CTLGROUP

www.CTLGroup.com

Firm *overview*

CTLGroup is an internationally-recognized expert consulting engineering and materials science firm that provides engineering, testing and scientific services to our clients across the globe. Our engineers, scientists, architects and technical specialists deliver a multi-disciplinary approach to solve the most complex problems. With a corporate history that spans nearly 100 years, we serve clients across the following markets:

- Buildings & Facilities
- Emergent Solutions
- Energy & Resources
- Materials & Products
- Litigation & Insurance
- Transportation
- Green Solutions
- Water & Wastewater

Our engineering expertise is complemented by one of the largest and most comprehensive private material and structural testing laboratories in the world. Our experts can address problems from the materials and structural perspectives to deliver an integrated solution.

We have been involved in the development of some of the most advanced materials, authored testing standards, contributed to the construction of global landmarks and have been called on as experts for some of the most notorious catastrophes and disasters.

Across the construction life-cycle, CTLGroup experts help define problems, avoid issues and provide repair resolutions.

consulting services

- Building Performance Assessment
- Building Sustainability
- Failure Investigation
- Mass Concrete Consulting
- Materials Consulting
- Metallurgical & Mechanical Consulting
- Nondestructive Evaluation
- Repair & Rehabilitation
- Structural Engineering
- Structural Evaluation
- Structural Health Monitoring

testing services

- Chemical Testing
- Fatigue Testing
- Mechanical Behavior Testing
- Nondestructive Testing
- Petrography
- Physical Testing
- Sensors & Structural Monitoring
- Specialized Testing

key facts

- 15% of staff hold PhD degrees
- ACI certified technicians
- Licensed in all 50 states
- 60,000 SF of material and structural testing laboratories
- Laboratories are validated by US Army Corps of Engineers
- IAS ISO 17025 accredited
- AASHTO accredited
- 10 CFR 50, Appendix B/NQA-1 Compliant
- ISO 9001:2008 Bureau Veritas Certified
- Stadium® certified user

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REPRESENTATIVE CLIENTS

BP
Department of Defense
The DOW Chemical Company
HDR
Moffatt & Nichol
Holcim
Kiewit
Lafarge
FirstEnergy
Chevron
NYC Department of Buildings
Parsons Brinckerhoff
Skidmore Owings Merrill
US Army Corps of Engineers
Walsh Construction
Winston & Strawn

REPRESENTATIVE PROJECTS

Burj Khalifa Tower Materials Testing & Consulting
Frank Lloyd Wright's Unity Temple Restoration
Hurricane Katrina Damage Investigation
Luling Bridge Stay-Cable Replacement Design
World Trade Center Collapse of 9/11
Safeco Field Performance Monitoring

CODES & STANDARDS DEVELOPMENT

IgCC
ACI
ASHRAE 189.1
ASTM

CREATIVE SOLUTIONS TO COMPLEX PROBLEMS
IN ENGINEERING AND MATERIALS SCIENCE

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Laboratories *overview*

LEADING SOLUTIONS IN MATERIALS SCIENCE

testing services

- Analytical Chemical Testing
- Fatigue Testing (Stay Cable,AREMA, AAR)
- Mechanical Behavior Testing
- Mortar | Cement | Concrete Testing
- Nondestructive Testing
- Petrography
- Physical Testing
- Specialized Testing

quality management system (QMS)

CTLGroup has one of the most demanding QMS for laboratory testing of materials and structural components.

Through our QMS, our firm has achieved various accreditations and certifications:

- IAS ISO 17025 accredited
- AASHTO accredited
- 10 CFR 50, Appendix B/NQA-1 Compliant
- ISO 9001:2008 Bureau Veritas
- ACI certified technicians
- Association of American Railroads
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CTLGroup's world-class laboratories are designed and staffed to provide the most demanding Quality Management System for routine and complex analysis testing of materials and structural components.

Our scientists and engineers regularly help solve a wide range of problems in cementitious materials, aggregates, building systems, and metals, and develop specialized testing programs for unique challenges.

For decades, our experts have been involved in the development of nationally recognized tests and standards, giving them unique insight and ability to create solutions. With 60,000 square feet of laboratory facilities on campus, it enables the firm to provide a combination of testing, research and engineering services rarely matched in the industry.

We have an unparalleled capability to not only perform tests and evaluations, but to also interpret the data and translate them into meaningful results and action plans.

Laboratory Facilities & Resources

CTLGroup's laboratory facilities are internationally respected as one of the most comprehensive testing and research facilities in cementitious materials, chemical admixtures, mortars, construction products and structural systems. The firm's 60,000 square feet of facilities consist of industry-leading:

- Materials Laboratories (Analytical Chemical, Mortar, Cement, Concrete, Physical Testing)
- Petrography Laboratory
- Creep & Shrinkage Laboratory
- Structural & Transportation Laboratory
  (One of the largest private structural labs in the U.S., conducting static or dynamic testing of full-scale engineered systems and components.

