Wagon Works by the National Park Service's Historic American Engineering Record (HAER, now part of the New Heritage Conservation and Recreation Service) was initiated by the Corps on June 8, 1973. HAER undertook field measuring of the Wagon Works during the summers of 1973 and 1974. From these detailed field notes a set of equally detailed measured drawings of the building and all mechanical equipment were produced. More than 200 large format photographs of both the building and all mechanical equipment were also taken as part of this cooperative project between HAER and the Corps.

These drawings and photographs are of the highest quality and are principally intended as archival documents which will eventually be deposited in the Library of Congress. However, immediate practical use was made of the photographs in keying and in inventorying the small tools and other portable items when later removed, and of the measured drawings in preparing the working drawings for the relocation project. This number of photographs is more than would normally be taken by HAER. However, this extraordinary number, which concentrated on recording every part of the interior, especially production areas, was shot at the special re-

quest of the Corps in anticipation of their use in the inventorying.

Normally, HAER also would have done some historical research on the Wagon Works as well, but this was largely obviated by Paul Kuke's Master Thesis on the Wagon Works done in 1968. In it he documented the history of the plant and its industrial processes and products, mostly through interviews with Franklin P. Gruber and study of the actual equipment.

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4. Preliminary Preservation Planning

Between 1970 and 1975, the Corps engaged in protracted discussions with PHMC, and various units with NPS and other preservation organizations in a futile attempt to obtain any monies that could be used in either acquiring the non-real property within the Wagon Works or in relocating the building. All requests on the State and Federal levels were turned down, since the NPS preservation grant program established by the NHPA cannot be used to fund Federally owned properties. Neither NPS or PHMC were able or made any serious attempt to undertake ownership and thus fund the preservation of the Wagon Works under programs for properties owned by them. As a result, at a meeting on January 22, 1974, the inability of all interested parties to provide any funding for the proposed relocation was established, and the Corps then began exploring the possibility of obtaining a special appropriation from Congress for this task. Only Berks County, on February 21, 1974, tentatively agreed to provide a new site and eventually take title to the building. However, they also lacked the funds required for relocation. But, by fortuitous circumstance, on May 24 the Archeological and Historic Preservation Act of 1974 (P.L. 93-291), also known as the Moss-Bennett Act, an amendment to the

Reservoir Salvage Act of 1960 (P.L. 86-523), was signed by the President. This law authorized Federal agencies to spend up to one percent of a project's appropriation for the survey and preservation of historical or archeological resources.

The Corps immediately began to use the Moss-Bennett authority to plan for the preservation of additional historical resources within the reservoir pool, primarily the relocation of the Wagon Works. A feasibility study of alternative methods and sites for the Wagon Works Relocation was contracted to National Heritage Corporation (now John Milner Associates) on July 18, 1974. This "Gruber Wagon Works Relocation Study", submitted to the Corps on August 29, considered the three potential sites that had then been established and developed a matrix of preliminary cost estimates for each site for each of five relocation methods.

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Only one of these five methods retained the complete early twentieth century industrial character of the Wagon Works through relocation of the entire structure and major machinery intact. However, the cost to relocate the building at any site by using the intact relocation method that retained the integrity of the entire plant and then to restore the structure and its contents far exceeded the funding provided by the Moss-Bennett Act.

The Corps clearly favored the use of the Red Bridge site offered by Berks County because of the County's firm commitment to take title to and responsibility for the structure following its relocation and restoration. Neither of the established public historic property holding agencies, the Pennsylvania Historical and Museum Commission or the National Park Service at any time made serious proposals to maintain and operate

the Wagon Works. This resulted even though the Wagon Works had been declared by these same agencies, and the Smithsonian Institution, to be clearly of national sigmificance. It was recognized as possibly the only, and probably the best, surviving intact example of a bygone rural American industry. The Corps felt it preferable that an agency with historical or local recreational responsibilities take over the preservation management and museum operation of the Wagon Works. The Corps has no authority or expertise in these areas.

As a result of the development of these preliminary costs, and the consensus of opinion heavily supporting the intact preservation of the Wagon Works, the Corps, in consultation with PHMC and NPS at an August 31, 1974 on-site meeting, estimated that about one million dollars would be required to relocate the complete structure and restore it and its machinery. The Corps then initiated an attempt to obtain a special authorization from Congress in that amount to carry out both the relocation and restoration. However, on February 19 of the following year, the Corps was informed by their legal council that they cannot by statute make an authorization request; such initiative must come directly from Congress. The Corps neverless continued to plan for at least the relocation of the complete fabric of the Wagon Works under the existing Moss-Bennett authority.

5. Acquisition of the Wagon Works

Before the Philadelphia Engineer District was notified on July 3, 1974, of the approval of the Moss-Bennett legislation, the Corps purchased the Wagon Works on June 10, 1974. This settlement included the acquisi-

tion of all the non-real contents of the building. A special appraisal of the contents of the building by two well qualified curators of historic industrial technology, John S. Watson, Principal Curator, History, New York Office of State History and M. W. Thomas, Jr., Associate Director and Chief Curator, New York State Historical Association, had intrinsic museum value at $50,545.

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The extra funds required to purchase the contents of the Wagon Works were specially authorized from within the Corps, while a matching expenditure of $8,000 for the HAER recording project was retroactively funded with Moss-Bennett money.

Following the purchase of the building and all its equipment and furnishings, all hand tools, small portable objects and wagons were inventoried, crated as required and moved to storage in nearby, secure Corps owned buildings. An inventory of 4,087 groups of objects (about 19,000 individual items) was keyed to the HAER photographs to allow their eventual replacement in the restored building.

Bib. 5

6. Consultation with the Advisory Council on Historic Preservation

The Philadelphia District Engineer had been informed in 1973 of the requirement established by the National Historic Preservation Act for all Federal agencies to take into account the effect of any of their undertakings on any property listed on the National Register. The Advisory Council on Historic Preservation (ACHP) had to be given "reasonable opportunity" to comment on any such undertaking. The Advisory Council was established under Title II of the NHPA and by

early 1970's had become actively involved in reviewing the effect of Federal projects on properties listed in, or eligible for, listing in the National Register.

The Advisory Council's responsibilities had been greatly enlarged to include review of properties determined eligible for inclusion in the National Register following the May 13, 1971 issuance of Executive Order 11593 by the White House. Thus, the Wagon Works had actually been under their purview more than a year prior to its actual listing.

The Corps was required to submit the proposed action, including alternatives, for review initially by the State Historic Preservation Office (SHPO). In Pennsylvania, that authority is contained within PHMC. Upon reviewing a project and applying the Advisory Council's Criteria of Adverse Effect, the State Historic Preservation Officer finds that the proposed action has either "no effect", "no adverse effect", or "adverse effect". In the latter two cases, the Advisory Council is provided documentation to review the no adverse effect finding and to comment on the adverse effect ruling.

As a result of a site meeting at the Wagon Works with a representative of the State Historic Preservation Officer on December 16, 1974, a ruling of adverse effect was issued by PHMC on December 20, 1974, for each of the proposed alternatives for the Wagon Works proposed by the Corps. The Advisory Council Criteria of Adverse Effect b, "Isolation from alternation of its surrounding environment", obviously applied to any relocation alternative, and to the dikes created by the one alternative that retained the Wagon Works at its original

Bib. 4

site. The Corps was required then to prepare a Preliminary Case Report for submission to the State Historic Preservation Officer and the Advisory Council on Historic Preservation containing all relevant information concerning the undertaking. According to the ACHP procedures, this report then would be followed by a consultation process to determine a mutually agreeable course of action to avoid or mitigate the undertaking. This consultation process then would be concluded by a Memorandum of Agreement between the Corps and the ACHP detailing actions to be taken to avoid or mitigate the finding of adverse effect.

Bib. 4

The Preliminary Case Report was completed and presented to the SPHO and ACHP in July, 1975. It contained a complete review of events since the beginning of Corps' involvement in the project. A detailed description and evaluation of six proposed site alternatives for each of five alternative preservation treatments for the fabric were included along with the preliminary costs associated with each. Following several discussions with ACHP over the next year, including on-site inspection by ACHP, the Corps submitted a Memorandum of Intent to ACHP on June 8, 1976 outlining the proposed relocation to the Red Bridge site. ACHP did not carry the consultation further and no draft Letter of Agreement was submitted to the Corps by ACHP. Nor was any further action pursued by ACHP. The Corps then proceeded to carry out the essentially intact relocation of the Wagon Works to the Berks County park site on Red Bridge Road.

7. Preservation Funding

Following the inability of the Corps to initiate a special authorization that would include funds or full relocation and restoration of the Wagon Works, a sud-

den grass roots effort to effect the same result began among concerned people in Berks County. Strong local sentiment favoring the preservation of the entire Wagon Works and an equally strong letter writing campaign by local citizens was initiated primarily by the Berks County Historical Society in March, 1975. The effort to United States Senators from Pennsylvania and the United States Congressman from the district including Berks County eventually resulted in status inquiries from Senator Hugh Scott and Congressmen Gus Yatron to the Philadelphia Engineer District in early April.

Explanatory correspondence from the District Engineer to these legislators explained the national significance of the Wagon Works. He went on to point out the preferred alternative of relocating the Wagon Works intact to the Berks County site and restoring it was then estimated to cost $922,000. The fact that no other historic preservation agency was able to provide these relocation funds was also pointed out.

As a result, both Senator Scott and Congressman Yatron introduced companion bills (S. 1497 and H.R. 6505) in later April, 1975, to authorize the funding necessary to carry out the full relocation and restoration of the Wagon Works. Both bills were finally included as Section 129 of the omnibus Water Resources Development Act of 1976 (P.L. 94-587) passed on October 1, the last legislative day of the 94th Congress, and was signed by the President on October 22.

By this date the Corps was already fully committed to the relocation of the Wagon Works to the Berks County site with relocation work underway. Now, however, the restoration of the structure was also assured.

Funding of the relocation was then retroactively transferred from the Moss-Bennett authorization to the Scott-Yatron rider.

8. Effect of Relocation on National Register Status

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Sec. 60.166

The National Register of Historic Places published their formal regulations concerning the status of properties relocated subsequent to their National Register listing on February 10, 1976, just a few week prior to the commencement of consultant procurement for the relocation of the Wagon Works. This policy had been evolving during the same period that the Corps was considering relocating the Wagon Works. During this period, in 1974 and 1975, the Corps and National Heritage Corporation (now John Milner Associates) had inquired about the effect relocating the Wagon Works would have on its National Register listing.

The position of the National Register was that only if the Wagon Works was relocated intact with its full complement of tools and equipment to a compatible site would it still be eligible for inclusion in the National Register. Although no firm statement as to the certain National Register Status of the relocated Wagon Works was made, the implication was that it would have to be renominated even if relocated intact. The published regulations confirmed this, but added specific application procedures that could be followed if the Federal agency wished for the property to remain in the National Register during and after the relocation. If these procedures were not followed, the property would automatically be deleted from the National Register, and the Federal agency would have to renominate the relocated property if it wished to have it re-entered in the

National Register. Reinclusion in the National Register depends on the resulting condition of the relocated fabric and the relative retention of the environmental character of the original site. However, if the property was moved in a manner consistent with a Memorandum of Agreement with the Advisory Council on Historic Preservation it would be exempted from these regulations.

The Corps proceeded with the intact relocation of the Wagon Works without the Memorandum of Agreement with the Advisory Council, but with the intention of renominating the Wagon Works following relocation if required. (The Corps was not then aware of these relocation regulations.) The Wagon Works was automatically deleted from the National Register.

9. National Historic Landmark Designation

The need for National Register renomination has now been obviated because the Wagon Works was declared a National Historic Landmark on December 22, 1977 by the Secretary of the Interior. The National Historic Landmark nomination was prepared by the American Association of State and Local History on contract to the National Survey of Historic Sites and Buildings in June, 1977, after the relocation and reassembly were completed at the Red Bridge site. Properties designated as National Historic Landmarks possess national significance and are considered to be of exceptional value in illustrating a specific theme in the history of the United States. National Historic Landmarks are a part of the National Register, are afforded the same legal protections as a National Register listed property and are eligible for matching Department of the Interior preservation grants when not Federally owned.

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Reference 1. Consultant Procurement

On March 19, 1976, the Corps issued a Request for Technical Proposals for the relocation of the Wagon Works. A two step method of procurement that amounted to a design-build package was required. The first step called for the submittal of an unpriced prequalifying proposal which outlined in detail the method to be used to disassemble, transport, and reassemble the complete Wagon Works, including its entire complement of heavy machinery, and two small outbuildings. These proposals, adjudged as responsive to the Corps' criteria, included essential historic preservation requirements and other qualifications. Once prequalified, the submitters then competitively bid for the actual award of the contract. This second step was required to be bid as a firm-fixed-fee on the technical proposal submitted in step one.

Plate A2-7

The Step 1 Proposal was due on April 26, 1976. Six proposals were received from joint contractor/design professional teams. Five were adjudged qualified for the project and so notified on May 20. Four of these groups submitted bids on their proposals by the June 22 bidding deadline. Bids were opened and an award was made to a team which consisted of R. S. Cook & Associates, Inc., General Contractors; C. Van Howling & Sons, Inc., Moving Contractors; National Heritage Corporation (now John Milner Associates), Preservation Architects and Planners; and the Keast & Hood Company, Structural Engineers. The low bid of $387,000 was estimated to include all costs, including utility relocation necessitated by the building

relocation. A contract with the Corps was executed on July 22, and site investigation and design work began soon thereafter. The final working drawings and specifications were approved on October 12, and construction work began.

2. Relocation Site

The Step 1 Proposal required planning for relocation to two possible sites. In addition to the Berks County Park site at Red Bridge, the Corps requested that relocation proposals include plans for an alternate storage site near Blue Marsh Dam on Federal land. The execution of a formal lease with Berks County for relocating the structure onto their land took place on April 30, 1976. When this agreement between Berks County and the Corps was formalized, the requirement of the Step II procurement on relocation to the alternate site was then dropped. Thus, the Step II bidding was only for relocation to the Red Bridge site. The agreement with Berks County provided for the lease of the new site, intact relocation of the Wagon Works to it, and retention of ownership of the Wagon Works by the Corps until restoration is completed. At that time, ownership of the structure will pass to the County.

Plate A7-1

Bib. 7

3. Relocation Design

The basic design premise was simply to alter the fabric as little as possible. Maximizing the size of individual sections along separation planes that would satisfy the height and width limitations presumably would minimize removal and separation of original fabric. During the Step 1 prequalification, it first had seemed logical to separate the building only along the planes between the various historical additions.

This proved to be partially unworkable, however, because it would have resulted in greater fabric disturbance. The building was separated then, into four major sections, with the appendages separated into several minor parts.

Plate A5-1A

At no time was fabric simply indiscriminately cut along a single plane. Explicit, detailed instructions were provided for removing individual pieces of original fabric as well as specific procedures for cutting or disassembling each affected structural member or joint. The unfinished interior of the Wagon Works, which has been termed "open finish" and is common to most early frame industrial structures, simply would not allow reconnecting crudely butt-cut members together with exposed places and cleates.

Bib. 7
Plates A1-5 and A1-8B

Instead, each affected structural connection was field sketched in axonometric projection and transcribed directly to the working drawings. Joints were designed carefully to separate horizontally. In addition, disconnection of joints along the same separation plane was studied systematically to make certain that any member, continuous between two adjacent joints, either was included with the same building section or removed intact. In those few cases where new cuts had to be made through structural members, the joints were to be lap-cut and, upon reassembly, pegged together. Each member was to be tagged for identification by building section. And siding and flooring at separation planes were to be removed either to existing or new staggered joints.

Plates A5-1B and A5-2A

Of extreme importance, structural reinforcing was to be introduced throughout the building: to strengthen existing unstable conditions, to provide support

along separation planes, and to support the temporarily disconnected structural system.

Additionally, the machinery and power generating and transmission system also had to be relocated. Wherever possible, these mechanical devices and assemblies were to be left in place, stabilized and moved with each building section. However, it was necessary to

Plate A6-24A remove the entire main drive shaft and several counter shafts hanging from the cellar ceiling to

Plate A5-3A accommodate rigging beams. It also was necessary to separately remove the Otto gasoline engine and several machine tools because they were in the cellar or on slabs-on-grade. In order to schedule these removals, the mechanical system was fully cataloged for premove tagging to be sure, for example, that each pulley and shaft assembly would be reassembled correctly.

Highway regulation made it necessary to limit any one section of the building to a maximum width of 30 feet. The move had to traverse five miles of a two-lane primary highway and a half mile of a narrow secondary road onto the new site. The roof and gables of the

Plate A5-3B elevator penthouse were to be removed to bring its overall height down to that of the other two large sections to minimize the cost of relocating electric primaries. Overhead electric primaries that crossed the route with less than the predetermined clearance would have to be temporarily raised. Secondary lines would be extended with temporary wire coiled to their poles. All electric modifications had to be made in advance of the moving the first of the three largest sections. The electric secondaries and telephone cables were then dropped ahead of and crossed by the moving rigs. At no time was service to be in interrupted. The cost of utility relocation came out of the

original contract amount along with all other costs.

4. The Relocation

Plates A5-2B and A5-4A The actual pulling apart and relocation of the various sections followed structural stabilization and structural and mechanical disassembly in late Fall, 1976. The three largest pieces were each supported on a rigging bed of steel beams carried on three multiple wheel dollies. This steel had been needled through holes punched through the stone foundation. It consisted of stringers placed transversely to the direction of travel and forward converging girders placed longitudinally under which the dollies were located in triangular support. The smaller sections were moved on "low boy" type flat bed trailers.

Plate A5-4B

Plate A5-5B The three largest sections were taken to the new site in two separate operations: the central and largest section singly on December 8 and 9, and the other two, in convoy, on December 22 and 23. Each of the three were moved about 800 yards through a frozen, and fortunately level, corn field just above the new site because trees along the narrow public right-of-way at that point made it impassable. The largest control section was moved to the new site first because of the advantage of fitting the adjacent smaller and lighter pieces to it.

Plate A5-6A

Plate A5-6B

Plate A5-7A

Plates A5-7B and A5-8 Generally, the reassembly proceeded in the reverse order to the disassembly. During reassembly, several badly rotted or fractured structural members were replaced, principally sill plates, where it would have been more difficult and costly to do so following reassembly. A new foundation was built beneath each section after it was finally positioned, leveled and structurally reassembled. The foundation consists

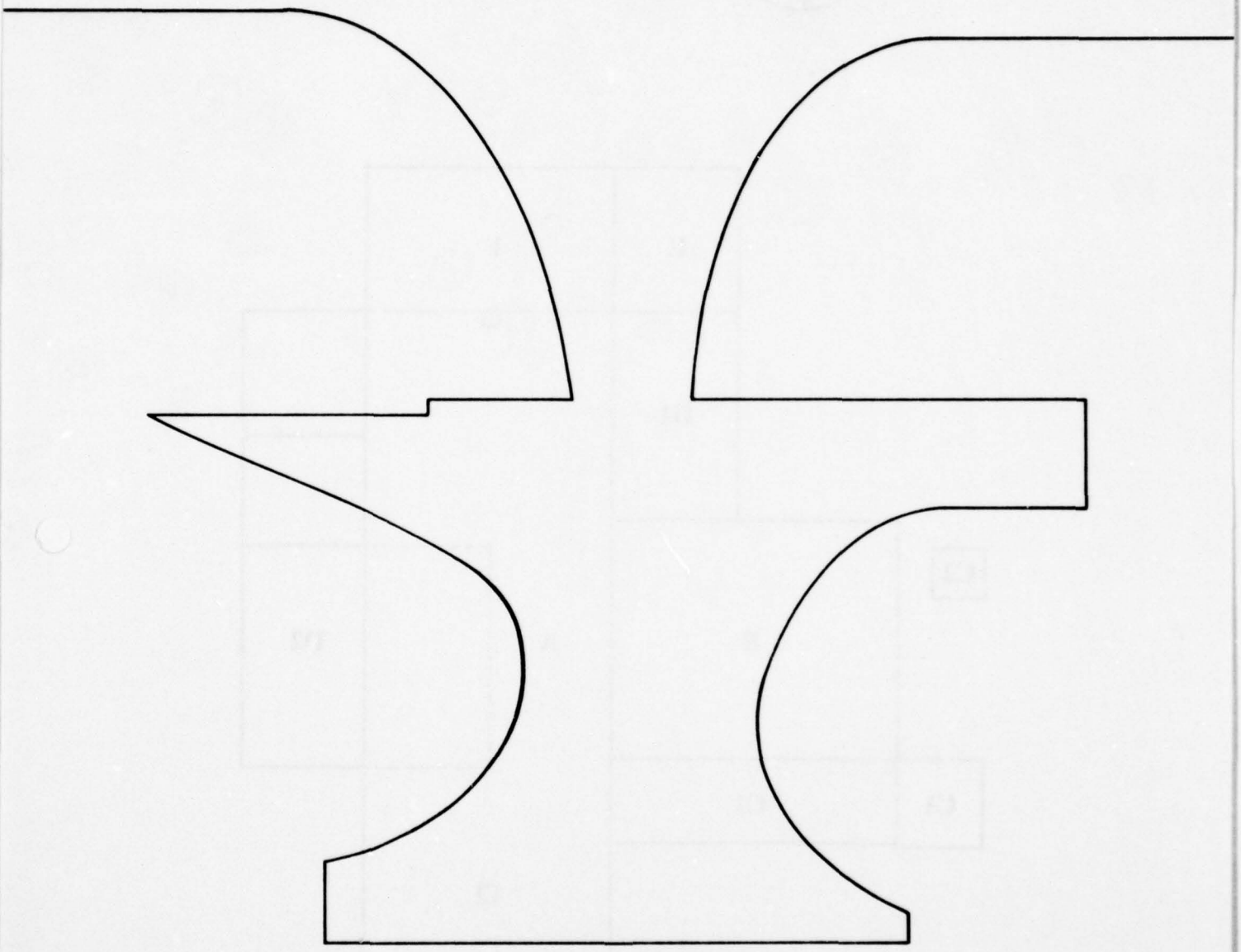
Plate A5-9A

of a permanent concrete block core and temporary exterior block veneer. The veneer will be replaced during the restoration with stone from the original walls. That stone was salvaged from the old foundations and stored at the new site. The roof is temporarily sheathed in plywood and asphalt roll roofing; the old slate was removed because it was badly decayed. All machinery and shafting has been reinstalled, but will not be finally leveled and made operational until restoration of the building fabric is completed.

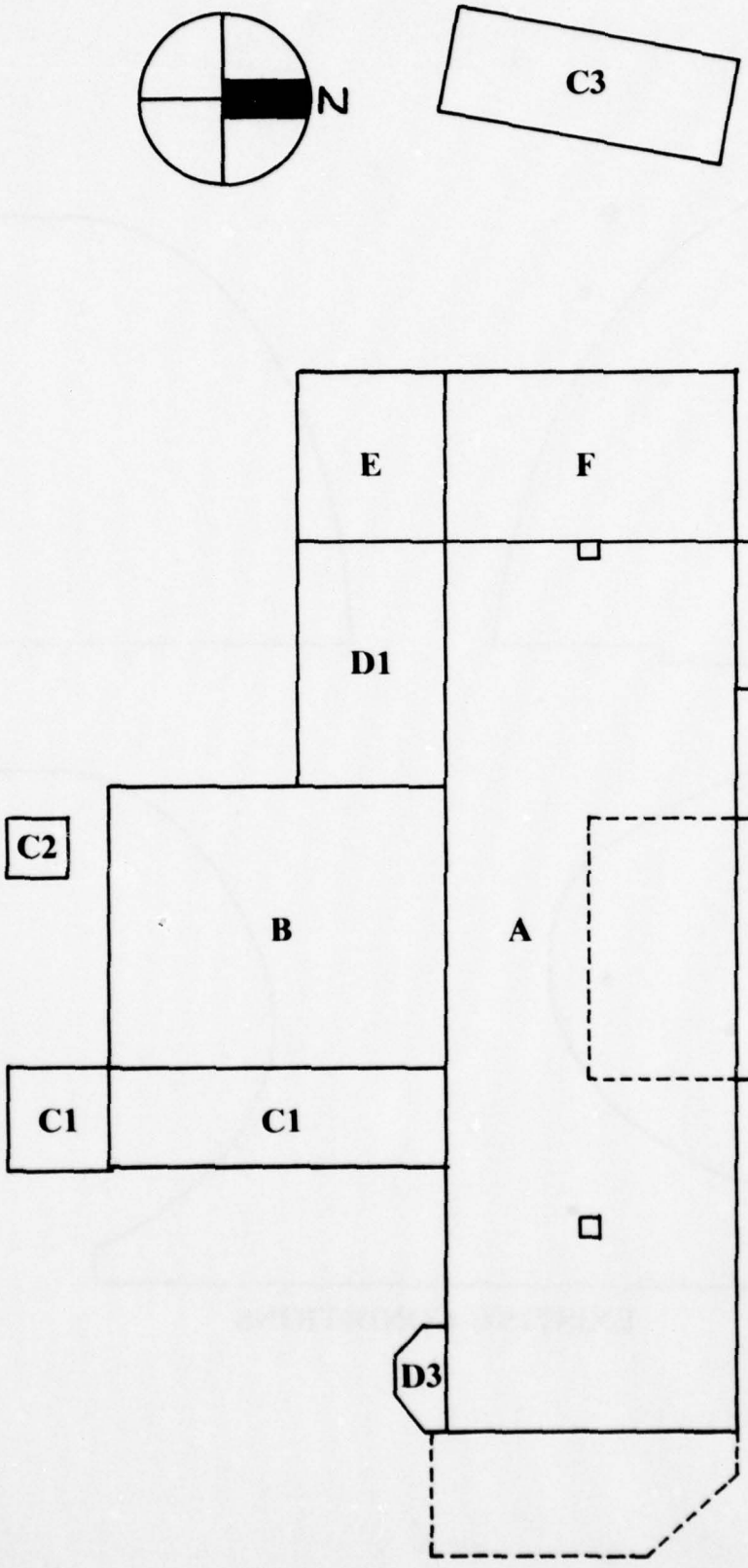
Plate A5-9B

Plate A5-10A

The final cost of the relocation was $406,000. An additional expenditure of $19,000 was largely for the replacement of decayed structural members.



EXISTING CONDITIONS



CHRONOLOGICAL DEVELOPMENT KEY

Reference

1. Basis for Evaluation

This section of the report outlines the investigative results necessary to determine the existing architectural, structural and mechanical condition of the Wagon Works. Primarily the data presented has resulted from on-site physical investigation of the extant building, review of the documentary and iconographical material previously accumulated by the Corps of Engineers, and comparison with known industrial structures of similar date and construction. Accumulated results form the basis for later recommendations. The investigative tasks are divided into major architectural and technological areas in which components then are outlined in detail.

2. Background Considerations

The conglomerate structure known as the Gruber Wagon Works is typical of an active industrial complex of the historic period, c.1883-1915. Its additive nature was responsive to changing technology of an expanding industrial concern: function and utility determined the ultimate building design which changed with technology and prosperity until the product produced was eliminated by the same changing technology. Building appointment reflected the pride of its original owners, decreasing as necessity dictated expansion. The result is a fascinating compositional and technological study of early twentieth century American industrial development.

3. Plans and Dimensions

Plate A5-1A

The complex was divided into four major sections for

relocation. However, for the purposes of this report, it is best to study the composition as an original building with subsequent additions in order to explain the final structure configuration. Each additive element of the extant factory is identifiable, though the final combination maintains a basic three-bay structure on each level (cellar, first and second floor). Each bay functionally fit the assembly process for wagon making, the combination preserving the original functional units throughout the processes of acretion.

Apdx. A4

Plate A2-1

Building A, 1833, the original building, was a two and a half story rectangular block, 23'-8" x 83'-0", over a low cellar (6'-0"$\pm$ clear height). Its bays divided functions and were designated Bench Shop, Wood Shop and Blacksmith Shop on the first floor. A Paint Shop and storage areas were contained on the second floor. Small porches on north and east elevations allowed ramped access to the second floor for raising and lowering the wagons before and after painting.

Plates A1-1 and A1-2

Plate A2-2

Addition B, 1885, was called the Farm Shop since lumber was reused from another Gruber farm structure. It was a single rectangular bay, three and a half stories, 25'-0" x 31'-0", constructed south of and enlarging the original central bay of building A (the Wood Shop). An original exterior wall was removed in this area. The ground floor (clear height 6'-2"$\pm$ under the summer beam) contained a stable while the second floor provided additional storage and drying space.

Plate A2-3

Additions C1, 1896, were single story rectangular shed additions east of addition B encompassing a block 10'-0" x 40'-0". They were constructed to house a boiler and a gasoline engine for powering wagon making equipment. The two sheds were separated by a covered passage.

Building C2 is a single-hole shed roof outhouse, 4'-0" x 4'-6". It is situated south 3'-11" and east 3'-0" of the addition B west wall.

Plate A1-4A

Building C3 is a single story, gable roof frame structure, 10'-0" x 20'-6". A shed roof section, 5'-0" x 10'-0" provides rear access. The structure is 19'-9" west of addition F and contained storage for wrought iron bar stock.

Plate A2-4

Addition D1, 1905, was a three-story single bay block, 23'-1" x 14'-3", constructed in the southwest corner between A and B. It expanded the blacksmithing operation to include mechanically powered machine tools. The A south wall was removed for this addition.

Addition D2, 1905, was a complex structure replacing the northern porch. A hand-operated, enclosed elevator connected the first, second and attic levels. The elevator shaft was centered on the original middle bay, and a single story storage area was added to the west at the second floor level. The entire addition was elevated above an open carriage way at the first floor level. The rectangular block extended 12'-0" beyond and 48'-0" along the original north elevation. Windows, doors and roofing in the area of connection along the A north wall were removed at the second and attic floor level for access to the elevator.

Addition D3, 1905, was a semi-octagonal, single-story addition, 5'-0" x 10'-6". Added to the south elevation of A at the east corner, it was hung from the first story by metal rods. The small room served as the Wagon Works' office.

Plate A2-5

Addition E, 1908, was a shed roofed, single story rectangular block, 14'-3" x 16'-5", enlarging D1 to the

to the west. Constructed on a concrete slab, the addition houses a hydraulic setting machine.

Plate A2-6 Addition F. 1910, completed the expansion as a single bay, single story block, 28'-3" x 16'-5". Added to the blacksmith shop west of the original west wall of A (removed), it housed two additional forges.

Reference 1. Location

Plate A1-2B Gruber's Wagon Works was originally located on Licking
Plate A2-7 Creek about 1000 feet above the confluence with Tulpehocken Creek. The plant drew its first source of production power from the creek water. The new site, part of a larger plot within the Red Bridge Historic Area, is situated downstream on Tulpehocken Creek approximately five miles east of the initial site. The plot is on the side of hill above the floodplain and commands a panoramic view of the immediate Tulpehocken Creek valley.

2. Topography

Plate A7-1 The new site naturally slopes at a six to ten percent grade from northwest to southeast toward the creek. Though the new site is further removed from creek water than the first site, the general area is reminiscent of
Plate A1-2B the old rolling site. And the relocation general con-
Plate A6-1B tractor, while grading for general drainage with a swale west of the Wagon Works, approximated original site grading conditions at the structure including some inherent difficulties.

3. Physical Development

The relocation work involved excavation for the new foundations and temporary drainage grading. Though the new site is located in a limestone belt, no pinnacles were encountered during the excavation.

The relocation did not involve reconstruction of roads or construction of other site improvements. Generally, the site was seeded and a security chain link fence enclosure was installed surrounding the immediate building complex. Two dusk to dawn pole lights were erected. Electric service was not brought into the structure.

Plate A6-1A
Plate A6-2A
Plate A7-1

4. Site Problems

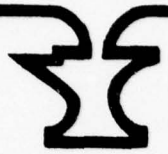
Problems with the new site are based with the temporary, and reconstruction, grading and a high water table. Specifically:

a. The combination of abundant surface water from Red Bridge Road and the hill top and high ground water levels continuously saturate the northern wall of the complex.

b. Reconstruction grading at the building inherently allows water to enter the structure, which, when combined with a lack of foundation dampproofing and drainage, causes severe water accumulation in the cellar areas.

Plates A6-2A and A6-2B

c. Temporary drainage grading was not located according to the relocation construction documents and did not completely take into account the abundant surface water problem noted above.



Reference

1. Foundations

The frame structure originally rested on twenty-inch thick rubble stone foundations without footings, typical of rural Pennsylvania farm structures of the historic period.

Apdx. D2

The original field stone was photographed and stockpiled by section on the new site for reuse as a stone veneer.

Plates A6-7A & A6-20B

Stone has been reconstructed beneath additions C1 and the Iron Storage Shet.

See p.24

The relocated structure was placed on 16" to 24" concrete masonry unit (CMU) foundations on concrete footings. Reinforced footings were designed to span potential limestone sinkholes up to six feet.

Plates A6-2B A6-3A A6-6 A6-7

The exposed exterior face of all foundations and certain interior faces have been constructed of CMU in stack bond for ease of replacement with reconstructed stone veneer. Interior walls of A, B and D-1 have been constructed with widened footings to receive a later eight-inch stone veneer. Some other wall areas, including 8"core walls have been constructed in running board. The outhouse (C2) foundation was stuccoed.

Plate A6-20A

See p.31

Footings and foundations were constructed without exterior pargeting, dampproofing, or a tile drainage system. The CMU cores on the north wall are grout filled. Foundations have not been constructed under five anvil locations in the forge areas.

2. Framing

The structural complex is wood frame typically from below the first floor framing up. All major structural elements

are typically White Oak of principally mortise and tenon construction.

Plate E-1

Plate A1-5A

The first floor is framed with joists either tenoned or simply abutting sill plates on perimeter masonry walls, and simply resting on longitudinal summer beams. Joists vary from squared rough "trees" to circular sawn joists and rafters: In building A, log and sawn joists (averaging 2-3/4" x 8") and occasionally mortised into sill plates and overlap on top of post and pier supported summer beams (9" x 12"). The addition B summer beam (9" x 12") is lap jointed and post supported between the north and south walls. Joists are mortised into the summer beam and occasionally into sill plates. Joists in additions D-1 and F are simple span and mortised into sill plates.

Plate E-2

Unaltered second floor framing connections have joists mortised and tenoned into summer beams and rest, unnailed, on ribbons.

Unaltered third floor framing connections have all joists mortised and tenoned into both summer beams and perimeter rafter plates.

Plate A1-5A

Walls are examples of classic balloon framing, i.e., studs (nominal 3" x 5"), are mortised into the sill plate and extend the full two-story height to the rafter plate. One-inch ribbons (ledgers) are let into the vertical studs at the perimeter for carrying the second floor joists. The second floor joists are not, however, nailed directly to the side of the studs as would normally be expected in a balloon frame. The entire structure and additions are diagonally braced at exterior corners and the primary cross walls.

Beams under-trussed with steel or iron rods provide support in areas where walls were removed: Portion of the building A wall removed for addition D-1 necessitated resupport for second and attic floor framing; queen post trussed beams were added at each location. The summer beam of A above the Blacksmith Shop at the second floor level has been stiffened by queen post trussing in the same way.

Plate A6-8A
Plate A6-4A

Two types of structural roofs cover the complex. Gable roofs (buildings A, B and D-2) have rafters lapped and pegged at the ridge (no ridge pole) and are notched over a rafter plate at the attic floor level. The rafter plates are wire nailed to attic joists which are extended over wall framing for buildings A and B. For D-2, the rafter plate is part of the stud wall being wire nailed as a plate to the tops of the studs.

Building A attic floor has been stiffened over its entire length, with six king post over-trussed beams spaced along the longitudinal section, though concentrated at the area of removed roof for the D-2 addition. One king post trussed beam is located over the plate where the wall below was removed for addition B. The king post trussed beams consist of cleats wire-nailed to the attic floor rafters notched over the cleats to a mitred ridge (no ridge pole), an iron king post tie rod from the ridge through summer beams below the floor and nailed diagonal struts from mid-rafter to third points at the floor level. Six of these beams are block-wedged and braced between the roof framing and a continuous purlin on each slope to increase the roof support. The purlin is located at the top of the diagonal struts.

Plates A3-7 to A3-10
Plate A3-6

The addition B attic floor has been stiffened over its entire length by three king post roof trusses: truss rafters are larger members with a vertical tie rod extend-

Plates A3-8 and A3-9

ing from the ridge through summer beam below the attic floor.

The gable roofs originally were open-lathed (approximately full cut 1" x 3" @ 12") with solid ridge and eave boards (12" wide). A temporary plywood sheathing diaphram (1/2") was installed on top of extant lath over all pitched roof areas for relocation stability; this diaphram is still existing. Approximately eleven plywood panels are nailed inside lath between the rafters on south slope of building A. New lath was installed between the plywood joints and at deteriorated locations over addition D-2 without regard to required spacing.

The balance of roof areas are flat or shed roofs. Joists/rafters are simple span between wall ledgers and stud wall plates with roof areas sheathed with solid boards (1" x 12" full cut) which are butt jointed.

4. Framing Problems

Generally in good condition, the Wagon Works structural system, however, sags in places due to the problems listed below.

Of primary concern is the presence of wood-boring beetles and fungii (indicating early stages of dry and wet rotting) in all sections. The beetle problem obviously has been with the building for some time; in addition B, where the problem is most severe, it appears that the reused lumber from which this addition was erected, may have contained the beetles at the time of its construction (1885). Generally, infestation is most obvious in the first floor framing of A & B exposed to cellar areas where there is a close relation to grade.

The fungus problem occurring throughout the structure is the result of vacancy and leaking roofs.

As noted, the following are major structural problem areas:

Ground Floor (first floor framing)

Plate A6-5B a. Southeast corner, building A: one joist section is seventy percent cut away.

b. Summer beam, east end of building A (room 001): rotted and temporarily shored.

Plate A6-6A c. Lintle over door (opening B001) rotted, broken, and temporarily shored.

Plate A6-7B d. Summer beams, building A, room 002 between east masonry wall and forge foundation: rotted and temporarily shored. (Original posts were not reinstalled after relocation.)

Plate A6-6B e. Lintle over door D001, addition D-1 was replaced during relocation: insufficient length -- temporarily shored.

Plate A6-7A f. Opening B002, west wall end of room 008 South: post rotted bottom cut off during relocation; temporarily shored in plan.

Plate A6-24B g. Addition D-1: supports under power punch machine are rotted at bottom ends.

First Floor (second floor framing)

a. Addition D-1: water damage and joists rotting in easternmost area under roof leaks.

b. Building A: southern trussed summer beam in room 103 rotted from water damage.

c. Addition D-2: southern sill plate fractured.

d. Addition D-2: eastern sill plates rotted.

e. Building A, western summer beam post: tenon cut during relocation - temporarily braced.

Plate A6-8B f. Addition D-1: support posts under elevator rotted on bottoms; condition under casing unknown.

Plate A6-9A g. Addition F, northwest corner post: 18" ± rotted from roof down.

h. Addition B, east side: studs temporarily shored; rotted bottoms cut off.

i. Additions D-2 and E, south and west exterior walls: rotted stud bottoms suspected.

Second Floor (attic floor framing)

a. Addition B, wall plate: rotted.

Plate A6-8A b. Building A wall, south support beam at addition B: broken near west end; temporary post below (replacement piece). Plate should have been replaced contiouous over corner post to overlap joint in western bay.

c. Addition B, west wall: wedge can be removed when lintle below is replaced and building is leveled.

d. Addition D-1, northeast corner post: seventy percent rotted away (note: post continues into elevator structure above).

Roof

a. South shed roofs on additions D-1 and D-2: twenty-five percent rotted sheathing boards.

b. Additions E and F: thirty-five percent rotted sheathing boards.

c. Addition C: five percent rotted sheathing boards.

Bib. 7

d. Ridge boards cut for installation of ventilators during relocation affect structural integrity of original roof diaphram on building A and addition B.

e. Addition F: supports for monitor rotted - temporarily braced.

f. Addition C: rafter ends at addition B are blocked but not connected to adjacent studs.

g. Addition B: fifty percent of rafter ends rotted.

h. Addition D-2: roof plates and rafters rotted from water damage.

i. Addition D-3: metal tie rod bent.

Framing Connections

a. Connections adjacent to deteriorated members are loose.

Reference 1. Roof

The gable roofs of A, B and D-2 (elevator enclosure) originally were slated over open oak lath. The slate (12" x 23" x 3/16" with 10-1/2" exposure) was a varied medium gray, natural cleft regional material. It was nailed on the lath with steel nails ten inches from the top surface. All slate was removed (rotted) during the relocation contract since it was "washed-out" and temporary plywood sheathing and asphalt roofing paper was installed. "Washed-out" is a process of natural organic imbedded material rotting and leaving an inorganic material through cyclical rainwater washing. Over sixty percent of the open lath has been removed; half of that remaining is either rotted or fractured.

The slated roofs had continuous board gutter guards (approximately 2" x 4") bolted to Gruber made forged
Plates A6-10 metal straps set between the slates and hooked over the open lath. All extant metal strap anchors were removed and salvaged during the relocation process.

Plate A2-7 The balance of the roofs were solid board sheathed and covered with flat seam unsoldered tin plates (approximately 1'-6" x 2'-4") except for the boiler room addition (C1), the outhouse (C2) and iron storage shed (C3) which were standing seam tin. All tin roofs were rudimentary flashed and painted. All are rusted and in bad condition. Thirty-three percent of the underlying board sheathing is rotted.

Plate A2-4 The boiler room roof (C1) has a large roofing patch where the original chimney had been located.

2. Chimneys

Two brick chimneys are located in the original building A. A flue for heating stoves extended from the center of room 201 connecting stoves on the first and second floor levels. An industrial flue extended from the forges at west gable end connecting a heating stove in room 103A. The brick above the roof was removed during relocation and stored in the attic. Both chimneys are cracked at the attic level and were temporarily braced during relocation. The western chimney bracing was

Plate A6-15A removed. The eastern chimney remains wrapped and braced at the attic level. The molded red bricks are in good condition except in room 201; that chimney brick is spalled and is heavily covered with paint brush-outs from workers in the Paint Shop. Flue pipe openings are

See p.55 intact and in fair condition.

3. Gutters and Leaders

Rainwater is conducted from the entire complex by gutters,

Apdx. D5 all of which were semicircular galvanized steel. Gutter hardware was iron or steel and consisted of Gruber-built

Plates A6-11B straight drive hangers, Gruber-built dog-leg drive han-

to A6-14B gers, Gruber-built dog-leg, side nail hangers, and builder's side-nail adjustable hangers. All leaders were corrugated galvanized steel spiked with clamps to a soldered adjustable leader rack. Gutters were probably not added until between c.1893-1905.

All leaders and gutters are deteriorated or missing. Approximately ninety percent of the gutter hardware remains, with sheet metal straps and clamps heavily corroded on the balance though support members are reusable. Most leader hardware is either deteriorated or missing.

4. Cornice

Plates A6-11A and A6-17 Building A and additions B and C1 are trimmed with flat and beaded board approximations of plain eave and barge cornices, including gable eave returns. This cornice is generally in good condition except for the east and west *Plates A6-16* elevations of addition B, which are approximately eighty percent deteriorated.

The balance of the roofs have exposed and decoratively sawn joist ends, with additions D1 and D2 trimmed with *Plate A6-15B* vertical siding, sawtooth cut. Generally, all joists are in good condition except the north elevation of *Plate A6-9* addition D2 (thirty-five percent rotted) and the elevations of additions E and F.

5. Siding

Five types of siding are extant on the structure. Siding type, size and paint finish are the prime resources for verifying building chronology.

Plates A6-2 A6-6B and A6-8B "German" shiplap horizontal siding, with five and a half inch exposure, covered A and B. This siding was reused as the structure was expanded; remnants appear on addition D1 (south and west elevations), addition E (south and west elevations) and addition F (north and partial west elevation). All are in good condition, with less than ten percent deteriorated or loose.

"German" shiplap horizontal siding, with three and a half inch exposure, covered additions D1, D2 and part of F (west elevation). More extensive rotting and loosening has occurred particularly at juncture of addition D1 with the roof of building A. Fractured structural members *Plate A6-6B* have loosened siding adjacent and above.

Vertical, double-beaded, tongue and groove White Pine boards (1" x 6") cover additions C1 and C2 with some rotting at the board bottoms.

Plates A6-17B and A6-20

Vertical tongue and groove White Pine boards (1" x 4") are used as casing on columns under addition D1 and to make up sliding doors. Casing under D1 is decoratively cut between column bays forming an arcade; anvil logo cut-outs occurred on the east and west elevations (the east is missing). Approximately ten percent of the casing is deteriorated.

Plate A6-18A

The office addition D3 is sheathed with 1" x 4" boards and sided with shaped shingle siding in good condition.

Plate A6-3A

All siding is face-nailed with machine-made cut nails. The horizontal siding is nailed at stud locations along the lower third of the siding. All horizontal siding was trimmed with overlapping corner boards (1" x 4"). All siding was originally painted.

6. Paint

The exterior of the building always was painted, though at present much of the paint is weathered off. Two basic schemes occurred during the historic period: all surfaces initially were painted red-iron oxide (c.1883-1896). With the addition in 1896, the entire building was painted in a more Victorian scheme: siding and sash were painted cream with window and door trim, corner boards and cornices painted dark brown. This scheme lasted until past the end of the historic period (c.1915) The paint study revealed only pigmentation; gloss was not determined.

Apdx. D3

7. Windows and Glass

Two types of windows are utilized throughout.

Plates A6-1A and A6-21A

Double-hung sash with inoperative by screw attached block top sash range in these configurations: 2/2, 4/4, 6/6 and 9/6 with the latter two most common. Three and a half sets of 6-light sash are stockpiled in the attic, most likely removed from earlier demolished portions of building A.

Plate A6-1A

Fixed light sash, similar to double-hung in configuration, are used as required by condition; e.g., sliding doors, monitor over addition F and added lights over windows D101, D102, and D103 in addition D1 (south elevation, first floor).

Plate A6-1B

The frames of all windows are constructed with the walls of board casings on the exterior with an integral sill. A drip cap and moulding appear at the head on buildings A, B, C, C1 and D2 with a double reeded apron under the sills. Board casings with board drips and aprons appear on additions E and F. Generally, no interior trim except a board stool is evident.

Sash generally are glazed with float glass primarily 9" x 14" but range in sizes from 8" x 10" to 18" x 18". All glazing is from the exterior with white lead putty. Sash are 1-1/2" thick with 1/4" muntins.

All windows generally are in good condition with five percent of the sash having loose or missing muntins. Sash operation on all windows is poor. Thirty percent of all glass is broken, or missing, and glazing is in poor condition.

8. Doors and Hardware

Apdx. D4 Four types of doors are used in the structure. Doors are surveyed in the Appendix. Frames are constructed similarly to the windows, cased with plain boards.

Type 1: Eight-paneled doors swung on cast-butt hinges are located in the original building A (1-3/4" thick).

Plate A1-5B Most have been modified or replaced, presumably when the elevator was installed (1905). Originally, all exterior doors were locked with lever operated, cast-iron box locks with bit keys.

Type 2: A four panel sliding door on cast-iron runners and tracks (1-1/4" thick) separates rooms 102 and 103.

Type 3: Boarded sliding doors on cast-iron runners and tracks occur at exterior openings B001, C002, D001, A108, F102, F106 and A216. All are tongue and groove vertical boards (1-3/4" thick). All doors above the ground floor have fixed sash in exterior openings.

Type 4: Vertical board and batten (1-1/4" thick) doors on Gruber-made straps close openings A005, B107 and B206.

Reference 1. Plan

The extant conglomerate of additive structures, c.1883-1910, contains the following spaces:

Plate A4-1 Ground Floor

a. A walk-in full cellar under original building A, room 001, contains the line shaft for powering equipment to the first floor and a coal bin.

Plate A6-24A
Plate A7-2

Plate A6-7B b. A crawl space cellar under original building A, room 002 features the forge foundation.

c. A walk-in, full cellar under addition B contains a stable (room 006) and originally contained the tailrace for water power from room 001.

Plate A7-1

d. Working rooms in addition C1 contained the gasoline engine room (008) and boiler room 010 (now storage).

Plate A4-2 First Floor

Plate A1-6A a. Bench shop (room 001, building A) with office attached to south (room 104, addition D3).

Plate A1-6A b. Wood Shop (building A and addition B, room 102) contains wood storage, wagon erection bays, and wood working machinery.

Plate A1-7A c. Blacksmith and Machine Shops (building A and additions D1, E and F contain the forges, two wagon erection bays, tire making operation and metal work machinery.

Plate A4-3 Second Floor

a. Paint shop (building A, room 201).

b. Elevator and storage (building A and additions B and D2 (rooms 202 and 203) for paint drying and elevator to first floor and attic.

c. Storage (addition D2).

Plate A4-4 Attic Floor

a. Storage space encompassing pitched roof sections of structure (building A and additions B and D2) accessible by stair and elevator.

2. Stairs

One stair and two access steps control interior circulation.

Plates A1-6A and A6-23A In the southeast corner of building A, a run between the first and second floors connects the Bench Shop, Office and Paint Shop and is original to the structure. It is enclosed at the second floor. The run from the second floor to the attic is not original to the structure but was probably relocated when the elevator was installed (1905) and the use of the door (A215) from the Paint Shop was eliminated. The original attic run was located in the center of room 201, turned 90 degrees and north of the stair to the first floor. In addition B, southeast corner, a stair opening originally connected the first and second floors. It was closed and the stair removed to install the spoke tenoning machine (I-10) and spoke lathe (I-11).

Plate A4-3

Plate A6-22A An 18"± level change from the Wood Shop to the Blacksmith and Machine Shops in building A is accommodated at door A121 by a single step with hinged riser for a storage box.

Plate A6-22B The exterior west elevation of addition F contained a

single board step cantilevered from the stone foundation on Gruber-made forged brackets for access to door F106. Only one bracket remains.

Both stair runs in building A, southeast corner, are in poor condition: treads are extremely worn, and sixty percent of the treads and risers are loose and deteriorated. The stair in addition B was closed (c.1900) with "German" siding. The step connecting building A is in fair condition: the tread is worn and the cast hinges are loose. In general the stairs are not considered adequate or safe for public use.

3. Floors

Above earthen ground floors, the building is floored entirely in wood except for a reconstructed (c.1977) concrete slab-on-grade under the hydraulic tire setter (I-28a in room 103E) and a partially reconstructed (1972) concrete slab-on-grade in the gasoline engine room (008). Thirty percent of the engine room slab remains uncompleted for installation of engine exhaust system. The wood flooring is random width (3-1/2" to 11") Yellow Pine plank, butt-edged (minimum 1" thick) and face nailed with machine-made cut nails. Some oak planks are evident as patches.

Plate A4-1 and A4-2

Condition of wood floors varies:

Ground Floor:

Plate A6-27A

a. Boiler Room (010) floor is in poor condition and rotted.

First Floor:

a. Boards are in fair condition, generally sound though extremely worn, retaining extremely good historical character.

Bib. 9

b. Whole boards have been temporarily removed in each space for ventilation with wire mesh nailed over the openings.

Second Floor:

a. Boards are generally in fair to poor condition and very worn and uneven.

b. Flooring in paint shop (room 201) is covered with paint; historic character is valuable.

Attic Floor:

a. Boards are in fair condition, generally sound. Some rotting has occurred under the roof where it leaks, and discontinuous boards, south of the east chimney, present the major problem areas.

4. Finish

Plate A1-5

Generally, the entire structure is open and unfinished, except that the Bench Shop (room 101) is sided with vertical beaded boards. In the Blacksmith Shop (room 103D1), the east wall is original siding, painted. Unpainted board partitions separate rooms 102, 103 and 201 and 202. The storage room (room 204) south wall is original building A siding, painted.

All interior finishes, such as they are, are in fair condition, giving an illustion of historic industrial character. Miscellaneous graffiti throughout the structure relates to historic use.

Plate A6-23B

Reference 1. Machinery and Furnishings

Bib. 7

Apdx. E

Bib. 5

Plate E-3

All mechanically powered and significant manually powered machinery and furnishings were inventoried as part of the relocation documentation. A condition survey as well as a survey of the electric drive machinery is included in the Appendix. Essentially, all machinery remains in original locations except for the dado cutting machine (I-5) which was originally located in the Bench Shop. Some hand-operated machinery, obsoleted by extant powered machines of the historic period, were in the building. All have been removed with the small tools to storage. One important machine was removed and sold by the Grubers: a hub mortising machine with indexing head was once located in the Wood Shop, probably over the summer beam and driven from pulley D-112, or a now missing pulley. A manually operated tire bender (I-21) is in storage.

All machinery appears to be in near operable condition although some items have worn bearings and are out of adjustment. The wheelwright benches (room 101) all have undergone minor alterations for the installation of electrically driven bench tools.

2. Gasoline Engine System

Initially powered by water turbine, the Wagon Works' machinery drive system derived its power from a gasoline engine for most of the historic period.

a. Engine

Plate A1-7A

Built by the Otto Gas Works of Philadelphia, serial number 10337, the engine is a single cylinder two-

stroke, four-cycle, stationary apparatus. Fueled by gasoline, the 16-3/4 inch diameter horizontal piston was spark-fired to develop 15 horsepower.

The connecting rod turns a crank shaft with two large flywheels and a belt-drive pulley. A flywheel governor and valve mechanism are controlled by the external horizontal cam shaft which is driven from the crank shaft by bevel gearing.

A "hit-or-miss" governor controlled device, operating from the cam shaft, maintains the engine speed at 260 r.p.m. It sensed the engine speed through the governor and automatically regulated the intake of fuel. When the engine would begin running too fast, no fuel mixture was introduced into the cylinder and there was no ignition. The double flywheels did the work until the engine slowed down and began firing normally again.

Use of the engine was discontinued at an undetermined date following a breakdown, possibly the result of cylinder/piston wear, valve wear or bearing wear. Much surface rust exists on the rear of the engine as a result of roof leakage. The engine was not reconnected to its water cooling, gasoline or exhaust lines following relocation.

Plate A6-28

b. Engine Electrical

Evidence of removed electric wiring indicates that originally a DC circuit, probably from batteries of primary voltaic (wet chemical) cells, provided the electricity for spark. An existing DC circuit from a dry-cell battery system replaced the original system. The disconnected electrical wiring and one battery remains. A cord from the Bench Shop to a

knife switch in the engine room was probably used to disconnect the battery.

The original glass wet-cells are not extant and the dry cell battery and existing wiring are deteriorated and disconnected. Condition of the sparking plug is unknown.

c. Engine Cooling

Originally, the cooling system was non-recirculating water from a pump in the original turbine pit (room 101) piped through the engine to a drain on the exterior. The original pump is a suction-type (piston contains valves) with an attached closed secondary chamber of unknown function. The piston connecting rod was mechanically driven by a crank from a counter shaft. The extant cooling system is gravity fed from a tank in space 102B.

Plate A7-2

The pump and all piping were removed and stored in the building during relocation but not reinstalled. The pump is heavily corroded, the casing is broken in two places, and it is presumed not to be operable.

d. Engine Exhaust

An exhaust manifold was connected to an iron pipe with a clay tile sleeve beneath the concrete floor. A wrought iron pipe exhaust stack outside room 108 sat on a concrete base at grade level and was connected to the underfloor pipe. The underfloor pipe was cut to disconnect the stack during relocation because all pipe fittings were frozen by corrosion. The wrought-iron stack is corroded to a protective patina; it is stored in the building. The clay tile sleeve units were broken during removal and discarded. The engine

room concrete floor was not poured in southern third of the room to allow subfloor exhaust reconstruction.

e. Engine Fuel

The engine was fueled by a two pipe system from a buried exterior gasoline tank through a fuel pump on the engine. The gasoline tank was removed, probably in the 1950's, when a house was built near or on its site. The tank is stored in the attic.

3. Mechanical Transmission System

Apdx. E This system also was previously inventoried as part of the relocation documentation including shaft assemblies, pulleys, bearings, couplings, clutches, cranks and belts. Some machines do not have individual stationary power disconnecting devices and are assumed to have been operated by a portable device. Individual disconnecting devices, either belt shifters or clutches, are located
Apdx. E with certain drive system components. Power disconnecting devices are generally out of adjustment. Some are missing various wooden parts.

All components of the transmission system were reinstalled after the relocation, though all shafting was left loose and unleveled in the bearings. The shafting, pulleys, bearings and couples appear to be in good condition though some hanger bearings are badly worn. Drive belts and belt fasteners are leather or cotton; all are generally deteriorated.

4. Forges

Plates A1-7A The 1883 original building had two forges on the west end
A6-7B (room 103A) consisting of stone foundations below floor
and A6-26 level (replaced with concrete block foundation under the relocation contract); a brick chimney and hearth above the floor with a sheet iron surface; and blower tubing

Plates A6-26B and E-2 and firepot of cast-iron. A later electric blower on the north side and a manual blower on the south side of the chimney remain. Anvils and a swage block were set on log posts adjacent to each hearth projecting through the floor to foundation supports (not rebuilt during relocation). Smoke chambers entered the chimney beside each firebox at the hearth level.

Plates A3-1 and A6-27B

Plate A6-26A The original forges are in poor condition: the brick hearth base is deteriorated; the north firepot casting is fractured; brickwork around the smoke chambers is broken and falling out; and the anvil and swage block bases are deteriorated.

When the 1910 addition F was constructed, two additional forges were added. Originally on stone foundations below the floor, this forge construction was removed above the floor level after the peak production period (c.1923).

Plate A7-3 Evidence is strong, however, for that later forge configuration. A patch in the floor corresponds to a stone foundation evidence at the original site (reconstructed in concrete block under the relocation contract). Additionally, rectangular patches in the floor locate former anvil bases constructed similarly to the anvils in the original building. Excessive floor wear evidences active blacksmith stations and the sheet iron hearth is cut off indicating a former extension. Blowers, blower tubing, smoke chambers and chimney or exhaust hoods are not extant, but tapering siding (original west wall of building A) indicates an exhaust profile up the chimney mass concluding with two flue openings in the top of the chimney. The suggestion is that metal hoods were connected to pipe flues. Hooks and rings in the adjacent ceiling joists suggest active use of removed forges during period of highest activity.

Plate A6-27A

5. Electrical System

An ungrounded, 2-wire, 110 volt AC system was used historically to activate light fixtures, outlets and the later addition of electric motors. The system is an exposed insulated wire with porcelain ceramic knob and tube insulators.

Plate A6-25B

Apdx. A4

There are four AC circuits as follows:

Circuit 1 - basement spaces 001, 008, 006, 010 (ten lights, one remote light switch, one outlet, one electric motor with knife switch).

Circuit 2 - first floor spaces 10k, 102A & B, and 103D1 (fifteen lights, three outlets, two electric motors with knife switches, one electric motor with outlet plug only).

Circuit 3 - first floor spaces 10k, 102A, 103A, E & F, and 108 (twelve lights, five outlets, one electric motor with knife switch, one electric motor with outlet plug only).

Circuit 4 - second floor spaces 201, 202, first floor space 108, two exterior feeds from second floor (eleven lights, one electric motor with knife switch, former exterior service to barns or exterior lights).

The AC wiring system is in poor condition as a result of ioration of wire insulation; the knob and tube insulators are generally in good condition. The system does not meet existing electrical codes because it is not grounded, has exposed wire at light fixture terminals, circuit panel, fuse panel and knife switches, and exposed splices at branch circuit terminals. The electric motors, though

their condition is presently undeterminable, appear to be in working condition. All light fixtures and outlets are in poor condition from corrosion.

During relocation, the system wiring was cut and ends color-coded at cut lines. The wiring has not been reconnected. The exterior wiring and some insulators were removed and not replaced in spaces 008, 009 and 010; these materials are now stored in the Bench Shop.

6. Elevator

Plate A6-29A The elevator is a four-point, cable-hung, open platform suspended from 2-2 cable drums on a windlas shaft. One cable from each drum, extending across the shaft opening to a sheave, allows manual operation from the single windlas at all levels via a spur gear on the windlas meshed with a pinion gear (Ratio: 10-1). The pinion shaft is manually-operated by the friction of an endless
Plate A6-29B rope on a large sheave. The rope passes through cast sleeves in the floor. A lever-operated, banded hand brake is located on the pinion shaft. Generally operable, the wire rope cables, gearing, sheaves, shafting and bearings appear in good condition. Brake leather is dry and worn and the brake is out of adjustment. The endless fiber-rope is badly worn. The platform binds at its southeast corner when raised to the attic floor level.

7. Cast-Iron Stoves

Wood/coal burning stoves provided heat for working in cold
Plate A6-25A weather. The stoves are cast-iron pot-belly type of varied southeastern Pennsylvania manufacture. The stoves are connected to the chimneys via sheet metal pipe flues.

Plate A3-1 Four stoves remain the plant:

a. Bench Shop - with vertical flue to east top of chimeny

in Paint Shop. Evidence of an earlier stove location is shown by an adjacent flue to the east base of the chimney in Paint Shop room 201.

b. Paint Shop - with vertical flue to the north side top of the chimney in this room.

c. Blacksmith Shop, east wall - with missing horizontal flue (hangers remain) to the east side top of the forge chimney.

c. Blacksmith Shop, west of the forge chimney - not an original location. This stove may have been located in the wagon and lumber storage area of second floor where a flue opening remains in east side top of the forge chimney.

All stoves have some cracked and broken castings such as sliding doors. One stove has a section of cast-iron bowl replaced with sheet metal. The extant two flues, one in the Bench Shop and one in the Paint Shop, are both in good condition with minor surface corrosion. The balance of flues are missing though extant hangers indicate locations.

Plate A3-1 A fifth stove, located in the Wood Shop, was removed to storage. This location was not original as no evidence exists for a flue connection. (The Wood Shop was unheated). This stove also may have been located on the second floor storage area.

8. Iron Storage Shed (Addition C3)

Plate A1-4A This single-story, wood frame structure houses wrought-iron bar stock in pigeon-holes. Generally in good condition, the structure was relocated on a reconstructed stone

Plate A6-2A foundation. Current grading at the site causes constant

moisture accumulation within the shed.

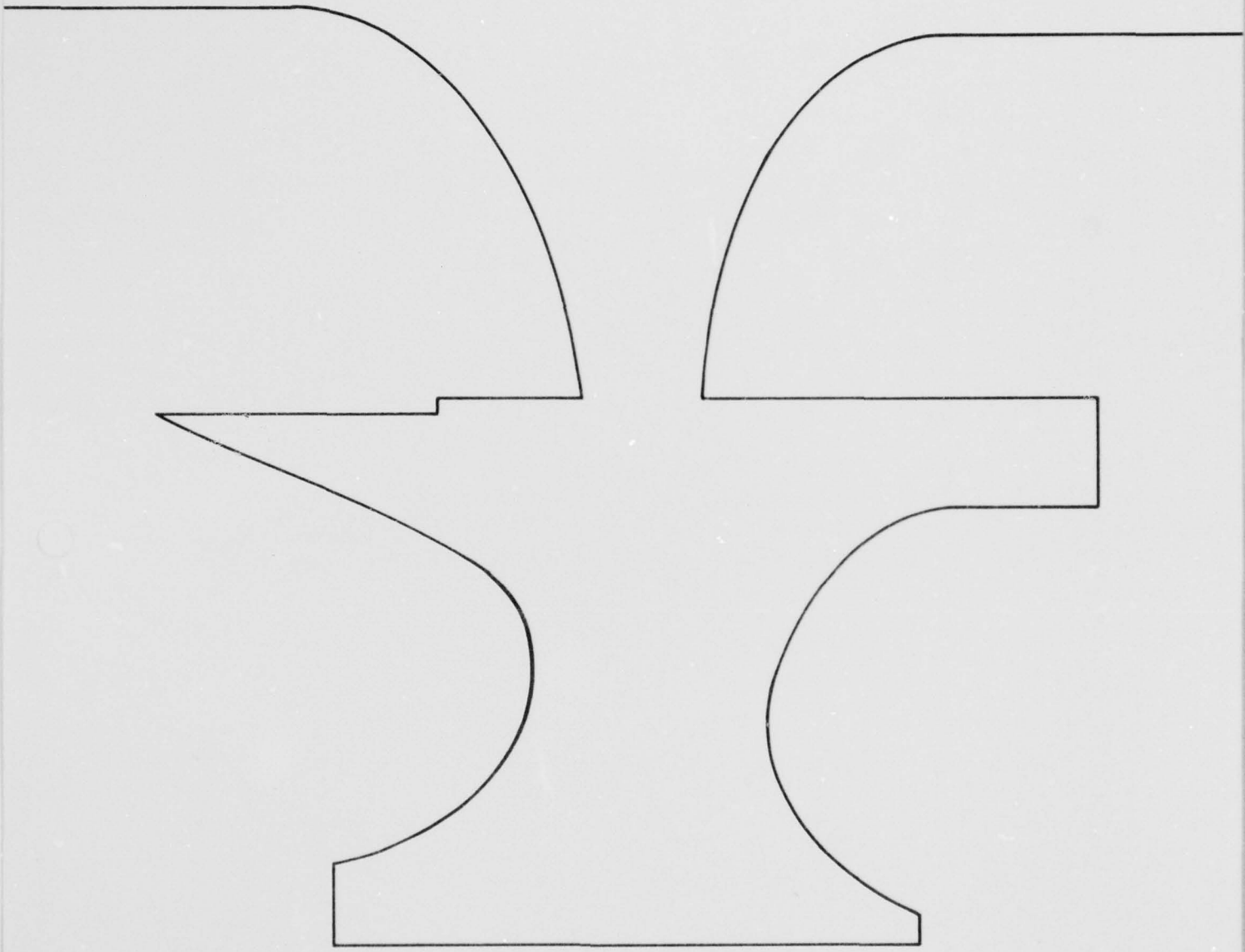
9. Outhouse (Addition C2)

The necessary structure was relocated on a stuccoed concrete block foundation. It is not functionable. Generally in good condition, the vent door in the east side is missing.

Plate A6-20A

10. Urinals

Two porcelain enamel, cast-iron fixtures were conveniently located (rooms 102B and 202B) on the south wall with immediate discharge to the exterior via 1" diameter lead piping. Both fixtures are badly deteriorated and only small segments of the pipe remain.



RESTORATION PLAN

Reference 1. General Considerations

The Gruber Wagon Works offers an unparalled opportunity for the permanent display of an entirely complete archaic American industry - the integrated factory production of the farm wagon. It is especially significant that this seemingly last remaining intact wagon-making operation is located in Pennsylvania, since the Commonwealth historically had the largest number of wagon and wheel manufacturing concerns of any state. Because of its thematic historical importance to Pennsylvania, as well as the entire country, it is imperative that it be managed and exhibited in a highly professional manner that both respects its national significance and maintains its intrinsic character.

It should be pointed out that the operation of the Wagon Works as a production facility has been ruled out. This conclusion has been reached for three reasons: first, reinstitution as an active shop would seriously compromise the possibility of its dual use as a museum facility because of seriously conflicting safety, protection, and circulation requirements; second, wear on the antique machinery and tools would be unacceptable over the long run if in frequent use; and third, use of the Wagon Works as a museum facility only has already been planned.

The use of the Wagon Works as a museum necessarily would not rule out its occasional use to restore Gruber Wagons for display there or in another building. However, custom building of historical reproduction wagons by mechanized methods is currently being done by Arkansas Village,

Jonesboro, Arkansas, largely with machinery acquired from the defunct Hoopes Brothers and Darlington Wagon Wheel Works of West Chester, Pennsylvania. In addition, a small number of individuals are also engaged in wagon restoration and building around the country by hand and/or with modern and some antique machinery. None of these operations are known to contain anything nearing the completeness and integrity of the Gruber Wagon Work:, but do satisfy the demand for restoration and new construction of farm wagons.

