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University of Arizona, College of Agriculture and Life Sciences
and The Controlled Environment Agriculture Program, CEAC

Station Report

Greenhouse Engineering
Division of Alex Turkewitsch, P.Eng. Ltd.

Projects Completed in 2004

We completed 2 projects at the University of Guelph in 2004. First was an extensive renovation and upgrade of E and F wings at the Bovey Greenhouse Complex. This was part of the transfer of work and facilities from the Vineland Research Station to the main campus in Guelph. Evaporative coolers and basewalls were replaced, benches and recirculating irrigation systems installed, an air fog humidification system installed, a novel bench blackout system developed and 16 independent blackout benches installed. The bench blackout system consists of rollup sides and ends with a suspended curtain roof. Two tube motors are used, one for the roof and another for all four sides. Greenhouse Engineering worked with Frank Jonkman & Sons Ltd, the greenhouse manufacturer to develop this product. The greenhouse computer control system was converted to an Argus system. E and F wings are now completely up to date and the computer system has been integrated with the other areas at the Bovey Complex that have gradually been converted to the Argus system.

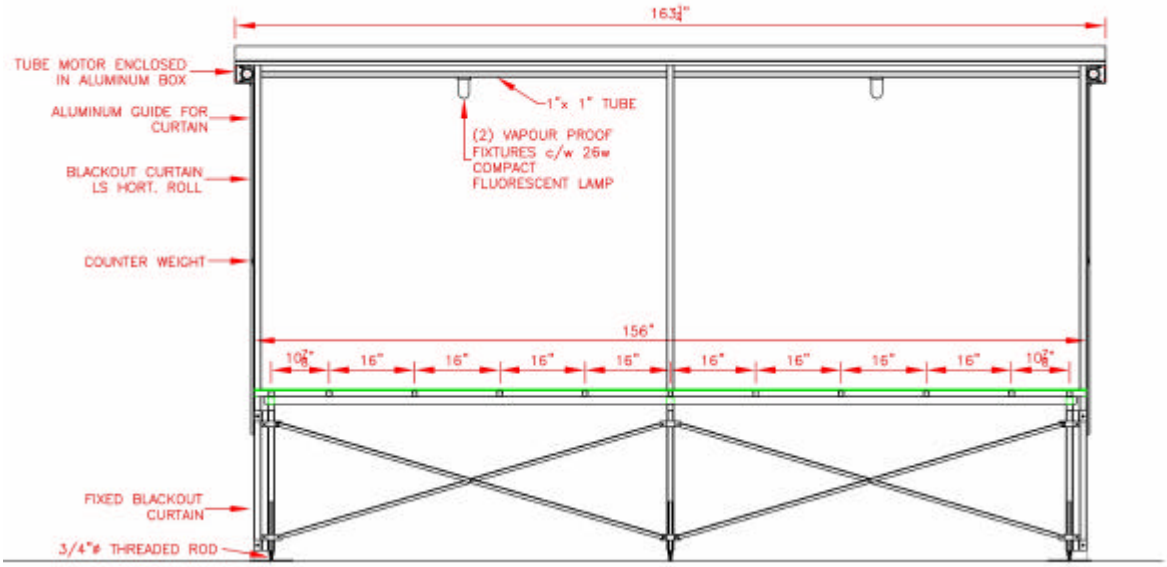

Figure 1 – University of Guelph Bovey Complex - Greenhouse Blackout Bench - Longitudinal Section

The second project at the University of Guelph is the New Science Building Rooftop Greenhouse and Growth Chamber Facility. This facility was constructed to replace the current facilities of the Botany Department in the Axelrod Building. The new greenhouses are to meet the specific and general needs of researchers working in diverse disciplines. About 40% (1 large and 1 small compartment) is air conditioned, the other 4 compartments are cooled by evaporative cooler units. One of the compartments is intended for C4 plants, with higher lighting from MH fixtures. The greenhouse structure and specialty systems and equipment was supplied by Frank Jonkman & Sons Ltd. The control system for the greenhouses was by Priva Computers. Conviron supplied the growth rooms, the pathogen suite and the tissue culture suite.

