



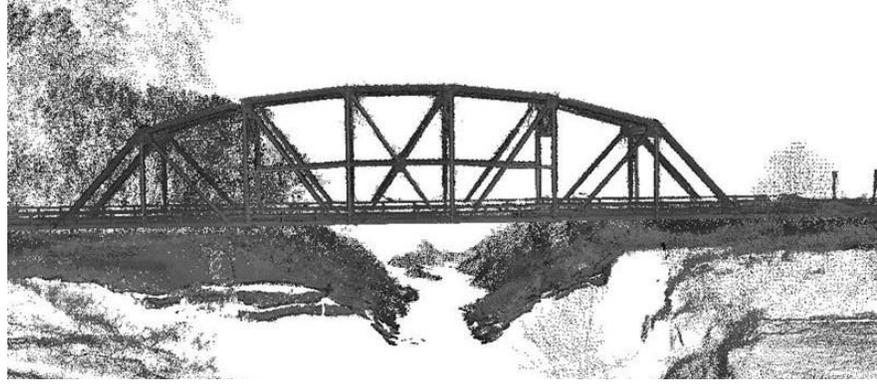
THE NEBRASKA 2003 DECEMBER CIVIL ENGINEER

OFFICIAL PUBLICATION OF THE NEBRASKA SECTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Project Spotlight:

400 BRIDGES IN 30 DAYS - NDOR Bridge Height Survey

-Russ L. Tamblyn, Lamp Rynearson, and Associates



See Page 3

Highlights of This Issue:

Page 2 - "The Magic Box" Photo Trivia

Page 3 - "Project Spotlight"
-400 Bridges in 30 days

Calendar of Events:

December:

11 - Nov/Dec Meeting, The Steak House, Lincoln, NE 5:30 P.M.

19 - Younger Members FAC

January:

31 - Future City Competition

Answer to:

Magic Box Trivia

-Photo shown on Page 2
-Nebraska Public Power and Irrigation District



"This northwesterly view shows two control structures and a channel carrying North Platte River water which flows into the base of the spillway, through a 28-foot diameter conduit and is released into a stilling basin below Kingsly Dam."

This Month's Meeting:

The Upcoming Legislative Session

Featuring: Sen. Ronald E. Raikes

Occupation taxes, license fees, engineering service taxes, government projects and government spending. Come get your questions answered and find out what's going on in the Legislature this session.

Location: The Steak House, 35th and Cornhusker.

Times:

Social Hour 5:30
Dinner 6:30
Presentations 7:30

Spouses and guests welcome
RSVP

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See www.neasce.org for more information

Get Your Project in Next Month's Spotlight!

If you'd like to see your project in an upcoming NE-ASCE Newsletter please send articles and pictures to peggy-m@ira-inc.com

Spotlights will be 1- 2 pages as space permits. Companies supporting the NE-ASCE Newsletter will be given precedence, but any company with ASCE members may participate.

From the President - Mark Stark, P.E.

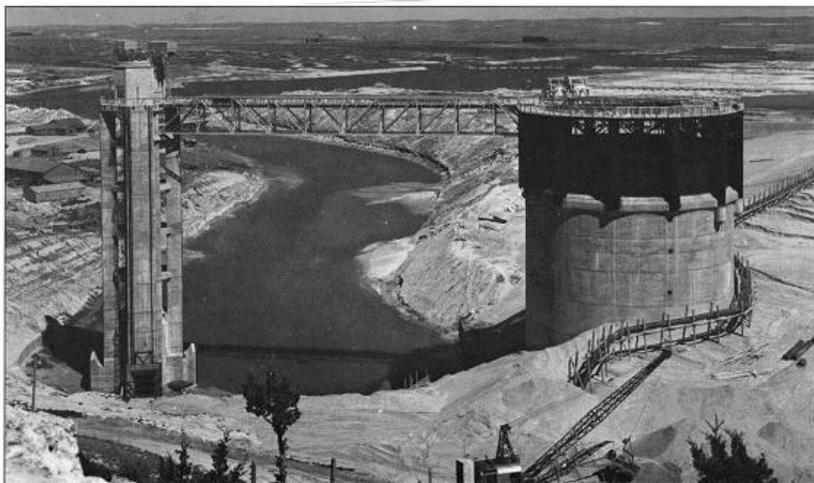
Wow, another month has flown by and it's time to write to you again. Hats off to Aaron Buettner, the Construction Committee Chairperson, for arranging last month's meeting at Misty's. Terry Gibson with the Nebraska Department of Roads came and spoke to us about the reconstruction of I-80 between Lincoln and Omaha. Terry also told us a little bit about the Department's plans to extend the six-lane section all the way to the Minden exit, 10 miles east of Kearney. Construction between Omaha and Lincoln is expected to take until 2012 so completion really isn't that far away. Welcome news for those of us traveling the I-80 corridor on a regular basis.