Basic considerations must soon be addressed in planning for this museum operation after responsibility for the
Bib. 7 structure and its contents passes from the Corps of Engineers to Berks County. Important questions must be answered concerning such museological considerations such as the accessioning of the collection of hand and machine tools, wagons and other items; their long-term preservation; the security of these artifacts; staffing the museum; the interpretation and exhibition of the building and its collections; visitor reception, orientation and control; funding sources for museum operation, etc. These considerations are briefly discussed below to suggest a satisfactory scenario for eventual implementation of a museum operation.

2. Development Plan for the Red Bridge Historical Area

The Park and Recreation Board of Berks County is planning the development of a major interpretive park facility at
Bib. 7 the site to be known as the Red Bridge Historical Area. It will be an additional component of their Tulpehocken Creek Park which extends about three miles along the creek northwest from the Reading city limit to the Corps of Engineers fee line below Blue Marsh Dam. The abandoned Union Canal is located in this linear park on the north

bank of the creek. Its towpath is now a National Foot Trail that links the various nodal park facilities together.

Plate A6-1B The Red Bridge is still extant but is no longer open to vehicular traffic. It will provide pedestrian access from the south side of the creek to both the towpath and the proposed park facilities on the north side of the creek, including the Gruber Wagon Works. The bridge, built in 1867 and originally known as Wertz Bridge, is a covered Burr arch truss spanning 204 feet. It is reportedly the longest single span covered bridge surviving in Pennsylvania. It is not listed on the National Register.

The County is planning to acquire an additional thirteen acre parcel on the west side of Red Bridge Road directly across from the thirty-two acre parcel on which the Wagon Works is now located. The thirteen acre tract contains a farmstead including a late eighteenth or early nineteenth century stone farmhouse, a barn probably built within the last thirty to forty years, and several small outbuildings. The farmstead is located at the north end of Red Bridge, about 150 yards south of the Wagon Works on Red Bridge Road.

The farmhouse and barn are now planned to house a 1,400 piece collection of Union and Schuylkill Canal artifacts recently donated to the County. This collection will relate thematically to the adjacent Union Canal (in operation from 1827 to 1884), especially Lock 48 which was recently restored by the County. The lock is located about a mile above Red Bridge and will be accessible via the towpath trail. The lock and adjacent canal prism remains, in the County Park, are not on the National Register.

Thus, Berks County will be actively responsible for a major canal museum as well as the restored Wagon Works, and more passively with Red Bridge and, although somewhat remote from the Red Bridge site, the canal lock. Together, these elements represent a mascent museum of technology and suggest the establishment of a museological organization capable of the coordinated planning, management and operation of this important melange of 19th and 20th century American industry and engineering. It is also felt that the Wagon Works, because of its unique characteristics and national significance should be considered the major element of this group, and its integrity vigilantly protected.

3. Interpretation and Exhibit of the Wagon Works

The Gruber Wagon Works, as an intact entity of original building and equipment, when restored will form a museum of the highest authenticity because of its intrinsicly accurate context. Because it contains a rare stationary gasoline engine and an example of all but one of the mechanically driven woodworking and machine tools that were normally associated with an integrated local wagon works, its very fabric is its own museum exhibit. The hub mortising machine, essentially a standard mortising machine with an indexing device mounted on the table, was sold and removed from the shop well before Corps involvement in the project. No further foreign exhibit material needs to, or should, be added to its rich contents, since this would only detract from the ambience of the shop as it existed during its most active period. Thus, no display panels or three dimensional interpretive exhibits are recommended for use anywhere within the building, although every effort should be put forth to acquire a replacement hub mortising machine. When interpreted either by trained guide, or audio equipment, in conjunction with

operation of some of the machinery and major hand tools and display of several Gruber wagons, the Wagon Works is expected to provide an exhibition complete enough for the general visitor to appreciate its technological and social implications.

The actual visitation to the Wagon Works must be limited
Plate A7-3 to controlled groups of eight to ten persons at any one time in each of the three major first floor shops. This size group appears to be the largest that can be visually controlled, spacially accommodated in the more restricted areas, and audibly addressed in a context of operating machinery. It is axiomatically assumed that any exhibit of the Wagon Works will be accompanied by at least partial operation of the machinery and mechanical power transmission system.

Audible interpretation seems capable of being logically instituted in the six major exhibit spaces within the Wagon Works. These six areas, which are both functionally and acoustically suggested by the physical layout, are in
Plate A7-2 suggested order of visitation: 1) Engine Room (remote viewing); 2) Main Shaft Room; 3) Bench Shop; 4) Wood Shop;
Plate A7-3 5) Mechanical/Blacksmith Shop; and, 6) if workable, wagon
Plate A7-4 display area on the second floor.

This circulation scheme is based on several criteria. First, the progression through the Wagon Works in this order is the most logical succession of spaces in terms of power production, transmission and use, and the chronological extension of mechanical power from the nineteenth century production areas into the twentieth century additions. Second, this circulation path is generally direct; the only major conflict would be in the main shaft area
Plate A7-2 which dead ends. However, this space contains ample area and, in conjunction with the gasoline engine area, can be used to hold school groups (usually twenty-five to forty

children) where they can then be subdivided to optimally sized groups for transit through the last four areas where the small group size must be maintained. Third, this succession of spaces, while not actually following the production sequence, has certain functional relationships within spaces among the various machine groupings and locations. Finally, to see a variety of completed wagons at the end of the tour, either on the second floor or in another building suggests a logical progression from raw material to finished product. It would be instinctive to include as many work pieces and parts in assembly within the three shop spaces as possible.

Plate A1-8

Two methods of audible interpretation are possible. The first interpretive method is that of the trained guide. This person would be required to explain the general use of each of the major areas and, through the use of the tools and machinery, how wagon parts and assemblies were made and put together. Also, the guide would give a descriptive summary of each of the major machines, directly at each machine. The guide would also be able to actually operate the macinery, or at least set them in motion, to help explain their function and operation.

The second interpretive method is that of an audio system that would perform much as the trained guide, but would not require the training program that would be needed for such guides to be effective. This method would still require that each group be accompanied by a guide, but the function of that person would be limited to security, timely movement of the tour group through the building and operation of selected machinery in coordination with the taped audio material. This guide would also be responsible for starting the audio loop in each space. The main advantage of this method, in addition to the drastic reduction in the training program, is the assurance of a controlled quality of interpretation.

A remote possibility would be the non-guided touring of the structure using only a visitor activated audio system. This method could only be recommended if the hand tools and other small objects were firmly secured in place or not displayed at all. Neither of these restrictions can be instituted because of the impracticality of the former and the serious interpretive impairment caused by the latter.

Auxilliary spot lighting would be effectively used to highlight each important work station, machine or wagon in synchronization with the taped audio system so as to sequentially "point" to each item in the absence of a trained guide. The interpretive aid could also be used with the trained guide through manual operation of the interpretive spotlights; this combination of the two methods would seem to be the logical solution at Gruber, given the potential problems of finding guides or acquiring sufficient reliable volunteers.

Reference 1. Concept

The common theme that has bound support for preserving Gruber Wagon Works since its discovery has been its eventual restoration and display as a functional museum. Indeed, the enabling Congressional legislation authorized and amended that dual effort.

With this background, the Corps of Engineers has planned that the"Building will be restored to its early twentieth century state of evolution as shown in photographs and measured drawings prepared by the Historic American Engineering Record, except that it shall be strengthened structurally."

Apdx. B
A/E Contract

Specifically this means the restoration of the building architecturally and structurally. It has also been interpreted to include the disposition of the Wagon Works' complement of mechanical power systems and machinery. The function of this report section is to establish a plan for directing that restoration work.

As the Wagon Works declined in the period after c.1920 when the motorized truck started to rapidly replace the farm wagon, fewer new wagons were required and the Wagon Works became a repair shop. From that period, electric motors were individually installed to operate specific machines used in this repair work. The specialized wagon-making equipment was never electrically motorized, indicating that this machinery still was run occasionally by the gasoline engine. Thus the electric motors were not a part of the wagon making process, but were only to operate individual machinery, most of which post-date the active period of wagon making.

Therefore, the restoration will return the Wagon Works to its architectural and mechanical condition of c.1915. At that time, all architectural and mechanical additions had been made and the electric light system installed, though none of the electric motors, with the possible exception of a rheostatically controlled blower on the forge, had been installed. The c.1915 date seems to be the period of maximum development of the wagon making trade before the post-World War I decline began.

2. Use Restrictions

Federally owned facilities, though not required to meet lower governmental building code restrictions, accommodate local restrictions whenever possible, particularly for public safety and, as in this case, where facilities are to be turned over to local governments for perpetual use. Further, Federal statute and agency regulations often exceed local code ordinances. The following code restrictions apply to the Gruber historic facility:

Bib. 2

a. Construction type: Ordinary and wood frame.

b. Occupancy classification (proposed): Educational.

c. Limitations imposed by a & b above:

1) One story use permitted only.

2) 8,000 square feet maximum floor area permitted.

3) Unencumbered access to exits.

4) Two exits remotely located, but none exist more than 100 feet from another.

5) Restricted use of cellar area.

6) 100 pounds per square foot controlling live load for occupied spaces.

3. General Program of Restoration

Within the guidelines established above and in the previous museological section, the restoration program is planned around the exhibition of the Gruber Wagon Works based on a controlled guided tour for reasons of safety and security. The tour would involve the entire first floor, and the basement areas containing the line shaft, engine room and stable area. These spaces will be restored to historic appearance but the remainder of the basement spaces on the west end of the building will remain unfinished and closed to the public. To make the interior as authentic as possible, all hand tools, hardware stock, patterns and power tool bits, cutters, and other pertinent items in storage would be returned to their documented locations adjacent to the machinery, work benches and forges. Security of these pieces primarily would be the responsibility of the guide. All extraneous materials and equipment that have accumulated over the years such as the electric motors and electrically powered tools will be removed from the display areas.

Chapter 11

See pp.63-64

Bib. 8

Initially it was felt that the upper floors should remain closed except by special application with no additional access provided because of the obtrusive effect such installation would have on the building's historic appearance. The Paint Shop and historic use of other upper floor spaces could be described by guides, and the elevator worked from the ground level (first floor) to illustrate its function and operation, and to allow a glimpse of the upper floor structure.

Nonetheless, it is recognized that additional display space of extant Gruber wagons in the building is limited unless the second floor is utilized. The second floor cannot be open to the public for structural and fire egress reasons. Therefore, as a compromise alternative, a lightweight stair and viewing platform is planned for installation on the elevator platform which could be lowered to the ground level as needed to allow visual access to the second floor. Hence, permanent obtrusive impact would be eliminated, yet allowance would be made for display of the upper floor areas including the wagons and elevator machinery.

Apdx. D1
Bib. 2
Plate A7-4

The gasoline engine will be restored to operating condition including the installation of its historic exhaust system, the electric ignition system, a new underground fuel tank and a water-cooling system. Water for this cooling system would be provided form a new well on site. The restored pump will be displayed in a reconstructed turbine pit. The restored engine would be capable of operating the line shaft and machinery on an occasional basis. Continuous operation of the line shaft for machinery exhibition will be accomplished by turning at the end with an electric motor.

Plate A7-2

All mechanical equipment will be operable and it would be the responsibility of the exhibiting agency to decide which of these machines would be operated. Existing clutches on each machine will be made operable and provision for shifting each out of gear will be provided. Those machines that did not have separate clutch mechanism will be idled with portable shifting devices (probably the original method). The line shafts and belt shifts on the first floor is most cases are out of reach, or shrouded, and could, therefore, be operated along with the engine and main shaft. Some additional belt shrouding will have

to be provided.

The c.1912 electrical task lighting system would be rewired with new insulated wire matching the appearance of the original. Reenergized to illuminate the work stations at machines, all fixtures will be restored to operating condition. Modern lighting fixtures for accent and safety illumination will be provided on separate circuits to provide sufficient lighting levels for visitor circulation and optimal viewing of machinery and tools.

Heat will be provided by the restored coal-burning cast-iron pot-belly stoves. Supplemented with electric space heaters, room 101 would be comfort-conditioned as a space for tour guides and visitor discussions. The building would be unheated in all other spaces and at all other times -- it was not heated extensively during its historic functioning period. The cellar will be ventilated to control moisture.

4. Use of the Building

As a prerequisite to finalizing recommendations for restoration of the structure, the following is a proposed room usage schedule. (Note that non-public spaces -NP - are those not physically accessible to the public though many -NPV- are visually connected to public access, and some have exhibits).

		Space No.	Space Name	Public/ Non-Public
Plate A4-1	Cellar	001	Line Shaft Exhibit	P
		002	Mechanical & Storage	NPV
		003	Crawl Space	NP
		004	Crawl Space	NP
		005	Emergency Generator & Mechanical	NP
		006	Stable	NPV

		Space No.	Space Name	Public/ Non-Public
		007	Exhibit	P/NPV
		008	Engine Shed	NPV
		009	Passage	P
		010	Boiler Room	NP
		011	Crawl Space	NP
Plate A4-2	First Floor	101	Bench Shop	P
		102A	Wood Shop	P
		102B	Wood Machine Shop	P
		103A	Blacksmith Shop	P
		103D1	Blacksmith Shop	P
		103E	Blacksmith Shop	P
		103F	Blacksmith Shop	P
		104	Office	NPV
Plate A4-3	Second Floor	201	Paint Shop	NPV
		202A	Storage-Wagon Display	NPV
		202B	Storage-Wagon Display	NPV
		202D1	Storage-Wagon Display	NPV
		203	Storage-Lumber	NPV
		204	Elevator	P
Plate A4-4	Attic Floor			NP/NPV

Reference 1. Grading

Specific site grading around the building must be accomplished to assure proper drainage away from the structure. The drainage problem is accentuated by the building's siting with topography rising up in front of the structure. An out-growth of solving this problem will be establishing the basis for historic setting site improvements.

Plate A7-1

Specifically, the following grading criteria would be accomplished:

a. Establish a positive slope away from the north facade of the building of at least one percent for a minimum of 25 feet.

b. Cut and mold definite swales to the east of the main structure and to the west of the Iron Storage Shed for positive drainage of ground water from north and east of the building complex.

c. Lower the grade at the building from six to eight inches below all wood siding to prevent moisture from rotting wood sills and siding.

d. Cut grade between Door A005 and the eastern porch to allow minimum one percent grade away from a lowered door sill at A005, the reconstructed steps from the upper level and from addition C1. Grading around the east facade porch could establish a ramp for allowing handicap access to the lower level.

Plate A7-2

e. Establish minimum one percent negative slope away from all sides of the Iron Storage Shed including lowering the grade to a level at least six inches below the siding. Establish a positive swale east and west of this structure to assure continuous positive drainage.

f. Lower the grade on the south elevation from Door D001 west to accommodate a lowered floor in that room and effect positive drainage of at least one-percent south from the building.

Plate A7-1

g. Reconstruct a drainage tailrace from the reconstructed archway south of addition B to accommodate foundation, mechanical equipment and engine cooling drainage.

2. Grade Surface Treatment

The following work would be basic to successfully completing the surface treatment adjacent to the structure, visually and functionally:

a. Remove the chain link fence.

b. Provide erosion control for all disturbed slopes over 3:1, new swales and all remaining disturbed work areas.

c. Construct stabilized gravel or "slurry" paving around the building to allow for foul weather circulation and to establish a historic setting in context. All walkways will be a minimum of 4'-0" wide.

3. Site Improvements

Though improvements at the site generally are not the

responsibility of the Corps of Engineers, site development such as roads, walks and parking areas will be essential for public access. However, part of the restoration would include the original concrete retaining wall and steps on the south end of the east porch. The steps would be extended to accommodate a lower grade entrance to the cellar at Door A005 and to assure safe clearance under the office addition (D3).

4. Site Utilities

The preservation and operation of Gruber Wagon Works as a functional museum is dependent on an adequate supply of water and electricity. Unfortunately, the new site is not serviced currently by a substantive enough quantity of either utility.

a. Water

Availability and cost of installing water to the site is the primary determinate of the type and extent of fire suppression for the National Landmark structure. In addition, water is needed for cooling the Otto engine and for the Blacksmith Shop. Several alternatives are available.

Obtaining city water with constant pressure is the most expensive possibility in any size. Two tap locations are available. One is a thirty-six inch diameter steel main located on the opposite side of Highway 183 at the junction with Red Bridge Road. The distance for required line installation is over 2,700 feet which would cost between $50,000 and $70,000 depending on the size of pipe installed. The other location is on the site side of the new controlled areas highway north of the Wagon Works; an existing unused one-inch diameter connection is loca-

Bib. 7
Dwg. 42972

ted 600 feet southwest of the Route 183 overpass. If easements to land between the sites of the connection and Wagon Works could be obtained, the line installation would involve between 3,500 feet to 6,000 feet and cost between $60,000 and $102,000. The city water alternatives are prohibitively expensive.

Two other alternatives exist. Tulpehocken Creek is a constant flowing natural water source that could be tapped for water. Lying 400 feet from the site, the creek water could be pumped directly to the historic structure in sufficient quantity for fire suppression. A sub-alternate to that proposal is to build an emergency holding pond of 100,000 gallons or more capacity to be fed by creek water. This is presented as a possibility only with a later funding potential for consideration with further development of the County Park. It would be prohibitively expensive to construct as part of the Gruber Wagon Works restoration.

It is recommended that water for the fire suppression system be provided by laying an 8" diameter pipe to the creek and using a diesel powered pump. For cooling water and the Blacksmith Shop, it is recommended that a well be drilled on site. Both pumps would be installed in the Mechanical Room (005).

See p.68
Plate A7-2

b. Two electrical systems are recommended. One is an overhead single phase, 110V line which would reconnect, at the aerial historic juncture, to the original knob and tube wiring and supply general lighting requirements. This service is presently available on site.

The other system requires heavier service and would involve additional work by the electric utility, Metropolitan Edison. 230V single phase power would be made available approximately 300 feet from the building. Service to the structure will be brought in underground and a converter installed to change the single-phase to a three-phase. Both single-phase (heaters) power and three-phase (line shaft motor) service are required.

Reference 1. Foundations

Work on the foundations involves both cosmetic reconstruction and structural rehabilitation.

Plate A3-1
Plate A7-2
Apdx. D2

A cosmetic stone veneer will complete the building's historic appearance. All above grade concrete block surfaces will be removed and a stone veneer constructed to match the original configuration. The interior veneer construction will be limited to those spaces visible to the public. All foundations are to be at least 24 inches thick.

Plate A7-2

New concrete masonry units (CMU) foundations will be installed adjacent to the forge foundation for support of the swage block and two anvils in room 002 and the anvils in rooms 003 and 004. New CMU piers are to be built under the power punch and shear machine (I-24) in room 005 (fireproof construction required for space use proposed). A concrete foundation is required under the engine exhaust stack adjacent to the exterior east wall of room 008.

See p. 51

The north foundation wall must be pargetted and dampproofed and a continuous drain installed to prevent damage from excessive water penetration. This will necessitate excavation of the entire north facade and trenching around the building to install a drain tile system. It is intended to drain this system to a reconstructed tailrace exiting from the south wall of addition B.

Plates A7-1 and A7-2

Plate A7-2 The floor levels in rooms 001 and 005 will be lowered to accommodate public and mechanical facility requirements. Underpinning of some footings will be required. Since the foundations are not low enough to accommodate the level change needed, a 1:1 battlement in earth, stabilized by chemical treatment, will join the old and new levels and protect footings. Underpinning will be required at door A005 entry and under one wooden post.

2. Framing

Rehabilitation and reconstruction of the framing is essential to the preservation stability of the Wagon Works. Deterioration of the structural condition continues: it is imperative that arresting water penetration of the structural skin becomes the first order of business, specifically including the foundation damp-proofing, grading and roofing tasks.

Particularly, the following work items are required:

a. All broken, missing or badly rotted joists, beams, sills or summer beams throughout the structure are to be replaced. In general, all new parts are to match the appearance and quality of a removed member.

b. Addition B will be leveled above the replaced lintle, door B001, removing wedge-shaped flooring support between the second floors of rooms 202B and 202D1.

c. Rotted posts, beams and other structure parts surrounding the elevator from the ground floor to the roof will be replaced.

d. Stud blocking on the east side of room 102B will be replaced.

Apdx. F
Bib. 1

e. All structural framing, particularly on the first floor level, will be treated for wood boring beetles, termites and dry-rot.

f. All loose siding will be renailed or reset to help recreate the building's structural skin.

g. The temporary plywood roof sheathing will be removed and roofing lath restored in keeping with the historical and architectural integrity of this National Landmark.

h. Rotted or broken sheathing on flat roofs will be repaired and plywood sheathing installed over original board sheathing prior to installing new metal roofing.

Apdx. D2
Bib. 2

i. Structural supports will be added in rooms 001 and 002 as required to establish first floor live load limits.

Reference 1. Roof

After framing integrity, watertight roofing is essential to the maintenance of a long lasting structure. A large part of the Gruber Wagon Work's structural problems have been caused by roofing failures. Though an accurate reconstruction of both slate and painted metal roof is preequisite, it is the recommendation of this report that longer-lasting, relatively maintenance free roofing materials be installed.

a. Slate Roofs

The original Pennsylvania slate appearance can be matched with a more durable material from Virginia.

Plate A6-10A

While maintaining all detail characteristics of the Gruber Slate roofs, the new slate work would be installed on open lath (slating) in strick accordance

Bib. 17

with the 1926 standards of the National Slate Association. The entire slate roofing system would be flashed per the above reference standards with a long-lasting material such as lead-coated copper. Flashing would be concealed wherever possible from exterior appearance, except as originally exposed on the building. Exposed flashing would be painted.

Snowguards would be reinstalled with the new slate roofing. The extant forged wrought iron straps, in good condition, would be electrolytically cleaned,

Plate A6-10B

stabilized and painted. New guard straps required would match the original appearance, but would be made of hot-dipped galvanized mild steel bar stock (parenthetically, wrought iron is prohibitively

expensive). The board guards will be made of Western Red Cedar for durability, attached to the anchors with galvanized or stainless steel carriage bolts, washers and nuts. The entire snowguard assembly would be painted.

b. Metal Roofs

For durability, the flat and standing-seam painted metal roofs would be made of a long-lasting metal such as lead-coated copper. Though not historic, all flat seams would be fully soldered for prevention of moisture penetration. Roofs would be flashed to meet the design criteria of the Gruber original appearance and the recommendations of the Copper and Brass Research Association.

2. Chimneys

Chimney restoration has to be considered in conjunction with utilization of the forge and cast-iron stoves.

Plate A1-1A

Though the required repair work and reconstructions above the roof will be made, workable chimneys for reuse of the stoves and forges must include basic fire protection devices. This work would include chimney cleaning and general repair, sealed stove and forge pipe entrances, and flue linings. The eastern chimney would have to be rebuilt completely from the attic floor; the second floor level part must be preserved intact.

3. Gutters and Leaders

Apdx. D5

These items will be restored and rebuilt to their original extent, not only for historical purposes, but for control of on-site rainwater. All parts will be made of long-lasting material such as lead-coated copper, and will be painted.

4. Cornices

Cornice repair/replacement will occur as the roofing is replaced when the exact conditions of all material can be determined. Rotted joist ends would be cut off behind the facade face and replaced with scabs or dutchmen. All cornice work is to be painted.

5. Siding

Siding repair is another key to maintaining the building's structural and historical integrity. All deteriorated siding material would be taken out and replaced, generally in whole board lengths. Obvious single pieces would be spliced in, e.g., under window sills. All loose siding would be renailed. For structural reasons, some siding, particularly on the west and south elevations of

Plate A6-6B Addition B, will need to be removed and reset as the building section is leveled. All siding at grade level on the east and north elevations would be replaced as

Plate A6-20B would selected bottom boards on Addition C1; all wood sills beneath siding must be covered. Weather worn characteristics of extant siding would be induced onto new boards by light sand blasting prior to installation. All siding will be painted.

6. Paint

The entire building exterior would be repainted with an oil-based, semi-gloss enamel as follows:

Apdx. D3

Snowguards, cornice, trim and frames of windows and doors, corner boards and doors:	Munsell 7.5Y3/2
Siding sash, gutters & leaders:	Munsell 2.5Y8/6
Flashing and metal roofing:	Munsell 10Y4/4

Unfinished, exposed replacement framing will receive treatment of clear linseed oil with lampblack pigment to blend with original members.

7. Windows and Glass

All sash, fixed and operable, will be tagged and removed for repair. Repair will include dipping each sash in a controlled paint removal solution for cleaning and loosening of glazing putty. Glass would then be removed, cleaned and reglazed after the sash are repaired and tightened. Glazing will reuse the old glass first at the first floor sash level. The balance of the glass being either the historic glass or new antique reused material or new B-quality float glass.

See p.43

Frame repair will take place while the sash are out of window openings. Repair generally would be by dutchmen prior to sash replacement (dutchmen are oversize controlled patches of deteriorated sections rather than replacement of an entire board).

Sash would be prime painted and reinstalled once the exterior carpentry work is completed. All sash are to be operable with first floor windows receiving an unobtrusive locking device.

8. Doors and Hardware

All hardware on the building's exterior would be removed, cleaned, repaired and primed prior to reinstallation. All hardware, including box locks, will function and missing keys would be provided.

Apdx. D4

A separate keyed locking system would be installed to assure security. The system will be master-keyed.

Repair of doors, frames and sills would be performed as indicated with dutchman repair preferred over total replacement.

Reference 1. Finish

Plates A1-5 and A1-6A

Generally, the interior of this building is its open frame structure except for the horizontal boarding in the Bench Shop (room 101). All spaces were unfinished. The proposed restoration would limit interior work to structural repair, and blending of that repair to match the appearance of the existing adjacent surfaces. All repair work is to be the same wood species (generally White Oak) and graining characteristics of the member repaired. The objective is to represent the structure as if no restoration work had been accomplished, so that the interior appears as it did when the factory was in the zenith of its operation, c.1915.

2. Insulation

See p.48

Plate A4-1

See p.69

The building cannot be insulated, invisably, due to its exposed structural finish. The Bench Shop (room 101) however, with its boarding, will have formaldehyde foam insulation blown in between the exterior siding and interior boards to provide a more controllable heated space for tour guides in winter weather.

3. Stairs

Plate A7-3

Apdx. I

None of the existing stairs would be used by the public. A stairway would be constructed over the stairs at Door A120 which will meet current safety standards (three risers and a handrail) and carry through the floor preservation and circulation scheme.

All stairs will be repaired to maintain their extant condition; in general, this repair would be limited to re-

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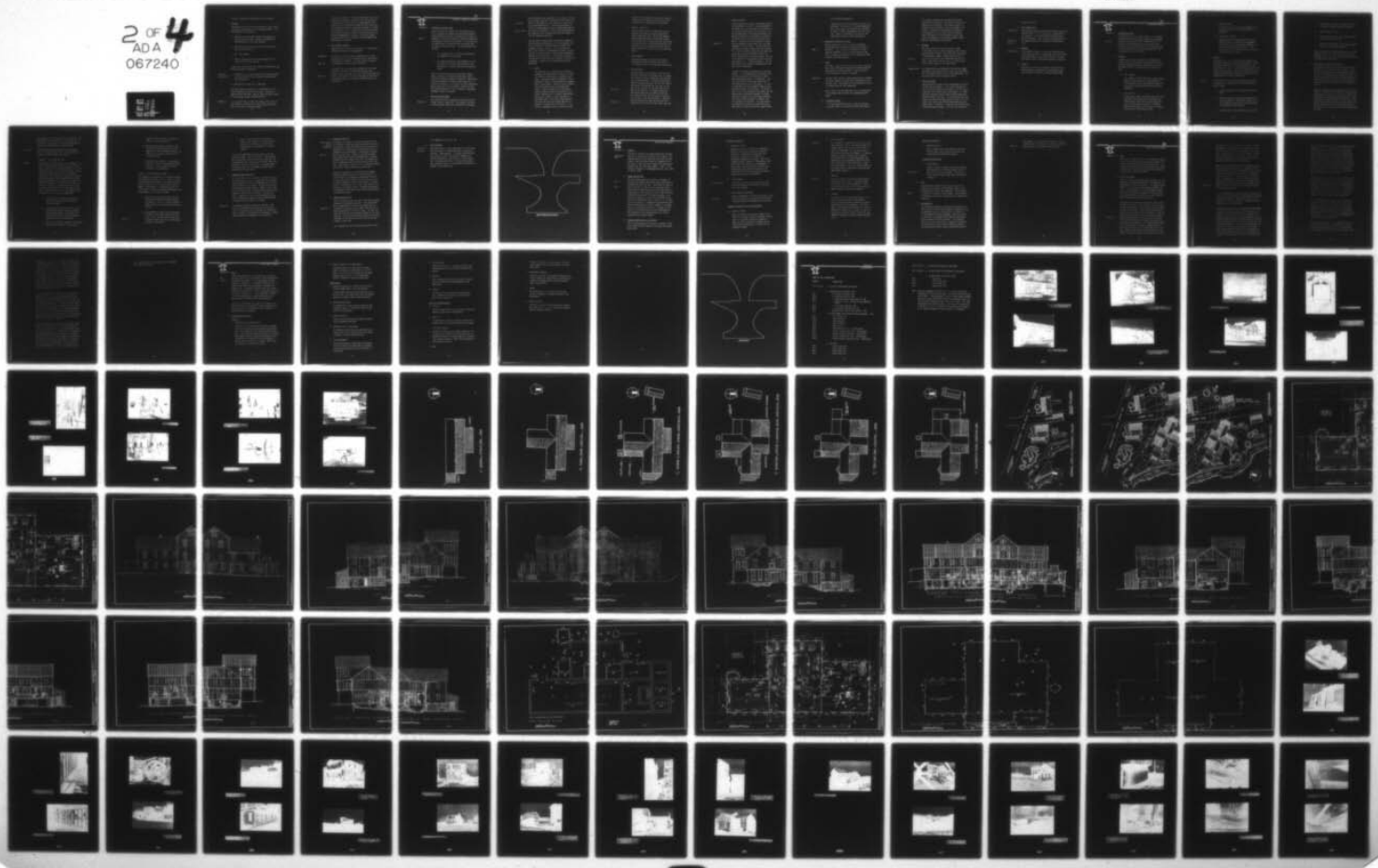
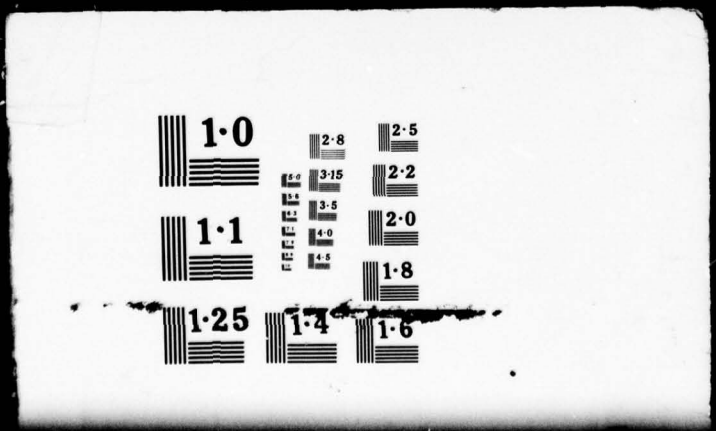




(entire floors), instead of zoning dis-
charge to individual spaces

nailing. Extremely broken boards will be replaced.

4. Flooring

Preservation of the extant wood flooring is a key to the picturesque image completion of the wagon factory. The work generally is defined as:

a. Replace all rotted and/or broken floor boards to exactly match the width, species and general wear characteristics of the piece removed.

b. Reinstall flooring removed for ventilation during the relocation contract.

c. Nail loose boards.

d. Broom or vacuum clean the structure only prior to installation of floor matting.

In addition, new concrete floor slabs are required to complete the adaptive restoration:

Plate A7-2
See pp. 51-52

a. Completion of the engine room floor in Room 008 after installation of the engine exhaust system and fuel line connections.

b. New mechanical room floor in Room 005.

The public would be admitted to a large portion of the cellar Room 001 as part of the display. That space, beginning with Door A005, does not have sufficient height to allow access without some modification.

Plate A7-2

It is proposed here to lower the earthen floor level in that space to a minimum 7'-0" clear height at the door and in the room in a controlled area.

Finally, to protect the flooring from further wear and to preserve its character, control visitor circulation and to visually orient the public to a programmed exhibit layout, wood or neoprene mats would be installed on top of the wood and earthen (stabilized) flooring. A system of railings for visitor security will be installed with this matting as design elements at pot-belly stoves, but are not recommended as a general circulation feature - a guide should be able to control visitor movement and keep people on the mats.

5. Miscellaneous Features

Several features would be reconstructed to complete the functional exhibit of the Wagon Works.

Plate A7-2

The coal bin and chute (opening A006) would be reconstructed after the cellar flooring exhibit construction in Room 001 is completed. This work would be based on extant materials and the HAER field notes.

Bib. 12

The turbine pit, a stone masonry chamber will be reconstructed in Room 001 from the HAER recording data. Though this was the water source for cooling the gasoline engine, that historic cooling system would not be reconnected functionally, but would be restored as part of the exhibit.

See p.74

Reference 1. Machinery and Furnishings

General and specific details for the rehabilitation of all mechanically powered and significant manually powered machinery and major furnishings are listed in *Apdx. E* Appendix E. With the exception of the Otto engine and the mechanical transmission system, it is not possible to rehabilitate the machinery and furnishings under the present contract funding. The work generally will include:

a. All equipment that is not to be retained will be removed from the building.

b. All remaining machinery and equipment will be protected from further deterioration by the application of surface coatings and protective covers.

Under the musuem program to be completed by Berks County, machinery not rehabilitated under contract should be restored to operation condition. Where machinery was converted to electric motor operation, it should be returned to its original belt-drive operation. Where electrically driven machines replace original belt-drived machines of similar function, replacement equipment should be obtained.

2. Gasoline Engine System

The proposed period of restoration includes the Otto *Plate A7-2* Engine located in space 008. This engine, installed in 1906, was the last major prime mover of the Wagon

Works machinery, and essentially it is intact. The extent of repair required is uncertain at this time. Supposedly, the engine was shut down after a failure in the cylinder/head section. Exterior examination revealed no major damage or areas of undue deterioration. This piece of machinery is a rare surviving example of this type and size of engine and should be restored to its full operating condition.

See p.50

See a. below

The Otto engine remained the prime source of power at the conclusion of operations. It is not proposed, however, to reoperate the wagon making machinery and equipment with this engine. On a daily operating basis, the problems of maintenance and repair and the need for a skilled operator would create unnecessary problems for the new owner. In addition, the continued operation of the engine will eventually lead to its own demise. Therefore, the following work will be undertaken:

a. Engine

The engine will be restored to its operating condition for demonstration publically at specific times during the day or on specific occasions. The engine should be completely disassembled and rebuilt, replacing worn and damaged parts in the process. Both the actual restoration and operation could be arranged with special interest groups such as the Rough & Tumble Engineers Historical Association from Kinzer, Pennsylvania, or similar organizations whose basic interest is the restoration of early machinery. Preliminary investigations have indicated that such people would be interested in undertaking this project. It is further recommended that this work be carried

out during the restoration process to ensure its completion and proper installation and interfacing with the remainder of the machinery.

b. Engine - Electrical

The electrical system for the engine will be restored including the control wiring which went to the bench shop. The battery powered spark system should not be functional because of the difficulty of maintaining the system. Wet cell jars with appropriate wiring would be reinstalled but actual operation would be from an AC/DC converter that would not be viewed by the public.

c. Engine Exhaust

The complete exhaust system will be rebuilt using the salvaged parts where possible and in a manner similar to the original installation.

d. Engine Cooling

The sump pump in this turbine pit will be cosmetically restored to the degree that it assumes its original position, appearance and operation, but is non-functional. A reconstructed system could be provided and water fed into the rebuilt turbine pit for pumping, but this does not appear to be practical for the few times the system will be required. For engine operation, the cooling water will be taken from the site well system and fed into the original system at a point out of view from the public. The drain would be modified to enter the building drain system and exit out the tailrace under space 007.

See p.74

Plate A7-1

e. Engine Operation

The Otto engine will not be reconnected directly to the primary line shaft. During operation of the engine, the line shaft drive belt should be on the idler pulley which will allow for a visual interpretation of the engine operation. For general operation of the machinery, an electrical motor will be used to drive the main line shaft. The motor is to be installed in space 002 and connected to the end of the line shaft extending into this space. The shaft would be modified to receive a pulley and clutch mechanism. On/off switches controlling the motor will be placed at various locations on the first floor, depending on the museum program. The size of the motor will be equivalent to the existing Otto engine, i.e., fifteen horsepower. The original shaft speed, which was approximately 230 rpm, will be maintained.

Plate A7-2

In order to simulate the operation of the Otto engine, it is recommended that the engine drive pulley be backdriven by the main line shaft when the electric motor is in operation. This will require shifting the main drive belt to the driven pulley on the line shaft. It is desirable under the usual operation mode to have the engine appear to be working. To accomplish this, it will be necessary to disconnect the connecting rod to allow the flywheels to rotate, which will simulate the basic engine operation. This would allow the engine to "operate" and still protect the cylinder. The final method will depend on the ease of accomplishing the above and the probable operating schedule based

on the museum requirements.

A new engine fuel tank and supply lines will be provided. The tank will be located underground, well outside the building and will be designed to meet all modern requirements for such a system. Special attention will be given to the safety and security of this installation.

3. Mechanical Transmission System

General and specific details for the restoration of the mechanical transmission system are listed in Appendix E. The line shafts including all of the mounting components, drive and idler pulleys, couplings, clutches and bearings will be restored to their original operating condition.

Apdx. E

4. Forge

The extant original forge on the east side of the chimney in room 103A would be carefully dismantled and reconstructed to working condition. Cast iron parts will be repaired or recast as required.

The west forge would be reconstructed based on evidence of similar masonry and metal plate construction as on the east side. John Gruber will be consulted to assist in ascertaining the final appearance.

Plate A7-3

Anvils (four) and the swage block will be reinstalled on new timber bases to match the fragmented extant bases.

5. Electrical System

It is the recommendation of this report to display, in working order, the restored knob and tube electri-

cal system to operate task lighting at machinery. Fuses and knife switches in the office are not to be accessible to the public. All electric motors including circuiting thereto, are to be removed. The system, if rewired with insulated wire (matching the appearance of the historic wire), spliced in strict accordance with the National Electric Code (NEC) and grounded at the building entrance, would meet NEC requirements for operation.

6. Elevator

The device which eliminated the need for ramps to the upper floors, currently operates over its full working height, binding only at the attic floor level in the southeast corner. Restoration of the elevator and its use will be accomplished not only as a part of the factory function, but as a means of providing visual access to the second floor.

See p.68

Plate A6-29A The system requires replacement of the one-inch diameter endless hemp rope and brake lining, and adjustment and "fine-tune" balancing to be fully operational. The platform requires minor carpentry repair.

7. Cast Iron Stoves

These pot-bellied stoves require replacement of various castings due to breakage. To be used as heating devices, the stoves would be positioned in their original locations, set on sheet metal stove plates. All flues would be replaced to their proper chimney insert with galvanized metal flue pipe. All stoves would have flue dampers and should burn only anthracite coal. It is intended that these stoves provide the primary heat for guided tours. Obviously, circulation must be kept away from these heating devices - rails will be erected to

serve as barriers.

8. Iron Storage Shed

Plate A1-4A

This extremely interesting building requires only minor carpentry repair to its siding and a locking device for the doors. Its standing seam sheet metal roof would be replaced. The structure's preservation will

Plate A6-2

be immensely improved by solving the grading problems.

See p.71

9. Outhouse

Plate A6-20A

This structure requires a false door reconstruction on the east side which allowed access to the pit below. A new sheet metal roof would be installed. To prevent usage, a door locking device would be installed.

10. Urinals

The two cast-iron urinals fragments would be recast, porcelainized and reattached to lead piping on the south exterior of addition B (rooms 102B and 202B).

Reference 1. Supplementary Heat

To supplement the coal burning stoves, it is recommended that electric-resistance, fan-driven unit heaters be used to heat room 101 only. Anthracite coal is the only fuel recommended for use in these stoves. Elsewhere, the structure would remain unheated, except for the mechanical equipment and residual heat from the forge and stone in room 103.

See p.69

2. Lighting

Lighting of the Gruber Wagon Works is required for visitor safety, building security and exhibit display. Under the restoration program, electrical service will be connected and will provide for the following systems:

a. Site Lighting

The existing "dusk-to-dawn" site lighting would remain for the duration of the restoration to provide general site illumination and security. Future site lighting by Berks County should be considered.

b. Task Lighting

As previously noted, the historic knob and tube electrical system with the building would be rehabilitated, providing low level task lighting at the machinery originally illuminated. Wattage would be kept at low levels to minimize glare occuring from the bare bulbs.

c. Exhibit Lighting

A system of display lighting programmed to fit a guided tour will be installed under the restoration.

d. Circulation Lighting

Minimal additional illumination would be provided for visitor circulation to supplement spill-over from task and display lighting. Fixtures would be surface-mounted and, in particular, would light doors, exits, walk constructions and changes in level.

3. Security

The remote location, priceless antique contents and vulnerable character of the Gruber Wagon Works creates an extremely high risk of vandalism and theft, and the potential of fire. It is an absolute necessity that the building and general contents be protected from intruders by an electronic system with audible alarm and immediate signal to local authorities.

Apdx. H The proposed system described in Appendix H outlines the basics of a system that will be installed which would include:

a. Contact detectors at all accessible exterior doors.

b. Contact detectors at selected accessible windows (including all grade level windows) with most attention being given to windows adjacent to important artifact displays.

c. Infra-red (non-visible) detection across indi-

vidual rooms to prevent undetected horizontal or vertical movement inside the structure.

d. Audible exterior alarm.

e. Signal transmission to local authorities and a security central station.

f. Continuous maintenance of the system by Berks County to assure proper operation.

Future contents protection would not be part of this immediate system, but could be compatible with the proposed installation. The contents security will be initiated with the exhibitry.

4. Fire Detection and Fire Suppression

The extreme vulnerability of this National Historic Landmark to fire, and its remote location, is cause for serious consideration to the immediate installation of a fire detection and suppression system. The rare nature of this particular building necessitates primary consideration be given for its protection, which will have the additional effect of protecting visitors.

Under the restoration, the sensory portion of a fire detection system would be provided by a combination of continuous small pneumatic tubing, which detect pressure changes, and ionization smoke detectors. Detection would be signaled through a control panel to an audible local alarm, activating an extinguishing system and notifying local fire department authorities. Detection is the first step in saving the Wagon Works from fire.

Two systems of fire extinguishment are possible, each with distinct characteristics. Both systems can be installed in the structure for less than $70,000 and work within the constraints of water supply.

See p.69

Since the building would essentially be unheated, both of the above systems would involve dry piping systems to prevent damage from freezing.

System 1. High Expansion Foam

Apdx. G

This system is conceptualized in the Appendix. Its basis is the high and rapid expansion of limited water resources and a detergent concentrate (1:1000) into an effective fire extinguishing agent. The application at Gruber would involve a maximum of 27,000 CFM of foam generation from two to five generators diversely located throughout the building. The main advantage of this system is the rapid dispersal of suppression of a detergent foam with limited water resources (fifteen gallons per minute). It has little residual effect on building and contents. Concentrate cost is minimal. Several problems detract from the system's capability:

a. Foam discharge openings (and/or ducts) are relatively large which necessitate discreet placement.

b. Larger generating machines which are less expensive than several smaller machines, are relatively heavy. The structure of Gruber would limit the size and therefore increase the cost of installation.

c. Due to the structure's openness, the system would have to discharge in large zones

(entire floors), instead of zoning discharge to individual spaces.

d. With the elevator down, potential foam leakage would necessitate provision of some type of foam containment "barrier" in order for the system to be effective on the upper floors.

e. Foam generation requires a like amount of outside air intake to the amount of foam generated. This air must be directly available to the generators.

System 2. Water Sprinkler System

This commonly used system has its biggest advantage in the localized control of fire. That is, zoning for protection can be done on a room-by-room basis with any combination of rooms having activation as needed. Water deluge is considered the most reliable means of extinguishing deep-seated wood fires. Disadvantages of this system include:

a. Heavy amount of water discharge into the building causing damage to both building and contents. This is a minimal concern at Gruber because of the absence of finish materials.

b. A large amount of water must be constantly available for use under pressure (50 psi). In this case, water would be brought from Tulpehocken Creek directly to the structure by pump for discharging.

See p. 74

c. Visual impact of piping and sprinkler heads in each space is a distraction from the historic character of the building, though today not unexpected in a factory setting.

It is the recommendation of this report to use the sprinkler system. Due to the nature of the building, this system offers better control by zoning, will be less obtrusive and is better suited for the type fires which are a distinct possibility. Increased damage to the structure and its contents by using water is considered to be negligible.

5. Emergency Power Generation

Bib. 2 It is necessary to have emergency lighting for visitor and staff safety. And for reliability, the fire pump must be capable of starting independently of the electrical system in the building. Standby battery power could be used for both systems. However, in the case of the lighting system, an undesirable feature is that emergency lights would be visible in the restored areas. Therefore, a diesel powered generator, capable of handling the emergency lighting and emergency starting of the fire pump will be used.

Plate A7-2 The generator would be located in room 005. Fuel would be stored underground outside the structure. This cellar masonry walled room would be fireproofed with a two-hour fire-rated ceiling and doors. Engine exhaust would be discharged out the south wall.

6. Lightning Protection

Plates A5-10A, A6-9B, A6-11A *and* A6-15B

An exposed, air terminal lightning protection system was installed on the Wagon Works during the relocation construction. Though the building most likely was not protected from lightning during the historic period, retention of such protection is technically advisable due to its open site. Indeed, as previously noted, every effort must be made to safeguard this important structure and its contents from fire. An exposed system is compatible with the active period of the structure. The system as installed is of a temporary nature and requires safety protection at grade level.

See p.96

Under the restoration, the system would be removed (necessary when the roofing is replaced) and reinstalled under the standards of the National Fire Protection Association, National Electric Code, by an experienced lightning protection contractor. An Underwriter's Laboratories, Inc., Master Label would be obtained for the reinstallation. Grounded cables would be protected 10 feet above grade level by painted polyvinylchloride piping.

7. Handicap Accessibility

Public law now requires that public facilities be made accessible to handicapped persons. The Gruber Wagon Works proposed exhibit takes into account this requirement by designating doors A005, A105 and F102 as handicap entrances accessible by ramp. The two first floor entrances would have portable ramps for use when required. A handicapped person would have to use both entrances to see the entire exhibit due to the level changes at door A120.

Plate A7-3

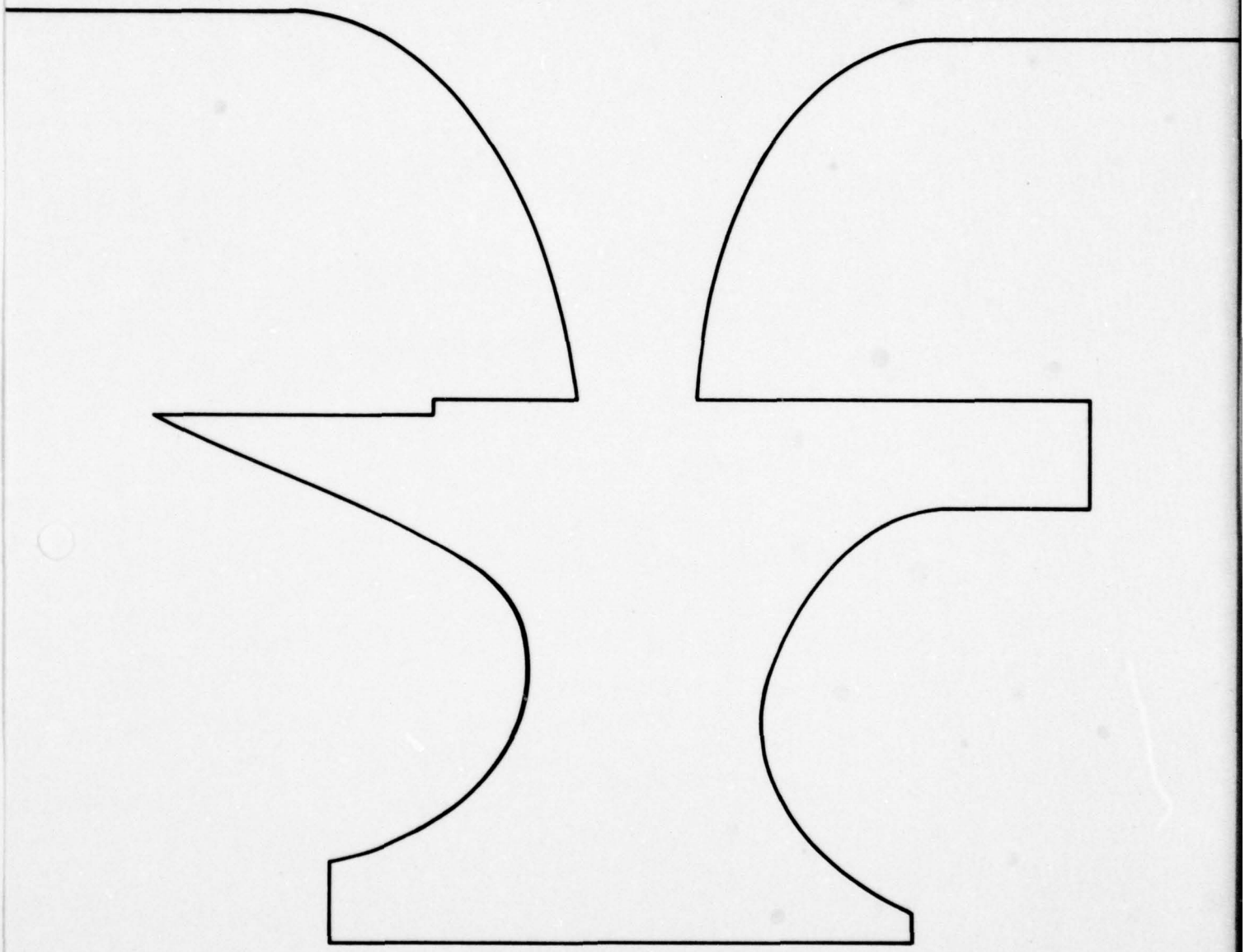
The proposed circulation walkway would have to meet

the standards of the public law.

8. Stair Platform

Plate A7-4
See p.68

The second floor of Gruber Wagon Works is to be accessible by means of a lightweight metal stairway and platform. Constructed on the surface reinforced elevator platform, this stair would be lowered into position when desired, and raised to lock the building. The walkby platform will allow visual contact with the upper floors of the Wagon Works and with the products of the manufacture.



RECOMMENDATIONS

Reference 1. Schedule

Restoration Plan

The work of restoring the Gruber Wagon Works has been detailed in the previous section of this report. The program outlined, once concurred with by the involved Federal, State and County agencies, immediately will be placed in the final design stage with Construction Documents due for completion August 1, 1978. A construction schedule is recommended from late Fall, 1978 to Spring, 1979.

2. Budget Restrictions

Bib. 11

Bib. 7

The legislation enabling the Corps of Engineers to relocate and restore Gruber Wagon Works establishes an estimated cost for that work. The amount of funds actually available to the Corps will necessarily be a major factor in determining the final construction interpretation of that legislation that, under the Corps' responsibility, the facility must be capable of accepting visitation to a basic working exhibit at the end of the construction period. Equally, it is essential that a basis for safeguarding and preserving this one-of-a-kind National Historic Landmark is included. Hence, to accomplish these goals, a program of work items has to be established with the recommendation that completion of the museum details will be the responsibility of Berks County.

3. Program Responsibility of the Corps

The following addresses the essential elements of the Corps restoration and adaptive use program for Gruber Wagon Works:

Structural Integrity

a. Treatment of Pests

Investigation has indicated that "powder-post beetles" are gradually destroying the wood structure. Indications are that the Corps might be in a position to accomplish a structures treatment this Spring. Since this program requires a period of inoccupancy, treatment prior to construction is recommended. A pest control specialty contractor and/or the Pennsylvania State University Extension Service should be consulted to determine precise methods and locations of treatment.

Apdx. F

b. Framing Repair

This work is critical to the structure's continued existance and its ability to function as a public museum.

See pp. 77-78

c. Site Grading and Drainage

Grading adjustments are required to assure a long lived structure and to solve the problems noted, including foundation dampproofing and drainage.

See p. 31

Preservation/Restoration of the Building

a. Exterior Facades

Stabilization of the structure, beyond repair noted in "b" above, requires re-roofing, siding repair and painting (including treatment of wood for dry-rot and pests), opening repairs (particularly reglazing), and installing the foundation veneer.

b. Fire Protection

See p.99

It is essential to protect this priceless structure from fire. Due to its remote location and timber construction, a signal alarm alone to a local fire department will not serve to protect the building and its contents. A lightning arrestor system already has been installed. The installation of a complete detection and suppression system throughout the entire building, including the attic and cellar, is additionally essential. This will include provision of a water source, pumping facilities and emergency power generation.

c. Security

See p.95

Due to its remote location and limited promise of adequate surveillance, a detection system with audible alarm and connection to a local *lar enforcement* agency is the best guarantee to thwart potential intruders and vandals.

d. Interior

A limited amount of repair and cleaning is required to put the interior into workable shape, with the exception of the forge complex, which requires major rebuilding. This phase would include adaptive restoration of stoves and chimneys for comfort heat, electric system renovation and auxiliary electric service for supplementary heating, building lighting and exhibitry.

Machinery Restoration

a. Machinery Repair

Repair, clean and put into operating condition the line shaft, Otto Engine (for display) and reconstruct the turbine pit and sump.

Display and Exhibition

a. Public Safety

Install a system of public flow control through the structure to assure safe passage and protection from running machinery. This would include lighting, ramps, steps, mats and possibly railings.

See pp. 86, 94

4. Cost

The preliminary probable construction cost for the program outlined above, if the schedule noted is held, is estimated to be less than $440,000. This estimate is detailed in Appendix C and includes a twelve percent contingency, but does not include costs of construction inspection.

Apdx. C

5. Documentation

The immediate production of construction drawings and specifications for the above program is essential if the recommended schedule of construction is accepted. It is recommended that those documents, with cost control by the Corps, be produced along standard Construction Specifications Institute guidelines. The documents should be of sufficient detail to award a construction firm-fixed-price contract after competitive bidding. The specifications should require pre-qualification of

the bidders for restoration experience and strict quality control of construction procedures. Drawings would be based on the HAER measured drawings.

Reference 1. Basis

Berks County, Pennsylvania will be the perpetual owner/curator of the Gruber Wagon Works and will control its surroundings in the Red Bridge Historical Area. The following recommendations are made to assist the County in planning for the proper interpretation and exhibit of the National Historic Landmark.

2. Visitor Facilities

Prior to arriving at the Wagon Works proper, it will be necessary to provide the facilities for reception and orientation of the visiting public. No graphic display material is to be part of the Gruber Wagon Works exhibit. Hence explanation of the development history and Corps of Engineers involvement in the relocation and restoration must be made prior to the visitor actually arriving at the historic facility.

The County also is currently developing several other thematic attractions in the vicinity. Thus, it would be logical to provide a centralized facility for these visitor services prior to their actual visitation of either the Canal Museum or the Wagon Works. Since the existing farm buildings appear to have already been

See p.60

largely programmed for the Canal Museum (the second floor of the farmhouse will probably be reserved for a caretaker's apartment), it will undoubtedly be necessary for the County to provide a separate Visitors' Center for both the Canal and Wagon Works Museum. Visitor control is additionally required because of the County's intention to make both museums fee facilities.

Requirements of visitor reception, ticketing, exhibit orientation to museum facilities, restrooms, offices, gift/book shop, etc. should be expected to take up at least 2,000 square feet. A small orientation theater would require an additional 500 square feet. Thus, ultimately harmonious and unobtrusive provision of these areas will need to be considered.

Other site considerations should be studied as part of the technological museum area. In addition to the siting and relation of museum elements to the visitors' center, consideration must be given to provision for unobtrusive parking on the north side of Tulpehocken Creek, a pathway system to both connect the various facilities together (yet respect the integrity of the Wagon Works), and planting to screen the Wagon Works from non-thematic and non-historic elements located in close proximity to it.

Plate A7-1

It is recommended that site development, adapted building use, and any proposed new construction be addressed to the entire site in a comprehensive master plan to provide the fullest environmental protection that will be feasible for the Wagon Works.

3. Professional Establishment and Operation of the Museum

In order for the Gruber Wagon Works to function as a museum of the quality that should be expected for a National Historic Landmark, the establishment of a progressive professional museum program should be pursued. Such a program would investigate areas beyond the basic interpretive program, visitor control and overall site and visitor center planning program outlined above. This program should include either the employment of both a qualified museum director and a technological curator for both the Canal Museum and the Wagon Works

to establish and carry out the museum programs. Another possibility is the retention of a qualified museum planning consultant to carry out the establishment tasks for both museums and provide consultation services following the initial start-up. Under either method, work would involve the establishment of the basic interpretive program, its associated historical research and a guide training program. Also included would be the provision and administration of such activities of equal long-term archival establishment, museum accessioning of all artifacts, and establishment of an artifact security system.

Restoration and preservation of small artifacts would be performed using proper shop and laboratory techniques. Archival materials that may be acquired concerning the Wagon Works would also be preserved and cataloged as part of these activities. All documentary materials might not be kept by the County, but perhaps they could be deposited in an established historical library willing to take possession.

It is recommended that a library type accessioning system be established to professionally catalog and identify all hand tools, individual machines and woodworking tools and their miscellaneous fixtures, wagons and other shop products such as sleighs and wheel barrows, etc. prior to their replacement within the Wagon Works. This task should be performed or directed by museum professionals.

Within the Wagon Works, it is recommended that a security system be provided in addition to building security for individual control of all easily portable hand tools, machinery fixtures and other small

furnishings. An electronic detection system similar to those now commonly used in libraries and some commercial establishments which sounds an alarm upon attempted unauthorized removal is suggested for each of these items. The alarm devices, activated by a magnetic chip applied to the artifact, would be located at the exit(s) only. This would allow the handling of selected tools, etc. within the Wagon Works by staff members for exhibit purposes or by visitors as permitted but prohibit unauthorized removal. Work to establish this system should also be performed or directed by museum professionals.

It is understood that John Gruber has volunteered to donate his time to train volunteer guides for the Wagon Works. His knowledge and interest should without question be used to the utmost. At the same time, long term considerations for continuity of the interpretive program and the other behind-the-scene museum work should be established. The time is approaching when it will fall on succeeding generations to maintain the vitality of the Wagon Works by calling on the knowledge of John Gruber and that which was provided previously by Franklin P. Gruber.

Planning and development grants for the museum establishment of the Wagon Works should be actively pursued. As soon as possible a grant application strategy should be planned in anticipation of the important museum work that should be implemented. The unique museum potential of the Gruber Wagon Works should provide excellent results for such efforts, if properly carried out. It is recommended that this grant application process be instituted in the very near future by Berks County so that museum planning can be

well underway prior to the transfer of the restored building to the County.

Reference 1. Basis

Bib. 7 and 10

Gruber Wagon Works will be transferred to the control of Berks County Park and Recreation Board following its functional restoration. It is anticipated that the structure, along with its incredible contents, will be opened to the public soon thereafter, presumably by Summer, 1979. The County necessarily has many responsibilities to assume first to set up the detailed museum and then to maintain it. If the recommended schedule is to hold, planning will have to begin soon, with muselogic work interfacing with the restoration.

To assic in programming this work, the following list outlines areas of assumed Berks County responsibilities previously noted or recommended in this report and and Preliminary Case Report.

2. Program Responsibilities

Planning

a. Comprehensive Site Master Plan

Establish, with professional assistance, a general plan for the integrated interpretative development of all site features within the Red Bridge Historic Area. This plan should address potential visitation, environmental control, adaptive building use, new construction, circulation, visitor orientation, visitor control, security, utilities, costs, funding sources, and program priorities.

b. Museum Program for the Wagon Works

A museum director and technological curator, and/or a contracted professional, must plan in detail the professional program for the interpretation and exhibition of the Wagon Works. Specific procedures should be established.

Construction

a. Accession, Restoration, Preservation and Installation of Wagon Works' Tools and Exhibits.

A professional team should be contracted to perform the work including control over the replacement of all items to their original location.

b. Machinery Restoration

A technolgoical curator should arrange for the systematic repair, cleaning and return to operation of all machinery.

c. Contract Security

Expand the building security system to protect display elements from theft.

d. Exhibition of the Wagon Works

A professional team should be contracted to establish and install the exhibition and touring structure, including guide training.

e. Site Development

Design and construct appropriate site improvements to establish the Wagon Works historical setting and provide access and circulation to the museum.

f. Visitor Center

Establish (construct) a visitor orientation and interpretation facility including restrooms and parking.

g. Staffing

Set up volunteer guides and hire staff to assure proper interpretation and maintenance of the Wagon Works.

h. Signage

Design and install coordinated interpretative and informational devices to minimize visual effect in the structure.

Operation and Maintenance

a. Electric

Assume responsibility for the electric utility and maintain lights, heat, and exhibitry.

b. Security

A professional should be retained to monitor and maintain the fire detection and security systems.

c. Fire Control System

Establish a regular and systematic checking, testing and repair schedule for maintaining the Fire Suppression System in a ready condition, including creek intake mechanisms. diesal pump and generator and suppression devices.

d. Heat

Provide for supply of anthracite coal and train tour guides and staff in the proper use of pot belly stove.

e. Maintenance Schedule

Establish a regular and systematic checking and repair schedule for maintaining and preserving all systems at the Wagon Works including building repair and painting.

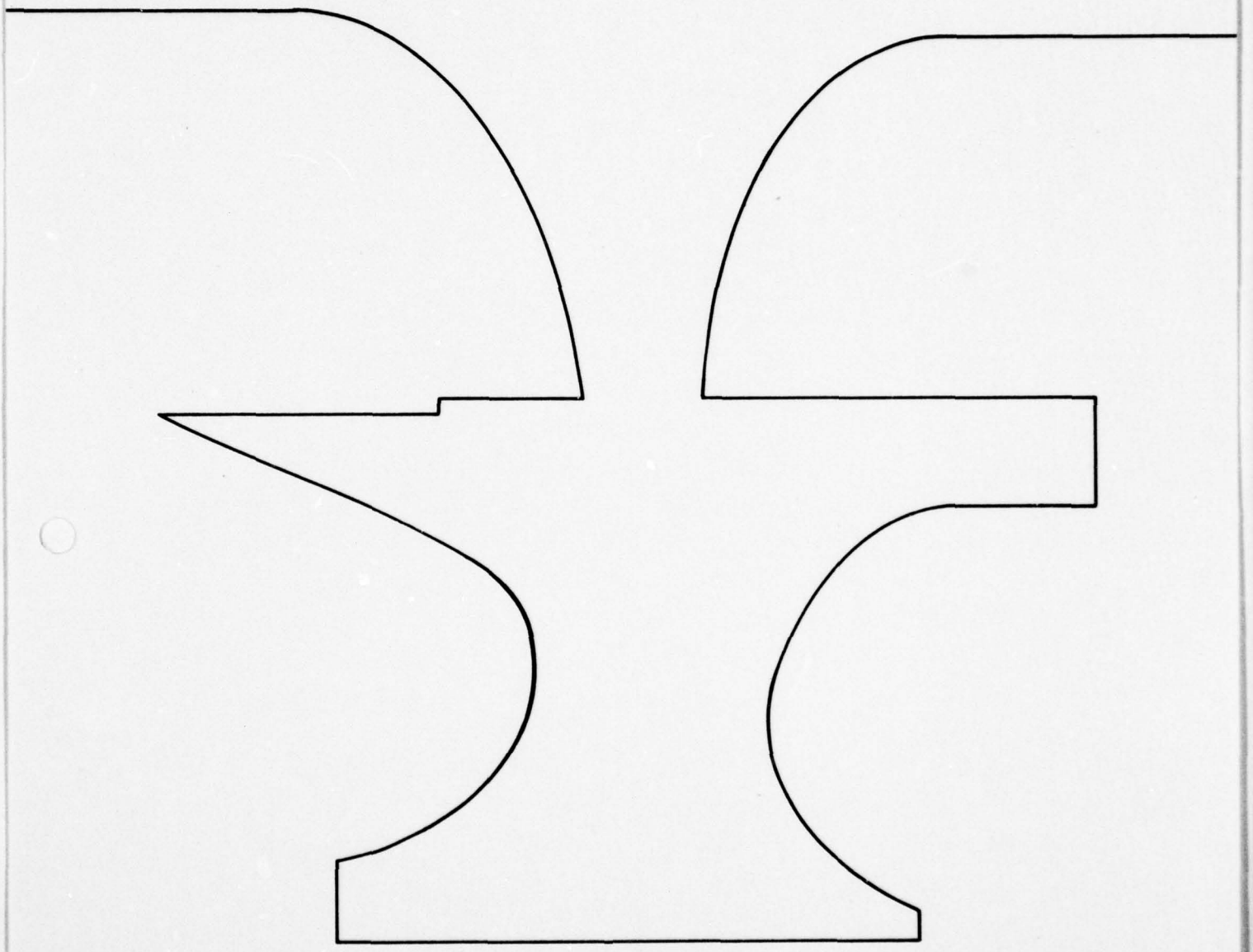
f. Guides

Set up procedure for continual staffing and training of guides for conducting tours of the Wagon Works.

g. Museum Displays

Establish a regular checking and repair schedule for preserving the building contents and keeping them in restored condition.

