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A Marketers Perspective on Changes Influencing

Ash Utilization

Now and In the Future

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March 30th. 2005 Fredericton, Canada

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CURRENT FLY ASH ARENA

- Current Market
- Historic Trends
- Social Viewpoint
- Service Life
- Why Change is Needed
- Why the Concrete Industry

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Current Market

Hand full of large marketers representing the power plants with a small group of independents.

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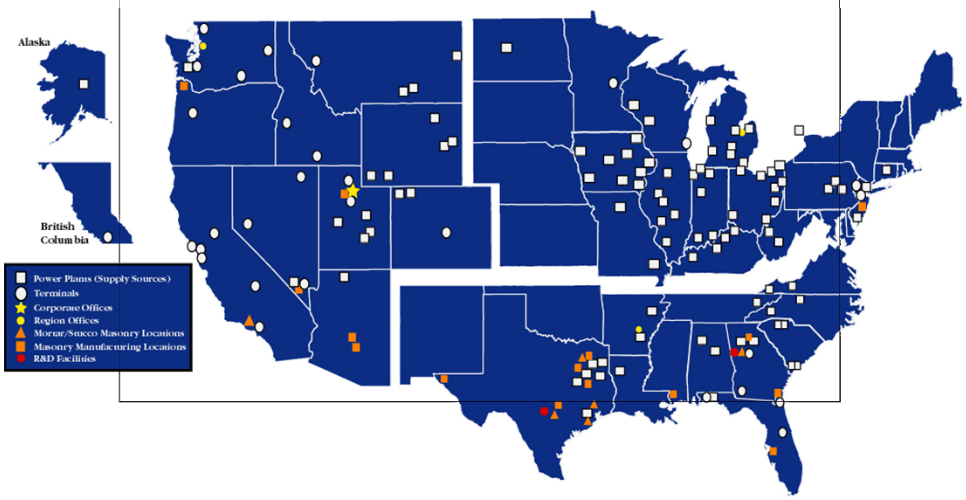
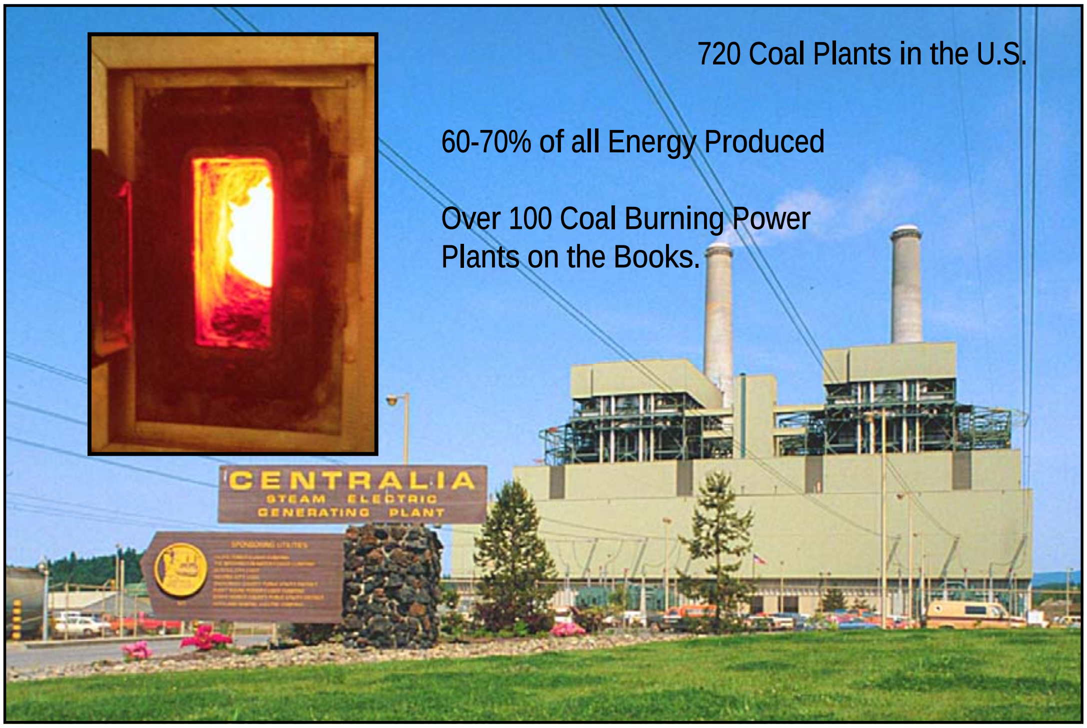
Unparalleled Marketing Reach

