

Essentials for making Modern Concrete

“Chemistry for Construction”

Shivram Bagade, NRMCA –Kuala Lumpur. 28th June 2019.

Contents.

1 Environmental Challenges to us.

2 Needs of Modern Construction & Concrete Industry.

3 BASF Value addition to concrete industry.

4 BASF's contribution to Iconic local projects.

5 Conclusion.





Environmental Challenges for the Construction Industry



Bloomberg

Climate Changed

Cement Produces More Pollution Than All the Trucks in the World

There are greener ways to make it, but customers are slow to embrace the change.

By [Vanessa Dezem](#)

June 23, 2019, 1:00 AM EDT



Consumes up to 40 % of the world's energy



Contributes to 30 % of the global greenhouse gas emissions



Causes 10% of the world's emission of fine dust



Displaces the most productive land



Contributes to loss of biodiversity and ecosystems



Concrete: most widely used man-made material (1m³ /Pers/annum)

Impact of Climate Change: *Water is coming!*



Date	Global Population (billions) ^a	Global GDP (10 ¹² US\$ yr ⁻¹) ^b	Per Capita Income Ratio ^c	Ground Level O ₃ Concentration (ppm) ^d		Global Temperature Change (°C) ^f	Global Sea-Level Rise (cm) ^g
1990	5.3	21	16.1	—		0	0
2000	6.1-6.2	25-28	12.3-14.2	40		0.2	2
2050	8.4-11.3	59-187	2.4-8.2	~60		0.8-2.6	5-32
2100	7.0-15.1	197-550	1.4-6.3	>70		1.4-5.8	9-88

Source: IPCC (Intergovernmental Panel on Climate Change)

Impact of Climate Change in Asia

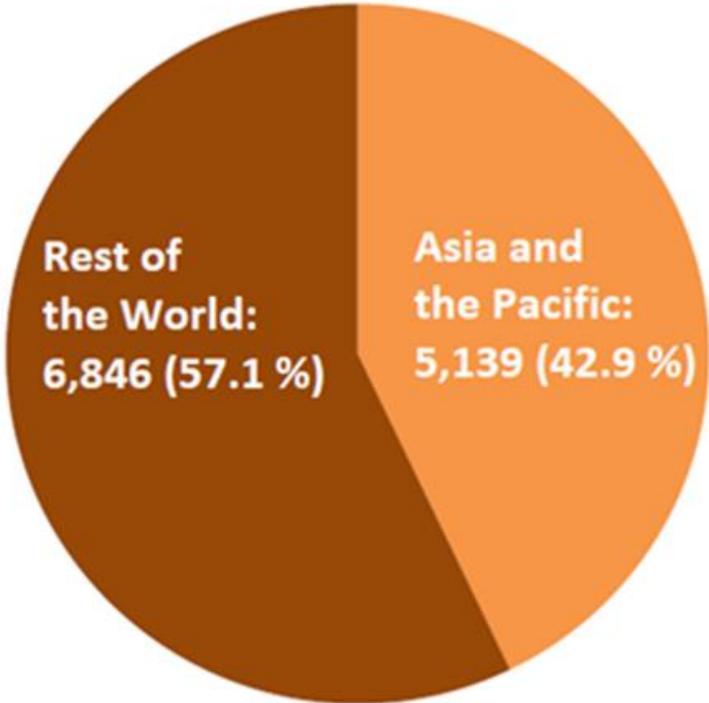


Figure 1. Total Occurrences of Natural Disaster Events (1970-2014)

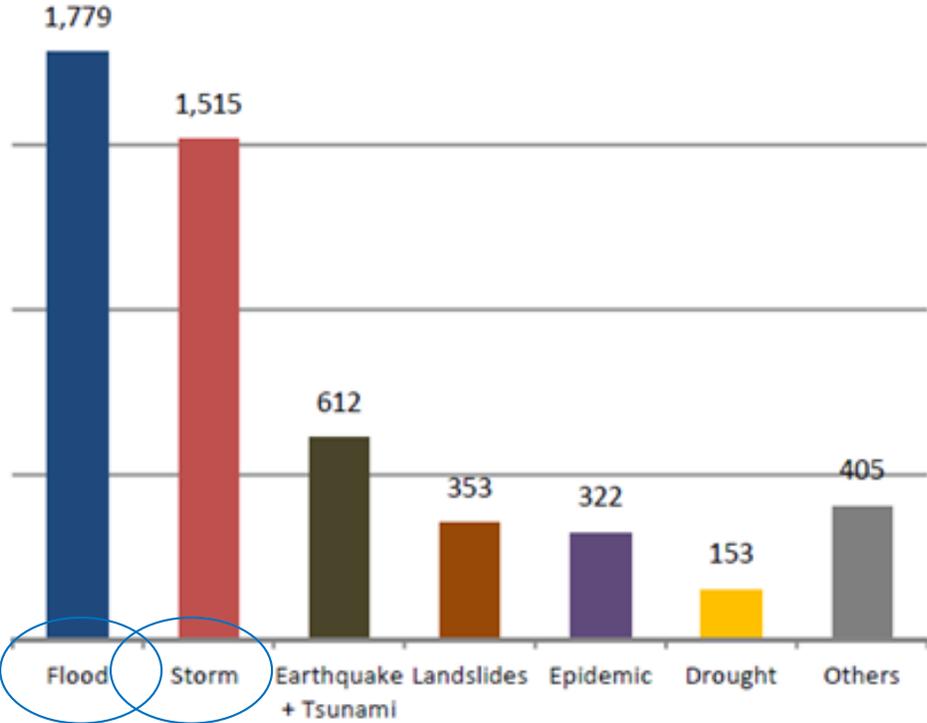


Figure 2. Occurrences of Natural Disaster Events in Asia and the Pacific by types (1970-2014)

