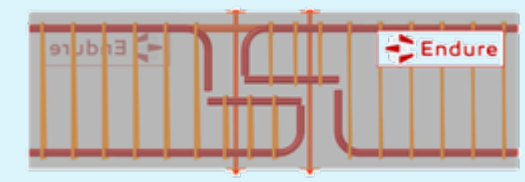




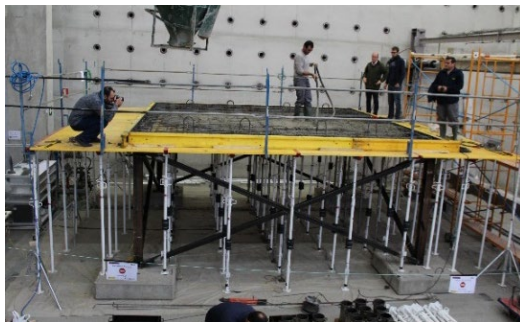
A Framework for Improving Building Robustness Through Fuse-Segmentation

Manuel Buitrago, Nirvan Makoond, Jose M. Adam
mabuimo1@upv.es



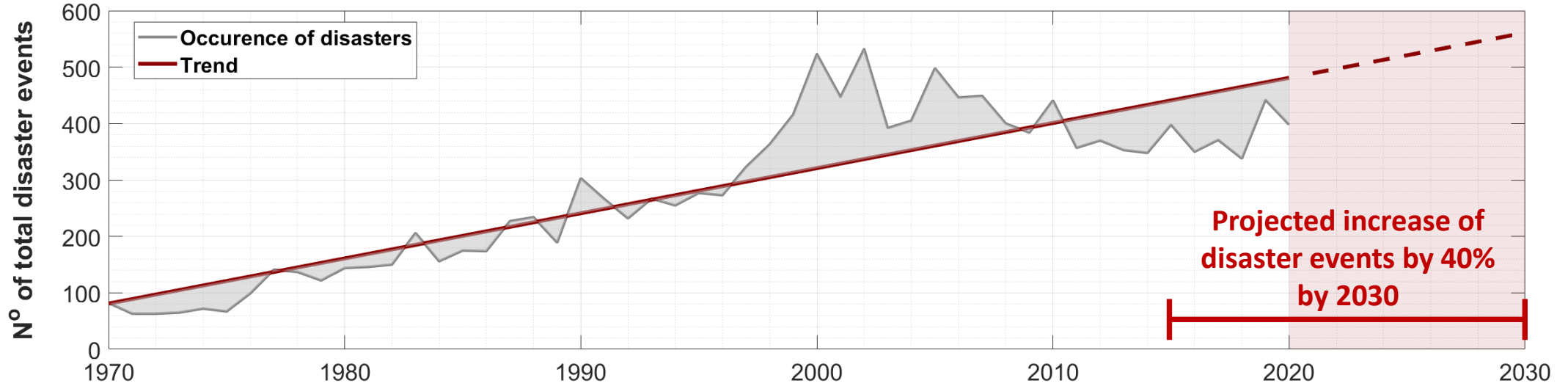
Outline

- 1 Introduction to fuse-segmentation and the Endure project
- 2 A performance-based approach for fuse-segmentation design
- 3 Designing & testing structural fuses
- 4 Testing real buildings
- 5 Coming tasks



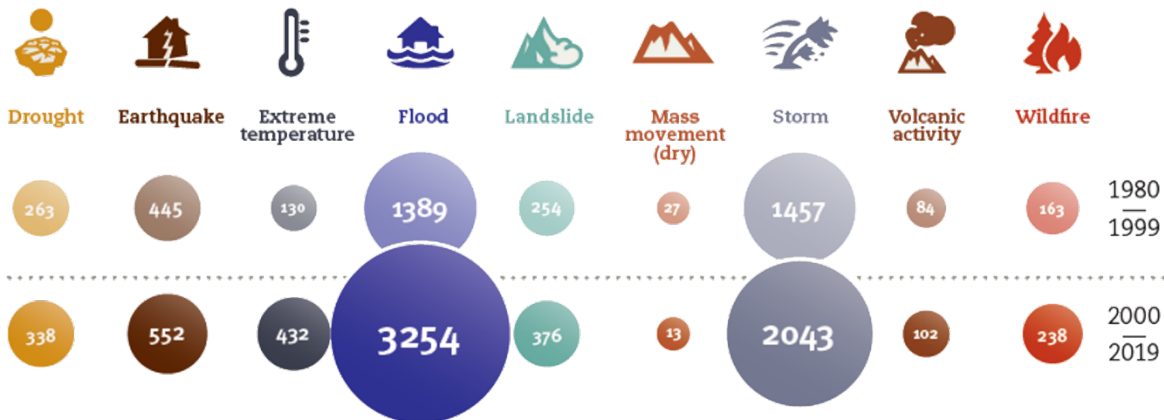
Fuse-segmentation & the Endure project

A world at risk



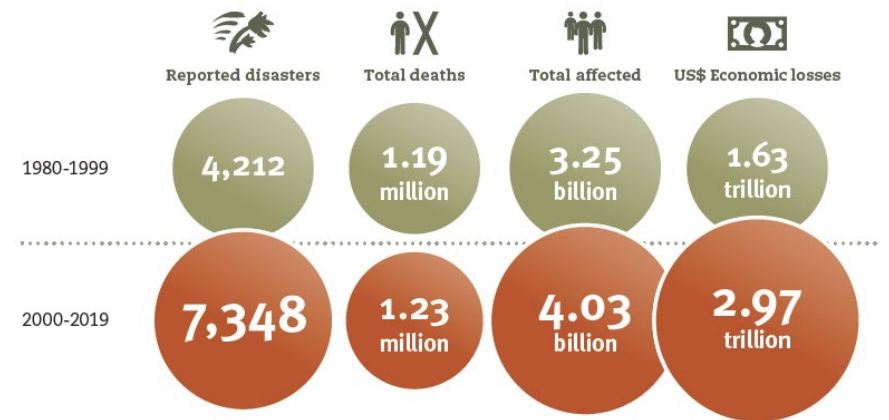
Data from EM-DAT, 2021

Types of disaster events (Total N° in 20 years)



UNDRR, 2019

Consequences (Total N° in 20 years)



UNDRR, 2019

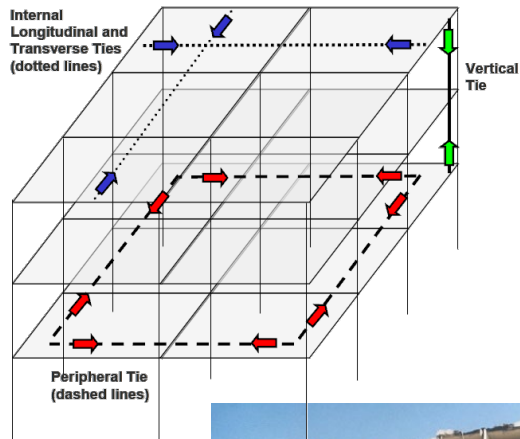
Building collapses



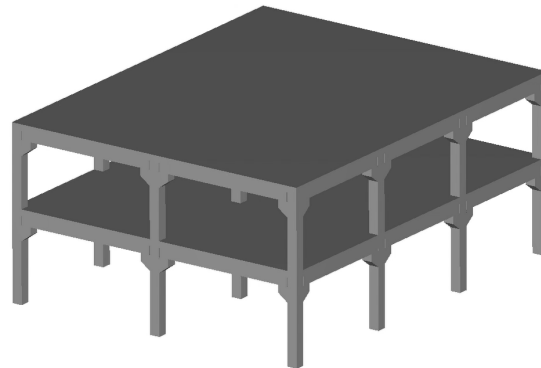
Current design philosophies

Continuity, Redundancy & Ductility

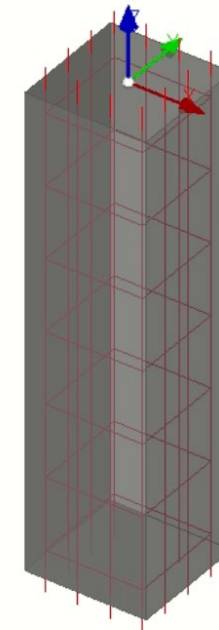
Prescriptive Tie Force Requirements



Alternative Load Path Method



Key Elements (Specific Local Resistance)



