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CIVIL ENGINEERING EDUCATION PROGRAM IN RESPONE TO THE INFRASTRUCTURE DEVELOPMENT IN RECENT YEARS IN VIET NAM

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Abstract. The development of infrastructure systems including long-span bridges, highways, high buildings, large dams, etc… requires graduates to acquire certain knowledge to meet the demands of working positions in many foreign consultancy companies and entrepreneurs. At traditional thought on the work of civil engineering, there is a concern on the balance between the design philosophy of Soviet-Union standards and the new design philosophy under ASSHTO's standard systems. This study's contribution is to clarify the advantages and disadvantages of the new civil engineering education program, developed for undergraduates at University of Transport and Communications (UTC), to adapt to job requirements of foreign companies in the designing and construction of infrastructures in Viet Nam based on ASSHTO's standard system.

1 INTRODUCTION

In current years, along with renovations in state policies, Vietnamese Government has made considerable socio-economic achievements. These achievements are represented through impressive indices of the economic growth which one of all is GDP (Gross Domestic Product) with an increase of 6.68% in 2015, and 6.81% in 2017. Along with economic development and adaptation, motivation of economy, culture, education and national security, infrastructure has been ceaselessly improved in Viet Nam. It was showed off through representative constructions as high buildings, which more and more pop up to replace tenement houses being degraded in inner city and to meet housing of city dwellers in belt areas or outskirts, as well as commercial demand. Typically, some skyscraper such as AON Landmark 72 Building, Bitexco Financial Tower, or Lotte Center Ha Noi Building, can be mentioned. Along with that, infrastructure systems of transport have been also enlarged and constructed progressively. In Viet Nam, highways, large bridges, tunnels, metropolitan railways of transportation infrastructure have been invested and constructed intensively. Some outstanding constructions could be mentioned: Hai Van tunnel, Thu Thiem tunnel, Deo Ca tunnel, Can Tho Bridge, Bai Chay Bridge, Metropolitan railways in both Hanoi and Ho Chi Minh City.

Dragon bridge

Ha Noi - Hai Phong expressway

Figure 1: Some typical projects in Viet Nam

Particularly in road transport, according to statistics [1] in 2010, the total length of roads in Vietnam is 258,200km with national road and highway accounting for 18,744km of length. By 2014, the total length of roads had extended to 300,000km and national road systems lengthened to 19,457km. This shows the significant development of infrastructure in Viet Nam in current years. However, in order to ensure the rapid, quality and stable development, skillful and high quality human resource are needed. These resources could be supplied by engaging experts from developed countries like Japan, South Korea, France, and Australia in short-term… However, in long-term, to sustainably develop by domestic resource and to suit Vietnam's economic conditions, engineers and human resources should be proactively educated and trained in Vietnam. This is appropriate although it would cope with a great deal of difficulty in recent circumstances in Viet Nam. In spite of impressive records of developments, Vietnam is still a developing country with a starting point as an agricultural

country. Nevertheless, along with the integration in economy, education and culture, difficulties have been overcome to train human resources corresponding with demands.

With difficulties enlisted above, to meet the need of human resources for roads and bridges infrastructure developments, UTC has properly innovated and improved its curricular. Specifically, in order to catch up tendency of deep and large integration and collaboration of Viet Nam with developed countries, the university has established the proper syllabus which is upgraded with educational system of developed countries for road and bridge engineers. Using to train alumnus, apart from old knowledgeable systems which are still needed in the courses, the university has added more major documents, learning resources and standard from developed countries. To be more detailed, the new standards of road-bridge engineering [2, 3, 4, 5] have been integrated into syllabus apart from the older standard [6, 7, 8, 9]. Besides amendments in systems of documents, UTC has also changed its educational approach for students by adapting to new knowledge supplemented. Thanks to such changes, graduates from UTC have met working assignments in infrastructure development.

2 THE LIMITATIONS OF THE PHILOSOPHY AND DESIGNED METHODS BASED ON BRIDGE AND CULVERT STANDARDS OF THE SOVIET UNION (BASED ON SNIP 02) ARE TAUGHT TO ENGINEERS OF UNIVERSITY OF TRANSPORT AND COMMUNICATIONS

Design standards of bridge and culvert of the Soviet Union, which is a basement of Snip 02 and Design standards of bridge and culvert 22TCN 18-79 of Viet Nam, is one of the first generations of its system based on the limited state methods. The working state of structures is divided into two ranges: one range maintaining working capacity and the other one having no working capacity. Two ranges are separated by a set of limited state. Checking formula according to this standard is:

$$N \leq F.\ R \tag{1}$$

Of which:

N: is calculating force.
F: characteristics of section.
R: corresponding calculated strength.

