EFMD

Engineering & Facilities Management Division

LAWA Survey and Remote Sensing Standards

Document history

revision letter	release date	major changes	approved by
A	January 2013	new version of standards	

Contents

About this book

The standards described in this document are provided to help LAWA staff, surveyors, consultants and project partners prepare and exchange survey information for LAWA projects. These standards help ensure efficient exchange of information between LAWA and all authorized users of LAWA survey data.

Relation to existing standards

These standards have adopted a series of standards already in use for Surveying and Remote Sensing developed by NGS, FAA, and LAWA.

Who should read this book

These survey data standards are for use in-house by LAWA and for survey consultants, in order to ensure all survey drawings and digital CAD data files will meet LAWA standards.

How this book is organized

After the introduction, this book contains the following chapters and appendixes:

Survey and remote sensing standards in use at LAWA

provides an overview of LAWA specific standards, plus related federal, local, and national standards

Overview of survey and remote sensing data processes

summarizes survey and remote sensing data collection methods, including best practices and required levels of accuracy

Survey data submission

outlines LAWA policy for CAD file and other formats to be used when submitting survey data.

Measurement standards for drawings inside buildings

summarizes a consistent approach toward accurate field measurements for the creation of new as-built drawings inside buildings.

Related documents

The variance request form, CAD and GIS standards along with other documentation related to these standards are available on the LAWA website.
http://www.lawa.org/laxdev/Handbook.aspx

Abbreviations

AC	Airport Circular (FAA)
AIP	Airport Improvement Program
ALM	airborne LIDAR mapping
ATLM	Airborne Terrestrial LIDAR mapping (alternative name for ALM)
EDM	electronic data measuring
FAA	Federal Aviation Administration
FGDC	Federal Geographic Data Committee
FIDS	Flight Information Display System
GBL	ground based LIDAR
GBLS/GBLM	ground based LIDAR scanning/mapping (alternative name for TLM)
GPS	global positioning systems
LIDAR	light imaging detection and ranging
MCLM	mobile compensated LIDAR mapping
MLE	Master Lease Exhibits
NGS	National Geodetic Survey
NSRS	National Spatial Reference System
NSSDA	National Standard for Spatial Data Accuracy
OPUS	Online Positioning User Service (from NGS)
PAC	Primary Airport Control Station
RTK GPS	Real Time Kinematic GPS
SAC	Secondary Airport Control Station
SDSFIE	Spatial Data Standard for Facilities Infrastructure and Environment
TLM	terrestrial LIDAR mapping

Introduction

The Survey and Remote Sensing Standards document is not intended to define a surveyors method of data collection. These standards apply, whether traditional theodolites, electronic data measuring (EDM) devices, global positioning systems (GPS), light imaging detection and ranging (LIDAR) or aerial photography are used.

The surveyor is free to choose the data capture technologies and methods that give the best results for the type of project and the required levels of accuracy.

This manual is set up in such a way, that the building specific measurements and civil site specific typical topics are separated. Consultants working on building specific projects see section “Measurement standards for drawings inside buildings”.

- except for some specialized schematics, the software used to produce CAD drawings is AutoCAD (a recent version)
- the unit of measurement used for CAD architectural drawings is the inch
- the unit of measurement used for CAD civil drawings is the U.S. foot
- project codes are defined by LAWA on a project per project basis
- all civil drawings must be created in NAD 83 California State Planes, Zone V, US Foot coordinate system
- all civil drawings will identify the survey epoch used, for example Multi-Year CORS solution 2011, National adjustment of 2011 (NA2011), Geoid Model GEOID12A 2012
- all architectural drawings must use positive values for coordinates
- all spatial data must be created in Model Space
- all graphical elements must be in Paper Space

Changes or additions

Any deviation from these standards must be approved by LAWA, in advance and in writing. Requests need to be submitted on the “Request for variance” form, available from the LAWA website http://www.lawa.org/laxdev/Handbook.aspx

Suggestions for improvements or extensions to these standards are encouraged, to meet unforeseen requirements and as a way to improve effectiveness and clarify any ambiguities.

Comments on the suitability of the contents for the stated purposes are welcomed. Comments should be directed to:

Paul Burns
GIS Manager, Engineering & Facilities Management Division (EFMD) Los Angles World Airways

Compliance

Having up to date, accurate, fully compliant data available to the LAWA community is an integral part of planning within any project. The aim of these standards is to ensure a smooth data transfer of information into the LAWA geospatial data base and efficient data maintenance through the complete data lifecycle. Accordingly, the terms and conditions of a LAWA contract require compliance with these standards. Failure to comply with these standards may be taken into account when inviting organizations to participate in future LAWA projects.

LAWA or a third party reviewer will perform detailed quality assurance procedures on all data submitted. Data must be submitted for review at 30% and As-Built. Files containing significant errors will be rejected and returned to the submitter for correction and re-submittal. To avoid delays to project planning, LAWA maintain the right to rework and make compliant the relevant data and back-charge the supplier.

The individual or organization submitting the files is also responsible for ensuring that all links between drawings and reference files will be preserved and automatically reconstructed when data is transferred to the LAWA CAD environment.

Survey and remote sensing standards in use at LAWA

Survey data for the airport is in 2D and 3D AutoCAD (.dwg) CAD files, structured as defined in the LAWA CAD standards. The LAWA GIS standards also apply, when attribute data is being collected.

LAWA Standards

This section provides an overview of LAWA specific standards, plus related federal, local, and national standards.

LAWA CAD Standards

The LAWA CAD standards are based largely on the AIA CAD Layer Guidelines and the National CAD Standards (NCS), adapted where necessary to suit LAWA-specific requirements. The document *CAD Standards for LAWA Projects* is available from the LAWA web site at www.lawa.org/laxdev/Handbook.aspx

United States National CAD Standard® Content (NCS)

The United States National CAD Standard (NCS) consists of the Foreword, Administration, AIA CAD Layer Guidelines, Uniform Drawing System and the Plotting Guidelines http://www.nationalcadstandard.org/ncs5/content.php

LAWA GIS Standards

The LAWA GIS standards are directly based on the ANSI Spatial Data Standard for Facilities Infrastructure and Environment (SDSFIE), Release 2.60, extended in certain areas to handle specific information relevant to LAWA. *GIS Standards for LAWA Projects* presents the most important aspects of SDSFIE as it applies to LAWA. The document is available from the LAWA web site at www.lawa.org/laxdev/Handbook.aspx

SDSFIE is developed and maintained by the Federal CADD/GIS Technology Center, Vicksburg, MS. For further details on SDSFIE 2.60, use the online browser available at http://tools.sdsfieonline.org/browser/

LAWA Survey and Remote Sensing standards

The LAWA Survey and Remote Sensing Standards are based on requirements laid out in Airport Circulars published by the FAA, adapted where necessary to suit LAWA-specific requirements.

A list of related FAA circulars follows.

Related FAA circulars

❖	Check the FAA site for information on latest versions

AC 150/5300-13 Airport Design

http://www.faa.gov/documentLibrary/media/advisory_circular/150-5300-13/150_5300_13.pdf (current version change 18, draft of change 19 is available on FAA website)

AC 150/5300-16 General Guidance and Specifications for Aeronautical Surveys

For setting and recovering Geodetic Control Monuments (primary and secondary control points) at the airport http://www.faa.gov/documentLibrary/media/advisory_circular/150-5300-16A/150_5300_16.pdf (current version 16)

Existing PAC and SAC marks can be retrieved from http://www.ngs.noaa.gov/cgi-bin/airports.prl?TYPE=PACSAC

AC 150/5300-17 Standards for Using Remote Sensing Technologies in Airport Surveys

Standards for remote sensing technologies such as aerial photography and LIDAR http://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5300_17c.pdf (currently version c)

AC 150/5300-18 General Guidance and Specifications for Submission of Aeronautical Surveys to NGS Field Data Collection and Geographic Information System (GIS) Standards

Guidance for surveyors, including data capture rules for airport specific features such as runways, navaids and point line markings. http://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5300_18b.pdf. (current version b)

❖	The data standard format defined in AC150/5300-18 is not used at LAWA. The FAA GIS Standard is an aggregation of detailed features outlined in the LAWA GIS Standards.

Local standards

City of Los Angeles, Bureau of Engineering Manual Part J – Survey

Based on traditional survey methods (theodolite measurements), but also covers certain safety issues such as testing for gas in manholes.

http://eng.lacity.org/techdocs/survey_man/Survey_Manual.pdf

State of California standards

- All cadastral surveys must comply with all State of California regulations
- Coordinates are based on the California Coordinate System of 1983 (CCS83), Zone 5. US Foot
- Orthometric Elevations use the North American Vertical Datum of 1988 (NAVD 88)

National standards

National standards are to be followed only when other standards (LAWA, State of California, or FAA) do not provide guidance. Surveyors must have LAWA approval before implementing national standards in a LAWA project.

Digital Photogrammetry: An Addendum to the Manual of Photogrammetry, Chapter 3

American Society for Photogrammetry and Remote Sensing (ASPRS) publication ASCE C - I 38 -02

Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data – Section 5, Quality Levels of Service Attributes, A through D

FGDC-STD-008-1999

Content Standards for Digital Ortho-Imagery, 1999

Federal Geographic Data Committee, Subcommittee on Base Cartographic Data
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/framework-data-standard/GI_FrameworkDataStandard_Part2_DigitalOrthoimagery.pdf

Engineering & Design Photogrammetric Mapping, 2002

U.S. Army Corps of Engineers (USACE 2002)
http://publications.usace.army.mil/publications/eng-manuals/EM_1110-1-1000_sec/EM_1110-1-1000.pdf

Spatial Data Standard for Facilities, Infrastructure, and Environment

U.S. Army Engineer Research and Development Center, CADD/GIS Technology Center (SDSFIE)
http://www.sdsfie.org/

Overview of survey and remote sensing data processes

The LAWA Survey and Remote Sending Standards cover items such as:

- setting airport geodetic control points or temporary monuments
- topographical surveys
- LIDAR surveys
- aerial photogrammetric projects

Projects at LAWA that receive AIP grant funds must follow the most recent versions of the survey and submission requirements laid out in FAA Advisory Circulars AC 150/5300/16, AC 150/5300-17 and AC 150/5300-18.

The data standard format defined in AC150/5300-18 is not used at LAWA. The FAA GIS Standard is an aggregation of detailed features outlined in the LAWA GIS Standard.

The following items required by the FAA must also be provided to LAWA:

- imagery plans
- survey quality control plans
- any survey and remote sensing submissions required under the FAA Airport GIS program

At the beginning of any project, LAWA will provide the surveyor with all necessary or available digital files in AutoCAD .dwg format, plus any relevant LAWA documentation related to survey standards. LAWA will also provide a plot of existing data within the area to be surveyed, if the project specifications require this.

LAWA requires that all survey data returns are provided both in hard copy and digital AutoCAD .dwg format. Returns follow the file breakdown and standards as set out in the LAWA CAD standards and the LAWA survey and remote sensing standards.

Where the returns are to be delivered incrementally, each subsequent submission after the first contains only the features that were not included in any previous submission. Submission 3, for example, isolates only the features that have not been previously included in submissions 1 and 2. Each digital submission is accompanied by a Transmittal letter and a plot of the data in the digital files.

At the end of a project which has used a series of submissions, LAWA must be provided with a final report. This report is accompanied by a complete set of final digital .dwg files, including a final survey point data file, and a plot of the data in the digital files.

LAWA must always be provided with a project related comprehensive survey report at completion, even if the project does not require a FAA Airport GIS submission. This report must include all information necessary to confirm the integrity of the survey, and an outline of all processes involved and used to collect the survey data.

Any outstanding or unresolved problems, for example unopened manholes/catchbasins or features still unidentified, are noted in the final report so that appropriate action can be taken by LAWA.

General airport control points can be obtained from LAWA upon request

The final digital files submitted contain all features collected during the project, and reflect any changes/updates made during the project. All civil site or utility projects that submit survey data to LAWA must be tied to the NSRS. For all internal building surveys, see section “Measurement standards for drawings inside buildings”.

Survey and remote sensing data collection methods

All civil site or utility projects that submit survey data to LAWA must be tied to the NSRS.

A second order horizontal and vertical control network has been established at the site.

This network consists of approximately 109 survey monuments and temporary benchmarks. In some areas, above ground features were pre-marked with paint to meet municipal utility color coding standards and help feature recognition during data capture. These PAC and SAC control marks can be obtained from the NGS. Any additional LAWA control points can be obtained from LAWA.

LAWA survey standards for NSRS

Obtain the current list of existing control points at use at LAWA. PAC and SAC data can be obtained from the NGS
http://www.ngs.noaa.gov/cgi-bin/airports.prl?TYPE=PACSAC

Geodetic verification

After recovering the PAC and SAC data, the contractor will conduct two independent GPS sessions, each 10 minutes or longer, between the existing stations. The collected data will be post-processed and adjusted while constraining to PAC data.

The results of the network adjustment will be compared to published values for each SAC, and should identify any possible disturbance. The computed distance from the PAC must agree to within ± 3 cm in distance; the difference in ellipsoidal height must agree to within ± 4 cm, and the difference in orthometric height must agree to within ± 5 cm. The contractor must contact LAWA for guidance in repositioning the SAC point (or points) if any discrepancy outside these tolerances is found.

Positional accuracy

Shall be tested and reported following the guidance in the National Standard for Spatial Data Accuracy (FGDC-STD-007.3-1998). All projects require independent NSSDA check points as defined in AC 150/5300-17C.

- for small projects, one independent check point is required
- for large projects such as aerial control for the entire airport, five NSSDA check points are required

Check points for GPS

When using remote sensing technologies, additional check points provide a means of verifying the georeferencing of the data. Collect and provide additional NGS Online Positioning User Service (OPUS) check points within the project area, for an independent check of accuracies. Do not use these check points as part of georeferencing solution for the data. Submit a copy of the OPUS and GPS solution for each check point.

Check point traverse for theodolite surveys

If using traditional theodolite survey methods create a separate traverse that ties your check point traverse to your main project adjusted traverse and provide the comparison of coordinate values of the tie points.

Surveyed accuracies

- accuracy requirements shown are relative to the PACs and SACs or other approved airport control points used for the project
- hard surfaces and features: 0.03 feet horizontally and 0.02 feet vertically
- original ground and graded dirt areas: 0.10 feet horizontally and vertically
- features captured by aerial photography from various scales over the runways and built up areas attain accuracy's of 0.66 feet horizontally and 1.0 feet vertically.

Federal Geographic Data Committee (FGDC) standard FGDC-STD-008-1999 compliant metadata assigned during the survey contains the accuracy and date of data capture of the feature or point.

Global Positioning Systems (GPS)

GPS has become the primary method for data collection of most surveys. Here are a set of best practices that should be followed when doing work at LAWA.

Suggested best practices for static GPS

- establish new station (PAC, SAC or temporary control, etc.) in accordance with FAA AC150/5300-17
- use observation times based on required accuracy and baseline length
- complete GPS log sheet for all observations
- set GPS receivers to a 15° elevation mask
- utilize ground planes for all control observations
- utilize fixed height tripods or rover poles for all observations (mitigating instrument height errors)
- inspect and calibrate plumb of fixed height tripods and rover poles before performing observations
- monitor receiver during all session to ensure uninterrupted and good quality GPS data
- verify fixed height tripod height prior to all sessions
- capture required hand-held digital photographs for specific station types (see AC 150/5300-18b section 1.5.2)

Suggested best practices for RTK GPS

- create a new observation (DC) file on a daily basis
- set base station PDOP mask to 5.0
- set base station antenna mask for 15°
- set base station RMS limits to 0.20
- set base station to collect IN-FILL data for the duration of full day at 15-second epochs
- periodically check base station for plumb and battery power supply
- periodically check in other existing control for accuracy check

Light Imaging Detection and Ranging (LIDAR)

Specific standards and recommended practices must apply when using LIDAR scanners.

LIDAR scanners are used for a variety of survey tasks and currently fall into four principle categories:

- ground based LIDAR (GBL), generally used for measuring atmospheric composition
- airborne LIDAR mapping (ALM), also known as airborne terrestrial LIDAR mapping (ATLM)
- mobile compensated LIDAR mapping (MCLM)
- terrestrial LIDAR mapping (TLM),sometimes referred to as ground based LIDAR scanning (GBLS or GBLM)

LIDAR scanning technologies, regardless of type, are line-of-sight instruments and unable to detect what is not visible to the sensor. Be aware of your scanner’s limitations and local terrain variations, and plan your project to cover any potential gaps or shadows in data coverage.

LIDAR projects are to follow all requirements outlined in AC 150/5300-17 Standards for Using Remote Sensing Technologies in Airport Surveys

Aerial imagery

Specific standards and recommended practices apply when working with aerial imagery.

LAX has been flown with three different flying heights. Make use of existing photo control from previous projects where possible.

Existing flight lines will be used when any new aerial photo is acquired. Only models that require updating will be re-triangulated.

The imagery flight missions can consist of any of these three flying altitudes, dependent upon the Project Statement of Work:

1920 feet above-mean-terrain (1"=320' photo scale)

The coverage area for this photo scale is limited to the airport property boundaries and the areas immediately adjacent to the airport which have already been digitally mapped.

