Airports GIS

AC 150/5300-16
Geodetic Control

Presented to | FAA Regions | Alaska

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Geodetic Control | Agenda

- **Background (10 min)**

- **Requirements (10 min)**

- **Best Practices and Lessons Learned (10 min)**

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Why does FAA require Geodetic Control?

- **To ensure a base level of survey data and mapping accuracy when collecting airport data for planning, engineering, and airspace-related projects**

Airports GIS data is a NextGen enabler

- **The role and importance of airport and aeronautical data in meeting the safety, regularity, and efficiency of air navigation changed significantly with the implementation of area navigation (RNAV), required navigation performance (RNP) and airborne computer based navigation systems**

What is Geodetic Control?

- **Establishing and/or verifying defined points of reference by measurements of angles and distances, or by the Global Positioning System (GPS)**

Who defines Geodetic Control standards?

- **The National Spatial Reference System (NSRS), under the control of the National Geodetic Survey (NGS) and managed by the Federal Geodetic Control Subcommittee (FGCS), is the standard in defining the latitude, longitude, elevation, scale, gravity, and orientation of control points throughout the United States**
- **Geodetic control surveys included in NSRS meet data recording, submittal, project review, and least squares adjustment requirements established by the FGCS**

NGS | Continuous Operating Reference System

- **CORS sites provide GPS carrier phase and code range measurements in support of three-dimensional positioning activities throughout the US and its territories**

  http://www.ngs.noaa.gov/CORS/

- **Surveyors, GIS/LIS professionals, engineers, scientists, and others can apply CORS data to position points at which GPS data have been collected**

- **The CORS system enables positioning accuracies that approach a few centimeters relative to the National Spatial Reference System, both horizontally and vertically.**
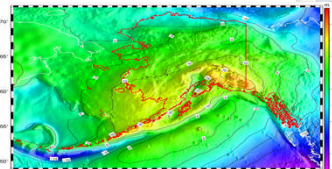

Standards: Datum and the GEOID Model

- **Accuracy of GPS height measurements depends on several factors; the most crucial is "imperfection" of earth's shape**

- **Geodetic datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth**

- **GEOID models are used to represent local variations in gravity that change the local definition of a level surface**

  GEOID09 is a refined hybrid model of the geoid in the United States and other territories, which supersedes the previous models GEOID06, GEOID03, GEOID99, GEOID96, GEOID93, and GEOID90.

- **Datum required for Airports GIS:**
  - **Horizontal | NAD83** (w/adjustments)
  - **Vertical | NAVD88**

- **GEOID09 is the current model (-16 needs to be updated)**

ARP Policy on Permanent and Secondary Geodetic Control Stations (PACS/SACS)

- **AC150/5300-16 | Geodetic Control:** data is submitted through the Airports GIS website so that NGS can validate and verify the PACS/SACS identified for geodetic control used to establish mapping and data accuracy for FAA airport and airspace projects

- **Permanent Control:** FAA Regional Airports Divisions determine which airports require permanent geodetic control monumentation in the form of PACS or SACS based on the activity (operational or proposed future construction) at the airport
- For all airports in the National Plan of Integrated Airport Systems (NPIAS), we strongly **recommend** that at least PACS be established

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PACS/SACS Stability Requirements

PACS | Stability Code A or B

Stability Code A
- **Expected to hold elevation**
- **Bedrock/outcrop, foundation in bedrock**
- **Sleeved, deep settings with galvanized stainless steel pipe**

Stability Code B
- **Probably hold an elevation**
- **Unsleeved, deep settings**
- **Massive retaining walls, abutments, piers, etc.**

SACS | may use Stability Code C, but prefer Stability Code A or B
Stability Code C   - **May hold an elevation but subject to ground movement**

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Considerations in Setting Monuments

- **Permanency with appropriate geographic location and spacing**
- **Ease of recovery, location should allow efficient use by surveying community**
- **Accessible by public (public property should be utilized where feasible)**
- **Minimal multi-path**
- **No known potential conflict with future development**

- **Aerial-photo identifiable**
- **Adequate GPS satellite visibility (unrestricted at 15 degrees above the horizon). Minor obstructions are acceptable, but must be depicted on the Station Location Sketch and Visibility Diagram**
- **Accessible by vehicle (two-wheel drive preferred)**
- **Stability, bedrock being most preferred**

Protect the monuments: they are important and expensive!

