

Juan E. Quiroz Ph.D., PE

Principal, Structural Engineer · 22 Years of Experience

Dr. Quiroz has 22 years of experience as a project and design engineer on numerous projects involving feasibility studies, analysis, design, preparation of construction drawings, review of contractor design and submittals. These projects have included hydroelectric power plants, spillways, dams, navigation locks, pumping stations, major underground facilities, retaining, water/wastewater conveyance structures, penstocks, tunnels and shafts. He is also experienced with building structures, bridges, footings, tanks, and most civil infrastructure.

Dr. Quiroz has extensive expertise on numerical analyses and earthquake engineering, ranging from staged construction to non-linear dynamic Finite Element Analyses (FEA), including soil-structure interaction (SSI) for heavy infrastructure. Dr. Quiroz is currently the structural group lead for the Energy & Infrastructure division in Chicago and adjunct professor at the Illinois Institute of Technology (IIT).

EDUCATION

Ph.D. Structural Engineering, Illinois Institute of Technology, Chicago, Illinois, 2013

Ms. Structural Engineering, Universidad Nacional de Colombia, Medellín, Colombia, 2001

Bs. Civil Engineering, Universidad Nacional de Colombia, Medellín, Colombia, 1998

REGISTRATIONS

Professional Engineer, State of California

MEMBERSHIPS

Member, American Institute of Steel Construction

Member, United States Society on Dams

Member, American Concrete Institute

Member, American Society of Civil Engineers

AWARDS

2015 "Top 20 under 40" by the ENR magazine

2000 "Alejandro Ángel Escobar" for the "Hydrological Balance of Colombia" project

PROJECT EXPERIENCE

Dams/Hydro Power

Nalsyagu Gad Dam (Dam Analysis/Design)

Client: Nepal Electricity Authority

Nalsyau Gad Storage Hydroelectric Project is located in Jajarkot District in the mid western development region of Nepal. The dam is RCC and arch shaped with an approximated maximum height of 240m. The analysis of the dam was mainly focused on two levels of seismic ground motions, OBE with a PGA of 0.29g and an SEE with a PGA of 1.24g. The behavior of the dam was evaluated with a 3D FE analysis including the foundation and reservoir with acoustical elements.

Bluestone Dam Stress Analysis (Design Lead)

3D stress FE analysis of two spillway Monoliths for the evaluation of three proposed paths for new connecting galleries along with the identification of areas for potential stress concentrations and crack initiation. The study included 4 spillway monoliths, their foundation and piers, and the analysis was staged including the construction sequence.

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Warragamba Dam Raising Detailed Concept Design, Sydney (Design Lead)

Client: WaterNSW

Concrete raise of the existing Warragamba dam, which supplies 80% of drinking water for the city of Sydney, Australia. The Warragamba dam structural behavior is driven by several existing conditions including the narrow valley configuration, geologic features, different foundation stiffness between the abutment and the valley, an existing crack, post-tensioned cables, and an interim dam raising. The Finite Element Analysis (FEA) required a 3D staged construction analysis of the original dam construction and subsequent dam raising, including the dynamic analyses for two different EQ levels, in addition to thermal analyses.

Neelum-Jhelum Hydropower Project - Wing Wall Seismic Performance - Pakistan, 2017-2018 (Reviewer)

Technical reviewer for the seismic performance of the wing wall located at the right abutment. The Rockfill Dam is largely retained by the right abutment, and by various RCC, mass concrete, and reinforced concrete structures, including the wing wall Blocks. The seismic performance included a series of comprehensive non-linear dynamic simulations of the wall and embankment under seismic loading conditions using the FE method.

Pineflat Dam - USSD Workshop on Seismic Analysis of Dams

Client: USSD

Workshop on Evaluation of Numerical Models and Input Parameters in the Analysis of Concrete Dams, for the USSD 2018 Annual Conference. The workshop examined the analysis of the tallest monolith of Pine Flat Dam, considering various material properties and loads. The primary goal of the study is an evaluation of analysis methods, the accuracy of the numerical solutions, confidence in dynamic linear analysis of concrete dams, establishing a list of parameters that warrant additional investigation and expanding on a potential benchmark study for future workshops.

