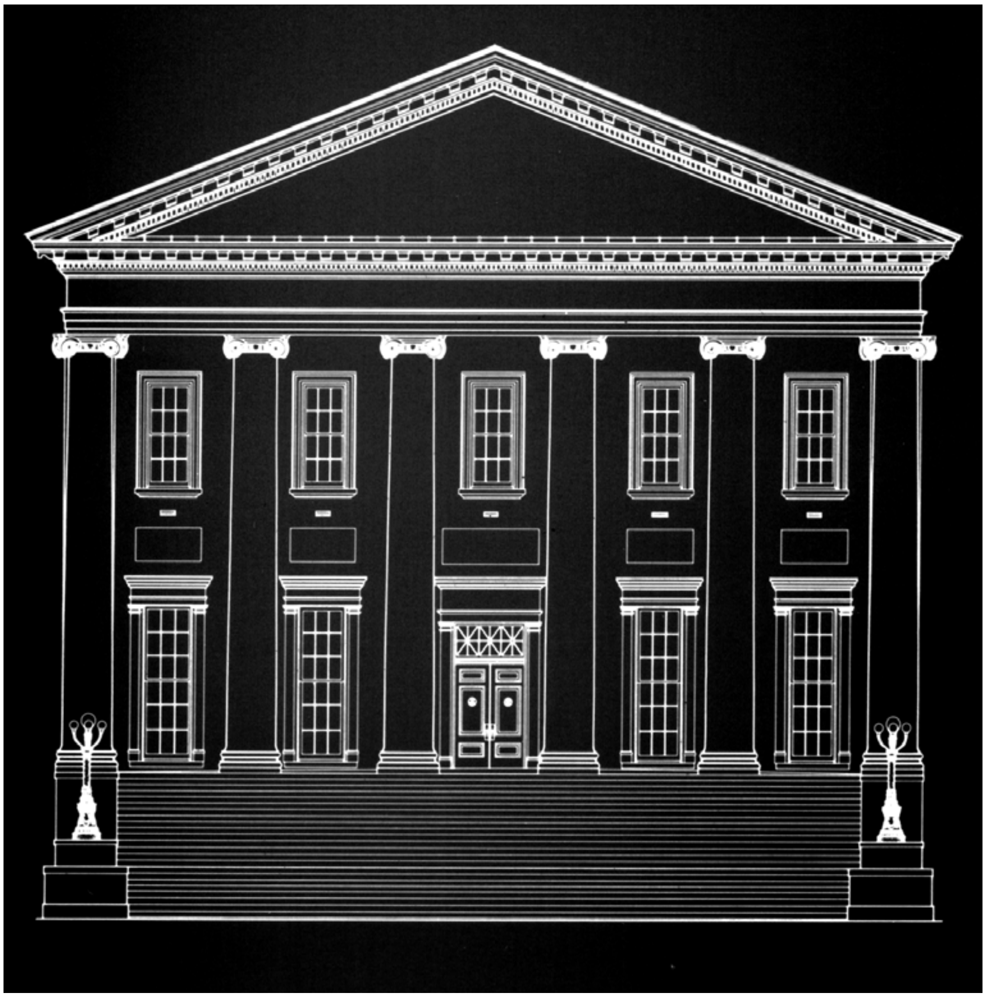
HABS GUIDELINE

RECORDING STRUCTURES AND SITES

with

HABS MEASURED DRAWINGS



U.S. Department of the Interior
National Park Service
Heritage Documentation Programs
Historic American Buildings Survey
1201 Eye Street, NW, 2270
Washington, DC 20005
(202) 354-2135
http://www.cr.nps.gov/habshaer

December 2005

HABS Guidelines

Recording Historic Structures and Sites with HABS Measured Drawings

Front Cover: Virginia State Capitol, Richmond, Richmond County, Virginia.

LEGISLATIVE AUTHORITY FOR HABS/HAER AND THE USE OF OTHER GUIDELINES

The legislative authority for HABS/HAER is the1935 Historic Sites Act (Public Law 74-292) and the 1966 National Historic Preservation Act (Public Law 89-665), as amended in 1980 (Public Law 96-515).

These guidelines should be used in conjunction with:

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- *HABS Historical Reports*
- *Historic American Engineering Record Field Instructions (1981)*
- *Transmitting HABS/HAER Documentation*
- *HABS/HAER Photography: Specifications and Guidelines*

HABS Guidelines: Recording Structures and Sites with HABS Measured Drawings was written by Joseph D. Balachowski, Architect, Historic American Buildings Survey (HABS) with advice and assistance from architects in private practice, professors of architecture, and the staff at the Historic American Buildings Survey/Historic American Engineering Record, National Park Service, U.S. Department of the Interior.

Washington, D.C., October, 1994. March 2001.

Appendix G: HABS/HAER Guidelines: Recording Structures and Sites with HABS Measured Using Computer-Aided Drafting was written by Mark Schara, HABS Architect.

Washington, D.C., August 2001.

 HABS Guidelines: Recording Structures and Sites with HABS Measured Drawings was made accessible on the Internet by Robert R. Arzola, HABS Architect.

March 2000 in .HTML format
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HISTORIC AMERICAN BUILDINGS SURVEY

America's historic structures and sites are vigorous evidence of our cultural past. They reflect the resourcefulness of the earliest pioneers, the high-style tastes of more affluent generations, the less formal vernacular constructions, and the technological advances that engendered the modern urban skylines of today. To comprehend what these structures reveal of the past, and to place that knowledge in the perspective of architectural evolution, it is necessary to document these historic buildings comprehensively--those safely preserved as well as those threatened by neglect, natural disasters and development.

The Historic American Buildings Survey was established in 1933 as a program within the National Park Service; this was the first major step by the Federal government to establish a comprehensive program to record America's historic buildings.

Under a 1934 agreement among the National Park Service, the Library of Congress and the American Institute of Architects, the NPS administers HABS with congressionally appropriated funds supplemented by donations from individuals, foundations, historical organizations, state and local governments, and other Federal agencies. The National Park Service is responsible for setting qualitative standards, and organizing, staffing and selecting recording projects. HABS staff directs the preparation and editing of records, and transmits them to the Prints and Photographs Division of the Library of Congress. The Library preserves the records, makes them available for study and publication, and supplies reproductions to the public upon request. The American Institute of Architects provides professional counsel through its national membership. In 1969, the Historic American Engineering Record (HAER) was established as a companion program to HABS, to document structures representing technological and engineering significance.

Since the 1950s, HABS summer teams have consisted of university students and graduates in the fields of architecture, landscape architecture, engineering, architectural history and related disciplines, working under professional supervision. Since 1984, HABS has cosponsored foreign interns through the International Council on Monuments and Sites (ICOMOS). This effort has brought architects and historians from many foreign countries to work on summer recording projects.

In addition to providing invaluable HABS records, fieldwork offers the next generation of architects and historians an opportunity to study our architectural and cultural heritage. HABS works closely with groups and institutions actively engaged in preserving and recording their local and regional architectural resources. Priority is given to structures and sites administered by the National Park Service, to nationally significant structures--including National Historic Landmarks--and to threatened historic structures.

PREFACE

HABS Guidelines: Recording Structures and Sites with HABS Measured Drawings replaces *Field Instructions for Measured Drawings*, HABS, 1980-82. It is intended to be a comprehensive guide for producing existing-condition measured drawings of buildings and other structures, as well as natural and man-made sites in the realm of landscape architecture. This manual will guide documentation teams through an intensive process that will culminate in a set of graphic documents produced to standards of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Division of the National Park Service, United States Department of the Interior. Recorders wishing to submit their documentation to HABS for transmittal to the Library of Congress are especially encouraged to follow the procedures outlined here.

In addition to measured drawings, large-format photography (4" x 5" or 5" x 7" negative) and written historical reports complete the typical HABS documentation package. Photography captures detail, textures and many other types of views either too time-consuming or impossible to draw accurately. Photography also provides information on current furnishings, visual context for the drawings and histories, as well as a sense of massing through perspective views with greatly reduced distortion.

Historical reports take the form of general overview reports or individual building histories. Overview reports investigate the broader architectural context of the structure or site, and focus on historical background or architectural trends. Individual histories explore all relevant historical and architectural facets of single structures.

After the field work has been completed, all field notes and completed documentation are brought to the Washington office for editing, reproduction, and finally, transmittal to the Prints and Photographs Division of the Library of Congress. There it is archivally stored with an anticipated shelf-life of five hundred years. The documentation is copyright-free, and reproductions are available from the Library of Congress.

The techniques described in this handbook have been developed and refined since the establishment of HABS in 1933. Some are labor-intensive, even old-fashioned, while others take advantage of the latest photographic and surveying technology. Because this handbook cannot address every conceivable measuring problem, recorders are encouraged to use their ingenuity, as well as their knowledge of mathematics and surveying in solving these problems.

HABS Guidelines: Recording Structures and Sites with HABS Measured Drawings may also be used by private firms producing documentation for any number of purposes. Contractors producing mitigative documentation in conjunction with regional offices of the National Park Service should confirm specific documentation and submission requirements with the relevant agencies in addition to using this publication as a technical guide. Teams entering documentation in competitions such as the Charles E. Peterson Prize should follow contest rules; final editing should take place before submission.

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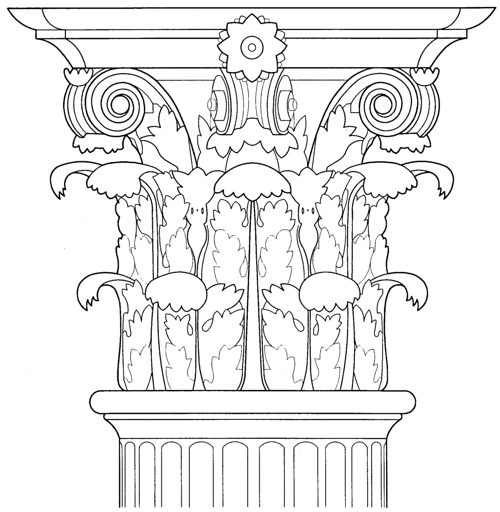

HABS

SECTION 1.0
PROJECT PREPARATION

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1.0.0 PROJECT PREPARATION

1.1.0 PROJECT PLANNING

1.1.1 The primary objective of project planning is to determine the scope of work, and the number of personnel, kinds of equipment, and financial resources required to complete the job. First, buildings and sites must be evaluated in terms of size and complexity.

1) From written or graphic documents, or by pacing off or measuring, determine the overall dimensions of the structure;

2) Determine sheet sizes. For drawings at 1/4" scale, multiply the dimension in feet by 0.25 to determine the drawing size in inches, for example, a building 50' in length will be drawn 12-1/2" long (50 x 0.25 = 12.5). To draw at 1/8" scale, multiply by 0.125, (50 x .125 = 6-1/4"); to draw at 1/16" scale, multiply by 0.0625 (50 x 0.0625 = 3-1/8").

3) For sites to be drawn at engineering scales, information should be gathered from previous surveys and descriptions, as well as paced off or measured in a preliminary fashion.

1.1.2 The number, size and complexity of the anticipated images will determine the number of architects required. HABS estimates that one architect should be able to completely ink three relatively complex to five relatively simple 24" x 36" sheets, working 40 hours per week, in twelve weeks. This estimate includes time spent working with teammates obtaining measurements for the entire set of drawings.

1.1.3 An early concern of project planners is the need for special equipment such as electronic surveying devices, cherry pickers and scaffolding which are expensive and must be arranged for far in advance of the project. Other expenses will include measuring and drafting supplies, as well as film and reproduction costs for drawings, photography and written reports.
For projects undertaken by HABS, the entire scope of work, including selection of images and personnel, and the budget, is determined in the Washington office and defined in a Memorandum of Agreement with the project sponsor.

1.2.0 BUDGETING TIME

1.2.1 Recording time is divided into three phases: measuring, drawing in pencil, and inking. Project supervisors should monitor the progress of their teams, and be especially mindful that accurate measuring and the frequent checking of pencil drawings will ensure that the ink drawings require minimal changes.

1.3.0 PROJECT SAFETY

1.3.1 Old structures can present a number of safety hazards which must be identified and assessed before measuring begins. At national parks, as well as other public and commercial sites, a safety officer should be consulted for information on potential hazards. Hazardous conditions can be broadly categorized as those due to:

> 1) Design, construction or site characteristics: steep and slippery roofs; steeples, towers and similar structures with limited or absent built-in access; ceiling areas in churches, barns, auditoriums, etc.; attics, basements and crawl spaces with protruding nails, live pipes and wires, and mechanical equipment; old wells, cisterns, tunnels and excavations; electrified fences; the presence of unpredictable animals such as livestock and guard dogs; climatic conditions such as extreme heat, humidity, cold, wind, rough seas; the presence of poisonous and thorny vegetation;
>
> 2) damage resulting from abandonment, neglect, accidents, vandalism and aging: rotted floors and ceilings; unstable walls; glass and metal shards; toxic materials; animal droppings; infestation by bats, poisonous insects, spiders, scorpions or reptiles;
>
> 3) social, communication problems: high-crime areas, both urban and rural, potential presence of individuals known to be hostile to the Federal Government.

1.3.2 Safety precautions

> 1) Always apprize owners/managers of your intentions, schedule site visits and full team walk-throughs well in advance of the commencement of the project; obtain written permission for legal and insurance purposes;
>
> 2) always wear clothing appropriate to the site and environmental conditions; sturdy boots and jeans are always highly recommended;
>
> 3) do not rely on team-mates' physical strength for support or attachment, but use ropes and harnesses;
>
> 4) use flashlights, hard hats, face masks, goggles, ear protection, and any other devices deemed necessary;
>
> 5) whenever possible, use ladders, scaffolding and cherry pickers;
>
> 6) avoid highly unstable building elements;

7) avoid areas where the risk of harassment or assault is high;

8) always schedule site visits with another team member; if this is not possible, be certain that your team mates know of your whereabouts.

1.4.0 MEASURING, SURVEYING AND DRAFTING EQUIPMENT

1.4.1 The following materials and equipment are commonly used at HABS documentation projects:

- transit and/or Electronic Distance Measuring Device (EDM) for site survey and horizontal datum lines

- chalk line (blue powder only!), string level for marking horizontal datum lines

- drafting tape on which to mark datum points on structures and objects where use of a chalk line is prohibited

- tape measures from 6 to 300 feet (preferably metal)

- carpenter's square

- carpenter's level

- extendable measuring pole

- plumb bob to check columns and walls

- profile comb to describe full-size profiles of moldings and other difficult to measure ornamentation

- calipers for measuring diameters of objects circular in plan/section, such as balusters

- string

- stakes, nails, hammer

- flashlight

- rods marked at 12" intervals for use in supplemental photography

- wall calipers to measure wall thicknesses

To ensure accuracy and consistency throughout the measuring process, steel rather than cloth tape measures should be used--preferably of the same brand.

1.4.2 Equipment and materials for field notes and preliminary drawings

- graph paper for field notes

- clip boards or other convenient boards for sketching in the field

- vellum or drafting film for preliminary drawings; trace is not acceptable

- parallel rule, with brake if possible

- triangles, French curves, templates

- 2H or harder leads, lead pointer, colored pens

- vinyl eraser ("white soap eraser"), brush

- architect and engineer scales, preferably of one brand, otherwise check for consistency

- flexible curve or ship's curve

- plastic lead is not recommended. Frequent pointing of leads while drawing enhances accuracy.

1.4.3 Equipment for ink drawings

- HABS drafting film

  34" x 44" / Arch E (drawing surface = 31 - 5/8" x 39 - 7/8")
  24" x 36" / Arch D (drawing surface = 21 - 3/4" x 31 - 3/4")
  19" x 24" (drawing surface = 15 - 3/4" x 20")

- technical inking pens

  .13 mm - .8 mm (6 x 0 - 3)

- black ink for matt drafting film, non-etching, reproducible (Diazo), "Pelikan FT" or similar

- mechanical lettering set with 240, 200, 175, 140, 120, 80 template sizes

- triangles and templates with inking edges or raising bumps

- chamois or tissue

- trace for masking completed areas

- vinyl eraser (use electric erasers with great care!)

- erasing shield

- cleaning fluids or alcohol for technical pens and drafting film.

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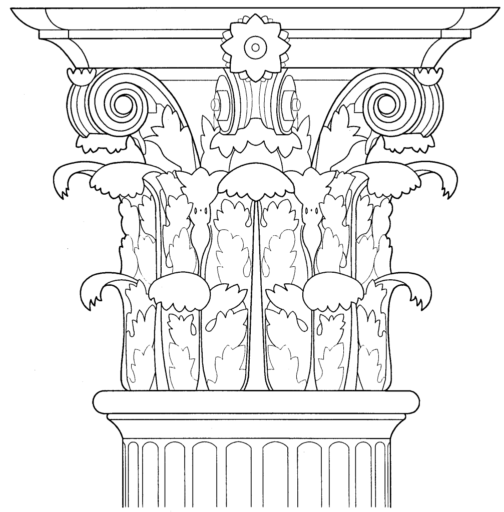

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SECTION 2.0
FIELD NOTES

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2.0.0 FIELD NOTES

2.1.0 Sketching and field-noting requirements
2.2.0 Supplementary information: 35 mm, field photography, historical research, photogrammetry

2.1.0 SKETCHING AND FIELD-NOTING REQUIREMENTS

2.1.1 The field sketches, dimensions and notes are produced on graph paper with 8 divisions per inch. Only one side of the graph paper may be used. Sketch with a 2H or similar lead to produce dark lines without smearing. Colored pens or pencils may be used to write the dimensions in a system that separates horizontal, vertical and diagonal measurements.

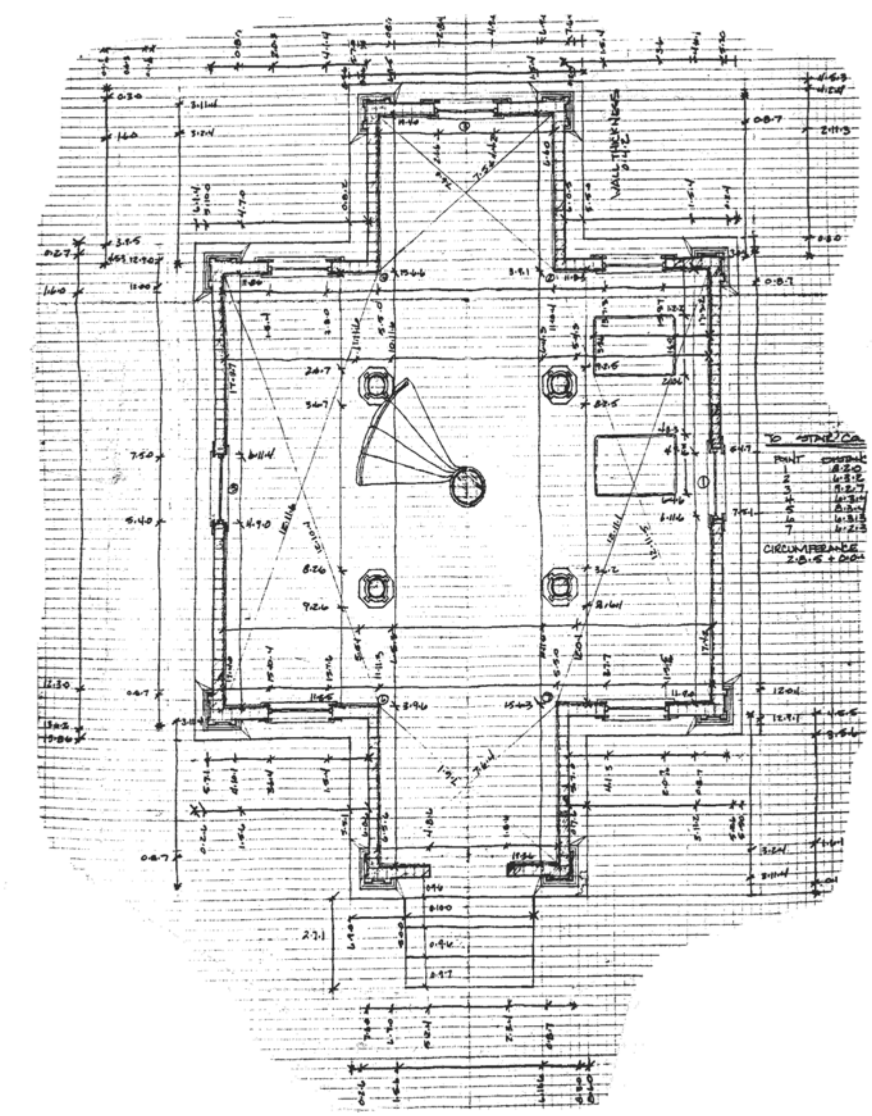

Figure: 2.1: Field sketch of ground level plan, Michigan Island Light, Apostle Islands National Lakeshore, Bayfield, Wisconsin.

2.1.2 Sketches quickly become covered with numbers, so making them readable for future restorers and researchers is essential (Figure 2.1). Complex elements should be simplified into a systematic collection of detail sketches, so that windows, doors, moldings, etc., are recorded separately from their placement on the structure and the structure's overall dimensions.

2.1.3 It is important to make the field note sketches large enough to accommodate dimensions and other notes neatly. Graph paper grids are useful in developing proportional sketches. Only the hard edges of structures and objects are shown; textures, shading and plants are not.

2.1.4 Three-dimensional sketches can be used to clarify overall massing, and for locating detail elements--which must be keyed to two-dimensional field notes. Objects and surfaces which project from the plane of the main drawing at an angle--such as the sides of a bay window--are best drawn separately as elevations.

2.1.5 The location and configuration of an unusual material such as bark siding or a repair patch of a different material should be called out with a note. This is preferable to drawing the material.

2.1.6 Field sketches may be hard lined, but time constraints will usually mandate freehand drawing. Further suggestions for producing readable field sketches can be found in the paragraphs on measuring plans, elevations, sections, details and landscapes.

2.1.7 Sheets must be labeled with the project name, structure, drawing name, delineator, date, and HABS number if known, and placed in the field notebook cover provided.

2.2.0 SUPPLEMENTARY INFORMATION: 35 MM, FIELD PHOTOGRAPHY, HISTORICAL RESEARCH, PHOTOGRAMMETRY

2.2.1 35 mm or digital field photography is an invaluable tool in producing and refining measured drawings, when it is undertaken in a timely manner, with very specific subjects. Because it cannot approach large-format (4" x 5" or larger) photography in image quality, it is not used for comprehensive documentation to HABS standards. This includes: stone, adobe, plaster and similar textures; wrought iron, tile patterns, stained glass and other ornamentation; cracking, weathering and other types of damage. Photographs may be used for tracing highly irregular ornamentation, or for reference in reproducing textures.

2.2.2 Hints for successful photography:

1) shoot and process the film early in the project;

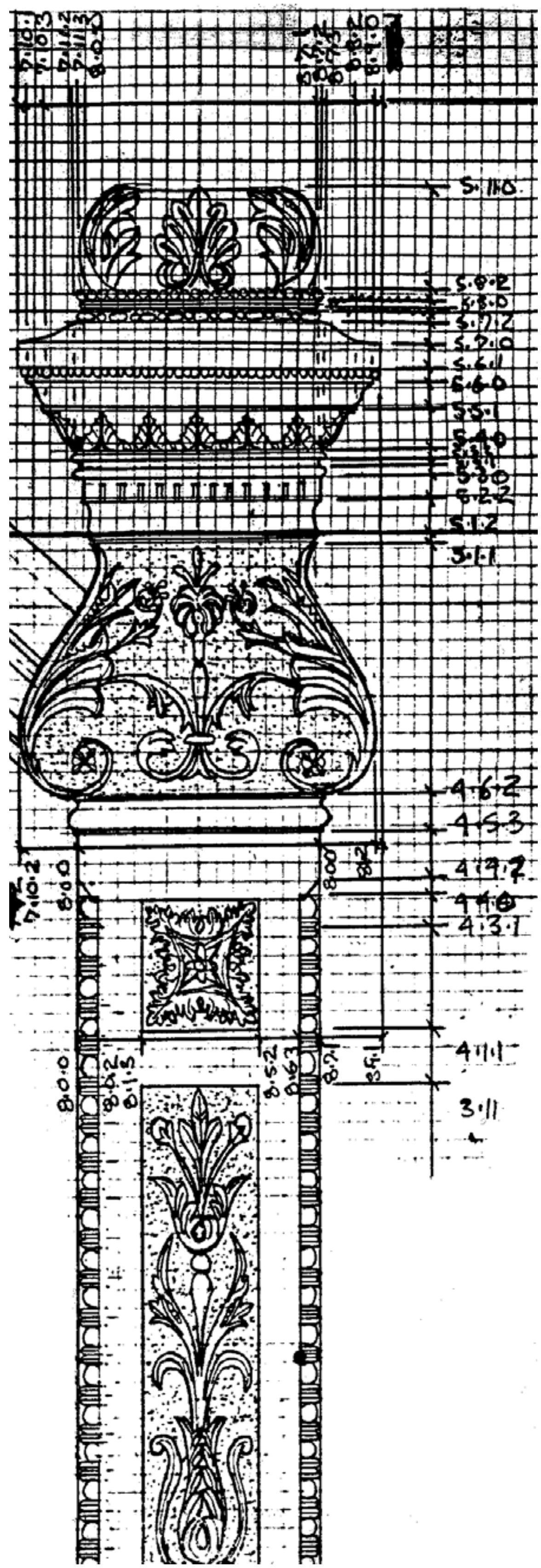

Figure 2.2: Newel Postfield sketch. George W. Eckhart House Wheeling, WV

2) use 100 ASA film outdoors, 400 ASA indoors;

3) bracket exposures: for important shots, change exposure by 1/2 f-stop on either side of light meter reading;

4) use a tripod and cable release, especially on close-ups in dim light;

5) hold camera parallel to image plane of the subject;

6) use 50 mm or longer lenses to minimize distortion;

7) use slides to record documentation process.

8) A perspective correcting lens is helpful, but not essential.

2.2.3 Use a measuring rod with 12" interval markings in the major plane of the photographic image to assist in determining the scale of the object. This recording technique is not a substitute for standard field-noting techniques.

2.2.4 For more information on the photographic recording of historic structures, refer to the appropriate works listed in the Bibliography.

2.2.5 The value of measured drawings is greatly enhanced by adding notes derived from sources such as team historians or other human resources. They can often provide information on architectural and historical significance; construction history and methods; origins of materials; and the relationship of the site to local commercial and industrial activities. This type of information should be sought out as early in the project as possible.

2.2.6 In recent years, the ability to accurately record structures has been enhanced through photogrammetry. Photogrammetry is the use of specialized cameras which either use stereo views or electronic technology to produce images which are virtually undistorted and dimensionally exact. In some instances, the images can be translated through computer aided drafting (CAD) software into drawings plotted in the same fashion as construction drawings. This technology is most appropriate for the documentation of large, complex details, identical repetitive elements, and large "organic" structures such as pre-historic ruins. The Bibliography contains references on this subject.

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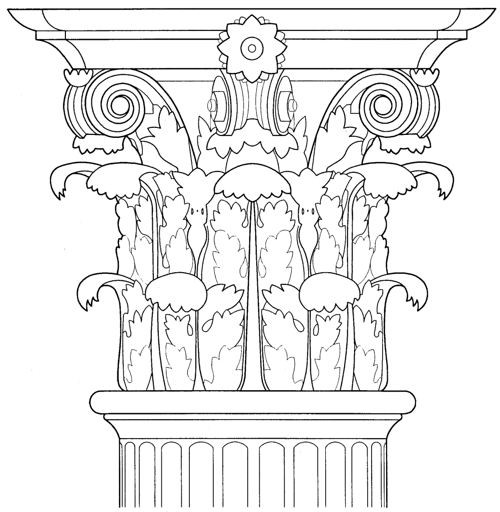

SECTION 3.0
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3.0.0 MEASURING STRUCTURES

3.1.0 Sketching and measuring plans
3.2.0 Sketching and measuring elevations
3.3.0 Sketching and measuring sections
3.4.0 Sketching and measuring details
3.5.0 Sketching and measuring roofs

3.1.0 SKETCHING AND MEASURING PLANS

3.1.1 A plan is a horizontal slice through one level of a structure, generally cut at waist height or 3' - 4' from the floor, through openings such as doors and windows (Figure 3.1).

