

DESIGN OF COMPOSITE BOX GIRDER BRIDGES CURVED IN PLAN

IVÁN CAMPO RUMOROSO

Pedelta

Universidad de Cantabria

ivan.campo@alumnos.unican.es



1. Introduction
2. Science & Technique
3. Technology
4. Educational Activities
5. Results
6. Scientific Criticism
7. Work Plan
8. Mobility
9. Funding
10. Ethics
11. Conclusion

Research objective:

- Efficient design of composite box girder bridges
 - Efficient in terms of design time required
 - Efficient in terms of steel weight



Queensferry Crossing. Ramboll & LAP

Research focus:

- Cross-frame design



Puente de Vall d'en Bas. Pedelta

Research output:

- Integrated tool for calculation and design
 - Previously: Two models

Global model
Global design

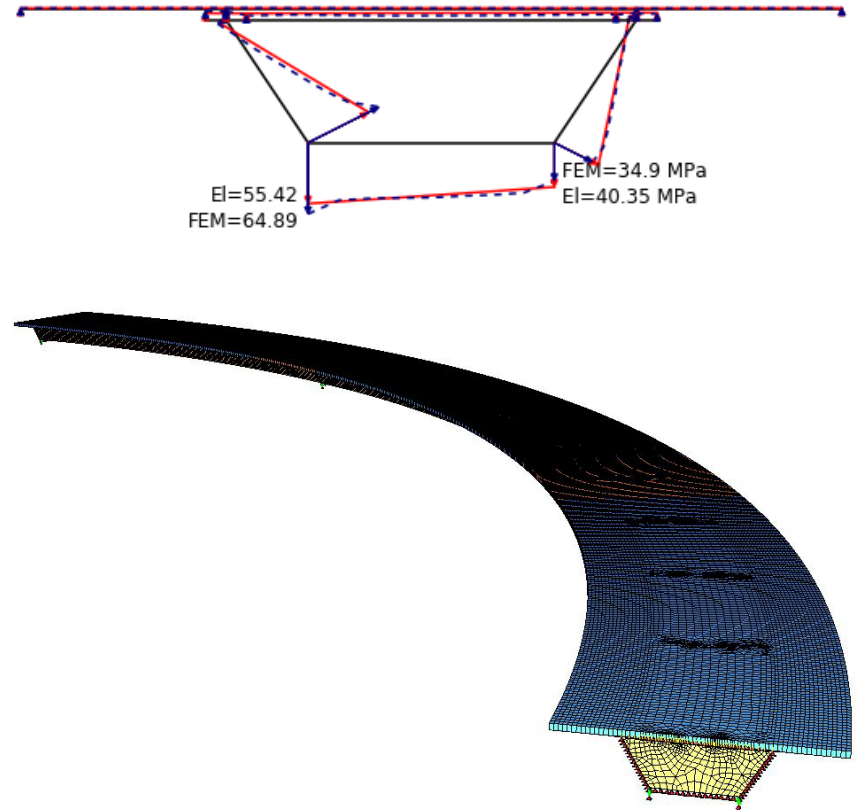


Distortion model
Cross frame design

- Proposal: Only one model

New finite element that include distortion
Global and cross-frame design combined

- Guidelines to optimize the cross-frame design



Objectives:

- Understanding of a field of study and command research methods
- Cope in contexts in which there is little specific information
- Integrate knowledges, face complexity and formulate judgements with limited information

Example:

- Feixa Llarga bridge
 - Evaluation: End of fatigue life
 - Owner wanted to preserve it
 - Solution: combine American and European methods



Puente de la Feixa Llarga. Pedelta

CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

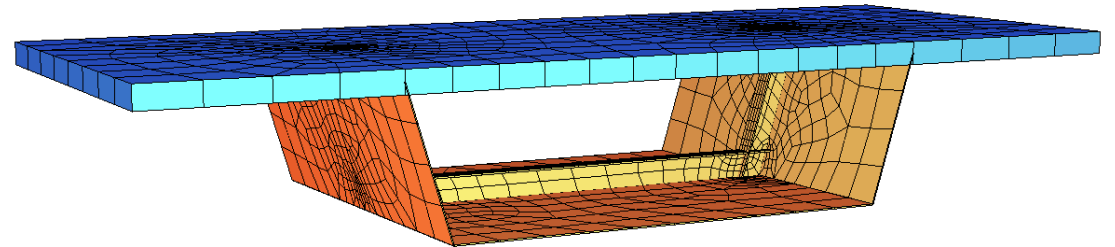
CA 06

New software learn:

- Python -> Self-study -> The finite element is implemented in Python
- Latex -> Self-study -> Final document and articles written in Overleaf
- Rhinoceros & Grasshopper -> Catedra Arenas Course

Other software:

- Sofistik -> Used in the company
- Excel -> Used in the company



CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

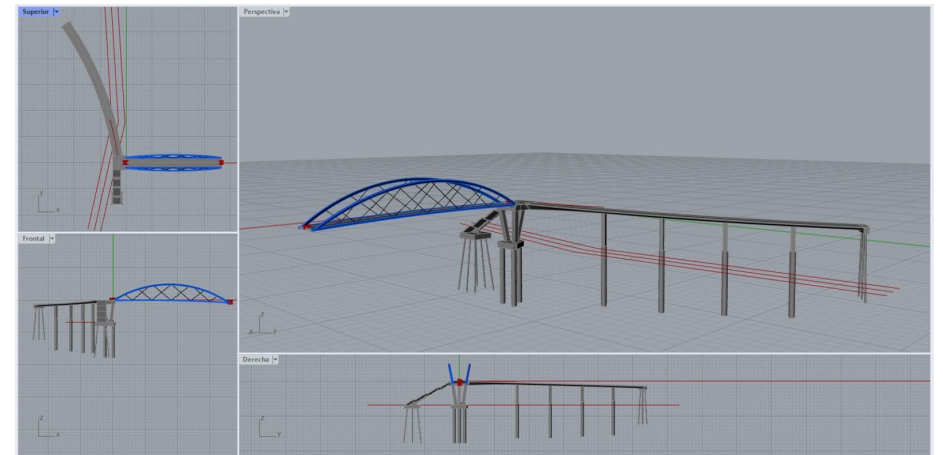
CA 06

EDUC Courses:

- Basic training: 30 h course
- Advanced training: 30 h courses
 - Profesional future, European projects, forensic science, creativity techniques, and ideas and concepts for solution searching

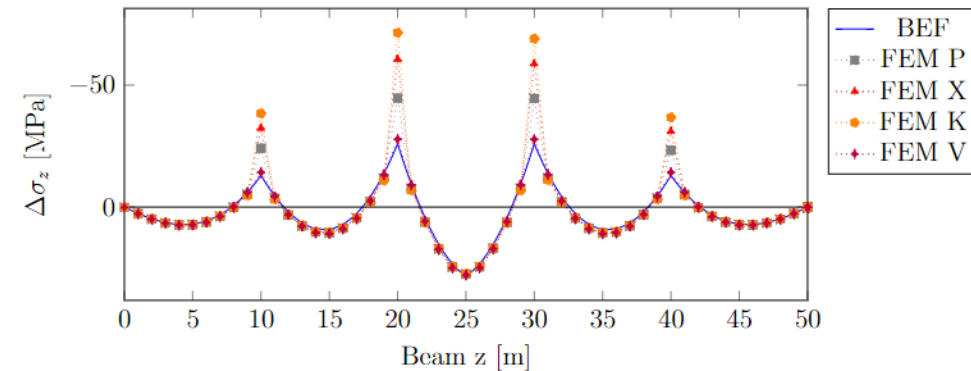
Other Courses:

- Advanced training: 10 h already recognized
 - S4D4C European Science Diplomacy Course
- Specific training: 16 h
 - Parametric design: Catedra Arenas Course
- FCE exam: 18 June



Articles:

- Based on new findings
- Distortion analysis of horizontally curved box girder bridges
 - Under internal review
- Implementation of solid plate diaphragms in a high order beam element
 - Co-author with Dr. Francisco Cambronero Barrientos
 - Under preparation
- Beam element for horizontally curved box girder bridges
 - Under preparation. Expected at the end of the year



CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Congress:

- VII Congreso Internacional ACHE (A Coruña, 2017)
 - Viaductos de San Felipe y Las Tinajas en zonas de alto riesgo sísmico (Ruta 60, Chile)
- IABSE Symposium Prague 2022 (May 25-27)
 - New beam element for horizontally curved steel-concrete composite box girder bridges
- VIII Congreso Internacional ACHE (Santander, June 20-22, 2022)
 - Evaluación y diagnóstico del Puente Pedro de Valdivia. Viga Gerber de hormigón armado del año 1954
 - Organizational committee member



CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Strengths:

- It is an original research
- Results may become useful
- Results are showing excellent correlations

Weaknesses:

- Multiple parameters involved
- Eurocodes oriented



CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Opportunities:

- Not as developed as expected
- New opportunities -> Future research

Threats:

- Part-time dedication
- Final date: 06-06-2023 -> Work plan

EAE-11

$$T_{Ed} = M_t + \frac{M_y}{R}$$

Proposal

$$T_{Ed} = M_t + \frac{M_y}{\beta R}$$

$$\beta = \frac{b_b}{b_t}$$

CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Final document index:

1. Introduction
2. State of art
3. Finite element definition
4. Cross-Frames
5. Verification examples
6. Parametric study
7. Conclusion

Appendix A: Notation

Appendix B: Integrals

Appendix C: Section properties obtention example

Appendix D: Classic theory of distortion

Schedule

1. Begin of 2023
2. End of 2022
3. Under revision
4. Under revision
5. Under revision
6. Mid autumn 2022
7. Begin of 2023

Appendix A: Implemented in Latex

Appendix B: Under revision

Appendix C: Under revision

Appendix D: Under revision

CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Congress:

- 3 International Congress

Career:

- 10-year experience in international companies
- Projects in 15 countries



CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Conflict of interest:

- Respect the interest of all companies

Publications:

- Honesty

CB 11

CB 12

CB 13

CB14

CB 15

CB 16

CA 01

CA 02

CA 03

CA 04

CA 05

CA 06

Educational activities almost completed:

- Transversal training and specific training completed
- FCE exam in one month

Theoretical background is already complete and will be published:

- It will be presented in the IABSE Symposium
- It will be presented in Journals
 - An article under internal review and two more under preparation

Mobility will be completed next month

Final document will be submitted before April 2023

- Theoretical background already written