Continuing Education Program for Training Professional Engineering of Multi-complex Construction Project

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Abstract

Over the past years, complex construction projects which had the object to accomplish housing complex, commercial complex etc., recently are changing into multi-purpose complex construction projects because of the development of IT sector. The quality of life is improving and life patterns are changing. Departments of urban planning and engineering, civil engineering and architecture engineering in every university educate students according to the changing world in order to handle these complex construction projects in real world. In most cases department of urban planning and engineering teaches project planning and departments of civil and architecture engineering teach project design construction, In most of the projects planning is followed by design and construction, but recent study of the present curriculum shows that it is difficult to expect the continuity. The present curriculum of civil engineering needs to be changed as complex projects deal with numerous different structures during the design and construction phases of these projects. Therefore, this study reviewed current education programs of Urban Engineering and Civil Architectural Engineering related to design and construction of multi-complex projects. Investigation on importance of operation that operates on the designing phase which includes both engineering fields was made. After understanding the designing phase through the multi-complex project process continuing education program to improve the efficiency of operation is proposed.

Introduction

Throughout the world, land development has been generally for the single-purpose of commercial, residential or industrial complex development. With the economic development, life style is changing and single-purpose complexes are unable to meet the educational, recreational, social, cultural and modern transportation needs of the people. Therefore, concept of construction is changing from single-purpose to multi-purpose complex (multi-complex).

Modern multi-complex development requires the knowledge of civil engineering, architecture, urban planning and high technology.

This paper reviews the current education in engineering schools in areas of urban planning, civil engineering, and architecture related to design and construction of multi-complex projects. After understanding the whole process of multi-complex development from design to construction, continuing education program to improve the efficiency of operation is proposed.

Complex Development Process

In general, a prospective site for complex project development is selected based on basic plans of national land development, its feasibility is studied, and then conceptual design is prepared. After that preliminary design phase comes and a selected set of options is assessed in more detail. The output of the preliminary design phase is the selection

and scope of the option to be implemented. Final design phase is used to deign details and drawings, as appropriate, for the selected option. Finally, contract is awarded and the complex is developed. Therefore, planning, design and development of complex requires civil engineering, architecture and urban planning specialists.

In particular, general manager should be able to solve technological problem and operation in all areas of work but it is quite difficult because most of the engineers know about their major only. Therefore, a comprehensive human resource development program focused on improvement in technological management abilities throughout the project should be performed systematically, but the current system is hardly satisfactory.

Existing Education Related to Complex Development

As mentioned earlier, in most of the universities, the education related to complex development is fragmented into architecture, civil engineering and urban planning. Status of courses in urban and civil engineering related to complex design is shown in the Table 1.

Urban Planning		**Civil Engineering**	
Introduction of the Urbanology	- Introduction of the Urban Planning - Urban Planning History - Urban Development History and etc.	Applied Mechanics	- Statics and Dynamics - Structural Mechanics and etc.
Estate Planning	- Urban Design - Estate Design - Land Usage Planning - Traffic Planning and etc.	Surveying	- Survey - GIS and etc.
Surveying	- Survey - GIS and etc.	Hydraulics	- Hydrodynamics - Hydraulics / Hydrology and etc.
Land and Region Planning	- Land and Region Planning - Land Usage Planning - Urban Economics - Urban Policy and etc.	RC and Steel Structure	- Reinforced Concrete Engineering - PS Concrete Engineering - Steel Structure Engineering and etc.
Urban Planning Relating Laws	- Urban Relating Laws - Urban Development - Urban Re-development - Urban Science of Public Administration and etc.	Soil and Foundation	- Soil Dynamics - Foundation Engineering and etc.
Other	- CAD - Design Law and etc.	Waterworks and Sewerage Engineering	- Environmental Engineering - Waterworks and Sewerage Engineering and etc.
		Construction Engineering	- Construction Engineering - Construction Management and etc.
		Other	- Project Management - Transportation Engineering - Harbor Engineering - Numerical Analysis and etc.

Existing education lacks comprehensive understanding of complex development. For example graduates in urban planning may perform planning but have insufficient knowledge of engineering for design.

There are not enough programs in universities for continuing education therefore companies working on complex development are left with single option of expensive on-the-job trainings (OJT). To solve this problem, it is required to reorganize university curriculum of engineering programs. But in existing education exclusive program for complex development is hardly possible. Furthermore, generally four-year programs in universities offer courses of 135~145

credits, therefore it is difficult to teach additional subjects. Thus, education on complex development needs to be promoted through special graduate schools or continuing education institutions.

Questionnaire Survey for Analyzing Complex Development

This study conducted a questionnaire survey of 210 complex development experts regarding university courses in areas of complex development.

According to the results of the questionnaire survey on the types of knowledge required for complex design works, knowledge related to basic planning such as roads, city panning and civil engineering works were being highly utilized as presented in Table 2.