HEADWATERS Facilities Serve Customers Coast to Coast





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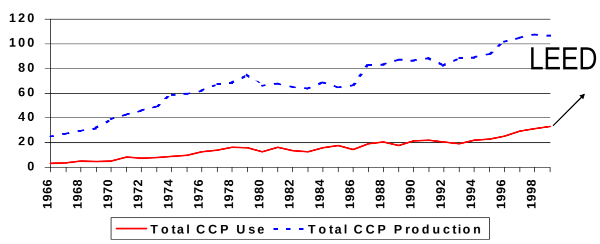
Historic Utilization Trends

Engineer, Architect & Governing Officials

Steady increase in utilization of all CCP's

Utilization growth lagging growth in supply

CCP Production & Use in USA



SOURCE: American Coal Ash Association

“LEED” Leadership in Energy & Environmental Design

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:

Sustainable site planning (22%)
- Safeguarding water and water efficiency (8%)
- Energy efficiency and renewable energy (27%)
- Conservation of materials and resources (20%)
- Indoor environmental quality (23%)

Social Viewpoint

Being driven by World opinion and environmental stewardship

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Kyoto Protocol

A global accord that attempts to reduce the emission of greenhouse gases to prevent global warming.

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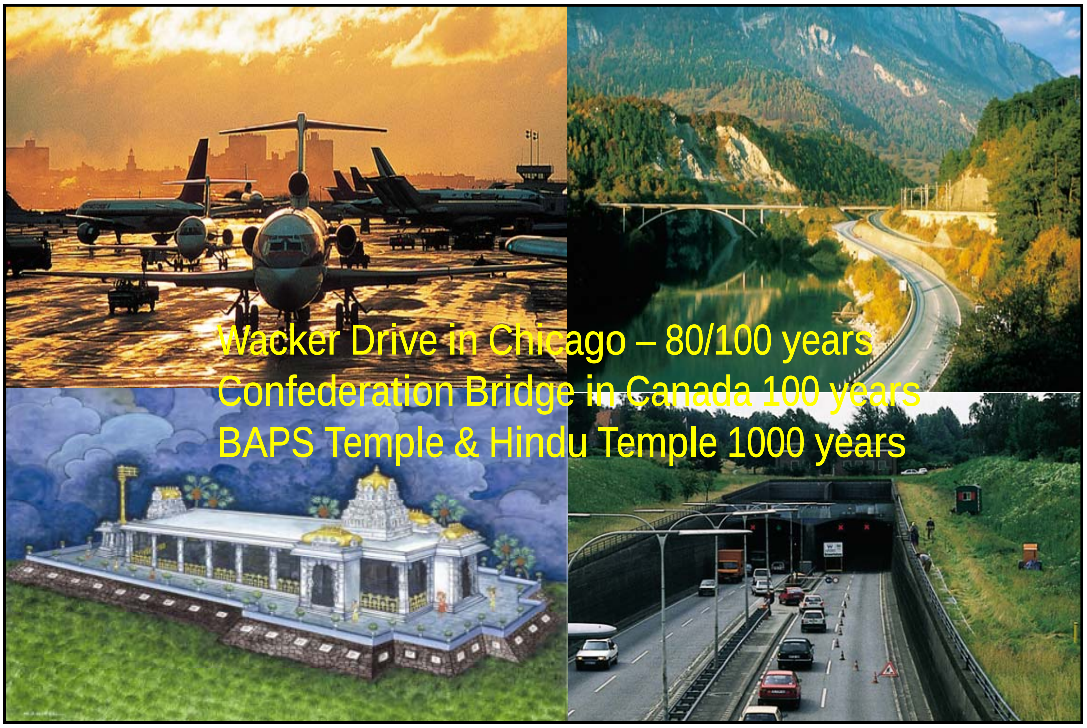
Service Life

Leaving the throw away mentality

As low as 17 year average in some states



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Why Change is Needed

If the true societal costs of energy use, resource consumption, pollution from manufacturing, and waste disposal were incorporated into the costs of our building materials, using recycled content materials wouldn't be an altruistic, feel-good practice. It would simply be the most economically attractive option.

