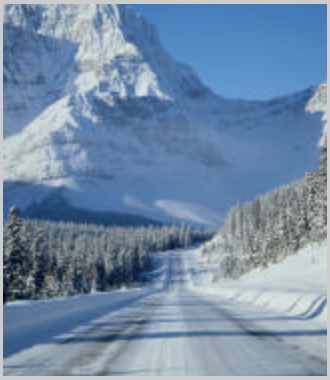
Autodesk Standard Keeps Alaska DOT on the Same Page



Alaska's Department of Transportation has standardized its design process on Autodesk products such as AutoCAD, Autodesk CAD Overlay and Autodesk Land Development Desktop.

In Alaska, where proximity to the polar regions makes each year an extreme cycle of dark wintry days and sunny summer nights, they have a joke about the seasons. It goes like this:

"You know about our four seasons in Alaska, right? Winter, Still Winter, Almost Winter, and Construction Season."

Ask around at the state's Department of Transportation and Public Facilities and you're likely to hear that joke a few times. In fact the Alaska DOT, as the agency responsible for the constant stream of road, bridge, airport and harbor projects that Alaskans must navigate every summer, may even be the reason the joke started.

Obvious circumstances explain the agency's schedule. From October through mid-May, ice, snow, darkness and sub-zero temperatures make construction in the state almost impossible. That leaves a window in between during which any fieldwork by the agency's surveyors, engineers, geologists, designers and contractors can be done.

The conditions that the Alaska DOT operates in - harsh climate, limited daylight, vast distances - mean a narrow margin for error in an enterprise that involves scores of variables. Road and runway designs must be checked against actual features in the field. Survey point data must be taken and retaken until every necessary land attribute is recorded. Soil samples must be gathered, sensitive environmental areas mapped, private property boundaries measured, utility lines marked. Sometimes a single DOT project can reflect the contributions of 20 or more different people, depending on its complexity.

To keep them all speaking the same language, the Alaska DOT for years has standardized its design process on Autodesk products such as AutoCAD, CAD Overlay and Land Development Desktop. Many users in the agency also work in other design formats, often shifting back and forth several times a day. But when designs move from one workstation to another from an engineer to a drafter, from an outside consultant to a project manager - they are quickly translated into AutoCAD files, per the department's policy. Most of Alaska's design community operates that way; perhaps more than any other state, Alaska operates on a common Autodesk standard.

For Surveyors, 16-Hour Days

The Alaska DOT does more than build roads. Huge expanses of Alaska are not traversed by highways, so residents rely on a network of small airports. Tour boats and merchant ships frequent the state's long coastline. So, in addition to the 5,000 miles of road and countless bridges it must build and maintain, the DOT also builds runways at 261 rural airports and operates the state's "marine highway" system of waterways, harbor facilities and ferries.

But looking at the life cycle of a single project helps illustrate how different divisions within the agency use mapping and design tools. In the DOT's Central Region, which is based in Anchorage and is about the size of California, a typical project might involve realigning a stretch of highway whose curves have made it unsafe - essentially rebuilding the road along a new right-of-way. That process generally begins by taking aerial reconnaissance photographs of the job site.

In Alaska, aerial photos must be taken during a brief window in either spring or fall, when important terrain features are not obscured by winter snow or thick summer foliage. Surveyors then visit the site and travel its length, armed with tools like Electronic Distance Meters (EDMs) and sophisticated Global Positioning System (GPS) devices. Surveyors plot a "centerline" for the realigned road, and measure precise

"When I'm drawing in LDD [Land Development Desktop], I can choose from an archive of possible road alignments, which saves time."

-Charlie Wagner
Engineering Assistant
Alaska DOT

coordinate positions - called points - for ground-level features like utility lines and private driveways, and landmarks like the slope of a hillside, the edge of a stream bed or the corners of a nearby building.

In the summer, an Alaskan surveyor's workdays are often 16 hours long, as they scramble to get the most out of the extended daylight. This compensates for the short days of winter, when the sun rises at 10 a.m. and sets between 2:30 and 4 p.m., and instruments can freeze up. At the office, surveyors download their point data into Autodesk's Land Development Desktop, where they construct a digital terrain model - a detailed drawing showing elevations and topographical features, whose surfaces are rendered as a shifting mesh of triangular faces.

Environmental Concerns

This model then goes out to a series of specialists, who flesh out the road's design in stages and estimate its costs. "Preliminary designers" lay out a basic alignment for the road, keeping it within certain required thresholds - for example, curves cannot exceed a certain sharpness. Checking maps from the state Department of Natural Resources, they prepare an environmental document assessing what sensitive areas might be affected, such as wetlands. If several environmental concerns come up, designers will incorporate those features into large AutoCAD drawings of the project displayed at public hearings.

"When I'm drawing in LDD [Land Development Desktop], I can choose from an archive of possible road alignments, which saves time," said engineering assistant Charlie Wagner. "The elements of a design break down into various objects, and you can change their properties by right-clicking instead of navigating through menus. I'm a right-click kind of guy."

Over in the Right-of-Way section, engineers consult subdivision plats to see whose private property lines the project may cross, and estimate the cost of buying the land. Using an Autodesk product called CAD Overlay or a similar tool, an engineer takes the aerial photos and layers them beneath the base map - "rectifying" the photo by matching its landmarks. A stop sign in the aerial photo, for example, is paired with that sign's survey point on the layer above, and the photo image swings around until the two layers correspond. The adjustment is called a rubbersheet. Then the engineers add private property boundaries to the emerging drawing. When the drawing leaves their shop, the land is ready to be bought.

