

FEATURE ARTICLE

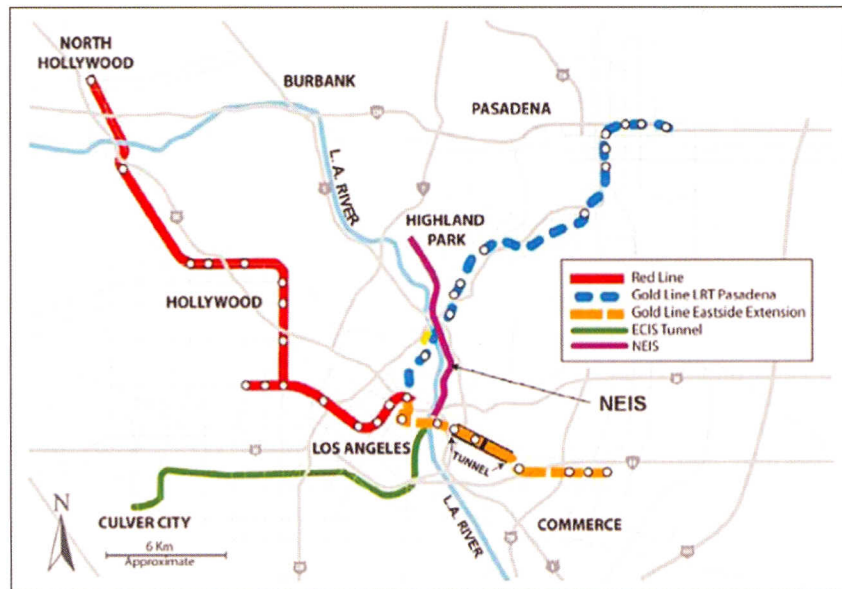
Los Angeles tunnels are expanded with help of TBM monitoring system

During the last 20 years, more than 80 km (50 miles) of tunnels have been constructed in the Los Angeles, CA area.

Recent projects include The East Central Interceptor Sewer (ECIS), completed in 2004. It spans more than 18 km (11 miles). The Northeast Interceptor Sewer (NEIS), completed in 2005, spans 11 km (7 miles). And the 2-km (1.3-mile) Metropolitan Transportation Authority's Gold Line Eastside Extension (MCGLEE) was completed in 2006.

All of the tunnel routes lay beneath heavily populated urban environments so minimizing ground surface settlement was critical to the success of the projects. Previous tunneling efforts in the Los Angeles area using open shield methods resulted in significant settlement that damaged roads, utilities, buildings and other structures. Earth pressure balance (EPB), or slurry machines, were specified for these projects to reduce subsidence risk. The contractors chose EPB tunnel boring machines (TBM) for the work. The closed and pressured face of the EPB TBM reduces loss of ground at the tunnel face and, when the machines are used in combination with gasketed pre-cast tunnel liners and backfill grout behind the installed segments, losses from over-cut

Map of tunnels under the greater Los Angeles, CA area.



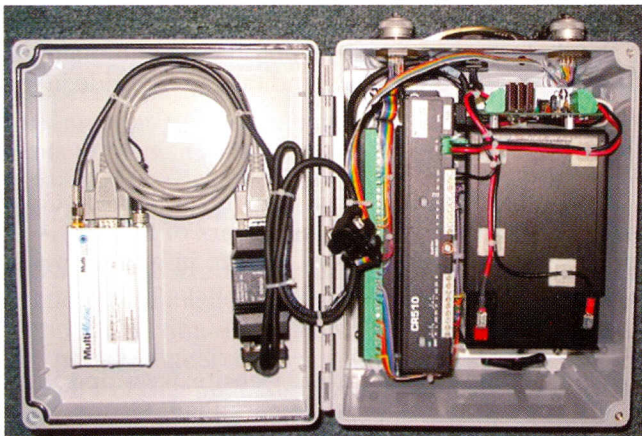
of the excavated surface are also reduced.

To monitor the specified maximum allowable settlements for all three contracts the projects included comprehensive settlement monitoring along the paths of the TBM's. This was accomplished using Multiple-Position Borehole Extensometers (MPBX's) with three anchors. The lower anchors were installed 1.5 m (5 ft) above the tunnel crown; surface anchors at 1.5 m (5 ft) below ground surfaces and middle anchors installed between upper and lower anchors. The MPBX's were installed at 15 m (50 ft) intervals in high-risk areas and at 75m (250 ft) intervals in lower-risk areas. Conventional survey of settlement points was also undertaken in conjunction with the automated monitoring to verify the data.

