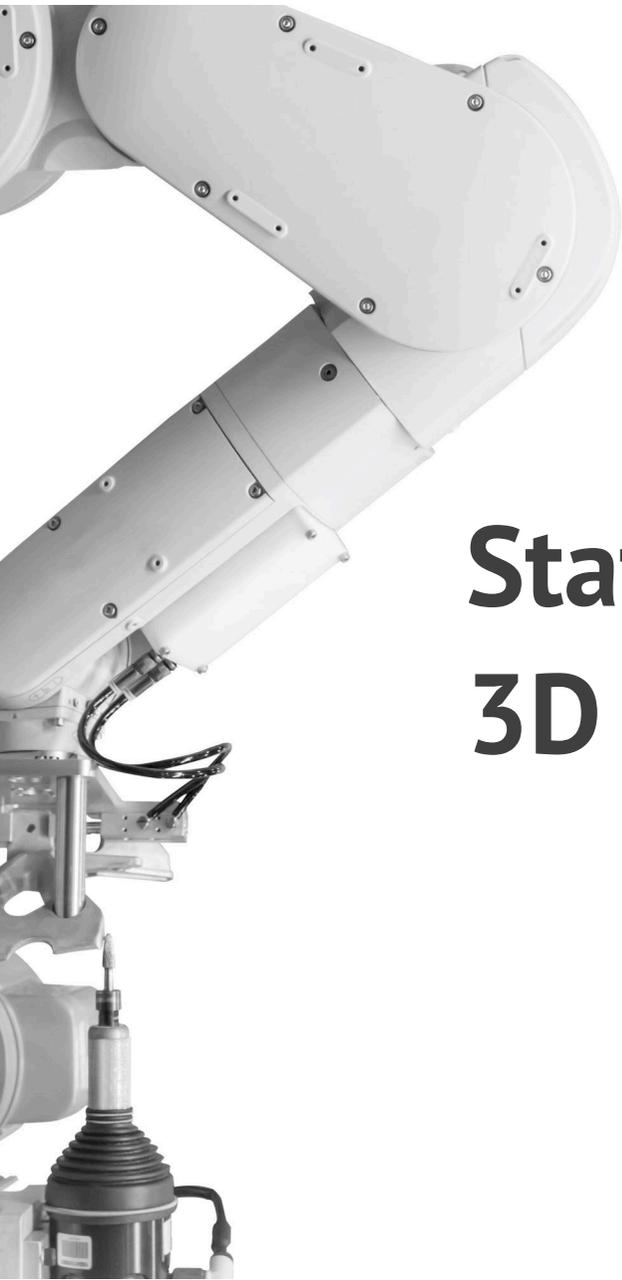


**State of construction 3D printing.  
Geopolymer concrete application on the real  
scale project in the Extreme North.**

**Marina Dudnikova**

**Andrey Dudnikov & Alex Reggiani**

RENCA



# State of construction 3D printing today



Construction 3D printing is an emerging technology that is gaining more and more popularity. There are lots of attractive videos in the internet showing 3D printing of houses that look very promising.

*Apis Cor*

vocativ





**Chinese company prints  
10 houses in 24 hours**

**House in 24 hours for \$4000**



But they *don't reflect the real state of development* of this technology. It's more like a concept-car in automotive industry - you can build one, but the industry is not ready for making a series production.

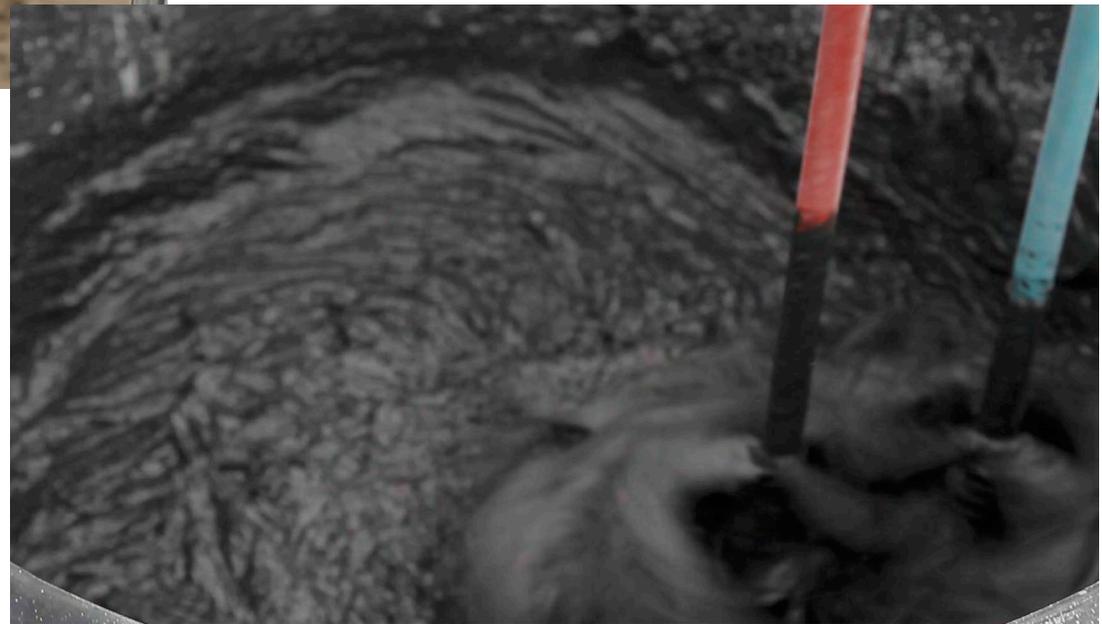
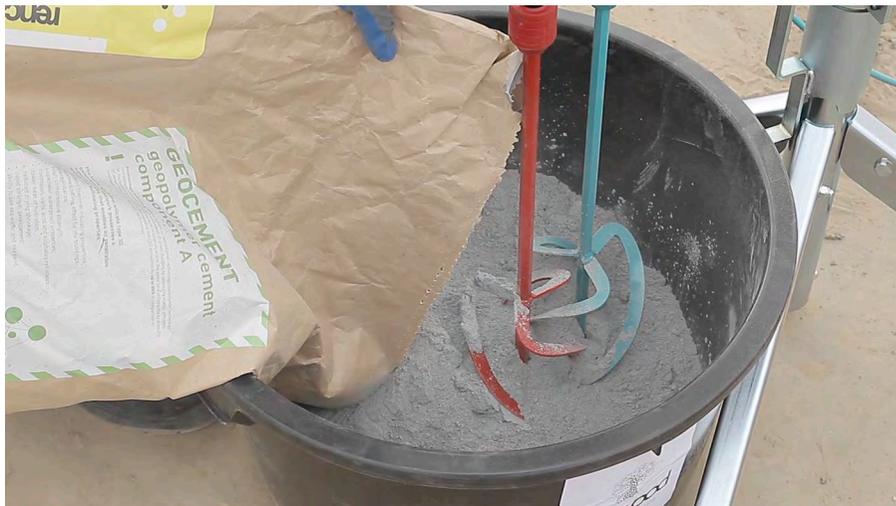