Figure 1. Coverage area for 1"=320'

This flying height will produce sufficient accuracy confidence to collect planimetric features at a scale of 1"=40' as well as topographic contours at a 1 foot interval.

Due to the canyon type effect that can occur around the terminal areas an additional 1:320 flight is done over the terminal areas.

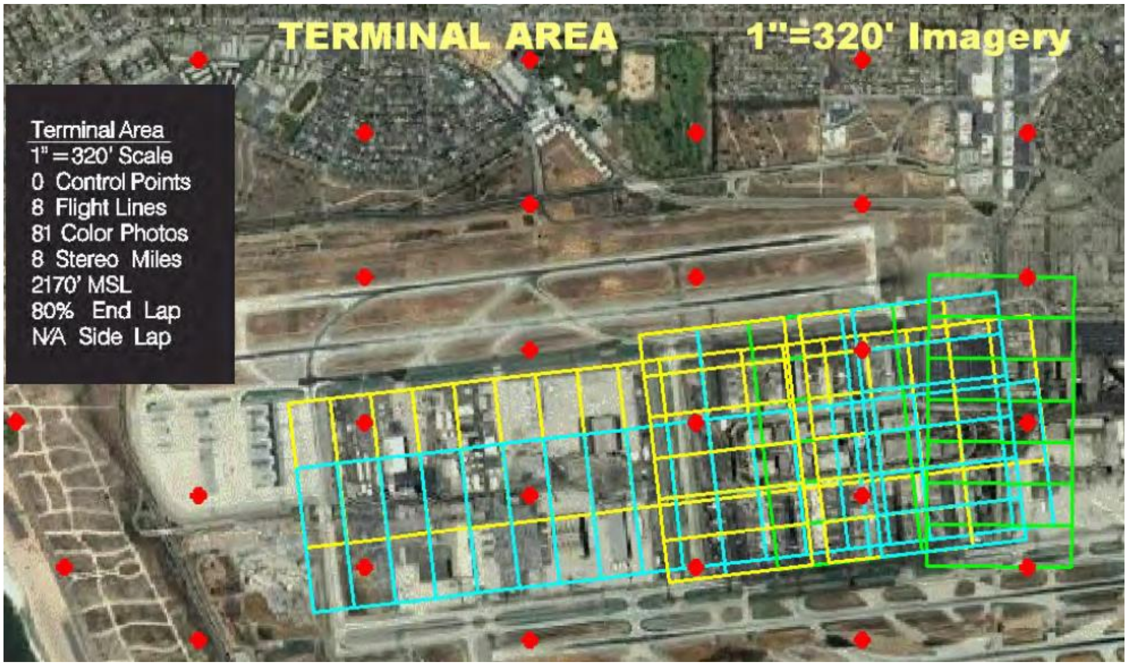


Figure 2. *Terminal Area Model Limits*

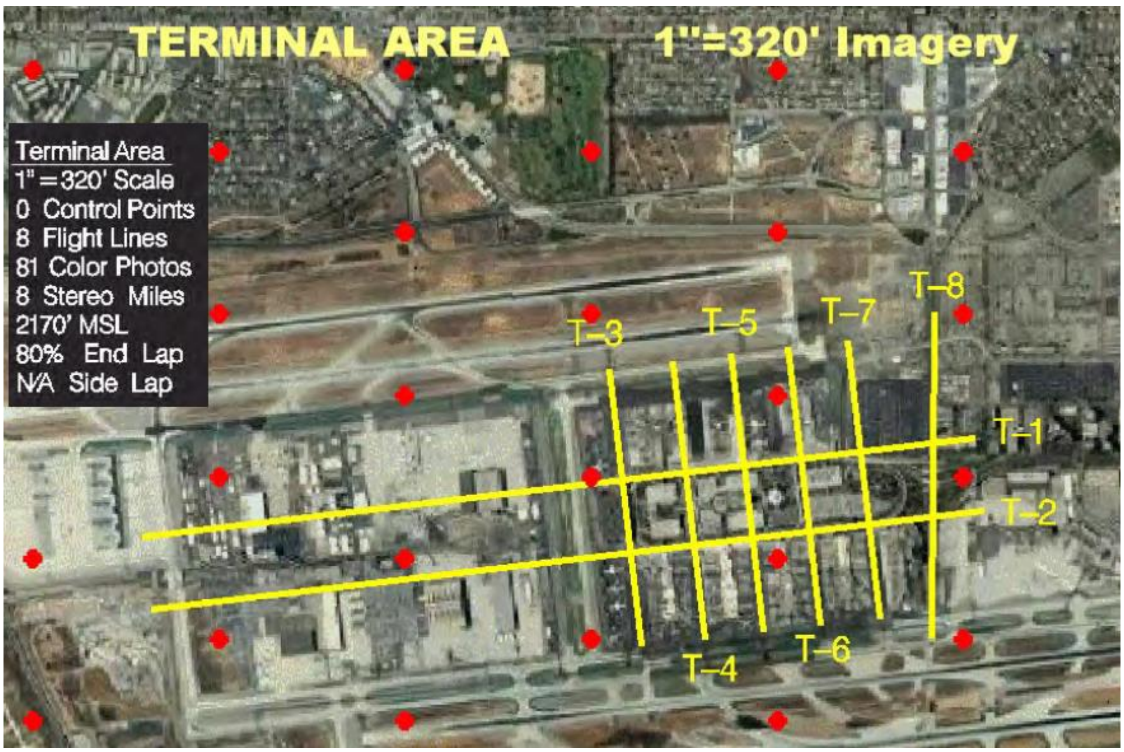


Figure 3. *Terminal Area Flight line locations*

This imagery will be used to produce orthophotography having a ground pixel resolution of 0.20' suitable for a 1"=40' scale

4000 feet above-mean-terrain (1"=667' photo scale)

The coverage area for this photo scale includes the lateral limits of the AC 150/5300-18 obstruction identification surfaces, excluding horizontal/conical surfaces. This imagery will be utilized for analysis of the primary, connection, approach, protection, and transitional surfaces.

This basically equates to that area which extends 20,200 feet from the runway ends, as well as 4,000 on both sides of the runway centerline.

Figure 4. Coverage area for 1"=667' photo scale (mid-level)

This imagery will be used to produce orthophotography having a ground pixel resolution of 0.50' suitable for a 1"=100' scale.

The flight mission at 4000 feet above-mean-terrain consists of 7 flight-lines, each having 150 images.

9000 feet above-mean-terrain (1”=1500’ photo scale)

The coverage area for this photo scale will span the entire lateral limits of the vertically guided surfaces area. It will be utilized in analyzing the horizontal and conical obstruction identification surfaces.

Figure 5. Coverage area for 1”=1500’ photo scale (high-level)

This imagery will be used to produce orthophotography having a ground pixel resolution of 1.0’ suitable for a 1”=200’ scale.

The flight mission at 9000 feet above-mean-terrain consists of 6 flight-lines, with a total of 72 images.

Selection of flight altitudes

The flight altitudes mentioned above will allow for collection of obstruction data, planimetric features, and topographic data within the accuracies prescribed by section 5 of AC150/5300-18B.

This circular requires the following levels of accuracy

- horizontal position of obstructions within +/-20 feet
- within the primary, connection, transitional, protection, and approach surfaces, vertical orthometric height of obstacles within +/-3 feet
- within the horizontal and conical surfaces, orthometric height of obstacles within +/-10 feet.

All three of the planned photo scales were selected to ensure these accuracies will be met using remote sensing. The flying heights are designed to deliver a level of detail which will allow these imagery layouts to be utilized in future projects.

Methodology for controlling collection of imagery photos

The LAWA photo control network consists of 109 control points and 5 independent check points.

The position for each of the five check points was determined with OPUS software from the NGS. These check points were not utilized in the control solution of the imagery.

The 109 control points are distributed throughout the photo area, assuring quality control of the entire imagery area. A special concentration of control points is utilized in the immediate vicinity of the airport, where accuracy requirements are more stringent and where the planimetric and topographic data will be collected.

Survey data submission

This section outlines LAWA policy for CAD file and other formats to be used when submitting survey data.

CAD policy

It is the policy of the Los Angles World Airways (LAWA) that all CAD deliverables submitted to LAWA shall be in a AutoCAD *.dwg file format, structured in accordance with LAWA CAD

The LAWA CAD standards are based largely on the AIA CAD Layer Guidelines and the National CAD Standards (NCS), adapted where necessary to suit LAWA-specific requirements. The document *CAD Standards for LAWA Projects* is available from the LAWA web site at www.lawa.org/laxdev/Handbook.aspx. These standards currently cover .dwg files only.

The LAWA Standards include, but are not limited to: file naming conventions, drawing numbers, file and level structure, fonts, line colors, line weights, symbols, patterns and reference files.

The CAD system in use at LAWA for drawing/data management, which is also the basis of facility management systems, is AutoCAD by Autodesk.

If any secondary consultant uses a CAD package other than AutoCAD, it shall be the responsibility of the prime consultant to ensure all CAD data submitted to LAWA is structured in accordance with LAWA CAD Standards.

Templates

Project partners and subcontractors who need to implement the CAD standards for LAWA projects can download templates to provide a working environment based on the LAWA CAD Standards. Each template (.dwt file) defines the layers for a specific discipline. Sample title blocks can also be downloaded

Submission formats for survey data

The submission format for survey data is based on AC 150/5300-17, with slight modifications. The following directory structure is to be used when submitting data.

1. Summary
2. Project control or photo control notes
3. Project control coordinates
4. Photo control network diagram
5. LIDAR & camera calibration report
6. LIDAR path or flight report
7. LIDAR path or flight layout
8. LIDAR or aerial triangulation
9. Digital model imagery
10. AutoCAD drawings

LIDAR projects are to follow all requirements outlined in AC 150/5300-17.

An explanation and sample data requirements for each directory follows.

Section 1 – Summary

This section contains project summary and summary of any deviations

Summary Report should contain a report of any issues that could affect the project, such as problems with Control points, accuracy issues, site access problems, or changes in flight lines or camera during a flight. The report should ensure that any deviations from the project plan are annotated and properly recorded due to unusual circumstances or problems, equipment malfunctions, changes to proposed methodologies/equipment or any deviations from these specifications.

SUBMISSION FORMAT .pdf

Section 2 – Project Control or Photo Control Point Notes

This section contains survey documentation.

Station location sketch and visibility diagrams are required for each point listed in the control coordinate listing of the files. All station location sketch and visibility reports are to be uniquely numbered and correspond to the hand held photographs supplied, and numbers match the point numbers in the project control or photo control coordinate listing.

SUBMISSION FORMAT .txt, Excel

Hand held photographs are required for each control point, navaid or runway end. Each point should have one hand held photo (up close) taken from 5-6 feet away and one hand held photo taken from 10-30 feet away. All photos include the airport name or airport call letters and survey point number.

SUBMISSION FORMAT .pdf or .jpg

Rinex Version of all GPS station data is required in RAW format as below

Raw GPS input files	aaaaddds.xxx	aaaa = alphanumeric 4-character station identifier ddd = day of year s = session yy = year of observations xxx = receiver-dependent file extension (for example .DAT, .EPH, .ION, or .MES)

Rinex Sample Raw observation is shown below

RINEX2 Observation File	aaaaddds.yyo

NSSDA check Points

- Raw GPS observations must be provided for all points listed as the NSSDA check points
- 5 check points are required for FAA photogrammetric imagery projects
- submit OPUS results for each temporary GPS station including the NSSDA check points

SUBMISSION FORMAT .txt, Excel, .pdf or .jpg

Section 3 – Project control or photo control coordinates

This section contains survey data and Airborne GPS data collected during the acquisition of GPS and Aerial Photography GPS (ABGPS) data.

Provide an ASCII text file of the final imagery control point values identifying any changes from the remote sensing plan, as illustrated in Table 3-2 of AC 150/5300-17C. This section should only include the coordinate values (easting, northing, elevation) for the control points being used in the project and the five OPUS check points

SUBMISSION FORMAT .txt, Excel, .pdf or .jpg

Section 4 – Project control or photo control network diagram

This section contains the ground control diagram.

Provide a KML or PDF depicting all control stations the data used in geo-referencing the project including information regarding their tie to the NSRS

SUBMISSION FORMAT .pdf, .jpg or .kml

Section 5 – LIDAR or camera calibration report

This section contains a .pdf of the calibration report

There is no standard format for the calibration reports. However, they must contain, at a minimum, the following information:

- date the calibration was performed
- name of the person, company, or organization responsible for performing the calibration
- methods used to perform the calibration
- final calibration parameters or corrections determined through the calibration procedures.
- discussion of the results
- sensor maintenance reports with maintenance history of the sensors used in data collection

Calibration submission for LIDAR equipment must follow AC 150/5300-17, Section 5.4 "What are the system calibration requirements for using LIDAR to collect airport data"

SUBMISSION FORMAT .pdf or .jpg

Section 6 –LIDAR or flight report

Only required for Aerial Photogrammetric projects

SUBMISSION FORMAT .pdf or .jpg

Section 7 – Flight or path layout

This directory contains a diagram that depicts the flight paths or paths used in LIDAR data acquisition, plus altitudes that were flown during imagery acquisition.

SUBMISSION FORMAT .pdf or .jpg

Section 8 –LIDAR and Aerial Triangulation (AT)

This directory contains AT reports, spreadsheets, or ASCII files that describe the triangulation results for project including LIDAR and aerial photography projects as defined in AC 150/5300-17c section 3.4.d.7.

SUBMISSION FORMAT .txt, Excel or .pdf

Section 9 – Digital Model Imagery

This directory contains raw stereo images (TIF images) or LIDAR point clouds

SUBMISSION FORMAT Tiff or point cloud

Section 10 – AutoCAD drawings

AutoCAD submission best practices (.dwg)

Project partners and subcontractors who need to implement the CAD standards for LAWA projects can download templates to provide a working environment based on the LAWA CAD Standards. Each template (.dwt file) defines the layers for a specific discipline. Sample title blocks can also be downloaded.

AutoCAD Best Practices

all spatial data must be created in model space

all graphical elements must be in paper space

the unit of measurement used for cad civil drawings is the u.s. foot

all civil drawings must be created in nad 83 california state planes, zone v, us foot coordinate system

proper orientation of point features should be maintained wherever possible

underground services should be connected wherever possible.

for any feature that cannot be identified by the field crew, enter the point into the digital file as an unidentified feature, using the block ID from the LAWA block library. At the same time, a LAWA EFMD engineer or GIS specialist should be notified of the point in question so that an investigation can be started by LAWA to obtain identification for the feature. A photograph, taken by the field crew of the unidentifiable point and forwarded to LAWA, will aid in the identification process. When identification has been obtained, LAWA will notify the surveyor so that the proper symbology for the point can be input into the digital file.

if a new feature has been collected that does not match any existing feature, a LAWA representative should be notified. The representative will then determine the proper symbology and feature number to be used and forward this to the surveyor for input in the digital file.

survey plans submitted to LAWA should be legible at the plotted scale, with the spot elevations not appearing too dense in nature

digital spot elevations are to be structured so the elevations of a specified interval are on the appropriate layer within the CAD file. The remaining elevations must be placed on a separate CAD layer specified in the LAWA CAD Standards. This will allow for spot heights to be shown on any drawing without being too dense in appearance, yet still contain all collected spot elevations within the file which can be used for design, planning, etc. purposes.

when submitting a CAD file, the settings for the relevant layers should be “tuned on” and “thawed”

Typical civil site projects

All drawings submitted with survey data will have a file-name starting with V- , as outlined in the CAD Layer Assignment table for LAWA projects.

Prefix	Data
V-SURV	Survey lines (Traverse/Base Lines)
V-AIRF	Airfield
V-BLDG	Buildings
V-PROP	Property
V-SITE	Site
V-TOPO	Topography
V-UTIL	Utilities

Submission of borehole data

Data submission requirements

All borehole locations are to be submitted geo-referenced according to LAWA standards. LAWA will then use this data to update the digital graphics database for the design and management of the facility.

Deliverables

- hard copy of the geo-technical report describing project findings and test results including borehole logs and the corresponding hard copy site plan drawings
- ASCII file with x,y and z coordinates and number of each borehole

  Note: Although it is not a requirement, it would be preferable to be given all site plan drawings in an AutoCAD.dwg format**.**

- reports in PDF Format

Borehole numbering convention policy

Each borehole must be numbered consisting of the **Project Number** and a sequential **log number.** If a borehole is not associated with a project, the number 999 will be assigned as the project number.

BRH 265-001

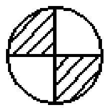


Figure 6. Sample borehole where BRH265 represents the project number and 001 represents the sequential number.

Measurement standards for drawings inside buildings

The buildings digital graphics database was built up from hard-copy drawings for many of the existing airport buildings, including terminals, administration building, central work shop, central utility plant, fire hall/maintenance garage and so on. These drawings included architectural floor plans and a combination of reflected ceiling plans, structural, electrical and mechanical information.

These files use the same coordinate system as the site data. Therefore, the buildings and their corresponding data sets fit directly on top of the site information.

Other airport buildings, including aircraft hangars, cargo buildings, airline administrative buildings and so on. are not included in the database because these tenants manage their own facilities. Drawings of these buildings are either digitized or re-drawn if they are required for a LAWA project, and are ultimately added to the building digital graphics database.

