18 – The InstaBase Concept

SUMMARY

The InstaBase concept is simply an initial base composed of inflatable modules all connected together. As a compacted payload, it would be lowered from a Starship to a vehicle that would transport it to a robotically prepared site. Setting it up would be a simple matter of inflating it with condensed air. The InstaBase would be either an alternate to StarHab or an intermediate phase between StarHab and the International Lunar Base. SpaceX has rendered an inflatable base looking very much like the InstaBase.

When the first permanent crew arrives on the Moon, what sort of habitat will they live in?

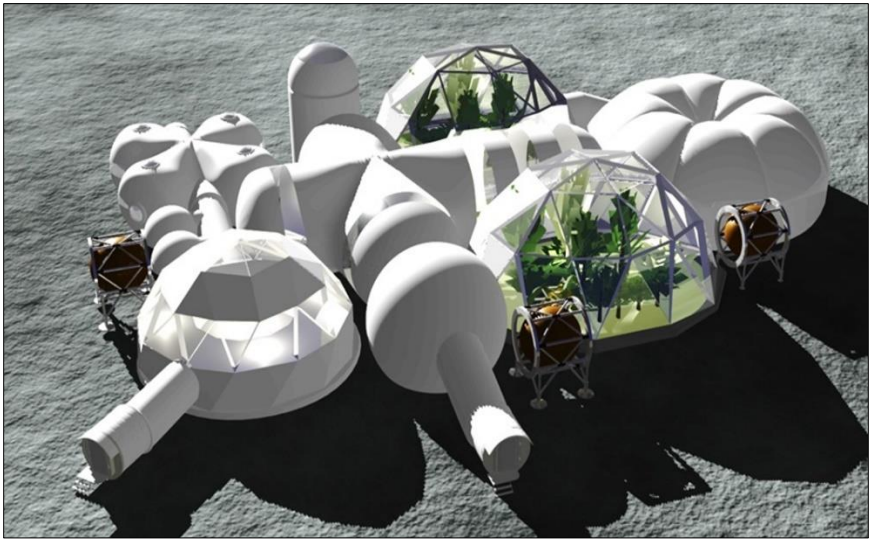
INTRODUCTION

The name InstaBase comes from the concept of an inflatable base that can be set up very quickly simply by opening the valve on a tank containing liquified air. It contrasts with other construction concepts that take a great deal of time and energy assembling habitats using local resources.

The InstaBase is proposed as an alternative or an immediate follow-on to the StarHab concept where an Initial Permanent Crew would reside for six to twelve months in a small but fully functional base. It would precede the very large specialty habs and so would not be replicated in large numbers. Both the StarHab and InstaBase concepts are equally applicable to both the Moon and Mars.

Although the Space Development Network came up with the InstaBase concept several years ago, we are pleased to see SpaceX has apparently conceived of a very similar concept as evidenced by their artistic rendering of a very similarly sized, inflatable concept during their Starship test launch #9 pre-flight show.

Please see Chapter 19 where the pros and cons of inflatable habitats are discussed.



Artist rendering of the instaBase.

COMPARISON WITH OTHER HABITATS

Why is the InstaBase a preferred base option for the Initial Permanent Crew? Here, we'll go one by one through the other options.

StarHab - StarHab (horizontalized Starship habitat) is a perfectly good alternative to the InstaBase. But later we will be moving on to very large, inflatable specialty habs which would constitute the initial habitats for the International Lunar Base. The volume of the InstaBase was sized for an Initial Permanent Crew of eight. As a result, it came to about 2,500 cubic meters which coincidentally is almost the exact volume of the StarHab after the propellant tanks are vented, cut into, and set up for habitation. However, if we wanted to increase the size of the InstaBase, the payload mass of the Starship would allow for it to be even larger.

