The Evolution of Roofing Membranes

Summer Camp '17

Helene Hardy Pierce
GAF

August 1st, 2017

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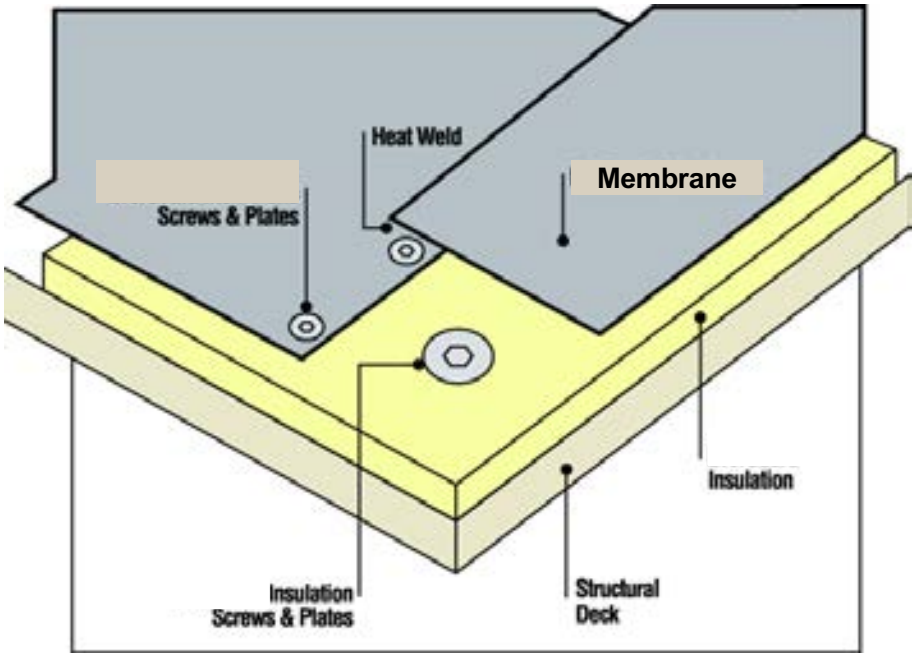
Carl G. Cash Award

ASTM INTERNATIONAL

So let's talk about roofing membranes…

The Roofing System…



- System
  - Wind/Fire
  - Traffic
  - Bldg. Use
  - Access
  - Secondary Use
  - Maintenance

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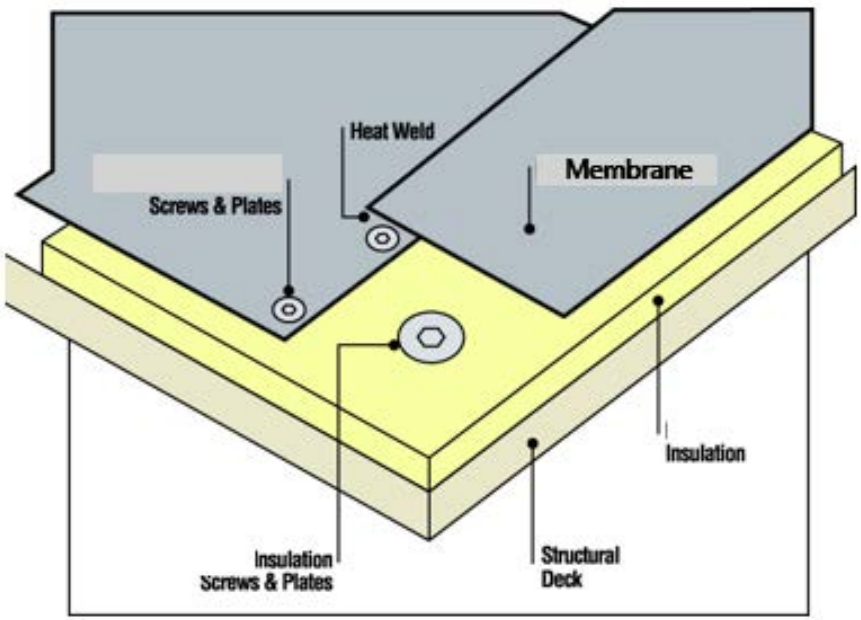
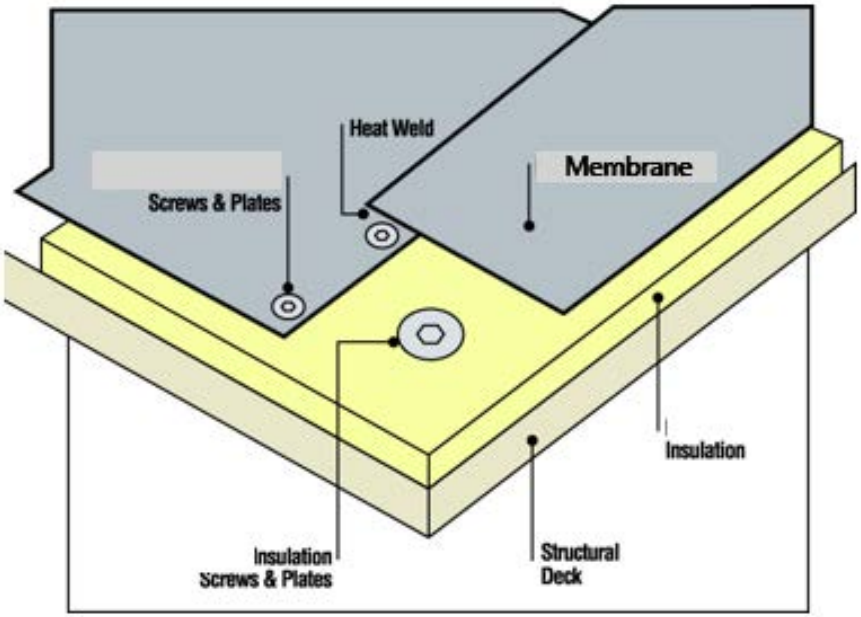
Structural Deck…



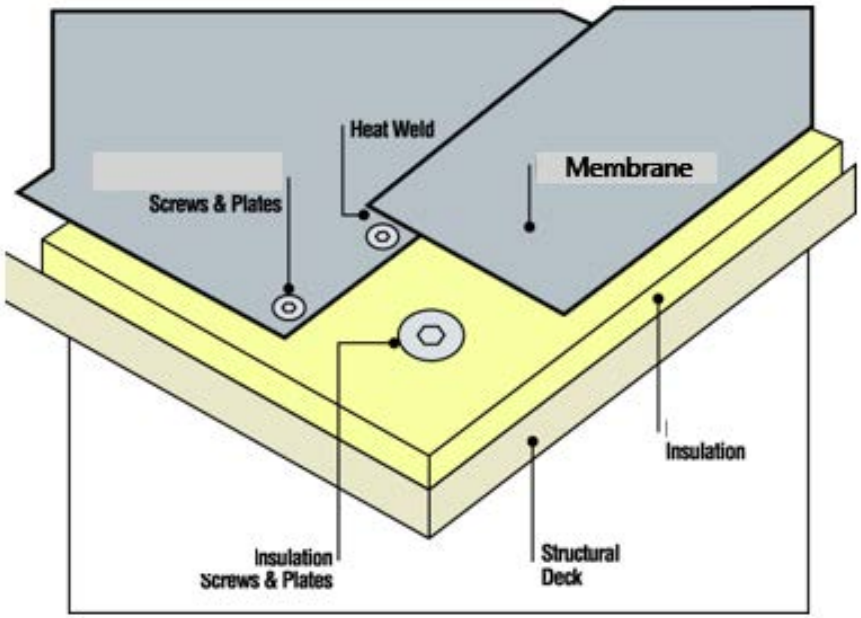
- Deck
  - Ability to attach
  - Moisture
  - Movement
  - Slope
  - Movement relative to walls
  - Air leakage

Insulation…



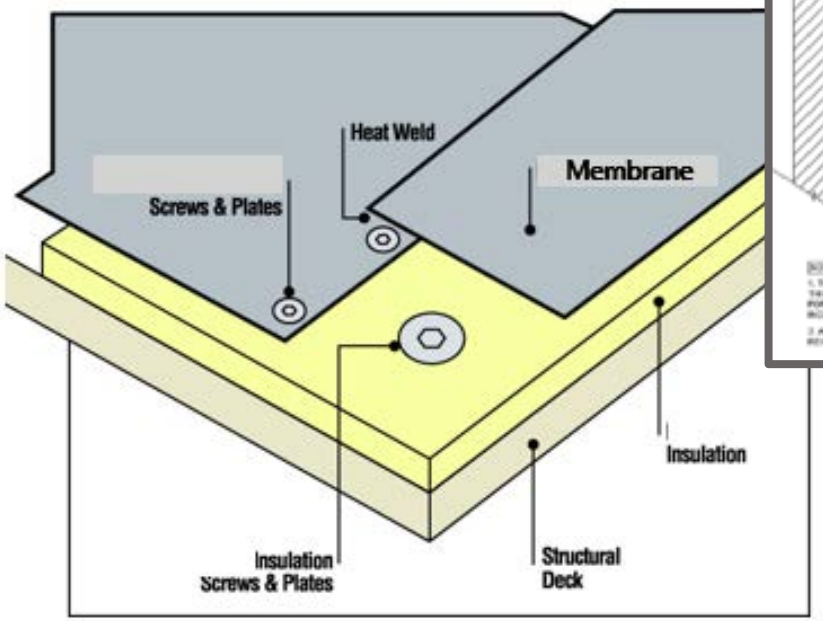
- Insulation
  - Number of layers
  - Attachment
  - Compatibility
  - Fastener location
  - Durability to traffic
  - Coverboard or not
  - Joints staggered

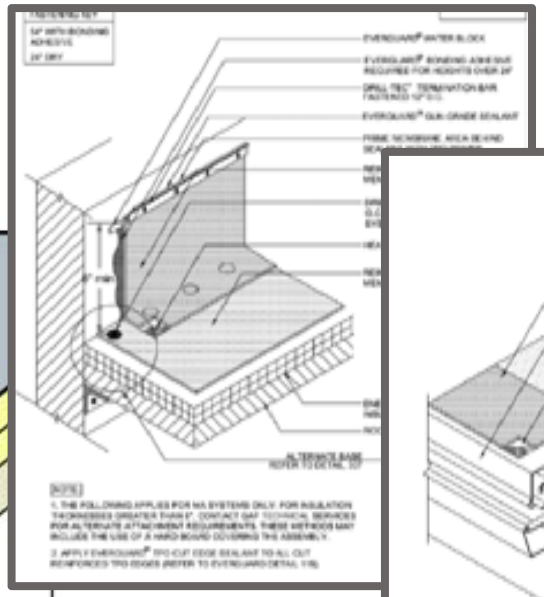
Membrane…

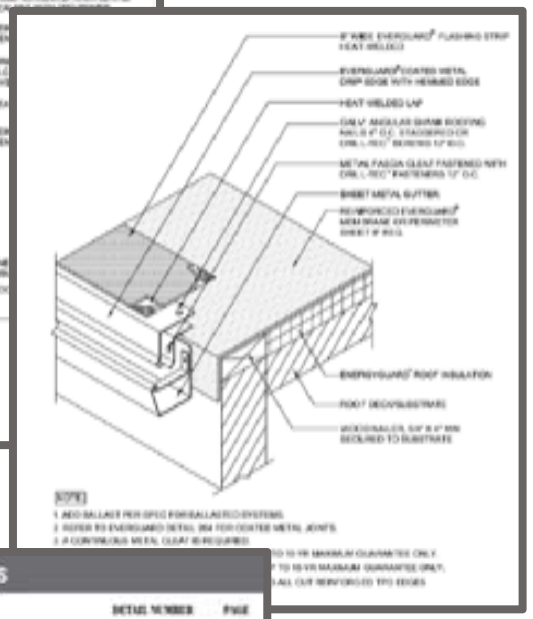


- System Type
  - Mechanically attached
  - Hot asphalt
  - Heat welding
  - Fully adhered
- Membrane
  - Number of layers
  - Type
- Vapor Retarder
  - Need
  - Type
  - Attachment
  - Compatibility

Details







ROOFING DETAILS

DETAIL NAME	DETAIL NUMBER	PAGE

Critical to ANY Installation…

Paraprosdokian…

WHERE THERE'S A WILL, I WANT TO BE IN IT

*Paraprosdokians…are figures of speech in which the latter part of a sentence or phrase is surprising or unexpected; frequently humorous.

