Titanium Pedestrian Bridge Design Competition

By:

Charles Clark, Executive Director, DMTC
Ted Curtis, VP of Capital Planning, University of Akron
Michael Trzcinski, Senior Technical Consultant, DMTC

Special Advisors:

Gary Nemchock, President, Architectural Titanium
Stan Seagle, Consultant

International Titanium Association
Orlando, Fl  October 3-6, 2010
Titanium Pedestrian Bridge Design Competition

Background

The United States Congress created the Defense Metals Technology Center (DMTC) in 2007 as a U.S. Army Center of Excellence and headquartered it on the campus of Stark State College in North Canton, Ohio, down the road from the Pro Football Hall of Fame. North Canton is in the middle of what the DMTC calls America’s Metals Heartland, where the nation’s metals industry traditionally has been strongest.

The DMTC is working conscientiously to fulfill the envisioned mission of its supervisors at U.S. Army Armament Research Development and Engineering Center (ARDEC) at the Picatinny Arsenal in New Jersey. That mission is to serve as an honest broker among the nation’s industrial, academic, and military sectors in fostering the development of innovative cost-saving techniques for the advancement of strategic metals’ production – particularly titanium – in America’s Metals Heartland and throughout the country.

The DMTC has taken on numerous projects, including supporting internships at the Picatinny Arsenal for engineering students interested in working with specialty metals, such as titanium.

Throughout 2009 and 2010, the DMTC sponsored a unique and innovative Design Competition for university architecture, engineering, and industrial design students to devise the world’s first bridge comprised entirely of titanium.

It has been the determination of the DMTC to demonstrate to titanium producers, the military, and the American public the amazing and versatile applications of titanium. The DMTC hopes that the resulting publicity will help drive down the cost of titanium, and thus help the military to use titanium increasingly in life-saving armaments.

Co-sponsored with the University of Akron, the Design Competition has garnered extraordinary worldwide attention on the Internet, as well as from newspapers and trade publications, explaining the attractiveness and benefits of titanium.
The History

Quaker Oats built a storage facility in 1936 and until 1970, stored grain in its silos, which was delivered by rail. In the late 1970s, the 36 silos – each 120 feet high and 24 feet in diameter – were converted into Quaker Square, enclosing a Hilton Hotel, along with a retail/restaurant complex.

As part of its continuing investment in the revitalization of the surrounding neighborhood, The University of Akron in 2006 purchased Quaker Square (by then a Crowne Center Hotel), and converted 100 of the hotel rooms into student dormitory space. The remaining hotel rooms are now known as the Quaker Square Inn at The University of Akron. From the Inn, one can look across the CSX tracks to the Main Campus, including the University’s celebrated E.J. Thomas Performing Arts Hall.

The idea of Quaker Square came from Ted Curtis. Curtis envisioned a complex in Akron much like Ghirardelli Square in San Francisco – a modern retail adaptation of an abandoned industrial complex. He brought in such prominent investors as movie stars Gregory Peck and Karl Malden, and comedian Flip Wilson. Quaker Square is listed in the National Register of Historic Places.

A New Challenge

The new dormitory housed in Quaker Square Inn has required students to walk several hundred yards south or east to conventional street bridges to access the main campus. More audacious Quaker Square residents jump a wire fence, dash down a gully, and scurry across the tracks. With numerous trains speeding by daily, this contrivance is hazardous – and is a growing concern to the University and CSX.

Charles Clark, Executive Director of DMTC, and Ted Curtis came up with the idea of a design competition for an all-titanium pedestrian bridge. The competition would offer a venue for DMTC to pursue its mission, and at the same time create an opportunity to meet a need for The University of Akron.
The Design Requirements

A practical objective is solving a logistical dilemma: designing a pedestrian bridge linking one side of the campus to another across busy tracks.

For the Design Competition, it was required that all components of the bridge must be made of titanium, including rebar and fasteners; the titanium must be obtainable from American manufacturers; the bridge must have state-of-the-art accessibility; and it must be practical, feasible and affordable, with aesthetic attributes.

The proposed entrance to the bridge would be in a parking lot near the Olson Research Center on the east side of the campus. The opposite entrance would be from the second floor of the hotel.

On the Quaker Square side, the Bridge Design that could address this logistical challenge would need an entrance/exit on the second-floor interior of the Inn. The bridge also would require a separate entrance/exit at the exterior ground-level parking area of the Inn, which would easily be accessed by a pedestrian ramp. To link to the Main Campus – the east side of the University – the bridge (some 200 feet in length) should be designed to slope appropriately across the tracks into an open parking area.

