LAWA

Measurement Standard
As-Built Terminals

Prepared by Kelar Corporation
Los Angeles, California
December, 2005

INTRODUCTION

This Standard provides consistent tools toward accurate field measurements for the creation of new As-Built Drawings that will, in-turn, be used to create up-to-date verifiably accurate Master Lease Exhibits (MLE), of various terminals. Using these Standards, one would expect to be able to duplicate a measurement at random, and get a result reasonably similar to the original measurement.

The new As-Built Drawings are to adhere to the latest LAWA CAD Standards published on the LAWA web site:

http://www.lawa.org/lawa_sd.cfm

All measuring and the resulting drawings are to follow the Standard parameters as set forth in this document. Field measurements and factual observations duly documented shall take precedence over existing As-Built Drawings or any other existing construction documents.

Methods described in this Standard are the result of several years' field experience measuring and drawing several airport terminal structures over 100,000 square feet per floor, and several stories in height. The intention is to provide proven methods to avoid common errors, remove the necessity to repeat the entire learning curve, providing the new or novice measuring team with some basic rules helpful to this end. The experienced measuring team will recognize many shared methods, and may appreciate this measuring standard as a useful tool.

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MEASURING STANDARDS

FIELD MEASUREMENT SHEETS:

- **Small Scale Sector Map: showing all Sectors per Level in one Terminal**

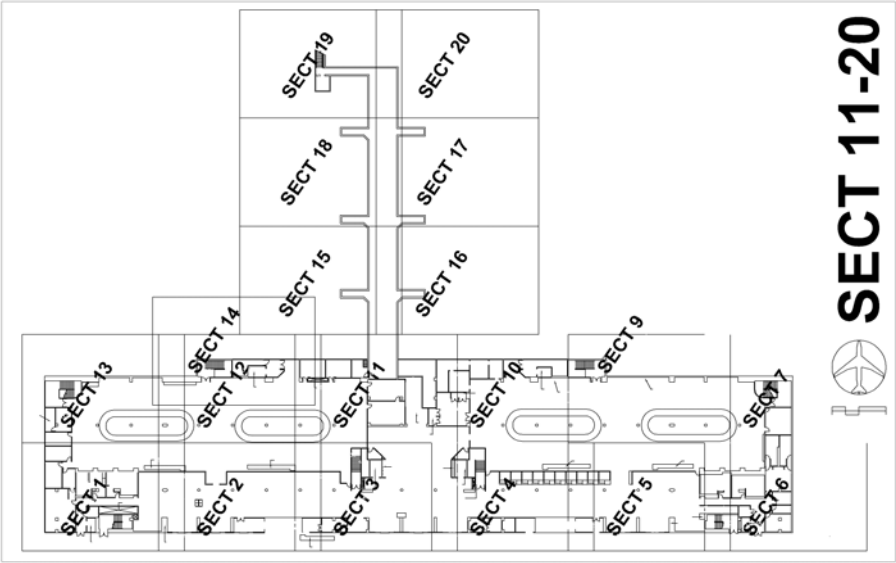


Figure 1: Sector Map Showing Total Floor Plan

- LARGE SCALE SECTOR DRAWING: **Individual Sectors for measuring**

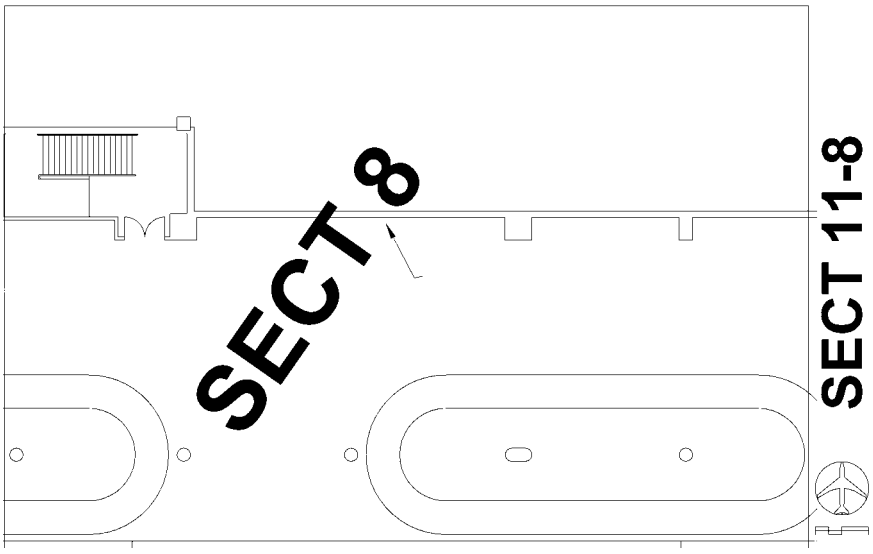


Figure 2: Single Sector Showing Partial Floor Plan

Drawing Setup in AutoCAD:

- Units: Engineering
- Precision: 1/256”
- Line Type Scale: 0.5 or 0.3 when necessary for short lines
- PSLTSCALE: 1.0
- Plotted Scale:
  - 11” x 17” Sector Sheets for Field Measuring: 1/8” = 1’ – 0”
  - 11” x 17” As-Built Drawing Sheets: 1” = 40’
- Rounding Off:
  - CAD Dimension Round-Off: 1/16”
  - Field Measurements to be to nearest 1/16”
  - CAD Drawings to be to nearest recorded Field Measurement. Do not round-off recorded Field Measurements when drawing the data. Dimensions will round off to the nearest 1/16”, but the drawing object data will be drawn as measured.
- Snap Setting: Setting is ON, and 1/16” to ensure drawing accuracy.
- Sheet Size: 11” x 17”
- Drawing CAD Object Properties
  - Grid Lines: Refer to Grid Lines Section of this Standard
  - Layers
  - Line Types
  - Text Styles
  - Dimension Styles
  - Blocks or Symbols
  - Refer to the LAWA CAD Standards for additional properties

MASTER LEASE EXHIBIT (MLE) DRAWING:

The typical MLE drawing shown below in Figure 3, is a reference only to show the intended future use of this measuring work. This example shows a complete drawing using the new As-Built drawing as a base for the MLE in the next phase applying lease information and other details.

The drawings created from the field measurements will provide the basic information/raw cad data for the MLE drawings. For this reason the new As-Built drawings must conform to the LAWA CAD Standards.

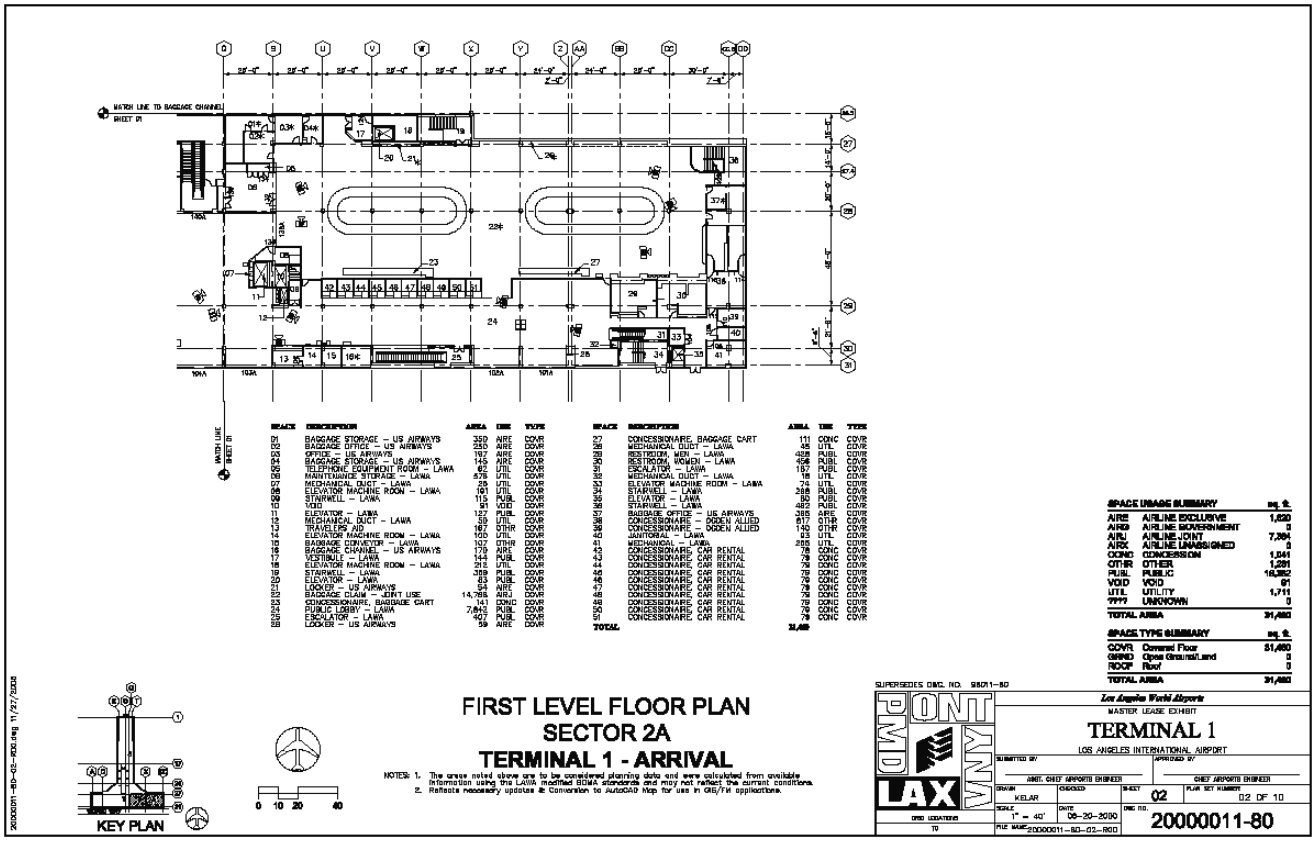


Figure 3: Typical MLE (Master Lease Exhibit) drawing

Photographs

- **For reference:**

Field observations of unusual conditions may require photographs for greater understanding during the conversion of field data to drawing data.

- **Before Measuring:**

The Measuring Team should walk the site and photograph as much in general as possible to provide a thorough over-all description of the terminal.

- **Additional photographs:**

Photographs are to be taken in areas where the method of measuring needs to be explained clearly to a draftsperson.