# REAL State of construction 3D printing today

# Problems with mixing and pumping

The existing solutions cannot fulfill the needs towards rapid setting concrete for 3D printing. They are all designed for normal setting concrete mixes. The only existing solution is to mix it *manually* or try to adjust semi-automatic solutions for this extraordinary case.





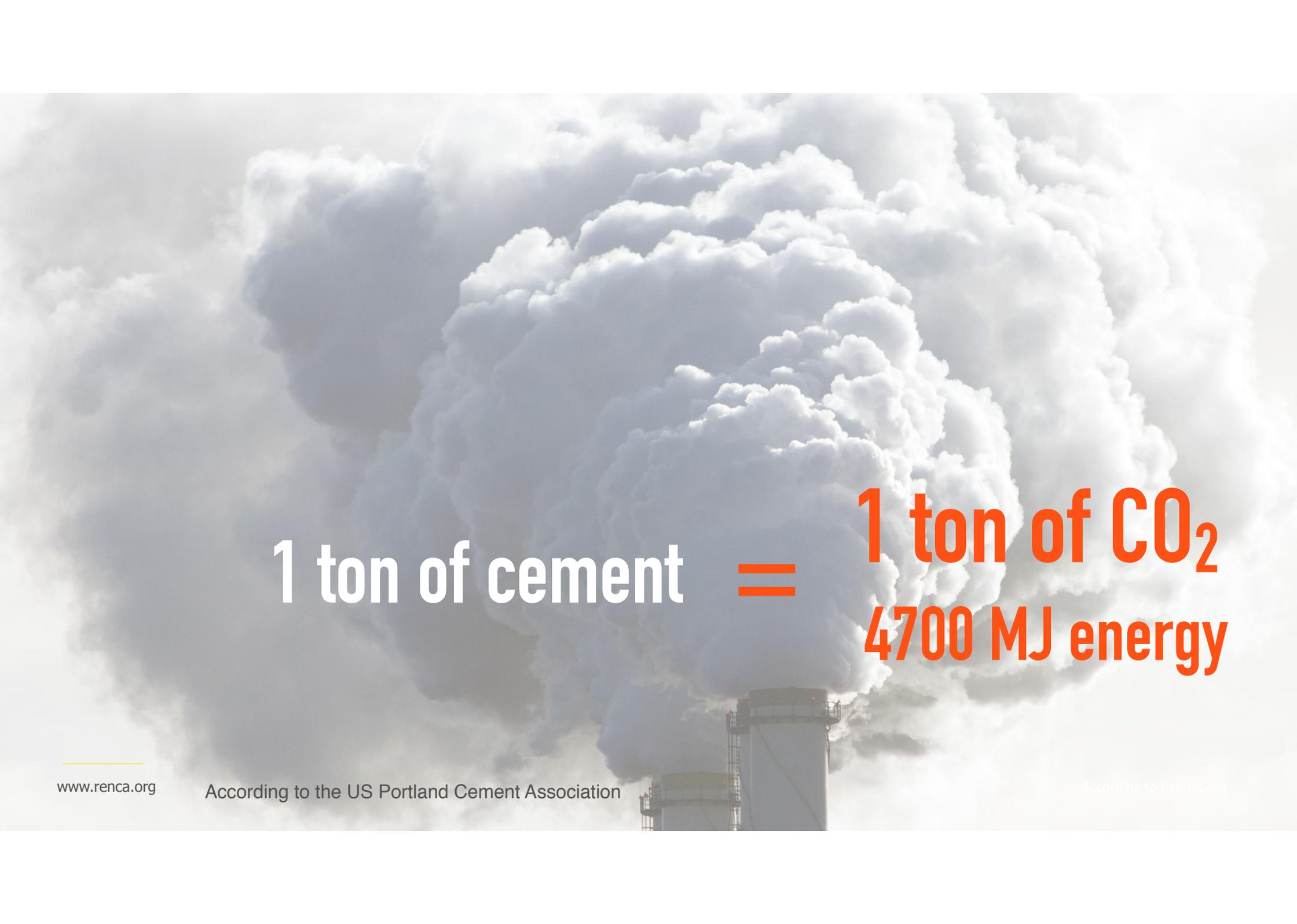
# Problems with the concrete mix

With the introduction of construction 3D printing, the whole industry must switch its approach towards special concretes for this specific application. They must have adjustable setting time depending on the temperature, be fast setting, with good thixotropy and adhesion between the layers and be suitable for pumping through the nozzle of the 3D printer.

