

## Task Group 4 –Nonlinear Design Rules

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### Minutes of the 2<sup>nd</sup> TG4 web-meeting

Tuesday March 1<sup>st</sup>, 2021 - 14:00 – 17:00 CET

## 1 Chairman Welcome of Participants

PARTICIPANT	E-mail Address	Member	Country	Present
Andrea Tonti	<a href="mailto:a.tonti@inail.it">a.tonti@inail.it</a>	YES	Italy	YES
Yves Simonet	<a href="mailto:yves.simonet.ys@outlook.fr">yves.simonet.ys@outlook.fr</a>	YES	France	YES
Fernando Lidonnici	<a href="mailto:fernando.lidonnici@fastwebnet.it">fernando.lidonnici@fastwebnet.it</a>	YES	Italy	YES
Roman Satosek	<a href="mailto:roman.satosek@danfoss.com">roman.satosek@danfoss.com</a>	NO	Slovenia	YES
Claude Faidy	<a href="mailto:claude.faidy@gmail.com">claude.faidy@gmail.com</a>	YES	France	YES
Michele Camposaragna	<a href="mailto:m.camposaragna@enginsoft.com">m.camposaragna@enginsoft.com</a>	NO	Italy	NO
Mayur Brijlani	<a href="mailto:mayur.brijlani@gmx.de">mayur.brijlani@gmx.de</a>	YES	Germany	YES
Luca Gaetani	<a href="mailto:luca.gaetani@eleo2.eu">luca.gaetani@eleo2.eu</a>	YES	Italy	NO
Vincenzo Lasalandra	<a href="mailto:v.lasalandra@nier.it">v.lasalandra@nier.it</a>	NO	Italy	NO
Andrea Burberi	<a href="mailto:burberi@enerconsulting.it">burberi@enerconsulting.it</a>	YES	Italy	YES
Francesco Iob	<a href="mailto:francesco.iob@rina.org">francesco.iob@rina.org</a>	NO	Italy	YES
Philippe Rohart	<a href="mailto:Philippe.Rohart@cetim.fr">Philippe.Rohart@cetim.fr</a>	NO	France	YES
Andrea Magri	<a href="mailto:andrea.magri@lr.org">andrea.magri@lr.org</a>	YES	Italy	NO
Guy Baylac	<a href="mailto:guy.baylac114@gmail.com">guy.baylac114@gmail.com</a>	YES	France	NO
Pai Gopalkrishna	<a href="mailto:gopalkrishna.ipr@gmail.com">gopalkrishna.ipr@gmail.com</a>	NO	India	YES
Luca Casiraghi	<a href="mailto:luca.casiraghi@rtmbreda.it">luca.casiraghi@rtmbreda.it</a>	NO	Italy	YES
Davide Gadenz	<a href="mailto:gadenz@sant-ambrogio.it">gadenz@sant-ambrogio.it</a>	YES	Italy	YES

## 2 Chairman General EPERC Introduction

### 2.1 Remarks on previous meeting

- No Urgent remarks
- Send an email (with EPERC in the Title) if you have a particular remark

### 2.2 Remember EPERC Strategic Plan

- Comparison of International Codes & Standards
- Identification of Gaps & Needs with Code Organization and Industry
- Developments of R&D programs associated to dedicated Road Map developed by topics at the TG level
- Development of Recommended Practices with all the rules/data validation
- Performance of Benchmarks on practical cases
- Code Case Proposal

- Knowledge transfer through: Regular Thematic Technical Seminars, International Conference, Training courses, Master Classes, Summer School, Reports and Documentation
- Communication and Registration to different EPERC Activities through: [www.eperc-aisbl.eu](http://www.eperc-aisbl.eu)

## 2.3 Overview of the EPERC TG4 Road Map

- WP1 : International Codes comparison
- WP2 : Major failure Mode to Consider
- WP3 : Major Degradation Mechanisms
- WP4 : Flaw Tolerance
- WP5 : Specific Cases
- WP6 : Preliminary Recommended Practices
- WP7 : EPERC TG4 R&D program
- WP8 : Benchmarks
- WP9 : Final Recommended Practices
- WP10 : Synthesis and Code Cases Proposals
- WP11 : Knowledge Transfer

## 3 Selected Topics for this 2nd meeting

### 3.1 Up-date and supplement existing Code comparison

### 3.2 Develop our 1st report on "Preliminary Recommended Practice for inelastic analyses"

#### ▪ 3 steps:

- literature review
- status of EN Standards for Vessels, Piping, Heat Exchangers, Valves and associated supports
- recommended practices

#### ▪ 3 analysis methods:

- limit analysis
- elastic-plastic analysis
- elastic-visco-plastic analysis

#### 3.2.1 Monotonic loads

- Plastic collapse
- Plastic instability
- Buckling

#### 3.2.2 Cyclic loads

- Progressive deformation
- Fatigue:
  - Evaluation of plasticity strain amplification coefficient ( $K_e$ ,  $K_v$ ,  $K_f$ ...)
  - Cyclic elastic-plastic strain evaluation: cycle by cycle + extrapolation rules

#### 3.2.3 Fracture Mechanic

- Reference stress method: plastic limit analysis of "typical" cracked components
- Low and High temperature fatigue and creep crack growth

#### 3.2.4 Creep consequences

- Combined with monotonic loads
- Creep-Fatigue Interaction

- Cyclic elastic-visco-plastic strain evaluation: cycle by cycle + extrapolation rules
- Particular effect of temperature changes in inelastic analyses

## 4 General Discussion and remarks

- Stress-strain curve for limit analyses of collapse load, in particular for stainless steels
- Flow stress for limit analyses of plastic instability
- Interaction between buckling and plastic instability
- Use of Tresca, Von Mises or max "principal stress"
- Differences between limit analyses in Vessels (shell) and Pipes (beam)
- Effect of pipe material anisotropy
- How to design a valve with an EN standard?
- Max pressure associated to EN 13445 and EN 13480?
- How to consider brazing welds in Heat Exchangers?
- **Short information by any participant on different type of Heat exchangers:** tube bundle, plates, tubes...

## 5 TG4 Tasks before next meeting

### 5.1 Code comparison up-date

- **Author:** Claude FAIDY
- **Contributor** for CODAP consideration of "Inelastic Analyses: Y. Simonet and P. Rohart
- **Reviewers:** all TG4 members
- **Planning: draft report for April 4**

### 5.2 Literature review

- List from each participant to be sent to TG4 Chairman: Claude Faigy
- **Planning: first status at the next meeting**

### 5.3 Status of EN Standards on Inelastic Analysis Requirements

- EN 13445: Mayur Brijlani
- EN 13480: Claude Faigy
- Other EN: like "bolted flanges", on voluntary basis...
- **Planning: 2 set of slides for presentation at the next meeting**

## 6 Conclusion

- Any participant can send an email to the TG4 Chairman (with EPERC in the Title), in order to ask a question, propose remarks or suggestions, present a practical case to the TG4 Chairman and to registered EPERC members
- **NEXT TG4 meeting:** preliminary date to be confirmed:
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April 12, 2022 – TEAMS Meeting

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