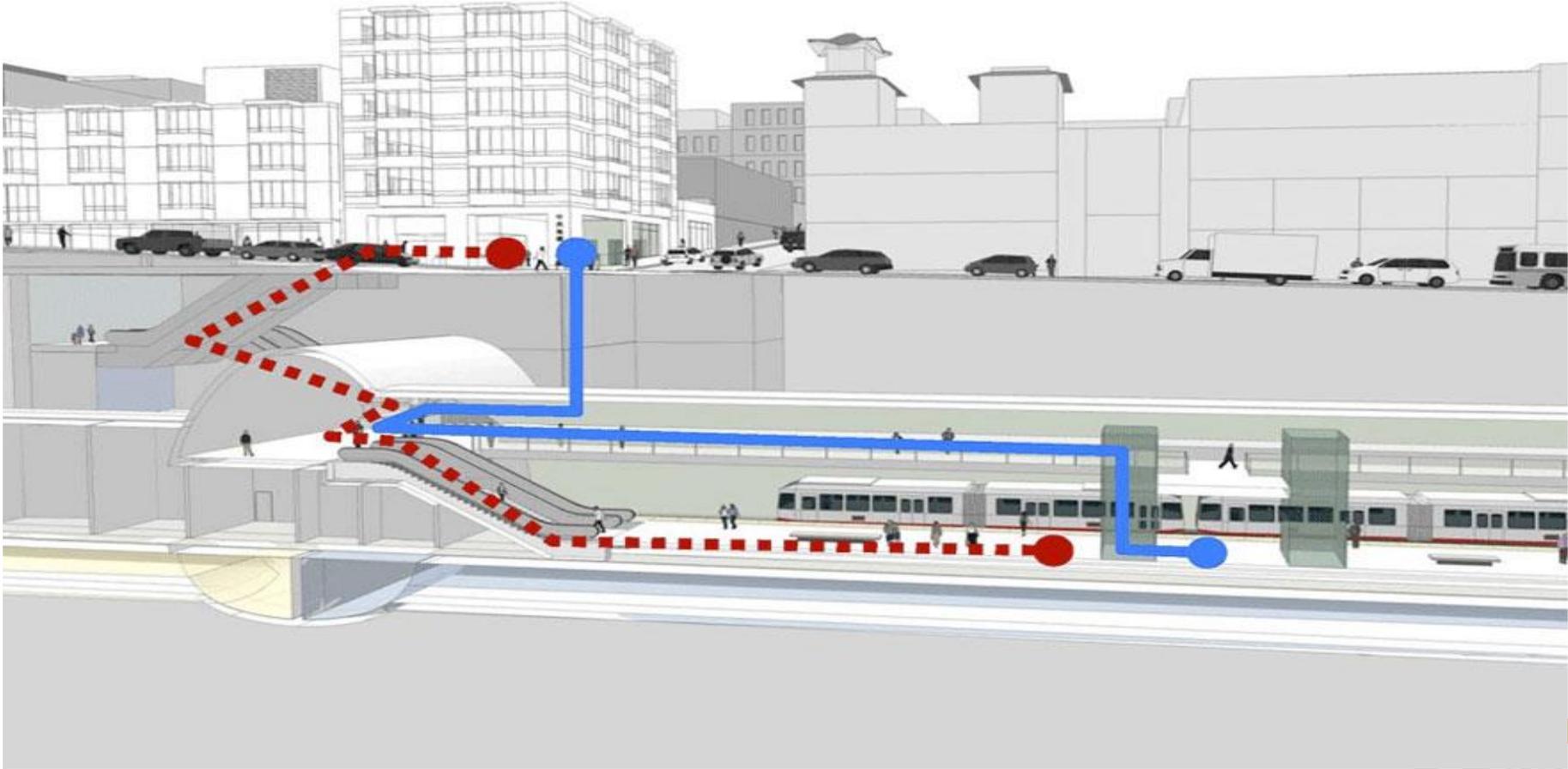
Source: unescap.org

**UN estimates a population increase
of up to 9.6 bn people in 2050**



Source: iStock by Getty
image/Singapore

What is desired today?



What Is Desired Today?



Tun Razak Exchange, Kuala Lumpur, Malaysia

Photo Credit: <http://www.tunrazakexchange.com>

BASF
We create chemistry

**MASTER[®]
BUILDERS**
SOLUTIONS

Iconic Skyscrapers in the World- Trend



508m

Taipei 101



Self
Consolidating
Concrete

541m

One World Trade
Center



Green Sense
Concrete

601m

Makkah Royal
Clock Tower



MasterGlenium

632m

Shanghai Tower



Smart Dynamic
Concrete
MasterSure

828m

Burj Khalifa



MasterGlenium
SKY

~1000m

Kingdom Tower
(under construction)



MasterGlenium
SKY

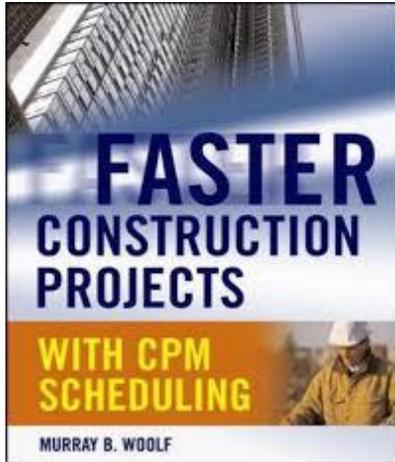
» All skyscrapers in the world above 500m height are built with premium range BASF admixtures

Needs and demands of the modern construction industry.

- **Productivity enhancement.**
- Durable and Sustainable structures.
- Robust solutions.
- Better Utilization of space- UG and Skyscrapers.
- To build lighter and stronger elements.
- **Enhancement in resources efficiency. (Men, Material and Machinery).**
- Alternative building materials.
- Digitalization in construction-BIM
- Safe work environment.
- To minimize the construction cost and maintenance cost in particular.



In-house Challenges-Malaysia



Construction Skilled Labour Shortage – The Challenges in Malaysian Construction Sector



Construction industry faces labour shortage

KUALA LUMPUR: The construction industry faces a critical shortage of workers, says the Master Builders Association Malaysia (MBAM).

Its President Mathew Tee said construction is not a glamorous industry, and despite the higher pay it is still difficult to attract local workers, hence the need to employ more foreign workers.

The industry is now in a boom period, he said, with the 2012 and 2013 output at around RM125.2 billion and RM117 billion respectively while this year the momentum is expected to continue with output at close to RM120 billion.

Tee said there are a lot of high volume projects in the market with more to come, citing a RM15 billion privatised highway project.

"The construction industry is very important to the economy as it has spill-over effects on other industries, as such we should always be ready," he said at a press conference after an MBAM dialogue with affiliate members here.

Registration of foreign workers, which takes about seven to nine months, should ideally take just two months so as not to delay the delivery capabilities of construction companies, he said, adding there should be a one-stop centre to expedite the registration process.

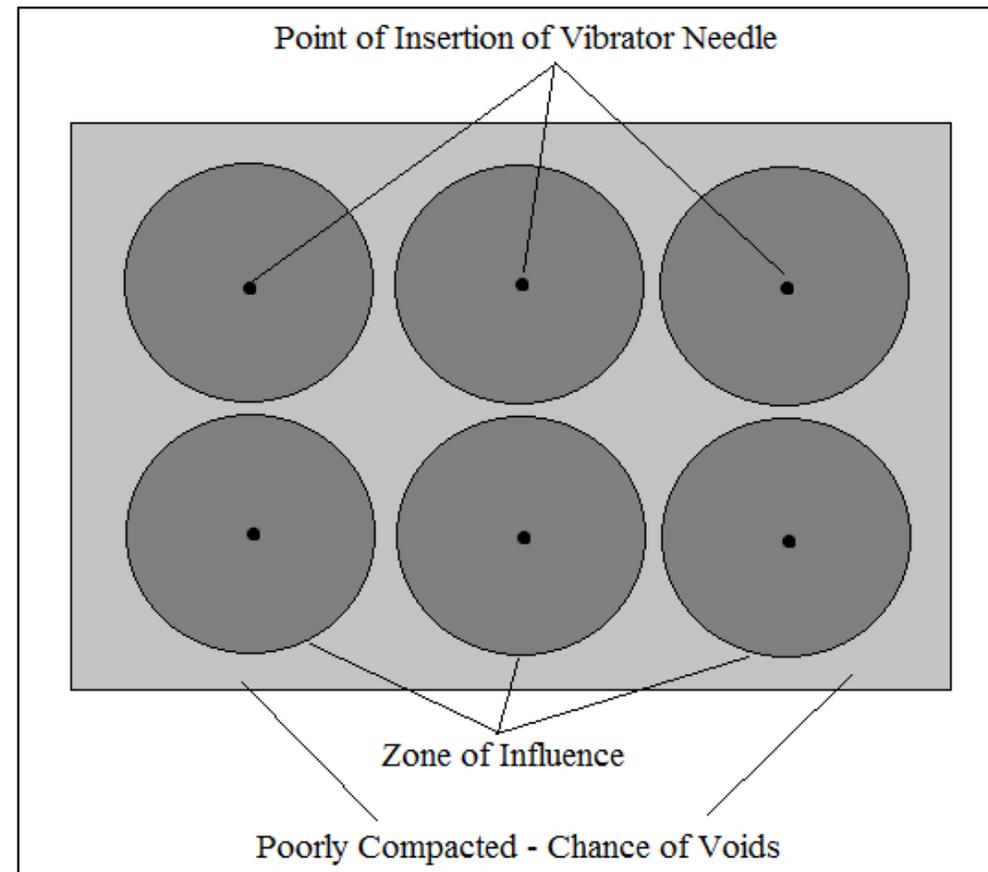
Another issue brought up at the dialogue was the association's appeal, put forward since 2006, for import duties and sales tax on heavy construction

Needs and demands of the modern concrete industry.

- **Productivity enhancement.**
- Robust solutions to accommodate fluctuations in concrete making materials.
- Faster mixing, Less sticky mixes. (Operational efficiency)
- Flexibility in mobility. (Logistics efficiency, faster turn around of trucks).
- Easy placement. (Time efficiency and no post application challenges).
- Enhancement in strength. (Accommodates the fluctuations and Inefficiency of Concrete Ingredients).
- Safe working environment

Challenges in Concrete Placement

Issue 1 : Compaction



Challenges in Concrete Placement

Issue 1 : Compaction



Challenges in Concrete Placement

Issue 2 : Management of Skilled Workforce

Management of Skilled Work force



Workmanship Control !!!

Challenges in Concrete Placement

Issue 3 : Complicated Shape of structure

Concrete Pour



Peak Productivity with Smart Dynamic Concrete

Reduced manpower requirement ,Faster Completion, less wastage and better finish.



