What Does High Performance Roof Design Look Like?

PEDCO 5th Annual

High Performance Building Workshop

Thursday, October 6, 2016

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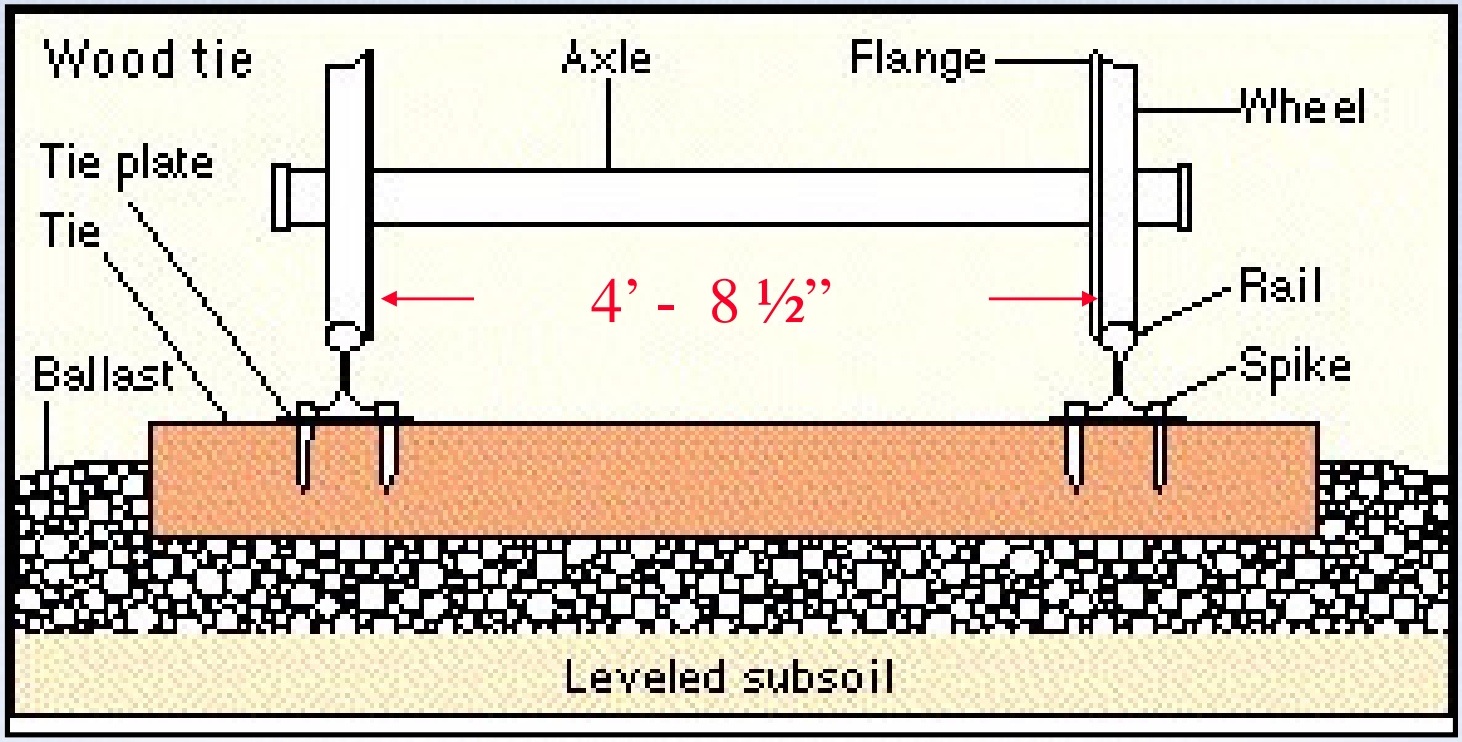
This presentation provides an insight into the impact of paradigms...



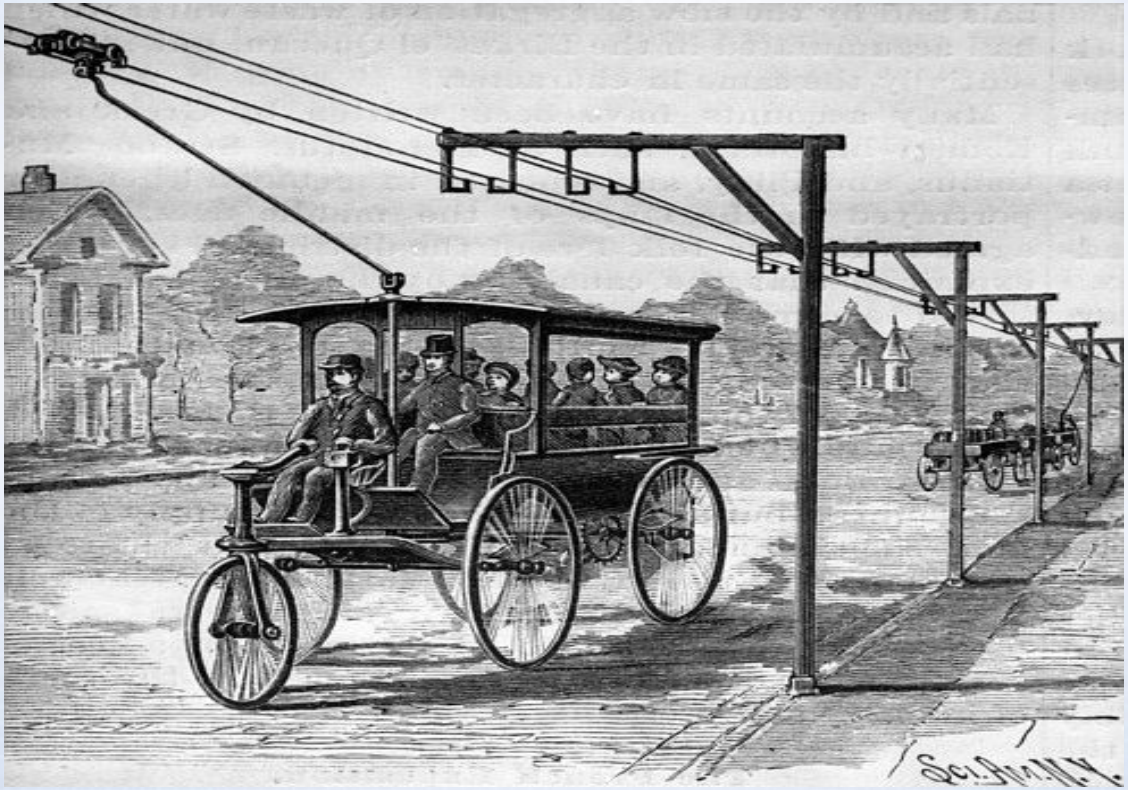
With US <u>Standard</u> railroad gauge, the distance between the rails, is 4 feet - 8.5 inches.


Because that's the way they built them in England.

US railroads were built by

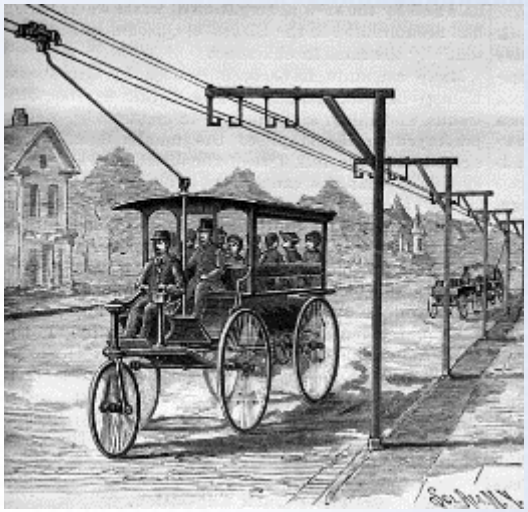
English expatriates.

Who were the same people that built the pre-railroad tramways.



The wheel spacing for the tramways came from…

….the same jigs and tools that they used for building wagons.

