TATRO HINDS
ADVANCED CONCRETE ENGINEERING

Stephen B. Tatro, P.E.

PRESENT

Civil engineering consultant specializing in the evaluation, testing, design, and construction of concrete materials for dams and other concrete structures.
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TECHNICAL EXPERTISE

- Concrete Materials Design
- Concrete Construction
- Mass Concrete
- Roller Compacted Concrete
- Fiber-Reinforced Concrete
- Specifications
- Concrete Repairs
- Shotcrete
- Chemical Grout Systems for Concrete
- Waterstop Installations
- Laboratory and Field Studies
- Mixture Design
- Prepare Contract Documents
- Thermal and Cracking Analyses
- Concrete Condition Evaluation

EDUCATION

B.S. Civil Engineering, 1979, Walla Walla College, Walla Walla, Washington, USA
M.S. Civil Engineering, 1985, Purdue University, West Lafayette, Indiana, USA
Licensed professional engineer in the State of Washington, USA.

CAREER HISTORY

Mr. Tatro is a concrete materials engineer. He has extensive experience in concrete materials, design, and construction. He has performed materials designs, supervised field applications, managed construction contracts, and evaluated concrete and materials problems during his career with the US Army Corps of Engineers (1979-2011). Promoted to senior engineer in 1984 and to manager of the dam safety program in 1986. Designated senior technical specialist for concrete materials in 1990. Expertise in areas of roller compacted concrete, shotcrete, contract preparation, quality control issues, and trouble-shooting field problems. Technical competence led to providing materials consulting services to other Corps of Engineers organizations in fields of concrete thermal analysis, waterstop replacements, shotcrete, roller compacted concrete design and construction. Concurrent private consultation from 1985-2011.

PROJECT MANAGEMENT

Effectively managed numerous programs and projects. Managed the structural instrumentation program and the dam safety assurance program for 8 major dam projects. Managed teams of designers for the design of multi-disciplined projects. Negotiated and managed contracts for design services.

CONSTRUCTION MANAGEMENT

Effectively managed construction activities by communicating with contractor staff, negotiating changes, directing activities, controlling costs, and coordinating with the design, construction, and owner team members. Projects include technical oversight for tunnel excavation project, served as construction project engineer for several roller compacted concrete dams, a directed labor drilling and grouting contract, and for expedited repairs to a damaged navigation lock structure.

PUBLICATIONS

More than thirty publications for technical journals, magazines, and symposiums including the *International Commission of Large Dams, Journal of the American Concrete Institute, The Transportation Research Board, Proceedings of the American Society of Civil Engineers, Civil Engineering Magazine, and Concrete International: Design and Construction.*

PROFESSIONAL AFFILIATIONS

Fellow, ACI International, (American Concrete Institute)
Member, Association of State Dam Safety Officials (ASDSO)
Member, United States Society of Dams (USSD)

Experience Summary

Publications

1. Tatro, Stephen B. "Willow Creek Dam - To Be or Not To Be," *Water for Resource Development*, American Society of Civil Engineers, New York, NY, 1984, pp. 255-259.

2. Tatro, Stephen B., and Schrader, Ernest K. "Thermal Considerations for Roller Compacted Concrete, *Journal of the American Concrete Institute*, V.82, No. 2, March-April, 1985, pp.119-128.

3. Tatro, Stephen B. "The Effect of Steel Fibers on the Toughness Properties of Large Aggregate Concrete," *Informational Report JHRP-86/3*, Purdue University School of Civil Engineering, Indiana Department of Highways, March 27, 1986, 118pp., (Master's Degree Thesis).

4. Tatro, Stephen B. "After Action Report - Emergency Repairs to Outlet Tunnel, Oakley Dam, Cassia County, Idaho," Walla Walla District, Corps of Engineers, April 1985, 49pp.

5. Schrader, Ernest K., and Tatro, Stephen B. "Cavitation and Erosion Damage to Concrete in Dams," *Concrete International: Design and Construction*, Vol.9, No.3, American Concrete Institute, Detroit, Michigan, March 1987, pp.15-23.

6. Tatro, Stephen B. "Performance of Steel Fiber Reinforced Concrete Using Large Aggregate," *Transportation Research Record 1110*, Concrete and Concrete Construction, Transportation Research Board, National Research Council, Washington, DC., 1987, pp.129-137.