Environmental Building News February 2005

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American Lung Association calculated that the healthcare costs of automobile caused air pollution in the U.S totaled about $100 billion per year, or roughly a $1.00 per gallon

Societal costs of petroleum
Is est. at $5.00 gallon

Environmental Building New Feb 05

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Societal and Industry must change together because it is not just one segment of a market being affected, its all of them…

Current total annual cost
For corrosion in U.S. 276 billion

2005 TEA-21 Reauthorization Bill

Obligation level

$241 to $284 billion over the
Next five years.

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40% of Corrosion can be prevented by existing technologies and best known practices. Battelle Memorial Institute.

Direct Cost Savings

- 110 billion annually

Indirect Cost Savings

- 139 billion annually

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The production of every ton of Portland cement contributes about one ton of CO_2 into the atmosphere.

Expert estimate that Cement production contributes about 7 percent of carbon dioxide emissions from human sources.

If all the fly ash generated each year were used in concrete production, the reduction of carbon dioxide released through substitution of Cement and fly ash would be equivalent to eliminating 25 percent of the world's vehicles. 500 BILLION SOCIETY REDUCED TO 375 BILLION OR 125 BILLION SAVINGS

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Why the Concrete Industry?

"Concrete is second only to water as the world's most heavily consumed substance"

John Sedgewick
Atlantic Monthly, April 1991

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The U.S. Market 2004

Cement Consumption	108 Million Tons
<u>Cement Production</u>	<u>78 Million Tons</u>
Cement Shortfall	30 Million Tons
GGBFS Consumption	3 Million Tons
GGBDS Production	1.8 Million Tons
Total BFS including air cooled	9-12 Million Tons
Fly Ash consumption	13 Million Tons/concrete
Fly Ash all application	28 Million Tons/other
Fly Ash Disposed	39 Million Tons
Total Fly Ash Produced	80 Million Tons

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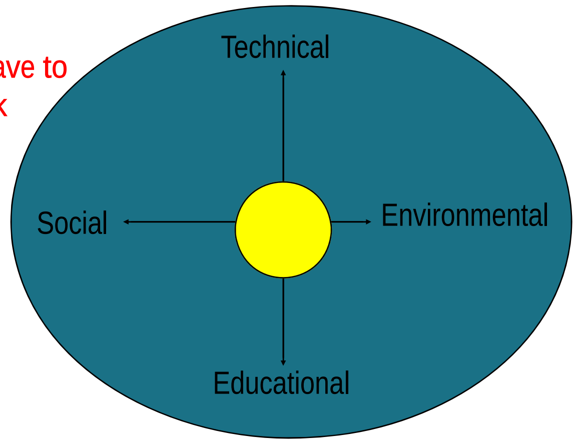
What the Future has for CCP's

All elements will have to synergize and work together.



We must learn from the past & not make the same mistakes

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Change Definition
Change Perception
Educate Specifiers
Address Head on Elements Driving Change
- A. Prescriptive- VS – Performance
- B. LEED/ USGBC Programs
- C. Material Selection or Changes
- D. Social Costs
- E. Processes and Systems being used

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Change Definition

POZZOLAN

- A siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

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POZZOLAN

- A siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- A siliceous or siliceous and aluminous industrial recovered product which by its self or in combination with other cement enhancing materials influences the properties of ordinary portland cement to produce a concrete with a sustainable service life three and four times that of ordinary portland cement.

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Perception of CCP's

Technical

Few Understand

Cause and Effect

Relate to the Masses

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Education of the Specifiers

- 85% of the Engineering Schools, one course is taught in concrete construction and that is with a structural class.
- 10% of the Engineering Schools give one course in concrete technology. (Free elective)
- 4% of the Engineering Schools give two classes.
- 1% of the Engineering Schools specialize in concrete technology.