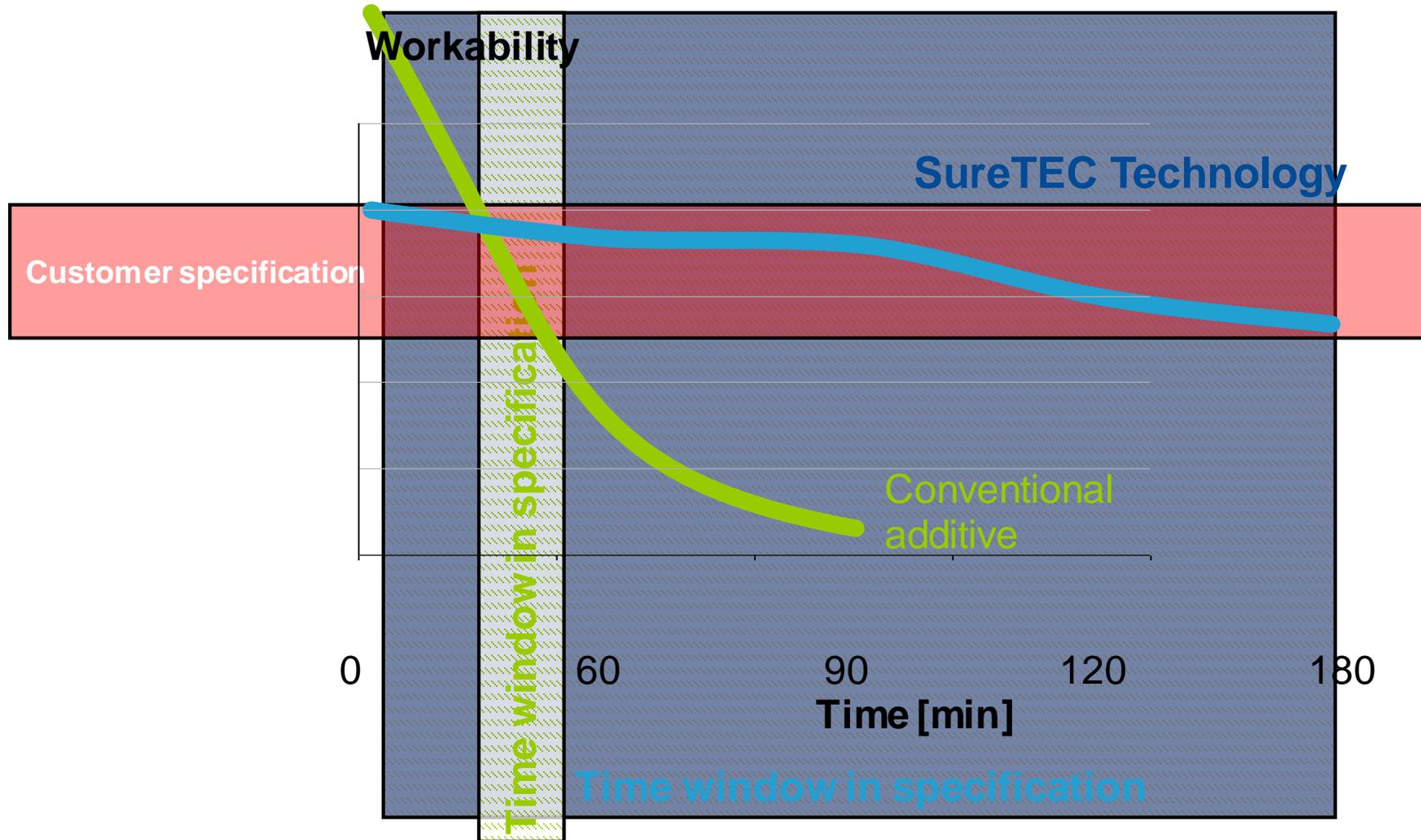
Peak Productivity with MasterSure

Concrete's limited shelf life is big challenge for Concrete Technologists globally.



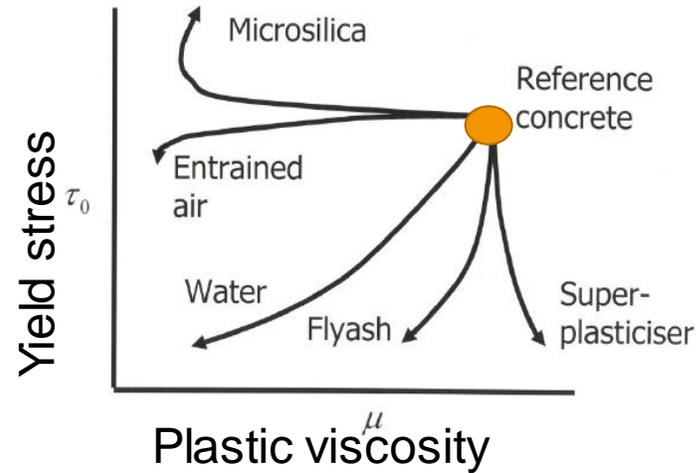
Peak Productivity with MasterSure

Long Hual concrete, minimize rejection, Retention as per the demand, flexibility in design, economical.



The effect of water on rheology of concrete

- Water helps the workability and finishability of concrete
- Water is the only component acting on both, the plastic viscosity & yield stress of concrete



- Theoretically ~25 liters of water is sufficient to hydrate 100 kg of cement, however workability of such a mix is very low

- ✓ Any surplus water is only required for rheological reasons



✓ **But this does not come without consequences...**

What's the solution?

MasterEase

Rheology made easy

- ✓ **MasterEase** reduces the **Viscosity** of concrete hence improves **Rheology** making it less **Sticky**, which means that.....
- ✓ **MasterEase** makes it easier to **Produce**, **Pump**, **Place**, **Vibrate**, **Trowel** & **Finish**

Batching

Challenge

Longer mixing time

» Faster Wet out –

- Increased Productivity by 20%
- Lesser wear & tear
- Reduced maintenance cost by 25%