CTLGroup's laboratory staff comprises several PhDs, registered professional engineers and accredited technicians. Our team includes chemists, process engineers, chemical engineers, a metallurgist, pavement engineers, civil engineers and materials engineers, many of whom are world-recognized authorities in their fields. We are multi-disciplinary professionals accustomed to working together to meet our clients' needs.

Testing Areas of Scope:

- Materials analysis & characterization
- Materials performance assessment
- Research & product development
- Failure Analysis
- Construction materials optimization
- Service life prediction and modeling
- Specialized Testing

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Buildings & Facilities

PRACTICE | *at-a-glance*

services highlights

- Structural systems
- Façades
- Roofs
- Flooring
- Finishes
- Foundations & shoring
- Structural design evaluation & peer review
- Smart buildings & structural health monitoring
- Nondestructive testing
- Failure & service deficiency investigations
- Green building

key facts

- 15% of our staff hold PhD degrees
- Licensed in all 50 states
- Staff includes LEED accredited professionals
- Staff includes Licensed Air Barrier Field Auditors

CTLGroup's Buildings & Facilities Practice Group helps clients with complex structural and materials issues affecting:

- University & education buildings
- Healthcare & laboratory buildings
- Municipal buildings
- Historic buildings & landmarks
- High-rise commercial & residential buildings
- Parking garages & structures
- Stadiums
- Cultural & religious facilities
- Manufacturing & industrial plants
- Special non-building structures

The needs of our Buildings & Facilities clients vary considerably. However, CTLGroup expertise consistently brings value to each project, providing innovative and cost effective solutions. Our primary areas of practice include:

- Building envelope studies, maintenance, rehabilitation & repair programs
- Design & installation of structural monitoring systems
- Failure & forensic investigations
- Nondestructive field testing of structural assemblies & components
- Strength & service evaluation of existing building structures
- Development of practical solutions to address structural deficiencies
- Troubleshooting construction problems & techniques leading to improvements in safety and efficiency
- Geological & geotechnical considerations
- Concrete moisture investigations
- Flooring consulting & testing
- Green building, infrastructure, pavement & materials practices

REPRESENTATIVE ENGAGEMENTS

National Institute of Health Parking Structure *performed field evaluation, laboratory testing, engineering analysis and cost estimating activities for parking structure comprised of cast-in-place reinforced concrete*

Western Illinois University Thompson Hall *condition assessment of existing façade and design of exterior cladding replacement*

New York City High Risk Construction Oversight *reviewed high risk construction operations, including high-rise concrete construction, excavations & hoisting operations*

Safeco Field *real-time structural monitoring of retractable roof system*

ASHRAE Standard 189.1 and the IgCC *key participation in development of next generation green building code*

Burj Khalifa *advanced materials performance evaluation for supertall structures*

Federal Courthouse Retrofit *complete analysis, design & construction oversight of major structural retrofit*

Frank Lloyd Wright Unity Temple *award-winning historic renovation*

Deep Space Antenna Pedestal *condition assessment of concrete deteriorated by alkali-silica reactions*

Puerto Rico Aqueduct & Sewer Authority *confined space inspection and repair procedure development for cracking & deterioration*

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Parking Structures

SECTOR | *at-a-glance*

highlights

- Condition Assessment/Investigation
- Pavement Evaluation
- Asphalt & Concrete Evaluation
- Sub-Base & Base Issue Investigation
- Repair Recommendations & Estimates
- Repair Inspection/Construction Quality Assurance

CTLGroup has been a pioneer in the evaluation and rehabilitation of parking structures. Our experts have developed the leading industry methodologies for condition assessment, repair and restoration design techniques and diagnostic methods for service life prediction. Our global portfolio of work encompasses over a 1,000 precast and cast-in-place, reinforced and prestressed parking structures. CTLGroup's projects have been recognized by numerous awards for excellence in repair design.

CTLGroup experts help clients across the construction and maintenance life cycle of parking structures. We evaluate parking structures of all types and ages, providing expert condition evaluation and investigation, repair prioritization and budgetary cost-estimating to assist owners with planning for construction and long-range maintenance. We develop cost-effective rehabilitation plans and innovative repair techniques to ensure long-term durability. CTLGroup experts are called on for highly specialized failure analysis and litigation support.

