TOWARD A 3D PRINTED LUNAR VILLAGE

E. Dini – Monolite UK, D-Shape

V. Colla, P. Lamia – Scuola Superiore di Sant'Anna (Pisa)

G. Cesaretti – SITAEL S.p.A

M. C. Bernasconi – MCM Consultants (CH)

Xavier De Kastelier, Foster+Partners

L. Priami , A. Autino – D-Shape

Image: F+P, ESA

TOWARD A 3D PRINTED LUNAR VILLAGE

d-shape

→ MOON 2020-2030

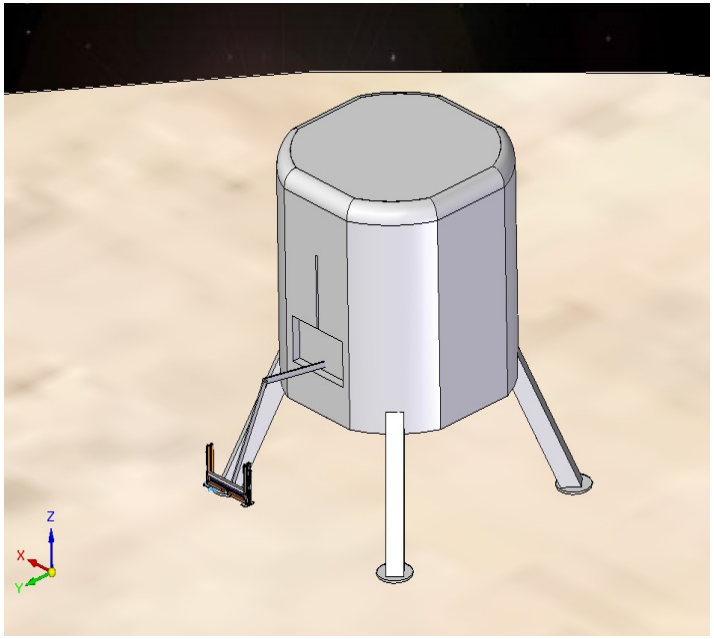
esa

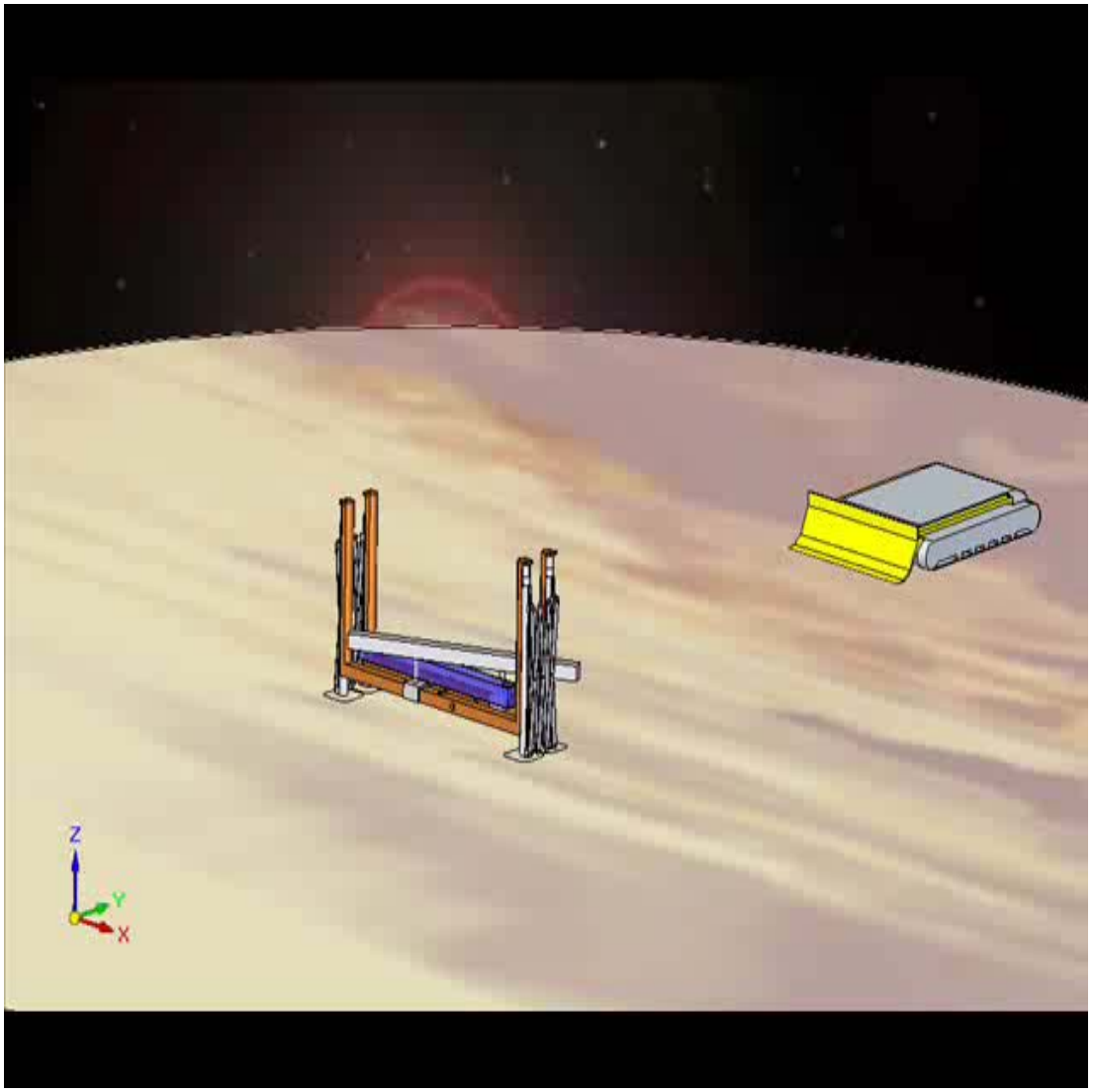
TOWARD A 3D PRINTED LUNAR VILLAGE

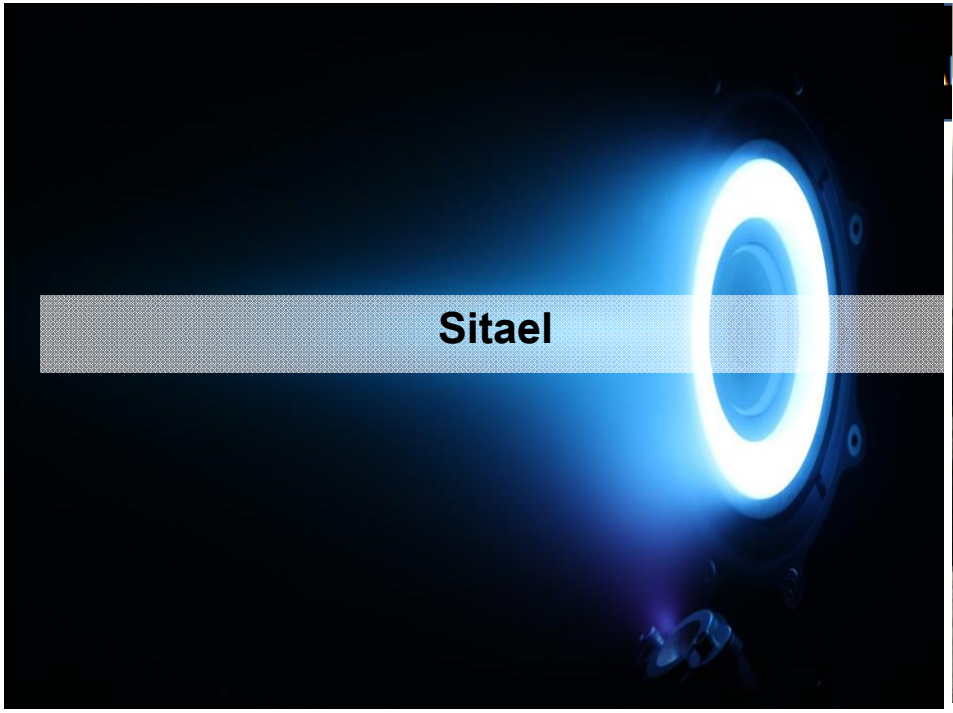