Solution

Quick dispersion and homogeneity



MasterEase - 01:32 Min

Standard PCE 02:25 Min

Pumping

Challenge

To achieve concrete output equal to pump output

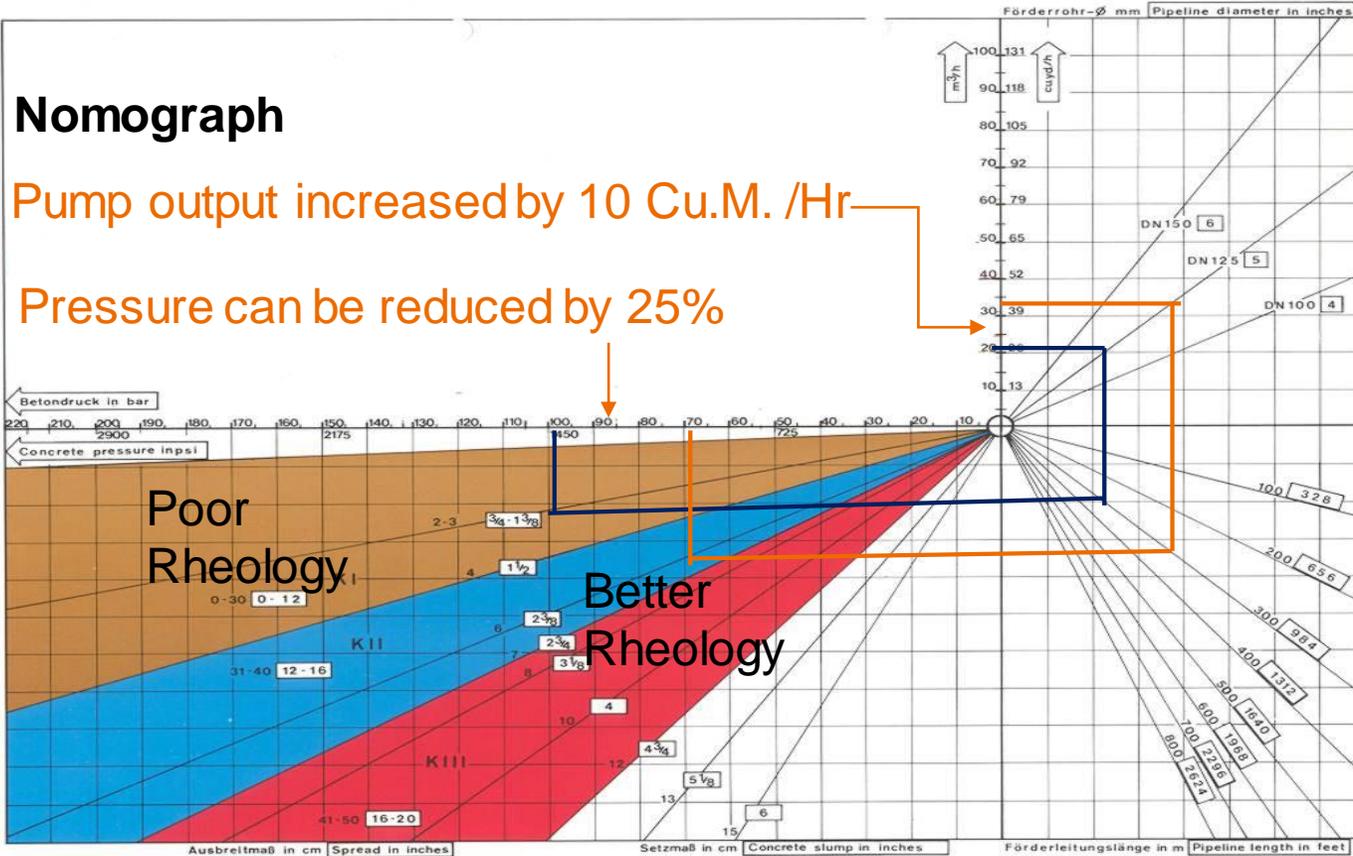
Solution

Reduce pressure & friction factor requires to pump concrete

Nomograph

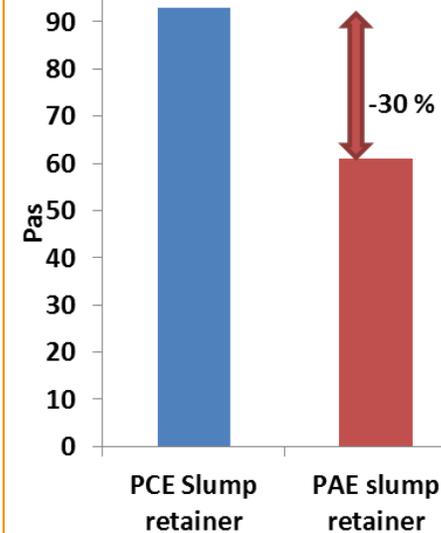
Pump output increased by 10 Cu.M. /Hr

Pressure can be reduced by 25%

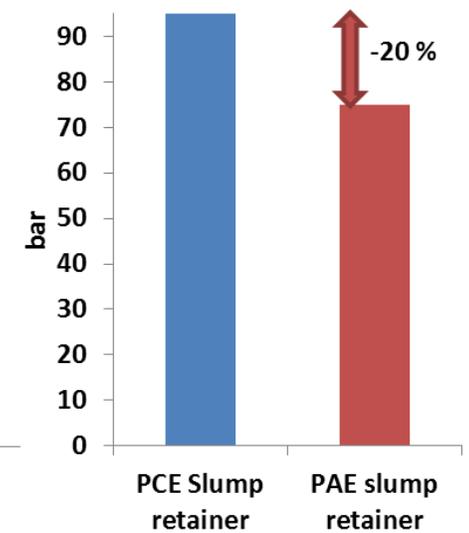


- » Lower yield stress –
 - Lower capital cost
 - Increased productivity.
 - Lesser Wear and tear cost.

Plastic viscosity



Pump pressure



Piping

Challenge

Pipe line choking & bursting

Solution

Reduced stickiness & concrete pressure

» Reduced Plastic Viscosity-

- Maintain Safety
- Saving in piping and man hour cost
- Reduced concrete wastage

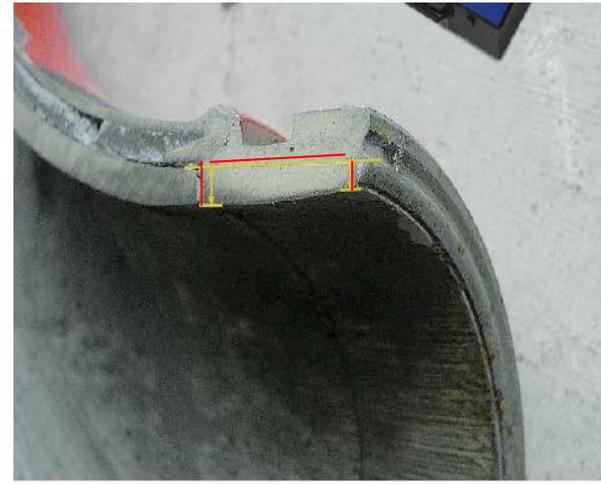
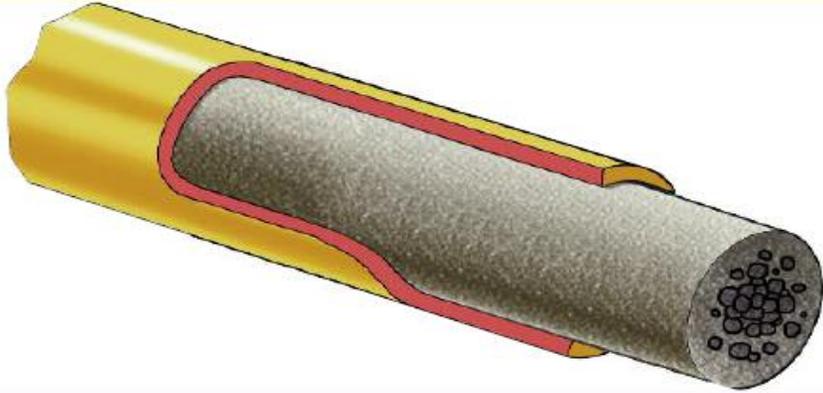


Fig. 32: Measuring pipe wear: wall thickness measuring units for two-layer lines (le) and single-layer lines (ri)

Concrete Finishing Solution: MasterEase



Why MasterEase ?

Max. 25% water reduction

Easy to handle

Higher Setting time

BNS

MasterEase

Water reduction = Standard PCE

Longer workability retention

Better **Rheology** Retention

Excellent water reduction

Higher Early Strength

Concrete becomes sticky

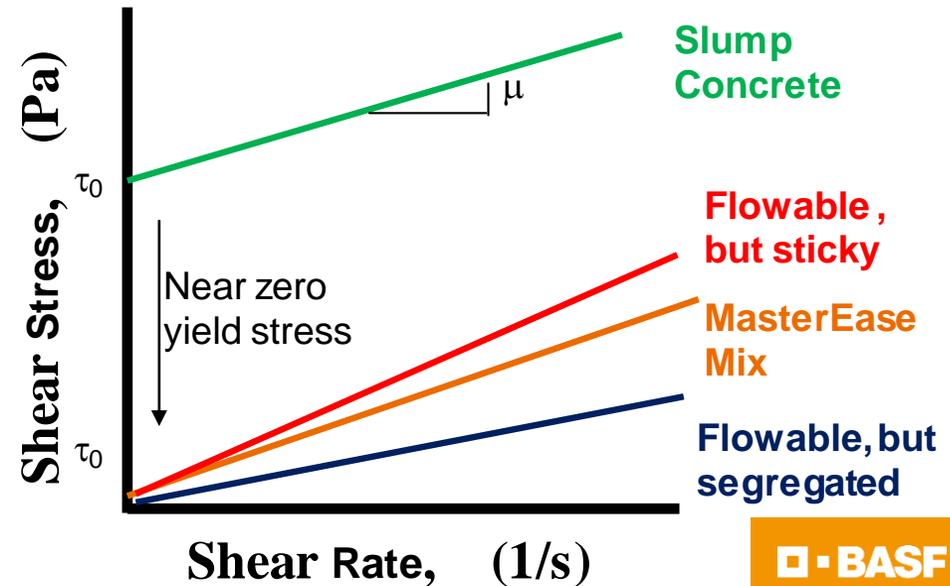
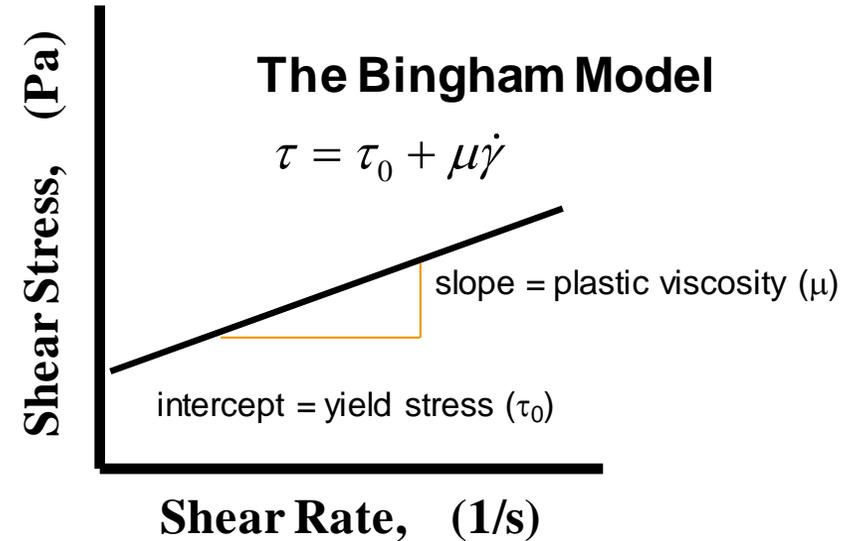
PCE

