WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Sustainable Energy Efficient Roofs: Myths vs. Facts

Presented to:

cefpi where great schools begin
COUNCIL OF EDUCATIONAL FACILITY PLANNERS INTERNATIONAL

Southern Regional Conference
Austin, Texas
April 6, 2013

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PERSONNEL QUALIFICATIONS

Edis Oliver / Principal

EDUCATION

- Texas A&M University
  - Bachelor of Science, Mechanical Engineering, 1964
  - Bachelor of Business Administration, 1964
- University of Chicago
  - Master of Business Administration, 1969

PRACTICE AREAS

- Condition Assessment
- Construction Safety
- Facility Management
- Roofing and Moisture Protection
- Preventative Maintenance Programs
- Project Administration

REGISTRATIONS

- Professional Engineer in TX
- Licensed Risk Manager for the Texas Department of Insurance

CONTACT

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EXPERIENCE

Edis Oliver joined WJE in 2006 and has over forty years of experience in the construction and engineering field. Mr. Oliver is also experienced in the management of large scale roofing contracts, which has given him unique, real world experience in providing the best roofing values to clients. He was formerly an engineer with Otis Elevator Company and Honeywell, Inc. where he was selected for the Honeywell President's Club for outstanding achievement. In 1973, he founded Oliver Roofing Systems, Inc. Over a ten-year period, he developed it into a successful $4.5 million roofing contractor firm, which he later sold to employees. In 1991, Mr. Oliver founded Edis Oliver & Associates, a licensed engineering and roof consulting firm. That firm developed into a premier roof consulting firm in Texas, with key accounts at universities, school districts, and governmental agencies.

Mr. Oliver was selected by the Roofing Contractors Association of Texas to write the roofing contractor certification manual in 1991, entitled "Managing a Roofing Company Texas."

REPRESENTATIVE PROJECTS

Condition Assessment

- United Launch Alliance - Decatur, AL: Assessment of roof hail damage at rocket assembly plant
- Texas Tech University Health Science Center - Amarillo, TX: Investigation of roof wind blow-off at health care facility
- Edcouch-Elsa Independent School District - Edcouch, TX: Assessment of roof conditions on five schools during litigation

Facility Management

- IBM Corporation, Austin Facility - TX: Development of roof management program for 2 million-square foot plant
- North East Independent School District - San Antonio, TX: Development of roof management program for district consisting of 8 million square feet and seventy-five campuses
- San Jacinto College District - Houston, TX: Development of roof management program for three college campuses
- North East Independent School District - San Antonio, TX: Development of roof designs for $462 million school bond program
- San Jacinto College District - Houston, TX: Development of roof designs for $75 million bond program

Roofing and Moisture Protection

- Fort Hood Maintenance Facility - Fort Hood, TX: Survey, design, and performance of construction administration work for 225,000-square foot maintenance facility.
- Jester Center, University of Texas at Austin - TX: Survey, design, and performance of construction administration work for $1 million roof replacement

SEMINARS

- AIA Austin Summer Conference, Seminar on "Roof Construction"
- Building Enclosure Council, San Antonio, Seminar on "Roof Construction"
- AIA Texas Convention, Seminar on "Roof Construction"
- San Antonio CEFPI Chapter Seminar on "Roof Construction"

AWARDS

- Curtis Blackwell Memorial Award, Roofing Contractors Association of Texas, for the individual who made the greatest contribution to the roofing industry in Texas for the year 2012
- Texas Consulting Engineers Council, Silver Medal Award for roof replacement design at National Guard Armory at Ellington Field, Houston, TX

PROFESSIONAL AFFILIATIONS

- Professional Roofing Standards Council, Roofing Contractors Association of Texas, former president
- Associated Builders and Contractors, CenTex Chapter, former president
- Austin Roofing Contractors Association, Future Directions Committee, Roofing Contractors Association of Texas, former president

Sustainable Energy Efficient Roofs

Myths vs. Facts

Southern Regional Conference
Austin, Texas

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Sustainable Energy Efficient Roofs

Myths vs. Facts

Presented by
Edis Oliver, PE
Principal

WJE

Goals for the Program

- Define a "Sustainable Roof"
- Learn the challenges in roof design
- Learn all components in roof selection.
- Learn how to procure sustainable energy efficient roofs

About WJE

- Engineers, architects and material scientists
- Completely independent.
- No ties to any:
  - Manufacturer
  - Distributor
  - Contractor
- No exclusionary or proprietary specifications

Sustainable Roof Definition

- A sustainable roof is that which:
  - Has the longest trouble-free service life.
  - Has the lowest life cycle cost.
  - Produces the greatest energy saving.
  - Best serves as a platform for other requirements.

