Solarpunk Building Materials

As we've said elsewhere, solarpunk buildings should use materials appropriate to their surroundings. Climate, weather (including rainy seasons, severe heat, long winters, etc), threats to the structure (such as insects and mold), and available materials should all be a factor, as should the needs of the community - perhaps importing an advanced material from further away will allow a structure to last and cause less harm than rebuilding it regularly.

The following is a far-from-exhaustive list of materials and building styles you may want to include depending on your setting:

Salvage

Few solarpunk stories seem to take place in 'clean slate' settings like space colonies (though some great ones absolutely do!), and if anything, a solarpunk society on earth would probably strive to preserve intact habitats and do less greenfield construction than our present day one. So it's likely existing buildings would see a fair bit of upkeep and modification, if only because they already exist and the resources to build them have already been spent.

But there are plenty of circumstances where maintaining a building or bringing it up to modern standards isn't worthwhile, and deconstruction makes more sense. Deconstructed (and even demolished!) buildings can yield all sorts of useful building materials, depending on the structure's condition at the time, and the care with which it's taken down. Generally this is a less cost-efficient source of materials than extraction from raw sources but part of that is because our current society has had a lot of time to iterate and improve on logging, mining, and other extractive fields - a solarpunk society might get equally good at deconstruction. And there are a few advantages: deconstruction sites/sources of salvaged material are almost guaranteed to be much closer to the places they'll be reused, and these materials are generally retrieved in a much more ready-to-use state. For example, dimensional lumber pulled from a stick-frame house might have some extra nails stuck in it, but it's already cut to size and will be easier to work down than a green tree, which must be cut down, transported, milled to rough dimensions, dried, possibly treated with preservatives, milled to final dimensions, and transported again.

Ideally, a deconstructed structure should provide every building material used in its construction, but realistically there are going to be limitations. Shingles (asphalt roofing shingles or wooden siding shingles) are going to be basically impossible to remove intact. Some forms of insulation (especially old stuff like newspaper, sawdust, or asbestos) won't be worth reusing and may even necessitate hazardous materials disposal. Horsehair plaster can be extremely fragile and probably wouldn't be worth reusing even if it survived removal, transportation and storage. Even modern sheetrock will be a pain to salvage. Some wood will be rotten or infested with ants, termites, or other insects. Wiring and plumbing will take a lot of inspection and some careful documentation of original use before it's considered safe to reuse, and many folks will be (not unreasonably,) reluctant to use reuse it even then. Even brick and concrete can be damaged by the elements.

That said, a tremendous amount of construction supplies, from doors and windows, to lumber and plywood can be obtained, saving both the materials and avoiding transportation and wasted space in a landfill. To get an idea of the sheer scope of materials, hardware, and *stuff* which might be salvaged, here's a few real life businesses which wholesale recovered materials:

- https://junkyardsnearme.net/building-material-salvage-yards-near-me/ - this one has some good

photos of salvage yards
- https://www.habitat.org/restores/find-donate-building-materials-habitat-restore
- https://www.rebuildgreen.net/services/salvage-and-material-resale
- https://www.seconduse.com/inventory/ - this appears to be an inventory of thousands of items from bowling alley parts to cabinet doors to light switch covers
- https://thereusepeople.org/shop/page/11/

Even concrete slabs can be cut up to produce new building materials or reused in creative ways! This is huge as concrete rubble accounts for 25-30% of solid waste in landfills.

Concrete rubble can also be reused in other ways, such as in landscaping. There's also a rich history of cobblestone buildings where concrete rubble may be a suitable replacement for stone.

Geopolymers

If you're looking for a drop-in replacement for Portland Cement (which is used to produce the vast majority of our built-up concrete environment) then you probably want Geopolymers. The concrete industry is a huge portion of human CO2 production today (around 8% total), due both to the release of CO2 from the chemical process of baking the limestone, and from burning fuel to produce the tremendous amounts of heat necessary for that reaction.