**Geopolymer concretes meet all these requirements, moreover they are eco-friendly and cost less than the same solutions based on OPC.**

# Why geopolymer concrete is the best material for construction 3D printing?

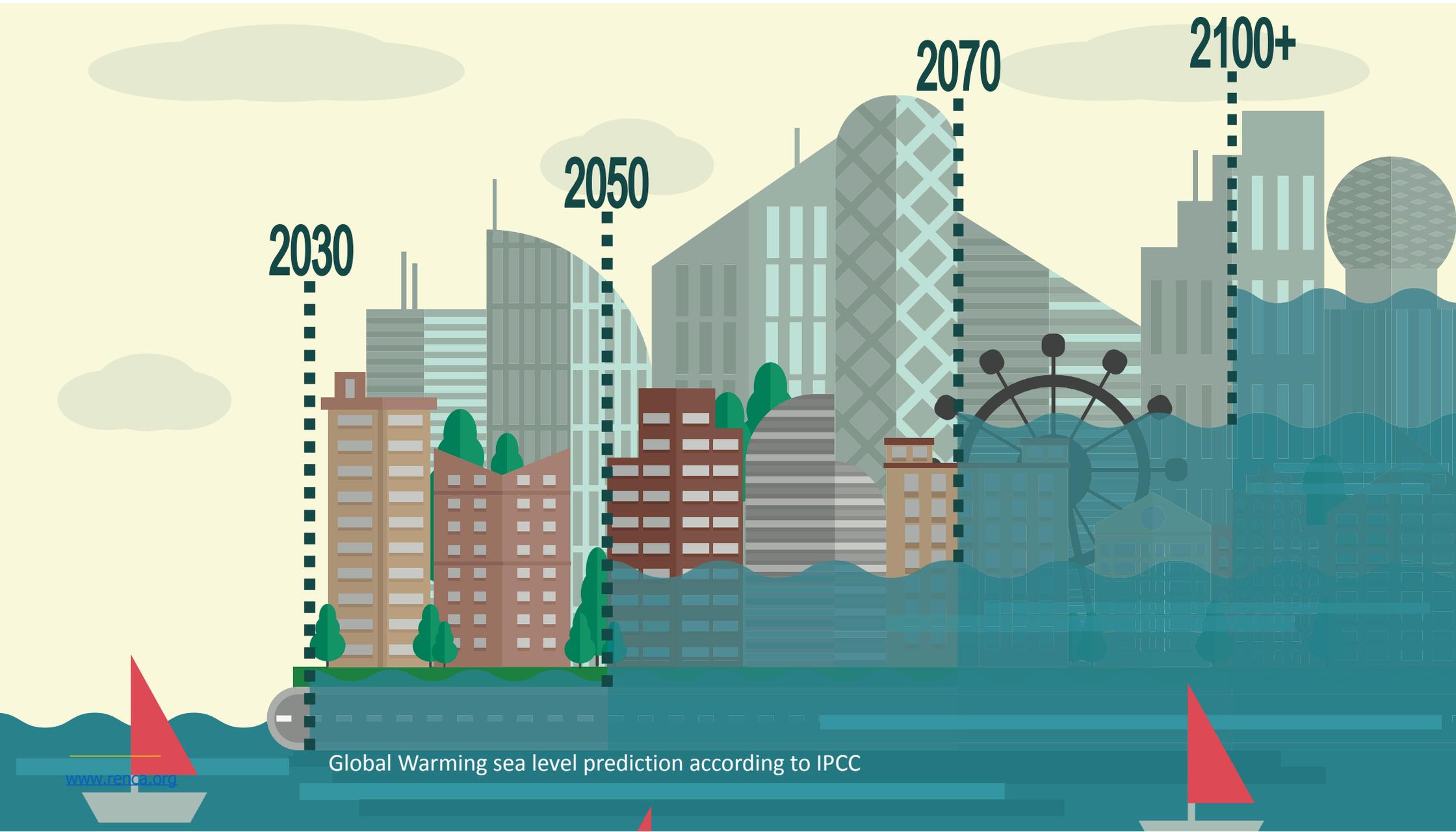




1 ton of cement

=

1 ton of CO<sub>2</sub>  
4700 MJ energy



2030

2050

2070

2100+

Global Warming sea level prediction according to IPCC

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

According Geopolymer Institute for 1 ton of Fly-Ash based geopolymer 50 kg CO<sub>2</sub> for OPC 1020 kg of CO<sub>2</sub> per 1 ton.

**10X**  
less  
CO<sub>2</sub>

Geopolymer  
Technology

[www.renca.ru](http://www.renca.ru)

**10X**  
less  
energy

According to the US Portland Cement Association energy needs for OPC 4700 MJ/ton  
According Geopolymer Institute for 1 ton of Fly-Ash based geopolymer cement 375 MJ

Using geopolymer technology you can easily reach the desired parameters for construction 3D printing, without introducing expensive additives and reaching even better properties in terms of:



fire resistance



chemical resistance



waterproof properties



thermal resistance

# Price comparison of geopolimer for 3D printing and Portland cement based mix:

Geopolymer concrete for 3D printing is **20-40% cheaper** than Portland cement based mix with the same properties depending on the availability of raw materials and the region.



# geopolymer cement and geopolymer reagent geosilicate:

# Microactive fillers and aggregates



kerwood

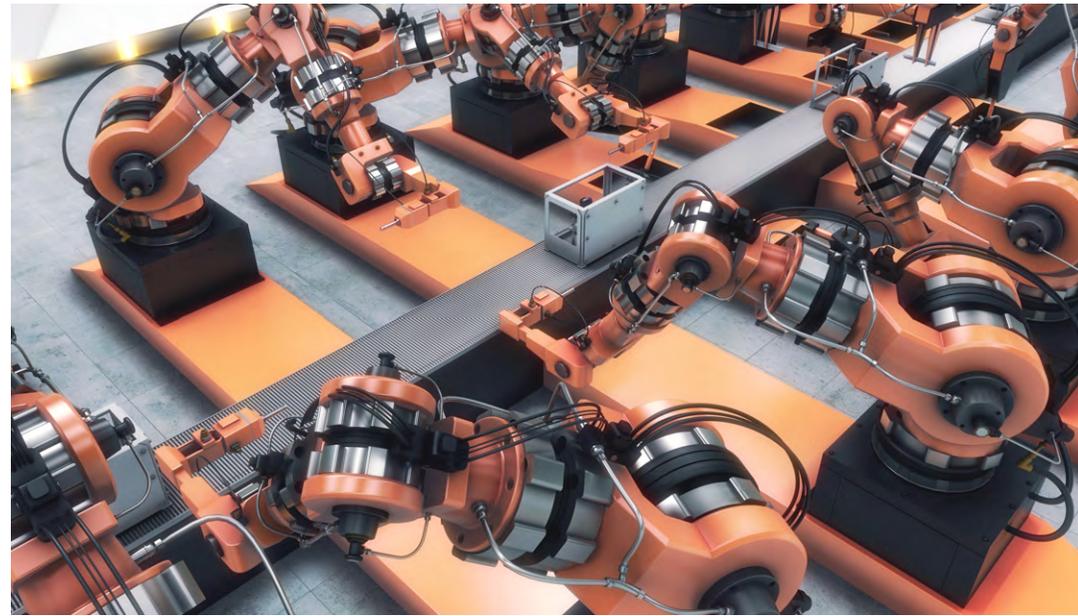


Introduction of micro active fillers based on natural raw materials will improve the properties of 3D geopolymer concrete, taking part in a reaction of geopolymerization, reduce the weight of the structure and reduce thermal conductivity of the building.



