Re: How would you connect two space stations?

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From: William Mook (*william.mook_at_mokindustries.com*)
Date: 02/18/05

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Date: 18 Feb 2005 08:04:46 −0800
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Imagine a transparent spherical structure made ofa stationary glass bubble. This glass is blown from silicon oxide and sodium carbonate with a blowing agent in zero gee from asteroidal feedstock using a solar furnace.

Once the glass bubble is blown to sufficient size and appropriate thickness, it is 'tapped' with access ports at its 'poles' and evacuated of the blowing gas (carbon dioxide generated from an oxide reaction).

Materials are inserted through the access ports and floated down to the interior of the glass bubble.

The final materials brought to this stationary pressure vessel is are aluminum air locks − connected with an aluminum structure − which inserted in the access holes.

The sphere is pressurized with an oxygen/nitrogen atmosphere at this point to create a shirt−sleeve environment.

The materials placed on the interior of the glass pressure vessel are erected into a strip magnetically levitated strip covering half the interior surface. The stationary portion of the strip facing outward through the glass is covered with solar cells which power the strip. The moving portion of the strip, facing inward away from the glass, is moved by solar power, accelerating to a speed necessary to maintain the desired gee forces (0.5gee in this case)

There is a region between the stationary (or nearly stationary) pressure vessel and moving band that consists rings that move with gradually increase speed − the difference between each band speed is about 2 kilometers per hour − the speed of a moving sidewalk. This set of moving bands operates in a way very similar to the 'slidewalks' in Issac Asimov's stories and in Robert Heinlein's short story "The Roads Must Roll" with each band moving slightly faster than the previous band.

One may float from the zero gee portion to a slowly moving band, and then navigate from band to band in an easy manner as speeds and gee forces gradually increase − until the wide central band is reached.

This allows for constant traffic between the stationary and moving portions of the 'station' and with clever design provides for air circulation and a number of other features.

Another method of navigating between the rotating and non rotating portion of the station would be some sort of small aircraft that had an operating speed that exceeded the speed of rotation at the station's moving periphery. In this case a person could have a small aircraft at their home in the moving section of the station, and take off, navigating first to cancel the motion of the moving band, and then landing on any portion of the moving portion of the station.

So one could walk to their destination or fly. When taking a vehicle it will also be possible to fly out of station through one of the airlocks mentioned previously. An aircraft could seamlessly dock with a more energetic rocket propelled stage on its way through an automated airlock the served the station to avoid hazardous accumulations of rocket propellants within the pressure vessel.

One can also imagine a solar powered continuous airlock that operating like a rotating door. Outbound sections would automatically depressurize and the gases removed would be used to automatically re−pressurize inbound sections of the airlock. That way, continuous traffic could be maintained with space outside the pressure vessel as well.

Leakage along the moving seams would have to be made up on a regular basis, but in a high−traffic situation this materials that would be made into make−up gas would be a very small portion of the total traffic volume.

Putting numbers to this general picture we can imagine a stationary bubble 1,000 meters in diameter. With an atmospheric pressure of 101,325 pascals the total pressure exerted by the air would be around;

F = pi * r^2 * p

where pi = 3.14159
r = 500 m
p = 101,325 pascals

F = 79,580,468,906 Newtons

http://www.engin.umich.edu/students/support/mepo/ELRC/me211/flash2/spherical_02.swf

The thin wall stress is given by;

sigma * 2 * pi * r * t

Where sigma = tensile strength of bulk glass is 0.487 GPa.
pi = 3.14159
r = 500 m
t = unknown

Solving for t;

t = F/(sigma * 2 * pi * r) = 5.2 cm

This is 163,361 cubic meters of glass − so this gives us the size and mass of the original oxide powders that must be blown into a 1,000 m diameter sphere.

Now rotational motion exerts an acceleration amounting to;

a = v^2 / r

and r=426 m (average between 363.5 (rim) and 500 (center)

while a = 4.91 m/sec/sec

so, we can solve for V of the band

V = sqrt(a * r) = 46.73 m/sec −−> 164 kph

(about 100 mph)

So, if each band increased in speed by 2 kph, you'd need 82 bands to accelerate to this speed. If each band were 2 m wide the set would cover 164 meters along the circumference of the sphere. If the central band started at 45 degrees − measured from the nearest airlock/pole − then 164 meters would traverse 18.8 degrees − so, the first 2 kph band would be positioned 26.2 degrees from the pole.

If the band were cylindrical in nature, and didn't follow the pressure vessel wall, it would have a radius of 363.5 meters and the velocity to attain 4.91 meters/sec/sec would be

V = sqrt (4.91 * 363.5) = 42.25 m/sec −−> 152 kph

This would permit space under the cylindrical band for stationary equipment that kept the band moving, it would also provide for a constant gee force and direcdtion across the band. There would also be fewer transition bands needed since the speed is also lower. The area would be less than following the pressure vessel wall though.

Light would be available through the glass bubble, additional light could be reflected through the glass in concentrated form and expanded by appropriate optics − if needed.

Small areas of solar collectors operating at high intensity could be
placed in the high concentrated light source to provide power and heat
if needed as well.

Michael Smith wrote:
> *On Fri, 18 Feb 2005 05:08:44 GMT*
> *"Mike Rhino" <october2003@alexanderpics.com> wrote:*
>
> > *Suppose you wanted two space stations, one with zero g and one with*
.5
> > *g with regular traffic going between them. Should they be*
connected
> > *together and how? When people move about within a space ship, that*
> > *changes the center of gravity. The spinning ship may have a wobble*
> > *which would cause a problem with rigid connectors. Slightly*
flexible
> > *could work. A connection would allow you to send power from zero g*
> > *solar collectors to a spinning ship.*
>
> *If the zero G platform is built strong enough to take some gravity*
(the
> *ISS is not) then it could be carefully coupled via a bearing to the*
> *rotating structure. The rotating structure could be trimmed by*
pumping
> *water around the rim.*
>
> *A better option would be to rotate the (near) zero G structure but*
keep
> *it close to the axis so gravity is low.*
>
> *Or you could use gravity gradients to provide gravity on an elongated*
> *station, and part of it will be in microgravity.*
> --
> *Michael Smith*
> *Network Applications*
> *www.netapps.com.au | +61 (0) 416 062 898*
> *Web Hosting | Internet Services*