Politechnika Krakowska
im. Tadeusza Kościuszki

Karta przedmiotu

obowiązuje studentów rozpoczynających studia w roku akademickim 2016/2017

Wydział Inżynierii Środowiska

Kierunek studiów: Inżynieria Środowiska — Profil: Ogólnoakademicki

Forma sudiów: stacjonarne — Kod kierunku: 2

Stopień studiów: II

Specjalności: Hydrotechnika i geoinżynieria

1 Informacje o przedmiocie

Nazwa przedmiotu	Soil-structure interaction
Nazwa przedmiotu w języku angielskim	Soil-structure interaction
Kod przedmiotu	WIŚ IŚ oIIS C10 16/17
Kategoria przedmiotu	Przedmioty kierunkowe
Liczba punktów ECTS	2.00
Semestry	1

2 Rodzaj zajęć, liczba godzin w planie studiów

Semestr	Wykład	Ćwiczenia	Laboratorium	Laboratorium komputerowe	Projekt	Seminarium
1	15	0	0	15	0	0

3 Cele przedmiotu

Cel 1 Introduction to modern methods of nonlinear soil-structure interaction analysis carried out with aid of finite element method

Cel 2 Introduction to calibration of nonlinear soil constitutive models based on laboratory and in situ testing

Cel 3 Introduction to principles of discretization of subsoil-construction systems by taking into account nonuniform distribution of geotechnical layers and presence of underground water

4 Wymagania wstępne w zakresie wiedzy, umiejętności i innych kompetencji

1 Finalized courses on mechanics, strength of materials and structural mechanics

5 Efekty kształcenia

EK1 Wiedza Student knows basic elements of finite element method, knows differences between plane stress/strain, axial symmetry and 3D models in statics, seepage and coupled consolidation problems

EK2 Umiejętności Student is able to analyze problem of stability of natural slopes taking into account effect of seepage using ZSOIL software. Student is able to decide and argue whether a given problem can be reduced to 2D or must be analyzed as a 3D one.

EK3 Wiedza Student knows theory of ideal elastic-plastic Mohr-Coulomb model and its calibration rules based on results of laboratory (triaxial test) and in situ testing (CPTU). Student knows the theory of the Hardening Soil model that includes strong stiffness variation in the range of small strains and methods of its calibration based on triaxial test (including measurement of shear wave velocity) and in situ test results (CPTU)

EK4 Umiejętności Student is able to calibrate both Mohr-Coulomb and Hardening Soil models based on results of drained triaxial tests. Student is able to specify geotechnical layers in subsoil based on CPTU profiles (qc,fs,u2) and is able to calibrate aforementioned models by using CPTU correlation formulas

EK5 Wiedza Student knows rules of construction of discretized models for soil-structure interaction problems, knows all modeling objects like shell, bar, beam, membrane anchor, interface and continuum elements, all aspects concerning boundary and initial conditions including initial effective stress conditions and initial pore water pressures

EK6 Umiejętności Student is able to construct a discretized model of a diapraghm wall stiffened by internal supports or external anchors, including simultaneous dewatering during excavation stage, is able to construct a 3D model of a large raft stiffened by piles treated as a foundation for a high building

6 Treści programowe

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W1	Introduction to theory of partially saturated soils tretaed as a two phase continuum. Balance equations of momentum and mass for fluid. Boundary and initial conditions for nonlinear static, seepage and coupled problems in the analysis of soil-structure interaction	4
W2	Introduction to finite element method for linear and nonlinear static, seepage and coupled problems	3
W3	Constitutive equations for soils. Elastic-plastic Mohr-Coulomb model, and Hardening Soil model with strong stiffness variation in the range of small strains	4
W4	Calibration of Mohr-Colulomb and Hardening Soil models based on laboratory triaxial tests (enhanced by measurement of shear wave velocity), oedometric test and CPTU testing	4

Laboratorium komputerowe		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
K1	Introduction to ZSOIL FEA system. Construction of a simple model for retaining wall and analysis of the global safety factor using c-phi reduction method	4
K2	Construction of a model of a natural slope subject to long-term rain infiltration and analysis of its stability	2
K3	Introduction to modeling in 3D. Basic rules for analysis of soil-structure interaction, generation of nonuniform distribution of geotechnical layers for given set of boreholes.	2
K4	Deep excavations. Static analysis of a diapraghm wall. Estimation of material parameters for soils based on triaxial laboratory testing enhanced by measurement of shear wave velocity	3
K5	Static analysis of large foundation raft strenghtened by piles founded on weak subsoil. Construction of FE computational model of a raft and subsoil, estimation of material parameters for soils based on CPTU profiles in given set of boreholes, opimization of number, length and placement of piles	4

