Lime-Based Interface Solutions for Rammed Earth–Hemp Concrete Hybrid System

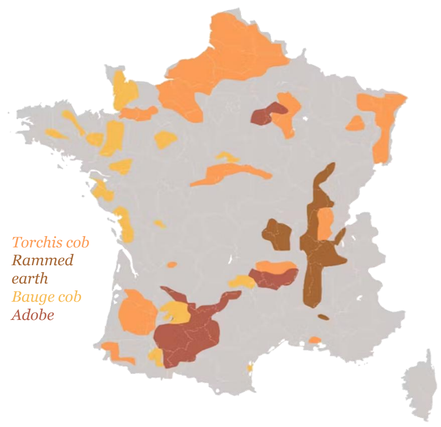
Assessment Using a Double-Sided Push-Out Test

INTRODUCTION

CONTEXT

Rammed Earth (RE), is a traditional construction technique, exhibits insufficient thermal insulation and limited mechanical performance under shear and tension, particularly in extreme conditions.

Many rammed earth buildings in Auvergne-Rhone-Alpes region



RESEARCH OBJECTIVES

- Use **Vegetal Concrete (VC)** panels for insulation purpose.
- Evaluate the mechanical properties and behavior of RE and VC.
- Evaluate the mechanical behavior of the RE-VC hybrid system at the interface.
- Assess the influence of applying VC on the structural performance of RE.

Rammed Earth *Vegetal Concrete*

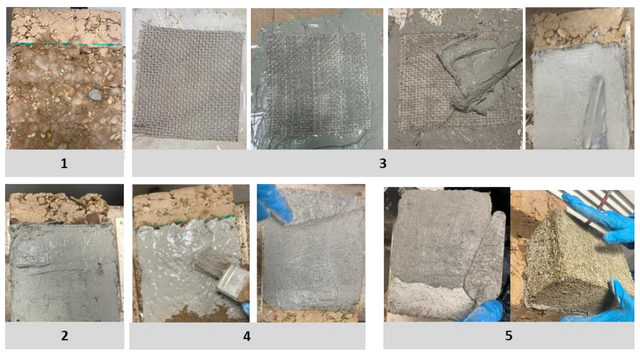
METHODS

FORMULATION

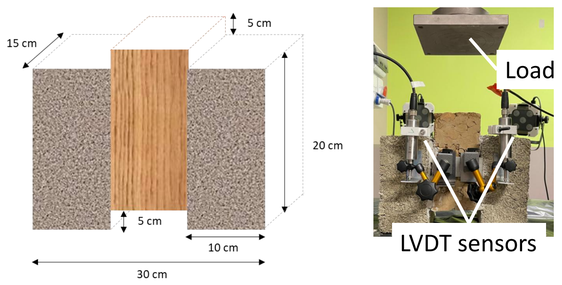
Material	Composition
Rammed earth (RE)	Gravel: 45.3%, Sand: 26.9%, Silt: 14.4%, Clay: 13.4%, Water content ~10%
Hemp-lime concrete (HC)	Hemp shives : Formulated lime (Tradical PF 70) : Water ≡ 0.5:1:1 (by weight)

ASSEMBLING

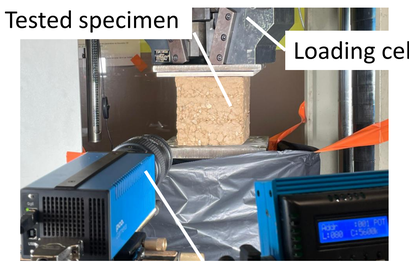
1. Humidification
2. Solution 1: Lime paste (LIME)
3. Solution 2: Textile reinforced matrix (TRM)
4. Solution 3: Lime slurry and lime mortar (MOR)
5. Applying thin layer of each solution on HC before assembling.



EXPERIMENTS



Push-out test configuration and setup



2D digital image correlation DIC technique

Compression test setup

CONCLUSION

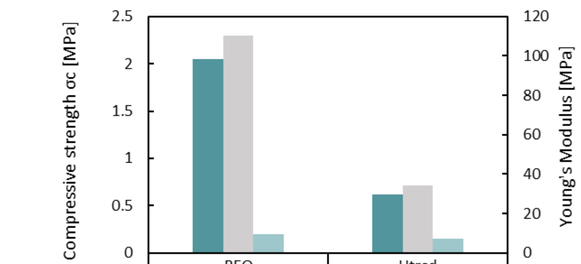
- The MOR solution demonstrated the highest interface shear strength.
- TRM exhibited better binder cohesivity and stiffness than LIME but showed the lowest shear strength.
- Rotation effects were significant, as evidenced by the notable differences between DIC-derived slip and LVDT-measured slip.