7. Tatro, Stephen B., and Waring, Stephen T. "Waterstop Technology - The Next Chapter," *Proceedings of the International Conference on Hydropower*, Volume 2, Portland, Oregon, American Society of Civil Engineers, New York, NY., August 1987, pp.1442-1451.

8. Cannon, R. W., Tuthill, L., Schrader, E. K., and Tatro, S. B. "Cement - Know When to Say When," *Concrete International: Design and Construction*, Vol.14, No.1, American Concrete Institute, Detroit, Michigan, January 1991, pp.52-54.

9. Tatro, Stephen B., and Schrader, Ernest K. "Thermal Analysis of RCC - A Practical Approach," *Roller Compacted Concrete - III*, American Society of Civil Engineers, New York, NY, February 1992.

10. Tatro, Stephen B., and Hinds, James K. "Roller Compacted Concrete Mix Design," *Roller Compacted Concrete - III*, American Society of Civil Engineers, New York, NY, February 1992.

11. Tatro, Stephen B., "Lessons Learned from Cuchillo Dam RCC Construction," *Proceedings of the 1992 American Association of State Dam Safety Officials Conference*, AASDO, Lexington, KY, September 1992,

12. Tatro, Stephen B., "Zintel Canyon Dam - A Question of Cost," *American Association of State Dam Safety Officials Newsletter*, Vol 8, No. 2, AASDO, Lexington, KY, April 1993.

13. Lui, Tony, and Tatro, Stephen, "Performance of Roller Compacted Concrete--Corps of Engineers' Experience," *Proceedings of the International Symposium on Roller Compacted Concrete Dams*, Spanish National Committee on Large Dams, Santander, Spain, October 1995.

14. Tatro, Stephen B., "The River Runs Through It - Dismantling the Lower Snake River Hydropower System," *Proceedings of the 1998 Association of State Dam Safety Officials Conference*, ASDSO, Lexington, KY, (July 1998).

15. Tatro, Stephen B., Commentary on the Corps of Engineers Approach to Thermal Analysis of RCC Structures, *Proceedings of the International Symposium on Roller Compacted Concrete Dam, Chengdu, China*, Chinese Society for Hydroelectric Engineering (April 1999)

16. Osmun, Daniel W. and Tatro, Stephen B., and Zylman, Robert A., "Infrastructure Protection Considerations Associated with Removal of Lower Snake River Dams*," Proceedings of the 19th USCOLD Lecture*, United States Commission on Large Dams, Atlanta, GA, (Summer 1999)

17. Tatro, Stephen B., "Dam Removal – The Rest of the Story," *Civil Engineering Magazine*, American Society of Civil Engineers, New York, NY, (May 1999)

18. Dikeou, J. T. and Tatro, S. B., "Lower Monumental Lock Wall - Deterioration, Repair and Subsequent Performance," *Proceedings of the ICRI Workshop on Concrete Repair and 4th South African Conference on Polymers in Concrete*, Kruger National Park, South Africa, (June 2000)

19. Tatro, Stephen B., "Fast-Track Design and Construction of a Small RCC Dam*," Proceedings of the 17th Annual ASDSO Conference*, Providence RI, (September 2000)

20. Hollenbeck, Robert E., and Stephen B. Tatro, "Nonlinear Structural Analysis of Zintel Canyon Dam,", *Technical Report ERDC/SL TR-00-7*, US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS, (September 2000), 81pp.

21. Tatro, Stephen B., Bombich, Anthony, and Hess, John "Case Histories of Mass Concrete Thermal Studies, "*Technical Report ERDC/SL TR-00-8*, US Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS, (September 2000), 75pp.

22. Schrader, Ernest K., and Tatro, Stephen B. "Polymer Impregnation Repairs Of Cavitation/Erosion Damage At Dworshak Dam," *Concrete International: Design and Construction*, American Concrete Institute, Detroit, Michigan, (September 2001).

23. Tatro, Stephen B., Hinds, James K., and Ellis, Stanley "Dam Fast - Design and Construction of the Pajarito Canyon RCC Dam," *Proceedings of the 2001 Association of State Dam Safety Officials 2001 Conference*, ASDSO, Lexington, KY, (September 2001).

