

RECENT WORK EXPERIENCE:

H C Fennell Consulting, LLC

North Thetford, VT

Founder and President

October 2009 – Present

Consultant: General

Provides services to the polyurethane foam industry, building owners, architects and engineers, foam manufacturers, contractors, attorneys, insurance companies, government agencies, indoor air quality professionals, and building science experts.

Consultant: Forensic services

Perform indoor air quality and bulk foam sample collection and physical properties testing. Coordinates air quality laboratory testing and assesses test results for foam failure clients. This has included development of laboratory test methods and standards related to polyurethane foam installations. Perform building performance testing related to the polyurethane foam installation. Write findings reports based on the forensic inspections and documentation reviews.

Consultant: Remediation planning

Provide remediation planning including writing bid specifications, dimensional stability stabilization, un-reacted chemical neutralization, IAQ safety protocols, foam removal and replacement plans, and plans for other project-specific lower-cost remediation methods.

Consultant: Expert testimony

Provide technical support for the legal team, including preparation for depositions and special interrogatories, review of opposing responses, understanding foam processing and various installation methods, related codes and building science problems; indoor air quality issues; and expert testimony.

Consultant: Commissioning

New foam installation oversight services are also provided including product and installer selection, documentation reviews, design support, inspections, and quality assurance oversight.

Consultant: Other

Other foam-related work includes education/training, standards development, manufacturing production and means and methods development, and research.

**Conservation Services Group, Inc.
(CSG)**

Westborough, MA

Technical Research Manager

February 2010 – July 2011

Technical Research Manager: Conduct and manage research programs for energy efficiency products and procedures; design, deliver, and evaluate field testing systems; develop standard work requirements for national utility programs, develop foam and sealants specifications, position papers.

Building Science Trainer: Work included WX Boot camp training, WAP program training program evaluations, and building science-related

presentations at national and regional conferences.

Curriculum development: Managed the CSG Curriculum Task Force that developed the MassGREEN Initiative (MGI) training program for the Massachusetts State College system.

Standards development: Development work included ANSI-accredited national standards for weatherization training programs, on-site blower door and air leakage testing protocols, and for the installation and applications of polyurethane foams.

**Building Envelope Solutions, Inc.
(aka FOAM-TECH)**
North Thetford, VT

Founder and President

January 1982 – October 2009

Building Envelope Solutions, Inc. (BES) was a nationally-known Vermont corporation involved in building diagnostics and high-end energy conservation construction services.

Field Applications of Polyurethane foam: Developed the on-site techniques and delivery systems that made foamed-in-place injected polyurethane (IPF) foams available to the general construction industry.

The FOAM-TECH Division: This foam and coatings portion of the Company provided specialized field-applied polyurethane foam contracting services, with a particular focus on critical-environment buildings and process applications (Over 4,000 completed projects). Served specialty markets including art galleries, museums, pool and spa structures, historic and landmark buildings, and environmental mitigation projects. Projects include the Guggenheim Museum. Work included the development of many specialized applications and delivery systems for polyurethane foam and air barrier systems required to meet specific energy, air leakage, and moisture control requirements.

The Thermal Envelope Services & Testing (TEST) Division: performed building envelope commissioning, quality assurance, diagnostic testing, air barrier modeling, and other design support services. **Certification - Infrared thermography - diagnostics and quality assurance testing (Performed over 500 infrared scans and reports).**

Building diagnostics: Over twenty-five years of experience with infrared thermography, blower door, and other building analysis techniques and a broad understanding of theoretical and applied building science as related to building envelope diagnostics and failures. Work included hundreds of major remediation projects. Extensive work on building failures and historic renovation projects in collaboration with numerous building science experts. Projects include the Park Avenue Armory (NYC). **Certifications - Infrared thermography and Pressurized Theatrical Fog air leakage diagnostics - building**

diagnostics and quality assurance testing.

Building envelope commissioning: Provided architects and general contractors with design support, plan reviews, quality assurance, field inspections, and other building envelope commissioning services provided to prevent or remediate building failures. Participated in the design and provided commissioning services for numerous cost-effective high-performance buildings, which relied on the development of comprehensive air and vapor barrier specifications and proprietary quality assurance protocols for air leakage.

Product/Method development:

A number of trade-name products, methods and other innovations were developed to meet specific building performance needs¹.

