Comprehensive Project Design

Assures Project Specifications are Met

SURDEX CORPORATION

Developing an efficient project design is critical to ensuring all product specifications are met. This design includes the appropriate sensor selection and subsequent creation of flight and control plans. When creating an efficient aerial imagery or lidar acquisition design, several specifications and considerations are taken into account. The type of product, product specifications, sensor, terrain, presence of tall buildings, shape of the project boundary and various other factors can influence the placement of flight lines in terms of spacing and orientation. These factors also determine the appropriate speed and height of the aircraft during acquisition. Proper planning – accounting for all these factors – will ensure efficient acquisition of data that meets all standards and specifications in a safe manner.

At Surdex, our Flight Acquisition Manager carefully designs a flight plan that addresses all these factors and collaborates with the Director of Image Processing and Director of 3D Mapping as needed. The Director of Image Processing designs a survey plan that also meets accuracy standards and all other specifications. The different factors they consider are described in detail in the following sections. Note that every project is unique and can require consideration of other factors not discussed here, such as tidal patterns or controlled burning.

Product Type and Specifications

The desired product and product specifications detailed by the client are critical to project design. These are determined by the client's intended use of the data. Imagery and lidar products require different flight line spacings, and lidar flight plans include a few cross lines (also called tie lines), which run perpendicular to the main flight lines and are not needed for aerial imagery acquisition. Specifications include product resolution (for imagery) or point density (for lidar) and accuracy standards.

Figure 1. Ground control survey point collected at sidewalk corner

In the geospatial services industry, the accepted accuracy standards are the ASPRS Accuracy Standards for Digital Geospatial Data; however, some clients use a different set of standards, and we design the project accordingly. The ASPRS standards define the ground control and check point survey accuracies based on the type of product and selected product accuracy. The number of check points (QC points), which are independent of the control points and are used to validate the solution, is defined by the standard for each type of product.

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Ground / Ground Features

Variation in elevation and presence of tall buildings in a project area also have an impact on flight line placement. Greater variation in ground elevation requires denser flight lines because it is more difficult for sensors to accurately capture such variability. Increasing the number of flight lines ensures there are no data voids or serious errors in the data. Also, tall buildings require very carefully planned supplemental flight lines. In some cases, supplemental flight lines are added between project-wide flight lines in downtown areas, which doubles the sidelap, to minimize building lean (figure 2). Other times, flight lines are added directly over specific tall buildings (figure 3). Alternatively, they may be aligned with major roads, regardless of their orientation (North-South, East-West, or diagonal – figure 4).

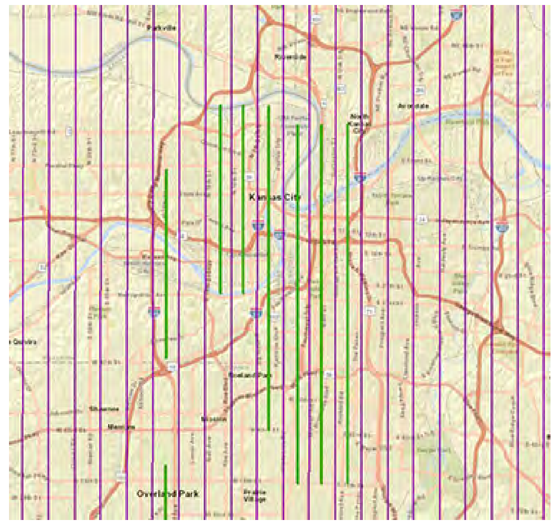

Figure 2. Supplemental flight lines (green) over tall building areas between project-wide flight lines (Kansas City, MO/KS)

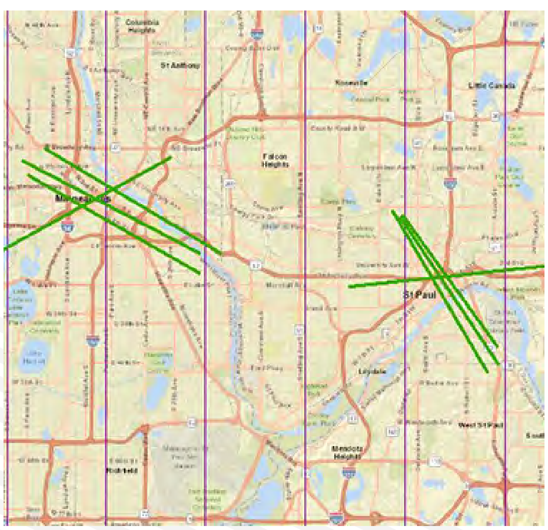

Figure 3. Supplemental flight lines (green) directly over tall buildings (Minneapolis-St. Paul, MN)