Our Multi-Disciplined Analytical Approach

1. Engineering consulting & troubleshooting
   - Investigation, evaluation, analysis & repair design
   - Cause determination & litigation support
   - Common functional & service life problems
   - Structural catastrophes
2. Structural diagnostics & monitoring
   - On-site behavior monitoring of facilities
   - Nondestructive testing
   - Instrumentation products & services
   - Vibration analysis
   - Load testing
   - Crack & defect analysis & monitoring
   - Structural integrity evaluation
3. Repair & rehabilitation
   - Cost-effective repair solutions to counteract effects of age
   - Programs to extend service life – development & design
   - Structural strengthening upgrades
   - Historic preservation & restoration
   - Construction contract administration
   - Specialized inspection & testing

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Litigation Support

SERVICE | *at-a-glance*

CTLGroup has provided technical support to the legal and insurance industries in cases that range from functional failures to catastrophic structural collapse. Our work has included the investigation of damage from terrorist attacks, structural system and component failures, and seismic and dynamic structural forces. The firm has also handled cases dealing with issues of construction material failures and durability, serviceability failures, construction delays and defects and design professional standards of care.

CTLGroup offers litigation support for traditional dispute resolution, as well as assistance with alternate dispute resolution methods. We understand the legal profession's special requirements and can clearly communicate the technical issues of a case – in consultation with counsel, in depositions, and in court. Using computer modeling and visualization software, CTLGroup can illustrate the pertinent facts of the case and create informative exhibits and demonstrative evidence.

A CTLGroup investigation provides our legal and insurance clients with an accurate assessment of damage and an expert, technical analysis of causation to be used for purposes of claims adjustment or litigation.

CTLGroup offers our clients a single source for expertise on construction-related issues that includes:

- Structural engineering and diagnostic investigations
- Construction materials evaluation and testing
- Structural system and component evaluation and testing

Drawing on this diversity of experience, we provide a broad array of investigative, forensic and failure analysis services to the legal profession and insurance industry. Our services also include post-disaster management support for governmental agencies, property owners and facility managers.

CTLGroup has experience investigating failure or distress in all types of structures, structural components and materials, including:

- Buildings
- Bridges
- Industrial facilities and equipment
- Machine components and parts
- Pipelines, pressure vessels and tanks
- False work, formwork, shoring and scaffolding
- Tunnels and subsurface construction
- Foundations and retaining structures

CTLGroup's most valuable strength is our ability to tackle each problem with a multi-disciplinary approach, providing construction-related consulting services tailored to each unique project.

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Air Barrier Testing

SERVICE | *at-a-glance*

Proper air-barrier installation can save energy, prevent future moisture issues. The importance of air barriers in properly designed building envelopes is becoming more apparent. Their use is growing quickly and becoming required by standard building codes and municipalities.

Organizations such as The U.S. Army Corps of Engineers, the International Energy Conservation Code (IECC), and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers are including air barrier requirements in their codes and standards. These requirements can range from proper design, to proof of performance through testing.

Approach

CTLGroup can assist clients related to the proper design and performance of air barriers. Services include:

- Blower-door testing
- Code interpretation of air-barrier requirements
- Proper air-barrier design and specification
- Observation of air-barrier installation
- Air-barrier repair solutions

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Building Envelope Evaluation

SERVICE | *at-a-glance*

Thermal Properties of Building Materials & Components

CTLGroup assists in improving the thermal performance of buildings by:

- Identifying areas of missing/poorly performing thermal insulation using infrared thermography
- Determining thermal mass effects of concrete and masonry
- Providing repair options when feasible and replacement options when necessary
- Providing pre-construction project document reviews

Water Leakage & Other Moisture Problems

CTLGroup conducts investigations into water leakage and other moisture related problems using a combination of the following methods:

- Field water penetration testing including spray rack nozzle and chamber testing
- Analysis of building wall components for condensation potential using WUFI
- Blower door field testing to identify gaps in air barriers
- Laboratory testing to determine water vapor transmission of materials
- Field observation and documentation, and project document review

Energy Codes

- Assistance with using state, IECC and ASHRAE energy codes
- Specifying insulation levels

Green Buildings

- Environmental life cycle inventory (LCI) and assessment (LCA) analyses
- ASTM C1549 - Standard Test Method for Determining Solar Reflectance (Albedo) Near Ambient Temperature Using a Portable Solar Reflectometer
- Comparative analysis of products' or services' characteristics to LEED point requirements and prerequisites

Once problems have been identified, CTLGroup can assist clients in implementing repairs by designing and specifying cost effective, durable repairs for the identified problems. We also assist in contract negotiation and construction observation to assure our clients that the repairs are implemented as specified.