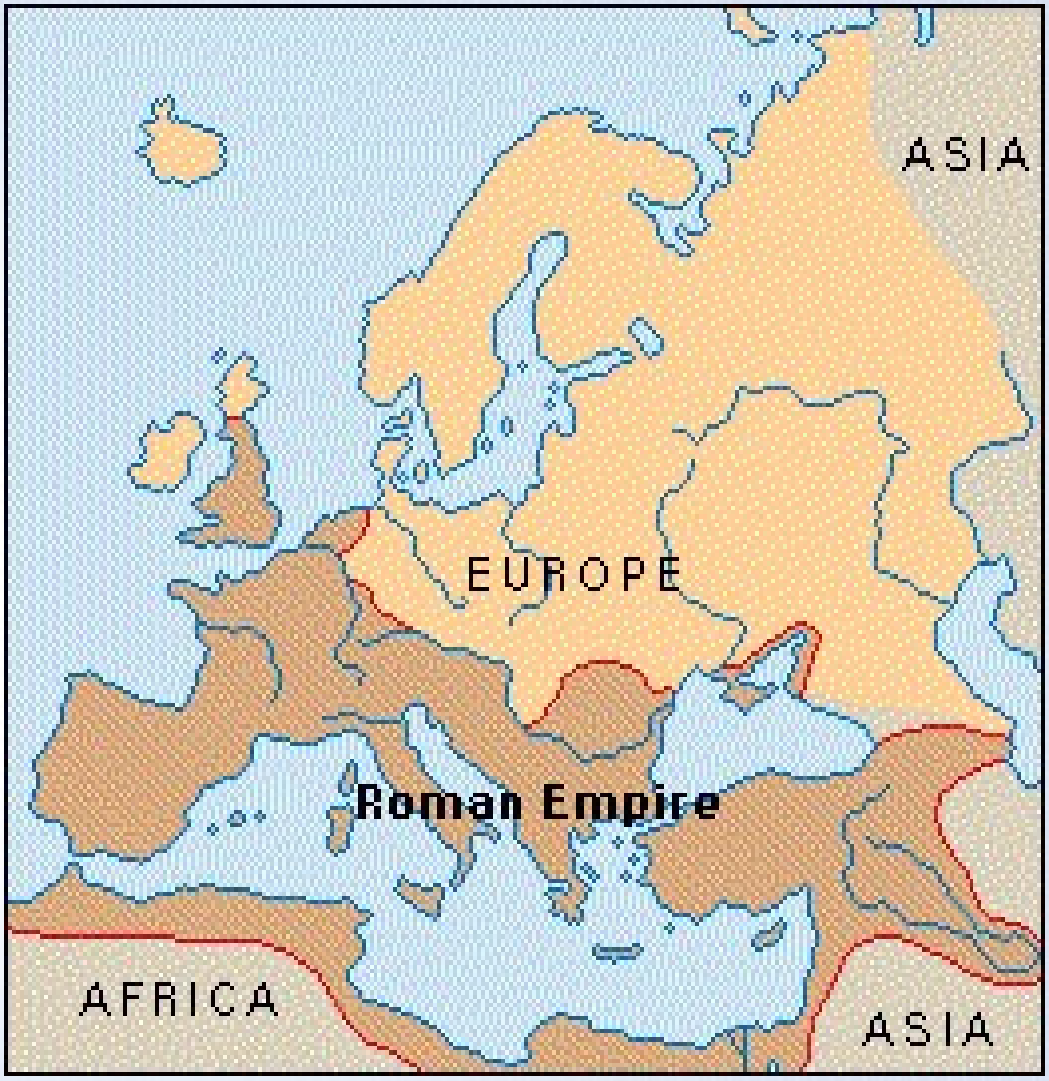


Why did the wagons have that particular odd wheel spacing?

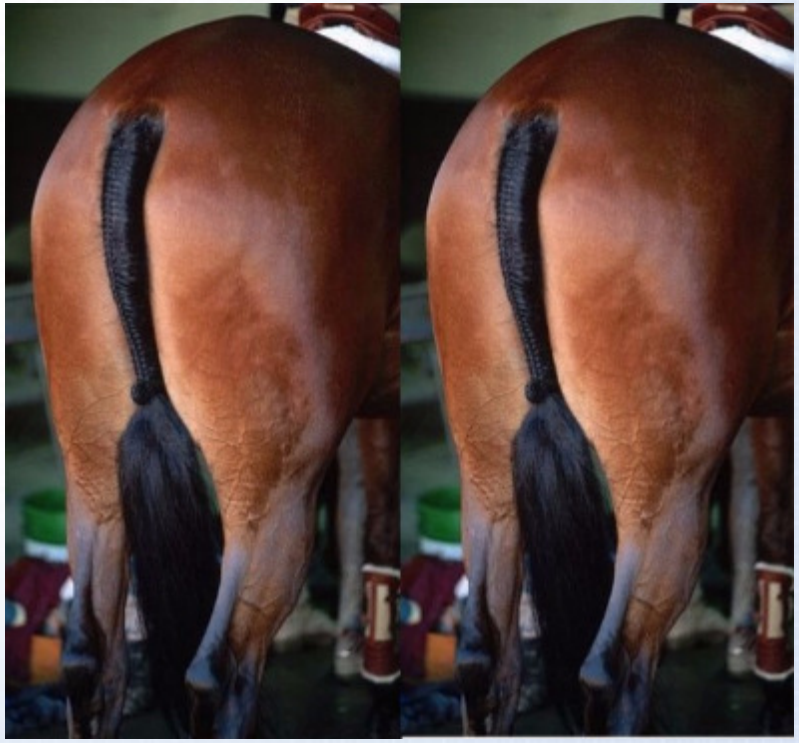
The wagon wheels had to roll within the ruts.

Who built those old rutted roads?

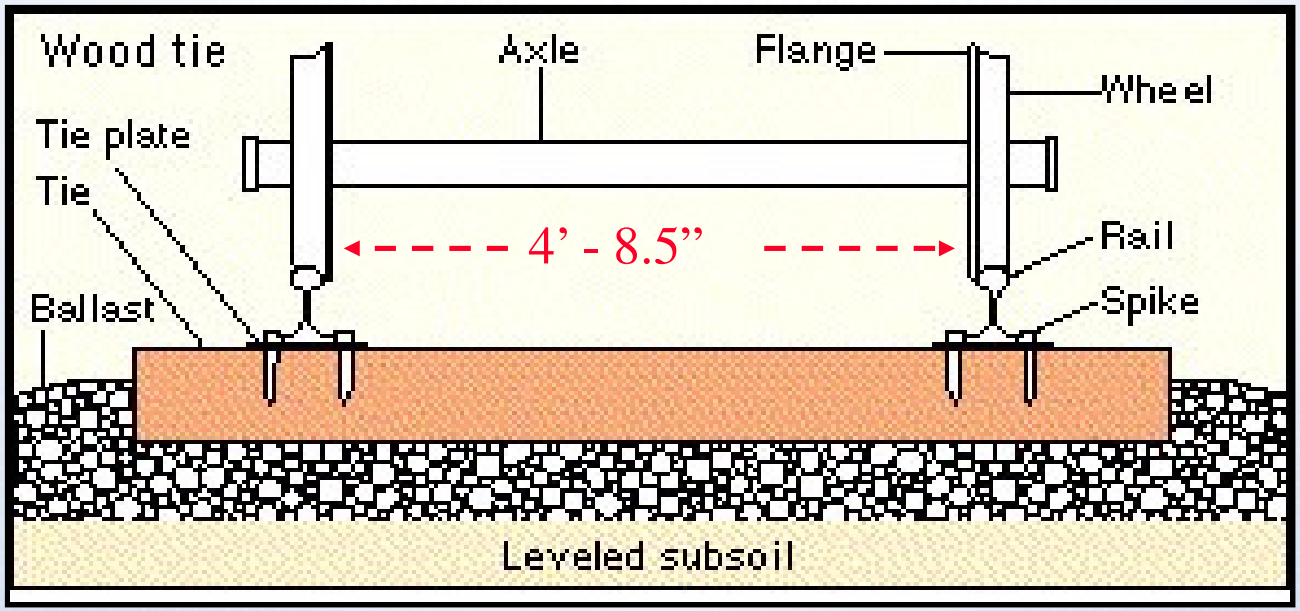
Imperial Rome built the first long distance roads in Europe for their Legions…the roads have been used ever since.



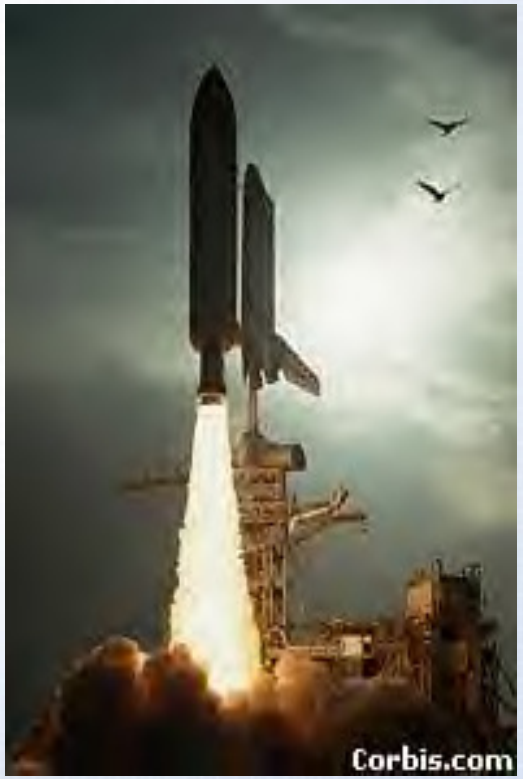
The wheel spacing for the chariots was just wide enough to accommodate the back ends of two Roman war horses.



