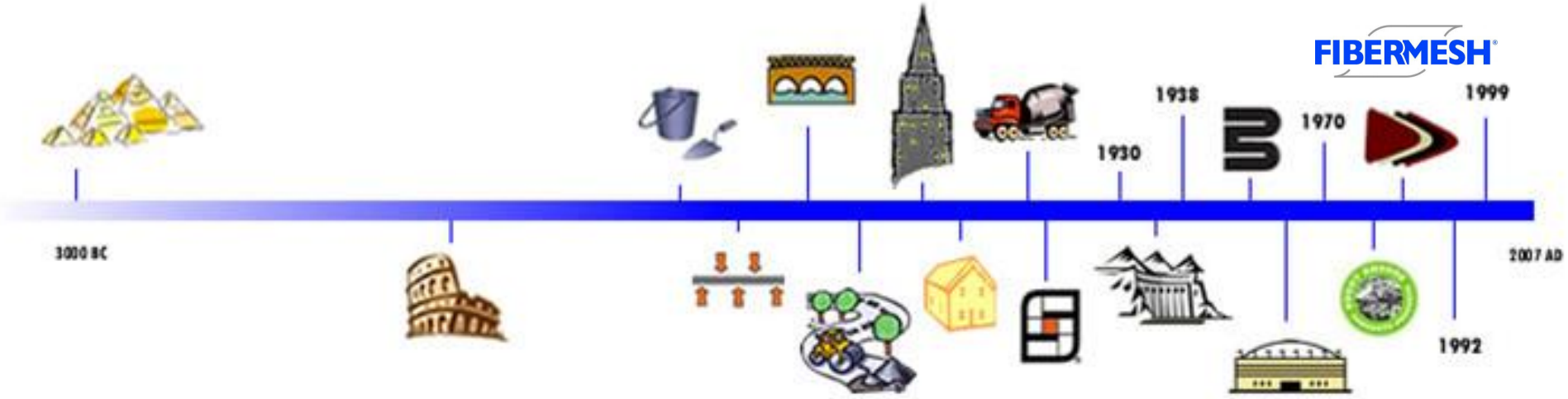
Agregando valor al concreto con el uso de fibras

Grover Vargas
Propex
Bolivia

EL MUNDO ESTA CAMBIANDO RAPIDAMENTE



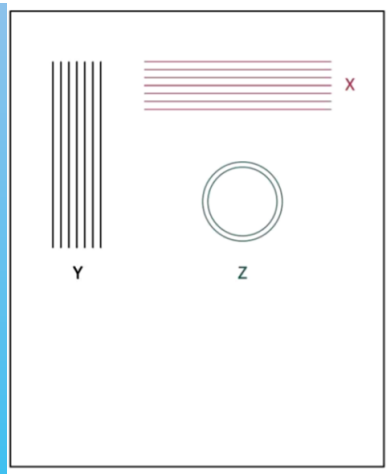
Hacia donde vamos ……?

http://www.concretenetwork.com/concrete-history/

Organizan:

Federación Iberoamericana del Hormigón Premezclado
Fihp 40 años

ASOCEM
ASOCIACIÓN DE PRODUCTORES DE CEMENTO



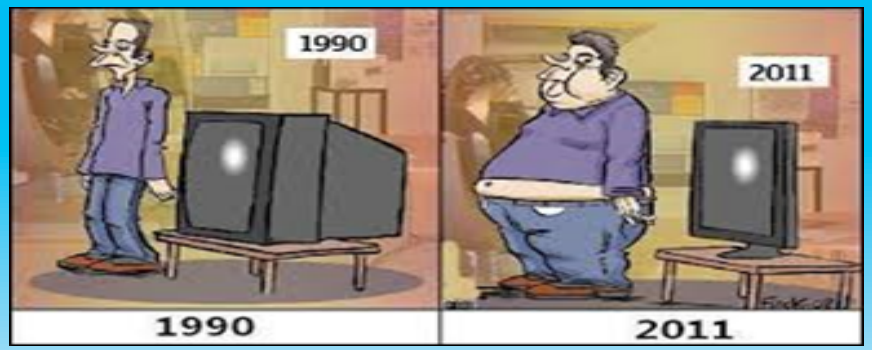
FIBERMESH	RANKING DIRECTION	RANKING MATERIAL
X = 3995 psi	2	2
Y = 4537 psi	1	1
Z = 3439 psi	3	4
		7
PVA		
X = 3303 psi	2	5
Y = 3812 psi	1	3
Z = 2898 psi	3	6
		14
NO FIBER REINFORCEMENT		
X = 1068 psi	3	9
Y = 1394 psi	1	7
Z = 1139 psi	2	8
		24

X	Y	Z
2	1	3
2	1	3
3	1	2
7	3	8

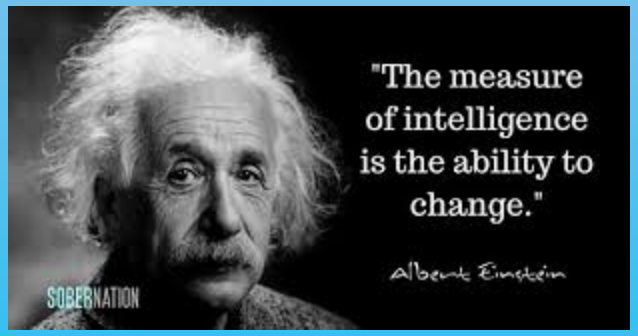
CONCLUSION:
Fibermesh = strongest material
Y = strongest direction


170
2000

- **Estamos preparados para reaccionar adecuadamente a los cambios?**
- **Como va a afectar la tecnologia a nuestra industria?**
- **A nuestro planeta?**
- **A mi como individuo?**

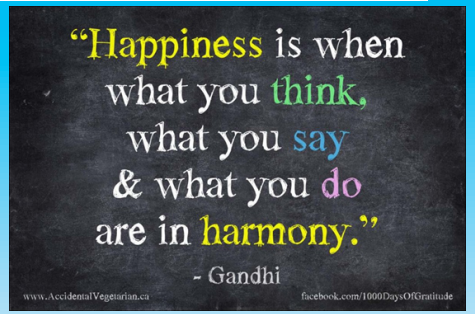


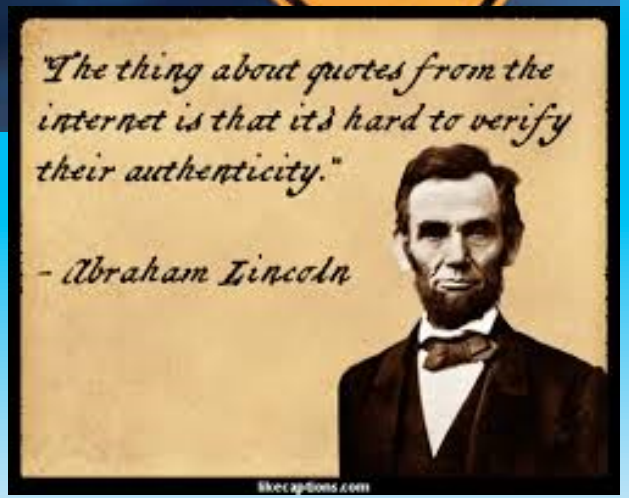
PORQUE CAMBIAR ?



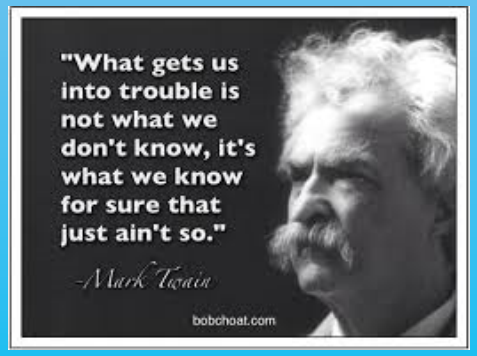
https://www.edx.org/course/science-happiness-uc-berkeleyx-gg101x-3