Limitations

Scenarios when current philosophies are ineffective

Large initial failures:

Failure of several columns;
Failure slab over one or more bays

Wide-span slabs:

Precast construction;
Posttensioned slabs;

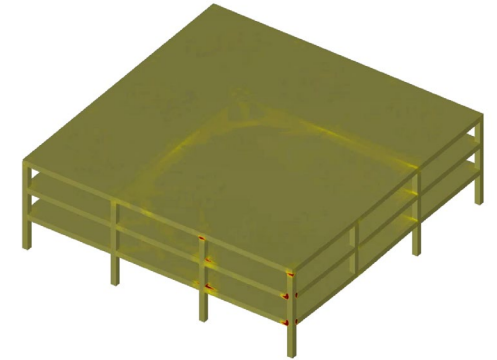
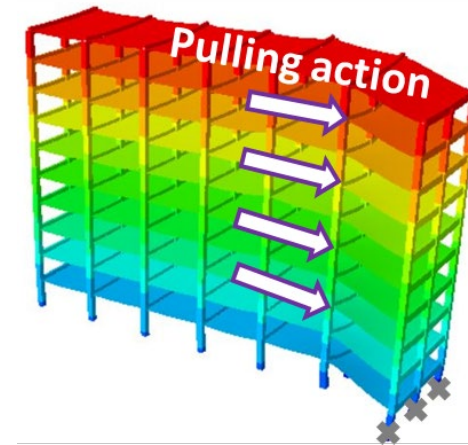
Continuity

Local failure pulls other zones

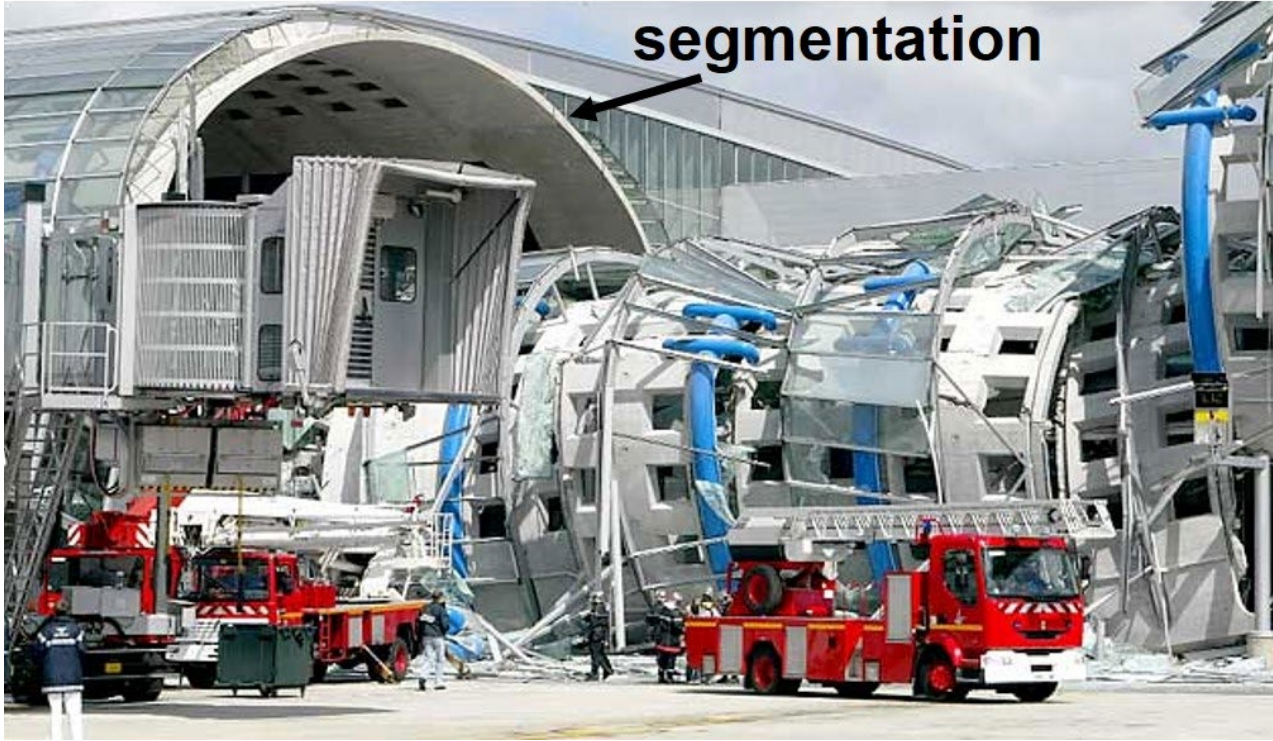
Increases risk of disproportionate collapse



New research is necessary



Segmentation

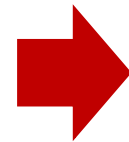


Segmentation

Durability issues

Costs

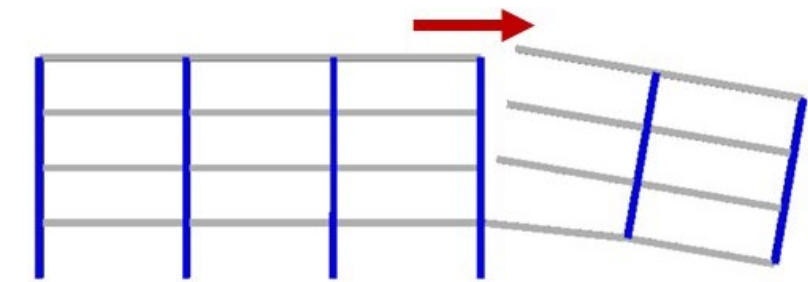
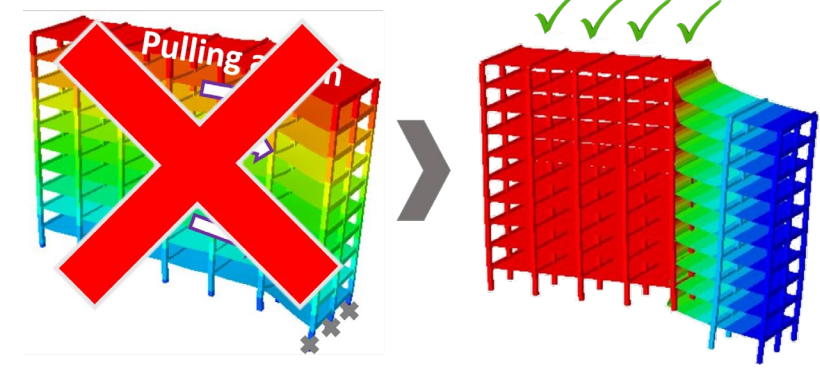
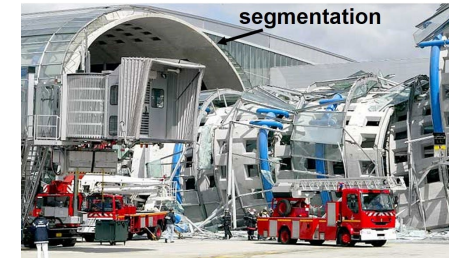
Minor structural robustness



New research is necessary

Endure

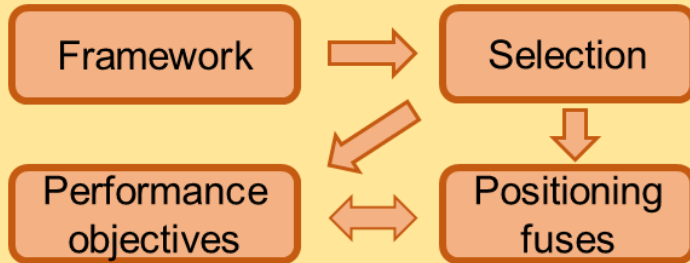
Call	ERC Consolidator Grant 2020
Acronym	Endure
Title	Fuse-based segmentation design: Avoiding failure propagation in building structures
Budget	2.509.375 €
Where	ICITECH - UPV
When	2022-2026