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Concrete Evaluation & Repair

SERVICE | *at-a-glance*

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CTLGroup can tackle any concrete issue, no matter how intricate or unique. We work with clients to develop and customize approaches in order to translate specific problems into practical solutions.

CTLGroup has considerable expertise and experience in the investigation, evaluation, analysis and repair design of concrete structures. Our projects have ranged from the analysis of marquee monuments, to high-rise structures and historic landmark buildings. CTLGroup's work extends to the evaluation and rehabilitation of all types of aging infrastructure.

From our vast exposure to concrete deterioration and previously unsuccessful repairs, CTLGroup experts are able to customize evaluation and repair programs to provide the most responsive, cost-effective solutions. With a wide range of performance deficiencies and client needs, each of our repair projects is unique.

CTLGroup has in-depth knowledge of current and historic construction materials for historic restoration projects. We can investigate how the structure was originally designed and built, review repairs made over the life of the structure, analyze/design replacements to simulate obsolete construction materials, and develop repairs to restore the structure.

Services

CTLGroup offers the most sophisticated suite of engineering, testing and consulting services to address concrete performance, durability and life-cycle serviceability with the most progressive repair and restoration techniques available in the construction industry today.

Concrete/Structural Evaluation

- Nondestructive testing
- Condition assessments
- Structural integrity evaluation
- Facade inspections
- Forensic investigations
- Failure analysis
- Corrosion assessment, testing & protection planning
- Materials & building systems certification & code compliance
- Structural performance evaluation
- Investigation of material durability issues

Repair/Rehabilitation/Restoration Design

- Structural strengthening repairs
- Enhance long-term durability repairs
- Investigation of the makeup of historic materials & specifications of remedial repair materials & techniques
- Material & repair mock-ups
- Construction administration & observations

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Floor Systems & Consulting

SERVICE | *at-a-glance*

Whether a floor is located in a healthcare facility, warehouse, retail store or commercial building, CTLGroup helps solve floor problems. We assist our clients in avoiding floor troubles by guiding floor design and construction efforts.

Concrete floors, with and without finish flooring, are subject to a range of problems that can compromise their safety, usefulness and appearance. An enduring solution first requires an accurate evaluation of the root cause of the problem.

Faced with an existing floor problem, our materials scientists and engineers work together to determine its source and recommend practical, enduring solutions. Whether your finished floor surface is resilient, textile, concrete, polymer coating or another material, CTLGroup has the technical knowledge and experience to solve the problem.

Design Services

At the design stage, CTLGroup develops and reviews specifications to meet owners' needs. Our engineers and scientists:

- Evaluate and recommend slab thickness and reinforcement plans
- Plan joint layouts and moisture-resistant details
- Develop and review specifications
- Review concrete mix designs
- Provide moisture-control options

Construction Services

Proper slab performance depends on proper construction methods. To help construction crews build slabs right, CTLGroup experts can:

- Conduct pre-construction meetings
- Observe slab placement and verify conformance
- Recommend sawcut joint timing and depth
- Monitor drying

Forensic Services

When floor problems arise, they often involve multiple parties – tenants, owners, architects and contractors – and require expert assistance to resolve. CTLGroup typically follows a four-step plan when investigating problems, beginning with document review and proceeding through site inspection, material sampling and laboratory analysis. Our multidisciplinary teams:

- Review background documents
- Visually assess slab condition
- Determine slab thickness nondestructively

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Floor Systems & Consulting

- Survey sub-slab voids
- Select, obtain and perform laboratory examination and testing of cores
- Evaluate warping or curling of slab panels
- Measure slab-edge deflection
- Analyze load-carrying capacity
- Compare as-built vs. design service life
- Chemically analyze floor system components
- Diagnose and resolve moisture problems

Remediation Services

Because a damaged or deteriorated floor can severely impact a company's operations, managing repairs efficiently is crucial. CTLGroup has the skills to develop lasting and cost-effective solutions. Our experts can:

- Identify causes of distress
- Determine repair needs
- Develop technical repair specifications
- Observe and document repairs

Example Problems Addressed:

- Slab surface delamination
- Excessive random cracking
- Bumps in vinyl tile
- Adhesive oozing

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Masonry Consulting Services

SERVICE | *at-a-glance*

At CTLGroup, we solve problems involving all masonry materials and systems. Our clients include architects, structural engineers, contractors, facility owners, government agencies, insurance companies, attorneys and material manufacturers. Our services include:

Masonry Inspections - Detailed on-site inspections can include thorough visual observation, nondestructive testing and exploratory examinations. When needed, site and laboratory testing of materials assure conclusive results. Upon completing the investigation, we prepare a comprehensive report addressing the current condition of the masonry, causes of masonry distress and repair recommendations.