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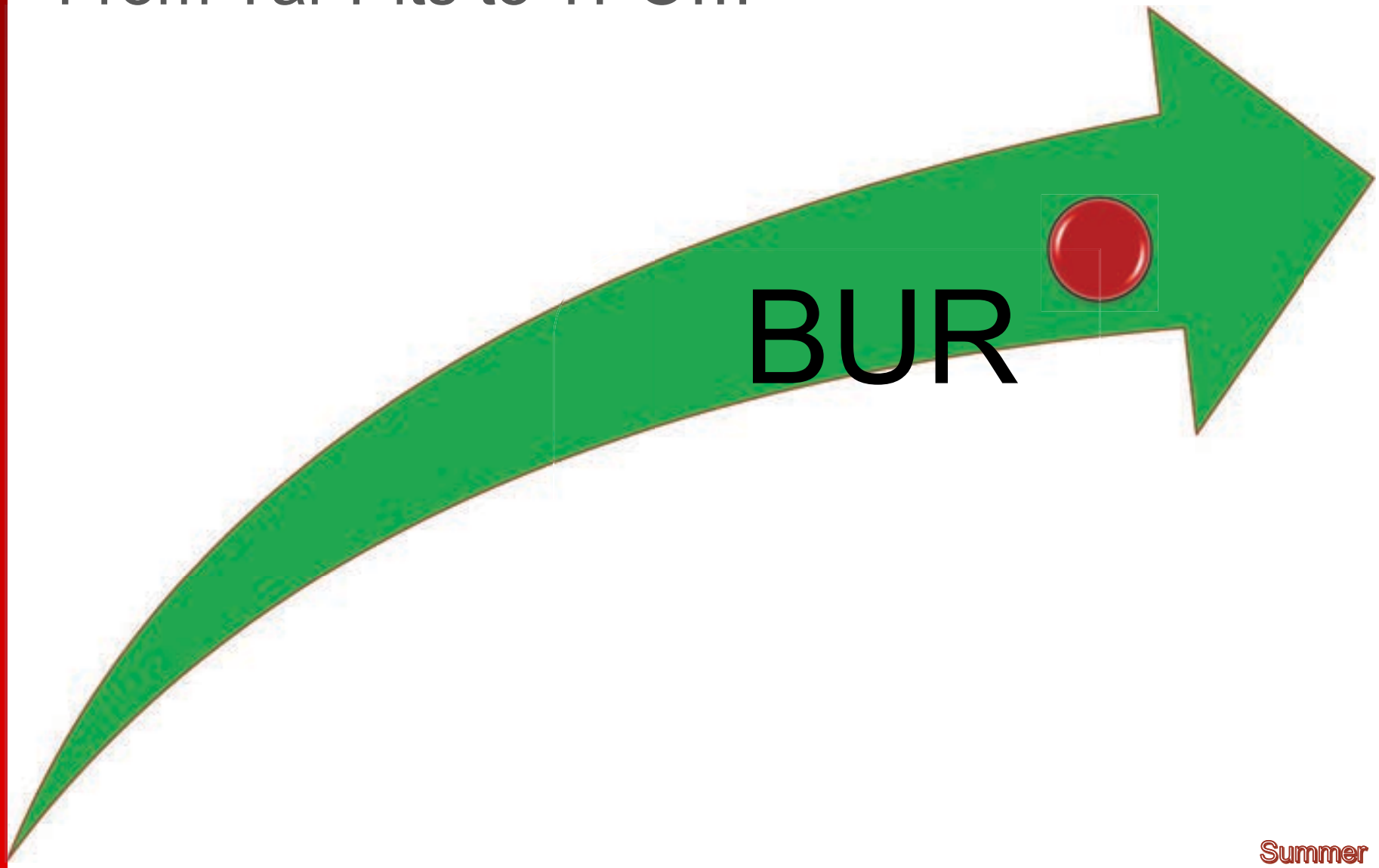
Evolution…

WHERE DID WE COME FROM?

From Tar Pits to TPO…



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Tar pits are composed of heavy oil fractions called gilsonite, which seeped from the Earth as oil. In Hancock Park, crude oil seeps up along the 6th Street Fault from the Salt Lake Oil Field, which underlies much of the Fairfax District north of the park.[3] The oil reaches the surface and forms pools at several locations in the park, becoming asphalt as the lighter fractions of the petroleum biodegrade or evaporate.

This seepage has been happening for tens of thousands of years. From time to time, the asphalt would form a deposit thick enough to trap animals, and the surface would be covered with layers of water, dust, or leaves. Animals would wander in, become trapped, and eventually die. Predators would enter to eat the trapped animals and also become stuck.

Indians would use surface bitumen to waterproof…

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From 1896…

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Represents over 50 years actual experience…

THE BARRETT HAND BOOK

THE object of this Hand Book is to carefully and fully describe the many and varied uses of Coal Tar Pitch and Tarred Felt in building construction, and to place before Architects, Engineers, Builders and Owners a series of Standard Roofing Specifications.

The accompanying Specifications represent the results of over fifty years actual experience of the most prominent and successful contractors and professional men.

We also furnish information regarding many

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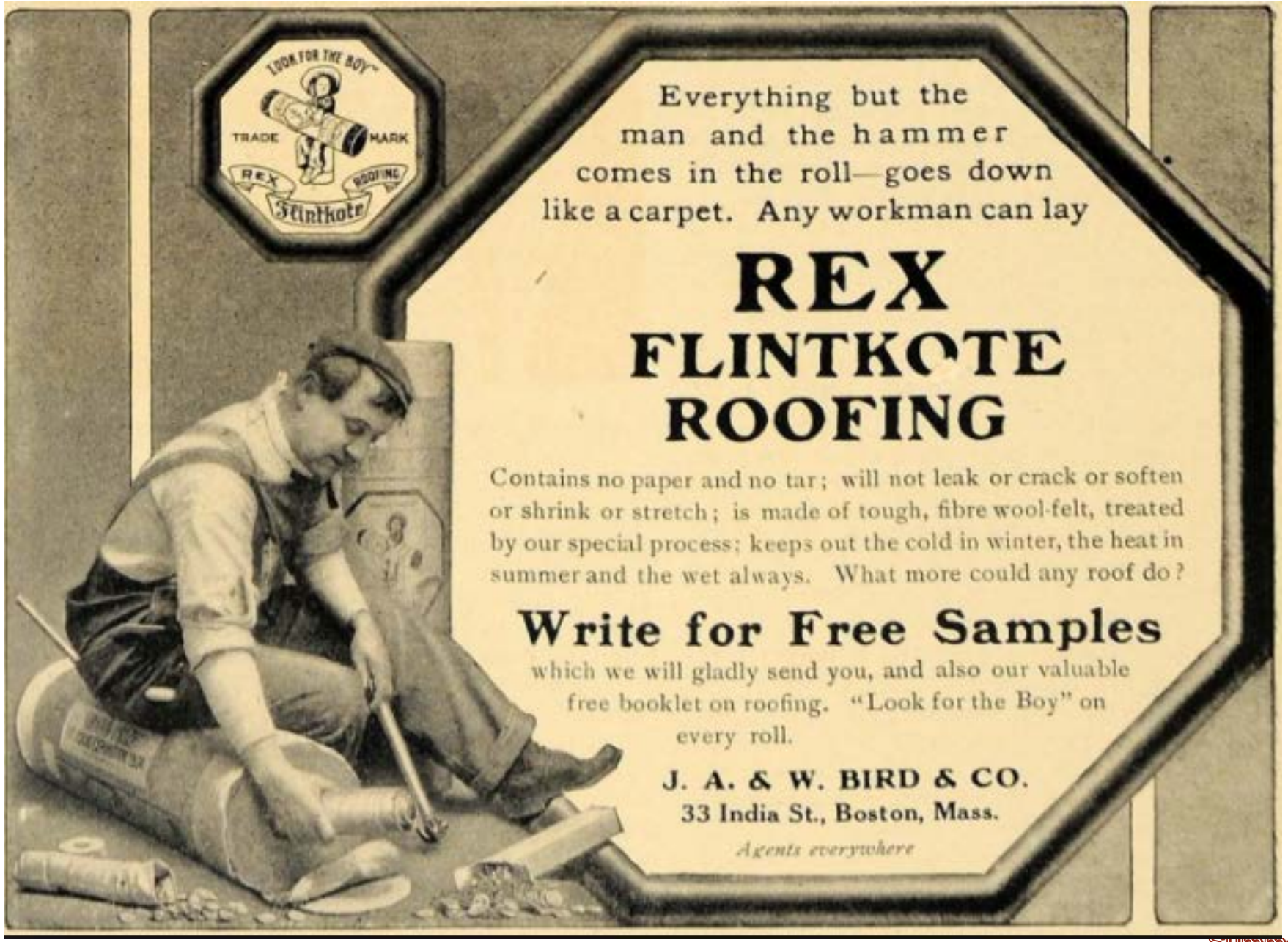

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Bitumen…

- Pitch
- Asphalt
  - Type I — Dead Level Applications
  - Type II
  - Type III
  - Type IV — Steep Slope Applications 2/12+
- Rubberized

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Plies…

- Type IV Fiberglass
- Type VI Fiberglass
- Fiberglass Reinforced
- Polyester Reinforced

Surfacing…

- Protection
  - UV Degradation
  - Roof Top Traffic
  - Wind Damage
- Aggregate
- Mineral Surface (Granulated)
- Coating

