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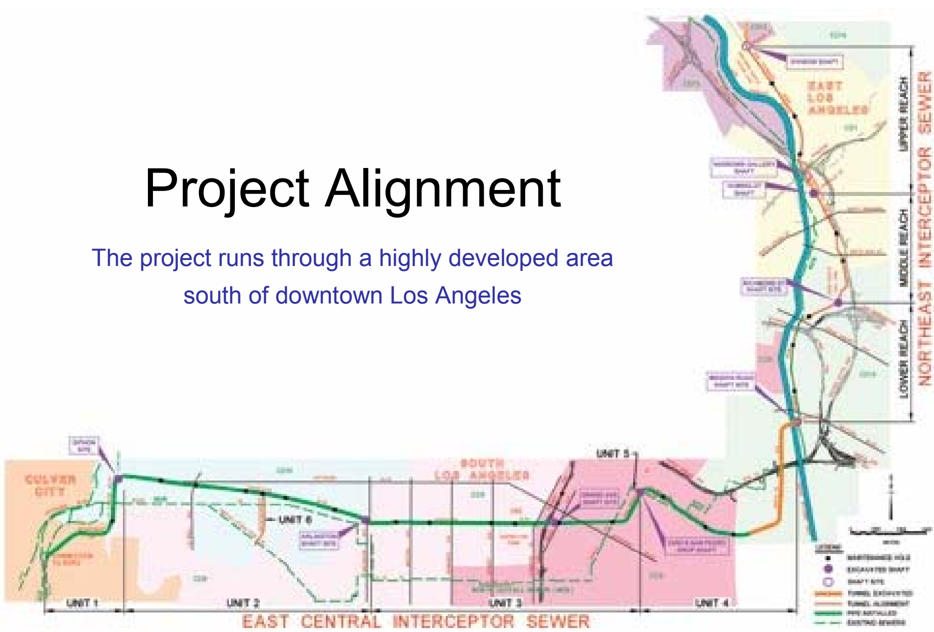
ECIS and NEIS

- The East Central Interceptor Sewer (ECIS) was a tunnel construction project for the City of Los Angeles comprising 11.4 miles of 11-ft finished diameter sewer winding through the City's south side.
- The Northeast Interceptor Sewer (NEIS) project consists of an approximately 8.5 kilometer long sewer system that extend from the termination point of the ECIS just east of the Los Angeles River.

Project Alignment

The project runs through a highly developed area
south of downtown Los Angeles



Project Need

- Both projects will relieve the aging existing sewer system, which was constructed between 1924 and 1930. The system has been strained by structural defects resulting from corrosion, as well as by population growth that has transformed the region over the last 70 years.
- Number of sewer overflows resulting from the El Nino storms of 1997-98 that required the construction of new sewers to provide additional capacity.

Tunneling method

The City specified the use of new earth-pressure balance (EPB) tunnel boring machines (TBM). EPBs are typically used in soft ground applications, but due to highly publicized incidents involving ground settlement in previous tunneling operations in Los Angeles, the City opted for the EPB method due to its ability to minimize the risk of ground loss.

Tunneling procedures

Seven major shafts were built
first at different locations.

TBM

TBMs were lowered into the shafts where they started digging the tunnel.

Dirt was moved to each shaft location by muck trains and then was brought up to the surface for disposal.

Constructing the tunnel

- Approximately 100 feet was dug during a typical work day.
- Precast concrete tubes were installed.

Challenges

Despite continual advancements in technology, no one can be exactly sure of the actual subsurface conditions or how the ground will behave once excavated. An increasingly dense maze of existing structures -- both on the surface and underground -- make tunnel construction even more difficult.

Issues

- There was intense media scrutiny during the construction of the MTA lines with much negative press on ground surface settlement, sinkholes, damage to residences and businesses, noise and vibration issues, and disruption to traffic flow.
- The project was constructed in soft ground conditions in primarily alluvial soil conditions.
- To minimize any significant damage to any structure or utilities during construction, minimum allowable action levels were established.

Vibration

Performance specifications were written to limit the vibration caused by tunnel boring machines and muck trains. Various mitigation measures were used to limit the vibration including:

- Straight rail and smooth curved rail;
- Used isolators such as wood ties or resilient pads between the rail and the concrete segment.
- Eliminated gaps between adjacent rail sections;
- Offset rail splices by three to four feet;
- Maintained the wheel roundness on the muck train wheels.

Vibration Limits

Ground vibration on the surface at the nearest affected building was

ECIS

- TBM and microtunneling equipment – 0.508 mm/s
- Muck Trains – 0.254 mm/s

NEIS

- TBM and microtunneling equipment
  Day time – 2 mm/s, Night time – 0.5 mm/s
- Muck Trains
  Day time – 1 mm/s, Night time – 0.4 mm/s

Vibration Monitoring

- Monitoring was required for a minimum of 8 hours per week for each TBM and 8 hours per week for each muck train.
- In average, 24 hours of vibration monitoring was conducted every week.
- Weekly reports were submitted to city.