Project Document Review - We examine all masonry-related information in the architectural drawings, structural drawings and project specifications to detect design oversights and code violations, then provide a summary of the existing documents and offer industry-recognized design alternatives.

Construction Inspections - The ACI 530/ASCE5/TMS402 Code requires inspection and quality control of materials in masonry construction. Construction monitoring helps ensure trouble-free, reliable structures, and built-in conformance with the contract documents. We offer qualified inspection services for both new construction and remedial work on aging structures.

Historic Restoration - CTLGroup offers in-depth knowledge of current and historic construction materials for historic restoration projects. We can investigate how the structure was originally designed and built, review repairs made over the life of the structure, analyze/design replacements to simulate obsolete construction materials, and develop repair programs to restore the structure.

Litigation Support - Our professional staff can conduct forensic investigations for masonry building failures and produce a detailed report that contains all the technical documentation needed to support our expressed opinion. CTLGroup also offers expert witness testimony and litigation strategies.

Preventive Maintenance Programs - A simple field inspection by CTLGroup can often identify and resolve potential problem areas before a structure suffers significant damage and needs costly repairs. In some instances, nondestructive onsite tests are needed to supplement visible clues. Following these steps, CTLGroup can develop cost-efficient preventive maintenance programs for facility owners and managers.

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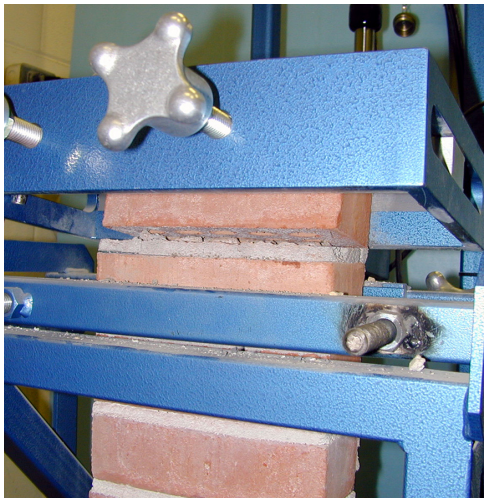
Masonry Consulting Services



Laboratory Testing Services - CTLGroup can perform numerous masonry-specific ASTM tests in our state of the-art laboratories. Some of these tests include:

- Test Method for Pullout Resistance of Ties and Anchors Embedded in Masonry Mortar Joints, ASTM E-754
- Test Method for Water Permeance of Masonry, ASTM E-514
- Method for Conducting Strength Tests of Panels for Building Construction, ASTM E-72
- Test Method for Diagonal Tension (Shear) in Masonry Assemblages, ASTM E-519
- Test Method for Measurement of Masonry Flexural Bond, ASTM C-1072
- Test Method for Examination and Analysis of Hardened Masonry Mortars, ASTM C 1324
- Test Methods for Sampling and Testing Concrete Masonry Units and Related Units, ASTM C-140
- Test Method for Linear Shrinkage of Concrete Masonry Units, ASTM C-426
- Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, ASTM C-780
- Test Method for Sampling and Testing Brick and Structural Clay Tile, ASTM C-67
- Test Method for Compressive Strength of Masonry Prisms, ASTM C-1314
- Test Method for Sampling and Testing Grout, ASTM C-1019
- Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces, ASTM C-1601

Non-standard tests, such as bond pulloff and falling head permeability tests, also are available.

Research/Product Development and Evaluation - Recognized for our basic research on masonry and related materials, CTLGroup can help develop new products and improved test methods. We also serve clients by performing evaluations and feasibility studies on new coatings, sealers, mortars, masonry units, and accessories, prior to their commercial introduction. Staff experts actively develop and implement new and improved field and laboratory test methods.

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Roofing Evaluation

SERVICE | *at-a-glance*

Condition assessment and materials testing of the historic Chicago Avenue Water Tower and Pumping Station roofing structure, resulting in a roof replacement to maximize service life.

Our building experts focus on the elimination of moisture intrusion, enhancing energy efficiency and maximizing service life of existing roof structures and elements.

Our roofing portfolio has developed from our specialized consulting services in the investigation and evaluation of performance problems in buildings over the construction and maintenance life cycle.

Roofing materials and systems are an integral component of the enclosure and the building as a whole. Conducting an accurate evaluation of the existing conditions is the first step to improving a roofing system. Once the condition of the existing building components have accurately assessed, including projected remaining useful life, CTLGroup assists clients in implementing cost-effective roof repairs by designing and specifying durable solutions designed to meet the client's needs and budget.

CTLGroup's building envelope specialists are comprised of engineers, architects and materials scientists qualified in identifying and correcting all types of building envelope (roofs, windows, walls, doors) issues. Our staff are licensed and certified by the Building Enclosure Council, the Air Barrier Association of America and the U.S. Green Building Council.

