The Final Report

of

Academic Consortium 21 Special Project Fund

Academic Consortium 21 & The Workshop on Smart Civil on Construction and Operation (2019)

Northerastern University, Shenyang, P. R. China

July 8, 2019 to July 12, 2019

Contents

1. Project Summery

With the rapid development of information technology, the traditional construction method in civil engineering is now facing an opportunity to upgrade with strong information tools. ‘Internet +’, and ‘Big Data’ are widely used in civil engineering instead of being concept. Based on the technology of Internet of Things and Cloud Computing, the effective reference to the construction and operation can be obtained making the civil engineering more ‘smart’ and reducing huge labor cost and energy consumption. With the strong tendency of ‘Smart City’ around the world, the ‘Smart Civil Engineering’ has a bright future.

However, ‘Smart Civil Engineering’ is a combination of multi-disciplines including civil engineering, computer science, electronics and communication engineering. There are many research gaps in the development of ‘smart civil engineering’ due to the relatively short time of development in this field. At the same time, the differentiated practical application in the field of ‘Smart Civil Engineering’ remains a relative huge gaps between different countries because of economic differences. To develop such challenging project, the resources and skills of AC21 members around world needs to draw together. A relevant workshop for AC21 members is intensively needed for the development of ‘Smart Civil Engineering’. The AC21 Special Project Fund (SPF) will enhance the close relationship between AC21 members and accelerate the progress of facilitating the organisation of the workshop for further collaborative projects.

Academic Consortium 21 & The Workshop on Smart Civil on Construction and Operation (2019) was hosted by Northeastern University from July 8th to 13th , 2019. It contains the following parts: the invited reports, 'One Belt and One Road' special report, 'Smart Civil' special courses, cultural journey and site visit.

The six-days workshop on 'Smart Civil Engineering' is the central activity providing a good opportunity for the researchers from AC21 members including three Chinese universities (Northeastern University, Nanjing university, Tongji University and Shanghai Jiaotong University) and two international universities (the University of Adelaide, North Carolina State University), together with the other non-AC21 participants to review the current progress in this field, share recent advances in the application and deeply discuss the critical issues in the field of 'smart civil engineering'. Four critical issues were drawn up as follow:

1. The achievement of optimized construction using the critical construction parameter based on the analysis technology of 'Big Data'.

2. The effective health monitoring of structure in active service based on the Internet of Things technology and Cloud-based Data sharing.

3. The operation and maintenance of underground space in the city including utility tunnel and subway tunnel using the intelligent tools for health monitoring and space management.

4. The monitoring and automatic early warning system of highway slope around city using Intelligent Cloud Monitoring.

During the workshop, recent application cases and advance development were introduced. Valuable feedback and high-quality idea were proposed for later development. Therefore, the workshop has brought a strategy for short-term and long-term collaborations between members of AC21.

For the short term, the workshop can strengthen the research collaborations among AC21 members. For the long term, the proposed workshop may help to establish bridges among different AC21 members for in-depth academic exchange and potential education collaborations. For instance, Tongji University has announced to establish the first undergraduate major of smart civil engineering in China. Therefore, the major of smart civil engineering will be the trend to be established in late future creating the potential exchange in education and introduce of high-level talents worldwide.

2. Timetable

Date	Time	Activities	Place
8 Jul	Whole Day	Registration	NEU International Hotel 1st Floor
9 Jul	08:30-09:20	Opening Ceremony of Academic Consortium for the 21st Century & The Workshop on Smart Civil on Constructionand Operation (2019)	Cai Guanshen Auditorium, 1st Floor Hanqing Conference Center
	09:20-11:40	Invited Reports 1	
	14:00-17:00	Invited Reports 2	
10 Jul	Branch Venue 1		
	08:30-11:30	'One Belt, One Road' - International workshop on 'Smart Civil Engineering' in disaster prevention and control progress	Dacheng Building 201
	14:00-17:00		
	Branch Venue 2		
	08:00-12:00	Special Lecture on New Progress in Rock Mechanics of 'Smart Civil Engineering'	Dacheng Building 203
	14:00-18:00	Special Lecture:'Smart + Geotechnical Mechanics'	
11 Jul	Branch Venue 1		
	08:30-11:30	'One Belt, One Road' - International workshop on 'Smart Civil Engineering' in underground space construction and operation	Dacheng Building 201
	14:00-17:00		
	Branch Venue 2		
	08:00-12:00	Special Lecture:'Smart + GeotechnicalMechanics'	Dacheng Building 203
	14:00-18:00	Special Lecture on New Progress in Rock Mechanics of 'Smart Civil Engineering''	
12 Jul	Branch Venue 1		
	08:30-11:30	Site Visit: Smart Construction and Operation	Liao Yang City
	14:00-17:30		
	Branch Venue 2		
	08:00-12:00	Special Lecture:'Smart + Geotechnical Mechanics'	Dacheng Building 203
	14:00-18:00	Special Lecture on New Progress in Rock Mechanics of 'Smart Civil Engineering'	
13 Jul	09:00-10:00	Closing Ceremony and Outstanding Student Awards	Dacheng Building 201
	10:00-	Farewell	