24. *Significance of Tests and Properties-169D*, Chapter 24, Thermal Properties, American Society for Testing and Materials, Houston, TX, Contributing Author (2006)

25. Tatro, Stephen B., Hinds, James K., West, Jana L., "Properties of Grout Enriched Roller Compacted Concrete," *2008 Conference Proceedings*, United States Society of Dams, (2008)

26. Tatro, Stephen B., Hinds, James K., West, Jana L., "Properties of Grout Enriched Roller Compacted Concrete," *Technical Report, US Army Corps of Engineers*, Walla Walla, WA (2008)

27. Tatro, Stephen B., Harrison, William, "Waterstop Technology – The 21st Century", *Proceedings of the International Convention of Long-Term Behavior of Dams, Graz, Austria*, International Commission on Large Dams, Paris, France (October 2009)

28. Tatro, Stephen B., Hinds, James K., "Large-Scale Concrete Testing," *2012 Conference Proceedings*, United States Society of Dams, (2012)

29. Tatro, Stephen B., Harrison, William, “Waterstop Technology Prototype Testing And Demonstration For High-Head Structures”, *Proceedings of the International Commision of Large Dams, Seattle, Washington,* International Commission on Large Dams, Paris, France (June 2013)

30. Tatro, Stephen B., Harrison, William, “Waterstop Technology for High-Head Structures”, *Proceedings of the 2013 Canadian Dam Association, Montreal, Quebec*, Canadian Dam Association, Toronto, Ontario (October 2013)

31. Dolen, Timothy, Tatro, Stephen B, “Things I Wish I Knew About RCC Dam Construction 40 Years Ago”, *2023 Conference Proceedings*, United States Society of Dams, (2023)

Experience Summary
Range of Concrete Experience

Mr. Tatro has been involved in many aspects of concrete evaluation, design, and construction. As a member and past chairman of the American Concrete Institute, Committee 207, Mass Concrete and Committee 210, Erosion of Concrete in Hydraulic Structures, Mr. Tatro has been the primary author of subcommittee reports "Cooling and Insulating Systems for Mass Concrete" and "Effect of Restraint, Volume Change, and Reinforcement on Cracking of Massive Concrete", and "Deterioration of Concrete in Hydraulic Structures.

Mr. Tatro has worked on hundreds of projects during his 44-year career involving the planning, design, construction, and rehabilitation of concrete structures. A brief list of technologies and typical projects follow that illustrate the diversity of expertise and experience in concrete technology.

CONVENTIONALCONCRETE, MASS CONCRETE, AND CONCRETE PAVEMENTS

Participated as designer and construction engineer on numerous design and construction teams for RCC dams. Designed and constructed numerous mass concrete structures ranging from massive spillway deflectors, stilling basin repairs, navigation lock monoliths, bridge piers and tremie seals, tunnel linings, and massive structural elements. Design and construction of conventional fixed-form, conventional slip-formed, and RCC pavements for military, industrial, and aviation applications. Most recently prepared the Corps of Engineers Guide Specification for RCC pavements.

ROLLER COMPACTED CONCRETE

Involved in more than 60 RCC projects as lead designer, resident engineer, design team, consultant, expert panel reviewer, and troubleshooter. Most recent projects are expert panel member for Wyaralong Dam (Australia), Metolong Dam (Lesotho), Portugues Dam (Puerto Rico), and Trung Son Dam (Vietnam). Served as design team member for Gibe3 Dam (Ethiopia), Valenciano Dam (Puerto Rico), and Diamer Basha Dam (Pakistan), Punatsangchhu Dam (Bhutan), Pardise Dam (Australia) and projects in the USA in Alabama, Alaska, California, Oregon, North Dakota, Nevada, and Washington.

MATERIALS AND LABORATORY INVESTIGATIONS

Performed numerous investigations into the availability and quality, of aggregates, cements, flyashes, admixtures, and placing conditions on concrete products. Designed laboratory investigation programs for aggregate, concrete, and forensic applications. Performed the mixture design program for several RCC dam projects and a slurry wall project. Performed laboratory investigations of chemical grout methods of waterstop repair. Currently developing testing equipment and methods for improved testing of shear, direct tension, adiabatic temperature rise, creep of concrete.

THERMAL AND CRACKING ANALYSIS

Performed numerous thermal analyses of mass concrete structures. Developed the definitive approach to non-NISA analyses utilized throughout the world. The approach was authored in the Corps of Engineers ETL 1110-2-542 on Thermal Analyses.