Neutralization Method Research – *To develop a method for neutralizing B-side residue on substrates under misapplied polyurethane foam installations after the foam has been removed.*

The AVID System (Air Vapor Insulation Drainage) - *basement and crawl space insulation, moisture, and radon control system;*

SUPERGREEN FOAM – *the first US zero ODP (Ozone Depletion Potential) polyurethane foam system;*

The IPF Method: *Developed the method and related delivery systems for on-site closed-cell injected polyurethane foam (IPF);*

Strategic Air Sealing (SAS) *air leakage repair protocol;*

TECH-FORMS - *Composite enclosure system for light construction;*

Autonomous Real-time Remote Observatory (ARRO) - *two generations of structures were designed and produced under contract with the Cold Regions Environmental Research Laboratories and the University of New Hampshire Aerospace Department, both funded by the National Science Foundation. They were installed in McMurdo Divide in Antarctica. These structures are net-zero energy weather stations.*

Intellectual property:

U.S. Government Patent No. 3,789,562, Structural Space-grid Building System with Insulated In-fill Panels (1973) DeChicchis, Fennell, and Schwartz. Modular energy-efficient building system.

U.S. Government Patent Serial No. - 10/961,702, Canadian Patent No. – 2,484,409, Construction Bracket and Roof Venting Method, (2005) Fennell.

U.S. Government/Canadian Patents applied for, Liquid-Applied

¹ Innovations list available upon request

Standards development:

Membrane (LAM) expanding air and vapor barrier system, (2006), Fennell.

U.S. Government Patent, Reusable Modular Components for High-performance Building Construction, (2007), Fennell.

Numerous peer reviews for ANSI and ASTM standards and work requirement documents for the polyurethane foam and energy conservation industries.

US Army Corp of Engineers air tightness standard. Provided training by invitation at the NZE Installations and Deployed Bases workshop in Colorado Springs, Colorado on 2/3-4/09, Army Corps of Engineers Air Barrier Solutions 2009 Workshop in Richmond VA on 9/24/2009, and the Army Corps of Engineers Air Barrier Solutions 2010 Workshop in Williamsburg, VA on 1/28/2010; Provided peer review for the "Airtightness Test Form Guide for U.S. Army Corp Buildings rev. 2008/10/25" which is now the "U.S. Army Corps of Engineers Air Leakage Test Protocol for Building Envelopes Version 3 - May 11, 2012." Contact and input continued until the current version was published. This work also supported the development of the new ASTM standard for testing large commercial and multi-family structures.

Author: ASTM Standard – **Standard Test Method for Identifying Air Leakage Locations by Fan Pressurization and the Introduction of Theatrical Fog.**

Participated in the development of **models and standards** for the Northeast Advanced Vehicle Consortium (NAVC) and Defense Advanced Research Projects Agency (DARPA) funded Electric and Hybrid-Electric Vehicle Program related to the development of the Cold-Weather Specifications for electric vehicles.

Co-author of industry guidance documents created by the Spray Polyurethane Foam Alliance (<http://www.sprayfoam.org/about/committees>). Committees served on include:

- Building Envelope
 - Technical Oversight
 - Safety
 - Consultants
 - Equipment
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PUBLICATIONS & PRESENTATIONS:

Publications:²

Co-author: ***Infrared Thermography as Quality Control for Foamed-In-Place Insulation***, As Printed in SPIE Vol. 1094 Thermosense XI (1989).

Author: ***Setting Air Leakage Standards for Buildings*** (ASHRAE Journal, September 2005).

Author of ***The Use of Urethane Foam Technology in Historic Renovation and Remediation Work***, Presented at: Materials & Media 1 - Restoration and Renovation Exhibition and Conference (2002). (National Trust for Historic Preservation, AIA/CES).

Author of numerous trade journal articles related to building science and foam technologies.

Presentations: Provider of AIA/CES and CSI/CEN educational programs for architectural firms, AIA chapters, and other professionals and energy conservation groups throughout the design³ and construction industries, including the SPFA 2016, 2017, 2018, 2019, and 2020 conferences and the 2018 and 2019 IAQ and Energy conferences.

Training: Developed and provided numerous in-house and industry-wide training programs related to building performance, foam application best practice, and energy conservation needs⁴.

EDUCATION:

Carnegie-Mellon University
Pittsburgh, PA
Bachelor of Architecture

Emphasis - Material and energy-efficient building forms and related systems.

Secondary emphasis - Industrial engineering for mechanical systems and **mass-produced building systems**.

Involved in the Student/Faculty Organization (Reasonable Facsimile Earthworks) responsible for the design and construction of the Pittsburgh Children's Museum, a mobile environmental display (prototype of current program units). This project included my first work with a spray foam installation (1971).

