A Space Renaissance Project

The urban planning of the future is in space:

Lagrange Asteroid City (LAC) - Asteropolis

General Requirements Document

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Contents

1 Premises

1.1 Scope of this document

Scope of this document is to provide the general requirements of a space city, carved into an asteroid and placed in a Earth-Moon Lagrange point.

1.2 LAC realization phases

We consider three main phases:

A) feasibility study, the phase of this proposed study
B) open tendering, with the goal to select the main contractor
C) executive design, to develop the whole project and realize the LAC

1.3 Scope of the project

The scope of the proposed project is to cover the phase (A): to design the LAC and the missions required to develop it at the extent sufficient to raughly understand the overall cost and realization time.

1.4 List of revisions

Release	Date	Reasons for review
1.00	01/08/2016	First issue of this document

2 Requirements

2.1 LAC basic requirements

2.1.1 Location

The Lagrange Asteroid City shall be located at one of the Moon-Earth Lagrange point, L4 or L5.

2.1.2 Size

The size of the final LAC shall be calculated, taking into account several parameters. Such parameters shall be defined during the first phase (analysis) of the project.

2.1.3 Urban capacity

The urban dimension of the LAC should be suitable to accomodate a resident population in the order of the thousands people.

2.1.4 Artificial gravity

The LAC body shall be rotating on its axis, at a speed sufficient to generate an uniform gravity of 1G, equal to the Terrestrial one, on the internal surface.

2.1.5 Internal shape of the habitat

Compatibly with the shape of the asteroid body, the internal shape of the habitat should comply with the above artificial gravity requirement.

Therefore the internal shape of the habitat should be cylindrical.

2.1.6 Rotation axis

The whole body should be rotating on the axis of such cylinder.

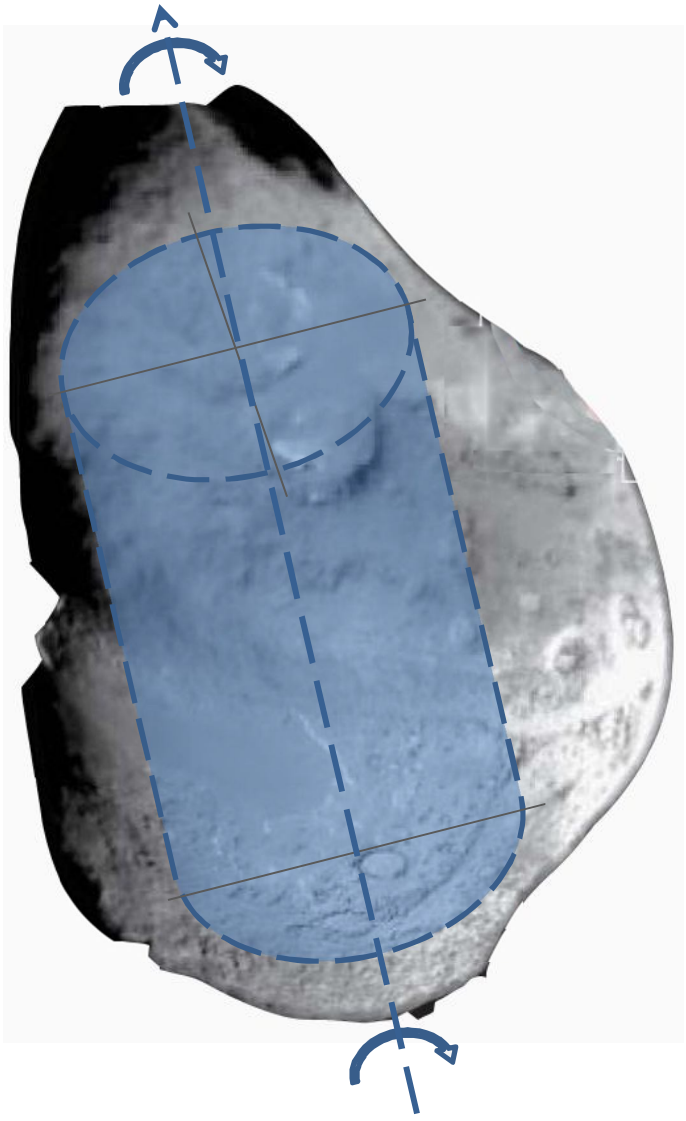

Figure 1. LAC habitat rotation concept

2.1.7 LAC habitat

The interior space shall allow to allocate a mixed habitat, including urban, rural, industrial, garden and forest environments.

