

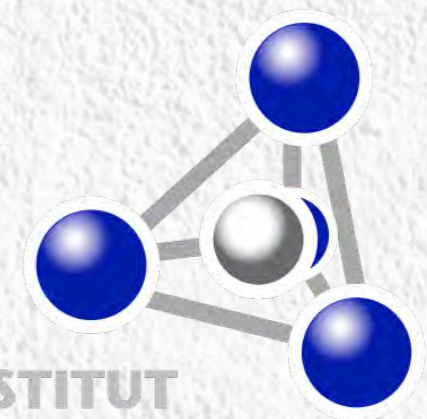
**renca**

# **RENCA Geopolymer Mortar for The First 3D Printed House – Fight Against the Nature**

**Alex Reggiani**

**Marina Dudnikova & Andrey Dudnikov**

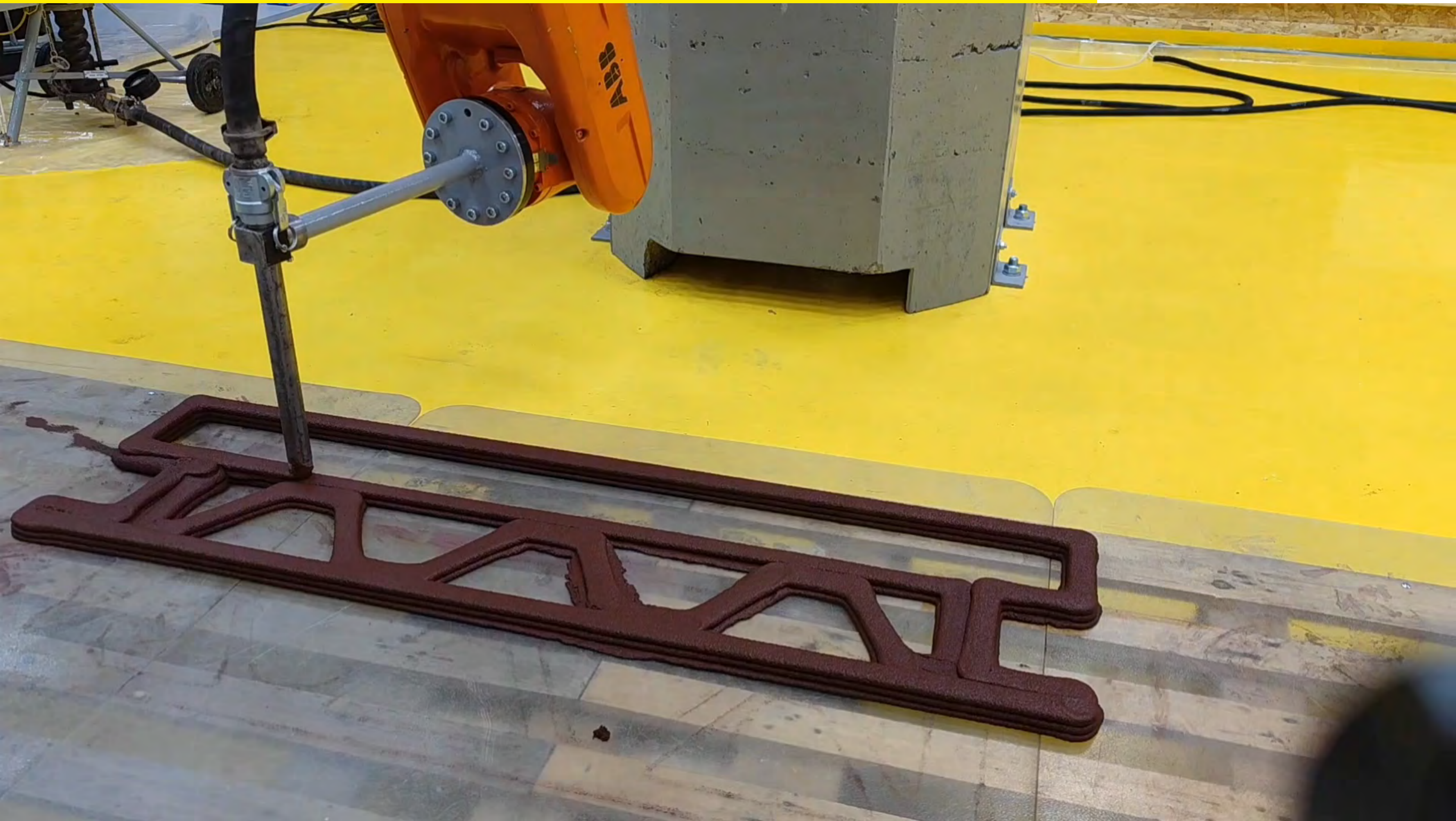
RENCA Inc



INSTITUT  
