Prospectus for Substantive Change

DOCTORAL PROGRAM IN CIVIL ENGINEERING

Presented to:
Commission On Colleges
Southern Association of Colleges and Schools
795 Peachtree Street, N.E.
Atlanta, Georgia 30365

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Florida International University
Miami, Florida

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I. Rationale for the Change

A. Goals and Objectives

1. Provide highly trained professionals, at the Ph.D. level in Civil Engineering, to serve the governmental and private sectors, in academic and professional positions at the local, state, and national levels.
2. Help satisfy the need of existing engineers to obtain a doctoral degree in this important subject area.
3. Provide "place-bound" students (many of whom are minorities) a greater opportunity for advanced graduate study.
4. Supply additional minority graduates to advanced civil engineering fields, where minorities are inordinately underrepresented.
5. Encourage graduates to extend their careers and join the academic teaching force.
6. Enhance the reputation of FIU through increased research and publications.
7. Help attract more "high-tech" industries to Dade County and Florida.
8. Provide local industry and business with advanced courses to reinforce professionals in the latest technologies.

B. Level and Emphasis

This is a graduate program at the doctorate level for students with a baccalaureate or master's degree in engineering or science (see admission requirements below). The student that enters this proposed program must have a strong background in math through differential equations, physics (with calculus), engineering science, civil engineering, environmental engineering, and computer applications. This background is required for the emphasis of the program, which includes advanced courses in air pollution, water pollution, water resources, waste management, soil contamination, geotechnical engineering, transportation, construction, structures, computer applications, and a dissertation.

C. Needs that Elicited this Program Response

The list below gives a concise summary of pertinent data from various sources.

1. National statistics reflect a need for doctorate engineers

(a) According to the "National Science Board: Science & Engineering Indicators - 1996," Undergraduate enrollments have grown moderately from 1978 to 1993 (1.6 percent) across the total population of students, but some minority groups have significantly increased their access to higher education. However, the rate of increase of total number of engineering students slowed down since 1983. Declining enrollments are not evenly distributed among major specialties: 1994 enrollments in mechanical and aerospace

engineering have declined and enrollments in civil and environmental engineering have increased. This trend coupled with the anticipated loss of 20% of U.S. engineering faculty due to retirement in the next 10 years, indicates even worse future shortages of Ph.D.'s in engineering, both in industry and education. To overcome these expected shortages, it is imperative to increase the number of Ph.D.'s in the near future. It is documented that since about 1977, there have not been enough doctorates to fill open faculty positions, much less industry positions, and this trend will continue over the next ten years (and probably longer).

(b) The severe decline of U.S. citizens and minorities at the doctorate level is also of national importance. By 1985, the ratio of U.S. citizens per thousand with earned engineering doctorates dropped to 0.3 (from 1.01 in 1970). The share of Hispanics with earned doctorates dropped from 1% in 1986 to 0.90% in 1995; FIU can alleviate this situation since the majority of our local population is composed of Hispanics. (Source: *ASEE, Directory of Engineering Graduate Studies and Research*, 1995-1996). Currently, at the undergraduate level, FIU's student profile includes 54 percent Hispanic and 13 percent Black students. In the Master's Degree programs in engineering at FIU, 34 percent are Hispanic and 8 percent are Black students. (Source: *Fact Book, State University System of Florida*, 1994-1995).

2. Florida statewide statistics show a need for doctorates in Civil and Environmental Engineering

(a) Present trends indicate that the demographics of the engineering work force and its supporting infrastructure is likely to become more diverse with increasing numbers and proportions of women, minorities, and foreign nationals. Our College could excel in this area by becoming a major source of Hispanic and Black engineers, providing a constructive impact on engineering, not only statewide, but nationwide. At the graduate level, 34 percent of students enrolled in Master's Degree programs in engineering are Hispanic and 8 percent are Black. These numbers are significantly lower at the State level. Statewide, there are only 8.6 percent Hispanic and 7.4 percent Black enrollment in the Master's Degree programs. (Source: *Fact Book, State University System of Florida*, 1994-1995).

(b) Graduate programs in all areas of engineering at FIU will help the university become part of the focus of government and industry on research and graduate education.

The following excerpts from the FIU mission statement provide additional reasons why the SUS should initiate the proposed program at FIU:

(1) "Among the most urgent needs are for greater capacity to assist meeting needs in high technology industries..."

(2) "The projected growth and diversity of the area requires the University to be responsive to international business, high technology industry..."

(3) "Preparation of men and women for work in the urban professions-business, education, and engineering are emphasized.."

(4) "...the University offers degree programs at the bachelor, master, and doctoral levels, conducts basic and applied research, and provides public service."

The goals of the proposed program are in close conformity with these approved institutional mission statements: In engineering, the Ph.D. is the terminal degree and a required credential for university faculty positions, as well as job entry in certain high technology positions.

One of FIU's institutional goals is to "become a major international education center by helping to create greater understanding among the peoples of the Americas and of the world." Based on the interest expressed by both local and international agencies, the Ph.D. in Civil Engineering will attract foreign students; and the graduate curriculum will appeal universally to high technology interests.

Graduates of this program are needed statewide and nationally in the job market. Therefore, since the quality of education is judged at least in part by how the graduates are sought by industry and other institutions, this program will improve the overall quality of educational offerings at FIU and thus the SUS.

By serving the local community, the proposed program will help increase the representation of minorities, especially Hispanics, in governmental and private industry (in fields of research and development, space program, defense, etc.), and in public and private teaching institutions.

Civil and Environmental Engineering is a high quality discipline required by society to improve the standard of living, and to help

solve society's major problems (restoration of the environment, waste management, etc.).

In Reaching for the Top, the University Planning document, six strategic themes are identified: international, urban, environmental, health, transportation, and information system. The Department of Civil and Environmental Engineering will play a major role in all these areas. Two of them, environmental and transportation are distinct disciplines of this department. In the international area, the department will provide education to international students, and training to engineers through on-going and future collaborative agreements. In the information area, there is potential and there are on-going efforts for development among others in the area of Geographic Information Systems.