About the 'inside buildings' standards

These standards provide consistent tools toward accurate field measurements for the creation of new as-built drawings that will, in-turn, be used in facilities management 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.

Measurements will be used to create accurate as-built drawings in AutoCAD (.dwg) and in GIS (.shp) format. The new as-built drawings are to adhere to the latest LAWA CAD Standards published on the LAWA web site and detailed in the LAWA Design and Construction handbook.
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 of field experience measuring and drawing several airport terminal structures over 100,000 square feet per floor. The intention is to provide proven methods to avoid common errors, remove the necessity to repeat the entire learning curve and provide new or novice measuring teams with 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.

Quick review list of topics covered

- paper requirements
- as-built drawing requirements
- drawing CAD setup for as-built drawings
- photographs
- equipment acceptable for use on this project
- elevators, stairs, and aligning multiple floors
- included items
- excluded items
- rounding off of field measurements
- rounding off of drawings
- accuracy in measuring and drawing
- wall thicknesses accurately measured
- dimension and measuring points
- walls – odd angles, vertically, horizontally, and curved
- redundant measurements
- door information
- security key pads (also known as Acams)
- column diameter
- areas undefined by walls or other enclosures

Standards

The standards defined and illustrated in this chapter cover:

- field measurement sheets
- drawing setup in AutoCAD
- master lease exhibit (MLE) drawing
- photographs
- equipment – measuring devices
- aligning multiple floors
- included and excluded items
- inaccessible areas
- structural changes during measuring
- gridlines in drawings
- accuracy of measurements
- wall thickness
- door dimension points
- walls - curved, non-rectilinear, and sloped
- redundant measurements
- door information to be shown on drawings
- security key pads (Acams)
- columns
- miscellaneous equipment in public areas
- areas not enclosed or defined by walls

Field measurement sheets

Field measurement sheets can be either of:

small scale sector map

all sectors per level, for one terminal

large scale sector drawing

individual sectors, for measuring

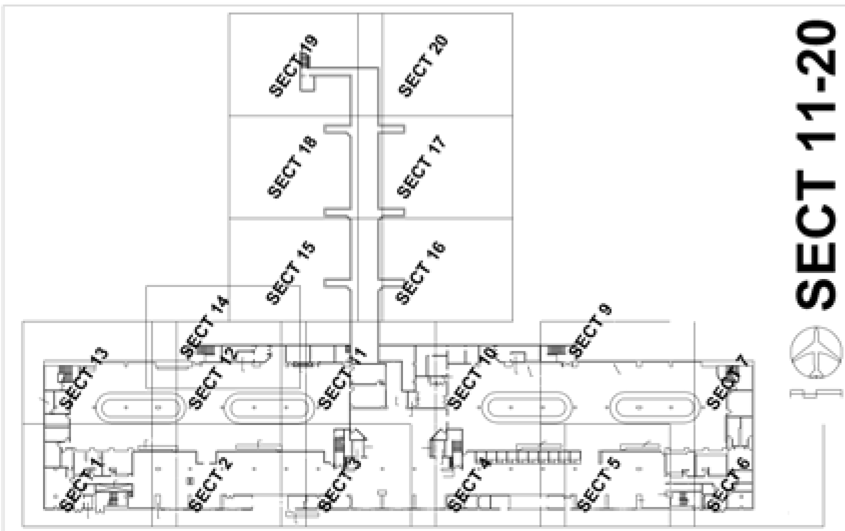


Figure 1. Sector map showing total floor plan

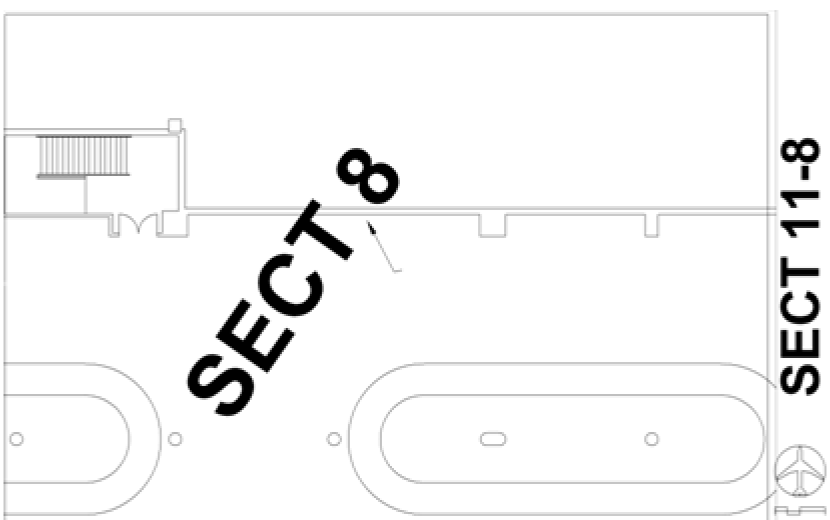


Figure 2. Single sector showing partial floor plan

Drawing setup in AutoCAD

Units	Engineering US. feet
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" and 24” x 36”
Drawing CAD Object Properties	Grid Lines: refer to Grid Lines section of this Standard
Layers	LAWA CAD standards
Line Types	LAWA CAD standards
Text Styles	LAWA CAD standards
Dimension Styles	LAWA CAD standards
Blocks or Symbols	LAWA CAD standards

Refer to the LAWA CAD Standards for additional properties.

Master Lease Exhibit (MLE) drawing

The typical MLE drawing shown below 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.

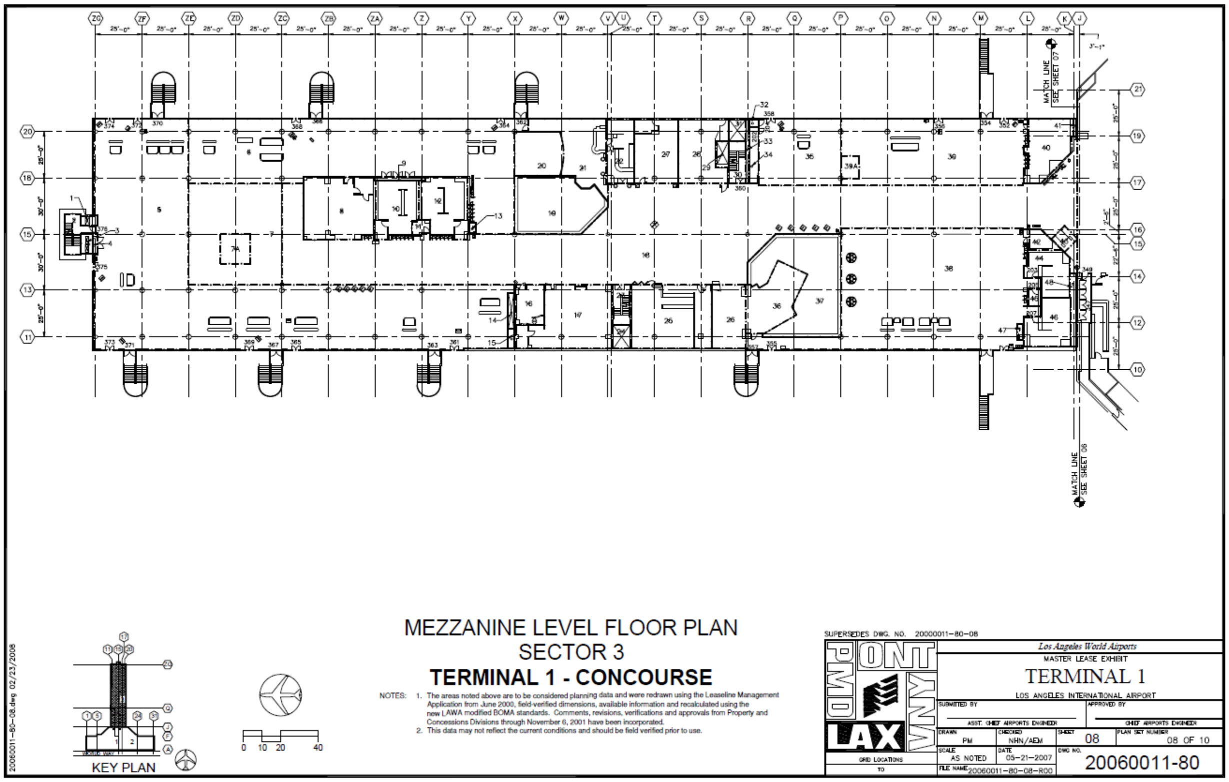


Figure 3. Typical MLE (Master Lease Exhibit) drawing

Photographs

Photographs are used for one of three reasons:

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.

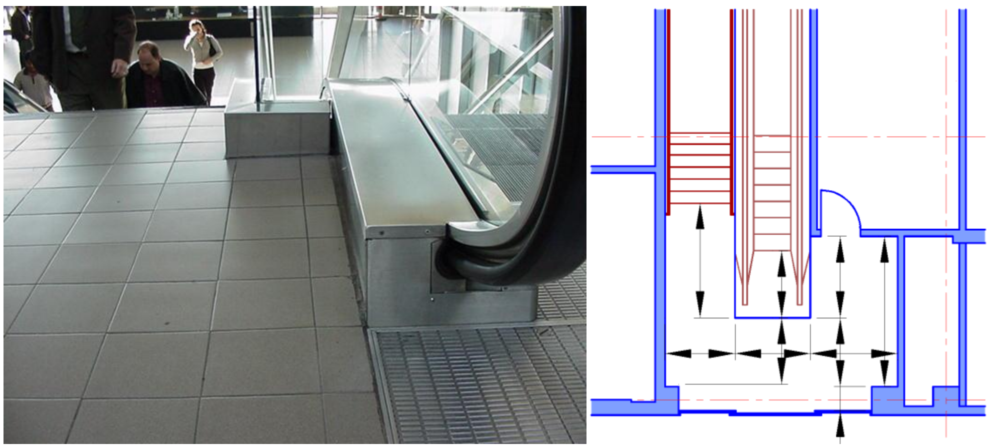


Figure 4. Complex stair and escalator relationship

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.

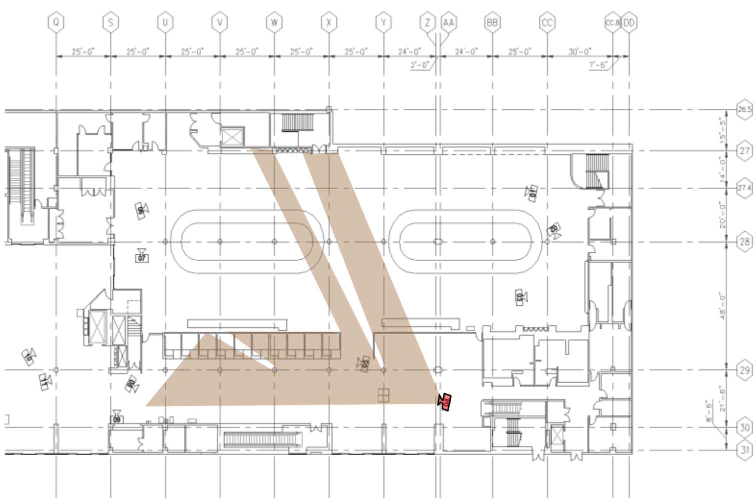


Figure 5. Arrival Public Lobby – overhead FIDS

Equipment – measuring devices

❖	minimum device accuracy to be 1/16"

Acceptable measuring devices are:

- manual: recommend 100’ and 30’ metal tapes
- digital: Leika Disto Classic or equal
- LIDAR based survey

Sonar based measuring equipment, and non-metallic tapes and tapes that may stretch with use, are not acceptable.

Notes on measurements

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.

Using elevators to align multiple floors

Align floors, above to below, using elevators as a guide. Measuring correctly to vertically line up multiple floors is critical.

❖	Stairs can also be used: see Using stairs to align multiple floors

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 the elevator lobby to adjoining spaces.

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

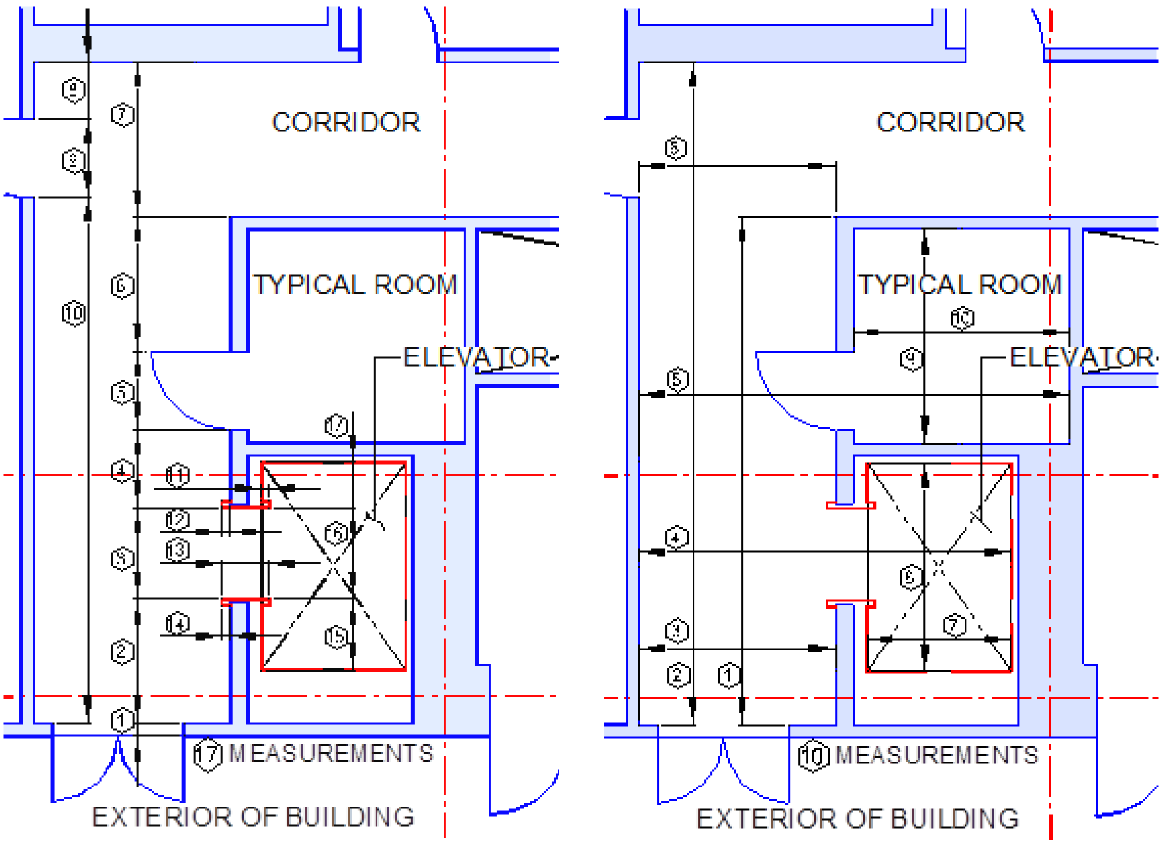


Figure 6. Elevator as datum

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.

Using stairs to align multiple floors

Align floors, above to below, using stairs as a guide. Measuring correctly to vertically line up multiple floors is critical.

❖	Elevators can also be used: see Using elevators to align multiple floors

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.

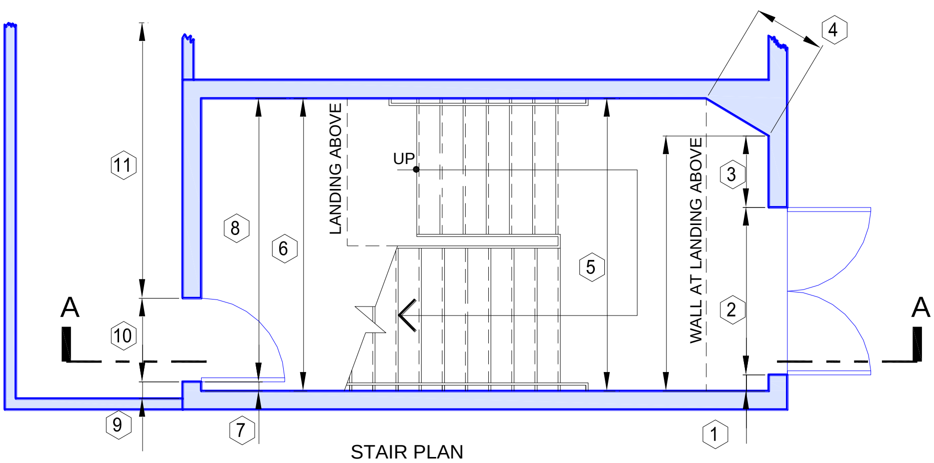


Figure 7. Stair plan

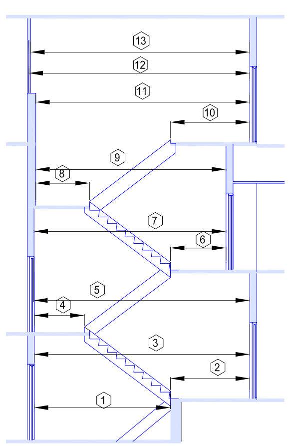


Figure 8. Stair section

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.