d-shape

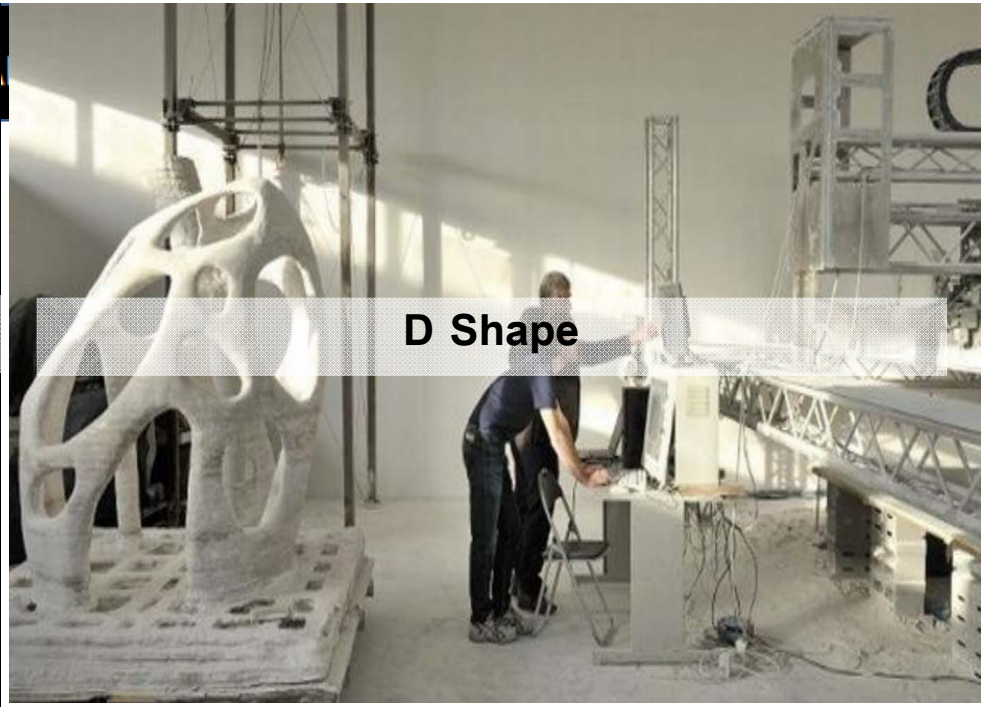
→ MOON 2020-2030

esa






Sitael


D Shape


Scuola Superiore de Sant'Anna


Specialist Modeling Group |
Foster+Partners

ORBITAL TECHNOLOGIES CORPORATION

ONLINE STORE - SHOPPING CART

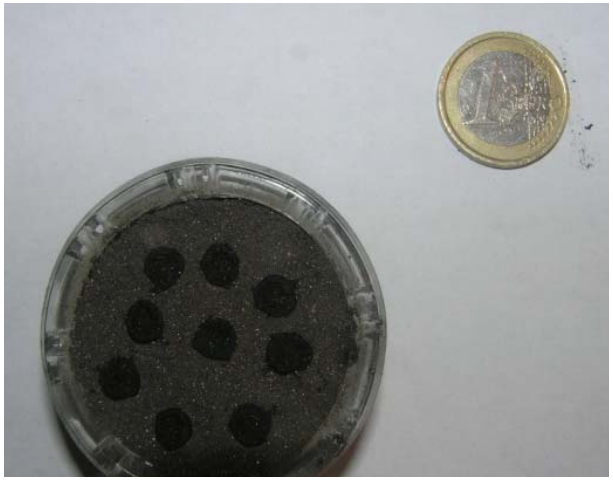
Description	Price	Qty	Amount	
JSC-1A simulant 25 kg	$650.00	100	$65000.00	Modify Qty
SUBTOTAL			$65000.00	

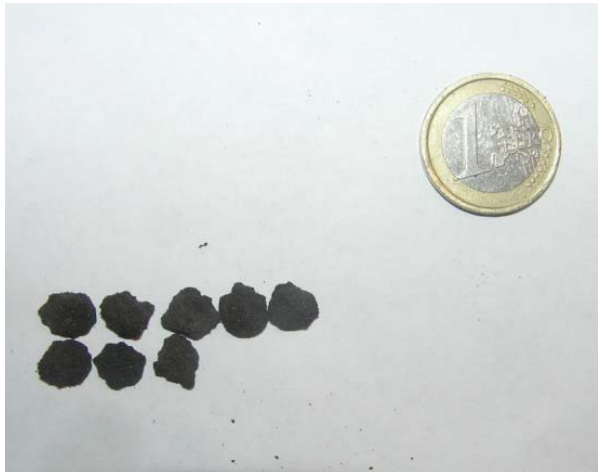
Tax and shipping are calculated upon checkout if applicable.