NOTES



APPENDIX

INDEX TO THE ILLUSTRATIONS

A5-1 to A5-10 5. Relocation Photographs (captioned)

A6-1 to A6-29 6. Existing Condition Photographs (captioned)

7. Exhibition and Circulation Plans

A7-1 Site Plan

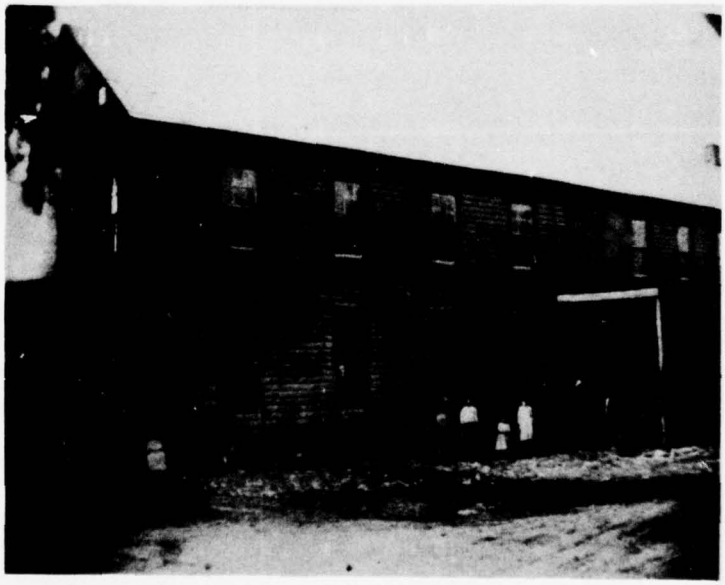
A7-2 Cellar Floor Plan

A7-3 First Floor Plan

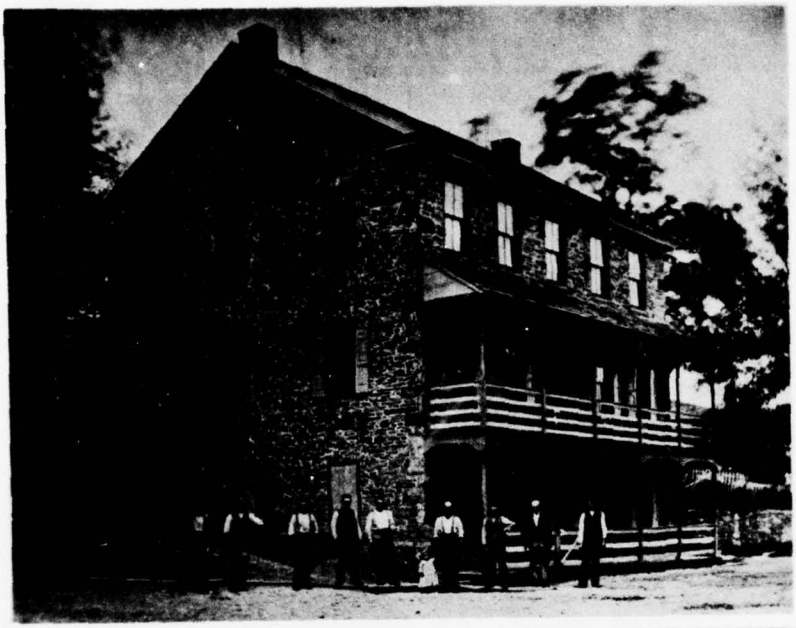
A7-4 Second Floor Plan

Note: Historic photographs (Plates A1-1, A1-2, A1-3A, A1-8A) and photograph of the relocation model (Plate A5-1A) were furnished by the Corps. The photographs noted with HAER negative numbers were part of the 1974 Historic American Engineering Record survey, and were furnished for the report by the Corps. All other photographs were taken by Robert L. DeSilets, R.A. and Charles A. Parrott, III, R.A., of John Milner Associates and prepared by Mr. George Eisenman, Dillon and Company, Philadelphia.

A) c. 1886 Wagon Works with Family and Work Crew

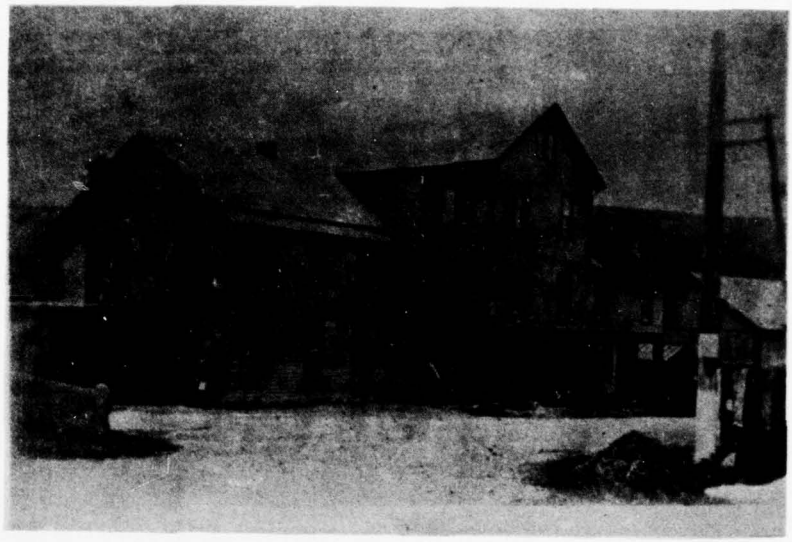


B) c. 1890 Wagon Works

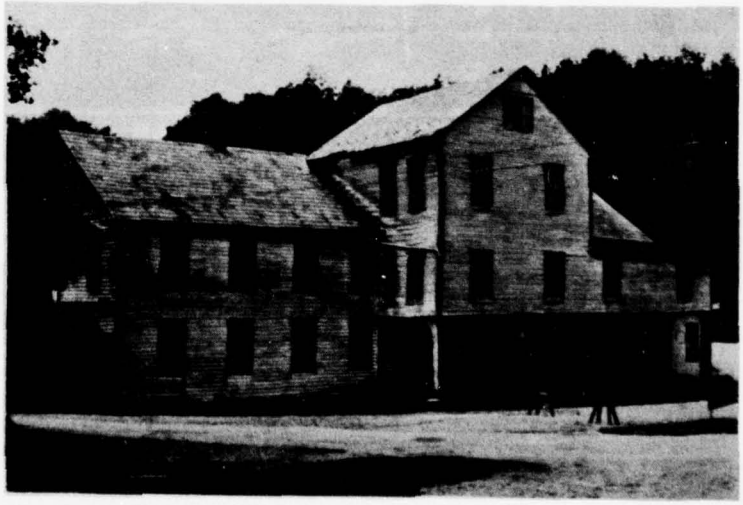


A) c. 1836 Gruber Home,
(Obold Store & Post Office)

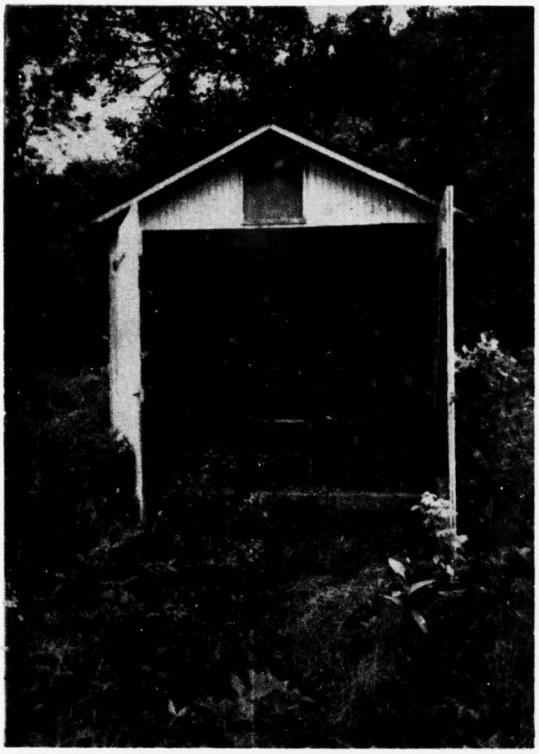
B) Pleasant Valley Showing
Gruber Homestead



A) c. 1920 Wagon Works

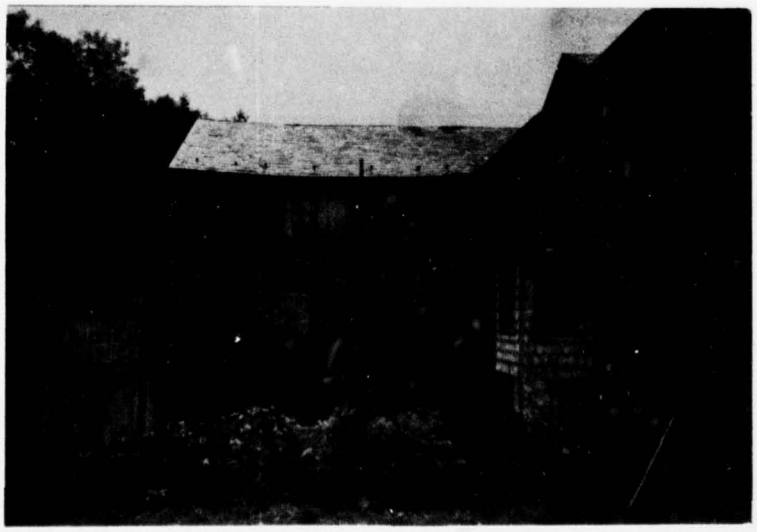


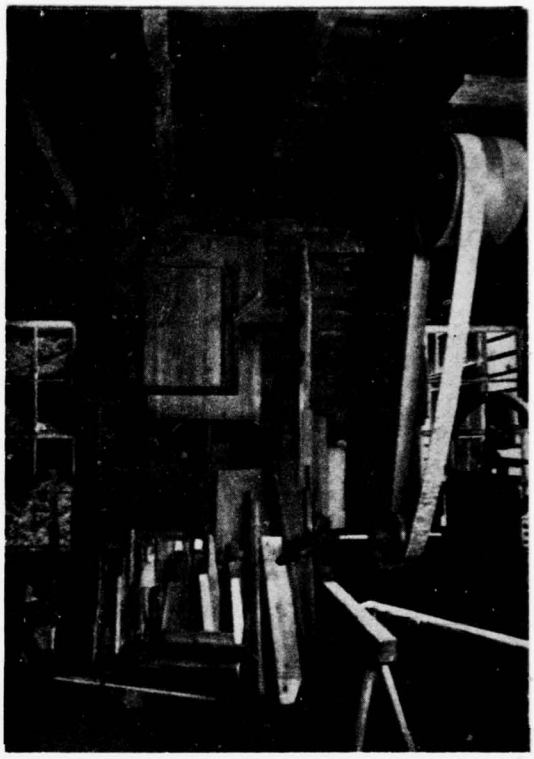
B) 1973 Wagon Works



A) 1974 Iron Storage Shed

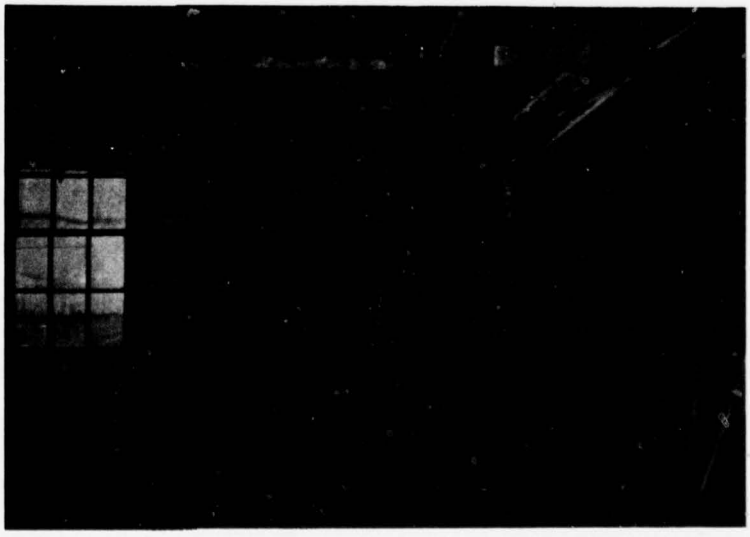
B) 1974 SE Corner of Building 'A' and Additions "B", "C-1", & "D-3"

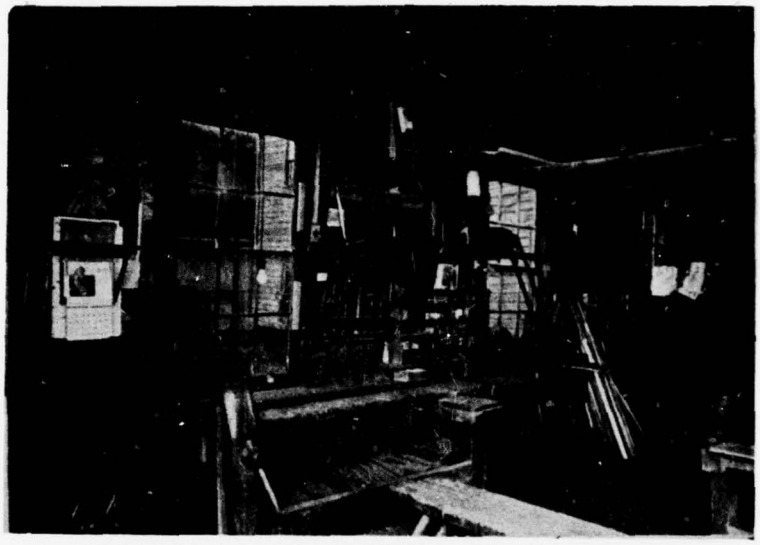




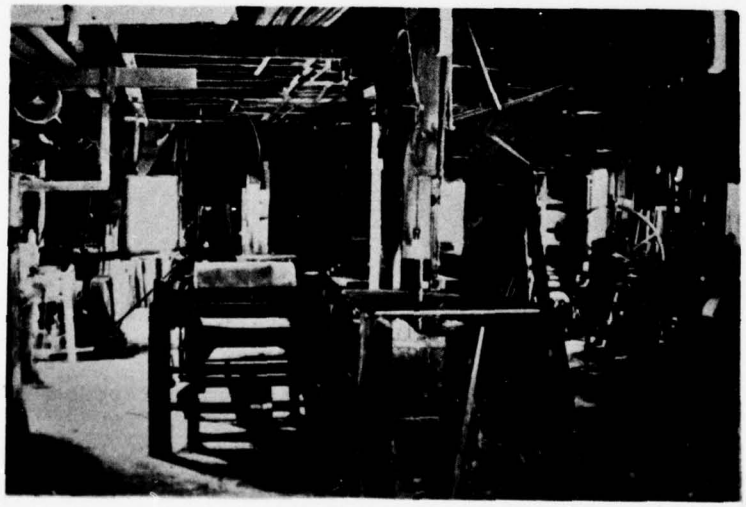
A) 1974 Detail of Balloon Framing, Room 102A

B) 1974 Interior Detail of Doors A105



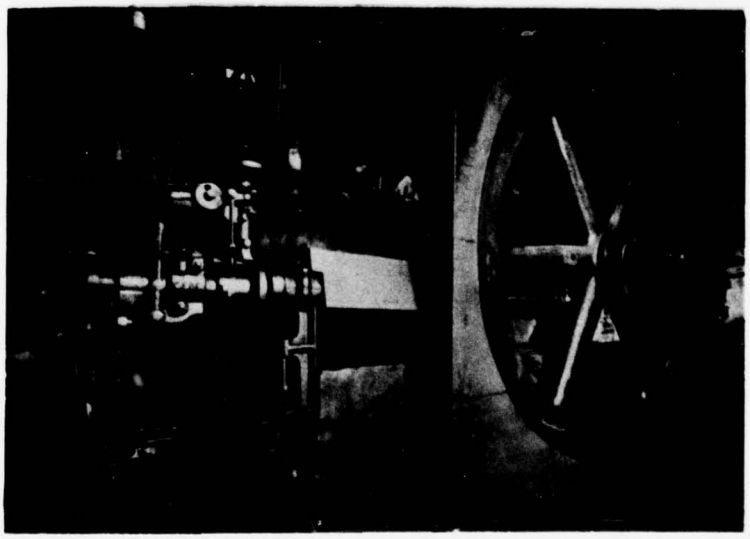


A) 1974 Bench Shop

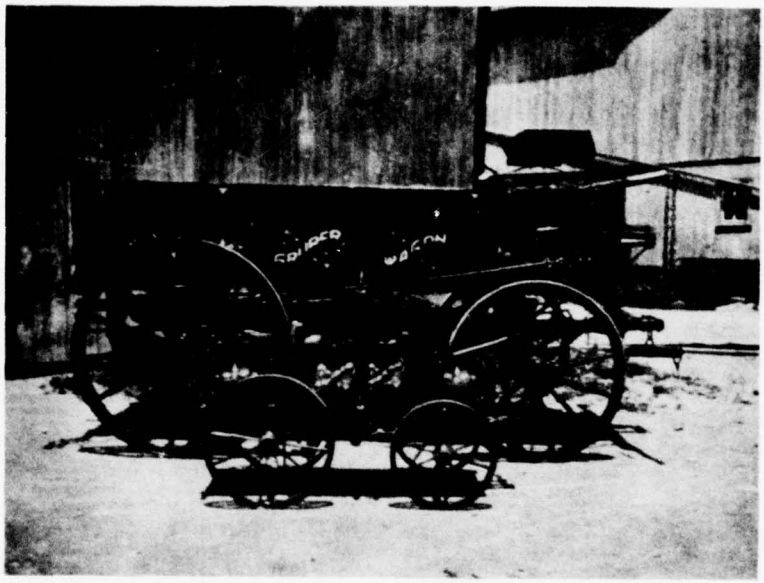


B) 1973 [redacted]

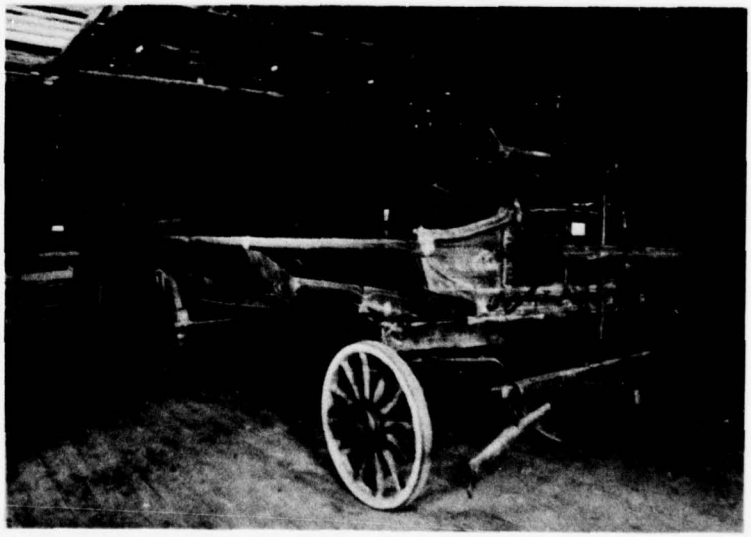
A) 1973 Blacksmith & Machine Shops



B) 1928 DC6 Gasoline Engine [illegible] Reg. #30408

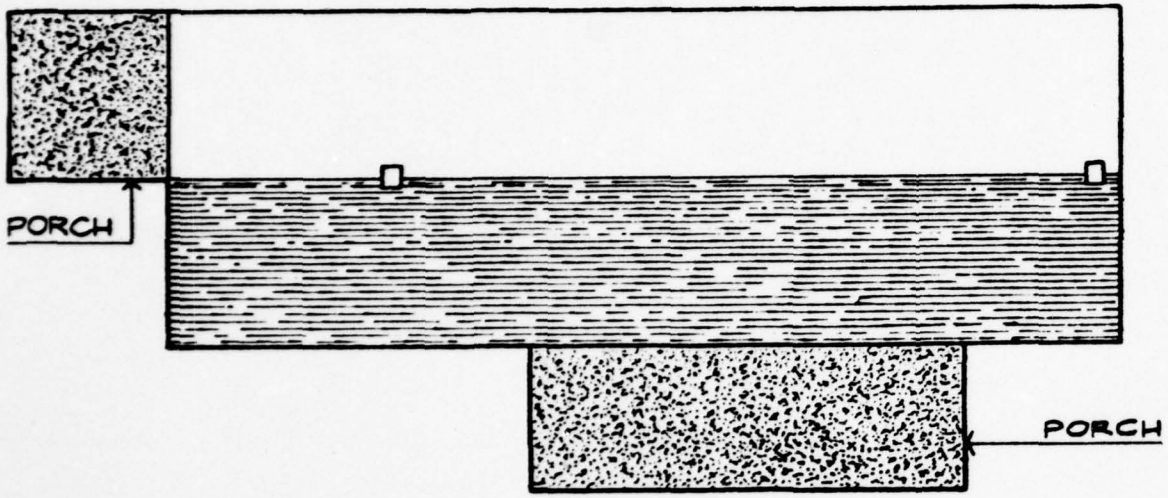


A) Gruber Farm Wagons

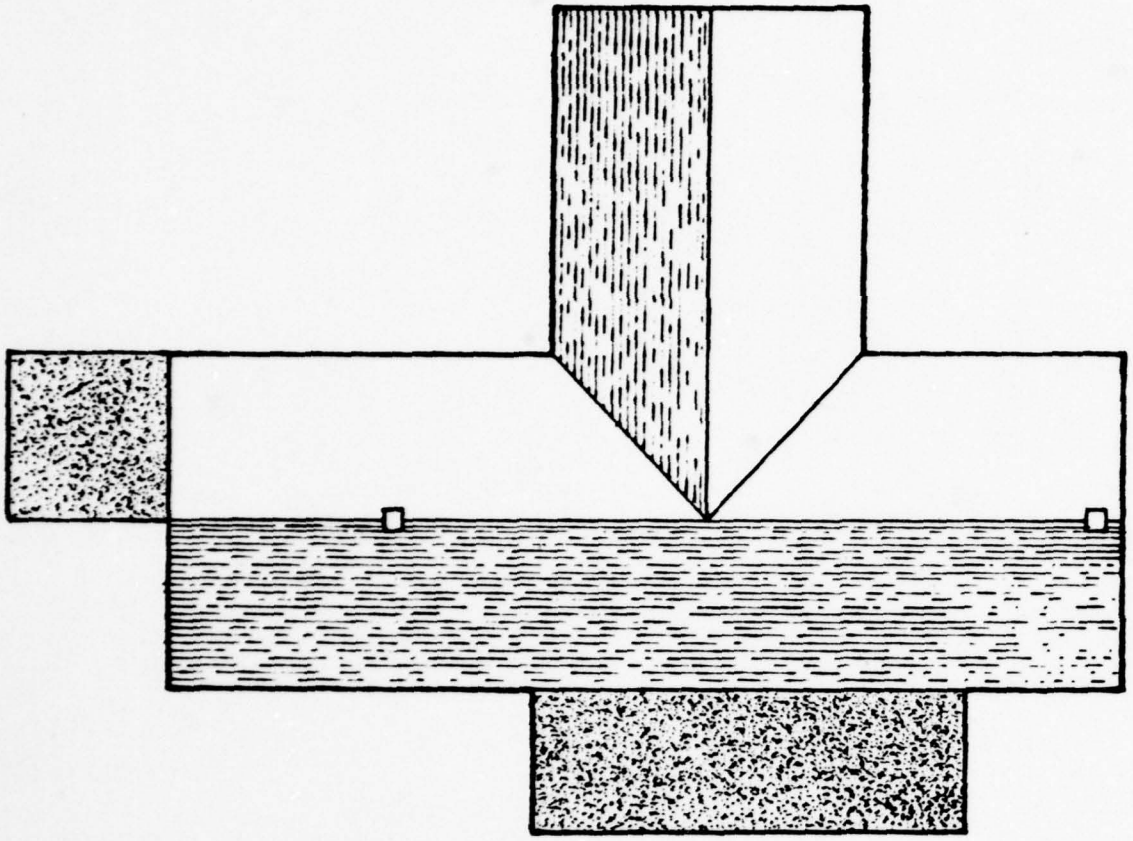


B) Gruber Hay Wagon

A2-1



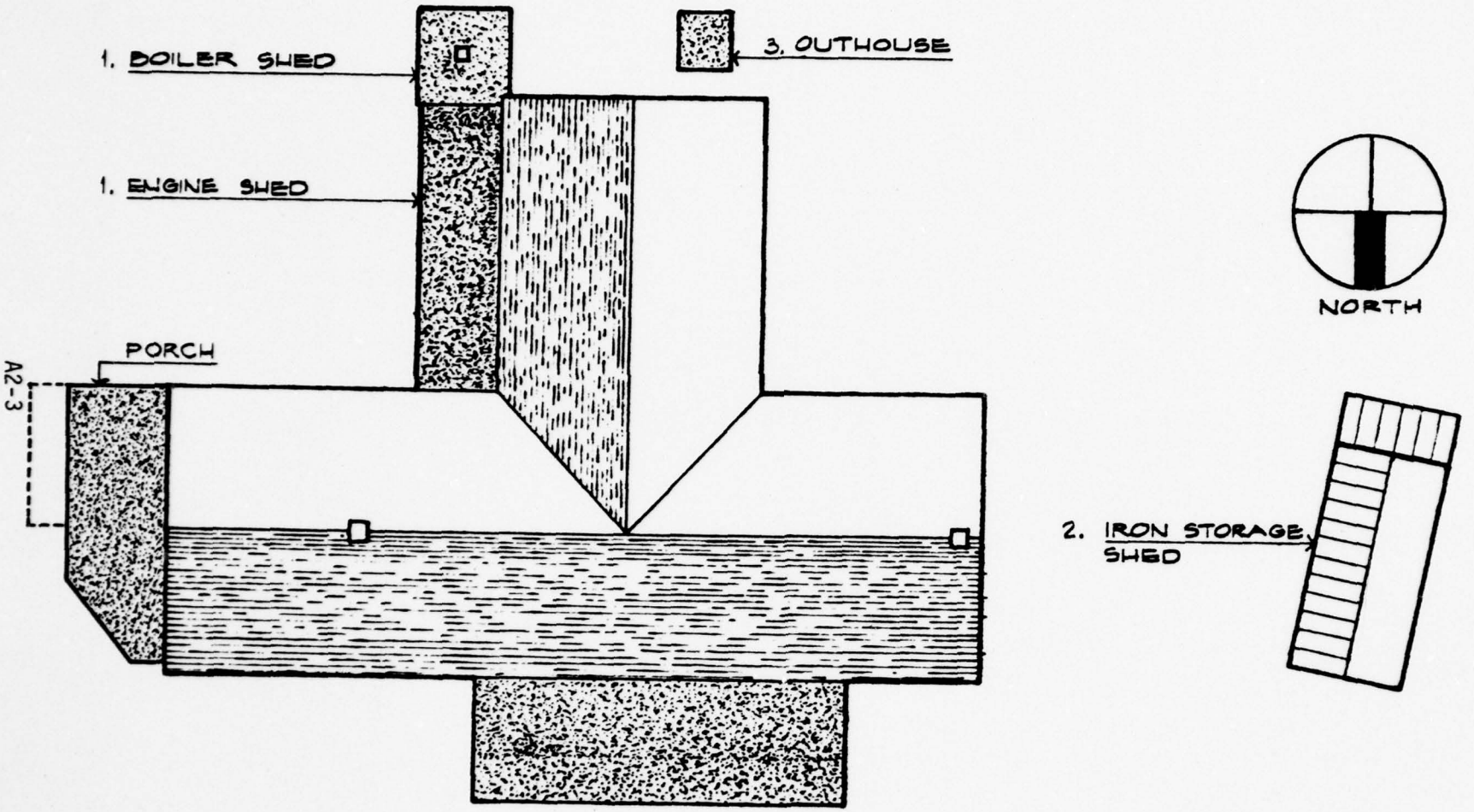
A ORIGINAL STRUCTURE 1883



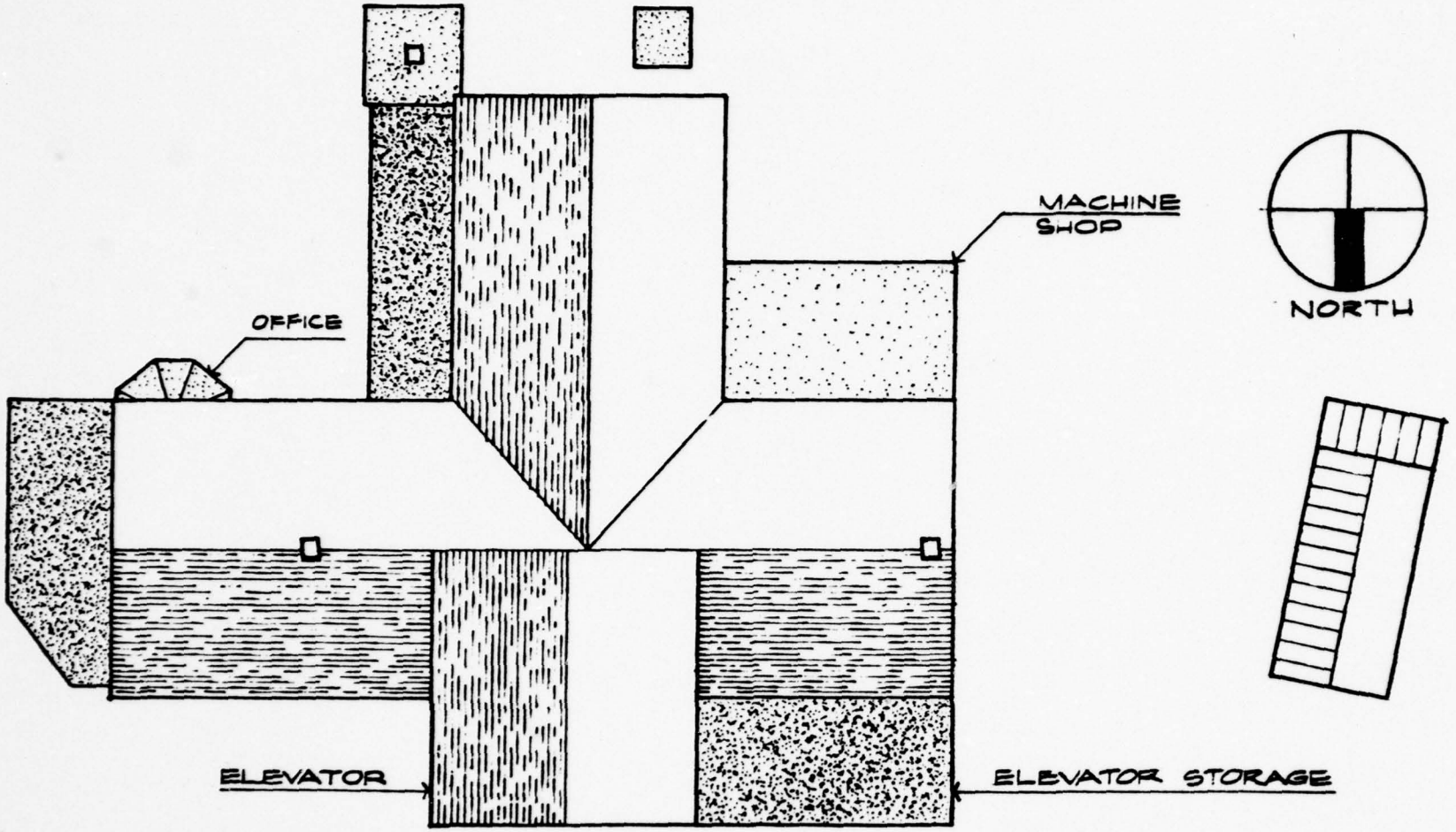
NORTH

A2-2

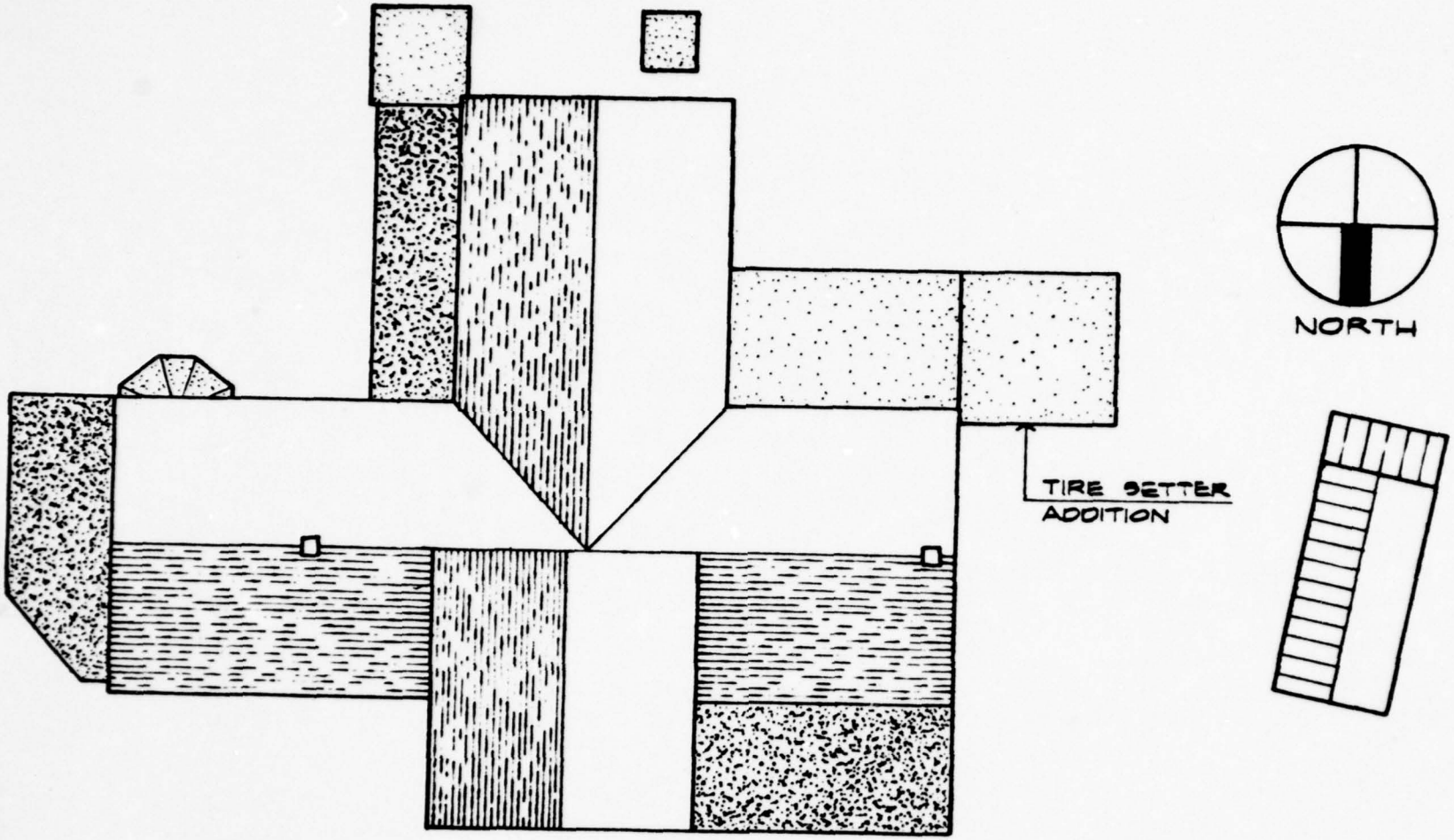
B FARM SHOP ADDITION 1885



C ENGINE & BOILER SHEDS ADDITIONS 1896

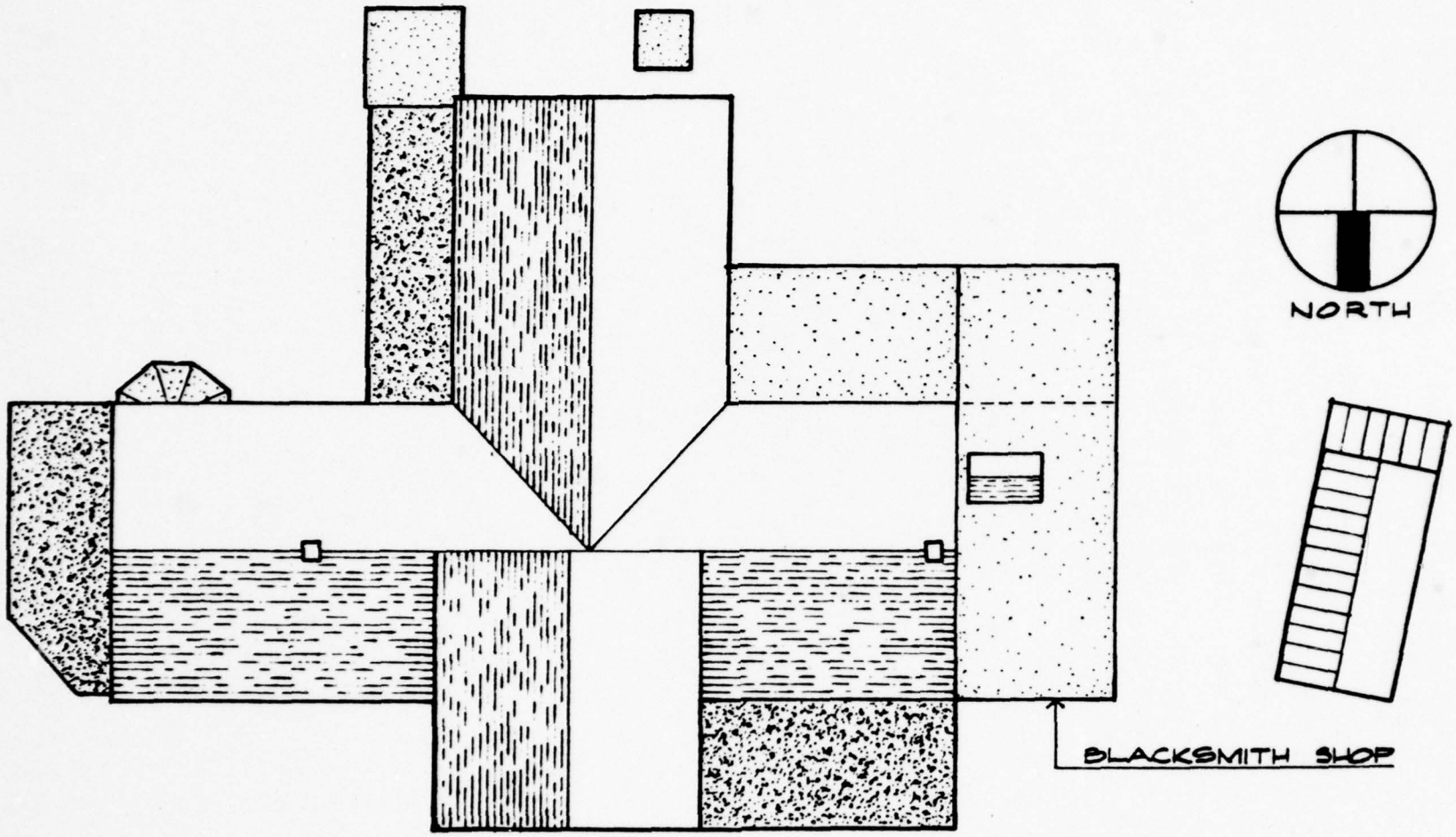


D ELEVATOR, OFFICE & MACHINE SHOP ADDITIONS 1905



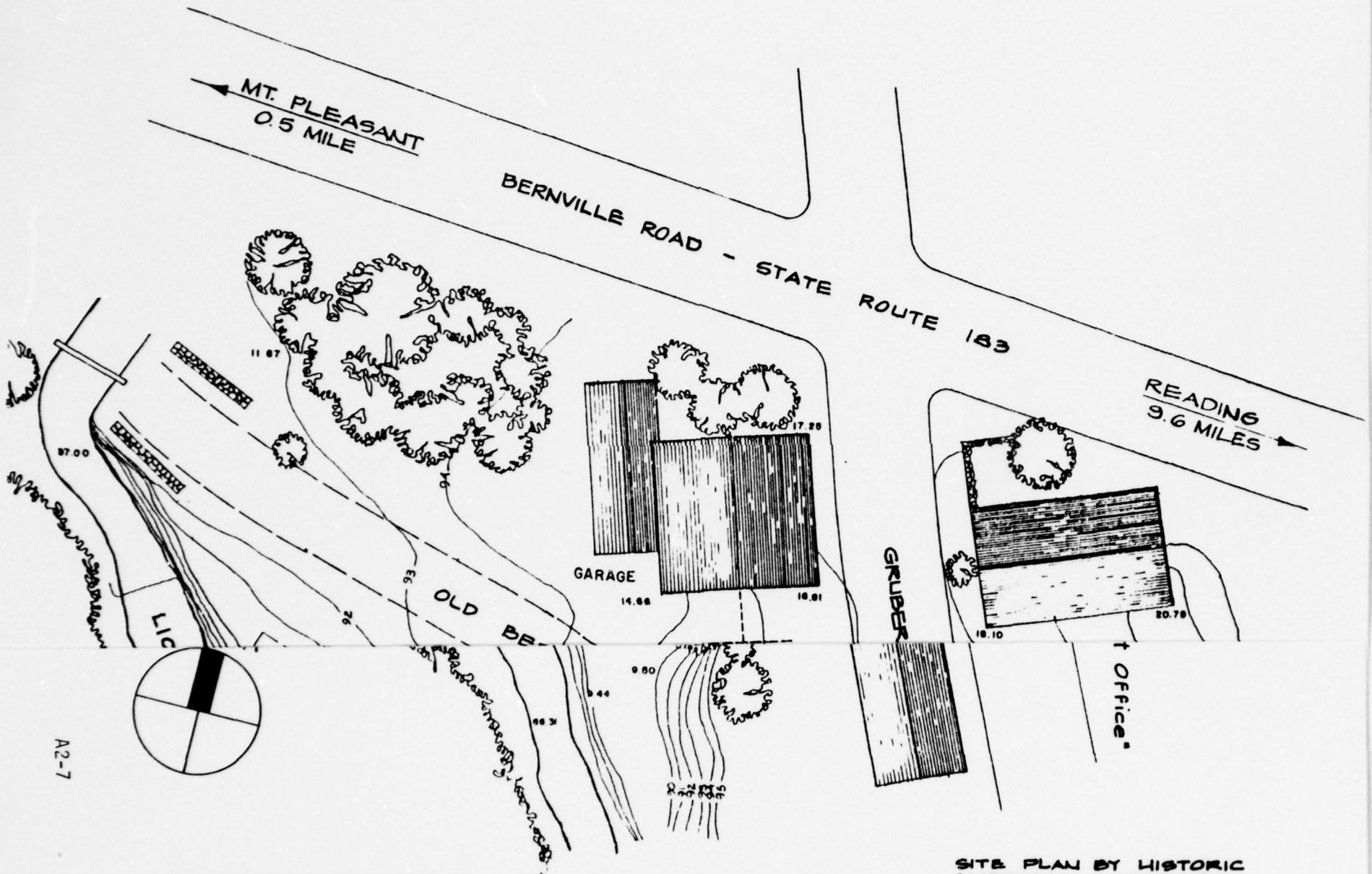
A2-5

E TIRE SETTER ADDITION 1908



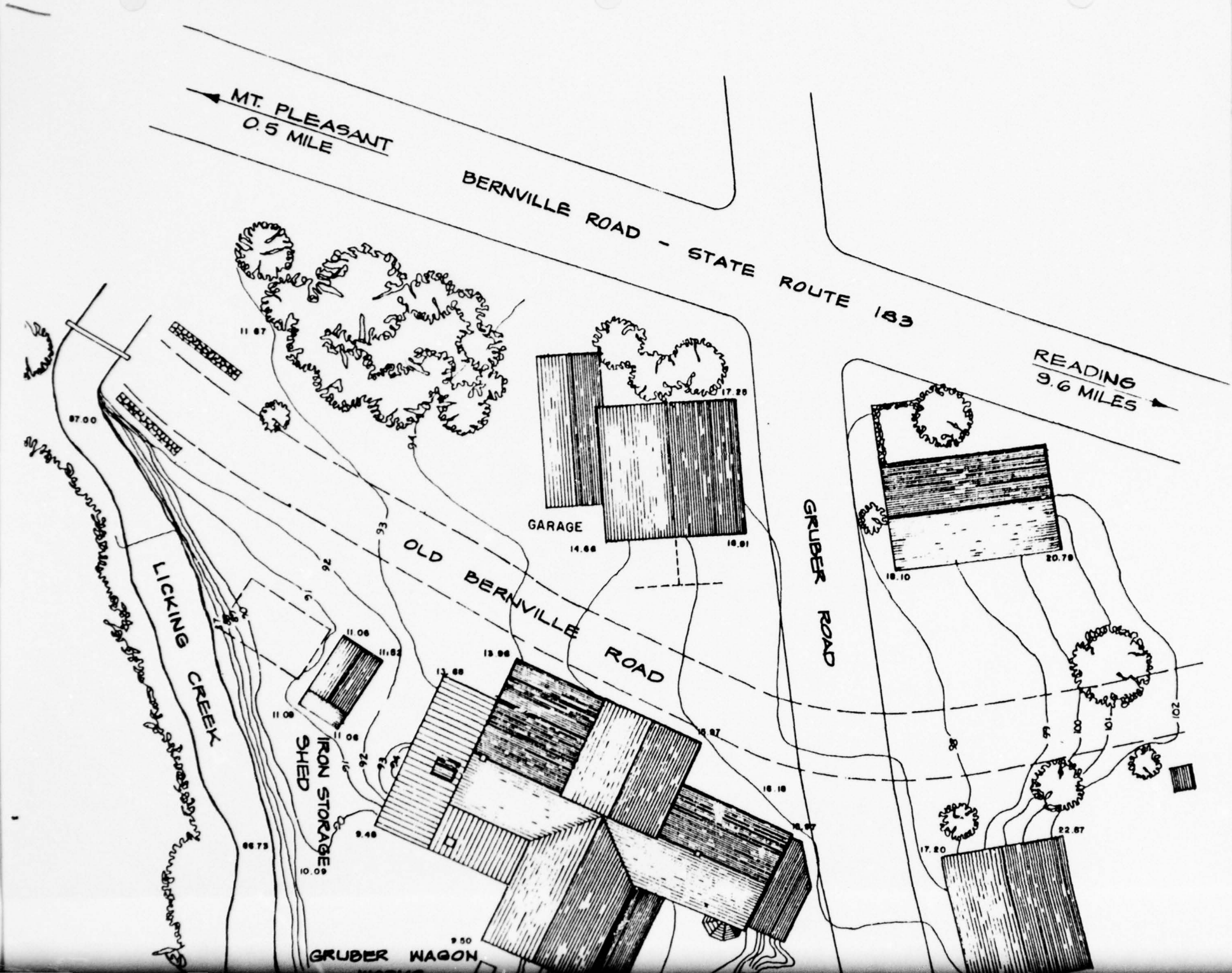
A2-6

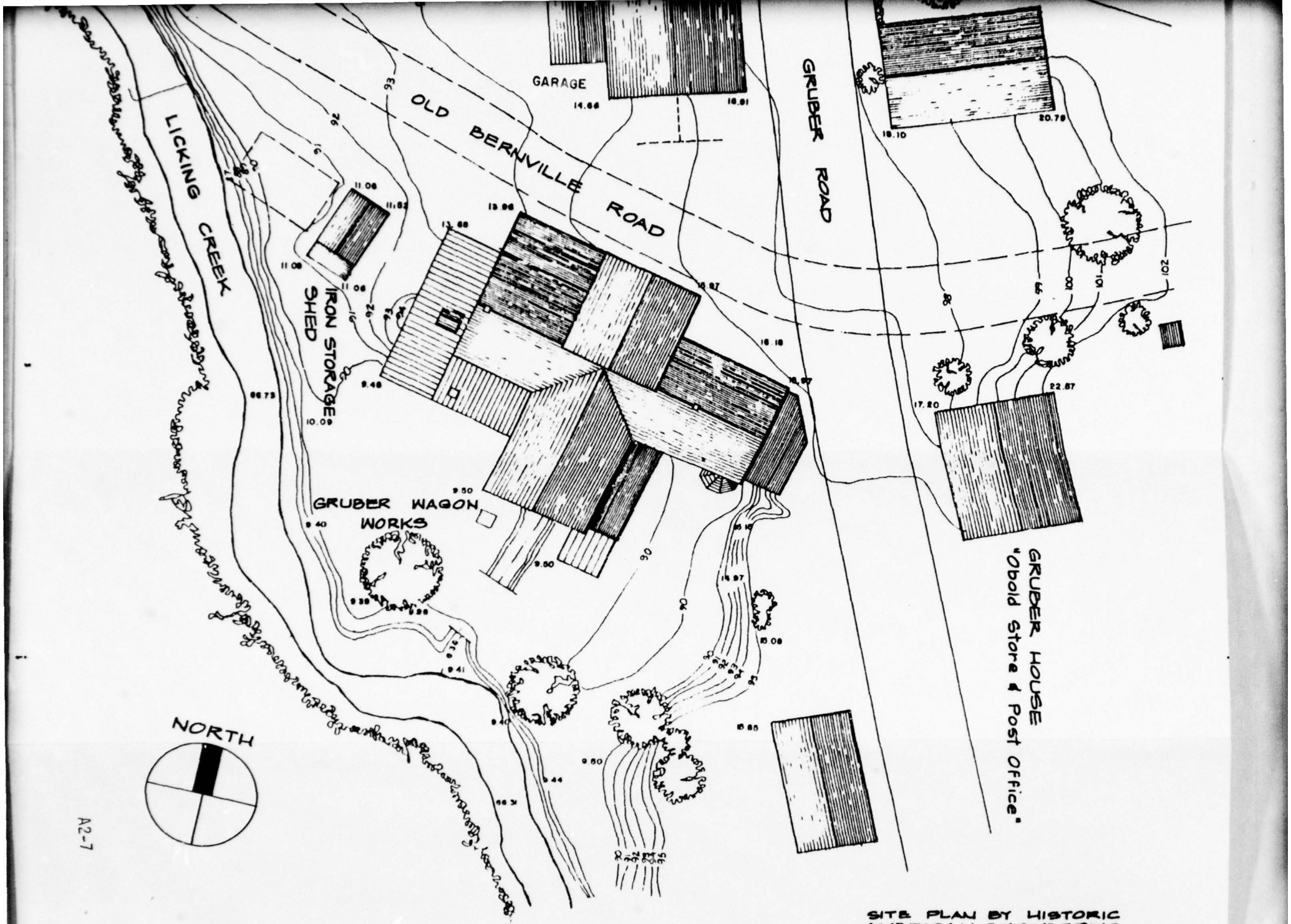
F BLACKSMITH SHOP ADDITION 1910



ORIGINAL SITE AT PLEASANT VALLEY

SITE PLAN BY HISTORIC AMERICAN ENGINEERING RECORD

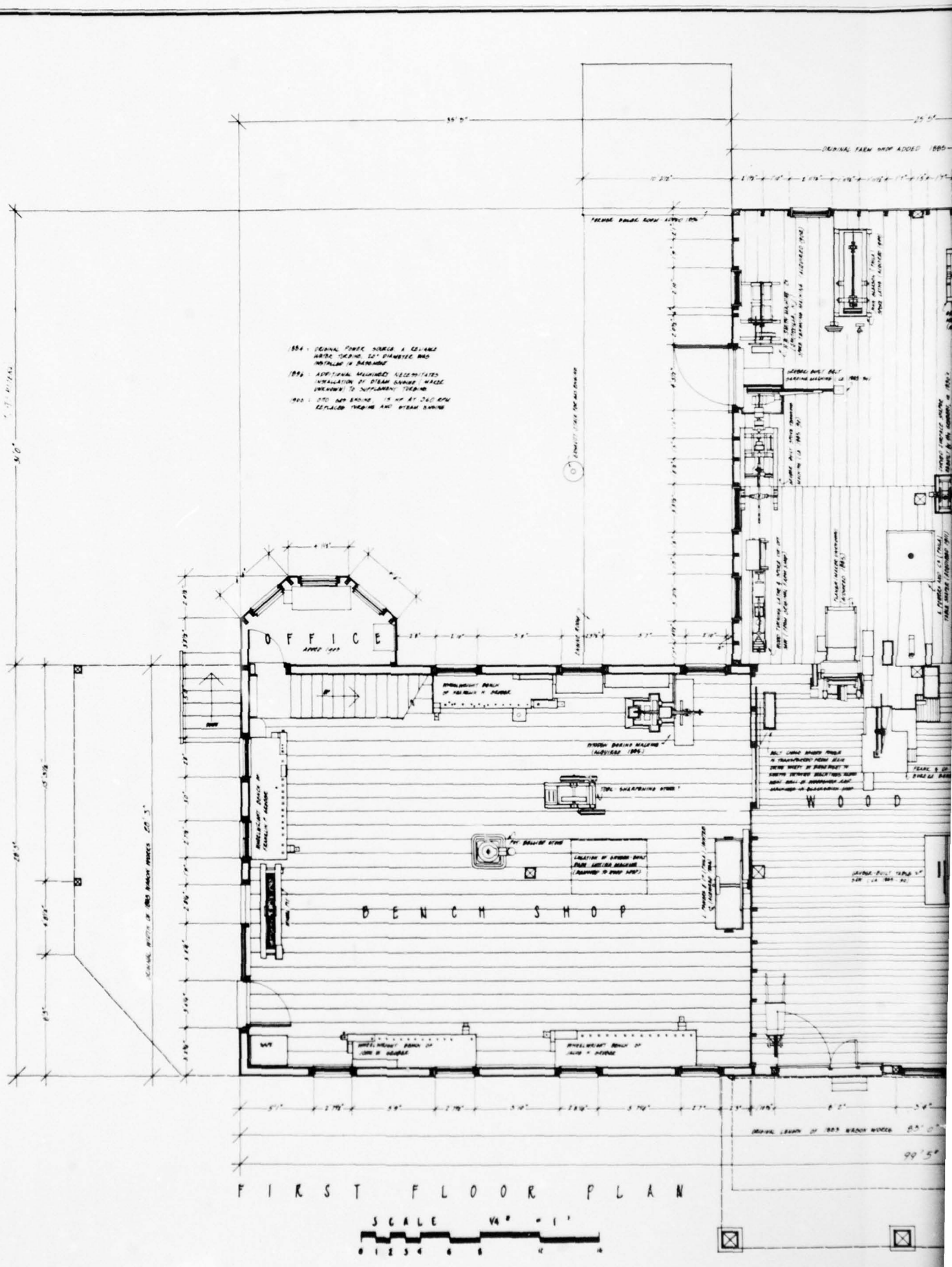

MT. PLEASANT
0.5 MILE
BERNVILLE ROAD - STATE ROUTE 183
READING
9.6 MILES
GARAGE
OLD BERNVILLE ROAD
GRUBER ROAD
LICKING CREEK
IRON STORAGE SHED
GRUBER WAGON



ORIGINAL SITE AT PLEASANT VALLEY

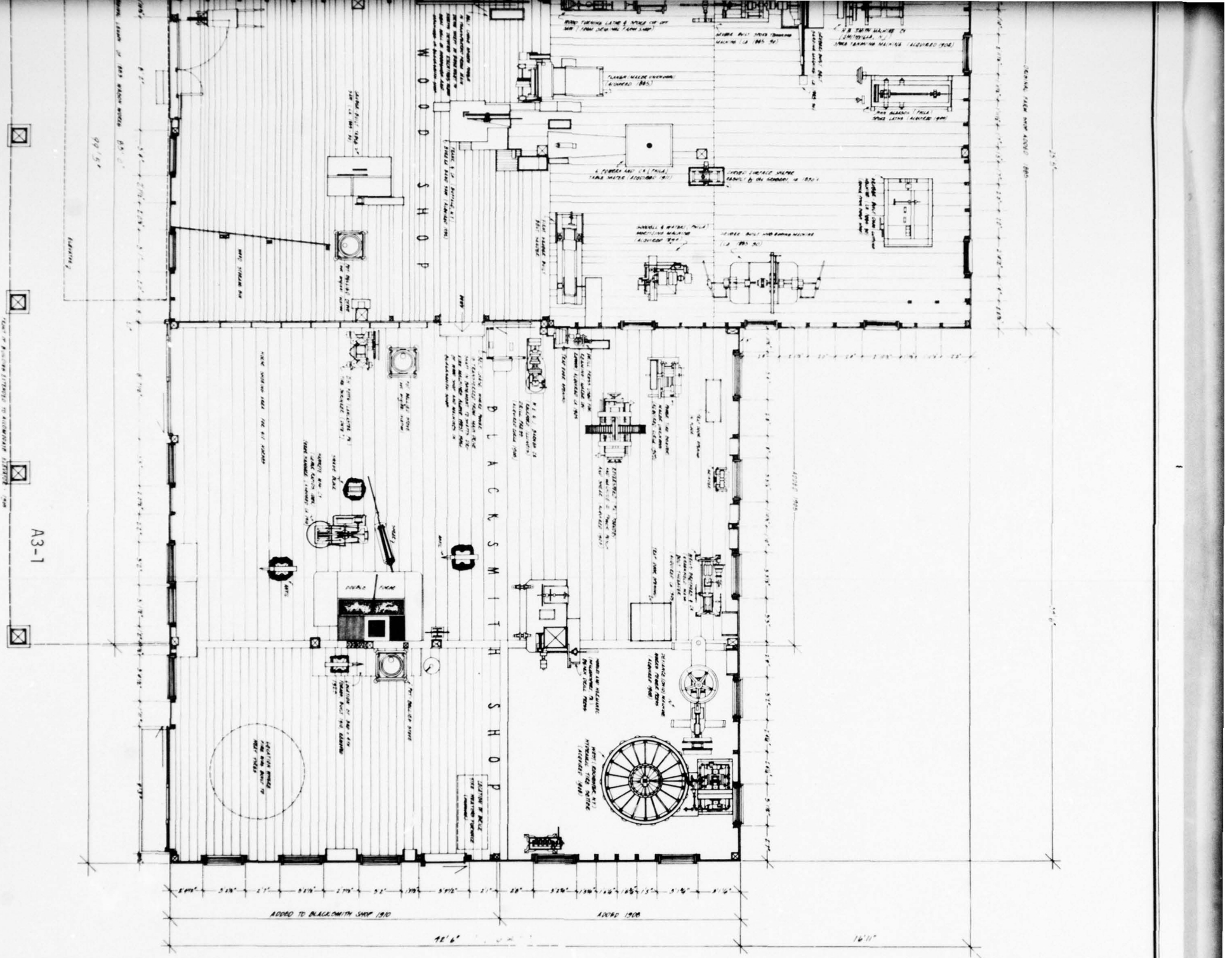
SITE PLAN BY HISTORIC AMERICAN ENGINEERING RECORD

A2-7



FIRST FLOOR PLAN

SCALE 1/4" = 1'



DRAWN BY: ROLAND DAVID SCHAAF 1974

OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION
GRUBER WAGON WORKS EMERGENCY RECORDING PROJECT
UNDER DIRECTION OF THE NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
GRUBER WAGON WORKS 1882, 1906
96 MILES NORTHWEST OF READING AT THE INTERSECTION OF STATE ROUTE 183 AND STATE HILL ROAD
MT. PLEASANT — BERKS COUNTY — PENNSYLVANIA

RECORD NO
HAER
PA-14

HISTORIC AMERICAN ENGINEERING RECORD
SHEET OF SHEETS

LIBRARY OF CONGRESS CATALOG NUMBER

NORTH ELE

SCALE : 1/4"

0 1 2 3 4 5 6

T H E L E V A T I O N

SCALE : 1/4" = 1'

0 1 2 3 4 6 8 12 16

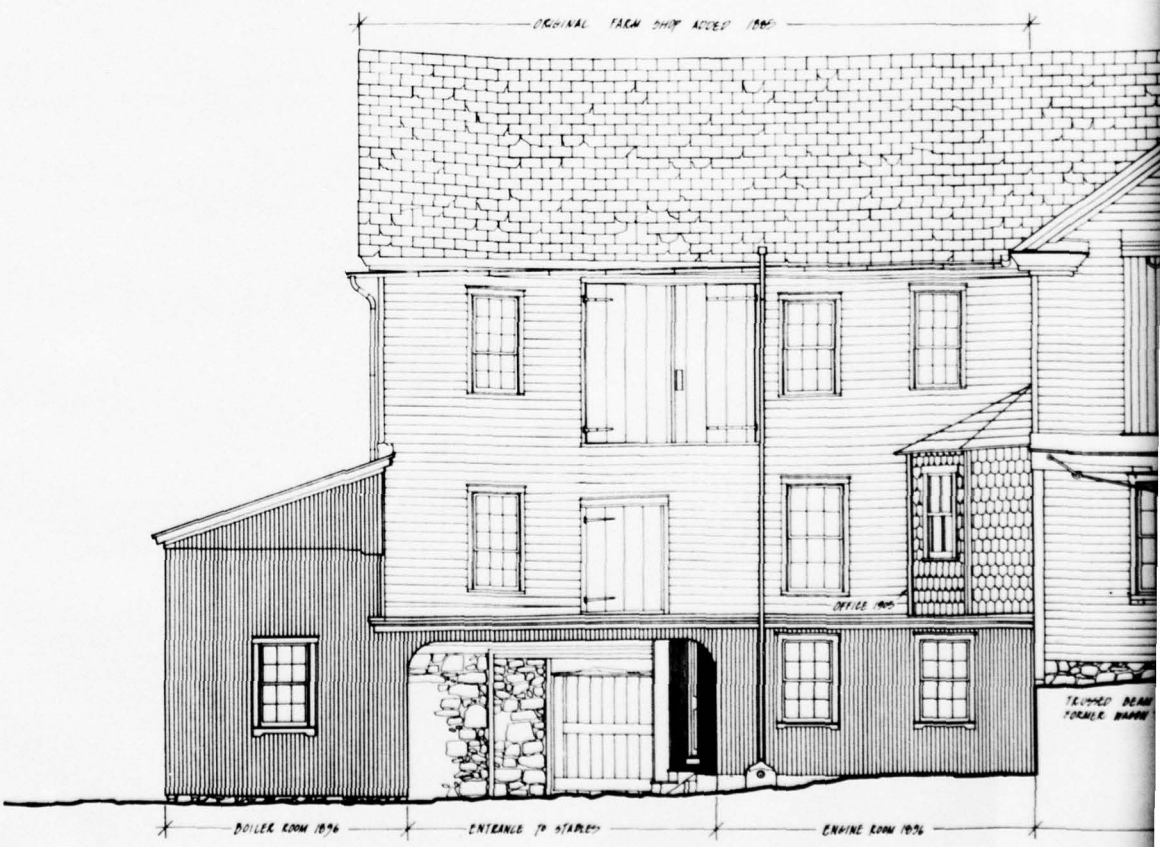
NAME AND LOCATION OF STRUCTURE

RECORD NO

HISTORIC AMERICAN ENGINEERING RECORD
SHEET OF SHEETS

UNDER DIRECTION OF THE NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

DRAWN BY:



EAST ELE

SCALE

EAST ELEVATION

SCALE 1/4" = 1'

0 1 2 3 4 0 8 12 16

A3-3

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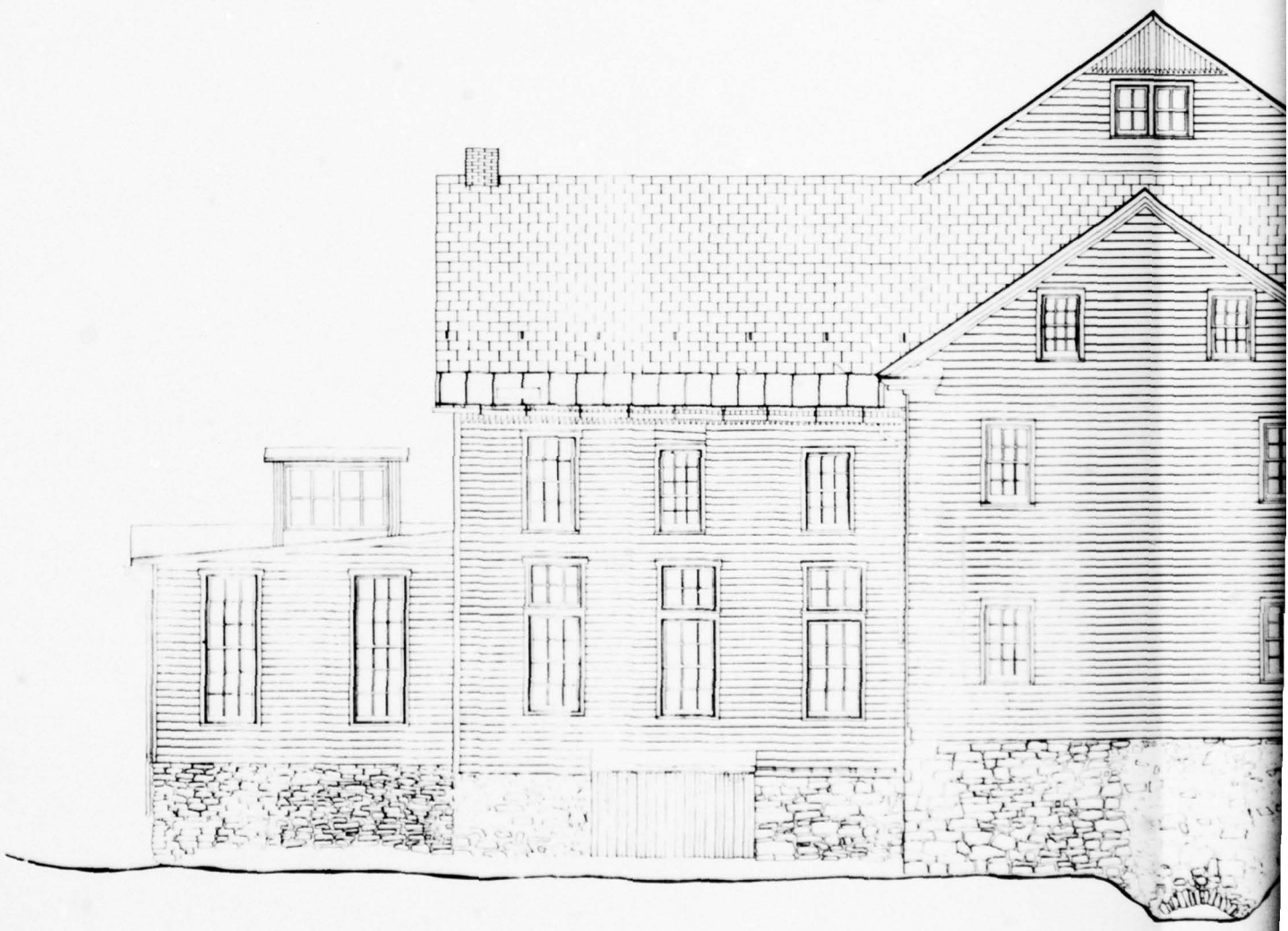

SOUTH ELEV

SCALE : 1/4" = 1

T H E L E V A T I O N

SCALE : ¼" = 1'

0 1 2 3 4 6 8 12 16

HISTORIC AMERICAN ENGINEERING RECORD
SHEET OF SHEETS

RECORD NO

UNDER DIRECTION OF THE NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

DRAWN BY

WEST ELE

SCALE

ST ELEVATION

SCALE : ¼" = 1'