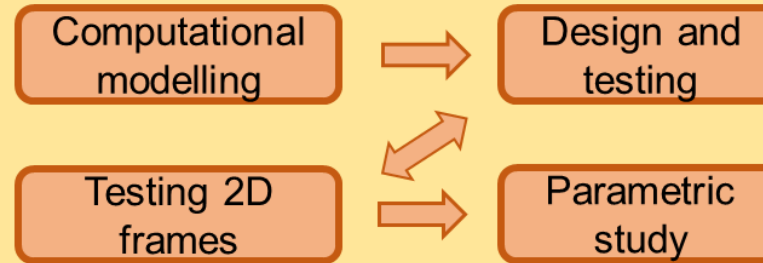
European Research Council
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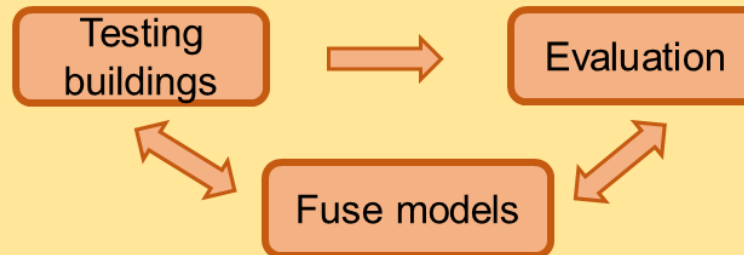
WP1. Performance-based approach for the design of fuse-segmented buildings



WP2. Designing, manufacturing and testing fuses



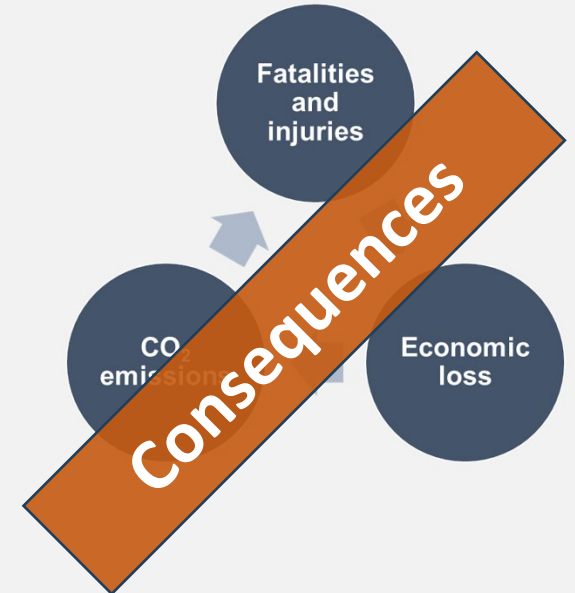
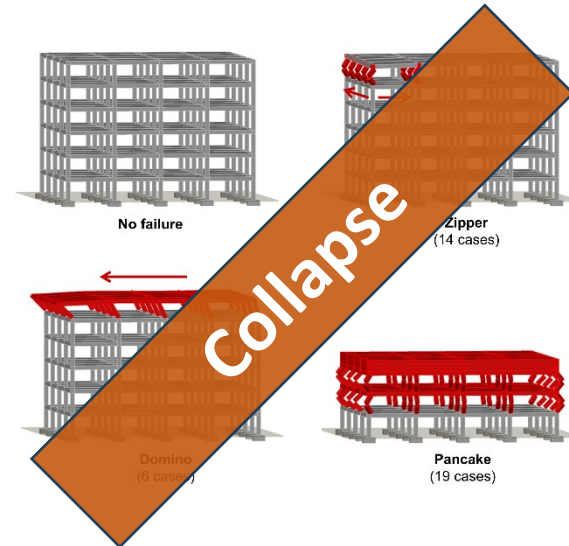
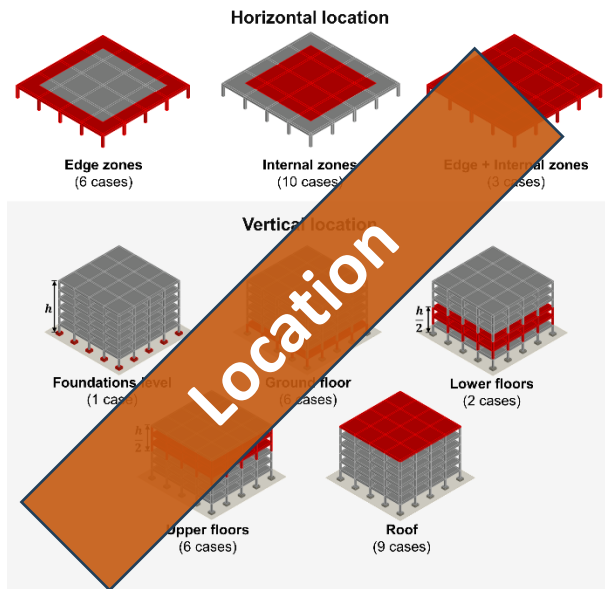
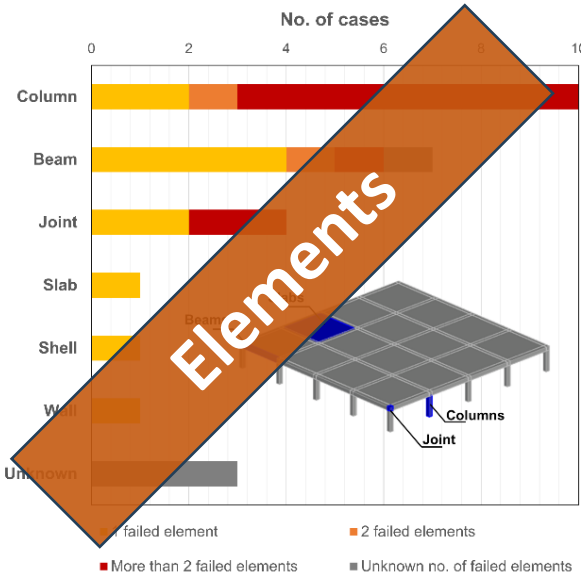
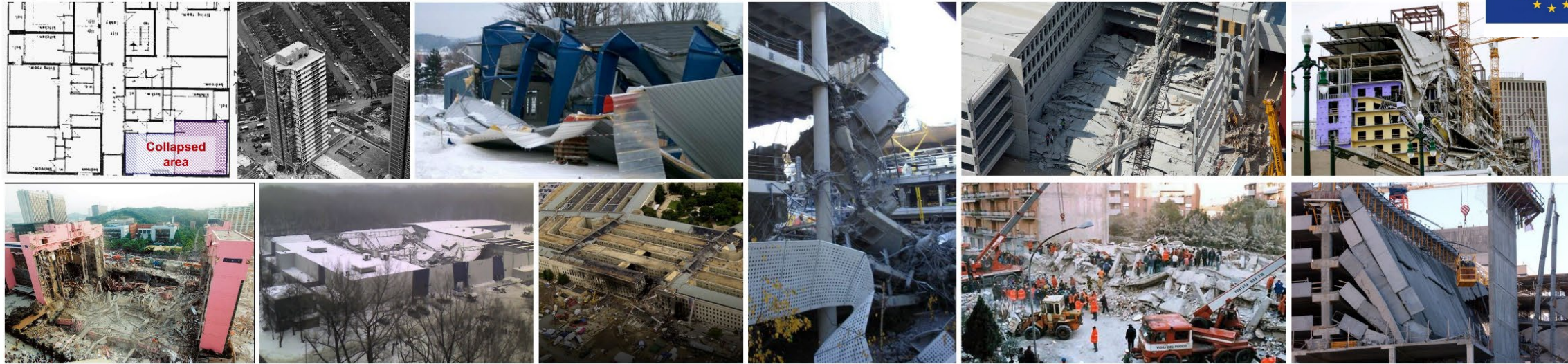
WP3. Implementation and validation – testing on real buildings