Requirements for Sustainability

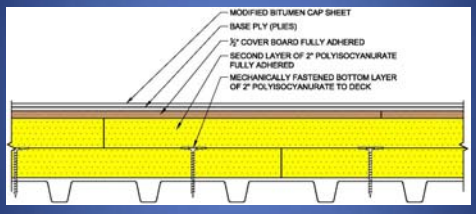
- Sound roof drainage design.
- Proper wind resistant construction.
- Proper energy efficiency.
- Proper installation of ***all*** roof components
- Regular inspection and maintenance.

Roof Terminology

- Low slope roof = Less than 3:12 pitch
- Steep slope roof = Greater than 3:12
- Should be no such thing as a "Flat" roof

Design for Area Wind Zone

2009 IBC Requires R-22 Roof Insulation

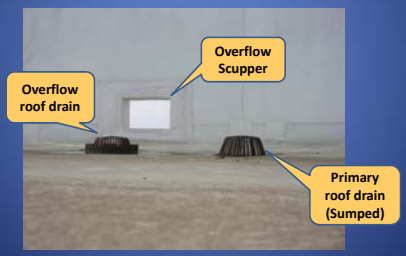


All Roof Components?

- Roof drains
- Through-wall flashings
- Roof mounted equipment
- Access ladders, steps, and cross-overs
- Lightning protection
- Skylights
- Fall protection and tie-offs/restraints

Roof Drains

- 2009 IBC requires 100% redundancy with primary and overflow roof drains.



Raise Through-wall Flashings

Roof Access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Access Ladders




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Fall Protection



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Fall Restraints and Tie-Offs

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Lightning Protection

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Skylights

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Manage Equipment

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Manage Equipment

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Manage Equipment

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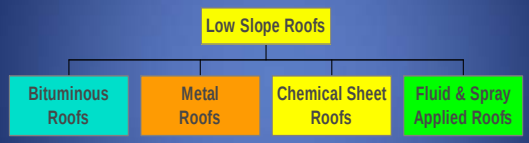
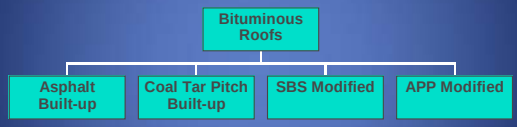
Types of Roof Coverings
Low Slope Roof Family



Low Slope Roof Family



Common Low Slope Roofs

- Multi-ply bituminous Asphalt based
  - Asphalt built-up with gravel surface
  - Modified bitumen
- Single-ply chemical
  - Ethylene propylene diene monomer (EPDM)
  - Polyvinyl chloride (PVC)
  - Thermoplastic olefin (TPO)

Multi-ply Bituminous Asphalt Based

- Nailable deck = Lightweight insulating concrete, gypsum or wood
- Non-nailable substrate = roof insulation
- 3 or 4 layers of glass fiber ply sheet
- Hot asphalt binds and waterproofs
- Smooth surface or gravel aggregate

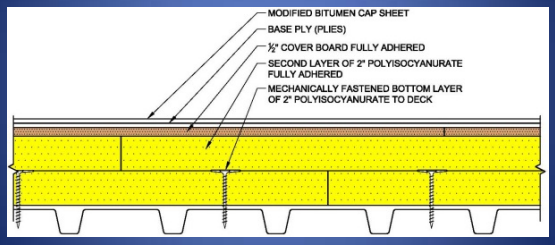
Lightweight Insulating Concrete




Ply Application


Good Metal Deck Prep for Roofing

Proper Metal Deck Roof Construction



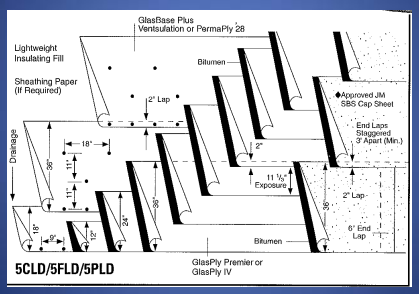
Rigid Roof Insulation on Metal Deck

Second and Third Layers with Staggered Joints

Texas Energy Code

- Applies to all buildings in Texas
- Reroofing is a "*substantial modification*" to a building.
- All buildings must comply (minimum R-22 roof insulation).
- Public buildings must have design submitted to SECO.