0 1 2 3 4 6 8 12 16

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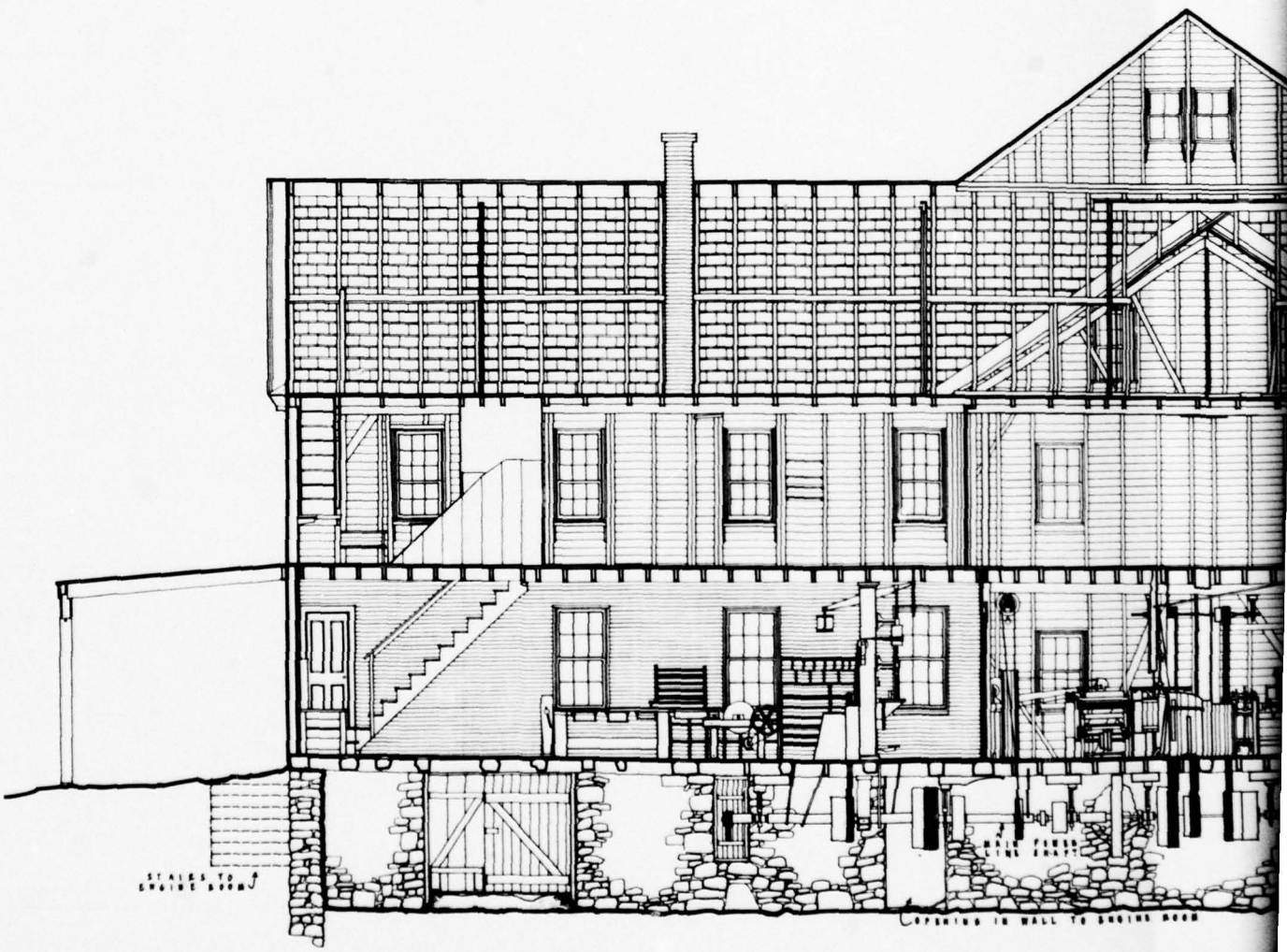
HISTORIC AMERICAN BUILDINGS SURVEY
UNITED STATES DEPARTMENT OF THE INTERIOR

SHEET 07

HISTORIC AMERICAN ENGINEERING RECORD



LONGITUDINAL SECTION

SCALE : ¼" = 1'

0 1 2 3 4 6 8 12

ON STORAGE OVER WOOD & BLACKSMITH SHOPS
WOOD SHOP BLACKSMITH SHOP

1906, 1910 ADDITION
TO BLACKSMITH SHOP

ECTION LOOKING SOUTH

ALE : 1/4" = 1'

3 4 6 8 12 16

A3-6

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GRUBER WAGON WORKS EMERGENCY RECORDING PROJECT
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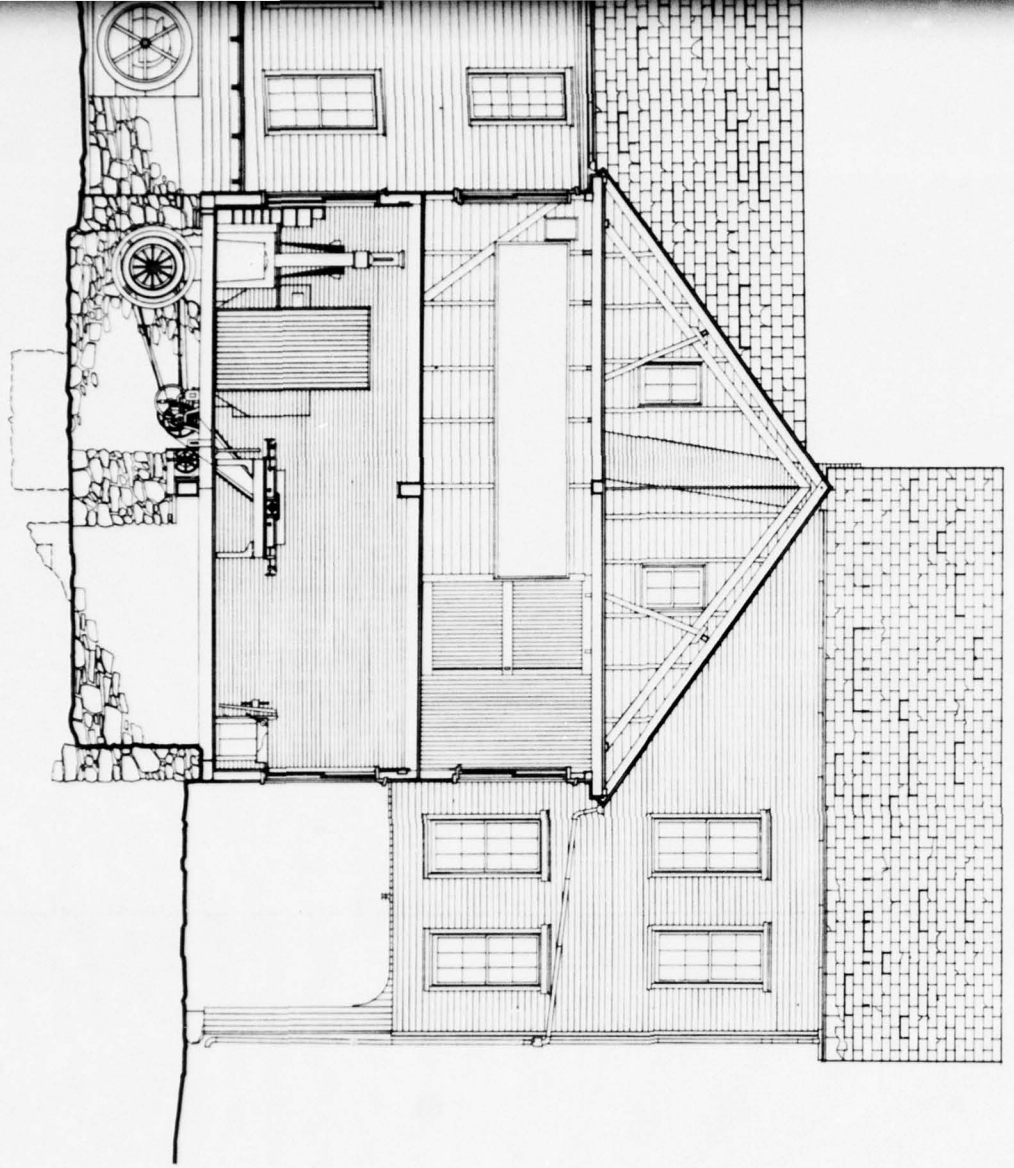
SECTION THROUGH BEN

SCALE

0 1 2 3 4 6



GH BENCH SHOP LOOKING WEST

SCALE: 1/4" = 1'

A3-7

DRAWN BY: ROLAND DAVID SCHAAF, DEC 1974

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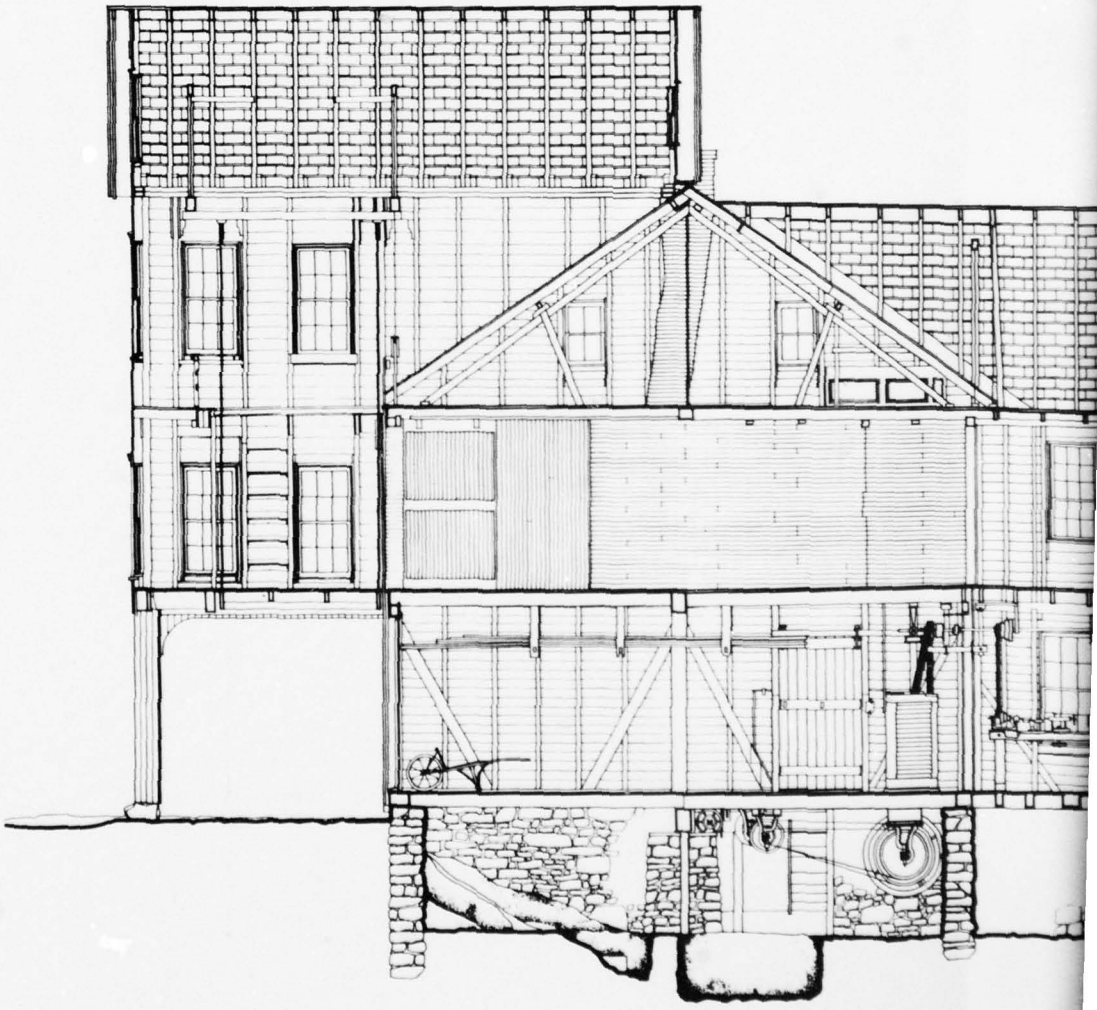
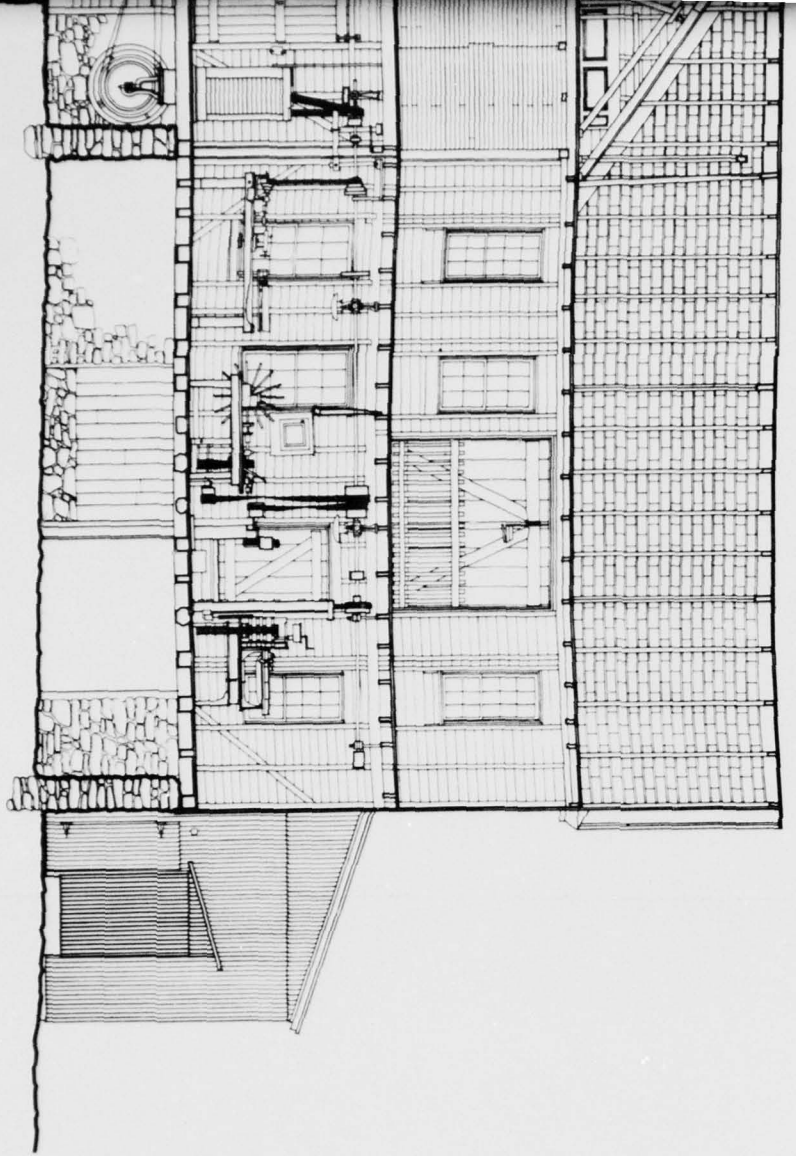
HISTORIC AMERICAN ENGINEERING RECORD
SHEET 4 OF 8 SHEETS



SECTION THROUGH WOODSHO

SCALE - 1/4" = 1'

0 1 2 3 4 6 8 12 16



WOODSHOP LOOKING EAST

A3-8

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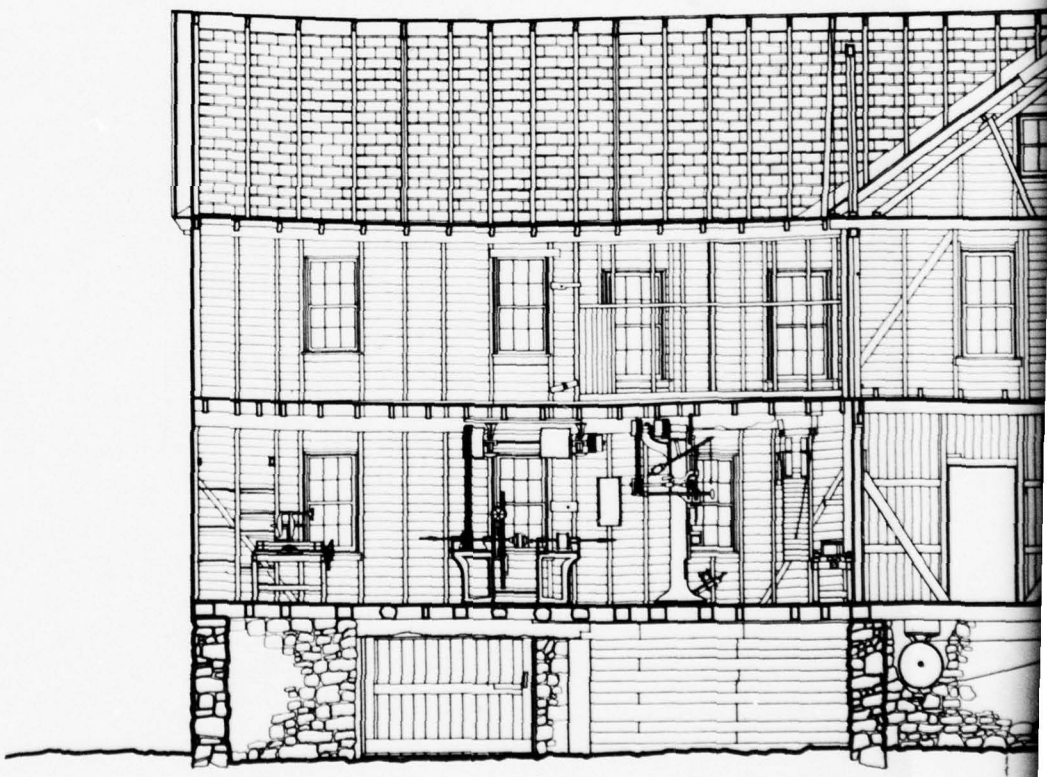
RECORD NO HAER PA-14

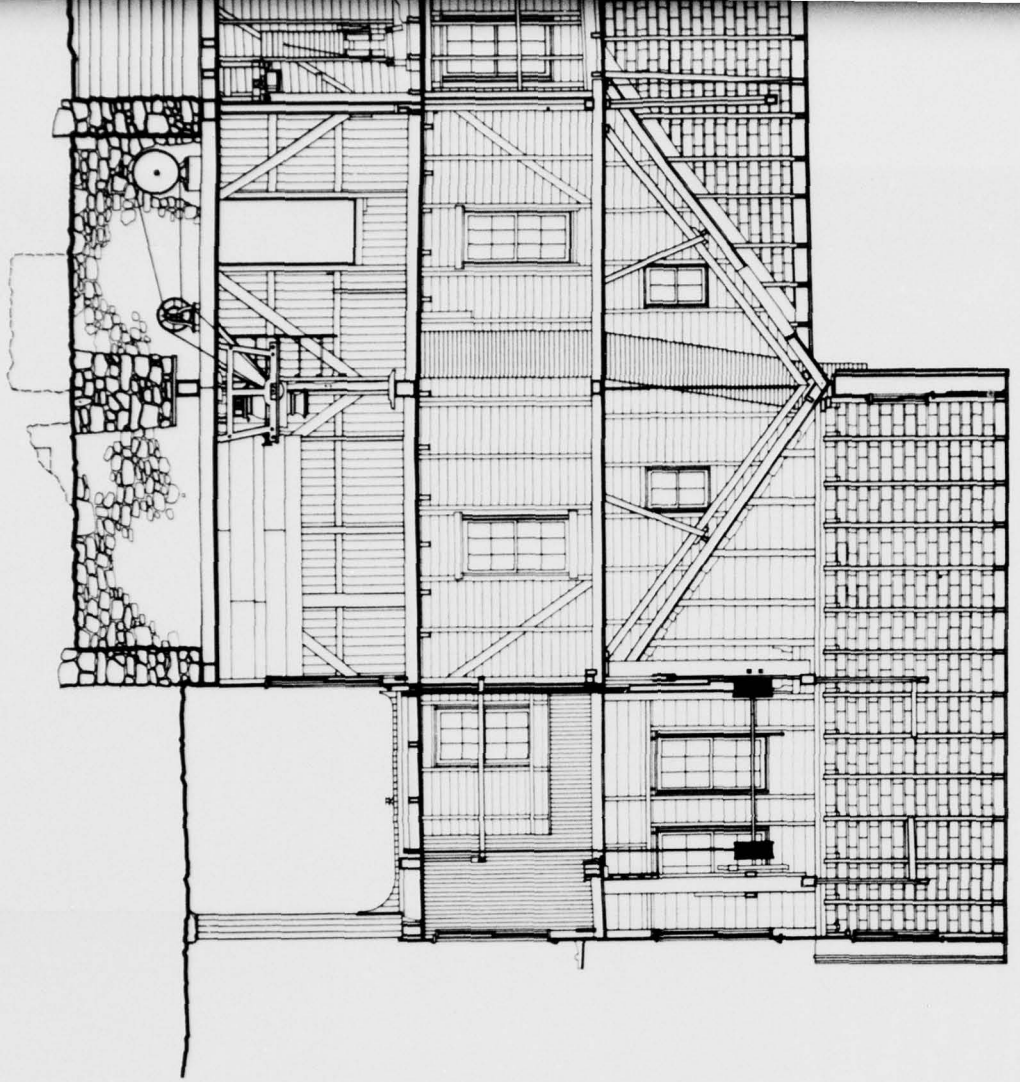
HISTORIC AMERICAN ENGINEERING RECORD
SHEET 7 OF 8 SHEETS



SECTION THROUGH WOODS

SCALE · ¼" =

0 1 2 3 4 6 8



SCALE: 1/4" = 1'

0 1 2 3 4 5 6 8 12 16

H WOODSHOP LOOKING WEST

A3-9

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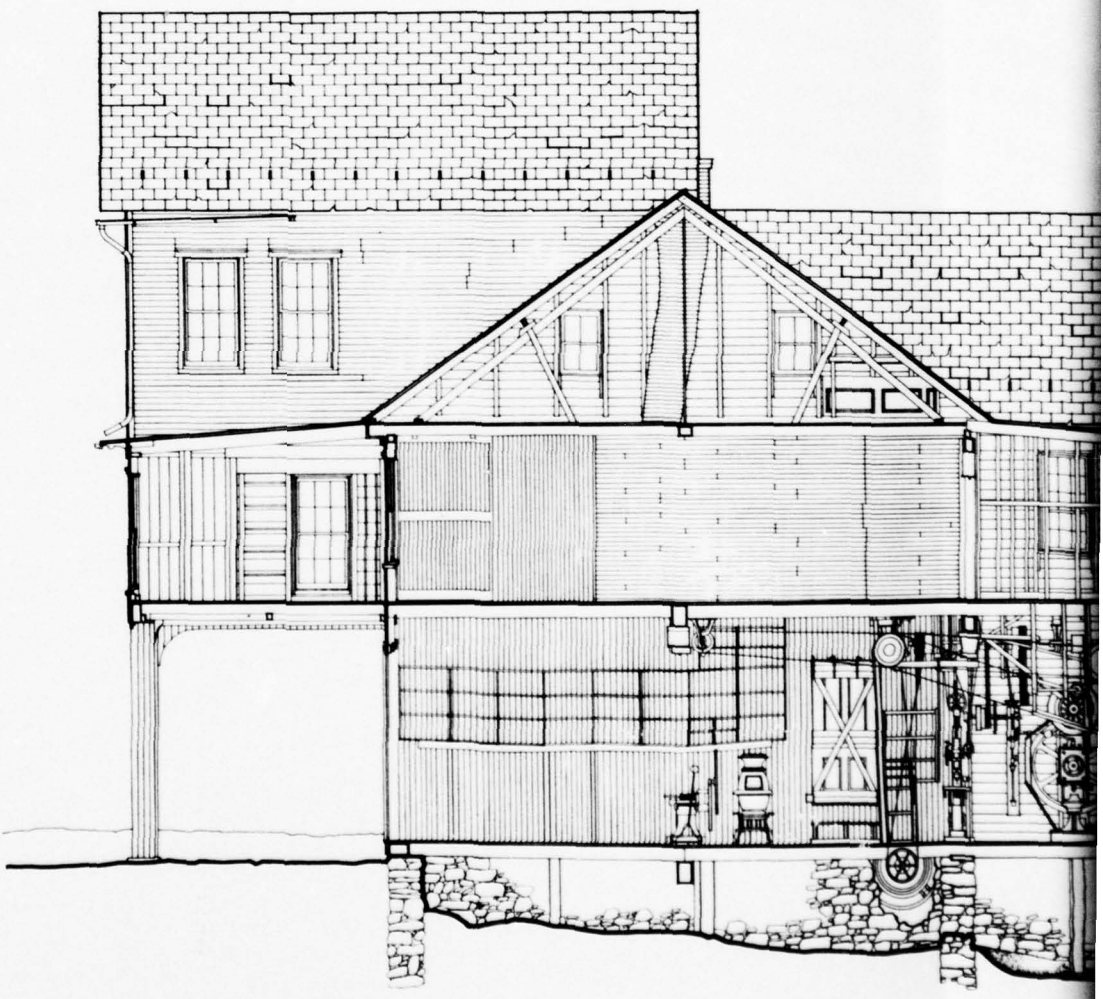
HISTORIC AMERICAN ENGINEERING RECORD
SHEET 5 OF 8 SHEETS



SECTION THROUGH BLACKSMI

SCALE 1/4"

0 1 2 3 4 6 8 12

LACKSMITH SHOP LOOKING EAST

SCALE 1" = 1/4"

0 1 2 3 4 6 8 12 16

DRAWN BY: ROLAND DAVID SCHAAF DEC 1974

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UNDER DIRECTION OF THE NATIONAL PARK SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR

MT. PLEASANT

96 MILES NORTHWEST OF READING AT THE INTERSECTION OF STATE ROUTE 183 AND STATE MILL ROAD
BERKS COUNTY

NAME AND LOCATION OF STRUCTURE
GRUBER WAGON WORKS 1882, 1906

PENNSYLVANIA

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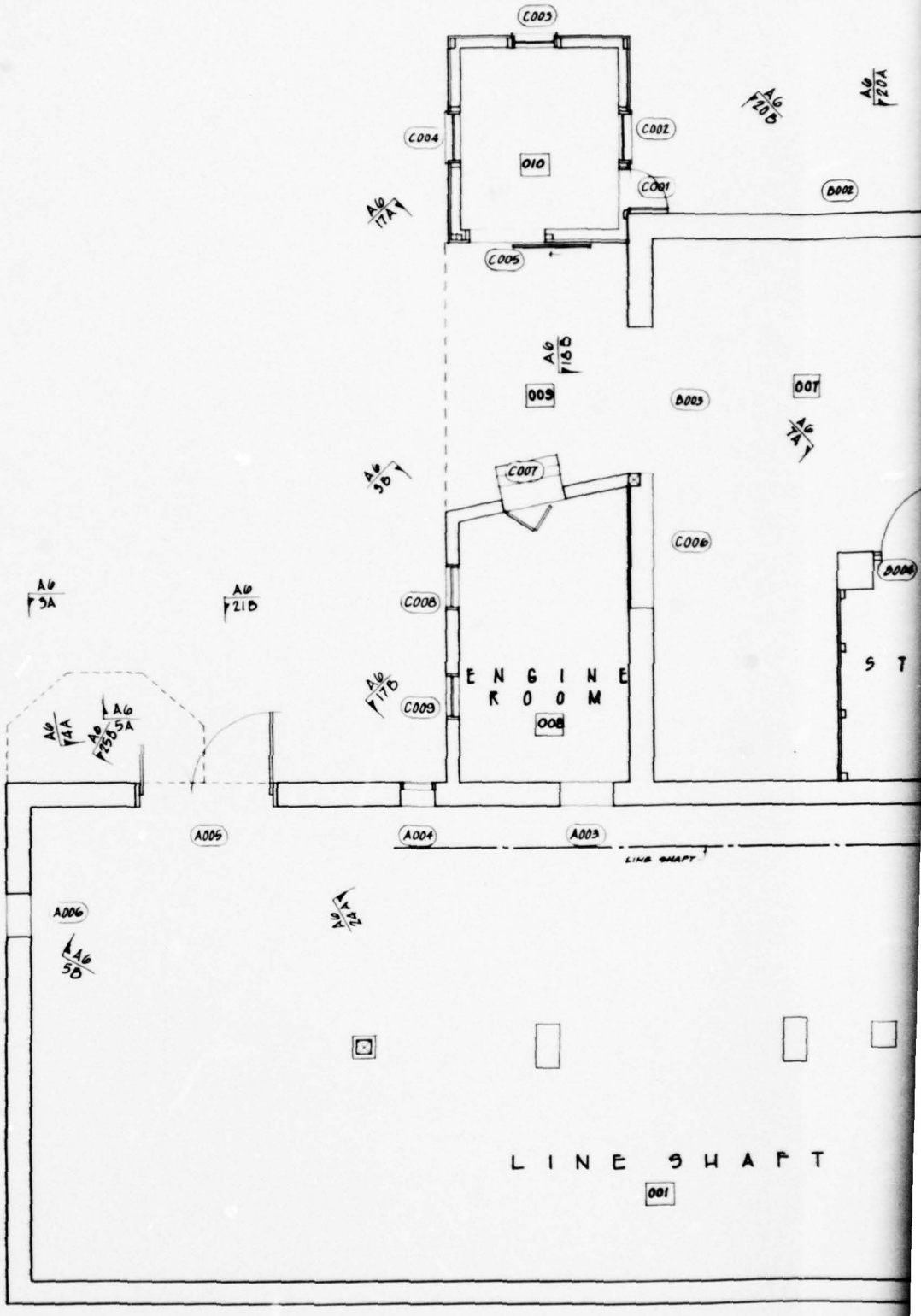
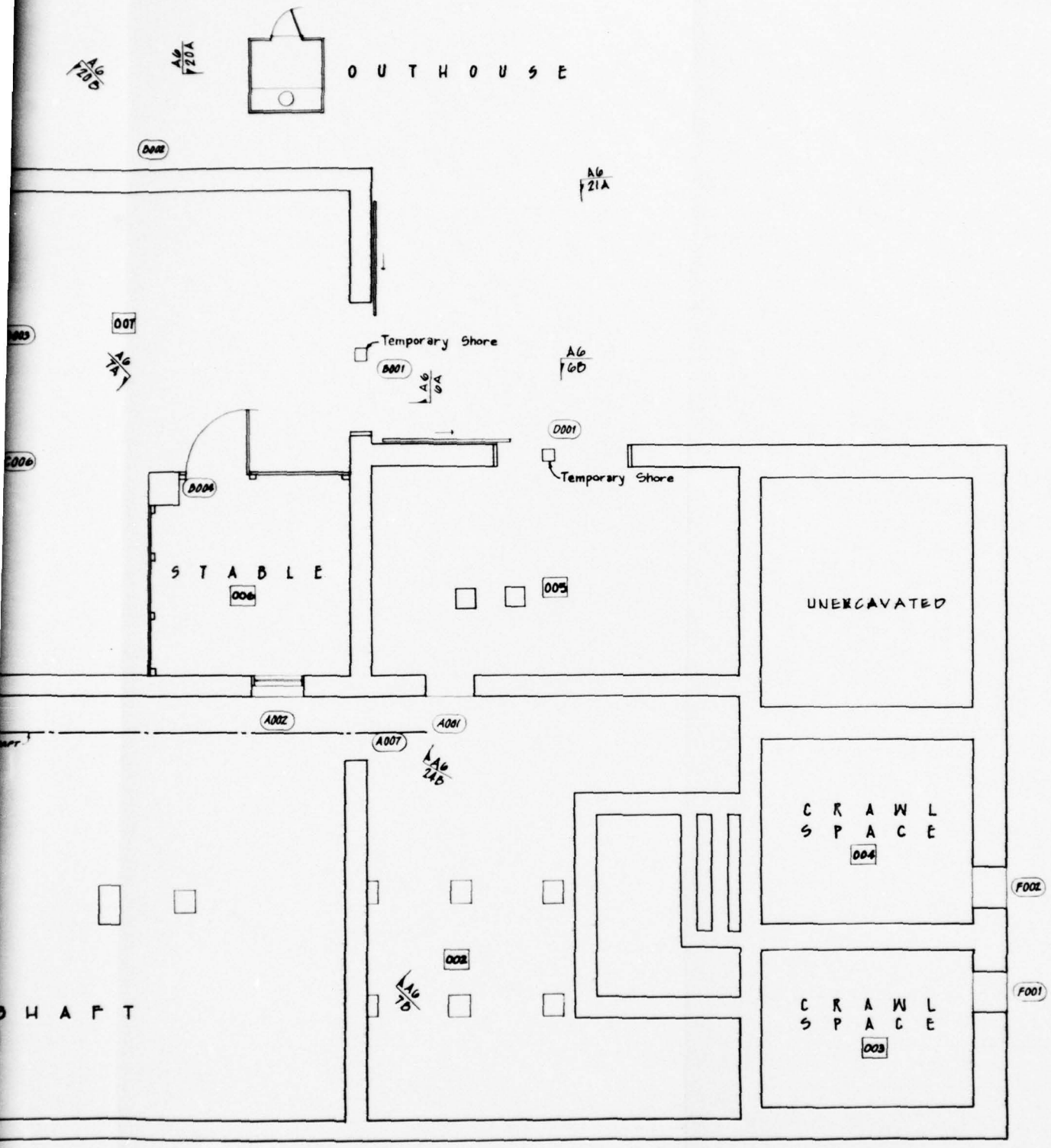
HISTORIC AMERICAN ENGINEERING RECORD
SHEET 6 OF 13 SHEETS



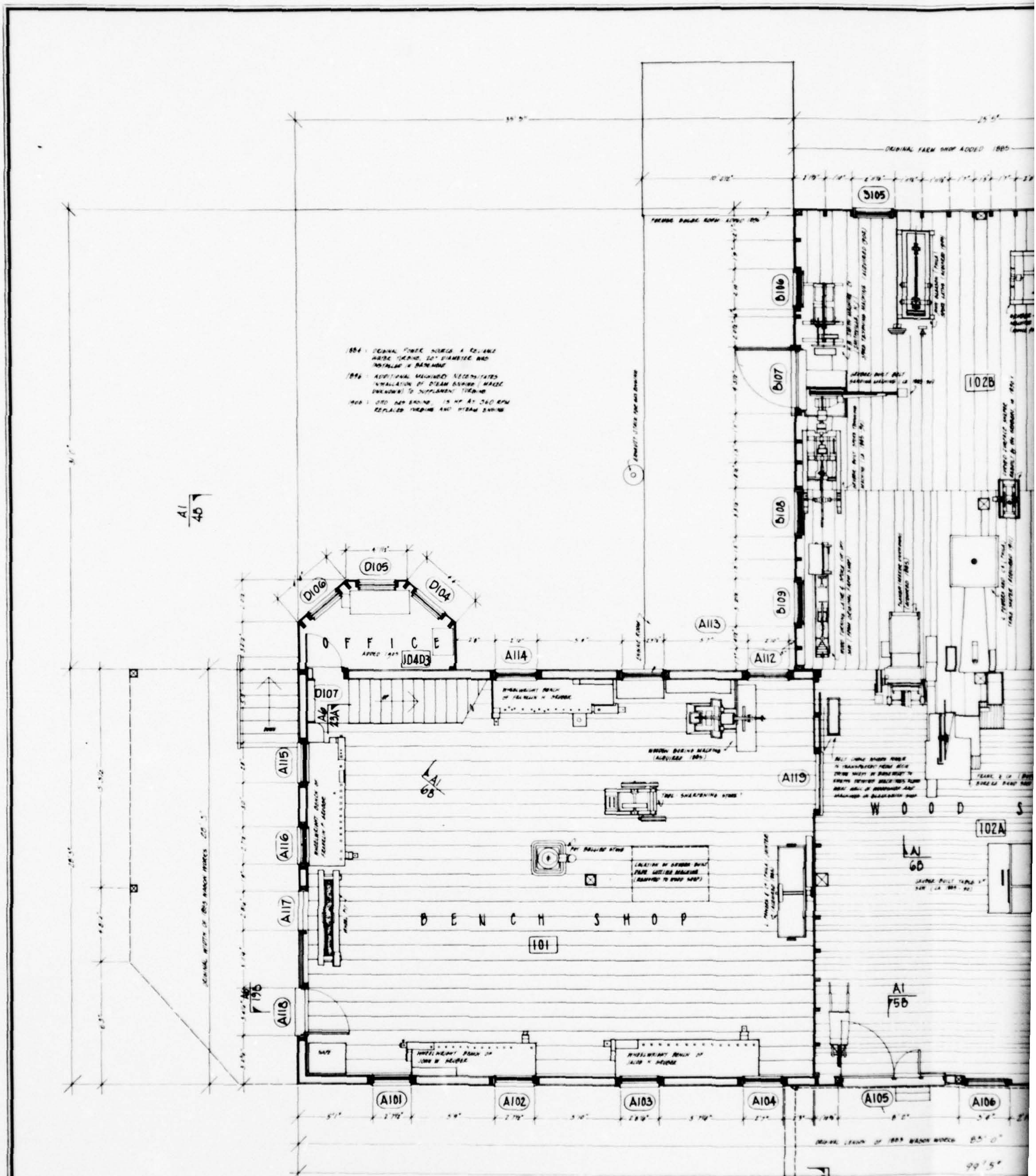
NOTE : All Foundation Walls Exist As Concrete Block Masonry

KEY CELLAR PLAN

SCALE 1/8" = 1'

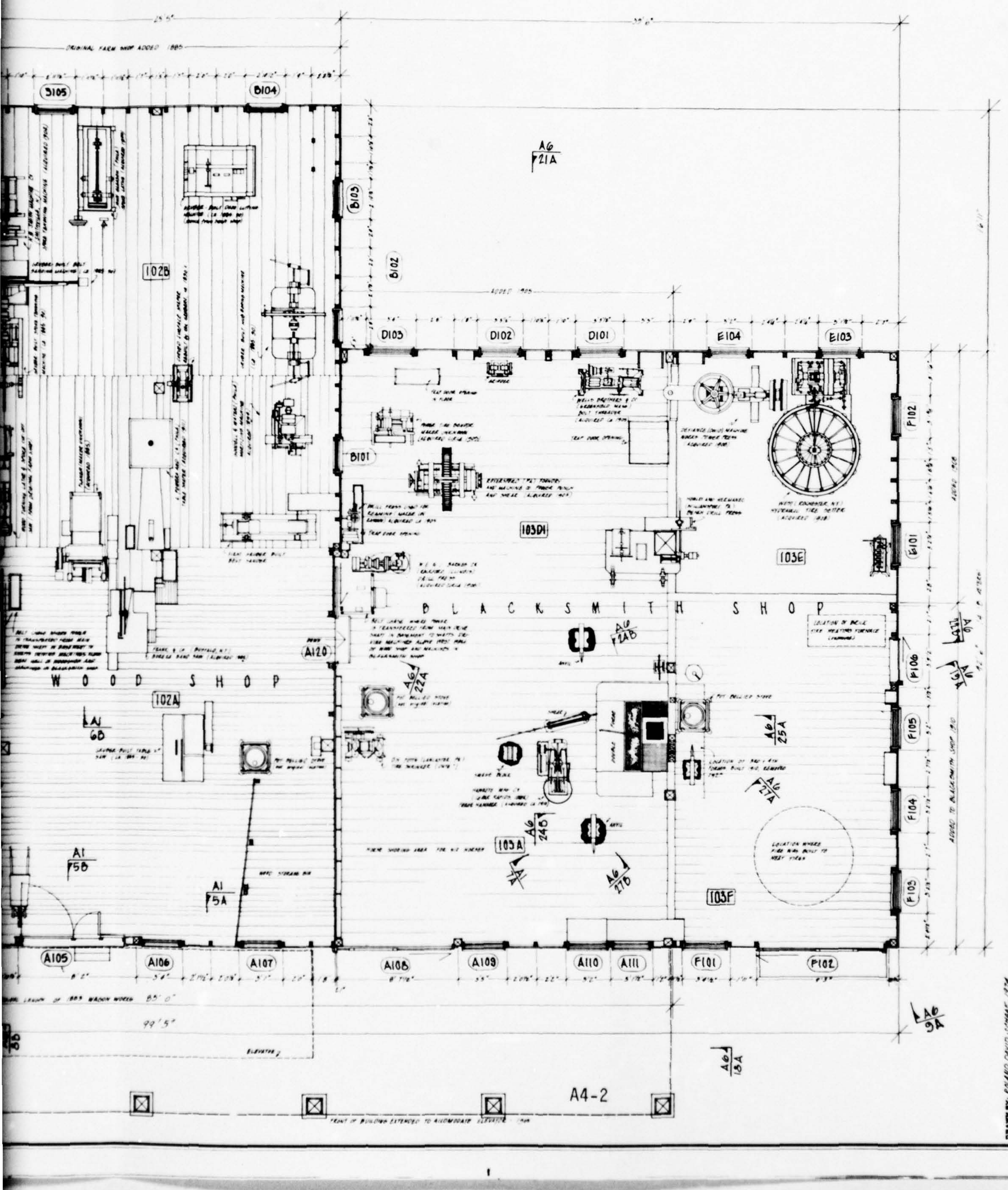


PHOTOGRAPH KEY
SECTION (Top)
PLATE (Bottom)



KEY FIRST FLOOR PLAN

SCALE 1/4" = 1'



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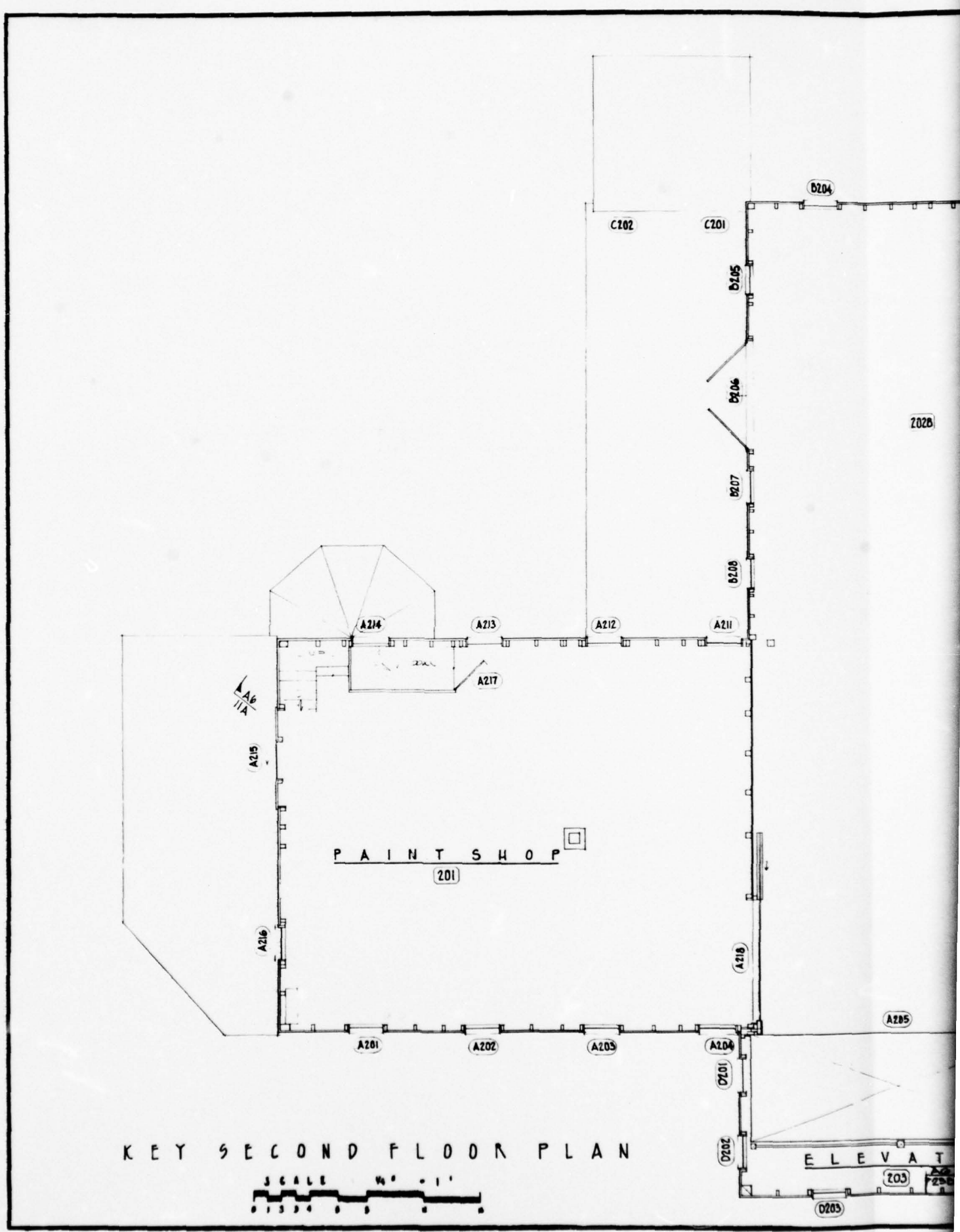
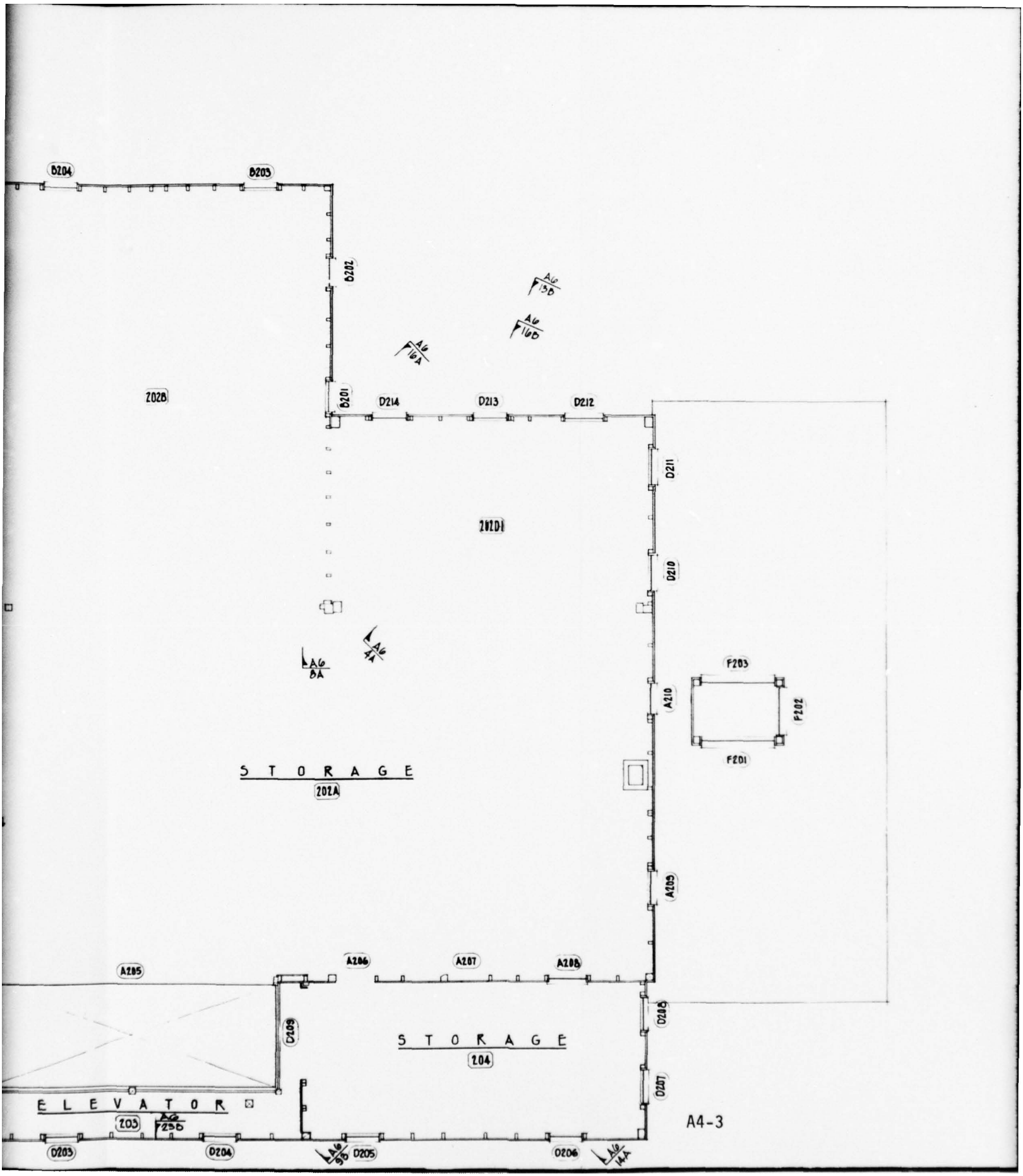


KEY SECOND FLOOR PLAN


D204
D203
D202
A6 15D
A6 16D
A6 16A
202B
D201
D214
D213
D212
D211
201D1
D210
A6 4A
A6 8A
F203
A210
F202
F201
S T O R A G E
202A
A209
A205
A206
A207
A208
D208
D209
S T O R A G E
204
D207
E L E V A T O R
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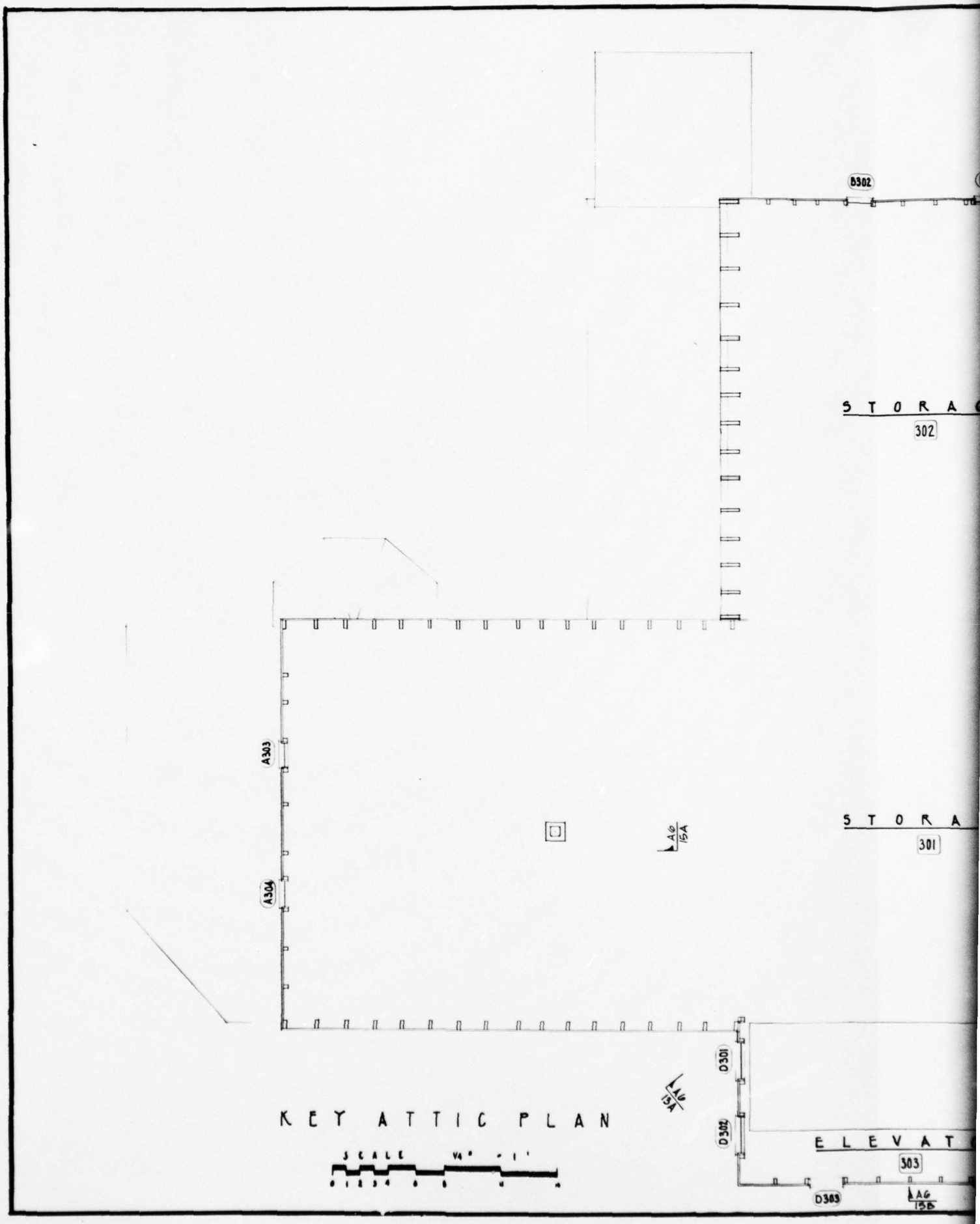
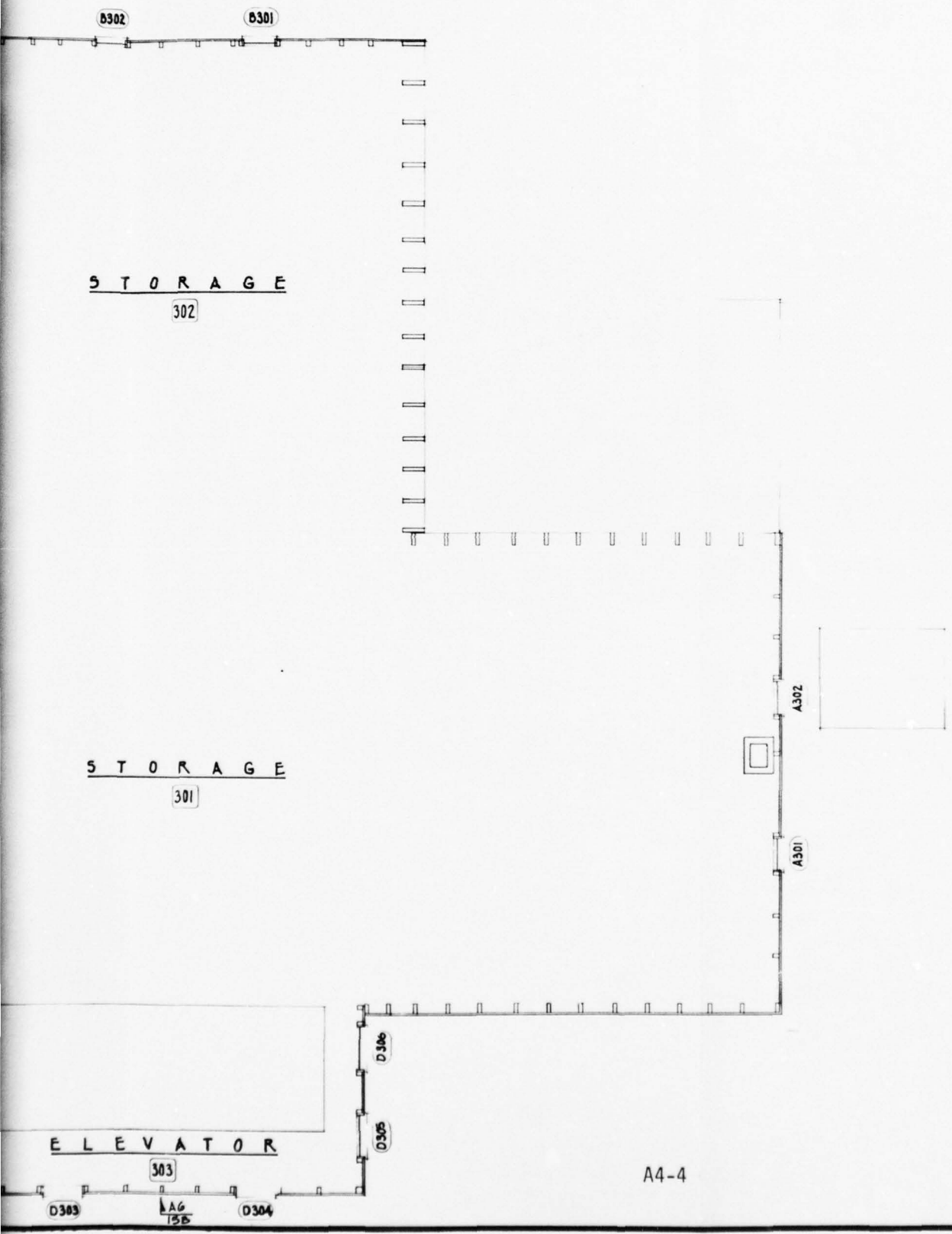
A6 12D
D203
D204
A6 9D
D205
D206
A6 14A

A4-3



KEY ATTIC PLAN

SCALE 1/4" = 1'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D301
STORAGE
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STORAGE
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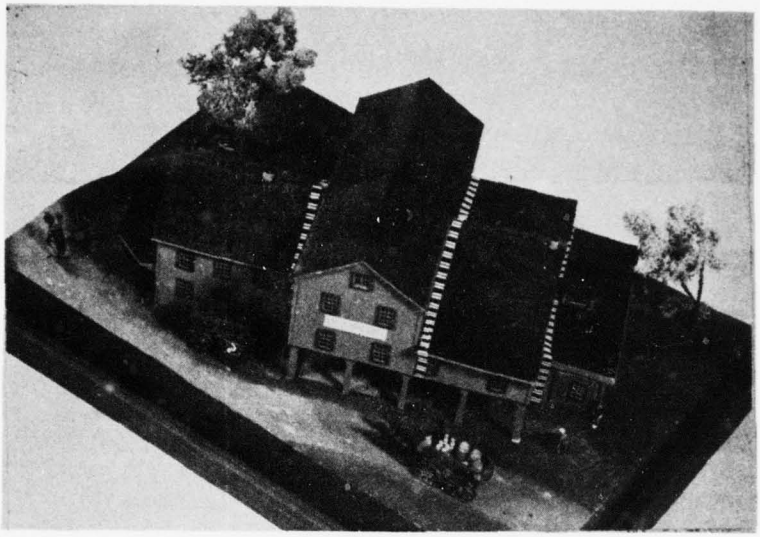
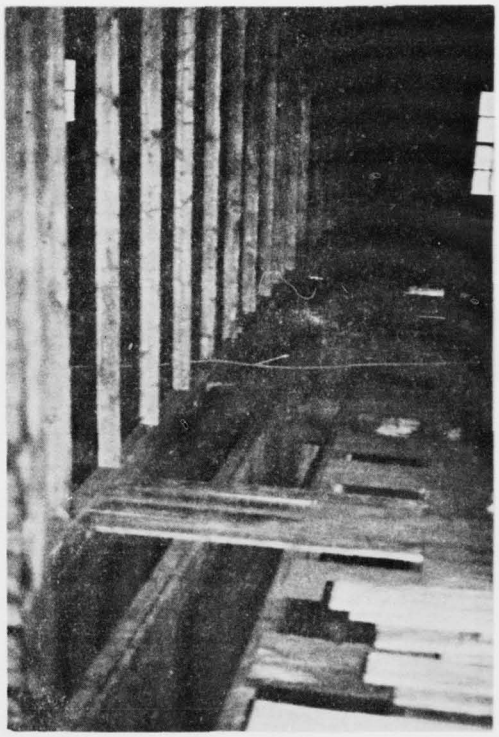
D306
D305
ELEVATOR
303
D303
AG
15B
D304

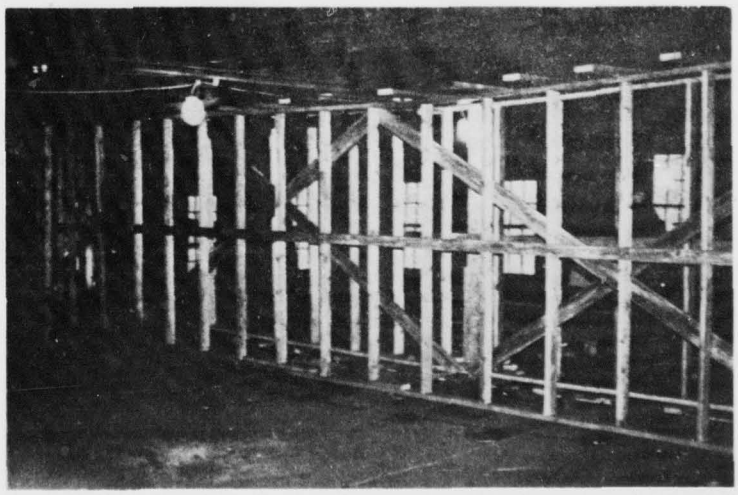


A) Model of Wagon Works Showing General Separation Planes

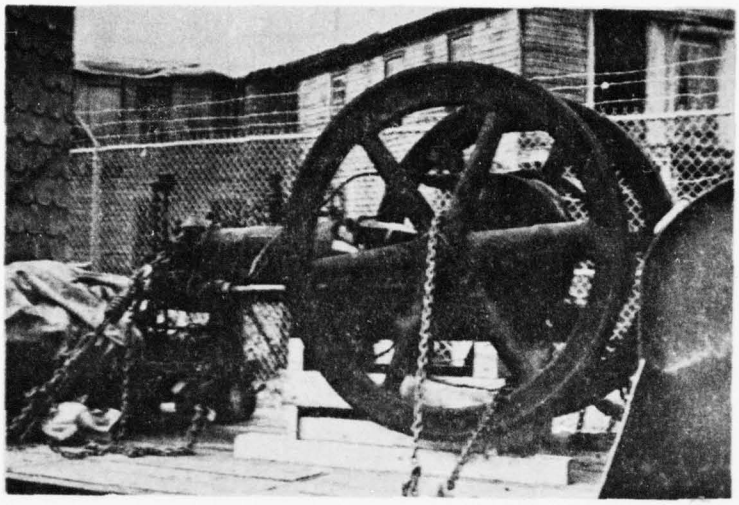
B) Removal of Siding Along Separation Plane



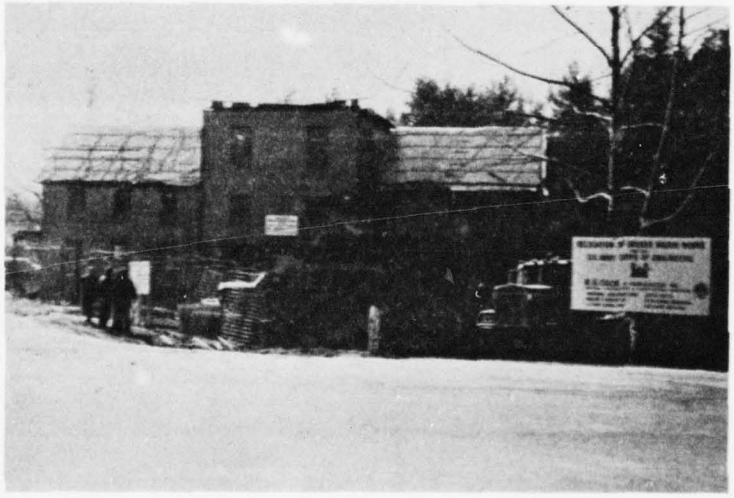
A) Removal of Flooring
Along Separation Plane



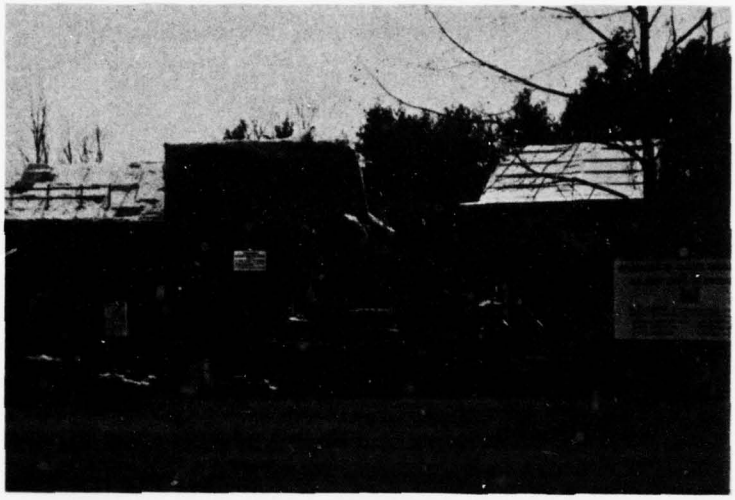
B) Structural Reinforcing



A) Otto Engine During Relocation



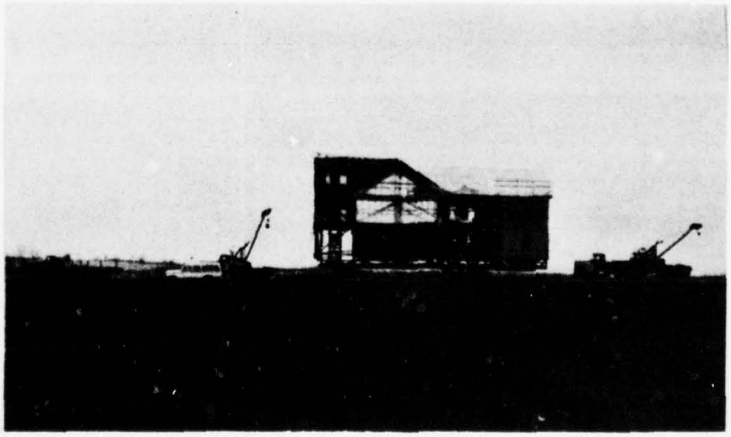
B) Elevator Penthouse Gable Roof Removed



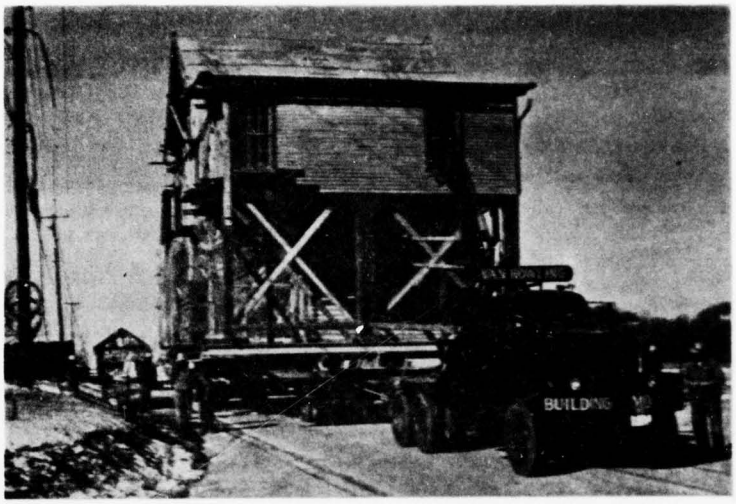
A) Separation into Major Sections

B) Needling Stringers Through Pierced Foundation

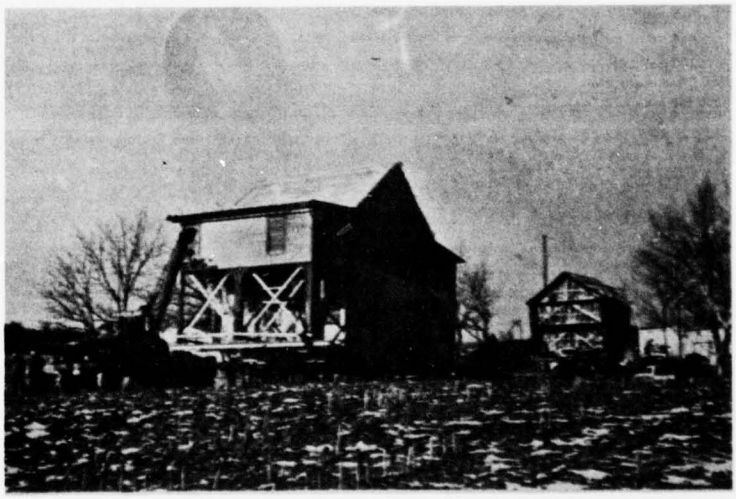
A) Section Rigged On Stringers, Beams and Dolleys



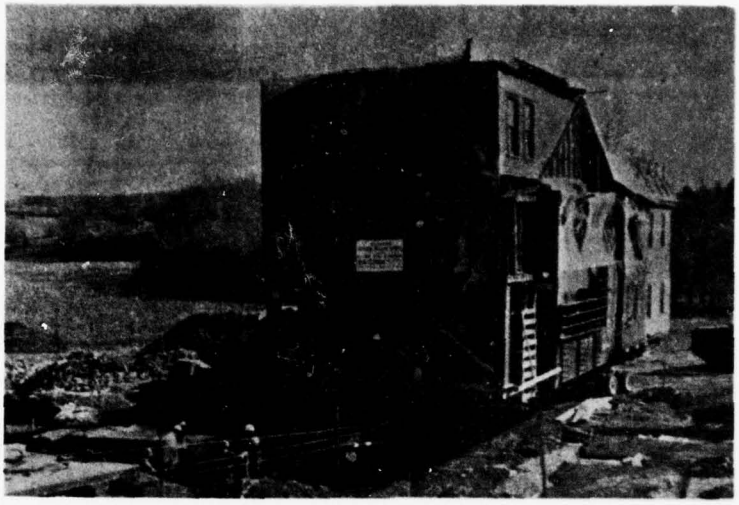
B) Movement of Largest Section Over Highway



