1465 & 170 West Leg Project

Overview
The Schneider Corporation
Richard S. Rayback, PLS

Mission
- Provide design level survey data for Interstate Highway

Project Size
- 10 miles of Interstate Highway
- 13 Interchanges
- 170 miles of Differential leveling
- 95 (Pivotal) Horizontal Control Points
- 850 Aerial Control Points
- 130 Section Corners
- 22 Survey Field Crews

Project Constraints
- Project Size
- Time Schedule
- Mapping Accuracy
- Line of Sight
- Traffic Safety
- Contract Space
- Restricted Air Space
- Airport Access and Security
- Industrial site access and security

Goals
- Meet INDOT Design Manual for survey standards, specifications, and accuracy
- Complete the project on schedule
- Comply with all work zone traffic and safety regulations
- Protect the public from harm
- Protect the survey crews from harm
Hybrid Procedures and Techniques

It was apparent that conventional survey methods could not accomplish the desired accuracy within the time allotted. There were also concerns about the safety of the survey crews and motorists.

- I-465 carries approximately 80,000 vehicles per day
- I-70 carries approximately 50,000 vehicles per day

The decision was made to utilize low altitude, high accuracy stereo photography to keep survey personnel off of the Interstate travel lanes. This type of photography is capable of producing mapping with elevations of pavement surfaces that rival that of conventional (on the ground) survey measurements.

The I-465 / I-70 project was a large scale cooperative survey project that required 7 INDOT consultants to provide design level survey data. The consultants consisted of 6 survey firms utilizing conventional and GPS survey techniques and 1 aerial mapping firm utilizing low altitude, high accuracy stereo photography.

Planning, Team Work, Communication and Information Sharing

The first meeting of the 7 consultants took place at INDOT's office at the Indiana Government Center North on January 24, 2001.

The Team Members

INDOT
Spectrum Mapping, LLC
Bermudez Kochmarner & Associates
Butler Freeman Servent Consulting Engineers LLC
The Schreiber Corporation
Weinport LLC
UST Consultants Inc

Planning

Each of the survey firms would be assigned a portion of the 18 mile project which was already broken down into segments for budget and design purposes. Considerations were made concerning the assignment of segments based on the resources each firm was able to commit to the project and reverse training of credentials they possessed.
For example USI was badged and trained to work on the Airport facility so they were assigned that area.

One firm (The Schneider Corporation) would be responsible for all primary horizontal control throughout the project.

Firm Responsibilities

Within each firm's area, they would be responsible for the following:
- Secondary Horizontal Control
- Vertical Control
- Set out proposed panel point positions
- Survey horizontal and vertical position of panel points
- Redeem research
- Survey pitfalls

Responsibilities

- Property owner interviews
- Supplement to ground topo
- Under greats
- Topo field cross sections
- Unknown object determination and locations
- Survey existing centerline and right of way control
- Location Control Route Survey
- Centerline Monumentation

Team Work

Butler Fairman Scuffett Consulting Engineers (BFSC) researched and recovered road plans, bridge plans, and notebooks.

BFSC generated a report that tabulated the 1465/176 plans and notebooks by project number and stationing.

Team Work

Woolpert recovered benchmark data sheets as well as performing remanufacture and recovery of benchmarks.

The Schneider Corporation recovered HARN control as part of the horizontal control network mission planning.

Benchmark recovered by Woolpert were surveyed with GPS by Schneider as part of the horizontal control network. Horizontal positions and GPS derived elevations of benchmarks were provided to all survey consultants for their use in planning local loops within their respective areas.
Primary horizontal control network and reference ties were provided to all survey consultants for their use.

Due to the use of GPS by all survey firms, minimal secondary control was needed.

**Project Traffic Safety**

*Instructions from INDOT—*

*Do not cross interstate pavement on foot.*

*Absolutely, positively, Do NOT cross interstate pavement on foot!*

**Vehicles are not to be parked on shoulder pavement.**

*Within Interstate R/W, park in grass area well clear of pavement. If vehicle or personnel must be on shoulders, proper advanced warning signage, cones, and lighting must be deployed.*

If personnel must be in median, access should be attempted at bridge crossings. If this is not possible, access will be to drive to the median and deploy proper personnel and equipment. Advanced warning signage, cones, and lighting must be deployed. There will be no lane closures or interruption to traffic flow or speed. Comply with all traffic work zone regulations.

**Vertical Datum**

The North American Vertical Datum of 1988 (NAVD 88) was derived from various benchmarks along the project route. The elevation of these benchmarks were published by the National Geodetic Survey (NGS).

**Vertical Control Network**

Each survey firm is responsible for vertical control within their respective segment.
All firms used Digital Leveling Instruments

**Vertical Control Network**

The Schneider Corporation ran the first level line from "ZID A" and "ZID B" to the 1465 project area, both monuments being First Order, Class II vertical control on the north side of the Indianapolis International Airport.