OTHER SPECIALTY CONCRETES AND APPLICATIONS

Designed repairs and new installations utilizing a wide range of specialty concretes and specialty applications. They include shotcrete, fiber reinforced concrete, epoxy mortar, polymer impregnation, latex modified concrete, auger-cast piles, slurry walls, shrinkage compensating concrete, non-shrink grout, high performance pneumatic grout (nuclear facility application), tremie concrete, underwater concrete, self-consolidating concrete. Designed replacement waterstop systems for concrete monolith joints that included acrylamide, urethane, silicone, and other grouts. Developed the latest grout innovation for replaceable waterstops for dams and mass concrete structures. Received the Corps of Engineers Innovator of the Year Award for that development

Experience Summary

Roller Compacted Concrete

Mr. Tatro has been involved with roller compacted concrete (RCC) beginning as a design team member for the design of Willow Creek Dam. He has been involved in more than 60 RCC projects as a designer, construction manager, consultant, and expert panel reviewer. As a member of the American Concrete Institute, he is the past chairman of Committee 207, Mass Concrete. A summary of the type of services provide for projects is listed below followed by a table listing the specific projects.

PLANNING PHASE

Participated with planning design teams to evaluate the feasibility of dam structures. Participation included issues of site selection, foundation conditions, material sources and quality, material supply logistics, construction logistics, and design and construction schedule.

DESIGN

Participated on design teams in various capacities; lead designer of projects responsible for the compete design of the project; part of the design team providing the RCC expertise to the project. On many projects he has performed the thermal and cracking analysis for a full range of materials and construction scenarios. Also performs RCC trial mixture programs to establish mixture proportions and performance.

TENDER ASSISTANCE

For several projects, provided assistance to contractors in preparing tenders (bids). Evaluated the site conditions and material sources, recommended equipment and crew configurations and provided production rates and schedule considerations for tender pricing.

ENGINEERING DURING CONSTRUCTION

Most projects require engineering and design assistance during construction. Provided such assistance on a number of projects. Reviewed submittals, participated in and evaluated test section construction and initial and ongoing placements. Provided on-call services as issues developed.

CONSTRUCTION MANAGEMENT

On several projects provided the on-site construction management for the RCC construction. Beyond the engineering during construction listed above, this function provided the day-to-day oversight of construction activities, evaluation of next-day, next-week, and next-month activities and facilitation of necessary

changes.

EXPERT PANEL REVIEW

Provide expert panel review of design and construction on behalf on owner, financiers, or regulators for projects. Usually work with a team of experts providing periodic review of activities and evaluation of content, quality, and progress.

TROUBLESHOOTING AND EVALUATION

Provided evaluation of post-construction conditions at several projects to determine deficiency and remedial actions.

SUMMARY OF EXPERIENCE ON RCC PROJECTS

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Project Name	Location	Ht./Vol	Dates	Activity on Project
Paradise Dam	Queensland, Australia	Ht - 50 meters RCC vol = 800,000 cubic meters	2019-2020, 2022 - current	Previously provided advisory services to owner for evaluation of existing dam. Currently serving as RCC advisor to project owner including developing RCC mix designs, reviewing specification. Project is a 400,000 cubic meter buttress to existing 400,000 cubic meter project. Currently in the design phase.
Pacheco Dam	California, USA	Ht - 105 meters RCC vol = 3.5M cubic meters	2021-current	As a technical review board member, provide comprehensive project design review, construction review, and operations oversight for the development of a full project dam safety program. Project was a hardfill design, recently changed to CFRD.
Pipestem Dam	Jamestown, North Dakota, USA	Ht- 34 meters RCC vol = 75,000 cubic meters	2020-current	Performed materials availability study for RCC mixtures. Performed trial mixture program for RCC mixtures and soil cement mixtures. Work still in progress. Performing construction phase RCC advisory services.
Priest Rapids Dam	Washington, USA	Ht ~20-25 meters RCC vol = 50,000 cubic meters	2019-current	On the construction team for IMCO construction. IMCO was the successful low bidder. RCC consultant and RCC superintendent for 2 construction seasons.
Prado Dam	California, USA	Ht – 49 meters RCC vol = 150,000 cubic meters (est)	2019-current	Phase 1 - Performed RCC trial mixture studies and thermal analyses for an RCC spillway ogee modification and RCC training walls. Work also included advising Corps of Engineers designer's of RCC construction details, preparing contract documents, and construction support. Project reconfigured as Phase 2 and performing thermal studies, specification development and RCC details.
Las Vegas Wash Weirs	Nevada, USA	Ht – up to 10 meters RCC vol = 20,000 cubic meters	2022-current	Project is a series of up to 9 RCC weirs (flow control structures) to prevent head cutting of a tributary into Lake Mead. Providing RCC advisory services including, trial mix designs, specifications, RCC details, and construction phase support.

