Structural Behavior of Self-Consolidating Carbon Nanofiber Concrete

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August 2010
Abstract

• Investigate the effectiveness of carbon nanofiber as a strain monitor.

• Study the structural behavior of the materials the columns were made of (SCRC and SCCNFC).

• Examine the self-sensing abilities of the concretes.
Carbon Nanofibers

- Mechanical and Electrical properties:
  - Increased Strength
  - Increased Ductility
  - Increased Conductivity

- The Difficulty
  Dispersion of fibers in concrete
Experimental Program

• Comparison of:
  Self-Consolidating Reinforced Concrete (SCRC)
  Self-Consolidating Carbon Nanofiber Concrete (SCCNFC)

• One-tenth of Axial Load capacity was applied.
• LVDTs (Linear Voltage Displacement Transducer)
• Wire Mesh
Materials

• Cement
• Fly Ash
• Coarse Aggregate
• Fine Aggregate
• High-Range Water Reducer
• Viscosity Modifying Agent
• Carbon Nanofibers (PR-19-XT-LHT-OX)
Specimens

• Six #8 longitudinal rebar
• #2 Stirrups spaced 4.75 in apart

• Foundation 60in x 60in
• Two layers of #8 rebar
• #3 Stirrups
Construction of Specimens

• Slump Flow
• 22”-26” Desirable

• Rebar cage was set in place for pouring.
Construction of Specimens

- Foundation was casted first.
- Column casted
Construction of Specimens

- Wire mesh were inserted

- Wire mesh configuration
Loading Protocol

- Reversed-Cyclic Loading
- 146 kip Actuator

- Axial Load was applied
Loading Protocol

- Reversed-cyclic Loading began
  Two complete cycles of ± 20 kips
  Two complete cycles of ± 40 kips
  Two complete cycles of ± 60 kips

![Horizontal Loading Program](image)
Experimental Results

- SCRC Column
  Failed in Shear and crushing of concrete at 62.0 kips.
  .5 in was the Maximum drift

![RC Column Force vs. Displacement Curve](image)
Experimental Results

• SCCNFC Column
  Failed in Shear and crushing of concrete at 66.97 kips.
  .4 in was the maximum drift
Electrical Readings

- SCRC shows a bad correlation between force, strain, and resistance.
Electrical Readings

- SCCNFC shows good correlation between force, strain, and resistance.
Conclusion

The addition of Carbon nanofibers in a concrete mixture:

• increases both the strength and ductility of the column.

• resulted in more effective health monitoring.

• can be used as a reversible strain sensor.
Acknowledgements

The research study described herein was sponsored by the National Science Foundation under the Award No. EEC-0649163. The opinions expressed in this study are those of the authors and do not necessarily reflect the views of the sponsor.