Approval of a Ph.D. in Civil Engineering is of **vital importance**, not only for our College, but for the University and the community at large. We could become the major source of minority Ph.D. engineers in the state and nation.

(c) The largest educational challenge in the State is to renew and revitalize the engineering faculty and curricula, where the state of knowledge changes so rapidly. This can only be accomplished through a strong, high quality engineering college, which of course implies the existence of Ph.D. programs.

(d) The Ph.D.C.E. program is included in the Master Plan of the Board of Regents.

3. Summary of prospective student inquiries

(a) Based on the survey conducted among the graduate students enrolled in Civil and Environmental Engineering program, more than 50% of the respondents expressed an interest in obtaining the Ph.D.C.E. degree at FIU.

(b) Approximately 1/3 of our current graduate students anticipate continuing on their Ph.D. program at FIU. Six students are expected in the 1st year and 16 by the 5th year.

4. Additional facts that establish the need for the program

(a) Letters from industry indicate strong support and need for the program.

(b) At the University of Miami, there are about 20 students enrolled

(Fall 1996) in a similar program; this illustrates a current pool of students who aspire to this degree.

(c) Graduate engineering enrollment has increased steadily in our College since the implementation of two graduate programs in 1985. Headcount enrollment in the Civil Engineering Department is shown below:

GRADUATE ENROLLMENT IN THE DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING AT FLORIDA INTERNATIONAL UNIVERSITY

FALL 1993			FALL 1994			FALL 1995			FALL 1996		
Civil Eng	Env Eng	Total	Civil Eng	Env Eng	Total	Civil Eng	Env Eng	Total	Civil Eng	Env Eng	Total
18	32	50	26	26	52	35	19	54	35	34	69

Graduate enrollment in the Master's programs in both Civil Engineering and Environmental Engineering is steadily increasing. The total for both Master's programs was 50 students in 1993, 52 students in 1994, 54 students in 1995, and 69 students in 1996.

Nationwide, according to *ASEE, Directory of Engineering Graduate Studies and Research*, 1994-1995, 8.1% of the students enrolled at the engineering Master level continue their education toward a Ph.D. in engineering. This would represent a significant number of students at the Ph.D. level in Civil Engineering, if approved.

(d) Research activities, even without established Ph.D. programs, have been significant. The tables below illustrate the level of research activities in the School of Engineering.

RESEARCH DOLLARS

UNIT	89/90	90/91	91/92	92/93	93/94	94/95	95/96
ENG.	$1,599,736	$2,412,059	$3,332,251	$4,063,353	$5,439,939	$6,189,912	$8,720,709
CIVIL ENG.	$334,400	$592,565	$441,364	$1,639,990	$490,941	$2,010,831	$2,025,079
CE/ENG %	21%	25%	13%	40%	9%	33%	23%

Funded research increased from $334,400 in 89/90 to $2,025,079 in 95/96.

(e) The excellence demonstrated by educational institutions acts like a magnet, drawing top talent to a region. A good example is New England. A student who graduates from a New England school is likely to continue living in the region. Lynn Browne of the Federal Reserve Bank of Boston has been quoted as saying that, "Almost all scientists and engineers living in New England received their last schooling there; conversely, very few of those living in the region were educated somewhere else. Such a pattern makes a persuasive case that New England institutions of higher education play a vital role in attracting and retaining professional manpower."

Clientele for this program will come from several sources: graduates of FIU, other SUS universities, and other Florida non-SUS institutions; practicing engineers in South Florida, out-of-state, and foreign graduates. Due to the high percentage of minorities in this area and in engineering at FIU, we expect this proposed doctoral program to continue a trend of having a significant percentage of minority clientele. (Please see BOR Table One for details and estimated numbers in the above mentioned sources.) State and local clientele will come from many organizations. Examples of local agencies include South Florida Water Management District, Metropolitan Dade County Department of Environmental Resource Management, Metropolitan Dade County Department of Public Works, Metropolitan Dade County Department of Solid Waste Management, Miami-Dade Water and Sewer Authority Department, Florida Power and Light. Examples of private organizations include Wingerter Laboratories, Baljet Environmental, Metcalf & Eddy, Inc., Law Environmental, Inc., and Hazen and Sawyer. Examples of Federal Agencies include NASA, U.S. Environmental Protection Agency, U.S. Geological Survey, Department of Agriculture, Department of Energy, Department of Defense, and Department of Transportation.

(1) <u>Individuals drawn from Agencies/Industries in the service area (e.g., older returning students):</u>

There are approximately 6,000 engineers employed by industry in Southeast Florida from which, it is projected, a small percentage will enter the Ph.D. program at FIU. Several have already expressed interest. At least four are

anticipated in the 1st year of the program and seven by the 5th year.

(2) **Students who transfer from other graduate programs within the university:**

There may be transfers anticipated from other FIU majors to the department, especially in the area of environmental engineering (e.g., geology, biology, environmental studies, mechanical engineering, and others), as shown in BOR Table One. At least two are expected by the 5th year.

(3) **Individuals who graduated from preceding degree programs at other SUS universities:**

In some cases, graduates of one university may prefer to obtain a graduate degree from a different university to diversify their studies and research. The Florida SUS system graduates approximately 1700 bachelor's and 400 master's degrees in all engineering (Engineering Review 1987, Hogan). FIU expects to get a small percentage of this 400 as transfer students to the Ph.D. program. (Recall the 400 is **all** engineering.) One student is expected at the beginning of the program and about four by the 5th year.

(4) **Individuals who have graduated from preceding degree programs at non-SUS Florida colleges and universities:**

These numbers are based on existing (and projected) enrollments at the only non-SUS university in this area (the University of Miami and Florida Institute of Technology). Many of these students would prefer access to a State supported university. At the present time, we already have four such prospective Ph.D. students. Three students are anticipated by the 5th year.

(5) **Additional in-state residents:**

There are no other institutions beyond those covered in other categories that could supply students from accredited B.S. programs, since all applicants **must** have a degree.

