Foreword

- Recommendations and Advice Content – The authors
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This collaborative work elaborated by professionals confronted daily to the use of FE methods targets young engineers, who recently graduated from university and often studied exclusively the fundamentals of the FE calculations. Its objective is to answer some recurring questions (such as the mesh size, how to smoothen the peaks, …,) to avoid some issues, and to specify what the FE cannot do. The task force favored to name the project Recommendations and Advices rather than Guide because the document aims to share applications and discuss about finite elements and not create an exhaustive guideline.

The content of the website is dynamic and evolving. The task force is open to suggestions and correction propositions. We are especially interested in complementary examples for Part 3. If you have any recommendations, please contact us on the comments page or by email at elements.finis@afgc.asso.fr.

The three parts can be studied independently.

The first part discusses the theoretical elements.

The following topics will be considered:

- Chapter 1 discusses general information about the method.
- Chapter 2 explains the different concepts related to FE calculations in structural dynamics.
- Chapter 3 describes non-linear static calculations.
- Chapter 4 is about the modeling of civil engineering materials and the questions related to considering phasing.
- Chapter 5 explains why post-treatment is necessary to transcribe the peculiarity of “composite materials” that constitute reinforced concrete.
- Finally, chapter 6 highlights the possible use of the FE method applied to geotechnical problems. The rest of the document has nothing to do with this specific topic.

The second part provides elements to incorporate into a structural analysis using the FE method.

Two main reasons push the engineer to use iterative methods with various step verifications and specific treatments:

- The first reason is that the FE calculation methods are deduced from the Strength of Materials hypotheses and are not consistently compatible with the regulatory calculation methods. It is true for reinforced concrete for which the regulatory deformation diagram is not agreeing with the one represented by the FE. Additionally, the regulation stipulates calculations that not all the software take into consideration (contributing widths, offset of the bending moment diagram in the strut-and-tie method, crack consideration, …) It is also true for steel for which there are discrepancies between the regulatory assembly or instability calculations and the results found using FE methods, which can be very precise.
- The second reason is related to the theoretical calculation, which considers homogeneous elements and does not directly handle materials such as reinforced concrete. In this case, data processing is necessary to transcribe the peculiar behavior of concrete and its reinforcement. The focus must be specifically directed towards steel netting (especially for shells) that can create the illusion that the software is performing the regulatory calculation whereas it is not always the case.

The second part starts by advising to create a structural analysis using FE. Later, the first chapter presents the objectives of the calculations to perform. Then, the second chapter describes the modeling of the structure. It focuses on detailing the various materials, the treatment of the interfaces, (to complete,) for the different types of calculations from the simplest to the most complex one. The third chapter discusses the treatment of the results. Finally, the two last chapters highlight in detail the verifications that must be conducted to validate the results and the final formatting of the computation report. The latter will attest to the work that was performed, the accurate inclusion of the structure’s use, the objectives related to the construction phases, and of course the project’s compliance with the regulation.

For each step, the authors worked on demonstrating, using examples, all the precautions one must take when using simplifications, and the verifications to conduct to ensure the accuracy of the hypotheses. Those will allow to obtain a rigorous model and results that will be as close as possible to the real behavior of the studied structure.

The authors

The Recommendations and Advice were written between 2016 and 2019 by the Task Force about Finite Elements of the French Association of Civil Engineers (AFGC.) Thank you to all from the group who participated, editors, and proofreaders. This paper is posted online so that the users can share with the team all their questions, comments, observations, and suggestions.

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- a practical example illustrated or not,
- a question.

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Part 3	Example y	My comment

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