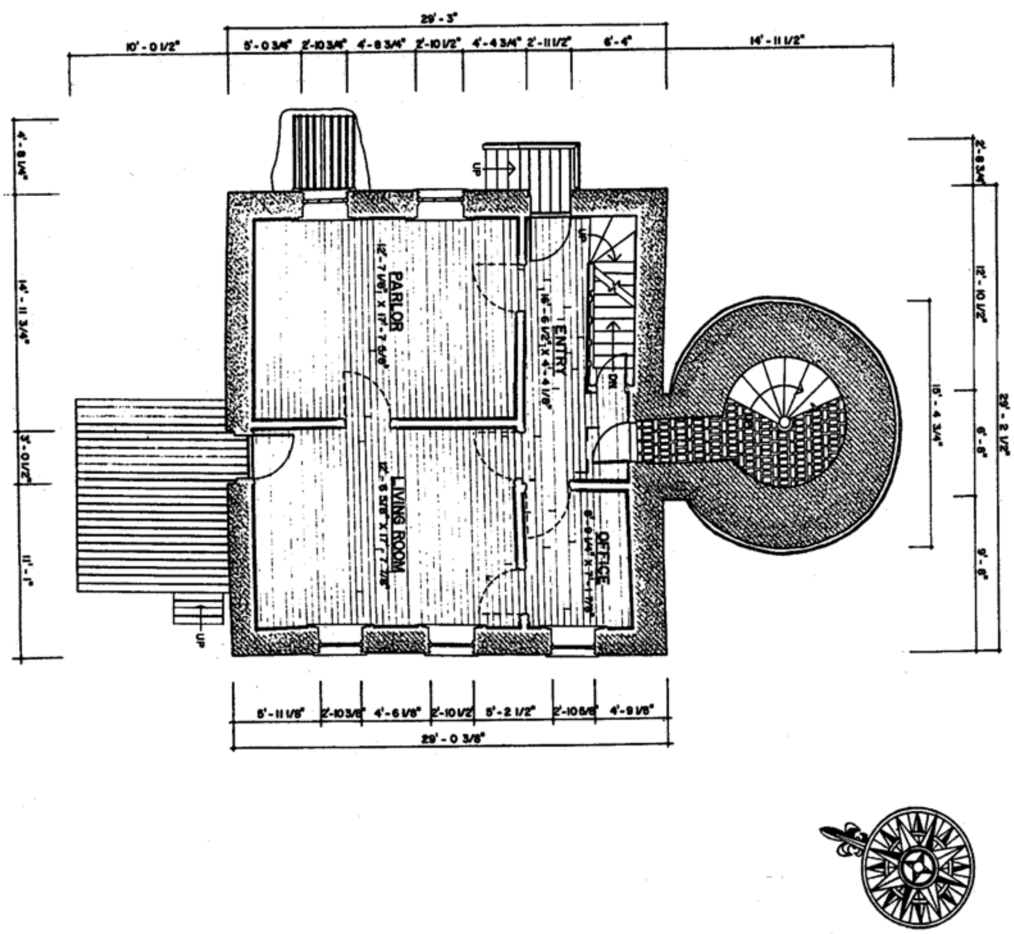


Figure 3.1: Measured drawing of the first floor plan. Rock Harbor Lighthouse, Isle Royal National Park, Michigan.

3.1.2 The interior of the plan drawing shows flooring materials (floor boards, tile patterns, concrete, stone or dirt); moldings; door and window frames; door swings; and structural materials denoted by various poché techniques. Dashed lines are used to indicate elements above the cut line, such as mantels, arches or stairs.

3.1.3 The exterior of the plan drawing shows roof lines above and porch or skirt roofs of the floor immediately below, basement window wells, paving stones immediately adjacent to the structure, and portions of walkways away from the structure.

3.1.4 Most measurements are taken from conveniently located 0 points and are read as "running" rather than "incremental" dimensions. For ease in notation, dimensions may be written as 3.10.1, 6.1.3, instead of 3'-10 1/4", 6'-1 3/4", etc. If greater accuracy is required by an object to be drawn at a larger scale, one may write either 1'-3 13/16" or 1.3.13, so long as consistency is maintained.

3.1.5 The establishment of reference lines and points is crucial to accurately measuring the exterior of a structure, which, due to variations in wall conditions may vary from interiors. There are several methods of placing a building within a "reference polygon". Figure 3.2 shows that the reference polygon need not have parallel or perpendicular sides, nor must any of the sides be parallel to any side of the target structure.

Method 1:

1) Lay out sides AD, A'ABB', D'DCC' and BC with stakes and strings, making sure that a) the stakes at points A, B, C and D do not cause the strings A'B and D'C' to bend, and that b) the strings are level;

2) determine the precise lengths of all strings;

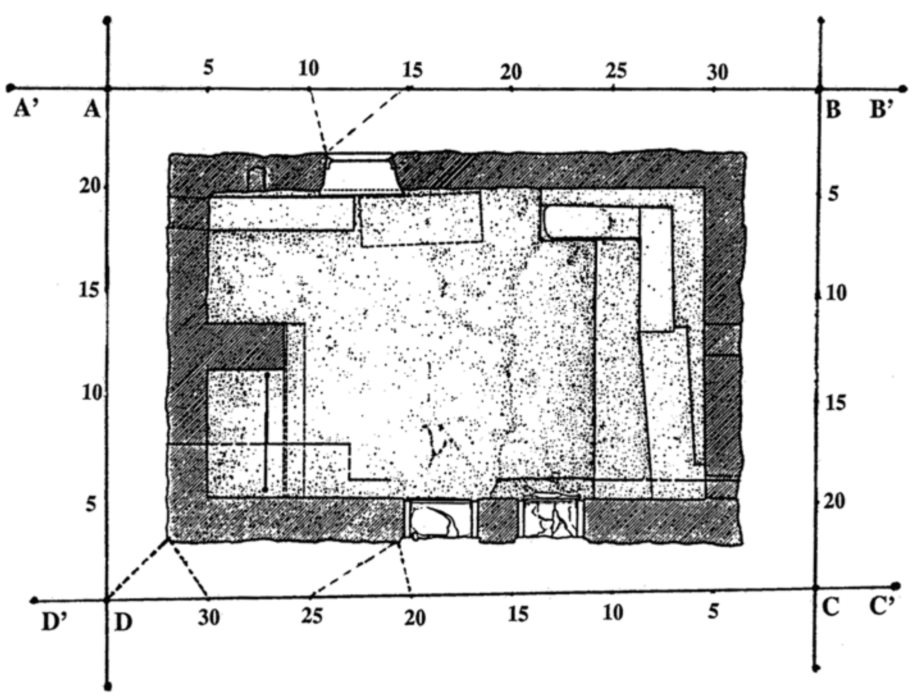


Figure 3.2: Establishment of a reference box and triangulation points. Measured drawing of the Spring House, Mumma Farm, Antietam National Battlefield, Sharpsburg, Maryland.

3) triangulate distances A'D, AD', B'C and BC'. All four sides are now located relative to each other without having measured the angles at A, B, C or D;

4) divide sides AB, BC, CD and DA into convenient increments from which to triangulate points on the structure.

Method 2:

1) To lay out box ABCD (Figure 3.3), first set up a transit several feet away from one corner at A such that two sides of the structure can be seen. Sight to a point B' beyond the end of one side and mark its location with a stake and nail.

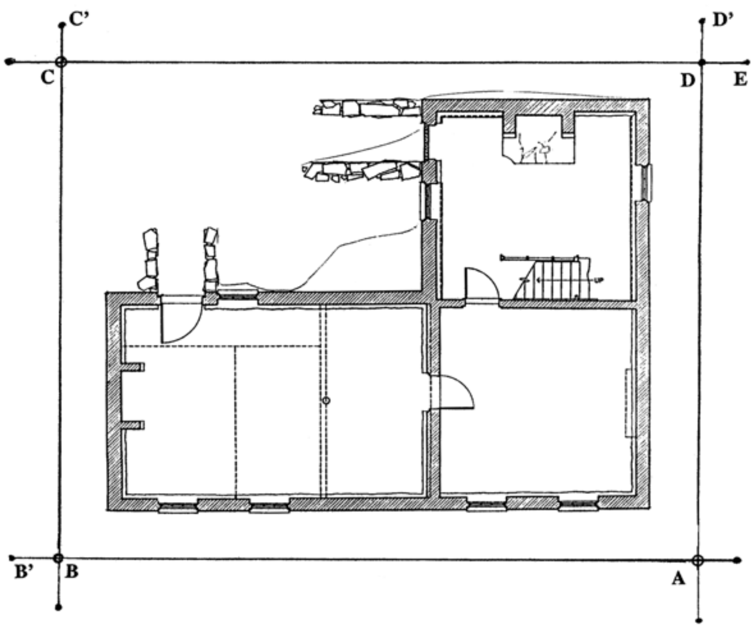


Figure 3.3: Establishing a perfectly rectangular reference box with a transit. Measured drawing of Clifton Farm House, Monocacy National Battlefield, Frederick, Maryland.

2) Swing the transit exactly 90º, sight to a point D' and mark its location with a stake and nail. Connect points D', A and B' with string.

3) Using a plumb bob suspended below the center of the transit, center it at point B, preferably at a distance from A which is a multiple of 5 or 10 feet. Sight back to A, note the bearing, then swing 90º, sight to C' and mark it with a stake and nail.

4) Repeat the procedure at C, sighting back to B, then swinging 90º to establish E and D--at the crossing of A-D' and C-E.

5) Divide each side of box ABCD into convenient increments using tape with pen marks on the string. Each corner and all other plan features can now be located from nearby pairs of points on the box.

3.1.6 It is sometimes useful to construct x and y coordinate axes for use as datum lines. First, perpendicular lines must be constructed. The "x-y coordinates" method can be used to locate one or more structures in plan and relative to each other, reference interiors to exteriors, and measure interiors. To construct perpendicular reference lines at a site, if a transit is not available (Figure 3.4):

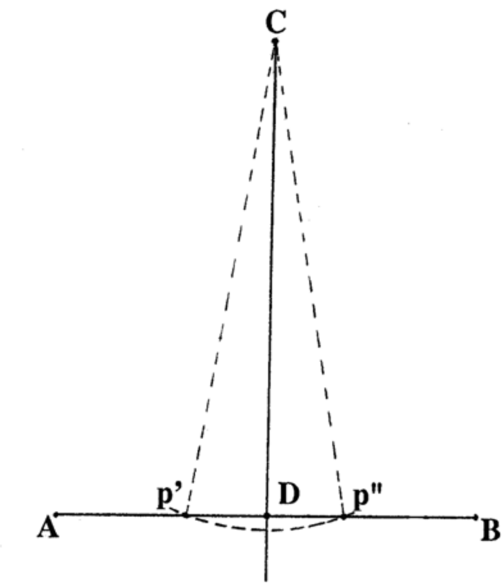


Figure 3.4: Constructing perpendicular datum lines.

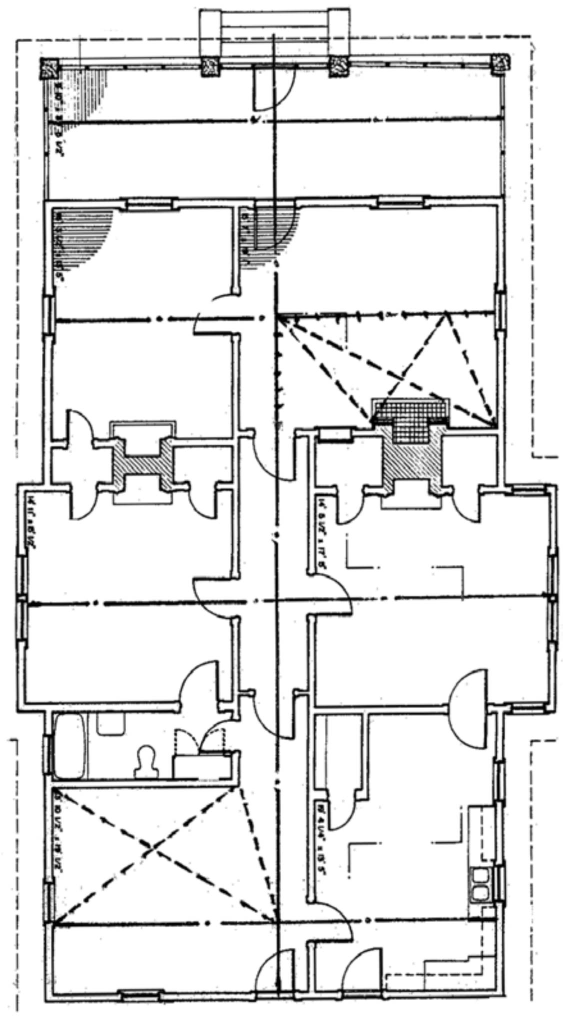


Figure 3.5: Interior perpendicular datum lines. Jimmy Carter Boyhood Home, Jimmy Carter National Historic Site, Plains, Georgia.

1) Lay out a line AB with stakes and/or nails, and string, checking it for horizontality with a string level;

2) choose a point C, secure a steel tape measure to a stake, unroll it to a point beyond AB;

3) using the tape measure as a compass, swing an arc through two points on AB, marking the intersections p' and p" precisely with pen marks on tape;

4) point D is half way between p' and p", and CD is perpendicular to AB.

3.1.7 Structures and site features with sharp corners and edges can be located relative to the reference lines constructed in 3.1.6. Distances along the perpendiculars are measured, and if necessary, verified through triangulation. If a transit is used inside a structure to define datum lines, the lines--after being set up with string--can also be used as a basis for section measurements.

3.1.8 Large interior and exterior spaces can be measured with a transit or theodolite/EDM (Figure 3.7). In this case, each point (A1..A13, etc.) was surveyed from at least one major survey station (A, B, B2, etc.); major changes in wall direction were surveyed from two stations. Angles and distances were recorded systematically by station.

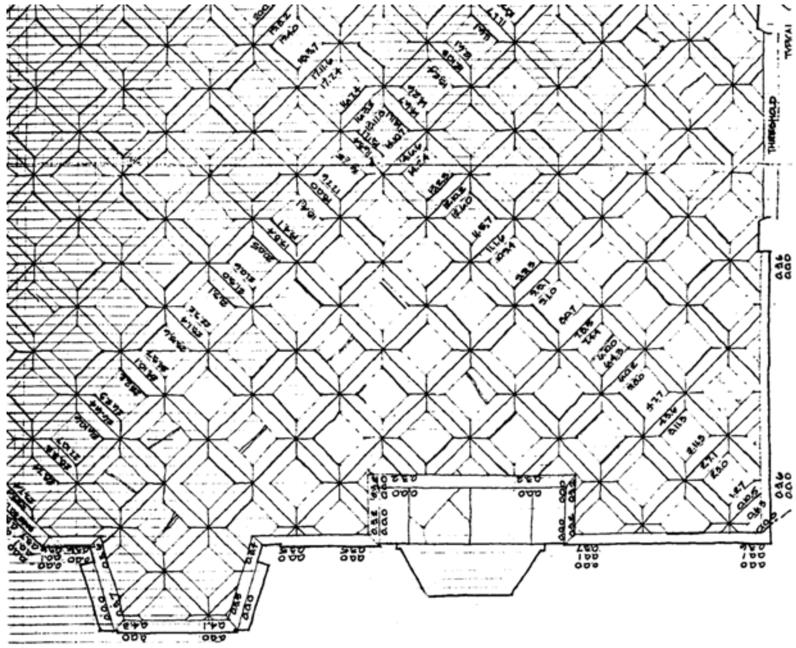


Figure 3.6: Measuring a complex floor pattern. Field sketch of the Parlor, Monticello, Charlottesville, Virginia.

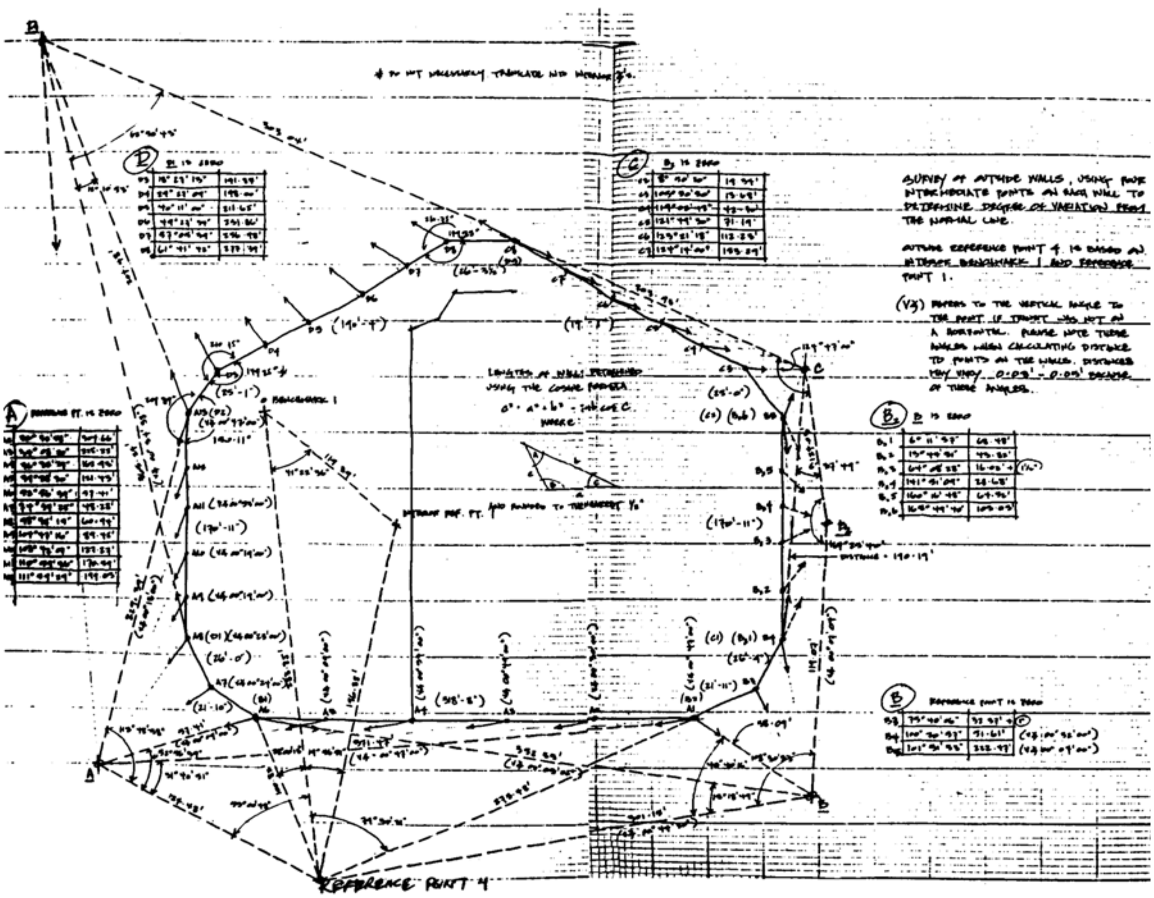


Figure 3.7: Use of a theodolite/EDM to find distances and angles. Site survey, Fort Sumter National Monument, Sullivan's Island, South Carolina.

3.1.9 In addition to measuring rooms individually, as many overall dimensions as possible should be taken. A run through several connected spaces can include wall thicknesses, partition-wall locations and stairs; a separate run should be made for floor boards. When construction materials differ from wall to wall, or if other irregularities are suspected, wall thicknesses should be measured through as many openings as necessary.

3.1.10 Individual rooms must be measured around their perimeters to locate openings, mantels and other elements. Tiles, inlays and other regular flooring materials may be sized and counted, but irregular floorboards--such as those often found in barns and older houses--must be measured in runs across the entire space. Where individual floorboards vary in width, or are not laid parallel to the walls, a number of dimension runs must be taken.

3.1.11 Because of construction material deterioration, settling, wind damage, and other reasons, historic structures are rarely "square"; a building or room perceived to be rectangular in plan may in fact have two acute (< 90º) and two obtuse (> 90º) angles as corners. Diagonal measurements taken at plan height will reveal the true configuration of the space. In large open plans with columns it may be more practical to determine the squareness of each bay, since intervening columns and tape sag over a long distance will make corner-to-corner measurements impossible.
Diagonals are also useful in locating fireplaces, built-in furniture, and other features.

3.1.12 Stair treads in good condition should be spot checked for regularity, otherwise each tread must be measured individually, keeping in mind that the edge of the nose, not the face of the riser will be seen in plan. The center post and top and bottom rungs of circular stairs should be located relative to known points in the space.

3.1.13 Reflected ceilings are located relative to floor plans by dropping a plumb bob at the corners to the floor. A tape measure can then be tacked or held at one end, stretched across the ceiling and read from below. These measurements will also be used to construct section drawings. If possible, diagonal measurements should also be taken.

3.1.14 Unless it can be demonstrated that appliances such as stoves, furnaces and bathroom fixtures have historical or other contextual significance, they should be drawn schematically, rather than in detail.

3.1.15 New partition walls, counters and building additions should be measured and drawn as they exist; notes will call out materials and dates on the final drawings. Evidence of elements no longer extant, such as "paint shadows" or missing trim should be recorded. Consultation with project historians and others knowledgeable about the structure will determine if missing elements are to be noted on the drawings.

3.1.16 The failure of floor plans to "line up" is often a symptom of buildings changing shape due to various types of structural distortion. Suspending a plumb bob from the top of a wall may show the wall to be leaning several degrees from vertical, causing floors to move horizontally relative to each other.

3.1.17 Recording circular, elliptical, polygonal and irregular spaces.

In Figure 3.8:

1) Locate and triangulate known points such as door frames A, B, C, D;

2) from A and B, locate e, f, g, h, etc., and from C and D locate i, j, k, l, m, etc.;

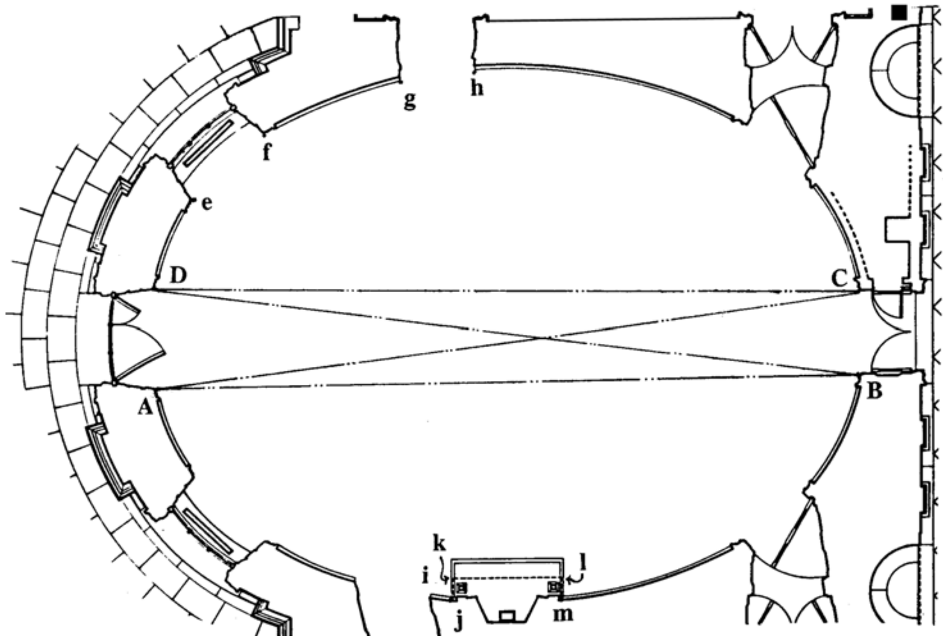


Figure 3.8: Beginning triangulation of an elliptical space. Blue Room, The White House, Washington, DC.

In Figure 3.9:

1) locate reference points at W, X, Y, and Z;

2) plot curves by triangulating tile locations a, b, c, etc.

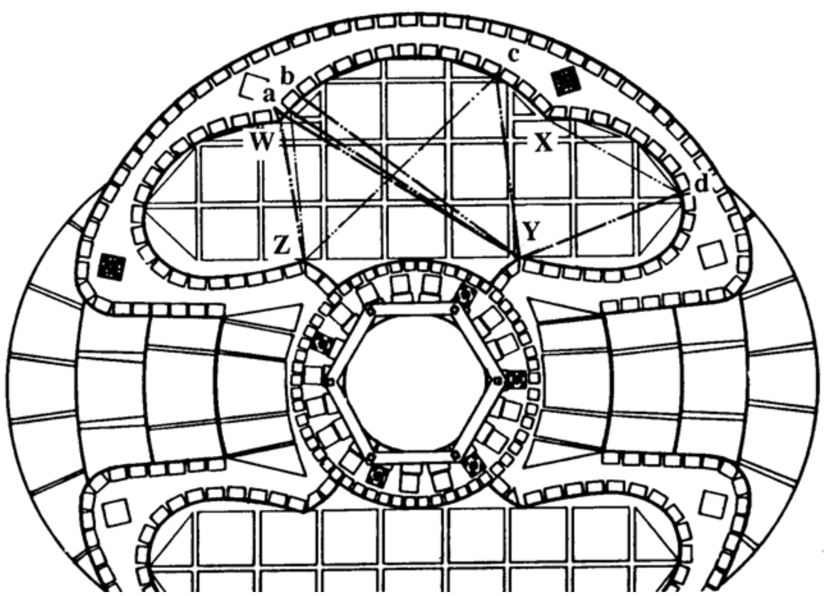


Figure 3.9: Plotting irregular curves. Wishing Well, Scotty's Castle, Death Valley National Monument, California.

A second method is to lay a sufficient number of straight datum lines (strings or measuring tapes) on the floor (AB, AF, CD in Figure 3.10). Locate the end points relative to nearby known points. In this case, measure to each mortar joint at right angles to the tape measure. Connecting the points will produce a plot of the curve.

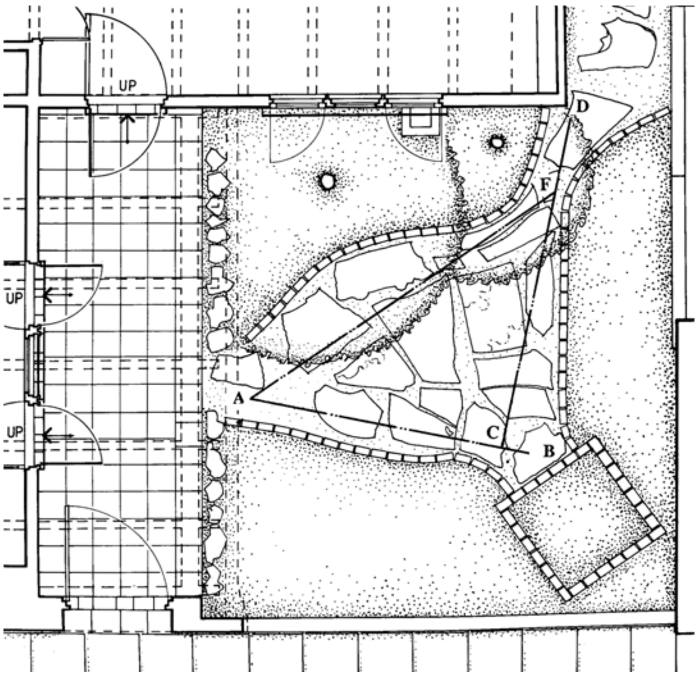


Figure 3.10: Plotting irregular curves from straight datums. Measured drawing of the Joers-Ketchum Rowhouse patio, Rancho Santa Fe, California.

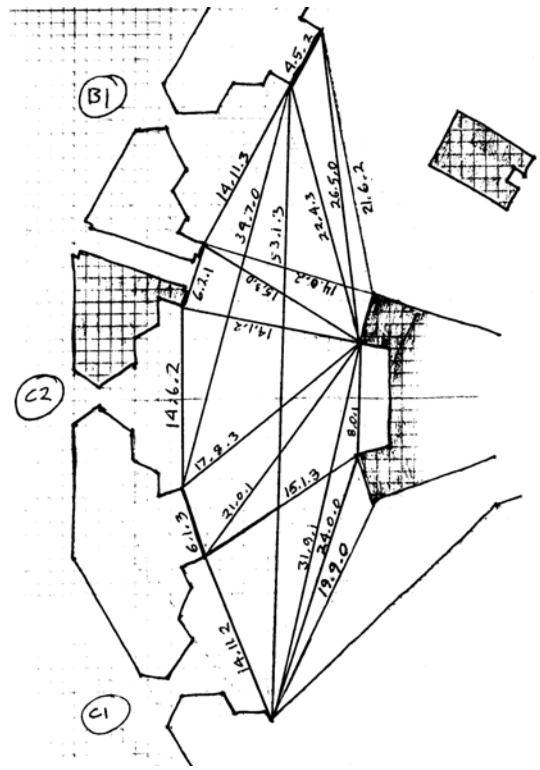


Figure 3.11: Triangulation in a highly irregular space. Field sketch of the left flank angle, Ft. Sumter National Monument, Sullivan's Island, South Carolina.

3.2.0 SKETCHING AND MEASURING ELEVATIONS

3.2.1 Elevations represent the planar surfaces of structures as ideally seen without the distortion of photography and natural vision. Field sketches show structures without planting, shades or shadows, glass, utility cables or screens. Gutters and other features that obscure the "essential" elevation are to be rendered separately as details.

3.2.2 Rather than delineate every brick course or row of siding or shingles, count the rows to window openings and other significant features, remembering that top rows of brick are often hidden behind gutters and roof overhangs. Decorative and structural elements, such as finials and column capitals, will appear curvilinear in perspective, but are in fact linear in elevation and must be drawn as such.