(6) **Additional out-of-state residents:**

It is estimated that the new program and the location of the university will attract some out-of-state students. One

student is anticipated at the beginning of the program and three by the 5th year.

(7) Additional foreign residents:

At the Ph.D. level nationally, foreign students represent 49% (*ASEE, Directory of Engineering Graduate Studies and Research*, 1994-1995) of all engineering degrees (they represent 31% at the M.S. level). Therefore, it is predicted conservatively that about 15% of new Ph.D. students will be in the "other" category. The location of the university will attract several students from South America. Three prospective foreign Ph.D. students from abroad have already (two with FIU M.S.C.E. degrees) expressed strong interest in pursuing their Ph.D. degree at FIU. Two students are expected at the beginning of the program and about six by year five.

The Master Plan Update 1986-2001, approved by the Board of Regents, projects graduate FTE enrollment in engineering to increase from 34 to 266. It is projected that the enrollment in the Ph.D. Engineering degree program can reach 10% of the overall projected graduate FTE's in engineering five years after implementation.

The State and its engineering colleges should aggressively promote engineering education among women and minority pre-college student population. Funding should be provided for innovative programs that address this problem.

It is strongly believed that a Ph.D. program in Civil Engineering is one of these innovative programs.

II. Legal Authorization for the Change

The Implementation proposal for the Ph.D. Program in Civil Engineering is currently before the Florida State University System Board of Regents. The Board of Regents, acting for the State of Florida, will authorize FIU to initiate this program.

III. Proposed Timetable for the Ph.D. in Civil Engineering

The process to determine the feasibility and to plan this program has occurred over the past few years. The current implementation plan that was submitted to the Board of Regents (4/97) was developed from previous work and new sources. The schedule for implementation is as follows:

July 1997 Board of Regents Summer Meeting

	Approval Pending
August 1997	Counsel and Advise Students Review/Approve Applications
August 25, 1997	Fall Courses Begin First Student Enrollment

IV. Description of Program, Including Admission Requirements or Procedures, Instruction, Curriculum, and Graduation Requirements.

A. Admission Requirements

The requirements for admission to the doctoral program in Civil Engineering are:

1. Applicants having a Master's degree in Civil Engineering or Environmental Engineering from a U.S. institution must satisfy the following requirements for admission to the doctoral program:

   a. GPA of at least 3.3/4.0 in the master's program
   b. GRE verbal plus quantitative of at least 1000 points
   c. Three letters of recommendation in the forms provided by the department

2. Credentials of all other applicants including those with foreign degrees and those with B.S. degrees in other disciplines will be examined by the Graduate Admission & Review Committee on a case by case basis.

3. Non-English speaking natives should have a TOEFL score of at least 550 points.

In addition to the departmental requirements, all students must satisfy the University's Admission and Graduate Policies and Procedures.

B. Graduation Requirements

Maximum Length of Study: the maximum length of study should be 7 years for students admitted with a B.S. degree and 6 years for students with an M.S. degree. For those students who have not completed their studies within these limits, the length of study can be extended on a yearly basis after petition by the student and approval by the student's supervisory committee.

Identification of Research Area: Within 15 months upon acceptance into the Ph.D. program, the student has to identify an area of research of his/her interest. There are currently three main areas of research or specialization: (1) Structural and Geotechnical Engineering; (2) Environmental and Water Resources Engineering; and (3)

Transportation Engineering. The student has to contact the Department for a list of all faculty members, visit them, and be accepted by one professor willing to guide the dissertation research.

Course Requirement: The program will consist of at least 90 semester credit hours beyond the baccalaureate degree, 66 hours of which are course work and 24 hours dissertation, or at least 60 semester credit hours beyond the M.S. degree, 36 hours of which are course work and 24 hours dissertation. A central requirement is completion and oral defense of a dissertation based upon original research. The selection of courses must be structured based on the rules that follow. A list of core and elective courses also follows:

1. Minimum credits in Mathematics 6
2. Minimum 6000 or higher level credits in Civil & Environmental Engineering 21
3. Minimum total credits in Civil and Environmental Engineering 42
4. Minimum core credits in each of the three major areas in Civil and Environmental Engineering (core courses follow) 18
5. Maximum credits outside Civil & Environmental Engineering and Mathematics (with advisor's approval) 18
6. Minimum Dissertation credits 24
7. Total minimum credits beyond the B.S. degree 90
8. Total minimum credits beyond the M.S. degree 60
9. Additional engineering courses (3000 and 4000 level) may be required as deficiencies for students coming from non-engineering majors.
10. All courses and dissertation topics must be approved by the student's advisor in consultation with the student's supervisory committee.

Supervisory Committee: The student's supervisory committee should be appointed as soon as possible within the 15-month period after the student has been admitted to the Ph.D. program. The committee should have at minimum five members, at least three from the Department of Civil and Environmental Engineering, and at least one from outside. All committee members should have a Ph.D. degree.

Residency Requirements: The Ph.D. student should spend at least one academic year in full residency, after successfully passing his/her Comprehensive Examination (see following description).

Examinations: Students must demonstrate graduate knowledge acquisition in three incremental stages in order to be awarded a Ph.D. degree in Civil Engineering:

Stage I - Qualifying Examination: the student must successfully pass a Qualifying Examination based on the student's course work. This examination will take place at a time determined by the student's graduate advisor and supervisory committee and as soon as possible after the student has completed at least 48 credits of course work. This exam cannot be taken later than the semester the student has completed 66 credits of course work. The Department will be announcing each semester the dates of the Qualifying Exams and the students who are candidates to take it. The exam will have two parts. Part A applies to all students within each major area, and contains 8 to 10 problems from the core courses. Students select 6 problems to solve. The exam will be given in one designated room and will last 8 hours and will be open-book. Part B is specific to each student's area of specialization, will be prepared by the advisor and supervisory committee, and will contain problems within each student's main area of research. The examination will last one weekend (i.e., problems will be given to the student at 5:00 pm on a Friday and returned by 9:00 am on the following Monday) and will be also open-book. All exams will be graded within a month from the date of the examination. Each student will be informed in writing about his/her overall performance. A student can only fail this exam once. If the student fails the exam, the student will have to take it again the following semester.

