

PART 1: GENERAL

- 1.01 Included in this section are the requirements for Computer Aided Drafting (CAD) standards and policies surrounding architectural drawings, engineering drawings and graphics for LEHIGH. The intent is to allow Consultants to utilize their own drafting standards and CAD systems while still allowing The University to utilize the drawings in its system without complications. All construction drawings submitted to LEHIGH for all renovation and construction projects must conform to the Drawings Standards as defined in this document and be submitted as described in the Deliverables.
- 1.02 The department of Campus Planning & Projects at Lehigh University (LEHIGH) currently has about 99% of building floor plans (called Bookplans) in AutoCAD .dwg format. LEHIGH currently maintains approximately 170 buildings on 2,355 acres with approximately 4.5 million GSF of building footprint. Because LEHIGH actively pursues land acquisitions, building floor plans must continually be added to its collection of drawings.
- 1.03 Accurate and up-to-date Bookplans are essential for showing building information such as room numbers, room usage, square footages, department ownership, and staff locations. This data is used for a variety of purposes by many departments on Campus including, but not limited to: Campus Police, Facilities and Campus Planning, Technology Departments, Reservations, Registrar, Controller, Maintenance Staff, Transportation, Parking, Residence Halls, Dining Services, Athletics, Risk Management, and Health and Safety.
- 1.04 Information from the “as Builts” submitted by the contractor is used to create the Bookplans. Consistency of information is important to reduce time for LEHIGH staff and outside consultants to search existing site and building conditions on campus and to update the numerous Bookplans in a timely manner for use by the LEHIGH community.
- 1.05 CAD Standards
- A. The following are general guidelines and cannot address every drafting condition. The consultant may propose changes and additions or request exceptions to the requirements. Request shall be made to the Facilities Project Manager.
  - B. A Lehigh University Facilities Services and Campus Planning approved AutoCAD template is available at the Planning office. The .dwg file includes all LEHIGH established layers, preferred furniture and fixture symbols, line types, dimension and text styles, and accepted paper sizes.
  - C. CAD Drafting
    - 1. It is assumed that the CAD user has a solid understanding of the common commands and features of computer aided drafting (CAD) and AutoCAD design software. Superior drafting skills remain a very important role even with the advent of CAD systems.

2. Please pay special attention to drafting techniques. Do not allow overlapping lined, large hatch patterns, etc. which would cause the files to be unreasonably large and/or messy. Always purge drawings of excess data or unused layers, etc., prior to the submission to LEHIGH.
3. The Consultant shall assure its work and that of subconsultants are orderly and completely legible.

D. Layering

1. The overall goal is to strive for as few and as uniformly named layers as possible and that all layer names be readily discernable as to the content of each layer. Note: Numbered layering systems will NOT be acceptable under any circumstances.

E. Layer Control

1. Each layer may have several linetypes or symbols. Be sure to use the correct color and linetype (NOT “bylayer” in this case).
2. Freeze layers rather than turn layers OFF. Elements that are part of a block that are on a different layer than others in that block may still appear when you turn the layer off instead of freezing it.
3. The table of required layers listed below contains the standard layers used by Lehigh University Campus Planning for Bookplans. There may be more layers added in the future. All AutoCAD drawings provided to LEHIGH must be in compliance with the following table of LEHIGH established layer standards:

**REQUIRED LAYERS**

| Layer Name      | Layer Color | Description   |
|-----------------|-------------|---|
| A-Area_poly     | red         | <b>Closed</b> polyline around perimeter of assignable rooms   |
| A-Area_text     | red         | Square footage of room is <i>field</i> linked to A-Area_poly layer; placed in lower right hand corner of room.                      |
| A-Department    | Red         | LU Department name  |
| A-Doors         | cyan        | All interior doors, exterior doors and door details   |
| A-Flr_plan      | white       | All walls, columns, and stairs  |
| A-Notes         | white       | Layer used for other text and stairs UP/DN notations  |
| A-Room_capacity | magenta     | Capacity of offices, classrooms conference rooms, etc. Please note this is not the Maximum Capacity as determined by the Fire Code. |
| A-Room_maxcap   | green       | Maximum capacity of the room as determined by the Fire Codes.   |

