A New University Greenhouse From Inception to Completion©

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At our Washington State University Extension office complex known as the Heritage Farm we have 79 acres of county-owned farm ground which includes community garden plots, agricultural research plots, and a collection of older greenhouses utilized by our Master Gardener Foundation. While the individual greenhouses are serviceable they are very dated.

INCEPTION

Washington State University conducted agricultural research at the Heritage farm from 1949 until 2008, at which time Clark County resumed ownership of the property with the intent of keeping it as a working farm. County staff reviewed the assortment of older greenhouses on the farm and determined that they should be replaced with modern structures incorporating the latest in greenhouse technology. In January, 2010, I approached the county with a proposal to build a new 30-ft × 60-ft gable greenhouse (GH). My initial proposal was readily accepted based on a projected cost estimate. In early discussions with staff from Clark County the issue was raised as to whether the new structure would have to meet the standards of the International Building Code for a GH. When I discussed inviting not only volunteers but also the general public into the building the county Building Inspector stated that clearly it had to have a Commercial Building Permit. As such agricultural buildings do not have to meet code as they are not open to the public (Bartok, 2005). Before our GH could be erected it had to have stamped engineering drawings sent by our manufacturer (Conley's Greenhouse Manufacturing and Sales) to the County Building Department. Our GH had to meet the same standards as those for a retail garden center (Humphrey, 2010), including a 25-lb snow load. As for the site for the new GH, the county General Services' staff recognized that the majority of the structures on the site were dilapidated and should be removed over time as opposed to being updated. Any new structure had to be placed on top of previous GH foot print. In addition, the county Fire Department had to review the plans for the entire GH complex. The Fire Marshall determined that no fire flow had been set for the entire GH complex. We could not exceed a total of 9,620 ft^2 of GH without triggering the need to either install sprinklers or put in a new fire hydrant. As our new structure would be open to the public it had to have doors and walkways that complied with the Americans for Disabilities Act (ADA).

PROJECT DEFINITION

The first step in considering what our new GH would include directed us to look at comparable research and public school structures. We reviewed coded houses in northwestern Oregon and southwest Washington. In keeping with the goal of building a structure with a professional appearance we looked at gable truss structures with rigid glazing. County staff members expressed strong support for a well-designed structure that resembled those found at other public high schools and universities in the surrounding community. We discounted semi-gable (arch) or quonset bow designs as these were so often associated with lower-end facilities. Rather than using the common polyethylene or corrugated polycarbonate for glazing we opted for double-wall polycarbonate as it offered better insulation, durability, strength, and appearance.

For summer ventilation we opted for a design that incorporated both a roof vent as well as side vents. By incorporating a dual venting design we hoped to reduce the summer heat load by both wind pressure and thermal gradients (Buffington, 2010). Our naturally vented GH used less energy and was quieter than one with the traditional intake shutters and exhaust fans. To reduce the apparent heat load during the summer months we looked at a shade curtain system built truss-to-truss in a slope-flat-slope design. This design will enable us to hang plants and horizontal air flow fans from the roof trusses without interfering with the shade panel. A flat panel shade curtain would have been less expensive. During the winter months the shade panel can reduce heat loss significantly. We did understand that natural ventilation may not be enough to keep the interior temperature comfortable during the summer months. Accordingly, we had the engineering plans include space on the end walls for an evaporative pad on the windward wall and two exhaust fans on the leeward side. In our Northwest location this could reduce the ambient temperature by 15–18 °F depending on the relative humidity.

For heating the GH we looked at the newer condensing unit heaters. These units capture and utilize latent heat from the water vapor in the exhaust stream, enabling them to be 93% efficient (Schaffart, 2010). As a backup we had the standard 78% efficient power vented unit heater. Our greenhouse heating was designed to maintain a 50 °F temperature differential. For environmental control in the new GH we looked at electronic controllers that could regulate the heater, vents, shade curtain, and eventually the pad and fan system (Jones, 2008). We selected a Wadsworth EnviroSTEP unit that could manage 12 programmable relay stages. In time we may tie this unit into a personal computer.

For benches we looked at both stationary as well as rolling designs. We settled on five of each, with steel legs and hot-dip galvanized wire mesh bench tops. We discounted plastic bench tops as they did not appear to offer sufficient flex resistance. In order to keep the benches stabile their legs were set into concrete caissons.

For task lighting we had a combination T-5 fluorescent fixtures as well as high-pressure sodium lamps for seed starting. We have already started discussions with a major greenhouse lighting company in our community to donate lights to our new GH.

PROJECT DESIGN

During the design stage we worked with private greenhouse consultants to compare the costs associated with all the different variables we had reviewed. We looked at prices for gable houses from Stuppy (Classic 2000), AgraTech (SolarLite), Nexus (Vail), and Conley (7500 series). We settled on the Conley structure as they could custom design a structure to fit our space limitations. We had considerable input from the Master Gardener volunteers who will utilize the GH. They agreed to contribute $6,000 towards the new benches for the GH. While we were very fortunate to have as many of the advanced features we reviewed, budget limitations precluded us from having a full concrete pad, a pad and fan evaporative cooling system, and potable water delivered to the new GH. All told the entire project including site improvement cost on the order of $150,000.

IMPLEMENTATION

The GH was ordered from Conley GH in March 2011, and it arrived on 2 April 2011. We next had to develop a Request for Proposal for a contractor to build the structure. We assigned a value of $35,000 to cover construction. Of the three firms we solicited none of them felt they could meet this bid, as the county asked them to pay prevailing wages. During a second round of bids I was able to find a local contractor who would do the work, as long as he had assistance from the county Facilities Management staff.

UTILIZATION

The new GH was set up for teaching as well as raising plants to sell to support the Master Gardener Program. Currently, we raise nearly $35,000 per year from the sale of bedding plants, vegetable starts, houseplants, and herbaceous perennials. As this will be an ADA compatible structure we will be able to offer classes to mobility limited participants.

LITERATURE CITED

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