7 Narzędzia dydaktyczne

N1 Ćwiczenia laboratoryjne

N2 Wykłady

N3 Praca w grupach

N4 Konsultacje

8 Obciążenie pracą studenta

Forma aktywności	Średnia liczba godzin na zrealizowanie aktywności
Godziny kontaktowe z nauczycielem akademickim, w tym:	
Godziny wynikające z planu studiów	30
Egzaminy i zaliczenia w sesji	6
Godziny bez udziału nauczyciela akademickiego wynikające z nakładu pracy studenta	24
Sumaryczna liczba godzin dla przedmiotu wynikająca z całego nakładu pracy studenta	**60**
Sumaryczna liczba punktów ECTS dla przedmiotu	2

9 Sposoby oceny

Ocena formująca

F1 Projekt zespołowy

Ocena podsumowująca

P1 Projekt

P2 Średnia ważona ocen formujących

Warunki zaliczenia przedmiotu

W1 During submission of the report summarizing given project student must answer few questions concerning the project

Kryteria oceny

Efekt kształcenia 1	
Na ocenę 2.0	Student does not know basic rules of finite element modeling that concerns static, seepage and coupled problems related to soil-structure interaction; in the final colloquium student achieved less than 51% of points from part concerned with this educational effect
Na ocenę 3.0	Student knows basic rules of finite element modeling that concerns static, seepage and coupled problems related to soil-structure interaction; in the final colloquium student achieved 51-60% of points from the part concerned with this educational effect
Na ocenę 3.5	In the final colloquium student achieved 61-70% of points from the part concerned with this educational effect
Na ocenę 4.0	In the final colloquium student achieved 71-80% of points from the part concerned with this educational effect
Na ocenę 4.5	In the final colloquium student achieved 81-93% of points from the part concerned with this educational effect
Na ocenę 5.0	In the final colloquium student achieved 94-100% of points from the part concerned with this educational effect
Efekt kształcenia 2	
Na ocenę 2.0	Student is unable to carry out stability analysis of a natural slope, subject to seepage, using FEM model; student does not comply with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated on mark 2 in scale 2 to 5 or student achieved less than 51% points for answers concerning the report matter
Na ocenę 3.0	Student is able to carry out stability analysis of a natural slope, subject to seepage, using FEM model; student complies with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated at least on mark 3 in scale 2 to 5 and student achieved 51-60% points for answers concerning the report matter

Na ocenę 3.5	The report was evaluated at least on mark 4 in scale 2 to 5 and student achieved 61-70% points for answers concerning the report matter
Na ocenę 4.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 71-80% points for answers concerning the report matter
Na ocenę 4.5	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 81-93% points for answers concerning the report matter
Na ocenę 5.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 93-100% points for answers concerning the report matter
Efekt kształcenia 3	
Na ocenę 2.0	Student does not know the basic theory for elasto-plastic Mohr-Coulomb and Hardening Soil models; does not know on how to estimate their parameters based on laboratory and field testing (CPTU); in the final colloquium student achieved less than 51% of points from part concerned with this educational effect
Na ocenę 3.0	Student knows basic theory for elasto-plastic Mohr-Coulomb and Hardening Soil models; knows on how to estimate their parameters based on laboratory and field testing (CPTU); in the final colloquium student achieved 51-60% of points from part concerned with this educational effect
Na ocenę 3.5	In the final colloquium student achieved 61-70% of points from the part concerned with this educational effect
Na ocenę 4.0	In the final colloquium student achieved 71-80% of points from the part concerned with this educational effect
Na ocenę 4.5	In the final colloquium student achieved 81-93% of points from the part concerned with this educational effect
Na ocenę 5.0	In the final colloquium student achieved 94-100% of points from the part concerned with this educational effect
Efekt kształcenia 4	
Na ocenę 2.0	Student is unable to estimate effective stresses in given subsoil relief or is unable to derive geotechnical layers from given CPTU profile; student is unable to estimate material properties for Mohr-Coulomb and Hardening Soil models based on triaxial and field testing (CPTU); student does not comply with assumed deadlines for submission of the report summarizing carried out simulations; student does not comply with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated on mark 2 in scale 2 to 5 or student achieved less than 51% points for answers concerning the report matter
Na ocenę 3.0	Student is able to estimate effective stresses in given subsoil relief and is able to derive geotechnical layers from given CPTU profile; student is able to estimate material properties for Mohr-Coulomb and Hardening Soil models based on triaxial and field testing (CPTU); student complies with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated at least on mark 3 in scale 2 to 5 and student achieved 51-60% points for answers concerning the report matter