Roof Application Schematic



Four Application Methods for Modified Bitumen

- Mop plies in hot asphalt
- Heat weld plies with open flame torch
- Adhere plies with cold MB adhesive
- Self adhering plies

Mopping plies in hot asphalt

Torching Energy Star Cap Sheet

Applying with Cold Adhesive

Ballasted EPDM Reroof

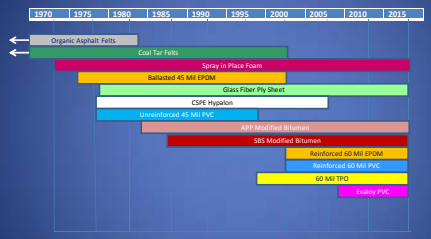
TPO with Heat Welded Seams

Myth No. 1

- Myth:
- The skin or roof covering is the most important consideration in a roof decision.

- Fact:
- Wrong. The complete assembly (air to air) is the most important consideration.

Life Cycle of Low Slope Roof Products



Estimated Roof Lives

Type	Avg. Years, RIEI
Metal Panels	25
Coal Tar Pitch BUR	23
Asphalt BUR	16.7
SBS Modified	16.6
TPO	15.0 *
APP Modified	14.1
Reinforced PVC	14.2
EPDM	13.0
Reinforced Hypalon	12.8
Polyurethane Foam	12.1

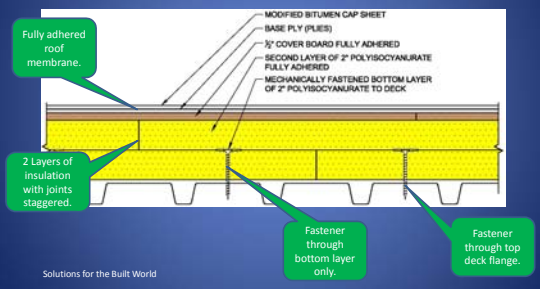
Data from Roofing Industry Educational Institute, 2000

Myth No. 2

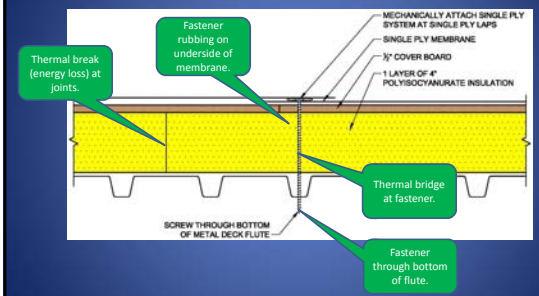
- Myth:
- Single-ply roof membranes are cheaper than multi-ply modified bitumen membranes.

- Fact:
- Wrong. Single-ply roofs are usually applied over cheaper assemblies.

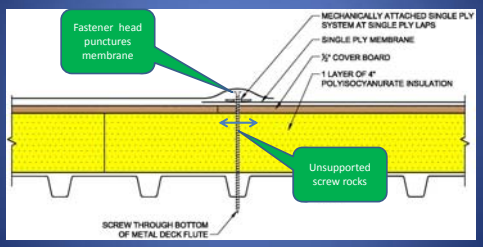
Proper Modified Bitumen Roof System



Typical Single Ply Roof Assembly

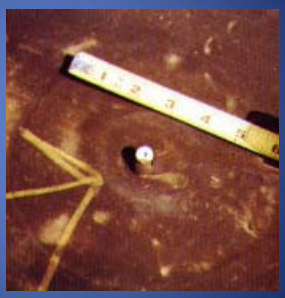


Single Insulation Layer Failure Mode



Single Ply Failure Mode

- Fastener Backout



Summary Note

- When roof membranes are both fully adhered, *not mechanically fastened…*
- When the roof insulation assemblies are identical…
- The cost of a single-ply membrane and multi-ply modified bitumen membane *are equal*.

Myth No. 3

- Myth:
- White roofs save energy.

- Fact:
- Wrong. Heat island effect maybe, but energy for your building? Unlikely.