Noise

- A performance specification was prepared which specified maximum construction daytime and nighttime limits for each worksite.
- A maximum nighttime noise limit at a fixed distance of 50 feet was established for each piece of construction equipment used between the hours of 10 p.m. and 7 a.m.
- Acoustical enclosures were required for all cranes, compressors, pumps, and generators.
- Use of strobe lights or flag persons was required during evening hours to silence the back-up alarms
- Deliveries to and from the worksites were restricted to daytime hours
- Precast concrete or removing of concrete from precast forms were prohibited at worksites.

Soundwalls

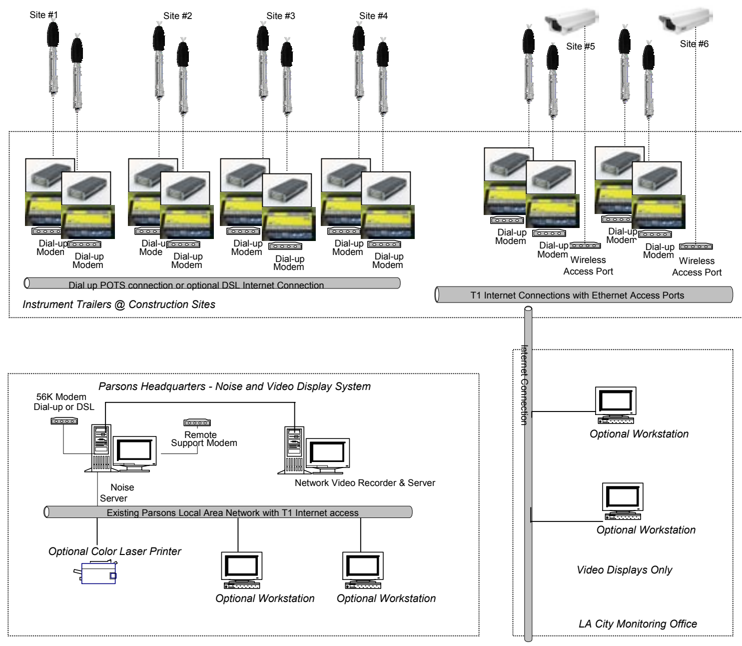
30 feet high soundwalls were constructed around shaft sites when there were noise sensitive receptors

Soundwalls

The soundwalls were constructed of fiberglass filled acoustical curtains with a minimum STC rating of 25, and a minimum NRC rating of 0.15.

Noise Monitoring

- Long-term, continuous, 24-hour noise measurements were conducted at eight construction access/work areas while work was being conducted.
- Noise and audio levels were recorded at each location.
- Video monitoring was conducted at two location.



