

ACI Nozzleman Certification—Why, Who, When, and How

By Charles Hanskat

ASA is the largest ACI sponsoring group offering ACI Shotcrete Nozzleman Certification in the world. Since I came on board as the ASA Executive Director 3 years ago, the certification program has evolved and improved in many ways. Yet, as ACI readily admits, the nozzleman certification program is one of the most complicated certifications programs they offer. Although I was an ACI examiner for shotcrete certification several years before becoming ASA Executive Director, learning all the ins and outs of the program has been a distinct challenge. Fortunately, I've had our in-house expert on the certification process, Alice McComas, to help guide me along the way. In this article, I hope to translate some of the policy requirements into a more readable format, as well as give an insight into the finer details of the current ASA/ACI nozzleman session process and requirements.

At ASA, we recognize the importance of nozzleman certification to the shotcrete industry, and strive to provide a consistent, high-quality, and relevant experience for the session hosts and the nozzlemen participants. In 2017, we conducted 78 sessions, with 260 new certifications, 139 recertifications of existing nozzlemen, and 77 nozzlemen-in-training (NIT). Those sessions were spread primarily across the United States and Canada, but also included a session in Australia.

Checking the ACI website shows we have a total of 1713 certified nozzlemen worldwide, so adding 337 is nearly a 20% gain. In a time where attracting young people to enter construction careers is an industry challenge, it is encouraging to see this kind of growth, in what is admittedly a tough, physically demanding, and often dirty job.

Over the years, we've printed several articles about the ACI Nozzleman Certification. The first, in the November 1999 *Shotcrete* issue, "ASA Holds Initial Shotcrete Nozzleman Certification," documented the first shotcrete nozzleman certification session.

This was a pilot run put together by a collection of ASA members with extensive shotcrete experience, and was the model for the formal ACI Nozzleman Certification program that followed, established in 2001. A Summer 2013 *Shotcrete* article by J. F. Dufour, Marc Jolin, and Randle Emmrich, "Shotcrete Nozzlemen: ASA Educates-ACI Certifies," presented the then-current policies of the ACI Shotcrete Nozzleman program and identified ASA's role as an ACI Sponsoring Group. That article also described the ASA full-day nozzleman education course for all nozzlemen seeking new certification. Another article in the Summer 2013 issue, "ACI Nozzleman Certification Sessions: What Not to Do," by Bill Drakeley, was directed to the potential ASA/ACI nozzleman session hosts. It covered the do's and don'ts, with a lot of great tips for a company hosting a session. You can find all these articles in our magazine archive (www.shotcrete.org/ArchiveSearch).

So where are we with the ASA/ACI Nozzleman Certification program today? To help explain our comprehensive, but complicated program, I'll break it into more manageable chunks: Why, Who, When, and How.

WHY

Before ACI Nozzleman Certification was available starting in 2001, specifiers were often hesitant to specify shotcrete

ASA Holds Initial Shotcrete Nozzleman Certification

Streetsboro, Ohio, a small town just southeast of Cleveland, recently became the site for a landmark occasion in the shotcrete industry. For six days in September, 1999, the back lot of the Master Builders' manufacturing plant and a local hotel in Streetsboro became the venues for the first shotcrete nozzleman certification held by an industry association in North America.

The first three days were comprised of intensive training, peer-review, and curriculum development by a dedicated group of acknowledged industry experts. Working day and night, and even into the wee hours of the morning, they completed the necessary documentation, test procedures, and examination questions to enable the first class of nozzleman candidates to take a two-day instructional course and complete their certification examination on the last day. A total of 13 nozzlemen were enrolled, and all were certified in some or all of the configurations on which they were tested.

Personnel
Before the program was undertaken, an initial Certification Board was named to oversee this pilot offering. Chairing this first Board was Dr. D.R. "Bossy" Morgan of AGRA Earth and Environmental, Ltd. The other members were George Yeggy, Allenstown Shotcrete Equipment Co.; Lars Balck, The Cron Corporation; Marc Jolin, SEM Engineers; and Larry Torker, Johnson Western Granite Company. These and several others were invited to participate in the planning sessions which were held from Sunday through Tuesday preceding the classes and certification testing. Joining Morgan, Yeggy, Balck, and Jolin were Neil McAuliff, AGRA Earth and Environmental LTD; Ray Schaffers, RCS Consulting and Construction, Inc.; Jean Francois Dufour, King Packaged Materials Co.; Pierre Lacombe, SEM Engineers and Pat Bridger, Allentown Shotcrete Equipment. Observing for future program participation were Roland Heese, AGRA Earth and Environmental LTD; and Ray Braddock, BEK Inc.

