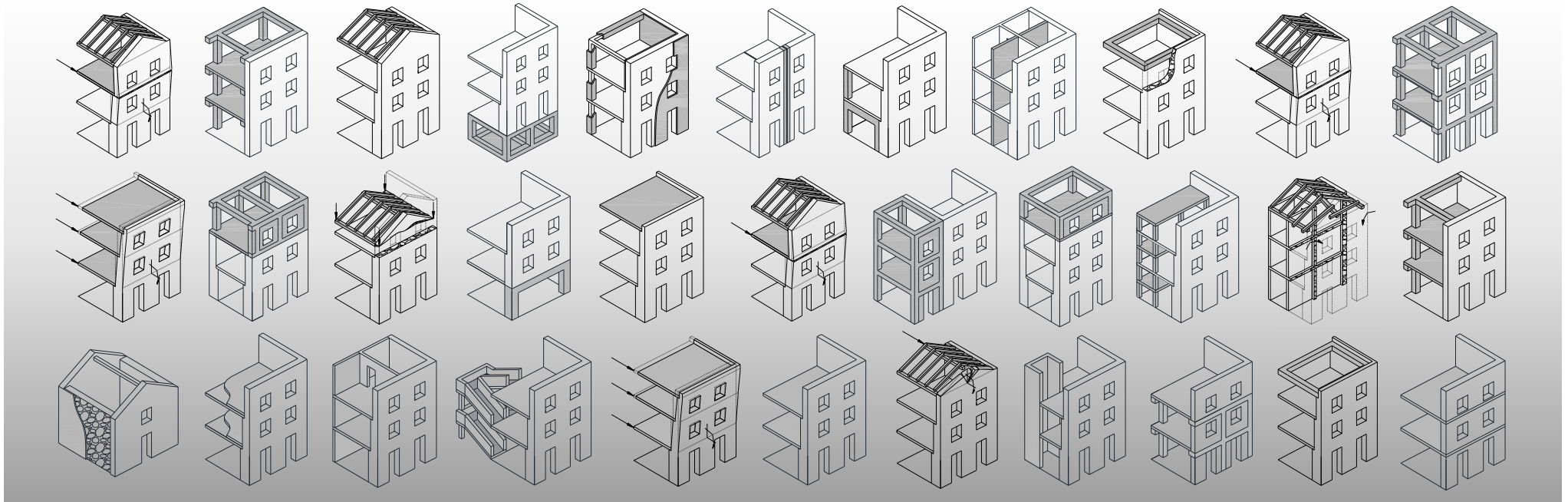


A BIM-BASED METHODOLOGY FOR THE SEISMIC PERFORMANCE ASSESSMENT OF EXISTING URM-RC BUILDINGS:

Expeditious modelling and analysis framework

Gonalo Correia Lopes (4th year, U. Aveiro)

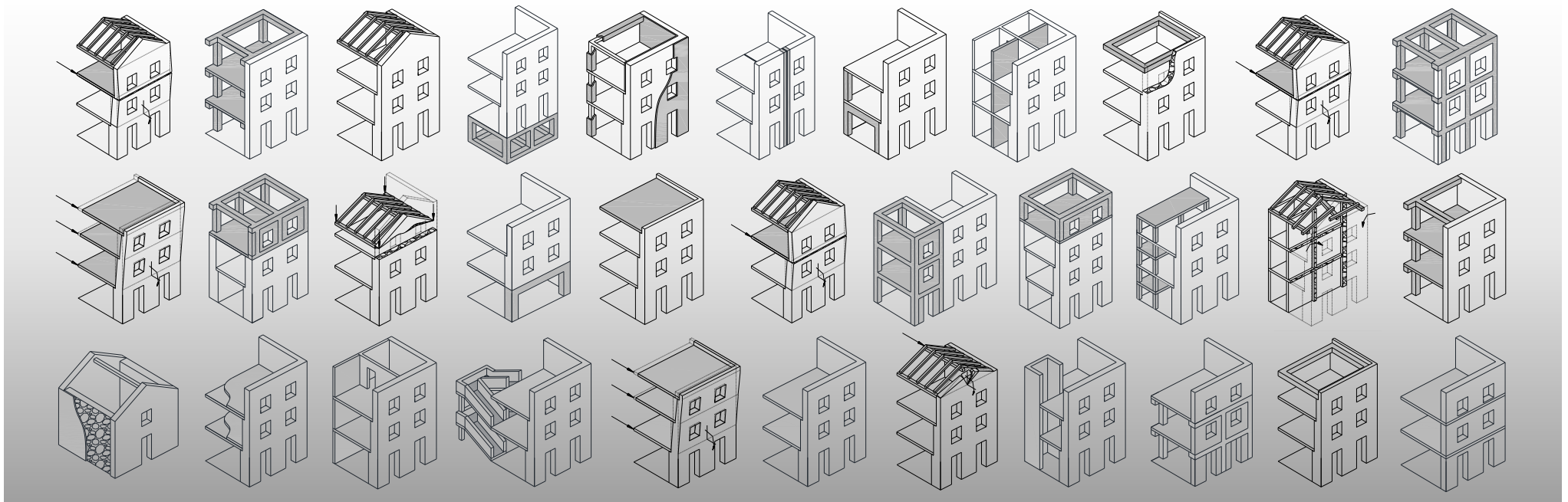
Supervision: Romeu Vicente (U. Aveiro), Miguel Azenha (U. Minho), Tiago Miguel Ferreira (U. Minho)