Aluminum Cylinders - We have a lot of experience with aluminum cylinders on the ISS. So, there's that. But assembling a large base with numerous cylinders would require a corresponding numerous launches and hence price. At this point, if we were to launch a Starship next to the ISS and utilize its propellant tanks for habitable volume then it would have 2.5 times the internal volume of the ISS in a single launch! Just because we did things a particular way before doesn't mean that we have to continue that same approach. Capabilities are moving forward and so should we.

3D Printed Habs - As discussed in some detail in the Specialty Hab chapter, 3D printed habs have significant disadvantages compared to the inflatable InstaBase. Time for construction, large power requirements, risk of equipment breakdown, safety issues when not using the best materials, and lack of off-Earth experience all make this option not a realistic probability.

In Situ Produced Habs - Habs produced from locally produced metals or bricks suffer similar disadvantages to 3D printed habs. Let's just leave it at that.

Lava tubes - Very popular in some quarters is the idea that the best first location for a lunar base would be within a lava tube. The advantages include natural shielding from micrometeorites, radiation, and thermal extremes. All true. However, there are no known lava tubes near the lunar south pole where the very valuable Peaks of Eternal Light (PELs) and permanently shadowed regions (PSRs). This includes having to deal with the 14-day night when one has a base away from the poles. In the shielding section of this chapter, it is shown how providing sufficient shielding to any initial habitat is not particularly difficult.

UniHab - This concept preceded the InstaBase concept. Both have roughly the same internal volumes for each habitat section but the UniHab (as the name suggests) is a unified habitat where all of the sections are rooms within a single structure. The overall structure is shaped like a thick pancake with a roof held flat by internal walls and tethers. The diameter of the UniHab is 36 meters with an indoor centrifuge of 15 meters diameter. It was specifically sized to accommodate an Initial Permanent Crew of eight composed of four couples. With a relative flat (air mattress-like) roof, the UniHab can be unfurled via inflation, deflated flat, and the robotic tractors could push regolith onto the top of the UniHab which would then be inflated thereby easily lifting the regolith shielding via enormous air pressure. The tractors could then push regolith on the sides thereby providing complete protection. But the reason why our Network moved on to the InstaBase concept is because the end result would be a flat mound of dirt not "worthy of a great nation". In other words, aesthetics won out. But from the standpoint of ease of shielding, the UniHab is a bit superior. And also, to construct our own, full-scale mock-up of such a base, it would be eminently easier to compose if of individual modules rather than have to roll up and pull the entire base into a trailer in one move.

DELIVERY AND SET UP

The InstaBase would be delivered to the lunar surface as a standard payload in a Starship and lowered to the ground. Surface vehicles would transport it to a spot where robotic tractors had pre-prepared the surface. The straps on the InstaBase package would be cut and small amount condensed air would very quickly inflate the InstaBase giving it its final shape but at significantly less than the final 1/2 atm. Robots would drive around the periphery and anchor the edges of the InstaBase's floor to the ground using ground anchors. The InstaBase would then be inflated to the final 1/2 atm.

SHIELDING

Teleoperated robots with a stacking conveyor would pour regolith into holes at the top of each module. These holes would be propped up via large springs. The regolith would slide down between the outermost layer and the inner layer of each habitat. Tethers would maintain a consistent width between the inner and outer layers. A device within the habitat would vibrate the air inside to vibrate the inner wall thereby facilitating the regolith to slide between the two layers of the wall. The result would be a layer of regolith of a consistent width providing shielding against radiation, micrometeorites, and wide thermal swings.

DESIGN

The InstaBase is a conceptual design to accommodate an Initial Permanent Crew of eight. More professional improvement of the design is welcome. The habitats involved with crew living were sized to rooms within a typical house with common areas sized for up to eight people. There are four bedrooms and two bathrooms. The GreenHabs were sized to provide for the full nutrition needs of the Crew of eight using work done at the University of Arizona (Tucson) Prototype Lunar Greenhouse. The centrifuge diameter is somewhat arbitrary. Obviously larger is better but there has to be a reasonable limit. A lookout town is mostly an aesthetic design choice.