Also participating in the planning sessions was Merle Hank, Chairman of ACI Committee C-690 Shotcrete Nozzleman Certification, who acted as both contributor and observer to assure that the ASA program was developed in accordance with both current ACI documents and also with the plans for the future ACI Shotcrete Nozzleman Certification program.

Preparation
In addition to working diligently on the classroom presentation and the written exam, all these future trainers and examiners spent many hours in actual outfitting and also in observing and critiquing each other. A wide variety of equipment and materials was used in these sessions to assure that each person was familiar with all the situations on which the candidates would be tested. Both wet and dry mix shotcretes were used, as well as different configurations of nozzles and hose sizes.

Each afternoon, after the shooting sessions were over, work started again on the documentation portion of the program. The

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Shotcrete magazine article from November 1999

because they were not familiar with the details required for quality shotcrete placement. Some had problems when they did try to allow shotcrete on a project, and an inexperienced contractor did a poor-quality job. ASA was formed in 1998 to help raise the visibility and quality of shotcrete in the concrete construction industry. Outreach seminars, trade shows, and active ACI committee involvement were ways we worked towards the goal, but we also saw that getting an ACI nozzleman certification in place would give us a tool for specifiers to more confidently start including shotcrete in their specifications.

ACI is an international organization that has produced codes and standards used by engineers and contractors globally for nearly a century. Their certification programs for individuals, such as Field Testing Technician, or Flatwork Finisher and Concrete Special Inspector, are internationally recognized and accepted as setting the standard for concrete-related certifications.

Thus, ASA identified the nozzleman certification process as a key to getting better specifier recognition of shotcrete. We also felt that by quantifying the experience, knowledge, and performance of a nozzleman, we could ultimately increase the quality of shotcrete placement. ASA members developed the initial program and pilot session along with ACI Committee C660, Shotcrete Nozzleman Certification, and then actively participated on Committee C660 to get the formal policy to match the needs of the industry.

That said, we firmly feel that simply specifying a certified nozzleman does not guarantee a properly executed shotcrete project. Yes, the nozzleman directly controls the actual placement of concrete and is a key member of the shotcrete team. However, true quality comes from a shotcrete contractor who gets the correct concrete mixture; provides proper, well-maintained equipment; has a trained crew, from the pump or gun operator through the finishers; and recognizes the importance of curing and protection of freshly shotcreted work.

The nozzleman certification is in many ways like a driver's license. You know how to drive a car, and the rules of the road, but you have not in any way experienced all the potential situations that may arise when driving. The nozzleman certification establishes you know the basics of shotcrete, can successfully pass a written exam to confirm that knowledge, and then prove to an examiner you can shoot a panel that has a few reinforcing bars. It doesn't mean you can successfully shoot a very thick section with congested reinforcing. It doesn't mean you can shoot around large embeds or in limited access areas. The ability to properly and consistently shoot more complicated work comes with experience. Often, an engineer on a complicated project will require the certified nozzleman to shoot a mockup panel to prove they have the ability to place quality shotcrete and fully encase the reinforcement.

Nozzleman certification also gives the nozzleman benefits. Through our ASA Education program, they learn more about the shotcrete process and the theory and practice for safety, selecting materials, equipment,

placement, curing, and protection. It is also an achievement, a "status" level they've achieved as a shotcrete craftsman.

WHO

Nozzleman applicants must have verifiable work experience shooting shotcrete. This is not time preparing substrates, building forms, shoveling rebound, operating the pump or gun, finishing, or curing. This is time the nozzleman is on the nozzle and placing concrete. For those workers looking to become nozzlemen, operating the blowpipe (air lance) adjacent to a nozzleman can give good experience on identifying good placement techniques.

Full Nozzleman Certification

The full nozzleman certification is in the shotcrete process (dry- or wet-mix) and orientation (vertical or overhead), and requires a minimum of 500 hours of shooting overall, and at least 100 hours in the specific process and orientation being pursued. These shooting hours can be from any project before the certification. As an example, if a nozzleman has 500 hours in wet- and dry-mix and wants to be certified in both vertical and overhead for both processes, they would need to show at least 100 hours in each of the wet-mix vertical, wet-mix overhead, dry-mix vertical, and dry-mix overhead categories.