CTLGroup suite of roofing consulting services:

Services

- Field inspection & observation to verify existing as-built conditions
- Field water penetration testing to identify & verify suspected sources of water leakage
- Roof core analysis & testing to verify as-built conditions & components
- Infrared thermography to detect moisture infiltration
- Blower door field testing to identifying gaps in air barriers
- Laboratory testing to detect water vapor transmission of materials
- Storm damage assessment
- Preparation of detailed plans & specifications for repair design
- Assistance with contractor selection, bid review & negotiations
- Construction observation and field testing during installation/repair
- Structural Health Monitoring for roof performance and integrity

REPRESENTATIVE ENGAGEMENTS

CenturyLink Roof Truss, Seattle, WA *design and installation of custom-built load cells for roof truss tendon anchorages to verify post-tensioning forces of the sports complex*

Chicago Avenue Water Tower and Pumping Station, Chicago, IL *condition assessment and structural integrity of the historic roof structure, resulting in roof replacement to maximize service life*

Cincinnati Museum Center, Cincinnati, Ohio *evaluation and repair recommendations for the plaza fountain waterproofing system*

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Roofing Evaluation

Sensors and structural integrity monitoring of CenturyLink Field Roof Truss

Cook County Juvenile Detention Center, Chicago, IL *roof evaluation*
Dyett Middle School, Chicago, IL *evaluation and repair recommendations for indoor swimming pool steel roof deck system*
Great Lakes Naval Station, Great Lakes, IL *roof evaluation of training facilities*
Illinois Capital Development Board, Stateville Correctional Center, Crest Hill, IL *roof evaluation*
Jardine East Filter Building Roof Replacement, Chicago, IL *visual survey of the roof underside to document the most critically deteriorated areas that represented safety hazards and potential building performance issues*
Kraft Foods Headquarters, Northfield, IL *investigation of leakage into office spaces below the plaza, repair design, and construction observation services*
Kennedy Space Center Launch Control Building, Cape Canaveral, FL *structural evaluation of the roof to assess overall condition and determine causes of deterioration; develop remedation recommendations both short and long term*
Little General Store, Bradshaw, WV *cause analysis of roof collapse*
Metropolitan Water Reclamation District Lab Building, Chicago, IL *roof assessment as part of inspection, water penetration testing, and repair design for water leakage and air exfiltration of the existing facade*
Nassau County Jailhouse, Mineola, NY *roofing condition assessment and repair design*
Richard J. Daley Library, University of Illinois at Chicago, IL *roof condition assessment and design repair - **Roof Consultants Institute, Outstanding Construction Award***
Safeco Field Retractable Roof, Seattle, WA *performance monitoring*
Saint John Chrysostom Great Orthodox Monastery, Pleasant Prairie, WI *roof evaluation of existing monastery building*
St. John's Military Academy, Delafield, WI *condition assessment and design repair of masonry and roofing of Victory Memorial Chapel*
Strawberry Square, Harrisburg, PA *roof evaluation of this distinctive retail complex*
Temple Sholom, Chicago, IL *masonry and roofing investigation and roof replacement*
University of Illinois at Chicago, Campus Buildings IL *condition assessment, repair design associated with masonry, facade, roofing, concrete and waterproofing repairs at Chicago Circle Center; Behavioral Sciences Building; Roosevelt Road Building; Education, Communication and Social Works Building; College of Medicine, East Tower; School of Public Health; and University of Illinois Medical Center*

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Restoring Frank Lloyd Wright's Unity Temple

PROJECT EXPERIENCE

Client

Unity Temple Restoration Foundation

Unity Temple was conceived by Frank Lloyd Wright and constructed in Oak Park, Illinois in 1908-09. It was masterfully rendered, inside and out, with reinforced concrete. Unity Temple is an early example of Wright's use of concrete; both as structural and architectural elements.

CTLGroup's role is comprised of a survey and evaluation of the concrete's condition and the development of an ongoing phased rehabilitation plan. It is mandatory that CTLGroup achieves the highest possible aesthetic standards, maintains strict historical accuracy, and protects the integrity of existing building features. Our engineers and consultants are required to carry out repairs without interrupting the operations of the Unitarian Universalist congregation.

CTLGroup's restoration program has been successful in restoring distressed concrete elements of this historic treasure. The Unity Temple Restoration Foundation has derived the greatest benefit from their available funding. Recently, CTLGroup embarked on the fourth phase of the restoration program, which will continue to revive this momentous structure.