BUR

BENEFITS

- Multi-ply
- Waterproofing
- Surfacing Options

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BUR

BENEFITS	• Multi-ply • Waterproofing • Surfacing Options
LIMITATIONS	• Labor • Fumes • Temperature

BUR

BENEFITS

- Multi-ply
- Waterproofing
- Surfacing Options

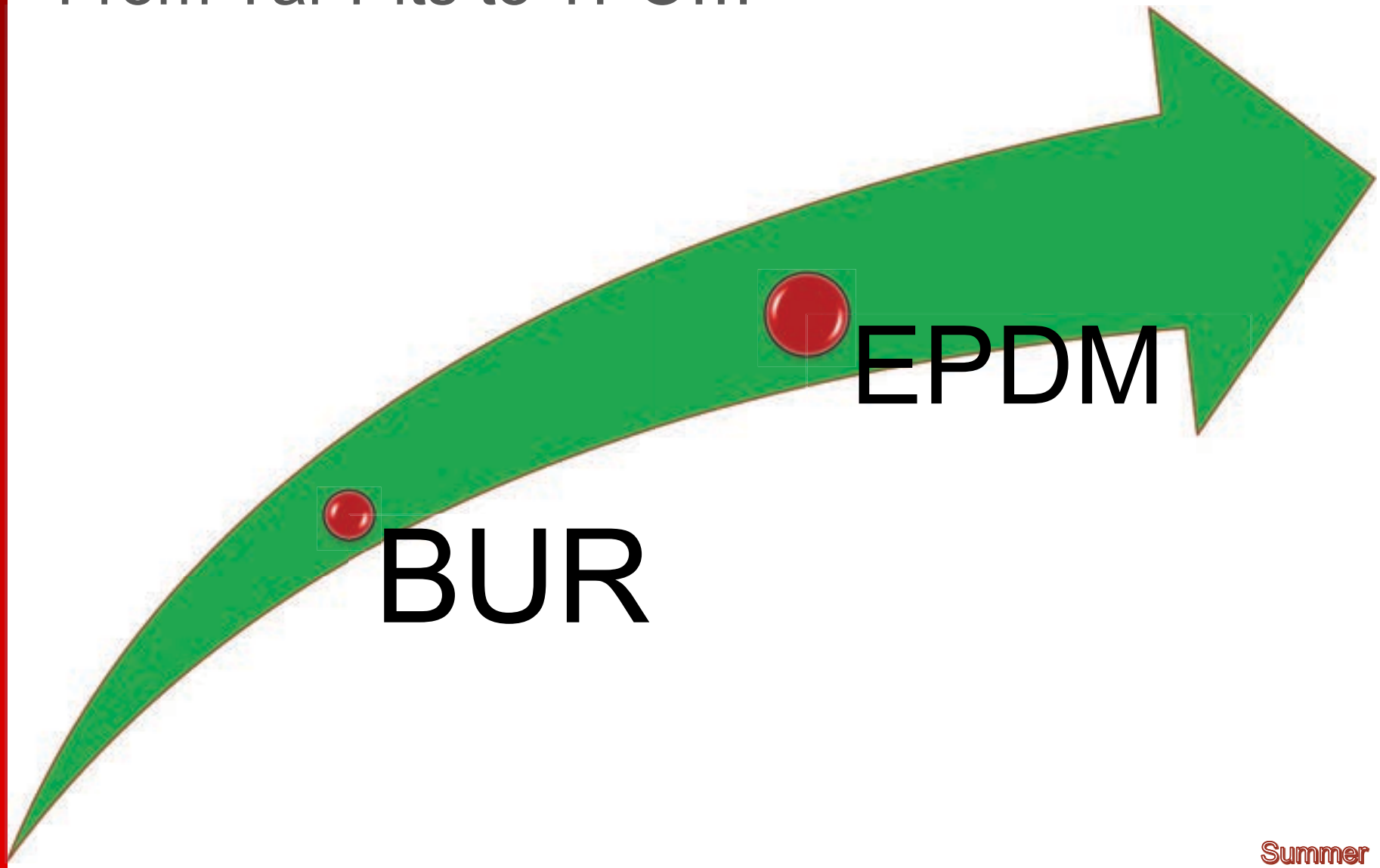
LIMITATIONS

- Labor
- Fumes
- Temperature

MISPERCEPTIONS

- “Old Technology”
- Not Energy Star/Reflective
- No Longer Available

From Tar Pits to TPO…



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EPDM…

- Since 1960's
- Went down quickly-large panels
- Very economical-gravel ballast
- More versatile-building movement
- "Cleaner" than BUR

EPDM

BENEFITS

- Very Stable Membrane
- Large Sheet Size
- Taped Seams Perform Well

LIMITATIONS

MISPERCEPTIONS

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EPDM

BENEFITS

- Very Stable Membrane
- Large Sheet Size
- Taped Seams Perform Well

LIMITATIONS

- Low Reflectivity
- Taped/Glued Seam vs. Heat Fused/Welded
- “Single Ply”

MISPERCEPTIONS

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EPDM

BENEFITS

- Very Stable Membrane
- Large Sheet Size
- Taped Seams Perform Well

LIMITATIONS

- Low Reflectivity
- Taped/Glued Seam vs. Heat Fused/Welded
- “Single Ply”

MISPERCEPTIONS

- Most Are Ballasted
- Black ≠ Energy Efficient
- Not Puncture Resistant

Flexible membranes
Easy walls
Huge sheets

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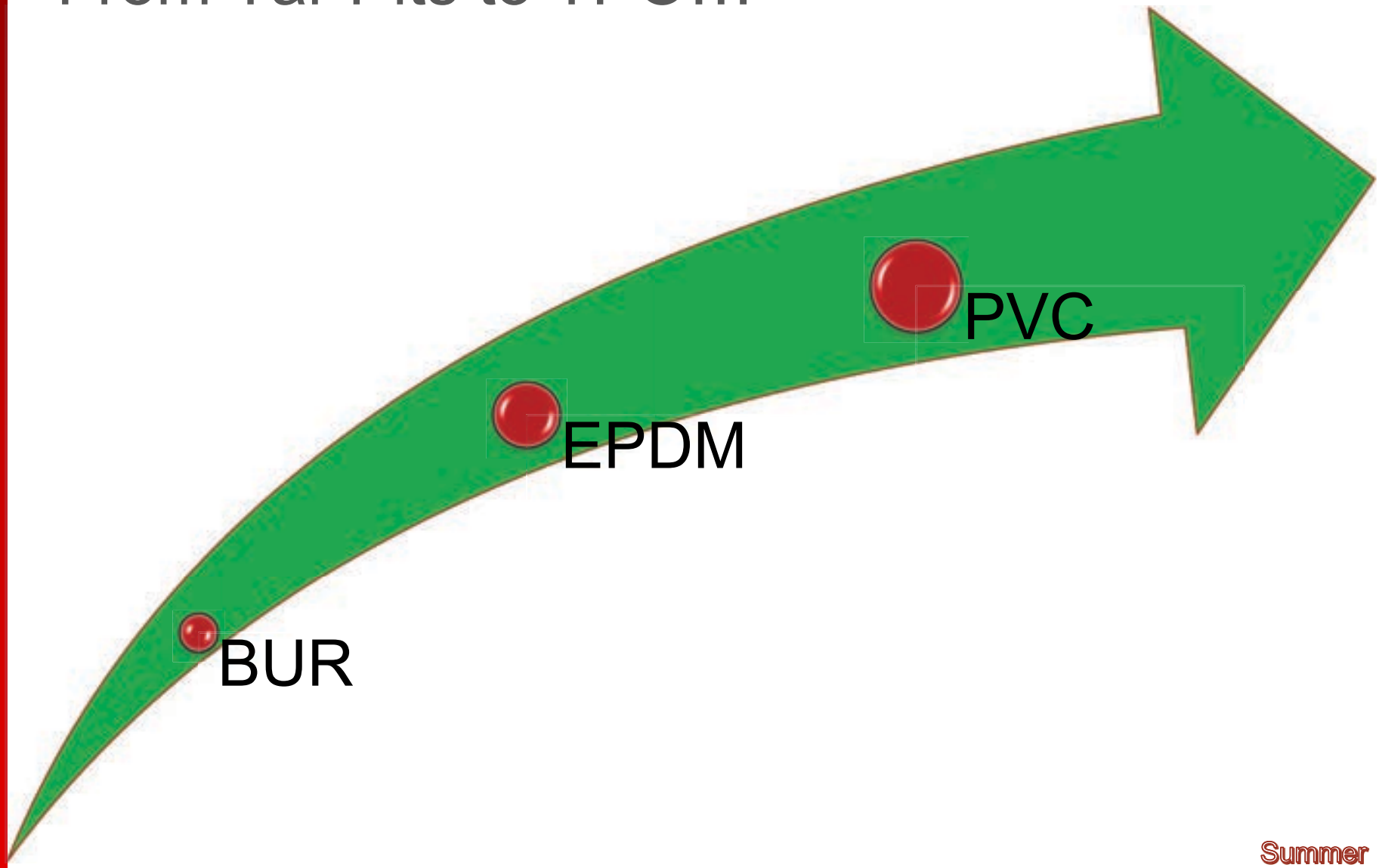
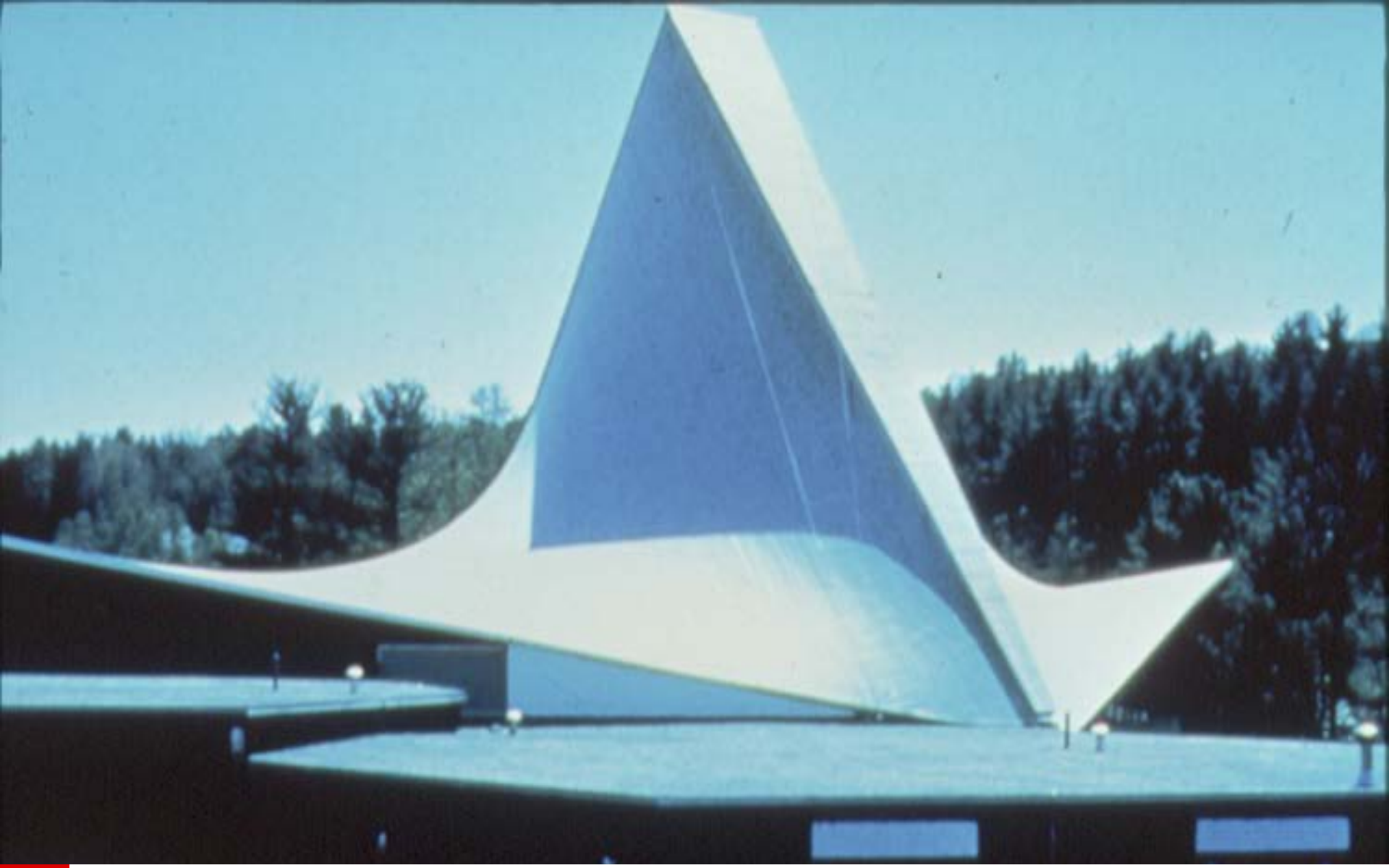
From Tar Pits to TPO…