The three tunneling projects combined utilized approximately 360 MPBX's to monitor thousands of surface settlement points along the various routes. Most of the extensometers and survey points were installed/located at traffic lanes and streets. This allowed a definitive analysis of tunneling performance during the excavation process and provided for development of action plans in the event of subsidence exceeding approved limits.

The MPBX's were installed above ground to follow

Canary Systems CDMA cellular modem package.



the path of the TBM's underground. This required drilling and installation of manholes in high traffic urban areas to accommodate the extensometers, the head assembly with transducers and the data collection package.

The MPBX's were equipped with vibrating wire transducers to provide stable and highly reliable displacement measurements.

Canary Systems was tasked with the design and supply of the automated data acquisition platforms. During the course of working on all three projects, Canary Systems provided several versions of the automated data collection packages. The improvements were a reflection of advances in wireless communications. All three versions used a Campbell Scientific CR510 with power supply (to provide for up to three months of operation without charging) and sensor interface packaged to fit beside the extensometer head in the manholes. Field personnel would periodically

visit the manholes and collect data by connecting a portable data storage module that automatically collected data. The second version included a spread spectrum radio that allowed the field personnel to drive to the vicinity of the manhole and, with a base station radio attached to a personal computer, data were collected wirelessly. This provided a safer method of collecting data as most manholes were located in high-traffic areas. The last version included a CDMA cellular modem which provided for data collection from the contractors office.

Canary Systems also supplied its MultiLoggerDB software package with Insite client data access software for managing the systems and the data collection from all locations. With the CDMA equipped units, data collection and reporting was completely automated, thereby saving time and money and providing near real time monitoring. ■

UCA membership dues and you

How it works

Since UCA of SME was initiated in 2006, there has been some confusion about the UCA membership dues billing process. The following outlines the basic billing process for each type of UCA membership.

There are two basic types of membership; Individual and Corporate/Sustaining. Which type of membership you hold determines the particulars of your dues bill.

Individual dues

Annual dues for individual members of UCA are \$130 for the year 2008. The first billing is sent in September for the coming year. All individual members of UCA are sent a dues bill through traditional mail. The dues bill has the UCA of SME logo on the top along with the header, "This is Your 2008 Membership Card." The dues bill itemizes your charges and any credits or debits you may have. It also allows you to change your address and other demographic particulars.

Along with the bill, you will receive a wallet-size membership card with your UCA member number. Members may choose to pay their dues online or by traditional mail in a pre-addressed return envelope.

Many members of UCA are also members of the International Tunneling Association (ITA). For those UCA members that are also ITA members, the first UCA dues bill includes ITA dues. This will be itemized on the bill.

It is important to note that members of UCA are not automatically members of ITA. However, an individual must be a member of UCA to be a member of ITA. ITA is a separate association with distinct benefits, procedures and fees. A link to the ITA Web site can be found at the UCA Web site at www.uca.smenet.org.

If the individual member does not pay the first bill, he/she will receive another in mid-October. The final dues bill is mailed in late November. If membership dues are still not paid after the third billing, the mem-

ber's December issue of *Mining Engineering* magazine will include a false cover stating that the December issue will be their last until dues are paid.

Corporate/sustaining dues

UCA corporate/sustaining memberships are available to any company in the tunneling business.

A corporate membership is \$750 and includes two complimentary individual memberships.

A sustaining membership costs \$1,500 and includes five complimentary individual memberships.

The two or five complimentary individuals are identified by the official company contact as the individuals holding the complimentary memberships. Although your company may have a corporate/sustaining membership, you may or may not hold one of the complimentary memberships. If you are not one of the complimentary members, you are not a member of UCA unless you purchase and individual membership.

Corporate/sustaining membership renewal notices are sent only to the official company contact on record. The complimentary individual members do not receive a dues bill of any kind. The renewal notice indicates which individuals are included in the company's complimentary allotment and provides the opportunity to change or update that information. The official company contact does not need to be one of the complimentary individual members.

The bottom line

If you receive a UCA of SME dues bill, you are on record with UCA as an individual member and responding to that bill continues your membership into the next calendar year. If you have questions regarding your dues bill, please contact us at: membership@smenet.org, 303-973-9550. Thank you for your continuing support of UCA of SME. ■