Stage II - Comprehensive Examination (Proposal Presentation): the student must successfully complete a Comprehensive Examination. The examination will be in the format of a graduate seminar. It will consist of presenting a dissertation proposal in front of the supervisory committee, other faculty members, students and visitors. The proposal has to be prepared based on the guidelines for thesis preparation and have the approval of the advisor and the supervisory committee. In the proposal the student has to demonstrate that the work is original and of practical significance to the profession, and that he/she has adequately been prepared to undertake it as determined by the majority of the committee. Preliminary results of the work in progress should also be presented (i.e., the proposal will ideally be presented one year before the expected graduation but not later than the end of the fourth year). A student can fail the Comprehensive Exam only twice (i.e., a student can take this exam a total of 3 times).

Stage III - Final Oral Defense: the student must conduct the proposed research, write a dissertation and successfully complete the oral defense of the work as determined by the majority of the supervisory committee. The defense will be in the format of a graduate seminar. Final defense should take place no later than the end of the seventh year after admission with a BS degree or the sixth year after admission with an MS degree unless an extension has been granted (see previous description for length of study). A student can fail the Final Oral Defense only twice. Following a successful defense of the dissertation, as determined by a majority vote of the student's supervisory committee, the dissertation must be forwarded to the Dean of the College of Engineering and Design and the Dean of Graduate Studies for their approvals. All dissertations should also conform to the University guidelines (see "Regulations for Thesis and Dissertation Preparation"). One final approved bound copy of the dissertation

should be delivered to the Chairperson of the Department of Civil and Environmental Engineering, one to the advisor and one to each member of the supervisory committee. Additional copies must be given to the Division of Graduate Studies as specified by the University guidelines.

C. A SEQUENCED COURSE OF STUDY (CORE AND ELECTIVE COURSES)

The following is a list of graduate courses that may be taken.

Mathematics: 6 credits beyond advanced differential equations selected from the following list (based on student needs, research needs and advisor's approval):

MAD 5405	Numerical Methods
MAP 5236	Mathematical Techniques of Operations Research
MAP 5316	Ordinary Differential Equations
MAP 5317	Advanced Differential Equations for Engineers
MAP 5326	Partial Differential Equations
MAP 5407	Methods of Applied Analysis
MAS 5145	Applied Linear Algebra
STA 5126	Fundamentals of Design of Experiments
STA 5236	Regression Analysis
STA 5676	Reliability Engineering
STA 5800	Stochastic Processes for Engineers
STA 6807	Queuing and Statistical Models
New course	Partial Differential Equations

Civil & Environmental Engineering: 60 credits selected from the following list can be taken as core courses or electives. Core courses in each of the following three major areas are indicated with an *:

Major Area in Structural and Geotechnical Engineering:

CCE 5035	Construction Engineering Management
CCE 5505	Computer Integrated Construction Engineering
CEG 5065C	Geotechnical Dynamics
CEG 6017	Theoretical Geotechnical Mechanics *
CEG 6105	Advanced Foundations Engineering *
CES 5106	Advanced Structural Analysis *
CES 5565	Computer Applications in Structures *
CES 5606	Advanced Structural Steel Design *
CES 5715	Prestressed Concrete Design *
CES 5800	Timber Design
CES 6706	Advanced Reinforced Concrete Design *
CGN 5320	GIS Applications in Civil and Environmental Engineering
CGN 5905	Directed Independent Study
CGN 5930	Advanced Special Topics in Civil Engineering
CGN 6916	Engineering Project

CGN 6939	Graduate Seminar
CGN 6XXX	Advanced Topics in Artificial Intelligence
CGN 6XXX	Advanced Topics in GIS Applications for Civil and Environmental Engineering
CGN 6XXX	Expert Systems in Civil Engineering
EGM 5111	Experimental Stress Analysis
EGM 5351	Finite Element Methods in Mechanics *
EGM 5421	Structural Dynamics *
EGM 6533	Advanced Mechanics of Materials *
EGM 6653	Theory of Elasticity *
EGM 6675	Advanced Plasticity
EGM 6736	Theory of Elastic Stability *
EGM 6796	Theory of Plates and Shells *
EGM 6XXX	Advanced Structural Dynamics in Civil Engineering
EGM 6XXX	Structural Reliability
EGN 5455	Numerical Methods in Engineering

Major Area in Environmental and Water Resources Engineering:

CGN 5320	GIS Applications in Civil and Environmental Engineering
CGN 6XXX	Advanced Topics in Artificial Intelligence
CGN 6XXX	Advanced Topics in GIS Applications for Civil and Environmental Engineering
CWR 5235	Open Channel Hydraulics *
CWR 5251	Environmental Hydraulics
CWR 6117	Statistical Hydrology
CWR 6125	Groundwater Hydrology *
CWR 6126	Advanced Groundwater Hydrology
CWR 6236	Engineering Sediment Transport
EES 5135	Water Quality Indicators
EES 5137	Biological Monitoring of Freshwater Ecosystems
EES 5506	Occupational Health
EES 5605	Noise Control Engineering
EES 5606	Environmental and Human Factors
EES 6508	Occupational Health and Toxicology
EGN 5455	Numerical Methods in Engineering
ENV 5002C	Fundamentals of Environmental Engineering *
ENV 5007	Environmental Planning
ENV 5008	Appropriate Technology for Developing Countries
ENV 5062	Environmental Health
ENV 5065	Vector and Pest Control
ENV 5105	Air Quality Management *
ENV 5116	Air Sampling Analysis
ENV 5126	Air Pollution Control
ENV 5334	Spill Response and Hazardous Materials Transport
ENV 5335	Advanced Hazardous Waste Treatment Processes *
ENV 5356	Solid Wastes *