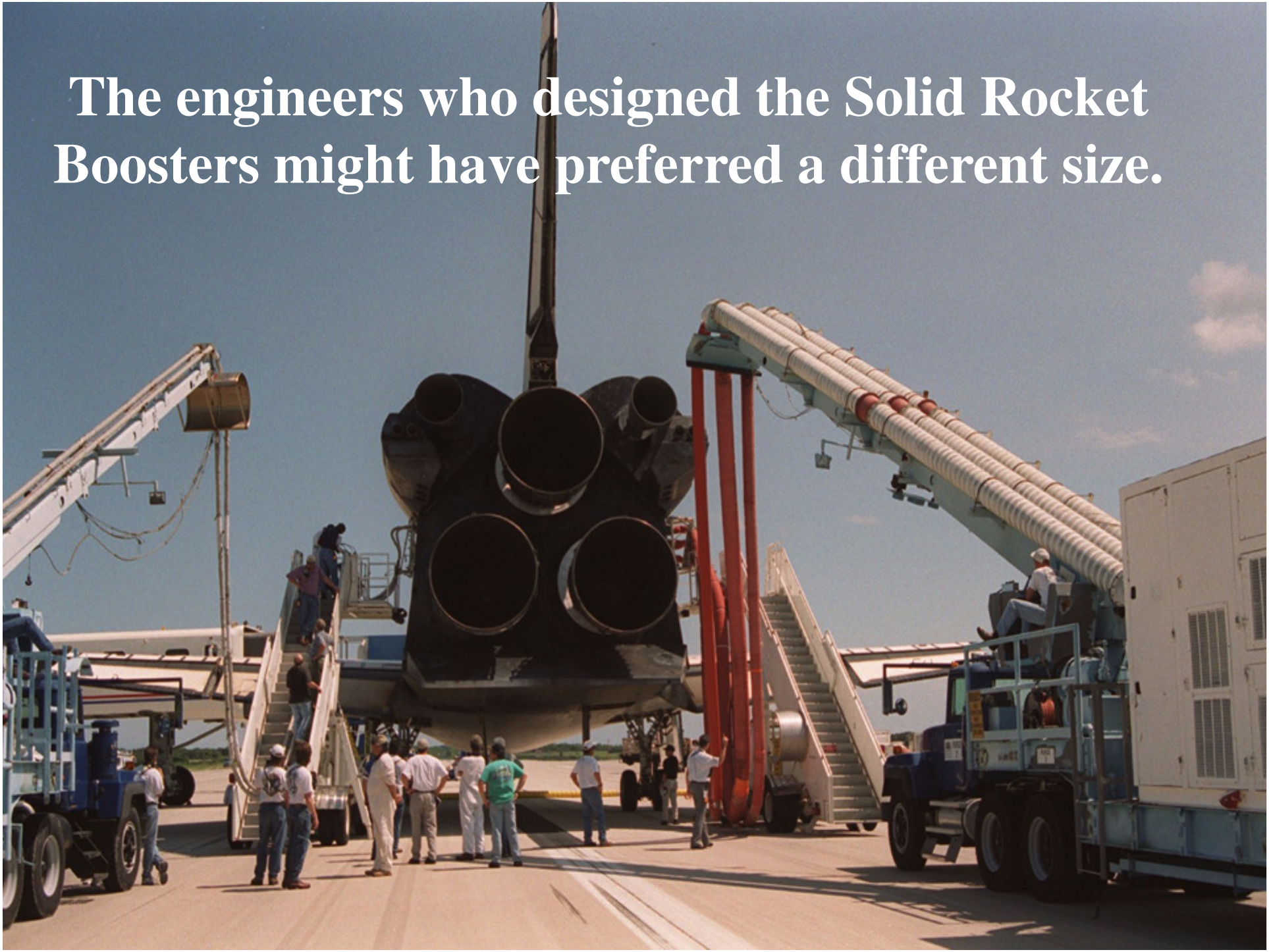
Now, we move gallop forward to the effects of <u>Standard</u> track gauge.



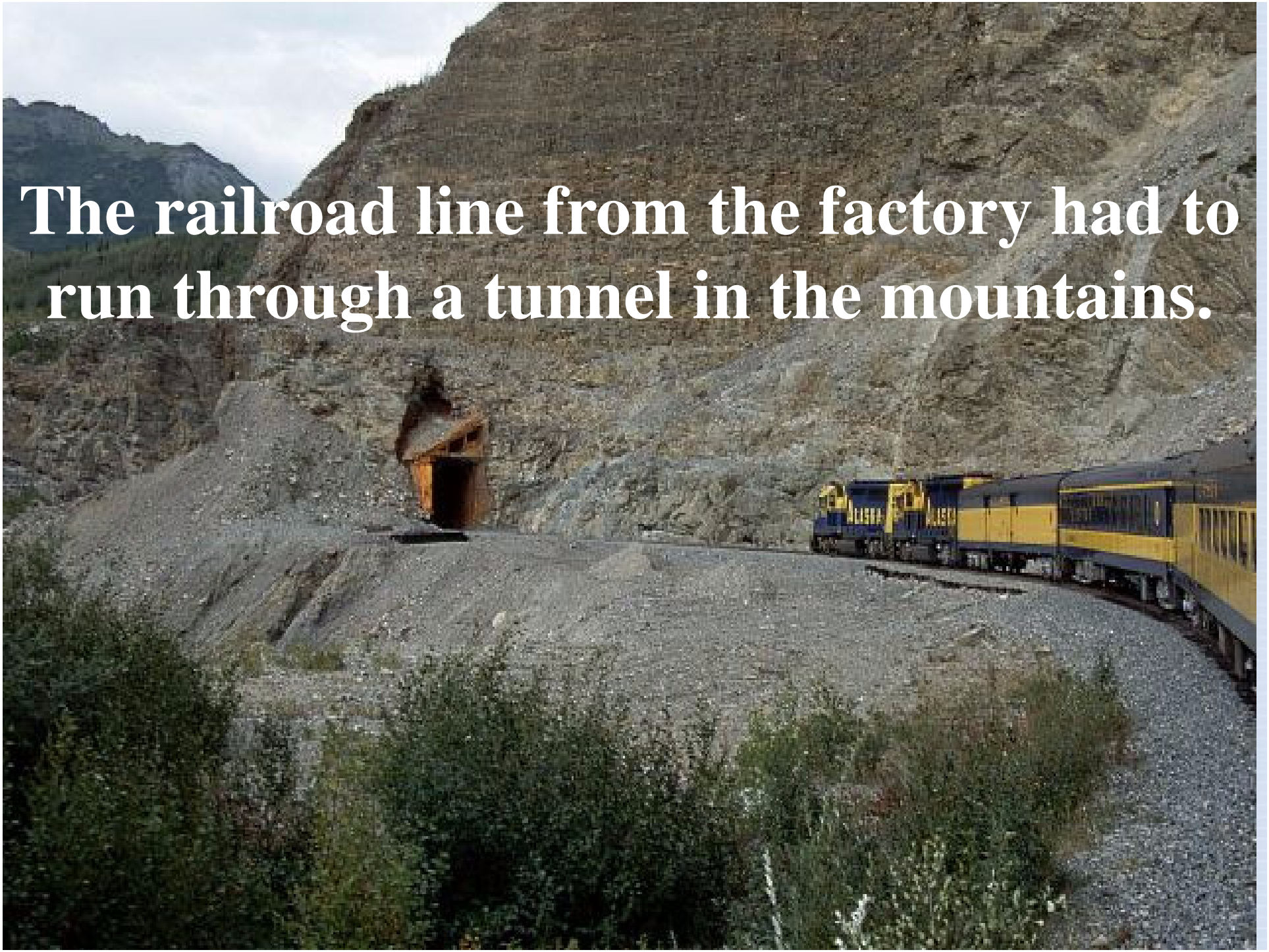
There were two big booster rockets attached to the sides of the main fuel tank on the space shuttle.



The Solid Rocket Boosters were made by Thiokol at their Utah factory


The engineers who designed the Solid Rocket Boosters might have preferred a different size.


…but they had to be shipped by train
from the factory to the launch site.


The railroad line from the factory had to run through a tunnel in the mountains.

The tunnel is slightly wider than the Standard railroad track gauge.

Remember the railroad track is…

…about as wide as the rear end of two Roman war horses.

So a major design feature of what was arguably one of the world's most advanced transportation system was determined by a horse's asset!

Moral of the story….and you thought being a horse's asset wasn't important!

High Performance Roof Design

Setting The Stage For Success

- Two distinct tracks will be discussed
  - New roof design
  - Existing roof system upgrade options
  - Roofing systems from an ASSET mindset is the critical focus point. It's all about the ASSET!