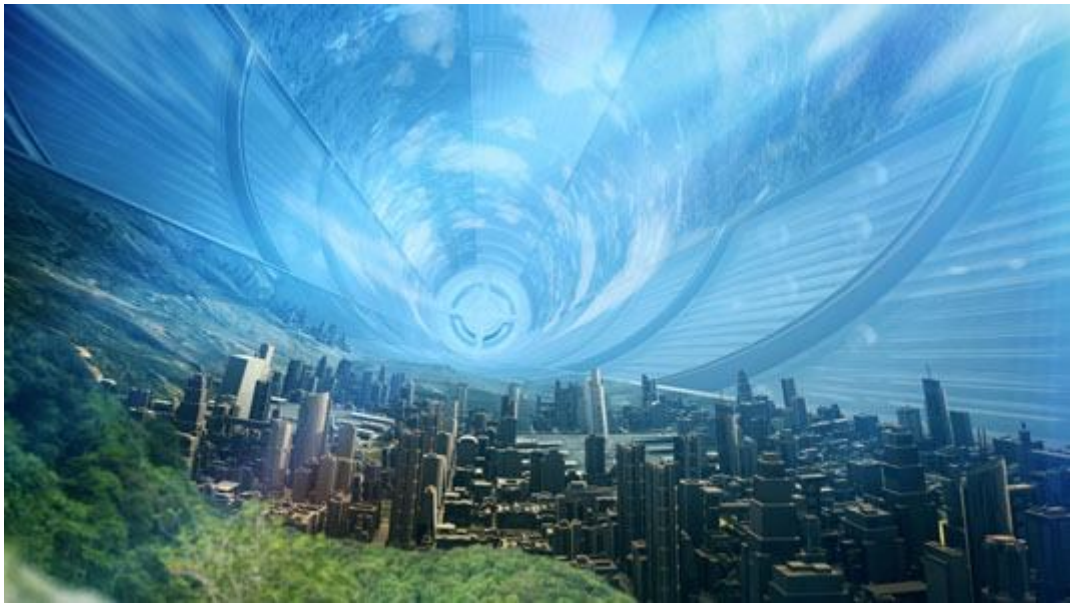

Figure 2. LAC interiors - Artistic view

2.1.8 Keeping LAC rotation

The LAC shall be kept in a constant rotation velocity, by means of proper methods, choosen during the project first stage (scientifical and technical requirements analysis). A possible method could be using solar sails, mounted on the LAC, with possibility of automated orientation, in order to keep the rotation speed constant.

2.1.9 Protection from cosmic heavy radiations

The tickness of the LAC protection wall, i.e. the remaining part between the internal cylindric habitat and the external asteroidal surface, shall be enough to downsize the radiation value no higher than the average value on Earth surface.

2.1.10 LAC power supply

The power supply system shall be based on external solar arrays, endowed with proper automation to allow 24/24 collection of solar power.

2.1.11 LAC lighting

The light inside LAC will be provided by means of optical fibres, receiving the solar light from outside, and distributing it inside the cylindrical habitat.

The lighting system should be flexible enough to allow automated parametrical day/night cycles.

2.1.12 Oxygen production and re-production

The LAC internal habitat will be pressurized with a gas mix having the same chemical composition of the Earth atmosphere.

Oxygen will be produced by:

- extraction from the Moon surface
- reproduction from forests and properly selected plants

2.1.13 Water production and recycling

The water feeded to the LAC habitat for all purposed will be extracted from Lunar poles. The water will also be recycled from draining and water purifiers.

2.1.14 Weather

Artificial rain will be programmed inside the LAC habitat, dropping water from the axis to the cylindric ground.

2.1.15 LAC structural layout

The shape of the asteroid -- similar to an oval potato -- shall be exploited to accomodate the large 1G gravity cylindrical habitat and, in the extremities, some smaller cylindrical infrastructures, as shown in Figure 3.