ENV 5512	Water and Wastewater Analysis *
ENV 5512L	Water and Wastewater Analysis Laboratory
ENV 5517	Water and Wastewater Treatment *
ENV 5659	Regional Planning Engineering
ENV 5666	Water Quality Management *
ENV 5905	Independent Study
ENV 5930	Special Topics in Environmental Engineering
ENV 5XXX	Reactor Design
ENV 6045	Environmental Modeling
ENV 6070C	Pollution Prevention
ENV 6510C	Advanced Unit Operations I *
ENV 6511C	Advanced Unit Operations II *
ENV 6511L	Advanced Unit Operations II Lab *
ENV 6516	Advanced Treatment Systems
ENV 6558	Industrial Wastewater Treatment
ENV 6615	Environmental Impact Assessment *
ENV 6916	Engineering Project
ENV 6935	Graduate Environmental Seminar *
ENV 6XXX	Engineering Assessment of Metal Contaminants and Colloidal Transport

Major Area in Transportation Engineering:

CCE 5035	Construction Engineering Management
CCE 5505	Computer Integrated Construction Engineering
CGN 5320	GIS Applications in Civil and Environmental Engineering
CGN 5905	Directed Independent Study
CGN 5930	Advanced Special Topics in Civil Engineering
CGN 6916	Engineering Project
CGN 6XXX	Advanced Topics in Artificial Intelligence
CGN 6XXX	Advanced Topics in GIS Applications for Civil and Environmental Engineering
CGN 6XXX	Expert Systems in Civil Engineering
EGN 5455	Numerical Methods in Engineering
TTE 5007	Transportation Systems in Developing Nations
TTE 5015	Applied Statistics in Traffic and Transportation
TTE 5100	Transportation and Growth Management
TTE 5107	Highway Safety Analysis
TTE 5205	Advanced Highway Capacity Analysis *
TTE 5215	Urban Traffic Characteristics *
TTE 5805	Advanced Geometric Design of Highways *
TTE 5835	Pavement Design *
TTE 5925C	Urban Traffic Workshop
TTE 5930	Transportation Seminar
TTE 6257	Traffic Control Systems Design *
TTE 6506	Urban Mass Transit and Transportation Planning *
TTE 6526	Airport Planning and Design *
TTE 6606	Transportation Systems Modeling and Design *

TTE 6607	Transportation Demand Analysis *
TTE 6650	Transportation and Land Development
TTE 6837	Pavement Management Systems *
TTE 6XXX	Bearing Capacity of Roads and Airfields
TTE 6XXX	Pavement Maintenance and Rehabilitation
TTE 6XXX	SUPERPAVE Asphalt Mixture Design and Analysis
TTE 6XXX	Transportation Network Analysis
TTE 6XXX	Port Planning and Development
TTE 6XXX	Planning and Design of Intermodal Facilities
TTE 6XXX	Airport Terminal Design and Operations

Other Engineering and Science: a list of other courses from other engineering departments or from science may be taken as electives (up to 18 credits with advisor's and supervisory committee's approvals). A list follows:

Engineering courses:

EGM 6570	Fracture Mechanics
EIN 5322	Engineering Management
EIN 5359	Industrial Financial Decisions
EIN 6357	Advanced Engineering Economy
EML 5125	Classical Dynamics
EML 5709	Intermediate Fluid Mechanics
EML 6233	Fatigue and Failure Analysis
EML 6532	Advanced CAD/CAE
EML 6712C	Advanced Fluid Mechanics
EML 6725	Computational Fluid Dynamics

Science courses:

Specific to the student's research area and topic and following advisor's and supervisory committee's approvals.

Dissertation: 24 credits

CGN 7XXX Dissertation

V. Identification of Resources Required to Support the Program, Including Financial Resources

A. Resources to be Dedicated to the Program

The new Engineering and Applied Science (EAS) building has enabled the department to allocate additional laboratory space to house necessary research equipment. Library holdings are adequate. Also, there exists a good interlibrary loan service. Most faculty are currently involved in research and are supporting graduate students at the M.S. level.

Of course implementation of the Ph.D. program will require additional faculty

members, office and laboratory space, and research equipment to accommodate a larger faculty and graduate student population. But the space problem has been resolved with the move into the EAS building. In addition, teaching assistantships and tuition waivers for graduate students will be required to allow continuity of research projects and efforts.

This program will enhance existing cooperative efforts between the Department of Civil and Environmental Engineering and several other departments, schools or research centers at Florida International University, such as the: Drinking Water Research Center, Hemispheric Center for Environmental Technology, Landscape Architecture, Geology, Chemistry, Mechanical Engineering, and Construction Management, among others. For example, interrelated research projects exist, and new ones will be initiated, by these departments working together to produce stronger proposal teams for funding. This will provide research topics for Ph.D. students at the same time. These departments will continue to share courses and certainly share even more courses after implementation of the proposed program. In addition, students in the Ph.D. program will be required to take advanced graduate courses in Mathematics, Physics, Chemistry, and Computer Science, according to their areas of specialization.

The FEEDS (Florida Engineering Education Delivery System) program serves the universities of the State of Florida. Students in the Ph.D. program will be allowed to take up to 12 credits from any other university, including those in the SUS served by FEEDS.

In addition to collaboration with local universities, there are collaborative agreements between the department and universities or government authorities in South America, such as with Brazil and Colombia, among others. The Ph.D. program will enhance/expand these existing opportunities.

The proposed Civil Engineering Ph.D. program at FIU will serve the local population by providing a highly sophisticated doctoral program in civil engineering. The only private local institution that offers the degree is the University of Miami. The cost of studies at the University of Miami makes it inaccessible to many students requiring financial assistance.

B. Needed Resources for Implementation

One of the areas in need of increased resources is the library. That is, acquiring new volumes, periodicals and journals specifically related to civil and environmental engineering, and updating the current holdings on civil and environmental engineering related subjects. The cost of journals consists of a expenditure for back issues and continuing subscriptions.

Some research equipment will be necessary to accommodate a larger and more advanced student population due to the implementation of the proposed program.

Teaching assistantships (TA's) and tuition waivers for graduate students will be necessary.