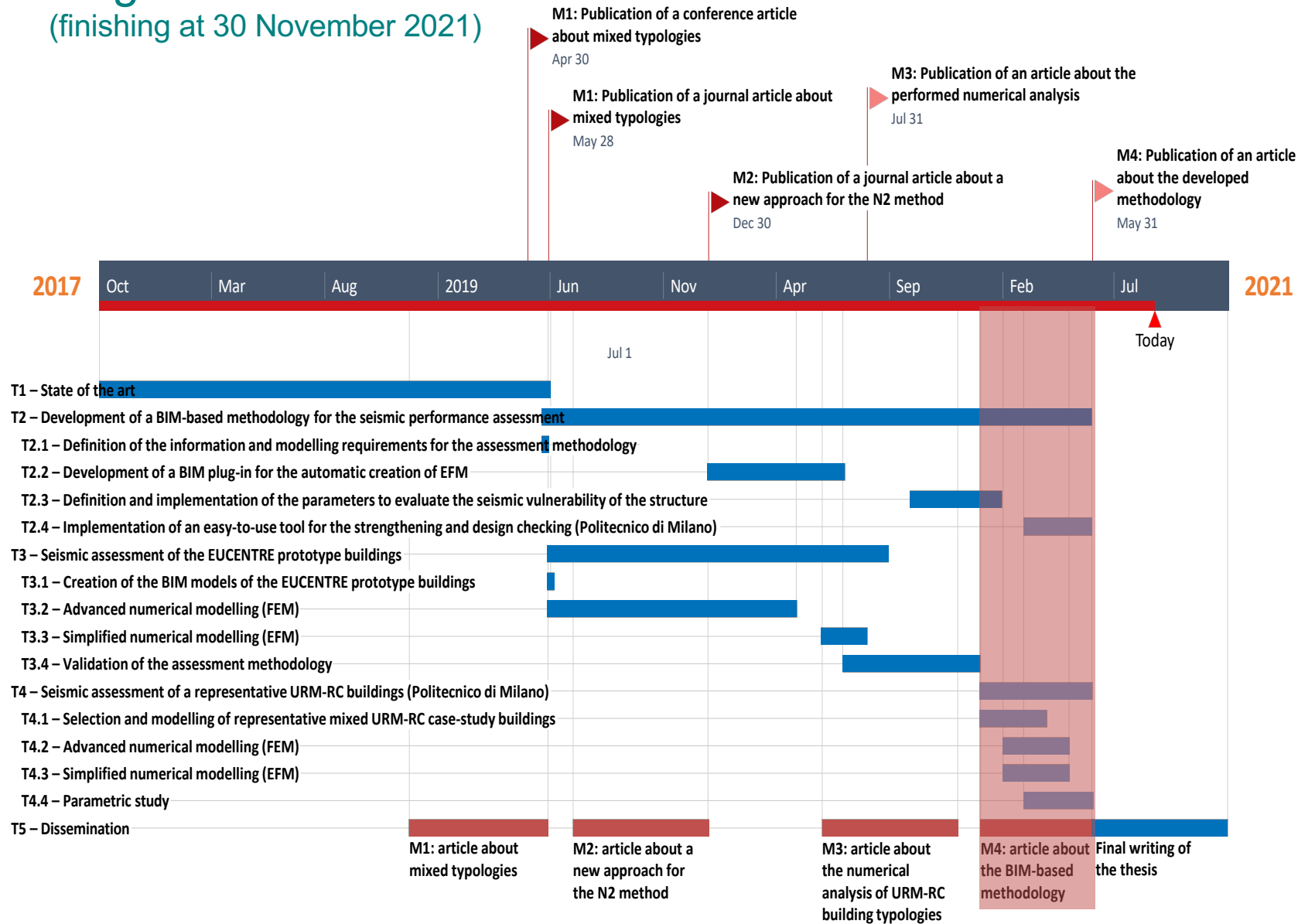
Presentation summary

Part 1: Thesis timeline and publications

Part 2: Proposed seismic assessment methodology

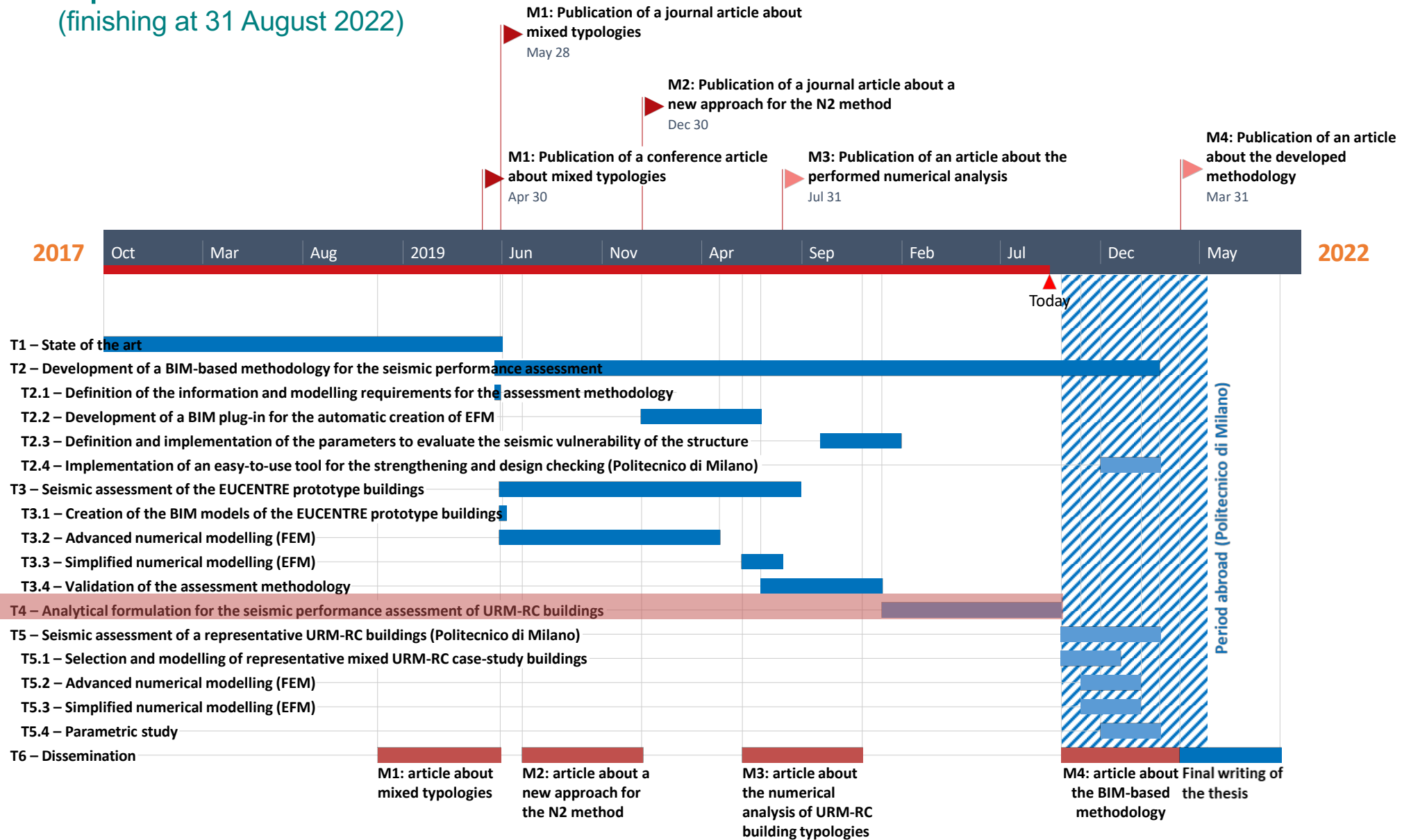


Original thesis timeline (finishing at 30 November 2021)



Updated thesis timeline

(finishing at 31 August 2022)



Current impact

• Articles in International Journals



Intervened URM buildings with RC elements: typological characterisation and associated challenges

Lopes, G. C., Vicente, R., Ferreira, T. M., & Azenha, M. (2019).
Bulletin of Earthquake Engineering, 1-33.



Displacement-based seismic performance evaluation and vulnerability assessment of buildings: The N2 method revisited

Lopes, G. C., Vicente, R., Ferreira, T. M., Azenha, M., & Estêvão, J. (2020).
Structures (24), 41-49.



Numerical simulations of derived URM-RC buildings: assessment of strengthening interventions with RC