3. Opening Ceremony and Invited Reports

The concept of the Academic Consortium 21 (AC21) is to promote the progress of education and research. Through the mutual cooperation among member universities, the bridge between different regions and societies of the world can be realized, thus realizing the coexistence of human beings across the border and region in the 21st century, as well as human beings. The diverse life and mutual understanding of society share the inherent intellectual and cultural values of human beings.

On July 9th, the opening ceremony and special invitation report of the forum was held. The special report was divided into three parts. At the opening ceremony, Mr. Han Zhongjun, the vice director of the Department of International Cooperation & Exchange of Northeastern University, firstly gave a speech on the opening ceremony.

▲Mr. Han Zhongjun gave speech of opening ceremony

Mr. Han stressed: Academic Consortium 21 is an international academic alliance aiming at the process of academic internationalization. The Workshop on Smart Civil on Construction and Operation (2019) received the financial support from AC 21.. This will greatly promote the internationalization and double-first class university construction of

Northeastern University, and the academic cooperation in the field of civil engineering.

Session 1 of Invited Reports

As hosts, Prof. Robert Zimmerman and Liu Jishan introduced the first reporter Prof. Zhang Mingzhong.

Prof. Zhang from University College London, UK gave report firstly. His report titled ‘Sustainable and Resilient Concrete Infrastructure: From Materials to Structures’. In the report, he introduced a numerical simulation method that considers the random shape of concrete aggregates, and introduces this numerical simulation method into the numerical calculation of concrete strength, and compares it with the experiment.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Prof. Robert Zimmerman (left) and Liu Jishan (right) were the hosts of 1st section</td><td>▲Prof. Zhang Mingzhong from UCLA gave the report ‘Sustainable and Resilient Concrete Infrastructure: From Materials to Structures’</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Prof. Ni Pengpeng from Sun Yat-sen University</td><td>▲Prof. Zhang Mingzhong was issued a certificate for the invited lecture</td></tr>
</table>

The second guest was Prof. Jiang Qinghui from Wuhan University，China. He reported ‘Stability analysis and safety control for high slopes of southwest hydropower projects in China’. In the report, he introduced the construction of the high slope project in Southwest China.

		
▲Prof. Jiang Qinghui from Wuhan University gave report ‘Stability analysis and safety control for high slopes of southwest hydropower projects in China’	▲Prof.Tae-Min Oh from Pusan University gave report ‘Rock Excavation using Waterjet Technology’, introducing the latest waterjet cutting tunnel technology in Korea’	▲International students

The third guest is Prof. Tae-Min Oh from Pusan University in South Korea. The report titled ‘Rock Excavation using Waterjet Technology’, introducing the latest waterjet cutting tunnel technology in Korea’. Talha Javed, an international student from Africa, raised questions about the control system. Prof. Oh introduced the working principle of the new technology based on questions.

Session 2 of the Invited Reports

This session was hosted by Prof. Jiang Qinghui and Xu Tao.

The fourth guest was Prof. Peng Yongbo from Tongji University, China. The report titled ‘Random Optimal Control of Engineering Structures’, he introduced the application of the latest algorithms to obtain structural

optimization in the design of building structures. The fifth guest is Prof. Ni Pengpeng from Sun Yat-sen University. His report titled ‘Nonlinear Soil-pipeline Interaction under Different Ground Motion’. He introduced a contact model suitable for underground pipelines and soils, and introduced his proposed constitutive model and experimental verification.