Mark Stark, P.E.
NE-ASCE President

The November / December meeting is coming up really quickly due to the Thanksgiving Holiday. We'll be having Senator Ron Raikes speaking to us about upcoming issues before the legislature this spring. Even though this is the short 60 day session, the Legislature has a \$200 million shortfall to deal with this year. This means that several of the bills that were not killed in committee last years are around and can be reintroduced this year. Senator Raikes sits on the Revenue Committee, one of the two key committees that deal with taxing engineering services. Gordon Kissel, the Professional Engineers Coalition, (PEC), lobbyist will be there also to give his viewpoint on this year's session. As you may or may not know, we had a few bills that were introduced last year that would have had a direct impact on your livelihood. One of the bills was introduced by Senator Ray Aquilar of Grand Island and would have placed a sales tax on engineering services. That bill was held in committee last year so it is still possible that we can see that one reintroduced. Another bill introduced by Senator Chris Buettler of Lincoln was designed as a backup to Senator Aguilar's bill and would charge licensed Engineers a professional "privilege" tax of \$1,250 annually. Through Gordon's effort and PEC members testifying before the Appropriations Committee, this bill was killed in committee and cannot be reintroduced this year. Please be sure to make this next meeting so you have an opportunity to meet to Senator and ask him any questions you might have.

This month's Magic Box trivia comes from the Fall 1991 UNL Contacts magazine that contained a history of Civil Engineering at the University of Nebraska between 1877 and 1990. The history was compiled and written by Dr. Ralph Marlette whom several of our more experienced members had as an instructor. Aside from mentioning several graduates and their accomplishments in Nebraska, Dr. Marlette also provided several great photographs including the one shown below. Dr. Marlette also included an addendum to the article that talked about a darker time in civil engineering history when



certain highway construction contractors were indicted for "bid rigging". This practice involved certain contractors that met prior to bid openings and fixing their unit prices so that a given contractor would be the low bidder on a given project. This practice continued for some time until the NDOR and Federal Highway Administra-

tion noticed that project prices were increasing. Federal indictments, fines and prison terms were dealt to those offenders and an elaborate system to track bid prices and follow bidding practices was established at the Department to prevent this abuse of taxpayer dollars.

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400 BRIDGES IN 30 DAYS cont. from page 1

In June 2002, the Nebraska Department of Roads (NDOR) selected Lamp, Rynearson & Associates, Inc. (LRA), to conduct a bridge clearance height survey. NDOR was implementing an internet based, over sized load permitting system. We were asked to complete a project that involved collecting clearance data on over 400 structures across an entire state without closing a single lane of traffic.

While analyzing the best possible way to undertake this project, a multitude of factors came into play. Safety was our number one concern. How could we keep our field personnel out of harms way while collecting survey information on an Interstate system. Accuracy played a close second. We needed to



Field operator prepares equipment

maintain a high degree of accuracy throughout the entire project. Speed ran a not so distant third due to the fact that the less time we spent on the highway, the safer we would be. Some of the other considerations involved point cloud registration, data management, efficient data extraction and an end product that the client would find beneficial above and beyond traditional methods.

To complete the task, the process involved various field and office tools. We initially considered using a Leica TCRA 1101 reflectorless total station (Leica Geosystems, Atlanta, Ga.). However, the speed of 3D scanning had too much potential to conduct a faster and more thorough survey of each bridge site. At first, the NDOR was skeptical of using 3D scanning for such a large project. After capturing over one million data points, the vertical measurements were extracted and checked in the field using a laptop computer. NDOR engineers matched known measurements with our new data to within 1/8 of an inch. After the field survey

test, NDOR was satisfied to move forward with the project.