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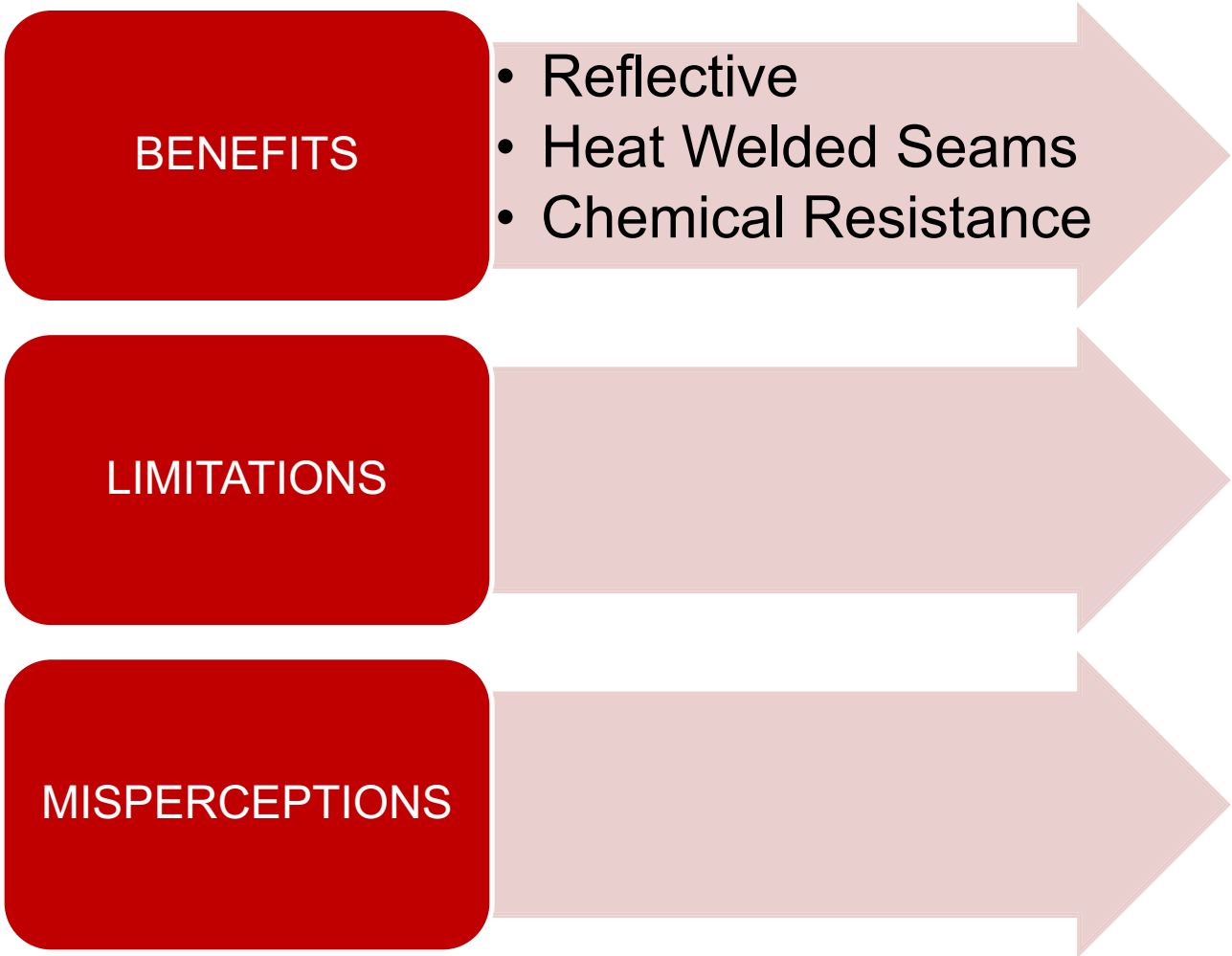
PVC…

- Introduced in early 1970's
- Heat welded seams
- Highly reflective - white
- Very chemical resistant
- High fire resistance

PVC



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PVC

BENEFITS	• Reflective • Heat Welded Seams • Chemical Resistance
LIMITATIONS	• “Red Listed” by some • High Temperature • Single Ply
MISPERCEPTIONS	

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PVC

BENEFITS

- Reflective
- Heat Welded Seams
- Chemical Resistance

LIMITATIONS

- “Red Listed” by some
- High Temperature
- Single Ply

MISPERCEPTIONS

- Shatters
- Shrinkage
- Impact Resistance

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Cool membranes
Seam performance
Grease resistance

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Paraprosdokian…

If I agreed with you, we'd both be wrong.

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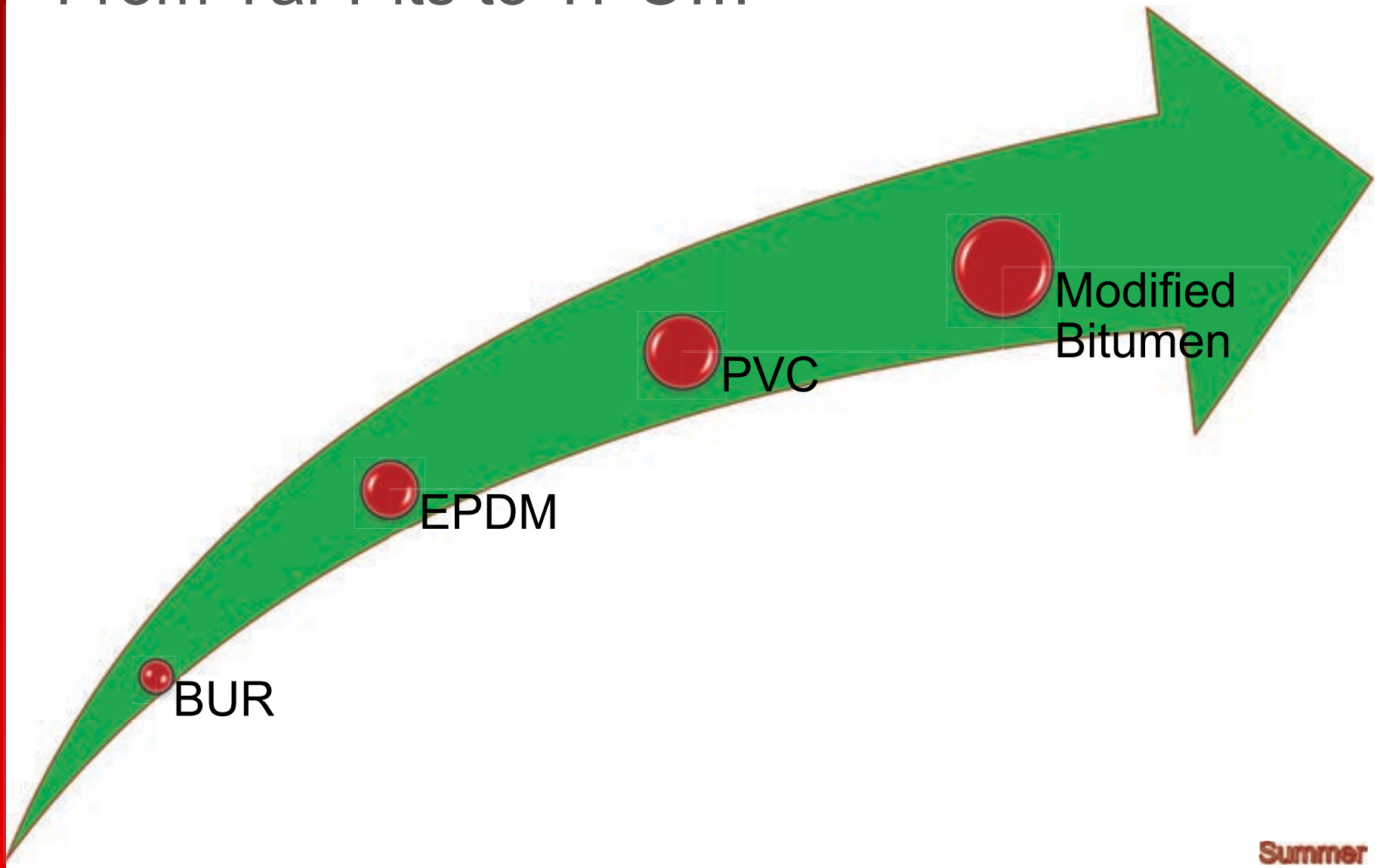
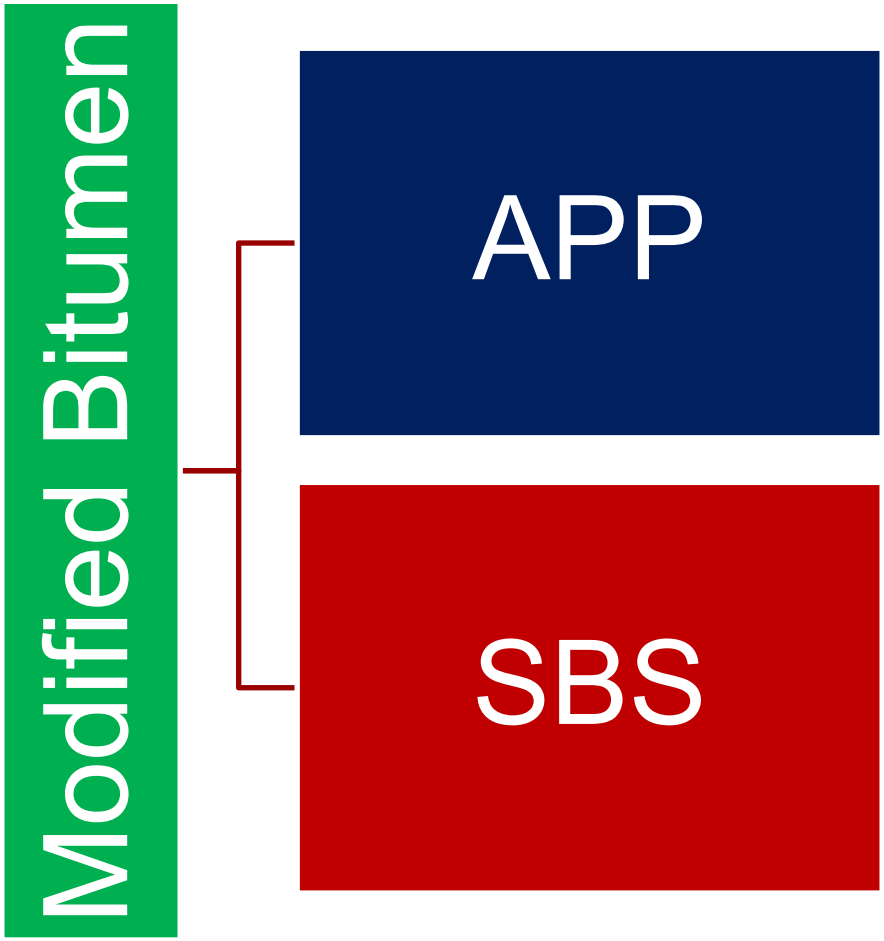
From Tar Pits to TPO…