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<tr><td>▲Prof. Jiang Qinghui (left) and Xu Tao (right) were the hosts of 2nd section</td><td>▲Prof. Peng Yongbo from Tongji Universitygave the report ‘Random Optimal Control of Engineering Structures’</td></tr>
<tr><td> 
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<tr><td>▲Prof. Ni Pengpeng from Sun Yat-sen University gave report ‘Nonlinear Soil-pipeline Interaction under Different Ground Motion’</td><td>▲Prof. Ni pengpeng was issued a certificate for the invited lecture</td></tr>
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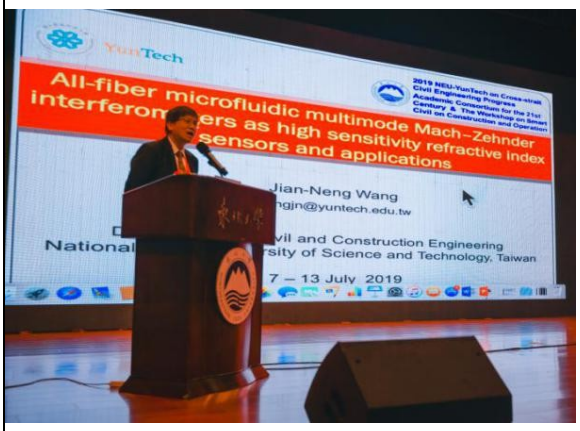
Prof. Muhammad Zaffar Hashmi of COMSTATTS University, Pakistan, whose title is ‘Impact of Arsenic on Paddy Soil Geochemistry’, describes the chemical effects of arsenic on soil in Pakistan.

	
▲Prof. Muhammad Zaffar Hashmi from COMSTATTS University gave report 'Impact of Arsenic on Paddy Soil Geochemistry'	▲Prof. Muhammad Zaffar Hashmi was issued a certificate for the invited lecture

Session 3 of Invited Reports

Prof. Hashmi and Ni Pengpeng co-chaired the invitated reports.

Prof. Wang Jianneng from Yunlin University of Science and Technology, Taiwan, China gave the report 'All-fiber microfluidic multimode MachZehnder interferometers for sensing applications'.

	
▲Prof. Muhammad Zaffar Hashmi (left) and Ni Pengpeng (right) were the hosts of 3rd section	▲Prof. Wang Jianneng from Yunlin University of Science and Technology gave report 'All-fiber microfluidic multimode MachZehnder interferometers for sensing applications'

	
▲Prof. Wang Jianneng was issued a certificate for the invited lecture	▲Prof. Jiao Mingruo from the Earthquake Administration of Liaoning Province gave report ‘Study on Earthquake, Geological Structure and Seismogenic Geodynamic Environment in Northeast China’

Prof. Jiao Mingruo from the Earthquake Administration of Liaoning Province, China whose report was titled ‘Study on Earthquake, Geological Structure and Seismogenic Geodynamic Environment in Northeast China’, introduced the earthquake monitoring report in Northeast China and the prediction time of the current earthquake warning technology. Next is Prof. Carlos Carranza-Torrs from the University of Minnesota, USA, who presented the report ‘Computational tools for the determination of factor of safety and location of the critical failure surface for slopes in Mohr-Coulomb dry ground’.

	
▲Prof. Carlos Carranza- Torres from the University of Minnesota gave report ‘Computational tools for the determination of factor of safety and location of the critical failure surface for slopes in Mohr-Coulomb dry ground’	▲Prof. Xu Tao from NEU

Prof. Jeon Seokwon from Seoul National University, Korea. brought a report entitled ‘Construction and operation of super-long tunnels in South Korea’. He introduced the ultra-long tunnel project currently under construction in South Korea.

▲ Prof. Jeon Seokwon from Seoul National University gave report ‘Construction and operation of super-long tunnels in South Korea’

After the invited report, all the experts and the participants took a group photo. The invited reports of top scholars from around the world provided a wealth of curriculum resources and exchange opportunities. ‘Smart Civil’ Forum provided a platform for pragmatic cooperation for the internationalization of civil engineering disciplines, and promoted international academic exchange, cooperation and sharing.

▲Group photo of all the participants

4. Special report of One Belt and One Road

Special reports were given by 19 outstanding doctoral students from across the country from July 10th to July 11th, on two topics: underground space construction and operation and disaster prevention and control progress.

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<tr><td>  </td><td>  </td></tr>
<tr><td>▲Dr. Huang gave report</td><td>▲Judges discussed with students</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Mr. Chidawa form Nigeria summarized</td><td>▲Prof. Oh from Pusan University summarized</td></tr>
</table>

▲Prof. Muhammad Zaffar Hashmi summarized

▲Awarding outstanding reports

▲Group Photo

5. Special Lecture on Smart Civil

From July 10th to 12th, Prof. A.P.S Selvadurai from McGill University and Prof. Robert Zimmerman from Imperial College of Technology gave lectures in the 203 classroom of Dacheng Teaching Hall, NEU Campus. The lectures were given and the two professors taught 12 hours each. The courses focused on 'Wisdom + Geotechnical Mechanics' and 'New Progress in Rock Mechanics in Smart Civil Engineering'. Two professors are very rich in teaching content, with a strong classroom learning atmosphere and active interaction between teachers and students. The members who participated in the class said that the two professors were very knowledgeable and brought a lot of new international knowledge and new methods to the forefront, which enabled members to gain knowledge and broaden their academic horizons.

