AGA- GALVANIZE THE FUTURE ESSAY CONTEST

MEMO

From: Kien Nguyen, Ph.D. candidate
To: Civil, Environmental and Architectural Engineering Department, the University of Kansas
Date: March 30, 2016

The Necessity of Opening the Course "Hot-Dip Galvanizing - The Art of Coating" at Civil, Environmental and Architectural Engineering Department, the University of Kansas

1. Background

In the United States, corrosion annually costs 3% of the gross domestic product (GDP), or more than $400 billion (1). This is an enormous amount of money, which is why corrosion protection systems are becoming more prevalent in the steel industry. One of the most effective methods for preventing corrosion is hot-dip galvanizing, in which steel components or structures are submerged in molten zinc at approximately 860^0F for a short duration (3 to 15 minutes). Hot-dip galvanizing is known for its low initial cost, durability, longevity, availability, versatility, and sustainability. In addition, the galvanized coating makes the steel surface bright and clean (as shown in Figure 1) which is well-suited for architectural applications. Given these advantages, hot-dip galvanizing is a commonly-used technique for preventing corrosion in steel structures and components.

a) b)

Figure 1: Surface of steel structures. a) Before galvanizing; b) After galvanizing

The prevalence of hot-dip galvanizing in practice should encourage US engineering schools to prepare students for new opportunities and challenges in this field. However, there has been very little response from engineering institutions to this need. With the ambition to be a top tier

international university pioneering in educating world leaders, the University of Kansas (KU) has a strategic plan, known as "Bold Aspirations", in which creating a vibrant new curriculum is one of the focuses (3). This plan makes KU the ideal place to develop and initiate a course called "**Hot-dip galvanizing – the art of coating**" for their engineering and architectural students.

2. Objective

The object of this document is to analyze the benefits of the course titled **"Hot-dip galvanizing – the art of coating"** to KU engineering and architecture students. This document also describes why this course complements the KU strategic plan, and why the KU Department of Civil, Environmental, and Architectural Engineering (CEAE) is the best department for hosting this course.

3. The hot-dip galvanizing industry: Background

Hot-dip galvanizing has had a long history. Its appearance was marked in 1837 when a French engineer, Stanislaus Sorel, took out a patent for an early galvanizing process. With the growth of the global steel production in the twentieth and early twenty-first centuries, the quantity of hot-dip galvanized steel products has increased rapidly, as shown in Figure 2. Currently, galvanized steel structures and components are widely-used in many aspects of the economy, such as: building construction, transportation, agriculture, manufacturing, energy supply, mining, and offshore production. It is easy to find a galvanized structure in our everyday lives, such as nuts and bolts in your garage, light poles on the street, and bridges on our highways. One piece of evidence showing the prevalence and importance of hot-dip galvanizing is the dense publishing of ASTM Standard A123, a guide for hot-dip galvanizing in the United States, in the years 2008, 2009, 2012, 2013, and currently 2015. With the advancement of metallurgy and furnace technology, hot-dip galvanizing has become a more efficient and sustainable solution to create recyclable structures. This environmentally friendly quality is a perfect protection choice for steel structures.

There is an urgent need to educate engineering and architecture students about the hot-dip galvanizing process. From some personal communications with major galvanizers in the US, Valmont and AZZ, the author has learned that it is a major challenge within the industry to identify engineers who are well-qualified for their projects. An additional challenge occurs when engineering firms specify galvanizing work without possessing basic knowledge of the process. This situation demands a solution - educating a generation of engineering and architecture students regarding the hot-dip galvanizing industry. However, as far as the author knows, there has been no institution that has done this by developing a galvanizing course for engineering and architecture students. This is a clear opportunity for KU to be a pioneer in this area. With Kansas City, MO situated geographically near KU, there are a major engineering consulting firms such as Burns & McDonnell, Black & Veatch, Blue Scope Steel, etc., in the near vicinity who would

benefit from a better trained work force of engineers. Even so, the target will serve not only the demand of the engineering industry in Kansas City, but also in America and around the world.

