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STEEL BRIDGE COMPETITIONS: A CASE OF HANDS-ON STRUCTURAL STEEL EDUCATION

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ABSTRACT

Each year since 2007, the steel bridge building competition "Design and Construct" is organized by the Construction Club of Boğaziçi University and is open to the undergraduate or graduate students enrolled in civil engineering and architecture programmes in Turkey and abroad. The competition provides an opportunity for students to have a comprehensive hands-on practice of the steel design process from conceptual design to fabrication and assembly in a team setting. Another important aspect of the competition is that it provides to present their work to a jury of steel design professionals and to other teams from various countries and universities. This paper presents the experience of Department of Civil Engineering of Istanbul Kültür University who participated at the competition every year with a number of teams since 2007 and outlines the benefits and opportunities of this hands on learning opportunity for students.

Key Words: Steel Design, Steel Education, Hands on instruction.

INTRODUCTION

Student competitions provide excellent opportunities for the students of civil engineering to put their theoretical knowledge acquired from lectures into test on a small-scale engineering design task such as the design and construction of a concrete canoe or a steel bridge. These competitions are annualy hosted by universities and sponsored by construction companies and relevant engineering institutions such as the American Society of Civil Engineers (ASCE) and the American Institute of Steel Construction (AISC) (American Institue of Steel Construction [AISC], 2013a). The organizing committee provides a set of criteria and constraints regarding the design, fabrication, erection and evaluation of the design product. Students may enter these competitions in teams and submit their designs according to the rules and the time table set forth by the organizing committee. Student teams are fully responsible for the design as well as the coordination of fabrication and erection processes.

Steel bridge competitions are perhaps one of the most popular and sensational student competitions in the field of civil engineering. The origins of the steel bridge student competition in United States of America go back as early as 1987 and the competiton became a nation wide event since 1992, sponsored by the American Society of Civil Engineers and American Institute of Steel Construction (AISC, 2013b). The success of the ASCE/AISC steel bridge competiton led to the spread of this event in other parts of the world. Some of the international examples of these student steel bridge competitions include "Design&Construct (DECO) Steel Bridge Competition" in Turkey, "Wroclaw Student Steel Bridge Contest" in Poland, "Japan Steel Bridge Competition" and BRICOM Asia (Student Organization Active Builders, 2013), (Japan Steel Bridge Competition 2012, 2012), (Bricom Asia , 2009).

The first student steel bridge competition in Turkey was conducted as a one time event during the "MIM Günleri" organization at the Istanbul Technical University (Mim günleri, Mimarlık İnşaat Mühendislik Günleri, 2002). The student steel bridge competition was later turned into an annual event by the Contruction Club of Boğaziçi University under the title of "Design&Construct". A historical overview of the student steel bridge competitions in Turkey are presented in Table 1 (Boğaziçi University, 2013a).

Table 1: A Historical Overview of the Student Steel Bridge Competitions in Turkey

Year	Organization	Hosting Institution	Winning Team/University
2002	Steel Bridge Student Competition	MİM Günleri, İstanbul Technical University	SpanTECH Istanbul Kültür University
2007	"Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	SpanTECH Istanbul Kültür University
2008	""Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	CETAYFA Boğaziçi University
2009	"Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	4BlackSea Karadeniz Technical University
2010	"Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	Steel Punch Karadeniz Technical University
2011	"Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	Steel Fighters Istanbul Kültür University
2012	"Design&Construct" Steel Bridge Competition	BÜYAP Construction Club, Boğaziçi University	CRO Team K University of Zagreb

This paper presents the experience of Department of Civil Engineering of Istanbul Kültür University who participated at the steel bridge competition every year with a number of teams since 2007 and outlines the benefits and opportunities of this hands on learning opportunity for students.

DESIGN&CONSTRUCT (DECO) STEEL BRIDGE COMPETITION

Design&Construct (DECO) steel bridge competition is a three day event held by the Construction Club of Boğaziçi University (BUYAP) since 2007. After the call for applications of the competition is announced, interested students of civil engineering and architecture form teams and start working on the conceptual design of the bridge. The bridges designed by the competing teams are evaluated according to the following criteria:

- Uniqueness and Aesthetics
- Workmen-Time Efficiency

- Deflection Efficiency
- Dead-Weight Efficiency
- Compatibility to the Competition Program

After the call for applications is announced, interested students of civil engineering and architecture form teams and start working on the conceptual designs of their bridges according to the set of criteria and constraints set forth by the organization (Boğaziçi University, 2013b). Students usually come up with a number of conceptual models and use finite element analysis software to assess the structural performance of these models under vertical and horizontal loading. This is a highly iterative process which involves trying out various configurations of structural members. Once students feel they have obtained the "optimum" structural system configuration for their bridges in terms of "self-weight", "deflections" and "ease of fabrication and assembly", they prepare and submit the structural calculations, structural plans and connection details of their models to the organizing committee in accordance with the competition guidelines.

The list of teams which will proceed to the next stage of the competition is announced by the organizing committee upon the completion of the technical evaluation of structural designs by a jury of steel design experts. The teams that pass the technical evaluation, start working on the fabrication of their bridge models. Structural members and connections are cut and welded in a steel workshop facility (Figure 1). Students are fully responsible for the procurement of the appropriate steel sections and the supervision of the fabrication process. Structural members are cleaned up and painted after the dimensions and worksmanship of each part is throughly inspected.