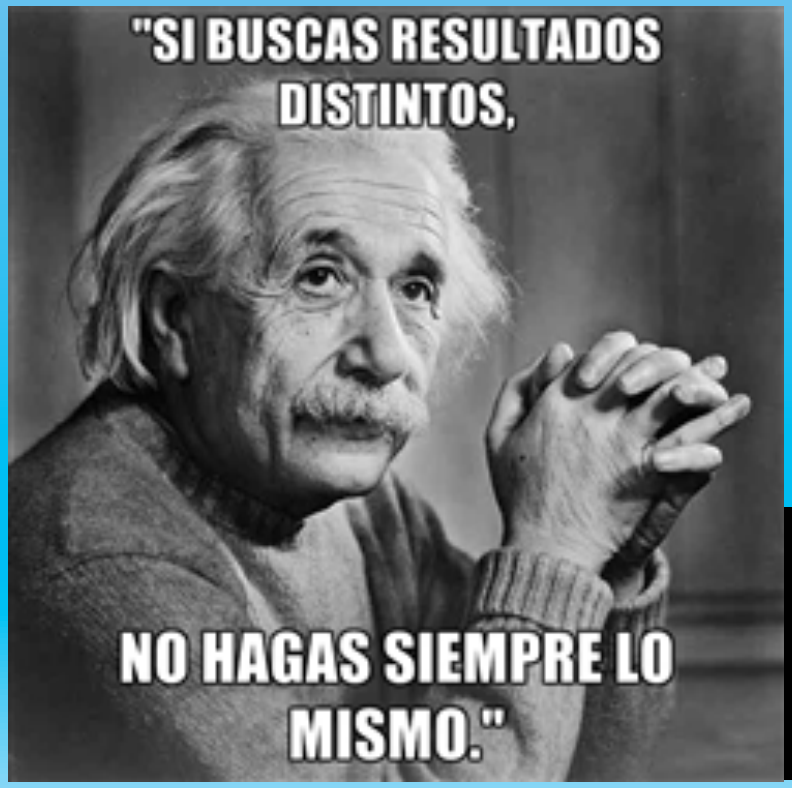
Berkeley
UNIVERSITY OF CALIFORNIA

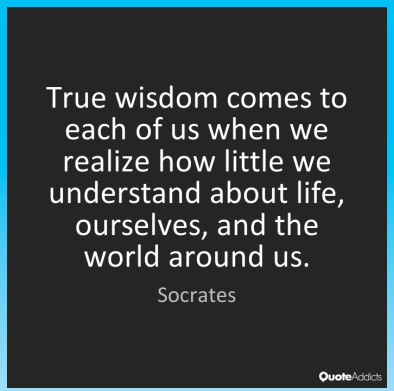




DONDE COMENZAR .....?



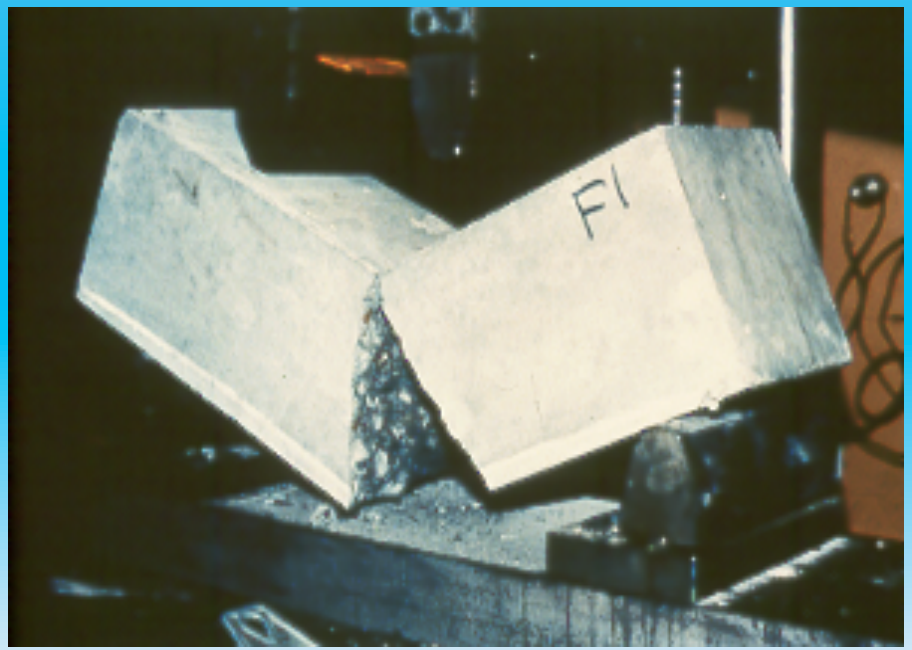




- Para que sirven las fibras?
- Que tipos de fibras hay?
- Que ventajas ofrecen?
- Como agregan valor al concreto?
- Casos de Exito

Para que sirven las macro-fibras?

Para que un material fragil sea mas Ductil

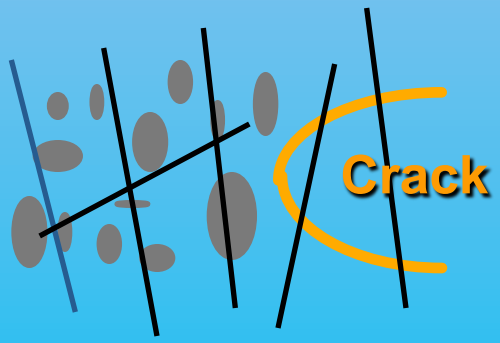


Para que sirven las macro-fibras?

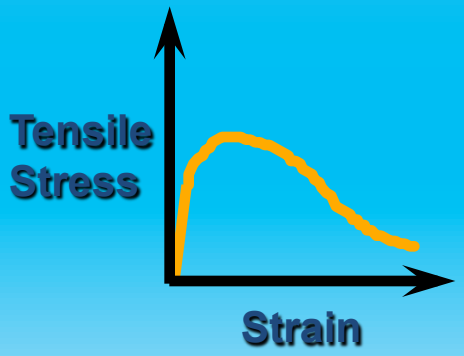
Para que un material fragil sea mas Ductil

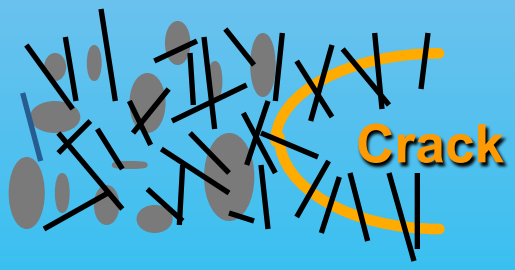
Como trabajan las Macro Fibras?

EN-14889 Establece los requisitos para usos estructurales y no estructurales de las fibras sinteticas.

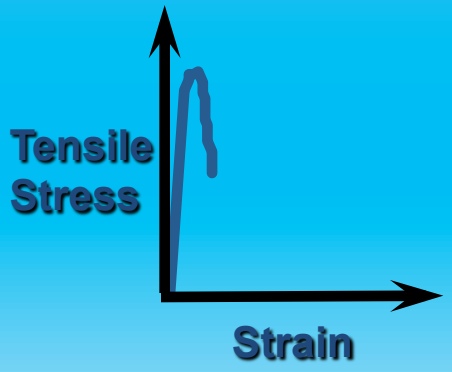


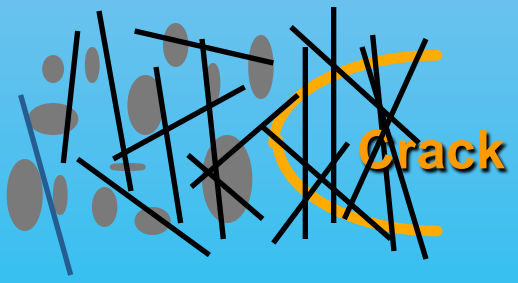
(a) Resistencia Residual



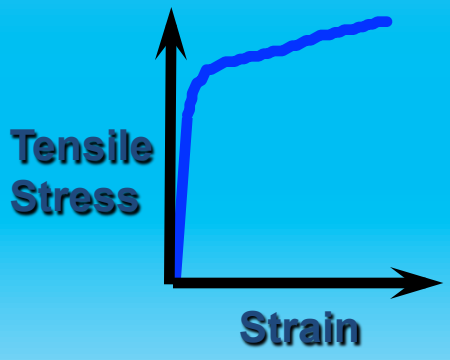


(b)Sin Refuerzo



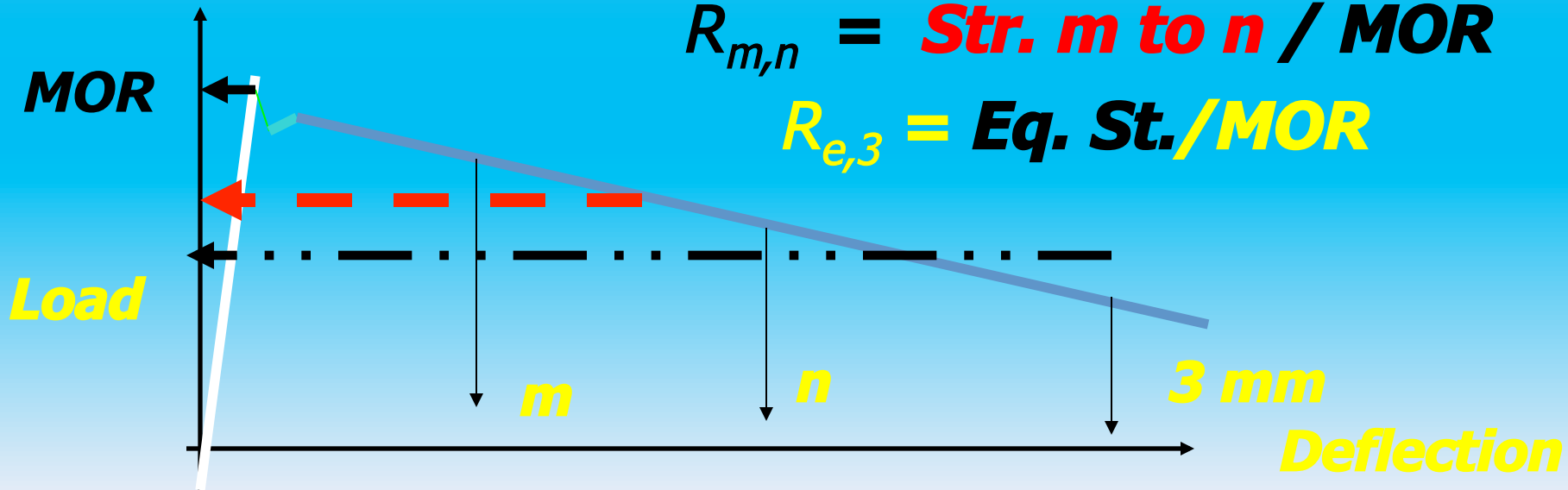


(c) Refuerzo “Estructural”