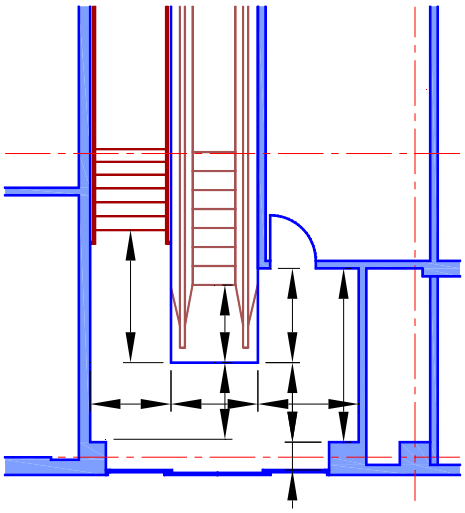


Figure 4: Complex stair and escalator relationship

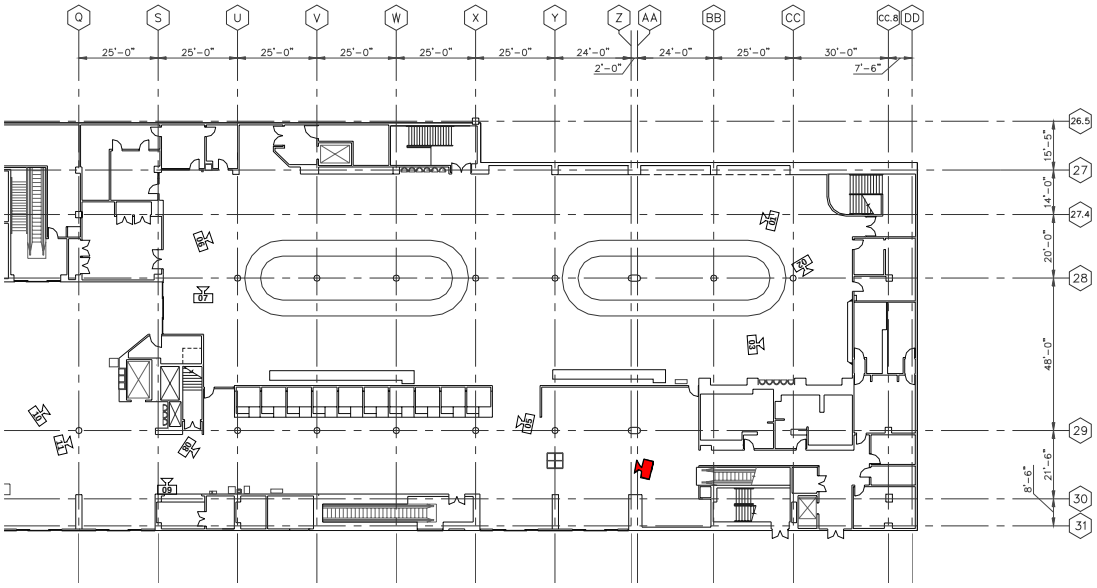
This example illustrates the need for precise measurements of the curbs and grates in the floor, and surrounding the stair and escalator. In order to locate them relative to each other, to total structure, and to the floors above and below, the metal grates in the floor and the curbs must be measured.

Also, sometimes these measurements will be necessary to adequately measure the location of boundary walls, not otherwise measurable.

Photographic Record:

Maintain a stored record of all photographs taken. This may include maps of where the photographs were taken. An example is shown below.

Figure 5: Arrival Public Lobby – Overhead FIDS



Equipment – Measuring Devices

- **Acceptable**
  - Manual: Recommend 100’ and 30’ metal tapes.
  - Digital: Leika Disto Classic or equal.
  - Accuracy: Minimum Device accuracy to be 1/16”.
- **Not Acceptable**
  - Sonar based measuring equipment
  - Non-metallic tapes and tapes that may stretch with use.
- **Additional Notes**
  - **Measurements Less than 18”**

Because of the nature of the two primary measuring instruments, metal tape and digital, the metal tape is to be used for all measurements less than 18”.

- **MEASUREMENTS GREATER THAN 100**

Great care must be taken to accurately mark the incremental beginnings and endings. Use structural landmarks whenever possible, and accurately measure the landmarks, and their relative positions to other notable landmarks in the vicinity.

- **Measuring in Sunlight**

Certain measurements such as outdoors in sunlight should be done with the metal tape.

Aligning Multiple Floors

Align floors, above to below, using elevators (Fig. 6), and/or stairs (Fig. 7), as a guide. Measuring correctly to vertically line up multiple floors is critical.

- **Elevators**

Elevators are excellent tools to use as datum reference (the whole cab). The cab interior is always the same physical space on every level. Key to this is to measure the interior of the cab and relate it to the exterior landing area, and then expand outward from this elevator lobby to adjoining spaces.

Refer to Figure 6 below for illustrations of critical measurements inside and outside an elevator that are to be used for vertical floor alignments.