Lopes, G. C., Mendes, N., Vicente, R., Ferreira, T. M., & Azenha, M. (2021).
(Journal of Building Engineering)

• Conference articles



BIM-based methodology for the seismic performance assessment of existing buildings

Lopes, G. C., Vicente, R., Ferreira, T. M., Azenha, M., & Rodrigues, H. (2020).
ENCORE 2020.



Desafios e direções de investigação na identificação e caracterização de tipologias de edifícios de alvenaria intervencionados com recurso a betão armado

Lopes, G. C., Vicente, R., Ferreira, T., & M., Azenha, M. (2019).
SÍSMICA 2019.

• Articles in National Journals



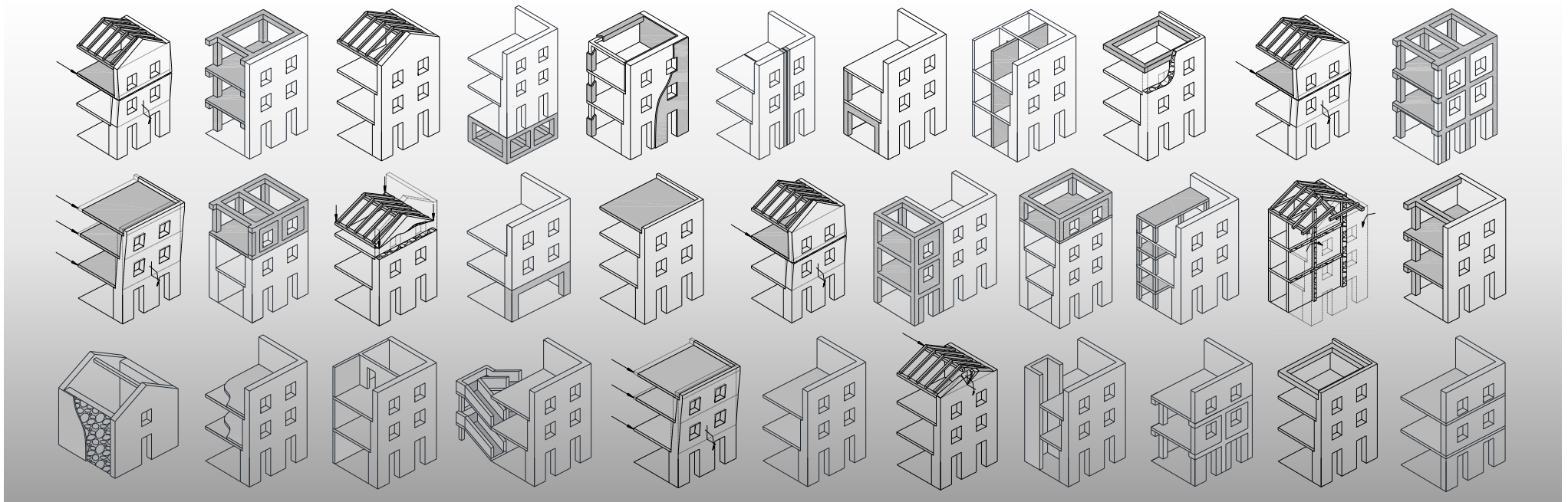
BIM-based methodology for the seismic performance assessment of existing buildings

Lopes, G. C., Vicente, R., Ferreira, T. M., Azenha, M., & Rodrigues, H. (2020).
Revista portuguesa de engenharia de estruturas 2020.