Toughness Measurement:

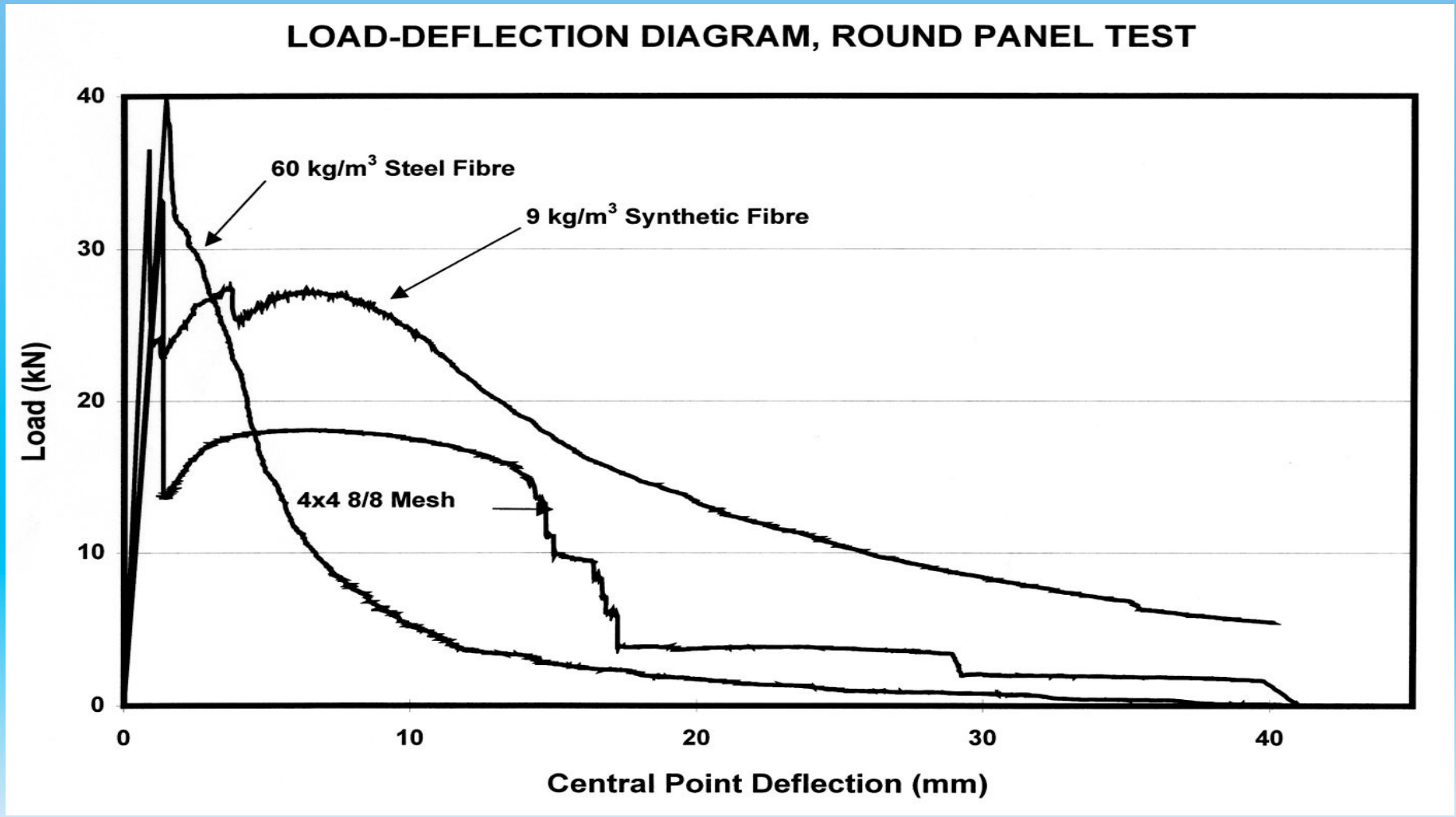
- ***ASTM C 1018/1609 - Beam***
- ***ASTM C 1399 – Beam – ARS values***
- ***ASTM C 1550 – Round Panel - Energy***
- ***JCI – SF-4 - Beam - Equiv. Strength***
- ***EFNARC - Square Panel - Energy***



$R_{m,n}$ = **Str. m to n / MOR**

$R_{e,3}$ = **Eq. St./MOR**

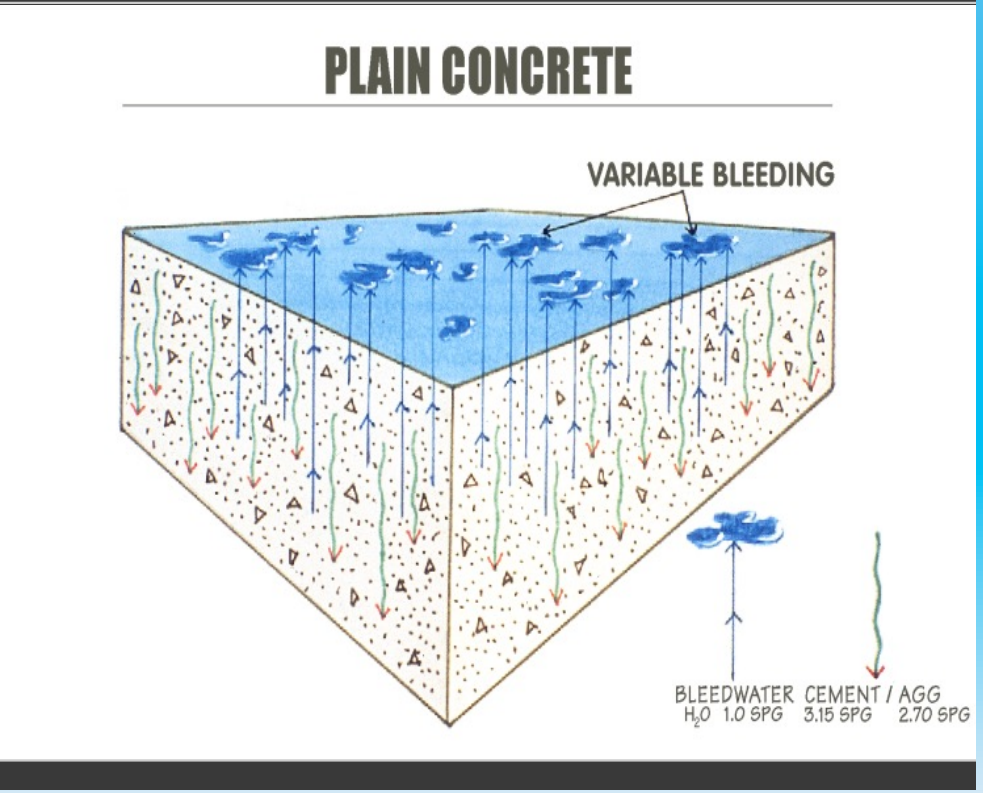
ASTM C 1550 Round Panel

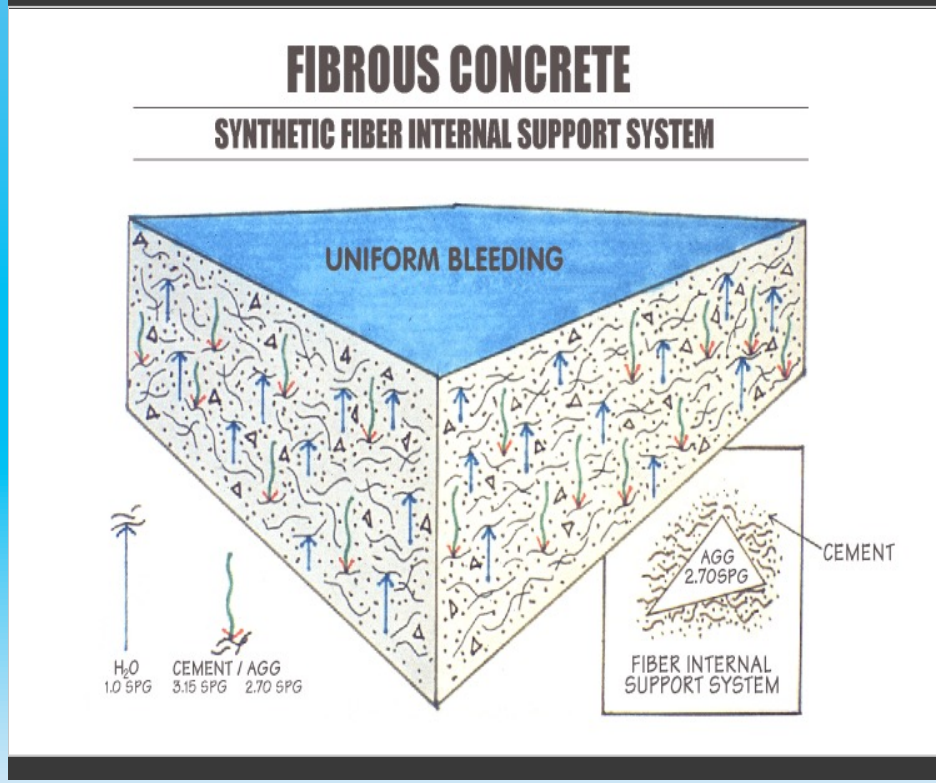


Como trabajan las Micro Fibras ?

