

Through the Roof

The logo for Turf, featuring the word "Turf" in a bold, black, sans-serif font. A green grass blade graphic is integrated into the letter 'T'.The logo for Tree Services, featuring the words "Tree Services" in a bold, black, sans-serif font. A small green leaf graphic is above the 'i' in "Services". Below the main text is the tagline "Taking Tree Care to New Heights" in a smaller, italicized font.The logo for DesignBuild, featuring the word "Design" in a black, sans-serif font and "Build" in a bold, orange, sans-serif font. A small orange square graphic is above the 'i' in "Design".The logo for PLOW, featuring the word "PLOW" in a bold, blue, sans-serif font. A registered trademark symbol (®) is to the upper right of the word.

Source: www.TurfMagazine.com

Penn State's Center for Green Roof Research

Statistics show that green roof installations are skyrocketing. In fact, some figures show that the number of green roofs being installed in the United States is climbing at a rate of 25 percent each year.

"Green roofs are in the exponential growth phase right now," says Rob Berghage, director of the Penn State Center for Green Roof Research and associate professor of floriculture at the school.

The center was established in 2000, at a time when "green roof" was hardly the household term it is today. "Green roofing had been around in Europe for years, but in North America it was just a blip at that time; only a few people were talking about it, and really nobody was doing anything with it," recalls Berghage. "The whole industry in this country at that time was pretty much made up of the lunatic fringe. Now, it's very mainstream, and there are many reputable folks out there now."



"In my mind, the best-performing green roofs are nice little meadows that are a mix of native and nonnative plants: you've got sedums and herbaceous plants," says Rob Berghage, director of the Penn State Center for Green Roof Research.



The green roof on the Forest Resources building at Pennsylvania State University provides one on-campus site for the school's Center for Green Roof Research to study.

The Penn State Center for Green Roof Research began by trying to prove to North America what green roofs can do in terms of controlling stormwater runoff and reducing energy consumption. "We wanted to provide some serious, scientific information. There was data out of Europe, but most of it was in



German,” says Berghage. Penn State also wanted to account for the performance of green roofs in the unique climate of the northeastern United States.

After years of demonstrating the effectiveness of green roofs (and with building developers and regulators getting the message), Berghage says Penn State’s green roof research has turned to improving design and construction of green roofs, as well as long-term maintenance strategies for these still somewhat misunderstood green spaces. “There have been some failures, and people have learned from those failures,” he says. “We’ve examined many projects to determine what is working and what isn’t.”

Currently, there are two main types of green roofs being installed: those designed primarily for stormwater regulatory compliance that may not even be visible, and those that are meant to be viewed and have both environmental and aesthetic components. Even within these two broad categories, “every project is different; it’s kind of amazing,” says Berghage.

While the center does conduct some resistance testing on waterproofing materials used in green roof construction, “We primarily work with the area above the waterproofing material,” says Berghage. He refers to that as the “green arts,” and it includes growing media and plants.

“We’ve done a lot of experimentation over the years to test soil media. We use standard tests to evaluate the material for suitability,” Berghage explains. An important part of that testing looks at particle size distribution to ensure the growing media (like a natural soil) is made up of different particle sizes. That helps to ensure the media has good moisture-holding capacity, while also allowing water to drain through.

	
There are now many different nursery-grown plants proven to perform well in green roof applications	Weighing lysimeters are used to measure water use by various green roof plants.

Typically, the most successful media tends to be about 90 percent (by weight) a lightweight aggregate and 5 to 10 percent organics. By volume, the mix is usually 80 percent inorganic and 20 percent organic, but that ratio can vary. West Coast applications often feature aggregate such as lava rock and pumice. “On the East Coast, many of the lightweight aggregates that are used come from the concrete industry, things like expanded slates and shales and clays. They’re mined out of the ground, run through a kiln and turned into a popcorn-like material,” says Berghage.

The goal is to find a media that’s light enough not to overburden the building structure, while also stable enough to last at least 30 years—the minimum life expectancy for a good green roof, according to Berghage. It’s important to get the soil right initially, because most plants used in green roof installations are ground cover plants that won’t respond well if the soil needs to be topdressed or mulched to improve performance. “And, structural steel has gotten awfully expensive,” says Berghage, “so you want to keep the weight down as much as you can.”