Part 1: Thesis timeline and publications

Part 2: Proposed seismic assessment methodology

Expeditious modelling and analysis framework



Goals / Contributions



Faster numerical the analysis



Robustness of the models



Automation and simplification of processes



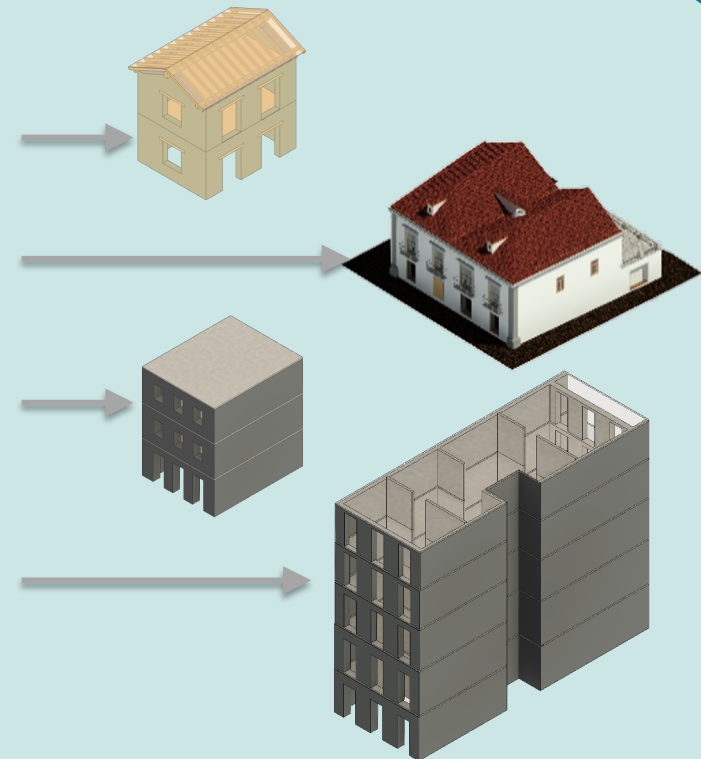
Convenience in engineering practice

Validation strategy of the seismic assessment methodology

- Comparison amongst different types of:
 - **Building geometries** (pier H/D ratio, opening ratio, number of storeys)
 - **Material properties**

Case-study URM-RC buildings

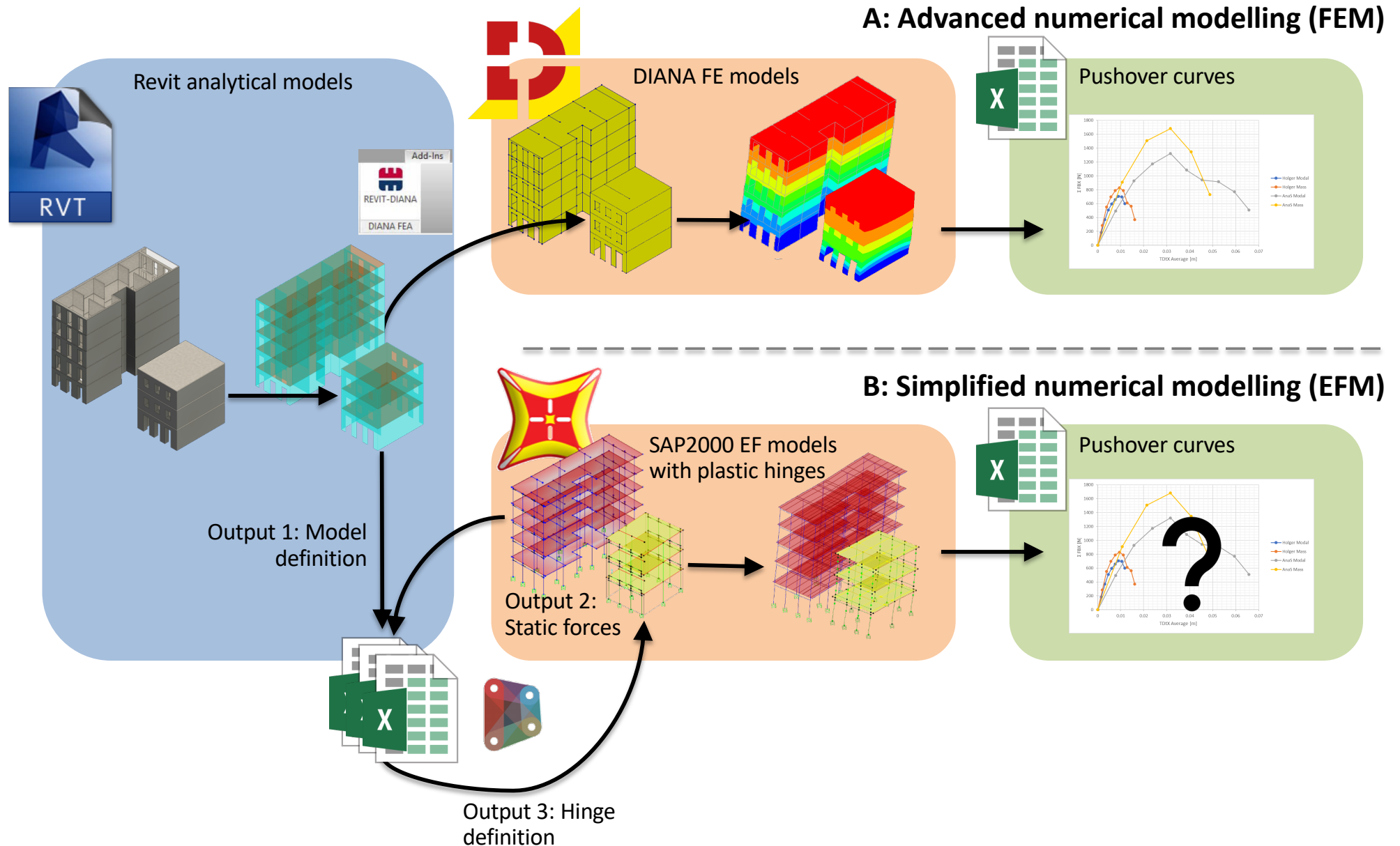
- EUCENTRE buildings – Model from experimental seismic table test campaign (unreinforced and reinforced typologies)
- 2 storey building – Model from laser scanning survey + ambient vibration testing
- 3 storey building – Model based on statistical study of the Portuguese building stock (Lovon, H., et al. 2021)
- 5 storey building – Model follow the minimum dimensions recommended by the Health Regulation for Buildings (RSEU, 1903)
- ...