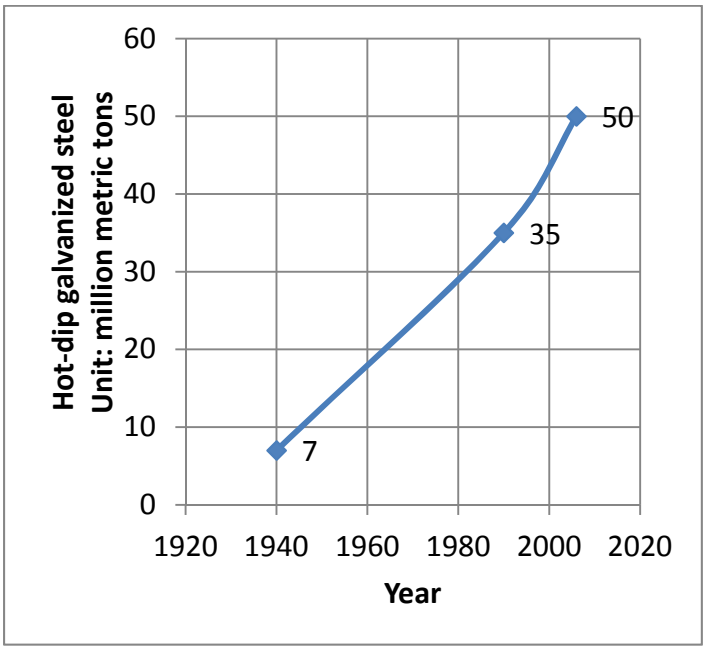

Figure 2: Rapidly increase of hot-dip galvanized steel production in the world (5).

4. **The benefits to KU students who will be future important human resource in the hot-dip galvanizing industry**

Students enrolling in this course will gain the state-of-the-art knowledge of hot-dip galvanizing (as stated in the attached course syllabus), one of the most effective methods to protect steel structures from corrosion. Upper-level undergraduate and graduate Students in the Civil, Environmental, and Architectural Engineering Department and in the School of Architecture at the University of Kansas are qualified to take this class. Students from other engineering disciplines (Mechanical Engineering; Petroleum Engineering, etc., will also be able to enroll in the course). The objective of this course is to educate students regarding many aspects of the hot dip galvanizing industry, such as processes, applications, advantages, and limitations. Students will understand the behavior and performance of the galvanized coating, specification requirements, how to specify galvanized coatings, how to prevent and deal with possible issues in a galvanizing project. This knowledge is not based only on the vast literature on hot-dip galvanizing, but also on the practical experience provided by the galvanizing industry.

With this knowledge of hot-dip galvanizing, students will have an advantage when competing in a competitive job market with a wide range of job opportunities. This course will also supply students with the ability to work well in a challenging area where adequate knowledge also requires a combination of chemistry, physics, material engineering, and thermal engineering expertise. While architects are more involved in the initial stage of a project such as planning and

designing, engineers must provide solution to make the product sustainable and realistic. Engineers and architects occupy a wide range of jobs, including architectural design, structural design, structural detailing, project management, site execution, contracting, operation, health and safety, sales, and customer service. In addition, students enrolled in this course can also pursue a research career to further develop hot-dip galvanizing processes and technology.

Being knowledgeable regarding hot-dip galvanizing will also increase chances for collaboration between parties in a galvanizing project, in which our engineering and architectural graduates will represent owners, design professionals, and contractors. While hot-dip galvanizing is a common specification on many steel projects, it requires all parties to understand the project goal. When representatives work together, there is more chance to collaborate if they have the basic knowledge of hot-dip galvanizing. Hence, the chance for success of the project will increase.

5. This course and the CEAE Department's and the University's strategic plans

KU is making a map toward recognition as a world-class research university (3). To make this ambition to be true, KU has created a strategic plan, titled "Bold Aspirations," in which the creation of a vibrant new general education curriculum is one of the major strategies towards scholarly excellence. To follow this trend, the CEAE Department is promoting innovation and renovating the program to be more competitive department. The primary goal of the department is to prepare its students such that they are well-prepared to serve and lead as excellent engineers and to have a positive impact on the world (4).