Oroville Dam	California, USA	Ht – 235 meters RCC vol = 300,000 cubic meters	2018	Chute spillway was damaged during flood discharge. The damaged foundation rock was replaced with RCC and capped with a conventional concrete spillway chute and training walls. Provided testing services to evaluate autogenous volume change of concrete mixtures. Assistance not directly related to RCC materials.
Scoggins Dam	Hillsboro, Oregon	Ht = 50 meters RCC vol =400,000 cubic meters	2018-	Currently providing consultation on the use of local sandstone deposits as an RCC aggregate. Future work will include design team participation and construction phase support services.
BC Hydro-Site C	Peace River, BC	Ht – 60 meters RCC vol – 175,000 cubic meters	2018-	The RCC dam includes a mass concrete powerhouse structure. Provide consultation on thermal control plans for mass concrete and thermal testing of materials for the powerhouse construction. Assistance not directly related to RCC materials. Also performing shear testing of RCC core to evaluate strength of seasonal cold joints.
Lower Slate Lake Tailings Dam	Kensington Gold Mine, Alaska	Dam Ht. – 25 meters RCC volume – 2500 cubic meters	2018	In conjunction with a stage 3 tailing dam raise, the spillway chute was to be raised 25 feet using RCC as the base structure. The RCC was placed in a narrow rock cut chute with 33% grade and difficult truck and equipment access. Provided assistance to the contractor in preparing and placing first time RCC and negotiating with the design engineer on necessary design modifications.
Bella Bella Dam	Bella Bella, British Columbia	Dam Ht. – 5 meters RCC vol = 2500 cubic meters	2016	Performed trial mixtures and test section for small RCC dam constructed in a remote region of British Columbia. All materials were pre-bagged and barged to the site.
Skagway Highway Dam	Alaska	Ht= 20 meters Vol = 30,000 cm	2015-2019	Provide comprehensive RCC design consultation for design and construction phases of a dam project.
Turkey Peak Dam	Texas	Ht= 50 meters Vol = 400,000 cm	2015-2017	Provide comprehensive RCC design consultation for design and construction phases of a dam project.
Tempe Town Dam	Arizona	Ht= 5 meters Vol = 2,000 cm	2014	Performed a construction phase thermal and cracking analysis for an RCC foundation mat evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.

Las Cruces Dam	Mexico	Ht= 190 meters Vol = 2,000,000+cm	2013	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Susu Dam	Malaysia	Ht= 110 meters Vol = 1,000,000+ cm	2013	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Ratle Dam	Kashmir, India	Ht= 100 meters Vol = 800,000 cm (RCC)	2012	Provide comprehensive RCC design and construction consultation for proposal and negotiation phases of the EPC project.
Punat-sangchhu Dam	Bhutan	Ht= 100 meters Vol = 800,000 cm (RCC)	2012-2019	Provide comprehensive RCC consultation to the construction contractor for construction phases of the project.
MSH-SRS	Washington, USA	Ht= 2 meters Vol = 5,000 cm	2012	Provide comprehensive RCC consultation to the contractor for the construction phases of a stilling basin replacement project.
Ft. Peck Spillway		Ht= 20 meters Vol = 40,000 cm	2012-2016	Provide comprehensive RCC design consultation for design and construction phases of a stilling basin replacement project.
Dahla Dam	Afganistan	Ht= 20 meters Vol = 20,000 cm	2012-2015	Provide RCC design review and consultation for design phase of the project.
Duck River Dam	Alabama, USA	Ht= 40 meters Vol = 220,000 cm	2011-2017	Provide comprehensive RCC design consultation for design and construction phases of the project.
Chontal Dam	Ecuador	Ht= 142 meters Vol = 2,000,000+ cm	2011	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Alvito Dam	Portugal		2011	Assisted client in the evaluation of client-performed thermal and cracking analysis for an RCC dam.

