Ch 10. Modulus of Foundation

Copyright Materials

ALLANA BUICK & BERS
Making Buildings Perform Better

Best Practice

Allana Buick & Bers, Inc. (ABBAE) is a Registered Provider with the American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that me be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Karim P. Allana, PE, RRC, RWC

- **Education:** B.S., Civil Engineering, Santa Clara University
- **Registration:** P.E., Civil Engineering, California, Washington, Nevada, and Hawaii
- **Certification:** Registered Roof Consultant (RRC), Roof Consultants Institute, and Registered Waterproofing Consultant (RWC)
- **Overview:**
  - CEO and Senior Principal at Allana Buick & Bers.
  - Former Turner Construction Employee (Project Engineering and Superintendent)
  - Over 37 years experience providing superior technical standards in all aspects of building technology and energy efficiency.
  - Principal consultant in forensic investigations of building assemblies, failure analysis, evaluation and design of building infrastructure and building envelope evaluation and design.
  - Expert in all aspects of building envelope technology.
  - Completed numerous new construction, addition, rehabilitation, remodel and modernization projects for public and private sector clients.
  - Specialization in siding, roofing, cement plaster, wood, water intrusion damage, window assemblies, storefronts, below grade waterproofing, energy efficiency, solar engineering and complex building envelope and mechanical assemblies.

ABBAE Firm Overview

- Allana Buick & Bers (ABBAE) is an Architectural Engineering firm specializing in Building Envelope Systems
- ABBAE is one of the 5 largest building envelope consultants in the country
- ABBAE has over 33 years of experience & over 12,500 projects
- ABBAE is also a leading Forensic Defect firm with hundreds of forensic projects (litigation)
- Locations – 16 offices across California, Nevada, North Carolina, Oklahoma, Oregon, Texas, Virginia, Washington, Colorado and Hawaii

Staff & In-House Expertise

- Licensed Professional Engineers – Civil, Structural, and Mechanical
- Registered Architects
- Building Enclosure Commissioning Process Providers (BECxPs)
- Registered Building Envelope Consultant (RBEC)
- Registered Roofing Consultants (RRCs)
- Registered Waterproofing Consultants (RWCs)
- Registered Exterior Wall Consultant (REWCs)
- Registered Roof Observers (RROs)
- Certified Exterior Insulation and Finish System (EIFS) inspectors
- Curtain Wall Specialists
- ICC Certified Building Inspectors
- Quality Assurance Monitors
- Water Testing Experts
- Leak Investigation and Diagnosis Experts
- Infrared Imaging and Nuclear Moisture Scanning Experts

ABBAE Building Expertise

- Building Envelope Systems
  - Roofing Systems
    - High-Slope/Low-Slope Roofs
    - Green/Garden Roofs
    - Drainage Systems
    - Pedestrian Plazas
  - Exterior Wall Systems
    - Wall Cladding/Siding/GFRC/pre-cast
    - EIFS/cement plaster/stucco
    - Sheet Metal Flashings
  - Windows and Glazing Systems
    - Punched Windows
    - Curtain Wall/Window Wall Systems
    - Sliding Glass Doors
    - Skylights
- Building Envelope Systems (cont'd)
  - Roofing & Waterproofing Systems
    - Deck/Balcony/Lanai Waterproofing
    - Podium Waterproofing
    - Pool/Spa Deck Waterproofing
    - Above-Grade/Below-Grade Waterproofing
    - All types of low and steep sloped roofing
  - Commissioning BECx
    - OPR/BOD/Commissioning Plan
- Mechanical/HVAC Systems
  - HVAC design
  - Plumbing systems
  - Commissioning and testing

ABBAE Core Services

- Consulting and third-party peer review services
- Engineer of record for building envelope systems
- Contract administration services
- Inspection services (usually direct with owner)
- Air and water performance testing
- Mock-up design, observation, and testing
- Building assessments and forensic investigations
- Litigation support and expert witness services
- Educational seminars with AIA credits

Wear Slabs Poured over Rigid Insulation

- Load capacity is a function of:
  - Concrete strength
  - Concrete thickness
  - Reinforcement
  - Modulus of Foundation of substrate

Modulus of Foundation of Plastic Foam Insulation

- Density and resultant compressive strength of rigid foam insulation
- Thickness of layers
- Number of layers

