Ford Rouge Center Dearborn Truck Plant
GREEN ROOF PROJECT

By D. K. Russell

Figure 1: Ford roof in summer.

Introduction

Ford Motor Company was at a crossroads in 1999. Discussions were ongoing about what to do with the aging Rouge Manufacturing Complex in Dearborn, Michigan – the flagship of Ford's worldwide operations. Many observers predicted it would be abandoned due to old age and deteriorating infrastructure. After many internal debates among top management personnel and several discussions with architect William McDonough, a leading advocate of "eco-effective" design, Bill Ford, Jr. announced a decision to continue operations at the Rouge. He challenged Ford engineers to find ways to make the Ford Rouge Center a model of 21st Century sustainable manufacturing.

Figure 2: "Green" roof in autumn.

Ford planners considered several novel approaches to environmental challenges at the site. One McDonough proposal, adding a green roof to a planned assembly plant design, was met with universal puzzlement. Was this a serious suggestion? No one knew for sure what a green roof was or what advantages it might bring.

Stormwater Management

Stormwater management is a major concern at the Rouge. Most of the 1,100 acres that comprise the site are already built upon or paved. Adding a green roof to a proposed new assembly plant was evaluated as an initiative that could aid in minimizing and cleaning water run-off. It would also help keep the new building cooler in the summer and add to the lifespan of its roof. The

green roof could be a noteworthy focal point of a site-wide stormwater management plan to include drainage swales, water storage lagoons, ponds, and porous pavement in parking lots.

Making the business case was another matter. Obviously, building material needs would change significantly with the addition of water-retaining vegetation on the roof. Preliminary cost estimates for a green roof ranged from two to three times the price of a conventional roof system. As part of an overall site design, however, the cost of all proposed stormwater reduction initiatives was weighed against the cost of a traditional stormwater management system consisting of miles of drainage pipes and a water treatment plant. In that context, the business case was favorable, and the decision was made to go forward with the green roof.

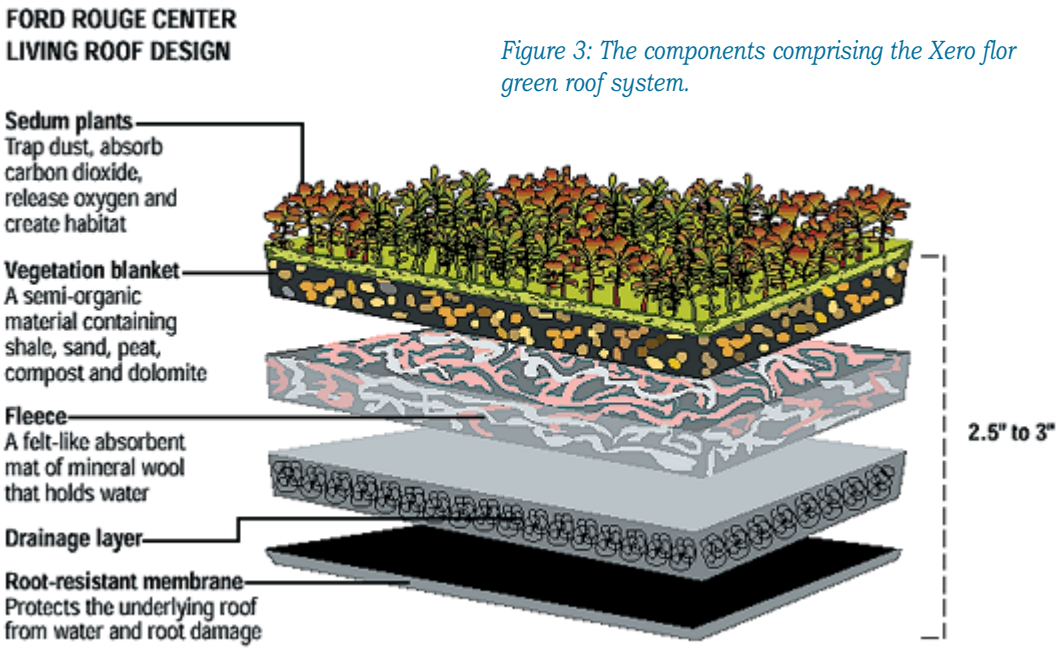

Figure 3: The components comprising the Xero flor green roof system.

Building Materials were Upgraded

Structural steel for the project had to be ordered before roof planning was completed. A preliminary roof design, based on sedum plants growing in four inches of topsoil at saturated conditions, added 25 psf to the original anticipated load. A truss and beam purlin design was specified, and a three-inch galvanized steel roof deck was called for rather than a traditional 1.5-inch deck. A two-inch polyisocyanurate layer was used with a top board of perlite (*Figure 3*).

Due to the potential for water and root penetrations to be problematic, much attention was given to selecting appropriate protective membranes for the vegetation underlayment. The Siplast modified bitumen system was selected based on performance expectations and its two-ply design. A Paradiene Tarabase layer covers the metal deck, and a Teranap waterproofing membrane is placed on top of that. The combined thickness is 160 mils.