Polymer Modified Bitumen…



APP...

- Atactic Polypropylene
- Developed in Italy, introduced to US in late 70's
- Excellent inherent flexibility and stability
- Heat (Torch) Applied

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SBS...

- Styrene Butadiene Styrene
- Developed in Northern Europe
- Excellent flexibility and elongation characteristics
- Hot Applied
- Cold Applied
- Torch Applied
- Self Adhered Applied

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Mod Bit

BENEFITS

- Multi-ply
- High Abuse/Puncture
- Easy Repair/Maintenance

LIMITATIONS

MISPERCEPTIONS

Summer Camp '17

Mod Bit

BENEFITS

- Multi-ply
- High Abuse/Puncture
- Easy Repair/Maintenance

LIMITATIONS

- Labor
- Open Flames (APP)
- Cost

MISPERCEPTIONS

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Mod Bit

BENEFITS	• Multi-ply • High Abuse/Puncture • Easy Repair/Maintenance
LIMITATIONS	• Labor • Open Flames (APP) • Cost
MISPERCEPTIONS	• “Old Technology” • Not Energy Star/Reflective • Durability in High UV

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Technology + Asphalt
Ability to mix with BUR
BUR + cold adhesive
Strain Energy

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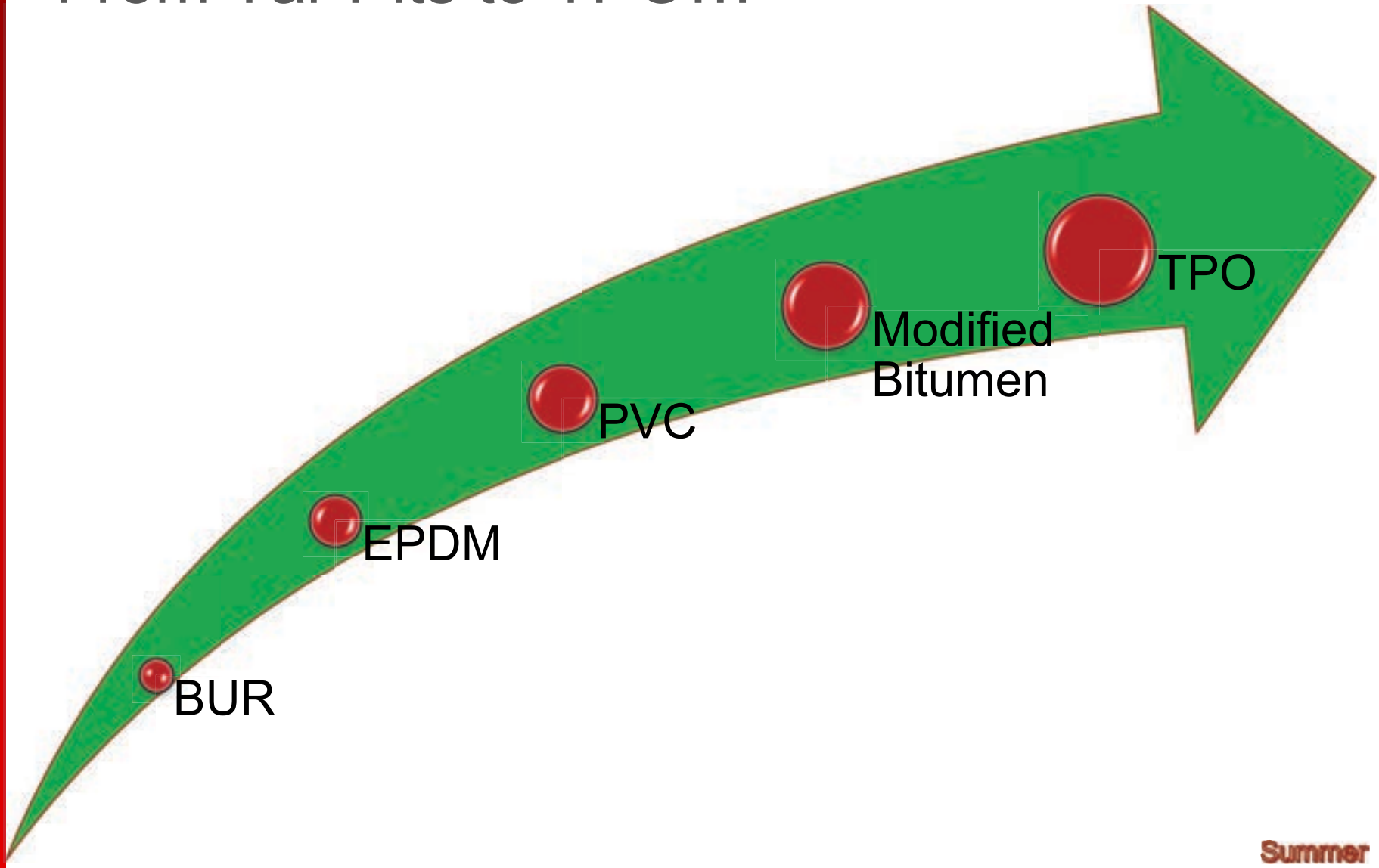
From Tar Pits to TPO…



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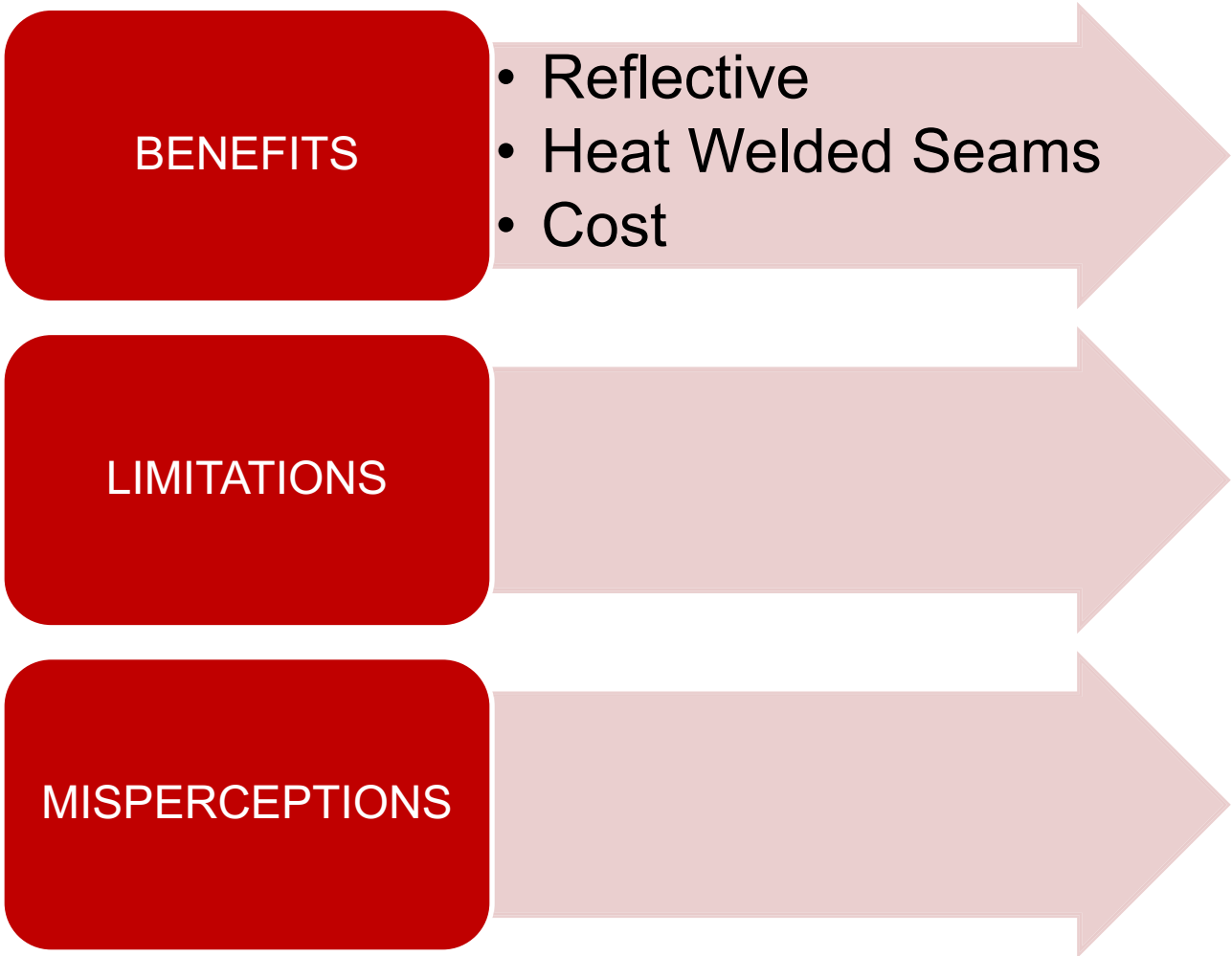
TPO…