Vizcachas Dam - Quellaveco Project in Peru - Peru, 2017-2018 (Seismic Design)

Client: Fluor Anglo American

Seismic evaluation, stability, and stress assessment of the Vizcachas RCC dam in Perú. The evaluation included vibration frequencies, non-linear time-history dynamic FEA including SSI with absorbing boundaries and contact interactions. The analyses were performed under OBE and MCE earthquake levels. Downstream stilling basing slab was also evaluated.

Upper Bhote Koshi Hydropower - Penstock, Bhoti Koshi River, Sindhupalchok District, Nepal

The Gorkha earthquake (April 25, 2015) and several aftershocks struck the Central Himalaya where the Upper Bhote Koshi Hydroelectric Project is located, severely impacted the project after numerous landslides. To restore the project, a sensitivity study was performed to better understand the seismic hazard that exists in the region, with respect to the penstock. This study was carried out using non-linear FE analyses.

Gulpur Hydropower Project, Azad Jammu and Kashmir, Kotli District, Pakistan, 2017

Senior level technical reviewer of the analysis and design of the dam, powerhouse, and other major structures. The project is located in Azad Jammu and Kashmir (AJ&K), Pakistan, and includes a 63-m high concrete gravity dam, gated overflow spillway (17,000 m³/s). Two, 7-m-ID intakes, 50 m deep shafts, and 100 m long penstock connected to a surface powerhouse. The river diversion includes 2 x 200+ m long and 10-m ID horseshoe tunnels and a 30 m high concrete gravity cofferdam. Duties included the review of several calculations, drawings, analysis models, and meetings with the contractor's designer. Some of the key components included dam and powerhouse stability, dynamic time-history 2D and 3D FEA, reinforcement design review, construction details, and support during construction.

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Rocky Mountain Rotor Analysis, 2016

Client: Oglethorpe Power Corporation

Technical lead and reviewer of the 3D FE Analyses for the generator rotor, spider and rim for the Rocky Mountain Hydroelectric Station. Several analyses were performed to evaluate stresses and fatigue estimations. The analyses included contact problems, cyclic-symmetric boundary conditions, and centrifugal loading cases, and stiffening scenarios.

Monticello Dam Blind Prediction Analysis Workshop, 2016

Client: USSD

A workshop was hosted by the Earthquakes Committee to examine the predictions of multiple organizations, using various numerical prediction codes and the same input motion. Monticello Dam experienced an earthquake in 2015. The team was responsible for performing a SSI dynamic analysis including wave propagation and Absorbing Boundary Conditions (ABC) in three-dimensions. Particular emphasis was given to the response of the abutments with respect to traditional massless methods.

Red Rock Hydroelectric Project, Iowa, 2013-2017

Client: Missouri River Energy Services (MRES)

The Red Rock Powerhouse is located on the left downstream side of the Red Rock Dam Spillway and houses two vertical Kaplan turbine units with a total generating capacity of 36.4 MW under a rated net head of 48.6-ft. and maximum plant discharge of 8,900 cfs. A concrete intake structure within the upstream side of the dam contains trash racks and rake, bulkheads and emergency closure gates. During the design stage (2013) participated on the supervision of the structural staged analysis and design of the intake structure. During construction services (2016) included comprehensive 3D FE analyses including stage construction for excavated fills and concrete placements, soil plasticity, temporary excavation supports and operational loading. These analyses included intake excavation system, two downstream penstocks underground, and the powerhouse. The powerhouse spiral case involved the modeling of the wicket gates, posttension anchors and construction sequencing.

Manatee Cooling Pond Soil-Cement Replacement Project, Florida, 2017

Client: Ballard/ NextEra Energy

Independent technical reviewer for the concrete panel design. The project consisted on the design and construction of a stair-step panel overlay atop approximately 10,000 ft. of existing soil-cement slope protection of the cooling pond embankment. The purpose of the overlay is to replace the functionality of the existing soil-cement slope protection.

Yards Creek Intake, New Jersey, 2017

Client: First Energy

Independent technical reviewer for the structural design on the shaft and intake structure upgrades. The Pumped Storage Generating Station is located in New Jersey with 3 405-MW units. The facility had no means of shutting-off the flow in the exposed penstock in case of an emergency. Upgrade and modifications to the intake and shaft were completed.