“The most important feature was safety,” commented Ellis Tompkins, Rail & Public Transportation Engineer. “Most of the structures are located on Interstate 80 with 75 MPH traffic. The laser scanning could be accomplished without lane restrictions or extensive signage. The equipment was located in the median with no disruption of traffic and therefore safe for both the highway user and the crew completing the data collection.”

The Field Work

Initially a typical bridge site scan project averaged approximately 40 minutes of actual equipment set up, data collection and tear down. The scanner took a little over four minutes to collect three million data points from one side of the bridge. After reviewing the fieldwork, we decided to add a second field operator to the one-man crew. This shortened the elapsed time per bridge to less than 15 minutes! On our best day, we were able to capture 31 bridges in a 10-hour period, including drive time between bridge sites.



The Crew's view: Laptop display screen

“The system is fast,” noted Tompkins. “Conventional surveying would have required approximately two to four hours per structure. It provided accuracy down to a hundredth of a foot and still maintained the speed of setup and collection of data.”

Data Processing

One of our largest challenges initially was keeping up with the speed of the field crew. The project involved collecting two scans per bridge over a 25 to 30 minute period, equating to 80 mega-

bytes of field data for each of the 400 bridge sites statewide. We were collecting data from 15 and 18 bridge sites per day. “The raw data sent back to the office averaged 2.5 gigabytes per day,” noted Cudaback. “Some engineering and surveying firms would not manage that much data over a one-year period, much less in one day.” Our post-processing specialist aligned various scans into one coordinate plane, verified accuracy, did minor clean-up and extracted vertical height measurements and exported them to a spreadsheet that could be used by the NDOR. Additionally, we had to organize the latitude/longitude data and 700+ digital images.

Aligning the Scans

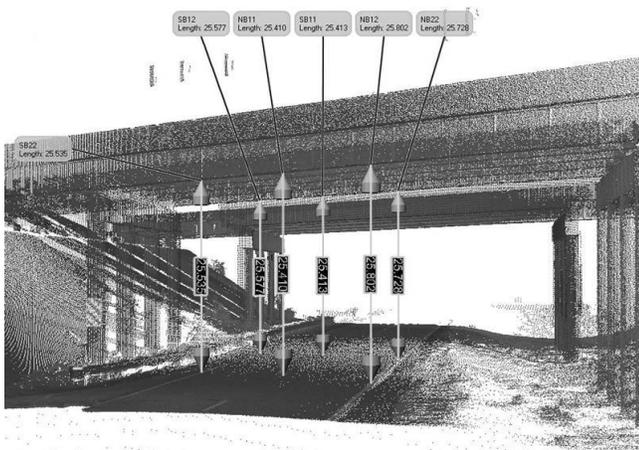
The first step of the process began by converting the raw data from 3D RiScan Pro to a PolyWorks format. These raw data files were extremely large and very time-consuming to process. In the field, an operator took two scans of the bridge site that required point cloud-to-point cloud alignment in a coordinate plane. PolyWorks incorporated algorithms within the software that analyzed the geometry of every point within the cloud. It used all of the geometric information within each point cloud to conduct a best-fit alignment procedure over millions of corresponding points. Because it is based on the shape of the natural features in the scenery, the PolyWorks alignment technique did not require the use of reflective targets in each scan to align the point clouds. This method allows for faster and safer field operations. The alignment of 2 scan locations took approximately 10 minutes. Once the scans are aligned into a single data set for each bridge site, it was easily geo-referenced to real world coordinates.

Vertical Clearance Extraction

Our next step was to extract the vertical clearance data from the aligned data set. Initially extracting vertical measurements with PolyWorks took approximately 40 minutes per bridge site. In order to expedite the process, we along with the InnovMetric support team, exploited PolyWorks' ability to create reliable and automated software macro's to automate the bridge height extraction process. This lowered the initial 350+ mouse clicks down to 12 and reduced the time to process

400 BRIDGES IN 30 DAYS

..... cont. from page 3



Extracted Clearance Dimensions

each bridge site from 40 minutes to 10 minutes. This one process alone saved us 200 hours of processing time.