Note any unusual physical features and verify with LAWA FMG Engineers and/or GIS staff, if they are to be documented. 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 readable condition.

Included items

- 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, candy vendor or others
- baggage handling equipment such as carousels in the baggage arrival areas
- trash compaction machinery, whether private or LAWA owned
- free standing portable offices

  There are offices of this type throughout the airport facility. All of them are to be measured and noted on the drawings.

- all FIDS (Flight Information Display System) monitors

  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

Excluded items

- in restrooms: plumbing fixtures, stall partitions, mirrors, or counter tops
- in various public areas: movable, freestanding objects
- 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.

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 is subject to inclusion or exclusion in the measurement process, as a separate decision.

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.

Accuracy of measurements

single measurement

½" 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 ½" 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 to ½" 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 single or cumulative measurements.

Wall thickness

- measure and note all wall thicknesses as accurately as possible

  See Figures 7, 9 and 13, for methods of determining 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.

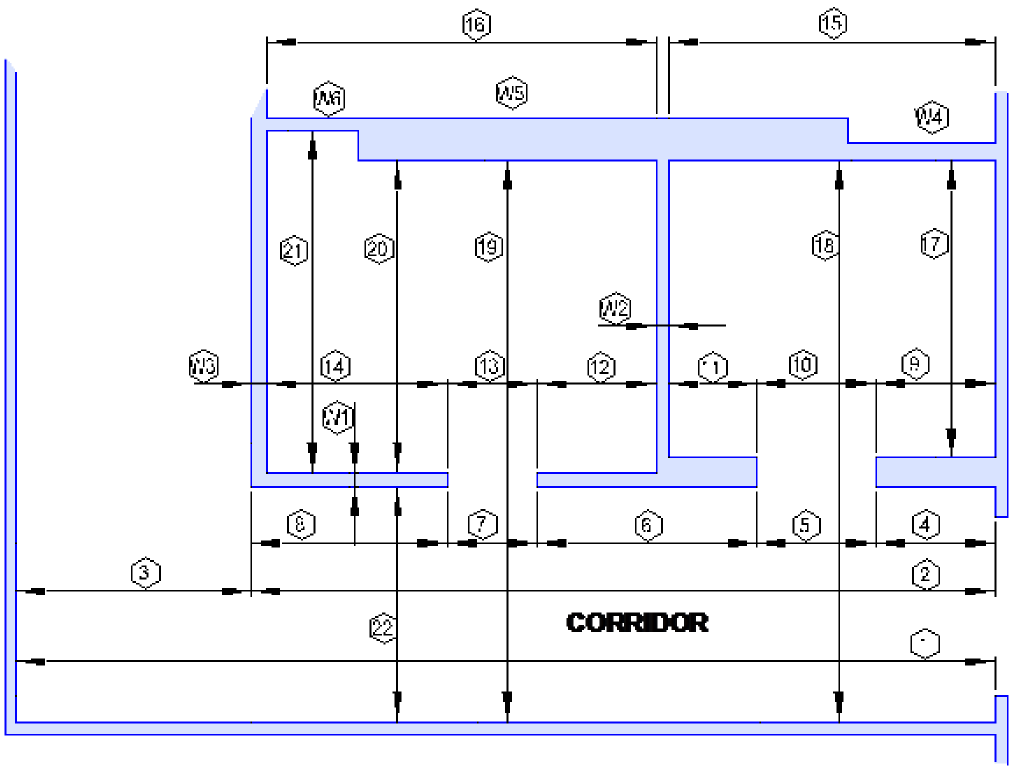


Figure 9. Wall thickness measurement guidelines

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 occur when a wall changes thickness inside a room, and dimensions 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 for error

❖	Lesson: be observant and diligent

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 CDs 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.

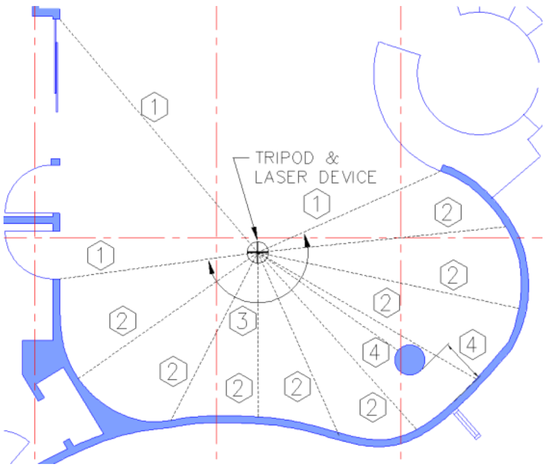


Figure 10. Curved walls

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. Known column using surrounding known fixed elements

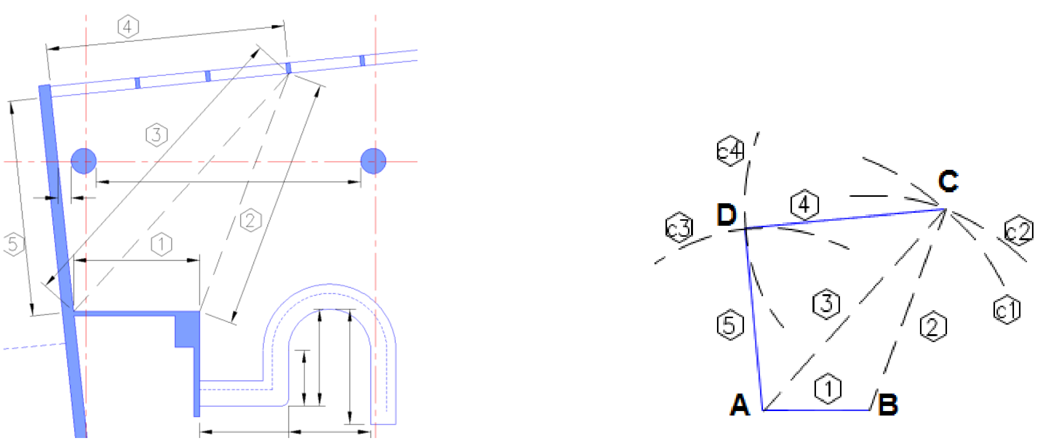


Figure 11. Non-rectilinear walls

1. Use points A & B to draw circles C1 & C2
2. Use point of intersection of C1 & C2 to draw circles C3 & C4
3. Draw wall from points C to D to A to B

Figure 12. Sloped walls

Measure all sloping walls at their floor line

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: typical measurement points for doors are shown in the figure below

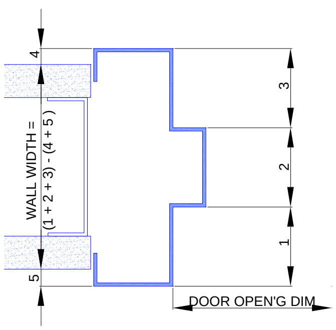


Figure 13. Door jamb - typical measure points

Security key pads (Acams)

- show the location relative to the door opening
- show the number of the key pad whenever possible.
- show the door number (QR code) whenever possible

Columns

- 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**.**

To determine the as-built diameter of round columns, measure the circumference and calculate the diameter using the formula

Diameter (D) = Circumference (C) divided by pi or D = C ÷ 3.14

Miscellaneous equipment in public areas

This category concerns items such as:

- FIDS (Flight Information Display System) equipment
- vending machines
- baggage cart storage racks
- lockers in public areas
- security equipment
- kiosks
- wifi antennas
- internet charging stations

FIDS (Flight Information Display System) equipment

Figure 14. FIDS examples

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

Vending machines

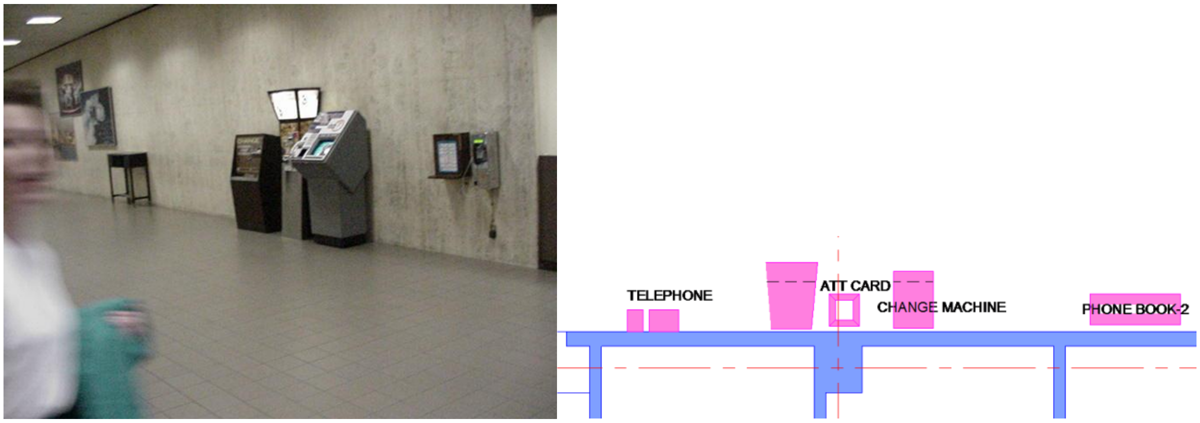


Figure 15. Vending machines

Baggage cart storage racks

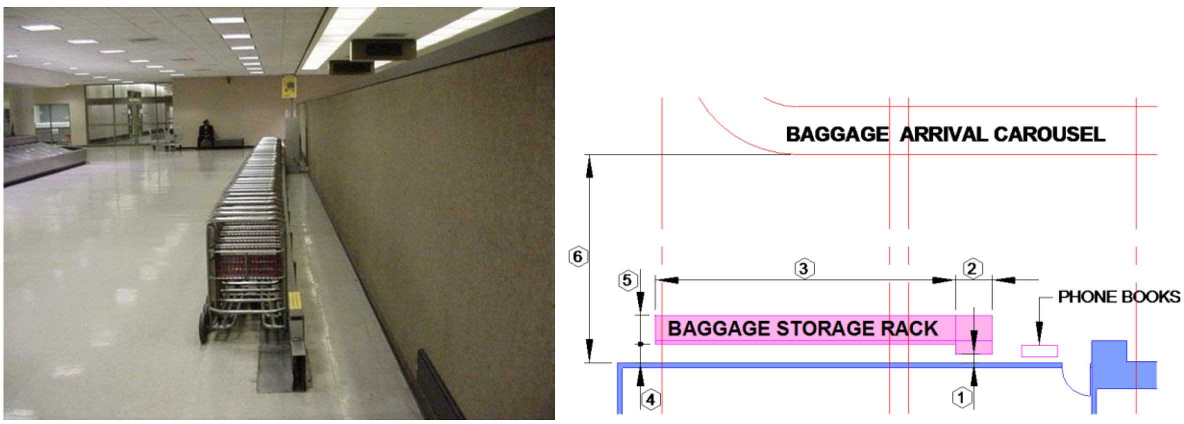


Figure 16. Baggage cart storage racks

Lockers in public areas

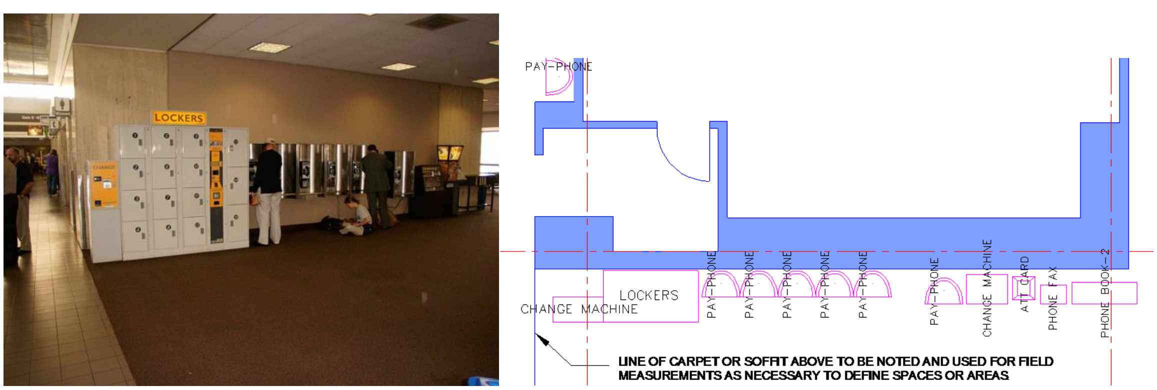


Figure 17. Lockers in public areas

Security equipment

When measuring security equipment and areas:

- Always inform a TSA supervisor
- use a 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, as an example.

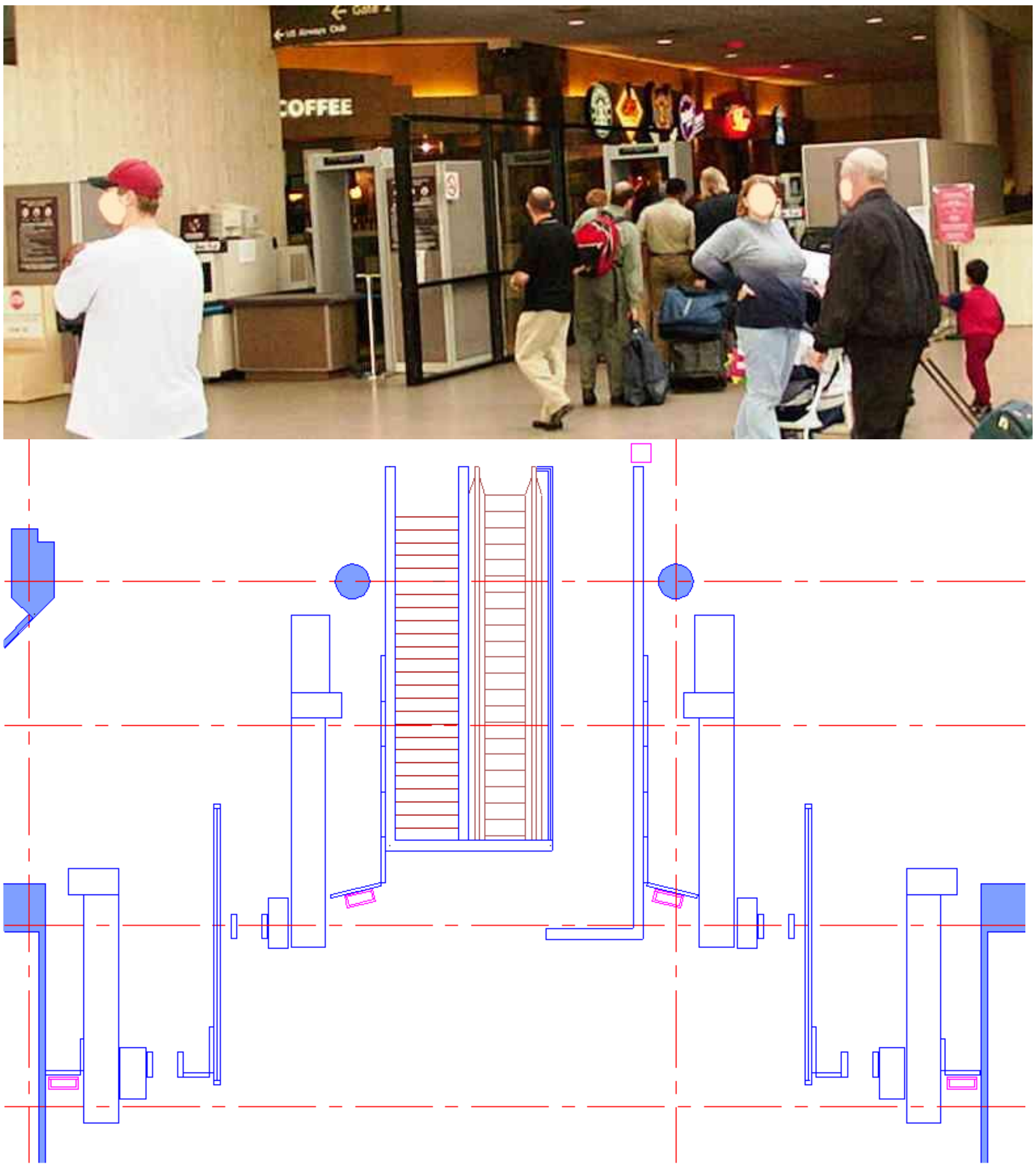


Figure 18. Security areas

Kiosks

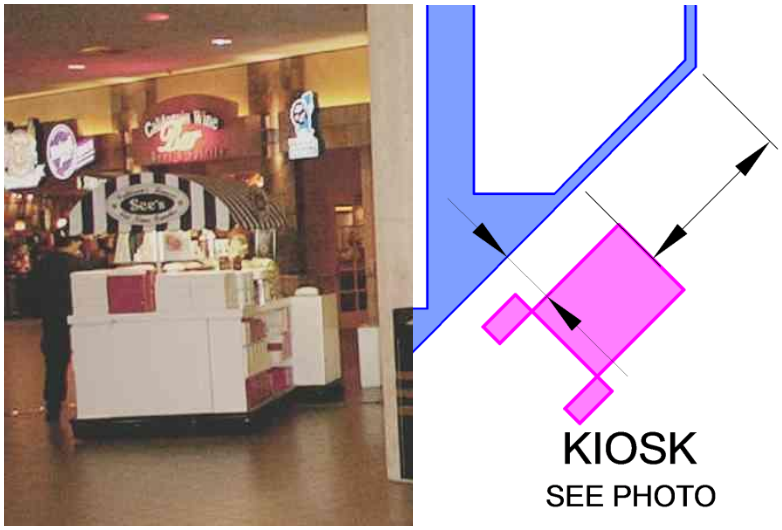


Figure 19. Typical kiosk area

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 outermost edge is to be the measuring point. These lines can define the outermost edges of the building in some cases.