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Cowlitz Falls – Powerhouse Stability Analysis, Washington, 2014

Client: Lewis County PUD

Dynamic and post-earthquake analyses of the Cowlitz Falls (70MW) powerhouse for a stronger revised seismic event after a Part 12 Safety Inspection Report. A series of 3D FE analysis were conducted including several powerhouse/rock interface and residual stresses scenarios.

Wheeler Hydro Plant – Generator Rotor Analyses, 2015

Client: Tennessee Valley Authority

Technical lead and reviewer of the 3D FE Analyses for the generator rotor poles, spider and rim for the Wheeler Hydroelectric Station (Unit 10). Several analyses were performed to evaluate stresses and fatigue estimations. The analyses included contact problems, cyclic-symmetric boundary conditions, and centrifugal loading cases.

Wanapum Dam – Remedial Spillway Strengthening, Washington, 2014-2015

Client: Grant County PUD

Evaluation and strengthening plan to repair the open joint and cracking developed in the ogee section of Monolith No. 4 and other spillway monoliths for stability against similar failure modes for the Wanapum hydroelectric project (1040MW). Supervision of the static, dynamic, and post-earthquake analyses of the spillway structure including lift joints and cracking features.

Lima Pumped Storage Feasibility Study, South Africa, 2007-2008

Client: ESKOM

Feasibility studies of a 1,500-MW underground pumped storage project in South Africa. Four alternative locations were analyzed with heads ranging from 550 to 850 meters. Evaluation of the orientation of the machine and transformer halls using 3D finite element methods. Analysis features include: geostatic analyses, staged construction (element removal for excavation), initialization of stresses and elasto-plastic material behaviors.

Karahnjúkar Hydro, Landsvirkjun, Iceland, 2006-2008

Design engineer for the 198m high Kárahnjúkar dam (the highest CFRD dam in Europe as of 2008). The project also features two adjacent saddle dams, two reservoirs, six Francis turbines (each 115MW), underground powerhouse; and an open chute spillway. The study included 2D and 3D FEA for the CFRD dam: Linear and non-linear elasto-plastic material behaviors (rockfill, gravels, concrete slabs), staged construction, contact problem (tangential and normal interface behavior). A state-of-the-art study was developed to estimate stress concentrations and overall behavior of face slabs for loading conditions under construction and during reservoir filling.

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Neelum-Jhelum Hydropower Project, Pakistan, 2012-2013

Client: Pakistan W&P Development Authority

Technical reviewer of several detailed design features for the \$2.2 Billion Neelum-Jhelum Hydropower Project (969 MW); Involvement included among others a non-linear dynamic stability evaluation of a 45m high, gated spillway concrete gravity dam (PMF=7,600m³/s); analysis and design review of piers and walls; and a staged 3D excavation stress analysis of the four-unit underground power-station complex. Additional tasks involved a non-linear dynamic stability analysis and design of several RCC and concrete wall structures intended for slope stabilization. These analyses included an elasto-plastic jointed rock material model to replicate the ubiquitous jointed rock properties of the site. For the review of the powerhouse structure, a dynamic SSI of the underground structure was also performed including the wave propagation and its effect on the response of the system.

Grand Coulee - Third Power Plant, PN Region, Washington, 2009

Client: Bureau of Reclamation

Structural engineer for stress evaluations using fatigue and several 3D FEA of the inner and outer head cover, wicket gate, operating ring and other components of one of the biggest turbines (600MW). The studies included contact problems and cyclic symmetry for reduction of analysis data and mesh sensitivity analyses.

Singoli Bhatwari Hydroelectric Project, India, 2009

Client: Larsen and Turbo Limited

Analysis engineering for the post-tensioned cables, trunion beam and reinforcement design for the piers. 3D FEA performed to estimate stresses under static and dynamic cases. All piers across the river were modeled as well as the breast wall.

Cannelton Hydroelectric Project, Ohio, 2009

Client: American Municipal Power - Ohio

Structural engineer for modeling and setting up of a staged construction 3D analysis using FEM for one of the powerhouses. Duties included training and mentoring engineers on ABAQUS and support during structural design.