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Chemistry

Chemical Compound	Class F	Pozzzolans Class C	Class N	Slag	Cement
SiO_2	54.90	39.90	58.20	38.0	22.60
Al_2O_3	25.80	16.70	18.40	7.9	4.30
Fe_2O_3	6.90	5.80	9.30	Tr.	2.40
CaO	8.70	24.30	3.30	41.90	64.40
MgO	1.80	4.60	3.90	6.89	2.10
So_3	0.60	3.30	1.10	--	2.30
Na_2O & K_2O	0.60	1.30	1.10	.4	0.60

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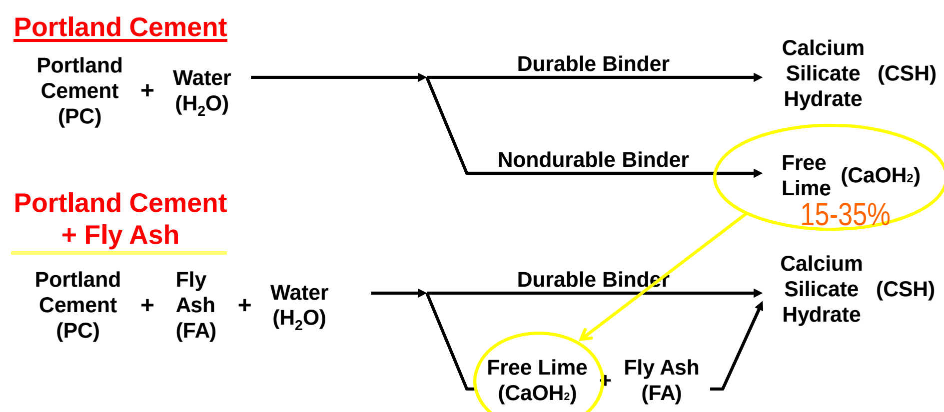
HYDRATION PRODUCTS OF CEMENTING BINDERS



Through Pozzolanic Activity, Fly Ash Combines with Free Lime to Produce the Same Cementitious Compounds Formed by the Hydration of Portland Cement

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Elements Driving Change

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The Concrete Construction Industry is changing and is going to continue.

Prescriptive VS Performance

LEED & BEE's Leadership in Energy & Environmental Design®

Material Selection

ASR, CO2's, Chlorides, Corrosion………

Social Costs.

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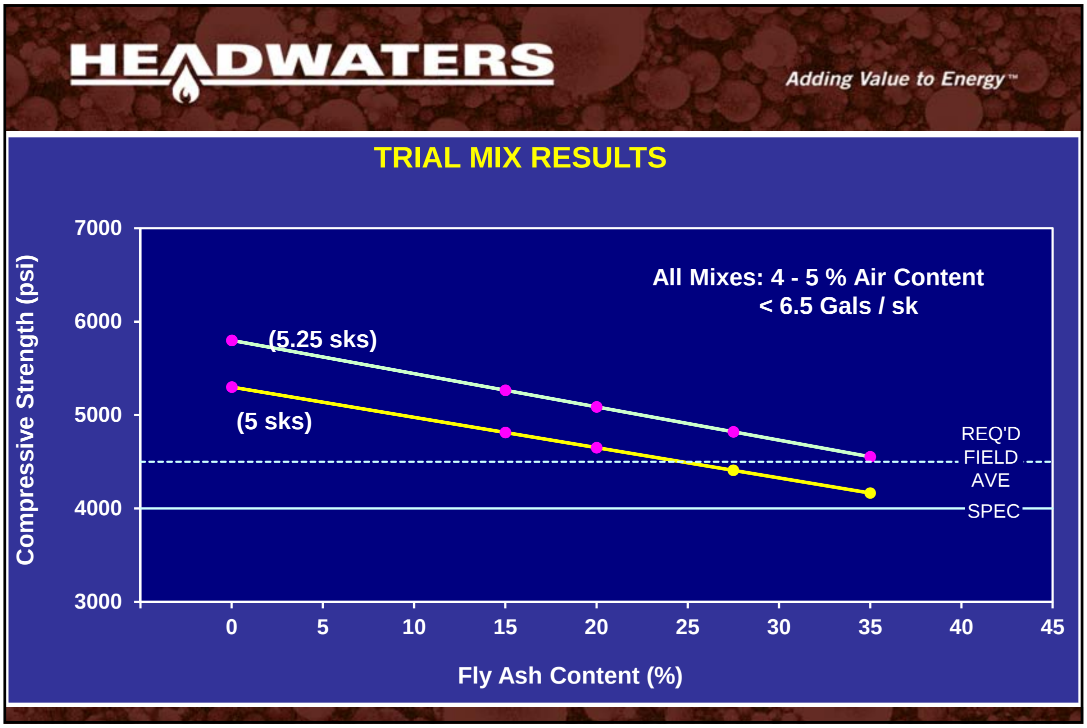
Prescriptive VS Performance Mixes

- What is better for concrete and the environment?