"Cool Roofs": The Hot Topic

Two key attributes of a roofing system that affect a building's energy usage:

- **Reflective Properties**
- **Insulative Properties**

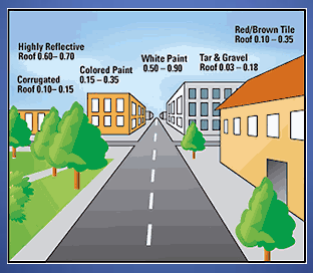
Reflectance…

- Reduces heat gain
- Cools roof surface

Simply put… a highly reflective roof can return a significant portion of the sun's energy back to the atmosphere and the roof's surface stays cooler

How Cool is a Cool Roof?

Some Typical Reflective Values



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Source: U.S. DOE/EPA

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How Cool is a Cool Roof?

89 ºF noon

EPDM single-ply 173 °F

BUR topped with aggregate 159 °F

BUR topped with capsheet 158 °F

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How Cool is a Cool Roof?

89 ºF noon

Cool single-ply 121 °F

Cool coating over BUR 108 °F

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So What Are the Trade-Offs?

Insulation ??? R-Value

??

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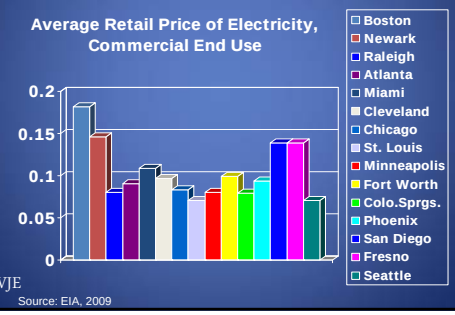
Energy Costs…
Electricity for Commercial Customers, $/kwh



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Source: EIA, 2009

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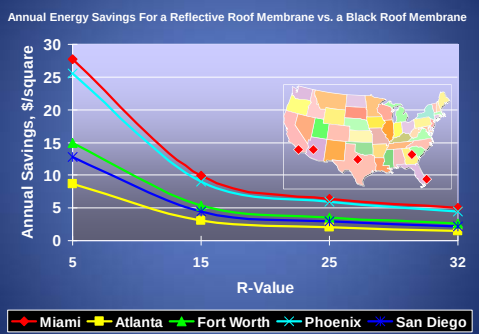
Annual Energy Savings
Southern



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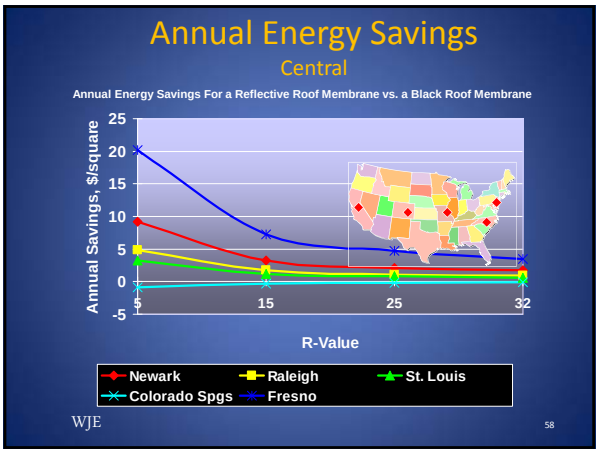
Annual Energy Savings

Central



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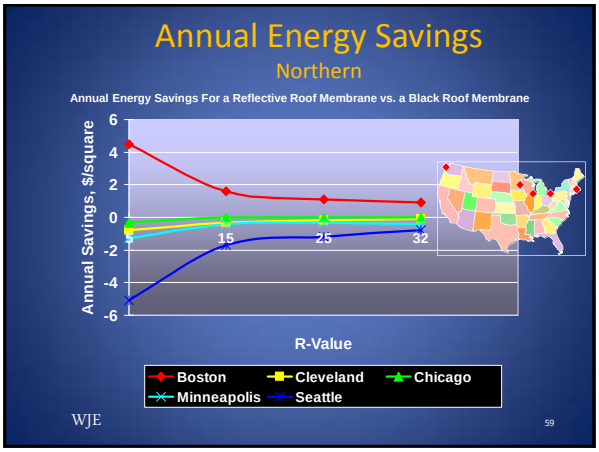
Annual Energy Savings