Nozzleman-in-Training (NIT)

In 2015, ACI Committee C660, which oversees the ACI Nozzleman program, added a new category of "Nozzleman-in-Training" to applicants seeking certification. The NIT requires a minimum of only 25 hours of shooting experience in the process being pursued for certification. The NIT is limited to certification in the vertical orientation in the process where they have documented their shooting hours. If a NIT wants to pursue both wet- and dry-mix, they would need to show 25 hours of shooting experience in each process.

The thought behind adding the NIT was to help answer the question, "How do I get my 500 hours of shooting experience?" The NIT program, with the ASA education and CP-60 Craftsmen Workbook, introduces the entry-level nozzleman to the basics of the shotcrete process that they may not get from just on-the-job shooting. The 25 hours gives a measure of confidence that the NIT had seen and could safely handle a shotcrete nozzle during placement.

The NIT must attend the full-day ASA Nozzleman Education class, take the ACI written exam on the process they are pursuing, and take the ACI performance exam. Upon successfully passing the exams, they will be given a NIT certification. The NIT then documents their shooting hours on a project-oriented weekly form after passing the exams. When they reach the minimum of 500 hours, their revised work experience is then reviewed by an ASA examiner for upgrade to a full nozzleman certification. Thus, the NIT is not a full nozzleman certification, but provides a clear path for those seeking the full certification.

We've also found the NIT program is popular with companies hosting sessions. It allows hosts to maximize

the value of the sessions for new or recertifying nozzlemen by including the “up and coming” nozzlemen who look to full certification in the future.

Recertification

A certified nozzleman can recertify at any point in their 5-year certification period. If a nozzleman recertifies before his certification expires, their new certification extends from the time they took and passed the performance exam for the recertification. If the nozzleman’s certification expires, they have 1 year from the expiration date to recertify under the same rules as a nozzleman in good standing.

The required work experience hours (shooting on the nozzle) for recertification are a little more complicated.

The policy requires:

1. At least 1000 hours over the last two (2) years immediately prior to seeking recertification, with at least 200 hours in the process for which recertification is sought; or
2. At least 2500 hours over the last five (5) years immediately prior to seeking recertification, with at least 500 hours in the process for which certification is sought.

When a nozzleman recertifies by documenting their shooting hours and taking the performance exam, an expanded oral examination by the ACI examiner (usually about 20 to 30 minutes long) will be given to verify they have retained the basic knowledge about concrete and shotcrete in the written exam. They will not need to take the written exam.

Optionally, the nozzleman seeking recertification can elect to take a written exam instead of the oral exam, and will NOT have to document any hours. In effect, their minimum 500 verified shooting hours from the original certification are still valid. We find this is useful when a nozzleman advances to a supervisory position, and may not be shooting regularly, but still wants to maintain their certification status. This option is also available to nozzlemen seeking recertification whose certification expired for less than 1 year.

Session Hosts

Our certification sessions are normally “hosted” by a shotcrete company that has a number of nozzlemen needing certification. We refer to these as the “Hosts.” We need a contact assigned from the Host to help the coordination of the session. The Host is fully responsible for providing a facility for the education if we have new nozzlemen certifications, and a quiet area for taking the written exam. The Host also needs to provide a site for shooting the shotcrete performance panels and all materials, equipment, and setup of panels for the performance exams.

Often, a Host will open their session to participants outside their company to help defray the cost of the overall session. ASA keeps a list of individuals or smaller companies who can’t afford a session on their own. If a Host decides to accept outside participants, ASA will connect the two, and allow them to contact the Host directly for full information on the session. The Host is responsible for

providing the outside participants a price, information on timing and location of the session, and collecting payment for their inclusion in the session. ASA looks to only the Host for full payment for all aspects of the session.

Occasionally, ASA has a Host conduct an “open session.” This is a session where more than half the participants are not employed by the Host. To help assure the open session is well organized and can give the nozzlemen a good opportunity to demonstrate their skill, ASA staff will interview the Host on the specifics they intend to provide for the session, and make recommendations on any improvements that may be needed.

ASA/ACI Examiners

ASA has 16 ACI examiners who have been vetted by ACI Committee C660 to conduct the ACI shotcrete nozzleman certifications. Our examiners all have extensive experience in placing or evaluating shotcrete in field conditions. Examiners must undergo a training program that includes working with existing examiners on at least two sessions, plus taking the written exams for the process they are qualified to conduct. They are also reviewed and approved by ASA to professionally present the ASA nozzleman education program. We have four examiners in Canada, one in Mexico, and 11 in the United States. Our Mexican examiner is fluent in Spanish, and one of our Canadian examiners is fluent in French.