  Less Cement is that best??????????????????

  Less Cement in a mix always reduces CO2's,

  or does it??????????????????????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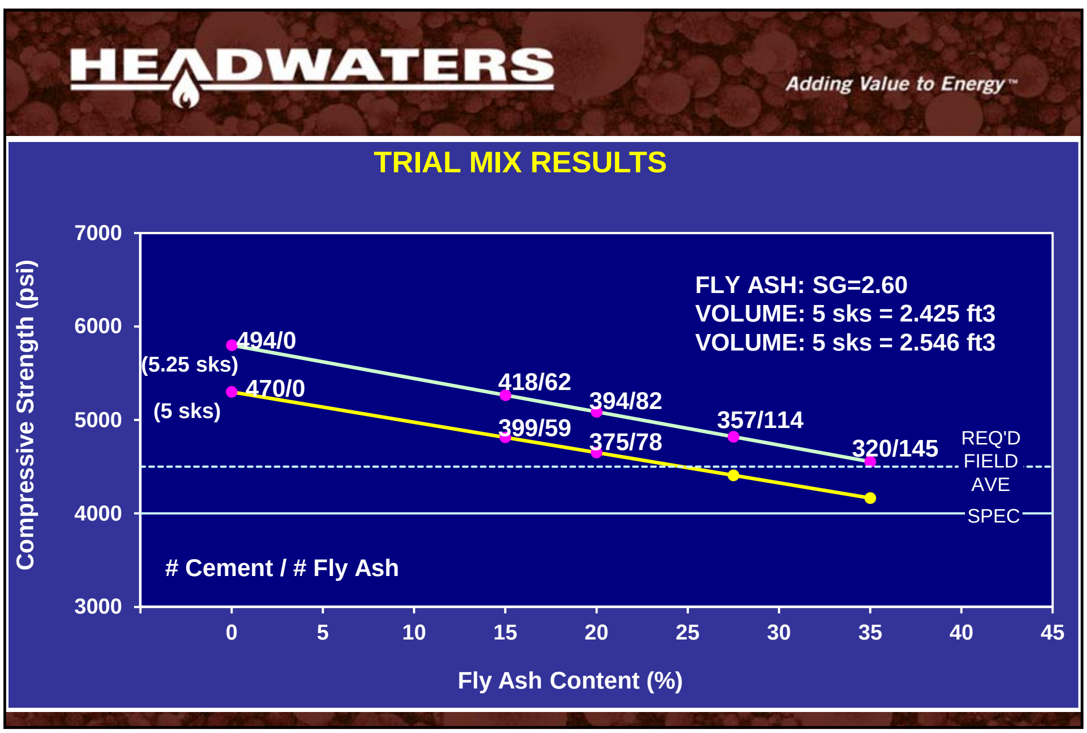
TRIAL MIX RESULTS
All Mixes: 4 - 5 % Air Content
< 6.5 Gals / sk
(5.25 sks)
(5 sks)
REQ'D
FIELD
AVE
SPEC
Compressive Strength (psi)
7000
6000
5000
4000
3000
0
5
10
15
20
25
30
35
40
45
Fly Ash Content (%)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TRIAL MIX RESULTS
FLY ASH: SG=2.60
VOLUME: 5 sks = 2.425 ft3
VOLUME: 5 sks = 2.546 ft3
494/0
(5.25 sks)
470/0
(5 sks)
418/62
394/82
399/59
375/78
357/114
320/145
REQ'D
FIELD
AVE
SPEC
Cement / # Fly Ash
Compressive Strength (psi)
7000
6000
5000
4000
3000
0
5
10
15
20
25
30
35
40
45
Fly Ash Content (%)