Historical Documentation

Three varieties of concrete were named in Wright's original specifications: Portland cement facing mortar, stone concrete, and structural cinder concrete (floor and cantilevered slabs). Each variety was confirmed and characterized from core samples taken and studied in the CTLGroup laboratories.

Condition Survey

CTLGroup engineers and specialists conducted a condition survey including: visual inspection, mechanical sounding, non-destructive testing, and evaluation of core samples. All have informed the restoration plan. CTLGroup is in the midst of a comprehensive condition survey of the exterior walls and interior concrete elements.

Documentation

Undersides of the cantilever and fascia displayed cracking, de-lamination, and spalling; this distress posed a threat to the integrity of the historic building, and, most immediately, to public safety. The roofs deflected as much as 5 inches, exposing rebar to weather distress. Cinder aggregates contained iron particles that corroded, causing chunks of concrete to pop off the building. Additionally, corrosion was evident on one of the ornamental columns. Currently, under review are wall, shotcrete, and crack repairs; cantilevered roof slab repair; and miscellaneous structural strengthening repairs.

Demolition

Conventional demolition methods were unsuitable because of their percussive, corrosive, or water consequences. Other specialized demolition methods had to be used; CTLGroup tested and recommended the use of

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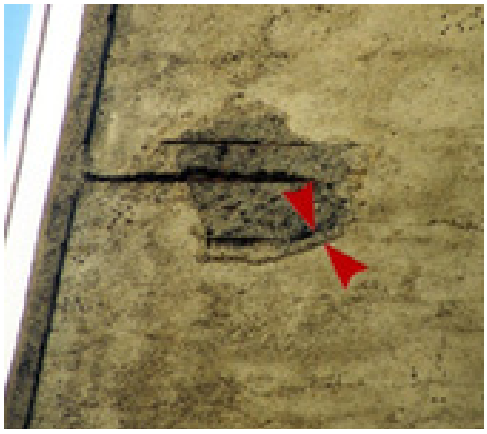

an expanding chemical compound which, when strategically injected into a series of saw cuts and drill holes, allowed a predicted and controlled removal of defective concrete. By controlling the cracking and size of the concrete removal, the safety and integrity of adjacent art-glass windows, façade details, and ornamental columns was preserved and could be reliably addressed.

Fascia and Soffit Restoration

After demolition, new reinforcing was added to fascias and soffits as part of the reconstruction. CTLGroup designed the reinforcing material to control shrinkage-related cracking in the future.

Ornamental Column Damage Mitigation

CTLGroup injected lithium hydroxide under low pressure, thereby increasing pH to lessen future corrosion.

Mix Design Development and Acceptance

CTLGroup designed cementitious materials that would visually match the original. Trial mixes and field mockups were presented. CTLGroup's research revealed sources of pea gravel and aggregate similar to that used in the original Wright mix designs. Materials were purchased for the whole project in order to eliminate "batch" inconsistencies from occurring. Lastly, CTLGroup performed exterior wall cleaning trials to verify suitability of cleaning methods for future project phases.

Awards

- 2003 Historic Preservation Award, Oak Park Preservation Commission
- 2002 Award of Excellence, International Concrete Repair Institute

Consulting Services

- Construction Methods Consulting
- Construction Process Review
- Impulse Response Testing
- Specialized Concrete Mixture Development
- Structural Engineering and Design
- Ground Penetrating Radar

Testing Services

- Chemical Testing
- Physical Testing
- Petrography

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Capitol Complex Underground Parking Garage Evaluation

PROJECT EXPERIENCE

Client
Illinois Capitol Development Board

CTLGroup was retained by the Illinois Capitol Development Board to evaluate the condition of the Capitol Complex Underground Parking Garage (Lot U) and to provide a comprehensive condition assessment, report, and repair recommendations. Constructed in 1976, the 3-story below ground precast concrete structure is 240 ft. by 395 ft.

Our Approach

CTLGroup's evaluation included document reviews and visual observations to evaluate issues related to water infiltration, and deteriorated concrete. CTLGroup reviewed waterproofing systems, double t beams, topping slabs, support beams, columns, ramps, walls, mechanical, electrical plumbing (MEP), and fire systems. Destructive and nondestructive testing was conducted inhcluding chain drag, core removal for laboratory testing, hammer sounding, ground penetrating radar, and the creation of inspection openings.

CTLGroup proposed schematic repairs for distressed items and developed cost estimates to execute the necessary repairs. Repair recommendations included replacement of lighting/mechanical/sprinkler system in a phased approach according to immediate needs and project budgeting.

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University Hall Facade Evaluation and Repair

PROJECT EXPERIENCE

Client
Ratio Architects, Inc.