Thornton Composite Reservoir & Dam, Chicago, Illinois, 2008

Client: Metropolitan Water Reclamation District

Design engineer for the analysis of an RCC gap dam bridging across the existing gap between the North and Main Lobes. The analysis consisted on the geometric evaluation of different shapes to minimize stress concentrations and then stability analysis and footprint foundation bearing evaluations. The RCC dam had a slight arched geometry, requiring a 3D analysis.

Lower Baker Dam, Washington, 2005

Client: Puget Sound Energy

Structural engineer for the stability evaluation of the existing spillway pier. The analysis included the calculation of a cross canyon earthquake response of the pier using site-specific time-history records.

Nechí Hydroelectrical Project*, Colombia, 1998

Client: EPM, Colombia INTEGRAL S.A.

Diversion tunnel concrete lining design. FEA for dam gallery. Several retaining wall and open channel designs. Powerhouse structure concrete details. FEA of diversion tunnel walls for steel closure gates.

Los Potreritos*, Colombia, 1998

Client: EPM, Colombia INTEGRAL S.A.

Quantity estimations and shop drawings review.

Porce II Hydroelectrical Project*, Colombia, 1998

Client: EPM, Colombia INTEGRAL S.A.

Structural analysis and design, technical support and development of construction drawings.

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Lake Mead Intake No.3, Nevada, 2006

Client: Southern Nevada Water Authority (SNWA)

Structural analysis of tunnel/shaft connections for the new intake structure and tunnel beneath the lake. The SNWA constructed a third deep-water intake in Lake Mead to protect the existing water system capacity against the potential inoperability of Intake No. 1 should the lake levels fall below 1050 ft. The connection was designed to resist the stresses caused by internal and external pressure loads. A 3D FE model was used for the analyses.

Karahnjúkar Hydro, Landsvirkjun, Iceland, 2005-2006

Participated as structural engineer for the analysis and design of several components for the Kárahnjúkar hydroelectric project. Among the structures designed are: Bottom outlet structure, intake shaft, flip bucket, parapet wall at the crest, two tunnel plugs, a tunnel shaft and the toe concrete wall at the canyon to start dam construction works.

Pinalito Hydroelectric Project, Dominican Republic, 2005

Client: Harza-Hidrobrasileira

Finite Element Analysis (FEA) of several dam monoliths for the 60m high Pinalito RCC dam. The scope of work included sensitivity analysis of foundation parameters and seismic evaluations for synthetic time-history records.

Tekeze - Arch Dam, Ethiopia, 2005,2007

Client: Ethiopian Electric Power Corporation

The Tekeze Dam is a double-curvature logarithmic spiral arch dam with a total height of 190m. Structural design and analysis of this project consisted of 4 sub-phases: 1) entire arch dam analysis including the foundation block, where a staged construction analysis was performed in the lines of the odd-and-even cantilever method followed by a full 3D FEA including a cracked base procedure; 2) the bottom outlets 3D FEA which was based on the sub-modeling technique to evaluate the stress concentrations around these openings; 3) low level outlet walls and trunnion beam analysis and posttensioned design; and 4) the left abutment stress analysis for an over excavated area restituted with anchored concrete lifts.

Sigatoka Ba Qaliwana (Nadarivatu) Dam Design, Fiji, 2005

Client: Sustainable Energy Limited

FEA stress analysis of a 60m high RCC dam including the foundation for static and response-spectra dynamic analysis. The study included stability evaluation for an MDE case.

Alpaslan II Hydro, Turkey, 2004

Client: Dsi-General Directorate of State Hydraul

Structural analysis and design of the spillway (7,100 m³/s) and adjacent structures for the 110m high Alpaslan II earth-fill dam. The items designed included: spillway, slab, concrete lined chute and stilling basing walls. Stability, concrete design and quantities estimations.

Tekeze Field Staff - CM, Ethiopia, 2004

Client: Ethiopian Electric Power Corporation

Structural design revisions for several lattice steel towers (high voltage transmission lines). Structural review included pad & chimney foundations for concrete and steel elements, drawings, and tower test evaluations.

