

# SAFE JOINTS

Joints as key elements against the collapse of steel and composite structures under exceptional loadings

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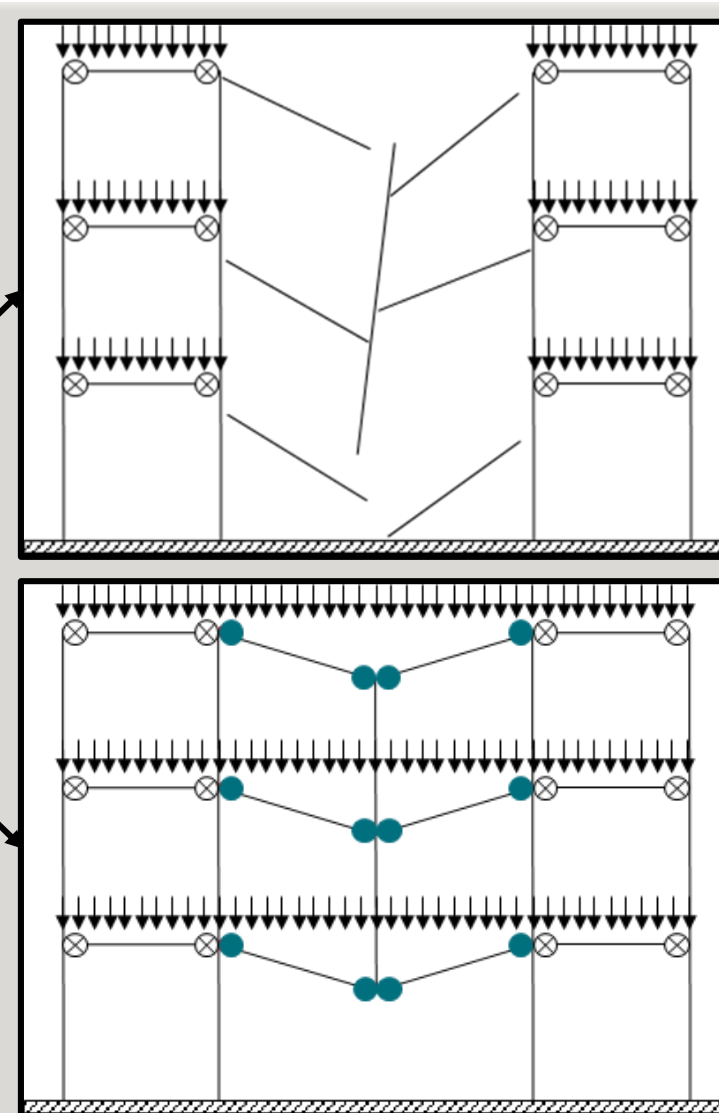
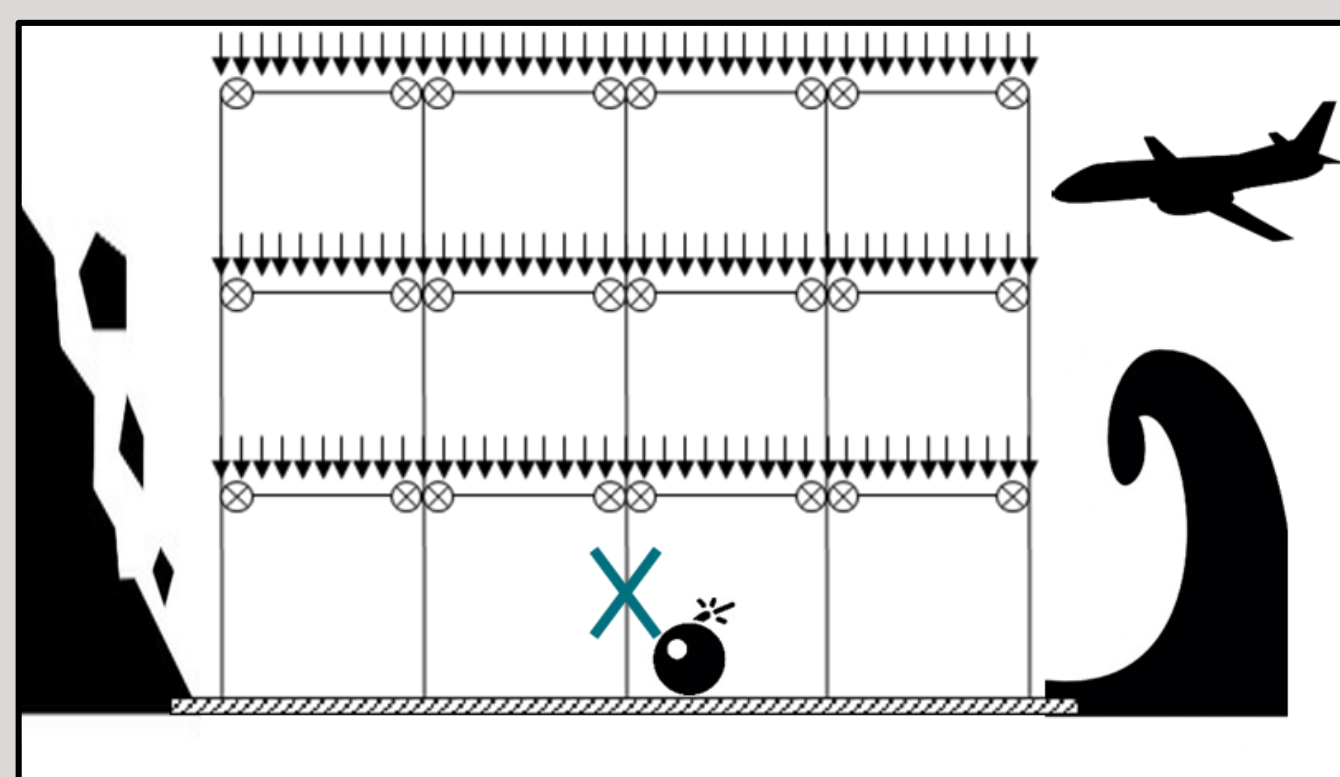
Prof. Jean-Pierre Jaspart