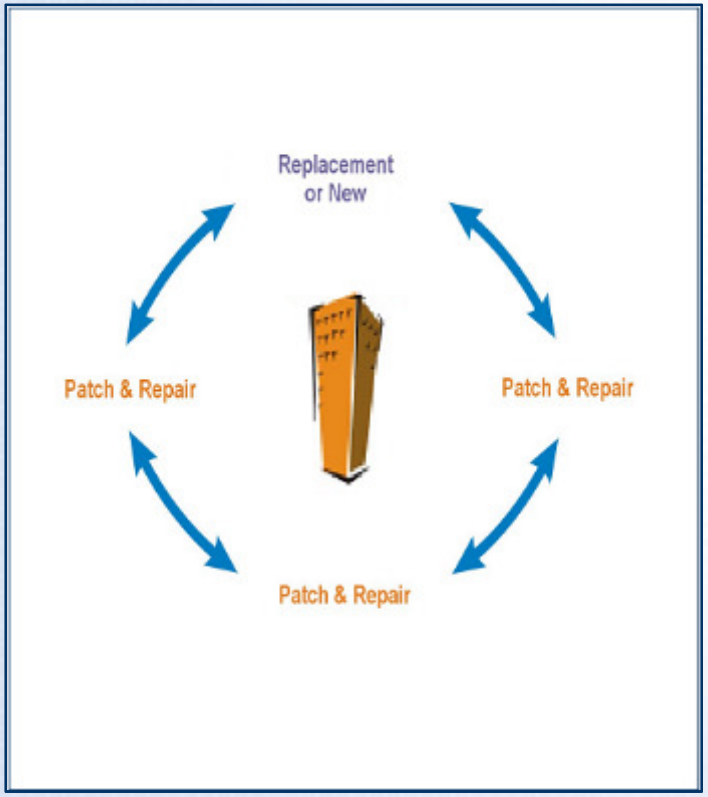
What Does High Performance Roof Design Look Like…Financially?

- Less Expensive
- Less Disruptive
- Requires Asset Mgmt. Approach
- Enhances Orgs Sustainable Initiatives
- Improves Whole Building Performance

What Do Traditional Roof Design Programs Look Like?

- More Expensive
- More Disruptive
- Reactive Repetitive Approach
- Severe Organization & Environ Impact
- Degrades Whole Building Performance

What Do Traditional Roof Design Programs Look Like?



- Replace
- Repair
- Repeat
- "20-Year" designs fail in 12 - 15 years.
- Resource inefficient
  - Capital & Materials

Managing the Building Envelope

Financial Assets for Return on Investment

- Organization facilities are composed of building assets that represent significant asset value.
- Facilities represent 25-40% of corporate wealth. *
- Less than 10% are managed as financial assets for a return on investment.
- Roof systems are 3-12% of the initial building cost, are one of the top 2 building owner headaches** and are the most litigated construction discipline.

*Harvard Study **BOMA

The Reality…

"Asset Managers are under attack from the combination of aging inventories, decreased budgets, less support staff, and the demand for increased efficiency. The result has not been creative cost avoidance strategies through planned preventive maintenance but rather short-term expenditure avoidance through repair deferment. This repair backlog can have, and is having, an enormous economic impact."

-Source: *Property Management Magazine*

The Reality…

"The number of DoD facilities that are so poorly maintained that they now meet the Pentagon's definition of "failing" has more than doubled in just the past year, a result of conscious decisions to make building upkeep a low priority during a period of constrained budgets…. At this time last year, the Pentagon reported that 7 percent of its facilities were in failing condition. As of this week, the figure stands at 18.9%….. over 52,000 buildings, 1 in 5…

-Source: *Federal News Radio Sept 2016*

Why is this important…

- Roof replacement cost 2x / 8-10 years
- Ave. roof life expectancy about 15 years
- Every $1 today spent on a disposable roofing asset will cost $4.6 to replace in 20 years
- Choices have MAJOR downstream organizational financial impacts
- Roof funding difficult & getting tougher

Insanity: doing the same thing over and over again and expecting different results.

-Albert Einstein

The Alternative…

- Select higher performance new roof design
- Maintainable roof systems at Year 20 WILL YIELD another 20 years of service life at 45% the cost of roof replacement
- Assess existing inventory and determine where roof assets are in life cycle stage. Implement asset management approach!
- “YUGE” cost saving potential!!!

Best In Class Options

Characteristics

- High energy efficiency
  - Design varies by climate zone
  - Building envelope connected
- High recycled or bio preferred content
- Ultra low VOC
- Highly maintainable
- Multiple synergistic impacts (more than roof)

Best In Class Synergies

Industry Standard – Concept of *Triple Bottom-line*

Creating **VALUE** for SHAREHOLDERS and SOCIETY alike

Typical Measure	Social **(People)**	Environmental **(Planet)**	Economic **(Profit)**
	Labor practices	Air quality	Sales, profits, ROI
	Community impacts	Water quality	Taxes paid
	Human rights	Energy usage	Monetary flows
	Product responsibility	Waste produced	Jobs created
	Total	**Total**	**Total**

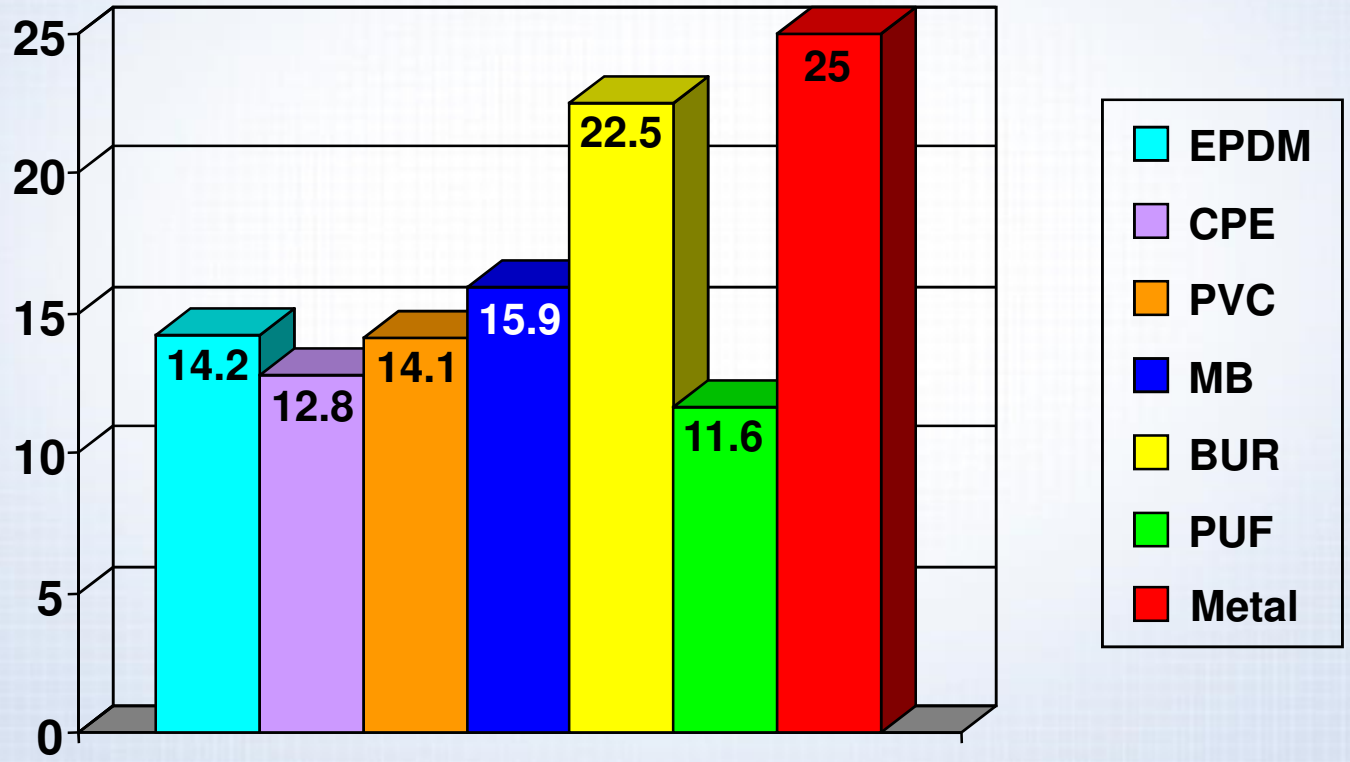
Best In Class Options

Business Case First - Organization

- Business case must support or no go
- Lowest roof asset life cycle costs
- Synergistic building performance impact
  - Tighter building envelope, field and transitions
  - Increased energy efficiency - cost reduction
  - Reduced envelope component damage
  - Increased HVAC system life
- New business development!