- Introduced in late 1980's
- Heat welded seams
- Highly reflective - white
- Cost effective
- High UV/heat formulations

TPO



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TPO

BENEFITS	• Reflective • Heat Welded Seams • Cost
LIMITATIONS	• Chemicals • Weather - Adhered • Single Ply
MISPERCEPTIONS	

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TPO

BENEFITS	• Reflective • Heat Welded Seams • Cost
LIMITATIONS	• Chemicals • Weather - Adhered • Single Ply
MISPERCEPTIONS	• Length on Market • Performance • Impact Resistance

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- High UV/Heat Resistant Formulations
- Cost Effective Alternative to PVC

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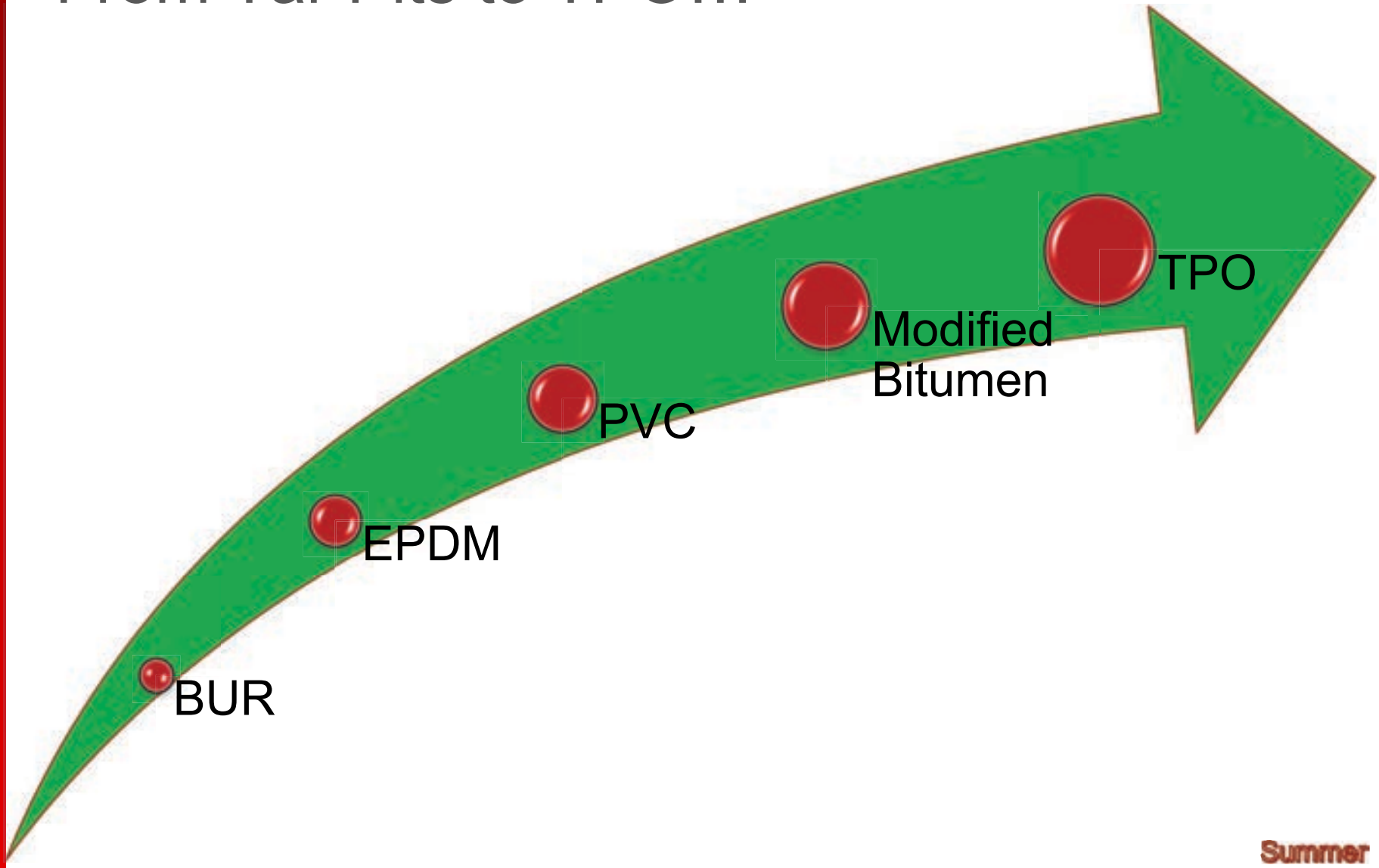
From Tar Pits to TPO…



Ads Evolved Too…

And … circa 2013…"As Seen on TV"!

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Paraprosdokian…

TO STEAL IDEAS FROM ONE PERSON IS PLAGIARISM. TO STEAL FROM MANY IS RESEARCH.

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Installation Evolution…

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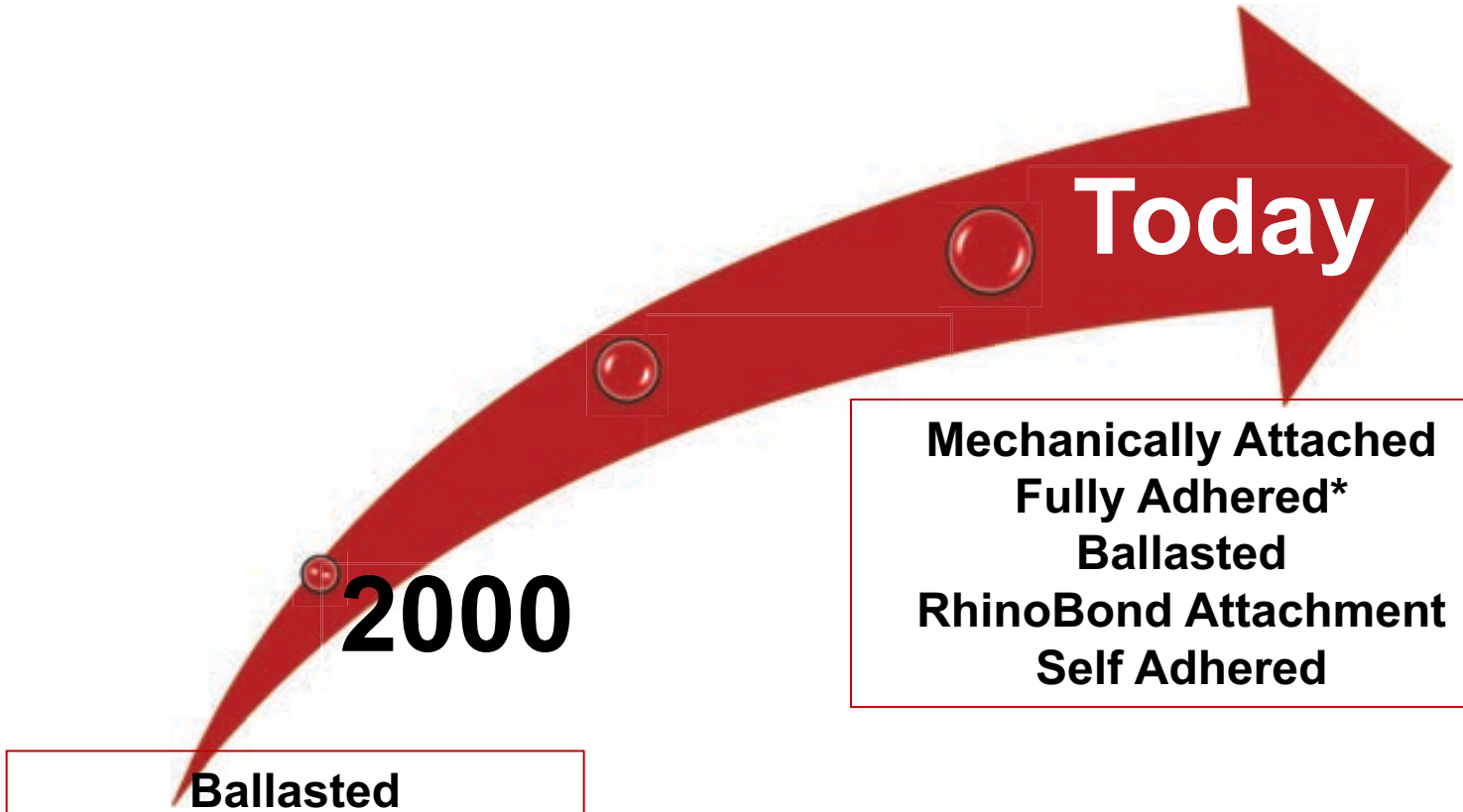
Single Ply Membranes…

Not As Simple As a Few Years Ago…



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Mechanically Attached

Ballasted

Fully Adhered

- Solvent Based
- Low VOC
- Water Based
- Low Rise Foam
- 2 Part

RhinoBond® System

Self-Adhered

Installation Methods

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Mechanically Attached

- Cost effective
- Most common installation method
- No sprayers or additional capital investment
- No odors
- Up to 50% faster installation than fully adhered smooth membranes
- Membrane carries wind load
- Wide application temperature

Mechanically Attached Limitations/Considerations

- Deck type/holding power
- Insulation thickness
- Tapered insulation ↑ difficulty*
- Impact resistance
- Need for an air barrier
- Moisture
- Roof as a platform

* Note: tapered with any mechanical attachment increases difficulty

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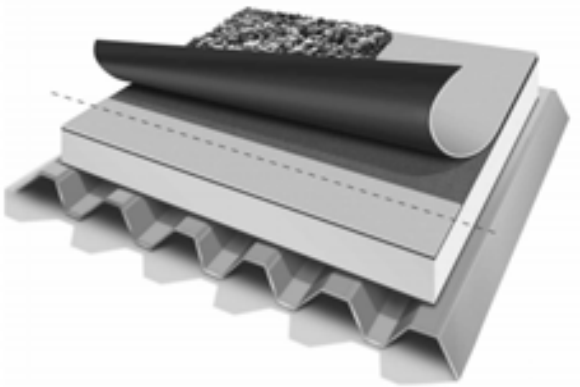
Ballasted

- Low labor cost
- No sprayers or additional capital investment
- No odors
- Ballast provides wind resistance
- Minimal fastening required
- Ideal for very wide sheets
- High impact resistance



Ballasted Limitations/Considerations

- Deck type – capacity for load
- Availability of quality ballast
- Leak detection
- Wind resistance – code restrictions
- Roof as a platform

Fully Adhered – Bonding Adhesive

- No sprayers or additional capital investment
- Excellent wind uplift performance
- Familiarity with workers
- Solvent, low VOC, and water based adhesives
- Uniform, smooth appearance
- Ability to “bury” fasteners