WHEN

When should you get your nozzlemen certified? Sooner than later. Getting your nozzlemen certified gives you as a shotcrete contractor the opportunity to show owners or specifiers, that you have made the commitment to pursue quality shotcrete work. A certified nozzleman does not assure the shotcrete project is executed properly, but it is certainly an important step in establishing your shotcrete credibility.

Bidding work that requires a certified nozzleman and waiting until the job is awarded to you is often too late. The fastest a session can be scheduled without a substantial rush fee is 3 weeks, and we prefer at least 4 weeks. We have ASA/ACI examiners spread across North America. However, this is not a full-time job for them, and on occasion, we run into scheduling conflicts that can make a quick session difficult or impossible to schedule on your timetable.

Our normal sessions are 3 days long, with 1 day for the ASA education, 1 day for taking the written exam and shooting the performance exam panel, and then on the third day, coring the panel for evaluation of the cores and quality of reinforcement encasement. If the session includes a larger group of nozzleman candidates where we’d need to shoot more than 14 performance panels, we will often require an additional day or provide a supplemental examiner to allow for the shooting and coring times. If a session runs into problems with weather, equipment failure, or material issues, the session Host can coordinate with the examiner to extend the session by a day.

We conduct sessions based on the session Host's schedule. When needed, our examiners can conduct portions of the sessions on weekend days to reduce the impact on your job schedule. You should plan on full days for the session. The education is a full day of content, and unless shooting and coring goes very smoothly, those two operations can easily extend to later in the afternoon.

HOW Book a Session

First, contact us! E-mail to info@shotcrete.org, call us at (248) 848-3780, or go to our Education page on the ASA website (www.shotcrete.org/Education). After contacting us, our Program Coordinator, Alice McComas, will coordinate producing a quote for the session, assigning an examiner, collecting payment and the work experience forms before the session, and then verifying the paperwork from the examiner upon completion of the session.

Before you call or fill out the online request, you should have this information handy:

- The number of nozzlemen to be certified:
 - How many are full, new certifications?
 - How many are NITs?
 - How many are recertifications?
 - Do they have the required hours, or will they be taking the written exam?
- What are the processes (wet or dry) and orientations (vertical or overhead) to be shot?
- What time frame (days) are you thinking of holding the session?
- Will any of the nozzlemen need a Spanish version of the workbook or exam?
- Will any of the nozzlemen require oral administration of the written exam?
- Contact information for the individual assigned as the Host contact for the session.

We have many certification session resources on our Education web page, including:

- Typical timeline for Certification and or Education Session;
- ASA Certification and Education Fees Price List;
- ASA-Sponsored ACI Shotcrete Nozzleman Certification Policy for Hosts and Participants;
- Nozzleman-In-Training Program Overview;
- Nozzleman Work Experience Form for Certification;
- Nozzleman Work Experience Form for Nozzleman-in-Training (right click to save file);
- Test Panel Configuration for Shotcrete Nozzleman Certification;

- Certification User's Manual;
- Order the latest Annual Nozzleman Compilation;
- Certification/Education Session Quote Request Form (for both wet-mix and dry-mix);
- ACI Shotcrete Nozzleman and Nozzleman-in-Training Dry-Mix Program Description;
- ACI Shotcrete Nozzleman and Nozzleman-in-Training Wet-Mix Program Description; and
- ACI Shotcrete Nozzleman Certification Policy.