Control de asentamiento plastico y exudacion

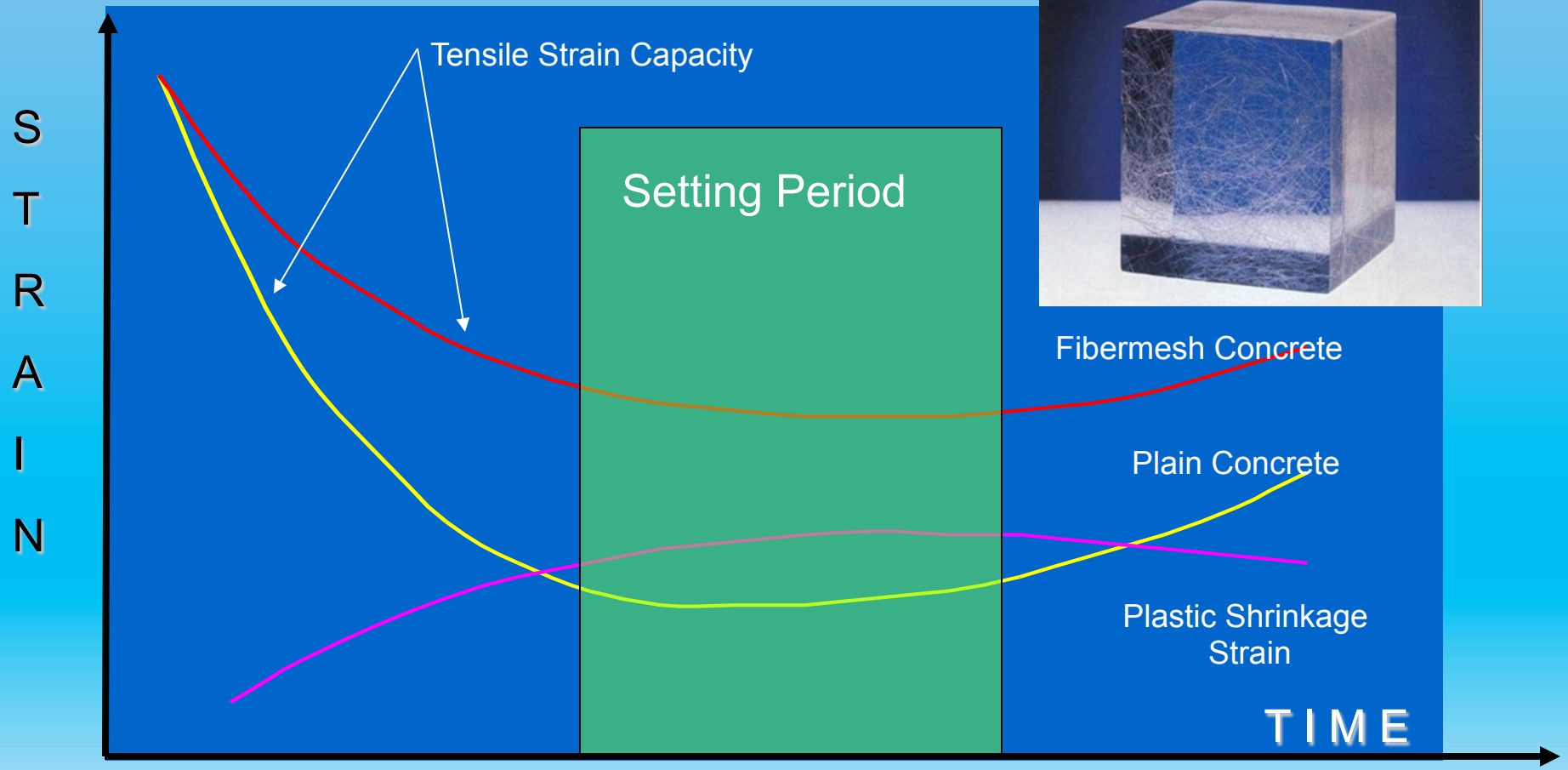
Reduce fisuracion Plastica



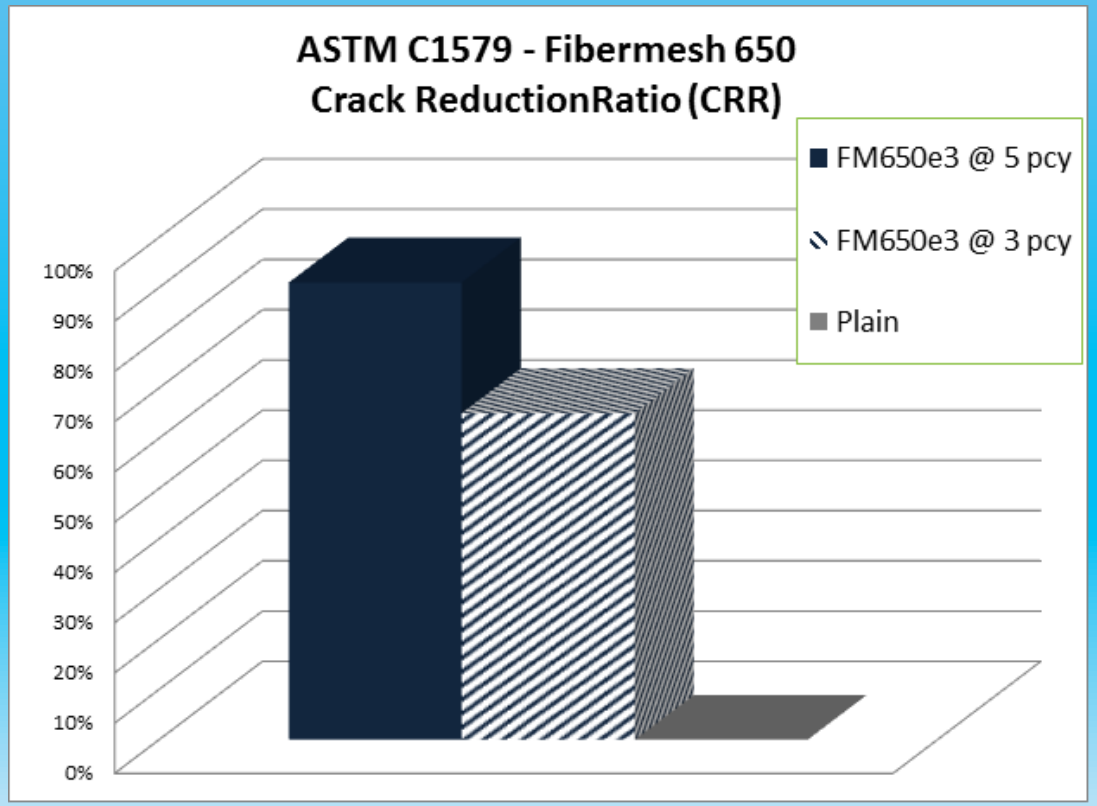


Micro-Synthetic Fibres

Principals of Tensile Strain –Early Age Concrete



Efecto en la reduccion de fisuras



Fibre Types:

Macro Fibres

- *Over 0.4 mm Diameter*

(Steel and Polymers)

Micro Fibres

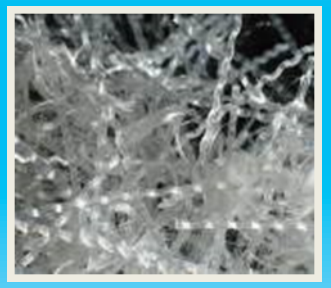
- *Less than 100 Denier*

(0.125 mm for Polypropylene)

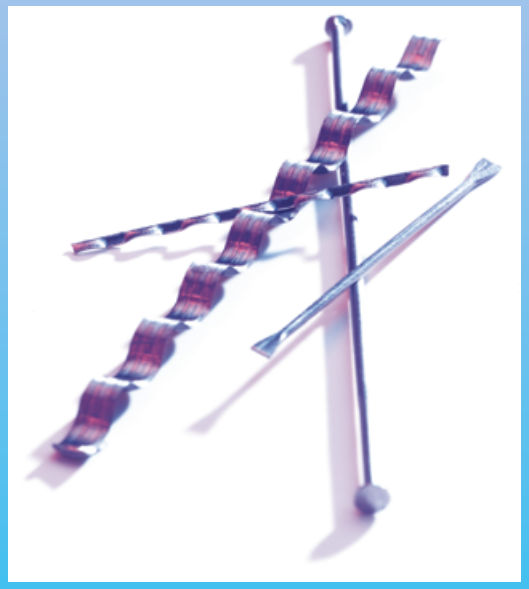
(Polymers, Carbon, Glass)