We expect to recruit three new faculty over the next three years. BOR Table Two shows a summary of resources needed over the next three years. The information is shown in the attached BOR Table Two. The shift of instructional effort to the new program will be small since many existing Civil and Environmental Engineering courses are also suitable for first year Ph.D. students, and new graduate courses can be taken by both M.S. and Ph.D. students as well.

Financial Resources with Specific Budget for the first and fifth years is shown in BOR Table Three.

VI. Faculty, Qualifications, and Teaching Assignments

FIU's current capability to offer a Ph.D. program in Civil engineering is excellent. There are currently sufficient faculty and expertise. As of today, there are 17 full-time faculty members (6 full professors, 2 associate professors, 8 assistant professors, and 1 instructor), 2 adjunct professors, and 5 research professors. There are also a number of visiting professors and research associates that are involved in both research and teaching.

A completed roster provides information regarding current faculty members who will participate in the proposed program, their rank, highest and next highest degrees earned, university granting degree, academic discipline, and teaching assignment.

VII. A Description of the Processes for Evaluating the Effectiveness of the Program, and How the Results of Evaluation Will Be Used to Make Any Necessary Changes to the Program

The faculty of the Department of Civil and Environmental Engineering will function as committee of the whole to develop and monitor all aspects of the proposed program. New faculty and consultants with doctoral level supervisory experience will provide further development and monitoring expertise.

The progress of students through the Curriculum will be followed. Course evaluations, graduate seminars, and informal discussions with graduate assistants will be used for initial feedback. Upon graduation former students will be surveyed about research/teaching/advanced practice settings will de determined.

The following University process will also occur:
"As part of this process of institutional effectiveness, qualitative and quantitative measures are evaluated annually using standardized measures for every program. These outcome measures are published each year by the Division of Graduate Studies as part of the Graduate Programs Annual Report. This report provides data and information

which can be used by program faculty, department chairs, and the academic dean to determine what resources are needed and what modifications are necessary to increase program effectiveness. The Faculty Senate Graduate Council, working with the Dean of Graduate Studies, uses this report to monitor graduate program development. This assessment also assists in maintaining program accreditation standards, and standards of the Board of Regents, and other governmental agencies, such as the Department of Education.

The Provost uses the assessment information in discussions with academic deans to determine the progress made by each academic unit. The results are also used by the Provost, the Academic Affairs Staff, and the Academic Affairs Planning Committee to determine if the program is fulfilling its University Mission."

APPENDIX

BOR TABLES 1 THROUGH 3

AND

ROSTER OF INSTRUCTIONAL STAFF

BOR TABLE ONE

*NUMBER OF ANTICIPATED MAJORS FROM POTENTIAL SOURCES**

GRADUATE DEGREE PROGRAM

NAME OF PROGRAM: Ph.D. Degree in Civil Engineering

CIP CODE: 14.0801

ACADEMIC YEAR	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
	1997	1998	1998	1999	1999	2000	2000	2001	2001	2002

Source of Students (Non-Duplicative Count)**	HC	FTE	HC	FTE	HC	FTE	HC	FTE	HC	FTE
a. Individuals drawn from agencies/ industries in your service area (e.g., older returning students)	4	3.2	4	3.2	5	4.0	6	4.8	7	5.6
b. Students who transfer from other graduate programs within the university	0	0.0	0	0.0	1	0.8	2	1.6	2	1.6
c. Individuals who have recently graduated from preceding degree programs at this university**	6	4.8	12	9.6	14	11.2	15	12.0	16	12.8
d. Individuals who graduated from preceding degree programs at other SUS universities**	1	0.8	1	0.8	2	1.6	3	2.4	4	3.2
e. Individuals who graduated from preceding degree programs at non-SUS Florida colleges and universities**	0	0.0	0	0.0	1	0.8	2	1.6	3	2.4
f. Additional in-state residents**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
g. Additional out-of-state residents**	1	0.8	0	0.0	1	0.8	2	1.6	3	2.4
h. Additional foreign residents**	2	1.6	3	2.4	3	2.4	4	3.2	6	4.8
i. Other (Explain)**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL	14	11.2	20	16.0	27	21.6	34	27.2	41	32.8

* List projected yearly enrollments instead of admissions.

** Do not include individuals counted in any PRIOR category.

BOR TABLE TWO

FACULTY PARTICIPATION IN PROPOSED DEGREE PROGRAM BY FIFTH YEAR

Faculty CODE	Faculty Name or "New Hire"	Academic Discipline/ Specialty	Rank	(For Existing Faculty Only) Contract Status	(For Existing Faculty Only) Highest Degree Granted	Initial Date for Participation in Proposed Program	5th Year Workload in Proposed Program (% Personyear)	Current Committees # of Ph.D. Director/ Committee Member	Current Committees # of M.S. Director/ Committee Member	Current Publications # of Journal Papers	Current Publications # of Conference Papers/ Reports
A	Fuentes, H.R.	Environmental Engineering	Associate	Tenured	Ph.D.	Aug-97	0.05	2/3	33/37	25	87
A	Jolibois, S.C.	Transportation Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	2/3	2	12/4
A	Prieto-Portar, L.A.	Geotechnical and Structural Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	0/0	1/2	10	36/127
A	Rogge, W.	Environmental Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	2/3	20	26/4
A	Laha, S.	Environmental Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	3/2	5	10/4
A	Lee, Y.-K.	Transportation Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	2/1	2	11/4
A	Nii O. Attoh-Okine	Transportation Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	2/0	16	30/0
A	Shen, D.L.	Transportation Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	0	32	29	92
A	Tall, L.	Applied Mechanics/Structural Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	11/36	19/26	101	N.A./106
A	Tang, Z.W.	Environmental Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	12/14	23	20/8
A	Tansel, B.	Environmental Engineering	Associate	Tenured	Ph.D.	Aug-97	0.05	0/0	21/26	23	74/26
A	Thompson, L.E.	Structural Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	0/4	25/60	3	22/160
A	Tsihrintzis, V.A.	Water Resources/Environmental Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/0	10/24	20	51/91
A	Ural, O.	Structural Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	7	25	70	25
A	Wang, T.L.	Structural Engineering	Full	Tenured	Ph.D.	Aug-97	0.05	0/1	7/4	30	17/7
A	Zhao, F.	Computer-Aided Engineering	Assistant	Tenure Earning	Ph.D.	Aug-97	0.05	0/1	4/2	9	19/16
C	New Faculty Member	Water Resources/Environmental Engineering	Assistant	Tenure Earning	Ph.D.	Aug-98	0.75				
C	New Faculty Member	Transportation Engineering	Assistant	Tenure Earning	Ph.D.	Aug-99	0.75				
C	New Faculty Member	Structural/Geotechnical Engineering	Assistant	Tenure Earning	Ph.D.	Aug-99	0.75				