# There are none cases of series construction using 3D printing

Until now, there are only single occasions of using construction 3D printing around the world. One company has build the house in Russia, the other has build one in Copenhagen, but no one has yet build a whole village or at least 10 to 50 houses with reasonable timeline and at fair cost. The main obstacle is...



# There is no complete system. Yet.

The existing companies on construction 3D printing market have good solutions for robotics, but lack the knowledge in concrete and have no machinery for mixing big amounts of the new type of concrete - fast setting, rapid hardening, with adjustable properties depending on the temperature and size of the 3D printed element or the house.



**RENCA** delivers all-in-one solution:

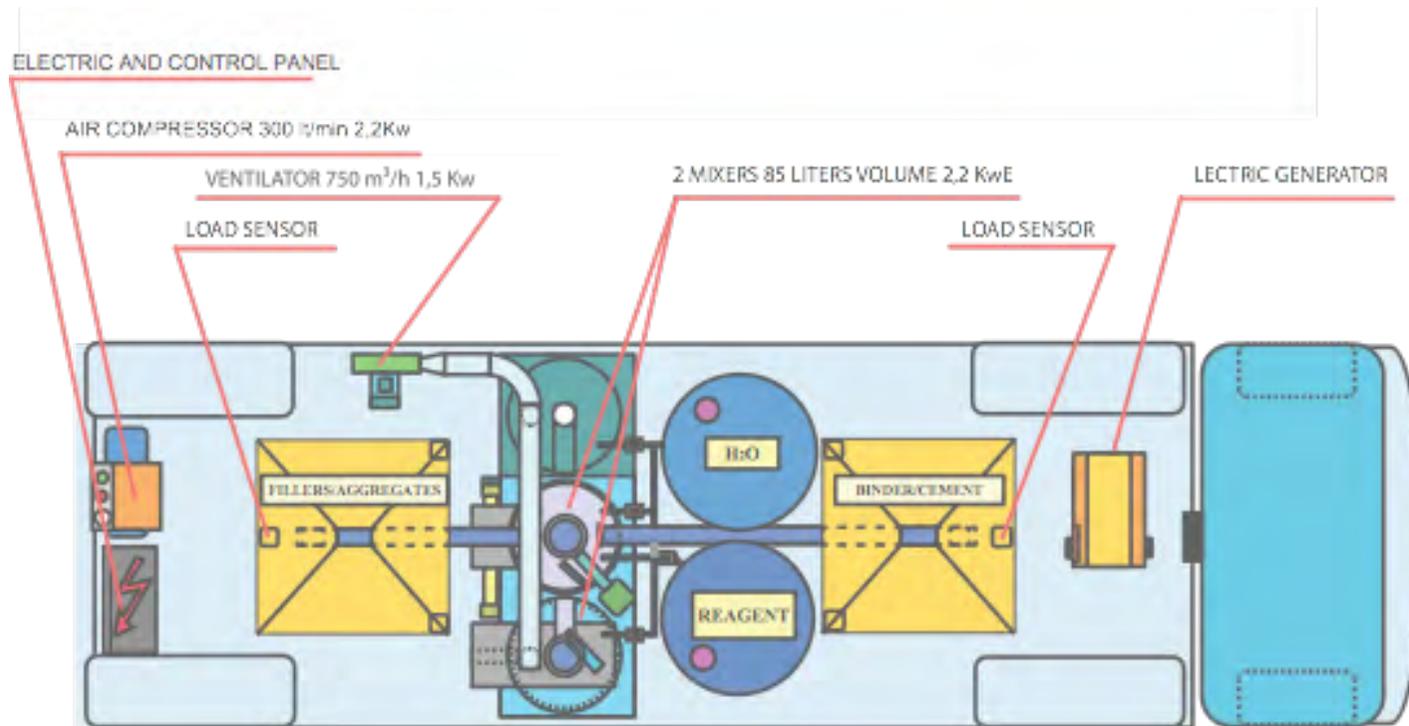
**Geopolymer cement** and concrete for 3D printing production