|                    |         |  |
|--------------------|---------|--|
| A-Room_number      | red     | Rectangular block including room number  |
| A-Room_use         | red     | Notation of room name type (ie OFFICE, OFFSEV...)  |
| A-Room_usecode     | red     | FICM code for room usage   |
| A-Windows          | green   | All windows and window frame details   |
| D-Dimensions_CAD   | 202     | Dimension layer used for measurements  |
| D-Dimensions_Field | 211     | Dimension layer used to record field measurements  |
| D-Dimensions_Web   | white   | Dimension layer used to measure Residence Hall and Greek House bedrooms for use in publishing on Residential Services website. Measurements are rounded down |
| E-Electrical       | red     | Electrical layer used for light switches, outlets, etc   |
| E-Fire_alarm       | 93      | Electrical layer for electrical fire-safety equipment such as pull stations, etc.  |
| E-Lighting         | 51      | Electrical layer for overhead lighting   |
| E-Rfl_ceiling      | white   | Layer for reflected ceiling layout   |
| E-Telcom           | white   | Electrical layer for telcom jacks; labeling starts with A, B, C... clockwise from main room entrance   |
| F-Built_in         | 107     | Layer used for built-in furniture  |
| F-Furniture        | 107     | Layer used for furniture layouts   |
| F-Equipment        | 107     | Kitchen or Lab equipment, etc.   |
| M-Duct             | yellow  | Mechanical layer used for duct work  |
| M-HVAC             | yellow  | Mechanical layer for vents, AC, heat, etc.   |
| P-Fixtures         | cyan    | Plumbing layer used for bathroom fixtures  |
| P-Plumbing         | cyan    | Plumbing layer for piping  |
| P-Sprinkler        | red     | Plumbing layer for fire-safety equipment such as sprinklers, etc. (includes water lines)   |
| SpaceID            | White   | Unique space identifier: BuildingNumber-FloorNumber-RoomNumber. 0000-0-00000<br>It must fit inside the room polyline.  |
| T-Floor_summary    | white   |  |
| T-TB_notes         | white   | Text notes of title block  |
| T-TBlock           | white   | Title block frame and divisions  |
| X-Viewport         | magenta | Frame of layout paper space; used for scaling and printing   |
| X-Dept_color       | white   | Color coded department referenced in title block   |
| X-Occupant_name    | 220     | Name of person(s) occupying space  |

#### F. Scale and Units

1. Objects shall be drawn to actual scale 1" = 1."
2. Use engineering units for civil site plans, utility plans, paving plans, demolition plans, and profiles.

3. Use architectural units for building drawings, structural plans, floor plans, reflected ceiling plans, sections and details.
4. In some cases the use of engineering units may be appropriate for civil details and sections.

G. Object Properties

1. Properties shall be set 'BYLAYER'. Do not adjust object properties by entity (forcing colors or line types) unless approved by LEHIGH.
2. LINE TYPE: Use only AutoCAD™ or LEHIGH approved line types.
3. TEXT STYLE: Use upper case proportional text – AutoCAD style ROMANS and True Type font Arial or LEHIGH approved text styles.
4. COLOR: Use basic 0-9 colors as shown in the drawing standard file for all walls, windows, doors, room numbers, room use, notes, and polylines as these conform to our plot style table - Bookplan.ctb
5. FONTS: Use only AutoCAD™ standard fonts. Do not submit third party fonts.
6. MENU FILES: Do not submit or use any third party \*MNU\* files or menus in the drawing.
7. PLOT STYLE TABLES: All custom .ctb files MUST be included.
8. LINE TYPE SCALES: The linetype scale for a given plotted scale drawing shall be as follows:  
1/8" = 1'0" .30;      1/16" = 1'0" .60;      1/32" = 1'0" .90.
9. XREF FILES: All linked drawings MUST be included and referenced to 0,0,0.

