

ECCS course « Fatigue Design Of Steel And Composite Structures »

Reference book : A. Nussbaumer, L. Borges, L. Davaine, *Fatigue Design of Steel and Composite Structures: Eurocode 3: Design of Steel Structures, Part 1-9 Fatigue; Eurocode 4: Design of Composite Steel and Concrete Structures*, ECCS Eurocode Design Manuals, 2nd edition, John Wiley & Sons, 2018.

Speakers: Prof. Luis Borges, University of Coimbra, Portugal and Structurame, Geneva, Switzerland
Prof. Johan Maljaars, TU Eindhoven and TNO Delft, The Netherlands
Prof. Alain Nussbaumer, EPFL, Lausanne, Switzerland

<u>Date</u>	<u>Topic</u>	<u>Content</u>	<u>Comment and possible exercises</u>
DAY 1			
10 -11AM	Introduction	<ul style="list-style-type: none"> - Content, objectives - Logic of the book and of the lectures - Structures at risk, examples of cracking 	<p>Must follow ECCS manual logic, at least for some regrouping of topics.</p> <p>Inclusion of design examples within lectures</p>
11AM-1PM	Basis of fatigue design	<ul style="list-style-type: none"> - Concept of S-N curves, main parameters - S-N curves: experimental determination, definitions of stress range and nb of cycles - Terminology (in relation to Eurocodes) - Variable amplitude, damage sum and equivalent damage concept - 	<p>Introduce main concepts to put all participants at same min., level of understanding.</p>
2 -4PM	Basis of fatigue design (cont.)	<ul style="list-style-type: none"> - Variable amplitude, damage sum and equivalent damage concept (cont.) - Verification methods (with stress ranges, with nb. of cycles, with damage sum) - 	<p><i>Exo damage sum calculation</i></p>
4 -6PM	Codes of practice	<ul style="list-style-type: none"> - Different existing codes : Eurocodes, IIW, DNV, ... - Separation between action effects and resistance - Application and limitation range : materials, corrosion - Fabrication and quality assurance, EXC classes 	<p>Show where information can be found, also outside of Eurocodes, similarities between all codes.</p> <p>Sensitization wrt fabrication (EN 1090-2)</p>
DAY 2			
9AM -1PM	Actions and action effects	<ul style="list-style-type: none"> - Fatigue loads, fatigue load models (general) - Road bridges load models (FLM1 to FLM5), railroad models (UIC 71, ...) - Service life, new vs existing bridges - Damage equivalent factors, « span » or critical length, simultaneity (multiples charges) - Combination road and railway traffic - 	<p>Go beyond strict application of Eurocodes, consider practical questions often asked</p>
2 – 6PM	Determination of stresses and stress ranges	<ul style="list-style-type: none"> - Calculation of stresses: nominal, modified nominal, geometric - Calculation of stress ranges: in bolted, welded connections, multiaxial cases - In steel-concrete composite bridges 	<p><i>Exo determination of stress in bolted detail, in welded detail</i></p>



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DAY 3

9AM -1PM	Fatigue strength and detail categories	<ul style="list-style-type: none"> - Catalogue of construction details - Classification by identification, by analogy - Fatigue strength modifications: size effect, mean stress and residual stresses, - Hot spot stress method for fatigue design - Special details: orthotropic plates, tension elements (EN1993-1-11), reinforcing steel (EN1992-2) - 	<i>Exo detail classification</i>
2 - 5PM	Safety and design methods	<ul style="list-style-type: none"> - Steel quality choice: link between fatigue and brittle fracture (EN 1993-1-10) - Design methods: safe life, damage tolerant - Partial factors for fatigue determination - Evolution of reliability index during life wrt fatigue, influence of inspections, inspection interval determination - 	<i>Exo verification of a detail in a bridge</i>