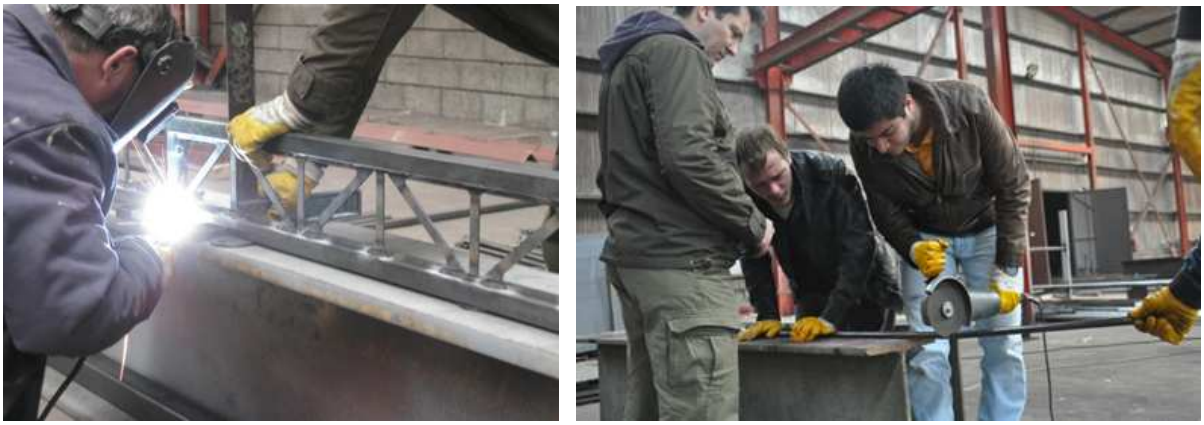

Figure 1: Fabrication of the Structural Members at the Workshop by Students.

After the completion of the fabrication process, students practice working on the assembly of the bridge to improve their team coordination skills and to reduce the time spent on the assembly of their bridges in the day of the competition. It is mandatory for the students to use work gloves, steel toed boots, safety goggles and a hard hat at all times during the assembly of the bridge.

On the day of the competition, competing teams assemble their bridge models in the locations designated for the team by the organizing committee (Figure 2). Uniqueness and aesthetic merit of the bridge designs are evaluated in the first stage of the competition.

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Figure 2: Bridge Exhibition at the Southern Campus of Boğaziçi University.

Other criteria are evaluated in the second phase of the competition where the competitors assemble their bridges (Figure 3) and the bridges are subjected to the vertical and horizontal loads prescribed by the competition rules (Figure 4). An extensive description of the competition rules and evaluation criteria is presented in the competition web page (www.boundc.com). The event ends after the presentations from sponsors and the award ceremony.

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Figure 3: Erection of the Bridge at the Competiton Site by Students.

Figure 4: Application of the Vertical Loads to the Bridge.

RESULTS AND CONCLUSIONS

The primary aim of the student steel bridge competitions is to supplement the steel design courses in civil engineering programs by providing an opportunity for the students to work on a small-scale design project, where they are involved in all the stages from conceptual design to fabrication and erection. Students also gain experience on the project management aspects of a design project such as the procurement of the construction materials, management of the project cost, project planning, coordination of the fabrication processes as well as dealing with spatial constraints and client demands. Another important benefit of the competition for the students is teamwork experience. Students have to work as a team starting from conceptual design to the erection of the bridge on the competition site, for which a perfect coordination of the team members is essential for the minimization of construction time.

In our experience, steel bridge competitions have been quite beneficial for our students who have participated in these events. Even the students who did not participate in the competition were motivated by the efforts of the students entering the competitions, particularly the bridge assembly exercises held on the university grounds.

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REFERENCES

American Institude of Steel Constructrion (2013a). *Student Steel Bridge Competition 2013 Rules*. Retrieved March 20, 2013 from http://www.aisc.org/WorkArea/showcontent.aspx?id=21576

American Institude of Steel Constructrion (2013b). *2013 Competition Guide*. Retrieved March 20, 2013 from http://www.nssbc.info/

Boğaziçi University (2013a). *Previously on DECO.* Retrieved March 8, 2013 from http://www.boundc.com/2012/en/gecmis_yillar.php

Boğaziçi University (2013b). *Boğaziçi University Construction Club Design and Construct 2013 International Student Steel Bridge Competition Regulations.* Retrieved March 8, 2013 from http://boundc.com/2012/dosya/DECO_Regulations.pdf

Bricom Asia (2009). *Objectives.* Retrieved March 15, 2013 from http://www.cv.ncu.edu.tw/html/bricomasia2009/web/objective.html

Japan Steel Bridge Competition 2012, (2012) *2012 Ver.1 Official Rule Book.* Retrieved March 15, 2013 from http://www.cive.gifu-u.ac.jp/~complab/SteelBridgeCompetition2012/gaiyo.html

Mim günleri, Mimarlık İnşaat Mühendislik Günleri. (2002). *Çelik Köprü Yarışması 2002.* Retrieved March 15, 2013 from http://www.mimgunleri.itu.edu.tr/celikkopru.html

Student Organization Active Builders (2013). *Rules and Regulations of WSSBC 2013*. Retrieved March 18, 2013 from http://wkluczyk.info/skms/ang/rules_wssbc2013.pdf