University Hall is a 28-story reinforced concrete building originally designed by Skidmore, Owings, and Merrill. The building expands as it rises from 150 feet to 170 feet in width by a series of cantilevers. The narrow, recessed windows match those of the classroom buildings scattered throughout campus.

Our Approach

CTLGroup conducted a facade inspection for field evaluation of the exterior cladding and glazing and an architectural document review of the building. Based on the findings from the initial evaluation, CTLGroup is currently working on repair design schemes to correct the concrete spall in the building's exterior columns and beams. In order to provide a long-lasting repair to the building, CTLGroup is providing materials testing of concrete samples of University Hall for material compatibility of existing and repair materials.

Further sample removal was conducted for inspection of openings in the facade. Based on our materials testing results, CTLGroup will provide a concrete mix design compatible with the existing materials for the facade patching and repairs. In addition, evaluation of the windows was conducted to determine the extent of the repairs needed for the glazing. Site mock-ups have been provided.

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Thompson Hall Façade Evaluation

PROJECT EXPERIENCE

Client
Western Illinois University

Photo courtesy of Western Illinois University Visual Production Center

Built in 1969, Thompson Hall is a 19-story student residential building on the Western Illinois University (WIU) campus in Macomb, IL. The existing cladding was seriously deteriorated, allowing water leakage and air infiltration into the rooms, common areas, and mechanical spaces of the building. As a result, the WIU Board of Trustees elected to have an assessment study conducted on the building's aging façade and roof.

Our Approach

CTLGroup was engaged by WIU to evaluate the condition of the existing building's façade to determine the repair or possible replacement of the exterior cladding. CTLGroup conducted document review, visual observations, water leakage testing and infrared thermal scanning of the building cladding to arrive at specific recommendations. The condition study found that the cladding exhibited serious deterioration and questionable structural attachment. The university decided to re-clad the building based on CTLGroup's findings and to upgrade the HVAC systems and interior finishes. CTLGroup was commissioned by the university to be the Project Architect for the full building renovation.

As the Project Architect, CTLGroup selected architectural and engineering consultants to assist in the design and preparation of construction documents and specifications for the total removal and replacement of the exterior cladding system with a new aluminum frame and glass curtain wall. Legat Architects designed the new cladding system and interior refurbishment of the dorm rooms. KJWW Engineering Consultants was selected to design the upgrades to the building's HVAC system.

A unitized system was chosen for aesthetic, functional, and structural capabilities. Speed of installation was also important since the majority of the exterior cladding was added during the 2012-13 winter months. Asbestos abatement and project construction was completed within 14 months so as not to interfere with student re-occupancy in the late summer of 2013.

The new insulated metal panels and curtain wall improve thermal resistance, reduce air infiltration, and increase resistance to water penetration. The new façade system nearly triples the natural light entering each dorm room.

Lighter, reflective panel colors energize the building and compliment the prominent color of brick throughout campus. The use of metal panels creates visual interest at opaque areas of the façade through a checkerboard pattern. In addition to the cladding upgrades, the HVAC vertical distribution piping was replaced to further improve the energy efficiency of the facility and further enhance student comfort level.

Thompson Hall's improved aesthetics and interior environment enhance the university's ability to attract and retain students which was a major goal of the project. The total building renovation cost $22 million and includes an attractive and sustainable facade totaling 154,000 square feet.

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Floor Evaluation Services

PROJECT EXPERIENCE

Client
Wohlt Cheese Corporation

CTLGroup performed an evaluation of the second floor at the Wohlt Cheese Corporation facility located in New London, Wisconsin. The epoxy second floor processing area was exhibiting cracking. Water leakage from the second to the first floor filler room was also present. Cracking and delamination of the epoxy floor was evident in the clean and strip room (slab-on-grade), with the majority of the problems occuring in the cooker room (elevated slab). The objectives of CTLGroup's work were as follows:

1. Observe and document existing conditions on the second floor.
2. Evaluate the cause of the epoxy floor cracking and debonding.
3. Evaluate the cause of the water leakage.
4. Provide repair concepts.

Our Approach

- Review of available documents
- Field investigation
- Laboratory examinations and testing
- Data analysis
- Report preparation

Field evalutions included visual reviews, a delamination survey, core sampling, inspection openings, and an elevation survey. The epoxy floor was sounded by tapping a wooden dowel on the floor. Hollow sounds encountered during the survey indicated debonded epoxy floor. The survey indicated localized areas of debonded floor. Areas of leakage were also observed during a cleaning operation.

When the laboratory and field evaluations had been completed, CTLGroup developed an extensive report based on our findings. The report provided a detailed description of the consulting services performed, along with associated observations and conclusions. Recommendations for repairs and budgetary cost estimates are also presented.

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