Figure 20. Areas not enclosed or defined by walls

Carpet lines, ceilings, adjacent face of walls or columns, or exterior face of walls, also referred to as “drip lines".

Surveyed by	K. Reimers	Date	Jan 2009	F.B.	41234	Pg.	1
Reviewed by	N. Turner	Date	Jan 2010				
Type of Survey	Horizontal and Vertical Control Network					W.O.	E1800490
Job Number	90977	Title Page	1	Sheet	1	of	17

LAX Horizontal and Vertical Control Network

Horizontal Control Was Established Using GPS

Vertical Control Was Established Using Diferential Leveling

Survey Crew
K. REIMERS
R. HOLME
N. TURNER
L. BURKE
E.CHING
K.WERETKA
J. BAWAYAN
C. ZAMORA
M. JOYCE
C. PRIETO

Vertical Control: NAVD88
NGS Benches DY1315, DY1310,DY1296 DY1304
City BPM 17-19900
Horizontal Control:
CSRC CGPS Stations UCLP, TORP, DSHS, and LASC
California Zone 5 Coordinates
NAD83, National Special Reference System 2007 (NSRS2007)
Epoch 2007.0

Purpose: The purpose of this project is to establish horizontal and vertical control values for current and future projects at Los Angeles International Airport.

Datums: The vertical datum for this project is the same as the NGS bench marks, whose orthometric heights were derived from differential leveling; NAVD 88, 1995 adjustment. Leveling was performed using the Federal Geodetic Control Subcommittee (FGCS) specification for Second Order Class II Geodetic Leveling as defined in the publication “FGCS Specifications and Procedures to Incorporate Electronic Digital / Bar-Code Leveling systems”, adopted June 14, 1995, with modifications as set forth in the document “Specifications and Procedures for Second Order, Class II Geodetic Leveling to Establish Elevation on CORS” as published by the California Spatial Reference Center (CSRC), March 10, 2003. All level lines were double run.

The horizontal control is California Zone V Coordinates, North American Datum of 1983 (NAD83), National Special Reference System 2007 (NSRS2007), California Special Reference System (CSRS) Epoch 2007.00, as supplied by the California Special Reference Center. Superseded control can be found in Appendix A

Horizontal Control: Primary control stations were CSRC continuously operating GPS reference sites (CGPS) UCLP, TORP, DSHS, and LASC.

Array: SCIGN
Name: UCLA
SOPAC Site ID: UCLP

Array: SCIGN
Name: Torrance Ariport
SOPAC Site ID: TORP

Array: PBO
Name: DSHS_SCGN_CS1999
SOPAC Site ID: DSHS

Array: SCIGN
Name: LASC_SCGN_CS1998
SOPAC Site ID: LASC

Station	North	East
TORP	1748959.858	6461222.724
LASC	1796299.020	6468688.999
DSHS	1831273.115	6456057.891
UCLP	1847829.439	6427838.469

A total of 38 stations were observed, which includes the four CSRC CGPS stations. The static GPS survey was done in compliance with NOAA Technical Memorandum NOS NGS-58, Guidelines For Establishing GPS-Derived Ellipsoid Heights (Standards: 2 Cm and 5 Cm), Version 4.3

Processing: All data for the static survey was processed using Trimble Geomatic Office, Version 1.63. The network adjustment was completed using this same software.

A minimally constrained adjustment was performed to check the internal consistency of the network, detect blunders or ill-fitting observations; and obtain accurate observation error estimates. The average vector residual was 0.02 feet. Vector weighting was established with fixed centering and height estimates set to 3mm.
A constrained network adjustment was preformed to establish control values that fit coordinate values established and published by the CSRC. The stations fixed for this adjustment were LASC, DSHS, and UCLP. TORP was not fixed but was used as a check. A variance factor of 1.09 was produced. A scalar value of 3.98 was applied to the vector covariances.

The final adjusted coordinates were rotated, translated, and scaled to fit existing local airport coordinates found in CEFB 43071, Page 1028. The established airport coordinates were verified using RTK , and following procedures prescribed in “National Geodetic Survey User Guidelines for Classical Real Time GNSS Positioning” . All points fell within the estimated accuracy for Class RT1 .

Origin North, 1801390.089 , Translation North, -1805665.142
Origin East, 6435488.816 , Translation East, -6446317.891
Rotation angle, 6°46'03", Scale Factor, 0.99999844

GPS Equipment
Unit 1:
Trimble 5700, SN 440103753, with Zephyer Geodetic Antenna, SN 41249-00,
Unit 2:
Trimble 5700, SN 220272556, with Zephyer Antenna, SN 11909734
Unit 3:
Trimble 5700, SN 220272473, with Zephyer Antenna, SN 12235208
Unit 4:
Trimble R8/5800, SN 4588158267 with TRM TSCR 2, SN SCS17A3748
Unit 5:
Trimble R8/5800, SN 4588158978 with TRM TSCR 2, SN SCS17A3748

California Coordinate System Zone V Epoch 2007.0 NAD83(NSRS2007)
Elevations NAVD 1988

	Northing	Easting	Elev	Desc.
30	1797928.691	6433844.709	127.479	PSO#30, 1"IP W/ CAP
241010	1805460.989	6440757.143	107.051	241010, S&W
241018	1805135.953	6436242.988	119.908	PSO#1018, S&W
241020	1805436.902	6438181.782	120.507	241020, BR DISK
241040	1804865.977	6433940.954	116.074	241040, SSDM
241050	1804409.599	6429461.900	114.218	241050, S&W
481010	1801809.661	6437274.766	121.134	481010, BR DISK
961010	1803999.682	6441551.521	104.166	961010, S&W
6R1020	1803943.572	6440421.016	113.558	6R1020, S&W
6R1025	1802723.112	6429773.849	102.602	6R1025, SPK
6R1026	1802909.103	6431701.631	106.862	6R1026, SPK
6R1027	1803233.436	6434017.737	113.718	6R1027, SPK
6R1030	1803542.836	6436531.053	118.676	6R1030, SSDM
6R1040	1803264.545	6434773.712	115.190	6R1040, S&W
7L1000	1801241.107	6446411.367	92.500	7L1000 , SSDM
7L1005	1801436.618	6445563.365	96.277	7L1005, SPK
7L1010	1800893.166	6441551.581	108.965	7L1010, S&W
7L1020	1800158.084	6437322.577	127.662	7L1020, S&W
7L1030	1799921.838	6435119.570	121.170	7L1030, S&W
7R1003	1798002.510	6435059.078	114.974	7R1003, S&W
7R1004	1798344.916	6437898.273	120.900	7R1004, S&W
7R1005	1798706.310	6441535.653	110.748	7R1005, S&W
7R1006	1799374.920	6446439.531	95.471	PSO#5 SPK
SA1020	1799172.117	6432322.983	102.731	SA1020, SSDM
SA1030	1801273.386	6431897.923	104.931	SA1030, S&W
SA1059	1798517.355	6433148.699	89.399	SA1059, S&W
WP1046	1805390.143	6447172.193	101.025	WP1046, S&W
WP1047	1805410.435	6444484.629	102.944	WP1047, S&W
WP1049	1805998.850	6438390.359	112.524	WP1049, S&W
WP1050	1805805.557	6436375.518	135.592	WP1050, S&W
WP1051	1805526.102	6434047.318	109.994	WP1051, S&W
WW1000	1801040.761	6429938.421	106.343	WW1000, S&W
WW1001	1801414.257	6432879.485	101.832	WW1001, S&W
WW1002	1801527.806	6434246.252	105.925	WW1002, S&W
WW1004	1801728.760	6435518.745	110.718	WW1004, SPK

LAX Coordinates

Station	Adj. North	Adj. East
241010	-853.346	-5117.746
241018	-644.166	-9638.744
241020	-573.783	-7677.998
241040	-640.988	-11956.549
241050	-566.371	-16458.169
481010	-4068.862	-9006.129
961010	-2398.079	-4501.105
6R1020	-2320.578	-5630.344
6R1025	-2277.865	-16347.130
6R1026	-2320.341	-14410.866
6R1027	-2271.200	-12072.681
6R1030	-2260.126	-9540.421
6R1040	-2329.392	-11318.309
7L1000	-5710.116	-0.200
7L1005	-5416.038	-819.253
7L1010	-5482.952	-4867.119
7L1020	-5714.563	-9153.274
7L1030	-5689.560	-11368.767
7R1003	-7588.383	-11655.012
7R1004	-7582.936	-8795.254
7R1005	-7652.691	-5140.637
7R1006	-7566.616	-192.145
SA1010	-7518.586	-12869.617
SA1020	-6104.504	-14234.212
SA1030	-3967.790	-14408.695
SA1059	-6852.006	-13491.408
WP1046	-1679.651	1244.249
WP1047	-1342.796	-1422.194
WP1049	-40.330	-7404.654
WP1050	5.154	-9428.231
WP1051	2.003	-11773.137
WW1000	-3967.885	-16381.954
WW1001	-3943.568	-13417.374
WW1002	-3991.871	-12046.751
WW1004	-3942.269	-10759.445

Station Descriptions

30	FD 1" IRON PIPE WITH CAP DESIGNATED "GPS 30", 3M SOUTH OF TOP OF SLOPE SOUTH OF SERVICE RD. "A", 67M EAST OF RED & WHITE COMMUNICATION SHACK ON THE SOUTH SIDE OF SERVICE RD. "A".
1990	
241010	SET SPIKE & WASHER IN DWPWS MONUMENT PILE, 6.9M WEST OF EASTERLY PERIMETER FENCE, EAST OF RUNWAY 24R, 4.6M EAST OF SIDEWALK, 14M NORTHEAST OF SERVICE RD CURVE, CONCAVE TO SOUTHWEST.
241018	FD SPIKE & WASHER IN CENTER OF SERVICE RD NORTH OF RUNWAY 24R, 9M EAST OF CENTERLINE PRODUCED OF GEORGETOWN AVE., 0.56km WEST OF NGS COLIN. IN CENTER OF AERIAL TARGET.
241020	FD BRASS DISK 29M NORTH OF SERVICE RD NORTH OF RUNWAY 24R, .77km WEST OF EASTERLY SERVICE RD. LOCATED IN NORTHEAST CORNER OF CONC. VAULT FOR CONTROL, NORTH OF O.9M HIGH AND 1.3M WIDE CONC. PILE FOR CABLE RACE.
241040	SET STD. SURVEY MONUMENT ON NORTH SIDE OF SERVICE RD NORTH OF RUNWAY 24R, 1.12km WEST OF NGS COLIN.
241050	SET SPIKE & WASHER IN DWPWS MONUMENT PILE, NORTH SIDE OF SERVICE RD NORTH OF RUNWAY 24R, AT BEG. OF CURVE CONCAVE TO SOUTHEAST. NEAR WESTERLY END OF RUNWAY 24R.
481010	FD BRASS DISK 3.4M WEST OF WEST EDGE OF SERVICE RD "Q", EAST OF TAXIWAY "Q", WEST OF BRADLEY TERMINAL. LOCATED IN SOUTHEAST CORNER CONC. VAULT FOR FUEL.
961010	SET SPIKE & WASHER IN WEST CURB ISLAND EAST OF SEPULVEDA BLVD., 0.8M SOUTH OF NOSE OF ISLAND, 0.3M NORTH OF NORTH CURB PRODUCED 96TH ST. CITY OF LOS ANGELES.
6R1020	SET SPIKE & WASHER IN CONC. PIER 0.4M X 0.4M SQ., 29M SOUTH OF CENTERLINE STRIPE OF SERVICE RD "E", NEAR LAX GATE #3, EAST OF TAXIWAY E7.
6R1025	FD SPIKE & WASHER 1.5M SOUTH OF NORTH EDGE SERVICE RD "AA", 5M WEST OF SIGN "ªE17 E". NORTH OF REMOTE GATES.

6R1026	FD SPIKE & WASHER 1M NORTH OF NORTH EDGE SERVICE RD. "E", 60M EAST OF EAST EDGE OF FUEL FARM TANKS.
6R1027	FD SPIKE & WASHER 1M NORTH OF NORTH EDGE SERVICE RD. "E", 60M EAST OF EAST EDGE OF FUEL FARM TANKS.
6R1030	FD NAIL; RESET STD SURVEY MON., 4.5M NORTH OF NORTH EDGE SERVICE RD. "E", ON CENTERLINE PRODUCED OF TAXIWAY "S". 10M WEST OF SIGN "SªE?"
6R1040	SET SPIKE & WASHER 4.2M SOUTH OF SOUTH EDGE SERVICE RD."E" IN CONC. VAULT FOR TEL MH. 66M EAST OF CENTERLINE TAXIWAY E-13 (COAST GUARD HELI CROSSING).
7L1000	FD SPIKE, RESET STANDARD SURVEY DISK MONUMENT. 5.4M SOUTH OF SERVICE RD C, NORTH OF EAST END RUNWAY 7L. 25M NORTH NORTHEAST OF SIGN "B1 B?".
7L1005	FD SPIKE 10cm DOWN IN 3" IRON CASING FLUSH WITH SURFACE CONC. 60M NORTHEAST OF NORTHEAST EDGE SERVICE RD C" CURVE, CONCAVE TO SOUTHWEST. SOUTH OF ASIANA CARGO BLDG. 12M WEST OF CHAIN LINK FENCE, DESIGNATED "GPS 10"
7L1010	SET SPIKE & WASHER 0.9M SOUTH OF K-RAIL ON NORTH SIDE OF OVERPASS OVER SEPULVEDA BLVD., 0.75M WEST OF EASTERLY EXPANSION JOINT, 21M NORTH OF N EDGE TAXIWAY "C"
7L1020	SET SPIKE & WASHER 2.7M NORTH OF NORTH EDGE SERVICE RD "C", 9.5M WEST OF CENTERLINE TAXIWAY "Q". LOCATED IN THE SOUTHEAST CORNER OF CONC. VAULT FOR "LOW FUEL POINT DRAIN"
7L1030	SET SPIKE & WASHER 9M NORTH OF SERVICE RD "C', WEST OF AMERICAN AIRLINES HANGER. LOCATED ON SOUTHWEST CORNER OF CONC. PAD FOR SIGN "C C14?"
7R1003	SET SPIKE & WASHER ON CONC. SLAB OF TAXIWAY SIGN "DEPARTURES MONITOR 120.95 NOW". 8M NORTH OF NORTH EDGE SERVICE RD "A", SOUTH OF TAXIWAY U7R.

7R1004	SET SPIKE & WASHER ON CONC. SLAB OF TAXIWAY SIGN "DEPARTURES MONITOR 120.95 NOW". 8M NORTH OF NORTH EDGE SERVICE RD "A", SOUTH OF TAXIWAY U7R.
7R1005	SET SPIKE & WASHER 0.8M SOUTH OF CURB SERVICE RD A, ON BRIDGE OVER SEPULVEDA BLVD. O.4M EAST OF EAST ABUTMENT EXPANSION JOINT. 6.9M SOUTH OF CENTERLINE OF SERVICE RD "A".
7R1006	FD SPIKE DESIGNATED "PSO #5" (PSOMAS) 1.4M NORTH OF SERVICE RD A AND W OF SERVICE RD F ON CURVE, 3M EAST OF GUARD RAIL. 9.5M WEST OF CENTERLINE OF CULVERT UNDER SERVICE RD. EAST END OF RUNWAY 7R.
SA1020	SET STD. SURVEY MONUMENT 0.7M NORTH OF SOUTH EDGE SERVICE RD. "AA" IN CURVE CONCAVE NORTHEAST, 28M WEST OF CENTERLINE PRODUCED OF TAXIWAY AA, 275M WEST OF INTERSECTION WITH SERVICE RD "A".
SA1030	FD LEAD & TACK, RESET SPIKE & WASHER 1.5M EAST OF WEST K-RAIL OF SERVICE RD "AA" ON OVERPASS OF WORLD WAY WEST. LOCATED ON CENTERLINE OF WORLD WAY WEST, DESIGNATED "S 39+67.50, W 6+50
SA1059	FD SPIKE & WASHER 3.5M EAST OF CENTERLINE STRIPE OF SERVICE RD "A", ON CURVE CONCAVE TO EAST, 220M SOUTH OF INTERSECTION WITH SERVICE RD "AA"

WP1046	SET SPIKE & WASHER IN NORTH CURB ARBOR VITAE ST., 29M WEST OF BEG CURB RETURN WEST OF AVIATION BLVD., 2.55M EAST OF PP#41162385. LABLED "WP1046"
WP1047	SET SPIKE & WASHER IN NORTH CURB WESTCHESTER PARKWAY, 28M WEST OF BEG CURB RETURN WEST OF AIRPORT BLVD., 16M EAST OF LIGHT STANDARD. LABLED "WP1047"
WP1049	SET SPIKE & WASHER IN SOUTH CURB WESTCHESTER PARKWAY, 0.16 km WEST OF EMERSON AVE., SIGNED AS "FIRE STATION", 13.8M WEST OF FIRE PLUG. LABLED "WP1049"
WP1050	SET SPIKE & WASHER 12.3M NORTH OF SOUTH CURB WESTCHESTER PARKWAY ON WEST BULKHEAD OF BRIDGE OVERPASS OVER LINCOLN AVE.
WP1051	SET SPIKE & WASHER 1.8M NORTH OF NORTH CURB WESTCHESTER PARKWAY 1.1 km EAST OF FALMOUTH AVE. 12 M WEST OF FIRE PLUG. LOCATED IN NORTHEAST COR OF WESTERLY MOST OF TWO CATCH BASINS.
WW1000	FOUND LEAD & TACK; RESET SPIKE & WASHER ON CENTER LINE INTERSECTION OF WORLD WAY WEST AND PERSHING DR. LOCATED ON MEDIAN ISLAND ON OVERPASS BRIDGE.
WW1001	SET SPIKE & WASHER ON NORTH CURB OF WORLD WAY WEST, 0.3M EAST OF BEG CURB RETURN EAST OF MAINTENANCE RD., SOUTH OF LAX BLDG. #7333 WORLD WAY WEST.
WW1002	SET SPIKE & WASHER IN SOUTH FLOW LINE OF 1.22M GUTTER OF WORLD WAY WEST. 3.83M WEST OF SPANDREL EAST OF CONTINENTAL AIRLINES ENTRANCE GATE #5, 6 54.86M WEST OF CENTER LINE OF COAST GUARD WAY.
WW1004	FOUND SPIKE IN NORTH CURB OF WORLD WAY WEST, 3.28M EAST OF BEG CURB RETURN IN CURVE. LOCATED IN SOUTH WEST CORNER OF CONCRETE CATCH BASIN AT THE WEST END OF TERMINAL LOOP OF WORLD WAY WEST.