FUTURE WORK

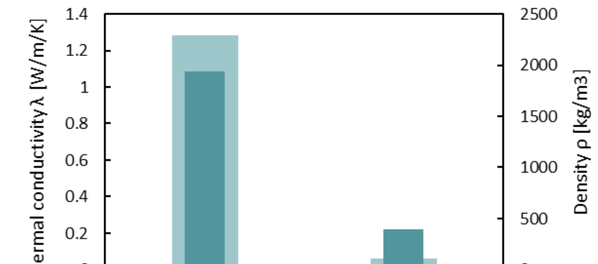
- Optimization of the mechanical and chemical interlocking at the interface
- Assessments of compatibility for earth-based mortars

RESULTS

INDIVIDUAL CHARACTERIZATION

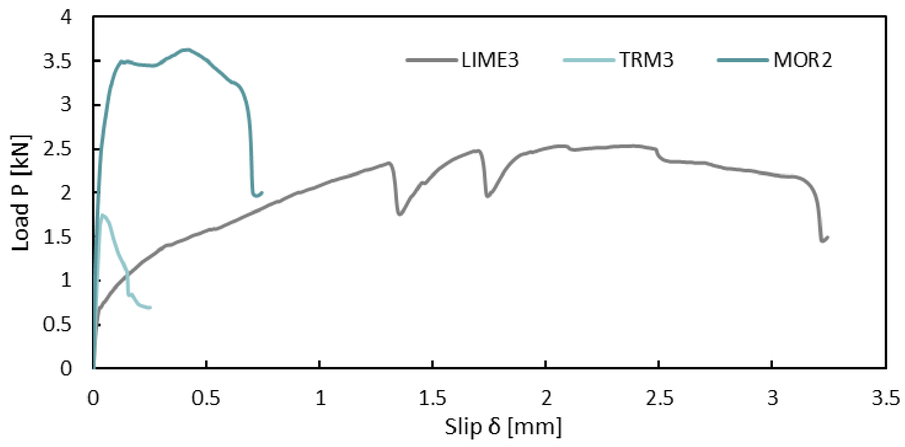


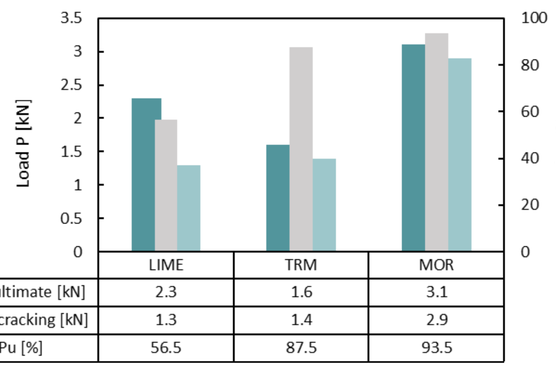
	REO	Htrad
σc-peak	2.05	0.62
σc-1.5% strain	0.2	0.146
Young's Modulus	110.17	34.14



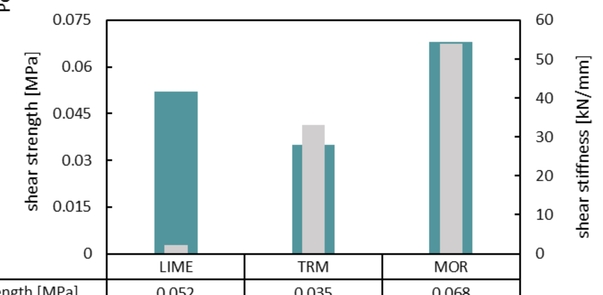
	RE	HC
λ W/m/K	1.283	0.06
ρ kg/m3	1939.42	390.55

ASSEMBLY: CHARACTERISTIC VALUES AND PROPERTIES



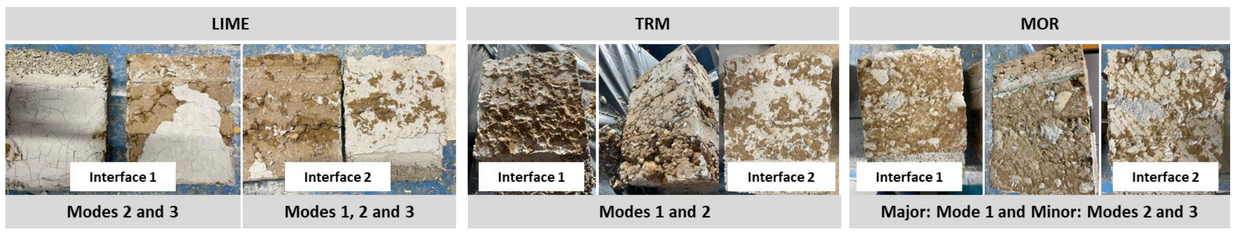


	LIME	TRM	MOR
Pu-ultimate [kN]	2.3	1.6	3.1
Pcr-cracking [kN]	1.3	1.4	2.9
Pcr/Pu [%]	56.5	87.5	93.5



