



## RELIABILITY - BASED OPTIMIZATION

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### Topics:

1. Uncertainty and its origin in structural analysis.  
*Types of uncertainties, human error modelling*
2. Mathematical background, probability theory, statistics  
*Random variables – moments, selected distributions, parameter estimation*
3. Random modelling of structural loads and resistance  
*Dead and live load models, environmental loads, resistance parameters*
4. Randomfields, geometric and material imperfections – generation and identification  
*Simulation techniques, numerical examples of generation of structural imperfections*
5. Three levels of random structural analysis and design  
*Partial safety factors, reliability index, first-order second-moment reliability*
6. The Monte Carlo simulation method  
*Direct Monte Carlo method, stratified and Latin Hypercube sampling*
7. Application of the Monte Carlo techniques to the reliability estimations of structures  
*Numerical examples: shells (tanks, silos), soil continuum, trusses and others*
8. The response surface method in reliability analysis  
*Numerical examples - composite shells, silos*
9. Reliability of structural systems  
*Reliability / probability of failure of series and parallel systems*
10. Random load combinations  
*Time variation, load combination models, load coincidence method*
11. Random vibrations. Stochastic processes  
*Auto-power spectral density, Markov processes, single-degree-of-freedom systems*
12. Sensitivity analysis of structures  
*Impact of geometric imperfections on structural reliability – distributions*



13. Probability-based optimization of structures  
*Deterministic vs. probabilistic analysis, random optimization problems*
14. Random optimum design  
*Optimum design problems, simple cases*
15. Selected cases of optimum design  
*Spatial trusses, reticulated shells, indeterminate frames, two-dimensional structures.*

**Literature:**

1. Ditlevsen O., Madsen H.O. *Structural reliability methods*. John Wiley&Sons 1996
2. Elishakoff I. *Probabilistic methods in the theory of structures*. John Wiley & Sons 1983
3. Hart G.C. *Uncertainty analysis, loads, and safety in structural engineering*.  
Prentice-Hall 1982
4. Madsen H.O., Krenk S., Lind N.C. *Methods of structural safety*. Prentice-Hall 1986
5. Melchers R.E. *Structural reliability analysis and prediction*. John Wiley & Sons 2001
6. Nowak, A.S., Collins K.R. *Reliability of structures*. McGraw-Hill Higher Education 2000
7. Rubinstein R. Y. *Simulation and the Monte Carlo method*. John Wiley & Sons 1981
8. Thoft-Christensen P., Murotsu Y. *Application of structural systems reliability theory*. Springer-Verlag 1985

TERMINY WYKŁADÓW			
Data	Dzień tygodnia	Godzina	Sala
2014-04-11	Pt	17.00-19.45	GG 162
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