Best In Class Options

Business Case First - Organization



Carl Cash Survey: 4th International Roofing Symposium

Best In Class Options

Business Case - Organization

Cost Analysis

Traditional 2 ply SBS roof based on a 7500 square foot roof area

a)	Initial installed roof cost (2009 costs are $16.50/sf)	$123,750
b)	Maintenance costs at yr 15 to extend roof service to year 30	$131,000*
	i) 2009 cost for this work would be $5.50/sf x 7500	
c)	Maintenance costs at yr 30 to extend roof service to year 45	$415,000*
	i) 2009 cost for this work would be $5.50/sf x 7500	
d)	**Total 45 year costs**	**$669,750 ($14,884/yr of svc)**

Traditional ballasted EPDM roof based on a 7500 square foot roof area

a)	Initial installed roof cost (2009 costs are $11.00/sf)	$82,500
b)	Roof replacement costs at yr 15 to provide service to year 30	$261,700*
c)	Roof replacement costs at yr 30 to provide service to year 45	$830,000*
d)	**Total 45 year costs**	**$1,174,200 ($26,093/yr of svc)**

Vegetated roof based on a 7500 square foot roof area

a)	Installed roof cost	$292,500
b)	Maintenance costs (horticultural allowance $556/yr)	$25,000
c)	Maintenance cost (flashing work) at year 20	$58,000*
	i) 2009 cost for this work would be $12,500	
d)	**Total 45 year costs**	**$375,500 ($8,344/yr of svc)**

Best In Class Options

Business Case - Organization

- Re-purpose existing building materials. Not landfill.
- Passive heat shedding potential varies with media and plant choices as it relates to energy costs

Best In Class Options

Business Case - Organization

Passive (FREE) Heat Shedding

- Varies on plant and media design
  - Organic vs aggregate media
  - Native plants vs succulent
- 8,000 btu's heat release per gal water evaporation
- Recent 50,000 sf 8" veg roof, organic GM example
  - 2,400,000 gallons retained stormwater
  - 15,200,000,000 BTU's passive heat reduction
- HVAC system reductions

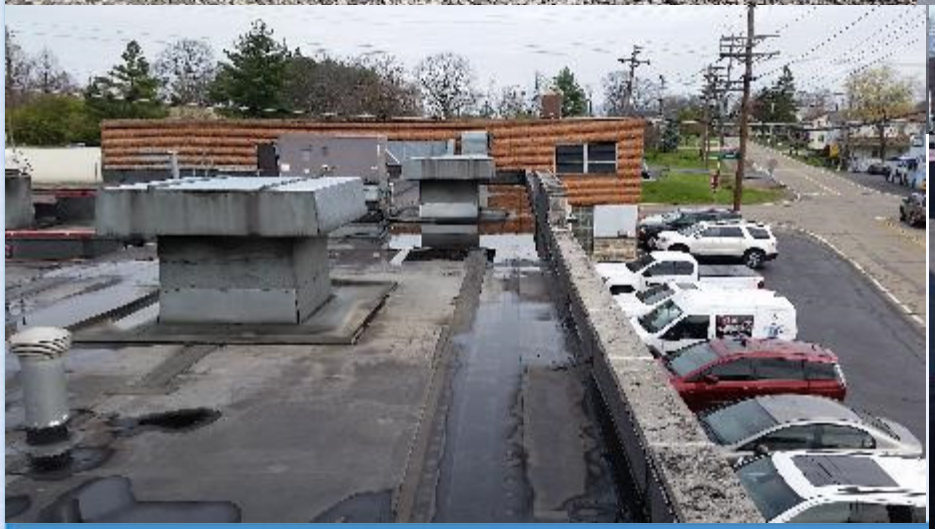
Best In Class Options

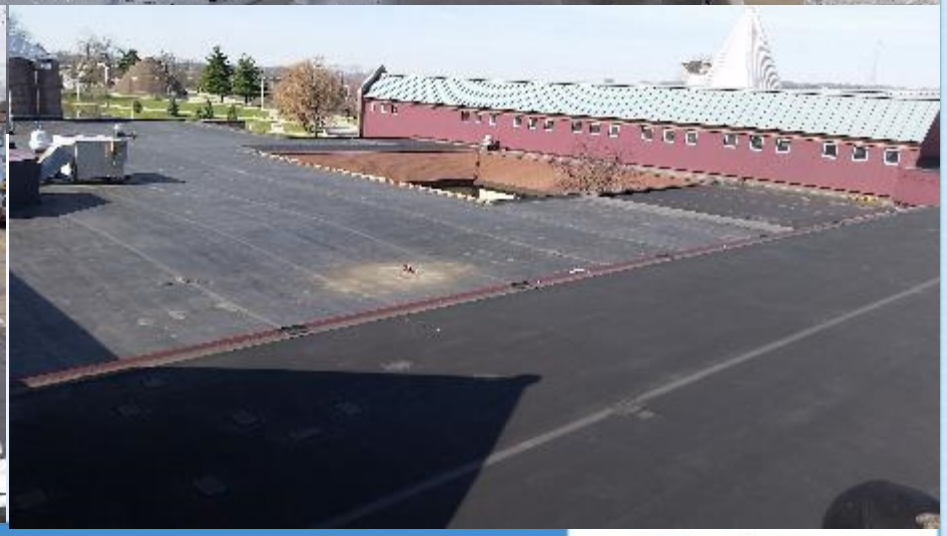
Business Case - People

- Increased human productivity
  - More uniform temperatures and humidity
  - Create less stressful environment
  - Adobe, healthcare, schools,
  - Life stresses increasing rapidly, need relief

Traditional Roofing

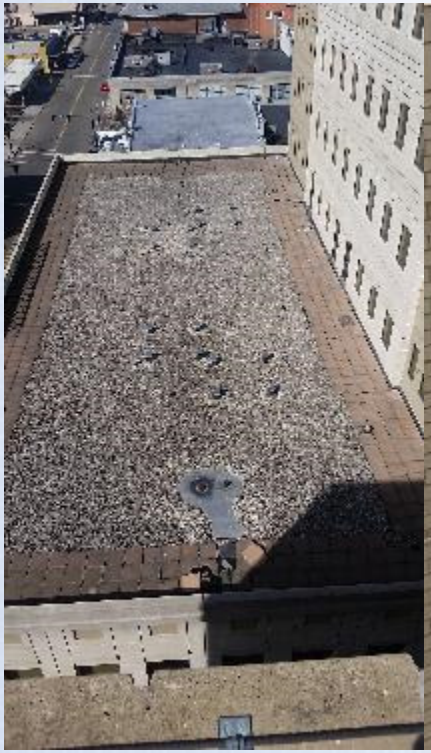
Business Case - People





Traditional Roofing

Business Case - People



Best In Class Options

Business Case - People

Before:

- Hot
- Unappealing
- Uninspiring

Best In Class Options

Business Case - People

Afterwards:

- A place of rest, calm and healing. Quiet repose
- Connection to nature
- Energizing
- Appealing workplace
- Healthcare
- Offices
- Schools
- Municipal
- Manufacturing
- Institutional

Best In Class Options

Business Case - People

- Place to gather/think-groups or alone
- Sort through challenging issues
- Better patient healing experiences
- Improved family support
- Business development?

Best In Class Options

Business Case - People

- A place to focus and decompress
- Foster problem solving
- Creative energy
- Natural teaching environment
- Business classrooms

Best In Class Options

Business Case - People

Before:

- Resource inefficient
- Facility cost drain
- Energy inefficient
- Heat island
- EYESORE

Best In Class Options

Business Case-People

Afterwards:

- A place to get a stress break, to re-energize
- Tangible commitment to people
- Quieter, restorative work environment
- Walking the talk
- Like getting a raise!!!

Best In Class Options

Business Case-People

Best In Class Options

Business Case - Environment

- Synergistic environmental impact
  - Eliminate landfill contribution for 60 years
  - Significant raw material demand reduction
  - Control heat island effects (bldg. & vicinity)
  - Retain stormwater onsite
    - Reduce downstream waterway issues (biz or E +)
    - Reduce potable water demand (biz or E +)
    - Serious Blue roof concerns

Best In Class Options

Business Case - Environment

- Global dimming/pollution
- Major ecosystem declines
- Surface, water and air temperature increases
- Changing water resource distribution/availability
- Increased weather intensity erratic volumes of rainfall,
- Global ice melts
- This is the only planet and environment we have to live on!

Best In Class Options

Business Case - Environment

- Re-purpose Existing building materials. Not landfill
- Passive heat shedding potential varies with media and plant choices as it relates to energy atmosphere impacts

Best In Class Options

Business Case - Environment

- Reflective roofing with solar.
- Grid energy shedding solution with energy atmosphere and energy cost impacts

Best In Class Options

Business Case - Environment

- Create habitat to restore pollinators CRITICAL to commercial crop production
- Last several years and ZIKA
- Business case, People or Environmental win…all three?

Best In Class Options

Business Case - Environment

- Retain rain water locally and release within the same area vs downstream into local waterways, then regional waterways, then national and global water bodies

Best In Class Options

Business Case - Environment

- Habitat restoration and biodiversity are critical environmental infrastructures that need to be rebuilt!