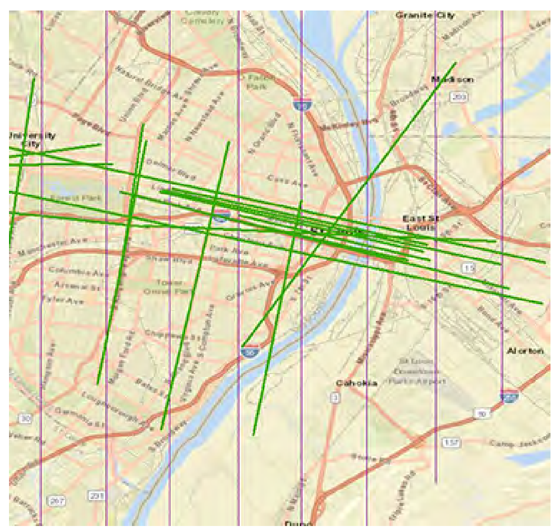

Figure 4. Supplemental flight lines (green) aligned with major roads, with additional cross-flights (St. Louis, MO)

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Sensor

The appropriate sensor will be determined based on the product type and accuracy specifications. Different sensors have different swath widths, and focal lengths, and other specifications, so the sensor selection will impact the number of ground control points as well as flying heights and flight line spacings. The flying heights for our imagery and lidar sensors for different resolutions are detailed in the tables below. Note that for lidar acquisition, these heights only generally apply to acquisition of flat terrain with a single engine aircraft using a basic lidar plan; these heights vary with different types of terrain, different aircraft, reflectivity of the ground, intended use of the final data, and other factors.

Surdex's Imagery Sensors		
Sensor	**Resolution (GSD)**	**Flying Height**
ADS100	12″	12,300′
DMC	12″	10,000′
ADS100	6″	6,150′
DMC	6″	5,000′
ADS100	3″	3,075
DMC	3″	2,500′

Surdex's Optech Galaxy Prime Lidar Sensors	
Points Per Square Flying Meter (PPSM)	**Height***
2	9350′
4	8800′
8	6000′
10	5800′
16	5000′

**Estimates for lidar acquisition of flat land with single-engine aircraft using basic plan*

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Project Boundary

The shape of a project boundary can impact the orientation of flight lines. Because the sun moves from east to west in the sky, north-south oriented flight lines are typically preferred to minimize adverse solar affects in the imagery. In some scenarios, however, east-west flight lines may be optimal. For example, panhandle areas that are much larger in the east-west direction than in the north-south direction, such as in Oklahoma, are acquired with east-west flight lines because these enable significantly more efficient coverage of the area. Sometimes even diagonal flight lines are used for a-typically shaped project areas (figure 5).

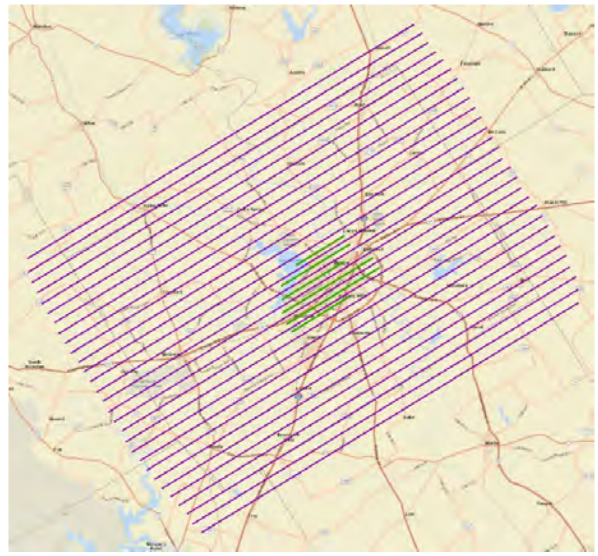

Figure 5. Diagonal flight lines were used for this project area as they capture it most efficiently (Waco, TX)

Restricted Airspace

Some project areas include or are near restricted airspaces, such as Military Operations Areas (MOAs). Proximity to these airspaces may restrict the allowable flying height as well as the acquisition timeframe. To ensure trouble-free access to these areas, Surdex coordinates with the FAA and military operations centers, providing flight plans and any other necessary information in advance of acquisition. In our experience, continuous communication and strict observation of all instructions has resulted in successful acquisition around these airspaces.

Summary

Numerous factors must be incorporated into a project design that guarantees all project specifications and standards are met without compromising safety. Surdex takes the time to carefully design our approach for each client's project because we know this step is critical to the project's success. If you need advice on comprehensive and safe project design, we are here to help.