Northern



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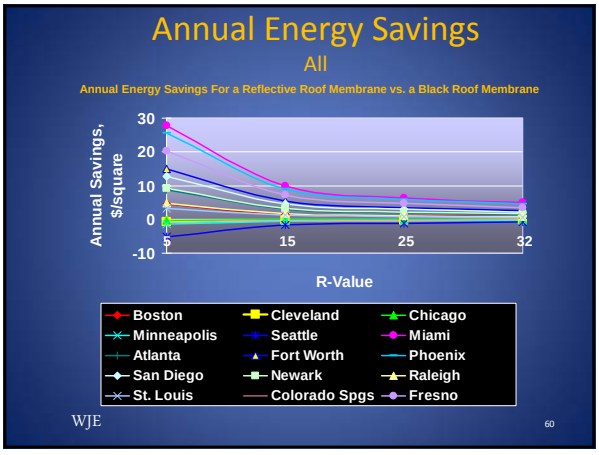
Annual Energy Savings

All



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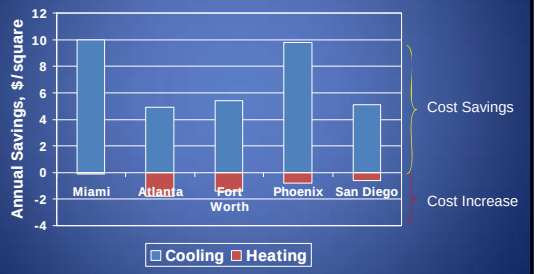
Another Way To Consider the Trade-Offs...Southern

Annual Energy Savings with R-15 Insulation For a Reflective Roof Membrane vs. a Black Roof Membrane



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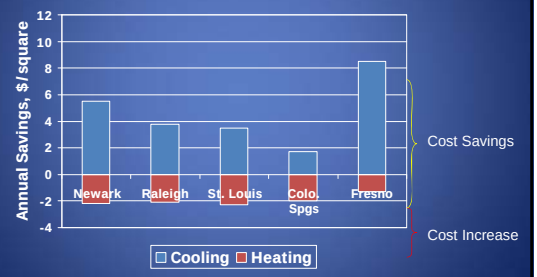
Another Way To Consider the Trade-Offs...Central

Annual Energy Savings with R-15 Insulation For a Reflective Roof Membrane vs. a Black Roof Membrane



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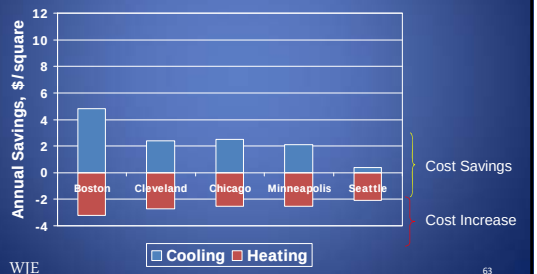
Another Way To Consider the Trade-Offs...Northern

Annual Energy Savings with R-15 Insulation For a Reflective Roof Membrane vs. a Black Roof Membrane



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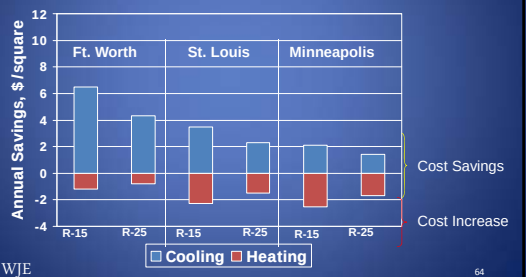
Considering the Effect Insulation Has…

Annual Energy Costs/Savings For a Reflective Roof Membrane vs. a Black Roof Membrane



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Insulation vs. White Roof

- Best value = R-22 Roof Insulation.
- Works summer and winter and day and night.
- White roof offers little energy saving if building has at least R-16 roof insulation.
- White roof does not stay white.
- White roof is mostly “feel good” for the heat island effect.

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Myth No. 4

- Myth:
- Recovering an existing roof is just as good as tearing the old roof off plus it saves money.

- Fact:
- Wrong. Recovered roofs only last 2/3 as long as when roofs are torn off plus they fail to meet the Texas energy code.