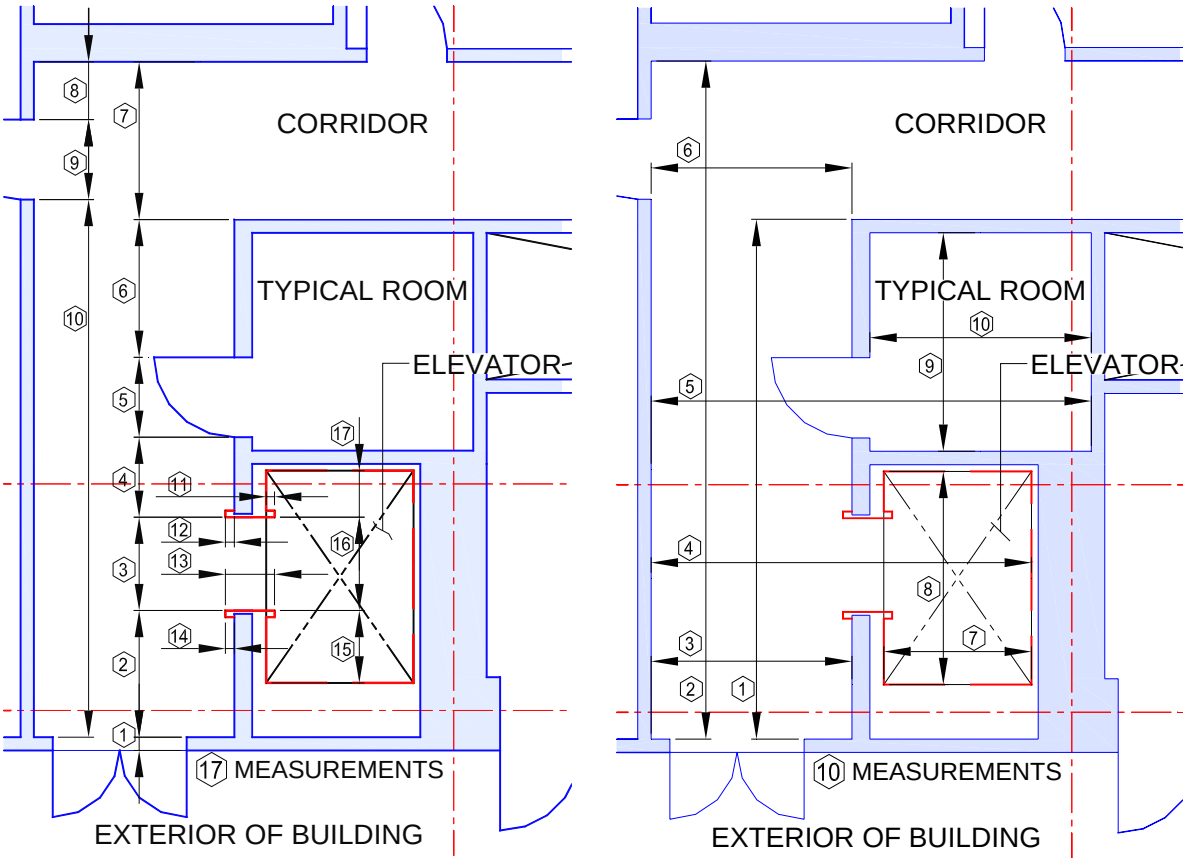


Figure 6: Elevator as Datum

Notice that the inside of the elevator cab is a vertical link to the floor levels above and below. In order to utilize this with accuracy, one must follow the concept as illustrated in these figures. In Figure 6, the elevator cab is linked to the outside surface of an exterior wall. In addition, these drawings show how wall thickness can be determined, and also apparent redundancy can help verify measurements later in the office.

- **Stairs**

Stairs are also good tools for floor to floor alignment, but unlike the elevator cab, the stairwell walls are not always located in the same location on every landing of the stairs. This makes measuring the stairwell more complicated than the elevator, and the measurer must be observant so not to miss a critical difference. Key to this, similar to the elevator, is diligent measuring of the interior of the stairwell, and relating it to the exterior adjacent area, and then expand outward from the stair area to adjoining spaces.

