Using Automated UT at San Francisco's New Airport Terminal

Using automated ultrasonic testing in a one-of-a-kind situation proves beneficial

BY EDWARD KING

Imagine arriving for your first visit to the United States at the new San Francisco International Airport (SFIA). You step into the new international terminal with its 83-ft-high ceilings and skylights held aloft by giant football-shaped trusses spanning 840 ft in overall length — Fig. 1. The west window wall alone is 700 ft long and more than 80 ft tall. The effect of natural light from the combination of the huge window wall and roof skylights is totally stunning. You find yourself completely mesmerized, taking in the power and grace of the roof structure 80 to 90 ft above. Is this an airport or a cathedral?

A project such as the new San Francisco International Airport comes around only once in a lifetime. Imagine the ingenuity, foresight and persistence it takes to build a $2.4-billion international terminal directly over an eight-lane thoroughfare into an existing, major airport. It sounds crazy and incredible, but the project appears to be shaping up as a huge success for the City and County of San Francisco.

Using a Local Firm for the Project

We at Inspection Services, Inc., have been fortunate enough to have grown along with the expansion of SFIA. This fantastic opportunity has arisen directly from the airport's policy of supporting small, local firms with diverse backgrounds. SFIA is persistent in making sure women- and minority-owned businesses are represented in the construction services process.

One of our major responsibilities at the international terminal was to perform independent welding inspection and testing of the long span trusses, also known as football trusses, because of their enormous football-like shape.

We were presented with the following issue and asked whether we could devise a workable solution.

The new international terminal's roof structure is to be supported by large-diameter (12–14 in.), heavy-walled (2.5-in.-thick) pipe trusses that support a clear span roof structure of more than 800 ft, approximately 80–90 ft above the new main terminal entrance. The trusses have about 140 critical field splices to be performed on scaffolding directly above the existing eight-lane thoroughfare into the airport terminal.

The project's structural engineer was extremely concerned about the contractor's ability to perform these critical field welds and had requested 100% radiographic testing of the field splices. Radiographic testing on this diameter (12–14 in.) and wall thickness (2.5 in.) of pipe can be performed (to our knowledge) only with a high-energy-type source such as cobalt radiation. Cobalt radiation and similar sources require a clear working space of 150 ft in all directions during testing. To provide safe working space, the main roadway into SFIA would need to be shut down for as long as six to eight hours every night, for as many as 10–12 weeks.

Even if the main roadway could be rerouted, what effect would the high-intensity radiation have on the air traffic control tower and several other 24-hour operations working in the vicinity?

The structural engineer was adamant we have a permanent record of critical welds. If a seismic event

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occurred in the area, he wanted to be able to retest the critical field welds and compare them with documents compiled during the original construction.

Fig. 1 — The football-shaped trusses at San Francisco International Airport.

A Different Approach

Our lead inspector on the project, John Lowengart, had several years of experience in the nuclear power industry with automated ultrasonic testing (UT), and he recommended the process as a viable alternative to radiography. New equipment generated from advances in microchip technology has changed the automated UT industry. Automated ultrasonic units, which had previously been large and wieldy and had cost more than $500,000, could now be purchased for $50,000–$75,000. Now compact and transportable, these new units looked much like an average portable computer connected to an ultrasonic transducer. Automated UT could also provide SFIA with a permanent record of all ultrasonic scans by saving them to writable CD-ROM discs for future use.

Lowengart was familiar with a local manufacturer of automated ultrasonic units in Martinez, Calif., called Automated Inspection Systems (AIS), and he set up an appointment for a demonstration.

The biggest plus for automated UT was there is no safety hazard involved.

The company's units had been used in the United States, Brazil, Canada and Asia primarily for pipe walls. Their automated unit had proven its ability to outperform radiography on several fronts. Advantages included the following:

- Results were nearly immediate, so welds were tested within minutes after completion.
- Repairs could be performed and retested again with nearly immediate results.
- Sensitivity of ultrasonics has proven much more reliable in that radiographic testing can easily miss critical cracks and incomplete fusion, resulting from improper welding procedures. These cracks will not show up in the plan view created by radiographic testing, but they are easily detected with shear-wave ultrasonics.
- Costs are comparable for both methods.
- Automated UT scans can be saved on a writable CD-ROM disc that never wears out, as opposed to radiographic film that typically has a life of 10 to 15 years.
- Clients can hire their own ultrasonic technician to review and comment on ultrasonic data of the welds. If needed, this can be done from a distant location.

The largest plus for automated UT, particularly at SFIA was there is no safety hazard involved as with the use of a radiographic source.

The downside of presenting automated ultrasonic testing was that, to our knowledge, this technology had never previously been performed in structural steel construction testing services.

The Presentation

With the support of AIS and a joint-venture partner, we set up a presentation for the project's structural engineer and the construction management group, SFO Associates. The presentation was performed for a large group that included a portion of the structural steel inspection staff involved with testing and inspection at the site, many of whom were familiar with automated UT in other industries.

When we discussed the implications to airport operations of using high-intensity radiography (requiring 150 ft clear working space) at the project site, the room become extremely quiet; you could have heard a pin drop. Obviously, this group was well attuned to the operational and management nightmares they would encounter while using radiography in this sensitive area.

Our presentation was successful in having our joint venture awarded a contract for testing 144 field splices of the roof trusses with automated UT. Our success, in my mind, was not due to our performance at the presentation but a direct result of the circumstances brought on by SFIA's extremely aggressive international terminal plan.

Imagine building a $2.4-billion terminal directly over an eight lane highway. And what is even more amazing is that they are almost complete — apparently on time.

A True Gateway

Standing inside San Francisco's new international terminal is an experience that mere photographs cannot possibly hope to capture. You must be there to appreciate the shear magnitude of structural design intertwined with the graceful architectural use of light and space. The new terminal structure is truly worthy of San Francisco's claim to being "America's Gateway to the Pacific," and it is a true joy to experience in person. ❖