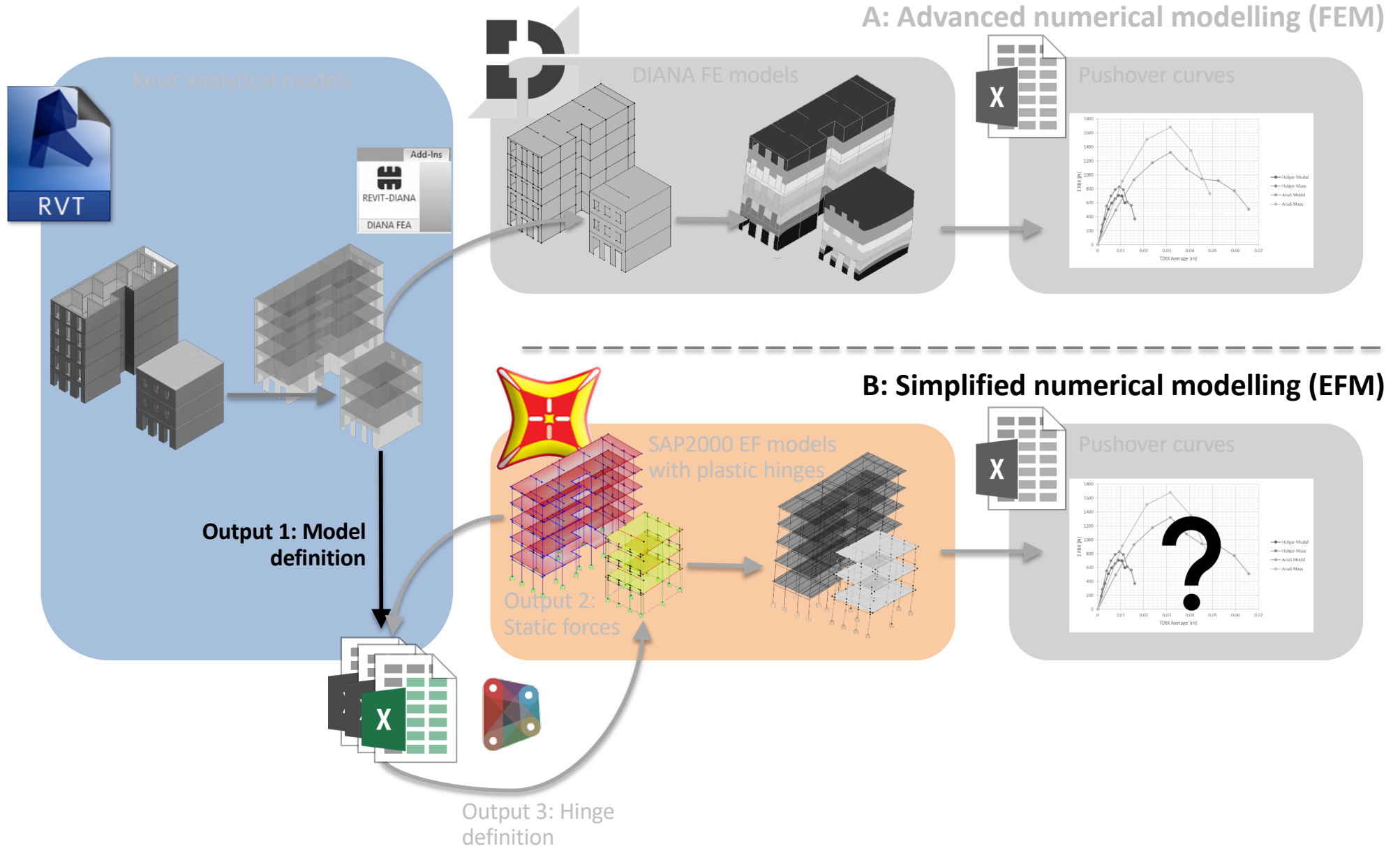
Validation strategy of the seismic assessment methodology

- Comparison amongst different types of:
 - Building geometries (pier H/D ratio, opening ratio, number of storeys)
 - Material properties
 - **Analysis methods** (experimental and numerical), based on:
 - Damage observation (damage patterns, failure modes and severity of cracking)
 - Modal analysis (modal shapes, frequencies)
 - Pushover analysis (target displacement, stiffness, capacity)