Fully Adhered – Bonding Adhesive Limitations/Considerations

- VOC content of adhesive
- Weather limitations for both application AND storage
- Open time – largest installation time
- Material costs
- Wet decks and adhesives don’t play well

Fully Adhered – Fleece-Back Laid in Wet

- Fast installation time – low labor cost
- Excellent wind uplift performance
- Low odor/VOC compliant
- No open cure times
- Uniform, smooth appearance
- Ability to “bury” fasteners
- Excellent impact resistance

Fully Adhered – Fleece-Back Laid in Wet Limitations/Considerations

- Material costs
- Wet decks and adhesives don’t play well
- Substrates
- Cure times

Fully Adhered – Low Rise Foam & 2 Part Adhesives

- Fast installation time – low labor cost
- Excellent wind uplift performance
- Low odor
- VOC compliant
- Uniform, smooth appearance
- Ability to “bury” fasteners
- Excellent impact resistance

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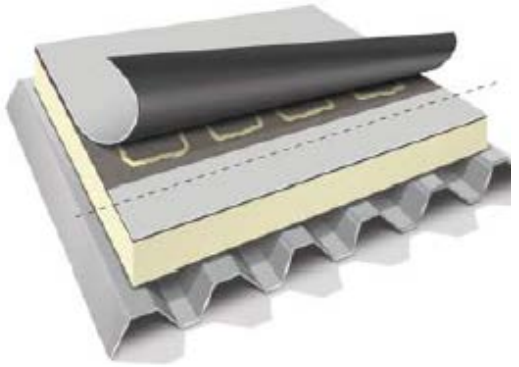
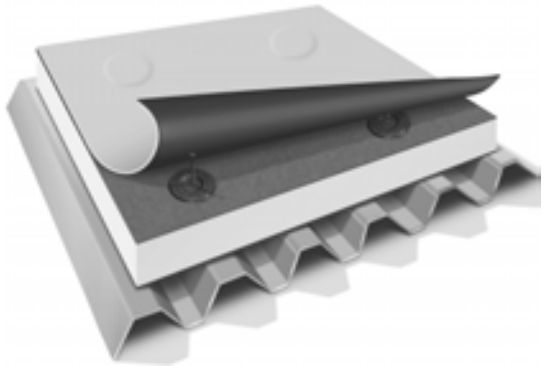
Fully Adhered – Low Rise Foam & 2 Part Adhesives Limitations/Considerations

- Depending on adhesive, equipment cost can be high
- Material costs
- Wet decks and adhesives don't play well
- Substrates



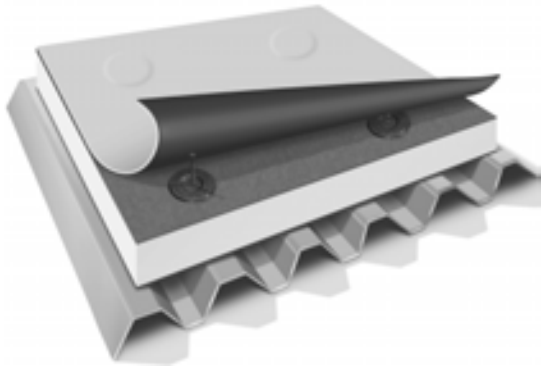
Rhinobond® System

- Moderate material cost
- No open cure times
- No need for half sheets at perimeter and corners
- Less flutter than MA systems
- Less fatigue on fasteners
- Wide application temperature



Rhinobond® System Limitations/Considerations

- Equipment cost (however, can increase speed with second machine)
- Deck type/holding power
- Tapered insulation ⬆ difficulty
- Impact resistance
- Need for an air barrier?
- Moisture
- Roof as a platform



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Self-Adhered

- No sprayers or additional capital investment
- Excellent wind uplift performance
- No odors/no adhesives
- No open cure times
- Ability to “bury” fasteners

Self-Adhered Limitations/Considerations

- Material cost
- Single layer of insulation
- Self-adhered lap vs. heat welded lap
- Aesthetics

Paraprosdokian…

I'M SUPPOSED TO RESPECT MY ELDERS, BUT ITS GETTING HARDER AND HARDER FOR ME TO FIND ONE NOW.

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Market Evolution…

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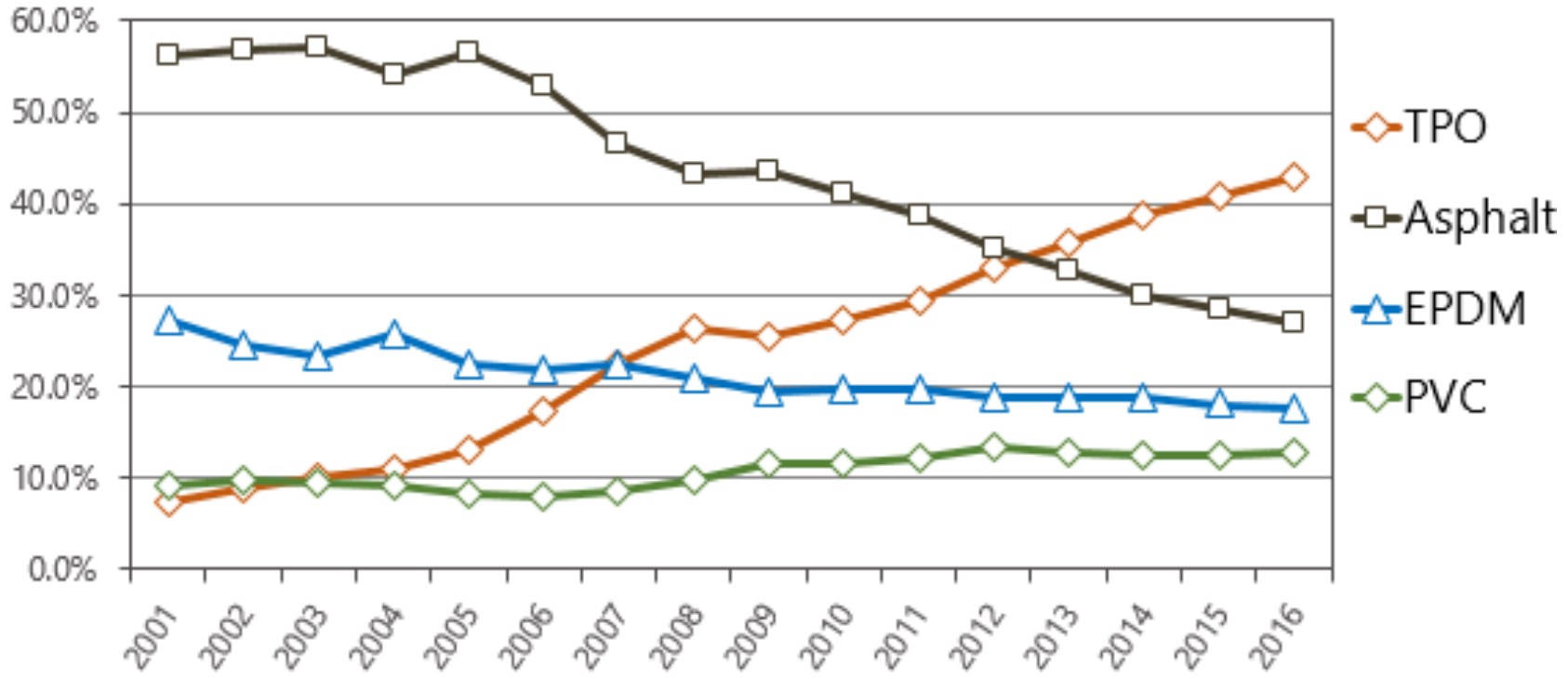
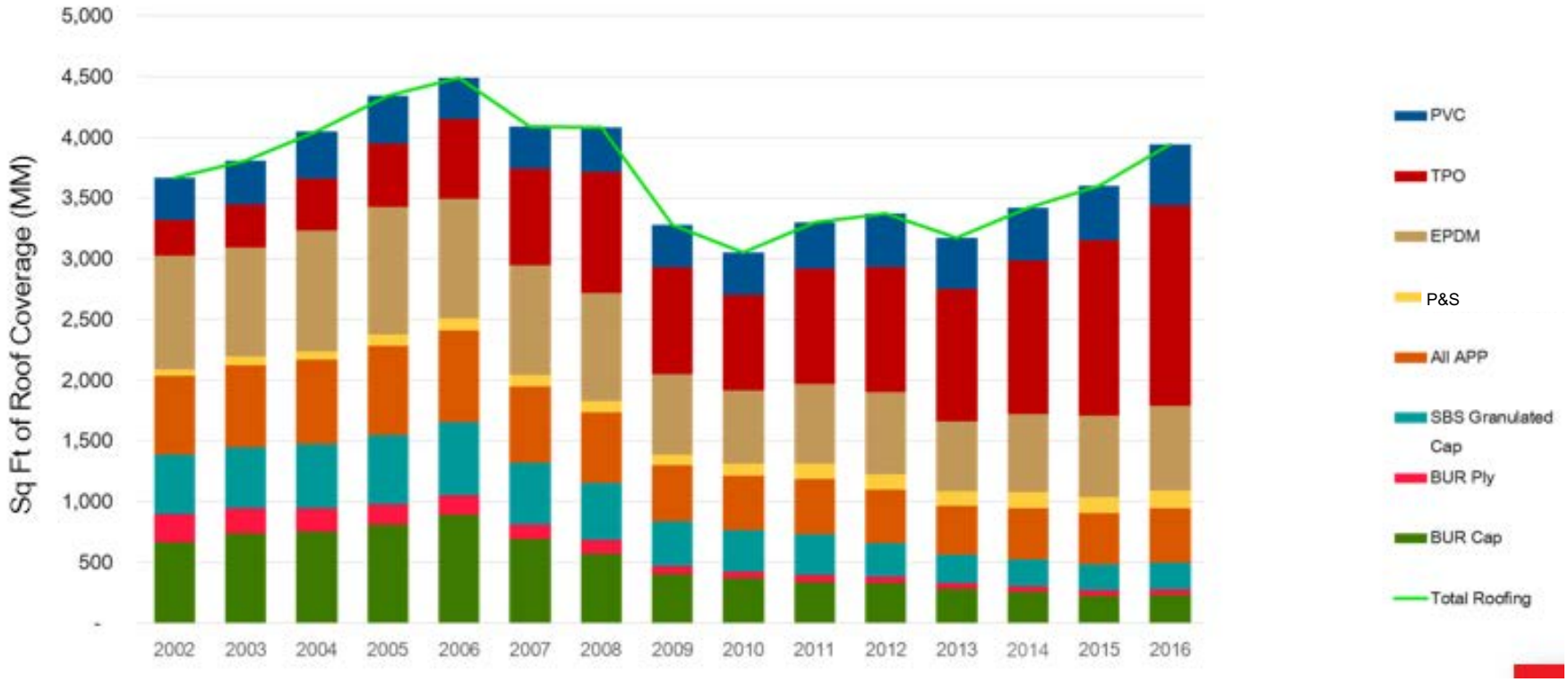
Technology Transition