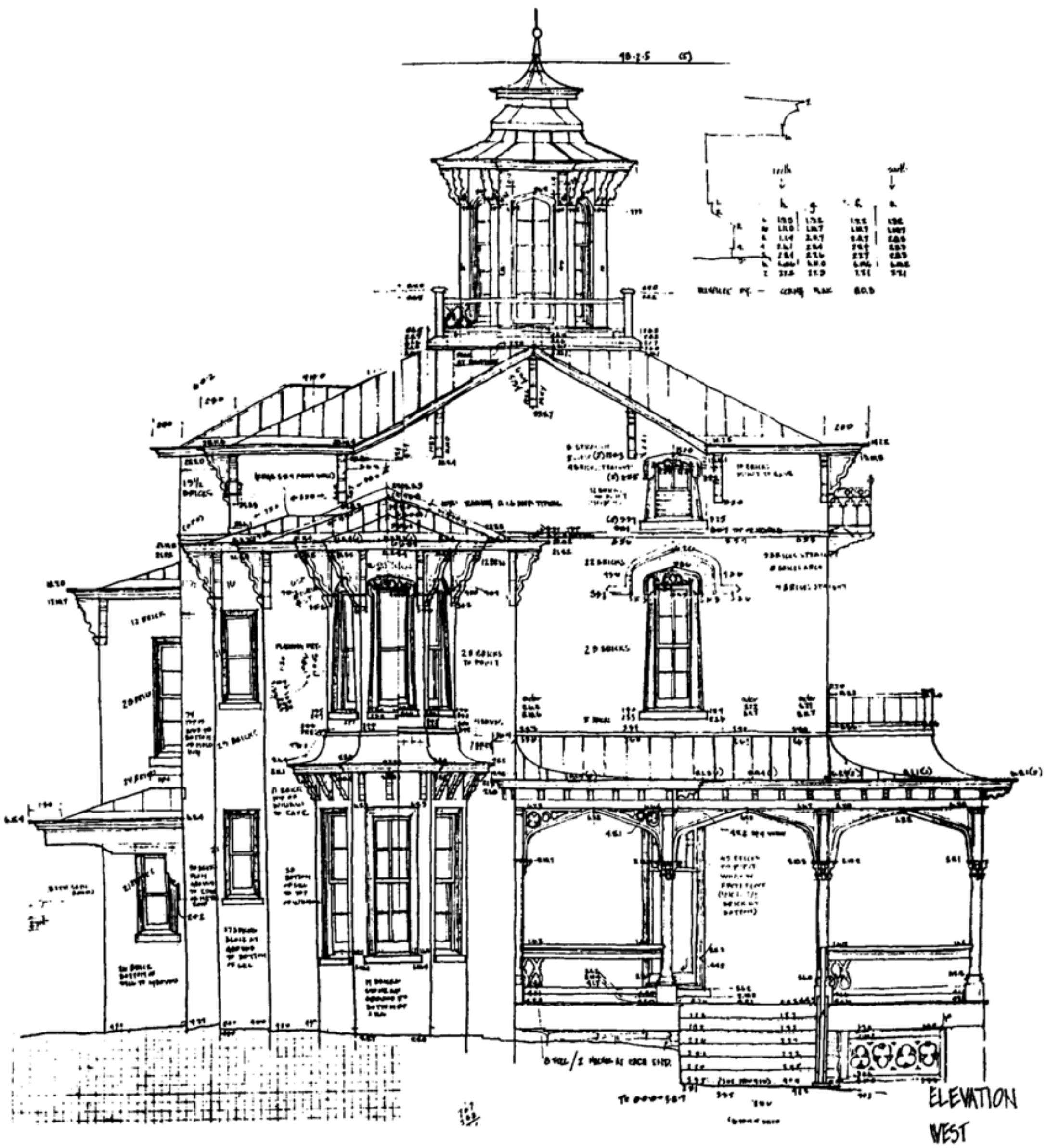


Figure 3.12: Field sketch of west elevation, Asa Packer Mansion, Jim Thorpe, Pennsylvania.

3.2.3 As in construction drawings, field sketches will refer to details drawn at larger scale for clarity. Porches, screen doors and window shutters may be drawn separately. (In many instances, screen doors, gutters and non-historical building elements are "graphically removed" from the final drawing, that is, when it is determined that to draw them would obscure more important features. Graphic removal must be approved by project leaders and historians.) Larger structures should be sketched as logically separate elements, e.g. main block--hyphens--wings.

3.2.4 Accurate datum lines are the key to successful measurement of elevations and sections. A transit or similar surveying instrument is located at a distance from the structure that affords the best view of the maximum possible number of elevational features. This is especially important for structures with highly articulated surfaces. Points are marked by datum number with ink on drafting tape or other materials not injurious to the structure. Snap chalk lines between points; these lines are the "zero" from which vertical measurements are taken up and down. **USE BLUE POWDER ONLY! RED AND YELLOW ARE PERMANENT.**

Virtually all structures will require at least two horizontal datums. It is therefore imperative to label them clearly on all field notes and preliminary pencil drawings, and to note the vertical distances between the datums.

3.2.5 When the digital measuring pole is used, the dimension may be calculated back to the datum line or directly from the surface on which the pole is standing.

3.2.6 Measuring structures of more than one story in height will often require more than one datum line. The higher datums can be established with transits located on surrounding higher ground or other structures.

3.2.7 Because roof ridges can be irregular, a datum line can be established between chimneys or other roof projections, and checking horizontality with a string level. More information on measuring roofs can be found in 3.5.0.

3.2.8 A symptom of lateral wall shifting in its own plane is a rhomboid appearance, that is, the absence of right angles at the corners of walls, doors and windows (Figure 3.14). To record such an elevation, horizontal datums must be established with plumb bobs or suspended chalk lines. Determining the plumbness of walls in elevation will also prove useful in developing sections.

3.2.9 Sharing dimensions can save a great deal of time during the measuring phase. Some elevational features can only be reproduced from plan information, such as spiral stairs and bay windows (see 14.0.0; Appendix F: Projections

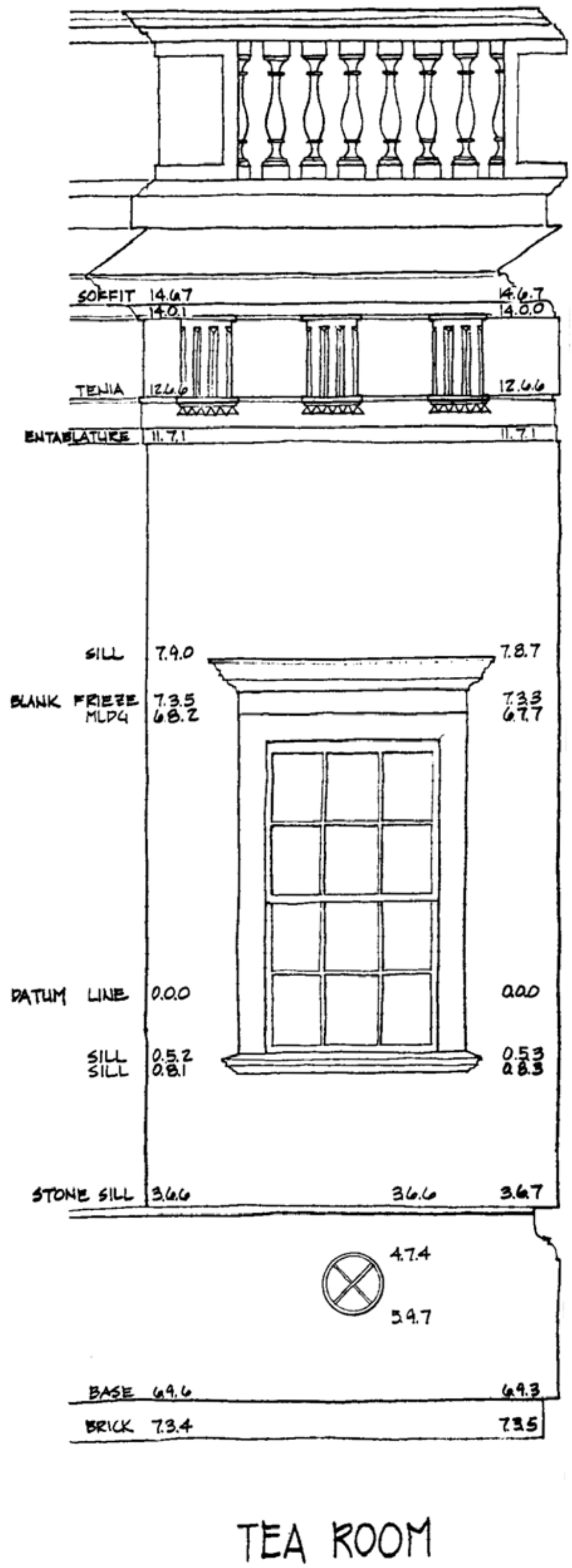


Figure 3.13: Field sketch of the Tea Room elevation, Monticello, Charlottesville, Virginia.

From Plans to Elevations.)

3.2.10 When building elements project forward significantly from the principal plane of the elevation, the elevations of these elements should be sketched and measured separately. In the final drawings, projected elevations are located relative to principal elevations triangulated measurements and projection from floor plans.

Figure 3.14: A building leaning 3º to 6º out of plumb, requiring vertical control lines for measurement. Store/saloon, Rock Creek Station, Wyoming. Photographer: Jack E. Boucher, 1974.

3.2.11 The tops of building walls are often concealed by roof overhangs and gutters. Recorders may find it useful to indicate the true tops of walls and bottoms of overhangs with a dashed line on field sketches, in order to clearly show wall heights.

3.3.0 SKETCHING AND MEASURING SECTIONS

3.3.1 Section drawings or "cross-sections" serve several purposes: they show the relationships among rooms and circulation routes; reveal structural deformation and major elements of construction; and show interior elevations if those are not drawn individually by room (Figure 3.15). These drawings can even help determine the order of construction of complex structures.

3.3.2 Section cuts must be chosen on the basis of logic and the amount of information they will convey. Whenever possible, cuts should run through wall openings, especially exterior doors and windows.

3.3.3 Sections may be cut as uniform, vertical slices through a structure (Figure 3.15), or "jogged" to cut through important openings and to reveal more important spaces (Figure 3.16). In a multi-story structure, the jogs may vary slightly from floor to floor, but should be close to each other in the vertical and horizontal planes.

3.3.4 Horizontal datums may be established either from outside the structure through openings; transferring exterior datums with string levels through openings; or establishing new interior datums with a transit (space and light permitting) or string level. Field notes must reflect referencing datums from sections to corresponding elevations.

3.3.5 Vertical datums (control lines) are used to locate walls and determine their plumbness. A plumb bob is suspended from the tops of walls and columns, and distances from the tip of the plumb bob back to the base of the wall or column is recorded.

3.3.6 Large, open interior spaces such as atriums, auditoriums, barns and churches must be sketched as a series of vertical planes for clarity in producing the field notes, with each overlaid "interior elevation" sketched and measured on separate sheets of graph paper. Datum points must be established on all columns and other elements which are located between the plane of the section cut and the farthest plane of the interior elevation. The information gathered on these field notes will prove invaluable in producing isometric framing drawings (Figure 3.17 and Figure 3.18.)

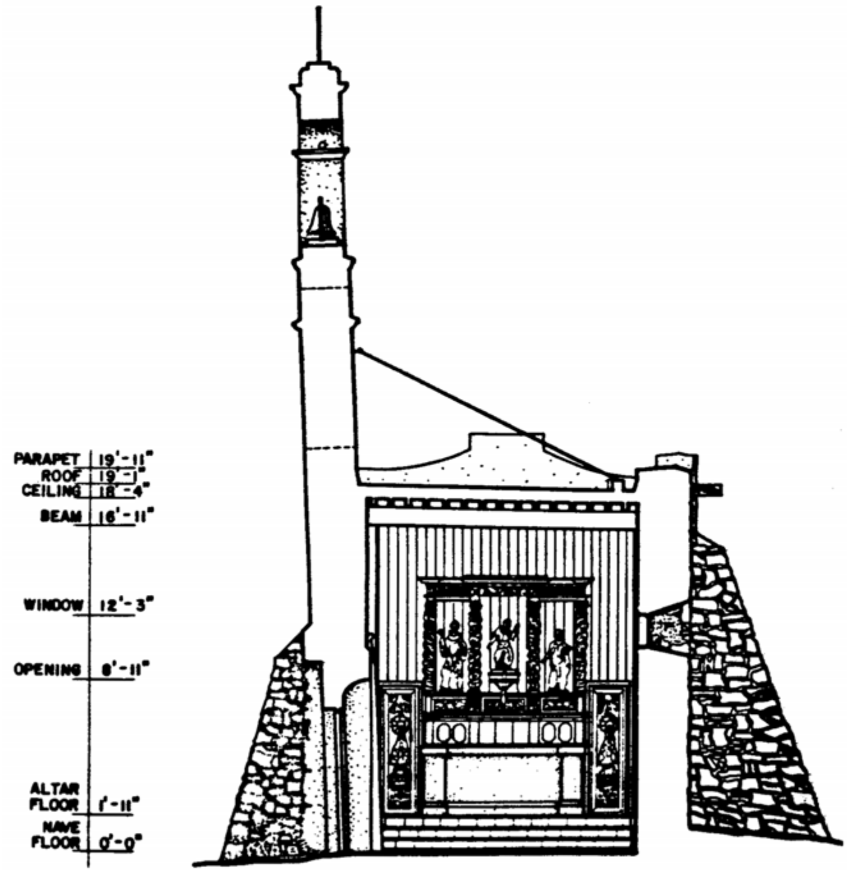


Figure 3.15: Mision San Juan de Capistrano, San Antonio Missions National Historic Park, San Antonio, Texas.

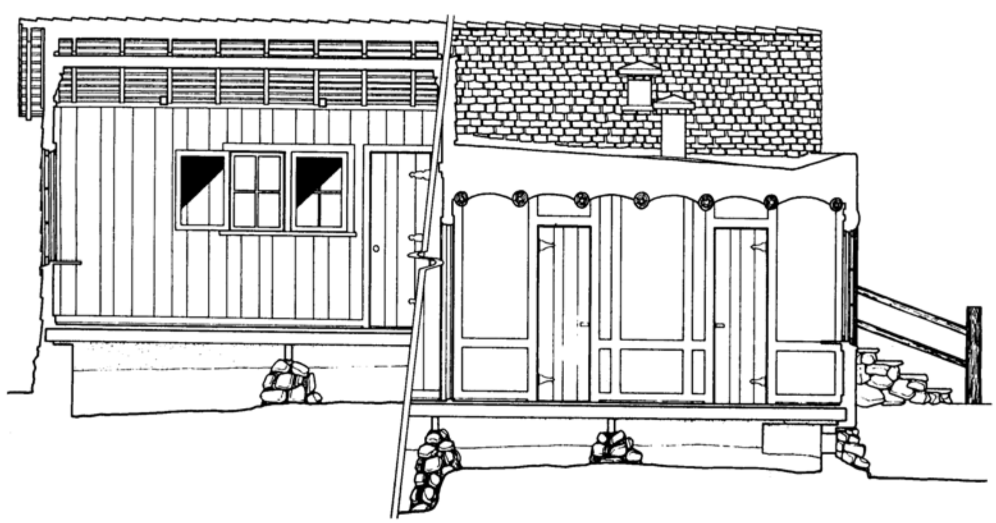


Figure 3.16: Stepped or "jogged" section. Bright Angel Lodge Cabin, No. 6179-82. Grand Canyon National Park, Arizona.

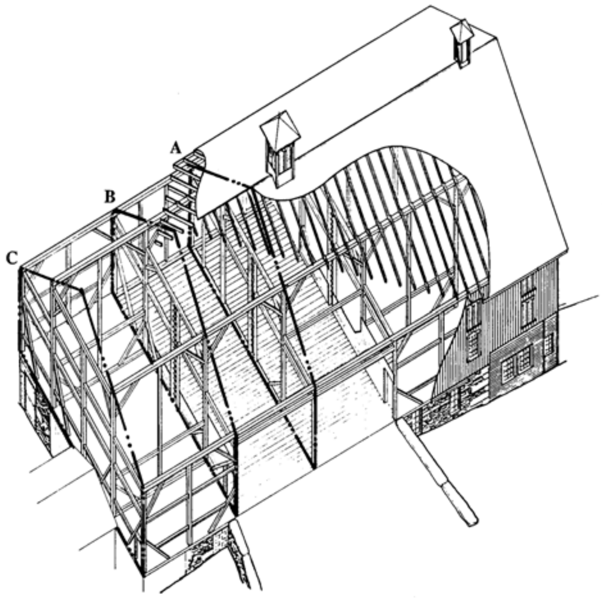


Figure 3.17: Dimensions were recorded at planes A, B, and C to produce the section drawing in Figure 3.18. Barn, Farm One, Eisenhower National Historic Site, Gettysburg, Pennsylvania.

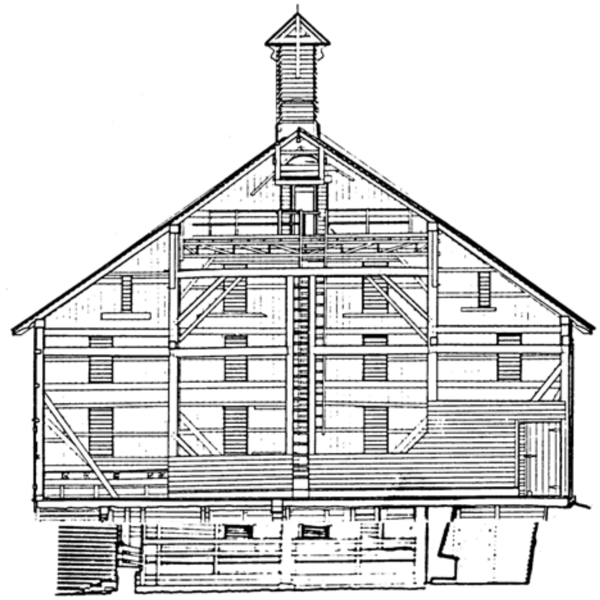


Figure 3.18: Transverse section. Columns and other elements in bent B are neither plumb nor in line with those in bent A, and can therefore be seen between bent A and the end wall.

3.3.7 Exposed framing in attics and similar structures is usually best shown with a cut line on the near side of the ridge. A tape is strung along the underside of rafters; if all rafters are known to be of the same size, the dimension at the lead edge is sufficient for recording. However, many older structures will have hand-hewn structural members of varying sizes, so both edges will require recording. Measuring from center to center is not acceptable in such cases.

3.3.8 The curvature of a dome may be plotted by first stringing a tape across the diameter of the drum supporting the dome. A plumb bob is then suspended from various points along the dome ceiling down to incremental points along the tape. The length of the string is recorded each time. The distances from tape to ceiling at 90º to the horizontal tape will provide points along which the curve can be plotted. As in all hand measuring operations, attention to safety is especially critical in measuring high interior spaces.

3.3.9 The most precise way to record irregular structures such as stone and adobe walls is with vertical, incremental control lines. The method is similar to measuring domes. Distances from the line at 90º to it are recorded at the chosen increments. Notice that on the field sketch, an irregular surface may be drawn as a straight line, because plotting the points will define the true shapes on the final drawings. (A variation of this technique will also be used to measure landscape features.)

3.4.0 SKETCHING AND MEASURING DETAILS

3.4.1 Several criteria may be employed to test the usefulness of each potential detail drawing:

1. Frequency of occurrence. Are there typical doors, windows and moldings that are integral parts of the whole structure and provide uniqueness of character to it?

2. Do the elements demonstrate significance in history or in the realms of architectural, landscape or interior design?

3. Can the detail drawing explain a unique or unexpected method of construction or design?

4. Will the project sponsor need the drawing for future maintenance, restoration or publication?

5. Can the proposed drawing serve as a title sheet element or enhance the set in some other way?

6. Is the element so complex that recording it will take time from producing other drawings?

7. Can the element be better captured photographically?

3.4.2 Detail sketches must be drawn LARGE! Because details are typically drawn at 1-1/2"=1'-0" or larger, the level of detail and accuracy increases greatly. Also, dimensions will frequently be taken to 1/8th, 1/16th and even 1/32nd of an inch.

3.4.3 Maximum use of artistic talent is encouraged in field sketching decorative elements. A limited amount of shading and other rendering techniques can enhance field sketches, but team members should use field photographs to reproduce textures and three-dimensionality. Shining a flashlight down on the element will produce crisp shading lines suitable for later drawings.

3.4.4 Profile gauges, tracings and pencil rubbings can produce fairly accurate representations of moldings, tiles, ornamental cast iron and stone texture. If possible, compensate for paint layers that tend to obscure the sharpness of detail.

Supplemented with photographs and measurements, these artistic techniques can be used to produce striking ink drawings. These techniques must be implemented with caution in order to avoid damaging historic fabric.

3.4.5 Both incremental and running dimensions may be used to measure small objects, but incremental dimensions should only be used if the shape of the object prevents running measurement. The datum point should also be selected for convenience, and not necessarily placed at one end. On field notes it may be useful to indicate the beginning of a line of running dimensions with an arrow.

3.4.6 Where possible, determine the radius of a round object by measuring its circumference with a flexible tape. Calipers, dividers and carpenter's squares can also be useful in measuring objects that are round in cross-section, such as balusters, decorative urns and spheres, and columns.

When determining column diameters, care must be taken to account for entasis--the slight convex curvature of the vertical profile of the column--if it is present. In Roman entasis, for example, curvature begins at one-third the distance from the bottom of the base to the top of the capital; in Greek entasis, curvature begins at the base. Field notes and detail drawings should reference heights from the base at which diameters were determined (see 13.0.0 Appendix E: Measuring Circular Objects and Areas.)

3.4.7 If taking precise measurements is less important than capturing the essence of an ornamental detail, photographs used in conjunction with overall dimensions may serve as underlays for drawings. This recording technique is particularly appropriate for stained glass windows, tiles and similar flat, asymmetrically ornamented surfaces.

3.5.0 SKETCHING AND MEASURING ROOFS

Architectural scholars have identified over 30 different roof types, which for purposes of documentation can be divided into flat, gable (including gambrel), hip (including mansard and jerkinhead), composite and dome roofs.

3.5.1 Flat roofs are often hidden behind parapet walls, and therefore are usually depicted in section cuts. The amount and direction of slope may be determined by measuring down from the parapet tops, then double-checking through use of a string and line level.

3.5.2 Gable or ridged roofs (including gambrel, Figure 3.20) can be measured from datums located on the end walls beneath them. One method of measuring a gambrel roof is to:

1) stretch a tape between the lowest points on the roof;

2) suspend a plumb bob from the center and intermediate ridges to the tape, and note the distance from 0;

3) note the distances from ridges to tape, and from the tape ends to the datum. Be sure to use only the top or the bottom of the tape as the intermediate datum, in order not to introduce the width of the tape as an error factor;

4) document the roof cladding (slate, shingles etc.) by counting courses and spot checking their width. Note where courses begin and end in relation to the roof structure and other roof features.

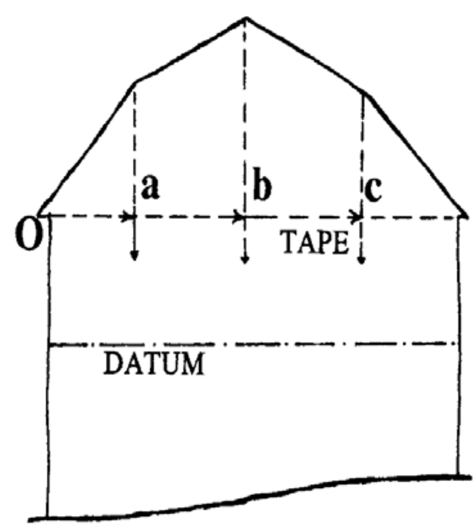


Figure 3.20: Measuring a gambrel roof.

3.5.3 The first task in measuring a hip roof is determining the height of the peak. The following method requires the greatest possible precision:

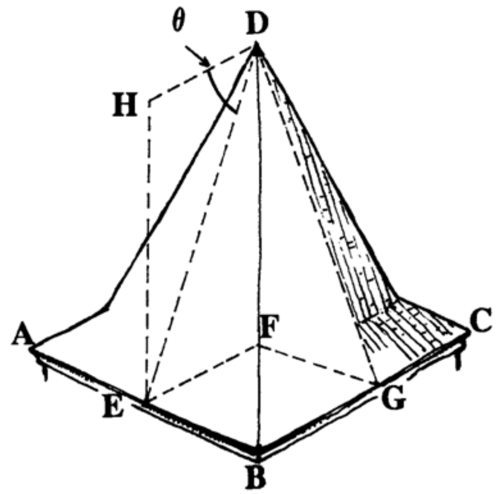


Figure 3.22: Calculation of roof height using Pythagorean Theorem.

1) In Figure 3.22, determine if angle ABC = 90º;

2) using the technique for constructing perpendicular lines discussed in 3.1.6 (Figure 3.4), find point E, where DE is perpendicular to AB at E in elevation;

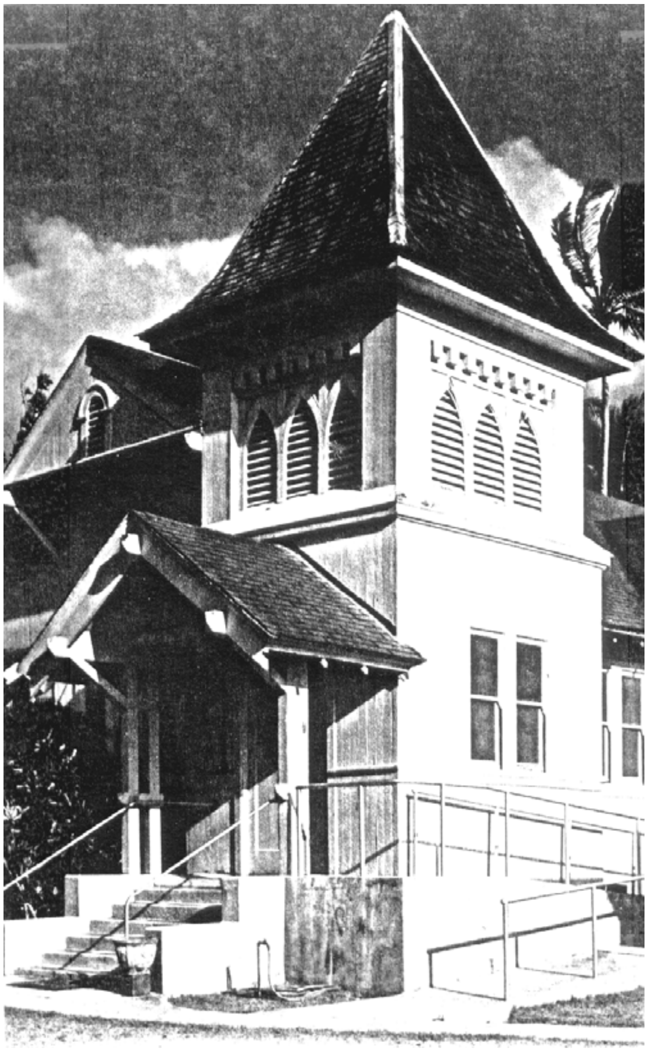


Figure 3.21: Hip roof with concave chamfering on the belfry of Kanaana Hou Church, Kalaupapa National Histoic Park, Hawaii.

3) likewise find point G. where DG is perpendicular to BC at G in elevation.

4) measure DE as a straight line through the air, not on the roof surface;

5) measure BG, which is equivalent to EF and DH;

6) according to the Pythagorean Theorem, $a^2+b^2=c^2$,
or $(DH^2+(EH)^2=(DE)^2$, so $(EH)^2= (DE)^2-(DH)^2$;

7) EH is the height of point D above line AB at point E, or in other words, if line AB is perfectly horizontal, the height of the peak above the eave line.

3.5.4 Using the sine function of the roof slope angle requires less measuring and calculation, but a far higher degree of precision. In Figure 3.23, sine θ = x/h, where h is the length of the roof surface and x is the height of the ridge above the base of the roof; so x = sine θ/h. The angle can be measured by placing one edge of an adjustable triangle on the roof, holding a spirit level on the horizontal edge, and reading the angle when the bubble is centered. Depending on the h-value, small errors in reading the angle can cause large errors in the x-value. Note also, that surface angles of the roof materials (shingles, for example) will often differ from the roof slope.

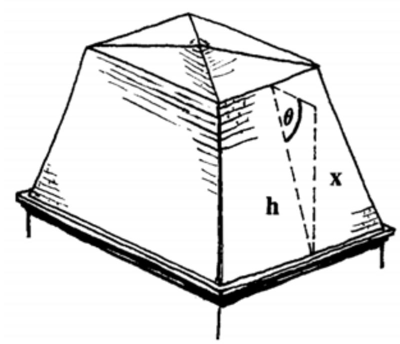


Figure 3.23: Sine method for determining roof heights.

3.5.5 When measuring a mansard or similar roof, the heights and horizontality of all eave and ridge lines will require checking.

3.5.6 The fundamental difficulty in measuring curved roof structures is ascertaining whether the curves are truly circular, and if not, what their true configurations are. The curves can be triangulated from surrounding elements.

1) To measure a dome, lay a cloth, plastic, or preferably metal tape measure along the curve in a plane perpendicular to the plane of the base of the dome, keeping it taut (Figure 3.24);

2) set up one or two braced stadia rods, camera tripods, ladders or other stable devices, and establish triangulation points A, B, C and D in the same vertical plane as the tape. Triangulate from these points up and down the surface of the dome to a consistent set of points on the tape. Depending on the dome's curvature, it may become necessary to triangulate from more than one location. (see 13.0.0 Appendix E: Measuring Circular Objects and Areas.)