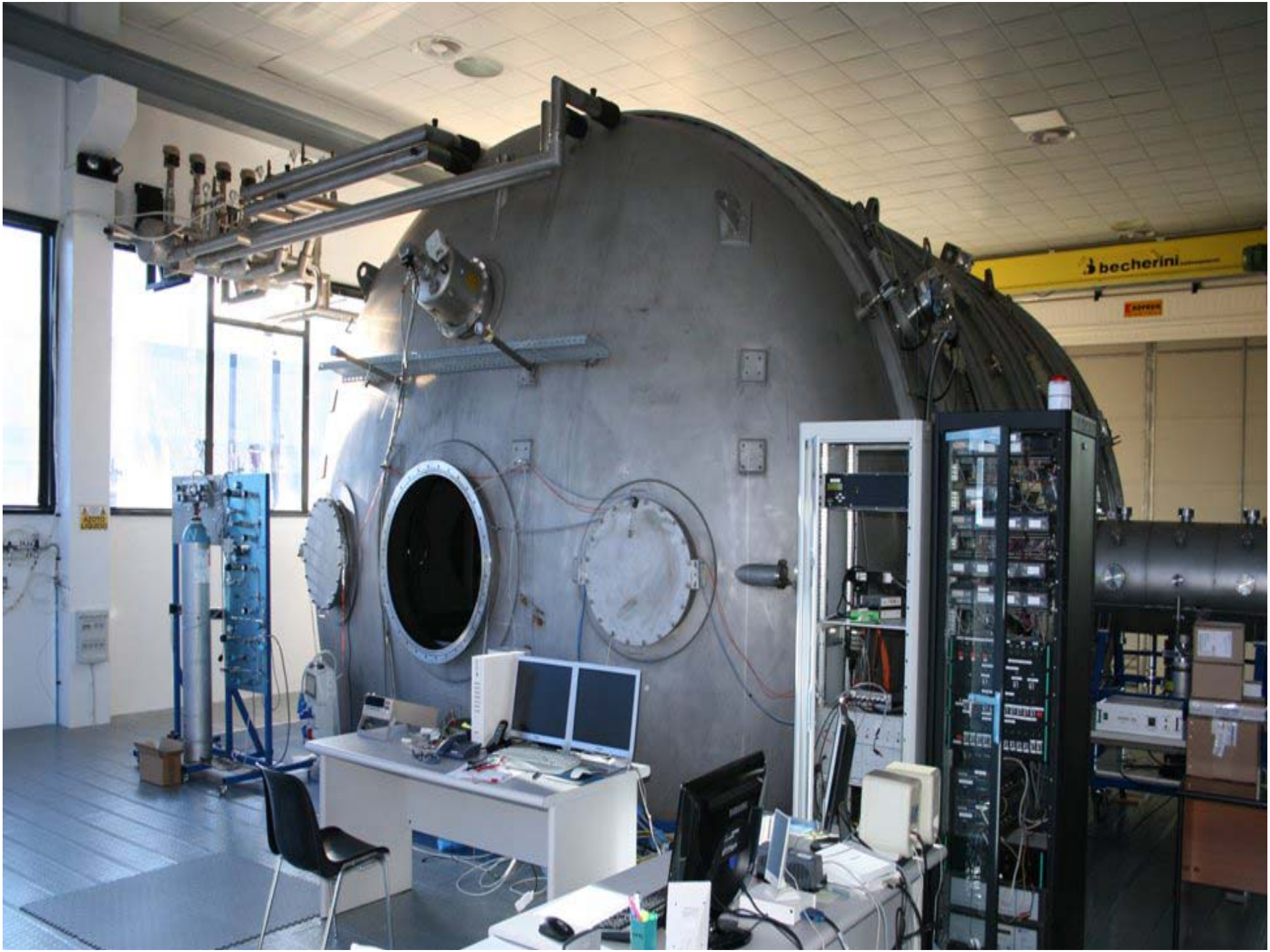
Checkout

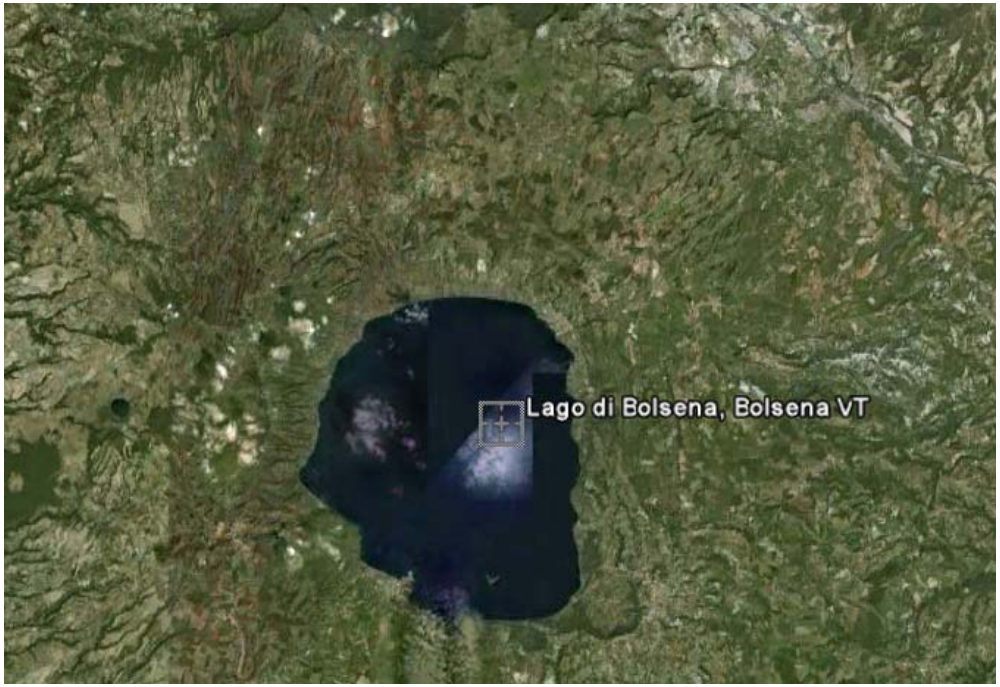
Magnesium oxide

Magnesium chloride






becherini

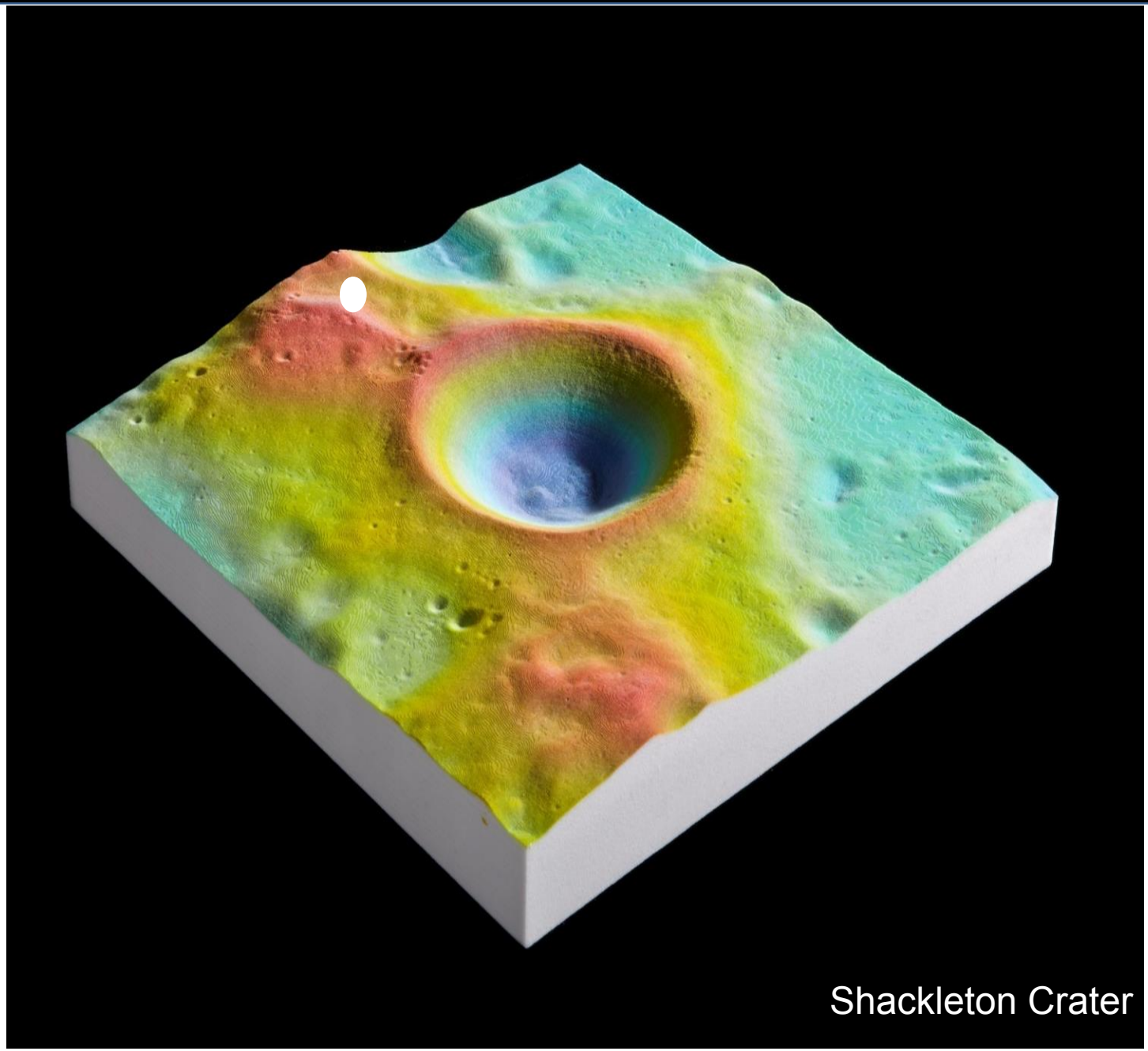


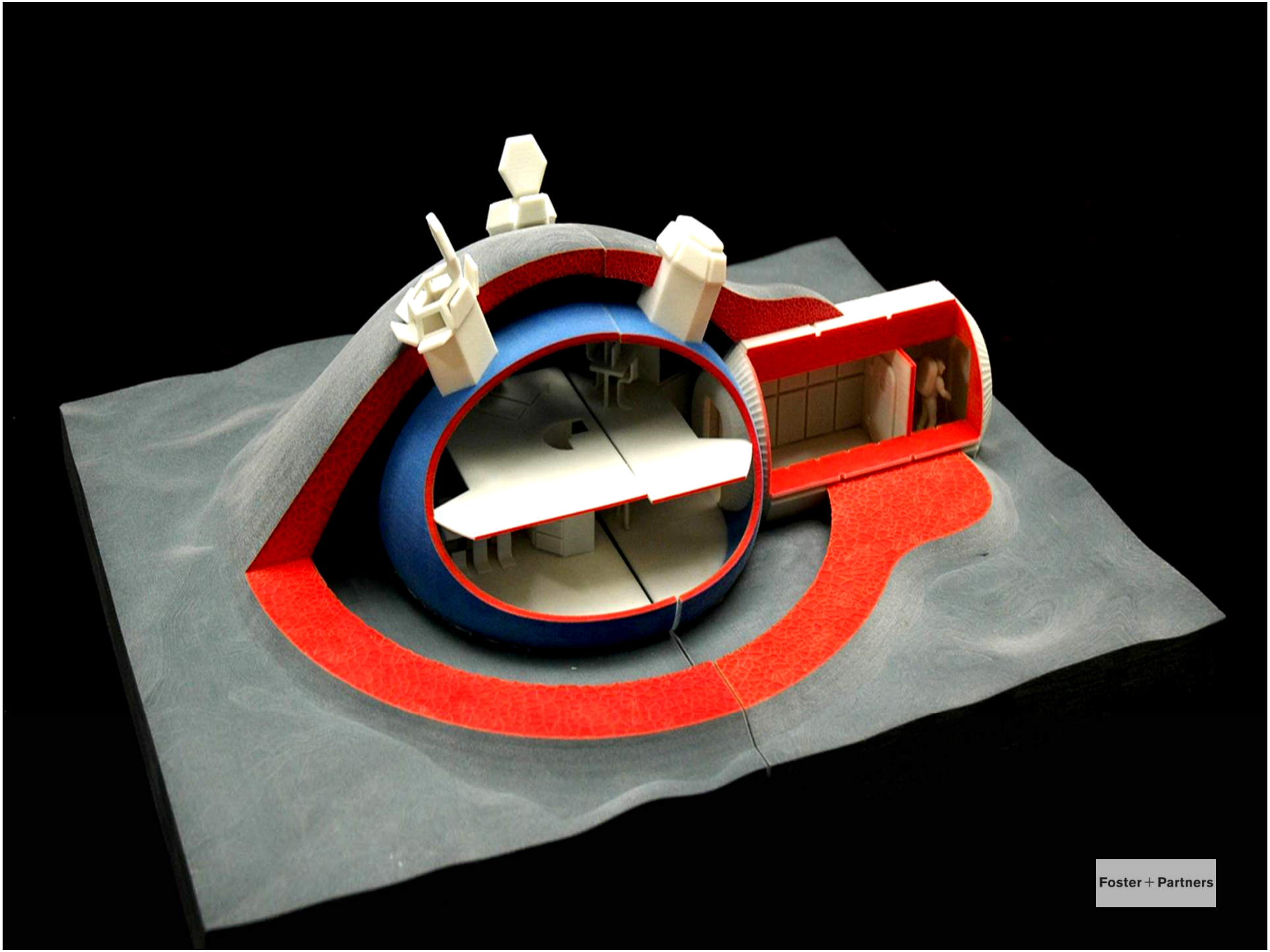
Surroundings of the Bolsena Lake, (Lazio, Italy. Cursor at 42°36'20'' N, 11°57'26'' E)

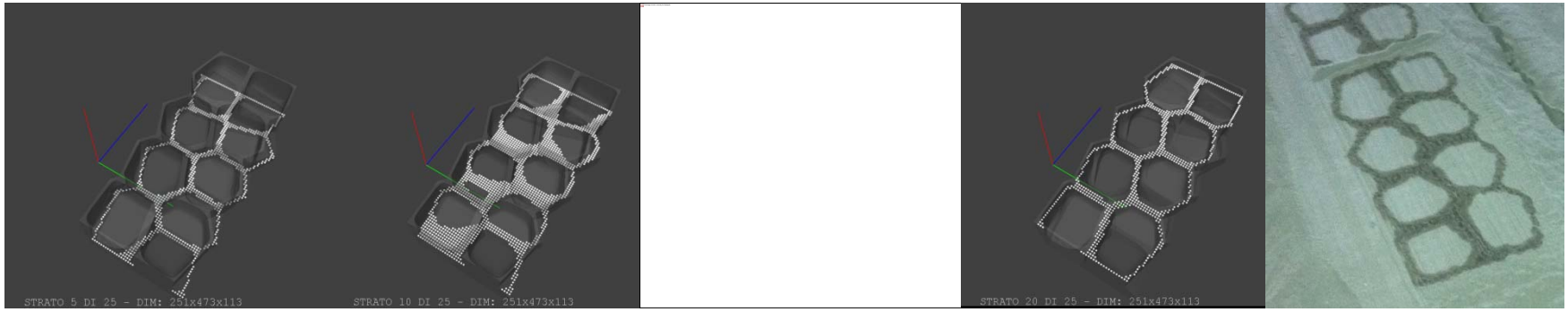
Oxide	DNA-1	JSC-1A	Lunar Soil 14163
	% Weight	% Weight	% Weight
SiO2	41,9	41	47,3
TiO2	1,31	1,6	1,6