Na ocenę 3.5	The report was evaluated at least on mark 4 in scale 2 to 5 and student achieved 61-70% points for answers concerning the report matter
Na ocenę 4.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 71-80% points for answers concerning the report matter
Na ocenę 4.5	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 81-93% points for answers concerning the report matter
Na ocenę 5.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 93-100% points for answers concerning the report matter
Efekt kształcenia 5	
Na ocenę 2.0	Student does not know basic rules that must be preserved when generating 2D/3D FEM models for soil-structure interaction problems; in the final colloquium student achieved less than 51% of points from part concerned with this educational effect
Na ocenę 3.0	Student knows basic rules that must be preserved when generating 2D/3D FEM models for problems of soil-structure interaction; in the final colloquium student achieved 51-60% of points from part concerned with this educational effect
Na ocenę 3.5	In the final colloquium student achieved 61-70% of points from the part concerned with this educational effect
Na ocenę 4.0	In the final colloquium student achieved 71-80% of points from the part concerned with this educational effect
Na ocenę 4.5	In the final colloquium student achieved 81-93% of points from the part concerned with this educational effect
Na ocenę 5.0	In the final colloquium student achieved 94-100% of points from the part concerned with this educational effect
Efekt kształcenia 6	
Na ocenę 2.0	Student is unable to make a 2D FEM model of diaphragm wall (anchored or one with partial floors) or is unable to make a 3D simple model of a foundation raft stiffened locally by piles; student does not comply with assumed deadlines for submission of the report summarizing carried out simulations; student does not comply with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated on mark 2 in scale 2 to 5 or student achieved less than 51% points for answers concerning the report matter
Na ocenę 3.0	Student is able to make a 2D FEM model of diaphragm wall (anchored or one with partial floors) and is able to make a simple 3D model of a foundation raft stiffened locally by piles; student complies with assumed deadlines for submission of the report summarizing carried out simulations; the report was evaluated at least on mark 3 in scale 2 to 5 and student achieved 51-60% points for answers concerning the report matter
Na ocenę 3.5	The report was evaluated at least on mark 4 in scale 2 to 5 and student achieved 61-70% points for answers concerning the report matter

Na ocenę 4.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 71-80% points for answers concerning the report matter
Na ocenę 4.5	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 81-93% points for answers concerning the report matter
Na ocenę 5.0	The report was evaluated at least on mark 5 in scale 2 to 5 and student achieved 93-100% points for answers concerning the report matter

10 Macierz realizacji przedmiotu

Efekt kształcenia	Odniesienie danego efektu do szczegółowych efektów zdefiniowanych dla programu	Cele przedmiotu	Treści programowe	Narzędzia dydaktyczne	Sposoby oceny
EK1	K_W11, K_W12, K_U03, K_U04	Cel 1	W1 W2 K1 K2	N2	P2
EK2	K_W11, K_W12, K_U03, K_U04	Cel 1	W1 W2 K1 K2	N1 N2 N3 N4	F1 P1
EK3	K_W11, K_W12, K_U03, K_U04	Cel 2	W3 K3 K4 K5	N2	P2
EK4	K_W11, K_W12, K_U03, K_U04	Cel 2	W3 K3 K4 K5	N1 N2 N3 N4	F1 P1
EK5	K_W11, K_W12, K_U03, K_U04	Cel 3	W3 W4 K3 K4 K5	N2	P2
EK6	K_W11, K_W12, K_U03, K_U04	Cel 3	W3 W4 K3 K4 K5	N1 N2 N3 N4	F1 P1

11 Wykaz literatury

Literatura podstawowa

[1] **A. Truty, Th. Zimmermann, K. Podleś** — *ZSOIL.PC Getting Started*, Lausanne, 2013, Elmepress

Literatura dodatkowa

[1] Content of lectures in the pdf form delivered to every student

[2] Specific reports in english delivered by the lecturer

12 Informacje o nauczycielach akademickich

Osoba odpowiedzialna za kartę

dr hab. inż., prof. PK Andrzej Truty (kontakt: andrzej.truty@gmail.com)

Osoby prowadzące przedmiot

1 dr hab. inż. Andrzej Truty (kontakt: andrzej.truty@gmail.com)

4 dr inż. Krzysztof Podleś (kontakt: k_p@bci.pl)

13 Zatwierdzenie karty przedmiotu do realizacji

(miejscowość, data) (odpowiedzialny za przedmiot) (dziekan)

Przyjmuję do realizacji (data i podpisy osób prowadzących przedmiot)

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