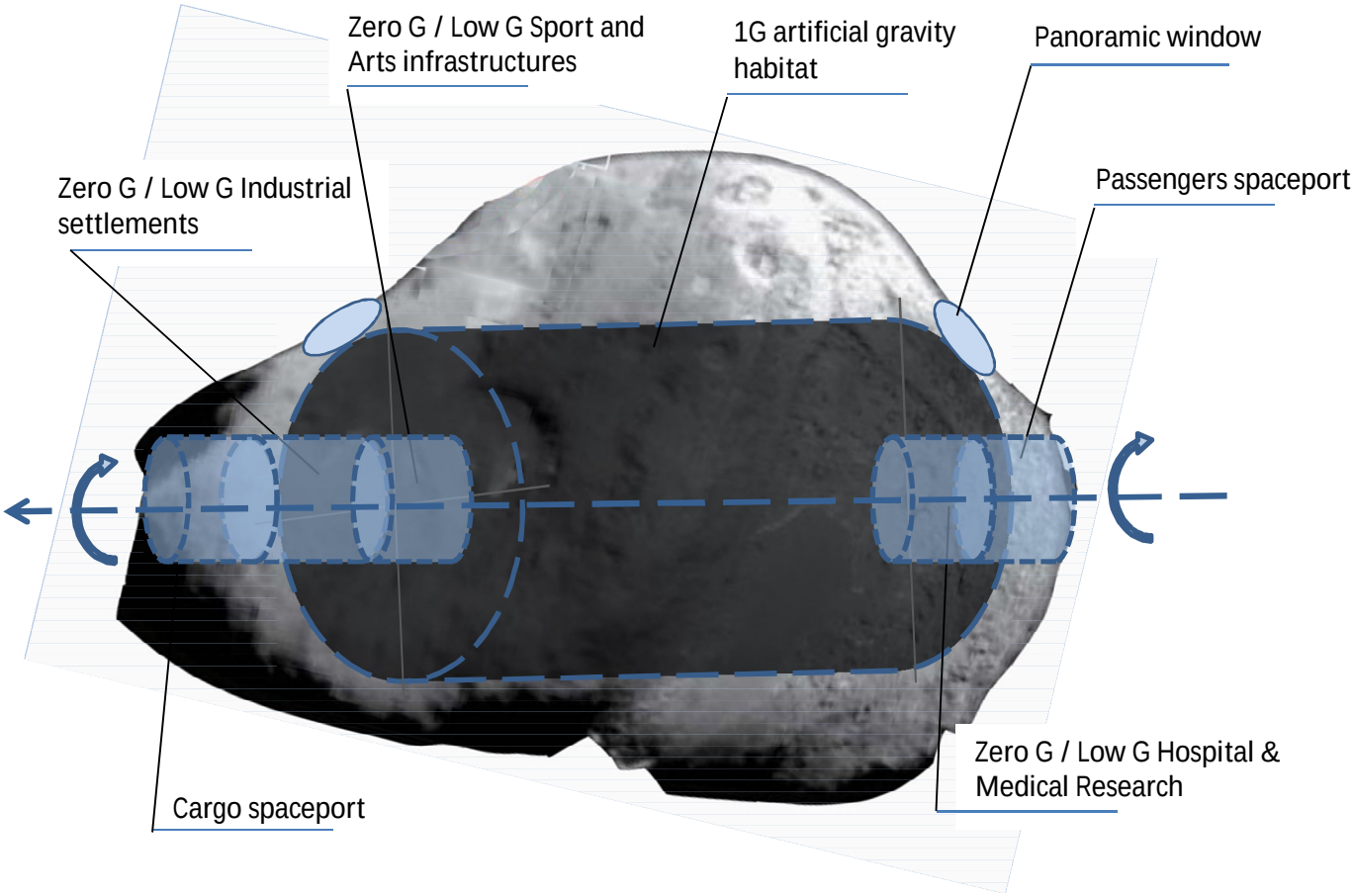

Figure 3. LAC structural layout

An initial and not exhaustive list of the infrastructures to be allocated at the extremities of the hub:

- Cargo spaceport
- Zero G / Low G Industrial settlements
- Zero G / Low G Sports and Arts infrastructures
- Zero G / Low G Hospital & Medical Research Center
- Passengers spaceport

2.1.16 Urbanistic environment

The LAC habitat shall be designed in a manner that different areas, for living, working and enjoying cultural and entertainment events will allow the LAC citizen to enjoy both their privacy and shared time.

