Shotcrete Nozzleman Certification in North America

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Subject of Presentation

- Shotcrete Information Sources In North America
- Nozzleman Certification History in North America
- American Shotcrete Association (ASA)
- ASA Nozzlmen Certification Program
- American Concrete Institute Nozzleman Certification Program
- Details of ACI Program
- Qualification for Specific Projects
- Conclusions
Shotcrete Information Sources in North America

- American Concrete Institute (ACI) Guides and Specifications
- ASTM International (ASTM) Test Methods and Materials Specifications
- American Shotcrete Association (ASA) Shotcrete Magazine www.shotcrete.org
Early Shotcrete History

1907: Carl Akeley in Chicago developed the original dry-mix shotcrete (gunite) gun

1930: American Railway Engineering Association introduced the term Shotcrete

1950: Inception of American Concrete Institute ACI 506 Shotcrete Committee

1955: Introduction of the wet-mix shotcrete method in North America
Shotcrete Nozzleman Certification
History in North America

1982: ACI 506.3 R *Guide to Certification of Shotcrete Nozzlemen* published
1997: ACI C660 Shotcrete Nozzleman Certification Committee Formed
1998: American Shotcrete Association (ASA) Formed
1999: ASA Shotcrete Nozzleman Training Program Developed
1999-2001: ASA Shotcrete Nozzleman Certification Program Implemented
2001: ACI C660 Shotcrete Nozzleman Certification Program Rolled Out
2002: ACI CP-60 (02) ACI Certification: Shotcrete Nozzlmen Publication Issued
American Shotcrete Association (ASA)

- ASA is a non-profit organization of Contractors, Engineers, Manufactures, Suppliers, Owners and Users formed in 1998 with a common interest in Promoting the Safe and Beneficial Use of the Shotcrete Process
American Shotcrete Association (ASA)

The prime objectives of the ASA are to:

- Encourage and promote the use of shotcrete in appropriate applications
- Educate and inform the construction and mining communities as to the benefits of shotcrete
- Provide potential users of shotcrete with reliable reference sources
- Promote and provide training of craftsmen in the shotcrete industry
- Act as a sponsor for the ACI C660 Shotcrete Nozzlemen Certification Program
American Shotcrete Association (ASA)

Committees

- Education
- Safety
- Publications
- Marketing/Membership
- Pool and Spa
- Underground
ASA Education Committee and Safety Sub-Committee

- Has developed a Shotcrete Nozzleman Education and Training program in support of the ACI C660 Shotcrete Nozzleman Certification program
- Provides speakers for presentations at World of Concrete and other industry forums
- Safety Sub-Committee has issued a *Pocket Safety Manual*, issues regular *Safety Bulletins* and is preparing a comprehensive *Shotcrete Safety Manual*
ASA Publications and Marketing/Memberships Committees

- Publications committee is responsible for Shotcrete Magazine which has been issued 4 times a year since 1999

- Marketing/Membership Committee
  - Promotes growth of ASA Membership (522 members in April, 2008)
  - Supports ASA web site (www.shotcrete.org)
  - Supports ASA participation in trade shows/conventions
  - Provides shotcrete educational material for lunch box seminars to Owners, Engineers, Government Agencies
ASA Underground Committee

- Promotes the safe and beneficial use of the shotcrete process in the underground environment
- Has prepared an *Underground Shotcrete Education Module*
- Has developed a list of approved *Underground Shotcrete Educators*

Note: There is currently no specific Shotcrete Nozzleman Certification Program for Underground Shotcrete applied by manipulator arms in North America
ACI Nozzleman Certification Program

Procedure that allows verification of the knowledge and ability of a nozzleman to shoot correctly

Certification is available in the following categories:

- Dry-mix vertical
- Dry-mix overhead
- Wet-mix vertical
- Wet-mix overhead
ACI Nozzleman Certification Program

Nozzleman Benefits
- Formal craftsman qualification
- Personal recognition
- Listed on the ACI website as a certified nozzleman

Contractor Benefits
- Gives a competitive edge
- Provides credibility
- Promotes quality end-product
- Retains higher quality work force
ACI Nozzleman Certification Program

Specifier/Owner Benefits
- Quality assurance
- Peace of mind
- Minimizes error; saves time & money

Shotcrete Industry Benefits
- Increased market
- Better trained workforce
- Adds credibility
- Internationally recognized program
ACI Nozzleman Certification Program

Q: Why is nozzleman certification necessary?