A performance-based approach

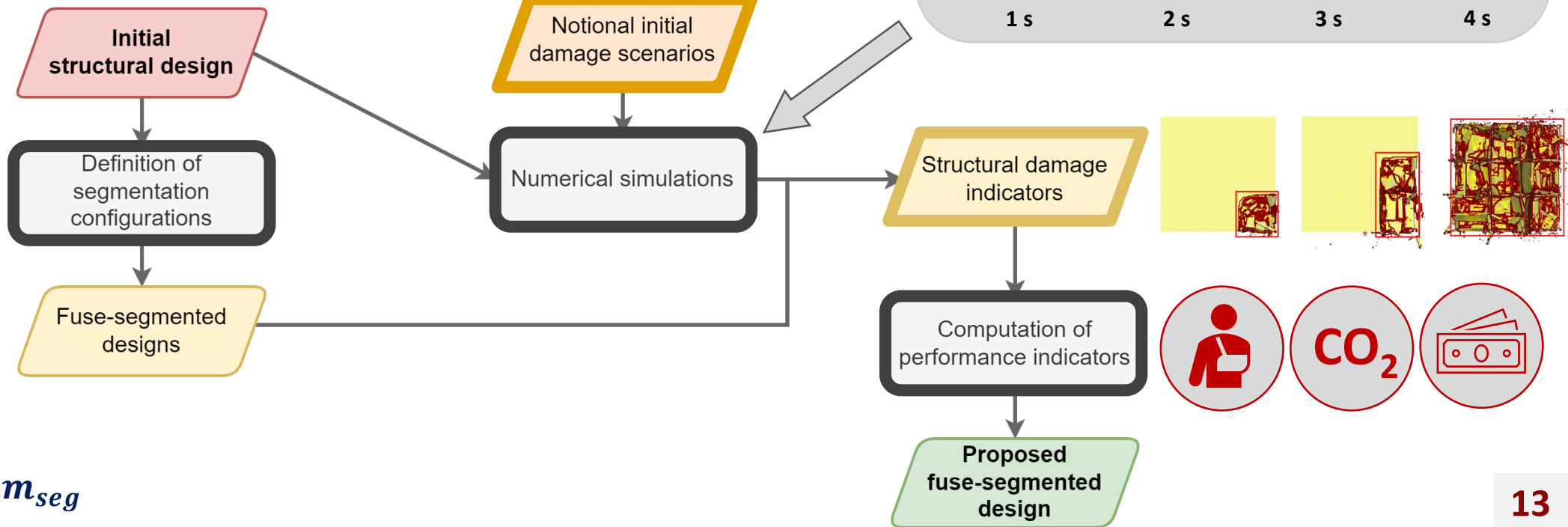
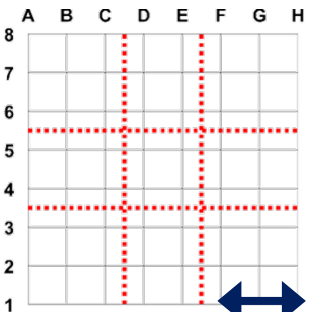
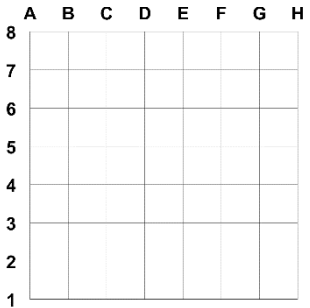
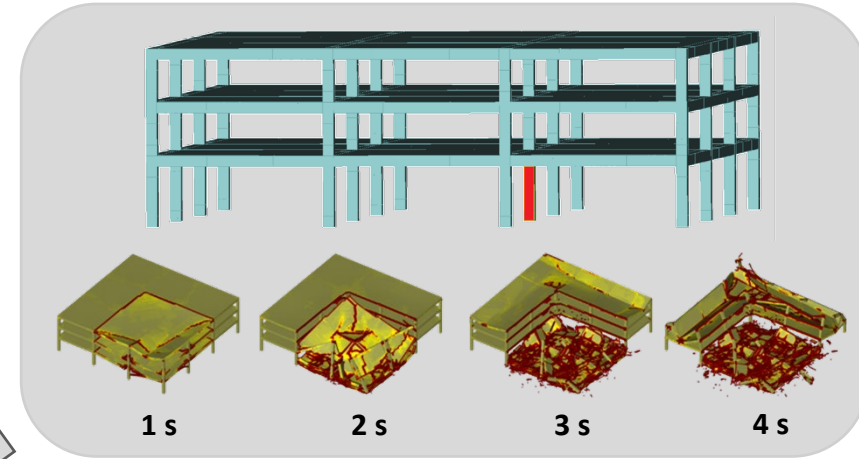
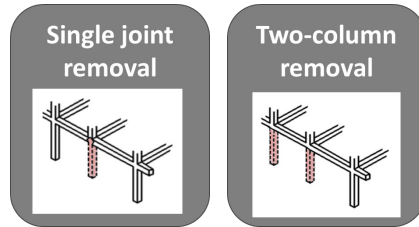
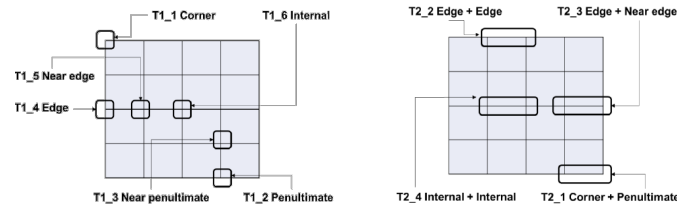
Analysis of past failures



Design framework



European Research Council
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Designing & testing structural fuses

Endure project – Experimental campaign



WP2. Designing, manufacturing and testing fuses

Computational modelling



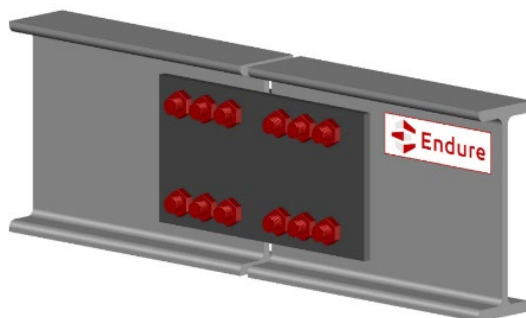
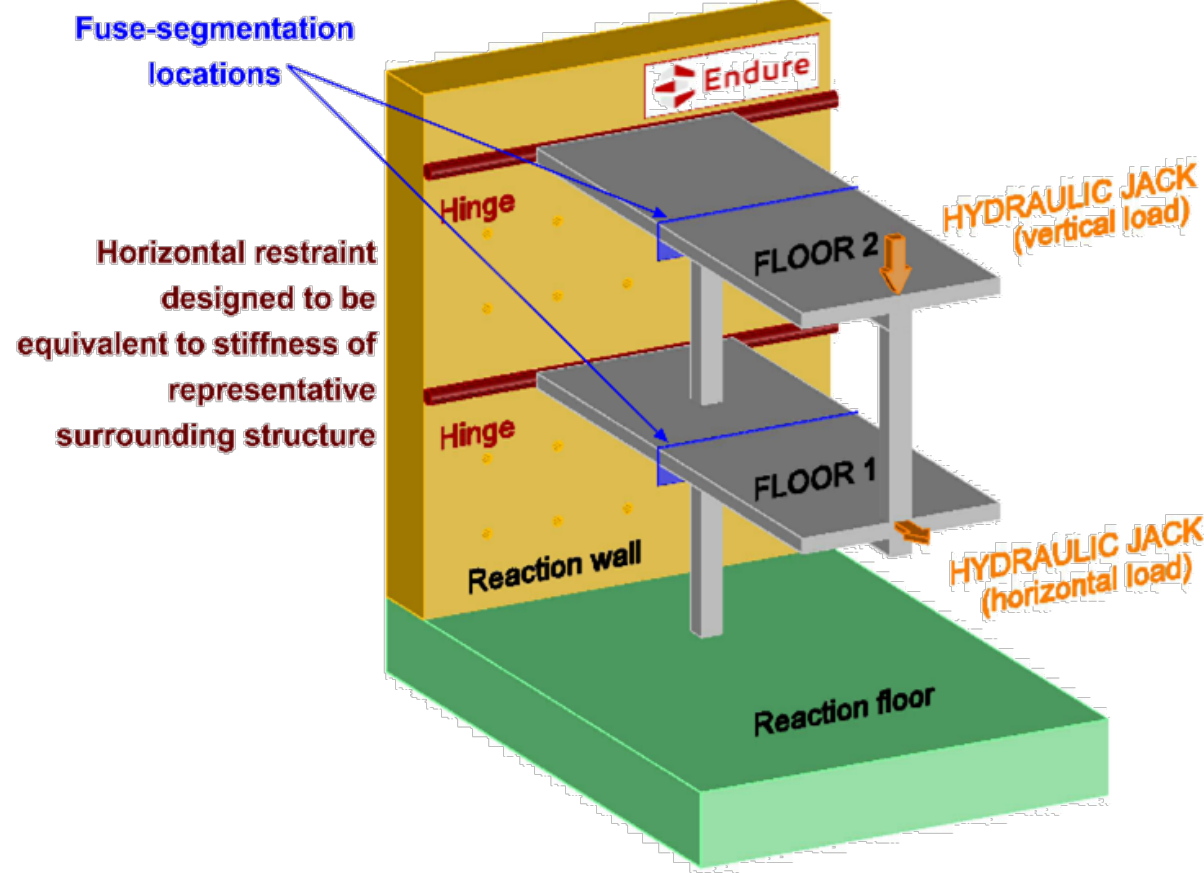
Design and testing