Figure 2 – University of Guelph New Science Building – View from the southwest

We also completed the rooftop greenhouse facility as part of the New Science Laboratory Building for the University of California at Davis last year. This is an evaporatively cooled greenhouse with conventional HPS lighting and a variety of benching and irrigation features. The greenhouses were constructed by Nexus Corporation and the control system was by Argus. Low iron patterned glass was used extensively. The cooling system incorporates large rooftop air handler units with wet pad sections and perimeter cooling fans. Both systems are run on variable frequency drives, allowing the facility to be operated at positive, negative or neutral pressure.

Figure 3 – University of California at Davis – Science Laboratory Building - Rooftop Greenhouse

The relocation of the University of Toronto Botany Department greenhouses to their new rooftop location was finally completed with the removal, historical restoration and relocation at its new site of the Botany Conservatory at Allan Gardens. This greenhouse, originally constructed in 1932, was given a new life when the University of Toronto donated it to the City of Toronto to make way for a new Pharmacy building. The Botany Conservatory is now the Children's Conservatory in Toronto's downtown core. It is fully computerized by way of a Priva system. Greenhouse Engineering was prime consultant on this project, which included a historic building restoration architect, a design architect, mechanical and electrical engineers, among others. The greenhouse contractor was Faber Solariums, Ltd. The electrical load panel, control relays, motor starters, thermal overload devices, computer interface boards, override switches and the greenhouse control computer are all included in one single cabinet, which was delivered to the site fully configured and requiring only a single power feed and direct field connections to all the connected loads and sensors.

Figure 4 – University of Toronto Botany Conservatory reborn as the City of Toronto Children's Conservatory

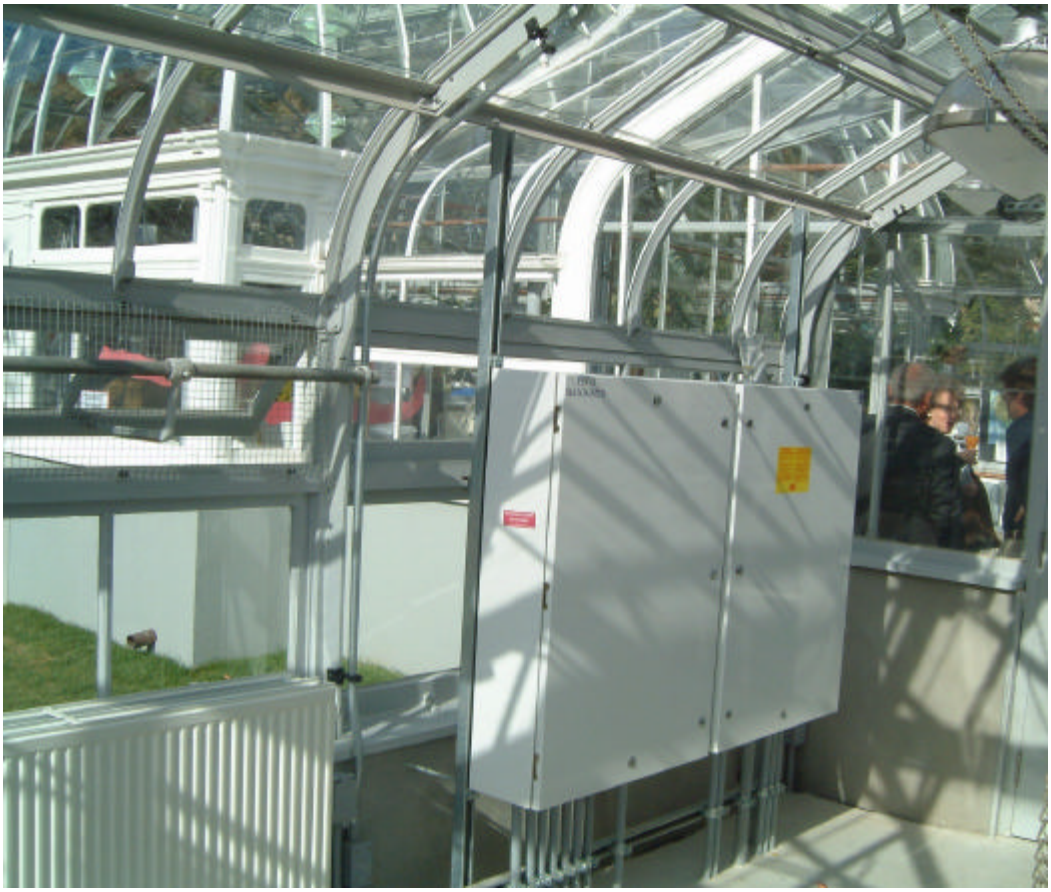

Figure 5 – Children's Conservatory – "Computer in a Box"