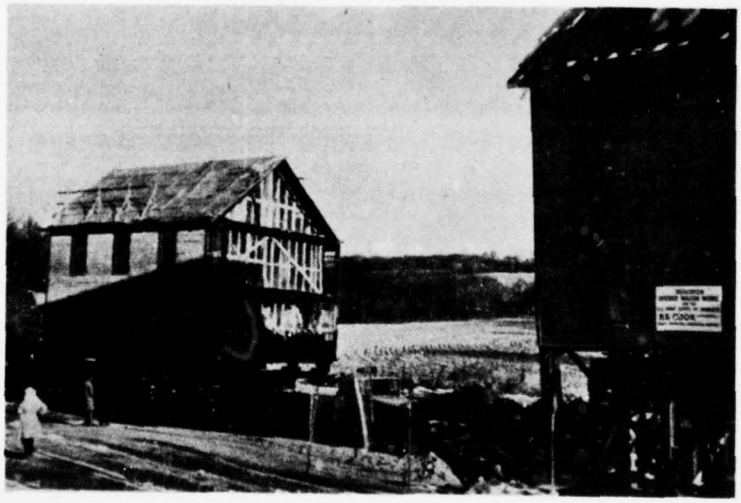
A) Movement of Flanking Sections Over Highway



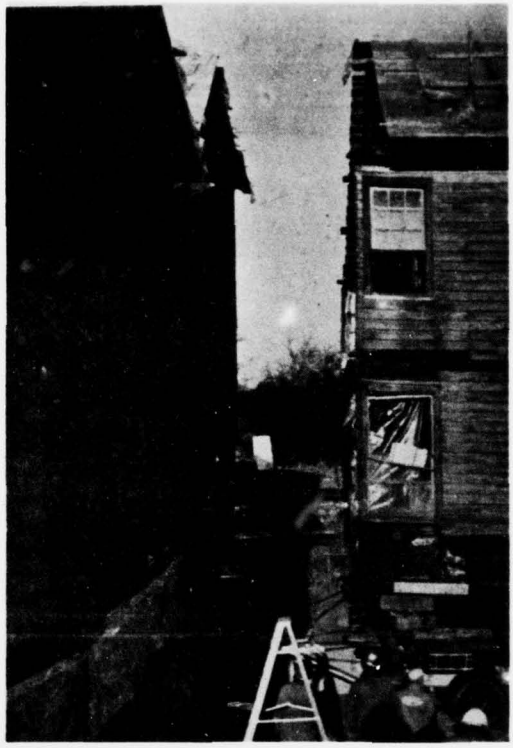
B) Movement Through Field



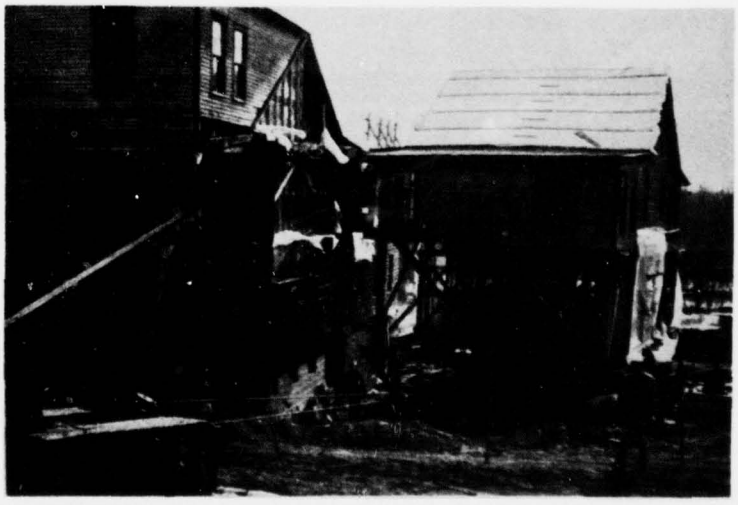
A) Movement of Largest Section into New Location



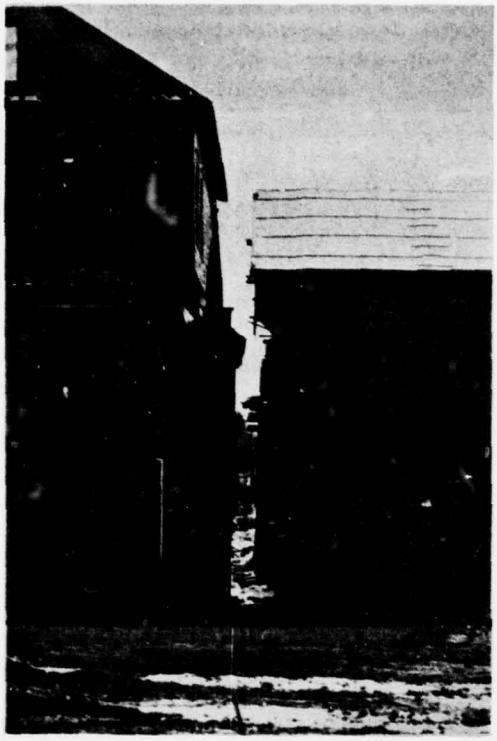
B) Movement of East Flanking Section into New Location



A) Movement of East Flanking Section into New Location



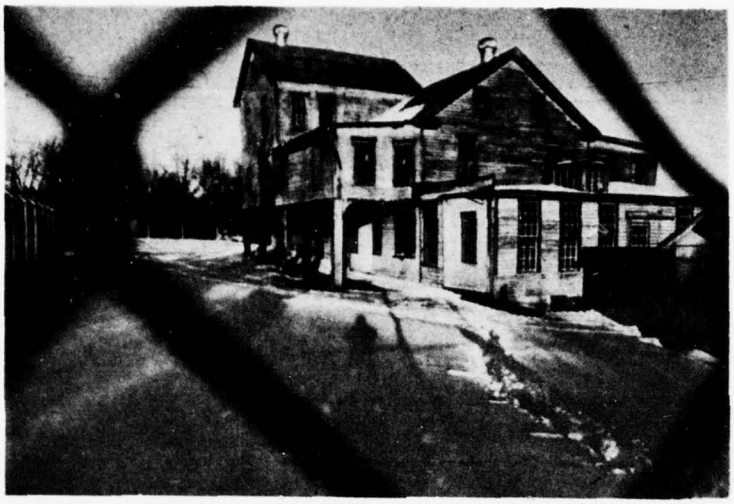
B) Movement of West Flanking Section into New Location



A) Movement of West Flanking Section into New Location

B) Reassembly Construction

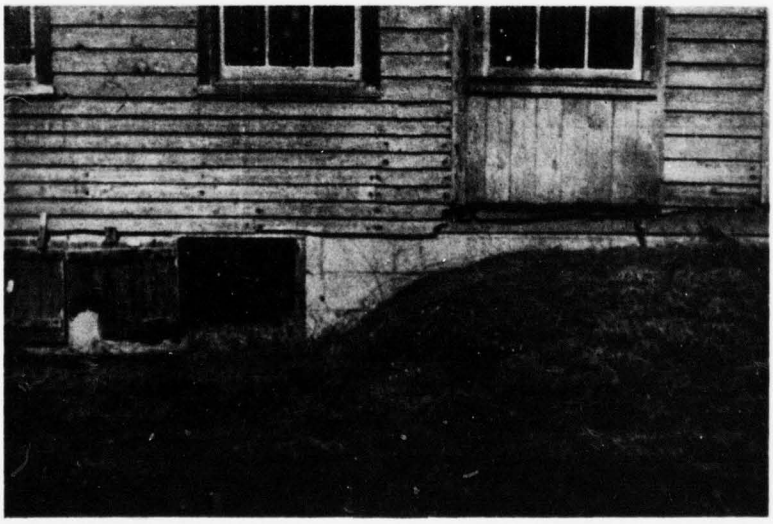
A) Reassembled Wagon Works



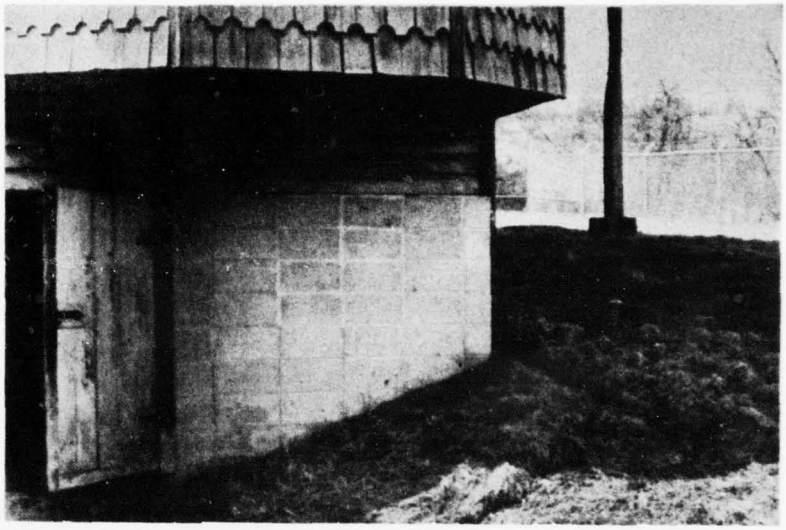
A) Gruber Wagon Works
from the Northwest

B) The Red Bridge Site
from the Northeast

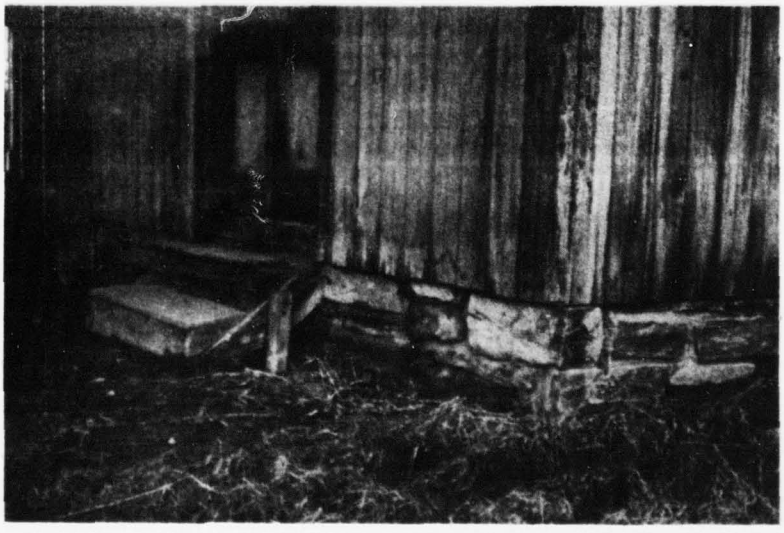
A) Northwest Corner of Structure Showing Existing Grading



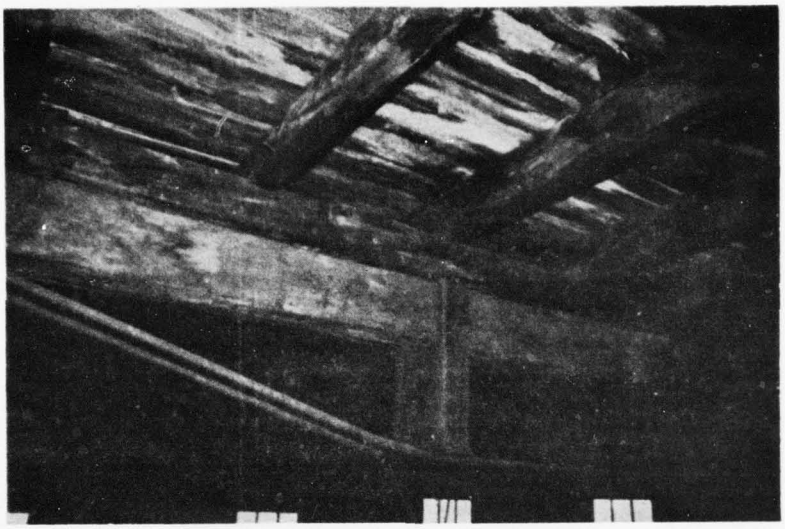
B) Grading Detail; Openings F002, F105, F106



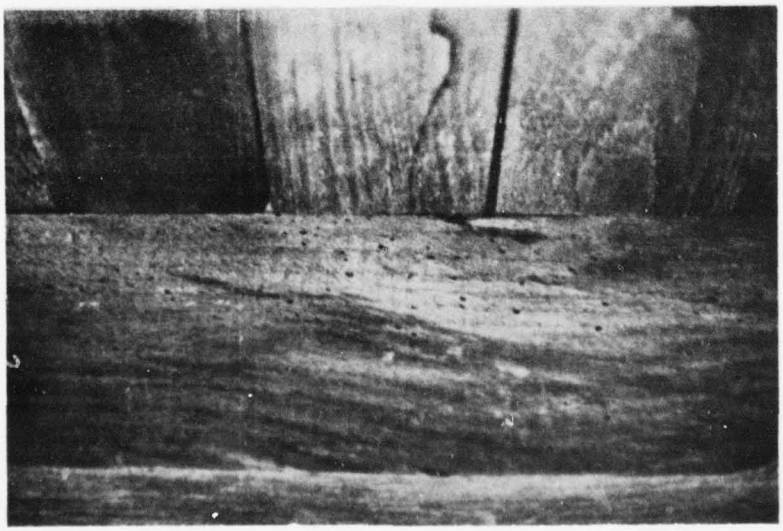
A) Grading Detail, Office Addition "D-3", South-east Corner



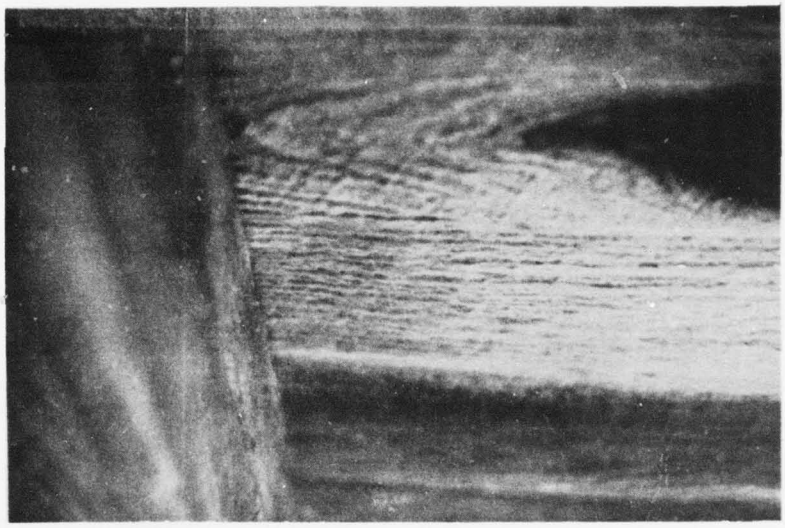
B) Stone Foundation Under Engine Room Addition "C-1"



A) Steel Trussed Wall Plate, Second Floor



B) Indication of Powder Post Beetle Infestation



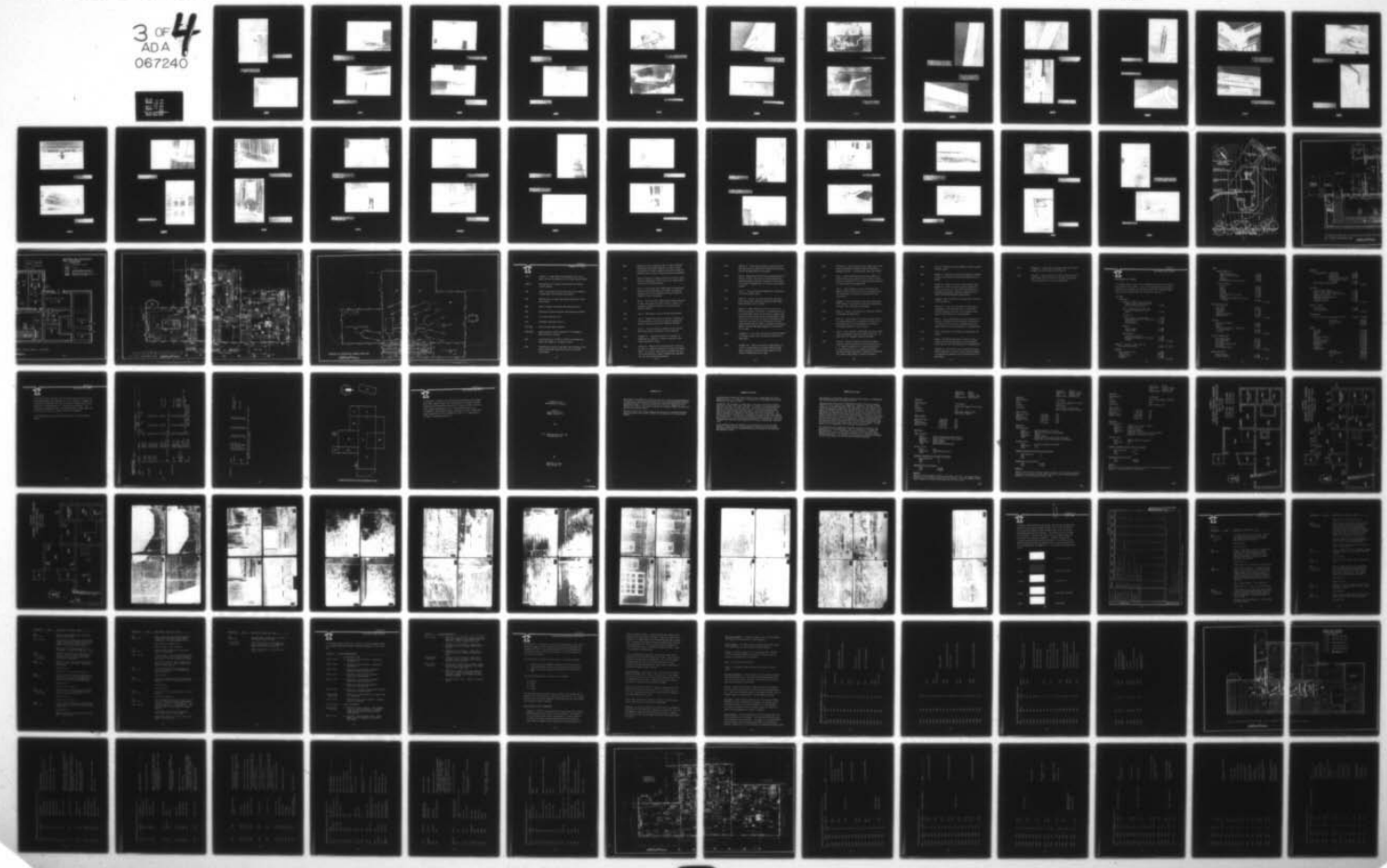
A) Fungus Indicating Early Rotting

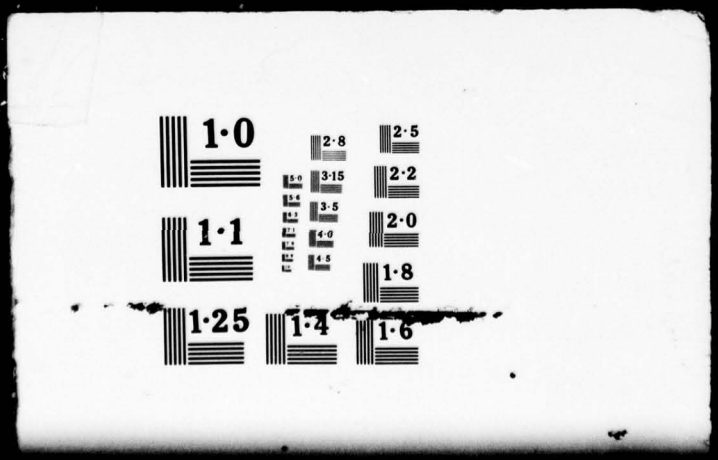
B) Cellar Room 001, First Floor Joist, Southeast Corner

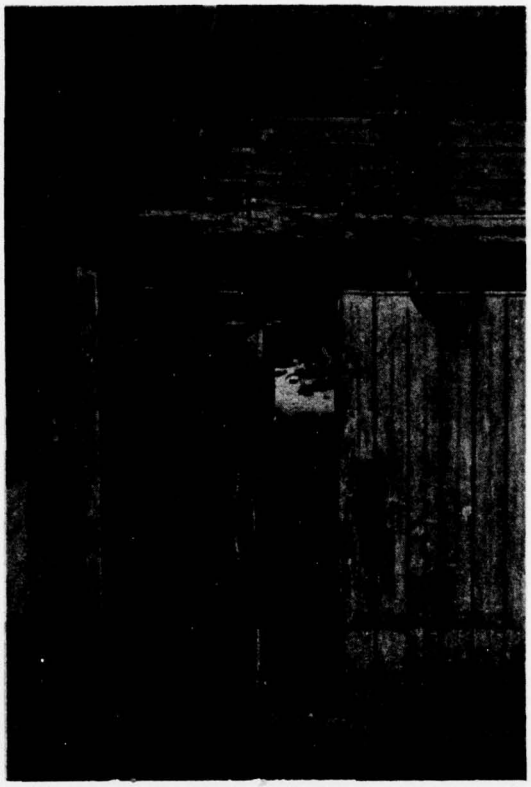
AD-A067 240 MILNER (JOHN) ASSOCIATES WEST CHESTER PA F/G 5/11
GRUBER WAGON WORKS, BLUE MARSH LAKE, BERKS COUNTY, PENNSYLVANIA--ETC(U)
APR 78 R L DESILETS, C A PARROTT DACW61-78-C-0038

UNCLASSIFIED NL

3 OF 4
ADA
067240

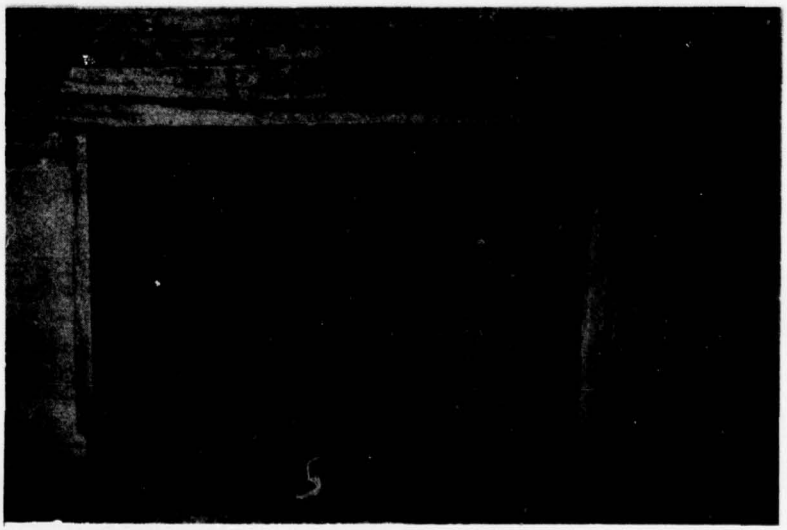


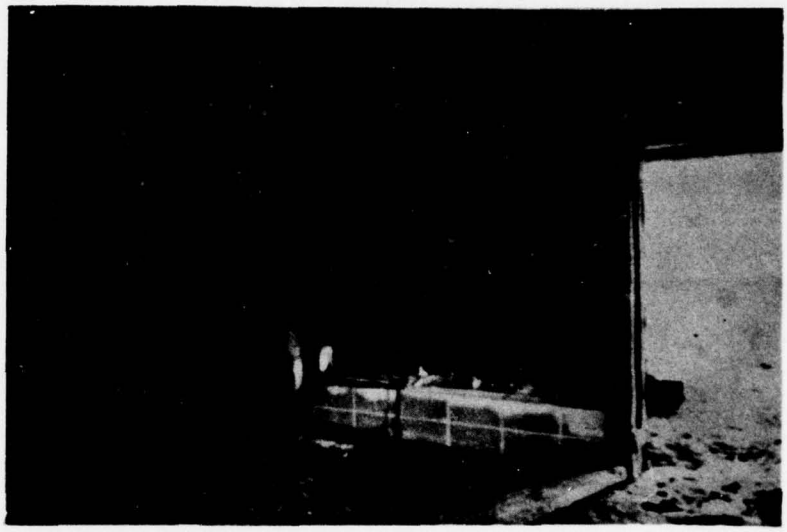




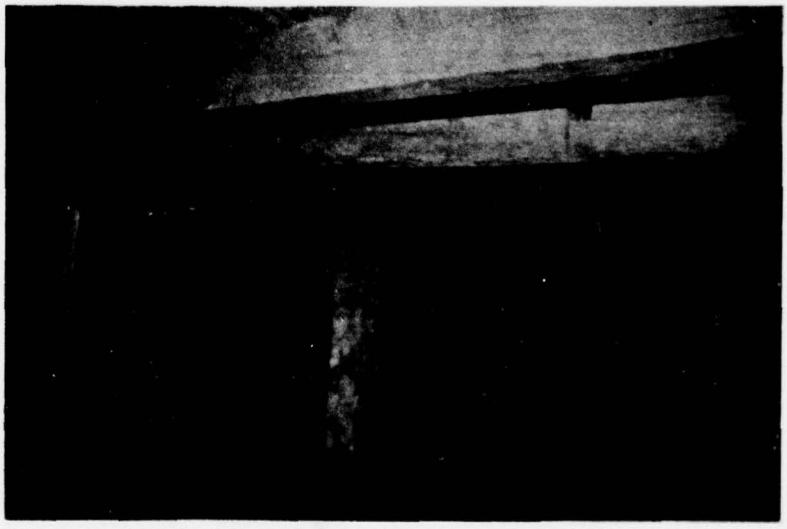
A) Shored Door Opening B001, Rotted Lintle

B) Shored Door Opening D001, Lintle Broken

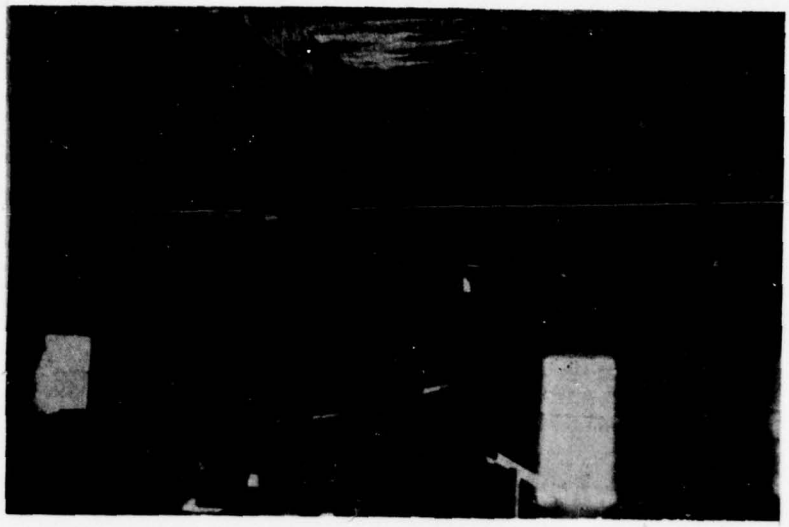




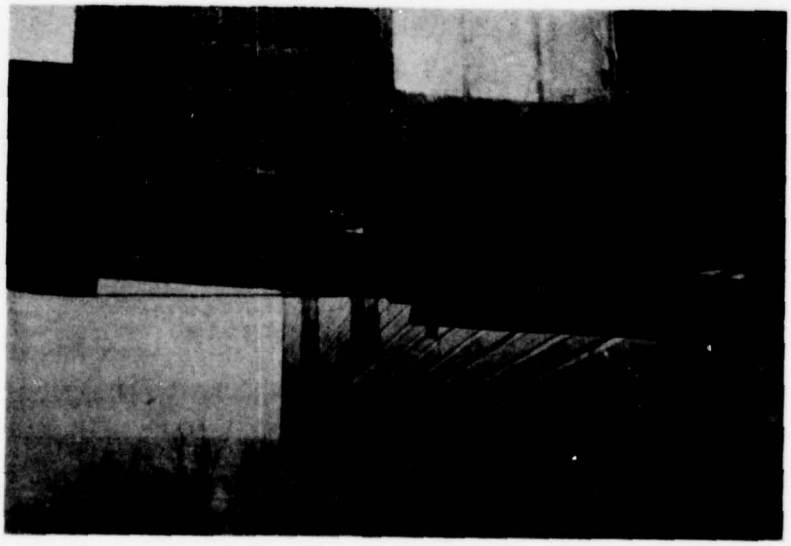
Southwest Corner of Engine Room 008 from Cellar Area 007



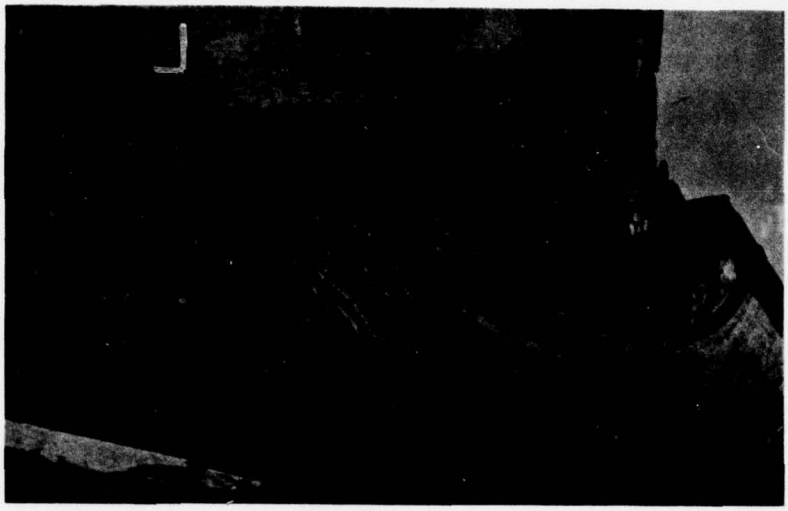
Summer Beam, Forge Room 002



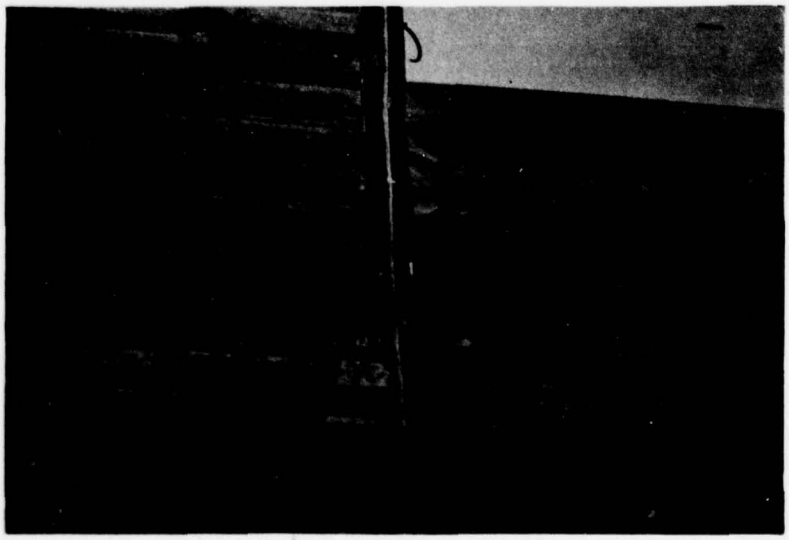
A) Fractured Wall Plate, Second Floor



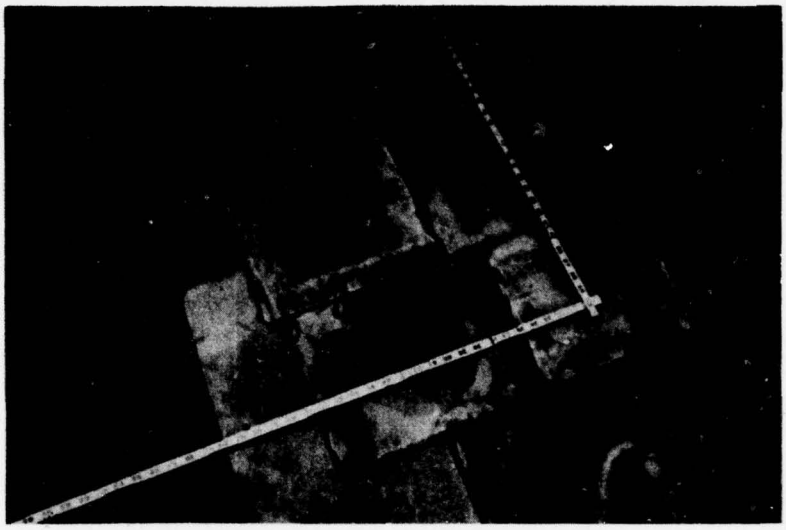
B) Fractured [illegible] Under [illegible] Floor



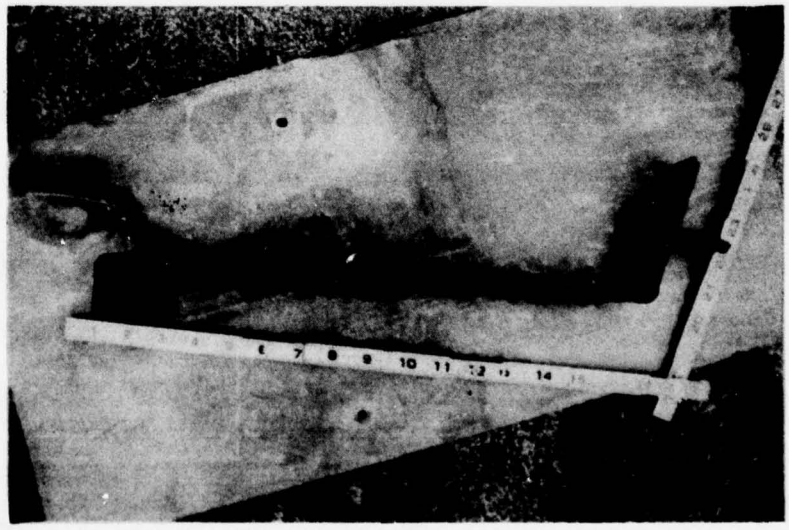
[redacted] of Sheating, [redacted] Corner Addition "F"



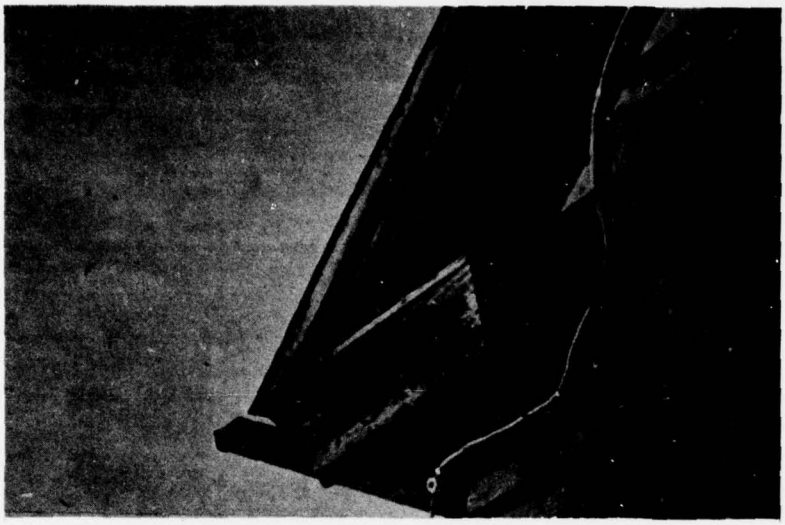
[redacted] Elevator, [redacted]



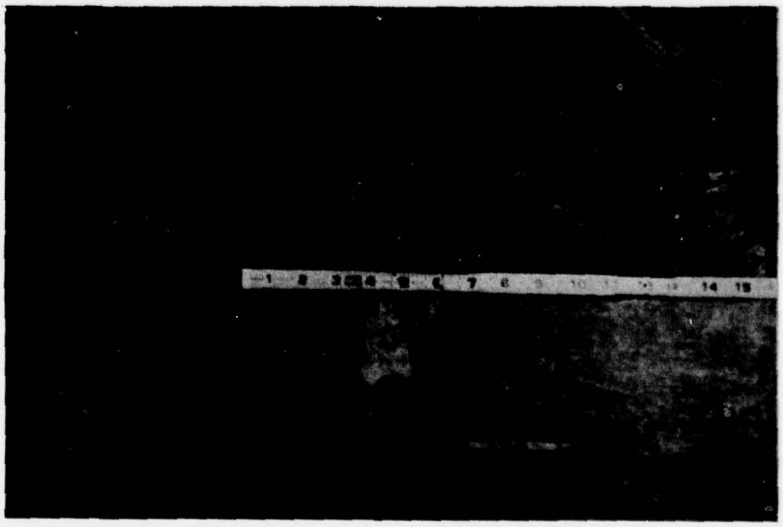
A) Slate Roofing and Snow-guard Layout



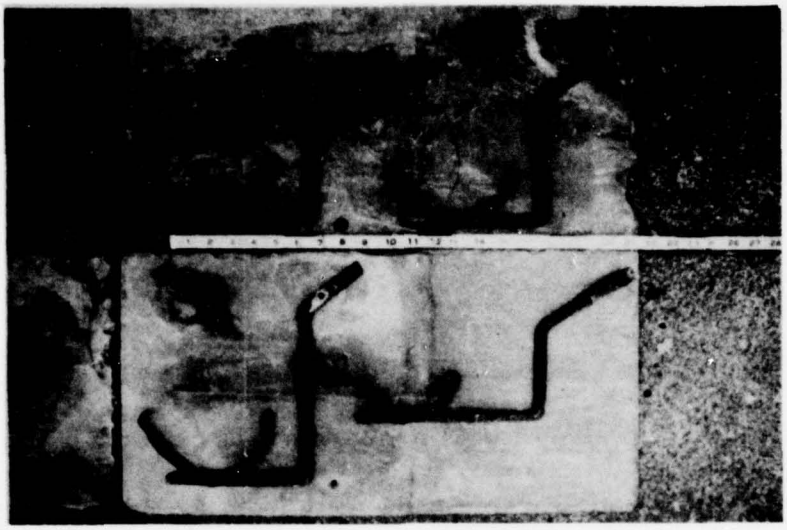
B) Snow Guard Bracket



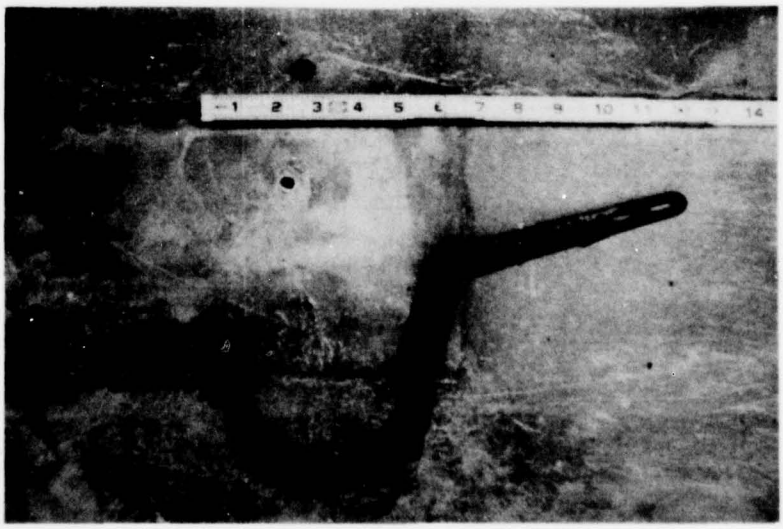
A) Building "A" Cornice and Return, East Elevation



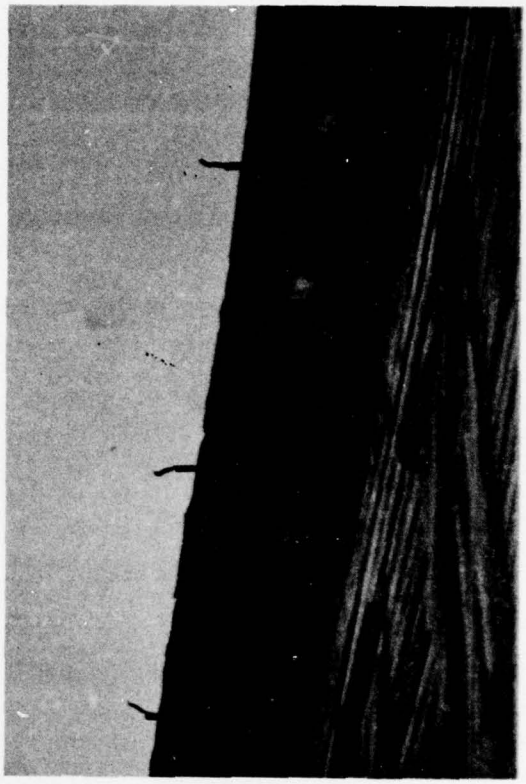
B) Drive Gutter [redacted]



A) Side Nail Gutter Bracket

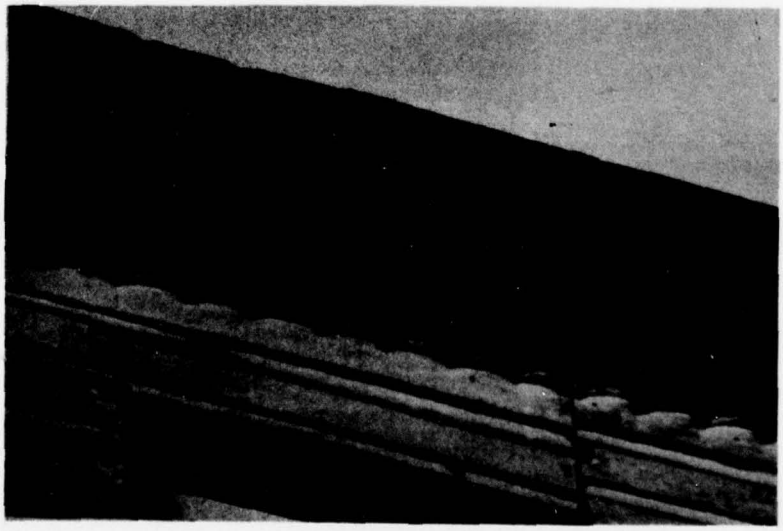


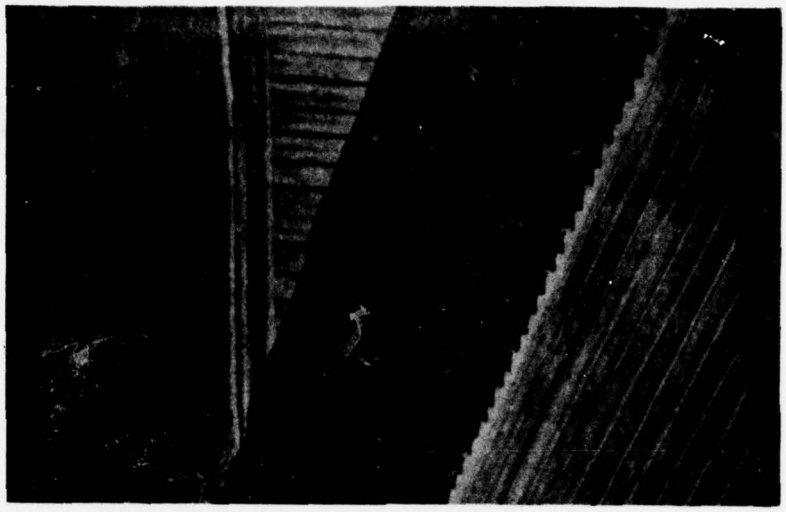
B) Adjustable Gutter Bracket



A) Elevator, East Elevation Roof, Cornice Trim and Gutter Hangers (See A4-30)

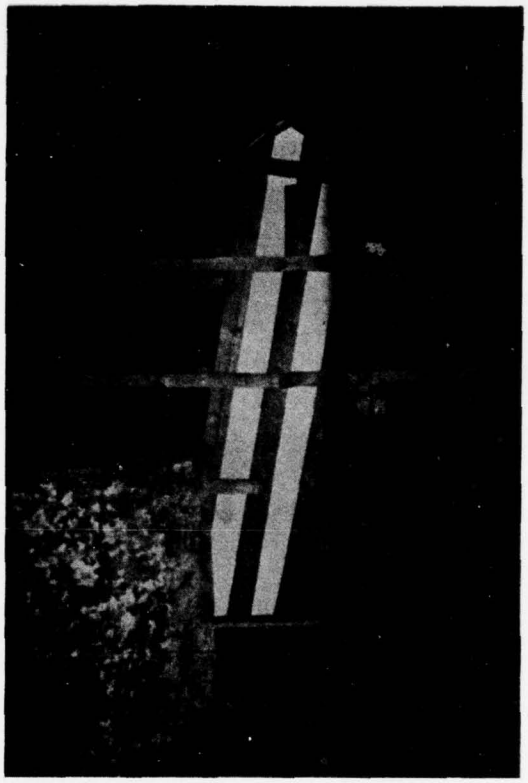
B) Cornice Section D-1, South Elevation (See A4-39)





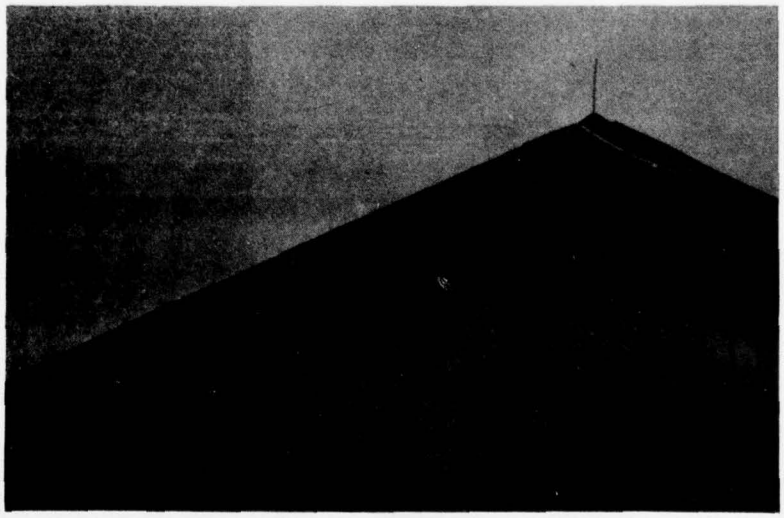
A) Elevator Storage
tion, North Elev
Roof Eave

B)



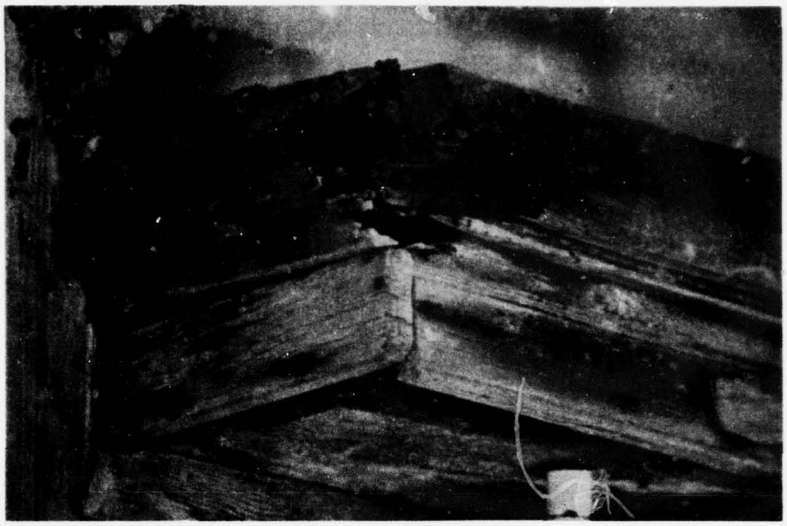
[redacted] East Chimney,

B) Elevator North Gable

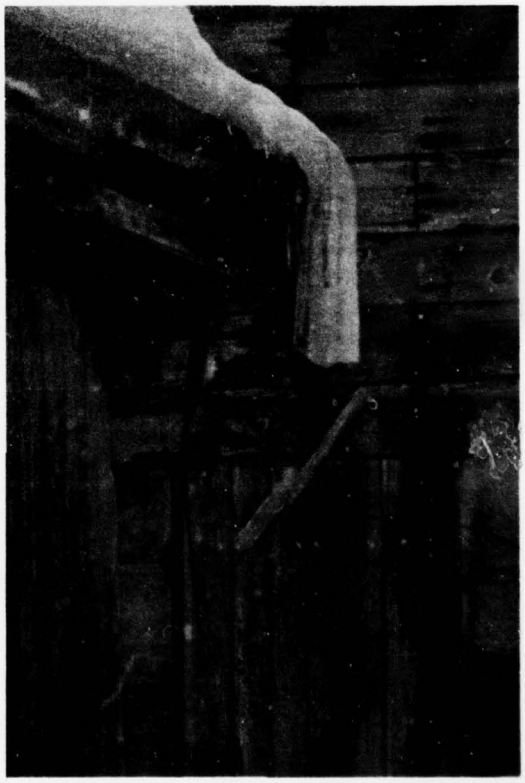


A) Deteriorated Roof Juncture, Section B-1 and B (West Elevation of B)

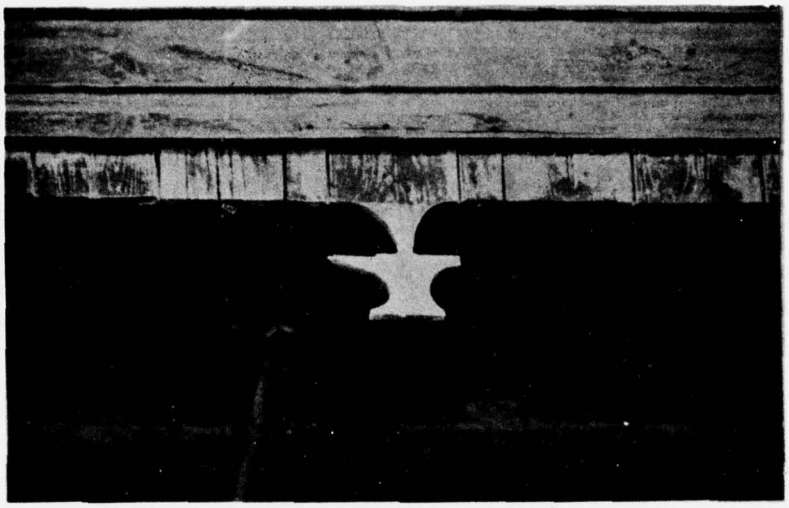
B) Deteriorated Cornice, Section B, West Elevation



A) South End of Cornice, Addition "C-1"



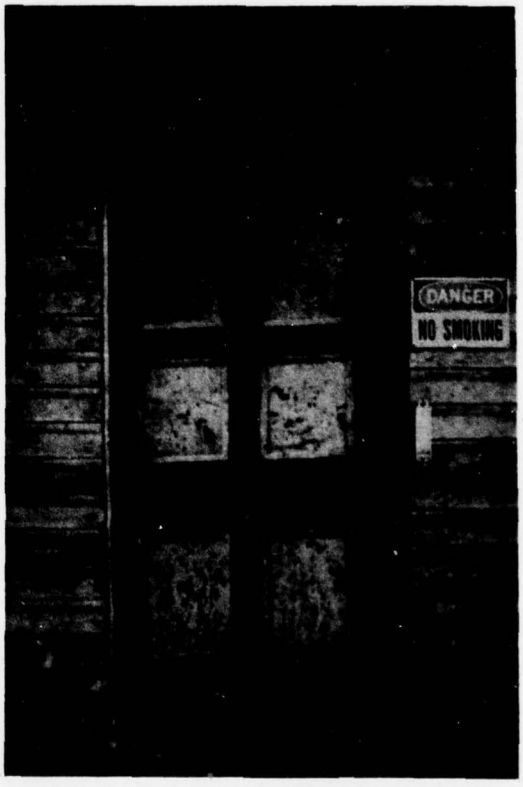
B) Addition "C-1" Cornice Abutting South Elevation Building "A"



A) Anvil Logo [illegible]
Elevator

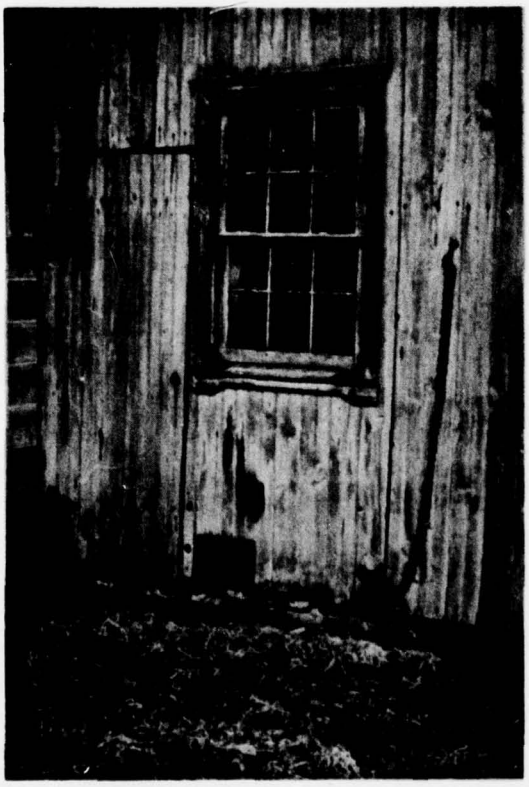
B) Broken [illegible]
Opening

[redacted] Pull

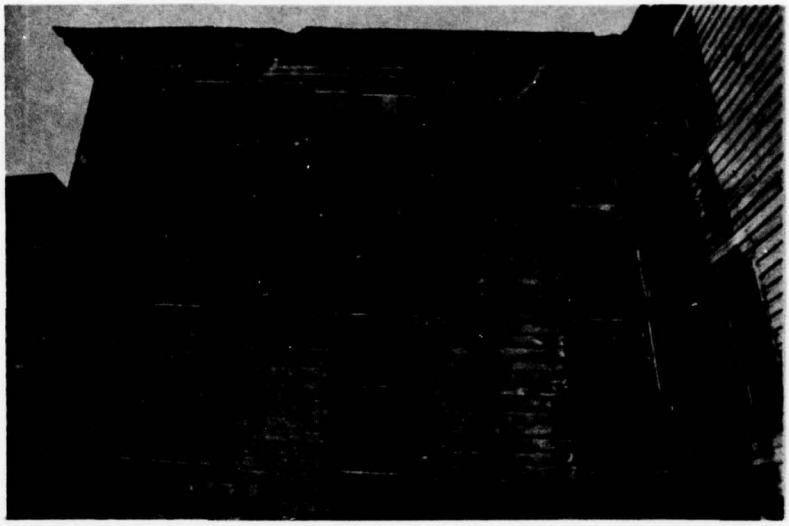


[redacted]

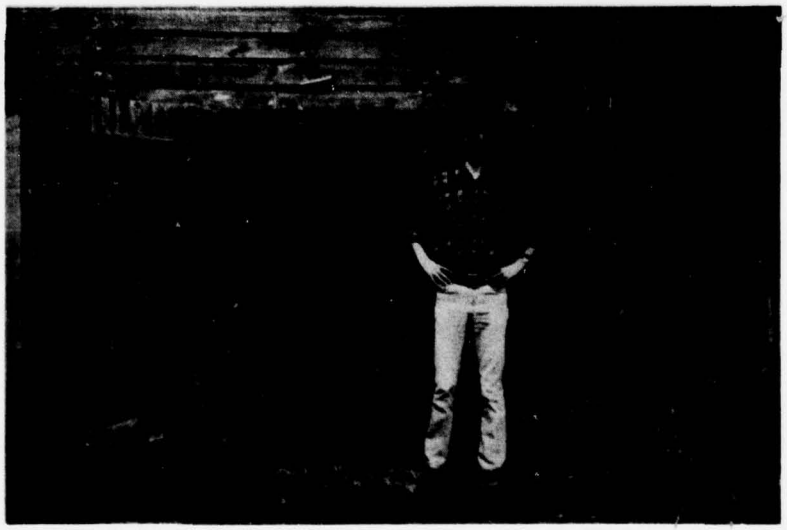
A) Outhouse Cleanout Location, East Elevation



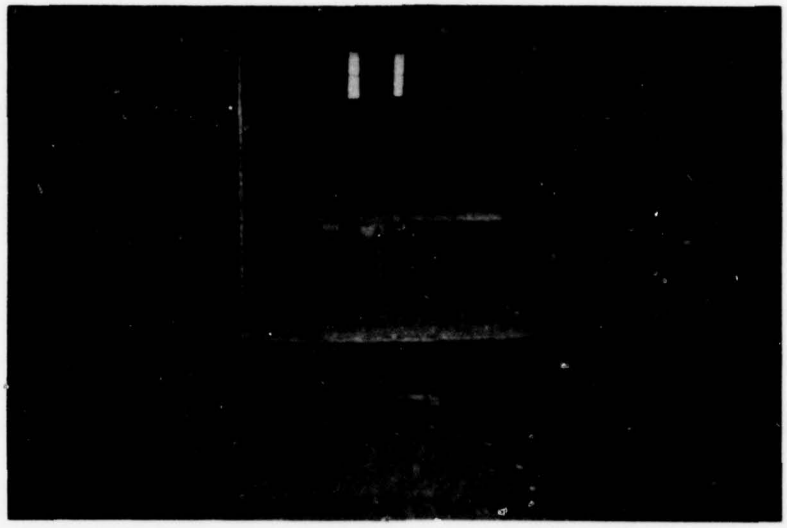
B) East Elev... "C-1", Open... and CO02



A) Section D-1, South Elevation, First Floor to Roof Eave

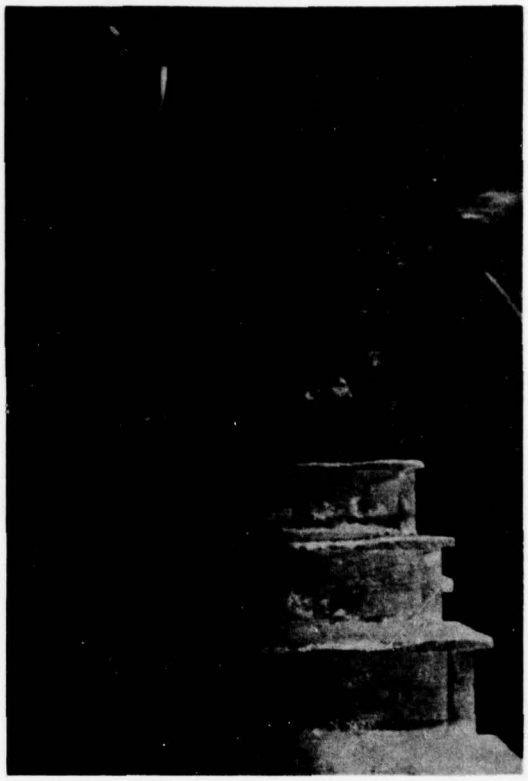


B) Door Opening A005 Indicating Height



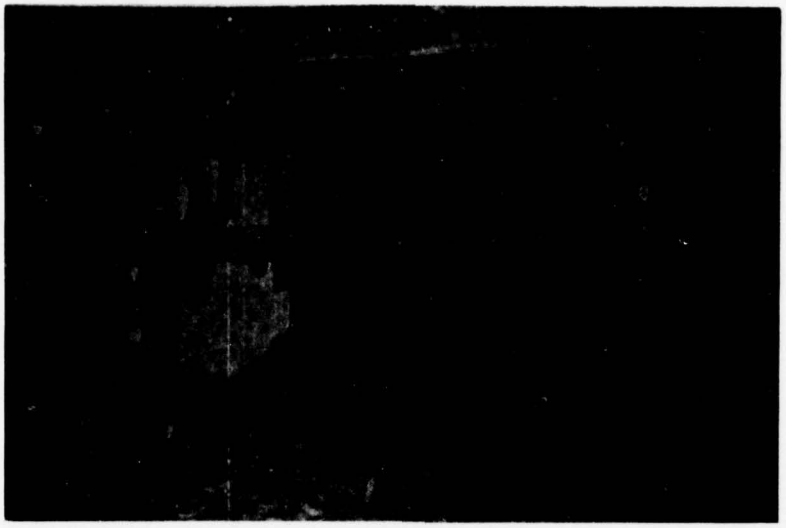
A) Steps Between Rooms 102 and 103

B) Bracket [illegible] for Step

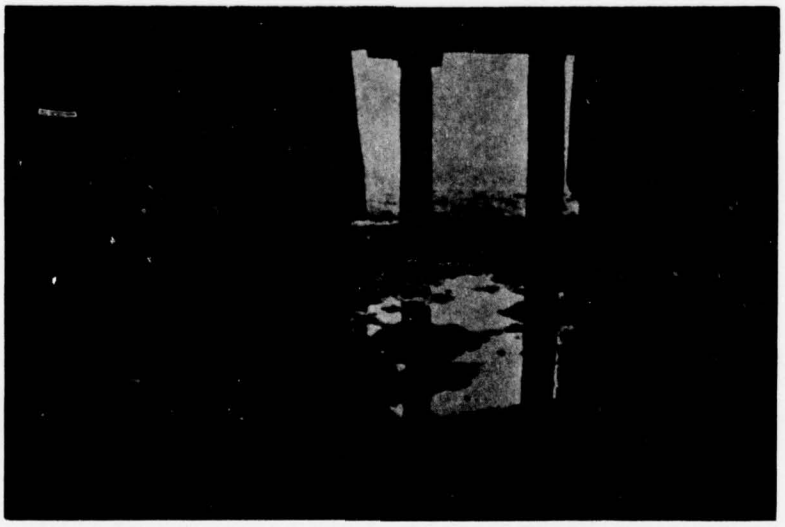


A) [illegible]-to-Second Floor, [illegible] 101

B) "Graffiti" on Elevator North Wall, Room 205

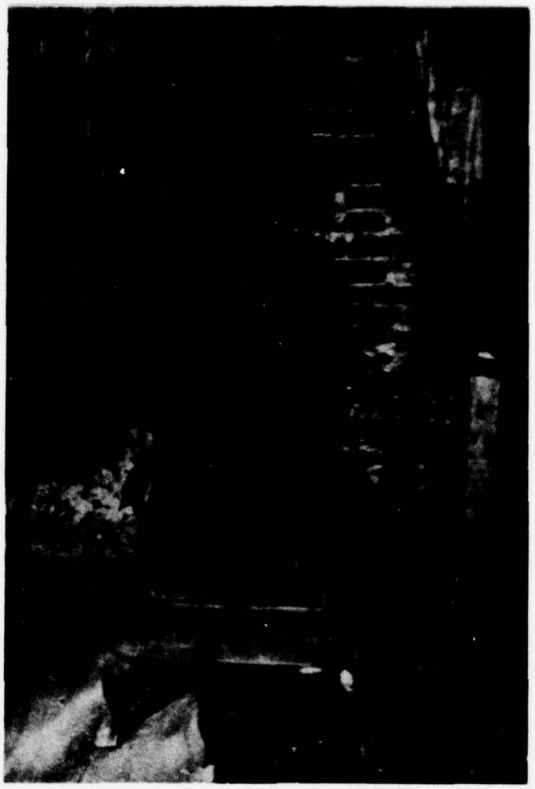


[redacted]



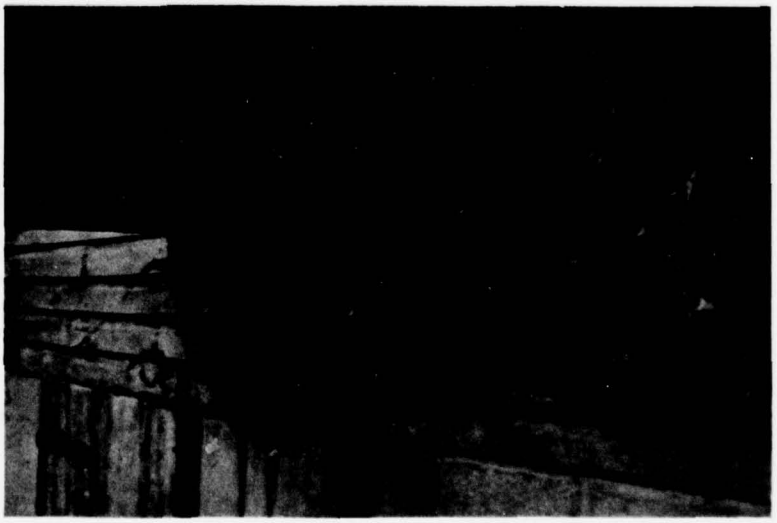
[redacted]

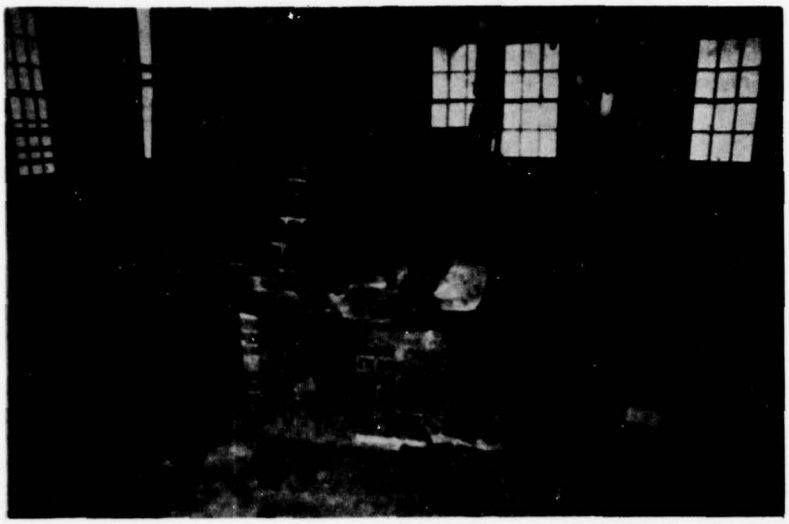
[redacted]



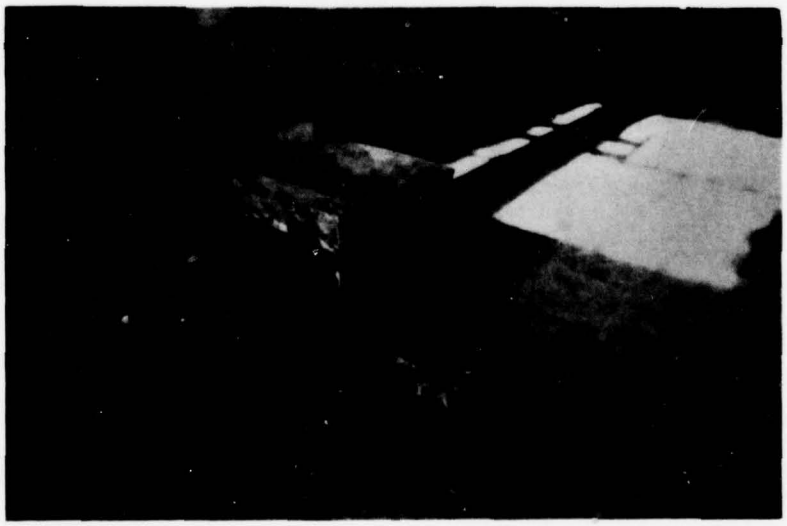
A) Cast Iron Wood Stove (Typical)