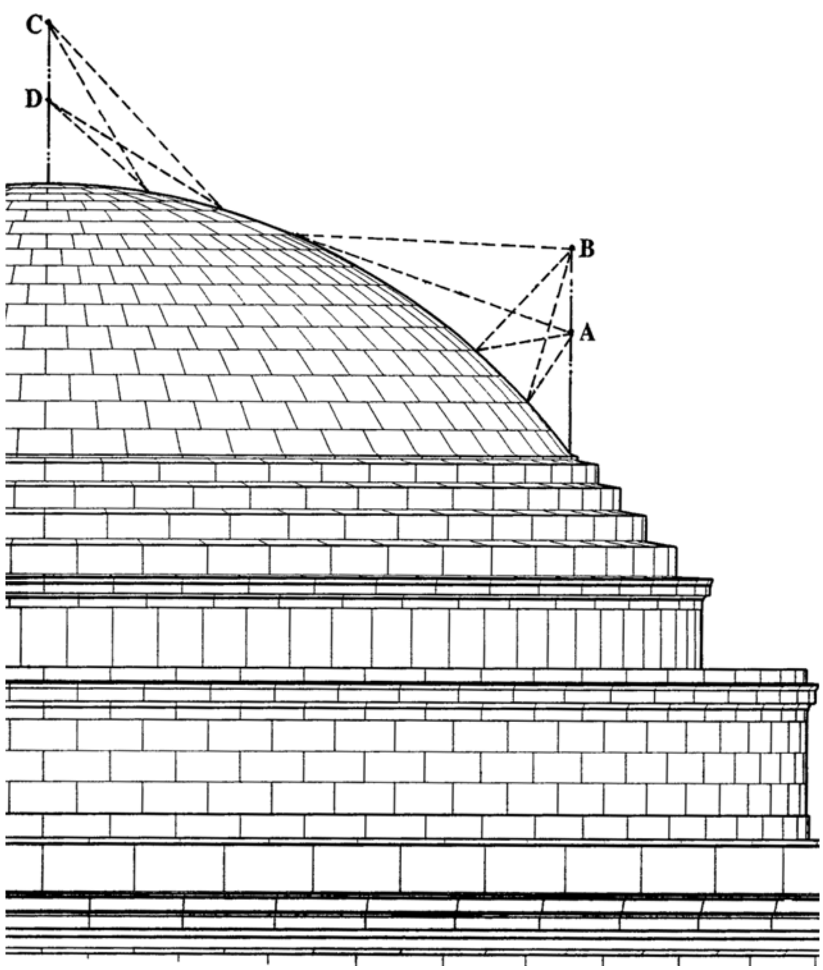


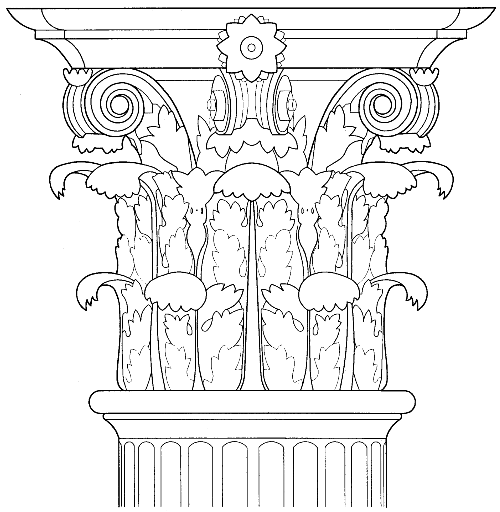
Figure 3.24: Triangulating the curve of a dome. Jefferson Memorial, Washington, D.C.

HABS GUIDELINE

RECORDING STRUCTURES AND SITES

with

HABS MEASURED DRAWINGS



HABS

SECTION 4.0
PRELIMINARY DRAWINGS

U.S. Department of the Interior
National Park Service
Heritage Documentation Programs
Historic American Buildings Survey
1201 Eye Street, NW, 2270
Washington, DC 20005
(202) 354-2135
http://www.cr.nps.gov/habshaer

December 2005

4.0.0 PRELIMINARY (PENCIL) DRAWINGS

4.0.1 Preliminary drawings provide the means to identify and correct errors in measuring. Once drawing has begun, errors in wall alignment, window placement, roof heights, for example, quickly become apparent, especially when plans are overlaid, elevations are matched with adjacent elevations and corresponding sections, etc. Corrections are of course more easily made on pencillings than on ink drawings.

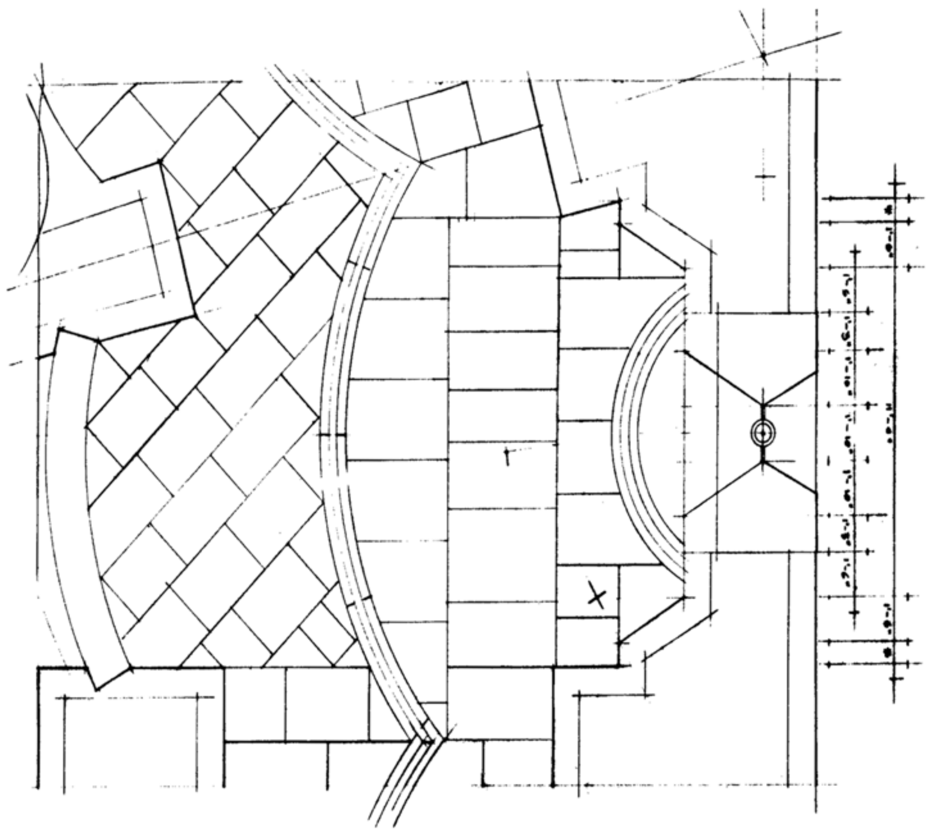


Figure 4.1: Layout of a casement plan. Fort Sumter National Monument, Sullivan's Island, South Carolina.

4.0.2 A number of factors may contribute to the misalignment of drawings. Plans will not line up if walls are not plumb; this is especially true if roof weight is causing walls to spread apart. Adjacent elevations will not align if, for example, the end point of an eave line is visible on one elevation, but on the adjacent elevation the eave line is hidden by a gutter and not measured. Also, improperly established or recorded datum lines and the use of different brands of measuring devices and drawing scales lead to mismatches. Finally, variations in temperature and humidity cause vellum to change shape and size, so drafting film is recommended when highly accurate preliminaries are required.

4.1.0 APPLICATIONS OF THE VARIOUS SCALES, AND CHOOSING THE PROPER ONE

4.1.1 At the outset of the project, the choice of scales for final drawings (as well as the level of detail required in field notes) is made according to the following criteria:

1) Level of detail, amount of graphic and notational information required for the set.

2) Size of the structures to be drawn.

3) Available time and financial resources.

4) Final sheet composition, compatibility with other sheets in a set.

In general, measured drawings should impart the maximum amount of information possible. The above criteria are not necessarily listed in order of importance, and will often compete with each other. For example, clients may want highly detailed drawings of a large, significant structure, but sheet size limitations may require smaller overall drawings supplemented by several detail sheets. On the other hand, small, simple structures may not require highly detailed drawings, but small-scale drawings would impart almost no information.

4.1.2 In the foreseeable future, the metric system may replace the English system in architectural practice, as it already has in the sciences and such disciplines as archaeology.

Although buildings designed in the English system should be recorded as such, prehistoric structures and sites should employ the metric system. The basic units of both systems are presented in 15.0.0 Appendix G: English and Metric Systems.

4.1.3 Metric architectural scales. The ratios represent centimeters to centimeters.

use	scale
Details of smaller elements	1:2, 1:5, 1:10
Details of larger elements	1:20, 1:25, 1:50
Most architectural drawings	1:50
Sketch plans	1:100
Site plans	1:200, 1:500, 1:1000
Maps	1:2000, 1:5000, 1:10000, 1:15000, 1:25000, 1:50000, 1:100000

4.1.4 English System Architectural Scales[1]

scale *x*"= 1'-0"	ratio (metric)	smallest unit[2]	use
1/16"	1:192	4"	Drawings of large structures without details included. Materials shown in plan only.
1/8"	1:96	2"	Sketch plans and elevations of structures not slated for comprehensive measured drawings; streetscapes, and overall plans and elevations of very large structures such as fortifications. Construction and finish materials, ornamentation are greatly abstracted or omitted.
3/16" 1/4"	1:72 1:48	1-1/2" 1"	The most commonly used scales. Most ornamentation, finish and construction materials can be delineated; only very small and intricate elements may be abstracted. Floor materials (wood, tiles) and landscape materials (courtyard pavers, brick, stone) can be shown accurately in plan. In elevation, brick is represented with horizontal lines only, except to show course changes. Door and window elements (mullions, shutters, sash, frames and panels) are to be delineated as measured, but at these scales, lines should not be drawn closer than 1" to each other. Stained glass, carved stone, plaster and similar designs are usually stippled rather than hard lined at these scales.
1/2"	1:24	3/4"	Used primarily for smaller structures such as out-buildings, as well as some detail. Larger structures drawn at this scale require a very high degree of accuracy in measuring--often to 1/16" or 1/32". Door and window elements are more highly articulated, and butt joints, mullions, hardware, pegs and even floor board nails should be drawn as measured. Stippling is used more to show stone texture; some graining can define the ends of timber beams.
3/4"	1:16	3/8"	Door and window details, other features of similar size.
1-1/2"	1:8	3/16"	Ornamental and construction details.
3"	1:4	3/32"	Hardware, smaller ornamentation, molding profiles.
Full Size	1:1	N/A	Intricate objects, elaborate moldings and ornamentation.

[1] Burns, John A., ed. *Recording Historic Structures.* Washington, D.C.: American Institute of Architects Press, 1989.

[2] The smallest unit that can be drawn relates to the surveying practice of a drawing accuracy of 1/50" at map scale. This converts to approximately 1" at a scale of 1/4" = 1'-0" (1:48).

4.1.5 Drawings produced at larger scales display the highest degrees of accuracy, and can be the most aesthetically pleasing of HABS existing-condition drawings. Measurements are obtained by hand and by using profile combs, rubbings and careful photography. (Photographs must be taken with the camera film plane parallel to the picture plane of the object. The delineator should note that 35 mm camera lenses and enlargement on photocopiers introduce degrees of distortion. Hand measurement should be used for verification.)

Drawings at full scale may use texturing (stippling) to emphasize curvatures and the three-dimensional quality of bas-reliefs and other ornamentation. This technique can be used very successfully in delineating carved wood, stone and cast plaster.

4.1.6 Mixing of scales among plans, elevations and sections is generally not recommended. However, if it has been determined that, for example, that simple, repetitive plans of a very large structure can be drawn at 1/8" = 1'-0", but the elevations and sections need to display more detail, they should be drawn at 1/4" = 1'-0". A corresponding increase from 3/16" = 1'-0" is to 3/8" = 1'-0".

4.2.0 SHEET LAYOUT

4.2.1 A number of aesthetic and informational considerations should be kept in mind when laying out individual sheets of drawings. The future use of the drawings--as determined by clients and communicated to project leaders--will determine the character and level of information to be imparted by the drawings.

4.2.2 Drawings should fit comfortably on a sheet and not look cramped. Adequate space should be left on sheets for dimensions and notes. Notes are useful in conveying additional information about the structure or site. A typical note that would appear on a HABS drawing would call out materials used in construction. Drawings from the first half of this century--especially detail sheets--tend to condense a great deal of information. Such sheets can be artistically exquisite compositions and suitable for exhibition and publication. Sheet density is to be considered because drawings are later reduced for publication, portfolios, and transmission to the Library of Congress.

4.2.3 Some or all of the following items will add to the "size" of most drawings, and should be factored into sheet lay-out: titles, dimensions, scales, north arrows, materials and planting lists, plan keys, areas dashed-in for reference such as roof lines and basements, details, reconstructions based on measured remains, and exploded views.

4.2.4 When more than one drawing is to appear on a sheet, the combination must enhance comprehension of the structure (See Figure 4.10). One should avoid half-filled sheets with drawings that cannot be referenced to its companion on the same sheet. A HABS drawing set typically consists of a title sheet, site plans, floor plans, elevations, sections, and details.

4.2.5 Drawings of sites and structures requiring match lines are often reduced to photographic negatives, then spliced together to produce composite plans, elevations, etc. These drawings must be rendered with the utmost precision and consistency of line weight and texturing. When drawing large site plans, one must plan match line cuts around, rather than through buildings, in order to facilitate splicing.

In addition to graphic scales and north arrows, site plans will often include planting lists, structure lists, historical and other descriptive notes, and vicinity and location maps. Planning the sheet composition will include obtaining over-all site dimensions early in the project in order to choose a graphic scale.

4.2.6 Elevations of more than one but less than two sheet lengths may be drawn on one sheet with match lines. Another possible technique is to combine sections and elevations running continuously across two or more sheets.

4.2.7 Title sheets generally include a location map, a statement of significance, and a project information statement. In addition, title sheets often display rendered, drafted or photographically transferred images which represent the project.

A statement of significance describes the architectural and/or historical importance of the project. It is prepared by the project architectural supervisor or historian, and is then submitted to the HABS Washington office for review before inking. It should be carefully proofread for grammatical, spelling and factual errors.

It is the responsibility of the project supervisor to compose a project information statement that briefly describes the conditions under which the documentation was carried out. Credit should be given to sponsors and participants--including their titles and professional or academic affiliations. This statement must also be approved by the Washington office.

For HABS projects, texts are composed, typed with justification at the desired column width on a word processor, at a font size equivalent to the mechanical lettering template to be used (18-point type for 175 Leroy template.) The printed text is then laid under the drafting film for tracing with ink.

4.2.8 Site plans are either incorporated into title sheets or drawn by themselves, depending on the site's extent and significance. At a minimum, documentation will include the following information:

1) buildings designated by roof plan, and called out or listed in a key;

2) trees showing trunk diameter at breast height and canopy, called out by abbreviations and listed by common and botanical names;

3) other significant plants, similarly identified;

4) walls, fences, sculptural elements, street furniture, retaining walls, paving, utility poles;

5) water features;

6) title, graphic scale, north arrow.

Sites documented more thoroughly may require additional drawings such as topographic surveys, site sections and axonometrics, and maps showing development over time. (See also 6.0.0 Landscape Documentation, and 7.0.0 Documentation of Construction Histories and Site Development.)

4.3.0 PROCEDURE FOR PRELIMINARY PLAN DRAWINGS

1) Locate the appropriate reference points: plan boxes and individual points from which to begin placing the exterior walls through triangulation. Triangulated points are located by adjusting a compass to the desired distances on a scale, then drawing intersecting arcs;

2) using wall thicknesses, locate the major lines of the interior spaces;

3) complete interior space configurations by checking their diagonal measurements;

4) overlay plans of other levels to check for plumbness of walls and general accuracy;

5) complete door and window frames;

6) complete remaining features (hearths, floor tiles), locate appropriate appliances and fixtures;

7) mark points for dashed lines, floor boards and other simple, repetitive patterns;

8) mark points for dimension lines.

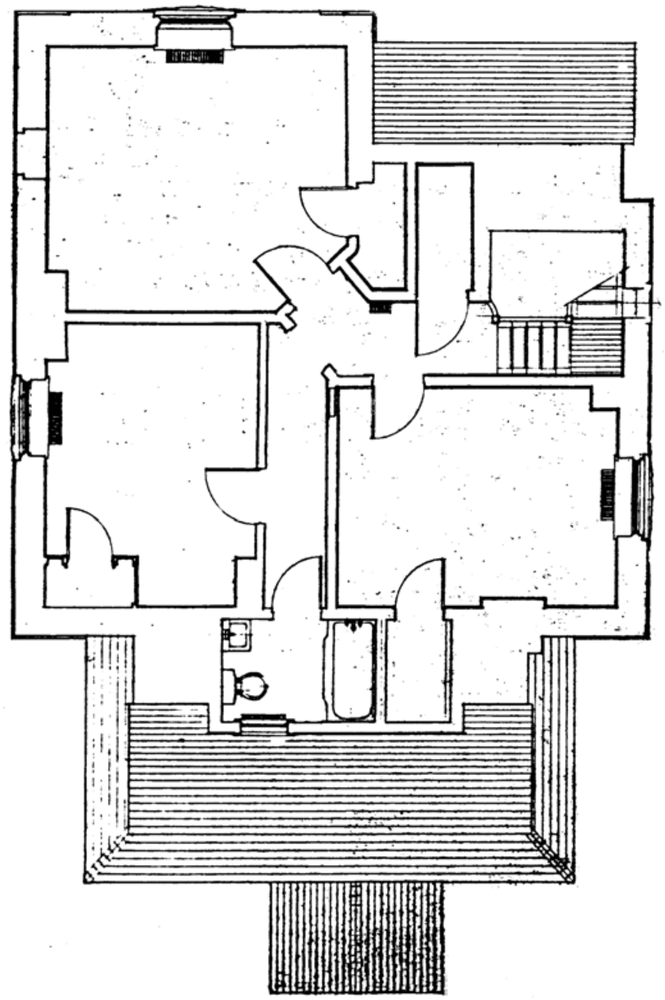


Figure 4.2: Layout of a second floor plan, Keeper's Quarters (East House), Devil's Island Light Station, Apostle Island National Lakeshore, Bayfield, Wisconsin.

4.4.0 PROCEDURE FOR PRELIMINARY ELEVATION DRAWINGS

1) draw horizontal datum lines, preferably with a .19 mm (4 x 0) pen in order to maintain a thin, accurate line;

2) if exterior walls, columns, etc. are not plumb, draw vertical datums as needed;

3) draw major walls and roof lines, and other vertical and horizontal elements;

4) draw major openings;

5) project foreshortened elements from plans (bay windows, spiral stairs, cylindrical structures), other elements angling or curving away from drawing plane (Figure 4.3);

6) locate dashed elements (basements, hidden lines, removals for graphic clarity);

7) locate marks for inking of siding, roof materials;

8) create templates for repeating elements;

9) notate areas to receive special treatment, such as stippling or other freehand techniques.

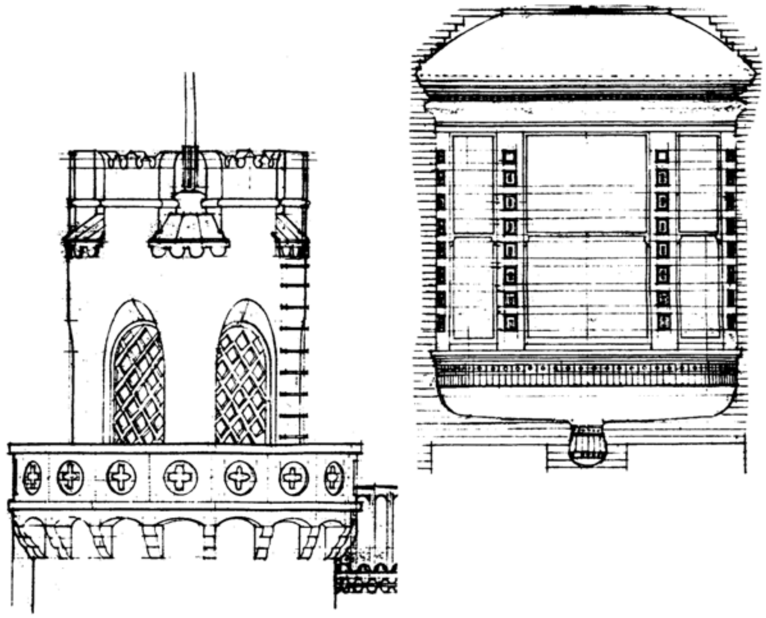


Figure 4.3: Layout of foreshortened elevation elements.(left) Scotty's Castle, Death Valley National Monument, California;(right) George W. Eckhart House, Wheeling, West Virginia.

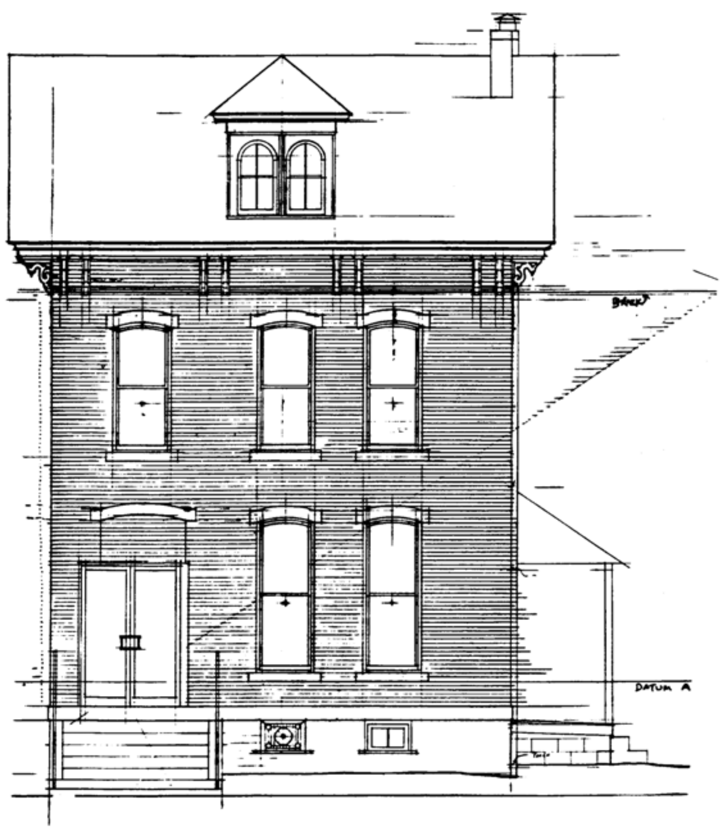


Figure 4.4: Charles E. Dudley House, Altoona, Pennsylvania. Note the equal division of spaces method to delineate brick courses.

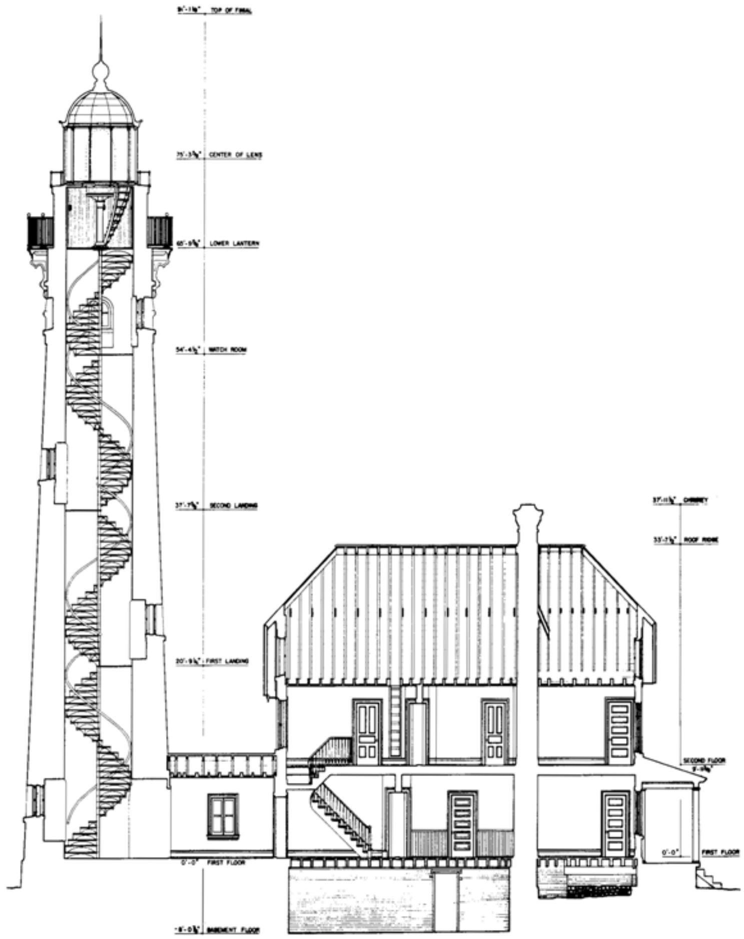


Figure 4.5: Au Sable Light Station. Pictured Rocks National Lakeshore, Alger County, Michigan.

4.5.0 PROCEDURE FOR PRELIMINARY SECTION DRAWINGS

1) clearly demarcate the section cut on the plan(s), making sure that it will be logical, illustrative of spatial relationships, and easily understood;

2) copy the wall locations from the plan;

3) if the wall planes are consistent between the section cut and the elevation it faces, trace the outline from that elevation;

4) to minimize confusion between elements close to the drawing plane and those far behind it, draw the section on separate sheets as a series of slices through the structure, the closest being the actual section cut, and the farther ones serving as interior elevations; this technique is particularly useful for large, columned spaces such as barns (see Figure 3.17 and Figure 3.18);

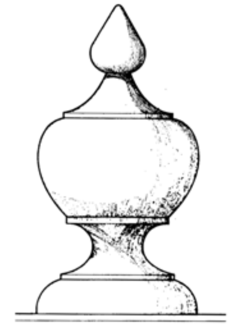
5) complete interior elevations, grade line, exterior elevation if applicable.

4.6.0 PROCEDURE FOR PRELIMINARY DETAIL DRAWINGS

1) Determine the location of the detail in the set (title sheet, detail sheet); this will help determine the scale at which it is to be drawn;

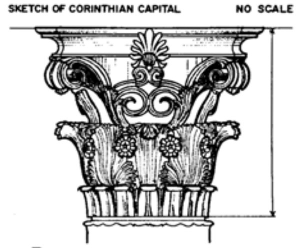
2) in the case of window and door details, determine the layout of their components (interior/exterior elevation, plan, section);

3) determine strategies for penciling and inking: whether the final drawing will be traced from a photograph, drawn freehand, or from measurements; the type of texturing to be used to show grain and curvature; level of abstraction, and, if necessary, shading.

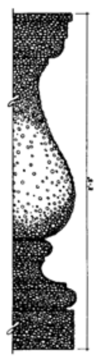


A

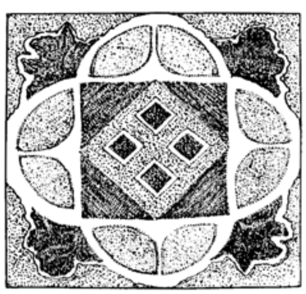
Figure 4.6: **A**: Wooden finial, shaded to emphasize roundness.



B



C



D

Figure 4.7: Various detail drawings.
B: Carved stone capital, partially traced from photograph.
C: Concrete aggregate baluster.
D: Glazed terra cotta tile, drawn from rubbing.

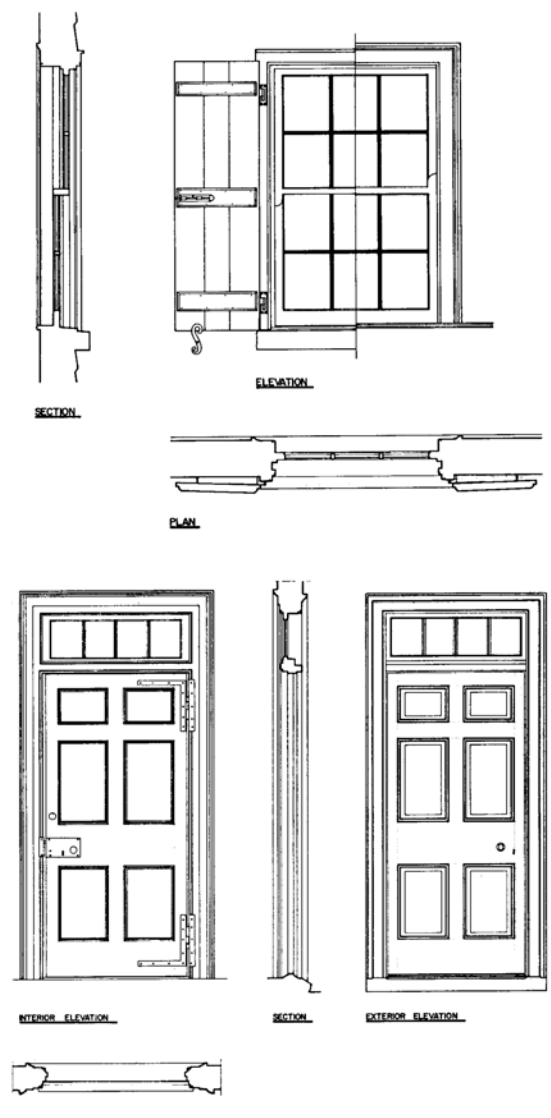


Figure 4.8: Typical treatments of window and door details.