By 2001, all bridge and culvert constructions in Vietnam calculated and designed are based on standard system which is built according to design standards of bridge and culvert of the Soviet Union. In order to synchronize with the system of designing standards, those regarding exploitation appraisal are built on Russian system. Over times, these standards have proven their effectiveness, efficiency and convenience in practice. Formula system of standards based on fundamental principle of mechanics, elastic theory, so generations of engineers and students educated by university of transport and communication absorb, apply creatively all knowledge learnt in practice.

In spite of positive side, this system of standards also shows its shortcomings. Steel structure only considered capacity of materials in elastic stage. For concrete structure, working of concrete beyond its elastic limitation was considered but all calculations still were based on elastic theory. It is the drawback of the standard system. Therefore, it can be see that mechanical properties of material in structure could not be maximized. Meanwhile, the value of the representative resistance, given for comparison with the multiple effects, is not the real

resistance of the structure due to the stability impact considered in a separate state. In addition, prestressed concrete structure did not take into account the tensile strength of concrete, leading to an overly safe design of the structure. This may lead to waste of materials forming up the structure. Especially as the quality characteristics of the material has been greatly improved nowadays. This was reflected in the size of large bridges when applying this standard design system.

3 USING AASHTO STANDARD SYSTEM IN DESIGN OF TRANSPORTATION CONSTRUCTION.

With a demand for innovation and integration, standard systems from developed countries have been introduced to students in the bridge and road sector in Vietnam. Typically, the standard generation system of the AASHTO LRFD has been gradually applied to substitute the standard of the Soviet Union for calculation and design of road bridges.

The AASHTO LRFD standard system is a new generation of standards in the world based on advances in bridge construction. With complete principles and logical approach, using this standard system in designing and calculating bridges, would ensure the safety of the work from the construction to the exploitation stage and aestheticism. Ideology, design philosophy in line with other major design standards have been approved and have been developing in both Asia and Europe and in the field of structural engineering in general. There are advantages from the familiarity of the limited state method like design standards of bridge and culvert of the Soviet Union but the AASHTO LRFD system applies theories of probability to guarantee reliability and safety of the works at a certain level. The checking formula for this standard is [2]:

$$\Sigma\eta_i \cdot \gamma_i \cdot Q_i \leq \varphi \cdot R_n \tag{2}$$

In which:

Q_i: force effect.
R_n : nominal resistance.
γ_i: load factor.
η_i: load modifier.
φ: Resistance factor.

Throughout the study, application of the AASHTO LRFD standard system has shown the advantages that have overcome the disadvantages of the Snip 02 previously applied in Vietnam in designing bridges. The application of this standard system in design and calculation of structures allows to exploit the characteristics of steel outside the elastic range. In calculation, the interaction between the stability and the working properties of steel would be considered together, thus the calculated resistance is the real resistance. This allows a better exploitation of working ability of the material, so the structure designed could be slender, aesthetic and would be more economical in using materials. Besides, on the basis of statistical probability theory, the statistic of impact loads was taken into calculating model in accordance with the real load. This ensures the sustainable exploitation without the overload in service stage.

As well as any standard system, although it is advanced, the usage and application of the

standard would still meet hidden difficulties. Based on the theory of reliability and statistical probability, calculating coefficients taking the checking formula into account would only ensure engineers to be able to use in design but would understand the root of these coefficients. It implies that engineers and user have to read the instructions carefully and to remember the formulas in the standard mechanically.

4 EVALUATING OPPORTUNITIES AND DIFFICULTIES WHEN IMPLEMENTING TRANSFORMATIONS, UPDATING STANDARDISED SYSTEMS AND CHANGES IN TEACHING SYLLABUS

Unlike some developed countries in the world, young generations in Vietnam get great financial support from families even during adulthood, which has been profoundly brought by long-standing cultures in education. This has an impact on teaching methods in education. Influenced by the out-of-date methods of educating as well, young generations in Vietnam lack, in their daily life, quite a number of aptitudes such as: social skills, living skills and self-study skills, self-reliant skills which to larger or lesser extent, it impedes the creativity and the ability of study on their own. Students in the major of civil engineering are no exception, therefore the methodology and syllabus must solve these issues in a way that keeps abreast of innovations and integrations, but well suits the characteristics of Vietnamese young generations as well.