**GÉOPOLYMÈRE**

# RENCA 3D Printing Factory 2022

# 3D Printing Process



# 3D Printing Process



# **3D Printing of The First Geopolymer House**

## **April 2023**

# First Trials



# First Trials

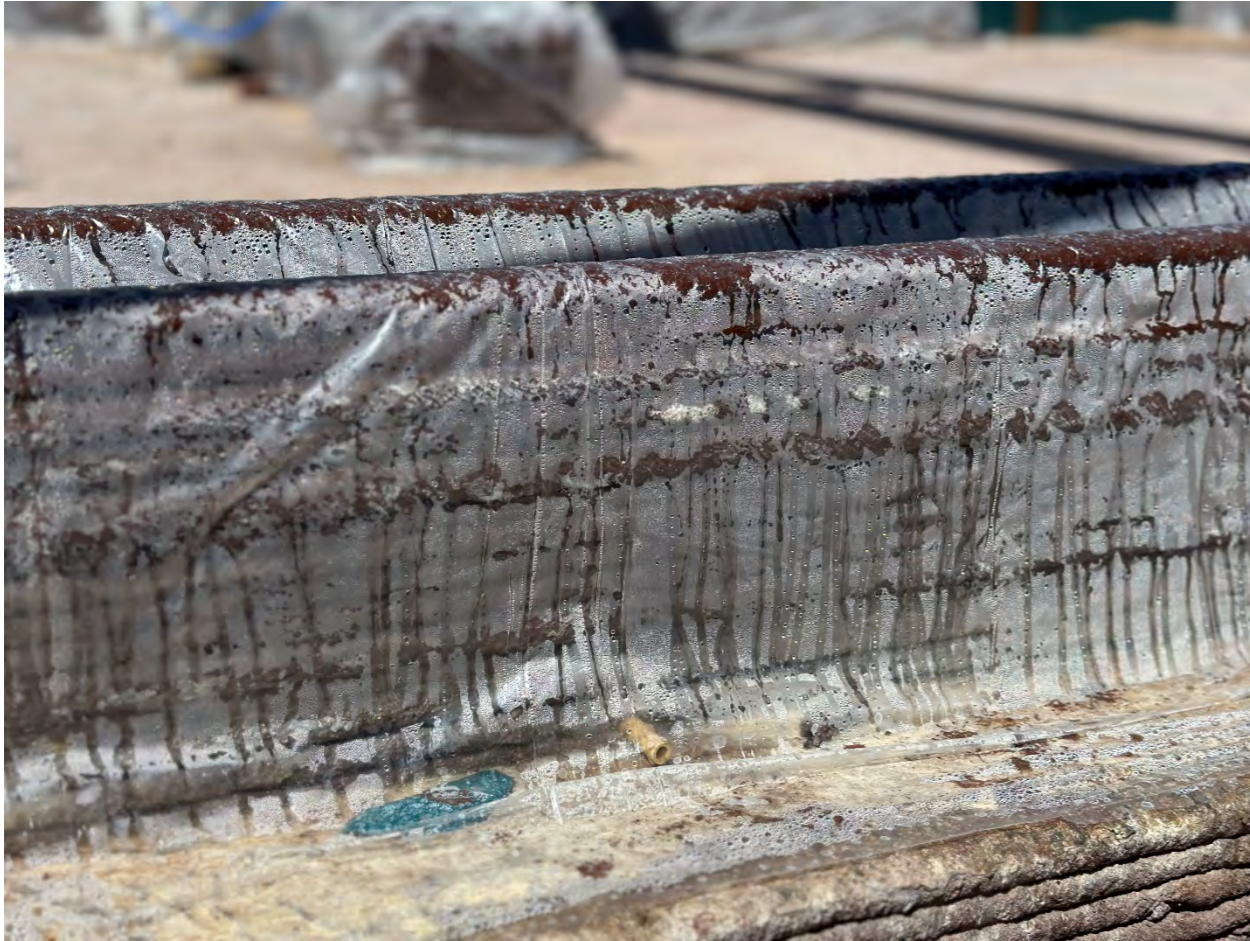


# First Trials





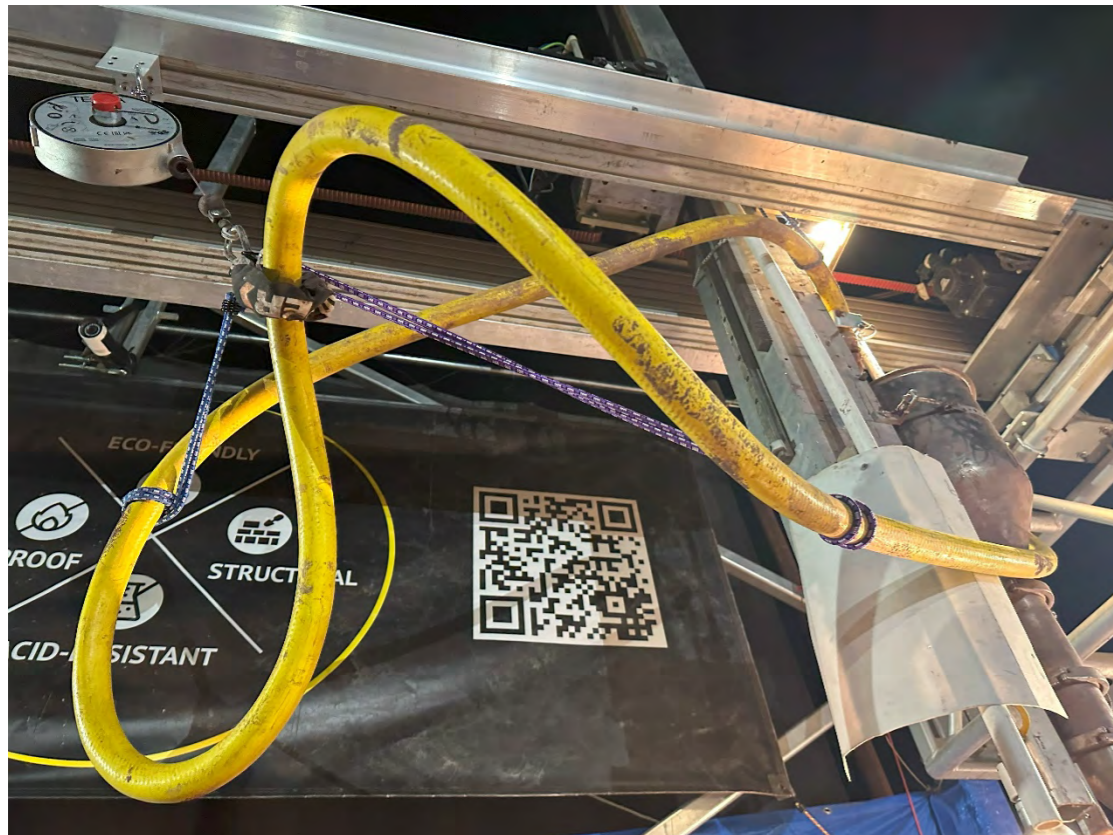
# Printing in The Desert at Heat



**+40°C, 10%  
Humidity  