Al2O3	16,02	15,9	17,8
Fe2O3	14,6	18,1	0,0
FeO	0,00	0,00	10,5
MgO	6,34	4,73	9,6
CaO	12,9	13,2	11,4
Na2O	2,66	2,5	0,7
K2O	2,53	1,05	0,6
MnO	0,213	0,24	0,1
Cr2O3	0,00	0,03	0,2
P2O5	0,341	0,63	0,00
LOI	0	0,00	0,00
Total	**98,9**	**99,0**	**99,8**

Major Element composition of DNA-1 compared with JSC-1A and a Moon sample from Apollo missions.

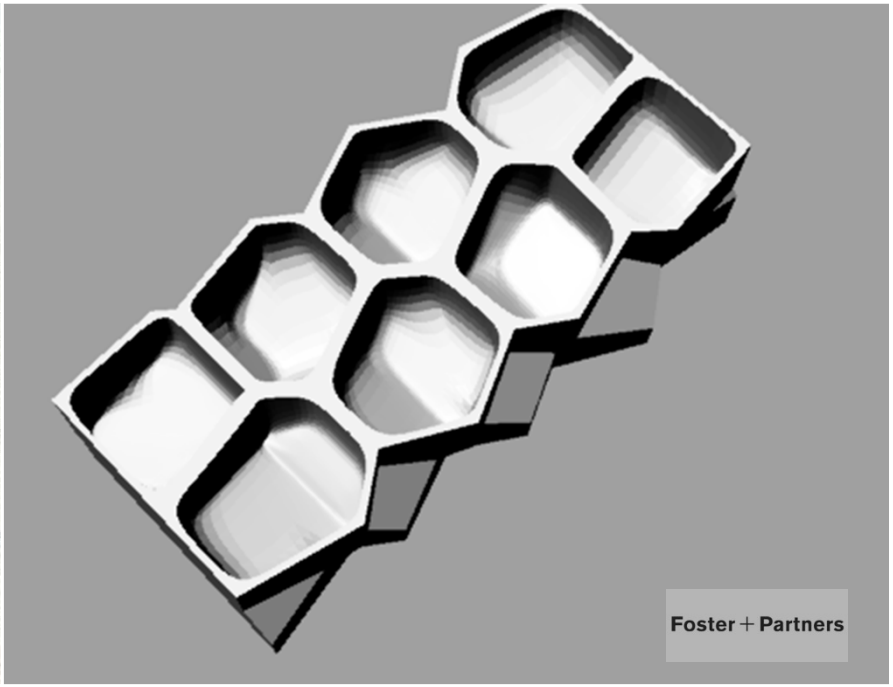
shape TOWARD A 3D PRINTED LUNAR VILLAGE → MOON 2020-2030 esa