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Lake Hodges Project, Virginia, 2004-2005

Client: San Diego County Water Authority

Structural engineer for the Lake Hodges Project. The project included the Emergency Storage Project, the Pumpstation, inlet/outlet structures and the Olivenhain Pipeline. The structural design included the MPT structure for the pumphouse transformers, roof slab, intermediate pumphouse slabs and walls, stairs, the take-off structure and the bifurcation Tunnel: 2D & 3D FE Model of the connections. Also, the structural analysis and design involved crane slabs, generator room, walls, hatches and beams.

Leaburg Spillway, Oregon, 2004

Client: Eugene Water & Electric Board

Performed seismic analysis for three 100ft wide spillways. The study included the pier No.6, a 50ft tributary ogee, apron, and spillway. The structure is supported on rock foundation and apron on top of riverbed gravel. 3D Seismic FE Modeling, with cracking evaluation, time-history & response spectra analysis was performed. Earthquake motion investigated in the flow, cross-stream and vertical directions using FERC criteria. Also, post-earthquake stability was verified.

Bath County Engineering Services, West Virginia, 2004

Client: Dominion Energy, Inc.

Analysis and design of the transformer support structure walls & details, crane pads on grade. Torsion evaluation of the main pier support.

Croton Falls, New York, 2004

Structural design of a flat roof slab and valve chamber. Construction drawings.

Emergency Spillway Tongue River Dam, Wyoming, 2004

Client: Department of Natural Resources & Conservation

Transient-Thermal Finite Element Analysis (DETECT), time-dependent heat flow and stress analysis. Crack propagation model and anchoring.

Canals

Probabilistic Risk Assessment, Panama, 2017

Client: ACP

The original Canal infrastructure is over 100yrs old and a thorough probabilistic performance-based earthquake engineering (PBEE) assessment program was needed. Developed a methodology and presented a pilot study for assessing the structural vulnerability, as a fragility function under seismic hazard, for the existing Panama Canal infrastructure. A conditional probability linking seismic hazard and structural response.

Third Set of Locks - Panama Canal Expansion Project, Panama, 2009-2015

Client: Autoridad Canal de Panamá (ACP)

Design engineer for the \$3.4 Billion Third Set of Locks Design-Build project (Panama Canal Expansion). Greatly involved with the analysis and design of the Lock structures consisting of several monoliths. Performed 2D and 3D FE analyses including advanced features for dynamic SSI analyses, including contact, non-linear material models, and special user elements for Absorbing Boundary Conditions, using ABAQUS software. Responsible for the performance-based evaluation, design, detailing and construction drawings for the lock structures. Project duties included design criteria selection, engineering & personnel coordination (internal & external), RFI support & technical QC evaluations during construction as well as leading the shop drawing review team.

Flood Management Solutions for Gatun Lake Northern Shore - Preliminary Design, Panama, 2012-2013

Client: Autoridad Canal de Panamá (ACP)

Member of the reviewer team for preliminary and detailed design of the spillway structure. Participated on peer review board (PRB) meetings and provided support for design criteria and analyses procedures.

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Panama Canal Proposal, Panama, 2008-2009

Client: Autoridad Canal de Panamá (ACP) & Grupo Unidos por el Canal (GUPC)

Tender Proposal Phase: Design engineer for the Third Set of Locks Design-Build proposal. Preparation of stability analyses for the lock chamber wall structures using Non-linear FEA. The analysis of the lock walls involved elasto-plastic material models, contact interfaces & dynamic time-history analyses (direct integration) using SSI techniques, including water elements and absorbing boundary conditions.

Chickamauga Monolith Design, Tennessee, 2007-2008

Client: Tennessee Valley Authority

After decommissioning of the existing lock due alkali-aggregate reaction problems, a new lock structure was constructed. Part of the new lock is built on top of the existing one and a staged construction analysis performed. For the remaining monoliths, several 3D FEA and detailed rebar designs were performed. Analyses included dynamic time-history analysis involving staged construction and contact interfaces between existing and new structures and their interactions with the foundation. Some of the monoliths are U-shaped and massive concrete design carried out.