Prof. Jean-François Demonceau

## Overview of the project

Nowadays, modern design norms require to the civil engineer to design **robust structures** in order to limit the occurrence of failures under exceptional loadings. In steel and steel-concrete composite construction, this request for robustness mainly focusses on the **joints between structural members**, these joints generally being the « weak » elements of a structure. In this context, it is recommended to provide an appropriate **ductility** to the joints but no design recommendations are nowadays provided in the norms. The purpose of the present work therefore consists in filling that gap.

### 1. CONTEXT: Robustness



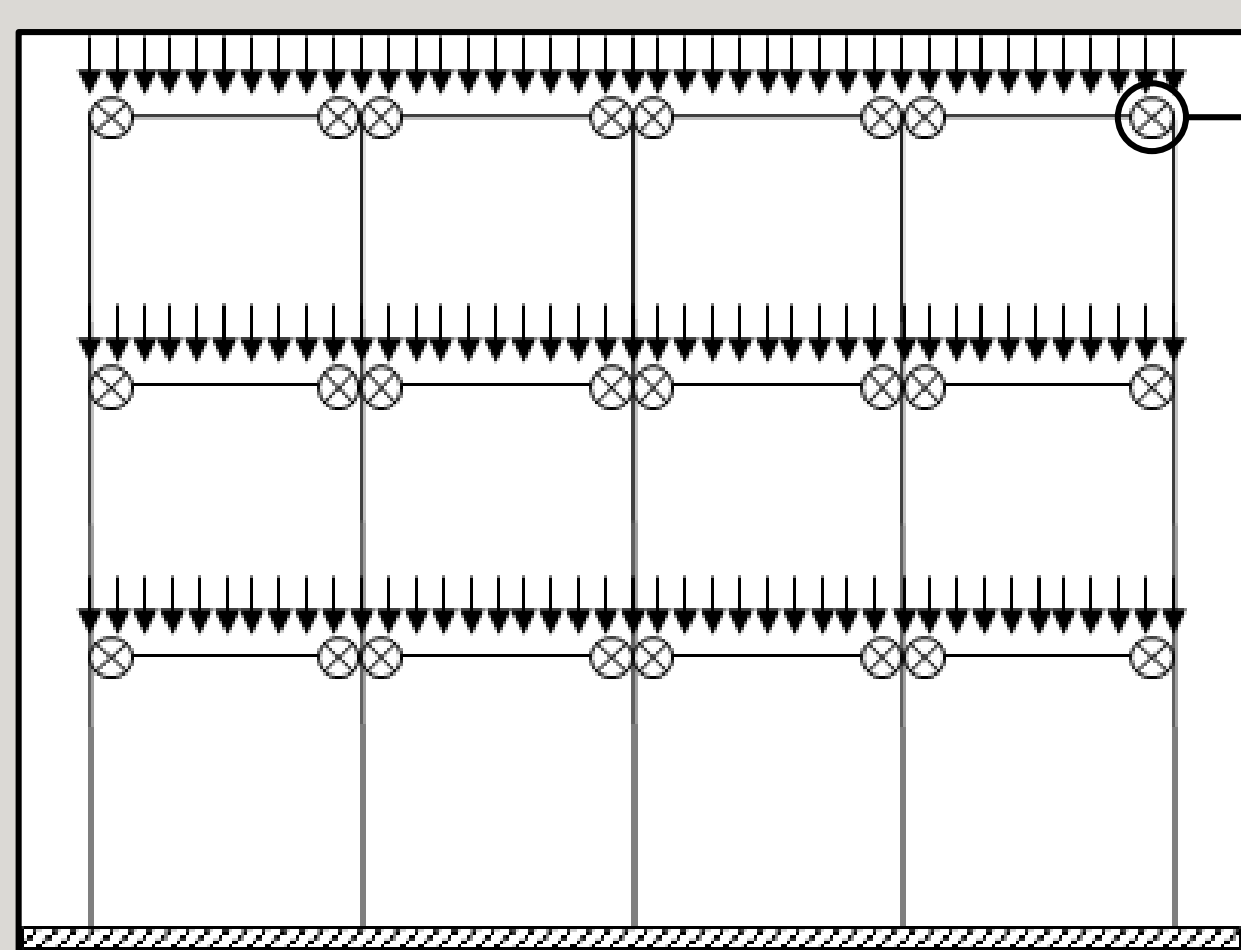
- Exceptional loading
- Damage
- Large deformations
- Progressive Collapse
- New state of equilibrium

**Robustness** = « ability of a structure to withstand events like fire, explosions, impact or the consequences of human error, without being damaged to an extent disproportionate to the original cause » (EN 1991-1-7)

Requirements: **ductility** (in the joints) + redundancy (in the structure)

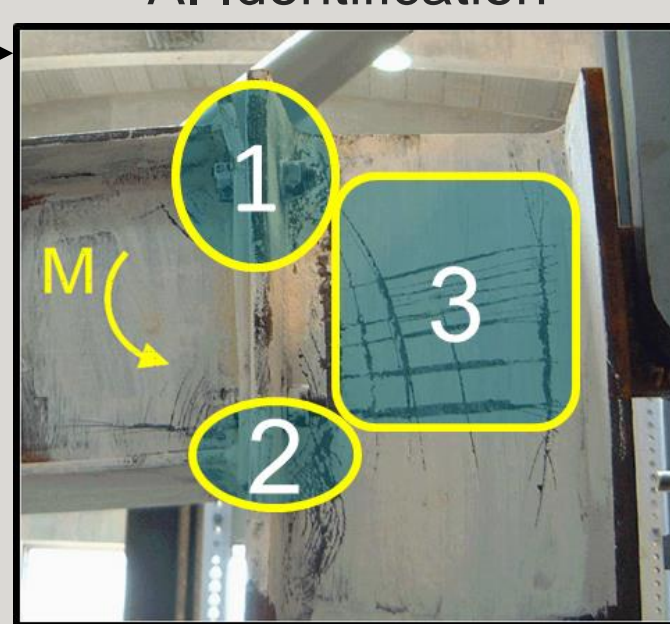
Goal: redistribution of the loads within the structure