Testing 2D frames



Parametric study

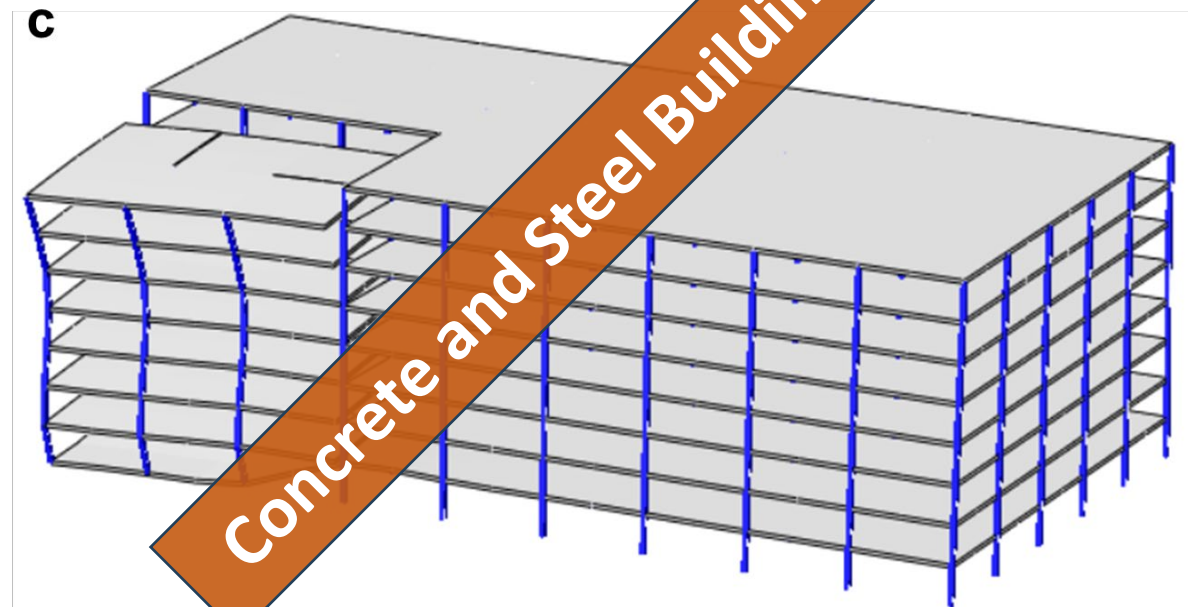
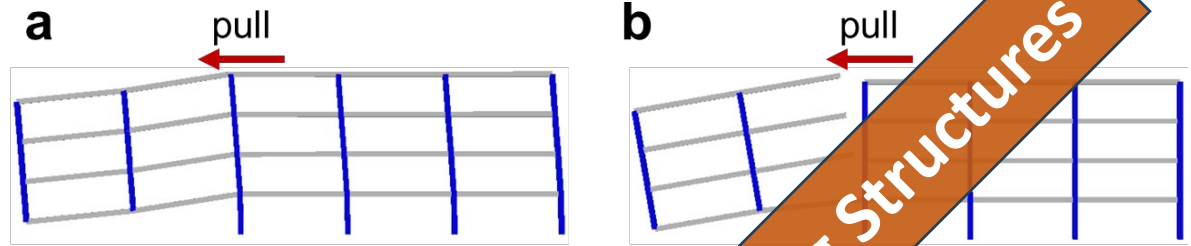
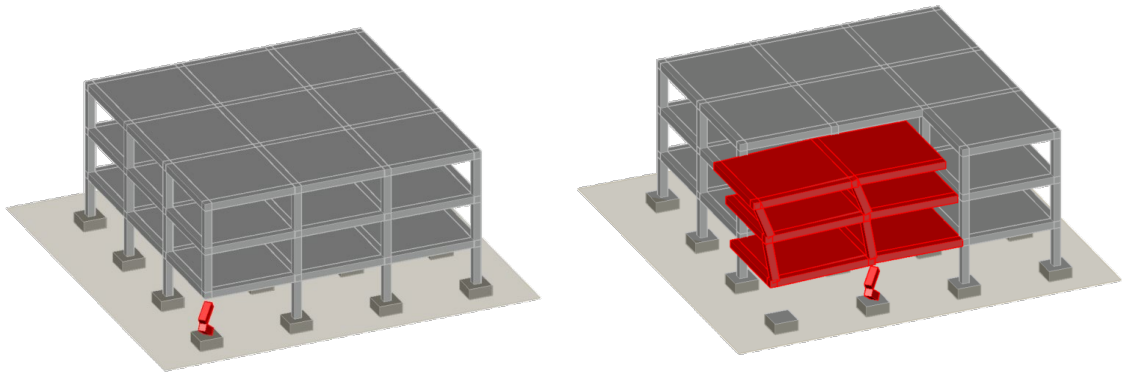
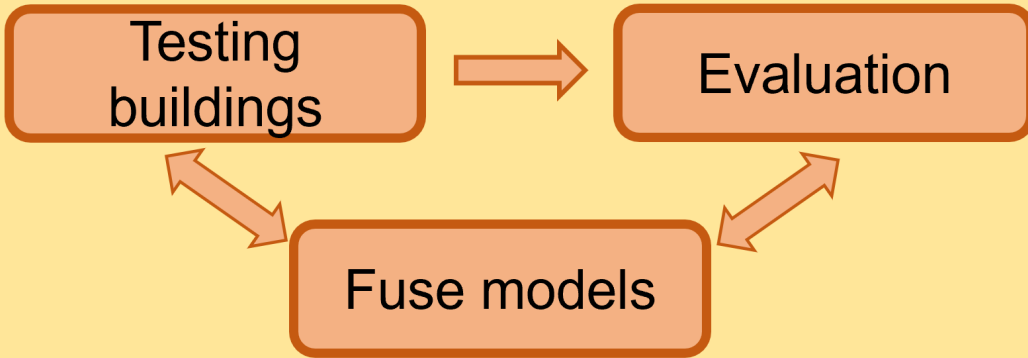




Testing real buildings

Endure project – Experimental campaign

WP3. Implementation and validation-testing on real buildings





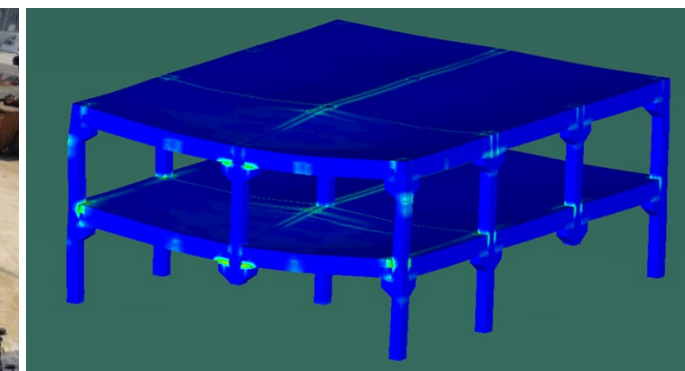
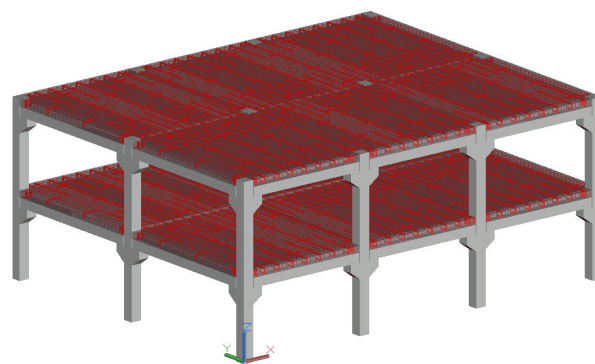
Thank you



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<https://b-resilient.webs.upv.es/>



