A Unique Opportunity for Advancing Students' Surveying Skills - Advanced Field Surveys at York University

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Advanced Field Surveys (AFS) is the second practicum right after the third year of undergraduate studies within the curriculum of Geomatics Engineering and Earth Science at York University. It is a unique opportunity for undergraduate students to advance their practical surveying skills in high accuracy and high precision surveying based on the fundamental skills that they learned while doing topographic mapping and ordinary engineering surveying in the first practicum.

AFS is a fifteen-day course for three credits that is taken after the students have completed most of the essential surveying courses, which include; Fundamentals of Surveying, Field Surveys, Adjustment Calculus, Geodetic Surveys, Geodetic Concepts, Analysis of Overdetermined Systems, Photogrammetry, GIS and Spatial Analysis, etc. In this practicum, students can systematically be trained through their involvement in designing, planning, organizing, scheduling and practicing the logistical aspects of high accuracy and high precision surveying related to the establishment of control networks which are necessary for the deformation monitoring of engineering structures and other specialized industry surveying tasks.

The tasks in this practicum are divided into field work and office work. The former will include instrument testing, calibration and operation of geodetic GPS receivers, precise levels and 1" high end total station systems. Specifically for this practicum, the Engineering Laboratory at York University is equipped with a number of high end geodetic instruments, such as Leica TC1800 total station systems (1", 1mm+1ppm), Leica GPS 1200 receivers, Trimble R8 receivers, the Zeiss Ni002 precise level and the Trimble DiNi (0.7) digital level and quite a few commercial software packages, such as Leica GeoOffice, MicroSurvey, and GeoLab together with other free software, such as Columbus Best Fitting software, etc.

AFS has been offered to undergraduate students annually since 2004. Two field sites were developed for this practicum, the Algonquin Radio Observatory (ARO) in Algonquin Provincial Park and the Rexall Centre (Figure 1) in Toronto, respectively. These sites have allowed us to simulate a real life engineering environment for the students.

The ARO antenna reflector is 46m in diameter and the first 36.6m is made up of 0.364cm steel plates surrounded by 4.6m of steel mesh. The surface accuracy was designed to be 0.32cm for the solid portion and 0.64cm for the mesh. The antenna is surrounded by a high stability network made up of 13 concrete piers.

The ARO practicum site supported by Natural Resources Canada was used from 2004 to 2006. The objective of the practicum at ARO was to determine the position of about 130 sticker targets on the surface of the Very Long Baseline Interferometry (VLBI) antenna based on a high accuracy 3D engineering control network that was established, partially using the existing pillars equipped with the forced-centering system, and partially using the selected ground points marked by metal nails. The expected 3D positional accuracy of each control point was better than ±5mm (1σ). The Columbus Best Fitting software was used to rigorously adjust the GPS base-

Figure 1 The Rexall Centre

lines that were processed by Leica GeoOffice and the horizontal directions, vertical angles and slope distances that were observed by using Leica TC1800 total station systems. The 3D targets were observed by using Leica TC1800 total station systems. Students developed their own utility to process the measurements and estimate the 3D coordinates of the targets.

The Rexall Centre site has been used since 2006 and is partially sponsored by Tennis Canada. The stadium is a typical large scale sport facility with a capacity of 12,500 seats. The objective of the practicum at the Rexall Centre is to determine the position of about 70 targets which are distributed on its columns outside. In order to do so, two layers of geodetic control are required.

First a global 3D engineering control network is established between Steeles Ave. West and Shoreham Dr. east of Murray Ross Pkwy on York's Keele campus in Toronto. Second, a local 3D traverse surrounding the stadium of the Rexall Centre is used, from which all of the targets can be observed using the total station systems. The accuracy requirements for the geodetic control and targets are similar to those at the ARO site. However, on the campus, there is no concrete pier available. This makes it more difficult to reach the accuracy requirements. At this site, static GPS baseline observation, elevations determined from precise levelling and precise measurements using total stations are intensively applied in order to obtain the best possible accuracy.

In spite of the two different practicum sites, the common course objectives and tasks have been shared: project planning; design, preanalysis, field observation and adjustment of 3D engineering control networks; observation and 3D coordinate estimation of targets; and writing a project report. Strictly following the field operation procedures with different types of instruments, rigorously processing the measurements, professionally executing the project and preparing the final report are just a few of the valuable skills that students learn during this practicum.

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Kun Qian (left) and Julien Li-Chee-Ming (right) were performing a precise levelling exercise for their Rexall Centre project, York University, Keele Campus, May 2008.