**Other Consultant Tie-in**

The differential level loops performed by USG and DUL were run from the first line performed by the The Schneider Corporation.

Benjamin Lodtmueller and Wellport then made connections from the USG and DUL level lines to other known benchmarks.

**Information Sharing**

Due to the communication and sharing of information, which had started with the independent level work that had become a vertical network, after consulting with BUCO and both consulting engineers, it was determined that a vertical network agreement was possible and warranted.

The Schneider Corporation was tasked with completing this agreement.

---

**LEVEL LINE ALIGNMENT 1465 6-13-90**

<table>
<thead>
<tr>
<th>Station</th>
<th>R.L.</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Check R.L.</th>
<th>Check X</th>
<th>Check Y</th>
<th>Check Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (A)</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 (B)</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 (C)</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 (D)</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5 (E)</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1465</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Vertical Control Network**

![Diagram of Vertical Control Network](Image)
**Milestones**

**6-9-2001—Serial Photogrammetry complete.**

**6-21-2001—Primary horizontal control complete.**

**7-6-2001—Vertical Network adjustment complete.**

**1-26-2002—Aerial Mapping complete.**

**7-2002—Rough Survey and supplemental topography complete.**

**Summary of Project**

- **36,000 Man Hours of Labor**
- **2.1 Million Dollar Survey Fee**
I465 & I70 Project Overview

The Schwind Corporation
Richard G. Rayback, P.S.

I465 & I70 Project Survey Field Work

The Schwind Corporation
Bruce Strick, P.S.

Time Line

- Set and Paint Panel Points
- Connect 10 points to be set
- Complete in one day with 4 people
- Begin: 5-28-01
- Complete: 6-2-01
- Radiometric Set: Primary Control
- Begin: 5-30-01
- Complete: 6-6-01
- Differential Leveling Primary Control Panel Points
- Begin: 5-30-01
- Complete: 6-7-01

HAINN Points

Primary Control South Area

Time Line

- GPS Primary Control & Reference Tiles
  - Begin: 5-29-01
  - Complete: 6-3-01
- RTK (Real Time Kinematic) Panel Points
  - Begin: 6-1-01
  - Complete: 6-26-01
- Route Survey Locations
  - Begin: 7-17-01
  - Complete: 7-23-01
Primary Control North Area

GPS Network Design
- After primary control was set, the network design phase began.
- Due to the long, straight geometry of the project area, offset points were needed to improve the geometric figure of the network.

North 1/3 of Project Area

Center 1/3 of Project

South 1/3 of Project

GPS Procedures
- The project network was run with the H400 points having a 10 minute occupation.
- The data was tied to the H400 points with the network.
- The network was controlled by a 10 minute occupation.
- At least 10 points at each end of the baseline were "keyed" method was used to improve control points along the baseline with a 10 minute occupation.
- Receivers used were Leica 589999, Leica 990999, and TK9900 5800 sections.
Static GPS Equipment

GPH Adjustment

- All baselines were observed independently to achieve good GPH quality
- Baseline checked
- Three "n" baselines were transformed
- Co-ordinate to refer GPH
- At least three points
- The network was adjusted horizontally by holding 7 NAP points that were included in the network
- The network was adjusted vertically by holding 7 at least 4 benchmarks directly and 3 other control points
- The network of benchmarks from Final Target Point

Coordinate Output

Transformation to Local System

- The results from the least squares adjustment and obtained by the STR software version 2.5 were calculated in the NAVD30 system
- The results were then converted from grid values to ground values using the average compensation better derived from the software

Transformation to a Local System

Reference Ticks

- Conversion to the NAVD30 system was used as the basis for the transformation
- The conversion to the NAVD30 system was used as the basis for the transformation
- The conversion to the NAVD30 system was used as the basis for the transformation
- Conversion to the NAVD30 system was used as the basis for the transformation
Panel Point Leveling

- Differential Levels were run from a 1" order vertical benchmark through all of the panel points and back to another 1" order vertical benchmark.
- Included in this level run were also all of the primary control points. This enabled us to compare the GPS-derived elevations to the actual differentially leveled elevations.

Panel Point Locations

- The 62 remaining points needed to complete the site survey to the final control and the local coordinate values of the panel points.
- The process used was RTK GPS. A setup consisted of one set of data at 0.2 to 0.25" and each panel point was located twice from the base station at specific times to ensure that the overlie configuration would be as close as possible between the two locations.

Time Line

- Undergraduate Deer Study
- Groundwater and Stormwater
- Stormwater Management
- Transportation
- Water Quality
- Roadway Alterations
- Storm Sewer Catchbasin
- Residence of Deeds
- Tidal Tests at End of Area Taper
- Metro Program
- Traffic Control

Utility Surveys

- The Trimble 7700 GPS System will be used to locate the panel points.