40 km/h Wind**



# Hose Management System



**+40°C, 10% Humidity  
40 km/h Wind**



**Equipment Failures**

# Night-Shift Printing



# Night-Shift Printing



# The Final Result



# The Final Result



# People are The Greatest Value



# People are The Greatest Value





# People are The Greatest Value



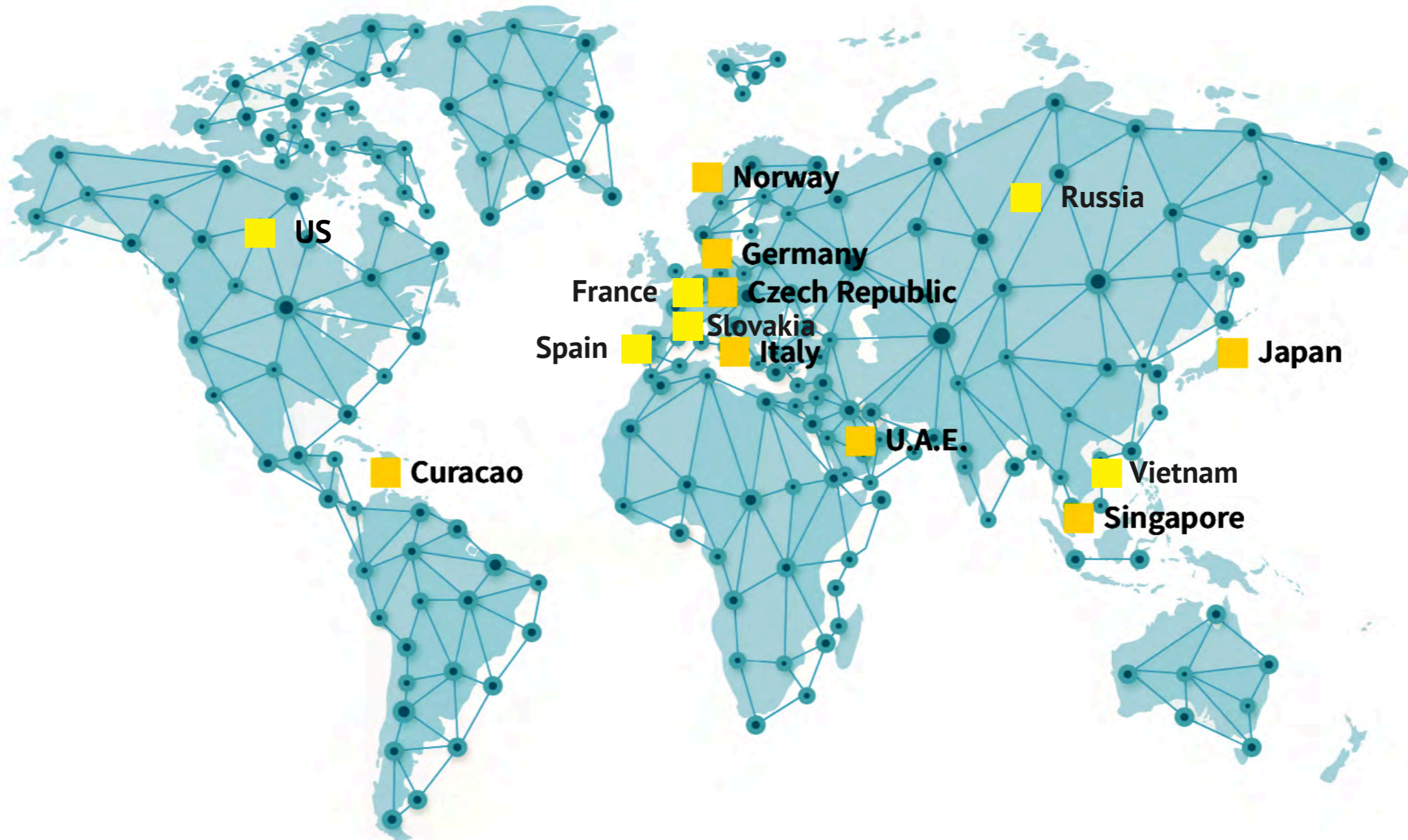
# **Why Geopolymer Mortar is Perfect Material for Construction 3D Printing?**

# Advantages of RENCA 3D ink

The only ink for construction 3D printing based on green and eco-friendly geopolymers technology available for commercial application.