**3D printers** and automatic mixing systems for concrete

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

renca

# Automatic mixing and supply system for 3D printing concrete



Mobile

Pumping of the concrete to 100 meters and more

Self-cleaning

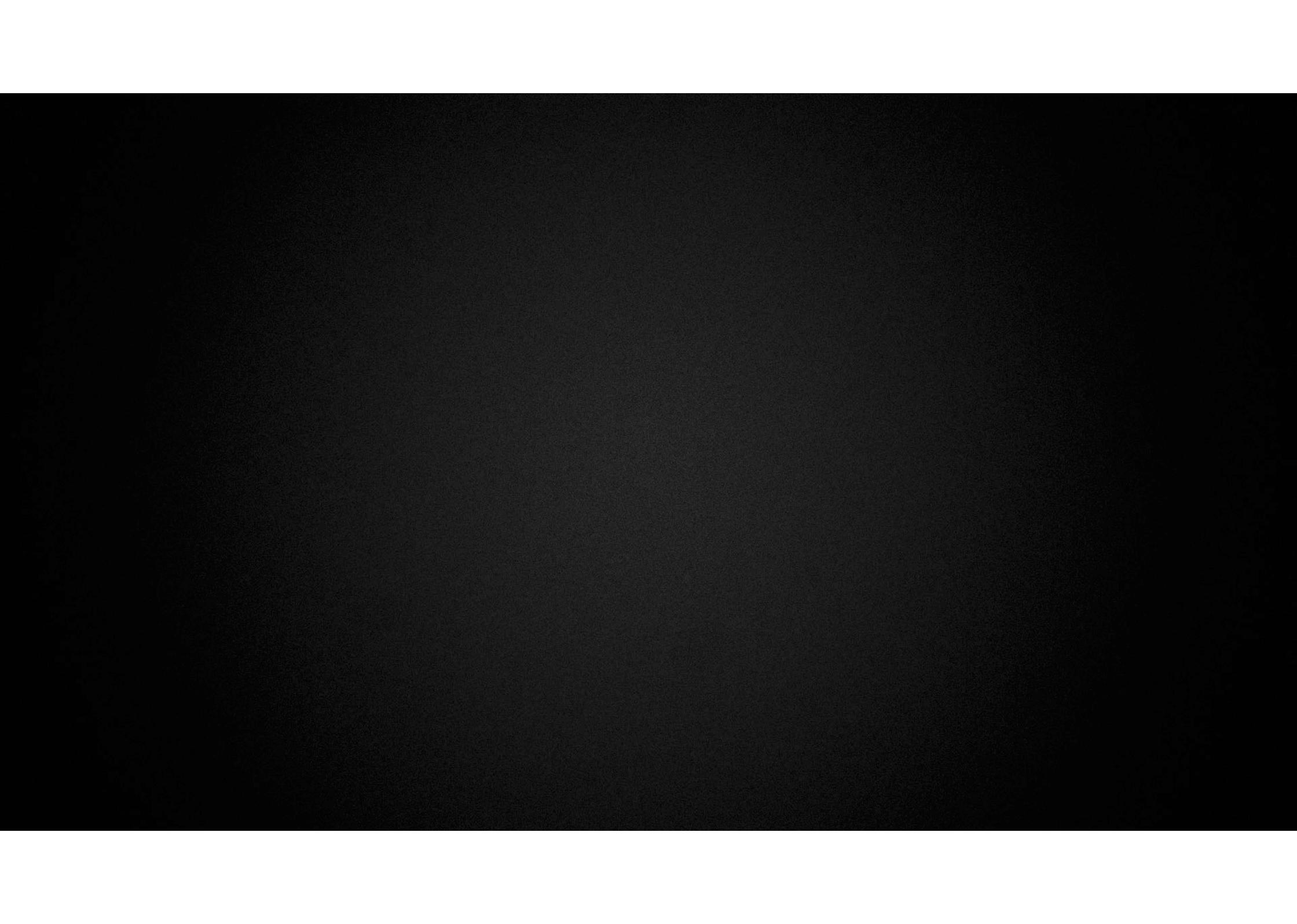
Autonomous design

Adjustable mix settings depending on the ambient temperature

**renca**

# Automatic Mixing System for Concrete

# **Geopolymer concrete application on the real scale project in the Extreme North.**



# Achievements

“25% of Dubai’s buildings will be 3D printed by 2030”



Renca together with Dubai Municipality is developing geopolymers concrete for 3D printing based only on local raw materials.



# Achievements 2018



Renca winner of KATERVA award in Materials, Resources & Water category.



