

Landing sites and settlement infrastructures for Lunar exploration

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Abstract

The selection of a landing site on the Moon is a complex issue because it will imply a long-lasting and permanent occupation. The landing site will have to cope with a large number of surface operations.

1. Introduction

The exploration of the Moon will be achieved by a strong and efficient human presence on the surface. This human exploration will consist of a permanent Lunar base (mimicking the ISS experience) and several outposts for the exploration of the surface. Selecting a landing site to construct a permanent base is a complicate task because it is necessary to keep in mind the large number of issues involving, among the other, personnel safety, resource availability, mobility, etc. Moreover, it is necessary to base the selection on the type of operations that must be performed. Therefore, it is of paramount importance to have a clear idea of the logistic, the scientific goals, the technological developments and the type of operations.

2. Surface operations

Several scenarios can be adequate for the establishment of a human settlement. However, it is probable that the first goal of the Lunar exploration is science. This goal is also complex because some sub-goals such as geological studies of the surface and subsurface, observation of the Universe, and observation of the Earth and its nearby space. Several other goals can be envisaged such as the human physiology in the space and in low-gravity bodies. In-situ resources are also an important item useful for the future exploration of more distant bodies, as well as increase the exploration capability by monitoring the infrastructure and their maintenance. However the most demanding operations are those that involve long outdoor activities (EBA: Extra Base Activities).

3. Landing site

The selected landing site must be selected bearing in mind that the locale will be the site of a long-lasting base. Most of the permanent base in remote areas of the Earth have been constructed according the experience acquired from short-term explorations. The area must be flat with a rather large open space for further development. Construction material, mostly the one for shielding, from space radiation must be readily available and the presence of lava tube for temporary shielding would be greatly welcome due to the efficient shield capability. The locale must have nearby launch and landing pads at a safe distance from the other infrastructure. The area must display geological feature suitable for the production of resources such as oxygen, hydrogen, water, etc. Transportation of the ore require large, sturdy and smooth ways. The locale must be also well connectable to the surrounding regions for exploration activities and maintenance of the remote infrastructures such as radio antennas or telescopes.

4. Exploration scenario

The base will be located in an area central to the scientific exploration and resource availability. Long-lasting itineraries will be performed with a manned rover. Outposts will be available for shelter and emergency. Several operations may require the transport of heavy equipment and a unmanned rover aid must be taken into consideration.

5. Moon analogue test of operations

Test of the infrastructures, operations and end2end mission can be performed in Moon analogue Terrestrial environments. A long-term campaign must be envisaged to increase efficiency and, mostly safety