1.06 Sheet Size Standards

- A. All documentation provided to LEHIGH in an **electronic** format must comply with one of the following sizes. (Note: 30in x 42in/Arch E1 is not an-acceptable page size).

| Sheet Size (inches) | Sheet Name              | Usage                                  |
|---------------------|-------------------------|--|
| 8.5in x 11in        | Letter, ANSI A          | All purpose                            |
| 11in x 17in         | Ledger, Tabloid, ANSI B | LEHIGH Bookplans & construction sheets |
| 22in x 34in         | ANSI D                  | Full size construction sheets          |
| 24in x 36in         | Arch D                  | Full size construction sheets          |
| 34in x 44in         | ANSI E                  | Full size construction sheets          |
| 36in x 48in         | Arch E                  | Full size construction sheets          |

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1.07 File Naming Protocol

A. The protocol for naming electronic drawing files is as follows:

1. CAD files are to be named:  
BuildingNumber\_BuildingName\_Year\_DrawingNumber-DrawingName  
Example: 001\_ServiceBuilding\_2014\_CS001-CoverSheet
2. PDF files follow the same format for CAD files.
3. External References that are used only as backgrounds and not altered shall retain their original file name - AND must be included along with the drawings.

1.08 Graphics Standards

A. Project, Record or As Built Drawing Requirements

1. Contact Lehigh University Campus Planning department to obtain symbols and blocks in electronic form.
2. All polylines used to calculate areas shall be closed.
3. All drawings shall be created and edited in model space.
4. All areas to be measured shall use polylines as the method for calculating space and retained within the drawing on the appropriate layers.
5. Use object snap grips to assure precise elements, proper text placement and no overlaid lines or symbols.
6. Provide straight leader lines at the beginning or end of single lines and notes.
7. All spaces are to be measured consistent with the most current Postsecondary Education Facilities Inventory and Classification Manual (FICM). Go to <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=92165> for more detailed information.
8. For all areas leased by LEHIGH, the rentable area shall be measured and calculated consistent with the Building Owners and Managers Association (BOMA) standard.

B. Objects in Drawings Requirements

1. All swinging doors shall be indicated open to 90 degrees to door opening in wall and shall have the open/close swing path shown with an arc from the open door end to corresponding door opening edge at the wall.

2. All restrooms shall include fixtures: toilets, sinks, and ADA required hardware if applicable.
3. All windows shall be drawn with a single line for all types of windows. This helps with readability when printing at smaller scales.

C. Drawing Layout Requirements

1. Provide a keyplan located in the upper right corner of the drawing in a “boxed in” area. If the drawing treats only apportion of the building or building complex, highlight that portion on the key plan. A small version (half-size) of the standard north arrow symbol will be place near the words “Key Plan.”
2. Grid identifier balloons shall be placed on the grid line ends at the top and to the left of the drawing.
3. Drawing areas separated by matchlines shall match floor-to-floor (vertically) and area-to-area (horizontally). Matchlines separating horizontal areas shall be drawn down the center of a wall.
4. Use associative dimensioning. Do not force the distance text in a dimension, except as follows: Details or sections where the item being dimensioned is divided by break lines or is partially drawn or for diagrams that are not drawn to scale.

D. Quality Control

1. “ISSUED FOR\_\_\_\_\_” shall be recorded on the drawing as a revision note and shall be identified by revision number as described in the document. Where applicable issued prints or drawings shall be stamped to indicate any restrictions on the release of the drawings.
2. “VOID-SUPERSEDED BY DWG. NO. \_\_\_\_\_” shall be clearly marked on the face of the drawing and recorded as a revision note and issued to the parties affected by this revision. Drawing numbers of superseded and voided drawings shall not be reused.
3. Issue of supplemental documents shall conform to LEHIGH University Design Standards requirements for Construction Administration. It is the Consultant’s sole responsibility to coordinate with code agencies in a timely manner to secure approval from code agencies of changes prior to issue of supplemental documents. The Consultant shall provide the same number and quality of documents as required in the “Issue for Construction” submittal, including signed and stamped sets where required by the Consultants contract.

E. Project Work

1. EXISTING CONDITIONS – the drawings shall utilize different line weights for depicting existing conditions versus new work or work to be demolished. All line weights shall be legible and reproducible.