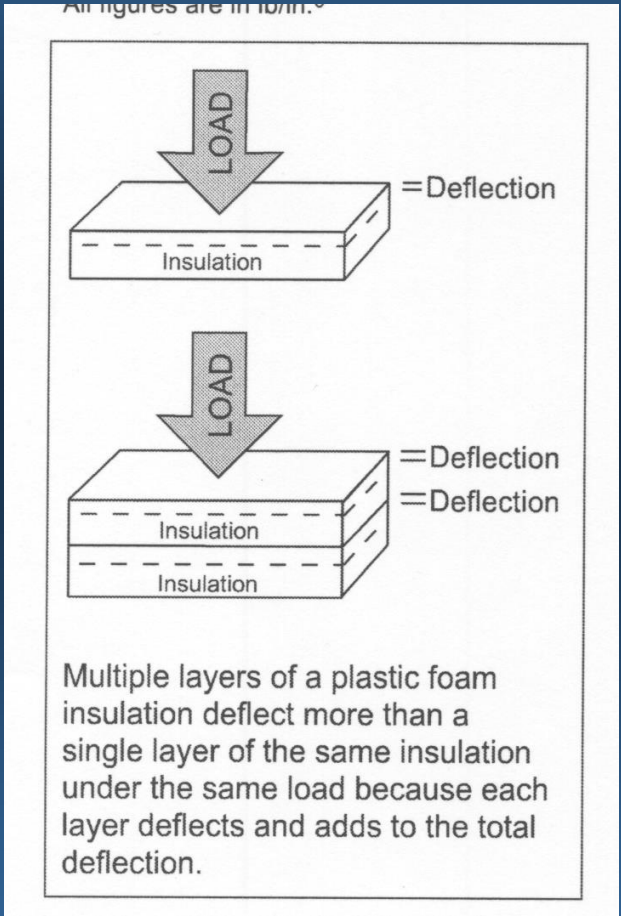
Modulus of Foundation of Plastic Foam Insulation

Table I – Foundation Modulus for STYROFOAM Brand Insulation[1]

Grade of STYROFOAM Brand Insulation	Thickness of Insulation (in.)					
	1	1.5	2	2.5	3	4
FREEZERMATE	–	–	700	655	610	525
High Load 40	1275	1100	980	850	750	600
High Load 60	1600	1400	1250	1100	1000	800
High Load 100	2300	2050	1800	1600	1400	1100

[1]All figures are in lb/in.3

Multiple Layers of Insulation

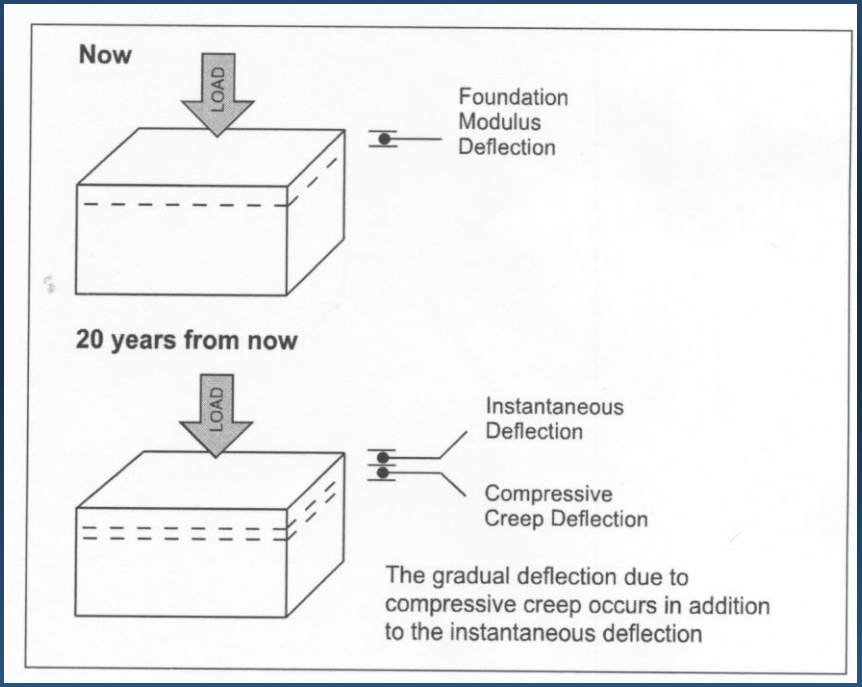


Multiple layers of a plastic foam insulation deflect more than a single layer of the same insulation under the same load because each layer deflects and adds to the total deflection.

The Foundation Modulus for multiple layers of insulation is equal to the Foundation Modulus of one of the layers divided by the total number of layers, if the layers are identical

Compressive Creep

- Creep is gradual, permanent deformation under constant load that is in addition to elastic deformation.
- Known as Compressive Creep



Limiting Compressive Creep

- Guidelines:
  - Compressive Creep should be limited to 2% of insulation thickness
  - To achieve guideline, do not exceed a load of one third the compressive strength of the insulation
  - Also – live loads should be limited to one fifth of the design compressive strength

Example Live and Dead Loads

Load Limit	Grade of STYROFOAM brand insulation			
	FREEZERMATE	High Load 40	High Load 60	High Load 100
Live (lb/in.^{2})	6.0	8.0	12.0	20.0
Dead (lb/in.^{2})	10.0	13.3	20.0	33.3

Example only – unique to Styrofoam Brand Insulation

Design of Concrete Slabs

- Based on the Theory of Plates on Elastic Foundations

Source: Theory of Plates ans Shells, Timoshenko and Woinowsky-Krieger: McGraw Hill 1959

Ch 10. Modulus of Foundation