In recent years, knowledge and information that UTC taught and instructed for students have been upgraded and innovated based on the development of achievements obtained. In civil engineering discipline, there is a difference between Vietnamese students and students of developed and other countries: foreign students are provided with foundational knowledge, followed by attaining considerable expertise in a specific area after graduating, while in Vietnam, almost all colleges tend to educate student following specific fields right from the start. This approach basically causes two main issues for learners: firstly, some learners could not make the decision of choosing a major shortly after finishing high school; secondly, students tend to face more hurdles in switching to other areas, though areas are in the same field.

From these points, University of Transport and Communications has established a syllabus that is suitable for students in the civil engineering discipline. As regards the difficulties mentioned above, namely low independence and low self-contained competence, the syllabus has been set up to tackle these weaknesses in order to, although curriculum innovated and applied advanced methods from developed countries, still suit the characteristics of Vietnamese students. Besides that, the syllabus helps to improve active learning ability among students: simultaneously the study will concern the interactions between lecturers and students, and between students together. Students attend classes not only to gain knowledge but also equip themselves with self-study and boost enthusiasm in learning. This approach enables students to be actively engaged in scientific research activities which intend to be systematic studying right when at university [10]. This would be truly beneficial for learners when they have intentions to switch to other areas in the same field. Self-study meets the demands of work to learners and sometimes it would meet the need of knowledge and innovation for the world [11], which is the key to success in career and life.

More specifically, there has been the innovation of syllabus in the civil engineering

discipline at University of Transport and Communications, Vietnam in recent years. Specific major in the transport construction field are trained thoroughly to students. The module has been changed from yearly based system to course credits. This module enables competent students to graduate earlier and also to gives those more choices to accomplish the required credits. Besides that, materials and standards have been updated from developed countries, however the key contents have also been retained to be suitable for the situation of Vietnam. It is clear that along with design standards of bridge and culvert of the Soviet Union and Snip 02 of Russia [6, 7, 8, 9] that was previously included in teaching lessons, new criteria and materials of AASHTO LRFD [2, 3, 4, 5] have also updated into the syllabus. However, there were significant differences between these standards, thus if all knowledge and contents are taught and instructed for students, then volume of knowledge would be excessive, and students would be passive in the way that they absorb knowledge. Therefore, contents of the knowledge and standard system have been comprehensively summarized by experts and premium lecturers to deliver to students. Specialized knowledge of majors are taught to students in the final year after they gain a grasp of foundational subjects in the previous years as in some foreign countries. Teaching methodology has been transformed to stimulate independence in learning. There used to be one-side interaction from lecturers in almost all subjects, which lessons have divided into 2 sections: theory and discussion. During discussion time, students are supposed to prepare for the topics to interchange with lecturers. This profoundly increase self-study and interactions between students together, between lecturers and students as well. Furthermore, students have built for themselves methods of self-study not only while studying in university but also they do the real work.

5 CONCLUSION

- Thanks to improvements in college syllabus to keep up with latest trends in all fields at global level, there have been significant achievements in upgrading syllabus for students in the major of civil engineering. The robust evidence lies in high proportions of students getting a job related to the major when graduated from universities. In addition, graduates in civil engineering at University of Transport and Communications have taken part in foreign invested projects and met the criteria set in the field. They have been also engaged in tasks of other majors such as civil constructing, irrigating. It can be seen from their positions in the jobs that they took part in and master of technology in large and complex constructions. This indicates the result of self-study which is consequence of innovating syllabus.
- System of latest standards has been updated into teaching and quickly comprehended by learners. Especially, graduates in civil engineering discipline have a good command of criteria system of Russia and AASHTO. They are well-adjusted and complete the assigned duties pretty well. Standards of AASHTO LRFD are widely used in designing new bridges in Vietnam. Standard of Russia are still flexibly used in appraising old bridges and designing railway bridges. At the same time, system of criteria of EURO CODE, BS, CEB-FIP, and SETRA… are studied by Vietnamese engineers to meet the needs of their jobs or related projects.

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