### 2. PROBLEMATIC: Joint ductility

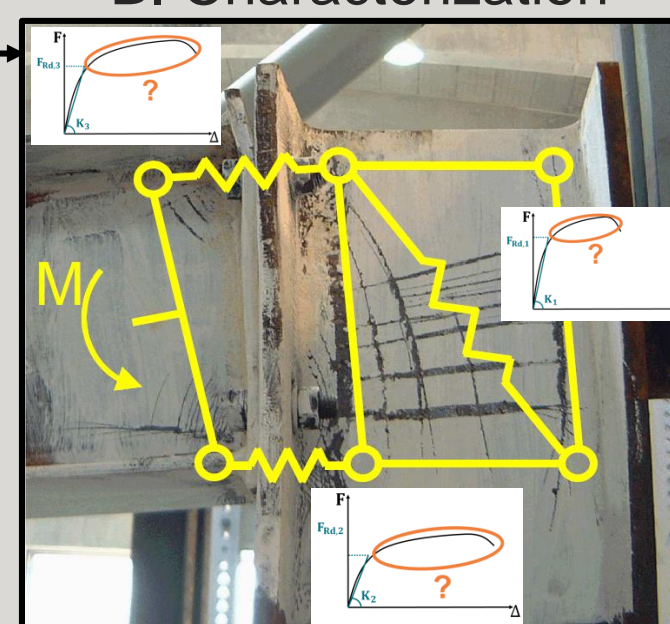


#### COMPONENT METHOD

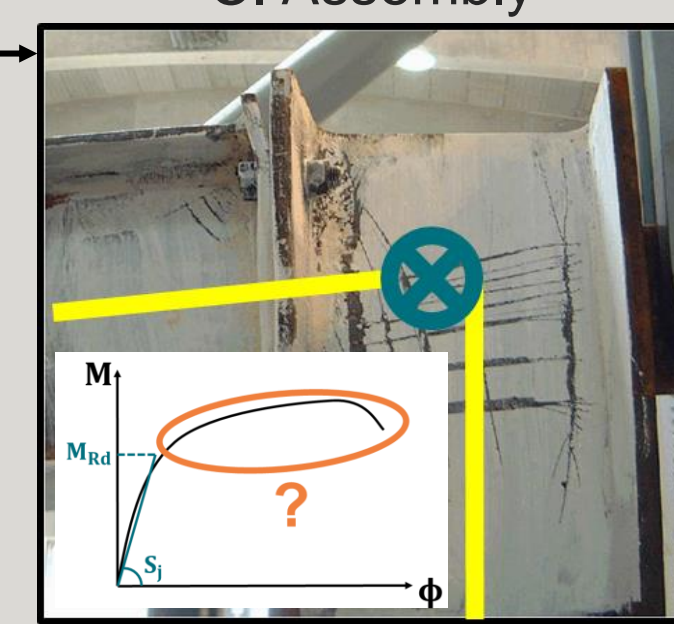
##### A. Identification



##### B. Characterization



##### C. Assembly



Purpose of the work

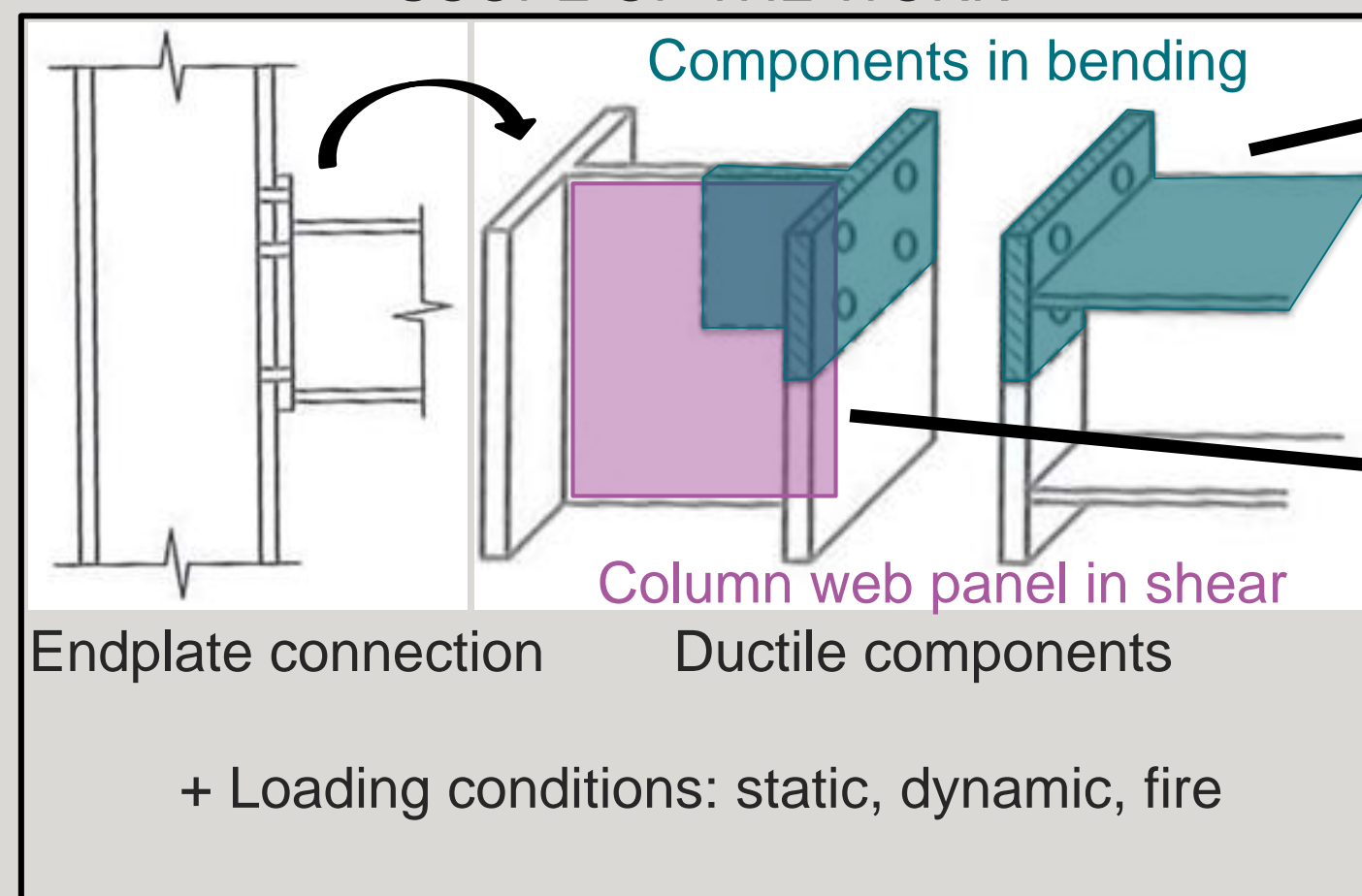