Existing Roofing System

Performance Upgrade Options

- Single Ply
- BUR
- Modified Bitumen
- Foam
- Shingles
- Metal

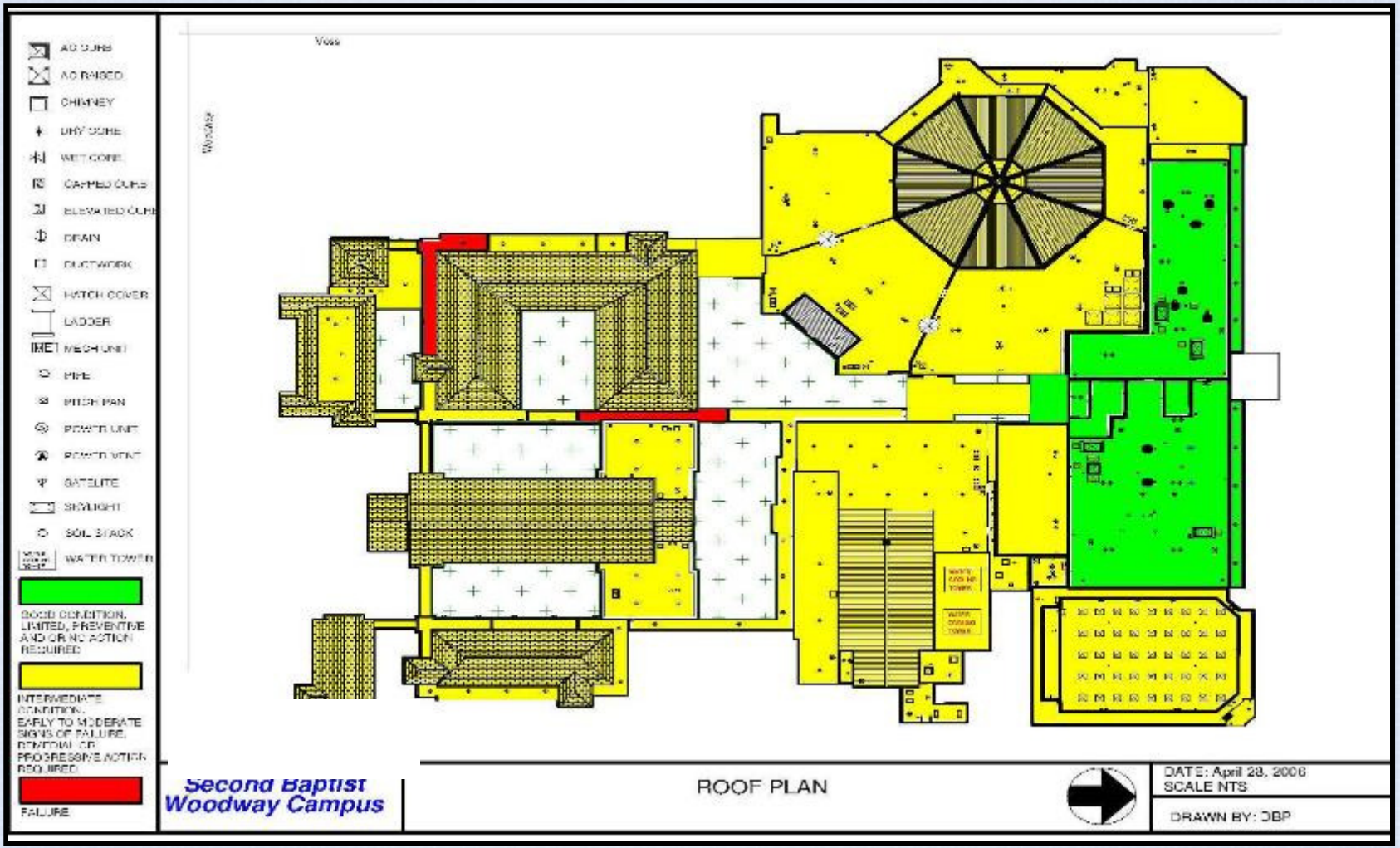
EXISTING ASSETS METHODOLOGY

A. Diagnostics: "Know What You Have."

- **Inventory, Inspection & Condition Assessment**
- **Plan: Upgrade Work (B), Maintenance (C)**
- **Lowest Cost & Highest ROI**
- **Green: Maintain/Repair the Good**
- **Amber: Restore the Marginal**
- **Red: Replace the Failed…as a last priority**

B. Implement Mtnc Schedule: "Protect What You Have."

Asset Management Model



Asset Management Model

Repair	Restore	Replace
GREEN **Asset is performing, preventive maintenance or corrective repairs needed**	**AMBER** **Major repairs & restoration is needed soon to significantly extend service life**	**RED** **Asset cannot be restored and major repairs will not add significant service life.**

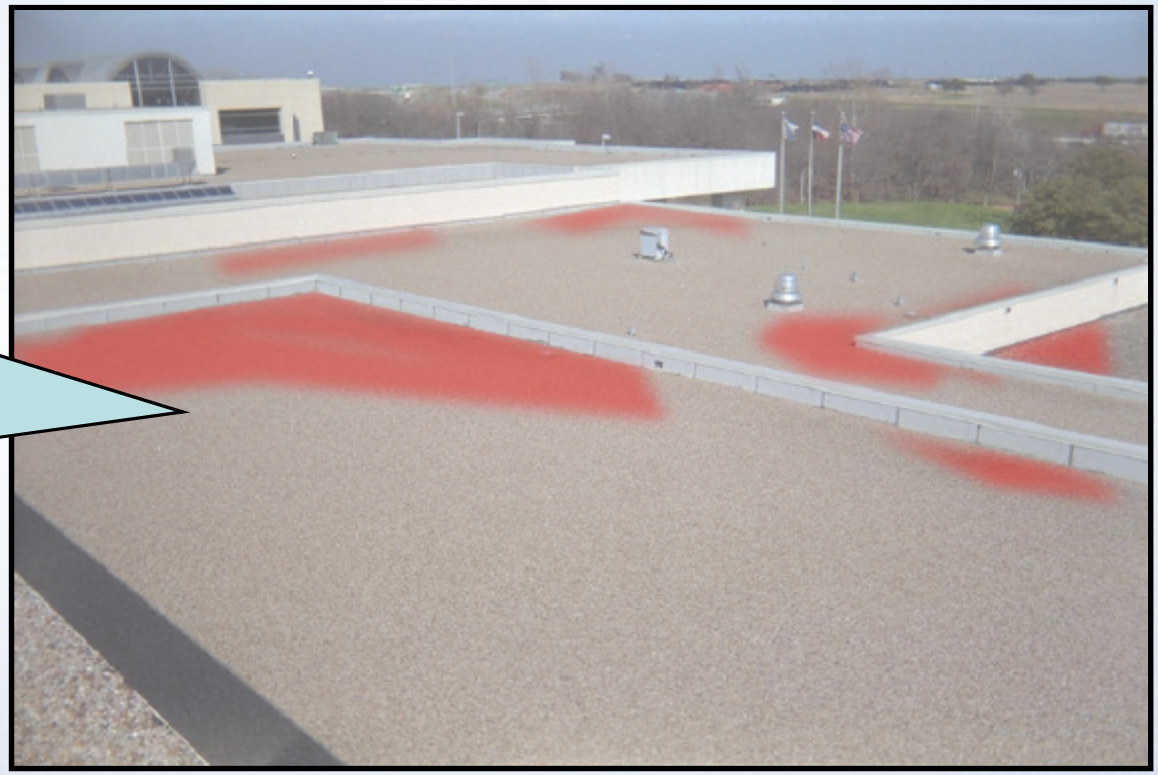
Cost of Neglect
Case Study – 1996 Infrared Results