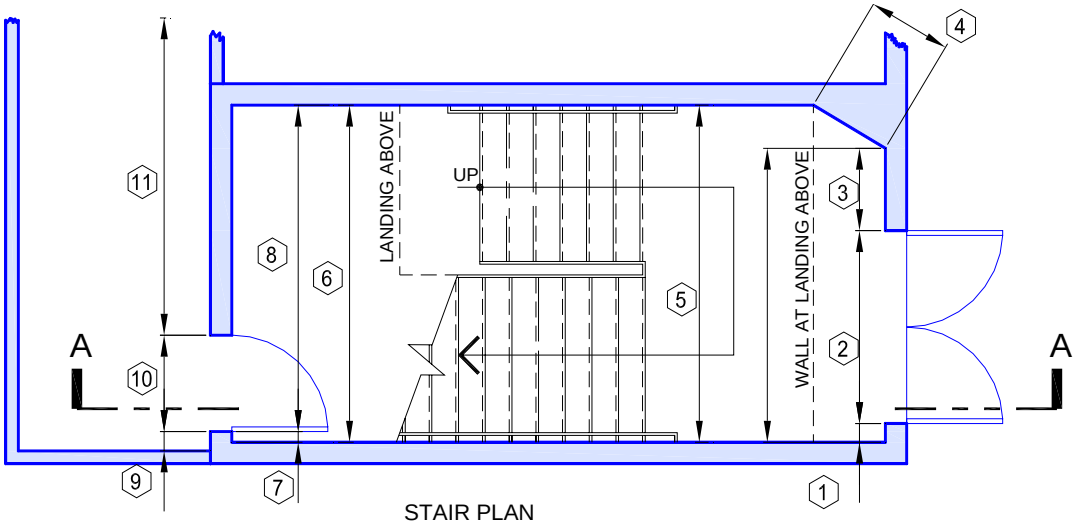


Figure 7: Stair Plan

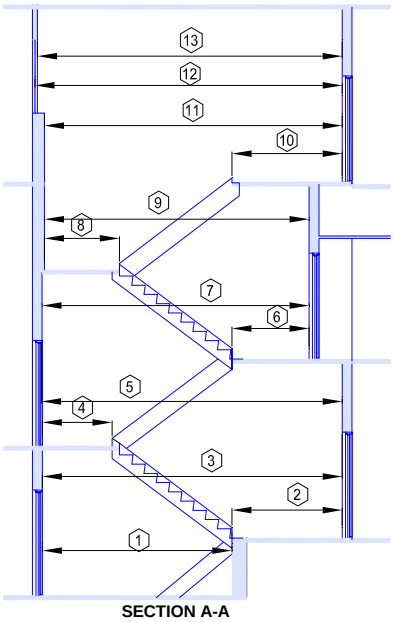


Figure 8: Stair Section

Included and Excluded Items

This list is for the purpose of answering just what is and is not to be measured or noted, in addition to the obvious physical structure of the airport terminals.

- **Excluded Items:**
  - Restrooms: Do not show plumbing fixtures, stall partitions, mirrors, or counter tops
  - Movable, freestanding objects in various public areas.
  - Do not note or measure any private non-LAWA equipment of any kind, unless LAWA specifically requests a usually excluded item to be included.
  - Verify with LAWA exactly what other items are excluded from measurement and data documentation as to their existence and/or location and size.
- **Included Items:**
  - Note any unusual physical features and verify with LAWA if they are to be documented.
  - Show all vending machines found in any public area.
  - All lockers found in public areas.
  - Free standing kiosks such as might be used by a flower retailer, or also by candy vendors or others.
  - Baggage handling equipment such as carousels in the baggage arrival areas,
  - Trash Compaction machinery, whether private or LAWA owned
  - There are free standing portable offices located throughout the airport facility. All of these are to be measured and noted on the drawings.
  - Note and measure all FIDS (Flight Information Dispensing System). Show the correct number of monitors installed in a single cabinet. Measure and locate the cabinets, or note the monitors when flush mounted within a wall. There should be an accommodation in the wall thickness for these, or there may be a monitor that protrudes from the wall on the interior space.
  - Security check points, Immigration and Agricultural examination tables and booths.
  - Other items not listed here, but included as they occur.
  - When questioning or deciding on items not listed in this section, always verify the status with LAWA before proceeding with your own decisions. All questions are to be in writing with a clear date of asking, the name of the requestor, and who it was sent to, along with the question itself. All written material should be in a reasonably readable condition.

Inaccessible Areas

All areas, rooms, and spaces are to be measured. Any of these found to be inaccessible are to be documented and reported to LAWA in a timely manner.

Structural Changes during Measuring

Often during a measuring assignment, a Lessee or LAWA may make changes to a structure that was already measured, or is about to be measured while this change is taking place. Request access if necessary, and measure the newly constructed structure. If the measuring of this area is completed prior to the beginning of the change, verify with LAWA or measuring supervisors whether this change will be included in the new As-Built drawings or will the measuring team ignore the change.

Each of these are subject to including or excluding in the measurement process, each as a separate decision process.

If at all possible for the measuring team, always try to get the latest data on the structure.

Gridlines in Drawings:

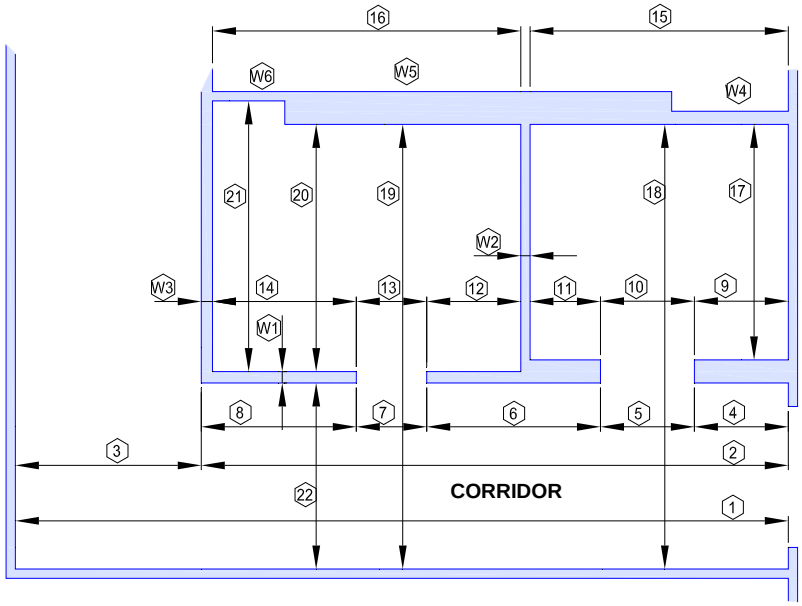
Grid Lines in Field Sector Sheets and new As-Built Drawings shall be drawn orthogonally located and labeled as represented on the existing As-Built reference construction documents. Grid lines are to follow the LAWA CAD Standard.