RENCA at top 100 innovative disruptive construction companies



Renca in TOP-50 of companies, offering solutions for Smart - buildings



# Future Projects



# *Fiamma Rossa*

A geopolymers twisted obelisk  
by Robotic 3D printing

designed by  
Giuseppe Fallacara

for  
**Nust Misis Fab Lab Workshop**

in collaboration with

**Renca Russia Group**

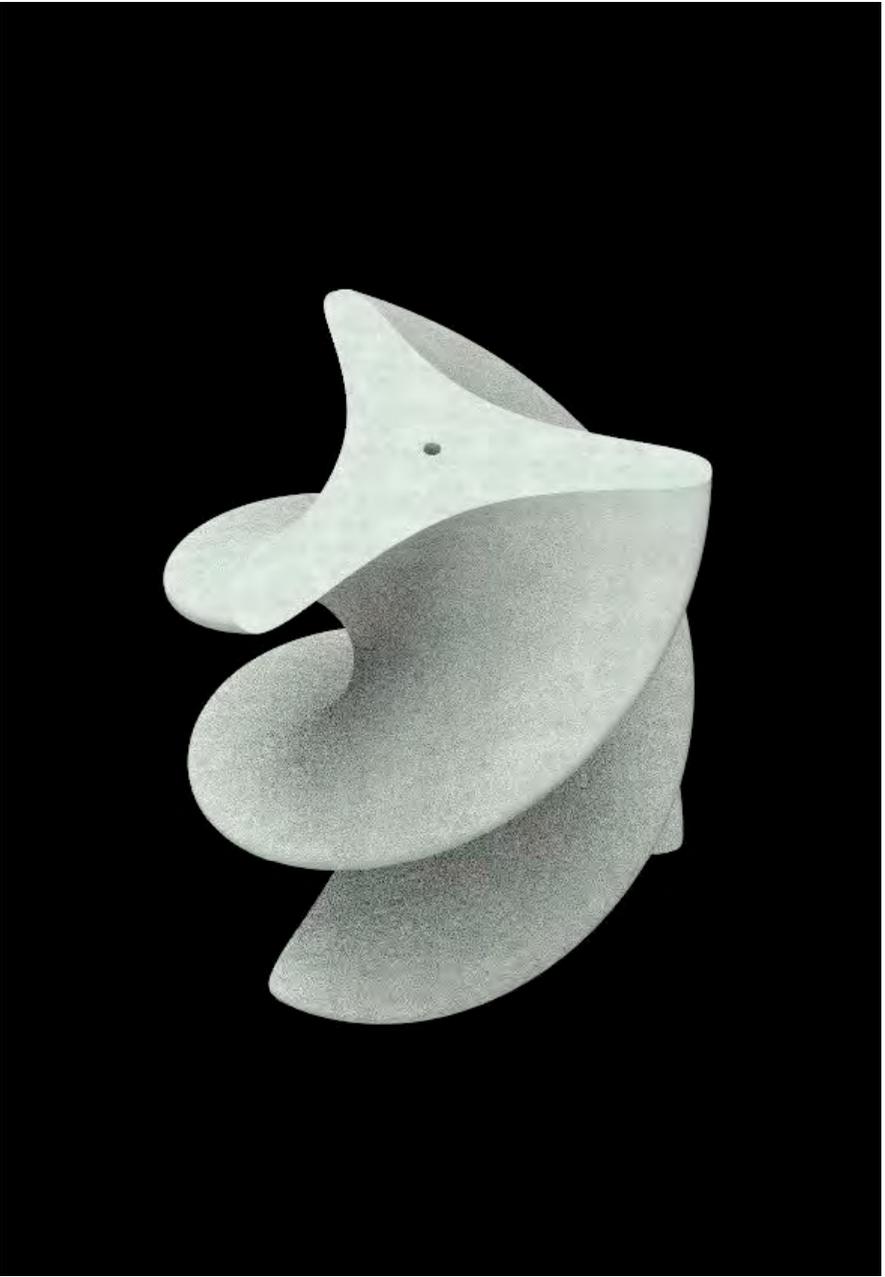
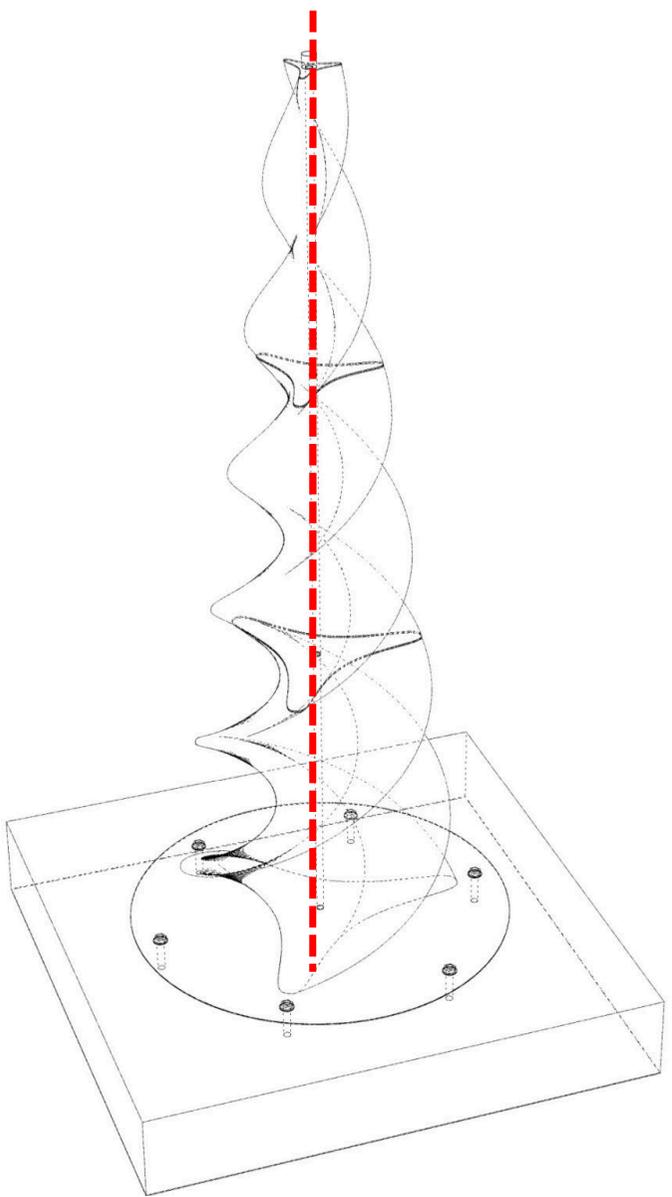
The flame of art