VERTICAL CONTROL REPORT

GEODETIC LEVELING FOR
LOS ANGELES WORLD AIRPORTS, LAX

2ND ORDER CLASS II LEVELING

RECON OPERATIONS COMBINED WITH
FIELD LEVELING:

JULY 01, 2008 TO JANUARY 29, 2009

CITY OF LOS ANGELES, DEPARTMENT OF PUBLIC WORKS, BUREAU OF ENGINEERING, SURVEY DIVISION

LOS ANGELES COUNTY, CALIFORNIA

LEVELS COORDINATOR; ROBERT N HOLME

Location:

The project was located wholly in Los Angeles County, California, including the areas of Los Angeles International Airport (LAX), Westchester, Inglewood, and Playa Del Rey. The area bounded was approximately 3.7 mi. in northing and 4.7 mi. in easting.

Scope:

Purpose: The purpose of the survey was to provide precise level elevations for the LAX Midfield Improvements project as well as future projects. The procedure involved using NGS Bench Marks and running 2nd Order, Class II leveling through fifty two Temporary Bench Marks (TBM); 28 located within the Security Identification Display Area (SIDA) of LAX and 24 TBMs in the surrounding areas. It is also intended to include these levels within a Bluebook project to be published by the NGS.

Specifications: Leveling was performed using the Federal Geodetic Control Subcommittee (FGCS) specification for Second Order Class II Geodetic Leveling as defined in the publication *"FGCS Specifications and Procedures to Incorporate Electronic Digital / Bar-Code Leveling Systems"*, adopted June 14, 1995, with modifications as set forth in the document *"Specifications and Procedures for Second Order, Class II Geodetic Leveling to Establish Elevation on CORS"* as published by the California Spatial Reference Center (CSRC), March 10, 2003. All level lines were double run.

Datum: The datum for this project is the same as the NGS bench marks, whose orthometric heights were derived from differential leveling; NAVD 88, 1995 Adjustment.

Monumentation: The only monuments that were established on this project were TBMs set at intervals along each level circuit. They were either a 2" MAG nail with L.A.C.E. washer set in existing concrete structures or 3" brass caps in concrete, set 12" down in well monument with iron cover (SSDM). All found marks were per NGS data sheets.

Instrumentation: For the differential level measurements used in this project, the following equipment was used:

Leica Model DNA-03, Serial No. 330614
Leica 3 Meter Invar rod, Type No. GPCL3, Serial No. 23050
Leica 3 Meter Invar rod, Type No. GPCL3, Serial No. 22644

In addition to the primary equipment listed above, both rods were equipped with fixed telescoping stays (Leica part 555-638), a fixed tripod (Leica GST-40) for the level, a set of solid turning pucks (similar to Leica part 197 000) and a digital thermometer / anemometer.

The same equipment was used on the entire project.

Comments:

Reconnaissance: The NGS bench marks, existing marks and potential sites for new TBMs, were reconnoitered previous to leveling for each individual level run. The proposed route would not be finalized until a successful validation run from one NGS BM to a closer BM was made. Once the route was established, new TBM's were set.

Proposed leveling plan map: This was a map prepared on a ledger size sheet showing the NGS benches used, the TBMs set, as well as the leveling route used. The map is attached at the end of this report.

Specifications: The specifications circa 2005 set forth by the NGS and those modified by the CSRC publication cited were used and no deviations were made from those specifications.

Lines:

LAX-001: Aug 15, 2008, Oct 06, 2008 to Oct16, 2008; Nov 20, 2008 to Dec. 04, 2008

Location: City of Los Angeles, LAX, and City of Inglewood; TG 702, 703, 673. The validation runs, one along Vista Del Mar, between DY1315 and DY1310 and the other between W 64th St and La Cienega Blvd to W Fairview Blvd and Beach St from AE1738 to AE1739 were within specifications and accepted. All validation circuits were double run. The primary level run began at DY1315 near the intersection of Vista Del Mar and Imperial Hwy, proceeding along Imperial Hwy to Main St (City of El Segundo); thence North through gate 361B into the **Security Identification Display Area** (SIDA) of LAX; thence Easterly along the North side of Service Rd. A, to Service Rd F, thence Northerly along Service Rd F to gate 263B, exiting SIDA LAX and proceeding Northerly along fire access rd to the intersection of Aviation Blvd. and 104th St.; thence Northerly along Aviation Blvd. to Century Blvd; thence Easterly along Century Blvd to La Cienega Blvd; thence Northerly along La Cienega Blvd entering the City of Inglewood, to W 64th St and AE1738.

LAX-002: Oct 20, 2008 to Oct 24, 2008

Location: City of Los Angeles, Westchester; TG 702, 703. The validation run along Vista Del Mar, between DY1296 and DY1304 was within specifications and accepted. All validation circuits were double run. The secondary level run began near the intersection of Arbor Vitae and La Cienega at LAX-001 TBM LC1030, thence Westerly along Arbor Vitae St, the name changing to Westchester Parkway, to Pershing Dr; thence Northerly along Pershing Dr to Waterview St; thence Westerly along Waterview St to Vista Del Mar and DY1296.

LAX-003: Oct 29, 2008 to Oct 28, 2008

Location: City of Los Angeles, LAX; TG 702. The closing level run began near the intersection of Imperial Blvd and Pershing Dr at LAX-001 TBM 7R1000, thence Northerly along Pershing Dr to Westchester Parkway and line LAX002TBM WP1100.

LAX-004: Oct 24, 2008 to Nov 04, 2008, Dec 11, 2008 (Night)

Location: City of Los Angeles, LAX; TG 702. The closing level run began near the intersection of Airport Blvd and Arbor Vitae at LAX-002 TBM WP2047, thence Southerly along Airport Blvd to 96th St; thence Westerly along 96th St to El Manor Av; thence Northerly along El Manor Av to an airport entry rd; thence Westerly along an airport entry road through Post 3, entering SIDA LAX; thence Westerly along the North side of Service Rd E through Gate 437B exiting SIDA LAX to Pershing Dr and LAX003 TBM 6R1100.

LAX-005: Nov 05, 2008 to Nov 07, 2008

Location: City of Los Angeles, LAX; TG 702. The closing level run began at LAX-001 TBM 7R1003, thence North-Westerly along Service Rd A to Service Rd AA; thence Northerly along Service Rd AA to Service Rd E and LAX004 TBM PSO 1026. The entire line was within SIDA LAX.

LAX-006: Nov 07, 2008 to Nov 10, 2008, Jan 29, 2009 (Night)

Location: City of Los Angeles, LAX; TG 702. The closing level run began at East end of Service Rd C at LAX-001 TBM 7L1000, thence Westerly along Service Rd C to Service Rd AA; thence Southerly along Service Rd AA to LAX005 TBM SA1020. The entire line was within SIDA LAX.

LAX-007: Nov 17, 2008 to Nov 19, 2008

Location: City of Los Angeles, LAX; TG 702. The closing level run began at Service Rd E at LAX-004 TBM 6R1020, thence Northerly along Perimeter Rd to curve Westerly; thence Westerly along Perimeter Rd to curve Southerly; thence Southerly to Service Rd E and LAX004 TBM 6R1060. The entire line was within SIDA LAX.

LAX-008: Nov 17, 2008 to Nov 19, 2008

Location: City of Los Angeles, LAX; TG 702. The closing level run began at Service Rd C at LAX-006 TBM 7L1020, thence Northerly along Easterly edge of Service Rd Q to Service Rd E and LAX004 TBM 6R1030. The entire line was within SIDA LAX.

Line LAX-009: Nov 12, 2008 to Nov 17, 2008

Location: City of Los Angeles, LAX; TG 702. The closing level run began near the intersection of Pershing Dr and World Way West at LAX-003 TBM 17-19900, thence Easterly along North side of World Way West to Post 5, entering SIDA LAX; thence Northerly along West edge of Service Rd S to Service Rd E and LAX004 TBM 6R1030.

Problems:

There were 5 reaches between TBMs 1003 – 1008 that were re-leveled later in the project; Nov 20, 2008 to Dec. 04, 2008. Although the original runs met specifications for 2nd order, class II precision, they were marginal for 2nd order, class I work. Since the equipment and procedures were designed to meet 1st order, class I precision, and all the other work done up to Nov 20th 2008 met or exceeded 1st order, class I precision (when calculated without corrections), it was determined that there were procedural or natural errors introduced into those level loops. Therefore the aforementioned reaches were releveled. After the re-leveling, line LAX-001 also met 1st order, class I precision.

Due to high volume of aircraft taxing on the North side of the Bradley terminal (crossing Service Rd E) and the South side of the Bradley terminal (crossing Service Rd C) during normal day time hours, it was required by LAX Operations for the survey crew to work at night to avoid the peak traffic. Due to problems with the battery powered light source, only 1 ½ hours were actually done at night; the remainder of the work was performed after sunrise during daylight hours.

The following 5 points established by Subcontractor Psomas were spike and washers set flush or below paving grade and therefore required 20mm spacers; Line LAX-004 6R1025, 6R1026 and 6R1027; Line LAX-005 SA1059; Line LAX-007 PSOMAS 1018.

Apendix A
Superseded Survey Control
NAD83 Cal. Zone 5, 1991.35 Epoch

LEVEL #	Desc.	Northing	Easting
5010	PSO # 30, 1"IP W/ CAP	1797927.001	6433846.179
7010	241010, S&W	1805459.299	6440758.613
7018	241018, S&W	1805134.263	6436244.458
7020	241020, BR DISK	1805435.212	6438183.252
7040	241040, SSDM	1804864.287	6433942.424
7050	241050, S&W	1804407.909	6429463.37
8010	481010, BR DISK	1801807.971	6437276.236
4010	961010, S&W	1803997.992	6441552.991
4020	6R1020, S&W	1803941.882	6440422.486
4025	6R1025, SPK	1802721.422	6429775.319
4026	6R1026, SPK	1802907.413	6431703.101
4027	6R1027, SPK	1803231.746	6434019.207
4030	6R1030, SSDM	1803541.146	6436532.523
4040	6R1040, S&W	1803262.855	6434775.182
1007	7L1000 , SSDM	1801239.417	6446412.837
600	7L1005, SPK	1801434.928	6445564.835
6010	7L1010, S&W	1800891.476	6441553.051
6020	7L1020, S&W	1800156.394	6437324.047
6030	7L1030, S&W	1799920.148	6435121.040
1003	7R1003, S&W	1798000.820	6435060.548
1004	7R1004, S&W	1798343.226	6437899.743
1005	7R1005, S&W	1798704.620	6441537.123
1006	7R1006 SPK	1799373.230	6446441.001
5020	SA1020, SSDM	1799170.427	6432324.453
5030	SA1030, S&W	1801271.696	6431899.393
5015	SA1059, S&W	1798515.665	6433150.169
2046	WP1046, S&W	1805388.453	6447173.663
2047	WP1047, S&W	1805408.745	6444486.099
2049	WP1049, S&W	1805997.160	6438391.829
2050	WP1050, S&W	1805803.867	6436376.988
2051	WP1051, S&W	1805524.412	6434048.788
9000	WW1000, S&W	1801039.071	6429939.891
9001	WW1001, S&W	1801412.567	6432880.955
9002	WW1002, S&W	1801526.116	6434247.722
9004	WW1004, SPK	1801727.070	6435520.215
DY9308	HPGN CA 07-01, DY9308	1821364.690	6439418.520
DY9342	HPGN D CA-07-CG, DY9342	17965410	6430349.060

NAD27 Cal Zone 7

Point	Northing	Easting
30	4087692.216	4160262.198
241010	4095247.125	4167149.383
241018	4094907.130	4162636.449
241020	4095214.498	4164574.182
241040	4094629.525	4160335.384
241050	4094158.295	4155857.989
481010	4091584.400	4163679.245
961010	4093788.512	4167948.588
6R1020	4093728.656	4166818.305
6R1025	4092472.914	4156175.536
6R1026	4092665.299	4158102.637
6R1027	4092997.307	4160417.590
6R1030	4093315.034	4162929.798
6R1040	4093030.924	4161173.438
7L1000	4091046.159	4172817.433
7L1005	4091238.853	4171968.810
7L1010	4090682.128	4167958.963
7L1020	4089933.052	4163732.541
7L1030	4089689.507	4161530.392
7R1003	4087770.063	4161476.280
7R1004	4088121.874	4164314.240
7R1005	4088495.314	4167950.296
7R1006	4089180.147	4172851.789
SA1020	4088930.536	4158736.391
SA1030	4091030.303	4158304.360
SA1059	4088278.544	4159564.255
WP1046	4095197.541	4173564.468
WP1047	4095208.929	4170876.920
WP1049	4095777.115	4164780.886
WP1050	4095577.146	4162766.750
WP1051	4095289.976	4160439.551
WW1000	4090791.181	4156345.696
WW1001	4091174.426	4159285.422
WW1002	4091292.507	4160651.766
WW1004	4091497.676	4161923.550