Shackleton Crater

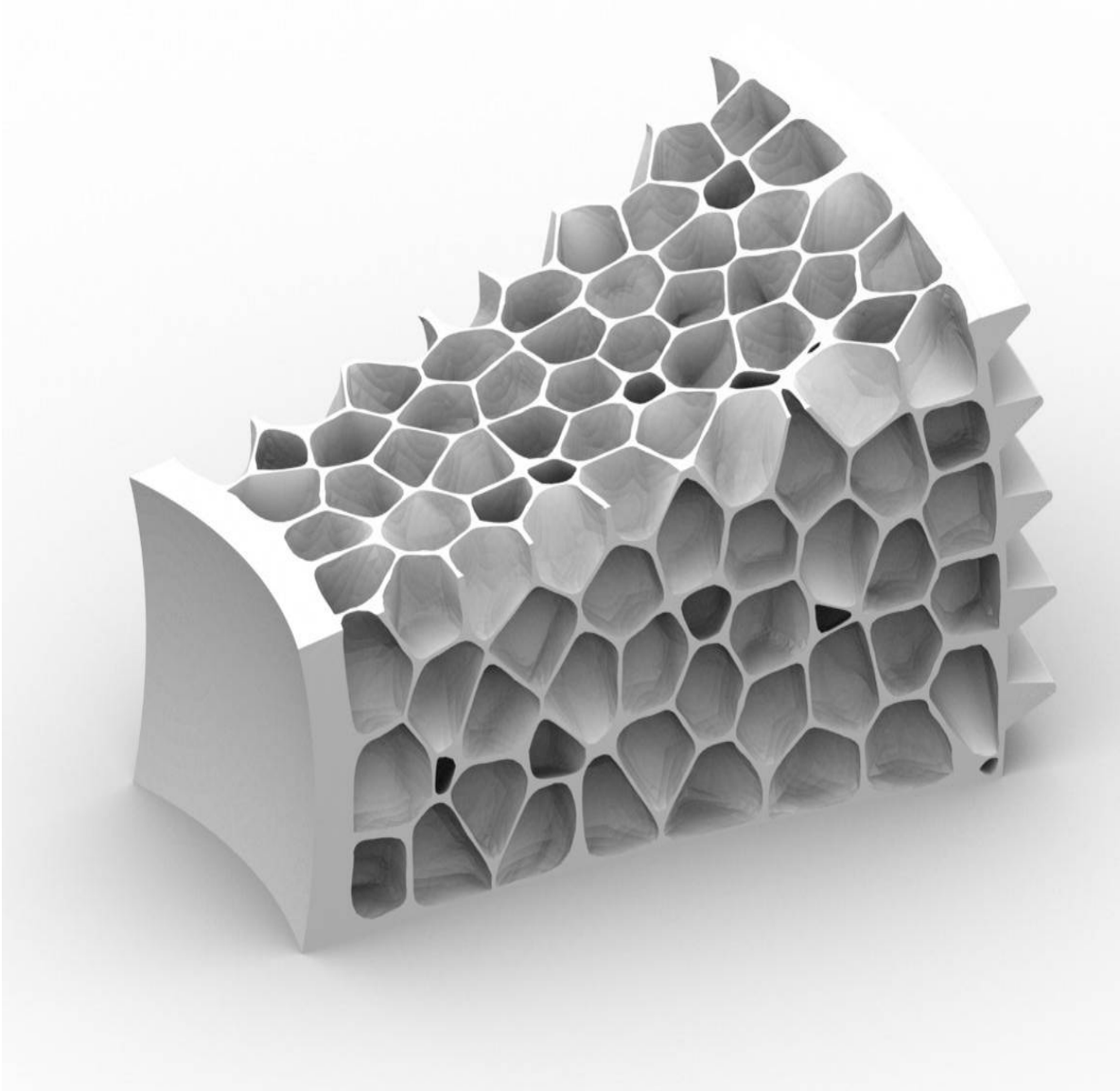

Foster + Partners

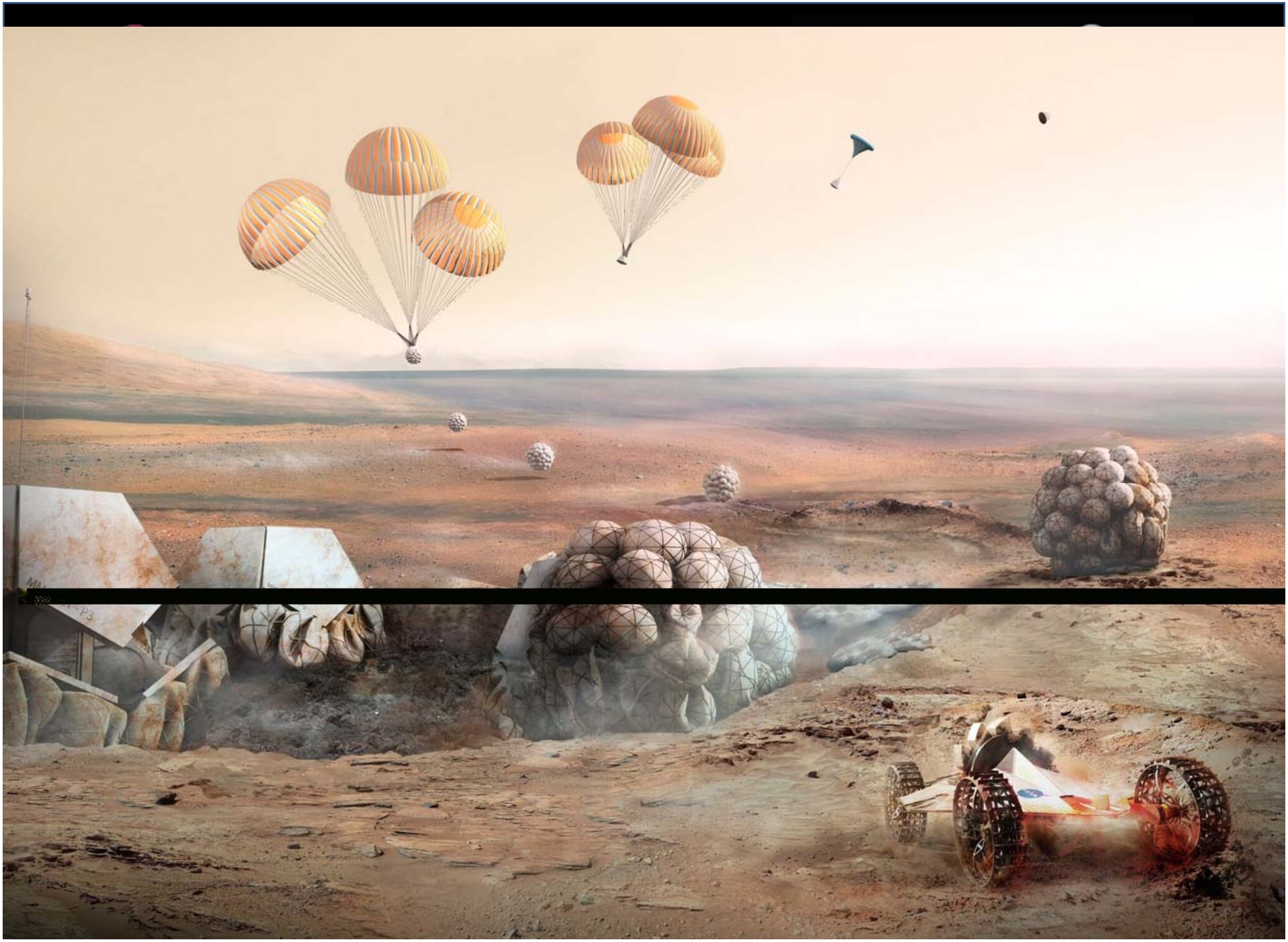

STRATO 5 DI 25 - DIM: 251x473x113
STRATO 10 DI 25 - DIM: 251x473x113
STRATO 20 DI 25 - DIM: 251x473x113


d-shape


Foster + Partners


esa





d-shape TOWARD A 3D PRINTED LUNAR VILLAGE → MOON 2020-2030 esa

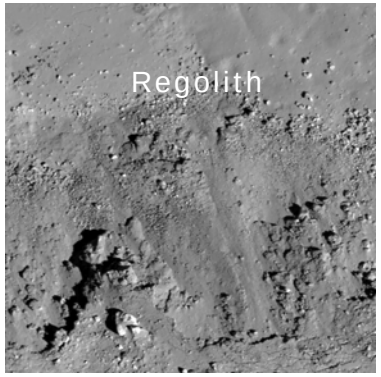

MM1 - H1 - P3


d-shape
TOWARD A 3D PRINTED LUNAR VILLAGE
→ MOON 2020-2030
esa

