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Seeing Red Over Green Roofs

By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow ASHRAE

This green roof stuff is getting out of hand. It is dumb to do a green roof to save energy. If dirt were energy efficient, we would call it insulation and put it in walls. It is just dirt. Insulation is better insulation than dirt. That is why we call it insulation.¹ And covering a roof with grass to deal with solar gain is also pretty dumb when you have something much more effective and less expensive available called a reflective membrane.

Besides, to keep the green roof green you have to water it. Perhaps that is why some folks now call them “vegetative roofs.”² If energy is your deal, add more insulation to your roof and install a reflective membrane and be done.³ It works better and costs less than adding dirt and grass. Tastes great, less filling. Now, you don’t need a goat to keep the grass in check. It gets complicated figuring out what to do with the goat.

Let’s go back to the water stuff and green roofs. Folks also like green roofs because you can store water in them; you can control the rain run-off from your building. You’re kidding, right? Storing rainwater on top of your building? Are

you on crack? The whole point is to get the rain off of your roof, which is why we slope them.⁴

And let’s not forget the wildlife habitat argument. Get serious. You want do something for birds? Easy, use less glass.

That green roofs have, up to now, been driven by the need for a checklist point is bemusing, but ultimately harmless. If you are so unsure of your ability as an architect or designer that you need to use someone else’s arbitrary and pretty capricious checklist to be part of some silly club, knock yourself out. To help these types of folks out, please note that the bike rack and shower checklist points make more sense; at

least they do not cost you a bucketful of money.

So what has got my goat, so to speak? Even worse than a checklist point, which you can ignore because it typically isn’t a legal requirement, some cities now require green roofs via bylaw—which is a legal requirement—and that makes me see red. My hometown for one.⁵ How did that happen?

Apparently, green roofs are sustainable, and, therefore, necessary. Just what does that mean anyway? Sustainable? Well, whatever it means is beside the point. Don’t bother me with details or facts. Everything needs to be sustainable today. And, green roofs are sustainable. You better have one, or no permit.⁶

Now I happen to like green roofs. Yes, you read that right. I will explain that seemingly unbelievable statement in good time. But as much as I like them, I don’t want to be told that I have to use them, and I sure don’t want to be misled about them, especially about their “environmental benefits.” One of the environmental movement’s biggest problems today is credibility because benefits (and dangers) have been so exaggerated.

So why do I like green roofs? I think they can look beautiful (*Photo 1, Photo 2 and Photo 3*). Not always. But when they do, it is pretty special. Most roofs are pretty ugly things, cluttered with all that mechanical stuff and design afterthoughts. You think looking down from a window in a tall building on a cityscape cluttered with ugly roofs gives you a

1. This logic reminds me of the crazies who like underground houses. Let’s use the insulation value of the ground and dig a big hole and bury the house and be energy efficient. I have news for all of you folks: it is cheaper and safer and easier to build on top of the ground and use something called “insulation” to get your efficiency. You can also use a pretty neat technology called a “window” to connect with the rest of the world.

2. They might be the same folks who changed global warming to climate change to climate disruption. What week is it? There might be another name change.

3. The assumptions are pretty important. Green roofs save energy compared to uninsulated roofs or poorly insulated roofs or even better, black poorly insulated roofs. Once you have more than R-20 in a roof assembly, that is, you meet the code, things pretty much don’t matter. In other words, go above R-20, and make green roof decisions for other reasons than energy. See “Potential Energy Savings of Various Roof Technologies” by S. Ray and L. Glicksman presented at Buildings XI Conference, and check out Figure 9. Note that grass, even when it is green, has a greater solar absorptance than a white membrane. The real effect of the grass comes from the evaporation of water. But that takes water, and you might not always have some. If you want to do the water evaporation thing, you probably could do as good a job by sprinkling the top of a white reflective roof. When the grass goes brown, forget about any energy benefit; also, be very worried about fire. Yup, a wildfire zone on the top of your building, another real good idea. And don’t get me started about “urban heat islands” and the benefits of green roofs. You get there faster with white roofs: cool roof technology.