B) Knob and Tube Exterior Wiring Under Addition D-3

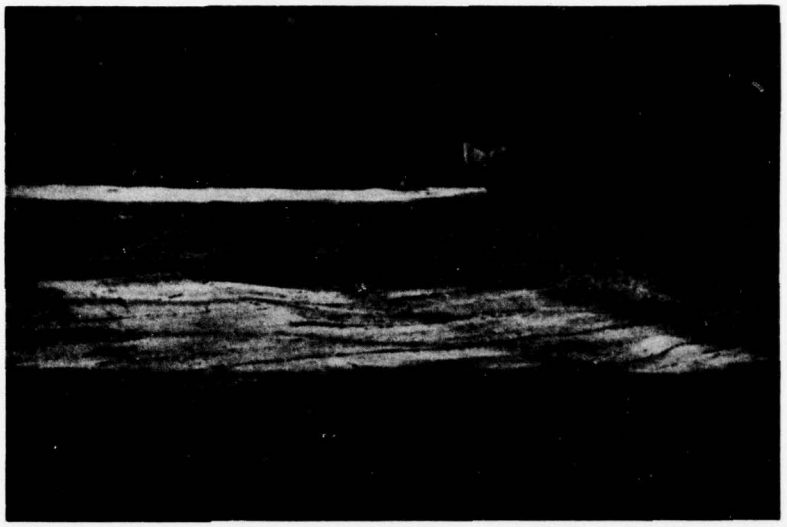




A) Forge, South Side

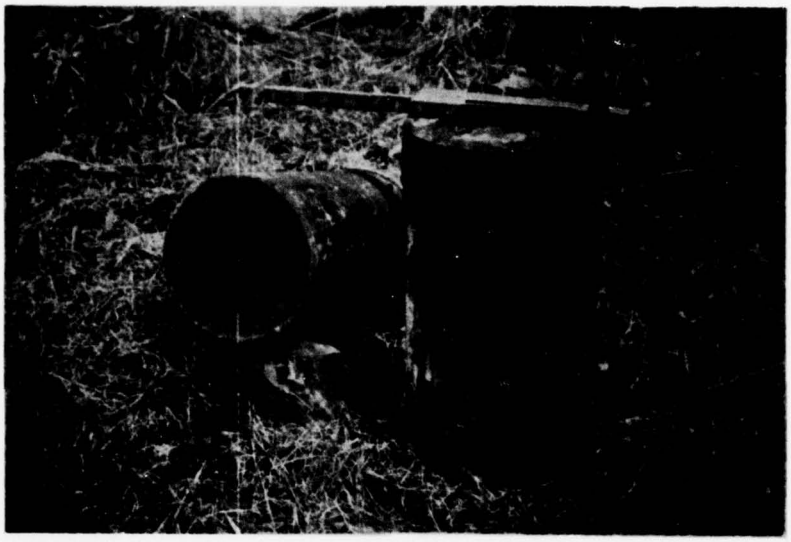


B) Cast Hearth From Forge

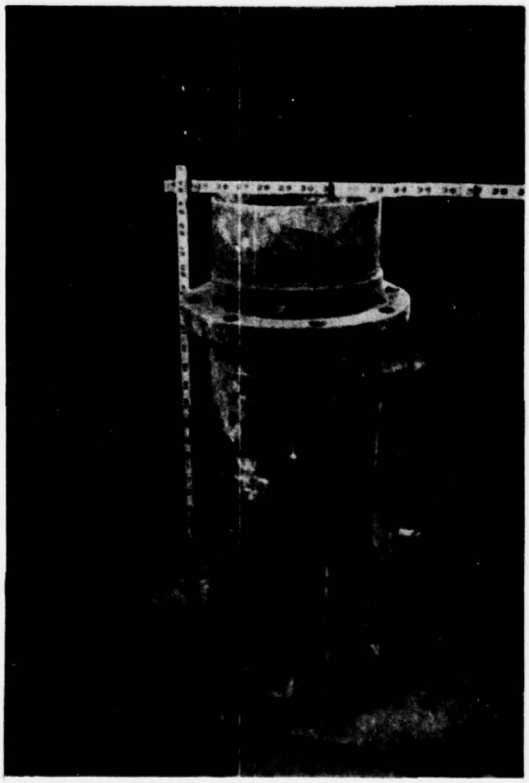


A) Floor Wear in Addition F Indicating North Forge Location

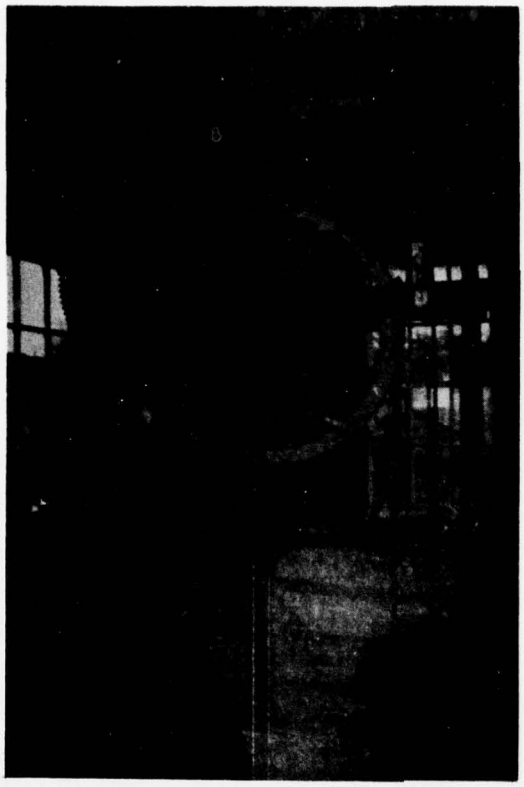
ginal Anvil



A) Cast Pis
Engine

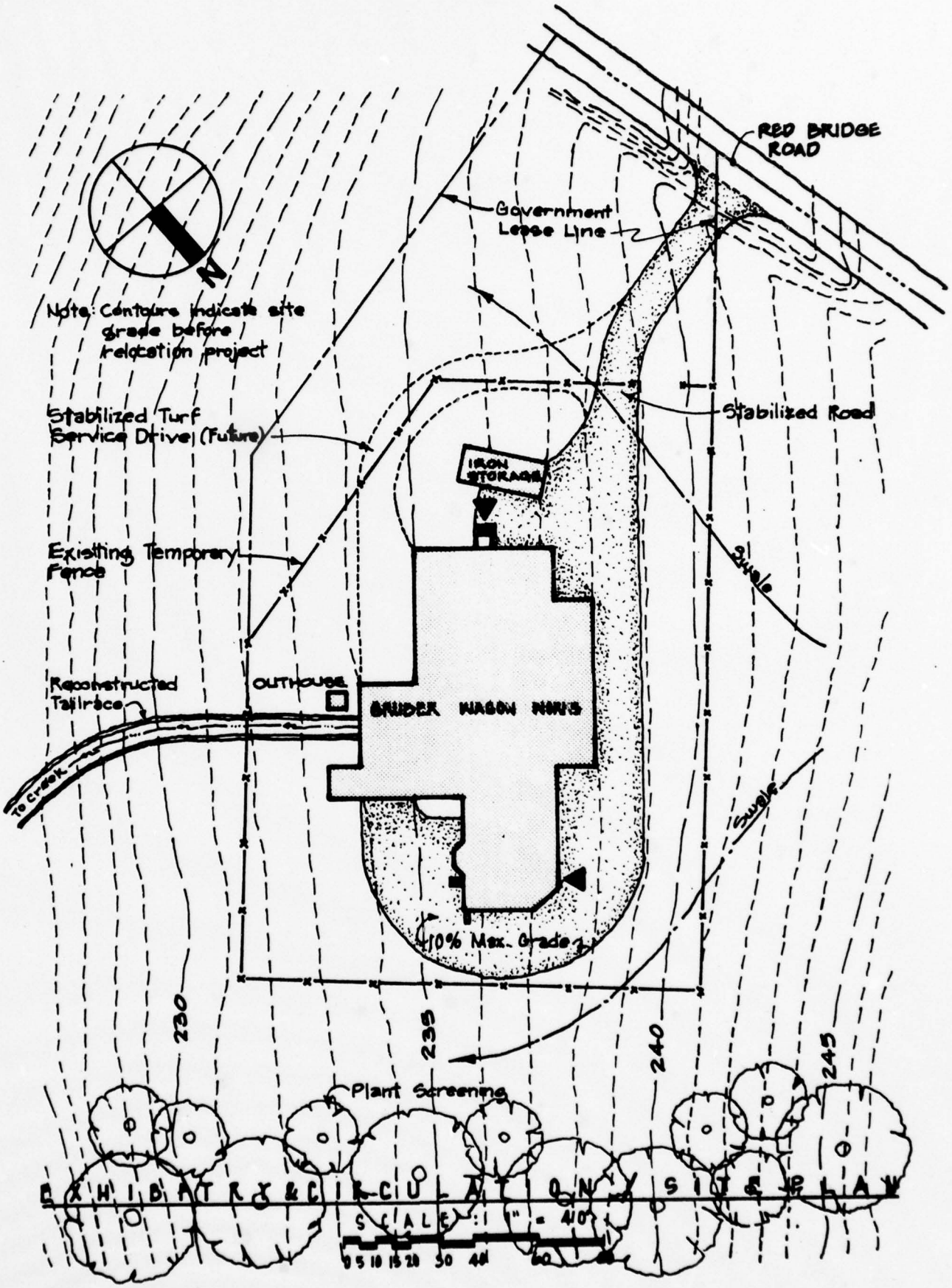


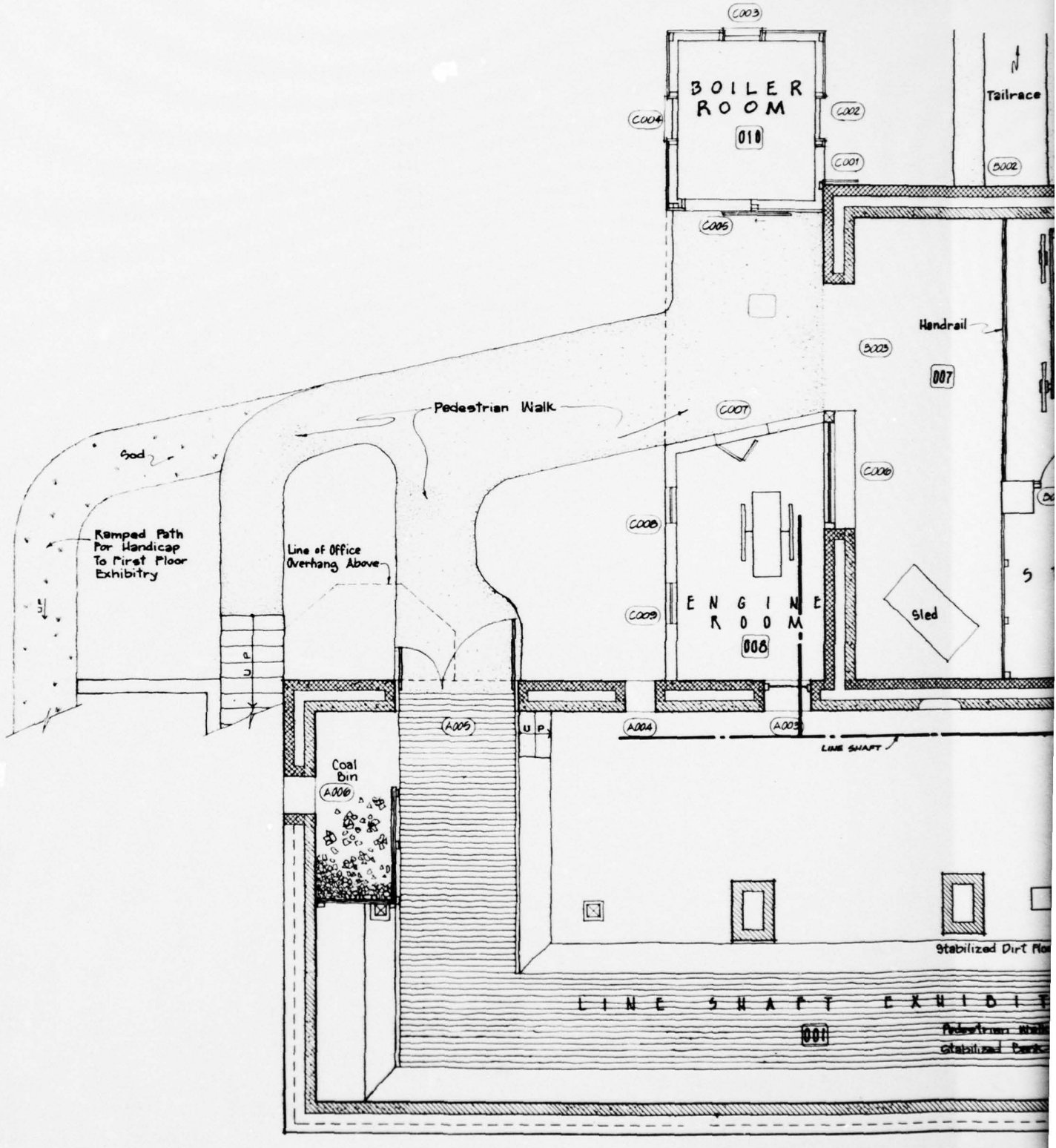
B) Cyl
Oth



A) Elevator Rope and Cast Iron Sleeves (Room 205)

B) Elevator Winch


RED BRIDGE ROAD
Government Lease Line
N
Note: Contours indicate site grade before relocation project
Stabilized Turf Service Drive (Future)
Stabilized Road
IRON STORAGE
Existing Temporary Fence
Swale
Reconstructed Tailrace
OUTHOUSE
GRUBER WAGON WORKS
To Creek
Swale
10% Max. Grade
230
235
240
245
Plant Screening
EXHIBIT & CIRCULATION SITE PLAN
SCALE: 1" = 40'
0 5 10 15 20 30 40 60

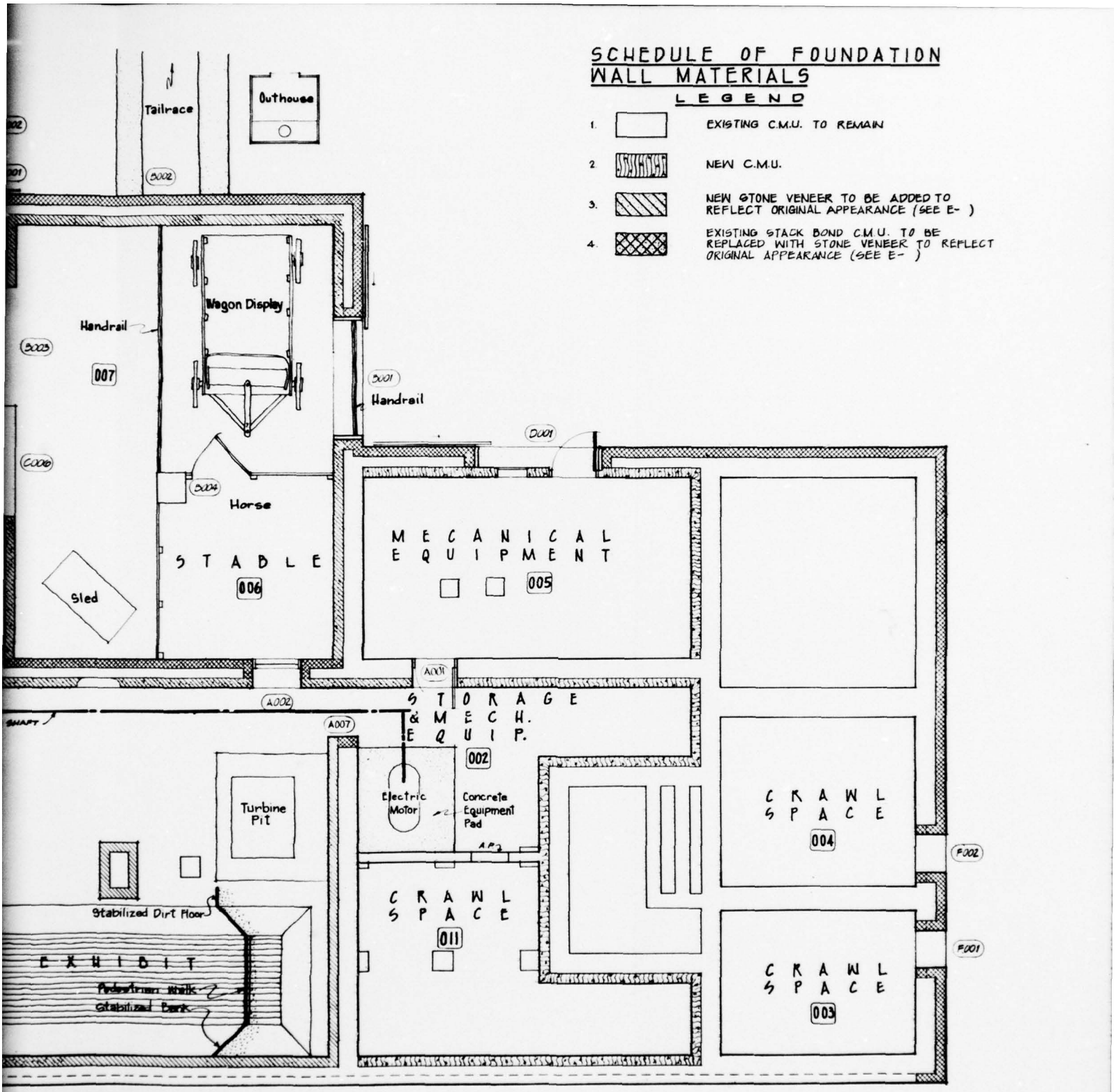


EXHIBITRY & CIRCULATION/ CELL

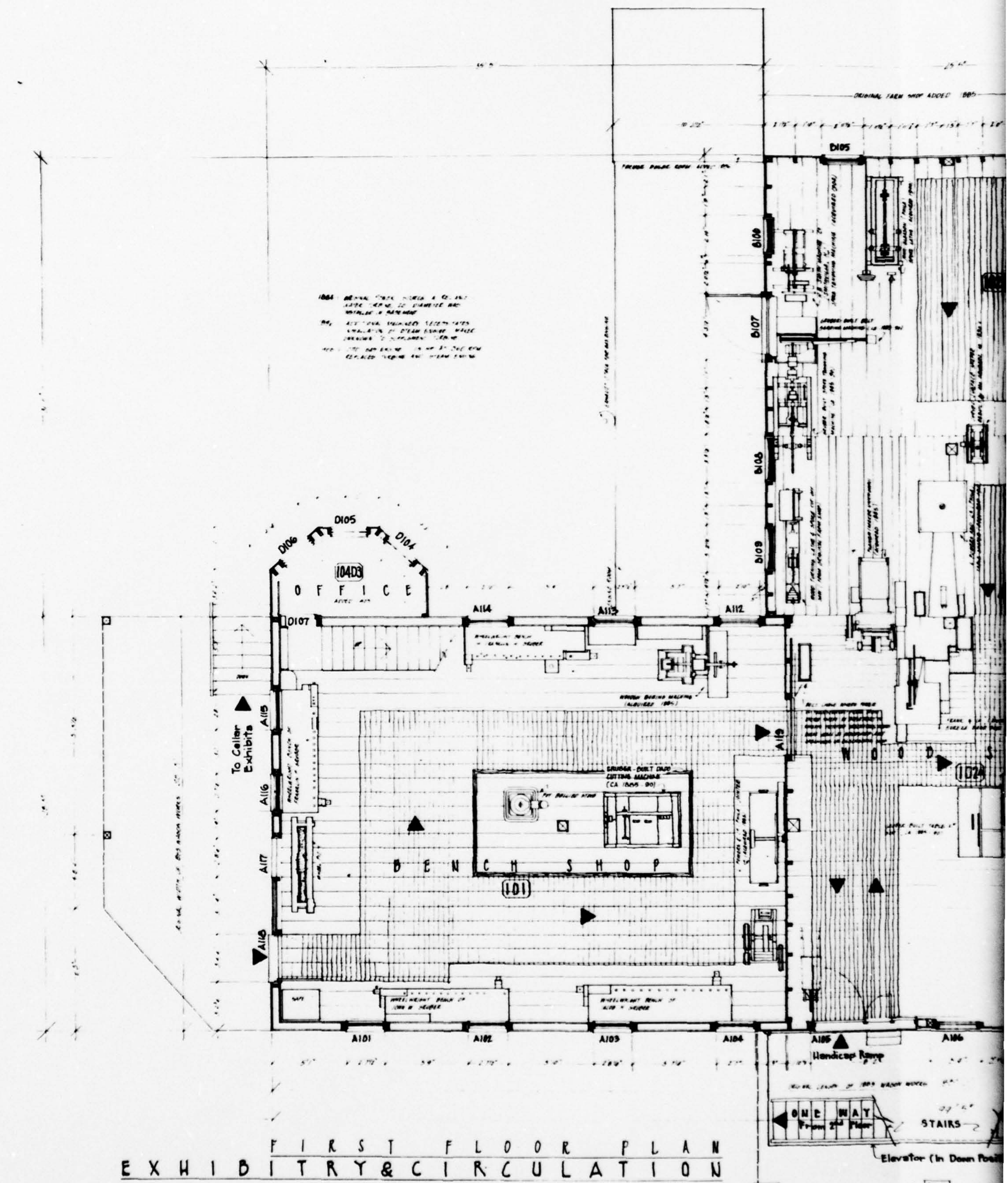
KEY ||||||||||| Controlled Pedestrian Circulation

SCALE 1/4" = 1'

0 1 2 3 4 8 0 4 8



N / CELLAR PLAN

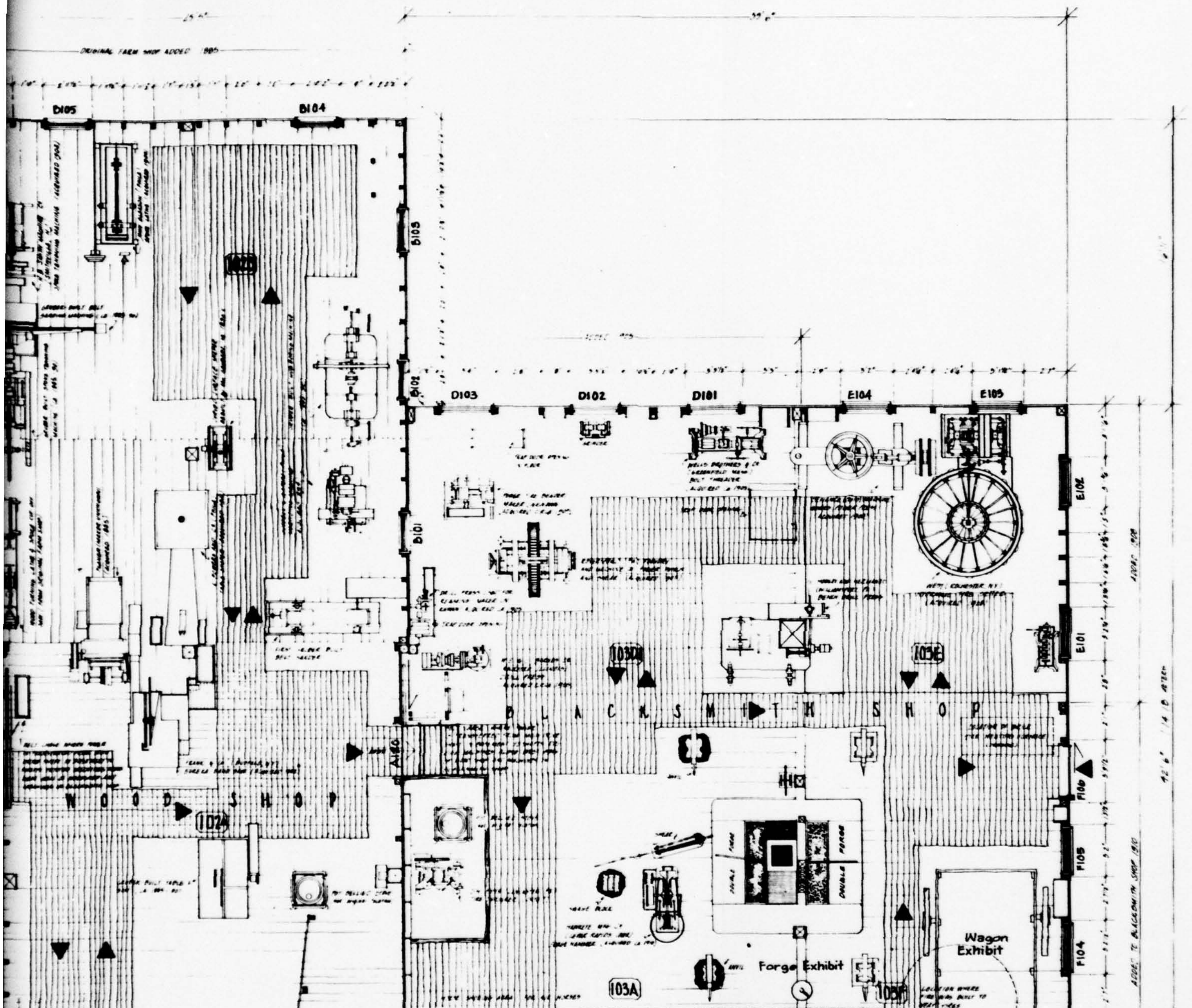


FIRST FLOOR PLAN
EXHIBITRY & CIRCULATION

KEY ||||||||||||| Controlled Pedestrian Circulation

SCALE 1/4" = 1'

0 1 2 3 4 6 8 12 16



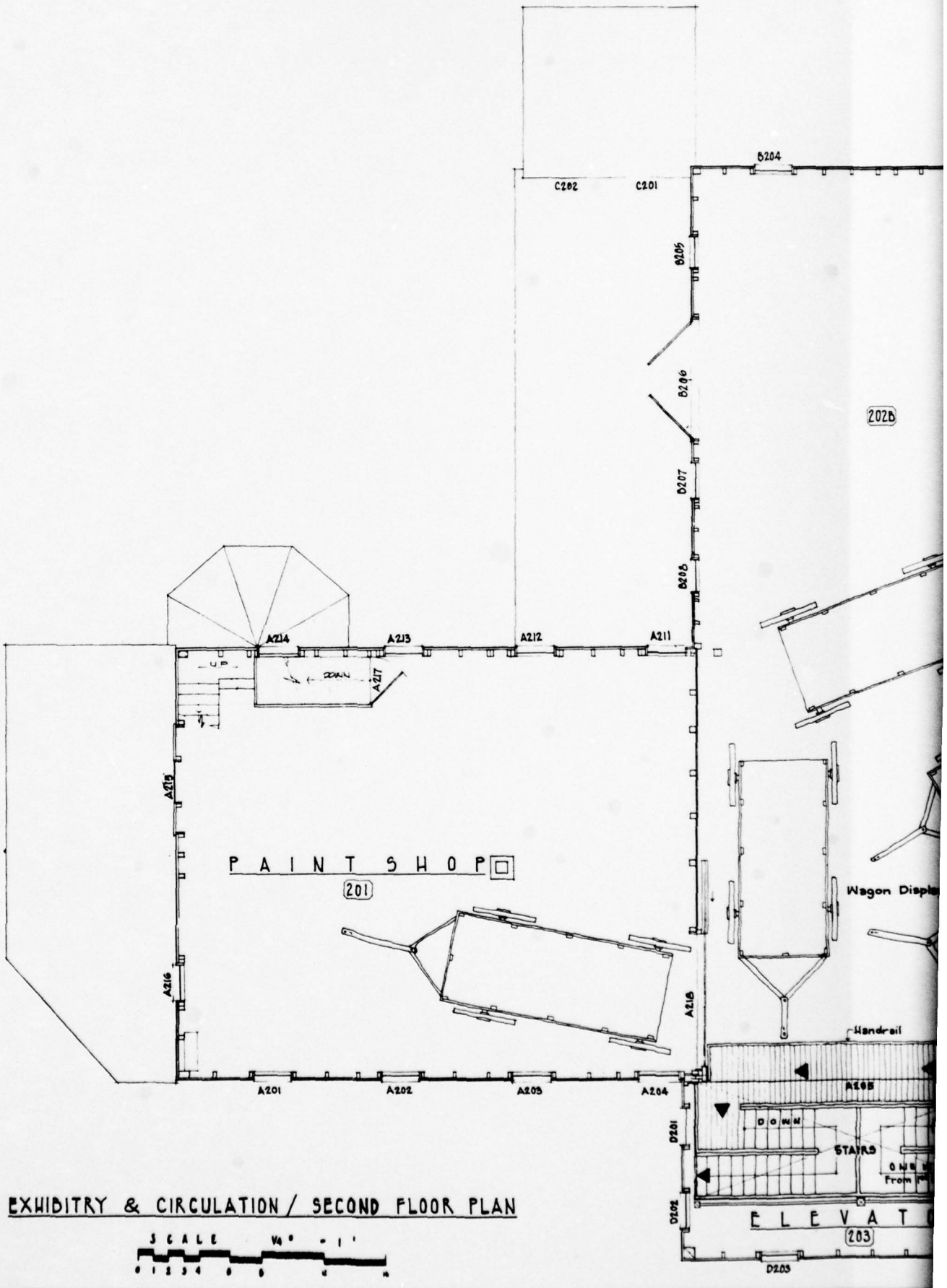
A7-3

HISTORIC AMERICAN ENGINEERING RECORD
SHEET OF SHEETS

RECORD NO. HAER PA 14

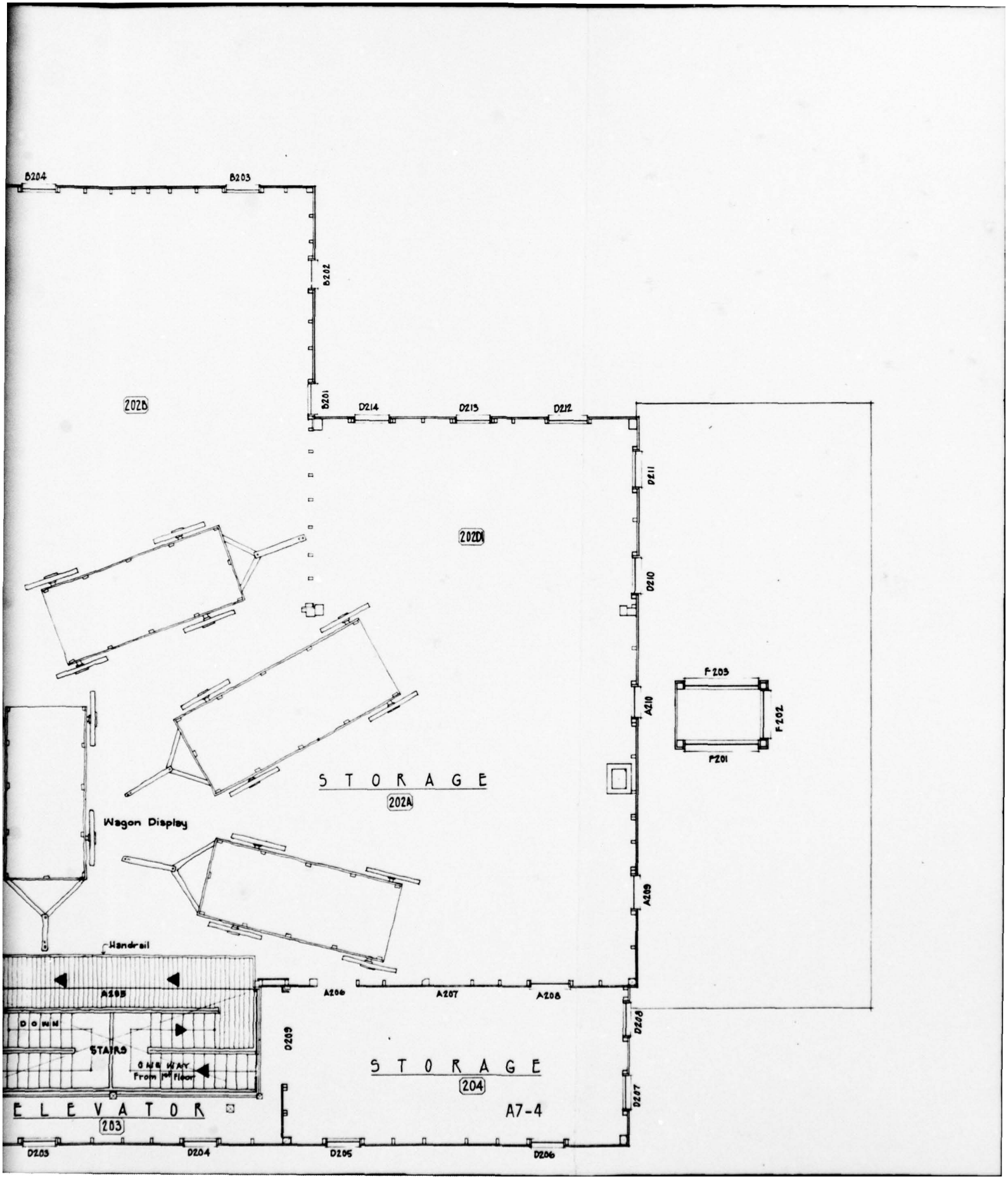
NAME AND LOCATION OF STRUCTURE
GRUBER WAGON WORKS 1882, 1906
96 MILES NORTHWEST OF READING AT THE INTERSECTION OF STATE ROUTE 183 AND STATE HILL ROAD
MT. PLEASANT BERKS COUNTY PENNSYLVANIA

DRAWN BY: ROLAND DAVID SCHAAF 1974
OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION
GRUBER WAGON WORKS EMERGENCY RECORDING PROJECT
UNDER DIRECTION OF THE NATIONAL PARK SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR



EXHIBITRY & CIRCULATION / SECOND FLOOR PLAN

SCALE 1/4" = 1'


B204
B203
B202
B201
202B
D214
D213
D212
D211
202D
D210
F203
A210
F202
F201
STORAGE
202A
Wagon Display
A209
Handrail
A205
A206
A207
A208
DOWN
STAIRS
ONE WAY
From 2nd Floor
D209
D208
STORAGE
204
D207
ELEVATOR
203
A7-4
D203
D204
D205
D206

1870's	Franklin H. Gruber began building wagons on his Blue Marsh farm and constructed his first shop (the Farm Shop).
1882-83	New shop built at Pleasant Valley below Mt. Pleasant. Turbine powered.
1885	Lumber from dismantled Farm Shop used to build addition to wood shop at the Pleasant Valley works.
1896	Addition built to house steam engine and boiler to augment turbine.
1905	Office, Elevator and Machine Shop additions built.
1906	Otto gasoline engine replaced steam engine and turbine.
1908	Tire setter addition built.
1910	Blacksmith shop addition built.
1910-1920	Period of peak wagon production
1920-1960's	Wagon production rapidly tapered off into gradually declining repair business.
1962	Flood Control Act of 1962 (PL 87-874) authorized Blue Marsh Lake Project on Tulpehocken Creek.
1965	Archeological survey of Blue Marsh area by National Park Service contractor identified no sites of national significance.

1966	National Historic Preservation Act of 1966 (PL 89-665) established the National Register of Historic Places and requires all Federal agencies take into account the effect of their projects on National Register properties.
1970	Corps of Engineers recognized possible historical significance of Wagon Works during initial real estate appraisal work for Blue Marsh project.
1970	July 9. Field inspection of Wagon Works by Pennsylvania Historical and Museum Commission (PHMC) and Northeast Regional Office of the National Park Service (NPS) at request of Corps of Engineers.
1971	May 13. Executive Order 11593 required Federal agencies to take into account the effect of their projects on properties determined eligible for inclusion on the *National Register*.
1972	June 2. Wagon Works listed on the National Register.
1973	June 8. Cooperative project for archival recording of the Wagon Works by the Historic American Engineering Record initiated and partially funded by the Corps.
1973	June 12. First construction contract let on the Blue Marsh Lake Project (relocation of Arco pipeline).
1973	November 16. Independent appraisal of contents of Wagon Works by curators of historic industrial technology submitted to Corps.
1974	January 22. PHMC and NPS established their inability to assist in funding relocation or restoration of Wagon Works. As a result, Corps begins to explore the possibility of obtaining a special Congressional appropriation for the relocation/restoration.

1974 February 21. Berks County agreed to provide new site and take title (on condition of relocation and restoration of the Wagon Works by the Corps).

1974 May 24. Archeological and Historic Preservation Act of 1974 (PL 93-291), also known as the Moss-Bennet Act, authorized Federal agencies to spend up to one percent of a project's appropriation for historic preservation purposes.

1974 June 10. Corps purchased the Wagon Works building and its entire contents intact.

1974 August 29. National Heritage Corporation (now John Milner Associates) submitted contracted Gruber Wagon Works Relocation Study to Corps.

1974 August 31. PHMC and NPS met with Corps on site to discuss relocation alternatives. All agreed $1 million as an approximate amount for the Corps to request from Congress to relocate and restore the Wagon Works intact. Corps agreed to initiate consultation procedures established with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP) as established under authority of the Historic Act of 1966.

1974 September 9. Corps began inventory, packing and removal to storage of small tools and portable objects from Wagon Works.

1974 December 20. Proposed relocation of Wagon Works results in a determination of adverse effect by SHPO under procedures established from authority of the Historic Preservation Act of 1966.

1975 February 19. Corps advised by their legal council that special appropriation request cannot be presented to Congress by Corps. Initiation must come from Congress.

1975 April. Locally organized letter writing campaign to Senator Scott and Congressman Yatron results in introduction of companion bills to authorize funding required to relocate and restore Wagon Works.

1975 July 1. Corps submitted required Preliminary Case Report to ACHP and SHPO describing the proposed action and alternatives considered and requesting on-site consultation.

1975 October 9. Corps initiated on-site consultation with SHPO and ACHP. Preservation alternatives presented as outlined in the Preliminary Case Report.

1976 March 19. Corps issued Request for Technical Proposals to Relocate the Wagon Works.

1976 April 30. Corps entered into lease with Berks County to relocate Wagon Works to temporarily leased site at Red Bridge and to turn Wagon Works over to County following restoration of the building.

1976 June 8. Corps submitted a Memorandum of Intent to ACHP outlining proposed relocation to Red Bridge site. No draft Letter of Agreement received from ACHP.

1976 June 22. Technical Proposals received and opened revealing low-bid design/construct team consisting of R. S. Cook & Associates, Inc., General Contractors; C. Van Howling & Sons, Inc., Moving Contractors; National Heritage Corporation, Preservation Architects; and, Keast & Hood Company, Structural Engineers.

1976 July 22. Relocation contract awarded to low-bid design/construct team.

1976 October 12. Relocation construction documents approved by Corps and relocation construction immediately commenced.

1976 October 22. Section 129 of the Water Resources Development Act of 1976 (PL 94-587) approved authorizing funds to carry out the relocation and restoration of the Gruber Wagon Works. Relocation funds were transferred from the Moss-Bennett appropriation.

1976 December. Major sections of the Wagon Works relocated to Red Bridge site.

1977 February 18. Corps received Award for Engineering Achievement of the Year with Historic Significance from the Engineers Societies in the Delaware Valley Area for the Relocation of the Wagon Works.

1977 March 4. Corps announcement published requesting submission of standard Architect-Engineer questionaires for selection of consultant to provide professional design services for the restoration of the Wagon Works.

1977 April. Relocation and reassembly of Wagon Works completed.

1977 August. John Milner Associates invited by Corps to enter into contract negotiations to provide professional services for the restoration of the Wagon Works.

1977 November 29. Corps enters into a contract with John Milner Associates to provide Historic Structure Report and construction documents for the restoration of the Wagon Works.

1977	December 22. Wagon Works designated a National Historic Landmark by the Secretary of the Interior.
1978	January 4. Corps announced the Honorary Annual Environmental Award from the Office of the Chief of Engineers for the Relocation of the Gruber Wagon Works.

PRELIMINARY COST ESTIMATES

The schedule below is based on the recommendations made in the restoration section of this report. The costs are grouped according to major sections and, in general, follow the CSI format and include the Wagon Works, the Iron Storage Shed, the outhouse and site work.

SITE WORK		
Demolition		
Roofing -- Removal of all metal and asphalt roofs, plywood sheathing, roof ventilators and lath	$ 3,000	
CMU -- Stripping of all CMU's that are to be replaced with stone veneer	$ 2,500	
Utilities --		
Well & Pump -- Cooling Water	$ 2,500	
Underground Fuel Tank -- Otto Engine	$ 400	
Utility Vault	$ 1,500	
Building Drains	$ 1,500	
Grading --		
Erosion Control	$ 3,000	
Grade Changes	$ 4,000	
Improvements --		
Excavation & Backfill	$ 700	
Concrete Retaining Walls and Steps	$ 1,900	
Walkways	$ 5,500	
		$ 26,500
CONCRETE -- Mechanical Room Floor and Miscellaneous Footings	$ 2,400	$ 2,400
MASONRY		
CMU Foundation Walls	$ 2,900	
Stone Veneer	$35,000	
Chimney Liners	$ 1,800	
Brickwork	$ 3,000	
		$ 42,700

WOOD

Rough Carpentry --

Shoring & Bracing	$ 6,000	
Major Structural Repair	$15,000	
Lath	$ 3,400	
Sheathing	$ 2,500	
Miscellaneous Structural Repair	$ 5,000	

Finish Carpentry --

Siding	$17,000	
Doors	$ 3,000	
Windows	$15,000	
Cornice	$ 8,000	
Flooring	$ 7,000	
Miscellaneous Trim & Repair	$ 5,000	
Hardware	$ 2,500	
Fumigation & Treatment for Insects & Fungus	$10,000	
		$ 99,400

MOISTURE PROTECTION

Slate Roof	$23,000	
Metal Roof	$12,500	
Snow Guards	$ 600	
Flashing	$ 600	
Gutters & Downspouts	$ 2,300	
Dampproofing	$ 2,300	
		$ 41,300

FINISHES

Special Floor Matting	$12,000	
Railings	$ 4,000	
Ramps	$ 1,000	
Fireproofing Ceilings -- Mechanical & Engine Room	$ 2,000	
Painting	$11,000	
		$ 30,000

SPECIAL CONSTRUCTION

Otto Engine Repair	$10,000	
Line Shaft Repair	$ 4,200	
Drive Belts	$12,500	
Pot Bellied Stoves & Pads	$ 1,500	
Fire Doors	$ 1,200	
Miscellaneous Metals	$ 1,000	
		$ 30,400

CONVEYING SYSTEM

Elevator Repair	$ 3,000	
Elevator Stairway	$ 4,500	
		$ 7,500

MECHANICAL

Fire Suppression - Inlet Basin	$ 5,000	
Suction Line	$12,000	
Diesel Pump	$20,000	
Sprinkler Heads & Piping	$18,000	
Miscellaneous Piping & Controls	$ 5,000	
Miscellaneous Piping & Valves	$ 2,000	
		$ 62,000

ELECTRICAL

Electric Space Heaters	$ 2,400	
Electric Motor - Machinery Drive	$ 4,000	
Wiring - Knob & Tube, Lighting, Outlets	$ 4,600	
Panelboard & Controls	$ 2,000	
Emergency Lighting Generator	$ 3,500	
Converter 1Ø to 3Ø	$ 5,000	
Underground Feeder	$ 6,000	
		$ 27,500

SECURITY SYSTEM

Fire Detection	$ 5,000	
Intrusion Detection	$ 5,000	
		$ 10,000

DOCUMENTATION

As-built Drawings & Photographic Record	$ 5,000	$ 5,000

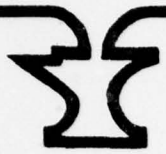
Sub-Total	$384,700
12% Contingency	$ 46,000
Total	$430,700

SUMMARY

Site Work	$ 26,500
Concrete	$ 2,400
Masonry	$ 42,700
Wood	$ 99,400
Moisture Protection	$ 41,300
Finishes	$ 30,000
Special Construction	$ 30,400
Conveying System	$ 7,500
Mechanical	$ 62,000
Electrical	$ 27,500
Security	$ 10,000
Documentation	$ 5,000
Sub-Total	$384,700
12% Contingency	$ 46,000
Total	$430,700
	$431,000

APPENDIX D1

STRUCTURAL LOAD SUMMARY



The intact and open structure, that forms the skeletal interior of the Gruber Wagon Works, also supported its historic function. However, an introduction of new public use into the structure necessitates an evaluation of its loading potential in contemporary terminology. The evaluation is prerequisite to a final determination of what spaces the public may visit with, or without, structural improvement.

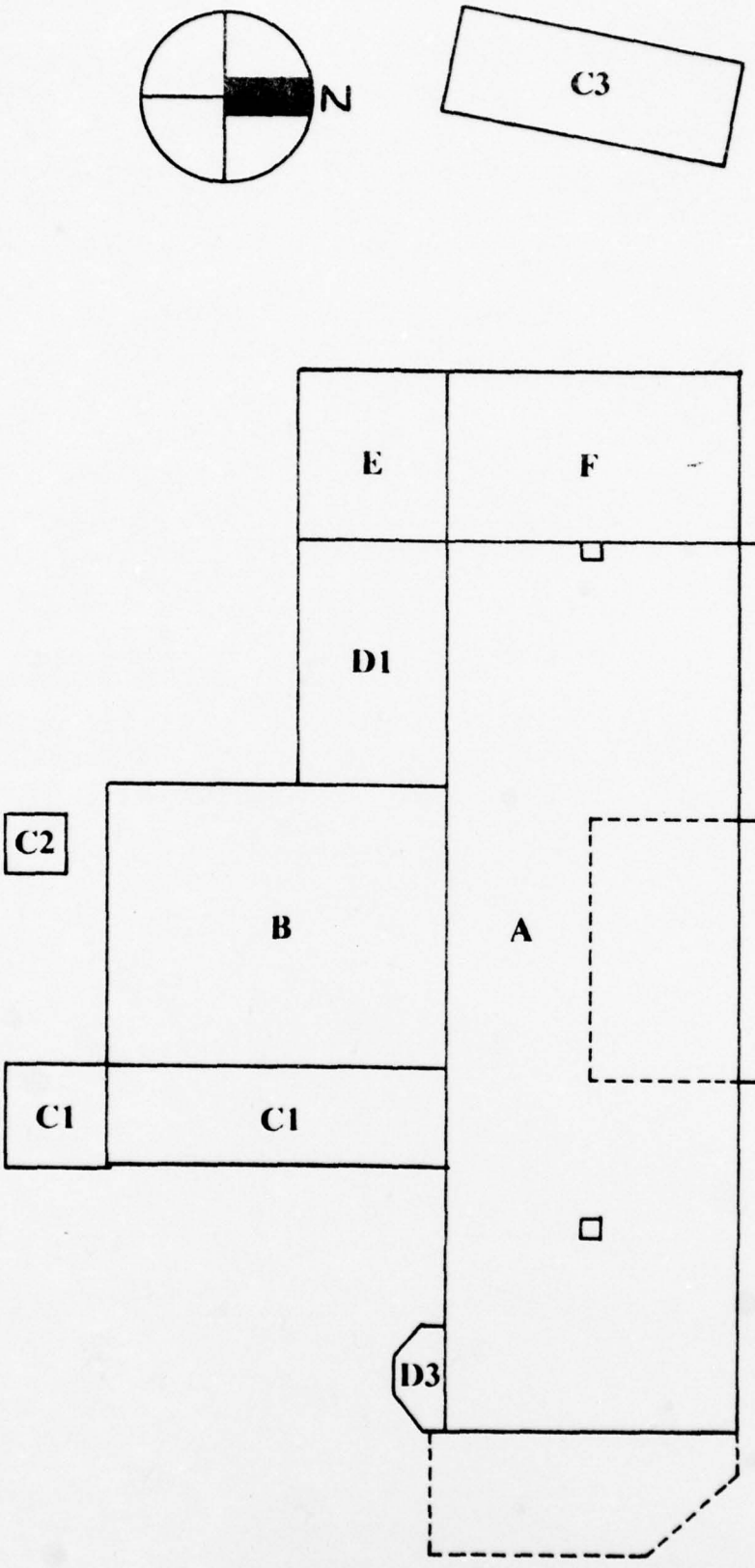
The following charts the existing loading potential of the building complex.

GRUBER WAGON WORKS
SUMMARY - ALLOWABLE LOADING

LEVEL	SECTION	MEMBER	LIMITING LIVE LOADS FLEXURE	HORIZ. SHEAR	DEFLECTION	REMARKS
Roof	A	Rafters	20 PSF	PSF	PSF	
	D2, Elev.	Rafters	20			
	B, South	Rafters	14			
Low Roof	A, Porch	Joists	140	85	150	
	D2, West	Joists	59	75	49	
	D1	Joists	35	59	22	
	F, North	Joists	26	50	14	
	E, South	Joists	17	41	6	
	C1	Joists	60	75	50	
Attic	A	Joists	38	42	25	
		Summer Bm	17	28	12	Gross Area
	B	Joists	35	38	22	
		Summer Bm	29	33	26	Gross Area
	NOTE: King Rod Trusses Must Be Braced					
	D1	Trussed Bm -- Inadequate for Roof & Floor LL				
Second Floor	A	Joists	108	80	95	
	A, East	Summer Bm	33	38	30	Gross Area
	B	Joists	90	61	85	
		Summer Bm	34	39	30	Gross Area
	A, Central	Summer Bm	21	31	15	Gross Area
	Between A & B	Beam	23	30	18	Gross Area
	D2, West	Flr. Bms.	126	155	110	
		Spandrel Bm	97	50	128	Low Roof, Wall, Floor
	D1	Joists	Better Than Original, Reduce For Line Shaft			
	D1	Trussed Bm	30	Restricted By Tension Rod		
	A, West	Trussed Bm	30	Restricted By Tension Rod		

First Floor	A, East	Flr. Bms.	100	100	70)	
		Center Bm	44	47	44)	Reduce In Area of
	A, Central	Flr. Bms.	122	125	125)	Line Shaft
		Center Bm	70	56	71)	
	B	Flr Bms.	155	196	130	
		Center Bm	41	50	36	Gross Area
	A, West	Flr. Bm.	75	89	67	
	D1	Flr. Bm.	120	155	98	
	F	Flr. Bm.	243	263	190	

NOTE: Allowable Stresses May Be Increased 25% for Short Term Loading;
Reduce to 90% for Cyclic Loading.



CHRONOLOGICAL DEVELOPMENT KEY

STONE MASONRY AND MORTAR

The attached, "A Report on the Stone Masonry and Mortar of the Gruber Wagon Works, Mount Pleasant, Pa." was submitted by National Heritage Corporation (now John Milner Associates) on June 24, 1976, as part of their contract requirements to R. S. Cook and Associates, Inc., Philadelphia, Pennsylvania, general contractors for the "Relocation of Gruber Wagon Works" (Contract DACW61-76-C-0217, U. S. Army Corps of Engineers, Philadelphia District).

A Report on the
Stone Masonry and Mortar

of the
Gruber Wagon Works
Mount Pleasant, Pa.

for

R. S. Cook and Associates, Inc.
Philadelphia, Pa.

by

National Heritage
West Chester, Pa.

INTRODUCTION

This report is intended to provide the materials analysis and documentation of the original stone masonry and mortar of the Gruber Wagon Works necessary to direct the proper technical and aesthetic design decisions during the restoration phase. At that time, the foundation wall stonework will be relaid as an interior and exterior veneer on a concrete block core wall built during the relocation phase.

The first part of this report presents the data on the foundation masonry, while the second part concerns itself with an analysis of the mortar and plaster.

FOUNDATION MASONRY

The foundation masonry was laid at various times between 1883 and 1910 as keyed on Plate 1. The character of the masonry is indicated by the colored photographs as keyed on Plate 2.

In general, the stonework is green grey to dark grey slate quarry rubble. That laid in 1883, 1885, 1896, and 1905 is generally of larger blocks than the thin blocks laid in 1908, and 1910. The stone of each of the four earlier accretions shows slight differences in sizing and shaping while that of the 1908 and 1910 additions show no appreciable differences. Exterior stonework or stonework on the interior that was originally an exterior face prior to an addition is somewhat more squared than that exposed on interior walls. In addition, the stonework exposed on the final exterior walls exhibits a slightly lighter color probably from weathering. The stone is moderately hard and finely bedded and has shown no appreciable deterioration.

A cut sandstone quoin was observed in the southeast corner of the 1883 section, and upon removal of the western most additions to the original structure, additional cut sandstone blocks were revealed in the northwest and southwest corners.

MORTAR AND PLASTER

The character of the mortar joints and plastered surfaces is indicated by the colored photographs as keyed on Plate 3.

The walls were laid up with a lime/clay/sand mortar that was virtually identical for all parts of the foundation. Because of the very similar nature of the mortars observed in the laboratory, only the analysis of a single representative sample has been presented. On these exterior faces where the stonework was not later pointed or dashed, the original mortar had generally crumbled and fallen or been washed from the walls to such a depth that the exterior walls gave the appearance of being dry laid. On certain interior walls that had not been stuccoed or pointed, the character of the original mortar joints was observable. These joints consisted of only crudely raked joints of the same mortar as used throughout the wall. In those cases where the bedding mortar did not exude near the wall face, the joint was not pointed further, but simply left unfinished. In many areas the joints appeared to not have been finished at all.

The interior walls of space 001 (including the piers), except for the northern half of the eastern wall, and the southern wall of space 007 were plastered. In all likelihood, these walls were not originally plastered, but were so treated later, probably in an attempt to reduce moisture penetration. The plaster in each space was observably different in color and composition, and thus were separately analysed.

Sample No.: GWW 01
Provenience: Plaster
Date: October, 1976
Collected By: Kevin Miller

Pre-Test:

Sample Weight:	11.97 grams
Color:	(Off) White (Munsell 10 YR 8/2)
Hardness:	Soft
Inclusions:	Very small pebbles, hair, small wood fragments

Test 1 (HCl):

Sand and Gravel:	5.60 grms.	47%
CO_2 Loss:	0.26 grms.	2%
Ca Mg Content:	4.91 grms.	41%
Residue (clay):	1.20 grms.	10%
	11.97 grms.	100%

Post-Test:

Sand and Gravel

Color:	Clear to Golden (No Munsell Match)
Angularity:	Ground River Gravel; Sand Rounded
Opacity:	Nearly Opaque
Impurities:	Organic Debris
Size:	Small Pebbles Predominate

Residue (Clay)

Color:	Pink
Impurities:	Large Amounts of Hair
Size:	----

Probable Component Ratio (Parts Per Volumn):

Sand and Gravel	3
Lime	4
Clay	1

Percentage of Lime to Clay:

Lime	81.16%
Clay	18.84%

Remarks:

Moderately course texture caused by fine gravel inclusion. Very small amount of sand included incidently as part of river gravel. Soft and somewhat friable mortar caused by relatively high proportion of clay to lime.

Sample No.: GWW 02
Provenience: Original Mortar
Date: October, 1976
Collected By: Kevin Miller

Pre-Test:

Sample Weight: 7.43 Grams

Color: Pinkish Grey (Munsell 5 YR 7/2)

Hardness: Medium Soft

Inclusions: Small Pebbles, Some Organic Debris (Wood and Plant Fibres)

Test I (HCI):

Sand and Gravel:	3.15 grms.	42%
CO_2 Loss:	0.19 grms.	3%
Ca Mg Content:	3.57 grms.	48%
Residue (clay):	0.52 grms.	7%
	7.43 grms.	100%

Post-Test:

Sand and Gravel

Color:	Weak Red (Munsell 10 YR 5/2)
Angularity:	Ground River Gravel; Sand Rounded
Opacity:	Opaque
Impurities:	Organic Debris
Size:	Gradation From Extremely Fine Individual Grains Up To 5 mm Fine Grained Flat Pebbles.

Residue (Clay)

Color:	2.5 YR 6/2 (Munsell Pale Red)
Impurities:	None
Size:	----

Probable Component Ration (Parts Per Volumn):

Sand and Gravel	4
Lime	7
Clay	1

Percentage of Lime to Clay:

Lime	87.85%
Clay	12.15%

Remarks:

Overall course texture caused by gravel inclusion. Sand included incidently as part of river gravel. Medium soft and mildly friable mortar cuased by moderately high proportion of clay to lime.

Sample No.: GWW 06
Provenience: Original Mortar
Date: October, 1976
Collected By: Kevin Miller

Pre-Test:

Sample Weight: 17.86 Grams

Color: Pale Yellow (Munsell 2.5Y7/4)

Hardness: Soft

Inclusions: Small Pebbles, hair

Test I (HCI):

Sand and Gravel:	13.19 grms.	74%
CO_2 Loss:	.10 grms.	1%
Ca Mg Content:	1.94 grms.	11%
Residue (clay):	2.63 grms.	14%
	17.86 grms.	100%

Post-Test:

Sand and Gravel:

Color:	Golden Brown (Munsell 10YR6/8)
Angularity:	Rounded River Sand
Opacity:	Clear to Opaque
Impurities:	Sandstone Fragments
Size:	Graduation from Extremely Fine Individual Grains Up to Sandstone Fragments

Residue (Clay)

Color:	10YR7/6 (Munsell Golden Tan)
Impurities:	None
Size:	----

Probable Component Ration (Parts Per Volume):

Sand and Gravel	4-1/2
Lime	1
Clay	1-1/2

Percentage of Lime to Clay:

Lime	42.45%
Clay	57.55%

Remarks:

Overall fine texture caused by gravel exclusion. Soft and friable plaster caused by high proportion of clay to lime.

PLATE 1

GRUBER WAGON WORKS
CONSTRUCTION SEQUENCE
KEY PLAN

SCALE: 1" = 10'

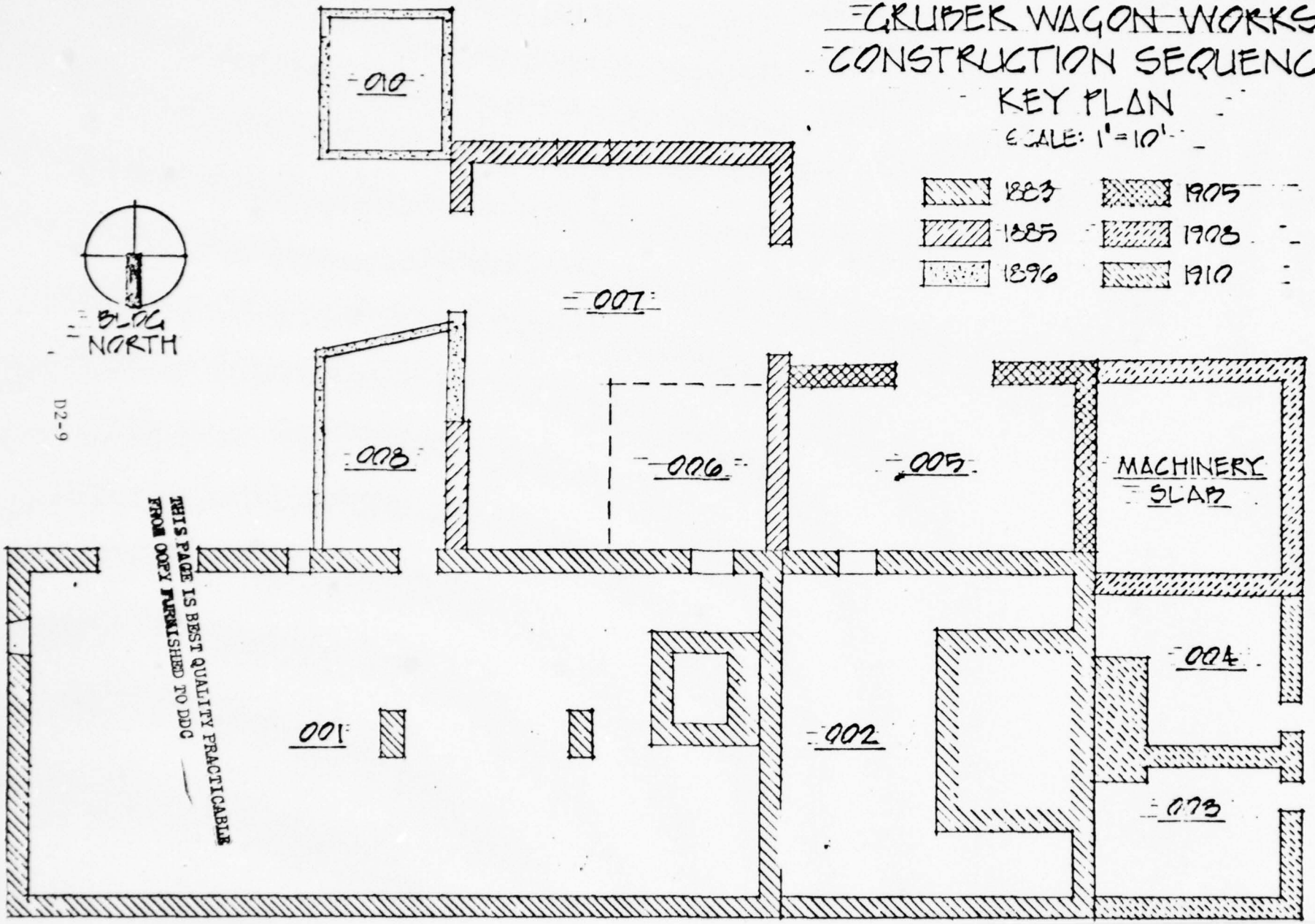


PLATE 2

GRUBER WAGON WORKS
FOUNDATION MASONRY
PHOTOGRAPHS KEY PLAN

SCALE: 1" = 10'

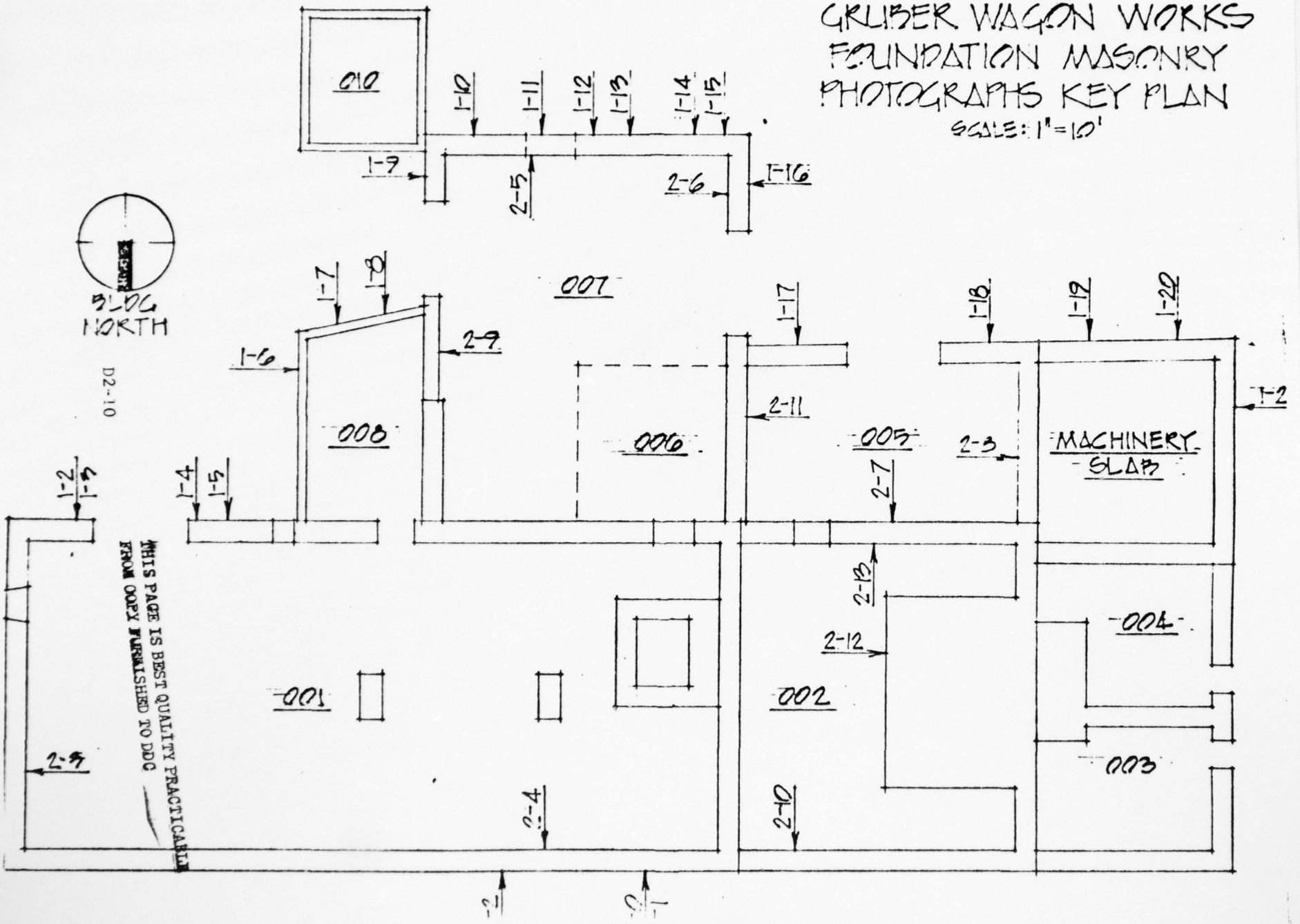
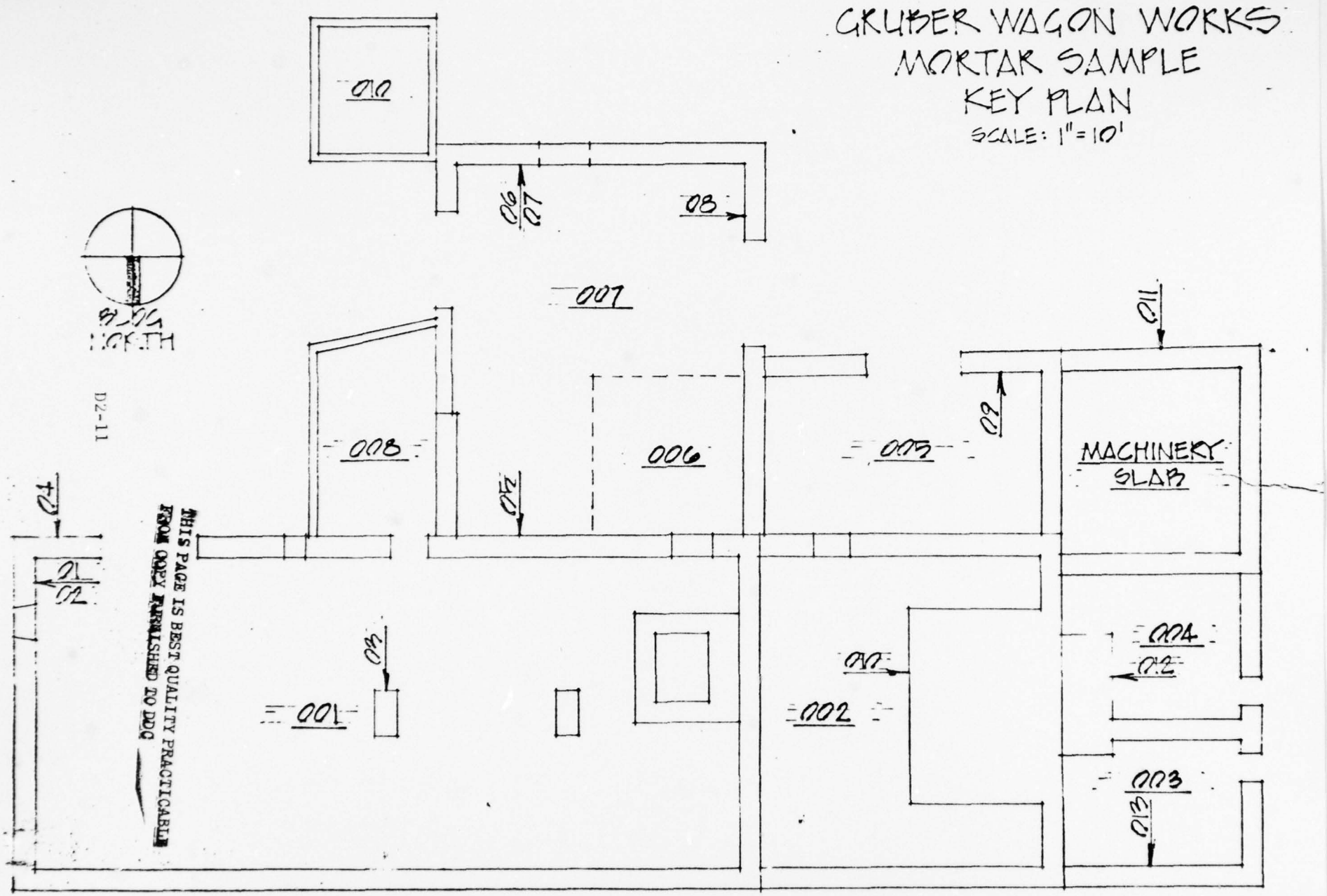