Levy County Nuclear Power Station	Florida, USA	Ht = 12 meters Vol = 15,000 cm	2010-2011	Performed direct tension and direct shear testing on large block samples for analysis of foundation base structure for nuclear power station. Work included design and fabrication of unique testing equipment and developing work protocols for nuclear safety standards.
Gibe III Dam	Ethiopia	Ht = 220 meters Vol = 5M+ cm	2010	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
San Vicente Dam Raise	California, USA	Ht = 96 meters	2010	Evaluated tender documents to assist construction contractor in preparation of tender.
Fish Creek Dam	Idaho, USA	Ht = 32 meters Vol = 80,000 cm	2009	Provide RCC consultation for planning level evaluation of dam rehabilitation options of an existing barrel arch dam constructed in the 1920s.
Metolong Dam	Lesotho, Africa	Ht = 65 meters Vol = 200,000 cm	2009-2018	Provide comprehensive project design review, construction review, and operations oversight for the development of a full project dam safety program.
Traveston Crossing Dam	Queensland Australia	Ht = 80 meters Vol = 500,000 cm	2008	Provide comprehensive project design review, construction review, during the alliance presentations, selection, design, and construction of the project.
Wyaralong Dam	Queensland Australia	Ht = 40 meters Vol = 200,000 cm	2008-2010	Provide comprehensive project design review, construction review, during the alliance presentations, selection, design, and construction of the project. Provide direct consultation on construction site activities related to RCC materials and placement.
Trung Son Dam	Mia Chau, Vietnam	Ht = 85 meters Vol = 500,000 cm	2008 - now	Provide comprehensive project design review, construction review, and operations oversight for the development of a full project dam safety program. Served as expert panel chairman for design phase of the project.
Dry Comal Creek Dam	Texas, USA	Ht = 33 meters Vol = 80,000 cm	2008 - 2009	Provide comprehensive RCC design consultation for design phase of the project.

Valenciano Dam	Puerto Rico	Ht = 33 meters Vol = 300,000 cm	2007-2009	Provide comprehensive RCC design consultation for design and initial construction phase of the project.
Nam Theun 1	Laos	Ht = 175 meters Vol = 3,000,000 cm	2007-2008	Provide comprehensive RCC design consultation and established material testing protocols and on-site laboratory for design-build project. Project work suspended in 2008.
Diamer Basha Dam	Pakistan	Ht = 280 meters Vol = 20,000,000 cm	2007	Performed a preliminary thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios
Portugues Dam	Puerto Rico	Ht = 75 meters Vol = 300,000 cm	2006 - 2011	Performed constructability review of design documents and construction contract. Provided RCC consultation on design features of project to design staff. Provide expert panel review during construction. Provided RCC consulting to construction contractor
Son La Dam	Vietnam	Ht = 115 meters Vol = 4,500,000 cm	2005-2006	Performed independent technical review of the design of the RCC, conventional concrete, and instrumentation, and construction of the RCC structure.
Success Dam	California, USA	Ht = 60 meters Vol = 1,000,000 cm	2004-2005	Developed RCC concept for rehabilitation of existing dam. After final explorations of the foundation were complete, an embankment dam was selected for the site
Pinebrook Dam	Colorado, USA	Ht = 26 meters Vol = 24,000 cm	2005, 2007	Provided RCC consultation on materials and laboratory mixture proportions. After construction, performed evaluation of cohesion properties of RCC.
Burnett River Dam (Paradise)	Australia	Ht = 32 meters Vol = 289,000 cm	2003	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Corral de Palmas	Mexico	Ht = 107 meters Vol = 410,000 cm	2003	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.

