# التطورات الحديثة في تحسين أداء الخرسانة في الأجواء الحارة

# *Advances in Hot Weather Concreting*


*Presented By*

**الدكتورالمهندس سامر مارتيني**

***Dr. Samer Al-Martini, P. Eng.***

***Associate Professor***

# الخطوط العريضة

نظرة عامة

تعريف المشكلة

الاحتياجات البحثية

منهجية تجريبية

برنامج تجريبي

النتائج

الاستنتاجات

# Hot weather concreting

- High water demand
- Low strength and durability
- Accelerate the rate of slump loss
- Faster setting time

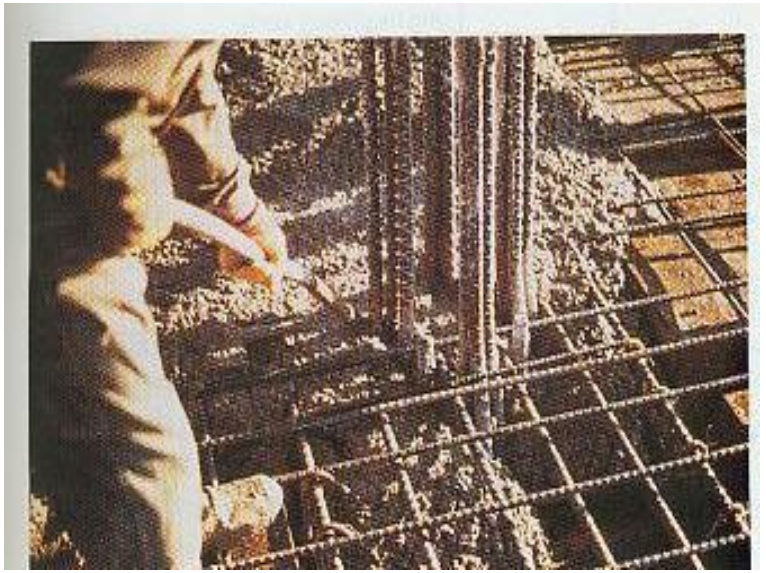
# What is SCC ?

Fresh concrete that can flow around reinforcement and consolidate within formwork under its own weight without vibration and that exhibits no defect due to segregation or bleeding.

# Hot Weather Concreting Problems

- High slump loss.

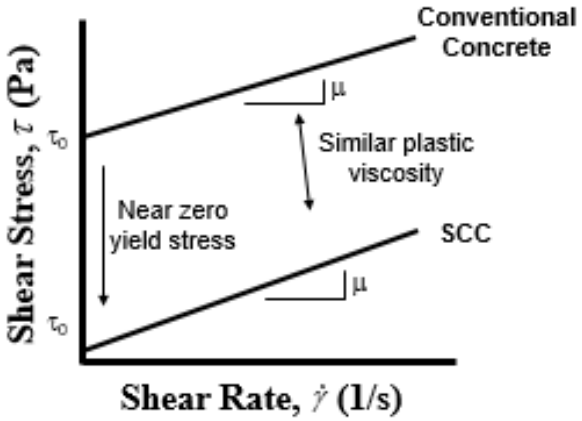
- Difficulty in concrete placement.



# Hot Weather Concreting Problems

## *Durability Problems*

# SCC Rheology


**Yield stress is the main difference between SCC and conventional concrete.**

# Coupled Effects of Mixing Time & Temp. on Rheological Properties of Cement Paste Incorporating SP

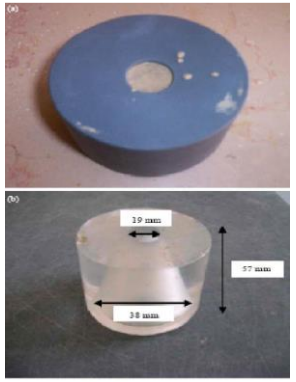
## *University of Western Ontario, Canada*

- **Superplasticizers tested:**
  - **Polycarboxylate (PCN)**
  - **Melamine (ML)**
  - **Naphthalene (NS)**
- **Continuous Mixing was conducted in an environmental chamber for up to 110 min.**
- **Ambient temperature ranged from 20-45$^{o}$C.**
- **Rheological test conducted from 20-110 min with 30 min interval between consecutive tests.**

# Apparatus (cement Paste) (Université Lille Nord de France)

## Cement Paste Mixer

## Mini Slump flow



## vicat apparatus

## Cement Paste Rheometer

# Coupled Effects of Mixing Time & Temp. on Rheological & Mechanical Properties of Concrete Incorporating SP

## *University of Ryerson, Canada*

- **Superplasticizers tested:**
  - **Polycarboxylate (PCN)**
  - **Melamine (ML)**
  - **Naphthalene (NS).**
- **Continuous Mixing and was conducted in an environmental chamber for up to 110 min.**
- **Initial curing (up to 24 hours) took place in the same environment of mixing.**
- **Ambient temperatures ranged from 20-45$^{o}$C.**
- **Rheological & mechanical tests were conducted from 20-110 with 30 min interva**