Accuracy of Measurements:

- Single Measurement: 1/2” maximum for any single measurement regardless of the distance measured.
- Cumulative Measurements: Strings of Measurements, such as a series of rooms along a corridor, shall be within 1/2” in either direction, larger or smaller than a single measurement along an adjacent space such as an adjacent corridor. This permits a tolerance of 1”, but limits it to1/2” greater or smaller than the total dimension. This limit is required to assure that as these cumulative spaces are drawn, that they do not produce over-lapping areas, or an interior that extends beyond the exterior of the building.
- Multiple or Redundant Measurements: These are useful to verify accuracy and are often needed in the case of a. and b. above.

Wall thickness

- Measure and note all wall thicknesses as accurately as possible.
- See Figures 6, 9, and 10, for one or more methods to determine the wall thickness.
- Use existing As-Built construction documents to verify walls when they are hidden behind temporary objects such as boxes or shelving that prohibits visual verification of the wall. Door and Window Jamb Details can provide this information as to original intent during construction.
- Measure to finish of wall.
- If there are two finish surfaces, (tile and paint over dry-wall), and both finishes are visible, measure to the painted dry-wall surface, and note that this is the case.



NOTES:

- INTERIOR ROOMS LOCATED ALONG AN ADJACENT CORRIDOR NEED TO HAVE THEIR LOCATION RELATIVE TO EACH OTHER AND THE CORRIDOR DEFINED ACCURATELY AND THOROUGHLY.
- POTENTIAL ERRORS CAN OCCUR WHEN A WALL CHANGES THICKNESS INSIDE A ROOM, AND DIMENSION 20 OR 21 IS NOT NOTED OR MEASURED.
- WALL THICKNESS ERRORS MAY PRODUCE ERRORS IN ADJACENT SPACE LOCATIONS, AND SUBSEQUENTLY CAUSE AN ENCROACHMENT INTO OTHER SPACES.

WALL THICKNESS CALCULATION EXAMPLES:

- W1 = 19 - (22 + 20)
- W2 = (4 + 5+ 6 + 7 + 12) - (15 + 16)
- W3 = 1 - (3 - 4 + 5+ 6 + 7 + 12)
- W4, W5, & W6 SHOW A POTENTIAL ERROR.

LESSON: BE OBSERVANT & DILIGENT.

Figure 9: Wall Thickness Measurement guidelines

Door Dimension Points

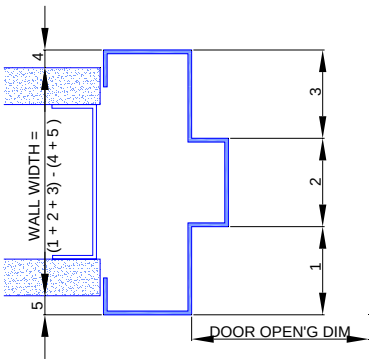
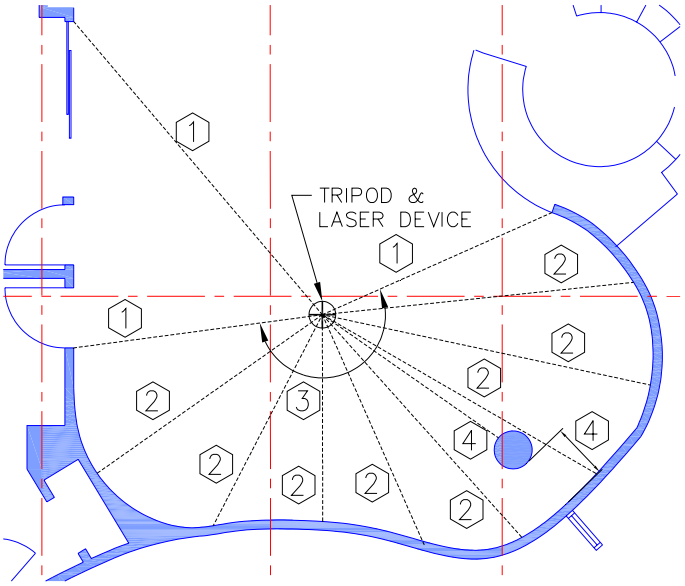


Figure 10: Door Jamb - Typical Measure points

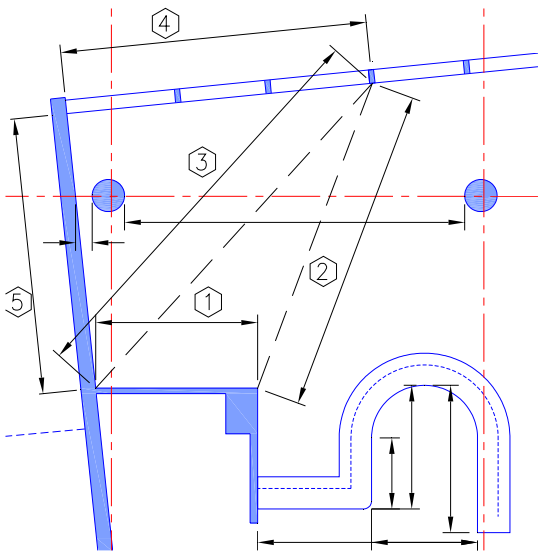
Walls: Curved, Non-Rectilinear, and Sloped

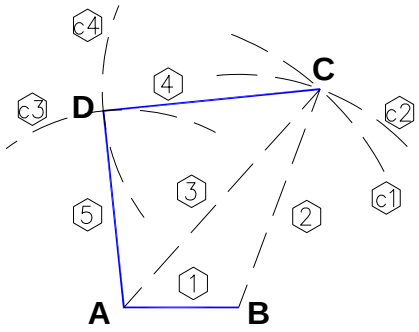
When walls are not perpendicular or parallel to each other and this becomes apparent, either through visual observation, or while drawing per the Field Measurements, but the CD's show the walls as perpendicular or parallel, measure from two diagonally opposed corners of the space, as accurately as possible to obtain the correct geometry of the space. This may require two diagonal dimensions to give the complete and accurate geometry.