Bringing the data together

Our post-processing specialist created a spreadsheet using the existing structure names and modified it to incorporate the vertical height measurements. The digital images taken with a Kodak camera were named and organized in the corresponding project directories and the updated coordinates of the structure were uploaded into the spreadsheet. By properly managing the incoming data, one 3D application specialist was able to process almost 400 bridges and keep up with the hectic pace of the field crew.

The quality control we had in place to check accuracy involved manually measuring the bridge height with a hand-held laser distance meter. The Riegl Z360 data with extracted measurements were compared to the manual field measurements with a typical accuracy of +/- 1/4 in.

3D Deliverables

To provide final viewable deliverables, we used LaserGen to create multiple 3D models at one time. The software eliminated most of the user involvement related to converting the data sets into models. LaserGen allowed the user to view point cloud data in a familiar MicroStation environment at NDOR as AutoCAD and MicroStation alone do not allow millions of 3D points to be displayed in an efficient manner.

When the project began, the NDOR did not realize the power of collecting millions of measurements at these bridge sites. During the project, periodic update meetings were held and the NDOR had a chance to view the 3D data in raw form. "The laser scanner collected data from every point on the roadway to every point on the bottom of the structure and provided a graphical view," commented Ellis Tompkins. "Though the project was used to implement an automated truck permit system, there are other uses for the data. For example, if a structure was damaged by a traffic accident or natural disaster, we can have an after-scan taken for comparison and determine the amount of change in the structure."

Conclusion

With raw field data amounting to 35 gigabytes and over 400 field sites, the project management aspect of this project was critical. After the conversion to PolyWorks and then to LaserGen, the final count was a massive 140 gigabytes of final data. In laymen's terms, this is enough data to fill four hard drives on today's average desktop computer.

3D scanning technology allowed LRA to accomplish this project by means of increased productivity. In planning ahead, we took the initiative to correctly manage this project in the beginning and eliminated any mistakes that could have resulted in lost revenue.

The NDOR project was one example of how 3D laser scanning technology was utilized, replacing traditional survey methods. Proper project planning, quality control procedures and project management skills play a vital role in the success of all scanning projects. By using previous experience and sourcing knowledgeable support, LRA was able to ensure a smooth project. We met and exceeded the NDOR's project requirements and were able to provide accurate deliverables within budget and on time.

October's Construction Meeting

Thanks to the Aaron Buettner for hosting last month's meeting. Terry Gibson with NDOR spoke about the future

Attendees of the October meeting :

Aaron Buettner	Derek Kowalski	Ray Moore
Terry Gibson	Matt Lindburg	Steve Nickel
Dave Johnson	Lindsey Madsen	Kristi Nohavec
Susan Jorrensen	Dan Mahrt	Deb Ohlinger
Steve Jorrensen	Marie Maly	Ed Prost
Steve Kathol	Thomas Marnik	Phil Rosshaelt
Sandi Keehn	Dave McIvor	Reed Schwartzkopf
Jeff Kopocis	Kendra McIvor	Will Sharp
Jeff Kortan	Dave Meier	Mark Stark
		Aaron Storo

Names listed above can be considered official documentation of attendance at the October meeting worth 1 PDH credit.

Check Out the Changes at NEASCE.ORG

The NE-ASCE Website has been redesigned to provide more timely and useful information. Upcoming Section Meeting information is accessible with a single click, along with a hotlink to the meeting RSVP contacts. In addition, Section and ASCE National News, an events Calendar, and the Current Newsletter are kept updated so you can stay on top of everything happening in the Section. Finally, a few pages have been added for the Younger Member Group and the Peck/Benak Engineering Achievement Scholarship, along with historical information, the Section's Governing Documents, current Executive Board, and Outside Links. Please visit often at www.neasce.org, and contact the Webmaster (**Rick Kaufmann**, webmaster@neasce.org or 402-330-2202) if you have comments or would like to submit items for web publication.