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Large-scale tests on RC purpose-built buildings for improved robustness

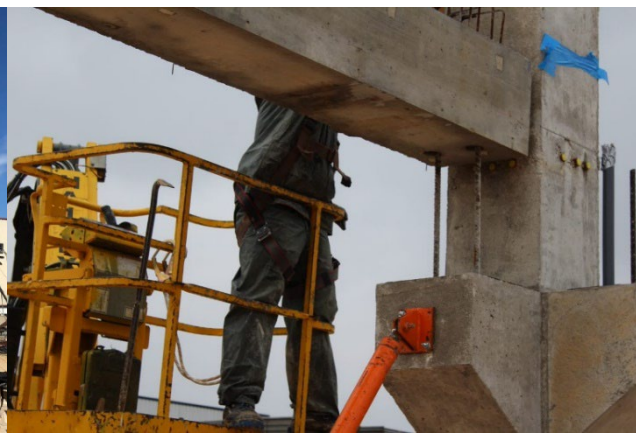
José M. Adam, Manuel Buitrago, Nirvan Makoond

joadmar@upv.es



Outline

- 1 Research at Building Resilient
- 2 Experimental campaigns
- 3 Outcomes and application
- 4 In two weeks





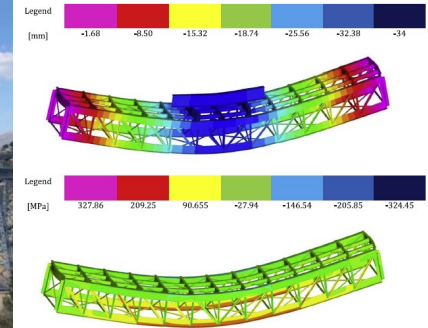
Research at Building Resilient



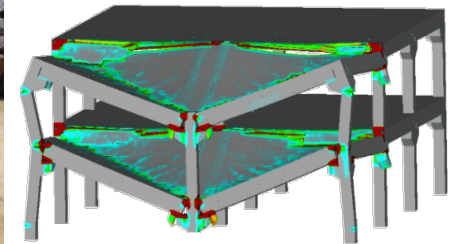
Research at Building Resilient



Structural assessment

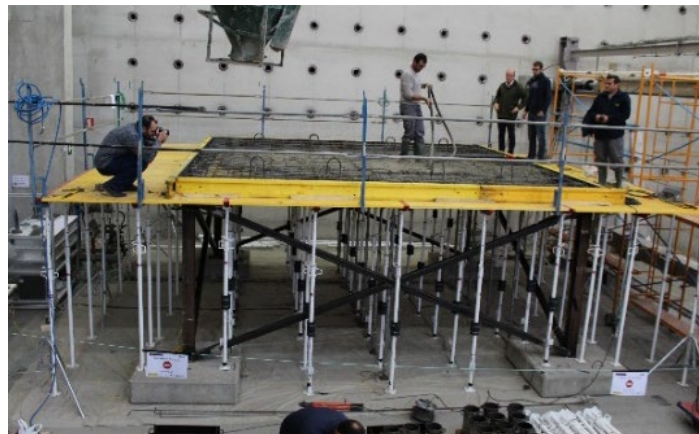


Structural robustness





Research at Building Resilient – ICITECH lab





Research at Building Resilient – Funding entities



European Research Council
Established by the European Commission



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VALENCIANA**



AVI AGÈNCIA VALENCIANA
DE LA INNOVACIÓ



GOBIERNO
DE ESPAÑA

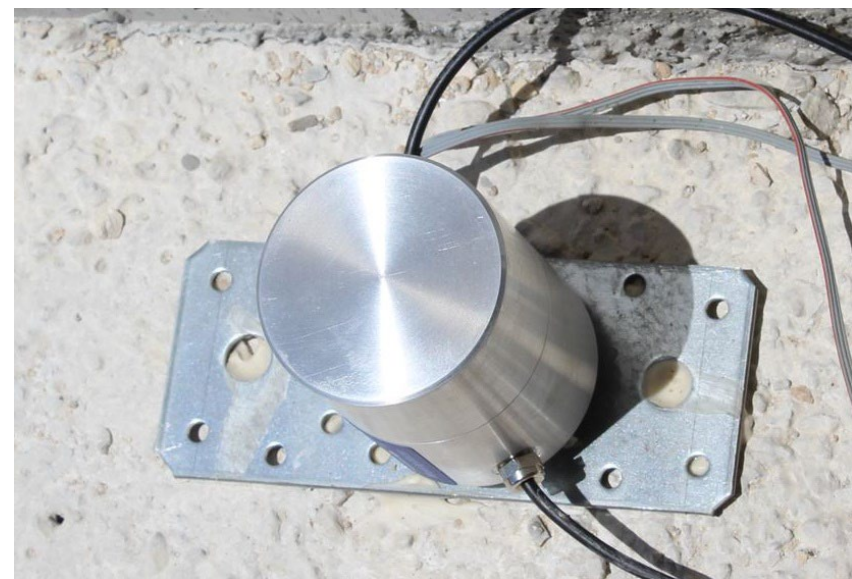
MINISTERIO
DE CIENCIA
E INNOVACIÓN





Experimental campaigns

Experimental campaigns – Complex and challenging tests – Monitoring

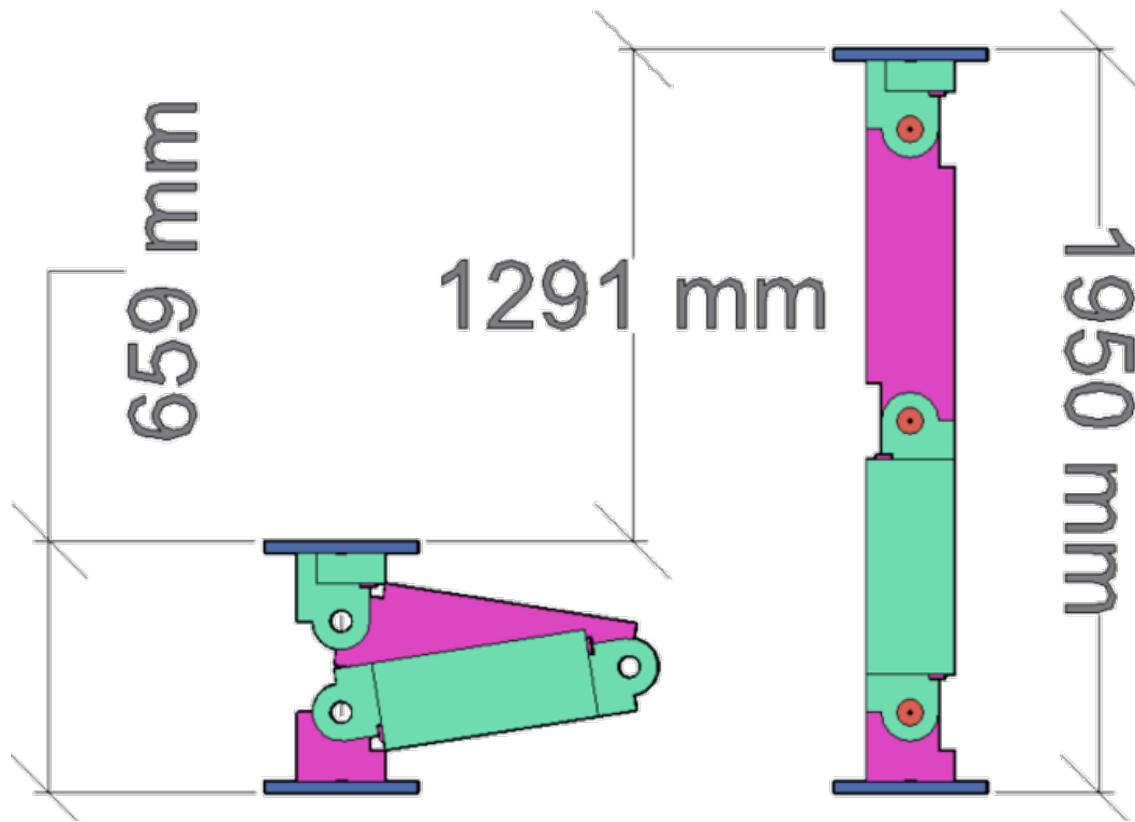


Experimental campaigns – Loading – Eurocodes – Concrete blocks



Experimental campaigns – Column removal

Different options for sudden removal → Collapsible column → 3 hinges and blocking system

