

Forensic Metrology – Surveying and Mapping at the Scene

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Forensic metrology is a measurement science that is familiar to security and law enforcement sectors. While many police and security forces rely on professional surveyors' expertise and traditional surveying technology to gather and record evidence at an accident or crime scene, more recently many investigators are using laser scanning technology to assist them in their forensic investigations.

In December of 2006, Paul Francis, O.L.S., O.L.I.P., President of Northway-Photomap Inc. was contacted by the Toronto Police Services' Forensic Identification Services

told was that FIS is nothing like CSI!

Greg Schofield has been with the Toronto Police Services for twenty-seven years and is the only civilian in the FIS unit who attends the crime scene. The maps, drawings and scale models that he produces are used during criminal trials to illustrate the scene for the judge and jury. Greg draws a complete sketch of the crime scene by hand. Measurements are usually taken with a Leica Disto or Sokkia Total Station. Features and evidence are referenced to local landmarks. To save time in making his sketches, Greg often goes to the City of Toronto mapping department for underlying plans of the crime scene area, which are accurate to within ± 20 cm.



Northway-Photomap Inc. used their laser scanner to capture the geometry of the skull.

(FIS) to assist in establishing the identity of a human skull that was found in the Eglinton Flats area of Toronto. The skull was scanned, and with the aid of specialized software from Northway-Photomap, a digital model of the skull was created. An expert from the University of Toronto was able to add facial features to produce an image of what the person may have looked like. Photographs were published but as of this writing, the person, unfortunately, remains unidentified.

Paul Francis wrote about this case in an article (*Surveyors Do What??*) published in the Summer 08 issue of the Ontario Professional Surveyor magazine. The article, which outlined some of Northway-Photomap's interesting projects, was on display at the AOLS booth at the Ontario Universities Fair in September. Greg Schofield, the Toronto Police Services Crime Scene Drafting Technician, happened to be attending the fair with his son and recognized the picture of the skull. After some discussion with Greg, I thought it would be interesting to visit the FIS to see how the police services were using mapping techniques and new scanning technologies to gather evidence for their crime scene investigations. We set up an interview at his office. One of the first things that I was



Greg Schofield (with his back to the camera) and his assistant measure the area where Tommy Vo was slain in 1995. Photo credit: Tony Bock/Toronto Star File Photo.

Greg's finished sketches look very similar to surveyors' field notes. A large-scale plan is often prepared from the notes for display during a trial.

A typical example of a case that Greg worked on is a homicide that occurred in 1995. Chang Thong Vo, better known as Tommy Vo, was shot to death on December 17, 1995 at 3:30 a.m. in the laneway outside of a popular late-night seafood restaurant in Toronto's east-end Chinatown. Greg went out the next day to map the scene. Greg and his assistant are shown in the photo from the Toronto Star. Figure 1 is a copy of one of the pages of field notes that he prepared at the scene. The

tion inside a building, a rolling truck on a rail line, or the standard surveyors tripod in the required locations."²² Greg says that the police would like to use scanners to gather and record evidence more often because of their higher accuracy and timesaving features, but it is not possible to bring in experts like Paul Francis for every case.

To further his knowledge and keep himself informed, Greg is also on the Board of Directors of the International Association of Forensic Security and Metrology (IAFSM), which includes members from many domestic and international police forces such as the FBI, the Secret Service, Scotland Yard, and equipment suppliers, such as Leica Geosystems, Trimble and Faro. Paul Francis is also a member. The goal of the association is to "act as a forum for the development and distribution of information, experience and best practices regarding technologies, techniques and research as applied to forensic and security metrology."²³

Greg Schofield and Paul Francis agree that the FBI leads the field in North America in the use of scanning technology. This is in part due to its access to funding and its readiness to aid other governmental agencies. When the Interstate 35W bridge collapsed in Minneapolis in 2007, FBI agents were

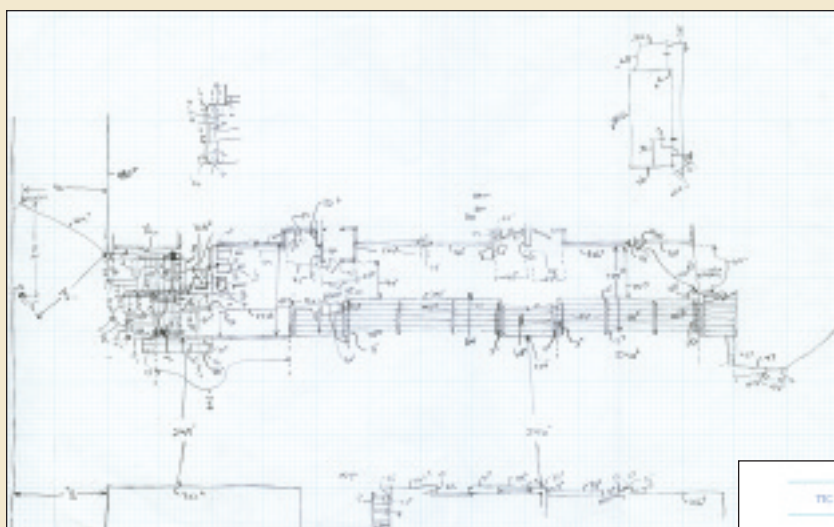


Figure 1 - Field Notes

hand-sketched notes show the details of the laneway in which the body was found. Figure 2 is the final plan, which includes the interior of the restaurant drawn with AutoCAD.