Fibre Materials:

- ***Steel***
- ***Synthetic***
- ***Glass***
- ***Natural***



Steel Fibers



ASTM A 820:

Type I – Cold Drawn Wire

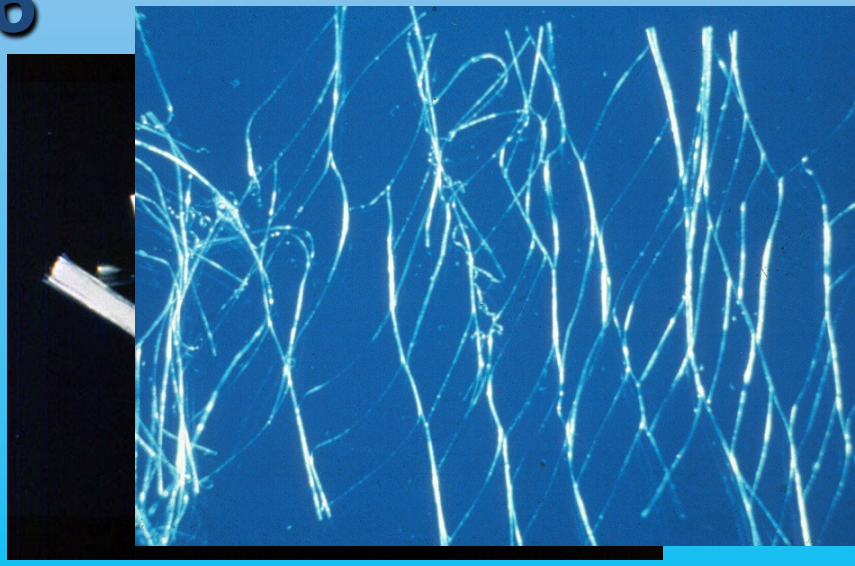
Type II – Slit Sheet

Types III & IV – Stainless & Other

Min. Tensile and Tolerances
Deformed or Not

Synthetic Fibers

ASTM C 1116



Micro Fibers

Monofilament

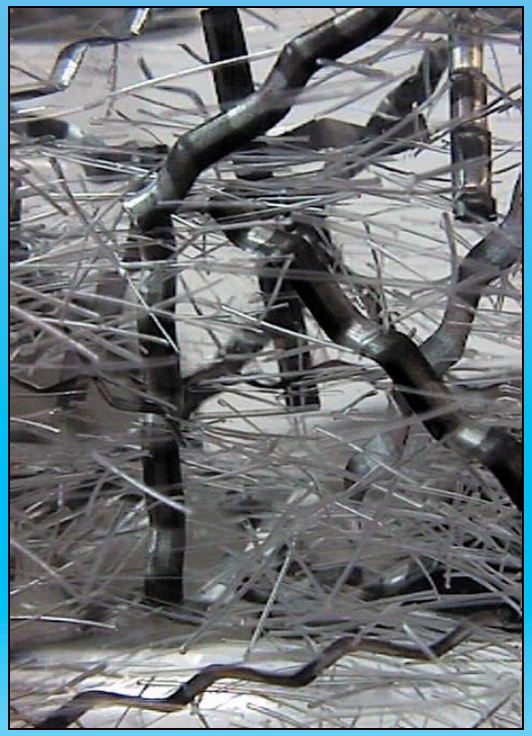
Fibrilated

Macro Fibers

Monofilament

Fiber Hybrids (Blends)

- Various lengths of same fiber
- Blends of Micro and Macro – same mt'l.
- Blends Steel and Micro Synthetic fiber
- Blends of materials in a fiber



VENTAJAS DEL REFUERZO CON FIBRA

Micro Synthetic Fibres

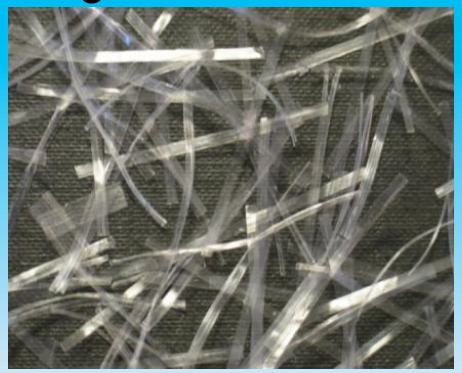
Benefits

- 3 Dimensional Reinforcement
- Increased early-age / green strength
- Increased cohesion & reduced segregation
- Reduced rebound & waste material
- Reduced plastic shrinkage and settlement cracking
- Increased impact & shatter resistance
- Chemically inert & alkali proof
- Non-corrosive
- Provides explosive spalling resistance
- Safe & easy to handle

Macro Fibras

Benefits

- 3 Dimensional Reinforcement
- Improves cohesion
- Increased resistance to long-term cracking
- Increased impact & shatter resistance
- Increased flexural toughness & shear strength
- Improved residual strength/ toughness (after cracking)

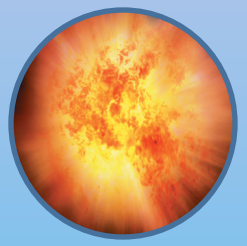


Macro Synthetic Fibres

Additional Benefits of Macro Sinthetic

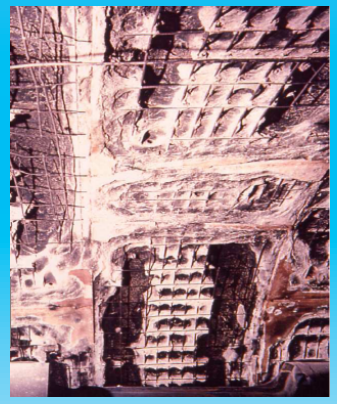
- Non-Corrosive
- Safe & Easy to Handle
- Logistics (Less material to move to remote areas)
- Reduced wear on concrete pumps & hoses
- Reduced carbon footprint

Consequences of Tunnel Fires



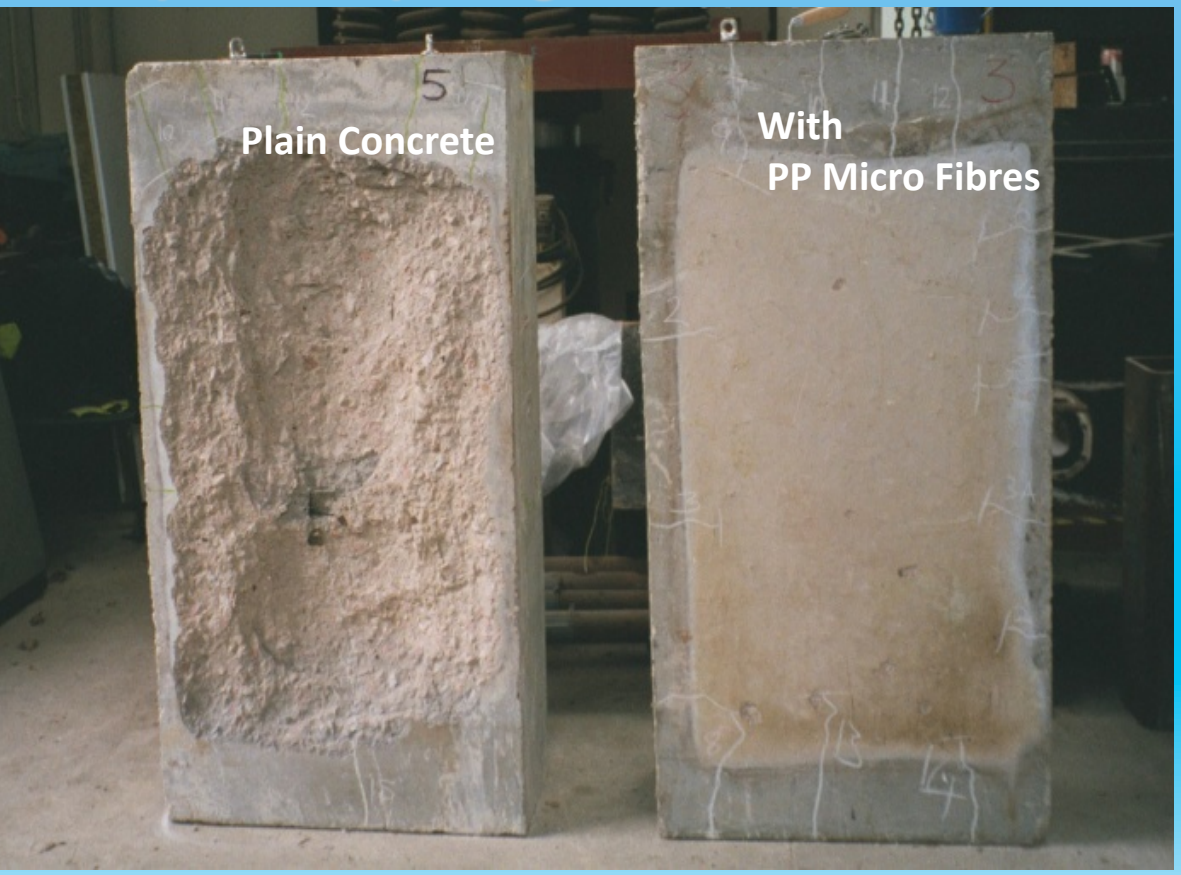
Fire in the Channel Tunnel, UK/France, 1996