2.1.17 Panoramic view of space

Provided that the LAC citizen shall normally live in an environment well protected from cosmic radiations, they must have the possibility to admire the vastity of space, also savoring the view of the Moon and Earth. This can be obtained by big salons, constructed on the external surface of the asteroid, endowed with big glass windows.

Such windows shall be as much as possible protected. However people will only be allowed to stay in such facilities fro a time short enough to avoid any danger for their health.

2.1.18 Zero gravity experience

Provided that the LAC citizen shall normally live in an environment endowed with 1G artificial gravity, they should also have the possibility to experience the zero G, for short periods, for scientifical purpose or just for fun.

Other scopes of zero gravity areas include sport, theatre and arts in general.

Zero gravity closed environments will be constructed, along the LAC rotation axis and on the two extremities of the rotating body.

2.1.19 Zero gravity and low gravity industry

2.2 LAC project requirements, a basic statement of work

2.2.1 A realistic representation of the LAC

The project team shall develop a realistic representation of the LAC in several ways: pictures, animated rendering, internal and external viewing and navigation.

2.2.2 Astrophysical science

The project team shall develop the basic calculations related to:

- selecting a near earth asteroid suitable to the goal, taking into account the impact on the geo-lunar gravitational environment, risks and possible mitigation
- choosing a destination location (L4 or L5)
- capturing the selected asteroid
- moving the selected asteroid to the choosen destination
- to choose the longitudinal axis, on which the habitat will be digged, and on which the asteroid will rotate
- the power required to make the asteroid spinning on the choosen axis

- any other required calculation and design item, from the astrophysical point of view

2.2.3 LAC cost of development

The project team shall provide basic calculation of the overall cost of development, including all the activities, missions and materials.

2.2.4 Raw materials procurement and processing

The project team shall provide a realistic forecast of the needed raw materials and where to procure them. Keeping in mind that a huge amount of materials will result from the escavation inside the asteroid, and should be used as much as possible for the building of the internal infrastructures and habitats. The reamining unused part, if any, shall be parked in a choosen orbital “warehouse” or on the Moon surface, for future uses.

2.2.5 Systems, equipments and machineries to be produced in situ

The project team shall provide a realistic forecast of the equipments and machineries to be produced insitu by means of additive manufacturing and 3d printing

2.2.6 Systems, equipments and machineries from Earth

The project team shall provide a realistic forecast of the equipments and machineries to be carried from Earth. Basically: 3d printers, escavators, inflatable habitats to accomodate the technicians, all parts and machines that cannot be 3D printed in situ.

2.2.7 Overall mission plan

The project team shall provide a realistic all inclusive plan for the development of the project.

Considering the three phases of the LAC realization, the project team should develop the following phase A documents, at least:

1) LAC design scientific calculations
2) LAC missions calculations
3) From Earth systems, equipments and machineries design, development, construction and testing
4) Design: urbanistic environment
5) Design: civilian infrastructures: water supply, energy supply, waste waters management, recycling plants, oxygen production
6) Design: astro-port, cargo bays, passengers transit
7) Design: space vehicles assembly and maintenance
8) Design: industrial settlements for raw materials processing and production of powders for additive manufacturing
9) Design: additive factories
10) Design: farming and breeding
11) Design: facilities for sport and entertainment, 1G and 0G arts and sports
12) Design: engines to be applied to the asteroid for moving it to destination
13) Design: facility to be settled on the asteroid to extract fuel from the asteroid itself
14) Mission: asteroid capture and transport to destination, starting from Earth
15) Mission: asteroid exact positioning and rotation kick-off
16) Mission: transportation of equipments and personnel from Earth to the destination

3 The project team

The project team shall be composed, in number and quality, by different profiles. At least:

- Astrophysicians
- Astronautic engineers
- Mechanical engineers, with particular mention to additive manufacturing
- Electronic engineers
- Computer science engineers
- Civilian engineers
- Psychologists
- Urbanists
- Architects
- Anthropologists
- Sociologists
- Economists
- Philosophers
- Forestry scientists
- Exo-biologists
- Agricultural scientists
- Movie directors
- Computer graphics experts