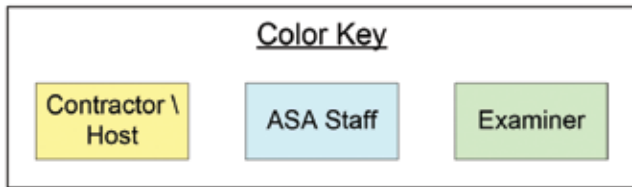
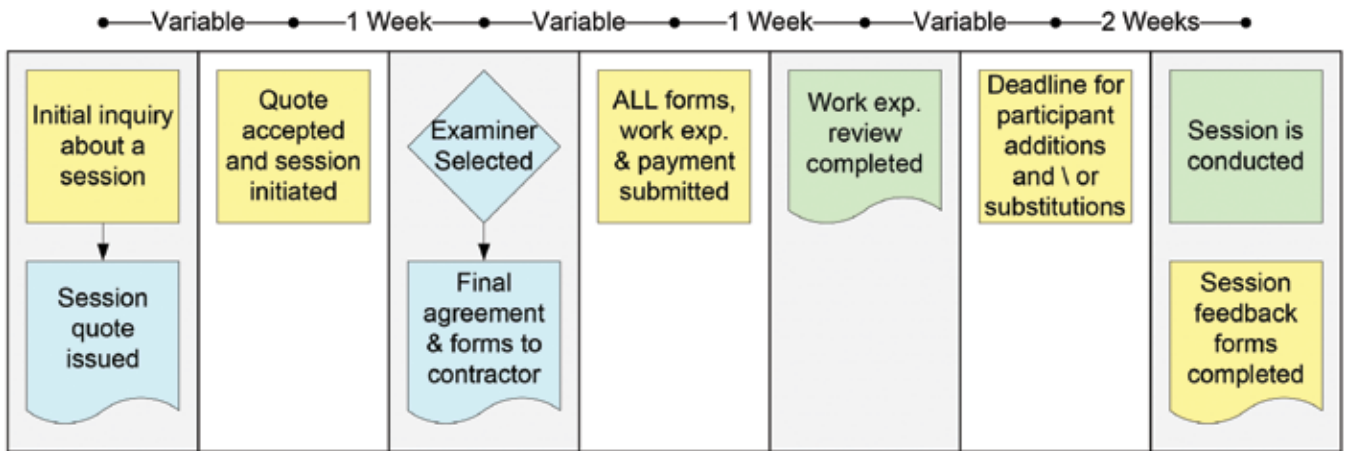
Our certification sessions are generally held at a Host Contractor site. The host location should provide a classroom (when there are new nozzlemen certifications) and panel-shooting facilities. Often, the session is at a company shop where there may be a training room and outside facilities for shooting the panels. However, we have conducted sessions on job sites or other facilities. I even did one on the owner's farm (complete with roosters and goats in the barn).

Unions can be Hosts for the sessions. However, ACI requires that the ACI certification cannot take place on union property. Thus, though the ASA day-long education can be presented at a union facility, the written and performance exams need to be conducted elsewhere. Often, we recommend the union look for a local shotcrete contractor and coordinate the session at their facilities, and with their equipment and proven materials.

When filling out the required work experience forms, we often see applicants correctly list the project, dates, employer, and contact, but in the "Wet or Dry Mix," and "Vertical or Overhead" fields list "Both." This is not acceptable, and requires staff or the ACI examiner to contact the host or nozzleman to get the breakdown of the hours shooting for each process and orientation. It is also important on the work experience to provide enough detail in the "Scope of Work" section so the examiner can establish the type of work (repair, soil nail, structural wall, and so on), the volume or area of concrete placed overall, and a range of thicknesses being shot on the project. We do check the shooting hours against the volume or area shot to confirm the stated numbers make sense from a practical field perspective.

Host the Session

As mentioned previously, we need confirmation of the session at least 3 weeks (and preferably 4 weeks) before the session start date to allow assignment of an examiner, review of work experience forms, securing necessary exams from ACI, and arranging examiner travel. The following is a typical timeline for our session process.



ASA Certification Session Process and Timeline

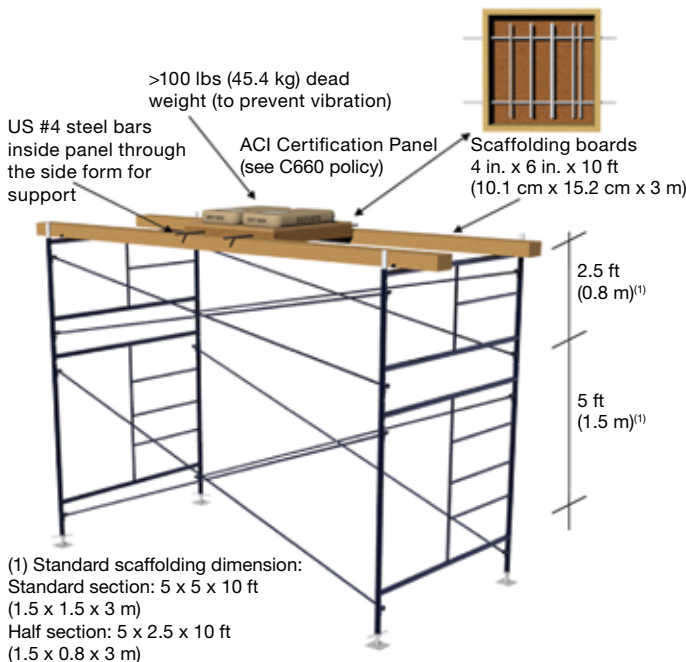
Once the session is booked, we assign an examiner to the session. The examiner is responsible for reviewing the work experience forms and contacting the Host well before the session. This pre-session contact gives the Host an opportunity to ask questions about the required facilities, daily schedule, materials, shotcrete equipment, and setup. In the pre-session contact, the examiner can get details on the location (or locations—sometimes the classroom session is at a different facility from the shooting location), equipment and materials to be used, safety, and overall setup. There may also be discussions on provisions for cold

or hot weather, rain, potential concrete delivery issues, use of admixtures (accelerator or retarder), or supplemental cementitious materials in the concrete.