MODULES

The InstaBase would be composed of 10 attached modules including:

- BedHab
- BathHab
- LivingHab & Kitchen
- The Bubble
- ArtsHab
- The Tower
- WorkHab
- GreenHab1
- GreenHab2
- SpinHab
- StorageHab
- The Garage

- **Living Quarters -** The BedHab would have four bedrooms, each with a king-size bed for a couple. There would also be the typical furniture in a bedroom. The BathHab would be composed of two bathrooms allowing different couples to utilize the facilities at the same time. The Kitchen would have everything that you would expect in a home kitchen but scaled up for eight people. In an overhead track would extend robotic arms that could help with food preparation thereby offloading cooking workloads. Above the kitchen would be the Livingroom where all eight crew could sit in couches and other furniture with a large screen for entertainment or communicating with Mission Control as a group. It would also be the room where board and floor games would be played. Extending from the Kitchen is a clear tube leading to a clear sphere. Two people could "exit" the InstaBase and stand in this sphere while still in the InstaBase's environment. In this way they could "go outdoors" without having to suit up.
- **ArtsHab / FitnessHab -** The ArtsHab would be a dual-purpose facility. Normally portable exercise equipment would be there. But on occasion, that equipment would be moved into neighboring modules to clear the floor. At that point the ArtsHab would turn into a PlayHab for things such as music and dance. The ceiling of the ArtsHab is a hemisphere. With "sticky" footwear, crew could run up the walls and even across the ceiling as part of their gymnastic or dance routines.
- **WorkHab -** The WorkHab has several different wings. The largest wing is for machining with a set of equipment to machine block of metal and work with sheet metal as well. Another wing would be dedicated to chemistry processing including organic chemistry using the organics extracted from ice in the PSRs. The GeoBio

wing would house animals used in the centrifuge studies and well as receive, store, and process rocks brought in by robots. Finally, the last wing would be for robotic assembly and repair. Specifically, some of the large

- **GreenHabs -** As mentioned above, these large modules are specifically sized to provide the full nutrition for the IPC on an ongoing basis. This volume of plants also can process the air and water needs for more than the crew of eight.
- **SpinHab -** This would contain a spinning cylinder with four rooms allowing crew to comfortably experience a full gee provided that they are conducting "sedentary activities" where they are not moving their head -- think of screen time. It would also be used to conduct animal experiments for the artificial gravity prescription (AGRx) for healthy gestation and childhood.
- **The Tower -** Crew could easily climb up in this lookout to windows and view more distant locations.
- **Storage Hab -** Certain food items, spare parts, and produced parts would be stored here.
- **The Garage -** Although not part of the current design, a garage with a large airlock could allow autonomous vehicles to be brought into the InstaBase so that they could be cleaned, repaired, and even assembled in a short sleeve environment.
- **Tanks -** There would be several tanks for fluids located at certain locations around the InstaBase. This would include tanks for water, nutrient solutions, waste, CO2, etc.

OUTDOOR SPACES

- **Air Locks -** Strategically placed around the base would allow ingress and egress. They should also allow for crew vehicles to attach to the InstaBase.
- **Metallurgy -** A purely outdoor area somewhat away from the InstaBase is where teleoperated robots could conduct metallurgy. Alternatively, the metallurgy work could be done next to the Parabolic Drapes. Read about metallurgy in Chapter 29.
- **Walkways / Driveways -** Microwave sintering could create dust-free paths by fusing together the regolith. This would allow limited EVAs in spacesuits without the risk of exposing the suits to the abrasive regolith.

PROGRESS

The Space Development Network has constructed a full-scale mock-up of the InstaBase to illustrate the concept. Using inexpensive sheet plastic and a high school gymnasium we assembled the entire base measuring 30 m x 52 m (100 ft x 170 ft). We have conducted displays to the community and at that National Space Society's annual ISDC conference.

The Network's inflatable InstaBase mock-up and SpaceFair.

To take it to the next level, professional space architects would need to completely redo and improve the design. Our concept serves as a conceptual starting point.

Download a file to print your own papercraft version of the InstaBase.