Rheology of concrete

- » Rheology defines the flow and inherent behavior of fluids
- » Concrete rheology measurements are typically expressed in terms of the Bingham model, which is a function of:
 - Yield stress: the minimum stress to initiate or maintain flow (related to workability)
 - Plastic viscosity: the resistance to flow once yield stress is exceeded (related to stickiness)



ICAR rheometer



MasterEase applications

Example: Reduced viscosity of a SCC C35/45



MasterEase applications

Example: Comparison of slump and T500 of a SCC C35/45 mix



MasterEase applications

Example: Comparison in V-funnel of a SCC C35/45 mix



MasterEase applications

Example: Comparison in L-flow box of a SCC C35/45 mix

Identical mix design



Identical slump flow





Strength Redefined

Master X-Seed STE

An innovative admixture
for strength enhancement



What is the big headache for Concrete Producers?



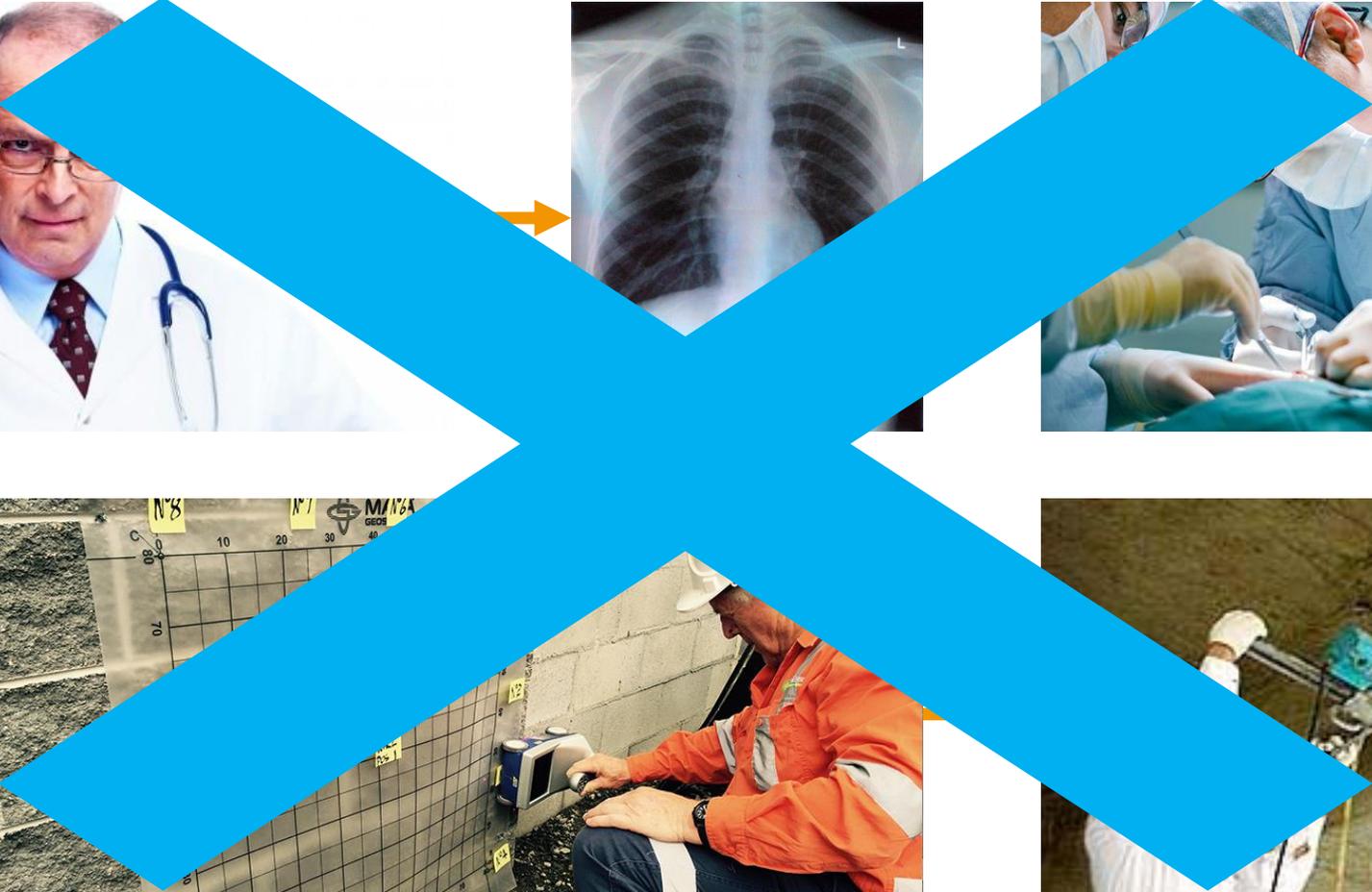
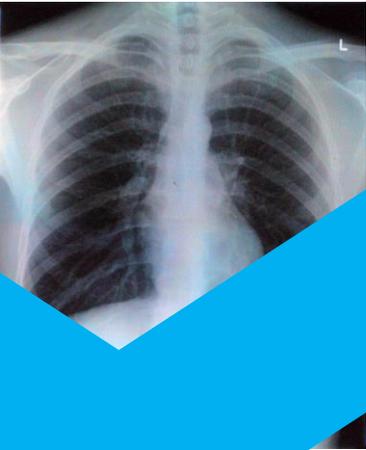
=



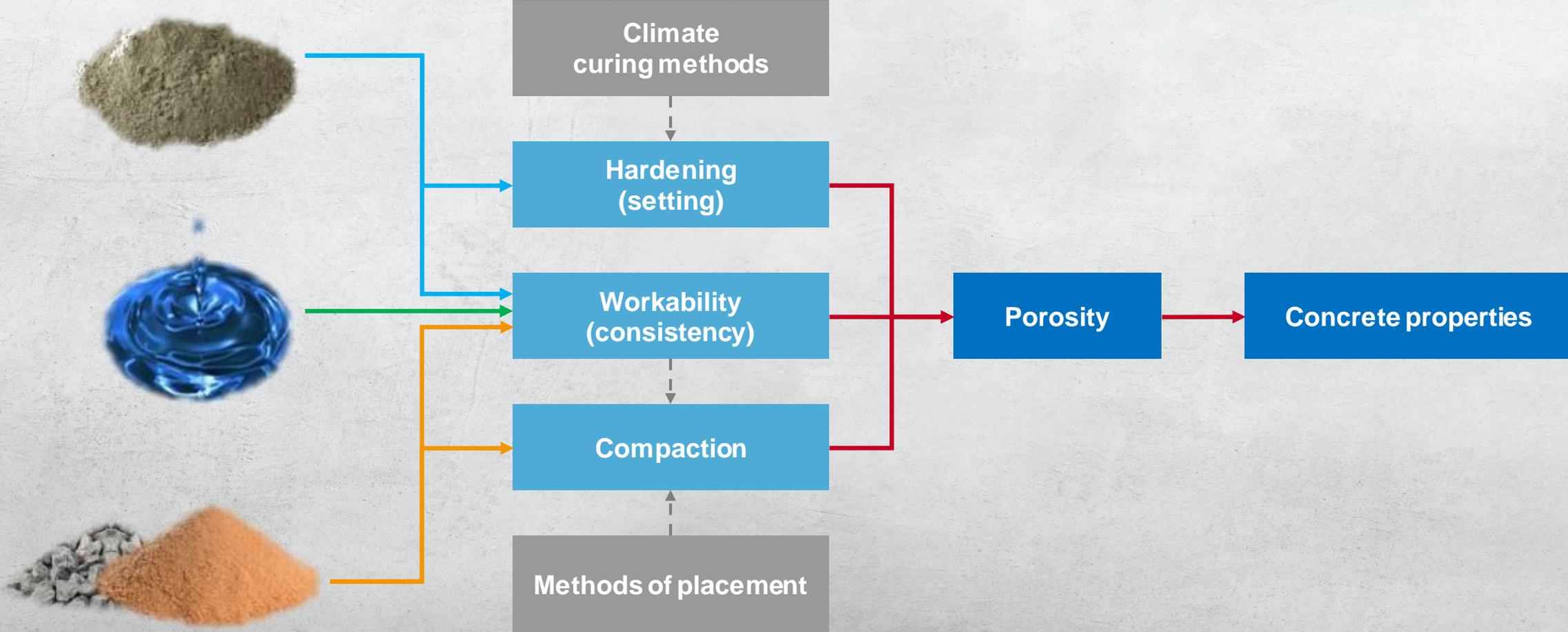
Solutions?