▲Prof. Robert Zimmerman from Imperial College of Technology gave lecture

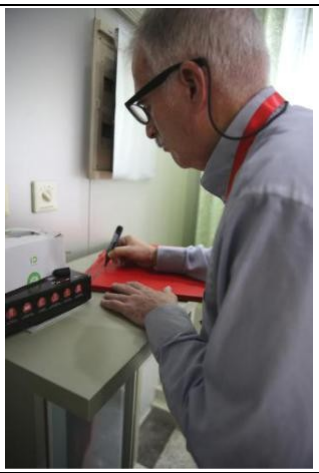
▲Prof. A.P.S Selvadurai from McGill University gave lecture

▲Group photo

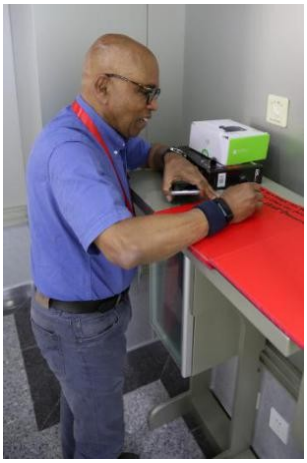
6. Cultural Journey

All participants visited the history of the NEU's history, renamed history, and future development plans. Finally, experts wrote a blessing in the history museum: ‘I wish Northeastern University could be better and better.’ After visiting the school history museum, experts and members moved the Hunnan Campus of Northeastern University to have a visit.

▲Invited experts and members visited the school history museum of NEU



▲Prof. Robert Zimmerman gave his wish



▲Prof. A.P.S Selvadurai gave his wish

	
▲Visit to the Hunnan campus	▲Visit to the library of Hunnan campus

7. Site Visit: Smart Construction and Operation

Through on-the-spot practice and study, members can feel the application of 'Smart Civil Engineering' in the construction and operation. The site visit is divided into three parts: 'Smart building construction', 'Smart city planning', 'Smart urban underground space construction'.

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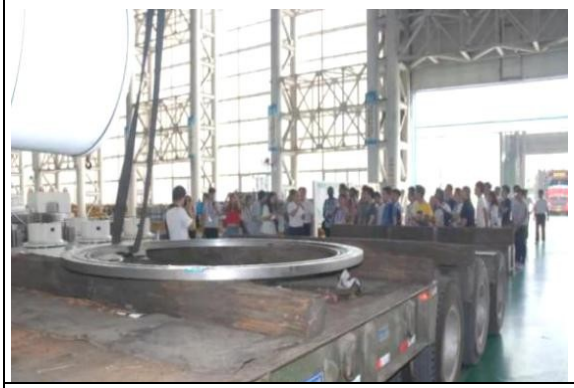
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Participants visited the construction site</td><td>▲Group photo on the construction site</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Participants visited the urban planning exhibition hall</td><td>▲Participants watched the urban planning exhibition hall</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>▲Participants visited the shield machine production</td><td>▲Experts took photo in front of shield machine</td></tr>
</table>

▲Participants took group photo in front of the urban planning exhibition hall

▲Participants took group photo in front of the company of large shield machine factory

8. Acknowledgement

We would like to show our best appreciation to AC21 General Secretariat and the AC21 Special Project Fund for their kind help and generous financial support.

The Financial Report of the Conference

The funding of $10000 was received in April, 2019. At that time, the currency exchange rate between the USD and CNY is 1:6.6969. The funding of $10000 was exchanged by the bank to be ¥66969. The details of the expenditure of the forum are as follow:

Item		**Funding Requested** **USD**	**Expenditure (including tax)** **CNY**
Transportation	Chinese invited participants	$3,000	¥20,090.70
	International participants		
	In-city transportation		
Accommodation	20 participants	$2,400	¥16,072.56
Forum expenses	Conference lunches, coffee breaks and dinners	$2,200	¥14,733.18
	Printing	$1,000	¥6,696.90
	Conference room renting	$600	¥4,018.14
	Local transportation and other expense	$800	¥5,357.52
Total		$10,000	¥66,969

Note:

1. All the funding received was full used in conference without residue.

2. Additional costs incurred during the conference, including the extra travel fee for participants, extra meal expense, and extra printing expense and so on, were supported by Northeastern University.