INSTITUTE OF COMMUNICATION, INFORMATION AND PERCEPTION TECHNOLOGIES

Scuola Superiore Sant'Anna

AGGLOMERATE POLYURETHANE FOAM



Bicomponent polyurethane foam

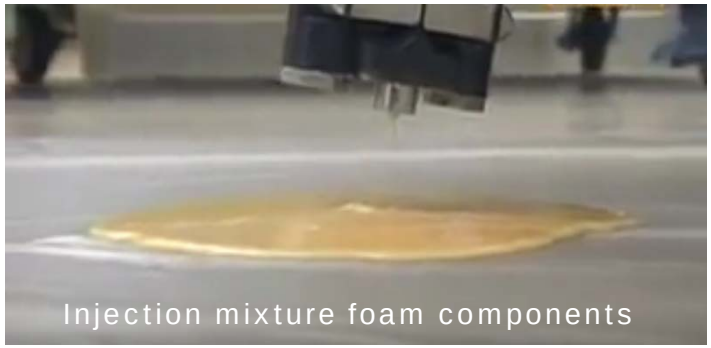
Before curing reaction

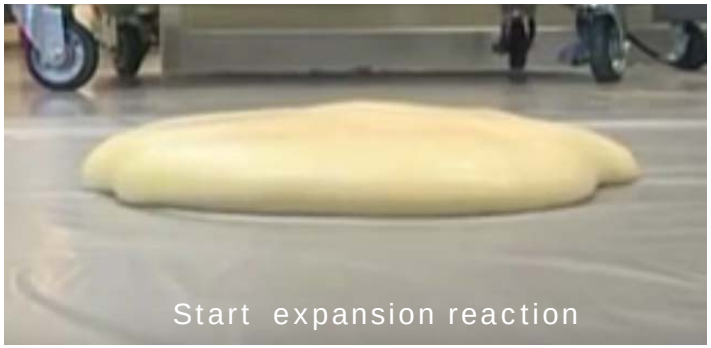
Regular shape by mold

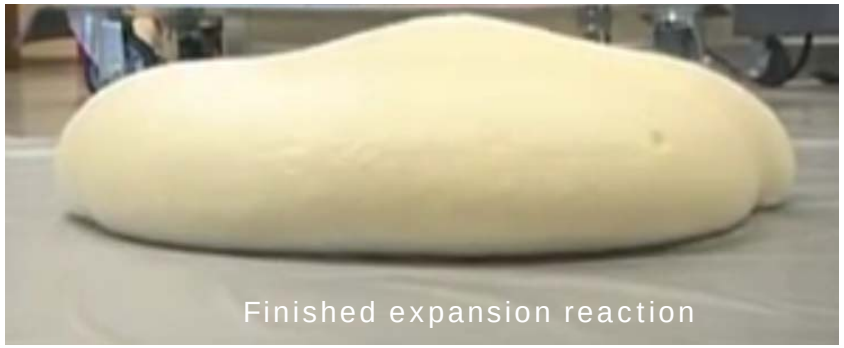
Expansion inflatable structure

INSTITUTE OF COMMUNICATION, INFORMATION AND PERCEPTION TECHNOLOGIES
Scuola Superiore Sant'Anna