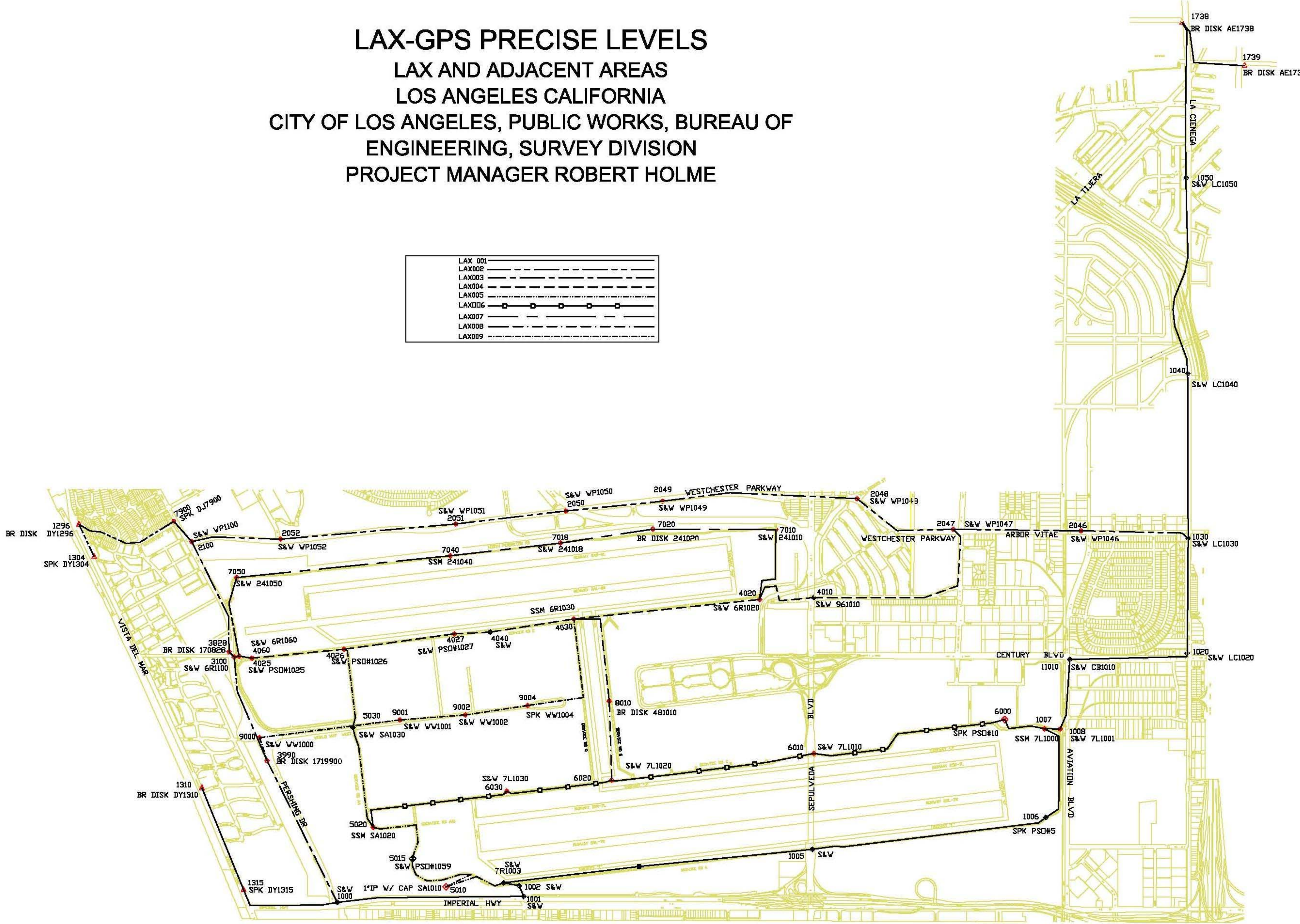
Elevations NGVD29 1985 ADJ

LEVEL #	METERS	US FT
DY1315	13.441	44.098
DY1296	16.629	54.557
1315	13.441	44.098
1296	16.629	54.557
1000	24.26584	79.612
1001	30.40769	99.763
1002	33.01865	108.329
1003	34.32345	112.610
1004	36.12909	118.534
1005	33.03413	108.379
1006	28.37663	93.099
1007	27.47043	90.126
1008	27.73727	91.001
1010	28.14304	92.333
1020	27.62284	90.626
1030	28.96942	95.044
2046	30.06747	98.646
2047	30.65321	100.568
2048	31.84463	104.477
2049	33.57359	110.149
2050	40.60491	133.218
2051	32.80268	107.620
2052	30.10654	98.775
2100	23.97354	78.653
7900	22.69279	74.451
3990	24.54787	80.537
3828	25.83173	84.750
3100	26.64384	87.414
4010	31.02648	101.793
4020	33.88965	111.186
4030	35.45014	116.306
4040	34.38795	112.821
4027	33.93926	111.349
4026	31.84963	104.493
4025	30.55121	100.233
4060	29.94083	98.231
5010	38.13469	125.114
5015	26.52742	87.032
5020	30.59086	100.364
5030	31.26108	102.562
6000	28.62181	93.903
6010	32.4897	106.593
6020	38.18908	125.292
6030	36.21073	118.801

LEVEL #	METERS	US FT
7010	31.90629	104.679
7020	36.00808	118.137
7018	35.82563	117.538
7040	34.65694	113.704
7050	34.09143	111.848
8010	36.19946	118.764
9000	31.69239	103.977
9001	30.31692	99.465
9002	31.56446	103.558
9004	33.02515	108.350

LAX-GPS PRECISE LEVELS

LAX AND ADJACENT AREAS
LOS ANGELES CALIFORNIA
CITY OF LOS ANGELES, PUBLIC WORKS, BUREAU OF ENGINEERING, SURVEY DIVISION
PROJECT MANAGER ROBERT HOLME



ONTARIO INTERNATIONAL AIRPORT
GPS COORDINATE CONTROL -- NAD83 AND NAVD88

HORIZONTAL DATUM: North American Datum of 1983 (NAD83 1994.9)
PLANE COORDINATES: California Coordinate System of 1983, Zone 5
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88 1994 Adjustment)

STATION	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	CONVERGENCE	COMBINED FACTOR
				METERS			US SURVEY FEET			
0072	N34°01'27.56673"	W117°46'16.21022"	558185.348	2021134.452	276.961	1831313.096	6631005.281	908.663	0°07'49.569975"	0.99995850
0702	N34°05'06.68653"	W117°40'11.75003"	564962.806	2030462.535	348.506	1853548.806	6661609.167	1143.390	0°11'17.316618"	0.99993448
2000	N34°04'14.87076"	W117°40'11.51667"	563366.293	2030473.761	318.109	1848310.913	6661645.998	1043.663	0°11'17.449636"	0.99994217
2001	N34°03'04.58128"	W117°36'36.86841"	561220.266	2035985.904	277.664	1841270.156	6679730.420	910.969	0°13'19.801697"	0.99995259
3001	N34°02'54.70756"	W117°36'39.29006"	560915.800	2035924.974	273.521	1840271.254	6679530.519	897.377	0°13'18.421328"	0.99995382
3002	N34°03'06.99324"	W117°36'58.71692"	561292.427	2035425.278	280.247	1841506.904	6677891.100	919.444	0°13'07.347790"	0.99995204
3003	N34°03'22.65109"	W117°37'42.82757"	561770.623	2034292.210	289.091	1843075.786	6674173.692	948.459	0°12'42.204194"	0.99994973
3004	N34°03'31.82859"	W117°37'42.74977"	562053.404	2034293.160	291.377	1844003.543	6674176.809	955.959	0°12'42.248538"	0.99994885
3005	N34°03'43.10227"	W117°37'09.14099"	562403.990	2035153.722	294.413	1845153.757	6677000.170	965.920	0°13'01.405943"	0.99994772
3006	N34°03'43.84004"	W117°36'39.54056"	562429.629	2035912.691	292.596	1845237.874	6679490.220	959.959	0°13'18.278541"	0.99994795
3007	N34°03'46.71789"	W117°35'36.06605"	562524.742	2037540.032	291.932	1845549.924	6684829.255	957.780	0°13'54.459768"	0.99994790
3008	N34°03'46.25304"	W117°34'32.81298"	562517.124	2039162.098	290.333	1845524.931	6690150.983	952.534	0°14'30.514771"	0.99994818
3009	N34°03'19.93301"	W117°34'33.05190"	561706.135	2039159.393	284.290	1842864.211	6690142.109	932.708	0°14'30.378582"	0.99995065
3010	N34°02'53.71680"	W117°34'33.21037"	560898.353	2039158.738	273.308	1840214.013	6690139.960	896.678	0°14'30.288254"	0.99995391
3011	N34°03'07.14752"	W117°35'35.83460"	561305.538	2037550.901	276.496	1841549.919	6684864.914	907.137	0°13'54.591697"	0.99995262
3012	N34°02'53.95851"	W117°35'35.75796"	560899.171	2037554.511	272.706	1840216.697	6684876.758	894.703	0°13'54.635380"	0.99995400
3013	N34°03'24.80971"	W117°34'57.18823"	561853.802	2038539.784	284.149	1843348.682	6688109.275	932.246	0°14'16.620587"	0.99995039
3014	N34°03'17.88554"	W117°34'57.18269"	561640.458	2038540.812	282.454	1842648.736	6688112.647	926.684	0°14'16.623743"	0.99995106
3015	N34°03'17.84131"	W117°36'58.40405"	561626.705	2035432.026	285.439	1842603.615	6677913.239	936.478	0°13'07.526125"	0.99995059
3016	N34°03'32.17730"	W117°37'11.02863"	562067.190	2035106.590	290.421	1844048.773	6676845.537	952.823	0°13'00.329968"	0.99994898
3017	N34°03'28.18265"	W117°36'46.34847"	561946.525	2035739.971	286.529	1843652.891	6678923.555	940.054	0°13'14.397954"	0.99994982
3018	N34°03'24.76042"	W117°37'10.29397"	561838.735	2035126.295	287.871	1843299.250	6676910.186	944.457	0°13'00.748732"	0.99994981
3019	N34°03'21.32446"	W117°36'07.28805"	561739.124	2036742.501	282.075	1842972.443	6682212.689	925.441	0°13'36.662855"	0.99995092
3020	N34°03'15.86288"	W117°36'58.85485"	561565.702	2035420.697	283.961	1842403.474	6677876.070	931.629	0°13'07.269165"	0.99995094
3021	N34°03'15.87325"	W117°36'34.63498"	561568.413	2036041.833	280.942	1842412.368	6679913.914	921.724	0°13'21.074777"	0.99995141
3022	N34°03'15.88224"	W117°36'10.86585"	561571.078	2036651.409	280.072	1842421.112	6681913.831	918.870	0°13'34.623467"	0.99995155

ONTARIO INTERNATIONAL AIRPORT
GPS COORDINATE CONTROL -- NAD83 AND NAVD88

IORIZONTAL DATUM: North American Datum of 1983 (NAD83 1994.9)
'LANE COORDINATES: California Coordinate System of 1983, Zone 5
/ERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88 1994 Adjustment)

STATION	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	CONVERGENCE	COMBINED FACTOR
			METERS			US SURVEY FEET				
3023	N34°03'15.90641"	W117°34'59.55905"	561579.225	2038480.122	280.732	1842447.841	6687913.534	921.035	0°14'15.269188"	0.99995145
3024	N34°03'30.74394"	W117°34'59.56431"	562036.393	2038478.091	285.688	1843947.733	6687906.870	937.295	0°14'15.266194"	0.99994980
3025	N34°03'30.74075"	W117°35'11.44934"	562035.036	2038173.306	285.382	1843943.281	6686906.921	936.291	0°14'08.491583"	0.99994985
3026	N34°03'30.73084"	W117°35'47.10484"	562031.014	2037258.941	285.176	1843930.085	6683907.042	935.615	0°13'48.167526"	0.99994988
3030	N34°03'04.38849"	W117°36'39.33971"	561214.081	2035922.546	277.502	1841249.864	6679522.553	910.438	0°13'18.393028"	0.99995262
3031	N34°04'40.82405"	W117°40'11.93528"	564165.924	2030460.402	331.956	1850934.369	6661602.169	1089.092	0°11'17.211026"	0.99993853
3791	N34°03'31.25475"	W117°38'36.53121"	562030.729	2032914.029	295.157	1843929.150	6669652.110	968.361	0°12'11.592479"	0.99994828
3819	N34°06'47.12187"	W117°48'44.19283"	568023.563	2017319.552	332.834	1863590.640	6618489.230	1091.973	0°06'25.218126"	0.99993144

NOTES: Stations 0072, 3791 and 3819 were constrained for both the NAD83 and the NAVD88 adjustment
See Sheet 2 of 2 for NAD27 and NGVD29 values.

VAN NUYS AIRPORT

GPS COORDINATE CONTROL -- NAD83 AND NAVD88 VALUES

HORIZONTAL DATUM: North American Datum of 1983 (NAD83 1994.9)
PLANE COORDINATES: California Coordinate System of 1983, Zone 5
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88 1994 Adjustment)

STATION	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	CONVERGENCE	COMBINED FACTOR
				METERS			US SURVEY FEET			
0015	N34°17'30.03826"	W118°29'17.62923"	587925.967	1955051.936	396.025	1928887.110	6414199.560	1299.292	-0°16'41.869570"	0.99989192
0148	N34°08'52.32937"	W118°19'51.06711"	571915.477	1969488.128	157.636	1876359.361	6461562.300	517.177	-0°11'18.922422"	0.99995241
0177	N34°11'41.89380"	W118°29'00.35761"	577196.998	1955442.031	224.850	1893687.151	6415479.397	737.695	-0°16'32.024539"	0.99993362
0193	N34°12'46.26834"	W118°29'02.27332"	579180.706	1955402.534	238.293	1900195.366	6415349.814	781.800	-0°16'33.116517"	0.99992856
1000	N34°12'04.20056"	W118°29'24.79969"	577887.332	1954819.603	230.170	1895952.022	6413437.314	755.149	-0°16'45.956816"	0.99993175
1001	N34°11'49.01038"	W118°29'23.36500"	577419.121	1954854.051	226.973	1894415.899	6413550.332	744.661	-0°16'45.139029"	0.99993295
1002	N34°11'49.16414"	W118°29'20.99123"	577423.563	1954914.847	227.259	1894430.473	6413749.794	745.599	-0°16'43.785951"	0.99993291
1003	N34°11'49.22349"	W118°29'20.10428"	577425.281	1954937.564	227.055	1894436.109	6413824.325	744.930	-0°16'43.280379"	0.99993293
1004	N34°12'53.11406"	W118°29'29.42194"	579395.004	1954708.640	240.776	1900898.442	6413073.263	789.946	-0°16'48.591553"	0.99992786
1005	N34°13'08.11900"	W118°29'27.55838"	579857.095	1954758.599	244.202	1902414.486	6413237.170	801.186	-0°16'47.529303"	0.99992665
1006	N34°13'08.35217"	W118°29'23.99451"	579863.834	1954849.852	243.743	1902436.595	6413536.556	799.680	-0°16'45.497855"	0.99992670
1007	N34°13'09.04449"	W118°29'23.52960"	579885.107	1954861.855	243.953	1902506.389	6413575.936	800.369	-0°16'45.232851"	0.99992664
1008	N34°13'08.06218"	W118°29'28.44710"	579855.455	1954735.843	244.462	1902409.105	6413162.512	802.039	-0°16'48.035883"	0.99992661
1009	N34°13'08.54361"	W118°29'21.08689"	579869.370	1954924.301	243.430	1902454.758	6413780.811	798.653	-0°16'43.840478"	0.99992675
1010	N34°12'42.55417"	W118°29'18.62987"	579068.292	1954983.297	237.826	1899826.555	6413974.367	780.267	-0°16'42.439947"	0.99992880
1011	N34°11'49.88945"	W118°29'16.97571"	577445.411	1955017.761	226.782	1894502.153	6414087.438	744.034	-0°16'41.497057"	0.99993294
1012	N34°11'38.04208"	W118°29'24.71837"	577081.341	1954817.754	224.385	1893307.700	6413431.248	736.170	-0°16'45.910464"	0.99993387
1013	N34°11'38.03501"	W118°29'32.57699"	577082.107	1954616.550	224.586	1893310.213	6412771.131	736.829	-0°16'50.389970"	0.99993384
1014	N34°12'04.19438"	W118°29'32.60486"	577888.118	1954619.784	229.723	1895954.600	6412781.741	753.683	-0°16'50.405857"	0.99993182
1015	N34°11'38.06165"	W118°29'01.97669"	577079.123	1955400.010	224.203	1893300.423	6415341.533	735.573	-0°16'32.947436"	0.99993390
1016	N34°12'04.21998"	W118°29'01.16813"	577884.999	1955424.589	229.657	1895944.368	6415422.172	753.466	-0°16'32.486547"	0.99993183
1017	N34°12'30.37464"	W118°29'01.19815"	578690.865	1955427.698	235.138	1898588.280	6415432.373	771.449	-0°16'32.503660"	0.99992977
1018	N34°13'16.75839"	W118°29'06.69705"	580120.694	1955293.834	244.847	1903279.310	6414993.187	803.302	-0°16'35.638099"	0.99992616
1019	N34°13'16.61808"	W118°29'31.68321"	580119.479	1954654.305	245.881	1903275.324	6412894.999	806.695	-0°16'49.880503"	0.99992601
1020	N34°13'16.58063"	W118°29'38.14544"	580119.137	1954488.902	246.306	1903274.202	6412352.339	808.089	-0°16'53.564052"	0.99992594

VAN NUYS AIRPORT
GPS COORDINATE CONTROL -- NAD83 AND NAVD88 VALUES

HORIZONTAL DATUM: North American Datum of 1983 (NAD83 1994.9)
PLANE COORDINATES: California Coordinate System of 1983, Zone 5
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88 1994 Adjustment)

STATION	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION	CONVERGENCE	COMBINED FACTOR
				METERS			US SURVEY FEET			
1021	N34°12'30.32478"	W118°30'04.06670"	578697.213	1953818.355	236.418	1898609.106	6410152.386	775.648	-0°17'"8.339478"	0.99992957
1022	N34°12'30.34445"	W118°29'40.49095"	578694.830	1954421.860	236.229	1898601.288	6412132.386	775.028	-0°16'54.901024"	0.99992960
1050	N34°13'09.49100"	W118°29'28.58188"	579899.496	1954732.608	244.743	1902553.596	6413151.898	802.961	-0°16'48.112710"	0.99992649
1051	N34°13'08.39210"	W118°29'33.48738"	579866.252	1954606.886	244.900	1902444.528	6412739.425	803.476	-0°16'50.908906"	0.99992652
1052	N34°11'41.34439"	W118°29'20.25282"	577182.533	1954932.580	225.870	1893639.694	6413807.973	741.042	-0°16'43.365049"	0.99993349
1217	N34°12'04.10704"	W118°28'59.98936"	577881.374	1955454.750	229.764	1895932.475	6415521.126	753.817	-0°16'31.814636"	0.99993181
6004	N34°07'33.20026"	W118°28'36.91502"	569531.519	1956005.864	365.013	1868537.992	6417329.239	1197.547	-0°16'18.661986"	0.99992395

NOTES: Stations 0015, 0148 and 6004 were constrained for the NAD83 and NAVD88 Adjustments
See Sheet 2 of 2 for NAD27 and NGVD29 coordinate values.