➔ Extension of the component method

↗ Toward the field of large deformations

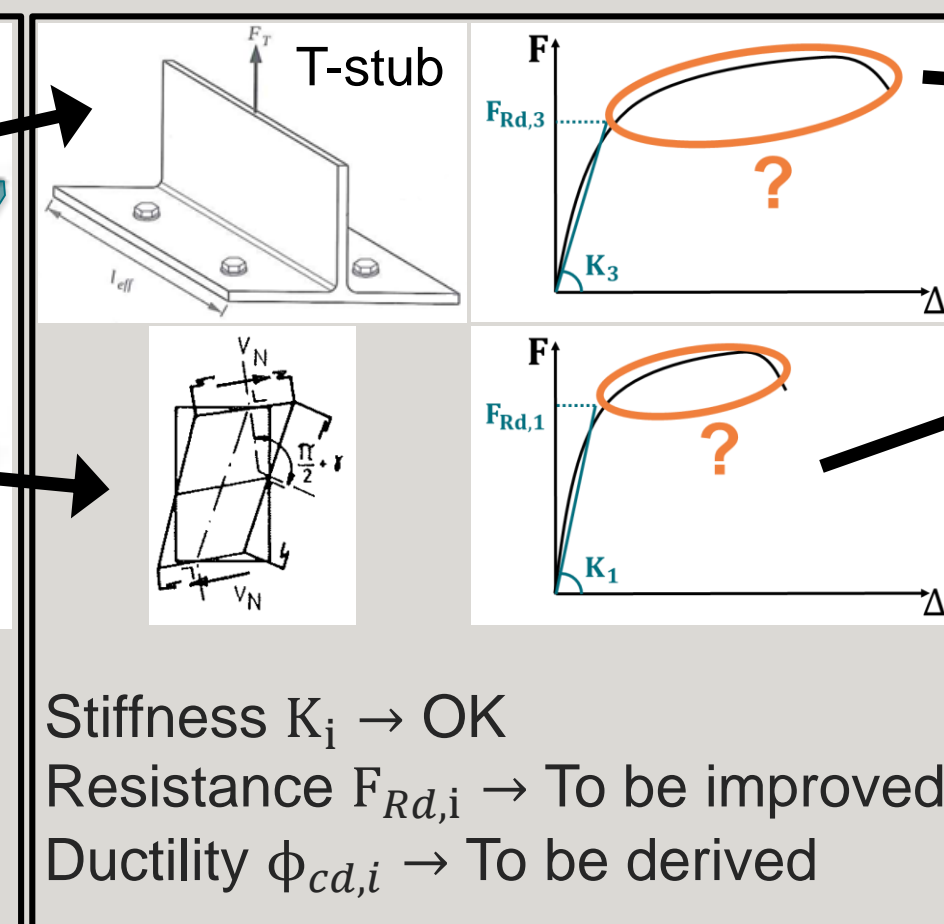
↘ Under complex loading conditions

### 3. PLAN OF THE ACTIVITIES

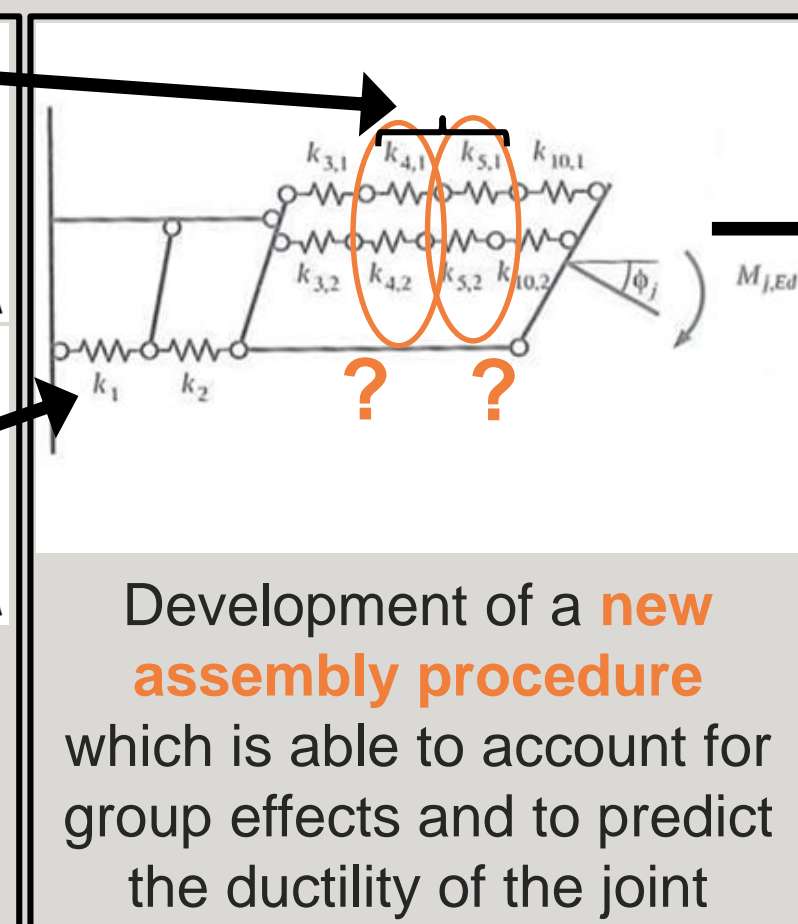
#### SCOPE OF THE WORK



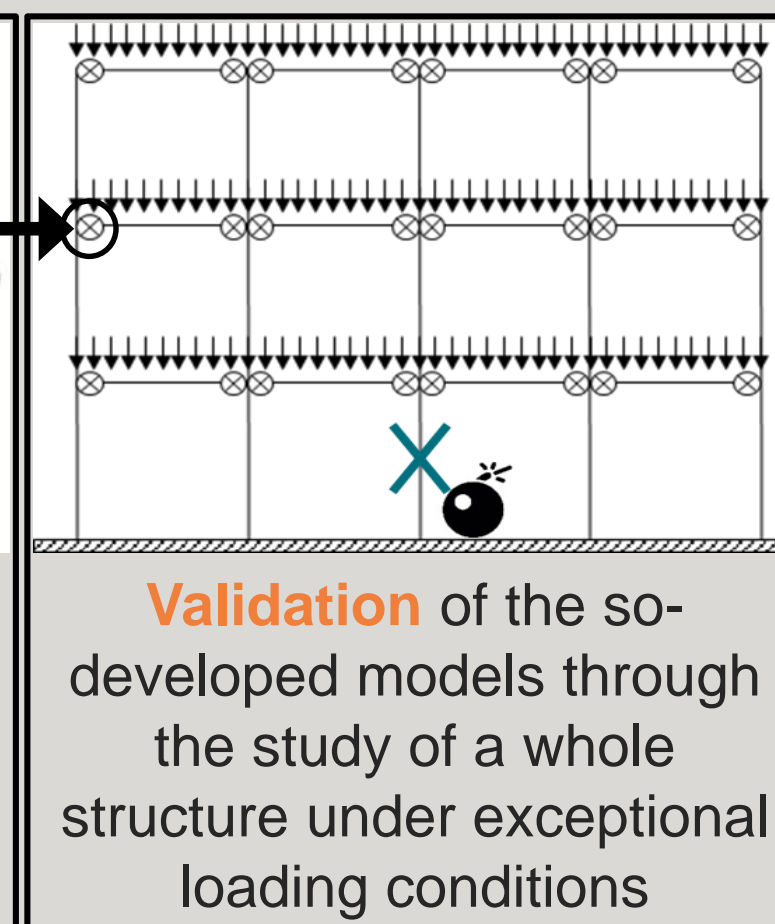