This course is suitable to the University's strategic missions: educating leaders, building healthy communities, and making discoveries that change the world. In particular, the course will help KU CEAE department to improve the quality of both professional and research training by providing pathways for our outstanding students who wish to play important roles in a critical industry. The new course will equip students with knowledge to work in the extensive industry of galvanizing and aid in its future direction. The innovation and pioneer spirit of this course will strengthen the future succeed of our students, which will be the primary measure of our program quality.

To position this course with respect to existing courses in the CEAE curriculum, this new course will be an advancement from the course CE 562 "Design of steel structures" and CE 715 "Corrosion Engineering". While CE 562 provides knowledge about the design of steel structures, and CE 715 provides general background and theory regarding corrosion protection, the proposed course will prepare students to plan, design, detail, manufacture, execute and lead corporations in the field of hot-dip galvanizing.

6. The availability of the KU CEAE Department to initiate this course

Currently, a research project entitled “Mitigation of Weldment Cracking of Highway Steel Structures due to the Galvanizing Process” is ongoing at the KU CEAE Department. One of the tasks of the project is to closely simulating a galvanizing process in the structural testing facilities at KU. The project was initiated in July 2014, and will run through December 2016. The project is being led by University of Kansas professors Caroline Bennett, Jian Li, and Stan Rolfe, and Professor Adolfo Matamoros who is at the University of Texas-San Antonio.

The author is currently participating in this project as a Graduate Research Assistant. With more than four years working experience in the structural steel industry, the author has had opportunities to specify hot-dip galvanizing for many steel building projects. Twenty of them were completely constructed, and more than a hundred of them were conceived for proposals. With this experience and a passion for continued learning, the author is confident that he will have proficient knowledge to run this course successfully. The availability of human and material resources, as well as the learning experiences obtained through the collaboration with the galvanizing industry are a guarantee for the success of this course.

7. Conclusion

Success happens when the conditions are right. The CEAE Department at KU has all the right conditions to initiate a course “**Hot-dip galvanizing – the art of coating”**: the availability of personnel specialized in hot-dip galvanizing, the availability of a laboratory set up for simulating a hot-dip galvanizing process as an illustration for teaching, and encouragement from the strategic plan “Bold Aspirations”. By initiating this course, the CEAE Department at KU will contribute to the development of the important industry of hot-dip galvanizing. The course will provide benefits to its engineering and architecture students by focusing on hot-dip galvanizing processes. With that knowledge, our students will be more competitive in the job market, and will be pioneers in the expanding industry of hot-dip galvanizing. The explosive growth of the hot-dip galvanizing industry clearly is an opportunity for any institution who wants to make a serious contribution to the development of this world.

References

[1] American Galvanizers Association (2010), “Performance of Hot-Dip Galvanized Steel Products”, Web.

[2] American Galvanizers Association, “Publication- Competition”, Web <http://www.galvanizeit.org/education-and-resources/publications/category/competition>

[3] University of Kansas, “Bold Aspirations – the strategic plan for KU”, Web <https://boldaspirations.ku.edu/bold-aspirations>

[4] CEAE Department, University of Kansas, Web: https://ceae.ku.edu/

[5] Peter Maass, Peter Peissker, “Handbook of Hot-dip galvanization”, Wiley-VCH, 2011.

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Course syllabus

CE 770 - HOT-DIP GALVANIZING: THE ART OF COATING

Fall 2016

Instructor: Kien Nguyen, PhD candidate
Office: 2413 LEEP2, 1530 W 15th Street, Lawrence, KS 66045
Phone: 785-979-9447
Email: qkien@ku.edu
Office hours: 8:00 am – 5:00 pm, Monday – Friday