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 1

JOB NO. [illegible] PARTY CHIEF Chris H NAME RAW JULIAN DAY: 254 DATE 9/10/96

BASE RECEIVER SERIAL NO. 3302A02327 ANTENNA SERIAL NO. 0220007782

ROVER RECEIVER SERIAL NO. N/A ANTENNA SERIAL NO. N/A

BASE STATION NAME 0 0 1 5 BASE FILENAME 0 0 1 5 - 2 5 4 - 1 ANTENNA HEIGHT: 1.360 METERS

ROVER FILE NAME __ __ __ __ - __ __ __ - __

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	0015	1.360 m	8	4.3	3" Brass Disk in rock USC & G Survey disk	
					stamped "Resevoir" "198?"	
		started 14:18				

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 1

JOB NO. 1DOA0103 PARTY CHIEF CH NAME RAW JULIAN DAY: 254 DATE 9/10/96
BASE RECEIVER SERIAL NO. 3302A02323 ANTENNA SERIAL NO. 0080116409
ROVER RECEIVER SERIAL NO. N/A ANTENNA SERIAL NO. N/A

BASE STATION NAME 1 0 0 0 BASE FILENAME 1 0 0 0 - 2 5 4 - 1 ANTENNA HEIGHT: 1.554 *METERS*

ROVER FILE NAME __ __ __ __ - __ __ __ - __

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	1000	1.554	5	3.6	C/L of Sherman + 200' W. of runway	PK + Washer
		Start 1546				

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 2

JOB NO. [illegible] PARTY CHIEF Chris H. NAME RAW JULIAN DAY: 254 DATE 9 / 10 / 96
BASE RECEIVER SERIAL NO. [illegible] ANTENNA SERIAL NO. [illegible]
ROVER RECEIVER SERIAL NO. 3302A02330 ANTENNA SERIAL NO. 0220010036

BASE STATION NAME ~~0015~~ 1000 BASE FILENAME _ _ _ _ - _ _ _ - _ ANTENNA HEIGHT: ________ *METERS*

ROVER FILE NAME 1001-254-1

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	1001	1.640 5.38'	7	3.2	98+00 E El= 742.085 (1980) 90+00.75N El= 742.155	Fd Lead + tack 200' W OF ℄ RUNW
2	1002	1.610	6	2.9	NO MARKINGS	Fd PK & WASH @ ℄ RUNWAY
3	1003	1.632	7	2.0	Fd Brass DISK 4" φ USC&GS (CENTER P.M.) "STA B AP 1960"	GET DESCR. IF AVAIL. & SEND TO CLIENT *
4	1004	1.624	7	2.2	98+00E EL=787.44 25+00.15N	Fd 1"φ PIN W/ P.M.
5	1005	1.651	6	2.6	Fd Brass DISK 4" USC+GS (center Punched) "STA A AP 1960"	Same as comment for # 1003
6	1006	1.609	7	2.2	Fd SPK & WASH @ ℄ RUNWAY N. END	
7	1007	1.612	7	2.3	Fd 3" Bross Disk in 11" Conc Cylinder	Stamped "FAA 16R, + 2.680, course width, mon. grid. chk., Point"
8	1008	1.628	7	2.4	Fd P.K + Washer C/L Runway N'ly	
9	1009	1.711	7	2.4	Fd SPK + Tin, 106+20, 10+00 620' E. of Runway, El= 795.895	'1980'
10	1010	1.717	8	1.9	Fd SPK & TIN, 106+20, 36+35.45 620' E of Runway El= 777.76	
11	1011	1.723	8	1.8	Fd. 3" Brass Disk Stamped "FAA 16R, +20°, Clearance, Gnd. chk., Point."	
				1		

PSOMAS

GPS KINEMATIC LOG SHEET

JOB NO. [illegible] PARTY CHIEF CH NAME CH JULIAN DAY: 254 DATE 9/10/96
BASE RECEIVER SERIAL NO. [illegible] ANTENNA SERIAL NO. [illegible]
ROVER RECEIVER SERIAL NO. 3302A02330 ANTENNA SERIAL NO. 0220010036

BASE STATION NAME 0015 / 1000 BASE FILENAME _ _ _ _ - _ _ _ - _ ANTENNA HEIGHT: ______ *METERS*

ROVER FILE NAME 1012-254-2

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	1012	2.088	8	2.2	Fd HEX BAR IN SSM @ ℄ INT ODESSA/VANOWEN	DN 0.370 m
2	1013	2.041	8	2.8	Fd SSM @ ℄ INT HAYVENHURST/VANOWEN	stamped "I23" Dn 0.420 m
3	1014	2.099	8	2.2	Fd HEX BAR IN SSM @ ℄ INT HAYVENHURST & SHERMAN WAY	Dn 0.470 m

PSOMAS

- ☐ Santa Monica 310/450-1217
- ☐ ~~Costa Mesa~~ 714/751-7373
- ☐ Riverside 909/787-8421
- ☐ Sacramento 916/929-7100

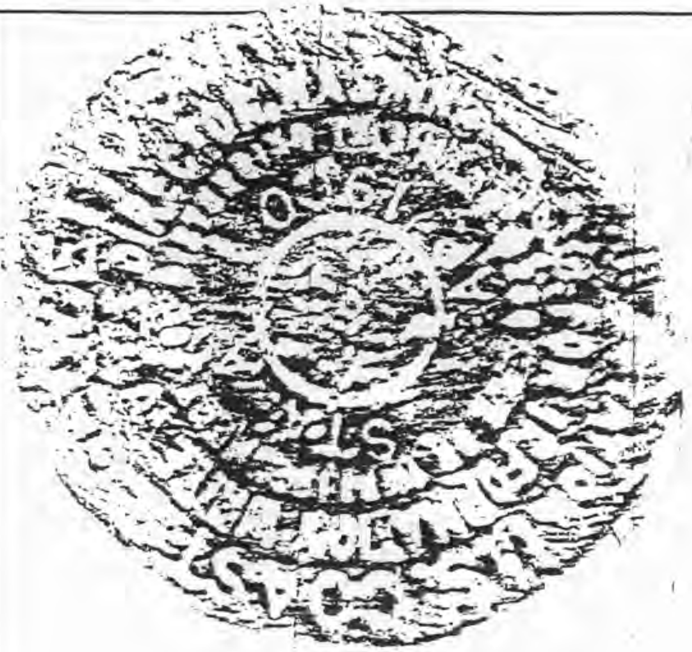
Job No. VAN NUYS AIRPORT BRASS DISK Sheet ____ of ____

Project Name ____

Field Crew ____ Date ____

Comments ____

Title ____



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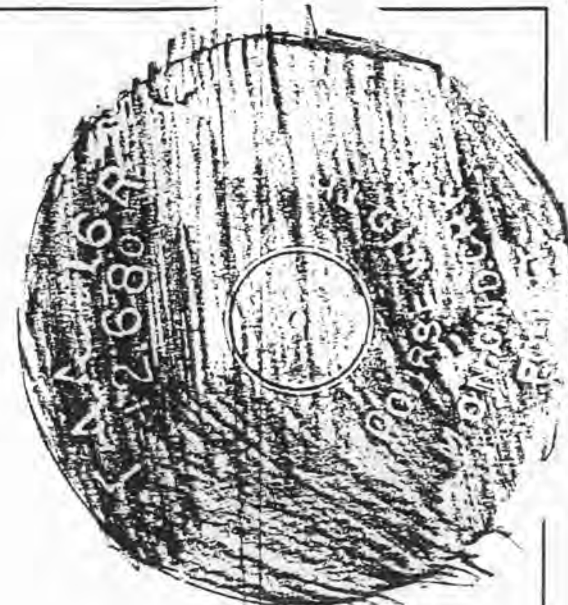

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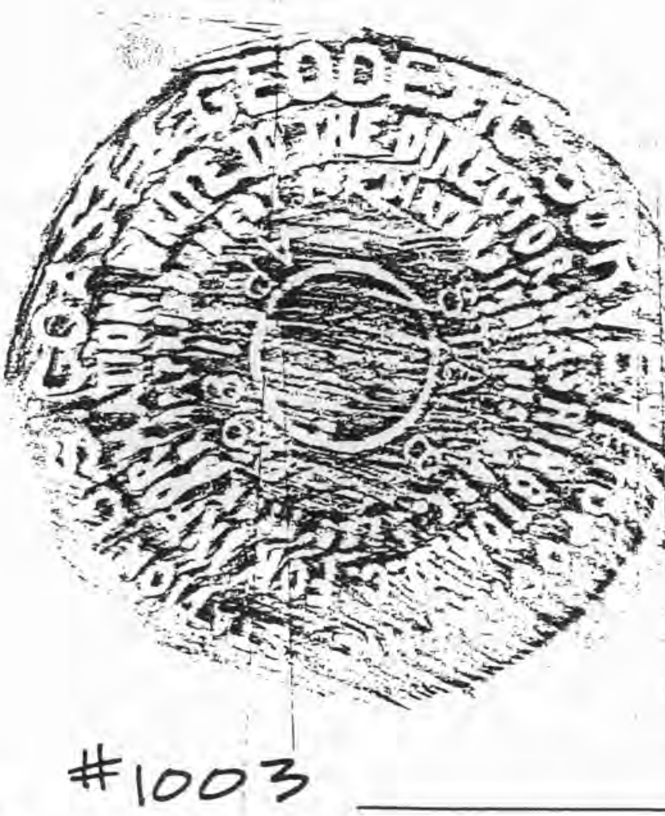

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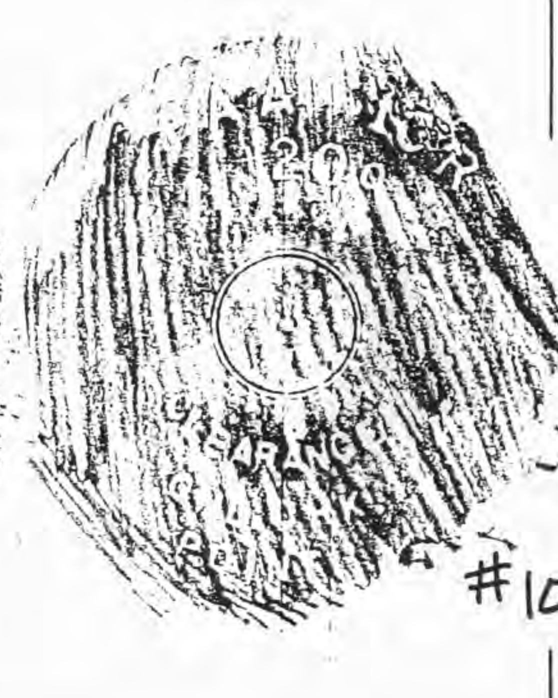

#1011

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 1

JOB NO. [illegible] PARTY CHIEF Chris H. NAME RAW JULIAN DAY: 255 DATE 9/11/96

BASE RECEIVER SERIAL NO. 3302A02330 ANTENNA SERIAL NO. 0220007782

ROVER RECEIVER SERIAL NO. ____ ANTENNA SERIAL NO. ____

BASE STATION NAME 1 0 0 0 BASE FILENAME 1 0 0 0 - 2 5 5 - 1 ANTENNA HEIGHT: 1.565 *METERS*

ROVER FILE NAME __ __ __ __ - __ __ __ - __

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	1000	1.565 m 5.14'	6	3.1		

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 1

JOB NO. [illegible] PARTY CHIEF Chris H. NAME RAW JULIAN DAY: 255 DATE 9/11/96

BASE RECEIVER SERIAL NO. 3302A02323 ANTENNA SERIAL NO. [illegible]

ROVER RECEIVER SERIAL NO. ____ ANTENNA SERIAL NO. ____

BASE STATION NAME 0 0 1 5 BASE FILENAME 0 0 1 5-2 5 5-1 ANTENNA HEIGHT: 1.325 METERS

ROVER FILE NAME __ __ __ __-__ __ __-__

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	0015	1.325 m 4.35'	6	3.3	Resevoir	
		start. 14:48				

PSOMAS

GPS KINEMATIC LOG SHEET

SHEET 1 OF 2

JOB NO. [illegible] PARTY CHIEF CH NAME CH JULIAN DAY: 255 DATE / /

BASE RECEIVER SERIAL NO. [illegible] ANTENNA SERIAL NO: [illegible]

ROVER RECEIVER SERIAL NO. 3302A02327 ANTENNA SERIAL NO. 0220010036

BASE STATION NAME 0015 1000 BASE FILENAME _ _ _ _ - _ _ _ - _ ANTENNA HEIGHT: ______ *METERS*

ROVER FILE NAME 0148-255-1

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	0148	1.622	6	3.4	BRASS DISK STAMPED "BURBANK J-7 1953"	"BURBANK" EW9585

PSOMAS

GPS KINEMATIC LOG SHEET

JOB NO. [illegible] PARTY CHIEF CH NAME CH JULIAN DAY: [illegible] DATE [illegible] 96

BASE RECEIVER SERIAL NO. 3302A[illegible] ANTENNA SERIAL NO. [illegible]

ROVER RECEIVER SERIAL NO. 3307A[illegible] ANTENNA SERIAL NO. [illegible]

BASE STATION NAME 0015 1000 BASE FILENAME _ _ _ _ - _ _ _ - _ ANTENNA HEIGHT: ______ *METERS*

ROVER FILE NAME 1015-255-2

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
1	1015	1.946	7	2.3	Fd SSM W/HEX DN. 1.2 FT	±65' W'LY OF ℄ INT WOODLEY & VANOWEN
2	1015	1.969	7	2.4	SAME	"
3	0177	1.468	7	2.4	Fd BM -0177	
4	1217	2.001	8	2.0	Fd HEX IN SSM ±100' DN 1.0 FT	E'LY OF ℄ INT WOODLEY / SHERMAN W
5	1016	1.997	8	1.9	Fd SSM @ ℄ INT WOODLEY/SHERMAN WAY	CITY OF LOS ANGELES SURVEY DIVISION ALUM. DISC 1968 DWN 1.0 1016 IS ±11.5' North of another well
6	0193	1.685	8	2.3	Fd BM @ NW COR CB	
7	1017	2.032	7	3.6	Fd BRASS DISK IN SSM "CITY OF LA SURVEY	(℄ INT WOODLEY/SATICOY) DIVISION 1969"
8	1018	2.094	6	5.8	Fd SSM W/ BRASS DISK @ ℄ INT ROSCOE & WOODLEY PLACE	(FIRST ORDER SURVEY CONTROL "PAC-B-10B RESET 1967")
9	1019	2.084	8	2.2	Fd Brass DISK W/PM @ ℄ INT HAYVENHURST & ROSCOE DN. 1.0 FT	
10	1020	2.166	8	2.2	"CITY OF LOS ANGELES 1971 SURVEY DIVISION"	DN 1.5'
11	1021	2.180	8	2.0	Fd LA DEPT PUBLIC WELL @ ℄ INT	WORKS BRASS DISK IN BALBOA & SATICOY DN 1.[illegible]
12	1022	1.963	7	2.3	Fd BRASS DISK IN SSM CITY OF L.A. SURVEY	DIVISION 1969"

PSOMAS — **GPS KINEMATIC LOG SHEET** — SHEET 1 OF 1

JOB NO. [illegible] PARTY CHIEF Chris H. NAME RAW JULIAN DAY: 255 DATE 9/11/96

BASE RECEIVER SERIAL NO. [illegible] ANTENNA SERIAL NO. [illegible]

ROVER RECEIVER SERIAL NO. ~~0220010039~~ 3424A06315 ANTENNA SERIAL NO. 0220010039

BASE STATION NAME 1 0 0 0 BASE FILENAME 1 [illegible] - 2 [illegible] - 1 ANTENNA HEIGHT: 1.565 METERS

ROVER FILE NAME 1050-255-1

DATA SET #	STATION #	ROD HEIGHT (m)	# OF SVs	PDOP	STATION DESCRIPTION	COMMENTS
* 1	1050	1.568 m	7	2.4	3" Brass Disk Stamped "FAA 16R, 0°, course align.,	gnd chk., Point" (See Rubbing)
2	1005 ~~1051~~	1.609 m	7	2.4	3" Brass Disk NE'ly Corner runway 16R.	
3	1006	1.593 m	8	2.0	P.K. + Washer c/L runway 16 L	Interupted by jet.
4	1006	1.574 m	8	2.0	P.K. + washer	
5	1007	1.590 m	8	1.9	3" Brass disk in 11" dia conc.	
6	1009	1.661 m	8	1.8	spike + washer	
* 7	1051	1.687 m	9	1.7	3" Brass Disk in 11" conc. cylinder stamped "	"FAA 16R, -2.65°, course width, mon. gnd. chk., point"
8	1004	1.673 m	8	1.9	spike	
* 9	1052	1.583 m	7	4.4	Indentical to #1050	
10	1001	1.698 m	8	2.0	Lead + tack	
11	1002	1.687 m	8	2.1	P.K. + washer	
12	1003	1.652 m	8	2.2	Brass Disk	
13	1010	1.663 m	8	2.2	P.K. + Washer	

1051

1050
℄ Runway Nly End

1052
℄ Runway S'ly End