

Graduate Study in Public Works Engineering and Management at the University of Florida

Ravi S. Srinivasan¹, Dr. Fazil T. Najafi², Dr. Dennis Y. Fukai³

¹ Graduate Student, Dept. of Civil and Coastal Engineering, University of Florida

² Professor, Dept. of Civil and Coastal Engineering, University of Florida

³ Asst. Professor, Dept. of Design, Construction & Planning, University of Florida

Abstract

Public Works and Infrastructure is a pervasive part of every aspect of urbanized life, and increasingly impacts the human and nature. The scale of infrastructure systems in the United States continues to increase, along with the number of institutions involved in planning and management of the infrastructure. Understanding the societal needs, the Department of Civil and Coastal Engineering at the University of Florida has a separate graduate program, for almost a decade, in Public Works Engineering and Management, one of its kind in the State of Florida, to foster leading edge research in the field of Public Works and Infrastructure Management. The curriculum includes a flexible and wide range of subjects that relate to the facilities managed by Public Works agencies. They include streets, parks, public buildings, highways, water and wastewater management systems and virtually any other asset owned by a Governmental agency. Furthermore, this need extends beyond traditional topics to an examination of customer service, ethics, use of technology, environmental responsibilities, and legal requirements. The responsibilities of the public works manager are becoming increasingly diverse. This paper explores the role of Public Works as an integral part of the society in incorporating entrepreneur skills to graduate students. This paper also details the Graduate Public Works Division at the Department of Civil and Coastal Engineering, University of Florida and various courses offered under the graduate program.

1. Introduction

Public works engineering, management and infrastructure is a pervasive part of every aspect of urbanized life, and increasingly impacts the human and nature. The scale of infrastructure systems in the United States continues to increase along with the number of institutions involved in planning and management of the infrastructure. The United States has a multi-trillion dollar investment in civil infrastructure systems. This investment is used to improve the quality and performance of infrastructure since they are vital to the nation's economic and social well-being. Transcending new knowledge to provide the intellectual support for infrastructure decisions is necessary to the well being of the society. Such knowledge can only be initiated through experience and research that is interdisciplinary.

Understanding the societal needs, the Department of Civil and Coastal Engineering at the University of Florida has a separate graduate program in Public Works Engineering and Management, one of its kind in the State of Florida to foster leading edge research in the field of public works engineering and management. This paper explores the role of public works as an integral part of the society in incorporating entrepreneur skills, engineering and management skills to graduate students. It also details the graduate courses taught at the Public Works Engineering and Management division.

2. Public Works Engineering Education

Most of the public works infrastructures were installed in the first half of this century and the life of those infrastructures are rapidly ending due to wear and tear. This poses a new problem to the public works administrators and infrastructure managers with regards to the job complexities involved during the construction, operation and maintenance of infrastructures. There exists a debate on the present Public Work's educational curriculum, which needs to be renewed owing to the complexities of job assignments¹. The American Public Works Association (APWA) needs to work closely with Universities to assist in educating and delivering successful public works managers².

There are few suggestions to strengthen the existing curriculum to bridge the gap between public works theory and practice²:(1) People skills – understanding human behavior and know-how to use that understanding (2) Administrative and analytical skills – to turn complex problems into rational policy choices and, (3) Financial skills – to run public works agencies effectively and efficiently. Currently, fewer than fourteen universities have any formal curriculum emphasizing public works. The Public Works Division of the Department of Civil and Coastal Engineering at the University of Florida has envisioned starting an International Public Works Center to foster leading edge research in the field of Public Works Engineering and Management³.

3. Public Works Engineering Education at the University of Florida

The Department of Civil and Coastal Engineering at the University of Florida has a Graduate Public Works Division (GPWD), one of its kind in the State of Florida. The GPWD has a separate curriculum with core public works courses that sets students to become future public works leaders. The GPWD curriculum includes a wide range of subjects that relate to the facilities managed by Public Works agencies like: (1) Public Works Planning (2) Public Works Management (3) Construction Scheduling and Planning (4) Site Planning and Feasibility (5) Civil Engineering Systems (6) Municipal Refuse Disposal (7) Legal Aspects of Civil Engineering (8) Developing Leadership Skills (9) Organization Behavior (10) Financial Accounting (11) Geotechnical Engineering (12) Foundation of Air Pollution (13) Mathematical Methods of Statistics (14) Topics in Geographic Information Systems (15) Traffic Signal Operation. Also, the GPWD exposes students, public works managers, and administrators to theory, practice and research. The success of the GPWD is evidently proved by a total of 417 successful students who were advised by Dr. Fazil T. Najafi, as the Group-Coordinator of GPWD, during Spring 1993 and Fall 2001⁴. A wide range of external guest-speakers from various disciplines like construction, structures, transportation, materials, geotechnical,

surveying, coastal, water resources, waste management and facility management frequent and deliver detailed lectures to students and also relate to real-time field problems and solutions.