POLYURETHANE FOAM EXPANSION

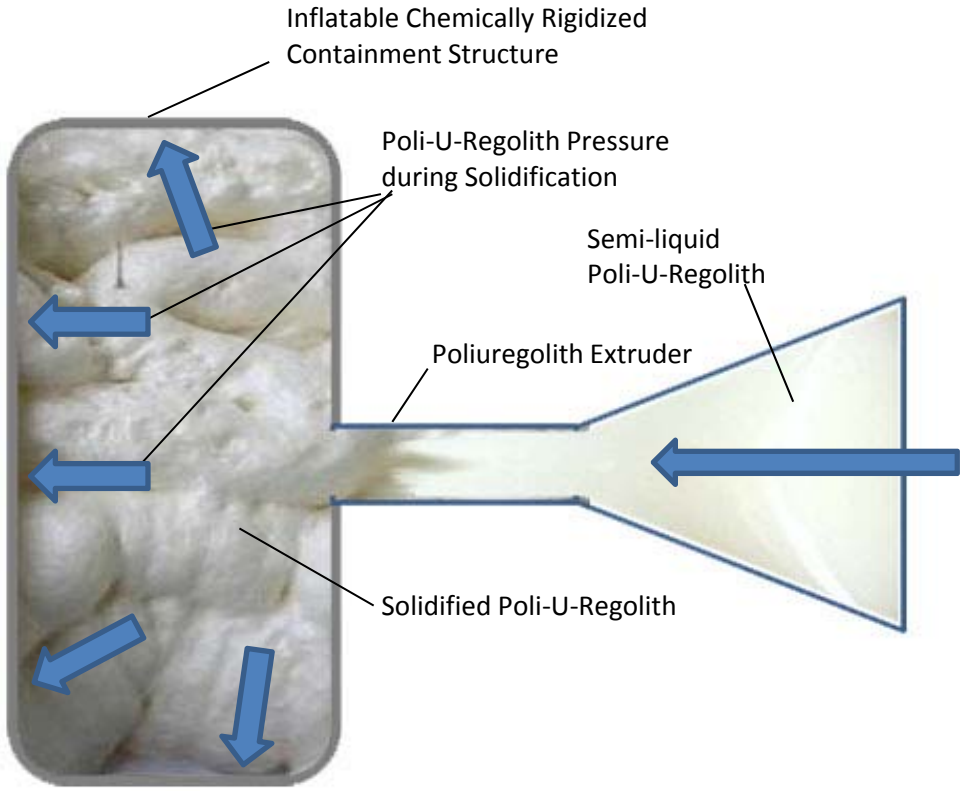

Injection mixture foam components


Start expansion reaction


Finished expansion reaction

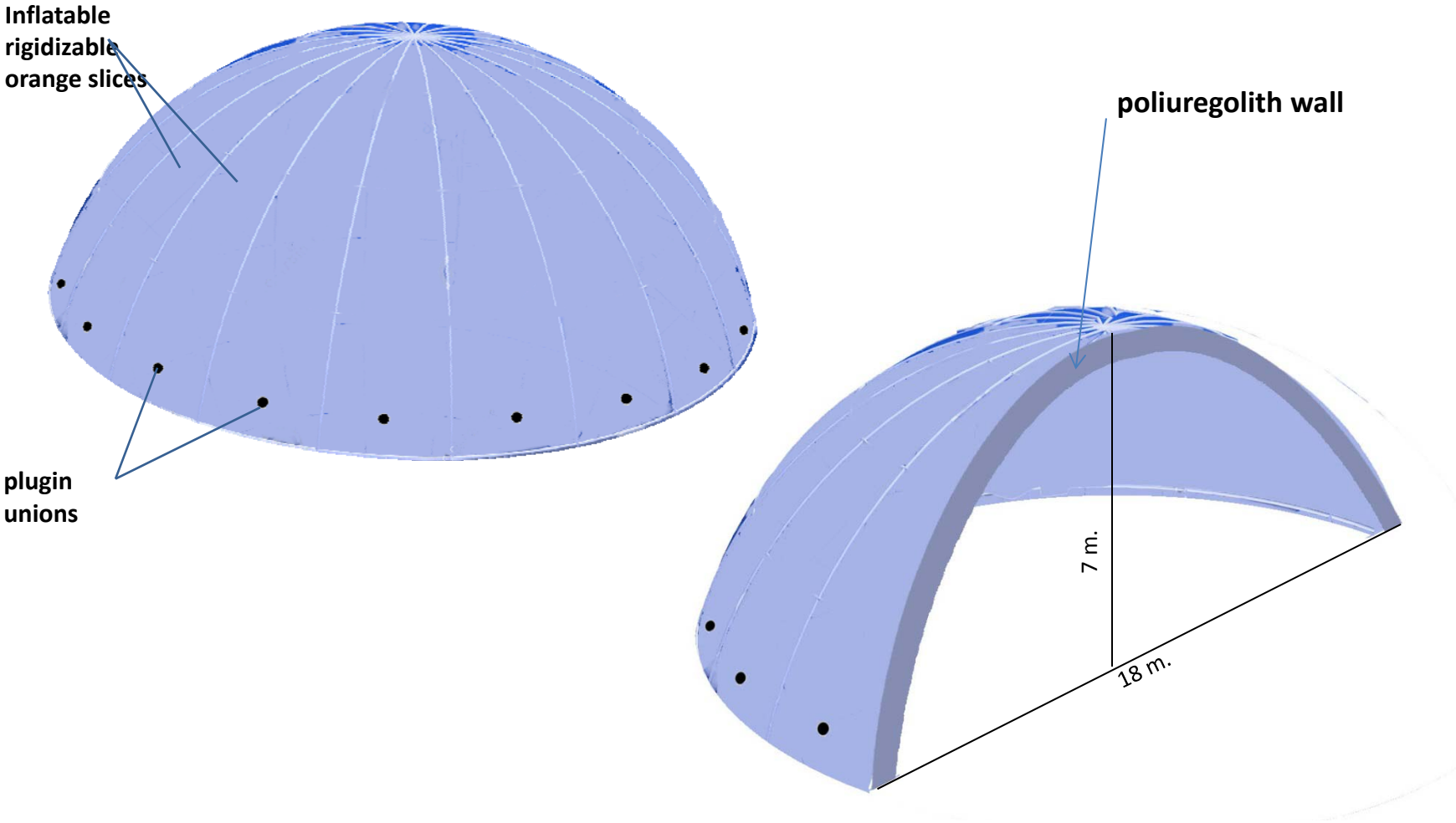
Typical expansion rate
1:100 times of liquid
1:200 times of liquid
1:300 times of liquid

INFLATABLE CONTAINMENT STRUCTURES

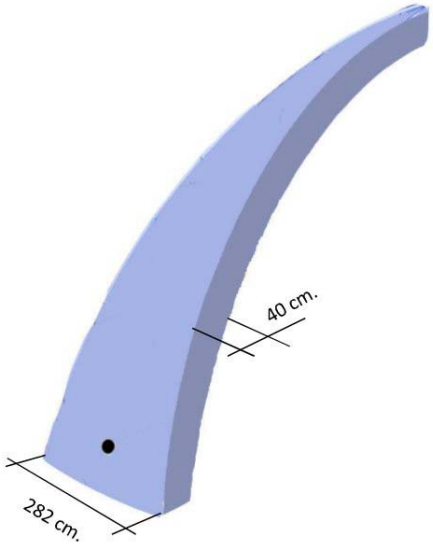


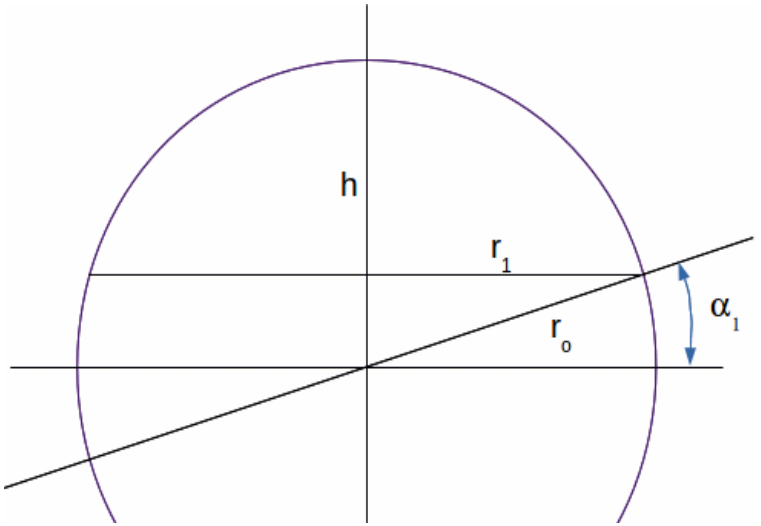
The Poli-U-Regolith expansion process inside ICRS

LUNAR "ORANGE SLICES DOME"



THE SLICE GEOMETRY

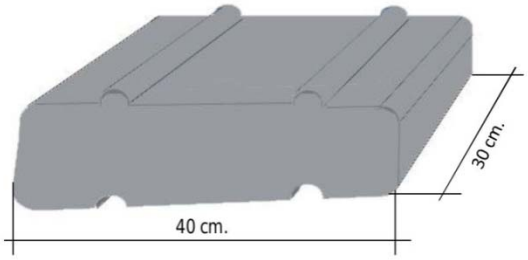


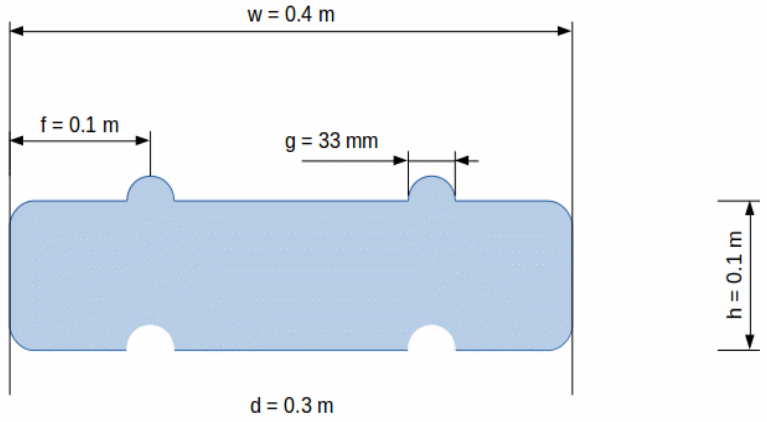


- Geometric parameters:
  - sphere radius 9.286 m
  - meridian arc length 1.3221 radians
  - slice area 49.701 m^2
  - slice volume 7.6471 m^3