# Materials
# Abu Dhabi University

- **Ordinary portland cement (similar to ASTM C150 Type I)**
- **Superplasticizers tested:**
  - **Polycarboxylate-based superplasticizer (PC)**

  **water to cement ratio (w/c) ranged from 0.325 to 0.45**

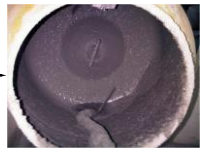
**Concrete**

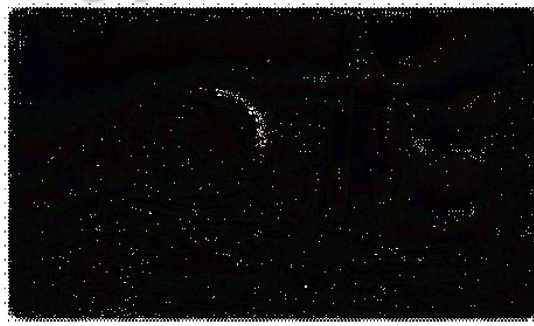
- **fly ash**
- **w/cm=0.36**
- **Locally produced well graded crush stone coarse (max size: 10 mm) and fine aggregates were used**

- **Superplasticizers tested:**
  - **Polycarboxylate-based superplasticizer (PC)**
  - **Naphthalene sulfunate-based superplasticizer (NS)**

# Apparatus(concrete) (Abu Dhabi University)

- **Concrete drum mixers:**
  - Concrete continuous mixing for up to 2-hrs.





- **Hot room**
  - Temperature ranged from 26 to 45 °C.