- 30 people injured
- Damage of the lining: Spalling
  depth up to 35 cm
- Estimated loss: 250 million Euros ($360M)
- Time required to repair: 6 months



Beneficios de la Microfibra contra fuego

Explosive Spalling Resistance



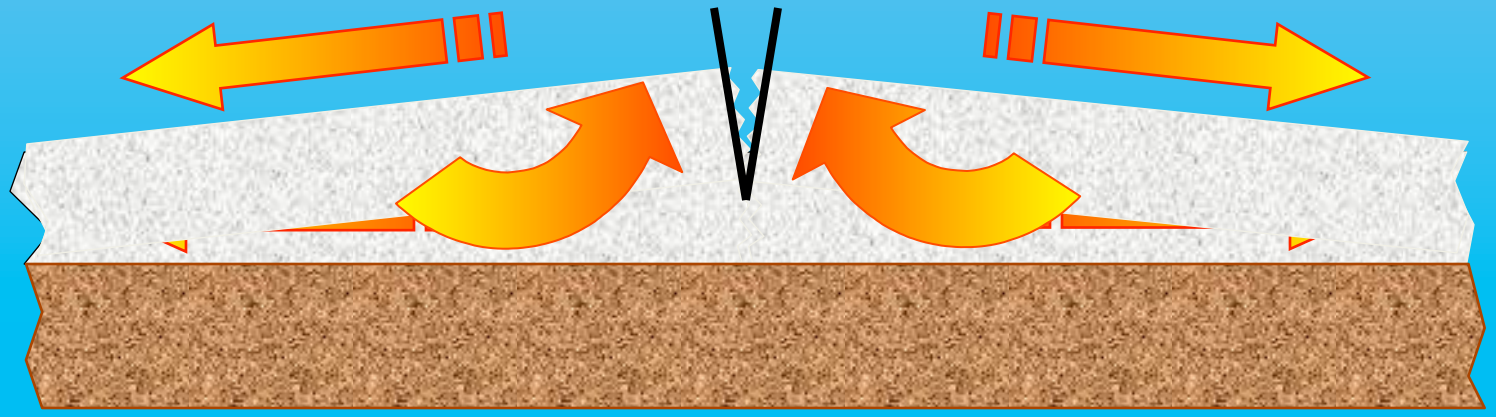
2006 – T.N.O. Centre for Fire Research

1 kg/m³ dosage

2 kg/m³ dosage

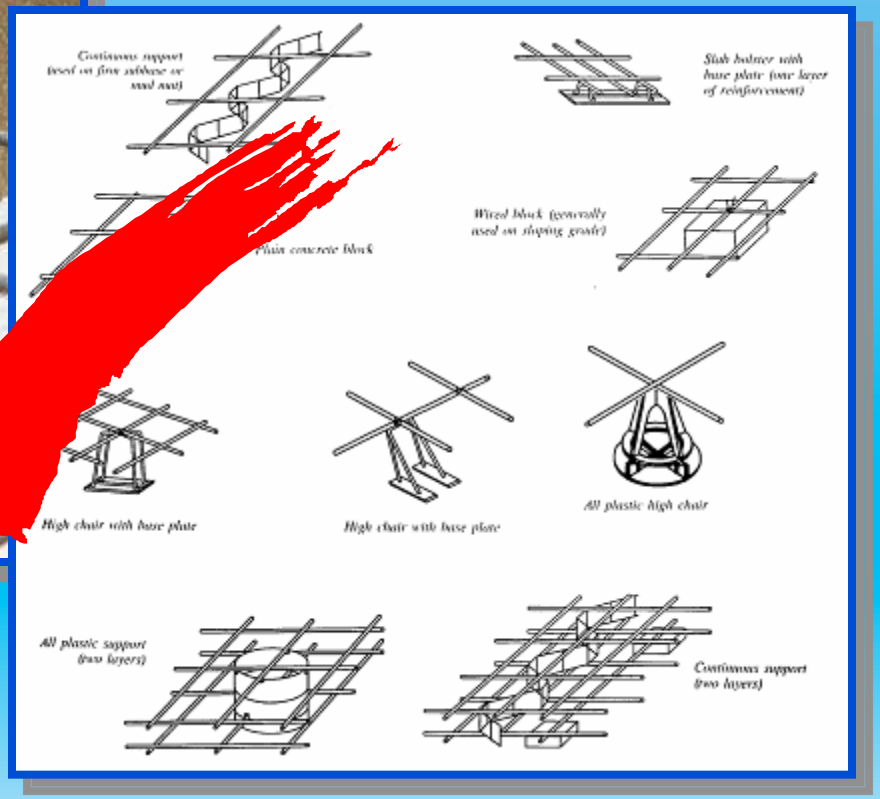
3 kg/m³ dosage

Crack Width Variance



- Differential drying causes curling
- Cracks (joints) form in “V” shape

Can Reinforcement be placed correctly?



Storage & Lifting

The Reality


Mesh is UNDER the vapor barrier !!!!

lywood for concrete truck and laser screed loa

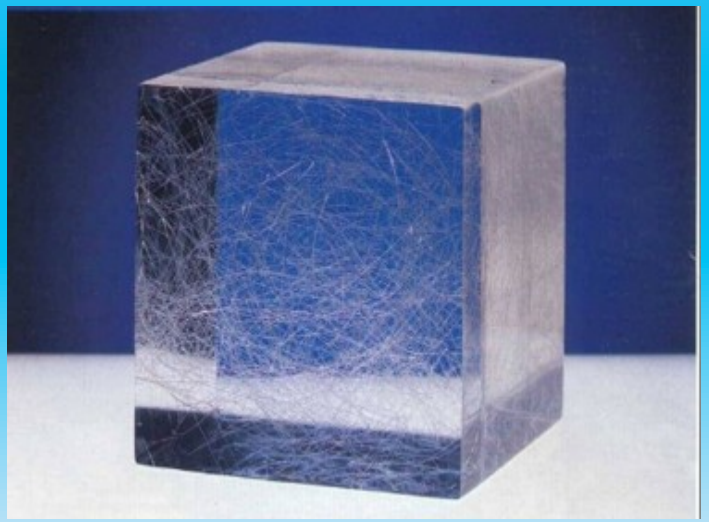

GAP

- **Forget** about supports
- **Forget** about misplaced reinforcement
- **Forget** the access problems

Fibre Reinforced Concrete
The Modern Day Alternative

Fibre reinforced concrete is concrete which contains discontinuous discrete fibres that are uniformerly distributed throughout the concrete to create a 3-dimensional system of reinforcement.

The inclusion of fibres in concrete improves many material properties including crack resistance, ductility, toughness, flexural strength, impact resistance and fatigue resistance. The degree of improvement is dependent upon the fibre type and dosage.



VENTAJAS DE LA MACRO FIBRA

- **Controlan la fisura a lo largo de toda la seccion**
- **Refuerzo siempre bien ubicado**
- **Elimina la instalacion del refuerzo convencional**

El concepto de Valor

- Reduce el tiempo de ejecucion
- Reduce el material requerido
- Menor costo

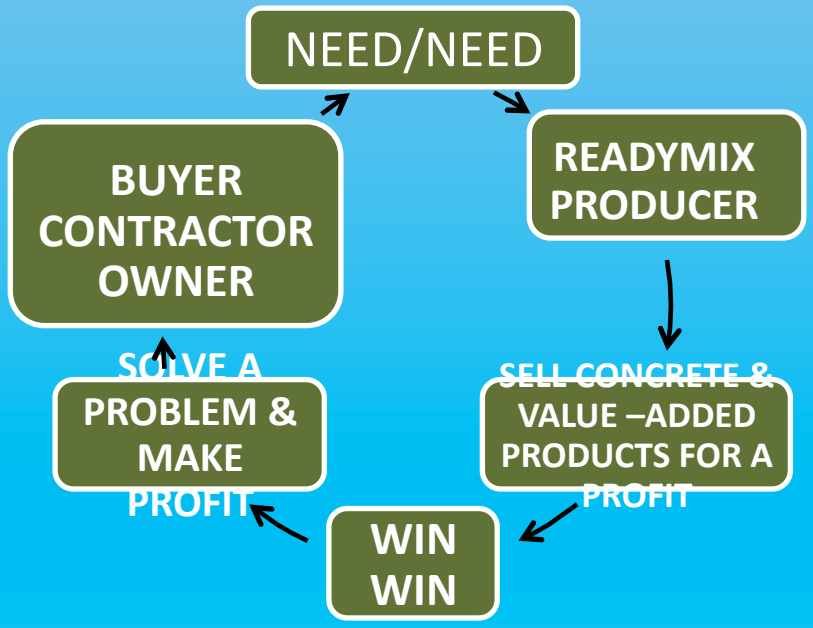
What is Value?