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PACS/SACS Requirements

- **Establish the PACS in a secure area on airport property**
  - A GPS-suitable site should be selected where surveying equipment may be left unattended at the mark with a minimum probability of disturbance
- **SACS should be established on airport property if practical**
  - If the siting requirements, such as, intervisibility and spacing cannot be met, one SACS may be set off the airport but no further than 1 km from the nearest airport boundary.
- **If establishing new PACS and SACS, the monuments should be set:**
  - No closer than 200 feet (60 meters) from a runway edge, or from the imaginary runway extension (not in the RSA)
  - If an existing control station is used, it should be at least 15 meters from a runway edge
  - In all cases, PACS and/or SACS should be at least 400 meters apart and intervisible

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PACS/SACS | Proximity to other Airport Features

- **PACS/SACS should be located so a surveying tripod can be situated over the mark**
  - ‣ If the mark could be in peril from snow removal, mowing, and other operations, it should be slightly recessed
- *NOTE: Consider the location of established PACS/SACS when planning new airport construction; if destroyed (or not exist) they should be replaced as part of a construction project*
- **PACS/SACS must not be within 1000 feet (305 meters) of the critical side of an:**
  - ‣ Instrument Landing System (ILS) Glideslope Antenna
  - ‣ Instrument Landing System (ILS) Localizer
  - ‣ Microwave Landing System Elevation Station
  - ‣ Microwave Landing System Azimuth Station
- **PACS/SACS should be strategically located so as to provide maximum use for subsequent surveys yet situated where the chances of future disturbance will be minimal**
  - ‣ An elevated site with runway end visibility is desirable. PACS and SACS should also be located where future station occupation will cause no interference to or from aircraft, including from prop and jet blast

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Existing PACS/SACS

http://www.ngs.noaa.gov/cgi-bin/airports.prl?TYPE=PACSAC

NOTE: Most Certificated Airports have/had PACS/SACS established by NGS

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Existing PACS/SACS (continued)

AIRPORTS->MARKS

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[Help]

Station List for Airport = ILN

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Pid...|St|Cty|Designation...............................|Type|
------|--|---|----------------------------------------|----|
AD8867|OH|027|A 01.....................................|SAC |
JY1551|OH|027|AIRBORNE AZ MK...........................|SAC |
JY1548|OH|027|AIRBORNE                                 |PAC |
AB3467|OH|027|VOR/DME MXQ..............................|... |
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Pid [Datasheet]	State	City	Designation	Type
JY1548	**OH**	**027**	**AIRBORNE**	**PAC**

Geodetic Control | Required Deliverables

- **Use the FAA Deliverable Checklist to guide the production and delivery or project deliverables**
- **Survey Work Plan**
  - ‣ prior to starting
- **Quality Control Plan**
  - ‣ prior to starting
- **Project Status Reports**
- **Project Sketch (Vector Diagram)**

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Temporary Geodetic Control

- **Utilize NGS Online User Positioning System (OPUS)**
- **Two independent, but intervisible marks**
- **Observe each mark in two continuous and independent sessions of at least 4 hours**
- **Submit data to NGS OPUS**
- **Follow other NGS requirements for OPUS**
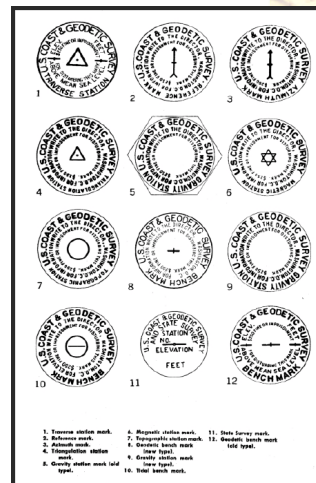- **Include results in project final report**

To PACS and SACS or not to PACS and SACS?

- **Consider: Value**
  - How often will they be used over the next five years? (construction activity)
- **Consider: Cost**
  - Basic airport establishment = $5-15K+
- **Consider: Geologic Stability**
  - Permafrost
  - Subsidence
  - Tectonic plate movement
- **Consider: Timing**
  - Recommendation: if PACS/SACS are not available for the project, establish them on the next major development project (DO NOT include PACS/SACS installation on a project's critical path)
- **Consider: Validation/Verification Process**
  - Surveying requires significant QA/QC time and detailed documentation

PACS/SACS | Additional Considerations

- **Temporary Survey Marks (TSM) can provide an equivalent level of accuracy, however:**
  - ‣ They must be re-established with each project,
  - ‣ Use is subject to atmospheric and meteorological conditions,
  - ‣ Those with limited experience in establishing temporary control typically have more likelihood of causing an error in this scenario
- **If PACS/SACS are not available in planning project–establish on next major development project**
  - ‣ DO NOT include PACS/SACS installation on a project's critical path
  - ‣ Create separate Airports-GIS Project (Airside Construction)
- **Minimum requirements – 1 PACS, Preferably 1 SACS**
- **Large (acreage) airports could have 2 PACS/4 (or more) SACS**
- **State-plane coordinates need translation and transformation**
- **-16 requires significant surveying documentation; provides value**

Questions

1. **Must you install PACS/SACS at NPIAS Airports?**

2. **Where can you find out if an airport has published PACS/SACS?**

3. **What is the current Geoid model for Alaska?**

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