# RENCA Worldwide Sales Network



# RENCA International Franchise Network

## RENCA DELIVERS THE ALL-IN-ONE SOLUTION:

The complete system for **geopolymer cement** production **3D printers** and automatic mixing system for concrete.

Technology for production a wide range of **sustainable products** based on local raw materials.

# RENCA Local Stocks



# RENCA services

# HOW WE WORK?

If you are interested in developing of geopolymer products based on local raw materials, RENCA can provide you *various services*:



## ✓ Studying raw materials

Thanks to our geologists-mineralogists we study locally available raw materials, that has potential to be used in geopolymer cement and concrete production. We collect samples and do research: we check chemical and mineralogical composition, particle distribution and other physical and mechanical properties.

### Fly-ash type F

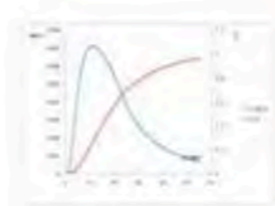
#### Mineralogical composition:

The mineralogical composition of fly-ash is presented by amorph phase (63-65%), the crystalline phase is represented by mulite (31%), graphite (3%), hematite (1%) and quartz (2%).



#### Particle distribution, $\mu\text{m}$ :

Median diameter  $d_{50}$  less than 21  $\mu\text{m}$



#### Chemical composition:

$\text{Al}_2\text{O}_3$	$\text{SiO}_2$	$\text{Fe}_2\text{O}_3$	$\text{TiO}_2$	MgO	MnO	$\text{K}_2\text{O}$	$\text{Na}_2\text{O}$	CaO	LOI
28,27%	59,00%	5,22%	1,25%	0,68%	0,12%	0,60%	0,62%	1,75%	2,14%

### GGBS ground granulated blastfurnace slag

#### Mineralogical composition:

The mineralogical composition of GGBS is presented by amorph phase (97-98%), the crystalline phase is represented mainly by melilite (2.0-3.0%).



Particle distribution,  $\mu\text{m}$ :  
Median diameter  $d_{50}$  less than 11  $\mu\text{m}$

#### Properties:

Beige powder

H<sub>2</sub>O content — less 0,1%

Specific area (BET) — 4500-5000  $\text{cm}^3/\text{g}$

Bulk density — 1,14  $\text{t}/\text{m}^3$

#### Chemical composition:

$\text{Al}_2\text{O}_3$	$\text{SiO}_2$	$\text{Fe}_2\text{O}_3$	$\text{TiO}_2$	MgO	MnO	$\text{K}_2\text{O}$	$\text{Na}_2\text{O}$	CaO	LOI
12,27%	38,16%	0,67%	1,63%	10,34%	0,67%	0,76%	0,44%	34,92%	< 0,10%



## ✓ Developing new recipes

Based on our expertise in geopolymers, we are developing new or adjusting existing recipes to current raw materials.



“ new recipes  
to current  
raw materials ”

## ✓ Testing new products

When the recipe is ready and has passed initial tests, we start the series of testing, such as:

- compressive, flexural, tensile and bending strength;
  - freeze-thaw cycles;
  - water resistance;
  - acid resistance;
  - heat and fire resistance;
- and other types of testing, that are particular for specific type of product.

### ACID RESISTANT GEOPOLYMER CONCRETE



After 28 days in  
10% Sulphuric  
Acid Solution:

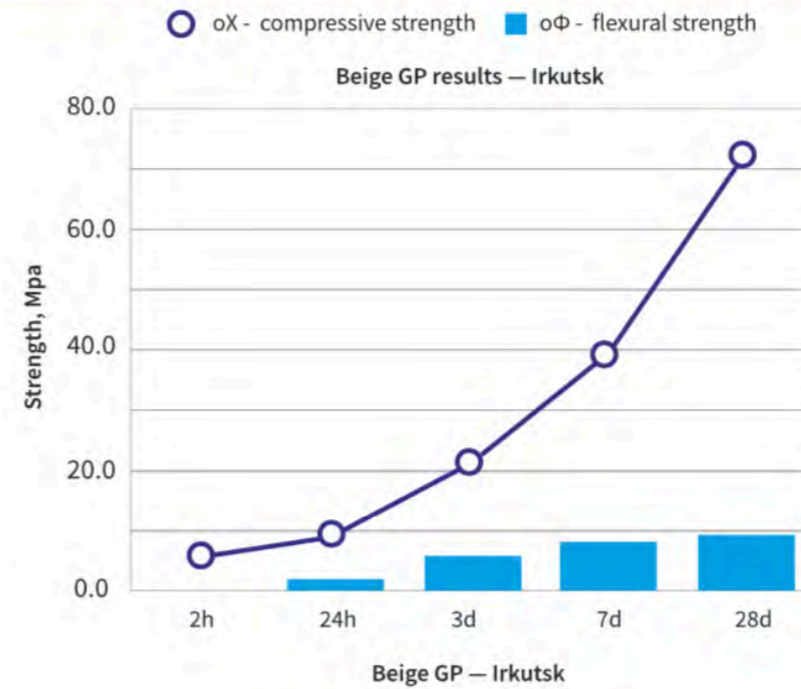
**OPC**  
40% weight loss  
70% Strength loss

**GPC**  
0% weight loss  
0% strength loss

## PROPERTIES OF BEIGE MK-750 BASED GP CONCRETE:

### Properties:

- Setting time: from 90 to 115 min. (at 18 °C in Irkutsk warehouse)
- Viscosity – thixotropic (shock table test)
- Density 2,0 g/cm<sup>3</sup>.
- Ability to harden at - 20 °C (after defrost for 2 hours in 20°C):
- 24h flexural strength: 1,0 MPa;
- Compressive strength: 5,2 MPa
- Freeze-thaw resistance: 500 cycles
- Water resistance: W16



Age	oX, MPa	oΦ, MPa
2 h	4,2	0,0
24 h	9,2	2,1
3 d	21,1	5,8
7 d	39,7	8,8
28 d	72,3	9,6

## ✓ Verification in external lab and certification

When needed we do verification of our test results in external laboratories and certification centers.



### DUBAI CENTRAL LABORATORY CERTIFICATION TEST RESULTS:



# RENCA products

# Ready to Use RENCA Products Worldwide Supply



**geopolymer  
cement and  
geopolymer  
reagent  
geosilicate**

# Repair Mortars

RENCA GP Repair mortars can be used for various applications:

- airport tracks repair;
- road repair;
- wall repair;
- structural repair.

RENCA GP Repair mortars have high performance with improved properties for higher thickness of layer (more than 2 cm) and designed for both hot temperatures  $+25^{\circ}\text{C}$  and above and severe cold temperatures down to  $-20^{\circ}\text{C}$ .

These recipes reduce shrinkage and increase mechanical properties in terms of flexural strength and traction. Thanks to unique adhesive properties of geopolymer concrete – it can be applied almost on any surface. Some compositions provide fast setting time and, in few hours, can hold the load.

” reduce shrinkage and  
increase mechanical  
properties “



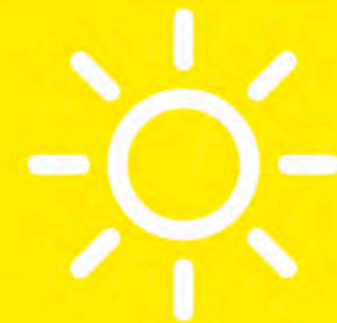
# 3D Printing Mortars

RENCA 3D GP cement is a batching type of mortar for construction 3D printing with fixed setting time and has two basic modifications:

- winter for temperature + 10°C;
- summer for temperatures +28...+35°C.



+ 10°C



+28...+35°C

*Depending on the request the recipe can be adjusted according to technical requirements of the customer.*

# Partners and Clients

# PARTNERS AND CLIENTS





# RENCA Inc

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🌐 [www.renca.org](http://www.renca.org)



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