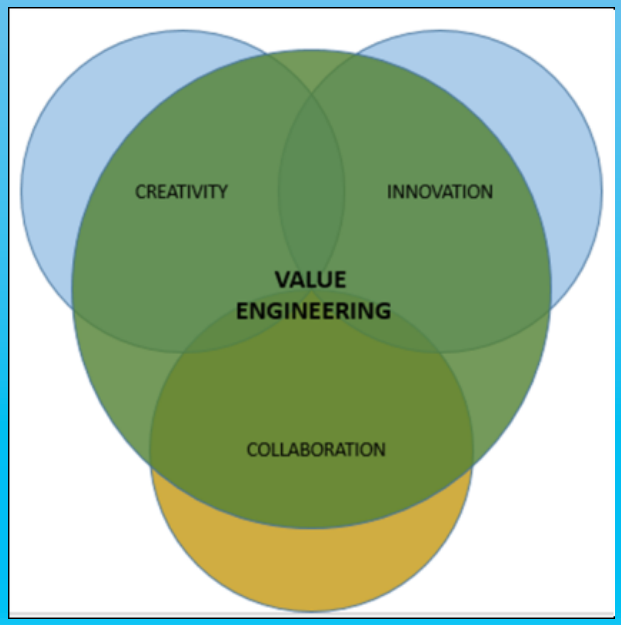
The Value Equation

$$\text{Value} = \frac{\text{Function}}{\text{Cost}}$$

http://www.value-eng.org/

Fibrocreto : el Concreto premezclado con fibras y su filosofia de agregar VALOR





Value Added is a philosophy in which two sets of needs exist.
Contractor has a **NEED** to solve a problem and make **PROFIT**, Ready mix company has a **NEED** to sell product for a **PROFIT**

Value Engineering Process

How Does the Value Methodology Work?

The value methodology works through a VE / VA / VM study that brings together a multidisciplinary team of people who own the problem and have the expertise to identify and solve it. A VM study team works under the direction of a facilitator who follows an established set of procedures - the VM job plan - to review the project, making sure the team understands customer requirements and develops a cost-effective solution.

– SAVE International

VE Process → *Team Leader + Multidisciplinary Team + VE Job Plan*

VM / VE / VA Job Plan

Information Phase	Function Analysis Phase	Creative Phase	Evaluation Phase	Development Phase	Presentation Phase	Implementation & Monitoring Phase
Project Initiation, Requirement, Existing Condition Budget, Project Stage etc.	*Project Scope, TOR, Policy, Design Criteria, Standards, Specifications etc.*	Creative Brainstorming to identify other ways to perform the project's function(s)	*Critical judgment of VE application* for value improvement while delivering the project's scope/function(s) and considering performance requirements and resource limits	*The VE Team develops the selected alternatives / proposals with sufficient documentation to allow decision makers to determine if the alternative should be implemented*	*The team leader develops a report and/or presentation that documents VE*	

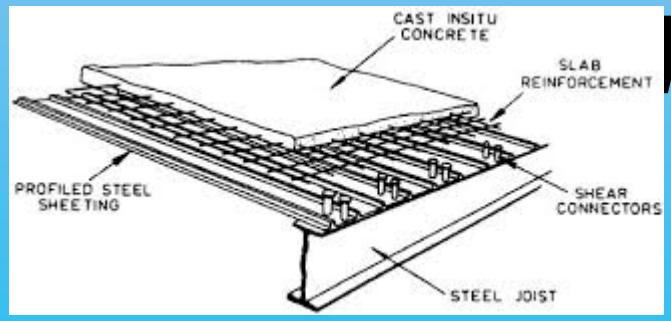
Casos de Exito

- CONCRETO ANTIBAC
- CONCREPISOS
- CONCREACERO
- SHOTCRETE CON FIBRAS

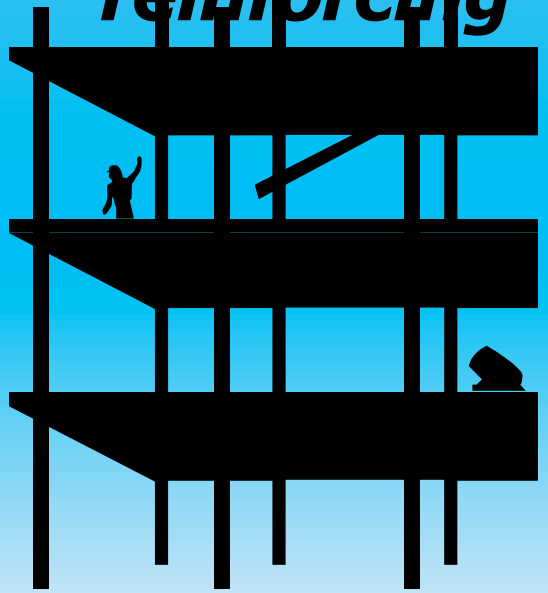
Antibacterial Concrete

Fiber with antimicrobial agents, which purpose is to change the metabolic function of microorganisms, preventing their growth and reproduction.

Composite Metal Decks – ID



Where the steel decks provides the moment reinforcing



Client: Titanium Towers.
Project: 14 levels of CMD plus mezzanine, 4.9 inch. thickness slabs and 3,500 psi concrete, 2.4 kg/m3 FM650.
RMC Company: CATSA (High Tech Concrete).
Propex - Sika Project: CONCREACERO.