4.7.0 PARALINE OR "AXONOMETRIC" DRAWINGS

These are useful in presenting structural information, especially of larger buildings with complex combinations of columns and truss work. These drawings impart a feeling for the mass and volume of the building without the distortion of essentially unmeasurable perspective renderings. Axonometrics are also extremely useful in illustrating mechanical processes and industrial layouts. Measurements obtained for plans, elevations and sections will be used to produce axonometrics.

4.7.1 There are six basic types of axonometric drawing: 30º oblique, 45º oblique, 45º dimetric (rotated plan, 15º dimetric, isometric (30º dimetric), and trimetric (rotated plan). Refer to Figure 4.9 to choose the type which will best illustrate massing, roof framing, interior structure, etc.

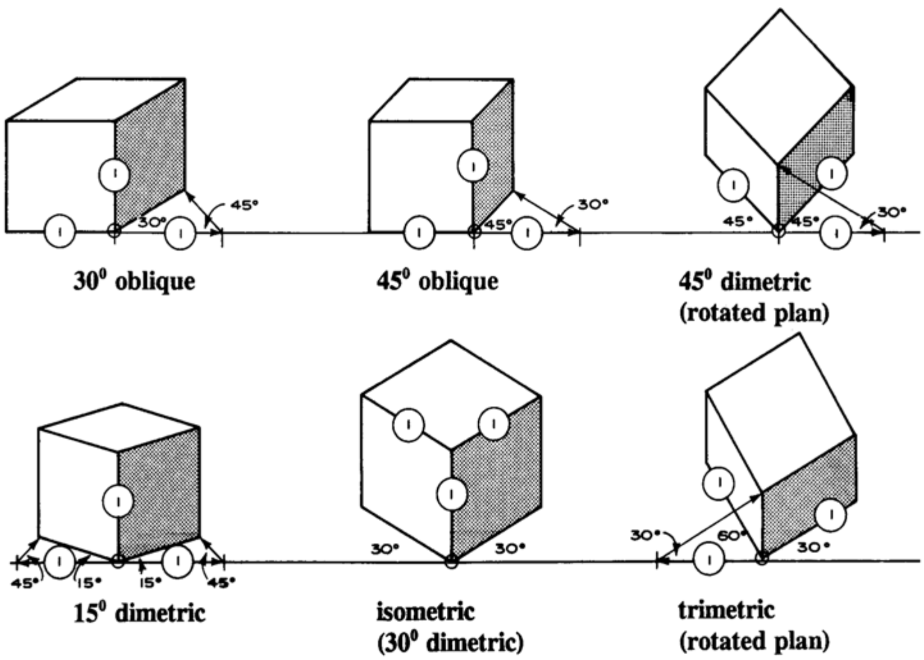


Figure 4.9: Generating axonometric drawings. HABS delineators usually employ the isometric (30º dimetric). Charles G. Ramsey, *Architectural Graphic Standards, 8th Ed.*, page 797.

4.7.2 Procedure for preliminary axonometric drawings:

1) Choose between an exploded or unexploded view, depending on the potential usefulness of each;

2) determine the scale and size of final drawing BEFORE beginning its construction;

3) determine the amount of structure to be revealed, and what kind of peel-away technique will be used;

4) begin the construction by drawing the base line which represents the picture plane;

5) using an adjustable triangle, construct the angles for the base lines of the drawing;

6) when laying out the measured lines, always hold the architect's scale against the parallel bar and against triangles braced by the parallel bar.

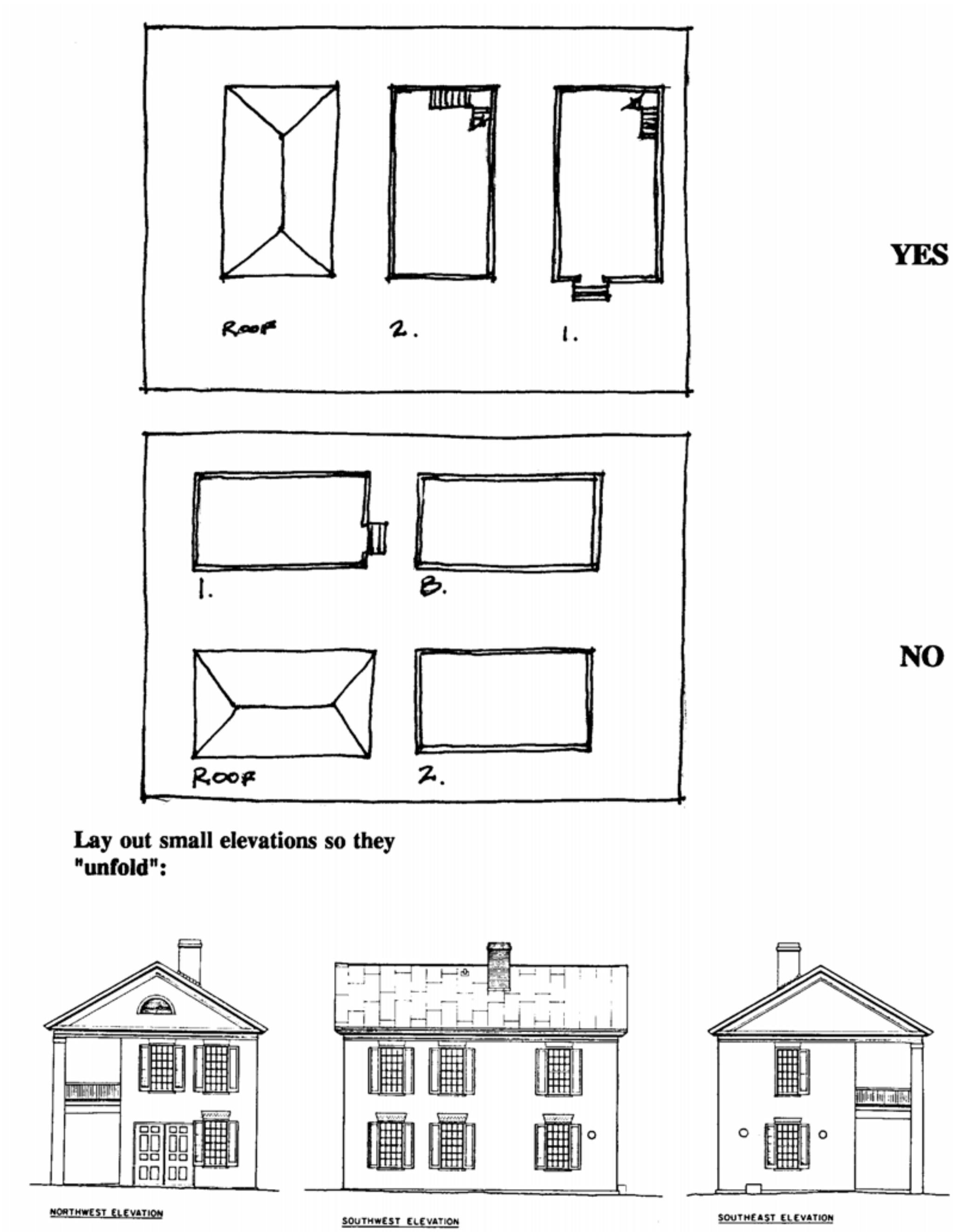


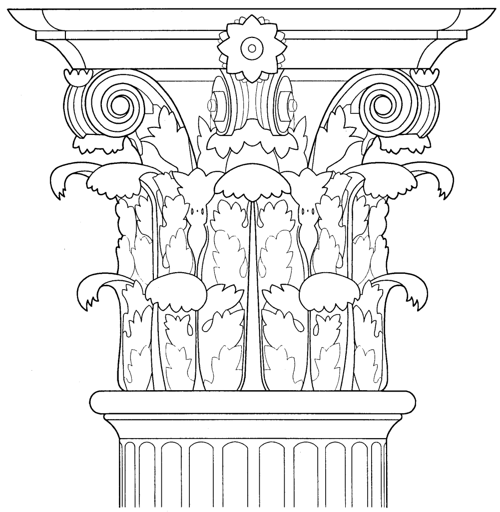
Figure 4.10: Proper sheet lay out for plans and elevations.

HABS GUIDELINE

RECORDING STRUCTURES AND SITES

with

HABS MEASURED DRAWINGS



HABS

SECTION 5.0
INK ON DRAFTING FILM DRAWINGS

U.S. Department of the Interior
National Park Service
Heritage Documentation Programs
Historic American Buildings Survey
1201 Eye Street, NW, 2270
Washington, DC 20005
(202) 354-2135
http://www.cr.nps.gov/habshaer

December 2005

5.0.0 INK ON DRAFTING FILM DRAWINGS

5.1.0 FINAL SHEET LAY-OUT

5.1.1 Before inking begins, all elements of the drawings should be composed in order to avoid squeezing notes and dimensions between the images and borders. Whether the principal image will appear on the sheet vertically or horizontally, composition usually begins by placing it somewhat above the center, since the drawing title and graphic scale will appear below the image. The Historic American Buildings Survey uses its own preprinted drafting film which must be used for HABS projects, Charles E. Peterson Prize entries, and other documentation produced to HABS standards. Sheets must be oriented with title blocks on either the right side or the bottom.

Next, a standard format for dimension lines (distance from the images and from each other) must be determined. Be sure to consider the placement of section cut indicators and notes in plan.

Finally, drawing titles, graphic scales, north arrows, plan keys and bodies of text must be positioned on the sheets. Ideally, text which approaches a paragraph or more in length should first be composed on a word processor, then printed out at the appropriate size for tracing.

5.2.0 INKING TECHNIQUES

5.2.1 One of the hallmarks of an excellent ink drawing is consistency of line weight, that is, individual lines drawn at the same thickness and density over their entire length, and lines which match each other throughout the set.

Pens should be held lightly, as close to perpendicular to the drafting film as possible. The drafting film must not be scored; removing ink from scratched drafting film is virtually impossible. Frequently wiping the nibs on a paper towel will help ensure an even flow of ink.

Lines that fade out or vary in thickness must be redrawn.

As a rapidograph is pulled across drafting film, its ink flow is fairly constant. So a slowly drawn line will be thicker than one drawn quickly, and at the end of a line, ink still flowing from the pen will tend to form a circular blob. Therefore, the best method of drawing a clean line--especially .35 (2 x 0) or thicker--is to draw past its designated length, then use an erasing shield to reduce it to its proper length.

5.2.2 Ink is most easily removed from drafting film with a slightly dampened white vinyl eraser. Care must be taken not to remove the tooth of the drafting surface, and for this reason electric erasers should never be used. After erasing, wiping the surface with a tissue or chamois is recommended.

5.2.3 Stippling is the technique used to produce textures and the illusion of three-dimensionality. Depending on the effect desired, pens between .19 mm and .30 mm (4 x 0 and 2 x 0) are used. Stippling must never be done rapidly! Each dot must be placed so that it appears round, otherwise numerous tiny streaks will result. Stippling is usually done on the reverse side of the drafting film; this allows for corrections in density or technique without erasing other features of the drawing.

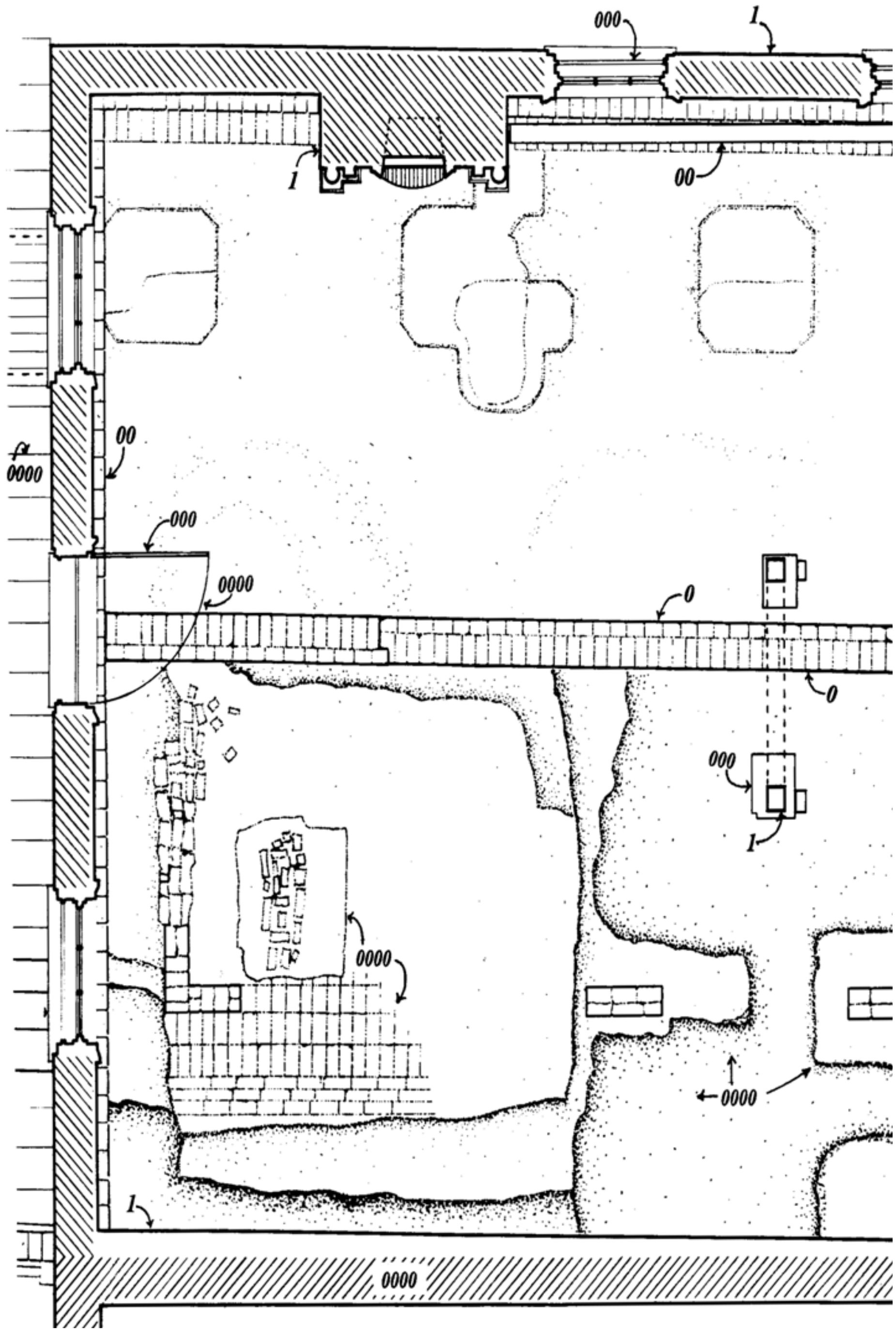


Figure 5.1: Range of line weights used on a plan drawn at 1/4" = 1'-0". Note that brick and stone poché stop at the inside surface of plaster finish.

5.2.4 When using a compass with an ink pen attachment, the compass needle should be set in several layers of drafting tape placed over the center of the circle, but never onto the drafting film itself. The center may be marked with an ink dot, which is then visible through the tape. The pen must be aligned perpendicular to the drawing surface.

5.2.5 Inking triangles and templates, or templates with raising bumps, should be used for all ink on drafting film work. Whenever possible, these tools should be held against a parallel bar, and the bar should be braked or weighed down.

5.3.0 LINE WEIGHTS

5.3.1 The following line weights are used on drawings at 1/4" = 1'-0".

.13 mm (6 x 0)	Fine ornamentation and detailing; limited texturing and small plant depiction on landscape and site plans; otherwise their use is to be avoided due to poor reproduciblity.
.19 mm (4 x 0)	Most stippling. Door swings, stair direction arrows, brick coursing, wood siding, window and door details, window and door frames in plan, floor boards, miter joints, mortise and tenon joints, most ornamentation and detailing; features in the background that would usually be drawn with a larger pen. Dashed lines indicating features above a cut line, such as roof lines, mantels, beams; in elevation, outlines of windows and doors partly hidden behind other building elements.
25 mm (3 x 0)	Most drafting lines. For landscape and site plans: to be used as primary tree indicator in conjunction with .19 mm, .30 mm and .35 mm pens to depict relative heights, densities and species. Roads on location maps traced from USGS maps.
.30 mm (2 x 0)	Outlines of openings, door and window frames.
.35 mm (0)	Edges within perimeter of drawing to show depth in elevation. Outlines of structures on site plans.
.50 mm (1)	Wall outlines in plan, major building outline in elevation, section cuts.
.60 mm (2)	Building outlines for those parts of structure that project forward from picture plane. This is one technique for showing relative depths.
.70 mm (2-1/2)	Ground line on sections and elevations.

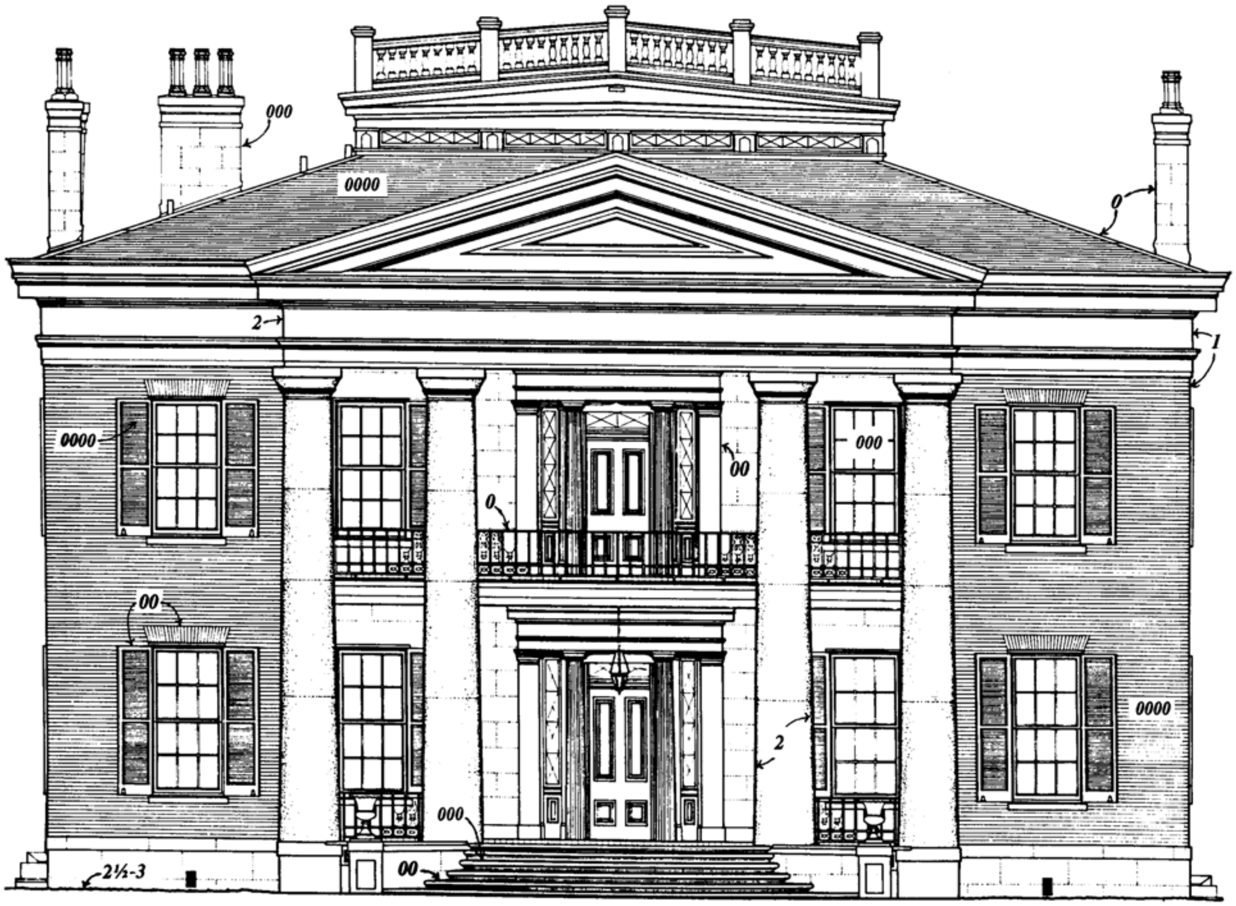


Figure 5.2: Range of line weights used on an elevation drawn at 1/4" = 1'-0", reduced to approximately 1/8" = 1'-0". Melrose, Natchez National Historical Park, Mississippi.

5.3.2 Drawings at larger and smaller scales will use the above range of line weights, with different maximum and minimum weights. Also, delineators should learn to produce bold, complex shapes (such as door and window frames in plan) by starting some lines with a fine pen, then carefully building up to the desired thickness. See Figures 5.1, 5.2, 5.3 for recommendations.

5.3.3 HABS sheets are transmitted to the Library of Congress without trimming at the trim lines. Therefore, no extraneous images or "squiggles" should appear anywhere on the sheets. All pencil marks should also be erased.

5.4.0 DRAWING ON THE REVERSE SIDE OF DRAFTING FILM

5.4.1 Stippling, brick courses, floor boards and poché patterns are usually drawn on the back sides of drafting film. In addition, to depict parts of structures in the distant background (especially in section), other elements may be drawn on the back.

5.5.0 MATERIALS SYMBOLS FOR PLAN POCHÉ

5.5.1 Materials symbols are used in plan drawings to depict building materials. The patterns depicted in Figure 5.4 are identical to those in Architectural Graphic Standards.

5.5.2 Poché patterns are drawn with the same precision as the rest of the image. The diagonal lines representing brick in plan, for example, should be at 45º to the run of the wall and spaced exactly. A change in the date of construction, as in the bricking up of an opening, will require a 90º change in the direction of the pattern.

The poché must also be drawn to match the true thickness of the material. The lines will be drawn short of the wall edge to depict the finish material. This is most easily accomplished by drawing through the wall edge (on the back!), then erasing.

Wood frame walls in plan have no poché.

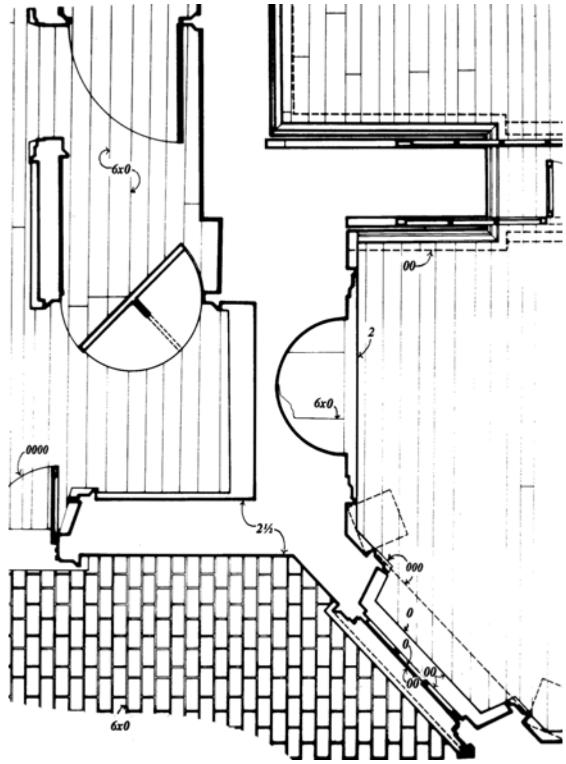


Figure 5.3: Plan inked at 1/2" = 1' - 0" shows significantly more detail than one drawn at 1/4" = 1' - 0", and requires a greater range of line weights. Monticello, Charlottesville, Virginia.

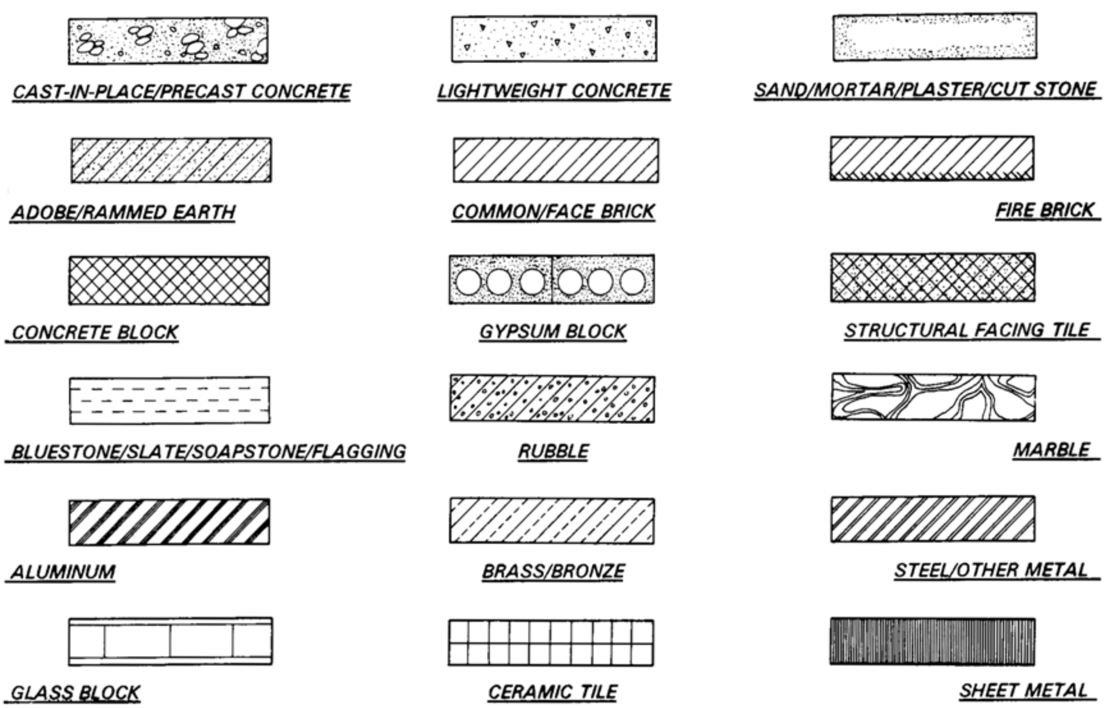


Figure 5.4: Architectural materials symbols. Charles G. Ramsey, *Architectural Graphic Standards, 8th Ed.*, page 794.

5.6.0 PLAN PROCESS

5.6.1 If a structure has more than one level, all plans must be checked against each other for discrepancies between walls, columns and stairs. Inking a plan proceeds by drawing:

1) the major walls, columns and other structural elements;

2) doors with swings, other openings, stairs, hearths, historic kitchen appliances and bathroom features;

3) elements above the cut line (indicated by dashed lines) such as mantels, skylights, reflected ceilings, roof lines;

4) elements drawn on the reverse side of the drafting film such as floor boards, floor tiles, spaces and elements seen below floor but above the cut line for the story below, material poché, stippling;

5) dimensions, section cut indicators, stair direction arrows, match lines;

6) drawing title(s), graphic scales;

7) notes, room labels, north arrow.

5.7.0 ELEVATION PROCESS

5.7.1 Each elevation should match all plans, with special attention paid to the placement of openings. In addition, each section should meet adjacent elevations cleanly at the corners, with special attention paid to matching cornices, quoins, and siding. If possible, one delineator should be responsible for all repetitive elements (windows, ornamentation) in order to preserve consistency in rendering the character of the structure. Order of inking:

1) outline of major wall and roof lines;

2) outlines of projections such as chimneys, side porches;

3) forward edges of roof, columns, porches, steps and other elements that project forward from drawing plane;

4) doors and windows;

5) remaining details, dashed-in indications of elements removed for graphic clarity, as well as partially or totally hidden elements such as basements;

6) ground line;

7) elements on reverse of sheet: building elements in far background; brick coursing, wood siding, roof materials, masonry and other stippling.

8) If necessary, carefully build up line weights on projecting wings, porches, etc. to increase perception of depth. For buildings, only wall and roof outlines, as well as porch columns and opening, need be emphasized in this manner.

9) Dimensions, drawing title, notes.

5.7.2 Various illustrations in this Handbook provide examples for rendering masonry, stone, adobe, wood, ornamentation, ghosts, corrugation, cracks and other damage.

5.8.0 SECTION PROCESS

5.8.1 Section cuts must be checked against plans and elevations--both forward and behind. The delineator must be sure that jogged sections are properly aligned and can be easily understood.

Drawing proceeds as follows:

1) Draw major cut lines to locate walls, floors, ceilings and stairs;

2) locate roof line;

3) locate slices through roof where section jogs;

4) draw any other elements which are cut, such as rafters and stair rails;

5) complete walls, interior openings beyond the cut, grade line;

6) complete interior elevations (hearths, crown molding, and other architectural details. Consult with project leader before rendering painted or stenciled ornamentation.)

7) Draw any elevations attached to the section.

No poché is shown in section floor and wall cuts.