PLATE 3

GRUBER WAGON WORKS
MORTAR SAMPLE
KEY PLAN

SCALE: 1" = 10'



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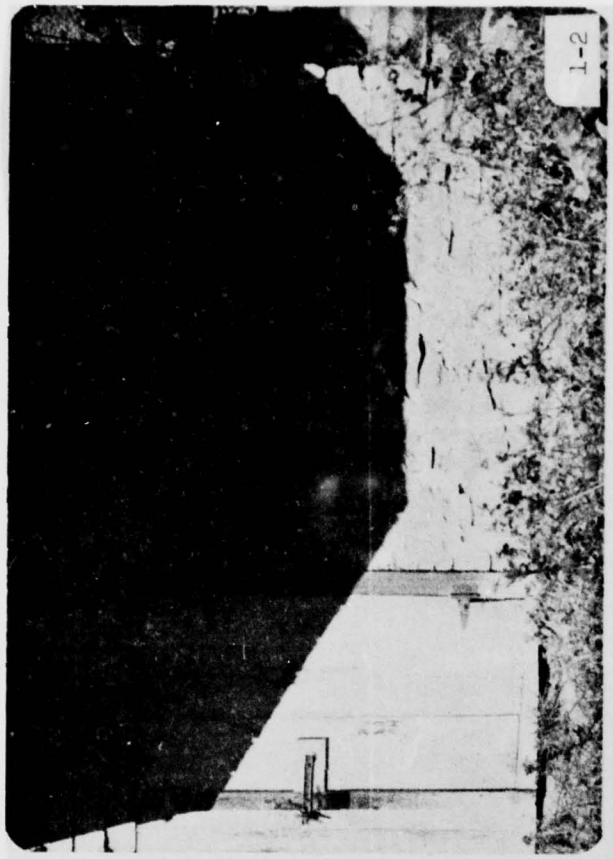
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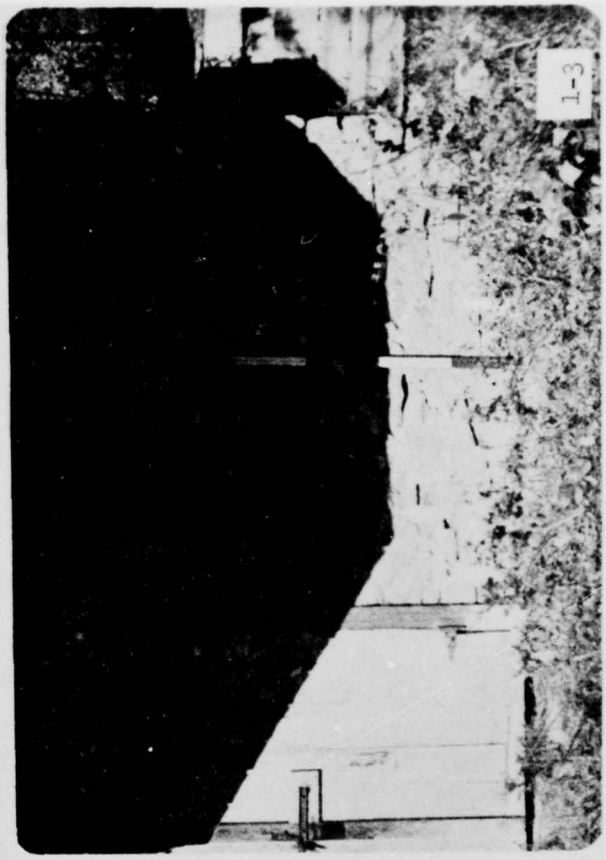
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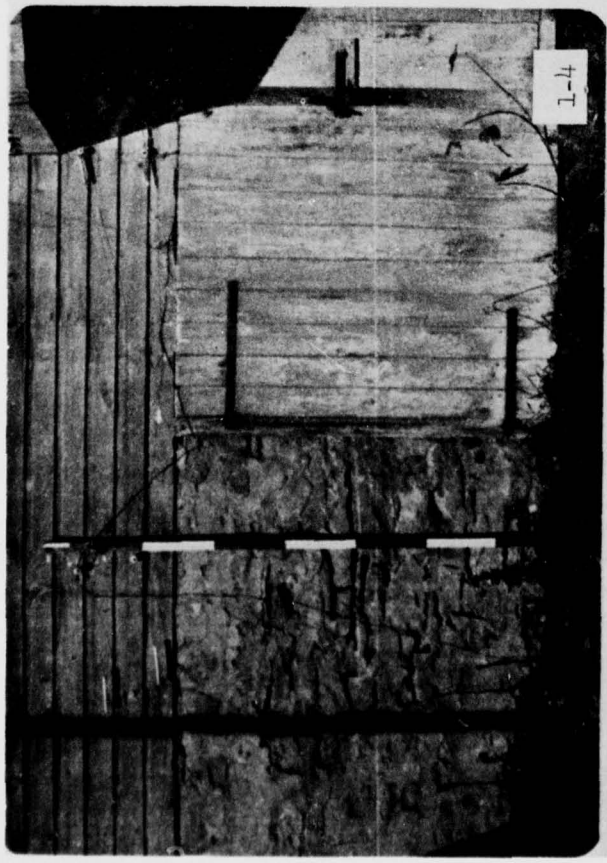
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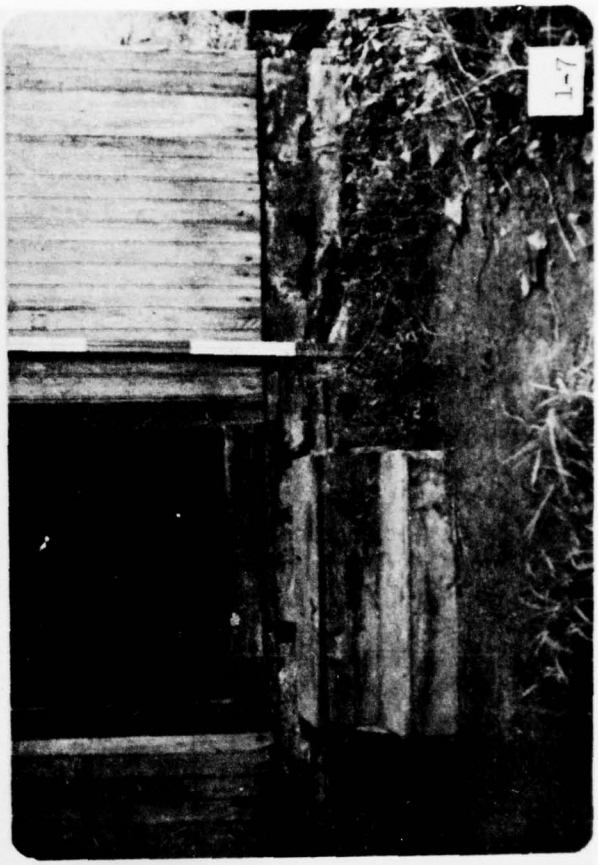
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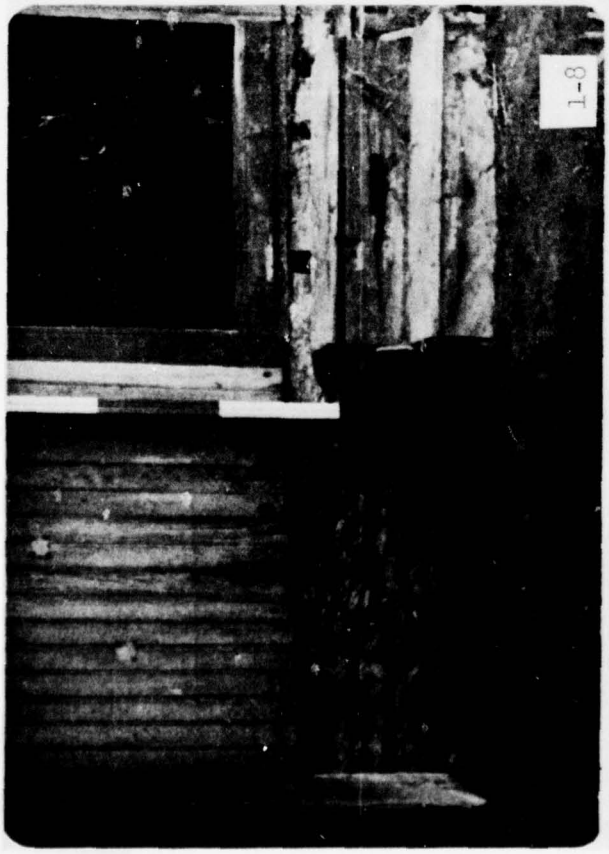
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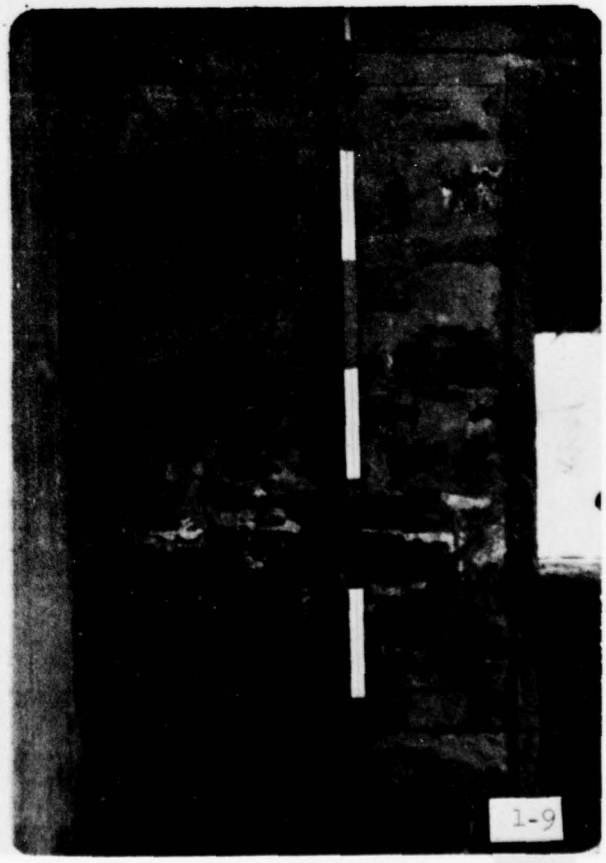
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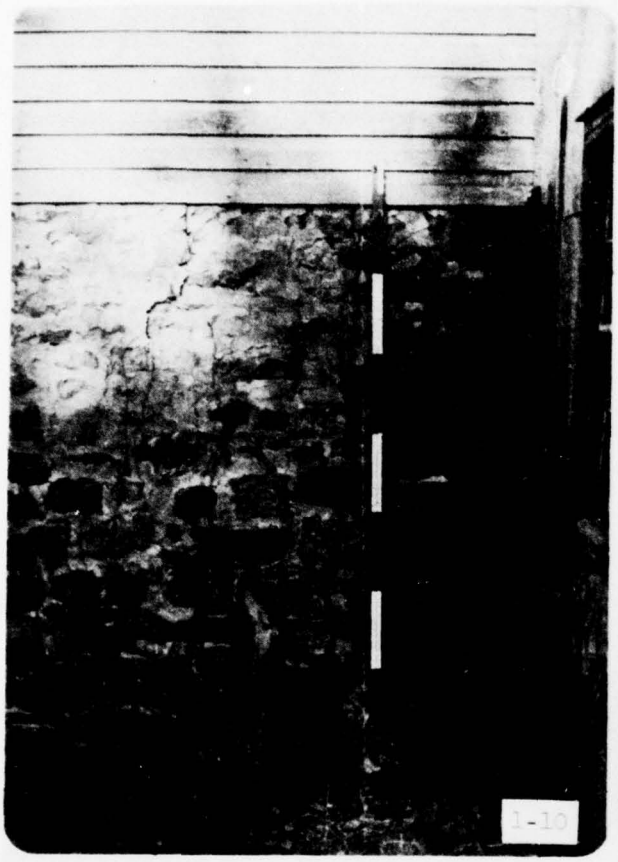
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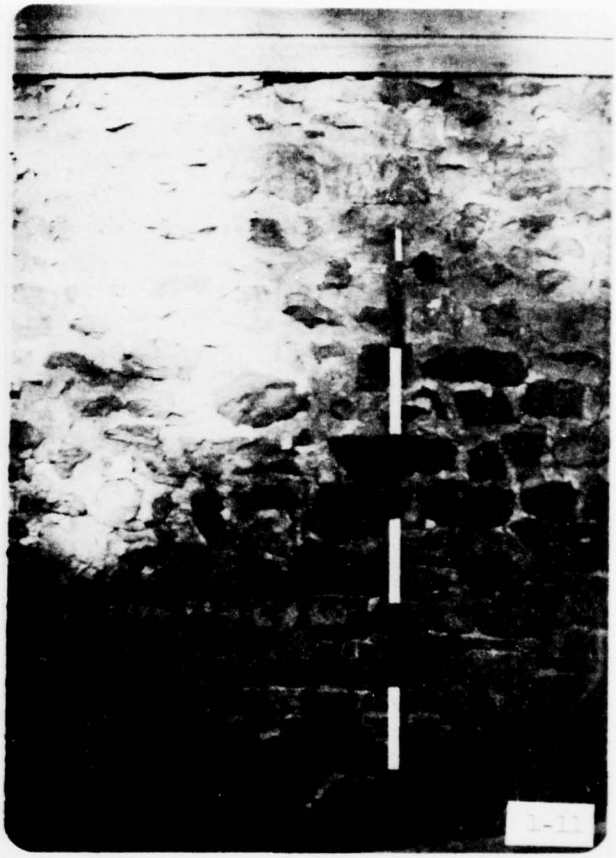
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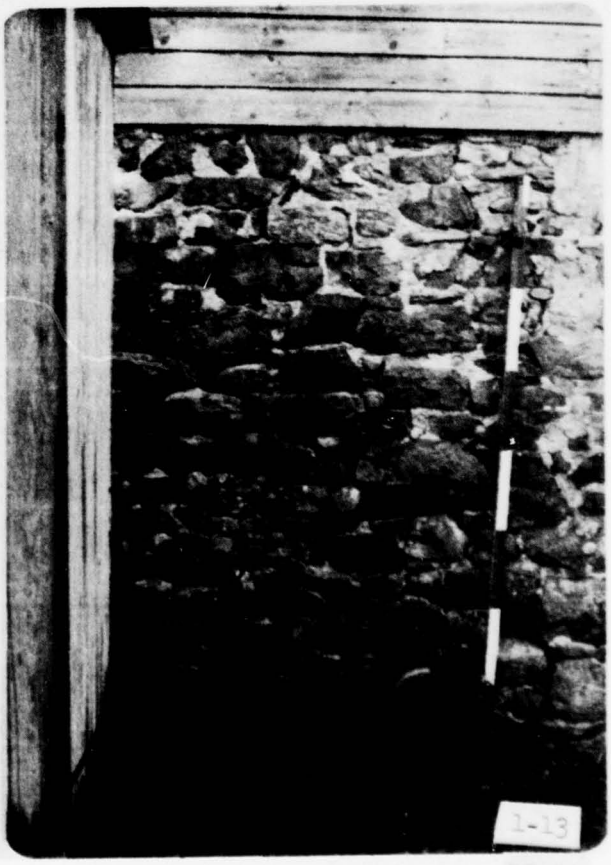
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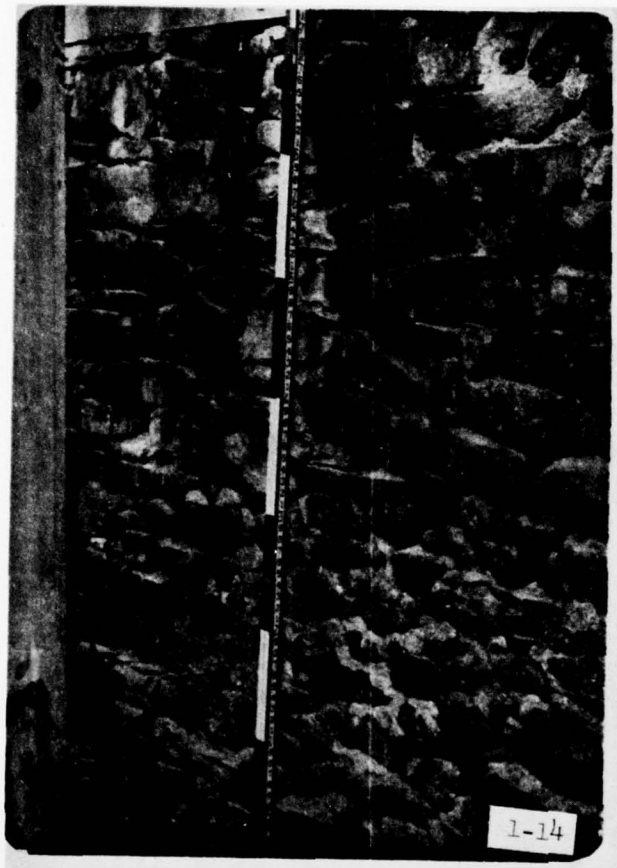
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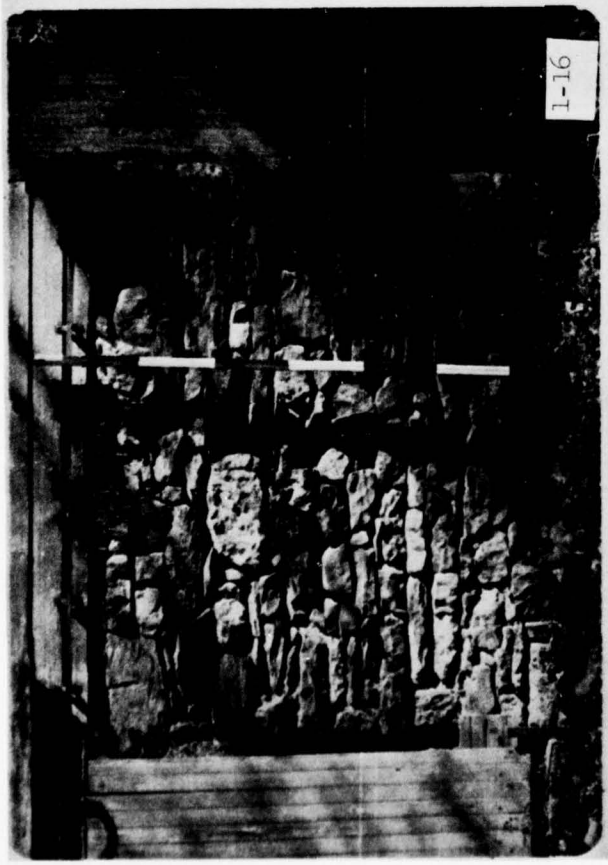
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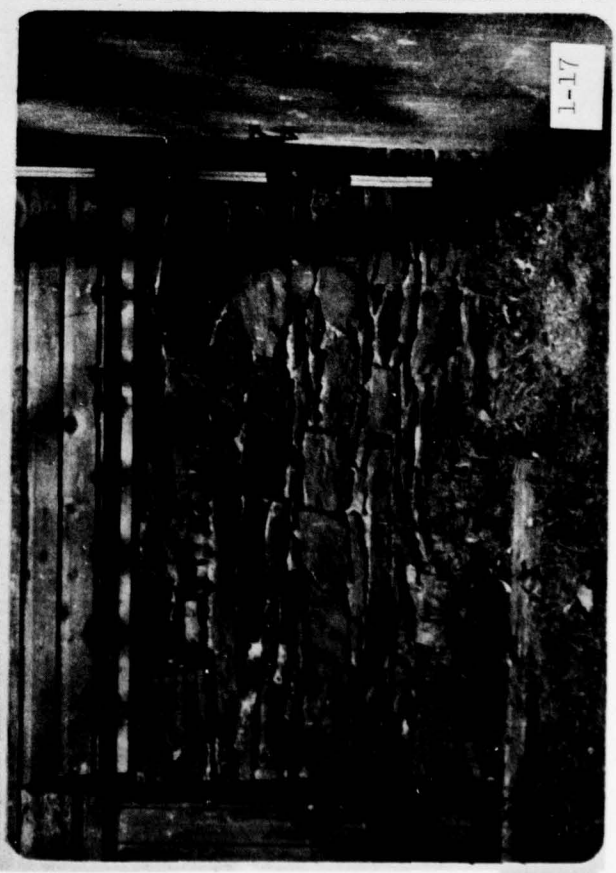
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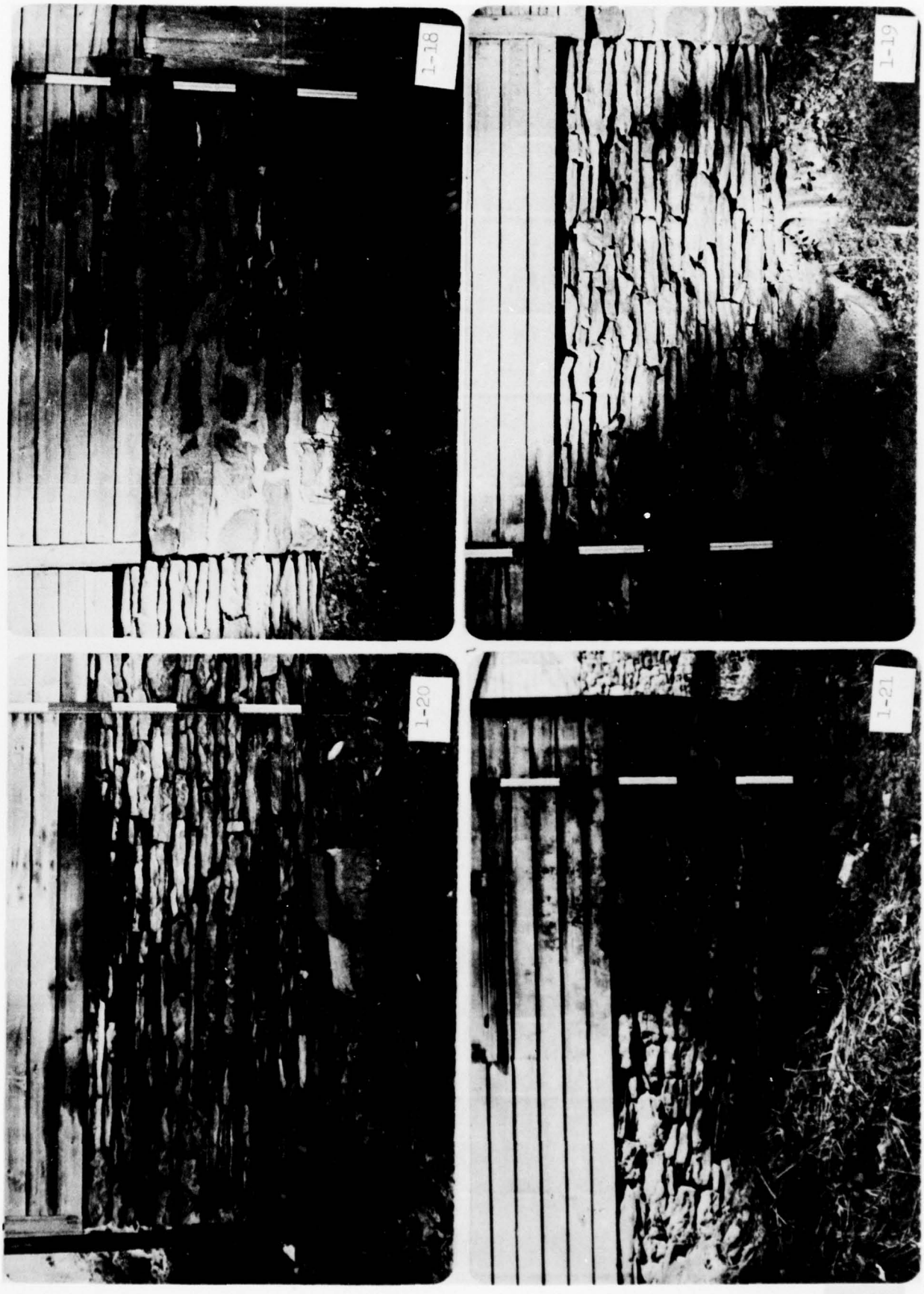
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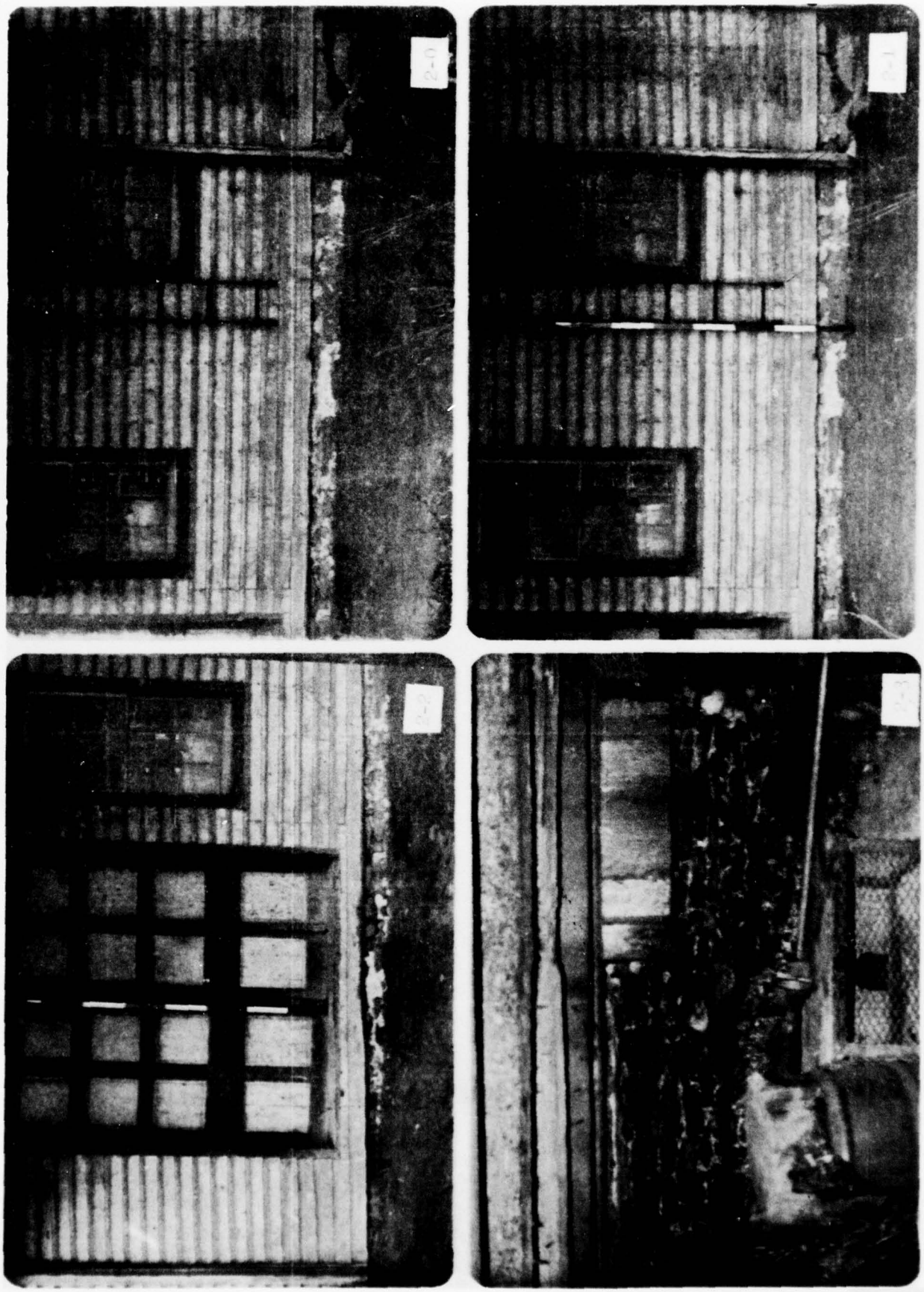

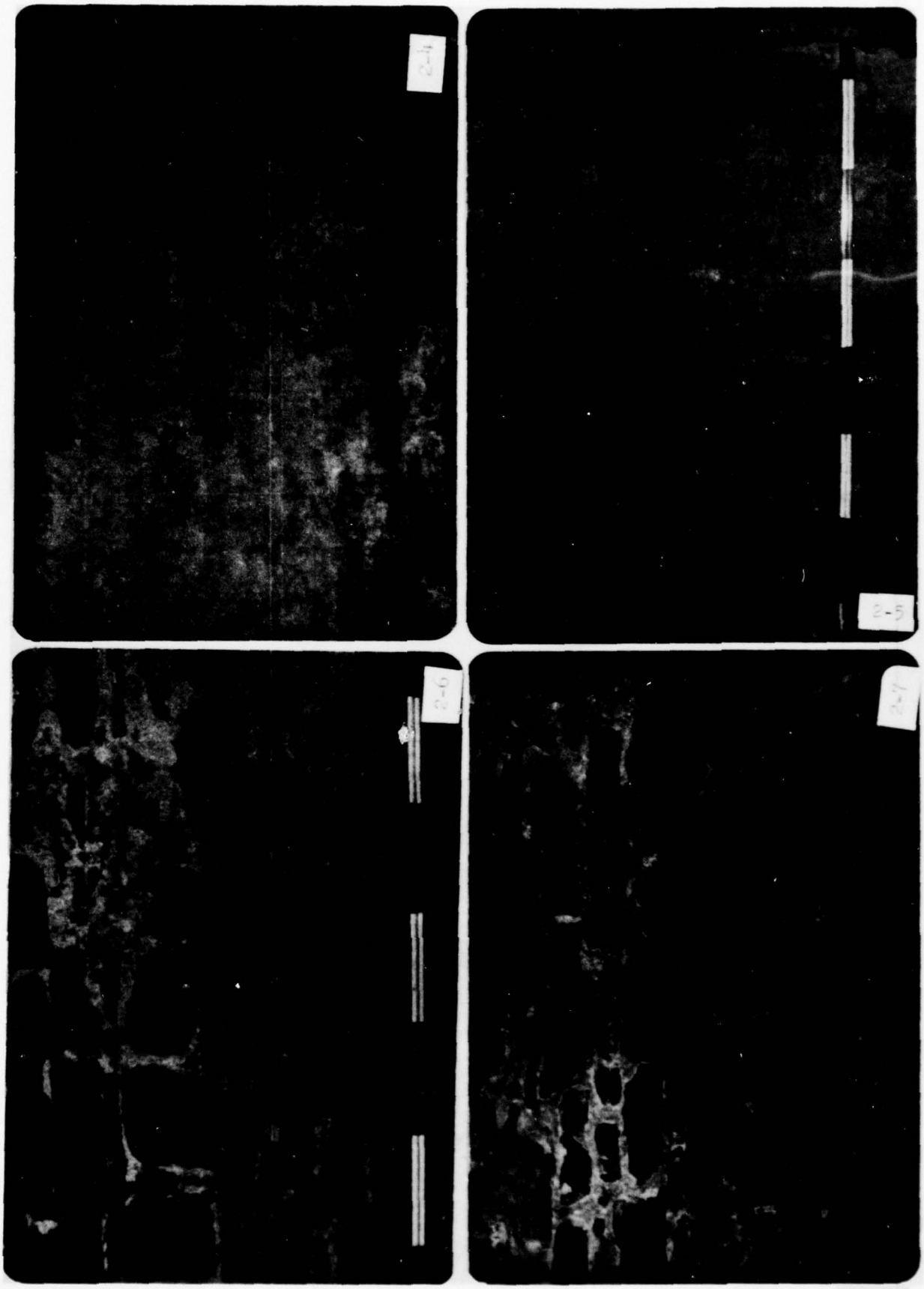
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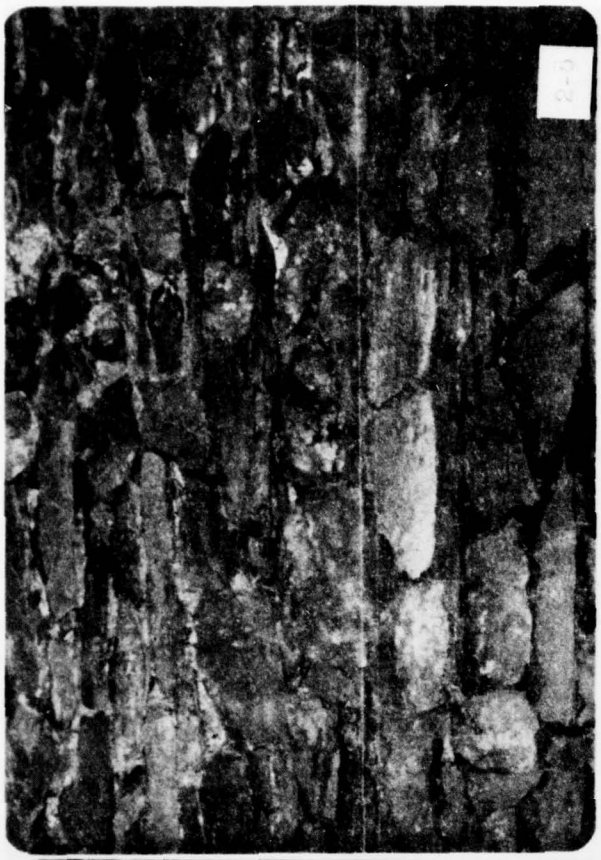

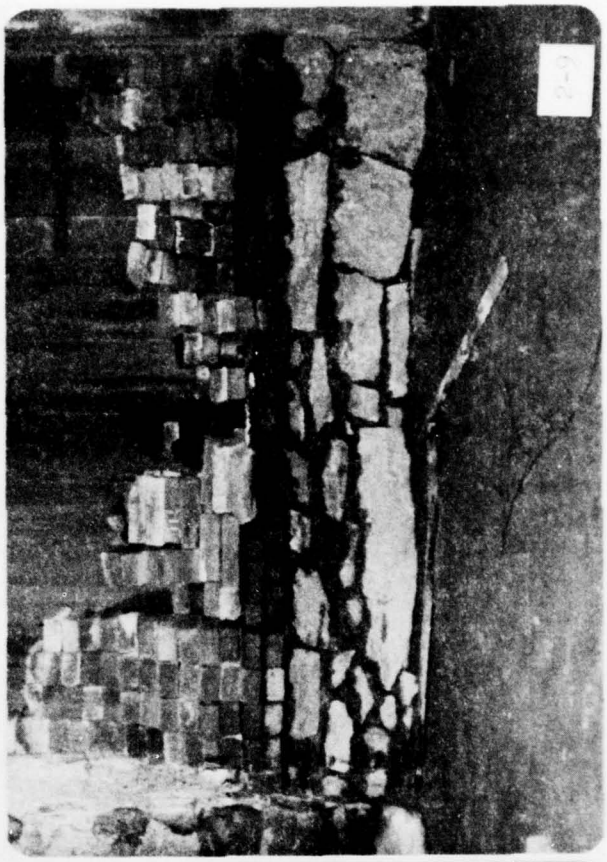

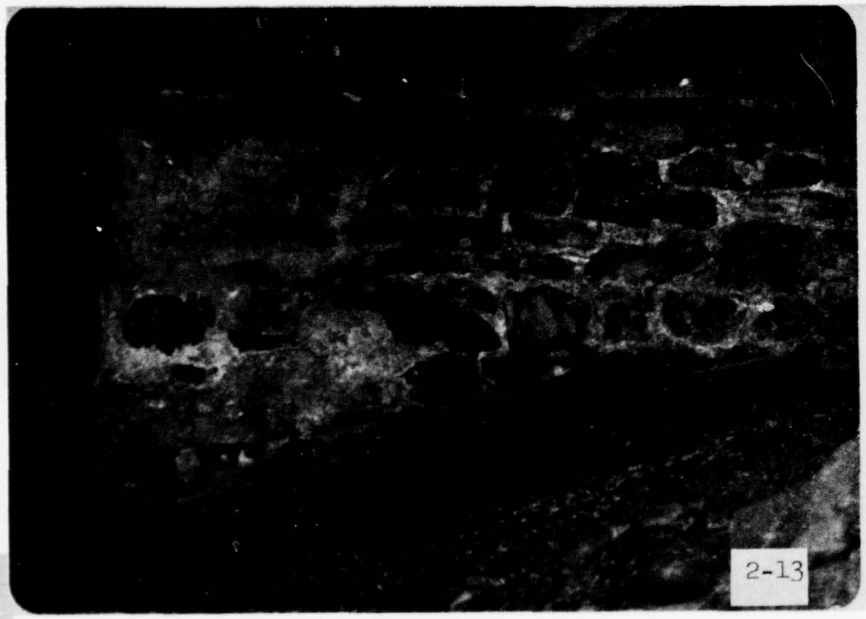
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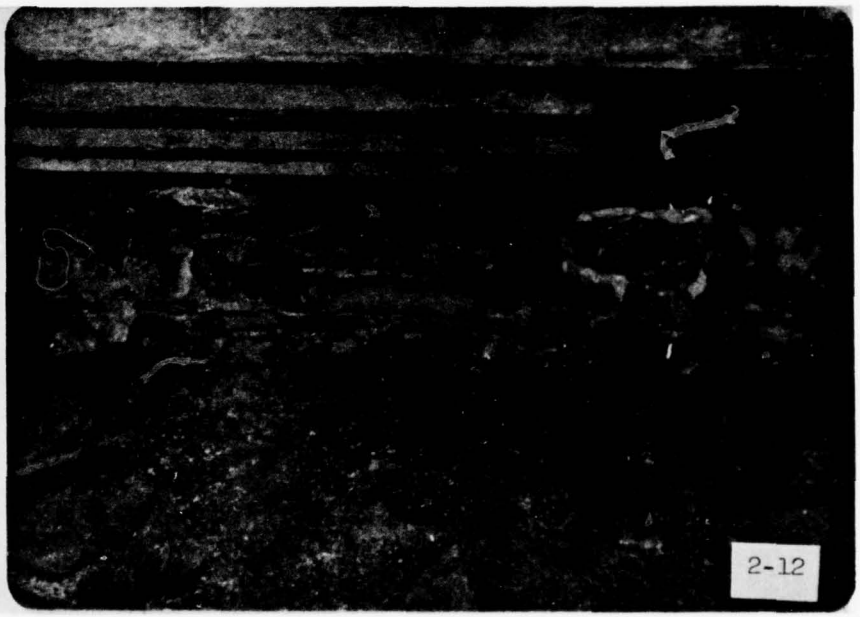
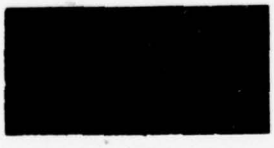

2-12

Little was paint-finished at the factory, save for the infrequent disposition of a particular workman to brush out his paint brush after finish painting a wagon or other equipment part, or to try out his wagon decorative painting technique. The building was only finished on the exterior. The following charts the paint samples taken and the results of microscopic examination. Samples illustrate the original and later historic painting schemes. Finish floss was not obtainable due to the extreme deterioration of the paint fabric; the colors presented are for pigment only. Also noted are the wagon paint colors.

10R4/4  Original Paint Color

2.5Y8/6  Siding and Windows

7.5YR3/2  Trim and Doors

2.5G4/8  Wagon Under Carriage

10R3/6  Wagon Body

project: GRUBER WAGON WORKS

	SAMPLE I.D.	BASE	1st COLOR	2nd COLOR	3rd COLOR	4th COLOR	5th COLOR	6th COLOR	7th COLOR	8th COLOR	9th COLOR
1	Engine Room Siding	Wood	2.5Y 8/6	5Y 8/1							
2	"A" Siding	Wood	10R 4/4	2.5Y 8/6	5Y 8/1						
3	"E" Siding	Wood	2.5Y 8/6	5Y 8/1							
4	A118 Stiles	Wood	10R 4/4	7.5YR3/2	2.5Y 8/6	5Y 8/1	10Y 5/1				
5	D103 Trim	Wood	7.5YR 3/2								
6	A118 Panels	Wood	10R 4/4	5Y 7/4	5Y 8/1						
7	Elev. Post Cover	Wood	7.5YR 3/2								
8	"A" Window Casing	Wood	10R 4/4	7.5YR3/2	10RY 6/2	10YR 4/2					
9	"F" Narrow Siding	Wood	2.5Y 8/6	5YR 8/1							
10	102 Orig Siding	Wood	10R 4/4								
11	101 Inter. Walls	Wood	10R 3/6	2.5G 4/8							

EVIDENCE

COMMENTS

11. Interior walls not finished; colors indicated are wagon paint colors from brush-off.

*Macbeth
A Division of Kollmorgen Corporation
2441 North Calvert Street
Baltimore, Maryland 21218

note: paint colors are keyed to the munsell color system

DOOR SCHEDULE

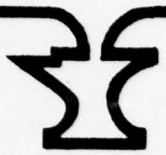
Reference Opening No.	Type	Description : Condition : Work
A004 *Plates A4-1, A6-17B and E-1*	4	Top hinged awning for pulley D-001; vertical 1" boards with horizontal battens. One pair tapered cast iron butt strap hinges and exterior 3" hook and eye. Good condition. Clean and paint.
A005 *Plate A4-1*	4	Unequal double doors; vertical 1" boards with battens. West leaf hinges with one pair Gruber made iron strap hinges; one pair tapered butt straps on east leaf. Gruber made hasp and keeper - outline of earlier decorative hasp evident. Good condition. Extend doors to new elevation; clean and paint.
A105 *Plate A4-2*	1	Double in-swinging doors - originally swung out. East leaf rehung on original cast butt hinges. West leaf cut in half: half leaves hinged together with original cast butt hinges and astragel and hinged to frame with one pair tapered cast butt straps. Lock on east leaf with Gruber made iron cane bolts on west leaf. Door in good condition. Sill badly worn. Replace top sill. Clean, fill and paint door.
A108 *Plates A4-2 and A6-19A*	3	Sliding door with 12-light fixed sash replaced original in-swinging double doors. Cast iron handle on door with cast iron catch/stop on sill of window A110, secured with interior hook and eye. Door and sash in good condition. Frame shored (without purpose).

Opening No.	Type	Description : Condition : Work
		Remove shore; clean and paint door.
A118 *Plates A4-2 and A6-19B*	1	Intact original entry door on one pair cast butt hinges. Opening can be enlarged to south to wagon size by loosening panels (including window A117) hinged on Gruber made iron strap hinges and one pair tapered butt strap hinges. Panel held in place by Gruber made iron cane bolt to floor and wooden, long handled turn button at top. Door and frame generally good condition except top panels of door replaced with horizontal boards. Lock escutcheon loose. Restore eight panelled door and nail escutcheon. Clean and paint.
A119 *Plate A4-2*	3	Sliding interior door with turn button removed side wall panels for pulling wagon from room to room. Good condition.
A120 *Plate A4-2*	2	Sliding interior panelled door in good condition.
A215 *Plates A4-3 and A6-19A*	3	Vertical double beaded board sliding door with 12 light fixed sash replaced original in-swinging double doors to roof of east porch. Cast iron handle on door secured with interior hook and eye. Use negated probably with elevator addition, 1905. Good condition. Clean and paint.
A217 *Plate A4-3*	4	Opening to stair enclosure hinged on one pair cast butts. Vertical board 1" thick. Lever activated box lock. Good condition.
A218 *Plate A4-3*	3	Vertical double baeded board sliding interior closure of paint shop from storage areas. Good condition.

Opening No.	Type	Description : Condition : Work
B001 *Plate A4-1*	3	Vertical double beaded board sliding door with cast iron handle.
Plate A6-19A		Fair condition: rotted lintle above, deteriorated sliding door hardware enclosure 10% rotted; broken boards at door bottom (see A4-18) and south 20% of door missing.
		Reset door sliding hardware after lintle replacement. Restore and rehang door. Paint.
B002 *Plates A4-1* *A6-7A* *and A6-18B*	-	Original large double door opening on strap hinges. Opening revised c. 1896 without doors and partially enclosed with engine room addition (room 008).
B107 *Plate A4-2*	4	Vertical board 1" thick out-swinging door in Gruber made cast iron straps. Secured with hook and eye.
		Good condition.
		Replace sill, clean and paint exterior.
B206 *Plate A4-2*	4	Vertical board out-swinging double doors on Gruber made cast iron straps, secured with hook and eye and safety protected with removable railing let-into interior jambs.
		Good condition.
		Clean and paint exterior.
C001 *Plates A4-1* *and A6-20B*	4	Vertical beaded boards matching siding adjacent on tapered cast butt hinges secured with hook and eye on interior.
		Good condition.
		Clean, repair and paint.
C005 *Plate A4-1*	3	Vertical double beaded board sliding door to boiler addition, secured with hasp and keeper (galvanized).
		Good condition.
		Replace locking device to match latch on door A005. Clean and paint.

Opening No.	Type	Description : Condition : Work
C007 *Plate A4-1*	2	Double hinged panelled doors with astragal on two pair of cast butt hinges, lever operated box lock, and bottom barrel bolt. Good condition; hardware loose. Repair hardware, clean and paint.
D001 *Plate A4-1* *Plate A6-19A*	3	Vertical double beaded board sliding door with cast iron handle. Fair condition: lintle rotted above (shored), sliding hardware loose, hood over hardware deteriorated. Door bottom boards 15% broken. Repair door, replace lintle, reinstall hardware and rehang door. Replace lumber jambs. Clean and paint exterior.
D107 *Plate A4-2*	2	Interior panelled door on decorative cast iron butts, wood knob (2-1/2" diameter) on cast iron box lock. Good condition.
F001 *Plate A4-2*	4	Access door on tapered cast iron strap butts secured with wood turn button (see A4-10 and A4-11). Good condition. Clean and paint.
F002 *Plate A4-1*	4	Same as F001 in poor condition due to ash pit covering. Replace door and paint.
F102 *Plate A4-2* *Plate A6-19A*	3	Vertical double beaded board sliding door with cast iron handle and secured with two hooks and eyes. Contains 12 light fixed sash. Cast iron catch/stop on sill of window A111. Adjacent wall panel to east removes for larger opening. Good condition except door bottom boards broken (20%) and sill plate rotted. Lower grade, replace sill plate, repair door boards, clean and paint.

Opening No.	Type	Description : Condition : Work
F106 *Plate A4-1*	3	Vertical double beaded board sliding door with twelve light fixed sash.
Plates A6-2B and A6-22B		Door in fair condition with broken sash, deteriorated hardware hood, rotted sill board, and exterior step missing. Repair door and sash, replace step and paint exterior.



GUTTER AND LEADER LOCATION

The following schedule types and locates the rainwater hardware extant on the Gruber Wagon Works (general reference Appendices A1, A2, A3 and A4).

Reference	Location/Description
	1. Gutter Hanger Types
Plate A6-11B	a. Building A, north elevation: Gruber-built straight drive
Plate A6-11A	b. Building A, south elevation: Gruber-built dog-leg drive
Plate A6-12A	c. Addition D-3, west Elevator elevation: Gruber-built dog-leg side nail
Plate A6-16B	d. Addition B, west Farm Shop elevation: Gruber-built dog-leg drive
Plate A6-13A	e. Addition D-3, east Elevator elevation: Gruber-built dog-leg side nail
	f. Addition B, west Farm Shop elevation: Gruber-built dog-leg drive
Plate A6-14A	g. Addition D-2, Elevator Storage north elevation: Gruber-built dog-leg side nail
Plates A6-13B and A6-13B	h. Addition D-1, south elevation: builders side-nail adjustable
Plate A6-9A	i. Additions E and F, west elevation: builders side-nail adjustable.
Plate A6-14B	2. Gutter and Leaders
Plates A1-3A and A1-3B	a. Building A, north elevation: from northwest corner at Elevator diagonally to northeast corner and joining east Elevator leader (Addition D-2).
Plate A1-4B	b. Building A, south Elevator (east): none; gutter flows into Addition B, east Farm Shop gutter.

Reference	Location/Description
Plate A6-14B	c. Addition B, east Farm Shop: gutter from southeast corner diagonally to southwest corner of Addition C, leader to below first floor
	d. Addition D-2, east Elevator: gutter from northeast corner joins leader from Building A north
	e. Addition B, west Farm Shop: gutter from north-corner joints leader from Addition D-1 south
Plates A5-10A and A6-1A	f. Addition D-2, west Elevator: gutter from northwest corner joins gutter from Elevator Storage on north elevation
Plates A6-1A and A6-2A	g. Addition D-2, north Elevator Storage: gutter from northwest corner diagonally to northeast corner of roof of Addition F
	h. Addition D-1, south: gutter from southeast corner joins leader from Addition "B", west Farm Shop, diagonally to southwest corner of the west Farm Shop
	i. Additions E and F, west: leader at southwest corner

MACHINERY AND MECHANICAL POWER SYSTEM

The following is a condition, location and identification survey of the mechanical power and drive system and the wagon-making machinery and equipment utilized in the Gruber Wagon Works. These improvements are all extant at the site and form an integral part of the unique character of this structure.

The description is divided into three parts, illustrated and keyed:

1. Lower Drive System Components/Reflected Cellar Ceiling Plan
2. Interior Machinery and Furnishings Schedule/First Floor Plan
3. Upper Drive System Components/Reflected First Floor Ceiling Plan

The following abbreviations are used on the schedules:

BR Bearing
CL Clutch
CR Crank
PL Pulley

The extant machinery and related upper and lower drive systems are for the most part in good condition, needing very few repairs. The included schedules list the various components of the machinery and drive systems and the specific repairs required.

General Repairs for All Components

Bearings - The basic bearing design is a hanger type with a poured babbitt bearing lining inside a cast iron housing. The housing is of a split design with the top cap removable. In most instances the top cap and lower cap were separated from each other with paper shims, presumably used to adjust the clearance between the

shaft and bearing surface. Several bearings were found to have excessive wear and should be replaced. These are noted in the Schedules. A random sampling of the remaining bearings revealed that; in general, the bearing surfaces, although usually scored, are in good condition. Oil holes are generally clogged and filled with debris which contributed to bearing scoring. There is no evidence of bearing seals.

Prior to operating the machinery, each bearing should be disassembled and the bearings examined and cleaned. Bearings with excessive scoring should be rebabbitted. All oil holes should be cleaned out and dust caps installed over the oil holes. Bearings should be lubricated with a good grade of machinery oil designed for babbitt journal bearings.

Machine Surfaces - Due to lack of use, surfaces such as machine ways, drive shafts, face plates, table tops, etc., have rusted. For the most part, this is a minor surface condition and has not yet damaged the work surface. However, the condition must be eliminated to avoid possible irreversible damage.

Surface rust should be carefully removed by rubbing with a fine grade of steel wool and coating with a rust inhibitor such as CRC 3-36. The coating must be maintained by periodic reapplication, approximately once a year.

Pulley faces should not be treated. Operation of belts across pulley surfaces will be sufficient to clean them

Cleaning - The historic character of the building is reflected in the condition of the machinery; therefore, in most cases it is not recommended to remove the accumulated chips and dust. However, dirt caused by birds and unrelated construction activities should be removed.

Machinery Alignment - All machines appear to be in good alignment. This should be verified prior to their operation.

Shaft Alignment - All shafts must be realigned after final structural stabilization of the building has been completed.

Pulleys - All pulleys appear to be in good condition. Bearing liners on the idlers should be checked for excessive wear and replaced if required prior to operation.

Belts - All belts must be replaced.

Oilers - All machines should be checked for broken or missing oilers.

Wood Machine Members - Several machines are either made of wood or have parts made of wood. These should be inspected during reinstallation and repaired as required. Dried-out parts can be salvaged by treating with finishing oil.

Bracing - Several machines have randomly placed bracing between the first floor ceiling joints and the main vertical machine member. These were presumably added for increased horizontal stability. Elements should be examined and all broken members replaced.

Adjustment - Almost without exception, all basic machine elements appeared to operate satisfactorily; however, all machines should be turned by hand to verify free operation of all moving parts. Any parts that appear to stick or hang-up should be carefully examined and disassembled and cleaned if required.

Electric Motors - With the exception of the forge blower motor, all electric motors are to be removed. The forge motor should be carefully examined prior to operation. The motor is to be disassembled and the windings, brushes and bearings examined and repaired as required. New wiring is to be installed for connecting to power source.

LOWER DRIVE SYSTEM COMPONENTS SCHEDULE *(reference Plate E-1)*

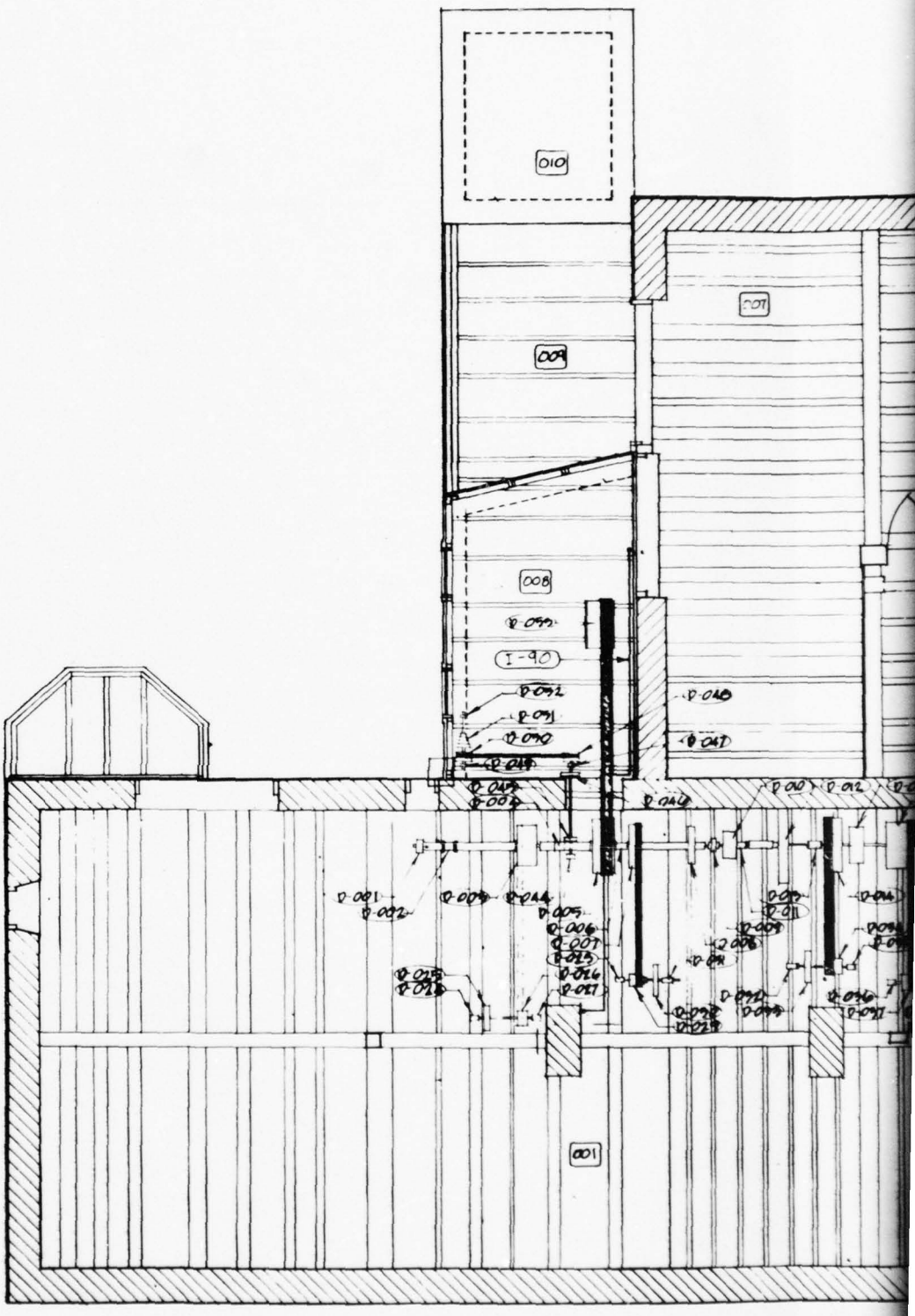
No.	Space	Type	Belt To	Note
D-001	001	PL		Belt for Power Takeoff
D-002	001	BR		
D-003	001	PL	D-026 & D-056	
D-004	001	BR		Wood Bearing & Hanger
D-005	001	PL	D-053	Drive/Idler Pair; Belt Shifter
D-006	001	BR		
D-007	001	PL	D-029	
D-008	001	PL	D-102	
D-009	001	CP		Rigid Coupling
D-010	001	PL	None	Does Not Operate Machine
D-011	001	BR		
D-012	001	PL	None	Does Not Operate Machine
D-013	001	BR		
D-014	001	PL	P-034	
D-015	001	PL	D-059	
D-016	001	PL	D-119 & D-037	
D-017	001	CP		Rigid Coupling

D-018	001	BR		
D-019	001	BR		
D-020	001	PL	D-043	
D-021	002	BR		
D-022	002	PL	D-061	
D-023	002	PL	D-126 & D-161	
D-024	001	BR		Hanger Inverted
D-025	001	PL	D-055	
D-026	001	PL	D-003	*Drive/Idler Pair; Belt Shifter*
D-027	001	BR		Hanger Inverted
D-028	001	BR		
D-029	001	PL	D-007	Drive/Idler Pair; Belt Shifter
D-030	001	PL	D-057	
D-031	001	BR		
D-032	001	BR		
D-033	001	PL	D-058	
D-034	001	PL	D-014	Drive/Idler Pair; Belt Shifter
D-035	001	BR		
D-036	001	BR		

LOWER DRIVE SYSTEM COMPONENTS SCHEDULE (cont.)

No.	Space	Type	Belt To	Note
D-037	001	PL	D-016	Drive/Idler Pair; Belt Shifter
D-038	001	PL	D-060	
D-039	001	BR		
D-040	001	CR		Pitman Rod to Engine Water Pump
D-041	001	BR		Wooden Bearing & Hanger
D-042	001	BR		Wooden Bearing & Hanger
D-043	001	PL	D-020	
D-044	001	BR		Wooden Bearing & Hanger
D-045	001	PL	None	No Extant Pulley on Main Shaft
D-046	008	PL		Belt Driven from Electric Motor
D-047	008	BR		Wooden Bearing & Hanger
D-048	008	PL	D-050	
D-049	008	BR		Attached Directly to Roof Boards
D-050	008	PL	D-048	Drive/Idler Pair; Belt Shifter
D-051	008	PL	D-054	Four Step Pulley
D-052	008	BR		Attached Directly to Roof Boards
D-053	008	PL	D-005	On Gasoline Engine

D-054	008	PL	D-051	On Metal Lathe
D-055	107	PL	D-025	On Dado Cutting Machine
D-056	101	PL	D-003	On Wood Boring Machine. Drive/Idler Pair
D-057	101	PL	D-030	On Joiner
D-058	107	PL	D-033	On Planer
D-059	102	PL	D-015	On Band Saw; Belt Shifter
D-060	102	PL	D-038	On Table Saw
D-061	103	PL	D-022	On Large Drill Press Drive/Idler Pair



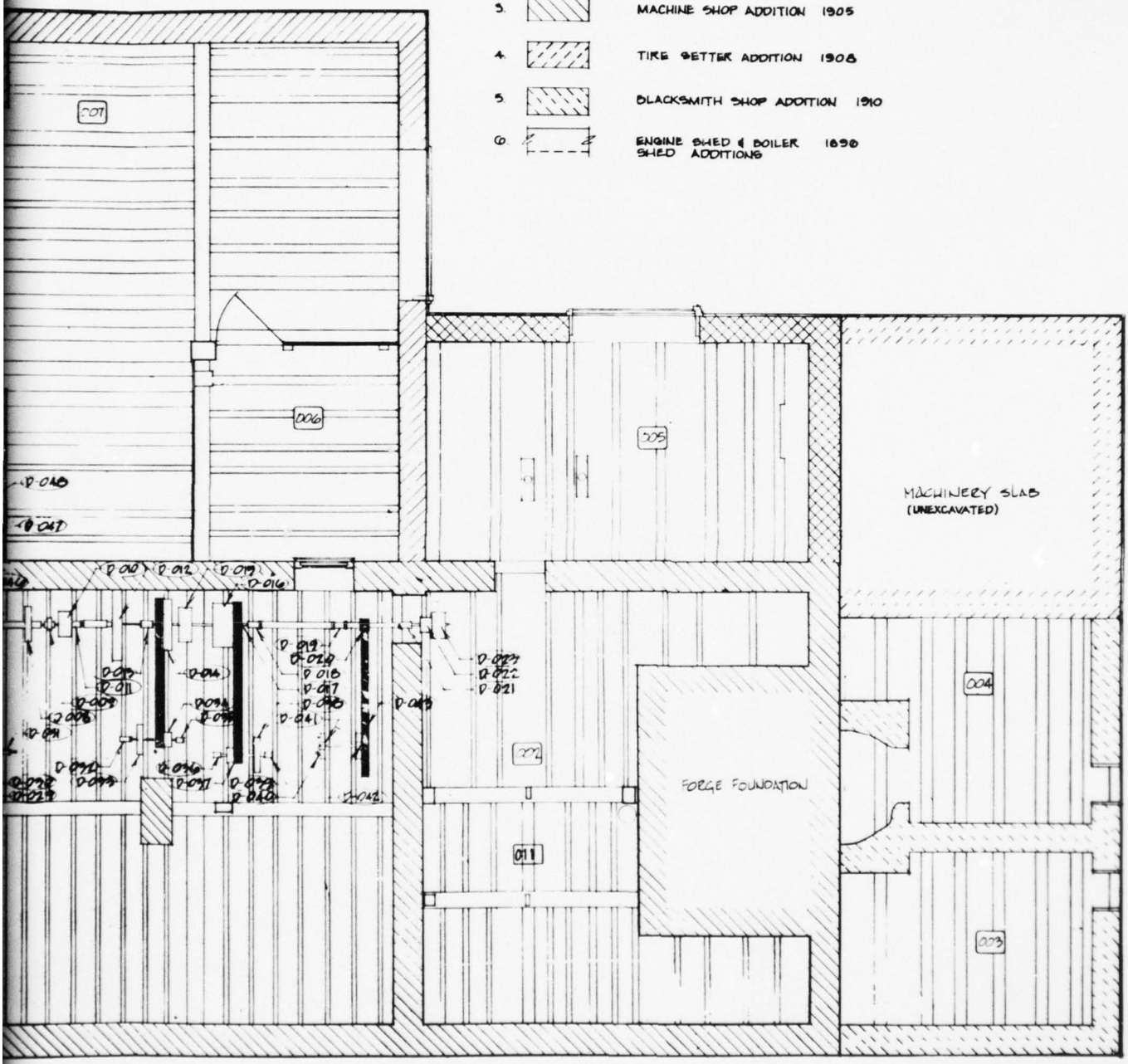
CELLAR REFLECTED CEILING PL

SCALE 1/4" = 1'

CHART OF ORIGINAL FOUNDATION WALLS

LEGEND

1. ORIGINAL WAGON WORKS 1885
2. FARM SHOP ADDITION 1885
3. MACHINE SHOP ADDITION 1905
4. TIRE SETTER ADDITION 1908
5. BLACKSMITH SHOP ADDITION 1910
6. ENGINE SHED & BOILER SHED ADDITIONS 1898



LING PLAN

INTERIOR MACHINERY AND FURNISHINGS SCHEDULE (*reference Plate E-2*)

No.	Space	Description	Repair Work Required
I-1a	101	Wheelwright Bench	Remove electric grinder blocking vise
I-1b	101	Wheelwright Bench	Remove pipe cutting vise
I-1c	101	Wheelwright Bench	Return from storage. Remove electric lathe
I-1d	101	Wheelwright Bench	Remove electric belt sander
I-2	101	Wheel Assembly Pit	
I-3	101	Joiner	
I-4	101	Wood Boring Machine	Reconnect foot treadle. Replace lower bearing on vertical tool shaft. Secure vertical machine post to second floor joist.
I-5	102B	Dado Cutting Machine	Return to original location in space 101. Replace missing belt shifter parts from counter shaft below floor.
I-6	101	Pot-Bellied Stove	Replace broken castings including bowl
I-7a	102B	Wood Lathe	Add new key to tailstock feed wheel Replace head stock bearing
I-7b	102B	Spoke Cut-Off Saw	
I-8	102B	Spoke Tenoning Machine	
I-9	102B	Small Belt Sander	Add hand crank for horizontal tension
I-10	102B	Spoke Tenoning Machine	Add shift lever
I-11	102B	Spoke Lathe	

INTERIOR MACHINERY AND FURNISHINGS SCHEDULE (cont.)