The company supplying the green roof, Xero flor, recommended a specific root resistant membrane be used in addition to the waterproofing membrane. The selected product is a 20-mil, high-density polyethylene film certified to German FLL standards. (The FLL is a green roof industry standards testing and certification organization. The American standards testing counterpart, ASTM,

Figure 4: Procedure for applying polyethylene root barrier, vegetation mat, and substrate sequentially at cultivation site in Allen Park.

Figure 5: Green roof membrane application.

is working on an adaptation of the FLL standards for the American market.)

The Xero flor Green Roof

After devoting development time to creating an original green roof system, Ford contracted a long-established company, Xero flor of Gross Ippener, Germany, for the project. The Xero flor product is an extensive green roof system utilizing layers of lightweight foundation materials, thin substrate, and vegetation. The saturated weight of the system is 11 psf, making it significantly lighter than the design specification of 25 psf. A unique feature of the system is that the vegetation layer is grown at ground level and transported to the roof after it has filled in.

Figure 6: Workers position individual squares of sedum on fleece underlayment.

Typically, Xero flor delivers the ready-to-install product from its "farm" in Germany. Since Michigan is not in the local delivery area, an alternate plan was developed to grow the vegetation blankets near the facility where it was to be installed. A fifteen-acre, Ford-owned site was selected to be the cultivation area. Materials, including specialized machinery, shadecloth, synthetic mats, absorbent fleece, drainage materials, and sedum seeds were shipped from Germany to Allen Park (near Dearborn) for the project.

Instead of soil, a growth mixture consisting of expanded shale, sand, compost, peat, and dolomite was obtained locally and spread over twelve acres of synthetic materials (see *Figure 4*). Distribution of seeds from eleven species of sedum and cuttings from two additional varieties of sedum was spread randomly over the twelve-acre plot. An irrigation system and shadecloth were utilized to keep the young plants moist during the initial growth period. The vegetation blanket was grown from May to September 2002 and installed in September and October.

Green Roof Installation

One major concern with the green roof installation was that the transfer from field to roof had to be quick and efficient. The

Left: Figure 7: Roof-dwelling birds (kildeer) appeared during the spring of 2003.

Below: Figure 8: Flowering plants on the roof.

roofing contractor, ChristenDetroit, coordinated efforts with the grower, Xero flor, to assure that cutting and transport operations took place sequentially over a four-week period. The vegetation blankets were cut into 1m x 1m squares, placed on wooden pallets, and loaded onto flatbed trucks. The materials were driven to the Rouge and hoisted to the roof by extension forklift trucks.

Pallets were placed on motorized four-wheel transports at roof level, and vegetated mats were distributed to areas to be covered. Prior to installing the mats, remaining system materials were rolled out. These included the root-resistant membrane, the drainage material, and the fleece layer. Due to windy conditions on several days, the sublayers were thoroughly wetted down to remain in place (*Figure 5*). This was also helpful for getting the vegetation off to a moist start after some drying occurred during transport.

Placement of the mats on the roof was similar to installing shingles on a roof. Pieces were staggered appropriately with edge materials butted together (*Photo 6*). The mats have a six-inch "flap" that extends from one side of the square. This allows each piece to be overlapped and held in place by the square next to it.

As the vegetation blanket was placed on each section of the roof, that portion of the roof's irrigation system was installed. The plants were watered on a daily basis for the first couple of weeks

Figure 9: Aerial view of new assembly plant and green roof.

after being transferred to the roof. During 2003, the irrigation system was used on an as-needed basis as the vegetation filled in. Plans are for it to be used sparingly in 2004 and possibly discontinued altogether after plant establishment is complete.

Maintenance

Maintenance activities during the first year were minimal. Because the plant coverage was approximately 70% shortly after installation, some vegetated areas were subject to weed infiltration. Weeding was performed periodically during the first summer and tapered off as sedum coverage increased. It is anticipated that weed removal will be a maintenance item in the second year, although to a lesser extent than in the first year.

Mowing is not required. The sedum selected for this installation is a low-growing variety that tends to propagate horizontally rather than vertically. To replenish lost nutrients in the substrate, a slow-release fertilizer application is planned each spring.

Summary

Green roof benefits are varied and not always obvious. Extending the life of the roof by minimizing expansion and contraction effects is predictable. Cooling the building interior in summer is an understandable benefit as well. Stormwater reduction and water cleansing advantages are notable as compared to a conventional roof. For the Rouge, however, bringing back wildlife to the site is a welcome change. Birds and butterflies are finding refuge on the roof (*Figures 7* and *8*), and workers are excited about the prospect of improving the environment that they work in and around every day. At 10.4 acres, the world's largest living roof has finally gotten off the ground. Hopefully it will benefit everyone at the Ford Rouge Center and become a blueprint for future industrial green roofs in North America. ■

About the Author

Donald K. Russell is manufacturing sustainability manager for the Environmental Quality Office of Ford Motor Company. For the past three years, he has been part of the Rouge Heritage Team evaluating environmental initiatives for the Ford Rouge Center. His recent projects include the green roof at the new Dearborn Truck Plant and a phytoremediation research study to identify plants capable of cleaning contaminants from soil.

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Green Building Co$t

The state of California recently published a study comparing the cost of 40 green buildings (most of them LEED certified) to conventional buildings. They determined that, on average, the initial costs of green buildings were only 2% higher, and the long-term benefit-to-cost ratio was 10 to 1.

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