Other consideration required for the design included CSX regulatory requirements and ADA (Americans with Disability Act) requirements.
Figure 2. The view of the Quaker Square Inn as viewed from the main campus

Figure 3. The entranceway of Quaker Square
Figure 4. The area over the railroad tracks from Quaker Square Inn

The Contest

Awards: As an incentive for the design competition, the DMTC offered scholarship money to students on the First and Second Place teams and three Honorable Mention teams. Likewise, it offered grants to the winning institutions for the study of specialty metals, including titanium, in commercial applications.

<table>
<thead>
<tr>
<th>Category</th>
<th>Award per Student</th>
<th>Award per University</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Place</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Second Place</td>
<td>3,250</td>
<td>3,250</td>
</tr>
<tr>
<td>First Honorable Mention</td>
<td>1,750</td>
<td>1,750</td>
</tr>
<tr>
<td>Second Honorable Mention</td>
<td>1,250</td>
<td>1,250</td>
</tr>
<tr>
<td>Third Honorable Mention</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Invitations were extended to 58 departments at 43 universities. These included:

- 15 Architectural Design departments
- 31 Civil Engineering departments
- 12 Industrial Design departments

17 schools submitted applications, 10 schools submitted designs and 5 teams from 4 schools won awards.

**Judges for Competition:** On the blue-ribbon panel were retired Ohio Congressman Ralph Regula, who helped shepherd the legislation through Congress to create the DMTC; Victor J. Scaravilli, chairman and CEO of Mole Constructors, Inc., an international tunnel builder; Lillian A. Kuri, Program Director of Architecture, Urban Design and Sustainable Development for the Cleveland Foundation; Leila L. Vespoli, Executive Vice President and General Counsel of First Energy Corporation; Job J. Lippincott, Publisher of Rubberworld Magazine, Paul Thomarios, President, Thomarios Companies, a national construction company; and Jeffrey Spangler, Principal, R.E. Warner & Associates, a Cleveland engineering firm.

Gary Nemchock, president of Architectural Titanium, which exclusively designs projects using titanium, served as an advisor to the judges.

Judges announced the five winners at a dinner and awards ceremony in May, 2010 at Infocision Stadium, the new University of Akron Football complex. Guests included Akron Mayor Don Plusquellic and University of Akron President Luis Proenza.

The University of Akron Blue Team won First Place, while judges chose Ball State of Indiana for Second Place. First Honorable Mention went to the University of Akron Gold Team. Second Honorable Mention was Kent State University, and Third Honorable Mention was Miami University of Ohio.
First Place Winner of Competition – The University of Akron Blue Team

Figure 5. First Place Team Members: Donna Orellana, Brett Klinger, Brian McGannon, and Mark Andrasik. Each will receive $5,000 to apply toward their tuition. The university also will receive $5,000.

Figures 6 and 7. First Place Bridge Design

The University of Akron’s Blue Team won First Place in the Design Competition. The team carefully considered access at the east side and at the west side (Quaker Square), practical cross-sectional dimensions for the walkway, CSX regulatory requirements, ADA requirements, aesthetics, current state of the art, and symbolic expression of their designs. The team finalized their structural systems by drawing inspiration from some of the existing cable-stayed bridges.

Additionally, the team performed structural analysis using SAP, and completed their designs based on AASHTO, OBBC, ASCE-07, ACI and AISC specifications to size the bridge components, including foundations. The teams developed a complete set of construction drawings, 3D renderings in AutoCAD and SolidWorks, construction specifications and detailed cost estimates.

The Blue Team presented a cable-stayed design with two main spans of 115 ft. and 135 ft. with an AFrame support tower of 63 ft. in height. Recognizing the importance of aesthetics of this symbolic landmark bridge, the team developed a system of titanium skin patterns that are placed outside the glass enclosure to create a “peeling” effect. Blue and yellow LED lights were placed at different angles to the skin to reflect
off the peeling titanium and to create a dynamic visual effect. The team utilized stairwells with titanium curtain walls on the east and west ends of the bridge to add an artistic flare to the overall design.

**Second Place Winner of Competition – Ball State University**

Figure 7: Second Place Winner - Ball State University

Figure 8. Ball State University won Second Place. Team members include David Kane, Xavier Colon, Adam Buente and Paul Lindsay. Each won $3,250 toward their education, and the school also received that amount.