No.	Space	Description	Repair Work Required
I-12	102B	Hub Boring Machine	
I-13	102B	Curved Surface Shaper	Add belt guard along table shaper
I-14	102B	Table Shaper	
I-15	102B	Mortising Machine	Rebrace vertical member to second floor joist Verify need of spring in vertical trough of main machinery casting Vertical feed jambed - cause unknown - suspect rust on machine slides
I-16	102B	Large Blet Sander	
I-17	102A & 102B	Planer	
I-18	102A	Band Saw	Replace bearings in upper blade wheel Replace friction coverings on both the upper and lower blade wheels
I-19	102A	Table Saw	
I-20	102A	Pot-Bellied Stove	Remove from 1st floor layout
I-21	103A	Hand Tire Bender	Return from storage
I-22	103A	Large Drill Press	Vertical power drive mechanism is missing. If a replacement can be found, it should be added. Hand feed is still possible. Main drive locks - cause is unknown
I-23	103D2	Small Drill Press	Replace table support casting Locate new table and install

I-24	103D2	Punching and Shearing Machine	Replace foot treadle clutch spring adjustment on punch side Disassemble both heads and clean and adjust prior to attempting to operate
I-25	103D2	Tire Bender	
I-26	103D2	Bolt Threader	Replace missing automatic pump oiler
I-27	103E	Pressing Machine	Replace missing hand crank shift lever
I-28a	103E	Hydraulic Tire Setter	Disassemble hydraulic system and clean. All lines and fittings should be examined for cracks and fractures Replace all filters and seals
I-28b	103E	Tire Setter Pump	Disassemble hydraulic system and clean. All lines and fittings should be examined for cracks and fractures. Replace all filters and seals
I-28c	103E	Tire Setter Oil Pan	Disassemble hydraulic system and clean. All lines and fittings should be examined for cracks and fractures Replace all filters and seals
I-29	103E	Bench Drill Press	Disassemble and free vertical feed
I-30	103D2	Hand Bench Drill Press	
I-31	103A	Double Forge	Reconstruct (see Plate A7-3)
I-32	103A	Trip Hammer	
I-33	103A	Hand Shear	
I-34	101	Bench Shop Handtools, Patterns and Miscellaneous	Return from storage

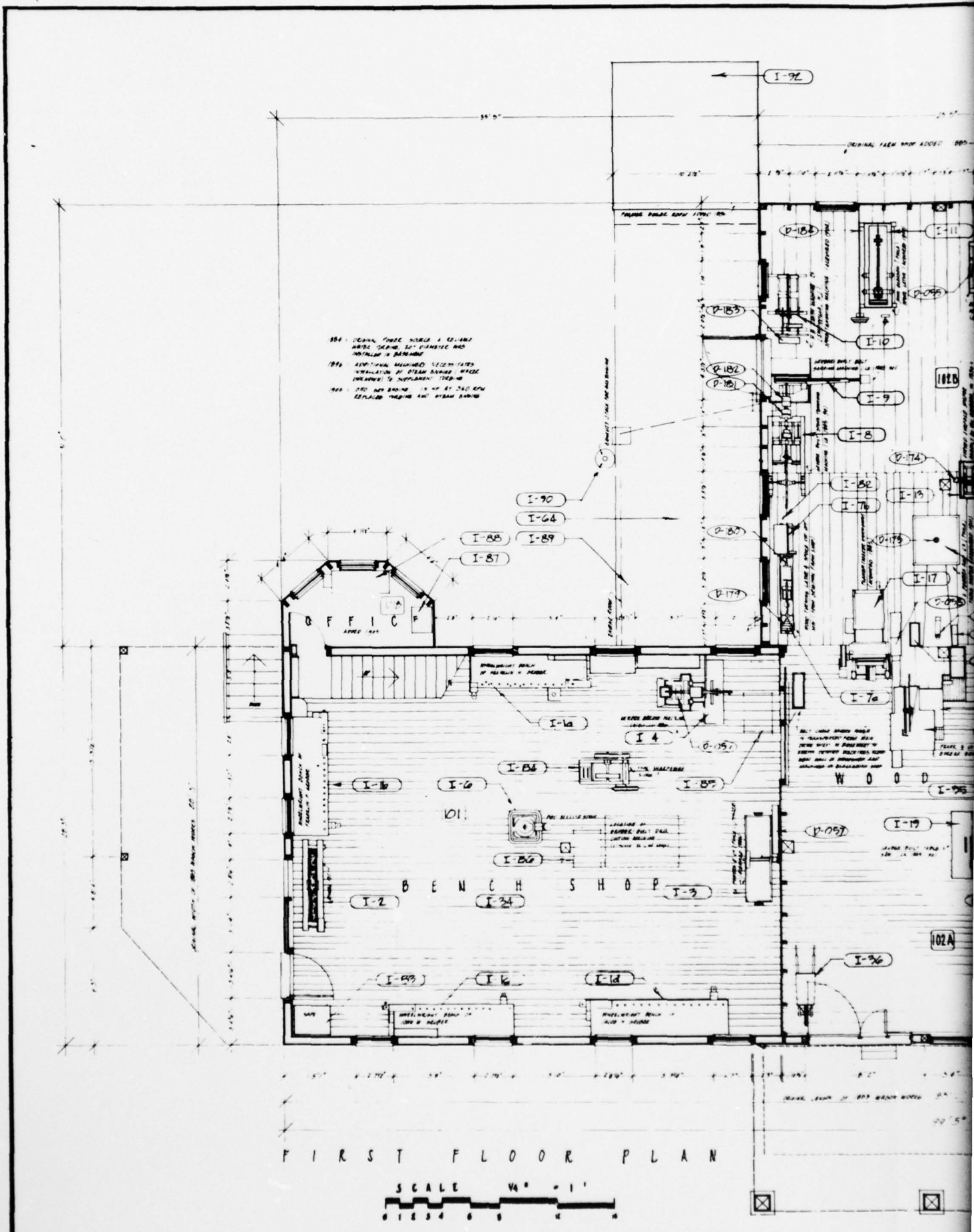
INTERIOR MACHINERY AND FURNISHINGS SCHEDULE (cont.)

No.	Space	Description	Repair Work Required
I-35	102A & 102B	Wood Shop Wood Stocks	Return from storage
I-36	102A & 102B	Wheel Barrows & Shop Carts	Return from storage
I-37a	103A & 103F	Forge Hand Tools	Return from storage
I-37b	103A	Anvil	Reinstall on new wood base
I-37c	103A	Anvil	Reinstall on new wood base
I-37d	103F	Anvil	Return from storage. Reinstall on new wood base.
I-37e	103A	Swage Block	Return from storage
I-37f	103F	Large Mandrel	
I-37g	103F	Anvil	Return from storage. Reinstall on new wood base.
I-38	103A	Hand Bench Punch	
I-39	103A & 103D1	Blacksmith Shop Wall Stocks and Miscellaneous Parts	Return from storage
I-40	103F	Pot-Bellied Stove	Remove from 1st floor layout
I-41 & 42	2nd floor	Horse Drawn Vehicles	Return from storage
I-43	2nd floor	Pot-Bellied Stove	Replace broken castings
I-44 thru I-56	2nd floor	Horse Drawn Vehicles and Miscellaneous Parts	Return from storage

I-57	2nd floor	Lumber Stocks and Miscellaneous Parts	Return from storage
I-58 thru I-62	2nd floor	Miscellaneous	Return from storage
I-63	3rd floor	All Material	Remove non-relevant material
I-64	008	Gasoline Engine (Otto)	Disassemble piston and cylinder and examine for damage - make necessary repairs. Disassemble cylinder head and valve mechanism and examine for damage - make necessary repairs. Examine all bearings and moving parts for wear - repair as required. Reconnect fuel lines, water cooling lines and exhaust lines.
I-65 thru I-73	Garage	Horse Drawn Vehicles and Miscellaneous Parts	Return from storage (see Plate A2-7)
I-74	Shed	Iron Stocks in Iron Storage Shed	Retain
I-75	103E	Hand Punch	Replace missing punches (2)
I-76	103A	Pot-Bellied Stove	Replace broken castings. Provide new flue to forge chimney.
I-77a	103A-103D1	Work Bench	
I-77b	103A	Work Bench	
I-78	103A	Drawer Chest	
I-79	103D1	Cabinet	
I-80	103D1	Grinder	Add new belt guards. Add new tool post holders. Replace left wheel bearing.

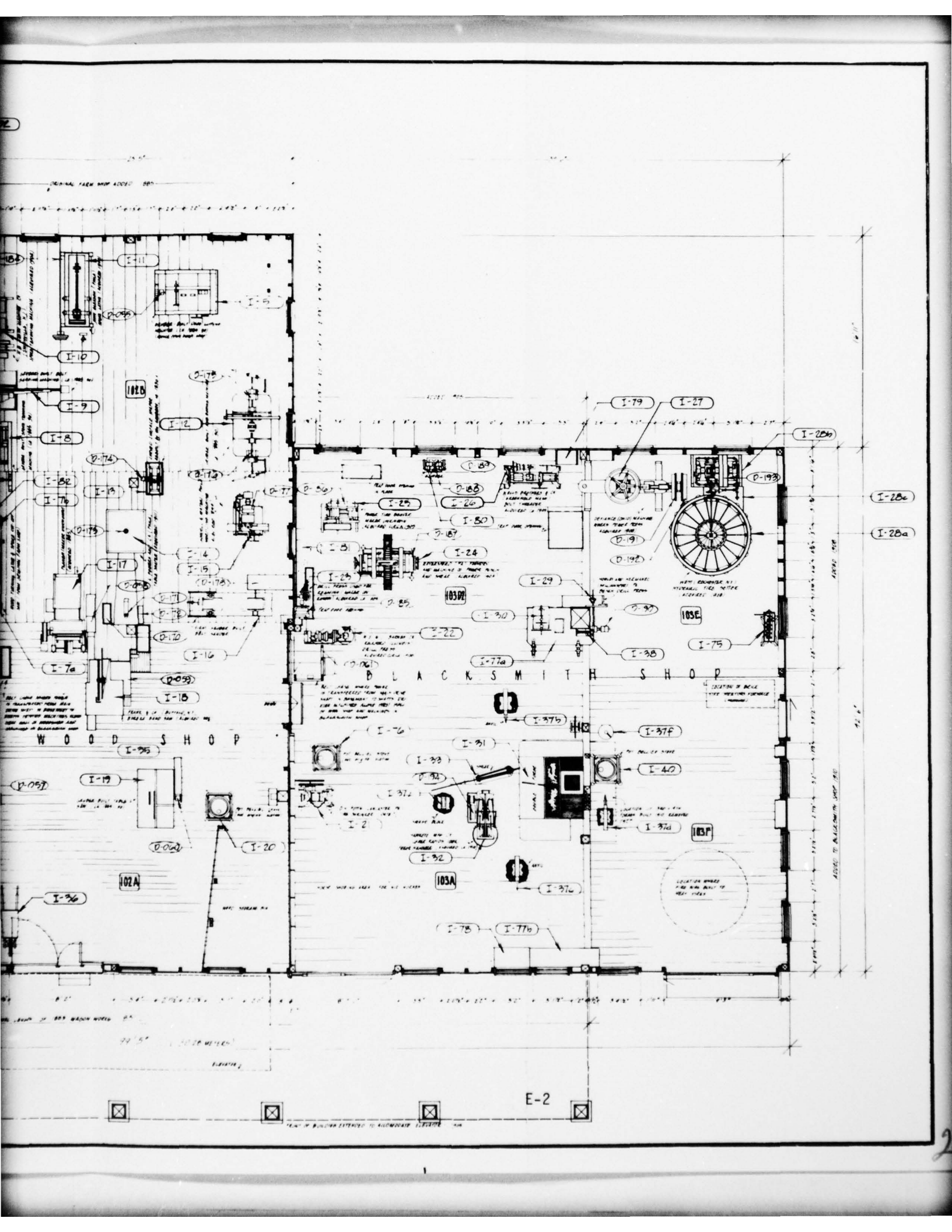
INTERIOR MACHINERY AND FURNISHINGS SCHEDULE (cont.)

No.	Space	Description	Repair Work Required
I-81	103D1	Electric Grinder	Remove
I-82	102B	Water Tank	Remove
I-83	101	Safe	
I-84	101	Electric Tool Sharpener	Remove electric motor. Provide foot treadle.
I-85	101	Electric Jig Saw	Remove
I-86	101	Electric Table Saw	Remove
I-87	108	Electric Grinder	Remove
I-88	108	Desk	
I-89	008	Metal Lathe	Replace fractured cast iron handle
I-90	001 & 008	Pump and Engine Water Pipe Assembly	Rebuild entire pump assembly including cylinder, piston and valve mechanism
I-91	008	Engine Exhaust Pipe Assembly	Reinstall to original operating configuration
I-92	010	Electric Grinder	Remove
I-93	Cellar	Miscellaneous Items	Discard non-relevant material
I-94	008	Electric Motor to Metal Lathe	Remove and restore drive from line shaft
		Hub Mortising Machine	Attempt to acquire



FIRST FLOOR PLAN

SCALE 1/4" = 1'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E-2

UPPER DRIVE SYSTEM COMPONENTS SCHEDULE (reference Plate E-3)

No.	Space	Type	Belt To	Repair Work Required	Note
D-101	102A	BR	--		
D-102	102A	PL	D-008		Drive/Idler Pair; Belt Shifter
D-103	102A	CP	--		Rigid Coupling
D-104	102B	PL	D-179		Four Step Pulley
D-105	102B	BR	--		Wooden Bearing & Hanger
D-106	102B	PL	D-180	Repair pulley	
D-107	102B	BR			
D-108	102B	BR			Wooden Bearing & Hanger
D-109	102B	PL	D-181		
D-110	102B	PL	D-182		
D-111	102B	BR	--		
D-112	102B	PL	None		Does Not Operate Machine
D-113	102B	PL	D-183		
D-114	102B	BR	--		
D-115	102B	BR	--	Replace bearing	
D-116	102B	PL	D-184	Replace pulley	
D-117	102B	BR	--		

UPPER DRIVE SYSTEM COMPONENTS SCHEDULE (cont.)

No.	Space	Type	Belt To	Repair Work Required	Note
D-118	102B	PL	D-170		
D-119	102B	PL	D-016		Drive/Idler Pair;Belt Shifter
D-120	102B	BR	--		
D-121	102B	PL	D-175		
D-122	102B	BR	--		
D-123	102B	PL	D-176		
D-124	102B	BR	--		
D-125	102B	PL	D-169		Drive/Idler Pair;Belt Tightener
D-126	103A	PL	D-023		
D-127	103A	BR	--	Replace bearing	
D-128	103A	PL	D-187		
D-129	103A	BR	--		
D-130	103A	PL	D-146		
D-131	103A	PL	D-132		
D-132	103D1	PL	D-131		Drive/Idler Pair;Belt Shifter
D-133	103D1	BR	--		
D-134	103D1	PL	D-152		

D-135	103D1	PL	D-156		
D-136	103D1	PL	D-158		
D-137	103D1	BR	--	Replace bearing	
D-138	103E	PL	D-190		
D-139	103E	CP	--		Rigid Coupling
D-140	103E	BR	--		
D-141	103E	PL	D-191		
D-142	103E	BR	--		Metal Bearing in Wooden Hanger
D-143	103E	PL	D-193		
D-144	103E	PL	D-194		
D-145	103E	BR	--		Metal Bearing in Wooden Hanger
D-146	103A	PL	D-130		Drive/Idler Pair
D-147	103A	BR	--		
D-148	103A	PL	D-195		
D-149	103A	BR	--	Bearing housing loose - Condition unknown	
D-150	103D1	BR	--	Replace bearing	
D-151	103D1	PL	D-188		

UPPER DRIVE SYSTEM COMPONENTS SCHEDULE (cont.)

No.	Space	Type	Belt To	Repair Work Required	Note
D-152	103D1	PL	D-134		Drive/Idler Pair
D-153	103D1	BR	--		
D-154	103D1	BR	--		
D-155	103D1	PL	D-189		Three Step Pulley
D-156	103D1	PL	D-156		
D-157	103D1	CL	--	Clutch frozen - disassemble	Friction Clutch
D-158	103D1	PL	D-136		
D-159	103D1	BR	--		
D-160	103A	BR	--		
D-161	103A	PL	D-023		Drive/Idler Pair; Belt Shifter
D-162	103D1	PL/CL	D-183		Claw Clutch Attached to Pulley
D-163	103D1	PL	D-178		
D-164	103D1	BR	--		
D-165	103D1	PL	None		Does Not Operate Machine
D-166	103D1	PL/CL	D-186	Replace clutch handle	Claw Clutch Attached to Pulley
D-167	103D1	PL	D-177		

D-168	103D1	BR	--	
D-169	103D1	PL	D-125	
D-170	103B	PL	D-118	
D-171	103B	PL/CL	D-173	Friction Clutch Attached to Pulley
D-172	103B	PL	D-173	
D-173	103B	PL	D-171	On Table Shaper
D-174	103B	PL	D-172	On Curve Shaper
D-175	103B	PL	D-121	On Hub Boring Machine
D-176	103B	PL	D-123	On Hub Boring Machine
D-177	103B	PL	D-167	On Mortising Machine. Drive/Idler Pair
D-178	103B	PL	D-163	On Large Belt Sander Drive/Idler Pair
D-179	103B	PL	D-104	On Wood Lathe Four Step Pulley
D-180	103B	PL	D-106	On Spoke Cut-Off Saw
D-181	103B	PL	D-109	On Spoke Tenoning Machine Drive/Idler Pair
D-182	103B	PL	D-110	
D-183	103B	PL	D-113	On Spoke Tenoning Machine Drive/Idler Pair
				On Small Belt Sander Drive/Idler Pair

UPPER DRIVE SYSTEM COMPONENTS SCHEDULE (cont.)

No.	Space	Type	Belt To	Repair Work Required	Note
D-184	102B	PL	D-116		On Spoke Lathe Drive/Idler Pair
D-185	103D1	PL	D-162		On Small Drill Press Three Step Pulley
D-186	103D1	PL	D-166		On Tire Bender
D-187	103D1	PL	D-128		On Punching and Shearing Machine Drive/Idler Pair
D-188	103D1	PL	D-151		On Grinder
D-189	103D1	PL	D-155		On Bolt Threader Three Step Pulley
D-190	103E	PL	D-133		On Bench Drill Press Drive/Idler Pair
D-191	103E	PL	D-141		On Pressing Machine Clean Clutch
D-192	103E	CL	--		
D-193	103E	PL	D-143		On Pressing Machine Drive/Idler Pair
D-194	103E	PL	D-144		On Tire Setter Drive/Idler Pair
D-195	103A	PL	D-148		On Trip Hammer

AD-A067 240 MILNER (JOHN) ASSOCIATES WEST CHESTER PA F/G 5/11
GRUBER WAGON WORKS, BLUE MARSH LAKE, BERKS COUNTY, PENNSYLVANIA--ETC(U)
APR 78 R L DESILETS, C A PARROTT DACW61-78-C-0038

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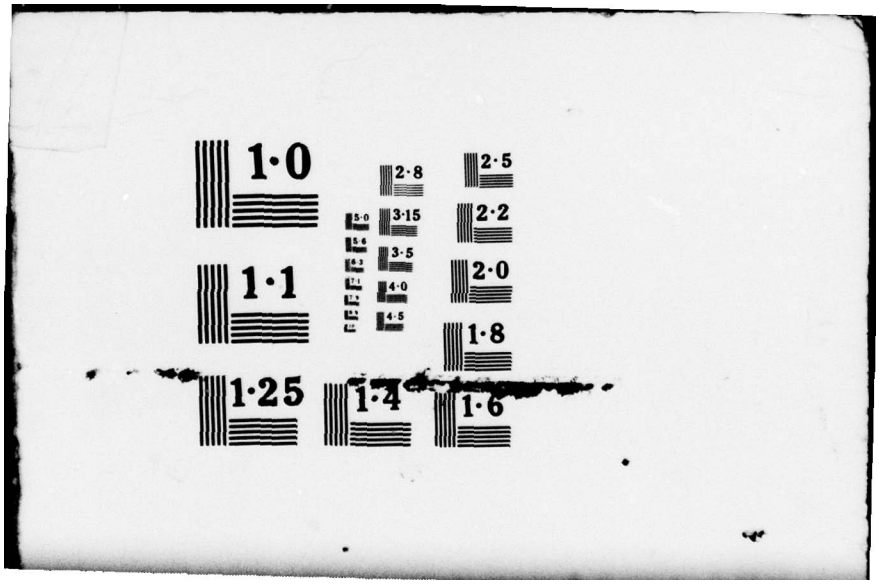
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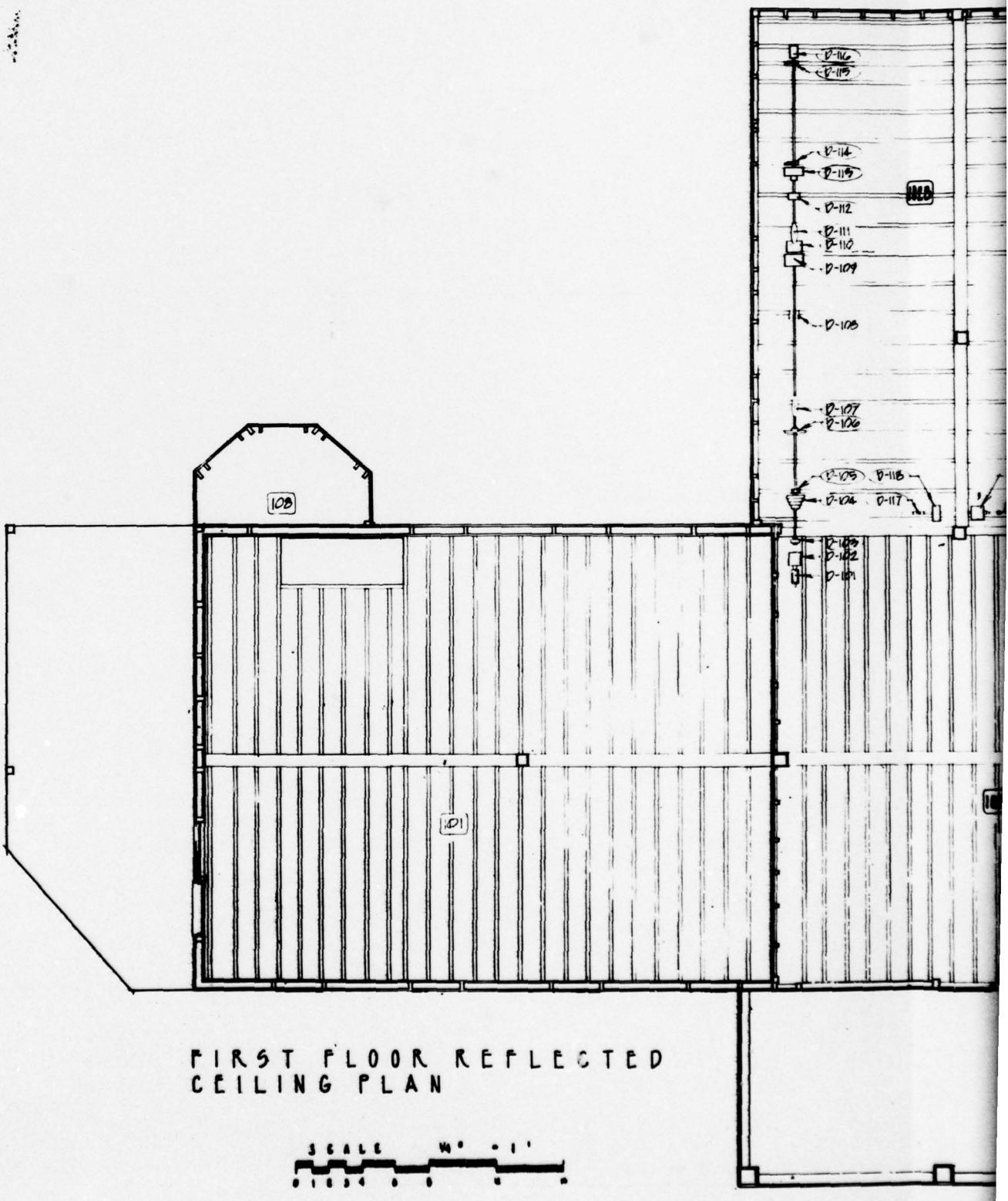

FIRST FLOOR REFLECTED CEILING PLAN

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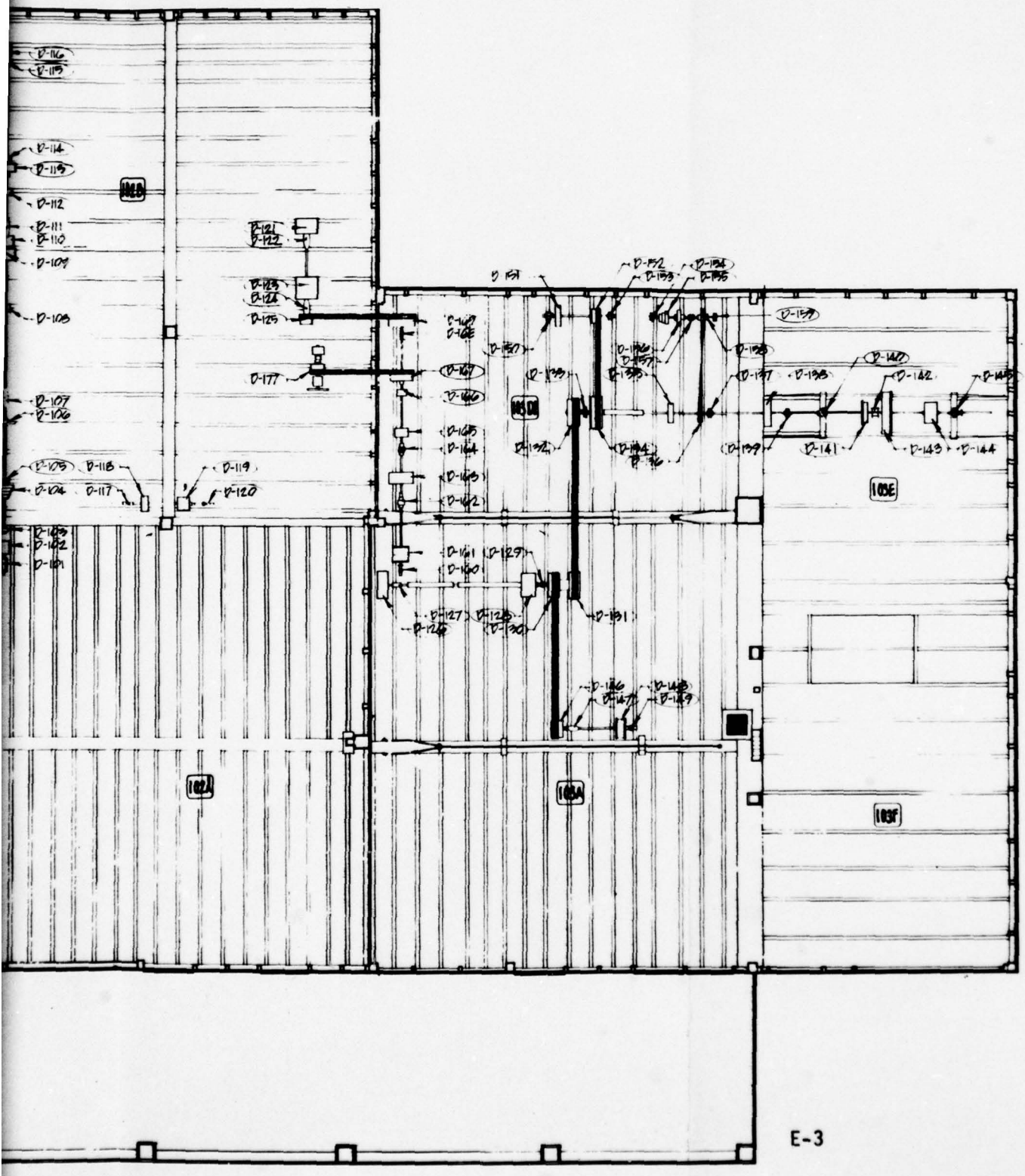
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103A
103B
103E
103F

WOOD BORING BEETLES

The following is excerpted from a bulletin of the Pennsylvania State University, College of Agricultural Extension Services, College Park, Pennsylvania, December, 1969, No. U.Ed. 0-370, by Arnold Mallis, Entomology Extension. Also, see U. S. Department of Agriculture, Leaflet No. 558, "Wood-destroying Beetles in Buildings and Furniture", U. S. Government Printing Office Stock No. 0100-2482.

Powder-Post Beetle

POWDER-POST BEETLES

Powder-Post beetles are small, brown insects usually less than one-quarter inch in length that attack seasoned wood. A certain sign of their presence is numerous small holes about 1/16 to 1/8-inch in diameter and a fine, powder-like sawdust in flooring, paneling, furniture, and other wood materials. The dust results from the boring of the larvae. The holes are the openings through which the adult beetles emerge.

Powder-Post beetles breed in dead and dried wood such as the dead branches and limbs of trees. Their presence is overlooked until they are discovered in stored lumber, rafters, joists, finished wood, and furniture products. As a rule, they enter lumber while it is being stored and cured, then later, emerge from the finished product.

Adult beetles deposit eggs in the pores and exit holes of seasoned lumber, usually in the spring. The mature larvae are small, white grubs about 1/5-inch in length. They produce the fine sawdust mentioned previously. The larvae winter in the wood and reach their adult stage in the spring.

Adult beetles emerge from the wood through small round exit holes. Although the Powder-Post beetle prefers the sapwood of oak and other hardwoods, some related insects may attack pine and other softwoods. Many of the insects will continue to breed in an infested piece of wood for generations. This practice can result in an ultimate destruction of the wood.

A coating of paint or varnish will prevent the beetles from laying more eggs in the wood, but will not destroy the eggs or larvae already there. However, to exterminate the emerging adults before they lay any eggs, spray infested structural timbers with a 5 percent methoxychlor spray (in odorless kerosene). Apply the spray in April in heated buildings, and in May in unheated structures. Infested floors, paneling, and related wood materials can be sprayed with aerosols recommended for fabric insects or for roaches, ants, and other crawling insects. Thoroughly wet infested surfaces. Also, fumigation with an extremely toxic chemical, Vikane (fumigout), can be accomplished in mid-June when temperature is consistently above 60°F; buildings must be posted off limits for at least a week, and guarded. Fumigation will kill all above ground insects in the house.

APPENDIX G

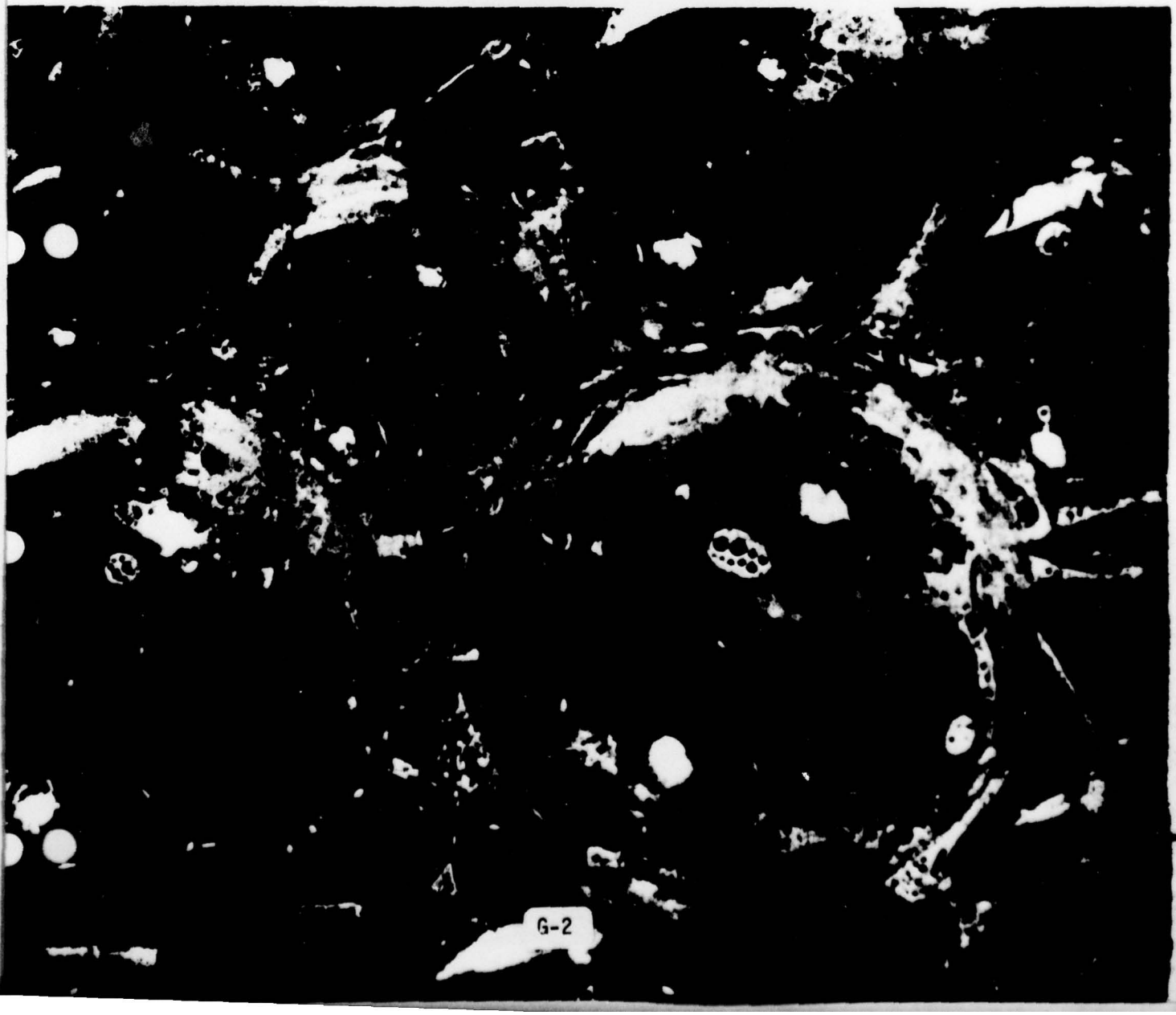
FIRE PROTECTION

The attached photocopies of Walter Kidde & Company, Inc., Belleville, New Jersey, Catalogue No. 1-64-6/71 describe the technical aspects of high density foam for suppression of fire. Foam is used to protect places such as paper storage plants, rubber tire and flammable liquid storage areas, high risk warehouses, hangers, and wood related structures.

HI-EX FOAM

KIDDE HI-EX FOAM SYSTEMS, PORTABLES, TRUCKS

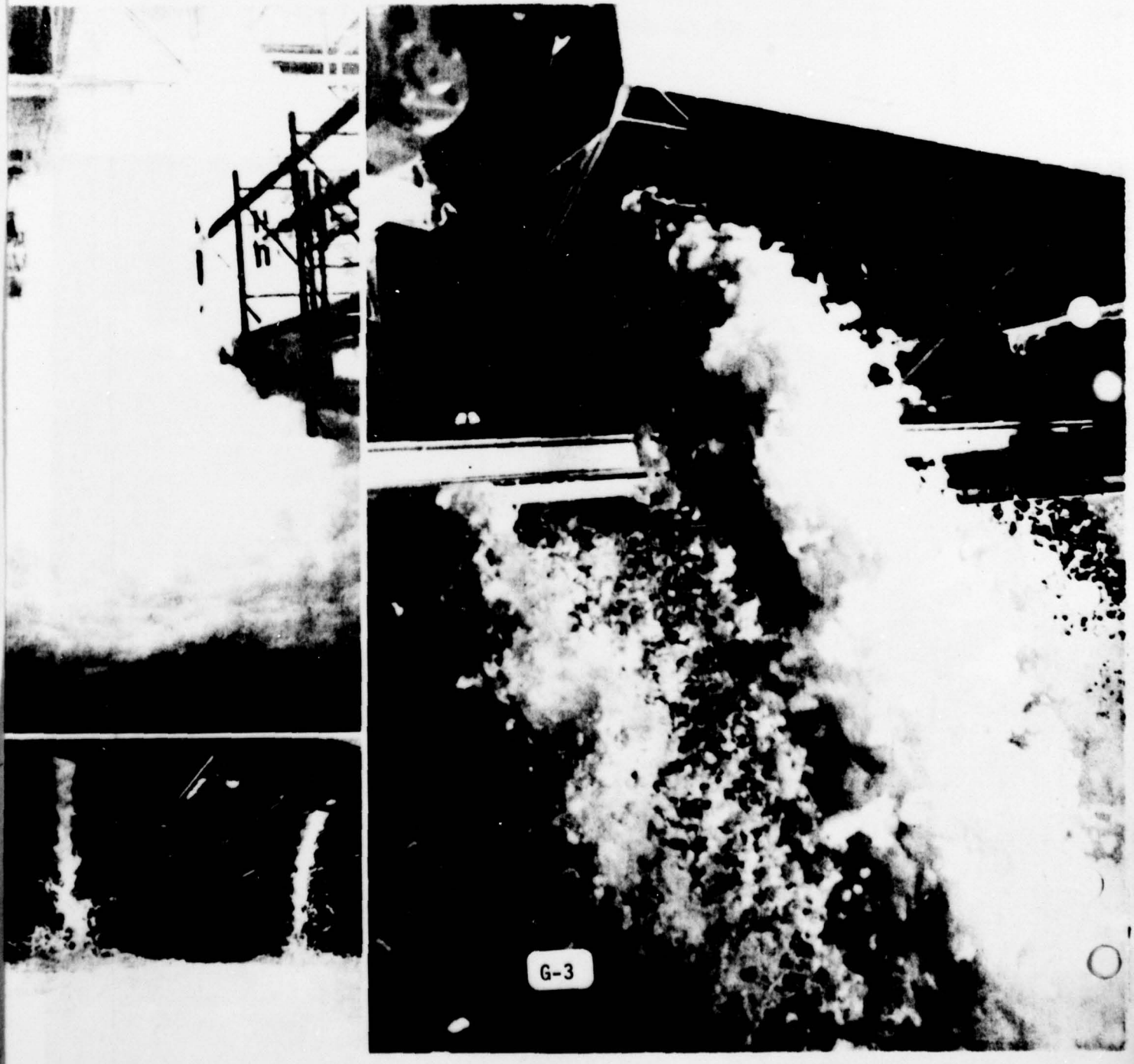
ATLAS FIRE EQUIPMENT, INC.
517 SOUTH BROADWAY
GLOUCESTER, NEW JERSEY 08030
609-456-3299 609-234-1084



G-2

Hi-Ex Foam is the expansion of water and detergent concentrate into billions of tiny, stable bubbles at the rate of 1000 gallons of foam for each gallon of water. Kidde's high expansion foam engineered systems, portable generators and fire trucks produce large volumes of Hi-Ex Foam and efficiently transfer this highly effective extinguishing agent to the fire location.

The clean, cool high expansion foam swiftly fills huge areas — flowing around all obstacles, flooding every void — to quench and smother fires. All Class A and B fires — burning paper, wood, plastics, textiles, rubber, flaming oil, grease, gasoline, paints, solvents — are quickly contained and extinguished by Hi-Ex Foam.



HI-EX FOAM

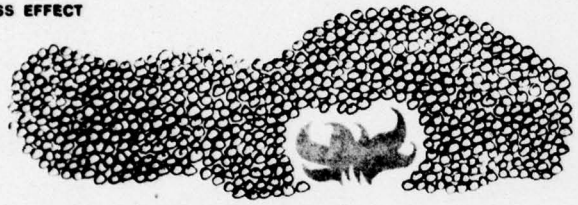
How Hi-Ex Foam is Produced

As the generator goes into action, the specified amount of biodegradable detergent concentrate is drawn from a storage tank and mixed with the correct quantity of water at an appropriate rate of flow. The water-concentrate mixture enters a bank of nozzles in the generator where it is sprayed onto a stainless steel screen. The generator fan moves air through the screen, expanding the concentrate-water mixture approximately 1000 times, producing billions of small, penetrating bubbles.

How Hi-Ex Foam Attacks Fires

When Hi-Ex Foam meets fire, three basic extinguishing effects occur. The *mass* effect of the tremendous volume of foam discharged is to fill all voids and seal the area involved in fire preventing currents of fresh air from reaching the base of the flames. The foam *mass* maintains a steam and oxygen-deficient atmosphere around the fire until it is extinguished.

MASS EFFECT

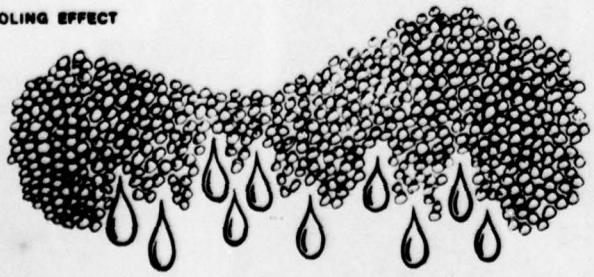


The *steam* effect results as the radiant heat of the fire vaporizes the water in the foam front. This conversion into steam absorbs a large quantity of heat energy and the oxygen content of the resulting steam-air mixture is about 7.5% — well below the level required to support combustion.

STEAM EFFECT

The *cooling* effect of Hi-Ex Foam occurs as the bubbles break and deposit their liquid content on hot or dry surfaces. Since the surface tension of the water in Hi-Ex Foam is quite low, this cooling and quenching effect penetrates far more deeply than is possible with equal volumes of plain water.

COOLING EFFECT



Foam Stability — The Key to Effective Water Transfer

The fire-fighting effectiveness of any foam depends upon its ability to hold and deliver the maximum amount of water to the point of application. Kidde's Hi-Ex Concentrate and generating technique combine to produce highest stability bubbles which assure minimum drainage or water loss in transit.

This stable quality of Hi-Ex Foam also allows it to be removed easily after complete extinguishment of the fire has been determined leaving little water damage.

Hi-Ex Foam Quickly Fills Large Difficult Areas

Fast foam protection can be achieved in all kinds of large areas, even warehouses with stock piled as high as 100 feet, filled with racks or obstructed with machinery and equipment. A 1½ million cubic foot (42,000 cubic meters) warehouse has been completely filled with Hi-Ex Foam in just 7 minutes. Hi-Ex systems, portable generators and trucks effectively protect warehouses, aircraft hangars, freighter holds and engine rooms, pumping stations, refineries, mining operations, garages and refueling bays.

Hi-Ex Foam Finds Hidden and Inaccessible Fires

Kidde's Hi-Ex Foam is especially effective in extinguishing hard-to-reach fires because it quickly flows around all obstacles, floods all openings and completely submerges all material and equipment in cooling and quenching bubbles. Flames which start at the base of high-rise storage racks, deep in stacks of roll paper and other combustibles, or in areas crowded with machinery and equipment are virtually impossible to reach by conventional fire-fighting methods.

Hi-Ex Foam Limits Water Damage

Utilizing its small water content with highest efficiency, Hi-Ex Foam completely submerges and protects valuable materials and equipment that cannot be deluged with large volumes of water. After a fire is extinguished, the stable foam can be swept or blown out of the area with minimum water damage.

Hi-Ex Foam Conserves Water

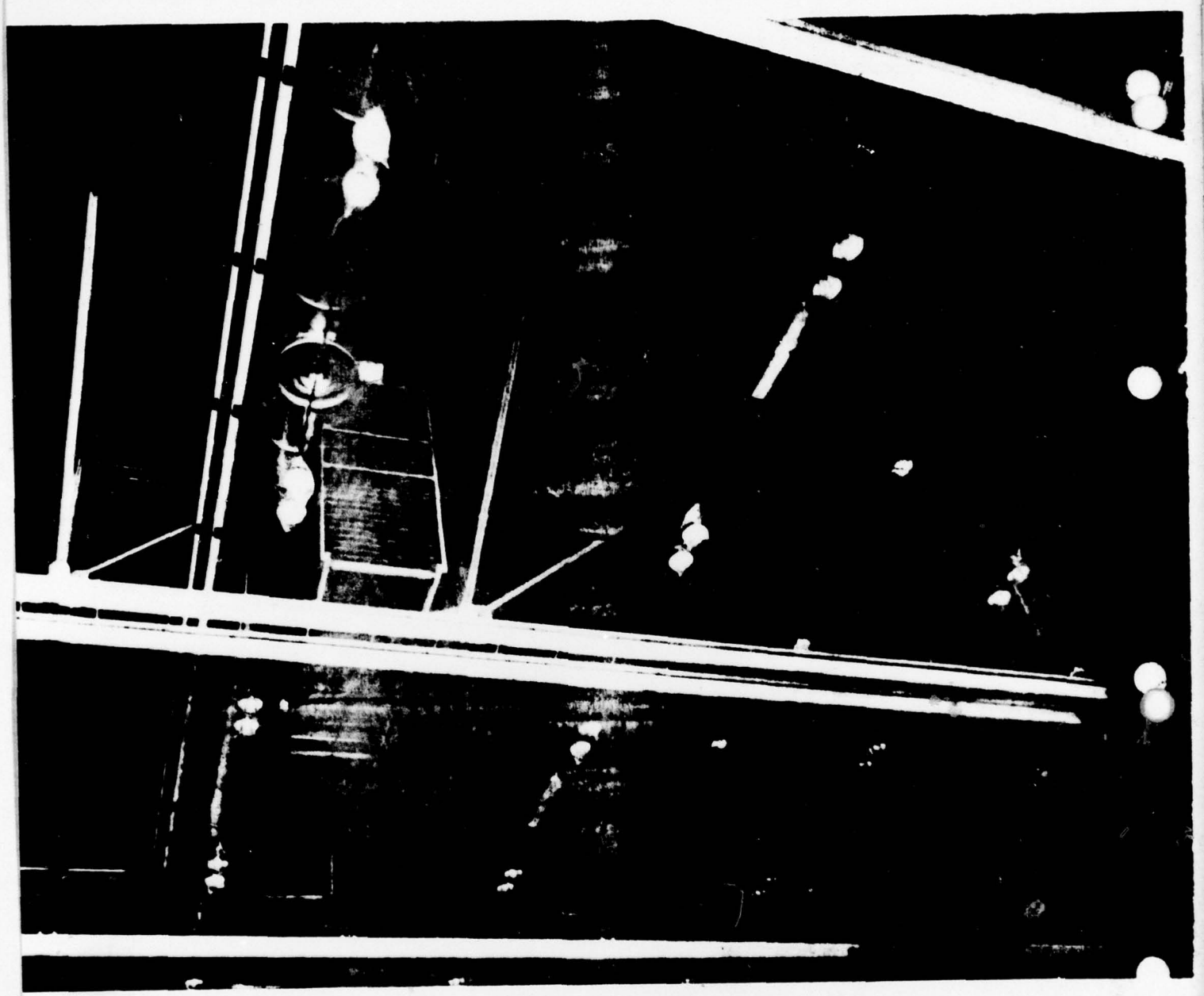
The high expansion quality of Kidde Hi-Ex Foam stretches the water supply to achieve maximum extinguishing effect. Water requirements for the various generator models range from 45 to 542 gallons per minute. Hi-Ex systems can also operate with lower water supply pressures than other fire-fighting methods. Because the concentrate is biodegradable when diluted, Hi-Ex Foam will not permanently pollute waterways into which it is released.

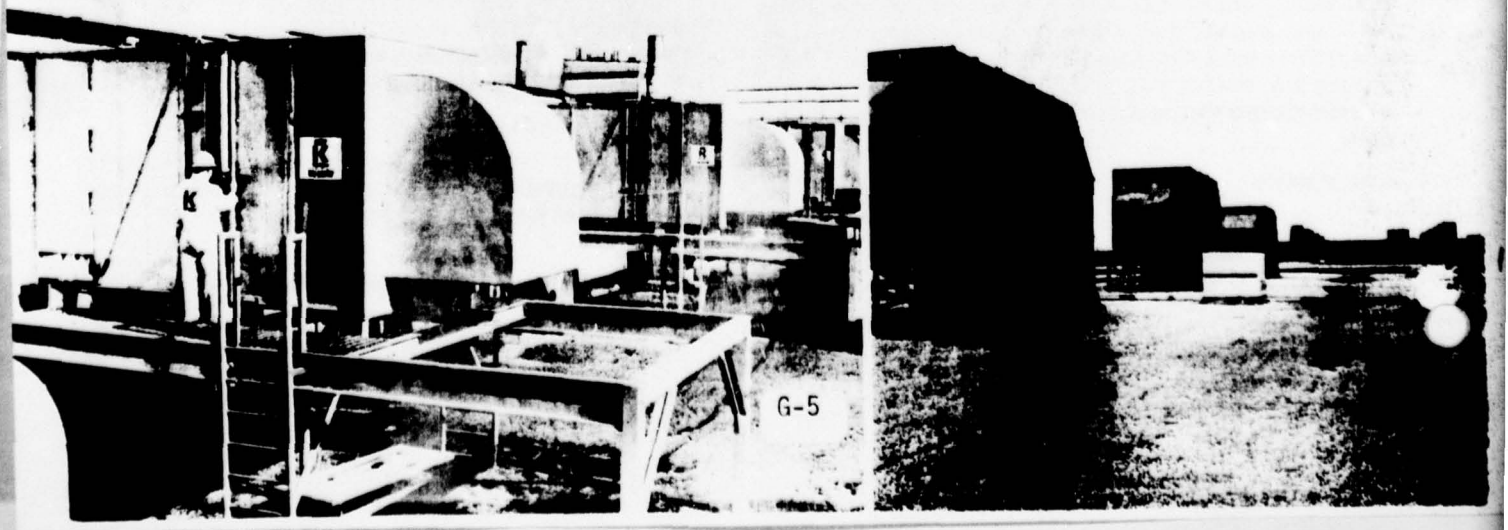
Hi-Ex Foam Isolates Fires

The ability of Hi-Ex Foam to surround a fire and prevent spread to adjacent areas is particularly valuable where chain reaction explosions and fires could take place if not properly contained.

Hi-Ex Foam Can Provide Refuge for Personnel

The insulating qualities of Hi-Ex Foam can protect personnel trapped by heat or flames. Mixed with outside air the foam is non-toxic, and by covering the nose and mouth with a cloth, persons can breathe even when completely submerged. However, vision is obstructed.





Kidde Engineered Automatic Hi-Ex Systems

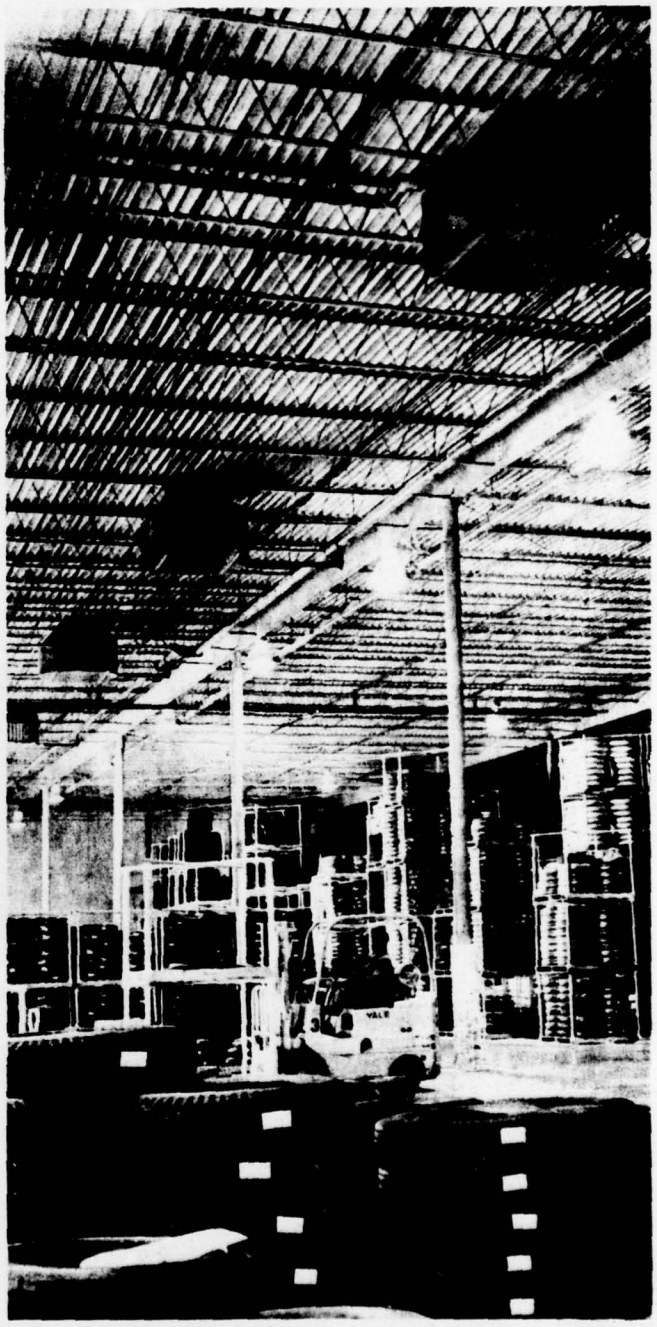
First to be listed by Underwriters Laboratories. Approved by Factory Mutual Laboratories. Approved by International Conference of Building Officials. Factory Insurance Association has accepted Hi-Ex Foam for protection of certain special hazard risks.

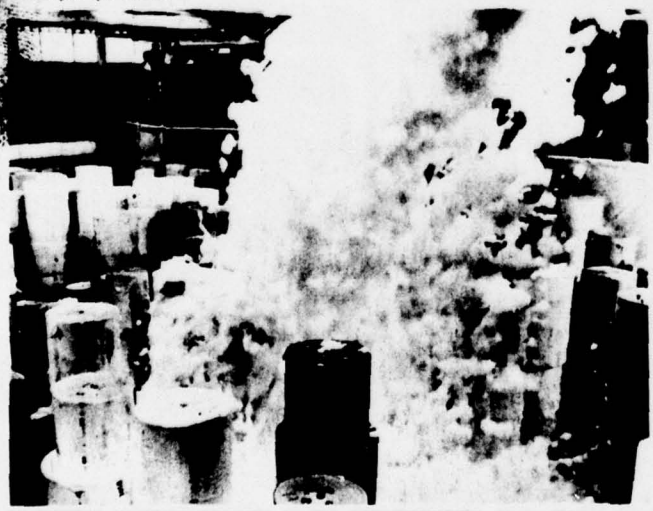
Kidde Hi-Ex Systems detect fire, turn on foam generators, close doors, open vents, sound alarms and signals, supervise their own operation, and deliver billions of fire-fighting bubbles. Generators are available in either electric or water-driven models.

An engineering survey determines the size, quantity and optimum placement of generators in each system. They can be mounted on rooftops, in truss areas, on outside walls or in adjacent rooms. If necessary, ducts can be built to bring outside air to the generators or to conduct Hi-Ex Foam from the generators to the hazard area. Outside air intake assures foam of consistently high quality, unaffected by smoke ingestion and reduces the danger of exposing personnel to contaminated, possibly toxic, foam.

Water-Driven Hi-Ex Generators

Standard model water-driven Hi-Ex generators include an outside air duct and ventilator hatch with trip latch release. If site conditions require, water-driven generators can be supplied without the ventilator and hatch or with an extended ventilator section. Design details will be provided with proposals.





ELECTRIC MOTOR-DRIVEN HI-EX GENERATORS Note: Water pressure at generator must be 15 psi.

Model No.	Height		Width		Length		Discharge Rate		Water Req.		Concentrate Req.		Weight	
	in.	(cm)	in.	(cm)	in.	(cm)	cfm	(M^3/min)	gpm	(l/min)	gpm	(l/min)	lbs.	(kg)
PI- 50A	40	(101.6)	40	(101.6)	88	(223.5)	5,000	(140)	45	(170)	0.7	(2.65)	350	(159)
PI-135A	58	(147.3)	58	(147.3)	102	(259)	13,500	(378)	100	(378)	1.6	(6.)	1160	(527)
PI-240A	76	(193)	76	(193)	132	(335)	24,000	(672)	177	(679)	2.7	(10.2)	2400	(1089)
PI-375A	94	(239)	94	(239)	140	(335.6)	37,500	(1050)	277	(1047)	4.3	(16.2)	3000	(1362)
PI-540A	112	(284.5)	112	(284.5)	149	(378.5)	54,000	(1512)	398	(1504)	6.0	(22.7)	4100	(1861)
PI-735A	134	(340)	134	(340)	151	(383.5)	73,500	(2058)	542	(2049)	8.3	(31.4)	6500	(2951)

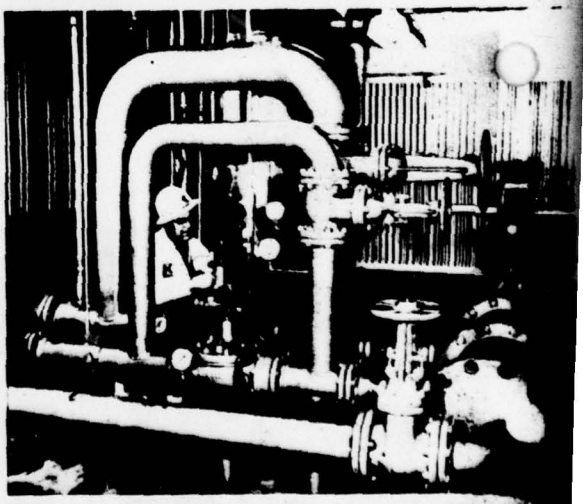
WATER DRIVEN HI-EX GENERATORS Note: Water pressure at generator must be 70 psi.

Model No.	Height*		Diameter		Weight*		Discharge Rate		Water Req.		Concentrate Req.	
	in.	(cm)	in.	(cm)	lbs.	(kg)	cfm	(M^3/min)	gpm	(l/min)	gpm	(l/min)
WD-150	55	(140)	66	(168)	550	(250)	15,000	(420)	150	(568)	2.2	(8.3)

*Height and weight does not include inlet fresh air duct and hatch.

HI-EX SYSTEM COMPONENTS

FIRE DETECTORS



Hi-Ex System Components

1. FIRE DETECTORS of various types can be used: rate-of-rise, fixed temperature, or combination types.
2. ELECTRICAL CONTROLS consist of a motor control center, relays, switches, disconnectors, and contactors to furnish and supervise delivery of power to the system, receive signals from the detectors, activate foam generating system, and sound alarms.
3. PUMP draws exact quantity of concentrate from
4. STORAGE TANK and delivers it to the water stream to form water-concentrate mixture.
5. WATER CONTROL VALVE regulates pressure and flow to insure that the proper amount of concentrate mix reaches the generator at the proper pressure.
6. GENERATOR contains bank of nozzles which spray the water-concentrate mixture onto a stainless steel screen and a fan which moves air through the screen to convert the concentrate mix into Hi-Ex Foam.

HI-EX FOAM CONCENTRATE

Kidde Hi-Ex Foam Concentrate / Type 15AE + 35
For Engineered Systems, Portable Generators, Trucks

First to be Listed by Underwriters' Laboratories, Inc.
Approved by Factory Mutual Engineering Division

Hi-Ex Foam concentrate is designed for use at a constant 1.5% injection rate with all normal water sources.

Kidde's foam concentrate has a warranted shelf life of 5 years if stored at temperatures not exceeding 120°F (49°C) while in original shipping containers or in Kidde approved system storage tanks. Under these conditions the concentrate will not rot, ferment, oxidize or deteriorate.

The rated temperature of +35°F (+1.7°C) is the lowest temperature at which the concentrate can be used to produce acceptable foam generation. So long as the foam concentrate remains above its rated temperature of +35°F (1.7°C), acceptable foam will be produced. Ambient air temperature may be much lower. Kidde Hi-Ex Foam has been used successfully in −40°F (−40°C) weather conditions.

As diluted with water during the foam generating process, the concentrate is biodegradable and will not cause permanent pollution of waterways into which foam might be released.

HI-EX FOAM CONCENTRATE SPECIFICATIONS

Part No.	Description	Weight lbs. (kg)
803522	5 gallon plastic container	42 (18.2)
803520	50 gallon plastic-lined steel drum	485 (220)

The letter below was received in response to an investigation by Westinghouse Security and John Milner Associates relative to the security of Gruber Wagon Works.

Westinghouse Security Systems

Kilbourn Inc.
9 Rittenhouse Place
Ardmore, Pennsylvania 19003
(215) MI 9-7400

Mr. Robert DeSilets
John Milner Associates
309 N. Matlack St.
West Chester, Pa. 19380

March 23, 1978.

Dear Bob,

In reviewing the requirements for security at the Gruber Wagon Works, I have decided that the best approach is to consider a two-fold system, that is a building system and a content protection system. Keep in mind that I would like to allow free movement within the building and at the same time not have to fasten any of the display items to their surfaces.

The only positive security approach would be to utilize library detection plates on each of the items on display (plates are discretly mounted) and to use only one exit door. The exit door would house the monitoring unit for the detection plates. Should any of the display items be removed, the monitor would reveal it. In turn, the monitor should alert an attendant or guard and at the same time notify the central station monitoring the building system so that the police could be notified to provide assistance. There should also be a provision to cancel police should the monitoring unit detect objects other than those being monitored by the plates. All other doors and/or accesses should remain locked (if possible) and control should be provided at the main entry door to prevent anyone trying to exit there. Where there are openings which cannot be secured, the building alarm system should maintain them on a 24-hour-always-armed basis. With this type of arrangement, controlled movement of people through the building may be desirable but is not required.

The building system is straightforward. All doors should be protected. All openings directly bordering a display site should also be protected. The interior of the building should be additionally protected by a series of infra-red electric eyes to span those areas which will reduce the possible human movement to a minimum, regardless of the point-of-entry. All protective devices within the system should be controlled by a digital push-button control located at the main entry. This control will arm/disarm the system with the exception of those openings on the 24-hour basis. These openings, however, should be controlled separately to facilitate maintenance, loading/unloading, etc.

The building system should be a separate item from the pilferage system. Most alarm companies do not specialize in this type of work. These types of systems are typically available from the manufacturer. I have located a source in New Jersey which I will forward information on. I cannot estimate a cost figure on this type of system.

The cost for the building alarm system should not exceed 5000.00 dollars including the monitoring of the fire suppression system. The cost of monitoring the system should not exceed 20.00 dollars per month or 240.00 dollars per year. The cost of maintenance on the system cannot be estimated because of the time factor concerning labor, materials and the like but a good gage would be no more than five percent of the system value per year after the warranty has expired.

I hope this is helpful. Should you have any questions, please contact me at the number above. I will forward more information concerning the details as soon as you desire.

Sincerely,

Charles R. Fairbank
Senior Security Consultant
Kilbourn, Inc.

The attached manufacturer's literature describes the proposed floor preservation and pedestrian circulation control matting. It would be used to define all pedestrian walkways. See appendix A-7.

Cactus Kid CUSHION WALK

Every day more people are turning to Cactus Kid Cushion Walk as the best solution to their floor mat problems. The combination of a firm hardwood surface with shock absorbing synthetic runners creates a type of luxurious foot comfort not found in other kinds of matting. The unusual versatility of Cushion Walk mats gives them a wide range of use. Their proven successes include applications in almost all classes of commercial and industrial fields.

SAFETY ENGINEERS LIKE THEM because they always lie flat and conform to many floor irregularities.

EMPLOYEES LIKE THEM because they're unusually easy on the feet and legs, and always provide a secure footing.

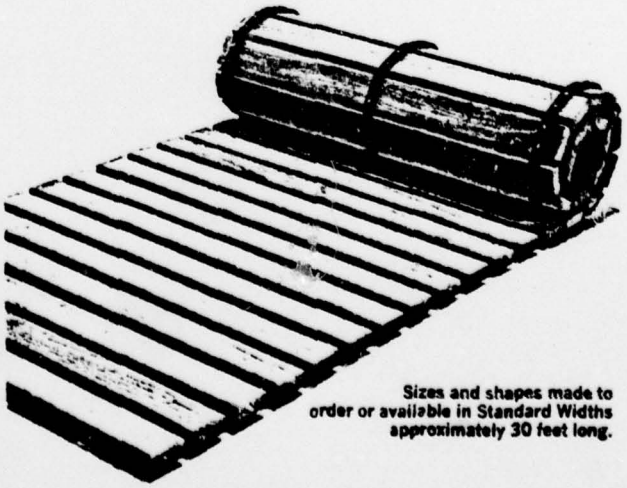
MANAGEMENT LIKES THEM because they increase efficiency by reducing fatigue.

JANITORS LIKE THEM because they are easy to roll, easy to handle and easy to keep clean.

MAINTENANCE MEN LIKE THEM because they are easy to alter in size and shape if addition of new equipment or relocation of old equipment makes this necessary. They're easy to repair.

CONSTRUCTION FEATURES:

- Hardwood slats 3/4" x 1-7/8" are spaced 1/2" apart.
- Slats are mounted on tough, oil resistant synthetic rubber (Neoprene) runners with galvanized steel nails.
- Nails are recessed into groove in runner to protect floor surface.
- Mat thickness is 1-1/8".
- Weight: 3 lbs. per sq. ft.
- Recommended maximum mat length, 72".



Sizes and shapes made to order or available in Standard Widths approximately 30 feet long.

U. S. GOVERNMENT DOCUMENTS

U. S. Department of Agriculture:

1. Wood-Destroying Beetles in Buildings and Furniture, Leaflet No. 558, May 1972.

U. S. Department of the Army:

2. Technical Manual, Fire Prevention Manual, TM 5-812-1, Headquarters, Washington, D.C., 1 April 1977.

3. Technical Manual, Historic Preservation Administrative Procedures, TM 5-801-1, Headquarters, Washington, D.C., 1 November 1975.

U. S. Department of the Army Engineers District, Philadelphia, Corps of Engineers:

4. "Preliminary Case Study Report on Gruber Wagon Works, Pleasant Valley, Pennsylvania". May 1975.

5. "Inventory - Contents of Gruber Wagon Works". 1974. Unpublished manuscript.

6. Watson, John S., and Thomas, M. W., Jr. "Appraisal of the Gruber Wagon Works". 1973. Unpublished manuscript.

7. National Heritage Corporation (now John Milner Associates) and Keast and Hood Company, "As-built Construction Drawings for Relocation of Gruber Wagon Works", contract no. DACW 61-76B-0059. June 1977 (over original drawings dated October 1976).

8. National Heritage Corporation, "Construction Specifications for Relocation of Gruber Wagon Works", contract no. DACW 61-76B-0059. October 1976.

9. National Heritage Corporation, "Gruber Wagon Works Relocation Study", August 1974.

U. S. Government:

10. Public Law (PL 94-587), Water Resources Development Act of 1976, Section 129.

11. Public Law (PL 93-291), Archeological and Historic Preservation Act of 1974. Also known as the Moss-Bennett Act.

U. S. Department of the Interior, National Park Service:

12. Historic American Engineering Record. "Gruber Wagon Works Emergency Recording Project", 1974.

    a. Field Notes

    b. Record Photographs, Negative Numbers 30403 to 30617

    c. Measured Drawings, Gruber Wagon Works 1882, 1906, 1974.

13. Pennsylvania Historical and Museum Commission. "National Register of Historic Places Nomination, Gruber Wagon Works", May 9, 1972. Listed June 2, 1972.

14. American Association of State and Local History (AASLH) National Historic Landmark Nomination, "Gruber Wagon Works" by George R. Adams, June 1977. Designated December 22, 1977.

OTHER REFERENCES

Books:

15. Lieckfeld, G., A Practical Handbook on the Care and Management of Gas Engines, New York: Spon, 1896.

16. Mercer, Henry C., Ancient Carpenters' Tool. Forward by Charles F. Hummel. New York: Horizon Press, 1929, 1951, 1960, 1968, 1975 for the Berks County Historical Society, Doylestown, Pa.

17. National Slate Association, Slate Roofs, orig. published 1926, republished by Vermont Structural Slate Company, Inc., Fair Haven, Vermont, 05743, 1976.

18. Richards, John, A Treatise on the Construction and Operation of Woodworking Machines...New York and London: Spon, 1872.

19. Smith, H. R. Bradley, Blacksmiths' and Farriers' Tools at Shelburne Museum. A History of their Development from Forge to Foundry, Museum Pamphlet Series, Number 7. Shelburne, Vt.: The Shelburne Museum, Inc., 1966.

20. Stritmatter, Albert. Gas Engine Troubles and Remedies, Cincinnati: Gas Engine Publishing Co., 1903.

21. Wildung, Frank H., Woodworking Tools at the Shelburne Museum. Museum Pamphlet Series, No. 3. Shelburne, Vt.: The Shelburne Museum, 1957.

22. Woodbury, Robert S., Studies in the History of Machine Tools. Cambridge: MIT Press, 1972.

Thesis:

23. Kube, Paul A., A Study of the Gruber Wagon Works at Mt. Pleasant, Pennsylvania. Unpublished Masters Thesis, Millersville State College, Millersville, Pa., 1968.

24. Smith, Peter, The Industrial Archeology of the Wood Wheel Industry of America... Unpublished Doctoral Dissertation, George Washington University, Washington, DC, 1971.

Trade Catalogs:

25. Otto Gas Engine Works, (Trade Catalogs with Various Titles) Philadelphia, c. 1890, 1893, 1899, 1900, 1904, 1906.

26. Otto Gas Engine Works, Instruction Book for the "Otto" Gasoline Engine, Philadelphia, c. 1895, c. 1902.