Chickamauga Lock Stability Analysis, Tennessee, 2005-2006

Client: Tennessee Valley Authority

Development of spreadsheets and macros for 2D and 3D stability analyses for several concrete monoliths. Sliding, overturning, bearing pressure, etc. for seismic conditions. Participated during report and implementation of analyses criteria.

Tunnels

Tunnel Dewatering Pump Station Project, Cleveland, Ohio, 2014

Client: NEORS

Staged construction and time-dependent creep deformation analysis for the underground dewatering pump station. The pump station consists of two 45-ft diameter and 243-ft deep shafts, and a 65ft-high and 56ft-wide underground tunnel. Tunnel and shaft supports included various dowels/bolts for a large underground opening in a rock mass with relatively high in-situ stresses. The analysis was carried out using FEM in order to capture the interaction between the soil and the structure. Lab test data and field measurements were utilized for the estimation of parameters, and a creep analysis was then performed for 100-years to assess the expected level of deformations in the tunnel.

Albany Park Stormwater Diversion Tunnel, Chicago, Illinois, 2014-2015

Client: City of Chicago

Technical reviewer and structural lead role for the shaft/tunnel connections analyses using 3D FEA, this included a disturbed zone and constructions staging. The project was required for the purpose of lowering flood elevations along the North Branch of the Chicago River (NBCR) by diverting excess storm water to the North Shore Channel (NSC). The tunnel is located approximately 110ft below grade, inlet and outlet shafts, flow diversion facilities at the tunnel west end, flow discharge facilities at the NSC, channel side slope protections and site restorations at the construction areas. The inlet and outlet shafts are 20 and 34ft in diameter. A 3D staged excavation analysis was required to determine the stresses and deformations in the surrounding rock as well as tunnel liner on the connections of the tunnel to the inlet and outlet shafts.

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Pawtucket Tunnel and Dewatering Pump Station

The Pawtucket Tunnel project includes a deep rock tunnel, a dewatering pump station, three drop shafts, five near-surface consolidation conduits, and a stub tunnel for a future connection. The tunnel is expected to be approximately 13,000 feet long and 150 to 200 feet deep to invert. Tunnel diameter of 28 feet and a pump station (rock cavern). Preliminary sizing of the shafts and tunnel linings.

Mining

Idarado Mining Company, Colorado, 2004

Bridge abutment and plug design for a 16ft wide by 60ft long single span bridge, development of construction drawings and reports.

Bamputañe Dam, Perú, 2007

Client: Sociedad Minera Cerro Verde

Structural analysis and design of conduit & intake tower. Provided calculations for inlet & outlet structures and spillway stability and design. The study involved seismic analyses and a 3D challenging geometry.

Bridges

Obra 808*, Bello, Colombia, 2001-2002

Client: City of Bello

Several simple span bridge designs and revision of hydrologic reports. Surveying supervision, field tasks coordination.

Montería Highway*, Montería, Colombia, 1996

Client: City of Montería

Quantity estimations, CAD drawing preparation and documentation of bridge detailing.

Buildings

Construction Inspections - Chicago Area*, Illinois, 2003

Client: IRI CEPCO

Field inspections, work coordination, CAD support, proposal and bid preparations.

Industrial Steel Roofing*, Colombia, 2001

Client: ICC

Inspection and analysis of existing industrial steel roofing systems.

High School Building*, Colombia, 2000-2001

Client: ICC

Analysis and design of reinforced concrete buildings for a high school facility.

Cultural Center Roof Design*, Andes, Colombia, 2000

Client: City of Andes

Analysis and design of roofing system for the city of Andes cultural center.

San Rafael Hospital*, Andes, Colombia, 1999

Client: City of Andes

Analysis and structural design of reinforced concrete building (San Rafael hospital) for the city of Andes.

Several Building Designs*, Colombia, 1999-2001

Analysis, design, licensing and construction drawings of building structures for the private sector.

Water

Mi Río*, Medellín, Colombia, 2000

Client: City of Medellín

Tasks coordination for Mi Río project. Hydraulic and hydrological studies supervision.

Andes Pumping System*, Andes, Colombia, 1999-2000

Client: City of Andes

Evaluation of pumping system, pipe network and underground tank storage. Detailed FEA analysis and reinforced concrete design for water supply pumping system.