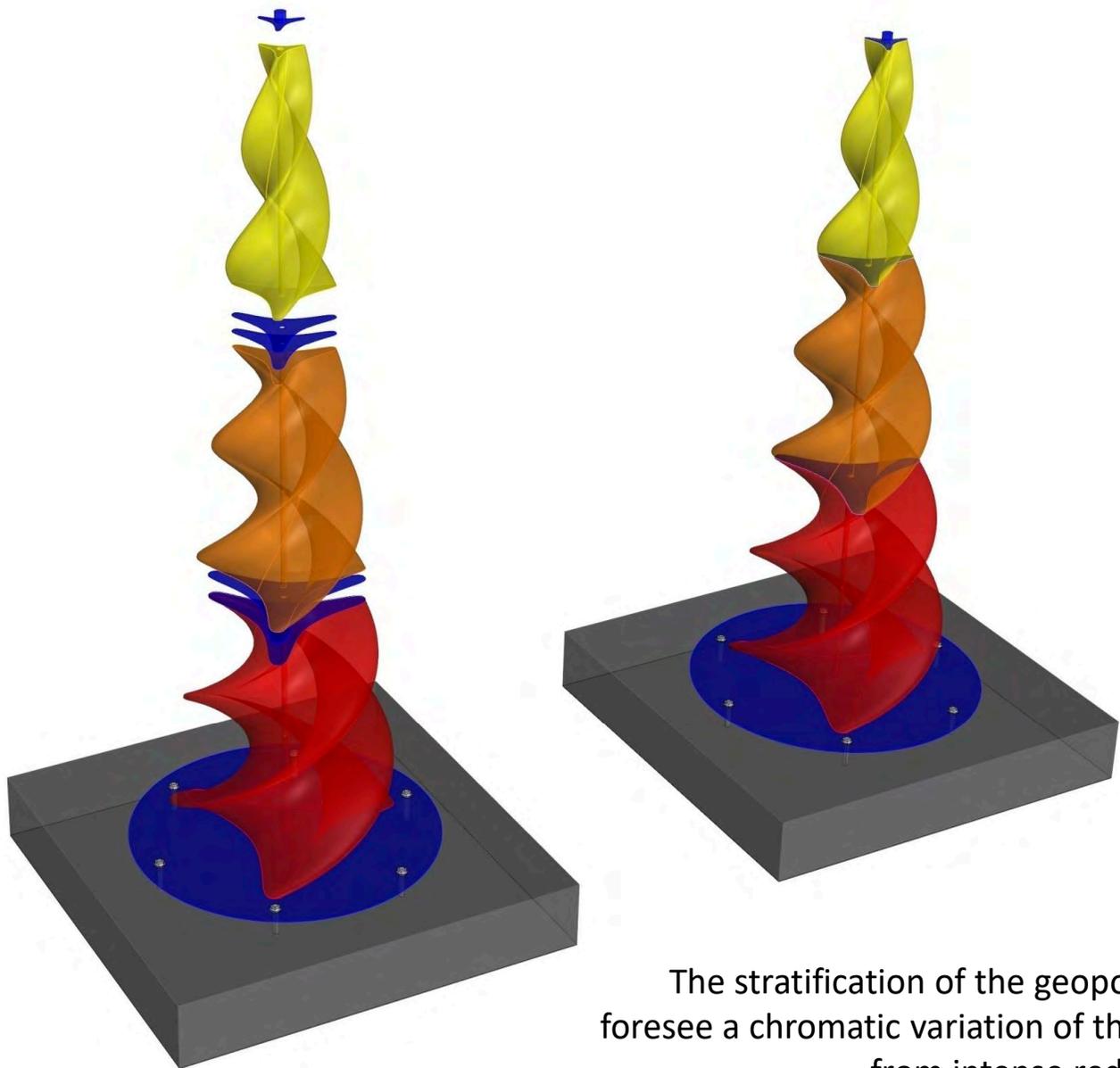


The flame of ingenuity and creativity

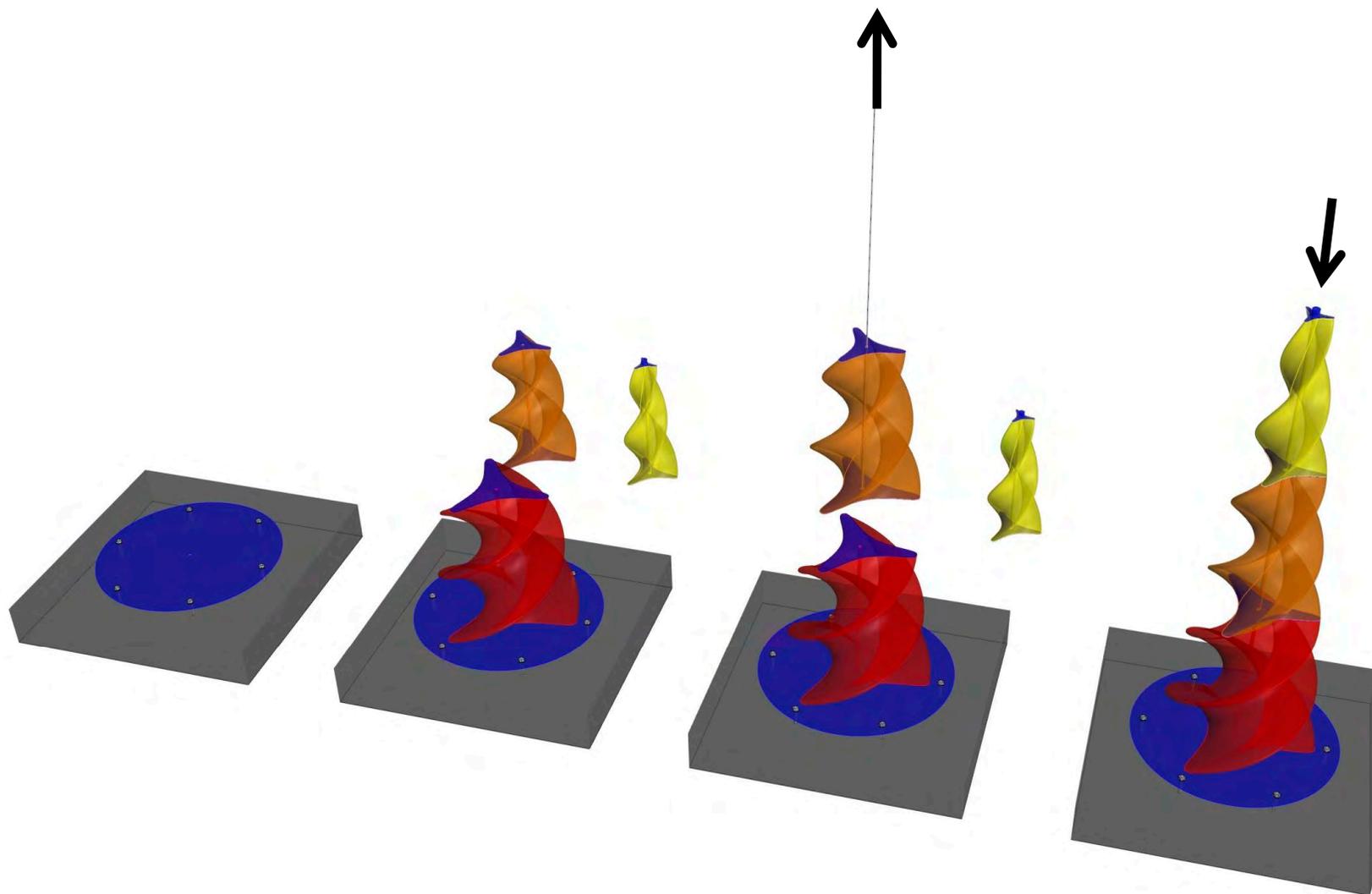


Lifting axis of blocks and prestressing of the obelisk

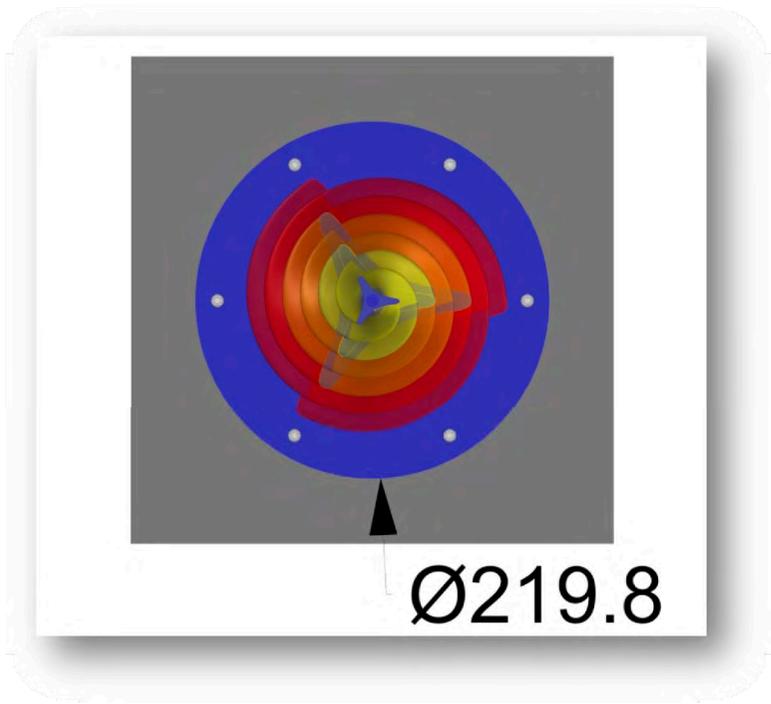




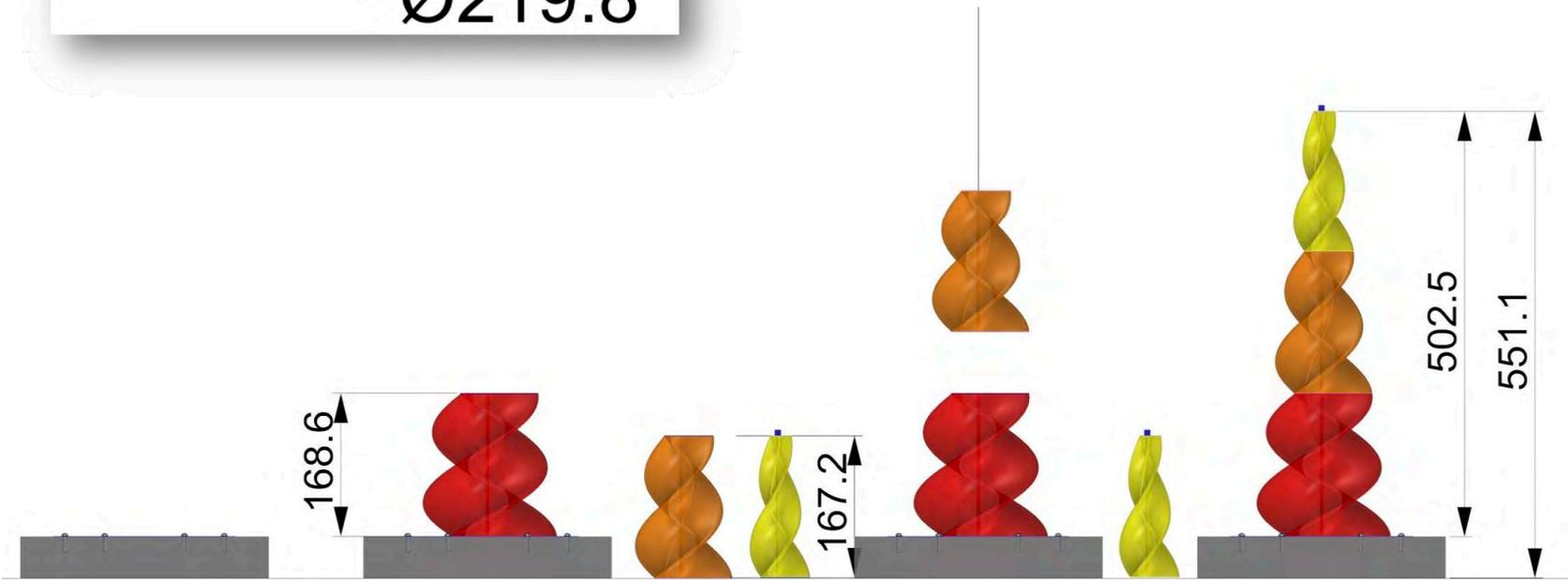
The stratification of the geopolymer can foresee a chromatic variation of the material from intense red to yellow.



Stages of construction and assembly of the obelisk



$\text{Ø}219.8$



***FUTURE - is now!***

**renca**

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

# Mongol Rally 2017 @geomongol

**GEPOLYMER**  
INSTITUTE

**MONGOL RALLIES**



# THE RALLY

**8 weeks**

**2 continents**

**20 countries**

**300+ cars**

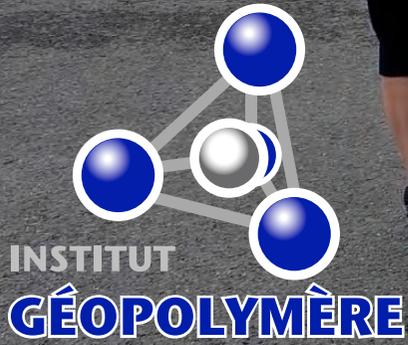