3.a. Goals

Apart from establishing and maintaining nationally and internationally renowned research and graduate programs in Public Works Engineering and Management, the goals of the GPWD at the Department of Civil and Coastal Engineering, UF are as follows:

- (1) Enhance the graduate program and have more flexibility in course selections to meet the future needs of graduate students in military, public works agencies and international communities.
- (2) Attract the undergraduate students to the Public Works Engineering and Management graduate program.
- (3) Continue to improve the undergraduate, graduate and Ph.D. program and courses in GPWD to meet the needs of national and international communities and needs.
- (4) Develop an International Public Works Center (IPWC) to focus on graduate teaching, research and implementing a new technology transfer program to meet the needs of national and international communities.
- (5) Develop Internet based course and expand course offering on Florida Engineering Education Delivery System (FEEDS).

4. Public Works Graduate Core Courses:

4.a. Public Works Planning:

The course teaches the students the basic concept of planning public works infrastructure with a functional approach. The students will also learn about the various land use, zoning concepts and related planning issues.

The objectives of this course are to enable students to:

- (1) Understand the definition of public works and how public works planning is done
- (2) Develop a functional approach to planning
- (3) Be able to implement public works needs with emphasis on the role of engineer
- (4) Study the evolution of cities and urban planning, land development, site analysis, zoning and landuse maps and plans
- (5) Understand the concepts for ideal comprehensive planning, Planned Unit Development, open space, recreation and conservation
- (6) Undergo field trips to residential, industrial and commercial landuse properties.

Public Works Planning course is taught at the Department of Civil and Coastal Engineering at UF by Dr. Fazil T. Najafi and a total of 99 students had enrolled and successfully completed between Fall 1998 and Summer 2001⁴. Students with varied backgrounds ranging from Environmental Engineering, Transportation, Construction Management and Business Management enroll to this course.

4.b. Public Works Management:

The goal of this graduate course is to further define Public Works by giving an overview of Public Works organizations, communications, equipment management, finance, planning issues, water resources, solid waste management, and legal aspects involved in Public Works.

The course teaches the students the basic concepts of managing public works organizations, leadership qualities and the art of communicating with different people within these organizations. The student will also learn about financial and legal aspects involved in public works. Furthermore, students will learn to identify public works problems and how to determine possible solutions.

The objectives of this course are to enable students to:

- (1) Understand the definition of public works and how public works organizations are managed
- (2) Develop leadership and communication skills, which are basic requirements of any manager
- (3) Be able to understand the financial aspects concerning public works activities
- (4) Apply knowledge gained from previous civil engineering courses to solve public works engineering problems
- (5) Study legal aspects in public works
- (6) Understand fleet management, building and grounds, street and highways, traffic, solid waste, water supply, and future issues in infrastructure.

Between the period Fall 1996 and Summer 2001, a total of 101 students had enrolled and successfully completed the Public Works Management graduate course under the guidance and professorship of Dr. Fazil T. Najafi⁴.

4.c. Public Works Elective Courses:

Since public works infrastructure extends to streets, parks, public buildings, highways, water and wastewater management systems, there is a need to understand beyond traditional topics to an examination of customer service, ethics, use of technology, environmental responsibilities, and legal requirements. The other required graduate courses with the Public Works engineering and management are:

Other Public Works elective courses include:

- (1) Construction Planning and Scheduling: Planning, scheduling, organizing and control of civil engineering projects with Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT). This course also teaches students on the application of optimization techniques.
- (2) Site Planning and Development: Principles and practices of land development including market analysis, site analysis, project programming, and financial feasibility.
- (3) Civil Engineering Systems: Civil engineering applications of operations research techniques, models of scheduling, linear programming, queuing theory and simulation.