Technology Transition…
digging a little deeper



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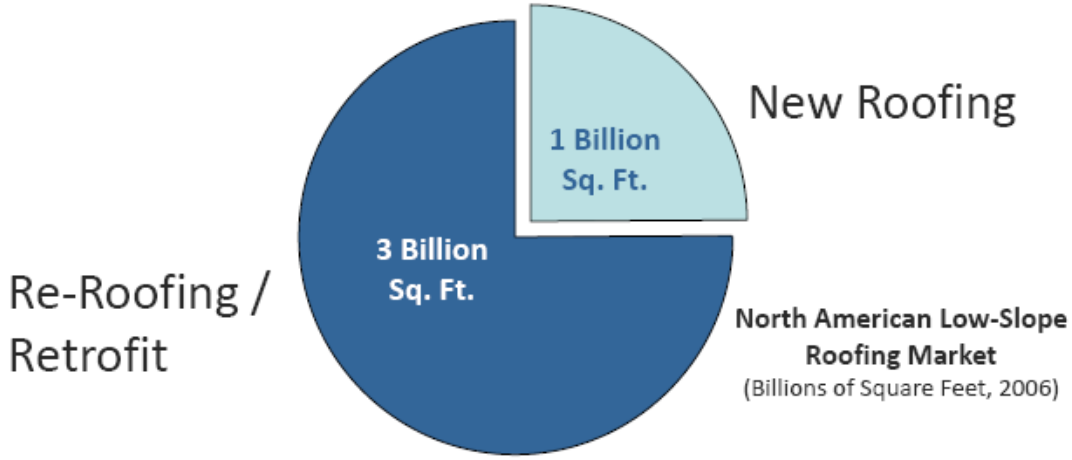
The Roof Retrofit Multiplier Effect:



Each year, 3 billion square feet of commercial roof retrofits are installed in North America, exceeding new commercial roof installations by 3 to1!

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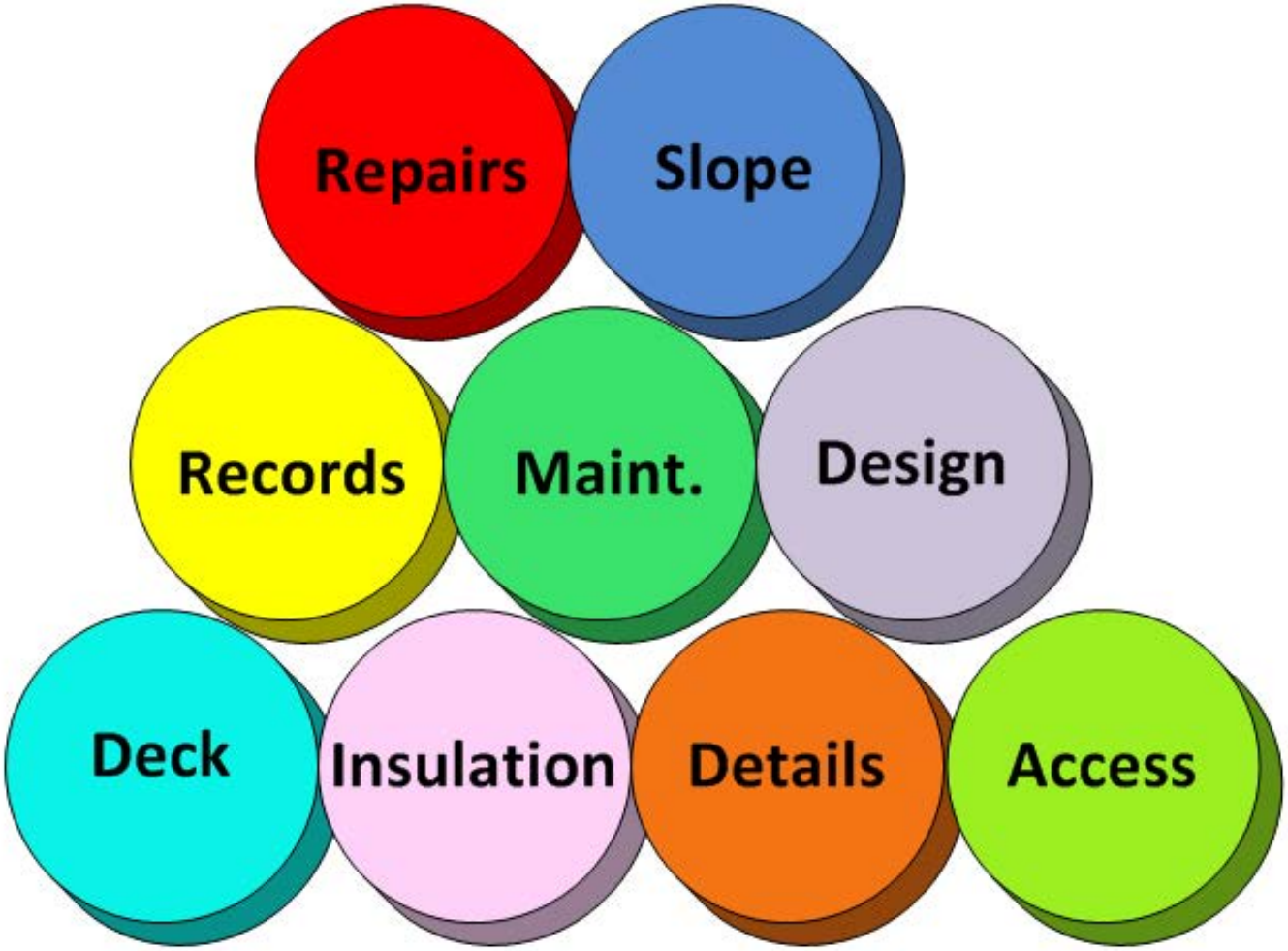
REGARDLESS OF MEMBRANE, Still Need Good Bones!!!



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Don’t Forget the “20 Questions!”

- Identify the poison pills
- Rule out what won’t work
- Drill down to better options

These questions should identify

WHAT won’t work,

WHAT will work,

and WHAT are the best options *for the specific property…* ***and WHY,*** *based on the needs of the building owner*

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PART IV: Theory Is Nice…But Let's Look at Reality

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Real World…

Specifics…

- New Construction
- Concrete Deck
- Iso Insulation

What Comes to Mind

- What is concrete poured over?
- Concrete = Adhered
- Is the deck flat?
- What kind of “concrete”?

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- Probably Not

Cost to fasten into concrete

Time

Tapered Insulation?

Vapor Retarder -

- Perhaps

Access

Owner Preference

Wind Limitations

Availability of Ballast

- Better/Best

Attachment Ease

Wind Uplift

Vapor Retarder +

Think Water

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Real World…

Specifics

- Tear Off to Existing Lightweight Concrete Poured over Tectum
- 1/4” – 1/2” Cracks

What Comes to Mind

- Deck movement
- Fastening to What?
- Cracks telegraphing
- Is the Lightweight wet?

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- Probably Not

What fastener are you going to use?

Can you engage the tectum deck?

Weight Concerns(ballast)

Traditional adhesive to what?

- Better/Best

To a MA base sheet

Separates the new roof from a problem substrate

Provided venting

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Real World

- Existing Standing Seam Metal Deck
- Want to Add Insulation

What Comes to Mind

- Attachment to what?
- Wind Performance
- Fire Performance
- This is NOT a traditional 22 gauge metal deck

Highlights… Retrofit Over Metal

- Retrofit – means existing metal building may well have been built with earlier/different strength limits
- Deflection limits for total load of L/60, whereas for membrane roofing “deck deflection should be no more than L/240 (4 times less deflection allowed)

Highlights… Retrofit Over Metal

- Retrofit – means existing metal building may well have been built with earlier/different strength limits
- Deflection limits for total load of L/60, whereas for membrane roofing “deck deflection should be no more than L/240 (4 times less deflection allowed)
- Most existing wind uplift ratings based on 22 gauge or thicker metal deck with 33 or 80 ksi yield strength
- FM 1-31 on Panel Roof Systems may be a good source of recommendations

(Probably) Not

Weight - ballasted

Deflection for fully adhered

Perhaps

Into secondary support structure

Only with structural evaluation

Better

Only into secondary support structure

Only with structural evaluation

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Real World…

- Metal Deck
- NE Coastal
- Replace due to Blow Off
- 85’ Building Height

What Comes to Mind

- Wind performance
- Parapet walls?
- Type of steel deck?
- Exposure – C or D?

Why?

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(Probably) **Not**

It's all about wind performance…

Check out FM Data Sheets…don't think you can get there!

Best Solution

Well attached insulation + fully adhered membrane

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Real World

- Steel Mill
- Needs to be Title 24 Compliant
- Metal deck

What Comes to Mind

- What's ending up on the roof?
- Temperature from operations (at penetrations, at deck)
- Rooftop traffic

Critical…

- Color of roof membrane in situ (like after it's been there for 6 months)
- Roof top temperature
- Temperatures at exhausts and things you have to flash

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Probably Not

Need high reflective membrane (vs. ballast)

Heat transfer via fasteners to membrane

Best Solution

Bury insulation fasteners to stop heat

Use high temperature membrane

Implement routine roof cleaning

Insulate penetrations from flashings

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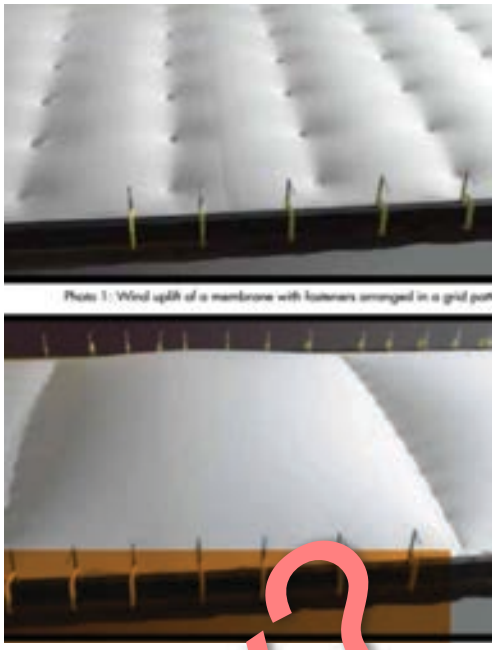
Real World…

Specifics

- Roof as a Platform
- Solar

What Comes to Mind

- Type of solar system
- Roof area to be covered?
- Age of existing roof?
- Ability to perform maintenance?
- Impact resistance?



Why?

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Paraprosdokian…

YOU DO NOT NEED A PARACHUTE TO SKYDIVE. YOU ONLY NEED A PARACHUTE TO SKYDIVE TWICE.

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THANK YOU!

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