Geopolymer is a fairly new material/process which uses a different chemical reaction to turn a mix of powders and water into a solid block of stone. It's seen some real life use and a lot of testing, and appears to cover all the uses of concrete, and to actually surpass it in some areas. Further, it's almost carbon-neutral, and repurposes industrial waste as a primary ingredient.

One thing to track is that geopolymers require a source of calcium aluminate. This can be Metakaolin (which would require mining) but there are a variety of industrial wastes which can provide this ingredient just sitting around poisoning huge swaths of land. Removing these waste heaps and safely containing them is absolutely something that should be done (for both the surrounding habitats and any neighboring people) but is often such a huge and expensive undertaking that it isn't done at all. Turning these waste products into a useful *input* for construction materials would enable Superfund-style cleanup and disposal with the safe disposal half of the work already guaranteed. It's a win-win.

Using them to produce geopolymers would be a win-win which produces our built environment while also providing containment for

- Blast Furnace Slag
- Electric Arc Furnace Slag
- Fly Ash
- Palm Oil Fuel Ash - left over from the burning of palm shells and husks and fibers in the production of palm oil (the industry has issues, but it seems like it could be done sustainably).
- Quartz mining tailings
- Sewage sludge
- Mineral wool waste -this compliments urban farming as mineral wool is a waste product of hydroponics, as well as used for housing insulation.

The base materials are very common on Earth and the number of possible sources are remarkable, with more or less levels of energy in processing.

The Differences:

Even if you haven't poured concrete yourself, you've probably noticed that for big construction projects, concrete is usually mixed at a factory a couple hours drive from the work site and delivered by caravans of cement trucks. This would change with Geopolymer. Compared to concrete geopolymer hardens very rapidly and so would often be mixed for use on-demand at the work location even at a relatively large volume. So you would have a pre-mix of the dry ingredients then an on-demand liquid mix of water, alkaline 'activator' (sodium silicate waterglass –usually pre-diluted with water as it's physically heavy and can be very viscous, but also shipped as a powder), and 'hardener' (sodium hydroxide). The fluids might be premixed together or added individually, the water content adjusted according the latent moisture in the aggregates and the work site (like traditional concrete geopolymer can be poured and cast underwater).

From a visual standpoint, there's probably not much to see with geopolymer production because of the simplicity. It's basically just a measured mixing process. And that work could be done in most any conventional industrial building or workshop. The huge roaring, rotary kilns used for Portland cement would be unnecessary, though some application of heat may be necessary depending on the source ingredients being prepared. This prep would probably be done near whatever heap of industrial waste is being used, because it's more efficient to transport refined materials than crude materials.

Why haven't we switched over already?

Some jobs have! The biggest real-world use I've found so far was an airport in Australia but the companies specializing in it have plenty of other projects to brag about.

The big difference is financial cost and inertia. Portland cement has been around for a long, long time, and the industry has had a lot of time to make improvements to their processes to drive down cost. It's also a known factor - civil engineers tend to appreciate consistency and Portland cement is a very well-understood material. They have entire books on its performance and limits in various conditions, and procedures for mixing, transporting, and pouring it in just about every circumstance you can imagine.

That institutional familiarity isn't there yet with geopolymers, so choosing to use it in a project probably feels like a risk.

That said, a solarpunk society is likely one that actually tracks its externalities and tries not to produce waste it can't account for, and once you factor in the true costs of Portland cement, the mining, the transportation, the CO2 production, geopolymers are a rather straightforward replacement.

Regional Options

The rest of these materials/processes are going to be much more regional - a material that's easy to make and lasts a long time in a hot dry climate might not make sense in a place with monsoons, etc, so consider the climate, weather, available materials, and other conditions in your setting as you look through these.

Cob

Cob is also popular with the self-sufficiency types who build thermal mass heaters and rocket mass heaters.

Mass Timber Constriction