

# CIVIL ENGINEERING, PH.D.

## Degree Requirements (60 Post-Baccalaureate Hours)

Completion of the doctoral degree requires a minimum of 60 credits beyond the baccalaureate degree, of which 12 must be ECIV 899. Students holding an M.E. or M.S. degree must complete a minimum of 30 credit hours beyond the master's degree. At least half of the course work must be completed at the 700 level or higher. At least 12 hours of core course work are required for each area of specialization (see "Core Courses" below).

For students pursuing a Ph.D. degree in the same area of specialization as their M.E. or M.S. degree, a minimum of 18 credit hours of course work is required. Core courses may be satisfied during the M.E. or M.S. degree. For students pursuing a Ph.D. degree in a different area of specialization from their M.E. or M.S. degree, a minimum of 24 credit hours of course work in the new area is required. "Area of specialization" refers to environmental, geotechnical, railway, structural, transportation or water resources engineering.

Credits earned in ECIV 798 do not count toward a student's program of study.

The residency requirement for the Ph.D. degree ensures that students benefit from and contribute to the complete spectrum of educational and professional opportunities provided by the graduate faculty of a comprehensive university. The granting of a doctoral degree presupposes a minimum of three full years of graduate study following admission to the doctoral program. As such, the residency requirement may be fulfilled by enrollment in at least 18 graduate credit hours within a span of three consecutive semesters (excluding summers). Enrollment in a summer term is not required to maintain continuity, but credits earned during summer terms may be used to count toward residency. Enrollment through the APOGEE program does not satisfy the residency requirement for the Ph.D. degree.

### Core Courses

Each area of specialization has specific graduate core course requirements that are presented in the tables below. These requirements are designed to provide opportunities for cross-disciplinary programs of study that require breadth and flexibility beyond classical courses offered for a given area of specialization, and that may better reflect the student's personal research and career interests. This can be achieved by allowing to substitute one additional core course with any USC graduate (500-level or higher) course, subject to the approval of the student's advisor and ECIV graduate director through the program of study (DPOS) form.

#### Environmental Engineering (12 hours)

Course	Title	Credits
ECIV 750	Principles of Environmental Engineering Process	3
Select three of the following:		9
ECIV 502	Life Cycle Assessment of Engineered Systems	
ECIV 555	Principles of Municipal Solid Waste Engineering	
ECIV 556	Air Pollution Control Engineering	
ECIV 558	Environmental Engineering Process Modeling	
ECIV 590	Intermediate Special Topics *	
ECIV 751	Water and Wastewater Treatment Theory I	
ECIV 752	Water and Wastewater Treatment Theory II	

ECIV 753	Unit Operations Laboratory for Water and Wastewater Treatment	
ECIV 755	Industrial Wastewater Treatment	
ECIV 790	Selected Topics in Civil Engineering *	
Select one USC graduate (500-level or higher) course *		
<b>Total Credit Hours</b>		<b>12</b>

\* To be approved by student's advisor and ECIV graduate director through program of study (DPOS) form.

#### Geotechnical Engineering (12 hours)

Course	Title	Credits
ECIV 730	Advanced Soil Mechanics	3
Select three of the following:		9
ECIV 590	Intermediate Special Topics *	
ECIV 731	Slope Stability, Retaining Systems and Lateral Earth Pressure	
ECIV 732	Theoretical and Numerical Methods in Geomechanics	
ECIV 733	Physico-chemical Properties of Soils	
ECIV 734	Soil Dynamics and Geotechnical Earthquake Engineering	
ECIV 736	Ground Improvement Techniques	
ECIV 737	Advanced Foundation Design	
ECIV 790	Selected Topics in Civil Engineering *	
Select one USC graduate (500-level or higher) course *		
<b>Total Credit Hours</b>		<b>12</b>

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#### Railway Engineering (12 hours)

Course	Title	Credits
Select two of the following "Fundamental" core courses:		6
ECIV 580	Railway Engineering I	
ECIV 582	Operation and Logistics of Railway Systems	
ECIV 588	Design of Railway Bridges and Structures	
ECIV 590	Intermediate Special Topics *	
Select one "Advanced" core course **		
Select one "Advanced or "Cross-Disciplinary" core course **		
Select one of the following "Advanced" core courses:		3
ECIV 707	Management of Engineering Projects	
ECIV 724	Dynamics of Structures	
ECIV 734	Soil Dynamics and Geotechnical Earthquake Engineering	
ECIV 784	Dynamic Analysis of Railway Systems	
ECIV 789	Design Project in Railway Engineering	
ECIV 790	Selected Topics in Civil Engineering *	
Select one of the following "Cross-Disciplinary" core courses:		3
Select one Environmental Engineering core course		
Select one Geotechnical Engineering core course		
Select one Structural Engineering core course		
Select one Transportation Engineering core course		
Select one Water Resources Engineering core course		

Select one USC graduate (500-level or higher) courses \*

**Total Credit Hours** **12**

\* To be approved by student's advisor and ECIV graduate director through program of study (DPOS) form.

\*\* Applies to PhD students with MS/ME degree only. May be taken for either "Fundamental" core course credit, or "Advanced" or "Cross-Disciplinary" core course credit, not both.

### Structural Engineering (12 hours)

Course	Title	Credits
ECIV 720	Advanced Structural Mechanics and Analysis	3
Select three of the following:		9
ECIV 590	Intermediate Special Topics *	
ECIV 722	Theory and Design of Plates and Shells	
ECIV 724	Dynamics of Structures	
ECIV 725	Advanced Analysis and Design in Structural Metals	
ECIV 726	Repair and Retrofit of Structures	
ECIV 727	Advanced Analysis and Design of Reinforced Concrete	
ECIV 728	Prestressed Concrete Analysis and Design	
ECIV 737	Advanced Foundation Design	
ECIV 790	Selected Topics in Civil Engineering *	
Select one USC graduate (500-level or higher) course *		
<b>Total Credit Hours</b>		<b>12</b>

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### Transportation Engineering (12 hours)

Course	Title	Credits
Select one of the following:		3
ECIV 535	Geotechnical Engineering in Transportation	
ECIV 540	Transportation Systems Planning	
ECIV 541	Highway Design	
Select one of the following:		3
ECIV 542	Traffic Engineering	
ECIV 748	Traffic Flow Theory	
Select one of the following:		3
ECIV 705	Deterministic Civil and Environmental Systems Engineering	
ECIV 706	Probabilistic Civil and Environmental Systems Engineering	
Select one of the following:		3
ECIV 590	Intermediate Special Topics *	
ECIV 790	Selected Topics in Civil Engineering *	
Select one USC graduate (500-level or higher) course *		
<b>Total Credit Hours</b>		<b>12</b>

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### Water Resources Engineering (12 hours)

Course	Title	Credits
Select up to one of the following:		0-3
ECIV 560	Open Channel Hydraulics	
ECIV 562	Engineering Hydrology	
ECIV 563	Subsurface Hydrology	
ECIV 590	Intermediate Special Topics *	
Select at least two of the following:		6-12
ECIV 760	Computational Hydraulics	
ECIV 761	Numerical Methods in Subsurface Hydrology	
ECIV 762	Advanced Hydrology	
ECIV 763	Unsaturated Flow Theory	
ECIV 764	Contaminant Transport	
ECIV 765	Erosion and Sediment Control	
ECIV 766	Fluid Transients	
ECIV 767	Sediment Transport and River Mechanics	
ECIV 790	Selected Topics in Civil Engineering *	
Select up to one of the following:		0-3
Select one USC graduate (500-level or higher) course *		
<b>Total Credit Hours</b>		<b>12</b>

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