2. DEMOLITION WORK – drawings indicating work to be removed or demolished shall carry line weights or types that differentiate demolition work from new or existing work. All line weights shall be legible and reproducible.
3. NEW WORK – new work shall be depicted in a heavier or bolder line than existing or demolished work. Drawings shall clearly depict routing of systems.
4. BACKGROUND PLANS – When the architectural floor plan or other drawing of existing and/or new work is used as a background for showing work designed by a particular design discipline or intended for construction by a particular trade, subcontractor or group, the background plan shall be legible and reproducible.
5. DEPICTING WORK IN OPERATIONAL AREAS – where new work must be installed adjacent to, above or below existing equipment, systems or facilities that must remain in operation during construction, the Consultant shall draw the entire affected facility/equipment including conduit runs, piping, duct work, etc. along with the new work. Indicate code-required and practical operational clearances to existing equipment and facilities on the drawing. This work shall not be “design build” and shall not be left to the Contractor to decide how to stage, place to route the new work. The consultant shall coordinate staging and scheduling requirements into the Contract Documents to assure continuous and unobstructed operation of the existing systems and facilities.

#### 1.09 Deliverables

- A. All documentation provided to LEHIGH must be in compliance with at least one of the following format and associated requirements.

| Format                                  | Filename Extension | Format Requirements  |
|---|--------------------|--|
| Microsoft Word 2010                     | .docx              |  |
| Microsoft Excel 2010                    | .xlsx              |  |
| Microsoft PowerPoint 2010               | .pptx              |  |
| Adobe PDF (Portable Document Format)    | .pdf               | Current version and not more than two versions prior.                        |
| Autodesk AutoCAD                        | .dwg               | AutoCAD 2013 Drawing (Preferred)<br>AutoCAD 2010/LT2010 Drawing (Acceptable) |
| Autodesk Revit                          | .rvt               |  |
| GPS Exchange File (GIS)                 | .gpx               |  |
| JPEG (Joint Photographic Experts Group) | .jpg               |  |
| PNG (Portable Network Graphics)         | .png               |  |

- B. Project Completion: Upon completion of a project or contract, all final files and as-built drawing files created must be provided to LEHIGH one of these formats. If additional

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original, editable formats exist, these shall be provided to LEHIGH in addition to the final format. Electronic formats do NOT replace complete set of paper copies of as-built and final documentation.

- C. LEHIGH will provide documentation to others in one or more of the formats listed above.
- D. Submittal Requirements
1. Drawings shall be submitted in hard copy and electronic media. Generally, the electronic media submittals shall be required a minimum of three (3) times during the design phase (record drawing) and then with the “as built” upon project completion.
    - Submittal of AutoCAD or Revit drawings are to be submitted at approximately 85% - 90% completion to the Facilities Space Data Manager. This is necessary to expedite internal office duties such as: LEED requirement maps, room numbering, and room assignments, etc.
    - Submittal of PDFs for the design phase shall be submitted as a combined set.
    - Submittal of AutoCAD drawings (.dwg files) shall also include every external reference file, shape file, image file, font, custom object (ObjectARX), data-link file (Excel, CSV), photometric data link and color-dependent plot style table file used for producing the drawings (see table above).
    - Submittal of AutoCAD drawings shall also be submitted with each drawing sheet as a single PDF file. There shall be only one drawing sheet per electronic PDF file. A file containing multiple drawings will be returned.
    - Prior to final submittal of Project, Record, and as Built drawings, purge all unused and non-standard blocks, layers, linetypes, etc.
    - Electronic CAD documents shall reflect “as-built” conditions.
    - Drawings shall be zoomed to extents.
- E. Electronic Documentation Delivery: All electronic documentation must be sent to the LEHIGH University Project Manager/Building Manager via the Project Manager’s/Building Manager’s University provided email (@LEHIGH.edu) or through a shared folder on Google Drive (<https://drive.google.com/>). If Google Drive is used, the Project Manager/Building Manager must have full editing permissions to all documents in the shared folder.
- F. Hard-Copy Documentation Delivery
1. All hard-copy documentation for Facilities Services must be delivered to:



LEHIGH University  
Facilities Services  
461 Webster Street  
Bethlehem, PA 18015

2. All hard-copy documentation for Campus Planning & Projects must be delivered to:

LEHIGH University  
Campus Planning and Projects  
461 Webster Street, Annex 3A  
Bethlehem, PA 18015

#### 1.10 Other Standards

- A. BIM: Standards to be determined
- B. GIS: Although the Bookplans do not inherently include GIS information, the Bookplans referenced as part of the University's Geographical Information Systems (GIS) database are currently in development.