BIM-based seismic assessment methodology

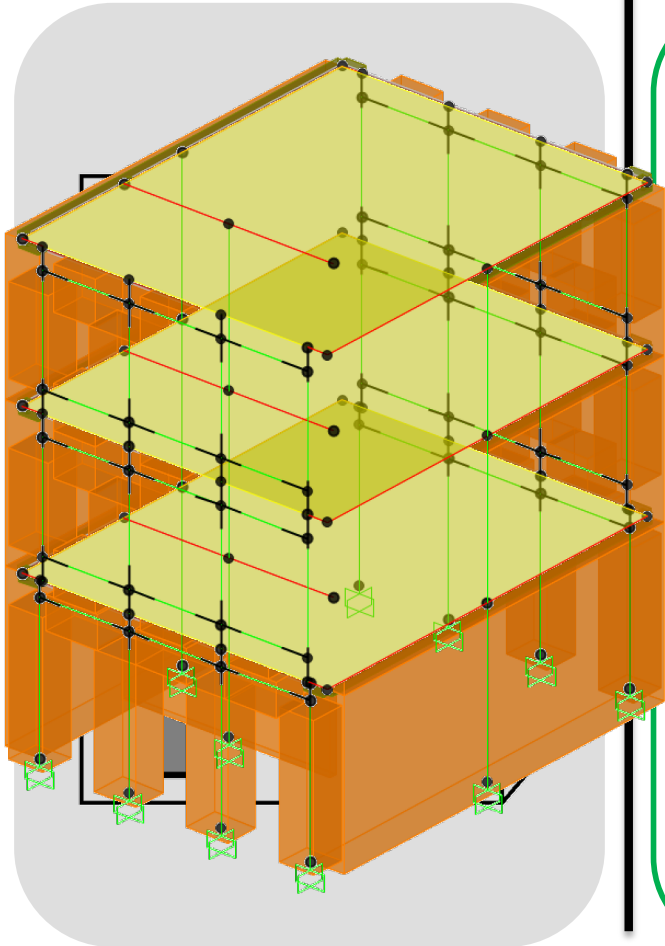


BIM-based seismic assessment methodology

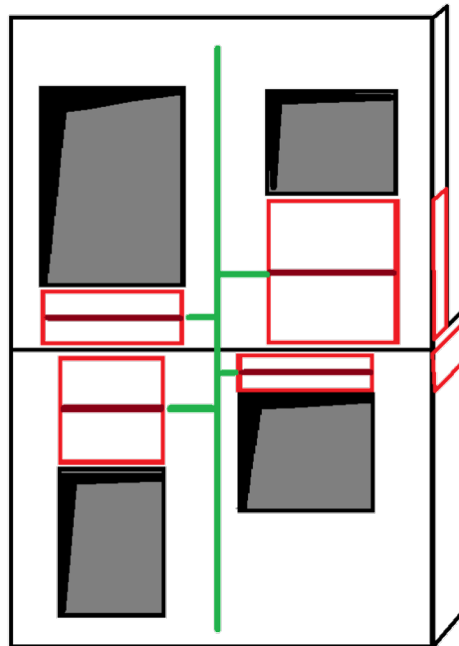


Modelling approach – irregular opening layout

- *Usually, adjacent spandrels are combined into one*

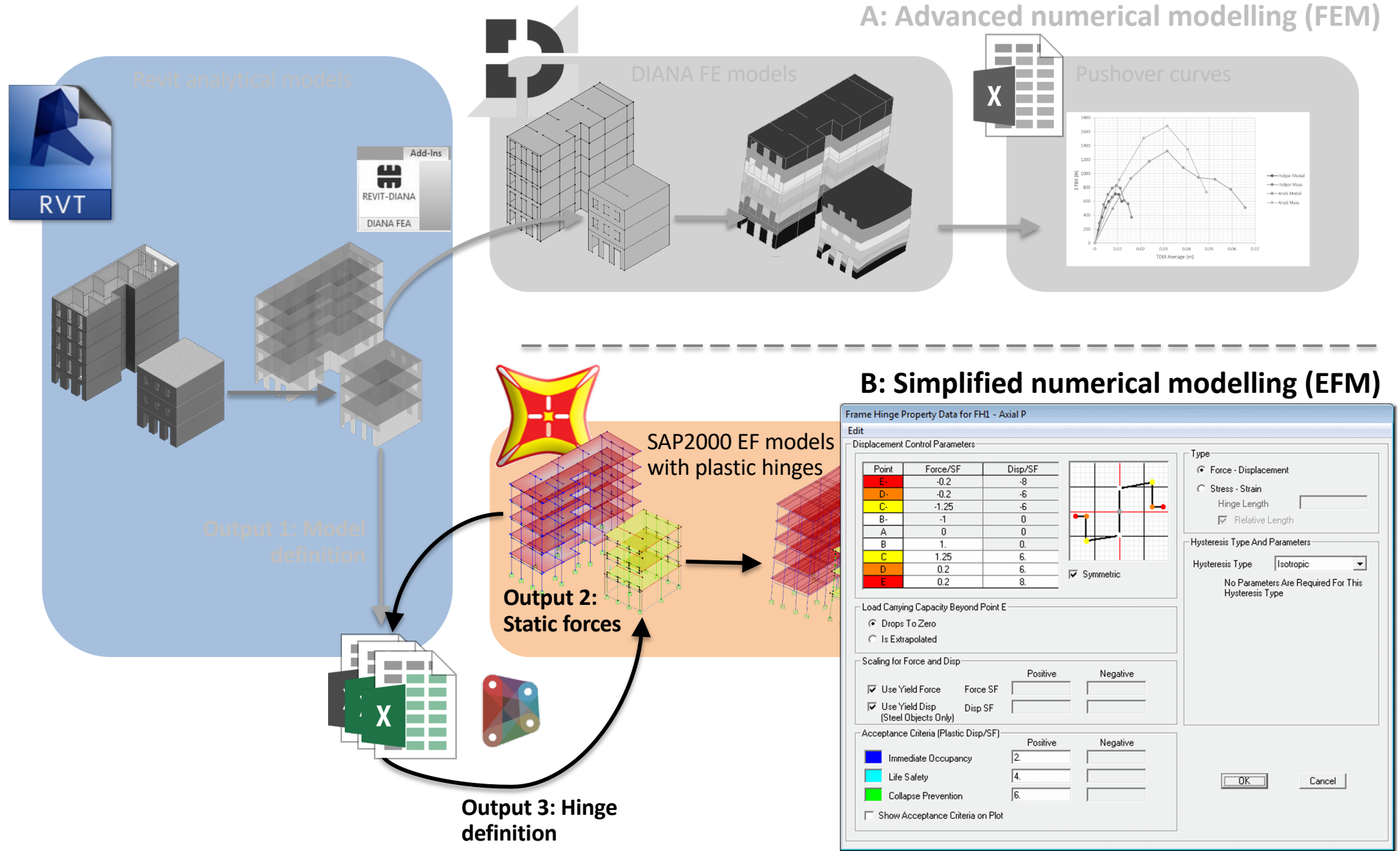


- However, adjacent spandrels may be separated by the storey level



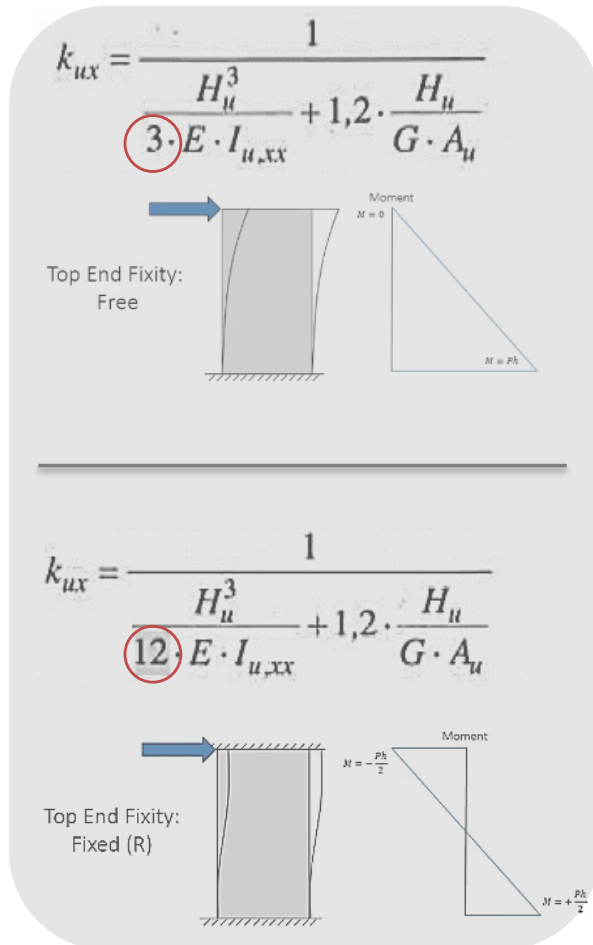
- The discretization criteria is able to cope with:
 - very irregular opening patterns
 - vertical and/or horizontal misalignments
 - spandrels with different heights
 - spandrels with different thicknesses