Photo 1 (upper left): Waterloo Green Roof. This is the roof one of my partners designed and built for his apartment building in Waterloo, Ontario. He invests his share of the company profits in Canadian real estate. I prefer mine in the form of liquid assets. I drink my profits. **Photo 2 (upper right):** Buffalo Green Roof. This is a green roof walk-out balcony deck at a college building in Buffalo, N.Y. It was gorgeous. I was just passing through. Loved it; took a picture of it. I don't know who did it. Whoever did—nicely done. **Photo 3 (left):** Tsukuba Green Roof. A conference center in Tsukuba, Japan, near the Japanese building research center.

warm and fuzzy? Give me some beauty any day. This discussion is on the verge of getting out of hand. Think about it. An engineer, a crotchety, gruff, irritating one to boot, talking about beauty? Wow. Well, let me tell you about beauty. The discussion might not be pretty, but here goes.

I think buildings should last a long time. Over my half century and then some of existence on this blue spinning celestial ball, I have learned, mostly the hard way, that in order for buildings to last a long time, people have to take care of them. Now, in order for people to take care of them, people have to want to take care of them. And guess what? People don't take care of ugly things. Ugliness is not sustainable. People need to want to live in a building and work in a building. Only then will they take care of it. That is why beautiful buildings are important. That is why architecture is important. I think we should have beautiful buildings. I think they should also be safe, durable,

comfortable and energy efficient. Note that the energy efficiency part is at the end of the list. Nowhere do I mention the words green or sustainable because the terms are too general to be meaningful to me.

Having said that, architectural hypocrisy is irritating. Don't tell me a green roof and an all-glass façade is energy efficient, and that overventilation is healthy, and that a bike rack is sustainable, and here are my checklist points to justify it. Be honest, say that a green roof makes the building look beautiful and the space useful and that, look, people are now enjoying the building, and I am all for it. I will happily give up some energy for beauty. Same thing for the glass façades. It's a look thing, not an energy thing. You know it, I know it, we all know it.

So we are going to have green roofs. I hope for the right reasons. But we are going to have them. Now what? Well, don't screw them up. Pick your spots. They are more expensive than

4. Relax, I know because of some site constraints, roof storage might be your only choice, but it sure as heck shouldn't be your first choice. Time for a reality check. The city of Toronto backroom folks pushed the green roof craze for the peak storm water issues the city was facing, not because of energy efficiency and "sustainability" or "green." The city had not made investments in infrastructure for decades and here comes a sleazy way to push the problem onto the backs of building owners while wrapping everything up in a flag of environmentalism. Nice, eh?

5. When Chicago went green roof crazy, I didn't care. I mean, it is Chicago. Why get worked up over a city that doesn't have a real baseball team? But when Toronto got the green roof bug my world was rocked. What happened to Toronto the Good? Was it that the Leafs haven't won a Stanley Cup in 44 years? Was it because of all those politically correct ecocrazy neighborhood activists from the Annex on City Council? This was way worse than Mel Lastman calling in the Canadian Forces because of a heavy snowfall. This was even worse than always losing to the Habs. I am sure this is why Rob Ford got elected mayor: to clean up this mess.

6. Just like green. Everything needs to be green. With green, though, we are already there society-wise. Pretty much everything is green today. Just look at what we call green. Toilet paper, dishwashing liquid, paper bags, plastic bags, everything, ad nauseum. Green is now a meaningless term because we have debased it to such an extent by calling everything green. One can only hope that the same will happen to "sustainability" as well. And then, maybe we can work on "organic" and "natural."