1,155 sf wet

$10.00 / sf

$11,550 cost

Cost of Neglect
Case Study – 1999 Infrared Results



6,160 sf wet

$12.00 / sf

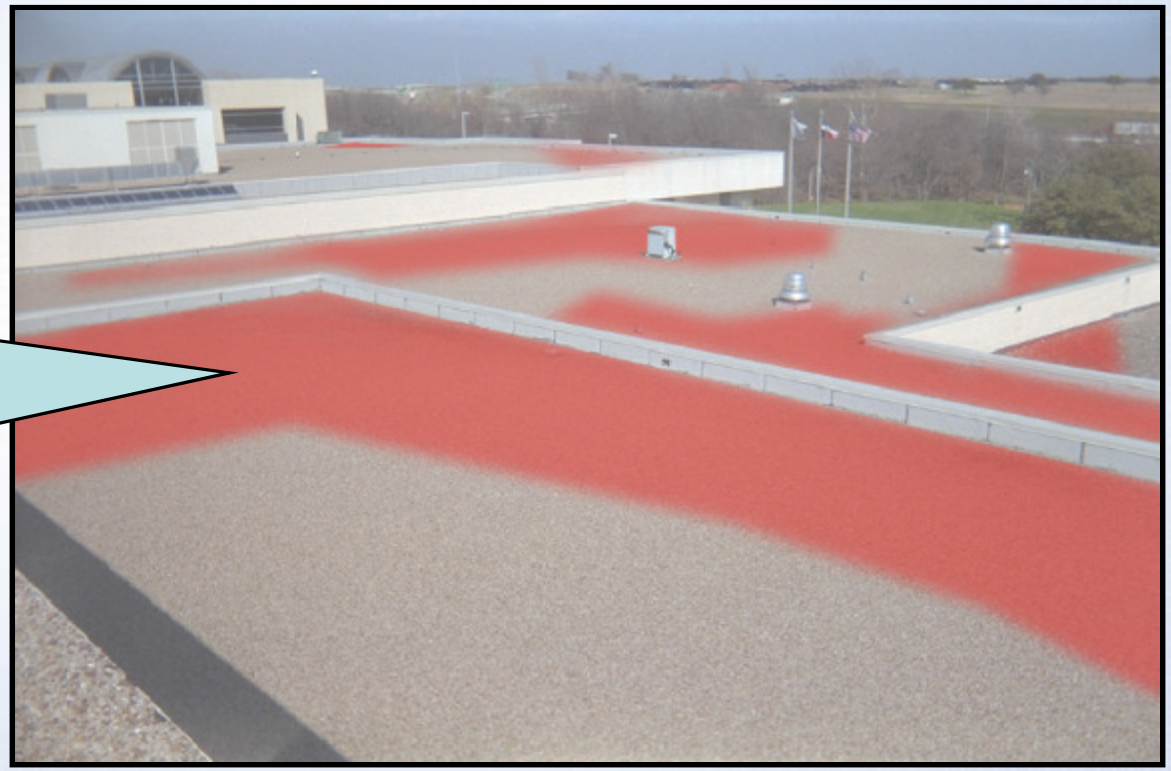
$73,920 cost

Cost of Neglect
Case Study – 2001 Infrared Results

27,201 sf wet

$14.00 / sf

$380,814 cost

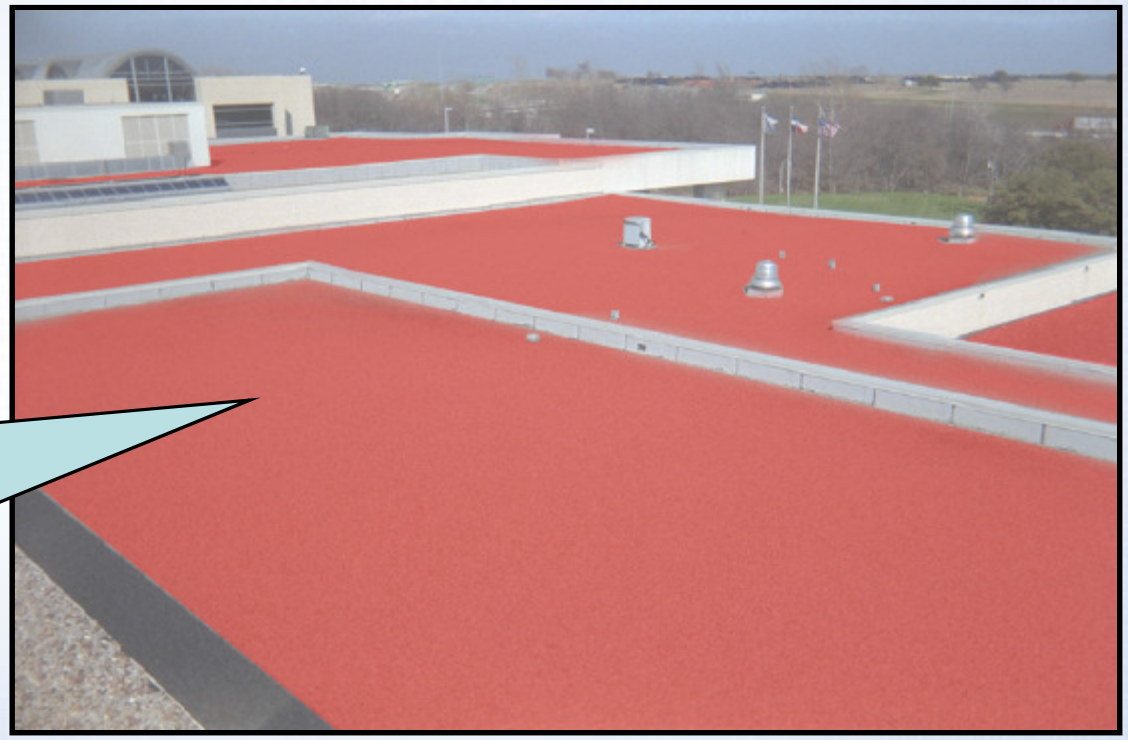


Cost of Neglect
Case Study – Roof Replacement

65,000 sf wet

$17.00 / sf

$1,105,000



Roof System Restoration

- 40-50% new roof cost
- Proactive
- Starts with diagnostic testing….

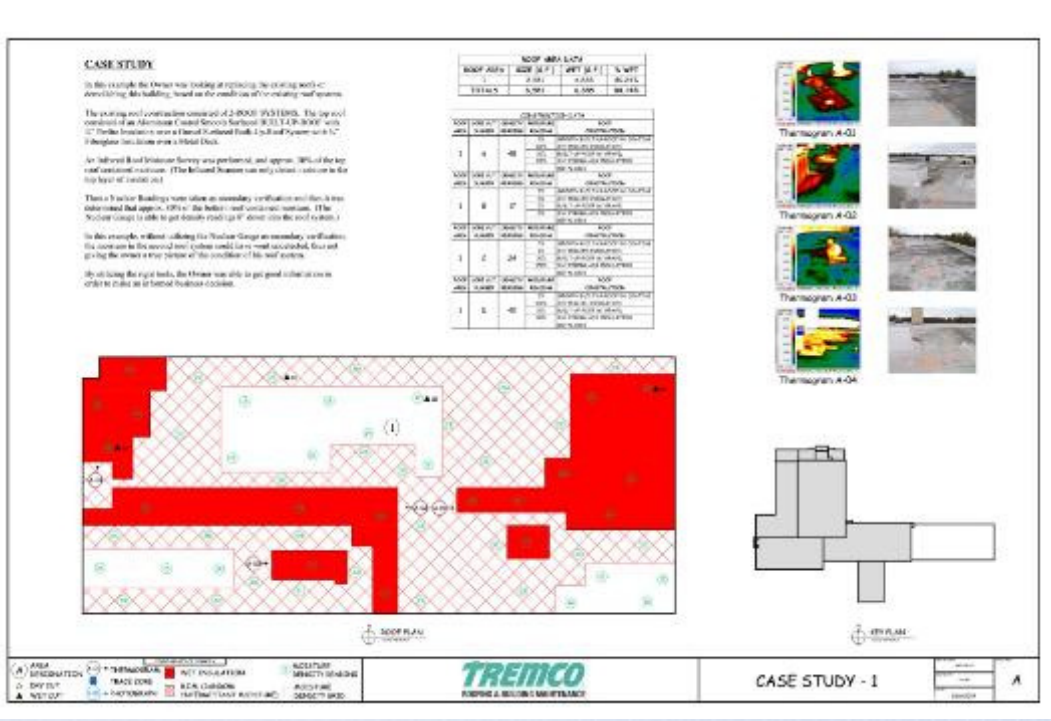
TRACE ANALYTICAL REPORT FOR UNIVERSITY OF CINCINNATI

Core: **Muntz Hall, Core 1**
Identification Number: **2061TH072**

Analysis	Procedure	Result
Core Size:	ASTM D 2829-95	**18.00 x 14.00 sq in**
Estimated Weight of Membrane:	ASTM D 2829-95	**173 lbs/100 sq ft**
Surfacing Bitumen Type:	SOLVENT TEST	**Tar**
Surfacing Bitumen Weight:	TRC 875	**27 lbs/100 sq ft**
Softening Point of Surfacing Bitumen:	ASTM D 3461-85	**No Data Available**
Penetration of Surfacing Bitumen: (@ 77 degree F)	ASTM D 5-95	**No Data Available**
Interply Bitumen Type:	SOLVENT TEST	**Tar**
Softening Point of Interply Bitumen below the First Ply	ASTM D 3461-97	**173 degree F**
Penetration of Interply Bitumen below the First Ply (@ 77 degree F)	ASTM D 5-95	**4 dmm**
Ply Type	ASTM D 2829-95 & NVLAP Test Method Code 18/A01	**Organic**
Number of Plies	ASTM D 2829-95	**5**
Interply Bitumen Weight	ASTM D 2829-95	**18 lbs/100 sq ft**
Tensile Strength, Machine Direction (@ 0 degree F, 0.05 in/min)	ASTM D 2523-78	**99 lbf/in**
Tensile Strength, Cross-Machine Direction (@ 0 degree F, 0.05 in/min)	ASTM D 2523-78	**71 lbf/in**

Comments:
No data available for softening point and penetration of surfacing bitumen due to contamination by dust and dirt. Material could not be tested.