A: Poor workmanship in the past by unqualified applicators
   - Continuous emerging technologies in both materials and equipment
   - Standardized methodology
   - Broader scope of applications requiring advanced skills
ACI Nozzleman Certification Program

Q: What is the pre-requisite to apply for certification?

A: A minimum of 500 hours of verified work experience as a nozzleman or a nozzleman-in-training is required.
ACI Nozzleman Certification Program

Q: What are the steps involved in the program?

A: Visit www.shotcrete.org for information on the program:
   – Submit completed application with verified credentials and payment to ASA headquarters
   – Take written and performance examinations for each certification category desired
ACI Nozzleman Certification Program

- Examination:
  - 90 minute written examination with 75% passing grade required
  - Performance examination also required
    - Oral evaluation of knowledge
    - Visual evaluation of shooting technique
    - Evaluation of test panels by core grading
Core samples (5) taken for core grading to assess quality of rebar encasement.
Overhead Standard Set-up

ACI SHOTCRETE NOZZLEMAN CERTIFICATION
- OVERHEAD STANDARD SET-UP -

US #4 steel bars inside panel through the side form for support

>100 lbs dead weight (To prevent vibration)

ACI Certification Panel (See C560 Policy)

Scaffolding Boards 4’ x 6’ x 10’

2.5’ (C)

5’ (U)

(i) Standard Scaffolding Dimension:
Standard Section: 5’ x 5’ x 10’
Half Section: 5’ x 2.5’ x 10’
Core Grading System

- Five cores are visually evaluated.
- To pass the test, the examinee must shoot a maximum of two cores of grade 3, and no cores with a grade of 4 or 5.
Core Grading System

Visual Examination

Grade 1  Intermediate grade  Grade 5

Intermediate grade
ACI Nozzleman Certification Program

In addition to the ACI requirements, ASA requires the nozzleman applicant participate in an education/training session.

ASA provides approved trainers for this purpose.
ACI Nozzleman Certification Program

Q: What is the cost to become certified?

A: ACI exam fees per examinee

- ASA Shotcrete Training Course fee
- Examiner fees
- Additional costs for materials, equipment, panels, coring, etc.
- For more information please visit: www.shotcrete.org
ACI Nozzleman Certification Program

Q: How long is the certification good for?

A: The certification is good for five years. Recertification applications are also available by visiting www.shotcrete.org
ACI Nozzleman Certification Program

AMERICAN CONCRETE INSTITUTE

This is to certify that

JEAN DEAUX

has demonstrated knowledge and ability by successfully completing the ACI certification requirements and is hereby recognized as an

ACI SHOTCRETE NOZZLEMAN, WET MIX PROCESS VERTICAL & OVERHEAD POSITIONS

Certified Date: 11/12/03  Expires: 11/12/08

Examiner:
Qualification of Nozzlemen for Specific Projects

- In addition to being ACI Certified Nozzlemen are required to prequalify to shoot on specific projects (if contains complex reinforcing/shooting details)
- Construct and shoot mock-ups with:
  - Proposed shotcrete mixture/supplier
  - Equipment proposed for use on project
  - Proposed nozzlemen and crew
- Shoot standard ASTM C1140 test panels for extraction of test specimens to qualify mix
Preconstruction Mock-up for a Seismic Retrofit Project
Qualification of Nozzlemen for Specific Projects

- ACI 506 Shotcrete Committee is preparing a Guide
- Shotcrete cores extracted from ASTM C1140 test panels to test for compressive strength, etc. to qualify mix and nozzlemen
- For fibre reinforced shotcrete, ASTM C1609 beams cut from panels for flexural toughness testing, or ASTM C1550 round panels shot and tested
Qualification of Nozzlemen for Specific Projects

Reinforced shotcrete mock-up test panels:
- Cores extracted and evaluated against ACI C660 core grading criteria, and/or
- Mock-ups stripped and saw-cut to check for defects such as:
  - Excessive voids around reinforcing steel
  - Shadows/sand lenses
  - Entrapped rebound/porous zones
Conclusions

The initiative in North America:

- By ASA to educate and train shotcrete nozzlmen and other members of the shotcrete crew, and
- By ACI to certify shotcrete nozzlmen
- In conjunction with the use of mock-ups and prequalification of nozzleman for specific projects

Is resulting in marked improvements in the quality of shotcrete being installed in underground and other applications, and large increases in the amount of shotcrete being used in North America