In Real Life – what happens after that?

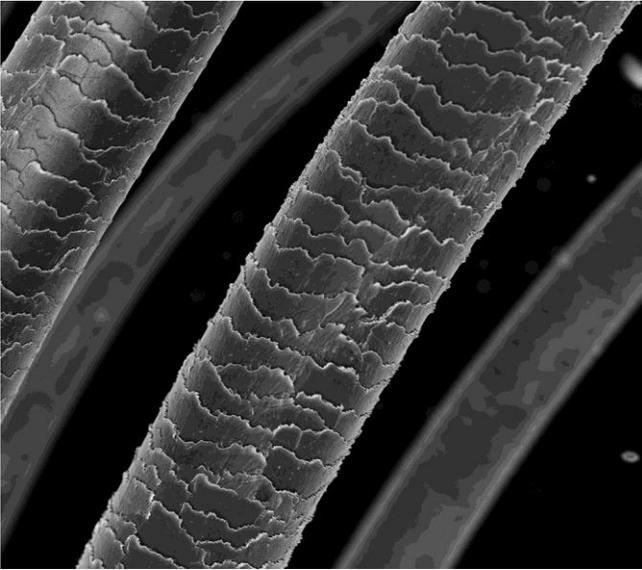


Factors influencing Strength and Properties of Concrete

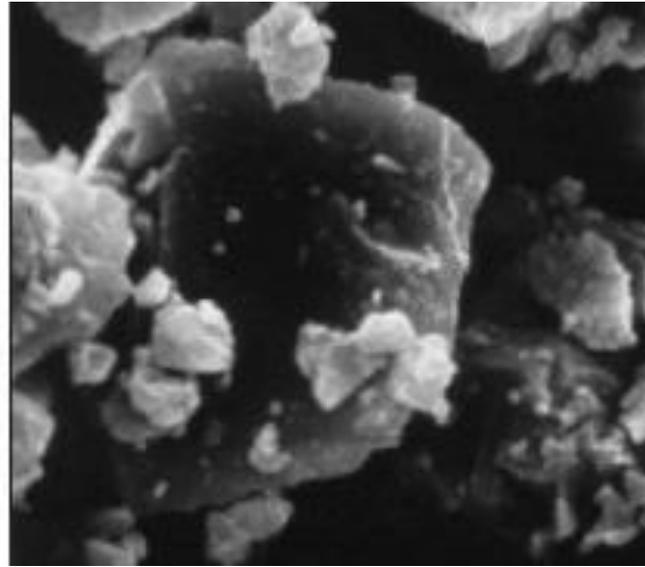


Scale of Things – Nanometers and More

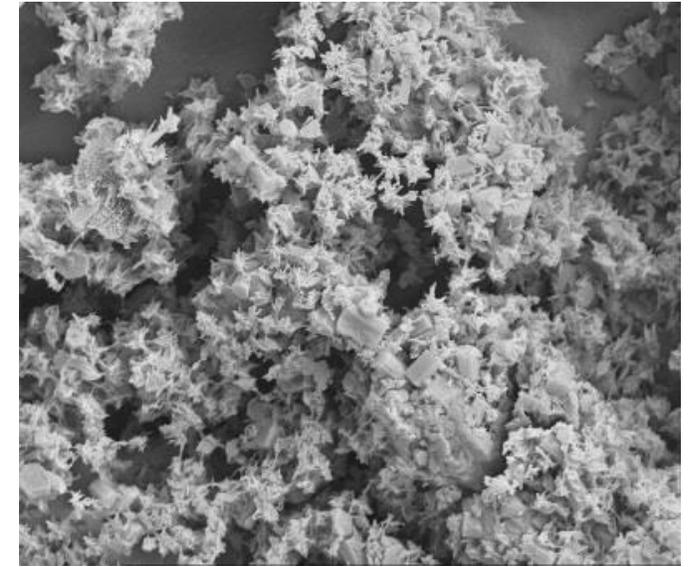
1,000,000 nm in one millimeter



Human Hair
~ 50,000 to 150,000 nm



Portland Cement
~ 20,000 to 45,000 nm



Master X-Seed Particles
~ 50 to 100 nm

Master X-Seed STE – Crystalline Calcium Silicate Hydrate (CSH) Nanoparticles



Admixture Includes CSH Seeds

- Nanoparticles improve cement hydration
- Breakthrough technology – creating a new category of admixture performance



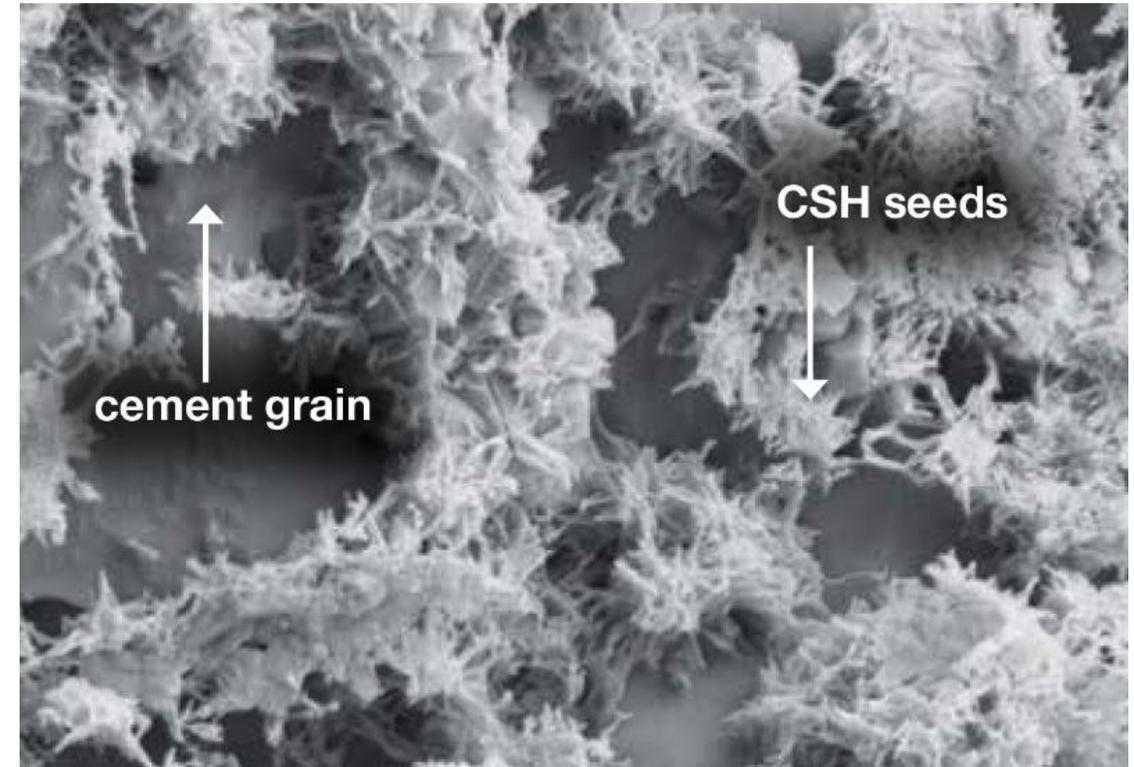
Unmatched Strength Enhancement

- Improves strength development
- Ability to increase the use of supplementary cementitious materials