Faculty CODE	Corresponding Faculty Position Category in TABLE 3 for the Fifth Year	Proposed Source of Funding for Faculty	TOTAL 5th Year Workload by Budget Classification
A	Current General Revenue	Existing Faculty – Regular Line	0.80
B	Current General Revenue	New Faculty – To Be Hired on Existing Vacant Line	0
C	New General Revenue	New Faculty – To Be Hired on a New Line	2.25
D	Contracts & Grants	Existing Faculty – Funded on Contracts & Grants	0
E	Contracts & Grants	New Faculty – To Be Hired on Contracts & Grants	0
		Overall Total for 5th Year	3.05

BOR TABLE THREE

COSTS FOR PROPOSED PROGRAM

	FIRST YEAR				FIFTH YEAR			
	GENERAL REVENUE		CONTRACTS		GENERAL REVENUE		CONTRACTS	
	CURRENT	NEW	& GRANTS	SUMMARY	CURRENT	NEW	& GRANTS	SUMMARY
INSTRUCTION & RESEARCH								
POSITIONS (FTE)								
FACULTY	0.8	0.75	0	1.55	0.8	2.25	0	3.05
A&P	0	0	0	0	0	0	0	0
USPS	0.2	0	0	0.2	0.2	0	0	0.2
TOTAL	1	0.75	0	1.75	1	2.25	0	3.25
SALARY RATE								
FACULTY	$58,437	$50,000	$0	$108,437	$58,437	$150,000	$0	$208,437
A&P	$0	$0	$0	$0	$0	$0	$0	$0
USPS	$4,375	$0	$0	$4,375	$4,375	$0	$0	$4,375
TOTAL	$62,812	$50,000	$0	$112,812	$62,812	$150,000	$0	$212,812
I&R								
SALARIES & BENEFITS	$82,598	$65,750	$0	$148,348	$82,598	$197,250	$0	$279,848
OTHER PERSONAL SERVICES	$2,122	$36,000	$155,000	$193,122	$2,122	$60,000	$400,000	$462,122
EXPENSES	$3,998	$2,000	$20,000	$25,998	$3,998	$7,500	$30,000	$41,498
OPERATING CAPITAL OUTLAY	$2,000	$50,000	$50,000	$102,000	$2,000	$120,000	$150,000	$272,000
ELECTRONIC DATA PROCESSING	$0	$2,000	$0	$2,000	$0	$5,000	$0	$5,000
LIBRARY RESOURCES	$0	$7,500	$0	$7,500	$0	$15,000	$0	$15,000
SPECIAL CATEGORIES	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL I&R	$90,718	$163,250	$225,000	$478,968	$90,718	$404,750	$580,000	$1,075,468
NON-I&R								
OTHER ACTIVITIES								
LIBRARY STAFFING	$300	$0	$0	$300	$300	$0	$0	$300
UNIVERSITY SUPPORT	$0	$0	$0	$0	$0	$0	$0	$0
FINANCIAL AID	$6,300	$20,000	$10,000	$36,300	$6,300	$35,000	$15,000	$56,300
STUDENT SERVICES, OTHER	$500	$0	$0	$500	$500	$0	$0	$500
TOTAL OTHER ACTIVITIES	$7,100	$20,000	$10,000	$37,100	$7,100	$35,000	$15,000	$57,100
SUMMARY*	$97,818	$183,250	$235,000	$516,068	$97,818	$439,750	$595,000	$1,132,568

** TOTAL I&R + TOTAL OTHER ACTIVITIES

* Should relate directly to numbers in Table 2

ROSTER OF INSTRUCTIONAL STAFF
Department of Civil and Environmental

NAME	HIGHEST DEGREE	NEXT HIGHEST	TEACHING ASSIGNMENT
Full-time Nil Attoh-Okine	Ph.D., Transportation Engineering University of Kansas (Transportation 21 hours Materials 15 hours)	M.S., Transportation Engineering Rostov Institute of Civil Engineering, Russia (Transportation 24 hours)	TTE 5835 Pavement Design (F) TTE 6xxx Bearing Capacity of Roads & Airfield (S) --- SUR 3101 Surveying (F,S)
Full-time Hector Fuentes DWRC Joint-line	Ph.D., Environmental Engineering Vanderbilt University (Environmental 24 hours)	M.S., Environmental Engineering Vanderbilt University (Environmental 18 hours)	ENV 5666 Water Quality Management (F) ENV 6935 Graduate Environmental Seminar (F) --- CWR 3103 Water Resources Engineering (S) ENV 4930 Integrated System Design (S)
Full-time Sylvan Jolibois, Jr.	Ph.D., Transportation Engineering University of California at Berkeley (Transportation 36 hours)	M.S., Transportation Engineering University of California at Berkeley (Transportation 24 hours)	TTE 5650 Transportation and Land Development (F) TTE 5805 Adv. Geometric Design of Highways (S) --- TTE 4201 Transp. and Traffic Engineering (F,S)
Full-time Shonali Laha DWRC Joint-line	Ph.D., Environmental Engineering Carnegie Mellon University (Environmental 24 hours)	M.S., Environmental Engineering University of Alabama at Tuscaloosa (Environmental 18 hours)	ENV 5xxx Reaction in Environmental Engr. (S) --- ENV 4401 Water Supply Engineering (F) ENV 4401L Water Supply Lab (F) ENV 3001 Introduction to Envi. Engr. (S) ENV 3001L Environmental Lab (S)

