Utilizing GIS in Support of Control Surveying

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Abstract

For a recent aerial mapping project in a metropolitan area of the United States, ESRI ArcGIS software was used to provide significant efficiency in support of the aerial ground control surveying and field editing. The mapping supported the engineering design of a 17 mile transportation corridor.

To compile the aerial mapping, 143 photo identifiable control points were required. The control points were identified on aerial photographs by a photogrammetrist and then plotted over statewide orthophotography in ArcGIS. The points were then uploaded to a tablet PC for navigation in the field. The field survey also relied on cellular Real-Time Kinematic (RTK) GPS.

Furthermore, as part of the field editing of the compiled mapping, the mapped building layer was converted to a .shp file. The .shp file was then used in ArcView on a tablet PC to record the number of stories, building material and use of buildings within the corridor.

Paper

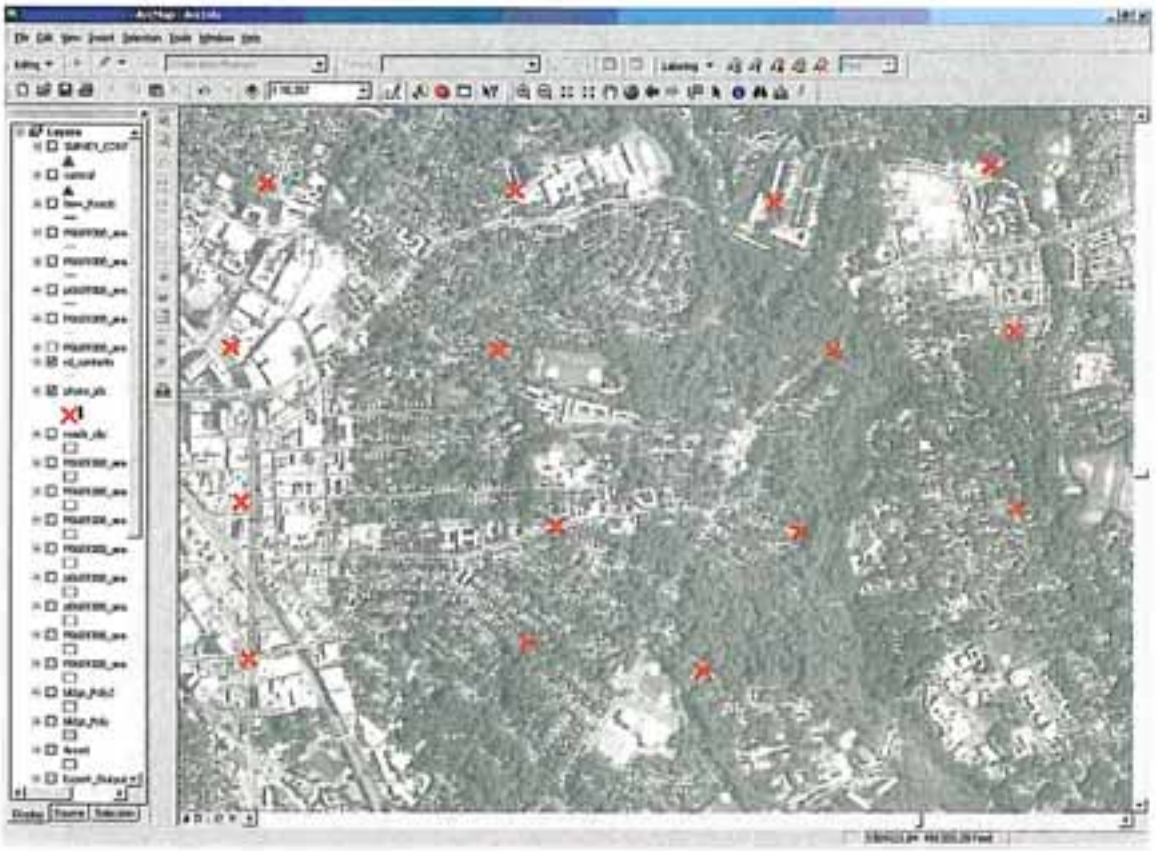
The advantages of using Geographic Information System (GIS) layers for planning purposes, such as engineering design, conservation, or public health and welfare are endless. In order to build any GIS there are numerous input sources. It is often that field surveys conducted with GPS equipment are used to collect features, especially when developing layers for infrastructure such as water systems or storm sewer systems, to name a few.