2004 also saw the culmination of a three year effort with Conviron to develop a research greenhouse product. The Aurora research greenhouse was unveiled in Winnipeg at the Conviron head office facility in October, 2004. Greenhouse Engineering performed the detailed structure and cladding design, the design of the shade systems, the lighting canopy and assisted in the overall design concept. An Aurora greenhouse facility is near completion at Penn State U, State College PA. This greenhouse might be considered to be a “solar assisted growth chamber”, for its degree of environmental control, uniformity and repeatability of environmental conditions and biological containment capabilities. The computer system is by Argus. Individual zones are as small as 6m x 7m. Within these zones, the control system has the capability of independent monitoring and control of each of three growing benches. Heating, cooling and dehumidification coils are contained below each bench. The structure is entirely of hollow aluminum sections that are powder coated. Glass units are 1.8m square and are fully gasketted on all four sides. A butyl “wet” seal is used between the pressure plate and the exterior surface of the glass. Single laminated glass or insulated glass units may be used in the roof areas. Vertical exterior glazing is of insulated glass units.

Figure 6 – Conviron “Aurora” Research Greenhouse – Exterior View

Figure 7 – Conviron "Aurora" Research Greenhouse – Interior View

We were also nearing completion at the end of 2004, of the extensive renovations at the McGill University Phytotron greenhouse facility. The Phytotron was originally constructed in 1986.The present work included upgrading the mechanical systems (heating, evaporative cooling units, ridge ventilators, insect screens), lighting, shading, blackout system and control computer upgrades. The computer system originally installed by DGT*Volmatic was improved by adding functions and by updating the central data logging and operator interface terminal.

Figure 8 – McGill University Phytotron – Rooftop Greenhouses

New Projects

We are working on a diverse slate of new projects, including a major greenhouse project for Université Laval, Sainte-Foy, Québec. This involves a consolidation of greenhouse facilities for the FSAA and FFG departments and is characterized by containment considerations (level 2P+) and recirculation and extensive treatment of nutrient solutions. These greenhouses, totaling about 1,100 m2 and divided into 20 zones, will be evaporatively cooled, using stainless steel cooler units.

Other projects in design include the Syracuse University rooftop greenhouse project, the Museum of Nature in Ottawa display greenhouse, Duke University collections greenhouses, AAFC Kentville, NS renovations, and Colgate University research and collections greenhouse project.

In the programming phase is an interesting project for the community council at Iqualuit, Nunavut, which is situated at the head of Frobisher Bay on Baffin Island. This will consist of domed greenhouses comprising several independent functions and environmental zones. A winter garden will be operated year-round, with supplemental lighting and a water feature. It will serve as a focal point for the attached community centre. Surrounding the winter garden will be several community gardens, consisting of garden plots for individual users. Attached to the west side will be a conservatory intended for a collection of tundra plants, for study and seed bank. Greenhouse Engineering is the greenhouse consultant and part of a design team that includes engineers and architects with extensive experience designing buildings for Canada's far north. On board with Greenhouse Engineering on this project are Turkewitsch, Faucher, Evans, Hall and Clive Clark.

