

# ME MS Journal

Brian Fehrman

August 16, 2012

## 1 8/15/2012

Types of orbital debris include: broken spacecraft, upper stage launch vehicles, intentionally released debris from missions, debris resulting from impacts, paint flecks, etc.

Over 21,000 objects larger than 10cm (softball). Around 500,000 particles between 1cm and 10cm (larger than marble). Over 100 million pieces smaller than 1cm (not trackable).

[1]

More than 100 billion meteoroids larger than 1 microgram enter the earth's atmosphere daily with speeds greater than 11km/s.

Smaller sized meteoroids in the micrometer range are estimated to travel around 60km/s. Whipple bumper can protect from collisions up to 18km/s.

[2]

## 2 8/16/2012

Shielding technology exists, so called Whipple Shields and variations of it. Also called meteor bumpers. Help to break the larger debris into smaller debris clouds. Not perfect, some debris will still make it to the main structure and can cause damage in the form of abrasions, cracks, and even craters.

[side notes]

Access to these structures is difficult, costly, and dangerous. Repair missions will inevitably leave behind more debris which will increase the likelihood of future damage to the structure being repaired as well as other structures.

[end side notes]

[3]

Much attention has been given to enhancing the self-healing within concrete using multiple methods.

[4]

Coatings have been made using epoxy resin filled microcapsules. These coatings were tested on cold rolled steel sheets and found to have good results.

[5]

White, Moore, and Sottos were the first to demonstrate the self healing concept less than 10 years ago. Self-healing polymers mimic biological systems which respond to damage. These systems recover mechanical function by remending original material and or polymerizing stored reserve material.

[side notes]

This Lee2009 article is what talks about the strong motivation for self healing materials in the recent times.

[end side notes]

[6]

## References

- [1] NASA. Orbital Debris. [http://www.nasa.gov/mission\\_pages/station/news/orbital\\_debris.html](http://www.nasa.gov/mission_pages/station/news/orbital_debris.html), March 2012. [Online; accessed 15-August-2012].
- [2] Sigrid Close. Shooting Stars Can Shoot Down Satellites. <http://spectrum.ieee.org/aerospace/satellites/shooting-stars-can-shoot-down-satellites/2>, April 2010. [Online; accessed 15-August-2012].
- [3] NASA. Hypervelocity Impact Technology. <http://ares.jsc.nasa.gov/ares/hvit/index.cfml>, August 2012. [Online; accessed 16-August-2012].
- [4] Min Wu, Bjorn Johannesson, and Mette Geiker. A review: Self-healing in cementitious materials and engineered cementitious composite as a self-healing material. *Construction and Building Materials*, 28(1), 2012.
- [5] Yang Zhao, Wei Zhang, Le ping Liao, Si jie Wang, and Wu jun Li. Self-healing coatings containing microcapsule. *Applied Surface Science*, 258(6), 2012.
- [6] B.L. Lee. Multifunctional design perspective for self-healing and autonomic response. Final Program and Abstract Book 2nd ICSHM - 28 June - 1 July 2009.