BIM-based seismic assessment methodology

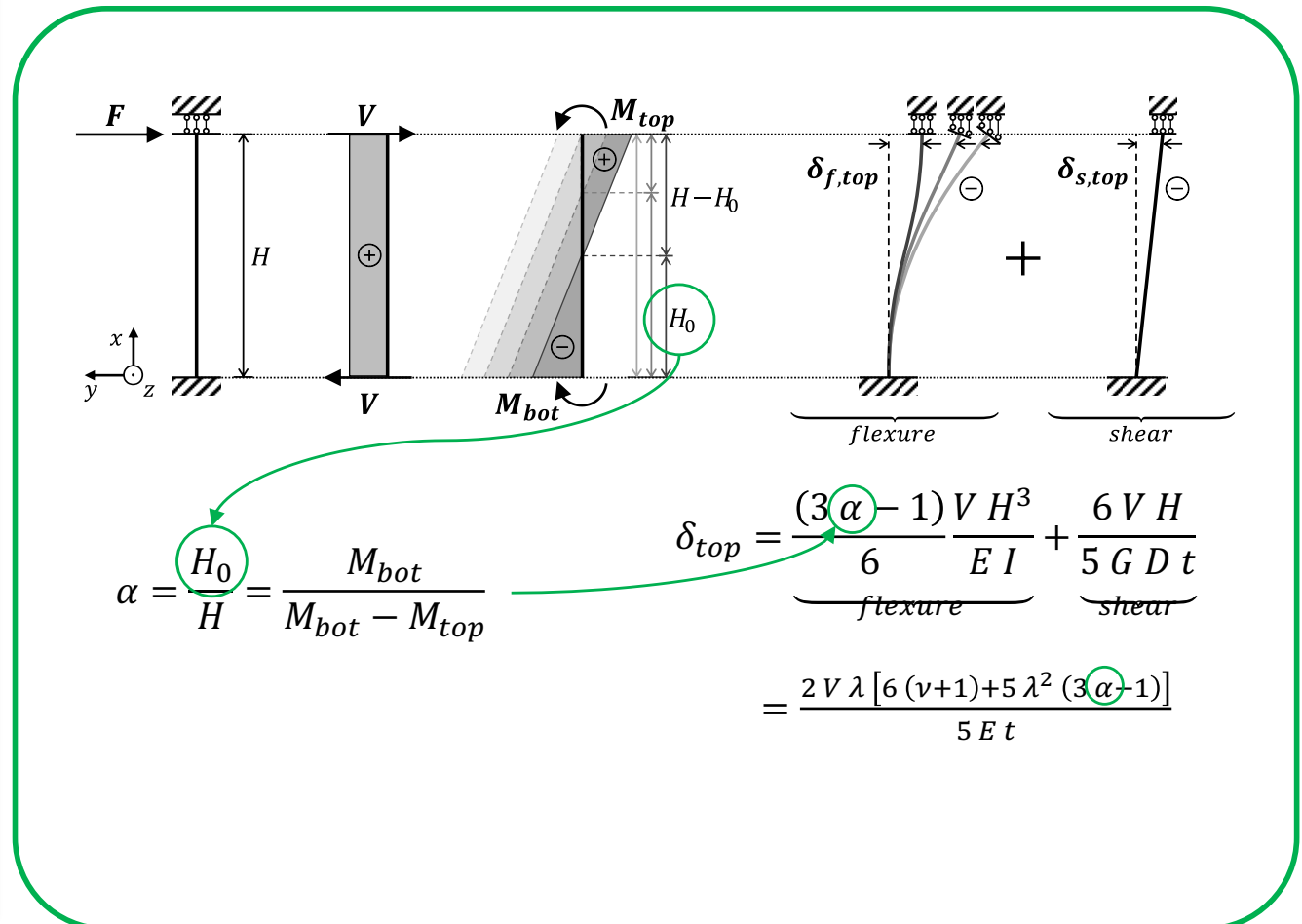


Analytical formulation – effective lateral stiffness / elastic deflection

- Usually, computed as one of two extreme cases

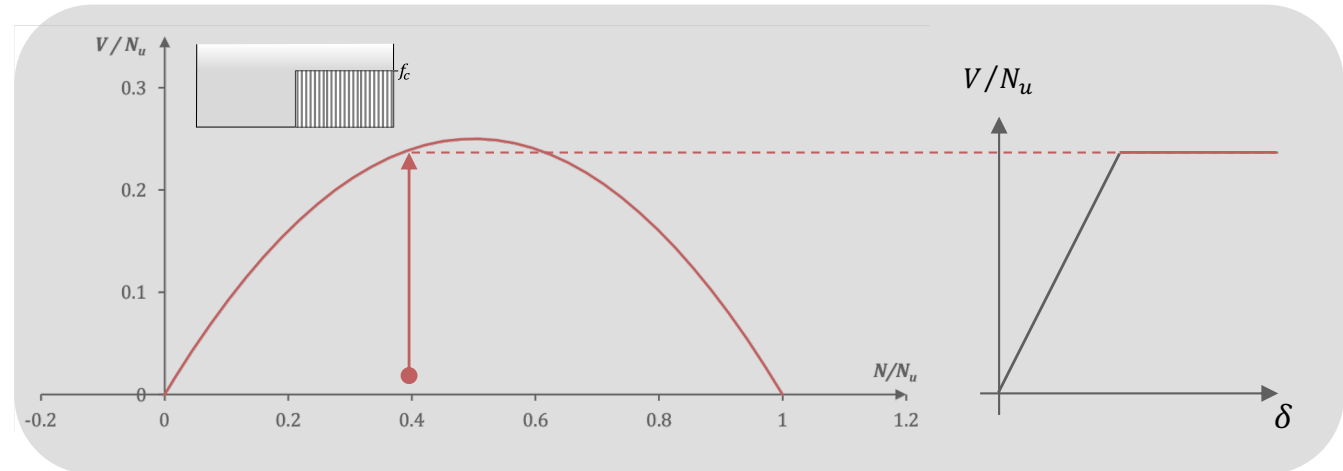


- However, lateral stiffness should depend on the zero-moment coefficient

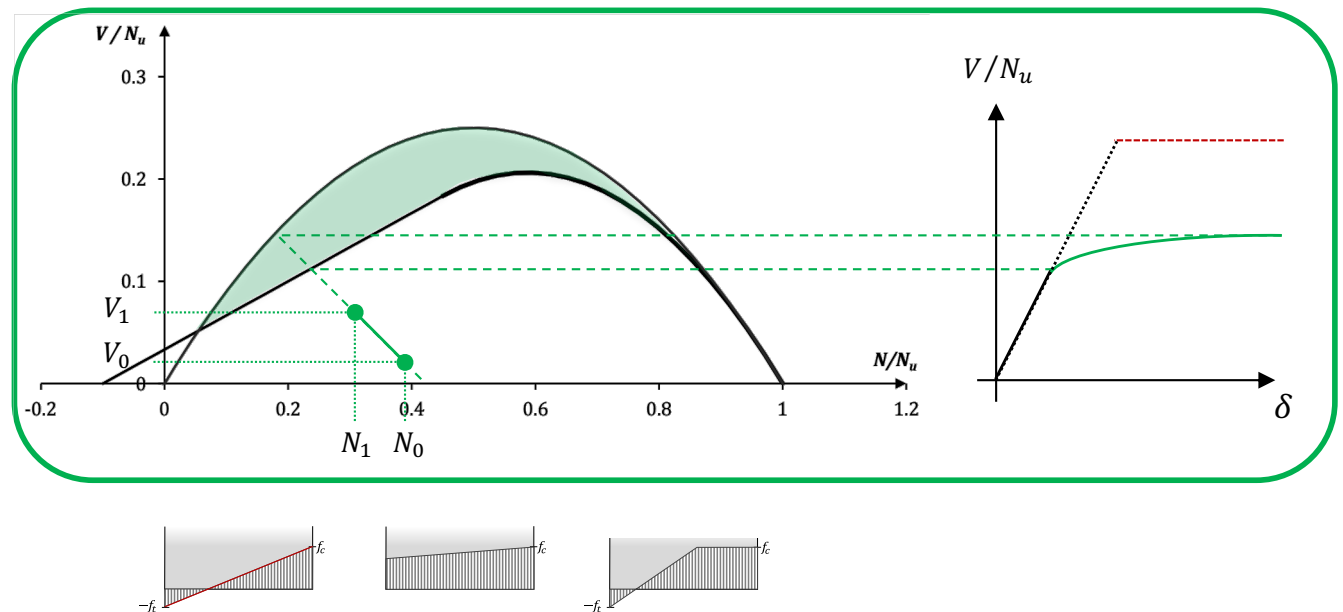


Analytical formulation – N-V interaction diagram

- Usually, the plastic hinge diagram is computed for the plastic moment with **constant axial force**



- However, the plastic hinge diagram should consider the elastic and post-elastic branches and depend on the **variation of the axial force**



Contributions / Goals



Speed of the analysis: EFM vs FEM



Robustness of the model creation plug-in:

- Able to handle irregular opening layouts
- Not dependent on software version compatibility



Automation and simplification of processes

- Modelling, analysis, and results



Convenience in engineering practice:

- Choice of a widely known commercial software
- Integrated multidisciplinary workflow: Architect – Engineer – Contractor – Client – User

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PhD candidate in Civil Engineering

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Thesis title: **A BIM-based methodology for the seismic performance assessment of existing URM-RC buildings**

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