1. ESTABLISH LOCATION OF THE TRIPOD RELATIVE TO SEVERAL KNOWN POINTS.
2. DISTANCE OF LINES OF MEASUREMENT FROM TRIPOD TO WALL.
3. NOTE ANGLE OF EACH LINE OF MEASUREMENT RELATIVE TO LAST ONE.
4. LOCATE COLUMN USING SURROUNDING KNOWN FIXED ELEMENTS.

Figure 11: Curved Walls





1. **USE POINTS A & B TO DRAW CIRCLES C1 & C2.**
2. **USE POINT A & INTERSECTION OF C1 & C2 TO DRAW CIRCLES C3 & C4.**
3. **DRAW WALL FROM POINTS C TO D TO A TO B.**

Figure 12: Non-Rectilinear

Measure all sloping walls at their floor line.

Figure 13: Sloped Walls

Redundant Measurements:

Utilize multiple measurements when necessary to assure that accuracy is maintained. An example of this is the incremental measuring of columns, including their individual sizes, and their locations relative to each other in a large space, and an over-all measurement of the same space. Another example would be a series of contiguous offices along a corridor. In this case, interior walls between offices become important measurements.

Door Information to be shown on drawings:

- Door Swing: Note Door swing accurately.
- Door Number: Note number accurately.
- Door Width: (See Figure 10, for correct Dimension Points)

Security Key Pads (ACAMS):

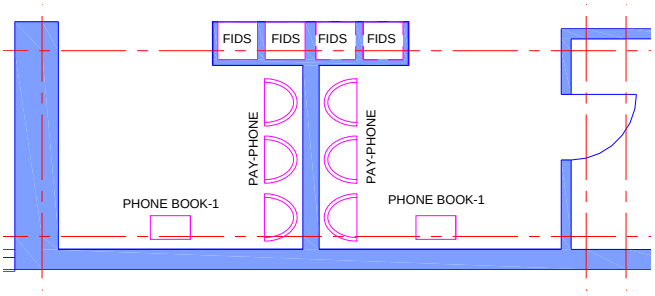
- Show the location as to where relative to the door opening.
- Show the number of the Key Pad whenever possible.

Columns

- As-Built Locations
  - Locate columns relative to adjacent columns, and to adjacent walls or windows.
  - Do NOT rely on existing As-Built construction drawings to locate the columns.
  - Measure the finish surface of the column. This may be the actual structural column or it may be an applied finish, or box around the column.
- **As-Built Diameter** of Round Columns
  - Round Columns: Measure the circumference and calculate the diameter.
  - Diameter (D) = Circumference (C) divided by Pi. **D = C ÷ 3.14**

Miscellaneous Equipment in Public Areas:

- FIDS **(Flight Information Display System)**



Use ceiling and floor tile grids when measuring the object is not feasible or accuracy is not possible with a tape or laser device.

Figure 14: FIDS examples.

- **Vending Machines**

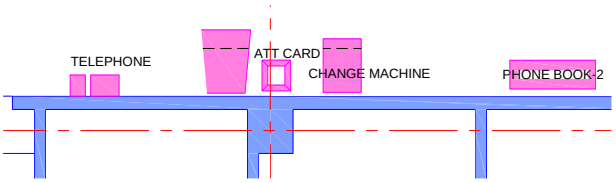


Figure 15: Vending Machines

- **Baggage Carts**

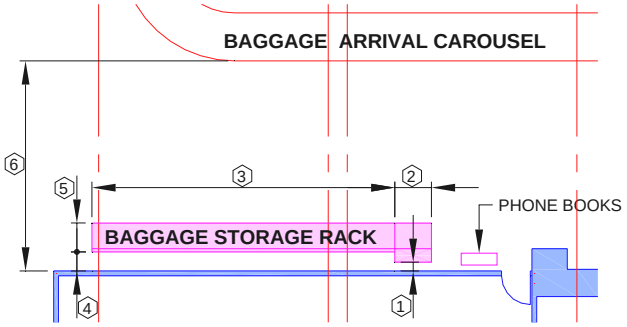


Figure 16: Baggage Cart Storage Racks

- **Lockers in Public Areas**

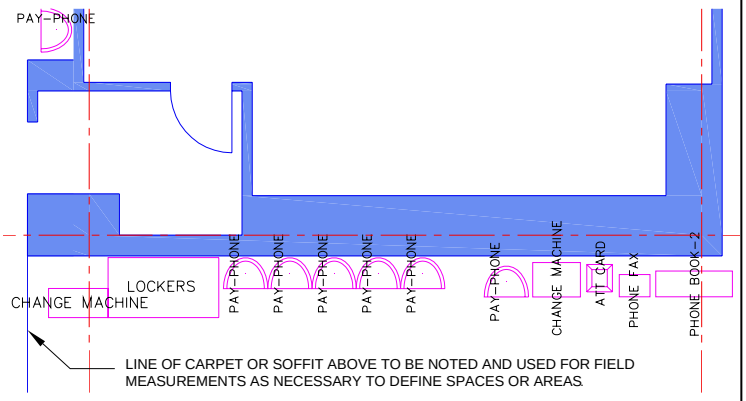


Figure 17: Public Lockers

- **Security areas**
  - Photograph to aid in drawing the space accurately
  - Measure a simple geometric shape such as a rectangle that encompasses the Security Area. See drawing below photo in Figure 18, as an example.