The advantage of Real-Time Kinematic (RTK) GPS has especially allowed for cost-effective surveying of features over large areas, enabling endless possibilities for projects that could have only been dreamed of previously. While we typically think of RTK surveys as an input source supporting GIS development, surveyors are beginning to tap into GIS in support of field surveys.

For a recent aerial mapping project, ESRI's ArcGIS ArcView 9.2 software was used to provide significant efficiency in support of the aerial ground control surveying and field editing. Traditionally, aerial ground control surveys may be performed by setting aerial targets at an appropriate size and frequency within the project area to be mapped, as directed by a photogrammetrist, or by obtaining the 9" x 9" contact prints for a project with photo-identifiable points (e.g. the corner of a sidewalk or end of a parking lot stripe), as identified by a photogrammetrist. In the later case, field technicians are able to easily navigate small project areas (e.g. a few hundred acre development site, an area-wide infrastructure improvement project or for highway improvements) with the contact prints and a local map of the area.

The aerial ground control surveying needed to support 1"=50' scale mapping of a 17 mile transportation corridor, required 143 photo-identifiable points distributed throughout the corridor. The aerial photography was captured at a negative scale of 1"=250', equivalent to a low flying height of 1500'. At this flying height, a small area of only approximately 66 acres is captured in each 9" x 9" contact print and in the dense, metropolitan area that this project was in, it made navigation difficult.

The supervising surveyor reviewed all photo-identifiable points, as selected by the photogrammetrist prior to the field survey to identify any points that appeared to have the potential for access issues, and alternates were chosen as necessary. Before commencement of field surveying, orthophotos at a scale of 1"=200' were obtained from a state-wide dataset and added as a layer to an ArcMap project. An experienced field technician familiar specifically with aerial ground control surveying, identified and heads-up digitized all photo-identifiable points as a layer in the ArcMap project.