- **Electrical heaters.**

# Apparatus, Cont.

- **Rheology Test:**
  - **Concrete Rheometer**

$$T = G + HN$$

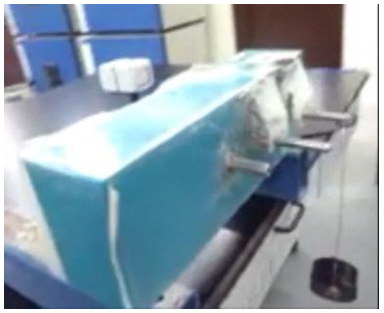
$T$ (Nmm) is the torque resistance

$G$ (Nmm) is the flow resistance

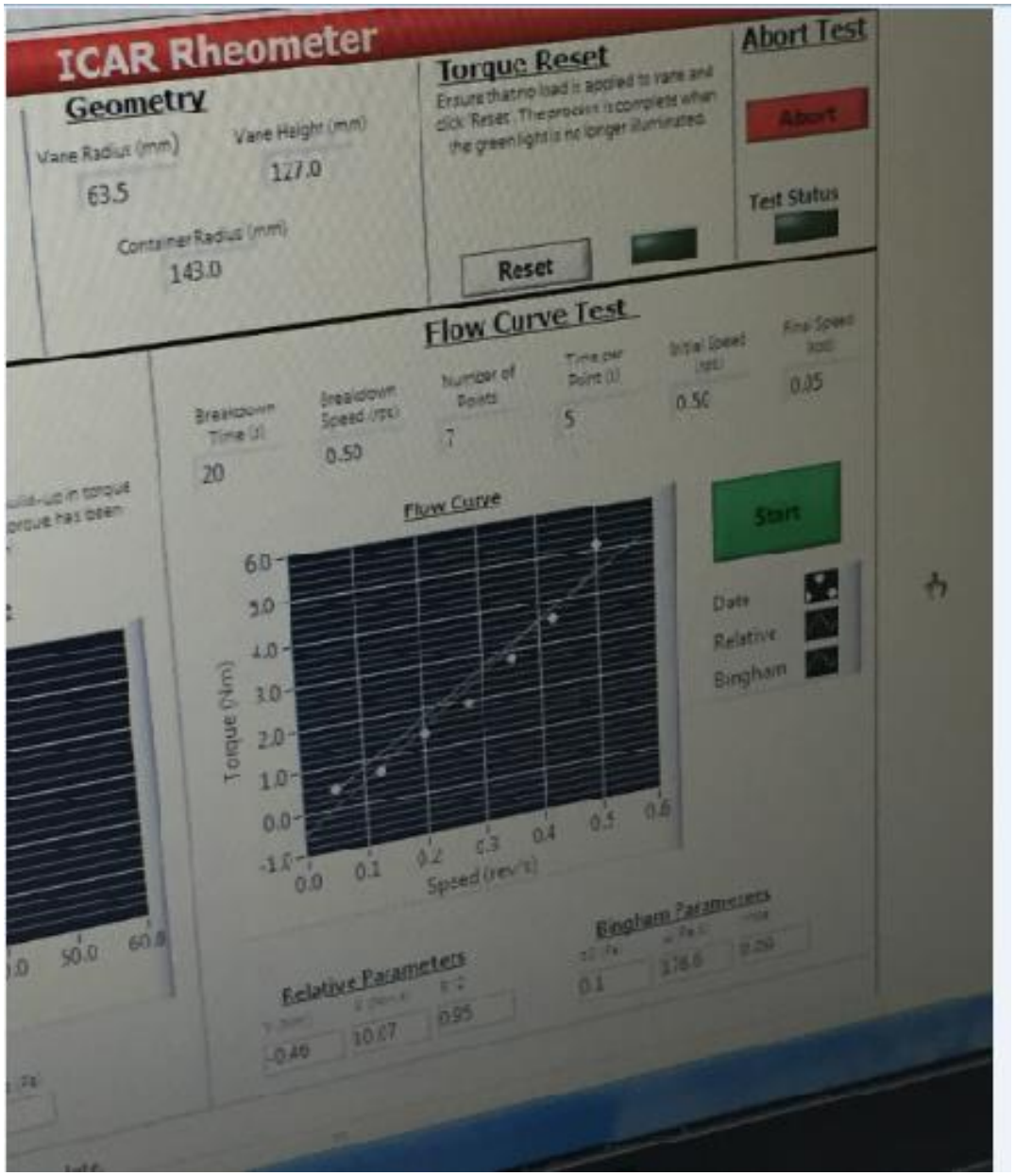
$H$ (Nmm·s) is the viscosity factor

$N$ is the rotational speed (m/s)

- **Probes calibration**



# ICAR Portable Rheometer




# Coupled Effects of Mixing Time & Temp. on Rheological & Mechanical Properties of Concrete Incorporating SP

*University of Ryerson, Canada*

## Testing Procedure *(Compressive Strength)*

- **Specimens were taken at 20, 50, 80, and 110 min.**
- **After initial curing (up to 24 hours), samples were cured in a standard curing room.**
- **Compressive strength was determined at ages of 12 hours, 1, 3, 7, and 28 days.**

# Visual Stability Index(VSI) Rating

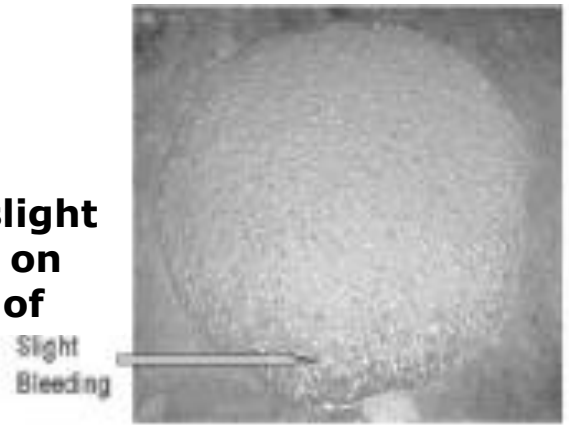
## (ASTM C 1611. 05)

VSI: It is a visual evaluation of the segregation of the SCC during the slump flow test.