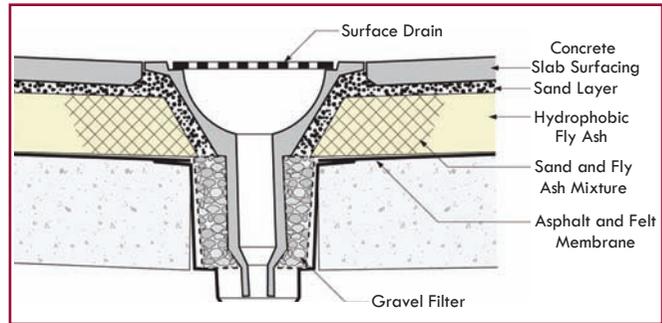
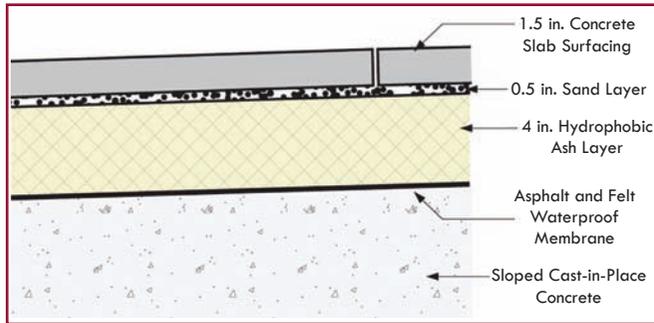


Figure 1 (left): Soviet-Era Protected Membrane Roof (PMR). Pretty impressive technology for the time. **Figure 2 (right):** More Soviet Era Stuff. Great roof drain. Could have also been the design for a shower drain. For real, not kidding.

any other option, and they don't save energy compared to an otherwise well-insulated roof. They should not be a code or bylaw requirement, and you shouldn't be encouraged to use them except for architectural reasons that are, in the truest sense of the word, "architectural."⁷

What do we know about building them? A great deal. The earliest ones go back to the old Soviet Union in the 1940s (*Figure 1* and *Figure 2*). Think of them as PMRs or IRMAs with dirt and grass ballast. We sure know about PMR and IRMA assemblies, and we sure know about green roofs. For the newbies, PMR stands for "protected membrane roof" and IRMA stands for "inverted roof membrane assembly." In these roofs the water control layer is (not always! fully adhered, alas) directly on the structural deck, and the thermal control layer and ballast are located above (*Figure 3*).

One of the great features of these systems is that the water control layer is also the assembly air control layer and vapor control layer, aka, the "Perfect Roof" (see ASHRAE Journal, May 2007 "The Perfect Wall"). The biggest benefit of the PMR is that the membrane is, well, protected. Protected from the things that destroy most membranes: heat, cold, ultraviolet radiation and mechanical damage from above. By keeping a "fully adhered" (yup, this "fully adhered" thing is a big deal) quality membrane below the insulation, it will never see temperatures much different than room temperature for its entire life, and will never be exposed to sunlight. It does not take a Ph.D. ("professional hairdresser") to figure out this means that the membrane will last a very long time. In green roofs, mechanical damage happens easier because of folks working on the roof (aka "gardening"), and the costs of getting at a leak are much more expensive than other roofs, so protecting the membrane should be a no-brainer. Therefore, the PMR is tailor-made for green roofs. Even the Feds have figured this out; the General Services Administration requires PMRs for all vegetative roofs—and the brain trust at City Hall in my hometown.⁸

In taking apart PMR or IRMA (including terrace and green roofs) that are 10 and 20 years old and older, we have learned that the insulation layer can get saturated if it is not drained

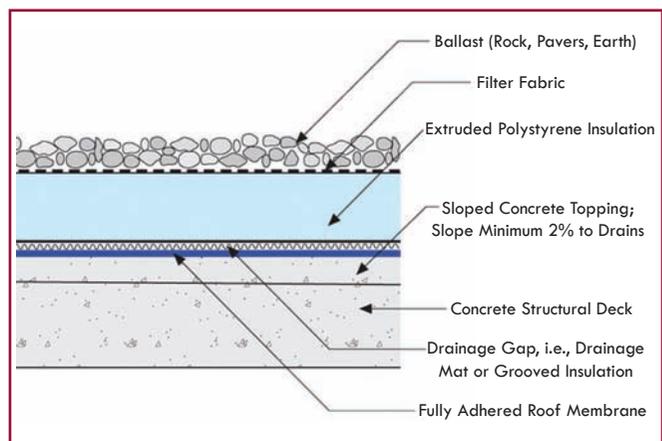


Figure 3: PMR and IRMA. Protected membrane roofs and inverted roof membrane assemblies date back in North America to before I was born—a time when the Toronto Maple Leafs were winning Stanley Cups. Note that drainage below the extruded polystyrene (XPS) layer is necessary to keep it from becoming saturated over time.