5.9.0 DETAIL PROCESS

5.9.1 Because details are drawn at large scales, it is tempting to use heavier line weights. However, it is preferable to use the same range as for 1/4" = 1' - 0" drawings, then use stippling for texture and shadows when appropriate.

5.10.0 AXONOMETRIC PROCESS

5.10.1 In addition to being dimensionally accurate, axonometric drawings must clearly differentiate among elements in different planes, various materials, and various levels of importance. A sense of depth can be imparted through the selective use of wood graining; the stippling of stone and masonry for texture; the use of the heaviest line weights at the picture plane and progressively lighter lines as the image recedes. Following the convention of sunlight falling from the upper left, these techniques can be employed to suggest shading in order to enhance the depth of the image.

5.11.0 DELINEATING IRON AND STEEL STRUCTURES

5.11.1 Historic architectural structures sometimes contain iron or steel building materials and structural systems, often similar to the subjects of documentation by the Historic American Engineering Record. Figures 5.9, 5.10 and 5.11 are examples of bridge drawings, showing a typical elevation, isometric and connection detail.

5.11.2 In the elevation (Figure 5.9), note that showing rivets adds texture to the drawing. Also, varying line weights on the diagonal bracing adds depth and helps differentiate among structural members.

5.11.3 An isometric (Figure 5.10) best illustrates the construction of a truss-like structure. The various line weights emphasize the three-dimensionality of beams and truss members. At this scale, bolt threads are rendered schematically, but not freehand. Nuts, bolt heads and other parts are drawn as exactly as possible. Decking and other contextual items are drawn on the reverse side of the drafting film.

5.11.4 In the connection detail (Figure 5.11), shading supplements the dashed lines that show how parts fit together, and adds depth and boldness to this type of drawing. The steel poché should be used at cut lines.

5.12.0 DIMENSION LINES

5.12.1 In determining the comprehensiveness of dimension lines, recorders must anticipate a variety of potential end uses of the drawings (restoration, maintenance, and publication); the complexity of the images; size of the images on the sheets; and type (plan, elevation etc.). In conjunction with the field notes, HABS ink drawings can convey the same amount of dimensional information as construction drawings. Alone, their purpose is to present over-all and major element dimensions, as well as style, form, construction history and materials, and existing conditions.

5.12.2 Plans show the most dimensions. The minimum required are: over-alls for all sides; over-alls for blocks, wings, etc.; widths of openings and distances between them.

5.12.3 Elevations show exterior and interior distances between major vertical divisions: from finished floor to finished floor; eaves or soffits; cornices; roof ridges and chimney heights. Unless the grade is relatively solid and permanent (brick or concrete surface), the 0' - 0" mark should be the first floor, with running dimensions up and down.

Both elevations and sections should also show floor to ceiling heights, using incremental dimensions.

5.12.4 Ornamental details usually require only over-all dimensions because they are best recorded photographically with scale sticks. Construction details may be shown with a combination of dimensions and notes calling out nominal/actual sizes of generic materials.

5.12.5 In plan, the first dimension line (rough openings) is typically drawn 3/4" to 1" from the image, and successive lines are 3/8" apart. The distance indicators should approach, but never touch the image. A dot (.70 mm or .80 mm pen) is placed at the intersections. The lines should be constructed uniformly throughout the set.

5.12.6 For elevations and sections, dimension lines should be located far enough away from the image to accommodate one or two-word notes, typically 1 - 1/2" to 2".

5.13.0 LETTERING

5.13.1 The HABS standard for inking text is either use of the Leroy or similar mechanical lettering system, or neat, consistent and unadorned hand-lettering. The use of "stickyback" or other types of press-on lettering is not acceptable.

The preferred style for all text, notes and dimensions is sans serif or "helvetica." Large, open-face, serif templates are used on title sheets. Only capital letters are used except to pluralize a date ("THE 1990s"). Because drawings are always reduced for transmittal, publication and microfilming, all lettering must remain legible when reduced. Text blocks are usually justified with the aid of a word processor; font sizes correspond to the Leroy templates: 24 point = 240 template, etc. If a word must be hyphenated, its syllabication should be checked. Words are not divided if two letters remain standing alone, or if they are proper nouns.

5.13.2 Lettering should be practiced well in advance of inking the drawings. The delineator should hold the scriber lightly, keeping his eye on the pin in the groove, rather than on the actual letter being inked. If text is being inked without a printed underlay, careful attention must be paid to even spacing between letters and words. Consistent line weight and crispness of the letters is as important as precise drafting of the images. A useful skill is the ability to letter backwards; when lettering dimensions on elevations and sections, inking from right to left will aid in aligning the text.

240	PAINTED DESERT INN
175	PLAN; KITCHEN (10′-6" x 8′-0")
140	9′-8 3/4"; WALLS: ADOBE
120	METERS: 1:50; USGS 1951 YOSEMITE
100	DURANGO

Figure 5.5: Examples of mechanical lettering.

5.13.3 Recommended mechanical lettering template sizes:

size	use
240 (1/4")	Name of structure in title block. Name of drawing.
175	Drawing subtitles, room labels with dimensions. Statement of significance, project information for 33" x 44" sheets.
140	Dimensions, materials lists and other notes. Statement of significance, project information for 24" x 36" sheets.
120 (1/8")	Scales, title block information, name of delineators. UTM information on location map.
100	Place names on location map.

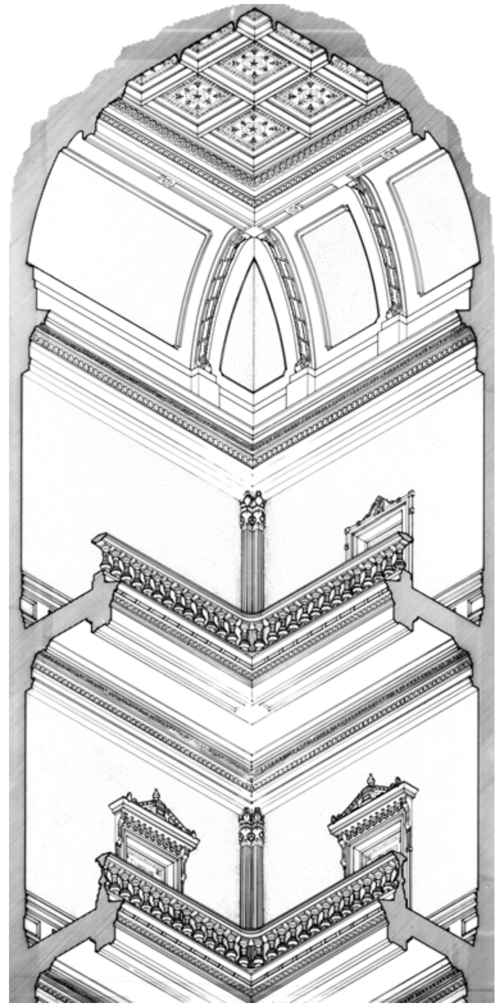


Figure 5.7: Isometric, upward view. Texas State Capitol, Austin, Texas.

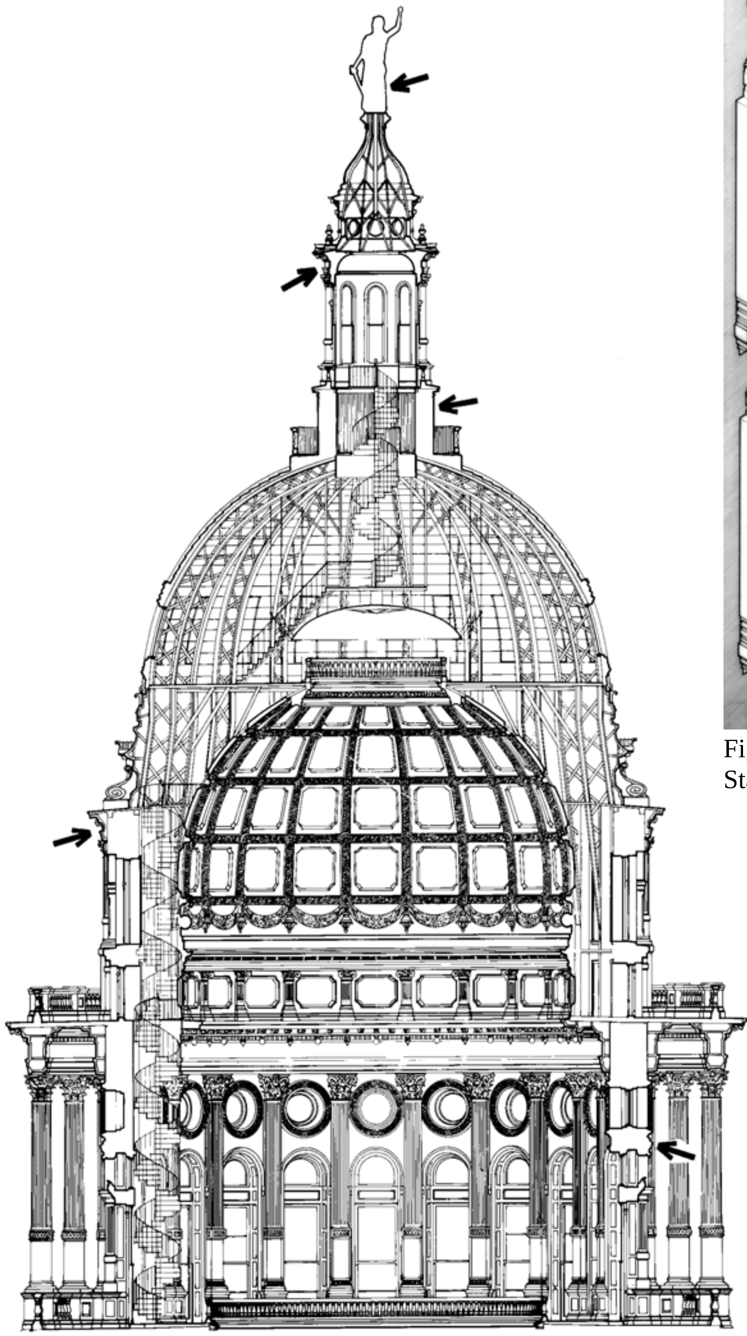


Figure 5.6: Reduction of a section/interior elevation through the dome of the Texas State Capitol, Austin, Texas. Blank areas indicated by arrows can not be recorded by conventional methods.

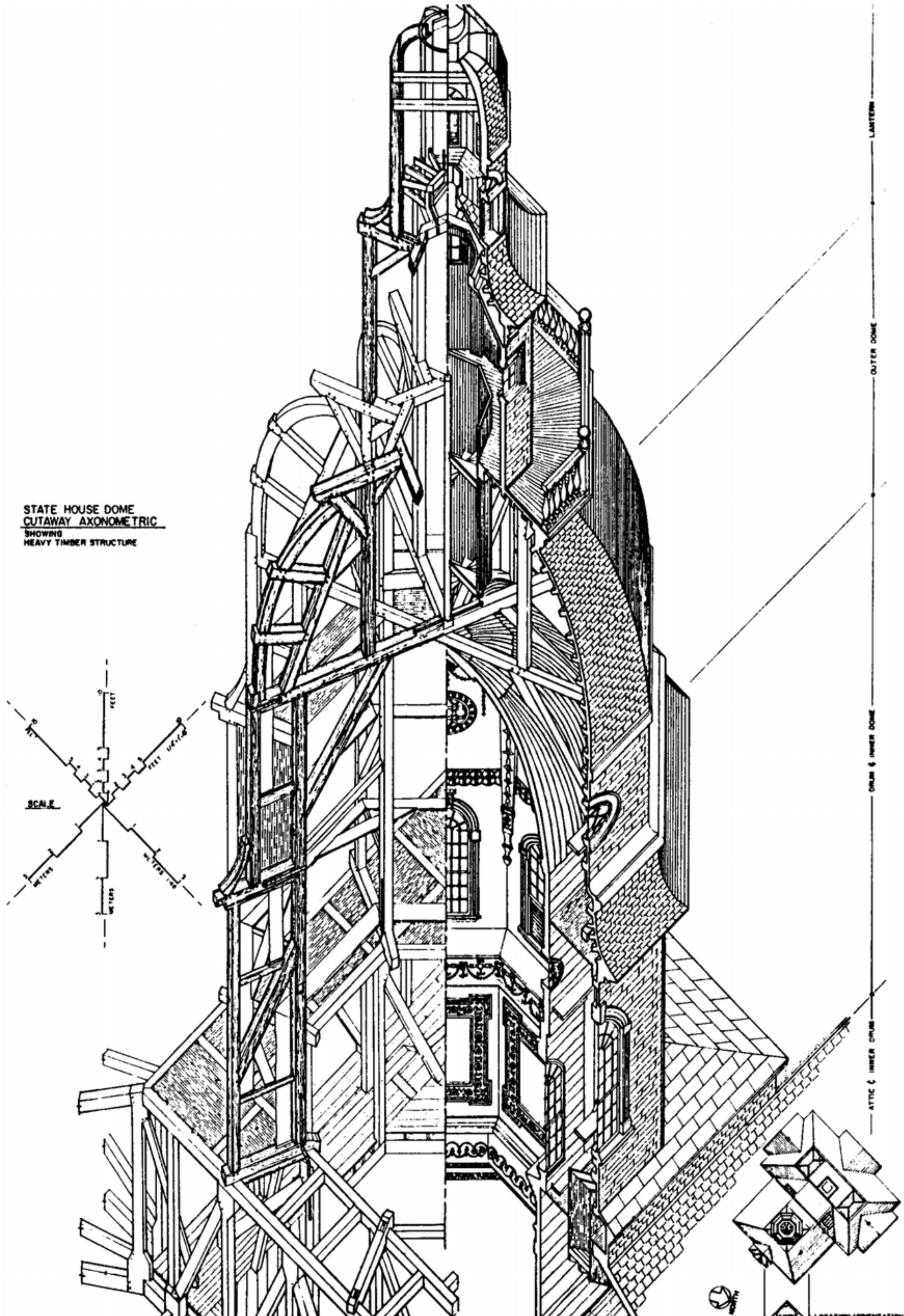


Figure 5.8: Cutaway axonometric drawing of the Maryland State House dome, Annapolis, Maryland, showing the heavy timber structure, cladding, and interior elevation.

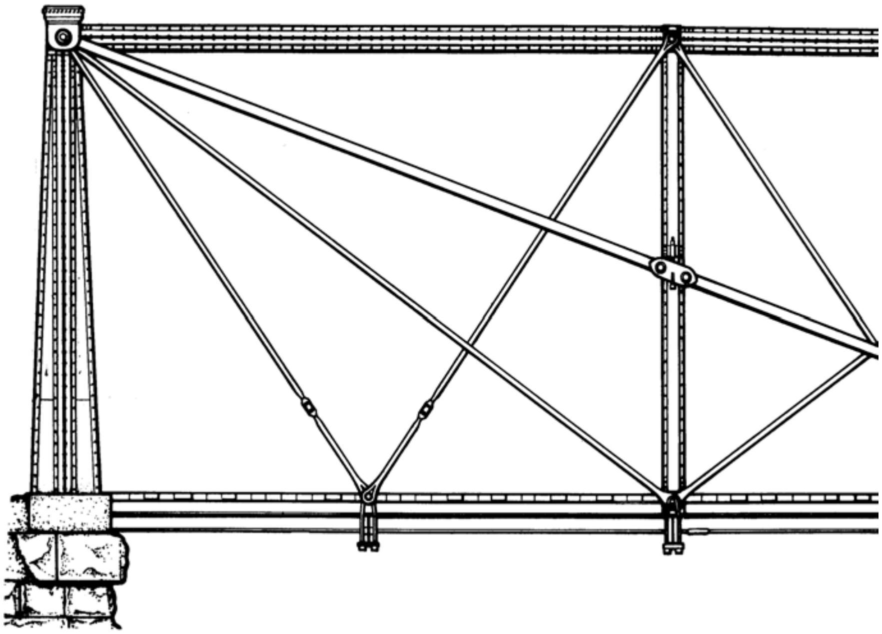


Figure 5.9: Elevation of a truss-like structure. Zoarville Station Bridge, Zoarville, Ohio (HAER).

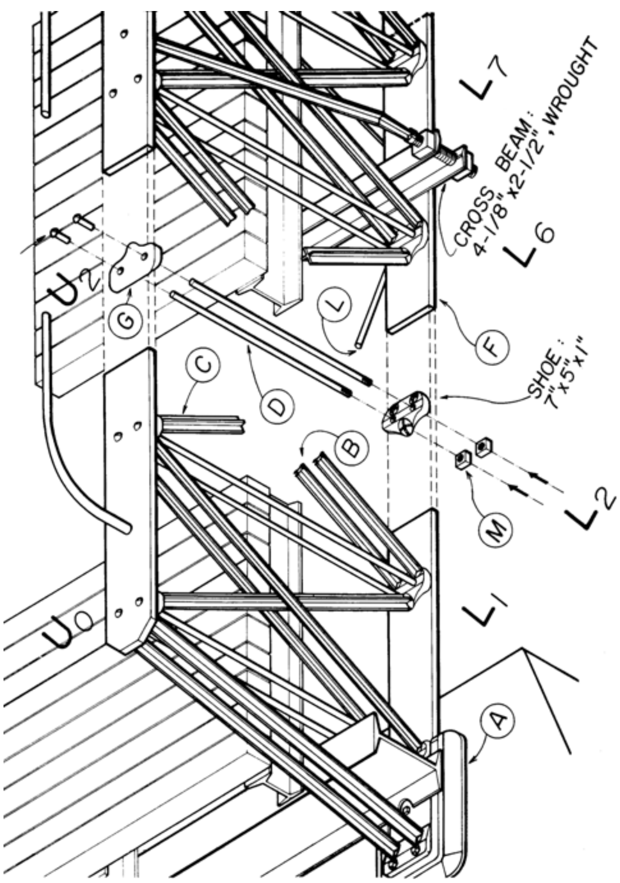


Figure 5.10: Partially exploded axonometric of a bridge truss, showing the use of several line weights to help distinguish the various elements. Sockman Road Bridge, Fredericktown, Ohio (HAER).

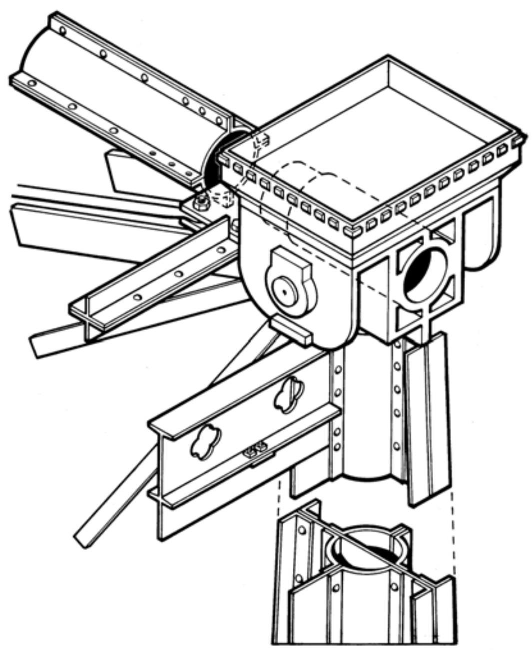


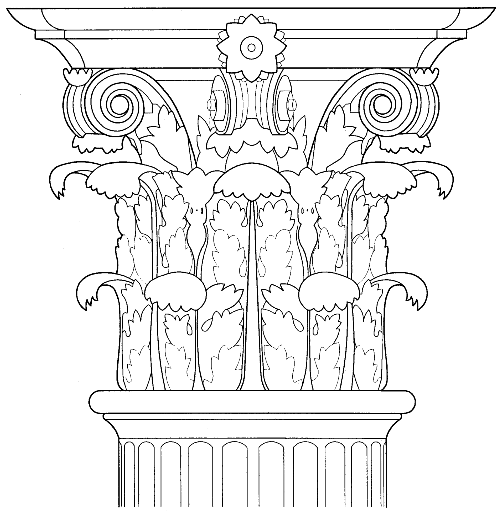
Figure 5.11: Dilineation of metal connection details. Zoarville Station Bridge, Zoarville, Ohio (HAER).

HABS GUIDELINE

RECORDING STRUCTURES AND SITES

with

HABS MEASURED DRAWINGS



SECTION 6.0
LANDSCAPE DOCUMENTATION

U.S. Department of the Interior
National Park Service
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6.0.0 LANDSCAPE DOCUMENTATION

6.1.0 LEVELS AND TYPES OF LANDSCAPE DOCUMENTATION

6.1.1 HABS undertakes various types of landscape documentation. These variations require differing recording techniques and degrees of accuracy, and result in different final products:

1) sites immediately surrounding and associated with documented structures;

2) parks, formal and informal gardens;

3) archaeological sites;

4) city plans;

5) heritage corridors.

6.1.2 A general site plan--usually associated with structures being documented--locates all structures, transportation routes, sidewalks and major paths, walls and fences, major trees and other plantings, and water courses. The most commonly used scales are 1 inch equaling 20, 30 or 40 feet; distances and dimensions should be accurate to 1 inch.

6.1.3 Comprehensive documentation is usually undertaken to record parks and gardens as entities in themselves. The drawings may include historical and developmental maps, topographical surveys, planting lists (including common and botanical designations), hardscape and furniture materials lists, elevations, details and site sections. Depending on the size of such sites, overall plans can be drawn to the common engineering scales or to the smaller architectural scales. Drawings focusing on particular areas, furniture and details will be produced at 1/8" = 1'-0" or larger, and will require measuring to 1/4" or closer.

6.1.4 Large sites combining structure and landscape such as fortifications may require maps which show the development of the fortifications, quarters, support structures and ordnance. In addition to the maps, plans, elevations, sections, details and axonometrics may be required to support future restoration work. The resulting drawings will need to reflect a very high degree of accuracy. (Drawings of such structures and sites often need to be drawn at a large scale. To fit on HABS standard film, it may be necessary to draw very large structures or landscapes in pieces or sections, using match lines to refer individual sheets to one another. If a drawing is broken up and placed onto several sheets, a location graphic or "key" should be used to provide clarity and maintain order of drawing sequence.)

6.2.0 PROCEDURE FOR RESEARCHING SITE PLANS

6.2.1 Depending on the nature of the documentation project, a site plan will complement historical and architectural information presented on structures, or will stand alone.

6.2.2 Previous site surveys, photographs and historical descriptions can provide valuable insights into site development over time, the prevailing condition and topography. This information can be used to plan the continuation of the physical survey.

6.2.3 Plant identification. If a landscape architect is not available, local horticulturalists, nursery personnel, agricultural agents and garden club members are all excellent sources. Take close-up photographs of leaves, flowers, fruit and bark, and if necessary, carefully collect samples. Finally, numerous plant identification publications are available--especially *Hortus III.*

6.2.4 Nomenclature. Planting lists must always include common and botanical names. The abbreviations are written in the form:

PG/HM--PROSOPIS GLANDULOSA--HONEY MESQUITE

Botanical nomenclature is universally understood, based on natural relationships among plants, and consistent in form. It consists of 1) genus and 2) species. Genus is applied to a closely related group of plants, such as dogwoods or honeysuckle; species is the particular kind of dogwood or honeysuckle. Place the genus name first, followed by species.

Common names readily identify plants to laymen. Since a variety of common names can be used for one plant, the preferred names as listed in *Hortus III* will serve as the standard for HABS documentation.

6.2.5 Information sources for site research:

Department of Natural Resources (state)	Landsat Imagery, Aerial Photographs
Department of Highways and Transportation (state)	Aerial Photography
U.S. Department of Agriculture Aerial Photography Field Office 2222 W., 2300 S. Salt Lake City, UT 84119-2020 or P.O. Box 30010 Salt Lake City, UT 84130-0010	Aerial Photography
U.S. Department of Agriculture Soil Conservation Service Cartographic & Geological Information Systems P.O. Box 2890 Washington, D.C. 20013	Soils, Aerial Photography
U.S. Department of Agriculture U.S. Forest Service Engineering Department attn: Geometronics 14th Street and Independence Avenue Washington, D.C. 20090-6090	Aerial Vegetation Surveys
U.S. Geological Survey U.S. Department of the Interior Washington D.C. 20240	Geology, Aerial Photography, Topographic and Location Maps
Bureau of Land Management U.S. Department of the Interior Washington, D.C. 20240	Aerial Photography, Surveys

6.3.0 PROCEDURE FOR MEASURING SITES

6.3.1 Small, easily measured sites and larger sites that are relatively flat can be recorded with hand-measuring, triangulation (Figure 6.1) and some work with surveying equipment such as a transit or builder's level. If base maps exist, they may be used for field noting in addition to new sketches.

6.3.2 A higher degree of accuracy is achieved with a theodolite, alone or in combination with an electronic distance meter (EDM) or laser total station. These instruments calculate distances and relative heights trigonometrically, virtually eliminating horizontal errors over great distances due to slope, as well as stretching and the catenary effect of tapes held in the air.

6.3.3 Archaeological sites with highly irregular shapes, such as pueblo ruins, are sometimes recorded in plan with aerial over-flight photogrammetry. A remotely controlled "drone" flies a special camera over the site. The series of continuous and overlapping images is read by a CAD system that digitizes the information and draws the plan. These sites can also be recorded using the above-mentioned surveying techniques. Wall intersections and other prominent features can be located by angle and distance from a benchmark with an EDM, then relative to each other through triangulation. Wall thicknesses and room shapes can then be determined.

6.3.4 If triangulation is undertaken carefully, it can be accurately used to survey a relatively flat site. The fundamental principle is to locate every unknown point from two other known points. First, structures are located relative to each other, then trees, roads, walks, utility poles, planting beds etc. are located relative to the nearest structures.

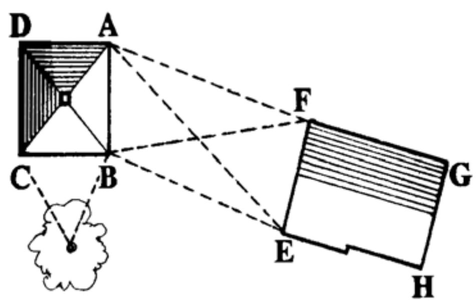

Figure 6.1: Site triangulation.

6.3.5 To locate a measured structure EFGH from another measured structure ABCD, run a tape from A and B to E, and again from A and B to F. The tape should be held as taut and level as possible. EFGH is now placed relative to ABCD.

6.3.6 Trees are located relative to structures by estimating the center of the tree, or by measuring the diameter and adding the radius (d/2) to a measurement to the nearest side. The canopy is recorded by laying a tape on the ground out from the trunk.

6.3.7 Structures situated great distances from each other can be located by establishing pairs of intermediate reference points between them, usually in the form of nails driven into stake. The stakes should be 10'- 20' apart. Triangulation can then be continued from these points. Maintaining tautness and horizontality to ensure accuracy can not be over-emphasized, because small initial errors can be greatly compounded over great distances.

6.4.0 PROCEDURE FOR DRAWING PRELIMINARY SITE PLANS

6.4.1 A site plan should be drawn in the order in which it was measured, that is, unknown points found relative to known ones, amorphous features such as plants and stones located relative to dimensionable ones.

1) Draw the principal structure in plan, taking care to show roof outlines if they project beyond the building walls;

2) locate all built structures relative to each other;

3) locate fences, walls, bollards, etc. relative to the nearest structures;

4) locate streets, walks and other hardscape;

5) draw tree trunks and canopies;

6) draw the remainder of the planting;

7) add graphic scales, planting lists, north arrows, plant designations, notes.

6.5.0 INKING SITE PLANS

6.5.1 The site plan should include a roof plan and enough detail of the surrounding area to indicate important relationships with nearby structures and landscape features. If the site itself is the focus of the project, as in the case of a formal garden, for example, the detail and relative line weights should reflect this emphasis.

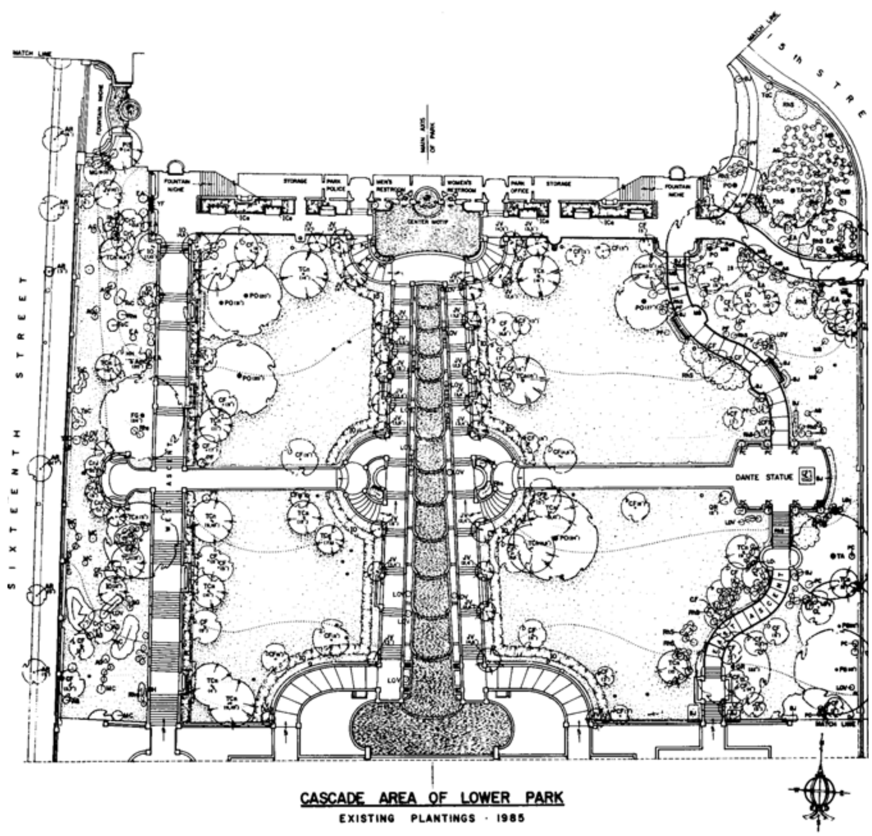

Figure 6.4: Meridian Hill Park, Washington, D.C. Drawing includes architectural, horticultural and topographical information.