**[0] No evidence of segregation in slump flow patty concrete**

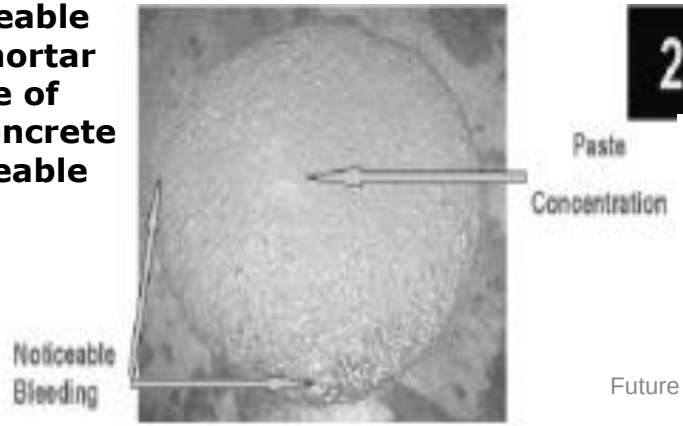
0

**[1] some slight bleeding on surface of**



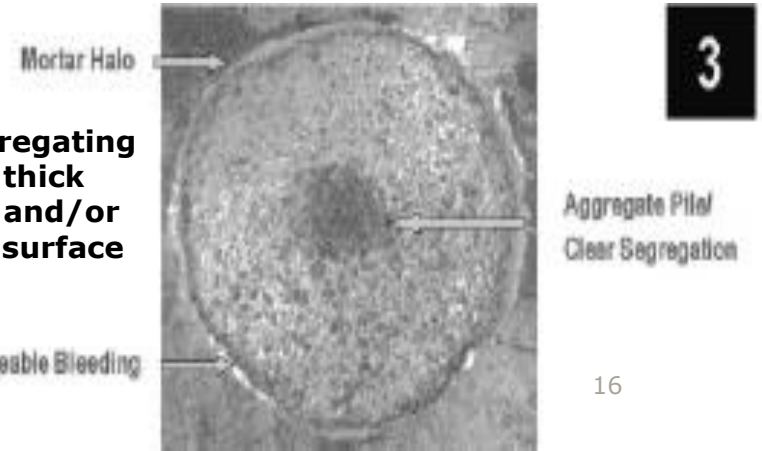

1

**[2 ] noticeable layer of mortar on surface of testing concrete and noticeable bleeding**




2

**[3 ] Clearly segregating by evidence of thick layer of mortar and/or bleed water on surface of testing concrete**




3

# Apparatus(concrete), Cont. (Abu Dhabi University)

- **Flowability Evaluation:**
  - Slump test
  - $T_{50}$ time
  - Visual Stability Index(VSI) Rating

- **Flexure test**

- **Compressive Strength after 1 day, 3, 7 and 28days**

# ASTM (C 1202)

- Cured in outdoor environment
- Casted after 110 min of mixing
- 6 hr of testing at interval of 30 min

جامعة أبوظبي
ABU DHABI UNIVERSITY

# Sustainable Concrete using Recycled Aggregate and Supplementary Cementitious Materials

# Common Sustainable Practice in Concrete Industry

- Partial replacement of cement content with common supplementary cementitious materials (SCM)
- The SCM materials are waste by-products of other industries, which can improve the quality of concrete making it more durable

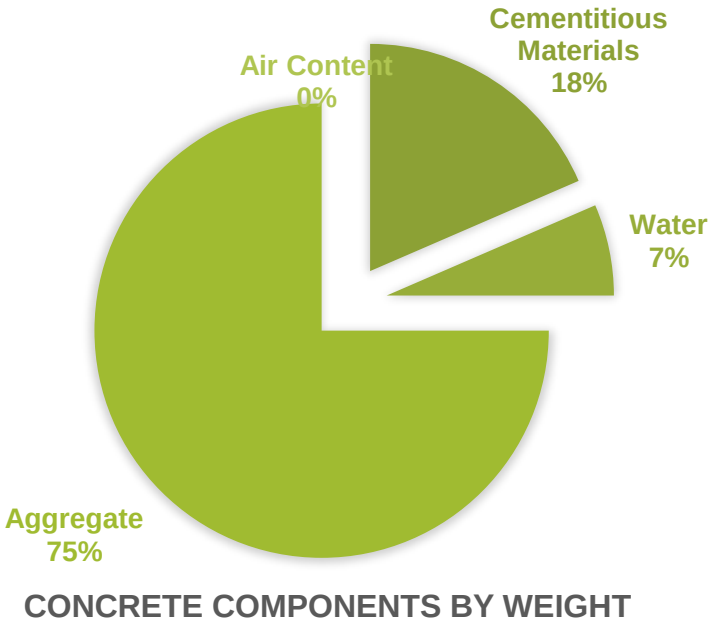
GGBS

Flyash

Microsilica

# Use of Recycled Aggregate as Sustainable Material

- Coarse and fine aggregates constitute around 75% by weight of an non-air entrained concrete
- Cement occupy only 16% to 18% of concrete mix by weight.
- Replacing part of the aggregate content with available sustainable materials will be more beneficial for environmental protection.
- Also it Reduces energy and cost of excavation of natural aggregate.
- it reduces the impact of waste material in the environment



# Experimental Program

## Recycled Aggregate Used
## About the Recycling Plant - Facts

- **About the Source of Recycled Aggregate Used**

Al Dhafra Recycling Industries is responsible for the processing of construction and demolition materials across the Emirate of Abu Dhabi.

- Target:

Reduce the level of construction and demolition material being disposed of in Abu Dhabi's landfills.

- Al Dhafra Recycling Industries' recycling facility can process between 5000 and 7000 tones of material per shift.

Al Dhafra Recycling Industries, located adjacent to the Al Muqadhara Abu Dhabi, UAE

# Acknowledgment

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# *ADU Master Student Ahmed Khartabil supervised by Dr. Samer Al Martini is the Winner of:*

***1 st FIB- UAE Graduate Fellowship Award, March 21-Society of Engineers*** *for their research proposal "Improving Mechanical, Durability & Structural Properties of Sustainable Recycled Aggregate Concrete by Incorporating Nano-Supplementary Cementitious Materials." The award comes with an amount of AED 20,000*