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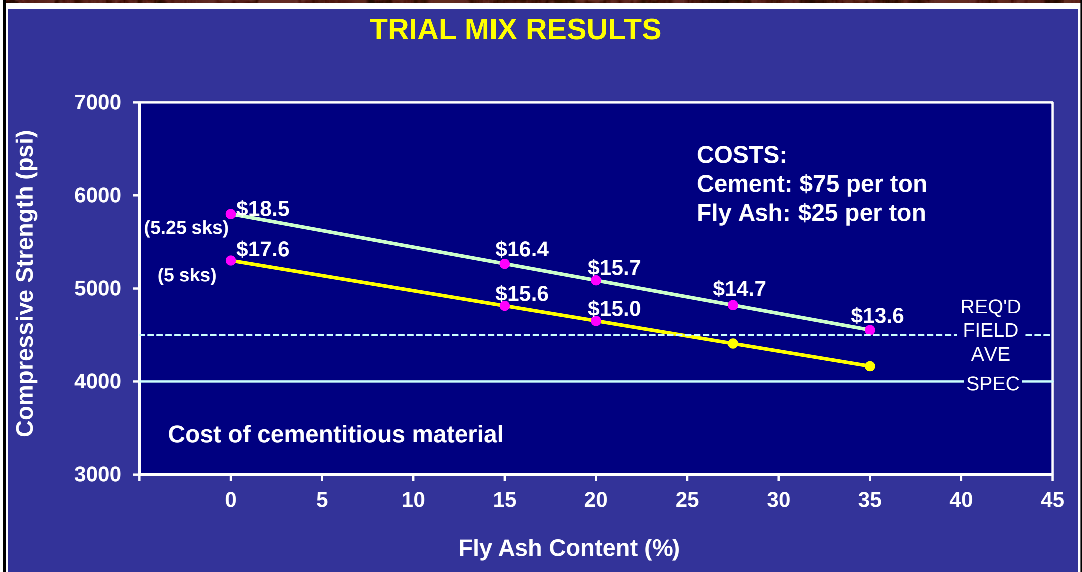

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Which is a better mix design?

	Cost of cementitious material	Strength*
5 sks w/o fly ash	▪$15.0	▪OK
5.25 sks w/ 35% fly ash	▪$13.6	▪OK

* Compared to required field average

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Better?

- $1.40/cy Savings
- Lower Temperature
- Better Finishing
- Better Pumpability
- Better Consolidation
- More Durable
- Lower Permeability
- Less Cracking

CA

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Material Selection

CHANGING PRODUCTS

LEED

HIGH VOLUME / PERFORMANCE

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COMPRESSIVE STRENGTH

CEMENT #	658	658	530	530	611
FLY ASH #	0	75	130	260	275
W/(C+P)	0.41	0.37	0.38	0.33	0.28
AIR%	6.6	6.2	5.9	5.4	4.7
COMP – 3 DAY	NONE	NONE	NONE	NONE	NONE
7 DAY	4765	4675	4295	4325	NONE
14 DAY	5480	5630	5185	5330	8015
28 DAY	6140	6580	6020	6315	8995
148 – 157 DAY	6730	7420	7360	8390	11995
300 DAY	6800	7780	8070/6900	8950	12430

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COULOMB RANKING

MIX	COULOMB	COULOMB RANGE	CHLORIDE PERM.	TYPICAL OF
658 / 0	4509	> 4000	HIGH	W/C > 0.6 PCC
658 / 75	2404	2000 - 4000	MODERATE	W/C 0.4 - 0.5 PCC
530 / 130	1497	1000 - 2000	LOW	W/C < 0.4 PCC
530 / 260	797	100 - 1000	VERY LOW	SILICA FUME
611 / 275	639	100 - 1000	VERY LOW	SILICA FUME

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Water Reduction – Future focus within LEED

- U.S. consumes 400,000,000 Yards of Concrete
- With 470 lbs of cement per cubic yard
- At a Water to cement ratio of .45 or 211 lbs/25 gallons.

- Fly ash reduces water by 2-10%

10,000,000,000 BILLION gallons of water is consumed in U.S. R/M market

200 MILLION to 1 BILLION gallons of water can be saved by utilization of fly ash into every cubic yard of concrete concrete.

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The Processes and Systems in which we use

- Not learning from past mistakes or successes?

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Processes and Systems in which we use?

Penguin Theory of Advancement

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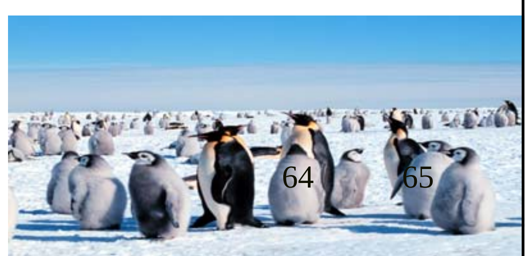
It’s done this way because that is how we have always done it.