SHOTCRETE FIBROREFORZADO

Ciclo de Avance En Un Túnel

Perforación

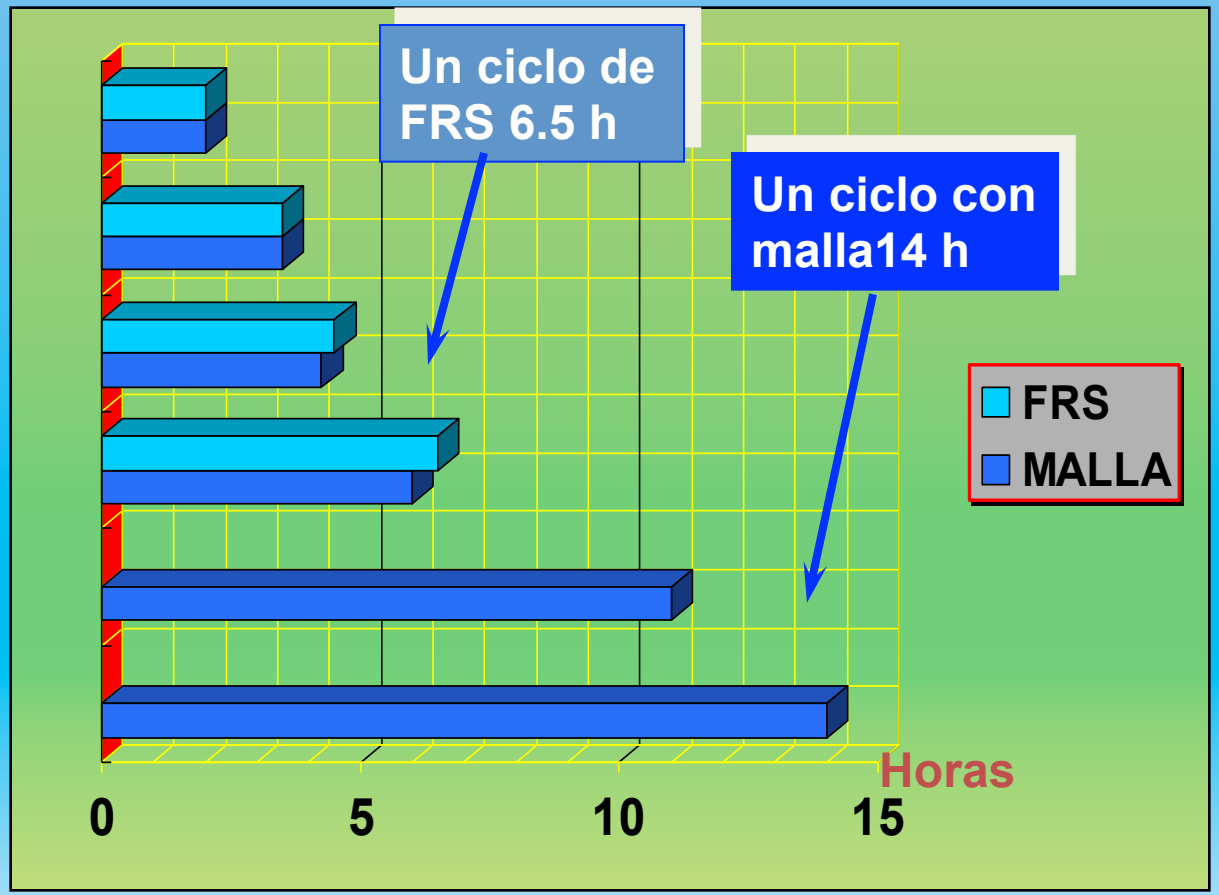
Carga/explosión

Lanzado

Limpieza

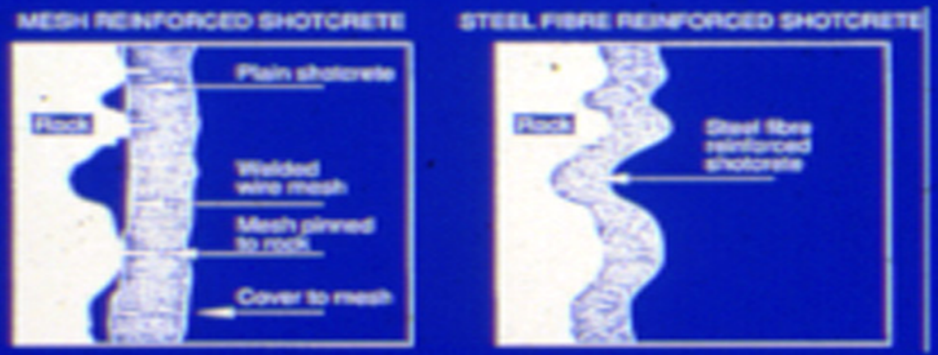
Instalación malla

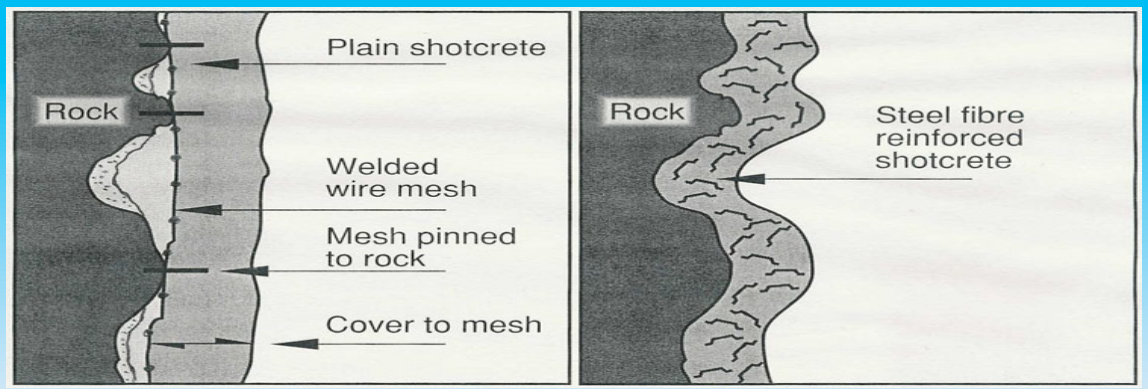
Lanzado



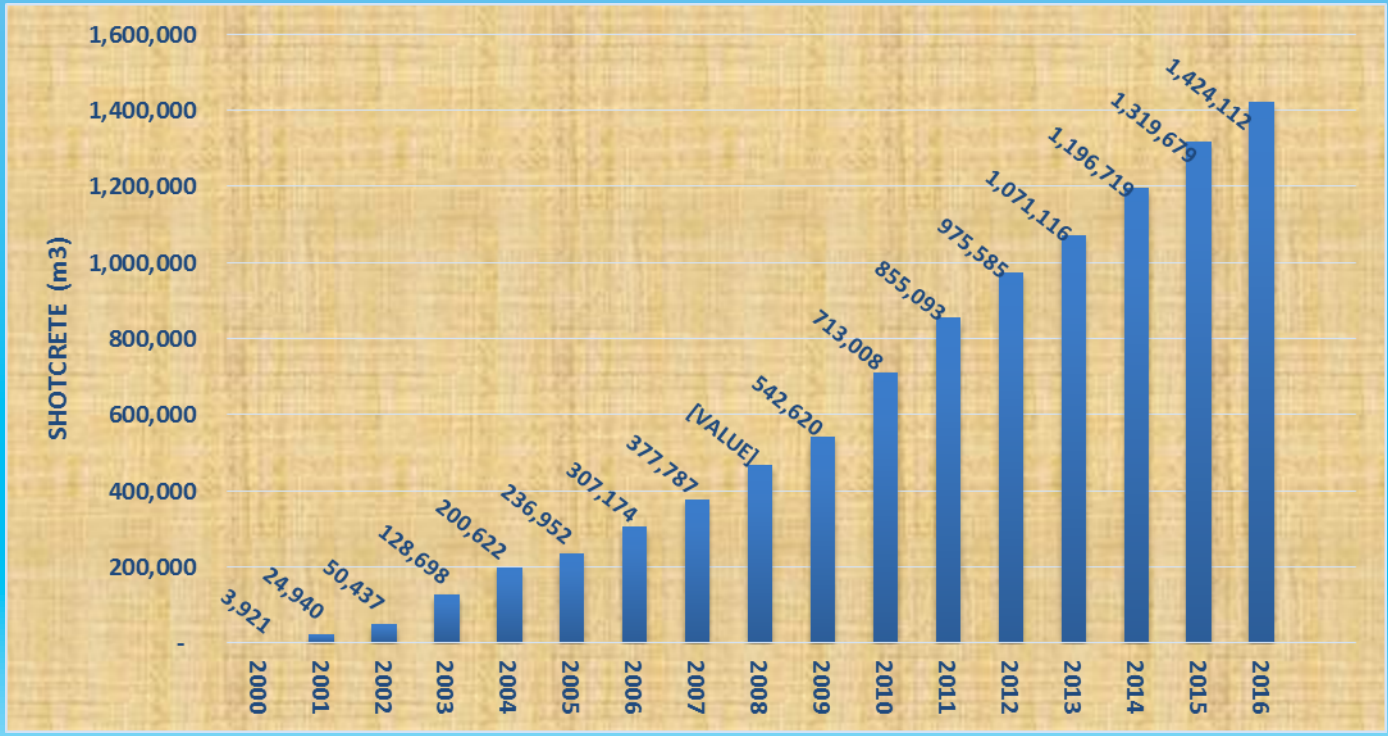
CONSTRUCTION SAVINGS

- PINNING MESH
- COVERING MESH
- SHOOTING THROUGH MESH
- FOLLOW CONTOURS





VOLUMEN ACUMULADO DE SHOTCRETE REFORZADO CON FIBRA SINTETICA - PERU



FUENTE : ESTIMACION PROPIA

BENEFICIOS GENERADOS

- AHORROS EN COSTO DEL REFUERZO
  - 6 usd/M3
  - 6 X 1,500,000 = 9,000,000 usd
- TRANSPORTE
  - 1 Contenedor (20,000 kg) de fibra sintetica refuerza 5,000 m3
  - Para reforzar 5,000 m3 se necesita 100,000 kg de fibra metalica – 5 Contenedores
  - Ahorro por contenedor = 4 * 2,000 = 8,000
  - Total ahorro = 6,000,000/20,000 -> 300 * 8,000 = 2,400,000 usd
- MAYOR PRODUCTIVIDAD DE LA MINA EN RELACION A LA MALLA
  - AHORROS…… ? .

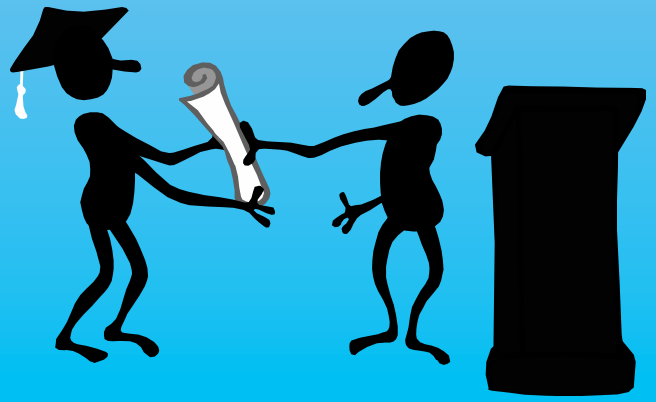
BENEFICIOS GENERADOS

- AHORROS EN EQUIPO:
  - INVERSION PARA PROYECCION :
    - 1 ROBOT + 2 MIXERS = 250,000 + 300,000 = 550,000
  - VOLUMEN QUE PROYECTA EN SU VIDA UTIL = 40,000 M3
  - COSTO DE EQUIPO X M3 = 550,000/40,000 M3 = 15 USD/M3
  - LA FIBRA DE ACERO DISMINUYE UN 25% LA VIDA UTIL
  - AHORRO POR M3 = 3.75 USD
  - TOTAL AHORRO POR EQUIPOS = 3.75 X 1.5 MM = 5,625,000 usd
- AHORRO TOTAL
  - COSTO DIRECTO+TRANSPORTE+EQUIPOS =
  - 9 MM+2.4MM+5.6 MM = 18,000,000 US$!!!!

RESUMEN

- ✓ HAY QUE ESTAR PREPARADOS PARA :
  - ADAPTARSE A LOS CAMBIOS
- ✓ USAR LAS NUEVAS TECNOLOGIAS :
  - PARA GENERAR MAYOR VALOR
- ✓ FOCALIZARNOS EN CAMBIAR AQUELLO :
  - QUE VA A TENER MAYOR IMPACTO

Preguntas ??



Muchas gracias por su atencion !!!

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