- (4) Municipal Refuse Disposal: Quantities and characteristics of municipal refuse and hazardous materials. The students also learn the collection methods, transfer stations, equipment, cost, refusal disposal practices and regional planning.
- (5) Legal Aspects of Civil Engineering: Engineer's view of contracts for design and construction, legislation and policy affecting labor-management relationships in construction.
- (6) Developing Leadership Skills: Concepts of leadership theory and methods to improve leadership skills.
- (7) Organization Behavior: Relationship between the individual administrators and supervisors, the employees supervised and associate at a comparable level in the organization.
- (8) Financial Accounting: Introduction to accounting for prospective managers. The students are taught with a primary emphasis on financial analysis and reporting.
- (9) Geotechnical Engineering: Topics include shallow foundations, bearing capacity, settlements, deep foundations, pile testing, earth pressures, excavations, retaining structures, and dewatering.
- (10) Foundation of Air Pollution: The students learn the principal types, sources, dispersion, effects, physical, economical and legal aspects of control of air pollutants.
- (11) Mathematical Methods of Statistics: Topics include probability and statistics, particularly discrete and random variables, sampling distributions, estimations and hypothesis testing towards application in engineering and natural science.
- (12) Topics in Geographic Information Systems (GIS): The students learn GIS database development, economic impact of GIS, development of standards, integration of data-sets, hardware and software developments, and advances in GIS technology.
- (13) Traffic Signal Operation: Topics include traffic control equipment, Manual of Uniform Traffic Control Devices (MUTCD) requirements, design and analysis of signal timing plans for simple problems.

5. Research

Public works infrastructure management is multidisciplinary and includes all aspects of Civil Engineering, e.g. construction, structures, transportation, materials, geotechnical, surveying, coastal, water resources, waste management and facility management. Because of the multidisciplinary nature of the Public Works infrastructure, there are many opportunities for inter-disciplinary research with Public Works and the other Civil Engineering areas. Some of the possible research collaborations include safety of public workers during highway reconstruction and maintenance, alternative construction methods and techniques to expedite reconstruction, management of traffic during highway projects, performance based Quality Assurance and Quality Control tests, strategies to minimize construction delays, development implementation and evaluation of performance based specifications for highway construction and workforce training and development.

6. Conclusion

The GPWD has been a success in its objective by developing and fostering leading edge research and educational programs in Public Works Engineering and Management. Furthermore, the GPWD is in discussion with the American Public Works Association (APWA) to set up a

separate International Public Works Center (IPWC) at the Department of Civil and Coastal Engineering, UF for the dissemination of knowledge in Public Works³. There are also other schools in the United States of America providing graduate program in Public Works. Varied background students ranging from Environmental Engineering, Transportation, Construction Management, Business Management attend courses taught at the GPWD. This enables wider pool of students with varied experience to discuss and disseminate the knowledge. The GPWD will identify, disseminate, and implement solutions to both long-term and short-term infrastructure problems and integrate a broader range of perspectives and disciplines into public works. Also, the Division will coordinate and promote interaction among international groups and agencies that deal with public works issues, evaluate emerging technologies, concepts, and procedures that may provide significant benefit to public.

7. Bibliography

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8. Biographical Information

RAVI S. SRINIVASAN

Ravi S. Srinivasan is a graduate student at the Graduate Public Works Division, Department of Civil and Coastal Engineering, University of Florida. His interest lies in the effective management in the assembly, inspection and maintenance of civil infrastructures and public works.

DR. FAZIL T. NAJAFI

Dr. Fazil T. Najafi is Professor and Coordinator of GPWD at the Dept. of Civil and Coastal Engineering, at UF. His research focuses on diverse areas such as the development of User Cost Data for Florida's Bridge Management Systems, Radon Reduction in the construction of new houses, the Oil Spill Response System in Florida, methods to reduce Urban Congestion, Transportation Planning and Cost Optimization, including Maglev systems, High Speed Rail, Tort Liability related to utility, Public Works Planning and Management, Construction Engineering and Management, Legal Aspects of Engineering and Engineering Cost Analysis. Current research involves in the evaluation of Flowable Fill in Florida.

DR. DENNIS Y. FUKAI

Dr. Dennis Y. Fukai is Assistant Professor at the School of Building Construction, at UF. His early research at the University of California, Berkeley, produced scaled animations of the assembly of a small building generated from a graphical database. Applications for his research include a visual approach to project management, 3D construction documents, and interactive education. Commercial services include 3D preconstruction model, project visualization, and sequence modeling.