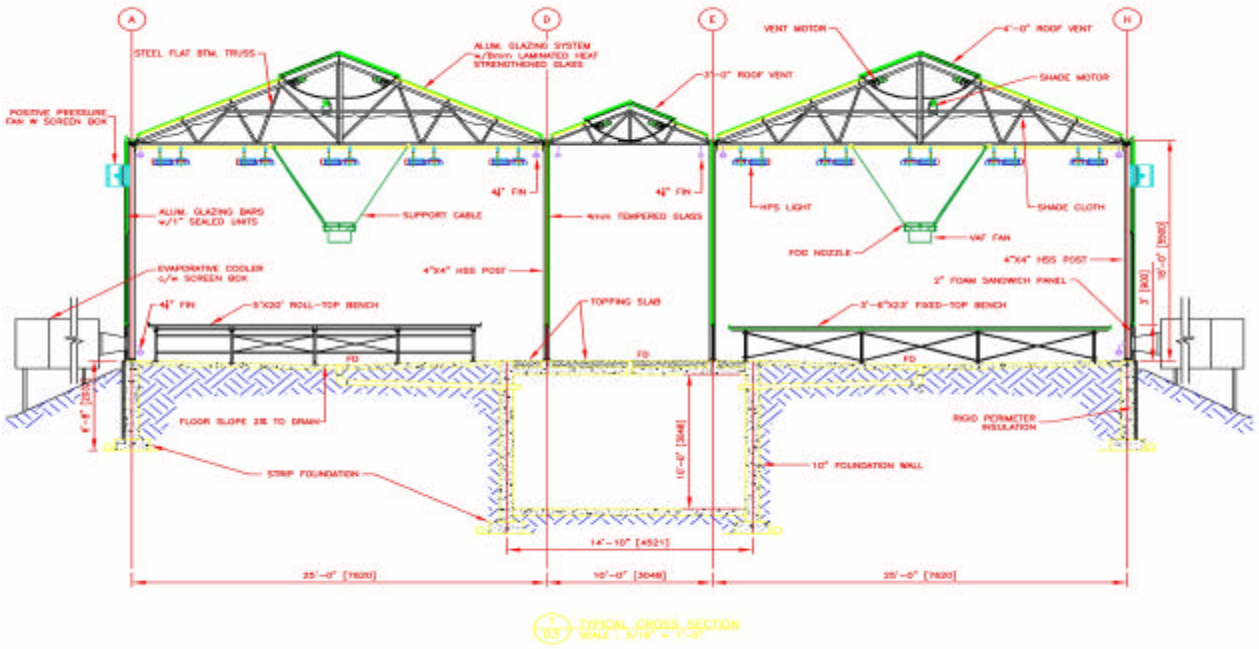

Figure 9 – Université Laval, Sainte-Foy, Québec – Typical Cross Section

Projects currently being constructed include the University of Florida at Gainesville rooftop greenhouse and growth chamber facility, the University of Pennsylvania at Philadelphia research greenhouse project, and Penn State University at State College – Conviron Aurora research greenhouse.

Cooperative Alliances

Over the past four years, Greenhouse Engineering has developed alliances with several consulting firms in complementary and related fields of practice. One of these is Montgomery Smith Inc., of Burlington, KY, headed by Jim Smith. Jim works extensively for conservatories, arboreta, botanical gardens, providing full scope design services, building evaluations, planning and advice for restorations. Our companies have collaborated on six projects over the past four years. We have also conducted six design projects in the past four years with CEA Technologies International, of Aylmer, Ontario, with agronomist Ron Evans. Ron is experienced with feasibility studies, economic analyses of greenhouse crop production systems, specialized growing systems and greenhouse technology. We collaborate regularly with Envirosult, a greenhouse consulting company based in Quebec and operated by Bruno Faucher. Bruno is experienced with all aspects of greenhouse design, with particular emphasis on greenhouse mechanical systems. As the programming phase and the task of determining functional requirements for research and institutional greenhouse facilities has become increasingly complex, we have added to our resource base a horticulturist. Bruce Hall is chief horticulturist at the University of Toronto Botany Department and collaborates with Greenhouse Engineering to advise on greenhouse management, cultural techniques, pest management and practical containment considerations.

ghe Greenhouse Engineering
Alex Turkewitsch, P.Eng. Ltd.

Alex Turkewitsch, P.Eng.
Mobile: (416) 318 5130

86 Glenview Avenue, Toronto, Ontario M4R 1P8, Canada
Tel: (416) 489 3816 Fax: (416) 481 3883
Alex@GreenhouseEngineering.com