above and below. This approach was not common practice in the early days; it should be standard practice today. For drainage, all that is needed is a small gap, 1/8 in. (3 mm) or so, provided by drainage layer materials. A good slope of at least 1/4 in. (6 mm) in 12 in. (305 mm) is important so that the water can run away. And the membrane should be protected even as it turns up at parapets, curbs, and penthouses to ensure that the membrane remains durable everywhere. There is one, and only one, insulation that can be used in this type of assembly: extruded polystyrene. Use a thick layer or a series of thick layers—as thick as you can get to reduce water uptake. Surface area results in water uptake. Less surface area, less uptake. For example, one 4 in. (102 mm) layer of rigid insulation has less uptake than two layers of 2 in. (50 mm) rigid insulation. All of the other insulation types get too wet and hold too much water.

7. Oh boy, an engineer commenting on architecture. Well, to paraphrase Georges Clemenceau "architecture is too important to be left to architects."

8. Check out the GSA's P100 Facilities Standards that establish design standards and criteria for new buildings. And guess what, the "Toronto Green Roof Construction Standard" is fabulous if you actually want to know how to build them. I shouldn't be surprised. My old friend Hitesh Doshi from Ryerson University chaired the Technical Advisory Group. Well done, Hitesh. Just don't forget about the drainage above and below the rigid insulation. Once again I mention it, and in a footnote, so I am really serious about this.



Photo 4: Root Barrier and Drainage Layer. Both are a big deal. Notice the filter fabric above the drainage mat and the root barrier under it.

How do you turn a PMR or IRMA into a green roof? Add a root barrier, a soil-based growth medium (aka “dirt”) and plantings (aka “grass”). Make sure that

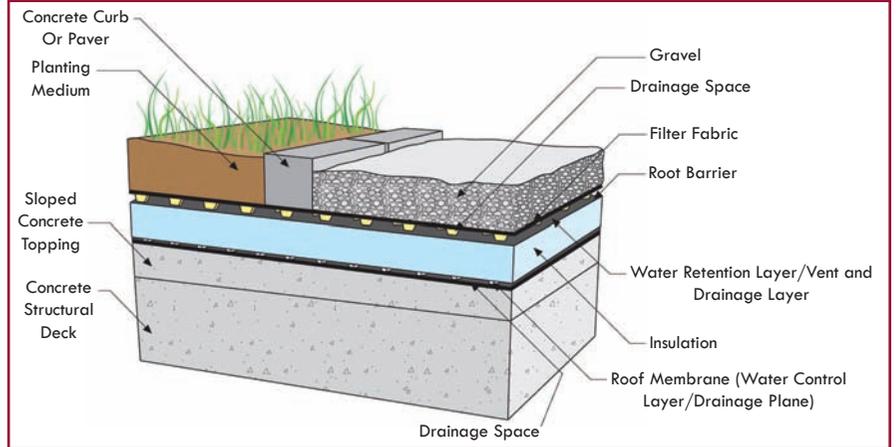


Figure 4: Green Roof. To turn a PMR or IRMA into a green roof, add a root barrier, a soil-based growth medium (aka “dirt”) and plantings (aka “grass”). Make sure that drainage occurs above and below the insulation layer.

drainage occurs above and below the insulation layer (*Photo 4*). I mentioned this earlier, and I mention it again here. This must mean that it is important (*Figure 4*).

That’s it. Take a PMR or IRMA roof design and modify the ballast to deal with

vegetation. Just do it for the right reasons. Take the beauty, hold the hypocrisy.

Joseph W. Lstiburek, Ph.D., PEng., is a principal of Building Science Corporation in Somerville, Mass. Visit www.buildingscience.com. ●

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