MONGOL RALLY is an international charity rally covering 16,000+ kilometers (1/3 of the Earth), crossing mountains, navigating deserts, passing through some of the most remote terrain on the planet, traveling from London, England, to Ulaanbaatar, Mongolia, with no set route and no back up in a 1 litre vehicle.



Mongol Rally is not just about having an insane trip and hang out with crazy people. It's also about saving the planet and making the world a better place. Each team participating in the Mongol Rally shall donate at least £1000 to charity, a half of this shall go to the Official Mongol Rally Charity - Cool Earth.



Thanks to Geopolymer Institute and personally Joseph and Ralph Davidovits we could made our contribution towards saving our Planet.





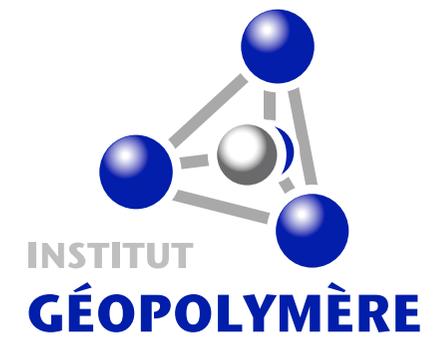




Mongolia, Ulan-Bator, at the steps of Genghis Khan statue.



*Thank you!*



[www.geopolymer.org](http://www.geopolymer.org)