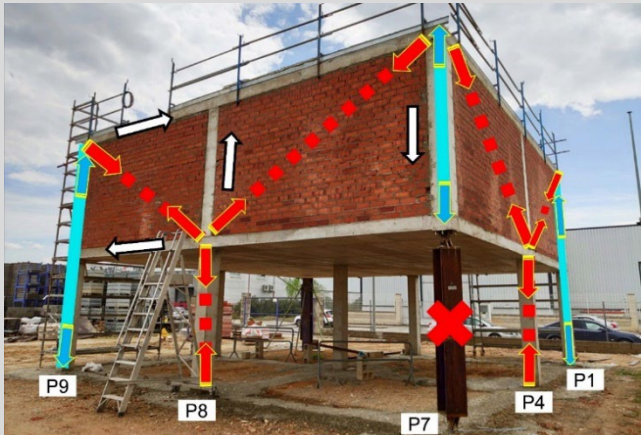




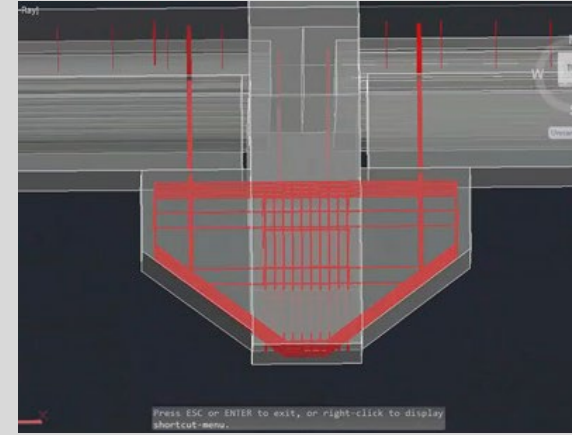
Outcomes and application

Outcomes and application

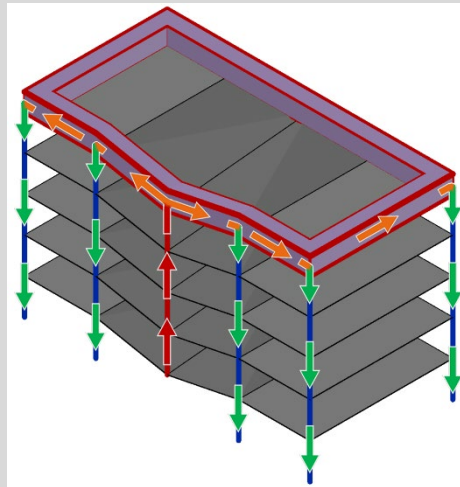
Cast in place



Precast



Retrofitting





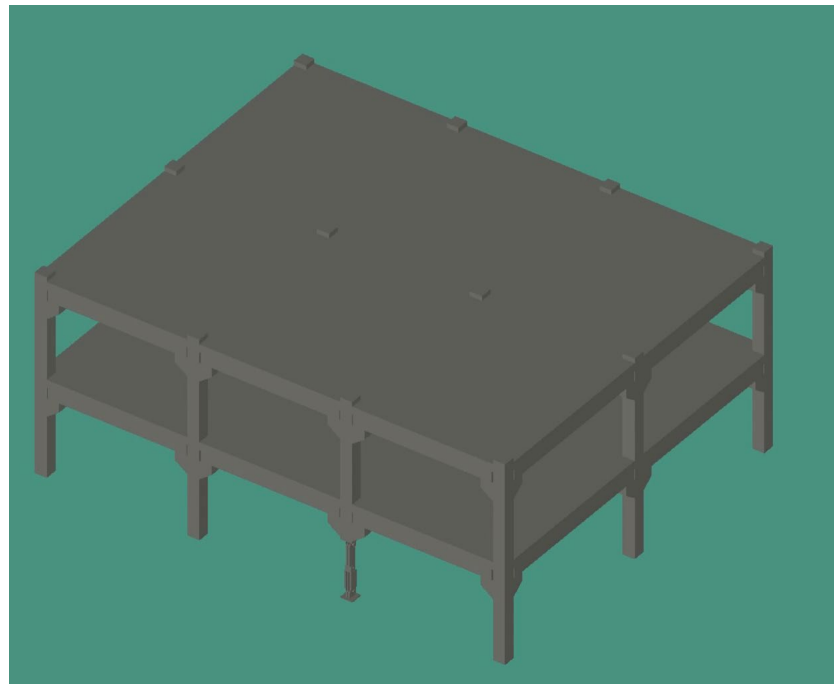
In two weeks



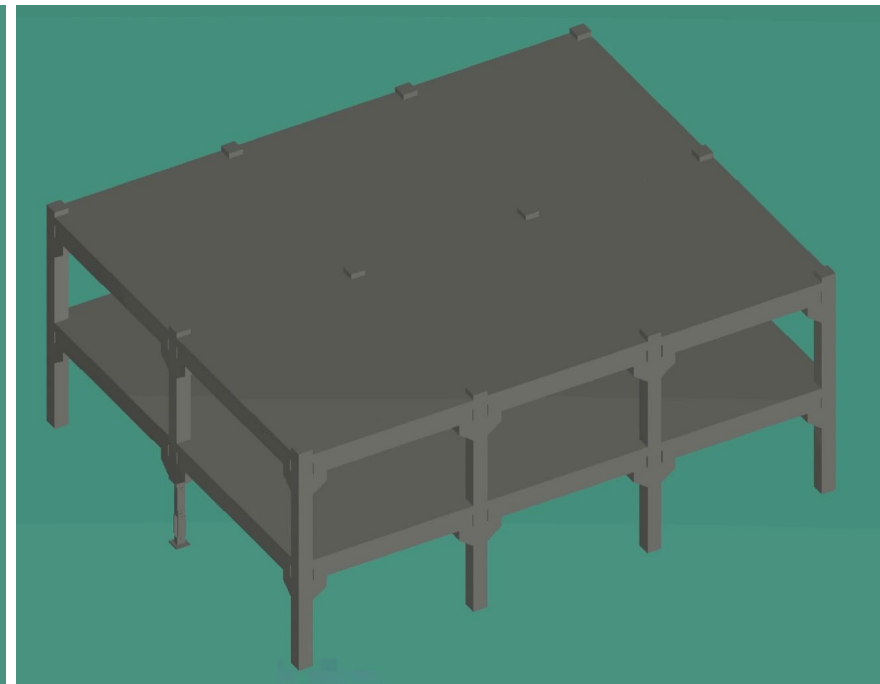
In two weeks – Partial collapse



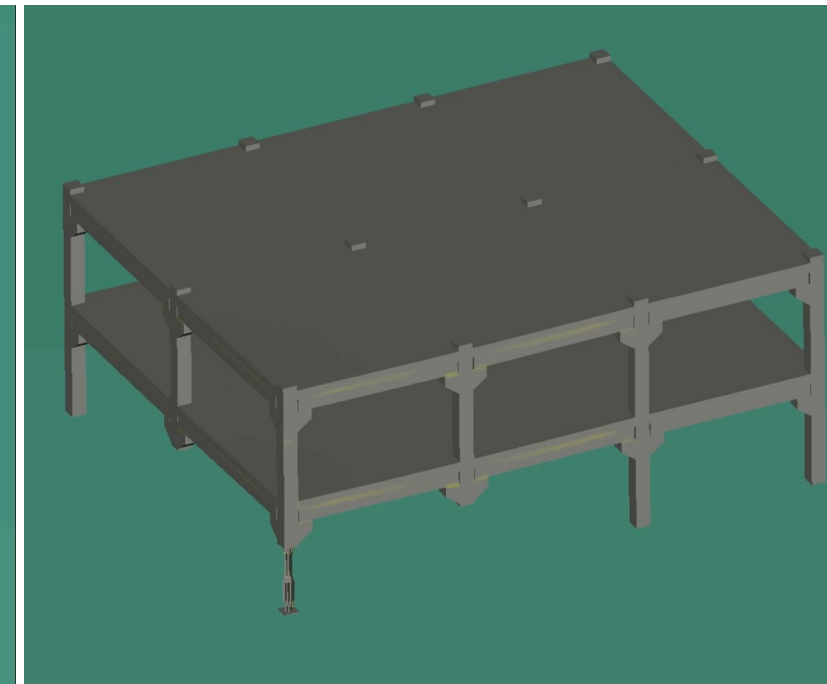
2 columns – 13 kN/m²



3 columns – 9 kN/m²



3 columns – 8 kN/m²