HABS GUIDELINE

RECORDING STRUCTURES AND SITES

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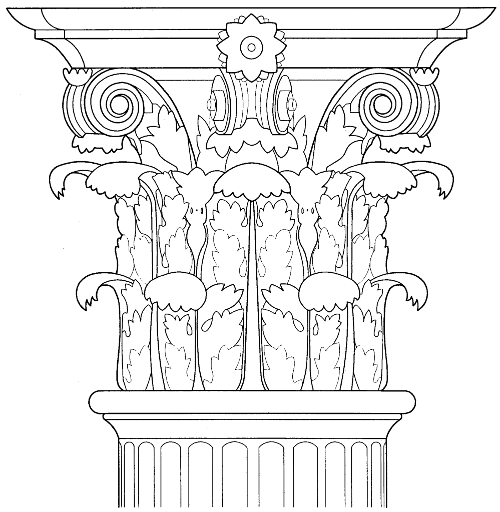
HABS MEASURED DRAWINGS



HABS

SECTION 7.0
DOCUMENTATION OF CONSTRUCTION HISTORIES AND SITE DEVELOPMENT

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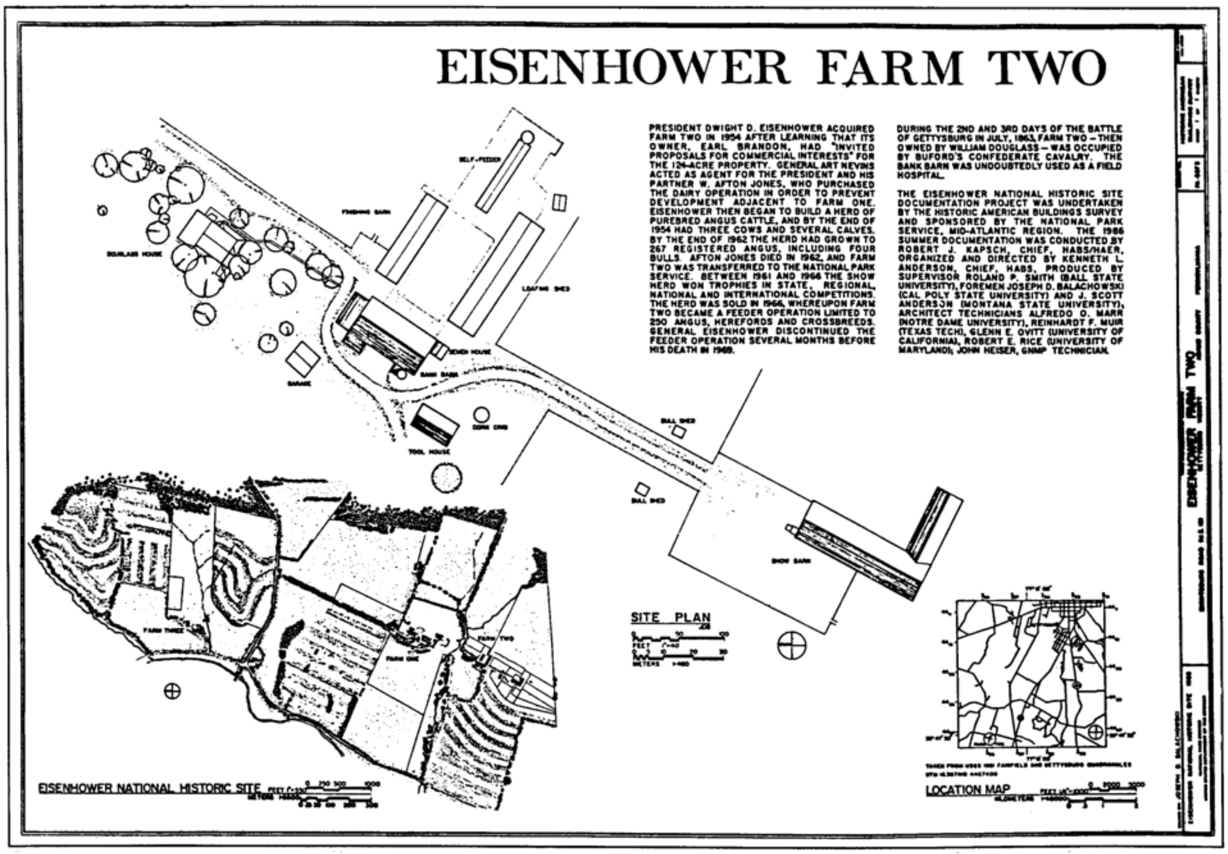

Figure 6.5: Three levels of site information on a title sheet: a group of related farm structures, three farms comprising a national historic site, and a location map for the entire vicinity.

7.0.0 DOCUMENTATION OF CONSTRUCTION HISTORIES AND SITE DEVELOPMENT

7.1.0 Construction histories of buildings substantially completed at one period in time
7.2.0 Buildings exhibiting evidence of major changes in form at specific points in time
7.3.0 Site development over time

7.1.0 CONSTRUCTION HISTORIES OF BUILDINGS SUBSTANTIALLY COMPLETED AT ONE PERIOD IN TIME

7.1.1 This type of structure can be recognized through its relatively homogeneous form; in other words, most of the changes have been to divide spaces with new partitions, remove interior walls, alter the scheme of ornamentation, or block or create openings.

Information on such structures can be assembled through a combination of on-site sleuthing, consulting with the project historian, researching available photographs, deeds and other court records, diaries and other personal records, and oral history. Repair, reconstruction and alterations are often indicated by paint shadows, material discoloration, changes in material and workmanship, unusual framing such as a wall located too close to a window, and the presence of incongruous materials or hardware such as mismatched baseboards or remnants of flashing.

7.1.2 Changes on these structures can be indicated on the existing condition drawings--to the extent that the drawings do not become so cluttered with historical information that they become unusable for future research, maintenance or restoration. Use poché patterns and dashed lines to denote alterations in plan. Stippling can indicate paint shadows, and dashed lines can show former detail profiles and the outline of building elements no longer extant. Use notes when appropriate.

7.2.0 BUILDINGS EXHIBITING EVIDENCE OF MAJOR CHANGES IN FORM AT SPECIFIC POINTS IN TIME

7.2.1 Careful research into records and photographs, a knowledge of the history of construction technology, and an eye for differences in massing, space configuration and style will aid the analysis of these structures. The resulting information is usually best represented in the following way:

1) The construction phases are drawn separately from existing conditions;

2) the representations are schematic, focusing on the major changes in form with less emphasis on detail;

3) the scale is reduced;

4) Use idealized forms, but retain as much dimensional accuracy as possible. Do not simply trace design drawings unless their translation into built forms can be confirmed;

5) if possible, use a reduced number of line weights; a heavy line weight and poché can emphasize the historic form, while a lighter line weight or dashed line will reference the current form;

6) annotate the drawings.

These drawings are to be placed at the end of the set.

7.3.0 SITE DEVELOPMENT OVER TIME

7.3.1 Documenting the development of a site over time can involve a great deal of research, sometimes resulting in conflicting information. When architects undertake this level of research, they must work with historians in planning the final graphic product.

7.3.2 In addition to sources mentioned above, maps from the Sanborn Fire Insurance Company are fairly accurate surveys of historic properties. In directing research:

1) an architectural supervisor should request maps drawn at or near the most significant historical periods of the site. For example, the historical development of a fort may be best explained through maps depicting it during each war in its history. (A 1987 HABS team at Fort Monroe, Hampton, Virginia, produced maps showing the state of the fort at the time of its completion, at the end of the Civil War, at the end of the two world wars as well as 1987.);

2) focus on eras for which the most reliable information is available, and date individual buildings;

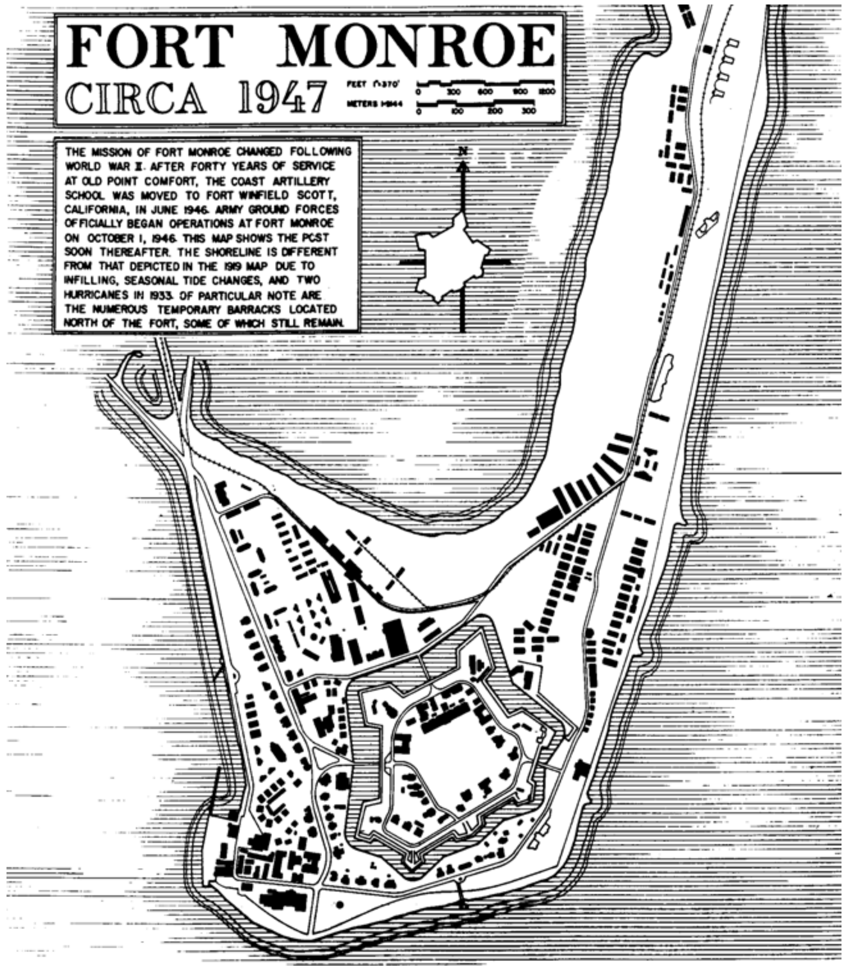

Figure 7.1: Fourth in a series of five developmental maps of Fort Monroe, Hampton, Virginia. Figure 7.1: Fourth in a series of five developmental maps of Fort Monroe, Hampton, Virginia.

3) avoid mixing eras on one map, especially by showing multiple building locations and configurations, changes in land and water forms;

4) for a series of overlays, use the most recent maps as a base map, trace unchanged features, then record the changes backwards in time;

5) to save time, if only a portion of the site has changed, consider drawing only the altered areas.

HABS GUIDELINE

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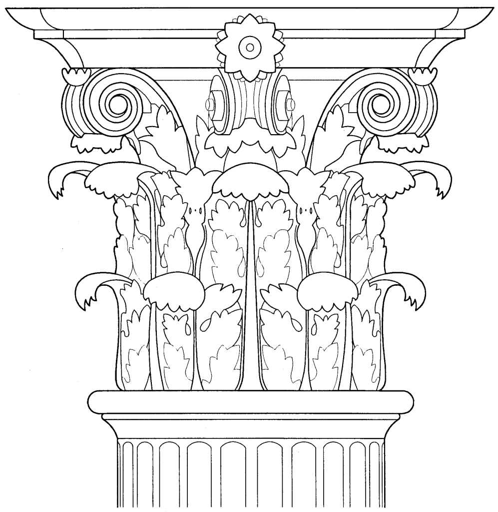

SECTION 8.0
COMPLETING THE SET

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8.0.0 COMPLETING THE SET

8.1.0 TITLE BLOCKS

8.1.1 All drawings are filed and retrieved by the information found in the title block; it is imperative that this information be correct. (The following guidelines apply to HABS-sponsored projects and to those recorders intending to submit their work to the Library of Congress through HABS. All others should obtain guidelines from their own sponsors.)

The left block should contain the project name and year. The name and location of structure block should include the historic name followed by any secondary names in parentheses, centered, and inked with the 240 (1/4") Leroy template. If possible, provide a numbered street or road address. If a road is numbered rather than named, indicate whether it is Federal, State or County. If a structure does not have a specific address, indicate the nearest roads or geographic features. Rural structures should be located according to the nearest town followed by the word "VICINITY." Independent cities (frequently found in Virginia, for example) should be indicated with the words "INDEPENDENT CITY" enclosed in parentheses. Finally, include the city or town, county/parish (with the words "COUNTY" or "PARISH") and state.

The survey number may be inked in if known; the Library of Congress index number is to be left blank. The name of the delineator(s) is inked above and to the left of the title block, followed by the year. The delineators' names and all title block items except the structure or site name is to be inked with a 120 (1/8") template.

The order for numbering sheets is:

1) title sheet
2) site plans
3) plans (basement to attic)
4) elevations (front, then counter clockwise)
5) sections
6) exterior details
7) interior details
8) axonometrics
9) construction history

Detailed instructions on assigning the correct names to structures and sites can be found in *HABS/HAER Guidelines: HABS Historical Reports.*

8.2.0 LOCATION MAP

8.2.1 The location map is drawn on the title sheet or with the site plan. It should be traced from a USGS 7-1/2' quadrangle map and must include the town used in the address, as well as Universal Transverse Mercator (UTM) grid ticks along each edge of the map. Label all UTM grid ticks. Auxiliary information to the location map includes the quad name and date, ratio scale, mile and kilometer scales, north arrow, and UTM coordinates for the site (UTM: zone.easting.northing). Because not all of the country is covered by 7-1/2' quad maps, 15' or other maps may be substituted. Credit the map source on the drawing.

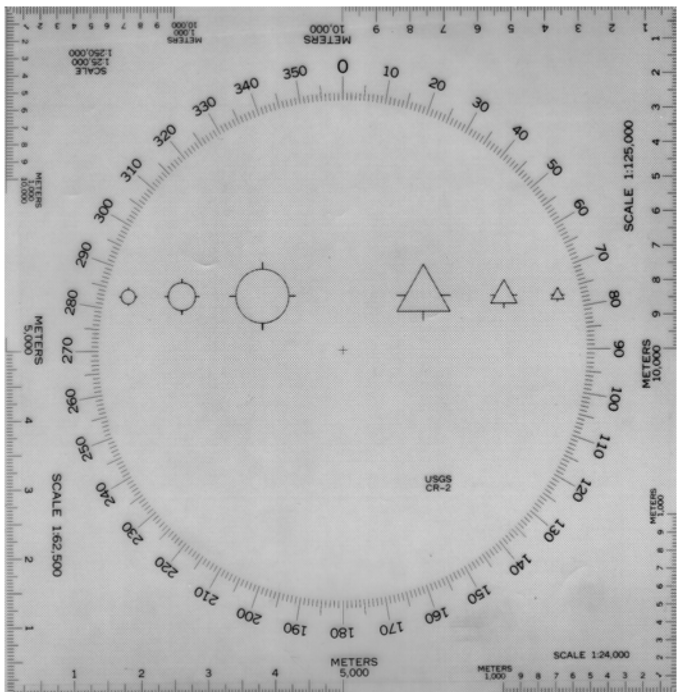

Figure 8.1: A UTM coordinate counter.

8.3.0 THE UTM GRID SYSTEM

8.3.1 The UTM Grid system provides an accurate method for recording the geographic location of a historic site; the coordinates are used in a computerized data retrieval system, and must be accurate. The UTM location of a site can be determined in the field by some Global Positioning System (GPS) devices or can be found using a USGS quadrangle map that has the blue UTM grid tick marks along its edges. Most USGS quadrangles published since 1950, and all published since 1959, regardless of scale, have these ticks.

In the UTM system, the earth is divided into 60 "zones," each six degrees wide, running north and south. Most of the United States is included in zones 10 through 19. Zones are numbered beginning at the 180º meridian near the International Date Line. On a map, each zone is flattened, and a square grid is superimposed upon it.

The grid is marked off in meters; any point in the zone may be referenced by citing its zone number, its distance in meters from the Equator ("northing") and its distance in meters from a longitudinal reference line ("easting"). These three figures comprise the complete "UTM grid reference" for any point, and distinguish it from every other point on earth.

8.3.2 The simplest method of determining a UTM reference requires drawing part of the UTM grid on the map, and measuring from the grid lines to the point. The following tools are required:

1) A UTM coordinate counter (available from the United States Geodetic Survey in Reston, Virginia);

2) an ink pen for marking reference points;

3) a very sharp pencil;

4) a straightedge (rather than a ruler, which may not be quite straight) long enough to span the entire map--generally about 36" long;

5) a flat work surface large enough to accommodate the entire map.

8.3.3 Steps for determining points:

1) Draw a line from the top of the map to the bottom, connecting the blue UTM ticks directly west of the point, i.e., with the highest easting value less than that of the point.

2) Draw a line from the left to the right side of the map, connecting the grid ticks directly south of the point, i.e., with the highest northing value below the point.

3) Copy the zone number onto a work sheet; this number can be found below the title of the quadrant;

4) Copy onto a work sheet the portions of the easting and northing values given with the map ticks through which the lines have been drawn.

5) On the coordinate counter, locate the scale that matches that of the map. Align the counter on the map so that:

a. the side of the scale that reads from right to left lies along the east-west line, and

b. the side of the scale that reads from left to right passes directly through the point.

c. Check the alignment to be sure that it is precise.

6) Read the coordinate counter scales, right to left for easting, upward for northing. Enter the measured values onto the form.

7) Check the figures for plausibility and for correct placement of the decimal. Check the figures for accuracy by remeasuring. Observe the correct order: zone number, easting, northing (Z, E, N), and the number of digits (Figure 8.2).

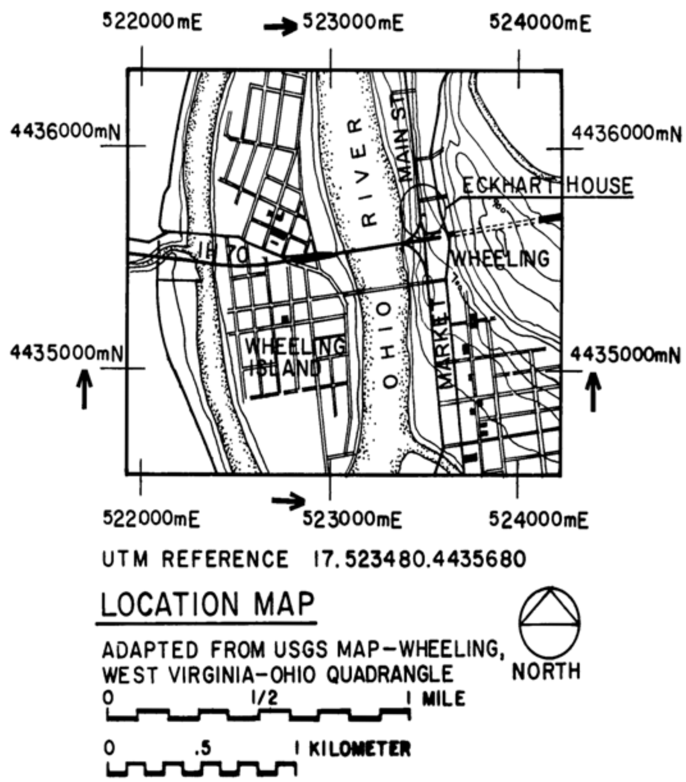

Figure 8.2: Arrows indicate direction of UTM calculation form easting and northing tick marks closest to the site. Note that the tick marks are NOT parallel to the edge of the sheet!

8.4.0 MATERIALS LIST

8.4.1 Materials lists are indispensable aids in interpreting measured drawings. If the use of materials is consistent throughout the structure, the list should appear on or near the title sheet and include structural, finish and ornamental materials. When materials change from floor to floor or elevation to elevation, those changes should be noted on the appropriate sheets. Door, window and detail sheets may have their own lists. The names and composition of materials should be verified before committing them to ink.

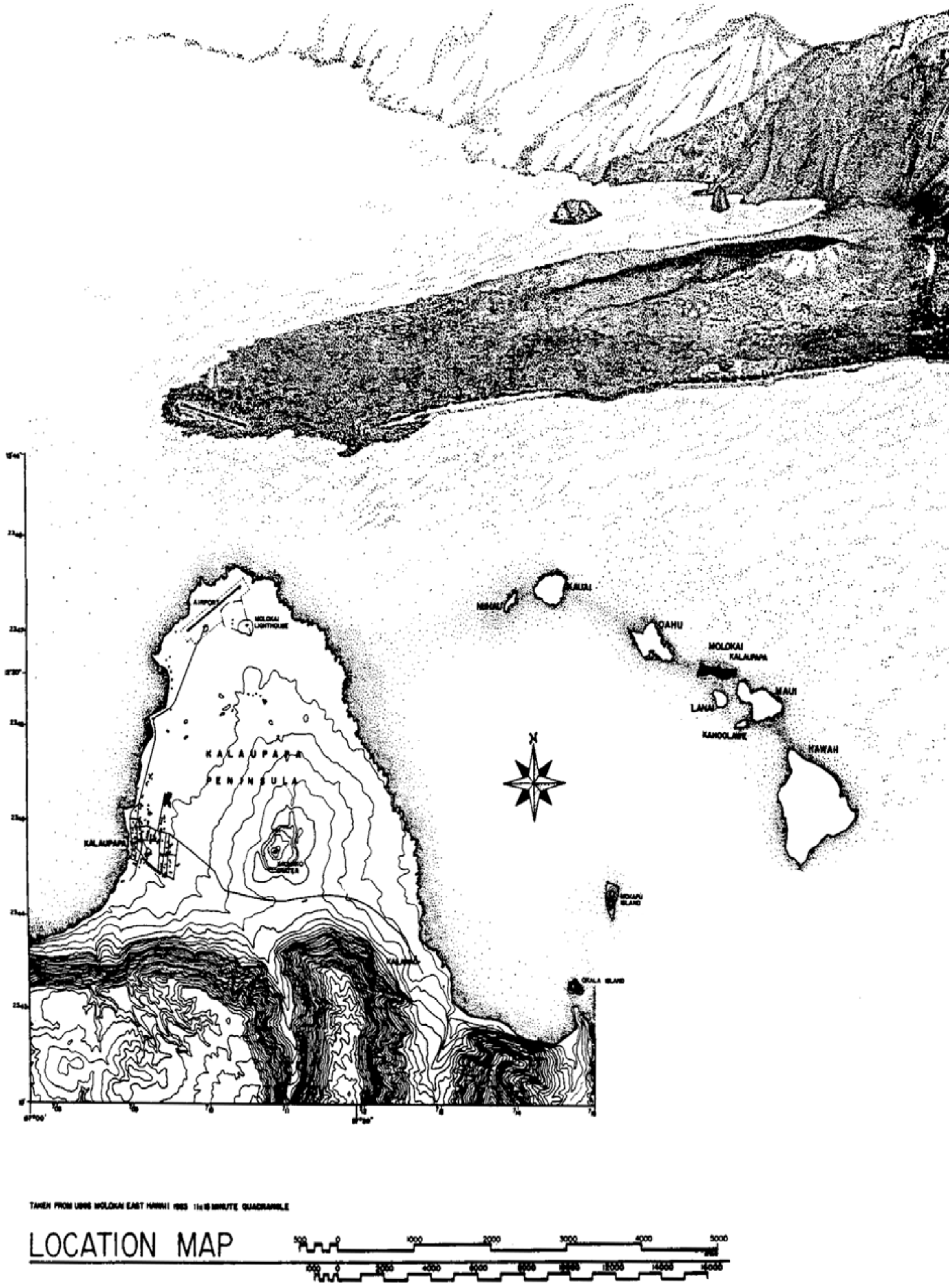

Figure 8.3: Location and vicinity maps, aerial perspective of Kalaupapa National Historical Park, Molokai, Hawaii.

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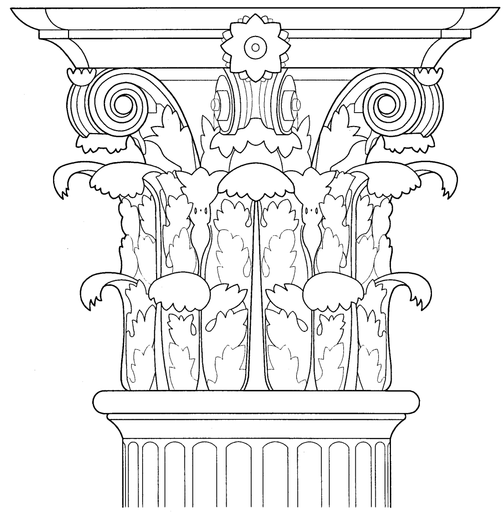

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APPENDIX A:
GRAPHIC CONSTRUCTIONS

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9.0.0 APPENDIX A: GRAPHIC CONSTRUCTIONS

9.1.0 DIVIDING STRAIGHT LINES AND SPACES INTO AN EQUAL NUMBER OF SEGMENTS

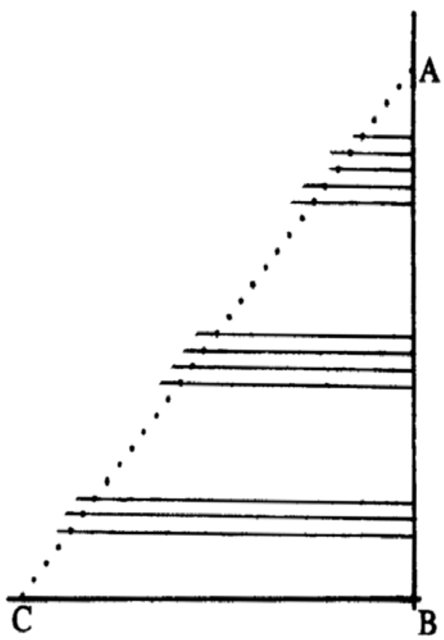

Figure 9.1: Dividing lines and spaces into equal segments.

9.1.1 When drawing repetitive lines that are precisely equidistant from each other, as may be the case with brick courses or floor boards, it is possible to lay out the lines without measuring from one to the next.

1) Draw a line AB perpendicular to the first of the set of parallel lines to be constructed (Figure 9.1);

2) place a scale, ruler or meter stick so that 0 is on the base line, and the number corresponding to the number of increments on a point the required distance from A;

3) with a 4 x 0 pen (if constructing the lines on vellum) mark each increment through which the lines will be drawn;

4) draw a few lines through these points to check the distance between them.

9.2.0 DIVIDING A CIRCLE INTO A NUMBER OF PIE SEGMENTS (inscribing a regular polygon of any number of sides in a given circle)

9.2.1 The technique illustrated in Figure 9.2 may be used to locate regularly occurring features on the plan of a cylindrical structure; or to draw a polygonal structure. For precision, it is recommended that a compass with a 4 x 0 pen be used. NB: This method will produce a geometrically correct polygon. Do not use this method to idealize the structure, but draw it as measured.

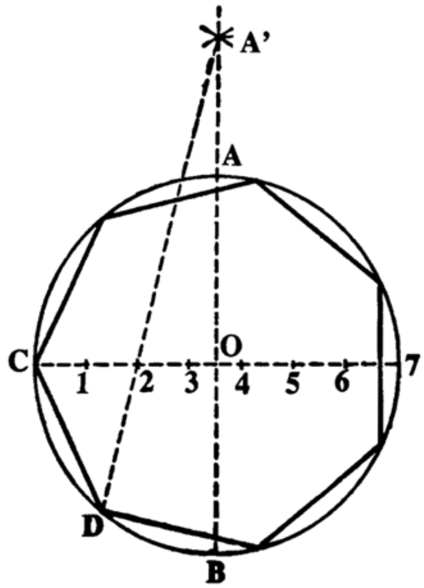

Figure 9.2: Dividing a circle into an equal number of segments.

9.2.2 For a polygon with seven sides:

1) Draw circle A7BC, with its center at O, and a radius of at least 3";

2) draw the two diameters C7 and AB perpendicular to each other;

3) using the technique for dividing lines in 9.1.1, divide the diameter C7 into seven equal parts--the number of required sides;

4) prolong the diameter AB;

5) with either C or 7 as a center, and C7 as a radius, describe an arc to intersect the vertical center line AB at A';

6) through A' and 2, the second division from C on C7, draw the line A'D cutting the circumference at D;

7) draw the chord CD; it is one side of the required polygon;

8) with the compass set to the length of CD, step off the remainder of the polygon on the circumference.

