WHAT ARE THE BENEFITS OF USING A HYBRID SIMULATION IN STRUCTURAL AND SEISMIC ENGINEERING?

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ABSTRACT

This poster is aimed to contrast the advantages of the hybrid simulation method to simulate structural behavior on structural components to characterized seismic response.

INTRODUCTION

The mitigation of **structural damage** caused by lateral forces induced by **major ground motions** is an essential governmental duty since economic and human losses can be **catastrophic**. Hence, **building codes** have undergone significant changes to achieve **earthquake-resistant constructions**. Most of the improvements are a consequence of experimental research because **assuming material behavior** under critical demands becomes **extremely complicated**. For this reason, hybrid simulation is beneficial in terms of **cost**, time consumption ,equipment availability and the **credibility of result** in Seismic/Structural Engineering.

- **STRUCTURAL ENGINEERING**

Sub-discipline of Civil Engineering in which professionals are trained to design and analyze the structural components that support and resist loads.

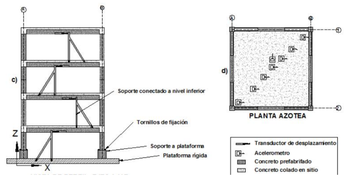

Figure 1. Basic structural detailing (Zamora-Romero, 2015)

- **SEISMIC ENGINEERING**

Brach of Engineering in which specialists are qualified to assess and design structures under seismic loading conditions to assure earthquake-resistant assemblies

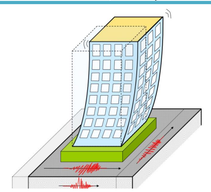

Figure 2. Schematic seismic loading (Murty, 2011)

- **DAMAGE ASSESSMENT**

The onsite process to evaluate and record the loss caused by an accident to estimate if the element can be replaced, restored or salvaged.

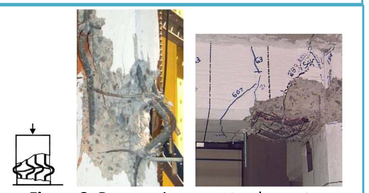

Figure 3. Damage in concrete elements (CENAPRED, 2011)

- **RATE-DEPENDENT EFFECTS**

The behavior of materials where deformation, and its results like cracking in concrete or buckling in steel, depend directly on the rate at which the load is applied

Figure 4. Damage in steel elements (CENAPRED, 2011)

TESTING PROTOCOLS

- **QUASISTATIC**

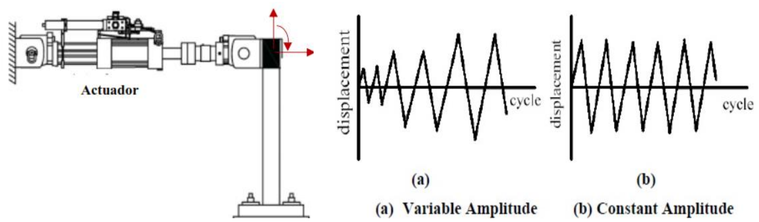

Figure 5. Scheme of quasistatic test (Zamora-Romero, 2015)

- **SHAKING TABLE**

Figure 6. Calibration and construction of a RC scaled model (Zamora-Romero, 2015)

- **HYBRID SIMULATION**

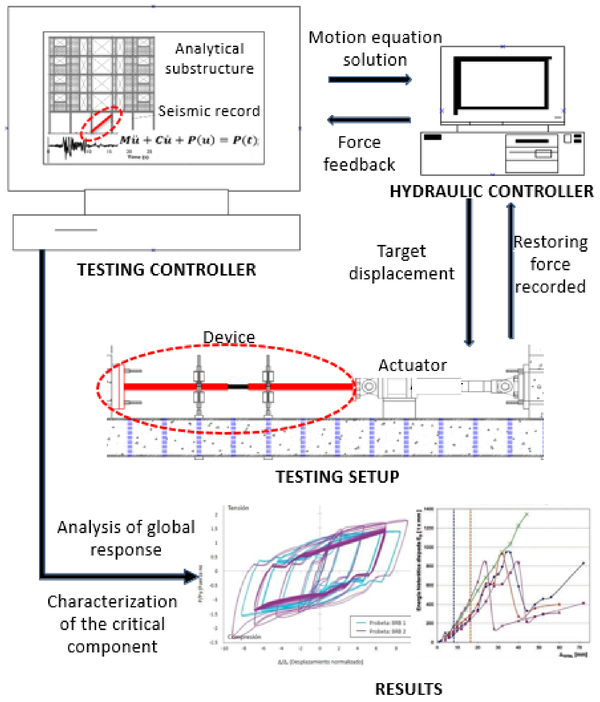

Figure 7. Scheme of hybrid simulation in structural engineering (Zamora-Romero, 2018)

ADVANTAGES

Table 1. Comparison between different testing protocols to evaluate structural response under seismic loading

	Quasistatic	Shaking table	Hybrid simulation
Dynamic evaluation	✗	✓	✓
Full-scale evaluation	✓	✗	✓
Rate-dependent effects	✗	✓	✓

CONCLUSIONS

Since **destructive tests** are the most reliable methods to evaluate the actual response of a **structural element** under critical demands, the advantages of hybrid simulation compared with other methods can be summed up as follows:

- Cost-efficient method compared to shaking table test for assessing realistically dynamic demands.
- Cracking, buckling, and yielding (degradation of material) can be assessed.
- It is possible to assess the global response of a complex model by testing physical a subassembly of it.
- An affordable upgrade to quasistatic equipment.

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