Photogrammetric Assessment of Flexure Induced Cracking of Reinforced Concrete Beams under Service Loads

Pease, Bradley Justin; Geiker, Mette Rica; Stang, Henrik; Weiss, Jason

Publication date:
2006

[Link back to DTU Orbit](#)

Citation (APA):

Pease, B. J., Geiker, M. R., Stang, H., & Weiss, J. (2006). *Photogrammetric Assessment of Flexure Induced Cracking of Reinforced Concrete Beams under Service Loads*.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Photogrammetric Assessment of Flexural Induced Cracking in Reinforced Concrete Beams under Service Loads

Brad Pease, Mette Geiker,
Henrik Stang, and Jason Weiss

2ND International RILEM Symposium,
September 11-13, 2006

Outline of Today's Talk

- Motivation & Goal
- Experimental Investigation
 - Sample Geometry
 - Three-Dimensional Photogrammetry Technique
- Test Results
 - Crack Geometry
 - Crack Measurements
- Conclusions

Outline of Today's Talk

- Motivation & Goal
- Experimental Investigation
 - Sample Geometry
 - Three-Dimensional Photogrammetry Technique
- Test Results
 - Crack Geometry
 - Crack Measurements
- Conclusions

Motivation and Goal

- Motivation
 - Cracking in concrete affects ingress and corrosion (i.e. service life)
 - Cracking in reinforced concrete is complicated by slip and separation at reinforcing bar
- Goal
 - Quantify crack geometry in reinforced concrete beam during loading

Experimental Observation of Cracks: Sample Geometry and Loading

- Reinforced beams
(150 x 150 x 600 mm)

Experimental Observation of Cracks: Sample Geometry and Loading

- Reinforced beams (150 x 150 x 600 mm)
- Face of concrete removed
- Exposed reinforcement and aggregate

Experimental Observation of Cracks: Sample Geometry and Loading

- Reinforced beams
(150 x 150 x 600 mm)
- Face of concrete removed
- Exposed reinforcement and aggregate
- 3-Point bending
 - 1.0 and 1.8 times estimated cracking load (13 and 25.2 kN)
 - 35 kN

3-D Photogrammetry

- Photogrammetry quantifies cracking during loading
- Two digital cameras placed equidistant from sample, focused on same point collect images
- Images separated into a mesh by software
 - Individual mesh box = facet

3-D Photogrammetry: General Measurement Process

- Coordinates assigned to facet corner and center by grayscale variation
- System tracks movement of facet center and corners

White line – original location
Black line – deformed shape

3-D Photogrammetry: Surface Preparation

- Grayscale contrast obtained by speckle pattern

3-D Photogrammetry: Deformation Measurement

- Sample deformation measured as mesh movements

Outline of Today's Talk

- Motivation & Goal
- Experimental Investigation
 - Three-Dimensional Photogrammetry Technique
- Test Results
 - Crack Geometry
 - Crack Measurements
- Conclusions

3-D Photogrammetry: Crack Geometry

- All beams loaded at constant rate, maximum – 3 min. unloaded – 3 min.
- Video of measured deformation projected on beam surface
- Crack opening measurements from tension face and near reinforcement

ARAMIS

— Crack Opening 1: X-Deviation
— Crack Opening 2: X-Deviation

gom
www.gom.com

Crack Measurements: Crack Shape

- Load vs. crack width at various loadings from two locations
- V-Shaped crack

Crack Measurements: Slip and Separation

- Slip and separation vs. crack width near tensile face

- Elastic slip response, inelastic separation

Crack Measurements: Slip and Separation

- Initiation of slip and separation
 - At estimated cracking load
 - $\sim 4 \mu\text{m}$ measured slip and separation
 - Measured deformations close to resolution, results inconclusive

Conclusions

- 3-D Photogrammetry used to quantify cracking under flexural loading
- Slip behavior between reinforcement and concrete is elastic while separation behavior is inelastic
- Slip and separation between reinforcement and concrete initiates after opening of crack at tensile face

Acknowledgements

Otto Mønsted

- FREMMER DANSK HANDEL OG INDUSTRI

Otto Mønsted Foundation – Travel Fund

The Velux Funds: Villam Kann Rasmussen Foundation – Funding for Aramis 3-D Photogrammetry Equipment