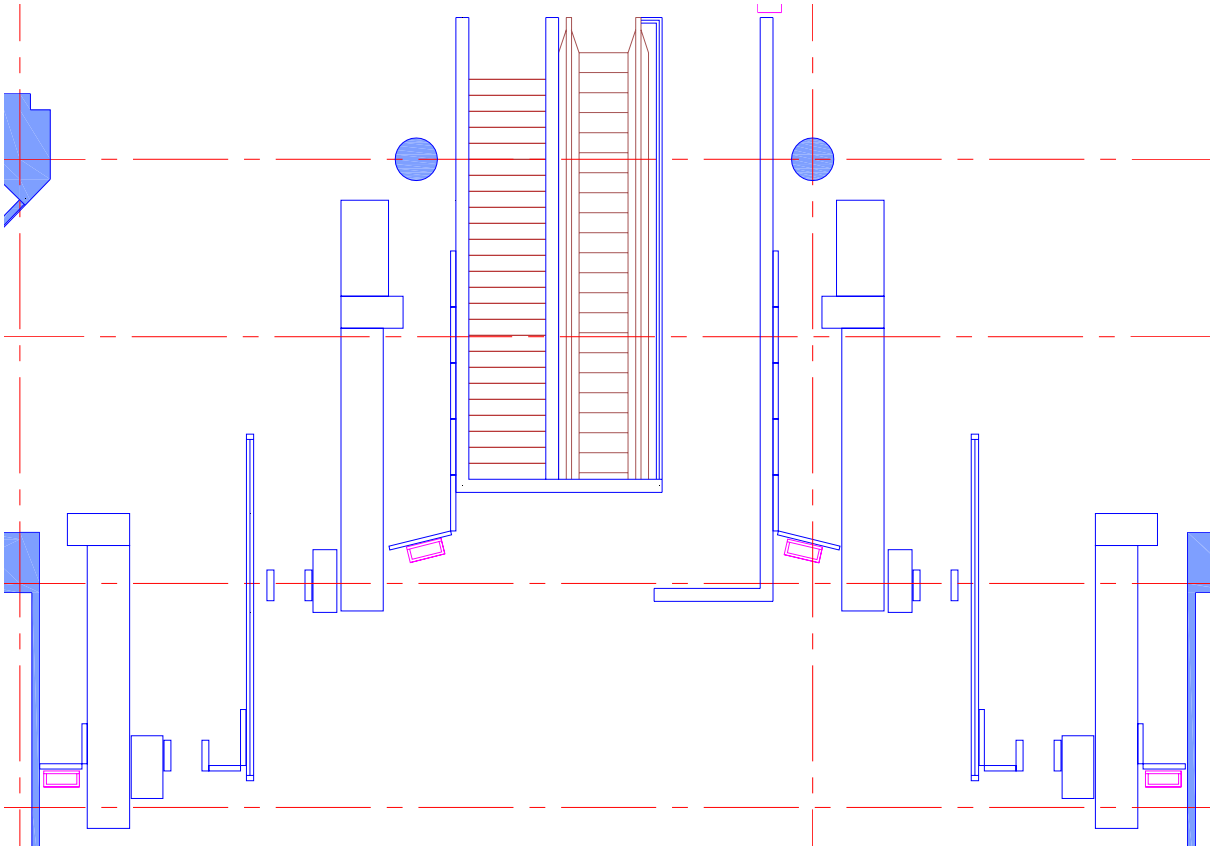


Figure 18: Security Equipment

- **Kiosks**

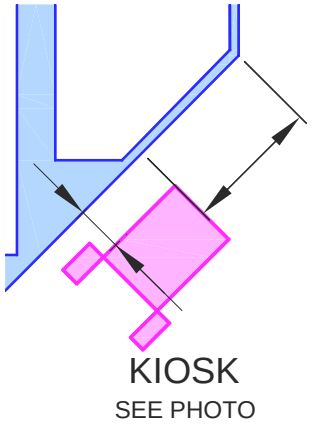


Figure 19: Kiosk – Typical Example

Areas Not Enclosed or Defined By Walls

Measure to carpet lines or soffit lines above, or other objects that delineate the space, and note that this was done. Show on the drawings the line of carpet or the soffit or other objects used.

Open areas such as exterior Baggage Handling areas, or interior Holding areas, or eating areas to use Soffit or Drip Lines above. For the purpose of this Standard, The edge joining the horizontal to the vertical outer-most edge is to be the measuring point. These lines can define the outer-most edges of the building in some cases.

Figure 20: Areas not defined by walls.

Carpet lines, ceilings, adjacent face of walls or columns, or exterior face of walls, also referred to as “Drip Lines”.