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Hydrological Balance of Colombia*, Colombia, 1997-1998

Client: Colombia's Department of Energy

Programing and research on interpolation methods for multivariable fields applied to hydrology. Data manipulation and estimation of variograms and geostatistic parameters.

Integrated Pipeline (IPL) Project, Texas, 2013

Client: Tarrant Regional Water District (TRWD)

Technical reviewer for the numerical modeling. The IPL project is an integrated water delivery system running from Lake Palestine to Lake Benbrook, with connections to Cedar Creek and Richland-Chambers Reservoirs. It consists of 150 miles of pipeline integrating TRWD's existing pipelines to the Dallas system to provide up to an additional 350 million gal/day of raw water to North Central Texas. 3D FEA models were created for several fittings of varying angles for various backfill materials and trench conditions. The interaction between the pipe structure and surrounding soil was investigated using staged construction techniques in ABAQUS.

Naval Military Facilities

PNSY Multi-Mission Drydock No. 1 (MILCON Project P381) , Kittery, Maine (Technical Reviewer)

Client: Naval Facilities Engineering Command (NAVFAC)

Structural reviewer of the new multi-mission drydock at the PNSY to allow for the concurrent maintenance of up to three

submarines by constructing two new drydocks at an existing drydock. Project features include reinforced concrete dockwalls and chamber slab, entrance structure, dewatering/drainage culverts, and utility tunnels. The project is designed for super flood conditions to allow in-haul/out-haul of submarines into/out of the existing drydock as well as dewatered conditions subject to full external hydrostatic pressure during submarine maintenance within the drydocks.

Shaft Systems

Connection Tunnels Mosholu, New York, 2004-2005

Client: Parsons, Brinckerhoff, Quade & Douglas Inc.

A complete structural analysis and design of the Mosholu Golf Course (MGC) Tunnels for the Croton Water Treatment Plant (CWTP) was provided. The design included several 3D FEA plus non-linear features to simulate the rock-structure interaction (SSI) for 5 tunnel connections and access shafts. Stress analysis and detailed reinforcement were produced. Also, pre-stressed beams and other structures related were designed. The tunnel diameters ranged between 9ft and 12ft.

Brightwater Conveyance Design, Washington, 2005

Client: King County

Design structural engineer responsible for layout, design, and preparation of construction drawings for 52' ID by 100' deep shaft with cast-in-place final lining, slurry diaphragm walls, ring beams and cover access for excavation protection, connecting two 16' ID tunnels, 6 miles in length and lined with precast concrete. The study included several 3D FE models considering the non-linear supporting behavior of the surrounded material. The portal (shaft) also has 6' ID microtunnel and energy dissipating stilling basin to convey influent flow to tunnel segment leading to the treatment plant. The study included the non-linear interaction between the structure and the surrounding rock support around several concrete connection tunnels.

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PUBLICATIONS

Design of Lock Gates under Seismic Actions. The World Association for Waterborne Transport Infrastructure (PIANC). Working Group 151 Publication, 2016.

Linear and Nonlinear Seismic Analysis for the Post Tensioning System Design of the Wanapum Dam Spillway Monoliths. USSD, April, 2016.

A Structural Analysis Framework for Concrete Faced Rockfill Dams. International Journal of Geomechanics, February, 2015.

Foundation and Structural Design of Lock Walls Founded on a Fault Zone. 7th International Conference - Case Histories in Geotechnical Engineering, April, 2013.

Absorbing Boundary Condition for Seismic Simulations in Panama Canal 3rd Set of Locks Design. NAFEMS North America, September, 2012.

Finite Element Simulations for the Panama Canal 3rd Set of Locks Project. ABAQUS Central Regional User's Meeting, September, 2012.

Instrumented Test and Structural and Fatigue Analysis of Head Covers and Gates Operating Mechanism for Unit G24 of Grand Coulee Third Power Plant. Hydrovision, July, 2011.

Systematized Shear Flow and Warping Determination for Thin Walled Sections Under Shear and Torsion Forces. Universidad Nacional de Colombia, April, 2001.

Interpolation's Methods for Hydrologic Parameters. Universidad Nacional de Colombia, April, 1998.