ROSTER OF INSTRUCTIONAL STAFF continued
Department of Civil and Environmental

NAME	HIGHEST DEGREE	NEXT HIGHEST	TEACHING ASSIGNMENT
Full-time Luis Prieto-Portar	Ph.D., Mechanics Princeton University (Geotechnical 21 hours Mechanics 15 hours)	M.S., Geotechnical Engineering Princeton University (Geotechnical 13 hours Mechanics 9 hours)	CEG 6105 Advanced Foundations Engineering (F) --- CGN 4802 CE Senior Design Project (F,S) CEG 4011 Geotechnical Engineering I (F,S) CEG 4011L Soil Testing Lab (F,S)
Full-time Wolfgang Rogge	Ph.D., Environmental Engineering California Institute of Technology (Environmental 36 hours)	M.S., Environmental Engineering California Institute of Technology (Environmental 24 hours)	ENV 5126 Air Pollution Control (F) ENV 5105 Air Quality Management (S) --- ENV 4101 Elements of Atmosp. Pollution (F) ENV 4551 Sewage and Wastewater Treatment (S) ENV 4551L Sewage and Wastewater Treat. Lab (S)
Full-time Chairperson David Shen	Ph.D., Transportation Engineering Clemson University (Transportation 36 hours)	M.S., Transportation Engineering Clemson University (Transportation 24 hours)	TTE 6506 Mass Transit Planning (F) TTE 6xxx Pln. & Design of Intermodal Facilities (S) ---
Full-time Lambert Tall	Ph.D., Structural Engineering Lehigh University (Structural 24 hours Mechanics 12 hours)	M.S., Structural Engineering Lehigh University (Structural 18 hours Mechanics 6 hours)	CES 5606 Advanced Steel Design (S) --- CES 3100 Determinate Structural Analysis (F) CES 4101 Indeterminate Structural Analysis (S) CES 4605 Steel Design (F,S) CES 4702 Reinforced Concrete Design (S)

ROSTER OF INSTRUCTIONAL STAFF continued
Department of Civil and Environmental

NAME	HIGHEST DEGREE	NEXT HIGHEST	TEACHING ASSIGNMENT
Full-time Zhonghong Tang	Ph.D., Environmental Engineering University of Delaware (Environmental 36 hours)	M.S., Environmental Engineering University of Missouri at Rolla (Environmental 24 hours)	ENV 5659 Regional Planning Engineering (F) ENV 6615 Environmental Impact Assessment (S) --- CWR 3201 Fluid Mechanics (F,S) CWR 3201L Fluid Mechanics Lab (F,S)
Full-time Berrin Tansel Spring 1998 Sabbatical	Ph.D., Environmental Engineering University of Wisconsin at Madison (Environmental 36 hours)	M.S., Environmental Engineering University of Wisconsin at Madison (Environmental 24 hours)	ENV 5930 Envi. Risk Assess. & Deci. Making (F) --- ENV 3001 Intro. to Environmental Engr. (F) ENV 3001L Environmental Lab (F)
Full-time LeRoy Thompson Spring 1998 Phased Retirement	Ph.D., Structural Engineering Rice University (Structural 24 hours Mechanics 12 hours)	M.S., Structural Engineering University of Missouri at Rolla (Structural 18 hours Mechanics 6 hours)	CES 5715 Prestressed Concrete Design (F) --- CGN 4802 CE Senior Design Project (F) CES 4702 Reinforced Concrete Design (F)
Full-time Vassilios Tsihrintzis DWRC Joint-line	Ph.D., Water Resources Eng. University of Illinois at Urbana-Champaign (Water Resources 24 hours Environmental 6 hours)	M.S., Water Resources Engineering University of Illinois at Urbana-Champaign (Water Resources 18 hours Environmental 3 hours)	CWR 5235 Open Channel Hydraulics (S) --- CWR 3103 Water Resources Engineering (F)

ROSTER OF INSTRUCTIONAL STAFF continued
Department of Civil and Environmental

NAME	HIGHEST DEGREE	NEXT HIGHEST	TEACHING ASSIGNMENT
Full-time Oktay Ural Fall 1997 Phased Retirement	Ph.D., Structural Engineering North Carolina State University (Structural 18 hours Construction 18 hours)	M.S., Environmental Engineering University of Tennessee at Knoxville (Structural 12 hours Construction 12 hours)	CCE 5035 Construction Engr. Management (S) --- CES 3100 Determine Structural Analysis (S) CCE 4001 Heavy Construction (S) CES 4101 Indeterminate Structural Analysis (S)
Full-time Ton-Lo Wang	Ph.D., Structural Engineering Illinois Institute of Technology (Structural 24 hours Mechanics 12 hours)	M.S., Structural Engineering Illinois Institute of Technology (Structural 12 hours Mechanics 12 hours)	EGM 5421 Structural Dynamics (F) EGM 6796 Theory of Plates and Shells (S) --- EGM 3520 Engr. Mechanics of Materials (F,S) EGM 3520L Materials Testing Lab (F,S)
Full-time Fang Zhao	Ph.D., Computer-Aided Engr. Carnegie Mellon University (Computer-Aided 21 hours Structural 6 hours Transportation 6 hours)	M.S., Structural Engineering Carnegie Mellon University (Computer-Aided 15 hours Structural 3 hours Transportation 3 hours)	CGN 6xxx Intelligent Civil Engr. Systems (F) CGN 5320 GIS Appl. in Civil and Envi. Engr. (S) CGN 6xxx Adv. Computing in Civil Engr. (S) --- CGN 4321 GIS Appl. in Civil and Envi. Engr. (F)

Note: (F) Fall 1997
(S) Spring 1998

DWRC: Drinking Water Research Center
Graduate Courses - 5000, 6000, and 7000 level
Undergraduate Courses - 1000-4000 level