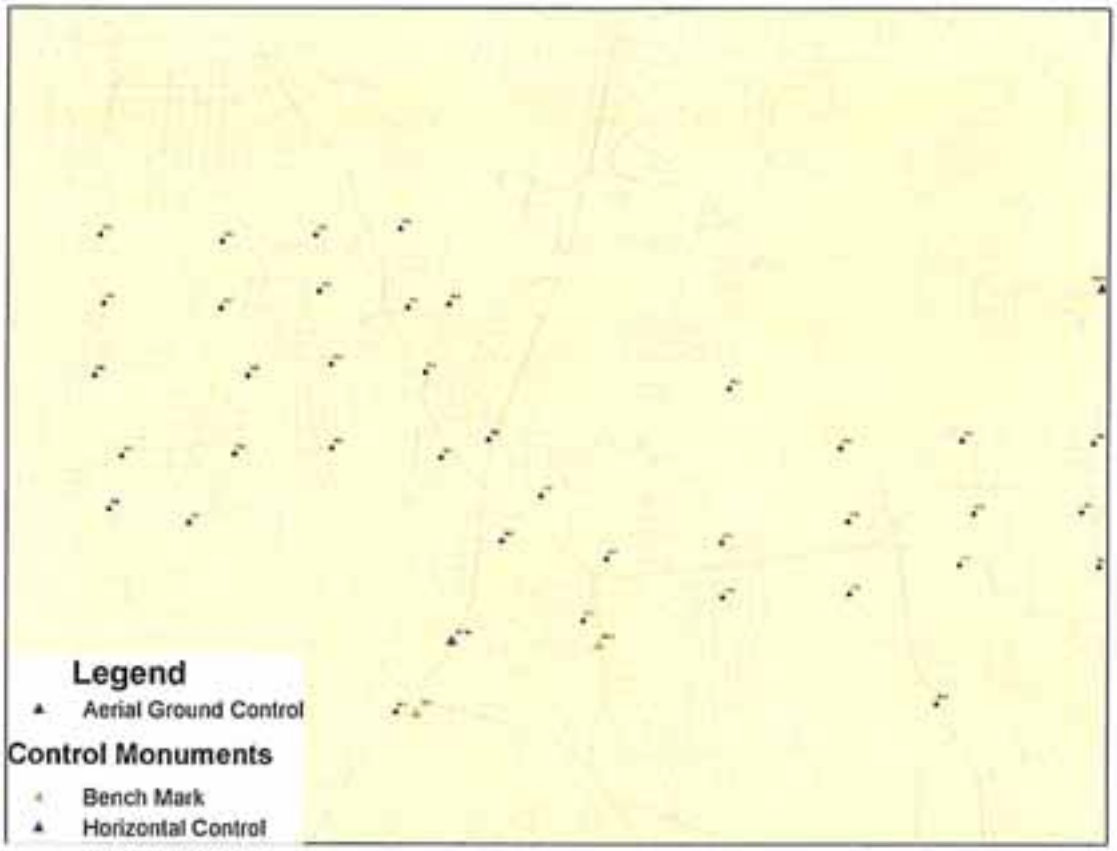


This process took nearly two days to accurately identify each point. Then the points were exported and uploaded to Delorme Street Atlas 2005 software on a Panasonic Toughbook. The field crew was ready to go into the field, equipped with contact prints, field computer and Trimble R8 GPS receivers.

A dense network of GPS-observable control points and benchmarks exists throughout the project area and was used to perform RTK surveying of the 143 aerial ground control

points. To increase the survey efficiency even greater, Airlink CDMA cellular modems were relied on for communication between base and rover receivers, in lieu of traditional radio broadcast RTK surveying. The Delorme software was used to simplify the navigation to each control point by the field surveyor.

The surveying was completed in 3 weeks by one person which included redundant observations on nearly two-thirds of the control points from a second GPS base station. It is estimated that without the use of the approximate coordinates for real-time navigation, the field effort may have doubled in time.