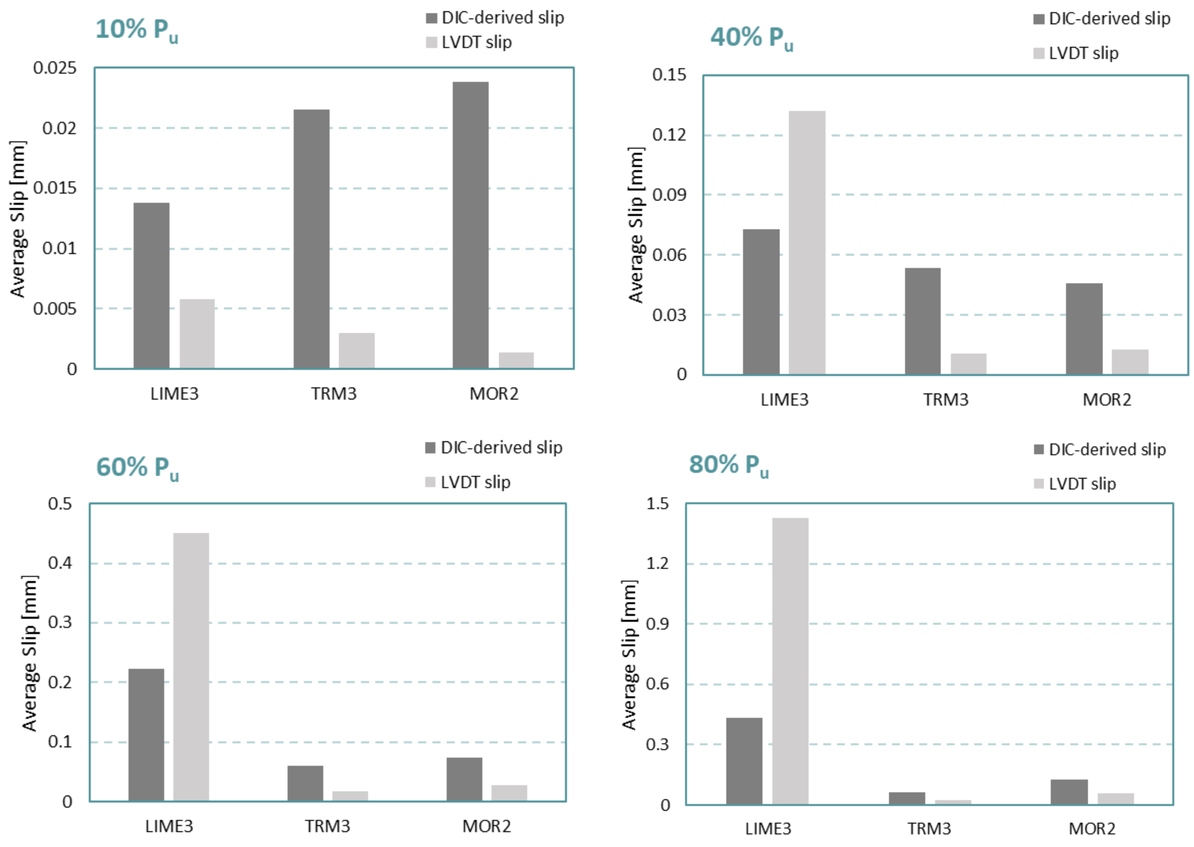
	LIME	TRM	MOR
Shear strength [MPa]	0.052	0.035	0.068
Shear stiffness [kN/mm]	2.29	33	54

ASSEMBLY: FAILURE MODES



Cohesive failure within the substrate. Mode 1
Adhesive failure at the interface. Mode 2
Cohesive failure within the overlay material. Mode 3

ASSEMBLY: DIC-derived slip vs LVDT slip



Sara KHALIL, Omayma HOMORO, Salah OULDBOUKHITINE, Sofiane AMZIANE
Université Clermont Auvergne, Clermont Auvergne INP, CNRS, Institut Pascal, F-63000 Clermont–Fd, France
sara.khalil@doctorant.uca.fr