Los Angeles Construction Site Noise and Video Monitoring System

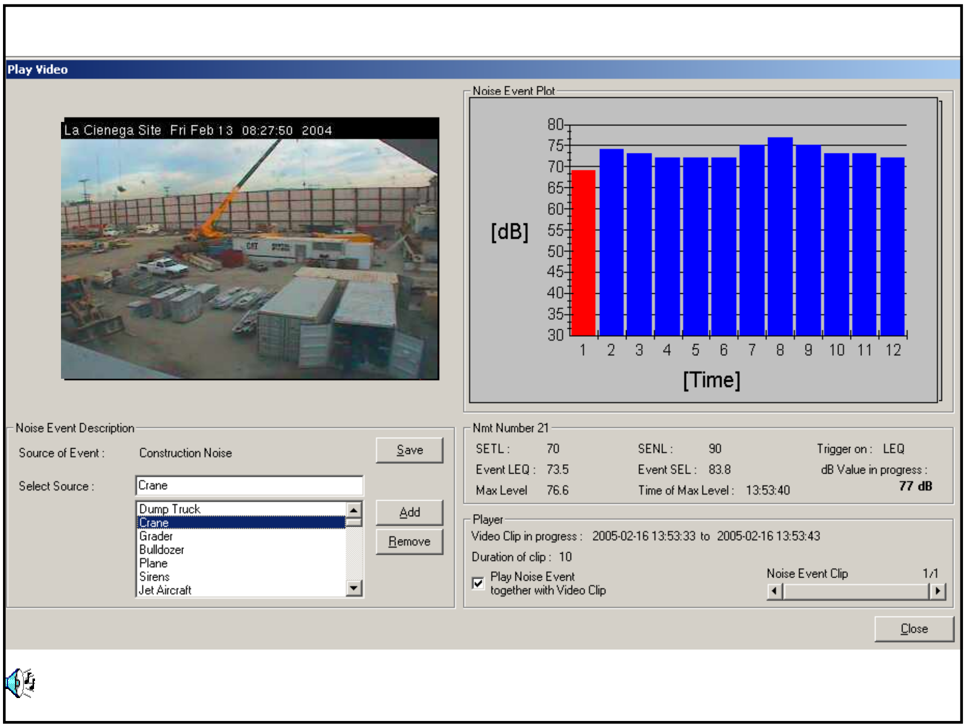
Noise Monitoring System

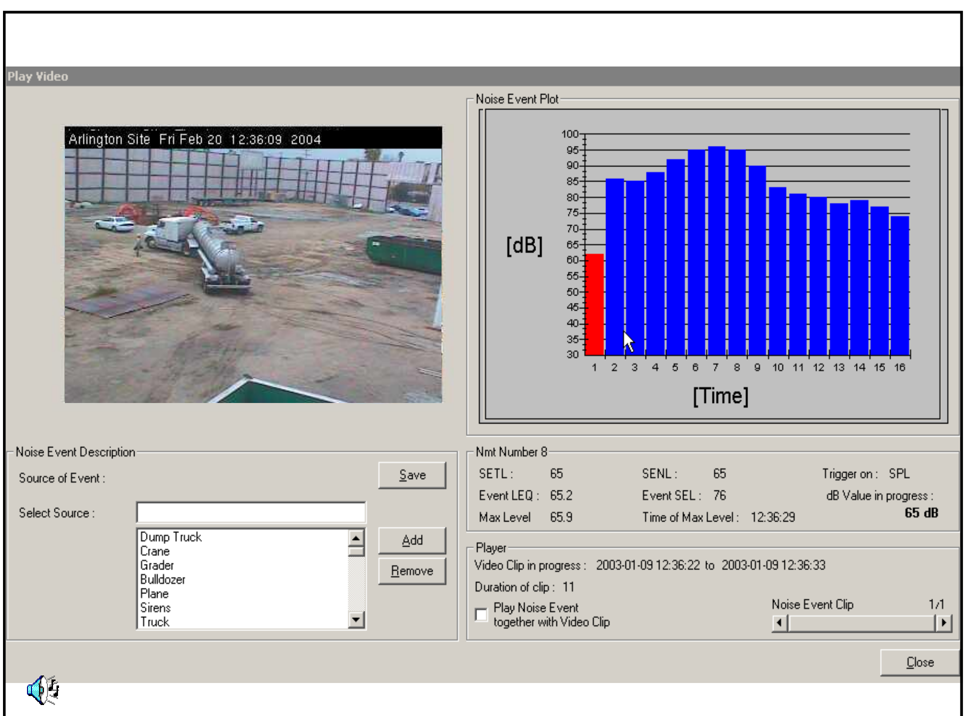
Each noise monitoring costs approximately $15,000 plus the central computer system

Noise Limits

- L_{eq} and L_{max} limits were established for each site for daytime and nighttime
- L_{eq} limits were from 55 to 75 dBA
- L_{max} limits were from 60 to 85 dBA

City could fine each noise violation and/or stop the construction work.


Play Video
La Cienega Site Fri Feb 13 08:27:50 2004
Noise Event Plot
[dB]
[Time]
80
75
70
65
60
55
50
45
40
35
30
1 2 3 4 5 6 7 8 9 10 11 12
Noise Event Description
Source of Event : Construction Noise
Save
Select Source : Crane
Dump Truck
Crane
Grader
Bulldozer
Plane
Sirens
Jet Aircraft
Add
Remove
Nmt Number 21
SETL : 70
SENL : 90
Trigger on : LEQ
Event LEQ : 73.5
Event SEL : 83.8
dB Value in progress :
Max Level 76.6
Time of Max Level : 13:53:40
77 dB
Player
Video Clip in progress : 2005-02-16 13:53:33 to 2005-02-16 13:53:43
Duration of clip : 10
Play Noise Event together with Video Clip
Noise Event Clip 1/1
Close


Play Video
Arlington Site Fri Feb 20 12:36:09 2004
Noise Event Plot
[dB]
[Time]
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Noise Event Description
Source of Event :
Save
Select Source :
Dump Truck
Crane
Grader
Bulldozer
Plane
Sirens
Truck
Add
Remove
Nmt Number 8
SETL : 65
SENL : 65
Trigger on : SPL
Event LEQ : 65.2
Event SEL : 76
dB Value in progress :
Max Level 65.9
Time of Max Level : 12:36:29
65 dB
Player
Video Clip in progress : 2003-01-09 12:36:22 to 2003-01-09 12:36:33
Duration of clip : 11
Play Noise Event together with Video Clip
Noise Event Clip 1/1
Close

Results of Measurements

- Measurements were conducted for four years.
- Each month close to hundred audio files were listen and identified.
- Weekly L_{eq} and L_{max} graphs were prepared for each site.
- No violation was recorded during both projects.

Conclusions

This remote continuous noise monitoring system can save substantial amount of fine and work stoppage due to the high noise levels by proofing that high noise levels are not from construction activities