Improving Concrete Performance

- Provides for strength safety factor and expanded performance space
- CSH nanoparticles provide flexibility in concrete design and production



Master X-Seed STE – Product Value

**Improving
Concrete Strength**



**Flexibility in
Design**

That's chemistry at work

**Environmental
Sustainability**



**...all through use of
CSH seeding**

Applications

	Enhanced Strength
	Cost Savings
	Increased durability
	Reduce Carbon Footprints

Applications



Enhanced Strength

- » **Scenario 1**
Upgrade the strength by one grade
- » **Scenario 2**
Expand or increase the safety margin factor of concrete
- » **Scenario 3**
As a stop gap measure for poorer quality cement and/or aggregates
- » **Scenario 4**
Earlier form stripping

Applications



Cost Savings

- » **Scenario 1**
Increase the use of cheaper SCMs
- » **Scenario 2**
Use of poorer quality cement and aggregates
- » **Scenario 3**
Faster turnaround of molds

Applications



Increased durability

- » **Scenario 1**
Increased SCMs for better durability
- » **Scenario 2**
Reduce heat of hydration for raft foundation or mass concreting



Reduce Carbon Footprints

- » **Scenario 1**
Higher SCMs

Small addition → Great values



Master X-Seed STE

- Improves concrete strength
- Allows higher incorporation of SCMs
- Zero negative influence on air content, workability and workability retention

Robustness

- Strength increase observed across varying mix designs and raw materials
- Performs in warmer climate (30°C)
- Works best with PCE admixtures

Sustainability

- Increase SCM content up to 20% to 40% with comparable 28-day strength
- LEED

Durability

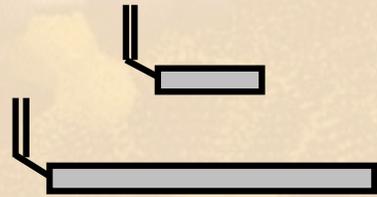
- Increased durability without loss of strength
- Low heat of hydration for mass concrete casting



Design of advanced polymers to formulate the Admixtures “customized to application”

➤ Specific performances are designed by adjusting functional building blocks

Side chain

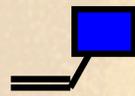


Water reduction capability

Functional building blocks



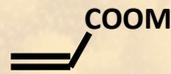
Viscosity control



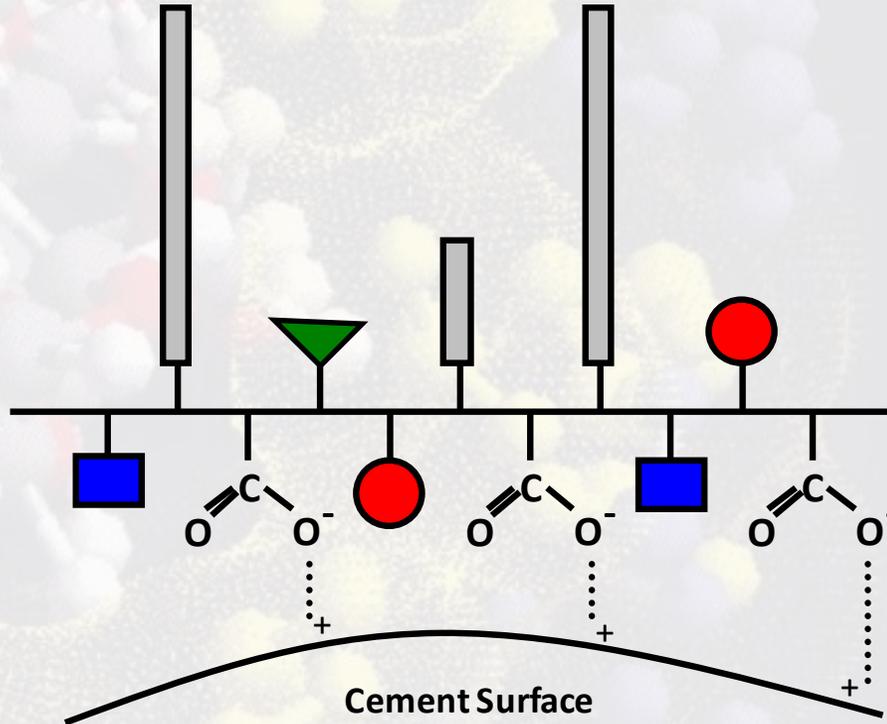
Workability retention



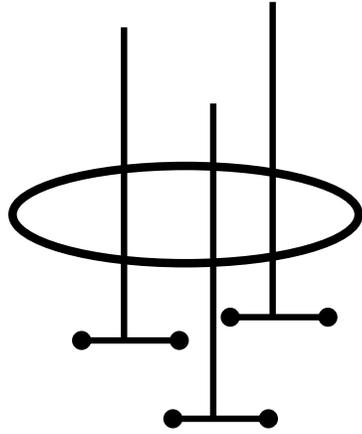
Thixotropy control



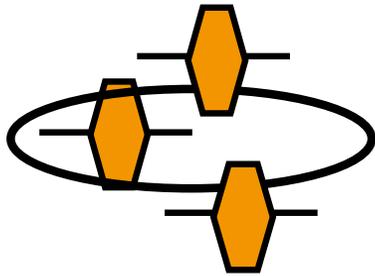
Cement affinity



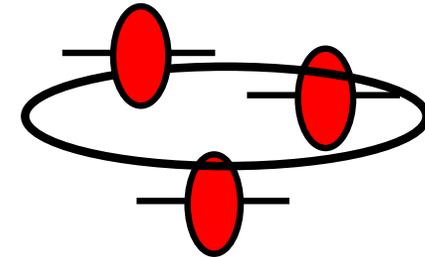
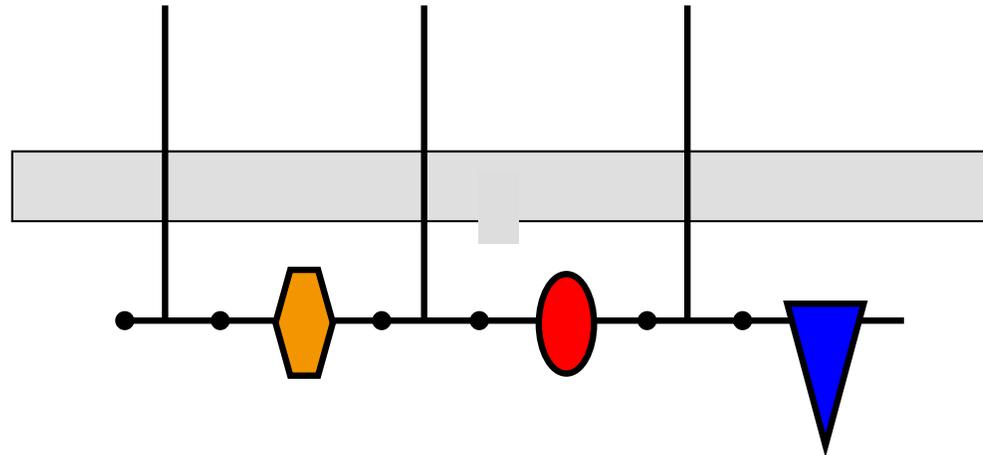
Customized formulations



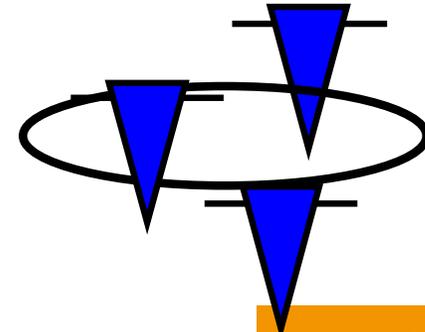
Water demand



Viscosity control



Strength control



Cement affinity

BASF Value addition to the Malaysian Iconic projects



Penang Second Bridge

- One of the Longest Bridge in South East Asia

- High Early strength requirements for Precast elements
- Ready Mix Concrete - Long slump retention up to 8 hours