The Toronto Police Service uses traditional survey instruments, such as Total Stations, which are limited to locating one point at a time. During our interview, Greg pointed out that it takes him several hours to prepare his notes from a crime scene. The management of FIS recognizes that there are more efficient ways to capture data, and following Greg's advice, has contracted Paul Francis and Northway-Photomap Inc. to provide laser scans for high profile cases. Once such case was the scene of the Uptown Theatre collapse in downtown Toronto in 2003. At that scene, Paul and his team completed 18 scans and collected over 21 million data points to fully document the damaged buildings and surrounding area, thus saving Greg hours, if not days, of painstaking measuring and sketching.

According to Northway-Photomap's website, "Laser Scanning provides the ability to capture the existing conditions to a high degree of accuracy, and review the data multiple times for various uses"²¹. Using 3D laser scanners can dramatically improve efficiency over current survey methods and 3D physical models can be more compelling for juries than simple photographs. Northway-Photomap Inc. is also aware that each scene has unique conditions and therefore has developed many methods of capturing the data, including for example, "from an elevated position in the rear of a pickup truck, an elevated posi-

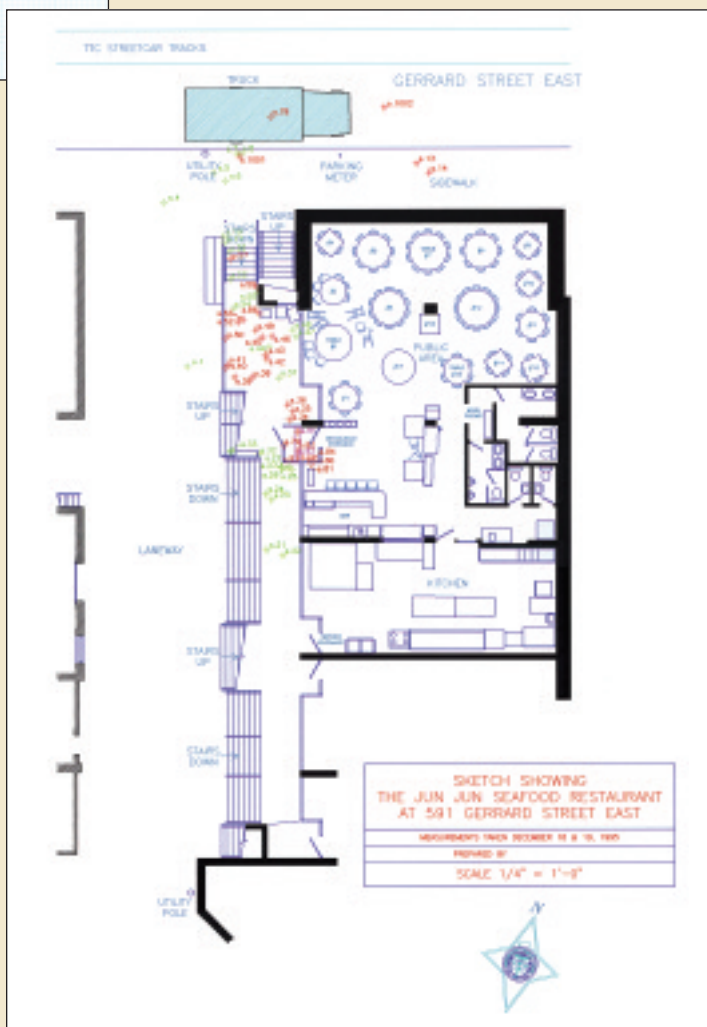


Figure 2 - Scene Plan

the first to be called in to determine if the collapse was the result of a criminal or terrorist act. Field teams were sent to create digital maps of the site using Total Stations and a 3D laser scanner. When it became clear that the collapse was due to a structural fault, the National Transportation Safety Board (NTSB) took the lead. The NTSB has an arrangement with the Evidence Response Team Unit at the FBI to dispatch specially trained agents to gather evidence in disasters.

The data collected on the I-35 bridge was analysed and sent to the NTSB where engineers married it with historical information about the bridge to build computer scenarios to help pinpoint the cause of the collapse. After the analysis of the data was complete, the NTSB ruled that the gusset plates on the bridge were not designed properly. It also found that the Minnesota Department of Transportation had not adequately overseen the bridge's design.

Scotland Yard is another leading organization that has used scanning technology in many high profile cases. Prior to the Diana, Princess of Wales Inquest, the tunnel where the accident occurred was scanned with lasers to create a 3D model to assist the coroner leading the inquest. According to the *Overview of The Operation Paget inquiry report into the allegation of conspiracy to murder*, which is posted on the Metropolitan Police - Scotland Yard website, during the investigation of Princess Diana's death, "a team of independent experts carried out what is believed to be the largest and most comprehensive survey and reconstruction of the

scene of an incident ever. We used the specialist skills of surveyors, photographers and computer modelers to collect data from 186 million points and reproduce the scene of the crash and surrounding area to within an accuracy of one centimetre."⁴

A scan of a skull, a homicide scene, a collapsed theatre, an auto accident; these are all examples of the many ways that police and security forces are using laser scanning technology to measure and document data for their forensic investigations. The resulting physical models and exhibits not only help investigators solve cases but also assist juries to make informed decisions. Is there a role for the professional surveyor in forensic metrology? Most definitely, as clearly demonstrated by the increasing frequency that the Toronto Police Services are relying on Paul Francis' expertise and his company's 3D laser scanners to survey and map the scene.

Thanks to Greg Schofield and Staff Inspector Stephen Harris of the Toronto Police Service for giving me the opportunity to visit the Forensic Identification Services to learn more about the fascinating field of forensic metrology.



¹ http://www.northway-photomap.com/services_lidar.php

² http://www.northway-photomap.com/services_lidar.php

³ <http://www.iafsm.com>

⁴ <http://www.met.police.uk/news/docs/OperationPagetOverview14Dec2006.pdf>, page 3.