Marco C Bernasconi
8953 Dietikon, Switzerland

GEOMETRIC OUTLINE: THE BASIC BUILDING BLOCK

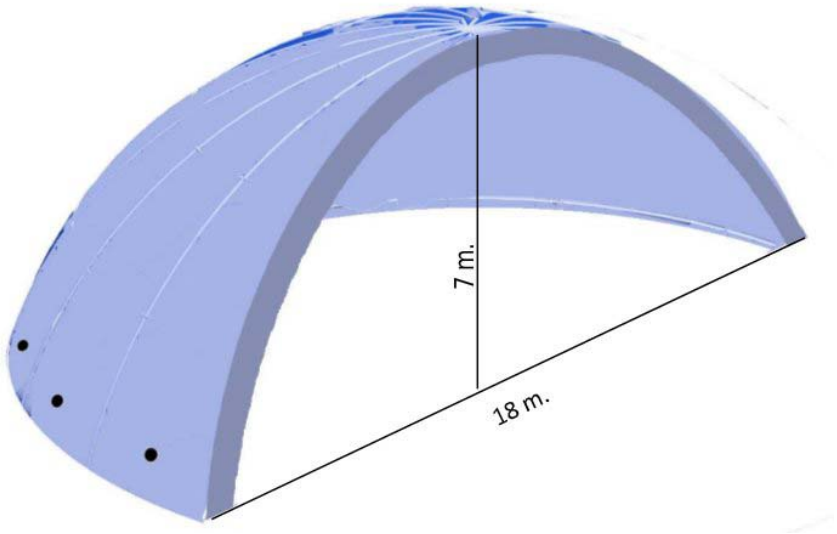




- Basically a parallelepiped with roundings on the four shorter edges, assumed having the same radius as that of the nubs and groves on the larger faces
- Geometric parameters:
  - area 0.4134 m^2
  - volume 0.0119 m^3

Marco C Bernasconi
8953 Dietikon, Switzerland

GEOMETRIC OUTLINE: THE "ORANGE SLICES DOME"

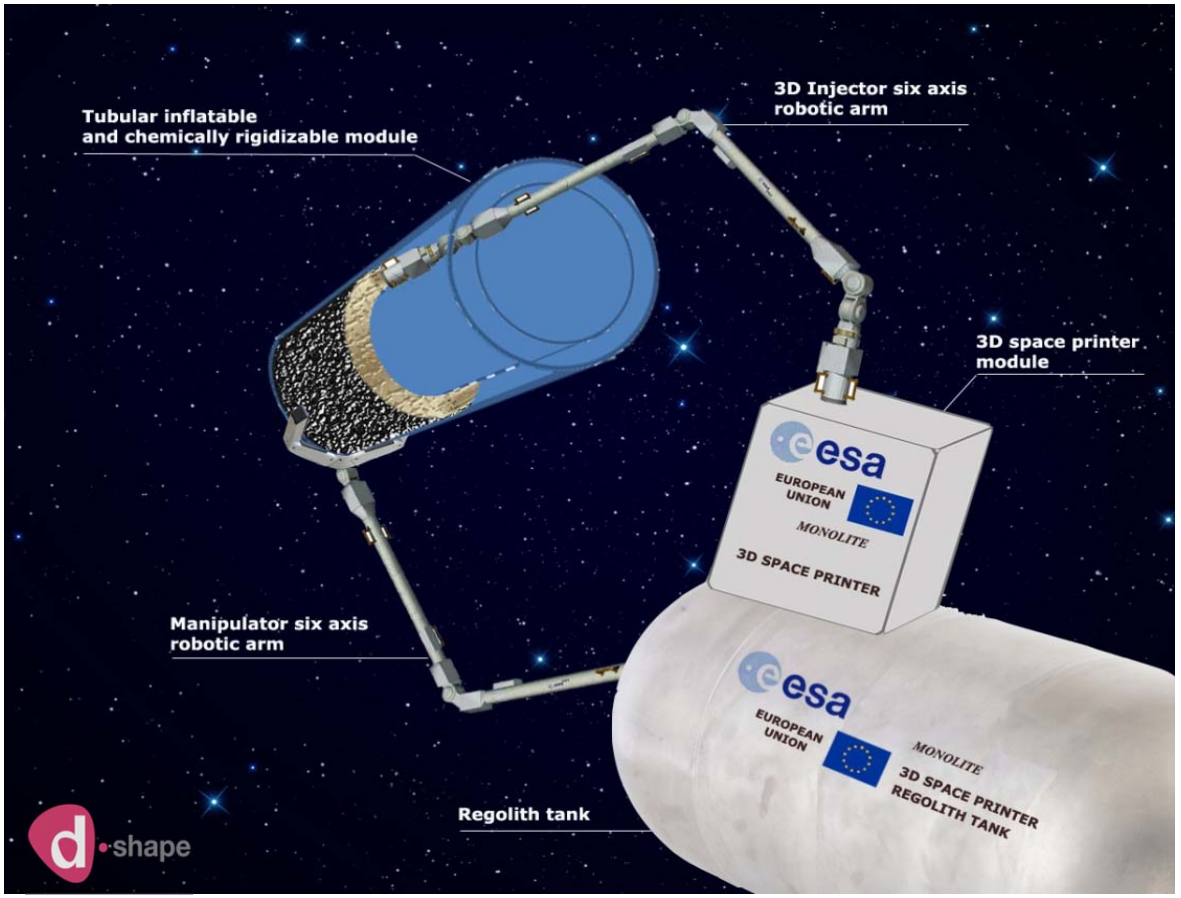


- Follows the geometry of a spherical cap
- From the subdivision of the cap into n slices results the actual modular element
- A pole hole of finite radius appears opportune for assemblying the cap – its radius was not indicated
- The meridian arc, α_o, over the cap can be estimated as:

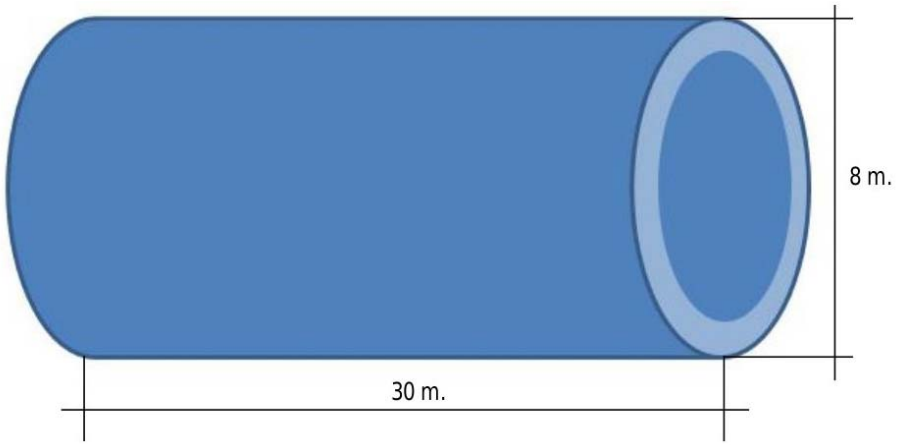
$$\alpha_o = \frac{\pi}{2} - \alpha_1 = \frac{\pi}{2} - \arctan\left(\frac{r_1^2 - h^2}{2hr_1}\right)$$

Marco C Bernasconi
8953 Dietikon, Switzerland

3D PRINTING AT ZERO G, VACUUM CONDITIONS



GEOMETRIC OUTLINE: THE ZERO-G HABITAT MODULE



- A cylindrical shell, with a wall thickness taken (conservatively) at 0.8 m
- To arrive at the required shape, m radial webs have to connect the two cylindrical membranes (not gas-tight, e.g. m = 36)
- Geometric parameters:
  - area 1393.359 m^2
  - radial webs area 864.0 m^2
  - volume 542.867 m^3

Marco C Bernasconi
8953 Dietikon, Switzerland