PAST WORK EXPERIENCE:

Emil Hanslin Associates, Inc. Director: Responsibilities included office administration, **project**

² Papers and Articles list available upon request

³ Presentations list available upon request

"The Studio", Grantham, NH **supervision, and design.** Special projects involved new SIP panel product development for local building system manufacturer (Yankee Barn Homes, Inc.). Associate Director (two years), Director (one year).

New Hampshire Water Supply & Pollution Control Commission

Concord, NH, Designer

New Hampshire Water Supply and Pollution Control Commission
Subsurface Waste Disposal System **Design License #505.**

Vermont Class 2 **Public Water System Operator #05183.**

DKS Consulting

Meriden, NH

Building envelope consultant: Subcontracted technical consulting services to DKS under contract to Dartmouth College. Provided data collection, engineering analysis, updated recommendations, and reports for energy conservation through the Federal Technical Assistance Grant Program.

General Consulting and Design

Design and construction management services: Provided architectural design services for high-performance and micro-load buildings in the northeast. Apprentice to David M. Schwartz, Architect. Noteworthy developments included long-term combined-storage for hybrid solar energy systems, high-efficiency low emission pyrolytic converters, and integral heat-sink cooling.

The GNS Company, Inc.

Pittsburgh, PA

Boston, MA

Secretary-Treasurer

Design-engineering work involved the development and manufacture of various products including non-structural and structural insulated **stressed-skin building panels**, flat plate solar collectors, and the first mass-produced Winston **Compound parabolic concentrating (CPC) solar collectors.**

Responsibilities included administration, building systems design, architectural design, solar systems engineering, and supervision of product installation.

Developed and installed the first integrated non-tracking parabolic solar collector structural building panel system.

ARK: Environmental Research

Pittsburgh, PA

Co-Founder

Research Associate for ARK: Environmental Research, a non-profit organization engaged in **architectural and environmental systems research.** Projects included low-cost housing system development. A space-grid structural system with foam insulated in-fill panels was patented.

U.S. Government Patent No. 3,789,562, DeChicchis, Fennell, and Schwartz.

Nonnac: Marine Flotation

Pittsburgh, PA

Service organization specializing in high-output truck-mounted foam processing equipment designed to install marine foam in the flotation compartments of barges and ships to reduce the likelihood and liability of having to raise sunken barges when damaged during normal use or floods in the Three Rivers shipping lanes in and around Pittsburgh, PA.

TEACHING EXPERIENCE:

2009, 2012 Carnegie-Mellon University
Pittsburgh, PA

Guest Lecturer at Carnegie Mellon University's Department of Civil and Environmental Engineering – *High-performance buildings, Introduction to "HAM" and "Foam Plastic Insulation."*

2008-University of Minnesota –
St. Paul, Minnesota

Guest Lecturer at the Graduate School of Architecture - *The Exterior Brick Cavity-wall Application – Theory & Details.*

2004-Carnegie-Mellon University
Pittsburgh, PA

Guest Lecturer at Carnegie Mellon University's Center for Building Performance - *Avoiding/Minimizing the Occurrence of Failures in Commercial Buildings.*

American Institute of Architects / Continuing Education System, Construction Specification Institute (CSI) / Construction Education Network.

AIA/CES (Registered Provider - Number H398) & CSI/CEN. Provide educational programs to assist architects and other industry members in maintaining their competence and in achieving their professional goals.

Boston Wind & Energy

Guest and term lecturer for adult education courses. Discussed such topics as Passive, Active and Hybrid Solar Heating techniques and architectural design for energy conservation.

ORGANIZATIONS:

Past, present, and certifications

Spray Polyurethane Foam Alliance (SPFA). Participating in the Building Envelope, Safety, Consultants, and Technical Oversight Committees

International Code Council (ICC) National and Vermont memberships

Building Performance Institute (**BPI**) – Building Analyst and Envelope/Shell Proctor certifications – Multi-family Standards

Technical Committee

Building Enclosure Council (New York)

American Air Barrier Association (ABAA). Participation in the Technical Committee involved in developing architectural air barrier specifications and certification standards.

Construction Specifications Institute (CSI), CDT qualification

New England Solar Energy Association (NESEA)

National Association of Home Builders (NAHB)

Associated Builders & Contractors NH/VT (ABC)

American Society of Testing Materials International (ASTM)

American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)

American Society of Professional Estimators (ASPE)

Town of Thetford Planning and Zoning Board, Thetford, VT.
Served on the Vermont Governor's Advisory Committee for the Vermont Residential Energy Building Standards.

Responsible for long-range master planning and approval of zoning applications and changes

Town of Thetford Energy Committee (Board Member)

References and additional information furnished upon request