Level of course: Upper-Level Undergraduate and Graduate Students
Prerequisite: CE 562: Design of Steel Structures
Required Specifications: ASTM A123, ASTM A153, ASTM 767
Recommended Textbook: Handbook of Hot-Dip Galvanizing, *Peter Mass, Peter Peissker*
Jones, Denny A., Principles and Prevention of Corrosion, 2nd edition, Macmillan Publishing Co., New York, 1996. (ISBN: 978-0133599930)
Other documents: other ASTM Standards, AGA Technical Notes
Lecture: Tuesday, 6:00 pm – 8:50 pm, 2150 Learned Hall

Course Description:

The course focuses on the state-of-the-art in hot-dip galvanizing, one of the most effective methods to protect steel structures from corrosion**.** The major content involves design and fabrication of steel structures according to hot-dip galvanizing requirements, and delving into current hot-dip galvanizing processes and practices.

Course Objective:

Upon completion of this course, students should be able to:

- Understand corrosion, its costs, its control, and the problems it may cause.
- Select the appropriate technology method to prevent corrosion for a particular project
- Apply knowledge about hot-dip galvanizing: process, types, application, advantages, and limitations to real design problems.
- Analyze the behavior and performance of hot-dip galvanizing coating.
- Apply the code requirements for hot-dip galvanizing.
- Plan, design, inspect and estimate cost for a galvanizing project.
- Know how an engineer collaborates with other parties in implementing a galvanizing project.
- Identify the causes of some possible problems in hot-dip galvanizing process, from that to develop a control plan to prevent those problems.

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Grading:

- Homework, Paper-Reviews, and Quizzes: 30%
- Group Project: 30%
- Exams: 40%

Your grades will be based upon the percentages described above. A conventional grading scheme will be used: 100-91 (A), 90-80 (B); 79-70 (C); 69-65 (D); <64: F.

Tentative Lecture Schedule:

Lecture	Topic Covered
1	Introduction to Corrosion Engineering – The History of Hot-dip galvanizing
2	Galvanizing Process/ Construction of Hot-Dip Galvanizing Plants
3	Surface-Preparation Technology
4	Corrosion Behavior and Performance of Zinc Coatings
5	Design and Fabrication according to Hot-Dip Galvanizing Requirements
6	Quality Management in Hot-Dip Galvanizing
7	Exam #1 / Group Project
8	Benefits of Using Hot-Dip Galvanizing
9	Current Practices/ Current Specifications
10	Environmental Protection, Health and Safety
11	Application of Hot-Dip Galvanizing/ Hot-Dip Galvanizing Around the World
12	Design Examples and Case Studies
13	Special topic: Control of cracking during galvanizing process
14	Group Project Presentations
15	Exam # 2

Word Count (not including words in Tables or Figures, References, Course Syllabus, and this page) 1785/2000

DISCLAIMER:

Please note that this essay and the course syllabus are a fictional proposal, which is submitted to be considered for the American Galvanizers Association's (AGA) *Galvanize the Future: An Edgar K Schutz Memorial Scholarship* essay contest, and shall not be interpreted as anything other than that.

My name is Kien Nguyen; currently I am a Ph.D. student in Structural Engineering at the University of Kansas, USA. I am working on the research project NCHRP 10-94 "Mitigation of Weldment Cracking of Highway Steel Structures due to the Galvanizing Process". I have had the opportunity to learn more about hot-dip galvanizing and have become more and more interested in it. I have four years work experience as a Design Engineer at Kirby Building Systems, Vietnam (known as Kirby Building Systems – a Nucor Company in the U.S.), where I did specify hot-dip galvanizing for many steel building projects. Twenty of them were completely constructed, and more than a hundred of them were conceived for proposals. I also worked as an adjunct lecturer during the same four years at Saigon Technology University, Vietnam after earning my B.S. (2008) and M.S. (2011) in Vietnam and South Korea, respectively. Both careers have influenced as well as emboldened my mind to take the path of a Ph.D. program. My future career goal is to be a faculty member at a major university. Therefore, creating a compelling and influential article like this essay's requirement is an excellent opportunity for me to prepare myself for my future job.

Thank you very much for considering me for the Edgar K. Schutz Memorial Scholarship.

(Signed)

Kien Nguyen