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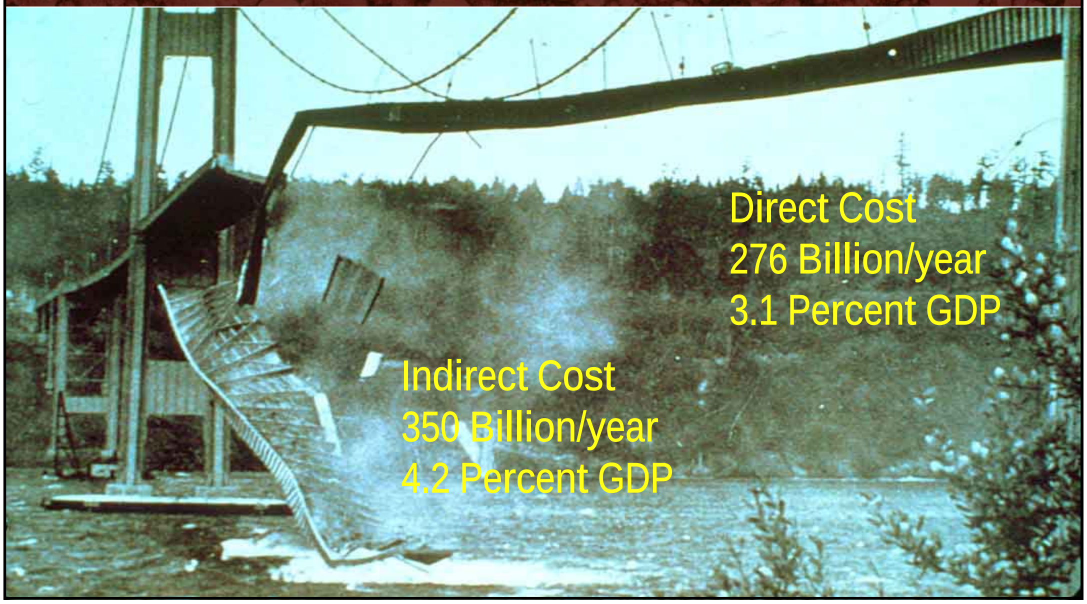

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Approximately 600,000 bridges in the U.S. and half were build between 1950 and 1994.

Although there is a downward trend in the % of structurally deficient bridges- decrease from 18% to 15% the cost of replacing the bridges has increased 12% during the same time period.

In addition, there has been an significant increase in the required maintenance to the 183,000 aging bridges.

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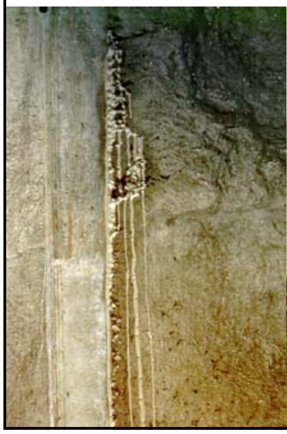
What Is the Social Cost?



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Cost to Repair of Concrete

Vertical Patching ($35.00 - 50.00/sf)
Horizontal Patching ($10.00-20.00/sf)
Epoxy Injection ($20.00-100.00/LF)
Foam Injection ($60.00-80.00/LF)
Corrosion Inhibitors
($60.00-6.00/Cubic Yard)
($1.75-2.00/SF)

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Significant Environmental Benefits

- **Because fly ash use displaces cement production, environmental benefits are substantial.**

- **Just One Ton of Fly Ash Usage Equals…**
  - Landfill Space Conserved: **Enough for 455 days of solid waste produced by an average American.**
  - CO_2 Emissions Reduced: **Equal to two months of emissions from an automobile.**
  - Energy Saved: **Enough to provide electricity to an average American home for 24 days.**

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BLENDED CEMENTS & TERNARY MIXES

- Performance, energy conservation, environmental impact and economics can be improved for the cement producer through the use of pozzolans as part of the cementitious materials.
- Materials may be blended or interground with portland cement.
- Type 1P cement has a pozzolan content of 15% to 40%.
  - Performance similar to Type 1 cement.
- Type 1(PM) cement has a maximum pozzolan content of 15%.

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Thank You