#### STEPS 1 & 2



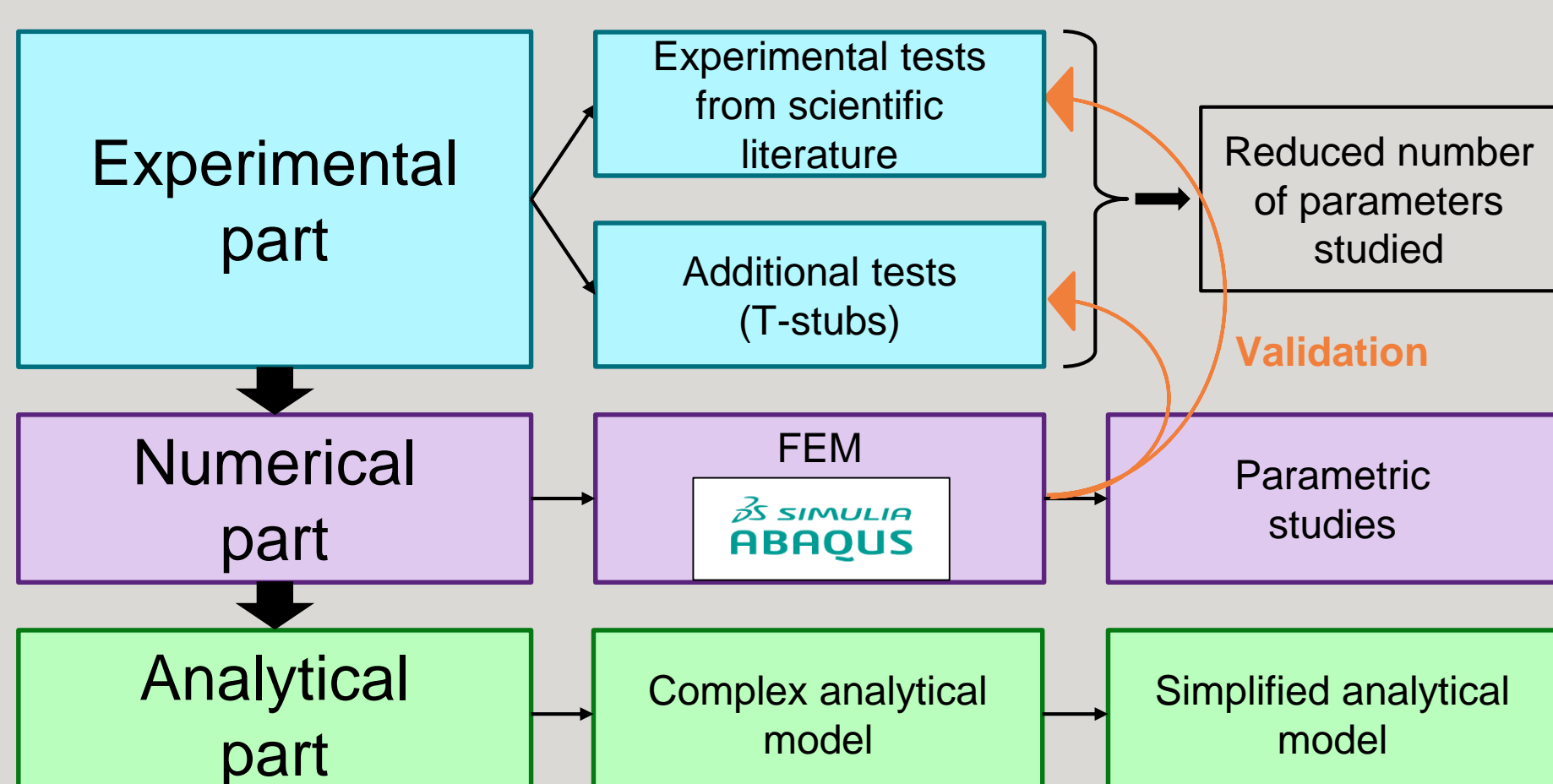
#### STEP 3



#### STEP 4



### 4. METHODOLOGY



### 5. CONCLUSIONS & PERSPECTIVES

This work falls within a more comprehensive approach which aims at ensuring an « appropriate » **robustness** to any structure.

In this context, the behaviour of steel and steel-concrete composite joints is investigated with the purpose of **setting a new path** by showing that this type of joint may well be characterized in terms of **ductility**.

By the end of the thesis, a **complete analytical model** for the characterization of bolted end-plate connections in terms of stiffness, resistance and ductility will be provided to the scientific community, subsequent steps being the extension of the model to other joint configurations and eventually the integration of the model within the structural Eurocodes.