Signature Tower: Record-breaking foundation concrete pour in KL Malaysia

<p>Massive 19,300m³ concrete pour for the raft foundation, or the size of 8 Olympic swimming pools!</p> 	<p>2 million kg of ice consumed to overcome the extreme heat generated during the process</p> 	<p>MasterGlenium SKY 8705</p> <p>MasterEase 3003</p>	<p>Signature Tower is mere 13 m short of Petronas Twins Tower</p> 
	<p>Approx. 8.5 million kg consumed</p> 	<p>Approx. 16 million kg of sand consumed</p> 	<p>Approx. 19 million kg construction aggregates consumed</p> 



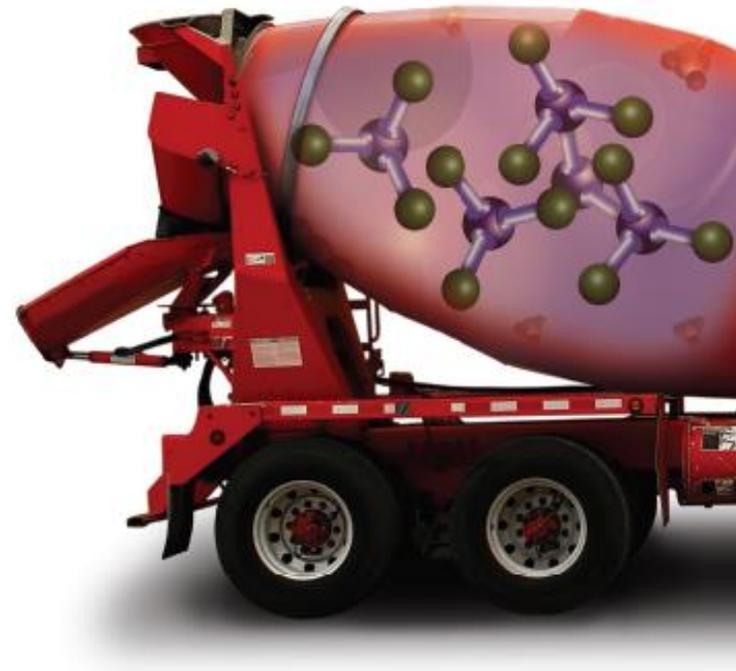
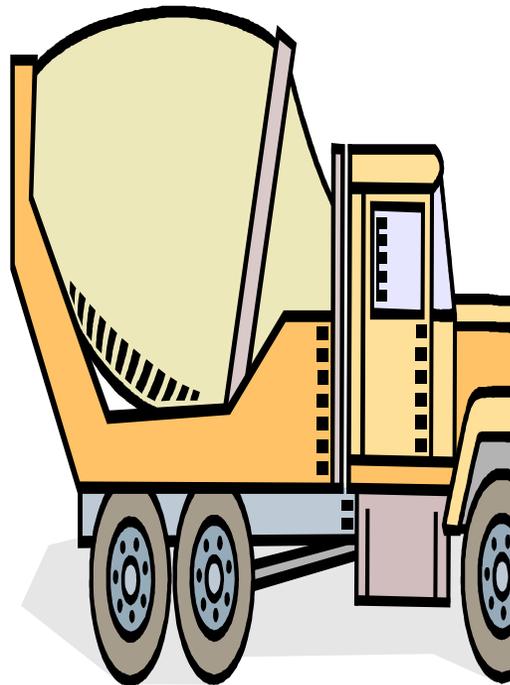
- One continuous pour over 48 hours
- Specially developed concrete mix design to control heat of hydration
- Exclusive **MasterGlenium & MasterEase** product to maintain good workability & improve concrete rheology/stickiness

What are some of the Challenges that Innovative Admixtures can Address?

Process Step	Admixture Solutions for:
Materials	<ol style="list-style-type: none">1. Higher Usage of Manufactured Sand2. More Sustainable Concrete Mixtures
Mixing	<ol style="list-style-type: none">3. Faster Mixing Times4. Production of Ultra High Strength
Transit	<ol style="list-style-type: none">5. Improved Slump Retention
Placing	<ol style="list-style-type: none">6. Reduction of Concrete Stickiness7. Easier & Faster Placement of Concrete
Hardening	<ol style="list-style-type: none">8. Faster Early and Late Strength Development

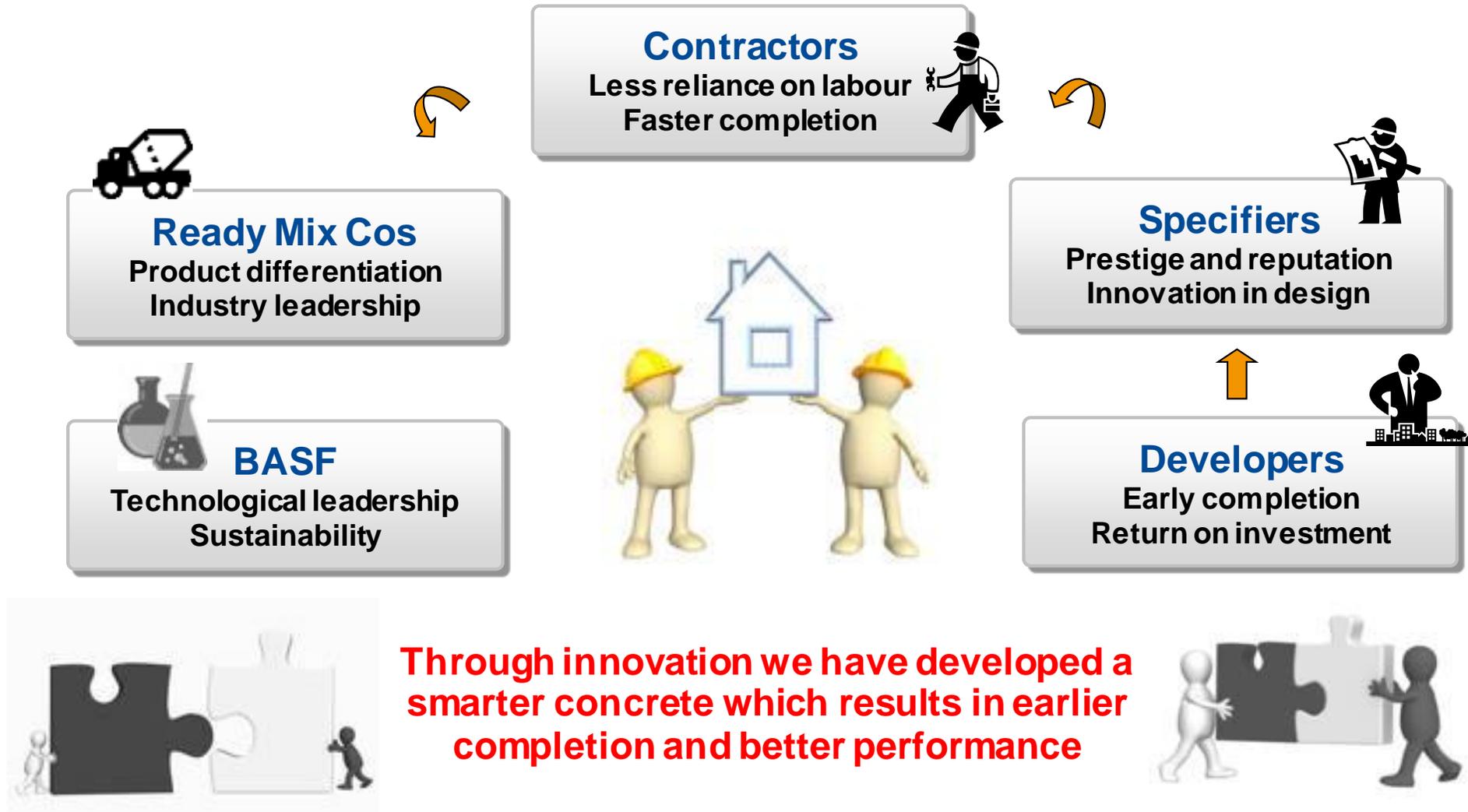


Say good bye to most of your day to day concrete issues by using Innovative Admixtures with right chemistry.



Beyond properties of concrete to project completion

It's not just about cost per cubic meter



Concrete.....

IN THE UNENDING SERVICE OF
NATION BUILDING.

LET US LEARN THIS SUBJECT TO BE
A PART OF NATION BUILDING
TEAM.

- M S SHETTY.



BASF's brand for the construction industry