9) The resulting polygon can now be reduced photographically or by projection.

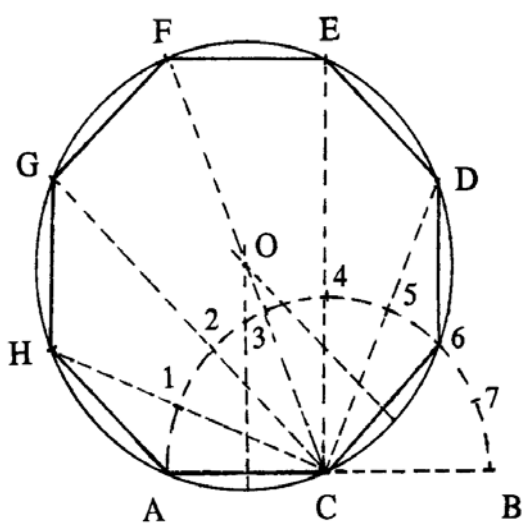

Figure 9.3: Constructing a regular polygon, given one side.

9.3.0 GIVEN ONE SIDE OF A REGULAR POLYGON, CONSTRUCT THE POLYGON

9.3.1 As above, the following method may be used to lay out a plan or detail ONLY if the structure as measured is perfectly regular. Also, it is preferable to use a 4 x 0 pen to plot the construction points. The following example is for constructing an octagon (Figure 9.3).

1) Set a compass to radius AC, draw semicircle A1234567B;

2) divide the semicircle into as many parts as there are sides (in this case, eight);

3) from point C, and through the second division from B (6), draw straight line C6;

4) bisect line AC and C6 by perpendiculars intersecti5) using O as a center, set the compass to radius OC, describe the circle AC6DEFGH;

6) from C, and through points 1, 2, 3, 4, 5 in the semicircle, draw lines CH, CG, CF, CE, CD, meeting the circumference of the circle;

7) joining points C and 6, 6 and D, D and E, etc. by straight lines will produce the required polygon.

9.3.2 The sum of the angles of a regular polygon is given by the formula S=(n-2)180º, where n is the number of angles. For a pentagon, S=(5-2)180º, S=540. For an irregular polygon, the sum will be the same but the angles will vary.

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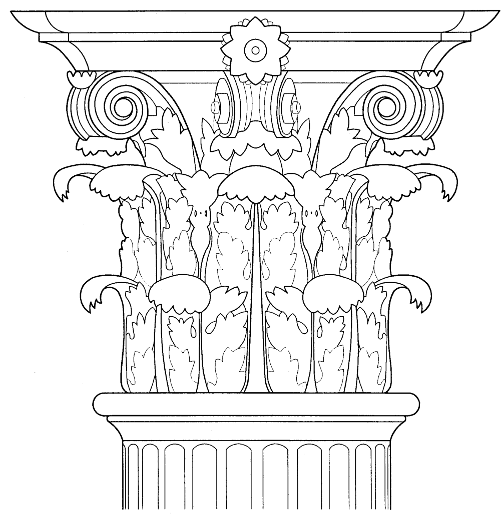

APPENDIX B: PERIMETERS, AREAS AND VOLUMES

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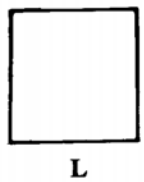
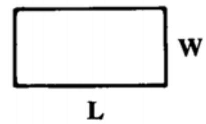
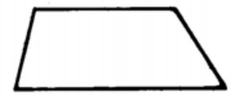
10.0.0 APPENDIX B: PERIMETERS, AREAS AND VOLUMES

10.1.0 Perimeters:



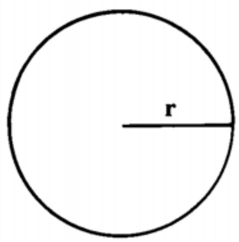


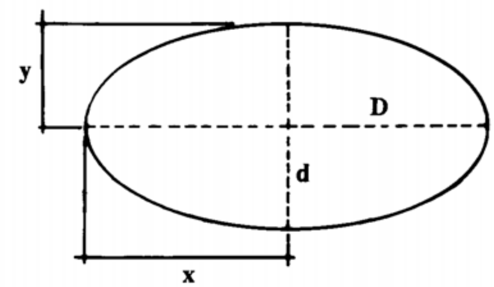


Square: $p = 4L$

Rectangle: $p = 2(L+W)$

Parallelogram, Trapezoid: sum of the lengths of the sides



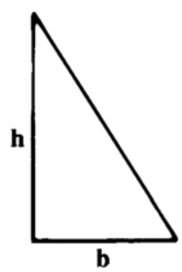


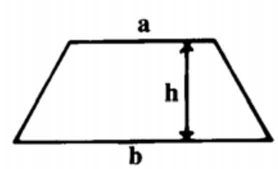
Circle: $C = 2\pi r$

Ellipse (approximate):

$$p=\pi\sqrt{2}\,(x^2+y^2)$$

10.2.0 Areas:





Square: $A = L^2$

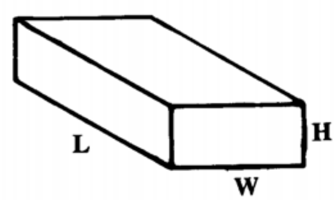
Rectangle: $A = LW$

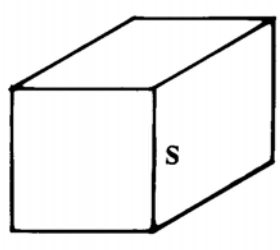
Right triangle: $A = bh/2$

Trapezoid: $$A=\frac{h(a+b)}{2}$$

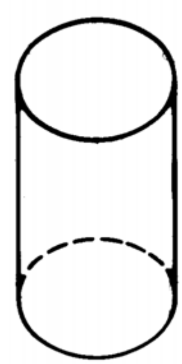
Circle: $A = \pi r^2$

Ellipse: (.7854)Dd





10.3.0 Volumes:



Cube: S^3

Parallelipiped: (L)(W)(H)

Sphere: $4/3\pi r^3$

Cylinder: (area of the base)(h) = $(\pi r^2)(h)$

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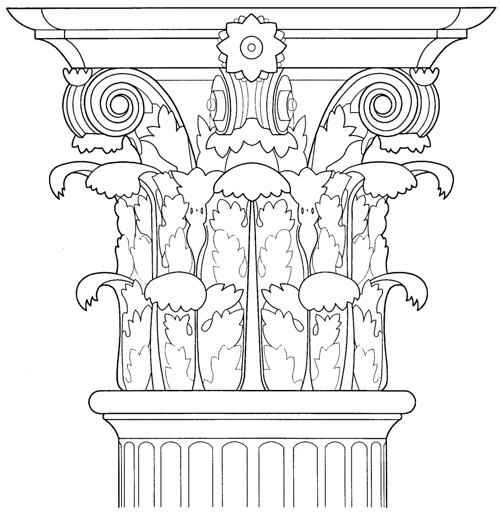

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APPENDIX C: USING TRIGONOMETRIC LAWS AND FUNCTIONS TO SOLVE SURVEYING PROBLEMS

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11.0.0 APPENDIX C: USING TRIGONOMETRIC LAWS AND FUNCTIONS TO SOLVE SURVEYING PROBLEMS

11.1.0 THE LAW OF COSINES

Trigonometric functions and laws are frequently used in surveying, and are especially useful in determining distances between points which cannot be measured directly. With the aid of a pocket calculator with trigonometric functions, the Law of Cosines can be used to solve a triangle of which one angle and two sides are known. In any triangle ABC:

$$a^2=b^2+c^2-2bc(\cos A)$$
$$b^2=a^2+c^2-2ac(\cos B)$$
$$c^2=a^2+b^2-2ab(\cos C)$$

11.1.1 In triangle ABC (Figure 11.1), three points must be located relative to each other. With the transit located at C, the distances AC and BC can be measured, as well as the angle between them. The distance between A and B cannot be hand measured. Side a = 110', b = 150', and ∠C = 75˚. Find AB:

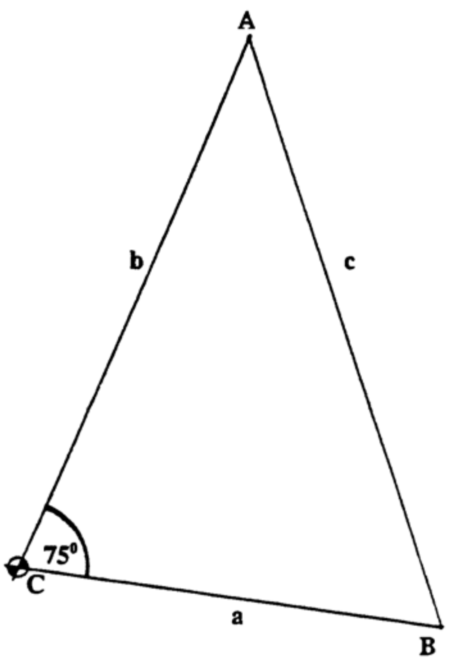

Figure 11.1: Using the Law of Cosines to find side c of triangle ABC.

$$c^2=a^2+b^2-2ab(\cos C)$$
$$=110^2+150^2-2(110)(150)\cos 75^0$$
$$=(12100+22500-33000)(0.2588)$$
$$=26058.9720$$

$$c=\sqrt{26058.9720}$$
$$c=161.43\,feet$$

11.2.0 THE LAW OF SINES

This law can be used to compute unknown sides of a triangle if two angles have been determined with a transit, and the length of one side is known:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

11.2.1 In triangle DEF (Figure 11.2), angle D = 35˚, angle E = 65˚, and side f = 160 feet; find sides d and e. First find angle F = 180˚ - (35˚ + 65˚) = 80˚. Side e can now be calculated:

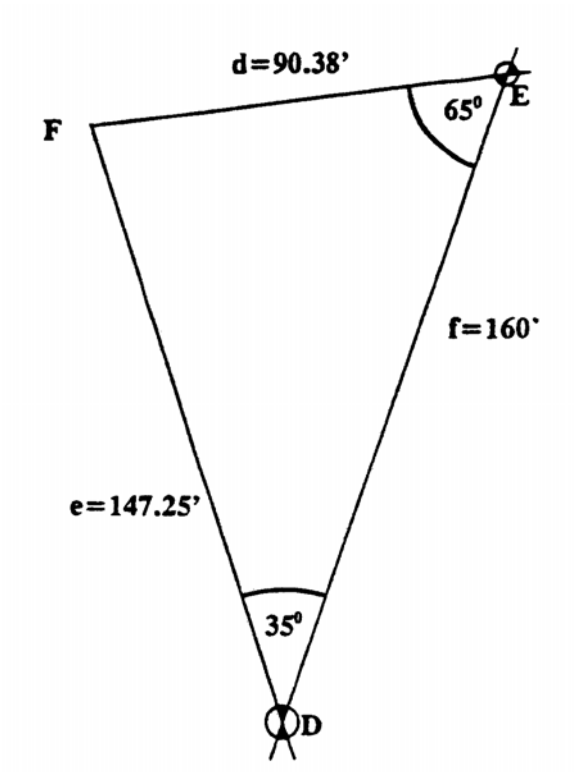

Figure 11.2: Using the Law of Sines twice to determine the unknown sides of a triangle, if two angles and the side between them are known.

$$\frac{\sin E}{e} = \frac{\sin F}{f}$$
$$e(\sin F) = f(\sin E)$$
$$e = \frac{f(\sin E)}{\sin F}$$
$$e = \frac{(160)\sin 65^0}{\sin 80^0}$$
$$e = \frac{(160).9063}{.9848}$$
$$e = 147.25 feet$$

Use original measurements to find side d:

$$d = \frac{f(\sin D)}{\sin F}$$
$$d = \frac{(160)\sin 35^0}{\sin 80^0}$$
$$d = 90.38 feet$$

11.3.0 TRIGONOMETRIC FUNCTIONS FOR RIGHT TRIANGLES (Figure 11.3)

$$\sin\theta = \frac{y}{r}$$

$$\cos\theta = \frac{x}{r}$$

$$\tan\theta = \frac{y}{x}$$

$$\operatorname{cosec}\theta = \frac{r}{y}$$

$$\sec\theta = \frac{r}{x}$$

$$\cot\theta = \frac{x}{y}$$

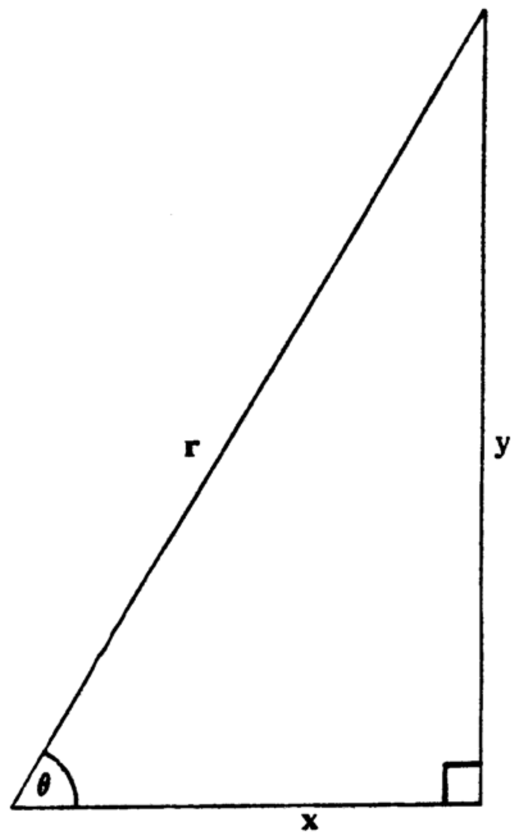

Figure 11.3: A right triangle in which r is the hypotenuse, y is the side opposite sine, and x is the side adjacent to sine.

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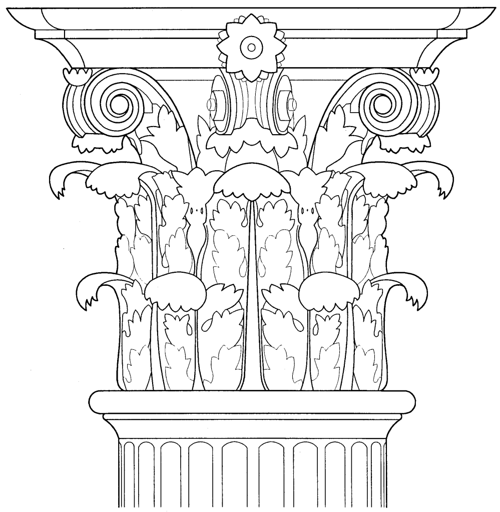

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APPENDIX D:
DETERMINING THE HEIGHTS OF TALL STRUCTURES WITH A TRANSIT

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12.0.0 APPENDIX D: DETERMINING THE HEIGHTS OF TALL STRUCTURES WITH A TRANSIT

1) Set up a transit at point A, at some convenient distance (such as 100') from the structure; note the exact location. Level the instrument. Sight back to the structure, place a target on it to line up with the cross hairs. The imaginary line between the transit crosshairs and the target will be a horizontal datum.

2) Tilt the transit to focus on a center point such as the tip of a weather vane. Note the angle of inclination to the nearest degree and minute possible. *Accuracy here is critical.*

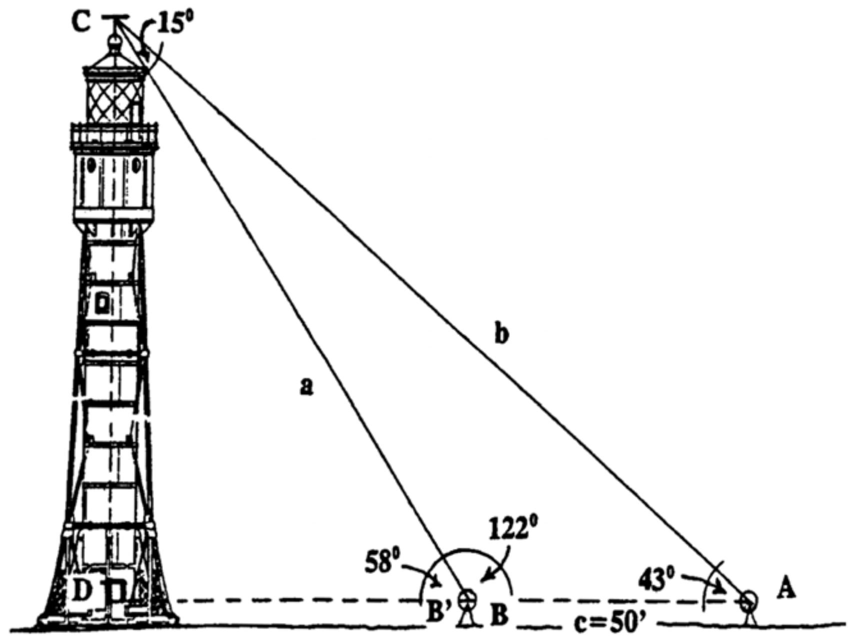

Figure 12.1: Using two transit positions to find the height of a tall structure.

3) Move the transit to point B, note the distance back from A. Set it up so that the crosshairs line up exactly with the target, i.e., on the datum line. Tilt and focus on the same point, note the new angle of inclination.

4) Calculate side a using the Law of Sines:

$$\frac{\sin A}{a} = \frac{\sin C}{c}$$
$$a(\sin C) = c(\sin A)$$
$$a = \frac{c(\sin A)}{\sin C}$$
$$a = \frac{c(\sin 43^0)}{\sin 122^0}$$
$$a = \frac{50'(.682)}{.259}$$
$$a = 131.752'$$
$$CD = \sin 58^0 (131.752')$$
$$CD = (.848)(131.752')$$
$$CD = 111.732'$$

5) To the length of CD add the height of the target from the base of the structure; this is the overall height.

NB: If D can be located directly below C, use one transit station at B', the tangent of B' and distance B'D to calculate CD.

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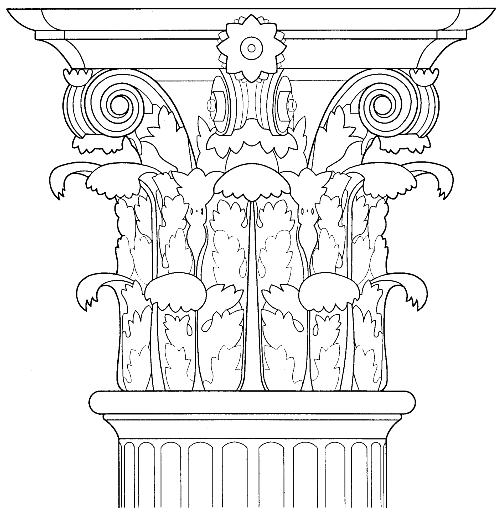

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APPENDIX E: PROJECTIONS FROM PLANS TO ELEVATIONS

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13.0.0 APPENDIX E: PROJECTIONS FROM PLANS TO ELEVATIONS

13.0.1 Building elements to be drawn in elevation at an angle to the principal elevation are foreshortened, and must be projected from plans. This problem occurs most frequently in drawings of cylindrical elements, curved stairs, bay windows and building wings.

13.1.0 PROCEDURE FOR PROJECTING RECTILINEAR PLAN ELEMENTS

1) Lay vellum or scrap drafting film over the area of the plan to be projected;

2) lay out the horizontal datum line and the horizontal lines of the image;

3) beginning with corners and edges closest to the picture plane, project the verticals;

4) erase all hidden lines.

13.2.0 CIRCULAR STAIR PROJECTIONS (Figure 13.1)

1) Overlay stair plan with vellum;

2) lay out lines representing height of each tread;

3) draw support column;

4) project the stair edges and corners, rotating the plan drawing in the direction of its rise;

5) erase all lines hidden behind the support column;

6) check the number of steps, as well as final positions at landings. Check handrails for smoothness, accuracy and three-dimensional realism.

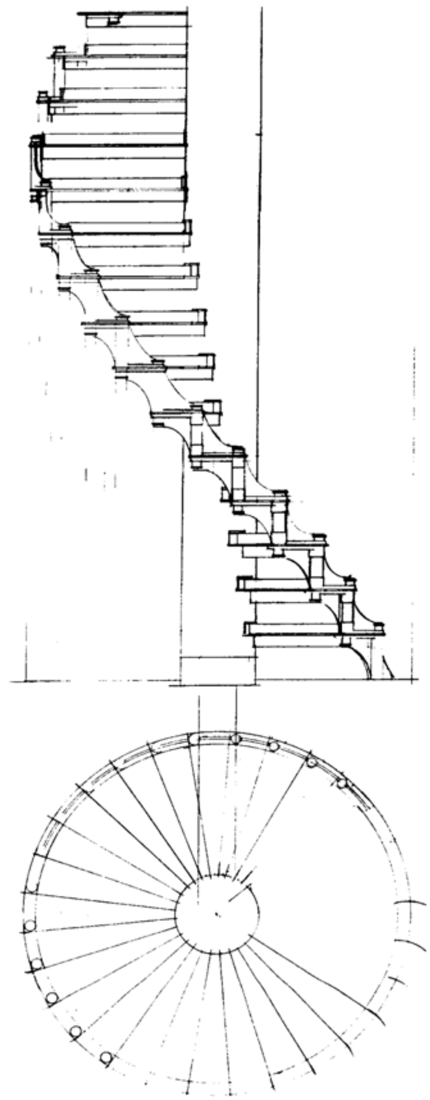

Figure 13.1: Projecting a spiral stair from a plan. Because the plan can seldom be overlaid from one stair rotation

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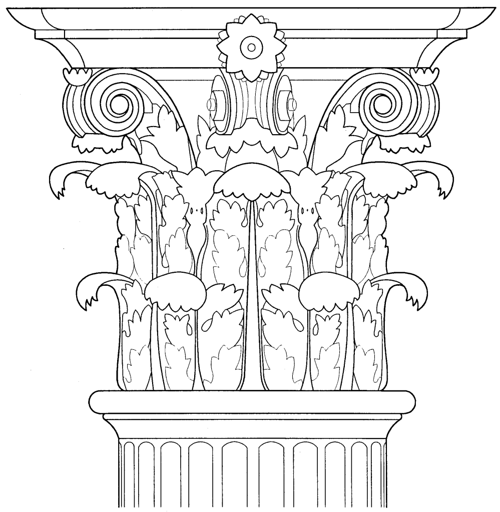

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APPENDIX F: ENGLISH AND METRIC SYSTEMS

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14.0.0 APPENDIX F: ENGLISH AND METRIC SYSTEMS

Metric length.

unit	abbreviation	number of meters	approx. equiv.
kilometer	km	1,000	0.62 mile
hectometer	hm	100	109.36 yards
dekameter	dam	10	32.81 feet
meter	m	1	39.37 inches
decimeter	dm	0.1	3.94 inches
centimeter	cm	0.01	0.39 inch
millimeter	mm	0.001	0.039 inch

Metric area

unit	abbreviation	number of sq.meters	approx. equiv.
square kilometer	sq km *or* km^2	1,000,000	0.3861 sq. mile
hectare	ha	10,000	2.47 acres
are	a	100	119.60 sq. acres
square centimeter	sq cm *or* cm^2	0.0001	0.155 sq. inch

Length (US)

unit	abbreviation	length	approx. metric equiv.
mile	mi	5280', 1760 yds	1.609 km
rod	rd	5.50 yds, 16.5 '	5.029 m
yard	yd	3', 36"	0.9144 m
foot	ft or '	12", 0.333 yd	30.48 cm
inch	in or "	0.083', 0.028 yd	2.54 cm

Area (US)

unit	abbreviation	area	approx. metric equiv.
square mile	sq mi or mi^2	640 acres	2.590 km^2
acre		43,560 ft^2	4047 $meters^2$
square rod	sq rd or rd^2	30.25 yd^2	25.293 $meters^2$
square yard	sq yd or yd^2	9 ft^2, 1296 in^2	0.836 $meters^2$
square foot	sq ft or ft^2	144 in^2	0.093 $meters^2$
square inch	sq in or in^2	0.0069 ft^2	6.452 $centimeters^2$

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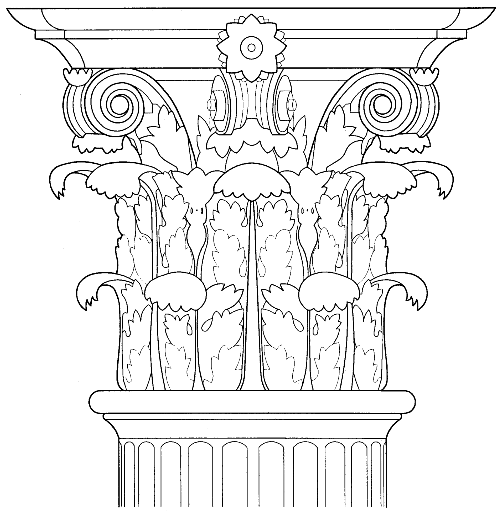

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APPENDIX G:
USING COMPUTER-AIDED DRAFTING (CAD)

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15.0.0 APPENDIX G: USING COMPUTER-AIDED DRAFTING (CAD)

15.1.0 FIELD RECORDS

15.1.1 Digital Records

A hard copy plot or printout of any digital data or image used in the field recording process should be included as part of the field records. (Examples include scanned raster images, digital photographs, and lists of electronic surveying data points.)

15.1.2 Photogrammetric Images

A print of any photgrammetric image used in the field recording process, along with dimensional information pertinent to control points in the image, should be included as part of the field records.

15.2.0 MEASURED DRAWINGS

15.2.1 CAD Software and File Formats

HABS/HAER does not require or recommend the use of any particular CAD software nor of any specific file format.

15.2.2 Layer Naming Conventions

HABS/HAER does not require the use of any specific layering system. HABS/HAER recommends the use of a layering system based on the *CAD Layer Guidelines* developed by the American Institute of Architects (AIA), as adapted to the specific needs of a particular project.

15.2.3 Line Weights

Line weights should be configured to correspond to those described in Section 5.3 of the HABS Guidelines or Section 4.9 of the HAER Guidelines.

15.2.4 CAD Fonts

HABS/HAER recommends the use of a sans-serif or Roman serif font for drawing text. Only one font should be used per project. All fonts should be TrueType (TTY) format.

15.3.0 FINAL PLOTS

15.3.1 Sheet Materials

Final plots must be made on 4 mil (0.004") thick drafting film (also known as mylar), with a single- or double-matte finish. For plotters using cut sheets, sheets preprinted with either a HABS or HAER border are available from the HABS/HAER office. For roll plotters, digital versions of the HABS and HAER title blocks, in either DXF or AutoCAD DWG formats, are available from the HABS/HAER office. Consult the HABS/HAER web site for information concerning the proper procedure for obtaining HABS or HAER pre-printed Mylar sheets or digital title blocks.

15.3.2 Pen Plotters

Plotters using pens which contain ink which meets the standards of the Library of Congress for archival stability, such as those listed in Section 1.4.3 of the HABS Guidelines or Section 4.9 of the HAER Guidelines, may be used for making final plots of HABS and HAER drawings.

15.3.3 Inkjet Plotters

Plots made by inkjet plotters do not meet the standards of the Library of Congress for archival stability, and therefore must never be used for making final plots of HABS and HAER drawings.

15.3.4 Electrostatic and Laser Plotters

Plots made by electrostatic and laser plotters (also known as LED plotters) meet the standards of the Library of Congress for archival stability, and therefore may be used for making final plots of HABS and HAER drawings.

15.4.0 DIGITAL FILES

15.4.1 Submission of Digital Files

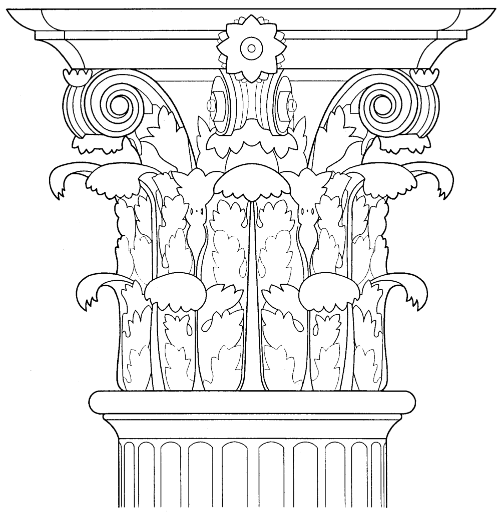
Neither the HABS/HAER office nor the Library of Congress currently maintains an archive of digital HABS and HAER files. Therefore the submission of such files, as an accompaniment to the final plots, is not required. Those who wish to do so may include, along with their field notes, a copy of their digital files on CD-ROM. This should be accompanied by a hard copy document which lists and describes the software used, the individual file names, the layering system, the corresponding line weights, and any other information pertinent to digital aspects of the project. (Keep in mind that the Library of Congress does not consider magnetic media to be archival. Thus the Library makes no guarantees that files submitted on such media will be able to be retrieved in the future.)

HABS GUIDELINE

RECORDING STRUCTURES AND SITES

with

HABS MEASURED DRAWINGS



HABS

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U.S. Department of the Interior
National Park Service
Heritage Documentation Programs
Historic American Buildings Survey
1201 Eye Street, NW, 2270
Washington, DC 20005
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http://www.cr.nps.gov/habshaer

December 2005

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