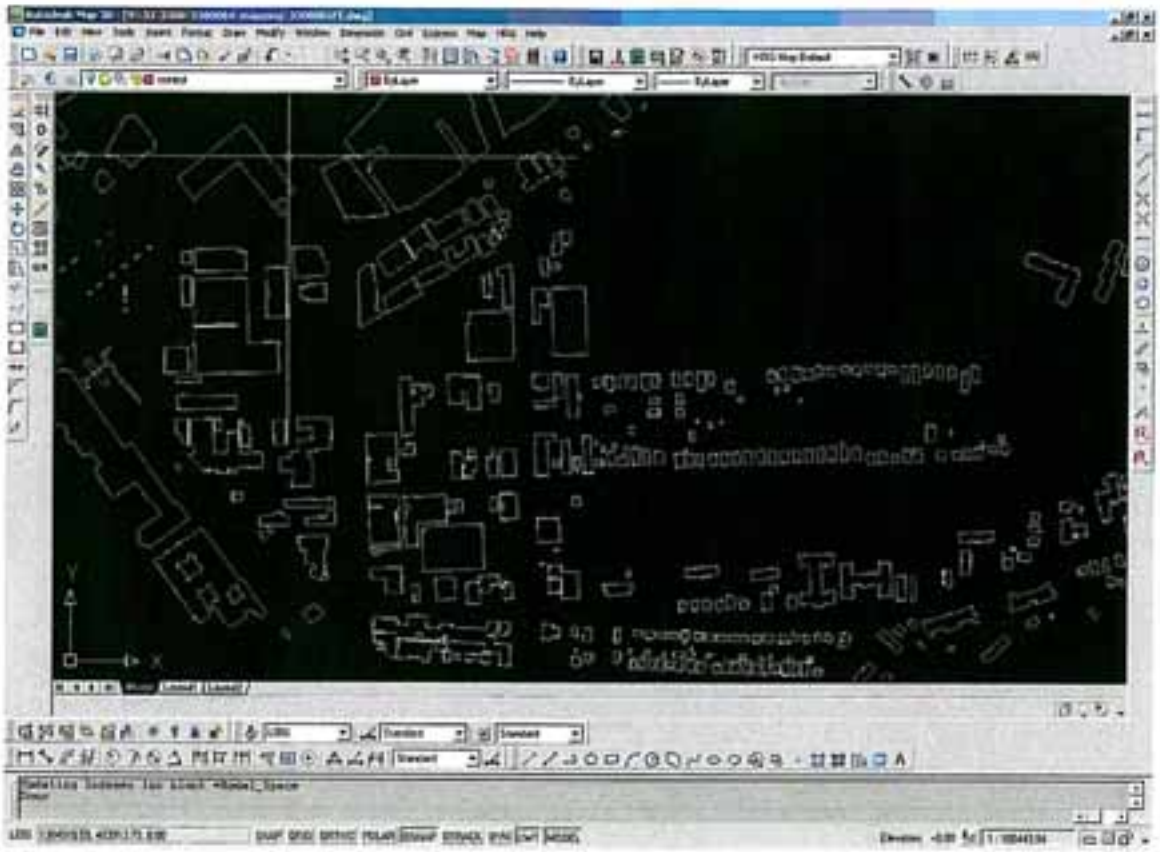


Upon the completion of map compilation of the route, crews took to the field again to provide field edits of the base mapping and obtain attributes on nearly 2500 buildings within the corridor. It is common for field editing to be conducted by visiting a site and marking up a plot of the mapping for said site. Then the marked-up plot is used by someone to make edits in AutoCad to the base map before final delivery and use.

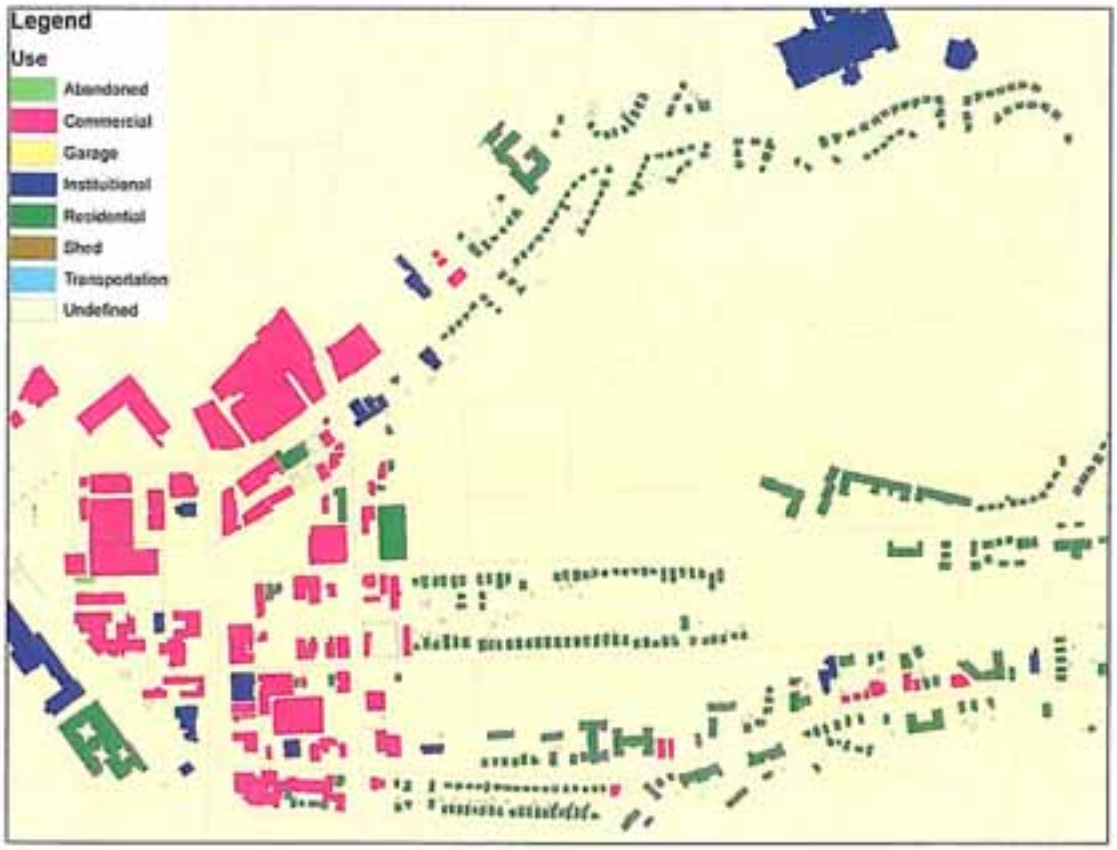
In this case, the site is a 17-mile corridor with nearly 32 miles of potential routes mapped at 1"=50' scale. This would yield approximately 90 24" x 36" plots to be marked up and then the edits would need to be incorporated into the base mapping back at the office.

For this project, two Panasonic Toughbooks were equipped with AutoCad 2006 and field edits were readily made in the CAD drawings as field personnel walked through the corridor. One of the two Toughbooks contained ArcGIS ArcView 9.2 and was used to obtain attributes on all buildings within the mapping corridor.