4 of 7



Gravel Surfaced MB BUR System Restoration

Gravel Surfaced MB BUR System Restoration

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Gravel Surfaced MB BUR System Restoration

- 75 year old, gravel surfaced Cincinnati BUR
- Restored twice
- PV panels were installed at year 70.
- Replacement price was $550,000
- Project was completed for $200,000
- Still going strong

Mineral Surfaced MB System Restoration

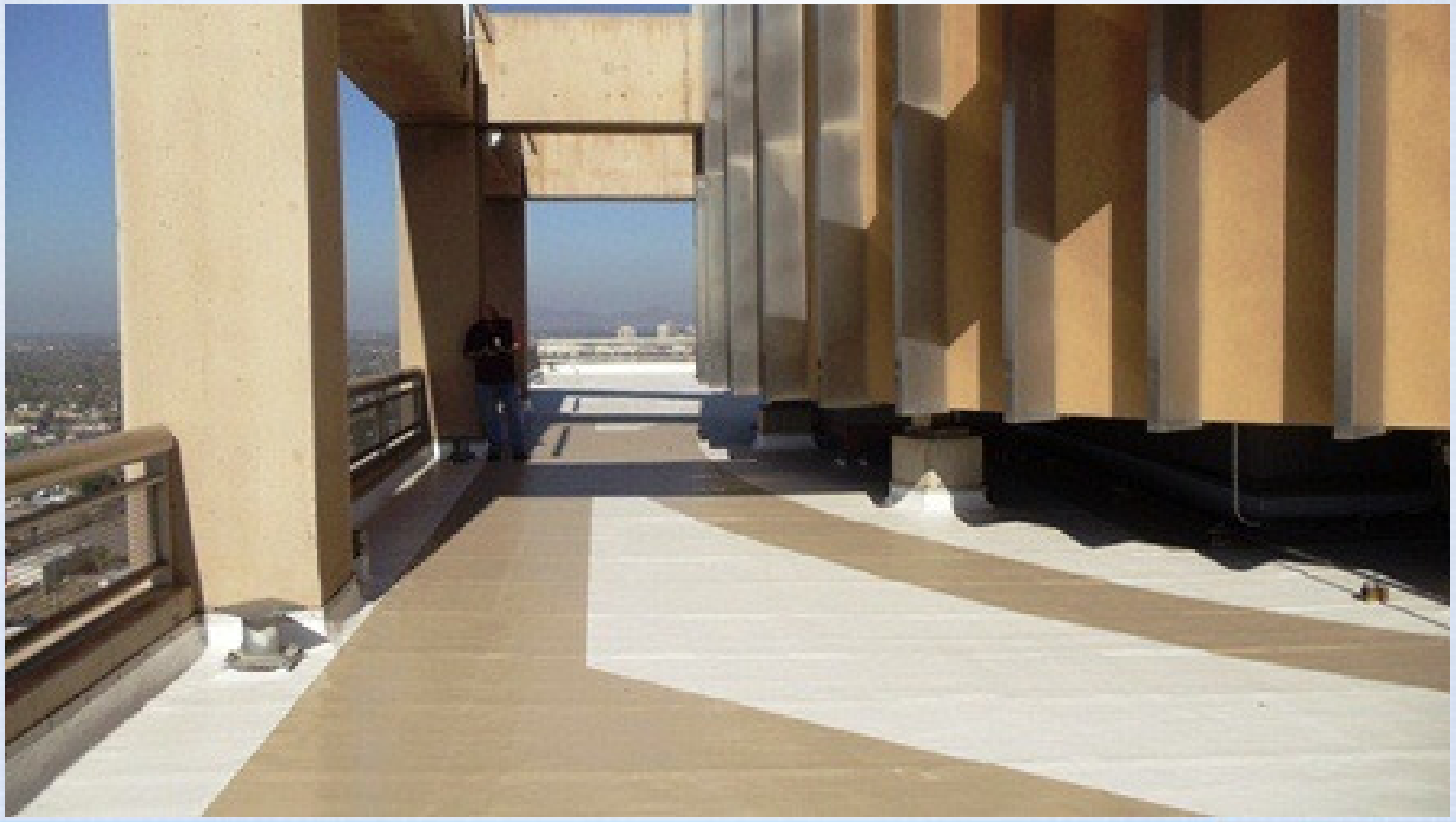
20 Years Ago - Fluid Applied System Restoration

Before

After

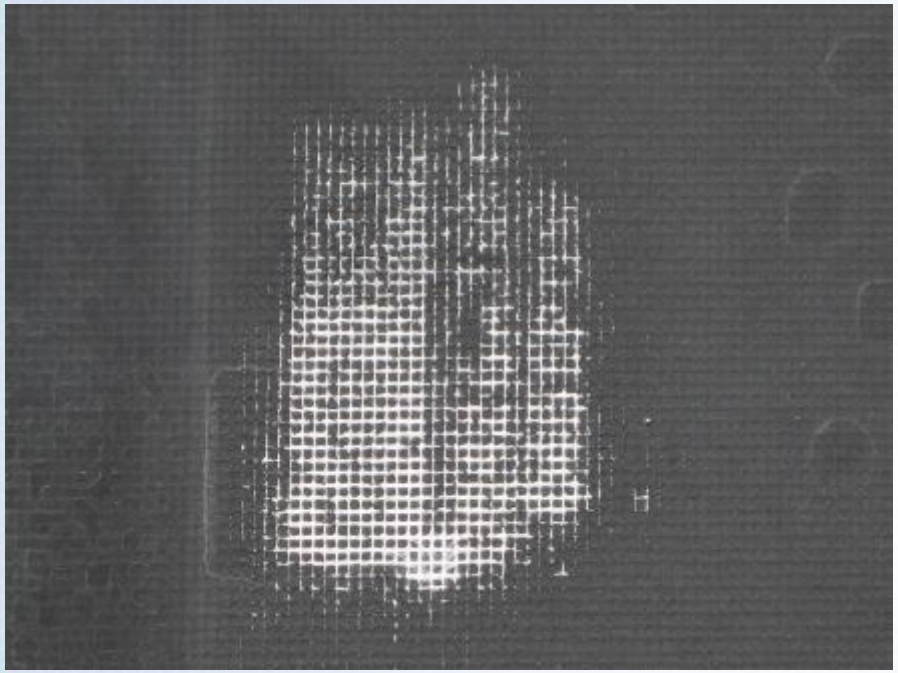
Mineral Surfaced MB System Restoration

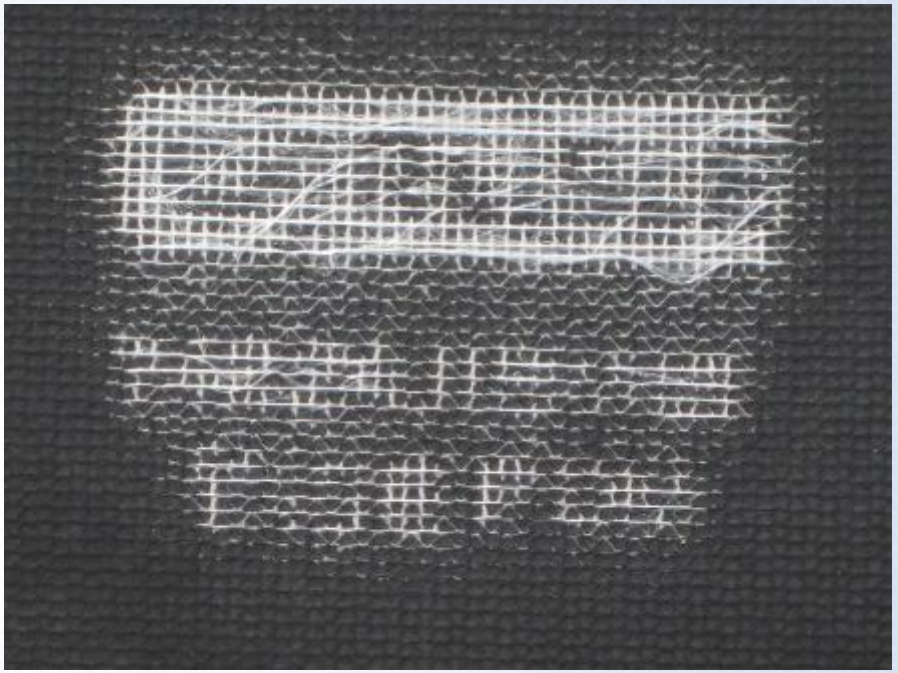
Second Fluid System Restoration



Single-Ply System Restoration

Fluid Applied Roof System Restoration – Not Coatings!





Single-Ply System Restoration

Single-Ply System Restoration

Fluid Applied Roof System Restoration

Single-Ply Roof Restoration

Fluid Applied Roof System Restoration

Single-Ply Roof Restoration

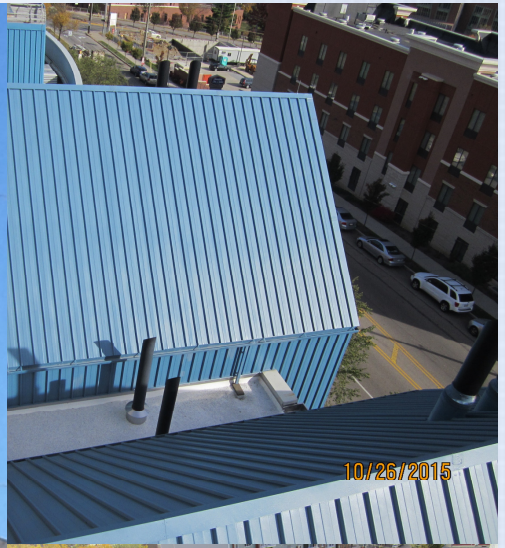
Fluid Applied Roof System Restoration

Metal Roof System Restoration

Fluid Applied Roof System Restoration

Metal Restoration

Fluid Applied Roof System Restoration



The Bottom Line

High performance roof design…..

- Cost effective with new design
- Synergistic impacts (People, Planet, Prosperity)
- Restorative and regenerative in nature
- Existing systems can be upgraded
- Requires an ASSET management approach
- Out of sight should be not be out of mind

QUESTIONS?


Please remain seated until the plane is parked at the gate.
At no time in history has a passenger beaten a plane
to the gate. So please don't even try.
Also, please be careful opening the overhead bins because...
"shift does happen".

THANKS!

David Hart

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