Testing the Soil

Meanwhile, the DOT's Materials Group sends geologists to the project site to drill test holes several feet deep along the length of the proposed road. These reveal a cross-section of the earth, showing whether the mixtures of gravel, clay and sand can support a highway. The position of each test hole is marked on the evolving design, and the section uses AutoCAD to produce vertical diagrams showing how each soil sample breaks down.

Sometimes the geologists find permafrost in the ground - beds of frozen ground, often with layers of peat on top. If the permafrost is exposed, the soil can collapse. So crews must remove the soil, provide an insulated layer or compress it.

"What's unique about our state is that our road system is very limited, and project locations are often very remote and hard to get into," said Angela Parsons, a Materials Group engineering assistant. "If you can't drive out to check an alignment, you may have to fly, which can be restricted by weather and cost. That's why we're interested in visualizing and planning projects with 3-D presentations and photo overlays."

"I've been designing since we did it on mainframes, and what used to take us six weeks, I can now do in five or 10 minutes."

-Randy Stefanich
Designer
Alaska DOT

Avalanche!

In the project design's last stage, drafters use Autodesk's Land Development Desktop to polish the design elements gathered along the way into a final drawing. Randy Stefanich, one of the designers who finishes drawings at this stage, is completing plans for a project along a stretch of the Seward Highway that was hit by massive avalanches in February 2000. The slides killed two people, and for days they cut off several towns on the Kenai Peninsula that had no link to Anchorage other than the highway.

Because the highway was carved out of steep, mountainous terrain, with railroad tracks and a lake just beneath, there is no room to realign it. So Stefanich is finishing up work on an avalanche dam - a "long, skinny pile of dirt" to protect the road. Fittingly, the dam will be perched near a town called Moose Pass.

"I've been designing since we did it on mainframes, and what used to take us six weeks, I can now do in five or 10 minutes," Stefanich said. "On the Moose Pass project, for example, I can do 10 versions of a line or a grade in one day. You can fine-tune your design much more than you ever could before, and the end result is a better project."

Moving Toward GIS

That's the life cycle of a DOT project. But down at the agency's headquarters in Juneau, planners are looking beyond particular projects, using mapping and design tools to develop a digital database for the entire road system. Placing all of Alaska's public roads on a common coordinate grid is the first step toward building a Geographical Information System (GIS), which would unify data currently scattered among different formats and stacks of paper.

"The big problem in Alaska is the lack of digital data, especially for the transportation infrastructure. We haven't been mapped by the USGS the way the other 48 states have," said Kerry Kirkpatrick, manager of the DOT's Statewide GIS Mapping office in Juneau. "So we started a multi-year project in which we drive every public road in the state with Differential GPS equipment to capture their centerlines. This is the foundation on which we can layer features like accident data, speed zones, traffic counts, culverts, bridges and guardrails."

Capturing a road centerline basically means driving the road while a Trimble GPS device in the vehicle determines location fixes, based on a constellation of satellites overhead. But here again, Alaska doesn't make things easy. Tall trees, tunnels and mountainous terrain sometimes block the satellite signals. So when the road's GPS track is downloaded back at the office, it can have spikes, voids or wandering vertices.

"Cleaning up the GPS data has turned into a huge task," Kirkpatrick said. So the DOT is investigating a system that would back up the GPS device with a gyro compass, a barometric altimeter and a digital mileage instrument. These would help keep the road's coordinate path continuous regardless of satellite interference. Until then, the DOT's GIS office in Juneau has been importing the raw GPS centerlines into AutoCAD to clean up the spikes and voids.

The GIS office also uses AutoCAD to create display maps and graphics that are shared throughout the state government, including large mural maps for conferences. "In other software packages you start drawing by selecting a page format, but AutoCAD allows us to work with various projection systems that model the real world," said DOT Analyst Programmer David Oliver. "By working with real-world coordinate systems, we're able to incorporate data from other sources directly into a drawing and have it fall into the right geographic location."

"In other software packages you start drawing by selecting a page format, but AutoCAD allows us to work with various projection systems that model the real world."

-David Oliver
Analyst Programmer
Alaska DOT

Posting Maps on the Web

The DOT has made it a priority to post as much GIS data on the Internet as possible, a job that has fallen to Kirkpatrick's office. As the road centerlines are completed, they go up on the DOT web site in a GIS map format; the agency has already posted them for 16 Alaska communities.

In addition, the agency has posted AutoCAD traffic-count maps for cities throughout Alaska http://www.dot.state.ak.us//external/mapping/adt.html - handy for helping the state, a city or a business analyze traffic volumes as they relate to surface wear or business location, for example - and a map showing DOT harbor facilities as red circles. http://www.dot.state.ak.us//external/mapping/Harbors/state_harbors.html Click on them and out pops an Acrobat PDF map of the dock with helpful details on equipment, berthing fees and contact numbers. To use these maps, web surfers download a free Autodesk viewer called Whip!

The Alaska DOT is committed to putting more map data on the web - much of it in AutoCAD format, some in other formats. The agency will always use several different mapping products. But it will continue connecting its planners, designers, consultants and other map users via a common Autodesk standard. As one DOT drafter said, "It's just so much easier when everyone's using the same system."

GPS centerlines on the DOT web site: http://www.dot.state.ak.us//external/mapping/dgps_centerline.html

The Alaska Department of Transportation & Public Facilities' Autodesk solution was sold and implemented by E-Terra. For more information about E-Terra, visit www.myeterra.com or phone 907-562-1500.

This case study was prepared by DLT Solutions of Herndon, Va., Autodesk's master government sales and marketing partner. DLT and Authorized Autodesk Resellers deliver the complete family of Autodesk and companion products to federal, state and local government agencies nationwide. For a free demo CD, call 1-888-223-7084 or visit www.autodeskgovernment.com
GSA schedule # GS-35F-4543G