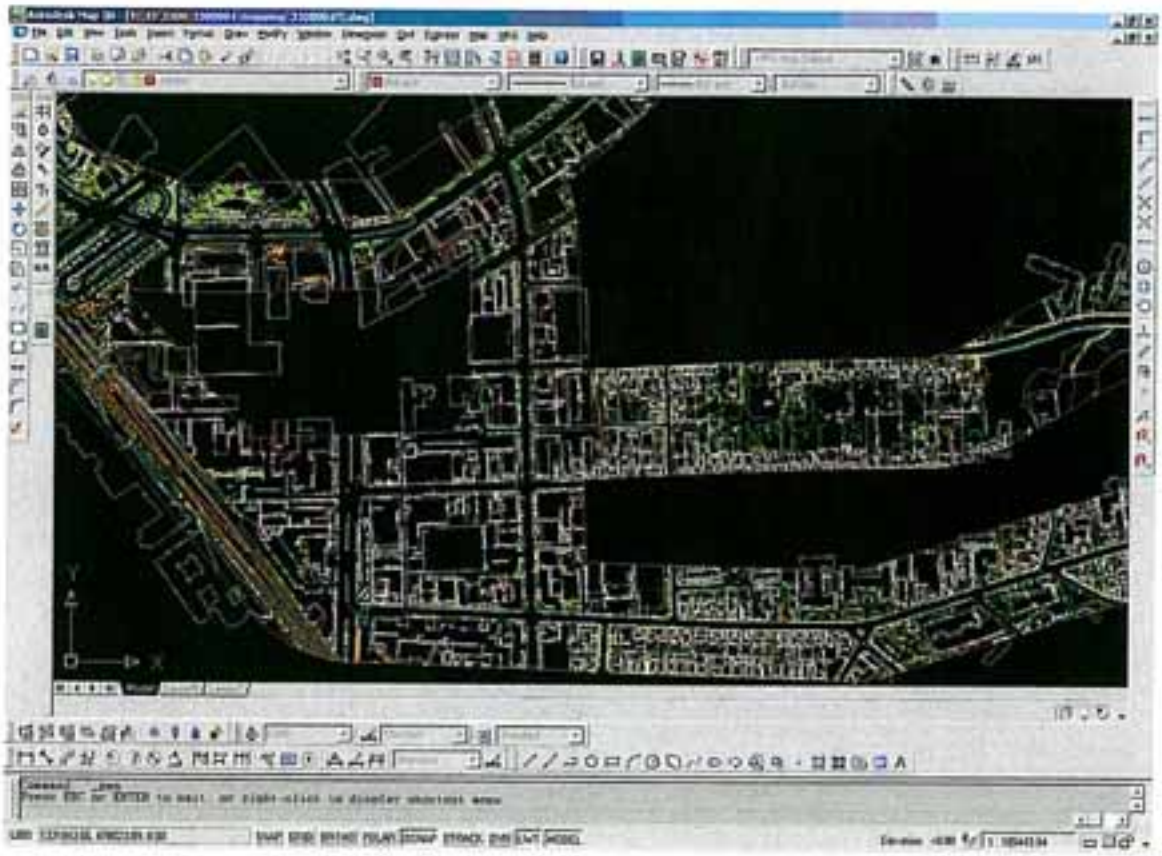
The building layer was first extracted from the CAD drawings and imported into an ArcMap project on the Toughbook. Attribute tables were added to accommodate collection of building material type (e.g. brick, concrete, etc.), building use (e.g. residential, commercial, etc.) and the number of stories.




Legend
Building Material
Block
Brick
Concrete
Frame
Masonry
Metal
Rubble
Wood



As each section of mapping was compiled and delivered to the crew for field editing, two technicians worked on the edits; one editing CAD and the other utilizing ArcView to collect attributes. During field edits of each section, the building attribution was completed before the CAD edits and the GIS technician then assisted with CAD edits to complete the section. By utilizing the mobile technology of the Panasonic Toughbooks combined with Arview 9.2, the field crew completed field edits in 5 weeks and was able to stay ahead of schedule.



The effectiveness of technology and support of ESRI's ArcGIS ArcView 9.2 resulted in a cost-effective solution to accomplish aerial ground control, field edits and building attribution that included nearly 2500 buildings through 32 miles of mapping. The use of ArcView 9.2 realized time savings during the field survey, ease of building attribution during field edits and ultimately aided in preparation of exhibits of control and building information.

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