Figure 9: First Honorable Mention - The University of Akron – Gold Team
Figure 8: Second Honorable Mention - Kent State University

Figure 9: Third Honorable Mention - Miami University
Summary

The Bridge Design Competition communicated the awareness and generated interest of titanium to engineering and design students, faculty and industry. The technical benefits of titanium as well as available resources, such as the ITA, were conveyed as well. Five teams from four schools received awards and the competition engaged political representation to elevate the needs of the U.S. Army and industry.

Defense Metals Technology Center
6200 Frank Ave. NW
North Canton, Ohio 44720

330-305-6605
www.defensemetals.org
Titanium Pedestrian Bridge Design Competition

By: Charles Clark, Executive Director, Defense Metals Technology Center (DMTC)
Ted Curtis, VP of Capital Planning, University of Akron
Michael Trzcinski, Senior Technical Consultant, DMTC

Special Advisors
Gary Nemchock, President, Architectural Titanium
Stan Seagle, Consultant

International Titanium Association
Orlando, Fl
October 3-6, 2010
Defense Metals Technology Center

DMTC was founded in 2007 to help establish an industrial base capable of affordably producing strategic metals necessary for national defense.
Purpose of Competition

1. To demonstrate the attributes of titanium for use in bridges and increase awareness for new uses of titanium:
   • Industry
   • Academia
   • Political Representatives
1. Growth of enrollment, campus and purchase of Quaker Square
   
   • 1936: Quaker Oaks Mill Complex built. 36 silos (120’ high x 24’ diameter)
   • Late 1970s’: Converted to a Hilton Hotel
   • 2006: Converted to a 100-room dormitory
2. Location of dormitory requires students to walk several hundred yards south or east to access conventional bridges to reach parts of the campus.

3. To take a shorter route, some students jump a wire fence, dash down a gully and scurry across railroad tracks.
A practical objective is solving a logistical dilemma

Design a pedestrian bridge linking one side of the campus to another across busy railroad tracks.
View Facing Quaker Square
Interface Point of Bridge & Quaker Square
Direction of Bridge from Quaker Square
Critical Stipulations for the Bridge Design

1. All components of the bridge must be made from titanium, including rebar and fasteners.
2. The titanium must be provided by American manufacturers.
3. State-of-the-art accessibility must be built into the design and meet ADA specifications.
4. The Bridge Design must be practical, feasible and affordable, with aesthetic attributes which will make it a campus and community landmark.
Participation

Invitations were extended to 58 university departments.

43 Universities comprised of:
   15 Architectural Design departments
   31 Civil Engineering departments
   12 Industrial Design departments

Of those....
   17 schools submitted applications
   10 schools submitted designs
   5 teams from 4 schools won awards
Participation - continued

Oct 29\textsuperscript{th}, 2009 – Site Visit
75 attendees comprised of judges, speakers, students and advisors
50 students attended the orientation meeting on this date

May 20\textsuperscript{th}, 2010 – Awards
162 attendees of judges, speakers, students, advisors and guests
Articles Published in numerous journals and newspapers
First Place Winner – University of Akron Blue Team
The University of Akron Blue Team Design

- Cable-stayed design with two main spans of 115 ft. and 135 ft., with an A-frame support tower of 63 ft. in height; Inspiration from some of the existing cable-stayed bridges and arch bridges
- Titanium skin patterns that are placed outside the glass enclosure create a “peeling” effect.
- Blue and yellow LED lights were placed at different angles to the skin to reflect off the peeling titanium and to create a dynamic visual effect.
- Titanium curtain walls on the east and west ends of the bridge add an artistic flare to the overall design.
The University of Akron Blue Team Design (continued)

- CSX regulatory requirements
- Americans with Disability Act requirements
- Structural analysis using SAP
- Designs based on AASHTO, OBBC, ASCE-07, ACI and AISC specifications to size the bridge components including foundations
- Developed a complete set of construction drawings, 3D renderings in AutoCAD and SolidWorks, construction specifications and detailed cost estimates
Second Place Winner – Ball State University
First Honorable Mention – Univ. of Akron, Gold Team
Second Honorable Mention – Kent State University
Third Honorable Mention – Miami University
## AWARDS

<table>
<thead>
<tr>
<th>Category</th>
<th>Award per Student</th>
<th>Award per University</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Place</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Second Place</td>
<td>3,250</td>
<td>3,250</td>
</tr>
<tr>
<td>First Honorable Mention</td>
<td>1,750</td>
<td>1,750</td>
</tr>
<tr>
<td>Second Honorable Mention</td>
<td>1,250</td>
<td>1,250</td>
</tr>
<tr>
<td>Third Honorable Mention</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Thank You

Questions?