The examiner is fully responsible for conducting the education and certification. He maintains full control of all exam materials, and conducts the session in a professional manner. With the years of field experience our examiners have, they usually establish a good relationship with the nozzlemen during the session, because most were nozzlemen at some point in their career and thus understand what a nozzleman must accomplish in the field. The examiner should not be there to promote any particular products, but present a neutral, unbiased viewpoint on proper shotcrete placement.

Written exams are all graded by ACI after they are returned to ACI headquarters by the Examiner. The performance exams are graded by the Examiner. The results of the performance exam (pass or fail) can be shared with the nozzlemen at the end of the session. Nozzlemen do not have to be present for the coring, but many examiners enjoy the opportunity to review the cores with the nozzlemen that shot them on the last day of the session.

The nozzlemen are informed of their certification status after all exams are returned for the session, and the written exams are graded by ACI. ACI can normally grade the exams and when they pass, post the nozzleman's certification on the certification website for verification (www.concrete.org/certification/verifycertification.aspx) within 2 weeks after receipt. The nozzleman's printed credentials are mailed to the address given in the session. If the Host wants to have the credentials mailed to the company first, they need to tell the nozzleman applicants to fill out the company address, rather than their home address, on the information form for the exams.



(1) Standard scaffolding dimension:
Standard section: 5 x 5 x 10 ft
(1.5 x 1.5 x 3 m)
Half section: 5 x 2.5 x 10 ft
(1.5 x 0.8 x 3 m)

Overhead standard setup—ACI Shotcrete Nozzleman Certification

IN SUMMARY

Whew, that's a lot of information, isn't it? The biggest recent change is the new shotcrete NIT certification that gives shotcrete contractors a good option for exposing their nozzleman trainees to the comprehensive shotcrete knowledge our full-day ASA Shotcrete Education class



More than one core drilling rig with crews who have experience in the operation

provides. It also allows the NITs to take the written and performance exams, and if successful on the exams, be upgraded to the full certification status upon reaching the required 500 hours. The other relatively new provision is clarifying the need for at least 100 hours work experience in the process AND orientation.

ASA constantly strives to improve the consistency, quality, and relevance of our shotcrete nozzleman sessions. We have several examiners-in-training to increase the size of our Examiner pool and allow us to be more responsive to our Host's requests for session dates. Our Education committee has a standing task to update and refine the education presentation. We work closely with ACI Certification to resolve issues that need clarification in the policy or procedures. We also closely review our process to streamline our administration and if needed suggest refinements to ACI Certification. If you have any questions about sessions, please contact Alice McComas at (248) 848-3780 or e-mail her at info@shotcrete.org. Also, if you have feedback for me on a past session, feel free to contact me directly at (248) 848-3742 or e-mail charles.hanskat@shotcrete.org.



Charles Hanskat is the current ASA Executive Director. He received his BS and MS in civil engineering from the University of Florida, Gainesville, FL. Hanskat is a licensed professional engineer in several states. He has been involved in the design, construction, and evaluation of environmental concrete and shotcrete structures for over 35 years. Hanskat is also a member of ACI Committees 301, Specifications for Structural Concrete; 350, Environmental Engineering Concrete Structures; 371, Elevated Tanks with Concrete Pedestals; 372, Tanks Wrapped with Wire or Strand; 376, Concrete Structures for Refrigerated Liquefied Gas Containment; 506, Shotcreting; and Joint ACI-ASCE Committee 334, Concrete Shell Design and Construction. Hanskat's service to the American Society of Civil Engineers (ASCE), the National Society of Professional Engineers (NSPE), and the Florida Engineering Society (FES) in over 50 committee and officer positions at the national, state, and local levels was highlighted when he served as State President of FES and then as National Director of NSPE. He served as a District Director of Tau Beta Pi from 1977 to 2002. He is a Fellow of ACI, ASCE, and FES and a member of ACI, NSPE, ASTM International, AREMA, ICRI, and ASCC.