In two weeks – Partial collapse

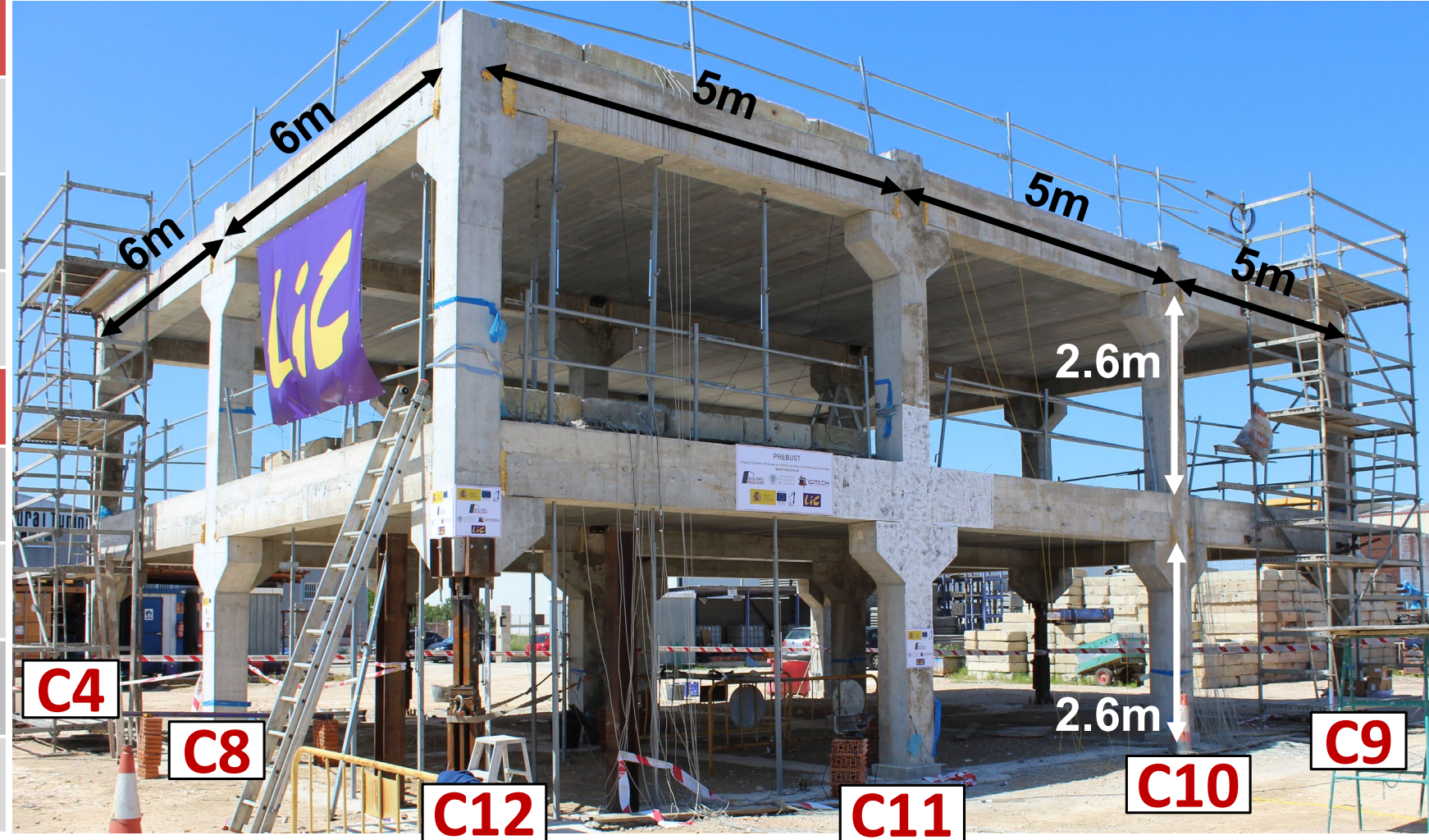


Preparation

- #1 Slab shoring
- #2 Cutting C8 and C11
- #3 Hydraulic jacks

Day of the test

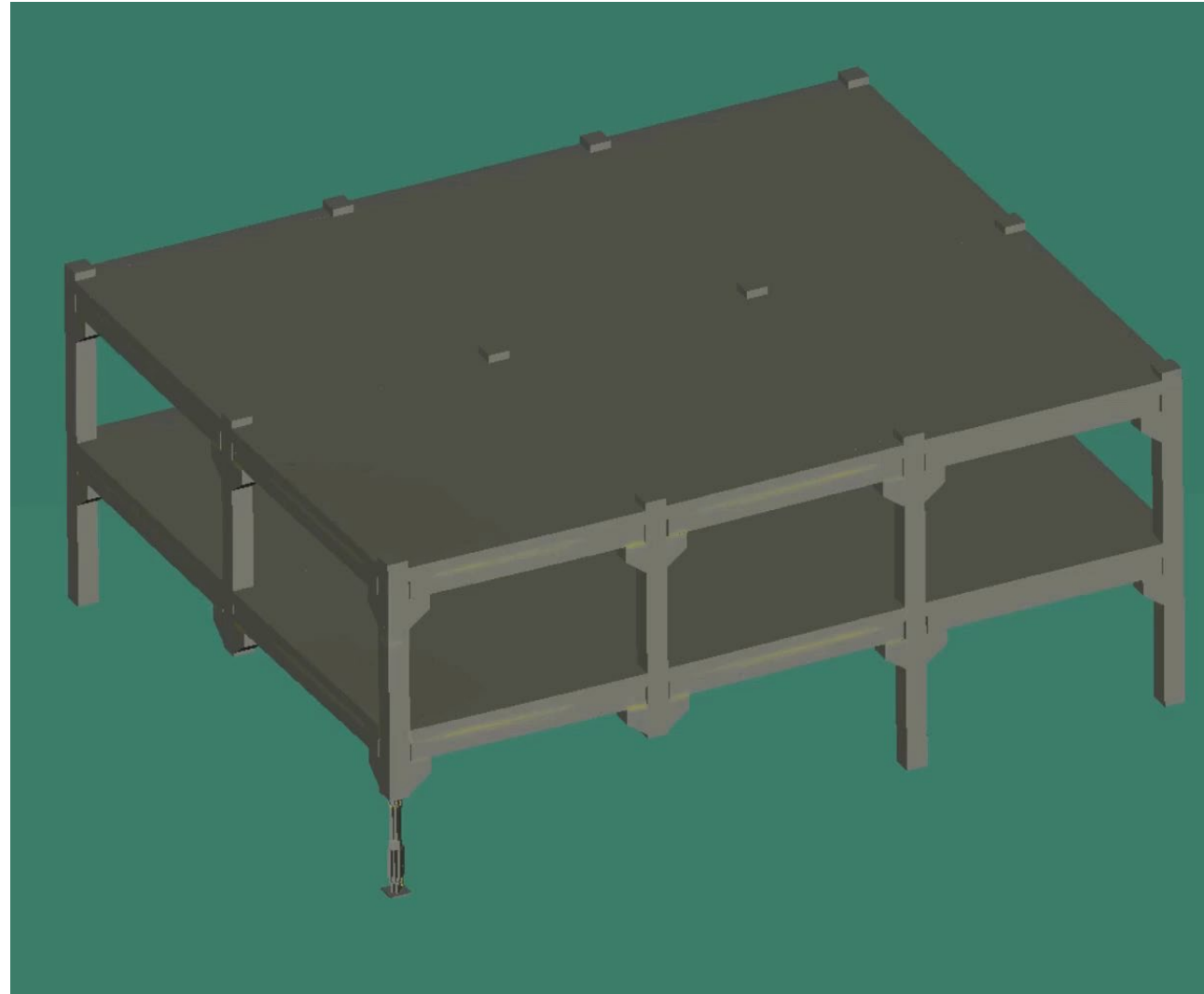
- #4 Remove shoring
- #5 Remove hydraulic jacks
- #6 Activate C12
- #7 Partial collapse?



In two weeks – Partial collapse



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Thank you



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