Table 2: Practical knowledge mainly used when executing complex design works

Practical Knowledge	**N**	**(%)**	**Practical Knowledge**	**N**	**(%)**
Road, Block, Earth Work and Arrangement	171	29.5	Soil	16	2.8
Storm Water	158	27.2	Surveying	10	1.7
Waste Water	105	18.1	Structure	10	1.7
Service Water	61	10.5	Other	6	1.0
Pavement	43	7.4			

* Multiple responses are available

While analyzing the subjects related high utility in complex development, it was found that education on roads, block deployment, etc. were being taught only in Urban Engineering discipline and education on rainwater, sewage, pavement, water supply/sewage system, soil, survey, structure, etc. only in Civil Engineering discipline. Therefore, considering that, complex design is an overlapping work between the two majors.

In order to organize the curriculum of complex design in continuing education, this study surveyed detailed jobs and works required in complex design and classified them into 6 groups, and measured their difficulty and importance (Table 3).

The result shows works related to complex design varied in importance and difficulty. It is believed that due to the characteristic of design works and repetition of design among projects are low in difficulty, but works related to licenses & permits and basic planning including earth work at the early stage of projects are less important but highly difficult. It shows that civil engineering majors' participation is low except in engineering areas because of insufficient understanding of other related areas.

Table 3: Difficulty and importance of the works relating to the complex design

Classification	Duty	Work Avg.		Duty Avg.	
		Difficulty	Importance	Difficulty	Importance
Estate Basic Practical Affairs	Surveying	3.64	3.64	3.61	3.19
	Soil	3.59	3.21		
Approval and Relating Laws and Ordinances	Various evaluations and relating organization approvals	3.67	3.05	3.67	3.05
Road and Pavement in the Estate	Road, block earth work and arrangement	1.48	3.53	1.43	3.37
	Pavement	1.31	2.98		
Public / Storm / Waste Water design in the Estate	Storm-water	1.36	3.32	1.31	3.32
	Waste water	1.25	3.42		
	Service water	1.27	3.23		
Structure and Facility	Structure	1.33	3.50	1.29	3.47
	Review the broad area arterial facility connections	1.27	3.45		
Design Statement and Addition	Design statement and addition	3.67	3.05	1.56	3.29

Continuing Education on Complex Development

As discussed above, following skills are required for complex development.

- Abilities to understand, calculate, explain and validate multi-complex designs and to examine facility designs.
- Abilities to understand and apply the protection of environment and to practically apply laws, various licenses and permits, and administrative procedures related to complex development.
- Abilities to estimate the cost of projects and utilize VE/LCC for analyzing feasibility.
- Abilities to coordinate and manage technologies related to civil engineering, construction engineering and urban engineering.

This study suggested 28 areas related to complex development on the basis of questionnaire survey.

Table 4: Continuing education courses for complex development professionals

Area	Course Name	Area	Course Name
General Construction and Safety	Construction Relating Policy and System	Civil Engineering	Civil Quality Test
	Construction Equipment		Surveying and Topographic Space Information
	Safety Health Practical Affair Course		Road Plan and Design, Geometric Structure, Transportation, Construction
Project Management	Construction Management Introduction		Concrete Pavement Design/Construction Practical Affairs
	Economical and Efficient Deriving Methods of the Construction(VE/LCC, EVMS etc)		Construction Statement Practical Affair
	Project Management Introduction		Quality Calculation of the Structure
Civil Engineering	Soil and Foundation		Landscape Method and Default
	Civil Structure		Quantity Calculation of the Earth Work
	Harbor and Costal	Urban Planning and Engineering	Estate Plan
	Road and Airport		Resident Development Plan
	Railway		Execution Plan and Design
	Water Resource Development		Design Influence Evaluation
	Public Water Supply and Sewerage		Environmental Influence Evaluation

In addition, this study derived 15 subjects for high ranking engineers and directors in the area of complex development, and suggested systematized curriculums for each job category as shown in table 5.

Table 5: Complex development education courses for the high ranking engineers and directors

Classification	Course Name
Economics and Management Areas	Macroeconomic Policy
	General Project Management
	Project Financing
	Technique Innovation Policy
	Contract and Technique Relating Laws and Ordinances
	Labor and Management Relationship, etc
Estate Development Professional Areas	Complex Estate Basic
	Approval and Relating Laws and Ordinances
	Estate Development Road and Pavement
	Estate Development Public Water Supply†Storm-water†Waste Water, River Design
	General Structure and Facility Management
	Design statement and addition
IT, Information Areas	Knowledge Management
	Management Information System

Conclusion

This study examined university curriculum of civil engineering and urban engineering programs for the design and construction of major structures in complex development, and investigated the importance of works performed by professionals at the stage of design where the two departments overlap with each other. Through these works, we derived limitations and problems in existing curriculums and understood design works related to complex development, and suggested continuing education courses for enhancing the efficiency of complex development.

However, this study suggested subjects related to complex development by job category only. Thus, there should be further systematic studies on the period of education, the teaching method of each subject, the organization of education staff, etc.

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