Tongue River Dam	Montana, USA		2001-2003	Performed detailed evaluation and analysis of concrete cracking of RCC facing panels on spillway. RCC used for embankment dam stepped spillway overtopping protection.
Loch Raven Dam Rehab	Maryland, USA	Ht ~ 45 meters Vol ~ 60,000 cm	2002-2003	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios
3rd Avenue Ext. RCC Embankment	Alaska, USA	Ht = 25 meters Vol = 50,000 cm	2001-2003	Provided RCC consultation and managed laboratory materials studies for the design and construction of 70,000 cy of RCC used as a highway embankment in a high rainfall area.
Randleman Dam	North Carolina, USA	Ht = 26 meters Vol = 63,000 cm	2002	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Saluda Dam	South Carolina, USA	Ht ~ 100 meters Vol > 1,000,000 cm	2002, 2004	Provided RCC consultation on design features and RCC thermal issues to the design firm. Later consulted on alternate RCC delivery systems and strength variation issues.
Olivenhain Dam	California, USA	Ht = 100 meters Vol=1,100,000 cm	2001	Provided RCC consultation on design features and RCC thermal issues to the owner's management firm.
Ghatghar Dam	India	Ht ~ 100 meters Vol > 500,000 cm	2001	Assisted Indian contractor in the preparation of proposals and tender documents for design and construction of RCC dam structure. Structure included over 500,000 cubic meters of RCC.
Shrinagar Dam	India	Ht ~ 100 meters Vol > 500,000 cm	2001	Assisted Indian contractor in the development of proposals and tender documents for design and construction of RCC dam structures. Structure included over 500,000 cubic meters of RCC.
Omkaresh war Dam	India	Ht ~ 100 meters Vol > 500,000 cm	2001	Assisted Indian contractor in the preparation of proposals and tender documents for design and construction of RCC dam structure. Structure included over 500,000 cubic meters of RCC.

Little Bow Dam	Alberta Canada	Ht = 10 meters Vol = 12,000 cm	2001	Performed a comprehensive design and constructability review for an RCC dam evaluating the design criteria, material selection, and construction scenarios
Weber Dam	California, USA	Ht = 19 meters Vol = 13,000 cm	2001	Assisted a contractor in the preparation of tender documents for the construction of RCC seismic rehabilitation of an existing dam.
Pajarito Canyon Flood Retention Structure	New Mexico, USA	Ht = 36 meters Vol = 48,000 cm	2000	Served as project engineer during the emergency design and construction of an RCC dam to protect nuclear facilities at the Los Alamos National Laboratory (LANL) in New Mexico. Coordinated activities and provided technical oversight of the design firm, construction firm, the construction management organization (Corps of Engineers) and the owner (LANL).
Pedrogao Dam	Portugal	Ht = 45 meters Vol = 147,000 cm	1999	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the performance of RCC mixtures, material placing temperatures, and construction scenarios.
Fourche-Maline Creek Dam	Oklahoma, USA	Ht = 5 meters Vol = 1500 cm	1999	Performed design and construction management of a small RCC replacement dam near Wilburton, Oklahoma. The RCC structure was conceived, designed, and constructed in less than 2 weeks.
Mujib Dam	Jordan	Ht = 61 meters Vol = 720,000 cm	1999	Performed a comprehensive thermal and cracking analysis for an RCC dam evaluating the effects of various RCC mixtures, material placing temperatures, and construction scenarios.
Marmet Navigation Lock	West Virginia, USA	Ht = 25 meters Vol = 100,000 cm	1999	Developed RCC concept for use in navigation lock replacement project. Performed thermal analysis, prepared the design document, and the developed contract specifications. Evaluation included the effects of lift height, placement interval, aggregate temperature controls, and various insulation requirements.
McAlpine Navigation Lock	Kentucky, USA	Ht = 26 meters Vol = 135,000 cm	1999-2007	Developed RCC concept for use in navigation lock replacement project. Performed thermal analysis, prepared the design document, and the developed contract specifications. Continue to provide consulting for construction of RCC placements.