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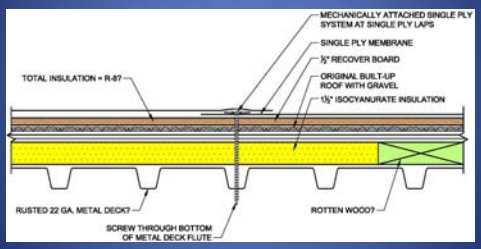
Recover Existing Roof



Recover is Poor Value

- Recovered roofs last about 2/3 as long.
- Likely to cover up long-term deficiencies:
  - Wet insulation
  - Rotten wood nailers
  - Rusted deck
  - Poor drainage
- Usually do not meet the Texas Energy Code.
- Likely not to retrofit for International Plumbing Code compliance.

Myth No. 5

- Myth:
- My 20 Year No Dollar Limit Roof Warranty will cover my problems.

- Fact:
- Wrong. Roof warranties exclude almost everything likely to go wrong on your roof.

Roof Warranty Coverages

- What does a roof warranty cover?
- Repair of leaks only if not caused by any of the listed exclusions in the warranty document.

Roof Warranty Exclusions

- Leaks caused by penetrations and equipment.
- Leaks at sheet metal, such as copings.
- Normal wear and tear.
- Materials failures not yet leaking.
- Wind damage above 55 mph, unless stipulated otherwise.
- Hail damage, unless stipulated otherwise.

Warranty Exclusions (Continued)

- Leaks at skylights
- Damage due to poor drainage or ponding.
- Deterioration due to chemicals.
- Failure of excluded materials.
- Damage due to excessive foot traffic.
- Unapproved modifications or alterations of the original roof.
- Work by unauthorized contractors.

New Technology - Solar

Solar Technology and Roofs

- Installation must allow for roof maintenance access.
- Installation must allow for solar service traffic.
- Installation must meet wind design standards.
- Solar reflectivity, heat load, and wind effects on roof systems are under study and long-term effects unknown.

Provide for Roof Maintenance

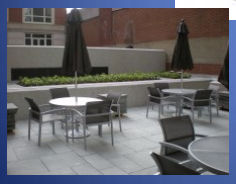
Possible Unintended Consequences

Possible Unintended Consequences

Solar Energy Tips

- Ensure solar design accommodates roof maintenance and repair.
- Ensure solar design accommodates ASCE 7 wind zone design.
- Plan for roof replacement as part of the solar installation unless a very new roof.

New Technology - Green



Green Roofs

- Weigh 35 to 65 lbs./sq. ft., or *up to 20 times* the weight of a conventional roof.
- Mostly limited to structural concrete decks.
- Know your plants.
- Plan for maintenance.

Madison High School Agri-Science North East I.S.D., San Antonio

Green Roof Collapse in Illinois

Keys to a Sustainable Energy Efficient Roofing System

- Most sustainable roof = longest life.
- Most energy efficient:
  - Insulation trumps "cool roof" effect
  - Texas Energy Code = R-22
- Design the entire assembly and all components, *not just the skin*.
- Tear off old roof; do not recover.

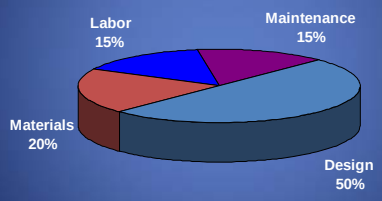
Keys to a Sustainable Energy Efficient Roofing System

- Good slope and drainage
- Wind resistant design
- Multiple layer insulation
- Equipment management
- Access ladders
- Fall protection
- Lightning protection
- Skylights

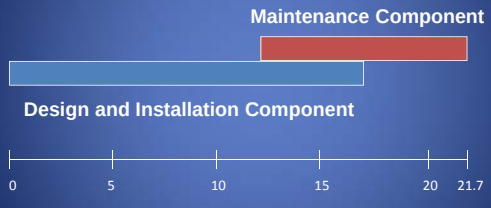
Sustainable Roof Procurement

- Design must consider entire assembly and all components, not just the skin.
- Material price competition at three levels:
  - National manufacturer – 4 or 5 manufacturers.
  - Local roof material distributor.
  - Local roofing contractors.
- Avoid proprietary or exclusionary products.
- Design-Bid-Build is best option.

Causes of Premature Roof Failure



The Roof Maintenance Component



The Wrong Way.

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The Right Way.

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Thank You.

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