Along with other groups across the country, the Penn State Center for Green Roof Research has evaluated a wide variety of plants to determine their suitability for use in green roof applications. "Plant selection is an interesting area because, obviously, different geographic regions are going to have different plant communities that are going to thrive," says Berghage. "We've looked a lot at the sedums and Delospermas, and we've evaluated different grasses, as well as a little perennial and annual native herbaceous materials. In my mind, the best-performing green roofs are nice little meadows that are a mix of native and nonnative plants: you've got sedums and herbaceous plants."

In cases where the green roof is not visible, the aesthetics of the plant choices is irrelevant. In fact, Berghage points out that in Europe there are proponents of a technique called "brown roofing." He explains, "They scrape the topsoil off the site where they're going to build, put it in a pile, build the building and then throw the topsoil, maybe mixed with some aggregate, up on top of the roof. Then, whatever seeds were in the ground, that's what grows. From a biodiversity standpoint, it works."

Many times, however, the green roof is a showpiece, so aesthetics do play a role in plant selection. "Whether or not you irrigate the roof, and how deep you make the soil, really impacts which plants will do well," says Berghage. "With a 4-inch roof, you're pretty limited to things like sedum. With 6 inches of soil, you can add some more herbaceous plants. And, if you go to 8 inches, you can add even more. Of course, the deeper the soil is up on the roof, the more you open the door to weed pressures and maintenance challenges. The other way to increase diversity on the roof is to irrigate it."

He estimates that nearly 50 percent of new green roof installations include some type of irrigation system. "There are definitely parts of the country where I would not install a green roof without irrigation," says Berghage. "Here, in many areas of the Northeast, irrigation is sometimes optional. In fact, you can kill sedum with too much water."

Berghage says that, at least in terms of maintenance, he doesn't view green roofs as being that different from ground-level gardens using the same types of plants. The number one priority is to control weeds. He explains: "It's like establishing a garden at home. During the first year, until you get a good plant community in there, you need to weed and maintain it more frequently. After that, you still need to get up there at least two times a year. You want to get up there in the spring when the spring weed crop flushes, and then you want to do it again later in the summer to get the summer weed crop. There are so many windblown seeds; it's amazing the number of seeds that can get up on even a roof that's 10 stories in the air."

He says that green roof maintenance is "a major issue" at the moment, and one where more research and training is needed. "The more green roofs we have, the bigger an issue it becomes," notes Berghage. "There are some manufacturers promoting green roofs as 'no maintenance' options, and that's just ridiculous. You can't have a planted system that you do no maintenance on and expect it to succeed, or at least be remotely aesthetically pleasing."

In my mind, one of the major factors that limited success when you see a green roof failure is that the maintenance wasn't carried out properly."

Building owners and managers often aren't used to dealing with plants, he says. "That's why many reputable green roofing companies include a two-year maintenance contract to be sure the roof gets established before turning over maintenance to the building owner."

After that, Berghage says, green roofs usually fare better when there's a professional landscaper involved. "There are some landscapers that are developing some significant levels of experience; they've worked on a number of green roofs and they're getting very, very good at it. Then, there are a lot of companies just starting out in the industry."

The Penn State Center for Green Roof Research continues to examine performance and maintenance issues associated with green roofs, ranging from seed pregermination to long-term fertility management. "Obviously, you have to grow the plants, but because it's a 'green' technology, we don't want to put so much fertility up there that we contaminate the runoff water. We're trying to find out where the balance is."

The goal remains to get the information out to those installing and maintaining green roofs. "There are so many people involved with green roofs today," marvels Berghage. "The industry has come so far so quickly."

Patrick White is a freelance writer and editor who is always on the lookout for interesting and unusual stories.

SIDEBAR 1

Going Green

According to the Penn State Center for Green Roof Research, green roofs provide the following benefits:

- They are aesthetically pleasing
- They reduce city "heat island" effect
- They reduce carbon dioxide impact
- They reduce summer air conditioning cost
- They reduce winter heat demand
- They can lengthen roof life by two to three times
- They can remove nitrogen pollution in rain
- They help neutralize acid rain effect
- They can reduce noise
- They reduce stormwater runoff
- They provide songbird habitat