Deer Creek Dam	Idaho, USA	Ht = 28 meters Vol = 45,000 cm	1998-1999	Technical manager for the concept design of a small RCC fast-track dam project for fishery enhancement on tribal lands. As team leader, directed the development of site hydrology, structural analysis, hydraulic design, foundation characterization, materials evaluations, and mixture designs.
Penn Forest Dam	Pennsylvania USA	Ht = 55 meters Vol = 283,000 cm	1996-1998	Served on the Board of Consultants as the expert on Roller Compacted Concrete materials, design, and construction on behalf of the City of Bethlehem. The Board convened on a quarterly basis to review the progress and recommend subsequent direction of foundation investigation, concept design, final design, preparation of contract documents, and on-going construction. The Board provided the additional function as the value engineering team for the project.
Lake Royer RCC Mod	Maryland, USA		1994	Served as the primary RCC reviewer for the design of the RCC overtopping protection project on behalf of the dam owner for an owner-design RCC structure. RCC review consisted of review of materials requirements, plant requirements, RCC placing req'ts, conventional concrete requirements, and construction issues.
Hughes River Dam	West Virginia, USA	Ht = 33 meters Vol = 65,000 cm	1994	Served as the primary RCC reviewer for the design of the RCC Dam on behalf of the dam owner. Design was contracted to a regional design firm. RCC review consisted of review of materials requirements, plant requirements, RCC placing requirements, conventional concrete requirements, and construction issues. When the project begins construction, will provide initial construction consultation to the owner.
Zintel Canyon Dam	Washington, USA	Ht = 39 meters Vol = 54,000 cm	1987-1993	Served as project engineer and materials designer for the RCC dam project. Performed thermal cracking evaluation, materials availability study, established concept designs and cost estimates during planning and engineering phases of project. Directed design activities, the preparation of contract documents, and the finalization of laboratory mix designs. During construction, served as the sole on-site project engineer, evaluating RCC performance and placement methods, providing recommendations for improvements and modifications during placement, and evaluating contractor proposals. Project concluded with no contractor claims, 4 technical contract modifications, and cost escalation of approximately 3 percent.

Elmer Thomas Dam	Oklahoma, USA	Ht = 35 meters Vol = 34,000 cm	1993	Provided RCC consulting services to the Tulsa District, Corps of Engineers for the construction management of the project. During the construction, served as on-site technical specialist, evaluating RCC performance and placement methods, providing recommendations for improvements and modifications during placement, and evaluating contractor proposals.
American River Dam	California, USA	Ht = 140 meters Vol = 4,000,000 cm	1993	Providing RCC consulting services to the Sacramento District, Corps of Engineers for preparation of concept report for the American River, Dam, one of the largest RCC dams in North America (450 feet high and 1.5 million cubic yards). Specific services include preparing preliminary thermal analyses to establish monolith joint spacing, mixture and placing constraints, and development of the construction process. Feasibility study only.
Victoria Dam	Michigan, USA	Ht = 37 meters Vol = 40,000 cm	1990-1991	Provided consulting services to Stone and Webster Engineering Corporation during the design and contract preparation phase of the project. During construction, served as technical consultant to the construction management staff for initial mix evaluations, mix adjustments, test section construction, and initial RCC placement for the dam.
Cuchillo Negro Dam	New Mexico, USA	Ht = 50 meters Vol = 82,000 cm	1988-1991, 1993	Provided consulting services to the Albuquerque District, Corps of Engineers for RCC design and construction. Activities during the design phase included performing thermal cracking evaluation of the RCC structure, evaluating aggregate sources, RCC and conventional concrete mix designs, authoring the RCC specification, providing placement details required for RCC construction. During construction, served as on-site technical specialist, evaluating RCC performance and placement methods, providing recommendations for improvements and modifications during placement, and evaluating contractor proposals. Later, authored the construction history report for the dam and spillway structures.
Galloway Dam	Idaho, USA	Ht = 91 meters Vol ~ 1,000,000 cm	1986	Developed detailed concepts and cost estimates for the feasibility study of a 300-foot (91 meters) high RCC structure. The structure consisted of a center channel RCC spillway section flanked by embankment sections on each abutment. Feasibility study only.

Monksville Dam	New Jersey, USA	Ht = 48 meters Vol = 232,000 cm	1984	Provided consulting services in the thermal evaluation of RCC. Participation involved finite element software development, and software troubleshooting to allow designers to perform on-site thermal evaluations.
Elk Creek Dam	Oregon, USA	Ht = 95 meters Vol = 1,000,000 cm	1983	Performed finite element temperature evaluation for the Portland District, Corps of Engineers. Evaluated the effects of RCC placement rates, placement schedule, and placement controls on temperature distribution in the structure. Construction halted prematurely.
Willow Creek Dam	Oregon, USA	Ht = 52 meters Vol = 331,000 cm	1980-1983	Performed finite element temperature study and cracking analysis for the RCC structure. As a design team member, performed RCC material performance testing, materials availability studies, site design, and design and evaluation of the post- construction chemical grout program
Other Miscellaneous RCC projects.				Provided consulting services in the thermal evaluation of several RCC structures. Participation involved finite element software development, and software to allow designers to perform in-house thermal evaluations.